

# **COMPARISON OF INCURRED BUT NOT REPORTED (IBNR) METHODS**

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# Comparison of IBNR Methodologies

## Foreword

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## Introduction

### Abstract

Recognizing the lack of comparative information on techniques used for estimating incurred but not reported (IBNR) reserves, the Heath Section Council of the Society of Actuaries commissioned a research project to assess the accuracy of commonly used IBNR estimation methods over a wide range of scenarios. Lewis & Ellis, Inc. (L&E) was awarded the contract to perform this research.

To conduct the study, a stochastic model was constructed to compare and score estimates produced by the IBNR methods that were selected for testing. The testing was done over a significant number of iterations and alternative business situations.

Findings from the model testing include the following:

1. When lag methods were tested, the more robust average lag methods and hybrid methods produced better results than straight average methods. Hybrid methods also produced fairly low mean errors and standard deviations
2. For the methods and scenarios tested, the one exhibiting the most consistency, in terms of relatively lower variance and mean error, was the Paid PMPM method. The method also often provided useful claim reserve estimates in recent incurral months as well as handling claims administration disruptions relatively better.
3. Traditional lag methods exhibited the least amount of variation in mean IBNR error when tested under an alternative business situation that entailed material shifts in per capita claims costs at various time points prior to the valuation date.
4. The two business situations tested that were the most problematic to the desired goal of reserve sufficiency were (a) very recent upward increases in claims costs and (b) rate spirals.

The following comments describe limitations of the study and practical considerations when calculating IBNR estimates, and highlight specific areas where caution should be applied when interpreting the results:

1. Advances in computing power and increasing software sophistication are making new and non-traditional methods more accessible to practicing actuaries. Yet, more sophisticated IBNR calculation methods, while possibly more accurate, often require additional assumptions and supporting data as well as adjustments (e.g., seasonality adjustment to Paid PMPM method) to derive reasonable results. These methods may also require advanced technical knowledge and the purchase of specialized software as compared to those methods generally in use by practicing health care actuaries.
2. The loss ratio method tested produced some of the more accurate results with fairly low standard deviations, but there are several important cautions in the interpretation of these results and the appropriateness of use of this method.
3. Most health care actuaries use a variety of methods to estimate IBNR, and the preferred method may be a combination of two or more of the tested methods (or other ones). For instance, lag methods tend to be the most common methods used by health actuaries; however, the results

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consistently indicate these methods have the highest standard deviations. Thus, the use of a second method is suggested in order to obtain reasonable results in the more recent incurral months.

4. Understanding a health plan's particular facts and circumstances (current environment) may be the most important assumption to specifically document prior to deciding on the most appropriate method for a specific analysis. The following four operational parameters are highlighted as particularly difficult to characterize and predict:
  - a. Seasonality of claim payments/processing;
  - b. Impact of large claims on the data;
  - c. Impact of "negative" claim amounts on lag factors and loss ratios; and
  - d. Credibility of the underlying trend in "cost" that results from the developed IBNR estimate.

Finally, it is important to note that ultimately the best method or combination of methods to use in a particular situation may be dependent upon factors and actuarial judgment that cannot be tested through a scientific model. In this sense, the report should not be construed as recommending or endorsing a best method. Rather, the report is intended to provide useful information about the advantages and disadvantages of many commonly used methods and advance knowledge in this area for the practicing health care actuary.

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### Background and Purpose

With increased scrutiny on financial reporting and ongoing solvency concerns, health actuaries are faced with the need, more than ever, to deliver reliable estimates of claim costs and reserves. A number of methods exist for calculating incurred but not reported (IBNR) reserves. However, practical techniques have not been substantially updated in a number of years. Further, significant changes in technology and speed of claim payment may make new techniques more applicable. Currently, when faced with a choice of which method may be most accurate and appropriate in a given situation, there is a dearth of information to guide health actuaries. As such, the Health Section Council (HSC) of the SOA identified a need for comparative information on the accuracy of various IBNR methods.

The HSC sought proposals and awarded a contract for research that would result in a practical guide on distinguishing between IBNR methods and to inform decision-making on the best method for a given circumstance. The HSC was also interested in creation of a basic software tool to accompany the practical guide. The focus of the research is on medical insurance, and, as such, the intended audience is health practitioners.

Lewis & Ellis, Inc. (L&E) was awarded the contract to perform this research. The project objectives specified that L&E should test a number of methods on a data set it provided and rate the methods for accuracy and applicability for a number of situations. The methods were supposed to include those commonly used by health actuaries to calculate IBNR such as the completion factor method (as well as variations of it) and others. Statistical model methods were to be potentially considered for evaluation. But, the methods considered for comparison should also be such that a practitioner could apply them without the need for special hardware or software packages. In order to easily compare the methods, L&E was asked to either use a commonly applied measure of accuracy or develop a new measure to score the IBNR methods.

### Reliances

There are many well-written and well-read pieces of actuarial literature (see bibliography) on health liabilities and their calculation. This literature has defined terms, methods and other relevant ideas so well and predominantly among practicing actuaries that we have taken liberties to replicate these definitions, methods, etc., albeit with intended references.

### Disclaimer

Users of this report should possess a certain level of familiarity with actuarial techniques and health care so as not to misinterpret the data presented. Any use or distribution of this report should be made in its entirety. In addition, any third party with access to this report acknowledges, as a condition of receipt, that L&E does not make any representations or warranty as to the accuracy or completeness of the material. Any third party with access to these materials cannot bring suit, claim or action against L&E, under any theory of law, related in any way to this material.

The report, accompanying model and other documentation contained herein do not represent an official position, statement or endorsement on behalf of the Society of Actuaries or its members for a particular method or combination of methods for calculation of incurred but not reported reserves (IBNR), nor

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should the material be construed to do so. It is the product of a research effort commissioned by the Society of Actuaries Health Section to add to the library of resource information for the estimation of IBNR reserves and further knowledge in that area. The material is neither intended to preclude the use of other methodologies for estimation of IBNR reserves for any purpose nor provide an official statement or position on the use, application or preferability of other methodologies as compared to the methodologies described herein.

### Defining IBNR

“IBNR” is an acronym, short for “incurred but not reported,” that is probably used the most by actuaries and non-actuaries alike to refer to a certain balance sheet liability of an insurer or HMO. Another common proxy for this acronym is “claim reserves,” which we will also use in this report. However, “IBNR” has a more formal definition (see below) in which it is merely one part of an insurer’s claim liabilities. For the purpose of this report we are not going to use the formal narrow definition of “IBNR.”

In this report we will broadly consider “IBNR” or “claim reserves” to represent a broad collection of insurer or HMO balance sheet entries technically representing a more formal definition of “liabilities” but not the formal definition of “reserves.” Whereas “liabilities” formally relate to events that have already occurred, but for which a payment has not yet been made and thus costs have already accrued, “reserves” are formally related to entries for amounts that the company has become obligated to pay, but for which the reimbursable event has not yet occurred, and thus these costs will accrue in the future. Our broad loose use of the acronym “IBNR” will encompass the following formal claim liability parts:

1. Incurred But Not Reported Claim Liabilities—Liabilities for claims that are anticipated but have not been reported to the health plan as of the valuation date. In this report, if we want to refer to this narrow formal definition, we will use the phrase “true IBNR.”
2. In Course of Settlement (ICOS) Claim Liabilities—Liabilities for claims reported and received but not yet adjudicated and paid as of the valuation date.
3. Due and Unpaid (D&U) Liabilities—Liabilities for claims that have been reported, adjudicated and processed, but for which final payment has not been recorded as of the valuation date. An example is a claim that has been adjudicated but as of the valuation date is being held until the next date on which the health plan processes claim checks.
4. Outstanding Accounting Feeds—Liabilities which have been acknowledged as payments, but for which no check has yet been cut as of the valuation date. The most common examples are payments agreed to be made to pharmacy benefit managers who process pharmacy claims at the point of sale and then bill the health plan monthly or bi-monthly for the claims. This liability definition overlaps with the D&U definition, with the distinction possibly being a system-to-system interface or batch processing claims versus payments made directly to a third party (e.g., claimant).
5. Disputed or Resisted Claims—Liabilities for claims that are in dispute, such as those for which a known litigation situation exists.
6. Margin—Liability for a reasonable and prudent level of conservatism to cover adverse claim deviation. Such a margin can be an explicit amount or implicitly provided for in the various actuarial calculations.



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We will also use “IBNR” instead of the phrase “unpaid claim liabilities,” which is used by the managed care and health maintenance organization industry, as well as use “IBNR” instead of “incurred but not paid” (IBNP), which many actuaries use as a more formal description of all claim liabilities.

For the purpose of this report, “IBNR” does not include:

1. Loss Adjustment Expenses (LAEs)—Liabilities for the administrative costs associated with the adjudication of unpaid claims.
2. Present Value of Amounts Not Yet Due (PVANYD)—This reserve covers claims that were incurred on or before the valuation date which have not accrued as of the valuation date.
3. Active Life Reserves—Active life reserves represent the combination of contract reserves and unearned premium reserves. The term "active life" differentiates the reserve nature from reserves related to insureds in claims status. Unearned premium reserves are typically an asset entry and represents premium that has been collected and entered in the ledger, but are actually allocated to a time period after the valuation date. A contract reserve is a reserve set up when a portion of the premium collected in the early years is meant to help pay for higher claim costs arising in later years.
4. Premium Deficiency Reserves—A premium deficiency reserve is a reserve that is established when future premiums and current reserves are not sufficient to cover future claim payments and expenses for the remainder of a contract period.
5. Provider Liabilities—Provider liabilities represent the reporting entity’s obligation to make future payments to providers under some form of risk-sharing arrangement.
6. Provider Insolvency Reserves—Additional liabilities that may arise if a capitated provider becomes insolvent.

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### Definitions

We consider the following to be common definitions for phrases used in conjunction with health claim reserves and IBNR.

Active Life Reserves<sup>1</sup>: The combination of contract reserves and unearned premium reserves. The term “active life” differentiates these reserves from reserves related to contracts in claims status or for “disabled lives.”

Age-to-Age Development Factors: Factors to complete paid claims to date in which the factors are based on the product of multiple representative ratios (i.e., the respective lag month for which the factor is generated through lag month of full completion) of one lag month’s cumulative paid claims to the prior lag month’s cumulative paid claims.

Age-to-Ultimate Development Factors: Factors to complete paid claims to date in which the factors are based on the ratio of the lag month’s cumulative paid claims to the fully complete ultimate claims.

Claims Adjudication<sup>2</sup>: The process by which the insurer’s claim processing area determines that an insured is eligible for payment and establishes an amount payable in relationship to the contractual benefits.

Claims Liability<sup>3</sup>: A claims liability is established when an event has occurred that creates an obligation to pay benefits, but complete payment has not yet been made as of the valuation date.

Contract Reserves<sup>4</sup>: A contract reserve is established when some portion of the premium collected in a contract’s early durations is intentionally designed to help pay for anticipated higher claims costs in later durations.

Claims Due and Unpaid: A reserve for claims which have been approved, but for which payment checks have not been sent.

Exposure: Unit of insured lives or premiums that contributed to exposure to a risk of a claim.

Excess/Shock Claim: Larger amount claims that have on average longer lag and may cause significant changes in total IBNR.

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<sup>1</sup> Lloyd, John C., “Health Reserves,” 3-5.

<sup>2</sup> Lloyd, “Health Reserves,” 3-5.

<sup>3</sup> Lloyd, “Health Reserves,” 3-5.

<sup>4</sup> Lloyd, “Health Reserves,” 3-5.

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Incurred Date<sup>5</sup>: The date on which an obligation to pay was established relative to a claim. For medical coverages, this is the date on which services were rendered by a provider or the initial date of service for a sequence of events which together constitute a claim.

In Course of Settlement (ICOS): The reserve amount attributed to claims already known and identified by the insurer but not yet adjudicated, settled and paid by the insurer. This reserve amount contrasts with claim liabilities which have not yet been identified by the insurer (a.k.a. “true” IBNR). Also can be described as reserves for claims that are on file in the company at the time the valuation is done, but have not yet been approved or paid.

IBNP<sup>6</sup>: The incurred but not paid (IBNP) liability reserve amount. Sometimes used formally in lieu of the more informal acronym “IBNR,” IBNP is another name, or acronym, for an insurer’s total claim reserve. IBNP is the sum total of all claim reserve parts (e.g., ICOS, true IBNR, etc.).

Lag<sup>7</sup>: The time between the incurred date of a claim and the date on which a claim payment is made. This time can be broken into two parts: (i) the time between the incurred date and the date upon which it is received for consideration by the insurer and (ii) the time between the insurer’s initial consideration date and the claim payment date.

Loss Adjustment Expense<sup>8</sup>: The liability associated with the expense of processing claims that will be paid after the valuation date.

Present Value of Amounts Not Yet Due (PVANYD): Also called “disabled life reserves” in the case of insurance providing ongoing periodic benefits past the reserve valuation date because of a benefit trigger that occurred on or before the valuation date (e.g., monthly loss-of-time benefits for disability due to accident or sickness, monthly reimbursements or payments for long-term care expenses, etc.). The common statutory definition is: “the reserve for claims unaccrued which may at the option of the insurer be discounted at interest.” This reserve is rarely considered part of the health IBNR.

PMPM: Per member per month, which is a statistic measure of the average monthly per capita incurred claims where the per capita basis is membership (e.g., number of insureds, including primary insureds, spouses and children).

Resisted Claims Reserve: Reserves for those claims in dispute and/or where the obligation to pay such claim is not reasonably clear as of the statement date.

Seasonality<sup>9</sup>: Tendency for the amount of incurred claim liabilities to vary in a consistent and predictable manner within the space of a calendar year. In health insurance, seasonality may be due to seasonal variations in morbidity (the rate at which individuals seek medical care), benefit design (such as when a

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<sup>5</sup> Lloyd, John C., “Health Reserves,” 3-5.

<sup>6</sup> Lynch, Robert, “Method for Calculating IBNP Health Reserves with Low Variance,” 7.

<sup>7</sup> Lloyd, “Health Reserves,” 4.

<sup>8</sup> Lloyd, “Health Reserves,” 3-5.

<sup>9</sup> Lynch, Robert G., Patent description “Method for Calculating IBNP Health Reserves with Low Variance,” Oct. 6, 2005.

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health plan has an annual deductible or annual out-of-pocket cost-sharing maximum), or calendar effects (for example, variation in monthly claims caused by the differing number of days in each month, or differences in the number of working days in a month.)

Valuation Date<sup>10</sup>: The date upon which an insurer's financial reports are compiled by closing the insurer's general ledger, creating a set of cash accounting entries, and creating reserve estimates. Typical valuation dates are year-end, quarter-end or sometimes every month's end.

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<sup>10</sup> Lloyd, John C., "Health Reserves," 4.

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## Executive Summary

The purpose of this section is to summarize the results of our testing and analysis of IBNR calculation methods. Later sections of the report explain the methods themselves.

With the wide variety of policy types, adjudication practices, lag times and other variables, it is impossible to say that a given method is the perfect method in all cases. Even in our testing, different methods for a particular block performed better under different scenario tests. We have, however, analyzed our results in an effort to provide some basic guidelines to help you determine the best method for your particular circumstances. We have based our conclusions on only a subset of the scenario tests that we created and tested. We have chosen to omit the rate shift, claim shift and disruption scenarios due to extreme variance of the results. We have assumed that, in situations like this, the actuary would be forced to make manual adjustments in some way, and could never simply run an IBNR calculation with the data as-is. As a result, we have focused on those scenarios that are more typical and that can, for the most part, be handled without any adjustments.

1. Lag methods tend to be the most common methods used by health actuaries; however, our results consistently show them to have the highest standard deviation. Even the more advanced lag methods, while their performance is definitely better than the simple methods, still generate a large standard deviation. Another problem with lag methods is that they require a significant amount of claims completion for a given month before they begin to develop any sort of accuracy. This can be seen in our results by simply looking at the mean error for the HMO Medicare block versus the Medicare Supplement block. For a block that completes fairly quickly like the HMO Medicare block, the mean error is in the low single digits. However, for the Medicare Supplement block, the mean error is around 28 percent. Thus, the use of a second method is required in order to achieve accurate results in the more recent incurral months. Our Hybrid Loss Ratio method illustrates one such method, where we combine the Loss Ratio method and the 9-Month Average Lag method based on the credibility of the completion factor. This is definitely a viable option, but there are other methods that produce accurate results without having to calculate and combine results from two different methods.
2. For rapidly completing blocks, such as the Rx block we tested, in virtually all scenarios, the results of the Paid PMPM method appeared the closest to the mean and had the lowest standard deviation. This method was designed to have a lower variance than other methods, and our testing proves that claim under certain conditions. Outside of the Loss Ratio method, which had certain inherent biases in our implementation thereof, the Paid PMPM method had the lowest standard deviation in virtually all of our tests on all blocks. However, it did have its own share of problems. First, the method does not handle seasonality very well. Even the fairly simple scenario with a seasonality pattern based on the number of workdays in a month causes the mean error and standard deviation to increase. The more complex seasonality scenarios show a much larger change in the mean error. In defense of the method, its documentation states that the data must be normalized for seasonality. However, we explain in this report the general difficulty of adjusting data for seasonality. The other major issue with this method is that large claims, especially on blocks with quicker run-out, tend to cause an overestimation of the IBNR. While this can be

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handled by simply removing the large claims and dealing with them separately, this forces two separate IBNR calculations.

3. Seasonality of the claims can have a material impact on the mean error. For example, seasonality exhibited by claim concentration early in a calendar year resulted in typical material positive errors (i.e., reserve sufficiencies) for the recent incurral months for a number of the IBNR calculation methods, when applied to a year-end valuation date. Seasonality exhibited by claim concentration later in the calendar year (e.g., large deductibles) exhibited the opposite typical results across most IBNR calculation methods.
4. We observe the following regarding the stochastic simulation approach:
  - a. The “mean” results show very low mean errors regardless of the incurral month set (e.g., all, recent, “credible” months) examined.
  - b. The “mean” results show some of the relatively lowest mean errors as well as lowest standard deviation of error for the recent incurral months (i.e., under 50 percent completion).
5. If you desire methods that are “immune” to premium rate shifts (e.g., the 15 percent rate shift scenario), there are a number of options available (e.g., Paid PMPM method, traditional lag methods) whose accuracy should not be impacted by premium stability, or lack thereof.
6. Applying an IBNR method (e.g., Benktander) that relies on premium for its IBNR calculation requires adjustment and likely actuarial judgment to offset expected material IBNR error by applying the method mechanically without adjustment.
7. With the “claim shift” scenarios, the variations of the traditional lag method saw the least, if almost no, changes in mean errors as compared to the base scenario. This is reasonable given that the observed payments as of the valuation date are assumed to already reflect these claim shifts and the lag factors continue, or “complete,” this observed shift. Other IBNR methods predicated on prior PMPM or similar claim levels don’t adequately recognize the claim shift.
8. A very “dangerous” scenario to the desired goal of reserve sufficiency is a recent unpredicted (i.e., it is not readily apparent to make a “manual” adjustment) upward shift in per capita claim levels.
9. Another “dangerous” scenario to reserve accuracy or sufficiency is a rate spiral. However, the traditional lag methods appear to be relatively unimpacted by our illustrative rate spiral scenario.
10. There is a material risk to IBNR accuracy when removing large claims from the data set from which the IBNR calculation method (e.g., traditional lag, Paid PMPM, etc.) is applied.
11. The Paid PMPM method appears to handle most of the claims processing disruption scenarios relatively better than other IBNR calculation methods.
12. Care should be taken in extrapolating conclusions among the block types. For example, the self-funded block type and the HMO Inpatient block type had the highest standard deviation of error results observed across most IBNR methods. We believe this is indicative of the variance in the completion distribution, particularly recent incurral months, from which we extrapolated from our single sample data for each block type. Other block type samples had more consistent completion patterns in our sample.
13. The Loss Ratio method produced some of the more accurate results with fairly low standard deviations. However, caution should be taken in the use of these results for two main reasons. First there is a bias in our data set simulations that results in the Loss Ratio method have a higher than expected degree of accuracy. By using loss ratios to develop our data set, and limiting the

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range of those loss ratios, the results are incurred claim totals that, on average, will hit the target loss ratio exactly. Second, the accuracy decreases when trends in the data don't move smoothly in one direction. The two varying trend scenarios illustrate this issue the best. The mean error is still in the single digits, but this is due to the first issue we just mentioned. Directly comparing the Base or Excessive Trend scenario to the two Varying Trend scenarios shows how much worse the accuracy gets when the predictability of the trends is removed.

Overall, the most consistent method was the Paid PMPM method. It was routinely among the methods with the lowest variance and mean error. It is also useful in the most recent incurral months, eliminating the multiple calculation issues. It requires slightly more complex calculations, needing trend adjustments and making use of linear regression; but it is not too difficult to accomplish in a simple spreadsheet. If lag methods are still the desired solutions, the more advanced average lag methods and the hybrid methods are much better alternatives to the straight average methods. The hybrid methods, especially, produce fairly low mean errors and standard deviations. The choice, however, really comes down to what method is best given your unique circumstances.

This document was designed to serve as a practical guide for the calculation of claim reserves, focusing on the different methodologies available for IBNR calculations. Our goal was to discuss major issues affecting today's actuaries as they attempt to establish claim reserves, but by no means do we consider our analysis exhaustive. Hopefully this guide will serve as a starting point for any actuary establishing a new reserving process or wishing to re-examine an existing process.

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### Summary of Methods to Calculate Claim Reserves

Two key pieces of actuarial literature<sup>11</sup> on health reserves and liabilities outline five basic types of approaches to calculate claim reserves. These types are:

- Tabular methods
- Case reserve methods
- Projection methods
- Loss ratio methods
- Development methods

We will try to add to the above list by outlining the following additional method categories:

- Methods delineating ICOS versus true IBNR
- Paid PMPM method
- Stochastic methods
- Neural network methods

#### Tabular Methods

Of the above five method categories, only tabular methods do not apply to “IBNR” as we have defined for this report. These methods are applied to develop reserves for present value of amount not yet due (PVANYD) based on a claim continuance table with an appropriate discount rate applied. The tabular method is applied to reported and known claims. For coverages with PVAYND such as disability income and long-term care, additional claim reserves are needed to fully establish the total claim liability. For these coverages, it is more common to separately establish the additional needed claim reserves of “true” IBNR and ICOS claims reserves. Also, these additional claim reserves are typically produced from internal studies developing historical averages or per contract estimates that reflect the carrier’s procedures and claims paying practices.<sup>12</sup> This report does not address such coverages and their additional claim reserves beyond their PVAYND.

#### Case Reserves Methods<sup>13</sup>

These methods are also known as the direct enumeration method or the examiners’ method. Claims examiners or other similarly qualified personnel attempt to estimate an amount to be paid based on specific information about a claim and historical experience with similar claims. Once this estimate has been developed, the reserve is calculated as the estimated claim amount minus amounts already paid. This method is applied on a claim-by-claim basis, so it is typically only used for very large claims, litigated claims or other small groups or subsets of claims. It is impractical to try to develop reserves for an entire book of claims using these methods. Additionally, these methods only generate a reserve for reported

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<sup>11</sup> Lloyd, John C., “Health Reserves,” 17 and *NAIC Health Reserve Guidance Manual*, 2000 National Association of Insurance Commissioners, Nov. 6, 2000, p. 12.

<sup>12</sup> Lloyd, “Health Reserves,” 19.

<sup>13</sup> Lloyd, “Health Reserves,” 17 and *NAIC Manual*, 15.



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claims, an ICOS reserve. A separate calculation must be performed to address the IBNR reserves. This report does not analyze case reserves.

### Projection/Exposure Methods

Exposure methods estimate incurred claims by analyzing the historical claims rate of a line of business against a measure of the company's exposure to liability for that line. An example of an exposure for an HMO would be covered members. Another common exposure example is premium. The estimate of the claim rate is multiplied by the exposure for the appropriate time period, and paid claims are then deducted to develop the reserve estimate. These methods are most often used when the data does not allow for the use of another method. This could be due to a low volume of data, low claims incidence, a relatively new block of business with immature data, or concerns about claims data credibility for developing reliable claim development patterns. These methods are often used in conjunction with the development methods to estimate claims for the more recent incurral months where the development methods are considered not credible.

#### *Per Capita Exposure Method<sup>14</sup>*

One common exposure method is the Per Capita method. The exposure basis for this method is some capita count, either the number of primary insureds, members or member-months. Pricing estimates and/or historical claims and membership data are used to develop an expected per capita claims amount (e.g., dividing the incurred claims by the membership over the same exposure period). This per capita claims cost is then applied to capita counts for a particular time period to determine expected incurred claims.

#### *Loss Ratio Exposure Methods<sup>15</sup>*

Loss ratio methods are another case of exposure methods. They develop an estimate of incurred claims by applying an estimated loss ratio (incurred claims over earned premiums) to earned premiums and then subtracting incurred and paid claims to develop the claim reserve. That estimated loss ratio will generally be developed based upon either the company's experience of similar lines of business, the assumptions used in pricing the coverage or the experience of other companies with similar lines of business. In addition to the uses mentioned above, the loss ratio method is also ideal when membership data is not available or when the claim costs are not available or not credible as the pricing loss ratio can be used. When using this method, it is important to always be cognizant of material rate increases that can change the underlying premium possibly without affecting the estimated incurred losses. If expected loss ratios are applied without recognizing material rate increases, then overstated reserves can occur.

#### *Average Claim Size Method*

The average claim size methods can also be considered a special case of exposure methods. This approach multiplies the predicted number of ultimate claims by an estimated ultimate average loss for each exposure period to produce ultimate loss estimates. While rare in A&H business, the method can be a useful supplement when you have access to both the number of claims as well as average claim. If development methods produce volatile estimates for recent periods, the average loss method, like the way the loss ratio method is often used, can provide more stable results or even results more responsive to

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<sup>14</sup> Lloyd, John C., "Health Reserves," 18 and *NAIC Manual*, 14-15.

<sup>15</sup> Lloyd, "Health Reserves," 18 and *NAIC Manual*, 15.

## Comparison of IBNR Methodologies

recent claim activity levels. This method is very sensitive to (i) how claims are counted, (ii) the stability of the underlying benefits and (iii) unusually large claims. Trend studies (e.g., curve fitting) of reliable prior average claims and claim numbers are useful in this exposure method type as well. We have included this method in our list; however, we did not test this method as part of this project.

### Development Methods

#### *Description of Typical Development Methods*

Development methods use various analyses of the historical claim payment pattern of a line of business to estimate ultimate paid claims for relatively recent incurral periods that are “incomplete,” or for which the claims payer hasn’t paid all eventual claims. These methods rely on the basic assumption that historical payment patterns (i.e., the time lag between the date of a particular medical service and the date on which the claim is paid) for a particular line of business are consistent and can be used to estimate future claims. These analyses are typically based on claim “triangles” which categorize claims according to both the period in which they were incurred and the period in which they were paid, adjudicated or reported. The end result is a triangle of known data that is used to develop known completion ratios and factors. These factors are analyzed in one of a number of ways to determine the completion factors to be used to estimate the ultimate expected incurred claims. Claims paid-to-date are then subtracted from the ultimate incurred claims to calculate the IBNR reserve.

More detail on development methods is included in Appendix A, which contains an excellent description of the method taken from John Lloyd’s paper, “Health Reserves.”

#### *Cross-Incurral Method*

This method is based on a modification of the standard development methods. While rarely used because of its unreliable premise, it is most likely used when a block is too “young” for which credible ultimate completed claims and thus completion factors can be gauged. Typical development methods calculate factors based on a particular incurral month, examining the pattern in which the claims, specific to that incurral month, are paid over time. The cross-incurral method develops factors by looking at a particular paid month and examining the pattern in which the claims are applied to different incurral months. The method’s premise, however unreliable, is this: “The completion of claim dollars across paid lag months is the same regardless of which incurral month you may choose.” That is, with this method’s premise you are “allowed to mix and match” incurral months in order to develop a complete series of lagged payments and thus develop a rough estimated set of completion factors.

Thus, the method develops completion factors across incurral months, giving the method its name. The method is implemented on an aggregate basis over a defined period of months as opposed to the development method, which does calculations for each incurral month and then averages the values. The cross-incurral method takes the entire amount of claims paid, regardless of incurral period, over a certain period of time. The completion factor for duration X is calculated as this total claim amount divided by the total of the claims paid through month X. This completion factor is then applied to the paid claims as of month X to get the expected incurred claims. The claim reserve is the incurred claims less the paid claims. Appendix B contains an algebraic definition of this method for further clarification.

## Comparison of IBNR Methodologies

### Paid PMPM Method

Robert Lynch has written articles (e.g., “Method for Calculating IBNP Health Reserves with Low Variance”) on this method and indicates the method is a way to reduce variance in claim reserve estimates. This method focuses solely on the paid amounts in the claims triangle and attempts to estimate each unknown “cell” of the triangle based on PMPM paid amounts. Mr. Lynch outlined two variations, respectively called the “Simple Paid Lag Method” or the “Regressed Paid Lag Method.” For the simple method, the future Paid PMPM amount for a given duration is simply the average of all previous PMPM amounts for that duration. A more sophisticated method involves regressing the prior paid amounts for a given duration against the cumulative paid amounts. This method presumably results in more precise figures for each of the unknown paid PMPM cells in the triangle. When all cells have been filled, the previously unknown PMPMs are multiplied by the membership for their respective incurral months to generate the IBNR reserve directly.

More details on this method can be found in Appendix C, much of which was taken from the article “Method for Calculating IBNP Health Reserves with Low Variance.” In addition, Appendix B contains an algebraic definition of this method for further clarification.

Note: The Paid PMPM method was evaluated and tested using publicly available material. The author of the materials, Robert Lynch, has noted that the method is under patent protection and proprietary. Readers may wish to consult appropriate legal counsel for guidance on the use of the method under their particular situation.

### Stochastic Methods

Whereas deterministic claim reserve methods make assumptions about the expected value (a.k.a. point estimate) of future claims already incurred, stochastic methods also model not only the expected value of future claims but also the variation about the expected value of the future claims already incurred. Stochastic models can also allow for random variation in the value of variables that contribute to incurred claims and/or claim reserves. Stochastic models are useful because<sup>16</sup>:

- Factors affecting actuarial problems do vary and stochastic models account for this.
- Probabilities can be attached to outcomes.
- Complex financial problems can be modeled, often using simulation, using the computing power of modern computers.

Comparatively, deterministic methods are much easier to implement and understand the result. Many actuaries are comfortable with deterministic methods, because they are fully aware and understand these methods’ faults (e.g., lack of variance allowance) and feel that they can account for the faults.

Also, deterministic methods often are supplemented by a contingency margin or even sensitivity testing with alternate scenarios or other deterministic methods. A stochastic method, however, can produce a

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<sup>16</sup> SOA 2005 New Orleans Health/Pension Spring Meeting—76PD, Stochastic Modeling in Health Insurance, Panelists: McEllin, Hendrickson, Yambao.

## Comparison of IBNR Methodologies

confidence interval. Clearly, actual claim run-out will be different from expected and a deterministic method may not give a good idea as to how much variance from expected can be.

Appendix D provides a list of additional literature on stochastic IBNR methods as well as a conceptual description of our chosen approach to implementing a stochastic IBNR method for our testing and analysis. The appendix finally contains a list of stochastic software tools.

### Neural Network Method

In Appendix H we have attempted to briefly describe a neural network method of calculating IBNR. This appendix will just give an overview of the capabilities and limitations of such methods using the example of a neural network implemented by Syed Mehmud, the individual who has suggested this approach be included among those tested against our simulated claim lag data sets. However, we were not able to include this method in our testing. For those who wish to delve deeper into details of neural networks Appendix H suggests other sources on this approach.

## Comparison of IBNR Methodologies

### Practical Considerations for IBNR Issues

#### Incurred Date Definition

The “incurred date” is the date on which a claim is deemed to have “occurred.” This date is important for both determining the basis of claim payment (i.e., how it affects deductible accumulation and coinsurance, for example) and for developing the IBNR reserve. The incurred date is especially important as the basis for using the development methods to calculate claim reserves. While the definition of incurred date varies slightly from carrier to carrier, the two most common definitions are the date of service and the date of diagnosis.<sup>17</sup>

#### *Incurred Date Based on Date of Service<sup>18</sup>*

The date of service is usually based on either the date on which a medical visit was performed, or, in the case of a hospital stay, the date of admission to the hospital. This is the most common date used as an incurred date because it is both easy to track and it is typically the closest date that is in line with how the insurance contract defines an eligible service. There are, at times, slight modifications made to this definition in particular circumstances. Some contracts specify that a re-admission to the hospital for the same condition within a certain number of days is considered a continuance of the previous admission. In this case, the incurred date would be the original hospital admission date instead of the new date. Also, outpatient services for a particular condition may be spread over several days. To the extent possible, the claims may be grouped together under one incurred date based on the date of the first service.

#### *Incurred Date Based on Diagnosis Date*

One other possible definition of incurred date is the date on which a medical condition is diagnosed. This diagnosis date may, and quite often does, coincide with an initial service date. However, future service dates that would otherwise be considered unique incurred dates are now tied back to this original diagnosis-based incurred date. The result is a claim reserve that essentially includes a reserve for present values for amounts not yet due (PVAYND).

A common and accepted means by which to establish the incurred date is to apply the language and spirit of the policy form and/or insurance contract. As such, using diagnosis date would require a consistent contractual establishment of liability predicated on condition diagnosis as opposed to delivery of covered medical service.

According to the NAIC Health Reserves Guidance manual, “the determination of the reserve amount should assume that all policies were terminated as of the close of business on the valuation date.” Under a standard insurance contract, where benefits are paid as services are delivered, this type of reserve would make no sense in light of such guidance. If the contract were to terminate, there would presumably be no

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<sup>17</sup> Lloyd, John C., “Health Reserves,” 5-6.

<sup>18</sup> NAIC Manual, 11 and Lloyd, “Health Reserves,” 5.

## Comparison of IBNR Methodologies

obligation to pay any future claims regardless of their relation to a prior diagnosis date. However, there is the exception of contracts that specifically contain deferred benefit provisions. If a contract contains wording stating that all claims pertaining to a previous diagnosis will continue to be paid after contract termination, this reserve methodology would have more merit. This type of situation is more common with disability and specified maternity contracts/riders than with typical hospital/medical expense policies. It is not uncommon to see maternity coverage, for example, that will continue to pay claims after termination if the pregnancy occurred prior to the policy terminating.

Another issue to consider when using diagnosis date as the incurred date is the possibility of excess conservatism in reserves inherent in the incurred claims. Claim reserves, as a necessity to estimating incurred claims levels, are a key component of incurred loss ratios. If claim reserves include future claim payments for medical services not yet delivered but are included because they are related to a past diagnosis, then one must ask whether the premiums against which incurred claims are compared are a consistent revenue item (e.g.: Are they really meant to cover future claims tied to a current diagnosis?).

## Methods Delineating ICOS versus True IBNR

This is actually not a method, per se, but rather a way to split the total claim reserve into its two formal parts and then apply methods to estimate each part. The majority of the methods, when applied to or based on paid claims, actually generate incurred but not paid (IBNP) reserves, which are a combination of what we refer to in this paper as the “True” IBNR and the ICOS claims. Informally, these two parts are known as the “unknown” (IBNR) and “known” (ICOS) parts of the total claim reserve.

True IBNR is the part of the total claim reserve that can result from claims that have not been submitted or reported to the insurer. Common approaches for developing true IBNR, or the “unknown” reserve portion, are:

- Projection methods (e.g., per capita IBNR times policy exposures, % of premium, etc.);
- Applying historical true IBNR claim counts multiplied by average payment per claim, albeit with appropriate adjustments for business volume changes<sup>19</sup>;
- Modification of development methods where lag is measured from incurred date to date of claim receipt by the insurer.

The loss ratio projection and projection methods “may be employed for coverages in which reported claims represent a substantial portion of the total claim reserve and produce consistent emerging experience.”<sup>20</sup>

A typical approach for estimating ICOS, or “known” reserve portion, is the case reserve method (see commentary above). Another approach to developing ICOS is the average claim size method. This method estimates ICOS by “multiplying reported claims times an average amount paid under previously closed claims.” This method obviously will not work for claims with a good deal of variance in the

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<sup>19</sup> Lloyd, John C., “Health Reserves,” 17-18.

<sup>20</sup> Lloyd, “Health Reserves,” 17.

## Comparison of IBNR Methodologies

amounts ultimately payable or a block for which closed claims are not likely to represent a credible estimate of open claims.<sup>21</sup>

Another approach to estimating ICOS is to tally up the total billed charges of claims currently known but still unresolved by the claim department and apply a factor, or “haircut,” representing an estimate of how much is paid in eventual benefits for every dollar of current pending charge. This factor estimate can be tracked historically. A similar but slightly more advanced approach is to tally the current adjudicated charge for all claims that exist in the various stages of claims adjudication and apply different factors to estimate eventual paid. For example, here are some descriptions of claims adjudication stages in which a claim might be classified and for which a unique paid-to-pending factor could be estimated.

- Opened mail;
- Disputed claims;
- Repriced via PPO network but without benefit adjudication;
- Repriced and benefit limits and cost-sharing applied;
- Benefit check cut but not yet released.

Usually as you move “down” the adjudication process, the paid-to-pending factors get larger, practically reaching 100 percent for checks cut but unreleased.

## Excess or Outlier Claims

Excess or shock claims, especially their timing, number and amount, are another special example of real world disruptions to a health actuary’s IBNR calculations. Shock claims have a material impact on completion factors produced by development IBNR calculation methods. Often the adjudication time for these excess claims is longer; thus, when they are paid, they can lower all paid lag month’s completion factors, raising the overall claim reserve produced. By incorporating the excess claim’s impact (e.g., lower completion factors), one is essentially providing an ongoing reserve for a similarly expected excess claim. Alternatively, in the rare case that the large excess claim is paid much faster than other claims, the resulting completion factors will be increased, thus lowering reserves, a likely unwanted result.

The most common way to account for excess claims’ impact on the development methods’ completion factors is to remove the excess claims completely from the completion factor calculation. If done this way, the actuary then has two choices: (a) keep the excess claims in the cumulative paid claims to which the completion factors are applied or (b) continue to keep the excess claims removed even from the cumulative paid claims and thus need another method to calculate claim reserves for future potential paid excess claims already incurred. If the second option is chosen, some alternative approaches include claim-specific excess claim reserves set with help from the claims adjudication staff.

A key factor in the choice of whether to remove excess claims from completion factor development is the relative materiality that excess claims have on the block in terms of size, completion factor impact and reserve impact.

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<sup>21</sup> Lloyd, John C., “Health Reserves,” 17.

## Comparison of IBNR Methodologies

In the paper “Using Statistical Analysis and Actuarial Judgment in the Calculation of Medical Liability” submitted for ARCH, Oct. 31, 2006, the three authors<sup>22</sup> discuss handling outliers in the context of their presentation of a statistical approach to determining IBNR.

## Outside Influences on Health Claim Reserves and Patterns

### *Seasonality*

Seasonality is a term actuaries use to refer to the consistent change in claims over time during the course of the year due to the utilization of services by the insured population. There are many different ways in which seasonality is introduced. The most common is due to benefit design. Plans with annual deductibles and other cost sharing elements see claims increase later in the year. Once the deductible has been met, more claim dollars are payable by the insurance company. Health valuation actuaries have seen seasonality in loss ratios for the following two products due to benefit design:

- Medicare Supplement products exhibit their worst loss ratios in the first month or two of a calendar year and progressively get better during the year. The primary cause is the early calendar year incurrals of the Medicare Part B deductible expense of approximately \$100 and to a lesser extent the Part A deductible.
- High-deductible products (e.g., HSA plan) can exhibit the opposite pattern of good loss ratios early in the calendar year and worsening loss ratios as deductibles are met.

Another major seasonal variation is due simply to the calendar. Not all months have the same number of days, so the total claims incurred in each month will vary. Holidays also affect seasonality as people are much less likely to go through with elective procedures during extended holiday periods, especially late in the year during Thanksgiving and Christmas.<sup>23</sup>

Measuring seasonality is a challenge of its own. Since seasonality patterns are measured over the course of the year, it takes analysis of several years of data in order to develop a stable history from which to draw results. This is further complicated by the fact that benefits and plan provisions often change from year to year. This tends to distort the data, making it hard to determine what changes are due to seasonality and what changes are due to benefit design. Thus it is usually only feasible to attempt to measure seasonality on mature blocks with several years of historical data that have not had any major changes to benefit plan design.<sup>24</sup>

### *Days in a Month to Generate Claim*

If an actuary is setting IBNR for a health product that exhibits a material and consistent pattern of claim incurrals for certain days of the week, then the actuary could use that information to (a) be a basis for the IBNR and/or (b) influence the judgment for decisions in employing a particular method. For example, if

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<sup>22</sup> Jinadasa Gamage, Jed L. Linfield and Krzysztof Ostaszewski.

<sup>23</sup> Lloyd, John C., “Health Reserves,” 30.

<sup>24</sup> *NAIC Manual*, 4 and Lloyd, “Health Reserves,” 7.



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one was setting IBNR for a block dominated by physician office and related charges, one might determine more people have a physician office visit in the middle of the week (i.e., Tuesday, Wednesday and Thursday) than on Monday or Friday, for instance. Also, very few office visits occur on weekends, so not many related outpatient claims are incurred on these days. The actuary could determine a weighted average expected claim for each of the weekdays. The “high claim days” of Tuesday/Wednesday/Thursday would get the highest weights and the weekend days would get little-to-no weight. The actuary could use this information to predict the total amount of claims that will be submitted in, say, December 2008, which has 14 “high claim days”—two more than that of the previous December. This approach can also allow the actuary to take into account that some months have five weekends, which allows for fewer “high claim days,” or even working days, than the more typical four-weekend month.

In addition, the timing and length of holidays could have a similar impact on certain claim type generation and could be accounted for in estimating a month’s incurred claims.

### *Claim Cost Trends*

One of the primary external influences on claim payments is claim cost trend. This trend is made up of two pieces: unit cost trends, the increase in per service unit cost for a particular service over time; and utilization trends, the tendency for a people to utilize more services over time. Because these trends can run at more than three times the average inflation rate, they are very important to consider when establishing reserves.

When analyzing claims trend, it is important to note that other issues can distort the trend values, resulting in understating or overstating the true claims trend. Changes in benefits, provider reimbursement levels and demographics can all affect the cost of services, which can compound the effective trend when analyzing historical data. Adjustments should be made to account for these items when attempting a trend analysis.<sup>25</sup>

It is very important to analyze trend when using exposure-based IBNR methods as discussed earlier. Historical loss ratios or PMPM amounts are used to project future claims, and if these amounts are not adjusted correctly for trend, the result could be misestimating the claim reserve. Often graphing and fitting trend lines to monthly PMPM incurred claim levels is a useful tool for estimating PMPM incurred claim levels for recent incurral months where calculated reserve levels are unstable yet large.

### *Growing/Diminishing Blocks*

The longest phase in the life cycle of a block of business is the middle “maintenance” phase where the block maintains a fairly constant membership and the historical data is useful for estimating what future results will be like. The beginning and ending phases, however, where the block is rapidly changing in size, present their own individual sets of challenges when it comes to calculating the claim reserve.

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<sup>25</sup> Lloyd, John C., “Health Reserves,” 30.

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When a product is first issued, there is no claim history on which to base a reserve. If a similar product exists in the company's portfolio, the data from that policy could be used to help estimate a reserve, but the credibility of the data for the new product still creates issues. The primary way to generate reserves early on is to use the Loss Ratio method with the pricing loss ratio. This method is normally used until the block reaches a size at which its own data can be considered credible. The definition of credibility varies based on the type of business and each carrier's own requirements, but typically a block can be deemed credible at between 200 and 400 member-months per month. At this point, assuming there is enough historical data, other IBNR methods can be used. Also, the cross-incurral method, while problematic, tends to produce the quickest indications of completion patterns for a new block of health business.

At the other end of the life cycle, when the block is decreasing in size, a different set of problems is encountered. While sufficient historical data is not a problem, you can again run into the problem concerning the credibility of the data. Without solidly credible data, the lag methods are difficult to use since they will generate volatile results. Exposure-based methods again have to be used. However, this is compounded by the tendency, especially for individual health insurance, for a rate spiral to begin. This results in a block of business that gets less healthy as the healthy insureds lapse and look for better coverage while the ill population persists. This results in a potential rapid increase in costs that must be accounted for when calculating reserves, especially for the recent non-credible incurral months.

### *Premium Changes (e.g., Rate Increases)*

Premium changes only directly affect reserve calculations using premiums (e.g., Loss Ratio method). Indirectly, rate increases can affect the growth rate and demographic makeup of a block, creating some of the issues described in the previous section.

When using the Loss Ratio method, or modification thereto, it is prudent to be aware of the rate increase percentages, their implementation dates, impact on block size and possible anti-selection. If exposure (e.g., membership or insured count) is available, these can be tracked by developing per capita premium as well as per capita incurred claims on a monthly (or quarterly) basis. Changes in per capita premium can be used as a means to gauge the premium rate change and then possibly use that information for adjusting loss ratio estimates for recent incurred months. Similarly, per capita claim trends should also be evaluated in "picking" loss ratios for recent non-credible incurred months.

### *Benefit Changes*

As opposed to issues with premium changes described above, the Loss Ratio method is the only method that is mostly unaffected by benefit changes, with the exception that over time it is expected that premiums will change relative to claims changes in response to a benefit change. However, the majority of the remaining methods have to make adjustments for changes in benefit levels.

The level of effect benefit changes has on the different lag methods depends upon the type of benefit changes implemented. If the changes are in the form of cost sharing, benefit limits or other monetary type changes, the lag methods should not be affected since the underlying payment pattern will not change. However, if the changes result in a shift of covered charges from one type of service to another (e.g.,

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more outpatient services, fewer inpatient services), this could affect the lag method since the payment patterns would be altered due to the differing lag times between types of services. Continuing to use older completion factors on the new claims would result in misestimating the claim reserve.

The methods that use membership as the exposure basis (e.g., PMPM and Paid PMPM methods) would be affected the most by a change in benefit structure. Any type of benefit structure change could result in the average claim size moving one direction or another. Historical averages are no longer applicable because of the changes. For the initial months after the benefit change, the claim reserve would have to be calculated by either estimating the average PMPM amount, or by using one of the other methods.

## Claim Administration Disruption/Backlogs

Claims inventory or claims adjudication processing changes are a special example of real world disruptions to a health actuary's IBNR calculations. Staffing changes, missed work days due to weather or other unexpected events, administration system hardware/software changes and changes in how providers file claims are just a few of the types of situations that cause disruptions and backlogs. It is the job of the actuary to recognize these disruptions as they occur and make use of the available data (e.g., claims inventory reports) to make certain that the reserve estimate is accurate.<sup>26</sup>

### *Days in a Month to Adjudicate*

If the actuary were tracking the working days in a month and assessing the ICOS reserve separately from the true IBNR reserve, he/she could use the days in each month for which the payor's claim department had available-to-adjudicate claims to assist in the assessment of ICOS and possibly of the reasonability of pending claim levels. For example, it would be reasonable for the month-end ICOS to be relatively high for months in which the number of working days is low.

### *ICOS Estimate as Gauge for Backlog*

Capturing pending claims charges in total but especially with some detail can assist greatly in making adjustments for claim backlogs and changes thereto. For example, if one can merely group the pending claim levels by incurral month, then one can apply a "haircut" factor (i.e., percentage estimate, less than 100 percent, of how much every pending claim dollar will eventually be paid) to get an estimate of eventual paid by incurral month. By creating a rough ICOS estimate for every incurral month, one can better gauge the reasonability of the total claims reserve produced by the actuary's typical method (e.g., development completion factor method) to ensure not only that the rough ICOS is covered, but also that there are appropriate levels of true IBNR reserve available for recent incurral months where true IBNR predominantly exists. In times of increasing claims backlog, often the rough ICOS rises, and so additional total reserve (e.g., via higher loss ratio and/or PMPM claims picks for recent incurral months) is needed to produce a reasonable amount of true IBNR.

Even if the pending claims data is not available by incurred month groupings or further groupings (e.g., classification by opened mail, repriced, benefits applied, check cut, etc.), then at least tracking total pending claims level over time (e.g., at the end of every calendar month) can give the actuary a gauge as

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<sup>26</sup> Lloyd, John C., "Health Reserves," 31.

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to the ever-changing claims backlog levels. Once tracked, the actuary will likely notice that pending claims levels are rarely static, either growing or decreasing, and this knowledge is helpful in judging the application of any IBNR reserve calculation method.

## Methods and Issues of Managed Care

John Lloyd's article "Health Reserves" provides excellent instruction on methods and issues surrounding managed care and handling IBNR health claims reserves. Appendix F presents the portion of his article covering these issues.

## Margin and Confidence Intervals

A chief actuary of a health insurer or the CFO of an HMO may ask the question: "How much margin do we need to be 80 percent (or 85 percent, 90 percent, 95 percent) confident that our IBNR estimate will not be short by 5 percent or more compared to actual claims run-out?" Mathematically, this can be written as what margin provides that:

$$\text{Probability (Estimate + Margin} > 95\%) > 85\%.$$

Here are a couple of ideas:

- Compare original best estimate reserves (no margin added) versus retrospectively restated reserves for the past two, three or four years (including periodic monthly or quarterly reserve estimates therein). Then increase your original reserves by X percent, such that only 20 percent of the months are more than 5 percent short. (X percent could be negative, if you tended to overstate reserves.). For other percentages (e.g., 85 percent, 90 percent, 95 percent), you can easily repeat this process for 15 percent, 10 percent and 5 percent of the months being more than 5 percent short. You may want to modify your results if the X percent is highly dependent on a major outlier.
- Reserves can be eventually understated due to two factors: utilization turns out to be higher than average, and the frequency (or severity) of large claims turns out to be higher than average. The averages are assumed and/or implied in most reserve models. So the probability of more large claims (for example) than expected in past incurred months but paid in future months should be quantified, using current data. (Also, knowing about these claims as soon as possible will assist in more accurate reserve estimates.)

Again, John Lloyd's article "Health Reserves" provides additional instruction on developing IBNR margin. Appendix G presents the portion of his article covering these issues. Appendix I also provides some additional discussion on confidence intervals for IBNR when using simple regression techniques.

In addition, in the above-referenced paper "Using Statistical Analysis and Actuarial Judgment in the Calculation of Medical Liability" and its follow-up paper,<sup>27</sup> the authors focus on the development of

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<sup>27</sup> The follow-up publication is "STATISTICAL METHODS FOR HEALTH ACTUARIES IBNR ESTIMATES: An Introduction," Oct. 9, 2007, with authors Jinadasa Gamage, Jed Linfield, Krzysztof Ostaszewski and Steven Siegel.

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confidence intervals around IBNR estimates. In doing so, the authors define an underlying probability distribution for either the claims data or the factors that are calculated by the completion factor method. They present an approach whereby regression is used to estimate the IBNR for the most recent lag months combined with a standard application of the completion factor method for the remaining prior months. They also introduce simulation techniques to allow calculation of a confidence interval for the entire IBNR estimate using the standard completion factor method as well as other approaches. Finally, the authors provide a foundation for an integrated statistical approach to calculating a confidence interval on the entire IBNR estimate without the use of the completion factor method.

## Follow-Up Studies<sup>28</sup>

Actuarial Standard of Practice No. 5, “Incurred Health Claim Liabilities,”<sup>29</sup> specifically addresses follow-up studies for claim reserves. Follow-up studies are performed to determine the accuracy of previous reserve estimates. A comparison is made between the reserve calculated as of a given valuation date and the sum of: (a) obligations incurred prior to the valuation date but paid after the valuation date; and (b) an estimate of any residual unpaid obligations remaining at the end of the period for which actual payment amounts are known.

Follow-up studies are valuable in determining whether or not a reserve methodology is producing accurate, adequate reserves. If follow-up studies consistently show prior reserve estimates to be adequate by a reasonable margin, then a reasonable observation is that a combination of the IBNR method and actuarial judgments applied thereto are good. However, follow-up studies showing a consistently deficient reserve might result in either an alteration (e.g., different judgment, different historical period for gauging completion factors, etc.) to the current methodology or a change in methodology altogether.

Follow-up studies are generally performed at the end of the year as part of an annual statement filing. Schedule H in the Life and Health form, Part 2B in the HMO form and Schedules P and H in the Property & Casualty form all require some form of follow-up study.

The following two exhibits show the testing required for Schedule H in the NAIC Life & Health Blank and for Part 2B in the NAIC HMO Blank. Exhibit 7 shows a Schedule H sample. In Part 3, line 3.1 shows the run-out of claims incurred during the previous year, line 3.2 shows the reserve held for those claims at the end of the previous year, and line 3.3 shows the deficit (excess) of the reserves versus the run-out. Column 2 shows an example of a sufficient reserve and column 6 shows an insufficient reserve. Exhibit 8 shows a Part 2B sample. It is very similar to the Schedule H test, only it does not display the resulting deficit (excess) amount. This can be calculated by subtracting column 5 from column 6. Row 1 shows excess reserves, and row 2 shows deficient reserves.

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<sup>28</sup> Lloyd, John C., “Health Reserves,” 10-11.

<sup>29</sup> *NAIC Manual*, 6.

# Comparison of IBNR Methodologies

## Exhibit 7

### ANNUAL STATEMENT FOR THE YEAR 2007 OF THE XXX LIFE & HEALTH INSURANCE COMPANY

### SCHEDULE H - ACCIDENT AND HEALTH EXHIBIT (continued)

	1	2	3	4	Other Individual Contracts				
					5	6	7	8	9
	Total	Group Accident and Health	Credit Accident and Health (Group and Individual)	Collectively Renewable	Non-Cancelable	Guaranteed Renewable	Non-Renewable for State Reasons Only	Other Accident Only	All Other
<b>PART 2 - RESERVES AND LIABILITIES</b>									
<b>A. Premium Reserves:</b>									
1. Unearned premiums	0								
2. Advance premiums	528,551	216,005				312,546			
3. Reserve for rate credits	0								
4. Total premium reserves, current year	528,551	216,005				312,546			
5. Total premium reserves, prior year	484,791	134,340				350,451			
6. Increase in total premium reserves	43,760	81,665				(37,905)			
<b>B. Contract Reserves:</b>									
1. Additional reserves	0								
2. Reserve for future contingent benefits	0								
3. Total contract reserves, current year	0								
4. Total contract reserves, prior year	0								
5. Increase in contract reserves	0								
<b>C. Claims Reserves and Liabilities</b>									
1. Total current year	5,782,568	2,568,000				3,214,568			
2. Total prior year	5,566,489	2,451,000				3,115,489			
3. Increase	216,079	117,000				99,079			
<b>PART 3 - TEST OF PRIOR YEAR'S CLAIM RESERVES AND LIABILITIES</b>									
1. Claims paid during the year:									
1.1 On Claims incurred prior to current year	4,053,858	1,899,069				2,154,789			
1.2 On claims incurred during current year	34,711,466	10,735,312				23,976,154			
2. Claims reserves and liabilities, December 31, current year:									
2.1 On claims incurred prior to current year	0								
2.2 On claims incurred during current year	4,533,478	2,568,000				1,965,478			
3. Test:									
3.1 Line 1.1 and 2.1	4,053,858	1,899,069				2,154,789			
3.2 Claims reserves and liabilities, December 31, prior year	4,196,213	2,451,000				1,745,213			
3.3 Line 3.1 minus Line 3.2	(142,355)	(551,931)				409,576			
<b>PART 4 - REINSURANCE</b>									
<b>A. Reinsurance Assumed:</b>									
1. Premiums written	0								
2. Premiums earned	0								
3. Incurred claims	0								
4. Commissions	0								
<b>B. Reinsurance Ceded:</b>									
1. Premiums written	0								
2. Premiums earned	0								
3. Incurred claims	0								
4. Commissions	0								

# Comparison of IBNR Methodologies

## Exhibit 8

STATEMENT AS OF ANNUAL STATEMENT FOR THE YEAR 2007 OF THE XXX HMO, INC

### UNDERWRITING AND INVESTMENT EXHIBIT

#### PART 2B - ANALYSIS OF CLAIMS UNPAID - PRIOR YEAR - NET OF REINSURANCE

Line of Business	Claims Paid During the Year		Claim Reserve and Claim Liability Dec. 31 of Current Year		5 Claims Incurred in Prior Years (Columns 1 + 3)	6 Estimated Claims Reserve and Claim Liability December 31 of Prior Year
	1 On Claims Incurred Prior to January 1 of Current Year	2 On Claims Incurred During the Year	3 On Claims Unpaid December 31 of Prior Year	4 On Claims Incurred During the Year		
1. Comprehensive (hospital and medical)	10,549,753	96,584,755	241,526	11,549,875	10,549,753	10,986,754
2. Medicare Supplement	215,487	3,658,745	10,254	205,887	215,487	198,654
3. Dental Only						
4. Vision Only						
5. Federal Employees Health Benefits Plan Premiums						
6. Title XVIII - Medicare						
7. Title XIX - Medicaid						
8. Other Health						
9. Health subtotal (Lines 1 to 8)	10,765,240	100,243,500	251,780	11,755,762	10,765,240	11,185,408
10. Healthcare receivables (a)	1,021,546	548,765		2,054,845	1,021,546	1,089,654
11. Other non-health						
12. Medical incentive pools and bonus amounts						
13. Totals (lines 9 - 10 + 11 + 12)	9,743,694	99,694,735	251,780	9,700,917	9,743,694	10,095,754

## Internal Consistency with Insurer Financials

When a reserve amount is published in a financial statement, it is assumed to be related in some way to the paid claims information found in the same financial statement. Thus, it is important when developing the reserves that the paid claim data used to calculate the reserve be reconcilable to the paid claim information published in the financial statement. This does not necessarily mean the two paid claim amounts should be exactly equal to one another. It is understood that often the defined set of claims needed to calculate a reserve is not necessarily the same as the set of claims needed for financials. However, there should be a way to reconcile the two amounts.<sup>30</sup>

## Documentation and Data Quality

Using accurate and complete data is essential in developing a comfortable reserve estimate. Data quality goes hand in hand with being consistent with insurer financials. By attempting to reconcile data, an essential quality check is being performed. However, there is more to maintaining data quality than simply reconciliation. Actuarial Standard of Practice (ASOP) No. 23, "Data Quality," goes into detail concerning the importance of data quality and the actuary's role in the process.

<sup>30</sup> Lloyd, John C., "Health Reserves," 6-7.

## Comparison of IBNR Methodologies

### Checklist for Actuaries Calculating Claim Reserves

The following checklist contains questions based on the considerations and topics discussed previously. This list is not exhaustive, but is intended to provide an initial framework when calculating claim reserves.

1. Has the claim data used been reconciled to the paid claims data reported in the financial statements for which the reserves are being calculated?
2. Do the paid claims used to estimate incurred liabilities match the ledger entries used for paid entries in the income statement?
3. Do the asset/liability estimates overlay with the entries being made by accounting?
4. Have you used multiple years of data (when available and when benefits have not changed significantly) to reasonably estimate the impact of seasonal effects?
5. Have you determined whether the "incurral date" assigned to claims for reserving purposes is identical with the contractually determined incurral date?
6. Have you reviewed the data for consistency and reasonableness?
7. Have you followed ASOP 23?
8. Have you disclosed any material biases that could result due to incomplete data?
9. Have you disclosed any reliance on data supplied by others?
10. Have you disclosed any data that you have not sufficiently reviewed and disclosed any limitations caused by the lack of review?
11. Have you accounted for all paid claims from the lines of business in question?
12. Have you documented the method used (by line of business, if based on different methods) in conformance with ASB standards of practice?
13. Have you created a follow-up study (for example, a Schedule H)?
14. Have you ensured that the payment data includes all types of obligations represented in the original reserve?
15. Do the follow-up studies indicate that the reserve methodologies and assumptions are not appropriate?
16. If yes, then what revisions have you made to the methodologies and assumptions to correct the inconsistencies?
17. Have you performed the follow-up studies for at least every year-end?
18. When working with the loss ratio method or any method employing premiums, have you recognized any rate increases appropriately?
19. Are exposure data (including membership and premium) and historical claims cost data available and reliable? (Helpful when determining the most appropriate reserving method)
20. Are there unusually large claims in the data? How are these generally handled?
21. Is claims data recorded for an incurred and payment date for each claim? (This is useful to determine if the development methods can be used.)
22. Is there a fairly consistent lag pattern from incurred to paid dates for claims? (This is useful to determine if the development methods can be used.)
23. What is the claims inventory? How quickly are these claims being paid?



## Comparison of IBNR Methodologies

24. Have you considered the effects of seasonality in your data? What adjustments have been made?
25. What trends are being projected for the time period?
26. Were there any demographic, morbidity, plan design or provider reimbursement changes?
27. Were there any internal departmental changes, for example, in underwriting or claims processing, that should be taken into consideration?

### Basic Review of IBNR Methods Tested

As indicated in the report section above, there are many approaches available for calculating IBNR, or claim reserves. For this study, we tested the methods outlined below. The sections below give a brief description of each method tested. More information on each of the methods below, including additional details and formulas, can be found in Appendix B.

#### Exposure Methods

##### *Loss Ratio Method*

The loss ratio method makes use of a historical loss ratio<sup>31</sup> based on past data to determine the expected incurred claims. This loss ratio is multiplied by the earned premium for a given incurred month to calculate the incurred claims.

##### *PMPM Method*

The average claims per policy method, or PMPM method, uses member-months as the exposure basis. Prior period complete data is used to generate expected PMPMs<sup>32</sup> by dividing each month's incurred claims by the member-months. This historical PMPM is then used in incomplete incurral months to calculate the expected incurred claims.

#### Basic Development Methods Tested

The approaches listed below are several methods we tested to determine those completion factors.

##### *Straight-Average Lag with Average Periods of 3, 6, 9, 12 Months*

The straight-average lag approach takes the known factors by paid duration for the most recent 3, 6, 9 or 12 incurral months and computes an arithmetic mean. This new average completion factor is then used to calculate the estimated IBNR. For this approach, we tested each of the 3-, 6-, 9- and 12-month averages.

##### *Straight-Average Lag without Outliers*

This approach is the same as the straight-average lag method above except we remove the highest and lowest completion factors from the data and then compute the mean of the remaining factors. For our tests we used a 12-month straight-average lag.

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<sup>31</sup> Historical loss ratio for incurred months with an implied completion factor greater than 0.75 is the rolling 12-month loss ratio as determined by the completion factor method using nine months of claims history. For those months with a completion factor less than 0.75, the applied loss ratio is the rolling 12-month loss ratio for the last incurred month with a completion factor greater than 0.75.

<sup>32</sup> Expected PMPMs are based on PMPMs observed 24 months prior to the valuation date; however, the observed exponential growth in these PMPMs is used as a growth trend through the valuation date.

## Comparison of IBNR Methodologies

### *Geometric Average Lag*

This method is the same as the straight-average lag method except that a geometric mean is used in place of an arithmetic mean. A geometric mean simply takes a series of  $n$  values, multiplies them together, and takes the  $n^{\text{th}}$  root. For our testing purposes we only used a 9-month geometric average lag.

### *Harmonic Average Lag*

This method makes use of the harmonic mean instead of the arithmetic or geometric mean. A harmonic mean is calculated by taking the reciprocals of  $n$  values, averaging those reciprocals together, and then taking the reciprocal of the resulting number. For our tests, we only computed a 9-month harmonic average lag.

### *Dollar-Weighted Average Lag*

The dollar-weighted-average approach computes an average by weighting each known completion factor with the actual claim dollars paid in each lag month. This method also results in a simpler method of calculation because the formula allows for calculating the completion ratios directly via the paid claims data instead of having to first calculate completion ratios using the claims triangle from above. We calculated a 12-month average lag for this approach.

### Cross-Incurral Period Method

Instead of determining completion ratios from duration to duration in a particular incurral month, the cross-incurral method determines completion factors directly to determine what percentage of the total paid claims is paid in a given month across all incurral months. This is done by totaling the claims paid in the last 9 months and then dividing by the cumulative claims paid as of the duration in question. For example, to derive the completion factor for duration 3, we take the total paid claims for the last 9 months and divide it by the total paid claims from durations 1, 2 and 3.

### Hybrid Chain-Ladder Methods

#### *Hybrid Loss Ratio Method with Outliers Removed*

This method involves a combination of the loss ratio approach and the straight-average lag without outliers approach. The two values are calculated independently and then averaged together using the completion factor as the weight.

#### *Bornhuetter-Ferguson with Straight-Average Lag*

This method combines the use of a standard completion factor approach with an average loss ratio approach. First, a set of completion factors must be calculated using one of the development approaches above. For our tests, we used the 9-month straight-average lag approach. Second, an average loss ratio must be calculated using the known data. This loss ratio should be for as long a period as is reasonable and credible. The reserve is set by taking the expected claims calculated using the loss ratio and the premium for the period in question and multiplying it by the fraction of initial claims remaining.

#### *Gunnar-Benklander with Straight-Average Lag*

This method uses a weighted average of reserves calculated by the loss development method and the Bornhuetter-Ferguson method. Where the claims are close to complete, the chain development method is

## Comparison of IBNR Methodologies

weighted higher; for newer claims, the Bornhuetter-Ferguson method is weighted higher. The factor used to weight the two values is the completion factor. For our tests we used the 9-month straight-average lag method as the chain development method.

### *Credibility-Weighted with Straight-Average Lag*

This method uses a weighted average of reserves calculated by the expected loss ratio method, the loss development method and the Bornhuetter-Ferguson method. The weighting selected depends on estimates of the variance in the loss development factors and in the claim amounts in any given month.

### *Paid PMPM Method*

This method attempts to estimate the reserve by examining paid claims by duration. Known data is organized into incurred date/paid date triangles and then each cell is divided by the member-months exposure for each month to derive a Paid PMPM amount for each cell. For a simple approach, average paid amounts by duration can be used to provide expected Paid PMPMs for the empty cells of the triangle. For a more advanced approach, a linear regression can be performed to generate a formula that is used to provide expected Paid PMPMs for the empty cells in the triangle. This method generates the reserve directly as opposed to generating expected incurred claims first.

### *Stochastic Methods*

Our selected stochastic model uses random numbers to complete a triangle of “per member per month” (PMPM) claim payment values. The distributions used for the random PMPM values are selected by curve fitting to experience values with adjustment for trend. A possible IBNR value is calculated from outstanding PMPM values combined with member counts. After many repetitions of this process, a distribution of possible IBNR values is generated. IBNR reserve is set by selecting a point from this IBNR distribution, generally based on probability of sufficiency.

## Definition of Accuracy Applied for IBNR Testing Purposes

To start our accuracy benchmarking of the IBNR methods tested, we calculate an error-estimate statistic for each lag simulation and for each tested IBNR method applied to each simulation. This error-estimate statistic is as follows:

$$= \frac{\text{ReserveEstimate} - \text{ActualRunout}}{\text{ActualRunout}}$$

However, this calculation is only performed for those incurral months with credible completion factors. This accuracy statistic borrows from the idea that practicing actuaries often ignore the reserve results produced by their applied basic development method for the most recent incurral months. The number of months ignored often depends on the calculated completion factors for each incurral month and the actuary’s unique threshold definition. We felt that with this dominant approach employed, that most practicing actuaries would be interested in observing which IBNR method(s) produced the most accurate

## Comparison of IBNR Methodologies

results for incurral months that would not be ignored. We felt that the actuary needs the most accurate method for these months so that the actuary can best estimate reserves for non-credible recent incurral months with the best information for relatively recent credible months.

With these error-estimate statistics calculated, we have measured the accuracy of each IBNR method as a two-step process:

1. Throw out those IBNR methods where the distribution of error estimate statistics does not have a 50<sup>th</sup> percentile that is greater than 0 percent. That is, if an IBNR method produces reserve estimates less than the actual run-out more than 50 percent of the time, then we will not consider it accurate.
2. Of those that met the test in #1 above, accuracy is then defined by having lower standard deviation of error estimates.

## Data Simulation

### Summary

In order to facilitate the testing of the different IBNR methods presented in this paper, we had to have sample data sets on which to run our tests. We used actual claims data from several different insurers with varying blocks of business to help test the different IBNR methods. These data sets, however, each only provided one set of claims triangles. In order to accurately measure the different methods, we estimated that we would need hundreds of random samples based on each of the data sets. We also had confidentiality concerns about using client data directly. Thus, we had to devise a way to randomly simulate sample data sets based on the actual data we possessed.

We aggregated claim experience from several clients in each of eight lines of business (LOBs) with differing payout patterns. The data set from each LOB was used to create a block of scenarios to which the IBNR calculations were applied. Selected LOBs are:

- Major Medical
- Medicare Supplement
- Self-Funded Employer
- HMO Medicare
- HMO Rx
- HMO Professional
- HMO Hospital
- HMO Managed Care<sup>33</sup>

Each of these experience data sets was used to generate a data block for IBNR testing. For each LOB we generated 250 scenarios consisting of a rectangle of random completion ratios (a.k.a. age-to-age development factors) for each incurral month – claim duration month combination. The “size” of the rectangle was 60 incurral months by 28 claim duration months. By simulating a rectangle, rather than only a claims triangle, we included completion ratios implied for both illustrative known past time

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<sup>33</sup> Represents HMO claims from all provider types and claim sources.

## Comparison of IBNR Methodologies

periods and unknown future payments. We separately generated a random total claim amount for each incurral month. We could then easily combine the simulated completion ratios with the simulated total incurred claims to yield a complete rectangle of claim payments. This rectangle not only had a claims triangle as of an illustrative valuation date but also simulated claims run-out after the valuation date. For each of the 250 scenarios for each of the eight LOBs we were able to apply each IBNR calculation method and compare results to simulated “actual” future payments.

### Description of Crystal Ball Use

Crystal Ball is a spreadsheet-based software suite for modeling and simulation. It provides high-level functionality suited for stochastic modeling such as random number distributions with automated iteration and results analysis tools. Other stochastic simulation software could be used for this purpose and is mentioned in Appendix D.

### Lag Set Simulation

#### Exposure (Premiums, Covered Lives) Simulation

In order to better examine the impact of other components of the study we held exposure (e.g., premiums, policy counts) constant for all simulations.

#### Total Incurred Claims Simulation

Premiums and related exposure, unique to each incurral month, were fixed for all simulations and thus each incurral month's incurred claims were a product of premiums times a simulated loss ratio. The loss ratios were randomly generated based on a normal distribution with a uniform mean and a standard deviation of 2.5 percent. Our assumption was that the loss ratio in a given incurred month would be within +/- 5 percent of the mean 95 percent of the time. In order to simulate the “actual” incurred losses, we started with a table of 60 incurred months. For each of these incurred months, we assigned the exposure and average premium per member month (which were both fixed) and then randomly created a loss ratio based on the distribution described above. This random generation was completed using Crystal Ball. One of Crystal Ball's features is the ability to generate a random number from any distribution by randomly generating a number between 0 and 1, the “y” value of the cumulative distribution function (CDF), and retrieving the resulting “x” value from the CDF. This loss ratio generation was performed 60 times, one for each of the incurred months we modeled. This loss ratio was then applied to premium total for each month, resulting in a unique incurred claims total for each of the 60 months. This process was performed 250 times. Note for consistency of testing that we applied the same 250 sets of monthly total incurred claim simulations to each of the eight modeled LOBs. The only, yet material, variation among the LOBs was each block's uniquely simulated 250 completion ratios.

#### Completion Ratio Simulation

We went through several steps to convert an experience data set to a block of scenarios. First each LOB's available data sample was laid out as shown as a lag triangle of cumulative claims.<sup>34</sup> For most data samples all claims were complete within 28 periods. Those few samples with longer tails had immaterial amounts further out, which we simply moved to the 28<sup>th</sup> period.

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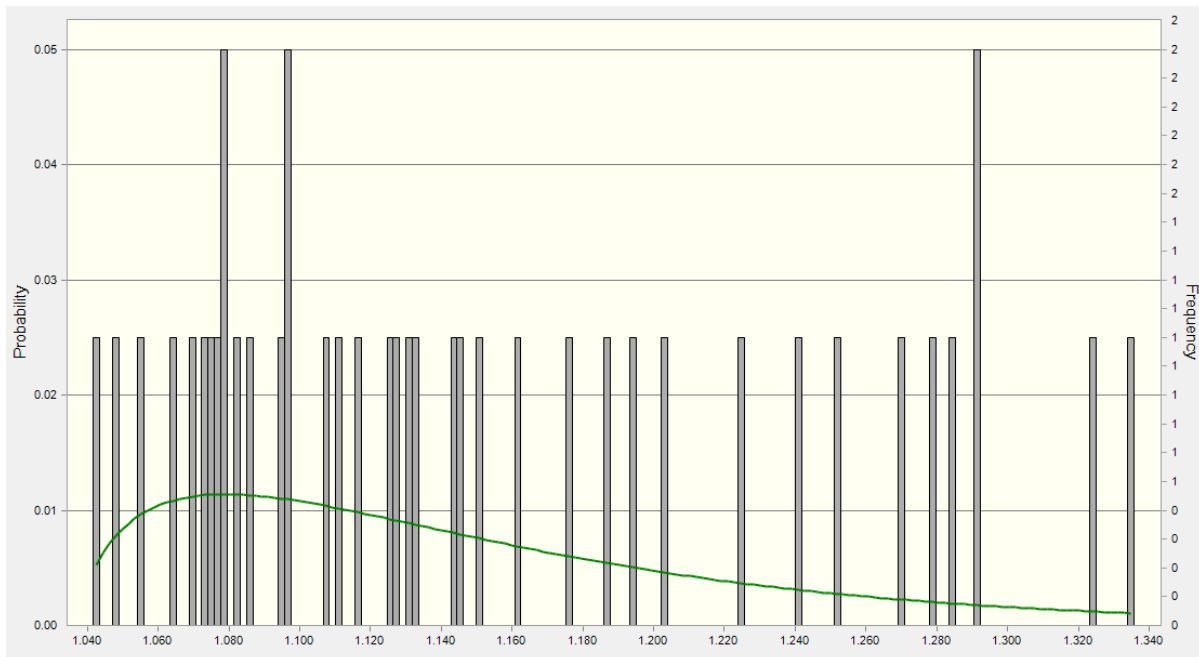
<sup>34</sup> See Exhibit 2 in Appendix A (Development Method Details) for an example.

## Comparison of IBNR Methodologies

The procedure laid out in Appendix A (Development Method Details) was followed to generate a triangle of age-to-age development factors (a.k.a. completion ratios) similar to Exhibit 4a in Appendix A for each sample from the eight business lines.

Extreme outliers of age-to-age development factors were removed as they are given too much weight by the curve fitting algorithms. We wanted to keep the variance fairly low so we would not get results that resulted in heavily skewed claim payment patterns. So, before fitting distributions to the data, we removed any completion ratios that seemed to be the result of a one-time event such as a large claim. For example, if we saw a set of completion ratios containing the values 2.34, 3.2, 1.8, 4.3, 17.8, 2.5 and 1.94, we would remove the 17.8 and fit the distribution with the remaining values. This allowed us to create tighter distributions with less chance for extreme outlier values.

At this point, the completion ratio data was fed into Crystal Ball, and it outputted a variety of fitted distributions by data set and by duration. Crystal Ball also ran the following tests to assess the fit of each potential distribution: the Anderson-Darling test, the Kolmogorov-Smirnov test and the Chi-square test. We also generated graphs, making it easy to visualize the frequency distribution of the actual data against the graph of the probability distribution function (PDF) of each of the tested distributions. A judgment call was made for each distribution based on the available test statistics and graphs to determine which distribution best fit each of the modeled completion ratios. For durations that did not have enough data (Crystal Ball requires at least 15 data points for a valid fit), we assumed a normal distribution. The following image shows an example of distribution fitting.



The vertical bars are the experience values, the curved line is a gamma function fit to minimize Chi-squared error. As many of the distribution functions have tails extending into negative values or to infinity, we truncated the distributions somewhere close to actual extremes experienced.

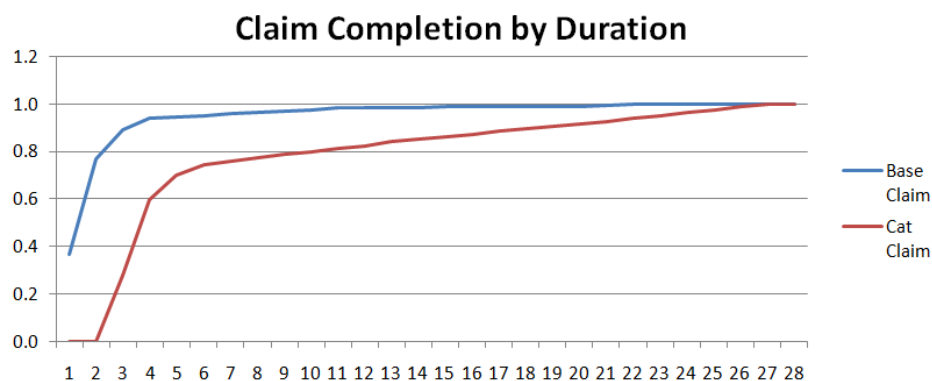
## Comparison of IBNR Methodologies

### Use of Correlation

Crystal Ball's curve fitting tools support calculation of correlation between variables. We attempted to find correlation between adjacent age-to-age development factors. The expectation was that we would find anti-correlation, which would tend to stabilize the completion factors. In general, curve fitting yielded positive correlation between adjacent period lag factors, which increases the variability of the completion factors. Upon further examination, we determined that data was not sufficient to calculate correlation coefficients.

### Excess Catastrophic Claim Simulation

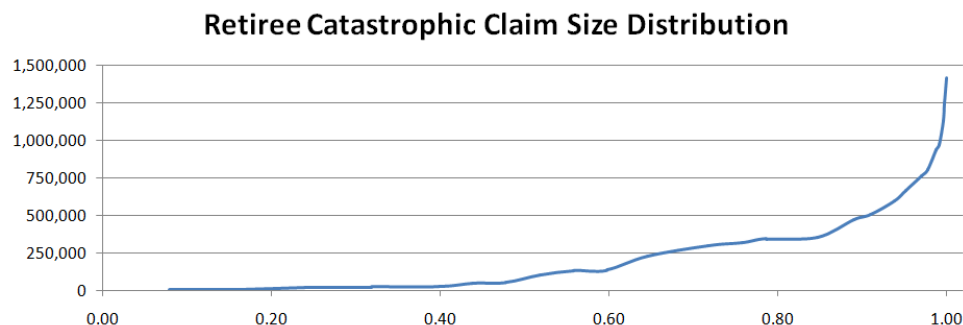
We presumed that the simulated total incurred claims, with our chosen limited standard deviation, represented claim sets without excess claims. As a result, we provided an optional provision for low frequency – high severity (catastrophic) claims. The number of catastrophic claims in each incurral period is a random number selected using a Poisson distribution with an expected count proportional to the member count. Each catastrophic claim has a separate random claim amount. Catastrophic claims are assumed to be adjudicated slower than the base claims. While forced to completion by the 28<sup>th</sup> claim duration, completion factors for the catastrophic claims are delayed and flattened relative to base claim completion factors. Flattening represents ongoing payments for a catastrophic claim. Each incurral period is delayed by a random number of periods representing the adjudication delay. An example of the delay in payout is shown below for a catastrophic claim delayed by two months.



Actuarial judgment was used to determine the flattening parameter and random delay distribution. Selected distribution for random delay in catastrophic claim adjudication is set to average three months.

Catastrophic claims were separated into three groups: (1) Total Working-Age Claims, (2) Hospital-Only Working-Age Claims and (3) Total Retiree Claims. Catastrophic claim probability and amounts were derived from contingency tables by selecting all claims amounts over a dollar cutoff (i.e., \$250,000 for working-age and \$1,000,000 for retirees) to determine probability and size distribution amounts of catastrophic claims. The distribution of claim amount for total retiree claims is as shown below.

## Comparison of IBNR Methodologies



Each data set was assigned one of these three types of catastrophic claims. Major Medical LOB, Self Funded Employer LOB and HMO Managed Care LOB were assigned the total working age catastrophic claims. HMO Hospital LOB was assigned hospital-only working-age catastrophic claims. HMO Medicare was assigned total retiree catastrophic claims. The remaining LOBs were not assigned any catastrophic claims.

Basic claims and catastrophic claims, as simulated into their respective claim lag cells, were added together to create a block of data set scenarios for each LOB.

### Determination of Number of Scenarios for Statistical Significance

In determining the number of simulations we would need to run, we began by assuming that a large number (e.g., >100) would be needed for each line of business, thus we could assume that the distribution of results would be approximately normal. Our desire was to target the number of simulations that would give us a 95 percent probability that the IBNR output would be within +/-2 percent of the expected mean. The equation to solve for the number of simulations is as follows:

$$.95 = P \left( -1.96 \leq \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \leq 1.96 \right)$$

where  $\bar{X}$  is the mean of the observations,  $\mu$  is the expected mean,  $\sigma$  is the standard deviation of the sample, and  $n$  is the number of simulations.

This formula, however, makes it difficult to choose a number of simulations since the standard deviation tends to vary based on the number of simulations. So, in actuality, we chose a number of simulations, and then tested the confidence interval after everything had been run. To complicate matters further, the standard deviation was different with each IBNR method, sample data set and stress test. This could have resulted in potentially more than 600 different simulation values. To keep things simple, we decided to select a single number of simulations to use for all testing, knowing that the confidence interval for each method/data set/stress test combination would be slightly different than our desired 2 percent interval. In the end, we selected 250 as the number of simulations to run. This resulted in confidence intervals ranging anywhere from 0.5 percent to around 10 percent, with the average being around 2 percent. The scenarios that had the higher confidence intervals were a few of the extreme stress tests where we would



## Comparison of IBNR Methodologies

expect a wider range of results. But, overall, we believe 250 simulations resulted in the desired confidence intervals.

### Description of Stress Testing Scenarios

For all of our stress tests, we start with the data from the input triangles as described in the Data Simulation section of this report. This data gives us total earned premium, incurred claims and membership for each incurred month. For each stress test, factors are applied to these numbers to create an alternate set of values. It is these resulting values that are tested against each of the IBNR methodologies.

#### Base Scenario

For the base scenario, we assume a steady, non-growing block of business where premium increases keep up with claims trend. We used a value of 10 percent of claims trend and premium growth.

#### Excessive Trend Scenario

The excessive trend scenario was modeled the same as the base scenario, except we used a 25 percent trend and premium growth instead of the base scenario trend assumption of 10 percent.

#### Varying Trend Scenarios

We modeled two different varying trend scenarios. Both scenarios used the same trend rates, which are based on trend rates as seen in the market over the past several years. In our model, we used 9.8 percent for 2001, 10.1 percent for 2002, 10.1 percent for 2003, 9.1 percent for 2004, 9.6 percent for 2005, 8.4 percent for 2006 and 7.6 percent for 2007. The difference between the two scenarios was how rate increases were incorporated to account for the trend. For the first scenario, we assumed rate increases were implemented all at once, such as would be done for a group plan. We also assumed the rate increases would be lagged 18 months behind the claims trend (i.e., to account for the insurer's lagging observance of the trend and further lagged implementation of comparable rate increase). For example, the rate increase implemented on Jan. 1, 2003 would be the observed 9.8 percent trend from 2001. For the second scenario, we assumed that the rate increases would be rolled in over time as with an individual health product. Again, it was assumed there would be an 18-month lag in the rate increases.

#### Membership Change Scenario

For the membership change scenario, we started with the base scenario described above. The only difference is that we assumed a 2.5 percent lapse rate that would affect the policy count, as well as premium and claims.

#### Seasonality Scenarios

Seasonality was modeled as a set of factors applied to the base claims cost to simulate changes in claim patterns resulting from three different seasonality scenarios.

- The first scenario was based on an assumption that a month's claims levels are directly related to the number of work days in a month. Admittedly, this assumption is applicable primarily to physician office visits; however, we applied the simulated seasonality factors to the entire claims cost for illustrative testing purposes. To determine these factors, we modeled each month in our simulation,

## Comparison of IBNR Methodologies

from January 2003 to December 2007. We calculated the number of work days in each month, taking into account weekends and standard holidays. This number ranged from 18 to 23. The factor for each month was determined by dividing the number of work days in a particular month by the overall average number of work days. The following illustrates these applied factors:

Month	Factor	Month	Factor	Month	Factor	Month	Factor	Month	Factor
Jan-03	1.009	Jan-04	0.961	Jan-05	0.961	Jan-06	0.961	Jan-07	1.009
Feb-03	0.913	Feb-04	0.913	Feb-05	0.913	Feb-06	0.913	Feb-07	0.913
Mar-03	1.009	Mar-04	1.105	Mar-05	1.105	Mar-06	1.105	Mar-07	1.057
Apr-03	1.057	Apr-04	1.057	Apr-05	1.009	Apr-06	0.961	Apr-07	1.009
May-03	1.009	May-04	0.961	May-05	1.009	May-06	1.057	May-07	1.057
Jun-03	1.009	Jun-04	1.057	Jun-05	1.057	Jun-06	1.057	Jun-07	1.009
Jul-03	1.057	Jul-04	1.009	Jul-05	0.961	Jul-06	0.961	Jul-07	1.009
Aug-03	1.009	Aug-04	1.057	Aug-05	1.105	Aug-06	1.105	Aug-07	1.105
Sep-03	1.009	Sep-04	1.009	Sep-05	1.009	Sep-06	0.961	Sep-07	0.913
Oct-03	1.057	Oct-04	0.961	Oct-05	0.961	Oct-06	1.009	Oct-07	1.057
Nov-03	0.865	Nov-04	0.961	Nov-05	0.961	Nov-06	0.961	Nov-07	0.961
Dec-03	1.009	Dec-04	0.961	Dec-05	0.961	Dec-06	0.913	Dec-07	0.913

- The second scenario was based on claims data from a Medicare Supplement-type policy. The assumption is that more claims are paid at the beginning of the year since the product serves to meet Medicare cost-sharing (e.g., deductibles) that tends to occur early in a calendar year. As time passes and the deductible is met, relatively fewer claim dollars are paid. For our scenario, the factors decrease over time through September and then move up slightly again in October, November and December. The following illustrates these applied factors:

Month	Factor
January	1.28
February	1.12
March	1.04
April	1.04
May	1.02
June	0.99
July	0.94
August	0.85
September	0.85
October	0.94
November	0.93
December	0.93

- The final scenario is exactly the opposite of the second scenario described above. It represents the claim pattern for an HSA or some other high-deductible type plan. Early in the year, few claims are

## Comparison of IBNR Methodologies

paid as the deductible has not been met. As time passes and the deductible is met, claim payments increase. The following illustrates these applied factors:

Month	Factor
January	0.93
February	0.93
March	0.94
April	0.85
May	0.85
June	0.94
July	0.99
August	1.02
September	1.04
October	1.04
November	1.12
December	1.28

### Premium Rate Shift Scenarios

We created three rate-shift scenarios to model a sudden shift in premium rates. We only applied a positive, or increasing, shift for these scenarios, assuming that a sudden decrease in premium was not a likely event. We started with assumptions for the base scenario and applied a 15 percent rate increase at each of three different points in time, resulting in three scenarios. For the first scenario, we applied the rate shift in incurred month 3 (i.e., three months prior to the valuation date). For the second scenario, we applied the shift in incurred month 8, and for the third, we applied the shift in incurred month 14. All three rate-shift scenarios assume that the rate increases for the simulated block occur at the chosen point in time and are not “rolling” through (e.g., as sometimes found in an individual health block).

### Claim Shift Scenarios

We created six claim-shift scenarios to model a sudden shift in claims. These scenarios were created exactly the same as the premium rate-shift scenarios, except we modeled both a claim increase and a decrease. A 15 percent increase and decrease were applied at three months, eight months and 14 months.

### Large Claim Scenarios

Our base claims data included no catastrophic large claims. For the two large claim scenarios, we first simulated large claims using simulation techniques similar to those used to simulate our base claims sets. The two scenarios used the same large claim data set. The only difference between the two scenarios is how the lag factors were calculated for the methods that made use of lag factors. In the first scenario, the factors are calculated based on the base claims data only, and then applied to the combined base claims and large claims data set to calculate IBNR. In the second scenario, the lag factors are both calculated based on and applied to the combined data set. The non-lag factor methods (i.e., loss ratio, paid PMPM, average claim size, etc.) produce the same results for both scenarios.

### Rate Spiral Scenario

## Comparison of IBNR Methodologies

The rate spiral scenario was created to model a rapidly deteriorating block of business. This deterioration included increasing loss ratios, rising premium and high lapse rates. For our model, we started with a 13.5 percent claims trend and a 3.5 percent monthly lapse rate. The premium increases are assumed to lag six months behind the claims trend. So, for the first six months, the premium stayed the same, the policies lapsed at 3.5 percent per month, and the claims increased 1.125 percent per month. After month 6, the lapse rate held at 3.5 percent and the cumulative premium increase was equal to the cumulative claims trend from six months prior. The claims trend, however, began increasing at a higher rate, equal to the 1.125 percent base trend rate plus 5 percent of the cumulative rate increase as of the current month. So, for example, in June 2004 in our model, the cumulative rate increase factor was 1.135 and May 2004 cumulative claims trend factor was 1.241. To determine the June 2004 trend, we took the 1.125 percent monthly base trend rate and added  $5\% \times 13.5\%$ , resulting in a new monthly trend of 1.8 percent.

### Disruption Scenarios

We modeled 12 different disruption scenarios to simulate different disruptions in claims processing and claims payment. The scenarios differed by the processing capacity during the disruption month, the recovery time to get claims back on track and at what point in time the disruption occurred. The table below shows each scenario and its characteristics.

Scenario	% of Normal Claims Processing Capacity	Months Prior To Valuation	Recovery Time (in months)
1	50% for one month	4	2
2	50% for one month	4	4
3	50% for one month	12	2
4	50% for one month	12	4
5	0% for one month	4	2
6	0% for one month	4	4
7	0% for one month	12	2
8	0% for one month	12	4
9	0% for one month, 50% for next month	4	2
10	0% for one month, 50% for next month	4	4
11	0% for one month, 50% for next month	12	2
12	0% for one month, 50% for next month	12	4

To illustrate this better, we will describe scenario 12. The valuation date for our simulation is Dec. 31, 2007. So, in this case, the disruption occurred in January 2007. For January 2007, we assumed 0 paid claims, and for February 2007, we assumed 50 percent of the claims were paid. For the next four months, an additional 37.5 percent of claims had to be processed each month in order to catch up.

## Results and Conclusions

In each of the sections below, we will discuss the results of each of the scenario tests. When discussing the different methods we will, at times, refer to them on a more generic basis. The following list shows our generic categories:

- Exposure-Based Methods

## Comparison of IBNR Methodologies

- Loss Ratio
- PMPM (or average claims per policy)
- Paid PMPM
- Simple Lag Methods
  - Lag 3 Month Average
  - Lag 6 Month Average
  - Lag 9 Month Average
  - Lag 12 Month Average
- Advanced Lag Methods
  - Lag – Dollar Weighted Average
  - Lag – Drop Extremes (based on the 12-month average)
  - Lag – Geometric Average
  - Lag – Harmonic Average
- Hybrid Methods (usually a hybrid of some exposure method and a lag method)
  - Benktander
  - Bornhuetter-Ferguson
  - Hybrid Loss Ratio
  - Credibility Weighted
- Lag – Cross-Incurral Method (this method is categorized by itself due to its unique nature and the fact that it does not fit in well with any of the other categories.)

Additionally, we will also be referring to the length of the run-out for each of the blocks. The list below shows each block in order of run-out with the quickest run-out (HMO Rx) at the top and the longest run-out (Medicare Supplement) at the bottom.

- HMO Rx
- HMO Medicare
- HMO Professional
- HMO Managed Care
- HMO Hospital
- Major Medical
- Self Funded Employer
- Medicare Supplement

In the course of discussing the results, we will present a portion of the results from our study. However, the entire set of results can be found in Appendix E, “Detailed Results of IBNR Tests.”

### Sample Testing Results

The following exhibits show one illustrative set of testing results. These results represent only one block type, our modeled and simulated major medical block type, and only represent reserves for incurral months where the completion factor percentage was in excess of 50 percent.

We realize that applying the majority of these IBNR methods to all incurral months is rarely, if ever, done in practice. Typically, the most recent incurral month(s) have IBNR amounts estimated using an exposure-based method since lag methods could potentially result in grossly over- or underestimated

## Comparison of IBNR Methodologies

incurred claim numbers. So an actuary, for example, might use the loss ratio method in the most recent two incurral months, and the 12-month average lag method for the preceding months. We also realize that actuarial judgment is used to determine how many of the recent incurral months would need an alternative method. Sometimes this is done by simply assuming a certain number of months, while other actuaries base it on the credibility of the completion factor. We have chosen 50 percent as the “credibility level” of the completion factor for our simulations. That is, if an incurral month’s completion factor, as implied by the actual run-out, is less than 50 percent, then that incurral month’s reserve is considered not “credible.”

Similar test results for the other block types and all other incurral months can be found in Appendix E.

# Comparison of IBNR Methodologies

## SAMPLE RESULTS – MAJOR MEDICAL

### MEAN ERROR

IBNR Methods	Base Scenario	Excessive Trend	Varying Trend & Single Rate Increase	Varying Trend & Rolling Rate Increase	Steady Member Loss	WorkDay Seasonality	Seasonality of beginning CY loss	Seasonality of ending CY loss
LossRatio	0.2%	0.4%	16.8%	9.2%	-0.2%	-16.2%	-13.9%	52.5%
PMPM	-6.5%	-10.9%	13.3%	13.3%	-10.6%	-22.6%	-26.1%	49.3%
Paid PMPM	3.7%	3.4%	10.6%	10.6%	4.7%	0.9%	9.7%	-0.4%
Benktander	6.2%	6.0%	6.3%	6.5%	6.7%	5.7%	7.9%	5.5%
Bornhuetter	4.4%	4.3%	5.5%	6.0%	4.6%	2.4%	12.2%	2.9%
Credibility Weighted	5.5%	6.1%	5.4%	6.3%	6.7%	3.9%	10.5%	4.2%
Hybrid Loss Ratio	1.8%	16%	2.0%	2.7%	2.3%	-0.3%	9.5%	0.2%
Lag - 12 Mo Avg	6.1%	6.0%	6.1%	6.1%	6.5%	6.1%	6.4%	6.2%
Lag - 9 Mo Avg	6.6%	6.4%	6.6%	6.6%	7.0%	6.6%	6.8%	6.6%
Lag - 6 Mo Avg	6.7%	6.5%	6.8%	6.8%	7.4%	6.8%	7.0%	6.8%
Lag - 3 Mo Avg	7.8%	7.5%	7.8%	7.8%	8.8%	7.8%	8.1%	7.8%
Lag - Cross Incurral	-0.1%	-5.3%	0.7%	0.7%	14.8%	-0.1%	0.3%	-0.2%
Lag - Dollar Weighted	4.2%	4.1%	4.2%	4.2%	4.5%	4.2%	4.5%	4.2%
Lag - Drop Extremes	2.0%	18%	2.0%	2.0%	2.5%	2.1%	2.4%	2.0%
Lag - Geometric Avg	5.6%	5.5%	5.7%	5.7%	6.1%	5.7%	5.9%	5.7%
Lag - Harmonic Avg	4.7%	4.6%	4.7%	4.7%	5.2%	4.7%	5.0%	4.7%
Stochastic Method	2.0%	2.0%	3.6%	3.6%	15%	-0.2%	9.6%	-13%

IBNR Methods	3-Month Prior Rate Increase	8-Month Prior Rate Increase	14-Month Prior Rate Increase	3-Month Prior Claims Decrease	3-Month Prior Claims Increase	8-Month Prior Claims Decrease	8-Month Prior Claims Increase	14-Month Prior Claims Decrease	14-Month Prior Claims Increase
LossRatio	210%	83.7%	69.1%	22.3%	-19.4%	100.9%	-75.9%	86.8%	-64.0%
PMPM	-6.5%	-6.5%	-6.5%	15.2%	-25.6%	134.0%	-112.7%	221.4%	-175.5%
Paid PMPM	3.7%	3.7%	3.7%	25.2%	-15.3%	51.5%	-32.9%	30.7%	-17.3%
Benktander	8.1%	8.9%	8.4%	8.2%	4.4%	9.7%	3.5%	9.0%	4.1%
Bornhuetter	10.6%	18.7%	16.9%	11.0%	-15%	21.2%	-8.3%	19.4%	-6.7%
Credibility Weighted	12.6%	13.1%	7.3%	13.2%	-1.4%	15.8%	-0.5%	8.6%	4.7%
Hybrid Loss Ratio	7.9%	10.1%	4.0%	8.3%	-3.9%	12.3%	-6.1%	4.8%	-0.4%
Lag - 12 Mo Avg	6.1%	6.1%	6.1%	6.0%	6.2%	6.4%	5.9%	6.2%	6.0%
Lag - 9 Mo Avg	6.6%	6.6%	6.6%	6.5%	6.6%	6.9%	6.3%	6.7%	6.5%
Lag - 6 Mo Avg	6.7%	6.7%	6.7%	6.7%	6.8%	7.1%	6.5%	6.9%	6.6%
Lag - 3 Mo Avg	7.8%	7.8%	7.8%	7.9%	7.7%	8.3%	7.4%	8.1%	7.6%
Lag - Cross Incurral	-0.1%	-0.1%	-0.1%	1.7%	-1.9%	5.7%	-5.0%	6.0%	-4.7%
Lag - Dollar Weighted	4.2%	4.2%	4.2%	4.2%	4.3%	4.5%	4.0%	4.2%	4.2%
Lag - Drop Extremes	2.0%	2.0%	2.0%	1.9%	2.1%	2.3%	1.8%	2.1%	1.9%
Lag - Geometric Avg	5.6%	5.6%	5.6%	5.6%	5.7%	5.9%	5.4%	5.7%	5.5%
Lag - Harmonic Avg	4.7%	4.7%	4.7%	4.7%	4.7%	5.0%	4.5%	4.8%	4.6%
Stochastic Method				8.2%	-4.1%	17.3%	-10.3%	16.5%	-9.4%

IBNR Methods	Large Claims not included in Lag Calc	Large Claims included in Lag Calc	Rate & Claims Spiral	Disruption Scenario 1	Disruption Scenario 2	Disruption Scenario 3	Disruption Scenario 4	Disruption Scenario 5
LossRatio	-12.6%	19%	-204.9%	-24.5%	-34.9%	0.2%	-0.1%	-38.6%
PMPM	3.7%	3.7%	-640.4%	-29.5%	-40.7%	-6.3%	-6.2%	-43.3%
Paid PMPM	12.4%	12.4%	-16.1%	2.2%	-0.7%	15.5%	10.7%	8.7%
Benktander	-36.3%	2.6%	-4.0%	-19.4%	-23.2%	5.0%	2.8%	-28.0%
Bornhuetter	-33.2%	3.1%	-40.0%	-20.9%	-26.0%	3.5%	16%	-30.8%
Credibility Weighted	-36.3%	2.6%	-7.2%	-20.3%	-25.4%	4.4%	2.7%	-32.4%
Hybrid Loss Ratio	-36.9%	-3.3%	-24.1%	-24.8%	-29.8%	0.7%	0.2%	-37.1%
Lag - 12 Mo Avg	-37.5%	3.6%	5.8%	-19.7%	-23.5%	7.6%	7.4%	-29.5%
Lag - 9 Mo Avg	-37.2%	2.7%	6.1%	-19.0%	-22.3%	5.3%	3.0%	-26.9%
Lag - 6 Mo Avg	-37.2%	2.0%	6.1%	-18.3%	-20.6%	6.9%	7.0%	-22.2%
Lag - 3 Mo Avg	-36.7%	1.8%	6.5%	-14%	-13%	8.0%	8.1%	17.5%
Lag - Cross Incurral	-41.2%	4.5%	-25.7%	-25.6%	-29.3%	-0.4%	-0.1%	-40.2%
Lag - Dollar Weighted	-38.6%	10.5%	3.9%	-21.4%	-25.2%	3.9%	4.2%	-43.2%
Lag - Drop Extremes	-40.0%	-4.8%	15%	-25.0%	-28.6%	0.6%	0.0%	-36.9%
Lag - Geometric Avg	-37.8%	1.5%	5.1%	-20.9%	-23.7%	4.3%	2.0%	-34.5%
Lag - Harmonic Avg	-38.3%	0.4%	4.2%	-22.6%	-24.9%	3.4%	10%	-41.1%
Stochastic Method	2.0%	-1.1%						

## Comparison of IBNR Methodologies

IBNR Methods	Disruption Scenario 6	Disruption Scenario 7	Disruption Scenario 8	Disruption Scenario 9	Disruption Scenario 10	Disruption Scenario 11	Disruption Scenario 12
LossRatio	-52.4%	3.2%	0.3%	-39.5%	-59.7%	-2.7%	-4.3%
PMPM	-58.2%	-6.1%	-5.9%	-29.8%	-60.8%	-5.6%	-5.9%
Paid PMPM	0.4%	-3.5%	-3.0%	-15.1%	-15.1%	0.1%	0.5%
Benktander	-36.2%	19.4%	3.8%	-60.9%	-50.2%	-10.5%	-17.8%
Bornhuetter	-40.0%	15.6%	2.5%	-59.4%	-53.4%	-10.1%	-16.6%
Credibility Weighted	-40.7%	14.7%	3.6%	-58.1%	-56.4%	-5.0%	-12.9%
Hybrid Loss Ratio	-47.4%	5.7%	-3.8%	-63.8%	-61.6%	28.0%	3.9%
Lag - 12 Mo Avg	-36.9%	18.4%	12.8%	-61.8%	-51.3%	52.6%	30.4%
Lag - 9 Mo Avg	-34.7%	20.5%	4.0%	-60.7%	-48.2%	-10.9%	-18.3%
Lag - 6 Mo Avg	-30.6%	7.2%	7.4%	-58.8%	-42.3%	7.7%	3.3%
Lag - 3 Mo Avg	4.5%	8.2%	8.4%	-39.2%	-6.6%	8.7%	8.4%
Lag - Cross Incurral	-44.8%	0.1%	-0.1%	-72.4%	-59.9%	12.1%	8.0%
Lag - Dollar Weighted	-42.6%	4.4%	4.2%	-49.5%	-47.6%	17.1%	12.7%
Lag - Drop Extremes	-46.4%	5.9%	-5.1%	-66.1%	-60.9%	36.6%	5.7%
Lag - Geometric Avg	-38.5%	19.0%	2.9%	-70.5%	-53.8%	-26.4%	-21.6%
Lag - Harmonic Avg	-41.6%	17.6%	17%	-79.0%	-58.1%	-44.0%	-24.9%
Stochastic Method							

## STANDARD DEVIATION

IBNR Methods	Base Scenario	Excessive Trend	Varying Trend & Single Rate Increase	Varying Trend & Rolling Rate Increase	Steady Member Loss	WorkDay Seasonality	Seasonality of beginning CY loss	Seasonality of ending CY loss
LossRatio	10.9%	10.5%	12.3%	11.7%	12.1%	9.8%	10.5%	16.3%
PMPM	13.9%	13.4%	14.5%	14.5%	15.0%	13.7%	15.1%	16.7%
Paid PMPM	19.0%	18.4%	19.9%	19.9%	20.6%	14.2%	17.9%	16.2%
Benktander	21.2%	21.0%	21.3%	21.3%	21.9%	21.0%	21.8%	21.3%
Bornhuetter	18.5%	18.2%	18.7%	18.8%	19.5%	18.0%	20.1%	18.4%
Credibility Weighted	18.8%	21.1%	18.4%	18.6%	21.8%	18.8%	20.9%	19.8%
Hybrid Loss Ratio	18.5%	18.3%	18.6%	18.7%	19.3%	18.0%	20.0%	18.4%
Lag - 12 Mo Avg	22.2%	22.1%	22.3%	22.3%	22.7%	22.2%	22.6%	22.5%
Lag - 9 Mo Avg	22.3%	22.2%	22.3%	22.3%	22.9%	22.3%	22.6%	22.5%
Lag - 6 Mo Avg	23.4%	23.2%	23.5%	23.5%	24.2%	23.4%	23.8%	23.6%
Lag - 3 Mo Avg	26.5%	26.3%	26.6%	26.6%	27.4%	26.4%	26.9%	26.7%
Lag - Cross Incurral	19.9%	18.7%	20.1%	20.1%	24.1%	19.9%	20.3%	20.2%
Lag - Dollar Weighted	21.9%	21.7%	21.9%	21.9%	22.5%	21.8%	22.2%	22.2%
Lag - Drop Extremes	21.7%	21.6%	21.7%	21.7%	22.2%	21.6%	22.0%	21.9%
Lag - Geometric Avg	22.1%	22.0%	22.1%	22.1%	22.7%	22.1%	22.4%	22.3%
Lag - Harmonic Avg	21.9%	21.8%	21.9%	21.9%	22.5%	21.9%	22.2%	22.1%
Stochastic Method	16.5%	16.3%	16.9%	16.9%	17.1%	16.1%	18.0%	16.1%



## Comparison of IBNR Methodologies

IBNR Methods	3-Month Prior Rate Increase	8-Month Prior Rate Increase	14-Month Prior Rate Increase	3-Month Prior Claims Decrease	3-Month Prior Claims Increase	8-Month Prior Claims Decrease	8-Month Prior Claims Increase	14-Month Prior Claims Decrease	14-Month Prior Claims Increase
LossRatio	12.7%	20.2%	18.2%	13.4%	9.5%	23.4%	11.3%	20.7%	10.6%
PMPM	13.9%	13.9%	13.9%	15.2%	13.4%	27.2%	19.7%	38.2%	27.6%
Paid PMPM	19.0%	19.0%	19.0%	21.4%	17.3%	26.2%	15.0%	23.8%	14.0%
Benktander	21.5%	21.7%	21.6%	21.5%	21.0%	22.2%	20.5%	21.9%	20.7%
Bornhuetter	19.4%	20.8%	20.6%	19.7%	17.5%	21.8%	16.1%	21.2%	16.5%
Credibility Weighted	19.7%	19.8%	19.0%	20.1%	17.7%	20.5%	18.1%	18.4%	19.7%
Hybrid Loss Ratio	19.5%	19.9%	18.9%	19.7%	17.5%	20.7%	16.9%	19.2%	18.0%
Lag - 12 Mo Avg	22.2%	22.2%	22.2%	22.1%	22.5%	22.6%	22.0%	22.4%	22.2%
Lag - 9 Mo Avg	22.3%	22.3%	22.3%	22.2%	22.6%	22.7%	22.0%	22.5%	22.2%
Lag - 6 Mo Avg	23.4%	23.4%	23.4%	23.3%	23.6%	23.9%	23.1%	23.6%	23.3%
Lag - 3 Mo Avg	26.5%	26.5%	26.5%	26.5%	26.6%	27.1%	26.1%	26.8%	26.3%
Lag - Cross Incurral	19.9%	19.9%	19.9%	20.1%	19.7%	21.4%	18.7%	21.3%	18.9%
Lag - Dollar Weighted	21.9%	21.9%	21.9%	21.7%	22.2%	22.2%	21.6%	22.0%	21.8%
Lag - Drop Extremes	21.7%	21.7%	21.7%	21.5%	21.9%	22.0%	21.4%	21.8%	21.6%
Lag - Geometric Avg	22.1%	22.1%	22.1%	22.0%	22.4%	22.5%	21.9%	22.3%	22.0%
Lag - Harmonic Avg	21.9%	21.9%	21.9%	21.8%	22.2%	22.3%	21.7%	22.1%	21.8%
Stochastic Method				17.6%	15.6%	19.3%	14.2%	19.1%	14.6%

IBNR Methods	Large Claims not included in Lag Calc	Large Claims included in Lag Calc	Rate & Claims Spiral	Disruption Scenario 1	Disruption Scenario 2	Disruption Scenario 3	Disruption Scenario 4	Disruption Scenario 5
LossRatio	40.1%	44.0%	28.1%	7.5%	7.2%	10.9%	10.9%	6.5%
PMPM	105.2%	105.2%	94.6%	10.9%	10.6%	14.0%	14.0%	9.5%
Paid PMPM	27.4%	27.4%	19.1%	14.0%	12.6%	19.5%	18.0%	12.3%
Benktander	17.8%	26.8%	19.4%	13.5%	11.8%	21.1%	20.7%	10.9%
Bornhuetter	18.6%	27.8%	10.4%	11.5%	9.8%	18.5%	18.2%	9.0%
Credibility Weighted	17.5%	26.4%	18.2%	11.2%	9.7%	18.3%	18.1%	7.5%
Hybrid Loss Ratio	16.5%	25.1%	13.5%	11.4%	9.6%	18.3%	18.3%	8.5%
Lag - 12 Mo Avg	17.8%	27.8%	22.7%	14.2%	12.5%	22.6%	22.5%	11.5%
Lag - 9 Mo Avg	17.9%	27.0%	22.7%	14.4%	12.7%	22.1%	21.7%	12.0%
Lag - 6 Mo Avg	18.1%	27.0%	23.5%	15.5%	13.9%	23.6%	23.6%	13.8%
Lag - 3 Mo Avg	19.2%	29.2%	26.4%	20.8%	19.5%	26.7%	26.7%	24.0%
Lag - Cross Incurral	16.4%	28.8%	15.1%	12.4%	10.7%	19.9%	19.9%	9.0%
Lag - Dollar Weighted	17.7%	31.2%	22.3%	13.9%	12.2%	21.8%	21.9%	9.4%
Lag - Drop Extremes	17.0%	25.5%	22.0%	13.8%	12.0%	21.3%	21.3%	10.6%
Lag - Geometric Avg	17.8%	26.7%	22.4%	14.0%	12.5%	21.9%	21.5%	10.6%
Lag - Harmonic Avg	17.6%	26.4%	22.2%	13.7%	12.3%	21.7%	21.3%	9.5%
Stochastic Method	16.5%	18.6%						

IBNR Methods	Disruption Scenario 6	Disruption Scenario 7	Disruption Scenario 8	Disruption Scenario 9	Disruption Scenario 10	Disruption Scenario 11	Disruption Scenario 12
LossRatio	6.3%	11.6%	11.1%	6.6%	5.3%	11.0%	10.9%
PMPM	9.1%	14.2%	14.3%	8.2%	7.1%	14.7%	14.6%
Paid PMPM	10.1%	20.3%	20.2%	7.0%	7.0%	21.4%	21.4%
Benktander	8.6%	23.8%	21.1%	4.5%	5.1%	20.0%	18.0%
Bornhuetter	6.9%	20.6%	18.6%	4.0%	4.1%	18.1%	16.5%
Credibility Weighted	6.4%	18.8%	17.7%	4.8%	4.0%	14.7%	14.9%
Hybrid Loss Ratio	6.3%	19.2%	17.7%	3.6%	3.8%	23.9%	19.6%
Lag - 12 Mo Avg	9.1%	25.2%	24.0%	4.9%	5.5%	33.5%	28.5%
Lag - 9 Mo Avg	9.6%	25.2%	22.0%	5.3%	6.0%	20.6%	18.5%
Lag - 6 Mo Avg	11.1%	24.1%	24.0%	6.3%	7.4%	24.3%	23.6%
Lag - 3 Mo Avg	19.6%	27.0%	27.0%	11.6%	14.5%	27.3%	27.3%
Lag - Cross Incurral	7.3%	20.2%	20.1%	3.6%	4.2%	22.5%	22.0%
Lag - Dollar Weighted	8.2%	22.2%	22.1%	6.0%	5.8%	24.8%	24.1%
Lag - Drop Extremes	8.0%	22.3%	20.2%	4.4%	4.7%	29.9%	23.0%
Lag - Geometric Avg	8.9%	24.9%	21.8%	4.4%	5.4%	17.2%	17.8%
Lag - Harmonic Avg	8.4%	24.6%	21.6%	4.3%	5.1%	14.3%	17.1%
Stochastic Method							

## Comparison of IBNR Methodologies

### Commentary on Test Results

The exposure-based methods and the hybrid methods were, with the exception of the HMO Rx block, fairly consistent across each block type. The results of the HMO Rx block, however, can be a bit misleading since this block had the shortest run-out of all of the blocks and, thus, the lowest reserve by quite a large margin. While the percentage numbers may be higher, the absolute dollar error for each of the methods is much lower. The simple lag methods were fairly consistent between one another within each block. However, the numbers varied from block to block. These variations tended to be in proportion to the run-out time of each block aside from the issues as described above with the HMO Rx block. The lag methods rely heavily on the paid claims to date, and for the blocks with the longer run-out, the most recent incurral has a fairly low paid amount and the paid amounts had a decent amount of variance from trial to trial. This resulted in a large variance in the completed claims for the most recent incurral months.

#### Rate Shifts/Claim Shifts

The loss ratio method and the other methods that make use of the loss ratio method (Bornhuetter, Benktander, etc.) perform fairly poorly under these types of stresses. The loss ratio used to estimate incurred claims is based on the experience loss ratio from 12 months prior. The shift in claims occurs during recent months so it is not reflected in the loss ratios. This results in an overstatement of the IBNR when rates shift up or claims shift down. The IBNR is understated when claims shift up. Our tests used an experience loss ratio with no adjustments. One possible solution to this problem is to manually adjust the experience loss ratio to account for any significant changes.

The other methods are unaffected by a rate shift because they do not use premiums in order to estimate IBNR. A claim shift does not affect the lag methods as long as the underlying payment pattern is not altered. In our scenarios, the pattern was unchanged, so the results for the lag methods were mostly the same as under the base scenario. The Paid PMPM method was affected by the claim shift because it could not account for the changes in more recent months.

#### Seasonality

Seasonality has very little effect on our implementation of the loss ratio method. We are using a 12-month average of loss ratios, so all seasonality effects are spread out over the course of the year. The lag methods are also unaffected by seasonality as long as the underlying payment pattern is unaltered. The Paid PMPM method performed poorly under seasonality test 3. The increase in claims in the more recent months could not be reflected in the computation, and thus the IBNR is understated. In fairness, however, documentation concerning this method specifically states that the claims must be adjusted for seasonality prior to performing the IBNR calculation. Attempting to programmatically determine seasonality for 2,000 data sets without cheating and using the actual seasonality modifications we used to generate the data sets would have been very difficult. So we can assume that the performance would be better if the claims were normalized for seasonality prior to the calculation. The other non-lag methods (i.e., Hybrid, Credibility-Weighted, etc.) also perform fairly poorly. They all tend to have a higher than normal positive mean error for the first two tests and a negative mean error for the last test. For the first

## Comparison of IBNR Methodologies

two tests, more claims are paid earlier in the year where the claims are more complete. In the more recent months, the IBNR estimates are overstated because of the fall-off in claims at the end of the year. The opposite is true for test 3. The claims are more concentrated at the end of the year, so the IBNR is underestimated.

### Membership

As policies lapse the loss ratio method is mostly unaffected. As long as it is a homogeneous mix of policies that is lapsing every month, the premium and claims fall off at the same rate, producing a constant loss ratio, which results in a consistent IBNR. However, if lapses were to all be in one particular age group or product mix for example, this would cause premium and/or claims to move at a different rate, resulting in a misestimation of the IBNR.

### Rate Spiral

As with the rate shift, as the experience changes in more recent months, the loss ratios used to project incurred claims do not include that recent experience. The rate spiral causes experience to worsen over time, which results in an understated loss ratio. Making manual adjustments to the loss ratio is the only way to account for this. This also affects the other methods that make use of loss ratios. The Paid PMPM method is also affected since in more recent months the observed trend is higher than the trend assumption used to attempt to normalize the claims. This also results in an understated IBNR. The lag methods are mostly unaffected since the underlying claim payment pattern is not modified.

### Excessive Trend

Across the board, excessive trend has little to no effect on each of the methods. Since the premium and claims trend at the same rate, the methods making use of loss ratios are unchanged. The exposure methods see a constant trend, so the methods can easily adjust for this change. There is no change in the underlying claim payout pattern, so this leaves the lag methods unaltered.

### Large Claims

The simulated large claims used for these two tests had three primary characteristics that affected the results of this scenario.

- First, the claim payments for an individual large claim were lagged out over several months, averaging around six months or so;
- Second, it was assumed that there would be a longer delay, which is three months on average, between the incurral date and the initial payment date; and
- Third, the occurrence of large claims in the simulations was fairly regular, with, on average, 35 of the 60 months having a large claim of average size around 130,000.

## Comparison of IBNR Methodologies

For test 2, the completion factors were calculated based on the total claims, large claims included. Because of the regular occurrence and size of the large claims in our data set, this resulted in the payment patterns being fairly consistent. Thus, the lag methods performed fairly well.

Test 1, however, had very poor results for the lag methods. For test 1, the completion factors were calculated based on the claims net of large claims. This resulted in underestimated IBNR estimates because the effect of the large claims and their assumed longer lag payment time on the total payment patterns was not taken into account; thus, the estimation assumed the claims completed faster than the shock claims actually did. This issue was especially prominent in more recent incurral months where not only were the completion factors too high, but they were being applied to paid-to-date numbers that did not have any large claims in them yet (i.e., because of the assumed delay in payment of shock claims). This resulted in significant error in the recent incurral months. The use of this particular large claims methodology would definitely require the use of another method (e.g., loss ratio method) in the more recent incurral months to obtain a more accurate IBNR.

The non-lag methods performed fairly well for both large claim tests. None of the methods rely on the lag pattern of the claims, but instead rely on the historical incurred/paid amounts only. The methods are aided by the regular occurrence and limited size of the claims. If large claims were to occur more frequently and/or have a larger severity, these methods might produce more error. But it is safe to say that, for a large block, the performance of these methods would mirror that seen in our tests.

### Varying Trend

The premiums and claims do not move at the same rate in our varying trend scenarios since the premium lags behind the claims 18 months. The trend data we used shows a decreasing annual trend over the last few years. This results in premium growing at a slightly faster rate than claims because the premium is being trended at a prior rate. The loss ratio and associated methods overestimate IBNR since the premium is higher with respect to claims. The lag methods remain unaffected since the underlying payment pattern is unaltered.

### System Disruption Tests

The system disruption tests managed to show that it is very difficult to use any IBNR method without attempting to address the disruption issues in the data. All of the methods blew up under the majority of the disruption scenarios we ran. A system disruption seems to be the one scenario that at least one IBNR method cannot address without manually adjusting the data first.

## **Comparison of IBNR Methodologies**

### Complete Results and Related Material

Please refer to the appendices for complete results and related material.

## Comparison of IBNR Methodologies

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## Comparison of IBNR Methodologies

### APPENDIX A

#### Development Method Details

*The following is an excerpt from the Society of Actuaries' study note titled, "Health Reserves," written by John Lloyd and published by the Society of Actuaries. It is provided for background on the development method.*

Most medical coverages exhibit payment characteristics suitable for application of the development method. This method assumes that the historical lag pattern, often with some judgmental modifications, will be an accurate representation of the payment of claims that have been incurred but not yet completely paid. The method provides an estimate of the ultimate aggregate payment for all incurred claims in a time period. By then subtracting period-to-date paid claims the actuary can compute an estimate of the unpaid claims reserves.

The method derives its name from the "development" of claims across lag periods as they progress period-by-period to some future date after which no more payments will be expected. The method is also known as the completion method because factors are computed which "complete" the current period-to-date payment totals for each incurral period to estimate its ultimate expected payout. The third term commonly associated with this method describes the pattern by which claims are ultimately paid across future lag periods as the run-out.

Characteristics of coverages for which the development method works well include:

1. Ability to systematically record an incurred date and a payment date as each claim is adjudicated and paid. The difference between these dates across policies in a valuation cell defines the lag pattern.
2. Fairly consistent lag patterns in the progression of claims from their incurred date to a date on which they are ultimately paid in full. Methods exist to smooth and adjust patterns for some disruptions, but the inherent payment pattern cannot be too erratic.
3. Incurred periods should have a relatively short duration relative to the ultimate run-out. Monthly periods typically are used for medical claims.
4. A sufficient volume of business must be included in a given valuation cell to obtain reasonable stable results. This amount varies by the nature of the benefits and the frequency of claim. Combining blocks of business to achieve credibility therefore requires that they exhibit similar patterns in reporting and processing.
5. The technique also requires either earned premiums or exposed contracts to assist in the calculations. These values help with certain volume adjustments and with the smoothing of statistical fluctuations described in more detail below.

The actuary will need claims payment data ranged by service date versus payment date. Monthly claim payments subtotaled by month of service are most commonly used for medical coverages. For some coverages with longer development period quarterly or annual periods may also work.

## Comparison of IBNR Methodologies

### Mechanics of Development Methods

Data in most methods are summarized by the calendar month paid versus incurred month or by the lag between paid month and incurred month. As shown in Exhibit 1, the resulting grid is usually referred to as the claims triangle. Medical claims usually require about 24 months of data to develop reasonable completion factors. Often 48 to 60 months of incurred and paid claims will be maintained to help develop historical trends in payment patterns and costs. In our abbreviated example, we will use 12 months of data to illustrate the process.

**EXHIBIT 1 -Paid Claims by Incurred Month (000's)**

		Month Incurred											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Months Lagged	1	1750	1500	1600	1125	1900	1500	2000	1700	1400	2225	1700	1575
	2	2500	2750	2800	2650	2200	2600	1950	2300	2900	2400	1950	
	3	1050	1550	1650	1550	1475	1350	1570	1650	1440	1525		
	4	700	725	675	740	650	650	750	700	725			
	5	125	100	125	70	60	100	90	115				
	6	70	75	50	45	60	60	60					
	7	35	30	25	55	40	30						
	8	25	10	40	15	15							
	9	15	25	20	5								
	10	30	25	10									
	11	5	5										
	12	0											

Arrangement of data in this fashion quickly illustrates the goal for the actuary. In Exhibit 1 we see that we would like to complete the bottom half of the grid with the paid amounts likely to occur for incurred months in which payments are still expected. In fact, one method sometimes employed for very stable lines of business was called the “Iceberg Technique.” The analogy was between the visible triangle and the tip of the iceberg—the amount below the water being extrapolated as a ratio of seen to unseen.

Average payments by lag or other broad averaging approaches could be used to fill in assumed payments. Unfortunately, the varying impacts of membership changes, cost trends and claims adjudication on health insurance seldom allow mere arithmetic or straight-line extension of existing payment patterns to fill in the “submerged” portion. Therefore, more elaborate projection techniques are employed.

In most methods, the next step employed is to develop cumulative incurred claims by service period. Cells are summed forward to obtain cumulative incurred and paid claims. The result is a progression of payments toward ultimate payout for a given service month. This is shown below in Exhibit 2 for the above data.



## Comparison of IBNR Methodologies

**EXHIBIT 2 - Cumulative Paid Claims by Incurred Month (000's)**

	Month Incurred												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Months Lagged	1	1750	1500	1600	1125	1900	1500	2000	1700	1400	2225	1700	1575
	2	4250	4250	4400	3775	4100	4100	3950	4000	4300	4625	3650	
	3	5300	5800	6050	5325	5575	5450	5520	5650	5740	6150		
	4	6000	6525	6725	6065	6225	6100	6270	6350	6465			
	5	6125	6625	6850	6135	6285	6200	6360	6465				
	6	6195	6700	6900	6180	6345	6260	6420					
	7	6230	6730	6925	6235	6385	6290						
	8	6255	6740	6965	6250	6400							
	9	6270	6765	6985	6255								
	10	6300	6790	6995									
	11	6305	6795										
	12	6305											

### Age-to-Ultimate Development Factors

Noting that at some lag duration no further payments are being recorded, we can deem this to be the duration at which the ultimate payment will be reached. The age-to-ultimate development method assumes that the percentage of ultimate payments recorded as of each lag duration will be the same for expected future payments. The terminology comes from property/casualty lines in which this ratio was typically computed from one year to the next—each “age” building toward an “ultimate” payment. This method is sometimes referred to as the mean factor method, since it is rarely satisfactory to use just one month’s incurral pattern, and some process of averaging across several months is employed to get a mean factor to represent the relationship of each age to the ultimate payout.

In our example, we assume that January is now fully paid at \$6.305 million. In Exhibit 3a below we divide the cumulative payment as of each lag month for January incurred services versus the ultimate cumulative payment at month 12. The resulting percentages represent the age-to-ultimate development of payments toward ultimate paid claims.

**EXHIBIT 3a—Percent of Ultimate Losses by Lag Month**

	Months Lagged											
	1	2	3	4	5	6	7	8	9	10	11	12
	27.8%	67.4%	84.1%	95.2%	97.1%	98.3%	98.8%	99.2%	99.4%	99.9%	100.0%	100.0%

If we assume that the January development pattern is representative of all expected future payments, we could estimate the unpaid portion of the outstanding months. Exhibit 3b shows the result of dividing each cumulative lag payment by its corresponding development factor. The resulting ultimate payment, less the amount paid so far, represents the unpaid balance.

## Comparison of IBNR Methodologies

### EXHIBIT 3b

Incurred Month	Projection of Incurred Based on January Patterns			Unpaid Balance (d)=(c)-(a)
	Cumulative Payments (a)	% of Ultimate (b)	Ultimate Payment (c)=(a)/(b)	
	Jan	1,575	27.8%	
Feb	3,650	67.4%	5,415	1,765
Mar	6,150	84.1%	7,316	1,166
Apr	6,465	95.2%	6,794	329
May	6,465	97.1%	6,655	190
Jun	6,420	98.3%	6,534	114
Jul	6,290	98.8%	6,366	76
Aug	6,400	99.2%	6,451	51
Sep	6,255	99.4%	6,290	35
Oct	6,995	99.9%	7,001	6
Nov	6,795	100.0%	6,795	0
Dec	6,305	100.0%	6,305	0
				7,831

This would work if we believed that all future months would develop on the same pattern as the January development. However, if we were to use the February pattern in our example we would get a different set of development percentages. Applied as in Exhibit 3b, these would create an estimate of \$9.4 million in unpaid claims instead of the \$7.8 million above. Therefore, the remainder of the analysis performed in mean factor development estimates consists of efforts to create factors that achieve a more stable and representative estimate of incurred claims. Averaging methods described below can be applied to achieve “mean factors.”

#### Age-To-Age Development Factors

In addition to a lack of stable development pattern by months, the age-to-ultimate method assumes you know the ultimate payment and the proposed pattern. It may take 24 to 36 months before some coverages achieve their ultimate payments for a given service month. After that much elapsed time, lag patterns may become somewhat suspect as a basis for current development. One approach is to utilize the month-to-month ratios between cumulative payment as a basis for projection. We begin by dividing the cumulative payments for a given service month using the second month’s total divided by the first month’s payment, the cumulative third payment by the second and so forth. By so doing, we obtain what are known as age-to-age development factors.

Since we do not have to wait for their ultimate development, this process allows us to use the relationships between payment patterns for more recent service months. We are describing their step-wise progress toward their ultimate development. Sequential factors are then linked together to describe the emergence of losses from month to month. This gives rise to the commonly used names of chain-link or chain-ladder development methods. Using our sample data, these are shown in Exhibit 4a. From the data in Exhibit 2:  $2.429 = (4,250/1,750)$  and  $1.365 = (5,800/4,250)$ .

#### EXHIBIT 4a - Age-to-Age Factors

Month Incurred

## Comparison of IBNR Methodologies

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.429	2.833	2.750	3.356	2.158	2.733	1.975	2.353	3.071	2.079	2.147	
2	1.247	1.365	1.375	1.411	1.360	1.329	1.397	1.413	1.335	1.330		
3	1.132	1.125	1.112	1.139	1.117	1.119	1.136	1.124	1.126			
4	1.021	1.015	1.019	1.012	1.010	1.016	1.014	1.018				
5	1.011	1.011	1.007	1.007	1.010	1.010	1.009					
6	1.006	1.004	1.004	1.009	1.006	1.005						
7	1.004	1.001	1.006	1.002	1.002							
8	1.002	1.004	1.003	1.001								
9	1.005	1.004	1.001									
10	1.001	1.001										
11	1.000											
12												

These ratios are less influenced by changes in exposure or cost trend, since they represent a claim development pattern for a given cohort of covered individuals for claims within the same service month. They can be combined in a variety of manners to attempt to develop more representative factors for expected future development.

Age-to-age development factors thus developed can then be easily converted to age-to-ultimate factors—referred to as completion factors. We have built factors that are based on ratios of the 2<sup>nd</sup>/1<sup>st</sup> lags, the 3<sup>rd</sup>/2<sup>nd</sup>, the 4<sup>th</sup>/3<sup>rd</sup> and so forth. If we assume that one lag period is now fully complete (in our case the 12<sup>th</sup> lag) we can then divide each ratio back down the sequence to obtain the ratio of each lag to the ultimate factor. As shown in Exhibit 4b, the ratio developed by these calculations produces the same set of age-to-ultimate ratios as we previously created. Obviously the goal will be to first use procedures to smooth the development factors before developing completions shown in our simple example.

**EXHIBIT 4b—Percent of Ultimate Losses by Lag Month**

	Months Lagged											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>Development Factor</b>	2.429	1.247	1.132	1.021	1.011	1.006	1.004	1.002	1.005	1.001	1.000	1.000
<b>Completion Factor</b>	0.278	0.674	0.841	0.952	0.971	0.983	0.988	0.992	0.994	0.999	1.000	
<b>Calculation</b>	<u>0.674</u> 2.429	<u>0.841</u> 1.247	<u>0.952</u> 1.132	<u>0.971</u> 1.021	<u>0.983</u> 1.011	<u>0.988</u> 1.006	<u>0.992</u> 1.004	<u>0.994</u> 1.002	<u>0.999</u> 1.005	<u>1.000</u> 1.001		

## Comparison of IBNR Methodologies

### APPENDIX B

#### Algebraic Definitions of IBNR Methods

##### *Development Methods*

Development methods use various analyses of the historical claim payment pattern of the line of business to estimate ultimate paid claims for relatively recent incurral periods that are “incomplete,” or for which the claims payor has not paid all eventual claims. These analyses are typically based on claim “triangles,” which categorize claims according to both the period in which they were incurred and the period in which they were paid, adjudicated or reported.

The basic paid claim development method is described algebraically as follows. Some of the descriptions use largely similar notation and descriptions found in “A Modified Development Method for Deriving Health Claim Reserves,” Transactions of the Society of Actuaries (1989) 41:89, by Mark E. Litow. Note that the following assumes that the incurral period is a calendar month; however, we acknowledge that other incurral periods (e.g., calendar quarter) can be used.

$PC^x_t$  = Claims paid for incurral month x (e.g., January 2006) in the  $t^{\text{th}}$  month (a.k.a. claim duration) after incurral month x. Note that the most recent incurral month has  $x=0$  and x increases for every incurral month prior to this most recent incurral month.

$CP^x_t$  = Cumulative total claims paid for incurral month x (e.g., January 2006) for claims paid from the incurral month x through t-1 additional payment months (a.k.a. claim durations) thereafter

$$= \sum_{i=0..t} PC^x_i$$

$CR^x_t$  = Monthly completion ratio for incurral month x and claim duration month t

$$= \frac{CP^x_t}{CP^x_{t-1}}$$

Note that  $CP^x_o$  represents those claims paid during the same month in which they were incurred and that  $CR^x_o$  has no meaning.

$(CR_t)^{[A]}$  = Average of monthly completion ratios, each for claim duration t, for a chosen set [A] of incurral months

The months chosen for this set are often the most recent (e.g., the last 12 incurral months) but choices vary widely. In addition, averaging techniques vary (e.g., harmonic averaging instead of straight averaging, removing outliers, etc.).

$(CF_t)^{[A]}$  = Completion factor for claim duration t for a chosen set [A] of incurral months

## Comparison of IBNR Methodologies

= Proportion of estimated ultimate incurred claims attributable to an incurral month that have been paid through duration t

=  $1 / [ (CR_{t+1})^{[A]} (CR_{t+2})^{[A]} \dots (CR_z)^{[A]} ]$  where z = highest claim duration possible

$(IC_t^x)^{[A]}$  = Estimated ultimate incurred claims attributable to an incurral month x for which claims have only been paid through claim duration t

$$= \frac{CP_t^x}{(CF_t)^{[A]}}$$

$(RES_t^x)^{[A]}$  = Estimated claim reserve attributable to an incurral month x for which claims have only been paid through claim duration t

$$= (IC_t^x)^{[A]} - CP_t^x$$

Variations in this basic development method and its use can be influenced by:

- Line of business;
- Whether method is intended to produce IBNR and ICOS combined or just IBNR alone. For example, the lag to be measured could be incurred-to-paid or merely incurred-to-received (by the insurer);
- Time duration of the claim—For short-duration claims such as medical claims, the period used is usually a calendar month. Such claims triangles are studied to determine what proportion of the claims incurred during some period have been paid (or adjudicated or reported, as the case may be) within various time-spans after the beginning of the incurral period. For longer duration claims, such as disability, it may be by quarter or annually;
- Closeness of the time period to the valuation date—For the most recent time periods, insufficient data may result in the development method producing unreliable incurred claim estimates. Another method should be used to estimate the incurred claims for these time periods, such as the loss ratio or exposure method;
- Length of time used to develop the completion factors, or the chosen set  $[A]$  of incurral months on which the average completion ratio is based;
- Method of developing the average completion factors (arithmetic means versus geometric, for example);
- Credibility assigned to the incurred claims estimates.

The last influence, credibility, is worthy of its own discussion, analysis and testing. Practically, most actuaries treat a credible incurral month as one where the  $(CF_t)^{[A]}$  completion factor is at or above a target level (e.g., 0.50). Noncredible incurral months are ones where the completion factors are below this target level. For these noncredible months, an exposure method is often supplemented to establish a more stable reserve.

## Comparison of IBNR Methodologies

Variations on the basic development method are as follows:

Basic Paid Claim development—This is in essence the basic development method described above. The ultimate claims are estimated by calculating age-to-ultimate development factors (a.k.a. completion factors ... as per above basic description) for each prior incurral period (e.g., month). The method assumes that claims are paid after a time lag that is consistent with that lag shown in the period from which the age-to-ultimate development factors were developed. In some circumstances, paid claims for recent periods may be too immature or erratic for accurate predictions. This approach involves no other material estimated elements (e.g., case or tabular reserves, excess reinsurance) and so the method is not influenced by outside element estimation approaches.

Incurred Loss development—This approach uses an initial claim triangle of both paid claims as well as case and/or tabular reserves. This approach is more common in lines of coverage with longer lag patterns and later payments triggered with an initial claim incurral (e.g., disability, long-term care, stop-loss). Since the underlying triangle contains both paid claims and specific-claim reserves, the resulting lag pattern may be less volatile than one just based on paid claims alone. This method, however, can be materially affected by the likely independent case/tabular reserving approach and assumes, if not requires, some consistency in this reserve approach.

Received Claims development—This development creates a triangle based on received claims. Instead of organizing the triangle by incurred month by paid month, it is organized by incurred month and “received month.” In our development method formulas above we substitute  $PC^x_t$  with something on the order of  $PC^r_t$  (i.e., claims received for incurral month  $x$  (e.g., January 2006) in the  $r^{\text{th}}$  month after incurral month  $x$ , but paid as of the valuation date). This approach will exclusively estimate the true IBNR (incurred but not reported) as opposed to ICOS (incurred but outstanding or pending claims). A separate approach to estimate an ICOS or pending reserve will be required. This approach is particularly useful, or a good complement to a primary development method, in a line of business such as Medicare Supplement business. This line is characterized often by batch-fed claims from a primary government-contracted Medicare payor and practically all claims, once received, are eventually paid. Thus the ICOS can be estimated reasonably, if not conservatively, as 100 percent of the received claims not yet paid and the true IBNR can be separately determined via claim triangle of claims incurred versus received.

### *Exposure Methods*

Exposure methods estimate incurred claims by analyzing the historical claims rate of a line of business against a measure of the company's exposure to liability for that line. An example of an exposure for an HMO would be covered members. The estimate of the claim rate is multiplied by the exposure for the appropriate time period, and paid claims are then deducted to develop the reserve estimate. Exposure methods are frequently used for:

- Lines of business where the volume of claims is too low for development methods to be applied
- Blocks of policies where fluctuations in claim payment patterns make a development method unreliable.

## Comparison of IBNR Methodologies

- Modifying incurred claims estimates made using a development method for the most recent durations (such as estimating the most recent month of experience for a first dollar medical coverage).

An important part of any exposure method is gauging the trend across incurral months of (estimated ultimate claims / exposure measure). Where exposure is covered members, this is essentially the well-known PMPM (per member per month) measure; where the exposure measure is premiums, the measure is essentially a monthly incurred loss ratio. Tracking this key measure across incurral months with a high confidence level of their estimated incurred losses can lead to predictive formulas (e.g., calculating trend lines through simple straight line or more complicated exponential curve fits) of similar measures for recent or future incurral months where the development method(s) are producing unreliable or widely varying ultimate claim estimates.

$(PMPM_h)$  = Historical PMPM used to calculate future expected PMPM amounts

$(Trend_x)$  = Expected claims trend amount in month x based on historical PMPM

$(M_x)$  = Total membership for incurral month x

$(PMPM_x)$  = Expected PMPM value for incurral month x

$(CP_x)$  = Cumulative actual paid claims for incurral month x

$(PMPM_x) = (PMPM_h) * (Trend_x)$

$IBNR = \sum (PMPM_x * M_x - CP_x)$

### *Loss Ratio Methods*

Loss ratio methods are a special case of exposure methods. They develop an estimate of incurred claims by applying an estimated loss ratio (incurred claims over earned premiums) to earned premiums and then subtracting incurred and paid claims to develop the claim reserve. That estimated loss ratio will generally be developed based upon the company's experience of similar lines of business, the assumptions used in pricing the coverage or the experience of other companies with similar lines of business. The loss ratio method is used when insufficient data is available to use another method, particularly in the early period of a new line of business, as a reasonability test of other methods or to modify incurred claims estimates made using a development method for the most recent durations (such as estimating the most recent month of experience for a first dollar medical coverage). One key adjustment to this method is always to be cognizant of material rate increases that can change the underlying premium possibly without affecting the estimated incurred losses. If expected loss ratios are applied without recognizing material rate increases, then overstated reserves can occur.

$(LR_h)$  = Historical loss ratio calculated based on existing claims data

## Comparison of IBNR Methodologies

$(EP_x)$  = Premiums earned during incurral month x

$(EP_x)$  = Expected total incurred claims in incurral month x

$(CP_x)$  = Cumulative actual paid claims for incurral month x

$(IC_x) = LR_h * EP_x$

$IBNR = \sum (IC_x - CP_x)$

### Hybrid Chain Ladder Methods

Each of these methods uses some variant of the loss development (chain ladder) method. The averaging technique used to select completion factors is not specified. As in the discussion of loss development above, the selected averaging set and method are specified with the superscript [A].

Bornhuetter-Ferguson—This method combines loss development method with expected loss ratio method. For each incurral period the reserve is set by multiplying the expected ultimate losses from the loss ratio method by the fraction of initial claims remaining calculated by the development method. This method does not adjust reserves for an incurral month based on claims paid for that month. Algebraically

$(RES^x_t)_{BF}^{[A]}$  = Estimated claim reserve attributable to an incurral month x for which claims have only been paid through claim duration t

$$= (1 - (CF_t)^{[A]}) \times P_x \times LR_x$$

$(CF_t)^{[A]}$  = The completion factor for claim duration t calculated with the development method

$P_x$  = Premium paid in the incurral month x

$LR_x$  = Expected loss ratio for incurral month x

Gunnar Benktander—This method uses a weighted average of reserves calculated by the loss development method and the Bornhuetter-Ferguson method. Where the claims are close to complete, the chain development method is weighted higher; for newer claims, the Bornhuetter-Ferguson method is weighted higher. For each incurral period:

$(RES^x_t)_{GB}^{[A]}$  = Gunnar Benktander estimated claim reserve attributable to an incurral month x for which claims have only been paid through claim duration t

$$= (CF_t)^{[A]} \times (RES^x_t)_{CL}^{[A]} + (1 - (CF_t)^{[A]}) \times (RES^x_t)_{BF}^{[A]}$$



## Comparison of IBNR Methodologies

$(CF_t)^{[A]}$  = The completion factor for claim duration t calculated with the development method

$(RES^x_t)_{CL}^{[A]}$  = The claim reserve calculated using the claim development (chain ladder) method

$$= (IC^x_t)^{[A]} - CP^x_t$$

$$= \left(1 / (CF_t)^{[A]} - 1\right) \times CP^x_t$$

$(RES^x_t)_{BF}^{[A]}$  = The claim reserve calculated using the Bornhuetter-Ferguson method

$$= \left(1 - (CF_t)^{[A]}\right) \times P_x \times LR_x$$

Credibility Weighted Method—This method uses a weighted average of reserves calculated by the expected loss ratio method (LR), the loss development (chain ladder—CL) method and the Bornhuetter-Ferguson (BF) method. The weighting selected depends on estimates of the variance in the loss development factors and in the claim amounts in any given month.

$(RES^x_t)_{CW}^{[A]}$  = Credibility weighted estimate of claim reserve attributable to an incurral month x for which claims have only been paid through claim duration t

$$= Z_{LR}^{x,t} \times (RES^x_t)_{LR}^{[A]} + Z_{CL}^{x,t} \times (RES^x_t)_{CL}^{[A]} + Z_{BF}^{x,t} \times (RES^x_t)_{BF}^{[A]}$$

$Z_{LR}^{x,t}$  = Weight assigned to the loss ratio method

$$= \text{Expected}((IC^x)^2) \times \text{Var}(CF_t)^{[A]} / D_x$$

$Z_{CL}^{x,t}$  = Weight assigned to the loss development method

$$= (\text{Expected}(CF_t)^{[A]})^2 \times \text{Var}(IC^x) / D_x$$

$Z_{BF}^{x,t}$  = Weight assigned to the Bornhuetter-Ferguson method

$$= 1 - Z_{LR}^{x,t} - Z_{CL}^{x,t}$$

$D_x$  = Balancing term

$$= E((IC^x)^2) \times \text{V}(CF_t)^{[A]} + (E(CF_t)^{[A]})^2 \times \text{V}(IC^x) + E(IC^x) \times E(CF_t)^{[A]}$$

## Comparison of IBNR Methodologies

We have approximated that expectations and variances of incurred claims and completion do not depend on  $x$ . For  $(IC^x)$  I use average and variance of CL ultimate claim amounts through six months prior to the valuation period, these claims all have a completion factor close to 100 percent (>97 percent). For variance of CF, I have assumed independence of each term in the original lag triangle.

### *Statistical and/or Stochastic Methods*

Whereas deterministic claim reserve methods make assumptions about the expected value (a.k.a. point estimate) of future claims already incurred, stochastic methods also model not only the expected value of future claims but also the variation about the expected value of the future claims already incurred. Deterministic methods often are supplemented by a contingency margin or even sensitivity testing with alternate scenarios or other deterministic methods. A stochastic method, however, can produce a confidence interval. Clearly, actual claim run-out will be different from expected and a deterministic method does not give a good idea as to how much difference this can be. Many actuaries agree that the basic development method suffers from a large error variance, especially in months immediately preceding the valuation date, where the bulk of claim reserve amounts lie.

The development method described above appears intuitively natural to most actuaries and was historically regarded as being deterministic and thus non-stochastic. But the development method(s) can further be based on a stochastic model.

In order to get the claim reserve variability, or prediction error, it is essential first to formulate an underlying statistical model making assumptions about the data. The predicted values should be the same as those of the development method in order to provide a stochastic model that is analogous to the development method. This can be achieved in two ways, either by specifying distributions of the data or just by specifying the first two moments. The aim is to produce the same reserve estimates as the chain ladder technique, and the differences between them are mostly in implementation.

Potential models include Poisson, negative binomial, normal approximation of the negative binomial, lognormal and Mack's method. As an example, one autogressive model describes the cumulative claim lag amounts as:

$$CP^x_t = CR^x_t * CP^x_{t-1} + e^x_t \text{ where } e^x_t \text{ is an additive error term and } E[e^x_t] = 0 \text{ and } E[CR^x_t] = (CF_t)^{[A]}$$

Another potential model expresses the individual claim lag components as:

$$PC^x_t = a^{1x} * b'_t * e^{1x}_t \text{ where}$$

$a^{1x}$  = parameter representing the effect of incurral month  $x$

## Comparison of IBNR Methodologies

$b'_t$  = parameter representing the effect of lag month t

$e^{x_t}$  = the multiplicative error term.

By taking logarithms of both sides of the above equation, the model can be expressed as:

$$Z^x_t = \log(PC^x_t) = \mu + a^x + b'_t + e^{x_t} \text{ where}$$

where  $\mu$  represents the overall mean claim lag value (on a logarithmic basis).

These are just two examples of models that lend themselves to stochastic modeling of claim lags, applying them to claim lag reserve calculation and developing claim reserve variability estimates.

### *Tabular Methods*

Tabular Methods are used to develop claim reserves by estimating the present value of future benefits based upon a continuance table with an appropriate interest rate applied. Minimum reserve standards in states may dictate which tables and interest rates may be used for particular lines of business. Internally developed tables or multiples of published tables may also be used. Tabular methods, as defined above, can only be used to determine reserves for reported claims; therefore, other methods must be used to develop claim reserves for incurred but not reported claims. Tabular methods are most commonly used for disability income and long-term care contracts.

### *Case Reserve (or Direct Enumeration) Methods*

Case reserve methods develop claim reserves by estimating the ultimate claim amount of a reported claim and subtracting any amounts already paid against that claim. The ultimate claim amount may be estimated based on the historical experience of the company with similar claims, an estimate developed by a claim examiner based upon the specifics of the claim, or by determination of the actual claim amount. An example of this method is estimating case reserves based on a block of authorized inpatient stays, outpatient procedures and/or specialty physician referrals, for which the full charges have not been reported or fully adjudicated and paid.

### *Cross Incurral Method*

This method is unconventional but has its use in specific situations (e.g., new block with growth and not enough data for viable completion factors via method(s) above). It is a modification of the dollar-weighted-average approach in that also uses claim dollars as averaging weights. This method also allows the choice of the number of historical months (Y) by which to gauge claim completion patterns. The method starts with the standard triangle of claims, noted by the notation  $PC^x_t$ , but then takes an unusual approach towards cumulative paid claims:

## Comparison of IBNR Methodologies

$CP(cip)_t^{[X:Y]}$  = Cumulative “cross-incurred” claims paid as of chosen (i) valuation month X (e.g., 60), (ii) Y historical months chosen for judging completion patterns (e.g., 12), (iii) lag month (t) and (iv) Z high enough lag duration as to be sure that all claims for any incurred month have been paid (e.g., 28).

$$CP(cip)_t^{[X:Y]} = \sum_{i=1}^t \sum_{j=X-Y+1}^{X-(t-1)} PC_i^j$$

As you can see, these cumulative paid claim calculations “move up” the triangle rather than “move across” the triangle (i.e., where rows are incurred months and columns are paid months). This method makes the key assumption that the amount of claims in each lag duration from incurred is the same and we can thus derive reasonable completion by mixing claim durations’ paid claims across varying incurred months. Such an assumption is very useful for a new block in which the later claim durations have not “been seen” often and the calculation of reasonable completion ratios by the basic development method is difficult.

This method also “skips” the typical calculation of completion ratios but rather “immediately” calculates completion factors.

$$CF(cip)_t^{[60:12]} = \left( \sum_{i=0..,11} CP(cip)_t^{[60:12]} \right) / \left( \sum_{i=0..,11} CP_Z^{[60:12]} \right)$$

Of course, a new growing block will experience growing claim levels, a phenomenon that will be experienced at all claim durations for each new incurred month that passes. Such claims growth, unless adjusted for, can materially understate the reserves. An appropriate adjustment may be to adjust the above cumulative paid claims formula for the business growth (e.g., recognized by exposure in the form of policy counts and/or premium).

$$CP(cip:adj)^{[X:Y]}_t = \sum_{i=1}^t \sum_{j=X-Y+1}^{X-(t-1)} PC_i^j * (E_j / E_{j+(i-1)})$$

where  $E_y$  is the exposure measure for payment month y and such that the adjustment grows for every payment month prior to Y in a steadily growing block of business.

Oposing to the approach’s typical understatement of reserves for a growing block of business, the approach overstates reserves for a diminishing block and if the method is employed, the above adjustment is a prudent idea.

### Paid PMPM Method

This method makes use of the standard incurred/paid claim triangles as described in previous methods. Once the base triangle has been built, each cell value,  $PC_t^x$ , is then divided by the membership of that

## Comparison of IBNR Methodologies

month,  $M^x$ . This results in a triangle of Paid PMPM amounts. At this point, the data should be normalized for trend and seasonality if possible. This will allow for more accurate results.

Once the Paid PMPM triangle is built, there are two methods available to calculate the incurred but not paid (IBNP) reserve: the simple method and the regression method. Both methods determine IBNP by determining the unknown Paid PMPM values. The simple method takes a weighted average of the known Paid PMPM values for a particular duration across all incurral months. The weight used to calculate this average is the number of member months for each of the incurral months.

$PC_t^x$  = Claims paid for incurral month x (e.g., January 2006) in the  $t^{\text{th}}$  month (a.k.a. claim duration) after incurral month x. Note that the most recent incurral month has  $x=0$  and x increases for every incurral month prior to this most recent incurral month.

$PMPM_t^x$  = Claims paid per member for incurral month x (e.g., January 2006) in the  $t^{\text{th}}$  month (a.k.a. claim duration) after incurral month x. Note that the most recent incurral month has  $x=0$  and x increases for every incurral month prior to this most recent incurral month.

$PMPM_t^*$  = Unknown Paid PMPM amounts for duration t. The calculated unknown amount is used to fill in all empty cells for the duration in question.

$M^x$  = Total membership for incurral month x

$$PMPM_t^x = \frac{PC_t^x}{M^x}$$

$$PMPM_t^* = \frac{\sum M^x PMPM_t^x}{\sum M^x}$$

$$IBNP = \sum PMPM_t^* \cdot M^x$$

The regression method is a more complicated method; however it provides more accurate results. To generate the unknown Paid PMPM values, the known paid values are regressed against the cumulative paid claim amounts. A separate regression is run for each unknown cell of the claims “rectangle.” After the regression is run, the unknown PMPM values are determined using the calculated regression coefficients. And as with the simple method, the IBNP is calculated by multiplying each of the PMPM amounts by the membership and adding the resulting values together.

## Comparison of IBNR Methodologies

### APPENDIX C

#### Description of Paid PMPM Method

Robert Lynch's article, "Method for Calculating IBNP Health Reserves with Low Variance," provides the following introduction as to the method's basis and goals in terms of concerns with existing IBNR estimation methods (as well as further explanation of the method later in this appendix):

<sup>1</sup>"The achievement of this goal (i.e., minimizing estimated IBNR and actual observed IBNR with hindsight) necessitates an understanding of the difference between the 'process variance,' measure by the standard deviation of the underlying claim incurred and payment process, and the 'method variance,' or standard error, which is a characteristic of the measurement method. Due to the heuristic nature of most of the calculation methods used by actuaries, a certain amount of method variance is to be expected. However, a critical evaluation of the most common methods for estimating IBNP reserves used by actuaries practicing in health care finance, shows that these methods are based on faulty assumptions and so yield, for the most part, a much higher error due to methodology than is necessary.

"A re-examination of one of the basic properties of variance will reveal why the usual IBNP liability reserve calculation methods result in a high method variance, and what will lower that variance. That key property is that statistical variances are additive under addition, but increase polynomially under multiplication. That is, the variance of the sum of a collection of random variables is, in general, the sum of the variances of the individual variables, while multiplication of random variables increases variance in proportion to the square of the multiplying factor.

"So, to keep the method variance (standard error) to a minimum, one should seek to use methods that rely on the summation of data, and avoid methods that use or result in multiplicative factors. A prime example of this principle in statistics is the 'Best (i.e., lowest variance) Linear Unbiased Estimator' of regression, which is derived by minimizing the sum of the squared errors."

The Paid PMPM method attempts to solve purported problems with development method and exposure methods. These problems are described as:

- "Development methods take into account variance in claims incurred but not in claims reporting, processing and payment. In doing so, these methods contain the implicit assumption that the rate of claims reporting, processing and payment is constant and does not vary with time.<sup>2</sup>" "This method relies on the principle assumption that the only source of variability in actual claims liabilities is in the frequency and intensity of health care services (morbidity), and there is no variability in the rate of claims reporting and processing. That is, incurred claims will be reported to and paid by the health insurance payer at a constant rate over time with no process variance from this source.<sup>3</sup>" These methods are "based on the calculation of the historical proportion of claims incurred in a given incurred period (usually the incurred month) and paid in that and any given succeeding period (usually the paid month), to the total incurred claims in the incurred period. This ratio is the

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<sup>1</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves with Low Variance, 2.

<sup>2</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves with Low Variance, 5.

<sup>3</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves with Low Variance, 2.

## Comparison of IBNR Methodologies

‘completion factor.’ For a recent month, the incurred and paid claims are then multiplied by the reciprocal of the completion factor to give an estimate of the actual incurred claims in the incurred period. The total incurred claims are estimated by simply adding together the amounts calculated for each month up to the valuation date. Since this process involves multiplying real data by a statistical parameter that is calculated using multiplication, it is no surprise that the standard error of the result is quite high. The fact that the Completion Factor Method suffers from a large method variance has been widely recognized. This method variance or error is sometimes described as a ‘low credibility,’ and is especially problematic in months immediately preceding the valuation date, where lies the bulk of IBNP claim liability reserve amounts.”

- “Exposure methods take into account variance in claims reporting, processing and payment, but not in claims incurred. In so doing, the methods contain the implicit assumption that all variation in the amount of claims incurred and paid through a given valuation date is due solely to variance in the rate at which claims are reported, processed and paid, and that the amount of incurred claims per exposure per month (a.k.a. PMPM) does not vary from the total projected, including effects of such variables as trend and/or seasonality for which allowance is explicitly made.<sup>4</sup>” “The Incurred Claims Method suffers from the obvious shortcoming that, for purposes of estimating incurred claims, it totally ignores the amounts for claims incurred and already paid for the claims incurred periods to which it is applied. This results in a negative correlation between claims already paid and claims not yet paid for any given month of incurred, which is totally the opposite relation from that assumed by<sup>5</sup>” development methods. If an exposure method “is applied to claim incurred periods with more than a minimal claims payment run-out period, the amount of claims already paid for a month may exceed the projected total incurred claim amount. Since negative IBNP liability reserve amounts are, in general, not allowed, this situation results in an inherent bias in the Incurred Claims Method towards over-estimation of incurred claims and IBNP liability reserve amounts.” As with development methods, the exposure method “for calculating IBNP claim liability reserve amount is based on a false assumption. That is, that the only source of variability in how much is paid in claims each month is due to the claims reporting and processing, and there is no variability in actual member morbidity.”

There are two main versions of the Paid PMPM Method:

- <sup>6</sup>”The Simple Paid Lag Method is one version of the Paid PMPM Method in which it is implicitly assumed that the IBNP amount for a given time period is independent of the amount of claims incurred and already paid.”
- <sup>7</sup>”The Regressed Paid Lag Method is one version of the Paid PMPM Method in which it is implicitly assumed that the IBNP claim amount for a given incurred period is related to or dependent on the amount of claims incurred and already paid.”

Note: The Paid PMPM method was evaluated and tested using publicly available material. The author of the materials, Robert Lynch, has noted that the method is under patent protection and proprietary. Readers may wish to consult appropriate legal counsel for guidance on the use of the method under their particular situation.

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<sup>4</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves With Low Variance, 6.

<sup>5</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves With Low Variance, 2.

<sup>6</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves With Low Variance, 6.

<sup>7</sup> Lynch, Robert, Method for Calculating IBNP Health Reserves With Low Variance, 7.

## Comparison of IBNR Methodologies

### APPENDIX D

## Stochastic Method Literature, Our Tested Implementation and Stochastic Software Tools

### Outside Sources of Method Description and Approaches

Here are some, though not all, existing publicly available delineations of stochastic claim reserving approaches, along with a brief synopsis of each publication.

*SOA Study “Statistical Methods for Health Actuaries IBNR Estimates: An Introduction”* (pages 56-65)

- Authors: Gamage, Linfield, Ostaszewski, Siegel
- Develop PMPM costs for each incurred month and for each incurred month break this PMPM amount by lag month (see Figure 4-1 on page 58).
- Fit a distribution, using “best fit” based on Chi-square test results, for each lag month PMPM using various incurral month instances of each lag month PMPM as the data samples for distribution fitting.
- Develop predicted future known lag month PMPM values for each applicable recent incurral month by using mean and/or confidence interval(s).
- Concerns or practical considerations of approach:
  - If negative claim values or large claim outliers were used to fit a distribution, spurious results may be generated during the simulation. Adjust the data manually or use the @RISK RiskTruncate function to eliminate unreasonable input values.
  - If claims have increased rapidly over time, the fitted distributions may underestimate the impact of the increase. The results should be reviewed carefully for such patterns and adjusted accordingly.
  - The number of iterations run will impact both the speed of the simulation and the accuracy of the results. For most Total IBNR calculations, the complexity of the calculations can be readily handled in Excel. As such, a high number of iterations (10,000 or more) should be able to be performed rapidly.

*“An Alternative Approach to Calculation of IBNR Reserve in Health Insurance”*

- Publication: ARCH 2007
- Authors: Gamage, Linfield, Ostaszewski
- Similar to simulation approach suggested in Section 4 of above SOA paper
- Let  $Y(i,t)$  be the PMPM amount for the claim incurred in the month  $i$  and reported in the lag month  $t$ , with  $i=1,2,\dots,n$  and  $t=1,2,\dots,k$ 
  - Alternative is to let  $Y(i,t)$  be the actual paid claim amounts for the claim incurred in the month  $i$  and reported in the lag month  $t$  (this alternative is applied in Appendix I of above draft SOA paper)
- Idea is to fit model of  $Y(i,t)$  with multivariate regression model. For example, authors use model of  $\ln(Y) = b(0) + b(1)*i + b(2)*t + b(3)*t^2 + b(4)*\ln(t) + \text{error}$ 
  - Paper mentions removing outliers as part of distribution fitting
- Develop unknown  $Y(i,t)$  PMPM estimates using maximum likelihood estimates (see Appendix II of above draft SOA paper also for guidance) as well as margin of error, lower and upper bound and confidence intervals
- Paper also suggests that model can be generalized to include additional factors, such as the number of days or working days in a month.



## Comparison of IBNR Methodologies

### *“Stochastic Modeling in Health Insurance”*

- Presenter: McEllin
- SOA 2005 June Spring Meeting—76OF, Stochastic Modeling in Health Insurance
- Estimate IBNR using three independent random variables for each incurred period.
  - Number of claims: number of claims during incurred period. Usually fit with Poisson or Negative Binomial.
  - Claim Severity: amount of claim, separate value for each claim. Commonly modeled with gamma, lognormal or Pareto.
  - Report lag: time from incurred date to report date, separate value for each claim. If longer than period between incurred date and valuation date, then claim belongs in IBNR. Often modeled with exponential, Poisson or lognormal distributions.
- Expected IBNR for any incurred period is simply the product of the expected values of the first two variables multiplied by the probability that report lag is large enough to put claim in IBNR.
- Adjust distribution parameters iteratively to match stochastic model to deterministic model result.
- Method estimates pure IBNR

### *SOA RSA “Stochastic Modeling in Health Insurance”*

- SOA 2005 New Orleans Health/Pension Spring Meeting—76PD, Stochastic Modeling in Health Insurance
- Panelists: McEllin, Hendrickson, Yambao
- High level wrapper for McEllin presentation above.
- Discussion of why to use stochastic modeling and general description.
- Distribution selection and parameter fitting.

### *“Time Series Applications to Unpaid Claim Reserves”*

- Author: Fearington
- SOA 2004 Anaheim Spring Meeting—18PD, Stochastic Modeling for Health Actuaries
- Develop separate time series models for
  - Completion ratios
  - Monthly incurred claims
  - Monthly incurred and paid amounts
- Combine multiple models using differing weightings by incurred month for final estimates.

### *SOA RSA “Stochastic Modeling for Health Actuaries”*

- SOA 2004 Anaheim Spring Meeting—18PD, Stochastic Modeling for Health Actuaries
- Panelists: Knapp, Fearington, Fuhrer
- Discusses application of stochastic methods to IBNR. High level wrapper for Fearington presentation above.
- Evaluate residuals in model. Make sure that model is not made to violate original assumptions that it was built on. Does unexplained trend or seasonality violate the model assumptions?
- Measures of goodness of fit.
  - Root mean squared error—Fearington’s favorite.
  - Akaike Information Criteria and Schwartz’s Bayesian Criteria provide a penalty for number of terms in the model. These help ensure model parameters are justified.

## Comparison of IBNR Methodologies

SOA “*Approaches to Determining Unpaid Claim Liabilities: Old and New*”

- SOA 2004 Boston Valuation Actuary Symposium—39TS, Stochastic Modeling for Health Actuaries
- Panelists: Fearington, Lynch
- Discusses purposes and limitations of current IBNR methods.
- Presents multiple linear regression model and simplifications to make it manageable.
- Evaluate residuals in model. Make sure that model is not made to violate original assumptions that it was built on. Does unexplained trend or seasonality violate the model assumptions?
- Presenting goals for stochastic model.
  - Residuals should have expected value zero, have a constant variance, be uncorrelated over time and be normally distributed.
  - Quantify confidence intervals.

## Comparison of IBNR Methodologies

### Description of Tested Stochastic Method

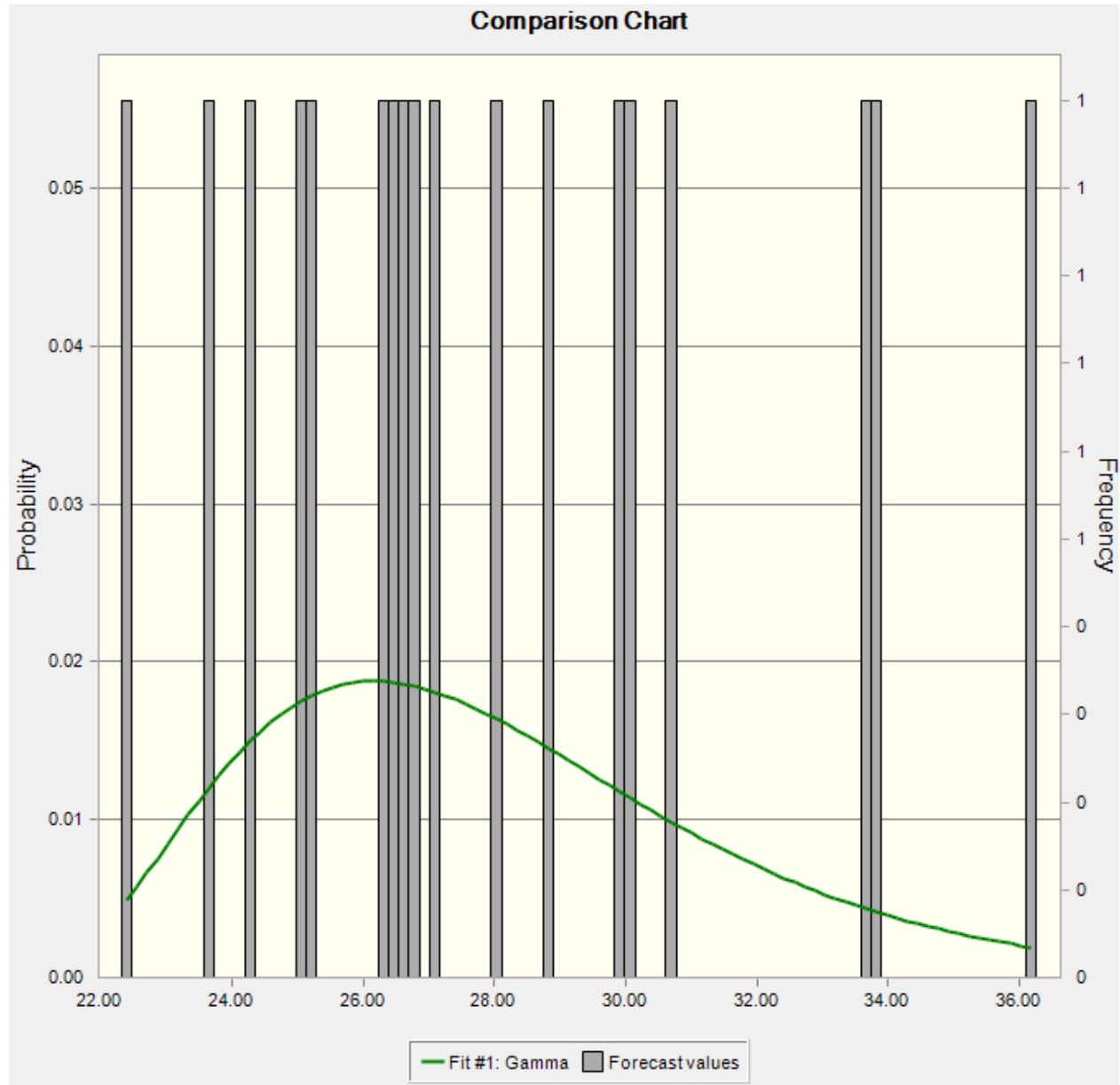
Our chosen stochastic method is used to independently solve for expected IBNR on each of the triangles used in the analytic IBNR estimation process. The triangle is expressed as amount paid in each claim duration (t) of each incurral month (x). This is referred to as  $PC^x_t$ .  $PC^x_t$  divided by the member count during the incurral month (x) gives  $PMPM^x_t$ . An assumption is made that, in the unknown development triangle, each  $PMPM^x_t$  is independent. For each duration (t), Crystal Ball is used to fit a probability distribution to the known  $PMPM^x_t$  values. Using the fitted distribution, Crystal Ball then creates random variables to fill the entire unknown triangle with PMPM amounts. Several iterations (i.e., 500) are made in which Crystal Ball assigns random numbers to each of the unknown payments. Outstanding payments for each incurral month are the sum of random PMPM amounts, over unpaid durations, multiplied by member count. Total IBNR is the sum of outstanding payments over all incurral months. The result of a simulation run is a set of 500 possible IBNR totals. The distribution can be used to estimate IBNR and the range of possible values. Given the large number of “actual” triangles being run through the model, we did not manually examine the resulting distribution for each triangle. Instead we have assumed that an actuary would base IBNR estimation on a statistical value from the distribution. For each input triangle we have extracted the mean, 50 percent value, 75 percent value and 90 percent value. The percentage values are the dollar amounts for which that percentage of the simulations yield smaller results. These results are the values which we compare to the analytic results.

A simplified example should make this clearer. An example known triangle is shown below.

Incurral Month	member months	payments per member - by duration				
		1	2	3	4	5
1	10,000	2.511	28.053	4.348	0.471	0.080
2	10,000	4.490	22.320	4.398	0.852	0.599
3	10,000	3.150	33.805	4.298	0.338	0.043
4	10,000	2.757	29.851	3.372	0.479	0.216
5	10,000	2.744	26.648	3.220	0.766	0.136
6	10,000	5.059	30.629	2.948	0.523	(0.057)
7	10,000	2.763	25.249	3.319	0.828	(0.121)
8	10,000	3.206	27.058	3.340	0.763	(0.356)
9	10,000	1.404	23.713	2.912	0.787	0.055
10	10,000	2.063	30.011	5.046	0.213	0.109
11	10,000	1.975	26.529	3.937	0.678	0.341
12	10,000	2.642	26.732	3.386	0.739	(0.467)
13	10,000	2.718	33.714	3.473	0.509	0.254
14	10,000	1.792	26.290	3.256	0.327	(0.335)
15	10,000	4.015	36.253	2.339	0.549	0.009
16	10,000	3.363	25.051	4.434	0.535	
17	10,000	2.900	28.766	3.779		
18	10,000	4.579	24.282			
19	10,000	5.155				

## Comparison of IBNR Methodologies

A distribution will be fit to the amounts paid in duration two—then used to generate random amounts for  $PMPM^{19}_2$ . Crystal Ball is set to select a distribution based on minimizing Chi-squared. In this case a gamma distribution has been selected. The data and fit chosen by Crystal are shown below. Because Crystal Ball can fit distributions with very long tails, we truncate the distributions somewhat outside the actual range seen.

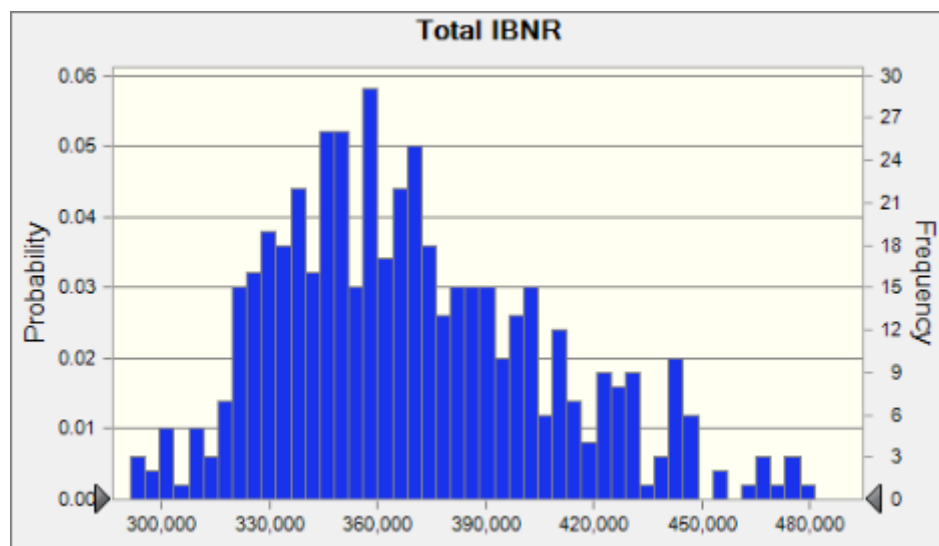


Once we fit a distribution for each empty cell of the data block, we will run the Crystal Ball simulation. The following chart shows incurral months 15-19 for a single Crystal Ball iteration. The fitted distributions for durations 2–5 are gamma, normal, uniform and student’s t, respectively. The shaded cells contain random payout amounts. The total future payments for these incurral months are \$432,615 in this iteration.

## Comparison of IBNR Methodologies

Incurral Month	member months	payments per member - by duration					outstanding payments
		1	2	3	4	5	
15	10,000	4.015	36.253	2.339	0.549	0.009	-
16	10,000	3.363	25.051	4.434	0.535	0.185	1,854
17	10,000	2.900	28.766	3.779	0.325	(0.451)	(1,266)
18	10,000	4.579	24.282	4.153	0.652	0.025	48,302
19	10,000	5.155	35.769	2.432	0.623	(0.452)	383,725
						total IBNR	432,615

After 500 iterations, total IBNR values have followed the pattern shown below. From this distribution an actuary would select a value as an IBNR estimate. We save the mean, 50 percent, 75 percent and 90 percent values. For this chart the values are \$371,788, \$364,884, \$394,129 and \$427,719, respectively.



This process is repeated for each of the 100 simulated experience data sets for each data block.

### Simplifying Assumptions

Crystal Ball is not able to fit a distribution if there are fewer than 15 data points. If there are any durations which do not have enough data, the data will be sparse for all of these durations. We assign a normal distribution for each duration. The mean in each duration is the average seen in that duration. The standard deviation used for all durations is the average of the standard deviations calculated for each of these low data durations.

In order to reduce the number of random variables, memory requirements and time to run the simulations, simplifying assumptions have been made. First random variable distributions which can be explicitly summed, such as normal, have been. In the example above, duration 3 is fit with a normal distribution, having mean  $m$  and standard deviation  $s$ . We can replace the two random variables shown with a single normal distribution having mean  $(m*2)$  and standard deviation  $(s*2^{1/2})$ .

## Comparison of IBNR Methodologies

The slowest part of the simulation is the process of fitting a distribution to the input data for each duration. We are simulating out to the 28<sup>th</sup> duration, which could have 27 different random number distributions. If we assign a separate random variable to each cell in the unknown triangle, we will have 378 ( $27 \times 28 / 2$ ) random variables. When summing a sufficient number of random variables, the sum becomes a normal random variable. In order to simplify our calculations, I have replaced the individual random values with a single normally distributed variable for each duration greater than 16. Each of those normal distributions is replacing the sum of 16 or more individual random numbers. This simplification cuts down on distribution fitting, as well as the ultimate number of random variables—cutting run-time to less than half. It should be noted that the vast majority of payments occur in the first few durations. In total the modified durations typically account for approximately 1 percent of the payments.

### Medical Trend—PMPM Growth Rate

In the real world claims per member grow over time. A growth rate can be entered to modify the stochastic process. Growth is projected as a monthly exponential curve  $(1+r)^t$ . All  $PMPM^x_t$  amounts for preceding months are inflated to current levels before performing distribution fitting. The random future  $PMPM^x_t$ 's are summed over duration for each incurral month. Then each incurral month total is adjusted back down to actual dollar amounts. Finally, sum over incurral months for total IBNR.

## Comparison of IBNR Methodologies

### Other Software Tools for Stochastic Simulation

Here are some, though likely not all, software tools for stochastic simulation.

#### Crystal Ball—Oracle

We used Crystal Ball<sup>1</sup> for much of our work in this report. Crystal Ball is a software application which runs as an add-in to Excel. Crystal Ball can turn deterministic spreadsheet models into Monte Carlo simulations. Functions include curve fitting, random number generation and managing data for the multiple runs required for stochastic simulation.

#### @Risk—Palisade

Similar to Crystal Ball, @Risk is an Excel add-in which supports stochastic modeling in Excel spreadsheets. We are not familiar enough with @Risk to provide a comparison of the tools.

#### Tillinghast Smart Modeling—Tillinghast

This is an insurance-specific Monte Carlo stochastic modeling tool.

#### SMART—Stochastic Model Checking Analyzer for Reliability and Timing

This is a software package for studying complex discrete-state systems. We are not familiar with this tool and cannot comment on its applicability.

#### AIMMS—Paragon

AIMMS is a mathematical programming language which supports generation of a stochastic model from any deterministic model. AIMMS can be used as an Excel add-in.

#### Digipede

Stochastic models require considerable computing time. Digipede provides tools to support network computation, which is well suited to stochastic modeling where each iteration can be run as a separate process.

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<sup>1</sup> For disclosure, L&E purchased Crystal Ball for use in this project and other tasks but derive no income or discounts from Crystal Ball.

## Comparison of IBNR Methodologies

### APPENDIX E

#### Detailed Results of IBNR Tests

In this appendix, we have included four different sets of results for each of the scenarios. The first set of results shows the results assuming the methods would be applied to all incurral months. However, we have also realized that applying the majority of these methods to all incurral months is rarely, if ever, done in practice. Typically, the most recent incurral month(s) have IBNR amounts estimated using an exposure-based method since lag methods could potentially result in grossly over- or underestimated incurred claim numbers. So an actuary, for example, might use the loss ratio method in the most recent two incurral months and the 12-month average lag method for the preceding months.

We also realize that actuarial judgment is used to determine how many of the recent incurral months would need an alternative method. Sometimes this is done by simply assuming a certain number of months, while other actuaries base it on the credibility of the completion factor. We have chosen 50 percent as the credibility level of the completion factor for our simulations. That is, if an incurral month's completion factor, as implied by the actual run-out, is less than 50 percent, then that incurral month's reserve is considered not "credible." So our second set of results shows only the results for the incurral months in which the completion factor is at least 50 percent. These second sets of results thus allow analysis of relative accuracy of IBNR methods on those months typically not "overridden" by the actuary and often relied upon by the actuary in choosing the alternative method and estimates for the recent "non-credible" incurral months. The third set of results then shows only the most recent incurral months, those where the completion factor does not apply.

The fourth set of results shows the results of our stochastic method simulations. Because the stochastic method generates a distribution of results, it allows the development of confidence intervals. Thus, the results for the stochastic simulations look a bit different. There are two main groups of results: Mean and 75% Confidence Interval. The Mean shows the average error, standard deviation of error and reserve deficiency assuming we use the mean amount calculated by the stochastic simulations. The 75% Confidence Intervals results show the same statistics assuming we want the value at which 75 percent of the distribution is less than the specified amount. The average error and standard deviation of error are based on the distribution of results for the 250 claim triangles we ran. This is not to be confused with the individual stochastic simulations run for each triangle. For each triangle, we ran 1,000 stochastic simulations, which generated a distribution of results from which we pulled a fixed point at the Mean and at the 75% Confidence Interval. We then did this 250 times, resulting in two different results distributions, one for the Mean and one for the 75% Confidence Interval. The average error and standard deviation of error are based on those two independent results sets. The third statistic, reserve sufficiency, shows what percentage of the time the selected results group had a reserve calculated that was greater than the actual run-out. As one would expect, this amount increases as the confidence level increases.

As a reminder, the error-estimate statistic shown in these detailed results is as follows:

$$= \frac{\text{ReserveEstimate} - \text{ActualRunout}}{\text{ActualRunout}}$$



# Comparison of IBNR Methodologies

## Base Scenario

- 10 percent annual trend and 10 percent rate increases at the beginning of every year

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.31%	-0.58%	-0.86%	-0.83%	-4.76%	0.11%	-1.82%
PMPM	-3.42%	-4.55%	-4.28%	-4.22%	-8.97%	-2.39%	-3.81%
Paid PMPM	0.39%	0.58%	0.34%	1.02%	0.35%	1.18%	0.49%
Benktander	1.79%	3.10%	1.15%	3.96%	3.01%	2.29%	3.40%
Bornhuetter	1.19%	1.84%	0.75%	2.67%	1.16%	1.40%	1.57%
Credibility Weighted	1.79%	2.02%	1.34%	2.86%	1.63%	2.07%	1.35%
Hybrid Loss Ratio	0.59%	1.33%	-2.07%	-0.73%	-0.39%	0.44%	-0.41%
Lag - 12 Mo Avg	2.99%	6.88%	1.65%	10.56%	19.74%	8.31%	27.63%
Lag - 9 Mo Avg	2.98%	6.84%	1.75%	10.51%	19.43%	8.81%	27.99%
Lag - 6 Mo Avg	3.14%	7.47%	2.03%	10.91%	19.53%	8.96%	27.73%
Lag - 3 Mo Avg	2.97%	7.50%	2.06%	10.37%	18.95%	10.10%	27.00%
Lag - Cross Incurral	-0.74%	-0.94%	-1.89%	-0.98%	-3.04%	-2.68%	-3.68%
Lag - Dollar Weighted	1.06%	1.53%	0.63%	2.69%	2.54%	0.10%	0.41%
Lag - Drop Extremes (10/12)	1.28%	4.27%	-2.57%	4.16%	10.63%	4.73%	12.18%
Lag - Geometric Avg	2.00%	4.13%	1.22%	6.59%	10.12%	4.72%	11.96%
Lag - Harmonic Avg	1.04%	1.61%	0.70%	2.79%	2.63%	0.93%	1.19%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.41%	4.74%	4.14%	4.79%	2.60%	4.18%	2.82%
PMPM	10.30%	9.59%	8.55%	6.53%	5.14%	5.28%	3.81%
Paid PMPM	3.65%	5.16%	4.02%	8.49%	3.84%	8.10%	9.15%
Benktander	8.96%	12.45%	6.89%	12.53%	9.11%	8.65%	7.70%
Bornhuetter	6.61%	8.83%	5.66%	9.73%	6.27%	6.94%	5.24%
Credibility Weighted	9.09%	9.15%	7.87%	9.64%	5.61%	7.73%	4.77%
Hybrid Loss Ratio	6.89%	8.90%	5.45%	9.79%	6.41%	7.52%	5.62%
Lag - 12 Mo Avg	15.68%	25.06%	10.32%	28.72%	39.70%	22.72%	38.62%
Lag - 9 Mo Avg	16.04%	25.52%	10.76%	29.36%	40.46%	23.34%	40.00%
Lag - 6 Mo Avg	16.62%	27.01%	11.12%	30.87%	41.80%	23.70%	44.20%
Lag - 3 Mo Avg	18.09%	29.47%	12.85%	33.74%	46.22%	27.06%	49.54%
Lag - Cross Incurral	14.08%	21.19%	9.27%	22.92%	25.25%	17.69%	21.43%
Lag - Dollar Weighted	15.37%	23.20%	10.27%	26.08%	29.31%	19.73%	25.40%
Lag - Drop Extremes (10/12)	15.57%	24.50%	10.02%	27.72%	36.02%	22.31%	33.75%
Lag - Geometric Avg	15.84%	24.54%	10.66%	28.02%	34.43%	21.92%	31.47%
Lag - Harmonic Avg	15.64%	23.63%	10.56%	26.76%	29.95%	20.59%	26.12%

## Comparison of IBNR Methodologies

### Base Scenario—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	0.87%	-1.47%	-2.04%	-1.78%	-8.17%	0.22%	-7.03%
PMPM	-9.98%	-11.58%	-9.52%	-8.25%	-14.62%	-6.46%	-12.97%
Paid PMPM	1.44%	2.02%	0.92%	2.20%	0.56%	3.74%	0.99%
Benktander	5.05%	4.37%	2.80%	8.04%	3.43%	6.17%	1.88%
Bornhuetter	3.92%	3.33%	2.10%	6.06%	1.58%	4.40%	0.91%
Credibility Weighted	4.72%	4.21%	2.76%	5.64%	2.25%	5.47%	1.83%
Hybrid Loss Ratio	2.51%	2.75%	-4.25%	-1.28%	-1.51%	1.80%	-4.69%
Lag - 12 Mo Avg	4.87%	4.14%	2.48%	8.89%	4.57%	6.09%	1.86%
Lag - 9 Mo Avg	5.23%	4.49%	2.90%	9.18%	4.66%	6.56%	2.06%
Lag - 6 Mo Avg	5.52%	5.41%	3.46%	9.66%	4.65%	6.74%	2.18%
Lag - 3 Mo Avg	6.02%	6.61%	3.94%	9.64%	4.71%	7.78%	3.17%
Lag - Cross Incurral	1.32%	-0.30%	-1.94%	0.54%	-4.18%	-0.14%	-4.59%
Lag - Dollar Weighted	4.00%	3.44%	2.00%	5.19%	1.94%	4.20%	0.87%
Lag - Drop Extremes (10/12)	2.76%	2.85%	-4.58%	-0.34%	-1.08%	2.00%	-4.98%
Lag - Geometric Avg	4.68%	3.98%	2.59%	7.24%	3.20%	5.63%	1.62%
Lag - Harmonic Avg	4.14%	3.46%	2.28%	5.36%	1.85%	4.72%	1.20%

##### Standard Deviation

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	13.03%	12.21%	9.29%	8.96%	4.00%	10.91%	8.55%
PMPM	29.45%	23.86%	18.27%	12.27%	7.95%	13.90%	11.48%
Paid PMPM	9.30%	12.38%	8.10%	15.80%	5.57%	18.97%	18.82%
Benktander	20.04%	20.49%	13.78%	25.87%	13.77%	21.21%	14.06%
Bornhuetter	17.12%	18.52%	12.34%	20.81%	10.00%	18.49%	12.40%
Credibility Weighted	18.30%	19.70%	13.54%	19.02%	8.83%	18.76%	13.36%
Hybrid Loss Ratio	16.92%	17.90%	11.00%	19.34%	9.79%	18.48%	11.59%
Lag - 12 Mo Avg	20.23%	20.07%	13.11%	28.12%	16.62%	22.24%	14.04%
Lag - 9 Mo Avg	20.87%	21.07%	14.22%	29.23%	17.22%	22.30%	14.57%
Lag - 6 Mo Avg	21.55%	21.60%	14.88%	31.02%	17.71%	23.42%	15.71%
Lag - 3 Mo Avg	24.86%	27.06%	19.17%	35.51%	20.32%	26.51%	18.78%
Lag - Cross Incurral	19.06%	18.73%	12.05%	24.65%	13.92%	19.91%	12.43%
Lag - Dollar Weighted	19.98%	19.96%	12.94%	27.05%	15.75%	21.87%	13.96%
Lag - Drop Extremes (10/12)	20.03%	19.97%	12.35%	26.29%	15.90%	21.67%	13.16%
Lag - Geometric Avg	20.73%	20.97%	14.16%	28.69%	16.72%	22.11%	14.51%
Lag - Harmonic Avg	20.59%	20.87%	14.10%	28.16%	16.27%	21.92%	14.44%

## Comparison of IBNR Methodologies

### Base Scenario—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	0.12%	0.10%	0.09%	0.28%	0.15%	0.22%	0.03%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	0.08%	0.09%	0.09%	0.18%	0.13%	0.19%	0.45%
Benktander	1.22%	3.68%	0.47%	1.96%	3.34%	1.35%	4.28%
Bornhuetter	0.70%	2.01%	0.19%	0.90%	1.18%	0.72%	2.09%
Credibility Weighted	1.30%	1.78%	0.85%	1.45%	1.20%	1.21%	1.46%
Hybrid Loss Ratio	0.46%	1.51%	-0.07%	1.13%	1.81%	0.54%	1.33%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.57%	0.48%	-1.25%	0.05%	1.02%	-2.88%	-2.95%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.79%	0.71%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	2.56%	2.57%	2.42%	2.30%	2.08%	2.24%	1.80%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	2.60%	2.74%	2.59%	3.05%	2.47%	3.58%	6.45%
Benktander	9.27%	15.70%	6.43%	8.51%	10.48%	7.45%	8.85%
Bornhuetter	5.60%	9.09%	4.04%	4.79%	5.67%	4.86%	5.36%
Credibility Weighted	9.79%	8.20%	9.02%	5.74%	3.70%	5.77%	3.52%
Hybrid Loss Ratio	5.60%	9.03%	4.03%	4.92%	5.75%	5.15%	5.53%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.04%	32.20%	13.66%	39.91%	60.58%	24.78%	28.39%
Lag - Dollar Weighted	20.59%	34.79%	14.77%	44.97%	69.32%	27.48%	33.49%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Base Scenario—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.67%	6.09%	50.40%	5.77%	6.48%	77.60%
HMO Professional	0.12%	7.53%	47.20%	5.77%	8.01%	72.00%
Managed Care	-0.23%	4.57%	48.80%	3.45%	4.76%	75.60%
HMO Hospital	0.16%	8.53%	45.60%	7.62%	9.18%	77.20%
Self Funded	-0.58%	5.67%	44.80%	4.65%	5.99%	77.20%
Major Medical	0.07%	6.41%	48.00%	5.15%	6.70%	77.60%
Medicare Supplement	-0.71%	4.90%	44.40%	4.16%	5.10%	78.80%

##### “Credible Months” (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	5.54%	18.98%	57.20%	17.45%	21.12%	78.40%
HMO Professional	8.65%	45.71%	47.60%	28.62%	53.05%	69.60%
Managed Care	0.19%	9.39%	49.60%	6.33%	9.96%	69.60%
HMO Hospital	1.82%	17.67%	45.20%	12.53%	19.43%	72.00%
Self Funded	-0.32%	8.79%	42.40%	5.19%	9.36%	71.20%
Major Medical	0.72%	10.87%	51.20%	7.47%	11.53%	72.80%
Medicare Supplement	-0.66%	6.77%	44.80%	4.57%	7.11%	74.80%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.40%	6.35%	51.20%	4.53%	6.67%	73.20%
HMO Professional	0.35%	7.51%	48.00%	4.55%	7.87%	67.20%
Managed Care	-0.15%	3.84%	50.00%	1.75%	3.94%	63.60%
HMO Hospital	-0.09%	4.61%	44.40%	4.38%	4.85%	82.00%
Self Funded	-0.37%	5.43%	42.00%	4.49%	5.57%	79.60%
Major Medical	-0.24%	2.64%	45.60%	2.64%	2.79%	82.40%
Medicare Supplement	-0.55%	2.38%	42.80%	3.57%	2.65%	92.40%

## Comparison of IBNR Methodologies

### Excessive Trend Scenario

- 25 percent annual trend and 25 percent rate increases at the beginning of every year

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.32%	-0.44%	-0.71%	-0.62%	-4.09%	0.17%	-1.59%
PMPM	-6.80%	-7.58%	-7.00%	-6.19%	-10.06%	-4.05%	-4.81%
Paid PMPM	0.37%	0.54%	0.32%	0.97%	0.34%	1.06%	0.48%
Benktander	1.76%	3.09%	1.11%	3.93%	3.05%	2.21%	3.39%
Bornhuetter	1.18%	1.84%	0.73%	2.63%	1.17%	1.36%	1.56%
Credibility Weighted	2.51%	3.96%	1.60%	5.24%	3.79%	3.57%	4.16%
Hybrid Loss Ratio	0.56%	1.29%	-1.97%	-0.62%	-0.32%	0.39%	-0.32%
Lag - 12 Mo Avg	2.97%	6.91%	1.63%	10.64%	20.24%	8.34%	28.04%
Lag - 9 Mo Avg	2.96%	6.87%	1.72%	10.59%	19.92%	8.83%	28.40%
Lag - 6 Mo Avg	3.11%	7.48%	1.98%	10.98%	20.02%	8.96%	28.14%
Lag - 3 Mo Avg	2.92%	7.47%	1.99%	10.42%	19.42%	10.07%	27.38%
Lag - Cross Incurral	-2.73%	-3.42%	-4.79%	-4.30%	-7.75%	-5.96%	-7.53%
Lag - Dollar Weighted	1.04%	1.52%	0.61%	2.68%	2.60%	0.04%	0.39%
Lag - Drop Extremes (10/12)	1.26%	4.26%	-2.48%	4.34%	11.00%	4.74%	12.49%
Lag - Geometric Avg	1.97%	4.13%	1.19%	6.62%	10.38%	4.68%	12.12%
Lag - Harmonic Avg	1.01%	1.60%	0.67%	2.78%	2.70%	0.85%	1.18%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.17%	4.52%	3.94%	4.69%	2.56%	4.03%	2.72%
PMPM	9.84%	9.20%	8.20%	6.29%	5.01%	5.05%	3.67%
Paid PMPM	3.60%	5.02%	3.92%	8.23%	3.80%	7.82%	8.95%
Benktander	8.94%	12.42%	6.78%	12.43%	9.22%	8.49%	7.66%
Bornhuetter	6.56%	8.73%	5.52%	9.58%	6.31%	6.75%	5.16%
Credibility Weighted	13.46%	15.68%	9.81%	15.08%	9.67%	11.10%	7.95%
Hybrid Loss Ratio	6.87%	8.83%	5.36%	9.69%	6.46%	7.37%	5.57%
Lag - 12 Mo Avg	15.74%	25.22%	10.34%	29.03%	40.73%	22.93%	39.23%
Lag - 9 Mo Avg	16.10%	25.68%	10.76%	29.67%	41.51%	23.54%	40.65%
Lag - 6 Mo Avg	16.67%	27.17%	11.13%	31.17%	42.88%	23.91%	44.93%
Lag - 3 Mo Avg	18.13%	29.60%	12.78%	34.01%	47.38%	27.30%	50.36%
Lag - Cross Incurral	13.83%	20.80%	9.00%	22.48%	24.99%	17.21%	20.87%
Lag - Dollar Weighted	15.44%	23.36%	10.30%	26.38%	30.05%	19.88%	25.75%
Lag - Drop Extremes (10/12)	15.62%	24.66%	10.05%	28.04%	36.95%	22.50%	34.27%
Lag - Geometric Avg	15.89%	24.69%	10.66%	28.31%	35.31%	22.10%	31.96%
Lag - Harmonic Avg	15.69%	23.78%	10.57%	27.03%	30.71%	20.74%	26.51%

## Comparison of IBNR Methodologies

### Excessive Trend Scenario—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.90%	-1.13%	-1.72%	-1.38%	-7.18%	0.36%	-6.36%
PMPM	-19.84%	-19.38%	-15.57%	-12.09%	-16.48%	-10.87%	-16.13%
Paid PMPM	1.38%	1.91%	0.88%	2.10%	0.55%	3.41%	0.91%
Benktander	5.00%	4.30%	2.74%	8.11%	3.55%	6.01%	1.84%
Bornhuetter	3.92%	3.31%	2.08%	6.09%	1.64%	4.33%	0.88%
Credibility Weighted	5.06%	4.37%	2.82%	7.88%	3.66%	6.10%	1.97%
Hybrid Loss Ratio	2.44%	2.63%	-4.10%	-1.08%	-1.43%	1.64%	-4.53%
Lag - 12 Mo Avg	4.83%	4.08%	2.44%	8.98%	4.73%	5.97%	1.83%
Lag - 9 Mo Avg	5.18%	4.43%	2.85%	9.28%	4.83%	6.41%	2.02%
Lag - 6 Mo Avg	5.45%	5.30%	3.37%	9.74%	4.81%	6.54%	2.15%
Lag - 3 Mo Avg	5.90%	6.42%	3.80%	9.72%	4.87%	7.46%	3.08%
Lag - Cross Incurral	-1.62%	-4.28%	-6.42%	-4.12%	-10.46%	-5.30%	-11.08%
Lag - Dollar Weighted	3.97%	3.39%	1.98%	5.24%	2.02%	4.10%	0.86%
Lag - Drop Extremes (10/12)	2.68%	2.73%	-4.44%	-0.12%	-0.98%	1.85%	-4.82%
Lag - Geometric Avg	4.63%	3.92%	2.54%	7.32%	3.32%	5.48%	1.59%
Lag - Harmonic Avg	4.08%	3.40%	2.23%	5.41%	1.93%	4.56%	1.16%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	12.31%	11.65%	8.88%	8.81%	3.95%	10.51%	8.30%
PMPM	28.44%	23.17%	17.73%	12.00%	7.87%	13.44%	11.29%
Paid PMPM	9.22%	12.08%	7.92%	15.44%	5.58%	18.39%	18.46%
Benktander	20.07%	20.32%	13.62%	26.02%	14.12%	21.04%	14.00%
Bornhuetter	17.10%	18.26%	12.12%	20.80%	10.21%	18.19%	12.26%
Credibility Weighted	20.28%	20.59%	13.92%	25.01%	13.47%	21.11%	14.21%
Hybrid Loss Ratio	16.93%	17.69%	10.88%	19.41%	10.02%	18.26%	11.56%
Lag - 12 Mo Avg	20.27%	19.93%	13.00%	28.40%	17.11%	22.13%	14.02%
Lag - 9 Mo Avg	20.90%	20.92%	14.08%	29.50%	17.71%	22.17%	14.54%
Lag - 6 Mo Avg	21.58%	21.45%	14.70%	31.29%	18.22%	23.23%	15.64%
Lag - 3 Mo Avg	24.87%	26.80%	18.82%	35.74%	20.87%	26.27%	18.57%
Lag - Cross Incurral	18.54%	17.78%	11.31%	23.80%	13.57%	18.70%	11.51%
Lag - Dollar Weighted	20.04%	19.83%	12.87%	27.35%	16.23%	21.73%	13.91%
Lag - Drop Extremes (10/12)	20.06%	19.82%	12.27%	26.58%	16.35%	21.56%	13.20%
Lag - Geometric Avg	20.76%	20.82%	14.02%	28.94%	17.19%	21.98%	14.48%
Lag - Harmonic Avg	20.62%	20.72%	13.96%	28.40%	16.72%	21.79%	14.41%

## Comparison of IBNR Methodologies

### Excessive Trend Scenario—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.12%	0.11%	0.10%	0.29%	0.16%	0.22%	0.02%
PMPM	-0.87%	-0.95%	-0.92%	-0.85%	-1.32%	-0.92%	-1.13%
Paid PMPM	0.08%	0.09%	0.09%	0.18%	0.13%	0.19%	0.45%
Benktander	1.22%	3.68%	0.47%	1.96%	3.32%	1.34%	4.24%
Bornhuetter	0.70%	2.01%	0.19%	0.89%	1.16%	0.72%	2.06%
Credibility Weighted	2.42%	5.15%	1.34%	4.73%	4.93%	3.33%	5.21%
Hybrid Loss Ratio	0.46%	1.51%	-0.07%	1.14%	1.81%	0.54%	1.32%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.56%	37.14%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.06%	37.59%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.23%	37.20%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.46%	35.89%
Lag - Cross Incurral	-2.14%	-1.24%	-3.06%	-2.09%	-1.71%	-5.32%	-5.99%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.08%	-0.77%	0.67%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.17%	18.64%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.40%	16.08%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.66%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.57%	2.59%	2.43%	2.32%	2.09%	2.27%	1.81%
PMPM	2.79%	2.79%	2.72%	2.33%	2.27%	2.08%	1.83%
Paid PMPM	2.60%	2.74%	2.59%	3.05%	2.47%	3.57%	6.43%
Benktander	9.27%	15.70%	6.43%	8.51%	10.48%	7.41%	8.79%
Bornhuetter	5.60%	9.09%	4.04%	4.79%	5.67%	4.83%	5.32%
Credibility Weighted	17.16%	21.32%	13.37%	18.24%	13.11%	12.44%	8.90%
Hybrid Loss Ratio	5.61%	9.04%	4.04%	4.93%	5.75%	5.14%	5.49%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.16%	51.73%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.86%	53.97%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.58%	59.92%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.88%	66.66%
Lag - Cross Incurral	18.66%	31.53%	13.36%	38.83%	58.60%	24.08%	27.39%
Lag - Dollar Weighted	20.60%	34.79%	14.78%	44.99%	69.31%	27.54%	33.58%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.53%	45.21%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.70%	42.25%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.67%	34.80%

## Comparison of IBNR Methodologies

### Excessive Trend Scenario—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.65%	6.06%	50.40%	5.75%	6.45%	77.20%
HMO Professional	0.96%	7.54%	52.00%	6.76%	7.99%	76.80%
Managed Care	-0.23%	4.51%	48.40%	3.45%	4.69%	76.00%
HMO Hospital	0.15%	8.41%	45.60%	7.68%	8.98%	78.40%
Self Funded	-0.61%	5.71%	45.60%	4.74%	6.04%	76.40%
Major Medical	0.07%	6.24%	48.40%	5.15%	6.53%	77.60%
Medicare Supplement	-0.70%	4.85%	44.40%	4.23%	5.05%	78.80%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	5.45%	18.88%	56.80%	17.38%	21.02%	78.00%
HMO Professional	16.49%	48.13%	55.20%	36.75%	55.75%	79.20%
Managed Care	0.20%	9.32%	49.60%	6.36%	9.88%	70.40%
HMO Hospital	1.70%	17.72%	44.80%	12.64%	19.46%	72.40%
Self Funded	-0.32%	9.00%	42.40%	5.35%	9.59%	71.20%
Major Medical	0.72%	10.70%	51.60%	7.50%	11.35%	73.60%
Medicare Supplement	-0.63%	6.74%	44.80%	4.66%	7.10%	74.80%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.39%	6.32%	51.20%	4.55%	6.64%	73.20%
HMO Professional	0.48%	7.50%	50.00%	4.90%	7.87%	69.60%
Managed Care	-0.15%	3.84%	50.00%	1.78%	3.93%	63.60%
HMO Hospital	0.06%	4.63%	46.40%	4.55%	4.82%	82.80%
Self Funded	-0.41%	5.40%	41.20%	4.52%	5.54%	80.80%
Major Medical	-0.22%	2.63%	44.40%	2.68%	2.77%	82.80%
Medicare Supplement	-0.56%	2.39%	42.00%	3.61%	2.65%	91.60%



## Comparison of IBNR Methodologies

### Varying Trend Scenario (a)

- Trends varying according to historical results; rate increases implemented at once with an 18-month lag in recognizing emerging trend

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	7.69%	6.28%	5.37%	3.91%	-1.11%	4.08%	1.09%
PMPM	13.39%	11.07%	9.70%	6.30%	-0.81%	5.98%	2.12%
Paid PMPM	4.06%	5.31%	4.18%	5.50%	3.30%	4.61%	2.95%
Benktander	1.39%	2.72%	0.82%	3.60%	2.72%	2.00%	3.21%
Bornhuetter	0.75%	1.48%	0.51%	2.53%	1.21%	1.38%	1.71%
Credibility Weighted	0.31%	0.28%	0.49%	1.22%	0.24%	0.91%	0.28%
Hybrid Loss Ratio	-1.13%	-0.26%	-3.48%	-2.02%	-1.34%	-0.59%	-1.19%
Lag - 12 Mo Avg	2.99%	6.87%	1.65%	10.55%	19.66%	8.31%	27.56%
Lag - 9 Mo Avg	2.99%	6.84%	1.76%	10.50%	19.35%	8.81%	27.91%
Lag - 6 Mo Avg	3.15%	7.47%	2.03%	10.90%	19.45%	8.96%	27.66%
Lag - 3 Mo Avg	2.98%	7.51%	2.07%	10.36%	18.87%	10.10%	26.94%
Lag - Cross Incurral	-0.40%	-0.52%	-1.41%	-0.44%	-2.31%	-2.14%	-3.07%
Lag - Dollar Weighted	1.07%	1.54%	0.63%	2.69%	2.53%	0.11%	0.41%
Lag - Drop Extremes (10/12)	1.28%	4.27%	-2.59%	4.13%	10.57%	4.73%	12.13%
Lag - Geometric Avg	2.00%	4.13%	1.22%	6.58%	10.08%	4.72%	11.93%
Lag - Harmonic Avg	1.05%	1.62%	0.71%	2.79%	2.62%	0.94%	1.19%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.63%	4.99%	4.31%	4.99%	2.67%	4.34%	2.91%
PMPM	10.48%	9.73%	8.73%	6.65%	5.18%	5.46%	3.91%
Paid PMPM	3.79%	5.42%	4.19%	8.82%	3.94%	8.39%	9.31%
Benktander	8.93%	12.42%	6.89%	12.52%	9.08%	8.66%	7.70%
Bornhuetter	6.59%	8.84%	5.69%	9.77%	6.28%	6.99%	5.26%
Credibility Weighted	8.51%	8.67%	7.59%	9.21%	5.31%	7.44%	4.60%
Hybrid Loss Ratio	6.78%	8.80%	5.41%	9.71%	6.34%	7.49%	5.60%
Lag - 12 Mo Avg	15.67%	25.03%	10.32%	28.66%	39.53%	22.69%	38.51%
Lag - 9 Mo Avg	16.03%	25.49%	10.76%	29.31%	40.28%	23.31%	39.89%
Lag - 6 Mo Avg	16.61%	26.98%	11.12%	30.81%	41.62%	23.66%	44.07%
Lag - 3 Mo Avg	18.08%	29.45%	12.86%	33.69%	46.02%	27.02%	49.40%
Lag - Cross Incurral	14.12%	21.26%	9.32%	22.99%	25.29%	17.77%	21.52%
Lag - Dollar Weighted	15.36%	23.17%	10.27%	26.03%	29.18%	19.70%	25.34%
Lag - Drop Extremes (10/12)	15.56%	24.48%	10.01%	27.67%	35.86%	22.27%	33.66%
Lag - Geometric Avg	15.83%	24.51%	10.66%	27.97%	34.28%	21.89%	31.38%
Lag - Harmonic Avg	15.63%	23.61%	10.56%	26.71%	29.82%	20.56%	26.05%

## Comparison of IBNR Methodologies

### Varying Trend Scenario (a)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	29.89%	22.08%	16.30%	10.31%	-0.48%	16.78%	8.60%
PMPM	36.19%	25.89%	19.48%	10.79%	-2.49%	13.26%	2.07%
Paid PMPM	9.02%	11.75%	7.57%	9.78%	4.48%	10.58%	5.57%
Benktander	5.06%	4.38%	2.82%	8.04%	3.45%	6.33%	2.08%
Bornhuetter	4.18%	3.71%	2.61%	6.59%	2.20%	5.50%	2.29%
Credibility Weighted	3.75%	3.66%	2.44%	4.43%	1.41%	5.39%	2.13%
Hybrid Loss Ratio	1.55%	2.02%	-4.85%	-1.84%	-1.74%	1.98%	-4.03%
Lag - 12 Mo Avg	4.88%	4.15%	2.49%	8.87%	4.54%	6.11%	1.86%
Lag - 9 Mo Avg	5.24%	4.50%	2.91%	9.16%	4.64%	6.58%	2.06%
Lag - 6 Mo Avg	5.53%	5.43%	3.48%	9.64%	4.62%	6.77%	2.19%
Lag - 3 Mo Avg	6.04%	6.64%	3.96%	9.62%	4.69%	7.83%	3.19%
Lag - Cross Incurral	1.81%	0.33%	-1.21%	1.28%	-3.24%	0.68%	-3.62%
Lag - Dollar Weighted	4.01%	3.45%	2.00%	5.18%	1.93%	4.22%	0.87%
Lag - Drop Extremes (10/12)	2.77%	2.87%	-4.61%	-0.38%	-1.10%	2.03%	-5.00%
Lag - Geometric Avg	4.69%	3.99%	2.60%	7.23%	3.18%	5.66%	1.63%
Lag - Harmonic Avg	4.14%	3.47%	2.29%	5.35%	1.84%	4.74%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	14.56%	13.75%	9.97%	9.94%	4.13%	12.33%	9.31%
PMPM	30.10%	24.42%	18.63%	12.54%	7.91%	14.55%	11.72%
Paid PMPM	9.92%	13.44%	8.58%	16.64%	5.73%	19.85%	19.25%
Benktander	20.04%	20.52%	13.82%	25.85%	13.71%	21.27%	14.10%
Bornhuetter	17.17%	18.67%	12.45%	20.95%	10.03%	18.74%	12.59%
Credibility Weighted	17.80%	19.46%	13.44%	18.32%	8.41%	18.44%	13.25%
Hybrid Loss Ratio	16.77%	17.85%	10.99%	19.25%	9.73%	18.57%	11.69%
Lag - 12 Mo Avg	20.22%	20.10%	13.13%	28.07%	16.54%	22.26%	14.04%
Lag - 9 Mo Avg	20.86%	21.10%	14.25%	29.19%	17.14%	22.33%	14.58%
Lag - 6 Mo Avg	21.54%	21.63%	14.91%	30.98%	17.62%	23.45%	15.72%
Lag - 3 Mo Avg	24.86%	27.11%	19.23%	35.47%	20.23%	26.55%	18.82%
Lag - Cross Incurral	19.14%	18.89%	12.17%	24.79%	13.96%	20.10%	12.57%
Lag - Dollar Weighted	19.97%	19.98%	12.96%	27.00%	15.67%	21.89%	13.97%
Lag - Drop Extremes (10/12)	20.02%	20.00%	12.36%	26.24%	15.82%	21.70%	13.15%
Lag - Geometric Avg	20.72%	21.00%	14.19%	28.65%	16.64%	22.14%	14.51%
Lag - Harmonic Avg	20.59%	20.90%	14.13%	28.12%	16.19%	21.95%	14.45%

## Comparison of IBNR Methodologies

### Varying Trend Scenario (a) —Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-2.65%	-2.66%	-2.52%	-1.89%	-1.97%	-1.81%	-1.42%
PMPM	2.72%	2.64%	2.60%	2.14%	1.62%	2.58%	2.17%
Paid PMPM	1.94%	1.98%	1.90%	1.77%	1.69%	2.03%	2.17%
Benktander	0.63%	3.08%	-0.13%	1.25%	2.61%	0.84%	3.96%
Bornhuetter	-0.08%	1.22%	-0.59%	0.12%	0.40%	0.17%	1.80%
Credibility Weighted	-0.47%	-0.71%	-0.41%	-0.69%	-1.02%	-0.51%	-0.09%
Hybrid Loss Ratio	-1.63%	-0.59%	-2.08%	-0.85%	-0.18%	-1.07%	0.06%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.52%	37.04%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.02%	37.48%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.19%	37.09%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.77%
Lag - Cross Incurral	-0.30%	0.77%	-0.95%	0.42%	1.47%	-2.47%	-2.45%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.79%	0.71%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.59%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.20%	1.69%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.50%	2.51%	2.38%	2.25%	2.04%	2.20%	1.78%
PMPM	2.86%	2.87%	2.79%	2.39%	2.33%	2.15%	1.89%
Paid PMPM	2.66%	2.80%	2.64%	3.10%	2.51%	3.64%	6.54%
Benktander	9.24%	15.64%	6.41%	8.47%	10.43%	7.43%	8.85%
Bornhuetter	5.56%	9.02%	4.01%	4.75%	5.62%	4.84%	5.36%
Credibility Weighted	8.85%	7.08%	8.36%	4.98%	3.23%	5.21%	3.16%
Hybrid Loss Ratio	5.49%	8.85%	3.96%	4.82%	5.63%	5.07%	5.48%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.06%	51.52%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.75%	53.76%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.47%	59.69%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.75%	66.38%
Lag - Cross Incurral	19.10%	32.32%	13.72%	40.09%	60.91%	24.90%	28.56%
Lag - Dollar Weighted	20.59%	34.78%	14.77%	44.96%	69.32%	27.48%	33.48%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.43%	45.05%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.61%	42.10%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.59%	34.68%

## Comparison of IBNR Methodologies

### Varying Trend Scenario (a) —Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	2.48%	6.20%	62.80%	7.67%	6.58%	87.60%
HMO Professional	2.88%	7.72%	63.60%	8.79%	8.19%	84.00%
Managed Care	1.58%	4.68%	62.40%	5.30%	4.89%	82.80%
HMO Hospital	1.78%	8.56%	53.60%	9.43%	9.19%	85.20%
Self Funded	1.18%	5.67%	55.60%	6.53%	6.00%	85.60%
Major Medical	1.81%	6.46%	58.00%	6.95%	6.75%	85.20%
Medicare Supplement	1.06%	5.05%	56.40%	5.99%	5.27%	87.20%

##### “Credible Months” (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	7.16%	19.28%	60.80%	19.19%	21.54%	80.80%
HMO Professional	18.66%	50.46%	56.80%	39.19%	58.13%	80.40%
Managed Care	1.86%	9.56%	56.00%	8.09%	10.15%	77.60%
HMO Hospital	3.10%	17.77%	50.40%	14.09%	19.56%	75.20%
Self Funded	1.28%	8.83%	51.60%	6.90%	9.40%	77.20%
Major Medical	2.34%	10.99%	54.00%	9.16%	11.67%	77.20%
Medicare Supplement	1.03%	6.96%	55.20%	6.34%	7.35%	80.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	2.24%	6.46%	61.60%	6.45%	6.79%	79.20%
HMO Professional	2.40%	7.66%	58.00%	6.82%	8.04%	76.40%
Managed Care	1.78%	3.92%	65.20%	3.66%	4.04%	80.40%
HMO Hospital	1.88%	4.72%	61.20%	6.45%	4.98%	94.80%
Self Funded	1.64%	5.52%	55.20%	6.61%	5.83%	89.20%
Major Medical	1.67%	2.65%	76.00%	4.59%	2.83%	95.60%
Medicare Supplement	1.40%	2.37%	73.20%	5.51%	2.58%	99.20%

## Comparison of IBNR Methodologies

### Varying Trend Scenario (b)

- Trends varying according to historical results; rate increases implemented over a 12-month time span with an 18-month lag in recognizing emerging trend

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	7.64%	6.23%	5.34%	3.90%	-1.12%	4.08%	1.09%
PMPM	13.39%	11.07%	9.70%	6.30%	-0.81%	5.98%	2.12%
Paid PMPM	4.06%	5.31%	4.18%	5.50%	3.30%	4.61%	2.95%
Benktander	3.00%	4.28%	2.24%	5.21%	4.11%	3.57%	4.78%
Bornhuetter	3.28%	3.90%	2.74%	4.65%	2.96%	3.35%	3.44%
Credibility Weighted	2.44%	2.81%	1.84%	3.92%	2.42%	3.09%	2.36%
Hybrid Loss Ratio	1.53%	2.27%	-1.13%	0.24%	0.51%	1.54%	0.69%
Lag - 12 Mo Avg	2.99%	6.87%	1.65%	10.55%	19.66%	8.31%	27.56%
Lag - 9 Mo Avg	2.99%	6.84%	1.76%	10.50%	19.35%	8.81%	27.91%
Lag - 6 Mo Avg	3.15%	7.47%	2.03%	10.90%	19.45%	8.96%	27.66%
Lag - 3 Mo Avg	2.98%	7.51%	2.07%	10.36%	18.87%	10.10%	26.94%
Lag - Cross Incurral	-0.40%	-0.52%	-1.41%	-0.44%	-2.31%	-2.14%	-3.07%
Lag - Dollar Weighted	1.07%	1.54%	0.63%	2.69%	2.53%	0.11%	0.41%
Lag - Drop Extremes (10/12)	1.28%	4.27%	-2.59%	4.13%	10.57%	4.73%	12.13%
Lag - Geometric Avg	2.00%	4.13%	1.22%	6.58%	10.08%	4.72%	11.93%
Lag - Harmonic Avg	1.05%	1.62%	0.71%	2.79%	2.62%	0.94%	1.19%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.61%	4.98%	4.30%	5.01%	2.67%	4.35%	2.91%
PMPM	10.48%	9.73%	8.73%	6.65%	5.18%	5.46%	3.91%
Paid PMPM	3.79%	5.42%	4.19%	8.82%	3.94%	8.39%	9.31%
Benktander	9.04%	12.55%	6.96%	12.66%	9.17%	8.76%	7.78%
Bornhuetter	6.75%	9.02%	5.79%	9.94%	6.38%	7.10%	5.34%
Credibility Weighted	8.66%	8.86%	7.66%	9.42%	5.44%	7.56%	4.69%
Hybrid Loss Ratio	6.96%	9.01%	5.52%	9.90%	6.46%	7.63%	5.70%
Lag - 12 Mo Avg	15.67%	25.03%	10.32%	28.66%	39.53%	22.69%	38.51%
Lag - 9 Mo Avg	16.03%	25.49%	10.76%	29.31%	40.28%	23.31%	39.89%
Lag - 6 Mo Avg	16.61%	26.98%	11.12%	30.81%	41.62%	23.66%	44.07%
Lag - 3 Mo Avg	18.08%	29.45%	12.86%	33.69%	46.02%	27.02%	49.40%
Lag - Cross Incurral	14.12%	21.26%	9.32%	22.99%	25.29%	17.77%	21.52%
Lag - Dollar Weighted	15.36%	23.17%	10.27%	26.03%	29.18%	19.70%	25.34%
Lag - Drop Extremes (10/12)	15.56%	24.48%	10.01%	27.67%	35.86%	22.27%	33.66%
Lag - Geometric Avg	15.83%	24.51%	10.66%	27.97%	34.28%	21.89%	31.38%
Lag - Harmonic Avg	15.63%	23.61%	10.56%	26.71%	29.82%	20.56%	26.05%

## Comparison of IBNR Methodologies

### Varying Trend Scenario (b) —Cont.

#### Results Set 2— “Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	21.04%	14.89%	10.75%	6.68%	-2.83%	9.21%	-0.15%
PMPM	36.19%	25.89%	19.48%	10.79%	-2.49%	13.26%	2.07%
Paid PMPM	9.02%	11.75%	7.57%	9.78%	4.48%	10.58%	5.57%
Benktander	5.38%	4.67%	3.10%	8.53%	3.88%	6.53%	2.11%
Bornhuetter	5.87%	5.17%	3.87%	7.85%	3.12%	6.04%	2.21%
Credibility Weighted	5.28%	4.80%	3.13%	6.72%	2.84%	6.29%	2.25%
Hybrid Loss Ratio	3.37%	3.59%	-3.48%	-0.48%	-0.77%	2.66%	-4.03%
Lag - 12 Mo Avg	4.88%	4.15%	2.49%	8.87%	4.54%	6.11%	1.86%
Lag - 9 Mo Avg	5.24%	4.50%	2.91%	9.16%	4.64%	6.58%	2.06%
Lag - 6 Mo Avg	5.53%	5.43%	3.48%	9.64%	4.62%	6.77%	2.19%
Lag - 3 Mo Avg	6.04%	6.64%	3.96%	9.62%	4.69%	7.83%	3.19%
Lag - Cross Incurral	1.81%	0.33%	-1.21%	1.28%	-3.24%	0.68%	-3.62%
Lag - Dollar Weighted	4.01%	3.45%	2.00%	5.18%	1.93%	4.22%	0.87%
Lag - Drop Extremes (10/12)	2.77%	2.87%	-4.61%	-0.38%	-1.10%	2.03%	-5.00%
Lag - Geometric Avg	4.69%	3.99%	2.60%	7.23%	3.18%	5.66%	1.63%
Lag - Harmonic Avg	4.14%	3.47%	2.29%	5.35%	1.84%	4.74%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	13.97%	13.22%	9.74%	9.64%	4.08%	11.68%	8.88%
PMPM	30.10%	24.42%	18.63%	12.54%	7.91%	14.55%	11.72%
Paid PMPM	9.92%	13.44%	8.58%	16.64%	5.73%	19.85%	19.25%
Benktander	20.09%	20.57%	13.85%	25.94%	13.76%	21.30%	14.10%
Bornhuetter	17.43%	18.87%	12.57%	21.16%	10.12%	18.81%	12.57%
Credibility Weighted	18.04%	19.62%	13.51%	18.66%	8.53%	18.56%	13.26%
Hybrid Loss Ratio	17.06%	18.08%	11.11%	19.50%	9.83%	18.67%	11.68%
Lag - 12 Mo Avg	20.22%	20.10%	13.13%	28.07%	16.54%	22.26%	14.04%
Lag - 9 Mo Avg	20.86%	21.10%	14.25%	29.19%	17.14%	22.33%	14.58%
Lag - 6 Mo Avg	21.54%	21.63%	14.91%	30.98%	17.62%	23.45%	15.72%
Lag - 3 Mo Avg	24.86%	27.11%	19.23%	35.47%	20.23%	26.55%	18.82%
Lag - Cross Incurral	19.14%	18.89%	12.17%	24.79%	13.96%	20.10%	12.57%
Lag - Dollar Weighted	19.97%	19.98%	12.96%	27.00%	15.67%	21.89%	13.97%
Lag - Drop Extremes (10/12)	20.02%	20.00%	12.36%	26.24%	15.82%	21.70%	13.15%
Lag - Geometric Avg	20.72%	21.00%	14.19%	28.65%	16.64%	22.14%	14.51%
Lag - Harmonic Avg	20.59%	20.90%	14.13%	28.12%	16.19%	21.95%	14.45%

## Comparison of IBNR Methodologies

### Varying Trend Scenario (b) —Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	1.44%	1.44%	1.50%	1.54%	1.39%	1.82%	1.59%
PMPM	2.72%	2.64%	2.60%	2.14%	1.62%	2.58%	2.17%
Paid PMPM	1.94%	1.98%	1.90%	1.77%	1.69%	2.03%	2.17%
Benktander	2.87%	5.37%	2.13%	3.95%	5.39%	3.08%	6.07%
Bornhuetter	2.87%	4.21%	2.35%	3.08%	3.36%	2.84%	4.17%
Credibility Weighted	1.96%	2.65%	1.43%	2.43%	2.24%	2.29%	2.66%
Hybrid Loss Ratio	1.45%	2.53%	1.00%	2.28%	2.97%	1.77%	2.60%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.52%	37.04%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.02%	37.48%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.19%	37.09%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.77%
Lag - Cross Incurral	-0.30%	0.77%	-0.95%	0.42%	1.47%	-2.47%	-2.45%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.79%	0.71%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.59%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.20%	1.69%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.59%	2.61%	2.46%	2.32%	2.11%	2.27%	1.83%
PMPM	2.86%	2.87%	2.79%	2.39%	2.33%	2.15%	1.89%
Paid PMPM	2.66%	2.80%	2.64%	3.10%	2.51%	3.64%	6.54%
Benktander	9.37%	15.86%	6.50%	8.61%	10.60%	7.54%	8.97%
Bornhuetter	5.72%	9.29%	4.13%	4.89%	5.79%	4.96%	5.48%
Credibility Weighted	9.00%	7.38%	8.45%	5.14%	3.40%	5.35%	3.29%
Hybrid Loss Ratio	5.66%	9.13%	4.09%	4.97%	5.81%	5.22%	5.61%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.06%	51.52%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.75%	53.76%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.47%	59.69%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.75%	66.38%
Lag - Cross Incurral	19.10%	32.32%	13.72%	40.09%	60.91%	24.90%	28.56%
Lag - Dollar Weighted	20.59%	34.78%	14.77%	44.96%	69.32%	27.48%	33.48%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.43%	45.05%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.61%	42.10%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.59%	34.68%

## Comparison of IBNR Methodologies

### Membership Change Scenario

- 2.5 percent lapse rate over the history of the block

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.30%	-1.01%	-1.31%	-1.47%	-6.74%	-0.05%	-2.52%
PMPM	-6.70%	-7.98%	-7.35%	-6.78%	-12.35%	-4.16%	-5.59%
Paid PMPM	0.45%	0.70%	0.39%	1.17%	0.36%	1.53%	0.56%
Benktander	1.87%	3.15%	1.27%	4.03%	2.90%	2.52%	3.43%
Bornhuetter	1.22%	1.85%	0.80%	2.75%	1.12%	1.51%	1.60%
Credibility Weighted	2.58%	3.84%	1.71%	5.03%	3.33%	3.65%	3.77%
Hybrid Loss Ratio	0.67%	1.44%	-2.33%	-1.02%	-0.58%	0.60%	-0.67%
Lag - 12 Mo Avg	3.04%	6.81%	1.71%	10.36%	18.47%	8.29%	26.59%
Lag - 9 Mo Avg	3.05%	6.79%	1.84%	10.32%	18.18%	8.81%	26.94%
Lag - 6 Mo Avg	3.23%	7.47%	2.18%	10.74%	18.28%	9.00%	26.69%
Lag - 3 Mo Avg	3.12%	7.64%	2.27%	10.24%	17.74%	10.26%	26.07%
Lag - Cross Incurral	4.44%	6.27%	6.50%	8.94%	12.55%	6.51%	7.45%
Lag - Dollar Weighted	1.14%	1.60%	0.69%	2.73%	2.40%	0.26%	0.47%
Lag - Drop Extremes (10/12)	1.36%	4.30%	-2.82%	3.69%	9.69%	4.73%	11.38%
Lag - Geometric Avg	2.08%	4.13%	1.32%	6.51%	9.47%	4.83%	11.57%
Lag - Harmonic Avg	1.13%	1.66%	0.80%	2.81%	2.46%	1.16%	1.22%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	5.14%	5.44%	4.77%	5.14%	2.75%	4.66%	3.14%
PMPM	11.54%	10.68%	9.44%	7.17%	5.47%	5.87%	4.17%
Paid PMPM	3.77%	5.59%	4.33%	9.21%	3.94%	8.92%	9.71%
Benktander	9.01%	12.56%	7.23%	12.82%	8.83%	9.12%	7.82%
Bornhuetter	6.72%	9.17%	6.11%	10.16%	6.17%	7.53%	5.48%
Credibility Weighted	13.10%	14.99%	9.84%	14.56%	8.78%	11.10%	7.63%
Hybrid Loss Ratio	6.94%	9.15%	5.74%	10.07%	6.26%	7.99%	5.78%
Lag - 12 Mo Avg	15.55%	24.67%	10.33%	27.93%	37.08%	22.27%	37.08%
Lag - 9 Mo Avg	15.92%	25.13%	10.81%	28.60%	37.80%	22.91%	38.38%
Lag - 6 Mo Avg	16.49%	26.61%	11.18%	30.11%	39.06%	23.24%	42.36%
Lag - 3 Mo Avg	18.00%	29.17%	13.11%	33.07%	43.27%	26.57%	47.51%
Lag - Cross Incurral	14.71%	22.33%	10.27%	24.15%	25.91%	19.15%	22.95%
Lag - Dollar Weighted	15.22%	22.82%	10.26%	25.35%	27.42%	19.43%	24.56%
Lag - Drop Extremes (10/12)	15.44%	24.13%	9.99%	26.94%	33.65%	21.88%	32.44%
Lag - Geometric Avg	15.72%	24.17%	10.71%	27.31%	32.18%	21.54%	30.25%
Lag - Harmonic Avg	15.52%	23.29%	10.62%	26.09%	28.02%	20.26%	25.15%



## Comparison of IBNR Methodologies

### Membership Change Scenario—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.78%	-2.50%	-2.93%	-2.94%	-11.02%	-0.18%	-8.87%
PMPM	-19.07%	-19.64%	-15.73%	-12.78%	-19.36%	-10.63%	-17.46%
Paid PMPM	1.60%	2.35%	1.06%	2.45%	0.56%	4.71%	1.22%
Benktander	5.22%	4.56%	2.99%	7.89%	3.15%	6.67%	2.03%
Bornhuetter	3.93%	3.39%	2.17%	6.00%	1.42%	4.61%	1.00%
Credibility Weighted	5.27%	4.62%	3.06%	7.55%	3.16%	6.72%	2.12%
Hybrid Loss Ratio	2.74%	3.09%	-4.63%	-1.74%	-1.71%	2.31%	-5.10%
Lag - 12 Mo Avg	5.00%	4.31%	2.62%	8.66%	4.17%	6.49%	1.97%
Lag - 9 Mo Avg	5.40%	4.68%	3.09%	8.94%	4.26%	7.04%	2.18%
Lag - 6 Mo Avg	5.74%	5.72%	3.77%	9.46%	4.26%	7.35%	2.31%
Lag - 3 Mo Avg	6.39%	7.18%	4.35%	9.47%	4.33%	8.75%	3.48%
Lag - Cross Incurral	9.21%	11.93%	11.46%	14.94%	16.92%	14.84%	15.11%
Lag - Dollar Weighted	4.13%	3.65%	2.07%	5.11%	1.77%	4.54%	0.92%
Lag - Drop Extremes (10/12)	2.99%	3.20%	-4.95%	-0.88%	-1.31%	2.49%	-5.38%
Lag - Geometric Avg	4.85%	4.17%	2.78%	7.08%	2.91%	6.12%	1.76%
Lag - Harmonic Avg	4.31%	3.65%	2.47%	5.25%	1.67%	5.21%	1.33%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	15.16%	13.87%	10.49%	9.45%	4.18%	12.11%	9.23%
PMPM	32.64%	26.00%	19.70%	13.21%	8.24%	15.05%	11.95%
Paid PMPM	9.53%	13.28%	8.65%	16.77%	5.56%	20.62%	19.85%
Benktander	20.02%	21.06%	14.35%	25.57%	12.88%	21.87%	14.37%
Bornhuetter	17.21%	19.34%	13.05%	20.93%	9.48%	19.52%	12.94%
Credibility Weighted	20.14%	21.26%	14.58%	24.27%	12.00%	21.82%	14.51%
Hybrid Loss Ratio	16.94%	18.58%	11.45%	19.26%	9.25%	19.26%	11.80%
Lag - 12 Mo Avg	20.17%	20.58%	13.51%	27.49%	15.43%	22.72%	14.23%
Lag - 9 Mo Avg	20.82%	21.60%	14.74%	28.65%	15.99%	22.86%	14.81%
Lag - 6 Mo Avg	21.50%	22.12%	15.48%	30.45%	16.44%	24.15%	16.08%
Lag - 3 Mo Avg	24.88%	27.90%	20.28%	35.04%	18.99%	27.41%	19.58%
Lag - Cross Incurral	20.53%	22.19%	14.85%	27.51%	15.13%	24.15%	15.91%
Lag - Dollar Weighted	19.89%	20.44%	13.27%	26.40%	14.59%	22.45%	14.29%
Lag - Drop Extremes (10/12)	20.00%	20.51%	12.67%	25.63%	14.78%	22.18%	13.17%
Lag - Geometric Avg	20.69%	21.50%	14.68%	28.13%	15.54%	22.68%	14.75%
Lag - Harmonic Avg	20.55%	21.41%	14.62%	27.64%	15.14%	22.49%	14.69%

## Comparison of IBNR Methodologies

### Membership Change Scenario—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.11%	0.10%	0.09%	0.25%	0.14%	0.22%	0.04%
PMPM	-0.71%	-0.78%	-0.75%	-0.70%	-1.14%	-0.75%	-0.95%
Paid PMPM	0.08%	0.09%	0.09%	0.18%	0.13%	0.19%	0.45%
Benktander	1.22%	3.69%	0.48%	1.97%	3.39%	1.36%	4.38%
Bornhuetter	0.70%	2.01%	0.20%	0.91%	1.23%	0.73%	2.17%
Credibility Weighted	2.36%	4.87%	1.32%	4.37%	4.46%	3.08%	4.80%
Hybrid Loss Ratio	0.45%	1.51%	-0.08%	1.11%	1.79%	0.54%	1.36%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.46%	36.84%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	10.96%	37.28%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.13%	36.88%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.34%	35.55%
Lag - Cross Incurral	3.31%	4.78%	3.30%	5.53%	8.25%	3.35%	4.99%
Lag - Dollar Weighted	0.87%	2.31%	0.26%	3.00%	6.13%	-0.80%	0.81%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.10%	18.50%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.35%	16.01%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.20%	1.74%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.52%	2.53%	2.41%	2.25%	2.06%	2.20%	1.78%
PMPM	2.78%	2.79%	2.72%	2.32%	2.27%	2.08%	1.83%
Paid PMPM	2.60%	2.74%	2.59%	3.05%	2.47%	3.59%	6.48%
Benktander	9.27%	15.70%	6.43%	8.51%	10.48%	7.55%	9.01%
Bornhuetter	5.60%	9.09%	4.04%	4.78%	5.67%	4.92%	5.47%
Credibility Weighted	16.74%	20.18%	13.15%	16.89%	11.90%	11.78%	8.39%
Hybrid Loss Ratio	5.59%	9.03%	4.03%	4.89%	5.74%	5.20%	5.62%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	31.87%	51.14%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.55%	53.35%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.27%	59.25%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.51%	65.86%
Lag - Cross Incurral	19.96%	33.87%	14.43%	42.63%	65.79%	26.58%	31.02%
Lag - Dollar Weighted	20.57%	34.78%	14.76%	44.93%	69.37%	27.36%	33.32%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.24%	44.75%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.42%	41.81%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.43%	34.46%

## Comparison of IBNR Methodologies

### Membership Change Scenario—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.70%	6.16%	49.60%	5.80%	6.55%	77.20%
HMO Professional	1.16%	7.79%	52.00%	6.96%	8.27%	77.20%
Managed Care	-0.41%	4.77%	47.60%	3.22%	4.97%	70.40%
HMO Hospital	0.08%	8.76%	45.60%	7.51%	9.36%	78.80%
Self Funded	-0.58%	5.53%	43.20%	4.38%	5.85%	76.00%
Major Medical	-0.17%	6.79%	46.40%	4.76%	7.10%	74.40%
Medicare Supplement	-3.33%	4.92%	24.40%	1.29%	5.15%	58.80%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	5.68%	19.36%	57.60%	17.60%	21.56%	77.20%
HMO Professional	18.20%	53.58%	56.00%	38.07%	61.82%	76.80%
Managed Care	-0.04%	9.62%	48.40%	5.99%	10.25%	69.20%
HMO Hospital	1.44%	17.49%	46.40%	12.01%	19.15%	70.80%
Self Funded	-0.38%	8.28%	43.60%	4.76%	8.80%	70.40%
Major Medical	0.35%	11.27%	48.40%	6.85%	11.91%	70.00%
Medicare Supplement	-4.20%	6.61%	26.00%	0.79%	6.94%	55.20%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.39%	6.39%	51.20%	4.45%	6.72%	72.80%
HMO Professional	0.51%	7.56%	51.20%	4.71%	7.92%	68.40%
Managed Care	-0.29%	3.83%	49.20%	1.47%	3.91%	63.20%
HMO Hospital	0.06%	4.63%	46.80%	4.36%	4.80%	82.00%
Self Funded	-0.34%	5.40%	41.60%	4.35%	5.53%	79.20%
Major Medical	-0.29%	2.63%	44.80%	2.42%	2.74%	84.00%
Medicare Supplement	-1.01%	2.32%	31.60%	2.75%	2.58%	87.60%

## Comparison of IBNR Methodologies

### Seasonality Scenario (a)

- Seasonality pattern determined by the number of workdays in a given month

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	1.65%	0.62%	0.24%	0.06%	-4.20%	0.28%	-1.27%
PMPM	-2.58%	-3.84%	-3.65%	-3.75%	-8.76%	-1.97%	-3.53%
Paid PMPM	10.31%	10.08%	7.35%	8.02%	6.31%	6.35%	4.73%
Benktander	6.84%	7.87%	5.48%	8.75%	6.87%	6.56%	6.93%
Bornhuetter	8.14%	8.29%	6.49%	7.94%	5.21%	5.74%	4.79%
Credibility Weighted	6.73%	8.51%	4.25%	8.60%	6.72%	6.16%	4.91%
Hybrid Loss Ratio	7.59%	7.84%	3.62%	4.50%	3.66%	4.54%	2.82%
Lag - 12 Mo Avg	3.00%	6.75%	1.66%	10.43%	18.87%	8.13%	26.86%
Lag - 9 Mo Avg	3.00%	6.73%	1.78%	10.40%	18.58%	8.62%	27.19%
Lag - 6 Mo Avg	3.17%	7.37%	2.07%	10.81%	18.68%	8.75%	26.92%
Lag - 3 Mo Avg	3.02%	7.44%	2.12%	10.28%	18.13%	9.86%	26.22%
Lag - Cross Incurral	-0.65%	-0.87%	-1.86%	-0.85%	-3.01%	-2.56%	-3.49%
Lag - Dollar Weighted	1.11%	1.57%	0.67%	2.78%	2.47%	0.20%	0.55%
Lag - Drop Extremes (10/12)	1.28%	4.18%	-2.69%	3.87%	9.94%	4.55%	11.75%
Lag - Geometric Avg	2.03%	4.08%	1.25%	6.57%	9.70%	4.67%	11.70%
Lag - Harmonic Avg	1.09%	1.62%	0.74%	2.86%	2.55%	1.01%	1.27%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.64%	5.01%	4.35%	5.07%	2.68%	4.28%	2.91%
PMPM	10.93%	10.13%	8.98%	6.82%	5.31%	5.47%	3.90%
Paid PMPM	5.53%	6.51%	5.08%	7.30%	4.10%	6.81%	7.29%
Benktander	9.36%	12.86%	7.25%	13.31%	9.36%	9.16%	8.08%
Bornhuetter	7.17%	9.48%	6.10%	10.53%	6.58%	7.41%	5.53%
Credibility Weighted	10.04%	10.39%	8.39%	10.94%	6.34%	8.50%	5.33%
Hybrid Loss Ratio	7.47%	9.57%	5.88%	10.61%	6.72%	8.00%	5.98%
Lag - 12 Mo Avg	15.45%	24.49%	10.20%	27.99%	37.79%	21.96%	37.33%
Lag - 9 Mo Avg	15.82%	24.95%	10.65%	28.65%	38.52%	22.56%	38.63%
Lag - 6 Mo Avg	16.40%	26.43%	11.04%	30.20%	39.80%	22.91%	42.70%
Lag - 3 Mo Avg	17.90%	28.91%	12.84%	33.10%	44.05%	26.18%	47.88%
Lag - Cross Incurral	14.02%	20.89%	9.22%	22.68%	24.41%	17.23%	20.95%
Lag - Dollar Weighted	15.18%	22.69%	10.15%	25.54%	27.98%	19.10%	24.68%
Lag - Drop Extremes (10/12)	15.34%	23.95%	9.88%	26.99%	34.30%	21.56%	32.69%
Lag - Geometric Avg	15.62%	24.00%	10.56%	27.36%	32.81%	21.21%	30.47%
Lag - Harmonic Avg	15.43%	23.12%	10.47%	26.14%	28.57%	19.95%	25.35%

## Comparison of IBNR Methodologies

### Seasonality Scenario (a)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-20.64%	-18.92%	-15.45%	-10.51%	-13.79%	-16.18%	-14.28%
PMPM	-32.41%	-29.77%	-23.56%	-17.46%	-20.51%	-22.57%	-20.98%
Paid PMPM	8.42%	6.14%	4.02%	5.30%	3.12%	0.94%	4.44%
Benktander	5.51%	4.83%	3.16%	8.68%	3.89%	5.67%	2.24%
Bornhuetter	5.44%	4.50%	2.89%	6.89%	1.98%	2.35%	1.30%
Credibility Weighted	6.26%	4.95%	3.26%	7.45%	3.91%	3.89%	3.16%
Hybrid Loss Ratio	4.10%	3.98%	-3.44%	-0.43%	-1.12%	-0.31%	-4.34%
Lag - 12 Mo Avg	4.84%	4.18%	2.48%	8.86%	4.45%	6.13%	1.82%
Lag - 9 Mo Avg	5.22%	4.54%	2.91%	9.17%	4.56%	6.59%	2.02%
Lag - 6 Mo Avg	5.53%	5.48%	3.49%	9.66%	4.56%	6.76%	2.14%
Lag - 3 Mo Avg	6.04%	6.69%	3.97%	9.63%	4.63%	7.76%	3.14%
Lag - Cross Incurral	1.31%	-0.26%	-1.95%	0.56%	-4.20%	-0.10%	-4.52%
Lag - Dollar Weighted	4.02%	3.54%	2.03%	5.24%	1.93%	4.22%	0.83%
Lag - Drop Extremes (10/12)	2.75%	2.90%	-4.66%	-0.45%	-1.17%	2.06%	-5.04%
Lag - Geometric Avg	4.68%	4.03%	2.60%	7.26%	3.14%	5.66%	1.60%
Lag - Harmonic Avg	4.14%	3.52%	2.30%	5.39%	1.83%	4.74%	1.19%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	13.00%	11.84%	9.09%	8.58%	3.98%	9.79%	8.28%
PMPM	30.35%	24.49%	18.49%	12.61%	8.07%	13.70%	11.49%
Paid PMPM	13.04%	14.65%	9.44%	12.90%	5.78%	14.20%	12.30%
Benktander	19.97%	20.64%	13.86%	25.90%	13.58%	21.04%	13.89%
Bornhuetter	17.27%	18.78%	12.46%	20.97%	9.92%	18.03%	12.30%
Credibility Weighted	18.80%	20.12%	13.75%	20.13%	9.41%	18.79%	13.51%
Hybrid Loss Ratio	17.06%	18.14%	11.12%	19.50%	9.71%	18.00%	11.53%
Lag - 12 Mo Avg	20.01%	20.08%	13.10%	27.84%	16.22%	22.20%	13.77%
Lag - 9 Mo Avg	20.68%	21.14%	14.25%	29.01%	16.83%	22.26%	14.31%
Lag - 6 Mo Avg	21.40%	21.70%	14.94%	30.87%	17.33%	23.41%	15.47%
Lag - 3 Mo Avg	24.70%	27.21%	19.28%	35.33%	19.90%	26.44%	18.55%
Lag - Cross Incurral	18.91%	18.76%	12.04%	24.49%	13.61%	19.86%	12.24%
Lag - Dollar Weighted	19.82%	19.98%	12.93%	26.87%	15.38%	21.84%	13.74%
Lag - Drop Extremes (10/12)	19.82%	19.98%	12.33%	26.00%	15.51%	21.64%	12.90%
Lag - Geometric Avg	20.55%	21.05%	14.19%	28.48%	16.34%	22.07%	14.25%
Lag - Harmonic Avg	20.42%	20.95%	14.13%	27.96%	15.92%	21.88%	14.19%

## Comparison of IBNR Methodologies

### Seasonality Scenario (a) —Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	13.05%	13.06%	12.82%	11.17%	10.81%	9.02%	3.42%
PMPM	12.51%	12.45%	12.19%	10.31%	9.59%	8.80%	2.68%
Paid PMPM	11.95%	13.42%	10.43%	11.61%	11.55%	9.74%	5.06%
Benktander	8.56%	11.22%	7.90%	10.82%	12.50%	8.02%	8.97%
Bornhuetter	10.38%	11.82%	9.83%	10.61%	10.92%	8.34%	6.33%
Credibility Weighted	7.96%	11.94%	5.64%	11.21%	11.64%	8.18%	5.83%
Hybrid Loss Ratio	10.22%	11.39%	9.68%	11.03%	11.77%	7.89%	5.66%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.40%	36.36%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	10.89%	36.78%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.06%	36.37%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.25%	35.05%
Lag - Cross Incurral	-0.46%	0.63%	-1.16%	0.26%	1.37%	-2.77%	-2.70%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	3.00%	6.08%	-0.76%	0.92%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.04%	18.27%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.32%	15.86%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.20%	1.81%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.91%	3.08%	2.72%	2.61%	2.39%	2.47%	1.95%
PMPM	3.11%	3.20%	3.00%	2.58%	2.52%	2.31%	1.92%
Paid PMPM	4.72%	4.34%	4.71%	3.83%	3.09%	4.38%	6.69%
Benktander	9.71%	16.43%	6.75%	8.95%	11.02%	7.98%	9.51%
Bornhuetter	6.14%	9.97%	4.43%	5.25%	6.21%	5.36%	5.86%
Credibility Weighted	11.24%	10.35%	9.96%	7.17%	4.81%	6.87%	4.39%
Hybrid Loss Ratio	6.14%	9.91%	4.43%	5.40%	6.31%	5.66%	6.05%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	31.65%	50.29%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.33%	52.46%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.04%	58.27%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.24%	64.74%
Lag - Cross Incurral	19.19%	32.43%	13.77%	40.39%	61.34%	24.63%	28.00%
Lag - Dollar Weighted	20.60%	34.76%	14.78%	45.00%	69.28%	27.10%	32.81%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.03%	44.05%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.22%	41.17%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.25%	33.97%

## Comparison of IBNR Methodologies

### Seasonality Scenario (a)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	7.64%	6.57%	87.20%	13.50%	6.95%	98.80%
HMO Professional	7.34%	8.28%	79.20%	13.70%	8.81%	95.20%
Managed Care	5.91%	4.99%	85.20%	10.13%	5.23%	97.60%
HMO Hospital	5.03%	9.46%	67.20%	13.10%	10.18%	91.20%
Self Funded	1.84%	5.79%	58.00%	7.47%	6.15%	89.60%
Major Medical	4.39%	6.82%	72.00%	9.79%	7.15%	90.80%
Medicare Supplement	1.03%	5.02%	59.20%	6.01%	5.25%	85.60%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	2.92%	18.80%	52.80%	14.64%	20.94%	73.20%
HMO Professional	13.43%	48.07%	52.00%	33.67%	55.33%	74.40%
Managed Care	1.68%	9.54%	56.80%	7.88%	10.19%	76.40%
HMO Hospital	2.02%	17.96%	48.80%	12.87%	19.86%	70.80%
Self Funded	-2.34%	8.42%	34.80%	3.26%	9.01%	60.00%
Major Medical	1.26%	10.85%	52.00%	8.01%	11.51%	73.20%
Medicare Supplement	-2.20%	6.60%	34.80%	3.06%	6.92%	67.20%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	8.92%	6.93%	89.20%	13.86%	7.27%	99.20%
HMO Professional	7.94%	8.15%	80.00%	12.81%	8.57%	96.40%
Managed Care	9.70%	4.25%	99.60%	12.38%	4.42%	100.00%
HMO Hospital	9.59%	5.24%	100.00%	14.92%	5.49%	100.00%
Self Funded	8.98%	5.99%	98.00%	14.68%	6.33%	100.00%
Major Medical	9.53%	2.94%	100.00%	13.00%	3.26%	100.00%
Medicare Supplement	8.93%	2.58%	100.00%	13.26%	2.89%	100.00%

## Comparison of IBNR Methodologies

### Seasonality Scenario (b)

- Seasonality pattern based on a Medicare Supplement plan; claims concentrated towards the beginning of the year

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.19%	2.10%	1.59%	1.07%	-3.35%	1.70%	-0.57%
PMPM	-4.18%	-5.29%	-4.89%	-4.68%	-9.45%	-2.79%	-4.07%
Paid PMPM	4.57%	5.60%	3.20%	7.23%	5.30%	6.02%	5.60%
Benktander	5.58%	6.79%	4.58%	7.93%	6.57%	6.49%	8.09%
Bornhuetter	8.14%	8.75%	7.56%	9.19%	7.19%	8.38%	8.32%
Credibility Weighted	5.41%	7.42%	3.57%	9.66%	7.16%	7.79%	7.92%
Hybrid Loss Ratio	7.56%	8.23%	4.59%	5.60%	5.40%	7.50%	6.33%
Lag - 12 Mo Avg	3.01%	6.92%	1.66%	10.58%	19.61%	8.40%	27.68%
Lag - 9 Mo Avg	3.01%	6.88%	1.77%	10.53%	19.29%	8.90%	28.03%
Lag - 6 Mo Avg	3.17%	7.52%	2.05%	10.93%	19.39%	9.05%	27.78%
Lag - 3 Mo Avg	3.01%	7.57%	2.08%	10.38%	18.80%	10.21%	27.06%
Lag - Cross Incurral	-0.59%	-0.75%	-1.73%	-0.76%	-2.86%	-2.42%	-3.36%
Lag - Dollar Weighted	1.10%	1.60%	0.67%	2.77%	2.57%	0.21%	0.57%
Lag - Drop Extremes (10/12)	1.32%	4.34%	-2.61%	4.12%	10.54%	4.85%	12.16%
Lag - Geometric Avg	2.02%	4.16%	1.23%	6.61%	10.05%	4.79%	12.01%
Lag - Harmonic Avg	1.06%	1.64%	0.71%	2.82%	2.61%	1.00%	1.23%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.46%	4.88%	4.24%	5.08%	2.63%	4.33%	2.92%
PMPM	10.97%	10.22%	9.11%	6.92%	5.42%	5.60%	4.03%
Paid PMPM	7.86%	7.82%	6.45%	8.29%	4.90%	7.48%	6.77%
Benktander	9.22%	12.81%	7.08%	12.95%	9.27%	8.96%	7.97%
Bornhuetter	7.07%	9.46%	6.05%	10.42%	6.60%	7.44%	5.60%
Credibility Weighted	11.09%	11.42%	8.87%	11.74%	6.88%	9.11%	5.85%
Hybrid Loss Ratio	7.35%	9.51%	5.79%	10.45%	6.71%	8.02%	6.02%
Lag - 12 Mo Avg	15.72%	25.11%	10.35%	28.68%	39.42%	22.79%	38.65%
Lag - 9 Mo Avg	16.08%	25.57%	10.78%	29.34%	40.18%	23.43%	40.05%
Lag - 6 Mo Avg	16.66%	27.07%	11.16%	30.87%	41.52%	23.78%	44.24%
Lag - 3 Mo Avg	18.12%	29.52%	12.90%	33.76%	45.90%	27.15%	49.60%
Lag - Cross Incurral	14.19%	21.34%	9.32%	23.04%	25.38%	17.90%	21.76%
Lag - Dollar Weighted	15.39%	23.20%	10.25%	26.00%	29.17%	19.82%	25.53%
Lag - Drop Extremes (10/12)	15.61%	24.56%	10.03%	27.69%	35.77%	22.38%	33.79%
Lag - Geometric Avg	15.87%	24.58%	10.68%	28.01%	34.19%	22.00%	31.51%
Lag - Harmonic Avg	15.67%	23.68%	10.59%	26.75%	29.74%	20.67%	26.15%



## Comparison of IBNR Methodologies

### Seasonality Scenario (b)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-9.08%	-9.54%	-8.21%	-5.69%	-10.81%	-13.88%	-26.75%
PMPM	-31.13%	-28.76%	-22.69%	-16.82%	-20.27%	-26.15%	-37.47%
Paid PMPM	7.16%	6.98%	4.03%	10.38%	5.43%	9.72%	5.17%
Benktander	6.24%	5.52%	3.93%	9.81%	5.07%	7.93%	3.77%
Bornhuetter	11.62%	10.65%	9.19%	12.50%	7.13%	12.20%	8.29%
Credibility Weighted	7.68%	7.04%	4.41%	12.57%	6.37%	10.54%	4.93%
Hybrid Loss Ratio	10.20%	10.03%	2.39%	4.68%	3.59%	9.53%	2.12%
Lag - 12 Mo Avg	4.96%	4.25%	2.52%	8.94%	4.50%	6.36%	1.96%
Lag - 9 Mo Avg	5.33%	4.60%	2.94%	9.22%	4.59%	6.83%	2.15%
Lag - 6 Mo Avg	5.64%	5.56%	3.53%	9.72%	4.57%	7.02%	2.27%
Lag - 3 Mo Avg	6.17%	6.83%	4.00%	9.67%	4.62%	8.12%	3.32%
Lag - Cross Incurral	1.57%	-0.05%	-1.72%	0.76%	-4.14%	0.32%	-4.44%
Lag - Dollar Weighted	4.09%	3.56%	2.06%	5.28%	1.91%	4.49%	1.02%
Lag - Drop Extremes (10/12)	2.91%	3.06%	-4.68%	-0.40%	-1.10%	2.38%	-5.18%
Lag - Geometric Avg	4.78%	4.08%	2.63%	7.30%	3.14%	5.90%	1.73%
Lag - Harmonic Avg	4.23%	3.57%	2.32%	5.41%	1.81%	4.99%	1.31%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	12.90%	12.16%	9.31%	9.15%	3.99%	10.45%	8.25%
PMPM	32.15%	25.92%	19.66%	13.24%	8.47%	15.11%	12.55%
Paid PMPM	16.73%	17.29%	10.78%	16.21%	7.31%	17.92%	12.38%
Benktander	20.36%	20.91%	14.04%	26.32%	13.78%	21.81%	14.36%
Bornhuetter	18.49%	20.01%	13.25%	22.19%	10.43%	20.06%	13.35%
Credibility Weighted	19.84%	20.85%	14.08%	22.38%	10.48%	20.90%	14.19%
Hybrid Loss Ratio	18.27%	19.33%	11.76%	20.57%	10.17%	20.04%	12.45%
Lag - 12 Mo Avg	20.37%	20.32%	13.21%	28.16%	16.40%	22.56%	14.03%
Lag - 9 Mo Avg	21.00%	21.30%	14.33%	29.28%	16.98%	22.62%	14.58%
Lag - 6 Mo Avg	21.70%	21.85%	15.04%	31.15%	17.47%	23.81%	15.80%
Lag - 3 Mo Avg	25.01%	27.37%	19.46%	35.67%	20.07%	26.87%	19.01%
Lag - Cross Incurral	19.25%	19.05%	12.19%	24.82%	13.85%	20.31%	12.53%
Lag - Dollar Weighted	20.12%	20.18%	12.99%	27.08%	15.57%	22.22%	14.10%
Lag - Drop Extremes (10/12)	20.18%	20.24%	12.42%	26.29%	15.69%	22.01%	13.07%
Lag - Geometric Avg	20.86%	21.20%	14.27%	28.74%	16.49%	22.43%	14.52%
Lag - Harmonic Avg	20.72%	21.10%	14.22%	28.21%	16.05%	22.24%	14.46%

## Comparison of IBNR Methodologies

### Seasonality Scenario (b)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	9.00%	9.00%	8.83%	7.75%	7.48%	9.24%	8.39%
PMPM	8.30%	8.24%	8.07%	6.81%	6.18%	8.25%	7.28%
Paid PMPM	4.26%	5.86%	3.11%	5.41%	5.55%	5.06%	6.02%
Benktander	6.28%	8.87%	5.59%	8.07%	9.69%	6.77%	9.93%
Bornhuetter	7.37%	8.77%	6.84%	7.60%	7.93%	7.40%	8.64%
Credibility Weighted	5.37%	8.87%	3.56%	8.46%	8.91%	7.38%	9.24%
Hybrid Loss Ratio	7.16%	8.29%	6.63%	7.93%	8.65%	7.35%	8.05%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	36.99%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.44%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.05%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.73%
Lag - Cross Incurral	-0.45%	0.65%	-1.14%	0.30%	1.45%	-2.69%	-2.58%
Lag - Dollar Weighted	0.89%	2.36%	0.28%	3.05%	6.24%	-0.73%	0.87%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.57%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.04%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.69%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.77%	2.86%	2.60%	2.46%	2.25%	2.41%	1.97%
PMPM	3.00%	3.04%	2.91%	2.49%	2.43%	2.28%	2.00%
Paid PMPM	8.73%	7.57%	8.10%	5.92%	4.57%	6.13%	6.81%
Benktander	9.57%	16.20%	6.65%	8.81%	10.85%	7.72%	9.21%
Bornhuetter	5.97%	9.69%	4.31%	5.10%	6.04%	5.18%	5.73%
Credibility Weighted	13.06%	12.89%	11.13%	9.33%	6.10%	8.04%	5.35%
Hybrid Loss Ratio	5.97%	9.63%	4.30%	5.23%	6.12%	5.48%	5.92%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.45%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.68%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.61%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.29%
Lag - Cross Incurral	19.15%	32.42%	13.75%	40.25%	61.29%	24.99%	28.70%
Lag - Dollar Weighted	20.60%	34.83%	14.78%	45.00%	69.56%	27.53%	33.54%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	44.99%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.04%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.64%

## Comparison of IBNR Methodologies

### Seasonality Scenario (b) —Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	7.86%	6.50%	88.80%	14.48%	6.83%	100.00%
HMO Professional	7.88%	8.28%	79.60%	14.86%	8.71%	98.40%
Managed Care	7.48%	5.03%	93.60%	12.50%	5.27%	99.60%
HMO Hospital	6.45%	8.95%	76.40%	14.78%	9.60%	96.00%
Self Funded	3.55%	5.81%	70.80%	9.45%	6.19%	93.60%
Major Medical	7.18%	6.71%	86.00%	13.02%	7.03%	98.80%
Medicare Supplement	4.77%	5.21%	81.20%	10.16%	5.47%	96.80%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	14.44%	21.19%	72.40%	27.60%	23.65%	87.60%
HMO Professional	23.57%	58.84%	63.60%	45.88%	67.89%	82.40%
Managed Care	8.84%	10.41%	80.00%	15.74%	11.11%	92.80%
HMO Hospital	7.51%	18.58%	60.80%	18.95%	20.43%	83.20%
Self Funded	1.98%	8.79%	54.00%	7.92%	9.30%	80.40%
Major Medical	7.89%	11.43%	74.80%	15.31%	12.10%	92.00%
Medicare Supplement	4.12%	7.17%	72.00%	9.91%	7.56%	90.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	7.39%	6.72%	83.60%	13.11%	7.01%	98.40%
HMO Professional	7.59%	8.12%	78.80%	13.10%	8.44%	95.60%
Managed Care	6.91%	4.12%	94.80%	10.58%	4.28%	100.00%
HMO Hospital	6.86%	4.95%	95.20%	12.35%	5.33%	100.00%
Self Funded	6.42%	5.93%	87.20%	12.27%	6.16%	100.00%
Major Medical	6.83%	2.98%	99.20%	10.62%	3.22%	100.00%
Medicare Supplement	6.47%	2.59%	99.60%	11.02%	2.93%	100.00%

## Comparison of IBNR Methodologies

### Seasonality Scenario (c)

- Seasonality pattern based on a high-deductible plan; claims concentrated more towards the end of the year

#### Results Set 1—All Incurral Months

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-2.11%	-2.77%	-2.89%	-2.49%	-5.77%	-1.30%	-2.80%
PMPM	-3.16%	-4.16%	-3.96%	-3.96%	-8.35%	-2.28%	-3.68%
Paid PMPM	-14.07%	-17.26%	-9.15%	-15.79%	-13.95%	-13.53%	-12.00%
Benktander	-10.81%	-9.02%	-10.13%	-8.76%	-7.84%	-9.68%	-7.70%
Bornhuetter	-17.08%	-15.60%	-15.42%	-12.66%	-11.61%	-12.38%	-10.10%
Credibility Weighted	-7.55%	-11.74%	-4.27%	-11.09%	-11.11%	-9.56%	-9.83%
Hybrid Loss Ratio	-17.78%	-16.20%	-17.98%	-15.72%	-12.92%	-13.48%	-12.00%
Lag - 12 Mo Avg	2.98%	7.17%	1.62%	10.91%	21.86%	8.80%	29.32%
Lag - 9 Mo Avg	2.95%	7.10%	1.70%	10.82%	21.49%	9.32%	29.73%
Lag - 6 Mo Avg	3.10%	7.69%	1.93%	11.21%	21.60%	9.46%	29.48%
Lag - 3 Mo Avg	2.88%	7.62%	1.92%	10.62%	20.92%	10.67%	28.73%
Lag - Cross Incurral	-1.04%	-1.19%	-2.07%	-1.36%	-3.23%	-3.08%	-4.26%
Lag - Dollar Weighted	0.99%	1.51%	0.55%	2.58%	2.78%	-0.15%	0.08%
Lag - Drop Extremes (10/12)	1.27%	4.44%	-2.28%	4.89%	12.29%	5.17%	13.21%
Lag - Geometric Avg	1.94%	4.25%	1.14%	6.69%	11.16%	4.88%	12.57%
Lag - Harmonic Avg	0.96%	1.60%	0.61%	2.68%	2.86%	0.79%	1.06%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.95%	4.17%	3.72%	4.13%	2.41%	3.83%	2.62%
PMPM	8.68%	8.17%	7.40%	5.72%	4.62%	4.74%	3.49%
Paid PMPM	6.64%	5.60%	5.99%	5.81%	3.59%	5.81%	5.49%
Benktander	8.00%	11.44%	6.06%	10.75%	8.42%	7.37%	6.79%
Bornhuetter	5.23%	7.19%	4.58%	7.78%	5.39%	5.66%	4.41%
Credibility Weighted	10.31%	9.68%	8.45%	9.33%	5.70%	7.57%	4.68%
Hybrid Loss Ratio	5.47%	7.23%	4.39%	7.82%	5.50%	6.13%	4.74%
Lag - 12 Mo Avg	16.14%	26.27%	10.61%	30.40%	44.28%	24.45%	41.39%
Lag - 9 Mo Avg	16.48%	26.72%	11.00%	30.99%	45.09%	25.12%	42.98%
Lag - 6 Mo Avg	17.06%	28.23%	11.35%	32.47%	46.59%	25.52%	47.46%
Lag - 3 Mo Avg	18.45%	30.62%	12.88%	35.19%	51.34%	29.10%	53.28%
Lag - Cross Incurral	14.16%	21.70%	9.37%	23.44%	27.02%	18.43%	22.08%
Lag - Dollar Weighted	15.84%	24.35%	10.61%	27.62%	32.65%	21.12%	26.89%
Lag - Drop Extremes (10/12)	16.01%	25.68%	10.33%	29.39%	40.14%	23.99%	36.06%
Lag - Geometric Avg	16.27%	25.67%	10.90%	29.55%	38.29%	23.53%	33.66%
Lag - Harmonic Avg	16.06%	24.72%	10.80%	28.19%	33.24%	22.03%	27.84%

## Comparison of IBNR Methodologies

### Seasonality Scenario (c)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	67.12%	53.00%	40.45%	26.07%	10.07%	52.54%	46.08%
PMPM	63.74%	49.06%	37.81%	22.91%	5.76%	49.26%	42.75%
Paid PMPM	-4.20%	-2.39%	-1.71%	-6.93%	-5.90%	-0.43%	-0.30%
Benktander	3.43%	2.72%	1.31%	5.63%	1.39%	5.54%	1.65%
Bornhuetter	-4.26%	-3.79%	-4.02%	0.05%	-2.88%	2.92%	1.22%
Credibility Weighted	1.21%	1.70%	1.24%	-0.54%	-2.33%	4.16%	1.65%
Hybrid Loss Ratio	-5.80%	-4.48%	-10.13%	-6.95%	-5.56%	0.15%	-4.01%
Lag - 12 Mo Avg	4.92%	4.03%	2.48%	9.06%	4.87%	6.16%	1.95%
Lag - 9 Mo Avg	5.26%	4.39%	2.88%	9.34%	4.97%	6.61%	2.14%
Lag - 6 Mo Avg	5.52%	5.25%	3.40%	9.81%	4.94%	6.79%	2.26%
Lag - 3 Mo Avg	5.97%	6.37%	3.85%	9.81%	5.00%	7.83%	3.23%
Lag - Cross Incurral	1.17%	-0.51%	-2.03%	0.52%	-4.05%	-0.16%	-4.48%
Lag - Dollar Weighted	4.01%	3.29%	1.97%	5.18%	2.03%	4.20%	0.92%
Lag - Drop Extremes (10/12)	2.73%	2.64%	-4.34%	0.14%	-0.82%	2.00%	-4.80%
Lag - Geometric Avg	4.70%	3.87%	2.56%	7.36%	3.41%	5.67%	1.70%
Lag - Harmonic Avg	4.14%	3.36%	2.25%	5.41%	1.97%	4.75%	1.27%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	17.34%	15.89%	10.69%	11.03%	4.35%	16.34%	11.78%
PMPM	28.61%	23.41%	17.77%	12.32%	7.56%	16.66%	13.01%
Paid PMPM	14.71%	15.37%	10.21%	12.81%	6.35%	16.20%	11.75%
Benktander	20.00%	19.97%	13.53%	25.69%	14.15%	21.26%	14.15%
Bornhuetter	15.94%	17.12%	11.61%	19.75%	9.89%	18.37%	12.54%
Credibility Weighted	18.94%	19.62%	13.59%	19.90%	10.07%	19.83%	13.88%
Hybrid Loss Ratio	15.76%	16.53%	10.34%	18.34%	9.71%	18.35%	11.77%
Lag - 12 Mo Avg	20.55%	19.90%	13.10%	28.81%	17.58%	22.48%	14.22%
Lag - 9 Mo Avg	21.16%	20.86%	14.18%	29.87%	18.19%	22.52%	14.72%
Lag - 6 Mo Avg	21.84%	21.35%	14.75%	31.61%	18.68%	23.57%	15.81%
Lag - 3 Mo Avg	25.12%	26.59%	18.86%	36.02%	21.38%	26.68%	18.86%
Lag - Cross Incurral	19.28%	18.58%	12.10%	25.14%	14.61%	20.16%	12.62%
Lag - Dollar Weighted	20.29%	19.87%	13.08%	27.70%	16.63%	22.16%	14.14%
Lag - Drop Extremes (10/12)	20.33%	19.79%	12.37%	27.01%	16.81%	21.88%	13.34%
Lag - Geometric Avg	21.02%	20.76%	14.12%	29.29%	17.64%	22.32%	14.66%
Lag - Harmonic Avg	20.88%	20.66%	14.06%	28.72%	17.15%	22.13%	14.59%

## Comparison of IBNR Methodologies

### Seasonality Scenario (c)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-29.54%	-29.62%	-29.03%	-24.60%	-24.22%	-22.35%	-16.92%
PMPM	-29.76%	-29.88%	-29.22%	-24.94%	-24.83%	-22.54%	-17.13%
Paid PMPM	-17.35%	-23.75%	-13.25%	-21.99%	-23.04%	-18.14%	-15.20%
Benktander	-15.67%	-13.64%	-16.62%	-18.42%	-17.75%	-14.95%	-10.12%
Bornhuetter	-21.59%	-20.57%	-21.99%	-21.44%	-21.26%	-17.83%	-13.16%
Credibility Weighted	-10.20%	-17.33%	-7.10%	-18.17%	-20.83%	-14.30%	-12.92%
Hybrid Loss Ratio	-21.95%	-21.14%	-22.41%	-21.51%	-20.98%	-18.27%	-14.10%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.86%	37.79%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.39%	38.30%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.57%	37.94%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.87%	36.68%
Lag - Cross Incurral	-0.89%	0.05%	-1.55%	-0.56%	-0.04%	-3.35%	-3.83%
Lag - Dollar Weighted	0.87%	2.31%	0.25%	3.01%	6.20%	-0.91%	0.24%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.42%	18.92%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.55%	16.21%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.18%	1.43%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.38%	3.02%	2.06%	1.99%	1.96%	1.97%	1.64%
PMPM	2.63%	3.29%	2.35%	2.10%	2.18%	1.89%	1.71%
Paid PMPM	7.41%	4.95%	7.42%	4.55%	3.14%	4.54%	5.33%
Benktander	8.27%	14.01%	5.71%	7.50%	9.24%	6.22%	7.52%
Bornhuetter	4.36%	7.08%	3.15%	3.73%	4.41%	3.72%	4.27%
Credibility Weighted	12.16%	10.53%	10.67%	8.04%	4.49%	6.73%	3.98%
Hybrid Loss Ratio	4.36%	7.02%	3.13%	3.82%	4.46%	3.95%	4.40%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	33.18%	53.23%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	33.93%	55.59%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	34.67%	61.63%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	39.16%	68.78%
Lag - Cross Incurral	18.62%	31.49%	13.37%	38.55%	58.29%	24.84%	28.22%
Lag - Dollar Weighted	20.63%	34.86%	14.80%	45.05%	69.53%	28.37%	34.27%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	32.52%	46.41%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	31.66%	43.40%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	29.54%	35.70%

## Comparison of IBNR Methodologies

### Seasonality Scenario (c)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-18.60%	4.70%	0.00%	-13.65%	5.03%	0.00%
HMO Professional	-17.56%	6.17%	0.40%	-12.20%	6.61%	4.80%
Managed Care	-16.83%	3.64%	0.00%	-12.98%	3.82%	0.00%
HMO Hospital	-16.16%	6.87%	0.80%	-9.58%	7.40%	10.80%
Self Funded	-15.98%	4.60%	0.00%	-11.17%	4.93%	1.20%
Major Medical	-14.73%	4.91%	0.40%	-10.13%	5.13%	2.80%
Medicare Supplement	-14.54%	3.99%	0.00%	-10.14%	4.19%	1.20%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	0.13%	17.97%	45.20%	11.59%	20.16%	67.60%
HMO Professional	8.55%	44.97%	46.40%	28.51%	52.25%	69.60%
Managed Care	-6.26%	8.87%	23.60%	-0.37%	9.45%	46.00%
HMO Hospital	-6.08%	16.87%	29.20%	3.89%	18.63%	51.60%
Self Funded	-9.23%	8.19%	14.40%	-3.91%	8.75%	31.60%
Major Medical	-6.74%	9.65%	20.00%	-0.39%	10.23%	46.80%
Medicare Supplement	-9.35%	6.13%	6.40%	-4.31%	6.51%	24.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-20.55%	4.82%	0.00%	-16.36%	5.12%	0.00%
HMO Professional	-19.05%	6.02%	0.00%	-14.90%	6.42%	0.80%
Managed Care	-22.93%	2.98%	0.00%	-20.30%	3.15%	0.00%
HMO Hospital	-22.98%	3.66%	0.00%	-18.97%	3.88%	0.40%
Self Funded	-23.37%	4.18%	0.00%	-19.12%	4.45%	0.00%
Major Medical	-23.11%	2.10%	0.00%	-20.41%	2.20%	0.00%
Medicare Supplement	-23.54%	1.89%	0.00%	-20.27%	2.10%	0.00%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (a)

- 15 percent rate increase implemented three months prior to the valuation date

#### Results Set 1—All Incurral Months

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	34.04%	30.97%	28.49%	22.03%	13.27%	20.22%	12.51%
PMPM	-3.42%	-4.55%	-4.28%	-4.22%	-8.97%	-2.39%	-3.81%
Paid PMPM	0.39%	0.58%	0.34%	1.02%	0.35%	1.18%	0.49%
Benktander	10.28%	11.29%	8.71%	12.74%	10.71%	11.16%	13.07%
Bornhuetter	15.46%	15.54%	13.61%	15.40%	11.99%	13.59%	12.96%
Credibility Weighted	10.17%	12.30%	6.93%	16.50%	12.31%	14.10%	13.80%
Hybrid Loss Ratio	12.13%	12.46%	8.94%	10.61%	9.33%	12.57%	10.89%
Lag - 12 Mo Avg	2.99%	6.88%	1.65%	10.56%	19.74%	8.31%	27.63%
Lag - 9 Mo Avg	2.98%	6.84%	1.75%	10.51%	19.43%	8.81%	27.99%
Lag - 6 Mo Avg	3.14%	7.47%	2.03%	10.91%	19.53%	8.96%	27.73%
Lag - 3 Mo Avg	2.97%	7.50%	2.06%	10.37%	18.95%	10.10%	27.00%
Lag - Cross Incurral	-0.74%	-0.94%	-1.89%	-0.98%	-3.04%	-2.68%	-3.68%
Lag - Dollar Weighted	1.06%	1.53%	0.63%	2.69%	2.54%	0.10%	0.41%
Lag - Drop Extremes (10/12)	1.28%	4.27%	-2.57%	4.16%	10.63%	4.73%	12.18%
Lag - Geometric Avg	2.00%	4.13%	1.22%	6.59%	10.12%	4.72%	11.96%
Lag - Harmonic Avg	1.04%	1.61%	0.70%	2.79%	2.63%	0.93%	1.19%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	5.40%	6.09%	4.90%	5.99%	3.10%	5.03%	3.20%
PMPM	10.30%	9.59%	8.55%	6.53%	5.14%	5.28%	3.81%
Paid PMPM	3.65%	5.16%	4.02%	8.49%	3.84%	8.10%	9.15%
Benktander	9.52%	13.16%	7.24%	13.30%	9.61%	9.18%	8.20%
Bornhuetter	7.51%	9.90%	6.23%	10.81%	6.92%	7.64%	5.77%
Credibility Weighted	9.72%	10.09%	8.25%	10.76%	6.31%	8.44%	5.31%
Hybrid Loss Ratio	7.70%	9.93%	6.08%	10.83%	7.06%	8.32%	6.22%
Lag - 12 Mo Avg	15.68%	25.06%	10.32%	28.72%	39.70%	22.72%	38.62%
Lag - 9 Mo Avg	16.04%	25.52%	10.76%	29.36%	40.46%	23.34%	40.00%
Lag - 6 Mo Avg	16.62%	27.01%	11.12%	30.87%	41.80%	23.70%	44.20%
Lag - 3 Mo Avg	18.09%	29.47%	12.85%	33.74%	46.22%	27.06%	49.54%
Lag - Cross Incurral	14.08%	21.19%	9.27%	22.92%	25.25%	17.69%	21.43%
Lag - Dollar Weighted	15.37%	23.20%	10.27%	26.08%	29.31%	19.73%	25.40%
Lag - Drop Extremes (10/12)	15.57%	24.50%	10.02%	27.72%	36.02%	22.31%	33.75%
Lag - Geometric Avg	15.84%	24.54%	10.66%	28.02%	34.43%	21.92%	31.47%
Lag - Harmonic Avg	15.64%	23.63%	10.56%	26.76%	29.95%	20.59%	26.12%



## Comparison of IBNR Methodologies

### Rate Shift Scenario (a)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	72.64%	57.11%	44.60%	29.70%	12.22%	20.97%	-7.03%
PMPM	-9.98%	-11.58%	-9.52%	-8.25%	-14.62%	-6.46%	-12.97%
Paid PMPM	1.44%	2.02%	0.92%	2.20%	0.56%	3.74%	0.99%
Benktander	7.39%	6.53%	4.90%	11.62%	6.58%	8.06%	1.88%
Bornhuetter	16.63%	14.49%	12.07%	16.43%	9.42%	10.64%	0.91%
Credibility Weighted	12.07%	10.11%	6.38%	19.68%	10.48%	12.65%	1.83%
Hybrid Loss Ratio	12.89%	11.92%	4.22%	7.75%	5.41%	7.89%	-4.69%
Lag - 12 Mo Avg	4.87%	4.14%	2.48%	8.89%	4.57%	6.09%	1.86%
Lag - 9 Mo Avg	5.23%	4.49%	2.90%	9.18%	4.66%	6.56%	2.06%
Lag - 6 Mo Avg	5.52%	5.41%	3.46%	9.66%	4.65%	6.74%	2.18%
Lag - 3 Mo Avg	6.02%	6.61%	3.94%	9.64%	4.71%	7.78%	3.17%
Lag - Cross Incurral	1.32%	-0.30%	-1.94%	0.54%	-4.18%	-0.14%	-4.59%
Lag - Dollar Weighted	4.00%	3.44%	2.00%	5.19%	1.94%	4.20%	0.87%
Lag - Drop Extremes (10/12)	2.76%	2.85%	-4.58%	-0.34%	-1.08%	2.00%	-4.98%
Lag - Geometric Avg	4.68%	3.98%	2.59%	7.24%	3.20%	5.63%	1.62%
Lag - Harmonic Avg	4.14%	3.46%	2.28%	5.36%	1.85%	4.72%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	18.17%	17.04%	11.21%	12.20%	4.61%	12.69%	8.55%
PMPM	29.45%	23.86%	18.27%	12.27%	7.95%	13.90%	11.48%
Paid PMPM	9.30%	12.38%	8.10%	15.80%	5.57%	18.97%	18.82%
Benktander	20.46%	20.86%	14.02%	26.58%	14.15%	21.54%	14.06%
Bornhuetter	19.11%	20.19%	13.27%	22.64%	10.77%	19.41%	12.40%
Credibility Weighted	19.52%	20.60%	13.93%	21.25%	9.66%	19.72%	13.36%
Hybrid Loss Ratio	18.61%	19.40%	11.86%	20.99%	10.52%	19.46%	11.59%
Lag - 12 Mo Avg	20.23%	20.07%	13.11%	28.12%	16.62%	22.24%	14.04%
Lag - 9 Mo Avg	20.87%	21.07%	14.22%	29.23%	17.22%	22.30%	14.57%
Lag - 6 Mo Avg	21.55%	21.60%	14.88%	31.02%	17.71%	23.42%	15.71%
Lag - 3 Mo Avg	24.86%	27.06%	19.17%	35.51%	20.32%	26.51%	18.78%
Lag - Cross Incurral	19.06%	18.73%	12.05%	24.65%	13.92%	19.91%	12.43%
Lag - Dollar Weighted	19.98%	19.96%	12.94%	27.05%	15.75%	21.87%	13.96%
Lag - Drop Extremes (10/12)	20.03%	19.97%	12.35%	26.29%	15.90%	21.67%	13.16%
Lag - Geometric Avg	20.73%	20.97%	14.16%	28.69%	16.72%	22.11%	14.51%
Lag - Harmonic Avg	20.59%	20.87%	14.10%	28.16%	16.27%	21.92%	14.44%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (a)—Cont.

#### Results Set 3 —Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	16.24%	16.35%	16.94%	15.31%	14.91%	20.17%	19.30%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	0.08%	0.09%	0.09%	0.18%	0.13%	0.19%	0.45%
Benktander	12.67%	15.43%	12.05%	15.77%	17.61%	13.61%	17.29%
Bornhuetter	15.80%	17.31%	15.22%	16.03%	16.36%	15.83%	17.40%
Credibility Weighted	10.22%	14.69%	7.89%	14.90%	15.46%	15.62%	18.20%
Hybrid Loss Ratio	12.64%	13.89%	12.85%	14.81%	15.61%	15.62%	16.53%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.57%	0.48%	-1.25%	0.05%	1.02%	-2.88%	-2.95%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.79%	0.71%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.07%	3.36%	3.03%	2.72%	2.56%	2.80%	2.31%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	2.60%	2.74%	2.59%	3.05%	2.47%	3.58%	6.45%
Benktander	9.96%	16.85%	6.93%	9.20%	11.32%	8.06%	9.61%
Bornhuetter	6.44%	10.46%	4.65%	5.50%	6.52%	5.59%	6.17%
Credibility Weighted	10.39%	9.47%	9.45%	6.43%	4.49%	6.50%	4.33%
Hybrid Loss Ratio	6.30%	10.22%	4.69%	5.58%	6.54%	5.93%	6.36%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.04%	32.20%	13.66%	39.91%	60.58%	24.78%	28.39%
Lag - Dollar Weighted	20.59%	34.79%	14.77%	44.97%	69.32%	27.48%	33.49%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (b)

- 15 percent rate increase implemented eight months prior to the valuation date

#### Results Set 1—All Incurral Months

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	62.77%	57.72%	52.29%	39.87%	27.33%	34.12%	23.63%
PMPM	-3.42%	-4.55%	-4.28%	-4.22%	-8.97%	-2.39%	-3.81%
Paid PMPM	0.39%	0.58%	0.34%	1.02%	0.35%	1.18%	0.49%
Benktander	10.30%	11.33%	8.80%	12.85%	11.00%	11.45%	13.59%
Bornhuetter	16.33%	16.86%	15.42%	17.34%	14.79%	16.18%	15.98%
Credibility Weighted	5.83%	7.41%	4.45%	11.05%	7.64%	9.74%	9.88%
Hybrid Loss Ratio	6.50%	7.39%	4.36%	6.10%	6.29%	8.56%	8.33%
Lag - 12 Mo Avg	2.99%	6.88%	1.65%	10.56%	19.74%	8.31%	27.63%
Lag - 9 Mo Avg	2.98%	6.84%	1.75%	10.51%	19.43%	8.81%	27.99%
Lag - 6 Mo Avg	3.14%	7.47%	2.03%	10.91%	19.53%	8.96%	27.73%
Lag - 3 Mo Avg	2.97%	7.50%	2.06%	10.37%	18.95%	10.10%	27.00%
Lag - Cross Incurral	-0.74%	-0.94%	-1.89%	-0.98%	-3.04%	-2.68%	-3.68%
Lag - Dollar Weighted	1.06%	1.53%	0.63%	2.69%	2.54%	0.10%	0.41%
Lag - Drop Extremes (10/12)	1.28%	4.27%	-2.57%	4.16%	10.63%	4.73%	12.18%
Lag - Geometric Avg	2.00%	4.13%	1.22%	6.59%	10.12%	4.72%	11.96%
Lag - Harmonic Avg	1.04%	1.61%	0.70%	2.79%	2.63%	0.93%	1.19%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	6.62%	7.53%	5.55%	7.06%	3.57%	5.65%	3.67%
PMPM	10.30%	9.59%	8.55%	6.53%	5.14%	5.28%	3.81%
Paid PMPM	3.65%	5.16%	4.02%	8.49%	3.84%	8.10%	9.15%
Benktander	9.52%	13.17%	7.25%	13.32%	9.64%	9.22%	8.24%
Bornhuetter	7.59%	10.08%	6.41%	11.08%	7.12%	7.87%	5.95%
Credibility Weighted	9.40%	9.67%	8.09%	10.29%	6.01%	8.17%	5.28%
Hybrid Loss Ratio	7.32%	9.54%	5.88%	10.47%	6.88%	8.11%	6.21%
Lag - 12 Mo Avg	15.68%	25.06%	10.32%	28.72%	39.70%	22.72%	38.62%
Lag - 9 Mo Avg	16.04%	25.52%	10.76%	29.36%	40.46%	23.34%	40.00%
Lag - 6 Mo Avg	16.62%	27.01%	11.12%	30.87%	41.80%	23.70%	44.20%
Lag - 3 Mo Avg	18.09%	29.47%	12.85%	33.74%	46.22%	27.06%	49.54%
Lag - Cross Incurral	14.08%	21.19%	9.27%	22.92%	25.25%	17.69%	21.43%
Lag - Dollar Weighted	15.37%	23.20%	10.27%	26.08%	29.31%	19.73%	25.40%
Lag - Drop Extremes (10/12)	15.57%	24.50%	10.02%	27.72%	36.02%	22.31%	33.75%
Lag - Geometric Avg	15.84%	24.54%	10.66%	28.02%	34.43%	21.92%	31.47%
Lag - Harmonic Avg	15.64%	23.63%	10.56%	26.76%	29.95%	20.59%	26.12%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (b)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	181.46%	145.65%	112.98%	74.60%	41.27%	83.73%	59.18%
PMPM	-9.98%	-11.58%	-9.52%	-8.25%	-14.62%	-6.46%	-12.97%
Paid PMPM	1.44%	2.02%	0.92%	2.20%	0.56%	3.74%	0.99%
Benktander	7.46%	6.65%	5.11%	11.86%	7.07%	8.95%	3.95%
Bornhuetter	19.39%	18.12%	16.39%	20.46%	14.18%	18.73%	12.78%
Credibility Weighted	8.62%	8.61%	5.44%	15.45%	7.46%	13.07%	5.99%
Hybrid Loss Ratio	9.10%	9.45%	2.40%	5.60%	5.00%	10.07%	3.00%
Lag - 12 Mo Avg	4.87%	4.14%	2.48%	8.89%	4.57%	6.09%	1.86%
Lag - 9 Mo Avg	5.23%	4.49%	2.90%	9.18%	4.66%	6.56%	2.06%
Lag - 6 Mo Avg	5.52%	5.41%	3.46%	9.66%	4.65%	6.74%	2.18%
Lag - 3 Mo Avg	6.02%	6.61%	3.94%	9.64%	4.71%	7.78%	3.17%
Lag - Cross Incurral	1.32%	-0.30%	-1.94%	0.54%	-4.18%	-0.14%	-4.59%
Lag - Dollar Weighted	4.00%	3.44%	2.00%	5.19%	1.94%	4.20%	0.87%
Lag - Drop Extremes (10/12)	2.76%	2.85%	-4.58%	-0.34%	-1.08%	2.00%	-4.98%
Lag - Geometric Avg	4.68%	3.98%	2.59%	7.24%	3.20%	5.63%	1.62%
Lag - Harmonic Avg	4.14%	3.46%	2.28%	5.36%	1.85%	4.72%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	31.81%	28.02%	15.72%	18.48%	6.23%	20.17%	12.75%
PMPM	29.45%	23.86%	18.27%	12.27%	7.95%	13.90%	11.48%
Paid PMPM	9.30%	12.38%	8.10%	15.80%	5.57%	18.97%	18.82%
Benktander	20.48%	20.90%	14.07%	26.65%	14.21%	21.72%	14.33%
Bornhuetter	19.63%	21.01%	13.88%	23.57%	11.26%	20.79%	13.69%
Credibility Weighted	18.94%	20.34%	13.83%	20.53%	9.35%	19.80%	13.73%
Hybrid Loss Ratio	18.03%	19.13%	11.77%	20.70%	10.48%	19.91%	12.52%
Lag - 12 Mo Avg	20.23%	20.07%	13.11%	28.12%	16.62%	22.24%	14.04%
Lag - 9 Mo Avg	20.87%	21.07%	14.22%	29.23%	17.22%	22.30%	14.57%
Lag - 6 Mo Avg	21.55%	21.60%	14.88%	31.02%	17.71%	23.42%	15.71%
Lag - 3 Mo Avg	24.86%	27.06%	19.17%	35.51%	20.32%	26.51%	18.78%
Lag - Cross Incurral	19.06%	18.73%	12.05%	24.65%	13.92%	19.91%	12.43%
Lag - Dollar Weighted	19.98%	19.96%	12.94%	27.05%	15.75%	21.87%	13.96%
Lag - Drop Extremes (10/12)	20.03%	19.97%	12.35%	26.29%	15.90%	21.67%	13.16%
Lag - Geometric Avg	20.73%	20.97%	14.16%	28.69%	16.72%	22.11%	14.51%
Lag - Harmonic Avg	20.59%	20.87%	14.10%	28.16%	16.27%	21.92%	14.44%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (b)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	7.58%	7.66%	8.30%	7.84%	7.59%	10.94%	11.60%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	0.08%	0.09%	0.09%	0.18%	0.13%	0.19%	0.45%
Benktander	12.67%	15.43%	12.05%	15.77%	17.61%	13.61%	17.29%
Bornhuetter	15.80%	17.31%	15.22%	16.03%	16.36%	15.83%	17.40%
Credibility Weighted	5.43%	7.79%	4.28%	8.22%	8.38%	8.95%	11.51%
Hybrid Loss Ratio	6.10%	7.27%	6.22%	8.01%	8.76%	8.64%	10.46%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.57%	0.48%	-1.25%	0.05%	1.02%	-2.88%	-2.95%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.79%	0.71%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.79%	2.91%	2.77%	2.50%	2.31%	2.51%	2.26%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	2.60%	2.74%	2.59%	3.05%	2.47%	3.58%	6.45%
Benktander	9.96%	16.85%	6.93%	9.20%	11.32%	8.06%	9.61%
Bornhuetter	6.44%	10.46%	4.65%	5.50%	6.52%	5.59%	6.17%
Credibility Weighted	10.07%	8.82%	9.24%	6.08%	4.10%	6.16%	4.13%
Hybrid Loss Ratio	5.94%	9.61%	4.40%	5.25%	6.15%	5.57%	6.12%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.04%	32.20%	13.66%	39.91%	60.58%	24.78%	28.39%
Lag - Dollar Weighted	20.59%	34.79%	14.77%	44.97%	69.32%	27.48%	33.49%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (c)

- 15 percent rate increase implemented 14 months prior to the valuation date

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	43.51%	39.67%	35.20%	26.38%	16.71%	23.14%	15.60%
PMPM	-3.42%	-4.55%	-4.28%	-4.22%	-8.97%	-2.39%	-3.81%
Paid PMPM	0.39%	0.58%	0.34%	1.02%	0.35%	1.18%	0.49%
Benktander	8.65%	9.73%	7.32%	11.13%	9.47%	9.67%	11.63%
Bornhuetter	13.41%	14.06%	12.82%	14.94%	12.91%	13.60%	13.69%
Credibility Weighted	1.83%	2.26%	1.48%	3.51%	1.84%	3.33%	3.25%
Hybrid Loss Ratio	0.73%	1.62%	-1.71%	-0.21%	0.54%	1.87%	1.77%
Lag - 12 Mo Avg	2.99%	6.88%	1.65%	10.56%	19.74%	8.31%	27.63%
Lag - 9 Mo Avg	2.98%	6.84%	1.75%	10.51%	19.43%	8.81%	27.99%
Lag - 6 Mo Avg	3.14%	7.47%	2.03%	10.91%	19.53%	8.96%	27.73%
Lag - 3 Mo Avg	2.97%	7.50%	2.06%	10.37%	18.95%	10.10%	27.00%
Lag - Cross Incurral	-0.74%	-0.94%	-1.89%	-0.98%	-3.04%	-2.68%	-3.68%
Lag - Dollar Weighted	1.06%	1.53%	0.63%	2.69%	2.54%	0.10%	0.41%
Lag - Drop Extremes (10/12)	1.28%	4.27%	-2.57%	4.16%	10.63%	4.73%	12.18%
Lag - Geometric Avg	2.00%	4.13%	1.22%	6.59%	10.12%	4.72%	11.96%
Lag - Harmonic Avg	1.04%	1.61%	0.70%	2.79%	2.63%	0.93%	1.19%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	5.80%	6.40%	5.00%	6.12%	3.16%	5.09%	3.36%
PMPM	10.30%	9.59%	8.55%	6.53%	5.14%	5.28%	3.81%
Paid PMPM	3.65%	5.16%	4.02%	8.49%	3.84%	8.10%	9.15%
Benktander	9.41%	13.03%	7.18%	13.17%	9.54%	9.11%	8.14%
Bornhuetter	7.40%	9.88%	6.30%	10.89%	7.00%	7.74%	5.84%
Credibility Weighted	9.09%	9.17%	7.88%	9.68%	5.66%	7.80%	4.97%
Hybrid Loss Ratio	6.90%	8.95%	5.49%	9.87%	6.50%	7.65%	5.83%
Lag - 12 Mo Avg	15.68%	25.06%	10.32%	28.72%	39.70%	22.72%	38.62%
Lag - 9 Mo Avg	16.04%	25.52%	10.76%	29.36%	40.46%	23.34%	40.00%
Lag - 6 Mo Avg	16.62%	27.01%	11.12%	30.87%	41.80%	23.70%	44.20%
Lag - 3 Mo Avg	18.09%	29.47%	12.85%	33.74%	46.22%	27.06%	49.54%
Lag - Cross Incurral	14.08%	21.19%	9.27%	22.92%	25.25%	17.69%	21.43%
Lag - Dollar Weighted	15.37%	23.20%	10.27%	26.08%	29.31%	19.73%	25.40%
Lag - Drop Extremes (10/12)	15.57%	24.50%	10.02%	27.72%	36.02%	22.31%	33.75%
Lag - Geometric Avg	15.84%	24.54%	10.66%	28.02%	34.43%	21.92%	31.47%
Lag - Harmonic Avg	15.64%	23.63%	10.56%	26.76%	29.95%	20.59%	26.12%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (c)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	136.77%	109.11%	83.61%	54.61%	28.35%	69.08%	54.54%
PMPM	-9.98%	-11.58%	-9.52%	-8.25%	-14.62%	-6.46%	-12.97%
Paid PMPM	1.44%	2.02%	0.92%	2.20%	0.56%	3.74%	0.99%
Benktander	6.99%	6.20%	4.66%	11.14%	6.40%	8.43%	3.61%
Bornhuetter	16.46%	15.56%	14.19%	18.60%	13.04%	16.86%	12.50%
Credibility Weighted	4.85%	4.85%	3.09%	6.97%	2.59%	7.25%	3.29%
Hybrid Loss Ratio	2.95%	3.55%	-3.40%	-0.19%	0.06%	4.03%	-1.56%
Lag - 12 Mo Avg	4.87%	4.14%	2.48%	8.89%	4.57%	6.09%	1.86%
Lag - 9 Mo Avg	5.23%	4.49%	2.90%	9.18%	4.66%	6.56%	2.06%
Lag - 6 Mo Avg	5.52%	5.41%	3.46%	9.66%	4.65%	6.74%	2.18%
Lag - 3 Mo Avg	6.02%	6.61%	3.94%	9.64%	4.71%	7.78%	3.17%
Lag - Cross Incurral	1.32%	-0.30%	-1.94%	0.54%	-4.18%	-0.14%	-4.59%
Lag - Dollar Weighted	4.00%	3.44%	2.00%	5.19%	1.94%	4.20%	0.87%
Lag - Drop Extremes (10/12)	2.76%	2.85%	-4.58%	-0.34%	-1.08%	2.00%	-4.98%
Lag - Geometric Avg	4.68%	3.98%	2.59%	7.24%	3.20%	5.63%	1.62%
Lag - Harmonic Avg	4.14%	3.46%	2.28%	5.36%	1.85%	4.72%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	25.89%	23.07%	13.67%	15.37%	5.39%	18.16%	12.34%
PMPM	29.45%	23.86%	18.27%	12.27%	7.95%	13.90%	11.48%
Paid PMPM	9.30%	12.38%	8.10%	15.80%	5.57%	18.97%	18.82%
Benktander	20.39%	20.82%	14.01%	26.51%	14.13%	21.62%	14.29%
Bornhuetter	19.17%	20.67%	13.71%	23.27%	11.13%	20.58%	13.72%
Credibility Weighted	18.32%	19.77%	13.58%	19.21%	8.89%	19.00%	13.50%
Hybrid Loss Ratio	17.00%	18.09%	11.14%	19.60%	9.97%	18.91%	12.01%
Lag - 12 Mo Avg	20.23%	20.07%	13.11%	28.12%	16.62%	22.24%	14.04%
Lag - 9 Mo Avg	20.87%	21.07%	14.22%	29.23%	17.22%	22.30%	14.57%
Lag - 6 Mo Avg	21.55%	21.60%	14.88%	31.02%	17.71%	23.42%	15.71%
Lag - 3 Mo Avg	24.86%	27.06%	19.17%	35.51%	20.32%	26.51%	18.78%
Lag - Cross Incurral	19.06%	18.73%	12.05%	24.65%	13.92%	19.91%	12.43%
Lag - Dollar Weighted	19.98%	19.96%	12.94%	27.05%	15.75%	21.87%	13.96%
Lag - Drop Extremes (10/12)	20.03%	19.97%	12.35%	26.29%	15.90%	21.67%	13.16%
Lag - Geometric Avg	20.73%	20.97%	14.16%	28.69%	16.72%	22.11%	14.51%
Lag - Harmonic Avg	20.59%	20.87%	14.10%	28.16%	16.27%	21.92%	14.44%

## Comparison of IBNR Methodologies

### Rate Shift Scenario (c)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.12%	0.10%	0.09%	0.28%	0.18%	1.62%	2.39%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	0.08%	0.09%	0.09%	0.18%	0.13%	0.19%	0.45%
Benktander	10.45%	13.15%	9.80%	13.08%	14.84%	11.23%	14.76%
Bornhuetter	12.87%	14.34%	12.30%	13.09%	13.41%	12.90%	14.43%
Credibility Weighted	1.30%	1.78%	0.85%	1.46%	1.23%	2.22%	3.52%
Hybrid Loss Ratio	0.46%	1.51%	-0.07%	1.13%	1.83%	1.60%	3.20%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.57%	0.48%	-1.25%	0.05%	1.02%	-2.88%	-2.95%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.79%	0.71%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.56%	2.57%	2.42%	2.30%	2.11%	2.27%	1.99%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	2.60%	2.74%	2.59%	3.05%	2.47%	3.58%	6.45%
Benktander	9.82%	16.62%	6.83%	9.06%	11.15%	7.94%	9.46%
Bornhuetter	6.28%	10.19%	4.53%	5.37%	6.35%	5.44%	6.01%
Credibility Weighted	9.79%	8.20%	9.02%	5.74%	3.71%	5.82%	3.72%
Hybrid Loss Ratio	5.60%	9.03%	4.03%	4.91%	5.76%	5.21%	5.71%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.04%	32.20%	13.66%	39.91%	60.58%	24.78%	28.39%
Lag - Dollar Weighted	20.59%	34.79%	14.77%	44.97%	69.32%	27.48%	33.49%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%



## Comparison of IBNR Methodologies

### Claim Shift Scenario (a)

- 15 percent claims decrease three months prior to the valuation date

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	40.39%	36.49%	33.18%	25.38%	15.06%	22.97%	14.08%
PMPM	42.77%	37.97%	33.53%	24.05%	12.25%	20.11%	11.84%
Paid PMPM	38.01%	37.64%	31.19%	29.04%	21.45%	23.47%	16.51%
Benktander	11.70%	12.58%	9.87%	13.99%	11.52%	12.47%	14.18%
Bornhuetter	17.81%	17.68%	15.53%	17.23%	13.21%	15.33%	14.33%
Credibility Weighted	11.81%	14.22%	7.90%	18.66%	13.70%	15.86%	15.35%
Hybrid Loss Ratio	14.39%	14.57%	10.57%	12.09%	10.45%	14.25%	12.10%
Lag - 12 Mo Avg	2.99%	6.81%	1.66%	10.36%	18.79%	8.18%	26.47%
Lag - 9 Mo Avg	3.00%	6.78%	1.78%	10.32%	18.49%	8.69%	26.81%
Lag - 6 Mo Avg	3.17%	7.45%	2.09%	10.73%	18.60%	8.85%	26.57%
Lag - 3 Mo Avg	3.04%	7.55%	2.15%	10.21%	18.06%	10.01%	25.92%
Lag - Cross Incurral	1.34%	1.18%	0.25%	1.18%	-1.01%	-0.46%	-1.63%
Lag - Dollar Weighted	1.09%	1.57%	0.66%	2.69%	2.44%	0.17%	0.38%
Lag - Drop Extremes (10/12)	1.30%	4.28%	-2.78%	3.71%	9.88%	4.58%	11.40%
Lag - Geometric Avg	2.03%	4.11%	1.25%	6.49%	9.63%	4.71%	11.47%
Lag - Harmonic Avg	1.08%	1.63%	0.74%	2.78%	2.50%	1.02%	1.14%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	5.98%	6.77%	5.40%	6.52%	3.27%	5.55%	3.48%
PMPM	11.94%	11.09%	9.81%	7.57%	5.63%	6.25%	4.36%
Paid PMPM	5.83%	7.61%	5.54%	10.46%	4.73%	9.66%	10.40%
Benktander	9.61%	13.35%	7.50%	13.58%	9.43%	9.59%	8.26%
Bornhuetter	7.71%	10.31%	6.60%	11.28%	6.91%	8.16%	5.96%
Credibility Weighted	9.81%	10.45%	8.44%	11.32%	6.43%	8.97%	5.67%
Hybrid Loss Ratio	7.84%	10.30%	6.37%	11.21%	7.05%	8.85%	6.42%
Lag - 12 Mo Avg	15.57%	24.77%	10.28%	28.07%	37.76%	22.26%	37.05%
Lag - 9 Mo Avg	15.93%	25.23%	10.74%	28.73%	38.48%	22.87%	38.33%
Lag - 6 Mo Avg	16.49%	26.71%	11.11%	30.23%	39.75%	23.22%	42.31%
Lag - 3 Mo Avg	18.00%	29.28%	12.96%	33.21%	44.05%	26.53%	47.49%
Lag - Cross Incurral	14.38%	21.57%	9.50%	23.22%	24.99%	17.99%	21.55%
Lag - Dollar Weighted	15.25%	22.95%	10.22%	25.52%	27.94%	19.37%	24.44%
Lag - Drop Extremes (10/12)	15.45%	24.23%	9.95%	27.08%	34.26%	21.86%	32.38%
Lag - Geometric Avg	15.73%	24.26%	10.64%	27.43%	32.76%	21.50%	30.19%
Lag - Harmonic Avg	15.53%	23.38%	10.55%	26.20%	28.51%	20.21%	25.10%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (a)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	84.08%	65.15%	50.17%	33.16%	13.44%	22.30%	-7.03%
PMPM	84.14%	63.57%	48.05%	29.38%	8.54%	15.16%	-12.97%
Paid PMPM	72.25%	63.83%	44.83%	39.51%	23.23%	25.19%	0.99%
Benktander	7.70%	6.88%	5.17%	11.79%	6.60%	8.19%	1.88%
Bornhuetter	18.34%	15.89%	13.18%	17.42%	9.90%	11.04%	0.91%
Credibility Weighted	13.29%	11.06%	6.88%	21.33%	11.15%	13.18%	1.83%
Hybrid Loss Ratio	14.63%	13.48%	4.95%	8.32%	5.85%	8.28%	-4.69%
Lag - 12 Mo Avg	4.82%	4.21%	2.49%	8.58%	4.22%	6.02%	1.86%
Lag - 9 Mo Avg	5.22%	4.58%	2.94%	8.88%	4.32%	6.52%	2.06%
Lag - 6 Mo Avg	5.53%	5.57%	3.55%	9.37%	4.32%	6.74%	2.18%
Lag - 3 Mo Avg	6.12%	6.90%	4.07%	9.36%	4.40%	7.87%	3.17%
Lag - Cross Incurral	3.76%	2.14%	0.46%	2.47%	-2.47%	1.71%	-3.60%
Lag - Dollar Weighted	3.98%	3.54%	2.01%	5.02%	1.80%	4.17%	0.87%
Lag - Drop Extremes (10/12)	2.79%	3.07%	-4.92%	-0.97%	-1.37%	1.94%	-4.98%
Lag - Geometric Avg	4.67%	4.06%	2.63%	7.02%	2.96%	5.62%	1.62%
Lag - Harmonic Avg	4.14%	3.55%	2.32%	5.19%	1.70%	4.73%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	20.12%	18.85%	12.18%	13.07%	4.77%	13.38%	8.55%
PMPM	34.76%	27.96%	20.54%	14.25%	8.36%	15.25%	11.48%
Paid PMPM	18.66%	20.79%	11.88%	20.11%	6.78%	21.37%	18.82%
Benktander	20.33%	21.34%	14.29%	26.30%	13.47%	21.55%	14.06%
Bornhuetter	19.32%	21.02%	13.72%	22.87%	10.42%	19.72%	12.40%
Credibility Weighted	19.59%	21.20%	14.23%	21.83%	9.57%	20.09%	13.36%
Hybrid Loss Ratio	18.74%	20.15%	12.18%	21.07%	10.17%	19.73%	11.59%
Lag - 12 Mo Avg	19.99%	20.43%	13.24%	27.41%	15.61%	22.05%	14.04%
Lag - 9 Mo Avg	20.64%	21.45%	14.42%	28.58%	16.19%	22.16%	14.57%
Lag - 6 Mo Avg	21.28%	21.99%	15.15%	30.35%	16.65%	23.35%	15.71%
Lag - 3 Mo Avg	24.69%	27.78%	19.69%	34.98%	19.21%	26.53%	18.78%
Lag - Cross Incurral	19.35%	19.57%	12.49%	24.72%	13.44%	20.15%	12.55%
Lag - Dollar Weighted	19.75%	20.30%	13.07%	26.38%	14.80%	21.65%	13.96%
Lag - Drop Extremes (10/12)	19.80%	20.34%	12.43%	25.55%	14.93%	21.51%	13.16%
Lag - Geometric Avg	20.51%	21.35%	14.36%	28.07%	15.73%	21.98%	14.51%
Lag - Harmonic Avg	20.38%	21.25%	14.30%	27.57%	15.32%	21.80%	14.44%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (a)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	19.57%	19.69%	20.27%	18.17%	17.73%	23.70%	22.70%
PMPM	22.99%	22.94%	22.45%	19.04%	18.12%	22.92%	21.89%
Paid PMPM	21.96%	22.61%	20.98%	19.24%	18.89%	23.01%	22.94%
Benktander	14.69%	17.50%	14.09%	18.20%	20.13%	15.77%	19.58%
Bornhuetter	18.47%	20.01%	17.87%	18.71%	19.04%	18.50%	20.11%
Credibility Weighted	12.06%	17.34%	9.28%	17.46%	18.17%	18.17%	21.15%
Hybrid Loss Ratio	15.15%	16.44%	15.40%	17.41%	18.24%	18.28%	19.21%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	1.33%	2.50%	0.73%	2.44%	3.79%	-0.53%	-0.35%
Lag - Dollar Weighted	0.87%	2.32%	0.26%	3.01%	6.15%	-0.81%	0.70%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.16%	3.53%	3.13%	2.79%	2.65%	2.92%	2.42%
PMPM	3.46%	3.75%	3.29%	2.84%	2.81%	2.74%	2.43%
Paid PMPM	3.62%	4.00%	3.43%	3.78%	3.14%	4.48%	7.69%
Benktander	10.08%	17.05%	7.02%	9.32%	11.47%	8.17%	9.74%
Bornhuetter	6.59%	10.70%	4.76%	5.63%	6.67%	5.71%	6.31%
Credibility Weighted	10.51%	9.72%	9.53%	6.55%	4.64%	6.64%	4.48%
Hybrid Loss Ratio	6.44%	10.44%	4.80%	5.69%	6.68%	6.06%	6.50%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.57%	33.11%	14.05%	41.38%	63.02%	25.70%	29.71%
Lag - Dollar Weighted	20.59%	34.81%	14.77%	45.02%	69.46%	27.50%	33.51%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (a)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	16.65%	7.02%	100.00%	22.59%	7.37%	100.00%
HMO Professional	15.78%	8.85%	98.00%	22.38%	9.33%	100.00%
Managed Care	14.51%	5.39%	100.00%	18.73%	5.58%	100.00%
HMO Hospital	13.59%	9.87%	92.00%	22.09%	10.59%	99.60%
Self Funded	8.50%	6.09%	92.00%	14.38%	6.41%	99.60%
Major Medical	13.54%	7.50%	98.80%	19.20%	7.81%	99.60%
Medicare Supplement	9.80%	5.43%	97.20%	15.18%	5.66%	99.60%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	13.95%	20.47%	74.40%	26.85%	22.71%	87.60%
HMO Professional	11.64%	47.36%	51.60%	31.68%	54.63%	74.00%
Managed Care	11.82%	10.59%	86.80%	18.54%	11.27%	96.80%
HMO Hospital	11.45%	19.25%	70.80%	23.26%	21.14%	90.40%
Self Funded	3.81%	8.74%	68.40%	9.76%	9.28%	86.00%
Major Medical	11.49%	12.26%	83.60%	18.80%	13.02%	94.40%
Medicare Supplement	6.95%	7.25%	82.40%	12.68%	7.61%	96.40%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	17.61%	7.39%	100.00%	22.48%	7.65%	100.00%
HMO Professional	17.81%	8.82%	99.60%	22.82%	9.16%	100.00%
Managed Care	17.07%	4.53%	100.00%	19.38%	4.59%	100.00%
HMO Hospital	17.28%	5.59%	100.00%	22.57%	5.90%	100.00%
Self Funded	16.41%	6.36%	100.00%	22.23%	6.78%	100.00%
Major Medical	17.12%	3.03%	100.00%	20.49%	3.20%	100.00%
Medicare Supplement	16.67%	2.77%	100.00%	21.24%	3.02%	100.00%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (b)

- 15 percent claims increase three months prior to the valuation date

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-29.86%	-28.85%	-27.18%	-21.25%	-20.76%	-17.82%	-14.53%
PMPM	-38.18%	-36.99%	-33.51%	-26.24%	-26.11%	-20.05%	-16.31%
Paid PMPM	-27.07%	-26.25%	-23.41%	-20.38%	-16.67%	-16.32%	-12.30%
Benktander	-5.68%	-4.12%	-5.59%	-3.85%	-3.86%	-5.70%	-5.22%
Bornhuetter	-11.32%	-10.23%	-10.68%	-8.67%	-8.57%	-9.53%	-8.62%
Credibility Weighted	-5.75%	-7.28%	-3.72%	-9.44%	-8.11%	-8.74%	-9.84%
Hybrid Loss Ratio	-9.80%	-8.77%	-11.84%	-10.71%	-9.15%	-10.38%	-10.41%
Lag - 12 Mo Avg	2.99%	6.93%	1.64%	10.73%	20.52%	8.42%	28.56%
Lag - 9 Mo Avg	2.97%	6.89%	1.73%	10.66%	20.19%	8.91%	28.92%
Lag - 6 Mo Avg	3.12%	7.49%	1.98%	11.06%	20.29%	9.05%	28.66%
Lag - 3 Mo Avg	2.92%	7.47%	1.99%	10.49%	19.67%	10.17%	27.87%
Lag - Cross Incurral	-2.67%	-2.90%	-3.89%	-3.02%	-5.01%	-4.78%	-5.70%
Lag - Dollar Weighted	1.04%	1.51%	0.60%	2.70%	2.62%	0.04%	0.43%
Lag - Drop Extremes (10/12)	1.26%	4.27%	-2.41%	4.51%	11.24%	4.85%	12.81%
Lag - Geometric Avg	1.98%	4.15%	1.19%	6.67%	10.52%	4.73%	12.36%
Lag - Harmonic Avg	1.02%	1.60%	0.67%	2.80%	2.74%	0.86%	1.23%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.89%	4.22%	3.64%	4.02%	2.44%	3.40%	2.44%
PMPM	9.50%	9.10%	7.79%	6.23%	4.94%	4.74%	3.46%
Paid PMPM	2.84%	4.06%	3.19%	7.14%	3.40%	7.01%	8.19%
Benktander	8.47%	11.79%	6.45%	11.76%	8.86%	7.97%	7.27%
Bornhuetter	5.78%	7.74%	4.97%	8.58%	5.75%	6.05%	4.68%
Credibility Weighted	8.58%	8.22%	7.48%	8.41%	4.96%	6.83%	4.11%
Hybrid Loss Ratio	6.19%	7.88%	4.80%	8.73%	5.89%	6.54%	5.01%
Lag - 12 Mo Avg	15.77%	25.29%	10.38%	29.24%	41.28%	23.11%	39.88%
Lag - 9 Mo Avg	16.13%	25.75%	10.80%	29.88%	42.07%	23.73%	41.35%
Lag - 6 Mo Avg	16.72%	27.25%	11.16%	31.39%	43.47%	24.10%	45.72%
Lag - 3 Mo Avg	18.16%	29.63%	12.79%	34.19%	47.99%	27.51%	51.20%
Lag - Cross Incurral	13.79%	20.82%	9.07%	22.57%	25.32%	17.37%	21.19%
Lag - Dollar Weighted	15.46%	23.40%	10.32%	26.54%	30.42%	20.03%	26.17%
Lag - Drop Extremes (10/12)	15.66%	24.72%	10.09%	28.24%	37.45%	22.68%	34.85%
Lag - Geometric Avg	15.93%	24.76%	10.69%	28.51%	35.78%	22.28%	32.50%
Lag - Harmonic Avg	15.73%	23.85%	10.60%	27.22%	31.12%	20.91%	26.95%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (b)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-64.27%	-55.07%	-44.93%	-30.56%	-26.74%	-19.36%	-7.03%
PMPM	-83.66%	-72.03%	-56.82%	-39.25%	-34.53%	-25.65%	-12.97%
Paid PMPM	-51.10%	-43.48%	-34.93%	-27.60%	-18.88%	-15.27%	0.99%
Benktander	2.99%	2.36%	0.85%	4.98%	0.72%	4.41%	1.88%
Bornhuetter	-7.37%	-6.76%	-6.99%	-3.27%	-5.57%	-1.47%	0.91%
Credibility Weighted	-1.98%	-1.28%	-0.62%	-7.27%	-5.39%	-1.35%	1.83%
Hybrid Loss Ratio	-6.97%	-5.86%	-11.80%	-9.16%	-7.83%	-3.93%	-4.69%
Lag - 12 Mo Avg	4.92%	4.09%	2.48%	9.16%	4.87%	6.18%	1.86%
Lag - 9 Mo Avg	5.26%	4.44%	2.88%	9.45%	4.97%	6.62%	2.06%
Lag - 6 Mo Avg	5.52%	5.30%	3.40%	9.92%	4.94%	6.76%	2.18%
Lag - 3 Mo Avg	5.95%	6.40%	3.83%	9.89%	4.99%	7.73%	3.17%
Lag - Cross Incurral	-0.98%	-2.60%	-4.21%	-1.33%	-5.86%	-1.94%	-5.55%
Lag - Dollar Weighted	4.03%	3.39%	1.99%	5.36%	2.08%	4.26%	0.87%
Lag - Drop Extremes (10/12)	2.75%	2.70%	-4.30%	0.20%	-0.82%	2.09%	-4.98%
Lag - Geometric Avg	4.69%	3.93%	2.57%	7.46%	3.42%	5.67%	1.62%
Lag - Harmonic Avg	4.14%	3.41%	2.26%	5.52%	1.99%	4.73%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	14.08%	11.85%	8.57%	8.06%	4.11%	9.51%	8.55%
PMPM	29.71%	24.18%	17.51%	12.98%	8.05%	13.39%	11.48%
Paid PMPM	7.77%	8.92%	6.46%	13.51%	5.11%	17.30%	18.82%
Benktander	19.84%	19.89%	13.42%	25.58%	14.04%	21.02%	14.06%
Bornhuetter	15.38%	16.61%	11.24%	19.15%	9.61%	17.48%	12.40%
Credibility Weighted	17.35%	18.59%	13.02%	16.79%	8.20%	17.67%	13.36%
Hybrid Loss Ratio	15.49%	16.19%	10.07%	17.96%	9.45%	17.45%	11.59%
Lag - 12 Mo Avg	20.45%	19.88%	13.05%	28.79%	17.53%	22.52%	14.04%
Lag - 9 Mo Avg	21.07%	20.85%	14.11%	29.87%	18.14%	22.55%	14.57%
Lag - 6 Mo Avg	21.79%	21.38%	14.71%	31.68%	18.65%	23.60%	15.71%
Lag - 3 Mo Avg	25.03%	26.58%	18.80%	36.07%	21.33%	26.62%	18.78%
Lag - Cross Incurral	18.77%	18.08%	11.69%	24.56%	14.28%	19.75%	12.31%
Lag - Dollar Weighted	20.19%	19.77%	12.88%	27.68%	16.59%	22.17%	13.96%
Lag - Drop Extremes (10/12)	20.23%	19.76%	12.32%	26.97%	16.76%	21.93%	13.16%
Lag - Geometric Avg	20.93%	20.75%	14.05%	29.29%	17.59%	22.35%	14.51%
Lag - Harmonic Avg	20.79%	20.65%	13.99%	28.73%	17.11%	22.15%	14.44%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (b)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-14.26%	-14.37%	-14.82%	-12.95%	-12.84%	-17.13%	-16.73%
PMPM	-17.67%	-17.77%	-17.37%	-14.85%	-14.98%	-17.70%	-17.33%
Paid PMPM	-16.02%	-16.51%	-15.30%	-13.88%	-13.73%	-16.70%	-16.18%
Benktander	-8.73%	-6.53%	-9.60%	-10.04%	-9.06%	-9.31%	-7.02%
Bornhuetter	-12.44%	-11.30%	-12.88%	-12.26%	-12.02%	-12.42%	-11.23%
Credibility Weighted	-6.66%	-9.72%	-5.38%	-10.38%	-11.34%	-11.33%	-13.09%
Hybrid Loss Ratio	-10.40%	-9.53%	-11.51%	-10.90%	-10.34%	-12.57%	-11.89%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-2.33%	-1.39%	-3.09%	-2.14%	-1.51%	-5.07%	-5.37%
Lag - Dollar Weighted	0.85%	2.28%	0.25%	2.96%	6.04%	-0.76%	0.72%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.36%	2.54%	2.26%	2.08%	1.91%	2.02%	1.70%
PMPM	2.58%	2.85%	2.44%	2.12%	2.12%	1.91%	1.75%
Paid PMPM	2.26%	2.53%	2.25%	2.64%	2.20%	3.04%	5.61%
Benktander	8.68%	14.70%	6.00%	7.92%	9.75%	6.92%	8.20%
Bornhuetter	4.87%	7.91%	3.51%	4.16%	4.93%	4.22%	4.66%
Credibility Weighted	9.29%	7.13%	8.70%	5.16%	3.03%	5.16%	2.86%
Hybrid Loss Ratio	4.99%	8.00%	3.55%	4.35%	5.06%	4.48%	4.81%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	18.56%	31.38%	13.31%	38.59%	58.41%	23.95%	27.21%
Lag - Dollar Weighted	20.59%	34.76%	14.78%	44.92%	69.20%	27.47%	33.48%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (b)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-11.63%	5.34%	0.80%	-7.18%	5.67%	13.20%
HMO Professional	-11.23%	6.69%	6.40%	-6.25%	7.07%	19.20%
Managed Care	-11.04%	4.01%	0.00%	-7.80%	4.19%	2.80%
HMO Hospital	-11.14%	7.52%	8.00%	-4.50%	8.07%	29.60%
Self Funded	-12.11%	5.08%	1.20%	-7.31%	5.39%	9.20%
Major Medical	-10.70%	5.48%	4.00%	-6.22%	5.75%	13.20%
Medicare Supplement	-12.07%	4.32%	0.40%	-7.75%	4.52%	4.80%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-3.16%	17.41%	39.20%	7.78%	19.30%	62.00%
HMO Professional	11.30%	47.81%	51.60%	31.37%	55.39%	72.80%
Managed Care	-7.98%	8.57%	18.80%	-2.47%	9.12%	39.20%
HMO Hospital	-8.08%	16.21%	27.20%	1.58%	17.76%	44.80%
Self Funded	-10.76%	8.15%	10.40%	-5.60%	8.65%	24.00%
Major Medical	-8.58%	9.68%	15.60%	-2.57%	10.32%	34.00%
Medicare Supplement	-11.29%	6.08%	4.00%	-6.51%	6.42%	14.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-12.43%	5.55%	0.00%	-8.85%	5.82%	8.00%
HMO Professional	-12.39%	6.60%	4.80%	-8.74%	6.89%	12.80%
Managed Care	-12.83%	3.37%	0.00%	-11.16%	3.43%	0.40%
HMO Hospital	-12.72%	4.16%	0.80%	-8.72%	4.40%	3.60%
Self Funded	-13.38%	4.75%	1.20%	-9.02%	5.12%	6.80%
Major Medical	-12.92%	2.31%	0.00%	-10.36%	2.42%	0.00%
Medicare Supplement	-13.44%	2.13%	0.00%	-10.05%	2.27%	0.00%



## Comparison of IBNR Methodologies

### Claim Shift Scenario (c)

- 15 percent claims decrease eight months prior to the valuation date

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	77.29%	70.93%	64.13%	48.62%	33.26%	41.67%	28.76%
PMPM	119.47%	109.44%	97.62%	72.22%	49.82%	58.70%	39.22%
Paid PMPM	22.25%	30.55%	21.86%	34.85%	22.14%	26.68%	19.96%
Benktander	11.82%	12.77%	10.13%	14.34%	12.18%	13.11%	15.28%
Bornhuetter	19.00%	19.45%	17.94%	19.79%	16.86%	18.77%	18.36%
Credibility Weighted	7.24%	9.10%	5.56%	13.41%	9.19%	12.04%	11.98%
Hybrid Loss Ratio	8.15%	9.06%	5.91%	7.68%	7.77%	10.62%	10.21%
Lag - 12 Mo Avg	3.01%	6.88%	1.66%	10.50%	19.37%	8.38%	27.39%
Lag - 9 Mo Avg	3.01%	6.85%	1.77%	10.45%	19.06%	8.89%	27.75%
Lag - 6 Mo Avg	3.18%	7.50%	2.07%	10.86%	19.16%	9.05%	27.50%
Lag - 3 Mo Avg	3.03%	7.58%	2.12%	10.32%	18.59%	10.24%	26.81%
Lag - Cross Incurral	1.86%	2.08%	1.54%	2.71%	1.41%	1.31%	0.52%
Lag - Dollar Weighted	1.08%	1.54%	0.63%	2.67%	2.48%	0.17%	0.44%
Lag - Drop Extremes (10/12)	1.32%	4.30%	-2.67%	4.00%	10.36%	4.81%	11.96%
Lag - Geometric Avg	2.03%	4.14%	1.24%	6.56%	9.92%	4.80%	11.87%
Lag - Harmonic Avg	1.07%	1.63%	0.72%	2.78%	2.57%	1.02%	1.20%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	7.44%	8.53%	6.17%	7.74%	3.80%	6.24%	3.99%
PMPM	13.25%	13.09%	10.61%	9.29%	6.15%	7.36%	4.89%
Paid PMPM	5.87%	8.63%	6.07%	12.24%	5.43%	10.06%	11.06%
Benktander	9.63%	13.34%	7.41%	13.48%	9.57%	9.47%	8.34%
Bornhuetter	7.78%	10.40%	6.66%	11.40%	7.16%	8.24%	6.13%
Credibility Weighted	9.19%	9.63%	8.09%	10.35%	5.88%	8.30%	5.36%
Hybrid Loss Ratio	7.42%	9.76%	6.06%	10.67%	6.87%	8.39%	6.36%
Lag - 12 Mo Avg	15.68%	25.02%	10.34%	28.51%	38.95%	22.72%	38.27%
Lag - 9 Mo Avg	16.04%	25.49%	10.79%	29.16%	39.70%	23.35%	39.64%
Lag - 6 Mo Avg	16.62%	26.97%	11.16%	30.67%	41.03%	23.70%	43.78%
Lag - 3 Mo Avg	18.09%	29.46%	12.95%	33.56%	45.38%	27.07%	49.09%
Lag - Cross Incurral	14.45%	21.77%	9.62%	23.53%	25.78%	18.45%	22.26%
Lag - Dollar Weighted	15.35%	23.14%	10.28%	25.85%	28.78%	19.77%	25.18%
Lag - Drop Extremes (10/12)	15.57%	24.47%	10.02%	27.51%	35.34%	22.31%	33.45%
Lag - Geometric Avg	15.84%	24.51%	10.69%	27.84%	33.78%	21.94%	31.19%
Lag - Harmonic Avg	15.64%	23.61%	10.60%	26.59%	29.39%	20.61%	25.89%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (c)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	222.48%	177.44%	137.21%	89.92%	49.47%	100.89%	69.70%
PMPM	326.56%	259.91%	199.96%	128.60%	71.49%	133.97%	88.45%
Paid PMPM	40.82%	58.67%	34.33%	58.53%	28.57%	51.51%	32.14%
Benktander	7.96%	7.11%	5.54%	12.39%	7.45%	9.70%	4.31%
Bornhuetter	22.10%	20.59%	18.74%	22.68%	15.86%	21.23%	14.44%
Credibility Weighted	10.19%	10.32%	6.47%	18.37%	8.81%	15.83%	7.30%
Hybrid Loss Ratio	10.95%	11.28%	3.80%	6.97%	6.29%	12.25%	4.19%
Lag - 12 Mo Avg	4.94%	4.21%	2.52%	8.80%	4.40%	6.36%	1.94%
Lag - 9 Mo Avg	5.32%	4.57%	2.95%	9.08%	4.49%	6.85%	2.14%
Lag - 6 Mo Avg	5.63%	5.55%	3.57%	9.57%	4.48%	7.10%	2.26%
Lag - 3 Mo Avg	6.19%	6.87%	4.08%	9.56%	4.54%	8.29%	3.32%
Lag - Cross Incurral	5.14%	4.21%	3.04%	5.34%	1.17%	5.74%	1.07%
Lag - Dollar Weighted	4.05%	3.48%	2.01%	5.10%	1.84%	4.46%	0.94%
Lag - Drop Extremes (10/12)	2.88%	3.01%	-4.78%	-0.58%	-1.16%	2.34%	-5.18%
Lag - Geometric Avg	4.77%	4.05%	2.64%	7.17%	3.07%	5.93%	1.71%
Lag - Harmonic Avg	4.22%	3.54%	2.33%	5.30%	1.76%	5.01%	1.29%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	37.64%	32.93%	18.03%	20.91%	6.69%	23.36%	14.09%
PMPM	57.37%	46.68%	27.38%	25.42%	10.24%	27.16%	16.26%
Paid PMPM	17.63%	24.39%	13.39%	26.08%	8.41%	26.16%	24.69%
Benktander	20.61%	21.23%	14.34%	26.64%	13.89%	22.24%	14.52%
Bornhuetter	20.16%	21.82%	14.42%	24.02%	11.16%	21.78%	14.12%
Credibility Weighted	19.01%	20.73%	14.10%	20.76%	9.05%	20.47%	13.97%
Hybrid Loss Ratio	18.38%	19.75%	12.12%	20.95%	10.35%	20.71%	12.79%
Lag - 12 Mo Avg	20.28%	20.32%	13.27%	27.88%	16.15%	22.59%	14.13%
Lag - 9 Mo Avg	20.92%	21.32%	14.44%	28.99%	16.72%	22.70%	14.68%
Lag - 6 Mo Avg	21.60%	21.85%	15.12%	30.80%	17.19%	23.89%	15.89%
Lag - 3 Mo Avg	24.93%	27.43%	19.65%	35.34%	19.78%	27.07%	19.15%
Lag - Cross Incurral	19.80%	19.88%	12.89%	25.57%	14.20%	21.44%	13.27%
Lag - Dollar Weighted	19.98%	20.17%	13.10%	26.74%	15.28%	22.23%	14.09%
Lag - Drop Extremes (10/12)	20.09%	20.24%	12.48%	26.02%	15.45%	22.03%	13.16%
Lag - Geometric Avg	20.78%	21.22%	14.38%	28.46%	16.24%	22.51%	14.62%
Lag - Harmonic Avg	20.64%	21.13%	14.32%	27.94%	15.81%	22.32%	14.56%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (c)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	9.67%	9.78%	10.53%	9.84%	9.56%	13.64%	14.39%
PMPM	22.99%	22.94%	22.45%	19.04%	18.12%	22.92%	21.89%
Paid PMPM	14.16%	15.16%	13.08%	13.09%	12.92%	15.33%	15.86%
Benktander	14.69%	17.50%	14.09%	18.20%	20.13%	15.77%	19.58%
Bornhuetter	18.47%	20.01%	17.87%	18.71%	19.04%	18.50%	20.11%
Credibility Weighted	6.76%	9.49%	5.44%	9.99%	10.21%	11.05%	13.95%
Hybrid Loss Ratio	7.68%	8.88%	7.93%	9.83%	10.60%	10.68%	12.66%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	1.48%	2.69%	1.06%	2.75%	4.30%	0.23%	0.78%
Lag - Dollar Weighted	0.87%	2.30%	0.26%	2.98%	6.13%	-0.80%	0.74%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.84%	3.00%	2.87%	2.52%	2.36%	2.55%	2.35%
PMPM	3.46%	3.75%	3.29%	2.84%	2.81%	2.74%	2.43%
Paid PMPM	3.91%	3.92%	3.79%	3.70%	3.01%	4.33%	7.22%
Benktander	10.08%	17.05%	7.02%	9.32%	11.47%	8.17%	9.74%
Bornhuetter	6.59%	10.70%	4.76%	5.63%	6.67%	5.71%	6.31%
Credibility Weighted	9.63%	8.40%	8.94%	5.74%	3.96%	5.95%	4.06%
Hybrid Loss Ratio	6.02%	9.77%	4.50%	5.32%	6.25%	5.66%	6.25%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.50%	33.03%	14.04%	41.19%	62.92%	25.73%	29.68%
Lag - Dollar Weighted	20.58%	34.79%	14.77%	44.94%	69.37%	27.52%	33.46%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (c)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	16.39%	7.05%	100.00%	22.59%	7.43%	100.00%
HMO Professional	16.32%	8.88%	98.40%	23.10%	9.39%	100.00%
Managed Care	15.67%	5.31%	100.00%	20.17%	5.51%	100.00%
HMO Hospital	14.76%	9.78%	94.80%	23.37%	10.53%	100.00%
Self Funded	11.03%	6.13%	96.40%	17.09%	6.50%	100.00%
Major Medical	15.74%	7.40%	99.20%	21.60%	7.75%	100.00%
Medicare Supplement	12.60%	5.45%	98.40%	18.13%	5.68%	100.00%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	21.67%	22.06%	84.40%	35.54%	24.44%	94.80%
HMO Professional	27.66%	58.66%	66.80%	50.70%	68.26%	85.20%
Managed Care	16.38%	10.94%	94.40%	23.44%	11.64%	98.80%
HMO Hospital	15.34%	19.92%	78.00%	27.54%	21.79%	95.20%
Self Funded	8.67%	9.23%	82.80%	14.92%	9.89%	93.60%
Major Medical	16.24%	12.60%	91.60%	23.90%	13.34%	99.20%
Medicare Supplement	11.56%	7.52%	94.40%	17.55%	7.91%	99.60%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	16.13%	7.33%	99.60%	21.24%	7.65%	100.00%
HMO Professional	16.56%	8.70%	98.80%	21.67%	9.09%	100.00%
Managed Care	15.61%	4.49%	100.00%	18.24%	4.67%	100.00%
HMO Hospital	15.72%	5.50%	100.00%	20.99%	5.86%	100.00%
Self Funded	15.14%	6.27%	100.00%	20.97%	6.70%	100.00%
Major Medical	15.74%	3.05%	100.00%	19.21%	3.17%	100.00%
Medicare Supplement	15.19%	2.69%	100.00%	19.71%	2.95%	100.00%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (d)

- 15 percent claims increase eight months prior to the valuation date

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-56.63%	-53.72%	-49.32%	-37.91%	-33.77%	-30.84%	-24.80%
PMPM	-94.32%	-89.25%	-80.25%	-61.54%	-53.83%	-47.89%	-36.15%
Paid PMPM	-16.40%	-20.79%	-16.66%	-22.15%	-17.12%	-18.48%	-14.76%
Benktander	-5.64%	-4.08%	-5.54%	-3.82%	-3.98%	-5.77%	-5.52%
Bornhuetter	-11.98%	-11.24%	-12.07%	-10.17%	-10.82%	-11.54%	-11.05%
Credibility Weighted	-1.46%	-2.43%	-1.11%	-3.90%	-3.49%	-4.34%	-5.97%
Hybrid Loss Ratio	-5.01%	-4.42%	-8.02%	-7.04%	-6.63%	-7.13%	-8.39%
Lag - 12 Mo Avg	2.97%	6.88%	1.64%	10.61%	20.03%	8.27%	27.81%
Lag - 9 Mo Avg	2.96%	6.84%	1.74%	10.56%	19.72%	8.76%	28.16%
Lag - 6 Mo Avg	3.12%	7.45%	1.99%	10.95%	19.82%	8.89%	27.91%
Lag - 3 Mo Avg	2.93%	7.45%	2.01%	10.41%	19.22%	9.99%	27.15%
Lag - Cross Incurral	-2.86%	-3.39%	-4.69%	-3.99%	-6.69%	-5.96%	-7.17%
Lag - Dollar Weighted	1.05%	1.54%	0.63%	2.72%	2.59%	0.05%	0.39%
Lag - Drop Extremes (10/12)	1.25%	4.25%	-2.50%	4.28%	10.83%	4.67%	12.35%
Lag - Geometric Avg	1.98%	4.12%	1.20%	6.61%	10.28%	4.65%	12.03%
Lag - Harmonic Avg	1.02%	1.60%	0.68%	2.80%	2.69%	0.86%	1.18%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.41%	4.94%	3.72%	4.21%	2.66%	3.27%	2.47%
PMPM	10.98%	11.11%	8.40%	7.68%	5.61%	5.10%	3.62%
Paid PMPM	3.48%	4.20%	3.71%	6.02%	3.78%	6.74%	8.70%
Benktander	8.46%	11.80%	6.51%	11.83%	8.76%	8.05%	7.22%
Bornhuetter	5.74%	7.68%	4.93%	8.50%	5.59%	6.00%	4.58%
Credibility Weighted	9.49%	9.28%	7.98%	9.56%	5.67%	7.62%	4.59%
Hybrid Loss Ratio	6.50%	8.28%	5.03%	9.15%	6.05%	6.90%	5.11%
Lag - 12 Mo Avg	15.68%	25.09%	10.32%	28.88%	40.28%	22.72%	38.88%
Lag - 9 Mo Avg	16.04%	25.54%	10.74%	29.52%	41.04%	23.33%	40.28%
Lag - 6 Mo Avg	16.62%	27.03%	11.11%	31.02%	42.40%	23.70%	44.52%
Lag - 3 Mo Avg	18.08%	29.48%	12.78%	33.88%	46.87%	27.07%	49.89%
Lag - Cross Incurral	13.79%	20.74%	9.00%	22.44%	24.79%	17.10%	20.77%
Lag - Dollar Weighted	15.39%	23.26%	10.27%	26.28%	29.73%	19.71%	25.60%
Lag - Drop Extremes (10/12)	15.57%	24.53%	10.02%	27.88%	36.54%	22.30%	33.98%
Lag - Geometric Avg	15.84%	24.56%	10.64%	28.17%	34.92%	21.91%	31.68%
Lag - Harmonic Avg	15.64%	23.66%	10.55%	26.90%	30.38%	20.57%	26.29%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (d)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-163.30%	-135.59%	-107.07%	-71.61%	-53.17%	-75.90%	-67.53%
PMPM	-259.30%	-215.11%	-167.53%	-112.47%	-81.84%	-112.67%	-92.95%
Paid PMPM	-28.04%	-36.64%	-25.61%	-35.39%	-22.45%	-32.87%	-24.82%
Benktander	2.90%	2.32%	0.73%	4.74%	0.30%	3.51%	-0.03%
Bornhuetter	-9.55%	-9.60%	-10.44%	-6.58%	-9.57%	-8.32%	-9.75%
Credibility Weighted	1.71%	0.85%	0.71%	-2.02%	-1.93%	-0.54%	-1.41%
Hybrid Loss Ratio	-3.74%	-3.63%	-10.32%	-7.55%	-7.60%	-6.09%	-11.69%
Lag - 12 Mo Avg	4.82%	4.09%	2.46%	8.96%	4.70%	5.90%	1.80%
Lag - 9 Mo Avg	5.17%	4.44%	2.87%	9.26%	4.80%	6.34%	2.00%
Lag - 6 Mo Avg	5.44%	5.31%	3.39%	9.73%	4.78%	6.48%	2.12%
Lag - 3 Mo Avg	5.89%	6.42%	3.83%	9.71%	4.85%	7.39%	3.07%
Lag - Cross Incurral	-1.83%	-4.01%	-6.03%	-3.40%	-8.62%	-5.04%	-9.44%
Lag - Dollar Weighted	3.97%	3.43%	2.00%	5.28%	2.03%	4.02%	0.82%
Lag - Drop Extremes (10/12)	2.67%	2.75%	-4.44%	-0.14%	-1.01%	1.76%	-4.81%
Lag - Geometric Avg	4.62%	3.93%	2.55%	7.31%	3.31%	5.41%	1.56%
Lag - Harmonic Avg	4.07%	3.41%	2.25%	5.41%	1.93%	4.50%	1.13%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	25.19%	19.78%	10.94%	11.67%	5.32%	11.27%	8.17%
PMPM	47.54%	38.37%	22.31%	21.82%	10.35%	19.70%	13.23%
Paid PMPM	8.28%	8.68%	7.16%	10.56%	5.63%	14.95%	18.87%
Benktander	19.63%	19.96%	13.39%	25.31%	13.67%	20.48%	13.74%
Bornhuetter	14.87%	16.11%	10.79%	18.39%	9.05%	16.09%	11.08%
Credibility Weighted	18.19%	19.29%	13.29%	18.58%	9.06%	18.10%	13.15%
Hybrid Loss Ratio	15.85%	16.56%	10.18%	18.15%	9.34%	16.87%	10.69%
Lag - 12 Mo Avg	20.19%	19.92%	13.00%	28.33%	17.00%	22.02%	14.01%
Lag - 9 Mo Avg	20.83%	20.92%	14.08%	29.46%	17.61%	22.05%	14.52%
Lag - 6 Mo Avg	21.51%	21.45%	14.72%	31.23%	18.12%	23.12%	15.61%
Lag - 3 Mo Avg	24.81%	26.82%	18.84%	35.68%	20.76%	26.14%	18.54%
Lag - Cross Incurral	18.47%	17.89%	11.42%	23.93%	13.65%	18.73%	11.77%
Lag - Dollar Weighted	20.00%	19.85%	12.85%	27.34%	16.14%	21.64%	13.91%
Lag - Drop Extremes (10/12)	19.99%	19.80%	12.27%	26.52%	16.25%	21.44%	13.20%
Lag - Geometric Avg	20.69%	20.82%	14.02%	28.90%	17.09%	21.85%	14.46%
Lag - Harmonic Avg	20.56%	20.72%	13.96%	28.35%	16.63%	21.67%	14.40%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (d)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-6.94%	-7.04%	-7.62%	-6.79%	-6.80%	-9.70%	-10.59%
PMPM	-17.67%	-17.77%	-17.37%	-14.85%	-14.98%	-17.70%	-17.33%
Paid PMPM	-10.69%	-11.37%	-9.97%	-9.66%	-9.63%	-11.49%	-11.31%
Benktander	-8.73%	-6.53%	-9.60%	-10.04%	-9.06%	-9.31%	-7.02%
Bornhuetter	-12.44%	-11.30%	-12.88%	-12.26%	-12.02%	-12.42%	-11.23%
Credibility Weighted	-2.07%	-3.29%	-1.89%	-4.44%	-5.21%	-5.41%	-7.23%
Hybrid Loss Ratio	-4.88%	-3.94%	-5.99%	-5.30%	-4.69%	-6.96%	-7.05%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-2.24%	-1.32%	-3.14%	-2.13%	-1.64%	-5.44%	-6.02%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.99%	6.08%	-0.77%	0.70%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.43%	2.48%	2.35%	2.18%	1.97%	2.11%	1.78%
PMPM	2.58%	2.85%	2.44%	2.12%	2.12%	1.91%	1.75%
Paid PMPM	2.69%	2.59%	2.78%	2.89%	2.36%	3.17%	5.75%
Benktander	8.68%	14.70%	6.00%	7.92%	9.75%	6.92%	8.20%
Bornhuetter	4.87%	7.91%	3.51%	4.16%	4.93%	4.22%	4.66%
Credibility Weighted	10.67%	9.03%	9.62%	6.46%	3.93%	6.13%	3.55%
Hybrid Loss Ratio	5.30%	8.50%	3.77%	4.62%	5.38%	4.78%	5.04%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	18.66%	31.54%	13.37%	38.88%	58.72%	24.03%	27.38%
Lag - Dollar Weighted	20.60%	34.80%	14.78%	45.01%	69.31%	27.47%	33.57%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (d)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-11.29%	5.32%	1.20%	-6.68%	5.65%	15.20%
HMO Professional	-11.22%	6.69%	6.00%	-6.12%	7.09%	20.00%
Managed Care	-11.48%	4.04%	0.00%	-8.14%	4.24%	2.40%
HMO Hospital	-11.76%	7.55%	6.00%	-5.12%	8.16%	26.40%
Self Funded	-13.54%	4.92%	0.40%	-8.76%	5.23%	4.40%
Major Medical	-11.84%	5.52%	3.20%	-7.34%	5.81%	9.60%
Medicare Supplement	-13.66%	4.16%	0.00%	-9.37%	4.38%	2.00%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-8.05%	16.37%	29.60%	2.26%	18.31%	52.40%
HMO Professional	-1.04%	40.95%	36.80%	16.71%	47.49%	56.40%
Managed Care	-10.63%	8.31%	9.20%	-5.24%	8.86%	29.20%
HMO Hospital	-10.51%	15.60%	22.80%	-1.04%	17.26%	39.60%
Self Funded	-14.01%	7.64%	3.60%	-9.02%	8.11%	14.00%
Major Medical	-11.42%	9.37%	11.60%	-5.59%	9.95%	23.60%
Medicare Supplement	-14.08%	5.80%	1.60%	-9.42%	6.12%	6.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-11.39%	5.57%	0.80%	-7.58%	5.83%	12.00%
HMO Professional	-11.30%	6.65%	6.00%	-7.45%	6.94%	14.80%
Managed Care	-11.75%	3.42%	0.00%	-9.89%	3.52%	0.40%
HMO Hospital	-11.76%	4.09%	1.20%	-7.66%	4.39%	5.60%
Self Funded	-12.37%	4.82%	1.20%	-7.85%	5.14%	10.00%
Major Medical	-11.92%	2.37%	0.00%	-9.15%	2.52%	0.00%
Medicare Supplement	-12.52%	2.07%	0.00%	-9.02%	2.27%	0.00%



## Comparison of IBNR Methodologies

### Claim Shift Scenario (e)

- 15 percent claims decrease 14 months prior to the valuation date

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	54.79%	50.01%	44.44%	33.26%	21.60%	29.17%	20.04%
PMPM	173.68%	160.11%	143.23%	106.86%	77.48%	86.01%	58.98%
Paid PMPM	9.49%	12.65%	9.02%	17.59%	9.45%	14.34%	11.22%
Benktander	10.08%	11.11%	8.61%	12.61%	10.76%	11.23%	13.33%
Bornhuetter	15.95%	16.57%	15.31%	17.46%	15.27%	16.12%	16.19%
Credibility Weighted	1.67%	2.17%	1.55%	3.67%	1.73%	3.92%	3.82%
Hybrid Loss Ratio	0.78%	1.72%	-1.63%	-0.08%	0.78%	2.35%	2.40%
Lag - 12 Mo Avg	3.00%	6.89%	1.67%	10.55%	19.63%	8.34%	27.57%
Lag - 9 Mo Avg	3.00%	6.85%	1.78%	10.50%	19.31%	8.85%	27.93%
Lag - 6 Mo Avg	3.16%	7.48%	2.06%	10.90%	19.42%	9.01%	27.68%
Lag - 3 Mo Avg	3.00%	7.54%	2.11%	10.37%	18.83%	10.19%	26.97%
Lag - Cross Incurral	0.15%	0.60%	0.32%	1.84%	1.52%	0.19%	0.11%
Lag - Dollar Weighted	1.08%	1.54%	0.65%	2.71%	2.52%	0.12%	0.44%
Lag - Drop Extremes (10/12)	1.30%	4.28%	-2.59%	4.14%	10.56%	4.76%	12.11%
Lag - Geometric Avg	2.02%	4.14%	1.24%	6.58%	10.06%	4.75%	11.94%
Lag - Harmonic Avg	1.06%	1.63%	0.72%	2.79%	2.61%	0.97%	1.19%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	6.34%	7.03%	5.33%	6.54%	3.34%	5.41%	3.59%
PMPM	14.94%	15.42%	11.46%	11.16%	6.90%	8.27%	5.34%
Paid PMPM	4.96%	6.61%	5.16%	9.34%	4.29%	9.29%	10.54%
Benktander	9.51%	13.16%	7.30%	13.31%	9.58%	9.25%	8.24%
Bornhuetter	7.57%	10.12%	6.50%	11.15%	7.12%	7.97%	6.00%
Credibility Weighted	7.87%	8.28%	7.27%	8.91%	5.13%	7.24%	4.70%
Hybrid Loss Ratio	6.91%	8.98%	5.54%	9.91%	6.50%	7.72%	5.91%
Lag - 12 Mo Avg	15.68%	25.05%	10.35%	28.68%	39.46%	22.74%	38.54%
Lag - 9 Mo Avg	16.04%	25.51%	10.79%	29.32%	40.22%	23.37%	39.92%
Lag - 6 Mo Avg	16.62%	26.99%	11.15%	30.83%	41.56%	23.73%	44.10%
Lag - 3 Mo Avg	18.09%	29.47%	12.90%	33.70%	45.95%	27.10%	49.44%
Lag - Cross Incurral	14.15%	21.38%	9.48%	23.21%	25.51%	18.05%	21.89%
Lag - Dollar Weighted	15.35%	23.18%	10.28%	26.03%	29.12%	19.76%	25.42%
Lag - Drop Extremes (10/12)	15.57%	24.49%	10.03%	27.68%	35.81%	22.33%	33.68%
Lag - Geometric Avg	15.84%	24.53%	10.69%	27.99%	34.22%	21.95%	31.41%
Lag - Harmonic Avg	15.64%	23.62%	10.59%	26.73%	29.77%	20.61%	26.07%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (e)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	172.23%	137.27%	105.41%	68.76%	36.53%	86.81%	69.38%
PMPM	498.96%	400.90%	310.01%	201.70%	119.28%	221.39%	169.11%
Paid PMPM	17.35%	23.92%	13.98%	30.60%	12.02%	30.74%	22.06%
Benktander	7.44%	6.61%	5.10%	11.75%	6.95%	9.01%	3.97%
Bornhuetter	19.07%	18.05%	16.68%	21.14%	15.28%	19.42%	14.81%
Credibility Weighted	4.82%	5.39%	3.41%	7.56%	2.58%	8.63%	4.52%
Hybrid Loss Ratio	3.14%	3.82%	-3.19%	0.07%	0.46%	4.79%	-0.84%
Lag - 12 Mo Avg	4.92%	4.17%	2.53%	8.87%	4.51%	6.19%	1.86%
Lag - 9 Mo Avg	5.28%	4.53%	2.96%	9.16%	4.61%	6.68%	2.07%
Lag - 6 Mo Avg	5.58%	5.46%	3.55%	9.64%	4.59%	6.90%	2.20%
Lag - 3 Mo Avg	6.10%	6.71%	4.06%	9.64%	4.66%	8.06%	3.27%
Lag - Cross Incurral	3.56%	3.26%	2.56%	5.62%	2.74%	6.00%	3.66%
Lag - Dollar Weighted	4.05%	3.47%	2.04%	5.21%	1.92%	4.24%	0.83%
Lag - Drop Extremes (10/12)	2.81%	2.89%	-4.62%	-0.37%	-1.09%	2.11%	-5.12%
Lag - Geometric Avg	4.73%	4.01%	2.65%	7.23%	3.16%	5.75%	1.64%
Lag - Harmonic Avg	4.19%	3.50%	2.34%	5.35%	1.82%	4.84%	1.21%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	30.72%	26.95%	15.41%	17.42%	5.88%	20.73%	13.78%
PMPM	79.66%	64.63%	34.59%	36.48%	13.09%	38.19%	22.14%
Paid PMPM	13.66%	17.60%	11.01%	19.36%	6.54%	23.78%	24.12%
Benktander	20.49%	20.95%	14.19%	26.62%	14.08%	21.87%	14.45%
Bornhuetter	19.63%	21.21%	14.16%	23.78%	11.27%	21.24%	14.15%
Credibility Weighted	17.35%	19.34%	13.46%	17.95%	8.04%	18.41%	13.36%
Hybrid Loss Ratio	17.05%	18.23%	11.28%	19.68%	9.94%	19.19%	12.18%
Lag - 12 Mo Avg	20.25%	20.13%	13.21%	28.08%	16.47%	22.37%	14.12%
Lag - 9 Mo Avg	20.89%	21.13%	14.35%	29.20%	17.06%	22.46%	14.67%
Lag - 6 Mo Avg	21.57%	21.64%	15.00%	30.98%	17.54%	23.61%	15.85%
Lag - 3 Mo Avg	24.89%	27.12%	19.40%	35.46%	20.15%	26.75%	19.07%
Lag - Cross Incurral	19.49%	19.59%	12.81%	25.69%	14.48%	21.30%	13.62%
Lag - Dollar Weighted	19.98%	20.00%	13.01%	26.97%	15.58%	22.00%	14.05%
Lag - Drop Extremes (10/12)	20.05%	20.03%	12.43%	26.25%	15.76%	21.80%	13.18%
Lag - Geometric Avg	20.75%	21.03%	14.29%	28.66%	16.56%	22.27%	14.61%
Lag - Harmonic Avg	20.61%	20.93%	14.23%	28.13%	16.12%	22.08%	14.54%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (e)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.12%	0.10%	0.09%	0.28%	0.19%	2.09%	3.17%
PMPM	22.24%	22.19%	21.72%	18.42%	17.51%	22.19%	21.20%
Paid PMPM	6.38%	6.93%	5.79%	6.05%	5.97%	7.10%	7.71%
Benktander	12.36%	15.11%	11.74%	15.40%	17.25%	13.27%	16.95%
Bornhuetter	15.39%	16.89%	14.81%	15.63%	15.97%	15.42%	17.01%
Credibility Weighted	0.99%	1.25%	0.69%	1.06%	0.87%	2.38%	3.84%
Hybrid Loss Ratio	0.46%	1.51%	-0.07%	1.13%	1.84%	1.96%	3.81%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.30%	0.86%	-0.70%	0.77%	2.23%	-1.54%	-0.68%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.99%	6.09%	-0.77%	0.77%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.56%	2.57%	2.42%	2.30%	2.12%	2.28%	2.08%
PMPM	3.44%	3.71%	3.27%	2.82%	2.79%	2.71%	2.40%
Paid PMPM	3.75%	3.55%	3.76%	3.51%	2.85%	4.02%	6.74%
Benktander	9.94%	16.82%	6.92%	9.18%	11.30%	8.04%	9.59%
Bornhuetter	6.42%	10.42%	4.63%	5.49%	6.49%	5.56%	6.15%
Credibility Weighted	7.67%	6.01%	7.43%	4.22%	2.92%	4.64%	3.08%
Hybrid Loss Ratio	5.60%	9.03%	4.03%	4.91%	5.76%	5.22%	5.77%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.08%	32.32%	13.74%	40.18%	61.29%	25.08%	28.97%
Lag - Dollar Weighted	20.58%	34.78%	14.77%	44.95%	69.30%	27.49%	33.57%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (e)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	14.02%	6.80%	99.60%	20.30%	7.16%	100.00%
HMO Professional	14.15%	8.73%	97.60%	20.96%	9.24%	100.00%
Managed Care	13.73%	5.30%	100.00%	18.38%	5.50%	100.00%
HMO Hospital	13.27%	9.72%	93.60%	21.80%	10.43%	99.60%
Self Funded	10.51%	6.24%	95.20%	16.57%	6.62%	100.00%
Major Medical	13.89%	7.27%	98.80%	19.75%	7.57%	99.60%
Medicare Supplement	11.29%	5.44%	97.60%	16.82%	5.67%	99.60%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	19.59%	21.62%	81.20%	33.28%	23.86%	92.00%
HMO Professional	26.86%	54.88%	67.20%	49.89%	63.18%	86.40%
Managed Care	15.12%	10.88%	91.60%	22.15%	11.63%	98.80%
HMO Hospital	14.76%	20.06%	77.20%	26.91%	22.13%	94.40%
Self Funded	9.30%	9.50%	84.80%	15.57%	10.16%	94.80%
Major Medical	14.76%	12.37%	89.20%	22.44%	13.15%	98.40%
Medicare Supplement	10.69%	7.47%	92.40%	16.70%	7.87%	98.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	13.71%	7.08%	98.40%	18.93%	7.38%	100.00%
HMO Professional	14.13%	8.63%	96.80%	19.28%	9.01%	100.00%
Managed Care	13.17%	4.35%	100.00%	16.10%	4.43%	100.00%
HMO Hospital	13.36%	5.37%	100.00%	18.59%	5.67%	100.00%
Self Funded	12.91%	6.16%	100.00%	18.70%	6.61%	100.00%
Major Medical	13.37%	3.03%	100.00%	16.85%	3.25%	100.00%
Medicare Supplement	12.90%	2.82%	100.00%	17.41%	3.06%	100.00%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (f)

- 15 percent claims increase 14 months prior to the valuation date

#### Results Set 1—All Incurral Months

##### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-39.95%	-38.05%	-34.42%	-26.10%	-24.44%	-21.38%	-18.03%
PMPM	-134.39%	-126.55%	-113.59%	-86.59%	-73.55%	-67.83%	-50.39%
Paid PMPM	-6.88%	-9.36%	-7.12%	-12.99%	-7.30%	-9.43%	-8.11%
Benktander	-4.34%	-2.82%	-4.37%	-2.45%	-2.78%	-4.33%	-3.96%
Bornhuetter	-9.72%	-9.06%	-10.04%	-8.30%	-9.38%	-9.49%	-9.27%
Credibility Weighted	2.06%	2.47%	1.38%	3.23%	2.06%	1.57%	0.44%
Hybrid Loss Ratio	0.44%	1.04%	-2.40%	-1.22%	-1.27%	-0.97%	-2.50%
Lag - 12 Mo Avg	2.98%	6.88%	1.64%	10.57%	19.83%	8.30%	27.67%
Lag - 9 Mo Avg	2.97%	6.84%	1.74%	10.52%	19.52%	8.79%	28.02%
Lag - 6 Mo Avg	3.13%	7.46%	2.00%	10.92%	19.62%	8.92%	27.77%
Lag - 3 Mo Avg	2.95%	7.48%	2.02%	10.37%	19.03%	10.03%	27.02%
Lag - Cross Incurral	-1.39%	-2.05%	-3.51%	-3.04%	-6.36%	-4.79%	-6.49%
Lag - Dollar Weighted	1.05%	1.53%	0.61%	2.68%	2.55%	0.08%	0.38%
Lag - Drop Extremes (10/12)	1.27%	4.26%	-2.56%	4.18%	10.68%	4.71%	12.24%
Lag - Geometric Avg	1.99%	4.12%	1.20%	6.59%	10.17%	4.69%	11.98%
Lag - Harmonic Avg	1.03%	1.61%	0.68%	2.79%	2.65%	0.90%	1.19%

##### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.17%	4.56%	3.76%	4.27%	2.54%	3.56%	2.58%
PMPM	12.52%	13.13%	9.14%	9.14%	6.29%	5.68%	3.90%
Paid PMPM	3.69%	4.74%	3.97%	6.67%	3.49%	6.48%	8.41%
Benktander	8.55%	11.93%	6.59%	11.96%	8.76%	8.21%	7.30%
Bornhuetter	5.89%	7.88%	5.04%	8.69%	5.64%	6.19%	4.67%
Credibility Weighted	10.81%	10.94%	8.69%	11.10%	6.62%	8.67%	5.39%
Hybrid Loss Ratio	6.87%	8.84%	5.38%	9.71%	6.34%	7.38%	5.44%
Lag - 12 Mo Avg	15.68%	25.07%	10.31%	28.75%	39.88%	22.71%	38.68%
Lag - 9 Mo Avg	16.04%	25.52%	10.74%	29.39%	40.64%	23.32%	40.06%
Lag - 6 Mo Avg	16.62%	27.02%	11.11%	30.90%	41.99%	23.68%	44.27%
Lag - 3 Mo Avg	18.08%	29.47%	12.81%	33.77%	46.42%	27.04%	49.62%
Lag - Cross Incurral	14.03%	21.06%	9.13%	22.72%	25.06%	17.43%	21.10%
Lag - Dollar Weighted	15.38%	23.22%	10.27%	26.12%	29.45%	19.71%	25.39%
Lag - Drop Extremes (10/12)	15.57%	24.51%	10.01%	27.75%	36.18%	22.29%	33.80%
Lag - Geometric Avg	15.84%	24.54%	10.64%	28.05%	34.58%	21.90%	31.51%
Lag - Harmonic Avg	15.64%	23.64%	10.55%	26.78%	30.08%	20.57%	26.16%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (f)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-125.81%	-104.56%	-81.84%	-54.22%	-41.79%	-63.96%	-64.24%
PMPM	-386.37%	-318.20%	-246.95%	-164.41%	-115.38%	-175.47%	-149.36%
Paid PMPM	-10.32%	-15.68%	-10.24%	-21.74%	-9.21%	-17.28%	-15.99%
Benktander	3.29%	2.70%	1.08%	5.29%	0.79%	4.07%	0.32%
Bornhuetter	-7.28%	-7.61%	-8.72%	-5.14%	-8.72%	-6.73%	-9.49%
Credibility Weighted	4.82%	3.96%	2.60%	5.81%	2.55%	4.72%	1.10%
Hybrid Loss Ratio	2.05%	1.95%	-5.04%	-2.28%	-3.00%	-0.41%	-7.57%
Lag - 12 Mo Avg	4.84%	4.11%	2.44%	8.90%	4.60%	6.03%	1.86%
Lag - 9 Mo Avg	5.20%	4.47%	2.86%	9.19%	4.71%	6.47%	2.05%
Lag - 6 Mo Avg	5.48%	5.37%	3.40%	9.67%	4.69%	6.62%	2.17%
Lag - 3 Mo Avg	5.96%	6.54%	3.85%	9.64%	4.75%	7.57%	3.11%
Lag - Cross Incurral	-0.32%	-2.89%	-5.22%	-3.18%	-9.24%	-4.67%	-10.74%
Lag - Dollar Weighted	3.97%	3.42%	1.97%	5.17%	1.96%	4.18%	0.90%
Lag - Drop Extremes (10/12)	2.72%	2.82%	-4.55%	-0.31%	-1.07%	1.93%	-4.87%
Lag - Geometric Avg	4.64%	3.95%	2.55%	7.26%	3.23%	5.54%	1.62%
Lag - Harmonic Avg	4.10%	3.44%	2.24%	5.36%	1.87%	4.63%	1.19%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	20.75%	16.38%	9.89%	9.86%	4.71%	10.55%	8.12%
PMPM	64.47%	51.96%	27.70%	29.64%	12.56%	27.59%	17.07%
Paid PMPM	9.03%	10.87%	7.97%	11.72%	5.10%	14.00%	16.67%
Benktander	19.71%	20.15%	13.49%	25.31%	13.53%	20.74%	13.79%
Bornhuetter	15.26%	16.53%	11.00%	18.62%	9.03%	16.48%	11.11%
Credibility Weighted	19.26%	20.16%	13.70%	21.09%	10.28%	19.67%	13.64%
Hybrid Loss Ratio	16.82%	17.66%	10.80%	19.10%	9.68%	17.98%	11.17%
Lag - 12 Mo Avg	20.21%	20.04%	13.04%	28.15%	16.74%	22.16%	13.99%
Lag - 9 Mo Avg	20.85%	21.03%	14.13%	29.26%	17.34%	22.20%	14.51%
Lag - 6 Mo Avg	21.53%	21.57%	14.79%	31.06%	17.83%	23.30%	15.62%
Lag - 3 Mo Avg	24.84%	27.03%	19.00%	35.55%	20.46%	26.34%	18.58%
Lag - Cross Incurral	18.75%	18.15%	11.53%	23.91%	13.50%	18.93%	11.59%
Lag - Dollar Weighted	19.98%	19.95%	12.91%	27.11%	15.89%	21.79%	13.93%
Lag - Drop Extremes (10/12)	20.01%	19.93%	12.29%	26.32%	16.01%	21.59%	13.15%
Lag - Geometric Avg	20.71%	20.93%	14.07%	28.71%	16.83%	22.01%	14.45%
Lag - Harmonic Avg	20.57%	20.84%	14.02%	28.18%	16.38%	21.82%	14.39%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (f)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.12%	0.10%	0.09%	0.27%	0.13%	-1.16%	-2.29%
PMPM	-17.13%	-17.23%	-16.84%	-14.40%	-14.54%	-17.17%	-16.83%
Paid PMPM	-4.89%	-5.23%	-4.55%	-4.41%	-4.45%	-5.36%	-5.27%
Benktander	-7.01%	-4.76%	-7.86%	-7.97%	-6.94%	-7.47%	-5.08%
Bornhuetter	-10.16%	-8.99%	-10.62%	-9.99%	-9.75%	-10.14%	-8.94%
Credibility Weighted	1.74%	2.77%	1.06%	2.26%	1.98%	0.90%	0.51%
Hybrid Loss Ratio	0.46%	1.51%	-0.07%	1.12%	1.78%	-0.50%	-0.50%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	10.53%	37.05%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.03%	37.50%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.77%	0.19%	-1.67%	-0.48%	0.11%	-3.87%	-4.63%
Lag - Dollar Weighted	0.86%	2.30%	0.25%	2.98%	6.09%	-0.80%	0.66%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.15%	18.60%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.38%	16.06%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.19%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.56%	2.57%	2.42%	2.30%	2.08%	2.22%	1.82%
PMPM	2.58%	2.83%	2.45%	2.13%	2.12%	1.91%	1.75%
Paid PMPM	2.98%	2.80%	3.07%	3.08%	2.49%	3.43%	6.03%
Benktander	8.78%	14.87%	6.08%	8.02%	9.87%	7.01%	8.31%
Bornhuetter	5.00%	8.11%	3.61%	4.27%	5.05%	4.34%	4.79%
Credibility Weighted	12.77%	12.21%	10.96%	8.92%	5.65%	7.69%	4.82%
Hybrid Loss Ratio	5.60%	9.03%	4.03%	4.92%	5.74%	5.10%	5.40%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	32.07%	51.55%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	32.77%	53.79%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.00%	32.11%	13.61%	39.71%	60.05%	24.56%	27.97%
Lag - Dollar Weighted	20.59%	34.79%	14.78%	44.98%	69.33%	27.48%	33.44%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	31.44%	45.08%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	30.62%	42.12%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	28.60%	34.70%

## Comparison of IBNR Methodologies

### Claim Shift Scenario (f)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-9.54%	5.35%	3.60%	-4.71%	5.71%	24.40%
HMO Professional	-9.58%	6.86%	10.80%	-4.30%	7.27%	28.40%
Managed Care	-10.04%	4.14%	0.00%	-6.53%	4.35%	7.20%
HMO Hospital	-10.63%	7.66%	9.20%	-3.93%	8.25%	30.80%
Self Funded	-12.85%	4.97%	0.40%	-8.05%	5.28%	6.00%
Major Medical	-10.32%	5.64%	4.80%	-5.74%	5.93%	15.20%
Medicare Supplement	-12.39%	4.25%	0.40%	-8.04%	4.47%	4.00%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-6.29%	16.87%	32.40%	4.28%	18.86%	55.60%
HMO Professional	-0.75%	41.76%	36.40%	17.25%	48.55%	58.80%
Managed Care	-9.61%	8.46%	12.00%	-4.13%	9.05%	32.40%
HMO Hospital	-9.98%	15.81%	21.20%	-0.47%	17.34%	41.60%
Self Funded	-14.04%	7.56%	4.00%	-9.03%	8.10%	13.60%
Major Medical	-10.11%	9.54%	14.40%	-4.16%	10.11%	30.00%
Medicare Supplement	-13.05%	5.86%	2.80%	-8.36%	6.15%	8.00%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-9.61%	5.61%	3.60%	-5.60%	5.95%	19.20%
HMO Professional	-9.49%	6.78%	10.00%	-5.49%	7.12%	22.00%
Managed Care	-10.01%	3.51%	0.40%	-7.91%	3.54%	0.80%
HMO Hospital	-10.04%	4.16%	2.40%	-5.91%	4.44%	9.20%
Self Funded	-10.66%	5.00%	3.20%	-6.10%	5.23%	13.60%
Major Medical	-10.10%	2.45%	0.00%	-7.33%	2.69%	0.40%
Medicare Supplement	-10.73%	2.04%	0.00%	-7.11%	2.26%	0.40%



## Comparison of IBNR Methodologies

### Large Claims Scenario (a)

- Lag factors calculated based on claims data with large claims removed; lag factors applied to full data set

#### Results Set 1—All Incurral Months

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-28.71%	-0.58%	-15.55%	-7.92%	-15.31%	-9.08%	-1.82%
PMPM	-4.75%	-4.55%	-4.22%	-4.51%	-9.13%	-1.38%	-3.81%
Paid PMPM	16.37%	0.58%	8.84%	5.60%	5.67%	5.92%	0.49%
Benktander	-57.18%	3.10%	-30.87%	-12.64%	-19.60%	-18.90%	3.40%
Bornhuetter	-52.73%	1.84%	-28.13%	-11.90%	-18.34%	-16.75%	1.57%
Credibility Weighted	-62.11%	2.02%	-33.52%	-13.25%	-20.80%	-20.42%	1.35%
Hybrid Loss Ratio	-57.58%	1.33%	-32.71%	-16.73%	-22.22%	-20.34%	-0.41%
Lag - 12 Mo Avg	-63.34%	6.88%	-34.28%	-10.58%	-11.97%	-19.49%	27.63%
Lag - 9 Mo Avg	-63.32%	6.84%	-34.23%	-10.58%	-12.19%	-19.12%	27.99%
Lag - 6 Mo Avg	-63.27%	7.47%	-34.07%	-10.27%	-12.21%	-19.05%	27.73%
Lag - 3 Mo Avg	-63.31%	7.50%	-34.03%	-10.63%	-12.34%	-18.30%	27.00%
Lag - Cross Incurral	-64.65%	-0.94%	-36.60%	-19.86%	-28.51%	-27.67%	-3.68%
Lag - Dollar Weighted	-64.00%	1.53%	-34.92%	-16.90%	-24.33%	-25.57%	0.41%
Lag - Drop Extremes (10/12)	-63.93%	4.27%	-37.09%	-15.82%	-18.63%	-22.16%	12.18%
Lag - Geometric Avg	-63.66%	4.13%	-34.57%	-13.73%	-18.88%	-22.17%	11.96%
Lag - Harmonic Avg	-64.00%	1.61%	-34.90%	-16.79%	-24.26%	-24.98%	1.19%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	27.54%	4.74%	25.36%	17.45%	17.42%	19.79%	2.82%
PMPM	89.98%	9.59%	72.81%	48.96%	48.44%	50.98%	3.81%
Paid PMPM	26.94%	5.16%	20.21%	13.99%	15.00%	16.16%	9.15%
Benktander	10.01%	12.45%	13.10%	13.74%	12.30%	12.75%	7.70%
Bornhuetter	11.30%	8.83%	13.85%	13.00%	12.40%	13.28%	5.24%
Credibility Weighted	9.40%	9.15%	13.21%	12.77%	11.31%	12.72%	4.77%
Hybrid Loss Ratio	9.39%	8.90%	11.95%	11.51%	10.50%	11.63%	5.62%
Lag - 12 Mo Avg	9.51%	25.06%	13.49%	24.06%	30.39%	21.05%	38.62%
Lag - 9 Mo Avg	9.64%	25.52%	13.62%	24.70%	31.07%	21.41%	40.00%
Lag - 6 Mo Avg	9.71%	27.01%	13.64%	25.70%	31.57%	21.56%	44.20%
Lag - 3 Mo Avg	10.15%	29.47%	14.50%	28.46%	36.55%	23.37%	49.54%
Lag - Cross Incurral	9.02%	21.19%	12.79%	19.67%	20.24%	17.08%	21.43%
Lag - Dollar Weighted	9.40%	23.20%	13.45%	21.92%	23.16%	18.49%	25.40%
Lag - Drop Extremes (10/12)	9.38%	24.50%	12.89%	23.06%	27.45%	20.51%	33.75%
Lag - Geometric Avg	9.54%	24.54%	13.54%	23.62%	26.80%	20.16%	31.47%
Lag - Harmonic Avg	9.46%	23.63%	13.46%	22.61%	23.69%	19.00%	26.12%

## Comparison of IBNR Methodologies

### Large Claims Scenario (a)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-35.68%	-1.47%	-20.71%	-11.21%	-19.63%	-12.55%	-7.03%
PMPM	-1.70%	-11.58%	0.08%	-5.11%	-10.53%	3.73%	-12.97%
Paid PMPM	24.28%	2.02%	16.64%	10.03%	8.85%	12.39%	0.99%
Benktander	-79.98%	4.37%	-47.98%	-21.62%	-28.68%	-36.34%	1.88%
Bornhuetter	-75.89%	3.33%	-44.66%	-20.10%	-26.19%	-33.16%	0.91%
Credibility Weighted	-80.44%	4.21%	-48.40%	-21.48%	-28.89%	-36.34%	1.83%
Hybrid Loss Ratio	-78.32%	2.75%	-49.81%	-27.15%	-30.47%	-36.90%	-4.69%
Lag - 12 Mo Avg	-80.90%	4.14%	-48.89%	-22.20%	-29.68%	-37.53%	1.86%
Lag - 9 Mo Avg	-80.81%	4.49%	-48.72%	-22.03%	-29.63%	-37.25%	2.06%
Lag - 6 Mo Avg	-80.74%	5.41%	-48.44%	-21.67%	-29.66%	-37.16%	2.18%
Lag - 3 Mo Avg	-80.71%	6.61%	-48.29%	-21.87%	-29.64%	-36.67%	3.17%
Lag - Cross Incurral	-81.54%	-0.30%	-51.13%	-28.13%	-35.58%	-41.18%	-4.59%
Lag - Dollar Weighted	-81.04%	3.44%	-49.10%	-24.81%	-31.36%	-38.58%	0.87%
Lag - Drop Extremes (10/12)	-81.26%	2.85%	-52.52%	-28.86%	-33.46%	-39.97%	-4.98%
Lag - Geometric Avg	-80.91%	3.98%	-48.88%	-23.41%	-30.58%	-37.79%	1.62%
Lag - Harmonic Avg	-81.01%	3.46%	-49.03%	-24.74%	-31.46%	-38.32%	1.20%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	41.06%	12.21%	40.74%	27.63%	23.74%	40.07%	8.55%
PMPM	140.47%	23.86%	125.03%	82.64%	68.79%	105.24%	11.48%
Paid PMPM	37.61%	12.38%	28.87%	20.34%	18.55%	27.37%	18.82%
Benktander	6.56%	20.49%	14.27%	19.34%	13.72%	17.82%	14.06%
Bornhuetter	7.80%	18.52%	15.19%	17.77%	13.80%	18.64%	12.40%
Credibility Weighted	6.44%	19.70%	14.19%	17.13%	12.87%	17.48%	13.36%
Hybrid Loss Ratio	6.58%	17.90%	13.06%	15.74%	12.02%	16.52%	11.59%
Lag - 12 Mo Avg	6.25%	20.07%	13.99%	20.27%	14.48%	17.77%	14.04%
Lag - 9 Mo Avg	6.42%	21.07%	14.20%	20.84%	14.73%	17.91%	14.57%
Lag - 6 Mo Avg	6.57%	21.60%	14.50%	22.11%	14.89%	18.14%	15.71%
Lag - 3 Mo Avg	6.60%	27.06%	15.47%	24.85%	16.19%	19.24%	18.78%
Lag - Cross Incurral	6.01%	18.73%	13.27%	18.00%	12.69%	16.41%	12.43%
Lag - Dollar Weighted	6.21%	19.96%	13.99%	19.44%	14.05%	17.67%	13.96%
Lag - Drop Extremes (10/12)	6.15%	19.97%	13.01%	18.84%	13.72%	16.96%	13.16%
Lag - Geometric Avg	6.38%	20.97%	14.15%	20.44%	14.41%	17.76%	14.51%
Lag - Harmonic Avg	6.34%	20.87%	14.10%	20.05%	14.14%	17.61%	14.44%

## Comparison of IBNR Methodologies

### Large Claims Scenario (a)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-5.16%	0.10%	-2.90%	-1.46%	-2.88%	-3.13%	0.03%
PMPM	6.57%	-0.47%	0.81%	-0.24%	-0.33%	0.19%	-0.66%
Paid PMPM	14.83%	0.09%	5.09%	2.55%	4.09%	4.58%	0.45%
Benktander	-5.33%	3.68%	-3.16%	1.54%	2.69%	-2.99%	4.28%
Bornhuetter	0.45%	2.01%	-1.00%	1.09%	1.39%	-1.54%	2.09%
Credibility Weighted	-20.13%	1.78%	-8.98%	-0.14%	-0.53%	-5.62%	1.46%
Hybrid Loss Ratio	-9.89%	1.51%	-5.06%	-1.05%	-1.86%	-5.16%	1.33%
Lag - 12 Mo Avg	-23.17%	10.44%	-10.20%	8.02%	29.51%	-3.13%	37.05%
Lag - 9 Mo Avg	-23.26%	10.15%	-10.27%	7.71%	28.85%	-2.67%	37.50%
Lag - 6 Mo Avg	-23.21%	10.61%	-10.23%	7.94%	28.92%	-2.58%	37.11%
Lag - 3 Mo Avg	-23.60%	9.90%	-10.48%	6.98%	27.85%	-1.52%	35.79%
Lag - Cross Incurral	-26.02%	0.48%	-12.78%	-5.98%	-9.39%	-14.95%	-2.95%
Lag - Dollar Weighted	-24.94%	2.30%	-11.44%	-3.25%	-4.83%	-13.11%	0.71%
Lag - Drop Extremes (10/12)	-24.31%	7.02%	-12.10%	4.38%	16.86%	-6.09%	18.60%
Lag - Geometric Avg	-24.14%	6.12%	-10.88%	2.21%	10.39%	-7.65%	16.06%
Lag - Harmonic Avg	-25.00%	2.41%	-11.47%	-3.11%	-4.31%	-12.23%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	29.45%	2.57%	19.89%	12.43%	17.55%	15.82%	1.80%
PMPM	40.46%	2.80%	25.24%	15.97%	21.85%	21.61%	1.84%
Paid PMPM	35.05%	2.74%	21.58%	13.90%	19.05%	16.88%	6.45%
Benktander	29.78%	15.70%	20.55%	15.75%	21.71%	16.90%	8.85%
Bornhuetter	31.88%	9.09%	20.95%	14.18%	19.95%	16.84%	5.36%
Credibility Weighted	26.35%	8.20%	20.83%	16.03%	20.37%	17.27%	3.52%
Hybrid Loss Ratio	27.47%	9.03%	19.32%	13.23%	18.48%	15.40%	5.53%
Lag - 12 Mo Avg	26.62%	37.99%	21.72%	49.63%	88.96%	33.07%	51.55%
Lag - 9 Mo Avg	26.83%	38.47%	21.97%	50.23%	90.58%	33.66%	53.79%
Lag - 6 Mo Avg	27.06%	40.30%	22.14%	51.20%	92.50%	34.24%	59.72%
Lag - 3 Mo Avg	27.60%	42.68%	22.82%	53.28%	103.49%	37.46%	66.42%
Lag - Cross Incurral	25.14%	32.20%	20.64%	39.85%	57.39%	26.24%	28.39%
Lag - Dollar Weighted	26.09%	34.79%	21.45%	44.53%	65.16%	28.39%	33.49%
Lag - Drop Extremes (10/12)	26.25%	37.16%	21.34%	48.19%	80.95%	32.35%	45.08%
Lag - Geometric Avg	26.53%	36.91%	21.81%	47.99%	77.60%	31.48%	42.12%
Lag - Harmonic Avg	26.24%	35.48%	21.66%	45.87%	67.76%	29.44%	34.70%

## Comparison of IBNR Methodologies

### Large Claims Scenario (b)

- Lag factors calculated based on claims data with large claims included; lag factors applied to full data set

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-4.39%	-0.58%	-2.83%	-1.22%	-6.17%	-0.91%	-1.82%
PMPM	-4.75%	-4.55%	-4.22%	-4.51%	-9.13%	-1.40%	-3.81%
Paid PMPM	16.37%	0.58%	8.84%	5.60%	5.67%	5.92%	0.49%
Benktander	-0.90%	3.10%	-0.97%	2.99%	0.46%	0.16%	3.40%
Bornhuetter	-0.62%	1.84%	-0.89%	2.15%	-0.82%	0.12%	1.57%
Credibility Weighted	-0.66%	2.02%	-0.86%	2.73%	0.62%	0.58%	1.35%
Hybrid Loss Ratio	-9.18%	1.33%	-8.99%	-3.74%	-5.07%	-3.17%	-0.41%
Lag - 12 Mo Avg	0.86%	6.88%	0.05%	8.96%	14.30%	5.53%	27.63%
Lag - 9 Mo Avg	-0.74%	6.84%	-0.79%	8.24%	13.33%	5.28%	27.99%
Lag - 6 Mo Avg	-0.66%	7.47%	-0.94%	8.17%	12.83%	4.82%	27.73%
Lag - 3 Mo Avg	-2.03%	7.50%	-0.59%	8.03%	13.13%	5.56%	27.00%
Lag - Cross Incurral	3.14%	-0.94%	0.52%	0.46%	-1.43%	-1.01%	-3.68%
Lag - Dollar Weighted	8.87%	1.53%	5.30%	5.26%	4.91%	3.04%	0.41%
Lag - Drop Extremes (10/12)	-13.38%	4.27%	-11.78%	-0.76%	1.50%	-1.22%	12.18%
Lag - Geometric Avg	-3.20%	4.13%	-1.91%	4.59%	5.42%	1.45%	11.96%
Lag - Harmonic Avg	-5.44%	1.61%	-2.95%	1.08%	-0.96%	-2.08%	1.19%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	33.89%	4.74%	27.97%	18.70%	19.53%	21.95%	2.82%
PMPM	89.98%	9.59%	72.80%	48.96%	48.43%	50.93%	3.81%
Paid PMPM	26.94%	5.16%	20.21%	13.99%	15.00%	16.16%	9.15%
Benktander	24.60%	12.45%	18.75%	15.83%	15.18%	16.39%	7.70%
Bornhuetter	25.76%	8.83%	19.57%	15.10%	15.38%	16.93%	5.24%
Credibility Weighted	25.02%	9.15%	18.99%	14.95%	14.74%	16.76%	4.77%
Hybrid Loss Ratio	22.71%	8.90%	17.06%	13.45%	13.63%	15.23%	5.62%
Lag - 12 Mo Avg	26.21%	25.06%	20.10%	27.38%	35.51%	25.78%	38.62%
Lag - 9 Mo Avg	25.47%	25.52%	19.46%	27.27%	35.43%	25.78%	40.00%
Lag - 6 Mo Avg	25.91%	27.01%	19.49%	27.56%	35.11%	25.48%	44.20%
Lag - 3 Mo Avg	28.76%	29.47%	22.49%	30.65%	41.28%	27.41%	49.54%
Lag - Cross Incurral	26.36%	21.19%	20.24%	23.13%	24.89%	22.32%	21.43%
Lag - Dollar Weighted	28.69%	23.20%	21.95%	26.18%	28.60%	24.56%	25.40%
Lag - Drop Extremes (10/12)	22.45%	24.50%	17.92%	25.59%	31.43%	24.38%	33.75%
Lag - Geometric Avg	24.64%	24.54%	19.18%	26.13%	30.85%	24.41%	31.47%
Lag - Harmonic Avg	23.93%	23.63%	18.93%	25.08%	27.52%	23.14%	26.12%

## Comparison of IBNR Methodologies

### Large Claims Scenario (b)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	-4.17%	-1.47%	-1.38%	-0.70%	-7.68%	1.87%	-7.03%
PMPM	-1.70%	-11.58%	0.08%	-5.11%	-10.53%	3.67%	-12.97%
Paid PMPM	24.28%	2.02%	16.64%	10.03%	8.85%	12.39%	0.99%
Benktander	0.58%	4.37%	1.43%	5.78%	1.18%	2.63%	1.88%
Bornhuetter	1.09%	3.33%	1.71%	4.86%	0.12%	3.06%	0.91%
Credibility Weighted	1.00%	4.21%	1.54%	4.96%	1.16%	2.58%	1.83%
Hybrid Loss Ratio	-11.27%	2.75%	-11.78%	-5.51%	-6.49%	-3.27%	-4.69%
Lag - 12 Mo Avg	2.54%	4.14%	2.62%	7.39%	2.81%	3.55%	1.86%
Lag - 9 Mo Avg	0.63%	4.49%	1.46%	6.55%	2.05%	2.72%	2.06%
Lag - 6 Mo Avg	0.69%	5.41%	1.14%	6.39%	1.58%	1.96%	2.18%
Lag - 3 Mo Avg	-1.09%	6.61%	1.31%	6.35%	1.80%	1.82%	3.17%
Lag - Cross Incurral	7.75%	-0.30%	5.23%	3.33%	-0.10%	4.47%	-4.59%
Lag - Dollar Weighted	14.93%	3.44%	12.13%	9.57%	6.87%	10.50%	0.87%
Lag - Drop Extremes (10/12)	-14.72%	2.85%	-14.05%	-6.00%	-8.01%	-4.84%	-4.98%
Lag - Geometric Avg	-1.79%	3.98%	0.34%	4.67%	0.36%	1.52%	1.62%
Lag - Harmonic Avg	-3.96%	3.46%	-0.70%	2.85%	-1.19%	0.38%	1.20%

##### Standard Deviation

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	48.66%	12.21%	44.84%	29.90%	26.23%	43.99%	8.55%
PMPM	140.47%	23.86%	125.02%	82.63%	68.79%	105.16%	11.48%
Paid PMPM	37.61%	12.38%	28.87%	20.34%	18.55%	27.37%	18.82%
Benktander	31.04%	20.49%	25.53%	24.28%	17.99%	26.76%	14.06%
Bornhuetter	32.38%	18.52%	26.63%	22.53%	18.27%	27.82%	12.40%
Credibility Weighted	31.35%	19.70%	25.60%	21.95%	17.33%	26.41%	13.36%
Hybrid Loss Ratio	27.54%	17.90%	22.89%	19.73%	16.31%	25.14%	11.59%
Lag - 12 Mo Avg	31.92%	20.07%	26.53%	26.63%	19.73%	27.84%	14.04%
Lag - 9 Mo Avg	31.09%	21.07%	25.48%	26.24%	19.20%	26.97%	14.57%
Lag - 6 Mo Avg	32.50%	21.60%	26.03%	26.86%	19.18%	27.03%	15.71%
Lag - 3 Mo Avg	34.63%	27.06%	28.83%	29.28%	21.33%	29.17%	18.78%
Lag - Cross Incurral	34.84%	18.73%	28.30%	25.51%	19.62%	28.82%	12.43%
Lag - Dollar Weighted	36.67%	19.96%	30.57%	28.18%	21.42%	31.24%	13.96%
Lag - Drop Extremes (10/12)	26.38%	19.97%	22.50%	23.23%	17.91%	25.51%	13.16%
Lag - Geometric Avg	30.19%	20.97%	25.17%	25.74%	18.81%	26.69%	14.51%
Lag - Harmonic Avg	29.43%	20.87%	24.92%	25.26%	18.48%	26.42%	14.44%

## Comparison of IBNR Methodologies

### Large Claims Scenario (b)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	7.67%	0.10%	1.77%	0.61%	1.07%	0.73%	0.03%
PMPM	6.57%	-0.47%	0.81%	-0.24%	-0.33%	0.19%	-0.66%
Paid PMPM	14.83%	0.09%	5.09%	2.55%	4.09%	4.58%	0.45%
Benktander	8.02%	3.68%	1.96%	2.58%	3.91%	1.87%	4.28%
Bornhuetter	8.05%	2.01%	1.89%	1.63%	2.01%	1.50%	2.09%
Credibility Weighted	8.12%	1.78%	2.26%	2.97%	4.51%	2.76%	1.46%
Hybrid Loss Ratio	6.06%	1.51%	0.72%	1.29%	2.38%	0.41%	1.33%
Lag - 12 Mo Avg	9.81%	10.44%	3.09%	15.46%	44.84%	10.97%	37.05%
Lag - 9 Mo Avg	8.59%	10.15%	2.53%	14.74%	43.50%	11.11%	37.50%
Lag - 6 Mo Avg	8.75%	10.61%	2.53%	14.71%	42.95%	10.85%	37.11%
Lag - 3 Mo Avg	7.56%	9.90%	2.75%	13.93%	42.71%	12.27%	35.79%
Lag - Cross Incurral	7.16%	0.48%	0.91%	0.88%	2.49%	-1.25%	-2.95%
Lag - Dollar Weighted	10.27%	2.30%	3.11%	4.21%	8.13%	1.48%	0.71%
Lag - Drop Extremes (10/12)	-0.28%	7.02%	-2.96%	10.04%	27.52%	5.17%	18.60%
Lag - Geometric Avg	5.76%	6.12%	1.39%	8.74%	22.81%	5.21%	16.06%
Lag - Harmonic Avg	3.16%	2.41%	0.31%	2.97%	6.35%	-0.18%	1.68%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	34.26%	2.57%	21.14%	12.83%	18.77%	16.92%	1.80%
PMPM	40.46%	2.80%	25.24%	15.96%	21.85%	21.60%	1.84%
Paid PMPM	35.05%	2.74%	21.58%	13.90%	19.05%	16.88%	6.45%
Benktander	34.43%	15.70%	21.85%	15.88%	21.98%	18.14%	8.85%
Bornhuetter	34.54%	9.09%	21.69%	14.25%	20.09%	17.62%	5.36%
Credibility Weighted	36.03%	8.20%	23.48%	16.92%	22.20%	19.72%	3.52%
Hybrid Loss Ratio	33.50%	9.03%	20.92%	13.69%	19.76%	16.98%	5.53%
Lag - 12 Mo Avg	39.80%	37.99%	25.78%	53.45%	100.14%	37.75%	51.55%
Lag - 9 Mo Avg	39.46%	38.47%	25.70%	53.58%	101.05%	38.33%	53.79%
Lag - 6 Mo Avg	39.41%	40.30%	25.78%	54.33%	102.60%	38.74%	59.72%
Lag - 3 Mo Avg	41.31%	42.68%	27.67%	56.73%	115.68%	41.96%	66.42%
Lag - Cross Incurral	38.13%	32.20%	24.76%	43.08%	65.20%	30.58%	28.39%
Lag - Dollar Weighted	40.37%	34.79%	25.94%	48.47%	74.45%	33.30%	33.49%
Lag - Drop Extremes (10/12)	35.87%	37.16%	24.22%	51.22%	89.13%	36.17%	45.08%
Lag - Geometric Avg	38.28%	36.91%	25.35%	51.16%	86.64%	35.83%	42.12%
Lag - Harmonic Avg	37.22%	35.48%	25.03%	48.90%	75.72%	33.52%	34.70%

## Comparison of IBNR Methodologies

### Large Claims Scenario (b)—Cont.

#### Results Set 4—Stochastic Simulation Results

##### All Incurral Months

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-5.88%	12.77%	29.60%	-0.62%	13.25%	40.00%
HMO Professional	0.52%	7.59%	49.60%	6.15%	8.03%	74.00%
Managed Care	-3.13%	9.21%	35.20%	0.60%	9.42%	51.20%
HMO Hospital	-2.13%	10.62%	40.80%	5.30%	11.42%	63.20%
Self Funded	-5.33%	9.71%	30.40%	-0.15%	10.23%	44.40%
Major Medical	-2.86%	10.52%	38.40%	2.11%	10.95%	57.20%
Medicare Supplement	-2.42%	4.80%	28.80%	2.33%	5.02%	69.20%

##### “Credible” Months (> 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-1.39%	21.67%	41.60%	9.82%	24.08%	64.40%
HMO Professional	13.34%	48.01%	52.80%	33.22%	55.69%	75.60%
Managed Care	-2.37%	12.38%	40.00%	3.57%	13.11%	58.80%
HMO Hospital	-0.70%	18.34%	41.20%	9.77%	20.19%	64.00%
Self Funded	-5.89%	11.61%	29.60%	-0.52%	12.31%	43.20%
Major Medical	-2.27%	13.60%	38.80%	4.17%	14.38%	62.80%
Medicare Supplement	-2.97%	6.59%	30.40%	2.23%	6.95%	62.80%

##### Most Recent Incurral Months (< 50% Completion Factor)

Block	Mean			75% Confidence Interval		
	Average Error	Std Dev of Error	Reserve Sufficiency	Average Error	Std Dev of Error	Reserve Sufficiency
HMO Medicare	-6.12%	12.85%	29.60%	-1.70%	13.20%	36.00%
HMO Professional	0.32%	7.54%	47.60%	4.52%	7.90%	66.80%
Managed Care	-3.30%	8.82%	33.60%	-1.17%	8.80%	41.60%
HMO Hospital	-2.19%	7.93%	38.00%	2.46%	8.36%	60.00%
Self Funded	-3.98%	9.63%	32.00%	0.96%	9.94%	51.20%
Major Medical	-3.10%	8.86%	35.60%	-0.06%	9.05%	45.20%
Medicare Supplement	-0.98%	2.31%	30.40%	2.83%	2.54%	87.20%

## Comparison of IBNR Methodologies

### Rate Spiral Scenario

- High lapse rates, increasing claims trends and accelerating premium increases

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-138.91%	-133.82%	-127.12%	-100.73%	-87.88%	-86.84%	-69.61%
PMPM	-409.65%	-393.01%	-362.81%	-281.86%	-242.94%	-228.78%	-174.02%
Paid PMPM	-10.67%	-22.24%	-7.00%	-34.76%	-38.82%	-32.83%	-47.09%
Benktander	-33.50%	-31.64%	-32.00%	-34.87%	-33.17%	-36.98%	-38.89%
Bornhuetter	-55.64%	-54.65%	-54.42%	-52.84%	-51.22%	-52.72%	-50.91%
Credibility Weighted	-11.82%	-19.95%	-7.68%	-26.55%	-26.44%	-24.95%	-31.91%
Hybrid Loss Ratio	-33.28%	-32.54%	-35.50%	-35.31%	-33.49%	-37.27%	-37.71%
Lag - 12 Mo Avg	2.93%	7.40%	1.57%	11.44%	25.01%	9.12%	32.17%
Lag - 9 Mo Avg	2.87%	7.30%	1.60%	11.32%	24.58%	9.62%	32.63%
Lag - 6 Mo Avg	2.98%	7.80%	1.75%	11.67%	24.68%	9.72%	32.38%
Lag - 3 Mo Avg	2.67%	7.53%	1.65%	11.01%	23.86%	10.83%	31.44%
Lag - Cross Incurral	-16.88%	-18.04%	-20.10%	-20.36%	-24.51%	-23.21%	-25.74%
Lag - Dollar Weighted	0.88%	1.49%	0.45%	3.20%	2.64%	-0.28%	0.16%
Lag - Drop Extremes (10/12)	1.19%	4.49%	-1.78%	5.99%	14.70%	5.47%	15.16%
Lag - Geometric Avg	1.84%	4.32%	1.03%	6.93%	12.77%	4.85%	13.68%
Lag - Harmonic Avg	0.83%	1.57%	0.47%	2.68%	3.30%	0.46%	1.00%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	6.88%	9.30%	5.30%	6.40%	4.84%	3.42%	3.21%
PMPM	22.63%	28.04%	14.10%	19.73%	13.81%	10.25%	6.74%
Paid PMPM	15.00%	17.06%	10.87%	16.04%	10.93%	10.37%	7.05%
Benktander	6.57%	9.62%	4.76%	8.33%	7.32%	5.25%	5.15%
Bornhuetter	2.73%	3.72%	2.25%	3.91%	3.08%	2.67%	2.26%
Credibility Weighted	11.17%	10.29%	8.74%	9.14%	5.69%	6.96%	3.94%
Hybrid Loss Ratio	4.45%	5.44%	3.38%	5.70%	4.33%	3.98%	3.17%
Lag - 12 Mo Avg	16.52%	27.33%	10.95%	32.52%	50.87%	26.11%	45.77%
Lag - 9 Mo Avg	16.85%	27.80%	11.29%	33.07%	51.76%	26.80%	47.63%
Lag - 6 Mo Avg	17.45%	29.33%	11.65%	34.55%	53.49%	27.28%	52.65%
Lag - 3 Mo Avg	18.77%	31.57%	12.95%	37.12%	58.71%	31.06%	59.05%
Lag - Cross Incurral	11.85%	18.29%	7.70%	19.49%	23.34%	14.81%	17.56%
Lag - Dollar Weighted	16.30%	25.40%	10.96%	29.65%	37.35%	22.45%	29.76%
Lag - Drop Extremes (10/12)	16.39%	26.71%	10.70%	31.48%	46.10%	25.61%	39.81%
Lag - Geometric Avg	16.64%	26.71%	11.18%	31.52%	43.92%	25.06%	37.21%
Lag - Harmonic Avg	16.43%	25.70%	11.08%	30.06%	38.09%	23.41%	30.69%



## Comparison of IBNR Methodologies

### Rate Spiral Scenario—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	-401.04%	-344.22%	-282.04%	-191.02%	-138.63%	-204.93%	-176.78%
PMPM	-1264.55%	-1081.82%	-869.59%	-581.84%	-415.25%	-640.37%	-557.70%
Paid PMPM	-4.67%	-6.49%	-3.91%	-26.05%	-19.00%	-16.13%	-9.23%
Benktander	-4.10%	-4.88%	-6.48%	-6.68%	-10.98%	-4.00%	-4.82%
Bornhuetter	-48.29%	-47.20%	-46.70%	-44.08%	-43.49%	-39.99%	-35.02%
Credibility Weighted	-3.45%	-3.44%	-2.10%	-17.12%	-13.44%	-7.18%	-3.65%
Hybrid Loss Ratio	-25.11%	-24.70%	-29.37%	-27.84%	-26.79%	-24.09%	-24.13%
Lag - 12 Mo Avg	4.88%	3.83%	2.38%	9.97%	6.12%	5.77%	1.79%
Lag - 9 Mo Avg	5.14%	4.15%	2.71%	10.25%	6.23%	6.11%	1.99%
Lag - 6 Mo Avg	5.29%	4.77%	3.02%	10.64%	6.14%	6.07%	2.14%
Lag - 3 Mo Avg	5.49%	5.46%	3.30%	10.61%	6.16%	6.55%	2.87%
Lag - Cross Incurral	-18.97%	-22.29%	-25.53%	-21.19%	-27.68%	-25.74%	-29.58%
Lag - Dollar Weighted	3.99%	3.18%	1.93%	5.92%	2.74%	3.86%	0.83%
Lag - Drop Extremes (10/12)	2.49%	2.08%	-3.37%	1.89%	0.10%	1.45%	-4.07%
Lag - Geometric Avg	4.55%	3.63%	2.39%	8.07%	4.33%	5.12%	1.53%
Lag - Harmonic Avg	3.97%	3.12%	2.07%	5.95%	2.58%	4.16%	1.07%

##### Standard Deviation

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	59.90%	47.24%	24.04%	32.35%	14.41%	28.14%	17.02%
PMPM	196.04%	155.30%	78.63%	104.37%	44.41%	94.55%	56.62%
Paid PMPM	21.80%	21.12%	14.52%	22.08%	14.27%	19.13%	14.10%
Benktander	19.12%	18.16%	12.17%	24.61%	14.99%	19.39%	13.49%
Bornhuetter	8.75%	9.03%	6.23%	11.36%	6.61%	10.35%	8.07%
Credibility Weighted	19.04%	18.54%	12.92%	18.70%	11.20%	18.25%	13.64%
Hybrid Loss Ratio	12.84%	12.32%	7.76%	14.73%	8.63%	13.49%	9.26%
Lag - 12 Mo Avg	21.17%	19.62%	13.01%	31.47%	21.26%	22.69%	14.64%
Lag - 9 Mo Avg	21.75%	20.49%	13.87%	32.46%	21.94%	22.66%	15.11%
Lag - 6 Mo Avg	22.47%	20.99%	14.30%	34.26%	22.56%	23.46%	16.05%
Lag - 3 Mo Avg	25.60%	25.50%	17.58%	38.48%	25.54%	26.36%	18.56%
Lag - Cross Incurral	15.94%	14.22%	9.00%	21.35%	13.45%	15.07%	9.63%
Lag - Dollar Weighted	21.15%	19.72%	12.98%	30.66%	20.32%	22.29%	14.46%
Lag - Drop Extremes (10/12)	20.90%	19.45%	12.40%	29.71%	20.29%	22.02%	14.00%
Lag - Geometric Avg	21.59%	20.38%	13.81%	31.77%	21.23%	22.43%	15.03%
Lag - Harmonic Avg	21.44%	20.28%	13.76%	31.09%	20.60%	22.22%	14.97%

## Comparison of IBNR Methodologies

### Rate Spiral Scenario—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-47.74%	-48.13%	-49.83%	-44.16%	-43.49%	-52.05%	-49.18%
PMPM	-112.25%	-112.46%	-110.01%	-93.70%	-91.97%	-107.36%	-100.84%
Paid PMPM	-11.89%	-27.68%	-8.09%	-39.09%	-55.55%	-37.30%	-54.19%
Benktander	-43.20%	-41.89%	-44.47%	-51.62%	-52.04%	-46.34%	-45.25%
Bornhuetter	-57.92%	-57.37%	-58.13%	-57.84%	-57.73%	-56.26%	-53.86%
Credibility Weighted	-13.97%	-25.94%	-10.03%	-31.52%	-37.41%	-29.75%	-37.18%
Hybrid Loss Ratio	-35.70%	-35.25%	-38.36%	-39.30%	-38.99%	-40.86%	-40.20%
Lag - 12 Mo Avg	3.31%	10.44%	1.69%	15.02%	44.91%	11.00%	38.38%
Lag - 9 Mo Avg	3.12%	10.15%	1.57%	14.62%	43.94%	11.54%	38.92%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.72%	38.59%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	13.05%	37.33%
Lag - Cross Incurral	-15.33%	-15.16%	-16.99%	-18.07%	-20.03%	-21.86%	-24.80%
Lag - Dollar Weighted	0.83%	2.28%	0.22%	2.99%	6.13%	-0.70%	0.34%
Lag - Drop Extremes (10/12)	1.77%	7.02%	-0.48%	11.15%	30.56%	7.53%	19.20%
Lag - Geometric Avg	1.93%	6.12%	0.87%	8.74%	23.07%	5.61%	16.37%
Lag - Harmonic Avg	0.76%	2.41%	0.19%	3.05%	6.51%	0.17%	1.31%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.95%	4.53%	3.38%	2.27%	2.50%	2.39%	2.74%
PMPM	5.45%	9.11%	3.63%	3.83%	4.60%	4.16%	4.00%
Paid PMPM	18.18%	22.14%	13.95%	21.32%	16.03%	12.08%	7.88%
Benktander	6.67%	11.31%	4.55%	5.89%	7.27%	4.62%	5.39%
Bornhuetter	2.34%	3.80%	1.69%	2.00%	2.37%	1.92%	2.15%
Credibility Weighted	13.41%	12.19%	11.36%	9.75%	5.24%	7.22%	3.85%
Hybrid Loss Ratio	3.65%	5.69%	3.02%	3.03%	3.49%	2.83%	3.06%
Lag - 12 Mo Avg	21.16%	37.99%	15.04%	50.28%	96.19%	33.64%	54.48%
Lag - 9 Mo Avg	21.44%	38.47%	15.30%	50.78%	97.48%	34.41%	56.91%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	35.17%	63.04%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	39.74%	70.44%
Lag - Cross Incurral	15.29%	25.73%	10.85%	29.97%	44.05%	19.17%	20.92%
Lag - Dollar Weighted	20.69%	34.90%	14.86%	45.15%	69.41%	28.74%	35.29%
Lag - Drop Extremes (10/12)	20.99%	37.16%	14.81%	48.87%	87.05%	32.97%	47.42%
Lag - Geometric Avg	21.17%	36.91%	15.14%	48.42%	82.51%	32.10%	44.37%
Lag - Harmonic Avg	20.91%	35.48%	15.00%	46.18%	71.38%	29.93%	36.46%

## Comparison of IBNR Methodologies

### Disruption Scenario (a)

- Claims processing at 50 percent capacity for one month; begins four months prior to valuation date and takes two months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-3.84%	-4.48%	-4.53%	-5.73%	-8.52%	-5.12%	-7.69%
PMPM	-7.61%	-8.44%	-7.88%	-9.04%	-12.63%	-7.53%	-9.61%
Paid PMPM	0.44%	8.15%	4.92%	2.83%	0.62%	2.43%	-1.39%
Benktander	4.33%	5.25%	3.02%	2.89%	1.93%	-0.16%	-0.96%
Bornhuetter	1.39%	1.84%	0.65%	0.19%	-0.96%	-2.09%	-3.41%
Credibility Weighted	1.74%	0.83%	1.81%	-0.80%	-1.53%	-1.80%	-4.21%
Hybrid Loss Ratio	-5.49%	-4.26%	-7.36%	-6.48%	-4.81%	-6.01%	-6.83%
Lag - 12 Mo Avg	8.98%	12.69%	6.59%	14.81%	24.72%	11.40%	31.05%
Lag - 9 Mo Avg	12.53%	16.13%	9.66%	18.09%	27.72%	14.92%	35.28%
Lag - 6 Mo Avg	19.89%	23.79%	15.97%	25.32%	34.64%	21.26%	43.05%
Lag - 3 Mo Avg	64.07%	68.59%	56.82%	73.85%	86.56%	71.78%	114.44%
Lag - Cross Incurral	-5.40%	-5.34%	-5.90%	-6.18%	-7.09%	-7.94%	-9.50%
Lag - Dollar Weighted	-0.14%	0.43%	-0.21%	0.78%	1.50%	-1.90%	-1.83%
Lag - Drop Extremes (10/12)	-7.60%	-3.23%	-10.18%	-3.69%	6.26%	-4.18%	6.43%
Lag - Geometric Avg	0.78%	2.90%	0.09%	3.82%	7.97%	1.34%	7.34%
Lag - Harmonic Avg	-7.53%	-6.43%	-6.68%	-6.36%	-4.81%	-8.40%	-9.29%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.52%	4.79%	4.19%	4.83%	2.63%	3.85%	2.76%
PMPM	10.01%	9.41%	8.38%	6.46%	5.02%	5.20%	3.74%
Paid PMPM	5.89%	6.91%	5.13%	8.20%	3.94%	7.64%	8.41%
Benktander	9.59%	12.71%	7.13%	13.17%	9.68%	8.49%	7.60%
Bornhuetter	7.11%	8.95%	5.79%	10.12%	6.70%	6.70%	5.14%
Credibility Weighted	7.27%	8.04%	6.43%	9.12%	5.38%	6.80%	4.23%
Hybrid Loss Ratio	6.63%	8.31%	5.21%	9.65%	6.52%	7.13%	5.44%
Lag - 12 Mo Avg	17.07%	27.00%	11.12%	31.25%	43.72%	24.35%	41.43%
Lag - 9 Mo Avg	18.13%	28.60%	11.95%	33.16%	46.39%	26.06%	44.86%
Lag - 6 Mo Avg	20.25%	32.61%	13.20%	37.65%	52.46%	28.81%	53.75%
Lag - 3 Mo Avg	30.28%	48.84%	19.94%	59.29%	86.29%	48.56%	100.32%
Lag - Cross Incurral	13.45%	20.07%	8.88%	21.80%	24.23%	16.74%	20.15%
Lag - Dollar Weighted	15.33%	22.90%	10.25%	26.00%	29.34%	19.58%	25.49%
Lag - Drop Extremes (10/12)	14.18%	22.61%	9.22%	25.60%	34.96%	20.62%	32.43%
Lag - Geometric Avg	15.75%	24.13%	10.58%	27.62%	34.07%	21.37%	30.61%
Lag - Harmonic Avg	14.27%	21.39%	9.74%	24.16%	27.15%	18.20%	23.08%

## Comparison of IBNR Methodologies

### Disruption Scenario (a)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-11.17%	-11.41%	-10.22%	-11.20%	-14.16%	-24.53%	-36.04%
PMPM	-20.95%	-20.62%	-17.13%	-17.16%	-20.26%	-29.49%	-40.10%
Paid PMPM	2.49%	21.97%	11.59%	6.14%	1.20%	2.15%	-5.98%
Benktander	0.46%	0.39%	-0.56%	3.44%	0.62%	-19.41%	-29.56%
Bornhuetter	-2.19%	-1.94%	-2.35%	-0.16%	-2.45%	-20.92%	-30.32%
Credibility Weighted	-2.80%	-1.91%	-2.11%	-2.59%	-3.11%	-20.32%	-29.72%
Hybrid Loss Ratio	-12.81%	-10.60%	-14.51%	-12.17%	-8.77%	-24.77%	-35.93%
Lag - 12 Mo Avg	-1.31%	-1.12%	-1.84%	3.97%	1.85%	-19.69%	-29.73%
Lag - 9 Mo Avg	1.18%	1.02%	-0.01%	6.05%	3.31%	-19.04%	-29.41%
Lag - 6 Mo Avg	5.80%	5.49%	3.38%	10.18%	6.02%	-18.31%	-28.94%
Lag - 3 Mo Avg	36.01%	34.37%	29.88%	40.54%	33.39%	-1.43%	-14.56%
Lag - Cross Incurral	-11.82%	-11.27%	-10.79%	-9.50%	-10.67%	-25.56%	-34.89%
Lag - Dollar Weighted	-7.65%	-6.18%	-5.47%	-2.97%	-2.78%	-21.38%	-30.34%
Lag - Drop Extremes (10/12)	-13.37%	-11.29%	-15.47%	-12.11%	-8.62%	-24.97%	-36.48%
Lag - Geometric Avg	-5.70%	-4.79%	-4.55%	-1.08%	-2.09%	-20.86%	-30.41%
Lag - Harmonic Avg	-11.28%	-9.51%	-8.25%	-6.69%	-6.19%	-22.58%	-31.35%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	12.11%	11.45%	8.88%	8.35%	3.85%	7.54%	6.17%
PMPM	26.47%	22.03%	17.12%	11.58%	7.54%	10.92%	8.61%
Paid PMPM	14.00%	17.74%	10.00%	15.04%	5.78%	14.02%	13.28%
Benktander	20.26%	20.02%	13.54%	25.74%	14.39%	13.48%	7.36%
Bornhuetter	16.99%	17.67%	11.90%	20.24%	10.38%	11.48%	6.44%
Credibility Weighted	15.61%	17.22%	12.08%	16.93%	8.23%	11.16%	6.88%
Hybrid Loss Ratio	14.84%	15.57%	10.00%	17.59%	9.69%	11.38%	5.79%
Lag - 12 Mo Avg	20.26%	19.54%	12.93%	28.44%	17.66%	14.24%	7.24%
Lag - 9 Mo Avg	21.36%	20.86%	14.14%	30.12%	18.70%	14.38%	7.67%
Lag - 6 Mo Avg	23.18%	22.21%	15.13%	33.27%	20.19%	15.46%	8.69%
Lag - 3 Mo Avg	32.36%	31.93%	21.67%	46.62%	29.08%	20.76%	12.24%
Lag - Cross Incurral	17.49%	17.03%	11.30%	23.05%	13.77%	12.37%	6.22%
Lag - Dollar Weighted	18.88%	18.66%	12.42%	26.24%	16.10%	13.90%	7.23%
Lag - Drop Extremes (10/12)	17.41%	17.36%	11.23%	23.53%	15.34%	13.77%	6.53%
Lag - Geometric Avg	19.70%	19.60%	13.50%	27.57%	16.89%	14.02%	7.53%
Lag - Harmonic Avg	18.49%	18.68%	13.02%	25.80%	15.72%	13.69%	7.41%

## Comparison of IBNR Methodologies

### Disruption Scenario (a)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.27%	0.23%	0.14%	0.34%	0.20%	8.30%	7.59%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	7.55%	6.80%
Paid PMPM	0.06%	0.14%	0.00%	0.02%	-0.02%	2.90%	1.19%
Benktander	7.61%	9.86%	6.46%	4.43%	5.02%	13.81%	14.73%
Bornhuetter	4.27%	5.42%	3.52%	2.18%	2.03%	11.42%	11.29%
Credibility Weighted	5.06%	3.59%	5.44%	2.28%	1.37%	11.44%	9.67%
Hybrid Loss Ratio	-0.68%	0.89%	-1.22%	0.91%	1.92%	7.43%	9.01%
Lag - 12 Mo Avg	16.04%	23.97%	14.07%	29.61%	63.88%	33.90%	64.51%
Lag - 9 Mo Avg	20.18%	28.29%	18.18%	34.20%	69.32%	39.41%	70.92%
Lag - 6 Mo Avg	29.15%	38.16%	26.86%	44.95%	83.07%	49.70%	82.65%
Lag - 3 Mo Avg	81.38%	94.02%	79.44%	113.74%	174.36%	123.90%	185.02%
Lag - Cross Incurral	-0.65%	0.42%	-1.33%	0.01%	1.03%	5.05%	4.61%
Lag - Dollar Weighted	5.30%	6.81%	4.69%	7.70%	11.07%	12.46%	14.04%
Lag - Drop Extremes (10/12)	-3.21%	4.02%	-5.31%	8.02%	32.50%	11.07%	30.13%
Lag - Geometric Avg	5.67%	10.00%	4.51%	12.06%	26.73%	17.60%	28.29%
Lag - Harmonic Avg	-4.21%	-2.51%	-4.74%	-3.22%	0.11%	2.24%	3.09%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.47%	2.46%	2.39%	2.29%	2.07%	3.08%	2.68%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.92%	2.65%
Paid PMPM	5.35%	4.31%	5.12%	3.74%	2.87%	4.57%	6.94%
Benktander	9.79%	16.53%	6.78%	8.71%	10.66%	10.04%	11.43%
Bornhuetter	5.82%	9.43%	4.19%	4.87%	5.74%	6.97%	7.48%
Credibility Weighted	6.66%	6.46%	5.72%	4.58%	3.22%	6.50%	4.80%
Hybrid Loss Ratio	5.53%	9.02%	4.00%	4.91%	5.76%	7.06%	7.59%
Lag - 12 Mo Avg	24.03%	43.18%	17.07%	57.49%	110.47%	40.62%	64.49%
Lag - 9 Mo Avg	25.33%	45.60%	18.07%	60.53%	116.80%	43.34%	70.24%
Lag - 6 Mo Avg	28.26%	51.66%	20.15%	67.78%	132.38%	48.39%	84.26%
Lag - 3 Mo Avg	41.65%	77.01%	30.23%	105.98%	217.09%	82.01%	155.82%
Lag - Cross Incurral	19.07%	32.24%	13.70%	39.90%	60.67%	27.51%	31.17%
Lag - Dollar Weighted	21.50%	36.27%	15.45%	46.91%	72.32%	31.93%	39.28%
Lag - Drop Extremes (10/12)	20.05%	36.25%	14.17%	47.44%	88.33%	33.65%	50.25%
Lag - Geometric Avg	21.93%	38.22%	15.68%	49.88%	84.95%	34.93%	47.75%
Lag - Harmonic Avg	19.79%	33.66%	14.20%	43.12%	66.88%	29.30%	35.71%

## Comparison of IBNR Methodologies

### Disruption Scenario (b)

- Claims processing at 50 percent capacity for one month; begins four months prior to valuation date and takes four months to catch up

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-23.94%	-23.39%	-21.40%	-17.84%	-17.38%	-13.90%	-12.25%
PMPM	-28.26%	-27.64%	-25.16%	-21.89%	-22.27%	-17.03%	-14.87%
Paid PMPM	-10.30%	-2.84%	-2.28%	-0.63%	-2.16%	0.32%	-1.79%
Benktander	-5.06%	-3.37%	-4.12%	-2.15%	-1.29%	-2.55%	-0.81%
Bornhuetter	-11.02%	-9.64%	-9.27%	-7.05%	-6.09%	-6.54%	-4.88%
Credibility Weighted	-9.60%	-10.84%	-6.09%	-9.01%	-7.28%	-6.05%	-6.02%
Hybrid Loss Ratio	-17.04%	-15.15%	-16.66%	-13.00%	-9.55%	-9.87%	-7.97%
Lag - 12 Mo Avg	5.78%	10.08%	5.13%	16.75%	28.68%	16.57%	41.99%
Lag - 9 Mo Avg	9.83%	14.06%	8.79%	20.66%	32.39%	20.92%	47.32%
Lag - 6 Mo Avg	18.24%	22.83%	16.30%	29.26%	40.84%	28.94%	57.31%
Lag - 3 Mo Avg	65.54%	71.13%	61.16%	83.33%	99.60%	87.38%	141.87%
Lag - Cross Incurral	-6.70%	-6.29%	-6.11%	-3.74%	-4.09%	-3.33%	-2.14%
Lag - Dollar Weighted	-2.39%	-1.44%	-1.33%	2.35%	3.85%	1.92%	4.84%
Lag - Drop Extremes (10/12)	-9.41%	-4.65%	-10.65%	-0.32%	10.59%	2.20%	17.15%
Lag - Geometric Avg	1.14%	3.68%	1.58%	8.58%	13.97%	8.78%	19.31%
Lag - Harmonic Avg	-5.32%	-3.99%	-3.76%	-0.60%	1.43%	-0.51%	1.86%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.86%	4.26%	3.63%	4.13%	2.49%	3.44%	2.72%
PMPM	8.91%	8.58%	7.56%	6.17%	4.96%	4.93%	3.70%
Paid PMPM	4.40%	5.14%	4.29%	7.40%	3.55%	7.09%	8.18%
Benktander	7.99%	11.17%	6.14%	11.51%	8.88%	7.79%	7.33%
Bornhuetter	5.36%	7.24%	4.71%	8.30%	5.69%	5.86%	4.67%
Credibility Weighted	5.93%	6.49%	5.70%	7.62%	4.47%	6.20%	3.88%
Hybrid Loss Ratio	5.00%	6.71%	4.24%	8.04%	5.59%	6.29%	4.97%
Lag - 12 Mo Avg	16.09%	26.20%	10.70%	31.57%	46.01%	25.74%	45.29%
Lag - 9 Mo Avg	17.14%	27.81%	11.52%	33.57%	48.89%	27.65%	49.24%
Lag - 6 Mo Avg	19.29%	31.85%	12.83%	38.28%	55.35%	30.81%	59.36%
Lag - 3 Mo Avg	29.19%	48.18%	19.69%	61.07%	91.86%	52.82%	111.96%
Lag - Cross Incurral	12.79%	19.63%	8.60%	22.06%	25.47%	17.58%	21.96%
Lag - Dollar Weighted	14.53%	22.31%	9.88%	26.21%	30.86%	20.46%	27.45%
Lag - Drop Extremes (10/12)	13.67%	22.48%	9.05%	26.69%	37.74%	22.37%	36.33%
Lag - Geometric Avg	15.40%	24.27%	10.49%	28.88%	37.25%	23.30%	34.76%
Lag - Harmonic Avg	14.23%	21.91%	9.80%	25.68%	30.19%	20.07%	26.63%

## Comparison of IBNR Methodologies

### Disruption Scenario (b)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-53.18%	-48.36%	-41.26%	-32.64%	-27.92%	-34.87%	-39.06%
PMPM	-60.93%	-55.84%	-47.57%	-38.94%	-34.67%	-40.67%	-44.28%
Paid PMPM	-25.74%	-6.46%	-8.24%	-1.06%	-3.27%	-0.70%	-5.98%
Benktander	-29.13%	-25.05%	-20.50%	-8.51%	-5.79%	-23.22%	-26.93%
Bornhuetter	-33.96%	-29.57%	-24.57%	-14.74%	-11.16%	-26.00%	-28.76%
Credibility Weighted	-34.46%	-29.24%	-23.51%	-18.93%	-12.77%	-25.44%	-27.75%
Hybrid Loss Ratio	-42.36%	-36.83%	-34.99%	-25.04%	-16.98%	-29.84%	-34.72%
Lag - 12 Mo Avg	-30.13%	-25.92%	-21.21%	-6.47%	-2.98%	-23.50%	-27.25%
Lag - 9 Mo Avg	-27.62%	-23.60%	-19.05%	-3.90%	-0.95%	-22.35%	-26.43%
Lag - 6 Mo Avg	-22.85%	-18.80%	-14.91%	1.23%	2.95%	-20.57%	-24.99%
Lag - 3 Mo Avg	2.94%	7.12%	10.58%	33.02%	33.19%	-1.25%	-7.30%
Lag - Cross Incurral	-36.56%	-32.73%	-27.89%	-17.97%	-14.76%	-29.32%	-32.89%
Lag - Dollar Weighted	-33.16%	-28.64%	-23.46%	-12.40%	-7.70%	-25.20%	-28.16%
Lag - Drop Extremes (10/12)	-40.00%	-34.66%	-33.18%	-20.68%	-12.99%	-28.60%	-34.27%
Lag - Geometric Avg	-31.00%	-26.66%	-21.62%	-8.96%	-5.11%	-23.67%	-27.20%
Lag - Harmonic Avg	-33.73%	-29.13%	-23.69%	-13.02%	-8.36%	-24.91%	-27.91%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	8.73%	8.37%	6.66%	7.00%	3.92%	7.24%	6.49%
PMPM	18.15%	16.15%	13.22%	10.83%	7.39%	10.56%	8.85%
Paid PMPM	6.53%	8.97%	6.40%	11.76%	4.86%	12.59%	13.28%
Benktander	10.11%	11.37%	8.92%	18.94%	12.07%	11.77%	7.56%
Bornhuetter	7.62%	9.57%	7.52%	13.84%	8.02%	9.80%	6.52%
Credibility Weighted	7.18%	9.64%	7.98%	11.58%	6.23%	9.74%	7.09%
Hybrid Loss Ratio	6.48%	8.24%	6.22%	12.20%	7.51%	9.62%	5.84%
Lag - 12 Mo Avg	10.17%	11.07%	8.47%	21.74%	15.56%	12.46%	7.44%
Lag - 9 Mo Avg	11.04%	12.13%	9.50%	23.29%	16.68%	12.71%	7.94%
Lag - 6 Mo Avg	12.39%	13.23%	10.37%	26.29%	18.32%	13.92%	9.05%
Lag - 3 Mo Avg	18.44%	20.37%	15.69%	38.50%	27.32%	19.45%	13.04%
Lag - Cross Incurral	8.81%	9.68%	7.38%	17.58%	12.03%	10.75%	6.36%
Lag - Dollar Weighted	9.59%	10.65%	8.15%	19.96%	14.05%	12.16%	7.40%
Lag - Drop Extremes (10/12)	8.65%	9.80%	7.36%	18.33%	13.61%	11.99%	6.68%
Lag - Geometric Avg	10.41%	11.60%	9.20%	21.70%	15.29%	12.47%	7.83%
Lag - Harmonic Avg	9.96%	11.23%	8.97%	20.56%	14.35%	12.26%	7.73%

## Comparison of IBNR Methodologies

### Disruption Scenario (b)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	1.00%	0.69%	0.53%	0.90%	0.82%	1.28%	1.65%
PMPM	-0.41%	-0.49%	-0.46%	-0.45%	-0.91%	0.01%	0.36%
Paid PMPM	3.28%	1.14%	4.58%	0.28%	-0.09%	1.27%	0.48%
Benktander	16.28%	18.90%	14.39%	7.38%	7.46%	13.02%	13.00%
Bornhuetter	9.11%	10.45%	7.92%	3.71%	3.29%	7.99%	7.69%
Credibility Weighted	12.20%	7.61%	13.52%	4.29%	2.58%	8.39%	5.38%
Hybrid Loss Ratio	5.09%	6.57%	3.85%	3.19%	3.86%	5.00%	6.07%
Lag - 12 Mo Avg	37.79%	47.68%	34.92%	49.34%	88.49%	46.62%	78.60%
Lag - 9 Mo Avg	43.18%	53.33%	40.26%	55.04%	95.22%	53.29%	86.34%
Lag - 6 Mo Avg	54.85%	66.18%	51.56%	68.32%	112.10%	65.95%	100.80%
Lag - 3 Mo Avg	121.06%	137.23%	118.08%	151.93%	222.62%	153.32%	220.36%
Lag - Cross Incurral	19.92%	21.52%	18.55%	16.74%	17.47%	16.28%	14.22%
Lag - Dollar Weighted	25.10%	27.31%	23.75%	23.77%	27.42%	22.42%	22.44%
Lag - Drop Extremes (10/12)	17.86%	26.81%	14.82%	28.24%	55.66%	25.38%	44.40%
Lag - Geometric Avg	29.84%	35.60%	27.87%	33.73%	51.17%	33.20%	44.05%
Lag - Harmonic Avg	20.12%	22.68%	18.89%	17.81%	21.84%	18.00%	17.80%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.68%	2.61%	2.49%	2.32%	2.10%	2.37%	1.91%
PMPM	2.92%	2.92%	2.83%	2.37%	2.30%	2.19%	1.93%
Paid PMPM	5.58%	4.35%	5.43%	3.74%	2.83%	4.14%	6.60%
Benktander	11.82%	20.00%	8.05%	9.97%	12.16%	9.41%	10.63%
Bornhuetter	6.92%	11.33%	4.87%	5.49%	6.49%	5.98%	6.39%
Credibility Weighted	8.59%	8.01%	7.38%	5.28%	3.60%	5.89%	3.77%
Hybrid Loss Ratio	6.69%	10.93%	4.68%	5.54%	6.54%	6.16%	6.53%
Lag - 12 Mo Avg	29.60%	53.25%	20.81%	67.15%	128.13%	44.19%	69.43%
Lag - 9 Mo Avg	31.23%	56.23%	22.04%	70.79%	135.55%	47.30%	75.87%
Lag - 6 Mo Avg	34.88%	63.72%	24.61%	79.37%	153.50%	53.10%	91.56%
Lag - 3 Mo Avg	51.69%	95.41%	37.13%	124.96%	253.18%	91.31%	171.34%
Lag - Cross Incurral	23.78%	40.25%	16.90%	46.74%	70.42%	29.86%	33.54%
Lag - Dollar Weighted	26.60%	44.95%	18.90%	54.87%	84.14%	34.46%	41.72%
Lag - Drop Extremes (10/12)	25.36%	45.90%	17.74%	57.27%	105.16%	37.87%	55.53%
Lag - Geometric Avg	28.01%	48.91%	19.82%	60.54%	102.64%	39.37%	53.43%
Lag - Harmonic Avg	25.80%	43.95%	18.32%	53.38%	82.40%	33.54%	40.68%



## Comparison of IBNR Methodologies

### Disruption Scenario (c)

- Claims processing at 50 percent capacity for one month; begins 12 months prior to valuation date and takes two months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.71%	-0.21%	-0.69%	-0.83%	-4.95%	0.05%	-1.96%
PMPM	-3.02%	-4.16%	-3.97%	-4.14%	-8.93%	-2.35%	-3.79%
Paid PMPM	0.66%	2.23%	1.44%	5.26%	-0.41%	3.93%	0.52%
Benktander	0.33%	1.67%	-0.36%	2.59%	1.62%	0.89%	2.26%
Bornhuetter	0.46%	1.08%	-0.14%	1.78%	0.18%	0.46%	0.80%
Credibility Weighted	0.72%	1.36%	-0.06%	2.09%	0.77%	1.01%	0.60%
Hybrid Loss Ratio	-0.85%	0.24%	-3.45%	-1.40%	-0.84%	-0.73%	-0.88%
Lag - 12 Mo Avg	14.42%	17.94%	11.11%	20.87%	29.68%	17.45%	39.08%
Lag - 9 Mo Avg	-0.31%	3.50%	-1.37%	6.64%	15.20%	4.72%	22.42%
Lag - 6 Mo Avg	3.58%	7.92%	2.36%	11.01%	19.59%	9.00%	27.73%
Lag - 3 Mo Avg	3.42%	7.97%	2.39%	10.48%	19.02%	10.14%	27.00%
Lag - Cross Incurral	-0.64%	-0.81%	-1.85%	-1.11%	-3.14%	-2.76%	-3.77%
Lag - Dollar Weighted	1.16%	1.67%	0.67%	2.57%	2.45%	0.01%	0.31%
Lag - Drop Extremes (10/12)	-2.92%	1.46%	-6.30%	1.70%	10.82%	1.27%	13.52%
Lag - Geometric Avg	-1.63%	0.54%	-2.20%	2.56%	6.09%	0.51%	6.81%
Lag - Harmonic Avg	-2.95%	-2.24%	-3.03%	-1.41%	-1.28%	-3.39%	-3.73%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.53%	4.89%	4.22%	4.91%	2.65%	4.19%	2.79%
PMPM	10.38%	9.67%	8.62%	6.56%	5.15%	5.29%	3.81%
Paid PMPM	6.08%	6.69%	5.61%	8.34%	4.12%	7.58%	7.67%
Benktander	8.92%	12.39%	6.92%	12.46%	9.03%	8.52%	7.60%
Bornhuetter	6.70%	8.92%	5.78%	9.78%	6.28%	6.89%	5.18%
Credibility Weighted	7.29%	8.42%	6.59%	9.25%	5.36%	7.24%	4.56%
Hybrid Loss Ratio	7.03%	9.09%	5.70%	9.94%	6.51%	7.35%	5.47%
Lag - 12 Mo Avg	17.48%	28.03%	11.35%	31.79%	44.49%	25.43%	43.68%
Lag - 9 Mo Avg	15.41%	24.53%	10.39%	27.98%	38.37%	22.14%	37.87%
Lag - 6 Mo Avg	16.77%	27.22%	11.24%	30.95%	41.85%	23.71%	44.12%
Lag - 3 Mo Avg	18.30%	29.76%	13.00%	33.86%	46.34%	27.05%	49.46%
Lag - Cross Incurral	14.22%	21.36%	9.38%	22.98%	25.28%	17.78%	21.42%
Lag - Dollar Weighted	15.51%	23.39%	10.39%	26.16%	29.38%	19.84%	25.39%
Lag - Drop Extremes (10/12)	14.94%	23.92%	9.77%	26.99%	36.48%	21.37%	34.61%
Lag - Geometric Avg	15.18%	23.53%	10.27%	26.61%	32.60%	20.79%	29.59%
Lag - Harmonic Avg	14.96%	22.61%	10.15%	25.34%	28.30%	19.55%	24.46%

## Comparison of IBNR Methodologies

### Disruption Scenario (c)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.35%	-0.27%	-1.44%	-1.72%	-8.45%	0.17%	-7.31%
PMPM	-8.72%	-10.50%	-8.79%	-8.07%	-14.55%	-6.33%	-12.90%
Paid PMPM	5.15%	9.27%	4.92%	12.58%	0.10%	15.54%	4.36%
Benktander	4.91%	3.99%	1.89%	6.14%	1.49%	5.01%	0.66%
Bornhuetter	4.23%	3.33%	1.55%	4.75%	0.13%	3.46%	-0.15%
Credibility Weighted	5.10%	4.32%	2.21%	4.64%	0.97%	4.44%	0.67%
Hybrid Loss Ratio	0.94%	1.20%	-5.74%	-2.29%	-2.28%	0.71%	-6.05%
Lag - 12 Mo Avg	13.96%	11.60%	8.09%	15.19%	8.97%	7.55%	2.98%
Lag - 9 Mo Avg	4.94%	3.98%	1.86%	6.83%	2.28%	5.30%	0.79%
Lag - 6 Mo Avg	7.11%	6.81%	4.35%	9.93%	4.75%	6.92%	2.28%
Lag - 3 Mo Avg	7.65%	8.07%	4.84%	9.91%	4.82%	7.95%	3.27%
Lag - Cross Incurral	1.90%	0.23%	-1.71%	0.38%	-4.38%	-0.42%	-4.72%
Lag - Dollar Weighted	4.60%	4.02%	2.25%	5.03%	1.74%	3.89%	0.68%
Lag - Drop Extremes (10/12)	0.36%	0.48%	-6.74%	-2.14%	-2.06%	0.55%	-6.64%
Lag - Geometric Avg	4.09%	3.22%	1.37%	4.70%	0.70%	4.34%	0.32%
Lag - Harmonic Avg	3.23%	2.45%	0.87%	2.60%	-0.78%	3.39%	-0.13%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	13.43%	12.67%	9.51%	9.18%	4.05%	10.94%	8.41%
PMPM	29.99%	24.21%	18.48%	12.31%	7.96%	13.96%	11.48%
Paid PMPM	15.38%	17.57%	11.01%	16.96%	6.29%	19.50%	15.49%
Benktander	20.73%	21.16%	14.19%	25.75%	13.66%	21.11%	14.10%
Bornhuetter	17.98%	19.31%	12.82%	20.94%	10.03%	18.50%	12.46%
Credibility Weighted	17.09%	19.26%	13.19%	18.46%	8.42%	18.32%	13.05%
Hybrid Loss Ratio	17.70%	18.59%	11.59%	19.68%	10.01%	18.32%	11.47%
Lag - 12 Mo Avg	22.78%	22.15%	14.31%	30.13%	17.69%	22.60%	14.34%
Lag - 9 Mo Avg	21.45%	21.67%	14.57%	28.77%	16.83%	22.13%	14.59%
Lag - 6 Mo Avg	22.61%	22.65%	15.46%	31.32%	17.81%	23.64%	15.86%
Lag - 3 Mo Avg	26.09%	28.26%	19.76%	35.81%	20.45%	26.65%	18.89%
Lag - Cross Incurral	20.08%	19.65%	12.66%	25.01%	14.08%	19.88%	12.44%
Lag - Dollar Weighted	21.03%	20.93%	13.60%	27.44%	15.93%	21.84%	14.02%
Lag - Drop Extremes (10/12)	20.42%	20.33%	12.75%	26.18%	16.00%	21.26%	12.96%
Lag - Geometric Avg	21.25%	21.54%	14.49%	28.15%	16.30%	21.92%	14.53%
Lag - Harmonic Avg	21.06%	21.40%	14.40%	27.56%	15.83%	21.72%	14.46%

## Comparison of IBNR Methodologies

### Disruption Scenario (c)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.06%	0.05%	-0.02%	0.25%	0.08%	0.17%	-0.06%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	-0.64%	-0.82%	-0.60%	-0.74%	-0.85%	-0.93%	-0.56%
Benktander	-0.76%	1.73%	-1.43%	1.14%	2.75%	-0.15%	3.18%
Bornhuetter	-0.43%	0.91%	-0.89%	0.47%	0.88%	-0.21%	1.43%
Credibility Weighted	-0.52%	0.67%	-1.19%	0.86%	0.92%	0.10%	0.85%
Hybrid Loss Ratio	-0.84%	0.76%	-1.34%	0.85%	1.83%	-0.66%	1.17%
Lag - 12 Mo Avg	16.08%	23.92%	14.09%	29.53%	63.28%	23.43%	52.10%
Lag - 9 Mo Avg	-1.51%	5.20%	-3.02%	9.28%	36.94%	5.58%	30.46%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.61%	0.46%	-1.29%	0.02%	1.07%	-2.86%	-3.00%
Lag - Dollar Weighted	0.82%	2.29%	0.21%	2.96%	6.18%	-0.75%	0.67%
Lag - Drop Extremes (10/12)	-3.25%	3.95%	-5.33%	8.01%	32.40%	2.71%	20.97%
Lag - Geometric Avg	-3.06%	0.93%	-4.09%	3.26%	16.71%	-0.22%	9.60%
Lag - Harmonic Avg	-4.61%	-3.04%	-5.18%	-2.56%	0.65%	-5.56%	-4.45%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.57%	2.58%	2.43%	2.28%	2.09%	2.25%	1.80%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	5.67%	4.41%	5.72%	3.85%	2.89%	4.43%	6.13%
Benktander	9.13%	15.48%	6.33%	8.46%	10.44%	7.35%	8.80%
Bornhuetter	5.54%	9.01%	4.00%	4.77%	5.66%	4.83%	5.35%
Credibility Weighted	6.78%	6.83%	5.72%	5.03%	3.55%	4.77%	3.23%
Hybrid Loss Ratio	5.55%	8.99%	4.01%	4.87%	5.72%	5.02%	5.43%
Lag - 12 Mo Avg	23.77%	42.88%	16.87%	56.59%	109.29%	36.21%	58.47%
Lag - 9 Mo Avg	20.42%	36.69%	14.56%	48.22%	92.40%	31.02%	50.98%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.05%	32.24%	13.68%	39.93%	60.60%	24.94%	28.46%
Lag - Dollar Weighted	20.61%	34.84%	14.80%	45.04%	69.41%	27.65%	33.58%
Lag - Drop Extremes (10/12)	19.88%	35.87%	14.10%	47.27%	87.99%	30.04%	46.31%
Lag - Geometric Avg	20.12%	35.12%	14.39%	45.86%	78.11%	28.95%	39.66%
Lag - Harmonic Avg	19.83%	33.70%	14.22%	43.64%	67.46%	27.06%	32.52%

## Comparison of IBNR Methodologies

### Disruption Scenario (d)

- Claims processing at 50 percent capacity for one month; begins 12 months prior to valuation date and takes four months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.55%	-0.42%	-0.87%	-0.96%	-5.08%	-0.12%	-2.19%
PMPM	-2.66%	-3.89%	-3.74%	-4.02%	-8.86%	-2.32%	-3.82%
Paid PMPM	1.06%	2.11%	1.01%	3.65%	-0.01%	2.56%	0.01%
Benktander	-1.98%	-0.46%	-2.30%	1.18%	0.59%	-0.25%	1.50%
Bornhuetter	-1.39%	-0.61%	-1.66%	0.69%	-0.60%	-0.41%	0.21%
Credibility Weighted	-1.40%	-0.47%	-1.97%	1.14%	0.02%	0.10%	-0.03%
Hybrid Loss Ratio	-1.97%	-0.74%	-4.47%	-1.90%	-1.33%	-0.95%	-1.23%
Lag - 12 Mo Avg	12.62%	16.16%	9.54%	19.00%	27.85%	15.64%	36.56%
Lag - 9 Mo Avg	-3.29%	0.73%	-3.89%	4.69%	13.77%	3.12%	21.45%
Lag - 6 Mo Avg	3.95%	8.22%	2.60%	11.16%	19.68%	9.04%	27.70%
Lag - 3 Mo Avg	3.79%	8.27%	2.63%	10.62%	19.10%	10.18%	26.97%
Lag - Cross Incurral	-0.20%	-0.48%	-1.54%	-0.96%	-3.10%	-2.66%	-3.75%
Lag - Dollar Weighted	1.60%	2.00%	0.98%	2.72%	2.47%	0.11%	0.35%
Lag - Drop Extremes (10/12)	-4.29%	0.25%	-7.61%	1.29%	9.97%	1.17%	12.88%
Lag - Geometric Avg	-4.44%	-2.11%	-4.56%	0.69%	4.64%	-0.95%	5.90%
Lag - Harmonic Avg	-5.57%	-4.76%	-5.22%	-3.20%	-2.72%	-4.72%	-4.55%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.49%	4.87%	4.23%	4.91%	2.64%	4.15%	2.80%
PMPM	10.44%	9.71%	8.66%	6.59%	5.17%	5.30%	3.81%
Paid PMPM	5.73%	6.44%	5.30%	7.86%	4.04%	7.21%	7.76%
Benktander	8.78%	12.29%	6.83%	12.35%	8.95%	8.44%	7.55%
Bornhuetter	6.60%	8.84%	5.72%	9.74%	6.24%	6.84%	5.15%
Credibility Weighted	7.47%	8.51%	6.73%	9.31%	5.39%	7.25%	4.62%
Hybrid Loss Ratio	6.99%	9.10%	5.71%	9.98%	6.51%	7.37%	5.49%
Lag - 12 Mo Avg	17.19%	27.60%	11.17%	31.29%	43.68%	24.90%	42.51%
Lag - 9 Mo Avg	15.17%	24.25%	10.23%	27.83%	38.37%	22.03%	37.81%
Lag - 6 Mo Avg	16.80%	27.29%	11.24%	31.00%	41.87%	23.70%	44.12%
Lag - 3 Mo Avg	18.34%	29.82%	13.00%	33.91%	46.36%	27.07%	49.47%
Lag - Cross Incurral	14.20%	21.34%	9.35%	22.96%	25.17%	17.74%	21.41%
Lag - Dollar Weighted	15.49%	23.36%	10.36%	26.13%	29.21%	19.79%	25.38%
Lag - Drop Extremes (10/12)	15.00%	24.01%	9.77%	27.30%	36.54%	21.46%	34.59%
Lag - Geometric Avg	14.92%	23.20%	10.11%	26.45%	32.43%	20.66%	29.54%
Lag - Harmonic Avg	14.69%	22.24%	10.00%	25.15%	28.05%	19.39%	24.38%

## Comparison of IBNR Methodologies

### Disruption Scenario (d)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.43%	-0.38%	-1.53%	-1.86%	-8.59%	-0.12%	-7.74%
PMPM	-7.66%	-9.82%	-8.27%	-7.82%	-14.45%	-6.22%	-12.99%
Paid PMPM	6.01%	8.43%	3.70%	8.92%	0.55%	10.70%	1.72%
Benktander	-0.85%	-0.73%	-1.80%	3.37%	-0.22%	2.82%	-1.26%
Bornhuetter	-0.72%	-0.70%	-1.54%	2.58%	-1.16%	1.62%	-1.79%
Credibility Weighted	0.24%	0.22%	-1.09%	2.92%	-0.20%	2.66%	-1.08%
Hybrid Loss Ratio	-1.87%	-0.92%	-7.76%	-3.22%	-3.00%	0.22%	-6.80%
Lag - 12 Mo Avg	13.73%	11.22%	7.74%	14.32%	8.25%	7.40%	2.66%
Lag - 9 Mo Avg	-0.99%	-0.90%	-1.97%	3.74%	0.28%	2.98%	-1.21%
Lag - 6 Mo Avg	8.33%	7.62%	4.93%	10.24%	4.88%	7.02%	2.17%
Lag - 3 Mo Avg	8.88%	8.87%	5.41%	10.21%	4.94%	8.05%	3.17%
Lag - Cross Incurral	3.52%	1.38%	-0.87%	0.85%	-4.13%	-0.07%	-4.70%
Lag - Dollar Weighted	6.26%	5.20%	3.11%	5.52%	1.99%	4.25%	0.74%
Lag - Drop Extremes (10/12)	-2.90%	-2.01%	-9.11%	-3.27%	-3.03%	0.03%	-7.44%
Lag - Geometric Avg	-1.75%	-1.59%	-2.41%	1.63%	-1.27%	1.99%	-1.69%
Lag - Harmonic Avg	-2.50%	-2.28%	-2.84%	-0.43%	-2.72%	1.01%	-2.16%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	13.37%	12.61%	9.48%	9.15%	4.02%	10.85%	8.40%
PMPM	30.42%	24.44%	18.62%	12.39%	7.99%	14.02%	11.49%
Paid PMPM	14.91%	16.85%	10.41%	15.55%	6.10%	17.97%	15.05%
Benktander	19.81%	20.44%	13.79%	25.24%	13.44%	20.72%	13.86%
Bornhuetter	17.30%	18.79%	12.53%	20.63%	9.89%	18.20%	12.28%
Credibility Weighted	16.84%	18.96%	13.07%	18.39%	8.41%	18.13%	12.97%
Hybrid Loss Ratio	17.34%	18.36%	11.43%	19.61%	9.96%	18.29%	11.38%
Lag - 12 Mo Avg	22.72%	22.05%	14.19%	29.93%	17.48%	22.54%	14.29%
Lag - 9 Mo Avg	20.42%	20.87%	14.12%	28.05%	16.44%	21.68%	14.31%
Lag - 6 Mo Avg	22.88%	22.76%	15.48%	31.42%	17.81%	23.61%	15.82%
Lag - 3 Mo Avg	26.40%	28.36%	19.77%	35.89%	20.45%	26.67%	18.87%
Lag - Cross Incurral	20.31%	19.75%	12.66%	25.07%	14.04%	19.93%	12.46%
Lag - Dollar Weighted	21.26%	21.03%	13.59%	27.52%	15.90%	21.88%	14.03%
Lag - Drop Extremes (10/12)	19.92%	19.99%	12.49%	26.07%	15.90%	21.27%	12.81%
Lag - Geometric Avg	20.24%	20.74%	14.05%	27.44%	15.92%	21.48%	14.24%
Lag - Harmonic Avg	20.06%	20.61%	13.98%	26.85%	15.46%	21.29%	14.17%

## Comparison of IBNR Methodologies

### Disruption Scenario (d)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-0.23%	-0.23%	-0.27%	0.13%	-0.05%	0.04%	-0.23%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	-0.47%	-0.55%	-0.48%	-0.47%	-0.54%	-0.70%	-0.35%
Benktander	-1.51%	1.04%	-2.11%	0.98%	2.67%	-0.80%	2.81%
Bornhuetter	-0.86%	0.51%	-1.28%	0.39%	0.83%	-0.63%	1.19%
Credibility Weighted	-1.35%	0.13%	-2.11%	0.65%	0.77%	-0.40%	0.60%
Hybrid Loss Ratio	-1.20%	0.42%	-1.67%	0.75%	1.66%	-0.76%	0.96%
Lag - 12 Mo Avg	13.53%	21.27%	11.60%	26.64%	59.75%	20.79%	48.83%
Lag - 9 Mo Avg	-3.16%	3.58%	-4.60%	8.35%	36.26%	4.29%	29.84%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.70%	0.32%	-1.37%	-0.12%	0.80%	-2.88%	-2.98%
Lag - Dollar Weighted	0.73%	2.14%	0.14%	2.80%	5.85%	-0.77%	0.70%
Lag - Drop Extremes (10/12)	-3.75%	3.43%	-5.89%	8.27%	31.70%	2.79%	20.38%
Lag - Geometric Avg	-4.50%	-0.53%	-5.44%	2.48%	15.98%	-1.29%	9.05%
Lag - Harmonic Avg	-5.81%	-4.33%	-6.27%	-3.21%	-0.10%	-6.42%	-4.87%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.55%	2.57%	2.47%	2.29%	2.08%	2.24%	1.85%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	5.17%	4.13%	5.25%	3.75%	2.88%	4.24%	6.17%
Benktander	9.12%	15.48%	6.33%	8.48%	10.47%	7.31%	8.78%
Bornhuetter	5.55%	9.03%	4.01%	4.78%	5.67%	4.82%	5.35%
Credibility Weighted	7.20%	7.10%	6.16%	5.17%	3.59%	4.94%	3.33%
Hybrid Loss Ratio	5.56%	9.01%	4.04%	4.90%	5.73%	5.03%	5.43%
Lag - 12 Mo Avg	23.29%	41.99%	16.53%	55.41%	106.95%	35.39%	56.90%
Lag - 9 Mo Avg	20.17%	36.29%	14.39%	48.00%	92.41%	30.87%	50.94%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	18.99%	32.11%	13.64%	39.80%	60.28%	24.87%	28.43%
Lag - Dollar Weighted	20.54%	34.69%	14.75%	44.85%	68.94%	27.59%	33.55%
Lag - Drop Extremes (10/12)	19.93%	35.91%	14.11%	47.66%	87.95%	30.08%	46.32%
Lag - Geometric Avg	19.85%	34.64%	14.21%	45.59%	77.73%	28.79%	39.59%
Lag - Harmonic Avg	19.54%	33.14%	14.03%	43.32%	66.87%	26.87%	32.39%

## Comparison of IBNR Methodologies

### Disruption Scenario (e)

- Claims processing at 0 percent capacity for one month; begins four months prior to valuation date and takes two months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-6.95%	-7.25%	-7.04%	-9.34%	-11.54%	-9.22%	-12.45%
PMPM	-11.43%	-11.99%	-11.20%	-13.36%	-15.98%	-12.13%	-14.73%
Paid PMPM	12.32%	27.74%	18.23%	16.22%	7.60%	11.46%	-0.05%
Benktander	58.59%	55.19%	46.81%	31.14%	23.37%	18.45%	5.95%
Bornhuetter	31.32%	29.22%	24.59%	14.68%	9.65%	6.48%	-1.56%
Credibility Weighted	0.94%	1.09%	0.99%	-2.62%	-3.00%	-4.12%	-7.98%
Hybrid Loss Ratio	-6.58%	-5.64%	-7.67%	-9.41%	-7.41%	-9.79%	-11.09%
Lag - 12 Mo Avg	18.61%	18.60%	15.63%	40.98%	49.38%	49.84%	109.18%
Lag - 9 Mo Avg	27.38%	27.23%	23.18%	57.40%	68.73%	70.39%	156.15%
Lag - 6 Mo Avg	45.01%	44.83%	38.35%	91.23%	108.93%	113.20%	270.84%
Lag - 3 Mo Avg	115.37%	116.79%	105.77%	235.78%	290.82%	313.82%	908.79%
Lag - Cross Incurral	-9.25%	-8.96%	-9.24%	-10.57%	-10.53%	-12.44%	-14.46%
Lag - Dollar Weighted	-9.55%	-8.61%	-8.68%	-7.37%	-5.33%	-9.48%	-8.85%
Lag - Drop Extremes (10/12)	-9.56%	-5.93%	-10.98%	-8.84%	2.66%	-10.34%	2.59%
Lag - Geometric Avg	213.78%	207.00%	178.31%	130.48%	118.40%	95.21%	77.94%
Lag - Harmonic Avg	-32.10%	-29.62%	-27.74%	-34.07%	-29.38%	-36.04%	-38.37%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.85%	5.24%	4.45%	5.17%	2.93%	3.93%	3.00%
PMPM	9.87%	9.41%	8.35%	6.68%	5.08%	5.33%	3.84%
Paid PMPM	10.77%	11.75%	8.28%	11.09%	6.16%	8.45%	8.11%
Benktander	14.63%	17.90%	9.87%	18.12%	13.84%	10.50%	9.24%
Bornhuetter	9.89%	11.61%	7.24%	12.34%	8.49%	7.44%	5.87%
Credibility Weighted	5.02%	6.42%	5.21%	7.94%	4.46%	5.60%	3.66%
Hybrid Loss Ratio	7.17%	8.58%	5.65%	9.99%	6.91%	7.01%	5.43%
Lag - 12 Mo Avg	12.68%	15.06%	9.21%	32.58%	47.04%	30.55%	120.82%
Lag - 9 Mo Avg	14.75%	18.36%	10.73%	40.40%	62.25%	39.07%	177.11%
Lag - 6 Mo Avg	19.04%	24.89%	13.30%	57.07%	93.95%	58.54%	338.43%
Lag - 3 Mo Avg	35.70%	49.54%	24.42%	126.49%	227.42%	145.16%	1049.78%
Lag - Cross Incurral	13.00%	19.21%	8.64%	20.93%	23.45%	15.98%	19.07%
Lag - Dollar Weighted	14.58%	21.68%	9.83%	25.00%	28.47%	18.79%	24.76%
Lag - Drop Extremes (10/12)	13.92%	21.47%	9.25%	23.99%	33.77%	19.04%	32.52%
Lag - Geometric Avg	55.69%	85.47%	33.96%	78.33%	99.87%	56.78%	67.35%
Lag - Harmonic Avg	10.45%	15.46%	7.56%	15.43%	15.51%	10.32%	12.82%

## Comparison of IBNR Methodologies

### Disruption Scenario (e)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-18.96%	-17.82%	-15.64%	-17.75%	-18.81%	-38.62%	-50.69%
PMPM	-29.40%	-27.83%	-23.46%	-24.37%	-25.16%	-43.29%	-54.25%
Paid PMPM	34.87%	68.66%	40.10%	31.79%	12.69%	8.73%	-9.58%
Benktander	50.48%	43.59%	32.45%	42.35%	28.60%	-28.01%	-41.42%
Bornhuetter	31.38%	26.42%	19.14%	20.14%	11.48%	-30.78%	-42.99%
Credibility Weighted	2.71%	2.82%	1.89%	-4.69%	-4.92%	-32.38%	-43.52%
Hybrid Loss Ratio	-13.94%	-12.48%	-14.41%	-17.02%	-12.76%	-37.12%	-49.01%
Lag - 12 Mo Avg	42.78%	38.50%	27.91%	68.12%	69.11%	-29.53%	-42.47%
Lag - 9 Mo Avg	63.58%	57.01%	42.28%	95.51%	96.46%	-26.94%	-40.87%
Lag - 6 Mo Avg	105.38%	94.66%	71.10%	151.85%	152.96%	-22.20%	-37.79%
Lag - 3 Mo Avg	271.61%	248.14%	198.81%	389.89%	404.78%	17.51%	-7.80%
Lag - Cross Incurral	-20.90%	-19.07%	-17.42%	-17.18%	-16.00%	-40.16%	-50.06%
Lag - Dollar Weighted	-32.56%	-27.82%	-23.77%	-18.81%	-14.30%	-43.15%	-51.34%
Lag - Drop Extremes (10/12)	-13.77%	-12.54%	-14.60%	-17.14%	-12.73%	-36.92%	-49.13%
Lag - Geometric Avg	-0.32%	-0.11%	-1.35%	4.48%	3.47%	-34.50%	-45.42%
Lag - Harmonic Avg	-34.44%	-29.36%	-24.68%	-24.03%	-18.81%	-41.11%	-49.36%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	11.92%	11.65%	8.99%	8.48%	4.14%	6.46%	5.32%
PMPM	24.29%	20.80%	16.34%	11.37%	7.38%	9.47%	7.14%
Paid PMPM	26.11%	29.58%	16.63%	22.20%	9.55%	12.34%	11.88%
Benktander	33.96%	34.56%	18.92%	37.49%	22.45%	10.94%	5.88%
Bornhuetter	25.14%	25.52%	14.86%	25.35%	13.78%	8.99%	5.01%
Credibility Weighted	13.06%	15.28%	10.68%	14.52%	6.73%	7.47%	5.02%
Hybrid Loss Ratio	16.00%	16.19%	10.68%	17.47%	10.07%	8.53%	4.17%
Lag - 12 Mo Avg	34.70%	36.48%	19.16%	62.22%	68.86%	11.48%	5.61%
Lag - 9 Mo Avg	41.45%	44.77%	22.71%	77.33%	90.69%	12.03%	6.33%
Lag - 6 Mo Avg	55.20%	60.84%	28.83%	109.10%	135.71%	13.80%	7.97%
Lag - 3 Mo Avg	107.47%	122.05%	54.80%	238.44%	319.54%	24.04%	14.97%
Lag - Cross Incurral	16.76%	16.37%	11.09%	22.05%	13.71%	9.03%	4.21%
Lag - Dollar Weighted	15.43%	15.90%	11.14%	23.69%	15.35%	9.38%	4.62%
Lag - Drop Extremes (10/12)	18.67%	18.22%	12.10%	22.95%	15.30%	10.58%	4.59%
Lag - Geometric Avg	22.35%	22.04%	14.55%	31.07%	20.49%	10.57%	5.29%
Lag - Harmonic Avg	14.88%	15.78%	11.54%	22.11%	14.04%	9.52%	4.88%



## Comparison of IBNR Methodologies

### Disruption Scenario (e)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	0.60%	0.64%	0.61%	0.81%	0.49%	18.33%	16.87%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	17.00%	15.55%
Paid PMPM	0.24%	0.43%	0.05%	0.04%	-0.06%	14.56%	7.48%
Benktander	65.75%	66.09%	60.23%	21.50%	16.39%	62.76%	42.66%
Bornhuetter	32.89%	33.00%	30.04%	10.63%	7.65%	41.91%	30.43%
Credibility Weighted	0.60%	0.64%	0.61%	0.81%	0.49%	22.62%	19.34%
Hybrid Loss Ratio	-1.05%	0.48%	-1.32%	0.96%	2.11%	16.28%	18.20%
Lag - 12 Mo Avg	5.77%	6.06%	5.72%	13.71%	19.20%	125.48%	228.30%
Lag - 9 Mo Avg	7.52%	7.90%	7.46%	18.22%	25.94%	163.03%	310.92%
Lag - 6 Mo Avg	11.05%	11.66%	10.96%	27.67%	40.40%	241.96%	512.96%
Lag - 3 Mo Avg	25.43%	27.39%	26.88%	70.57%	111.73%	595.30%	1627.90%
Lag - Cross Incurral	-0.70%	0.41%	-1.39%	0.05%	1.24%	14.45%	13.44%
Lag - Dollar Weighted	5.83%	7.33%	5.16%	8.98%	12.52%	23.01%	24.49%
Lag - Drop Extremes (10/12)	-5.47%	1.08%	-7.09%	3.83%	31.42%	15.57%	43.17%
Lag - Geometric Avg	347.36%	362.31%	336.06%	283.11%	315.87%	218.46%	173.68%
Lag - Harmonic Avg	-29.52%	-28.12%	-29.76%	-43.33%	-44.69%	-30.52%	-29.35%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.40%	2.44%	2.39%	2.27%	2.09%	5.06%	4.67%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	4.84%	4.58%
Paid PMPM	10.77%	9.97%	8.82%	7.44%	5.18%	9.32%	8.37%
Benktander	13.26%	21.80%	9.00%	9.36%	11.07%	18.21%	17.76%
Bornhuetter	7.04%	11.18%	5.01%	5.06%	5.83%	11.67%	11.44%
Credibility Weighted	2.40%	2.44%	2.39%	2.27%	2.09%	6.42%	5.81%
Hybrid Loss Ratio	5.54%	9.04%	4.00%	4.87%	5.84%	9.78%	10.33%
Lag - 12 Mo Avg	3.30%	3.73%	3.07%	7.74%	15.31%	59.63%	219.63%
Lag - 9 Mo Avg	3.56%	4.26%	3.26%	9.70%	20.85%	76.90%	321.10%
Lag - 6 Mo Avg	4.12%	5.46%	3.65%	14.08%	33.15%	115.89%	609.98%
Lag - 3 Mo Avg	6.91%	10.60%	5.71%	34.92%	94.41%	287.00%	1896.03%
Lag - Cross Incurral	19.17%	32.42%	13.79%	40.03%	61.06%	31.22%	34.78%
Lag - Dollar Weighted	21.69%	36.55%	15.60%	47.45%	73.24%	36.51%	45.02%
Lag - Drop Extremes (10/12)	19.66%	35.34%	13.94%	45.64%	87.97%	36.33%	58.94%
Lag - Geometric Avg	90.88%	156.45%	63.98%	168.22%	274.92%	113.78%	122.27%
Lag - Harmonic Avg	14.51%	24.67%	10.41%	24.65%	35.63%	17.93%	22.88%

## Comparison of IBNR Methodologies

### Disruption Scenario (f)

- Claims processing at 0 percent capacity for one month; begins four months prior to valuation date and takes four months to catch up

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-41.39%	-39.53%	-36.14%	-30.54%	-27.62%	-24.70%	-20.78%
PMPM	-45.43%	-43.97%	-40.43%	-35.25%	-32.93%	-28.64%	-24.07%
Paid PMPM	-8.56%	1.44%	2.50%	4.18%	-0.89%	3.90%	-2.05%
Benktander	25.70%	25.36%	21.86%	14.24%	12.02%	9.13%	3.45%
Bornhuetter	-1.31%	-0.77%	-1.32%	-3.55%	-3.41%	-4.90%	-6.13%
Credibility Weighted	-27.67%	-25.29%	-22.03%	-20.23%	-15.86%	-15.02%	-12.98%
Hybrid Loss Ratio	-29.78%	-27.47%	-27.62%	-23.50%	-18.23%	-19.14%	-15.15%
Lag - 12 Mo Avg	-9.98%	-7.99%	-6.93%	24.94%	37.95%	42.84%	111.97%
Lag - 9 Mo Avg	-3.70%	-1.65%	-1.13%	38.86%	55.15%	61.75%	155.44%
Lag - 6 Mo Avg	8.83%	11.24%	10.47%	67.44%	90.72%	101.06%	259.82%
Lag - 3 Mo Avg	60.02%	65.06%	63.33%	190.72%	252.35%	286.90%	879.63%
Lag - Cross Incurral	-10.79%	-10.02%	-9.18%	-5.78%	-4.87%	-3.82%	-0.82%
Lag - Dollar Weighted	-6.15%	-4.88%	-4.12%	1.06%	3.96%	2.39%	7.81%
Lag - Drop Extremes (10/12)	-17.82%	-13.31%	-17.75%	-7.80%	7.06%	-3.81%	20.11%
Lag - Geometric Avg	224.47%	222.09%	198.22%	161.14%	154.22%	132.34%	125.52%
Lag - Harmonic Avg	-22.25%	-20.04%	-18.33%	-22.93%	-18.70%	-23.59%	-22.44%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.84%	4.31%	3.40%	4.04%	2.77%	3.24%	2.92%
PMPM	8.01%	8.01%	6.87%	6.08%	4.94%	4.86%	3.80%
Paid PMPM	7.44%	7.58%	6.19%	8.14%	4.60%	7.02%	7.65%
Benktander	9.68%	13.29%	6.96%	13.59%	11.59%	8.64%	8.37%
Bornhuetter	5.57%	7.44%	4.64%	8.28%	6.24%	5.61%	4.82%
Credibility Weighted	3.02%	4.51%	3.82%	5.68%	3.27%	4.61%	3.20%
Hybrid Loss Ratio	3.98%	5.46%	3.60%	6.74%	5.02%	5.39%	4.51%
Lag - 12 Mo Avg	8.14%	10.41%	6.46%	26.15%	41.08%	27.40%	113.68%
Lag - 9 Mo Avg	9.63%	12.86%	7.65%	32.52%	54.28%	35.00%	162.26%
Lag - 6 Mo Avg	12.58%	17.52%	9.52%	45.98%	81.48%	52.37%	300.31%
Lag - 3 Mo Avg	23.91%	34.99%	17.75%	101.35%	194.14%	128.82%	1058.81%
Lag - Cross Incurral	12.00%	18.66%	8.20%	21.50%	25.76%	17.59%	22.45%
Lag - Dollar Weighted	13.99%	21.76%	9.65%	26.41%	32.30%	21.16%	29.39%
Lag - Drop Extremes (10/12)	12.34%	20.42%	8.37%	24.92%	38.32%	21.61%	40.26%
Lag - Geometric Avg	55.82%	89.68%	35.77%	89.56%	121.48%	69.65%	88.87%
Lag - Harmonic Avg	11.09%	17.22%	7.94%	17.42%	19.19%	12.29%	16.91%

## Comparison of IBNR Methodologies

### Disruption Scenario (f)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-74.69%	-68.88%	-60.85%	-50.70%	-41.84%	-52.42%	-55.40%
PMPM	-80.87%	-75.45%	-66.98%	-57.18%	-48.72%	-58.21%	-60.52%
Paid PMPM	-28.59%	-3.31%	-8.82%	5.11%	-1.63%	0.41%	-9.58%
Benktander	-23.78%	-20.26%	-17.42%	6.76%	8.01%	-36.17%	-40.07%
Bornhuetter	-37.14%	-33.22%	-29.00%	-13.81%	-9.76%	-39.95%	-42.78%
Credibility Weighted	-50.02%	-44.17%	-37.28%	-33.68%	-24.21%	-40.73%	-42.59%
Hybrid Loss Ratio	-59.89%	-54.56%	-50.98%	-40.81%	-29.60%	-47.42%	-51.07%
Lag - 12 Mo Avg	-25.24%	-20.83%	-17.96%	29.78%	44.95%	-36.95%	-40.83%
Lag - 9 Mo Avg	-15.38%	-11.19%	-9.48%	49.68%	67.29%	-34.70%	-39.15%
Lag - 6 Mo Avg	4.29%	8.33%	7.46%	90.44%	113.25%	-30.61%	-35.90%
Lag - 3 Mo Avg	84.35%	89.66%	84.40%	264.53%	319.12%	4.53%	-4.88%
Lag - Cross Incurral	-51.98%	-47.66%	-41.78%	-29.32%	-22.55%	-44.78%	-47.68%
Lag - Dollar Weighted	-50.82%	-45.81%	-39.37%	-25.10%	-16.48%	-42.62%	-44.92%
Lag - Drop Extremes (10/12)	-57.02%	-51.87%	-48.53%	-35.74%	-24.47%	-46.39%	-50.57%
Lag - Geometric Avg	-39.59%	-35.08%	-29.64%	-9.07%	-1.96%	-38.48%	-41.71%
Lag - Harmonic Avg	-51.45%	-46.27%	-39.55%	-27.23%	-18.48%	-41.60%	-43.76%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	7.40%	7.12%	5.53%	6.91%	4.34%	6.33%	5.83%
PMPM	13.49%	12.59%	10.54%	10.15%	7.14%	9.07%	7.59%
Paid PMPM	8.05%	9.86%	6.99%	11.57%	6.04%	10.08%	11.88%
Benktander	10.85%	13.84%	8.65%	21.14%	16.40%	8.56%	5.76%
Bornhuetter	6.77%	9.19%	6.31%	12.52%	8.72%	6.89%	4.86%
Credibility Weighted	3.71%	6.16%	5.34%	7.92%	4.27%	6.36%	5.10%
Hybrid Loss Ratio	3.94%	5.40%	4.42%	8.71%	6.13%	6.30%	3.96%
Lag - 12 Mo Avg	11.76%	15.32%	9.01%	38.77%	54.06%	9.09%	5.56%
Lag - 9 Mo Avg	14.42%	19.30%	10.93%	48.51%	71.24%	9.56%	6.25%
Lag - 6 Mo Avg	19.64%	26.77%	13.96%	68.92%	106.32%	11.07%	7.74%
Lag - 3 Mo Avg	39.06%	54.47%	27.09%	151.11%	247.08%	19.62%	14.26%
Lag - Cross Incurral	5.95%	6.78%	5.51%	14.18%	10.88%	7.32%	4.33%
Lag - Dollar Weighted	6.42%	7.43%	6.07%	16.28%	12.85%	8.24%	5.00%
Lag - Drop Extremes (10/12)	5.57%	6.61%	5.37%	13.91%	11.74%	7.99%	4.39%
Lag - Geometric Avg	8.45%	9.84%	7.65%	21.18%	17.74%	8.90%	5.60%
Lag - Harmonic Avg	6.62%	7.80%	6.66%	16.16%	12.57%	8.42%	5.30%

## Comparison of IBNR Methodologies

### Disruption Scenario (f)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	0.89%	1.02%	1.06%	1.52%	1.24%	2.76%	3.69%
PMPM	-0.43%	-0.51%	-0.48%	-0.45%	-0.90%	0.59%	1.68%
Paid PMPM	17.70%	9.12%	20.07%	3.42%	1.04%	7.69%	3.43%
Benktander	89.87%	91.05%	81.64%	27.86%	21.48%	54.68%	34.56%
Bornhuetter	44.95%	45.48%	40.74%	13.81%	10.20%	30.26%	19.98%
Credibility Weighted	0.89%	1.02%	1.06%	1.52%	1.24%	10.68%	8.02%
Hybrid Loss Ratio	9.01%	11.00%	7.81%	4.89%	5.48%	9.25%	10.44%
Lag - 12 Mo Avg	9.82%	10.24%	9.91%	18.80%	24.82%	123.11%	222.23%
Lag - 9 Mo Avg	11.60%	12.14%	11.72%	23.47%	31.81%	158.72%	295.87%
Lag - 6 Mo Avg	15.18%	16.01%	15.34%	33.22%	46.73%	233.38%	473.01%
Lag - 3 Mo Avg	30.08%	32.46%	32.19%	77.81%	120.34%	570.58%	1516.18%
Lag - Cross Incurral	43.05%	45.48%	40.69%	34.57%	35.06%	37.67%	32.88%
Lag - Dollar Weighted	52.27%	55.59%	49.81%	46.00%	50.29%	48.00%	45.81%
Lag - Drop Extremes (10/12)	33.47%	43.64%	29.35%	39.80%	76.68%	39.36%	70.96%
Lag - Geometric Avg	566.76%	594.31%	544.55%	442.73%	489.37%	304.06%	245.04%
Lag - Harmonic Avg	16.16%	19.29%	14.34%	-13.86%	-16.23%	-5.01%	-6.80%

##### Standard Deviation

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	2.62%	2.67%	2.59%	2.32%	2.18%	2.54%	2.19%
PMPM	3.05%	3.07%	2.95%	2.40%	2.33%	2.33%	2.17%
Paid PMPM	14.53%	12.63%	12.06%	8.31%	5.50%	7.24%	7.16%
Benktander	19.60%	32.59%	12.89%	12.38%	14.56%	15.43%	14.93%
Bornhuetter	10.17%	16.54%	6.89%	6.51%	7.52%	8.56%	8.40%
Credibility Weighted	2.62%	2.67%	2.59%	2.32%	2.18%	4.03%	3.34%
Hybrid Loss Ratio	7.88%	13.10%	5.43%	6.21%	7.42%	7.35%	7.69%
Lag - 12 Mo Avg	3.85%	4.39%	3.51%	8.59%	16.39%	54.96%	198.43%
Lag - 9 Mo Avg	4.12%	4.93%	3.72%	10.60%	22.07%	70.75%	282.80%
Lag - 6 Mo Avg	4.70%	6.15%	4.13%	15.03%	34.53%	106.33%	520.96%
Lag - 3 Mo Avg	7.52%	11.39%	6.27%	35.93%	95.42%	261.11%	1824.85%
Lag - Cross Incurral	29.52%	50.05%	20.75%	54.20%	81.13%	35.80%	39.34%
Lag - Dollar Weighted	33.85%	57.31%	23.78%	65.83%	100.53%	42.65%	51.20%
Lag - Drop Extremes (10/12)	29.99%	54.17%	20.73%	63.54%	121.28%	43.45%	70.12%
Lag - Geometric Avg	147.35%	254.97%	101.52%	246.87%	400.27%	143.34%	154.70%
Lag - Harmonic Avg	25.82%	44.09%	18.07%	38.63%	55.24%	23.19%	29.23%

## Comparison of IBNR Methodologies

### Disruption Scenario (g)

- Claims processing at 0 percent capacity for one month; begins 12 months prior to valuation date and takes two months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.69%	2.60%	1.95%	1.20%	-3.38%	1.55%	-0.65%
PMPM	-2.60%	-3.75%	-3.65%	-4.05%	-8.88%	-2.31%	-3.77%
Paid PMPM	-4.44%	-9.84%	-2.59%	-14.49%	-13.67%	-12.70%	-16.88%
Benktander	11.08%	11.79%	8.89%	9.45%	7.29%	6.17%	6.06%
Bornhuetter	9.83%	9.84%	7.75%	7.52%	4.81%	4.77%	3.89%
Credibility Weighted	9.24%	8.92%	7.80%	6.71%	4.78%	4.98%	3.49%
Hybrid Loss Ratio	3.19%	3.70%	0.62%	0.75%	0.67%	0.65%	0.56%
Lag - 12 Mo Avg	30.31%	29.53%	25.44%	55.45%	61.16%	69.32%	139.07%
Lag - 9 Mo Avg	11.54%	14.75%	8.90%	14.54%	21.93%	10.88%	26.99%
Lag - 6 Mo Avg	4.03%	8.40%	2.71%	11.12%	19.66%	9.05%	27.73%
Lag - 3 Mo Avg	3.88%	8.47%	2.75%	10.60%	19.10%	10.18%	27.00%
Lag - Cross Incurral	-0.11%	-0.25%	-1.44%	-0.95%	-2.98%	-2.63%	-3.66%
Lag - Dollar Weighted	1.73%	2.27%	1.11%	2.76%	2.66%	0.15%	0.38%
Lag - Drop Extremes (10/12)	-0.55%	3.05%	-3.31%	1.15%	11.15%	-0.12%	15.43%
Lag - Geometric Avg	8.56%	10.21%	6.74%	9.22%	11.74%	5.80%	10.40%
Lag - Harmonic Avg	5.52%	5.85%	4.51%	3.99%	3.40%	1.01%	-0.99%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.88%	5.27%	4.64%	5.24%	2.83%	4.37%	2.89%
PMPM	10.54%	9.83%	8.76%	6.68%	5.20%	5.35%	3.84%
Paid PMPM	12.46%	13.60%	9.32%	12.27%	7.95%	9.36%	6.72%
Benktander	9.75%	13.25%	7.53%	13.21%	9.41%	8.93%	7.80%
Bornhuetter	7.44%	9.66%	6.33%	10.36%	6.58%	7.16%	5.32%
Credibility Weighted	5.57%	7.45%	5.97%	8.66%	4.80%	6.68%	4.15%
Hybrid Loss Ratio	7.45%	9.49%	5.98%	10.22%	6.64%	7.47%	5.46%
Lag - 12 Mo Avg	11.89%	15.08%	9.28%	31.22%	46.69%	34.11%	132.24%
Lag - 9 Mo Avg	16.25%	25.63%	10.95%	28.51%	38.65%	22.46%	38.20%
Lag - 6 Mo Avg	16.98%	27.48%	11.41%	31.07%	41.91%	23.73%	44.04%
Lag - 3 Mo Avg	18.58%	30.11%	13.21%	34.02%	46.47%	27.05%	49.38%
Lag - Cross Incurral	14.45%	21.64%	9.57%	23.11%	25.39%	17.96%	21.50%
Lag - Dollar Weighted	15.75%	23.70%	10.59%	26.32%	29.55%	20.03%	25.47%
Lag - Drop Extremes (10/12)	14.83%	23.60%	9.74%	26.14%	36.43%	20.51%	34.73%
Lag - Geometric Avg	15.84%	24.36%	10.73%	26.89%	32.59%	20.97%	29.53%
Lag - Harmonic Avg	15.46%	23.21%	10.51%	25.37%	28.10%	19.63%	24.19%

## Comparison of IBNR Methodologies

### Disruption Scenario (g)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	9.66%	5.85%	3.44%	1.62%	-6.27%	3.16%	-4.64%
PMPM	-7.26%	-9.29%	-7.98%	-7.84%	-14.47%	-6.13%	-12.80%
Paid PMPM	3.20%	1.61%	1.01%	-8.70%	-5.80%	-3.48%	-3.64%
Benktander	37.74%	30.97%	22.95%	20.28%	11.08%	19.39%	12.96%
Bornhuetter	33.47%	27.19%	19.89%	16.65%	7.99%	15.60%	10.30%
Credibility Weighted	28.64%	23.96%	18.11%	13.62%	7.62%	14.68%	10.41%
Hybrid Loss Ratio	13.80%	11.06%	3.62%	1.79%	-0.09%	5.66%	-1.56%
Lag - 12 Mo Avg	87.25%	73.88%	53.90%	103.21%	91.47%	18.38%	11.68%
Lag - 9 Mo Avg	38.55%	31.67%	23.61%	21.95%	12.74%	20.46%	13.62%
Lag - 6 Mo Avg	8.95%	8.41%	5.33%	10.27%	4.86%	7.17%	2.43%
Lag - 3 Mo Avg	9.53%	9.73%	5.83%	10.25%	4.94%	8.19%	3.42%
Lag - Cross Incurral	4.00%	2.01%	-0.56%	0.79%	-4.20%	0.09%	-3.86%
Lag - Dollar Weighted	6.84%	5.93%	3.49%	5.50%	1.95%	4.40%	1.35%
Lag - Drop Extremes (10/12)	13.53%	10.64%	3.10%	1.33%	-0.33%	5.95%	-1.72%
Lag - Geometric Avg	35.06%	28.81%	21.56%	18.52%	10.31%	19.00%	12.75%
Lag - Harmonic Avg	31.67%	26.02%	19.55%	15.14%	7.98%	17.59%	11.91%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	14.94%	14.10%	10.51%	9.99%	4.31%	11.58%	8.74%
PMPM	30.85%	24.82%	18.88%	12.53%	8.03%	14.23%	11.63%
Paid PMPM	20.95%	21.36%	14.40%	20.80%	11.16%	20.25%	13.97%
Benktander	27.80%	26.81%	17.09%	28.87%	14.79%	23.80%	15.91%
Bornhuetter	24.08%	24.06%	15.25%	23.36%	10.87%	20.57%	13.82%
Credibility Weighted	18.42%	21.17%	14.10%	18.34%	7.85%	18.77%	13.12%
Hybrid Loss Ratio	21.30%	21.34%	13.18%	20.67%	10.30%	19.24%	12.34%
Lag - 12 Mo Avg	41.50%	42.80%	22.13%	65.27%	70.43%	25.18%	16.85%
Lag - 9 Mo Avg	28.86%	27.61%	17.66%	32.43%	18.31%	25.16%	16.62%
Lag - 6 Mo Avg	24.32%	24.22%	16.35%	31.79%	17.95%	24.06%	16.19%
Lag - 3 Mo Avg	27.93%	29.92%	20.61%	36.26%	20.61%	26.99%	19.14%
Lag - Cross Incurral	21.86%	21.20%	13.64%	25.55%	14.29%	20.18%	12.76%
Lag - Dollar Weighted	22.88%	22.56%	14.63%	28.04%	16.17%	22.17%	14.41%
Lag - Drop Extremes (10/12)	24.18%	23.26%	14.50%	26.68%	16.04%	22.28%	14.03%
Lag - Geometric Avg	28.19%	27.14%	17.40%	31.48%	17.66%	24.87%	16.47%
Lag - Harmonic Avg	27.54%	26.70%	17.15%	30.57%	17.08%	24.59%	16.34%

## Comparison of IBNR Methodologies

### Disruption Scenario (g)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	1.19%	1.14%	1.09%	1.15%	0.82%	1.00%	0.79%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	-6.70%	-14.73%	-4.45%	-18.20%	-24.05%	-16.16%	-21.09%
Benktander	0.24%	2.69%	-0.49%	1.38%	2.90%	0.93%	4.12%
Bornhuetter	0.14%	1.45%	-0.35%	0.60%	0.96%	0.48%	2.03%
Credibility Weighted	1.11%	1.46%	0.89%	1.28%	1.07%	1.04%	1.38%
Hybrid Loss Ratio	-0.63%	0.84%	-0.97%	1.27%	2.40%	-0.93%	1.60%
Lag - 12 Mo Avg	5.77%	6.04%	5.72%	13.66%	19.13%	95.29%	183.86%
Lag - 9 Mo Avg	0.76%	7.55%	-0.79%	10.67%	38.44%	7.59%	32.28%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.63%	0.49%	-1.32%	0.03%	1.25%	-2.87%	-3.11%
Lag - Dollar Weighted	0.80%	2.32%	0.18%	2.99%	6.40%	-0.74%	0.57%
Lag - Drop Extremes (10/12)	-5.61%	0.86%	-7.16%	3.68%	30.64%	-1.87%	21.91%
Lag - Geometric Avg	-2.02%	2.00%	-3.05%	3.44%	16.80%	0.74%	10.23%
Lag - Harmonic Avg	-4.95%	-3.32%	-5.46%	-3.64%	-0.42%	-5.70%	-4.84%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.53%	2.56%	2.41%	2.30%	2.10%	2.28%	1.78%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	15.89%	18.14%	12.45%	16.23%	11.86%	10.60%	7.61%
Benktander	9.14%	15.51%	6.34%	8.43%	10.42%	7.45%	8.86%
Bornhuetter	5.54%	9.01%	4.00%	4.75%	5.64%	4.86%	5.36%
Credibility Weighted	3.10%	3.68%	2.67%	2.49%	2.31%	3.04%	2.41%
Hybrid Loss Ratio	5.52%	8.99%	3.97%	4.86%	5.78%	5.04%	5.45%
Lag - 12 Mo Avg	3.28%	3.75%	3.08%	7.42%	14.93%	48.68%	177.82%
Lag - 9 Mo Avg	20.75%	37.35%	14.79%	48.48%	92.89%	31.26%	51.39%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.11%	32.35%	13.73%	40.05%	60.82%	25.16%	28.63%
Lag - Dollar Weighted	20.67%	34.98%	14.85%	45.21%	69.74%	27.89%	33.77%
Lag - Drop Extremes (10/12)	19.29%	34.80%	13.73%	45.36%	87.54%	28.63%	46.60%
Lag - Geometric Avg	20.25%	35.41%	14.48%	45.67%	77.85%	28.94%	39.53%
Lag - Harmonic Avg	19.76%	33.65%	14.18%	43.03%	66.68%	26.87%	32.09%

## Comparison of IBNR Methodologies

### Disruption Scenario (h)

- Claims processing at 0 percent capacity for one month; begins 12 months prior to valuation date and takes four months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	1.51%	0.43%	-0.18%	-0.54%	-4.87%	0.06%	-2.16%
PMPM	-1.88%	-3.21%	-3.19%	-3.80%	-8.75%	-2.24%	-3.82%
Paid PMPM	-4.26%	-9.85%	-2.31%	-14.78%	-13.54%	-12.82%	-16.96%
Benktander	-2.32%	-0.78%	-2.71%	0.75%	0.16%	-0.85%	1.01%
Bornhuetter	-1.12%	-0.39%	-1.59%	0.60%	-0.78%	-0.71%	-0.06%
Credibility Weighted	0.59%	0.82%	-0.12%	1.45%	0.08%	0.17%	-0.29%
Hybrid Loss Ratio	-4.18%	-3.12%	-6.83%	-4.22%	-3.48%	-3.55%	-2.93%
Lag - 12 Mo Avg	22.39%	21.82%	18.64%	43.56%	48.24%	54.57%	108.94%
Lag - 9 Mo Avg	-5.12%	-1.08%	-5.58%	2.46%	11.43%	0.63%	18.16%
Lag - 6 Mo Avg	4.78%	9.00%	3.19%	11.42%	19.83%	9.12%	27.67%
Lag - 3 Mo Avg	4.63%	9.06%	3.23%	10.89%	19.26%	10.26%	26.95%
Lag - Cross Incurral	0.25%	-0.09%	-1.27%	-0.97%	-3.17%	-2.68%	-3.79%
Lag - Dollar Weighted	2.06%	2.40%	1.26%	2.70%	2.40%	0.09%	0.30%
Lag - Drop Extremes (10/12)	-9.91%	-5.78%	-12.91%	-5.45%	5.22%	-5.85%	10.75%
Lag - Geometric Avg	-6.78%	-4.41%	-6.68%	-1.97%	2.08%	-3.71%	2.57%
Lag - Harmonic Avg	-8.44%	-7.55%	-7.77%	-6.29%	-5.50%	-7.72%	-7.92%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.73%	5.16%	4.48%	5.14%	2.73%	4.21%	2.81%
PMPM	10.65%	9.90%	8.83%	6.73%	5.23%	5.37%	3.84%
Paid PMPM	12.12%	13.20%	9.12%	11.97%	7.72%	9.14%	6.42%
Benktander	8.88%	12.42%	6.96%	12.42%	8.93%	8.40%	7.49%
Bornhuetter	6.82%	9.08%	5.93%	9.91%	6.29%	6.84%	5.13%
Credibility Weighted	5.68%	7.48%	5.96%	8.75%	4.92%	6.61%	4.26%
Hybrid Loss Ratio	6.98%	9.09%	5.78%	10.02%	6.47%	7.17%	5.36%
Lag - 12 Mo Avg	10.69%	13.20%	8.51%	27.29%	38.76%	28.91%	104.33%
Lag - 9 Mo Avg	14.77%	23.67%	10.02%	26.94%	37.09%	21.23%	36.48%
Lag - 6 Mo Avg	17.03%	27.62%	11.41%	31.17%	41.95%	23.72%	44.06%
Lag - 3 Mo Avg	18.65%	30.22%	13.20%	34.10%	46.50%	27.09%	49.40%
Lag - Cross Incurral	14.39%	21.56%	9.50%	23.06%	25.16%	17.87%	21.48%
Lag - Dollar Weighted	15.67%	23.60%	10.50%	26.24%	29.23%	19.91%	25.45%
Lag - Drop Extremes (10/12)	14.09%	22.69%	9.22%	25.75%	36.00%	20.03%	34.26%
Lag - Geometric Avg	14.45%	22.47%	9.86%	25.44%	31.07%	19.84%	28.24%
Lag - Harmonic Avg	14.13%	21.36%	9.69%	24.03%	26.65%	18.57%	23.12%



## Comparison of IBNR Methodologies

### Disruption Scenario (h)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	5.75%	2.14%	0.17%	-1.04%	-8.28%	0.35%	-7.64%
PMPM	-5.05%	-7.88%	-6.92%	-7.35%	-14.26%	-5.94%	-12.98%
Paid PMPM	5.41%	3.02%	2.35%	-8.81%	-5.62%	-3.05%	-3.08%
Benktander	2.47%	1.79%	-0.26%	3.29%	-0.62%	3.83%	-0.71%
Bornhuetter	2.83%	2.00%	0.13%	2.87%	-1.29%	2.55%	-1.33%
Credibility Weighted	5.90%	4.78%	2.18%	3.86%	0.21%	3.55%	-0.45%
Hybrid Loss Ratio	-5.11%	-4.31%	-11.17%	-7.36%	-6.53%	-3.83%	-10.72%
Lag - 12 Mo Avg	66.16%	55.62%	39.95%	81.77%	72.36%	12.83%	6.82%
Lag - 9 Mo Avg	2.24%	1.55%	-0.49%	3.35%	-0.43%	4.00%	-0.65%
Lag - 6 Mo Avg	11.49%	10.05%	6.50%	10.88%	5.11%	7.35%	2.20%
Lag - 3 Mo Avg	12.09%	11.36%	7.00%	10.84%	5.19%	8.39%	3.20%
Lag - Cross Incurral	5.67%	2.98%	0.07%	1.05%	-4.17%	-0.13%	-4.85%
Lag - Dollar Weighted	8.46%	6.87%	4.09%	5.74%	1.96%	4.16%	0.54%
Lag - Drop Extremes (10/12)	-7.36%	-6.47%	-13.46%	-9.50%	-8.32%	-5.05%	-12.05%
Lag - Geometric Avg	0.79%	0.31%	-1.34%	0.77%	-2.27%	2.85%	-1.25%
Lag - Harmonic Avg	-0.66%	-0.94%	-2.20%	-1.79%	-4.02%	1.72%	-1.84%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	14.46%	13.59%	10.12%	9.65%	4.14%	11.12%	8.50%
PMPM	31.75%	25.28%	19.16%	12.66%	8.07%	14.31%	11.63%
Paid PMPM	21.09%	21.22%	14.28%	20.40%	10.81%	20.18%	13.84%
Benktander	21.56%	21.89%	14.57%	25.56%	13.47%	21.10%	14.20%
Bornhuetter	19.20%	20.29%	13.36%	21.12%	10.03%	18.58%	12.59%
Credibility Weighted	16.44%	19.29%	13.16%	17.80%	7.82%	17.71%	12.66%
Hybrid Loss Ratio	17.92%	18.63%	11.71%	19.39%	9.75%	17.70%	11.23%
Lag - 12 Mo Avg	36.59%	37.26%	19.83%	56.87%	58.64%	23.98%	15.78%
Lag - 9 Mo Avg	22.10%	22.26%	14.86%	28.09%	16.24%	22.05%	14.65%
Lag - 6 Mo Avg	24.87%	24.41%	16.36%	31.96%	17.94%	23.98%	16.06%
Lag - 3 Mo Avg	28.59%	30.07%	20.59%	36.37%	20.60%	27.00%	19.08%
Lag - Cross Incurral	22.16%	21.21%	13.55%	25.60%	14.21%	20.14%	12.68%
Lag - Dollar Weighted	23.15%	22.54%	14.52%	28.09%	16.09%	22.08%	14.29%
Lag - Drop Extremes (10/12)	19.88%	19.80%	12.48%	24.57%	14.85%	20.18%	12.46%
Lag - Geometric Avg	21.77%	22.04%	14.74%	27.35%	15.66%	21.83%	14.56%
Lag - Harmonic Avg	21.45%	21.81%	14.62%	26.62%	15.14%	21.61%	14.48%

## Comparison of IBNR Methodologies

### Disruption Scenario (h)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-0.21%	-0.21%	-0.26%	0.23%	0.02%	0.10%	-0.20%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	-7.36%	-15.51%	-4.91%	-18.70%	-24.00%	-16.57%	-21.41%
Benktander	-3.34%	-0.72%	-3.84%	0.31%	2.21%	-2.14%	1.99%
Bornhuetter	-1.92%	-0.50%	-2.27%	0.04%	0.60%	-1.47%	0.69%
Credibility Weighted	-1.07%	-0.43%	-1.28%	0.25%	0.24%	-0.77%	0.03%
Hybrid Loss Ratio	-2.86%	-1.32%	-3.26%	0.15%	1.47%	-2.68%	0.04%
Lag - 12 Mo Avg	4.18%	4.41%	4.15%	10.64%	14.98%	75.93%	145.00%
Lag - 9 Mo Avg	-7.11%	-0.54%	-8.46%	4.41%	31.47%	0.14%	25.25%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.82%	0.20%	-1.48%	-0.25%	0.70%	-2.86%	-2.96%
Lag - Dollar Weighted	0.60%	2.02%	0.02%	2.67%	5.75%	-0.73%	0.73%
Lag - Drop Extremes (10/12)	-9.84%	-3.52%	-11.85%	0.88%	27.49%	-5.21%	19.14%
Lag - Geometric Avg	-8.88%	-5.08%	-9.74%	-1.85%	11.11%	-5.75%	4.45%
Lag - Harmonic Avg	-10.66%	-9.32%	-11.01%	-7.92%	-5.07%	-11.17%	-9.50%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.55%	2.57%	2.48%	2.29%	2.08%	2.25%	1.84%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	15.32%	17.22%	12.11%	15.33%	11.34%	10.21%	7.13%
Benktander	9.02%	15.34%	6.27%	8.46%	10.47%	7.23%	8.75%
Bornhuetter	5.51%	8.99%	3.98%	4.77%	5.68%	4.80%	5.34%
Credibility Weighted	3.31%	4.00%	2.84%	2.53%	2.31%	3.35%	2.67%
Hybrid Loss Ratio	5.48%	8.93%	3.98%	4.90%	5.77%	4.96%	5.43%
Lag - 12 Mo Avg	3.16%	3.48%	2.99%	6.53%	12.26%	40.74%	140.37%
Lag - 9 Mo Avg	19.36%	34.92%	13.82%	46.20%	89.22%	29.65%	49.20%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	18.98%	32.09%	13.65%	39.78%	60.18%	25.04%	28.59%
Lag - Dollar Weighted	20.53%	34.67%	14.76%	44.84%	68.84%	27.76%	33.73%
Lag - Drop Extremes (10/12)	18.65%	33.62%	13.21%	44.67%	86.47%	28.04%	46.03%
Lag - Geometric Avg	18.94%	33.08%	13.56%	43.60%	74.38%	27.54%	37.86%
Lag - Harmonic Avg	18.52%	31.39%	13.30%	41.15%	63.46%	25.61%	30.70%

## Comparison of IBNR Methodologies

### Disruption Scenario (i)

- Claims processing at 0 percent capacity for one month, then 50 percent capacity for the next month; begins four months prior to valuation date and takes two months to catch up

### Results Set 1—All Incurral Months

#### *Mean*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-33.59%	-32.83%	-30.98%	-30.83%	-29.38%	-26.88%	-24.50%
PMPM	-17.56%	-17.65%	-16.07%	-20.11%	-20.93%	-16.84%	-15.98%
Paid PMPM	0.31%	7.81%	17.32%	0.71%	-5.77%	2.56%	-5.18%
Benktander	19.94%	18.92%	14.78%	1.24%	-1.40%	-3.31%	-5.91%
Bornhuetter	-13.24%	-12.58%	-12.57%	-17.25%	-16.20%	-16.92%	-15.42%
Credibility Weighted	-55.93%	-53.17%	-49.88%	-42.75%	-37.37%	-35.90%	-30.58%
Hybrid Loss Ratio	-33.68%	-31.94%	-31.80%	-30.90%	-26.97%	-28.21%	-24.19%
Lag - 12 Mo Avg	-30.43%	-28.95%	-26.80%	4.28%	12.97%	21.10%	87.53%
Lag - 9 Mo Avg	-24.42%	-23.15%	-21.51%	15.16%	25.12%	35.35%	117.06%
Lag - 6 Mo Avg	-11.72%	-11.07%	-10.89%	37.92%	50.58%	65.61%	185.82%
Lag - 3 Mo Avg	39.15%	39.96%	37.77%	141.93%	175.10%	218.15%	630.99%
Lag - Cross Incurral	-12.23%	-11.86%	-11.58%	-7.57%	-7.31%	-4.72%	2.00%
Lag - Dollar Weighted	52.76%	52.45%	50.40%	52.95%	52.30%	53.10%	64.73%
Lag - Drop Extremes (10/12)	40.16%	44.65%	33.32%	52.40%	67.71%	52.70%	97.17%
Lag - Geometric Avg	318.35%	315.41%	281.88%	225.43%	215.49%	189.88%	187.79%
Lag - Harmonic Avg	-38.91%	-37.22%	-37.09%	-38.98%	-34.88%	-37.66%	-31.67%

#### *Standard Deviation*

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.51%	5.87%	3.60%	5.43%	4.75%	4.03%	4.71%
PMPM	8.00%	8.44%	6.68%	7.19%	6.03%	5.56%	5.36%
Paid PMPM	11.18%	10.94%	8.91%	9.34%	5.65%	7.29%	7.13%
Benktander	10.70%	14.61%	7.13%	13.07%	11.51%	7.97%	7.70%
Bornhuetter	5.47%	7.08%	4.28%	7.43%	5.93%	4.78%	3.96%
Credibility Weighted	3.30%	5.32%	3.02%	4.64%	3.63%	3.28%	3.78%
Hybrid Loss Ratio	4.30%	5.76%	3.51%	6.23%	4.88%	4.57%	3.69%
Lag - 12 Mo Avg	7.63%	8.82%	5.84%	21.74%	27.66%	20.14%	79.46%
Lag - 9 Mo Avg	8.84%	10.51%	6.82%	26.10%	35.39%	24.39%	102.49%
Lag - 6 Mo Avg	11.22%	13.71%	8.28%	35.45%	51.50%	35.22%	167.23%
Lag - 3 Mo Avg	21.02%	26.97%	15.08%	77.01%	123.17%	86.15%	585.48%
Lag - Cross Incurral	13.52%	21.26%	9.10%	23.44%	29.03%	19.94%	25.24%
Lag - Dollar Weighted	24.28%	37.41%	16.28%	43.26%	54.32%	35.03%	50.35%
Lag - Drop Extremes (10/12)	24.45%	40.07%	15.99%	48.14%	75.81%	41.59%	77.57%
Lag - Geometric Avg	78.22%	126.25%	50.01%	121.88%	169.01%	97.34%	126.93%
Lag - Harmonic Avg	11.87%	18.26%	8.23%	18.68%	21.52%	13.61%	19.27%

## Comparison of IBNR Methodologies

### Disruption Scenario (i)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-43.44%	-41.73%	-38.93%	-41.93%	-38.13%	-39.52%	-25.42%
PMPM	-25.78%	-25.31%	-22.86%	-29.59%	-28.91%	-29.79%	-14.38%
Paid PMPM	-35.67%	-7.60%	-10.48%	-5.66%	-10.07%	-15.13%	-9.58%
Benktander	-43.92%	-41.54%	-38.62%	-17.24%	-14.05%	-60.93%	-51.21%
Bornhuetter	-56.41%	-52.77%	-48.00%	-35.00%	-28.46%	-59.44%	-48.20%
Credibility Weighted	-76.64%	-71.32%	-66.17%	-59.60%	-49.32%	-58.08%	-46.05%
Hybrid Loss Ratio	-65.76%	-61.83%	-58.12%	-48.27%	-39.21%	-63.79%	-52.79%
Lag - 12 Mo Avg	-42.60%	-39.73%	-36.41%	3.00%	13.73%	-61.81%	-51.77%
Lag - 9 Mo Avg	-34.72%	-32.28%	-29.69%	17.23%	28.64%	-60.70%	-51.45%
Lag - 6 Mo Avg	-18.10%	-16.78%	-16.22%	46.93%	59.79%	-58.78%	-50.94%
Lag - 3 Mo Avg	48.27%	48.51%	45.32%	181.47%	210.36%	-39.15%	-31.64%
Lag - Cross Incurral	-76.07%	-72.11%	-66.54%	-49.97%	-40.91%	-72.40%	-62.16%
Lag - Dollar Weighted	-34.23%	-31.11%	-25.62%	-4.69%	2.49%	-49.49%	-34.41%
Lag - Drop Extremes (10/12)	-55.00%	-51.81%	-49.18%	-25.17%	-18.30%	-66.10%	-56.09%
Lag - Geometric Avg	-66.56%	-63.02%	-58.18%	-31.81%	-22.76%	-70.54%	-60.47%
Lag - Harmonic Avg	-90.35%	-86.09%	-81.13%	-62.93%	-51.02%	-79.04%	-68.74%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	6.75%	8.18%	5.08%	8.39%	6.72%	6.62%	9.60%
PMPM	10.97%	11.40%	8.79%	10.30%	8.12%	8.16%	10.83%
Paid PMPM	8.55%	9.53%	7.59%	10.45%	6.44%	7.03%	11.88%
Benktander	7.71%	9.02%	6.20%	16.97%	14.20%	4.51%	5.46%
Bornhuetter	4.44%	5.91%	4.43%	9.29%	7.17%	3.97%	4.70%
Credibility Weighted	4.54%	6.31%	3.79%	6.89%	4.94%	4.77%	6.85%
Hybrid Loss Ratio	3.24%	4.43%	3.50%	7.19%	5.41%	3.60%	3.87%
Lag - 12 Mo Avg	8.82%	10.31%	6.81%	28.88%	34.19%	4.91%	5.42%
Lag - 9 Mo Avg	10.65%	12.73%	8.18%	35.06%	43.83%	5.31%	6.18%
Lag - 6 Mo Avg	14.23%	17.22%	10.23%	48.26%	63.77%	6.34%	7.35%
Lag - 3 Mo Avg	28.32%	35.18%	19.64%	105.42%	150.11%	11.61%	13.26%
Lag - Cross Incurral	3.67%	4.34%	3.71%	11.34%	9.98%	3.57%	4.00%
Lag - Dollar Weighted	8.53%	9.13%	7.04%	21.89%	18.81%	5.99%	6.80%
Lag - Drop Extremes (10/12)	6.72%	8.03%	5.52%	18.50%	16.41%	4.38%	4.48%
Lag - Geometric Avg	5.72%	6.83%	5.34%	18.32%	17.46%	4.40%	4.96%
Lag - Harmonic Avg	3.77%	4.10%	4.08%	11.71%	10.51%	4.26%	4.65%

## Comparison of IBNR Methodologies

### Disruption Scenario (i)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-13.41%	-13.57%	-12.98%	-7.99%	-7.70%	-5.77%	-23.94%
PMPM	-0.53%	-0.65%	-0.62%	-0.53%	-1.09%	4.85%	-17.00%
Paid PMPM	77.49%	46.50%	81.92%	15.11%	5.83%	33.05%	-2.31%
Benktander	155.27%	161.49%	137.41%	41.78%	32.41%	94.80%	22.64%
Bornhuetter	77.66%	80.68%	68.58%	20.70%	15.54%	55.18%	5.19%
Credibility Weighted	-13.41%	-13.57%	-12.98%	-7.99%	-7.70%	1.29%	-20.92%
Hybrid Loss Ratio	33.86%	37.48%	28.47%	6.04%	4.52%	32.17%	-6.20%
Lag - 12 Mo Avg	-5.07%	-5.06%	-4.85%	8.30%	12.11%	163.10%	176.48%
Lag - 9 Mo Avg	-2.83%	-2.76%	-2.76%	12.50%	17.60%	199.82%	224.71%
Lag - 6 Mo Avg	1.94%	2.04%	1.46%	21.42%	29.37%	278.65%	337.08%
Lag - 3 Mo Avg	21.47%	22.76%	21.20%	64.49%	91.01%	658.89%	1054.42%
Lag - Cross Incurral	123.96%	133.17%	115.11%	85.36%	84.49%	111.09%	42.60%
Lag - Dollar Weighted	239.69%	256.85%	226.16%	181.10%	190.80%	229.08%	127.72%
Lag - Drop Extremes (10/12)	243.95%	278.57%	223.69%	222.82%	301.30%	256.17%	194.22%
Lag - Geometric Avg	1138.39%	1223.30%	1064.37%	783.00%	854.37%	634.88%	344.41%
Lag - Harmonic Avg	70.82%	80.72%	64.42%	14.25%	11.04%	33.36%	-8.02%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.29%	3.95%	2.95%	2.62%	2.24%	3.45%	5.02%
PMPM	3.75%	3.85%	3.53%	2.55%	2.45%	3.70%	4.88%
Paid PMPM	36.54%	35.77%	27.52%	16.44%	10.51%	16.91%	6.36%
Benktander	41.54%	71.32%	25.40%	19.94%	22.97%	30.05%	13.00%
Bornhuetter	21.10%	35.89%	13.07%	10.22%	11.64%	17.40%	6.14%
Credibility Weighted	3.29%	3.95%	2.95%	2.62%	2.24%	4.67%	4.18%
Hybrid Loss Ratio	16.02%	27.51%	10.01%	9.08%	10.67%	15.27%	5.48%
Lag - 12 Mo Avg	4.87%	5.68%	4.14%	8.68%	12.59%	66.10%	133.13%
Lag - 9 Mo Avg	5.15%	6.11%	4.37%	10.15%	16.10%	78.94%	171.76%
Lag - 6 Mo Avg	5.71%	7.11%	4.78%	13.43%	23.82%	110.87%	279.09%
Lag - 3 Mo Avg	8.93%	12.57%	7.06%	30.51%	64.21%	260.09%	971.09%
Lag - Cross Incurral	56.13%	97.77%	36.95%	78.08%	113.62%	63.12%	42.18%
Lag - Dollar Weighted	92.66%	161.26%	61.10%	138.27%	208.17%	108.76%	83.93%
Lag - Drop Extremes (10/12)	95.27%	174.31%	61.76%	159.62%	296.32%	127.67%	128.79%
Lag - Geometric Avg	335.77%	597.18%	216.37%	434.89%	689.08%	291.81%	209.73%
Lag - Harmonic Avg	46.98%	82.79%	30.88%	56.29%	78.90%	40.43%	31.82%

## Comparison of IBNR Methodologies

### Disruption Scenario (j)

- Claims processing at 0 percent capacity for one month, then 50 percent capacity for the next month; begins four months prior to valuation date and takes four months to catch up

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-54.26%	-52.36%	-48.77%	-42.77%	-38.31%	-34.65%	-27.24%
PMPM	-53.89%	-52.41%	-48.87%	-43.22%	-39.84%	-35.28%	-27.81%
Paid PMPM	-24.81%	-11.96%	-7.87%	-7.43%	-10.47%	-3.79%	-6.24%
Benktander	-2.07%	-1.43%	-1.86%	-6.61%	-5.31%	-6.08%	-4.39%
Bornhuetter	-24.71%	-23.43%	-21.92%	-21.28%	-18.20%	-18.10%	-13.56%
Credibility Weighted	-50.33%	-47.61%	-43.58%	-38.23%	-31.57%	-29.31%	-22.46%
Hybrid Loss Ratio	-42.28%	-40.23%	-39.08%	-34.47%	-28.84%	-28.53%	-21.19%
Lag - 12 Mo Avg	-31.99%	-30.00%	-27.05%	-3.67%	5.90%	11.81%	64.23%
Lag - 9 Mo Avg	-25.97%	-24.01%	-21.31%	6.30%	17.13%	24.61%	88.47%
Lag - 6 Mo Avg	-13.66%	-11.61%	-9.56%	27.40%	41.02%	52.03%	144.93%
Lag - 3 Mo Avg	36.42%	40.11%	42.73%	125.46%	160.39%	193.14%	517.44%
Lag - Cross Incurral	-24.88%	-23.72%	-21.59%	-14.77%	-11.99%	-9.12%	-0.44%
Lag - Dollar Weighted	-3.38%	-1.96%	-0.02%	8.36%	12.72%	13.64%	26.12%
Lag - Drop Extremes (10/12)	-8.83%	-4.86%	-8.75%	7.63%	23.91%	14.35%	54.39%
Lag - Geometric Avg	214.69%	215.24%	198.26%	171.48%	170.90%	151.79%	157.56%
Lag - Harmonic Avg	-28.32%	-26.24%	-24.13%	-25.49%	-21.02%	-23.96%	-17.94%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	3.20%	3.80%	2.75%	3.92%	2.93%	3.16%	3.38%
PMPM	6.18%	6.41%	5.43%	5.48%	4.56%	4.55%	4.09%
Paid PMPM	6.42%	6.47%	5.69%	6.91%	4.35%	6.10%	6.93%
Benktander	6.39%	8.95%	4.76%	9.66%	8.82%	6.48%	6.61%
Bornhuetter	3.34%	4.55%	3.02%	5.62%	4.61%	4.06%	3.59%
Credibility Weighted	1.98%	3.19%	2.54%	3.84%	2.41%	3.32%	2.90%
Hybrid Loss Ratio	2.70%	3.81%	2.54%	4.72%	3.79%	4.03%	3.45%
Lag - 12 Mo Avg	5.37%	6.30%	4.44%	16.10%	20.99%	15.49%	60.94%
Lag - 9 Mo Avg	6.34%	7.64%	5.27%	19.47%	27.11%	18.80%	78.30%
Lag - 6 Mo Avg	8.21%	10.16%	6.48%	26.81%	40.10%	27.51%	127.91%
Lag - 3 Mo Avg	16.20%	21.23%	12.57%	60.77%	100.63%	70.18%	458.98%
Lag - Cross Incurral	9.48%	15.14%	6.72%	18.85%	24.03%	16.66%	22.49%
Lag - Dollar Weighted	13.13%	20.72%	9.35%	27.23%	35.30%	23.22%	34.81%
Lag - Drop Extremes (10/12)	13.57%	22.64%	9.42%	30.10%	49.40%	27.78%	55.64%
Lag - Geometric Avg	52.13%	85.86%	34.98%	93.36%	133.76%	78.11%	105.88%
Lag - Harmonic Avg	9.92%	15.75%	7.18%	16.88%	20.04%	12.58%	18.81%

## Comparison of IBNR Methodologies

### Disruption Scenario (j)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-78.18%	-74.42%	-68.73%	-61.52%	-52.53%	-59.65%	-48.37%
PMPM	-78.04%	-74.77%	-69.13%	-62.31%	-54.63%	-60.80%	-50.01%
Paid PMPM	-49.05%	-23.26%	-24.84%	-12.90%	-14.81%	-15.13%	-9.58%
Benktander	-49.19%	-45.98%	-41.62%	-22.88%	-15.98%	-50.24%	-37.54%
Bornhuetter	-58.97%	-55.45%	-50.55%	-37.34%	-29.22%	-53.45%	-40.09%
Credibility Weighted	-72.43%	-67.59%	-61.35%	-54.88%	-43.19%	-56.43%	-42.34%
Hybrid Loss Ratio	-70.78%	-67.00%	-63.31%	-52.77%	-42.05%	-61.57%	-50.57%
Lag - 12 Mo Avg	-50.22%	-46.63%	-41.95%	-11.79%	1.38%	-51.32%	-38.97%
Lag - 9 Mo Avg	-42.56%	-39.12%	-34.81%	0.84%	14.92%	-48.24%	-36.17%
Lag - 6 Mo Avg	-26.90%	-23.57%	-20.21%	27.49%	43.59%	-42.29%	-30.65%
Lag - 3 Mo Avg	36.56%	41.10%	44.55%	150.32%	185.29%	-6.63%	7.94%
Lag - Cross Incurral	-68.02%	-64.49%	-59.06%	-45.01%	-35.98%	-59.88%	-47.99%
Lag - Dollar Weighted	-52.76%	-49.04%	-43.11%	-26.73%	-16.78%	-47.58%	-32.69%
Lag - Drop Extremes (10/12)	-64.60%	-61.12%	-57.62%	-40.59%	-30.09%	-60.91%	-50.44%
Lag - Geometric Avg	-56.36%	-52.68%	-47.37%	-25.38%	-15.49%	-53.78%	-40.94%
Lag - Harmonic Avg	-66.37%	-62.38%	-56.49%	-40.88%	-30.61%	-58.09%	-44.82%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.80%	4.92%	3.84%	6.17%	4.27%	5.35%	6.36%
PMPM	8.25%	8.06%	7.04%	8.06%	6.12%	7.11%	7.88%
Paid PMPM	6.27%	7.09%	6.00%	8.15%	5.19%	7.03%	11.88%
Benktander	5.28%	6.56%	4.75%	12.42%	10.99%	5.06%	5.86%
Bornhuetter	3.11%	4.44%	3.44%	7.04%	5.66%	4.12%	4.92%
Credibility Weighted	2.00%	3.24%	2.96%	4.98%	2.89%	4.05%	5.10%
Hybrid Loss Ratio	2.19%	3.26%	2.64%	5.31%	4.13%	3.76%	3.96%
Lag - 12 Mo Avg	5.84%	7.14%	4.99%	20.02%	25.18%	5.49%	5.69%
Lag - 9 Mo Avg	7.22%	8.98%	6.11%	24.55%	32.64%	5.99%	6.52%
Lag - 6 Mo Avg	9.87%	12.39%	7.75%	34.38%	48.37%	7.42%	8.16%
Lag - 3 Mo Avg	20.73%	26.82%	15.81%	78.60%	119.57%	14.46%	15.71%
Lag - Cross Incurral	3.29%	3.84%	3.29%	9.60%	8.56%	4.21%	4.40%
Lag - Dollar Weighted	4.75%	5.38%	4.51%	13.64%	12.25%	5.80%	6.03%
Lag - Drop Extremes (10/12)	4.17%	5.03%	3.86%	11.91%	11.25%	4.73%	4.40%
Lag - Geometric Avg	5.17%	6.17%	4.90%	15.56%	15.15%	5.42%	5.82%
Lag - Harmonic Avg	4.03%	4.79%	4.22%	11.82%	10.74%	5.10%	5.42%

## Comparison of IBNR Methodologies

### Disruption Scenario (j)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-1.36%	-1.23%	-1.13%	-0.79%	-0.93%	1.24%	-14.38%
PMPM	-0.45%	-0.54%	-0.51%	-0.47%	-0.95%	1.33%	-14.32%
Paid PMPM	29.98%	15.88%	33.27%	5.50%	1.42%	12.82%	-4.11%
Benktander	103.73%	105.60%	93.74%	31.15%	24.07%	58.00%	15.96%
Bornhuetter	51.89%	52.75%	46.78%	15.44%	11.47%	33.04%	2.69%
Credibility Weighted	-1.36%	-1.23%	-1.13%	-0.79%	-0.93%	9.77%	-10.33%
Hybrid Loss Ratio	21.43%	23.37%	19.05%	7.18%	6.55%	19.28%	-3.23%
Lag - 12 Mo Avg	8.57%	8.85%	8.65%	15.24%	18.35%	103.75%	128.16%
Lag - 9 Mo Avg	10.98%	11.35%	11.06%	19.38%	23.65%	130.68%	165.71%
Lag - 6 Mo Avg	15.96%	16.55%	16.03%	28.25%	35.18%	189.40%	253.69%
Lag - 3 Mo Avg	36.71%	38.77%	38.74%	71.85%	96.88%	484.11%	832.93%
Lag - Cross Incurral	72.73%	76.38%	68.85%	56.30%	56.31%	64.84%	28.86%
Lag - Dollar Weighted	108.68%	114.47%	104.17%	91.39%	97.54%	102.98%	62.47%
Lag - Drop Extremes (10/12)	117.46%	133.52%	109.21%	120.67%	175.89%	124.00%	118.91%
Lag - Geometric Avg	826.46%	869.01%	790.01%	628.34%	689.33%	450.63%	279.33%
Lag - Harmonic Avg	57.99%	63.14%	54.13%	11.74%	8.39%	25.98%	-1.17%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.69%	2.74%	2.64%	2.28%	2.11%	2.65%	3.29%
PMPM	3.20%	3.22%	3.08%	2.44%	2.36%	2.53%	3.35%
Paid PMPM	19.11%	17.28%	15.36%	10.42%	6.78%	9.23%	5.86%
Benktander	23.67%	39.59%	15.32%	14.07%	16.46%	17.04%	10.25%
Bornhuetter	12.18%	20.03%	8.08%	7.33%	8.45%	9.80%	4.95%
Credibility Weighted	2.69%	2.74%	2.64%	2.28%	2.11%	4.32%	2.21%
Hybrid Loss Ratio	9.89%	16.45%	6.65%	6.97%	8.21%	9.09%	4.66%
Lag - 12 Mo Avg	4.05%	4.42%	3.66%	7.26%	10.21%	40.44%	99.94%
Lag - 9 Mo Avg	4.33%	4.84%	3.88%	8.50%	13.11%	49.09%	128.62%
Lag - 6 Mo Avg	4.88%	5.83%	4.28%	11.34%	19.62%	70.95%	209.52%
Lag - 3 Mo Avg	7.85%	10.76%	6.56%	26.64%	55.22%	177.38%	748.39%
Lag - Cross Incurral	37.02%	63.00%	25.63%	63.33%	93.95%	43.56%	36.73%
Lag - Dollar Weighted	48.65%	82.72%	33.69%	88.72%	135.28%	59.69%	56.55%
Lag - Drop Extremes (10/12)	51.27%	91.76%	35.05%	102.14%	193.94%	71.68%	90.59%
Lag - Geometric Avg	214.28%	372.15%	145.56%	337.42%	543.65%	201.03%	172.30%
Lag - Harmonic Avg	36.73%	63.04%	25.26%	51.23%	72.83%	31.70%	30.40%



## Comparison of IBNR Methodologies

### Disruption Scenario (k)

- Claims processing at 0 percent capacity for one month, then 50 percent capacity for the next month; begins 12 months prior to valuation date and takes two months to catch up

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.14%	0.42%	-1.15%	-1.69%	-7.54%	-1.64%	-4.27%
PMPM	-1.42%	-2.83%	-2.83%	-3.63%	-8.62%	-2.15%	-3.78%
Paid PMPM	-1.87%	-6.98%	-0.71%	-11.73%	-11.85%	-10.49%	-15.34%
Benktander	-7.62%	-6.87%	-10.52%	-6.24%	-8.56%	-9.29%	-6.31%
Bornhuetter	-4.54%	-4.74%	-7.57%	-4.86%	-7.88%	-7.32%	-5.76%
Credibility Weighted	1.84%	0.82%	-1.96%	-1.34%	-5.27%	-3.55%	-4.46%
Hybrid Loss Ratio	27.63%	26.40%	21.66%	16.32%	12.39%	12.56%	7.89%
Lag - 12 Mo Avg	54.44%	51.10%	45.31%	56.16%	51.41%	56.38%	91.23%
Lag - 9 Mo Avg	-13.99%	-11.00%	-16.71%	-9.72%	-3.42%	-14.05%	0.16%
Lag - 6 Mo Avg	5.26%	9.43%	3.56%	11.60%	19.97%	9.20%	27.74%
Lag - 3 Mo Avg	5.11%	9.47%	3.60%	11.04%	19.39%	10.35%	27.04%
Lag - Cross Incurral	7.96%	7.09%	5.28%	3.97%	0.90%	1.56%	-0.66%
Lag - Dollar Weighted	10.18%	9.98%	8.19%	7.98%	6.80%	4.66%	3.88%
Lag - Drop Extremes (10/12)	60.79%	63.21%	50.11%	58.38%	65.45%	51.17%	72.19%
Lag - Geometric Avg	-35.61%	-32.82%	-33.91%	-27.62%	-23.03%	-28.41%	-22.52%
Lag - Harmonic Avg	-55.87%	-54.51%	-53.02%	-46.65%	-41.61%	-43.59%	-40.94%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	5.01%	5.46%	4.69%	5.35%	2.79%	4.14%	2.90%
PMPM	10.89%	10.12%	9.07%	6.94%	5.32%	5.46%	3.91%
Paid PMPM	13.49%	15.57%	9.84%	14.28%	9.38%	10.34%	7.72%
Benktander	9.07%	12.33%	6.95%	12.41%	8.62%	8.14%	7.39%
Bornhuetter	7.25%	9.33%	6.09%	10.19%	6.21%	6.84%	5.20%
Credibility Weighted	5.00%	6.80%	5.49%	7.97%	4.01%	5.81%	3.92%
Hybrid Loss Ratio	9.38%	11.67%	7.37%	12.26%	7.47%	8.75%	6.35%
Lag - 12 Mo Avg	13.85%	15.09%	10.43%	26.60%	26.05%	22.51%	65.32%
Lag - 9 Mo Avg	13.79%	21.47%	9.28%	24.62%	33.01%	18.61%	31.44%
Lag - 6 Mo Avg	17.10%	27.77%	11.50%	31.19%	41.89%	23.69%	44.18%
Lag - 3 Mo Avg	18.68%	30.25%	13.24%	34.03%	46.38%	27.10%	49.53%
Lag - Cross Incurral	14.89%	22.16%	9.83%	23.46%	25.43%	18.01%	21.61%
Lag - Dollar Weighted	16.30%	24.33%	10.92%	26.76%	29.61%	20.16%	25.62%
Lag - Drop Extremes (10/12)	24.59%	39.05%	15.67%	44.14%	61.80%	34.00%	56.65%
Lag - Geometric Avg	11.03%	17.34%	7.82%	20.28%	24.69%	15.66%	22.08%
Lag - Harmonic Avg	8.46%	13.29%	6.53%	16.53%	18.31%	13.26%	16.03%

## Comparison of IBNR Methodologies

### Disruption Scenario (k)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	8.75%	3.06%	-1.07%	-2.91%	-12.15%	-2.71%	-12.13%
PMPM	-3.32%	-6.71%	-5.99%	-6.95%	-14.04%	-5.62%	-12.76%
Paid PMPM	9.00%	5.90%	4.36%	-4.65%	-3.25%	0.14%	-1.18%
Benktander	-2.39%	-5.58%	-11.31%	-8.84%	-14.33%	-10.48%	-15.86%
Bornhuetter	-0.89%	-4.46%	-9.72%	-7.18%	-12.81%	-10.09%	-15.05%
Credibility Weighted	11.72%	6.57%	-0.51%	-1.41%	-8.20%	-4.99%	-11.16%
Hybrid Loss Ratio	75.01%	60.54%	43.50%	31.69%	19.29%	27.97%	17.69%
Lag - 12 Mo Avg	160.96%	129.84%	97.22%	105.29%	77.32%	52.62%	35.13%
Lag - 9 Mo Avg	-2.80%	-5.99%	-11.76%	-9.74%	-15.26%	-10.88%	-16.13%
Lag - 6 Mo Avg	13.54%	11.54%	7.54%	11.38%	5.37%	7.66%	2.45%
Lag - 3 Mo Avg	14.14%	12.78%	8.02%	11.31%	5.44%	8.70%	3.42%
Lag - Cross Incurral	31.87%	23.85%	16.25%	11.50%	2.70%	12.07%	4.30%
Lag - Dollar Weighted	35.85%	28.73%	21.07%	16.80%	9.28%	17.10%	10.93%
Lag - Drop Extremes (10/12)	94.65%	77.29%	57.69%	51.42%	34.96%	36.64%	24.33%
Lag - Geometric Avg	-48.12%	-42.12%	-38.55%	-31.91%	-29.55%	-26.37%	-27.60%
Lag - Harmonic Avg	-85.83%	-76.59%	-68.07%	-56.13%	-45.47%	-43.95%	-40.54%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	16.17%	14.87%	10.77%	10.11%	4.28%	11.00%	8.64%
PMPM	33.33%	26.30%	19.92%	13.20%	8.25%	14.74%	12.03%
Paid PMPM	23.65%	22.87%	15.31%	22.74%	12.06%	21.36%	14.51%
Benktander	22.98%	22.62%	14.54%	24.58%	12.52%	19.97%	13.80%
Bornhuetter	21.19%	21.53%	13.67%	20.93%	9.58%	18.07%	12.60%
Credibility Weighted	15.83%	18.49%	12.37%	15.65%	6.09%	14.69%	11.03%
Hybrid Loss Ratio	34.22%	31.27%	18.23%	27.36%	12.33%	23.88%	15.33%
Lag - 12 Mo Avg	58.98%	51.08%	27.76%	58.80%	40.67%	33.47%	20.55%
Lag - 9 Mo Avg	23.23%	22.80%	14.69%	26.18%	14.40%	20.57%	14.06%
Lag - 6 Mo Avg	26.76%	25.92%	17.10%	32.41%	18.03%	24.27%	16.40%
Lag - 3 Mo Avg	30.34%	31.02%	21.20%	36.59%	20.67%	27.25%	19.21%
Lag - Cross Incurral	28.26%	25.82%	15.82%	27.58%	14.76%	22.48%	14.24%
Lag - Dollar Weighted	29.73%	27.54%	16.99%	30.38%	16.82%	24.76%	16.09%
Lag - Drop Extremes (10/12)	43.57%	38.53%	22.35%	43.19%	23.86%	29.90%	18.81%
Lag - Geometric Avg	13.80%	16.50%	11.68%	20.45%	11.64%	17.21%	12.54%
Lag - Harmonic Avg	5.53%	10.25%	9.17%	15.82%	9.53%	14.32%	11.46%

## Comparison of IBNR Methodologies

### Disruption Scenario (k)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-0.47%	-0.63%	-0.99%	-0.22%	-0.95%	-0.95%	-1.49%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	-5.25%	-12.38%	-3.50%	-16.42%	-23.06%	-14.56%	-19.83%
Benktander	-8.73%	-6.07%	-9.35%	-1.93%	0.54%	-7.86%	-2.66%
Bornhuetter	-5.10%	-3.61%	-5.49%	-1.15%	-0.27%	-5.26%	-2.25%
Credibility Weighted	-1.91%	-1.51%	-2.58%	-0.45%	-0.89%	-2.41%	-1.96%
Hybrid Loss Ratio	8.30%	9.36%	7.02%	3.86%	3.29%	6.18%	4.89%
Lag - 12 Mo Avg	9.83%	9.98%	9.71%	13.63%	15.76%	59.81%	111.40%
Lag - 9 Mo Avg	-17.61%	-11.82%	-19.49%	-7.13%	16.23%	-14.56%	6.30%
Lag - 6 Mo Avg	3.24%	10.61%	1.65%	15.00%	44.29%	11.20%	37.11%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-0.92%	0.13%	-1.58%	-0.25%	0.87%	-2.28%	-1.85%
Lag - Dollar Weighted	0.60%	2.04%	0.01%	2.76%	6.07%	-0.02%	2.02%
Lag - Drop Extremes (10/12)	48.38%	58.93%	46.00%	69.39%	113.74%	59.71%	89.40%
Lag - Geometric Avg	-29.20%	-26.25%	-30.09%	-21.54%	-11.52%	-28.57%	-20.34%
Lag - Harmonic Avg	-42.13%	-41.36%	-42.03%	-36.27%	-34.44%	-42.81%	-40.75%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.54%	2.56%	2.46%	2.35%	2.09%	2.43%	2.02%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	16.86%	20.73%	12.94%	19.41%	15.56%	12.25%	9.13%
Benktander	8.73%	14.85%	6.05%	8.41%	10.45%	6.88%	8.57%
Bornhuetter	5.41%	8.83%	3.89%	4.77%	5.69%	4.72%	5.33%
Credibility Weighted	2.87%	3.29%	2.57%	2.57%	2.28%	2.82%	2.35%
Hybrid Loss Ratio	5.95%	9.56%	4.26%	5.03%	5.77%	5.54%	5.72%
Lag - 12 Mo Avg	3.44%	3.67%	3.18%	6.11%	8.06%	27.40%	86.41%
Lag - 9 Mo Avg	17.30%	31.08%	12.22%	41.29%	79.09%	25.78%	42.26%
Lag - 6 Mo Avg	22.14%	40.30%	15.77%	52.30%	100.90%	33.49%	59.72%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.24%	32.48%	13.82%	40.31%	60.98%	25.13%	28.65%
Lag - Dollar Weighted	20.79%	35.06%	14.94%	45.35%	69.69%	27.91%	33.75%
Lag - Drop Extremes (10/12)	30.97%	56.38%	22.04%	75.69%	148.44%	48.24%	75.55%
Lag - Geometric Avg	14.86%	25.96%	10.61%	35.05%	59.53%	21.65%	29.51%
Lag - Harmonic Avg	12.37%	20.82%	8.95%	28.88%	44.20%	18.06%	21.14%

## Comparison of IBNR Methodologies

### Disruption Scenario (I)

- Claims processing at 0 percent capacity for one month, then 50 percent capacity for the next month; begins 12 months prior to valuation date and takes four months to catch up

### Results Set 1—All Incurral Months

#### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-0.31%	-1.81%	-2.78%	-2.73%	-7.70%	-2.61%	-4.81%
PMPM	-0.53%	-2.22%	-2.36%	-3.38%	-8.62%	-2.24%	-4.06%
Paid PMPM	-1.59%	-7.10%	-0.31%	-12.37%	-11.94%	-10.90%	-15.65%
Benktander	-19.46%	-17.29%	-18.65%	-11.57%	-11.08%	-12.07%	-7.61%
Bornhuetter	-15.30%	-14.09%	-14.74%	-9.45%	-9.90%	-9.70%	-6.91%
Credibility Weighted	-9.12%	-8.76%	-10.15%	-5.83%	-7.61%	-7.33%	-6.49%
Hybrid Loss Ratio	12.60%	11.70%	6.81%	5.06%	2.52%	1.98%	0.20%
Lag - 12 Mo Avg	33.65%	31.48%	27.74%	38.85%	36.61%	40.36%	70.34%
Lag - 9 Mo Avg	-26.99%	-22.56%	-25.67%	-15.96%	-6.66%	-16.95%	-0.08%
Lag - 6 Mo Avg	-2.19%	1.59%	-3.74%	3.14%	10.57%	0.07%	15.35%
Lag - 3 Mo Avg	6.06%	10.18%	4.10%	11.38%	19.40%	10.28%	26.68%
Lag - Cross Incurral	6.57%	5.59%	3.79%	2.77%	-0.37%	0.18%	-1.90%
Lag - Dollar Weighted	8.63%	8.33%	6.55%	6.66%	5.41%	3.14%	2.54%
Lag - Drop Extremes (10/12)	29.81%	31.83%	20.37%	28.24%	35.72%	21.87%	44.25%
Lag - Geometric Avg	-31.41%	-28.32%	-29.03%	-22.21%	-16.76%	-22.57%	-15.69%
Lag - Harmonic Avg	-35.98%	-34.02%	-32.52%	-28.38%	-25.21%	-27.93%	-26.52%

#### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	4.81%	5.27%	4.55%	5.21%	2.73%	4.07%	2.80%
PMPM	10.86%	10.08%	9.00%	6.88%	5.27%	5.42%	3.84%
Paid PMPM	13.05%	14.96%	9.65%	13.59%	8.74%	9.95%	7.19%
Benktander	7.86%	11.40%	6.38%	11.50%	8.25%	7.70%	7.10%
Bornhuetter	6.25%	8.57%	5.65%	9.54%	5.97%	6.50%	4.96%
Credibility Weighted	4.85%	6.77%	5.43%	8.16%	4.36%	6.07%	4.03%
Hybrid Loss Ratio	7.97%	10.35%	6.41%	11.00%	6.79%	7.82%	5.69%
Lag - 12 Mo Avg	11.30%	12.58%	8.92%	22.92%	22.95%	19.83%	57.10%
Lag - 9 Mo Avg	12.39%	20.13%	8.61%	23.45%	32.32%	18.42%	31.61%
Lag - 6 Mo Avg	15.77%	25.66%	10.72%	28.53%	37.75%	21.46%	39.13%
Lag - 3 Mo Avg	18.85%	30.53%	13.32%	34.27%	46.46%	27.21%	49.39%
Lag - Cross Incurral	14.84%	22.19%	9.77%	23.46%	25.24%	18.02%	21.71%
Lag - Dollar Weighted	16.21%	24.35%	10.82%	26.70%	29.35%	20.06%	25.70%
Lag - Drop Extremes (10/12)	20.08%	32.13%	12.73%	35.98%	50.35%	27.66%	47.29%
Lag - Geometric Avg	11.79%	18.62%	8.28%	21.67%	26.51%	16.89%	24.00%
Lag - Harmonic Avg	11.22%	17.24%	7.97%	20.05%	22.27%	15.53%	19.31%

## Comparison of IBNR Methodologies

### Disruption Scenario (I)—Cont.

#### Results Set 2—“Credible” Months (> 50% Completion Factor)

##### Mean

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	3.84%	-0.96%	-3.46%	-4.33%	-12.13%	-4.27%	-13.07%
PMPM	-0.57%	-5.12%	-4.94%	-6.46%	-14.06%	-5.89%	-13.74%
Paid PMPM	12.04%	7.96%	6.11%	-4.98%	-3.22%	0.53%	-0.59%
Benktander	-37.68%	-32.23%	-28.91%	-19.67%	-18.51%	-17.81%	-20.77%
Bornhuetter	-34.42%	-29.43%	-25.94%	-16.63%	-16.20%	-16.56%	-19.34%
Credibility Weighted	-18.86%	-17.05%	-17.21%	-9.76%	-11.85%	-12.86%	-16.96%
Hybrid Loss Ratio	36.13%	26.98%	13.53%	10.20%	3.31%	3.92%	-4.85%
Lag - 12 Mo Avg	102.67%	81.71%	60.29%	73.73%	55.18%	30.41%	17.23%
Lag - 9 Mo Avg	-38.14%	-32.71%	-29.44%	-20.88%	-19.70%	-18.32%	-21.13%
Lag - 6 Mo Avg	11.41%	8.20%	3.64%	5.52%	-0.66%	3.35%	-2.47%
Lag - 3 Mo Avg	17.44%	14.71%	9.26%	11.93%	5.42%	8.44%	2.29%
Lag - Cross Incurral	27.94%	19.83%	12.80%	9.09%	0.67%	8.03%	-0.32%
Lag - Dollar Weighted	31.49%	24.36%	17.33%	14.16%	7.08%	12.74%	5.98%
Lag - Drop Extremes (10/12)	43.93%	33.17%	18.32%	18.20%	9.37%	5.68%	-3.94%
Lag - Geometric Avg	-45.77%	-38.86%	-33.93%	-26.41%	-23.36%	-21.55%	-23.27%
Lag - Harmonic Avg	-53.78%	-45.32%	-38.64%	-32.07%	-27.03%	-24.90%	-25.50%

##### Standard Deviation

IBNR Methods	HMO	HMO	Managed	HMO	Self Funded	Major	Medicare
	Medicare	Professional	Care	Hospital		Medical	Supplement
LossRatio	15.46%	14.21%	10.50%	9.77%	4.19%	10.86%	8.37%
PMPM	33.55%	26.28%	19.82%	13.08%	8.16%	14.61%	11.69%
Paid PMPM	23.50%	22.91%	15.28%	22.26%	11.63%	21.40%	14.61%
Benktander	15.46%	17.57%	12.31%	21.74%	11.73%	17.98%	12.45%
Bornhuetter	14.72%	17.35%	11.87%	18.80%	9.06%	16.48%	11.48%
Credibility Weighted	12.42%	16.20%	11.44%	15.59%	6.59%	14.89%	10.98%
Hybrid Loss Ratio	25.75%	24.72%	14.50%	22.91%	10.70%	19.61%	12.27%
Lag - 12 Mo Avg	44.51%	39.62%	22.29%	49.46%	35.53%	28.46%	17.36%
Lag - 9 Mo Avg	15.54%	17.62%	12.36%	23.01%	13.42%	18.46%	12.64%
Lag - 6 Mo Avg	25.51%	24.85%	16.50%	30.83%	16.85%	23.59%	15.83%
Lag - 3 Mo Avg	30.46%	31.03%	21.24%	36.73%	20.59%	27.34%	19.08%
Lag - Cross Incurral	27.00%	24.61%	15.21%	27.24%	14.54%	21.97%	13.61%
Lag - Dollar Weighted	28.29%	26.17%	16.27%	29.94%	16.55%	24.06%	15.29%
Lag - Drop Extremes (10/12)	31.35%	28.70%	16.75%	33.34%	18.97%	23.01%	14.08%
Lag - Geometric Avg	14.15%	16.67%	11.89%	21.56%	12.48%	17.78%	12.36%
Lag - Harmonic Avg	12.88%	15.79%	11.45%	20.19%	11.62%	17.12%	12.10%

## Comparison of IBNR Methodologies

### Disruption Scenario (I)—Cont.

#### Results Set 3—Most Recent Incurral Months (< 50% Completion Factor)

##### Mean

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	-1.89%	-1.97%	-2.13%	-0.96%	-1.38%	-1.64%	-1.87%
PMPM	-0.39%	-0.47%	-0.45%	-0.45%	-0.91%	-0.44%	-0.66%
Paid PMPM	-6.07%	-13.64%	-4.03%	-17.38%	-23.41%	-15.37%	-20.51%
Benktander	-10.77%	-7.98%	-10.98%	-2.33%	0.35%	-8.52%	-2.69%
Bornhuetter	-6.32%	-4.74%	-6.46%	-1.36%	-0.36%	-5.73%	-2.31%
Credibility Weighted	-4.40%	-3.49%	-4.84%	-1.26%	-1.30%	-4.16%	-2.64%
Hybrid Loss Ratio	3.74%	4.87%	2.74%	1.94%	2.05%	1.87%	2.27%
Lag - 12 Mo Avg	5.88%	6.01%	5.85%	9.31%	11.22%	46.53%	89.59%
Lag - 9 Mo Avg	-21.22%	-15.46%	-22.44%	-9.07%	14.58%	-15.38%	7.74%
Lag - 6 Mo Avg	-6.56%	0.09%	-8.09%	3.80%	29.69%	-0.33%	22.15%
Lag - 3 Mo Avg	2.75%	9.90%	1.37%	13.86%	42.50%	12.42%	35.79%
Lag - Cross Incurral	-1.02%	0.05%	-1.67%	-0.35%	0.65%	-2.44%	-1.95%
Lag - Dollar Weighted	0.46%	1.92%	-0.12%	2.64%	5.79%	-0.23%	1.89%
Lag - Drop Extremes (10/12)	25.64%	33.81%	22.74%	41.14%	77.20%	30.85%	61.60%
Lag - Geometric Avg	-24.34%	-21.13%	-25.05%	-16.12%	-5.00%	-22.19%	-12.61%
Lag - Harmonic Avg	-27.52%	-26.51%	-27.71%	-22.92%	-20.53%	-28.57%	-26.47%

##### Standard Deviation

IBNR Methods	HMO Medicare	HMO Professional	Managed Care	HMO Hospital	Self Funded	Major Medical	Medicare Supplement
LossRatio	2.49%	2.52%	2.43%	2.30%	2.06%	2.41%	1.96%
PMPM	2.80%	2.80%	2.73%	2.33%	2.27%	2.09%	1.84%
Paid PMPM	16.18%	19.27%	12.57%	17.70%	13.70%	11.34%	8.15%
Benktander	8.58%	14.67%	5.99%	8.36%	10.41%	6.75%	8.51%
Bornhuetter	5.35%	8.78%	3.88%	4.75%	5.67%	4.65%	5.31%
Credibility Weighted	3.16%	3.84%	2.73%	2.58%	2.31%	3.13%	2.63%
Hybrid Loss Ratio	5.70%	9.22%	4.10%	4.93%	5.70%	5.22%	5.53%
Lag - 12 Mo Avg	3.19%	3.36%	3.02%	5.40%	7.15%	24.57%	76.05%
Lag - 9 Mo Avg	16.49%	29.80%	11.77%	40.28%	77.88%	25.66%	42.63%
Lag - 6 Mo Avg	20.07%	36.57%	14.30%	47.10%	90.56%	30.03%	52.91%
Lag - 3 Mo Avg	23.10%	42.68%	16.64%	54.24%	108.94%	37.77%	66.42%
Lag - Cross Incurral	19.12%	32.29%	13.74%	40.10%	60.51%	25.10%	28.85%
Lag - Dollar Weighted	20.67%	34.86%	14.85%	45.14%	69.15%	27.82%	33.99%
Lag - Drop Extremes (10/12)	25.99%	46.92%	18.37%	62.30%	121.25%	39.31%	63.37%
Lag - Geometric Avg	15.85%	27.70%	11.35%	37.44%	63.85%	23.39%	32.17%
Lag - Harmonic Avg	15.21%	25.76%	10.94%	34.79%	53.55%	21.36%	25.62%

## Comparison of IBNR Methodologies

### APPENDIX F

#### Managed Care Issues

*The following is an excerpt from the Society of Actuaries' study note, titled "Health Reserves," by John Lloyd and published by the Society of Actuaries. It is provided to describe IBNR considerations under managed care.*

Certain operational aspects of managed care organizations (MCOs) offer additional opportunities to modify traditional (IBNR) calculations. Typical MCOs reimburse non-capitated providers on negotiated fee schedules or per incident contractual bases that provide additional knowledge of unpaid claims costs. MCOs also often include utilization controls or monitoring systems such as precertification, referral tracking systems and provider-specific utilization feedback. Such information can be valuable to the actuary attempting to estimate liabilities.

#### *Claims and Trends Insights*

As noted previously, "the less credible recent months are often estimated by a combination of completed claims and trended PMPM estimates. Given the more closely monitored claims and negotiated fee schedules in MCOs, it is often possible to improve estimated PMPM costs by an increase in understanding of changes in claims costs.

- Utilization reports such as days/1,000 authorized should be a predictor of changes in claims trend.
- Changes in contractual provider reimbursement should help anticipate changes in PMPM costs for those services.
- Distortions in PMPM costs due to catastrophic claims should be better documented using utilization and authorization data.

The above improvements in PMPM cost estimates should help improve the projected estimates. They should also help the actuary rationalize outcomes emerging in completed incurred claims experience.

#### *In Course of Settlement and IBNR*

MCO claims typically complete rather quickly due to the nature of their contractual benefits and their relatively tight provider network. It is not uncommon to see an MCO with an unpaid liability as much as 50 percent lower than a comparable traditional plan. Out-of-network claims will often complete more like traditional plans, but typically run a relatively small percentage of MCO costs.

As such, a good portion of the medical claims liabilities for an MCO can often be tied up in ICOS claims. This is combined with an improved ability to estimate ICOS claims due to improved tracking of claims by the authorization/utilization management systems. Reserve estimates can therefore be estimated more easily than traditional plans with longer lags and a more diverse provider population."

#### *Use of Authorization*

The availability of prior authorization information for claims not yet paid affords an MCO with alternative or parallel processes for computing IBNR. Theoretically, an MCO would have information on approved hospital inpatient stays, outpatient procedures and specialty physician referrals.

## Comparison of IBNR Methodologies

Some MCOs use this information as their sole basis for projecting the cost of these claims. They must then add amounts for unreported, emergency or out-of-network claims. These factors can become rather sizeable as the proportion of point-of-service, out-of-area or other less stringently pre-authorized reimbursements becomes an increasingly large part of the HMO claims incurred. At some point the choice of factor used to extrapolate “known” services becomes more relevant than the data itself.

A parallel development, which is often more satisfactory, combines authorization data with more traditional completion methodology. This process will improve the estimates created over either process used separately. Well-supported authorization data provide much better estimates of near-term emerging costs for blending with the development method than can be obtained from either the trended PMPM or loss ratio approaches.

Like the run-out studies for lag-based methods, the actuary should review the initial-versus-ultimate accuracy of the authorization logs. Tracking the services actually rendered versus those included in the end-of-the-month data can determine how suitable this information will be in a given situation. There are a number of ways to compensate for the shortcomings of initially available authorization data as long as the data-gathering is a systematic process.

In Example 6 below, the actuary has obtained end-of-the-month authorization data from the utilization review area of the MCO. The data shown are hospital days/1,000 being used to develop inpatient costs, but they could represent any category of prior authorized services. Combined with ancillary data and the analysis described below, this data can be used to estimate incurred claims.

**Exhibit 6 - Projection of Inpatient Claims Based on Authorization Data**

Incurral Month	Authorized			Trended Cost/Day	Lagged-Based		Blended Cost/Day	Incurred Claims (e)=(c)*(d)	Incurred & Paid (f)	Estimated IBNR (e)-(f)
	Hospital Days (a)	Completion of Days (b)	Incurred Days (c)=(a)/(b)		Cost/Day	Credibility				
Jan	1,600	0.980	1,633	1,100	1,001	1.00	1,001	1,634	1,634	0
Feb	1,450	0.980	1,480	1,115	979	1.00	979	1,449	1,449	0
Mar	1,575	0.980	1,607	1,095	962	1.00	962	1,546	1,538	8
Apr	1,700	0.980	1,735	1,125	1,185	1.00	1,185	2,056	2,037	19
May	1,625	0.980	1,658	1,135	1,438	1.00	1,438	2,384	2,349	35
Jun	1,500	0.980	1,531	1,150	900	1.00	900	1,378	1,350	28
Jul	1,475	0.980	1,505	1,090	1,200	1.00	1,200	1,806	1,752	54
Aug	1,625	0.980	1,658	1,095	1,329	1.00	1,329	2,204	2,094	110
Sep	1,575	0.980	1,607	1,105	1,297	0.75	1,249	2,007	1,807	200
Oct	1,600	0.975	1,641	1,110	1,125	0.50	1,118	1,834	1,467	367
Nov	1,375	0.950	1,447	1,115	925	0.25	1,068	1,545	1,081	464
Dec	1,250	0.900	1,389	1,125	0	0.00	1,125	1,563	469	1,094
TOTALS								21,405	19,027	2,378

Several notes are specific to certain columns above:

- Authorized services should be adjusted for differences between the initial authorized totals and the actual services that are later recorded. There are almost always differences between these two values as more information is developed. Services may be authorized but not rendered or may be reduced



## Comparison of IBNR Methodologies

due to later coordination of benefits activities. Services may also be added due to appeals, poor data or follow-up notifications. In many cases, some small percentage of services will be rendered without any prior authorization due to simple issues with the enforceability of rules.

- One way of recognizing the adjustment to authorizations is to leave column (a) as reported and to track the development between initial authorizations and the ultimate services actually covered. This recognizes authorization “leakage” against claims eventually paid and creates a set of completion factors to be applied against the authorization values. The above figures also show the actuary to believe that underreporting in the first month of the authorization process to be 10 percent short and then improving with each passing month. The actuary has also determined that authorized values will ultimately be short by about 2 percent versus days eventually realized.
- As in other completion methods, the estimated percentages are used to develop ultimate figure for services to be rendered.
- An average cost per claim or per day is needed to extrapolate the services to be provided into a dollar amount to be paid. The reliability of the estimate is obviously directly related to the error in this unit cost. It is common to approach this estimate using both anticipated payment data from hospital contracts and payment data actually realized.
  - Negotiated data and budgeted costs per day are often employed. This involves analysis of the contracts, emerging experience and trend to future service dates:
    - Hospital claims should include ancillary services as well as per diem charges. This can make the averages a little broader than one would like, since it is often the case that the initial days of hospitalization generate higher costs/day than later days during a given stay in the hospital.
    - Specialty physician or other referral services are harder to develop using this method because there tends to be much more variability in the average cost per services. If there was a sufficient volume of data, subdividing the services into less variable categories (e.g., outpatient surgery versus specialty office visits) would improve the average cost estimates.
    - As might be illustrated by the highlighted month of July, it is possible to reflect changes in per diem or other negotiated fee schedules by their impact on the cost per claim. As we attempt to project the most recent months, however, it is likely the estimates will become less accurate.
  - Many times, the actuary will blend the above estimates with the completed cost estimates developed from more traditional lag methods.
    - Completed estimates of cost per day can be developed using both the lag-based incurred claims and the days of hospitalization.
    - These are then credibility-blended with the authorization-based estimates.
    - We would assume that authorizations are more credible in the early durations when lags are often flawed. On the other hand, once relatively complete, lag-based estimates often point out the problems in cost/day estimates when it comes to using average intensity versus actual claims costs.
  - Incurred claims are then estimated by services anticipated times cost per service.
  - Incurred and paid claims are recorded by tracking payments against month of service. The reserve would then be incurred claims less known paid claims.

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Even in MCO situations in which prior authorization is not an absolute prerequisite for services, information on upcoming or current hospital or serious specialty claims may still be available. The development of this data into an IBNR estimate may be less rigorous than above, but may still provide valuable insight.

Many MCOs feel that their authorization process is “air-tight” and the above process is the preferred means of estimating unpaid liabilities. Others acknowledge that some services eventually slip through and the “completion of authorizations” is merely an estimate. As one might suspect, the process of developing an average cost/service can add considerable uncertainty. The authorization log is therefore another piece of data applied to develop an alternative view of the reserve estimate. It can be added to the range of estimates from which the actuary can determine a best estimate using insight and judgment.

## Comparison of IBNR Methodologies

### APPENDIX G

#### IBNR Margin

*The following is an excerpt from the Society of Actuaries' study note, titled "Health Reserves," written by John Lloyd and published by the Society of Actuaries. It is provided to describe margins for IBNR.*

The goal of reserve estimation is to establish estimates that make a good and sufficient provision to cover moderately adverse conditions. Conservatism in estimates can be held on an explicit or implicit basis. Explicit margins are usually added as loads to reserves developed with assumptions held near the mean value of the estimated liability. Employing conservative assumptions in the process of determining the liability is the most common approach to developing implicit margins.

Claims estimates rely on a wide range of assumptions and variables. These assumptions must attempt to reflect the risks assumed under the contracts. Assumptions will also change based on claims operations and provider reimbursement changes. Issues related to the quality of the data may influence the degree of conservatism the actuary may need to build into the estimates.

It is also common to combine blocks of business with similar payment patterns to increase data credibility and for the sake of efficiency in performing calculations. The contractual provisions, benefit structures and other dynamics of the plans being grouped may differ. Additional conservatism may be needed to compensate for the variance incurred cost for these different plans.

Often, the calculation approach determines the process for building in conservatism:

- Development methods can employ completion factors and projection factors that result in varying degrees of conservatism. The various averaging and smoothing techniques will typically create a series of potentially usable completion factors. The use of projection factors or other techniques to estimate the most recent months' incurrals also involves selection of various trends or PMPM costs. Implicit margin can be created by conservatism in the choice of completion and projection factors. More often, assumptions are held to "most likely" and explicit margin is then added to the "average" reserve.
- Projection methods tend to introduce margins in terms of the trends used to project costs per unit exposed toward the end of the valuation period. Most often, projected costs employ assumptions as to utilization and provider reimbursement trends. The trend assumptions reflect the degree of uncertainty and amount of conservatism the actuary is warranted in each reserving situation.
- Loss ratio projections may have explicit or implicit added margin, depending on the choice of loss ratio and its presumed relationship to the likely experience of the block.

Margin should relate to the degree of uncertainty in the estimate. Statistical considerations would tell us that larger blocks of business with more stable payment patterns would inherently require less margin to assure coverage of adverse outcomes. Conversely, coverages with a low frequency of claim and/or large average loss payment may require a higher margin load unless the exposure base has become extensive.

Margin requirements will also vary in relation to the amount of information and quantification of variables which may impact the reserve estimate. Well-documented and credible reports on claims

## **Comparison of IBNR Methodologies**

inventories, low variance in claims cost trend or fairly homogenous payments per claim are all examples of situations in which estimates may require less margin due to inherently less variability in projected outcomes.

The distribution of potential liability estimates can be used to develop reserves that the actuary believes to be designed to be adequate for some target percentage of the outcomes. This should then be validated by run-out studies to determine if the targeted margin has emerged following subsequent run-out. If the run-out shows that the margin is not materializing, the actuary may need to adjust the procedures or assumptions to re-establish the presumed margins on a going forward basis.

# Comparison of IBNR Methodologies

## Appendix H

### Advance Methods: Neural Network

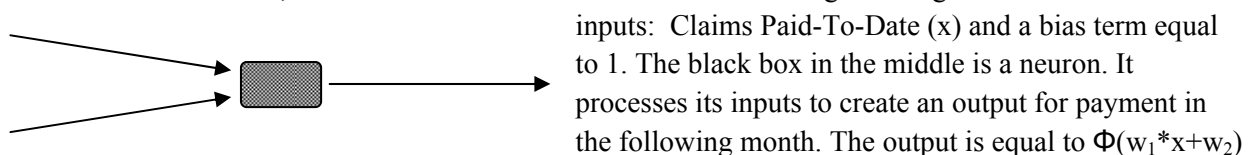
#### Neural Network Method

We do not claim to be an expert on neural networks and will not present a detailed tutorial on the implementation of such a system. This appendix will just give an overview of the capabilities and limitations of such methods using the example of a neural network implemented by Syed Mehmud. For those who wish to delve deeper into details of neural networks, we can suggest several sources, or simply google “neural network tutorials.”

The neural network is essentially a nonlinear pattern recognition system. As implemented in this case, it works off of very similar assumptions to the age-to-age development method. The difference is that rather than a linear relationship (Expected Claims Paid-to-Date (n+1) = x\*Claims Paid-To-Date (n)), there is a separate nonlinear relationship for each duration - fit between Claims Paid-To-Date amount and payment amount in the following claim lag duration. When using a neural network, instead of analytically solving for the relationship between values, it is determined by the network through a formal “learning” process. As with the developmental IBNR methods, there is an assumption that the durational payout pattern is dominant; however, the solution also contains constant terms similar to a Per-Member Exposure IBNR approach. Thus, if the historical data does not exhibit payments dependent upon Paid-To-Date amounts, the model will resemble a Per-Member model.

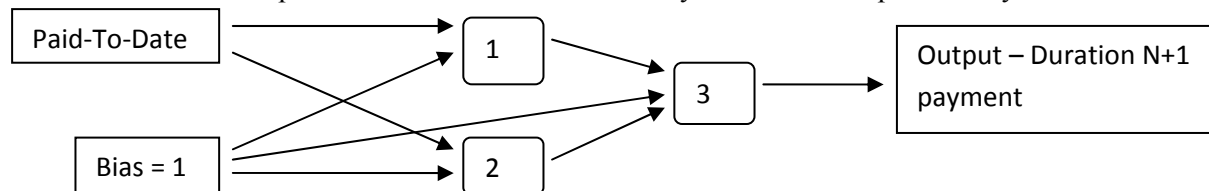
#### General Description of the Neural Network Implemented by Mehmud for IBNR

For each claim lag duration, Mehmud has created a separate neural net. The majority of claim payments are made in the first few claim lag durations. For later durations, payments are smaller and less organized. For these later durations, Mehmud has used a neural network consisting of a single node. There are two



where  $\Phi(v)$  is the hyperbolic tangent function:  $(\exp(v)-\exp(-v))/(\exp(v)+\exp(-v))$ .

For the early durations the network consists of three neurons similar to the one above. Inputs are fed to two independent neurons called “the hidden layer.” Output from neurons 1 and 2 is then used as input to the third node. The output of the neurons in the hidden layer do not correspond to any real world values



and so can have any values leading to a valid solution in neuron 3. Each neuron processes its input in the same way as in the single neuron network. The inputs are weighted and summed:  $v=\sum w_i*Input_i$ . Output from the neuron uses the same hyperbolic tangent function  $\Phi(v)$  applied to the inputs.

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### *Network Training*

The tricky part of solving this problem is setting up the formulas. We have defined the form of the solution above; now the various weights in each of the networks need to be set. This is done using a process called *Supervised Learning*. Each weight in a network is assigned a random value. Historical values are used as a training data set. The weights are adjusted through a nested iterative process. For each training data point, the weights are iteratively adjusted until the output value is acceptably close to the historical result. This process is repeated, looping through all of the training points until the network performs acceptably for each training point simultaneously. Training must be performed for each network being used—one per duration, in order to calculate the entire IBNR triangle.

### *Limitations and Concerns*

One limitation we have observed for this implementation is that the training applies all historical data equally. If claims processing has changed over time it may be necessary to entirely throw out older data, or to manually adjust the data before applying the training algorithm. It does not appear to be possible to assign higher weighting to more recent data as is done in some versions of our more simplistic age-to-age development methods.

### *Neural Network References*

The following are neural network tutorials which the author found educational. This is definitely not a comprehensive list of sources on the topic.

Artificial Neural Networks, Francisco J. Rodríguez and Dr. William A. Sandham  
<http://www.gc.ssr.upm.es/inves/neural/ann1/anntutor.htm>

Regression and Classification with Neural Networks, Andrew W. Moore  
<http://www.autonlab.org/tutorials/neural13.pdf>

This contains additional links to neural network tutorials and more advanced discussion. Also links for other artificial intelligence (AI) topics.

Neural Networks in Plain English, Mat Buckland  
<http://www.ai-junkie.com/ann/evolved/nnt1.html>

This is an excellent article on Back Propagation Networks (BPN)—the basis for supervised training of the neural networks we have discussed.

Back-Propagation Neural Network Tutorial, Philippe Crochat and Daniel Franklin  
[http://pcrochat.online.fr/webus/tutorial/BPN\\_tutorial.html](http://pcrochat.online.fr/webus/tutorial/BPN_tutorial.html)

## Comparison of IBNR Methodologies

### APPENDIX I

#### Confidence Intervals for Regressions

The stochastic method was the only method that gave a true confidence interval for its IBNR calculation. All other methodologies were deterministic, giving a single point estimate value for the IBNR. While this deterministic output is definitely the goal of these methods, it is possible, under certain conditions, to develop a confidence interval based off of the results of a regression analysis. For example, suppose an actuary uses a combination of the 12-month average lag method and a simple incurred PMPM method for the most recent three months. Typically the actuary will make some estimation of the incurred PMPM amounts for the most recent incurred months. If the actuary were to perform a regression to determine future expected PMPMs, the result would be an equation used to make the future calculations along with standard error amounts for both the slope and intercept estimates (assuming simple linear regression). These error values can be used to develop a confidence interval for making forecasts.

The simplest way to illustrate this is with an example. Suppose you have 24 months of incurred PMPMs (including those estimated by the lag method). Figure 1 shows a graph of the PMPMs over time. The desire is to estimate PMPMs for months 25, 26 and 27.

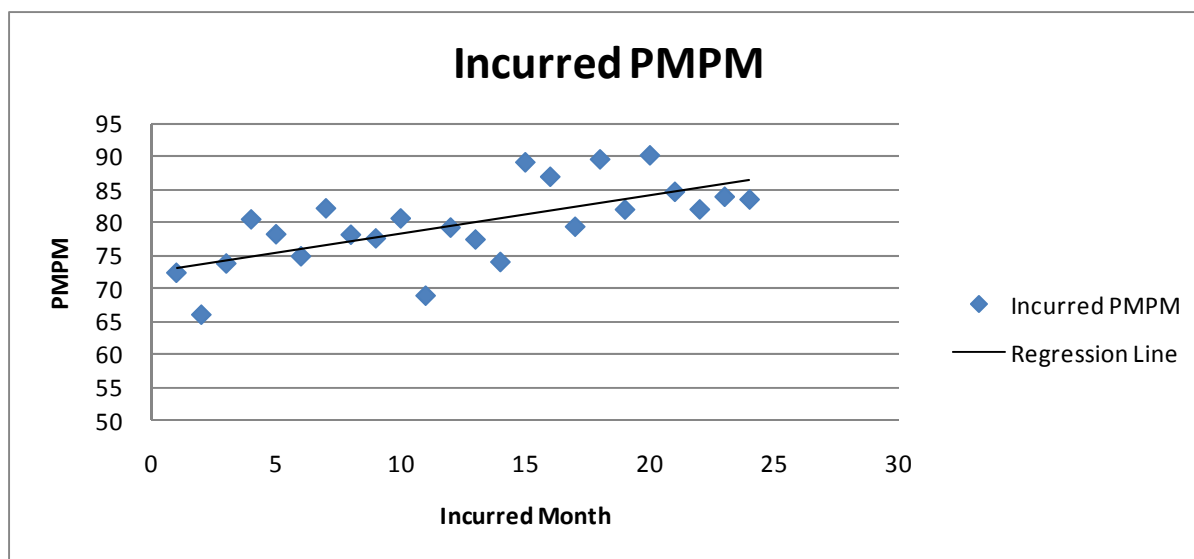


Figure 1

A regression has been performed on the data, resulting in the following equation:

$$PMPM_t = 72.4207 + .58521 \cdot Period_t$$

Period<sub>t</sub> is the month number you wish to estimate, in our case it would be 25, 26 and 27. Plugging our desired months into the equations we would come up with PMPM estimates of 87.05, 87.64 and 88.22. Showing the derivation of the regression is beyond the scope of this appendix. All of our regressions are performed using the `linest()` and functions in Microsoft Excel.

An additional benefit of using the `linest()` function in Excel is that it calculates the necessary standard deviations for the regression including the error of the slope ( $s_m$ ), the error of the intercept ( $s_b$ ) and the

## Comparison of IBNR Methodologies

error of the regression ( $s_y$ ). The most important of these for our purposes is the error of the regression which measures the variation between the estimated value of the PMPMs at each interval and the actual PMPM. While Excel calculates the error of the regression for you, the formula for it is included below:

$$s_y = \sqrt{\frac{1}{df} \sum (Y_t - \hat{Y}_t)^2} \quad (\text{Formula 1})$$

$df$  = degrees of freedom (T-r): in our case, we have two regression estimates (r) and 24 total values (T), so the degrees of freedom value is 22

$Y_t$  = the known PMPM values

$\hat{Y}_t$  = the estimated PMPM values from the regression for the known months.

The next step is to determine the standard error of the forecast. This error should be a function of all three errors mentioned above. The resulting equation for the standard error of the forecast is below:

$$s_f = s_y \sqrt{1 + \frac{1}{T} + \frac{(X_E - \bar{X})^2}{\sum (X_t - \bar{X})^2}} \quad (\text{Formula 2})$$

$T$  = total number of known PMPM values (24 in our example)

$X_E$  = period for which an estimate is being calculated

$\bar{X}$  = average of known x values (i.e., midpoint of the experience period).

The derivation of this formula is also beyond the scope of this appendix; however, it is derived from the formulas for the standard errors of each of the three regression errors listed above. This resulting equation is a point specific standard error of the forecast. Once the forecast error is calculated, a confidence interval can be developed. In this case, we use the student's  $t$  distribution to develop the confidence interval using the formula below:

$$\hat{Y}_E \pm t_{\alpha/2} \cdot s_f \quad (\text{Formula 3})$$

$t_{\alpha/2}$  = value from the  $t$  distribution at the desired confidence level (e.g., for a 95% CI,  $\alpha=0.05$ ) with  $T-2$  degrees of freedom.

In our example, the calculations generate the following confidence intervals for estimated incurred claims at a 95 percent level of confidence: (76.38, 97.72) for month 25, (76.86, 98.41) for month 26 and (77.34, 99.10) for month 27. This is a variance of +/- 12 percent around the mean.

### Potential Pitfalls

There are a few things the actuary should be aware of when attempting to develop confidence intervals using this methodology. First, confidence intervals should not be developed for incurral months too far in the future. This can be understood by looking at *Formula 2* above. As you can see, the third term under the square root increases by the square of the distance from the incurral month you are estimating and the midpoint of the experience period. This results in a standard error that increases as you attempt to make estimates further in the future. This in turn results in a confidence interval that gets larger over time. This is due to the error in the slope coefficient of the regression. As the slope of a line changes, points close to some pre-determined pivot point do not change value very much. However, points further down the line



## Comparison of IBNR Methodologies

change in proportion to their distance from this point. In the case of the forecast error, the pivot point is the mean of the x values, or the midpoint of the experience period in our case. Figure 2 below shows a graph representation of this phenomena. As you can see, as you move further out in time, the confidence intervals get larger due the effect of the slope error.

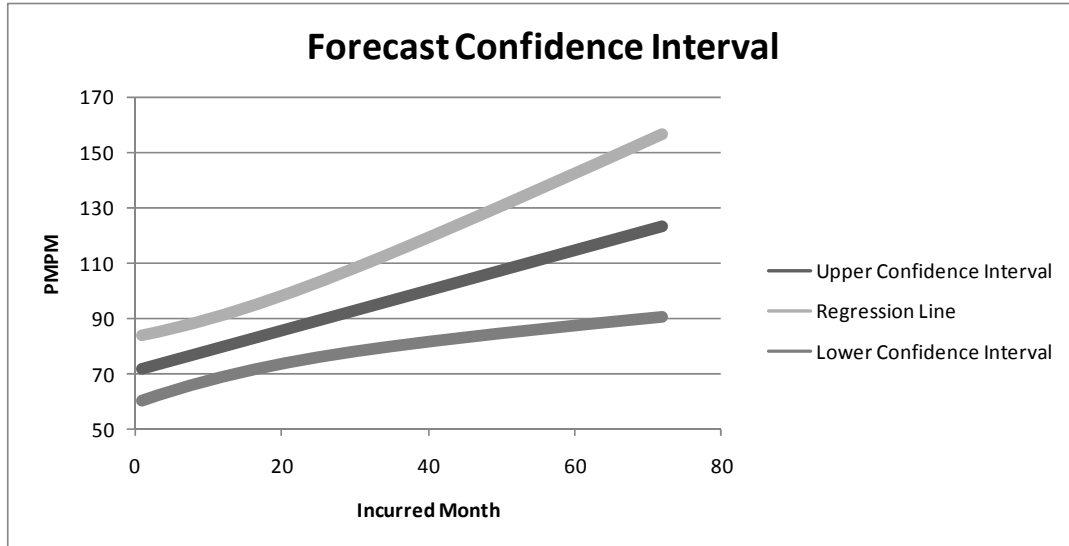


Figure 2

The second item the actuary must be aware of is that outliers can affect how useful these confidence intervals are. The effect of outliers can be seen by looking at *Formula 1* above. The standard error of the regression is the sum of the squared error terms between the known y's and the y's estimated by the regression. As outliers are introduced into the data, the resulting standard error will increase. For example, suppose you have data that results in the same regression equation as above. The only difference is that a few of the values lie further off of the regression line. Figure 3 below shows a set of data points that have the same mean and regression coefficients as developed above.

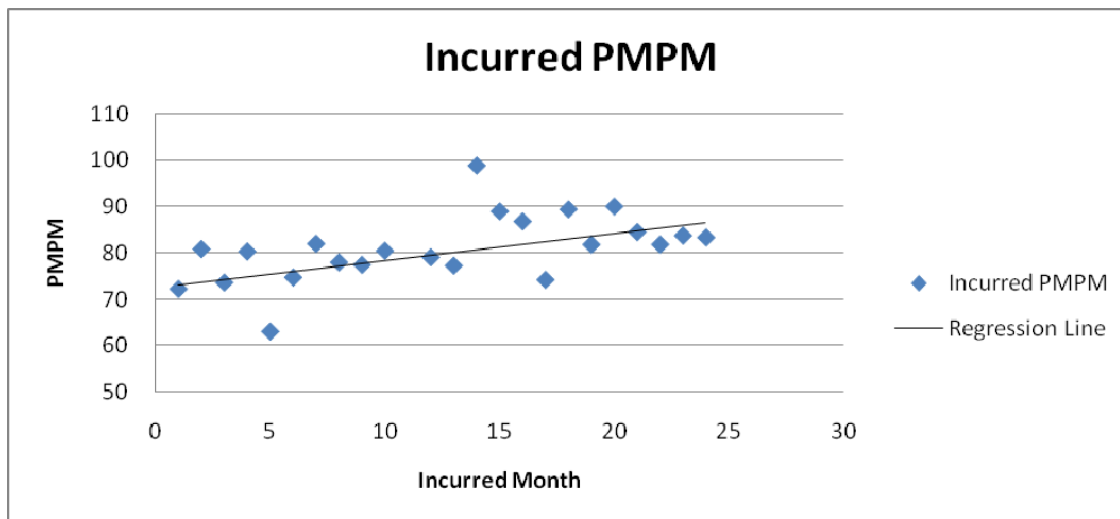


Figure 3

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The  $s_y$  term developed in the first example was 4.742. The  $s_y$  term in the above example is 8.994. Since the standard error used to develop the confidence interval is directly proportional to  $s_y$ , the resulting confidence interval will be twice as large.

The third item the actuary must be aware of is that the size of the confidence interval is directly affected by the number of data points in the experience period. As the size of the known data set decreases, the error term associated with the confidence interval increases. The second and third terms under the square root in *Formula 2* above are based on the size of the data set ( $T$ ). As  $T$  decreases, the  $1/T$  term begins to increase. Additionally, there are fewer values in the denominator of the third term, so the sum is smaller, resulting in a larger third term. In our first example above, the confidence interval varied approximately 12 percent from the mean. By reducing the experience period from 24 months to 12 months, the variance increases to 18 percent with no significant change in the mean and standard deviation of the data set, and no change in the regression. If the smaller experience period is compounded by outliers in the data, the variance of the confidence interval around the mean becomes over 30 percent.