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Health Section News

"For Professional Recognition of the Health Actuary"

Applying Diagnosis-Based Predictive Models to Group Underwriting

by Randall J. Ellis, Marilyn Schlein Kramer, Joseph F. Romano and Rong Yi

Introduction

The development of group premium health rates is a joint effort of pricing actuaries and underwriters. Typically actuaries set the broad rating approach and factors while underwriters examine the realities of a specific group against the theoretical relationships and guidelines inherent in the approach. Traditional actuarial tools and developments are used to arrive at such approaches and factors, but all are ultimately aimed at one point ... the understanding of risk associated with the specific group.

These traditional actuarial approaches and underwriting guidelines use demographic information such as age/sex, type of occupation, financial stability, insurance carrier turnover, employee turnover and prior cost experience to analyze risk. However, there is significant data supplied in medical claims that can improve the match of premium to expected medical expense, improve group retention and ultimately improve long-term financial results, assuming one can properly examine the data to better predict the implications of such experience use.

Predictive models that use medical and pharmacy claims information to accurately measure expected health care

consumption to support efficient allocation of resource have been the subject of increased interest. Most studies have focused on the statistical predictive power of the models, (i.e. R-squared values on the standard measure of a model's predictive power).[1]

As indicated in the study noted, diagnosis-based models outperform age/sex approaches. Coupled with the improvement in data accessibility and

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1 See the recent SOA research publication "A Comparative Analysis of Claims-based Methods for Health Risk assessment for Commercial Populations, May, 2002.

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Variablility of Health Costs

by John P. Cookson

At the February 2003 joint meeting of the Health Benefits Systems Practice Committee and the Health Section Council, we identified and reached consensus on a number of key healthcare issues facing our members for 2003. One of the identified areas with a particular need for the application of actuarial skill is "Demonstration and Measurement of Medical Treatment Variability." I interpret this issue broadly and it incorporates the variations of cost, outcomes and quality of care.

The geographic variability of Medicare costs was explored recently in two articles on "The Implications of Regional Variations in Medicare Spending" published in the February 18, 2003 issue of the Annals of Internal Medicine. Based on their analysis, the authors estimated that Medicare costs could be reduced as much as 30 percent without a loss of quality by standardizing the delivery of care across areas. This study focused on the medical treatment patterns between geographic areas. My own research has also shown significant cost differences between providers within a geographic area.

I believe that this important area needs further research, and that these differences by geographic area and between providers within a geographic area need to be brought out in public. Only by publicizing these differences, so that they can be discussed openly, will we be able to make significant progress on understanding and controlling health care costs.

I would like to see more effort from the actuarial profession in making progress on this issue. I believe it is important for us to take an active role on this and similar issues, so that the advantages of our unique background and training can be added to the voices heard on these matters.

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Letter from the Editor

Vancouver Was Great!

by Jeffrey D. Miller

Greetings! Welcome to the August edition of HSN. I know many of you were in Vancouver, and we had a great meeting. The combination of a great city and a great program attracted many health actuaries. We all need to stay up to date on trends and methods in this continuously turbulent environment of health insurance and healthcare.

Articles in this edition cover the topics of disease management programs, terrorism, Medicare trending in FAS 106 calculations, Medicare Plus Choice, and variability. Each offers some thoughts worth pondering in important areas of actuarial practice. Perhaps you can read them during the down times of the meeting.

My practice continues to focus on the future of major medical insurance for individuals and small groups. Economic leverage over healthcare providers is becoming more of a necessity if medical insurance premiums are to be affordable at all. Such leverage requires geographic concentration, and only the largest group carriers are even close to achieving that concentration. Many of these group carriers have been burned in individual and small-group business in the past, and they are hesitant to be too aggressive in this area. Many of the traditional players in these markets are still around, but their premiums are no longer affordable. The result is a growing number of uninsured.

One solution that may make sense is a two-pronged coverage. Catastrophic coverage is purchased from group carriers who can control the costs of the most serious conditions. Scheduled benefit plans are purchased from traditional carriers that are skilled in managing the risk of first-dollar coverage for business subject to greater potential adverse selection. Who knows? It may end up looking like Medicare and Medicare Supplement coverages. The result is probably a "Gap" in the middle that nobody likes, but may become a fact of life. It will be interesting to see how healthcare providers manage collecting the fees in the "Gap".

I wish you all the best of luck in pursuing the challenges and opportunities that remain for 2003. May your career as a professional health actuary bring you continuous joy and prosperity.

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quality over time, the cost to process such data as well as the cost of the models to use such information are small relative to the possible savings from improved margins.

However enticing such results might be, the prospective user of any predictive model approach for rating will want to review the answers to several key questions:

- How do diagnosis-based models compare against commonly used group underwriting models?
- What is the increased benefit (return on investment) from the added predictive power of the diagnosis based models?
- How can these models be used in the real world of a health plan which renews 100s to 1,000s of accounts each month?

In this study, we

- Compare a predictive model approach with traditional experience rating approaches. In performing this comparison we used the DxCG predictive models to examine the impact at various "group size" levels.
- Describe a new methodology for assessing model performance in group underwriting by using economic modeling principles, including simulation studies. The concept of "actuarially balanced rating" or "actuarially fair" rates as used in this simulation is described below.
- Suggest areas of further study and collaboration by health services researchers and actuaries.

Actuarially Balanced Rating

Most insurers break the universe of groups into broad categories, such as small group, mid market and large group. While the actual points of size delineation vary from insurer to insurer and geography to geography, the fundamental reason for such categorization is regulatory constraints which typically affect the amount or degree to which actual group data can be used to rate that specific group. This limitation can be extreme at the smallest of group sizes, but generally eases significantly as group size increases, linking expectedly with standard actuarial understanding of credibility metrics and group size pooling. Regardless of any limitation on use of information, however, understanding of a group's cost expectations is vital to efficient and optimal planning and profit realization at all group size levels.

Just as important, is a balancing of the various aspects that come together to develop a reasonable rating approach. While different actuaries may use slightly different terms, the essences of actuarial balance as used in this paper can be summarized as an appropriate blending of competing factors, any one of which, in the extreme, can lead to undesirable financial results. For purposes of understanding the simulation's use of balanced or "fair" rates, we can assume that the rates developed must be adequate to cover expected costs plus expenses and other profit loads, be competitive, be reasonably simplistic for both internal and external understanding, have a level of flexibility to respond to emergent issues and be compatible with necessary provider and regulatory constraints. For our purposes, rating structures which appropriately blend or balance these factors will result in rates that can be considered "fair" for all parties involved (i.e., the insurers and the group).

For the models, data and methods, we use the Diagnosis Cost Group (DCG) risk adjustment model.[2] The prospective DCG model uses a year of medical claims data (and demographics) to predict next year's costs at the individual and group levels. In predicting next year's costs, the DCG model identifies chronic conditions (that predictably and systematically result in higher costs) and quantifies their impact. Non-chronic conditions, such as broken legs, pneumonia, etc., are not used to predict costs because there is no reason to believe that having pneumonia in year 1 is associated with higher costs in year 2.

Specifically, we use the DCG/HCC (Diagnostic Cost Group/Hierarchical Condition Category) model which uses diagnoses from all sites of service—inpatient and outpatient. The DCG/HCC model is the basis by which Medicare will pay Medicare+Choice plans beginning in 2004. We refine the DCG/HCC model by also using prior costs and refer to it herein as the " DCG Underwriting Model."

We compare the DCG Underwriting Model to a traditional underwriting model. Since underwriting models tend to be proprietary, we used an age-sex, prior cost (experience rating) model as proxy for the "Traditional Model."

Thus, the sole difference between the DCG Underwriting Model and the Traditional Model is the use of diagnoses in the DCG model.

Since information on actual market prices (premiums) offered and accepted by employers are

2 Cite paper with DCG model description. Also refer to DxCG Web site.

unavailable for analysis, we use quantitative analyses based on simulations of employer groups drawn from the MedStat MarketScan commercial dataset from years 1997 through 1999. The dataset has demographic, diagnostic and pharmacy and cost information on over 2.38 million members who were eligible for health care insurance for at least 1 month in both 1997/98 (Year 1) and 1998/99 (Year 2). The dataset is drawn from employer-sponsored health plans from across the country. The data include fee for service, PPO and HMO plans and various benefit levels.

Unlike consumer products where market researchers can adjust prices and directly observe the consequences in terms of consumer demand and profit, the health care market offers no such "laboratory" for testing prices. As a result, we develop a "bidding system" to assess the impact of the models in terms of number of group accounts secured and resulting margins or profits in winning accounts.

We use a fixed sample size of 500,000 randomly selected from the MarketScan dataset. To simulate employer groups, random draws (with replacement) were used.

For each group, expected costs were calculated using the DCG Underwriting Model and the Traditional Model. Load factors (margin) were added to both to obtain "bid prices." To simplify the analysis, we did not consider the impact of state underwriting regulations. The lower price "wins" in each bidding process and market share is defined as the percentage of bidding processes won. Profitability is calculated as the difference of the "winning" price and actual Year 2 expenses for the group.

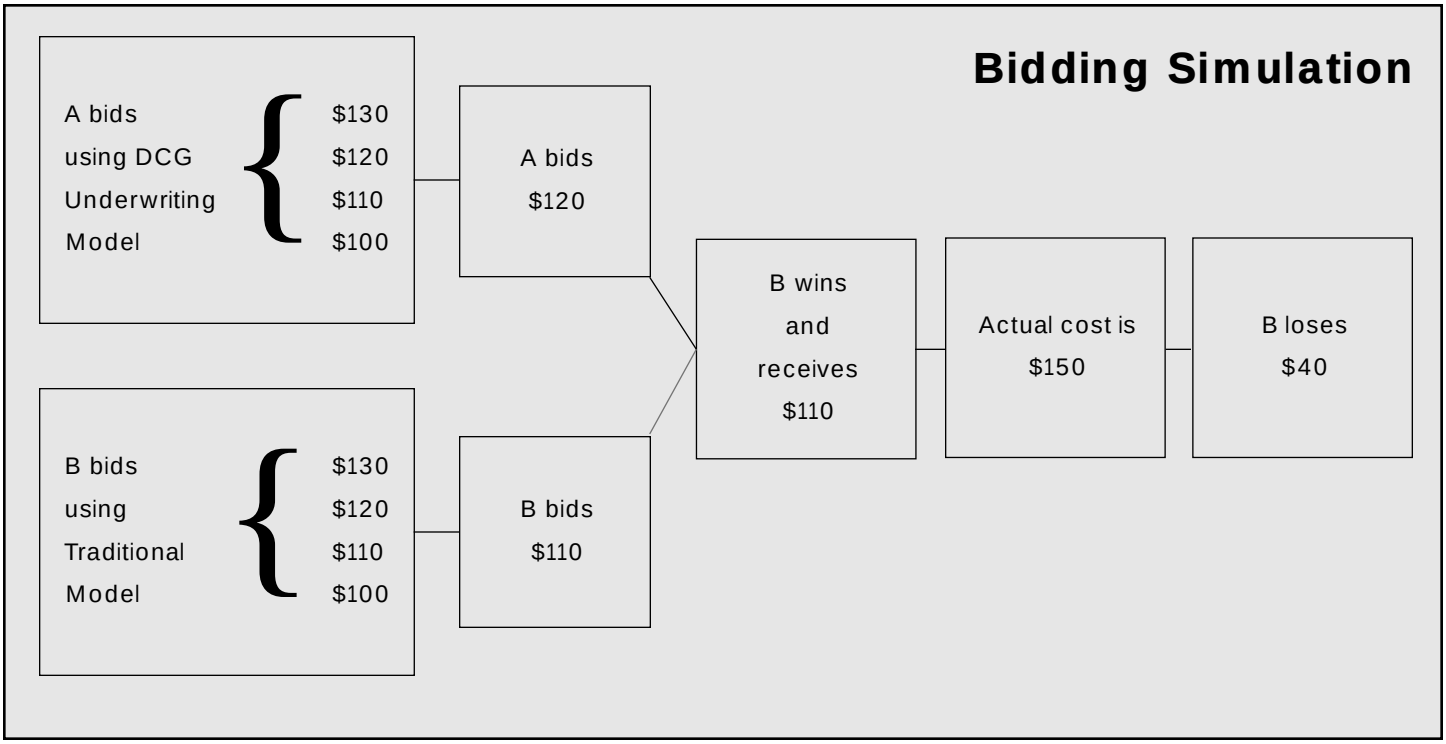
The following graph depicts the bidding process. Using the DCG Underwriting Model and diagnoses from Year 1, Insurer A bids $120 for year 2 while Insurer B using the Traditional Model bids $110. Insurer B "wins" having bid $10 less than Insurer A. Insurer B wins and receives $110. However, the actual (Year 2) per month cost of that group is $150 so Insurer B loses $40 per person.

The same bid calculations and bid results were simulated on group-sizes of 5, 25, 50, 100 and 500 lives with varying load factors. For each run, bids and results (market share, or number of accounts won, and profitability) for 1,000s of groups were calculated.

Results

Table 1 presents that individual R2 for each of the models. Note that these are validated R2 statistics, meaning that the models were calibrated on one set of data and test (validated) on a second set of data.

(continued on page 6)



Top-coding refers to capping claims levels at various thresholds ($25,000, $50,000 and $100,000 per person in a year). For example, a person with $125,000 in claims would be top-coded at $100,000 if a $100,000 threshold were imposed.

How and where does the DCG Underwriting Model outperform the Traditional Model? Table 2 compares the confidence intervals (CI) and positive predictive values (PPV) at each small group size between the two methods. We see that the DCG Underwriting Model has smaller confidence intervals at all group sizes, and this advantage is more pronounced as group size becomes smaller. In other words, the DCG Underwriting Model is more accurate than the Traditional Model in getting the group mean expenditure right. When looking at the high-cost or low-cost end of the population, we can see that the DCG Underwriting Model identifies more people when they are truly high or low cost at all group sizes.

Thus, the DCG Underwriting Model outperforms the Traditional Model in all key aspects. The question remains however, how much is that added predictive power "worth" when the models are used in underwriting?

Table 3 on page 7 answers this by presenting the bidding results and compares them accordingly to each small group size. Here we compute the number of accounts won by each method and their profits by assuming that the Traditional Model is fixed at 10 percent load factor while the DCG Underwriting Model varies between 0 to 10 percent. For example, when both assume 10 percent load factor, the DCG Underwriting Model generates $146 profit per member per year, while the Traditional Model generates $7 loss per member per year. As the DCG Underwriting Model lowers its load factor, it wins more accounts, although at a lower profit.

Table 1: Validated Individual Level R2 Statistics

	Traditional Model (Age/Sex and Prior Cost)	DCG Underwriting Model (DCG and Prior Cost)
Not Top-coded	11.4%	20.9%
Top-coded at $100k	13.7%	26.9%
Top-coded at $50k	13.0%	28.5%
Top-coded at $25k	11.7%	31.1%

Table 2: Confidence Interval and Positive Predictive Value

Group Size	Model	CI-to-Mean Expenditure (%)	Top 20% PPV	Bottom 20% PPV
100	DCG	4.97%	42.7%	42.5%
	Traditional	5.23%	39.0%	38.0%
50	DCG	9.21%	42.4%	43.6%
	Traditional	9.80%	39.2%	39.0%
25	DCG	16.41%	44.5%	41.7%
	Traditional	17.51%	39.6%	39.9%

Table 3: Comparison of Results with Traditional and DCG Underwriting Models

Group Size	Load Factor	% of Accounts "Won" Using DCG	DCG Underwriting	Traditional
100	10%	40.5%	$146	($7)
	9%	44.6%	$132	($22)
	8%	48.1%	$116	($35)
50	10%	47.3%	$92	($58)
	9%	49.9%	$84	($760)
	8%	52.4%	$73	($92)
25	10%	50.3%	$84	($138)
	9%	52.3%	$70	($152)
	8%	54.4%	$55	($164)

* Note: Assume constant load factor of 10% for the Traditional Model.

At all group sizes studied and for each load factor, the DCG method outperforms the traditional method in terms of profitability. DCG wins more accounts at the smaller group level.

Impact of Results for Underwriters

These results show that adding diagnosis information significantly improves predictive power of traditional methods with increased accuracy and specificity thereby supporting the goals of an actuarially balanced rating system. These findings support our understanding of how "one-time" and chronic conditions impact historic and future costs. Diagnosis models allow us to appropriately adjust for the impact of one-time conditions (broken legs, pneumonia, etc.) from future cost predictions while prior cost models implicitly assume that the high costs in Year 1 are "rolled forward" to Year 2. Conversely, someone diagnosed with metastatic cancer based on a diagnosis late in Year 1, will have very high costs predicted for Year 2, even if claims experience in Year 1 were relatively low. Such future costs would likely be understated in the traditional model approaches.

Moreover, as can be seen by the modeling, the improvement in predictive power translates into superior margins for health plans incorporating diagnoses into their underwriting models. Assuming the full costs of licensing and implementing diagnosis predictive models is charged to rating, net margins will still be higher than using traditional methods only when such costs are spread over the entire rating pool. Since such predictive models are also useful for medical management, a broader and lower "rating" allocation is reasonable, thus increasing the positive margin improvement when using a predictive model approach.

Some Final Thoughts

The paper has presented a preliminary examination about the natural extension of predictive software for use in a group underwriting environment. Although regulations may effectively limit a complete application of the methods described for certain size groups, the overall results will still likely be net accretive to the bottom line.

Like many approaches in rating, the methods indicated here may best be integrated over a period of time (for example, blended by "credibility like" factors to stabilize any year to year movement in a particular group's renewal levels).

And although the approach described here was focused upon renewal underwriting, use for new group rating points or debit approaches are possible and desirable. For example, insurers who use rating approaches that employ such point/debit systems generally determine such points based upon new enrollment questionnaires. The predictive model approach can validate, refine and expand the scientific basis of their point assignment to more accurately reflect the impact of one time versus recurring costs. Such a refinement would also support a new group/renewal linkage and bridge the transition of new group and renewal rating.

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Rong Yi, Ph.D, also contributed to this article.

ASOP 6 and Medicare Payment Projections

by Charles W. Edwalds

I welcome the ASOP 6 as an addition to the practice standards and the literature on valuing retiree group medical and life benefits. While I will not soon throw out the ACG 3, I recognize that it differed in form and content from an ASOP and that an ASOP was warranted for the sake of consistency in treatment by the standards.

One aspect of retiree medical that is addressed somewhat vaguely in the compliance guideline and is perhaps equally vaguely addressed by most practicing actuaries is the impact of Medicare, both in the valuation base year and to a greater extent in future years. The potential for understatement of the Post-retirement Benefit Obligation from this source is large. For this reason, I hope to see a productive dialogue on projecting Medicare payments per beneficiary under the scenario prescribed by applicable accounting and actuarial standards.

Health actuaries are generally well versed on the historic impact of Medicare cost shifting. The sources of impact on private paid medical expenditures include decreases in Medicare reimbursements to providers and Medicare HMO plans, increasing part A deductible and the growth in cost of services not covered, including Rx, private duty nursing, skilled nursing facility in excess of $101.50 per day, custodial care, etc. The reimbursement decreases have led to an increase in providers refusing to accept Medicare assignment, providers seeking to increase billed charges for non-Medicare covered services and for non-Medicare eligible patients. A shrinking number of participating providers being compensated a smaller proportion of eligible charges by Medicare has meant that private paid trends per capita have been higher than overall trend. The degree of cost shift from Medicare covered services onto non-Medicare covered services for Medicare beneficiaries versus that shifted to services for other patients is difficult to measure. However, many providers, due to geography, specialty, existing patient base and contracted rates for private pay patients, have less opportunity to shift costs onto non-Medicare patients.

What Do The Standards Say About the Impact of Medicare?

ACG 3 section 5.5 quotes paragraph 35 of SFAS 106: "an employer's share of the expected future post-retirement health care cost for a plan participant is developed by reducing the assumed per capita claims costs at each age at which the plan participant is expected to receive benefits under the plan by (a) the effects of coverage by Medicare and other providers of health care benefits… ." Section 5.6 addresses the Health Care Cost Trend Rate (HCCTR) that is applied to the per capita claim costs (PCCC) described in 5.5. In 5.6.3, the compliance guideline states "The HCCTR is defined as the rise in gross eligible charges before Medicare reimbursement. Erosion or increase in relative Medicare reimbursements can leverage incurred claims costs faster or lower than the underlying HCCTR."

The new ASOP 6 clearly states in 3.8.1(a), "The actuary should consider separate trend rates for major cost components such as hospital, prescription drugs, other medical services, Medicare integration and administrative services."

It is the author's observation that actuaries practicing in the retiree medical valuation area have frequently not addressed this issue. That is, the practice has been the use of the simple assumption that Medicare will offset a constant percentage of the gross per capita claim amount. This assumption would seem to fly in the face of the general acceptance of Medicare cost shifting as a historical fact, a present condition and a significant future probability.

What Can We Expect of the Future for Medicare?

Of course, the accounting standards as promulgated require that no future anticipated changes in Medicare programs should be recognized.[1] The state of existing Medicare as evidenced by the 2002 Medicare Trustee's Reports is such that Medicare Part A fund will be bankrupt in 2026 (down from 2030 last year) under the intermediate economic assumptions.[2] Centers for Medicare & Medicaid Services (CMS) in January 2003 produced updated National Health Expenditure (NHE) Projections through 2012. The projections for Personal Health Care Expenditures (PHE), a primary component of NHE, have been converted to per capita values (see Table 1). These projections include Medicare payments by type of service and expected Medicare beneficiaries.[3] They also, when converted to per capita values and compared for each year from 2001 through 2012, show a trend in Medicare per capita payments that is below the norm observed by the author for retiree medical select period trend assumptions. The trend is also below recently released CMS projections for increases in private insurance paid per capita Personal Health Expenditures (PHE) net of dental and prescription drug services, which are largely not covered by Medicare (see Table 2 on page 10). In previous

(continued on page 10)

1 SFAS 106, par. 40.

2 http://cms.hhs.gov/publications/trusteesreport/2003/secif.asp

3 http://cms.hhs.gov/statistics/nhe/projections-2002/

Table 1

Year	Paid PHE ($ billions)	Jan. 2003 Beneficiaries (thousands)	Paid per Beneficiary	Increase per Beneficiary January 2003	Increase per Beneficiary Spring 2003	Spring 2001
2001	234.5	38,617	6,073	7.3%	8.6%	6.2%
2002	246.5	39,359	6,263	3.1%	4.6%	5.8%
2003	254.0	39,775	6,386	2.0%	3.0%	5.6%
2004	266.5	40,318	6,608	3.5%	5.0%	4.7%
2005	282.7	40,932	6,907	4.5%	5.3%	5.7%
2006	301.1	41,471	7,260	5.1%	5.0%	5.5%
2007	320.9	42,148	7,614	4.9%	4.4%	5.2%
2008	343.8	42,914	8,011	5.2%	4.7%	5.1%
2009	368.2	43,812	8,404	4.9%	4.7%	5.1%
2010	393.8	44,855	8,779	4.5%	4.9%	5.3%
2011	421.6	46,025	9,160	4.3%	4.9%	-
2012	452.9	47,288	9,577	4.6%	-	-

Table 2

Private Insurance Paid PHE Net Of Rx & Dental						
	January 2003		Spring 2002		Spring 2001	
Year	per capita	Increase	per capita	Increase	per capital	Increase
2000	$1,106	6.2%	$1,085	4.6%	$1,094	6.8%
2001	$1,192	7.8%	$1,154	6.4%	$1,179	7.8%
2002	$1,267	6.3%	$1,244	7.8%	$1,279	8.5%
2003	$1,358	7.2%	$1,330	6.9%	$1,379	7.8%
2004	$1,451	6.8%	$1,421	6.8%	$1,476	7.0%
2005	$1,544	6.4%	$1,510	6.3%	$1,562	5.8%
2006	$1,644	6.5%	$1,596	5.7%	$1,637	4.8%
2007	$1,748	6.3%	$1,670	4.6%	$1,699	3.8%
2008	$1,847	5.7%	$1,741	4.3%	$1,757	3.4%
2009	$1,953	5.7%	$1,817	4.4%	$1,818	3.5%
2010	$2,061	5.5%	$1,890	4.0%	$1,880	3.4%
2011	$2,165	5.0%	$1,963	3.9%	-	-
2012	$2,266	4.7%	-	-	-	-

years the CMS projections after 2007 showed that Medicare payments per capita were expected to increase at a rate faster than private insurance payments per capita for PHE. (This sounds like a "reverse cost shift" onto Medicare, which would have been welcome news.)

Such a "reverse cost shift" is something most of us have not experienced. Looking closely at the recent history of the CMS projections of PHE there appear to be some significant change in the new projections. Table 2 shows a side by side comparison of the 2003, 2002 and 2001 released projections. We can recognize that the date this reverse shift is to occur was pushed back from 2006 in the 2001 PHE projections to 2008 in the 2002 PHE projections to not by the end of the 2012 select year in the current projection. Given the state of the Medicare HI Trust Fund, it is hard to believe that Medicare will in the near future be in a position to increase per capita payments at a rate faster than private sources. The fact that this "reverse cost shift" phenomenon has now been eliminated from the PHE projections is consistent with a general understanding of the financial status of Medicare.

Most pertinent to the discussion of ASOP 6 is the fact that the PHE projections now show that per capita private paid costs will in all future select

years shown increase at a faster rate than per capita Medicare payments. This is just the situation that may need to be replicated by post-retirement medical valuation assumptions.

Perhaps there is an "out" in ASOP 6, section 3.8 where the standard reads, "With respect to any particular measurement, each economic assumption selected by the actuary should be consistent with every other economic assumption selected by the actuary to be used over the measurement period. The actuary should reflect the same general economic inflation component in each of the economic assumptions selected by the actuary. The relationships among economic assumptions should be reasonable relative to the underlying economic conditions expected throughout the projection period." PHE projections are based on demographic and macroeconomic assumptions from the intermediate scenario in Medicare Trustees Reports. Projected growth in Medicare spending reflects the assumption that there will be no alterations to current law (this assumption is required by law for the Medicare Trustees Report).[4]

There is latitude for projections using different economic scenarios. However, I believe an actuary should be able to defend and describe any alternative economic scenario and explain the impact of it on results produced. If the actuary chooses a scenario similar to the CMS "high cost" scenario, this will generally cause the post-Medicare age retiree medical liability to increase. To choose a scenario similar to the CMS "low cost" scenario might produce favorable results but must be defended. While CMS produces projections under three scenarios, shareholders and other audiences of retiree medical valuation reports generally expect "a number" rather than a range under various scenarios as the result. The constraint of a single expense estimate required under accounting standards would seem to require that the result must be defensible under a best estimate of future conditions.

What is a best estimate for Medicare for the practicing actuary?

I believe a best estimate for every valuation of medical benefits covering a Medicare eligible population should have a Medicare trend that is less than the HCCTR, unless clear documentation is presented to defend the projection of Medicare payment increases at a rate equal to or greater than the HCCTR. The determination of the degree of difference between the HCCTR and Medicare trend rate at each year will be difficult. However, the magnitude of the difference is sufficiently large that addressing the impact of this difference should be a part of accepted actuarial practice.

4 For more information on assumptions in the intermediate scenario, see http://cms.hhs.gov/publications/trusteesreport/2003/secid.asp.

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International Actuarial Association (IAA) Health News

As an actuary interested in health issues, you will be pleased to learned that the organization of the Second International Colloquium on Health, being held in Dresden, Germany, April 27-29, 2004, is well underway.

The provisional program, call for papers and pre-registration forms are all available online at www.actuaries.org/public/en/IAAHS/conferences.cfm.

Also, at its meeting on May 17, 2003, the International Actuarial Association (IAA) Council approved the formation of a new Health Section (IAAHS). Further information on the IAAHS and how to join will be communicated through the IAA Secretariat and its member organization.

For further details, please access the IAA Web site at www.actuaries.org/members/en/IAAHS/documents/announcement.pdf or contact Howard Bolnick at hbolnick@kellogg.northwestern.edu or (312) 543-4973.

The Price of Terrorism

by Daniel L. Wolak

On February 7th the U.S. government moved the country to an Orange state of alert for a terrorist attack. There was concern in major cities that some type of event may occur.

On February 10th, underwriters and actuaries from group insurers across the country returned to work to address the risks of this warning. Their response, though, for group life, for disability and for medical benefits was likely no change in the business routine. Are we/they missing something? Are the insurers playing a game of Russian Roulette, with a gun with an unknown number of chambers? Will an event happen sometime in the next six years, 20 years or 50 years that will result in losses leading to insolvency for one or even several insurance entities? If yes, how should actuaries approach this risk?

Let's consider the ability of group writers to price for terrorism risk. For actuarial pricing, we need to have experience data. For terrorism in the U.S., we have one major data point, that being the events of 9/11. By my estimates and a survey prepared by my company, General & Cologne Life Re, Group Life insurance losses amounted to about two weeks of extra death claims, after catastrophe reinsurance recoveries, for group life direct writers. If we assume that terrorism claims will average 4 percent of total claims each year, 4 percent should be added to the pricing. If we assume every four years an event will occur where losses equal 4 percent of claims, 1 percent should be added to pricing, and so on. On the other hand, losses from disability claims and medical claims for group insurers were not significant. For group disability, the events of 9/11 did not provide us a data point for pricing of terrorism. For medical covers, the events of 9/11 and the anthrax scare of the following month provided us concerns but, again, not necessarily data for pricing. The challenge of this analysis is that it is based on one data point.

Due to market pressures, carriers have told me that they are unwilling or unable to allocate a larger share of the cat premium to large groups.

Another pricing issue is that the cost of catastrophe reinsurance has substantially increased and can now be a charge equal to 1 percent to 2 percent of a company's annual group life premium. How should such a charge be added to pricing? In reality, the cost of the catastrophe premium is more related to large risks than to small risks. To price with a level of actuarial fairness, a greater share of the cost as a percent of premium should be built into the rating for large groups with a large number of employees at one location than for smaller groups. Due to market pressures, carriers have told me that they are unwilling or unable to allocate a larger share of the catastrophe premium to large groups. To the contrary, due to competitive pricing pressures, the loads representing the charge for catastrophic risk for large groups are at times less than the load for smaller groups.

Let's look at the underwriting issue. Underwriters have always wanted to have a "good spread of risk". Now, the events of 9/11 raise the question of whether the underwriters are underwriting a good "concentration of risk"? As we returned to work on February 10th, the country was in a state of alert for terrorism. But how many group writers were willing to decline quoting on an account due to concerns of having a concentration in a target urban area? The real question is how many even know they had such an issue?

In the group market, the data that a group carrier has on its risks is limited in most cases, since billing is provided through employer summary data. The group writer will have data on the location of a company's main office and likely will know the location of branch offices. But in many cases census data is not split by the location of the employees. Because of this, group writers lack good data to analyze concentrations. But is such data available? It may be, since the workers compensation carriers normally require this information.

Another issue for group carriers is that the cost of catastrophe coverage has significantly increased since 2001, while maximum limits have decreased. Based on the information I have, I estimate that catastrophe reinsurance covered 30 percent to 40 percent of the group life claims from 9/11. But even without cat reinsurance, I believe that no group life carrier would have become

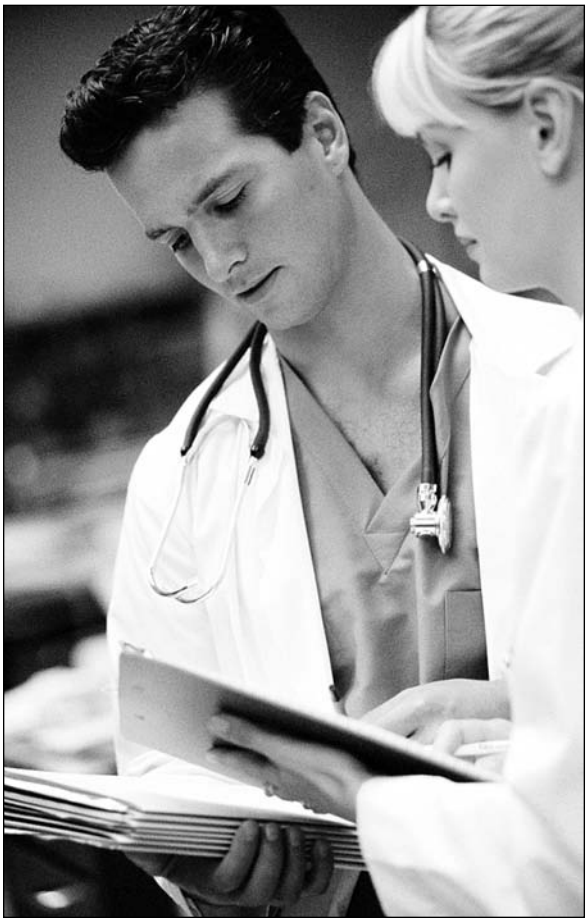
(continued on page 15)

A Very Complex Topic

by Jeffrey D. Miller, FSA

Over the four years that I have been editor of Health Section News many bright actuaries have submitted detailed and objective articles that help us manage heath benefit and health insurance systems more effectively. However, healthcare is not an objective topic when you or a loved one is the patient. I know you all have experiences with miracles or horror stories of the healthcare system. A recent experience has caused me to ponder the system as well.

On Sunday, July 6, 2003, a close friend of our family (we'll call her Jane) received a kidney and pancreas transplant. Jane was 52 years old and had been a diabetic since she was 14. Both her kidneys had failed by the time she was 37 years old, and her sister donated a kidney to her through a transplant 15 years ago. After 13 years the transplanted kidney failed, as is quite common among diabetics. She has been living with no kidney for the last two years, surviving through dialysis, and waiting for a transplant. While Medicare probably covers a large portion of the dialysis, other treatments over the past two years and the transplants will probably add up to close to $1,000,000.



As a juvenile onset diabetic, Jane has been uninsurable for 38 years. I think she's a world's expert on the health insurance system in the U.S. Prior to HIPAA, she was able to remain covered through her employment or her husband's employment with large employers. Most recently, a large U.S. company employed her for about two years, and I believe they have paid the majority of her recent claims. I'm sure they are aware of the situation.

Clearly, this transplant is a great thing for Jane. If both organs become functional, and things are looking good, she will no longer be a diabetic. However, the cost is astronomical, and is being born by one employer. Jane was very skillful and motivated to extend her life. Her most recent employer was stuck with the bill. That's the way the game is played in the United States.

However, many employers and insurers are taking steps to protect themselves from these types of claims. Many employers are adopting severe limitations on benefits. If Jane was having her transplant five years from now, she might not be so fortunate.

Healthcare financing has some interesting years ahead. By the way, the donor was a 15-year-old girl.

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Understanding the Economics of Disease Management Programs

by Ian Duncan

As managed care and health insurance organizations struggle to control their enrollees' utilization of medical resources, they seek less obtrusive and more cost-effective ways to reduce costs and improve patient outcomes. Disease Management (DM) is a widely-proposed solution for cost-reduction and quality improvement. Despite the interest in DM, and the number of programs that have been implemented in different health plans, the reaction to DM on the part of health insurers and other payers remains skeptical. Why has DM not proven to be the universal success that its proponents believe it to be, and why is there so much skepticism about it? Vendors and carriers seldom discuss their programs without claims of positive savings and Return on Investment (ROI), yet somehow the buyers seem unconvinced.

Some of the skepticism arises because it is difficult to reconcile savings claims with health plan trends that move inexorably upwards. Two things are necessary to close the gap: a better understanding of the economics of DM programs, (so that more-realistic expectations may be set) and more rigorous and scientific outcomes measurement.

A health plan is not a laboratory environment, and there are so many moving parts in a DM program that it becomes extremely difficult to set up a program and measure its outcomes with sufficient scientific rigor to convince the skeptics. Within the DM community, work is currently being done to develop a methodology that will both gain the support of the vendors and purchasers of DM services, and be practical to implement. I will be chairing a session on measurement methodologies and results at the SOA Spring meeting in Vancouver ("Disease Management: Substituting Facts for Assumptions," Monday June 23rd, 2.00 p.m.). Speakers will include Dr. Thomas Wilson, the principal author of the outcomes measurement methodology research sponsored by the Disease Management Association of America (DMAA), and David Wennberg, MD, MPH, of Dartmouth University and the Maine Medical Center, a respected researcher in this area.

But there is more to understanding ROI than measuring outcomes. This brief article is an introduction to understanding the economics of DM programs. Although both vendors and health plans focus discussion on ROI, a more important measure to a health plan is total savings. After all, if a plan achieves a high ROI but manages only 100 members, the total savings will have no impact on health plan trend, and probably will not cover the fixed costs of implementation. Total savings is the appropriate bottom-line measure for the health plan to aim to achieve.

A further distinction needs to be made between marginal and average ROI: average ROI tells the sponsor whether a program is profitable, overall, while marginal ROI is critical for deciding what kind of program to implement, how large it should be and whether the marginal intervention is economically justifiable.

The Risk Management Economic Model

The Risk Management Economic model was developed to help sponsors and providers of programs do several things:

- Understand the economics of DM programs, and develop a common framework for use in discussions of programs and their economics

- Understand the sensitivity of the financial bottom-line to different assumptions and variables and

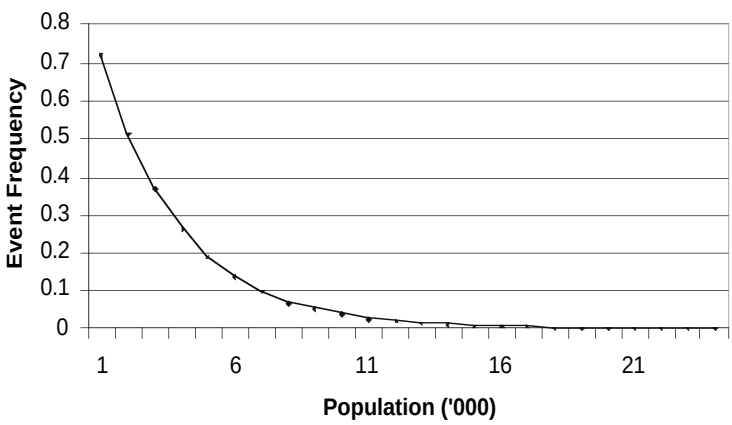
- Perform DM program projections that may then be compared with actual outcomes. Because it often takes a long time for results of DM programs to emerge, sponsors can determine interim results by measuring components and inputs (such as number of members managed), rather than outputs.

The Risk Management Economic Model—Key Components

- Risk Stratification: Identification of risk level through claims, surveys or other tools. "Risk" is defined as the probability of unfavorable economic outcome (high cost event) in the next 12 – 18 months. It is essential to have a good predictive model that risk-ranks all members,

(continued on page 16)

Figure 1.



THE PRICE OF TERRORISM | FROM PAGE 12

insolvent or financially impaired from its share of group life claims from 9/11.

A point to consider is that few, if any, group life carriers purchase enough catastrophe coverage to remain solvent in the face of a truly catastrophic event resulting in multi-billions of dollars of claims. The purpose served by the catastrophe cover is to reduce or eliminate the financial statement impact of a significant event. But in the case of a truly large-scale event impacting a city, claims would exceed the limit of coverage provided by catastrophe reinsurance. Claims in excess of these limits would then revert back to the carriers.

The ACLI, in its response to the US Treasury, stated that an analysis prepared by the ACLI calculated that an event that resulted in a 2.5 percent mortality rate in the county of Los Angles would likely cause the insolvency of at least one insurance company. A catastrophe with mortality rate of 30 percent of the population of Los Angeles County would destroy 100 percent of the life insurance industry surplus. So if we look at the terrorism issue as it relates to group writers, it all boils down to a solvency risk.

At the Vancouver Meeting I moderated a session to delve into some of the pricing and solvency issues that we are now faced with. I hope that this session provided the attendees with a good platform to return to their respective group companies and consider how better to address the new risks we face in the 21st century.

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according to their probability of experiencing the targeted event. An example of the risk distribution of a population is shown in Figure 1 on page 15. In this example, approximately 8 percent of thepopulation experiences events at a rate of 50 percent or more.

- Targeting: identification and prioritization of target members, and association of different outreach campaigns with member cohorts; (as the risk ranking declines, so the proportion that it is economic to reach falls).

- Contact Rate: the rate at which targeted members respond to the outreach effort.
- Member Re-stratification rates, based on the Nurse's assessment of:
  - Risk
  - Intervenability of condition(s)
  - Receptivity / Readiness to change
  - Self-management skills

- Engagement Rate (also called enrollment rate): the rate at which members are selected for ongoing coaching and management (<100 percent because of non-intervenable conditions and good member self-management skills).

- A definition of the proposed program, including metrics and cost-structure, such as:

  a. Number and risk-intensity of members to be targeted;

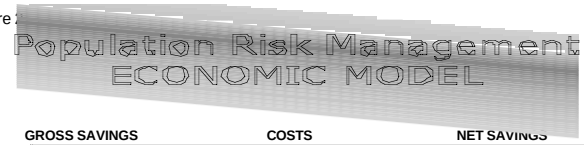
     The number of target members is important because without critical mass, a program will not achieve sufficient savings to justify its implementation. However, not all members are equally likely to experience adverse events, and targeting all members with a costly program is not economic.

  b. The number of nurses and other staff required to deliver the program and their cost, and other program costs (such as materials or equipment);

     One fact of life in these programs is that clinical staff are a costly resource, and can only manage a relatively small patient load. For example, assuming that the (loaded) annual cost of a nurse is $100,000, and 200 is the caseload that can be managed by a telephonic intervention nurse at one time, this implies an annual cost of the nurse component of $500 per member managed. Assuming that the frequency of events in the managed population is 25 percent and that nurses manage to avoid 25 percent of these events, this implies a nurse cost of $8,000 per member whose event is avoided. This amount is significant, compared to the cost of the hospital admission that is avoided.

     Some proponents of programs look for savings in areas other than hospital admissions, and these may be obtained (for example, in emergency room visits). However, since the objective of many programs is increased compliance with

Figure 2



GROSS SAVINGS		COSTS		NET SAVINGS
AUTOMATED	$ 240,111	AUTOMATED	$ 128,072	$ 112,040
NURSE	$ 131,206	NURSE	$ 100,000	$ 31,206
		FIXED		$ (30,000)
TOTAL	$ 371,317	TOTAL	$ 228,072	$ 113,246
		ROI (per $):		$ 1.63

AUTOMATED		Control Group	Lives	Cost Per Mailing
Cost/ Target	$50	0%	25,000	$50
Contact %	25	NURSE		
% Effectiveness	10	Contact % 50	Cost/Nurse $ 100,000	
		% Effectiveness 20	Cases/Nurse 200	

		Year 2										
Risk Rank	Population	Event Rate	Predicted Events	Cost Per Event	Gross Incremental Savings	Cost of Automated Intervention	Potential Incremental Savings		Projected Incremental Savings (automated)	Estimated Incremental Savings		Incremental Nurses	Projected Incremental Savings (nurse)
9	42	73.0%	30	$ 10,088	$ 7,661	$ 1,392	$ 6,269	☑	$ 6,269	$ 9,249	☑	1	$ (85,550)
8	168	51.0%	86	12,618	27,052	5,423	21,629	☑	21,629	29,764	☑	0	50,782
7	398	29.4%	117	12,489	36,556	12,116	24,439	☑	24,439	16,193	☑	0	65,973
6	742	21.2%	158	11,635	45,852	21,518	24,334	☑	24,334	(13,326)	☐	0	-
5	1,320	15.3%	202	11,263	56,818	34,442	22,376	☑	22,376	(69,277)	☐	0	-
4	2,271	10.8%	245	10,813	66,173	53,180	12,992	☑	12,992	(176,373)	☐	0	-
3	5,488	6.4%	350	11,251	98,543	116,570	(18,027)	☐	-	(1,073,843)	☐	0	-
2	8,515	4.4%	379	10,565	100,023	159,993	(59,970)	☐	-	(1,835,778)	☐	0	-
1	6,339	1.6%	103	11,455	29,615	104,949	(75,333)	☐	-	(1,517,619)	☐	0	-
Total	25,283	6.6%	1,670	$ 11,070					$ 112,040			1	$ 31,206

	Disease Distribution			
Risk Rank	% Asthma	% CHF	%CV	% Diab
9	41.5%	14.6%	60.9%	50.6%
8	38.4%	13.7%	56.0%	49.9%
7	37.5%	12.9%	49.0%	44.0%
6	35.8%	12.1%	42.0%	42.0%
5	27.1%	7.7%	38.0%	36.0%
4	22.2%	5.1%	32.0%	28.0%
3	18.4%	4.5%	25.0%	22.0%
2	10.1%	2.4%	18.0%	19.8%
1	8.5%	0.1%	11.3%	12.5%
Total	14.9%	3.4%	21.7%	21.3%

(continued on page 18)

physician-ordered treatments, we would expect increased physician, testing, and pharmaceutical drug costs to result. In my experience, the effect of a program on "all other (non-hospital admission) costs" is, at best, a wash, and if a program achieves savings, it does so through reduced hospital admissions and length-of-stay. It is a good idea to look at the admissions experience and costs of the target population, since this, effectively, is the base of expense that any program can affect.

c. The methodology for contacting and engaging or enrolling members (telephone, provider, internet, mail, etc.).
The methodology for reaching and engaging members is critical. Each method has its own cost structure and statistical outcomes in terms of the engagement rates (and behavior change) achieved. Encouraging a member, over the telephone, to participate in a program aimed at changing behavior is like encouraging the member to change his long-distance carrier or credit-card company: in other words, not easy. My own (unpublished) research indicates that those members who are more likely to participate tend to be those who have lower event rates and costs, while the higher utilizers tend to have lower participation rates. Mail programs have low participation rates, while telephonic programs have higher rates, particularly when the caller is a nurse.

The economic model needs to include very specific assumptions and data for the number of members targeted, the number reached (don't forget to allow for data issues like bad telephone numbers or members with caller ID who will not accept a call), and the number enrolling or engaging in the program.

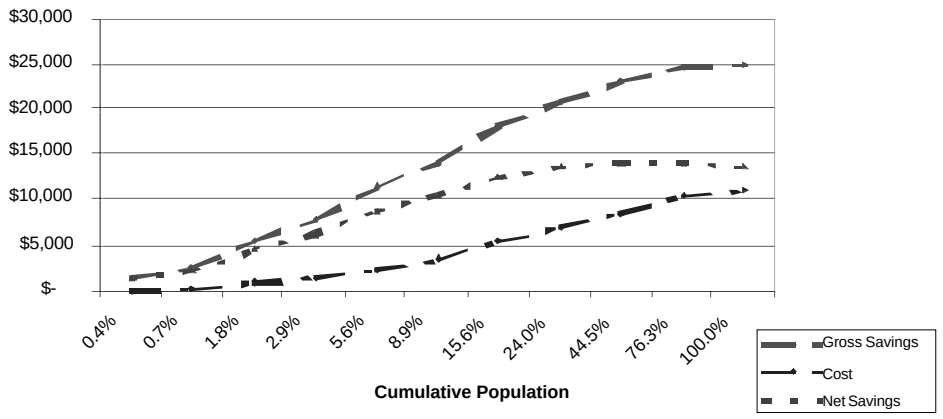
d. Referral/triage rules for members who need to be referred elsewhere within a care system. As we discussed earlier, clinical resources are costly, and cases should be referred to the appropriate level of management quickly and cost-efficiently. This includes members who, because they are controlling their own conditions or who clearly are not ready to comply, need to be referred to a lower-cost, "maintenance" program.

e. The predicted behavior of the target population, absent intervention, and the effectiveness of the intervention at modifying that behavior. This is the area where the whole model comes together: the combination of the variables tells us the potential for gross and net savings at each point in the risk-distribution.

f. The timing of program deployment, engagement, interventions and expected outcomes;

g. Other financial components of a program, such as guarantees, variability in outcomes, etc.

Figure 3.
Gross Cumulative Yield and Program Cost



Example of the application of the Economic Model

One relatively simple example of an economic model that allows the user to test the effect of different variables is shown below in Figure 2. on page 17. This model allows the user to optimize the level of interventions in a population (stratified into nine different strata according to risk rank, or predicted event frequency) with two different types of intervention, Automatic and Nurse-based. The total cost of these two different interventions varies, according to the number of members managed, and the risk rank to which each applies. In addition to predicting the event probability for the cohort, the prediction process also predicts the likely average event cost for the cohort (absent intervention). Applying assumptions in terms of the cost of different interventions and the outcomes, the expected financial outcomes for each type of intervention and each cohort is predicted. The user has the option of testing the result of adding different types of intervention to each cohort. Because the nurse-based intervention is relatively expensive, it is not generally economic to penetrate a population as deeply with nurse-based interventions as with automated means.

In this example, we optimize total savings from our program by implementing automated interventions down to stratum 4, while intervening with nurses in cohorts 9, 8 and 7. This program is predicted to cost $258,000 (including fixed costs) and to save a (gross) total of $371,000, for an ROI of 1.63. A higher ROI can be achieved by intervening only on higher risk-ranked cohorts, but the absolute level of savings will be smaller. A graphical example of the effect of penetration on savings is shown in Figure 3.

Designing a Program

The Economic Model allows the user to test the sensitivity of the return from different types of interventions, at different penetration levels in the population. The results may be summarized graphically in a form similar to
Figure 3 above.

Cumulative savings accrue with increased penetration into the population, though with decreasing marginal yield. In this example the cost of the intervention program increases, also at a decreased marginal rate (reflecting the greater user of automated interventions as the penetration increases). Net savings increases initially, then decreases. Highest ROI is achieved at the peak of the Net Savings curve (approximately 44 percent penetration) while absolute savings are not maximized until approximately 75 percent of the population has been targeted.

This simple approach to DM economics ignores many variables such as member turnover, timing (of interventions and events) etc. Nevertheless, understanding the simple model will provide a basis for assessing and discussing more sophisticated structures.

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Calculation of IBNR Reserves with Low Variance

by Robert G. Lynch

The most common and persistent bugaboo for Chief Financial Officers of managed care and health insurance organizations is the month-to-month variation in calculated reserves for "Incurred But Not Yet Paid" (IBNP) claims. While a certain degree of real variation in these reserves is to be expected, it is the duty of the financial actuary to calculate as accurately as possible the amount to be expected. The achievement of this goal necessitates an understanding of the difference between the process variance, measured by the "standard deviation" of the underlying claim incurral 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 used by actuaries practicing in health care finance shows that these methods 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 reserve calculation methods result in a high variance, and what will lower that variance. That key property is that variances are additive under additions, 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. (For ease of presentation here, I will assume that covariances are negligible.)

So, to keep the error variance to a minimum, one should seek to use methods that rely on the summation of data, and avoid methods which 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.

As an aside here, I would point out that there are really two different flavors of multiplication. The first, "counting" multiplication, is actually shorthand for the addition of large numbers of identical quantities. Because it is really just puffed-up addition and keeps one argument firmly planted in the domain of the Integers, it is quite well-behaved. The second avatar of multiplication, the true algebraic operator, is often expressed as an application of ratios or percentages. It is this latter "evil twin" operator which can nefariously lead the unwary into a statistical quagmire.

If you have trouble with the concept of two different kinds of multiplication, I offer the allegory that, when walking in the jungle, there are two kinds of tigers, "Nice" and "Not-nice". The "Nice" kind of tiger is cute, cuddly, and pretty, as well as having a big belly and purring a lot because it just ate a nice fat pig. The "Not-nice" tiger hasn't eaten in several days, and you never see them because, by the time you do, you are already lunch. The two kinds of tiger may appear similar, but the circumstances of the encounter make a great deal of difference in the quality of the results.

The "textbook" method used by most actuaries to calculate IBNP reserves is the Completion Factor method, which is mathematically equivalent to the "Chain Ladder" and "Lag" methods. As anyone who has studied for SOA Exam 5 (or its predecessors) knows, this method is based on the calculation of the historical proportion of claims incurred in a given incurral period (usually the incurral month) and paid in that and any given succeeding period (usually the paid month), to the total incurred claims in the incurral period. This

ratio is the "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 incurral month. 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 which is calculated using the subversive operator of multiplication (and is therefore itself a random variable), it is no surprise that the standard error of the result is quite high. Even though the SOA-approved text ("Group Insurance") on this topic recognizes that "Generally, months with completion factors lower than a [subjective] percentage are seen as non-credible estimates . . . " without identifying the root cause of the problem, this method remains the favored method by most actuaries.

Many CFOs, frustrated by the wild fluctuations in reserves produced by the Completion Factor method, have sought refuge and stability by turning to a different approach, which I will refer to as the Incurred Claims Per Member Per Month (Incurred PMPM) method. In this method, the average total incurred claims PMPM from historical (and supposedly complete) data is calculated, and trend is applied to project those amounts to recent months. Then this projected PMPM amount is multiplied by the number of member-months in the valuation period to yield the estimate of total incurred claim costs to be entered in the financials. (The "Loss Ratio" method is just a variant of this one.) The IBNP reserve is "backed-into" as an afterthought by subtracting the total incurred and paid claims amounts from this estimate of the total incurred claims amount.

This method gives a nice, stable projection of total incurred (or accrued) claims expenses, which is great comfort to CFOs, most of whom crave stability. However, for purposes of estimating incurred claims it totally ignores data on claims incurred and paid in recent months. Moreover, it inherently assumes a negative correlation between claims incurred and paid and claims incurred and not yet paid.

It is worthwhile scrutinizing the sources of variability in the process of claims incurral and payment to better understand what we are attempting to measure. People get sick, more-or-less at random, and, if they judge themselves to be sufficiently sick, seek out medical care by going to their doctor, or in some cases, the hospital emergency room. At that point they enter the complex world of the health care system, which provides them a selection of services or products which, hopefully, gets them well and back into their normal, healthy routine again. The amount and cost of this health care treatment can vary greatly in each case, depending on the presenting condition.

On the face of it, then, the actuary is concerned with dealing with these two largely random events: who gets sick how often, and how much does it cost?

However, between the point when the person (now a patient) enters the health care system, and the time when the paying party (e.g., the health insurer or HMO) actually cuts a check to the providers in the system to reimburse them for the expense of their services, a lot of things happen. And those things (let's call them "claims reporting and processing") usually take time (the "claim lag"). During the claim lag period, the value of those healthcare services (or at least the part for which the payer is liable) floats in the limbo of IBNP.

People get sick, more-or-less at random, and, if they judge themselves to be sufficiently sick, seek out medical care by going to their doctor, or in some cases, the hospital emergency room.

The problem from the actuary's point of view is that the amount of time involved in claims reporting and processing can vary a lot in a seemingly random manner, and may or may not relate to how many claims are floating around in the IBNP limbo, or how big they are.

Enter the IBNP calculation. The health care actuary applies the textbook Completion Factor method, because that is what he has learned and using it saves the bother of having to think too much ("If it's good enough for everybody else, then it's good enough for me!") Unfortunately, the Completion Factor method has an implicit, hidden assumption in it. That assumption is this:

The only source of variability in actual claims incurral is in the frequency and intensity of health care services (morbidity), and there is no variability in the rate of claims reporting and processing.

The actuary dutifully sends off his IBNP reserve report to the CFO every month, on the same day. The CFO, however, is incredulous of the actuary's reported reserve estimates, because from month to month they bounce around like a gerbil snacking on espresso beans. She knows this can't

(continued on page 22)

be right. She also knows that if her financial reports to the CEO and the board of directors don't resemble something approaching reality, she will be out on the pavement peddling pencils pretty promptly.

So the CFO thinks, "The health plan has a lot of members, and they don't all get sick at once. I will just project forward our past incurred PMPM claims using the trend rate I got from actuarial department (maybe they got that right, at least!), and book the difference as the IBNP reserve." She has unwittingly stumbled onto the "Incurred PMPM" method. Unfortunately, the Incurred PMPM method also has an implicit, hidden assumption in it. That assumption is this:

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.

So which one is using the best IBNP estimator? The answer is neither!

As a result, when incurred and paid claim amounts exceed the expected incurred claims, the IBNP is truncated at zero.

The score is now tied: Actuaries minus 1 vs. Accountants minus 1.

The actuary can derive a much better (i.e., lower error variance) estimator by reviewing and using the information from his first actuarial exam (the one on mathematics and statistics). Rather than calculating a factor by which to multiply monthly incurred and paid claims, project a collection of several values, which can be summed together to give an unbiased estimator of the IBNP reserves.

I propose the "Projected Paid Lag PMPM" method. It goes something like this: For each incurral month i with j months of lag, project from historical data the average dollar amount per member incurred in month i, but not paid until j months later. After adjusting those amounts for trend, add them all together for all the corresponding i's and j's in the IBNP limbo, and add all those together for every member m in every month i. For ease of calculation in this last step, one can also just multiply by M_i, the number of members covered in month i, and then add all the M_i's together. (Note that this is the "Nice" kind of multiplication.)

In order to illustrate the differences in results between these three methods, I have prepared a comparison of IBNP estimates calculated using each, together with realized "look-back" IBNP amounts. These calculations are made on real data, which has been transformed to preserve confidentiality. The data has also been adjusted in volume to represent a constant exposure of 100,000 members. The data is divided into three sets. One set of data represents claims incurred and paid under coverage of a closed-panel, integrated health care delivery system (IDS) or managed care organization (MCO). The second data set represents claims for health care services from providers in a non-network setting, who have no connection to the payer organization, as would be the case with an indemnity or fee-for-service (FFS) health insurance plan. The third data set represents an open-panel, loosely held managed care plan, such as a point-of-service (POS) or preferred provider organization (PPO).

I show the calculated results for estimates of IBNP amounts for periods with zero claims payment run-out, 1 month, 2 months, and 3 months of run-out, respectively. Table 1 shows the results for the IDS/MCO model, Table 2 shows results for the FFS-type coverage, and Table 3 the results for the POS/PPO payer organization. Scattergram plots of estimated IBNP values versus actual IBNP values are shown in Figures 1, 2 and 3.

One item which becomes apparent in examining the estimated values of IBNP amounts using the Incurred PMPM method is that it is biased towards over-stating the actual IBNP. This tendency is most noticeable in the examples with some period of claims payment run-out. This estimator bias results from the fact that negative values of IBNP are not allowed for individual months. As a result, when incurred and paid claim amounts exceed the expected incurred claims, the IBNP is truncated at zero. Since this truncation does not occur when incurred claims are less than the projected estimate, the method produces a biased estimator.

Figures 4, 5 and 6 present a comparison of the standard error of estimation for each of the three methods, together with the sample standard deviation of the actual IBNP. It is apparent from these figures that the Paid PMPM method yields substantially lower error with no run-out of claims payment. As the claims payment run-out payment gets longer, the standard error of estimate for the Completion Factor and Paid PMPM methods converge, although the Paid PMPM method contin-

ues to have a smaller standard error at all lengths of claims run-out.

I summarize the characteristics of each these three methods in Table 4.

A logical next step might be to ask if a hybrid of these three methods might yield better results by moderating the inaccuracies of the assumptions implicit to each. I applied such mixed methods to the sample data, using the Paid PMPM and Incurred PMPM methods, respectively, for the final three months of claims incurral leading up to the valuation date, and using the Completion Factor method for periods more than three months prior to the valuation date. The results are summarized in Tables 1, 2, and 3, and are listed immediately below the results for the "Pure" Paid PMPM and Incurred PMPM methods, respectively.

In this example, the hybrid methods appear to generally give improved results over any of the three pure method estimators. In particular, the hybrid 3-Month Paid Claims PMPM method appears to consistently yield better results than any other estimation method. This is somewhat surprising in light of the fact that, even with 3 months of claims run-out, the pure Paid Claims PMPM method appears to out-perform the Completion Factor method. Rather than speculate here on the reasons for this apparent paradox (see my earlier disclaimer on covariance), I would invite anyone who cares to repeat this analysis on separate data to check for the reproducibility of this result.

I have also experimented with refining the Paid PMPM method further by regressing claims incurred and paid in specific lag months against cumulative claims incurred and paid in prior lag months. This process appears to generally yield better results than those obtained using a simple average of claims incurred and paid by lag month, since it at least partly takes into account the relation between claims incurred and paid and those not yet paid. Not too surprisingly, however, I have found that the degree of improvement depends on the quality of the data.

In conclusion, it is apparent that it is time to discard the Completion Factor method for estimating IBNP reserves as fundamentally flawed. While an approach such as the Completion Factor method may have been a practical necessity in the age of slide-rules and adding machines, its lack of mathematical soundness condemns it in the age of computers. It is not sufficient to resolutely memorize cookbook methods in much the same manner as 16th-century scholars clung to Aristotle and Galen as Holy Writ. "If it's good enough for everyone else, . . ." is the logical equivalent of ". . . because that's the way we've always done it!", which should raise the hackles of any true professional.

We must critically revisit and re-examine our basic methods for sound thought and sound mathematics, discarding out-dated and unsound methods when necessary, and replacing them with newer, well-founded analyses. Otherwise, we are bound to become merely an association of complacent, over-paid technicians, doomed to the same destiny as the Dodo and the dinosaurs.

There is always a better way, it is up to us to find it.

Robert G. Lynch, ASA, MAAA, is senior associate actuary at Blue Cross/Blue Shield in Detroit, Mich.

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Table 1
IBNP Estimates for Tighly-Held managed Care Organization or Integrated Healthcare Delivery System

	Zero Runout IBNP						1-Month Runout IBNP					
	Average Estimated IBNP			Standard Error of Estimate			Average Estimated IBNP			Standard Error of Estimate		
Method	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Esxtimated IBNP * (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNP * (x 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims
Actual IBNP	$7,991	100.0%	130.8%	$840	10.5%	13.7%	$3,563	100.0%	58.3%	$603	16.9%	9.9%
Completion Factor	$7,621	95.4%	124.7%	$1,515	19.0%	24.8%	$3,217	90.3%	52.7%	$790	22.2%	12.9%
Pure Paid PMPM	$7,745	96.9%	126.8%	$962	12.0%	15.7%	$3,293	92.4%	53.9%	$759	21.3%	12.4%
3-Month Paid PMPM	$7,652	95.8%	125.2%	$791	9.9%	12.9%	$3,142	88.2%	51.4%	$625	17.6%	10.2%
Pure Incurred PMPM	$8,818	$110.3%	144.3%	$1,111	13.9%	18.2%	$4,607	129.3%	75.4%	$1,271	35.7%	20.8%
3-Month Incurred PMPM	$7,707	96.4%	126.1%	$1,137	14.2%	18.6%	$3,348	94.0%	54.8%	$938	26.3%	15.3%

	2-Month Runout IBNP						3-Month Runout IBNP					
	Average Estimated IBNP			Standard Error of Estimate			Average Estimated IBNP			Standard Error of Estimate		
Method	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Esxtimated IBNP * (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNP * (x 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims
Actual IBNP	$2,076	100.0%	34.0%	$483	23.3%	7.9%	$1,339	100.0%	21.9%	$308	23.0%	5.0%
Completion Factor	$1,809	87.2%	29.6%	$603	29.0%	9.9%	$1,113	83.2%	18.2%	$398	29.7%	6.5%
Pure Paid PMPM	$1,808	87.1%	29.6%	$615	29.6%	10.1%	$1,134	84.7%	18.6%	$408	30.5%	6.7%
3-Month Paid PMPM	$1,724	83.0%	28.2%	$488	23.5%	8.0%	$1,064	79.5%	17.4%	$342	25.6%	5.6%
Pure Incurred PMPM	$3,332	160.5%	54.5%	$1,420	68.4%	23.2%	$2,804	209.5%	45.9%	$1,584	118.3%	25.9%
3-Month Incurred PMPM	$2,030	97.8%	33.2%	$870	41.9%	14.2%	$1,462	109.2%	23.9%	$723	54.0%	11.8%

* Sample standard deviation is shown for actual IBNP, rather than standard error.

Table 2
IBNP Estimates for Open Indemnity Type Health Insurance Carrier

	Zero Runout IBNP						1-Month Runout IBNP					
	Average Estimated IBNP			Standard Error of Estimate			Average Estimated IBNP			Standard Error of Estimate		
Method	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Esxtimated IBNP * (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNP * (x 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims
Actual IBNP	$11,084	100.0%	181.4%	$957	8.6%	15.7%	$5,930	100.0%	97.1%	$800	13.5%	13.1%
Completion Factor	$10,462	94.4%	171.2%	$2,910	26.3%	47.6%	$5,817	98.1%	95.2%	$1,170	19.7%	19.1%
Pure Paid PMPM	$11,219	101.2%	183.6%	$1,005	9.1%	16.5%	$5,935	100.1%	97.1%	$860	14.5%	14.1%
3-Month Paid PMPM	$11,137	100.5%	182.3%	$976	8.8%	16.0%	$5,822	98.2%	95.3%	$801	13.5%	13.1%
Pure Incurred PMPM	$13,463	$121.5%	220.3%	$3,000	27.1%	49.1%	$8,612	145.2%	141.0%	$3,140	53.0%	51.4%
3-Month Incurred PMPM	$11,232	101.3%	183.8%	$1,109	10.0%	18.2%	$6,145	103.6%	100.6%	$991	16.7%	16.2%

	2-Month Runout IBNP						3-Month Runout IBNP					
	Average Estimated IBNP			Standard Error of Estimate			Average Estimated IBNP			Standard Error of Estimate		
Method	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Esxtimated IBNP * (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNP * (x 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims
Actual IBNP	$3,728	100.0%	63.8%	$514	13.8%	8.8%	$2,634	100.0%	45.1%	$402	15.3%	6.9%
Completion Factor	$3,510	94.1%	60.1%	$692	18.6%	11.8%	$2,422	91.9%	41.5%	$517	19.6%	8.8%
Pure Paid PMPM	$3,821	102.5%	65.4%	$580	15.6%	9.9%	$2,651	100.6%	45.4%	$424	16.1%	7.3%
3-Month Paid PMPM	$3,525	94.6%	60.4%	$461	12.4%	7.9%	$2,427	92.1%	41.6%	$359	13.6%	6.2%
Pure Incurred PMPM	$6,670	178.9%	114.2%	$3,292	88.3%	56.4%	$5,785	219.6%	99.1%	$3,433	130.3%	58.8%
3-Month Incurred PMPM	$4,087	109.6%	70.0%	$933	25.0%	16.0%	$3,153	119.7%	54.0%	$997	37.8%	17.1%

* Sample standard deviation is shown for actual IBNP, rather than standard error.

(continued on page 26)

Table 3
IBNP Estimates for Open-Access POS or PPO Type of Health Plan

	Zero Runout IBNP						1-Month Runout IBNP					
	Average Estimated IBNP			Standard Error of Estimate			Average Estimated IBNP			Standard Error of Estimate		
Method	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Esxtimated IBNP * (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNP * (x 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims
Actual IBNP	$9,538	100.0%	159.6%	$801	8.4%	13.4%	$4,746	100.0%	79.4%	$641	13.5%	10.7%
Completion Factor	$9,196	96.4%	153.9%	$1,727	18.1%	28.9%	$4,542	95.7%	76.0%	$860	18.1%	14.4%
Pure Paid PMPM	$9,474	99.3%	158.6%	$841	8.8%	14.1%	$4,612	97.2%	77.2%	$713	15.0%	11.9%
3-Month Paid PMPM	$9,399	98.5%	157.3%	$679	7.1%	11.4%	$4,486	94.5%	75.1%	$598	12.6%	10.0%
Pure Incurred PMPM	$10,695	$112.1%	179.0%	$1,787	18.7%	29.9%	$6,144	129.5%	102.8%	$1,900	40.0%	31.8%
3-Month Incurred PMPM	$9,468	99.3%	158.4%	$872	9.1%	14.6%	$4,720	99.4%	79.0%	$779	16.4%	13.0%

	2-Month Runout IBNP						3-Month Runout IBNP					
	Average Estimated IBNP			Standard Error of Estimate			Average Estimated IBNP			Standard Error of Estimate		
Method	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Esxtimated IBNP * (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	Average Total IBNP $ (X 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims	S.E. of Estimated IBNP * (x 1,000)	Percent of Actual IBNP	% of Avg Monthly Incurred Claims
Actual IBNP	$2,902	100.0%	48.6%	$412	14.2%	6.9%	$1,987	100.0%	33.2%	$292	14.7%	4.9%
Completion Factor	$2,678	92.3%	44.8%	$545	18.8%	9.1%	$1,782	89.7%	29.8%	$388	19.5%	6.5%
Pure Paid PMPM	$2,806	96.7%	47.0%	$462	15.9%	7.7%	$2,886	95.0%	31.6%	$319	16.0%	5.3%
3-Month Paid PMPM	$2,628	90.6%	44.0%	$371	12.8%	6.2%	$1,749	88.0%	29.3%	$278	14.0%	4.7%
Pure Incurred PMPM	$4,552	155.8%	75.7%	$2,021	69.6%	33.8%	$3,793	190.9%	63.5%	$2,140	107.7%	35.8%
3-Month Incurred PMPM	$3,000	103.4%	50.2%	$739	25.5%	12.4%	$2,239	112.7%	37.5%	$720	36.3%	12.1%

* Sample standard deviation is shown for actual IBNP, rather than standard error.

Table 4
Important Characteristics of the Completion Factor, Incurred Claims PMPM, and Paid Claims PMPM Estimators of IBNP and Incurred Claims

Characteristics of IBNP Reserve/Incurred Claims Estimation Method	IBNP Reserve/Incurred Claims Estimation Method		
	Completion Factor/ Chain Ladder	**Incurred Claims PMPM**	**Paid Claims PMPM**
Assumptions which are Implicit to the Respective Methods	Variation in paid claim amounts are dependent only on variations in morbidity and total incurred claim costs. Conversely, total incurred claim costs are dependent only on claim amounts incurred and already paid. Rates of claims reporting and processing are stable and constant.	Morbidity and total incurred claim costs are fully predictable solely from past claim costs, adjusted for trend, etc. Total incurred claim amounts for recent months are independent of claims incurred for the same period and already paid (except when the latter is the greater).	Claim dollar amount incurred, but not yet paid are equal to past average PMPM paid amounts with similar lags, adjusted for trend, etc. Claim amounts are incurred, but not yet paid are independent of claim amounts incurred and already paid.
Error variance of IBNP estimate associated with respective methods	Very High	Moderate	Low
Error variance of Incrred Claim estimate associated with respective methods	Very High	Low	Low
Bias of IBNP and Incurred Claim estimator	Unbiased	Produces estimates biased towards the high side. Relative bias increases with longer claims run-out.	Unbiased
Correlation between IBNP estimates vs. claim amounts	Strongly positive correlation.	Strongly negative correlation.	Not related, 0% correlation.
Correlation between total incurred claim estimates vs. claim amounts incurred and already paid	100% positive correlation by ratio.	No correlation (except when Incurred and paid is greater than average total incurred).	Strong positive “additive” correlation.
Sensitivity of IBNP estimator to seasonility of morbidity (claims incurral)	Not sensitive, seasonaility is implicitly accounted for in method.	Very sensitive, but inversely. Without adjustment, any seasonility may contribute significant error to IBNP estimates.	Not sensitive. Adjustments may be made for known seasonal variations in morbidity.
Sensitivity of IBNP estimator to calendar seasonality (e.g., number of days in month)	Minimal sensitivity, primarily due to length of run-out period with paid-through end-of-month data.	Very sensitive, adjustments necessary.	Somewhat sensitive, adjustments necessary.
Sensitivity of IBNP estimator to benefit design seasonality (e.g., calendar-year deductibles, benefit limits)	May be slightly sensitive, depending on benefit design, adjustments may be necessary.	Very sensitive, adjustments necessary.	May be sensitive, adjustments necessary depending on benefit design.

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Table 4 (continued)

Characteristics of IBNP Reserve/Incurred Claims Estimation Method	IBNP Reserve/Incurred Claims Estimation Method		
	Completion Factor/ Chain Ladder/Lag	**Incurred Claims PMPM/ Loss Ratio Method**	**Paid Claims PMPM**
Sensitivity of IBNP and Incurred Claims estimates to trend effects.	Not sensitive to trend	Sensitive to trend, inaccuracy of trend assumptions may lead to significant error in IBNP estimates.	Slightly sensitive to trend, but potential for error significantly less than Incurred PMPM method.
Sensitivity of IBNP estimates to changes in morbidity or utilization patterns of covered population.	Very sensitive, but due to high variance of results, it may be difficult to identify changes immediately.	Very sensitive, but in the wrong direction. Change in morbidity may result in significant error of IBNP estimate.	Not sensitive. Method inherently assumes that remaining IBNP is constant after other adjustments.
Sensitivity of Incurred Claims estimates to changes in morbidity or utilization patterns of covered population.	Very sensitive, but due to high variance of results, it may be difficult to identify changes immediately.	Not sensitive. Method inherently assumes that morbidity does not change.	Somewhat sensitive. More sensitive in situations with rapid claims reporting and processing, less sensitive in slow or inefficient systems.
Sensitivity of IBNP estimates to variation in rate of claims reporting and processing.	Very sensitive, but in the wrong direction, any variation may result in significant error of IBNP estimate.	Very sensitive.	Somewhat sensitive, speeding up process causes over-estimation of IBNP, and vice-versa.
Sensitivity of Incurred Claims estimates to variation in rate of claims reporting and processing.	Very sensitive, any variation may result in significant error of Incurred claims estimates.	Not sensitive.	Somewhat sensitive, similar to IBNP estimator.

Figure 1 - Error in Total IBNR Estimates - Zero Run-Out
Closed Panel Integrated Delivery System or HMO

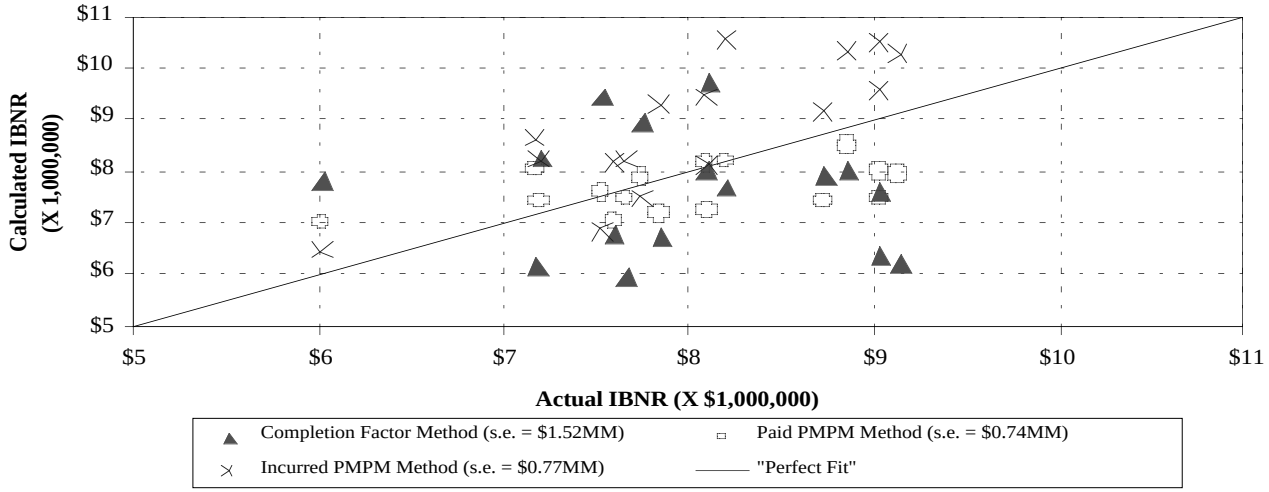

Figure 2 - Error in Total IBNR Estimates - Zero Run-Out
Open-Access Indemnity Health Plan

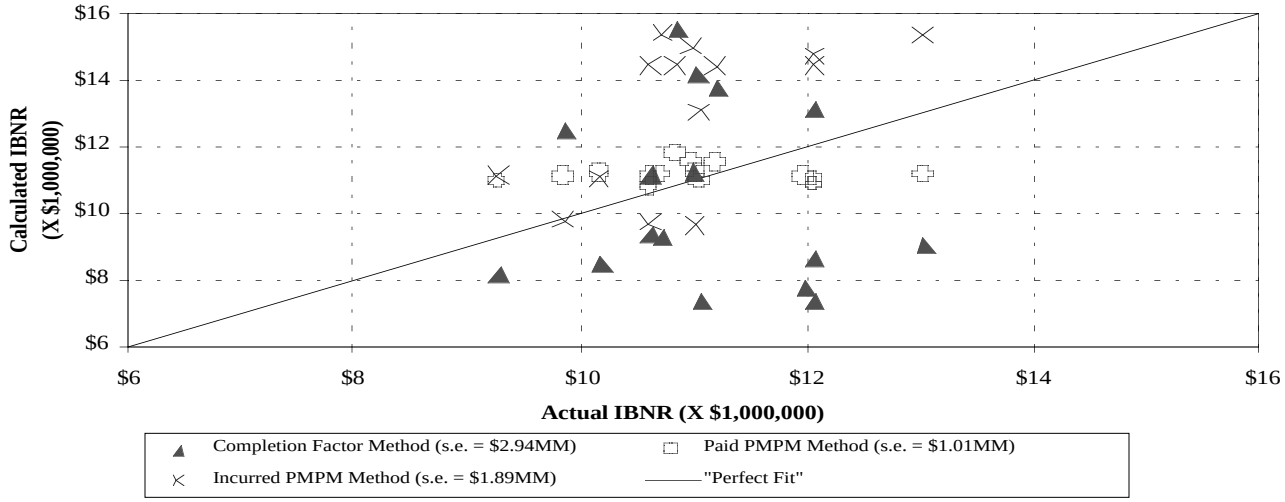

Figure 3 - Error in Total IBNR Estimates - Zero Run-Out
Open-Access POS or PPO Managed-Care Health Plan

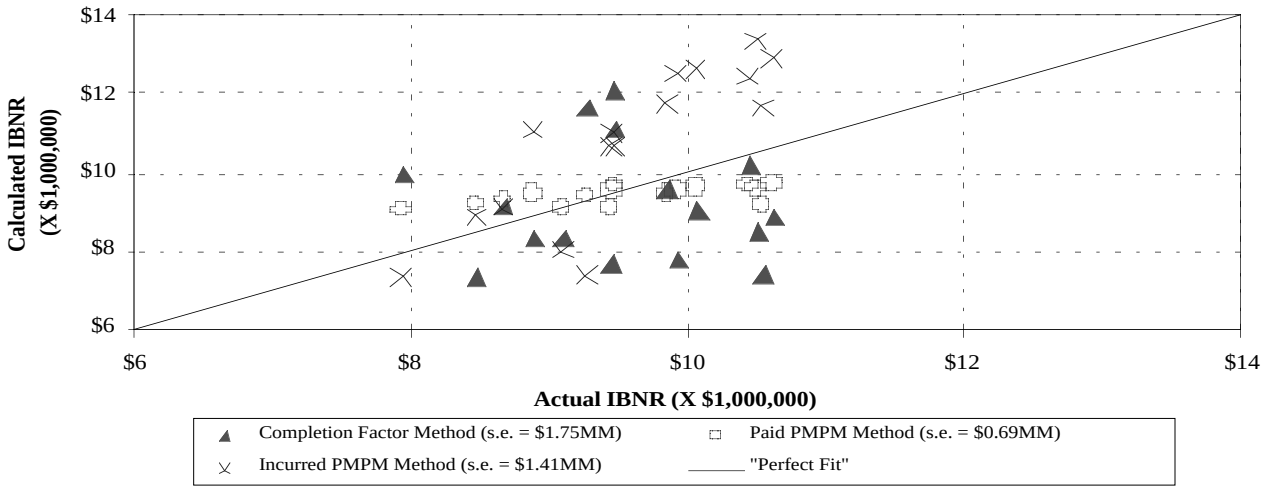

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Figure 4 - Standard Error of IBNR Estimates
Tightly-Held HMO or IDS: by Length of Claims Run-Out Period

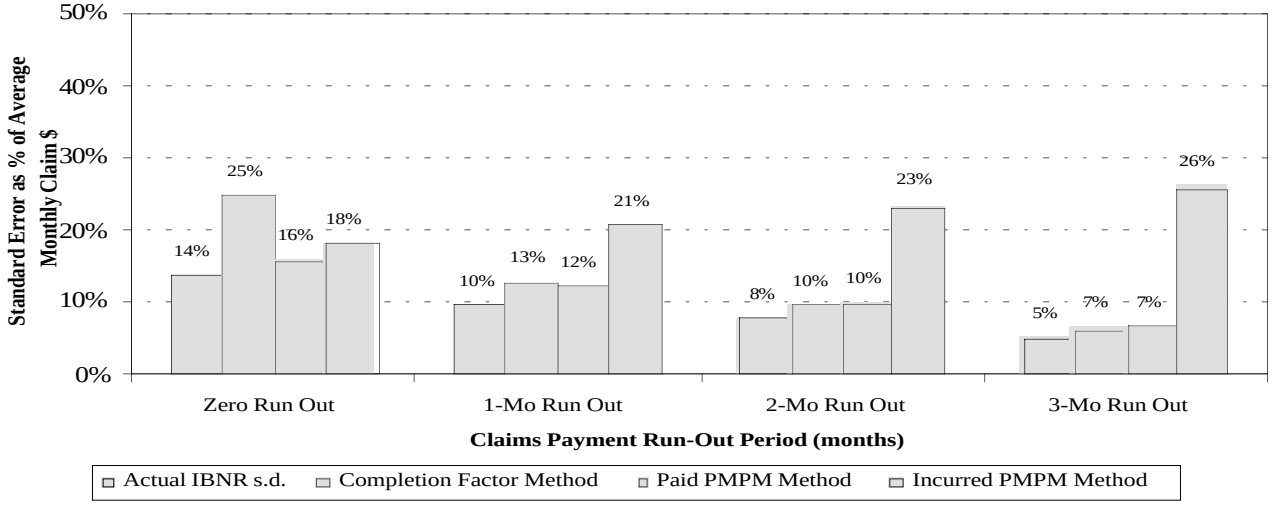


Figure 5 - Standard Error of IBNR Estimates
Open Indemnity / FFS Plan: by Length of Claims Run-Out Period

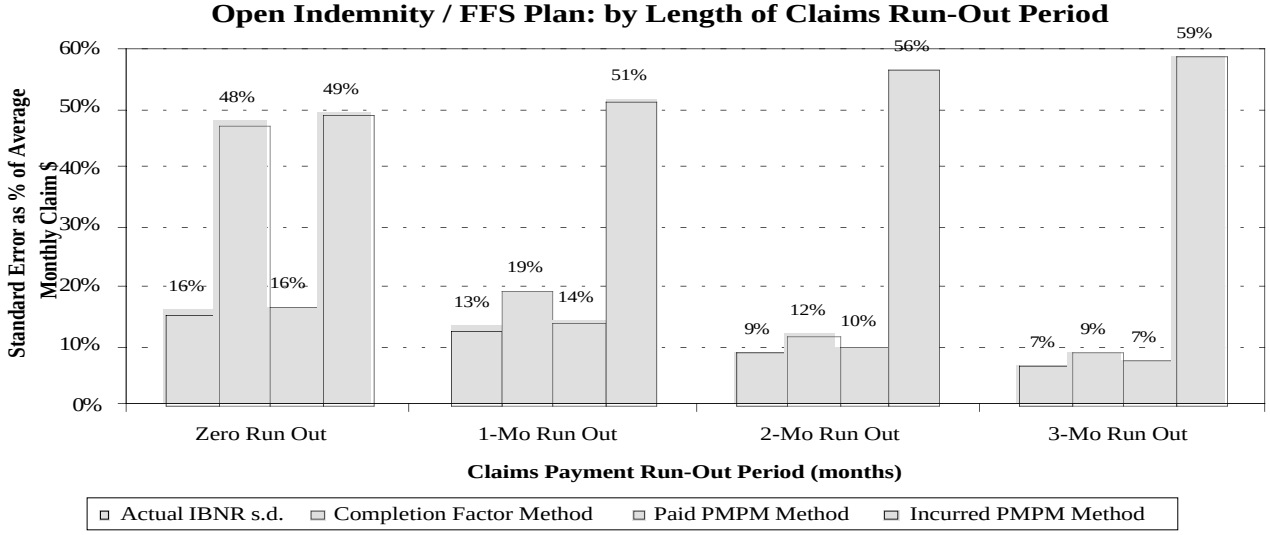
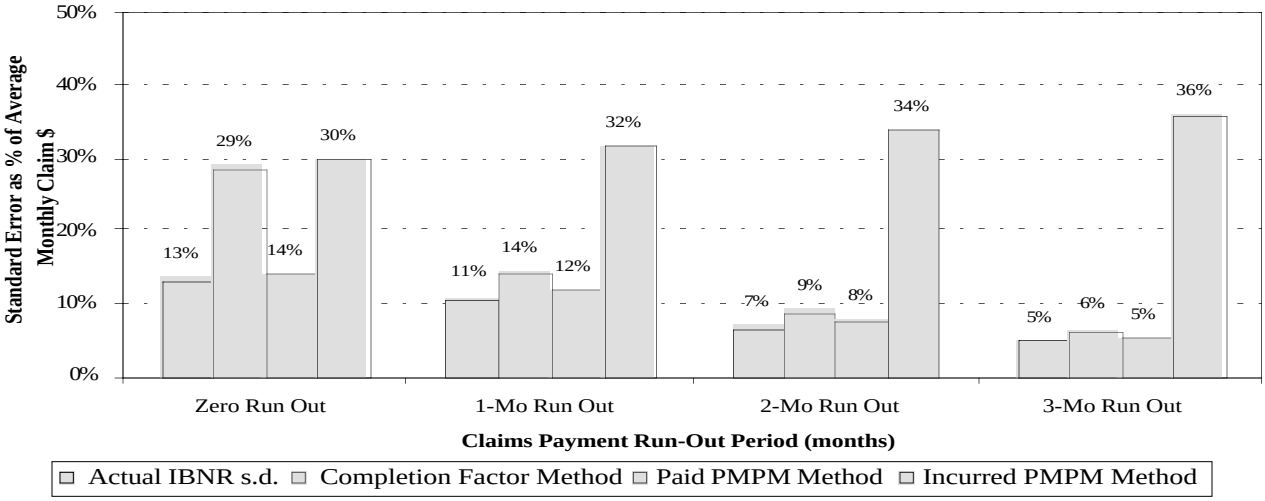


Figure 6 - Standard Error of IBNR Estimates
Open-Access POS or PPO Plan: by Length of Claims Run-Out Period



Health Care System in Crisis

The SOA's Health Benefit Systems Practice Area and Health Section Council have pledged their support for a new SOA project designed to shed some light on the current pressures within the U.S. healthcare system. This initiative was prompted by perceptions that cost increases are spiraling out of control and beyond levels of affordability, and that the actuarial profession is not adequately contributing to understanding and solving these problems.

The first phase of the Healthcare System in Crisis project is to develop a descriptive model that articulates the dynamics of the healthcare system and the interrelationships of the system stakeholders. The primary goal is provide the public with an actuarial perspective on competing interests in the healthcare system. A secondary goal is to increase the actuarial community's knowledge base of healthcare system dynamics in order to promote increased involvement by actuaries in health policy discussions and research in the future.

The working group has drafted a timeline for its work and identified interim deliverables to align with the Spring and Annual SOA Meetings. The first phase of the project is scheduled from April through June, and includes:

- Defining what is meant by "cost" for the purposes of the model.
- Identifying the major stakeholders in the health care system and grouping them for purposes of the model.
- Defining a template for collecting information on each stakeholder.
- Identifying underlying cost levers for each stakeholder, and evaluating ways that each stakeholder can affect (positively or negatively) the costs of other stakeholders. Both the cost and the revenue side of each stakeholder will be considered.
- Researching descriptive model types.
- Searching for other research that has been conducted on this issue. The SOA model should not duplicate work that has already been done, but rather should build on other research or take it into a new direction.

The next conference call of the working group will take place in early May. For more information on this project, please contact Jeff Allen, the working group chair, at jgallen@hewitt.com, or Kara Clark, SOA Health Staff Fellow, at kclark@soa.org.

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