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Session 64PD
Mortality: X-amining the X-Factor

Track: Reinsurance/Product Development

Moderator: JAY D. BIEHL
Panelists: JAY D. BIEHL
THERESA A. CHOKA
LARRY M. GORSKI
HENRY B. RAMSEY III
Recorder: JAY D. BIEHL

Summary: This session provides a description of the SOA Life Experience Committee's activities for the year 2000. The panel also discusses retrospective analysis of X-factors and the role of reinsurers.

Mr. Jay D. Biehl: I chair the Individual Experience Studies Committee, and we'll give you a little update of what's going on. Then we'll turn the bulk of our presentation over to our panelists to really talk about the X-factors and overview of retrospective X-factors and techniques.

At first glance the topics may not appear to be totally related, but they are, in fact, very related. A lot of experience studies have to be done to effectively analyze where your X-factors are and how your experience is playing out relative to the X-factors that were set into place.

Although there's a lot of discussion, and a lot of work has taken place on the X factors from the valuation actuary's perspective, we've tried to do this presentation a little differently from a product development actuary's focus. What happens if you get X-factors that start to play out a little differently from what was anticipated in the product pricing? And how does that cycle complete itself back from the valuation actuary and experience studies type of work into a product development type of role? So, we're trying to take a topic that's been talked about a lot over the last year or so and look at it from a little different angle. We're actually getting to the point in time where we're going to have to do something with the experience. How do you start looking at the techniques, and how do you start examining those?

First I'm going to talk a little bit about the Experience Studies Committee. There's been a lot of activity over the last couple of years. In the second quarter of 2000 we published, on the SOA Web site, the 1990-'95 basic experience tables. We've completed the individual experience years through 1994-'95. We're still five years behind current times, but we're getting closer to being caught up.

Note: The charts referred to in the text can be found at the end of the manuscript.

The work that went into the 1990-95 experience table was translated into a second committee whose charge is to produce the basic valuation table. There's a big step in taking experience studies tables that look at the experience of a particular point in time, and thinking about it as a valuation type of table going forward. An easy example is that in the experience table we had about 10-12 years worth of nonsmoker/smoker data, but if you think about it from the valuation perspective you can't just have nonsmoker/smoker data for 10 years. You have to have it for now until the end of the life of those policies. There are a lot of issues that we have to think through from an experience perspective into a forward-going valuation perspective.

The work out of this group will be published probably to the SOA Web site as an exposure draft in December. A lot of work has to go into that, in loading, individual company considerations, and a number of other things before it can actually be turned into what has been known as the 2000 CSO. The work is advancing and a lot of that information should start to flow out by the first of December.

The next steps for the Individual Experience Studies Committee is to work on the 1990-95 cause of death. Hopefully that will be out by the first quarter, and we're trying to get individual years mortality experience caught up-to-date. I really want to get to a cycle so that we can produce individual year experience studies within a year after the year end and start getting basic tables out on a regular basis. To do that, however, we really need your help. We need the people who have consistently contributed to the Individual Experience Studies Committee in the past to continue to contribute. That's really important, but there are only about 20 companies or so that actually make contributions, and we really would like to increase that number. Those companies that make contributions make up the underlying experience that goes into the 1990-95 table, and those types of tables and also set the basis for valuation tables and a number of other things. So, if you have any interest, please feel free to give me a call or e-mail or you can find me in the book, whatever.

With that said, I'm going to turn the remainder of this over to our panelists. We have a distinguished group. Our first speaker will be Larry Gorski. Larry is the life actuary for the Illinois Department of Insurance. He started with the department in 1973 as an actuarial examiner and became the life actuary in 1976. Larry graduated from Northern Illinois University with both a B.S. and an M.S. and is an FSA and a Member of the Academy. Larry's obviously very actively involved in a number of groups involved with the NAIC and the Academy. He's also a recently elected member of the Board of Governors.

Our second speaker will be Hank Ramsey. Hank is currently vice president and actuary at Prudential Insurance Company managing the product design and pricing for traditional products. He's also responsible for supporting the illustration actuary and has been with Prudential since 1997. He has a broad experience with life, health, and annuity product development; financial reporting; and financial planning. Hank has also participated in numerous industry committees.

Our final speaker today will be Tracy Choka. Tracy is second vice president and director at Lincoln Re. She heads up our underwriting and research and development area that encompasses the Lincoln mortality system, experience studies, impairment studies, and

underwriting manual development. Tracy joined the research and development area in 1999 after serving in various other capacities within the Lincoln Financial Group, which she joined in 1988. Tracy has a B.A. from Purdue University and is also an FSA and a Member of the Academy. So, with that said, I'll turn it over to Larry.

Mr. Larry M. Gorski: Why X-factors? The idea of somehow trying to incorporate more judgment into the valuation process goes back eight or nine years when we were working on the original version of XXX. We saw a proliferation of underwriting classes. We saw a lack of mortality experience for setting valuation rates. And so we had to come up with a new idea, and that's where the idea of X-factors was born. It never would have progressed unless the level of confidence in the appointed actuary was there. The idea of an appointed actuary has been in our world now for almost ten years or so, and over that time I think regulators have grown more confident in the work of the appointed actuary. That's what makes this next step possible. A level of confidence in the appointed actuary is going to make future steps possible. And, lastly, I think the increases in improvement in computer technology, both software and hardware, make this whole idea workable, and you'll understand what I mean when I get to the end of my comments.

I view the X-factors as a bridge to freedom: freedom for the valuation actuary to take better control over the valuation process, freedom for the regulator to do other things besides argue with companies over reserving. So, I think it's a bridge to freedom. But I think the way to make this successful is to remember that your judgments should be disciplined. Maybe discipline was a poor word choice. I wasn't indicating the distinct approach of discipline. I was thinking of the more rigorous document approach to judgment as opposed to drawing a line through a few points or waving your hands and walking away from the assignment.

The idea of X-factors, incorporating them into the XXX regulation, was done very quickly, and there are a lot of details still missing. Some of the details, I think, are addressed in the draft Actuarial Standard of Practice (ASOP). If you haven't had a chance to look at the second draft, I encourage you to do so.
Some of the missing details are purely regulatory. When should the certification be filed? I've prepared some sample language, which I'll be sending out in my Halloween letter. There's really nothing different in there. So, there is at least one state's attempt to developing sample language. California may be doing the same thing.

Can certification be rejected? Of course it can. What happens when the appointed actuary changes? This question has meaning within the context of my model toward the whole process. I view the process of X-factors as really having three stages. In step 1ou set your initial X-factors, and that may be initial for the first year, or initial for a new underwriting class, or a new product or what have you. Step 2 is the assessment step (we've talked about this), the use of hypothesis testing. Step 3 is the resetting process. So, the question is what happens if the appointed valuation actuary changes somewhere in that time frame, and the new appointed actuary is being asked to assess a prior actuary's X-factors? There may be some ASOP issues there. That's probably a question that the Actuarial Standards Board (ASB) should think about.

Can the appointed actuary rely on another for data? Of course, the actuary can. The ASOP deals with that. How does the actuary assess the data for reasonableness? I'm not saying

should the actuary. The answer to the should is, yes, he or she should. The question is how. And the reason why I say assessing the data for reasonableness, there may be some questions as to the nature of the exposures that are going into the hypothesis testing stage. So, there may be a need for some thought on the how part of this question. Can the actuary use other than actual experience for assessing the X-factors? My view of this question and the answer is no. When one is assessing actual experience, it should be your actual experience and not the use of other company experience or even noninsurance experience or what have you. The answer to that question is yes. I think when you set X-factors or reset X-factors you should be able to look at everything and anything that has some bearing on setting the X-factors. However, when you're assessing those X-factors then I think you're limited to using your actual experience. That step I view as testing or assessing the actuary's judgment that went into the process.

One question I didn't address is, are there any safe harbors? I think someone's going to discuss some of the difficulties in setting safe harbors, and maybe we can talk about in that context.

Regulatory expectations. And I view this as a sort of the regulatory community as a whole. The first expectation is the implementation of a disciplined methodology by the appointed actuary for setting, assessing, and resetting X-factors. I think we all think in terms of this three-stage paradigm for the X-factors. Some of my comments will relate to the ASOP so you can see that at least some of the regulatory thinking is already embodied in the ASOP.

I think the first time I said something about annual review of mortality people jumped on me for that. Well, that's actually mentioned in the ASOP, Paragraph 3.6 rules from year to year. In our prepresentation discussion we were talking about a situation where the actuary changes the process or is changing the rules for assessing X-factors or resetting the X-factors. I think as a regulator that the regulatory community as a whole is going to frown on changing the rules. It looks too much like game playing. We've had too much experience with rate setting in the A&H area where you're using credibility theory. In one year claims get this level of credibility when it looks like a rate increase would be indicated by that, and when experience is good all of a sudden there's no amount of data that would substantiate that. So, changing the rules from year to year is probably a no-no.

Margin in X-factor adjusted mortality. We're all expecting some degree of margin in the setting of the X-factors, recognizing that you're doing reserving from a statutory valuation standpoint. The ASOP, Paragraph 3.5, deals with that. The big thing I'm going to hit on, from a couple different perspectives, is documentation from both the setting of the X-factors and assessing the X-factors.

Professional responsibilities. I think you need to remain objective under pressure. Obviously, there's a lot of pressure to sell product, be creative with product, either in design or X-factors to avoid deficiency purposes. As a professional you're going to have to remain objective under that pressure. Document work. Documentation is critical, and I'm going to say more about that when I get to the end of my comments.

Adhere to ASOPs. That's obvious. Be aware of regulatory requirements and expectations, and remember the purpose of X-factors is statutory reserves. A few things on documentation, and

this is from the perspective of setting the X-factors, your sources of experiences, and, again, when you're setting or resetting X-factors. I think you have a tremendous amount of latitude as to what you're going to look at to set those X-factors. When you assess the X-factors I expect the assessment based on your actual experience, but in setting and resetting you have a lot of leeway.

The rationale for the slope of X-factors. This gets to an issue that's addressed in the ASOP, and it really deals with the granularity of the X-factor classes. I'm not going to dwell on it because there is a discussion in the draft ASOP. I think some of the other speakers are going to talk about an example in this area, but if you're going to define a multiplicity of X-factor classes, I think you should be thinking of the rationale for the slope of those X-factor classes if your classes somehow vary with age or duration. Extent of margin should also be considered. And then also you should be thinking about the methodology and parameters for both assessing and resetting X-factors, and then in your documentation you should actually include your X-factors and the plans of insurance those X-factors apply to.

Retrospective assessment of X-factors. I and others have talked about the use of Monte Carlo simulations or the Panjer method for developing a distribution. To me, this is going to be a key to the success of the whole process, assessing the X-Factors, and I'm not focusing on a single methodology. There are many approaches to this. What I am suggesting, though, is that the ASOP in Appendix 1 where it, I think, muddies the water between the assessing step and the resetting step, is doing a disservice to the profession. I've said that already to the ASB, that I view the assessment step as a separate and independent step in the process. You're assessing the actuary's judgment that went into setting the factors, and, based on the results of that, you use that information in your resetting stage, but they're two separate stages. You should discuss the experience used for assessing, results of testing, and the action taken.

I think I need to spend at least a few minutes on the responses we've seen to competitive pressures because I mentioned the actuary should remain objective in the face of competitive pressures, and everyone here I'm sure is very much tuned in to all the innovative product designs. We won't talk about that here because that's not our purpose, but I see a couple possibilities for X-factor manipulation. One is omitting the assessment stage, simply resetting X-factors and blindly moving ahead without ever really assessing the reasonableness of those X-factors from a prospective standpoint. The second step in my paradigm is game playing with the X-factor classes. So, I think as regulators we're going to be watching that very carefully.

I've talked about the generic regulator's perspective and the professional's responsibilities. When I say regulator it's really my perspective on setting, assessing, and resetting the X-factor. I think it's appropriate and necessary to consider all relevant experience when you're setting the factor or resetting the factor. I'm not trying to eliminate or constrain actuarial judgment. I think it's both necessary and expected. I think it's also important to consider margins in light of the purpose and impact of a poor choice. If, in fact, your X-factors turn out to be on the wrong side of the ledger, there could be some severe penalties for the company in terms of setting up deficiency reserves or maybe some personal impact of that choice also. Documenting is the key.

Now the assessing stage, and I've said all this before, so there's not much need to get into this. Use a statistically grounded method. My method of choice is hypothesis testing. To me it's the approach to use when assessing the appropriateness of X-factors. There's been work done on it, and there's going to be more work done on that. So, there's no need to dwell on that, but it is a very important step here. Simply making a new estimate based on additional experience is not sufficient. That's my comment to the ASB on the draft ASOP. And use the same methodology and same parameters every year. When I start seeing people changing the rules from year to year I'd have to suspect that there's something going on there. There's something that I, as a regulator, need to be cognizant of. Document. It's the key to survival here.

Resetting the X-factors. Actuarial judgment is necessary and acceptable, as I said before, and here's where I start getting into some new ground. After participating in the session, *Regulatory Update on XXX* at the San Diego 2000 spring meeting, I gave some thought to the setting and primarily the resetting of the X-factors. I reviewed papers in the Transactions of the SOA over the last 25 years, and, lo and behold, there are some very good papers introducing and using ideas from Bayesian Graduation that I think are very applicable either to the resetting of the X-factor process or the resetting of mortality rates and then backing out X-factors. In TSA 19, 1967—there's a paper by Kimeldorf and Jones called "Bayesian Graduation," and that was really the second of two papers where he introduced the idea of Bayesian Graduation. That gives one, very good framework for doing what actuaries do best, and I'll go back. The Bayesian statistician views experimental data as evidence to be assimilated into the experience and knowledge of the experimenter. As a regulator, as an actuary, I recognize that actuarial work is art and science. You bring together your views. You collect some data. You modify your views. That's exactly what Bayesian statistics is all about, taking your views on, in this case, mortality rates or X-factors, blending in experience, but blending it in a rigorous way to develop new parameter values. And I'll just back up a second. From the Bayesian standpoint the graduation process is stated in a context of multivariate statistical estimation and analyzed according to Bayesian procedures. I didn't know until a few minutes ago, that there was a session on credibility theory from a health actuary's perspective that talked extensively about Bayesian statistics and Bayesian Graduation.

To a Bayesian, prior information must also be used in the form of a probability distribution to summarize a degree of certainty that exists about the parameters of the selected model. Bayesians view the parameter of interest as a random variable. You need probability distribution for that variable. That sometimes gets difficult. There are more recent papers that provide alternative suggestions for getting to that process. And I think this ties into my comments on the importance of documentation. If you're going to use the Bayesian approach to credibility or blending experience with your assumptions, you have to do that in a disciplined way which means you have to document your assumptions. My views on the importance of documentation I think go hand in hand in using Bayesian techniques, and this is not going to be a teaching session. I just wanted to throw those ideas out there so you have at least some idea as to where some regulators are looking to in this whole process.

And I also mentioned early-on computer technology. I think some of the reasons why the ideas in those papers that go back to the mid-1960s and early 1970s weren't used and forgotten is because we didn't have PCs back in the late 1960s or early 1970s. You had a mainframe computer. You had to get time on a mainframe computer, and you couldn't use

those ideas for those kinds of problems. The software wasn't there to implement those ideas. I think those were impediments to ideas that may have been before their time, which make them usable or practical ideas today.

The future of X-factors. In any kind of discussion on X-factors there's always a discussion about one of the constraints, and that's the constraint that the X-factors have to be nondecreasing, maybe level or increasing, and there are some problems with the application of the X-factor to the select adjusted mortality rates at the older ages in particular. That has started to get some discussion at the NAIC. It's quite possible that that particular constraint may get modified or eliminated in the not-too-distant future. There's been a great reluctance to reopen the regulation because of all the controversy in Version 1 and Version 2, and everything, but I think that's one that deserves serious consideration.

Next, and this is the bridge to the future, I'd like to see the idea of X-factors and all of the discipline involving X-factors be extended to basic reserves and, in particular, to be extended to the idea of somehow allowing valuation actuaries to modify the 2000 CSO Mortality Table based on their own experience. So, if things go well with X-factors for deficiency reserves, these next ideas may be in the future. And, with that, I'll turn it over to our next speaker.

Mr. Henry B. Ramsey III: I've titled my portion of the presentation, "X-amining the X-Factor**:** A Pricing Actuary's View." I'm here as the token pricing actuary sandwiched between a regulator and a reinsurer. I suppose that's appropriate since we pricing actuaries frequently find ourselves in a situation where on one hand our pricing is limited by how aggressive our reinsurer is willing to be, and on the other hand by how much leeway the regulator will give us.

When I was asked to speak here today I was far from an expert on X-factors. So, in preparation for the presentation I was forced to do some research. Let no one's work evade your eyes. Remember why the good Lord made your eyes. So, don't shade your eyes but plagiarize, only be sure always to call it research. I followed this advice and read an assortment of papers, articles, and editorials. I'm still far from an expert on the subject, but hopefully I'll spark a few ideas and provide some help when you decide to do some research on your own.

I decided to cover four topics in my presentation. First, a summary of what market forces are exhibiting today and some implications on overall industry deficiency reserves. Second, a review of some interesting aspects of how you set your X-factors. Third, a review of published literature on how to validate those X-factors. And, finally, how you might reset the X-factors if your validation doesn't work out how you planned. Setting, validating, resetting—sounds familiar.

So, let's talk about what's going on in the market. For this presentation I developed a quick index of term rates as charged by the marketplace. The index covers only products issued outside New York and uses the best premium class available from each company. It includes only policies at a $250,000 face amount and weights together gender, issue age, and level period accommodations, to get an index for each company. And then I used Life Insurance Marketing and Research Association (LIMRA) market share, to weight together the top ten selling companies in each quarter to yield a market premium index. I made two versions of this index: one for the guaranteed products and one for nonguaranteed products over the last

three quarters. As you'd expect, the premium rates for the guaranteed index are essentially equivalent to the nonguaranteed in the last quarter of 1999 and diverge in 2000. Using this very rough index, it looks like overall premium rates have increased by approximately 6% for the guaranteed products and decreased by 3% for nonguaranteed products. Keep in mind this index is for the market as a whole and that changes in certain product segments, such as the price for 20-year guaranteed products, have changed more significantly.

I want to share one interesting fact regarding the nonguaranteed premium index. Three of the top-selling LIMRA companies don't even offer a nonguaranteed product. I excluded those companies when I calculated the nonguaranteed premium index. But it's interesting to note that the three companies were not just in the top ten of LIMRA sales; they were all in the top five. Clearly, not offering a nonguaranteed product has not prevented them from being successful.

Now let's talk a little about those premiums and X-factors. In addition to looking at the index overall, we looked in detail at the male, age 45, 20-year level premium cell. For this pricing cell we found the lowest rate for the top 10 companies and matched it up with a conservative X-factor of 50% at all durations. In this case the first-year deficiency reserve is 13 times premium. We decided to do a few more example deficiency reserves (Table 1). At the conservative X-factor of 50%, even the industry average premium yields a deficiency reserve of 6 times premium. If we reduce the X-factor to 34%, the deficiency reserves of the average premium go away, but the deficiency reserves for the best premium are still at 4 times premium. Only when we reduce the X-factor to 25% do the deficiency reserves disappear from the best premium rate.

TABLE 1
Market Implications

Deficiency Reserves as Multiple of Premium			
Male Best Class Age 45 20-yr Level			
X-factor:	50%	34%	25%
Best Premium	13x	4x	0x
Avg. Premium	6x	0x	0x

That was the best of those top ten companies. So, what does this mean for the industry? Well, if the appropriate X-factor for mortality isn't low enough to eliminate those deficiency reserves, I guess there's a lot of opportunity out there for reinsurers.

Based on a simple doubling of LIMRA sales data for the first 6 months of 2000, we estimated the industry would sell term premium of $1.75 billion and term face amount of $750-800 billion in the year 2000. If you assume that 20% of this amount is subject to deficiency reserves, and the deficiency reserves are equal to 4 times premium, then the industry additional deficiency reserves in 2000 are over $1.4 billion. I'll leave it to Tracy to describe how the offshore reinsurer industry is going to absorb all those reserves.

Now I'd like to make a few comments about setting X-factors. As you all know, the slope of the 1980 CSO with 20-year select factors is pretty steep. As I was preparing this presentation, one of the ideas I plagiarized from a fellow actuary was to describe a set of reasonable pricing

assumptions as a percentage of 1980 CSO, 20-year select rates for the first 20 durations. This ratio might decline from 90% or 100% in the first year to 50% or 60% in the 20th year. That forces the valuation to be as much as two times the anticipated pricing in duration 20 when you pick an X-factor which doesn't decrease by duration and meets that first-year minimum. It doesn't seem fair to me.

Another interesting perspective comes when you consider how to group your X-factor classes. Setting an X-factor for each issue age might be very precise, but it's an awful lot of work. One X-factor for all issue ages might not be sufficiently precise. Grouping by individual issue age groups might be a reasonable alternative. One issue which appears to be unresolved is how to aggregate when you're demonstrating compliance with the requirements of the regulation. The requirements appear in the NAIC model regulation in Sections 5(b)(3)(d), and 5(b)(3)(e). We've all read them. The first requirement specifies that the actuarial present value of death benefits using valuation mortality must be greater than the present value of anticipated mortality. The second requirement is that the valuation mortality rates in each of the next five years must be greater than the anticipated mortality rate. Some would interpret the requirement to apply narrowly to each issue age. Others interpret the requirement more broadly to permit aggregation across many issue ages, as long as the tests are passed.

But your company's competitive goals affect this decision. For example, if you want to be more competitive at the younger issue ages, you might want to use age-specific X-factors to minimize the deficiency reserves for the youngest ages. On the other hand, if you want to be more competitive at older issue ages, you're better off using one X-factor across all ages.

One comment here. Larry and the other regulators may expect or recommend margins, but, as I read it, the regulation and the ASOP do not require that margins be used for setting or evaluating X-factors. You can use margins if you want to. The draft ASOP suggests that you should consider including a margin for conservatism as the uncertainty considering the level of anticipated mortality increases. You may choose to include some margins for a new underwriting class with no experience or if you're concerned about the impact of needing to increase X-factors at a later valuation date. Remember, however, that with a normally sloped experience mortality table you're likely to have substantial margins in your later duration X-factors whether you want them or not.

One additional point for us pricing actuaries to remember is that we make assumptions about how the policies will be reserved when we design and price these brands, but the valuation actuaries will actually decide. At Prudential the valuation actuaries are in another building. They assume the pricing actuary is going to be aggressive, and that you will not meet your profitability expectations and the valuation actuaries are taking a conservative tack. You have to involve the valuation actuaries early in the process, probably even before they want to pay attention.

Now I'd like to talk a little bit about the process of validation. After you've been using these X-factors for a while, you need to validate that they're still appropriate. Actually, the draft ASOP says that you have to annually review relevant emerging experience. So, even if you only recently commenced sales of a new policy series or if there is not much exposure in your study, you should review the experience to the extent that it's relevant.

All of the methods of validating X-factors that I'm looking at today test the same hypothesis. The hypothesis is that your X-factor adjusted mortality is appropriate. The alternative hypothesis is that the X-factor adjusted mortality is too low and needs to be increased. You'll reject the hypothesis if the actual claim amount is greater than the expected. The basic approach is to calculate the amount of expected claims at a 95% significance level. Then you compare the actual claim amount to the expected claim limit at that 95% significance level, and if the actual is greater than the expected claim limit, you reject the hypothesis. You have to repeat this process for every X-factor class that you are using, and you have to do it for all classes in the aggregate. The hard part of this process is creating the probability distribution of total claims. If you have a probability distribution, you can easily find the 95% significance level; that is, the level of claims that you expect to be at or below 95% of the time. Then the comparison of actual to this 95% level is straightforward, if somewhat repetitious.

I'll go over three methods to estimate the aggregate distribution probability of claims: the Monte Carlo method, the Panjer method, and the normal distribution method. All are used to estimate the expected claim limit at that 95% significance level. The Monte Carlo method for estimating an aggregate probability distribution has been around for almost 40 years. I assume you're all familiar with the basic approach. Monte Carlo simulations can be applied to X-factor testing by running the population through the model repeatedly and estimating the aggregate probability distribution of total claims.

An article Regulation XXX*: Opining on the Appropriateness of X-factor Modified Select Factor Adjusted Mortality Rates* (1999) written by Larry Gorski describes how to calculate the expected claim limit and what he called the rejection region. His article used an analysis of the number of claims to calculate the rejection region. An NAAJ (2000) article *A Monte Carlo Approach for Validating X-factors* written by Xu, Xuesheng and Mary Broesch of ING Re is also on this subject. Their paper extends Larry's approach to cover a compound Monte Carlo simulation using an assumed distribution of the amount of each policy, as well as the assumed mortality rate.

The Panjer method uses a recursive approach to directly calculate the complete aggregate distribution of claims. The method is documented in detail in Transactions Paper (1980), *The Aggregate Claims Distribution and Stop-Loss Reinsurance* by Harry H. Panjer. It is further explained in, *An Overview of the Panjer Method for Deriving the Aggregate Claims Distribution a* paper written by Lloyd Spencer of Lincoln earlier in 2000 and published in Small Talk.

This method requires that you first group all policies into an issue amount category and then provide a step-by-step calculation of the probability of claims of all possible face amount combinations. You can then sum the probability of each possible amount combination to get the probability distribution of aggregate claims. Note that the Panjer method uses policy, not groups, to approximate the distribution of the policy amounts.

And, last, there's the normal distribution approach. This approach is based on the assumption that the normal distribution can be used to approximate the distribution of aggregate claim amounts directly. The approach has the advantage that the calculations are simple and direct. The 95% significance level of the amount of claims can be calculated quickly. This is the method that is described in Chapter 2 of the textbook Actuarial Mathematics, 2nd edition (1997) written by Bowers, Gerber, Hickman, Jones & Nesbitt. The Course 8 Study Note:

Experience Assumptions for Individual Life Insurance and Annuities (2000) written by Richard F. Lambert, approximates the distribution of aggregate claims for individual life insurance.

The approach depends on the assumption that each claim is independent and derives the expected mean aggregate claim amount as the sum of the expected claim for each policy, and the variance of the aggregate claim amount is the sum of the variances for each policy. Anyone who's passed this exam involving actuarial mathematics in the last 20 years should be familiar with this. This is by far the most straightforward of the alternative methods. However, there are those who say this is not as reliable as some of the other methods. It's certainly, in my opinion, more conservative and will probably lead to more rejections.

Be careful to document why you made each of those choices. One interesting question that has yet to be answered is what significance level do you choose? I've been using 95% in my examples to this point, but there is no magic to that number. In fact, Larry's paper used the 75% number. I found it interesting that all the papers written by actuaries in insurance companies use 95%, and the regulator used 75%. I tried to look at the ASOP for a third viewpoint, but it does not suggest any particular significance level.

So, another unanswered question is, who should decide that significance level? Larry's paper suggests that choosing the significance level might be the regulator's responsibility. I'm also curious as to whether it's then appropriate to have a lower threshold if you're doing a study based on number rather than study based on amount. Note that the tests I'm describing only address whether the X-factor adjusted deficiency reserve mortality is adequate. None of the tests look at whether the X-factor is too high.

Finally, a general comment on the hypothesis testing approach. As noted in the appendix to the ASOP, hypothesis testing must be used with great caution. Emerging mortality may be substantially in excess of expected but still be deemed acceptable through hypothesis testing. So, another approach to validating is to treat each year-end as an opportunity to re-create the entire set of X-factors. This is one area that Larry might have problems with. The creation of a new set would take into account emerging experience on the block or any other new experience deemed relevant in setting an assumption. Then you could compare the current set of X-factors to the new set and further investigate differences. If you can explain the differences, then this is a more acceptable approach, at least from one regulator's perspective.

So, what happens when you change those X-factors? Well, you may be obligated to change your X-factors because you failed the validation or you may have passed the hypothesis testing, but you want to change your X-factors because you've changed your experience mortality assumption based on a recent study. This is particularly true if you depend on an aggregate mortality rate to demonstrate compliance for the test. When you reset the X-factor the new X-factors are subject to the same requirements as were applied to the X-factors you set at issue. You can reset all X-factors or just selected ones.

Even if your mortality has not changed, you may want or need to change your X-factor. If you set a common X-factor for a range of issue ages, and the actual distribution between ages is different than anticipated, you may need to change the X-factor. Another potential reason is to reduce the X-factor at later durations just to reduce the margin embedded in them. After a

couple of years your X-factor may have a 25% margin in it just because of differences in the slope of the 20-year select 1980 CSO and your experience mortality table.

When you make a change to the X-factors you need to review the effect of that change on your business from several perspectives. If you increase the X-factors, it may or may not lead to an increase in deficiency reserves. You would normally be expecting your deficiency reserves to decrease each year. The effect of an increase in X-factors may be only to slow that rate of decrease. If you are expecting the X-factors on a block to decline to zero in a given year, an increased X-factor may still result in the deficiency reserves being zero. If you're using the same X-factors for policies issued over several calendar years, you have to be careful. The increase in X-factors will have the greatest effect on policies issued this year because it's first-year deficiency reserves that are the biggest numbers.

Whatever your decision, you really need to look at all aspects of your X-factors every year. I'm sure Larry will look forward to reading all about it in your annual X-factor report. And that concludes my presentation. And now I'll turn the podium over to Tracy to talk about the reinsurer's point of view.

Ms. Theresa A. Choka: Have you heard enough yet on Regulation XXX? What's left for me to say on this topic? What I want to do is demonstrate an example of an annual assessment of your mortality, the look-back component, but also I want to bring in some reinsurance perspective.

So, the purpose of my discussion is to provide an overview of Regulation XXX, product development, and reinsurance, all three pieces. The first objective will be to have a real brief discussion on where reinsurance has been this last year or so in the environment of Regulation XXX. The bulk of my presentation will then provide you with an example of experience studies and X-factor analysis; in particular, the retrospective X-factor analysis piece, which is the look-back, annually assessing your mortality. What does that really mean? Let's see an example of that.

In closing then I'll talk briefly about what this all means from a product development or a pricing actuary's perspective. There's so much of the discussion focused on valuation. How does the annual assessment look from a product development perspective? What does that mean? And one real important thing I need to mention is obviously I come from a research and development area, and I just want you to know that we don't use the same definition of research that Hank uses. OK?

So, to begin with, XXX and reinsurance, where have we been? I guess the first quote I saw related to an XXX compliant product was back in July of 1999. So, what's been going on from the reinsurance side? Obviously, first-dollar reinsurance either on a YRT basis or a coinsurance basis; unfortunately, I'm not going to get into a big discussion on offshore reinsurance. That's for other experts, not myself. Second, capital management. This is a similar topic. It comes into play with the additional surplus strain that you have on the deficiency reserves. Third, from a product development perspective reinsurers and consulting firms have been active in designing and assisting in the design of products for XXX, assisting with product filings, and assisting with Actuarial Memoranda.

What else has been going on? Product outsourcing I think has been helpful in dealing with producing XXX-compliant products. This obviously provides "A to Z" for the direct writing company; you'll get assistance in administration, underwriting, and product design. The reinsurers obviously are there to either assist their alliance partners or the affiliates. Mortality assumption setting. Obviously, reinsurers are involved from this perspective. What goes along with that and what went along with that at the outset is assistance in calculating your prospective X-factors, and then, of course, assistance in preparing your Actuarial Opinion and your report.

I'd say what I've really spoken about up to this point is everything that's been going on since last July. I think now the latest topic that you're really going to be hearing about quite a bit, and you've heard a great deal about from both Larry and Hank, is the experience studies component—annually assessing and looking back at your experience. Again, reinsurers can provide assistance in executing your retrospective X-factor analysis and with your Actuarial Opinion and report that go right along with that.

One other thing. Jay asked us to speak to product development or the pricing side, but for a little bit of a valuation flavor I do want to point out one thing. Lloyd Spencer is the one who helped me find this, buried in this letter, Item No. 12. The California Department of Insurance is requesting a copy of the Actuarial Report required by this model if you have business subject to the valuation of life insurance policy model regulation. So, not only will you have to prepare it, but already the state of California was asking that you submit a copy of it, and it's due March 15. So, if you haven't found that in that letter, there's a little aside for the valuation actuaries.

Now getting on to what I hope will be a real live example for you, let's set the stage. The requirements of Guideline XXX, as you've heard now a few times, are to measure your emerging mortality experience for each X-factor class and all X-factor classes combined; to apply your statistical analysis, whether it's Panjer, Monte Carlo, or your normal distribution; to define any future expected mortality as necessary; and then to prepare the associated Actuarial Report and Opinion. So, that's what you need to do. The statistical analysis obviously then begins with setting your null hypotheses. X-factor mortality is consistent with emerging experience in each class and for all classes combined. If there's evidence to the contrary, you need to reject that in all hypotheses. What is the significance level? The discussions we've had with Larry have been that really you should look to your regulators to set that level, and if there's no explicit guidelines the 95th percentile has been suggested.

Now we get to what hopefully will put this all together for you a little bit. Chart 1 represents your probability distribution, of your actual-to-expected claims by number. This one was done by number, and this one was done using the Panjer approach. For each expected class and for all classes in aggregate the actual-to-expecteds run along the y axis, and the percentiles are on the x axis. There's a separate line or separate distribution for each X-factor class and in aggregate.

This distribution was calculated again using the Panjer approach. It is a by-number calculation. The sample block of business underlying these distributions is about 58,000 policies. It represents one year of exposures. Expected deaths, so you can get a feel for what we have here, is about 51 by number and 6.6 million by amount. The average face amounts range

from $40,000 to $150,000. The average size increases by age group. And you can see with the picture that the variance obviously is greater and obviously greater volatility to be expected for the X-factor class that has the fewer number of policies, and that would be the male, age 25. The number of policies in each age group increases with age. So, you can see a tightening of the distribution as you get down to the aggregate.

Again, Chart 1 demonstrates the distribution by number. The distribution amount was also calculated, a very similar pattern except that the probability distribution function has a wider confidence interval because you have the greater variance with the fluctuations that we would have by amount. Everybody got their bearings there? OK.

Chart 2 shows actually the execution of your retrospective X-factor analysis. Along the x axis you can see each X-factor class and the aggregate. The y axis again shows your actual-to-expected by number of claims. So, this relates to the previous chart. The band on the graph represents a 90% confidence interval, and the 95th percentile is the uppermost point within each confidence interval. So, the top of the box is your 95th percentile. For this demonstration you can see that the ratio of actual-to-expected claims is less than 100% because the 100% is this point toward the middle. The ratio of actual-to-expected claims is less than 100% for your select males, age 35, and males, age 55, again by number, but your actual experience for males, age 25 and 65 and in aggregate, was greater than expected. So, they're in excess of 100%. You can also see, though, that those still remain less than the 95th percentile.

For illustrative purposes we intentionally have select males, age 45, who are not only much worse than expected, but they also fall in excess of the 95th percentile. This would imply evidence to the contrary or a cause for rejecting your null hypothesis. The appointed actuary is now expected to redefine future expected mortality.

As an aside, I've mentioned that in this example the amount of increase in expected mortality to get you to move that confidence band to cover actual experience is an increase in mortality of about 16%. What that is by number, is there were about four deaths expected in that category, so in that category you should have expected about five claims because in actual experience there were eight claims. So, that's a pretty significant move there. OK.

Chart 3 is really the exact same graph with just one difference. This demonstrates your actual-to-expected distribution by dollar amount instead of by number, so you can see the broader confidence intervals. In this case actual experience does fall within the 95th percentile by class and in aggregate so that you would accept a null hypothesis in all cases.

Certainly there are many questions that remain, and there'll obviously be quite a bit more debate on those. Which statistical tests should be performed? Maybe the ideal is to perform Monte Carlo and Panjer, maybe looking at those by number and by amount to examine the relationships of actual-to-expected from several different angles. Clearly, though, the rigor is mandatory. As Larry has said many times, no hand waving, and your approach must be consistent from year to year. That's certainly required.

And, as you may have heard already, credibility is clearly not an excuse for not completing the statistical analysis that's necessary. As far as significance level, you may need to look to the regulators or the 95th percentile. As far as aggregation, I'm not sure that that question has

necessarily been answered yet, and we can maybe even talk with Larry about that a little bit when we get to some of the open questions.

Let's get back to the product development actuary in the midst of all this or, in other words, what's in it for me as a product development actuary? What does this exercise of annually assessing your mortality mean for the product development actuaries? Perhaps increased responsibility. Experience studies may currently be performed by the product development area, and the statistical testing will need to be incorporated and performed as a part of the routine experience studies. At a minimum the product actuary will need to sign a reliance statement within the Actuarial Opinion in the cases where the appointed actuary has relied upon the product actuary in establishing underlying mortality assumptions.

Perhaps as a product actuary you've wanted experience studies to be performed on a more routine basis, and XXX requirements might be the additional motivating factor for getting resources committed to the task on an annual basis. And, of course, the work to be done to satisfy the retrospective X-factor analysis can be extrapolated into the product development arena to assist in managing distribution risk, profitability objectives, and product design as well.

Before I close, I just want to mention one thing that I read. The SOA gives you a nice packet when you're preparing a presentation, and they had a fact in there that really struck me, and I wanted to mention that here before I close. They said that 80% of what we've just spoken about will be forgotten by all of you within 2 hours of our discussion, which is certainly disheartening when you think of all the hours that we spent putting our presentations together. It goes on to say that another 10% of what we said will be forgotten by 6 o'clock tonight. So, by 6 o'clock tonight you'll have forgotten 90% of what we've just spoken to you about, and by tomorrow you'll really only remember 1-2% of what we spoke about.

So, with that as a setup, this is what I want you to hang on to by tomorrow is what to do next. Obviously, talk to your appointed actuary. Hank points to a good example. If you're like Prudential and your valuation actuaries are in the other building, you'd better go have a discussion with them about this requirement that needs to be signed off by March 15, 2001. Obviously, what you're also going to need to do is talk to your IT staff and your administration staff, because you're going to have to be capturing this data in the right way to be able to execute the analysis. And, of course, talk to your reinsurer about ways that they can assist in executing and analyzing experience studies and, in particular, the assessment of anticipated mortality each year for Regulation XXX.

Mr. Biehl: We have some time now for questions.

From the Floor: Thank you, Jay. I don't have a question. While people are coming up with real questions, I'm going to offer a blatant commercial. At 2**:**15 this afternoon, Session 81, is a field trip to the Gleacher Center at the University of Chicago, we are going to hear from Robert E. McCulloch, professor of Statistics and Econometrics. He's written dozens of articles and he is a real authority on Bayesian statistics. I think he will talk about applications of Bayesian statistics to direct market or market segmentation.

Mr. Gorski: I guess I'd like to follow up on that comment. In shifting gears from the retrospective assessment to the resetting mode that I'm talking about, I went to a couple of web sites, and there's an organization called the International Bayesian Statistical Association, which I joined. Their dues are only $20. What's kind of interesting is that in other fields, primarily in medical research, there's a tremendous use of Bayesian statistical analysis. There is a free software package called WIN BUGS that comes with 20-25 different examples from the medical research field, and at least a couple of those examples are not too different from the kind of work we do. There was one example dealing with analyzing mortality experience by hospital. That sounds a little bit like the kind of work we do. There were examples from areas close to what's being done in the health insurance area.

So, there are resources out there. I think there's a lot of work that we all need to become familiar with that we can then use in our own work, and I was surprised to hear your comments about that session this afternoon. So, there may be something out there. So, when I started talking about Bayesian statistics an hour ago I wasn't just spouting off. I actually went back to the Transactions and other places, and there's a tremendous amount of work out there of a real practical nature, and that's why I made the comments about the computer technology. I suspect that the papers that were written in the Transactions 18-20 years ago were before their time. They were great ideas, but they couldn't be applied. Maybe now we can apply some of those ideas.

From the Floor: This is for Larry and Tracy. How much can a small company rely on their reinsurance statistics? They may not have written a product before, and they don't have enough significant experience. Can they use reinsurers' experience or do they have to assess their own data?

Mr. Gorski: Well, remember, I took the whole process and broke it into three steps—setting, assessing, and resetting—and I think there's a tremendous latitude at the setting and resetting stage to incorporate reinsurers' data, published data, and your own intuition as to the effects of changes in underwriting. You have a tremendous amount of leeway there, and I don't think any regulator's going to question you on that, but that's where the true-up process of the assessment stage comes in. I view that as assessing in a disciplined way where the actuarial judgments than go into the other two steps. So, look to whatever data you can, anything that you think is appropriate from a professional standpoint, but I'm suggesting that you somehow be held accountable for that through the assessment process.

From the Floor: Tracy, do you keep the statistics by company so that you can help in that true-up process for a small company?

Ms. Choka: No.

From the Floor: What services are you really offering? In general, what are reinsurers doing with regard to the three steps Larry mentioned?

Ms. Choka: First of all, unless we are participating as a reinsurer, on all of your business, we wouldn't have all that data. So, certainly to assist the client company we would need to provide their experience for the year because the statistical analysis, as Larry is alluding to, really applies to your experience for the year, so you would have to look back. So, the reinsurer is

not going to have that unless you're in a first-dollar quota share position where you're getting a percentage of all your products. So, you really wouldn't be in a position to do it without working closely with the client company.

From the Floor: It is a possible reason to reinsure more of your business if the cost is reasonable because companies are going to need that help.

Ms. Choka: That's right.

Mr. Gorski: I'd like to follow up and maybe clear the air a little bit. I don't want anyone to think that in some way we, as regulators, are somehow working with reinsurers and trying to drum up business with them. That's not my motivation at all, and I'm sure that's run through a few people's minds because I've been asked that question already. My real motivation is I believe that the regulatory system as we know it is pretty near broke. I mean it just can't adapt to all the changes that are taking place in the insurance world in the U.S. and across the world, and I think a lot of us recognize that. We'd like to move from where we have been to a new paradigm. Fortunately, or unfortunately, the old paradigm has worked. There haven't been many insolvencies. So, it's very difficult to change what has been—from at least an appearance standpoint—successful. I don't know whether it's pure coincidence or there's any causality between the regulatory environment and the record on solvencies or insolvencies for life companies, but, nevertheless, there is a strong record. So, it's difficult to move from where we have been and where we are now to a new method and model, but I think we have to. I don't think the existing framework is going to work in the future, and to make that step I think we need to incorporate all of these ideas into our professional actuarial work to give everyone comfort that the actuary can do a good job. So, that's my motivation, to move, in a reasoned way, from where we have been to where I think we need to be in the not-too-distant future.

From the Floor: I first started working with deficiency reserves in 1975, and every deficiency reserve regulation has had one minor flaw in it, and that is it ignores lapses totally. So, we're doing this very sophisticated analysis of one factor to come up with something that is justifiable in terms of mortality and totally ignoring the fact that if I have a deficiency 20 years from now, I won't have 100% of my policies in-force. Is there any hope that regulators will take that into account?

Mr. Gorski: I think your comments are very appropriate after what I just said. That's the old model, not looking at lapses. Lapses are considered to some degree on contract reserves for A&H insurance. So, that impediment has been broken at least in that area. And I suspect that at some point in time the issue of lapsation for statutory valuation of life products will be considered, but I don't think it's a barrier that can't be broken down. Every wall can be broken down, but it has to be done in a reasoned way, and if everything goes well in this area, that's another barrier to break.

Ms. Faye Albert: I just wanted to ask for an expansion from Hank Ramsey or perhaps any of the other panelists on the market implications. I thought that Table 1 was really alarming, and I just wonder how companies are planning to deal with all this additional surplus that is going to be necessary.

Mr. Ramsey: I have to admit that what I prepared were assumptions upon assumptions upon assumptions, and so I did not have a good measure of what the industry deficiency reserves will be for this year, but I wanted to pick a series of reasonable assumptions, string them together, and see how far we went. I know that each of us in our direct writing companies strive to minimize their deficiency reserves, and we're doing all that we can within both hopefully the letter and the spirit of the regulation to comply while minimizing. I can't add a whole lot to that example except it's one possible result.

Mr. William C. Koenig: I have first a comment, then a question about the 95th percentile. I think it's one thing to ask an actuary to demonstrate with 95% certainty that the X-factors are adequate. I think it's another thing entirely to ask the regulator to prove with 95% certainty that the X-factors are inadequate. There was some desire on some people's part to have the ASB endorse the 95th percentile assumption. I guess I'd just like to say that it is not the ASB's intention to put the regulator in the position of having to prove with 95% certainty that the X-factors are inadequate. My question for Larry is how would you react to Ms. Choka's example where actual mortality was in excess of what the X-factors were producing, but within the 95th percentile?

Mr. Gorski: First, I'd like to comment on your initial comment concerning setting the parameters for the critical rejection region. I think that is a regulatory function. I liken it to the process that takes place when we adopt valuation mortality tables, let's say the 1980 CSO or the 1958 or the 2000 one that's adopted. Usually the process works like this. A basic table is developed, then experience tables are developed, and then there's interaction with the regulators as to what level margin should be in the table. There may be suggestions or evaluation by the profession of different alternative suggestions, but in the end the margins become a regulatory issue and the regulators decide on what that margin is by adopting a valuation table based on input from the profession and all the work done by the profession as to basic tables. I see the setting of the parameter for the rejection region, whether it be at 75%, 90%, or 95%, as a regulatory decision. I intentionally set it at 75% for that first paper because if I set it at 95%, no one would ever discuss the point, and I was very clear in that. I said I'm setting it here, but in the end it's a regulatory judgment, and that's what I think.

From the Floor: How would you react to Ms. Choka's example where actual mortality was in excess of that produced by the X-factors but within the 95th percentile?

Mr. Gorski: My recollection is that it was within the acceptance region. So, I don't view it as a regulator's decision. I think at that point in time, as long as it is within that acceptance region, it's strictly a professional actuary's decision. In the aggregate it's within. There's one case in the number of claims example, select male, age 45, where the actual claims fall outside of the acceptance region. It falls within the rejection region. Now, it's based on number of claims, which I think is probably a simplistic way of going about the analysis. When you look at the analysis, expected claims or distribution of expected claims based on amount of claims, actual results in every case fall within the acceptance region. So, I don't have any regulatory concern with these results. I would not find it, as an example, where we may reject an opinion or certification because I think the analysis supports the continuation of the existing X-factors.

I think our role here is to set some target, some limits, but there's also an awful lot of professional judgment. If the professional valuation actuary feels that the X-factors were

inappropriate and were set to eliminate or reduce deficiency reserves, then that becomes that actuary's responsibility to modify those X-factors. I don't think this objective test is the end of the analysis. It's not too unlike what takes place with asset adequacy analysis (AAA). We set minimum reserves both for life business and annuity business, and then we ask the actuary to do AAA, and we know that the formula reserves, particularly on the annuity side, miss an awful lot of the realities of the business with respect to lapsation and disintermediation risk, etcetera, and so the professional actuary has responsibilities there. My concern when we went to the X-factor route, and Bill Shriner may want to comment on this, is that I did not want this mechanism for deficiency reserves to disappear completely. When we had the discussion on deficiency reserves I thought unless there was some regulatory discipline on the process the idea of deficiency reserves would just fall by the wayside.

Mr. Martin E. Uhl, Jr.: I want to just repeat the question Mr. Ramsey asked, and I haven't heard it answered, and that is, should we test to see if the factors are redundant and expand on that in the sense that we can lower the X-factor if we determine that they are redundant?

Mr. Gorski: There's probably some hidden agenda behind that question. I'm not going to catch all the nuances. But I see no regulatory impediment to reducing X-factors as long as they meet the constraints. OK? So, if you set X-factors at some level because of concern or lack of certainty over the initial setting, over time I think those X-factors can come down. In fact, the way I interpreted Hank's comment and your question initially about X-factors for redundancy, I see no reason that at some point in time with sufficient evidence that mortality has improved because, remember, the whole process is supposed to be with mortality improvement up to the date of valuation, not beyond, and if mortality improves, there's no reason why regulators can't entertain removing those artificial constraints from the X-factors. So, if you wanted to do the analysis now about evaluating redundancy in the X-factors beyond the floor of 20%, fine, and that's information that we will consider in the future.

Ms. Choka: In the picture that I presented we had a discussion about whether it should be a one-tailed or a two-tailed test. I intentionally left it as a two-tailed test, and you show the confidence interval in both directions. So, we could have also demonstrated a line down below the fifth percentile, and that's why I think product development and pricing really want to be integrally involved in this analysis, because if you start seeing it fall below those, it gives you an opportunity to go through that exercise to perhaps lower your mortality assumptions because experience has demonstrated that it makes sense to do so. So, that was also part of the intentions of that illustration and why it was presented that way.

Chart 1

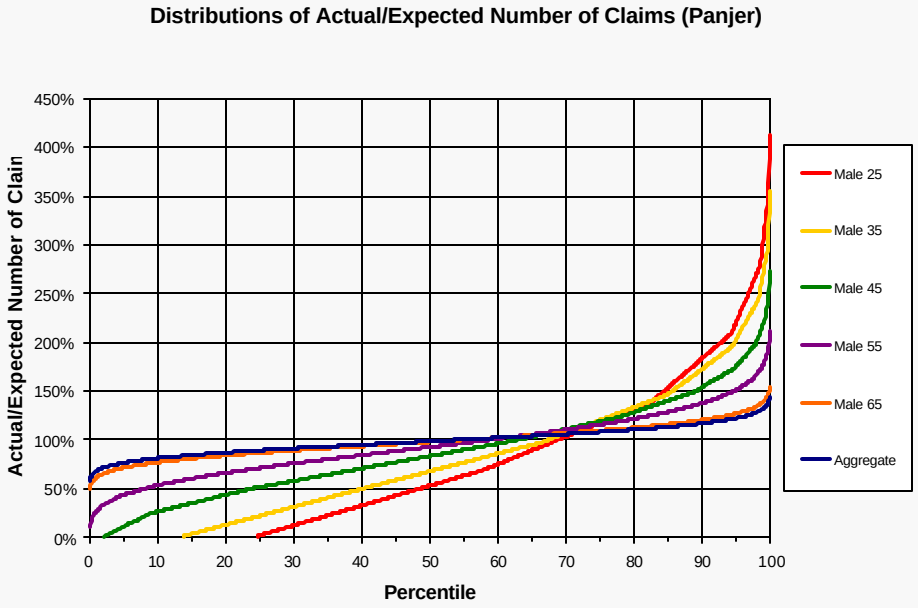

Chart 2

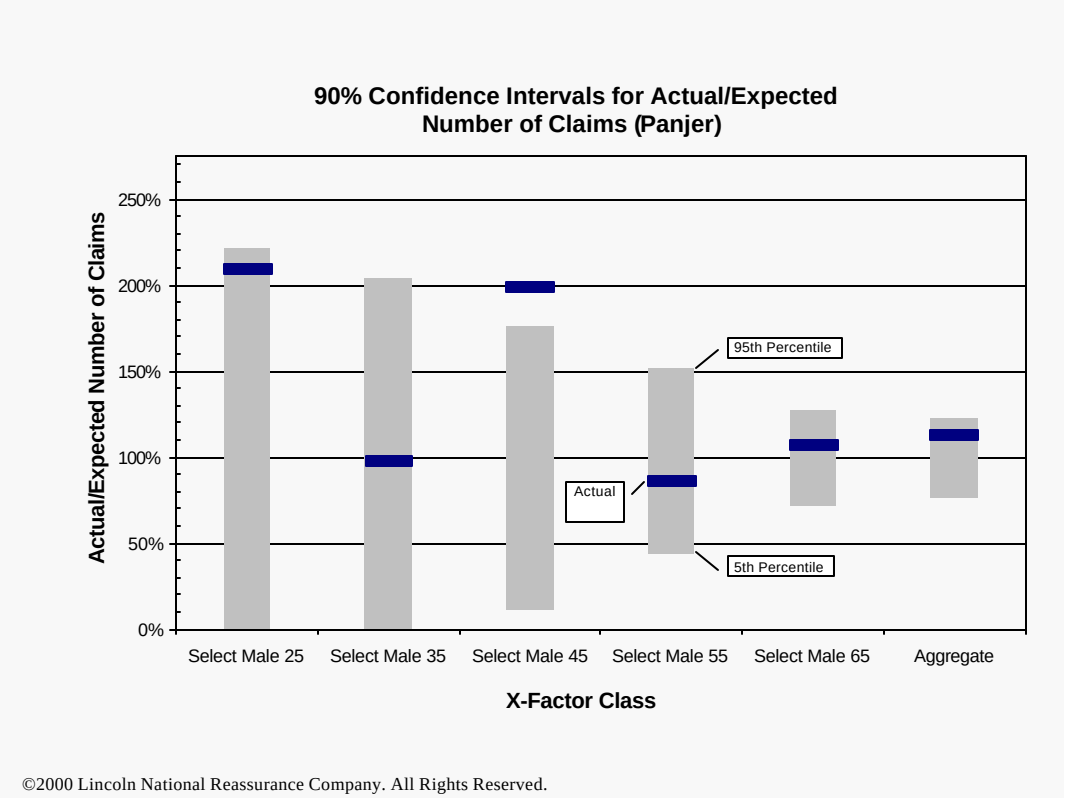

Chart 3