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Mortality and Lapse Rates

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Summary: Panelists discuss the results of two SOA research projects. One project explored the traditional antiselection hypothesis, examined the differences in mortality between companies, and related them to the differences in overall lapse rates. The other project assessed the suitability of models involving random mortality rates in analyzing insured life mortality and developed models for the relationship between mortality and lapse rates.

Mr. John M. Bragg: Our two panelists are Faye Albert, with Albert Associates in Miami, and Bruce Jones, associate professor in the Department of Statistical and Actuarial Sciences at the University of Western Ontario. We have had a lot of interesting times working on this subject of mortality and lapses. As you know, it is an old subject in the actuarial profession. We think we're making some advances and have made some new discoveries about this topic.

Ms. Faye Albert: The study that I'm going to tell you about is the one that was commissioned by the SOA. Jack Bragg and I collaborated on it. The name of the study is "Mortality Rates as a Function of Lapse Rates." It's available at the following Web site: www.soa.org/library/mrlr.pdf. This covers information for 1991 and 1992. It was mortality experience by amount on standard, ordinary policies issued on a smoker and nonsmoker basis. These policies were submitted over a long period of time and comprise quite a lot of data. The volume for durations one through ten was especially substantial. To compare mortality with

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

lapse experience, we segregated the companies into three lapse categories—high, medium, and low—and then studied the mortality for each one of those categories in turn.

I would guess that everybody's familiar with the idea of select and ultimate mortality based on issue date. Select lives are healthy in the early years and the insured, over time, loses the effect of selection as a result of good health wearing off with age. The mortality experience by amount, as I mentioned, was pretty substantial. We had 1.293 trillion exposed and 1.5 billion deaths. We felt that our experience was adequate enough to come to some conclusions.

This data was collected from 13 different companies. The data went back for most of the companies at least 15 years, and we had some ultimate experience as well. We captured lapse information from the companies where we had exposures year by year, and we studied it. The data collected were grouped data, but the information covered over several years. We categorized the companies into three groups according to low, medium, or high lapse experience.

In our own data, the Bragg data, we had substantial differences in the groups of companies for all durations (Table 1). The lowest lapse rate was 11.3%, the medium was 13.9%, and the high was 18.2%, for an aggregate lapse rate over all durations of 14.8%. Segregating duration 1, you can see that there are differences by categories that endured throughout the term of the study. We felt confident that we had been able to isolate the variables we were interested in, which were low, medium, and high lapses. Just to make sure that we had done this right, we compared the lapses in the Bragg study with what would have been the lapse rates for these same companies for A.M. Best. You can see in Table 2 that A.M. Best shows the same progression of low, medium, and high lapses for these companies.

TABLE 1
STUDY LAPSE DATA BY DURATION

	Low	**Middle**	**High**	**Total**
Total	11.3	13.9	18.2	14.8
Duration 1	13.7	14.5	21.6	18.6
Duration 2-15	10.9	13.5	15.9	13.2

TABLE 2
LAPSE RESULTS FOR COMPANIES IN THE STUDY

	Best's 1992 Data % of Industry	**Study Recent Data % Lapse**	**% Lapse**	**% Lapse**
Lapse Category	All Durations	All Durations	Duration 1	Duration 2-15
Low	11.3	13.9	18.2	14.8
Middle	13.7	14.5	21.6	18.6
High	10.9	13.5	15.9	13.2

The paper goes into this more, but we were concerned about making sure that the lapse experience we were quoting was as accurate as possible, so the comparison that we did to Best was just a check for reasonableness. Best's data are not separated by duration and contain other business besides standard ordinary business. In the 1980s, because of replacements, the lapse rates were strange in some of those companies, but we felt that the 1990–94 lapse rates were consistent between the Bragg data and the Best data. Does anybody have any questions about our information and how we got it?

Ms. Susan Benjamin: How did you treat term conversions?

Mr. Bragg: The companies are supposed to keep term conversions under their original designation as to issue date. That's the instruction to them.

Mr. Steven A. Smith: How much of your data came from term insurance after the level premium paying period, where there's a big spike in the lapse rate, as opposed to looking at something where the lapse rate might be a little bit higher? Do you have any data on that? How much of your experience or exposure measures term insurance after the level premium paying period? For example, you have 10-year level premium followed by a much higher YRT, and you have very high lapses at the end of the 10th year. Does your experience segregate that kind of business from all others?

Ms. Albert: Our experience was not segregated by plan. We didn't have any way to segregate it by plan. We didn't believe that there was a lot of term with this type of business in it, but we don't really know that.

Mr. Bragg: By 1991 and 1992, the reentry term phenomenon had really not come on in terms of the 10 years being up yet, so it was not contaminated by that feature.

Ms. Albert: We grouped the companies into lapse categories and then we went on to review the mortality. Table 3 shows how we based our comparisons of actual to expected on the mortality tables that Jack Bragg did. The data was originally split into smoker and nonsmoker, but for purposes of this study, we did not use that split. There are durations by lapse category and a total actual to expected.

One of the things we noticed first was that the ultimate data showed that the actual to expected was very low. We think that is because we didn't have very much experience in this category. Let's concentrate on the first 15 durations where we had more experience. You'll see that the total actual to expected was 95.6%, which is pretty reasonable. Look at the actual to expected mortality in duration one by lapse category. You can see that the low and middle lapse companies had very good mortality all the way through duration five; however, the high lapse companies had very high mortality. After that, in duration six and later, it looks like the distinctions in mortality between these companies that were separated on the low, middle, and high lapse bases, are not very distinguishable.

TABLE 3
ACTUAL TO EXPECTED MORTALITY

Duration/ Lapse Category	1	2	3–5	6–10	11–15	Total Dur. 1–15	Ultimate Data
Based on Bragg 1991 Life Tables							
Total Actual ($,000)	180,618	195,835	676,875	479,006	53,025	1,585,359	50,485
Total Expected ($,000)	202,685	229,943	696,290	469,300	59,425	1,658,188	66,705
Low	77.8%	75.6%	84.7%	100.7%	88.4%	88.6%	
Middle	66.2	63.0	83.5	113.8	90.7	84.4	
High	120.0	110.4	115.2	97.1	9.4	110.5	
Total Act/Exp	89.1	85.2	97.2	102.1	89.2	95.6	75.7%
Based on 1975-80 Select Basic Tables							
Low	68.6%	63.5%	68.5%	78.6%	71.8%	71.7%	
Middle	53.4	49.4	64.6	87.5	70.8	65.8	
High	99.3	86.1	88.0	74.4	78.8	85.6	
Based on 1975-80 Ultimate Basic Tables							
Duration/Lapse type	1	2	3–5	6–10	11–15	Total	
Low	28.1%	31.7%	43.5%	58.2%	58.1%	44.8%	
Middle	22.2	24.9	43.1	70.0	64.0	39.4	
High	44.8	45.8	60.6	59.5	66.6	55.4	
Total Act/Exp	31.8	35.0	50.5	60.6	59.6		

Mr. Bragg: Regarding 113.8% (middle category, durations 6–10), there was a large claim in there that affected that number.

Ms. Albert: This is the information we used to explain what our results meant. Again, Table 3 shows our results. First of all, it appears as though lapses, especially in the earlier durations, seem to be related to mortality rates. The relationship diminishes by about the sixth duration. We were pretty concerned about this 113.8%, and we also were concerned about the fact that the low and middle lapse companies didn't seem too differ much. In fact, the middle lapse companies had lower mortality than the low lapse companies.

One factor that may contribute to an explanation is the average size of policies in these companies. You can see in Table 4 that the average-size policy that was issued for the low lapse company was small, $55,800, compared with the middle lapse company, which was $100,800. We suspect that even though the lapse rates were a little bit higher on these companies, perhaps the people were in a higher socioeconomic group. That may have accounted for the mortality being more favorable.

TABLE 4
AVERAGE SIZE POLICY
BASED ON 1991 EXPOSURES

	Number	Amount ($000,000)	Average Size
Low	3,515,244	196,159	$ 55,800
Middle	1,599,406	161,182	100,800
High	4,018,313	313,576	78,000

Mr. Bragg: Since we did this study, Bragg Associates has come out with a study by policy size group which shows that policies of $100,800 would have mortality that is 14% better than policies of $55,800.

Ms. Albert: That's the study of mortality by amount size only.

Mr. Bragg: As Faye and I both know, we're dealing with a block of real data here.

Ms. Albert: Our results (the coming together of mortality at high durations) were surprising. Many people said if we did a regression analysis, perhaps we would see something different. The results of our regression analysis showed that there was some connection, but with just 11 data points you can't really tell a whole lot. I just want to show you what the 11 data points look like and what the relationship was. Chart 1 displays the companies by lapse rates. These are from low to high increasing lapse rates. You can see that the actual to expected mortality goes up and down. It seems to have an increasing trend, which might be related to the lapse rates, but this is for all durations.

One of the things that we came away with is that even though we had a lot of basic data, we only had 11 companies, so it was difficult splitting it into three groups to distinguish one type of experience from the other. I'm very proud of the work that we did on this study. It's the first time that any study of mortality and lapse experience has been done. The Society has more information; perhaps this will help motivate our researchers to carry on with that data and combine it with this data or do separate studies to see whether our findings are correlated. That's it.

Mr. Bruce Leonard Jones: My presentation today is from a paper that appeared in January 1998 in *The North American Actuarial Journal*. This work was funded by the SOA, so I would like to express my thanks to the SOA.

When I began this project, my objective was to develop a model for analyzing the relationship between mortality and lapses on an individual life basis. I think I've made some good progress on that, but it is ongoing work that I don't consider to be finished at this point. While I would like to be presenting you with a usable model, I can't yet, but I can say that I think I have some interesting ideas that may help you. And I do intend to continue my work on this.

I'll start out with a brief definition of selective lapsation and why it's important. Then I'll talk about why selective lapsation occurs and perhaps more precisely what it is about a group of insured lives that allows selective lapsation to occur. Then I'll present a mortality model, extend that model to the case of a group of lives insured under a life insurance policy, and provide some results from that model.

A fairly simple definition of selective lapsation is that the good risks have a greater tendency to lapse their life insurance policies than the poorer risks. The idea is that the good risks may feel that they don't need the life insurance or may see more attractive options elsewhere in terms of replacing their life insurance policies. This is going to result in a poorer group of persistent policyholders. If we think in terms of good risks and poor risks and the good risks are more likely to lapse, that leaves us with a group of poorer risks. And if this occurs over time, then our group of persistent policyholders is getting worse and worse and we would expect to experience worse mortality at later durations. This is important to an actuary involved with pricing life insurance, particularly in a situation where typical lapse patterns are expected. In a case where it's a traditional product and there is experience on mortality and lapses and we're not expecting anything different, there likely isn't anything special that needs to be done. If, for whatever reason, we're expecting heavy lapses, then we need to think about the impact that the heavy lapses will have on the mortality experience.

What is it about an insured group that allows selective lapsation to occur? I think there are two important ideas here. One is that although an insurer attempts to classify risks, it's impossible to end up with a completely homogenous group of insureds. There's always going to be some heterogeneity and, as a result of that, we have this good risk/bad risk mix within our group and the possibility of selective lapsation. Also, we have the possibility of deterioration in health of some of our insured lives, and if that deterioration is severe enough, we would expect an insured to make every effort to keep his or her life insurance in force. These two ideas are somewhat central to the model that I've developed. As we go along, I'll refer to them.

I'd like to look briefly at a model of mortality, first presented in the demography literature, that allows us to reflect the heterogeneity of a group of lives. If we consider a cohort of lives, all the same age and with each life we're going to associate a positive continuous, unobservable, random variable, which I'm going to call *z*, often referred to as the frailty of the individual. Each individual in the group has his or her own frailty variable, and that frailty affects the distribution of the future lifetime of the individual. I'll let *t* be the future lifetime of the individual. We're interested in the distribution of that random variable *t*, recognizing that it's going to depend on the individual's frailty. The higher the value of the frailty random variable, therefore, the higher we expect mortality to be.

We can define the distribution of that random variable *t* in terms of what's called the survival function, which gives us the probability that *t* is greater than some value. The function *s* of *t* and *z* is the survival function, but it's conditional on the frailty value. From that survival function, we can determine the force of mortality in the usual way. The force of mortality also will define the distribution of the future lifetime of the individual, again conditional on the value of the frailty variable. What we can do next is describe how the distribution depends on the frailty variable. The assumption being made here is that individuals with different frailty values have a force of mortality that's proportional, and the proportionality factor is the frailty variable. Someone with a frailty value of 2 has twice the force of mortality of someone with a frailty value of 1.

The expected value of the frailty variable is 1. We don't really need that assumption, but we're making it so that we can then say that the average individual has force of mortality $\bar{\mu}$ (t). We could, of course, multiply *z* by a constant and divide *t* by the same constant and have exactly the same conditional forces of mortality. We're arbitrarily saying that the average individual has *z* equal to 1. We've now defined this conditional distribution of the future lifetime of the individual, but when I introduced this idea of the frailty variable, I said it was unobservable. We can't actually observe what an individual's frailty value is, so rather than being interested in the conditional distribution of the future lifetime given that frailty variable, we're really interested in an unconditional distribution. We just want to know what the probability is that a randomly selected individual in the group will survive a given period of time. In order to determine that unconditional survival function, or what I'm calling here the "cohort survival function," we need to find the expected value of that conditional survival function. That's where the probability density function of the frailty variable comes in.

From that cohort survival function, we can determine the cohort force of mortality again in the usual way. It turns out that we can show that the cohort force of mortality for values of t greater than zero is smaller than the force of mortality for the average individual. However, at time zero they're the same, but after time zero the cohort force is smaller. The second statement, involving the derivatives of the forces, says that the derivative of the cohort force is smaller than the force of the average individual, meaning that that cohort force of mortality is flatter. This is stating things mathematically, but imagine we have this group of lives, each with different values of this frailty variable, and the ones with the higher frailty variable are dying faster. They have a higher force of mortality, which means that over time the average frailty value of the survivors is decreasing. Since that average frailty value is decreasing, we have a flatter cohort force of mortality than the force that we have for the average individual.

This is a mortality model that allows for heterogeneity within the group. The next thing I set out to do was extend that model to allow for a deterioration in the health of an individual so we can set this into a life insurance context and allow for both mortality and lapse. The way that I've done this is to think of things in terms of a multistate model, in which the model I just described is a two-state model: alive, and dead. The individuals start out in the alive state and eventually move to the dead state. In Chart 2, I'm extending that to a four-state model where the insureds all start out in the healthy state and can move to an impaired state while they're still insured. Over time, we're going to have some of our lives moving to the impaired state, so we'll have a mix of healthy and impaired lives. You can think of this in terms of the selection effect wearing off, so you no longer have a group of healthy lives. Instead, you have this mix of healthy and impaired lives. The individuals can leave the insured group either by withdrawing, lapsing, or dying. However, notice that while there's an arrow from both healthy and impaired to dead, there is only an arrow from impaired to dead and not from impaired to withdrawn. The assumption here is that if insureds enter that impaired state, they will not lapse. They realize that their health is poor and that they have an elevated mortality rate; therefore, they will not lapse their insurance policy.

We can define forces of transition between the states in this model just as we think of a force of mortality. The force of transition is going to be the instantaneous rate of transition between states, and each of the forces depends on the random variable z, which I'm now calling the risk level, rather than the frailty, but it's the same thing. The reason I've switched the terminology is that frailty may not provide the best description, because the individual may be a bad risk for reasons other than being frail. It makes sense that, for the forces of transition from healthy to impaired, healthy to dead, and impaired to dead, we would expect the force to increase with the value of the frailty variable. What I'm saying is that the more frail you are, the more likely you are to die and the more likely you are to become impaired. Just as a start, I'm assuming that we have the same sort of relationship where the forces of transition for different values of the frailty value are proportional, because they were in the earlier mortality model. That is the case for the 1 to 2, 1 to 4 and 2 to 4 forces. We can certainly alter the relationship if we wanted to. This is just a starting point.

In considering the force of transition from healthy to withdrawn or the force of lapse for the healthy lives, I've introduced another parameter to allow some flexibility here. That's this parameter gamma. You can see that if we set gamma equal to zero, then the frailty variable doesn't affect the force of lapse at all. If we set it equal to a negative number, then the force of lapse is inversely related to the frailty value. The more frail the individual is, the less likely that individual is to lapse. That's consistent with this selective lapsation idea. However, I'm also allowing for the possibility that gamma might be positive, in which case we're saying that the more frail an individual is, the more likely he or she is to lapse. I think some of the ideas that Faye talked about might lead one to believe that a positive value of this gamma parameter could be possible. In particular, if we assume that our frailty or risk level variable is correlated with socioeconomic factors, then we might conclude that. Someone with a fairly high income might be better able to keep his or her insurance policy in force and see greater value in having the insurance policy, so we might see a low lapse rate for that individual and also lower mortality. Clearly, we have some added flexibility with this parameter gamma.

Based on this four-state model, we can write down an expression for the cohort force of mortality again. That appears in the paper, but I won't look at that here. For someone who starts out in a healthy state, we can determine what the force of mortality is over time, allowing for the possibility of different values of the risk level variable z, and also for the possibility of movement to the impaired state.

Mr. Paul Margus: Regarding your z constant, where for each person these constants are forever. It doesn't vary with time?

Mr. Jones: That's right. We can think of that as being fixed at birth.

Mr. Margus: Does that also mean that it doesn't vary as people move among the different states?

Mr. Jones: That's right. I didn't use any data at all. I just made some arbitrary decisions about some of the functions involved here. What I've assumed is that the force of mortality is $\bar{\mu}(t)$, so that's the force of transition from the healthy state to the dead state. I've assumed Gompertz Law and I'm looking at an individual age 35 here, so this gives the force of mortality and the force of transition to that dead state at various times in the future. I've also assumed that the force of transition to the impaired state is the same.

If you move to the impaired state, your force of mortality is multiplied by 10. I've assumed that the force of lapse, or force of transition, from the healthy state to the withdrawn state decreases exponentially from 0.15 towards 0.03 over time. Based on this, initially I kept the value of *z* fixed at 1. At first, everyone has the same risk level and we're just allowing for this four-state model to operate. We start the individuals out in state 1, and I'm looking at the ratio of the cohort force of mortality to the force of mortality of someone in the healthy state. Chart 3 has two lines. The dotted line is without lapses, so I've zeroed out the lapses, and the solid line is with lapses. What we see is that we have higher ratios with the lapses than we do without. The reason that both of these are going up is we start out with 100% of the insureds in the healthy state and then over time we have some moving to the impaired state. It's the proportion of the insureds in the healthy and impaired states that determines what this cohort force of mortality is going to be. In the case where we have lapses, and those lapses are all from the healthy state, we have more individuals coming out of that healthy state, which pushes down the proportion of individuals in the healthy state, so we now have a higher proportion in the impaired state and that's why the solid line lies above the dotted line. This is without allowing for any variation in the value of the risk level parameter *z*.

To introduce some variation, we need to choose a distribution to use. A popular choice, one that's been used quite commonly in the frailty literature, is the gamma distribution. It's a two-parameter distribution, with a variety of shapes. The parameters are often referred to as the shape parameter and the scale parameter. We've fixed the expected value or the mean of this random variable to be 1, which means that we can really only choose one parameter and the other one is determined by the fact that we fixed the mean. Assume that we're going to set the shape parameter and allow the scale to be determined. Chart 4 graphs the probability density function for three different values of that shape parameter: 1, 2, and 4. As we increase the shape parameter, the distribution becomes more and more compressed and actually starts to look like a normal distribution. It becomes more and more squeezed the higher we make the shape parameter. What that means is, with a high shape parameter, we have very little heterogeneity. With a small shape parameter such as 1, we have a lot of heterogeneity. By choosing this parameter, we can control the amount of heterogeneity that we want to introduce into the model.

Chart 5 looks again at ratios of the cohort force of mortality to the force of mortality for the healthy life. The alpha is that shape parameter. This alpha equals 1, which means there is quite a lot of heterogeneity. The gamma here is the parameter that determines the relationship between the force of lapse and the risk level variable. You will recall that when gamma is equal to one, we have a positive relationship between the risk level and the lapse rate. When it's negative, we have a negative relationship.

Things are a little bit difficult to interpret now that we've introduced both the healthy and impaired state and the possibility of variability in this risk level parameter. In Chart 3, we were able to think in terms of the cohort force of mortality as being determined by the proportion of individuals in the healthy state and in the impaired state. Now we also have to think in terms of the average value of that risk level variable in both states. That's going to affect the cohort force of mortality as well. It will be the proportion of the healthy and impaired states, as well as the average values of the risk level variable that will affect us. It's a little bit more difficult to come up with some intuition about how these ratios should behave, but one thing that these charts show us is that the variation is fairly significant as we alter the value of the gamma parameter. The behavior of lapses relative to the risk level variable can make some significant differences in mortality.

Chart 5 is for a shape parameter of 1. As we increase the shape parameter, we get less heterogeneity. Of course, as we increase it further, the lines essentially become the same curve.

In summary, what we've shown is that with the multistate model, we end up with higher mortality with lapses than we have when we don't have lapses. Allowing for heterogeneity, we also see some significant differences in the cohort force of mortality, particularly if we have a lot of heterogeneity.

All of the numbers that I used here I made up. I tried to pick numbers that might be reasonable, but they didn't come from data. Of course, to really use a model like this we need to fit it to data. That will be somewhat challenging because we have some qualities here that are unobservable, such as the risk level. Also, I didn't say what I meant by impaired either. We need to determine what this impaired state means, but we probably can't observe individuals moving from healthy to impaired. We don't know when an insured dies whether he or she was healthy or impaired. Perhaps something other than insured life data might have to come into play in attempting to do the estimation necessary to calibrate this model. Also, it may be possible, with underwriting information, to say something or get some idea of what we think this risk level variable is for an individual. It might not be quite as unobservable as I've said.

Some refinements of this model will be necessary and I think there's a lot of room to do that. In making the model more complicated, it also becomes more difficult to come up with reasonable parameter estimates, but it may be that a more complicated model is needed. Or, it may be that just some small refinements are needed to make the model useable. Finally, once one has a useable model, there is certainly a lot that can be done in terms of analysis in order to make statements about the relationship between mortality and lapses.

Mr. Bragg: I am really proud of Bruce's paper. I'm also proud of Faye's. Bruce's paper is an all encompassing thing. It certainly presents the historic selective lapse theory, but it also is sufficiently general that it can apply to the type of information in the other paper. One of the things I really like about it is that he takes heterogeneity into account. People aren't all the same. I think it's a great paper.

Mr. Gottfried O. Berger: I think the fundamental problem is, do insured people actively antiselect against the companies? That is, do they know everything about their health status and does this knowledge of their health status drive them to antiselect?

Mr. Jones: In terms of the model, I think that you're probably right. My assumption is that we have lapses from the healthy state and no lapses from the impaired state is somewhat questionable. We may certainly have some impaired individuals who lapse their policy, and we may have some individuals who don't realize that they have an impairment that increases their chances of death. What I've tried to do is come up with something that may be a little rough but perhaps approximates what's going on. Another possibility would be to introduce two levels of impairment and allow different rates of lapse from those levels. There are certainly a lot of things that one can do other than suggesting that lapses should be completely zero from the impaired state. I certainly recognize that, and it may be that something else is more appropriate than what I've assumed.

Mr. Berger: When you said that the z parameter is unobservable, I guess it has to be unobservable or we would classify the risks according to their z value. Right? It's something that has to be beyond underwriting as we know it. Is that your assumption there?

Mr. Jones: Yes, that's the idea. We certainly might be in a situation where we are observing information and really do believe that insured x has a higher force of mortality than insured *y*, but it may not be practical to put them in different risk classes. Having put them in the same class, we typically disregard the additional information that we have in our analysis. It is possible that we could bring that information back into this analysis.

Mr. Berger: Normally, if I knew somebody was more frail, I would rate him or her. We'd no longer have heterogeneity, if I knew everybody's value.

Mr. Jones: True, depending on how extreme it is. It may be that one individual has somewhat higher blood pressure than the other, but is not substandard.

Mr. Berger: On the fitting parameters, I assume what you mean is that you start out with a select and ultimate table that you got from some data. You also have the lapse table and the lapse experience for the same group. Taking those two tables, you try to guess what some of these parameters might have been that could have generated that guess. Do you then get an underlying mortality table for the various types of states, superimpose a different lapse table, and get a different composite mortality rate?

Mr. Jones: Yes, that's one approach. I've actually spent a bit of time attempting to do that kind of thing with very little success. What I would prefer to work with is seriatim data, where I can actually have information on dates of death and dates of withdrawal.

Ms. Albert: Gottfried, I think your point is very well taken. One of the concerns we had in our study was that we didn't have enough refinement in our data to be able to recognize that once lives became impaired, they would be much less likely to lapse. That distinction needs to be made in doing any kind of analysis of lapse rates. It was definitely a concern. You can see the level of data that we were starting out with. There really isn't a possibility of fitting that data to a model. We don't have information down to the seriatim level yet. This is being collected now by the Society, but we are starting now with grouped data.

Mr. Margus: Do we know of any other studies?

Mr. Bragg: Not that I know of. We believe that Faye's study was the first study made with real data involving lapses and mortality. It could be improved in the future. Other studies like it will be done.

Mr. Stephen L. Kossman: How do you take into consideration, in the antiselection, that the person will lapse his or her policy if he or she is substandard to go on to extended term insurance? In the second paper it would seem that you have a higher degree of impaired people who would antiselect. I think you were unable in the first paper to distinguish between term policies that might have no cash value and term policies with cash value, which I would think would give very different results in what the person might do. It seems that there are two opposing sides of the spectrum—a person who knows he or she is in bad health may either keep the policy in force because of it or consciously lapse the policy because of it.

Ms. Albert: That's an interesting point. I think you're right. Somebody might do that if they were expecting to die shortly.

Mr. Jones: I don't have an answer to any of the questions you asked. One of the things that occurred to me in looking at all of this was that if we did find ourselves in a situation where this risk level variable z is positively related to the lapse rate, that would likely only be over a fairly limited range of values. Certainly, as it became very large, it would need to be negatively related. I think there are some fairly difficult issues related to how an insured will behave when he or she has some knowledge of his or her health. I'm not sure that we can come up with a model that addresses those very well.

Mr. Mark D. J. Evans: In Chart 2 I think there's an arrow missing. I think you need an arrow from the impaired to the withdrawn state. You talked about some of that. I would suggest there's quite a bit of transition from the impaired state to the withdrawn state. Faye Albert saw that in her paper. I think a lot of this goes to the sophistication level of the customer. Once very sophisticated customers become impaired, they're going to make sure they keep their policy in force. I'm not saying that that force or that activity or characteristic does not exist, but I think there's another very large characteristic that does exist: the lifestyle choices that people make that tend to cause high mortality also tend to cause high lapsation. So you have a significant force operating in a different direction. This is going to depend on the socioeconomic status of your marketplace.

To make this a little more concrete, let me give a specific example that should be pretty easy to follow. Let's say that after someone purchases a life insurance policy he starts using cocaine. I think we would all agree that that causes an increased mortality risk and would quite likely put him in this impaired state. But, the financial strains, etc. of being a cocaine user also increase the probability of lapsation. In 20 years of doing mortality studies, I've seen quite a bit of circumstantial evidence that in certain markets for life insurance, in fact, you have correlation between those forces that cause high mortality and those forces that cause high lapsation. I can't cite chapter and verse on this, but I think there was a recent article that came out from the SOA saying that some researchers spotted the same trend with Society data. In conclusion, this whole concept is an interesting theory, but I think it needs to be expanded and tested against data to see if there's some validity to that or not.

Mr. Bragg: Very interesting comments indeed. Faye's paper has a socioeconomic explanation, which is that the lower socioeconomic portion of the insured group has higher mortality and higher lapsation. From the viewpoint of Bruce's paper, they would be impaired and in that upper right-hand box in Chart 2, but some of them may escape to the lower left-hand box. We will now ask Dr. Irwin Vanderhoof to make some comments.

Dr. Irwin T. Vanderhoof: I would like to speculate on the answer to my good friend Gottfried Berger's question as to whether antiselection actually occurs. My speculation is that the right answer is the worst possible answer, and that is sometimes. That's the worst possible answer because it means that the parameters are not stable. Why should the parameters not be stable? When HIV started, if people had HIV and were starting to come down with AIDS, they had to do anything they could to raise money to continue to live for whatever period was possible, so they'd cash in their life insurance. When viatical settlements became more popular, suddenly they took the reverse route by selling the policy to a settlement company. Suddenly, the lapses vanished. This question of selection against the company on lapse is going one way or the other, depending upon the cultural circumstance.

In addition, if you had real smart agents, at least in my day, they used to come around to their clients and say, "You're healthy, I can get you a term policy that's cheaper." The agents would troop around from company to company every four or five years, take all their healthy policyholders with them, and leave the sick policyholders with the last company. It has changed since the companies have clamped down on this sort of behavior on the part of agents. Depending on the cultural and business mix, high lapses can mean high lapses of healthy people. It can also mean high lapses of unhealthy people and those conditions probably change every 10–20 years. As to previous examples, look at the pools of CMOI's. For a long period, they'll behave with relatively stable prepayment rates. Then all of a sudden there's a big change in the interest rates charged on mortgages and the behavior changes in a rational fashion. Usually it suddenly jumps off a cliff, rather than changing nice and gradually. The same thing is true with policy loans. Policy loans went along as a nice way to make a little money for companies, then interest rates changed and very suddenly the number of policy loans went up rapidly. All I'm saying is that the answer is probably "sometimes" and it needs to be watched because it's probably not stable.

Mr. Andrew D. Smith: I don't think I heard Faye mention specifically in her portion of the presentation that the middle lapse rate group had the best mortality, if I'm not mistaken, over the whole range of durations. I noticed that the face amount was considerably larger—it was $100,800 in the middle lapse group versus $55,800 in the lower lapse group. To me it seems that it would be simply a question of more underwriting. If you have higher face amounts, get more underwriting. Then you will have lower mortality. I'm curious if you agree with that. Second, given all the data, 1.2 trillion exposed, maybe you could just come up with another parameter grouping by policy size. You could then throw out that underwriting factor because presumably you'd have about the same amount of underwriting for the same policy size. I think that would shed additional light on this topic.

Mr. Bragg: We do agree with the point you're making. The middle lapse rate group of companies are in policy size group 5 of the Bragg Study by Policy Size Group. The lower lapse group companies are in group 4. The middle lapse companies would have 14% lower mortality for that reason. Better underwriting, yes, but a better socioeconomic group as well. It would be better if we could sort these things out as has been suggested, but you have to do what you can with a block of real data and try to understand it. All three of them end up in the high durations with about the same mortality.

Mr. Thomas E. Rhodes: First of all, I'd like to thank Faye and Jack for their paper. It has spurred the Individual Life Insurance Committee to do a study on the seriatim data from 1990 to 1995. Now that the 1985–90 basic table is done, I think the 1990–95 basic table will probably precede the lapse study, but it's still an excellent paper. I wanted to comment further on the $100,800 face amount on average in the middle lapse rate group. Since the period was 1990–91 and there was a lot of high mortality in the early durations, could that be due to the presence of AIDS deaths in the early durations in the other categories?

Mr. Bragg: Certainly there were AIDS claims in it. You're wondering whether there were more AIDS claims in the high lapse group than in the low lapse rate group?

Mr. Rhodes: Yes. Assume that $100,000 is the typical blood testing amount. Recall that the middle lapse rate group was averaging of $100,800 and both the lower and higher lapse rate categories had lower average face amounts. It strikes me that in the period of 1990–91 you could have lower average size category policies not being blood-tested and, therefore, have higher AIDS claims just due to the fact of the lower in face amount.

Mr. Bragg: I've thought a lot about that and don't believe that it influences it all that much. I think all three groups have AIDS claims in them. The companies were sending us their AIDS claims, so I know they all had AIDS claims in them. The blood testing, which really started about 1989, and even later for some companies, was only for $100,000 and over. Is that right Tom?

Mr. Rhodes: Yes.

Mr. Bragg: I don't think it really affects the results of this study very much. You were talking about 1991 and 1992 experience here. As we have studied since then, the blood profile work has had marvelous results.

Mr. Rhodes: I just think we all noticed in 1990–95 a great decrease in mortality because of, I believe, the blood testing and its antecedents.

Mr. Bragg: Please refer to Table 5. I did this comparison of overall mortality, year by year, going all the way back into the early 1970s, with a lapse index. This lapse index comes from Best's lapse rates. It seems to me that since this is a discussion about mortality and lapse, this is a good thing to look at. This doesn't have anything to do with separating companies into high, medium, and low lapse rate groups, etc; it's just a simple overall comparison of what has happened. The mortality has gone as a percentage of the 1975–80 basic. It was 76.6% in 1989, 76.3% in 1990, and 76.7% in 1991. Then it dropped dramatically to 71.4% in 1992. Why? It's partly due to that blood profile thing, don't you think?

TABLE 5
COMPARISON OF MORTALITY AND LAPSE EXPERIENCE

	Overall Mortality (% of 1975–80 Basic)	Lapse Index (1993 = 1.000)
1970–75	121.0	
1975–80	102.3	
1980–85	88.1	
1986	80.8	
1987	80.9	
1988	81.9	
1989	76.6	1.471
1990	76.3	1.320
1991	76.7	1.214
1992	71.4	1.128
1993	71.7	1.000
1994	72.5	.847
1995	70.8	.878
1996		.817

Source: Mortality/Aids/Persistency Reports, Bragg Associates, Inc.
Best's Review

Mr. Rhodes: Yes. I agree about that drop in the early 1990s. It would depend on companies starting blood profiling earlier and other companies by necessity catching on. I would concur with that.

Mr. Bragg: It is partly that blood profile. In 1995, it is the lowest of all. In 1987, it was 80.9%, and then it was 81.9% in 1988. Then it dropped to 76.6% in 1989. Some blood profiling had started by then.

Mr. Rhodes: I'd point out that, in addition to the blood profile knocking out the AIDS claims, it did take some period of time for the underwriters to adjust and realize the wealth of additional data that they had. That could be the reason for the first drop in 1990, but this is speculation.

Mr. Bragg: The blood profile and the underwriting are an awfully big part of it. Look at the lapse index. It's really way down. There was a slight uptake in 1995, but then it went back down again. I don't have the lapse index numbers for the early 1980s, but I would expect they might be pretty close to 2. Back then, a tremendous amount of rolling over of business was taking place. It was amazing.

Mr. Rhodes: Your paper did show a correlation between lapse rate level and general rate of mortality, and this supports that.

Mr. Bragg: Yes. This supports Faye's and my paper definitely, because it shows there is a connection between the two in an overall general way.

Mr. Rhodes: I would question the lapse index and how much of that was universal life (UL) business and how lapses are measured on UL business. That is just a question I have about the lapse index in general.

Mr. Bragg: These are from the Best results and you know what its formula is like. We have the Best formula in the paper. It's lapses divided by the previous years in force plus new business.

Mr. Rhodes: True. How do they handle a lapse?

Mr. Bragg: I can tell you how we handled the lapse numbers that came from the data in the paper. We used our own lapse rates for study purposes. We only used the Best lapses to corroborate that we were putting the companies in the right groups. To get our lapse rates, we compared the business in force from one year to the next. This meant that for UL it would stay in force as long as there was any funding to keep it in force. It has nothing to do with anybody paying premiums; it has to do with business going off the books as UL would do when it runs out of funding.

Mr. Rhodes: An alternate definition of lapse for UL would be failure to pay the target premium or failure of the sum of premium payments to exceed the sum of target premiums. That's the definition I would use in a pricing setting. If you had more and more content of UL, where the lapse was only counted if the cash value was insufficient to cover the cost of the monthly deductions, that would tend to lower the lapse index.

Mr. Bragg: Yes. We were quite pleased with the way we were measuring lapses because it had to do with business going off the books, and thus out of the mortality exposure.

Mr. Rhodes: I would concede your point about your study being more accurate than the Best study.

Mr. Bragg: I have one last visual aid. Table 6 doesn't have anything to do with lapses. It compares the percentage who smoke and mortality. You see how the smoking percents have come down. Everybody knows that, of course. For males, it went from 40.8% in the early 1970s to 19.3% in the 1990s. This information is for company new issues. Isn't it amazing what has happened to the mortality? I believe it has a lot to do with the fact that people quit smoking.

TABLE 6
COMPARISON OF SMOKERS TO MORTALITY
AS A PERCENTAGE OF 1975–80 BASIC

	Percentage Who Smoke		**Overall**
	Male %	**Female %**	**Mortality**
1970–75	40.8	34.2	121.0
1975–80	40.4	30.7	102.3
1980–85	25.7	26.2	88.1
1986–90	20.5	18.2	79.3
1991–95	19.3	17.4	72.5

Source: Mortality/AIDS/Persistency Reports, Bragg Associates, Inc.

Mr. Rhodes: Given that the level of smoker mortality to nonsmoker is in the 1.9–2.1 range, you're correct.

Mr. Bragg: Right. You have to get into the details of the right-hand column to find out how all the bits and pieces change. I believe that a lot of the recent drop is because "quitters" have "quit" longer than was the case in the 1980s. As some of you probably know, I'm on a 2000 CSO crusade these days. Mortality dropped from the late 1980s to the early 1990s from 79.3 to 72.5. That's my case for basing 2000 CSO strictly on data for the 1990s.

CHART 1
LAPSE RATES VERSUS LOSS RATIOS

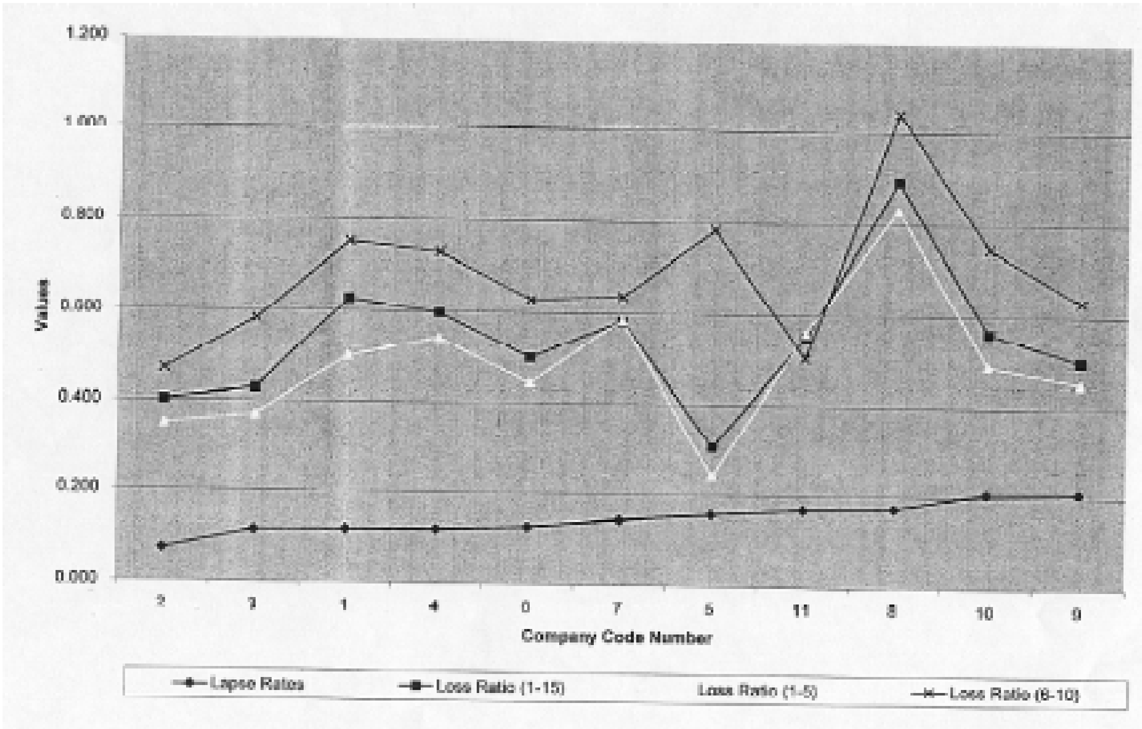

CHART 2
EXTENSION OF THE MODEL

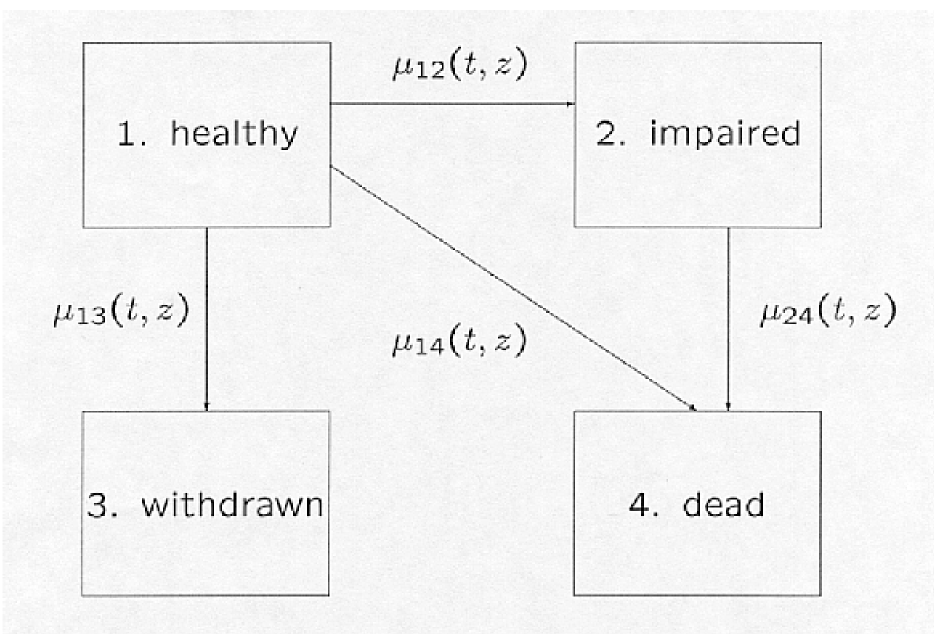

CHART 3
RATIO OF $\bar{\mu}(t)$ TO $\mu_{14}(t)$

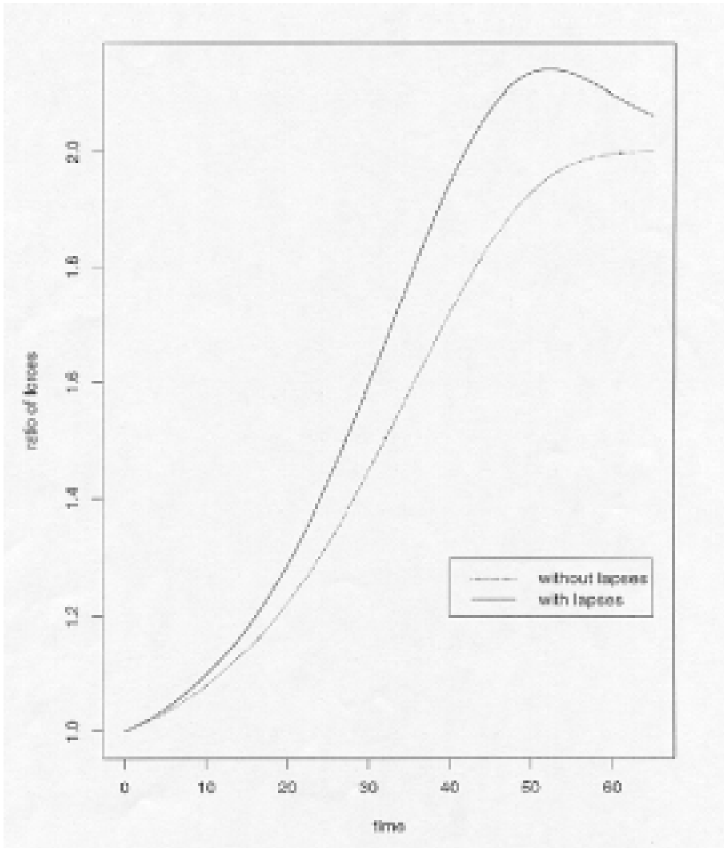

CHART 4
GAMMA PROBABILITY DENSITY FUNCTIONS

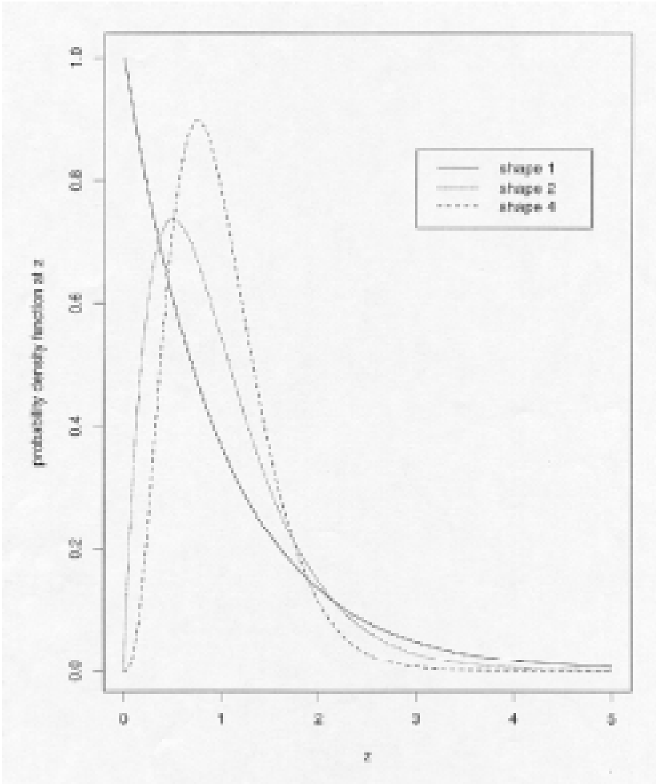

CHART 5
RATIO OF $\bar{\mu}(t)$ TO $\mu_{14}(t)$
WITH HETEROGENEITY ($\propto = 1$)