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# PROJECTED ANNUITY/PENSION MORTALITY

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1. Considering mortality and other factors, should projected mortality be used for active lives and/or retired lives in:
   a. Individual and group annuity statement valuations?
   b. Pension fund valuations?

2. What techniques are suitable, practical or useful in recognizing future improvement in mortality?

3. Projected mortality vs. Actuary's Opinion.

4. Should valuation mortality tables be updated frequently? How often? How can the need for updating be recognized?

This session will include discussion of the paper, «The Application of the Commissioners Annuity Reserve Method to Fixed Single Premium Deferred Annuities» by Jay M. Jaffe.

MR. ROBERT J. JOHANSEN: The 1983 Table a, like its predecessors, is a static table reflecting probable 1983 annuitant mortality with a 10 percent loading. The loading is intended to provide for variations in mortality levels from company to company, not to cover future mortality improvement. Yet mortality improvement is almost certain to occur after 1983 and Projection G indicates about 2 percent a year at the financially important ages.

The purpose of this discussion is to explore the need for using projected mortality, where the mortality rate depends not only on age but also on the number of years after, say, 1983, in which the age is attained. Thus, the projected mortality rate at age 75 in 1993 would be given by $(1 - \frac{s_{75}}{100})^{10} \cdot q_{75}$ where $s_{75}$ is the annual improvement rate at age 75 expressed as a percentage.

In our discussions, we must keep in mind that mortality is not the only factor; interest is important and, in pension valuation there are other factors too. Perhaps projected mortality does not have sufficient impact to justify the complication. Perhaps it does.

In order to provide a few points of reference some annuity values were calculated on 1983 Table a with Projection G and compared with unprojected values. They appear in the following table.

Effect of Projecting Mortality

1983 Table $a$ with Projection Scale G - Base Year 1983

| | | Unprojected Annuity $\ddot{a}_x$ (1) | Projected Annuity $\ddot{a}_x$ (2) | Ratio (2) ÷ (1) (3) |
|---|---|---|---|---|
| Male 65 | 7% | 10.265 | 10.566 | 1.029 |
| | 9% | 8.999 | 9.204 | 1.023 |
| Male 75 | 7% | 7.867 | 8.094 | 1.029 |
| | 9% | 7.130 | 7.301 | 1.024 |
| Male 85 | 7% | 5.450 | 5.566 | 1.022 |
| | 9% | 5.097 | 5.193 | 1.019 |
| Female 65 | 7% | 11.246 | 11.589 | 1.030 |
| | 9% | 9.734 | 9.958 | 1.023 |
| Female 75 | 7% | 8.868 | 9.149 | 1.032 |
| | 9% | 7.948 | 8.155 | 1.026 |
| Female 85 | 7% | 6.041 | 6.192 | 1.025 |
| | 9% | 5.615 | 5.738 | 1.022 |

With interest at 7%, an annuity due at male age 65 was 10.548 with projection, or 2 3/4 percent more than without. At age 75 the projected annuity due was 8.089 with projection or 2.8 percent more than without. At 9% the male 65 annuity was 9.190 or 2 percent more and at 75 it was 7.298 or 2 1/3 percent more. On the other hand, the projected annuity at 9% was 10 1/2 percent less than the 7% unprojected annuity at age 65 and 7.2 percent less at age 75.

The table indicates a similar relationship for annuities on female lives at ages 65 and 75.

The first speaker, Jay Jaffe, is a consulting actuary with his own firm. He is a member of the Academy and CAPP and is an FCIA and an Enrolled Actuary. His specialty is the development and implementation of marketing programs for insurance companies.

In addition to his current paper, «The Application of the Commissioners Annuity Reserve Method to Fixed Single Premium Deferred Annuities», he has authored articles on marketing for Bests and a National Underwriter article on Pricing Direct Response Products. He will present his paper first and then discuss the subject of projected mortality for individual annuity valuation.

The second speaker is Scott McClester, Vice President and Assistant Actuary in Prudential's Group Pensions Office. He is involved in a variety of actuarial tasks including Annual Statement valuation, earnings analysis and tax analysis.

Scott is a member of the Society's Committee on Annuities chaired by Bob Chmely. That Committee has been working with the problem of developing a new Group Annuity mortality table for valuation and is currently working on an interim table to replace the 1971 GAM. He will talk about projected mortality for group annuity valuation.

Paul Jackson, a member of the Board of Governors, is the third speaker. Paul is at the Wyatt Company in Washington where he is a consultant for some of the largest corporations and employee benefit plans. He is also a member of CAPP.

Paul has authored many papers including «Non-Insured Pension Mortality - The U P 1984 Table», and «Mortality Rates under Non-Insured Pension Plans in the United States of America.»

Paul Jackson's remarks will cover the place of projected mortality in pension plan valuation in the light of the many factors which must be accounted for.

MR. JAY M. JAFFE: The paper that I wrote about deferred annuities has been distributed for quite awhile. I wrote the paper to try to answer questions about a subject for which I hadn't found any clear answers. As I am into the area, I discovered I really wasn't fulfilling my objective. As usual I was creating more questions in my mind than I was answering. My purpose there and now was more to establish a framework for discussion about the subject of annuities under the Commissioners Annuity Reserve Method than to find definitive answers. I hope that we will have this discussion later on.

I also learned that there were 50 answers to the problem that I was raising . . . one for each of the 50 states. So that didn't solve anything either.

It was fun writing the paper and a lot of work. I encourage all of you, if you have something on your minds, to take the time and do set it in writing. The Society needs your contributions. Publishing a paper is a long process to go through with the Society and its committee, but it is very educational. I can attest to the fact that they have some very critical readers, and they do a very fine job.

Since the writing of the paper, which is about 1 1/2 years old, the topic that I wrote about is probably of less interest than reserving for the more current product which is variable annuities. I anticipate we might also have some discussion about variable annuity reserving.

Finally, the topic of individual annuity reserves under the Commissioners Annuity Reserve Method is certainly a dynamic subject. Whatever answers or conclusions that we think we have down pat today are certainly not going to be the answers and conclusions of tomorrow.

There were five written discussions of my paper and they will be published. I am grateful that these actuaries took the time to read and review my paper. The discussions cover two general areas.

The first was the bail-out or window provision. This is the provision which allows the annuitant to surrender a policy without penalty if the company's declared interest rate drops below a predetermined rate or window. I found

that the discussants had more than one opinion as to what should be done. Secondly the reviewers all consistently brought up the need for actuarial judgement to be applied in reserving annuities, and I very much concur in this feeling. Each actuary must review the particular policy provisions and his or her entire corporate picture before selecting an annuity reserving method which is appropriate for the annuities issued by the actuary's company.

Putting that aside, I was picked to lead off with my other hat to talk about individual projected annuity mortality and its effect. The topic of this session didn't get my blood running when Bob first contacted me to be part of the panel. As an actuary, I have always understood the need for adequate statutory statement reserves but have never been faced with an actual situation which required consideration of the adequacy of reserves for immediate annuities involving life contingencies.

By number there really are very few companies which have a significant volume of annuities (especially individual annuities) in the pay out stage and involving life contingencies. But being a good panelist, I accepted my assignment and began to research the subject to discover if I had been overlooking anything.

The actuary's opinion which must be part of every Annual Statement requires the actuary signing the statement to be certain that the statement reserves

> «make a good and sufficient provision for all unmatured obligations of the Company guaranteed under the terms of its policies.»

In order for statutory immediate annuity reserves to meet the test, the reserves must be adequate to cover:

1. Future payments, and

2. Expenses

Because statutory reserves do not incorporate specific expense provisions, the statutory mortality and interest assumptions must include sufficient conservatism to be able to handle future expenses associated with paying the periodic benefits.

In recent years there was no question in most of our minds that benefit paying annuity reserves were adequate because interest rates have been high and statutory valuation rates relatively low. The typical valuation rate was 7 1/2% while companies were earning well above 10% on new funds received.

To illustrate the adequacy of these reserves for a $5,000 annual annuity, assume the cost of maintaining the annuity is $50 per year, the valuation rate is 7% and the company is actually earning 11%. The adequacy test might look like:

| | | |
|---|---|---|
| 1. | $\ddot{a}_{65}$(1971 IAM, 11%) | 7.751 |
| 2. | (5000 + 50) x (1) | 39,143 |

| | |
|---|---|
| 3. $\ddot{a}_{65}$(1971 IAM, 7%) | 9.832 |
| 4. (5000) x (3) | 49,160 |
| 5. Adequacy = (4) - (2) | 10,017 |

But the recent changes allowing the maximum statutory interest rate to be a more realistic rate have changed the picture completely. No longer does an actuary have the luxury of not testing the adequacy of benefit paying annuities if higher valuation interest rates are employed.

For 1982 the maximum valuation rate for newly issued single premium immediate annuities will exceed 13% according to California Department of Insurance Bulletin 82-3.

At high rates of interest the choice of a valuation mortality table is important but any change in the interest earnings will have far more impact on company solvency. Suppose we have a choice of using either the 1971 Individual Annuity Male Mortality Table or the comparable 1983 Table *a*. The percentage differences at similar interest rates are really quite small:

$\ddot{a}_{65}$

| Interest | 1971 IAM | 1983 *a* | $\frac{1983\ a}{1971\ IAM}$ |
|---|---|---|---|
| 5% | 11.332 | 11.918 | 1.052 |
| 7 | 9.832 | 10.265 | 1.044 |
| 9 | 8.670 | 8.999 | 1.038 |
| 11 | 7.751 | 8.008 | 1.033 |
| 13 | 7.012 | 7.218 | 1.029 |

In contrast, look what happens if the 1983 Table *a* is used but actual interest earned is less than 13%:

$\ddot{a}_{65}$

| Interest | 1983 *a* | $\frac{1983\ a}{1983\ a\ @13\%}$ |
|---|---|---|
| 5% | 11.918 | 1.651 |
| 7 | 10.265 | 1.422 |
| 9 | 8.999 | 1.247 |
| 11 | 8.008 | 1.109 |
| 13 | 7.218 | 1.000 |

Just a 2% drop in interest rates is more important to the solvency test than changing mortality to the 1983 Table *a* from the 1971 IAM.

The impact from using a more modern mortality table also depends on the maturity of a company's block of business. At attained ages through 80, the results are very similar to those I have presented. But above age 80, the 1983 Table *a* provides significantly greater margins over the 1971 IAM.

The message from this observation is that an actuary must not only compare individual valuation factors but must also test the reasonableness of the adequacy of reserves by examining his company's actual block of business.

At a recent Society Meeting in Montreal I was part of a panel discussing single premium deferred annuities. All of the panelists agreed that it is necessary for a company to have an investment policy consistent with the manner in which it credits interest to the SPDA's.

The same point is relevant to immediate annuities. A company which is offering competitive single premium annuity rates cannot invest the premiums in short term assets which are subject to fluctuating interest rates if it intends to minimize its risk of doing business.

A new type of single premium immediate annuities has come into use recently. The structured settlement annuity is used to pay benefits arising from a judgement against an insurance company. One of the incentives for using an annuity is that the casualty insurer which bears the ultimate liability can use a lower settlement value by purchasing an annuity from a life insurance company rather than posting the non-discounted value of future payments on its books as the liability.

In many structured settlement annuities the annuitant is a substandard risk. Each of these cases is carefully underwritten and bidding among a small group of carriers is the usual way such annuities are purchased.

The dollar volume of these structured settlement annuities is growing and the relative importance of these annuities on reserves may be significant in a particular company. Keep in mind that million dollar plus settlements are very common today so even a few annuities can represent large dollars of reserves.

The actuary should be concerned about mortality improvements when evaluating the adequacy of structured settlement reserves. Is there the possibility that greater mortality improvements will occur among substandard than standard lives? If so, an actuary whose company is active in the structured settlement market and which values such annuities at the maximum statutory current interest rate will have his work cut out before signing the actuarial opinion of the annual statement.

We have seen a large increase in annuity sales in the last decade. While much of the premium volume has been for single premium deferred annuities, many of these contracts will ultimately mature and be turned into benefit paying annuities. Thus, the adequacy of reserves for premium paying annuities is predicted to become more important over time.

Another type of annuity which has also been growing in importance is the variable annuity. As long as the mortality element is guaranteed, these annuities have many of the same reserve considerations as traditional fixed payment annuities.

If I were signing the actuary's opinion for a client with a material volume of benefit paying annuities --- either group or individual, I would make an adequacy test at least every few years. If my reserves needed strengthening, I would not wait for a new statutory mortality table.

Statutory mortality tables could easily be projected to the current year for each year's valuation. This would create a few complications for actuaries and regulators but none that would be insurmountable. This process would mean, in effect, that actuaries would be trying to maintain a certain mortality margin in annuity reserves regardless of year of issue.

Would the use of projected mortality tables for annuity reserves be acceptable to the IRS if it becomes a common practice? If an actuary periodically upgrades company's annuity reserves to recognize mortality improvements, the reserve strengthening would probably be absorbed over 10 years rather than all at once.

There is no question about the need for adequate annuity reserves. But what margin is adequate? This is not a question which has been answered nor is it likely to ever be clearly answered.

As I said earlier, what once appeared to be a very dry topic has actually turned out to be very interesting. My preparation for the panel has been personally very educational. I will be very interested in hearing the audience's comments and opinions.

MR. ROBERT S. MC CLESTER: As Bob said earlier this morning, I am going to be talking about mortality from the viewpoint of annual statement valuation for group annuities.

Concerns about mortality assumptions have been growing during the last few years on both a company and an industry basis. Several insurance companies have seen their mortality gains eroding and, in fact, producing statement losses. Generally this is a slow process. Many companies will strengthen the reserves on their own but some will not. On an industry basis the NAIC became concerned with the passing of the dynamic valuation law. As Jay was saying, much of the interest margin was removed. The NAIC felt any mortality margins should be examined closely, and two groups were appointed to study this issue. Bob's group came up with the 1983 Table a and, for group annuities, we have just recently come up with a draft that has been submitted to the Society. Due to a scarcity of up-to-date group annuitant inter-company data, we relied heavily on population data, other insurance data and data from a few companies with annuitant experience.

With this as background, I am going to discuss the topics on the agenda as they relate to statutory valuations for insured group annuities:

Should projected mortality be used?
What techniques can be used for projections?
When should mortality tables be updated?

The first question is whether projected mortality should be used in group annuity statement valuations at all. The key point is whether the current tables are still conservative.

There is evidence from all sources that people are living longer. This seems to be true for virtually all parts of the population, not just insured lives but the general population as a whole. Current tables were built by projecting smoothed experience data to some present time and adding a margin. One result of that is that generally data is three to four years old before it is even used for the table. The other result is that use of a static table is heavily dependent on the adequacy of that margin; the longer you go from the time the table was produced, the more that margin becomes eroded.

Looking at the 1971 GAM margins we can judge how conservative it has been. For males the margin in the table is 8%. Based on available experience that we came up with on our studies, this margin was eliminated by about 1976. For females the margin was 10% and was probably eliminated by about 1977. So you can see if you just look at it purely from a mortality standpoint, projected mortality of some kind should be used. Longevity has increased significantly, especially since the mid 1970's. In our studies it appeared that around 1975 was a breakpoint in which there was a real improvement in mortality that extends through the current time. Improvements are expected to continue. Note, however, that caution is necessary in designing a projection scale. How long is this improvement going to continue? Will it continue on the same level? That is really anybody's guess. The 1971 GAM recommended Projection scale D. Even using this scale the margin for males was eliminated probably by the end of 1981 or sometime during 1982. So it appears that, again, viewing it purely from a mortality standpoint, there is a need for using some kind of projection, and definitely a need for a new table. A new static table, of course, is not the final solution. Any static table will become outdated at some time. We could even go as far as to design a dynamic mortality table which would change every year. However, experience is not up to date enough to allow this on other than some approximate basis.

Some practical factors make compulsory use of projection scales more difficult. There are systems complexities; it makes the entire valuation process more difficult. Also, switching to a projection scale will involve some surplus strain, but as Bob's figures show, this strain is generally in a 2 to 4% range for the interest rates that may be involved. The other argument against use of projected mortality is that with the present high interest rates the effect of mortality is not as great. Generally, there is going to be some interest margin and the effect of the mortality is not nearly as great as the interest factor in the calculations.

The second area that I'm going to discuss is to mention three methods of recognizing future improvements in mortality. The first is just using some type of straight age rating. Ages could be graded back by some constant amount and this is very simple to administer. This recognizes future mortality improvement only to a limited extent. In effect you are creating a new static table that can be used for some time; you create more margin. The problem with this method is that the change in mortality rates is not usually this consistent. Mortality improves at a different degree at different ages.

The rating could be changed depending upon the age, similar to a generation rating scale which is the second way that I have designated to recognize a change in mortality. In generation rating, the age rating varies depending upon the year of birth. Rating will vary each year for particular ages.

This becomes a little harder to administer but perhaps it becomes more accurate. Again, this recognizes future mortality improvement only to a limited extent. In effect a new static table is created each year and, again, you don't really reflect future improvements after that point in time.

The third method is through some type of projection scale - you assume a percentage decrease in mortality rates each year since some base year. The percentages can and usually do vary by age. This is probably the most difficult to administer from a systems viewpoint but it is the most accurate, again, depending upon the accuracy of the projection scale being used.

The third point that I want to address is how often should mortality tables be updated? Changes occur relatively slowly and there is no real need to react too fast. In addition, a detailed study is quite time-consuming. Generally, you need at least five years of reliable data to be able to construct a good table. So you have to wait for trends to emerge. The best procedure is to conduct annual experience studies. Each annual study would be evaluated compared to previous studies, and as trends emerge and it is obvious that margins are becoming eroded, construction of a new table will become necessary. However, the Group Annuity Mortality Committee has not been able to produce studies since 1975, mainly because companies have not been able to contribute for one reason or another. It has generally been a low priority item in most companies. They don't have the time or the manpower to give us experience data. Companies are also going away from traditional purchased annuity products. So there has been more of a limit on the amount of data we can assemble. We should begin collecting data from non-traditional sources and on non-purchased annuities if different companies can contribute that kind of information. If anyone has any recommendations for different sources of pension mortality, we would be glad to receive that. In addition, if anyone would like to contribute data for their company, we would be glad to receive that information.

In conclusion, theoretically projected mortality should be used, but I don't think there is a need to make its use compulsory. As Jay said, the mortality impact is really less significant because of the current interest rates in the marketplace. The key is to be able to measure how much the initial margins are eroded and where that initial margin stands at the current time. Thank you.

MR. PAUL H. JACKSON: My approach to the topic this morning is from the standpoint of pension plans (uninsured pension plans presumably). The law now includes in the term «pension plan» both defined benefit plans and defined contribution plans (which used to be referred to as saving plans). I am going to focus specifically on the defined benefit plans. These are plans which, in the plan document itself, specify a particular benefit that will be paid on the occurrence of some future contingency, and a plan where the value of that benefit is not necessarily related to the amount of money or assets in the fund at that time. There is, of course, another characteristic of the defined benefit pension plans. Because of the vagueness of the obligation, they require actuaries to determine the value of such liabilities.

The actuarial valuation process that is used to determine the value of liabilities or the required contribution to a pension plan is a special

purpose economic model. Economic models in general do not represent reality in its total and unrefined state, but rather eliminate certain unimportant distinctions in an effort to achieve practical computational ease. The real question to an actuary valuing a pension plan is whether the method and the assumptions that he is using work. Does it cost a lot? This depends largely on the computer facilities available. A full list of actuarial assumptions would include interest, mortality, salary increase, rates of retirement, rates of disability, rates of separation from service, rates of escalation of social security, rates of escalation of benefits after retirement, percentages with spouses or other eligible beneficiaries, and so on. And in the valuation process some of these factors may be dropped because they do not contribute very much. These assumptions, under ERISA, are supposed to represent the actuary's best estimate. There are some in the actuarial profession who have held that these must stand alone, each on its own feet, and there are others who have held that they can be combined for computational convenience. But looking at these factors as indigenous variables in an economic model, the question is «Should the actuary select, for assumption X, a series of values X1 through X50 for each year in the future, or should he use some sort of average?» When you look at these assumptions the first amazing conclusion that you reach is that all of them vary by calendar year, and almost all of them vary in a manner involving trends. Further, most of them are interrelated and depend to some extent on economic variables such as the rate of inflation. For disability rates, early retirement rates, withdrawal from service, the connection is not quite so obvious, but they too vary on the basis of economic conditions. Rates of retirement drop as individuals perceive inflation to be rising and they are less certain of the value of the benefit that they are going to get.

In considering whether to use a single average value instead of these streams of varying future values, the actuary will have to consider a number of different factors. One is the effect of gains and losses that might develop under the program. Do they reduce or increase contributions? Usually they do, but at certain points in time, for example, after plan termination or after the plan's sponsor has gone out of business, gains and losses may have no effect on the contribution because there is no contribution at that point.

The actuary has to also consider variations in pension plan sponsors. Some are permanent, or almost permanent, such as a federal or state government. Some are semi-permanent, such as a major public utility. Most private companies have an uncertain future, and the degree of uncertainty frequently will depend upon the size of the organization and its age. Looking, for example, at the maturity of a plan sponsor - it ranges from new companies, which may have excellent prospects which typically have low current earnings and weak credit facilities available to them, through mature companies which may have just gone through a period of fast growth where they have strong earnings and have strong credit lines available to them, and finally you end up with some senile companies in declining industries with future prospects that are shriveling, with a work force that is declining, spotty profits, credit lines weakening, and so on.

The general principles that are used in actuarial work suggest that averages for the particular actuarial assumptions are perfectly appropriate under certain circumstances. Whether you decide to compute things by an average or by a more precise method, obviously depends upon whether that choice is going to have any effect on the solvency in the long run or in the ability

of a fund to pay benefits to someone. Averages should not be used where they might have some negative impact on the solvency of the pension plan. Averages can, of course, be permitted where they don't make much difference, such as for an actuarial assumption that has a weak influence. So the actuary has to look at each actuarial assumption and look at the pattern of gains and losses that might be developed under that assumption if he uses an average value versus a precise figure for each year in the future. If the gains and losses are completely random, then an average is clearly acceptable. However, if the expected trend for the particular assumption is such that the use of a fixed average would produce early gains, gradually declining to be followed and offset in the long run by later losses, the early gains will probably lower the pension plan sponsor's contribution in some of the early years, while the later losses may well occur after plan termination or after the plan sponsor has gone out of business. Looking at the other type of situation, where the use of an average would result in early losses followed by later gains, there is no problem with solvency, but there may be a problem with IRS pressure. For example, if you use an interest rate of 8% because you assume that next year the rate will be 15% but that figure will decline after the year 2020 to 4 1/2%, the IRS may accept a valuation using the declining pattern, but they may question the 8% valuation as using an unrealistic rate.

In the case of mortality, the usual forecast is for geometric improvement in the long run. This at least seems most likely, as a result of the various factors impinging on mortality. The use of an average rate of mortality that is conservative but that reflects the long run trend, would produce early gains and later losses. Therefore it falls too into a category where the use of an average is suspect.

Under pension plans, however, the assumption of mortality is generally a weak one in the sense that the results are not very sensitive to changes in mortality. The decision to use mortality of various patterns, however, may have an impact on option values and that should be explored.

The conclusion, under pension plans is that forecast mortality tables or improvements might possibly be justified under some of the very large plans, possibly some of the public plans where they have special purpose valuations, but they are not usually used under the medium size and smaller pension plans where the usual approach would be to take a table such as UP84, and if it is not appropriate on that basis, to set the ages back one or two years.

The other assumptions, however, will also have a bearing on the actuary's choice as to what he does with mortality. There are a number of other assumptions where the use of an average rate would develop early gains and later losses. The most important one, perhaps, is the interest rate. If you use an average rate versus a precise pattern of rates, you then put yourself in a position where when someone comes along and says we will immunize bonds, or we will take some of the fund and buy annuities, and you end up with a lower contribution requirement to the plan simply because you have used an average rate of interest. If you had used a declining pattern of interest rates, there would have been very little difference in the contribution.

Besides interest, other factors that develop early gains and later losses are salary increases, cost of living adjustments, rates of retirement, and

so on. So that in general, the actuary ought to be looking at the possibility of adopting actuarial assumptions that vary by calendar year. They pose no insurmountable problems. Solvency is not endangered by using the more precise assumptions, it is endangered by using an average to replace them. There is extra complexity in the mechanical process. If variable economic assumptions are used, there is no insurmountable computational complexity in varying all the other actuarial assumptions by calendar year. At least if the likely patterns are discernible, all ought to be varied. Assumptions that vary by calendar year will produce a present value of benefits that is lower for older actives and retireds and higher for younger actives when compared with present values on an average value basis, and this may prevent some plans from failing the top-heavy test. Assumptions that vary by calendar year avoid an artifical lowering of plan contribution requirements as a result of annuity purchase or immunization of the bond portfolio. Assumptions that vary by calendar year develop realistic withdrawal liabilities for multi-employer plans. Accordingly, it is my judgement that except for small plans where size alone requires computational simplicity, projected mortality, retirement, and economic assumptions that vary by calendar year should always be used.

(There was no discussion on Mr. Jaffe's paper, «The Application of the Commissioners Annuity Reserve Method to Fixed Single Premium Deferred Annuities». The following discussion focused on the use of projected mortality for valuation.)

MR. RICHARD S. HESTER: I understand Paul Jackson to be saying that the actuary who believes that mortality will improve in the future should use such an assumption if the expense of doing so is not prohibitive. I believe we all subscribe to this reasoning.

In an attempt to bring the cost of using such an assumption within reason for very small plans, I developed a slightly different method of approximation than those that Scott mentioned. The following short description may be of value.

The 1983 Table *a* was developed by a Society Committee for use as a valuation standard. As such, the primary concern was the mortality associated with lives which will be in benefit status during the next 10 to 20 years. Also, the Table was designed for use with large groups of lives, the entire individual annuity business of each insurer.

Pension actuaries must be concerned with establishing reasonable funding targets for lives which will not retire for 40 years or more. Those of us servicing small groups must also be conservative enough to allow for adverse experience within each group.

It seems clear, then, that funding of pension plans should consider future mortality improvements both for the individual about to retire and the one who will still be alive 60 years from now. For those who have access to large, high speed computers, it is a relatively simple task to do this by calculating projected annuity values directly.

For those without such computer facilities, there are two traditional choices: use a constant age set back or use a table projected 10 or 20 years into the future. In either case, it is obvious that no static table can provide a good approximation to both the participant retiring in 1983 and the one born in 1963.

To solve this problem, we used Projection G to produce annuity values covering a wide range of birth years and retirement ages. (Although Projection G is the Committee's estimate of improvements during the balance of this century, we allowed it to run on without change or interruption.) Interest rates of 5% and 9% were used. The results were quite interesting.

If we only had to worry about a single retirement age, the projected values can be approximated nicely by a set back to 1983$a$ varying linearly with the year of birth. For example, at retirement age 65 one could use a set back equal to 1/7 of a year times (the year of birth minus 1911). Rounded to the nearest interger, this is 2 years for 1918-1921, 3 years for 1922-1929, etc.

When this approximation was tested against other retirement ages, however, the results were unsatisfactory in that the estimated values tended to be too high at the younger ages and too low at the older ages. To overcome this, a second degree equation was created based on a variable equal to the sum of (a) the years from 1900 to the year of birth and (b) the years from 1900 to the year of retirement. (If the deduction of 1900 from the year of birth is understood, this is equivalent to: Age at Retirement plus 2 times Year of Birth.) Table I shows the results of this formula rounded to the nearest interger. Table II compares the values found by applying Table I with those actually projected.

While they are not shown, the results at 5% for males were almost identical. Female values were not run at 5%. In fact, the entire job of developing the formula was done without investigating female mortality. When we were satisfied with the male results, the female table was tested at 9%, as shown in Table II, and, simplicity being important, it was not considered necessary to come up with a separate female formula.

Using this method, it should now be possible for even the smallest consulting office to fund for future benefits on a more rational basis.

Table I

| Birth-Retirement Variable | Set Back |
|---|---|
| 87-99 | 1 |
| 100-113 | 2 |
| 114-127 | 3 |
| 128-142 | 4 |
| 143-157 | 5 |
| 158-173 | 6 |
| 174-191 | 7 |
| 192-209 | 8 |
| 210-228 | 9 |
| 229-249 | 10 |
| 250-272 | 11 |
| 273-299 | 12 |

it preferable to have a different active life mortality table from a retired life table?

MS. CATHY H. WALDHAUSER: IDS Life has over $300 million in variable annuity reserves. The number of companies offering variable annuities has increased significantly in recent years. Has any consideration been given to the greater need for mortality projection in the valuation of variable annuities than fixed annuities? Offsetting gains from investment margins will normally be much smaller than for fixed contracts.

MR. JOHANSEN: Generally, a mortality charge is deducted as part of the cost to the variable annuity; it might be worthwhile to compare the cost based on projected mortality with that based on unprojected mortality, and compare the difference with the contingency provision in the mortality charge.

MR. SAMUEL ECKLER: Concerning the structured settlement annuity and the use of an improvement factor, I think you made the observation, Jay, that where substandard mortality is involved, the use of the improvement factor may be more critical. Is there any evidence to support that statement that you made? I think what you mean is that the improvement factor may have a greater effect on the amount, or the improvement factor for substandard mortality may be larger than that for standard annuitant mortality.

MR. JAFFE: To begin with I am not sure that the industry as a whole knows how to underwrite substandard annuities. What is substandard? What does impairment mean? I have not done any research to substantiate my point of view, but I feel that many impairments can be impacted significantly by mortality improvements - major medical breakthroughs. As a working actuary, my observation on the whole subject today is that I wonder if we have not gone into an era when we are going to see quantum leaps in mortality. We were talking at breakfast that in the 60's and early 70's mortality was fairly flat, but in the last seven or eight years we have seen some dramatic changes in life expectancy. I wonder if that is the pattern we are going to see in the substandard area as specific impairments receive specific treatments by the medical community. This is an area that would bother me most because there is very little spread of risk. A large company can have 50 or 100 cases or 200 cases that constitute $50 million to $100 million worth of reserves in any given year. It is a frightening subject from an actuarial point of view.

MR. ECKLER: I just want to make one observation. Legal cases are becoming far more prevalent than they have been in the past. We do use substandard mortality rates in establishing the amount of the damages. We have not been using certain known patterns. I am not sure it would be unacceptable if no improvement factor is used, and the use of an improvement factor will have a very significant effect on the amount of damages.

MR. JAFFE: I have two additional comments. One is that I would like to advise anybody who is working in the actuarial field to read a new paper that is being published by the Council of the American Academy on Actuarial Professional Liability. I think it is very relevant to this discussion because the actuary is forced to make a projection. The other comment is whether you take into account projected mortality or use unprojected mortality to some extent depends on which side of the fence you are on.

For those of you who are not familiar with structured settlements, the subject is very fascinating because there are interactions between the casualty insurer, the life insurer, the beneficiary, the tax people, and the beneficiary's attorney. I would think that on the question of improvement of mortality of impaired lives, it could very well depend on the nature of the impairment. For life insurance underwriting we have all kinds of studies which indicate that for impairment X the mortality keeps getting worse after it has been initially diagnosed or after the individual is insured. On others, it stays almost flat, and on some, it decreases with duration since occurrence.

MR. JACKSON: I was not planning on saying anything, but Bob said that he had a small computer and he could program in the mortality improvement. Then he entered the interest rate. I was making a note of this because it seems to me that one of our problems as actuaries is that we started out with a profession which originated at a point in time where there were no computers, but large worksheets on which actuaries developed commutation functions. With commutation functions, variable mortality rates, variable interest rates, and other things are not only intractable, they make it impossible to get anything done within a finite timespan. But today we have computer programs which can not only develop results on a deterministic approach but even on a stochastic approach. The stochastic approach is one that takes into account the range of possibilities and develops a range of results, whereas under the deterministic approach, you take each assumption down to one average value and develop one result. I think the actuarial profession somehow is going to have to expand from its deterministic commutation function origins. By the year 2000, at least, we are going to have available a broader range of tools. We need more complex approaches for valuation of an insurance company, for government certification, for looking at actuarial obligations from a management standpoint, or to try to see what is really happening.

MR. JOHANSEN: I do not believe my VIC-20 has enough capacity to handle a Monte Carlo problem, but I think this particular program could be modified to have an interest rate which varies by year.

MR. ROBERT J. POLILLI: We were getting into the single premium annuities market in the past year and had the opportunity to calculate settlement option rates. We found that we needed a great deal of flexibility, and a much bigger computer. We developed a program that would run settlement options at five different interest rates, but then we were faced with the question of what interest rate to use in the long run. Realizing that investments do not last forever we projected out, starting at 15% and then reducing the interest rate. We ran some return on investments where I got my first surprise about how thin margins become.

The book profits for the first 25 years looked fine in summary, but as we went down the column of book profits year by year we saw that at around year 16 everything started going negative. Of course, part of that was due to our interest assumption that we had to reinvest money at year 15. We had been on the 1971 IAM table for the reserves.

The third situation was that after 15 years of inflation our maintenance expenses were very high. So the combination of all three elements ended up with the book profits in a negative position for the last years of the projection.

Table II

1983*a*, 9%

Ratio of Estimated (Set Back) Monthly Life Annuity Due
to
Values Obtained by Applying Projection G

| Age | Year of Birth | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1908 | 1918 | 1928 | 1938 | 1948 | 1958 | 1968 | 1978 |
| | | | | Males | | | | |
| 50 | | | | 100% | 100% | 100% | 99% | 99% |
| 55 | | | 100% | 100 | 100 | 99 | 99 | 99 |
| 60 | | | 101 | 100 | 99 | 100 | 99 | 99 |
| 65 | | 101% | 100 | 100 | 101 | 100 | 100 | 99 |
| 70 | | 101 | 100 | 101 | 101 | 100 | 100 | 99 |
| 75 | 100% | 99 | 101 | 100 | 100 | 99 | 101 | 100 |
| 80 | 99 | 101 | 100 | 99 | 101 | 100 | 100 | 100 |
| 85 | 100 | 99 | 98 | 101 | 100 | 99 | 99 | 99 |
| 90 | 98 | 97 | 101 | 100 | 100 | 100 | 100 | 101 |
| | | | | Females | | | | |
| 50 | | | | 100% | 100% | 100% | 99% | 99% |
| 55 | | | 100% | 100 | 100 | 99 | 99 | 99 |
| 60 | | | 100 | 100 | 99 | 100 | 99 | 99 |
| 65 | | 100% | 100 | 99 | 100 | 99 | 99 | 99 |
| 70 | | 100 | 99 | 100 | 100 | 99 | 99 | 99 |
| 75 | 100% | 99 | 101 | 100 | 99 | 99 | 100 | 100 |
| 80 | 99 | 101 | 100 | 99 | 101 | 101 | 101 | 100 |
| 85 | 100 | 99 | 98 | 101 | 101 | 101 | 101 | 101 |
| 90 | 98 | 97 | 101 | 101 | 101 | 101 | 102 | 102 |

MR. JOHANSEN: Mr. Herman Lewis, at Metropolitan Life, designed a program for calculating projected annuities on a Commodore VIC-20. He gave me the program; I modified it; tried it on my VIC-20 and it worked.

Incidentally, I would like to stress that the purpose of the 10% margin in the statutory table is not to cover future mortality improvements but to cover the range of experiences of the various companies which would be using that statutory table. Because some companies, depending on their market will have a lower than average mortality and some will have higher, a margin is added so that the table will then be a safe one for as many companies as possible.

MR. JAMES L. COWEN: Actually my comment refers to what was said by Mr. Hester. Rather than taking different setbacks at different ages, isn't

We made a recommendation last week that perhaps the best way to go about correcting the problem was to use a dual interest rate since our computer had a vector of interest rates. I found it surprising that the three elements combined made the reserves very inadequate beyond year 15 or 20 or whenever you had to reinvest the funds.

MR. RALPH E. EDWARDS: I was interested in the last speaker's comment to the extent that he discounted for 15 years at high rates. How much effect does something that far off have on the current competitive position? Is it only 1 or 2%, or is it really substantial?

MR. POLILLI: The nice part of that was it didn't affect the competitive position very much. This was something we were doing for our actuarial students who would be in the company 15 years from now and facing the problem.

MR. JOHANSEN: I would take it that the present value of these losses discounted at high interest would be within reason, but when you look at the book profits year by year you can foresee the problem of explaining to the board of directors 20 years from now why they have substantial losses on this business because their predecessors had very profitable years.

(There was a substantial show of hands from the audience responding positively to a question from the moderator as to whether they thought it important to take projected mortality into consideration before determining premium rates or reserves.)