

NEW MORTALITY BASIS FOR ANNUITIES

- A. Are the projection factors set forth in the Jenkins-Lew paper reasonable measures of the likely improvement in future annuitant mortality rates?
- B. What are the implications with respect to (a) individual annuities, (b) life income settlement options, and (c) group annuities of recognizing the validity of the factors for business in force as well as for new business? In particular, are the present premium and valuation standards for annuitants' mortality satisfactory?
- C. What steps can be taken to give practical effect to such implications, and what additional tools are desirable for the purpose?

MR. MANUEL GELLES said there is no doubt that the Jenkins-Lew projections for future annuitant mortality are reasonable. It is interesting to note the small effect on annuity values of assuming some improvement in mortality at ages over 89. If, in Projection B of the paper, the annual mortality improvement rate at age 85 of .25% is assumed to apply at ages over 85, 2½% life annuity values for 1970 are increased by less than .5% from ages 50 to 65, about .6% at age 70, .7% at age 75, and 1.4% at age 80. There is some margin at the older ages in the 1949 Table itself as is evident from the description of the construction of this Table.

Settlement option losses due to improved mortality may be more than offset by extra insurance gains, also due to improved mortality, on some plans of insurance. It is essential, of course, in this treatment that extra insurance gains which should offset life income deficiencies be not paid out in dividends.

The relative importance of future interest and mortality deficiencies should be noted. The ratios of the Jenkins-Lew 1975 annuity value at 2% for 10 years certain and life to the corresponding 1949 values at 2% and 2½% are shown below. From these figures it appears that a reduction

At Age	RATIO OF 1975 VALUE AT 2% TO	
	1949 Values at 2%	1949 Values at 2½%
50 female.....	1.057	1.135
60 female.....	1.058	1.117
70 female.....	1.040	1.081

of ½% in interest rate may be about as important financially as probable improvement in mortality over the next 25 years.

Existing insurance with life income guarantees on obsolete bases comprises a broad field for examination. To bring an American Annuitants'

3% option up to the Jenkins-Lew 1949 Table at $2\frac{1}{2}\%$ costs about three times as much as to go from this 1949 Table to their 1975 Table, also at $2\frac{1}{2}\%$. In addition, in strengthening reserves, one must consider obsolete interest guarantees in settlement options not involving life contingencies.

MR. E. G. FASSEL felt that the Jenkins-Lew projection factors are reasonable, in general, and preferred the B factors. However, he was skeptical of no further improvement in mortality at ninety and over.

Formerly, people understood three dimensions but whether there could be a fourth dimension was a mystery. Now it is common to recognize time as the fourth dimension. That concept is becoming understood as the thing lacking in annuity tables. What we need is a progressive mortality table devised to recognize the secular trend, *i.e.*, time, as one of the variables. The Jenkins-Lew projection factors provide the means for such a table. The table resulting from the projection factors is in reality a family of mortality tables for successive classes of lives. Each year of birth constitutes a class with its own mortality table throughout life, each with slightly lower mortality rates than the class before. It seems practicable to derive a substantially equivalent Gompertz table in which the family of tables can be merged into a master table, as overlapping components lying on a common path. Each component would merely be the master table with transfer of origin, *i.e.*, a rate back of age in the master table.

With such a table, a ready solution for life income settlement options would be to include a secular trend factor in the policy. For example, suppose that the factor is a rate back of one year for each twenty-five year difference in year of birth. The policy table might apply to lives born in 1900-1924. Then for lives born 1850-1874 the same table would apply with the age rated up two years, born 1875-1899 up one year, born 1925-1949 down one year, born 1950-1974 down two years, etc.

A Gompertz table would have obvious advantages in valuation.

MR. H. H. HENNINGTON stated that the Jenkins-Lew paper gives us the opportunity in group annuity work of improving the equity in costs between employers who have different types of pension plans. In the past a more conservative interest assumption has often been used to provide for improving mortality. As an expedient, this has worked fairly well in most group annuity situations, but has been wide of the mark in some cases.

He had made some test calculations using projection B factors, $2\frac{1}{2}\%$ interest, and modifying the 1949 Table at ages from 60 to 90 to produce higher mortality rates at these ages more suitable for group annuity experience. The mortality was graded up to 115% of the rates in the Annuity Table for 1949, with the maximum increase of 15% at age 75. The

test premiums used a somewhat different loading formula than in the present group annuity rates of the Equitable, which are based on the 1937 Standard Annuity Mortality Table with ages set back one year and with $2\frac{1}{4}\%$ interest. The results were striking. The test premiums gave rates at a typical age for the no death benefit deferred life annuity about 6% higher than present rates. On the other hand, the rates for the deferred cash refund annuity with death benefit prior to retirement were about 15% lower than present rates.

As Mr. Blagden pointed out in his discussion of the Jenkins-Lew paper, it would be possible to avoid the introduction of mortality projection in the calculation of premium rates for group annuities. Even if this were done, it would seem essential for proper dividends to each policyholder for the reserves to be calculated on a basis introducing a projection for mortality improvement. If one can introduce the mortality improvement projection in the reserves for purposes of dividend calculations, it would seem likely that mortality improvement could and should be introduced into the construction of premium rates.

MR. J. R. GRAY believed that the assumptions behind projection scale B are as good an estimate of actual amount as we are likely to make. They do, however, produce some peculiar results. He had calculated the projected annuity values in 1951 at decennial ages, and interpolated for individual ages. He then worked back from such annuity values to the probabilities which would support such a single table. This gave values of p_x greater than unity up to age 37 in the male table, which caused him to throw out all thoughts of using such a synthetic table as a practical tool. He did not think that we need question the projections simply because of the occurrence of such peculiar results. They are a natural result of the very low mortality at the younger ages.

The practical solution for settlement options is not clear, but a possibility lies in the direction of showing a table of settlement options based on the projected mortality for an annuity taken in 1970, and providing that such table will be used with the age rated down one year for any settlements which commence between 1980 and 1990, and a further year for every decennium beyond that. A similar solution might be used for Deposit Administration guarantees.

In connection with regular group annuities, the most practical procedure may lie in the direction of breaking the calculation in two parts at the normal retirement age, using one set of projection factors for the before retirement portion and another set for the after retirement portion. While it would be possible to take the attitude that, on group annuities, it is the total premium collected on the group which matters and that the 1949 Table without projection would produce about the required

amount in total, we are concerned with the equities of individuals in the case of employees leaving with vested rights and in the case of the entire contract becoming paid-up. He would much rather see the use of group annuity premiums which fit more accurately from age to age.

MR. W. J. NOVEMBER reported on a recent study of the mortality among nonrefund annuitants who purchased their contracts from the Equitable before 1931. The contracts were observed between 1933 and 1948 anniversaries, with the observation period broken down into three five-year groups, 1933-1938, 1938-1943 and 1943-1948. The expected deaths were calculated by the Jenkins-Lew 1943 Experience Table. There were 375 male deaths in the experience, involving 658 contracts, and 681 female deaths involving 1,170 contracts. The mortality ratios (by lives) for the three periods were 137%, 126% and 114%, respectively for both sexes combined. They were reasonably consistent by sex and also by attained age up to 90. For attained ages 90 and over the corresponding ratios were 107%, 105% and 100%. The geometric improvement from the first to the last period was 2.2% per year for attained ages 70-79 and 80-89, 0.7% for ages 90 and over.

The Equitable also compared its 1945-48 experience on matured deferred annuities of the type described in *TASA XLVIII*, 133, with its 1940-45 experience. An approximate mortality decrease had occurred on nonrefund of 20% by amounts, 10% by contracts; on refund, 7% decrease by amounts, 3% increase by contracts.

He felt that the Jenkins-Lew projection scales are deserving of acceptance as being reasonable with the knowledge now available to us.

MR. W. F. MARPLES said that Messrs. Jenkins and Lew in their exhaustive paper had mentioned the two British Annuitant Mortality Tables. The British Offices experience was based on the experience of annuity contracts issued by Insurance Offices whereas the British Government experience was based on annuity contracts issued through the Post Offices or the National Debt Commissioners. The average annuity bought was very much less in the latter case than in the former and indicated that different strata of the population had been tapped. It was not surprising to find that the mortality of the Government Annuitants experience was heavier than the Offices Annuitants experience.

In the course of his pension practice in Great Britain the experience of many municipal pension funds had passed through his hands. The accompanying summary shows a marked difference in mortality between staff and manual worker pensioners and between districts. There was a suggestion that the mortality was heaviest in the areas of greatest humidity and urbanization and that as the climate became drier toward the East the mortality fell. Census tables support these area differences. The ex-

posures lie between 1941 and 1948, and expected mortality is according to the British Government Annuitants Table.

AREA	MALE STAFF PENSIONERS			MALE MANUAL WORKER PENSIONERS	
	Number of Funds	Exposed to Risk	Actual Deaths Percentage of Expected	Exposed to Risk	Actual Deaths Percentage of Expected
Lancashire and Merseyside (excluding Liverpool).....	12	5,757	106.1%	17,983	115.1%
Liverpool.....	1	1,879	94.2	512	98.8
East and North East.....	8	3,620	103.7	6,703	111.9
Birmingham Area.....	7	2,188	97.8	11,054	111.1
Midlands.....	5	1,416	76.1	6,932	113.0
South East and South West....	11	1,246	66.4	5,451	95.1
Total.....	44	16,106	97.2%	48,635	110.9%

It was suggested that these figures showed that pensioner mortality lagged at least 20 years behind annuitant mortality and that an allowance for this could be made by rating back the age of the pensioner annuity progressively for successive age groups of active members.

MR. H. E. BLAGDEN mentioned the recent experience of Prudential under group annuity contracts and stated that in his opinion it is desirable to use a mortality table which at all ages produces higher annuity values than the 1937 Standard Annuity Table. His company has developed such a table and plans to use it for rates and reserve calculations.

MR. W. A. JENKINS presented tables (Tables 1, 2 and 3) comparing annuities and settlement options on the 1949 Table (projection B) and $2\frac{1}{2}\%$ with those on the bases in most common use today. He assumed $2\frac{1}{2}\%$ interest as the rate commonly used for life insurance; also that the average year of issue for contracts issued over the next ten years would be 1955, and that life income settlement options arising from death would commence, on the average, twenty years after contract issue. The tables indicated that present immediate annuity rates are about right up to age 65 and too conservative thereafter, but that present settlement option rates are inadequate in most instances. This conclusion should be modified, one way or the other, to the extent that the actuary believes that there is too much or too little conservatism in the three elements upon which it is based, *i.e.*, $2\frac{1}{2}\%$ interest, the 1949 Select Table, and Projection Scale B. Such a modification should also be made if the actuary's company will continue to experience annuity mortality departing materially from the joint experiences upon which the 1949 Table was based.

He put little stock in the view sometimes expressed that margins should, could and would be withheld during the premium paying period

TABLE 1

COMPARISON OF VALUES OF IMMEDIATE NONREFUND LIFE ANNUITIES OF \$1 PER ANNUM
 Annuity Table for 1949 (with Projection Scale B for Single Premium Immediate Annuities Issued in 1955) at 2½% Interest
 vs.
 1937 Standard Annuity Table (Set Back 1 Year) at 2% Interest

AGE AT ISSUE	PERCENTAGE 1949 TABLE PROJECTED VALUE IS OF STANDARD ANNUITY TABLE VALUE			
	Male		Female	
	1949 Table Value Select	1949 Table Value Ultimate	1949 Table Value Select	1949 Table Value Ultimate
45	100%	100%	100%	100%
55	101	101	101	100
65	101	100	98	98
75	96	94	91	89
85	86	83	78	74

TABLE 2

COMPARISON OF VALUES OF LIFE ANNUITIES DUE OF \$1 PER ANNUM, 10 YEARS CERTAIN
 Select Annuity Table for 1949 (with Projection Scale B for Life Income Settlement Option Annuities Beginning in 1975) at 2½% Interest
 vs.
 1937 Standard Annuity Table (Set Back 1 or 2 Years) at 2% or 2½% Interest

AGE WHEN ANNUITY BEGINS	PERCENTAGE 1949 TABLE PROJECTED VALUE IS OF STANDARD ANNUITY TABLE VALUE					
	Standard Annuity Table Set Back 1 Year at 2% Interest		Standard Annuity Table Set Back 2 Years at 2½% Interest		Standard Annuity Table Set Back 1 Year at 2½% Interest	
	Male	Female	Male	Female	Male	Female
35	101%	99%	109%	107%	110%	109%
45	103	101	109	108	111	110
55	104	102	108	107	110	109
65	102	99	104	102	106	104
75	97	93	98	94	100	96

(of current issues) to offset settlement option deficiencies, especially for retirement income endowments and deferred annuities. Even if done, inequity would result. Nor could he concur with the view that deficient life income settlement options were justifiable for sales reasons alone. Seeds of this kind were sowed in the 1920's and are now being reaped. Each part of the contract should be put on what promises to be a reasonably self-supporting basis.

TABLE 3
COMPARISON OF VALUES OF LIFE ANNUITIES DUE OF
\$1 PER ANNUM, 10 YEARS CERTAIN

Select Annuity Table for 1949 (with Projection Scale B for Annuities
Beginning at Age 65 at Maturity of Retirement Income Insurances
and Deferred Annuities Issued in 1955) at 2½% Interest

vs.

1937 Standard Annuity Table (Set Back 1 or 2 Years) at 2% or 2½% Interest

AGE WHEN ORIGINAL CON- TRACT ISSUED	PERCENTAGE 1949 TABLE PROJECTED VALUE IS OF STANDARD ANNUITY TABLE VALUE					
	Standard Annuity Table Set Back 1 Year at 2% Interest		Standard Annuity Table Set Back 2 Years at 2½% Interest		Standard Annuity Table Set Back 1 Year at 2½% Interest	
	Male	Female	Male	Female	Male	Female
15	107%	103%	109%	105%	111%	108%
25	105	102	107	104	110	107
35	104	100	106	103	108	105
45	102	99	104	102	106	104
55	100	98	102	100	104	103

MR. WALTER KLEM suggested the possibility of varying life income settlement option guarantees by the decade in which proceeds were applied. Four columns might be printed in the policy. The first, calculated for 1955, would be applicable to life incomes commencing in the decade of the 50's. The next would apply to the 60's, etc. The last, calculated for 1985, would apply to life incomes commencing in 1980 or later. The amount of decrease in income occasioned by shifting from one column to the next would be less (under the Jenkins-Lew projections) than the increase in income caused by the payee growing one year older. A consistent procedure for the retirement endowment type of policy would involve premium rates for maturity values determined by the calendar year of maturity. A policy with maturity age 65 and issue ages to 55 would require an increase in maturity value and in corresponding premium for two issue ages at the beginning of each of the second to the

tenth calendar years in the decade, and for the remaining issue ages at the beginning of the succeeding decade.

MR. W. M. RAE pointed out one solution to the settlement option problem. Estimate the weighted average future date, say, 30 years from now, at which life income settlement options on current issues may be expected to commence. Then calculate forecast rates, by using projection factors, for life incomes commencing at that time. One could use these forecast rates, or some more easily computed approximation thereto, as the guaranteed life income rates.

If the 30 year forecast rates are computed on nonparticipating assumptions, then no dividends, either excess interest or otherwise, should be paid on any of the life incomes, unless true profits have actually arisen. Margins in the early years over the guaranteed basis are likely to be book profits only, and should be set aside in a reserve fund (not in surplus) to offset the practically certain later losses.

At the present time, however, there seems to be a rather general practice of paying excess interest dividends on current basis life income settlement options. This is difficult to justify in view of the fact that the life income settlement option rates of many companies are about as liberal as, or more liberal than, what seem to be reasonable nonparticipating 30 year forecast rates.

MR. M. J. WOOD had found that the Annuity Table for 1949 (projection B) with $2\frac{1}{2}\%$ interest closely reproduced their present 2% rates for individual immediate life annuities, except at the very old ages where the rates on this new basis were considerably lower. This comparison led to the question as to whether the proposed one-year adjustment would cover the selection at the older ages, such as 85, where one would expect the purchasers of life annuities to be much healthier than those of the same age who bought annuities ten or twenty years earlier. The best measure of this selection was found in the last intercompany experience (TASA XLIX, 116) which showed mortality at ages 80 and over of about 50% of the 1937 Standard Annuity Table for the first two policy years. The life annuity rate for a male age 85 based on the Annuity Table for 1949, with 2 years of select mortality equal to 50% of the 1937 Standard Annuity Table, was determined to be about 12% higher than the corresponding rate based on the proposed one-year-select adjustment. This answer appears none too conservative when one considers the possible wide variations between select and ultimate mortality at the older ages. This points to a possible solution in using a severe adjustment for a two-year select period at ages 80 and over grading down to the one-year adjustment proposed in the Jenkins-Lew paper at about age 65.

MR. E. A. LEW observed that when we use projection factors we

thereby tacitly recognize that a specific allowance must be included in annuity values for future improvement in mortality. This implies a belief that in calculating annuity values it is advisable to consider separately the margin that may be needed with respect to the mortality element. It is also important to bear in mind that the assumption as to the interest rate may carry an even greater weight than the assumption regarding mortality in the case of those annuity contracts under which the payments are likely to extend over a long period of years into the future. In this respect, conservative assumptions appear to be particularly desirable for life income settlement options, not only because of the long range projections involved but also because a separate margin for expenses is not customarily provided.

He emphasized that the particular projection factors presented in the paper by Mr. Jenkins and himself were not intended so much to illustrate probable future mortality levels as to indicate two possible scales of the age incidence of future mortality decreases. Projection factors which assume scales of mortality decreases by age proportionate to Scale A or B could for all practical purposes be computed as corresponding multiples of the projection factors shown in their paper.

In connection with annuitant mortality at the advanced ages it should be kept in mind that the Annuity Table for 1949 contains some margin for mortality fluctuations and like contingencies. A comparison of the mortality rates shown in the 1943 Experience Table and the Annuity Table for 1979 brings out the effect of this margin in combination with Projection Scale B. At ages 75 and over the differences in mortality rates between these two tables are equivalent to the following annual rates of improvement in mortality (on a geometrical basis):

Age	Male	Female
75.....	.9%	1.0%
80.....	.6	.7
85.....	.4	.5
90.....	.2	.2
95.....	.1	.1

It should be clear, therefore, that the Annuity Table for 1949 when used together with Projection B allows in effect for mortality decreases greater than those explicitly provided by Projection B alone.

MR. C. M. STERNHELL made some explanatory comments on his method of calculating projected annuity values, the paper concerning which appears in this volume. The method is extremely simple. The value of an annuity without projection in 1950 is the customary N_x/D_x . To change this to the value with projection in 1950 requires the adding of a

second equally simple term, J_x/D_x . To change it to the value with projection in the year $1950 + k$ calls for adding a third term, kH_x/D_x .

The annuity values produced by this method are approximately the same as those that are produced by using the Jenkins-Lew projection factors. This is because the basic assumptions underlying the two methods are exactly the same, except that the proposed method ignores the second and higher powers of the rate of mortality improvement. The error introduced thereby is very small and generally on the conservative side. Conventional methods of allowing for mortality improvement were thoroughly tested and abandoned in favor of this method because it gave good accuracy for all ages and types of annuity contracts. This method will work satisfactorily for any reasonable mortality improvement assumptions which are of the Jenkins-Lew type, *i.e.*, the rate of improvement at a given age is the same for all calendar years. It is well to note that, with this assumption, results by the year of birth theory and year of exposure theory are identical so that the supplementary commutation column method may be used with either of these theories. This method is also applicable under the year of issue theory, provided that it is assumed that the annual rates of decrease in the mortality rate at any attained age will remain constant as the year of issue advances.

MR. R. M. DUNCAN had prepared $2\frac{1}{4}\%$ standard commutation columns for the Annuity Table for 1949 (without Projection) Ultimate and $2\frac{1}{4}\%$ supplementary commutation columns for its projection by the method of Mr. Sternhell. He kindly offered to make these available to any member who requests them from him.

MR. E. F. ESTES recalled that back in 1946 he had made up a table influenced largely by the then mortality of life income settlement

AGE	a_x (MALE)		
	S.A.(-)2%	Estes Table	A1979 $2\frac{1}{2}\%$
35.....	25.78	24.56	25.15
45.....	21.45	21.01	21.37
55.....	16.87	16.93	17.10
65.....	12.37	12.56	12.49
75.....	8.31	8.34	7.88

options as reported by Mr. Murphy. From this his company had concluded that the 1937 Standard Annuity Table at 2% interest, rated down two and seven years, would be a reasonably safe standard to use for settlement options, bearing in mind that their shortest certain period was ten years. It might be of interest to compare life annuities on this basis with their table and with the Annuity Table for 1979.