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**ACTUARIAL NOTE: MORTALITY EXPERIENCE OF BANKERS
LIFE INSURANCE COMPANY OF NEBRASKA 1945-1950**

JAMES F. MACLEAN

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B. FRANKLIN BLAIR:

It is very interesting to have a report on the mortality of one of the smaller companies. The insurance business is growing so rapidly that many of the so-called smaller companies will soon be able to make valuable contributions to the field of mortality statistics.

**TABLE A
EXTENSION AT YOUNGER AGES OF 1946-1949 SELECT
AND ULTIMATE BASIC TABLES
MORTALITY RATES PER 1,000**

SELECT TABLE			ULTIMATE TABLE			
Policy Year	Issue Ages		Att'd Age	Mortality Rate per 1,000	Att'd Age	Mortality Rate per 1,000
	0-4	5-9				
1	2.54	.51			15	.67
2	1.25	.50	1	1.56	16	.74
3	.99	.48	2	1.25	17	.81
4	.76	.47	3	.89	18	.87
5	.65	.47	4	.72	19	.94
6	.59	.50	5	.65	20	1.00
7	.54	.54	6	.58	21	1.05
8	.51	.60	7	.54	22	1.09
9	.49	.67	8	.50	23	1.12
10	.48	.74	9	.48	24	1.13
11	.50	.81	10	.47		
12	.54	.87	11	.47		
13	.60	.94	12	.50		
14	.67	1.00	13	.54		
15	.74	1.05	14	.60		

As the Provident Mutual has only recently started to issue nonmedical business, we were especially interested in Mr. MacLean's comparisons of results in his company on medical and nonmedical business.

Like Mr. MacLean, we also have been confronted with the necessity of

extending the 1946-1949 Select and Ultimate Basic Tables at the younger ages. Besides extending the ultimate table, we developed "select" rates for ages at issue 0-4 and 5-9, as shown in the accompanying Table A. The figures for ages 0-4 are of course considerably affected by the assumed distribution of business by age at issue, which might vary considerably from company to company. As this situation is most extreme at age 0, no

TABLE B
MORTALITY CHARGE IN DIVIDEND FORMULAS PER
\$1,000 NET AMOUNT AT RISK

Attained Age on Dividend Due Date	Average Mor- tality Charge for Five Com- panies Derived from 1951 For- mulas As Shown in Schedule M (1)	Mortality Charge Used by Bankers Life of Nebraska (2)	Mortality Charge Accord- ing to 1946-1949 Ultimate Basic Table (3)
10.....	\$ 1.27	\$.50
15.....	1.18	.86
20.....	1.42	.99
25.....	1.62	1.16
30.....	1.90	1.30	\$ 1.26
35.....	2.42	1.13	1.62
40.....	3.41	1.53	2.32
45.....	5.13	3.17	4.02
50.....	7.99	5.50	6.84
55.....	12.62	7.40	11.44
60.....	19.77	13.32	19.15
65.....	30.89	20.92	29.68
70.....	47.88	28.70	43.57
75.....	73.48	56.32	65.03
80.....	111.72	96.95	96.95
85.....	166.00	149.31	149.31
90.....	242.95	212.04	212.04
95.....	362.29	275.14	275.14

ultimate rate has been shown at that age. Our ultimate rates for ages 1 to 24 were taken as 47% of the rates for white males in the 1939-1941 U.S. Life Tables on the assumption that that ratio, which holds for ages 25 to 29, would also apply at ages below 25.

There is another section of Mr. MacLean's note on which I would like to comment. On page 127 he gives a mortality table which his company decided to use to determine the mortality contribution in their three-factor dividends. This table almost exactly reproduces their aggregate experience. It is doubtful if most companies have quite this close an agree-

ment between their actual aggregate mortality experience and the mortality contribution in their dividend scales. To throw further light on this point, Schedule M was examined in the 1951 annual statements of over 25 of the larger United States companies.

For only five of these companies could the mortality charge in the 1951 dividend scale be determined for quinquennial ages. (Of these five companies, three contributed data to the 1946-1949 Basic Tables.) As shown in the accompanying Table B, these mortality charges were in general rather higher than those used by the Bankers Life of Nebraska and were much closer to but still slightly higher than those which would result from the use of the 1946-1949 Ultimate Basic Table.

The differences between the figures in columns (1) and (2) of this table are probably, at least in part, the result of the fact that many companies do not include the savings in select mortality over the actual ultimate mortality level as part of the mortality contribution of their dividend scale but rather use such savings as an offset to initial expenses. Thus, these companies would base the mortality contribution in their dividends on the gains taken as the difference between tabular mortality and *ultimate* experience, whereas Mr. MacLean's company uses the difference between tabular mortality and *aggregate* experience. The basis used by the Bankers Life of Nebraska would presumably result in higher mortality contributions but not necessarily in higher total dividends. Thus the fact that the figures in column (2) are lower than those in column (1) does not necessarily mean that the net costs of the company using the mortality charges in column (2) are lower than the average net costs of the five companies represented in column (1).

JAMES S. ELSTON:

Mr. MacLean has presented some extremely interesting mortality statistics and comparisons which should be a model for many companies. The most interesting feature is how favorable the mortality has been. The comparison of the results on the three different mortality tables and especially the low ratios on the American Experience Table bring to my mind the discussions after the publication of the American Men Mortality Table and, in particular, the one in 1931 in *RAIA* XX, 298, on whether the American Men Table should be made even a permissive standard of valuation. Several other actuaries favored such a change and I expressed my agreement as strongly as I thought wise. But some of the actuaries opposed it because they considered the American Experience Table the only safe one. The American Men Table was then already becoming out of date. Although it would have had no practical value, if Mr.

MacLean had also given his comparison on the American Men Select Table basis it would have been interesting as filling the gap between the results on the American Experience and on the CSO.

Mr. MacLean emphasizes "how misleading mortality ratios by the older tables can be." The over-all ratio of 8% on the nonmedical business and the ratio of 1% on the part of that at age 0 on the American Experience Table is almost unbelievable. I realize that companies may work their experience on the American Experience Table to help them distribute their dividends more equitably on policies based on that table, but such a result as this even in a small group at comparatively young ages on short durations is startling, especially to me because we discontinued all of our detailed calculations on the American Experience Table about twenty-five years ago and I hadn't realized the extent of the change when calculated on this basis. I am not so surprised at the 40% in the corresponding medical business where the exposure of the juvenile ages is comparatively small, but these two figures illustrate as forcefully as possible the dangers of paying attention to over-all figures only and also of using outdated mortality tables without making further analyses.

It appears to me that the only valid comparisons now must be on the 1946-1949 Basic Table or on somewhat corresponding unpublished company tables. My paper on "Analyses of Joint Mortality Experience 1939-1945" in *TASA XLVIII*, 239, showed how inadequate the CSO Table was for mortality comparisons because of the unprecedented improvement in mortality that had already taken place year by year. The 1946-1949 Basic Table published only four years later has already replaced my table for comparison of very recent experience because of the subsequent improvement in mortality.

About every ten years we have changed the mortality table on which our detailed studies are made. Prior to our changing to the Joint 1937-1940 Table we used a succession of Travelers tables.

We work our experience as a whole on regular standard business on the 1946-1949 Basic Table for the last twenty years of issue separately, contrasting medical with nonmedical, but the fifteen-year select period involves such a huge amount of work for our further analyses by form of policy, amount of insurance, and for various classes of substandard insurance that we are still making these studies in the form of a five-year select table. We are using the Joint Experience from 1937-1940 as a basis, which we have continued for the sake of comparisons with the past, but even with such a late table as this we have to be very careful in the interpretation of results, especially if they involve the mortality experience

over a fairly long period. For instance, we just worked a special experience covering the exposure years 1931-1951 involving a separation between medical and nonmedical. Since the mortality rates at the younger ages and shorter durations in 1951 are something on the order of half of those in 1931, and since the relative proportions of nonmedical to medical in our case have changed radically during that period, the ratios on the total medical and nonmedical are considerably affected by the relative proportions of the component parts.

This characteristic is even emphasized indirectly in Mr. MacLean's paper on pages 116 and 117 where he gives the number of deaths and ratios of actual to expected by amounts by ages at issue. Unfortunately for my analysis, the deaths are by number and the ratios by amount so the best I could do was to assume that the same ratios applied by number for each age group. Working backward this way to obtain the expected by age groups I obtained a ratio of 80% for the total of all ages on the medical and a ratio of 92% on the nonmedical. The differences between these and the 81% and 100%, respectively, are apparently mostly owing to using ratios by amounts as if they were the same as by numbers. Using the same figures but excluding the juvenile ages I obtained ratios of 81% on the medical and 116% on the nonmedical. The underwriting, premiums and reserve structure, and the mortality table itself, are such that it seems to me that the Juvenile should be considered as a separate section of business and I wonder if, therefore, comparison of the nonmedical ratio of 116% (ages 10 and over) with a medical ratio of 80% isn't a more significant comparison than the ratio of 100% to 81%. Of course, if I had had detailed ratios on the same basis as to number and amount, an even better comparison could have been made.

The Travelers Insurance Company, in its first mortality experiences after issuance of insurance at juvenile ages, included them in the non-medical group—cases issued on the medical basis being comparatively insignificant. The insurance was for very small amounts at the youngest ages increasing appreciably each year to age 10. The original calculations were made on the ultimate amounts but, for comparison with the actual death claims, ratios were applied by duration and by age groups in such a way as to make approximate allowance for the reduction in the expected to match the corresponding actual. These adjustments were made, of course, by amounts of insurance and no adjustment was made by numbers. It was only a few years before the effect of the relatively different weights in the experience by number and that by amounts at the juvenile ages became very evident in the total nonmedical experience, so that it

appeared that to obtain most meaningful ratios on the nonmedical we had to take out the juvenile ages entirely and treat them as a separate class of business.

As our experience is worked on a five-year select basis and as that involves the awkward tables by ages at issue during the select period and by attained age during the ultimate, Mr. MacLean's analysis of all business, even "31 and over" years in force, by ages at issue produces quite different tables from ours.

RICHARD A. GETMAN:

Mr. MacLean's interesting paper has been discussed primarily from the standpoint of its actuarial aspects. I would like to interject a practical note stemming from the second paragraph of the paper in which is stated, "Our first objective is to furnish management with the facts of our experience. . . . Our second objective is to determine experience rates of mortality for dividend purposes."

Ordinarily these different objectives exhibit different treatments in presentation. For example, in the comparison between medical and non-medical business the data have been presented in age groups and to some extent in duration groups. This treatment is used partially to offset variations arising from paucity of data but primarily to show a greater over-all picture. In the aggregate table, where duration is not a factor, the data have been shown for individual ages.

The different treatments in presentation suggest different treatments in processing the raw data. For example, when age groups are satisfactory for presentation it might be desirable to summarize the raw data mechanically according to the central age of each group and thereby reduce the punch-card file to less than 20% of its original size. Such a reduced file would thereafter provide savings in making other mortality comparisons. When it comes to ultimate mortality statistics, where the value arising from summarized data is greatest, the use of independently summarized data by attained age is probably widespread.

The thought occurred to me that it might be feasible to analyze mortality statistics on an ultimate basis by individual attained ages but using the cards already summarized by age groups at issue rather than reverting to raw data based on individual ages at issue. In order to study the effect of this procedure, I went back to the American-Canadian Mortality Investigation, where considerable detailed statistics are available, and made a comparison. In the following table the left-hand portion is taken from Volume 1, page 203, and shows a comparison of actual with expected deaths with first five insurance years excluded; that is to say, the actual

COMPARISON OF MORTALITY STATISTICS
(Each Amount Shown to Nearest Thousand Dollars Only)

AT-TAINED AGE	BASED ON INDIVIDUAL AGES AT ISSUE				BASED ON AGE GROUPS AT ISSUE			
	Exposed to Risk	Actual Deaths	Ex-pected Deaths	Actual to Expected	Exposed to Risk	Actual Deaths	Ex-pected Deaths	Actual to Expected
20.....	\$ 578	\$ 3	\$ 2					
21.....	2,396	7	10					
22.....	5,663	14	23		\$ 24,610	\$ 101	\$ 101	
23.....	12,580	71	53		21,495	85	90	
24.....	21,798	87	93		19,241	76	82	
20-24..	\$ 43,014	\$ 182	\$ 180	100.9%	\$ 65,347	\$ 261	\$ 273	95.7%
25.....	\$ 35,340	\$ 156	\$ 152		\$ 17,353	\$ 79	\$ 75	
26.....	56,838	243	247		15,496	40	67	
27.....	78,493	342	345		146,881	653	645	
28.....	103,050	409	454		134,895	592	595	
29.....	129,713	592	575		126,369	557	560	
25-29..	\$ 403,434	\$ 1,742	\$ 1,773	98.2%	\$ 440,993	\$ 1,921	\$ 1,942	98.9%
30.....	\$ 159,874	\$ 646	\$ 713		\$ 119,849	\$ 515	\$ 535	
31.....	191,208	877	857		113,023	467	506	
32.....	223,505	888	1,008		319,738	1,397	1,442	
33.....	259,625	1,326	1,192		302,258	1,423	1,387	
34.....	294,590	1,360	1,379		289,525	1,462	1,355	
30-34..	\$1,128,803	\$ 5,096	\$ 5,148	99.0%	\$1,144,392	\$ 5,263	\$ 5,225	100.7%
35.....	\$ 331,085	\$ 1,777	\$ 1,583		\$ 280,510	\$ 1,402	\$ 1,341	
36.....	363,553	1,892	1,796		270,440	1,394	1,336	
37.....	395,256	1,919	2,024		493,024	2,504	2,524	
38.....	426,577	2,241	2,269		466,948	2,475	2,484	
39.....	455,391	2,285	2,532		447,222	2,432	2,487	
35-39..	\$1,971,862	\$10,114	\$10,204	99.1%	\$1,958,143	\$10,207	\$10,172	100.3%
40.....	\$ 483,040	\$ 2,682	\$ 2,821		\$ 434,357	\$ 2,638	\$ 2,537	
41.....	506,935	3,231	3,123		420,375	2,777	2,590	
42.....	527,266	3,511	3,448		609,590	3,905	3,987	
43.....	542,723	3,844	3,767		573,101	4,170	3,977	
44.....	553,027	4,062	4,104		542,003	3,958	4,022	
40-44..	\$2,612,990	\$17,329	\$17,262	100.4%	\$2,579,426	\$17,447	\$17,112	102.0%
45.....					\$ 520,198	\$ 3,755	\$ 4,130	
46.....					500,326	4,176	4,263	
45-46..					\$1,020,524	\$ 7,931	\$ 8,393	94.4%

deaths are compared with those expected according to the AM⁽⁵⁾ Table and, accordingly, the comparison is a test of the graduation of the raw data. For the study at hand we may assume that we are comparing any raw data with a table assumed to have a reasonably close relationship. I then went into the tables for individual entry ages and assumed ages 15-19 to be 17, ages 20-24 to be 22, etc. The right-hand portion of the table is comparable to the left-hand portion with the sole exception that issue ages were based on central rather than individual ages.

It will be noticed that the exposed to risk and deaths look peculiar as the eye progresses from one attained age to another. A comparison of the ratio of actual to expected is also peculiar for age group 20-24, but is good thereafter and should be entirely suitable for those many comparisons wherein a considerable margin of error exists, or where emphasis is placed upon relative rather than absolute mortality ratios.

It is suggested that by streamlining the processing of mortality statistics, either considerable savings might arise without distorting the interpretation of such statistics or more extensive comparisons might be possible for the same effort expended.

HODGE L. JONES, JR.:

Guarantee Mutual conducts a policy year mortality investigation each year using valuation group summary cards. We exclude the first three years of exposure in order to approximate an ultimate exposure. The ratios of actual to expected mortality using the 1946-1949 Ultimate Basic Table are shown in the following table. This represents an experience from policy anniversaries in 1948 to 1951. Total death claims for the period numbered 663, 670, and 684 for 1948, 1949 and 1950, respectively.

We expected our mortality to be somewhat less than that of the Basic Table because of (a) the longer select period of the Basic Table, (b) the more recent period covered by our studies, (c) a more favorable geographical location of our risks, and (d) our tendency to avoid large metropolitan areas.

Age Group	1948	1949	1950	Total
25-35	94.87%	75.96%	77.84%	81.89%
36-60	83.80	78.24	95.47	85.95
61 and up	86.20	85.73	78.05	83.16
Total	85.44%	82.31%	85.12%	84.27%

(AUTHOR'S REVIEW OF DISCUSSION)

JAMES F. MACLEAN:

It is extremely gratifying to see the extensive discussion of this note and the various points that were of interest.

As both Mr. Blair and Mr. Elston point out, we must be very careful in the selection of a standard of expected mortality on juvenile business. We especially feel that an age grouping of 0-4 and 5-9 is somewhat dangerous. The rates of mortality change so rapidly that the composite result is overly affected by differing amounts of exposed business. For instance, in the Bankers virtually one-third of the business written below age 10 is at age 0, so that the group result is heavily weighted by the experience at issue age 0.

Mr. Getman's discussion is quite pertinent to the smaller company. In our work, summary cards are used for all tabulations—the detail cards are used as a control file on changes.

Mr. Jones indicated that Guarantee Mutual results were similar to Bankers in their general level.

At the time of the original experience, a complete breakdown by sex was not available. We wondered, therefore, if the low over-all result might be from an undue proportion of female risks. A subsidiary investigation showed the following distribution by sex:

	BY NUMBER OF OF POLICIES		BY AMOUNTS OF INSURANCE	
	Male	Female	Male	Female
Nonmedical.....	66%	34%	75%	25%
Medical.....	83	17	90	10