MORTALITY EXPERIENCE OF FELLOWS
OF THE ACTUARIAL SOCIETY OF AMERICA
AND THE AMERICAN INSTITUTE OF ACTUARIES

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ABSTRACT

This study develops mortality ratios, using contemporary population tables as the base, for the 897 Fellows of the two predecessor bodies to the present Society observed to anniversaries in 1985.

It is a sequel to a study by John R. Larus, the results of which are printed in *TASA* XXXIX [5]. The Larus study embraced 506 Fellows (of the Actuarial Society only). Its exposures totaled 8,000 years; the exposures in this follow-up study total 34,000 years.

The aggregate mortality ratio found by Mr. Larus was 78 percent. The present result shows 64.4 percent.

The paper mentions some of its authors' adventures in compiling this material and expresses some thoughts about future work.

INTRODUCTION

This is the third mortality study of actuaries, and by far the largest in terms of exposures and deaths, that has yet been published. Its first known predecessor was a report in 1899 [12] by the Secretary of the Actuarial Society, Israel C. Pierson, on its members' mortality during that body's first ten years; its second, published in 1938 [5] by John R. Larus while he was the Society's Editor, gave the experience among the Society's Fellows from 1889 to 1937.

We know of no such study published outside North America; indeed there seems to be a dearth of analyses embracing even the broader category of mathematicians. The closest parallel, drawn to our attention by Edward A. Lew, is in a paper by Leon Solomon, "The Age Constitution and the Future Fellowship of the Royal Society (of London)" in that body's *Proceedings* [13]; its population was scientists of many species who had achieved eminence before they entered that experience.

Studies of other learned professions have been made from time to time. Clergy and physicians seem to have been given greatest attention, the former because their mortality has been exceptionally favorable, and the latter, regrettably, for the opposite reason.

Opinions that mathematicians tend to be relatively long-lived have been expressed. Eric T. Bell [1] in his *Men of Mathematics* (1937) quotes an 1869 remark by mathematician and sometime actuary James Joseph Sylvester:

"[T]here is no study in the world which brings into more harmonious action all the faculties of the mind than [mathematics]. ... The mathematician lives long and lives young; the wings of the soul do not drop off, nor do its pores become clogged with the earthy particles blown from the dusty highways of vulgar life."

Miles M. Dawson, the eminent New York consulting actuary, in his 1898 book *Things Agents Should Know* [2], expressed his belief that actuaries would enjoy unusually low mortality because of the lessons they would learn from their own mortality studies. The rapid spread of nonsmoking habits among actuaries after the size of the mortality differential between smokers and nonsmokers was made clear in the 1960s may be considered confirmation of Mr. Dawson's view.

In 1914, past Actuarial Society president Emory McClintock [7, p. 250] remarked without elaboration that "it seems hard to kill off an actuary, the apparent longevity of the Society being very good." This shows him to have been an astute observer; Mr. Larus's study a quarter of a century later showed a mortality ratio (measured by population yardsticks) of 69 percent for the period 1889 to 1915.

THE LARUS STUDY

Inasmuch as this present study has followed the lead of Mr. Larus in its use of population tables, it is appropriate to begin this description by quoting from his paper (p. 24):

"When [United States Life Tables] appeared, at the turn of the century, the records of only a few states . . . were available. Subsequent tables have been based on more extensive geographical lines, so that by 1920 the Registration States covered, with the exception of Iowa, the residence of practically all our United States members. As a standard for the experience of the Society from its formation in April, 1889 to the anniversary of the individual members in 1905, the Table for White Males in the Original Registration States, 1900–1902, has been used, and for the next decade the corresponding table for 1909–1911. Between anniversaries in 1915 and 1925, the Table for White Males in the Registration States of 1920 (1919 to 1921) has been employed,—and the corresponding table, 1929 to 1931, to cover subsequent data."

The present authors have continued to use the successive Census Bureau White Male Tables through the successive decades up to the close of our

study in 1985. This paper's Appendix A shows mortality rates per 1000 at decennial ages by the several yardstick tables.

At the time of the Larus study there had been only 121 deaths among the Actuarial Society Fellows. One of the deceased was a woman, that is, the first woman Fellow, Emma Warren Cushman, elected in 1895. The total number of women in the study was 10; the number of expected deaths (by the White Male tables) was 1.5.

Larus's Table I summarizing the experience for male Fellows is reproduced here in part as Table 1.

TABLE 1

DATA FROM THE LARUS TABLE ON EXPERIENCE FOR MALE FELLOWS
OF THE ACTUARIAL SOCIETY OF AMERICA

	Deaths	Expected	Ratio
Anniversary			
1889–1905	26	30.0	87%
1905–1915	17	32.2	53
1915–1925	32	35.1	91
1925–1937	45	57.6	78
Total	120	154.9	78%
Attained Age			
–39	4	17.1	23%
40–49	11	20.7	53
50–59	22	28.5	77
60–69	26	39.7	65
70–79	41	33.1	125
80–	16	15.8	101
Total	120	154.9	78%

The author's summing up was:

"Even when consideration is given to irregularities due to smallness of numbers, the results in the second half of this table indicate that up to age 70 the actuary enjoys a mortality noticeably better than normal, while the mortality up to age 40 is quite remarkable... ."

We note that two of the four deaths below age 40 arose from the influenza epidemic of 1918.

THE PRESENT INVESTIGATION

Although this is a sequel to the Larus investigation, there is one important difference: Mr. Larus followed only the experience of Fellows of the Actuarial Society, whereas we have covered the Fellows of both bodies that

preceded the present Society. Each life is observed from the first entrance date in either body, and observation in the case of withdrawals continues until the Fellow is no longer in either body.

Furthermore, the much greater volume of exposures has permitted us to examine the experience in four categories: Canadian men, United States men, Canadian and United States women, and Overseas Fellows. This geographical separation reflects each person's status at the time his or her actuarial career began. The Overseas category comprises a group of what may be considered honorary memberships conferred upon eminent actuaries of other countries; such memberships were granted frequently during the Actuarial Society's first 15 years but rarely after that.

The most troublesome parts of this work have been making sure that we did not inadvertently omit any member and collecting data on birth dates, particularly of actuaries who withdrew or whose dates were not given in full in their obituaries. Larus remarked on this latter difficulty, and James R. Herman went over some of the same ground in writing his paper "Actuaries—Past, Present and Future" for the final volume of the old *Transactions* [4]. We have tried to make this the last time that such compilation *ab initio* will be necessary by filing in the Society library a complete list of the 897 Fellows with applicable dates. But the Society needs to be mindful of historical needs before records are destroyed. A formal Board directive on this point would doubtless be helpful.

Incidentally, a difference of one turned up between our count and Mr. Herman's of the Fellows admitted to the Actuarial Society. This involved Samuel E. Stilwell, elected in 1891 but required to withdraw in 1894, because during that era the Society excluded persons engaged in life insurance sales work. Herman treated him as a new member when he returned in 1903; in our work the hiatus is ignored.

Table 2 summarizes our results by exposure periods.

Table 3 gives this study's results by attained age for each of the two groups large enough to warrant this analysis, U.S. men and Canadian men. Ages in this study are at nearest birthdays.

In Table 4 the same statistics are shown for three major calendar-year blocks by attained ages, combining the data for U.S. men and Canadian men.

TABLE 2

EXPECTED DEATHS, ACTUAL DEATHS, AND MORTALITY RATIOS BY CALENDAR YEARS

Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
	All Lives			U.S. and Canadian Men			U.S. and Canadian Women		
1889–1905 ...	30.31	26	85.8%	23.39	17	72.7%	0.19	0	⎫
1905–1915 ...	37.61	21	55.8	29.22	15	51.3	0.40	0	
1915–1925 ...	46.27	40	86.4	38.34	37	96.5	0.58	1	
1925–1935 ...	67.04	47	70.1	56.00	36	64.3	0.47	0	45.5%
1935–1945 ...	73.10	55	75.2	68.80	53	77.0	0.90	0	
1945–1955 ...	90.04	70	77.7	85.69	65	75.9	1.86	1	⎭
1955–1965 ...	129.61	71	54.8	125.77	71	56.5	3.84	0	⎫
1965–1975 ...	188.59	113	59.9	182.30	109	59.8	6.29	4	38.5
1975–1985 ...	208.04	118	56.7	200.01	115	57.5	8.03	3	⎭
Total	870.61	561	64.4%	809.52	518	64.0%	22.56	9	39.9%
	U.S. Men			Canadian Men			Overseas Fellows		
1889–1905 ...	20.86	16	76.7%	2.53	1	⎫	6.73	9	
1905–1915 ...	25.23	15	59.5	3.99	0	⎪	7.99	6	
1915–1925 ...	31.61	32	101.2	6.73	5	54.2%	7.35	2	
1925–1935 ...	41.60	27	64.9	14.40	9	⎭	10.57	11	
1935–1945 ...	48.14	36	74.8	20.66	17	82.3	3.40	2	
1945–1955 ...	57.73	43	74.5	27.96	22	78.7	2.49	4	
1955–1965 ...	88.29	45	51.0	37.48	26	69.4			
1965–1975 ...	120.69	77	63.8	61.61	32	51.9			
1975–1985 ...	130.30	80	61.4	69.71	35	50.2			
Total	564.45	371	65.7%	245.07	147	60.0%	38.53	34	88.2%

TABLE 3

EXPECTED DEATHS, ACTUAL DEATHS, AND MORTALITY RATIOS BY ATTAINED AGES

Ages	U.S. Men			Canadian Men		
	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
–39	19.00	6	31.6%	10.06	7	69.6%
40–49	38.92	13	33.4	17.06	8	46.9
50–59	82.19	45	54.8	33.69	29	86.1
60–69	146.13	102	69.8	61.27	25	40.8
70–79	158.57	119	75.0	77.19	43	55.7
80–89	98.75	62	62.8	38.30	28	73.1
90–96	20.89	24	114.9	7.50	7	93.3
Total	564.45	371	65.7%	245.07	147	60.0%

TABLE 4

MORTALITY RATIOS, U.S. AND CANADIAN MEN COMBINED, FOR CALENDAR-YEAR BLOCKS
BY SELECTED GROUPS OF ATTAINED AGES

Ages	1889–1925			1925–1955			1955–1985		
	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
–49	25.45	9	35.4%	49.01	20	40.8%	10.57	5	47.3%
50–59	18.62	13	69.8	42.04	30	71.4	55.22	31	56.1
60–69	23.97	22	91.8	49.77	35	70.3	133.66	70	52.4
70–79	16.30	19	116.6	42.15	49	116.3	177.31	94	53.0
80 and over ..	6.61	6	90.8	27.52	20	72.7	131.32	95	72.3
Total	90.95	69	75.9%	210.49	154	73.2%	508.08	295	58.1%

DISCUSSION OF FINDINGS

For the period 1889 to 1905 this study naturally shows inconsequential differences from the Larus study. For 1889 to 1935, approximately the period that Mr. Larus studied, our exposures are larger than his because we included Fellows of the American Institute. One point of interest is that Larus's mortality ratios are mildly higher than they would have been if he had segregated North American experience from that of the honorary overseas members.

The most striking feature of the "All Lives" portion of Table 2 is the sharp decline in the ratios to population mortality that has occurred since 1955. The figures in Table 4 seem to dispose of any thought that this might be attributable to the large decennial shift in age distribution that comes from this having been a closed group since 1948. Naturally there were no longer any lives exposed below age 60 in 1985.

The most useful measure of these results would come from comparing them with data from other professions. The problem is finding material that is comparable. It is of interest that the study [13] of Royal Society members mentioned early in this paper (which employed population yardsticks in roughly the same way as Larus and we have done) showed a mortality ratio of 69.3 percent, in the same range as this present result.

In the early days of the Actuarial Society several papers on mortality among relevant outside groups were presented in the *Transactions*. Volumes IX and X ([8], [14]), for example, have papers giving experience among Yale graduates; Volume XIX [9] has one on clergy mortality in which author Walter S. Nichols remarked (p. 75) that his and other data tally "with the general view that clergymen and lawyers are among the best insurance risks, while the lives of physicians are decidedly inferior."

Actuaries on this continent have published little on this subject since then, except in formal mortality studies. An interesting exception is Frank L. Griffin's 1940 paper, "Mortality of United States Presidents and Certain Other Federal Officers" [3], which study showed a mortality ratio to the American Men Ultimate Table of 102 percent based on 107 deaths.

In the present Society's *Transactions,* the late Arthur Pedoe presented two papers in the early 1960s ([10], [11]) on mortality by social classes and professions; his results did not encourage any expectation of mortality ratios to population tables in the low-60 range that have now turned up for actuaries.

Mr. Lew's 1984 paper with Lawrence Garfinkel, "Mortality at Ages 65 and Over in a Middle-Class Population" [6], presents an opportunity for a different kind of comparison in that those authors gave figures arising during the 1960s and into the 1970s labelled "Ostensibly Healthy Males" (OHM). We have applied those OHM graduated mortality rates (p. 265) to the exposures of U.S. and Canadian male actuaries in the years 1955 to 1985 with the results shown in Table 5.

TABLE 5

MORTALITY RATIOS, U.S. AND CANADIAN MALES, TO OHM TABLE
(EXPOSURE YEARS 1955–1985)

Age Group	Expected Deaths	Actual Deaths	Mortality Ratio
65–79	171.12	134	78%
80 and over	101.18	95	88
Total	279.30	229	82%

Perhaps Mr. Lew, in a discussion of this paper, would give us the benefit of his appraisal of the above ratios. And other discussions comparing mortality of actuaries with that of any other professional groups will be welcomed.

Following are the exposures upon which the figures in the present study are based. They are compared with the exposures in the Larus study [5] and Dr. Solomon's Royal Society study [13]:

Exposures of Present Study
    Canadian Men   10,201 years
    United States Men   22,251
    Women   692
    Overseas   1,005
      Total, Present Study   34,149 years
  Exposures of Larus Study   7,944 years
  Exposures of Solomon Study   19,989 years

We have not undertaken a mortality study of Associates even though there is now sufficient material to make this worthwhile. We did look into the deaths of Associates of the Actuarial Society and American Institute (that is, those who were not Fellows of either body) and found that they numbered only 52. But there were 427 Associates on the Society of Actuaries original roster, about 180 of whom had not become Fellows 15 years later; this would produce a considerable exposure over the entire period from 1898, when the first Associate who never became a Fellow was admitted, to the present era. Since the names of Associates of the Actuarial Society and American Institute who died before the merger of those bodies have never been published in toto, we furnish a list in Appendix B for possible future use.

Also we will file the working papers for this study of Fellows in the Society's archives.

Apart from the possibility that a few of those who withdrew from membership might have done so in contemplation of death, the risk of deaths not having been recorded seems trivial, but in fact this almost did happen. A check made to determine that a Fellow of the year 1924 born in 1890 was still alive showed that indeed he wasn't—he had died in 1973! And after this paper had been submitted, a 1940 Fellow was discovered to have died in 1981. To help assure that these were isolated cases, we arranged for obliging local actuaries to make direct enquiries of all Fellows and Associates who were born before 1900, with satisfying results.

INCIDENTAL INFORMATION

The highest age attained by any Fellow up to the close of this study was 96 years, 5 months, 28 days, achieved by Solomon A. Joffe at his death in 1964. That record was eclipsed twice in 1989, first by Henry P. Morrison, who died at age 96 years, 8 months, 9 days, and then by Clarence R. Goodrich, who died nine days before his 97th birthday.

The youngest Fellow at qualification was Harold J. George in 1941—22 years, 6 months, 10 days. Sadly, in 1952 he became one of the Society's youngest to die.

The oldest to achieve Fellowship by examination in the American Institute was Manitoba's Professor L.A.H. Warren. Born in 1879, he qualified as an Associate of the Actuarial Society in 1922; not until 1935 did he pass his final American Institute examination. Many a time he sat in the examination room with some of his own students.

The oldest to achieve Fellowship by examination in the Actuarial Society was Thomas J. Maccabe, New York. Born in 1878, he graduated from college in 1896, joined Metropolitan Life in 1913 and completed his examinations in 1928 at nearest age 50.

Turning to aggregate numbers: Of the 897 Fellows in this study, 216 died and 39 withdrew before the two bodies merged in 1949, leaving 642 to become charter Fellows of the present Society. Those on the rolls at their 1985 anniversaries numbered 287; by July 31, 1989 this number had declined to 234. The earliest Fellowship year now represented on the roster is 1923.

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APPENDIX A

MORTALITY RATES PER 1000 AT DECENNIAL AGES IN THE POPULATION TABLES FOR WHITE MALES EMPLOYED IN THIS STUDY

Age	1889–1905* 1900–1902†	1905–1915 1909–1911	1915–1925 1919–1921	1925–1935 1929–1931	1935–1945 1939–1941	1945–1955 1949–1951	1955–1965 1959–1961	1965–1975 1969–1971	1975–1985 1979–1981
30 ..	7.99	6.60	5.73	4.05	2.79	1.82	1.56		
40 ..	10.60	10.22	7.50	6.85	5.13	3.91	3.32	3.40	
50 ..	15.37	15.53	11.74	13.03	11.55	10.12	9.55	8.92	7.06
60 ..	28.59	30.75	24.62	27.01	25.48	23.81	22.71	22.58	17.62
70 ..	58.94	62.14	54.63	58.49	54.54	50.27	48.71	49.16	41.48
80 ..	133.53	135.75	119.73	129.75	124.71	109.93	107.32	104.66	90.99
90 ..	262.78	255.17	238.19	246.21	248.94	228.90	236.01	213.44	190.58

*Period of exposures in this study.
†White males population table employed.

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APPENDIX B

Date of Death	Name	Year Admitted	Which Body
April 30, 1901	Daughtrey, William Lamb	1900	Soc.
April 6, 1912	Nelson, Nels	1909	Inst.
March 8, 1917	Chubb, William	1906	Soc.
Sept. 1, 1917	Travassos, Abel	1904	Soc.
April 30, 1918	Cushing, Robertson Macaulay	1909	Soc.
Oct. 15, 1918	Johnson, Oscar Fritz	1918	Soc.
Aug. 4, 1920	Atkins, Leonard G.	1910	Soc.
July 12, 1921	Fitzgerald, William George	1906	Soc.
April 15, 1923	Mather, Stanley P.	1912	Soc.
1924	Clement, Arthur Enoch	1919	Inst.
Aug. 13, 1924	Strong, Allan Wilmot	1906	Soc.
Nov. 2, 1924	Brough, Franklin	1906	Soc.
Aug. 5, 1927	Beecroft, John Daniel	1916	Soc.
Oct. 17, 1928	Venus, Henry A.	1927	Soc.
Nov. 11, 1928	Grigg, Benjamin Wills Newton	1906	Soc.
Aug. 19, 1929	Forster, Robert Elder	1900	Soc.
1930	Maynard, Joseph Duryea	1916	Inst.
May 20, 1930	Kaufman, Henry Nicholas	1898	Soc.
June 5, 1930	Smith, Harry Allan Le Fevre	1929	Soc.
Oct. 4, 1930	Burkart, Charles J.	1914	Inst.
Nov. 2, 1930	Ryan, Harwood Eldridge	1907	Soc.
Oct. 13, 1931	Stanton, Dorothy Rosemary	1929	Soc.
Aug. 26, 1932	Wheeler, Roy Arthur	1917	Soc.
Dec. 6, 1934	Stanley, Walter Newell	1902	Soc.
July 8, 1935	Yort, Jens Peter Marius	1915	Inst.
March 16, 1936	Scott, Martin R.	1914	Inst.
Sept. 11, 1936	Davis, Francis Franklin	1919	Soc.
Dec. 15, 1936	Brooks, Charles Edward	1918	Inst.
March 14, 1937	Egan, Thomas J.	1935	Both
Sept. 21, 1937	Vail, Roger Sherman	1909	Inst.
Feb. 24, 1938	Wiggins, Horace Scoville	1909	Inst.
April 9, 1938	Franks, James Brown	1910	Soc.
June 15, 1938	Smith, Charles Gordon	1907	Soc.
Jan. 11, 1939	Halliday, William Ross	1911	Soc.
April 4, 1939	Brown, James Cornelius	1903	Soc.
May 6, 1939	Hollies, William St. George	1932	Inst.
Sept. 24, 1941	Reid, Edward Ernest	1906	Soc.
Oct. 12, 1941	Keys, Millard	1917	Soc.
Aug. 18, 1942	Reilly, John Franklin	1920	Inst.
Sept. 28, 1942	Sturtevant, Robert Brown	1915	Inst.
Oct. 5, 1942	Strudell, Fred David	1913	Inst.
April 22, 1943	Williams, John Forest	1910	Soc.
Oct. 2, 1943	Forbes, Charles Savage	1906	Soc.
June 19, 1944	Springer, Harold Merle	1925	Soc.
Sept. 4, 1944	Moore, George Cecil	1906	Soc.
May 11, 1945	Vanular, John Henry	1939	Both
Jan. 1, 1946	Davenport, John Sidney	1900	Soc.
March 13, 1946	Mehlman, Harry	1932	Inst.
Dec. 9, 1946	Bliss, George Isaac	1903	Soc.
July 31, 1948	Carrington, John Randolph L.	1903	Soc.
1948	Fetsch, Harry Christian	1912	Soc.
May 13, 1949	Barlow, Howard Carter	1909	Soc.

DISCUSSION OF PRECEDING PAPER

STEVEN HABERMAN:

The authors have written an interesting paper on the mortality experience of the Fellows of the Society's two predecessor bodies, following the lives until 1985.

The overall mortality ratio is 64.4 percent relative to contemporaneous life tables for white males. How is this to be interpreted? The authors indicate that it would be useful to compare this index (and the other more detailed results quoted in the paper) with data from other professions. I would take this point further and argue that the indexes calculated by the authors are only meaningful if they can be compared with corresponding indexes for other occupational groups and for specific socioeconomic groups. Without such comparisons, one is left to wonder at the significance of the low mortality rates observed for this particular group of individuals.

Pursuing this point, I would draw attention to the selective forces that operate in relation to membership of a well-defined occupational group. There is a positive selective force operating on entry to an occupation (called by scientists the "healthy worker effect"; see Fox and Collier [2]), whereby the impaired and disabled are more likely to be excluded from entry. A second selective force operates through the process of survival as a member of an occupation, in that the impaired and disabled are more likely to withdraw or retire. Given these two selective forces and the characteristics of the Fellows in the study who presumably had to achieve a certain status before their qualification or admission as Fellows, it is clear that "duration since entry" provides a time dimension that may be worth analyzing, just as in the classical case of temporary initial selection in life insurance. Therefore, I would like to see analyses of the authors' data that examine the effect of "duration since entry."

The authors' presentations in Tables A, B, and C recognize that the mortality rates can be considered as being associated with a calendar-year effect, a national effect, and an attained-age effect. Indeed Table C explores the possibility of a significant interaction between attained age and calendar year. The tabular presentations are essentially marginal explorations of the data and do not permit either a detailed analysis of interactions or a consideration of statistical significance. A modeling framework that addresses these problems is that offered by generalized linear models as facilitated by the statistical package, GLIM. In recent years, this framework has been applied to the variation in life insurance lapse rates by age, duration, policy type,

company (Renshaw and Haberman [7]); the variation in extra mortality rates by age, duration, year, medical factors (Haberman and Renshaw [3], [4]); and Renshaw [5]; and now the graduation of mortality rates (Renshaw [6]).

It would be useful to mention here the modeling of extra mortality rates quoted above. This rests on the proportional hazards models introduced by Cox [1], where the force of mortality at time t is considered to be a function of a vector of covariates z (for example, age, calendar year, country, duration of membership). The model then assumes that

$$\mu(t, z) = \mu^* (t) \exp (\beta^T z) \qquad (*)$$

where $\mu^* (t)$ is a "baseline" set of forces of mortality (that is, hazard rates) and β^T is a vector of regression coefficients that are estimated by a technique akin to maximization of the likelihood function. This approach would enable the regression coefficients to be estimated in an "optimal" manner and would enable statements to be made about the statistical significance of these coefficients. It would also permit complex structures involving interaction of factors to be explored, in a manner analogous to analysis of variance.

Applications of Equation (*) have proliferated in the field of medical statistics in which $\mu^*(t)$ is *unknown*. The actuarial applications referenced above and the study of Cook and Moorhead provide situations in which there are sensible choices of $\mu^*(t)$: for Cook and Moorhead's study, this would be the set of life tables used by them in the paper under discussion.

The multiplicative factor, $\exp(\beta^T z)$ may be considered as adjusting the "baseline" force of mortality by an amount of reduced mortality (in this case) attributable in some way to the occupational status, inter alia, of the Fellows under observation. Akin to Cook and Moorhead's mortality ratio, this factor would be used as a relative measure of the reduced mortality.

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EDWARD A. LEW:

First, I thank Jack Moorhead and John Cook for their valuable contribution to the profession by way of updating our family history of longevity. It can be regarded as a timely application of life table techniques to *Our Yesterdays*.

The authors have demonstrated clearly that the actuarial profession has been long-lived in relation to contemporaneous death rates in the general population. Over the period 1955–85 actuaries aged 65 and older recorded distinctly lower death rates than ostensibly healthy men drawn from the middle class. The question naturally comes up, How do actuaries compare with other long-lived professions?

Professional men as a class have experienced significantly lower mortality than that observed in the general population. The most reliable data for the U.S. were derived by Kitagawa [4] in the so-called 1960 Matched Records Study and showed a mortality ratio of 80 percent for male professional, technical and kindred workers in the age range 25–64. The corresponding mortality ratio for men who had four or more years of college was 70 percent. The latest British investigation [11] of mortality by occupational groupings covered the years 1979–83 and, for men in professional and related pursuits, came up with a mortality ratio of 66 percent in the age range 15–64.

Evidence from disparate sources indicates that some categories of scientists have experienced very low relative mortality, of the order of 55 percent of that in the general population. This evidence includes (1) a series of U.S. Public Health Service Reports based on the 1950 census by occupational groupings [9], (2) a Metropolitan Life Insurance Company study [6] of professional and business men who were listed in the *1950–51 Who's Who in America*, and (3) the 1979–83 British investigation of occupational mortality [11]. This last study showed a mortality ratio of 60 percent for the category "scientists, physicists and mathematicians" and a 66 percent mortality ratio for "economists, statisticians and system analysts."

An earlier 1970–72 investigation of occupational mortality by the Registrar General for England and Wales [10] came up with a mortality ratio of 50 percent for university professors. The Metropolitan Life study [6] of prominent men listed in the *1950–51 Who's Who* showed a mortality ratio of 60 percent for college professors.

A 24-year post-World War II follow-up study [12] of U.S. Army officers commissioned during that war showed that those with at least a high school education registered a mortality ratio of 53 percent in relation to contemporaneous death rates in the general population. A review of the figures published by the Veterans Administration for the period 1976–83 [8], [13] showed that officer personnel of the U.S. armed forces on active duty recorded a mortality ratio of 52 percent, but with much higher ratios at ages under 35 in the Marine Corps. British Army officers at ages under 55 recorded a mortality ratio of 54 percent during the mid-1970s.

Several mortality studies [3], [5] of U.S. clergymen in the principal Protestant denominations produced mortality ratios close to 70 percent, with ratios of about 55 percent at ages under 65 and ratios of about 75 percent at ages 65 and older. The clergymen in the Metropolitan Life study [6] of prominent men listed in the *1950–51 Who's Who* registered a mortality ratio of 62 percent.

A comprehensive mortality investigation [2] of U.S. physicians over the period 1969–73 showed an overall mortality ratio of about 75 percent in relation to that of the general population. By specialty the relative mortality of physicians ranged from about 85 percent among general practitioners to less than 60 percent for certain specialties, such as pediatrics and pathology; not so very long ago the mortality of general practitioners was little different from that of the general population [1]. It is significant that in more recent years the mortality of physicians under 65 years of age was only about 65 percent of that in the general population, while at ages 65 and older it was about 80 percent.

It thus appears that actuaries rank with the most long-lived professions, such as scientists, college professors, army officers, and some medical specialties. If the death rates for actuaries developed by the authors over the period 1955–85 were to continue in the future, the life expectancies of actuaries aged 60, 65, 70, and 75 would be approximately 21.4 years, 17.5 years, 13.9 years, and 10.6 years, respectively. The U.S. 1979–81 decennial life tables for white males show corresponding figures of 17.6 years, 14.3 years, 11.4 years, and 8.9 years, respectively.

In my judgment the most remarkable feature of the mortality experience among actuaries during the period 1955–85 lies in the very low mortality at ages 60 and older. While the low mortality at ages under 60 reflects in large measure the effects of "class selection," including high educational attainments, the very low mortality at ages 60 and older bespeaks of such characteristics as moderation, carefulness, and discipline associated with our profession.

I would surmise that a lifestyle calling for continuing professional and public activity in retirement might well be a significant factor for longevity.

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JOHN M. BRAGG:

Papers that are of interest to the actuarial profession from a personal standpoint are very rare. This is one of them, and the authors deserve congratulations.

The study is based on a closed block of 897 lives, measured over a very long exposure period; 561 of the lives have died. This then is a very mature closed block. Studies of closed blocks are not common, and I hope that this particular one will continue to be studied. Having said that, though, I also hope that future studies will include the much larger group of later members of the profession. (As an FSA 1949, I just barely missed being in the exposure for this study!)

When I read the paper, I immediately wondered how the results would compare with insured life mortality. This thought was reinforced by Miles Dawson's belief, quoted in the paper: "... actuaries would enjoy unusually low mortality because of the lessons they would learn from their own mortality studies." To answer this question, I have compared the most recent experience (1955–1985), for U.S. and Canadian men combined, with the Society's 1975–80 Basic Ultimate Table (male). This could be done only approximately from the data in the paper, but the attempt was worth making. I proceeded by adjusting the expected deaths in the third-last column of Table 4 by the ratio of 1975–80 Basic mortality (ultimate) to the average population mortality shown in the last three columns of Appendix A:

U.S. AND CANADIAN MEN COMBINED
EXPERIENCE FOR 1955–85

Ages	Based on Population Mortality (Table 4)	Based on 1975–80 Basic (Ultimate) (estimated)
−49	47.3%	97.1%
50–59	56.1	103.0
60–69	52.4	83.9
70–79	53.0	72.5
80 and over	72.3	88.3
Total	58.1%	82.9%

I then looked up the latest available results for male Standard Ordinary mortality (durations 16 and up) from the *1984 Reports* of the Society of Actuaries (p. 23). This experience covered the years 1979–84, and the result

was 93.2 percent. A comparison with 82.9 percent would confirm the belief (which I think we all share) that actuaries "enjoy unusually low mortality." It is rather interesting to be confirming Mr. Dawson's opinion 92 years after it was stated!

I also wondered how the experience would compare with modern non-smoker mortality experience. I was encouraged in this by the statement in the paper: "The rapid spread of nonsmoking habits among actuaries after the size of the mortality differential between smokers and nonsmokers was made clear in the 1960s may be considered confirmation of Mr. Dawson's view." To test this point, I proceeded in the same way to compare the most recent block with the 1986 Bragg Nonsmoker Male Mortality Table, which had been constructed from 1980–84 data.

U.S. AND CANADIAN MEN COMBINED
EXPERIENCE FOR 1955–85

Ages	Based on 1986 Bragg Nonsmoker Male (Ultimate) (estimated)
−49	137.4%
50–59	147.3
60–69	110.7
70–79	85.8
80 and over	94.7
	99.1%

The closeness of the total result to 100 percent was quite astonishing, but the high results at younger ages seemed to mean that the lesson had especially been learned by the more senior Fellows! This meaning is probably not correct, however; because of the closed-block structure, most of the younger-age deaths must have occurred in the earlier part of the 1955–85 exposure period, before the effect of smoking became clear.

Both tables shown above may also be showing the strong improving trend in mortality that has been taking place. (Higher age tends to mean later experience.) This trend is evident from Society of Actuaries *Reports* and in studies made by the author of this discussion, and it appears to be continuing into the 1980s.

Cook and Moorhead are to be thanked for presenting us with this most interesting paper, and I hope that similar studies will be made in the future.

SHEILA I. KELLEY:

Because one of the authors is my father, it was easy for me to obtain data on experience of those 76 actuaries among the 897 exposed who served as presidents of either of those predecessor bodies or of the present Society. The results, displayed within the same eras as those in the paper itself, are as follows:

MORTALITY OF ACTUARIAL PRESIDENTS, 1889–1985
(LIFE-YEARS EXPOSED = 1,627 YEARS)

Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratios	
			Presidents	All Male U.S. and Canadian Fellows*
1889–1905	1.81	2	110%	73%
1905–1915	4.40	3	68	51
1915–1925	6.99	6	86	97
1925–1935	6.68	5	75	64
1935–1945	8.19	11	134	77
1945–1955	10.11	8	79	76
1955–1965	12.39	9	73	56
1965–1975	12.34	8	65	60
1975–1985	12.93	7	54	57
Total	75.84	59	78%	64%

*Data in authors' paper, Table 2 (U.S. and Canadian Men).

Thus, mortality among our presidents has run 14 points above that for all Fellows on this continent. The probable error in the 78 percent mortality ratio shown above for presidents is ± 7 by the formula 2/3 M.R./$\sqrt{\text{Actual Deaths}}$.

Mr. Griffin's paper of a half-century ago (authors' reference [3]) happened also to show a substantial excess of U.S. Presidents' mortality over that of all senior federal officers.

Note that almost 10 percent of all the deaths of our presidents occurred in a single cataclysmic year, 1942. Those who died that year were Henry W. Buttolph at age 71, Robert Henderson at age 70, William A. Hutcheson at age 74, John M. Laird at age 57, and Thomas B. Macaulay at age 81.

The only one of our presidents to die while still in that office was Franklin B. Mead in 1933 at age 58.

HARRY A. WOODMAN:

It is reassuring to learn from this paper that we, as actuaries, can expect long lives. The paper supports the findings in previous studies that those in most professions experience much better than population mortality.

It is interesting to consider the possible reasons for this favorable mortality experience. As Cook and Moorhead state, actuaries are often in a better position to closely evaluate the causes of poor mortality and to be motivated to avoid these causes.

In addition to a greater sensitivity to such health factors as smoking, cholesterol, blood pressure, and exercise, actuaries have benefitted from the relatively low-stress environment of an insurance industry that has not, until recently, been exposed to external competition to any great extent. One wonders whether the greater stresses experienced by actuaries today will have an impact on actuaries' longevity.

The use of population mortality for expected deaths, which was certainly a reasonable and readily available measure for comparison, overstates the favorable level of mortality for actuaries as compared to other actively at-work persons. It is well-known that actively at-work persons experience better mortality than the population as a whole.

If an adjustment for this factor were made, the favorable mortality ratio for actuaries would be somewhat increased (as would the mortality ratio for other occupations). For illustration only, if we assume that 10 percent of the population is unemployed (including many in poor health) and experiences mortality twice that of the remaining population, the expected mortality ratio of the employed population would be reduced by about 9 percent; or if the unemployed population experiences mortality three times that of the employed population, the expected mortality of the employed population would be reduced by 17 percent. This would increase the mortality ratio for actuaries from about 65 percent, as related to the total population, to about 70 percent to 80 percent, as related to the employed (that is, actively at work) population—still an excellent result.

As in most mortality studies of this nature, there is a concern about the possible bias that could be introduced by an understatement of deaths among those lives that cannot be traced. Fortunately the number of untraced lives is relatively small. Perhaps efforts can be made by the Society office to obtain further information.

We hope that the substantial amount of research that has been done by the authors will be preserved in the Society library as they have suggested, and that this study will be updated from time to time. As experts in the study of mortality experience, actuaries should be sufficiently interested in their own mortality experience to make these studies. We are glad that John Cook and Jack Moorhead have taken the time to produce this study, and we thank them for their excellent efforts.

Information drawn from many studies indicates that there are wide mortality differentials within "normal" groups, that is, those without a concentration of medically impaired risks or large exposure to accident hazards. We have learned more and more about these wide mortality differentials as we have studied mortality of insureds versus annuitants, males versus females, smokers versus nonsmokers, and blue-collar versus white-collar workers. The relatively low mortality for actuaries is another example of favorable white-collar-worker experience.

CHARLES G. GROESCHELL:

This paper will be of great interest, now and in the years to come, to every actuary in and out of North America. It was of particular interest to me because of a much more modest and simpler study I did several years ago on the members of my graduating class of 1938 from Washington & Jefferson College and reported at our fiftieth class reunion in 1988.

In 1938 W & J was an all-male school with enrollment limited to 500, and there were only 104 graduates. During the next 50 years there were only 35 deaths. Using successive Census Bureau White Male Tables, as was done in the paper, the ratio of actual to expected deaths was 74 percent. On the basis of the 1980 CSO Table, this ratio was 80 percent. The only male table that I could find that produced a ratio over 100 percent was Northwestern Mutual's current dividend mortality table for Select male lives, where the ratio was 110 percent. We had only three more deaths than that expected by this table.

Because of the apparent dearth of information on the mortality experience by occupation, I explored classifying the members of the 1938 class by the occupation they pursued. The results are shown in the following table:

Occupation	Graduates	Deaths Number	Deaths Percent
Lawyers	8	1	12.5%
Clergy	6	1	16.7
Education and Military	15	3	20.0
Physicians	12	3	25.0
Business	26	11	42.3
Science and Professional	18	8	44.4
Other and Unknown	19	8	42.1
	104	35	33.7%

The numbers are small, and the classifications might not be entirely consistent (changes in occupation and the like). However, the figures for the first four occupation classes are likely to be correct. They indicate quite an agreement with the observations in the paper, except that W & J's physicians in the class of 1938 were not "decidedly inferior risks."

(AUTHORS' REVIEW OF DISCUSSION)

JOHN H. COOK AND ERNEST J. MOORHEAD:

The six actuaries who did us the honor of discussing our paper have added scientific perspective and have confirmed our belief that the task of assembling all our data was well worth while.

Of the two selective forces pointed out by Haberman—the "healthy worker effect" at entry and withdrawals from membership by actuaries whose health was failing—the former is far more significant than the latter because, of the 897 entrants, only 49 withdrew during the 96-year exposure period. Furthermore, Larus in his 1938 paper concluded (reference [5]), after studying the subsequent experience of 22 of these, that resignation seemed not to be coupled with ill health. We appreciate Haberman drawing the modern modeling technique to our attention.

Lew has given readers the benefit of his intimate knowledge of mortality experience among professional and other special groups. It seems that in modern times a rather narrow range of ratios (to population measuring sticks) embraces almost all of these. Of special interest is the decline in the mortality level in the medical profession since general practitioners have moved sharply away from their practice of being personally available to patients at all hours of day and night.

Bragg has made an extensive study of relationships to experience of various groups of insured lives. We are pleased to assure him that his approximations are very close to the mark. Also, a study of the results among Fellows who qualified in 1949 and later is already under way.

Kelley's analysis seems to tell us that if actuarial presidents have been under any increased strain during their terms of office it has not been severe enough to damage their health materially. Woodman, however, raises the grim prospect that all actuaries may be harmed by the new stresses of today's members in a competitive struggle that has no precedent in the profession on this continent (except perhaps in the era just before the Armstrong Investigation of 1905).

Groeschell is one of perhaps numerous actuaries who have studied the experience among their college or other identifiable groups. That same subject came up in the discussion of Larus's 1938 paper, which we acknowledged as our inspiration. One of the Actuarial Society's humorists, Henry H. Jackson, having ascertained that the experience of a group of Yale graduates was even more favorable than that of the actuaries, posed this question[*]:

> ... Underwriting Departments are confronted with a new perplexity. If an Actuary who is also a Yale graduate, Mr. Larus for instance, applies for insurance, shall he be given a credit of 18 points for being an Actuary, or a credit of 26 points for being a Yale graduate, or a credit of 44 points for being both an Actuary and a Yale graduate?

About five years having elapsed since the close of our observations, we are relieved to find that only a single death has since turned up as unreported. This was a Fellow who had died in 1982 at age 86. The 69 deaths between 1985 and 1990 anniversaries produce a mortality ratio of 61 percent based on the 1979–81 U.S. Life Table, a continuation of the low ratios reported in the paper.

As we go to press, the number of survivors of the original 897 actuaries has fallen to 211. We shall continue following their experience as long as time is granted us to do so.

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[*]JACKSON, H.H. Discussion of "Mortality Study of Fellows of the Actuarial Society of America," *TASA* XXXIX (1938): 345–47.