MORTALITY EXPERIENCE OF MEMBERS OF THE SOCIETY OF ACTUARIES

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ABSTRACT

This study develops mortality ratios, using contemporary population tables and standard industry tables as the base of expected deaths, for 3,037 members (2,811 Fellows and 226 Associates) of the Society of Actuaries observed from January 1, 1955 through December 31, 2004.

It is a sequel to and an expansion of a study by John H. Cook and Ernest J. Moorhead, which was published in TSA, Volume XLII, 1990, p. 35. The sequel is the mortality experience of Fellows of the two predecessor bodies to the Society of Actuaries. The expansion is to all Fellows with fellowship attained in one of the calendar years 1949 through 1974 and to pre-1949 male Associates who did not become Fellows. The Cook-Moorhead study developed more than 34,000 years of exposure for pre-1949 Fellows; the exposures in this study total more than 100,000 years for pre-1975 Fellows and Associates.

The present study shows an aggregate mortality ratio of 59.6% for male pre-1949 Fellows and an aggregate mortality ratio of 49.7% for male pre-1975 Fellows where the base of

expected deaths is male population mortality developed by the Social Security Administration.

For the observation period 1985-2004 the mortality ratios relative to the male 1983 GAM are 75.1% for male pre-1949 Fellows and 60.0% for male pre-1975 Fellows; the mortality ratios relative to the male 1975-80 Basic Table Ultimate are 69.5% for male pre-1949 Fellows and 53.2% for male pre-1975 Fellows; the mortality ratios relative to the male 2001VBT Ultimate are 79.4% for male pre-1949 Fellows and 65.6% for male pre-1975 Fellows. These results when compared against recent life and pension mortality experience suggest FSAs rank with the most long-lived groups. Carriers who have actual experience on comparable professional groups might be able to contribute to the discussion of precisely how good the mortality experience of actuaries is.

INTRODUCTION

Actuaries and other individuals interested in studying human mortality even in a peripheral sense may want to read this paper because it documents the mortality experience of actuaries, illustrating an approach that is easy to use on any group of delineated individuals whose birth years are known. This paper also illustrates how one might test the statistical significance of various findings and identifies sources of data that are available. Finally, if comparable data is available on other professional groups, then comparable studies might reveal facts about similarities or differences in mortality experience, which may have practical applications in underwriting.

This is the fourth mortality study of actuaries that has been published, and it is the largest in terms of number of lives, exposures and deaths. The first study was published in 1899 by the Secretary of the Actuarial Society, Israel C. Pierson, and covered its members' mortality during that body's first 10 years. The second study was published in 1938 by the Actuarial Society's editor, John R. Larus, and covered the mortality experience of Fellows from 1889 anniversaries to 1937 anniversaries. The third study was published in 1990 by John H. Cook and Ernest J. Moorhead and expanded the prior two studies by including not only the experience of Fellows in the Actuarial Society of America but also the mortality experience of Fellows in the American Institute of Actuaries. These two bodies merged in 1949 to form the Society of Actuaries. The Cook-Moorhead study examined the experience of the pre-1949 Fellows from 1889 anniversaries to 1985 anniversaries.

The present study has a 50-year observation period, calendar years 1955-2004, and covers experience of (1) Pre-1949 Fellows, (2) 1949-1974 Fellows of the Society of Actuaries, and (3) Pre-1949 male Associates who did not become Fellows. Because this study is a calendar year study and not an anniversary-to-anniversary study, only the year of death was necessary to calculate mortality ratios and not the full date of death. The move to a calendar year study was critical because most of the deaths now being reported by the Society of Actuaries show only the year of death.

Table 1 gives the number of lives, exposures and deaths in the present study and the prior two studies.

TABLE 1

	Number of Lives	Exposures (years)	Number of Deaths
Larus study	496	7,944	120
Cook-Moorhead study	897	34,149	561
Present study	3,037	100,985.5	1,146

Of the 3,037 lives in the present study, 2,749 are male Fellows including 587 pre-1949 Fellows, 62 are female Fellows including 13 pre-1949 Fellows, and 226 are male pre-1949 Associates who did not become Fellows (12 female pre-1949 Associates who did not become Fellows were excluded from the mortality study because the number of lives in this cohort was too small to draw any conclusions).

Prior studies used the White Male Tables from the U.S. Decennial Life Tables published by the National Center for Health Statistics in conjunction with each decennial census as the base for the expected deaths. This study uses the male and female Life Tables of the Social Security Administration as the base of expected deaths for a number of practical reasons: (1) The Tables of the Social Security Administration were all constructed using the same method, thus assuring consistency over the 50-year exposure period; (2) They were all readily available in electronic format on the Internet, saving hours of work; (3)

Calendar year 2000 was available, while the latest U.S. Decennial Life Table based on the 2000 census was not yet available; (4) The tables gave mortality rates through age 110, which better matched the longevity being experienced; and (5) With their extensive data base covering the United States, Social Security published mortality rates would serve as a good approximation to general population mortality.

For the exposure years 1985-2004, other bases of expected deaths were developed for male Fellows by using the 1983 GAM, the 1975-80 Basic Ultimate Table, and the 2001 VBT Ultimate. These serve as convenient measures of actuarial mortality relative to pension groups and insured individual lives after the effects of selection.

SUMMARY OF THE COOK-MOORHEAD STUDY

The Cook-Moorhead study examined experience in four categories: Canadian men, U.S. men, Canadian and U.S. women, and overseas Fellows. The exposure period was from anniversaries in 1889 to anniversaries in 1985, separated into the 1889-1905 period and then subsequent 10-year periods; and the base of expected deaths were Census Bureau White Male Tables through the successive decades to match the exposure periods. A summary of the results for the entire exposure period by category is given in Table 2a.

TABLE 2a

Category	Expected Deaths	Actual Deaths	Mortality Ratio
All Lives	870.61	561	64.4%
U.S. and Canadian Men	809.52	518	64.0
U.S. and Canadian Women	22.56	9	39.9
U.S. Men	564.45	371	65.7
Canadian Men	245.07	147	60.0
Overseas Fellows	38.53	34	88.2

An investigation by 10 year exposure period showed a sharp drop in mortality ratios after 1955. Table 2b presents this finding for the All Lives category.

TABLE 2b

Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio
1889-1905	30.31	26	85.8%
1905-1915	37.61	21	55.8
1915-1925	46.27	40	86.4
1925-1935	67.04	47	70.1
1935-1945	73.10	55	75.2
1945-1955	90.04	70	77.7
1955-1965	129.61	71	54.8
1965-1975	188.59	113	59.9
1975-1985	208.04	118	56.7
Total	870.61	561	64.4

Another interesting feature of the mortality experience among male actuaries during the period 1955-1985 was not only their low mortality at the younger ages but also their continuing low mortality experience at ages 60 and older. Table 2c shows this experience for U.S. and Canadian men combined.

TABLE 2c

U.S. and Canadian Men combined, exposure period 1955-85

Ages	Expected Deaths	Actual Deaths	Mortality Ratio
- 49	10.57	5	47.3%
50 - 59	55.22	31	56.1
60 - 69	133.66	70	52.4
70 - 79	177.31	94	53.0
80 and over	131.32	95	72.3
Total	508.08	295	58.1

Discussion of the Cook-Moorhead paper also presented evidence that the actuarial profession ranked with the most long-lived professions.

THE PRESENT INVESTIGATION

The present investigation is, in part, a sequel to the Cook-Moorhead study, continuing the investigation of the mortality experience of the pre-1949 Fellows of the two predecessor bodies to the Society of Actuaries. There were 600 of these Fellows, 587 males and 13 females, out of the original group of 897 Fellows, alive on January 1, 1955, the starting point of the exposure period for the present investigation. Table 3a gives the mortality experience of the male Fellows by 10-year calendar year periods where the base of expected deaths is male population mortality from Actuarial Study No. 116 of the Social Security Administration for calendar years 1960, 1970, 1980, 1990 and 2000. Table 3a also presents on the same base the mortality experience of 226 male pre-1949 Associates who were Society members on January 1, 1955 and who did not subsequently become Fellows.

TABLE 3a

	Pre-1949 Male Fellows			Pre-1949 Male Associates		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1955 - 64	133.39	73	54.7%	55.71	46	82.6%
1965 - 74	186.21	107	57.5	59.70	48	80.4
1975 - 84	211.55	113	53.4	64.32	34	52.9
1985 - 94	203.61	133	65.3	64.29	40	62.2
1995 - 2004	152.41	103	67.6	37.27	30	80.5
Total	887.17	529	59.6	281.29	198	70.4

Of the 587 Fellows in this table, eight withdrew or lapsed membership in the Society of Actuaries at some point during the 50-year observation period; and thus, there were 587 – 529 – 8 = 50 individuals who remained in the study at its end on December 31, 2004 (such individuals will be referred to as enders). The oldest ender is age 100 and the youngest is age 80, and both attained Fellowship in 1948. The earliest year of Fellowship remaining at the end of the study is 1935. Of the 226 Associates, 18 withdrew from the Society, leaving 226 – 198 – 18 = 10 enders. Two of them are centenarians at ages 102 and 103, while the youngest Associate is age 78. The earliest year of Associateship for an ender is 1931.

Table 3b gives this study's results by attained age where attained age is calendar age or the year of death minus the year of birth.

TABLE 3b

	Pre-1949 Male Fellows			Pre-1949 Male Associates		
Age	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
- 39	.41	0	0.0%	.19	1	526.3%
40 - 49	11.06	5	45.2	3.19	2	62.7
50 - 59	58.51	31	53.0	19.14	13	67.9
60 - 69	142.18	65	45.7	50.71	34	67.0
70 - 79	250.43	118	47.1	77.98	57	73.1

80 - 89	307.18	201	65.4	89.93	55	61.2
90 and over	117.41	109	92.8	40.16	36	89.6
Total	887.17	529	59.6	281.29	198	70.4

Included in this table for Fellows is the death of one centenarian at age 101. There were no centenarian Associate deaths.

The present investigation is also, in part, an expansion of the Cook-Moorhead study because it documents the mortality experience of individuals who became Fellows in the years 1949 through 1974. Table 4a presents the experience of 2,162 male Fellows, following the methodology used in Table 3a.

TABLE 4a

1949 – 1974 Male Fellows

Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio
1955 – 1964	20.26	7	34.5%
1965 – 1974	79.06	39	49.3
1975 – 1984	155.48	60	38.6
1985 – 1994	273.54	105	38.4
1995 – 2004	453.91	189	41.6
Total	982.26	400	40.7

Of the 2,162 Fellows, 331 lapsed their membership in the Society of Actuaries, leaving 2,162 – 400 – 331 = 1,431 enders. The oldest ender in this cohort is age 95 and four enders at age 54 are the youngest.

Table 4b shows this mortality experience by age similar to Table 3b.

TABLE 4b

1949 – 1974 Male Fellows

Age	Expected Deaths	Actual Deaths	Mortality Ratio
- 39	43.35	16	36.9%
40 – 49	100.67	45	44.7
50 – 59	199.26	65	32.6
60 – 69	271.45	100	36.8
70 – 79	243.82	111	45.5
80 – 89	111.16	59	53.1
90 and over	12.56	4	31.8
Total	982.26	400	40.7

Combining Table 3a for Fellows and Table 4a gives the mortality experience of pre-1975 male Fellows. This is presented in Table 5a along with the mortality experience of pre-1975 female Fellows. There were 13 pre-1949 female Fellows who were Society members on January 1, 1955, the starting date of the study. These females were joined by 49 women who attained Fellowship in the years 1949 through 1974; and their combined experience is shown in Table 5a. The base of expected deaths for this cohort is female population mortality from Actuarial Study No. 116 of the Social Security Administration.

TABLE 5a

	Pre-1975 Male Fellows			Pre-1975 Female Fellows		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1955-64	153.65	80	52.1%	2.51	0	0.0%
1965-74	265.28	146	55.0	4.62	4	86.5
1975-84	367.03	173	47.1	7.59	5	65.8
1985-94	477.16	238	49.9	8.48	7	82.5
1995-2004	606.32	292	48.2	6.18	3	48.5
Total	1869.44	929	49.7	29.39	19	64.6

Among the 62 female Fellows, 10 lapsed their membership in the Society, leaving 62 – 19 – 10 = 33 enders. The oldest female ender is age 89 and the youngest is age 56. None of the 13 women from the pre-1949 Fellows cohort are alive.

Table 5b shows this mortality experience by age.

TABLE 5b

	Pre-1975 Male Fellows			Pre-1975 Female Fellows		
Age	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
- 39	43.76	16	36.6%	.47	0	0.0%
40 – 49	111.74	50	44.7	1.25	0	0.0
50 – 59	257.77	96	37.2	2.71	1	37.0
60 – 69	413.63	165	39.9	5.06	2	39.5
70 – 79	494.25	229	46.3	7.05	5	70.9
80 – 89	418.33	260	62.2	8.96	5	55.8
90 and over	129.97	113	86.9	3.89	6	154.4
Total	1869.44	929	49.7	29.39	19	64.6

Finally, in order to compare the mortality experience of Fellows of the Society of Actuaries to others, expected deaths relative to the 1983 Group Annuity Mortality Table, the 1975-80 Basic Ultimate Table, and the 2001 VBT Ultimate were calculated for the pre-1949 and the pre-1975 male Fellows cohorts. A summary of these results is shown in Tables 6a, 6b and 6c.

TABLE 6a

Male Fellows with Base of Expected Deaths from 1983 GAM, no projection

	Pre-1949 Fellows			Pre-1975 Fellows		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1985 - 1994	177.82	133	74.8%	360.99	238	65.9%
1995 - 2004	136.29	103	75.6	522.06	292	55.9
Total	314.11	236	75.1	883.05	530	60.0

TABLE 6b

Male Fellows with Base of Expected Deaths from 1975-80 Basic Ultimate

	Pre-1949 Fellows			Pre-1975 Fellows		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1985 - 1994	192.17	133	69.2%	408.88	238	58.2%
1995 - 2004	147.36	103	69.9	588.09	292	49.7
Total	339.53	236	69.5	996.96	530	53.2

TABLE 6c

Male Fellows with Base of Expected Deaths from 2001 VBT Ultimate

	Pre-1949 Fellows			Pre-1975 Fellows		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1985 - 1994	163.36	133	81.4%	328.11	238	72.5%
1995 - 2004	133.70	103	77.0	479.54	292	60.9

Total	297.06	236	79.4	807.65	530	65.6

DISCUSSION OF FINDINGS

(1) Males who became Fellows of the Society of Actuaries more than 30 years ago (pre-1975) have excellent mortality experience, approximately one-half of what the general male population experiences. Not only is the mortality of actuaries low at the younger ages, but low mortality continues at the older ages above age 60 and even above age 90 FSA mortality is about 13% lower than population mortality. Moreover, the mortality experience for more recent male Fellows, those in the years 1949 through 1974, is better than the mortality experience of the original cohort of pre-1949 Fellows. If we use the *t distribution* to test the difference in the A/E means between the two cohorts of FSAs, then we find a *t value* of 5.1 (8 degrees of freedom), which exceeds the critical value at the 95% confidence level, rejecting the hypothesis that the means are equivalent and indicating that the better mortality experience of the later FSAs is statistically significant.

(2) The mortality experience of female Fellows is based on significantly fewer lives and therefore the findings are limited. Their mortality relative to the general female population is also excellent, comparable to their male counterparts before age 70. At ages 70 and over, however, female mortality is worse as expected deaths are 19.90 and actual deaths reach 16, or the 80% level, which doesn't happen to the male Fellows before age 90. Thus the data, albeit limited, suggests that the effects of selection, whether it is the high educational attainment effect or simply the healthy worker effect, wear off earlier

for female Fellows. Subsequent studies of Fellowship years after 1974 when females entered the profession in much greater numbers would have to be done in order to validate this finding.

(3) The mortality experience of Fellows when compared against recent pension plan experience and individual life experience after the effects of selection appears to be outstanding.

Recent pension plan experience is reported on the Society of Actuaries Web site under the headings Retirement/Pension, Experience Studies, and 1999-2000 Group Annuity Experience Report. A/E ratios based on male lives are shown relative to different expected death tables; and using the 1983 GAM, mortality ratios are 107%, 105%, 106%, 107%, 106%, and 104% for the years 1995 through 2000, respectively. The 1999-2000 Group Annuity Report does not separate experience into blue and white collar nor by the size of the annuity; however, relative mortality can be used to estimate what the published ratios would be if the reported pension groups were white collar or if the annuity amounts were large. One source for relative mortality is to look at the construction of the RP-2000 Mortality Tables. Healthy male annuitants who were deemed to be receiving a large annuity had relative mortality around 75%. At this level a reported mortality ratio of 105% would be around 79%. Yet actuarial mortality relative to the 1983 GAM is at 75.6% for pre-1949 FSAs and 55.9% for pre-1975 FSAs during the observation period 1995-2004, which suggests that actuarial mortality may be better than the experience of other highly paid groups. Carriers who have actual experience on

comparable professional groups might be able to contribute to the discussion of precisely how good the mortality experience of actuaries is.

Other evidence that actuarial mortality is unusually low comes from the ultimate experience of individual life policies as reported on the Society of Actuaries Web site under the heading Life Insurance, Experience Studies, and 1995-2000 Individual Life Experience Report. A/E ratios by face amount in the ultimate period are shown. Based on the 1975-80 Basic Table, the mortality ratio is 76.7% for the period anniversaries in 1995 through anniversaries in 2000, while based on the 2001 VBT the comparable mortality ratio is 102.2%. During the observation period 1995-2004, actuarial mortality is much lower: 69.9% for pre-1949 FSAs and 49.7% for pre-1975 FSAs based on the 1975-80 Basic Table, and 77.0% for pre-1949 FSAs and 60.9% for pre-1975 FSAs based on the 2001 VBT.

(4) The mortality experience of pre-1949 male Associates who subsequently never attained Fellowship is significantly worse than the experience of pre-1949 male Fellows. Using Table 3a in order to test the hypothesis that FSA mortality is a good measure of ASA mortality, we take the FSA mortality ratio of .596 and apply it to ASA expected deaths of 281.29 obtaining a mean of 168 actual deaths with a standard deviation of 8.2. 198 actual ASA deaths are well outside two standard deviations of the mean, and thus the hypothesis is rejected at the 95% confidence level. As may be seen in Table 3b, it is only at ages 80 and over that the mortality ratios of the FSA cohort slightly exceed the ASA cohort.

Examining FSA and ASA mortality using a different FSA cohort as shown in Tables 7a and 7b does not change this finding. That is, a direct comparison of two cohorts of pre-1949 male Associates, one of individuals who subsequently attained Fellowship and the other of those who didn't, shows significantly better mortality for the 149 individuals who became Fellows.

TABLE 7a

	Pre-1949 Male Associates (Attained Fellowship 1949 or later)			Pre-1949 Male Associates (Remained Associates)		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1955 - 64	8.77	3	34.2%	55.71	46	82.6%
1965 - 74	20.91	9	43.0	59.70	48	80.4
1975 - 84	35.62	17	47.7	64.32	34	52.9
1985 - 94	51.73	23	44.5	64.29	40	62.2
1995 - 2004	77.13	35	45.4	37.27	30	80.5
Total	194.16	87	44.8	281.29	198	70.4

TABLE 7b

	Pre-1949 Male Associates (Attained Fellowship 1949 or Later)			Pre-1949 Male Associates (Remained Associates)		
Age	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
- 39	1.02	0	0.0%	.19	1	526.3%
40 - 49	7.49	5	66.7	3.19	2	62.7
50 - 59	19.88	5	25.1	19.14	13	67.9
60 - 69	35.58	17	47.8	50.71	34	67.0
70 - 79	55.38	27	55.4	77.98	57	73.1
80 - 89	63.73	28	43.9	89.93	55	61.2
90 and over	11.08	5	45.1	40.16	36	89.6
Total	194.15	87	44.8	281.29	198	70.4

Given that both cohorts of Associates have achieved a high educational level and have a good understanding of health issues, the uniformly wide differences in mortality ratios across exposure periods and attained ages groupings are surprising.

(5) Cook and Moorhead, in their 1990 paper, separated mortality experience by geographical location at the time the person's actuarial career began and showed results for Canadian men, U.S. men, Canadian and U.S. women, and overseas Fellows. The overseas category comprised a group of eminent actuaries from other countries each of

whom were granted honorary memberships in the early years of the Actuarial Society, one of the predecessor bodies to the Society of Actuaries. None of the overseas Fellows were alive at the start of the present investigation. The mortality experience of the 13 women, 11 who started their careers in the United States and 2 who began in Canada, is included in Tables 5a and 5b. Tables 8a and 8b separate the mortality experience of the 587 men from the pre-1949 cohort into the experience of 397 U.S. men and 190 Canadian men.

TABLE 8a

	Pre-1949 United States Men			Pre-1949 Canadian Men		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1955 - 64	93.11	45	48.3%	40.28	28	69.5%
1965 - 74	123.44	75	60.8	62.78	32	51.0
1975 - 84	138.61	79	57.0	72.94	34	46.6
1985 - 94	129.24	82	63.4	74.38	51	68.6
1995 - 2004	108.34	70	64.6	44.07	33	74.9
Total	592.73	351	59.2	294.44	178	60.5

TABLE 8b

	Pre-1949 United States Men			Pre-1949 Canadian Men		
Age	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
- 39	.39	0	0.0%	.02	0	0.0%
40 - 49	8.35	3	35.9	2.71	2	73.8
50 - 59	39.92	16	40.1	18.59	15	80.7
60 - 69	95.96	48	50.0	46.22	17	36.8
70 - 79	167.13	80	47.9	83.30	38	45.6
80 - 89	204.64	133	65.0	102.53	68	66.3
90 and over	76.34	71	93.0	41.07	38	92.5
Total	592.73	351	59.2	294.44	178	60.5

A standardized statistical test shows that overall Canadian mortality does not vary significantly from U.S. mortality. 1949 and later Fellows are not identified as to where they began their actuarial career, and this, in conjunction with the similar mortality experience shown above, led to the decision not to investigate later cohorts for possible mortality differences by country.

(6) The significant improvement in mortality experience between the pre-1949 cohort and the 1949-1974 cohort discussed in Finding (1) above led to further subdivisions of the 1949-1974 cohort in order to investigate whether the later years of Fellowship has better

mortality experience than the early years. Because of the way the data was collected, it was convenient to group the Fellowship years 1949-1968 together. Tables 9a and 9b show the mortality experience for 1,286 male Fellows from 1949-1968 along with the experience for 876 male Fellows from the later years 1969-1974.

TABLE 9a

	1949 -1968 Male Fellows			1969 -1974 Male Fellows		
Exposure Period	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
1955 - 64	20.26	7	34.5%	N/A	N/A	N/A
1965 - 74	72.27	38	52.6	6.79	1	14.7%
1975 - 84	127.93	50	39.1	27.55	10	36.3
1985 - 94	220.36	88	39.9	53.19	17	32.0
1995 - 2004	360.39	154	42.7	93.52	35	37.4
Total	801.21	337	42.1	181.05	63	34.8

TABLE 9b

	1949 -1968 Male Fellows			1969 -1974 Male Fellows		
Age	Expected Deaths	Actual Deaths	Mortality Ratio	Expected Deaths	Actual Deaths	Mortality Ratio
- 39	24.67	9	36.5%	18.68	7	37.5%
40 - 49	64.71	36	55.6	35.97	9	25.0
50 - 59	132.84	46	34.6	66.41	19	28.6

60 - 69	223.86	81	36.2	47.59	19	39.9
70 - 79	232.53	104	44.7	11.29	7	62.0
80 - 89	110.04	57	51.8	1.12	2	179.0
90 and over	12.50	4	31.8	.00	0	N/A
Total	801.21	337	42.1	181.05	63	34.8

Mortality has improved in the later cohort in each exposure period and at the younger ages under age 60. A *t value* of 3.9 (4 degrees of freedom) exceeds the 95% confidence limit, rejecting the hypothesis that the A/E means of the two cohorts are equivalent and indicating that the mortality improvement for later FSAs is statistically significant.

(7) The present investigation has documented the deaths of 1,145 Fellows and Associates and 367 withdrawals during the 50-year observation period. A great deal of time and effort went into maintaining the credibility of the study and assuring that significant numbers of deaths were not overlooked. Three sources of information from the Society of Actuaries were primary in this regard. First, the Society published obituaries of deceased members in their *Transactions* and recently began to list deceased members and place obituaries on their Web site; second, Society Yearbooks, which through 1991 also served as a Directory of members, listed deceased members; and third, *The Actuary*, which up to recently listed deaths of members. These three sources collectively were outstanding in reporting the deaths of members. Unfortunately, during the last 10 years of the study, some deaths were not reported to or by the Society, and the number of Fellows withdrawing from membership more than tripled during this time (see Table 10), making

alternate sources of information regarding deaths critical to the accuracy of this study. Additionally, some members who had either withdrawn from membership or were deceased continued to be reported as members in the Directory.

One of the main alternate sources of finding deaths not reported by the Society was a public Internet site that links to Social Security death records. The Internet site http://ssdi.genealogy.rootsweb.com/cgi-bin/ssdi.cgi is easy to use and with a name and a date of birth, deceased members and their dates of death were quickly validated. There were limitations to this source, however, including Canadian members not part of the United States Social Security system; and if survivor benefits were being paid to dependents on behalf of a deceased member, that member's death record was not available on the Social Security Web site. Nevertheless, this site was a valuable source of information. In many cases, deaths from this source were recorded before the Society's Deceased Members Web site reported the death; and this is the source of most of the deaths not reported by the Society but included in this investigation. Also, the Canadian Institute of Actuaries (CIA) was very helpful in verifying the status of Canadian FSAs who had dropped their membership in the Society but continued in the CIA.

In order to find other deaths not in Social Security or Society records, I made use of other Internet sites that specialize in finding individuals, and I also wrote to many Society members, asking about the status of specific individuals. In this way, I was able to validate the correct status of many members. I wish to thank all the Society members who

responded to my letters, e-mails and phone calls, which helped to ensure the accuracy of this study.

Finally, a death of a member found through an alternate source was only included as a death in this study if the source documented the death in the year, or an earlier year, that would have been the withdrawal year if the death had not been discovered. Deaths discovered later than the year of withdrawal were not recorded as deaths but as withdrawals.

(8) The number of withdrawals or lapsed memberships increased dramatically by exposure period and cohort block as shown in following table:

TABLE 10

Number of Withdrawals from Membership by Male Fellows

Period	Pre-1949 Fellows	1949-1968 Fellows	1969-1974 Fellows	Total
1955-1964	2	0	N/A	2
1965-1974	1	4	1	6
1975-1984	5	16	8	29
1985-1994	0	41	26	67
1995-2004	0	103	132	234
Total Wx	8	164	167	339
Total in study	587	1286	876	2749
% that Wx	1.4%	12.8%	19.1%	12.3%

The 226 pre-1949 Associate cohort had 18 withdrawals (8.0%) during the 50-year observation period: 1 in 1955-64, 10 in 1965-74, and 7 in 1975-84. The 62 female Fellows cohort had 10 withdrawals (16.1%): 2 in 1965-74, 3 in 1985-94, and 5 in 1995-2004.

(9) The hypothesis that selection at withdrawal contributes to the low mortality ratio of actuaries because members withdraw for health reasons in anticipation of death is not supported by this data.

A summary of the analysis of the 339 Fellows who withdrew their membership in the Society is given in Table 11, which shows that the status of 295 withdrawals is known while the status of 44 former members has not been determined.

TABLE 11

Verification of Withdrawals of Male Fellows

Explanation	Number
(a) Retained actuarial membership other than the Society of Actuaries	69
(b) Confirmed withdrawal through correspondence	19
Located through an Internet search	193
Personal knowledge	1
(c) Subsequent death	13

(d) Overseas – status unknown	3
Canadian – status unknown	15
United States – status unknown	26
Total	339

(a) Table 11 shows that although 69 FSAs dropped their membership in the Society of Actuaries, they continued membership in other actuarial bodies. For example, 53 of them remain Fellows of the Canadian Institute of Actuaries (FCIA). All 69 of these men would have added exposure years to the above studies and improved mortality ratios if they had not been withdrawn from the studies in the year they lapsed their Society membership. Furthermore, an estimate of the number of expected deaths for this cohort after membership ended through the end of the observation period is 6.16.

(b) I validated that 213 former members were alive after their withdrawal year: 19 through correspondence, 1 through personal knowledge, and 193 through Internet searches. An estimate of the expected deaths after membership ended through the end of the observation period for these 213 individuals is 29.06.

(c) Thirteen of the Fellows who withdrew were subsequently found as deceased through an alternate source. Table 12 gives the year and age when the lapse occurred, the subsequent age at death, the time interval in years between withdrawal and death and the expected deaths for the years lived after membership ceased.

TABLE 12

	Year of Wx	Age at Wx	Age at Death	Interval*	Expected deaths
1	2002	62	63	1	.02
2	1977	73	75	2	.11
3	1990	55	64	9	.13
4	1998	64	67	3	.06
5	1982	54	59	5	.07
6	1963	65	74	9	.43
7	1993	60	63	3	.05
8	1991	71	77	6	.30
9	1982	50	67	17	.29
10	1990	59	70	11	.26
11	1992	57	68	11	.22
12	1982	80	88	8	.98
13	1985	63	80	17	.74
				Total	3.66

* in years between lapse and death

Although the number of individuals covered in Table 12 is small, the time interval between lapse and death does not support the hypothesis that individuals withdraw membership because of poor health and an imminent death. The estimated expected deaths for the years lived after membership ceased is 3.66 for these 13 individuals. Thus, for the 295 withdrawals in Table 11 where the status is known, we have 13 actual deaths and an estimated 38.88 expected deaths or a 33.4% mortality ratio. This is consistent with Larus's conclusion in his 1938 paper that "resignation does not seem to have been coupled with ill health."

Table 13 shows the withdrawal ages of the 339 Fellows.

TABLE 13

Age	Number of Withdrawals
32 - 39	8
40 - 49	25
50 - 59	127
60 - 69	163
70 - 79	13
80	1
82	1
91	1
Total	339

These numbers are consistent with the notion that most members who withdraw membership from the Society do so when they reach early retirement or retirement age. The youngest person to withdraw was age 32, one year after Fellowship, in 1972. In Table 11 he is part of the United States-unknown status category. Of the 16 individuals who withdrew at age 70 or older: three are known to have subsequently died and are listed in Table 12; three are in the Canadian-unknown status category; one is overseas-unknown status; one is MAAA only; two are FCIA only; one is confirmed alive through correspondence after his 1998 withdrawal; and five have been found through Internet searches including the age 91 2003 withdrawal.

Finally, if I look at the 44 individuals in the status unknown categories in Table 11 and make the worst-case assumption that all are really deceased in the year of withdrawal, the study for pre-1975 male Fellows would show 973 deaths, and a 52% mortality ratio instead of 49.7%. The conclusion of the study that FSAs have outstanding low mortality would not change.

SOME TECHNICAL DETAILS REGARDING THE INVESTIGATION

On April 16, 1997, the Society of Actuaries provided John H. Cook with date of birth of the Fellows used in this study post 1948. (From the previous investigation, he already had the date of births of the pre-1949 Fellows and the year of birth of the pre-1949 Associates). However, the Society's listing did not provide any information on Fellows who had died or lapsed their membership before the listing was prepared and occasionally did not have the year of birth on one of the other FSAs. For these Fellows a year of birth was assigned based on their year of Fellowship. For example, the class of 1970 admitted 143 Fellows but for 15 of them, a year of birth was not available. For the other 128 individuals, 126 of them were males, and their average age in 1970 was 31.10. Thus, a year of birth of 1939 (1970 – 31) was assigned to the remaining 15 male FSAs. (The average age of Fellowship for almost all the other classes was age 30).

Using the terminology and notation given in Gershenson (1961), the definitions and exposure formulas used in this investigation are: Deaths, new entrants and withdrawals tabulated by calendar age; starters (age x): x = 1954 – calendar year of birth; enders (age x): x = 1964 – calendar year of birth for the first observation period (1/1/55 – 12/31/64) and analogous starter/ender definitions for subsequent periods.

Exposure (x) = Sum (t =lowest tabulated age to x-1) j(t) + f(x) where

j(t) = (s + n – w – e – d)(t) and f (x) = .5n(x) - .5w(x).

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