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Mortality Rates as a function of Lapse Rates

by

Faye S. Albert
Albert Associates

David G. W. Bragg
John M. Bragg Associates, Inc.

John M. Bragg
John M. Bragg Associates, Inc.

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Introduction

The differences between select and ultimate insurance mortality are usually explained in terms of:

- Deterioration of a person's physical condition, which occurs due to aging.
- Anti-selection which occurs as some policyholders allow their coverage to lapse. Those policyholders who find their health has become poor keep their coverage, while those who remain healthy discontinue their insurance.

This investigation explores the differences in mortality between companies related to the differences in lapse rates of the companies.

Acknowledgments

The authors would like to thank the data contributors for making their experience available to Bragg Associates for the benefit of the actuarial community. The companies included in this Study from that data base are identified in Appendix C. Lapse rates from Bests Reports were consulted.

Also, we would like to acknowledge the members of the Society of Actuaries Life Research Committee and the Project Oversight Group for their encouragement and their excellent suggestions. Zain Mohey-Deen in the Society of Actuaries office was a most helpful coordinator.

Data

The 1991 and 1992 mortality experience by amount of insurance used in this study is a subset of the Bragg Associates data bank. This encompasses standard ordinary business issued on a nonsmoker/smoker differentiated basis. Such differentiation started in the 1960s but did not become almost universal until the early 1980s. This study does not include any undifferentiated business; even the ultimate business included in this study was originally issued on a nonsmoker/smoker basis.

The subset of companies selected for this study included those which had consistently submitted data year after year, so that study lapse rates could be calculated. The companies differ a great deal in size, markets served, average-size policies issued, and underwriting requirements. Such factors as well as lapse rates will affect the overall mortality results. However, such factors are less likely to affect the progression of mortality results by duration, an important element of this study.

The volume of data for durations 1 through 10 was substantial, less for durations 11-15 and ultimate.

Mortality Rates as a function of Lapse Rates

| 1991 and 1992 Amount Data included in study | Exposures (\$,000) | Deaths (\$,000) |
|---|--------------------|------------------|
| Low Lapse Companies | \$ 413,788,208 | \$ 630,705 |
| Medium Lapse Companies | 305,307,342 | 294,063 |
| High Lapse Companies | 574,196,491 | 660,589 |
| Grand Totals | \$1,293,292,041 | \$ 1,585,357 |
| Ultimate Data | \$ 4,463,875 | \$50,485 |

The gross comparison of ultimate mortality uses data from 5 companies only. There were not sufficient data for durations 16 and longer in years 1991 and 1992 from all the Study companies. Ultimate experience is from issues in 1977 and earlier where it was available from Study companies.

Method

The sample companies were separated into low, medium and high lapse groupings and the mortality experience in each was analyzed by duration from issue.

Actual mortality was calculated directly from the data. Actual to expected mortality ratios were calculated using three different bases for expected mortality: the Bragg 1991 Select and Ultimate Life Tables; the 1975-80 Select Basic Tables; and the 1975-80 Ultimate Basic Tables.

Results

Lapse categories

Lapse experience was available from the Study data and compared with Bests results. Direct comparison is not straightforward, however. Differences arise because Bests does not separate first year and renewal results, reinsurance treatment may complicate the comparison, and the Bests data includes business other than underwritten standard ordinary business. Exposures reported in Bests for the 1980s were distorted because of the massive internal replacements in the industry. Review of the lapse rates reported in Bests for 1990, 1991, 1992, 1993 and 1994 shows the lapse classifications for companies in the Study remain essentially the same. Factors such as marketing type, field force, socio-economic class and such have remained essentially constant for at least fifteen years for each of the 13 companies, or their predecessor companies, involved in the study. These are the factors usually deemed to affect lapses. Classification of each company into a single lapse category seems appropriate for purposes of the Study.

Mortality Rates as a function of Lapse Rates

Bests lapse rates are based on a rough formula approximating the appropriate weighting for first year and renewal business = $Lapses_y / [Inforce_{y-1} + Issues_{y-1}]$. The first column in the table below shows the percentages which the 1992 Bests lapse rates of the study companies bore to the overall industry Bests lapse rates for 1992.

The Study lapse calculations were based on the most recently available annual Bragg persistency data for each company. The lapse ratio varied for individual companies based on when information was available from years 1989 to 1992. Bests data is shown here to corroborate the distinctions in lapse grouping established in the Study.

| Lapse Results for Companies in the Study | | | | |
|---|---------------|-------------|---------|----------|
| | BEST's | STUDY | | |
| | 1992 data | Recent data | | |
| | % of Industry | % lapse | % lapse | % lapse |
| Lapse Category | All Dur | All Dur | Dur 1 | Dur 2-15 |
| LOW | 89.5% | 11.3% | 13.7% | 10.9% |
| MIDDLE | 97.8% | 13.9% | 14.5% | 13.5% |
| HIGH | 117.4% | 18.2% | 21.6% | 15.9% |
| Total | 103.1% | 14.8% | 18.6% | 13.2% |

Renewal lapse rates tend to come closer together than first year lapse rates, the same as mortality results.

See graph of Study lapse data by duration (Appendix A).

The following table is an additional indication that the lapse categories are appropriate. The low lapse companies have a higher share of exposures at the longer durations, as one would expect, and the reverse is true for the high lapse companies.

| Relative exposures by duration | | | |
|---------------------------------------|---------------|----------------|-----------------|
| | Durations 3-5 | Durations 6-10 | Durations 11-15 |
| LOW | 31.0% | 40.5% | 59.6% |
| MIDDLE | 19.4% | 22.8% | 27.8% |
| HIGH | 49.6% | 36.7% | 12.6% |

Mortality Rates as a function of Lapse Rates

Mortality results

Appendix B and the associated graph show actual to expected mortality results.

First, it may be of interest to review total mortality results compared with the 1975-1980 Basic Ultimate Tables. The upward wave in mortality at durations 3-5 may be associated with the loss of the contestable and suicide clauses, as well as loss of select status. Mortality appears to deteriorate into the 6-10 durations; loss of select status is a major factor in this. However, there is no evidence of further deterioration; thereafter, there may even be improvement.

High lapse rates are associated with relatively higher mortality rates using any of the three tables as the expected basis. Companies that suffer poor persistency are the ones who suffer poor mortality. However, when examining results by duration, the high lapse companies are eventually left with a block of business where mortality is not much worse than that of the remaining companies. This is contrary to previous conjecture. As duration increases, the mortality ratios among the different categories of companies converge. In fact mortality ratios in durations 6 and subsequent do not appear convincingly different from what might be experienced ultimately.

There is much less ultimate data than during the 15 year select period. Of the 13 companies in the study, 3 were in both the select and ultimate blocks; 8 were in the select block only; and 2 were in the ultimate block only. Of the 11 companies in the select block, 10 had business extending into the 11th through 15th durations. All 11 had business in the 6th through 10th durations. Nevertheless, the low actual to expected ratio where ultimate experience is available is surprising.

The select period mortality experience differential is not as pronounced for the high lapse group as for the lower lapse companies. This suggests the selection may be flatter, and the select period not as long for the high lapse group. In 1990 the authors noticed a sharp upward wave in mortality at durations 3-5, after the contestable and suicide period have elapsed, which was built into the 91 Bragg Life Table. This phenomenon is apparent in the results of the present study, especially when measured against the 1975-80 Ultimate Basic Tables. This result appears in all three categories, but especially in the middle lapse category. The 15-year select period model appears to depend on the circumstances which are being studied. Investigation of the most appropriate select period is a good topic for future study.

It will be observed that the results for durations 11 to 15, which might be thought of as near-ultimate, differ substantially when measured on the 1975-80 Select Basic Tables and the 1975-80 Ultimate Basic Tables. This occurs because the select tables do not grade into the ultimate tables.

Mortality Rates as a function of Lapse Rates

The low and middle lapse category companies do not have much different mortality experience from each other, and the middle lapse category even has **better** mortality than companies in the low lapse category for all durations. Other factors besides lapse rates may be affecting the results. For example, average policy size is larger for companies in the middle lapse category. This suggests underwriting may have been stricter for companies in the middle lapse category.

Average Size Policy - Based on 1991 exposures

| Lapse Category | Number | Amount (\$,000,000) | Average Size |
|----------------|-----------|---------------------|--------------|
| LOW | 3,515,244 | 196,159 | \$55,800 |
| MIDDLE | 1,599,406 | 161,182 | \$100,800 |
| HIGH | 4,018,313 | 313,576 | \$78,000 |

The Connection between Lapse Rates and Mortality

Do high lapse rates go along with overall poor mortality experience? Yes, seems to be the general belief, along with the corollary that persons who lapse tend to be the better risks. This Study investigates both whether total lapse results correlate with total mortality results, and the corollary, that high lapse rates result in deterioration in mortality as duration increases. This paper supports the former, but not the latter.

Consistent with the results of this Study, John M Bragg's paper from the 20th International Congress of Actuaries ⁽¹⁾ correlates lapse and overall mortality results for two lines of business and for two socio-economic classes. The results are repeated here because of their pertinence to the current study. Persistency is based on 1971 and 1972 issues. Expected mortality is based Table X-18. Experience is for years 1964 through 1973.

| Company Type | Socio-Economic Group | Five Year Persistency | Mortality Ratio % |
|----------------|----------------------|-----------------------|-------------------|
| Small Ordinary | Higher | 0.52 | 86% |
| Small Ordinary | Lower | 0.30 | 150% |
| Industrial | Higher | 0.28 | 124% |
| Industrial | Lower | 0.22 | 178% |

This 1976 paper demonstrates that better persistency, i.e., lower lapsation, correlates with better mortality. It supports the general belief, but does not address the corollary belief. It also supports a belief that lower socio-economic classes are subject to both higher lapsation and higher mortality.

Mortality Rates as a function of Lapse Rates

Investigation of the Corollary Belief

Do high lapse rates mean that experience on the remaining block of business tends to deteriorate, i.e., the corollary belief? To examine this, the authors performed correlation and regression analyses involving the lapse and durational mortality results of individual companies in the study. To preserve anonymity, no individual results are published. All 11 companies had mortality results that were credible through duration 10. The authors considered an individual cell to be credible if it contained at least 35 actual deaths, and no large claim which would have distorted results. Only 6 companies had credible mortality results for durations 11-15; consequently, correlation and regression work involving durations 11-15 was limited to just those 6 companies.

For each company, total lapse rates were available, and mortality results on an actual to expected basis for durations 1-5, 6-10, and 11-15 were calculated. The expected mortality basis was the 1975-1980 Ultimate Basic Tables. For all credible cases, ratios of later to earlier mortality results were performed. Then actual\expected ratios of the longer to earlier durations were regressed against lapse rates. As an adjunct inquiry of interest, regression analysis was also done for later vs earlier actual\expected mortality experience, regardless of lapse results.

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Regression Analysis

Ratio of Actual to Expected Mortality Ratios

| | | Longer vs Earlier Durations | | Longer to Earlier Durations vs Lapse Rates | |
|--------------------------------------|----------------------------|-----------------------------|---------------------------------|--|---------------------------------|
| | | R-squared | Standard Error of coefficient t | R-squared | Standard Error of coefficient t |
| Entire Study 11 companies | Durations 6-10 vs 1-5 | .30 | 0.27 | 0.00 | 0.02 |
| Data for 15 durations 6 companies | Durations 6-10 vs 1-5 | 0.98 | 0.08 | 0.26 | 0.15 |
| | Durations 11-15 vs 1-5 | 0.77 | 0.16 | 0.12 | 0.06 |
| | Durations 11-15 vs 6-10 | 0.76 | 0.17 | 0.22 | 0.08 |
| Data for 10 durations 5 companies | Durations 6-10 vs 1-5 | 0.09 | 0.57 | 0.01 | 0.03 |

R-square results can vary between 0 and 1.

Explanation of Results

The study corroborates the general belief that high lapse rates go along with overall poor mortality experience. However, this is largely the result of poor early duration mortality.

The study does not corroborate the corollary that high lapsation results in deterioration of remaining block, because persons who lapse tend to be the better risks. The reverse in fact seems to be the case.

For the Study companies:

- There is a strong relationship between later and earlier duration mortality. This is expected because of factors that affect all durations, such as markets served and strength of

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underwriting.

- There is little evidence of a direct relationship between lapses and the changes in mortality results by duration. So the premise that high lapse rates result in deterioration of mortality as duration increases, is not supported.

Here is an explanation consistent with our results. Many lapses occur primarily for economic or similar reasons, and not because of conscious knowledge or concern about state of health. These persons who lapse may be, on average, in lower socio-economic classes, and are subject to higher mortality. Some of these people die before lapsing, however, resulting in poor early duration mortality. Gradually, however, the remaining block improves, both as to socio-economic content and mortality.

Additional areas to study

Plan distinctions in mortality would be most interesting, but making these presents some problems. Contributions to the data block are generally not separated by plan of insurance. Consequently, this study could not be performed in a manner which would separate term and permanent business. Further, much business currently labeled as permanent is essentially term insurance. An example would be the product known as Universal Life Term. There are ways to estimate the plan composition of the Study companies, however.

In the mid-eighties many companies started issuing term policies with re-entry features. Under the most common arrangement, the policyholder was permitted to exchange for a new policy at the tenth anniversary if satisfactory evidence of insurability was provided. The effect of this feature on tenth year lapse rates, and the subsequent mortality among those not able to provide satisfactory evidence will be most interesting. This paper does not address these questions. Little of this business would have reached its ten-year reentry point by the exposure period for this study (1991-1992).

There has been much discussion in the actuarial profession about annually renewable term insurance business with increasing premiums. The discussion concerns anti-selection at lapse and the presumed higher mortality emerging from the continuing block. In this study it has not been possible to separately identify and analyze such business.

The authors have considerable knowledge about the insurance patterns of the companies in this study. Some Annual Renewable Term business is present, but the large majority of the term business in this study is level-premium. Our estimate is that, on an overall basis, term insurance represents about 60% of the exposure. By far, the largest part of this would be level premium term. The investigation of Annual Renewable Term alone would more directly address the business where antiselection has traditionally been assumed most prevalent.

Mortality Rates as a function of Lapse Rates

Plan content estimates along with company lapse categories might help answer the question as to whether the behavior of policyholders is rational because of self-knowledge. If renewable term were specifically identified, however, company anonymity would be compromised. Changes in the level of premium rate from one duration to another are not readily available, although it is suspected that where the premium rate jumps, more than usual lapses occur.

First year and renewal lapse rates are available from the underlying data as are the additional variables age at issue, sex and smoker/non-smoker. The study could be expanded to explore the relationships between lapse, mortality and these other characteristics.

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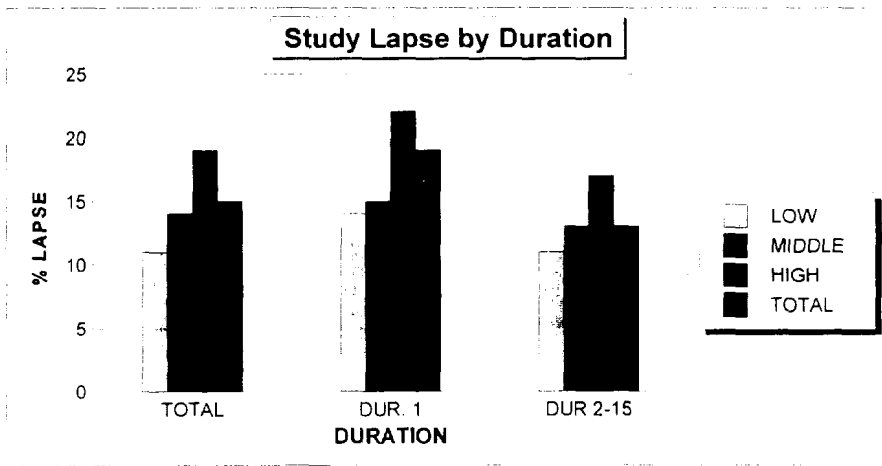
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Appendix A

| STUDY LAPSE DATA BY DURATION | | | | |
|------------------------------|------|--------|------|-------|
| | LOW | MIDDLE | HIGH | TOTAL |
| TOTAL | 11.3 | 13.9 | 18.2 | 14.8 |
| DUR. 1 | 13.7 | 14.5 | 21.6 | 18.6 |
| DUR 2-15 | 10.9 | 13.5 | 15.9 | 13.2 |



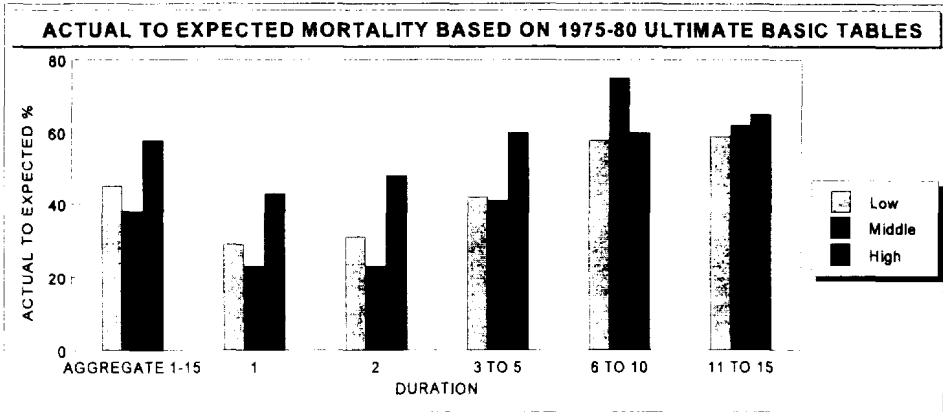
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Appendix B

| ACTUAL TO EXPECTED MORTALITY | | | | | | | |
|---|---------|---------|---------|---------|--------|--------------------|------------------|
| Duration/ Lapse Category | 1 | 2 | 3 to 5 | 6 to 10 | 11-15 | Total Durs 1-15 | Ultimate Data |
| Total Actual(\$,000) | 180,618 | 195,835 | 676,875 | 479,006 | 53,025 | 1,585,359 | 50,485 |
| Total Expected (\$,000) Based on Bragg 1991 Life Tables | 202,685 | 229,943 | 696,290 | 469,300 | 59,425 | 1,658,188 | 66,705 |
| Based on Bragg 1991 Life Tables | | | | | | | |
| LOW | 77.8% | 75.6% | 84.7% | 100.7% | 88.4% | 88.6% | |
| MIDDLE | 66.2% | 63.0% | 83.5% | 113.8% | 90.7% | 84.4% | |
| HIGH | 120.0% | 110.4% | 115.2% | 97.1% | 93.4% | 110.5% | |
| Total Act/Exp | 89.1% | 85.2% | 97.2% | 102.1% | 89.2% | 95.6% | 75.7% |
| Based on 1975-80 Select Basic Tables | | | | | | | |
| LOW | 68.6% | 63.5% | 68.5% | 78.6% | 71.8% | 71.7% | |
| MIDDLE | 53.4% | 49.4% | 64.6% | 87.5% | 70.8% | 65.8% | |
| HIGH | 99.3% | 86.1% | 88.0% | 74.4% | 78.8% | 85.6% | |
| Based on 1975-80 Ultimate Basic Tables | | | | | | | |
| LOW | 28.1% | 31.7% | 43.5% | 58.2% | 58.1% | 44.8% | |
| MIDDLE | 22.2% | 24.9% | 43.1% | 70.0% | 64.0% | 39.4% | |
| HIGH | 44.8% | 45.8% | 60.6% | 59.5% | 66.6% | 55.4% | |
| Total Act/Exp | 31.8% | 35.0% | 50.5% | 60.6% | 59.6% | | |

Mortality Rates as a function of Lapse Rates

Appendix B (continued)



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Appendix C

Companies Used in the lapse/mortality Project:

Allstate
Equitable
Farmers New World
Federal Kemper
John Hancock
Liberty Life Assurance
Minnesota Mutual
New York Life
Phoenix Home
Primerica
Sun Life
Union Central
United of Omaha

