MORTALITY IN SUBSTANDARD LIFE INSURANCE
A PROGRAM TO COMPARE ONE COMPANY’S EXPERIENCE IN VARIOUS IMPAIRMENTS

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Physicians who underwrite substandard life insurance applications would like to know how their predictions of life expectancy for different impairments match the real outcome in these cases.

In our company the only figure available to us from the actuaries was the mortality for substandard business as a whole. We were told that the work involved in following the mortality of individual impairments would not be justified since the numbers of cases involved would not yield significant results.

While accepting that a traditional actuarial study of following all the policies issued with a certain impairment and later determining the mortality in the group would not only be a very long one but would also be too small to be helpful, one of us (BHM) thought that a different approach would be of interest and devised the following study.

We started with deaths and then went back to the underwriting involved. When a death claim arrived for a case issued originally at standard rates, the rating used for the issue indicated the life expectancy which the underwriter considered likely for this person. When this was compared with the actual age of death, the error in the prediction could be calculated.

The essential advantage of this method is that numbers of deaths accumulate very much more quickly than in a prospective study. In this study, we have collected 755 deaths in policies issued at various times, at substandard rates, to analyze, whereas had we confined ourselves to cases issued and dying during the study period, we should have had only 19 cases to look at.

Control
Because we use only cases who have in fact died, there might be an error in that a higher proportion of short-lived rather than long-lived cases would be present. If for instance the numbers of applications increased steadily year by year, the deaths would include a higher proportion of cases issued recently and have a higher mortality experience. To act as a control for this we also performed the same calculations for policies issued at standard rates, which would be subject to the same factors.

Purpose
It must be emphasized that the purpose of the study was not to determine actual mortality rates, but to compare the mortality rates in different impairments in relation to the underwriting assessment, to see if there was a consistent variation from the expected mortality, i.e., if the underwriting of some impairments is more lenient or more strict than the experience justified. The absolute mortality should not be emphasized because of this approach, but the relative mortality of different groups in relation to underwriting predictions is compared.

Methods
Substandard cases
We have used the department PC and a Lotus 123 spreadsheet to store and calculate our data. All the data entered into the file was abstracted from the files by one of the medical directors. When death claims are processed, the claims worker puts on one side all cases which were issued originally at a substandard premium, whether or not the additional rating was later removed. The medical director goes through all these cases and extracts the desired information which includes the name, number, date of birth, date of issue, date of death, underwriting diagnoses (first, second, and third), rating (percentage and flat extra), cause of death (principal and accessory), agency, and how much of the risk, if any, was reinsured. If a person has more than one policy issued at the same time, only one record is made. If the policies are underwritten on different occasions, a record is made for each separate underwriting assessment.

The program in the worksheet then calculates the life expectancy for each case based on the age, sex and rating, (these were based on the life tables regarded as ultimate mortality used in our company in the 1970s) and compares it with the actual number of years lived. The difference (excess of expected years over experienced) is recorded as “premium years deficit” for each case, i.e. the number of years premium which the company had expected but did not get (this number may be positive or negative).

The program keeps a running summary of the results. It allows the results to be extracted in any way desired, based on the data entered into the worksheet. For instance the results for any impairment, any agency, any period of time, any cause of death can easily be extracted. If the diagnoses are entered in the form “heart, murmur, VSD” the extract can give all heart cases or a particular subset as desired.

Standard cases
The mortality in cases issued at standard premiums is handled differently. Each month we receive from the main-frame a report of the death claims paid during the last three months, with the name, sex, date of birth, date of issue, date of death,
agency and re-insurance, down-loaded onto a floppy disk. (Now this is done directly into the PC.) To allow for delays in paying claims, we extract from these files only those deaths which occurred in the first of the three months, then combine these files every three months, and store the results in a file in the PC. This file calculates the life expected and experienced for each case and summarizes the total. Every month the current total is transferred to the main study file which keeps a running total of the standard cases. Some of this sounds cumbersome but was necessitated by the limit of our floppy disks and the size of a Lotus worksheet.

Results
A summary as displayed on the worksheet is shown in figure 1.

**Figure 1**

Medical Department Mortality Study
Policy Deaths During Period

<table>
<thead>
<tr>
<th></th>
<th>no. of policies</th>
<th>average age at issue</th>
<th>average yrs lived</th>
<th>average yrs expected</th>
<th>premium yrs deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substd</td>
<td>755</td>
<td>42.69</td>
<td>70.64</td>
<td>27.95</td>
<td>28.92</td>
</tr>
<tr>
<td>Std</td>
<td>13358</td>
<td>36.95</td>
<td>72.87</td>
<td>35.92</td>
<td>37.96</td>
</tr>
</tbody>
</table>

A graph of the figures for selected first impairments is shown in Table 1.

**Table 1**

Years Deficit by Category

<table>
<thead>
<tr>
<th>category</th>
<th>no of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>cancer</td>
<td>167</td>
</tr>
<tr>
<td>diabetes</td>
<td>107</td>
</tr>
<tr>
<td>bp</td>
<td>37</td>
</tr>
<tr>
<td>build</td>
<td>16</td>
</tr>
<tr>
<td>aviat.</td>
<td>43</td>
</tr>
<tr>
<td>urine</td>
<td>55</td>
</tr>
<tr>
<td>heart</td>
<td>25</td>
</tr>
<tr>
<td>ulcper</td>
<td>48</td>
</tr>
<tr>
<td>ecg</td>
<td>37</td>
</tr>
<tr>
<td>occup.</td>
<td>43</td>
</tr>
<tr>
<td>sub</td>
<td>13358</td>
</tr>
<tr>
<td>ashd</td>
<td>755</td>
</tr>
<tr>
<td>std</td>
<td>26</td>
</tr>
<tr>
<td>build</td>
<td>143</td>
</tr>
<tr>
<td>bp</td>
<td>107</td>
</tr>
</tbody>
</table>

Discussion
It will be seen that the standard cases average out with a small premium deficit of 2 years. The substandard cases have an average premium deficit of 1 year. The deficit of 2 years in the standard group does not indicate that the company has been operating at a loss, for several reasons: (1) the built-in error in starting with deaths in a company with increasing numbers of cases during the years being analysed, (2) pricing is a separate matter from underwriting, and (3) the expected mortality from say 200% has changed over the years but we have used a fixed table for the study. It is for this very reason that the standard cases are included as a control, and in a real sense the premium deficit in the various impairments should be compared with this standard deficit of 2 years as a baseline.
The main comparison to be drawn is between the various impairments, and again it must be emphasized that the mortality of an impairment is in relation to the underwriting assessment. A value for the actual mortality can be obtained by keying the spreadsheet to change all rating values to 100%, which can be done easily.

In comparing different impairments, certain differences stand out. For instance, it seems that in our company we have been too liberal in our underwriting of cancer and diabetes, and too strict with ECG abnormalities. Depending on the number of cases, it is easy to use the worksheet to calculate the answers to such questions as how the figures would have looked if the ECG cases had been taken standard, or if we consider only cases issued after 1970. It is particularly convenient that all these “what if” questions can be answered by a medical director playing with the PC and need not involve any help from another department. Once the original program is set up, these manipulations can be easily performed.

It is not feasible to give the details of the spreadsheet program here, but an outline of it is given in the appendix. Copies of the program itself may be obtained on request by any interested medical director.

Acknowledgements: We should like to thank Claude Trudel A.S.A. for actuarial advice in setting up the program; David Wesley M.D. Chief Medical Director at National Life for helpful suggestions in writing this paper and for a continuing interest in the study; Michelle Campo for secretarial help and for entering much of the data into the computer; and Laurie Morill for selecting out the cases issued at substandard rates when she was processing the death claims.

APPENDIX

The following information may be helpful in determining whether one can use the worksheet program.

Hardware Requirements

- IBM PC family of computers (including the PC, PC/XT, PC/AT, and PS/2) or computers that are 100% compatible.
- Two floppy drives or one fixed drive (hard disk) and a floppy drive.
- A hard disk and a 80286 or better CPU recommended.
- Color or monochrome display. No mouse or pointing device needed.

Software Requirements

- Lotus 123 Release 2.01 or later, or other spreadsheet program capable of reading Lotus worksheets, such as Quattro Pro. Important: The worksheet program cannot be run without first obtaining an appropriate spreadsheet program. These can range in price from $100 (discount) for Quattro Pro to several hundred dollars (list) for a recent version of Lotus.
- DOS 2.0 or later disk operating system.

Procedures

All death claims to be studied must be abstracted from company records. Medical judgement is required in classifying the impairments and the causes of death. Also, there may be a need to convert permanent flat extra ratings to permanent rating as percentiles. The following must be abstracted:

- policy number
- name
- sex
- date of birth
- date of issue
- date of death
- agency
- permanent rating
- temporary flat extra
- percent reinsured
- reinsurer
- primary impairment
- secondary impairment
- tertiary impairment
- primary cause of death
- secondary cause of death

The above are entered into the first 16 columns of the spreadsheet. Each row represents a death claim record. Multiple policies are counted as one death for policies underwritten with the same information but as multiple deaths for policies underwritten at different times. The next 6 columns are calculated by the program:

- age at issue
- years lived after issue
- life expectancy at issue (calculated from rating)
- difference between expected and actual years lived
- ratio between expected and actual years lived
- an intermediate calculation (used to calculate above)

Elsewhere in the spreadsheet a life expectancy table must be entered. It should be based upon the ultimate mortality tables used during the appropriate issue years, e.g., 1960s. The table must include modifications for ratings from 100-500%. A sample table is included with copies of the worksheet program.

Standard deaths are used as a control. Underwriting data and cause of death are not required for the standard experience. Thus, manual abstraction can be avoided by down-loading extract files from the company’s main-frame. These files can be imported into a spreadsheet using a Lotus macro. If the number of standard death claims exceeds the size of the Lotus spreadsheet, then quarterly spreadsheets can be calculated and the subtotals combined to yield the annual experience.

The spreadsheet program is menu-driven. A macro displays a menu and when the user selects menu choices, other macros begin that perform the work of the program. The main menu offers:
LAST ENTRY
This places the cursor at the last entry, i.e., in position for additional data to be entered.

EXTRACT
Pressing this gives a place to enter a criterion for extracting from the spreadsheet. Pressing "ENTER" will then extract the records that meet the criterion and show them.

SUMMARY
This choice will calculate the current figures and show as in the table the current summary of standard, sub-standard deaths and the corresponding premium-year deficits.

PRINT
This will print the current summary (printer must be connected and on).

GRAPH
This extracts from the data the updated values for selected impairments, and displays them in a graph as shown in the table. The figures most recently extracted may be shown any time by pressing F 10 (the Lotus graph key).

Medical Directors interested in obtaining a copy of the worksheet-program should write to:
Dr. Brian H. McCracken
c/o Medical Department, National Life of Vermont
National Life Drive
Montpelier, VT 05602
Please include a formatted floppy disk with your request, either 5.25 or 3.5 size.