MORTALITY STUDIES

A. What measures of mortality, either detailed or abbreviated, are being used to obtain an accurate portrayal of mortality trends?

MR. H. A. GARABEDIAN discussed the question of how to report the results of an experience in abbreviated, but intelligible and credible terms to company executives who are not interested in laboring over long technical reports from the actuary. He felt that the results should be as free as possible from bias and distortion, and to achieve this purpose they should be determined by a tabular measure which as nearly as possible expresses normal mortality by an index of 100% at every point in the table.

He pointed out that bias and distortion in results can be caused either by an inappropriate choice of the tabular measure, or by influences inherent in the experience being measured, such as in the injudicious combining of unlike segments of business. The long term trend toward improved mortality has been itself a primary cause of bias in mortality results, accentuated by the marked variation by age in the degree of improvement.

Mr. Garabedian thought that nonactuarial executives prefer to see an experience of their company compared with that considered normal for the industry for the particular class of business in question. As an example, he felt the Joint Committee's 1946–1949 Select Basic Table was a very satisfactory measure for John Hancock's Ordinary medical standard business for the same period of experience. By this table, for the years of issue 1935–1949 exposed between anniversaries in 1945 and 1950 the ratio is 99.8%. This, he thought, is a highly significant and credible result, though abbreviated, and can be reported with confidence and a minimum of explanation.

As an indication of the bias and distortion that would be introduced into an abbreviated result for the same experience by the use of the 1925–1939 Basic Table, the experience which produced a ratio of 99.8% above would produce 61% of the 1925–1939 Basic Table. The ratios for the latest years of issue were about 40% and for the earliest years of issue about 73%.

In closing, Mr. Garabedian remarked that it would be desirable to have additional tables similar in construction to the 1946–1949 Select Basic Table, representing industry experience taken successively over short pe-

riods. He felt such tables provide not only convenient tools with which to measure comparable company experiences over the same periods, but enable actuaries to prepare abbreviated but meaningful reports with a minimum of bias.

MR. N. W. MACINTYRE described the studies made annually by the Mutual Life of New York to measure their mortality against that of similar companies in the industry. They obtained the material submitted by the sixteen large companies to the Recent Issues Mortality Studies and assembled the mortality figures.

Their 1951 report included the issues of 1945–1949 exposed from issue to the 1950 policy anniversary and the issues of 1935–1949 exposed between the 1945–1950 policy anniversaries. The expected deaths were computed by the 1946–1949 Basic Table and their analysis includes a detailed breakdown for all ages, by year of issue, and for all durations, by decennial issue age groups. Ratios of actual to expected deaths are compiled for each individual company as well as an average for all companies.

The report gives them an indication of the effectiveness of their underwriting compared to that of the industry and upon further study they were able, in some instances, to adjust their underwriting processes to advantage. They furnish each of the contributing companies with a copy of the study but the companies, other than the Mutual Life, are not identified.

In closing, Mr. Macintyre mentioned another mortality report that they assemble monthly which is a mortality ratio that makes allowance for the seasonal variation in mortality and also for the varying number of days in the month. The numerator is the actual deaths for the year to date; the denominator is the average deaths over the last five years, both being based on the amount at risk. He pointed out that, if the amount of insurance is the same in each age and duration group, this ratio should decrease from year to year because of the continuing improvement in mortality.

MR. D. N. McCORMICK reported on the progress made by the Canadian Association of Actuaries in obtaining mortality statistics among companies operating in Canada. After sending out questionnaires a committee recommended the study of the experience on standard ordinary policies and actual collection of material commenced for the policy year from the anniversary in 1949 to the anniversary in 1950. He indicated that arrangements were also made to have similar experience contributed for each policy year in the future.

He mentioned that the data submitted is by age and duration for the first five policy years and by attained age only for the sixth and later policy years. The material is in such form that it may be used for year-by-

year comparisons of mortality or, at some later date, combined to form a Canadian mortality table if it is so desired.

MR. M. F. FEAY agreed with Mr. Garabedian and Mr. Macintyre that the mortality ratio obtained from the gain and loss exhibit is not a satisfactory index of the trend in mortality. He pointed out that since the expected mortality is based on one or more ultimate tables used for reserve purposes the following distortions are produced:

(1) An increase in the ratio arising from either a decrease in new business or an increase in the age of business in force.

(2) A decrease in the ratio arising from an abnormal increase in new business.

(3) An increase in the ratio as the proportion of business in force valued on the CSO Table (as against the American Experience Table) increases.

Mr. Feay then gave a description of a method which removes these distortions by obtaining an over-all ratio of actual to expected mortality based on the net amount at risk which takes account of the incidence of mortality by duration as well as by attained age and includes the experience under standard and substandard ordinary insurance. He pointed out that this differs from the method presented in an informal discussion by Mr. McVity (*RAIA* XXXVII, 356) in that Mr. McVity's method was based on the face amount of standard insurance. The method, as used in the Equitable (N.Y.), was then described by Mr. Feay as follows.

For standard issues a select and ultimate mortality table with a fifteen year select period based on recent experience was adopted as the standard of comparison.

No substandard tables were available so mortality for each substandard class is expressed as a percentage of the standard rate; the percentage does not vary by age but decreases with duration to a level percentage for the ultimate rate. As a guide in determining these percentages they used a recent study of the substandard business which expressed the mortality in each substandard class as ratios to standard mortality for various duration groups. Substandard mortality tables secured by applying these crude ratios to the standard mortality rates were then used to determine ratios of actual to expected mortality. Tests showed that if they assumed that each substandard class had the same ratio of actual to expected mortality as the standard class the effect on the over-all ratio for standard and substandard combined was negligible. The crude experience ratios of substandard to standard mortality were then adjusted by graphic graduation to produce the same ratio of actual to expected mortality in each valuation class.

In order to minimize the calculations during a calendar year, average select rates of mortality, independent of issue age or plan, are determined at the beginning of the year. The insurance in force and mean reserve thereon as of the preceding December 31 are tabulated by valuation class, year of issue and issue age group. Because of the rapid decrease in mortality rates in the early years of life the tabulations are by individual ages for ages 0 through 7, but for quinquennial age groups thereafter. The face amount less reserve is multiplied by the appropriate mortality rate and the results summed by year of issue. The total for each year of issue divided by the total face amount less reserve for that year of issue produces the average select rates. One average rate is secured for the entire ultimate experience.

The face amount less reserve during the calendar year is estimated by first securing the face amount of insurance exposed to risk by the usual methods and then multiplying by an average net risk factor. To determine the average net risk factor an average mean reserve factor, independent of issue age and plan, for each select year of issue and valuation class and one average reserve factor for the ultimate section of each valuation class is determined from the insurance in force at the end of each of the three preceding calendar years. Average ages at issue are secured therefrom by using representative plans and, by extrapolating, projected average reserve factors are secured. Deducting these projected average reserve factors from unity and employing the insurance in force at the end of the preceding calendar year, an average net risk factor for each select year of issue and one average factor for the entire ultimate experience is secured.

For terminations other than by death, termination rates for the first fifteen years, varying by duration only, and one over-all termination rate for the ultimate experience are determined from the experience of the previous calendar year. These termination rates are applied to the amounts of insurance exposed to risk of termination during the first n quarters of the current calendar year to secure a distribution of terminations by duration which is then adjusted pro rata so that the total adjusted figures equal the total amount actually terminated during the first n quarters of the current year.

The exposed to risk of death based on amounts of insurance for the first n quarters of the current calendar year is secured for each select year of issue, with one exposed to risk for the ultimate experience. These are multiplied by the average net risk factors and by the average mortality rates to secure the expected net loss.

The actual net loss for the year is taken as the reported death claims less the terminal reserves released by death plus the increase in the in-

curred but unreported death claim liability, where the incurred but unreported liability is the excess of the face amount over the reserve.

Reinsurance ceded is deducted from all reserves, and amounts of insurance and additions to policies by dividends are treated as ultimate throughout. Term and group conversions are included as issued in the year of conversion. This treatment of additions to policies tends to understate the ratio whereas the treatment of conversions tends to overstate the ratio. The net effect of these and other approximations does not appear to be great since, using a mortality table based on experience during the five years 1945–1950, the method produced ratios of 99.7%, 100.9% and 99.3% for the three calendar years 1949 to 1951, inclusive. The ratios by quarter years varied from 90% to 113.2% over the same three years.

MR. J. W. RITCHIE described the studies made by the Mortality Department of the Sun Life of Canada. He first mentioned the standards used to measure the mortality trends and results for special classes which vary by type of business as follows:

(i) For ordinary insurance they use mortality tables based on their recent experience, while the results of the intercompany mortality studies are used as a standard to compare their experience with that of other companies.

(ii) For group insurance they used the CSO Table which is the basis of their premium rates.

(iii) For ordinary annuities, group annuities and settlement options involving life contingencies they used the a–1949 Table and modifications of the 1937 Standard Annuity Table.

Mr. Ritchie then outlined the three types of studies made.

Semiannual Studies

These are estimates of the ordinary insurance mortality for Canada and the United States by various classes based on number of policies and amounts.

Annual Studies

(a) Study of ordinary mortality for Canada and the United States separately by various classification groups. The incidence of death by cause is also analyzed.

(b) Investigation of ordinary mortality for various territories such as Great Britain, South Africa, etc. Various classification groups are used and here again the trend of the incidence of death by cause is studied.

(c) Investigation of group insurance mortality for Canada, the United States and other territories by various classification groups.

(d) Investigation of group annuity mortality by territory.

Periodic Studies

These studies cover mortality experience under numerous classifications such as ordinary annuities, settlement options, large amount policies, etc. Accidental death benefit experience is also investigated periodically.

Mr. Ritchie then described mortality studies made by their Actuarial Department which cover ordinary and group insurance, are based on net amounts at risk and are made monthly and annually. The expected mortality is based on their valuation tables with some adjustments for their foreign business to allow for higher mortality. Single ratios of actual to expected are prepared for each of nine subdivisions which are made mainly by country, for all ordinary insurance, for all group insurance and for all ordinary and group insurance combined.

As part of the procedure for making the monthly studies, the expected mortality calculated for the annual study is expressed as a ratio to the mean insurance in force during the year for each of the nine subdivisions. The trend of these ratios for successive years is analyzed as a means of fixing a set of ratios for use in calculating the expected mortality for the monthly studies made during the current year. In each monthly study the expected mortality for the year to date is calculated using the mean in force for the period. The actual mortality figures for the year to date are correct and not estimated since their system produces monthly totals for claims incurred and reserves released thereon.

In concluding, Mr. Ritchie mentioned that their Actuarial Department makes an annual study of the mortality ratio for each ceding company in their Reinsurance Section. They keep on record an accumulative ratio of actual to expected mortality for the business assumed from each ceding company.

MR. J. H. MILLER felt that instead of measuring mortality or mortality improvement by ratio of an observed q_x to some basic q_x, it might be more appropriate at times to use a weighted difference in the rates of mortality or the ratio of the life expectancies on the two tables.

He expressed the belief that there is a misconception, outside the actuarial profession, that improvement in mortality of individuals over the years has largely been confined to ages under fifty or sixty. In this connection he pointed out how important the financial effects of relatively smaller improvements at the higher ages can be.

In concluding his remarks, Mr. Miller mentioned a paper by Mr. R. D. Clarke presented at the Centenary Assembly of the Institute of Actuaries (Vol. 2, p. 12) which approaches mortality from a theoretical point of view and assumes that, at birth, everyone has a normal life span determined by heredity and other influences. The deaths are divided into two main groups: (1) those which occur because the normal life span has run out (senescent deaths), and (2) all remaining deaths, whether from accident, disease or any other cause (anticipated deaths). He felt that, since it is not possible to make such a separation, the difference in rates of mortality furnishes a practical measure of mortality changes consistent with this concept.