

THE ANALYSIS OF PERMANENT HEALTH INSURANCE DATA

INTRODUCTION

It has always been envisaged by the PHI Sub-Committee, from the first Report of the Advisory Sub-Committee for the investigation of sickness statistics in September 1971 (reprinted in 'Investigation of Sickness Statistics', *C.M.I.R.* 2 (1976)), that an investigation on a 'Disability Annuity' basis would be carried out. However, it was noted in that first Report that "disability annuities have to be derived from 'select' data with a very long period of selection (15 years was used in the United States of America) and a number of years' experience must be amalgamated to produce results which are statistically reliable". Records for claims were therefore gathered in a form which would allow rates of termination of claim 'whether by recovery or death' to be investigated. In this Report the Sub-Committee presents the results of its investigations on these lines for the first time.

Rates of claim inception, i.e. 'rates of starting a claim at age x ' have been calculated and published from the very first investigation. Graduations of the male claim inception rates for 1972-75 were published in 'Sickness Experience 1972-75 for Individual Policies', *C.M.I.R.* 4 (1979) and graduations of the male standard experience for 1975-78 were published in 'Sickness Experience 1975-78 for Individual PHI Policies', *C.M.I.R.* 7 (1984).

In this Report the Sub-Committee is at last able to present its investigations of sickness claims on a 'disability annuity' basis for consideration by the actuarial profession and by PHI offices. The Report is long, and it has taken a long time to produce. As the investigation progressed it became apparent that a new and clearly stated model of sickness was required. Such a model had been proposed by Dr H. R. Waters (1984). In 1986 Dr Waters was invited to become a member of the Sub-Committee. His contribution to the development of the model is readily apparent from the fact that three of the six Parts into which this Report is divided carry his name as the author.

The use of this new multiple state model resulted in complexities that had not initially been suspected. It was felt that the use of the full model, although theoretically justifiable, resulted in what were probably unacceptably heavy computational requirements. It was necessary therefore to search for a way of simplifying the results in order to facilitate practical calculations. This too took a substantial amount of time, as did the search for satisfactory bivariate formulae to represent rates of recovery and death which varied both by age and by duration of sickness. This latter task fell to Mr P. H. Bayliss, who had been responsible for the graduation work in the earlier reports on sickness statistics. Part B of this Report is recognised as his work.

A major advantage of the multiple state model used as the basis of this Report is that it allows the two different approaches, the Manchester Unity Sickness Rate approach and the Claim Inception Rate and Disability Annuity approach, to be seen as alternative representations of the same underlying model, providing alternative ways of calculating the same functions. The apparent conflict between the approaches is seen to be groundless, and it is shown in Part F of the Report that each approach has its merits for calculating the values of different types of benefit. The choice is not one of principle, but of computational convenience. It has to be noted, however, that a single Sickness Rate table, as in the original Manchester Unity tables, does not provide a satisfactory approximation; rather a table dependent on age at entry is required.

In its Report in *C.M.I.R.* 7 (1984) the Sub-Committee discussed the problems of interpreting figures for sickness rates gathered on an 'aggregate' basis, i.e. not sub-divided by duration since the commencement of the policy. The investigations in Part E about the construction of select tables of sickness rates demonstrates why an 'aggregate' rather than a 'select' investigation is unsatisfactory, at least for the sickness period denoted as '104/all'.

Many techniques new to the actuarial profession have had to be developed in the course of this investigation. These include:

- graduation of bivariate data, and corresponding graduation tests;
- numerical solution of the simultaneous differential equations that define the multiple state model;
- criteria for condensing complete tables of rates, sub-divided by age at entry and attained age, into tables with a select period for a limited number of years;
- investigation into the relative accuracies of different methods of approximation.

Many of these are interesting problems in their own right.

The Report is sub-divided into six Parts. In Part A the mathematical basis of the multiple state model is described. In Parts B and C the rates of recovery and death among the sick and rates of falling sick among the healthy are analysed, and graduation formulae that satisfactorily fit the data are developed. In Part D the numerical methods required to solve the differential equations of the model are described, ready for Parts E and F, in which the calculation of probabilities and the calculation of monetary functions are described, and many numerical examples are given.

A glossary of the notation for those functions that appear in more than one Part is included as an Appendix.

It should be noted that the data used throughout this investigation is that for the Male Standard Experience for individual PHI policies for 1975-78. Comparison of the experiences for females, for group and unit cost policies and for all investigations for 1979-82 will follow in subsequent Reports.

The size of the task that has been undertaken by the members of the Sub-Committee and in particular by members of the Task Force responsible for the work—R. H. Plumb (Chairman), P. H. Bayliss, E. A. Hertzman, G. C. Orros,

H. R. Waters and A. D. Wilkie—has been daunting. The length of this Report may be just as daunting to many readers. The Task Force in particular feels perhaps that, to adapt Horace:

Parturiunt mures, nascetur immensus mons;

but it hopes that some others may attempt to scale the mountain with them.

Those who feel that they need to revise their knowledge of the practical aspects of PHI business may like to read or reread the papers by Bond (1963), Sansom (1978) and Sanders and Silby (1988). Those who wish to review the earlier investigations of the PHI Sub-Committee are referred in particular to reports in *C.M.I.R. 2* (1976), *C.M.I.R. 4* (1979) and *C.M.I.R. 7* (1984).