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A multiple state model for the analysis of permanent health insurance claims by cause of disability☆

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Abstract

In this paper, we present a multiple state model for permanent health insurance (PHI) which enables us to analyse PHI claims by cause of disability. This new model, which is a generalisation of the model proposed in Continuous Mortality Investigation Reports [The analysis of permanent health insurance data, Continuous Mortality Investigation Report No. 12, The Institute of Actuaries and the Faculty of Actuaries, 1991] is very useful in the underwriting and claims control stages of PHI business.

In the last sections of the paper, we use the model mentioned above to calculate the average duration of a claim and claim inception rates by cause of disability. For that purpose, we use the approximations to the transition intensities obtained by Cordeiro [A stochastic model for the analysis of permanent health insurance claims by cause of disability, Ph.D. Thesis, Department of Actuarial Mathematics and Statistics, Heriot-Watt University, Edinburgh, UK, 1998] and numerical algorithms which make possible an efficient evaluation of basic probabilities. We also make general comments on the results obtained.

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1. Introduction

Permanent health insurance (PHI for brevity) is a class of long-term sickness insurance which provides cover against the risk of loss of income due to disability. In general terms, a PHI policy entitles the policyholder to an income during periods of disability longer than the deferred period of the policy. Each PHI policy has a deferred period, which is chosen by the policyholder when the policy is effected. Benefits only start to be paid after the end of the deferred period.

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In this paper, we are interested in individual conventional policies with level benefits. This type of policy, one of those sold by UK insurance companies, entitles the policyholder to a regular level income during periods of disability longer than the deferred period. The most common deferred periods for this type of policy are: 1, 4, 13 and 26 weeks. In exchange for these benefits, the policyholder has to pay a regular level premium throughout the term of the policy: from the time when he effects it, at which he is required to be healthy, to his 60th or 65th birthday (usually, the age of his retirement). In general, the premiums are waived whenever the policyholder is claiming. The most important feature of this type of PHI policy is that both the benefits and the premiums are fixed when the policy is effected and they remain guaranteed throughout the term of the policy.

In this paper, we present a multiple state model which enables us to analyse PHI claims by cause of disability. This new model can be considered as a generalisation of the multiple state model for PHI proposed in CMIR (1991). The latter model has three states: healthy, sick and dead, and the important quantities for the model are the transition intensities. The action of the transition intensities governs the movements of a policyholder between the three states.

In the new model, we study in this paper the state sick defined for the model presented in CMIR (1991) is replaced by n states ($n > 1$), each of which represents a different class of causes of disability. These n states, considered together, group all possible causes of disability. The set of transition intensities defined for this new model allows the calculation of quantities such as the average duration of a claim and claim inception rates by cause of disability. This fact makes the model very useful in the underwriting and claims control stages of PHI business.

With the model proposed in CMIR (1991), with only one state grouping all possible causes of disability, it is impossible to calculate the quantities mentioned in the previous paragraph and, therefore, to study PHI claims by cause of disability.

In the last sections of the paper, we use the new model mentioned above, in practice, to calculate the average duration of a claim and claim inception rates by cause of disability. For that purpose, we use the approximations to the transition intensities defined for the model obtained in Cordeiro (1998).

Although the work in this paper relates more directly to the work presented in CMIR (1991) and, therefore, we will reference it often throughout the paper, we should also refer to the work of other authors who made important contributions to the study of multiple state models applied to (life, disability, etc.) insurance. For the mathematical and statistical aspects of these models, we refer to the work of Haberman and Pitacco (1999), Hoem (1969, 1972, 1976, 1988), Wolthuis (1994). For another application of multiple state models to a class of long-term insurance (in this case, care insurance for elderly individuals), we refer to the work of Jones (1995, 1997a,b).

In Section 2, we describe the model intuitively using a diagram. In Section 3, we present the mathematical basis of the model and define the basic probabilities which are required for the calculation of more complex quantities concerning PHI business. In Section 4, we present formulae for the basic probabilities. In Section 5, we derive numerical algorithms which make possible an efficient evaluation of some of the basic probabilities. In Section 6, we give formulae for the average duration of a claim and the claim inception rate for a given class of causes of disability and talk about the importance of the model for PHI business. Finally, in Section 7 we calculate the average duration of a claim and claim inception rates for different deferred periods, classes of causes of disability and ages at the beginning of sickness (or attained ages). We also make a general analysis of the results obtained.

2. Description of the model

In order to describe intuitively the new model, we are studying, we produced a diagram, which is shown in Fig. 1.

From Fig. 1, we can see that the model has $(n + 2)$ states: healthy (denoted by H), dead (denoted by D), sick with a sickness from class 1 (denoted by S_1), sick with a sickness from class 2 (denoted by S_2), etc., sick with a sickness from class n (denoted by S_n).

When a policyholder effects his policy, he enters state H (since he is supposed to be healthy at that time). From this state, he may transfer at any future time either to one (and only one) of the states $S_1, S_2, \ldots, S_n$ (he may become sick with a sickness from one of the classes of causes of disability) or to state D (he may die). The transition intensities associated with these two transitions are denoted by $\sigma(i)_x$ (where i is the class within which is grouped