

The impact of the determinants of mortality on life insurance and annuities

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Abstract

Extended risk classification has become an important issue recently in life insurance and annuity markets. Various risk factors have been explored and identified by past research. Using those risk factors, one can construct various risk classes. This enables insurers to provide more equitable life insurance and annuity benefits for individuals in different risk classes and to manage mortality/longevity risk more efficiently. The challenge of modeling mortality using various risk factors is to reflect complicated mortality dynamics in a model while maintaining statistical significance. This paper discusses the development of a mortality model that reflects the impact of various risk factors on mortality. Longitudinal survey data from the Canadian National Population Health Survey was used to determine the significant risk factors and quantify their effect on mortality. The model is used to illustrate how the various risk factors influence actuarial present values of life insurance and annuity benefits.

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1. Introduction

1.1. Background

Mortality is one of the most important concerns of actuarial work related to life insurance and annuity products. A great number of medical and epidemiological studies have discovered and verified risk factors of adult mortality and evaluated mortality differentials based on identified risk factors. In addition to age and sex, those risk factors include socio-economic/demographic status such as education, income, occupation and marital status (Lantz et al., 1998; Bassuk et al., 2002; Sorlie et al., 1995; Rogers, 1995), behavioral factors such as smoking (Godtfredsen et al., 2002; Tessier et al., 2000; Sunyer et al., 1998; Prescott et al., 1998), alcohol intake (Thun et al., 1997; Klatsky et al., 1992; Scherr et al., 1992), physical activity (Erikssen et al., 1998; Blair et al., 1989) and obesity (Dorn et al., 1997; Landi et al., 1999). Also, health indicators such as blood pressure (Lindholm et al., 1986) and cholesterol level (Anderson et al., 1987) are known risk factors of mortality.

If the important mortality risk factors are considered in actuarial work, more risk classes can be obtained and more equitable premiums can be provided for insureds in different risk classes. This issue is well addressed by Brown and

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McDaid (2003). Even if utilizing certain risk factors is prohibited in underwriting, the difference of mortality risks or longevity risks among insureds can be taken into account for setting reserves and establishing a valuation process for more efficient mortality risk management. The challenge in modeling mortality with various risk factors is to consider the complexity of mortality dynamics. Two important characteristics of mortality dynamics are interactions among risk factors and variability of certain risk factors over time.

1.2. The structure of mortality dynamics

Brown and McDaid (2003) reviewed a number of papers and identified several risk factors on the mortality of elderly populations. Similarly, past studies have found evidence that risk factors affecting the mortality of older adults also affect the mortality of younger adults. In other words, the important mortality risk factors influence the mortality of all adult age groups. Those risk factors can be classified according to the cause–effect relationships among them. We consider the following three categories of risk factors:

- socioeconomic/demographic risk factors: age, sex, education, income, occupation, marital status, etc;
- behavioral risk factors: smoking, alcohol intake, physical activity, dietary habit, body mass index, etc;
- health indicators: blood pressure, cholesterol level, blood sugar level, etc.

Socioeconomic/demographic risk factors are the fundamental determinants of mortality. Those factors affect both behavioral risk factors and health indicators. Behavioral risk factors mediate the effects of socioeconomic/demographic factors on mortality. Also, behavioral risk factors have some influence on socioeconomic/demographic risk factors. These two groups of factors determine health outcomes, which are normally measured and used to indicate specific diseases. Finally, mortality is directly influenced by health indicators. Also, mortality can be directly affected by socioeconomic/demographic variables (e.g. sex difference of mortality) and behavioral risk factors (e.g. accidental death caused by driving habits). The mortality dynamics are illustrated in Fig. 1.

Mortality is accelerated by incidence of any disease. Furthermore, major adult diseases are closely related to health indicators. Therefore, socioeconomic/demographic and behavioral risk factors affect mortality through health indicators. This is supported by past research that found mortality risk factors affect major adult diseases. Health indicators can be used for short-term prediction of mortality, since people who have poor health have high mortality, which is obvious. However, if we focus on a long-term prediction of mortality using basic determinants of mortality, this will provide a more fundamental understanding of mortality.

In addition, policyholders at the issuance of the policy are normally healthy because of the underwriting criteria for insurability. Also, the durations of life insurance policies and annuities are fairly long. In this case, only long-term prediction of mortality using factors other than health outcomes remains. Therefore, investigation of the impact of socioeconomic/demographic and behavioral risk factors on mortality is very useful. This supports the use of a model with only basic determinants of mortality, especially for actuarial applications. Therefore, this paper explores an appropriate mortality model with available socioeconomic/demographic and behavioral risk factors.

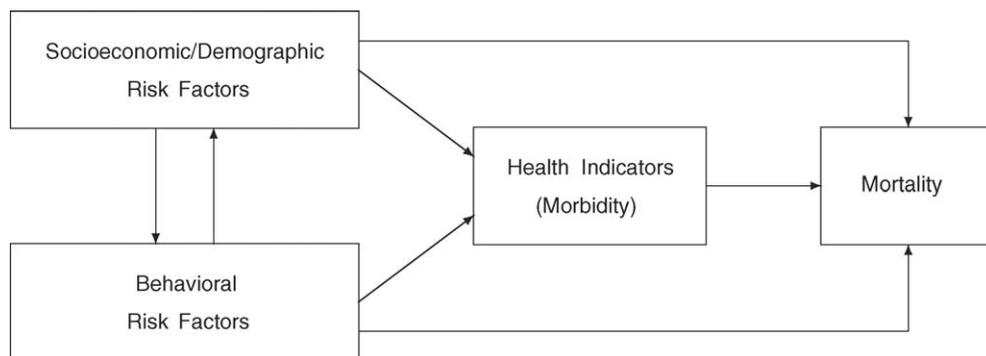


Fig. 1. Mortality dynamics.

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