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**Optimal Risk Classification and Underwriting Risk for  
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## **Optimal Risk Classification and Underwriting Risk for Substandard Annuities**

Substandard annuities pay higher pensions to individuals with impaired health. These products are increasingly prominent in the U.K. insurance market where more than 20% of annuities sold are based on enhanced rates. Outside the United Kingdom, however, substandard annuities are surprisingly rare. It is not obvious why substandard annuity markets are so small, especially given that such a risk classification generally increases a company's profitability. Furthermore, substandard annuities would make private pensions available for a broader range of the population and would thus improve retirement incomes for insureds with a reduced life expectancy. Thus, there must be important reasons behind the reluctance of many insurers to enter the substandard annuity market.

In this paper, we contribute to the literature by providing a comprehensive analysis of challenges and chances for life insurers offering substandard annuity products. First, we provide qualitative background information about different types of substandard annuities, their respective underwriting and classification, potential market size, and associated underwriting risk.

Second, we develop a theoretical model to determine the optimal risk classification system for substandard annuities that will maximize an insurance company's profits. This is done based on given price-demand dependencies in population subgroups and classification costs. Risk classes are distinguished by the average mortality of contained insureds, whereby mortality heterogeneity is included by means of a frailty model. In addition, we solve for the optimal risk classification system when taking into account the costs of insufficient risk assessment (underwriting risk) that occurs when insureds are assigned to inappropriate risk classes. This extension is crucial, as underwriting risk is considered to be the most significant risk factor in the issuance of substandard annuities and thus should be taken into account when making informed decisions. We model these costs by assuming error probabilities for wrongly classifying insureds into a higher risk class, thus underestimating the true costs of insurance. When considering costs of underwriting risk, a modified risk classification system might be optimal, depending on the underwriting quality.

Third, we discuss key aspects regarding a practical implementation of our model, along with market entry barriers and risks and advantages inherent in being a substandard annuity provider.

In conclusion, extended risk classification in annuity markets could not only increase the profitability of insurance companies, it would benefit society at large as the introduction of substandard annuities makes it possible for many formerly uninsurable persons to secure for themselves a private pension.