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Modeling Mortality in Life Insurance Applicants

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This article is the first in a series of articles on insurance applicant mortality risk analytics.

Over the last few years, ExamOne has developed a mortality risk assessment model capable of accurately determining the relative likelihood of premature death in the insurance applicant population. The model determines a percentile ranking of comparative mortality risk, normalized by age, gender and smoking status. We call the ranking a “risk IQ.” The model embodies a true multivariate analysis eliminating previously intractable underwriting issues stemming from co-morbidities and correlations among assessed variables (e.g., the tendency of overweight individuals to also exhibit elevated blood pressure and cholesterol, etc.). The model is capable of assigning separate hazard functions and weightings to each variable depending upon applicant age and gender. In females 18 to 29, for instance, blood pressure appears to have few implications for mortality, and elevated BUN is a serious risk factor—whereas in males 50 to 59, blood pressure is a leading contributor to the risk profile, while BUN plays a more moderate role.

In evaluating the results from the model and its methodologies, the most striking finding has been the extent to which deaths are concentrated among the upper ranges of the model. Based on the data reviewed over a 10-year period, more than 30 percent of all Social Security Death Master File deaths were attributable to applicants with risk IQs of 90 or above. A remarkable 10 percent of deaths originated from the 1 percent of applicants with risk IQs of 99. Claims studies with multiple carriers have revealed that conventional underwriting does successfully identify some, but not all, of these cases. Only 34 to 50 percent of applicants with risk IQs of 99 are currently declined.

Deaths among applicants with low risk IQs are distinctly less probable. The mortality rate of applicants with risk IQs less than 75 is approximately 60 percent of the 2001 select VBT table. This is a level generally considered consistent with a preferred or preferred plus underwriting decision. In most carriers, no more than 35 to 40 percent of applicants are currently classified as preferred risks. The additional 35 to 40 percent of the applicant population with risk IQs less than 75, most of whom are excluded from conventional preferred pools due to isolated BMI or cholesterol elevations, can be considered the “hidden healthy” and could be accepted into preferred pools without experiencing an increase in mortality outcomes.

The misclassifications common under established underwriting systems also include under-ascertainment of risk. In one large carrier, more than 12 percent of policies issued in the best underwriting class were associated with risk IQs of 75 or above. As a group, these “cryptic risk” cases will experience a claims rate more than twice that for which the class has been priced, with obvious, and substantial, financial implications (in a 20-year term \$500,000 policy issued to a 45-year-old cryptic risk male, the expected value of claims will exceed premiums by ~\$6900 on a present value basis). In the carrier study above, applying a model which calculates a risk IQ was a better predictor of claims over a four-year period than the actual underwriting decision (C-statistics: 0.748 vs. 0.668), despite the fact that the algorithm lacked access to driving records or family/medical history—both of which were available to the human underwriters.

In the near future, we intend to integrate reflexive laboratory test results (e.g., PSA, pBNP, etc.) into this mortality model. In the intermediate term, it should be possible to fully incorporate the results of tele-underwriting

interviews. As current and future versions of this mortality modeling system achieve greater utilization and additional data and experience, adverse selection may become a reality. Hidden healthy cases lost from standard pools, and the inadvertent attraction of cryptic risk cases to preferred pools, will likely become a pressing issue for product actuaries. ●

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