MS Module 23: Actuarial risk classification (overview)

(The attached PDF file has better formatting.)

Reading on discussion forum: Actuarial risk classification

Actuarial pricing and risk classification use several methods: one-way relativities, minimum bias balance principle, least squares analysis, χ^2 functions, and generalized linear models. One-way relativities were used almost exclusively until about 60 years ago and are still common today, but statistical models are increasingly preferred.

- This module covers additive vs multiplicative models and minimum bias balance principles.
- The next module covers least squares analysis, χ^2 functions, and maximum likelihood bias functions.

Generalized linear models with log-link functions are often the optimal method but they are complex and hard to implement. A time consuming procedure that is not understood is not persuasive. The multiplicative minimum bias procedure using the balance principle is equivalent to a generalized linear model with a log-link function.

The previous modules assume additive models when the data have two or more dimensions. If home prices are a function of the size of the lot on which the home is built and of the number of rooms in the home, we assume price = $\beta_0 + \beta_1 \times$ lot size $+ \beta_2 \times$ rooms + a stochastic error term.

Actuarial pricing generally assumes multiplicative models. If expected losses are a function of the age groups and the location (territory), we assume expected losses = base rate × age group relativity × location relativity × a stochastic error term.

Additive models are the easiest to work with and they often reflect reality. If the model is multiplicative, taking logarithms of both sides yields an additive model. Moreover, the statistical model is not that important for most applications. If an additive model gives a *p* value of 2% and a multiplicative model gives a *p* value of 4%, the difference is large but probably won't affect the operations of the firm using the model.

Actuaries use models to price insurance products. If an additive model gives a price of 900 and a multiplicative model gives a price of 1,100, the difference may separate success from failure.

The reading on the discussion forum explains additive models, multiplicative models, and combined models.

Know the iterative procedure to balance a minimum bias problem. The final exam problem may give relativities for one dimension along with observed data and derive the relativities for the other dimension at the next iteration. The exam problem will specify the type of model: additive, multiplicative, or combined.

Learn first the procedure for one observation in each cell, then the additional step for multiple observations. The final exam problems have multiple observations in each cell.

Business applications differ from research work: the practicing actuary optimizes a result (an insurance price or a mortality estimate), whereas the research asks whether a result is plausible. The actuary does not just ask whether territory or sex affects auto accidents; the actuary must estimate premium rates for drivers by territory or sex. The actuary does not just ask whether education or income affects mortality; the actuary must estimate premium rates for persons of different education or income. Some class variables may be prohibited, and practical constraints make some variables (such as alcohol consumption) unmeasurable, so actuaries may optimize their estimates from other variables.