

Questions from the 2007 Exam:

4. (2 points) There are a variety of methods available to a ratemaking actuary when determining classification rates.
- (1 point) Compare the Generalized Linear Model to the Classical Linear Model with respect to the following:
 - The distribution of the response variable.
 - The relationship between the mean and variance of the response variable.
 - (1 point) Describe two ways in which a Generalized Linear Model is superior to a Minimum Bias Procedure.

Supporting materials. An excerpt from our study manuals

Linear models

A GLM is a general form of a linear model.

Linear models (LMs) and GLMs express the relationship between an observed response variable, Y , and a number of covariates (also called predictor variables), X .

Linear models can be expressed as the sum of its mean, μ , and a random variable, ε : $Y = \mu + \varepsilon$

They assume that

- the expected value of Y , μ , can be written as a linear combination of the covariates, X , and
- the error term, ε , is normally distributed with mean zero and variance σ^2 .

Limitations of Linear Models

Some problems with the required assumptions are:

- The response variables may not be normal and have constant variance for response variables.
- The values for the response variable may be restricted to be positive. The Normality assumption violates the restriction that the values for the response variable may have to be positive.
- If the response variable is strictly non-negative, then variance of Y tends to zero as the mean of Y tends to zero (i.e. the variance is a function of the mean).
- Many insurance risks tend to vary multiplicatively with rating factors, and thus the additivity of effects in the (LM2) and (LM3) assumptions are not realistic.

Generalized linear model assumptions

GLMs:

- Include a wide range of models (linear models are a special case)
- Have no restriction assumptions of Normality, constant variance and additivity of effects
- Have a response variable assumed to be a member of the exponential family of distributions
- Permit the variance to vary with the mean of the distribution.
- Assume the covariates effect on the response variable to be additive on a transformed scale.