Coursework 3: STAT 570

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1. Consider the Poisson-gamma random effects model given by

$$Y_i \mid \mu_i, \theta_i \sim \text{Poisson} \left(\mu_i \theta_i \right) \tag{1}$$

$$\theta_i \sim \text{Gamma} \left(b, b \right), \tag{2}$$

which leads to a negative binomial marginal model with the variance a quadratic function of the mean. Design a simulation study, along the lines of that which produced Table 2.3 in the book (overdispersed Poisson example) to investigate the efficiency and robustness under

- a Poisson model;
- quasi-likelihood with $\mathbb{E}\left[Y\right] = \mu$ and $\text{Var}\left(Y\right) = \alpha\mu$; and
- sandwich estimation.

Use a log-linear model

$$\log \mu_i = \beta_0 + \beta_1 x_i, \tag{3}$$

with $x_i \sim_{\text{iid}} \mathcal{N}\left(0, 1\right)$ for $i = 1, 2, \ldots, n$, and $\beta_0 = -2$ and $\beta_1 = \log 2$.