Statistics 520

Five Minute Quiz 3

Fall 2025

1. (2 pts.) A linear regression model for a set of independent response random varibles $Y_1, \ldots, Y_n$ and associated covariates $\boldsymbol{x}_1, \ldots, \boldsymbol{x}_n$ may be written as,

$$Y_i = \boldsymbol{x}_i^T \boldsymbol{\beta} + \sigma \epsilon_i, \tag{1}$$

where $\epsilon_i \sim$ iid F for F a location-scale family such that $E(\epsilon_i) = 0$ and $var(\epsilon_i) = 1$. What might motivate choosing F to be something other than a normal distribution?

A: If we are interested in some aspect of the distributions of the Y_i other than expected value, such as an upper quantile.

2. (2 pts.) Suppose we have a random variable Y that has distribution, for $\boldsymbol{\theta} = (\theta_1, \ldots, \theta_s)^T \in \Theta$ and $y \in \Omega$,

$$f(y|\boldsymbol{\theta}) = \exp\left[\sum_{j=1}^{s} \theta_j T_j(y) - B(\boldsymbol{\theta}) + c(y)\right]. \tag{2}$$

Identify what each of the following quantities are equal to,

$$\frac{\partial B(\boldsymbol{\theta})}{\partial \theta_k} =$$
$$\frac{\partial^2 B(\boldsymbol{\theta})}{\partial \theta_k \, \partial \theta_h} =$$

A:

$$\frac{\partial B(\boldsymbol{\theta})}{\partial \theta_k} = E\{T_k(Y)\}$$
$$\frac{\partial^2 B(\boldsymbol{\theta})}{\partial \theta_k \, \partial \theta_h} = cov\{T_k(Y), T_h(Y)\}$$