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Calculating the Variance in Generalized Linear Models

From the SAS online documentation, the general form for a density or probability function of the exponential family can be expressed as:

$$f(y \mid \theta) = \exp\{\frac{y\theta - b(\theta)}{a(\phi)} + c(y, \phi)\}$$

where θ is the natural location parameter, and Φ is the dispersion parameter.

For this family of distributions, the variance of y, $Var(\mathbf{y})$, can be expressed as a function of the mean of **y** as $Var(\mathbf{y}) = V(\mu)\alpha(\Phi)$, where $V(\mu)$ denotes the variance function, and $\alpha(\Phi)$ denotes a function of the dispersion parameter. For the normal distribution, $V(\mu)$ is the identity function and $\alpha(\Phi) = \sigma^2$, so the relationship between the mean and variance can be expressed as $Var(Y) = V(\mu)\alpha(\Phi) = \mu^0 \bullet \sigma^2$.

An alternative parameterization for the general form for a density or probability mass function for an exponential family distribution is:

$$f(y \mid \theta) = h(y) \cdot c(\theta) \cdot e^{\sum t_i(y_i)(W_i(\theta))}$$

When written in this form, the canonical link can be identified as $\boldsymbol{W_i}(\Phi)$. (Casella and Berger 1990)

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