Chapter Five

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Exercise One

Question

Consider the single response variable Y with $Y \sim \text{Bin}(n, \pi)$.

Solution

(a): Find the Wald statistic $(\hat{\pi} - \pi)^T(\hat{\pi} - \pi)$, where $\hat{pi}$ is the maximum likelihood estimator of π and $\boldsymbol{\mathcal{J}}$ is the information.

(b): Verify that the Wald statistic is the same as the score statistic $\boldsymbol{U}^T\boldsymbol{\mathcal{J}}^{-1}\boldsymbol{U}$ in this case (see Example 5.22).

(c): Find the deviance

$$2[l(\hat{\pi}; y) - l(\pi; y)].$$

(d): For large samples, both the Wald/score statistic and the deviance approximatley have the $\chi^2(1)$ distribution. For $n = 10$ and $y = 3$, use both statistics to assess the adequacy of the models:

(1) $\pi = 0.1$
(2) $\pi = 0.3$
(3) $\pi = 0.5$

Do the two statistics lead to the same conclusions?

Exercise Two

Question

Consider a random sample $Y_1, ..., Y_N$ with the exponential distributon

$$f(y_i, \theta_i) = \theta_i \exp(-y_i\theta_i)$$

Derive the deviance by comparing the maximal model with different values for θ_i for each Y_i and the model with $\theta_i = \theta$ for all i. #### Solution

Exercise Four

Question

For the leukemia survival data in 4.2:

Solution

(a): Use the Wald statistic to obtain an approximate 95% confidence interval for the paramter β_1. **(b)**: By comparing the deviances for two appropriate models, test the null hypothesis $\beta_2 = 0$ against the alternative hypothesis $\beta_2 \neq 0$. What can you conclude about the use of the initial white blood cell count as a predictor of survival time.