

# 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  $(\hat{\pi} - \pi)^T \mathcal{J}(\hat{\pi} - \pi)$ , where  $\hat{\pi}$  is the maximum likelihood estimator of  $\pi$  and  $\mathcal{J}$  is the information.

(b): Verify that the Wald statistic is the same as the score statistic  $U^T \mathcal{J}^{-1} U$  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 approximately 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  $Y_1, \dots, Y_N$  with the exponential distribution

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

Derive the deviance by comparing the maximal model with different values for  $\theta_i$  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 parameter  $\beta_1$ .

(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.