STAT 442 Assignment 2
Sept. 18, 2008

Due: At the beginning of the lecture, Tuesday, Sept. 30.

1. Suppose you have observed a binomial random variable, X, corresponding to the number of successes in n independent binary trials, with $p = Prob\{Success\}$. The quantity $\theta = \frac{p}{1-p}$ is referred to as the odds of success.

a. Derive the log likelihood function for θ, based on n and X. Plot the log likelihood for the sleep apnea example considered in class (based on number of positive diagnoses).

b. Show that the maximum likelihood estimate of the odds of success is $\frac{x}{n-x}$, where x is the observed value of X.

c. Derive the expected Fisher information for θ. Provide a large sample 95% confidence interval for θ for the true odds of a positive sleep apnea diagnosis.

d. BONUS QUESTION: Use the *rbinom()* to generate 1000 simulated observations from repeated samples of 150 observations with underlying probabilities, .25 and .5, and evaluate the coverage probability of the Wald interval in each case.

2. The following data arose from a longitudinal follow-up study of women, some of whom had used oral contraceptives (OC) and some of whom hadn't. The table gives the number of cases of a certain cancer in each group, and the total time of follow-up (summed up over all the women in each group separately).

OC	cases	pyears
yes	9	2935
no	239	135130

a. Provide approximate (normal-based) 95% confidence interval for the expected number of cases per 1000 person-years in each groups.

b. Provide an estimate of the relative risk (for exposed versus un-exposed women) with an approximate 95% confidence interval.

c. BONUS QUESTION - using the formulas provided on pages 73 and 74 of the text and the R function *qchisq()* to obtain quantiles from χ^2 distribution, calculate exact confidence intervals for a.

3. Refer to exercise Chapter 2, exercise 2 (page 26) and Chapter 4, exercise 11 (page 106).

a. Provide solutions to both exercises

b. Conduct goodness of fit tests for the Poisson assumption using the Pearson and likelihood approaches.