BIOSTAT 651
Homework #4
due: Monday, April 3

- turn in at the start of class

- each sub-question=2 points; total 20 points

1. Researchers studied the effect of a new treatment on a kidney disease collected from 79 clinics. In each clinic, one patient received the treatment, and the other received the placebo. The response variable is whether the kidney condition is improved. The following table shows pairs by treatment and response (improvement=yes/no).

Placebo Response	New treatment Response No	New treatment Response Yes
No	7	36
Yes	18	18

NOTE: all the questions (a)-(d) should be done by hand.

(a) Carry out the McNemar test of whether the treatments have different effects on the kidney disease. Write out the null and alternative hypotheses, test statistics and the conclusion.

(b) The following logistic regression model can be used for this study

$$logit(\pi_{ij}) = \alpha_i + \beta X_{ij}, \quad (i = 1, \ldots, 79; j = 1, 2),$$

where $X_{ij} = 1$ if patient j in clinic i received the new treatment and 0 otherwise, and $\pi_{ij} = P(Y_{ij} = 1|X_{ij})$ with $Y_{ij} = 1$ if improvement=yes. Estimate β by maximizing the conditional likelihood.

(c) Carry out a score test for $\beta = 0$ using the conditional likelihood. Is the score test identical to the McNemar test in (a)?

(d) Repeat (c) using a Wald test.

2. A study was carried out to examine the relationship between drinking and obesity. The response was defined as

   $Y_i = 0$: normal

   $Y_i = 1$: moderate obesity

   $Y_i = 2$: severe obesity

   Drinking was coded using $D_i = 0$ for non-drinkers, $D_i = 1$ for casual drinkers and $D_i = 2$ for heavy drinkers. The total sample size was $n = 600$, with the observed data summarized by the following table:

	Y_i=0	Y_i=1	Y_i=2	total
D_i=0	150	100	50	300
D_i=1	80	70	50	200
D_i=2	20	30	50	100
total	250	200	150	600

   The assumed model is given by:

$$\log\left\{\frac{\pi_{ij}}{\pi_{i0}}\right\} = \beta_{0j} + \beta_{1j} I(D_i = 1) + \beta_{2j} I(D_i = 2)$$

   for $j = 1, 2$, where $\pi_{ij} = P(Y_i = j | D_i)$.

(a) Fit the above model and estimate $\beta_{01}, \beta_{11}, \beta_{21}$

(b) Provide interpretations for $\widehat{\beta}_{01}$ and $\exp\{\widehat{\beta}_{21}\}$.

(c) Compute 95% confidence intervals for β_{01} and $\exp\{\beta_{21}\}$.

3. Solve exercise 8.3 (a)-(c) on page 163 of Textbook.