Homework 5 Stats 449 (Due 11-13)

Instructions: Use R as needed in Problems 2 and 4 in this homework. **Attach** and annotate R output where relevant. Late homework cannot be accepted.

1) The table below shows results when subjects were asked"Do you think a person has the right to end his or her own life if this person has an incurable disease?" and "When a person has a disease that cannot be cured, do you think doctors should be allowed to end the patient's life by some painless means if the patient and his or her family request it?"

The table refers to these variables as "suicide" and "let patient die".

	Suicide	
Let Patient Die	Yes	No
Yes	1097	203
No	90	435

a) Perform McNemar's test. State the null hypothesis, the value of the test statistic, the critical value, and your conclusion. Interpret the result.

b) Calculate a 95% confidence interval for the difference of proportions. Is the result significant? Interpret the result.

2) A matched case-control study has 8 pairs of subjects. The cases have colon cancer, and the controls are matched with the cases on gender and age. A possible explanatory variable is the extent of red meat in a subject's diet, measured as "1 = high" or "0 = low". The (case, control) observations on this were (1,1) for 3 pairs, (0,0) for 1 pair, (1,0) for 3 pairs, and (0,1) for 1 pair.

a) Cross-classify the 8 pairs in terms of diet (1 or 0) for the case against diet (1 or 0) for the control. Call this table A. Display the $2 \times 2 \times 8$ table with eight partial tables relating diet (1 or 0) to response (case or control) for the 8 pairs. Call this table B.

Hint: See Lecture 15. Table A should look like the 2×2 table on pages 9 or 10. Fill in Table A below and show in your homework.

	Table A Cases		
Controls	High	Low	Total
High			
Low			
Total			

Table B should have the same format as the tables on pages 4 or 5. Table B should have 16 rows and 3 columns. Show Table B in your homework.

b) Calculate the McNemar Z^2 for Table A and the Cochran-Mantel-Haenszel (CMH) statistic for Table B. Compare.

Hint: Calculate McNemar's Z^2 by hand. Use R (not SAS) to calculate the CMH statistic (see the last page of Lecture 15 under "An Interesting Result." Follow the R code there. The code for the z variable is `z <- gl(8,2)`. How should you code the x and y variables? (Follow your B table). Adjust the code for the CMH statistic slightly using

```
mantelhaen.test(x,y,z,correct=F)
```

c) Using Table A, calculate n_{21}/n_{12}. Interpret this value. Compare to the Mantel-Haenszel estimate of a common odds ratio produced by R.

3) Suppose X, Y, and Z are random variables and that

$$Var(X) = 1 \qquad Var(Y) = 2 \qquad Var(Z) = 3$$

$$Cov(X,Y) = 1 \quad Cov(X,Z) = -0.5 \quad Cov(Y,Z) = -1$$

a) Calculate $Var(X + Y)$.

b) Calculate $Var(Y - Z)$.

c) Calculate $Var(2X + Z)$.

4) The data for this problem are in the file `bindat.csv` on our Canvas site in the Data folder. The variable y is a binary response and x_1, x_2, x_3, and x_4 are continuous predictor variables. Using R, fit the model

$$y_i \,|\, p_i \sim \text{Bernoulli}(p_i) \qquad y_i \,|\, p_i \text{ independent} \qquad i = 1, \ldots, 189$$

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \beta_4 x_{i4}$$

a) Test the hypothesis $H_0 : \beta_2 = \beta_4 = 0$ using a likelihood ratio test. Find the value of the test statistic, the critical value, the p-value, and state your conclusion.

b) Construct a 95% confidence interval for $\beta_3 - \beta_2$. Is the result significant?