Homework 5, Due Monday, October 10, 2016

You are welcome to use R but attach the code.

1. The text defined multiplicative interaction in terms of RR on pages 148 and 149. Jewell points out on page 149 that a lack of multiplicative interaction based on OR implies

$$\frac{p_{11}/(1-p_{11})}{p_{01}/(1-p_{01})} = \frac{p_{10}/(1-p_{10})}{p_{00}/(1-p_{00})}$$

   Pencil through the algebra to show this, and comment on what it means.

2. Researchers in Georgia collected data on death penalty sentencing in cases with black defendants. The data included the race of the victim (White or Black), and types of murder (Aggravation Level from 1 to 6). Aggravation level of 1 was unaggravated (e.g. barroom brawl) and 6 was most aggravated (e.g. vicious crimes involving torture). The data are shown below. I have modified the original data a bit to avoid a numerical issue (we may come back to that if we have time but the change does not impact the overall conclusion). Is there evidence that black murderers of white victims are more likely to receive the death penalty than black murderers of black victims after accounting for the aggravation level of the crime?

```
# The data
death.CMH<-array(c(2,1,60,181,2,1,15,21,6,2,7,9,9,2,3,4,9,4,1,3,17,4,1,1),
dim=c(2,2,6),dimnames=list(c("White","Black"),c("Death","NoDeath"),
c("AgLevel 1","AgLevel 2","AgLevel 3","AgLevel 4","AgLevel 5","AgLevel 6")))
```

   (a) Pool over Aggravation Level and estimate the the ratio of the odds of a white-victim murderer receiving the death penalty relative to the odds of a black victim murder receiving the death penalty along with an approximate 95% confidence interval.

   (b) Give an estimate of the Odds Ratio adjusted for Aggravation Level along with an approximate 95% confidence interval. Use the Cochran-Mantel-Haenszel method.

   (c) One key assumption of the CMH method is homogeneity or no interaction between race and aggravation level, i.e. the aggravation level specific odds ratios are all equal to one another. Is this assumption reasonable here? Justify your answer. Use the Breslow-Day test to investigate.

   (d) Based on these results which Odds Ratio would you report (1) the pooled odds ratio, (2) the Odds Ratio adjusted for Aggravation Level, or (3) the stratum level Odds Ratios? Justify your answer.

   I will send you a script file with the Breslow-Day function.

3. The table below contains data from a cohort study of smoking and lung cancer. Asbestos exposure was another risk factor of interest. The numbers in the table are deaths from lung cancer per 100000 people, i.e. they are P_{ij} values times 100000. You can work on this scale to answer the questions below.

	Asbestos No	Asbestos Yes
Cig No	11.3	58.4
Cig Yes	122.6	601.6

   (a) What would you expect the value to be in the lower right cell if the relation between asbestos and smoking were additive?

   (b) What would you expect the value to be in the lower right cell if the relation between asbestos and smoking were multiplicative?

   (c) Is the observed value more indicative of an additive interaction or a multiplicative interaction? Is the interaction synergistic or antagonistic and why?

4. Problem 11.2 on page 177. The way he sets it up is confusing.

   (a) Ignore the exposure variable and just use the cases and controls. The R code below sets up the data for you.

```
cases<-c(59,54,53,61,61)
n<-c(192,204,173,181,118)
```

   Do what he asks in the second paragraph.

   (b) Now using all the data in the table do what he asks in the third paragraph. You can just calculate age specific Odds Ratios using the ratio of cross products. Note that he is asking for a qualitative assessment only. You will just be looking at a simple graph and/or table.