Stats Clinical Trials - Math 150
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HW 11

1. Using the Ioannidis paper, explain the details of PPV for the model with multiple researchers. That is, derive the entire PPV equation (you may need to derive most of Table 3).

2. **Evaluating type I errors.** Consider the following claim: *If a null hypothesis is NOT rejected in multiple studies, then we have good evidence that the null is likely to be true.*

   I have created 5 datasets for you which all study the same phenomenon. For each dataset there is a treatment group and a control group. We are curious about whether the two groups differ, on average, with respect to the continuous response variable. There are pairs of columns representing each of the 5 studies. Your task is to:

   (a) Ascertain whether the response variable is different across the treatment and control. Look at p-values and confidence intervals.

   (b) Respond to the claim above.

   You might consider R code like the following:

```
> type1data = read.table(paste("http://pages.pomona.edu/~jsh04747/courses/math150/type1data.txt"), header=TRUE)
> attach(type1data)
> t.test(resp1~group1)

        Welch Two Sample t-test

data:  resp1 by group1
t = 1.9067, df = 27.997, p-value = 0.06687
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1311158  3.6594807
sample estimates:
mean in group control   mean in group treat
             6.663333              4.899151
```

   And the following:

```
> response = c(resp1, resp2, resp3, resp4, resp5)
> group = c(group1, group2, group3, group4, group5)
> t.test(response~group)
```

3. **Evaluating type II errors.** Consider a large randomized controlled trial designed to investigate problem drinking in Australian university students (Kypri et al., *Randomized controlled trial of proactive web-based alcohol screening and brief intervention for university students.*, 2009). They specified 7 outcomes in advance, 3 were primary and 4 were secondary. No adjustments for multiple comparisons were made, and the p-values were reported to be 0.001, 0.02, 0.001 (primary endpoints), 0.59, 0.87, 0.22, 0.001 (secondary endpoints).

   (a) Adjust the p-values using Bonferroni, Holm, and Benjamini-Hochberg. Do all 3 methods give the same conclusions with respect to significance? Explain.

   (b) Note that the Bonferroni and Holm adjusted p-values report the smallest familywise error under which each of the tests would reject the null hypothesis. Benjamini-Hochberg report the experiment wide FDR if all tests below a critical value are rejected.

   Explain why some of the adjusted p-values are repeated for Holm and BH.

   (c) Explain how adding 100 more null tests would change each of the adjusted p-values (and corresponding conclusions).