

## Homework 7: Due Wednesday April 6

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You may use R to assist you in your solutions for questions marked with \*.

1. (a) Using induction show that if  $A_1, A_2, \dots, A_m$  are events,

$$\mathbb{P}(A_1 \cup A_2 \cup \dots \cup A_m) \leq \sum_{i=1}^m \mathbb{P}(A_i).$$

- (b) In the multiple comparisons setting with  $m$  confidence intervals, if we wished to have a family experimental size of  $\alpha$ , and chose to set the individual sizes to be  $\frac{\alpha}{m}$ , using part (a) show that the family size is at most  $\alpha$ .
2. Suppose I had the following data:

Group 1	Group 2	Group 3
6	10	9
2	9	12
4	11	13
3	12	9

- (a) \* Produce the ANOVA for this data.
- (b) Calculate confidence intervals for  $\mu_1 - \mu_2$ ,  $\mu_2 - \mu_3$  and  $\mu_3 - \mu_1$  each with an individual 95% confidence level.
- (c) Calculate the same confidence intervals using Bonferroni's method.
- (d) \* Produce the same confidence intervals using Tukey's method.
3. Given the following output from R,

```
> summary(model)
```

Call:

```
lm(formula = data ~ groupA * groupB)
```

Residuals:

Min	1Q	Median	3Q	Max
-12.168	-6.560	-1.359	4.363	21.259

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	17.935	2.627	6.826	5.55e-08 ***

```

groupA2          10.059      3.716    2.707  0.01031 *
groupB2          11.466      3.716    3.086  0.00389 **
groupA2:groupB2  17.471      5.255    3.325  0.00204 **

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Residual standard error: 8.309 on 36 degrees of freedom  
Multiple R-squared: 0.7712, Adjusted R-squared: 0.7521  
F-statistic: 40.45 on 3 and 36 DF, p-value: 1.278e-11

```
> anova(model)
```

Analysis of Variance Table

Response: data

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
groupA	1	3532.2	3532.2	51.168	2.069e-08 ***
groupB	1	4080.8	4080.8	59.115	4.191e-09 ***
groupA:groupB	1	763.1	763.1	11.054	0.002044 **
Residuals	36	2485.1	69.0		

- (a) What is the predicted value for someone in groupA1 and groupB1?
  - (b) What is the predicted value for someone in groupA2 and groupB2?
  - (c) Test the hypothesis that the interaction term is equal to zero.
  - (d) Can we conclude that  $B$  has no effect on this data?
4. Problems from the textbook: 9.5.1, 9.5.6\*\*, 9.5.7\*, 9.5.9\*.
- \*\* Do not calculate the variance of each of the estimators.