**BF[1] – Multiple Comparisons**

**Type in your score here 🡪 \_\_25\_\_ out of 25 points possible**

1. (5 points) Ponder/Reflect Exercise – Reflect on what you have learned from this portion of the class. Examples of what you can do are: a brief outline of material covered, insights you gained from class or personal study, or items you feel that you need to follow up or work on. (3-5 sentences)

The pairwise comparisons help us dive deeper into the data. If we see significances, we can look to see which groups are showing that significance and to make better decisions on the data. Pairwise comparisons help us make more precise conclusions.

2. In this problem, you will use SAS or R to do a complete analysis of variance on the head injury severity scores associated with 7 types of cars. The data are found in the file headinjury.csv (note that it is comma-delimited) or SAS filename *headinjury*.

(a) (3 points) Give the name of the appropriate design for these data and write down the statistical model, carefully defining on the parameters in the model.

RBF[1] Basic Factorial Design

**yij = µ + αi + εij; i = 1, 2, 3, 4, 5, 6, 7; j = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10;**

(b) (3 points) Our primary interest is to see if the car types have different mean head-injury severity scores. Write down the appropriate null and alternative hypotheses, carefully defining all symbols.

Ho: α1 = α2 = α3 = α4 = α5 = α6 = α7 =0

Ha: at least one of the αi is different

(c) (3 points) Give the ANOVA table and interpret the proper F-test for the hypotheses of interest.

Df Sum Sq Mean Sq F value Pr(>F)

Type 6 2708060 451343 3.41 0.00561 \*\*

Residuals 63 8338789 132362

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

P-value is less than alpha so we reject the null.

We conclude that at least one of the means is different.

(d) (3 points) Do a pairwise comparison test using the following four methods: : (i) Tukey's HSD, (ii) Scheffe', (iii) Bonferroni, and (iv) Fisher’s LSD. Paste your output and interpret the results for using each of the four methods.

1= Compact 2=heavy 3=light 4=medium 5=minivan 6=pickup 7=van

See R script.

For Fisher’s LSD, Compact (1) is different than van (7); heavy car (2) is different than minivan (5), pickup (6) and van (7); medium car (4) is different than minivan (5) and van (7) (all the other differences displayed are redundant)

For Tukey’s, heavy car (2) is different than van (7), medium car (4) is different than van (7) (all the other differences displayed are redundant)

For Bonferroni, heavy car (2) is different than van (7), medium car (4) is different than van (7) (all the other differences displayed are redundant)

For Scheffe’s, heavy car (4) is different than van (7) (all the other differences displayed are redundant)

Fisher’s LSD picks up more differences and Scheffe’s picks up fewer.

3. Out of the four methods: (i) Tukey's HSD, (ii) Scheffe', (iii) Bonferroni, and (iv) Fisher’s LSD, choose the best method given the following scenarios:

(a) (2 points) You would like to do an exploratory analysis to see which means or contrasts are different.

Sheffe’

(b) (2 points) Based on the structure of the data, you know which contrasts or comparisons you know the 3 comparisons or contrasts that you want to make.

Bonferroni

(c) (2 points) You are interested in all pairwise comparisons, but you want to keep your family-wise Type I error rate at 0.05.

Tukey’s

(d) (2 points) You are interested in all pairwise comparisons, but you want the capacity to detect any real differences.

Fisher’s LSD