

## STA 3024 – Extra Problems - 1-Way ANOVA & RBD

- ✓ Four models of lacrosse helmets were compared. Measurements of Gadd severity index were made on each of 10 hits per helmet. Test whether helmet means are significantly different at  $\alpha=0.05$  significance level. Use Bonferroni's method to make all pairwise comparisons with an overall (experimentwise) error rate of 0.05. Higher scores mean higher impact.

Brand	Mean	SD	Sample Size
Sports Helmets Cascade	1166.1	152.40	10
Sports Helmets Cascade Air Fit	1117.6	216.23	10
Sports Helmets Ultralite	857.0	151.54	10
Bacharach Ultralite	1222.8	123.08	10

SSG=784747.5 dfG=3 MSG=261582.5  
 SSE=972848.1 dfE=36 MSE=27023.56  
 Fobs=9.68 Rejection Region: Fobs  $\geq F_{.05,3,37} = 2.88$  (approx)

$$\text{Bonferroni CIs: } (\bar{x}_i - \bar{x}_j) \pm 2.80 \sqrt{27023.56 \left[ \frac{1}{10} + \frac{1}{10} \right]} = (\bar{x}_i - \bar{x}_j) \pm 205.2563$$

- ✓ A drawing training procedure's effect is to compared with that of a sham (nonsensical) method and a placebo control (no training). A sample of 53 subjects were obtained, each drawing a picture prior to "training". 19 subjects received the training method of interest (Edwards' method), 18 received the sham treatment, and 16 received the placebo treatment (no training). Drawings were obtained after the training, and difference scores obtained for each subject (post training-pre training). Complete the following ANOVA table and test whether the mean change scores differ among the three conditions ( $\alpha=0.05$ ).

ANOVA				
Source	df	SS	MS	F
Groups	<b>2</b>	291.8027	<b>145.90</b>	<b>14.78</b>
Error	<b>50</b>	<b>493.3881</b>	<b>9.87</b>	
Total	<b>52</b>	<b>785.1908</b>		

(Answers in bold)

**Rejection Region: F<sub>obs</sub>  $\geq F_{.05,2,50} = 3.183$**

The means for the 3 conditions were 7.02, 7.90, and 2.40 respectively. Use Bonferroni's method to compare all pairs of conditions.

$$\text{Edwards vs sham} : (7.02 - 7.90) \pm 2.477 \sqrt{9.87 \left[ \frac{1}{19} + \frac{1}{18} \right]} \cong -0.88 \pm 2.56$$

$$\text{Edwards vs placebo} : (7.02 - 2.40) \pm 2.477 \sqrt{9.87 \left[ \frac{1}{19} + \frac{1}{16} \right]} \cong 4.62 \pm 2.64$$

$$\text{Sham vs placebo} : (7.90 - 2.40) \pm 2.477 \sqrt{9.87 \left[ \frac{1}{18} + \frac{1}{16} \right]} \cong 5.40 \pm 2.67$$

- ✓ Four diet plans were compared in terms of mean weight losses. Any patients who did not complete the year without giving up on the diet were assigned weight losses of 0. A total of 160 subjects were selected, and randomly assigned to diets so that 40 received each diet. Means and standard deviations are given below. Test whether there are any differences between diet effects ( $\alpha=0.05$ ). The means below include all 40 patients per treatment (with 0s for dropouts)

1. Atkins: Mean=4.6 SD=10.1 21 of 40 completed
2. Zone: Mean=7.0 SD=13.2 26 of 40 completed
3. Weight Watchers: Mean=6.6 SD=10.8 26 of 40 completed
4. Ornish (vegetarian): Mean=7.3 SD=16.1 20 of 40 completed

$F_{\text{obs}} = 0.36$  Do not conclude differences exist  $F_{.05,3,156} \approx 2.663$

Give the mean weight losses among those completing the 4 diets.

**Atkins:**  $40(4.6)/21 = 8.76$

**Zone:**  $40(7.0)/26 = 10.77$

**WW:**  $40(6.6)/26 = 10.15$

**Ornish:**  $40(7.3)/20 = 14.6$

- ✓ The following data represent the prize money won at the Daytona 500 in 2000 by car make (Chevy, Ford, and Pontiac). Treating this race as one realization of the many races that could have occurred, test whether the car makes differ in performance. Prize winnings are clearly not normally distributed, so use the appropriate nonparametric test.

90100 Chev (7)

82750 Ford (1)

88875 Pont (4)

90300 Chev (8)	83200 Ford (2)	89625 Pont (6)
91650 Chev (9)	84550 Ford (3)	108175 Pont(25)
92075 Chev (10)	89325 Ford (5)	113725 Pont(27)
93450 Chev (13)	92100 Ford(11)	118875 Pont(29)
98275 Chev(15)	93000 Ford(12)	119975 Pont(31)
99275 Chev (18)	94225 Ford(14)	143975 Pont(34)
104325 Chev (21)	98475 Ford(16)	166775 Pont(35)
106100 Chev (23)	99225 Ford(17)	228275 Pont(38)
107775 Chev (24)	99725 Ford(19)	
112225 Chev (26)	102825 Ford(20)	
116075 Chev (28)	105375 Ford(22)	
120025 Chev(32)	119475 Ford(30)	
198625 Chev (37)	129075 Ford(33)	
	182875 Ford(36)	
	326175 Ford(39)	
	420775 Ford(40)	
	528475 Ford(41)	
	840825 Ford(42)	
	2277975 Ford(43)	

$$R_C = 7+8+9+\dots+32+37 = 271 \quad n_C = 14$$

$$R_F = 1+2+3+\dots+42+43 = 446 \quad n_F = 20$$

$$R_P = 4+6+25+\dots+35+38 = 229 \quad n_P = 9 \quad N=43$$

$$\text{Test Statistic: } H = \frac{12}{43(44)} \left[ \frac{(271)^2}{14} + \frac{(446)^2}{20} + \frac{(229)^2}{9} \right] - 3(44) = \frac{12(21018.3635)}{43(44)} - 132 =$$

$$133.31 - 132 = 1.32$$

$$\text{Rejection Region: } H \geq \chi_{.05,2}^2 = 5.991$$

- ✓ The fog index measures the reading difficulty based on the average number of words per sentence and percent of words with 3 or more syllables. High values of the fog index are associated with difficult reading levels. Independent random samples of six