STA 4211 – Exam 1 – Spring 2015 – **PRINT** Name ______________________

For all significance tests, use α = 0.05 significance level. Show work for any partial credit!

Q.1. In the broiler chicken study, with factor A (base diet: Sorghum, Corn) and factor B (methionine: absent, present), there were 60 chickens assigned to each treatment (n_T=240). For the response weight of Whole Breast, the following table gives the treatment and marginal means based on the model:

$$Y_{ijk} = \mu_{\bullet\bullet} + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk} \quad i = 1,...,a;\ j = 1,...,b;\ k = 1,...,n$$

Diet\Methelonine	Absent(j=1)	Present (j=2)	Overall Mean
Sorghum (i=1)	606	610	608
Corn (i=2)	568	680	624
Overall Mean	587	645	616

p.1.a. Compute the following parameter estimates:

$\hat{\mu}_{\bullet\bullet} =$ __________ $\hat{\alpha}_1 =$ __________ $\hat{\alpha}_2 =$ __________ $\hat{\beta}_1 =$ __________ $\hat{\beta}_2 =$ __________

$\left(\hat{\alpha\beta}\right)_{11} =$ __________ $\left(\hat{\alpha\beta}\right)_{12} =$ __________ $\left(\hat{\alpha\beta}\right)_{21} =$ __________ $\left(\hat{\alpha\beta}\right)_{22} =$ __________

Q.2. An experiment was conducted to compare $r = 8$ fragrances used to effect phenobarbital sleep times in rats. There were $n_i = 10$ rats per treatment. The treatment means and SDs are given below (the overall mean is 70.25):

Trt	n_i	Mean_i	SD_i
Control (1)	10	68.2	4
Lemon (2)	10	53.7	3
Jasmine (3)	10	62.6	4
Rose (4)	10	78.9	5
Sandalwood (5)	10	76.9	4
Juniper (6)	10	72.1	4
Orris (7)	10	71.4	4
Mixed (8)	10	78.2	5

$$(68.2-70.25)^2 + \ldots + (78.2-70.25)^2 = 523.62$$

$$4^2 + \ldots + 5^2 = 139$$

p.2.a. Complete the following ANOVA table, and test H_0: $\mu_1 = \ldots = \mu_8$

Source	df	SS	MS	F*	F(.95)	Reject H0?
Treatments						Yes / No
Error				#N/A	#N/A	#N/A
Total			#N/A	#N/A	#N/A	#N/A

p.2.b. The P-value for the test is: > **0.05** **or** < **0.05**

Q.3. Players in the English Premier Soccer League are classified as one of 4 positions (Defender, Forward, Goalie, or Midfielder). Random samples of 8 players were selected from each position for players during the 2014 season. The players' Body Mass Indices were measured. The within position (Error) sum of squares is SSE = 68.

p.3.a. Compute the standard error of the difference between 2 means: $s\left\{\overline{Y}_{i\bullet} - \overline{Y}_{i'\bullet}\right\}$

$s\left\{\overline{Y}_{i\bullet} - \overline{Y}_{i'\bullet}\right\}$ = ___________________________

p.3.b. Compute Tukey's Honest Significant Difference for simultaneously comparing all pairs of positions, with a family-wise error rate of 0.05. Identify significant differences (if any) among all pairs of means.

Tukey's HSD = _________________________________

p.3.c. Compute Bonferroni's Minimum Significant Difference for simultaneously comparing all pairs of positions, with a family-wise error rate of 0.05.

Bonferroni's MSD = __________________________

p.3.d. Compute Scheffe's Minimum Significant Difference for simultaneously comparing all pairs of positions, with a family-wise error rate of 0.05

Scheffe's MSD = ________________________

Q.4. A study is conducted to compare 3 treatments for muscle soreness. Treatment A is a placebo, with no active ingredient, Treatments B and C are two competing brands, currently on the market. The mean pain reported scores (lower are better) are given below for the 3 treatments, and MSE. The experiment was conducted as a Completely Randomized Design, with 6 Subjects per treatment. $\overline{Y}_{A\bullet} = 80 \quad \overline{Y}_{B\bullet} = 40 \quad \overline{Y}_{C\bullet} = 60 \quad s^2 = MSE = 100$

Consider the Contrast comparing the Placebo with the 2 Brands: $L = 2\mu_A - \mu_B - \mu_C$

p.4.a. Compute $\hat{L}$:

p.4.b. Compute $s\left\{\hat{L}\right\}$:

p.4.c. Obtain a 95% Confidence Interval for L:

p.4.d. Conduct the t-test to test $\mathrm{H}_0 : L = 0 \quad H_A : L \neq 0$

Test Statistic: ____________________ Reject H_0 if the Test Statistic: _________________ Reject H_0? Yes / No

Q.5. A 2-Way ANOVA is conducted to compare reading times of 2 E-Readers, each at 3 illumination levels (6 treatments). A sample of 30 participants is selected, and randomized so that 5 receive each treatment. Complete the following ANOVA table.

Source	df	SS	MS	F*	F(.95)
E-Reader		400			
Illumination		600			
Interaction		100			
Error				#N/A	#N/A
Total	29	2300	#N/A	#N/A	#N/A

Q.6. The Brown-Forsyth test is a robust test of testing whether the treatment means are equal. **TRUE / FALSE**

Q.7. When applying Bonferroni's method for comparing all pairs of treatments, if the treatments have unequal sample sizes, the pair of treatments with the largest sample sizes will have the smallest minimum significant difference.

TRUE / FALSE

Q.8. For which scenario of the parameter values, will the power of the F-test be highest (assume $r = 3$, $n_1 = n_2 = n_3$):

Scenario 1: $\mu_1 = 80$, $\mu_2 = 100$, $\mu_3 = 120$, $\sigma = 10$ or **Scenario 2:** $\mu_1 = 90$, $\mu_2 = 100$, $\mu_3 = 110$, $\sigma = 5$

a. Scenario 1 has highest Power **b. Scenario2 has Highest Power** **c. Power is equal for scenarios**

Q.9. A published report, based on a **balanced 1-Way ANOVA** reports means (SDs) for the three treatments as:

Trt 1: 70 (8) Trt 2: 75 (6) Trt 3: 80 (10)

Unfortunately, the authors fail to give the treatment sample sizes.

p.9.a The Treatment degrees of freedom is the same for each sample size. The error degrees of freedom are:

$n_i = 2$: df_E = _______________ $n_i = 6$: df_E = ___________________ $n_i = 10$: df_E = _____________________

p.9.a. Complete the following table, given arbitrary levels of the number of replicates per treatment:

n	SSTrt	SSErr	MSTrt	MSErr	F_obs	F(.95)
2						
6						
10						

p.9.b. The smallest n_i, so that these means are significantly different is:

i) $n_i <= 2$ ii) $2 < n_i <= 6$ iii) $6 < n_i <= 10$ iv) $n_i > 10$