

STAT 514 Midterm 1 (Total 50 Points)

Name:

Section: 9:30am; 2:30pm

- **Exam time: 7:00-8:30pm.**
 - **Must show all work to get credits.**
 - **Hand in both exam and answer sheets.**
1. (10 points) Consider a study of the effect of a new drug on reducing heart rate for patients with unstable angina. Suppose we want at least 80% power for detecting a significant difference if the effect of the drug is to reduce mean heart rate 15 beats per minute over 24 hours and assume the standard deviation (σ) is 25 beats per minute (based on previous experience). How many patients should be enrolled in such a study? Use $\alpha=0.05$.
 2. (20 points) A consumer testing agency obtains four cars randomly from each of the following three makes: 1, 2, and 3. We wish to compare the four makes on their oil use per 100,000 miles driven. The mean responses by make of car were 5.1, 6.2, 4.6, and the sum of squares for error was 2.3.
 - (a) Construct the Analysis of Variance table for this experiment.
 - (b) State the hypotheses of the test and draw conclusion at $\alpha=0.05$.
 - (c) Compute the R-Square and explain it; Compute Coeff. Var.
 - (d) Suppose we are using the following ANOVA model: for $i=1,2,3$ and $j=1,2,3,4$, $Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$ where $\tau_1 + \tau_2 + \tau_3 = 0$ and ε_{ij} 's are assumed to follow $N(0, \sigma^2)$.

What are the estimates of τ_1, τ_2 and τ_3 ?
 - (e) Suppose we are interested in the following contrasts
$$\Gamma_1 = \mu_2 - \mu_3, \Gamma_2 = \mu_2 + \mu_3 - 2\mu_1, \text{ where } \mu_i = \mu + \tau_i.$$
 - (e1) Use Bonferroni method to construct confidence interval for Γ_1 and Γ_2 with overall confidence level at least 99%.
 - (e2) Use Scheffe's method to construct confidence interval for Γ_1 and Γ_2 with overall confidence level at least 99%.
 - (e3) Based on the results in (i) and (ii), test if Γ_1 and Γ_2 are equal to zero (two-sided). Which method should be preferred? Why?

3. (20 points) An experiment was conducted to test the effects of nitrogen fertilizer on lettuce production. Five rates of ammonium nitrate were applied to four replicate plots in a completely randomized design. The data are the number of heads of lettuce harvested from the plot.

Treatment (lbs N/acre)	Heads of Lettuce/plot	Mean	St. D.
0	100, 120, 90, 140	112.50	22.1736
50	130, 135, 145, 175	146.25	20.1556
100	148, 140, 150, 158	149.00	7.3937
150	145, 160, 165, 162	158.00	8.9069
200	130, 150, 155, 160	148.75	13.1498

The following ANOVA table is obtained from SAS.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	?	4939.300000	?	?	?
Error	?	?	?		
Corrected Total	?	8553.800000			

- (a) Fill in the missing values (indicated by “?”) in the ANOVA table.
 (b) Test whether the nitrogen fertilizer affects the lettuce production at the 0.05 level of significance.
 (c) What is the estimate of the population variance?
 (d) The researcher further uses the orthogonal polynomial contrasts to investigate the relationship between the fertilizer and lettuce production. He obtains the complete set of orthogonal contrasts from table IX in Montgomery:

C1: -2 -1 0 1 2
 C2: 2 -1 -2 -1 2
 C3: -1 2 0 -2 1
 C4: 1 -4 6 -4 1

The result on testing C2 is reported below:

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
c2	?	?	1817.160714	?	?

- (d1) Fill in the missing values (indicated by “?”) in the above SAS output.
 (d2) Derive the estimate of C2 and test if the quadratic effect is significant at $\alpha=0.05$.
 (d3) Given that $SS_{C1}= 2839.22500$, do you expect the higher order effects (cubic and 4th order) to be significant at $\alpha=0.1$? You are required to support your answer with necessary calculations.