

MAT 222 (Spring 2017) HW Problems (for chapters 12 and 13)

Chapter 12

From the Textbook (problems marked with * are recommended to be done with MINITAB):

12.9, 12.10, 12.13, 12.15, 12.25, 12.40, 12.41, 12.42, 12.46*, 12.47*, 12.54*, 12.55*, 12.56*, 12.57*

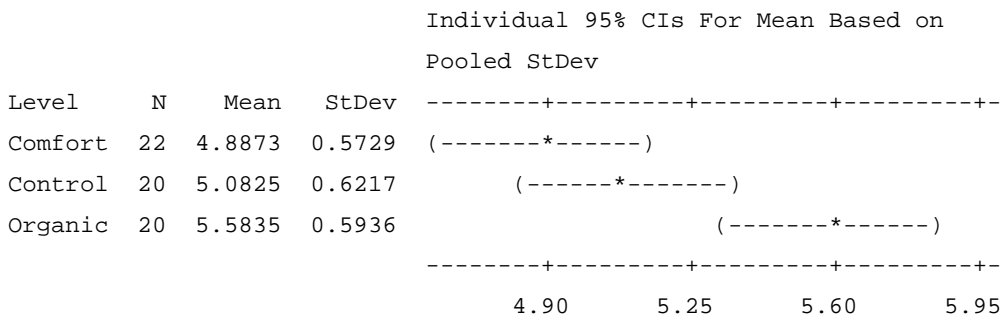
Additional Problems:

1. A One-Way ANOVA was done to analyze the quantitative variable "Score" against a categorical variable "Food" (representing three food groups: "Comfort", "Control", "Organic").

One-way ANOVA: Score versus Food

Source	DF	SS	MS	F	P
Food	___	5.330	_____	_____	0.001
Error	___	20.930	_____		
Total	61	26.260			

S = _____ R-Sq = 20.30% R-Sq(adj) = 17.59%



Pooled StDev = _____

- a. Fill in the missing parts in the output above.
- b. State the null and the alternate hypotheses for the F-test in the Analysis of Variance table.
- c. Using an appropriate contrast, we would like to compare the mean score of the control group with the average of the other groups. Compute the sample contrast, the standard error of the sample contrast, the t-statistic, and its degrees of freedom. You don't need to compute the p-value or provide the conclusion.

2. (From MAT222 Spring 2010 Final Exam¹ – see question 5. Ignore the points reference)

(20 pts) Battery life of MP3 players is of great concern to customers. A consumer group has tested three brands of such players to determine the battery life. Samples of players of each brand were fully charged and left to run at medium volume until the battery died. The number of hours that each player ran was recorded.

Consider the following summary statistics obtained:

Brand	n_i	\bar{x}_i	s_i
A	14	24.63	3.06
B	15	27.71	2.74
C	14	24.87	2.95

- (a) If one wanted to calculate the SSG, the between-group sum of squares, the value of the overall mean, \bar{x} , needs to be determined. Using the above information, show that $\bar{x} = 25.78$ and calculate SSG.

- (b) Choose the correct F value and its associate P-value to test $H_0 : \mu_A = \mu_B = \mu_C$, where $F(d_1, d_2)$ denotes the value of the test statistic with the numerator and denominator degrees of freedom, d_1 and d_2 , respectively. You do not need to calculate the F value.

$$\begin{array}{ll} \text{(i)} F(2, 43) = 5.06; P < 0.025 & \text{(ii)} F(2, 40) = 5.06; P < 0.025 \\ \text{(iii)} F(3, 43) = 5.06; P < 0.01 & \text{(iv)} F(3, 40) = 5.06; P < 0.01 \end{array}$$

- (c) What conclusion might you reach based on your answer in (b)?
- There is no evidence to suggest that the null hypothesis should be rejected.
 - There is sufficient evidence to conclude that the sample means are not equal.
 - There is sufficient evidence to conclude that not all the population means are equal.
 - There is evidence to support the conclusion that all the population means are different from each other.

- (d) Because one of the brands of MP3 players (Brand B) is known to be the most popular among customers, it was decided before the data were gathered to compare this brand against the other two to see if it had a longer battery life. What would be appropriate null and alternative hypotheses to establish to do such a test?

- $H_0 : \mu_A = \mu_B = \mu_C$ versus $H_a : \mu_B > \mu_A = \mu_C$
- $H_0 : \frac{\mu_A + \mu_C}{2} = \mu_B$ versus $H_a : \frac{\mu_A + \mu_C}{2} < \mu_B$
- $H_0 : \mu_A = \mu_B = \mu_C$ versus $H_a : \mu_B > \mu_A$ and $\mu_B > \mu_C$
- H_0 : all of the means are equal,
 H_a : all the other means are different from μ_B .

- (e) Calculate the test statistic to test the contrast in (d) and specify its degrees of freedom. Draw your conclusion at 0.05 level of significance. Note that $s_p^2 = 8.50$.

¹ See <http://researchguides.library.syr.edu/mathexams> for old final exams.

3. (From MAT222 Spring 2011 Final Exam² – see question 4. Ignore the question number & points reference)

4. [20 points] In a study of effective weight loss programs, 24 subjects who were at least 20% overweight took part in a three month group support program. The subjects were divided evenly into one of three different programs. Private weightings determined each subjects weight at the beginning of the program and four months after the program's end. The table below summarized the mean weight loss of each group, and the group's standard deviation of weight loss.

	\bar{x}	s
Program 1	13.2	4.23
Program 2	7.9	8.02
Program 3	17.3	4.55

a) [5 points] Is the assumption of equal population standard deviations reasonable? Explain.

b) [10 points] Calculate the pooled sample standard deviation, s_p .

c) [5 points] Using an ANOVA analysis, the F statistic is 4.11. Give the degrees of freedom and an approximate value of the p-value. What are your conclusions at the 5% significance level?

4. Iron-deficiency is a cause of concern in many developing countries. Some research has suggested that food cooked in iron pots contain more iron than food cooked in other types of pots. A study was conducted to analyze the effect of the type of pot used in cooking on the iron content in the food prepared. Result of the One-way ANOVA on the dataset is given below:

Source	DF	SS	MS	F	P
pot	___	_____	_____	_____	0.000
Error	___	15.580	_____		
Total	___	40.474			

S = _____ R-Sq = 61.51% R-Sq(adj) = 59.17%

Level	N	Mean	StDev	Individual 95% CIs For Mean Based on Pooled StDev
Aluminum	12	1.8733	0.5223	(-----*-----)
Clay	12	2.0367	0.6013	(-----*-----)
Iron	12	3.7133	0.8843	(-----*-----)

-----+-----+-----+-----+
2.10 2.80 3.50 4.20

Pooled StDev = _____

- Fill in the missing parts in the output above.
- State the null and the alternate hypotheses for the F-test in the Analysis of Variance table.
- Using the output above and an appropriate contrast, we would like to test whether the mean iron content of the iron pot group is higher than the average of the other groups. Compute the sample contrast, the standard error of the sample contrast, the t-statistic, its degrees of freedom, and the p-value. Provide the conclusion in context using significance level $\alpha=5\%$.

² See <http://researchguides.library.syr.edu/mathexams> for old final exams.

Chapter 13

From the Textbook (problems marked with * are recommended to be done with MINITAB):

13.4, 13.4, 13.5, 13.6, 13.7, 13.14, 13.15, 13.18, 13.22, 13.23, 13.24, 13.39*, 13.40*

Additional Problems:

1. The research study in the additional problem #4 from chapter 12 (see previous page) also considered the effect of the type of dish prepared, in conjunction with the potential effect of the type of pot used, via a Two-way ANOVA. Three pot types (aluminum, clay, iron) and three dish types (meat, legume, vegetables) were used as the factors with the iron content as the response.

Source	DF	SS	MS	F	P
pot	—	24.8940	12.4470	92.26	0.000
dish	—	_____	_____	_____	0.000
Interaction	—	2.6404	_____	_____	0.004
Error	—	3.6425	0.1349		
Total	35	40.4738			

S = _____ R-Sq = 91.00% R-Sq(adj) = 88.33%

- a. Fill in the missing parts in the output above.
 - b. Consider assessing the effect of the dish type. Specify the F-statistic for this test. In addition specify the numerator and denominator degrees of freedom of that F-statistic. State the conclusion in context.
 - c. Consider assessing the interaction effect of pot and dish types. Specify the F-statistic for this test. In addition specify the numerator and denominator degrees of freedom of that F-statistic. State the conclusion in context.
2. (From MAT222 Spring 2011 Final Exam³ – see question 5. Ignore the question number & points reference)

5. [20 points] An agricultural researcher conducted a Two-Way ANOVA to assess the effect of seeds and fertilizers on growing corn. Equal number of samples from each treatment group was taken. Below is the ANOVA output.

<i>Source</i>	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Seed	2	512.8667	256.4333	28.283	0.000008
Fertilizer	4	449.4667	112.3667	12.393	0.000119
Interaction	—	143.1333	17.8917	1.973	0.122090
Error	—	136.0000	_____		
Total	29	1241.4667			

Based on this output, answer the following questions.

- a) [4 points] Specify how many types of seeds, how many types of fertilizers, how many treatment groups, and how many samples from each treatment group were used in this study.
- b) [8 points] Consider the F-statistic = 12.393. State the null and alternate hypotheses tested by this statistic. Also, specify the numerator and denominator degrees of freedom for this statistic.
- c) [8 points] What is the pooled sample standard deviation?

³ See <http://researchguides.library.syr.edu/mathexams> for old final exams.

3. (From MAT222 Spring 2010 Final Exam⁴ – see question 6. Ignore the points reference)

(15 pts) Twenty high school-aged students are randomly selected from three different school districts: a district in the city, a district in the suburbs, and a district in a rural area. Each group of twenty students consisted of 10 boys and 10 girls. Each of the students was asked what price they paid for their last haircut. The data were entered into statistical software and a partial ANOVA table is obtained below.

(a) Complete the ANOVA table.

Source	DF	Sum of Squares	Mean Square	F
Sex		2674.0	2674.0	67.37
Region			351.8	
Sex* Region		231.8		
Error	54	2143.0	39.69	***
Total	59	5752.4	***	***

(b) What is the value of the pooled standard deviation, s_p ?

(c) Is the interaction effect statistically significant at the 5% significance level? Include the P-value (or the range of the P-value) and the degrees of freedom.

(d) Is the main effect for region statistically significant at the 5% significance level? Include the P-value (or the range of the P-value) and the degrees of freedom.

⁴ See <http://researchguides.library.syr.edu/mathexams> for old final exams.