

Name Key
Please ALSO write your name on the back of the last page.

Ag 400 - Quiz 5
Fall 2008

NOTE: Unless otherwise noted, use the .05 level to determine statistical significance.

- A. The following data were compiled from a random sample of 40 students enrolled in Ag 400 over the last five years concerning the relationship between number of class absences students had during the semester and their final exam grade.

	Number of absences			Total for all 40 students
	Less than 5	5-9	10 or more	
Number of students	10	20	10	40
Sum of the final exam score	800	1500	700	3000
Sum of the squares of the exam scores	64,450	113,450	49,450	227,350
Sum of the squares of the deviations about the mean	450	950	450	
Variance in final exam scores	50	50	50	

- (20) 1. Test the statistical significance of the relationship between number of absences and score on the final exam. Use the .05 level to determine statistical significance. Report the following items:
- a. State the Null Hypothesis and the Alternative Hypothesis in words, not statistical symbols.

H_0 : there is no relationship in the population between the number of absences and final exam grade.

H_A : there is a relationship...

b. Complete the following AOV Table and calculate F.

Sources of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	<u>2350</u>			
Among categories	<u>500</u>	<u>2</u>	<u>250</u>	<u>5.00</u>
Within categories	<u>1850</u>	<u>37</u>	<u>50</u>	

c. What is the critical value of "F" at the .05 level for evaluating the statistical significance of the above relationship?

Between 3.32 + 3.23

d. Reject or Do Not Reject the Null Hypothesis.

Reject H_0

e. What is the probability that you have made a Type I error in (d) above?

$.01 < \alpha < .05$

f. What is the probability that you have made a Type II error in (d) above?

$\beta = 0.00$

g. Make your conclusions.

There is a relationship between number of absences and final exam score. Those with < 5 absences had the highest exam scores. Those with 10 or more absences had the lowest scores.

(20) 2. Indicate whether each of the following statements is true (T) or false (F) in terms of the above data.

F a. The statistical unit in the above data is a class of students

F b. Based on the above data, you would reject the following Null Hypothesis at the .05 level of significance:

$$H_0: \sigma^2_{< 5 \text{ absences}} = \sigma^2_{5-9 \text{ absences}} = \sigma^2_{10 \text{ or more absences}}$$

T c. The relationship here between number of absences and final exam score could be tested for significance using linear correlation methods if you had access to information on the exact number of absences and final exam scores for each student in the sample.

F d. The variance in final exams scores for the entire sample is 50.

T e. In the above analysis, number of absences is treated as a nominal scale; final exam is treated as an interval scale.

F f. The figures calculated in (1) above are parameters because they allow us to generalize to the population.

T g. "F" is an inferential statistic; the mean final exam scores for the three "absence" categories are descriptive statistics.

T h. The "among categories sum of squares" in the above AOV Table is less than the "total sum of squares." The "among categories sum of squares" is never greater than the "total sum of squares."

F i. In this analysis "F" is positive and the "among categories sum of squares" is positive. This means that the relationship between number of absences and final exam score is positive.

F j. Scheffe's Test should be used to test the statistical significance of the difference between the means number of absences of those students who had less than 5 absences and those who had 10 or more absences.

- B. Suppose that the relationship between number of student absences and score on the final exam was further explored using a different and slightly larger random sample of Ag 400 students. The following data were compiled:

Number of Absences	Student Status	
	Undergraduate	Graduate
	-----Mean Final Exam Score-----	
<5	85 (10)	85 (10)
5-9	75 (10)	85 (10)
10 or more	65 (10)	85 (10)

- (4) 1. Complete the following analysis of variance table to obtain relevant F-value(s).

Sources of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-value
Total	10,250	59		
Among all 6 categories	3,500	5	700	5.60
Among absence categories	1,000	2	500	4.00
Between status categories	1,500	1	1,500	
Interaction	1,000	2	500	4.00
Within 6 categories	6,750	54	125	

- (24) 2. Indicate whether each of the following statements is true (T) or false (F) in terms of the above data. If any part of a statement is untrue, it should be marked false (F).

F a. The above analysis is a Randomized Block Design.

- F b. On the basis of the F-value of 5.60 on the AOV Table you should reject the following Null Hypothesis:

H_0 : there is no significant relationship in the sample between either number of absences or student status and final exam scores.

- T c. Degrees of freedom for testing the statistical significance of the F-value of 5.60 are 5 and 54.

- F d. The F-value of 5.60 is statistically significant at the .01 level. Based on this test, you should conclude that both "number of absences" and "student status" are significantly related to final exam scores.

- F e. The F-value for the Status x Absences Interaction is used to test the following Null Hypothesis:

H_0 : the relationship of student status to final exam score is the same for both undergraduate and graduate students.

- F f. The Status x Absences Interaction in this sample can be described as follows:

Graduate students have higher final exam scores than do undergraduates and as the number of absences increases, final exam scores decline.

- T g. In this sample, there is no relationship between number of absences and final exam scores for graduate students.

- F h. Graduate and undergraduate students in the sample are equally likely to be absent less than 5 times, but graduate students are more likely than undergraduates to be absent 10 or more times.

- F i. The interrelationship between student status and number of absences is statistically significant at the .05 level.

- F j. Based on the above analysis, the relationship between student status and final exam score should be described as follows:

Graduate students have higher final exam scores than do undergraduate students.

F k. The relationship between “number of absences” and final exam score in the sample should be described as follows:

As number of absences increases final exam scores decrease.

T l. In this analysis of variance “student status” and “number of absences” are treated as nominal scales; “final exam scores” are treated as interval data.

- (32) C. The attached output was obtained using SPSS. The data set contains information on the miles driven in a month and the gallons of gas used by a random sample of cars drawn from a large motor pool. The following variables are in the data set:

Miles driven in the month (MILES)
 Gallon of gas used (GALS)
 Type of car (MAKE)
 1 European make
 2 American make
 3 Japanese make

A new variable, miles per gallon (MPG) was calculated by dividing miles driven by the number of gallons of gas used.

Indicate whether each of the following statements is true (T) or false (F) in terms of this output.

- F 1. The interaction of MAKE and MPG is statistically significant at the .001 level.
- T 2. The sum of the squares of the deviations of the individual MPG scores from 25.00 equals approx. 1108.
- F 3. The relationship between MAKE and MPG is curvilinear and statistically significant at the .001 level.
- T 4. The Null Hypothesis tested by the F value reported on this output can be stated as follows:

$$H_0: \mu_{\text{European}} = \mu_{\text{American}} = \mu_{\text{Japanese}}$$

where μ = mean miles per gallon for cars in the three relevant populations.

- T 5. If you reject the Null Hypothesis concerning the relationship between MAKE and MPG you cannot have made a Type II error and the probability of having made a Type I error is less than .0005.
- F 6. The sum of the squares of the deviations of the individual MPG scores about the mean scores for their respective categories of car MAKE equals approximately 326.
- T 7. The dispersion in MPG scores is less for American-made cars than for either European or Japanese made cars, but these differences are not statistically significant at the .05 level.

- F 8. The strength of the relationship between MAKE of car and MPG can be measured by Eta. Here Eta equals approximately (.417).
- T 9. In the sample, American-made cars have the lowest mean miles per gallon, followed by European-made cars, with the Japanese-made cars having the highest mean miles per gallon.
- T 10. The variance in MPG scores for the total sample is approximately 14.6.
- T 11. Levene's Test tests the following Null Hypothesis:

$$H_0: \sigma^2_{European} = \sigma^2_{American} = \sigma^2_{Japanese}$$

where σ^2 = variances in miles per gallon for the relevant populations.

- F 12. On the basis of the data presented here, you should question the homogeneity of variance assumption since the variances in MPG scores for the three types of cars are not significantly homogeneous.
- T 13. On the basis of the output given here, you can conclude that American-made cars have significantly (.05 level) lower mean miles per gallon than do European-made cars.
- T 14. Approximately 29% of the variation in MPG among cars in the sample is accounted for by differences among the three makes of cars studied here.
- F 15. You would reject the following Null Hypothesis at the .05 level of significance on the basis of this output:
- H_0 : there is no difference in the sample between the mean miles per gallon for Japanese-made cars and the mean miles per gallon of American-made cars.
- T 16. The mean MPG for American-made and Japanese-made cars differ significantly from each other, while the mean MPG for European-made cars does not differ significantly from the mean for Japanese-made cars.

Oneway

Descriptives

MPG

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1.00	24	25.3718	3.4429	.7028	23.9180	26.8256	18.25	32.25
2.00	29	22.5916	2.8695	.5329	21.5001	23.6831	16.25	28.25
3.00	24	27.5385	3.4826	.7109	26.0679	29.0090	22.25	38.25
Total	77	25.0000	3.8188	.4352	24.1333	25.8668	16.25	38.25

Test of Homogeneity of Variances

MPG

Levene Statistic	df1	df2	Sig.
.651	2	74	.525

ANOVA

MPG

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	326.177	2	163.088	15.430	.000
Within Groups	782.135	74	10.569		
Total	1108.312	76			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: MPG

Scheffe

(I) MAKE	(J) MAKE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	2.7802*	.8971	.011	.5390	5.0213
	3.00	-2.1667	.9385	.076	-4.5112	.1778
2.00	1.00	-2.7802*	.8971	.011	-5.0213	-.5390
	3.00	-4.9468*	.8971	.000	-7.1880	-2.7057
3.00	1.00	2.1667	.9385	.076	-.1778	4.5112
	2.00	4.9468*	.8971	.000	2.7057	7.1880

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

MPG

Scheffe^{a,b}

MAKE	N	Subset for alpha = .05	
		1	2
2.00	29	22.5916	
1.00	24		25.3718
3.00	24		27.5385
Sig.		1.000	.066

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25.463.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.