PROVIDENCE UNIVERSITY

Midterm Spring 2005

Course: Statistics **Department: Business Administration** **Date: April 16, 2005**

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Student ID: _____ Name: _____

Note: Please return the question sheet with your answer sheet. Fail to retun the question sheet will result in ZERO score for the exam.

1. Martin Motors has in stock three cars of the same make and model. The president would like to compare the gas consumption of the three cars (labeled car A, car B, and car C) using four different types of gasoline. For each trial, a gallon of gasoline was added to an empty tank, and the car was driven until it ran out of gas. The following table shows the number of miles driven in each trial.

	Distance (miles)		
Type of Gasoline	Car A	Car B	Car C
Regular	22.4	20.8	21.5
Super regular	17.0	19.4	20.7
Unleaded	19.2	20.2	21.2
Premium unleaded	20.3	18.6	20.4

Using the .05 level of significance:

a. Is there a difference among types of gasoline? (10%)

b. Is there a difference in the cars? (10%)

n	4	4	4		
ΣA	78.9	79	83.8	$\Sigma T =$	241.7
$(\Sigma A)^2/n_A$	1556.30	1560.25	1755.61	$\Sigma T^2 =$	4890.83
	A	B	C	ΣB	$(\Sigma B)^2/c$
1	22.4	20.8	21.5	64.7	1395.36
2	17	19.4	20.7	57.1	1086.80
3	19.2	20.2	21.2	60.6	1224.12
4	20.3	18.6	20.4	59.3	1172.16

變異來源	平方和	自由度	均方	*F* 值	*p* 值
組間變異	3.92	2	1.96	1.391	0.3189
集群變異	10.21	3	3.40	2.414	0.1650
隨機變異	8.46	6	1.41		
總和	22.59	11			

2. What is the relationship between the amount spent per week on food and the size of the family? Do larger families spend more on food? A sample of 10 families in the Chicago area revealed the following figures for family size and the amount spent on food per week.

Family Size	Amount Spent on Food	Family Size	Amount Spent on Food
3	$99	3	$111
6	104	4	74
5	151	4	91
6	129	5	119
6	142	3	91

a. Compute the coefficient of correlation. (5%)

b. Determine the coefficient of determination. (5%)

c. Can we conclude that there is a postive association between the amount spent on food and the family size? Use the .05 significance level. (5%)

45	1111	217	128743	5163
A	B	A^2	B^2	A×B
3	99	9.0	9801.0	297.0
6	104	36.0	10816.0	624.0
5	151	25.0	22801.0	755.0
6	129	36.0	16641.0	774.0
6	142	36.0	20164.0	852.0
3	111	9.0	12321.0	333.0
4	74	16.0	5476.0	296.0
4	91	16.0	8281.0	364.0
5	119	25.0	14161.0	595.0
3	91	9.0	8281.0	273.0

(1) Ho：$\rho \leqq 0$ （右尾）
(2) 檢定統計量 $(r-\rho) / [(1-r^2)/(n-2)]$ 爲 df = n−2 = 8 的 t 分配
(3) α=0.05，拒絕區域 R = { t＞1.86 }
(4) 樣本統計量 t = 2.062 屬於 R，拒絕 Ho （p值 = 0.0731）

$r = [\Sigma AB-(\Sigma A)(\Sigma B)/n] / \sqrt{[\Sigma A^2-(\Sigma A)^2/n][\Sigma B^2-(\Sigma B)^2/n]} = 0.5892$
$t = (r-\rho) / [(1-r^2)/(n-2)] = 0.5892 / [\ 0.6529 / 8\ ] = 2.0624$

3. An ANOVA table is:

Source	DF	SS	MS	F
Regression	1	50		
Error				
Total	24	500		

a. Compute the ANOVA table. (5%)
b. How large was the sample? (5%)
c. Determine the standard error of estimate. (5%)
d. Determine the coefficient of determination. (5%)

Answer:

b. $n = 25$

c. $s_{y \cdot x} = \sqrt{19.5652} = 4.4233$

d. $r^2 = 50/500 = 0.10$

變異來源	平方和	自由度	均方	*F* 值
組間變異	50.00	1	50.00	2.556
隨機變異	450.00	23	19.57	
總和	500.00	24		

4. The following output was obtained.

Analysis of variance			
SOURCE	DF	SS	MS
Regression	5	100	20
Error	20	40	2
Total	25	140	
Predictor	Coef	StDev	t-ratio
Constant	3.00	1.50	2.00
X_1	4.00	3.00	1.33
X_2	3.00	0.20	15.00
X_3	0.20	0.05	4.00
X_4	-2.50	1.00	-2.50
X_5	3.00	4.00	0.75

a. What is the sample size? (5%)
b. Compute the value of R^2. (5%)
c. Compute the multiple standard error of estimate. (5%)
d. Conduct a global test of hypothesis to determine whether any of the regression coefficients are significant. Use the .05 significance level. (5%)
e. Test the regression coefficients individually. Would you consider omitting any variable(s)? If so, which one(s)? Use the .05 significance level. (5%)

Answer:
14.11. a. $n = 26$
b. $R^2 = 100/140 = 0.7143$
c. 1.4142, found by $\sqrt{2}$
d. H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ H_1: Not all β's are 0 Reject H_o if $F > 2.71$
Computed $F = 10.0$. Reject H_o. At least one regression coefficient is not zero.
e. H_o is rejected in each case if $t < -2.086$ or $t > 2.086$. X_1 and X_5 should be dropped.

5. The chief of security for the mall of the Dakotas was directed to study the problem of missing goods. He selected a sample of 100 boxes that had been tampered with and ascertained that for 60 of the boxes, the missing pants, shoes, and so on were attributed to shoplifting. For 30 other boxes employees had stolen the goods, and for the remaining 10 boxes he blamed poor inventory control. In his report to the mall management, can he say that shoplifting is twice as likely to be the cause of the loss as compared with either employee theft or poor inventory control and that employee theft and poor inventory control are equally likely? Use the .02 significance level. (10%)

(1) Ho：各組比例如資料所示（右尾）
(2) 檢定統計量 $\Sigma(Oi-Ei)^2/Ei$ 爲 df = 2 的卡方分配
(3) df = 2 之卡方分配，右尾，α = 0.02，求得 R = { $\chi^2 > 7.824$ }
(4) 樣本 $\chi^2 = 12 > \chi^{2*} = 7.824$ (屬於 R)
(5) 拒絕 Ho（p值 = 0.002）

參數一： 參數二： α = 0.02
自由度 = 3 − 1 = 2 χ^{2*} = 7.824

總和	1	100			12.000
組別	Pi	Oi	Ei	Oi–Ei	$(Oi-Ei)^2/Ei$
顧客	0.5000	60	50.00	10.00	2.000
內賊	0.2500	30	25.00	5.00	1.000
庫存控管	0.2500	10	25.00	- 15.00	9.000

6. The following sample data were obtained from three populations where the variance were not equal, and you wish to compare the populations.

Sample 1	Sample 2	Sample 3
21	15	38
29	17	40
35	22	44
45	27	51
56	31	53
71		

a. State the null hypothesis. (5%)
b. Using the .01 level of risk, state the decision rule. (5%)
c. Compute the value of the test statistic. (5%)
d. What is your decision on the null hypothesis? (5%)

$$H = 12/[N(N+1)]\times[(\Sigma A)^2/nA + \cdots + (\Sigma F)^2/nF] - 3(N+1)$$
$$= (12/272)\times 1322 - 51 = 7.324$$

	N = 16		H = 7.324
n_A	6	5	5
ΣA	60	19	57
$(\Sigma A)^2/n_A$	600.00	72.20	649.80
	A	B	C
	3	1	9
	6	2	10
	8	4	11
	12	5	13
	15	7	14
	16		

(1) Ho：各組沒有差異 （右尾）
(2) 檢定統計量 H 爲 df = 3 −1 = 2 的 χ^2 分配
(3) α = 0.01，拒絕區域 R = { $\chi^2 > 9.21$ }
(4) 樣本統計量 H = 7.324 不屬於 R，無法拒絕 Ho （p 值 = 0.0257）

7. Two groups of students were asked to rank the activities sponsored by the Student Government Association on campus. The following show their rankings.

Activity	Resident Student Ranking	Nonresident Student Ranking
1	3	6
2	1	2
3	8	5
4	2	1
5	5	7
6	7	8
7	4	3
8	6	4

Determine the Spearman rank-correlation coefficient and test for a significant correlation with $\alpha = 0.05$. (10%)

				$\Sigma d^2 =$	30.00
A	B	Rank A	Rank B	d	d^2
3	6	3.0	6.0	- 3.0	9.00
1	2	1.0	2.0	- 1.0	1.00
8	5	8.0	5.0	3.0	9.00
2	1	2.0	1.0	1.0	1.00
5	7	5.0	7.0	- 2.0	4.00
7	8	7.0	8.0	- 1.0	1.00
4	3	4.0	3.0	1.0	1.00
6	4	6.0	4.0	2.0	4.00

(1) Ho：$\rho=0$ （雙尾）
(2) 檢定統計量 $(r-\rho) / [(1-r^2)/(n-2)]$ 爲 $df = n-2 = 6$ 的 t 分配
(3) $\alpha=0.01$，拒絕區域 R = { $t<-3.707$ 或 $t>3.707$ }
(4) 樣本統計量 $t = 2.056$ 不屬於 R，無法拒絕 Ho （p值 = 0.0856）

$r = 1-6\Sigma d^2 / [n(n^2-1)] = 1-6\times30 / [8\times63] = 0.6429$
$t = (r-\rho) / [(1-r^2)/(n-2)] = 0.6429 / [\ 0.5867 / 6\ ] = 2.0557$

8. One thousand managers with degrees in business administration indicated their fields of concentration as shown below.

Major	Top Management	Middle Management	TOTAL
Management	300	200	500
Marketing	200	0	200
Accounting	100	200	300
TOTAL	600	400	1000

Test at $\alpha = .01$ to determine if the position in management is independent of the major of concentration. (10%)

(1) Ho：兩變數相互獨立（右尾）
(2) 檢定統計量 Σ(Oi–Ei)²/Ei 爲 df = 2 的卡方分配
(3) df = 2 之卡方分配，右尾，α = 0.01，求得 R = { $\chi^2 > 9.21$ }
(4) 樣本 $\chi^2 = 222.222 > \chi^{2*} = 9.21$ (屬於 R)
(5) 拒絕 Ho（p值 = 0）

自由度 = (3–1)×(2–1) = 2 α = 0.01 χ^{2*} = 9.210

觀察資料（Oi）			
總和	600	400	1000
組別	高階	中階	總和
企管	300	200	500
行銷	200	0	200
會計	100	200	300

理論次數（Ei）			
總和	600	400	1000
組別	高階	中階	總和
企管	300.00	200.00	500
行銷	120.00	80.00	200
會計	180.00	120.00	300

(Oi－Ei)²/Ei			
總和	88.889	133.333	222.222
組別	高階	中階	總和
企管	0.000	0.000	0.000
行銷	53.333	80.000	133.333
會計	35.556	53.333	88.889