UNIVERSITI SAINS MALAYSIA

Final Examination
Semester I, Academic Session 1994/95

October/November 1994

AGW513 - MANAGERIAL STATISTICS

Time: [3 hours]

Instructions

Please make sure that this examination paper consists of NINE printed pages before you begin.

There are EIGHT questions. Answer all the FOUR questions from Section A and any TWO from Section B. Show all your workings in the answer book.

SECTION A (Answer ALL questions)

Q1. At a rice research institute, four different varieties of rice are grown so that the yields can be studied. As it is felt that the location of the plot (such as amount of sunshine, wind, etc.) may also have an effect on the yield, the plots are divided into four equal strips. Rice yields are given in the following table:

Location	Yield (Rice variety)			
	A	B	C	D
1	21.0	25.0	21.0	21.0
2	25.0	27.0	24.0	24.0
3	25.0	28.0	24.0	23.0
4	23.0	26.0	25.0	22.0

Using the analysis of variance, test the following:

(i) There is no significant difference in the average yield for four different varieties of rice.

(ii) There is no significant difference in the average yield produced by the different locations in the plots.

Write a short report on your findings to the Director of the institute.

[18 marks]

Q2. In a transportation system, the manager wishes to determine the relationship between travel time (TIME), the number of miles travelled (MILES) and the number of deliveries made (DELIV). An additional variable (TYPE) indicating the type of the vehicle, which is coded 0 if the vehicle is a "pick-up" and 1 if it is a van, has also been included in the multiple regression analysis. The computer output obtained for the analysis is as follows:

Variable	Coefficient	Standard Error
CONSTANT	0.534	1.22
MILES	0.04521	0.01600
DELIV	0.7123	0.2635
TYPE	0.8000	0.5392

R-bar-squared = 78.5%

Analysis of variance:

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Square	F-Ratio
Regression	3	20.5821	6.8607	12.0462
Error	6	3.4172	0.5692	
Total	9	23.9993	2.6666	

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(a)   Write the regression equations for travel time for (i) "pick-up" vehicle, (ii) van.

(b)   Test the significance of the model and also the regression coefficients and explain what they indicate.

(c)   What would be the travel time (i) for a van making two deliveries and travelling 75 miles? (ii) and for a "pick-up" making 3 deliveries and travelling 50 miles?

(d)   Draw your conclusions about the analysis and make suggestions for improvements.

[16 marks]

Q3.   (a)   Describe briefly the characteristics of the normal distribution and outline the importance of the distribution in the statistical analysis.

(b)   In a factory producing soft drinks, there is a canning process to fill the cans. The contents of the cans is normally distributed with mean 327.5 ml and variance 1.69 ml square. The cans are all marked as containing 325 ml.

    (i)   What percentage of days production will contain more than 330 ml?

    (ii)   If the cans contain less than 325 ml, the production supervisor is likely to be punished under the Weights and Measurement Act. What are his chance of being punished? If the production run is for 8,000 cans per hour, how many cans would contain less than the stated content?

    (iii)   Between what limits does 92% of the days' production fall?

    (iv)   If two cans are selected at random from the days' production, what is the probability that both the cans will contain less than 325 ml?

[18 marks]

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Q4.   The Association of Malaysian Manufacturers are currently studying the pay differentials of operators in electronic industry in Bayan Lepas Free Trade Zone and Prai Free Trade Zone. A sample of operators was selected from each Zone and a summary of their monthly wages is given below:

Monthly Wages (RM)	Number of Operators	
	Bayan Lepas	Prai
300 - 329	15	13
330 - 359	22	38
360 - 389	41	54
390 - 419	42	63
420 - 449	27	46
450 - 479	16	36
480 - 510	12	30

(i)   Using the above sample data summarize the pay structure of the operators in the above two zones and write a short report for the Association.

(ii) Does the above result indicate any evidence of a significant difference in the average earnings of the operators in the two zones?

[16 marks]

SECTION B (Answer any TWO questions)

Q5.   (a)   A factory manager wishes to know whether the efficiency of operators can be improved by imparting "proper-on-the-job-training". The following data gives the efficiency ratings taken before and after the "proper-on-the-job-training" for a randomly selected sample of 15 employees. From the sample results, draw conclusions about the efficiency of the operators. Use $\alpha = 0.01$. [Note: A higher number indicates a higher efficiency].

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Employee	Efficiency Rating		Employee	Efficiency Rating	
	Before Training	After Training		Before Training	After Training
1	51	62	9	52	70
2	55	55	10	55	68
3	60	78	11	48	58
4	58	77	12	40	53
5	43	57	13	59	50
6	47	60	14	48	61
7	58	69	15	54	74
8	59	78			

(b)   In-Tech, a large semi-conductor manufacturing company, has manufacturing facilities in three different regions of Malaysia. One year after introducing a change in working conditions and employee benefits in all the three factories, the company selected at random 250 employees from each plant and were asked to rate the degree of their satisfaction with the new system. The following table shows the results. Do these data provide sufficient evidence to suggest that the employees at the different plants are not homogeneous with respect to satisfaction with the new system? (Use α = 0.05).

Plant	Degree of Satisfaction			
	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
1	135	70	25	20
2	145	80	15	10
3	140	75	20	15

[16 marks]

Q6.   (a)   The director of Human Resources suspects that more lenient standards are being used in giving performance ratings in the marketing department than in the operations department. Data for the last 10 such ratings in each department is given below. Use an appropriate nonparametric test, and test the hypothesis that there is no difference in the performance ratings. Use α = 0.05.

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Performance Ratings (Maximum = 100)

Marketing Dept.	72	80	86	90	95	92	88	96	91	82
Operations Dept.	80	79	90	82	81	84	78	74	85	71

(b) Professor Tan, the Dean of a Management School, has ordered text books for the courses offered by the School from United Book Sdn. Two-fifth of these books are obtained for the suppliers from KL while the remaining are obtained through Singapore dealers. Singapore and KL suppliers have problems in timely supply of the books and on the basis of past experience, these probabilities of delayed supply respectively are 0.05 and 0.10. If Prof. Tan receives a delayed shipment of books, which supplier (KL or Singapore) is more likely to have supplied the shipment of books? What is the probability of receiving a delayed shipment?

[16 marks]

Q7. (a) Food Specialities, a chain of 145 supermarkets, has been bought-out by KFC, a larger nationwide supermarket chain. Before the deal is finalised, KFC wants to have some assurance that Food Specialities will be a consistent money maker. The Financial Controller of KFC decided to look at the financial records of 36 of the Food Specialities Stores. Food Specialities have claimed that each store's profits have an approximately normal distribution with the same mean and a standard deviation of RM1,200. If Food Specialities is correct in their claim, what is the probability that the sample mean for the 36 stores will fall within RM200 of the actual mean?

(b) The Happy-Home match making organisation claims that 50% of all couples it introduces eventually marry. You have canvassed 50 friends who have used the service, and 30 of them claim that there is no chance that they will marry the person to whom Happy-Home introduced them.

Assuming that the above information is from the random sample of the clients of Happy Home, what is the probability that 30 or more of the sample individuals will not eventually marry the person to whom they were introduced, if the success rate claimed by Happy-Home is accurate?

[16 marks]

Q8. (a) Critically examine the merits and demerits of probability sampling and non-probability sampling methods. What are the sampling and non-sampling errors?

(b) It is desired to choose a representative sample of 500 people for a study on household savings. Comment on the following methods used for obtaining the sample.

(i) Choosing 500 names at random from the telephone directory.

(ii) Selecting the first 500 people who visit a large supermarket in the heart of the city.

Suggest an appropriate sampling method to select a sample for conducting the above study.

[16 marks]

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$$r = \frac{s_{xy}}{\sqrt{s_{xx} \; s_{yy}}} \qquad , \qquad r_S = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$

$$\hat{b}_1 = \frac{\Sigma xy - n\bar{x}\bar{y}}{\Sigma x^2 - n\bar{x}^2}$$

$$\hat{b}_o = \bar{y} - \hat{b}\bar{x}$$

$$\hat{\sigma} = \sqrt{\frac{\Sigma(y - \hat{y})^2}{n-2}}$$

$$R^2 = 1 - \frac{\Sigma(y - \hat{y})^2}{\Sigma(y - \bar{y})^2}$$

$$s_b^2 = \frac{\hat{\sigma}^2}{\Sigma x^2 - n\bar{x}^2}$$

$$Z = \frac{x - E(x)}{SD(x)}$$

$$t = \frac{\bar{x} - \mu_o}{\sigma/\sqrt{n}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$$

$$P = \sum_{i=0}^{x} \binom{n}{i} p^i q^{n-i}$$

$$\chi^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i} \qquad \text{or} \qquad \chi^2 = \frac{(|B-C|-1)^2}{B + C}$$

$$D = \max \{|F_0(X) - S_n(X)|\}$$

$$D* = \frac{1.36}{\sqrt{n}}$$

$$E(U) = \frac{2n_1 n_2}{n_1 + n_2} + 1$$

$$\text{Var}(U) = \frac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$$

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

$$E(U) = \frac{n_1 n_2}{2}$$

$$\text{Var}(U) = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12}$$