MUEO

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UNIVERSITY EXAMINATIONS

2006/2007 ACADEMIC YEAR

FIRST SEMESTER EXAMINATION

FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION

COURSE CODE: MBA 860

COURSE TITLE: QUANTITATIVE METHODS OF MANAGEMENT

DATE: 19TH MARCH, 2007 **TIME:** 9.00 A.M. – 12.00 NOON.

INSTRUCTION TO CANDIDATES

- SEE INSIDE.

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MBA 860: QUANTITATIVE METHODS OF MANAGEMENT

INSTRUCTIONS

1. Write your index number in the space provided in the answer booklet.
2. Answer Question 1 and three other Questions.
3. Show your working as much as possible.

Question 1: (21 marks)

(a) Explain the difference in the following terminologies used in quantitative methods:
- (i) Probability tree and decision tree. (2 marks)
- (ii) Binomial distribution and Poisson distribution (2 marks)
- (iii) Differential calculus and integral calculus (2 marks)
- (iv) Marginal analysi
- (v) s approach and break-even analysis (2 marks)

(b) Given the Leontief model $X = AX + D$.
By using matrix operations find X. (3 marks)

(c) A company has the following demand and total cost functions for a particular item:

Demand $P = 5{,}625 - 3q^2$

Total cost $TC = 500 + 864q$

where P is the price of the item, q is the quantity produced and sold and TC is the total cost of producing the item.

Required:
- (i) Determine the price and quantity for maximum sales revenue and find the maximum revenue. (4 marks)
- (ii) Determine the price of quantity for maximum profit and find the maximum profit. (3 marks)

(d) The Environmental Protection Agency (EPA) has set a limit of 4 parts per billion, on average, of a certain toxic substance in a drinking water source. A recent random sample of 36 water specimens from this source yields an average level of 4.45 parts per billion for this substance and a standard deviation of 0.9 parts per billion.
- (i) Assuming the EPA limit is still being maintained, determine the probability that the average amount of this substance for a random sample of 36 water specimens would be 4.45 parts per billion or more. (2 marks)
- (ii) In view of your answer to part (i), should there be good reason for concern that the EPA average limit is being exceeded? Explain. (1 mark)

Question 2: (13 marks)

(a) Home Products Limited, a local manufacturing company produces three types of animal feeds coded P, Q and R. You have been contracted to collect and analyze data and advise the management on the best blend of the feeds that exactly meet the required nutritional

requirements coded A, B and C. The data you collected indicates that each unit of feed P is 10% of A, 25% of B and 5% of C, while each unit of feed Q is 15% of A, 10% of B and 30% of C. Each unit of feed R contains 8% of A, 20% of B and 25% of C. It is required that the blend must have 33 grams of A, 55 grams of B and 120 grams of C.

Required:
Model the problem as a matrix, hence find the number of units of feeds P, Q and R that must be in the blend to exactly satisfy the nutritional requirements. (6 marks)

(b) Upishi Bora Consultants surveyed Kenyan market to study the consumer's switching for 4 cooking oils. A sample of 600 respondents has been chosen, which provided the following information regarding the use of Elianto, Chef, Golden Fry and Rina. From the undertaken sample, 190 were using Elianto, 150 Chef, 120 Rina and rest Golden Fry. Due to vigorous advertising campaign, the following switching pattern has been observed. Out of users of Elianto 20 switched to Chef, 30 to Golden Fry, 10 to Rina and rest remained brand loyal. From the users of Chef 80 remained brand loyal, 25 switched to Elianto, 30 to Golden Fry and remaining to Rina. Out of the users of Golden 70 remained brand loyal, 20 switched to Rina, 25 to Chef and remaining to Elianto. Similarly from the users of Rina 10 switched to Elianto, 18 to Chef, 12 to Golden Fry and rest remained brand loyal.

Required:

(i) Construct consumer's brand switching matrix. (4 marks)

(ii) If the consumer's switching pattern persists, calculate the future market share for the four cooking oils. (3 marks)

Question 3: (13 marks)

(a) The total profit per unit of electricity produced and sold in Kenya, has been found to be related to the expenditure per unit for labour and raw materials. Let x represent the shillings per unit spent on labour and y represents the shillings per unit spent on raw materials; specifically the profit function (π) is

$$\pi = 40x + 60y + 10xy - 10x^2 - 5y^2.$$

Required
Determine the value of x and y that maximize profit? (5 marks)

(b) A manufacturer of a new patented product has found that he can sell 70 units a week direct to the customer if the price is \$48. In error, the price was recently advertised at \$78 and, as a result, only 40 units were sold in a week. The manufacturers fixed costs of production are \$1,710 a week and variable costs are \$9 per unit.

You are required

(i) to show that equation of the demand function linking price (P) to quantity demanded (x), assuming it to be a straight line, is

$$P = 118 - x$$ (2 marks)

(ii) to find where the manufacturer breaks even (2 marks)

(iii) to recommend a unit price which would maximise profit (2 marks)
(iv) to find the quantity demanded and profit generated at that price in (iii). (2 marks)

Question 4: (13 marks)

(a) An international firm is ordering items in the batches of 120 items and tests them at delivery. The batch is returned to the supplier if it contains 4 or more defective items. What is the probability that a batch will be rejected and sent back to the supplier, if it contains:
(i) 1.5% defective items
(ii) 2.3% defective items (5 marks)

(b) Under the system of floating exchange rates, the rate of foreign money to the U.S. dollar is affected by many random factors, and this leads to the assumption of a normal distribution of small daily fluctuations. The rate of German marks per U.S. dollar is believed in a certain period to have a mean of 2.06 and a standard deviation of 0.08. Find the following:

(i) The probability that tomorrow's rate will be above 2.10. (3 marks)
(ii) The probability that tomorrow's rate will be below 1.90. (2 marks)
(iii) The probability that tomorrow's exchange rate will be between 2.00 and 2.20. (3 marks)

Question 5: (13 marks)

(a) Briefly explain the following terms as applied in statistical hypothesis testing.
(i) Confidence interval (ii) Type I error (iii) Type II error
(iv) Level of significance (v) Power of a test (5 marks)

(b) A production engineer wants to test the assertion that workers using method A will on average complete a job in the same time as they would by using method B. Eight workers are selected at random, and each is made to do a given job first in one way and then in the other way (although half use A first and the other half use B first). A significance level of $\alpha = 0.01$ is desired. The results of the experiment are shown below.

Worker	*Method A*	*Method B*
1	10.0	9.8
2	11.1	11.0
3	9.8	8.2
4	10.0	9.5
5	10.3	10.6
6	10.5	10.2
7	11.3	10.6
8	9.5	10.0

Make the test assuming the underlying population of differences is normally distributed. (8 marks)

Question 6: (13 marks)

(a) A banker claims that the life of a regular savings account opened with his bank averages 18 months with a standard deviation of 6.45 months. What is the probability that

(i) there will still be money in 22 months in a savings account opened with the said bank by a depositor. (3 marks)

(ii) the account will have been closed before 2 years? (2 marks)

(b) Starting annual salaries for individuals with master's and bachelor's degrees were collected in two independent random samples. Use the following data to develop a 95% confidence interval estimate of the increase in starting salary that can be expected upon completion of a master's program.

Master's Degree
$n_1 = 60$
$\bar{x}_1 = \$35,000$
$s_1 = \$2,500$

Bachelor's Degree
$n_2 = 80$
$\bar{x}_2 = \$30,000$
$s_2 = \$2,000$

(I) Develop a point estimate of the difference between the mean annual salaries of master's and bachelor's degrees holder. Is the increase in starting salary significant?

(II) What assumptions were made to compute the interval estimate? (8 marks)

Question 7: (13 marks)

(a) TNN and ActMedia provided a television channel that showed news, features, and ads, and was targeted to individuals waiting in grocery checkout lines. The television programs were designed with an eight-minute cycle on the assumption that the population mean time a shopper stands in line at a grocery store checkout is eight minutes. A sample of 120 shoppers at a major grocery store showed a sample mean waiting time of 7.5 minutes with a sample standard deviation of 3.2 minutes.

Test $H_0 : \mu = 8$ and $H_a : \mu \neq 8$. Use a 0.01 level of significance. Does the population mean waiting time at the grocery store differ from the 8 minute waiting time assumption? (5 marks)

(b) A businessman has to select two independent investments A and B available to him but he lacks the capital to undertake both of them simultaneously. He can choose to take A first and then stop, or if A is successful then take B, or vice versa. The probability of success on A is 0.7 while for B it is 0.4. Both investments require an initial capital outlay of $ 2000 and both return nothing if venture is unsuccessful. Successful completion of A will return $ 3000 (over cost), successful completion of B will return $ 5000 (over cost). Draw the decision tree and determine the best strategy. (8 marks)

FORMULAE

1. Z formula for sample means $$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

Z formula for sample means when there is a finite population $$Z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}}$$

Z formula for sample proportions $$Z = \frac{\hat{p} - p}{\sqrt{p.q/n}}$$

2. $100(1-\alpha)\%$ confidence interval to estimate μ; $$\bar{X} - Z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \le \mu \le \bar{X} + Z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$$

Confidence interval to estimate μ using the finite correction factor;

$$\bar{X} - Z_{\alpha/2}\frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}} \le \mu \le \bar{X} + Z_{\alpha/2}\frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}$$

Confidence interval to estimate μ : large samples and population standard deviation unknown

$$\bar{X} - Z_{\alpha/2}\frac{s}{\sqrt{n}} \le \mu \le \bar{X} + Z_{\alpha/2}\frac{s}{\sqrt{n}}$$

Confidence interval to estimate μ : small samples and population standard deviation unknown

$$\bar{X} - t_{\alpha/2,n-1}\frac{s}{\sqrt{n}} \le \mu \le \bar{X} + t_{\alpha/2,n-1}\frac{s}{\sqrt{n}}$$

Confidence interval for P $$\hat{p} - Z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}} \le p \le \hat{p} + Z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}}$$

χ^2 formula for single variance $$\chi^2 = \frac{(n-1)s^2}{\sigma^2}; \qquad df = n-1$$

Confidence interval to estimate the population variance

$$\frac{(n-1)S^2}{\chi^2_{\alpha/2}} \le \sigma^2 \le \frac{(n-1)S^2}{\chi^2_{1-\alpha/2}} \qquad df = n-1$$

3. Z test for difference in two independent sample means $$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

t test for two independent sample means, small samples, population variances unknown

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}; \qquad df = n_1 + n_2 - 2$$

t test for the difference in two related samples $\qquad t = \frac{\bar{d} - D}{s_d / \sqrt{n}}, \qquad df = n - 1$

4. Quadratic equations

If $ax^2 + bx + c = 0$ then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.