 Serial No………………

Society of Certified Management Accountants of Sri Lanka

Technician Stage
Pilot paper

Instructions to the Candidates

1. Time allowed is **two (2)** hours.
2. Answer **any five(5)** questions
3. Answers should be entirely in the **English language.**

Subject	Subject Code
Business Mathematics	**(BMT)**

Question No. 1 (20 Marks)

(i) Annual copper production, in millions of tons, of a certain country is given by the equation

$y = 24 \ell n (2+t)$,
where t=0 is 1990.

(a) Graph this function. **(8 Marks)**
(b) Find the copper production in 2020. **(2 Marks)**
(c) In what year will copper production reach 96 million tons? **(5 Marks)**

(ii) If Rs. 10,000/- is invested at 12% per year compounded continuously, how long will it be until the investment is Rs. 50,000/-? **(5 Marks)**

(Total 20 Marks)

Question No.2 (20 Marks)

(i) A person has a total of Rs. 58,000 invested in stocks and bonds. The stocks pay 9% per year, the bonds 12% per year. Using a matrix method, find how much does he have invested in each if the total annual payment is Rs.6, 000/-. **(7 Marks)**

(ii) The supply and demand functions for a certain commodity are
$S(P) = P - 8$ and $D(P) = 5760/p$

respectively, where p is the price in rupees.

(a) Find the equilibrium price and the corresponding number of units supplied and demanded. **(3 Marks)**
(b) Draw the supply and demand curves on the same set of coordinate axes. **(8 Marks)**
(c) Where does the supply curve cross the p axis? Describe the economic significance of this point. **(2 Marks)**

(Total 20 Marks)

Question No.3 (20 Marks)

(i) Three fair coins are tossed.

(a) Use a tree diagram to list the sample space S. Hence state the number of outcomes in S. **(5 Marks)**

(b) If the random variable x represents the number of heads obtained, find the probabilities P(X = x) for x = 0, 1, 2 and 3. **(2 Marks)**

(c) Obtain the probability distribution of x. **(2 Marks)**

(d) Find the expected value of X. **(2 Marks)**

(e) Find the standard deviation of X. **(4 Marks)**

(ii) In a certain factory machines X, Y and Z manufacture 25%, 35%, and 40% of the electric items that are the output of the factory. Of their output,6%, 4% and 5% respectively are defective. The electric items are stored in a room without regard to the machine. An item is selected from the room at random.

(a) Determine the probability that the selected item is defective. **(3 Marks)**

(b) Determine the probability that the selected item was manufactured by machine Y, gives that it is defective. **(2 Marks)**

(Total 20 Marks)

Question No. 4 (20 Marks)

The number of cars passing a check point during 100 intervals each of 5 minutes were noted:

Number of Cars	0	1	2	3	4	5	6 or more
Frequency	5	23	23	25	14	10	0

(i) Find the mean of this distribution. **(4 Marks)**

(ii) Fit a Poisson distribution to these data. **(4 Marks)**

(iii) By combining all classes after the fourth class, find expected frequencies for this distribution. **(4 Marks)**

(iv) Find the computed value of Chi-squared (χ^2) **(4 Marks)**

(v) Test the goodness of fit using 5% level of significance. **(4 Marks)**

(Total 20 Marks)

Question No. 5 (20 Marks)

(i) Suppose the length of time (in days) between sales for a salesperson is modeled by an exponential random variable with mean 2.5. What is the probability that the salesperson goes more than 6 days without a sale? **(6 Marks)**

(ii) A sample of size 64 is taken from a normal population with unknown mean μ and known variance 16.An investigator wishes to test the null hypothesis.
$H_0 : \mu = 30$ against the alternative hypothesis $H_1 : \mu > 30$. He decides on the following criteria :
Accept H_0 if the sample mean $\overline{X} \leq 34.8$ and reject H_0 if $\overline{X} > 34.8$

(a) Find the probability that he makes a type I error. **(7 Marks)**

(b) If he uses an alternative hypothesis $H_1 : \mu = 39.2$, find the probability that he makes a type II error. **(7 Marks)**

(Total 20 Marks)

Question No. 6 (20 Marks)

(i) A man has Rs.1000/- to spend on prizes for 13 children. He can buy bags of nuts (Rs.60 each) and bags of sweets (Rs.80 each) and there must not be less than 6 of either sort and each of children must get at least one prize.

(a) Derive a set of inequalities satisfying the given conditions to formulate a linear programming problem. **(3 Marks)**

(b) Sketch the feasibility region. **(4 Marks)**

(c) How can the money be spent? **(4 Marks)**

(d) What is the largest number of bags he can buy? **(1 Mark)**

(ii) A firm has an annual demand of 9000 units, ordering cost of Rs. 1500 per order, carrying cost (holding cost) of Rs. 300 per unit per order, and the shortage cost of Rs 200 per unit. The daily demand averages 30 units per day with average lead time 3 days. The lead time demand is normally distributed with a standard deviation of 10 units.

(a) Find the economic order quantity. **(3 Marks)**

(b) Find the critical probability. **(3 Marks)**

(c) Find the reorder point. **(2 Marks)**

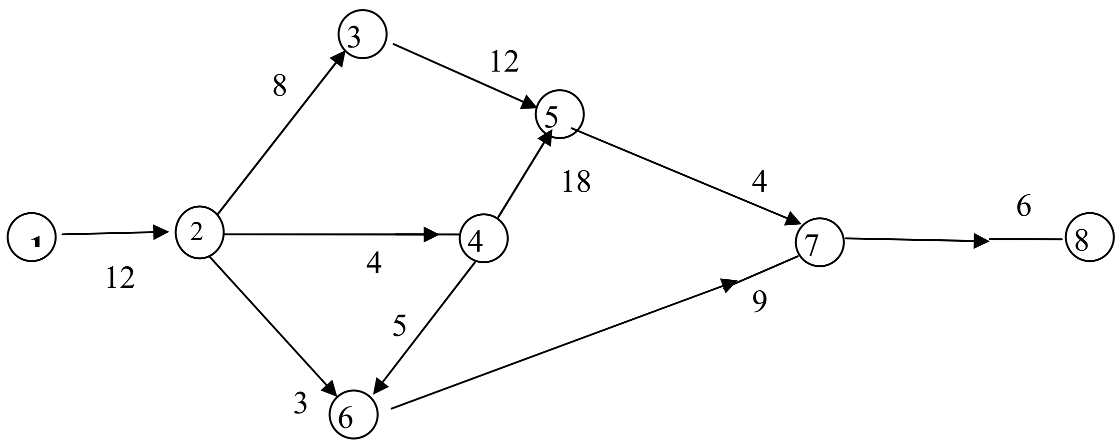
(Total 20 Marks)

Question No. 7 (20 Marks)

(i) The earliest start (ES) and latest start (LS) times for activity 6-7 of a network shown in the figure are 21 and 29 respectively.

(a) Determine ES and LS for all other activities of the network. **(12 Marks)**

(b) What is the critical path? **(4 Marks)**



(ii) Find the equation of the least square regression line for the points (0, 4), (1, 3), (2, 1) and (3, 2) **(4 Marks)**

(Total 20 Marks)

End of question paper

LIST OF FORMULAE

1) Continuous Compound Interest Formula:

$A = pe^{rt}$, where

P = amount invested, A = amount accumulated after t years, and i = 100, r = interest rate per year compounded continuously.

2) Bay's Theorem :

$$P(A_i / B) = \frac{P(B/A_i)P(A_i)}{\sum_{j=1}^{n} P(B/A_j).P(A_j)} \quad \text{where}$$

$A_{1,} A_2 ...., A_n$ are n mutually exclusive events of the same sample space S and B is an arbitrary event of S.

3) Poisson Distribution:

$$P(X = x) = \frac{e^{-\lambda}\lambda^x}{x!}; \ x= 0, 1, 2……,$$

Where λ is the mean of the distribution?

4) χ^2 - statistic for the Goodness of Fit:

$$X^2_{cal} = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \text{ , where}$$

n = number of classes of the distribution,
O_i = observed frequency of the its class, and
E_i = expected frequency of the its class.
Also degree of freedom = n-2 for Poisson fitting

5) Large Sample Test Statistic for Population Mean:

$$Z = \frac{\overline{X} - \mu}{\sigma/\sqrt{n}} \text{ , where}$$

μ = population mean, $\overline{X}$ = sample mean, σ =population standard deviation, and n = sample size

6) Exponential Probability :

P(x> a) = $e^{-\lambda a}$, where $\frac{1}{\lambda}$ = mean of the exponential distribution.

7) Economic Order Quantity:

$$Q = \sqrt{\frac{2DC_o}{C_h}}$$, where

D= annual demand, C_o = ordering cost per order, C_h =holding cost per unit per order, and Q= economic order quantity.

8) Critical Probability :

$$P = \frac{DC_s/Q}{C_h + DC_s/Q}$$, where

P = critical probability, C_s = shortage cost per order, D = annual demand, C_h = holding cost per unit per order and Q= economic order quantity

9) Reorder Point:

$R = D_d L + Z\sigma$ where

R= reorder point, D_d = daily demand, Z= Z – score of the critical probability and σ = standard deviation

10) Least Square Regression Line:

$Y = a_o + a_1 x$, where

$$a_1 = \frac{\Sigma x_i y_i - (\Sigma x_i)(\Sigma y_i)/n}{\Sigma x_i^2 - (\Sigma x_i)^2/n}$$ and

$$a_0 = (\Sigma y_i - a_1 \Sigma x_i)/n$$, where

n= number of points, x_i = x-coordinate of the its point, and y_i =y- coordinate of the its point.