MSTE-002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 2021

MSTE-002 : INDUSTRIAL STATISTICS-II

Time : 3 hours *Maximum Marks : 50*

Note :

(i) *Question no.* ***1*** *is* ***compulsory****. Attempt any* ***four*** *from the remaining questions no. 2 to 7.*

(ii) *Use of non-programmable scientific calculator is allowed.*

(iii) *Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.*

(iv) *Symbols have their usual meanings.*

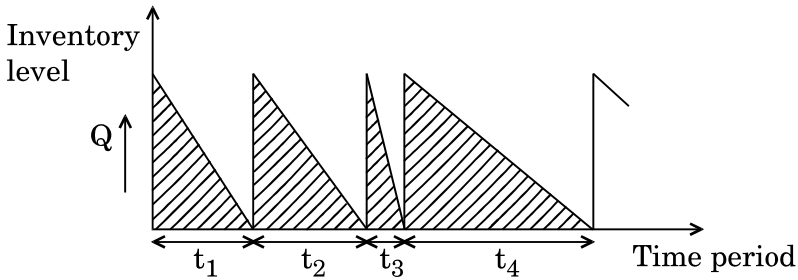
1. State whether the following statements are *True* or *False*. Give reasons in support of your answers. *5×2=10*

(a) In a regression model

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + e$$

if $H_0 : B_1 = 0$ and $H_0 : B_3 = 0$ are rejected and $H_0 : B_2 = 0$ is not rejected, then the variable X_2 will remain in the model.

(b) The following figure represents Economic Order Quantity (EOQ) model with uniform demand, and replenishment rate :



(c) The moving average method in time series removes the seasonal as well as irregular effects.

(d) If the basic solutions for a system of equations are (2, 0, -1), (0, 3·2, -2) and (0, 2, 3), then only (0, 2, 3) is feasible.

(e) In regression analysis, if $SS_{Reg} = 2{\cdot}84$ and $SS_{Res} = 4{\cdot}26$, then coefficient of determination is 0·4.

2. Use penalty (Big-M) method to solve the following LP problem : *10*

Maximize $z = 5x_1 + x_2$

subject to the constraints :

$5x_1 + 2x_2 \leq 20$

$x_1 \geq 3, x_2 \leq 5$

and $x_1, x_2 \geq 0$.

3. (a) A batch of five jobs can be assigned to five different machines. The time required (in hours) for each job on each machine is given in the following table :

Job \ Machine	M_1	M_2	M_3	M_4	M_5
J_1	10	5	13	15	16
J_2	3	9	18	13	6
J_3	10	7	2	2	2
J_4	7	11	9	7	12
J_5	7	9	10	4	12

Find an optimal assignment schedule of jobs to different machines which minimize the total set-up time. Also find the optimal total time. *7*

(b) Arrivals of the customers at a barber shop are considered to be Poisson with an average arrival rate 3 per hour. The service time is assumed to be distributed exponentially with mean 12 minutes. Find

(i) the probability that a person arriving at the shop will have to wait,

(ii) the average number of customers at the shop. *3*

4. A company wants to test the effect of age and gender on the productivity (in terms of units produced by the employees per month). The HR manager has taken a random sample of 10 employees and collected information given below :

Employee	Productivity (in units)	Age (in years)	Gender (0 for female and 1 for male)
1	35	40	1
2	26	34	0
3	25	28	0
4	36	34	1
5	30	38	0
6	21	26	1
7	26	31	1
8	36	38	1
9	27	31	1
10	25	31	0

Fit a regression model. Also estimate productivity of a male employee of 35 years. *10*

5. A company is interested in forecasting the demand for one of its products. The data on demand for the last 12 months are given below :

Month	Demand (in 100 units)
January	15
February	14
March	16
April	17
May	15
June	18
July	20
August	22
September	23
October	21
November	24
December	26

(i) Compute 3-monthly moving average.

(ii) Forecast the demand for all the months using exponential smoothing technique for $\omega = 0{\cdot}2$.

(iii) Plot the demands obtained in (i). *3+5+2*

6. (a) Write short notes on the following : *5*

(i) Residual Plot

(ii) Normal Probability Plot

(b) The following data give the time needed to process Jobs A and B on five machines M_1, M_2, M_3, M_4 and M_5, that is, for each machine. Calculate the total time required to complete both jobs. *5*

Job A :	Sequence	M_1	M_2	M_3	M_4	M_5
	Time (in hrs)	6	8	4	12	4

Job B :	Sequence	M_2	M_3	M_1	M_4	M_5
	Time (in hrs)	10	8	6	4	12

7. (a) Suppose a stationary time-series has 8 successive observations as follows :

140, 120, 130, 150, 100, 120, 150, 130

Calculate : *6*

(i) Autocovariances C_0, C_1, C_2, C_3 and C_4.

(ii) Autocorrelation coefficients r_1, r_2, r_3 and r_4.

(iii) Plot the Correlogram.

(b) The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is ₹ 36 and cost of carrying inventory is 25% of the investment cost in the inventories. The price of raw material is ₹ 10 per kg. Find the economic lot size to be ordered and the total minimum cost. *4*