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MSTE–002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2025

MSTE-002 : INDUSTRIAL STATISTICS—II

Time : 3 Hours *Maximum Marks : 50*

Note : *(i) Question No.* ***1*** *is compulsory.*

(ii) Attempt any ***four*** *questions from the remaining question nos.* ***2*** *to* ***7****.*

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

(iv) Symbols have their usual meanings.

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

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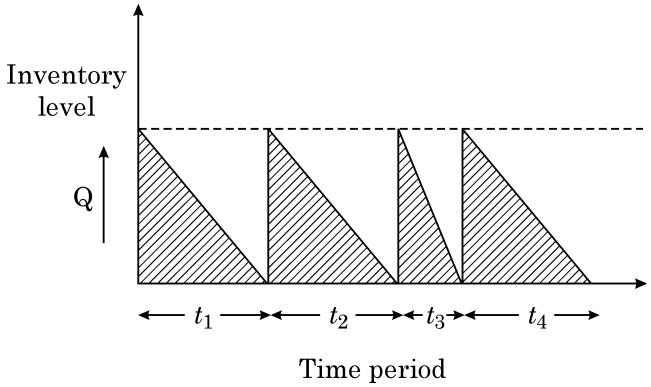
1. State whether the following statements are True *or* False. Give reasons in support of your answers : 5×2=10

   (a) If the arrival rate is 6 per hour and service rate is 8 per hour in M/M/1 model, then the probability of no customer in quere is 1/4.

   (b) If there are 3 variables and the basic solutions for these variables are (–2, 1, 0), (0, 2, 1), (0, 2, –1) and (1, 1, 1), then only (1, 1, 1) is feasible.

   (c) For testing regression coefficient, if the null hypothesis $H_0 : b = 0$ is accepted, then the regression line between the variables will be significant.

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



(e) The auto-regressive AR(2) model :

$$X_t = 0.70\ X_{t-1} - 0.60\ X_{t-2} + a_t$$

is stationary.

2. (a) Find the maximum value of following : 5

$$Z = 2x_1 + 3x_2$$

Subject to :

$$x_1 + x_2 \leq 30$$

$$x_2 \geq 3$$

$$x_2 \leq 12$$

$$x_1 - x_2 \geq 0$$

and $0 \leq x_1 \leq 20.$

(b) Find the basic feasible solution using Vogel's approximation method of the

following transportation problem in which the cells contain the transportation cost in rupees : 5

Warehouse / Factory	W_1	W_2	W_3	W_4	Capacity
F_1	42	48	38	37	160
F_2	40	49	52	51	150
F_3	39	38	40	43	190
Requirement	80	90	110	220	500

3. (a) A small garment making unit has five different types of garments. All five tailors are capable of stitching all five types of garments. The output per day per tailor and the profit (in rupees) for each type of garment are given as follows :

Tailor	Garment 1	2	3	4	5
A	7	9	4	8	6
B	4	9	5	7	8
C	8	5	2	9	8
D	6	5	8	10	10
E	7	8	10	9	9

Find which type of garment should be assigned to which tailor in order to maximize the profit, assuming that there are no other constraints. 6

(b) There are 5 jobs each of which has to go through both machines X and Y in the order XY. The processing times (in hours) are given as :

Job	A	B	C	D	E
Machine X	2	4	5	7	1
Machine Y	3	6	1	4	8

Determine a sequence of these jobs that will minimize the total elapsed time T. Also, obtain the total minimum elapsed time and the idle time for each machine. 4

4. A PGDAST student is interested in developing a linear model for the electricity consumption of a household during summer. For this purpose, he selects 10 houses and records the electricity consumption (in kWh); size of house (in square feet) and a

variable AC, which indicate I for presence and 0 for absence of AC. The data obtained is as follows :

Unit (in kWh)	Area (in sq. feet)	AC	Unit (in kWh)	Area (in sq. feet	AC
510	520	0	840	850	1
840	550	1	770	900	0
965	750	1	1000	850	1
610	1050	1	850	1200	0
900	1000	0	450	550	0

Fit a regression model. Also, estimate the electricity consumption for a household, whose house size is 1200 square feet and having AC. 10

5. Suppose a stationary time series has 8 successive observations as follows : 10

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

Calculate :

(i) The autocovariances C_0, C_1, C_2, C_3 and C_4

(ii) The autocorrelations r_1, r_2, r_3 and r_4

(iii) Plot the correlogram

6. (a) A mobile company is manufacturing mobile phones since 2017. The data of manufactured mobile phones (in '000) for the period 2017 to 2022 is given below : 6

Year	**Manufactured Mobile Phones**
2017	15
2018	20
2019	18
2020	16
2021	20
2022	22

Compute the exponentially smoothed series of manufactured mobile phones, using the smoothing coefficient as 0.4. Also calculate forecast error and plot the original and smoothed values.

(b) The customers arrive at a barber shop according to Poisson process with an arrival rate 3 per hour. The service time is assumed to be exponentially distributed with mean 12 minutes. 4

Find :

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

(ii) expected queue length.

(iii) average waiting time of the customers at the shop.

7. (a) Define the following : 2+3

(i) Residual plots

(ii) Assumptions in the regression analysis

(b) What is convex set, show that the set

$S = \{(x, y) : 0 \leq y \leq 5$ when $0 \leq x \leq 2$ and $3 \leq y \leq 5$ when $2 \leq x \leq 7\}$

is not a convex set. 5

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