No. of Printed Pages : 7 **MSTE-002**

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 2022

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 calculator (non-programmable) is allowed.*

(*iv*) *Use of Formulae and Statistical Tables booklet for PGDAST is allowed.*

(*v*) *Symbols have their usual meanings.*

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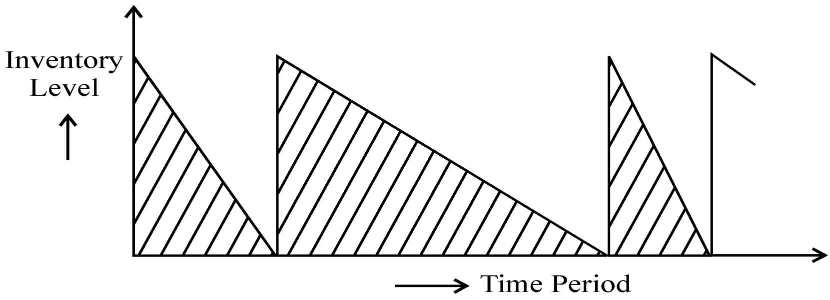
1. State whether the following statements are True *or* False. Give reasons in support of your answer : 5×2=10

(a) For the following set of equations, the possible number of basic solution is 6 :

$$x_1 + 2x_2 + 3x_3 + 4x_4 = 5$$

$$4x_1 + 3x_2 + 2x_3 + x_4 = 1$$

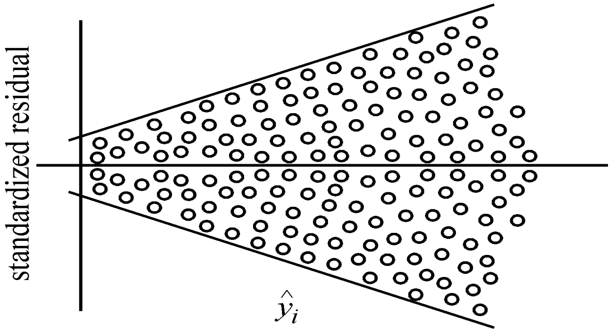
(b) The inventory model given below shows that the demand is uniform :



(c) In forward method of selection of variables in regression analysis, each time a new variable is entered into the model and all previous variables in the model are checked for continued importance.

(d) In ratio to trend method of seasonal component analysis, we find the trend by moving average method.

(e) If a researcher obtained a residual plot as given below :



then we can say that there exists an error in the regression calculation.

2. (a) A manufacturer produces two different models : X and Y, of the same product. Model X makes a contribution of ₹ 50 per unit and model Y, ₹ 30 per unit towards total profit. Raw materials r_1 and r_2 are required for production. At least 18 kg of r_1 and 12 kg of r_2 must be used daily. Also, at most 34 hours of labour are to be utilized. A quantity of 2 kg of r_1 is needed for model X and 1 kg of r_1 for model Y. For each of X and Y, 1 kg of r_2 is required. It takes 3 hours to manufacture model X and 2 hours to manufacture model Y. How many units of each model should be produced to maximize the profit ? 7

(b) Find all basic solutions for the system of equations : 3

$$x_1 + 2x_2 + x_3 = 4$$

$$2x_1 + x_2 + 5x_3 = 5$$

3. (a) A department has five employees with five jobs to be performed. The time (in hours) each man will take to perform each job is given in the following effectiveness matrix :

		Employee				
		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated so as to minimize the total man-hours ? 7

(b) A road transport company has one reservation clerk on duty at a time. He handless information of bus schedules and makes reservations. Customers arrive according to Poisson distribution with rate of 8 per hour and the clerk can service 12 customers on an average per hour : 3

(i) What is the probability that the clerk being idle ?

(ii) Find the average number of customers waiting for the service in the system.

4. Using the data given in the following table, find the regression coefficients and fit the regression equation :

(where X_2 indicates types of machines : A and B)

Y	X_1	X_2
10	30	A
10	20	A
20	50	A
15	10	B
15	10	B
10	10	B
20	30	B
25	40	B
30	80	A
15	20	B
20	10	B
10	40	A

Also find the regression equations for each machine. 10

5. Apply the ratio to moving average method for calculating the seasonal indices for the time series data of production of a commodity (in thousand) of a firm :

	Q_1	Q_2	Q_3	Q_4
2015	480	410	600	650
2016	580	520	680	740
2017	600	560	750	780
2018	630	590	800	840

Also find deseasonalised values. 10

6. (a) Consider an AR (2) process given by :

$$X_t = X_{t-1} - 0.5X_{t-2} + a_t$$

Verify whether the series is stationary or not. Also find ρ_1 and ρ_2. 4

(b) Find an initial basic feasible solution for given transportation problem by using Vogel's approximation method : 6

	D_1	D_2	D_3	D_4	Supply
S_1	11	13	17	14	250
S_2	16	18	14	10	300
S_3	21	24	13	10	400
Demand	200	225	275	250	

7. (a) It is given that :

$\bar{X} = 6.97, SS_x = 6.40, \; n = 10, \; \sigma^2 = 5.42,$
$SS_{xy} = 61.81$

On the basis of the above information :

(i) Find Var $\hat{a}$ and Var $\hat{b}$.

(ii) Test the hypothesis at 5% level of significance :

$H_0 : b = 8$ against $H_1 : b \neq 8.$ 6

(b) Find the sequence that minimizes the total elapsed time required to complete the following tasks on two machines :

Task	Machine I	Machine II
1	5	2
2	7	6
3	3	7
4	4	5
5	6	9

Also calculate the idle time on Machine I and Machine II. 4