No. of Printed Pages : 7

MSTE-001

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 2021

MSTE-001 : INDUSTRIAL STATISTICS-I

Time : 3 hours *Maximum Marks : 50*

Note :

(i) Question no. ***1*** *is* ***compulsory****.*

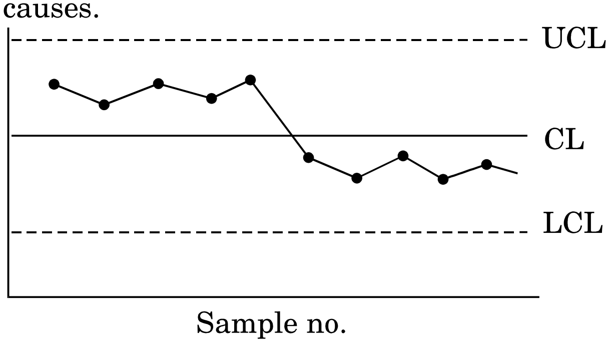
(ii) Attempt any ***four*** *questions from the remaining questions 2 to 7.*

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

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

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

(a) From the control chart given below, we can conclude that the process has only chance causes.



(b) The OC curve for a sampling plan is a graph of the probability of rejecting a lot versus the proportion of defective units in the lot.

(c) For two-person zero-sum game having the following payoff matrix for player A :

		Player B		
		B_1	B_2	B_3
Player A	A_1	1	2	6
	A_2	4	7	2
	A_3	3	5	10

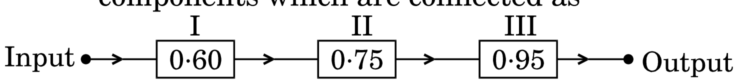
Then the first row is dominated by the third row.

(d) In decision making process, if a vendor of newspapers has the following information :

No. of Newspapers Demanded	300	400	500	600
No. of Days	40	100	40	20

Then the process of decision making is "decision making under certainty".

(e) If a reliability engineer has a system of three components which are connected as



then to improve the reliability of the system, he/she should concentrate to improve the reliability of the III component.

2. The branch manager of a bank wanted to study the waiting times of customers for issuing the Demand Draft during the peak hours (11 AM to 1.30 PM). Random samples of 4 customers were selected for 10 days and time (in minutes) was measured when each customer entered in the queue to when he/she began to be served. The results are given below :

Sample No.	Time			
	X_1	X_2	X_3	X_4
1	18	16	16	15
2	18	16	20	18
3	15	18	19	12
4	18	18	20	15
5	16	16	18	16
6	20	15	16	16
7	20	25	19	20
8	16	16	17	16
9	18	18	18	17
10	15	16	17	18

(i) Construct suitable control charts for variability as well as average time.

(ii) Draw conclusions about the process.

(iii) If process is out-of-control, calculate the revised control limits. *10*

3. (a) A manufacturer of men's jeans purchases zippers in lots of 1000. A single sampling plan with sample size 15 is used and it is decided that if more than 2 zippers are found defective, the lot will be rejected. It is also decided that AQL = 0·04 and LTPD = 0·12. If there are 5% defective zippers in each lot, calculate the

(i) Probability of accepting the lot

(ii) Producer's risk

(iii) Consumer's risk

(iv) Average Outgoing Quality (AOQ), under acceptance and rectifying sampling plans. *2+2+1+1*

(b) Describe OC curve. *4*

4. A two-person zero-sum game has the following payoff matrix for player A :

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	3	2	4	1
	A_2	3	4	2	4
	A_3	4	2	4	1
	A_4	1	4	1	4

Solve the game using dominance rules. Is the game fair ? *10*

5. (a) The failure probability density function of a component is given by

$$f(t) = 2e^{-2t};\ t > 0$$

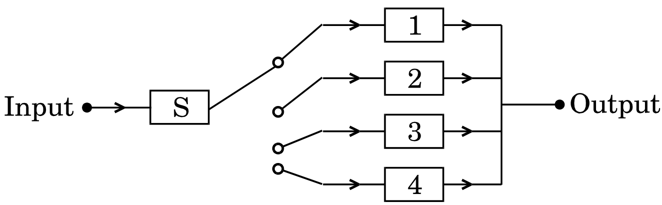
Find : *2+2+2*

(i) Reliability function

(ii) Failure rate

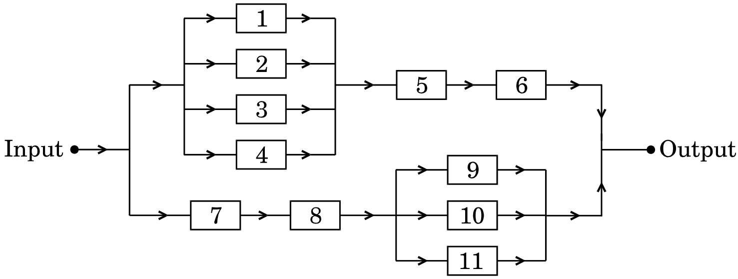
(iii) Mean time to failure

(b) A standby system has four components which are connected as shown in the figure given below :



where component 1 is normally operating and components 2, 3 and 4 are standby. The reliability of component 1 is 0·80. The reliability of component 2 given that component 1 has failed is 0·90. The reliability of component 3 given that components 1 and 2 have failed is 0·70 and that of component 4 given that components 1, 2 and 3 have failed is 0·60. Evaluate the reliability of the system by considering that the switch is perfect. *4*

6. (a) Evaluate the reliability of the system for which the reliability block diagram is shown in the figure given below :



Assume that components 9, 10 and 11 are not identical and at least two components of this group must be available for system success.

All other components are independent. The reliability of each is given as follows :

$R_1 = 0{\cdot}6$, $R_2 = 0{\cdot}6$, $R_3 = 0{\cdot}6$, $R_4 = 0{\cdot}6$,

$R_5 = 0{\cdot}7$, $R_6 = 0{\cdot}7$, $R_7 = 0{\cdot}8$, $R_8 = 0{\cdot}7$,

$R_9 = 0{\cdot}7$, $R_{10} = 0{\cdot}8$, $R_{11} = 0{\cdot}9$,

where R_i denotes the reliability of the i^{th} component (i = 1, 2, ..., 11). *6*

(b) The following data give the payoff values (in thousand rupees) representing profits of a company :

State of Nature	Course of Action		
	A_1	A_2	A_3
N_1	1500	1800	2500
N_2	2400	1600	2000
N_3	1200	2000	3000

Identify the optimum course of action under each of the following approaches : *4*

(i) Optimistic

(ii) Pessimistic

7. (a) A manufacturing process produces a certain type of bolts of average diameter 2 cm with an S.D. of 0·06 cm. Calculate the process capability. If the specification limits are $2{\cdot}0 \pm 0{\cdot}05$, is the manufacturing process capable of meeting the specification requirements ? *3*

(b) A manufacturer of buttons produces lots of 1000 buttons for shipment. A buyer uses a double sampling plan with $n_1 = 5$, $c_1 = 0$, $n_2 = 20$, $c_2 = 2$ to test the quality of the lots. If the incoming lot quality is 0·04, what is the probability of accepting the lot on

(i) the first sample ?

(ii) the second sample ? *2+5*