No. of Printed Pages : 7 **MSTE-001**

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2017

00871

MSTE-001 : INDUSTRIAL STATISTICS I

Time : 3 hours *Maximum Marks : 50*

Note :

(i) *All questions are **compulsory**. Questions no. 2 to 5 have internal choices.*

(ii) *Use of scientific calculator is allowed.*

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

(iv) *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 answers. *5×2=10*

(a) The variation due to chance causes in the diameter of ball bearing is not tolerable.

(b) The process capability of a manufacturing process of a certain type of bolt, with mean diameter 2 inches and standard deviation 0·05 inches, will be 0·30.

(c) If the probability of accepting a lot of satisfactory quality is 0·9401, then the producer's risk will be 0·9401.

(d) Hurwicz criterion is a method to solve the problems that involve decision-making under certainty.

(e) Two independent components of a system are connected in parallel configuration. If the reliabilities of these components are 0·6 and 0·7 respectively, the reliability of the system will be 0·42.

2. A factory producing dry-cells wanted to test the life of cells produced daily. The cells will be considered satisfactory if their life is 25 hours. For this, a sample of 5 cells was drawn on 12 consecutive days. The results are as follows :

Days	Life of Cells (in hours)				
	1	2	3	4	5
1	27·0	28·0	25·5	26·5	23·0
2	23·5	27·5	26·0	27·0	29·0
3	27·5	27·0	28·0	26·5	24·5
4	28·0	26·5	27·5	28·5	27·0
5	27·5	24·5	25·0	26·0	27·5
6	26·5	26·0	27·0	27·5	26·0
7	21·0	22·0	28·0	26·5	25·0
8	25·5	24·5	25·0	27·5	27·5
9	28·0	26·5	30·0	29·5	27·0
10	25·0	27·0	26·5	24·5	23·0
11	22·0	26·5	27·5	23·5	25·5
12	26·0	28·0	27·0	30·0	29·0

Check whether the process mean and variability are under statistical control, using suitable control charts. Also, compute revised control limits if the process is out-of-control. *10*

OR

(a) Sixteen boxes of electric switches each containing 20 switches were randomly selected from a lot of switch boxes and inspected for the number of defects per box. The number of defects per box were as follows :

12, 15, 9, 14, 18, 26, 8, 6, 11, 12, 16, 13, 13, 19, 18, 14, 21

Draw a suitable control chart and state whether the process is under statistical control or not.

(b) A TV voltage stabilizer manufacturer checks the quality of 50 units of his product daily for 15 days and finds the fraction of non-conforming units as follows :

Day	Fraction Defective
1	0·10
2	0·20
3	0·06
4	0·04
5	0·16
6	0·02
7	0·08
8	0·06
9	0·02
10	0·16
11	0·12
12	0·14
13	0·08
14	0·10
15	0·06

Construct the appropriate control chart and state whether the process is under statistical control or not. *5+5*

3. A leather bag manufacturing company supplies bags in lots of size 150 to a buyer. A single sampling plan with n = 10 and c = 1 is being used for the lot inspection. The company and the buyer decide that AQL = 0·08 and LTPD = 0·16. If there are 15 defective bags in each lot, compute the

(a) probability of accepting the lot,

(b) producer's risk and consumer's risk,

(c) AOQ, if the rejected lots are screened and all defective bags are replaced by non-defectives, and

(d) average total inspection. *2+4+2+2*

OR

A manufacturer of computer chips produces lots of 1000 chips for shipment. A buyer uses a double sampling plan with $n_1 = 5$, $c_1 = 0$, $n_2 = 20$, $c_2 = 5$ to test the quality of the lots. If the incoming quality of the lot is 0·03, calculate the

(a) probabilities of accepting the lot on the first and second samples,

(b) probability of accepting the lot,

(c) AOQ, if the rejected lots are screened and all defective chips are replaced by non-defectives, and

(d) average total inspection. *6+1+1+2*

4. A glass factory specialised in crystals is developing a substantial backlog and the firm's management is considering three courses of action : Arrange for sub-contracting (S_1), begin overtime production (S_2), and construct new facilities (S_3). The correct choice depends largely upon future demand which may be low, medium or high. By consensus, the management ranks the respective probabilities as 0·10, 0·50 and 0·40. A cost analysis reveals effect upon the profits shown in the following table :

Demand	Probability	Course of Action		
		S_1	S_2	S_3
Low (L)	0·10	10	– 20	– 150
Medium (M)	0·50	50	60	20
High (H)	0·40	50	100	200

Show this decision situation in the form of a decision tree and indicate the most preferred decision and corresponding expected value. *10*

OR

(a) A company management and the labour union are negotiating a new three-year settlement. Each of these has 4 strategies. The costs to the company are given for every pair of strategy choice as follows :

Union Strategies	Company Strategies			
	I	II	III	IV
I	20	15	12	35
II	25	14	8	10
III	40	2	10	5
IV	– 5	4	11	0

(i) What strategy will the two sides adopt ?

(ii) Determine the value of the game.

(iii) Obtain the saddle point.

(iv) Is the game strictly determinable and fair ?

(b) In a game of matching coins with two players, suppose A wins one unit of value when there are two heads, wins nothing when there are two tails and looses 1/2 unit of value when there is one head and one tail. Then determine

(i) the payoff matrix,

(ii) the best strategies for each player, and

(iii) the value of the game to A. *5+5*

5. The density function of the time-to-failure in years of a particular component is given by :

$$f(t) = \frac{100}{(t+10)^3}; \; t \geq 0.$$

Calculate : *10*

(a) Reliability of the component

(b) Reliability after 2 years of operation

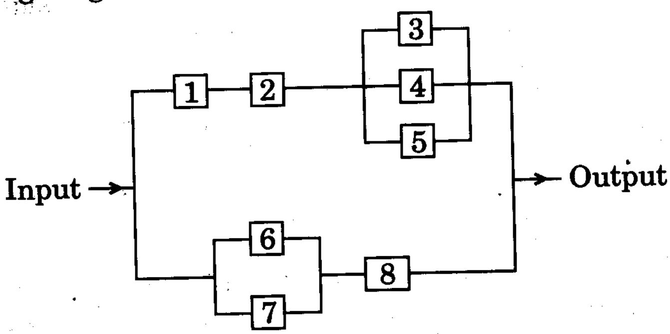
(c) Mean time to failure

(d) Failure rate

(e) Life of the component if a reliability of 0·45 is desired

OR

Evaluate the reliability of the system for which the reliability block diagram is shown in the figure given below :



Assume that all components are independent and the reliability of each component is given as follows :

$R_1 = 0{\cdot}7$, $R_2 = 0{\cdot}8$, $R_3 = 0{\cdot}6$, $R_4 = 0{\cdot}55$,

$R_5 = 0{\cdot}5$, $R_6 = 0{\cdot}6$, $R_7 = 0{\cdot}7$ and $R_8 = 0{\cdot}95$,

where R_i denotes the reliability of the i^{th} component, (i = 1, 2, 3, ..., 8). *10*