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MSTE-001

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2020

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 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 answers : 5×2=10

(a) If process capability is greater than tolerance, then process is capable of producing products of desired specification whether it is under statistical control or not.

(b) The specification limits and natural tolerance limits are same in statistical quality control.

(c) In rectifying sampling plan, if the acceptance criteria are not satisfied, then we reject the lot.

(d) In game theory, if a player has optimum strategy (2/5, 0, 3/5), then it is a mixed strategy.

(e) A parallel system fails when a component has failed.

2. (a) A dairy product manufacturing company uses automatic machines to fill 500 ml flavoured milk packets. A quality control inspector collects 10 samples each of four packets randomly at different times and

measures the volume of each filled packet. The observed data are given below :

Sample No.	Volume (in ml)			
	Obs. 1	Obs. 2	Obs. 3	Obs. 4
1	497	495	500	510
2	505	505	502	502
3	499	500	500	498
4	500	510	500	498
5	505	500	502	502
6	510	515	510	505
7	498	500	500	500
8	490	495	490	500
9	499	500	500	498
10	500	500	500	500

Test whether the process is under statistical control with respect to the average volume of milk packets. if the process is out-of-control, calculate the revised centre line and control limits and also plot the chart. 7

(b) What are the differences between control charts for variables and attributes ? 3

3. Suppose a consumer receives lots of 500 LED bulbs from a new supplier. To check quality of lot, the consumer draws a random sample of 20 LED bulbs and accepts the lot if at most 2 bulbs are defectives, otherwise the lot is refected :

(i) Construct the OC curve.

(ii) If AQL = 0.05 and LTPD = 0.10, find producer's and consumer's risks.

(iii) If incoming lot quality is 4%, find AOQ under acceptance as well as rectifying sampling plan. 5+3+2

4. The manager of a flower shop promises its customers to deliver all flower orders within four hours. The daily demand for roses is as follows :

Dozens of roses	Probability
70	0.1
80	0.2
90	0.4
100	0.3

The manager purchases roses for ₹ 20 per dozen and sells them for ₹ 50 per dozen. All unsold roses are donated to a local hospital. How many dozens of roses should the manager order each day to maximize the profit ? What is the optimum expected profit ? 10

5. (a) If probability density function of time to failure (in hours) of an appliance is :

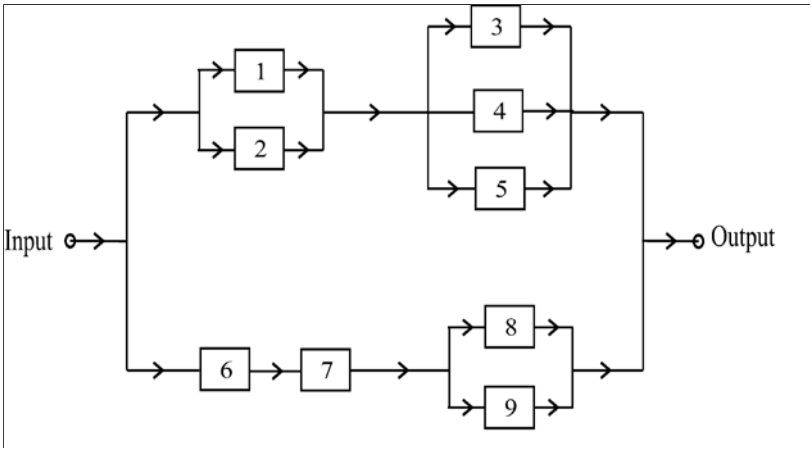
$$f(t) = \frac{1}{(t+1)^3}; t > 0$$

then find : 2+2

(i) Reliability function

(ii) Failure rate

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



Assume that components 3, 4 and 5 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 component is given as follows :

$R_1 = 0.7$, $R_2 = 0.8$, $R_3 = 0.6$

$R_4 = 0.6$, $R_5 = 0.9$, $R_6 = 0.7$

$R_7 = 0.8$, $R_8 = 0.9$, $R_9 = 0.7$,

where R_i denotes the reliability of the ith component ($i = 1, 2, ...9$). 6

6. (a) A two-person zero-sum game has the following pay-off matrix for player A :

		Player B		
		B_1	B_2	B_3
Player A	A_1	1	7	2
	A_2	6	2	7
	A_3	5	1	6
	A_4	4	2	5

(i) Does there exist a saddle point ? 2

(ii) Obtain the optimal strategy for players A and B. 4

(iii) Find value of the game. 1

(b) Differentiate between single and double sampling plans. 3

7. (a) A quality controller of a tennis ball manufacturing company selects 15 random samples, each of size 50 balls drawn from time to time. Each ball is ispected for defects. After the inspection, the following data are obtained :

Sample No.	Proportion Defectives
1	0.10
2	0.04
3	0.08
4	0.02
5	0.01
6	0.05
7	0.01
8	0.15

9	0.06
10	0.05
11	0.12
12	0.02
13	0.06
14	0.02
15	0.01

Estimate the proportion defective of the process. Does the process appear to be under statistical control with respect to the proportion of defective balls ? 6

(b) Define the reliability and hazard rate. 4