No. of Printed Pages : 7

MSTE-001

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

01275

June, 2018

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 controllable.

(b) The process capability of an automatic machine for which 25 samples each of size 4 are selected, having the values of $\Sigma \overline{X} = 525$ and $\Sigma R = 30$, will be 3·50.

(c) If the probability of accepting a lot of unsatisfactory quality is 0·7358, then the consumer's risk will be 0·2642.

(d) Laplace Criterion suggests that the decision maker should neither be too optimistic nor too pessimistic.

(e) Two independent components of systems are connected in parallel configuration. If the reliabilities of these components are 0·6 and 0·7, respectively, the unreliability of the system will be 0·88.

2. An analyst collects seven samples each consisting of 20 observations during a production shift. She measures and records the weight in ounces of each part. She calculates the mean and standard deviation for each sample as follows :

Sample No.	$\overline{X}$	SD
1	1·001	0·014
2	1·000	0·010
3	1·010	0·008
4	1·005	0·010
5	1·010	0·005
6	1·001	0·016
7	1·004	0·007

Using $\overline{X}$ and S-Charts, draw conclusion about the process. If process is out of control, calculate the revised control limits to bring the process under statistical control. *10*

OR

(a) An analyst takes 10 samples of bean bags from a production line over a shift. The number of minor defects in each sample is recorded as follows :

Sample	1	2	3	4	5	6	7	8	9	10
No. of Defects	4	7	2	8	6	3	5	4	2	6

(i) Which control chart should be used in this case ?

(ii) Calculate the control limits for this chart.

(iii) Draw the control chart. Are these data from a controlled process ? *1+1+3*

(b) An analyst collects 10 samples of 50 observations during a production shift. The number of defective units in each sample is determined and recorded as follows :

Sample	1	2	3	4	5	6	7	8	9	10
No. of Defective Units	5	3	7	2	1	4	10	4	1	6

Construct the appropriate control chart and state whether the process is under statistical control. *5*

3. A toy manufacturing company supplies toys in lots of size 400 to the buyer. A single sampling plan with n = 15 and c = 0 is being used for the lot inspection. The supplier and the buyer's quality control inspector decide that AQL = 0·01 and LTPD = 0·10, then

(a) Compute the producer's risk and consumer's risk for this plan.

(b) If the rejected lots are screened and all defective toys are replaced by non-defective toys, construct the AOQ curve. *4+6*

OR

(a) Differentiate between single and double sampling plans.

(b) A manufacturer of LED bulbs produces lots of 100 bulbs. A buyer uses a double sampling plan with $n_1 = 5$, $c_1 = 0$, $n_2 = 15$ and $c_2 = 1$ to test the quality of the lots. Given that the incoming quality of a lot is 0·02. Calculate the probabilities of accepting the lot on the first sample and on the second sample. Also calculate, what is the probability of final acceptance ? *3+7*

4. The manager of a flower shop promises its customers delivery within four hours on all flower orders. All flowers are purchased on the previous day and delivered to the customer by 8·00 am the next morning. The daily demand for roses is as follows :

Dozens of Roses	70	80	90	100
Probability	0·1	0·2	0·4	0·3

The manager purchases roses for ₹ 10 per dozen and sells them for ₹ 30. All unsold roses are donated to a local hospital. How many dozens of roses should a customer order each evening to maximise its profits ? What is the optimum expected profit ? *10*

OR

Two breakfast food manufacturers, ABC and XYZ are competing for an increased market share. The payoff matrix, shown in the following table, describes the increase in market share for ABC and decrease in market share for XYZ.

ABC	XYZ			
	B_1	B_2	B_3	B_4
A_1	2	– 2	4	1
A_2	6	1	12	3
A_3	– 3	2	0	6
A_4	2	– 3	7	1

Determine optimal strategies for both the manufacturers and the value of the game. *10*

5. The failure data for 1000 devices are shown in the following table : *10*

Operating time (in hours)	No. of Failures
0–10	207
10–20	175
20–30	148
30–40	120
40–50	105
50–60	67
60–70	50
70–80	74
80–90	35
90–100	19

Estimate :

(a) Reliability,

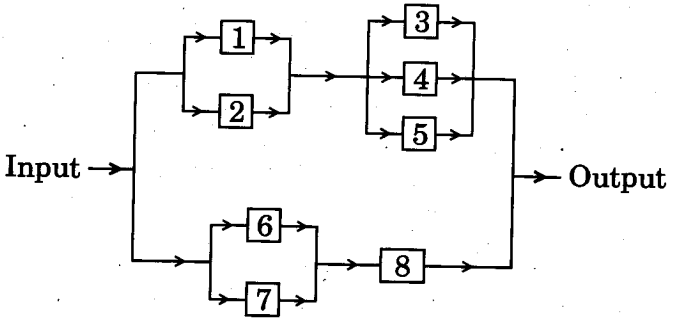
(b) Cumulative failure distribution,

(c) Failure density, and

(d) Hazard function.

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*