KCG
COLLEGE OF TECHNOLOGY
Affiliated to Anna University
AUTONOMOUS

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023
I Year, 2ndSemester
23MA204-PROBABILITY AND STATISTICS
(Regulation 2023)
QUESTION BANK

Q.No	Part A- Questions	CO's	Bloom 's Level
1.	A bag contains 3 red, 6 white and 7 black balls, Find out the probability that two balls drawn are red and white?	CO1	K2
2.	Derive the moment generating function of the distribution given by $f(x) = \gamma e^{-\gamma x}, x > 0.$	CO1	K2
3.	For a binomial distribution, mean is 2 and variance is 4/3.Find out the first term of the distribution	CO1	K2
4.	State any two properties of probability mass function	CO1	K1
5.	Let X be a random variable with E(X)=1, E[X(X-1)]= 4. Find Var(X), Var(3-2X).	CO1	K3
6.	If the r.v has the mgf $M_x(t) = \frac{2}{2-t}$, determine the variance of X.	CO1	K3
7.	If the probability that a target is destroyed on any one shot is 0.5, calculate the probability that it would be destroyed on 6th attemp	CO2	K2
8.	A continuous random variable X has the density function $f(x) = 3x^2, 0 \le x \le 1$, *find* α *such that* $P(X \le \alpha) = P(X > \alpha)$.	CO1	K2
9.	One percent of jobs arriving at a computer system need to wait until weekends for scheduling, owing to core-size limitations. Calculate the probability that among a sample of 200 jobs there are no jobs that have to wait until weekends.	CO1	K2
10.	The number of monthly breakdown of a computer is a r.vhaving a Poisson distribution with mean equal to 1.8. calculatethe probability that this computer will function for a month with only one breakdown.	CO2	K2
11.	If X is a Uniformly distributed r.v with mean 1 and variance $\frac{4}{3}$, Determine P(X<0)..	CO2	K2
12.	The time required to repair a machine is exponentially distributed with parameter $\lambda = \frac{1}{2}$. Calculate the conditional probability that a repair takes at 11h given that its direction	CO2	K2

<table>
<tr><td></td><td>exceeds 8h?</td><td></td><td></td></tr>
<tr><td>13.</td><td>If X and Y are independent binomial variates following $B\left(5,\frac{1}{2}\right)$ and $B\left(7,\frac{1}{2}\right)$ respectively. Determine $P[X+Y=3]$.</td><td>CO2</td><td>K2</td></tr>
<tr><td>14.</td><td>If a r.v ‘X’ is uniformly distributed over (-3,3), then compute P (| X – 2 | < 2).</td><td>CO2</td><td>K2</td></tr>
<tr><td>15.</td><td>If a random variable X takes values 1, 2, 3, 4 such that 2P(X=1) = 3P(X=2) = P(X=3) = 5P(X=4). Determine the probability distribution of X</td><td>CO2</td><td>K2</td></tr>
<tr><td colspan="4">BAYES THEOREM</td></tr>
<tr><td>1</td><td>Four boxes A,B,C,D contain fuses.The boxes contain 5000,3000,2000 and 1000 fuses respectively.The percentage of fuses in boxes which are defective are 3%,2%,1% and 0.5% respectively.One fuse is selected at random from one of the boxes.It is found to be defective fuse.Find the probability that it has come from box D.</td><td>CO1</td><td>K3</td></tr>
<tr><td>2</td><td>The members of a consulting firm rent cars from rental agencies.A,B and C as 60%,30% and 10% respectively,If 9%,20% and 6% of cars from A,B and C agencies need tune up
(a) If a rental car delivered to the firm does not need tune up what is the probability that it came from B agency
(b) If a rental car delivered to the firm need tune up what is the probability that came from B agency.</td><td>CO1</td><td>K3</td></tr>
<tr><td>3</td><td>There are 3 boxes containing respectively,
1 white 2 red, 3 black balls; 2 white, 3 red and 1 black balls;
3 white, 1 red and 2 black balls. A box is chosen at random and from it two balls are drawn at random. The two balls are 1 red and 1 white. What is the probability that they came from second box?</td><td>CO1</td><td>K3</td></tr>
<tr><td></td><td>RANDOM VARIABLE/MEAN/VARIANCE</td><td></td><td></td></tr>
<tr><td>4</td><td>If the discrete random variable X represents the maximum of the two numbers shown up when two dice are thrown. Find the probability of x</td><td>CO1</td><td>K3</td></tr>
<tr><td>5</td><td>The number of telephone calls received at an office has the probability function as given below
<table>
<tr><td>No of calls (x)</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>P(x)</td><td>0.05</td><td>0.20</td><td>0.25</td><td>0.20</td><td>0.15</td><td>0.10</td><td>0.05</td></tr>
</table>
(i) Verify that it is probability function
(ii) Verify that there will be three or more calls
(iii) Find the probability that there will an odd number of</td><td>CO1</td><td>K3</td></tr>
</table>

<table>
<tr><td></td><td>calls.</td><td></td><td></td></tr>
<tr><td>6</td><td>A discrete RV has the probability function
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>P(x)</td><td>a</td><td>3a</td><td>5a</td><td>7a</td><td>9a</td><td>11</td><td>13a</td><td>15a</td><td>17a</td></tr>
</table>
(i) Find the value of a
(ii) P(x<3), P(0<x<3), P(x≥3)
(iii) Find the distribution function of x</td><td></td><td></td></tr>
<tr><td></td><td>If $P(X=x)=\frac{x}{15}$, x = 1,2,3,4,5
i) Find P(x=1 or x=2)
ii) P(1/2 < x < 5/2 / x>1)
iii) Distribution function of x
iv) Find E(X), E(2x-2),Var(x)</td><td>CO1</td><td>K3</td></tr>
<tr><td>7</td><td>A random variable X has the following probability function:
X : 0 1 2 3 4 5 6 7
$P(X)$: 0 K $2K$ $2K$ $3K$ K^2 $2K^2$ $7K^2+K$
Find (i) K , (ii) Evaluate $P(X<6), P(X\geq 6)$ and $P(0<X<5)$ (iii) Determine the distribution function of X . (iv) $P(1.5<X<4.5/X>2)$ (v) $E(3X-4)$, Var$(3X-4)$ (vi) If $P[X\leq C]>\frac{1}{2}$, find the minimum value of C.</td><td>CO1</td><td>K3</td></tr>
<tr><td>8</td><td>A random variable X has density function given by $f(x)=\begin{cases}2e^{-2x}; x\geq 0\\ 0 \quad ; x<0\end{cases}$. Find m.g.f of X</td><td>CO1</td><td>K3</td></tr>
<tr><td>9</td><td>The p.d.f of triangular distribution is given by $f(x)=\begin{cases}x, & 0<x<1\\ 2-x, & 1<x<2\\ 0, & x>2\end{cases}$.
Find the mean, variance and cumulative distribution of X.</td><td>CO1</td><td>K3</td></tr>
<tr><td>10</td><td>A continuous random variable X has the p.d.f $f(x)=kx^3e^{-x}$, $x\geq 0$. Find the rth order moment of X about the origin. Hence find m.g.f, mean and variance of X.</td><td>CO1</td><td>K3</td></tr>
<tr><td>11</td><td>The distribution function of a random variable X is given by $F(x)=1-(1+x)e^{-x}$, $x\geq 0$. Find the density function, mean variance of X</td><td>CO1</td><td>K3</td></tr>
<tr><td></td><td>STANDARD DISTRIBUTIONS-DISCRETE</td><td></td><td></td></tr>
<tr><td>12</td><td>Derive the MGF , Mean variance of Binomial distribution</td><td>CO2</td><td>K3</td></tr>
<tr><td>13</td><td>Derive the MGF , Mean variance of Poisson distribution</td><td>CO2</td><td>K3</td></tr>
<tr><td>14</td><td>Derive the MGF , Mean variance of Geometric distribution</td><td>CO2</td><td>K3</td></tr>
<tr><td>15</td><td>State and prove the memoryless property of Geometric</td><td>CO2</td><td>K3</td></tr>
</table>

	distribution		
16	Out of 800 families with 4 children each, how many families would be expected to have (i)2 boys and 2 girls (ii) at least 1 boy (iii) at most 2 girls and (iv) Children of both the genders. Assume equal probabilities for boys and girls.	CO2	K3
17	6 dice are thrown 729 times how many times would you expect to have at least 3 dice should show a five or six.	CO2	K3
18	If the probability that a target is destroyed in any one shot is 0.6. What is the probability that it should be destroyed on the 5^{th} attempt	CO2	K3
19	A die is thrown until 6 appears what is the probability that it must be thrown more than 4 times.	CO2	K3
20	The probability that a razor blade manufactured by a firm is defective is 1/500. Blades are supplied in packets of 5 each. In a lot of 10,000 packets, how many packets would (i) be free defective blades? (ii) contains exactly one defective blade?($e^{-0.01}$=0.99) Let X be the number of defective blades in a packet of 5 blades. Then, X is B (n = 5, p = 1/500)	CO2	K3
21	The number of accidents in a year attributed to taxi drivers in a locality follows Poisson distribution with an average 2. Out of 500 taxi drivers of that area, what is the number of drivers with at least 3 accidents in a year?	CO2	K3
22	The probability that a razor blade manufactured by a firm is defective is 1/500. Blades are supplied in packets of 5 each. In a lot of 10,000 packets, how many packets would (i) be free defective blades? (ii) contains exactly one defective blade?($e^{-0.01}$=0.99) Let X be the number of defective blades in a packet of 5 blades. Then, X is B (n = 5, p = 1/500)	CO2	K3
	STANDARD DISTRIBUTIONS-CONTINUOUS		
23	Find the mean,variance and mgf of Exponential distribution and	CO2	K3

	also prove the memoryless property.		
24	Find the mean,variance and mgf of Uniform Distribution	CO2	K3
25	Find the mean,variance and mgf of Normal Distribution	CO2	K3
26	Trains arrive at a station at 15 minutes interval starting at 4 a.m. If passengers arrive at a station at a time that is uniformly distributed between 9.00 a.m. and 9.30 a.m., find the probability that he has to wait for the train for (i) less than 6 minutes (ii) more than 10 minutes.	CO2	K3
27	The length of the shower in a tropical island in a rainy season has an exponential distribution with parameter 2, time being measured in minutes. What is the probability that it will last for at least one more minute?	CO2	K3
28	The Amount of time that a surveillance camera will run without having to be reset is a random variable having the exponential distribution with θ=50 days. Find the probabilities that a camera will: a. Have to be reset in less than 20 days b. Will not have to be reset in at least 60 days	CO2	K3
29		CO2	K3
30		CO2	K3

UNIT 5				
Q.No	**Part A- Questions**	**Marks**	**CO's**	**Bloom's Level**
1.	A garment was sampled on 10 consecutive hours of production. The number of defects found per garment is given below: Defects:5,1,7,0,2,3,4,0,3,2.Compute upper and lower control limits for monitoring number of defects.(Apr/May 2019)	2	6	K2
2.	When do we use X and R charts?	2	6	K1
3.	Define Tolerance limits	2	6	K1

4.	Define control chart	2	6	K1
5.	Define Statistical quality control:	2	6	K1
6.	What are attributes?	2	6	K2
7.	What are the types of control charts?	2	6	K2
8.	What are the control charts for variables: The control charts for variables:	2	6	K2
9.	Name any two advantages of control charts?	2	6	K2
10.	What is the procedure for drawing X-R charts:	2	6	K1
11.	What are the control limits for mean?	2	6	K1
12.	What are the tools used in statistical quality control?	2	6	K2
13.	Define p-chart.	2	6	K1
14.	Define C-chart.	2	6	K1
15.	The total number of defects in 20 pieces of cloth is 220. What are UCL and LCL?	2	6	K2

<table>
<tr><td>Q. No</td><td colspan="3">Introduction -SQC</td></tr>
<tr><td>1.</td><td>Write a short note on Statistical Quality Control</td><td>CO6</td><td>K3</td></tr>
<tr><td>2.</td><td>Write a short note on control charts</td><td>CO4</td><td>K3</td></tr>
<tr><td></td><td colspan="2">X AND R CHART</td><td></td></tr>
<tr><td>3</td><td>The following are the sample means and ranges for 10 samples each of size 5 . Construct the control chart for the mean and range and comment on the nature of the control.
<table>
<tr><td>Sample no</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Mea</td><td>12.8</td><td>13.1</td><td>13.5</td><td>12.9</td><td>13.2</td><td>14.1</td><td>12.1</td><td>15.5</td><td>13.9</td><td>14.2</td></tr>
</table></td><td>CO6</td><td>K4</td></tr>
</table>

	n $\bar{x}$												
	Range R	2.1	3.1	3.9	2.1	1.9	3.0	2.5	2.8	2.5	2.0		
4	The following are the sample means and ranges for 10 samples each of size 6 . Construct the control chart for the mean and range and comment on the nature of the control.											**CO6**	**K4**
	Sample no	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
	Mean $\bar{x}$	37.3	49.8	51.5	59.2	54.7	34.7	51.4	61.4	70.7	75.3		
	Range R	9.5	12.8	10	9.1	7.8	5.8	14.5	2.8	3.7	8.0		
5	The table given below gives the measurements obtained in 20 samples construct control charts for mean and the range Discuss the nature of the control.											**CO6**	**K4**
	Sample	Measured values											
		1	2	3	4								
	1	44	26	24	34								
	2	50	48	51	43								
	3	32	28	26	22								
	4	52	55	56	44								
	5	16	16	21	26								
	6	36	36	35	31								
	7	21	22	18	21								
	8	29	21	23	22								
	9	26	46	44	14								
	10	24	22	22	44								
6	The following data gives the readings for 8 samples of size 6 each in the production of a certain product. Find the control limits using mean chart. Given for n = 6, A_2 = 0.483,											**CO6**	**K4**
	Sample	1	2	3	4	5	6						
	Mean	300	342	351	319	326	333						
	Range	25	37	20	28	30	22						
7	The following data gives readings of 10 samples of size 6 each in the production of a certain product. Draw control chart for mean and range with its control limits.											**CO6**	**K4**
	Sample	1	2	3	4	5	6	7	8	9	10		
	Mean	383	508	505	582	557	337	514	614	707	753		
	Range	95	128	100	91	68	65	148	28	37	80		
	CONTROL CHART FOR ATTRIBUTES												
8.	In a company manufacturing cricket ball, the quality controller												

<table>
<tr><td></td><td>inspects the balls and classifies them as defective or non-defective on the basis of certain defects. The company manager wants to maintain the process so that an average of not more than 5 percent of the output is defective. Suggest a suitable control chart for this purpose. If the company can work with a sample of size 500, calculate the centre line and control limits for this chart.</td><td>CO6</td><td>K4</td></tr>
<tr><td>9.</td><td>A factory manufacturing small bolts. To check the quality of the bolts, the manufacturer selected 20 samples of same size 100 from the manufacturing process time to time. He/she visually inspected each selected bolt for certain defects. After the inspection, he/she obtained the following data:
<table>
<tr><td>Sample Number</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Proportion Defective</td><td>0.10</td><td>0.04</td><td>0.08</td><td>0.15</td><td>0.08</td><td>0</td><td>0.01</td><td>0.05</td><td>0.05</td><td>0.08</td></tr>
<tr><td>Sample Number</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>Proportion Defective</td><td>0.10</td><td>0</td><td>0.06</td><td>0.05</td><td>0.03</td><td>0.20</td><td>0.05</td><td>0.07</td><td>0.01</td><td>0.08</td></tr>
</table></td><td>CO6</td><td>K4</td></tr>
<tr><td>10</td><td>The following data are found during the inspection of the first 15 samples of size 100 each from a lot of two-wheelers manufactured by an automobile company. Draw the chart for fraction defective (p) and comment on the state of control. If the process is out-of-control, calculate the revised centre line and control limits by assuming assignable causes for any out-of-control point
<table>
<tr><td>Sample Number</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td>Number of Defectives</td><td>3</td><td>4</td><td>6</td><td>2</td><td>12</td><td>5</td><td>3</td><td>6</td><td>3</td><td>5</td><td>4</td><td>15</td><td>5</td><td>2</td><td>3</td></tr>
</table></td><td>CO6</td><td>K4</td></tr>
<tr><td>11</td><td>List the different types of control charts for attributes.</td><td>CO6</td><td>K3</td></tr>
<tr><td>12</td><td>A daily sample of 30 shirts was taken over a period of 15 days in order to monitor the manufacturing process of the shirts. Each shirt was inspected and classified as defective or non-defective. If a total of 22 defective shirts were found in 15 days, what should be the upper and lower control limits of the proportion of defective shirts?</td><td>CO6</td><td>K4</td></tr>
<tr><td>13</td><td>A mobile manufacturer inspects 30 mobiles at the end of the day of production and notes the number of defective mobiles. This procedure is continued up to 12 days and 2, 1, 3, 0, 2, 1, 0, 5, 2, 0,</td><td>CO6</td><td>K4</td></tr>
</table>

<table>
<tr><td></td><td>3, 1 defective mobile are found. Is the production process under control with respect to the proportion defective?</td><td></td><td></td></tr>
<tr><td>14</td><td>In the production of tyres of an automobile, the output of a given size was inspected every day prior to the tyres being given to finished goods stores. The number of defective tyres found every day inspection is summarised in the following table:
<table>
<tr><th>Number of Sample</th><th>Number of Tyres Inspected</th><th>Number of Defective Tyres</th><th>Number of Sample</th><th>Number of Tyres Inspected</th><th>Number of Defective Tyres</th></tr>
<tr><td>1</td><td>650</td><td>70</td><td>11</td><td>670</td><td>71</td></tr>
<tr><td>2</td><td>510</td><td>74</td><td>12</td><td>660</td><td>75</td></tr>
<tr><td>3</td><td>600</td><td>58</td><td>13</td><td>600</td><td>77</td></tr>
<tr><td>4</td><td>590</td><td>61</td><td>14</td><td>550</td><td>78</td></tr>
<tr><td>5</td><td>630</td><td>65</td><td>15</td><td>540</td><td>64</td></tr>
<tr><td>6</td><td>650</td><td>115</td><td>16</td><td>610</td><td>90</td></tr>
<tr><td>7</td><td>700</td><td>82</td><td>17</td><td>670</td><td>96</td></tr>
<tr><td>8</td><td>740</td><td>55</td><td>18</td><td>660</td><td>110</td></tr>
<tr><td>9</td><td>580</td><td>80</td><td>19</td><td>650</td><td>78</td></tr>
<tr><td>10</td><td>600</td><td>90</td><td>20</td><td>590</td><td>60</td></tr>
</table>
Draw the appropriate control chart and comment on the state of the process.</td><td>CO6</td><td>K4</td></tr>
<tr><td>15</td><td>To monitor the manufacturing process of laptops, a quality control engineer randomly selects 50 laptops from the production line, each day over a period of 20 days. The laptops are inspected for certain defects and the number of defective laptops found each day is recorded in the following table: Construct NP chart and state whether the process is in control.</td><td>CO6</td><td>K4</td></tr>
</table>

Day	Number of Laptops Inspected	Number of Defective Laptops	Day	Number of Laptops Inspected	Number of Defective Laptops
1	50	4	11	50	6
2	50	8	12	50	1
3	50	6	13	50	5
4	50	10	14	50	3
5	50	4	15	50	2
6	50	3	16	50	3
7	50	4	17	50	7
8	50	7	18	50	9
9	50	8	19	50	2
10	50	4	20	50	4

16	Construct a control chart for defectives for the following data **Sample no** 1 2 3 4 5 6 7 8 9 10 **No. Inspected** 90 65 85 70 80 80 70 95 90 75 **No. of defectives** 9 7 3 2 9 5 3 9 6 7										**CO6**	**K4**
17	A control chart is to be formed for a process in which laptops are produced. The inspection unit is one laptop and control chart for the number of defects is to be used. Preliminary data are recorded and 45 defects are found in 30 laptops. Obtain the control limits for the chart.										**CO6**	**K4**
18	A plant produces paper for newsprint and rolls of paper are inspected for defects. The result of inspection of 20 rolls of papers are given draw the control chart for the given data.19,10,8,12,15,22,7,13,18,13,16,14,8,7,6,4,5,6,8,9.											
19	A plant produces paper for newsprint and rolls of paper are inspected for defects. The result of inspection of 20 rolls of papers are given draw the control chart for the given data: 9,10,8,12,15,22,7,13,18,13,16,14,8,7,6,4,5,6,8,9.										**CO6**	**K4**
20	The number of scratch marks on a particular piece of furniture is recorded. The data for 20 samples are given below: Draw the appropriate control chart and write the comments about the state of the process when: i)the management sets a goal of 5 scratch marks on an average per piece. ii) the management does not set the average number of marks										**CO6**	**K4**

<table>
<tr><td></td><td>per piece.
<table>
<tr><td>Sample Number</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Scratch Mark</td><td>6</td><td>3</td><td>14</td><td>7</td><td>2</td><td>5</td><td>12</td><td>4</td><td>7</td><td>3</td></tr>
<tr><td>Sample Number</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>Scratch Mark</td><td>2</td><td>7</td><td>6</td><td>8</td><td>4</td><td>10</td><td>5</td><td>4</td><td>13</td><td>9</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>21</td><td>As part of an overall quality improvement programme, a textile manufacturer decides to monitor the number of defects found in each inspected bolt (large bundle) of cloth. The data from 20 inspections are recorded in the table given below:
<table>
<tr><td>Bolt of Cloth</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Number of Defects</td><td>10</td><td>19</td><td>5</td><td>9</td><td>2</td><td>8</td><td>7</td><td>13</td><td>3</td><td>2</td></tr>
<tr><td>Bolt of Cloth</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>Number of Defects</td><td>22</td><td>4</td><td>6</td><td>9</td><td>7</td><td>2</td><td>5</td><td>12</td><td>4</td><td>2</td></tr>
</table></td><td>CO6</td><td>K4</td></tr>
<tr><td>22</td><td>Write the applications of C chart.</td><td>CO6</td><td>K4</td></tr>
<tr><td></td><td>TOLERANCE LIMITS - ACCEPTANCE SAMPLING.</td><td></td><td></td></tr>
<tr><td>23</td><td>Explain Sampling plan concepts</td><td>CO6</td><td>K3</td></tr>
<tr><td>24</td><td>Explain the advantages and Limitations of sampling plan concepts</td><td>CO6</td><td>K3</td></tr>
<tr><td>25</td><td>Write a short note on tolerance limits.</td><td>CO6</td><td>K3</td></tr>
</table>