SNS COLLEGE OF ENGINEERING

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Probability and Statistics

UNIT I

PART A

1. State Baye's theorem.
2. Define discrete and Continuous random variable.
3. Write down the axioms of Probability.
4. A CRV X that can assume any value between x=2 and x=5 has a density function given by f(x) = k (1+x). Find k.
5. X and Y are independent random variables with variance 2 and 3. Find the variance of3X+4Y.
6. The mean of a Binomial distribution is 20 and S.D is 4. Determine the parameters of thedistribution.
7. Define Poisson distribution and write its mean and variance
8. State Memoryless property of Exponential Distribution
9. Find the value of 'K' for a continuous random variable X whose probability density function is given by $f(x) = Kx^2 e^{-x}; x \geq 0.$
10. Write the mean and variance of Binomial distribution

PART – **B**

1. A random variable x has the following probability distribution

x	0	1	2	3	4	5	6	7
P(x)	0	K	2K	2K	3K	K2	$2K^2$	$7K^2$+K

(i) Find the value of K

(ii) Evaluate P[X<6] and P[X≥ **6**)

(iii) If P[X≥ ***C***)>1/2 find minimum value of C

(iv) Evaluate P[1.5<x<4.5/x>2]

2. A random variable X has the following probability distribution.

x	-2	1	0	1	2	3
P(x)	0.1	K	0.2	2K	0.3	3K

a. Find K
b. Evaluate P(x < 2) and P(-2 < x 2)
c. Find the Cumulative distribution of x.
d. Evaluate the mean of x.

3. The probability mass function of a discrete R. V X is given in the followingtable

X	0	1	2	3	4	5	6	7	8
P(X)	a	3a	5a	7a	9a	11a	13a	15a	17a

Find (i) the value of a , (ii) $P(X < 3)$, (iii) Mean of X, (iv) Variance ofX.

4. Find the MGF of Binomial distribution. Hence find its Mean and variance.
5. Find the MGF of Poisson distribution and hence find its mean and variance
6. Find the MGF of Exponential distribution and hence find its mean and Variance. Also provethe memory less property of the exponential distribution.
7. Find the MGF of Normal distribution & hence find its mean and variance
8. A bolt is manufactured by 3 machines A, B, and C. A turns out twice as many items as B andmachines B and C produce equal number of items. 2% of bolts produced by A and B are defective and 4% of bolts produced by C are defective. All bolts are put into 1 stock pile and1 is chosen from this pile. What is the probability that it is defective?
9. An urn contains 10 white and 3 black balls. Another urn contains 3 white and 5 black balls. Two balls are drawn at random from the first urn and placed in the second urn and then 1 ballis taken at random from the latter. What is the probability that it is a white ball?
10. 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
    iv. Children of both gender,

Assume equal probabilities for boys and girls.

11. The number of monthly breakdowns of a computer is a random variable, having a Poisson distribution with mean equal to 1.8. find the probability that this computer will function for amonth.
    i. Without a breakdown
    ii. With only one breakdown
    iii. With atleast one breakdown
12. The time (in hours) required to repair a machine is exponentially distributed with parameter
    =1/2
    (i)What is the probability that the repairs time exceeds 2 hour?
    (ii) What is the conditional probability that the repair takes 10 hour given thatits duration exceeds 9 hour?

Unit-II

Part-A

1. The joint probability mass function of a two dimensional random variable (X,Y)is given by p(x,y)= k(2x+y), x =1,2 y=1,2, where K is constant. Find the value of k
2. Let X and Y have the joint p.m.f

Y/X	0	1	2
0	0.1	0.4	0.1
1	0.2	0.2	0

Find P(X+Y>1).

3. The joint pdf of a random variable (X,Y) is $f(x,y)=ke^{-(2x+3y)}; x>0, y>0.$ Find the value of k.
4. The joint pdf of random variable (X,Y) is given as $f(x,y)=\frac{1}{x}, 0<x<y<1$ Find the marginal pdf of Y.
5. The two regression equations of two random variables x & y are $4x-5y+33=0$ & $20x-9y=107$. Find the mean values of x and y.
6. The regression equations are 3x+2y = 26 and 6x +y = 31. Find the mean values of x &y
7. What is the angle between two regression lines?
8. Write the properties of regression lines.
9. If Y=-2X+ 3, find Cov(X, Y).

Unit-II

Part-B

1. The joint probability mass function of (X Y), is given by p(x, y)=k(2x+3y) x = 0, 1, 2; y=1, 2, 3. Find k and all the marginal and conditional probability distributions. Also find the probability distribution of X+Y
2. The joint probability mass function of (X Y), is given by p(x, y)= $\frac{1}{72}$ (2x+3y) x = 0, 1, 2; y=1, 2, 3. Find k and all the marginal and conditional probability distributions.
3. The joint pdf of the random variable (X, Y) is given by $f(x,y)=Kxye^{-(x^2+y^2)}, x.>0, y>0.$ Find the value of K and also prove that X and Y are independent.
4. Given the joint pdf of X and Y $f(x,y)=\begin{cases} cx(x-y), 0<x<2, -x<y<x \\ 0 \, otherwise \end{cases}$,
   i. Evaluate c
   ii. Find Marginal pdf of X and Y.
   iii. Find the conditional density of Y/X
   iv. Two random variables X and Y have the joint p.d.f given by
5. .
   i) Find K
   ii) Obtain Marginal p.d.f of X and Y
   iii) Find the Correlation Coefficient between X and Y
6. The joint pdf of random variable if $f(x,y)=x+y, 0\le x\le 1, 0\le y\le 1$. Find the correlation coefficient between X & Y.
7. The joint probability density function of the two dimensional random variable (X,Y) is $f(x,y)=\begin{cases} 2-x-y, 0\le x\le 1,\ 0\le y\le 1 \\ 0,\ otherwise \end{cases}$. Find the correlation coefficient between X&Y.
8. Find the coefficient of correlation between X and Y from the data given below.

x	65	66	67	67	68	69	70	72
y	67	68	65	68	72	72	69	71

9. Find the coefficient of correlation between industrial production and export using the following data:

Production (X)	55	56	58	59	60	60	62
Export (Y)	35	38	37	39	44	43	44

10. The equations of two regression lines are 8x-10y+66 = 0 and 40x-18y-214 =0. Variance of x is 9. Find the mean values of x and y and correlation coefficient between x and y.
11. If X and Y are independent random variables with probability density function $f(x)=e^{-x}, x \geq 0$: $f(y)=e^{-y}, y \geq 0$ respectively. Show that the random variables $U=\frac{X}{X+Y}$ and V=X+Y are independent.
12. Two random variables X & Y have the following joint p.d.f . Find the probability density function of the random variable

Unit III

PART A

1. Define the following terms (i)Statistic, (ii)parameter (iii)Standard error (iv)Random sampling
2. Define Type-I and Type-II errors.
3. Define null and alternate hypothesis?
4. State level of significance
5. What are the applications of t-test?
6. Suppose the sample mean = 10.05, the sample standard standard deviation s = 2.4854 and the sample size n = 8. Test the null hypothesis $H_0 : \mu = 12.5$ against the alternative hypothesis $H_1 : \mu \neq 12.5$ at $\alpha = 0.05$ level of significance
7. Write the application of 'F' test.
8. State any two applications of ψ^2-test.
9. State the assumption of chi-square test.
10. What are the expected frequencies of 2x2 contingency table?

a	b
c	d

PART B

1. The means of two large samples of 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of standard deviation 2.5 inches?
2. A sample of 900 members has a mean 3.4 cm and standard deviation 2.61 cm. Is the sample from a large population of mean 3.25 cm and standard deviation of 2.61 cm?
3. The means of two large samples of 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of standard deviation 2.5 inches?
4. A random sample of 10 boys had the following I.Q's:70, 120, 110, 101, 88, 83, 95, 98, 107, and 100. Test the population mean I.Q may be 100.
5. Two independent samples of sizes 8 and 7 contained the following values. Test if the two populations have the same mean.

Sample I 19 17 15 21 16 18 16 14

Sample II 15 14 15 19 15 18 16

6. The marks obtained by a group of 9 regular course students and another group of 11 part time course students in a test are given below

Sample I	56	62	63	54	60	51	67	69	58		
Sample II	62	70	71	62	60	56	75	64	72	68	66

7. Examine whether the marks obtained by regular students and part- time students differ significantly at 5% and 1% levels of significance
8. The time taken by workers in performing a job by Method I and Method II is given below:

Method I	20	16	26	27	23	22	
Method II	27	33	42	35	32	34	38

Do the data show that the variances of time distribution from population from which these samples are drawn do not differ significantly?

7. Two independent samples of sixes 9 and 7 from a normal population had the following values of the variables.

Sample1	18	13	12	15	12	14	16	14	15
Sample2	16	19	13	16	18	13	15		

Do the estimates of the population variance differ significantly at 5% level of significance?

8. A group of 10 rats fed on diet A and another group of 8 rats fed on diet B, Recorded the following increase in weight

Diet A	5	6	8	1	12	4	3	9	6	10
Diet B	2	3	6	8	10	1	2	8		

Test the hypothesis that the sampled have same populations with equal variances at 5% level of significance

11. Test whether there is any significant difference between the variances of the population from Which the following samples are taken:

Sample I 20 16 26 27 23 22

Sample II 27 33 42 35 32 34 38

12. The following data gives the number of aircraft accidents that occurred during the various days of a week. Find whether the accidents are uniformly distributed over the week.

Days	Sun	Mon	Tue	Wed	Thu	Fri	Sat
No. of Accidents	14	16	8	12	11	9	14

13. The theory predicts that the population of beans in the four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four groups was 882,313,287 and 118. Do the experimental results support the survey?

Unit-IV

PART-A

1. State the basic principles of design of experiments.
2. What are the basic steps in ANOVA.

3. Write any two differences between CRD & RBD.
4. What are the advantages of a Latin square design?
5. Compare and contrast LSD and RBD.
6. What is ANOVA?
7. Write down the ANOVA table for one way classification.
8. Why a 2 x 2 Latin Square is not possible?
9. What is the aim of the design of the experiments?

PART-B

1. 1. The following are the number orf mistakes made in sucessive days by 4 technicians working for a photographic laboratory test at a level of significance = 0.01. Test whether the difference among the 4 sample means cab be attributed to chance.

Technician I (X_1)	Technician II (X_2)	Technician III (X_3)	Technician IV (X_4)
6	14	10	9
14	9	12	12
10	12	7	8
8	10	15	10
11	14	11	11

2. A completely randomised design experiment with 10 plots and 3 treatments gave the following results:

Plot No:	1	2	3	4	5	6	7	8	9	10
1Treatment :	A	B	C	A	C	C	A	B	A	B
Yield:	5	4	3	7	5	1	3	4	1	7

Analyse the results for treatment effects.

3. A set of data involving 4 tropical food stuffs A, B, C, D tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyze the data:

A	55	49	42	21	52
B	61	112	30	89	63
C	42	97	81	95	92
D	169	137	169	85	154

4. Four varities A, B, C, D of a fertilizer are tested in RBD with 4 replications. The plot yields in pounds are as follows:

Column/ Row	1	2	3	4
1	A(12)	D(20)	C(16)	B(10)
2	D(18)	A(14)	B(11)	C(14)
3	B(12)	C(15)	D(19)	A(13)
4	C(16)	B(11)	A(15)	D(20)

Analyse the experimental yield.

5. The following data represent the number of units of production per day turned out by different workers using 4 differet types of machines

Machine Type / Worker	A	B	C	D

s				
1	44	38	47	36
2	46	40	52	43
3	34	36	44	32
4	43	38	46	33
5	38	42	49	39

(i) Test whether the five men differ with respect to mean productivity and
(ii)Test whether the mean productivity is the same for the four different machine types

6. A company appoints four sales man A, B, C, D to observe sales in three seasons: summer, winter and monsoon. The figures (in laks of Rs.) are given in the following table.

Salesman					
		A	B	C	D
Seasons	Summer	45	40	38	37
	Winter	43	41	45	38
	Monsoon	39	39	41	41

Is there any significant difference between i) Salesman ii) Seasons

7. A variable trial was conducted on wheat with 4 varities in Latin Suare design. The plan of the experiment and per plot yield are given below: Analyse the data.

C(25)	B(23)	A(20)	D(20)
A(19)	D(19)	C(21)	B(18)
B(19)	A(14)	D(17)	C(20)
D(17)	C(20)	B(21)	A(15)

8. In a Latin Square Design experiment given below are the yields in quintals per acre on the paddy crop carried our for testing the effect of five fertilizers A, B, C, D, E. Analyze the data for variations.

B 25	A 18	E 27	D 30	C 27
A 19	D 31	C 29	E 26	B 23
C 28	B 22	D 33	A 18	E 27
E 28	C 26	A 20	B 25	D 33
D 32	E 25	B 23	C 28	A 20

9. Analyse the variance in the following Latin square of yields (in kgs) of paddy where A, B, C, D denote the different methods of cultivation.

D 122	A121	C123	B 122
B 124	C123	A122	D 125
A 120	B119	D120	C 121
C 122	D123	B121	A 122

Examine whether the different methods of cultivation have given significantly different yields.

10. The following is a Latin square of a design when 4 varieties of seeds are being tested. Set up the analysis of variance table and state your conclusion. The following is a Latin square of a design when 4 varieties of seeds are being tested. Setup the analysis of variance table and state your conclusion. You may carry out suitable

change of origin and scale.

A 105	B 95	C125	D 115
C 115	D 125	A105	B 105
D 115	C 95	B105	A 115
B 95	A135	D 95	C 115

11. Analyze 2^2 factorial experiments for the following table.

Treatment	Replications			
	I	II	III	IV
(1)	12	12.3	11.8	11.6
A	12.8	12.6	13.7	14
B	11.5	11.9	12.6	11.8
Ab	14.2	14.5	14.4	15

Unit-V Part-A

1. Write down the objectives of statistical quality control.
2. Define control chart.
3. What are the uses of Quality control chart?
4. What is the formula for c chart and p chart
5. The total number of defects in 20 pieces is 220.what is the UCL and LCL?
6. What is the tolerance limit?
7. Find the lower and upper control limits for X- chart and R-chart, when each sampleisofsize4 and $\overline{\overline{X}} = 10.80$ and $\overline{R} = 0.46$?
8. A garment was sampled on 10 consecutive hours of production. The number of defects found per garment is given below:
9. Defects:5, 1, 7, 0, 2, 3, 4, 0, 3, 2.Compute upper and lower control limits for monitoring number of defects.

Part-B

1. Given below are the values of sample mean $\overline{X}$ and sample range R for 10 samples each of size 5. Draw the appropriate mean and range charts and comment on the state of control of the process.

SampleNo	1	2	3	4	5	6	7	8	9	10
$\overline{X}$	43	49	37	44	45	37	51	46	43	47
R	5	6	5	7	7	4	8	6	4	6

2. The following data gives the average life in hours and range in hours of 12 samples each of 5 lamps. Construct X-chart and R-chart, comment on state of control.

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12
Mean X_i	120	127	152	157	160	134	137	123	140	144	120	127
Range R_i	30	44	60	34	38	35	45	62	39	50	35	41

3. The following data give the measurements of 10 samples each of size 5 in the production process taken in an interval of 2 hours. Calculate the sample means and ranges and draw the control charts for mean and range.

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

Observed measurements X	49	50	50	48	47	52	49	55	53	54
	55	51	53	53	49	55	49	55	50	54
	54	53	48	51	50	47	49	50	54	52
	49	46	52	50	44	56	53	53	47	54
	53	50	47	53	45	50	45	57	51	56

4. The following data give the measurements of 10 samples each of size 6 in the production process taken in an interval of 2 hours. Calculate the sample means and ranges and draw the control charts for mean and range.

Sample No.	1	2	3	4	5	6	7	8	9	10
Observed measure ments X	62	50	67	64	49	63	61	63	48	70
	68	58	70	62	98	75	71	72	79	52
	66	52	68	57	65	62	66	61	53	62
	68	58	56	62	64	58	69	53	61	50
	73	65	61	63	66	68	77	55	49	66
	68	66	66	74	64	55	53	57	56	75

5. A Plant producers paper for news print and rolls of paper are inspected for defects .the results of inspection.10 rolls of paper are given below draw the C Charts and comment on the state of control.

Roll No	1	2	3	4	5	6	7	8	9	10
No of Defects	19	10	8	12	15	22	7	13	18	13

6. 15 tape recorders were examined for quality control test. The number of defects in each tape recorder is recorded below. Draw the appropriate control chart and comment on the state of control.

Unit No.(i)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of defects(c)	2	4	3	1	1	2	5	3	6	7	3	1	4	2	1

7. Construct a control chart ford effectives 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

8. The data given below are the number of defectives in 10 samples of 100 items each. Construct a p-chart and an np-chart and comment on the results.

Sample No.	1	2	3	4	5	6	7	8	9	10
No. of defectives	6	16	7	3	8	12	7	11	11	4

9. The data given below are the number of defectives in 10 samples of 100 items each. Construct a p-chart and an np-chart and comment on the results.

Sample No.	1	2	3	4	5	6	7	8	9	10
No. of defectives	8	14	9	5	6	14	9	13	16	2