97

1B3N25452 (Pages : 2) Reg. No:............................

Name: ....

FARROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

STA3CJ201 – Mathematical Methods for Statistics

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

PART – A

All questions can be attended.
Each question carries **Three** mark.
Ceiling -24 Marks

		COs	Knowledge Level(KL)	Marks
1	Define absolute value of a real number.	**1**	**C**	**3**
2	State Completeness Property of Real line.	**1**	**C**	**3**
3	State Density Theorem.	**1**	**C**	**3**
4	Define Monotone sequence.	**2**	**P**	**3**
5	Define Cauchy criterion.	**3**	**P**	**3**
6	Define limit of function.	**4**	**C**	**3**
7	State Sequential Criterion for Continuity.	**4**	**C**	**3**
8	State Chain Rule.	**5**	**P**	**3**
9	State Caratheodory's Theorem	**5**	**C**	**3**
10	Define Riemann sum.	**6**	**C**	**3**

PART – B

All questions can be attended.
Each question carries six marks.
Ceiling -36 Marks

		COs	Knowledge Level(KL)	Marks
11	State and prove AM-GM inequality.	**1**	**C**	**6**
12	State and prove Archimedean Property.	**1**	**C**	**6**
13	Prove that all convergent sequence of real numbers are bounded.	**2**	**P**	**6**
14	State and prove Cauchy Convergence Criterion.	**3**	**P**	**6**
15	State and prove Squeeze theorem.	**3**	**P**	**6**
16	If $f: A \to R$ and if c is a cluster point of A, then prove that f can have only one limit at c.	**4**	**C**	**6**
17	State and prove The Mean Value Theorem	**5**	**P**	**6**
18	State and prove Fundamental Theorem of Calculus.	**6**	**C**	**6**

PART - C

Answer any *one* questions.
Each question carries **Ten** marks.

		COs	Knowledge Level(KL)	Marks
19	State and prove Bolzano- Weierstrass Theorem.	**2**	**P**	**10**
20	State and prove The Squeeze Theorem in context of Riemann Integral.	**6**	**C**	**10**

1 x 10 = 10 Marks

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1B3N25453 (Pages : 2) Reg. No:..........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

STA3MN201(P) – Statistical inference using R

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

(Use of Scientific Calculator and Statistical tables are permitted)

PART – A

All questions can be attended.
Each question carries **Three** mark.
Ceiling -24 Marks

		COs	**Knowledge Level (KL)**	**Marks**
1	Define sufficiency of an estimator with example.	CO2	U	3
2	x_1, x_2, x_3 are three independent observations from a population with mean μ and variance σ^2. If $t_1 = x_1 + x_2 - x_3$ and $t_2 = 2x_1 + 3x_2 - 4x_3$ are two estimators of μ, Compare their efficiencies.	CO2	U	3
3	Find the estimate of θ by the method of moments for the population with probability density function $f(x,\theta) = (1+\theta)x^{\theta},\ 0 \le x \le 1,\ \theta > 0$	CO2	U	3
4	Define null and alternative hypothesis.	CO4	U	3
5	Describe power of a test and level of significance.	CO4	U	3
6	Explain the two types of errors in tests of hypothesis	CO4	U	3
7	What are contingency tables?	CO6	Ap	3
8	Mention any three applications of chi-square distribution in testing of hypothesis.	CO6	Ap	3
9	Define range and write the R code for finding range.	CO7	Ap	3
10	Describe three math functions in R	CO7	Ap	3

PART – B

All questions can be attended. Each question carries **six** marks. **Ceiling -36 Marks**

		COs	**Knowledge Level(KL)**	**Marks**
11	Show that the sample mean is an unbiased and consistent estimator of population mean of any population having a finite variance.	CO2	U	6
12	Obtain the 95% confidence interval for the mean of a Normal population $N(\mu,\sigma)$ when σ known	CO3	E	6
13	If $X \geq 1$ is the critical region for testing H_0: $\theta=2$ against H_1: $\theta=1$ on the basis of a single observation from $f(x, \theta) = \theta\ e^{-\theta x}$, $X > 0$. Obtain the probabilities of type I and type II errors	CO4	U	6
14	Explain the test procedure for the proportion of success of a population.	CO5	Ap	6
15	Fit a Poisson distribution to the following data and test the goodness of fit. Observations : 0 1 2 3 4 Frequencies: 15 60 30 8 4	CO6	Ap	6
16	Explain the chi-square test of independence of two attributes	CO6	Ap	6
17	Define i)Barplot ii)Pie Chart iii)Histogram Explain the R codes of the above three.	CO7	Ap	6
18	Explain with example how we can find mean, median and mode using R.	CO7	Ap	6

PART - C

Answer any *one* questions. Each question carries Ten marks.

<table>
<tr><th></th><th></th><th>COs</th><th>Knowledge Level(KL)</th><th>Marks</th></tr>
<tr><td>19</td><td>If 8.6, 7.9, 8.3, 6.4, 8.4, 9.8, 7.2, 7.8 and 7.5 are the above observed values of a random sample of size 9 from a distribution $N(\mu,\sigma^2)$. Construct 90%, confidence interval for mean μ.</td><td>CO1</td><td>U</td><td>10</td></tr>
<tr><td>20</td><td>1025 school children were classified according to intelligence and apparent family economic level to produce the following:
<table>
<tr><th></th><th>Dull</th><th>Intelligent</th><th>Very capable</th></tr>
<tr><td>Very well clothed</td><td>81</td><td>122</td><td>133</td></tr>
<tr><td>Well clothed</td><td>141</td><td>157</td><td>53</td></tr>
<tr><td>Poorly clothed</td><td>127</td><td>163</td><td>48</td></tr>
</table>
Test for independence at 0.01 level</td><td>CO6</td><td>Ap</td><td>6</td></tr>
</table>

1 x 10 = 10 Marks

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1B3N25454 (Pages : 2) Reg. No:.........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

STA3CJ202(P)– Probability and Random Variables

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

(Use of Scientific Calculator is Permitted)

PART – A

All questions can be attended.
Each question carries Three mark.
Ceiling -24 Marks

		COs	Knowledge Level(KL)	Marks
1	Define classical and statistical definitions of probability.	CO1	Remember	3
2	State and explain the addition theorem on probability for two events.	CO1	Understand	3
3	Differentiate between pairwise independence and mutual independence.	CO2	Understand	3
4	State Bayes' theorem and mention any two applications.	CO3	Understand	3
5	Define a random variable. Give one example each for discrete and continuous types.	CO4	Remember	3
6	What is a probability density function? Write any two properties.	CO5	Understand	3
7	Define distribution function and mention any two properties.	CO4	Understand	3
8	Write the relation between MGF and moments	CO6	Apply	3
9	Define characteristic function. State any one of its uses.	CO6	Understand	3
10	State any two properties of expectation.	CO6	Remember	3

PART – B

All questions can be attended.
Each question carries six marks.
Ceiling -36 Marks

		COs	Knowledge Level(KL)	Marks
11	A coin is tossed 4 times. Find the probability of getting (i) at least 2 heads. (ii) exactly two heads.	CO1	Apply	6
12	If P(A)=0.5, P(B)=0.4 and P(AUB)=0.2, find P(A∩B), P(A|B) and P(B|A)	CO2	Apply	6

13	Discuss the transformation technique for continuous random variables with illustration	CO5	Analyse	6
14	Find the distribution function of a discrete r.v. X taking values 0, 1, 2, 3, 4 with $P(X=x)=\frac{1}{21},\frac{1}{7},\frac{1}{3},\frac{6}{21}$ and $\frac{4}{21}$ respectively.	CO4	Apply	6
15	Define pmf with an example. Obtain pmf of tossing two fair coins.	CO5	Understand	6
16	Let X be a r.v. with pdf $f(x)=\begin{cases} kx^2, 0\le x\le 1 \\ 0, otherwise \end{cases}$. Find (i) k , ii) $p\left(\frac{1}{2}\le x\le 1\right)$ iii) $p\left(-\frac{1}{2}\le x\le \frac{1}{2}\right)$	CO5	Apply	6
17	Let X be a r.v. with E(X)=3, Var(X)=4. Find E(2X+3) and V(3 – 4 X).	CO6	Apply	6
18	Find the MGF of a r.v. X defined by P(X=0)=½, P(X=1)=½.	CO6	Apply	6

PART - C

Answer any *one* questions.
Each question carries Ten marks.

		COs	Knowledge Level(KL)	Marks
19	In a class of 50 students, 28 opted for NCC, 30 opted for NSS and 18 opted both NCC and NSS. One of the students is selected at random. Find the probability that (i) The student opted for NCC but not NSS (ii)The student opted for NSS but not NCC iii)The student opted for exactly one of them.	CO3	Apply	10
20	Three machines A, B and C produce 50%, 30% and 20% of total items. Their defectives are 3%, 4% and 5% respectively. If a defective item is chosen, what is the probability that it was produced by machine B?	CO6	Understand	10

1 x 10 = 10 Marks

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Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

STA3MN205(P) - Inferential Statistics

(FYUGP 2024 Admission onwards)

Time: 2 hours

Max. Marks : 70

(Use of scientific calculator and statistical tables are permitted)

PART – A

All questions can be attended.

Each question carries **Three** marks.

Ceiling -24 Marks

		COs	**Knowledge Level(KL)**	**Marks**
1	Determine the pmf of binomial distribution for which mean is 3 and variance is 4.	CO1	U	3
2	Write down the probability distribution of a Poisson random variable with mean 2. What is its variance?	CO1	U	3
3	For a standard normal random variable, find $P(Z > 2.06)$.	CO2	AP	3
4	What is a sampling? Write its importance	CO3	U	3
5	a) Define null and alternative hypothesis. b) "A school wants to know if the new teaching method has changed the average test scores, which were historically 75." State the suitable null and alternative hypothesis.	CO3	U	3
6	Distinguish between critical region and critical value.	CO4	R	3
7	What is test statistic? Give an example.	CO4	R	3
8	Give the test statistic for Chi-square test for population variance. If the chi-square value is greater than table value, what will you conclude?	CO5	U	3
9	When will we use paired t test?	CO5	AP	3
10	What types of variations are there in one way ANOVA?	CO6	U	3

PART – B

All questions can be attended.

Each question carries six marks.

Ceiling -36 Marks

<table>
<tr><th></th><th></th><th>COs</th><th>Knowledge Level(KL)</th><th>Marks</th></tr>
<tr><td>11</td><td>Six dice are thrown 729 times. How many times do you expect at least 3 dice to show a 5 or 6.</td><td>CO1</td><td>U</td><td>6</td></tr>
<tr><td>12</td><td>The scores on a standardized math test are normally distributed with a mean of 500 and a standard deviation of 100. What percentage of students scored (i) between 400 and 600?
(ii) between 450 and 550</td><td>CO2</td><td>AP</td><td>6</td></tr>
<tr><td>13</td><td>A company claims that their new battery lasts more than 10 hours on average. A researcher wants to test this claim. A sample of 30 batteries is tested and yields a sample mean of 10.5 hours with a known population standard deviation of 1.2 hours. Test at 1% level of significance.</td><td>CO5</td><td>AP</td><td>6</td></tr>
<tr><td>14</td><td>Explain the procedure for testing of hypothesis.</td><td>CO3</td><td>U</td><td>6</td></tr>
<tr><td>15</td><td>The security department of a large office building wants to test the null hypothesis that $\sigma = 2.5$ minutes for the time it takes a guard to walk his round against the alternative hypothesis that $\sigma > 2.5$ minutes. What can it be concluded at the 0.01 level of significance if a random sample of size 21 yields s = 2.2 minutes?</td><td>CO5</td><td>AP</td><td>6</td></tr>
<tr><td>16</td><td>For the following random samples, test for the significant difference in means at $\alpha = 5\%$
<table>
<tr><td>Sample 1</td><td>8260</td><td>8130</td><td>8350</td><td>8070</td><td>8340</td><td></td></tr>
<tr><td>Sample 2</td><td>7950</td><td>7890</td><td>7900</td><td>8140</td><td>7920</td><td>7840</td></tr>
</table></td><td>CO5</td><td>AP</td><td>6</td></tr>
<tr><td>17</td><td>From the following data , test the hypothesis that inoculation against typhoid has no effect on immunity from attack.
<table>
<tr><th></th><th>Affected</th><th>Not affected</th></tr>
<tr><td>Inoculated</td><td>23</td><td>142</td></tr>
<tr><td>Not inoculated</td><td>97</td><td>563</td></tr>
</table></td><td>CO5</td><td>AP</td><td>6</td></tr>
<tr><td>18</td><td>What is ANOVA? What are its assumptions?</td><td>CO6</td><td>U</td><td>6</td></tr>
</table>

PART - C

Answer any *one* questions.

Each question carries **Ten** marks.

<table>
<tr><th></th><th></th><th>COs</th><th>Knowledge Level(KL)</th><th>Marks</th></tr>
<tr><td>19</td><td>Fit a Poisson distribution to the following data and test the goodness of fit.
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>f</td><td>95</td><td>75</td><td>44</td><td>18</td><td>2</td><td>1</td></tr>
</table></td><td>CO1</td><td>AP</td><td>10</td></tr>
<tr><td>20</td><td>Different teaching methods were used to prepare students for an exam. The exam scores are as follows
<table>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>85</td><td>78</td><td>90</td></tr>
<tr><td>88</td><td>82</td><td>85</td></tr>
<tr><td>90</td><td>80</td><td>87</td></tr>
</table>
Is there a significant difference between the three methods?</td><td>CO6</td><td>AP</td><td>10</td></tr>
</table>

1 x 10 = 10 Marks

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1B3N25456 (Pages : 2) Reg. No:...........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

ACT3MN201(P) – Risk Modelling and Survival Analysis

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

PART – A

All questions can be attended.
Each question carries Three mark.
Ceiling -24 Marks

		COs	Knowledge Level(KL)	Marks
1	What is meant by the future lifetime random variable (T_x)?	CO1	2	3
2	What is curtate expectation of life?	CO1	2	3
3	What does the notation $_tP_x$ represent in survival models?	CO1	2	3
4	Explain the meaning of the hazard rate in mortality studies.	CO1	2	3
5	What is meant by a short-term insurance contract?	CO2	2	3
6	List any three general features of an insurance product.	CO2	2	3
7	Define reinsurance.	CO3	2	3
8	List three reasons why machine learning growing rapidly.	CO5	2	3
9	State the meaning of the surplus process in ruin theory.	CO4	1	3
10	Define machine learning.	CO5	2	3

PART – B

All questions can be attended.
Each question carries six marks.
Ceiling -36 Marks

		COs	Knowledge Level(KL)	Marks
11	If $\mu_x = 0.01908+0.001(x -70)$ for $x \geq 55$, calculate $_5q_{60}$.	CO1	2	6
12	Derive the probability density function of T_x.	CO1	2	6
13	The random variable S has a compound Poisson distribution with Poisson parameter 4. The Individual claim amounts are either 1, with probability 0.3, or 3, with probability 0.7. Calculate the probability that S = 4	CO2	3	6

14	Derive an expression for the mean and variance of an aggregate claim amount (S)	CO2	2	6
15	Differentiate between proportional and non– proportional reinsurance.	CO3	2	6
16	What do you mean by time of ruin. Explain probability of ruin in discrete and continuous time.	CO4	1	6
17	Explain the different branches of machine learning.	CO5	2	6
18	Briefly explain the different stages of analysis in machine learning.	CO5	2	6

PART - C

Answer any *one* questions.

Each question carries **Ten** marks.

		COs	Knowledge Level(KL)	Marks
19	Derive mean, variance and m.g.f of skewness for compound Poisson distribution.	CO2	2	10
20	a) Given that e_{50}= 30, $\mu_{50+t} = 0.005t$ for $0 \le t \le 1$, calculate the value of e_{51}. b) The mortality of a certain species of furry animal has been studied. It is known that at ages over five years the force of mortality μ is constant, but the variation in mortality with age below five years of age is not understood. Let the proportion of furry animals that survive to exact age five years be ${}_5p_0$. i) Obtain an expression, in terms of μ and ${}_5p_0$, for the proportion of all furry animals that die between exact ages 10 and 15 years. c) A new investigation of this species of furry animal revealed that 30 per cent of those born survived to exact age 10 years and 20 per cent of those born survived to exact age 15 years. i)Calculate μ and ${}_5p_0$	CO1	3	10

1 x 10 = 10 Marks

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1B3N25457 (Pages : 2) Reg. No:..........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

STA3MN210(P) - Probability Theory and Sampling Techniques

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

Course Outcome Mapping Scheme

Q.NO	1	2	3	4	5	6	7	8	9	10
COS	CO1	CO3	CO4	CO3	CO3	CO3	CO3	CO3	CO4	CO6
Q.NO	11	12	13	14	15	16	17	18	19	20
COS	CO3	CO4	CO3	CO6	CO2	CO4	CO3	CO6	CO3	CO6

PART-A

[All questions can be attended. Each question carries 3 marks]

1. State the axiomatic definition of Probability.
2. Let X be a random variable with p.d.f

   $f(x) = \{k\, e^{-2x},\ x \geq 0$ and zero elsewhere, find the value of k.
3. Give a few situations where census becomes impractical.
4. Find the expected number of heads in 3 tosses of an unbiased coin.
5. For a random variable, show that V (aX – b) = a^2V(X) when they exist
6. Let X be a random variable with p.d.f

   $f(x) = \left\{ \frac{1}{2},\ -1 < x < 1 \right.$ and zero elsewhere. Obtain E(X) and V(X).
7. If $f(x) = \{kx,\ x = 1, 2, 3$ and zero elsewhere is a p.m.f. Find (i) k and (ii) $P(X \geq 2.5)$
8. Define random variable. Give an example.
9. What are the advantages of sampling over census?
10. List and define some basic data structures in R.

(Ceiling: 24 Marks)

PART-B

[All questions can be attended. Each question carries 6 marks]

11. Derive the mean of Normal distribution

12. Distinguish between sampling and non sampling errors

13. Define distribution function of a random variable and state its properties. Write down the distribution function of the number of heads on tossing a fair coin thrice.

14. For the data set given below

X	12	24	32	45	48
Y	8	12	16	18	23

Perform linear regression and create a regression plot using R.

15. What is the addition theorem of probability for any two events A and B? Deduce the case when A and B are mutually exclusive.

16. Explain systematic random sampling

17. If the random variable X follows Poisson distribution such that $P(X = 1) = P(X = 2)$, what is the mean and variance of the distribution? Find also $P(X = 0)$.

18. How can you calculate a correlation matrix in R. **(Ceiling: 36 Marks)**

PART-C

[Answer any one. Each question carries 10 marks]

19. (i) Define Normal distribution. State any four of the properties of normal distribution

(ii) The mean IQ of a large number of students of age 14 was 100 with the standard deviation 16. Assuming that the distribution to be normal, find what percentage of students had IQ between 80 and 120.

20 Briefly describe conditional statements and loops in R.

(1x10= 10 Marks)