Programme	BSc Statistics
Course Code	STA3MN201 (P)

Course Title	Statistical inference using R				
Type of Course	Minor				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Students should be comfortable with concepts such as probability distributions, random variables, and conditional probability.				
Course Summary	Upon completion of this course, students will be proficient in understanding and applying the concept of estimation and testing of hypothesis in statistics, allowing them to make informed decisions and draw reliable conclusions from sample data.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Articulate the purpose of estimation in making inferences about population parameters based on sample data and analyze data to help entrepreneurial decisions using critical thinking skills.	Ap	C	Instructor-created exams / Quiz
CO2	Explain the difference between point estimation and interval estimation	U	C	Practical Assignment / Observation of Practical Skills
CO3	Calculate and interpret confidence intervals for both population mean and proportion and critically evaluate ethical implications of statistical methods aligning with human values	Ap	F	Seminar Presentation / Group Tutorial Work/ Instructor-created exams
CO4	Explain how to formulate null and alternative hypotheses for different types of research questions	U	C	Instructor-created exams / Home Assignments
CO5	Introduce R software and discuss R code for various graphical representations of data.	U	F	One Minute Reflection Writing assignments/ Instructor-creat

Module	Units	Content	*	#	
		ed exams			
CO6		Apply estimation and hypothesis testing methods to real-world data sets.	Ap	P	Viva Voce/ Instructor-creat ed exams

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Units	Content	Hrs (45 +30)	Marks (70)
I		**THEORY OF ESTIMATION**	14	25
	1	Point estimation	1	
	2	Unbiasedness	2	
	3	Consistency	2	
	4	Efficiency	2	
	5	Sufficiency	2	
	6	Methods of estimation	2	
	7	Interval estimation	1	
	8	Confidence limits for mean	1	
	9	Confidence limits for proportion	1	
	Sections from References: Unit 1: 16.1, 16.2, 16.2.1 [Ref 1] Unit 2: 16.2.2 [Ref 1] Unit 3: 16.2.3 [Ref 1] Unit 4: 16.2.4 [Ref 1] Unit 5: 16.6.5 [Ref 1] Unit 6: 16.2.6 [Ref 1] Unit 7: 16.4 [Ref 1] Unit 8: 16.4.2 [Ref 1] Unit 9: 16.4.3 [Ref 1]				
II		**TESTING OF HYPOTHESIS**	10	20
	10	Statistical hypothesis, Simple and composite hypothesis	2	
	11	Null and alternate hypothesis, Two types of errors, Level of significance, Critical region, one tatiled and two tailed	2	

		tests		
	12	Large sample tests: Test for single proportion	3	
	13	Test of significance for a single mean	3	
	Sections from References:			
	Unit 10: 16.6.1 [Ref 1]			
	Unit 11: 16.6.3, 16.6.4, 16.6.5, 16.6.6, 16.6.7, 16.6.8 [Ref 1]			
	Unit 12: 17, 17.2.1 [Ref 1]			
	Unit 13: 17.3.2 [Ref 1]			
III		**CHI SQUARE TEST**	9	15
	14	Applications of Chi square distribution	2	
	15	Chi square test of goodness of fit	3	
	16	Chi square test for independence of attributes	4	
	Sections from References:			
	Unit 14: 18.3 [Ref 1]			
	Unit 15: 18.4 [Ref 1]			
	Unit 16: 18.6 [Ref 1]			
IV		**INTRODUCTION TO R**	12	10
	17	Installation & Basic Mathematical Operations	2	
	18	R Preliminaries	1	
	19	Methods of Data Input	1	
	20	Graphical Representations (R Code)	2	
	21	Diagrammatic Representations (R Code)	3	
	22	Descriptive Measures (Mean, Median, Mode, Range, Standard deviation, variance)	3	
	Sections from References:			
	Unit 19: 1.2&1.3 [Ref 5]			
	Unit 20: 1.4 [Ref 5]			
	Unit 21: 1.5&1.6 [Ref 5]			
	Unit 22: 1.8,2.3 [Ref 5]			
	Unit 23:2.2 [Ref 5]			
	Unit 24: 2.4,2.5 [Ref 5]			
V		**PRACTICUM**	30	
		Do practice problems in R software from any 5 units of the given list and one additional problem decided by the teacher-in-charge, related to the content of the course. Other units listed here may be used as		

		demonstrations of the concepts taught in the course.		
	1	Basic mathematical operations and R preliminaries		
	2	Methods of data input		
	3	Data accessing or indexing		
	4	Built in functions in R		
	5	Graphical representations (R Code)		
	6	Diagrammatic representations (R Code)		
	7	Mean, Median, Mode		
	8	Range, Standard deviation, variance		
Sections from References: Unit 1: 1.3&1.4 [Ref 5] Unit 2: 1.5 [Ref 5] Unit 3: 1.6 [Ref 5] Unit 4: 1.7 [Ref 5] Unit 5: 1.8 [Ref 5] Unit 6: 2.2 [Ref 5] Unit 7: 2.4 [Ref 5] Unit 8: 2.5 [Ref 5]				

Books and References:
1. Gupta, S. C.. (2015). Fundamentals of Statistics, Himalaya Publishing House.
2. Gupta, S. C. and Kapoor, V. K. (2002). Fundamentals of Mathematical   Statistics, 11th edition, Sulthan Chand, New Delhi
3. Prem S. Mann (2016), Introductory Statistics 9 th Edition, Wiley
4. The R book (2007) , Michael J. Crawley John Wiley Series
5. Sudha G Purohith, Sharad D Core, Shailaja R Deshmukh (2015), Statistics Using R

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	3	1	-	-	2	2	3	-	-	3	-
CO 2	-	2	-	3	2	3	3	3	1	-	-	-
CO 3	2	-	2	-	-	-	2	2	-	3	-	3

CO 4	-	-	3	-	-	-	1	3	-	3	-	-
CO 5	-	-	2	-	-	-	1	3	-	3	-	-
CO 6	2	-	2	-	-	-	1	2	-	2	-	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6	✓			

Programme	BSc Statistics				
Course Code	STA3MN202 (P)				
Course Title	Statistical inference for data science				
Type of Course	Minor				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Thorough knowledge in probability concept and Random variables.				
Course Summary	Students will possess a wide understanding of Law of Large Numbers, ANOVA, and non-parametric tests and they will be equipped to apply these statistical techniques to various scenarios, making informed decisions and drawing meaningful conclusions from data.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Introduce and explore different law of large numbers	U	C	Instructor-created exams / Quiz
CO2	Define and understand the rationale for testing differences between two populations	R	C	Practical Assignment / Observation of Practical Skills/ Instructor-created exams
CO3	Formulate null and alternate hypothesis for a real life two population problem and analyze data to help entrepreneurial decisions using critical thinking skills.	U	C	Seminar Presentation / Group Tutorial Work/ Instructor-created exams
CO4	Differentiate between one-way and two-way ANOVA and critically evaluate ethical implications of statistical methods aligning with human values.	U	C	Instructor-created exams / Home Assignments
CO5	Define and understand the principles of non parametric statistics	U	F	One Minute Reflection Writing assignments/

					Instructor-created exams
CO6	Describe analysis of variance and hypothesis testing using R software.	Ap	P		Viva Voce/ Instructor-created exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)					

Detailed Syllabus:

Module	Units	Content	Hrs (45 +30)	Marks (70)
I		**LAW OF LARGE NUMBERS**	10	15
	1	Chebychev's inequality (Definition and Problems)	2	
	2	Modes of Convergence of a Sequence of Random Variables	1	
	3	Weak Law of Large Numbers (Statement and Problems)	2	
	4	Bernoulli's Law of Large Numbers		
	5	Strong Law of Large Numbers	2	
	6	CLT (Lindeberg- Levy)	3	
	Sections from References: Unit 1: 7.5 [Ref 1] Unit 2: 7.6 [Ref 1] Unit 3: 7.7 [Ref 1] Unit 4:7.7 [Ref 1] Unit 5: 7.8[Ref 1] Unit 6: 9.16[Ref 1]			
II		**HYPOTHESIS TESTING: TWO POPULATIONS**	12	20
	6	Test of Significance for difference of two population proportions (Concept and Problems)	2	
	7	Test of Significance for difference of two population means (Large Sample-Concept and Problems)	2	
	8	Test of Significance for difference of two population means (Small Sample-Concept and Problems)	3	

	9	Paired t test(Concept and Problems)	3	
	10	F test for equality of proportions	2	
	Sections from References: Unit 6: 14.7.2 [Ref 1] Unit 7: 14.8.4 [Ref 1] Unit 8: 16.3.2 [Ref 1] Unit 9: 16.3.3[Ref 1] Unit 10: 16.7[Ref 1]			
III		**ANALYSIS OF VARIANCE**	8	15
	11	ANOVA	1	
	12	One-Way Analysis of Variance	3	
	13	Two -Way Analysis of Variance	4	
	Sections from References: Unit 11: 23.1,23.2 [Ref 2] Unit 12: 23.3[Ref 2] Unit 13: 23.4[Ref 2]			
IV		**NON PARAMETRIC TEST**	15	20
	14	Introduction to Non Parametric Methods	1	
	15	Advantages and Limitations	1	
	16	Sign Test- one sample	3	
	17	Wilcoxon Signed Rank Test	2	
	18	Mann- Whitney Test	2	
	19	Kruskal- Wallis Test	2	
	20	Single Sample Run Test	2	
	21	Median Test	2	
	Sections from References: Unit 14: 26.2[Ref 2] Unit 15:26.2.1 [Ref 2] Unit 16: 26.3[Ref 2] Unit 17: 26.4 [Ref 2] Unit 18:26.5 [Ref 2] Unit 19:26.7[Ref 2] Unit 20: 26.8[Ref 2] Unit 21: 26.9[Ref 2]			

V		**PRACTICUM**	30	
	Do practice problems in R software from any 5 units of the given list and one additional problem decided by the teacher-in-charge, related to the content of the course. Other units listed here may be used as demonstrations of the concepts taught in the course.			
	1	Plots to check normality		
	2	Hypothesis testing		
	3	Goodness of fit tests		
	4	Correlation		
	5	Inference procedures for correlation coefficient		
	6	Linear regression		
	7	Inference procedures for simple linear model		
	8	Polynomial regression models		
	Sections from References: Unit 1: 4.4 [Ref 5] Unit 2: 4.5 [Ref 5] Unit 3: 4.6 [Ref 5] Unit 4: 5.2 [Ref 5] Unit 5: 5.3 [Ref 5] Unit 6: 5.4 [Ref 5] Unit 7: 5.5 [Ref 5] Unit 8: 5.8 [Ref 5]			

Books and References:

1. Gupta, S. C. and Kapoor, V. K. (2002). Fundamentals of Mathematical Statistics. **,** 11th edition, Sulthan Chand, New Delhi.
2. Gupta, S. C. (2015). Fundamentals of Statistics,7 th Edition ,Himalaya Publishing House.
3. Gupta S.C (2021), Statistical Methods, 46 th edition, Sultan Chand and Sons.
4. Prem S. Mann (2016), Introductory Statistics 9 th Edition ,Wiley
5. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R (2023)
6. Sudha G Purohith, Sharad D Core, Shailaja R Deshmukh (2015), Statistics Using R

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	2	-	-	-	3	1	2	-	-	-	-
CO 2	2	-	-	-	-	2	2	1	-	-	-	-
CO 3	-	-	2	-	-	2	2	-	-	1	3	-
CO 4	2	-	-	-	-	-	2	1	-	-	-	3
CO 5	-	3	-	2	3	3	-	2	1	-	-	-
CO 6	-	-	-	-	-	2	3	1	-	-	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5	✓	✓		✓
CO 6	✓			

Programme	BSc Statistics				
Course Code	STA3MN210 (P)				
Course Title	Probability theory and sampling techniques				
Type of Course	Minor				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Understanding of basic algebraic operations and set theory. Familiarity with functions, graphs and their properties.				
Course Summary	Through theoretical concepts and practical applications, students will develop the skills necessary to analyze uncertainty, conduct sample surveys, and implement statistical quality control methods.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define and apply basic concepts of probability, including classical probability and the axiomatic approach, to analyze uncertain events and outcomes.	U	C	Instructor-created exams / Quiz
CO2	Differentiate between census and sampling methods and recognize the advantages and limitations of each approach in data collection and critically evaluate ethical implications of statistical methods aligning with human values.	Ap	F	Practical Assignment / Observation of Practical Skills/ Instructor-created exams
CO3	Describe the principal steps involved in sample surveys, including the organization and execution of large sample surveys.	U	C	Seminar Presentation / Group Tutorial Work/ Instructor-created exams
CO4	Define life tables and understand their construction, including calculating measures such as the force of mortality, and interpreting results in demographic analysis and analyze data to help entrepreneurial decisions using critical thinking skills.	U	C	Instructor-created exams / Home Assignments
CO5	Explain the concept of statistical quality control and differentiate between assignable causes and chance causes of variation in processes.	Ap	C	One Minute Reflection Writing assignments/ Instructor-created exams
CO6	Create basic plots in R to visualize range, variance and correlation between variables.	Ap	P	Viva Voce/ Instructor-created exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I		**Probability**	**10**	**15**
	1	Basic concepts of Probability ,Classical definition of Probability ,Axiomatic approach to Probability	2	
	2	Addition Theorem, Multiplication Theorem	3	
	3	Conditional Probability	3	
	4	Independence of events	2	
		Sections from References: Unit 1: 3.3-3.8 [Ref 1] Unit 2: 3.9,3.11 [Ref 1] Unit 3: 3.10[Ref 1] Unit 4: 3.11-3.15 [Ref 1]		
II		**Random Variables**	**8**	**15**
	5	Random Variables, Discrete and continuous random variables	2	
	6	Probability distribution , Distribution function (Applications in discrete case)	2	
	7	Mathematical expectation (Applications in discrete case)	2	
	8	Variance (Applications in discrete case)	2	
		Sections from References: Unit 5&6: 5.1-5.4.2 [Ref 1] Unit 7: 6.1-6.4 [Ref 1] Unit 8: 6.6 [Ref 1]		
III		**Sampling theory**	**19**	**25**
	9	Population and Sample	2	
	10	Census and Sampling Method	3	
	11	Advantages and Limitations of Sampling	1	
	12	principal steps in sample survey	3	
	13	Sampling Errors	3	
	14	Non-Sampling Errors	3	
	15	Simple random sampling(Concept and Methods of selection)	1	
	16	Stratified random sampling	1	
	17	Systematic Sampling	2	
		Sections from References: Unit 9: 15.2,15.3,15.6 [Ref 1] Unit 10: 15.6,15.7[Ref 1] Unit 11: 15.8 [Ref 1] Unit 12: 15.9.1[Ref 1] Unit 13&14:15.10[Ref 1] Unit 15:15.11,15.11.1 [Ref 1] Unit 17: 15.12,15.12.1 [Ref 1] Unit 17: 15.13 [Ref 1]		

IV		R programming								8	15
	18	Range								2	
	19	Variance								2	
	20	Loops- Brief explanation								2	
	21	Pearson's correlation								1	
	22	Conditional statements(Brief)								1	

Sections from References:
Unit 18&19: 2.1-2.3[Ref 3]
Unit 20: 7.5 [Ref 2]
Unit 21:   6.2 [Ref 2]
Unit 22:   7.3 [Ref 2]

V	**PRACTICUM**	30	

Do practice problems in R software from any 5 units of the given list and one additional problem decided by the teacher-in-charge, related to the content of the course. Other units listed here may be used as demonstrations of the concepts taught in the course.

1. Range
2. Mean Deviation
3. Quartile Deviation
4. Standard Deviation
5. Variance
6. Covariance
7. Correlation
8. Rank correlation

Sections from References:
Unit 1,2: 2.1   [Ref 3]
Unit 3: 2.2 [Ref 3]
Unit 4,5: 2.3 [Ref 3]
Unit 6,7,8: 6.2-7.5 [Ref 2]

Books and References:
1. Gupta, S. C. and Kapoor, V. K. (2020). Fundamentals of Mathematical   Statistics, 12th edition, Sulthan Chand, New Delhi
2. Douglas, Alex, Deon Roos, Francesca Mancini, Ana Couto, and David Lusseau. (2020), *An Introduction to R*. https://intro2r.com/index.html**.**
3. Sudha G Purohith, Sharad D Core, Shailaja R Deshmukh (2015), Statistics Using R.

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6

CO 1	2	1	-	-	-	-	3	-	-	-	-	-
CO 2	-	-	1	-	-	2	-	-	-	-	-	3
CO 3	-	-	-	1	2	-	-	-	3	-	2	-
CO 4	-	-	-	-	-	2	-	1	2	-	-	-
CO 5	-	-	2	-	-	-	1	-	-	-	-	-
CO 6	-	-	3	-	-	2	-	-	-	2	1	3

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓

CO 3	✓			✓
CO 4		✓		✓
CO 5	✓	✓		✓
CO 6	✓			