SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Science

Statistics (Minor)

Syllabus for the Academic Year 2024-2025

based on the National Education Policy 2020

SOPHIA COLLEGE (AUTONOMOUS)

DEPARTMENT OF MATHEMATICS & STATISTICS

COURSE DETAILS FOR MINOR:

	SEMESTER 3		SEMESTER 4
TITLE	**STATISTICAL METHODS-1**		**STATISTICAL METHODS -2**
TYPE OF COURSE DSC	**Minor**		**Minor**
CREDITS	**4**		**4**

Preamble:

In the current context, possessing a solid understanding of various statistical concepts has become crucial. Statisticians are constantly in demand in the software, research, industry, and education sectors. The various statistics course syllabi have been designed so that students can become competent in an extensive spectrum of statistical processes at the completion of each course. These techniques can be applied to further research while also applying statistical tools appropriately to a diversity of data sets in order to derive some reliable results. Different environments require for different applications of statistics. Quantitative results in various areas of research are referred to as statistics. The study of statistics is an important domain of knowledge that focuses on various techniques of collecting, presenting, analyzing, and interpreting data. It is the science of data-driven learning. The subject provides tools to facilitate decision-making in uncertain situations. Decision-making can be rendered simpler by statistics, which measures uncertainties and chance. In addition to building the foundations for the development of essentially every contemporary field, its descriptive and inferential responsibilities offer a variety of unconventional career possibilities, from financial analysis to sports analysis. The main goal of the curriculum is to get students ready to enter into a promising professional life even after graduation. Large volumes of data have been processed by computers over the past 20 years, and more complex methods of statistical analysis may be applied efficiently resulting in reliable results. Therefore, a number of fields, including agriculture, business, management, economics, finance, insurance, education, biotechnology, and medical science, among others, rely heavily on statistical techniques and procedures. Statistics can be divided into three broad categories, (1) descriptive statistics, which summarizes and describes data; (2) inferential statistics, that arrives at decisions about the population based on sample; and (3) operations research, that utilizes statistics in the fields of industrial and management.

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PROGRAMME OBJECTIVES	
PO 1	To teach students methods for effective data collection, organization, and summarization skills as well as analysis and interpretation approaches.
PO 2	Introduce students to regression analysis to model relationships between variables and make predictions.
PO 3	To provide students with a understanding of fundamental concepts - probability, random variables, and distributions.
PO 4	Encourage students to use statistical techniques to solve practical issues and assess the reliability of statistical findings in order to develop their critical thinking abilities.

PROGRAMME SPECIFIC OUTCOMES	
PSO 1	The learner will be able to understand the fundamentals of statistics, including the key concepts of probability theory, probability distributions, distribution theory, statistical inference, significance testing, and operations research.
PSO 2	The learner will be able apply the concepts taught in the practicals and will be able to analyse and evaluate data as well as come to reliable conclusions. This will prepare pupils for real-world situations.
PSO 3	Apply statistical, operations research, probability theory, time series, designs of experiments, and other principles to real-world issues
PSO 4	Know how statistics are used in fields like finance, sociology, science, and economics, among others.

SOPHIA COLLEGE (AUTONOMOUS)

Programme: Science Statistics Minor		**Semester – 3**	
Course Title: STATISTICAL METHODS-1		**Course Code: SSTA233MN**	
COURSE OBJECTIVES: 1. To understand the concepts of probability and probability distribution 2. To fit an appropriate distribution to data sets			
COURSE OUTCOMES: **Through this paper, the learner will be able to** 1. Differentiate between random and non-random experiments 2. Compute the probabilities of events 3. Understand the concept of a random variable, the probability distribution and its properties 4. Apply standard discrete probability distributions based on real life situations			
Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	**50 marks**

UNIT 1	1.1	Elementary Probability Theory : Trial, random experiment, sample point and sample space. Definition of an event. Operation of events, mutually exclusive and exhaustive events. Classical (Mathematical) and Empirical definitions of Probability and their properties. Independence of events, pairwise and mutual independence for three event, Conditional probability.	15 hours
	1.2	Theorems on Addition and Multiplication of probabilities. Bayes theorem and its applications.	
	1.3	Discrete random variable and properties of its probability distribution	

		Random variable. Definition and properties of probability distribution and cumulative distribution function of discrete random variable. Raw and Central moments (definition only) and their relationship.(upto order four). Concepts of Skewness and Kurtosis and their uses. Concept of Generating function, Moment Generating function, Cumulant Generating function, Probability generating function - M.G.F. and C.G.F- Definition & Properties. Expectation and Variance of a random variable. Theorems on Expectation & Variance.	
	1.4	Joint probability mass function of two discrete random variables, Marginal and conditional distributions. Covariance and Coefficient of Correlation. Independence of two random variables.	
UNIT 2	2.1	<u>Standard Discrete Distributions</u> Discrete Uniform Distribution– Definition, derivation of their mean and variance.	15 hours
	2.2	Bernoulli Distribution, Binomial distribution – Definition and properties, derivation of their mean and variance .	
	2.3	Poisson distribution – Definition and properties, derivation of their mean and variance. Poisson approximation to Binomial distribution(statement only).	
	2.4	Hyper geometric distribution- Derivation of their mean and variance, Binomial approximation to hyper geometric	

		distribution(statement only).	
	2.5	Fitting of distribution.	

REFERENCES

- Medhi J. : Statistical Methods, An Introductory Text, Second Edition, New Age International Ltd.
- Agarwal B.L. : Basic Statistics, New Age International Ltd.
- Spiegel M.R. : Theory and Problems of Statistics, Schaum' s Publications series. Tata McGraw-Hill.
- Kothari C.R. : Research Methodology, Wiley Eastern Limited.
- David S. : Elementary Probability, Cambridge University Press.
- Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
- Hogg R.V. and Tannis E.P. : Probability and Statistical Inference, McMillan Publishing Co. Inc.
- Pitan Jim : Probability, Narosa Publishing House.
- Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II : The World Press Private Limited, Calcutta.

PRACTICAL Course Title: STATISTICAL METHODS-1		**Course Code: SSTA233MNP**	
COURSE OUTCOMES: **Through this paper, the learner will be able to** 1. Differentiate between random and non-random experiments 2. Compute the probabilities of events 3. Understand the concept of a random variable, the probability distribution and its properties 4. Apply standard discrete probability distributions based on real life situations			
Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	

1	Probability

2	Theorems on Probability
3.	Discrete Random Variable
4	Binomial distribution
5	Poisson distribution
6	Hyper geometric distribution
7	Practicals based on the above topics using Statistical software

ASSESSMENT DETAILS:

I. **Internal Assessment (IA): 50 marks:** Two activity /test/assignment each of 25 marks.

II. **Semester End Examination (SEE):** Theory exam of 50 marks – Two hours duration

III. **Semester End Examination (SEE):** Practical exam of 50 marks – Two hours duration

SOPHIA COLLEGE (AUTONOMOUS)

Programme: Science Statistics Minor	**Semester – 4**
Course Title: STATISTICAL METHODS-2	**Course Code: SSTA244MN**

COURSE OBJECTIVES:

1. To introduce two main branch of Statistical Inferential theory – Estimation & Testing of hypothesis
2. To understand the importance of Bell curve and other distributions used in data analysis.
3. To assess population characteristics on the basis of sample using estimation and hypothesis testing theory.

COURSE OUTCOMES:

Through this paper, the learner will be able to

1. Obtain a probability density function and cumulative distribution function for a continuous random variable
2. Apply standard continuous probability distributions to different situations
3. Distinguish between point estimation and interval estimation
4. Frame a hypothesis and validate the hypothesis.

Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	**50 marks**

UNIT 1	1.1	Continuous random variable and Standard Continuous Distributions: Concept of Continuous random variable and properties of its probability distribution Probability density function and cumulative distribution function – Properties and its graphical representation. Expectation of a random variable and its properties. Measures of location, dispersion, Raw and central moments, skewness and kurtosis, M.G.F. and C.G.F- Definition & Properties.	15 hours
	1.2	Rectangular Distribution- Derivations of mean, median, variance. M.G.F, C.G.F	

		Exponential (location scale parameter) - Derivations of mean, median and variance, memory less property of exponential distribution, M.G.F, C.G.F	
	1.3	Normal Distribution , Gaussian (Normal) distribution- Properties of Normal distribution, Normal approximation to Binomial and Poisson distribution(statement only) , Use of normal tables.	
	1.4	Basic Concepts of Sampling and Estimation theory: Concept of Parameter and Statistic, Sampling distribution. Concept of bias and standard error. Central Limit theorem (statement only). Sampling distribution of sample mean and sample proportion. (For large sample only), Standard errors of sample mean and sample proportion.	
	1.5	Estimation- Point and Interval estimate (Confidence interval) of single mean, single proportion from sample of large size.	
UNIT 2	2.1	Concept of Statistical hypothesis, Null and alternate hypothesis, Simple and Composite Hypothesis, Types of errors, Critical region, Level of significance.	15 hours
	2.2	Large sample tests (using central limit theorem) ● For testing specified value of population mean	

		● For testing specified value in difference of two means ● For testing specified value of population proportion ● For testing specified value of difference of population proportion	
	2.3	Chi-Square Distribution: Degrees of freedom, P.D.F and properties , Chi-square table.	
	2.4	Applications of Chi-Square Distribution: Test of Goodness of Fit Test of independence of attributes (Yates correction)	

REFERENCES

- Medhi J. : Statistical Methods, An Introductory Text, Second Edition, New Age International Ltd.
- Agarwal B.L. : Basic Statistics, New Age International Ltd.
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- Kothari C.R. : Research Methodology, Wiley Eastern Limited.
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- Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
- Hogg R.V. and Tannis E.P. : Probability and Statistical Inference, McMillan Publishing Co. Inc.
- Pitan Jim : Probability, Narosa Publishing House.
- Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II : The World Press Private Limited, Calcutta.

PRACTICAL Course Title: STATISTICAL METHODS-2	**Course Code: SSTA244MNP**

COURSE OUTCOMES:

Through this paper, the learner will be able to

1. Obtain a probability density function and cumulative distribution function for a continuous

random variable 2. Apply standard continuous probability distributions to different situations 3. Distinguish between point estimation and interval estimation 4. Frame a hypothesis and validate the hypothesis.			
Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	

1	Continuous Random Variables
2	Uniform and Exponential distribution
3.	Normal Distribution
4	Estimation and Sampling Theory
5	Testing of Hypothesis
6	Test of Significance
7	Chi-Square
8	Practicals Using Statistical Software

ASSESSMENT DETAILS:

I. **Internal Assessment (IA): 50 marks:** Two activity /test/assignment each of 25 marks.

II. **Semester End Examination (SEE):** Theory exam of 50 marks – Two hours duration

III. **Semester End Examination (SEE):** Practical exam of 50 marks – Two hours duration