

Shri Vile Parle Kelavani Mandal's  
**MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF  
SCIENCE & AMRUTBEN JIVANLAL COLLEGE OF  
COMMERCE AND ECONOMICS (AUTONOMOUS)**

*NAAC Reaccredited 'A' grade, CGPA: 3.57,  
Granted under RUSA, FIST-DST & Star College Scheme of DBT, Government of India,  
Best College (2016-17), University of Mumbai*

Affiliated to the  
**UNIVERSITY OF MUMBAI**

**Program: B.Sc.- Statistics**

**F. Y. B. Sc.**

**Semester I & II**

**Choice Based Credit System (CBCS) with effect  
from the Academic year 2021-22**

**A.C. No: 9**

**Agenda No: 4-6 (a) (b) (c) (d)**

*ARajivalkar*

*MAAMAR*

*Bawant*

*Jain*

## PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc. program, the learners should be enriched with knowledge and be able to-

**PSO1:** Demonstrate the ability to use skills in Statistics and different practicing areas for formulating and tackling Statistics related problems and identifying and applying appropriate principles and methodologies to solve a wide range of problems associated with Statistics.

**PSO2:** Acquire:

- (i) Fundamental/systematic or coherent understanding of the academic field of Statistics and its different learning areas and applications.
- (ii) procedural knowledge that creates different types of professionals related to subject area of Statistics, including professionals engaged in government/public service and private sectors;
- (iii) skills in areas related to one's specialization area within the disciplinary/subject area of Statistics and emerging developments in the field of Statistics.

**PSO3:** Recognize the importance of statistical modeling and computing, and the role of approximation and mathematical approaches to analyze the real problems using various Statistical tools.

**PSO4:** Plan and execute Statistical experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate statistical software including programming languages, and report accurately the findings of the experiment/investigations.

**PSO5:** Demonstrate relevant generic skills and global competencies such as

- (i) problem-solving skills that are required to solve different types of Statistics related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;
- (ii) investigative skills, including skills of independent thinking of Statistics-related issues and problems

**PSO6:** Demonstrate professional behavior such as

- (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
- (ii) the ability to identify the potential ethical issues in work-related situations.
- (iii) communication skills involving the ability to listen carefully, to read texts and reference material analytically and to present information in a concise manner to different groups/audiences of technical or popular nature;
- (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Statistics and ability to translate them with popular language when needed;
- (v) ICT skills;
- (vi) personal skills such as the ability to work both independently and in a group.

## **PREAMBLE**

Credit Based Semester & Grading System (CBSGS) with continuous evaluation consisting of components of Internal Assessment & External Assessment was introduced by Mumbai University from the academic year 2011-12.

With Mithibai College being granted the autonomous status for 10 years up to 2027-28, the existing syllabus of Statistics prescribed by the university was restructured using UGC guidelines from the year 2018-19.

The semester pattern for academic transactions and the Choice Based Credit system will be followed for assessment. Continuous assessment will be an integral part of the credit system. This will help students learn the subject systematically and thoroughly.

We live in a very complicated world. Data gets generated from various activities that we undertake. Very few issues are clear-cut and without controversy. In order to understand and form an opinion about the nature we need to gather information, or data. To make the best use of data, one must have some knowledge of Statistics. Statistics is basically the art of learning from data.

A huge amount of data has been handled with the help of computers and more sophisticated statistical techniques can be used in an effective manner to draw valid conclusions. Knowledge of different aspects of Statistics has become crucial in the present scenario. There is a continuous demand for statisticians in fields of education, industry, software and research.

Statistical concepts and techniques will be taught to students so that they not only know how and when to use the statistical procedures but also to understand why these procedures should be used. Efforts will be taken to explain the ideas behind the statistical concepts and techniques. Concepts are motivated, illustrated, and explained in a way that attempts to increase one's intuition. It is only when a student develops a feel or intuition for statistics that she or he is really on the path toward making sense of data. To illustrate the diverse applications of statistics and to offer students different perspectives about the use of statistics, a wide variety of examples and problems from different reference books will be worked by students.

The syllabi of three-year B.Sc. degree course in Applied Statistics and Data Analytics are framed in such a way that the students at the end of the course, can be thorough in statistical techniques for pursuing higher studies and simultaneously can apply statistical tools judiciously to a variety of data sets to arrive at some valid conclusions.

The 2 courses of theory and practical's for Semester-I & Semester-II respectively are compulsory to all students offering Statistics at first year.

The courses are as follows: -

Semester I:	USMAST101:	Descriptive Statistics I
	USMAST102:	Statistical Methods I
Semester II:	USMAST201:	Descriptive Statistics II
	USMAST202:	Statistical Methods II

I profusely thank all the committee members for their efforts in drafting the syllabus.

- N.B.- (i) The duration of each theory lecture will be of 60 minutes. A course consists of 3 units. For each unit the number of hours allotted are 10. The total number of lecture hours for each course will thus be 30.
- (ii) There will be one practical per batch for each course. The duration of each practical will be of 2 hours, i.e. of 120 minutes.
- (iii) Thus in a week, a student will study 2 hours of theory and 2 hours of practical's.

### Evaluation Pattern for theory papers

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester End Examinations is as shown below:

#### a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	Test /Assignment.	15 marks
Component 2 (CA-2)	Test / Assignment / Project.	10 marks


#### b) Details of Semester End Examination


75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
Q1 to Q3	Attempt any two sub questions out of Three sub questions. A sub question may be further divided into 2 or more sub questions.	10	20 Marks 20 x 3 = 60 Marks
Q4	Attempt any three sub questions (out of Five sub questions)	5	15
<b>Total Marks</b>			<b>75</b>

### Evaluation Pattern for practical papers

In the Practical Exams, there will be 20% assessment for journal and laboratory work and 80% as term end component to be conducted as a semester end exam per course. For each course there will be one examiner per batch who will assess the practical examination answer books.

  
Signature  
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Approved by Vice –Principal

  
Signature  
Approved by Principal

<b>Program: B.Sc.- . (2021-22)</b>				<b>Semester : I</b>	
<b>Course: Descriptive Statistics I</b>				<b>Course Code: USMAST101</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
<b>Lecture (Hours per week)</b>	<b>Practical (Hours per week)</b>	<b>Tutorial (Hours per week)</b>	<b>Credit</b>	<b>Continuous Assessment and Evaluation (CAE) (Marks - 25)</b>	<b>Term End Examinations (TEE) (Marks-75 in Question Paper)</b>
02	02	-	2+1 = 3	25	75

**Learning Objectives:**

**UNIT I:**

- ❖ Statistics as a subject,
- ❖ The part played by Statistics in the Indian/Global Scenario.
- ❖ Data types, Presentation of data, representing the data in a tabular form.
- ❖ Qualitative and quantitative characteristics.

**UNIT II:**

- ❖ qualitative and quantitative characteristics,
- ❖ consistency of data,
- ❖ measures of association,
- ❖ Different ways of calculating the Measures of Central Tendency for different data types along with their merits and demerits.

**UNIT III:**

- ❖ The concept of spread of data and the various measures of dispersion.
- ❖ Representing the data in the form of Box - plot.
- ❖ The nature of the data using the concept of skewness and kurtosis based on quartiles and moments.

**Course Outcomes:**

After completion of the course, learners would be able to:

**(CO1: Remember)**

- CO1:** i) Understand the importance of Statistics  
ii) Identify different data types  
iii) Incorporate labels and titles correctly in diagrams and graph and give the units they have used.  
iv) Memorize all formulae required to find all measures of central tendencies and measures of dispersions.

**(CO2: Understand)**

- CO2:** i) Discuss different methods of data collection and basic sampling techniques.  
ii) Prepare contingency tables.  
iii) Understand concept of Box plot (five-point summary).  
iv) Discuss concept of skewness and kurtosis.  
v) Understand need of relative measures of dispersions.

**(CO3: Apply)**

- CO3:** i) Form a simple or complex table to represent data.  
ii) Draw and interpret: histograms, stem-and-leaf diagrams, & cumulative frequency distributions.  
iii) Apply the empirical relation between the mean, median and mode.  
iv) Apply correct formulae depending on data type under study (raw data, grouped and ungrouped frequency data).

**(CO4: Analyze)**

- CO4:** i) Distinguish between quantitative and qualitative characteristics.

- ii) Compare different measures of central tendency and study their merits and demerits.
- iii) Compare different measures of dispersion and study their merits and demerits.
- iv) Suggest best measure of central tendency and best measure of dispersion for a particular data.

**(CO5: Evaluate)**

- CO5**
- i) Find the association and its measure between attributes.
  - ii) To calculate the following: arithmetic, geometric and harmonic means, weighted arithmetic mean and combined arithmetic mean, median, mode, quartiles, deciles, percentiles, quantiles.
  - iii) To calculate the following: standard deviation, variance, quartiles, range and interquartile range.
  - iv) To calculate combined mean and variance.

**(CO6: Create)**

- CO6**
- i) Prepare schedules and questionnaires.
  - ii) Collect primary data using schedules and questionnaires and perform Descriptive Analysis.
  - iii) Perform Descriptive analysis on secondary data.
  - iv) Interpret results of descriptive analysis.

**Outline of Syllabus: (per session plan)**

Module	Description	No of hours
1	Types of Data and Graphical Representation	10
2	Basic Analysis of Categorical Data and Quantitative Data I	10
3	Basic Analysis of Quantitative Data II	10
	<b>Total</b>	<b>30</b>
<b>PRACTICALS</b>		<b>30</b>

Module	Descriptive Statistics I	No. of Hours/ Credits 30/2
1	Types of Data and Graphical Representation	10
	<p><b>Types of Data:</b></p> <ul style="list-style-type: none"> <li>• Concepts of a statistical population and sample from a population</li> <li>• Qualitative and quantitative data; nominal and ordinal data; cross sectional, time series data and panel data, discrete and continuous data; frequency and non-frequency data.</li> <li>• Different types of scales - nominal, ordinal, ratio and interval.</li> <li>• Collection and Scrutiny of Data: Primary data, designing a questionnaire and a schedule; checking their consistency. Secondary data, its major sources including some government publications.</li> <li>• Complete enumeration, controlled experiments, observational studies and sample surveys.</li> <li>• Scrutiny of data for internal consistency and detection of errors of recording. Ideas of cross-validation.</li> </ul>	5



2	Graphical Representation of Data: frequency and cumulative frequency distribution, frequency polygon, Ogives.
3	Histogram, Dot plot, Stem and Leaf diagram.
4	Classification and Tabulation.
5	Measures of Central tendency. Mean, Median and Mode.
6	Measures of Central tendency. Quartiles. Deciles, Percentiles & Quantiles.
7	Measures of Dispersion. Range, Quartile Deviation, Absolute Deviation, Box Plot.
8	Measures of Dispersion: Standard deviation, Variance, Combined variance, Missing Observations.
9	Measures of Central Tendency and Dispersion: Missing observations.
10	Missing Observations.

**RECOMMENDED READING:**

**Text Books:**

1. Prem S. Mann, Introductory Statistics, 9<sup>th</sup> edition, Wiley plus. July 2018
2. S. M. Ross Sheldon, Introductory Statistics. 4<sup>th</sup> edition, Academic Press.
3. Jay L. Devore, Probability and Statistics for Engineers and the Sciences, 9<sup>th</sup> edition, Cengage Learning.

**Reference Books**

1. Hogg R.V. and Tannis E.P., Probability and Statistical Inference, McMillan Publishing Co.
2. Statistics - An Introduction, Roger Kirk, 5<sup>th</sup> edition, Thompson Wadsworth.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams - Statistics for Business & Economics-Cengage (2019).
4. Ken Black, Business Statistics for Contemporary Decision making, 9<sup>th</sup> edition, Wiley plus.
5. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7<sup>th</sup> edition, Cengage Learning.
6. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8<sup>th</sup> edition, Pearson.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2<sup>nd</sup> edition, Springer-Verlag, New York (2012).



<b>Program: B.Sc.- (2021-22)</b>				<b>Semester : I</b>	
<b>Course: Statistical Methods I</b>				<b>Course Code: USMAST102</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
<b>Lecture (Hours per week)</b>	<b>Practical (Hours per week)</b>	<b>Tutorial (Hours per week)</b>	<b>Credit</b>	<b>Continuous Assessment and Evaluation (CAE) (Marks - 25)</b>	<b>Term End Examinations (TEE) (Marks-75 in Question Paper)</b>
02	02	-	2+1 =3	25	75

**Learning Objectives:**

**UNIT I**

To make the learner aware of

- ❖ The basic concepts of probability, conditional probability
- ❖ Use of prior probabilities and Bayes' theorem
- ❖ Independence of events

**UNIT II**

To make the learner aware of

- ❖ random variable and its use.
- ❖ types of random variable, (discrete as well as continuous).
- ❖ functions (Distribution function, raw and central moments, skewness and kurtosis) described by the random variables and their properties.
- ❖ applications of random variables in real life.
- ❖ Joint p.m.f. and p.d.f., marginal and conditional distributions, conditional expectation and variance, covariance and correlation coefficient.

**UNIT III**

To make the learner aware of

- ❖ The various standard univariate distributions.
- ❖ The properties and applications of these distributions.
- ❖ approximation of some standard distributions

**Course Outcomes:**

After completion of the course, learners would be able to:

**(CO1:Remember)**

- CO1:** i) Draw and use appropriate Venn diagrams.  
ii) Draw and use appropriate probability trees.  
iii) State p.m.f. and p.d.f. of various standard distributions and also their distribution function, skewness and kurtosis.

**(CO2:Understand)**

- CO2:** i) Distinguishing between the ideas of conditional probability and independence.  
ii) Understand and apply the ideas of randomness and variability.  
iii) Understand the need of random variable.  
iv) Understand which distribution is to be applied in different scenarios.

**(CO3:Apply)**

- CO3:** i) Apply the ideas and notation involved in set theory to simple examples.  
ii) Recall the basic axioms of probability and apply them.  
iii) Follow through, on examples, activities and relate the idea of probability to the given

<p>examples.</p> <p>iv)Identify and apply appropriate distribution in case of various real life problems.</p> <p>v)Calculate the probabilities of occurrence for different events.</p> <p><b>(CO4:Analyse)</b></p> <p><b>CO4:</b> i)Distinguish between the different discrete and continuous distributions.</p> <p><b>(CO5:Evaluate)</b></p> <p><b>CO5:</b> i)Derivation of distribution function, raw and central moments, skewness and kurtosis for various distributions.</p> <p>ii)Evaluation of distribution function, raw &amp; central moments, skewness&amp; kurtosis, conditional expectation &amp; variance, covariance &amp; correlation coefficient for various numerical problems.</p>		
<b>Outline of Syllabus: (per session plan)</b>		
<b>Module</b>	<b>Description</b>	<b>No of hours</b>
<b>1</b>	Probability -I	10
<b>2</b>	Random Variables and their Properties & Bivariate Probability Distributions.	10
<b>3</b>	Standard Univariate Discrete Distributions	10
	<b>Total</b>	<b>30</b>
<b>PRACTICALS</b>		<b>30</b>

<b>Module</b>	<b>Probability I</b>	<b>No. of Hours/Credits 30/2/3</b>
<b>1</b>	Probability	<b>10</b>
	<ul style="list-style-type: none"> <li>• Important Concepts in Probability: Random Experiment, Trial, sample point and sample space, definition of an event, operation of events, mutually exclusive and exhaustive events.</li> <li>• Definition of probability-classical and relative frequency approach to probability, Richard Von Mises, Cramer and Kolmogorov's approaches to probability, merits and demerits of these approaches (Only general ideas to be given).Statistical regularity.</li> <li>• Discrete sample space.</li> <li>• Properties of probability based on axiomatic approach,</li> <li>• Conditional probability.</li> <li>• Independence of events: pairwise and mutual independence of events.</li> <li>• Theorem on total probability.</li> <li>• Bayes' theorem and its applications.</li> </ul>	<p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">2</p> <p style="text-align: center;">2</p> <p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">2</p>
<b>2</b>	Random Variables and their Properties & Bivariate Probability Distributions.	<b>10</b>

	<p><b><u>Random Variables and their Properties:</u></b></p> <ul style="list-style-type: none"> <li>• Need of random variable.</li> <li>• Definition of discrete random variables, probability mass function.</li> <li>• Definition of continuous random variable, probability density function.</li> <li>• Distribution function, characteristics properties of df.</li> <li>• Illustrations of random variables and its properties</li> <li>• Expectation of a random variable and its properties -moments, measures of location, dispersion and its properties.</li> <li>• Raw and Central moments and their relationship upto 4<sup>th</sup> order with proof.</li> <li>• Skewness and kurtosis.</li> <li>• Applications of random variables in real life problems.</li> </ul> <p><b><u>Bivariate Probability Distributions:</u></b></p> <ul style="list-style-type: none"> <li>• Joint Probability mass function for discrete random variables.</li> <li>• Joint Probability density function for continuous random variables.</li> <li>• Properties of p.m.f. and p.d.f.</li> <li>• Marginal and conditional distributions.</li> <li>• Independence of random variables.</li> <li>• Conditional Expectation &amp; Variance, Covariance and correlation coefficient.</li> <li>• Examples involving various p.d.f.'s.</li> </ul>	<p>6</p> <p>6</p> <p>3</p>
<b>3</b>	<b>Standard Univariate Discrete Distributions</b>	<b>10</b>
	<p>Standard Univariate Discrete Distributions and their properties, derivation of mean, variance and recurrence relations.</p> <ul style="list-style-type: none"> <li>➤ Degenerate distribution</li> <li>➤ Two-point distribution</li> <li>➤ Discrete Uniform distribution</li> <li>➤ Bernoulli distribution</li> <li>➤ Binomial distribution</li> <li>➤ Poisson distribution</li> <li>➤ Hypergeometric distribution</li> <li>➤ Geometric distribution</li> <li>➤ Negative Binomial distribution.</li> </ul> <p>Approximation of Hyper geometric to Binomial and Binomial to Poisson distribution.</p>	<p>1</p> <p>2</p> <p>2</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>

<b>PRACTICALS</b>	
<b>Sr. No.</b>	<b>Topic.</b>
1	Probability: Basic.
2	Probability: Conditional and Independence.
3	Probability: Bayes Theorem.
4	Random variables: p.m.f's, c.d.f's.
5	Random variables: Expectation and Variance. Properties.
6	Random variables: Joint p.m. f's. Expectation, Variance Covariance, Correlation, Independence.
7	Standard Discrete Distributions: Uniform distribution.
8	Standard Discrete Distributions: Hypergeometric distribution.
9	Standard Discrete Distributions :Bernoulli and Binomial Distributions.
10	Standard Discrete Distributions: Poisson Distributions.
11	Standard Discrete Distributions : Geometric and Negative Binomial distributions.

### **RECOMMENDED READING:**

#### **Text Books:**

1. Prem S. Mann, Introductory Statistics, 9<sup>th</sup> edition, Wiley plus. July 2018
2. Hogg R.V. and Tannis E.P., Probability and Statistical Inference, McMillan Publishing Co.
3. S. M. Ross Sheldon, Introductory Statistics.4<sup>th</sup> edition, Academic Press.

#### **Reference Books**

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2. Statistics - An Introduction, Roger Kirk, 5<sup>th</sup> edition, Thompson Wadsworth.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams - Statistics for Business & Economics-Cengage (2019).
4. Ken Black, Business Statistics for Contemporary Decision making, 9<sup>th</sup> edition, Wiley plus.
5. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7<sup>th</sup> edition, Cengage Learning.
6. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8<sup>th</sup> edition, Pearson.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2<sup>nd</sup> edition, Springer-Verlag, New York (2012).

<b>Program: B.Sc.- Statistics</b>				<b>Semester : II</b>	
<b>Course: Descriptive Statistics II</b>				<b>Course Code: USMAST201</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
<b>Lecture (Hours per week)</b>	<b>Practical (Hours per week)</b>	<b>Tutorial (Hours per week)</b>	<b>Credit</b>	<b>Continuous Assessment and Evaluation (CAE) (Marks - 25)</b>	<b>Term End Examinations (TEE) (Marks-75 in Question Paper)</b>
02	02	-	2+1 = 3	25	75

**Learning Objectives:**

**UNIT I:**

- Understand and identify time series data.
- How a time series data is different from other data?
- To understand the different models of time series and to forecast future values.

**UNIT II**

- To express the relationship between two variables and to measure the extent of the correlation between two /three variables.
- To understand the concept of ranking of data and to find the correlation coefficient based on ranks.
- To understand the concept of Principles of least squares and to fit different types of curves to a given data set.
- To understand and calculate the regression between two variables and to learn their applications.

**UNIT III**

- To Clarify the Concept of index numbers.
- To understand why index numbers are called barometers of the economy of a country.
- To become familiar with price, quantity and values indices.
- To calculate different types of index numbers.
- To check if a index number is Consistent.
- To compute the deflated /real income.

**Course Outcomes:**

After completion of the course, learners would be able to:

**(CO1:Remember)**

**CO1:** Draw and label a scatter diagram. Define time series data. Describe the term index.

**(CO2:Understand)**

- CO2:** i) Explain the meaning of a particular value and the general limitations of r and r<sup>2</sup> as measures.
- ii) Explain the relationship between b and r.
- iii) The learner will be able to identify situations where different time series models can be applied using the methods studied.
- iv) Understand the difference between a weighted and an unweighted index.
- v) Construct and interpret a Standard index numbers for prices and quantities.
- vi) Construct and interpret a value index.
- vii) Explain how the Consumer Price Index is constructed and interpreted



	<ul style="list-style-type: none"> <li>• Method of Moving Averages</li> <li>• Method of Least Squares</li> <li>• Exponential Smoothing methods.</li> </ul> <p><b>Estimation of seasonal component by:</b></p> <ul style="list-style-type: none"> <li>• Method of simple averages;</li> <li>• Ratio to moving average method;</li> <li>• Ratio to trend method.</li> </ul>	
<b>2</b>	<b>Basic Analysis of Bivariate Data.</b>	<b>10</b>
	<ul style="list-style-type: none"> <li>• Scatter diagram.</li> <li>• Product - moment correlation coefficient and its properties.</li> <li>• Coefficient of determination. Correlation ratio.</li> <li>• Rank Correlation - Spearman's and Kendall's measures.</li> <li>• Calculation of correlation coefficient for grouped frequency distribution and tied observations.</li> <li>• <b>Simple Linear Regression:</b></li> <li>• least square estimates</li> <li>• Concepts of error in regression</li> <li>• Properties of regression coefficients and regression equations.</li> <li>• Interpretation of regression coefficients.</li> <li>• Angle between regression lines.</li> <li>• Relationship between correlation coefficient and regression coefficient.</li> </ul>	<p>2</p> <p>1</p> <p>1</p> <p>1</p> <p>2</p> <p>1</p> <p>2</p>
<b>3</b>	<b>Index Numbers:</b>	<b>10</b>
	<ul style="list-style-type: none"> <li>• Index numbers as comparative tool.</li> <li>• Stages in the construction of Price Index Numbers.</li> <li>• Measures of Simple and Composite Index Numbers.</li> <li>• Laspeyre's, Paasche's, Marshal-Edgeworth's, Drobisch &amp; Bowley's and Fisher's Index Numbers formulae.</li> <li>• Quantity Index Numbers and Value Index Numbers.</li> <li>• Time reversal test, Factor reversal test, Circular test.</li> <li>• Fixed base Index Numbers, Chain base Index Numbers.</li> <li>• Base shifting, splicing and deflating of an index number series.</li> <li>• Cost of Living Index Number.</li> <li>• Concept of Real Income based on Wholesale Price Index Number.</li> </ul>	<p>5</p> <p>5</p> <p>5</p>

### **PRACTICALS**

<b>Sr. No.</b>	<b>Topic.</b>
1	Correlation I : Scatter Plot, Correlation Ratio. Karl Pearson's Coefficient.
2	Correlation II : Coefficient of determination, Grouped frequency distribution.

3	Correlation III: Spearman's and Kendall's Measures.
4	Curve Fitting.
5	Time Series I: Estimation of Trend, Exponential Smoothing.
6	Time Series II : Estimation By Seasonal Component I
7	Time Series III : Estimation By Seasonal Component II.
8	Index Numbers I : Simple, Composite and Standard Index numbers.
9	Index Numbers II: Standard Index numbers and Tests for an Index Number.
10	Index Numbers III: Base shifting, splicing ,deflating, Cost of Living Index Number

### **Suggested Readings:**

#### **Text Books:**

1. Prem S. Mann, Introductory Statistics, 7<sup>th</sup> edition, Wiley plus.
2. S. M. Ross Sheldon, Introductory Statistics. 4<sup>th</sup> edition, Academic Press.
3. Medhi J., Statistical Methods, An Introductory Text, 2<sup>nd</sup> revised edition, New Age International Ltd.

#### **Reference Books**

1. Jay L. Devore, Probability and Statistics for Engineers and the Sciences, 9<sup>th</sup> edition, Cengage Learning.
2. Statistics - An Introduction, Roger Kirk, 5<sup>th</sup> edition, Thompson Wadsworth.
3. Ken Black, Business Statistics for Contemporary Decision making, 9<sup>th</sup> edition, Wiley plus.
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6. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7<sup>th</sup> edition, Cengage Learning.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2<sup>nd</sup> edition, Springer-Verlag, New York (2012).
8. John E. Freund's Mathematical Statistics with Applications, 8<sup>th</sup> edition, Pearson.
9. Snedecors G.W. and Cochran W.G., Statistical Methods, Iowa State University Press.



<b>Program: B.Sc.- Statistics</b>				<b>Semester : II</b>	
<b>Course: Statistical Methods II</b>				<b>Course Code: USMAST202</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
<b>Lecture (Hours per week)</b>	<b>Practical (Hours per week)</b>	<b>Tutorial (Hours per week)</b>	<b>Credit</b>	<b>Continuous Assessment and Evaluation (CAE) (Marks - 25)</b>	<b>Term End Examinations (TEE) (Marks-75 in Question Paper)</b>
02	02	-	2+1 = 3	25	75
<p><b>Learning Objectives:</b></p> <p><b>UNIT I</b></p> <ul style="list-style-type: none"> <li>❖ Standard continuous distributions and their properties.</li> <li>❖ Derivation of Mean, Median and Variance in case of various standard continuous distributions.</li> <li>❖ Memoryless/Forgetfulness property of Exponential distribution.</li> <li>❖ Importance and role of Normal distribution in statistical technique and real life.</li> <li>❖ Approximation of Binomial and Poisson distribution to Normal distribution.</li> <li>❖ Procedure of fitting of Normal and exponential distribution.</li> </ul> <p><b>UNIT II</b></p> <ul style="list-style-type: none"> <li>❖ The principles of estimation and hypothesis testing,</li> <li>❖ Acquaint learner's with the methods of estimation. (interval and point estimation)</li> <li>❖ the principles of hypothesis testing,</li> <li>❖ Constructing test procedures using normal distribution and Central Limit theorem.</li> <li>❖ Acquaint learner's with desirable properties that good estimators and hypothesis tests should have.</li> <li>❖ Construct and explain a simple chart showing the kinds of errors that can be made in hypothesis testing.</li> <li>❖ Understand different terminologies required to perform testing of hypothesis.</li> </ul> <p><b>UNIT III</b></p> <ul style="list-style-type: none"> <li>❖ various steps involved in testing of hypothesis.</li> <li>❖ difference between large sample and small sample tests.</li> <li>❖ test for specified value of population mean, difference of two means, population proportion and difference of population proportion for large sample.</li> <li>❖ chi-square distribution and its application</li> <li>❖ further applications of hypothesis testing using sampling /exact distributions.</li> <li>❖ They enable them to work with categorical variables. They will learn a new application and link it with different applications in the business and social statistical fields</li> </ul>					
<p><b>Course Outcomes:</b> After completion of the course, learners would be able to:</p> <p><b>CO1: (Remember)</b></p> <p><b>CO1:</b> i) State Memoryless/Forgetfulness property of Exponential distribution.  ii) State properties of Normal distribution.  iii) Define parameter, statistic, Concept of hypothesis, Null and alternate hypothesis, Types of errors, Critical region, Level of significance, Power.  iv) Steps involved in testing of hypothesis.</p>					

v) Probability distribution function of Chi-Square distribution and its mean and variance.

**CO2: (Understand)**

**CO2:** i) Describe conditions of approximation of Binomial and Poisson distribution to Normal distribution.

ii) Explain role of Normal distribution in statistical technique and real life.

iii) Discuss idea of sampling.

iv) Estimate values for common parameters such as means and proportions.

v) Recognize distribution of test statistics for a given test.

vi) Explain decision criterion for a given test.

**CO3 : (Apply)**

**CO3 :**i) Compute areas under the curve for a normal distribution.

ii) Apply Memoryless/Forgetfulness property of Exponential distribution at appropriate place.

iii) Appropriate use of approximation of Binomial and Poisson distribution to Normal distribution in different scenarios.

iv) Identify and apply appropriate continuous distribution in case of various real life problems.

v) Fit Normal and Exponential distribution for given data set.

vi) Calculate sample means, standard deviations and proportions, and demonstrate their use as estimators.

vii) State and apply the central limit theorem.

viii) Apply appropriate test procedure for given data.

ix) Application of Chi-Square distribution to test some special hypothesis.

**CO4 : (Analyse)**

**CO4 :** i) Distinguish between the different continuous distributions.

ii) Test for a sample mean, a sample proportion, the difference between two sample means and the difference between two sample proportions

iii) Confidence interval for the variance of a Normal population.

iv) Test of significance for specified value of variance of a Normal population.

v) Test for goodness of fit.

vi) Test for independence of attributes

viii) Yates' correction.

**CO5 : (Evaluate)**

**CO5 :**i) Derivation of Mean, Median and Variance in case of various standard continuous distributions.

ii) Evaluate values of test statistic for given data.

iii) Find table value corresponding to level of significance from available statistical tables.

iv) Find p-value

v) Conclude Decision of accept or do not accept based on decision criterion.

**CO6 : (Create)**

**CO6 :** i) Set up and design the null and alternative hypotheses for a problem and state

whether the latter is one- or two-sided, hence leading to a one- or two-tailed test.  
 ii) Perform real life experiment to prove or disprove some assumptions or certain myths using testing of hypothesis.

**Outline of Syllabus: (per session plan)**

Module	Description	No of hours
1	Standard Univariate Continuous Distributions	10
2	Sampling Distributions And Testing Of Hypothesis	10
3	Large Sample Tests and Chi-Square Distribution.	10
	<b>Total</b>	<b>30</b>
<b>PRACTICALS</b>		<b>30</b>

Module	Statistical Methods II	No. of Hours/Credits 30/2
1	<b>Standard Univariate Continuous Distributions</b>	<b>10</b>
	Standard Univariate Continuous Distributions: Standard univariate continuous distributions and their properties, derivation of their mean, median and variance. <ul style="list-style-type: none"> <li>• Uniform distribution and Triangular distribution</li> <li>• Exponential distribution (single or double parameter) Memoryless/Forgetfulness property of Exponential distribution.</li> <li>• Normal distribution.</li> <li>• Properties of Normal distribution/curve (without proof)</li> <li>• Normal approximation to Binomial and Poisson distribution (statement only).</li> <li>• Fitting of Normal and Exponential distribution. (for Practical's).</li> </ul>	5  5
2	<b>Sampling Distributions And Testing Of Hypothesis</b>	<b>10</b>
	<u>Sampling Distributions:</u> <ul style="list-style-type: none"> <li>• Concept of a statistic estimator and its sampling distribution.</li> <li>• Parameter and its estimator.</li> <li>• Concept of bias and standard error of an estimator.</li> <li>• Central Limit theorem (statement only).</li> <li>• Sampling distribution of sample means and sample proportion. (For large samples only).</li> <li>• Standard errors of sample mean and sample proportion.</li> <li>• Point and Interval estimate of single mean, single proportion from sample of large size.</li> </ul> <u>Testing Of Hypothesis</u> Statistical tests: Concept of hypothesis, Null and alternate hypothesis, Types of errors, Critical region, Level of significance, Power.	5  5



4. Ken Black, Business Statistics for Contemporary Decision making, 9<sup>th</sup> edition, Wiley plus.
5. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7<sup>th</sup> edition, Cengage Learning.
6. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8<sup>th</sup> edition, Pearson.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2<sup>nd</sup> edition, Springer-Verlag, New York (2012).
8. John E. Freund's Mathematical Statistics with Applications, 8<sup>th</sup> edition, Pearson.
9. Snedecors G.W. and Cochran W.G., Statistical Methods, Iowa State University Press