

Deccan Education Society's

Kirti M. Doongursee College of
Arts, Science and Commerce
(AUTONOMOUS)



Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Bachelor of Science
Course: F.Y.B.Sc.
Subject: Statistics

Choice Based Credit System (CBCS)
with effect from
Academic Year 2023-2024

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in Science Program will be able to	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

**Deccan Education Society's
Kirti M. Doongursee College (Autonomous)**

Proposed Curriculum as per NEP 2020

Year of implementation- 2023-24

Name of the Department: Statistics

Semester	Course Code	Course Title	Vertical	Credit
I	K23USSTATMJ111	Descriptive Statistics – I	Major	2
	K23USSTATMJ112	Statistical Methods– I	Major	2
	K23USSTATMJP11	Practical I	Major	2
	K23USSTATVC141	Elementary To Advanced Excel	VSC	2
	K23USSTATSC151	Statistics Using MS-Excel	SEC	2
II	K23USSTATMJ211	Descriptive Statistics – II	Major	2
	K23USSTATMJ212	Statistical Methods– II	Major	2
	K23USSTATMJP21	Practical II	Major	2
	K23USSTATMR221	Statistical Techniques-I	Minor	2
	K23USSTATOE231	Introduction to Statistics-I	OE	2
	K23USSTATVC241	Optimization Models	VSC	2
	K23USSTATSC251	Optimization Models Using Excel	SEC	2

Course Code	MAJOR SEM – I	Credits	Lectures /Week
K23USSTATMJ111	Paper I - Descriptive Statistics – I	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Describe the basic terminology of sampling and its methods. • Understand different data types and the skill of handling data. • Summarize quantitative and qualitative data. • Illustrate the concept of data measurement scale. • Apply measures of central tendency, measures of dispersion and location to the data. • Visualize data graphically. 			
Unit	Topics	No of Lectures	
I	<p>Types of Data and Data Condensation:</p> <p>a) Concept of population and sample. Finite, Infinite population, Notion of SRS, SRSWOR and SRSWR.</p> <p>b) Types of Characteristics, Different types of scales: nominal, ordinal, interval and ratio.</p> <p>c) Methods of data collection:</p> <p>(i) Primary data: concept of a questionnaire and a schedule.</p> <p>(ii) Secondary data.</p> <p>d) Types of data: Qualitative and quantitative data: Time series data and cross section data, discrete and continuous data.</p> <p>e) Tabulation.</p> <p>f) Dichotomous classification for two</p>	15	

	<p>and three attributes, Verification for consistency.</p> <p>g) Association of attributes: Yule's coefficient of association(Q). Yule's coefficient of Colligation(Y). Relation between Q and Y (with proof)</p> <p>h) Univariate and Bivariate frequency distribution of discrete and continuous variables. Cumulative frequency distribution.</p> <p>i) Graphical representation of frequency distribution by Histogram, frequency polygon, Cumulative frequency curve. Stem and leaf diagram.</p> <p>j) Diagrammatic representation using bar diagrams and pie chart.</p>	
II	<p>Measures of central tendency</p> <p>a) Concept of central tendency of data. Requirements of good measures of central tendency.</p> <p>b) Locational averages: Median, Mode, and Partition Values: Quartiles, Deciles, Percentiles.</p> <p>c) Mathematical averages: Arithmetic mean (Simple, weighted mean, combined mean), Geometric mean, Harmonic mean.</p> <p>d) Empirical relation between mean, median and mode.</p> <p>e) Merits and demerits of using different measures & their applicability.</p> <p>Measures of Dispersion, Skewness and Kurtosis</p> <p>a) Concept of dispersion. Requirements of good measure.</p>	15

	<p>b) Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation.</p> <p>c) Variance and Combined variance, raw moments and central moments and relations between them, their properties.</p> <p>d) Concept of Skewness and Kurtosis: Measures of Skewness: Karl Pearson's, Bowley's and Coefficient of skewness based on moments, Measure of Kurtosis.</p>	
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Textbooks:

- Gholba-Phatak-Jardosh: Descriptive Statistics, Vipul Prakashan.
- Welling-Khandeparkar: Descriptive Statistics, Manan Prakashan.
- Dr. Kore B G. and Dr. Dixit P. G.: Descriptive Statistics I, Nirali Prakashan, Pune.

Additional References:

- Gupta V. K. & Kapoor S. C.: Fundamentals of Mathematical Statistics, Sultan & Chand
- Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics
- Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.

Course Code	MAJOR SEM – I	Credits	Lectures /Week
K23USSTATMJ112	Paper 2 - Statistical Methods - I	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Define the concept of random variable and its probability distribution including properties. • Discuss basic rules of Probability. • Compute the probabilities of different events. • Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables. • Identify and relate standard discrete probability distributions to real world problems. 			
Unit	Topics	No of Lectures	
I	<p>Elementary Probability Theory</p> <p>a) Trial, random experiment, sample point and sample space.</p> <p>b) Definition of an event. Operation of events, mutually exclusive and exhaustive events.</p> <p>c) Classical (Mathematical) and Empirical definitions of Probability and their properties.</p> <p>d) Theorems on Addition and Multiplication of probabilities.</p> <p>e) Independence of events, pairwise and mutual independence for three event, Conditional probability.</p> <p>f) Bayes theorem and its applications.</p>	15	
II	<p>Discrete Random Variable and Some Standard Discrete Distributions</p> <p>a) Random variable. Definition and properties of probability distribution and cumulative</p>	15	

	<p>distribution function of discrete random variable.</p> <p>b) Raw and Central moments (definition only) and their relationship (up to order four).</p> <p>c) Expectation of a random variable. Theorems on Expectation & Variance.</p> <p>d) Joint probability mass function of two discrete random variables.</p> <p>e) Marginal and conditional distributions. Theorems on Expectation & Variance, Covariance and Coefficient of Correlation. Independence of two random variables.</p> <p>f) Discrete Uniform, Binomial and Poisson distributions and derivation of their mean and variance.</p> <p>g) Poisson approximation to Binomial distribution. Hyper geometric distribution, Binomial approximation to hyper geometric distribution.</p>	
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Textbooks:

- Gholba-Phatak: Statistical Methods, Vipul Prakashan.
- Welling-Khandeparkar: Statistical Methods, Manan Prakashan.
- Dr. Kore B. G. and Dr. Dixit P. G.: “Elementary Probability Theory”, Nirali Prakashan, Pune.

Additional References:

- Gupta V. K. & Kapoor S. C.: Fundamentals of Mathematical Statistics, Sultan & Chand.
- Mood A. M., Graybill F. A. and Boes D. C.: Introduction to the Theory of Statistics, McGraw Hill.
- Hogg, R. V., Tanis, E.A. and Rao J.M.: Probability and Statistical Inference, Seventh Edition, Pearson Education, New Delhi.

Course Code	SEM I	Credits	Lectures/ Week
K23USSTATMJP11	Practical - I	2	4
Course Outcomes:			
After successful completion of this course, students would be able to:			
<ul style="list-style-type: none"> • Represent statistical data diagrammatically and graphically. • Compute various measures of central tendency, dispersion, moments, skewness and kurtosis. • Understand Association and Independence of Attributes. • Apply the laws of probability. • Find various measures of discrete random variable and probabilities using its probability distribution. • Know the applications of some standard discrete probability distributions. 			
Paper 1			
1	Tabulation		
2	Attributes		
3	Classification of Data		
4	Diagrammatic representation		
5	Measures of central tendency		
6	Measures of dispersion		
Paper 2			
1	Probability		
2	Discrete Random Variables		
3	Bivariate Probability Distributions		
4	Binomial distribution		
5	Poisson distribution		
6	Hyper geometric distribution		

Course Code	VOCATIONAL SKILL COURSE SEM – I	Credits	Lectures /Week
K23USSTATVC141	Paper 1 - Elementary To Advanced Excel	2	2
Course Outcomes:			
After successful completion of this course, students would be able to			
<ul style="list-style-type: none"> • Know how to navigate the Excel user interface and use Excel commands. • Understand how to insert, delete, and adjust cells, column and rows. • Learn how to apply conditional formatting and work with ranges and charts. • Discover how to sort, filter and query data with database functions. • Understand how to create and modify tables, use lookup functions and apply data validation. 			
Unit	Topics	No of Lectures	
I	Elementary Excel <ol style="list-style-type: none"> a) Introduction: An overview of the screen, navigation and basic spreadsheet concepts, various selection techniques, shortcut keys, typing text or numbers into a worksheet, understanding workbooks, opening and viewing workbooks, selecting cells, creating a workbook, saving a workbook. b) Understanding the Ribbon, Customizing the Ribbon, Changing Excel's Default Options. c) Basic Functions, Mathematical functions. d) Formatting a worksheet, Proofing and Editing, Viewing, Page Layout and Printing. e) Date and Time Functions, Advanced paste special techniques. f) Sorting and Filtering. g) Protecting Excel. 	15	

II	<p>Advanced Excel</p> <ul style="list-style-type: none"> a) Logical Functions: If function, Nested if, using AND/OR/NOT functions. b) Lookup Functions: Vlookup/Hlookup, Index and Match. c) Pivot Tables: Creating, Formatting simple pivot tables, page field in a pivot table, formatting a pivot table, creating/modifying a pivot chart. d) Text Functions: Mid, Search, Left, Right, Trim, Clean, Upper, Lower, Substitute, Text, Proper, Dollar. e) Conditional Formatting. f) Advanced Filters and Sorting: Extracting records with advanced filter, Sorting by Top to Bottom, Left to Right, Sort by using Custom list. g) Hyper/Data linking: Hyper linking data, within sheet/workbook, linking and updating links between workbooks. h) Custom Views: Creating Custom views, displaying custom views, deleting custom views. i) Importing data from Database/Text Files, Web and Exporting Data. 	15
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Additional References:

- Paul McFedries and Greg Harvey: Excel All-in-one for Dummies, John Wiley and Sons, Inc.
- George Wahlberg: Excel 2022 From basic to advanced.
- Manisha Nigam: Advanced Analytics with Excel 2019, Second Edition, BPB Publications.

Course Code	SKILL ENHANCEMENT COURSE SEM – I	Credits	Lectures /Week
K23USSTATSC151	Paper 1 - Statistics Using MS-Excel	2	2
<p>Course Outcomes: After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Create different charts/diagrams using MS-Excel. • Edit chart area, titles, size. • Calculate measures of central tendency and measures of dispersion for the given data. • Compute probabilities of some standard discrete distributions. 			
Unit	Topics	No of Lectures	
I	<p>Graphical Representation Using MS-Excel</p> <p>a) Frequency distribution of the data.</p> <p>b) Graphical presentation of data: Histogram, frequency polygon, ogives using MS-Excel.</p> <p>c) Diagrammatic presentation of data: Simple bar diagram, Joint bar diagram, Subdivided bar diagram, pie chart using MS-Excel.</p> <p>d) Create a new chart, add additional data series, switch between rows and columns in source data, analyze data using Quick analysis.</p> <p>e) Resize charts, add and modify chart elements, apply chart layouts and styles, move charts to a chart sheet.</p> <p>f) Statistical operations by using SUMIFS, AVERAGEIFS and COUNTIFS functions.</p>	15	
II	<p>Elementary Statistics Using MS-Excel</p> <p>a) Computation of Measures of Central tendency for raw data Using MS Excel.</p> <p>b) Computation of Measures of Central tendency for</p>	15	

	<p>discrete and continuous data Using MS Excel.</p> <p>c) Computation of Measures of dispersion for Raw data Using MS Excel.</p> <p>d) Computation of Measures of dispersion for discrete and continuous data Using MS Excel.</p> <p>e) Computation of co-efficient of Skewness and Kurtosis Using MS Excel.</p> <p>f) Computation of probabilities and cumulative probabilities of Binomial and Poisson distribution.</p> <p>g) Fitting of Binomial distribution - Direct Method using MS Excel.</p> <p>h) Fitting of Poisson distribution - Direct Method using MS Excel.</p>	
<p>Additional References:</p> <ul style="list-style-type: none"> • Joseph Schmuller: Statistical Analysis with Excel for Dummies, Wiley Publications. • C. Bowen: Straightforward Statistics with Excel, Second Edition. • Rovai A.P.: Statistical Fundamentals: Using Microsoft Excel for Univariate and Bivariate Analysis 		

Course Code	MAJOR SEM – II	Credits	Lectures /Week
K23USSTATMJ211	Paper 1 - Descriptive Statistics – II	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Understand the concept of correlation coefficient and its relationship by using different methods of correlation. • Apply least square method to the linear / Non-linear data for establishing relationship between two variables. • Carry out a simple linear regression and interpret regression coefficient and coefficient of determination. • Compute the correlation between two variables and its interpretation. • Fit regression line and different types of curves using the method of least squares. • Identify various components of time series. • Understand concept and construction of index numbers. 			
Unit	Topics	No of Lectures	
I	<p>Correlation, Regression Analysis and Fitting of curves</p> <p>a) Scatter Diagram, Product moment correlation coefficient and its properties. Spearman’s Rank correlation. (With and without ties)</p> <p>b) Concept of linear regression. Principle of least squares. Fitting a straight line by method of least squares.</p> <p>c) Relation between regression coefficients and correlation coefficients.</p> <p>d) Concept and use of coefficient of determination (R^2).</p> <p>e) Fitting of curves reducible to linear form by transformation.</p>	15	

II	<p>Time Series</p> <p>a) Definition of time series. Its component. Models of time series.</p> <p>b) Estimation of trend by:</p> <p>i) Freehand curve method</p> <p>ii) method of semi average</p> <p>iii) Method of Moving average</p> <p>iv) Method of least squares (linear trend only)</p> <p>c) Estimation of seasonal component by:</p> <p>i) method of simple average ii) Ratio to moving average iii) Ratio to trend method.</p> <p>Index Numbers</p> <p>a) Definition of Index number</p> <p>b) Steps in the construction of an Index number.</p> <p>c) Measures of simple and composite index number.</p> <p>d) Standard Index numbers:</p> <p>(i) Laspeyre's</p> <p>(ii) Paasche's</p> <p>(iii) Dorbish & Bowley's</p> <p>(iv) Fisher's Index Number</p> <p>e) Quantity Index Numbers and Value Index Numbers. Time reversal test, Factor reversal test.</p> <p>f) Fixed base Index Numbers, Chain base Index Numbers. Base shifting, splicing and deflating.</p> <p>g) Cost of Living Index Number. Concept of Real Income.</p>	15
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Textbooks:

- Gholba-Phatak-Jardosh: Descriptive Statistics, Vipul Prakashan.
- Welling-Khandeparkar: Descriptive Statistics, Manan Prakashan.
- Dr. Kore B G. and Dr. Dixit P. G.: Descriptive Statistics I, Nirali Prakashan, Pune.

Additional References:

- Gupta V. K. & Kapoor S. C.: Fundamentals of Mathematical Statistics, Sultan & Chand
- Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics
- Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.

Course Code	MAJOR SEM – II	Credits	Lectures /Week
K23USSTATMJ212	Paper 2 - Statistical Methods – II	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Describe the importance and application of normal distribution. • Describe the problem of statistical inference. • Explain and recognize continuous random variable. • Apply the theoretical continuous probability distributions like Normal, Exponential, etc., in the relevant application areas. • Apply and interpret the central limit theorem for means. • Compute and interpret Confidence Intervals. 			
Unit	Topics	No of Lectures	
I	<p>Continuous random variable and Some Standard Continuous Distributions</p> <p>a) Concept of Continuous random variable and properties of its probability distribution.</p> <p>b) Probability density function and cumulative distribution function. Their graphical representation.</p> <p>c) Expectation of a random variable and its properties.</p> <p>d) Measures of location, dispersion, skewness and kurtosis.</p> <p>e) Raw and central moments (simple illustrations).</p> <p>f) Uniform, Exponential (location scale parameter), memoryless property of exponential distribution Derivations of mean, median and variance for Uniform and Exponential distributions.</p>	15	

II	<p>Normal distribution and Elementary topics on Estimation</p> <p>a) Normal distribution, Properties of Normal distribution (without proof).</p> <p>b) Normal approximation to Binomial and Poisson distribution (statement only). Properties of Normal curve. Use of normal tables.</p> <p>c) Sample from a distribution, Concept of a statistic, estimate and its sampling distribution. Parameter and its estimator.</p> <p>d) Concept of bias and standard error of an estimator.</p> <p>e) Central Limit theorem (statement only).</p> <p>f) Sampling distribution of sample means and sample proportion. (For large sample only).</p> <p>g) Standard errors of sample mean and sample proportion.</p> <p>h) Point and Interval estimate of single mean, single proportion from sample of large size.</p>	15
<p>Textbooks:</p> <ul style="list-style-type: none"> • Gholba-Phatak: Statistical Methods, Vipul Prakashan. • Welling-Khandeparkar: Statistical Methods, Manan Prakashan. • Dr. Kore B. G. and Dr. Dixit P. G.: “Elementary Probability Theory”, Nirali Prakashan, Pune. <p>Additional References:</p> <ul style="list-style-type: none"> • Rohatgi V. K. and Saleh A. K. Md. E. (2002): An introduction to probability and statistics, John Wiley and Sons. • Mood A. M., Graybill F. A. and Boes D. C.: Introduction to the Theory of Statistics, McGraw Hill. • Hogg, R. V., Tanis, E.A. and Rao J.M.: Probability and Statistical Inference, Seventh Edition, Pearson Education, New Delhi. 		

Course Code	SEM II	Credits	Lectures/ Week
K23USSTATMJP21	Practical - II	2	4
<p>Course Outcomes: After successful completion of this course, students would be able to:</p> <ul style="list-style-type: none"> • Compute correlation coefficient, interpret its value. • Compute regression coefficient, interpret its value. • Compute the index numbers. • Find various measures of continuous random variable and probabilities using its probability distribution. • Compute probabilities of standard continuous probability distributions. • Know some standard continuous probability distributions with real life situations. 			
Paper 1			
1	Correlation analysis		
2	Regression analysis		
3	Fitting of curve		
4	Time series		
5	Index number		
Paper 2			
1	Continuous Random Variables		
2	Uniform and Exponential Distribution		
3	Normal Distribution		
4	Applications of central limit theorem and normal approximation		
5	Estimation		

Course Code	MINOR SEM – II	Credits	Lectures /Week
K23USSTATMR221	Paper 1 - Statistical Techniques-I	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Describe the basic terminology of sampling and its methods. • Understand different data types and the skill of handling data. • Summarize quantitative and qualitative data. • Apply measures of central tendency, measures of dispersion and location to the data. • Visualize data graphically. 			
Unit	Topics	No of Lectures	
I	<p>Data processing and Graphing techniques:</p> <p>a) Definition of Statistics. Concept of population and sample. Finite, Infinite population, Notion of SRS, SRSWOR and SRSWR.</p> <p>b) Types of Characteristics.</p> <p>c) Methods of data collection:</p> <p>(j) Primary data: concept of a questionnaire and a schedule.</p> <p>(ii) Secondary data.</p> <p>d) Types of data: Qualitative and quantitative data: Time series data and cross section data, discrete and continuous data.</p> <p>e) Tabulation.</p> <p>f) Univariate frequency distribution of discrete and continuous variables. Cumulative frequency distribution.</p>	15	

	<p>g) Graphical representation of frequency distribution by Histogram, frequency polygon, Cumulative frequency curve(Ogive)</p> <p>h) Diagrammatic representation using bar diagrams and pie chart.</p>	
II	<p>Measures of central tendency</p> <p>a) Concept of central tendency of data. Requirements of good measures of central tendency.</p> <p>b) Locational averages: Median and Mode.</p> <p>c) Mathematical averages: Arithmetic mean (Simple, weighted mean, combined mean).</p> <p>d) Empirical relation between mean, median and mode.(Without proof)</p> <p>e) Merits and demerits of using different measures & their applicability.</p> <p>f) Estimating Median and Mode from graph.</p> <p>Measures of Dispersion</p> <p>a) Concept of dispersion. Requirements of good measure.</p> <p>b) Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation.</p> <p>c) Variance and Combined variance.</p>	15
<p>Textbooks:</p> <ul style="list-style-type: none"> • Gholba-Phatak-Jardosh: Descriptive Statistics, Vipul Prakashan. • Welling-Khandeparkar: Descriptive Statistics, Manan Prakashan. • Dr. Kore B G. and Dr. Dixit P. G.: Descriptive Statistics I, Nirali Prakashan, Pune. <p>Additional References:</p> <ul style="list-style-type: none"> • Gupta V. K. & Kapoor S. C.: Fundamentals of Mathematical Statistics, Sultan & Chand • Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics • Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi. 		

Course Code	OPEN ELECTIVE SEM – II	Credits	Lectures /Week
K23USSTATOE231	Paper 1 - Introduction to Statistics-I	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • (Describe the basic terminology of sampling and its methods. • Understand different data types and the skill of handling data. • Summarize quantitative and qualitative data. • Apply measures of central tendency, measures of dispersion and location to the data. • Visualize data graphically. 			
Unit	Topics	No of Lectures	
I	<p>Elementary Data processing and Graphing techniques:</p> <p>a) Definition of Statistics. Concept of population and sample. Finite, Infinite population, Notion of SRS, SRSWOR and SRSWR.</p> <p>b) Types of Characteristics.</p> <p>c) Methods of data collection:</p> <p style="padding-left: 20px;">(i) Primary data: concept of a questionnaire and a schedule.</p> <p style="padding-left: 20px;">(ii) Secondary data.</p> <p>d) Types of data: Qualitative and quantitative data: Time series data and cross section data, discrete and continuous data.</p> <p>e) Tabulation.</p> <p>f) Univariate frequency distribution of discrete and continuous variables. Cumulative frequency distribution.</p>	15	

	<p>g) Graphical representation of frequency distribution by Histogram, frequency polygon, Cumulative frequency curve.</p> <p>a) Diagrammatic representation using bar diagrams and pie chart.</p>	
II	<p>Measures of central tendency</p> <p>a) Concept of central tendency of data. Requirements of good measures of central tendency.</p> <p>b) Locational averages: Median, Mode.</p> <p>c) Mathematical averages: Arithmetic mean (Simple, weighted mean, combined mean).</p> <p>d) Merits and demerits of using different measures & their applicability.</p> <p>e) Estimating Median and Mode from graph.</p> <p>Measures of Dispersion</p> <p>a) Concept of dispersion. Requirements of good measure.</p> <p>b) Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation.</p> <p>a) Variance and Combined variance.</p>	15
<p>Textbooks:</p> <ul style="list-style-type: none"> • Gholba-Phatak-Jardosh: Descriptive Statistics, Vipul Prakashan. • Welling-Khandeparkar: Descriptive Statistics, Manan Prakashan. • Dr. Kore B G. and Dr. Dixit P. G.: Descriptive Statistics I, Nirali Prakashan, Pune. <p>Additional References:</p> <ul style="list-style-type: none"> • Gupta V. K. & Kapoor S. C.: Fundamentals of Mathematical Statistics, Sultan & Chand • Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics • Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi. 		

Course Code	VOCATIONAL SKILL COURSE SEM – II	Credits	Lectures /Week
K23USSTATVC241	Paper 1 - Optimization Models	2	2
<p>Course Outcomes:</p> <p>After successful completion of this course, students would be able to</p> <ul style="list-style-type: none"> • Formulate and solve a linear programming problem graphically and using simplex method. • Obtain dual of a given problem and solve the primal from the optimum solution of a primal. • Solve a transportation problem and its variants using various methods and optimize it. • Solve an assignment problem and its variants using Hungarian. 			
Unit	Topics	No of Lectures	
I	<p>Linear Programming Problem (L.P.P.) :</p> <p>a) Mathematical Formulation: Maximization & Minimization.</p> <p>b) Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution.</p> <p>c) Graphical Solution for problems with two variables.</p> <p>d) Simplex method of solving problems with two or more variables.</p> <p>e) Linear Programming Problem using MS-Excel.</p>	15	
II	<p>Transportation Problem:</p> <p>a) Concept, Mathematical Formulation.</p> <p>b) Concepts of Solution, Feasible Solution.</p> <p>c) Initial Basic Feasible Solution by Matrix Minima Method and Vogel's Approximation Method.</p> <p>d) Optimal Solution by MODI Method.</p>	15	

	<p>Optimality test, Improvement procedure.</p> <p>e) Variants in Transportation Problem: Unbalanced, Maximization type.</p> <p>f) Transportation problem using MS-Excel.</p> <p>Assignment Problem:</p> <p>a) Concept. Mathematical Formulation</p> <p>b) Solution by Hungarian method.</p> <p>c) Variants in Assignment Problem: Unbalanced, Maximization type.</p> <p>d) Assignment problem using MS-Excel.</p>	
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Textbooks:

- Milan Gholba: Operations Research 1, Vipul Prakashan.

Additional References:

- Operations Research: S. D. Sharma. 11th edition, Kedar Nath Ram Nath & Company.
- Operations Research: H. A. Taha, 6th edition, Prentice Hall of India.
- Quantitative Techniques For Managerial Decisions: J. K. Sharma, (2001), MacMillan India Ltd.

Course Code	SKILL ENHANCEMENT COURSE SEM – II	Credits	Lectures /Week
K23USSTATSC251	Paper 1 - Optimization Models Using Excel	2	2
Course Outcomes:			
After successful completion of this course, students would be able to			
<ul style="list-style-type: none"> • Solve Linear programming problem using MS-Excel. • Find optimum solution of transportation problem using MS-Excel. • Obtain solution for an assignment problem using MS-Excel. 			
Unit	Topics	No of Lectures	
I	Transportation Problem: <ol style="list-style-type: none"> Concept, Mathematical Formulation. Concepts of Solution, Feasible Solution. Initial Basic Feasible Solution by Matrix Minima Method and Vogel's Approximation Method. Optimal Solution by MODI Method. Optimality test, Improvement procedure. <ol style="list-style-type: none"> Variants in Transportation Problem: Unbalanced, Maximization type. Transportation Problem Using MS-Excel. 	15	
II	Assignment Problem: <ol style="list-style-type: none"> Concept. Mathematical Formulation Solution by Hungarian method. Variants in Assignment Problem: Unbalanced, Maximization type. Assignment Problem Using MS-Excel 	15	
Additional References:			
<ul style="list-style-type: none"> • Vikas Singla: Operations Research Using Excel, 1st Edition, Boca Raton. 			

Evaluation Scheme for First Year (UG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 10 marks

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hours

Theory question paper pattern: All questions are compulsory.

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subject carries 50 Marks.
- Duration: 2 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.