SOPHIA COLLEGE

(AUTONOMOUS)

Affiliated to the University of Mumbai

Syllabi for Semesters I to IV

Program : B. A./B.Sc

Course: Statistics

(Choice Based Credit System with effect from the year 2018-19)

FYBSc STATISTICS SEMESTER I

DESCRIPTIVE STATISTICS-1				
Course Code	Unit	Topics	Credits	L/Week
SBSSTT101	I	Types of Data and Data Condensation	2	3
	II	Classification of Data and Measures of central tendency		
	III	Measures of Dispersion, Skewness & Kurtosis		
STATISTICAL METHODS -1				
SBSSTT102	I	Elementary Probability Theory	2	3
	II	Concept of Discrete random variable and properties of its probability distribution		
	III	Standard Discrete Distributions		
SBSSTTP1		Practicals based on all courses in theory	2	6

FYBSc STATISTICS SEMESTER II

DESCRIPTIVE STATISTICS-2				
Course Code	Unit	Topics	Credits	L/Week
SBSSTT201	I	Correlation and regression analysis	2	3
	II	Time Series		
	III	Index Numbers		
STATISTICAL METHODS -2				
SBSSTT202	I	Continuous random variable and Standard Continuous Distributions.	2	3
	II	Basic Concepts of Sampling and Estimation theory		
	III	Testing of Hypothesis		
SBSSTTP2		Practicals based on all courses in theory	2	6

FYBA STATISTICS SEMESTER I

DESCRIPTIVE STATISTICS-1				
Course Code	Unit	Topics	Credits	L/Week
SBASTT101	I	Types of Data and Data Condensation	2	3
	II	Classification of Data and Measures of central tendency		
	III	Measures of Dispersion, Skewness & Kurtosis		
SBASTTP1		Practicals based on all courses in theory	1	3

FYBA STATISTICS SEMESTER II

DESCRIPTIVE STATISTICS-2				
Course Code	Unit	Topics	Credits	L/Week
SBASTT201	I	Correlation and regression analysis	2	3
	II	Time Series		
	III	Index Numbers		
SBASTTP2		Practicals based on all courses in theory	1	3

SYBA STATISTICS SEMESTER III

STATISTICAL METHODS -1				
Course Code	Unit	Topics	Credits	L/Week
SBASTT301	I	Elementary Probability Theory	2	3
	II	Concept of Discrete random variable and properties of its probability distribution		
	III	Standard Discrete Distributions		
OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-1				
SBASTT301	I	Linear Programming Problem	2	3
	II	Transportation Problem		
	III	Assignment Problem and sequencing		
SBASTTP3		Practicals based on topics of the syllabus	2	6

SYBA STATISTICS SEMESTER IV

STATISTICAL METHODS -2				
Course Code	Unit	Topics	Credits	L/Week
SBASTT401	I	Continuous random variable and Standard Continuous Distributions	2	3
	II	Basic Concepts of Sampling and Estimation theory:		
	III	Testing of hypothesis		
OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-2				
SBASTT402	I	PERT& CPM Analysis	2	3
	II	Game Theory		
	III	Decision Theory		
SBASTTP4		Practicals based on topics of the syllabus	2	6

List of Course Titles and Course Codes

Department: Maths & Statistics(Statistics) **Year : 2018-19**

Class	Sem	Paper No.	Course Title	Course Credits	Course Codes
FYBSc	I	I	Descriptive Statistics 1	2	SBSSTT101
FYBSc	I	II	Statistical Methods 1	2	SBSSTT102
FYBSc	I		Practicals	2	SBSSTTP1
FYBSc	II	I	Descriptive Statistics 2	2	SBSSTT201
FYBSc	II	II	Statistical Methods 2	2	SBSSTT202
FYBSc	II		Practicals	2	SBSSTTP2

Head of Department _____

List of Course Titles and Course Codes

Department: Maths & Statistics **Year: 2018 -19**

Class	Sem	Paper No.	Course Title	Course Credits	Course Code
FYBA	I	I	Descriptive Statistics 1	2	SBASTT101
FYBA	I	I	Practical	1	SBASTTP1
FYBA	II	I	Descriptive Statistics 2	2	SBASTT102
FYBA	II	I	Practical	1	SBASTTP2
SYBA	III	II	Statistical Methods 1	2	SBASTT301
SYBA	III	III	OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS 1	2	SBASTT302
SYBA	III		Practicals	2	SBASTTP3
SYBA	IV	II	Statistical Methods 2	2	SBASTT401
SYBA	IV	III	OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS 2	2	SBASTT402
SYBA	IV	I	Practicals	2	SBASTTP4

Head of Department _____

SEMESTER – I FYBSc & FYBA

DESCRIPTIVE STATISTICS-1

Learning Objectives:

1. To introduce the technique of data collection and its presentation.

2. To emphasize the need for numerical summary measures for data analysis.

Unit I - Types of Data and Data Condensation: 15 Lectures

i. Concept of population and sample. Finite ,Infinite population ,Notion of SRS SRSWOR and SRSWR

ii. Types of Characteristics, Different types of scales: nominal, ordinal, interval and ratio.

iii. Collection of Primary data: concept of a questionnaire and a schedule, Secondary data

iv. Types of data: Qualitative and quantitative data; Time series data and cross section data, discrete and continuous data.

v. Tabulation and Uni-variate frequency distribution of discrete and continuous variables. Cumulative frequency distribution, Bi-variate frequency distribution.

vi. Dichotomous classification- for two and three attributes, Verification for Consistency and Diagrams, Representation of data using bar diagrams(Simple, Multiple, Segmented and Percentage) , Pie diagram

vii. Association of attributes: Yule's coefficient of association Q. Yule's coefficient of Colligation.

Unit II – Graphical representation and Measures of central tendency

15 Lectures

i) Graphical representation of frequency distribution by Histogram, frequency polygon, Cumulative frequency curve. Stem and leaf diagram.

ii)Measures of central tendency

a) Concept of central tendency of data. Requirements of good measure

b) Locational averages: Median, Mode, and Partition Values: Quartiles, Deciles, and Percentiles.

c) Mathematical averages Arithmetic mean (Simple, weighted mean, combined mean), Geometric mean, Harmonic mean,

d) Empirical relation between mean, median and mode

e) Merits and demerits of using different measures & their applicability

Unit III - Measures of Dispersion, Skewness & Kurtosis: 15 Lectures

a) Concept of dispersion. Requirements of good measure.

b) Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation.

c) Variance and Combined variance, raw moments and central moments and relations between them and their properties

d) Concept of Skewness and Kurtosis: Measures of Skewness: Karl Pearson's, Bowley's and Coefficient of skewness based on moments. Measure of Kurtosis,

e) Box Plot

Distribution of the topics for the Practicals:

1. Tabulation
2. Attributes
3. Classification of Data
4. Diagrammatic representation.
5. Measures of central tendency
6. Measures of dispersion
7. Practical using Excel and R

i)Classification of Data and Diagrammatic representation.

ii)Measures of central tendency

iii)Measures of dispersion

References:

1. Agarwal B.L.: Basic Statistics, New Age International Ltd.
2. Spiegel M.R. : Tehory and Problems of Statistics, Schaum's Publications series, Tata Mc-Graw Hill
3. Kothari C.R. : Research Methodology: Wiley Eastern Limited.
4. Goon A.M. , Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II: The World Press Private Limited, Calcutta

SEMESTER – II FYBSc & FYBA

DESCRIPTIVE STATISTICS-2

LEARNING OBJECTIVE : To orient students on techniques of data analysis.

UNIT – I: Correlation and regression analysis **15 Lectures**

a) Scatter Diagram, Product moment correlation coefficient and its properties. Spearman's Rank correlation.(With and without ties)

b) Concept of linear regression. Principle of least squares. Fitting a straight line by method of least squares.

c) Relation between regression coefficients and correlation coefficient. Concept and use of coefficient of determination (R^2).

d) Fitting a quadratic curve by method of least squares.

e) Fitting of curves reducible to linear form by transformation.

UNIT – II : Time Series: **15 Lectures**

a) Definition of time series and its component. Models of time series.

b) Estimation of trend by: i) Freehand curve method ii) method of semi average iii)Method of Moving average iv) Method of least squares(linear trend only)

c) Estimation of seasonal component by i) method of simple average ii) Ratio to moving average iii)Ratio to trend method (iv) Link Relative Method

Unit III - Index Numbers **15 Lectures**

a) Index numbers as comparative tool. Stages in the construction of Price Index numbers.

b) Fixed base Index Numbers, Chain base Index Numbers. Base shifting, splicing

c) Composite & Weighted Index Numbers. Laspeyre's, Paasche's, Marshal-Edgeworth's, Dorbisch & Bowley's and Fisher's Index Numbers formula.

d) Quantity Index Numbers and Value Index Numbers Time reversal test, Factor reversal test, Circular test.

e) Cost of Living Index Number, Concept of Real Income based on Wholesale Price Index Number , deflating.

Distribution of the topics for the Practicals:

1. Correlation analysis
2. Regression analysis
3. Fitting of curve
4. Time series
5. Index number-I
6. Index number-II
7. Practical using Excel and R

i) Correlation analysis
ii) Regression analysis
iii) Fitting of curve

References:

1. Agarwal B.L.: Basic Statistics, New Age International Ltd.
2. Spiegel M.R. : Tehory and Problems of Statistics, Schaum's Publications series, Tata Mc-Graw Hill
3. Kothari C.R. : Research Methodology: Wiley Eastern Limited.
4. Goon A.M. , Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II: The World Press Private Limited, Calcutta

FYBSC/ SYBA Statistics Paper II
STATISTICAL METHODS-1

SEMESTER I/III

Pre-requisite:
1. Set Theory
2. Permutation & Combination

UNIT – I: Elementary Probability Theory : 15 Lectures

i. Trial, random experiment, sample point and sample space.
ii. Definition of an event. Operation of events, mutually exclusive and exhaustive events.
iii. Classical (Mathematical) and Empirical definitions of Probability and their properties.
iv. Theorems on Addition and Multiplication of probabilities.
v. Independence of events, pairwise and mutual independence for three event, Conditional probability
vi. Bayes theorem and its applications.

UNIT – II: Discrete random variable and properties of its probability distribution : 15 Lectures

i. Discrete random variable. Definition and properties of probability distribution and cumulative distribution function of discrete random variable.
ii. Raw and Central moments (definition only) and their relationship.(upto order four).
iii. Concepts of Skewness and Kurtosis and their uses.
iv. Expectation and Variance of a random variable. Theorems on Expectation & Variance.
v. Joint probability mass function of two discrete random variables, Marginal and conditional distributions. Covariance and Coefficient of Correlation. Independence of two random variables.

UNIT – III: Standard Discrete Distributions 15 Lectures

i. Discrete Uniform Distribution– Definition, derivation of their mean and variance.
ii. Bernoulli Distribution, Binomial distribution – Definition and properties, derivation of their mean and variance .
iii. Poisson distribution – Definition and properties, derivation of their mean and variance. Poisson approximation to Binomial distribution(statement only).
iv. Hyper geometric distribution- Derivation of their mean and variance, Binomial approximation to hyper geometric distribution(statement only).
v. Fitting of distribution.

Distribution of the topics for the Practicals

i. Probability.
ii. Discrete Random Variables
iii. Bi-variate Probability Distributions.
iv. Binomial distribution
v. Poisson distribution
vi. Hyper geometric distribution
vii. Practicals Using EXCEL and R- Binomial, Poisson, Hyper geometric distribution

REFERENCES

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

FYBSC/ SYBA Statistics Paper II
STATISTICAL METHODS-1

SEMESTER II/IV

UNIT – I: Continuous random variable and Standard Continuous Distributions

15 lectures

i. Concept of Continuous random variable and properties of its probability distribution
ii. Probability density function and cumulative distribution function – Properties and its graphical representation.
iii. Expectation of a random variable and its properties. Measures of location, dispersion, skewness and kurtosis. Raw and central moments
iv. Rectangular Distribution- Derivations of mean, median and variance
v. Exponential (location scale parameter) - Derivations of mean, median and variance' memory less property of exponential distribution

UNIT – II: Normal Distribution , basic Concepts of Sampling and Estimation theory: **15 lectures**

i. Gaussian (Normal) distribution- Properties of Normal distribution, Normal approximation to Binomial and Poisson distribution(statement only) , Use of normal tables.
ii. Concept of Parameter and Statistic, estimator and estimate
iii. Sampling distribution.
iv. Concept of bias and standard error of an estimator.
v. Central Limit theorem (statement only).
vi. Sampling distribution of sample mean and sample proportion. (For large sample only)
vii. Standard errors of sample mean and sample proportion.
viii. Point and Interval estimate (Confidence interval) of single mean, single proportion from sample of large size.

UNIT – III: Testing of hypothesis: **15 lectures**

i. Concept of Statistical hypothesis
ii. Null and alternate hypothesis
iii. Simple and Composite Hypothesis
iv. Types of errors, Critical region, Level of significance.
v. 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

vi. Application of Chi-Square Distribution:
    - Test of Goodness of Fit
    - Test of independence of attributes (Yates correction)

Distribution of the topics for the Practicals

i. Continuous Random Variables
ii. Uniform and Exponential distribution
iii. Normal Distribution
iv. Estimation and Sampling Theory
v. Testing of Hypothesis
vi. Test of Significance
vii. Practicals Using EXCEL and R

REFERENCES

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

SYBA Statistics Paper III
OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-1

SEMESTER III

UNIT – I: Linear Programming Problem(L.P.P) : 15 Lectures

i. Definition, Mathematical Formulation(Maximization and Minimization) Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution, Slack, Surplus & Artificial variable
ii. Standard form, Canonical form
iii. Graphical Method & Simplex Algorithm to obtain the solution to an L.P.P. Problems involving Unique Solution, Multiple Solution, Unbounded Solution and Infeasible Solution.
iv. Big M method.
v. Concept of Duality & its economic interpretation.

UNIT – II: Transportation Problem : 15 Lectures

i. Definition, Mathematical Formulation Concepts of Feasible solution, Basic feasible solution, Optimal and multiple solutions.
ii. Initial Basic Feasible Solution using North-West Corner rule, Matrix Minima Method , Vogel's Approximation Method.
iii. MODI Method for optimality.
iv. Problems involving unique solution, multiple solutions, degeneracy, maximization, prohibited route(s) and production costs, Unbalanced Transportation problem.

UNIT – III: Assignment Problem and sequencing 15 Lectures

Assignment:

i. Definition, Mathematical formulation. Solution by Hungarian Method. Unbalanced Assignment problems.
ii. Problems involving Maximization & prohibited assignments
iii. Travelling salesman problem

Sequencing : Processing n Jobs through 2 and 3 Machines and 2 jobs through m Machines.

Distribution of the topics for the Practicals

i. Formulation and Graphical Method
ii. Simplex Method
iii. Transportation
iv. Assignment
v. Sequencing

REFERENCES

1. Schaum Series book in O.R. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.
2. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
3. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
4. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.
5. Operations Research: S.D.Sharma.11th edition, KedarNath Ram Nath& Company.
6. Operations Research: H. A.Taha.6th edition, Prentice Hall of India.
7. PERT and CPM, Principles and Applications: Srinath. 2nd edition, East-west press Pvt. Ltd.

10 Kantiswarup, P.K. Gupta, Manmohan : Operations Research, Twelth edition, Sultan Chand & sons

11 Bronson R. : Theory and problems of Operations research, First edition, Schaum's Outline series

12 Vora N. D. : Quantitative Techniques in Management, Third edition, McGraw Hill Companies.

13. Bannerjee B. : Operation Research Techniques for Management, First edition, Business Books

SYBA Statistics Paper III
OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-2

SEMESTER IV

UNIT – I: CPM and PERT **15 lectures**

i. Concept of project as an organized effort with time management.
ii. Objective and Outline of the techniques.
iii. Diagrammatic representation of activities in a project
iv. Gantt Chart and Network Diagram.
v. Slack time and Float times. Determination of Critical path.
vi. Probability consideration in project scheduling.
vii. Project cost analysis. Updating.

UNIT – II: Game Theory **15 lectures**

i. Definitions of Two persons Zero Sum Game, Saddle Point, Value of the Game, Pure and Mixed strategy, Optimal solution of two person zero sum games. Dominance property, Derivation of formulae for (2x2) game.
ii. Graphical solution of (2xn) and (mx2) games. Solving game using LPP.

UNIT – III: Decision Theory **15 lectures**

i. Decision making under uncertainty: Laplace criterion, Maximax (Minimin) criterion, Maximin (Minimax) criterion, Hurwitz α criterion, Minimax Regret criterion. Decision making under risk: Expected Monetary Value criterion, Expected Opportunity Loss criterion, EPPI, EVPI.
ii. Bayesian Decision rule for Posterior analysis.
iii. Decision tree analysis along with Posterior probabilities.

Distribution of the topics for the Practicals

i. CPM-Drawing Network
ii. CPM- Determination of Critical Path and related problems
iii. PERT
iv. Game Theory-1
v. Game Theory -2
vi. Decision Theory Under Uncertainty
vii. Decision Theory Under Risk
viii. Decision Tree analysis

REFERENCES

1. Schaum Series book in O.R. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.
2. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.
3. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
4. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.
5. Operations Research: S.D.Sharma.11th edition, KedarNath Ram Nath& Company.
6. Operations Research: H. A.Taha.6th edition, Prentice Hall of India.
7. PERT and CPM, Principles and Applications: Srinath. 2nd edition, East-west press Pvt. Ltd.

13 Kantiswarup, P.K. Gupta, Manmohan : Operations Research, Twelth edition, Sultan Chand & sons

14 Bronson R. : Theory and problems of Operations research, First edition, Schaum's Outline series

15 Vora N. D. : Quantitative Techniques in Management, Third edition, McGraw Hill Companies.

16 Bannerjee B. : Operation Research Techniques for Management, First edition, Business Books

Pattern Paper:

Assessment of Practical Core Courses Per Semester per course

1. Semester work, Documentation, Journal ……. 10 Marks.
2. Semester End Practical Examination ---------- 40 Marks

Semester End Examination

Theory: At the end of the semester, Theory examination of 2.5 hours duration and 75 marks based on the three units shall be held for each course.

Pattern of **Theory question** paper at the end of the semester for **each course**.

1. There shall be four questions, first three questions shall be of 20 marks on each unit and fourth question will be of 15 marks based on Unit I,II and Unit III.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Sub-questions	Maximum marks
Q1	Part A: two theory sub-questions each one is of 8 marks and attempt any one. Part B: Four sub-questions, each one is of 4 marks and attempt any three.	20 each
Q2		
Q3		
Q4	There shall be 6 sub-questions each one is of 5 marks and attempt any 3.	15
Total marks		75

Internal Assessment :

The IA consists of test/project of 20 marks and class participation of 5 marks.