

Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN
INSTITUTE OF SCIENCE, SATARA**

(AUTONOMOUS)

Lead college of

Karmaveer Bhaurao Patil University, Satara

Reaccredited by NAAC with 'A+' Grade

Proposed Syllabus For

Bachelor of Science

Part - I

STATISTICS (Major)

Syllabus to be implemented w. e. f. June 2023

As Per NEP 2020

SYLLABUS FOR BACHELOR OF SCIENCE PART-I: STATISTICS

Preamble

This syllabus is framed to give sound knowledge with an understanding of Statistics to undergraduate students in the first year of three years B.Sc. degree course. Students learn Statistics as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Statistics popular, interesting, and encouraging to the students for higher studies including research. The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other Universities and the needs of industries and research. The syllabus is prepared after discussion at length with several faculty members of the subject and experts from industries and research fields. The units of the syllabus are well-defined, taking into consideration the level and capacity of students.

General Objectives of the Program:

1. To nurture academicians with focus and commitment to their subject.
2. To shape good and informed citizens from the students entering into the program.
3. To create a skilled workforce to match the requirements of society.
4. To impart knowledge of science based on this program.
5. To Developing a scientific attitude is the major objective to make the students open-minded critical and curious.
6. To develop skills in practical work, experiments, and laboratory materials and equipment along with collection and interpretation of scientific data to contribute to science.

General Outcomes of the Program:

1. The students will graduate with proficiency in the subject of their choice.
2. The students will be eligible to continue higher studies in the subject.
3. The students will be eligible to pursue her studies abroad.
4. The students will be eligible to appear the examinations for jobs in government organizations.
5. The students will be eligible to apply for jobs with a minimum requirement of B.Sc.

Program-Specific Objectives:

1. To understand the basic concepts of data and the scale of measurement of data.
2. To enable comparison data by using measures of central tendency and dispersion.
3. To establish a relationship between two or more variables and predict the value by regression analysis.
4. To calculate probability and measures of probability for discrete and continuous distributions.
5. To make inferences about a population from sample data.
6. To design the process and extend the sampling.
7. To enable the use of statistical techniques in time series, industry, demography, etc.
8. To understand and develop the necessary computer skill in practical by using MS Excel, R-software, and C-Programming.

Program-Specific Outcomes The students will acquire;

1. Knowledge of descriptive statistics and inferential statistics, sampling techniques.
2. Knowledge about univariate, bivariate, and multivariate data analysis.
3. Knowledge about correlation and regression analysis.
4. Knowledge of probability, discrete and continuous probability distribution, and various measures of these distributions.
5. Knowledge of different methods of estimation about the inference of parameters of standard discrete and continuous probability distributions.
6. Knowledge of applied statistics such as 'index number', 'time series', 'demography', 'reliability theory', 'industrial statistics', and 'operation research'.

B.Sc. Part I

1. **Title:** Statistics
2. **Year of Implementation:** June 2023
3. **Duration:** The course shall be full time
4. **Pattern:** Semester Pattern
5. **Medium of Instruction:** English
6. **Course Structure:**

B.Sc. - I: Semester – I

Sr. No	Course Title	Theory			Practical		
		Course Code	Lecture per week	Credits	Course Title	Lecture per week	Credits
1	Descriptive Statistics – I	BST 111	4	2	Practical Course – I BSP 113	4	2
2	Elementary Probability Theory	BST 112		2			

B.Sc. - I: Semester – II

Sr. No	Course Title	Theory			Practical		
		Course Code	Lecture per week	Credits	Course Title	Lecture per week	Credits
1	Descriptive Statistics – II	BST 121	4	2	Practical Course – II BSP 123	4	2
2	Discrete Probability Distributions	BST 122		2			

Title of Papers of B.Sc. I Course:

B.Sc. I, Semester – I, Theory: 30 lectures, 30 hours (for each paper)

BST 111: Descriptive Statistics – I

BST 112: Elementary Probability Theory

Practical: 60 Hours

BSP 113: Practical Course – I

B.Sc. I, Semester – II, Theory: 30 lectures, 30 hours (for each paper)

BST 121: Descriptive Statistics – II

BST 122: Discrete Probability Distributions

Practical: 60 Hours

BSP 123: Practical Course – II

B. Sc. Part-I (Semester-I)
BST-111: Descriptive Statistics-I (Credits: 02)
Theory: 30 Lectures (30 Hours)

Course Objectives: Students should be able to...

1. understand techniques of data collection and its presentation.
2. compute various measures of central tendencies and measures of dispersion.
3. summarize data through central tendencies and measures of dispersion.
4. apply measures of central tendencies in the computation of Index number

Credits (Total Credits 2)	SEMESTER – I BST 111 DESCRIPTIVE STATISTICS -I	No.of hours per unit
Unit – I	Data Collection, Presentation, and Measures of Central Tendency	(08)
	1.1 Definition and scope of Statistics, the concept of the statistical population sample, qualitative & quantitative data, variables. Scales of measurements: Nominal, Ordinal, Interval & Ratio. Collection and Summarization of univariate data and frequency distribution 1.2 Data Presentation: Diagrammatic & graphical presentation with real applications- Pie diagram, line diagram. Simple, multiple & partial bar diagrams, histograms, ogive curves 1.3 Mathematical and positional averages: Data Presentation: A.M, G.M, H.M, the relation between them and their properties. Median, Mode, and Partition values	
Unit - II	Measures of Dispersion and Moments, Skewness and Kurtosis	(08)
	2.1 Measures of Dispersion: Range, Quartile deviation, Mean deviation, Variance, standard deviation, coefficient of variation. Various properties of these measures and their utility. 2.2 Raw and central moments, factorial moments, and central moments in terms of raw moments up to 4 th order.	

	2.3 Definition, Measures of skewness: Bowley's coefficient, Karl Pearson's coefficient, a measure of skewness based on the moment 2.4 Kurtosis: Definition, measures of kurtosis, Sheppard's correction.	
Unit - III	Index Number	(07)
	3.1 Meaning and utility of index numbers, problems in the construction of index numbers. Types of index numbers: price, quantity, and value. 3.2 Unweighted and weighted index numbers using (i) aggregate method, (ii) average of price or quantity relative method. 3.3 Index numbers using; Laspeyre's, Paasche's, and Fisher's methods. Tests of index numbers: unit test, time reversal test, and factor reversal tests. Illustrative examples.	
Unit - IV	Theory of Attributes	(07)
	4.1 Notation, Dichotomous, class frequency, order of class, positive and negative class frequency, ultimate class frequency, fundamental set of class frequency. Relationship among class frequencies (up to three attributes). 4.2 Concept of consistency, conditions of consistency (up to three attributes). Independence and association of two attributes, Yule's coefficient of association (Q), coefficient of colligation (Y) Relation between Q and Y.	

Course Outcomes: Students will be able to ...

1. calculate the arithmetic mean, Geometric mean, and Harmonic Mean
2. differentiate between qualitative and quantitative data.
3. construct graphs and diagrams from data and interpret the result.
4. compute the Skewness and Kurtosis of the data.

Reference Books:

1. Newbold P., William L. C., Thorne B., 2021, Statistics for Business and Economics, Pearson
2. Larson R., Farber B., 2020, Elementary Statistics, Picturing World, Pearson
3. Triola M. F., 2020, Essentials of Statistics, Pearson
4. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
5. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
6. Agarwal B. L, 2015, Statistics, New Age International P Ltd. Delhi.
7. Rohatgi V. K., Saleh E. 2008, An Introduction to Probability and Statistics, Wiley
8. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.

B. Sc. Part-I (Semester-I)
BST-112: Elementary Probability Theory (Credits: 02)
Theory: 30 Lectures (30 Hours)

Course Objectives: Students should be able to ...

1. understand the concept of probability and its applications.
2. differentiate between random and non-random experiments.
3. compute probabilities of different events.
4. solve the examples of probability

Credits (Total Credits 2)	SEMESTER – I BST 112 ELEMENTARY PROBABILITY THEORY	No.of hours per unit
Unit - I	Probability	(08)
	<p>1.1. Concepts of experiments and random experiments. Definitions: Sample space, Discrete sample space (finite and countably infinite), Event, Elementary event, Compound event favorable event Definitions of Mutually exclusive events, Exhaustive events, Impossible events, and certain events. Power set $\mathcal{P}(\Omega)$ (sample space consisting of at most 3 sample points). Illustrative examples.</p> <p>1.2. Equally likely outcomes (events). Apriori (classical) definition of probability of an event. Axiomatic definition of probability with reference to a finite and countably infinite sample space.</p> <p>1.3. Proof of the results: i) $P(\Phi) = 0$, $P(A^c) = 1 - P(A)$, ii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only). iv) If $A \subset B$, $P(A) \leq P(B)$, v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq [P(A) + P(B)]$. Definition of probability in terms of odd ratio. Illustrative examples based on results.</p>	
Unit - II	Conditional Probability and Independence of Events	(08)
	<p>2.1. Definition of the conditional probability of an event. Multiplication theorem for two events. Partition of sample space. The idea of Posteriori probability, Statement and proof of Baye's theorem, examples of Baye's theorem.</p> <p>2.2 Elementary examples of probability and conditional probability. Concept of Independence of two events. Proof of the result that if A and B are independent then, A and B^c ii) A^c and B, iii) A^c and B^c are independent. Pairwise and Mutual Independence for three events. Elementary examples.</p>	
Unit - III	Univariate Probability Distributions (Finite sample space)	(07)
	<p>3.1 Definition of a discrete random variable. Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.) of a discrete random variable, Properties of c.d.f. (statements only).</p> <p>3.2 Probability distribution of a function of a random variable. Median and Mode of a univariate discrete probability distribution.</p>	
Unit - IV	Mathematical Expectation (Univariate random variable)	(07)

	<p>4.1. Definition of expectation of a random variable, the expectation of a function of a random variable. Results on expectation, i) $E(c) = c$, where c is a constant, ii) $E(aX + b) = aE(X) + b$, where a and b are constants.</p> <p>4.2 Definitions of mean, and variance of univariate distributions. Effect of change of origin and scale on mean and variance.</p> <p>4.3 Definition of probability generating function (p.g.f.) of a random variable. Effect of change of origin and scale on p.g.f. Definition of mean and variance by using p.g.f. Examples.</p>	
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Course Outcomes: Students will be able to ...

1. calculate probabilities and conditional probabilities.
2. identify the types of events.
3. compute the expectation of the univariate discrete random variable.
4. apply the concept of probability in real-life situations

Reference Books:

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, 2015 Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-I)
BSP-113: Practical Course – I (Credits: 02)
Practical: 60 Hours

Course Objectives: Students should be able to ...

1. understand the Consistency, Association of Attributes.
2. differentiate between variables and attributes.
3. compute various measures of central tendency and dispersion
4. calculate different types of index numbers.

Credits (Total Credits 2)	SEMESTER – I BSP 113 Practical Course - I (Based on Course BST 111 and BST 112)	No.of hours 60
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List of Practicals	
	<ol style="list-style-type: none"> 1. Diagrammatic & Graphical representation of the frequency distribution I (Line diagram, Bar diagram, Pie diagram). 2. Diagrammatic & Graphical representation of the frequency distribution II (Histogram, frequency polygon, frequency curve) 3. Diagrammatic & Graphical representation of the frequency distribution III (Location of Mode, Ogive curves, Location of Partition values) 4. Measures of Central Tendency I (ungrouped data) 5. Measures of Central Tendency II (grouped data) 6. Measures of Dispersion I (ungrouped data) 7. Measures of Dispersion II (grouped data) 8. Moments, Skewness, and Kurtosis (ungrouped data). 9. Moments, Skewness, and Kurtosis (grouped data). 10. Attributes (consistency, Association & Independence). 11. Applications of Probability-I (Elementary Examples based on the definition of probability by using combination and permutation, examples based on expectations) 12. Applications of Probability-II (Examples based on Conditional expectation and Variance, 13. Applications on Bayes' theorem. 14. Applications on Independence Probability 15. Index Number <p>(*Note: Expt. No. 1 to 9 are expected to solve using MS-EXCEL/ R-Software)</p>

Course Outcomes: Students will be able to ...

1. draw diagrams and graphs for frequency distribution
2. compute moments, skewness, and kurtosis.
3. find the probabilities of events and conditional probabilities.
4. summarized data and find averages as well as the spread of the data

Reference Books:

1. Ross S., 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, Statistics, 2015, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, Statistical Methods, 2002, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-II)
BST-121: Descriptive Statistics-II (Credits: 02)
Lectures (30 Hours)

Course Objectives: Students should be able to ...

1. understand the concept of correlation and regression.
2. compute the correlation of bivariate data.
3. interpret the relationship between two numeric variables.
4. build a Simple Linear regression model to predict the response variable.

Credits (Total Credits 2)	SEMESTER – II BST 121 DESCRIPTIVE STATISTICS -II	No.of hours per unit
Unit – I	Correlation	(08)
	<p>1.1. Bivariate Data, Covariance: Definition, Effect of change of origin and scale, Concept of correlation between two variables, Types of correlation. Scatter diagram and its utility.</p> <p>1.2. Karl Pearson’s coefficient of correlation (r): Definition, Computation for ungrouped and grouped data, Properties: i) $-1 \leq r \leq 1$, ii) Effect of change of origin and scale. (iii) Interpretation when $r = -1, 0, 1$. Spearman’s rank correlation coefficient: Definition, Computation (with and without ties).</p> <p>1.3 Derivation of the formula for without ties (In case of ties students are expected to compute Karl Pearson Correlation Coefficient), Illustrative examples.</p>	
Unit – II	Regression	(08)
	<p>2.1 Concept of Dependent and independent variables. Concept of regression, Lines of regression</p> <p>2.2 Identification of response and predictor variables and the relation between them.</p> <p>2.3 Meaning of regression, the difference between correlation and regression, Connection between correlation and regression. Fitting of line $Y = a + bX$. a and b are estimated using the least square method. Regression coefficient. Explained and unexplained variation, coefficient of determination, standard error of an estimate of a line of regression.</p> <p>2.4 Interchanging the role of X and Y we can study some more properties</p> <p>i) $b_{xy} \times b_{yx} = r^2$</p> <p>ii) $b_{xy} \times b_{yx} \leq 1$</p> <p>iii) $(b_{xy} + b_{yx}) / 2 \geq r$</p> <p>iv) Effect of change of origin and scale on regression coefficients,</p> <p>v) The point of intersection of two regression lines.</p> <p>vi) Angle between two regression lines.</p>	
Unit – III	Multiple and Partial Correlation (for trivariate data only)	(07)
	<p>3.1. Concept of multiple correlations. Definition of multiple correlation coefficient $R_{i.jk}$, derivation of a formula for multiple correlation</p>	

	<p>coefficient. Properties of multiple correlation coefficient; i) $0 \leq R_{i,jk} \leq 1$, (ii) $R_{i,jk} > r_{ij}$, (iii) $R_{i,jk} > r_{ik}$ $i = j = k = 1, 2, 3$. $i \neq j$, $i \neq k$. Interpretation of $R_{i,jk} = 1$, $R_{i,jk} = 0$,</p> <p>3.2. Coefficient of multiple determination R1.23. Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of the formula for $r_{ij.k}$. Properties of partial correlation coefficient (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} \cdot b_{ji.k} = r_{ij.k}^2$, relation between simple, multiple, and partial correlations. Illustrative Examples.</p>	
Unit – IV	Multiple Linear Regression (for trivariate data only)	(07)
	<p>4.1 Concept of multiple linear regression, Plane of regression, Yule's notation, correlation matrix. Fitting of regression plane by a method of least squares.</p> <p>4.2 The definition of partial regression coefficients, and their interpretation. Residual: definition, order, properties, derivation of mean and variance, Covariance between residuals. Illustrative Examples.</p>	

Course Outcomes: Students will be able to ...

1. estimate regression coefficients.
2. differentiate between dependent variables and independent variables for a simple linear regression model.
3. compute correlation coefficients, partial and multiple correlation coefficients.
4. apply simple linear regression to real-life data.

Reference Books:

1. Newbold P., William L. C., Thorne B., 2021, Statistics for Business and Economics, Pearson
2. Larson R., Farber B., 2020, Elementary Statistics, Picturing World, Pearson
3. Triola M. F., 2020, Essentials of Statistics, Pearson
4. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
5. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
6. Agarwal B. L, 2015, Basic Statistics, New Age International P Ltd. Delhi.
7. Saxena S., Kapoor J. N., 2010, Mathematical Statistics, Sultan Chand and Sons, Delhi. Kapoor V. K, Gupta S. C, 2008, Fundamental of Mathematical Statistics, S Chand and Sons, Delhi.
8. Gupta S. P, Statistical Methods, 2002, Sultan Chand and Sons, New Delhi.
9. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-II)
BST-122: Discrete Probability Distributions (Credits: 02)
Theory: 30 Lectures (30 Hours)

Course Objectives: Students will be able to ...

1. understand the fundamental concepts of discrete probability distributions.
2. differentiate between univariate discrete probability distributions and bivariate probability distributions.
3. analyze and interpret real-world data using discrete probability distributions.
4. apply probability theory to solve real-life problems.

Credits (Total Credits 2)	SEMESTER – II BST 122 DISCRETE PROBABILITY DISTRIBUTIONS	No.of hours per unit
Unit – I	Some Standard Discrete Probability Distribution (finite sample space)	(08)
	<p>1.1 Bernoulli Distribution: p.m.f., mean, variance, distribution of a sum of independent and identically distributed Bernoulli variables.</p> <p>1.2 Discrete Uniform Distribution: p.m.f., mean and variance</p> <p>1.3 Binomial Distribution: Binomial random variable, p.m.f. with parameters (n, p), Recurrence relation for successive probabilities, Computation of probabilities of different events, mean and variance, mode, skewness, p.g.f., Additive property of binomial variates. Examples.</p> <p>1.4 Hypergeometric Distribution: p.m.f. with parameters (N, M, n), Computation of probability of different events, Recurrence relation for successive probabilities, mean and variance of distribution assuming $n \leq N - M \leq M$, approximation of Hypergeometric to Binomial. Examples.</p>	
Unit – II	Some Standard Discrete Probability Distributions (countably infinite sample space)	(08)
	<p>2.1 Definition of a discrete random variable (defined on countably infinite sample space)</p> <p>1.1 Poisson Distribution: Definition of Poisson with parameter λ. Mean, variance, probability generating function (p.g.f.). Recurrence relation for successive Probabilities, Additive property of Poisson distribution. Poisson distribution as a limiting case of Binomial distribution, examples.</p> <p>2.2 Geometric Distribution: Definition of Geometric with parameter p. Mean, Variance, distribution function, p.g.f., Lack of memory property, examples.</p> <p>2.3 Negative Binomial Distribution: Definition of Negative Binomial with parameters (k, p), Geometric distribution is a particular case of Negative Binomial distribution, Mean, Variance, p.g.f., Recurrence relation for successive probabilities, examples</p>	
Unit – III	Bivariate Discrete Probability Distribution	(07)
	3.1 Definition of a bivariate discrete random variable (X, Y) on finite sample space, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof).	

	3.2. Computation of probabilities of events in the bivariate probability distribution, the concept of the marginal and conditional probability distribution, independence of two discrete r.v.s, Examples	
Unit – IV	Mathematical Expectation (Bivariate Random Variable)	(07)
	4.1 Mathematical Expectation: Definition of expectation of a function of r.v. in bivariate distribution, Theorems on expectations: (i) $E(X+Y) = E(X) + E(Y)$ (ii) $E(XY) = E(X) \cdot E(Y)$ when X and Y are independent, expectation and variance of a linear combination of two discrete r.v.s. 4.2 The definition of conditional mean, conditional variance, covariance and correlation coefficient, $Cov(aX+bY, cX+dY)$, the distinction between uncorrelated and independent variables, joint p.g.f, proof of the p.g.f. of a sum of two independent r.v.as the product of their p.g.f. examples.	

Course Outcomes: Students will be able to ...

1. explain the discrete probability distributions such as binomial, geometric, Poisson, and hypergeometric distributions.
2. compute mean, variance, and standard deviations for discrete probability distributions.
3. find the expectations of the bivariate probability distributions.
4. evaluate the strengths and limitations of different probability models and select appropriate models for specific applications.

Reference Books:

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, 2015 Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-II)
BSP-123: Practical Course – II(Credits: 02)
60 Hours

Course Objectives: Students should be able to ...

1. understand the basic concepts of regression analysis and correlation.
2. analyze and interpret data from regression and correlation techniques.
3. apply binomial distribution and Poisson distribution to solve real-life problems.
4. compute marginal and conditional probability distributions from bivariate probability distributions.

Credits (Total Credits 2)	SEMESTER – II BSP 123 Practical Paper - II (Based on Course BST 121 and BST 122)	No.of hours 60
List of Practicals		
	<ol style="list-style-type: none"> 1. Correlation coefficient 2. Regression 3. Multiple correlation coefficients. 4. Partial correlation coefficients 5. Multiple regressions - I. 6. Multiple regressions - II. 7. Bivariate Discrete distribution I. (Marginal Distribution) 8. Bivariate Discrete distribution II (Conditional distribution) 9. Bivariate Discrete distribution III (Expectations /conditional expectations) 10. Bivariate Discrete distribution IV (variances / conditional variance) 11. Bivariate Discrete distribution V (covariance/correlation coefficient) 12. Applications of Binomial Distributions. 13. Applications of Poisson Distributions. 14. Applications of Hypergeometric Distribution. 15. Applications of Geometric and Negative Binomial Distributions. (*Note: Expt. No.4,5 8,9,10 are expected to solve using MS-EXCEL/ R-Software) 	

Course Outcomes: Students will be able to ...

1. apply concepts of the probability distributions
2. write p.m.f for some standard probability distributions.
3. compute and interpret the regression equation, regression coefficients, and correlation coefficients
4. analyze and interpret real–world data using regression and correlation techniques.

Reference Books :

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press
4. Agarwal B. L, 2015, Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P., 2011, An Introduction to the Theory of Probability, World Scientific

Publishing Company.

6. Saxena S., Kapoor J. N., 2010, Mathematical Statistics, Sultan Chand & Sons, Delhi.
7. Kapoor V. K, Gupta S. C, 2008, Fundamental of Mathematical Statistics, S Chand and Sons, Delhi.
8. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, New Delhi.
9. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN
INSTITUTE OF SCIENCE,
SATARA**

(AUTONOMOUS)

Lead college of
Karmaveer Bhaurao Patil University, Satara

Reaccredited by NAAC with 'A+' Grade

Proposed Syllabus For

Bachelor of Science

Part - I

STATISTICS (Minor)

Syllabus to be implemented w .e. f. June 2023

As Per NEP 2020

B.Sc. Part I

1. **Title:** Statistics
2. **Year of Implementation:** June 2023
3. **Duration:** The course shall be full time
4. **Pattern:** Semester Pattern
5. **Medium of Instruction:** English
6. **Structure of Course:**

B.Sc. - I: Semester – I

Sr. No	Course Title	Theory			Practical		
		Course Code	Lecture per week	Credits	Course Title	Lecture per week	Credits
1	Elementary Statistics – I	BST 114	4	2	Practical Course – I BSP 116	4	2
2	Probability	BST 115		2			

B.Sc. - I: Semester – II

Sr. No	Course Title	Theory			Practical		
		Course Code	Lecture per week	Credits	Course Code	Lecture per week	Credits
1	Elementary Statistics – II	BST 124	4	2	Practical Course – II BSP 126	4	2
2	Probability Distributions	BST 125		2			

Title of Papers of B.Sc. I Course:**B.Sc. I, Semester – I, Theory: 30 lectures, 30 hours (for each paper)****BST 114: Elementary Statistics – I****BST 115: Probability****Practical: 60 Hours****BSP 116: Practical Course – I****B.Sc. I, Semester – II, Theory: 30 lectures, 30 hours (for each paper)****BST 124: Elementary Statistics – II****BST 125: Probability Distributions****Practical: 60 Hours****BSP 126: Practical Course – II**

B. Sc. Part-I (Semester-I)
BST-114: Elementary Statistics-I (Credits: 02)
Theory: 30 Lectures (30 Hours)

Course Objectives: Students should be able to...

1. understand techniques of data collection and its presentation.
2. compute various measures of central tendencies and measures of dispersion.
3. summarize data through central tendencies and measures of dispersion.
4. apply measures of central tendencies in the computation of Index number

Credits (Total Credits 2)	SEMESTER – I BST 114 ELEMENTARY STATISTICS -I	No.of hours per unit
Unit – I	Data Collection and Presentation	(08)
	1.1 Definition and scope of Statistics, the concept of the statistical population sample, qualitative & quantitative data, variables. Scales of measurements: Nominal, Ordinal, Interval & Ratio. Collection and Summarization of univariate data and frequency distribution 1.2 Data Presentation: Diagrammatic & graphical presentation with real applications- Pie diagram, line diagram. Simple, multiple & partial bar diagrams, histograms, ogive curves	
Unit - II	Measures of Central Tendency and Dispersion	(08)
	2.1 Mathematical and positional averages: Data Presentation: M, G.M, H.M, the relation between them and their properties. Median, Mode, and Partition values 2.2 Measures of Dispersion: Range, Quartile deviation, Mean deviation, standard deviation, coefficient of variation. Various properties of these measures and their utility.	

Unit - III	Moments, Skewness, and Kurtosis	(07)
	3.1 Raw and central moments, factorial moments, and central moments in terms of raw moments up to 4 th order. 3.2 Definition, Measures of skewness: Bowley's coefficient, Karl Pearson's coefficient, a measure of skewness based on the moment 3.3 Kurtosis: Definition, measures of kurtosis, Sheppard's correction.	
Unit - IV	Index Number	(07)
	4.1 Meaning and utility of index numbers, problems in the construction of index numbers. Types of index numbers: price, quantity, and value. Unweighted and weighted index numbers using (i) aggregate method, (ii) average of price or quantity relative method. 4.2 Index numbers using; Laspeyre's, Paasche's, and Fisher's methods. Tests of index numbers: unit test, time reversal test, and factor reversal tests. Illustrative examples.	

Course Outcomes: Students will be able to ...

1. calculate the arithmetic mean, Geometric mean, and Harmonic Mean
2. differentiate between qualitative and quantitative data.
3. construct graphs and diagrams from data and interpret the result.
4. compute various types of index numbers from the provided data.

Reference Books

1. Newbold P., William L. C., Thorne B., 2021, Statistics for Business and Economics, Pearson
2. Larson R., Farber B., 2020, Elementary Statistics, Picturing World, Pearson
3. Triola M. F., 2020, Essentials of Statistics, Pearson
4. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
5. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
6. Agarwal B. L, 2015, Statistics, New Age International P Ltd. Delhi.
7. Rohatgi V. K., Saleh E. 2008, An Introduction to Probability and Statistics, Wiley
8. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.

B. Sc. Part-I (Semester-I)
BST-115: Probability (Credits: 02)
Theory: 30 Lectures (30 Hours)

Course Objectives: Students should be able to ...

1. understand the concept of probability and its applications.
2. differentiate between random and non-random experiments.
3. compute probabilities of different events.
4. solve the examples of probability

Credits (Total Credits 2)	SEMESTER – I BST 112 PROBABILITY	No.of hours per unit
Unit – I	Sample Space and Events	(08)
	<p>1.1 Concepts of Experiments and Random experiments. Definitions: Sample space, Discrete sample space (finite and countably infinite), Event, Elementary event, Compound event favorable event Definitions of Mutually exclusive events, Exhaustive events, Impossible events, and certain events. Power set $P(\Omega)$ (sample space consisting of at most 3 sample points). Illustrative examples.</p> <p>1.2 Equally likely outcomes (events). Apriori (classical) definition of probability of an event. Equiprobable sample space, Simple examples of computation of probability of the events based on Permutations and Combinations.</p>	
Unit – II	Conditional Probability and Independence of Events	(08)
	<p>2.1 Axiomatic definition of probability with reference to a finite and countably infinite sample space.</p> <p>2.2 Proof of the results: i) $P(\Phi) = 0$, $P(A^c) = 1 - P(A)$, ii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only). iv) If $A \subset B$, $P(A) \leq P(B)$, v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq [P(A) + P(B)]$.</p> <p>2.3 Definition of probability in terms of odd ratio. Illustrative examples based on results.</p>	
Unit - III	Conditional Probability and Independence of Events	(07)
	<p>3.1 Definition of the conditional probability of an event. Multiplication theorem for two events. Partition of sample space. Idea of Posteriori probability, Statement and proof of Baye's theorem, examples of Baye's theorem.</p> <p>3.2 Elementary examples of probability and conditional probability. Concept of Independence of two events. Proof of the result that if A and B are independent then, A and B^c, ii) A^c and B, iii) A^c and B^c are independent. Pairwise and Mutual Independence for three events. Elementary examples.</p>	
Unit - IV	Univariate Probability Distributions (Finite sample space)	(07)
	<p>4.1 Definition of a discrete random variable. Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.) of a discrete random variable, Properties of c.d.f. (statements only).</p> <p>4.2 Probability distribution of a function of a random variable. Median and Mode of a univariate discrete probability distribution.</p>	

Course Outcomes: Students will be able to ...

1. compute probabilities and conditional probabilities.
2. identify the types of events.

3. compute the conditional probability of an event.
4. apply the concept of probability in real-life situations

Reference Books:

1. Ross S., 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, 2015 Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-I)
BSP-116: Practical Course – I (Credits: 02)
Practical: 60 Hours

Course Objectives: Students should be able to ...

1. understand the Consistency, Association of Attributes.
2. differentiate between variables and attributes.
3. compute various measures of central tendency and dispersion
4. calculate different types of index numbers.

Credits (Total Credits 2)	SEMESTER – I BSP 113 Practical Paper - I	No.of hours (60)
	List of Practicals	
	<ol style="list-style-type: none"> 1. Diagrammatic and Graphical representation of the frequency distribution I (Line diagram, Bar diagram, Pie diagram. 2. Diagrammatic and Graphical representation of the frequency distribution II (Histogram, frequency polygon, frequency curve) 3. Diagrammatic & Graphical representation of the frequency distribution III (Location of Mode, Ogive curves, Location of Partition values) 4. Measures of Central Tendency I (ungrouped data) 5. Measures of Central Tendency II (grouped data) 6. Measures of Dispersion I (ungrouped data) 7. Measures of Dispersion II (grouped data) 8. Moments, Skewness, and Kurtosis I (ungrouped data). 9. Moments, Skewness, and Kurtosis II (grouped data). 10. Attributes (consistency, Association & Independence). 	

	11. Applications of Probability-I (Elementary Examples based on the definition of probability by using combination and permutation, examples based on expectations) 12. Applications of Probability-II (Examples based on Conditional expectation and Variance, 13. Applications on Bayes' theorem. 14. Applications on Independence Probability 15. Index Number (*Note: Expt. No. 1 to 9 are expected to solve using MS-EXCEL/ R-Software)	
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Course Outcomes: Students will be able to...

1. draw diagrams and graphs for frequency distribution
2. compute moments, skewness, and kurtosis.
3. find the probabilities of events and conditional probabilities.
4. summarized data and find averages as well as the spread of the data

Reference Books

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, Statistics, 2015, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, Statistical Methods,2002, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-II)
BST-124: Elementary Statistics-II (Credits: 02)
Theory: 30 Lectures (30 Hours)

Course Objectives: Students should be able to ...

1. understand the concept of correlation and regression.
2. compute the correlation of bivariate data.
3. interpret the relationship between two numeric variables.
4. build a Simple Linear regression model to predict response variables.

Credits (Total Credits 2)	SEMESTER – II BST 124 ELEMENTARY STATISTICS -II	No.of hours per unit
Unit – I	Theory of Attributes	(08)
	<p>1.1 Notation, Dichotomous, class frequency, order of class, positive and negative class frequency, ultimate class frequency, fundamental set of class frequency. Relationship among class frequencies (up to three attributes).</p> <p>1.2 Concept of consistency, conditions of consistency (up to three attributes). Independent and association of two attributes, Yule's coefficient of association (Q), coefficient of colligation (Y) Relation between Q and Y.</p>	
Unit – II	Correlation	(08)
	<p>2.1 Bivariate Data, Covariance: Definition, Effect of change of origin and scale, Concept of correlation between two variables, Types of correlation. Scatter diagram and its utility. Karl Pearson's coefficient of correlation (r): Definition, Computation for ungrouped and grouped data, Properties: i) $-1 \leq r \leq 1$, ii) Effect of change of origin and scale. (iii) Interpretation when $r = -1, 0, 1$.</p> <p>2.2 Spearman's rank correlation coefficient: Definition, Computation (with and without ties). Derivation of the formula for without ties (In case of ties students are expected to compute Karl Pearson Correlation Coefficient), Illustrative examples.</p>	
Unit - III	Regression	(07)
	<p>3.1 Concept of dependent and independent variables. Concept of regression, Lines of regression</p> <p>3.2 Identification of response and predictor variables and the relation between them.</p> <p>3.3 Meaning of regression, difference between correlation and regression, Connection between correlation and regression. Fitting of line $Y = a + bX$. a and b are estimated using the least square method. Regression coefficient. Explained and unexplained variation, coefficient of determination, standard error of an estimate of a line of regression.</p> <p>3.4 Interchanging the role of X and Y we can study some more properties</p> <ul style="list-style-type: none"> i) $b_{xy} \times b_{yx} = r^2$ ii) $b_{xy} \times b_{yx} \leq 1$ iii) $(b_{xy} + b_{yx}) / 2 \geq r$ iv) Effect of change of origin and scale on regression coefficients, v) The point of intersection of two regression lines. vi) Angle between two regression lines. 	
Unit – IV	Multiple and Partial Correlation (for trivariate data only)	(07)

	<p>4.1. Concept of multiple correlations. Definition of multiple correlation coefficient $R_{i.jk}$, derivation of the formula for multiple correlation coefficient. Properties of multiple correlation coefficient; (i) $0 \leq R_{i.jk} \leq 1$, (ii) $R_{i.jk} > r_{ij}$, (iii) $R_{i.jk} > r_{ik}$ $i = j = k = 1, 2, 3$. $i \neq j$, $i \neq k$. Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$.</p> <p>4.2 Coefficient of multiple determination R^2. Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of the formula for $r_{ij.k}$. Properties of partial correlation coefficient (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} \cdot b_{ji.k} = r_{ij.k}^2$, The relation between simple, multiple, and partial correlations. Illustrative Examples.</p>	
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Course Outcomes: Students will be able to ...

1. calculate Correlation, Regression multiple, and Partial correlation coefficients.
2. differentiate between dependent variables and independent variables for a simple linear regression model.
3. compute correlation coefficients, partial and multiple correlation coefficients.
4. apply simple linear regression to real-life data.

Reference Books

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, 2015 Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-II)

BST125: Probability Distributions (Credits: 02)

Theory: 30 Lectures (30 Hours)

Course Objectives: Students should be able to ...

1. understand the fundamental concepts of discrete probability distributions.
2. differentiate between univariate discrete probability distributions and bivariate probability distributions.
3. analyze and interpret real-world data using discrete probability distributions.
4. apply probability theory to real-life problems.

Credits (Total Credits 2)	SEMESTER – II BST 125 PROBABILITY DISTRIBUTIONS	No.of hours per unit
Unit - I	Mathematical expectation (Univariate random variable)	(07)
	<p>1.1 Definition of expectation of a random variable, expectation of a function of a random variable. Results on expectation, i) $E(c) = c$, where c is a constant, ii) $E(aX + b) = aE(X) + b$, where a and b are constants.</p> <p>1.2 Definitions of mean, and variance of univariate distributions. Effect of change of origin and scale on mean and variance.</p> <p>1.3 Definition of probability generating function (p.g.f.) of a random variable. Effect of change of origin and scale on p.g.f. Definition of mean and variance by using p.g.f. Examples.</p>	
Unit - II	Some Standard Discrete Probability Distribution (finite sample space)	(08)
	<p>2.1 Bernoulli Distribution: p.m.f., mean, variance, distribution of the sum of independent and identically distributed Bernoulli variables.</p> <p>2.2 Discrete Uniform Distribution: p.m.f., mean and variance</p> <p>2.3 Binomial Distribution: Binomial random variable, p.m.f. with parameters (n, p), Recurrence relation for successive probabilities, Computation of probabilities of different events, mean and variance, mode, skewness, p.g.f., Additive property of binomial variates. Examples.</p> <p>2.4 Hypergeometric Distribution: p.m.f. with parameters (N, M, n), Computation of probability of different events, Recurrence relation for successive probabilities, mean and variance of distribution assuming $n \leq N - M \leq M$, approximation of Hypergeometric to Binomial. Examples.</p>	
Unit - III	Some Standard Discrete Probability Distributions (countably infinite sample space)	(08)
	<p>Definition of a discrete random variable (defined on countably infinite sample space)</p> <p>3.1 Poisson Distribution: Definition of Poisson with parameter λ. Mean, variance, probability generating function (p.g.f.). Recurrence relation for successive Probabilities, Additive property of Poisson distribution. Poisson distribution as a limiting case of Binomial distribution, examples.</p> <p>3.2 Geometric Distribution: Definition of Geometric with parameter p. Mean, Variance, distribution function, p.g.f., Lack of memory property, examples.</p> <p>3.3 Negative Binomial Distribution: Definition of Negative Binomial with parameters (k, p), Geometric distribution is a particular case of Negative Binomial distribution, Mean, Variance, p.g.f., Recurrence relation for successive probabilities, examples</p>	
Unit - IV	Bivariate Discrete Probability Distribution	(07)
	4.1 Definition of a bivariate discrete random variable (X, Y) on finite sample space, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof).	

	4.2 Computation of probabilities of events in the bivariate probability distribution, the concept of a marginal and conditional probability distribution, independence of two discrete r.v.s, Examples	
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Course Outcomes: Students will be able to,

1. explain the discrete probability distributions such as binomial, geometric, Poisson, and hypergeometric distributions.
2. compute mean, variance, and standard deviations for discrete probability distributions.
3. find the expectations of the bivariate probability distributions.
4. evaluate the strengths and limitations of different probability models and select appropriate models for specific applications.

Reference Books:

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
4. Agarwal B. L, 2015 Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P, 2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Feller W., 2008, An Introduction to Probability Theory and its Applications, Wiley
7. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.
8. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

B. Sc. Part-I (Semester-II)
BSP-126: Practical Paper – II (Credits: 02)
Practical: 60 Hours

Course Objectives: Students should be able to ...

1. understand the basic concepts of regression analysis and correlation.
2. analyze and interpret data from regression and correlation techniques.
3. apply binomial distribution and Poisson distribution to solve real-life problems.
4. compute marginal and conditional probability distributions from bivariate probability distributions.

Credits (Total Credits 2)	SEMESTER – II BSP 126 Practical Course - II (Based on Course BST 224 and BST 225)	No.of hours per unit
	List of Practical	
	<ol style="list-style-type: none"> 1. Correlation coefficient 2. Regression Analysis 3. Multiple correlation coefficients. 	

	<ol style="list-style-type: none"> 4. Partial correlation coefficients 5. Multiple regressions - I. 6. Multiple regressions - II. 7. Bivariate Discrete distribution I. (Marginal Distribution) 8. Bivariate Discrete distribution II (Conditional distribution) 9. Bivariate Discrete distribution III (Expectations /conditional expectations) 10. Bivariate Discrete distribution IV (variances / conditional variance) 11. Bivariate Discrete distribution V (covariance/correlation coefficient) 12. Applications of Binomial Distributions. 13. Applications of Poisson Distributions. 14. Applications of Hypergeometric Distribution. 15. Applications of Geometric and Negative Binomial Distributions. (*Note: Expt. No.4,5 8,13,13,14,15 are expected to solve using MS-EXCEL Software) 	
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Course Outcomes: Students will be able to...

1. apply the concept of the probability distributions
2. write pmf for some standard probability distributions.
3. compute and interpret the regression equation, regression coefficients, and correlation coefficients
4. analyze and interpret real–world data using regression and correlation techniques.

Reference Books:

1. Ross S. , 2019, A First Course in Probability, Pearson
2. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
3. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press
4. Agarwal B. L, 2015, Statistics, New Age International P Ltd. Delhi.
5. Mukhopadhyay P.,2011, An Introduction to the Theory of Probability, World Scientific Publishing Company.
6. Saxena S., Kapoor J. N.,2010, Mathematical Statistics, Sultan Chand & Sons, Delhi.
7. Kapoor V. K, Gupta S. C, 2008, Fundamental of Mathematical Statistics, S Chand and Sons, Delhi.
8. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, New Delhi.
9. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Department of Statistics

Open Elective (OE) Course Name: Statistics for Social Sciences

Semester – I

BST-117: Data Tabulation and Graphical Representation

Course Objectives: Students should be able to...

1. understand the fundamental concepts and techniques of data tabulation.
2. explore the importance of data visualization and its role in effective data communication.
3. develop skills in constructing frequency distributions and cross-tabulations for different types of data.
4. construct frequency distributions, relative frequency distributions, and cumulative frequency distributions for given datasets.

Credits (Total Credits 2)	SEMESTER – I BST 117 Data Tabulation and Graphical Representation	No. of hours per unit
Unit – I	Introduction to Data Tabulation Importance and need of data tabulation, Types of data, Scales of the data, Data collection methods, Data Sources	(05)
Unit – II	Data Tabulation Techniques Part of a table, Types of the table, simple or one-way table, two-way table, Contingency table, Frequency distribution, Cumulative frequency distribution, Relative frequency distribution, Percentage distribution, Grouping data	(08)
Unit – III	Graphical Presentation of Data Importance of graphical representation, Types of graphs, Bar graphs, Column graphs, multiple bar graphs, stacked bar graphs, percent stacked bar graphs, line graphs, pie charts	(08)
Unit – IV	Advanced Graphical Presentation of Data Histogram and frequency polygons, Box plots and violin graphs, Radar charts, Network diagrams, flowcharts, Word clouds	(09)

Course Outcomes: Students will be able to...

1. apply various methods of organizing, summarizing, and presenting data in tabular form.
2. differentiate between qualitative and quantitative data and choose appropriate tabulation techniques for each type.
3. construct bar graphs, histograms, line graphs, pie charts, scatter plots, and other visual representations.

4. create and interpret cross-tabulations and contingency tables to analyze the relationships between variables.

Reference Books:

1. Agarwal B. L, 2021, Programmed Statistics, New Age International Limited, New Delhi, Fourth edition,
2. Claus O. Wilke, 2019, Fundamentals of Data Visualization, O'Reilly Media, 1st edition.
3. Kieran Healy, 2018, Data Visualization A practical introduction, Princeton University Press.
4. Ross S. , 2019, A First Course in Probability, Pearson
5. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
6. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
7. Alexandru C. T, 2015, Data Visualization Principle, and Practice, CRC Press, Second edition.
8. Agarwal B. L, 2015 Statistics, New Age International P Ltd. Delhi.

BST-118: Basic Statistical Analysis

Course Objectives: Students should be able to ...

1. understand the concept of measures of central tendency and their significance in statistical analysis
2. explore the properties and limitations of measures of central tendency
3. calculate the range, variance, standard deviation, and interquartile range for given datasets.
4. apply correlation analysis in practical data analysis scenarios

Credits (Total Credits 2)	SEMESTER – I BST -118 Basic Statistical Analysis	No. of hours per unit
Unit – I	Measures of Central Tendency – I Mathematical Averages: Arithmetic Mean, Properties of A. M., Geometric Mean, Properties of Geometric Mean, Harmonic Mean, Properties of Harmonic Mean. Relation between A.M, G.M., and H. M.	(08)
Unit – II	Measures of Central Tendency – II Positional Average: Median for ungrouped data, Properties of Median, Median for grouped data, Mode for grouped and ungrouped data. Partition Values	(08)
Unit – III	Measures of Dispersion Range, Quartile deviation, Inter quartile range, Mean deviation, Variance, Standard deviation, Coefficient of Variation, and Various properties of these measures	(08)
Unit – IV	Correlation Bivariate Data, Covariance: Definition, Effect of change of origin and scale, Concept of Correlation between two	(06)

	variables, Types of correlation, Scatter diagram, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient	
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Course Outcomes: Students will be able to ...

1. calculate the mean, median, and mode for given datasets
2. differentiate between different measures of central tendency
3. apply measures of dispersion in real-life data analysis scenarios,
4. interpret the correlation coefficient to understand the strength and direction of a relationship between two variables

Reference Books

1. Prem S. Mann, 2020, Introductory Statistics, Wiley, 10th edition
2. Goon A. M, Gupta M. K., and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
3. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi
4. Gupta S. P, Statistical Methods, 2002, Sultan Chand and Sons, Delhi.
5. Barbara Finlay, Alan Agresti, 1997, Statistical Methods for the Social Sciences, Prentice Hall
6. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

BSP - 119 : Practical Course – I

Course Objectives: Students should be able to...

1. understand the fundamental concepts and techniques of data tabulation.
2. develop different types of the bar graphs such as multiple bar graphs, and stacked bar graphs.
3. calculate various measures of central tendency
4. apply correlation analysis in practical data analysis scenarios

Credits (Total Credits 2)	SEMESTER – I BSP – 119 Practical Course - I List of Practical (15) Based on BST -117 and BST -118	No. of hours per Practical
	<ol style="list-style-type: none"> 1. Data Tabulation – I (Frequency Distribution) 2. Data Tabulation – II (One Way and Two Way table) 	60 Hours

	<ol style="list-style-type: none"> 3. Construction of the bar graphs, Multiple bar graphs, and stacked bar graphs 4. Construction of line graphs and pie graphs 5. Construction of histogram and frequency polygon 6. Construction of Box plots 7. Construction of word clouds 8. Computation of Arithmetic Mean 9. Computation of Geometric Mean 10. Computation of Harmonic Mean 11. Computation of Median 12. Computation of Mode 13. Measures of Dispersion – I 14. Measures of Dispersion – II 15. Correlation Analysis 	
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Course Outcomes: Students should be able to...

1. differentiate between qualitative and quantitative data and choose appropriate tabulation techniques for each type.
2. create and interpret cross-tabulations and contingency tables to analyze the relationships between variables.
3. apply measures of dispersion in real-life data analysis scenarios,
4. interpret the correlation coefficient to understand the strength and direction of a relationship between two variables

Reference Books:

1. Agarwal B. L, 2021, Programmed Statistics, New Age International Limited, New Delhi, Fourth edition.
2. Kieran Healy, 2018, Data Visualization A practical introduction, Princeton University Press.
3. Elhance D. N, Elhance V, Aggarwal B. M, 2018, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi.
4. Goon A. M, Gupta M. K. and Dasgupta B, 2016, Fundamentals of Statistics Vol. I and II, Calcutta World Press.
5. Alexandru C. T, 2015, Data Visualization Principle, and Practice, CRC Press, Second edition.
6. Gupta S. P, 2002, Statistical Methods, Sultan Chand and Sons, Delhi.
7. Grewal P. S, 1990, Methods of Statistical Analysis, Sterling Publishers.

Semester – II
BST -127 : Introduction to Population Studies

Course Objectives: Students should be able to ...

1. understand concept of the vital statistics
2. differentiate between mortality rates and fertility rates
3. compute death rates such as CDR, SDR, and STDR
4. collect data related to vital events.

Credits (Total Credits 2)	SEMESTER – II BST -127 Introduction to Population Studies	No. of hours per unit/credits
Unit – I	Introduction of Vital Statistics Introduction and need of vital statistics, sources of population data, Basic concepts, and measures, a universe, and variables, Rates, Ratios and Proportions	(06)
Unit – II	Mortality Rates Need and importance of death rates, Crude death rate (CDR), Specific Death Rate (SDR), Standardized Death Rate (STDR)	(08)
Unit – III	Fertility Rates Need and importance of Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), and Total Fertility Rate (TFR).	(08)
Unit – IV	Basic Measures of Reproduction Rate Need and importance of reproduction rate, Gross Reproduction rate (GRR), and Net Reproduction Rate (NRR).	(08)

Course Outcomes: Students will be able to ...

1. introduce students to the field of population studies
2. compute fertility rates such as CBR, GFR, and TFR
3. analyze different measures of fertility rates and their calculation methods
4. interpret various birth kinds of fertility and mortality rates.

Reference Books

1. Jacob S. Siegel and David a. Swanson, 2004, The Methods and Materials of Demography, Second Edition, Elsevier Science, USA.
2. Asha A. Bhende and Tara Kanitkar, 2003, Principles of Population Studies, Sixteenth Revised Edition, Himalaya Publishing House, Mumbai.
3. Hinde, 1998, Demographic Methods, Andrew London: Arnold.
4. K.B. Pathak, and F. Ram, 1998, Techniques of Demographic Analysis, Mumbai: Himalaya Publishing House.

BST-128: Survey Sampling Techniques

Course Objectives: Students should be able to...

1. understand the concept of the sample survey
2. differentiate between population and sample survey
3. apply different sampling techniques to collect data
4. design a questionnaire to collect primary data

Credits (Total Credits 2)	SEMESTER – II BST-128 Survey Sampling Techniques	No. of hours per unit/credits
Unit – I	Introduction to Survey Sampling Population, sample, primary data, and secondary data Importance and Application of sample survey, sampling frames	(08)
Unit – II	Probability Sampling Methods Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling	(08)
Unit – III	Non-Probability Sampling Methods Convenience Sampling, Purposive Sampling, Snowball Sampling	(08)
Unit – IV	Survey Design Sample Size calculation, Survey data collection methods, Survey Questionnaire design	(06)

Course Outcomes: Students will be able to ...

1. understand the importance of sampling survey
2. differentiate between probability sampling and non-probabilistic sampling techniques
3. implement simple random sampling, systematic sampling, and cluster sampling.
4. design a sample survey to collect data

Reference Books :

1. Lohr S. L., 2019, Sampling: Design and Analysis, Cengage Learning
2. Fowler F.J., 2013, Survey Research Method, SAGE Publications.
3. Johnson T. P., Vos E. L., 2012, Applied Survey Sampling, CRC Press
4. Parimal Mukhopadhyay, 2008, Theory and methods of survey sampling, Prentice Hall of India private limited, 2nd Edition.
5. Rajendra Nargundkar, 2003, Marketing Research, Tata McGraw – Hill Education.
6. Naresh K. Malhotra, David F. Birks, 2000, Marketing research in applied approach
7. William G. Cochran, 1977, Sampling Techniques, John and Wiley sons Inc, 3rd edition.
8. Leslie K. 1965, Survey Sampling, Wiley

BSP -129: Practical Course – II

Course Objectives: Students should be able to,

1. differentiate between mortality rates and fertility rates
2. compute death rates such as CDR, SDR, and STDR
3. apply different sampling techniques to collect data
4. design a questionnaire to collect primary data

Credits (Total Credits 2)	SEMESTER – II BSP -129 Practical Course - II List of Practical (15) Based on BST 127 and BST 128	No. of hours
	<ol style="list-style-type: none"> 1. Mortality Rate – Crude Death Rate 2. Mortality Rate – Specific Death Rate 3. Mortality Rate – Standardized Death Rate 4. Fertility Rate – Age-Specific Fertility Rate 5. Fertility Rate - General Fertility Rate 6. Fertility Rate - Total Fertility Rate 7. Reproduction Rate – Gross Reproduction Rate 8. Reproduction Rate – Net Reproduction Rate 9. Sampling Techniques – Simple Random Sampling 10. Sampling Techniques – Systematic Random Sampling 11. Sampling Techniques – Stratified Random Sampling 12. Sampling Techniques – Cluster Sampling 13. Non-Probabilistic Sampling Techniques 14. Sample Size Calculation 15. Survey Design 	60 Hours

Course Outcomes: Students will be able to,

1. introduce students to the field of population studies
2. compute fertility rates such as CBR, GFR, and TFR
3. implement simple random sampling, systematic sampling, and cluster sampling.
4. design a sample survey to collect data

Reference Books:

1. Lohr S. L., 2019, Sampling: Design and Analysis, Cengage Learning
2. Fowler F.J., 2013, Survey Research Method, SAGE Publications.
3. Parimal Mukhopadhyay, 2008, Theory and methods of survey sampling, Prentice Hall of India private limited, 2nd Edition.
4. Jacob S. Siegel and David A. Swanson, 2004, The Methods and Materials of Demography, Second Edition, Elsevier Science, USA.

5. Asha A. Bhende and Tara Kanitkar, 2003 Principles of Population Studies, Sixteenth Revised Edition, Himalaya Publishing House, Mumbai.
6. Rajendra Nargundkar, 2003, Marketing Research, Tata McGraw – Hill Education.
7. Hinde, 1998, Demographic Methods, Andrew London: Arnold.
8. K.B. Pathak, and F. Ram, 1998, Techniques of Demographic Analysis, Mumbai: Himalaya Publishing House.
9. William G. Cochran, Sampling Techniques, 1977, John and Wiley sons Inc, 3rd edition

Indian Knowledge System
IKS-101: Indian Mathematics (Credits: 02)
Lectures (30 Hours)

Course Objectives: Students should be able to...

1. introduce students to the historical roots and significant contribution of Indian Mathematics.
2. understand the decimal nomenclature system used in the Vedas and its impact on the development of mathematics.
3. explore the ancient knowledge of numbers, fractions, and geometry as found in the Vedas.
4. study the simple geometric construction described in the Sulba – Sutras and their Practical Applications.

Credits (Total Credits 2)	IKS Course – I IKS – 101 Indian Mathematics	No. of hours per unit
Unit - I	Numbers, fractions, and geometry in the Vedas. Decimal nomenclature of numbers in the Vedas. Zero and Infinity. Simple constructions from Sulba-sutras.	(08)
Unit – II	The development of the decimal place value system which resulted in a simplification of all arithmetical operations. Linguistic representation of numbers.	(08)
Unit – III	Important texts of Indian mathematics. A brief introduction to the development of algebra, trigonometry, and calculus.	(08)
Unit - IV	How Indian mathematics continued to flourish in the 18/19/20th centuries. Kerala School. Ramanujan.	(06)

Course Outcomes: Students will be able to ...

1. apply the mathematical knowledge and concepts present in the Vedas, particularly in relation to numbers, fractions, and geometry.
2. explain the significance of the decimal nomenclature system used in the Vedas and its influence on subsequent mathematical developments.
3. demonstrate an understanding of the geometric constructions described in the Sulba-sutras and their practical applications.
4. analyze the linguistic representation of numbers and compare different numeral systems used in Indian mathematics.

Reference Books

1. Sundar Ram S. and Ramakalyani V., 2022, History and Development of Mathematics in India, DK Publishers of Indian
2. Like Hodgkin, 2005, A History of Mathematics, Oxford University Press.
3. B. V. Subbarayappa, Culture, and History of Mathematics, 2011, Hindustan Book Agency, New Delhi.

Skill Enhancement Course
SEC 103 : Data Visualization with MS-Excel (Credits: 02)
Theory: 15 Lectures (15 Hours)

Course Objectives: Students should be able to...

1. understand the concept of data visualization and its importance.
2. apply different excel functions on data such as Sum, Count, Mean, etc.

Credits (Total Credits 1)	SEC Paper – I SEC 103 Data Visualization with MS-Excel	No. of hours per unit
Unit - I	<p>Unit I: Introduction to MS-Excel</p> <p>1.1. Create Worksheets and Workbooks, Import data from a delimited text file, Add a worksheet to an existing workbook, Copy and move a worksheet</p> <p>1.2. Navigate in Worksheets and Workbooks, Search for data within a workbook, Navigate to a named cell, range, or workbook element, Insert and remove hyperlinks</p> <p>1.3 Getting Acquainted with Excel: Title Bar, Ribbon Tab, Scroll Bar, Microsoft office button, quick access toolbar, formula bar, status bar, workbook vie button</p> <p>1.3. Format Worksheets and Workbooks, change worksheet tab color, rename a worksheet, change worksheet order, Insert and delete columns or rows, change workbook themes, adjust row height and column width, Insert headers and footers</p> <p>1.4. Customize Options and Views for Worksheets and Workbooks, Hide or unhide worksheets, Hide or unhide columns and rows, Customize the Quick Access toolbar, modify document properties, and Display formulas.</p>	(07)
Unit – II	<p>Unit II: Creating Worksheet Chart</p> <p>2.1 Creating chart, selecting chart and chart element, moving and resizing chart, changing chart type, switching row and column data, choosing chart layout.</p> <p>2.2 Formatting Chart object, inserting an object into a chart, changing chart labels, axis display, and chart background.</p> <p>2.3 Creating Pivot tables and pivot charts, manipulating pivot tables, applying pivot table style, sorting and filtering pivot table data.</p>	(08)

	2.4 Use of functions: SUM, COUNT, MAX, MIN, AVERAGE, IF, AND and OR function	
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Course Objectives: Students will be able to ...

1. import data from a delimited text file.
2. create pivot tables and pivot charts.

**Paper Title – SEC Practical Paper (Credits: 01)
(30 Hours)**

Course Objectives: Students should be able to...

1. Perform simple Excel operations such as creating a worksheet, renaming a worksheet etc.
2. Construct charts such as Bar charts, Pie charts, etc.

Credits (Total Credits 1)	SEC Paper – I Practical Paper Syllabus (Contact Hrs 30, Credits 01)	No. of hours per unit
	<p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Perform following using MS-Excel <ol style="list-style-type: none"> i) Create Worksheet ii) Rename the worksheet iii) Hide the worksheet iv) Add and delete the worksheet v) Save the worksheet 2. Perform following using MS-Excel <ol style="list-style-type: none"> i) Insert and Delete Row and Column ii) Change Column width iii) Change Row height 3. Perform following using MS-Excel <ol style="list-style-type: none"> i) Header and Footer ii) Hiding Rows and Columns 4. Perform following using MS-Excel <ol style="list-style-type: none"> i) Change Font style ii) Fill and border the cell 	

	<ol style="list-style-type: none">5. Execute the following commands<ol style="list-style-type: none">i) Findii) Spell Checkiii) Copy and Paste6. Data formatting7. Data manipulation-I8. Data Visualization - Pivot table I9. Data Visualization - Pivot table II10. Data handling using functions	
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Learning Outcomes: Students will be able to ...

1. Perform complex calculations within a short time using MS-Excel
2. Apply Statistical functions to compute statistical measures of the data

Recommended Books:

1. Winston W. , 2019, Microsoft Excel Data Analysis and Business Modeling, Microsoft Press
2. Alexander M. and Kusleika R., 2018, Excel 2019 Bible, Wiley
3. Salkind Neil J, 2014, Statistics for people who (Think They) Hate Statistics, Using MS- Excel.
4. Frag Curtis, 2013, Step by Step Microsoft Excel.
5. John Walkenbach,2013, 101 Excel 2013 Tips , Tricks and Time savers.
6. Kumar Bittu, 2010, Microsoft Office.