Rayat Shikshan Sanstha's

SADGURU GADAGE MAHARAJ COLLEGE, KARAD

(An Autonomous College)

Revised Syllabus

Bachelor of Science

Part I

STATISTICS

Choice Based Credit System (CBCS) as per NEP - 2020

Syllabus Implemented w. e. f. June, 2024

Rayat Shikshan Sanstha's

Sadguru Gadage Maharaj College, Karad

(An Autonomous College)

Department of Statistics Class: B.Sc. I (CBCS) Curriculum with effect from June 2024

Syllabus

Preamble:

This syllabus is framed to give sound knowledge with understanding of Statistics to undergraduate students at first year of three years of 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 the higher studies.

General Objectives of the Program:

- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of Statistics
- Develop abilities in students to design and develop innovative solutions for benefits of society, leadership, teamwork and lifelong learning..
- To develop scientific attitude among the student so as to make students curious and open minded.
- Provides Students with skills that enable them to get employment in industries or pursue higher studies.

General outcomes of 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 appear the examination for jobs in government organizations.

4. 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 scale of measurement of data.

2. To enable comparison data by using measures of central tendency and dispersion.

3. To establish relation 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 population from sample data.

6. To design the process and extend the sampling.

7. To enable use of statistics techniques in time series, industry, demography ,etc.

8. To understand and develop the necessary computer skill in practical by using MS-Excel, R-software, C-Programming.

Program Specific Outcomes

The studies will acquire;

1. Knowledge of descriptive statistics and inferential statistics , sampling techniques.

2. Knowledge about the univariate, bivariate, multivariate data analysis.

3. Knowledge about the 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 inference of parameter of standard discrete and continuous probability distribution.

6. Knowledge of applied statistics such as ‘index number’, ‘time series’, ‘demography’, ‘reliability theory’, ‘industrial statistics’, ‘operational research’.

B.Sc. Part I

1. **Title** : Statistics
2. **Year of implementation**: The syllabus will be implemented from June 2023 onwards
3. **Duration** : The course shall be a fulltime
4. **Pattern:** Semester examination
5. **Medium of Instruction** : English
6. **Structure of Course** :

B.Sc.-I : Semester –I

Sr. No.	Paper Title	Theory			Practical		
		Paper Code	Lectures Per week	Credits	Paper Title	Lectures Per week	Credits
1	Descriptive Statistics - I	BST24- 101	4	2	Practical Paper- BSP24-103	4	2
2	Elementary Probability Theory	BST24- 102		2			

B.Sc.-I : Semester –II

Sr. No.	Paper Title	Theory			Practical		
		Paper Code	Lectures Per week	Credits	Paper Title	Lectures Per week	Credits
1	Descriptive Statistics - II	BST24- 201	4	2	Practical Paper- BSP24-203	4	2
2	Discrete Probability Distributions	BST24- 202		2			

Titles of Papers of B.Sc. course:

B.Sc.I Semester-I :

Theory:

BST24- 101: Descriptive Statistics-I

BST24- 102: Elementary Probability Theory

B.Sc.I Semester-II :

Theory:

BST24- 201: Descriptive Statistics-II
BST24-202: Discrete Probability Distributions

Practical (SEMESTER) :

BSP24-103: Practical Paper-I

BSP24-203: Practical Paper-II

B. Sc. I (Semester-I)

BST24-101: Descriptive Statistics-I

Theory- 30 Hours Credits:02

Objectives:

The main objectives of this course are:

1. To understand the basic concepts of data and scale of measurement of data.

2.To enable comparison data by using measures of central tendency and dispersion.

3.To analyze data pertaining to attributes and to interpret the results.

Syllabus Contents

Unit-1 15 hrs.

Introduction to Statistics:
Meaning of Statistics as a Science, Importance of Statistics, Definition of Statistics, Various fields where Statistics is used, Names of various statistical organizations in India.

Population and Sample:
Statistical population. Finite population, Infinite population, Census method, sampling method, Advantages of sampling method over census method.

Methods of sampling (Description only):
Sample and Random sample, Simple random sampling with and without replacement (SRSWR and SRSWOR), Stratified random sampling, Systematic sampling.

Nature of Data:
Primary and Secondary data, Quantitative and Qualitative data, Attributes, Variables, Discrete and Continuous variables, Scales of measurement- Nominal, Ordinal, Interval and Ratio scale, illustrative examples.

Presentation of Data:

Classification: Raw data and its classification, discrete frequency distribution, Continuous frequency distribution, Cumulative frequency distribution, Inclusive and Exclusive methods of classification, Open-end classes, Relative frequency distribution ,illustrative examples.

Tabulation: Parts of table, Characteristics of good table, Types of table, illustrative examples.
Diagrammatic Presentation: Introduction to Simple Bar Diagram, Multiple Bar Diagram, Sub-Divided Bar Diagram, Pie Diagram.
Graphical Presentation: Histogram, Frequency Polygon, Frequency Curve, Ogive curves and Box plot.

Unit-2 15 hrs.

Measures of Central Tendency:

Mathematical and positional Concept of central tendency of statistical data, statistical average, requirements of good statistical average.

Arithmetic Mean (A.M): Definition, Effect of change of origin and scale, Deviation of observations from A.M., Mean of pooled data, Weighted A.M.

Geometric Mean (G.M): Definition, Illustrative Example.

Harmonic Mean (H.M.): Definition, Relation: A.M $\geq$ G.M $\geq$ H.M (proof for n = 2 positive observations). Illustrative Example.

Median: Definition, Derivation of formula for grouped frequency distribution.

Mode: Definition, Derivation of formula for grouped frequency distribution.

Empirical relation between mean, median and mode. Graphical method of determination of Median and Mode.

Partition values: Quartiles, Deciles and Percentiles. Comparison between averages in accordance with requirements of good average. Situations where one kind of average is preferable to others. Illustrative Example.

Measures of Dispersion:

Concept of dispersion, Absolute and Relative measures of dispersion, Requirements of a good measure of dispersion.

Range: Definition, Coefficient of range.

Quartile Deviation (Q. D. or Semi-inter quartile range): Definition, Coefficient of Q.D.

Mean Deviation (M.D.): Definition, Coefficient of M.D., Minimal property of M.D.

Mean Square Deviation (M.S.D.): Definition, Minimal property of M.S.D.

Variance and Standard Deviation (S.D.): Definition, Effect of change of origin and scale, S.D. of pooled data (proof for two groups).

Coefficient of Variation: Definition and use. Illustrative Example.

Moments Skewness and Kurtosis:

Moments: Raw moments and central moments for ungrouped and grouped data. Effect of change of origin and scale on central moments, relation between central moments and raw moments (up to 4th order). Sheppard's corrections.

Skewness: Concept of skewness of a frequency distribution, types of skewness. Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness, measure of skewness based on moments.

Kurtosis: Concept of kurtosis of a frequency distribution, Types of kurtosis. Measure of kurtosis based on moments. Illustrative examples.

BST24-102: Elementary Probability Theory

Theory- 30 Hours Credits: 02

Objectives:

The main objectives of this course are:

1. To understand the basic concepts of probability and its applications.
2. To understand the concepts of random variables, univariate probability distributions.
3. To find, interpret the conditional probabilities of various events

Syllabus Contents

Unit-1 15 hrs.

Sample space and events:

Concepts of experiments and random experiments. Definitions: Sample space, Discrete sample space (finite and countably infinite), Event, Elementary event, Compound event. Favorable event. Algebra of events (Union, Intersection, Complementation). Definitions of mutually exclusive events, Exhaustive events, Impossible events, Certain event.

Power set |P(Ω) (sample space consisting at most 3 sample points). Symbolic representation of given events and description of events in symbolic form. Illustrative examples.

Probability: 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. Axiomatic definition of probability with reference to a finite and countably infinite sample space.

Proof of the results:

i) $P(\Phi) = 0$

ii) $P(A^C) = 1 - P(A)$

iii) $P(AUB) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only)

iv) If $A \leq B$, $P(A) \leq P(B)$

v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cap B) \leq P(A) + P(B)$.

Definition of probability in terms of odd ratio. Illustrative examples.

Unit-2 15 hrs.

Conditional Probability:

Definition of conditional probability of an event. Multiplication theorem for two events. Examples on conditional probability. Partition of sample space. Idea of posteriori probability, statement and proof of Baye's theorem, examples on Baye's theorem. Elementary examples.

Independence of events: Concept of independence of two events. Proof of the result that if A and B are independent then,

i) A and B^C are independent

ii) A^C and B are independent

iii) A^C and B^C are independent.

Pairwise and mutual Independence for three events. Elementary examples.

Univariate Probability Distributions (finite sample space):

Definition of 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). Probability distribution of function of random variable. Median and mode of a univariate discrete probability distribution. Examples.

Mathematical expectation (Univariate random variable):

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) = a E (X) + b, where a and b are constants.

Definitions of mean, variance of univariate distribution. Effect of change of origin and scale on mean and variance. Definition of raw, central moments. Pearson's coefficient of skewness, kurtosis. 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.

Learning Outcomes:

1) Students are able to draw diagram and graphs based on frequency distribution

2) Students are understand how to summarized data and find averages as well as spread of the data from central value (average).

3) Students get the knowledge about to compute moments and find out symmetry and skew symmetry of data.

4) Students are become to find the probabilities of events and conditional probabilities.

Notes:

i) Students must complete all the practices to the satisfaction of the concerned teacher.

ii) Students must produce laboratory journal along with completion certificate signed by Head of the Department at the time of practical examination.

iii) Knowledge of MS-Excel spread sheet should be tested on computer at the time of viva-voce.

Laboratory Requirement:

Laboratory should be well equipped with sufficient number of scientific calculators and computers along with necessary software's, UPS, and printers.

Semester-II

BST24-201: Descriptive Statistics - II

Theory- 30 Hours Credits:02

Objectives:

The main objectives of this course are:

1. To compute correlation coefficient for bivariate data and interpret it.
2. To fit linear curve to the bivariate data to investigate relation between two variables.
3. To compute and interpret various Mortality & Fertility rates.

Syllabus Contents

Unit-1 **15 hrs.**

Correlation:

Bivariate data. Need of analysis of bivariate data, Concept of correlation between two variables, Types of correlation.

Method of studying correlation: 1)Scatter diagram, its utility. Covariance: Definition, effect of change of origin and scale. 2)Karl Pearson's coefficient of correlation (r): Definition, Computation for ungrouped and grouped data, Properties : i) $-1 \leq r \leq 1$, Interpretation for different values of r.ii) Effect of change of origin and scale. 3)Spearman's rank correlation coefficient: Definition, Computation (with and without ties). Derivation of the formula for without ties and modification of the formula for with ties.

Illustrative examples.

Regression: Concept of regression, Lines of regression Y on X and X on Y Fitting of lines of regression by the least square method. Regression coefficients (bxy, byx) and their geometric interpretations, Properties:

i) $bxy \times byx = r^2$,

ii) $bxy \times byx \leq 1$,

iii) $(bxy + byx) / 2 \geq r$,

iv) Effect of change of origin and scale on regression coefficients,

The point of intersection of two regression lines. Derivation of acute angle between the two lines of regression. Concept of residual ,mean residual sum of squres, residual plot (residual vs fitted value) its interpretation Explained and unexplained variation, coefficient of determination, Illustrative examples.

Unit-2 15 hrs.

Attributes :

Introduction and Notation of Attributes, dichotomy, class frequency, order of class, positive and negative class frequency, ultimate class frequency, fundamental set of class frequency, relationships among different class

frequencies (up to three attributes). Concept of consistency, conditions of consistency (up to three attributes). Concept of independence and association of two attributes. Yule's coefficient of association (Q): Definition, $-1 \leq Q \leq 1$, interpretation. Coefficient of colligation (Y): Definition, interpretation. Relation between Q and Y: $Q = 2Y/(1+Y2)$, $|Q| \geq |Y|$. Illustrative examples.

Demography:

Introduction, vital events and need of vital statistics, Measures of fertility: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), Total Fertility Rate (TFR), Measures of reproduction: Gross Reproduction rate (GRR), Net Reproduction Rate (NRR), Measures of mortality: Crude death rate (CDR), Specific Death Rate (SDR) by i) direct method ii) indirect method, Standardized Death Rate (STDR), Population projection at time t, Life Table – Introduction of Life table and its Use .

BST24-202: Discrete Probability Distributions

Theory- 30 Hours Credits:02

Objectives:

The main objectives of this course are:

1. To apply standard discrete probability distribution to different situations.
2. To study properties of these distributions as well as interrelation between them.
3. To compute mean, variance, p.g.f . of discrete random variables.

Unit-1 15 hrs.

Some Standard Discrete Probability Distributions (finite sample space):

Definition of discrete random variable (defined on finite sample space)

Idea of one point, two point distributions and their mean and variances.

Bernoulli Distribution: p.m.f., mean, variance, distribution of sum of independent and identically distributed Bernoulli variables.

Discrete Uniform Distribution: p.m.f., mean and variance.

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.

Hyper geometric 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 (Statement only). Examples.

Unit-2 15 hrs.

Some Standard Discrete Probability Distributions (countably infinite sample space):

Poisson, Geometric and Negative Binomial Distribution

Definition of discrete random variable (defined on countably infinite sample space)

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.

Geometric Distribution: Definition of Geometric with parameter p. Mean, Variance, distribution function, p.g.f., Lack of memory property, examples.

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.

Bivariate Discrete Distribution:

Definition of 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). Computation of probabilities of events in bivariate probability distribution, concept of marginal and conditional probability distribution, independence of two discrete r.v.s, Examples. Mathematical Expectation: Definition of expectation of function of r.v. in bivariate distribution, Theorems on expectations:

i) $E(X+Y) = E(X) + E(Y)$,

ii) $E(XY) = E(X) \bullet E(Y)$ when X and Y are independent,

expectation and variance of linear combination of two discrete r.v.s., definition of conditional mean, conditional variance, covariance and correlation coefficient, $Cov(aX+bY, cX+dY)$, distinction between uncorrelated and independent variables, joint p.g.f, proof of the p.g.f. of sum of two independent r.v.as the product of their p.g.f. ,Examples

BSP24-103: Practical-I

Theory- 60 Hours Credits:04

Objectives:

The main objectives of this course are:

1. To represent statistical data.

2. To compute various measures of central tendency, dispersion, moments, Skewness and kurtosis.

3. To compute probability of various events.

4. To compute correlation coefficient for bivariate data and interpret it.
5. Predict value of dependent variable with the help of independent variable.

6. To know application of some standard discrete probability distributions.

List of Practical's:

Sem I

1. Diagrammatic & Graphical representation of the frequency distribution (Line diagram, Bar diagram, Pie diagram, Histogram, frequency polygon, frequency curve, Location of Mode, Ogive curves, Location of Partition values).

2. Measures of Central Tendency (ungrouped Data)

3. Measures of Central Tendency(grouped data).

4. Measures of Dispersion (ungrouped data)

5. Measures of Dispersion (grouped data)

6. Moments, Skewness and Kurtosis (ungrouped data).

7. Moments, Skewness and Kurtosis (grouped data).

8. Applications of Probability (Elementary Examples based on definition of probability by using combination and permutation, examples based on expectations, Conditional expectation and Variance)

9. Applications on Bayes' theorem.

10. Applications on Independence Probability

BSP24-203: Practical-II

Sem II

1. Correlation coefficient (ungrouped data and grouped data)
2. Regression (ungrouped data and grouped data).
3. Attribute.
4. Demography -I
5. Demography -II
6. Bivariate Discrete distribution I. (Marginal & conditional distribution, computation of probabilities of events).
7. Bivariate Discrete distribution II (Expectations /conditional expectations / variances/ conditional variance /covariance / correlation coefficient)
8. Applications of Binomial and Poisson Distributions.
9. Applications of Hypergeometric Distribution.
10. Applications of Geometric and Negative Binomial Distributions.

Learning Outcomes:

1) Students are able to find the coefficient of correlation between two and more variables.

2) Students are able to predict value of one variable when other is known by using technique of regression analysis.

3) To compute Mortality and Fertility rates.

4) Students must get knowledge about the how to use probability distribution to evaluate examples.

Notes:

i) Students must complete all the practical's to the satisfaction of the concerned teacher.

ii) Students must produce laboratory journal along with completion certificate signed by Head of the Department at the time of practical examination.

Laboratory Requirement:

Laboratory should be well equipped with sufficient number of scientific calculators and computers along with necessary software's, UPS, and printers.

EQUIVALENCE FOR THEORY PAPERS

(From June 2024)

Old Syllabus		**Revised Syllabus**	
Paper No.	**Title of the Paper**	**Paper No.**	**Title of the Paper**
Sem.I /P. I	Descriptive Statistics –I	Sem.I /P. I	Descriptive Statistics –I
Sem. I/ P.II	Elementary Probability Theory	Sem. I/ P.II	Elementary Probability Theory
Sem. II / P III	Descriptive Statistics –II	Sem. II / P III	Descriptive Statistics –II
Sem. II / P IV	Discrete Probability Distributions	Sem. II / P IV	Discrete Probability Distributions
Sem I & II/Practical	Practical I	Sem I & II/Practical	Practical I

Nature of Question Paper for Theory Examination (40+10 Pattern) as per NEP-2020:

Maximum Marks : 40

Duration : 2 Hrs

Que. 1 Select the most correct alternatives from the following [8 Marks]

Que. 2 Attempt any TWO of the following [16 Marks]

Que. 3 Attempt any FOUR of the following [16 Marks]