**Rayat Shikshan Sanstha's**

# Yashvantrao Chavan Institute of Science, Satara

## (An Autonomous Institute)

### Semester I: Statistics Course –I

### Statistics –BST-101: DESCRIPTIVE STATISTICS –I

**Theory: 36 Lectures (30 Hours)**

**OBJECTIVES:**

The main objectives of this course are:

1) To introduce the technique of data collection & its presentation.
2) To compute various measures of central tendencies, dispersion, moments, skewness, kurtosis and to interpret them.
3) To analyze data pertaining to attributes and to interpret the results.
4) To introduce of application of measures of central such as computation of Index number

**Unit – 1 Data Condescension, Presentation, and measures of central tendency (12L)**

1.1 Definition and scope of Statistics, concept of 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 diagram, histogram, ogive curves

1.3 Mathematical and positional averages: Data Presentation: M, G.M, H.M, relation between them and their properties. Median, mode ,partition values

**Unit – 2 Measures of Dispersion and moments, skewness and kurtosis (8L)**

2.1 Measures of Dispersion: Range, Quartile deviation, Mean deviation, standard deviation, coefficient of variation. Various properties of these measures and their utility.

2.2 Raw and central moments, factorial moments, central moments in terms of raw moment's up to 4th order.

2.3 Definition, Measures of skewness: Bowley's coefficient, Karl Pearson's coefficient, measure of skewness based on moment

2.4 Kurtosis: Definition, measures of kurtosis, Sheppard's correction.

**Unit – 3 Index Number (8L)**

Meaning and utility of index numbers, problems in 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. Index numbers using; Laspeyre's, Paasche's and Fisher's method. Tests of index numbers: unit test, time reversal test and factor reversal tests. Illustrative examples.

**Unit - 4 Theory of Attributes: (8L)**

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).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.

## Learning Outcomes:

Students are able to :

1) **Define-** Mathematical Averages (AM,GM,HM) , Positional Averages ( Median, Mode Partition values), Absolute (Range, Q.D., M.D., S.D. and Relative measures of dispersion, Moments Skewness and Kurtosis, Characteristics of Attributes, Different types of Index numbers.

2) **Explain-** Constructions of Diagrams and Graphs , Mathematical Averages and Positional Averages, Absolute and Relative measures of dispersion, Moments Skewness and Kurtosis, Characteristics of Attributes, Difference between attributes and variable. .

3) **Write-** Relation between AM ,GM, HM,Derivation of Median and Mode, Properties of Measures of central tendency and dispersion, First four raw and central moments, measures of Skewness and Kurtosis, concept of consistency in attributes, Yules coefficient of association ,coefficient of colligation and relation between them

## Books Recommended


1. Agarwal B. L. Basic Statistics(2015); New Age International (P) Ltd. (for Unit-I , II, III, IV)
   Unit-I: P. No. 13-41
   Unit-II: P. No.42-97
   Unit-III: P.. No. 368-384
2. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
   Unit-I : P. No- 42-89
   Unit-II ,III : P. No. 90-158
3. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
   Unit-I: P. No. 39-61, 127-176 Unit-II: P. No. 177-335
   Unit-III: P. No.337-387 Unit-IV: P. No. 495-535
4. Elhance D. N. , Fundamental of Statistics (1978),
   Unit-II : P. No. 87-177
   Unit- III: P. No. 236-249

**Semester I: Statistics Course –I**

**Statistics –BST-102: Elementary Probability Theory**

**Theory: 36 Lectures (30 Hours)**

**OBJECTIVES:**

The main objective of this course is to,

1. To introduce students to basic concept of probability,axiomatic theory of probability, univariate probability distribution.
2. To introduce difference between random and non-random experiments
3. To compute probabilities of different events.
4. To provide knowledge of concept of conditional distribution.

**Unit – I Probability (12L)**

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, certain event.Power set |P(Ω) (sample space consisting at most 3 sample points).Illustrative examples.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. Proof of the results: i) P (Φ) = 0, P (Ac) = 1- P (A), ii) P(AUB)=P(A)+P(B)-P(A∩B) (with proof) and its generalization (Statement only). iv) If A ⊂ B, P (A) ≤ P (B), v) 0 ≤ P (A ∩ B) ≤P (A) ≤ P (A∪B) ≤ [ P (A) + P (B)]. Definition of probability in terms of odd ratio. Illustrative examples based on results.

**Unit-2. Conditional Probability and Independence of events: (8L)**

Definition of 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 on Baye's theorem. Elementary examples on probability and conditional probability . Concept of Independence of two events. Proof of the result that if A and B are independent then, A and Bc , ii) Ac and B, iii) Ac and Bc are independent. Pairwise and Mutual Independence for three events. Elementary examples.

**Unit-3. Univariate Probability Distributions (finite sample space): (10L)**

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.

**Unit 4. Mathematical expectation (Univariate random variable): (6L)**

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.

Definitions of mean, variance of univariate distributions. Effect of change of origin and scale on mean and variance. 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:**

Students are able to;

**1) Define-** Sample space ( Finite and countable infinite) , Power set, Axiomatic definition of probability, Probability Mass function (pmf), Cumulative distribution function (cdf), Expectation of discrete random variable

**2) Explain-** Random experiment, events and types of events, Conditional Probability and Independence of events.

**3) Write-** Examples on sample space, simple examples on probability based on permutation and combination, Theorems on probability, Properties of cdf, Expectation Results.

**Books Recommended:**


1. Gupta S. P. Statistical Methods; Sultan Publication.(2014);
   Unit-I,II,III, IV: P. No. 751-803
2. Agarwal B. L. , Basic Statistics (2015), Unit-I : 98-121.
3. Saxena S, Kapoor J. N.; Mathematical Statistics, S. Chand (2005)
   Unit-I: P. No. 69-85 Unit-II: P. No. 86 -105
4. Kapoor V. k. ,Gupat S. C. , Fundamental of Mathematical Statistics( 2008) , S. Chand Unit – III,IV: P.No. 3.1 to 3.98
5. Mukhopadyay Parimal, Theory of Probability ( 1995)
   Unit – I, II,:P.No. 7-84
6. Grewal P. S., Methods of Statistical Analysis, Sterling Publishers, (1990)
   Unit – III,IV : P. No. 744-825


**B.Sc-I / Semester-I**

**BSP-103: Practical Paper-I**

**OBJECTIVES:**

1. To represent statistical data.
2. To compute various measures of central tendency, dispersion, moments, Skewness and kurtosis.
3. To understand Consistency, Association and Independence of Attributes.
4. To compute Index numbers

**List of Practicals:**

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 and grouped data) and Measures of Dispersion (ungrouped and grouped data).
3. Moments, Skewness and Kurtosis (ungrouped data).
4. Moments, Skewness and Kurtosis (grouped data).
5. Attributes (consistency, Association & Independence). 7.
6. Applications of Probability-I (Elementary Examples based on definition of probability by using combination and permutation, examples based on expectations)
7. Applications of Probability-II (Examples based on Conditional expectation and Variance,
8. Applications on Bayes' theorem.
9. Applications on Independence Probability
10. Index Number

(*Note: Expt. No. 1 to 3 are expected to solve using MS-EXCEL/ R-Software)

**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: Statistics Course –II

**Statistics –BST-201: Descriptive Statistics - II**
**Theory: 36 Lectures (30 Hours)**
**OBJECTIVES:**

The main objective of this course is to,

1. To introduce concept of correction coefficient and how to interpret it's value.
2. To introduce concept of Multivariate Data.
3. To compute correlation coefficients.
4. To understand concept of simple linear regression and multiple linear regression.

### Unit 1.Correlation (8L)

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 $r = -1, 0, 1$. 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.

### Unit 2. Regression (8L)

2.1 Concept of dependent and independent variables.Concept of regression, Lines of regression

2.2 Identification of response and predictor variables and relation between them.

2.3 Meaning of regression, difference between correlation andregression, Connection between correlation and regression. Fitting of line $Y= a + bX$. a and b are estimated using least square method.Regression coefficient. Explained and unexplained

variation, coefficient of determination, standard error of an estimate of line of regression.

2.4 Interchanging the role of X and Y we can study some more properties.i) bxy × byx= r2 , ii) bxy× byx≤ 1, iii) (bxy+ byx) / 2 ≥ 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 line

**Unit 3. Multiple and Partial Correlation (for trivariate data only) (10L)**

Concept of multiple correlations. Definition of multiple correlation coefficient Ri.jk, derivation of formula for multiple correlation coefficient .Properties of multiple correlation coefficient; i) 0 ≤Ri.jk≤ 1, (ii) Ri.jk> |rij|, (iii) Ri.jk> |rik| i = j =k = 1, 2, 3. i≠ j, i≠ k. Interpretation of Ri.jk=1, Ri.jk= 0, coefficient of multiple determination R1.23. Concept of partial correlation. Definition of partial correlation coefficient rij.k, derivation of formula for rij.k. Properties of partial correlation coefficient (i) –1 ≤ rij.k≤ 1, (ii) bij.k·bji.k= r2 ij.k., relation between simple, multiple and partial correlation. Illustrative Examples.

**Unit 4. Multiple Linear Regression (for trivariate data only) (10L)**

Concept of multiple linear regression, Plane of regression, Yule's notation, correlation matrix. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation. Residual: definition, order, properties, derivation of mean and variance, Covariance between residuals. Illustrative Examples.

**Learning Outcomes:**

Students are able to :

**Define-** Types of correlation, fitting of line of Regression, Coefficient of Determination, Residual.

**Explain-** Bivariate data, Correlation,Regression, Multiple and Partial correlation, Multiple Regression.

**Write-** Interpretation of r if r=1,r= -1, r= 0, Properties of correlation coefficient, Derivation of the formula for Spearman's rank correlation coefficient, Fitting of regression plan by method of least square, Properties of Multiple and Partial correlation coefficient.

**Books Recommended:**


1. Gupta.S.P.2002: Statistical methods, Sultan Chand & Son's New Delhi.

(Unit-I, II): P. No- 389-493

2. Gupta S. P. Statistical Methods; S. Chand Publication (2014); Unit-I,II,III, IV: P. No. 751-803
3. Agarwal B. L. , Basic Statistics (2015), Unit-I : 98-121.
4. Saxena S, Kapoor J. N.; Mathematical Statistics, S. Chand (2005), Unit-I, II: P. No. 377-383
5. Kapoor V. k. ,Gupat S. C. , Fundamental of Mathematical Statistics( 2008) , S. Chand Unit-I , II, III, IV : 10.1 – 11.26
6. Grewal P. S., Methods of Statistical Analysis, Sterling Publishers, (1990), Unit-I,II : P. No. 366-486

**Semester II: Statistics Course –II**

**Statistics –BST-202: Discrete Probability Distributions**

**Theory: 36 Lectures (30 Hours)**

**OBJECTIVES:**

The main objective of this course is to,

1. To introduce students with standard discrete probability distributions and bivariate probability distributions.
2. To understand use of discrete probability distributions in different situations
3. To distinguish between discrete random variables based on finite and countably infinite sample space and study of their distributions.
4. To compute mean, variance and p.g.f of discrete random variables.

**Unit 1.Some Standard Discrete Probability Distribution: (finite sample space (10L)**

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

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

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.

1.4 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. Examples.

**Unit 2. Some Standard Discrete ProbabilityDistributions:(countably infinite sample space): (10L)**

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

1.1 Poisson Distribution: Definition of Poisson with parameter $\lambda$ . 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.

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

1.3 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.

**Unit 3. Bivariate Discrete probability Distribution: (8L)**

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

**Unit 4. Mathematical Expectation (Bivariate Random Variable) (8L)**

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)$E(XY) = E(X)\cdot E(Y)$ 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.

**Learning Outcomes:**

Students are able to ;

**Define-**Discrete Random Variable. Bernoulli , Binomial, Discrete Uniform, Hypergeometric distributions, Poisson distribution, Geometric and Negative Binomial Distribution, Bivariate discrete random variable.

**Explain-** Results on expectation of discrete random variable, Mean and variance by using pgf.

**Write-** Properties of pgf, Probability mass function-Mean-Variance-moments- cdf for standard discrete probability distribution, Recurrence relation, concept of marginal and conditional probability, Theorems on expectation, conditional mean and conditional variance.

**Books Recommended:**


1. Gupta S. P. Statistical Methods; Sultan Publication.(2014); Unit-I,II,III, IV: P. No. 751-803
2. Agarwal B. L. , Basic Statistics (2015), Unit-I : 98-121.
3. Saxena S, Kapoor J. N.; Mathematical Statistics, S. Chand (2005)
   Unit-I: P. No. 126-140
   Unit-II: P. No. 179-190
4. Kapoor V. K. ,Gupat S. C. , Fundamental of Mathematical Statistics( 2008) , S. Chand
   Unit-III, IV : 4.1 – 5.72
5. Mukhopadyay Parimal, Theory of Probability ( 1995).
   Unit-I, II, III : P. No. 183-213
6. Grewal P. S., Methods of Statistical Analysis, Sterling Publishers, (1990)
   Unit-III, IV : P. No. 828-890
7. Gupta.S.P.2002: Statistical methods, Sultan Chand & Son's New Delhi.
   Unit-I, II, III: P. No.- 751 to 803, 805-858