

# **SHIVAJI UNIVERSITY, KOLHAPUR.**



Accredited By NAAC with 'A++' Grade

CHOICE BASED CREDIT SYSTEM

Syllabus For

**B.Sc. Part – I**

**Statistics**

**SEMESTER I AND II**

(Syllabus to be implemented from June, 2022 onwards.)

**B. Sc. Part – I Semester – I**  
**DSC –7A – STATISTICS – I**  
**(DESCRIPTIVE STATISTICS – I)**

**Theory: 30 hrs. Marks -50 (Credits: 02)**

**Course Outcomes:** The students will acquire knowledge of

- i. meaning and scope of Statistics, various statistical organizations,
- ii. data and types of data, various data presenting methods,
- iii. population, sample and various methods of sampling,
- iv. various measures of central tendencies and dispersion,
- v. moments, skewness and kurtosis.

**CONTENTS:**

**Unit - 1** **(15 hrs.)**

**1.1 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.

**1.2 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.

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

**1.4 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.)**

**2.1 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 examples.

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

**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 examples.

**2.2 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, variance and S.D. of pooled data (proof for two groups).

**Coefficient of Variation:** Definition and use. Illustrative examples.

**2.3 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.

### **Books Recommended:**

1. Bhat B. R., Srivenkatramana T. and Madhava Rao K. S. (1996): Statistics: A Beginner's Text, Vol. 1, New Age International (P) Ltd.
2. Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Gupta V.K. & Kapoor S.C.: Fundamentals of Mathematical Statistics.- Sultan & Chand.
6. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
7. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
8. Kore B. G. and Dixit P. G.: "Descriptive statistics-I", Nirali Prakashan, Pune.

9. Mood A. M., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
10. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Iowa State University Press.
11. Waiker and Lev.: Elementary Statistical Methods.

**Note:** 1. In theory examination, the weightage to numerical problems should not exceed 30%.  
 2. Students can use scientific calculators in theory examination.

**B. Sc. Part – I Semester – I**  
**DSC –8A – STATISTICS – II**  
**(ELEMENTARY PROBABILITY THEORY)**  
**Theory: 30 hrs. Marks -50 (Credits: 02)**

**Course outcomes:** Students will be able to;

- i. distinguish between random and non-random experiments
- ii. acquire knowledge of concepts of probability
- iii. use the basic probability rules, including additive and multiplicative laws
- iv. understand concept of conditional probability and independence of events.
- v. understand concept of univariate random variable and its probability distributions
- vi. acquire knowledge of mathematical expectation of univariate random variable.

**CONTENTS:**

**Unit – 1** **(15 hrs.)**

**1.1 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. Algebra of events (Union, Intersection, Complementation). Definitions of mutually exclusive events, Exhaustive events, Impossible events, Certain event. Power set  $|P(\Omega)$  (sample space consisting at most 3 sample points). Symbolic representation of given events and description of events in symbolic form. Illustrative examples.

**1.2 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. Definition of probability in terms of odd ratio with illustrative examples. Axiomatic definition of probability. Proof of the results: i)  $P(\Phi) = 0$ , ii)  $P(A^c) = 1 - P(A)$ , iii)  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$  (with proof) and its generalization (Statement only), iv) If  $A \subseteq B$ ,  $P(A) \leq P(B)$ , v)  $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$ .

**Unit – 2** **(15 hrs.)**

**2.1 Conditional Probability and Independence of events:** Definition of conditional probability of an event. Multiplication theorem for two events. Examples on conditional probability. 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.

Partition of sample space. Idea of posteriori probability, statement and proof of Baye's theorem, illustrative examples on Baye's theorem.

**2.2 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.

**2.3 Mathematical expectation (Univariate random variable):** Definition of expectation of a random variable. Expectation of a function of a random variable, Results on expectation of a functions of a random variable: 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 distribution,  $V(aX + b) = a^2V(X)$ , definition of raw, central moments, definition of probability generating function (p.g.f.) of a random variable, obtaining mean and variance by using p.g.f. Effect of change of origin and scale on p.g.f.

### Books Recommended

1. Bhat B. R., Srivenkatramana T. and Madhava Rao K. S. (1996): Statistics: A Beginner's Text, Vol. 1, New Age International (P) Ltd.
2. Edward P. J., Ford J. S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.
3. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
4. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan & Chand.
5. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
6. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
7. Kore B. G. and Dixit P. G.: "Elementary Probability Theory", Nirali Prakashan, Pune.
8. Meyer P.L. (1970): Introductory Probability and Statistical Applications, Addison Wesley.
9. Mukhopadhyay P. (2006): Probability. Books and Allied (P) Ltd.
10. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia).
11. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Iowa State University Press.

### Note:

1. In theory examination, the weightage to the numerical problems should not exceed 30%.
2. Students can use scientific calculators in theory examination.

## B. Sc. Part – I Semester – II

**DSC –7B – STATISTICS – III**  
**(DESCRIPTIVE STATISTICS – II)**

**Theory: 30 hrs. Marks -50 (Credits: 02)**

**Course Outcomes:** Students will acquire knowledge of;

- i. correlation coefficient and interpret its value.
- ii. regression coefficients, interpret its value and use in regression analysis.
- iii. qualitative data including concept of independence and association between two attributes
- iv. vital statistics and concept of mortality and fertility and growth rates.

**CONTENTS:**

**Unit – 1**

**(15 hrs.)**

**1.1 Correlation:** Bivariate data, Need of analysis of bivariate data, Concept of correlation between two variables, Types of correlation.

**Methods 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.

**1.2 Regression:** Concept of regression, Lines of regression of Y on X ( $Y=a + bX + \varepsilon$ ) and X on Y, fitting of lines of regression by the least square method, Regression coefficients  $b_{xy}$ ,  $b_{yx}$  and their geometric interpretations

Properties: i)  $b_{xy} \times b_{yx} = r^2$ , ii)  $b_{xy} \times b_{yx} \leq 1$ , iii)  $\frac{b_{xy} \times b_{yx}}{2} \geq r$ , 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 squares, Residual Plot (Residual versus fitted value) and its interpretation, Explained and unexplained variation, coefficient of determination, Illustrative examples.

**Unit – 2**

**(15 hrs.)**

**2.1 Attributes:** Introduction and Notations of Attribute, Dichotomy, class, order of class, positive and negative class, class frequency, ultimate class frequency, fundamental set of class frequency, relationships among different class frequencies (up to three attributes), Concept of consistency, 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  $Y$ : 1)  $Q = \frac{2Y}{1+Y^2}$ , 2)  $|Q| \geq |Y|$ , Correlation Coefficients: 1) Point Biserial Correlation Coefficient, 2) Phi Coefficient, 3) Tetrachoric Correlation Coefficient, Illustrative examples.

**2.2 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 - construction and its applications in insurance, Use and Applications

### **Books Recommended:**

1. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. I, New Age International (P) Ltd.
2. Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand & Sons Pvt. Ltd. New Delhi.
5. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan Chand & Sons Pvt. Ltd. New Delhi.
6. Kapur, J. N and Gupta, H. C. : Fundamentals of Mathematical Statistics, S. Chand and sons, New Delhi.
7. Kore B. G. and Dixit P. G.: "Descriptive Statistics-II", Nirali Prakashan, Pune.
8. Srivastav D. S: A Text book of Demography
9. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Iowa State University Press.
10. Waiker and Lev.: Elementary Statistical Methods.

Note:

1. In theory examination, the weightage to the numerical problems should not exceed 30%.
2. Students can use scientific calculators in theory examination.

## **B. Sc. Part – I Semester – II**

### **DSC –8B – STATISTICS – IV**

#### **(DISCRETE PROBABILITY DISTRIBUTIONS)**

**Theory: 30 hrs. Marks -50 (Credits: 02)**

**Course Outcome:** Student will be able to acquire knowledge of;

- i. bivariate discrete distributions, independence of bivariate r.v.s., Mathematical expectation of bivariate discrete random variable.
- ii. one point distribution, two point distribution, Bernoulli distribution,
- iii. Uniform distribution, Binomial distribution, Hypergeometric distribution,
- iv. Poisson distribution, Geometric distribution and Negative binomial distribution.

## CONTENTS:

### Unit – 1

(15 hrs.)

**1.1 Bivariate Discrete Distribution:** Definition of bivariate discrete random variable (X, Y) on finite support, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof), computation of probabilities of events in bivariate probability distribution, marginal and conditional probability distribution. Independence of two discrete r.v.s.,

**1.2 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, Proof of the p.g.f. of sum of two independent r.v. as the product of their p.g.f.

### Unit – 2

(15 hrs.)

#### 2.1 Some Standard Discrete Probability Distributions: (finite support):

**One point distribution:** p.m.f., mean and variance,

**Two point distribution:** p.m.f., mean and variance,

**Bernoulli distribution:** p.m.f., p.g.f., mean, variance.

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

**Binomial Distribution:** Binomial random variable, p.m.f. with parameters (n, p), recurrence relation for obtaining successive probabilities, mean, and variance, skewness, p.g.f., Additive property of binomial variates, distribution of sum of independent and identically distributed Bernoulli variables.

**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 distribution (Statement only).

#### 2.2 Some Standard Discrete Probability Distributions: (Countable infinite support):

**Poisson Distribution:** Definition of Poisson with parameter  $\lambda$ , mean, variance, probability generating function (p.g.f.). Recurrence relation for obtaining successive probabilities. Additive property of Poisson distribution. Poisson distribution as a limiting case of Binomial distribution (Statement Only).

**Geometric Distribution:** Definition of Geometric distribution with parameter p, mean and variance, cumulative distribution function. p.g.f. Lack of memory property.

**Negative Binomial Distribution:** Definition of Negative binomial distribution with parameters (k, p). Geometric distribution is a particular case of Negative binomial distribution, mean, variance, p.g.f., Recurrence relation for obtaining successive probabilities.

### Books Recommended:

1. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Edward P. J., Ford J. S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.

3. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics, Sultan & Chand
6. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
7. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
8. Kapur J. N. and Gupta H. C. : Fundamentals of Mathematical Statistics, S. Chand and sons, New Delhi.
9. Kore B. G. and Dixit P. G.: Discrete Probability Distributions, Nirali Prakashan, Pune.
10. Meyer P. L. (1970): Introductory Probability and Statistical Applications, Addison Wesley.
11. Mood A. M., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
12. Mukhopadhyay P. (2006): Probability. Books and Allied (P) Ltd
13. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)

**Note:** 1. In theory examination, the weight age to the numerical problems should not exceed 30%.

2. Students can use scientific calculators in theory examination.

### **Practical Paper-I (Credit 2+2)**

**Pre requisites:** Knowledge of the topics in the theory papers.

**Course Outcomes:** Students will able to;

- i. acquire knowledge of computations using MS-Excel.
- ii. represent statistical data diagrammatically and graphically.
- iii. compute various measures of central tendency, dispersion, moments, skewness and kurtosis.
- iv. compute correlation coefficient, regression coefficients.
- v. understand consistency, association and independence of attributes.
- vi. interpret summary Statistics of computer output.
- vii. know applications of some standard discrete probability distributions.
- viii. compute the various fertility rates, mortality rates and growth rates.

**List of Practicals:**

1. Data handling using MS-Excel
2. Computations using MS-Excel
3. Diagrammatic and Graphical presentation.
4. Measures of central tendency
5. Measures of the dispersion
6. Moments, skewness and kurtosis.
7. Use of random numbers to draw SRSWOR, SRSWR, Stratified and Systematic sample.
8. Computation of probabilities using Baye's theorem.

9. Correlation coefficient, and regression (ungrouped data)
10. Correlation coefficient and regression (grouped data)
11. Spearman's rank correlation coefficient
12. Attributes (Missing frequencies, consistency, association and independence).
13. Demography (Computations of Fertility rates, Mortality rates and Growth rates)
14. Applications of Uniform, Binomial and Hypergeometric distribution.
15. Applications of Poisson, Geometric and Negative Binomial distribution.
16. Bivariate Discrete distribution I. (Marginal and conditional distribution, computation of probabilities of events).
17. Bivariate Discrete distribution II (Expectation /conditional expectation / variance / conditional variance /covariance / correlation coefficient)
18. Case study equivalent to 3 practicals.

**Notes:**

- a. Students must complete all experiments using MS-EXCEL.
- b. Case study - Different data sets from newspapers, internet, magazines may be collected and students will be asked to use statistical techniques/tools which they have learnt.
- c. MS-EXCEL should be used at the time of practical examination for calculation.
- d. Student must complete the entire practical to the satisfaction of the teacher concerned.
- e. Student must produce laboratory journal along with completion certificate signed by Head of the Department, at the time of practical examination.

**Laboratory Requirements:**

Laboratory should be well equipped with at least 20 computers along with necessary Software's, at least two printers, sufficient back up facility (UPS/ Inverter/ Generator).

**Nature of Practical Question Paper:**

- a) In the practical question paper there shall be four questions each of 16 marks, a student has to attempt any two questions.
- b) Computations should be completed using MS-EXCEL and should be demonstrated to examiner. Experiment aim, formulae, results etc. should be written on practical answer paper.
- c) 8 marks are reserved for case study, 5 marks are reserved for the journal and 5 marks for the oral examination.
- d) Practical examination is of four hours duration which includes viva (oral) examination and on line demonstration.