Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur.

DEPARTMENT OF STATISTICS

Curriculum, Teaching and Evaluation Structure

for

B.Sc.-I Statistics

Semester-I & II

(Implemented from academic year 2024-25 onwards based on NEP Phase 2.0)

B.Sc. Part– I Semester –I STATISTICS

DSC-I: Descriptive Statistics I

Theory:30hrs.

Marks-50 (Credits:02)

Course Objectives

1. To study the scope of Statistics and sampling methods.
2. To study Descriptive Statistics.
3. To study moments, skewness, kurtosis.
4. To study applying appropriate methods for descriptive data.

Unit	Contents	Hours Allotted
1	**Introduction to Statistics & Measures of Central Tendency** 1.1 : Definition and scope of Statistics, Concepts of statistical population & sample Meaning of primary and secondary data. Qualitative data (Attributes): nominal and ordinal scale. Quantitative data (Variables): Interval and ratio scale, discrete and continuous variables. raw data. **Presentation:** Tabular & graphical including Histograms & Ogives. 1.2 : Concept of Central tendency, Statistical average, Requirements of good statistical average. 1.3 : **Arithmetic Mean (A.M)**: Definition, Properties: a. Effect of change of origin and scale, b. Sum of deviation of observations from A.M is zero. c. Sum of squares of deviation of observations from A.M is minimum. d. Combined mean of k series (prove for two series and generalize for k series) Weighted A.M. 1.4 : **Geometric Mean (G.M)**: Definition, Properties: i) G. M. of pooled data (for two groups), ii) G. M. of ratio of two series, is the ratio of their G. M's. 1.5: **Harmonic Mean (H.M.)**: Definition, Relation: A.M ≥ G.M≥ H.M (proof for n =2 positive observations). 1.6 : **Median**: Definition, Derivation of formula for grouped frequency distribution. 1.7 : **Mode**: Definition (Ungrouped & Grouped data). Empirical relation between Mean, Median and Mode. Graphical method of determination of Median and Mode. 1.8 : **Partition values** Quartiles, Deciles and Percentiles 1.9 : Comparison between averages in accordance with requirements of good average. 1.10 : Situations where one kind of average is preferable to others.	**15**

2	**Measures of Dispersion, Moments, Skewness and Kurtosis** 2.1 : Concept of dispersion, Absolute and Relative measures of dispersion, Requirements of a good measure of dispersion. 2.2: **Range:** Definition, Coefficient of range. 2.3: **Quartile Deviation (Semi-inter quartile range):** Definition, Coefficient of Q.D. 2.4: **Mean Deviation:** Definition, Coefficient of M.D. Minimal property of M.D. 2.5: **Mean Square Deviation (**M.S.D.)**:** Definition, Minimal property of M.S.D. 2.6**: Variance and Standard Deviation:** Definition, Effect of change of origin and scale, combined variance (proof for two groups). 2.7 : **Coefficient of Variation:** Definition and use. 2.8 : Comparison of S.D. with other measures. Examples. 2.9 : **Moments:** Raw moments (μ_r') and Central moments (μ_r) for ungrouped and grouped data. 2.10 : Effect of change of origin and scale on central moments, relation between central moments and raw moments (up to 4^{th} order). 2.11 : Sheppard's corrections. 2.12 : **Skewness:** Concept of skewness of a frequency distribution, Types of skewness. 2.13 : Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness, Measure of skewness based on moments. 2.14: **Kurtosis:** Concept of kurtosis of a frequency distribution, Types of kurtosis. 2.15: Measure of kurtosis based on moments. Examples.	**15**

Course Outcomes - At the end of this course students will be able to:

1. Know scope of Statistics and sampling methods.
2. Compute descriptive statistics.
3. Compute moments, skewness, kurtosis and its interpretation.
4. Use an appropriate measure in given situations/data.

B.Sc. Part– I Semester –I STATISTICS

DSC-II: Elementary Probability Theory

Theory:30hrs.

Marks-50 (Credits:02)

Course Objective-

1. To study Deterministic and Non-deterministic experiments.
2. To study basic concepts of probability.
3. To study theorems on probabilities and compute probabilities.
4. To study concept of discrete random variable and probability distributions.

Unit	Contents	Hours Allotted
1	**Probability** 1.1 : Concepts of experiments and random experiments. 1.2: Definitions: Sample space, Discrete sample space (finite and countably infinite). 1.3: Event, Types of events: Elementary event, Compound event, impossible events, Certain event, favorable event Algebra of events (Union, Intersection and Complement). 1.4: Definitions of Mutually exclusive events, Exhaustive events, 1.5: Power set |P(Ω) (sample space consisting at most 3sample points). 1.6: Symbolic representation of given events and description of events in symbolic form. 1.7: Illustrative examples. 1.8: 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. 1.9: Axiomatic definition of probability with reference to a finite & countably infinite sample space. 1.10: 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 $A \subset B$, $P(A) \leq P(B)$, v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$ 1.11: Definition of probability in terms of odd ratio. 1.12: Illustrative examples.	**15**
2	**Conditional Probability, Independence of Event & Univariate Probability Distributions** 2.1: Definition of conditional probability of an event. 2.2: Multiplication theorem for two events. Examples on conditional probability. 2.3: Partition of sample space. 2.4: Idea of Posteriori probability, Statement and proof of Baye's theorem, examples on Baye's theorem. 2.5: Concept of Independence of two events.	**15**

	2.6 : Proof of the results: If A and B are independent then, i) A and B^c , ii) A^c and B , iii) A^c and B^c are independent. 2.7: Pairwise and Mutual Independence for three events. 2.8 : Elementary examples. 2.9 : 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. (statement only), Probability distribution of function of random variable. Median and Mode of a univariate discrete probability distribution.	

Course Outcomes - At the end of this course students will be able to:

1. Distinguish between Deterministic and Non-deterministic experiments.
2. Understand the basic concepts of probability, conditional probability and independence of events.
3. Learn theorems on probabilities and compute probabilities.
4. Understand the concept of discrete random variable and probability distributions.

DSC-PR-I

Practical Paper-I (Credits 02) Marks: 50

Course Objectives-

1. To study graphical and diagrammatical representation.
2. To study descriptive statistics.
3. To study moments, skewness & kurtosis.
4. To study the occurrence of random event.

Sr. No.	Title of the Experiment
1	Graphical representation of frequency distribution.
2	Measures of Central Tendency I (Ungrouped data)
3	Measures of Central Tendency II (Grouped data)
4	Measures of Dispersion I (Ungrouped data)
5	Measures of Dispersion II (Grouped data)
6	Moments, Skewness and Kurtosis I (Ungrouped data)
7	Moments, Skewness and Kurtosis II (Grouped data)
8	Probability & Conditional Probability & Baye's Theorem
9	Independence of events
10	Univariate Probability Distributions

Course Outcomes - At the end of this practical paper students will be able to:

1. Use various graphical and diagrammatic techniques and interpret.
2. Compute descriptive statistics.
3. Computation of Moments, Skewness, Kurtosis & its interpretation.
4. Computation of various probabilities.

B.Sc. Part–I Semester-II STATISTICS

DSC-III: Descriptive Statistics II

Theory:30hrs.

Marks-50 (Credits:02)

Course Objective-

1. To study correlation coefficient for quantitative & qualitative data.
2. To study regression coefficients and regression lines.
3. To study attribute data & to analyze it.
4. To study vital statistics.

Unit	Contents	Hours Allotted
1	**Analysis of Bivariate Data** 1.1: **Correlation:** Bivariate Random variable (X, Y), Bivariate data, Formation of bivariate frequency distribution. 1.2: Definition and properties of Covariance of (X,Y). (Effect of change of origin and scale on covariance) 1.3: Concept of correlation between two variables, Types of correlation. 1.4: Scatter diagram, its utility. 1.5: 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. 1.6: Spearman's rank correlation coefficient: Definition, Computation (for with and without ties). Derivation of the formula for without ties and modification of the formula for with ties. 1.7: **Regression**: Concept of regression, Lines of regression, Fitting of lines of regression by the least square method (Statement only). 1.8: 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) $(b_{xy} + b_{yx}) / 2 \geq r$, iv) Effect of change of origin and scale on regression coefficients, v) the point of intersection of two regression lines. 1.9: Definition of acute angle between the two lines of regression. 1.10: Coefficient of determination. 1.11: Examples.	**15**

2	**Theory of Attributes & Demography:** 2.1: Attributes: Notation, 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). 2.2: Concept of Consistency, conditions of consistency (up to three attributes). 2.3: Concept of Independence and Association of two attributes. 2.4: Yule's coefficient of association (Q): Definition & interpretation. 2.5: Coefficient of colligation (Y): Definition, interpretation. 2.6: Relation between Q and Y, $Q = 2Y/(1+Y2)$, $\|Q\| \geq \|Y\|$. 2.7: Illustrative Examples. 2.8: Demography: Introduction and need of vital statistics 2.9: Mortality rates: Crude death rate (CDR), Specific Death Rate (SDR), Standardized Death Rate (STDR). 2.10: Fertility Rates: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), Total Fertility Rate (TFR). 2.11: Reproduction Rate: Gross Reproduction rate (GRR), Net Reproduction Rate (NRR).	**15**

Course Outcomes - At the end of this course students will be able to:

1.To compute correlation coefficient for quantitative, qualitative data and its interpretation.

2.To compute regression coefficients and regression lines.

3.Analyze data pertaining to attributes and interpret the results.

4.Understand the need of vital statistics and concepts of mortality and fertility.

B.Sc. Part–I Semester-II STATISTICS

DSC-IV: Discrete Probability Distributions

Theory:30hrs.

Marks-50 (Credits:02)

Course Objectives-

1. To study some discrete probability distributions.
2. To study mathematical expectation of different distributions.
3. To study relation between different discrete distributions.
4. To study bivariate random variable and probability distributions.

Unit	Contents	Hours Allotted
1	**Mathematical Expectation** & **Standard Discrete Probability Distributions:** 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) = a E (X) + b, where a and b are constants, 1.2: Definitions of mean, variance of univariate distributions. 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. 1.3: Examples 1.4: **Idea of one point, two-point distribution** and its mean, variance. 1.5: **Discrete Uniform Distribution**: p.m.f., mean and variance. 1.6: **Bernoulli Distribution:** p.m.f., mean, variance, distribution of sum of independent and identically distributed Bernoulli variables 1.7: **Binomial Distribution:** Binomial random variable, p.m.f. with parameters (n, p), Recurrence relation for successive probabilities, mean, variance, mode, skewness, p.g.f. and Additive property of binomial variates. Examples. 1.5: **Hyper geometric Distribution:** p.m.f. with parameters (N, M, n), Computation of probability of different events, situations where this distribution is applicable, Recurrence relation for successive probabilities, mean and variance of distribution assuming $n \leq N - M \leq M$, approximation of Hypergeometric to Binomial. Examples. 1.6: **Poisson Distribution:** Definition of Poisson distribution with parameter λ. Mean, variance, probability generating function (p.g.f.). Recurrence relation for successive probabilities, Additive property of Poisson distribution. Poisson distribution as limiting case of Binomial distribution, examples.	**15**

2	**Bivariate Probability Distribution (Defined on finite sample space) & Mathematical Expectation (Bivariate random variable)**: 2.1: Definition of bivariate discrete random variable (X, Y) on finite sample space. 2.2: Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof). 2.3: Computation of probabilities of events in bivariate probability distribution. 2.4: Concepts of marginal and conditional probability distributions, independence of two discrete r.v.s. 2.5: Examples and problems. 2.6: Definition of expectation of functions of r.v. in bivariate distribution. 2.7: **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 2.8: Expectation and variance of linear combination of two discrete r.v.s. 2.9: Definition of conditional mean, conditional variance, covariance and correlation coefficient, Cov (aX+bY, cX+dY). 2.10: Distinction between uncorrelated and independent variables 2.11: 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. 2.12: Examples and problems.	**15**

Course Outcomes - At the end of this course students will be able to**:**

1. Apply some univariate standard discrete probability distributions and it's real-life situations.
2. Obtain mathematical expectation of different distributions.
3. To learn relation between different discrete distributions.
4. Concept of bivariate random variable, probability distributions.

DSC-PR-II

Practical Paper-II (Credits 02) Marks: 50

Course Objectives:

1. To understand the concept of correlation & regression in real life situations.
2. To understand the concept of attribute.
3. To understand applications of discrete distributions.
4. To understand the concept demography.

Sr. No.	Title of the Experiment
1.	Correlation I (Qualitative Data)
2.	Correlation II (Quantitative Data)
3.	Regression I (Ungrouped data)
4.	Attribute I (Missing frequencies, Consistency)
5.	Attribute II (Association and Independence)
6.	Demography I (Mortality Rate)
7.	Demography II (Fertility Rate)
8.	Applications of Discrete Uniform & Binomial distribution
9.	Applications of Hypergeometric & Poisson distribution
10.	Bivariate Discrete distributions I & II

Course Outcomes - At the end of this practical paper students will be able to:

1. Compute correlation coefficient, regression coefficients.
2. Analyze data pertaining to attributes and interpret the results.
3. Apply various discrete distributions.
4. Compute mortality and fertility rates.

Note:

i. Calculations using statistical formulae should be done by scientific calculator and verify by using MS-EXCEL.
ii. Computer printouts should be attached to the journal if necessary.
iii. Student must produce the laboratory journal along with the completion certificate signed by Head of Department, at the time of practical examination.

Reference Materials -	
Text Books for Reading	
1.	Descriptive Statistics I (Nirali Prakashan/ Phadake Prakashan)
2.	Elementary Probability Theory (Nirali Prakashan/ Phadake Prakashan)
3.	Descriptive Statistics II (Nirali Prakashan/ Phadake Prakashan)
4.	Discrete Probability Distributions (Nirali Prakashan/ Phadake Prakashan)
5.	Descriptive Statistics by P.G. Dixit and V.R. Prayag
Books for Reference	
1.	Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
2.	Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi. 5.
3.	Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics. -Sultan & Chand.
4.	. Dr. Kore B. G. and Dr. Dixit P. G.: "Descriptive statistics-I", Nirali Prakashan, Pune
5.	Meyer P.L. (1970): Introductory Probability and Statistical Applications, Addision Wesley.
6.	Mukhopadhyay P. (2006): Probability. Books and Allied (P) Ltd.
7.	Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
8.	Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics. -Sultan & Chand
9.	Gupta V.K. & Kapoor S.C. Fundamentals of Applied Statistics. - Sultan& Chand
10.	Dr. Kore B. G. and Dr. Dixit P. G.: "Descriptive Statistics-II", Nirali Prakashan, Pune.
Books for Practical	
1.	Elements of Practical Statistics by S.K. Kapur
2.	Practical Statistics by S. Roychowdhury and D.Bhattacharya. (U.N. Dhur and Sons Private LTD)
3.	Practical Statistics by K. R. Gupta
4.	A handbook of practical statistics by Sudhir Kapoor

Suggested methods of Teaching:	
1.	Offline Traditional Board Teaching
2.	Power Point Presentation
3.	Online Teaching on platform of Zoom or Google Meet

Scheme of Course Evaluation		
1.	End Semester Examination (ESE)	40
2.	Continuous Internal Evaluation (CIE)	10
3.	**Total Marks**	**50**

Suggested techniques for Continuous Internal Evaluation (10 Marks)	
1.	Seminar
2.	Field Report
3.	Assignments
4.	Open book test
5.	Offline / online MCQ test
6.	Visit/Tour report
7.	Surprise test
8.	Formula Test

End Semester Examination Question Paper Pattern (40 Marks) Theory			
Q. No.	**Nature /Type of Question**	**Marks**	**Total**
1.	Multiple Choice Question (06)	Each for 01 Marks	**06**
2.	Write definition or Formulas (5)	Each for 02 Marks	**10**
3.	Solve the following question Any 3 out of 5	Each for 04 Marks	**12**
4.	Solve the following question A Or B	Each for 06 Marks	**06**
5.	Solve the following question A Or B	Each for 06 Marks	**06**
Total			**40**

Practical Examination

(A) The practical examination will be conducted for one day for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Question Paper Pattern (50 Marks) Practical Exam		
Q. No.	**Nature / Type of Question**	**Marks**
1	Attempt any one out of two	20
2	Attempt any one out of two	20
3	Oral	05
4	Certified Journal	05
Total Marks		**50**