VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

DEPARTMENT OF STATISTICS
Three/Four- Years UG Programme
Department/Subject Specific Core or Major (DSC)

Curriculum, Teaching and Evaluation Structure

for

B.Sc.-I Statistics

Semester-I & II

(Implemented from academic year 2023-24 onwards)

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

Department of Statistics

Teaching and Evaluation scheme

Three/Four- Years UG Programme

Department/Subject Specific Core or Major (DSC)

First Year Semester- I & II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-I										
1	DSC-I	DSC03STA11	Descriptive Statistics I	2	-	40	10	-	50	2
2	DSC-II	DSC03STA12	Elementary Probability Theory	2	-	40	10	-	50	2
3	MIN-I	MIN03STA11	Descriptive Statistics I	2	-	40	10	-	50	2
4	MIN-II	MIN03STA12	Elementary Probability Theory	2	-	40	10	-	50	2
5	OEC-I	OEC03STA11	Data Visualization & Sample Survey	2	-	40	10	-	50	2
6	OEC-II	OEC03STA12	Exploratory Data Analysis	2	-	40	10	-	50	2
7	IKS-I	IKS03STA11	Indian Knowledge System	2	-	25	-	-	25	2
8	DSC-PR-I	DSC03STA19	DSC Statistics Practical I	-	4	-	-	25	25	2
9	MIN-PR-I	MIN03STA19	MIN Statistics Practical I	-	4	-	-	25	25	2
10	OEC-PR-I	OEC03STA19	OEC Statistics Practical I	-	4	-	-	25	25	2
			Sem I Total	**14**	**12**	**265**	**60**	**75**	**400**	**20**
Semester-II										
1	DSC-III	DSC03STA21	Descriptive Statistics II	2	-	40	10	-	50	2
2	DSC-IV	DSC03STA22	Discrete Probability Distributions	2	-	40	10	-	50	2
3	MIN-III	MIN03STA21	Descriptive Statistics II	2	-	40	10	-	50	2
4	MIN-IV	MIN03STA22	Discrete Probability Distributions	2	-	40	10	-	50	2
5	OEC-III	OEC03STA21	Business Statistics	2	-	40	10	-	50	2
6	OEC-IV	OEC03STA22	Testing of Hypothesis	2	-	40	10	-	50	2
7	SEC-I	SEC03STA21	Basic statistics with MS-EXCEL	2	-	50	-	-	50	2

8	DSC-PR-II	DSC03STA29	DSC Statistics Practical II	-	4	-	-	25	25	2
9	MIN-PR-II	MIN03STA29	MIN Statistics Practical II	-	4	-	-	25	25	2
10	OEC-PR-II	OEC03STA29	OEC Statistics Practical II	-	4	-	-	25	25	2
	Sem II Total			**12**	**16**	**240**	**60**	**100**	**400**	**20**

B. Sc. Part – I Semester -I STATISTICS

DSC-I: DSC03STA11: Descriptive Statistics I

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. Know scope of Statistics and sampling methods.
CO2. Compute descriptive statistics.
CO3. Compute moments, skewness, kurtosis and its interpretation.
CO4. Apply an appropriate measure in given situations/data.

Unit	Contents	Hours Allotted
1	**Introduction to Statistics & Measures of Central Tendency** 1.1 : Definition and scope of Statistics, raw data, Meaning of primary and secondary data. Qualitative data (Attributes): nominal and ordinal scale. Quantitative data (Variables): Interval and ratio scale, discrete and continuous variables. 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 $\geq$ G.M $\geq$ H.M (proof for n =2 positive observations). 1.6 : **Median**: Definition, Derivation of formula for grouped frequency distribution. 1.7 : **Mode**: Definition, Derivation of formula for grouped frequency distribution. Empirical relation between Mean, Median and Mode. Graphical method of determination of Median and Mode. 1.8 : **Partition values** Quartiles, Deciles and Percentiles, Box Plot. 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-interquartile 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. 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.	**15**

References:

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. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Lowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan& Chand

B. Sc. Part – I Semester -I STATISTICS

DSC-II: DSC03STA12: Elementary Probability Theory

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. Distinguish between Deterministic and Non-deterministic experiments.

CO2. Understand the basic concepts of probability, conditional probability and independence of events.

CO3. Learn theorems on probabilities and compute probabilities.

CO4: Understand the concept of discrete random variable, probability distributions and mathematical expectation.

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 3 sample 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 and countably infinite sample space. 1.10 : Proof of the results: i) $P(\Phi) = 0$, ii) $P(A^c) = 1 - P(A)$, ii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only). iii) 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. 1.13: Definition of conditional probability of an event. 1.14: Multiplication theorem for two events. Examples on conditional probability. 1.15: Partition of sample space. 1.16: Idea of Posteriori probability, Statement and proof of Baye's theorem, examples on Baye's theorem.	**15**

2	**Independence of Event & Mathematical Expectation of discrete random variable (on finite sample space)** 2.1: Concept of Independence of two events. 2.2: 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. 2.3: Pairwise and Mutual Independence for three events. 2.4: Elementary examples. 2.5: 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. 2.6: **Mathematical Expectation**: 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, 2.7: 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. 2.8: Examples.	**15**

References:

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.II, World Press, Calcutta.
4. Mood A. m., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
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. Meyer P.L.(1970): Introductory Probability and Statistical Applications, Addision Wesley.
8. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John Wiley & Sons (Asia)
9. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan & Chand
10. Mukhopadhyay P. (2006): Probability. Books and Allied (P) Ltd

Note: 1. In theory examination, the weightage to the numerical problems should **not exceed 40%.**
2. Students can use scientific calculators in theory examination.

DSC-PR-I: DSC03STA19

Practical Paper-I (Credits 02)

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

CO1. Use various graphical and diagrammatic techniques and Interpret.

CO2. Compute descriptive statistics.

CO3. Computation of Moments, Skewness, Kurtosis & its interpretation.

CO4. Computation of various probabilities.

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
9	Conditional Probability & Baye's Theorem
10	Independence of events
11	Univariate Probability Distributions I
12	Univariate Probability Distributions II

B. Sc. Part – I Semester -II STATISTICS

DSC-III: DSC03STA21: Descriptive Statistics II

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. To compute correlation coefficient and its interpretation.

CO2. To compute regression coefficients and regression lines.

CO3. Analyze data pertaining to attributes and interpret the results.

CO4. Understand the need of vital statistics and concepts of mortality and fertility.

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. 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: Derivation 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.	**15**

	2.6: Relation between Q and Y, $Q = 2Y/(1+Y^2)$, $\|Q\| \geq \|Y\|$. 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). 2.12: Lifetable, Notations and terminology, Expectation of life, Stationary population, Stable population, Central Mortality Rate, Force of Mortality, Assumptions, Description and construction of life table, Uses of life table.	

References:

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. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Iowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Kapur, J. N and Gupta, H. C,: Fundamentals of Mathematical Statistics. S. Chand and sons, New Delhi.
8. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan &Chand

B. Sc. Part – I Semester -II STATISTICS

DSC-IV: DSC03STA22: Discrete Probability Distributions

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. Apply some univariate standard discrete probability distributions to different situations.

CO2. Obtain mathematical expectation of different distributions.

CO3. To learn relation between different discrete distributions.

CO4. Concept of bivariate random variable, probability distributions.

Unit	Contents	Hours Allotted
1	**Standard Discrete Probability Distributions:** 1.1 : Idea of one point, two-point distributions and its mean and variance. 1.2 : **Discrete Uniform Distribution**: p.m.f., mean and variance. 1.3 : **Bernoulli Distribution:** p.m.f., mean, variance, distribution of sum of independent and identically distributed Bernoulli variables 1.4: **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**

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.II, World Press, Calcutta.
4. Mood A. m., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
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. Meyer P. L. (1970): Introductory Probability and Statistical Applications, Addision Wesley.
8. 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 weightage to the numerical problems should **not exceed 40%.**
2. Students can use scientific calculators in theory examination.

DSC-PR-II: DSC03STA29
Practical Paper-II (Credits 02)

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

CO1. Compute correlation coefficient, regression coefficients.

CO2. Analyze data pertaining to attributes and interpret the results.

CO3. Apply various discrete distributions.

CO4. Compute mortality and fertility rates.

Sr. No.	Title of the Experiment
1.	Correlation I (Karl Pearson's correlation coefficient)
2.	Correlation II (Spearman's Rank correlation coefficient)
3.	Regression I(Ungrouped data)
4.	Regression II (Grouped data)
5.	Attribute I (Missing frequencies, Consistency)
6.	Attribute II (Association and Independence)
7.	Demography I (Mortality Rate)
8.	Demography II (Fertility Rate)
9.	Applications of Discrete Uniform & Binomial distribution
10	Applications of Hypergeometric & Poisson distribution
11.	Bivariate Discrete distribution I
12.	Bivariate Discrete distribution II

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.

B. Sc. Part – I Semester -I STATISTICS

MIN-I: MIN03STA11: Descriptive Statistics I

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. Know scope of Statistics and sampling methods.
CO2. Compute descriptive statistics.
CO3. Compute moments, skewness, kurtosis and its interpretation.
CO4. Use an appropriate measure in given situations/data.

Unit	Contents	Hours Allotted
1	**Introduction to Statistics & Measures of Central Tendency** 1.1 : Definition and scope of Statistics, raw data, Meaning of primary and secondary data. Qualitative data (Attributes): nominal and ordinal scale. Quantitative data (Variables): Interval and ratio scale, discrete and continuous variables. 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, Derivation of formula for grouped frequency distribution. Empirical relation between Mean, Median and Mode. Graphical method of determination of Median and Mode. 1.8 : **Partition values** Quartiles, Deciles and Percentiles, Box Plot. 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-interquartile 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. 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.	**15**

References:

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. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Lowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan& Chand

B. Sc. Part – I Semester -I STATISTICS

MIN-II: MIN03STA12: Elementary Probability Theory

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. Distinguish between Deterministic and Non-deterministic experiments.

CO2. Understand the basic concepts of probability, conditional probability and independence of events.

CO3. Learn theorems on probabilities and compute probabilities.

CO4: Understand the concept of discrete random variable, probability distributions and mathematical expectation.

Unit	Contents	Hours Allotted
1	**Probability** 1.2 : 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 3 sample 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 and countably infinite sample space. 1.10 : Proof of the results: i) $P(\Phi) = 0$, ii) $P(A^c) = 1 - P(A)$, ii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only). iii) 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. 1.13: Definition of conditional probability of an event. 1.14: Multiplication theorem for two events. Examples on conditional probability. 1.15: Partition of sample space. 1.16: Idea of Posteriori probability, Statement and proof of Baye's theorem, examples on Baye's theorem.	**15**

2	**Independence of Event & Mathematical Expectation of discrete random variable (on finite sample space)** 2.1: Concept of Independence of two events. 2.2: 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. 2.3: Pairwise and Mutual Independence for three events. 2.4: Elementary examples. 2.5: 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. 2.6: **Mathematical Expectation**: 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, 2.7: 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. 2.8: Examples.	**15**

References:

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.II, World Press, Calcutta.
4. Mood A. m., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
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. Meyer P.L.(1970): Introductory Probability and Statistical Applications, Addision Wesley.
8. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John Wiley & Sons (Asia)
9. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan & Chand
10. Mukhopadhyay P. (2006): Probability. Books and Allied (P) Ltd

Note: 1. In theory examination, the weight age to the numerical problems should **not exceed 40%.**

2. Students can use scientific calculators in theory examination.

MIN-PR-I: MIN03STA19:
Practical Paper-I (Credits 02)

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

CO1. Use various graphical and diagrammatic techniques and Interpret.

CO2. Compute descriptive statistics.

CO3. Computation of Moments, Skewness, Kurtosis & its interpretation.

CO4. Computation of various probabilities.

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
9	Conditional Probability & Baye's Theorem
10	Independence of events
11	Univariate Probability Distributions I
12	Univariate Probability Distributions II

B. Sc. Part – I Semester -II STATISTICS

MIN-III: MIN03STA21: Descriptive Statistics II

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. To compute correlation coefficient and its interpretation.

CO2. To compute regression coefficients and regression lines.

CO3. Analyze data pertaining to attributes and interpret the results.

CO4. Understand the need of vital statistics and concepts of mortality and fertility.

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. 1.5 : **Regression**: Concept of regression, Lines of regression, Fitting of lines of regression by the least square method. 1.6: 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. 1.7: Derivation of acute angle between the two lines of regression. 1.8: Coefficient of determination. 1.9: 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.	**15**

	2.5: Coefficient of colligation (Y): Definition, interpretation. 2.6: Relation between Q and Y, $Q = 2Y/(1+Y^2)$, $\|Q\| \geq \|Y\|$. 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). 2.12: Lifetable, Notations and terminology, Expectation of life, Stationary population, Stable population, Central Mortality Rate, Force of Mortality, Assumptions, Description and construction of life table, Uses of life table.	

References:

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. Snedecor G.W. and Cochran W. G. (1967): Statistical Methods, Iowa State University Press.
6. Waiker and Lev.: Elementary Statistical Methods.
7. Kapur, J. N and Gupta, H. C,: Fundamentals of Mathematical Statistics. S. Chand and sons, New Delhi.
8. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan &Chand

B. Sc. Part – I Semester -II STATISTICS

MIN-IV: MIN03STA22: Discrete Probability Distributions

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1.Apply some univariate standard discrete probability distributions to different situations.

CO2.Obtain mathematical expectation of different distributions.

CO3. To learn relation between different discrete distributions.

CO4. Concept of bivariate random variable, probability distributions.

Unit	Contents	Hours Allotted
1	**Standard Discrete Probability Distributions:** 1.4 : Idea of one point, two-point distributions and its mean and 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 1.4: **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**

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.II, World Press, Calcutta.
4. Mood A. m., Graybill F. A. and Boes D. C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
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. Meyer P. L. (1970): Introductory Probability and Statistical Applications, Addision Wesley.
8. 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 weightage to the numerical problems should **not exceed 40%.**
2. Students can use scientific calculators in theory examination.

MIN-PR-II: MIN03STA29:
Practical Paper-II (Credits 02)

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

CO1. Compute correlation coefficient, regression coefficients.

CO2. Analyze data pertaining to attributes and interpret the results.

CO3. Apply various discrete distributions.

CO4. Compute mortality and fertility rates.

Sr. No.	Title of the Experiment
1.	Correlation I (Karl Pearson's correlation coefficient)
2.	Correlation II (Spearman's Rank correlation coefficient)
3.	Regression I (Ungrouped data)
4.	Regression II (Grouped data)
5.	Attribute I (Missing frequencies, Consistency)
6.	Attribute II (Association and Independence)
7.	Demography I (Mortality Rate)
8.	Demography II (Fertility Rate)
9.	Applications of Discrete Uniform & Binomial distribution
10	Applications of Hypergeometric & Poisson distribution
11.	Bivariate Discrete distribution I
12.	Bivariate Discrete distribution II

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.

B. Sc. Part – I Semester -I STATISTICS

OEC-I: OEC03STA11: Data Visualization & Sample survey

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1.Prepare instruments for the data collection.

CO2.Learn basic concepts of sample survey & different methods of sampling.

CO3.Visualize data diagrammatically.

CO4. Visualize data graphically.

Unit No.	Content	Hours Allocated
1	**Data Visualization & Presentation of Data** 1.1: Introduction –Data (qualitative and quantitative data) 1.2: Types of Characteristics: different scales of measurement Attributes and Variables, Collection and Organization of Data (Primary data, secondary data, Time series data, Cross-sectional data, Failure data). 1.3: Basic Terms: Class interval, class frequency, class mark, class width, Classification, Methods of Classification, Tabulation, Frequency Distribution, Discrete and continuous frequency distribution, Cumulative Frequencies, Relative frequency. 1.4: Diagrammatic Representation of Statistical Data –Bar diagram, subdivided bar diagram, Multiple bar diagram, Box plot, Pie chart, Scatter diagram. 1.5: Graphical Representation of Statistical Data-Histogram, Ogive curves, Frequency polygon and frequency curves.	**15**
2	**Sampling Survey:** 2.1: Population, Sample, Sampling unit, Sampling frame, Sampling method, Census method. 2.2: Advantages and disadvantages of sampling methods 2.3: Principles of sampling survey, Principal steps in sample survey, 2.4: Designing a questionnaire, Characteristics of good Questionnaire. 2.5: Sampling and non-sampling errors 2.6: Determination of sample size: Cochran's & Sterling's formula. 2.7: Methods of sampling: **i) Probability Sampling:** SRS, stratified random sampling, Systematic sampling, Cluster Sampling **ii) Non-Probability Sampling:** Judgment sampling, Sequential sampling, Quota sampling, snowball sampling, Purposive sampling.	**15**

Reference Books:

1. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan &Chand
2. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
3. W. G. Cochran- Sampling Techniques Wiley Publication third edition.

B. Sc. Part – I Semester -I STATISTICS

OEC-II: OEC03STA12: Exploratory Data Analysis

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

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

CO1. Learn basic concepts in statistics.

CO2. Compute descriptive statistics.

CO3. Understand the concept of bivariate data.

CO4. Analyze data by using correlation and regression.

Unit No.	Content	Hours Allocated
1	**Measures of Central Tendency & Dispersion:** 1.1: **Introduction to statistics:** Meaning & scope of statistics 1.2: **Types of Data**: Raw data, Data, Qualitative & Quantitative data, Primary data and Secondary data, Discrete and Continuous data. **Measures of Central Tendency** 1.3: Concept of Central Tendency. 1.4: Arithmetic Mean: Definition, Combined mean. 1.5: Positional Averages: Median and Mode, Determination of mode and median by graph, Partition values (Quartiles and Deciles). 1.6: Empirical relation between Mean, Median and Mode. 1.7: Numerical examples. **Measures of Dispersion:** 1.8: Concept of Dispersion 1.9: Absolute and Relative measures of dispersion. 1.10: Range- Definition, Coefficient of Range. 1.11: Quartile Deviation (Q.D.) Definition, Coefficient of Q.D. 1.12: Mean Deviation (M.D.): Definition of M.D. about Mean, Coefficient of M.D. about mean. 1.13: Standard Deviation (S.D.) and Variance: Definitions, Coefficient of S.D.,Combined S.D. for two groups. 1.14: Coefficient of Variation (C.V.): Definition and its uses. 1.15: Numerical Examples.	**15**
2	**Analysis of Bivariate Data:** **Correlation:** 2.1: Concept and types of correlation. 2.2: Methods of studying correlation, scatter diagram, Karl Pearson'scorrelation coefficient (r), computation of r for ungrouped data, interpretation of r = -1, r =0, r=+1. 2.3: Spearman's rank correlation coefficient(R), computation of R (with and without tie). **Regression:** 2.4: Concept of regression. 2.5: Lines of regression, regression coefficients. Properties of regression coefficients (only statements) 2.7: Numerical examples on correlation and regression.	**15**

Reference Books:

1. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan &Chand
2. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.

OEC-PR-I: OEC03STA19:

Practical Paper-I (Credits 02)

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

CO1. Use various graphical and diagrammatic techniques and interpret.

CO2. Compute descriptive statistics.

CO3. Analyze bivariate data through correlation and regression.

CO4. Calculate the simple linear regression equation for a set of data.

Sr. No.	**Title of the Experiment**
1.	Classification & tabulation of data
2.	Formation of frequency distribution
3.	Diagrammatic Representation: Bar diagram, sub divided bar diagram, Multiple bar diagram
4.	Diagrammatic Representation: Pie chart, Boxplot
5.	Graphical Representation: Histogram, Frequency Polygon, Frequency curve, Ogive curves
6.	Measures of Central Tendency I (Ungrouped data)
7.	Measures of Central Tendency II (Grouped data)
8.	Determination of Median and Mode graphically
9.	Measures of Dispersion I (Ungrouped data)
10.	Measures of Dispersion II (Grouped data)
11.	Correlation I (Karl Pearson’s correlation coefficient)
12.	Correlation II (Spearman’s Rank correlation coefficient)
13.	Regression

B. Sc. Part – I Semester -II STATISTICS

OEC-III: OEC03STA21: Business Statistics

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1. Measure trend and seasonal indices in Time series.

CO2. Compute simple and weighted Index numbers.

CO3. Understand the concept of probability and probability distributions and apply probability distributions in real life.

CO4. Distinguish between process and product control, plotting control charts for variable and Attributes**.**

Unit No.	Content	Hours Allocated
1	**Time Series & Index Number:** **Time Series:** 1.1: Definition and uses of time series, components of time series. 1.2: Methods of determination of trend: method of moving averages, method of progressive averages, method of least squares (only for straight line), determination of seasonal variations by simple average method. 1.3: Numerical examples. **Index Number:** 1.4: Need and meaning of index number. 1.5: Problems involved in construction of index number. 1.6: Price, quantity and value index number. 1.7: Simple (unweighted) index number, weighted index number. 1.8: Laspeyre's, Paasche's and Fisher's index numbers. 1.9: Numerical examples. 1.10. Cost of living index number, Purchasing power of money.	**15**
2	**Probability Distributions & Statistical Quality Control:** 2.1: Binomial Distribution: 2.2: P. m. f., mean and variance (statement only). 2.3: Simple examples to find probabilities and parameters. Poisson Distribution: 2.4: P. m. f., mean and variance (statement only). 2.5: Simple examples to find probabilities and parameters. **Normal Distribution:** 2.6: P. d. f., mean and variance (statement only). 2.7: Definition of standard normal variate and its p.d.f. 2.8: Properties of normal curve. 2.9 Applications of Binomial, Poisson and Normal distributions in real life. 2.10: Examples to find probabilities for given area under standard normal curve. **Statistical Quality Control (S.Q.C.):** 2.10: Concept and need of S.Q.C. 2.11: Advantages of S.Q.C. 2.12: Chance and assignable causes, process control and product control. 2.13: Control chart and its construction. 2.14: Control charts for variable:Mean and range chart. 2.15: Control charts for attribute: Control chart for number of defectives (np-chart) for fixed sample size,Control chart for number of defects per unit (C-chart). 2.16: Numerical examples.	**15**

Reference Books:

1. Gupta V.K. & Kapoor S.C. Fundamentals of Applied Statistics- Sultan &Chand.
2. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics- Sultan & Chand.

B. Sc. Part – I Semester -II STATISTICS

OEC-IV: OEC03STA22: Testing of Hypothesis

Theory: 30 hrs.

Marks-50 (Credits: 02)

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

CO1: Understand concept of testing of hypothesis.

CO2: Develop test procedures for testing hypothesis.

CO3. Apply small and large sample tests in real life examples

CO4: Implement appropriate nonparametric tests for real life testing of hypothesis problems.

Unit	Content	Hours Allotted
1	**Parametric Tests** **2.1** Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistic, hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, One and two tailed test, Critical region, type I and type II errors, level of significance, p-value., power of test. **2.2 Large Sample Tests:** **i)** General procedure of testing of hypothesis **ii)** Test for means: Testing population mean H_0: $\mu=\mu_0$ and testing equality of two population means H_0:$\mu_1 = \mu_2$. **iii)** Test for proportion: Testing population proportion H_0: $P=P_0$ and testing equality of two population proportions H_0:$P_1 = P_2$. **iv)** Testing population correlation coefficient H_0: $\rho=\rho_0$ and testing equality of two population correlation coefficients H_0:$\rho_1 = \rho_2$ by Fisher's Z transformation. **2.3 Small Sample Tests:** **i)** Definition of student's t variate, t test for testing H_0: $\mu=\mu_0$, H_0:$\mu_1 = \mu_2$, paired t test and test for population correlation coefficient H_0: $\rho=0$. **ii)** **Chi square tests:** a) Testing population variance H_0: $\sigma^2 = \sigma_0^2$. b) Test for goodness of fit. c) Test for independent of attributes i) m×n contingency table ii)2×2 contingency table iii) Yate's correction for continuity iv) McNemar's test **iii)** F test for testing equality of two population variances H_0: $\sigma_1^2 = \sigma_2^2$	15
2	**Non- parametric Tests:** Notion of non-parametric statistical inference (test) and its comparison with parametric statistical inference. Concept of distribution free statistic. Test procedure of: i. Run test for one sample (i.e. test for randomness) and run test for two independent sample problems. ii. Sign test for one sample and two sample observations. iii. Wilcoxon's signed rank test for one sample and two sample	

	paired observations. iv. Mann-Whitney U - test (two independent samples) v. Median test vi. Kolmogorov Smirnov test for one and for two independent samples.	15

Reference Books:

1. Lehmann, E. L: Testing of Statistical Hypothesis
2. Rao, C. R.: Linear Statistical Inference
3. Gibbons, J. D.: Non-parametric Statistical Inference.
4. Doniel: Applied Non-parametric Statistics

OEC-PR-II: OEC03STA29:

Practical Paper-II (Credits 02)

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

CO1. Learn various methods of time series and
CO2. compute simple and weighted Index numbers.
CO3. Learn applications of various distributions and control charts
CO4. Learn applications of testing of hypothesis

Sr. No.	Title of the Experiment
1.	Time Series
2.	Index Number I (Unweighted & weighted index numbers)
3.	Index Number II (Cost of living index number & Purchasing power of money)
4.	Applications of Binomial, Poisson and Normal distribution.
5.	Control Chart for variable
6.	Control Chart for Attribute
7.	Large sample tests for means.
8.	Large sample tests for proportions.
9.	Tests for population correlation coefficients. (Using Fisher's Z transformation.)
10.	Tests based on Chi square distribution
11.	Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$.; paired t test)
12.	Test based on F distribution: $\sigma^2{}_1 = \sigma^2{}_2$
13.	NP test- -Run test (for one and two independent samples).
14.	NP test –Sign test and Wilcoxon's signed rank test (for one and two samples paired observation).
15.	NP test-- Mann-Whitney U- test & Median test (for two independent samples).
16.	NP test—Kolmogorov - Smirnov test (for one and two independent samples).

B. Sc. Part – I Semester -II STATISTICS

SEC-I: SEC03STA21: Basic statistics with MS-EXCEL

Marks-50 (Credits: 02)

Sr. No	Name of the practical
1	Introduction to MS-EXCEL.
2	Data sorting and filter.
3	Pivot table and pivot chart.
4	**Graphical representation:** Histogram, ogive curve, frequency polygon, frequency curve.
5	**Diagrammatic representation I:** Simple bar chart, Multiple bar chart, Subdivided chart.
6	**Diagrammatic representation I:** Pia chart, Scatter diagram, Boxplot.
7	**Statistical functions:** AVERAGE, MAX, MIN, COUNT, VAR, SLOPE,STDEV.P, GEOMEAN, HARMEAN, KURT, FREQUENCY, INTERCEPT, MEDIAN, CORREL, KURT, MODE,QUARTILES, COVARIANCE,PERMUT,PERCENTILES, SKEW.
8	**Mathematical functions:** ABS, COMBIN, EXP,FACT, GCD, LCM, INT, LN, LOG, MOD,MDETERM,MINVERSE, MMULT, POWER, RAND, RANDBETWEEN, SQRT, SUM.
9	**Logical functions:** AND, OR, NOT, TRUE, FALSE, IF, SWITCH, HLOOKUP AND VLOOKUP.

VIVEKANAND COLLEGE KOLHAPUR (Empowered Autonomous) ESTD JUNE 1964

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