Sangola Taluka Shetkari Shikshan Prasarak Mandal Sangola's

Vidnyan Mahavidyalaya, Sangola

Department of Statistics

Teaching Plan- 2020-21

B. Sc. I

Semester – I (CBCS)

Month	Shri. Ghadage V.K.
August	Admission Process
September	**PAPER-I: Descriptive Statistics-I** **Unit -1 Nature of Data** Population and Sample. Meaning of primary and secondary data. Qualitative data (Attributes), Nominal Scale and Ordinal scale. Quantitative data (Variables), Interval Scale and ratio scale, discrete and continuous variables, raw data. Classification of data, Discrete and continuous frequency distribution, inclusive and exclusive methods of classification, cumulative frequency distribution, relative frequency. Graphical representation of data: Histogram, frequency polygon, frequency curve and Ogive curve, Illustrative Examples. **PAPER –II: Probability and Probability Distributions-I** **Unit – 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 Mutuality exclusive events, Exhaustive events, impossible events, certain events. Power set IP (Ω). Symbolic representation of given events and description of events in symbolic form. Illustrative examples.
October	**Unit – 2 Measures of Central Tendency** 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. Harmonic Mean (H. M.) : Definition Relation : A. M. $\geq$ G. M. $\geq$ H. M.

	$G.M. = \sqrt{A.M. \times H.M.}$ 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. Partition Values : Quartiles, Deciles and Percentiles **Unit – 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. Axiomatic definition of probability with reference to a finite and countably infinite sample space. Proof of the results : i) P (Φ) = 0 ii) P (A^c) = 1 – P(A) iii) P (A U B) = P (A) + P(B) – P (A ∩ B), extension of this to P (A U B U C). iv) If A ⊂ B, P (A) ≤ P (B).
November	Graphical method of determination of Median, Mode and Partition values. Situations where one kind of average is preferable to others. Examples to illustrate the concept. **Unit – 3 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 (Semi-interquartile range) : Definition, coefficient of Q.D. Mean Deviation: Definition, coefficient of M. D., Minimal property of M.D. Mean Square Deviation: Definition, Statement and proof of minimal property of M. S. D. Variance and Standard Deviation : Definition, Statement and proof of effect of change of origin and scale on S.D. and Variance. S. D. of pooled data Coefficient of Variation: Definition and use. Comparison of absolute and relative measures of dispersion. Examples to illustrate the concept. v) 0 ≤ P(A ∩ B) ≤ P (A) ≤ P (A U B) ≤ P (A) + P (B) vi) P(A ∩ B c) = P (A) – P (A ∩ B) vii) P(A c ∩ B) = P (B) – P (A ∩ B). Illustrative examples. **Unit – 3 Conditional Probability and Independence of Events** Definition of conditional probability of an event. Multiplication theorem for two events P (A ∩ B) = P(A) P (B /A) Partition of Sample space Idea of Posteriori probability, statement and proof of Bayes theorem, examples on Bayes theorem. Concept of Independence of two events. Proof of the result that 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.

	Pairwise and Mutual Independence for three events. Simple examples.
December	Coefficient of Variation: Definition and use. Comparison of absolute and relative measures of dispersion. Illustrative Examples **Unit – 4 Moments, Skewness and Kurtosis** Moments : Raw moments, central moments and factorial moments for ungrouped and grouped data. Effect of change of origin and scale on moments. Relation between central and raw moments Relation between raw and factorial moments Sheppard's correction, need of Sheppard's correction. Skewness: Concept of Skewness of a frequency distribution, Types of Skewness and its interpretation. Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness, Measure of skewness based on moments. 4.6 Kurtosis : Concept of kurtosis of a frequency distribution, Types of kurtosis and its interpretations. 4.7 Measure of kurtosis based on moments. 4.8 Illustrative Examples. Unit – 4 Univariate Probability Distribution Definition of discrete random variables. Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.) of a discrete random variable,
January	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 and its interpretations. Measure of kurtosis based on moments. Illustrative Examples. properties of c.d.f. (statements only). Probability distribution of function of a random variable. Median and Mode of a univariate discrete probability distribution. Examples

B. Sc. II

Semester – III (CBCS)

Month	Shri. Ghadage V.K.
August	Admission Process
September	**Paper V: Probability Distribution – I** **Poisson distribution**: Probability mass function (p.m.f) Mean, variance, moments(up to fourth order), probability generating function (p.g.f), recurrence relation for Poisson probabilities, additive property, conditional distribution of X given X+Y where X and Y are independent r.v.s Poisson distribution as a limiting case of binomial distribution, illustration of Poisson distribution in real life situations and examples. **Geometric distribution**: p.m.f. Mean, variance, distribution function, p.g.f., lack of memory property. **Paper VI: Statistical Methods** **Multiple linear regression** Plane of regression, Yule's notation, correlation matrix. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation. Necessary and sufficient condition for three regression planes coincide (with proof). Residual: Definition, order, properties, derivation of mean and variance. **Multiple correlations**: Definition of multiple correlation coefficient derivation of formula for multiple correlation coefficient. Properties of multiple correlation coefficient Interpretation
October	**Waiting time distribution**: p.m.f. Mean, variance and p.g.f. by using relation with geometric. Examples. **Negative Binomial distribution**: p.m.f. Geometric distribution is a particular case of Negative Binomial distribution, mean, variance, p.g.f., recurrence relation of probabilities, additive property, NB(r, p) as a sum of r i.i.d geometric r.v.s, illustration of Negative Binomial distribution in real life situations and simple examples. **Multinomial distribution**: p.m.f., m.g.f., means, variances and covariance using m.g.f. marginal distribution. **Continuous Univariate Distributions** Definition of the continuous sample space with illustrations, definition of continuous random variable (r.v.), probability density function (p.d.f.) cumulative distribution function (c.d.f.) of continuous r.v., statement of properties of cumulative distribution function, sketch of p.d.f. and c.d.f. Expectation of r.v., expectation of a function of r.v, mean, median, mode, quantiles (partition values), harmonic mean, variance, raw and central moments, skewness, kurtosis, examples. **Partial correlations:** Definition of partial correlation coefficient, derivation of formula Properties of partial correlation coefficient Effect of partial correlation coefficient on regression estimate (Larger the regression coefficients better is the regression estimate). Examples and problems.

	Sampling Theory: Definition of population, sample, parameter, statistic, sample survey, census survey. Advantages of sample survey over census survey, estimator, unbiased estimator Methods of sampling: i) Deliberate (purposive) sampling ii) probability sampling and iii) Mixed sampling
November	Moment generating function (m.g.f.): definition, properties. Effect of change of origin and scale. Generation of raw and central moments. Definition of cumulant generating function. Transformation of continuous univariate r.v.: Distribution of Y=g(X) (g is monotonic and non-monotonic), application of m.g.f. in transformation of r.v. problems. Effect of change of origin and scale. Generation of raw and central moments. Definition of cumulant generating function. Transformation of continuous univariate r.v.: Distribution of Y=g(X) (g is monotonic and non-monotonic), application of m.g.f. in transformation of r.v. Examples and problems **Continuous Bivariate Distributions.** Definition of bivariate continuous r.v. (X,Y), joint p.d.f, marginal and conditional distributions. Evaluation of probabilities of various region bounded by straight lines. Expectation of g(X,Y), means, variances, covariance, correlation coefficient, conditional expectation, proof of E[E(X/y)]=E(X), riance, regression as conditional expectation. **Simple random sampling without replacement (SRSWOR):** i) Probability of a specified unit being selected in sample at any given draw is equal to $\frac{1}{N}$. ii) Probability of a specific unit included in the sample is $\frac{n}{N}$. iii) Probability of drawing a sample of size 'n' from a population of size N units is $\frac{1}{\binom{N}{n}}$ iv) $E(\bar{y}_n) = \bar{Y}_N$ v) $E(N\bar{y}_n) = \sum_{i=1}^{N} Y_i = \text{Population total}$ vi) $Var(\bar{y}_n) = \frac{N-n}{Nn}S^2$ vii) $E(s^2) = S^2$ viii) Estimated variance of sample mean **Simple random sampling with replacement (SRSWR):** i) $E(\bar{y}_n) = \bar{Y}_N$ ii) $E(N\bar{y}_n) = \sum_{i=1}^{N} Y_i = \text{Population total}$ iii) $Var(\bar{y}_n) = \frac{N-1}{Nn}S^2$ iv) E(Sample mean square) = Population variance v) Estimated variance of sample mean Standard error of sample means Comparison of SRSWR and SRSWOR.
December	Independence of r.v.s, theorems on expectation. i) E(X+Y) =E(X)+ E(Y) ii) E(XY) = E(X).E(Y), when X and Y are independent. M.g.f. of sum of two independent r.v.s as a product of their m.g.f.s, extension to several variables. Transformation of continuous bivariate r.v.s : Distribution of bivaraite r.v.'s using jacobian of transformation. Examples and problems. **Statistical Quality Control (SQC)**: Meaning and purpose of SQC, quality of product, process control, product control, assignable causes, chance causes, Shewhart's control

	chart: construction, working, theoretical basis, 3σ –control limits and lack of control situation. Control charts for variables: Control chart for process average ($\overline{X}$), control chart for process variation (R), Construction and working of and R chart for known and unknown standards, revised control limits, estimate of process s. d. Control charts for attributes: Defects, defectives, fraction defective, control chart for fraction defectives (P-chart) for fixed sample size and unknown standards, construction, working of chart, revised control limits. Control chart for number of defects(C-chart): for standards are not given, construction and working of the chart, revised control limits.

B. Sc. I

Semester – II (CBCS)

Month	Shri. Ghadage V.K.
February	**PAPER-III: Descriptive Statistics-II** **Correlation**: Bivariate data Concept of correlation between two variables, types of correlation. Scatter diagram, its utility Covariance: Definition, effect of change of origin and scale. 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 & scale. Interpretation when r = -1, 0, 1. Spearman's rank correlation coefficient : Definition, Computation (for with and without ties). Derivation of the formula for without ties. Illustrative Examples. **Regression**: Concept of regression, Lines of regression, fitting of lines of regression by the least square method. **PAPER –IV: Probability and Probability Distributions-II** **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 Definitions of mean, variance of univariate distributions. Effect of change of origin and scale on mean and variance. Definition of raw and central moments and factorial moments. Definition of probability generating function (p.g.f.) of a random variable. Effect of change of origin and scale. Definition of mean and variance by using p.g.f. Examples.
March	Regression coefficients (b_{xy},b_{yx}) And their geometric interpretations, Properties. 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. Illustrative Examples. **Theory of Attributes**: 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 **Bivariate Probability Distribution:** Definition of two dimensional discrete random variable, its p.m.f. and distribution function.

	Computation of probabilities of events in bivariate probability distributions. Concepts of marginal and conditional probability distributions. Independence of two discrete random variables. Examples. **Mathematical Expectation:** Definition of expectation in bivariate distributions. Theorems on expectation: E(X + Y), E(XY) (Statement only). Expectation and variance of linear combination of two discrete random variables.
April	Concept of Consistency, conditions of consistency Concept of Independence and Association of two attributes. Yule's coefficient of association (Q): Definition, interpretation. Coefficient of colligation (Y): Definition, Interpretation. Relation between Q and Y. Illustrative Examples. **Index Numbers**: Meaning and utility of price index numbers, problems in construction of index numbers. Probability generating function of sum of two independent random variables. Conditional expectation in bivariate probability distributions. Definition of conditional mean, variance in bivariate probability distributions Definition of covariance and correlation coefficient in bivariate probability distributions, distinction between uncorrelated variables and independent variables. Examples. **Some Standard Discrete Probability Distributions :** Idea of one point, Two point distributions and their mean and variance. Bernoulli Distribution p.m.f., mean, variance, distribution of sum of, independent and identically distributing Bernoulli variables.
May	Unweighted price index numbers using: i) Aggregate method ii) Average of price or quantity relatives method Weighted price index numbers using aggregate method: Laspeyre's, Paasche's, Fisher's Formulae Cost of living index numbers. Tests of Index numbers Illustrative Examples. Discrete Uniform Distribution: p.m.f. mean and variance. Binomial Distribution: p.m.f. Recurrence relation for successive probabilities, computation of probabilities of different events. p.g.f. and hence or otherwise mean and variance, Examples. Hypergeometric Distribution: p.m.f. mean and variance of distribution. Examples.

B. Sc. II

Semester – IV (CBCS)

Month	Shri. Ghadage V.K.
February	**Paper – VII: Probability Distribution –I** **Uniform and Exponential Distribution** **Uniform distribution**: Definition sketch of p.d.f for various values of parameters, c.d.f, mean, variance, m.g.f., moments, β_1 and β_2 coefficients. Numerical problems **Exponential distribution**: p.d.f. sketch of p.d.f for various values of parameters, c.d.f, m.g.f, mean, variance, coefficient of variation, moments, β_1 and β_2 coefficients, median, quartiles, lack of memory property, distribution of $-(1/\theta)$ logX, $-(1/\theta)$ log(1-X), where X~U(0,1). Exponential distribution with scale and location parameters. **Paper –VIII: Applied Statistics** **Time Series**: Meaning and need of time series analysis, components of time series; (i) Secular trend (ii) Seasonal Variation (iii) Cyclical Variation (iv) Irregular Variation, Additive and Multiplicative model, utility of time series. 1.2 Measurement of trend: (i) Moving average method (ii) Least square method. 1.3 Measurement of seasonal indices by i) simple average method ii) by ratio to moving average method.
March	**Gamma distribution**: p.d.f, sketch of p.d.f for various values of parameters, mean, mode, variance, moments,β1, β2 ,γ1 and γ2 coefficients, additive property, distribution of sum of i.i.d. exponential variates. **Beta distribution of first kind**: p.d.f , sketch of p.d.f for various values of parameters, symmetry around mean when m=n, mean, harmonic mean, mode, variance, uniform distribution as a particular case when m= n= 1, distribution of (1-X) **Tests of Hypothesis:** Notion of hypothesis, null and alternative hypothesis, simple and composite hypothesis, test statistic, critical region, idea of one and two tailed test, type I and type II errors, level of significance, p-value. Large sample tests: Construction of test statistic and identification of its probability distribution. a) Tests for means i) $H_0 : \mu = \mu_0$ ii) $H_0 : \mu_1 = \mu_2$. b) Tests for proportion: i) $H_0 : P_0 = P_1$ ii) $H_0 : P_1 = P_2$. c) Tests for population correlation coefficient: i) $H_0: \rho = \rho_0$ ii) $H_0: \rho_1 = \rho_2$, using Fisher's Z transformation. **Small sample tests**: construction of test statistic and identification of distribution of test statistic.
April	**Beta distribution of second kind**: p.d.f mean, harmonic mean, mode, variance, distribution of 1/X. Relation between beta distribution of 1st kind and beta distribution of 2nd kind. Distribution of X+Y, X/Y, and X/(X+Y), where X and Y are independent gamma variates. **Normal distribution** : p.d.f sketch of p.d.f for various values of parameters, properties of normal curve, mean, median, mode, variance, quartiles, point of inflexion, moments, recurrence relation for central moments, m.g.f., β1, β2 γ1, γ2 coefficients, standard normal distribution, additive property, distribution of X^2 if X~N(0,1), distribution of

	aX+bY+c when X and Y are independent normal r.v.s, normal as a limiting case of i) Binomial ii) Poisson illustrations of use of normal distribution in various fields. **t-tests for means:** i) H_0: $\mu = \mu_0$ (σ is unknown), ii)H_0: $\mu_1 = \mu_2$ ($\sigma_1 = \sigma_2$ is unknown) unpaired t test. iii) H_0: $\mu_1 = \mu_2$ (paired t test). **χ^2 -tests**: i) test for population variance (when mean is given and not given) ii) test for goodness of fit, iii) tests for independence of attributes (a) M X N contingency table (b) 2 X 2 contingency table, Yate's correction for continuity (concept only). **F- tests**: test for equality of population variance. Illustrative examples **Elements of Demography:** Introduction and need of vital statistics. Mortality rates: Crude Death Rate (CDR), Specific Death Rate, Standard Death Rate Fertility rates: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rate (ASFR), Total Fertility Rate (TFR). Reproduction rates: Gross Reproduction Rate (GRR), Net Reproduction Rate (NRR). Illustrative examples
May	**Chi-square distribution**: Definition of chi-square variate as a sum of square of n i.i.d standard normal varaites, derivation of p.d.f of χ^2 with n degrees of freedom (d.f.) using m.g.f. Sketch of p.d.f for various values of parameters(d.f), mean, mode, variance, moments, skewness, kurtosis, m.g.f., additive property, relation with gamma distribution, Normal approximation to χ^2 . **Students t- distribution:** Definition of t- variate, derivation of p.d.f., sketch of p.d.f for various values of parameters, mean, mode, variance, moments, $\beta1$, $\beta2$ $\gamma1$, $\gamma2$ coefficients. **Snedecor's F- distribution:** Definition of F- variate, mean, mode, variance. Interrelation between t, F and χ^2 **.** **Chebychev's inequality and Central limit theorem** Chebychev's inequality for discrete and continuous distribution and problems. Central limit theorem: Statement and proof (based on mgf) for iid r.vs. with finite variance. Problems based on Bernoulli, Binomial, Poisson , Geometric and Chi-Square distributions.

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