Sangola Taluka Shetkari Shikshan Prasarak Mandal Sangola's

Vidnyan Mahavidyalaya, Sangola

Department of Statistics

Teaching Plan- 2019-20

B. Sc. I

Semester – I (CBCS)

Month	Shri. Ghadage V.K.	Miss. Inamdar R.A.
June	**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.
July	**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. ≥ G. M. ≥ H. M. $G.M. = \sqrt{A.M. \times H.M.}$	**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)

	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	iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, extension of this to $P(A \cup B \cup C)$. iv) If $A \subset B$, $P(A) \leq P(B)$.
August	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) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$ vi) $P(A \cap B^c) = P(A) - P(A \cap B)$ vii) $P(A^c \cap B) = P(B) - P(A \cap B)$. Illustrative examples. **Unit – 3 Conditional Probability and Independence of Events** Definition of conditional probability of an event. Multiplication theorem for two events $P(A \cap B) = P(A)\, P(B/A)$ 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.
September	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.	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, properties of c.d.f. (statements only). Probability distribution of function of a random variable.

	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. Kurtosis: Concept of kurtosis of a frequency distribution, Types of kurtosis and its interpretations. Measure of kurtosis based on moments. Illustrative Examples.	Median and Mode of a univariate discrete probability distribution. Examples
October	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.	

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Semester – III (CBCS)

Month	Shri. Ghadage V.K.	Miss. Inamdar R.A.
June	Admission Process	Admission Process
July	**Paper VI: Discrete Probability Distributions and Statistical Methods** **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 V: Continuous Probability Distributions** Unit – 1 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. 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. Examples and problems.
August	**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.	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 **Unit – 2 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), conditional variance, regression as conditional expectation.
September	**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	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. **Unit – 3 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
October	**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.	**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 $-(1/\theta)\log X$, $-(1/\theta)\log(1-X)$, where X~U(0,1). Exponential distribution with scale and location parameters.

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Semester – II (CBCS)

Month	Shri. Ghadage V.K.	Miss. Inamdar R.A.
December	**PAPER –IV: Probability and Probability Distributions-II** **Unit – 1 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. **Unit – 2 Bivariate Probability Distribution:** Definition of two dimensional discrete random variable, its p.m.f. and distribution function.	**PAPER-III: Descriptive Statistics-II** **Unit – 1 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. **Unit – 2 Regression**: Concept of regression, Lines of regression, fitting of lines of regression by the least square method.
January	Computation of probabilities of events in bivariate probability distributions. Concepts of marginal and conditional probability distributions. Independence of two discrete random variables. Examples. **Unit – 3 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.	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. **Unit – 3 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
February	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. **Unit – 4 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.	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. **Unit - 4: Index Numbers**: Meaning and utility of price index numbers, problems in construction of index numbers.
March	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.	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.

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Semester – IV (CBCS)

Month	Shri. Ghadage V.K.	Miss. Inamdar R.A.
December	**Paper –VIII: Applied Statistics** **Sampling Theory**: Definition of population, sample, statistic, parameter, sample survey, census survey. Advantages of sample survey over census survey. Methods of sampling: i) Deliberate (purposive) sampling ii) probability sampling and iii) Mixed sampling. Simple random sampling (SRS): SRS with and without replacement. Proof of (i) Expected value of sample mean is population mean, (ii) Expected value of product of population size and sample mean is population total, (iii) Expected value of sample mean square is population mean square, (iv) Variance of sample mean and (v) Estimated variance of sample mean. Standard error of sample means, comparison of SRSWR and SRSWOR.	**Paper VII: Continuous Probability Distributions and Exact Sampling Distributions** **Gamma distribution**: p.d.f, sketch of p.d.f for various values of parameters, mean, mode, variance, moments,β_1, β_2 ,γ_1 and γ_2 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)
January	**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.	**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., β_1, β_2 γ_1, γ_2 coefficients,
February	**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).	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

	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 **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.	illustrations of use of normal distribution in various fields. **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 .
March	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. **4. 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	**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, β1, β2 γ1, γ2 coefficients. **Snedecor's F- distribution:** Definition of F- variate, mean, mode, variance. Interrelation between t, F and χ^2 **.**

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