D.B.F.DAYANAND COLLEGE OF ARTS AND SCIENCE, SOLAPUR
COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.I		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : I		
COURSE NUMBER (PAPER NUMBER) : PAPER : I		
TITLE OF COURSE (NAME OF PAPER) : Descriptive Statistics-I		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Nature of Data : 1.1 Population and Sample. 1.2 Meaning of primary and secondary data. 1.3 Qualitative data (Attributes) : Nominal Scale and Ordinal scale. 1.4 Quantitative data (Variables): Interval Scale and ratio scale, discrete and continuous variables, raw data. 1.5 Classification of data : Discrete and continuous frequency distribution, inclusive and exclusive methods of classification, cumulative frequency distribution, relative frequency. 1.6 Graphical representation of data: Histogram, frequency polygon, frequency curve and Ogive curves. 1.7 Illustrative Examples. Measures of Central Tendency : 2.1 Concept of central tendency of statistical data, statistical average, requirements of good statistical average. 2.2 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. 2.3 Geometric Mean (G. M.) : Definition 2.4 Harmonic Mean (H. M.) : Definition 2.5 Relation : A. M. ≥ G. M. ≥ H. M. (Proof for n = 2, positive observations) H.M. A.M.G.M. × = (Proof for n = 2, positive observations) 2.6 Median : Definition, Derivation of formula for grouped frequency distribution. 2.7 Mode : Definition, Derivation of formula for grouped frequency distribution. 2.8 Empirical relation between Mean, Median and Mode. 2.9 Partition Values : Quartiles, Deciles and Percentiles. 2.10 Graphical method of determination	To acquaint students with some basic statistics. A)To distinguish between i) Population and Sample. ii) primary and secondary data. iii)Qualitative data (Attributes) & Quantitative data (Variables) iv) discrete and continuous variables. B)To prepare Discrete and continuous frequency distribution, and represent with the help of graphs. . To compute various measures of central tendency & to determine them graphically.To identify the proper averages for the given situations. To compute various measures of dispersion.To distinguish between absolute and relative measures of dispersion. To compute raw,central and factorial moments.To know need of Sheppard's corrections.To compute measures of skewness and kurtosis. and to interpret them.	The students are able . A)To distinguish between i) Population and Sample. ii) primary and secondary data. iii)Qualitative data (Attributes) & Quantitative data (Variables) iv) discrete and continuous variables. B)To prepare Discrete and continuous frequency distribution, and represent with the help of graphs. The students are able to compute various measures of central tendency & to determine them graphically The students are able to compute various measures of dispersion,and to distinguish between absolute and relative measures of dispersion. The students are able to compute raw,central and factorial moments.To know need of Sheppard's corrections.To compute measures of skewness and kurtosis. and to interpret them.

of Median, Mode and Partition values. 2.11 Situations where one kind of average is preferable to others. 2.12 Examples to illustrate the concept. Measures of Dispersion : 3.1 Concept of dispersion, Absolute and Relative measures of dispersion, Requirements of a good measure of dispersion. 3.2 Range : Definition, Coefficient of range. 3.3 Quartile Deviation (Semi-interquartile range) : Definition, coefficient of Q.D. 3.4 Mean Deviation: Definition, coefficient of M. D., Minimal property of M.D. (Statement only). 3.5 Mean Square Deviation: Definition, Statement and proof of minimal property of M. S. D. 3.6 Variance and Standard Deviation : Definition, Statement and proof of effect of change of origin and scale on S.D. and Variance (for proof take individual data of n observations n xxx ,...., 21 and h Ax d i i − =), S. D. of pooled data (without proof). 3.7 Coefficient of Variation : Definition and use. 3.8 Comparison of absolute and relative measures of dispersion. 3.9 Examples to illustrate the concept. Moments, Skewness and Kurtosis : 4.1 Moments : Raw moments (r µ ') and central moments (r µ) and factorial moments ( ) (r µ ') for ungrouped and grouped data. 4.2 Effect of change of origin and scale on moments, relation between central and raw moments (up to 4th order), relation between raw and factorial moments (up to 2nd order). 4.3 Sheppard's correction, need of Sheppard's correction. 4.4 Skewness: Concept of Skewness of a frequency distribution, Types of Skewness and its interpretation. 4.5 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.		

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NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : I		
COURSE NUMBER (PAPER NUMBER) : PAPER : II		
TITLE OF COURSE (NAME OF PAPER) : Probability and Probability Distributions-I		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Sample Space and Events : 1.1 Concepts of experiments and random experiments. 1.2 Definitions : Sample space, discrete sample space (finite and countably infinite), event, elementary event, compound event. 1.3 Algebra of events (Union, Intersection, complementation) 1.4 Definitions of Mutuality exclusive events, Exhaustive events, impossible 6 events, certain events. 1.5 Power ser IP (Ω) (sample space consisting at most 4 sample points). 1.6 Symbolic representation of given events and description of events in symbolic form. 1.7 Illustrative examples. Probability : 2.1 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. 2.2 Axiomatic definition of probability with reference to a finite and countably infinite sample space. 2.3 Proof of the results : i) $P(\Phi) = 0$ ii) $P(A^c) = 1 - P(A)$ iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, extension of this to $P(A \cup B \cup C)$. iv) If $A \subset B$, $P(A) \leq P(B)$. v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$ vi) $P(A \cap B^c) = P(A) - P(A \cap B)$ vii) $P(A^c \cap B) = P(B) - P(A \cap B)$. 2.4 Illustrative examples based on the results in 2.3 above.	To distinguish between random and non random experiments.To find the probabilities of the events. To get acquainted with axiomatic definition of probability and proofs of some results and to solve the examples based on these results.	The students are able to distinguish between random and non random experiments and to find the probabilities of the events. The students are able to solve the examples based on these results.

Conditional Probability and Independence of Events : 3.1 Definition of conditional probability of an event. 3.2 Multiplication theorem for two events P (A ∩ B) = P(A) P (B /A) 3.3 Partition of Sample space 3.4 Idea of Posteriori probability, statement and proof of Bayes theorem, examples on Bayes theorem. 3.5 Concept of Independence of two events. 3.6 Proof of the result that if A and B are independent then, i) A and Bc, ii) Ac and B, iii) Ac and Bc are independent. 3.7 Pairwise and Mutual Independence for three events. 3.8 Simple examples. Univariate Probability Distribution (Defined on finite and countable infinite sample space): 4.1 Definition of discrete random variables. 4.2 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). 4.3 Probability distribution of function of a random variable. 4.4 Median and Mode of a univariate discrete probability distribution. 4.5 Examples.	To know the concept of conditional probabilities,independence of events,posteriori probability,proofs of some results. To introduce the concept of discrete random variable,it's p.m.f.,c.d.f. and to find median and mode of a random variable.	The students are able to know the concept of conditional probabilities,independence of events,posteriori probability,proofs of some results. The students are able to know discrete random variable,it's p.m.f.,c.d.f. and to find median and mode of a random variable.

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To get acquainted with concept of regression, to fit lines of regression by the least square method.
regression coefficients and their geometric interpretations , properties & acute angle between the two lines of regression

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NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : II		
COURSE NUMBER (PAPER NUMBER) : PAPER : III		
TITLE OF COURSE (NAME OF PAPER) : Descriptive Statistics-II:		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Correlation: 1.1 Concept of Bivariate data. 1.2 Concept of correlation between two variables, types of correlation. 1.3 Scatter diagram, its utility. 1.4 Covariance : Definition, effect of change of origin and scale. 1.5 Karl Pearson's coefficient of correlation (r) : Definition, Computation for ungrouped and grouped data. Properties (with proof) : i) $-1 \le r \le 1$ ii) Effect of change of origin & scale. 1.6 Interpretation when r = -1, 0, 1. 1.7 Spearman's rank correlation coefficient : Definition, Computation (for with and without ties). Derivation of the formula for without ties. 1.8 Illustrative Examples. Regression : 2.1 Concept of regression, Lines of regression, fitting of lines of regression by the least square method. 2.2 Regression coefficients (byx and xy b) and their geometric interpretations, Properties : i) 2 yxxy bb r =× ii) 1 bb yx xy ≤ × iii) r 2/)b(b yxxy ≥ + iv) Effect of change of origin and scale on regression coefficients. 2.3 Concept of coefficient of determination. 2.4 The point of intersection of two regression lines. 2.5 Derivation of acute angle between the two lines of regression. 2.6 Illustrative Examples. Theory of Attributes : 3.1 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	**To compute correlation coefficient between two variables,& to interpret the results.** **To get acquainted with concept of regression, to fit lines of regression by the least square method.** **regression coefficients and their geometric interpretations , properties & acute angle between the two lines of regression.** **To analyse the data pertaining to attributes and to interpret the results.** **To use the index numbers to various fields.**	**The students are able to find correlation between two variables and interpret the results.** **The students are able to fit lines of regression by the least square method.** **To find regression coefficients.** **The students are able to analyse the data pertaining to attributes and to interpret the results.** **The students become able to use the index numbers to various fields.**

attributes) 3.2 Concept of Consistency, conditions of consistency (upto three attributes) 3.3 Concept of Independence and Association of two attributes. 3.4 Yule's coefficient of association (Q) : Definition, interpretation. 3.5 Coefficient of colligation (Y) : Definition, Interpretation. 3.6 Relation between Q and Y: $Q = 2Y / (1 + Y2)$, $\| Q \| \geq \| Y \|$, $0 \leq \| Y \| \leq \| Q \| \leq 1$. 3.7 Illustrative Examples. Index Numbers : 4.1 Meaning and utility of index numbers, problems in construction of index numbers. 4.2 Unweighted price and quantity index numbers using : i) Aggregate method ii)Average of relatives method (A. M. and G. M. to be used as average). 4.3 Weighted price and quantity index numbers using aggregate method : Laspeyre's, Paasche's, Fisher's Formulae, cost of living index numbers. 4.4 Tests of Index numbers (time reversal and factor reversal tests). 4.5 Illustrative Examples.		

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NAME OF SUBJECT : STATISTICS
SEM I / II / III / IV / V / VI : SEM : II
COURSE NUMBER (PAPER NUMBER) : PAPER : IV
TITLE OF COURSE (NAME OF PAPER) : Probability and Probability Distributions -II

COURSE CONTENT	OBJECTIVES	OUTCOME
Mathematical Expectation (Univariate discrete random Variable) : 1.1 Definition of expectation of a discrete random variable, expectation of a function of a discrete random variable. 1.2 Results on expectation : i) E(c) = c , where c is a constant. ii) E(aX+b) = a E(X) + b, where a and b are constants 1.3 Definitions of mean, variance of univariate discrete distributions. Effect of change of origin and scale on mean and variance. 1.4 Definition of raw and central moments and factorial moments upto order 2. 1.5 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. 1.6 Simple Examples. Bivariate Probability Distribution (Defined on finite sample space) : 2.1 Definition of two dimensional discrete random variable, its p.m.f. and distribution function. 2.2 Computation of probabilities of events in bivariate probability distributions. 2.3 Concepts of marginal and conditional probability distributions. 2.4 Independence of two discrete random variables. 2.5 Examples. Mathematical Expectation (Bivariate discrete random variable) : 3.1 Definition of expectation in bivariate distributions. 3.2 Theorems on expectation : E(X + Y) and E(XY) (with proofs). 3.3 Expectation and variance of linear combination of two discrete random variables (with proofs). 3.4 Probability generating function of sum of two independent random variables. 3.5 Conditional expectation in bivariate	**To find mean,variance and moments of a discrete random variable..** **To compute probabilities of events in bivariate probability distribution.** **To find mathematical expectation ,correlation coefficient.** **To apply discrete probability distributions in different situations.**	**The students can find mean ,variance and moments and also identify the nature of distributions.** **The students are able to compute probabilities of events in bivariate probability distribution.** **The students are able to find mathematical expectation ,correlation coefficient.** **The students can apply discrete probability distributions in different situations.**

probability distributions. 3.6 Definition of conditional mean and conditional variance in bivariate probability distributions. 3.7 Definition of covariance and correlation coefficient in bivariate probability distributions, distinction between uncorrelated variables and independent variables. 3.8 Examples. Some Standard Discrete Probability Distributions (defined on finite sample space): 4.1 Idea of one point, two point distributions and their mean and variance. 4.2 Bernoulli Distribution- p.m.f., mean, variance, distribution of sum of, independent and identically distributed Bernoulli random variables. 4.3 Binomial Distribution – p.m.f pqp nqpCx xnx x n −=<< = === − 1 , 10 where otherrwise , 0 ; ..,0,1,2,....X ,)P(X Notation: X~) ,B(p n , recurrence relation for successive probabilities, computation of probabilities of different events. p.g.f. and hence or otherwise finding mean and variance, Examples. 4.4 Discrete Uniform distribution: p.m.f. otherwise , 0 , ... , , ,X , 1)P(X 321 = === n xxxx n x Finding of mean and variance. Examples. 4.5 Hypergeometric Distribution : p.m.f. MC x N- M C n-x P(x) = ----------------------, x = max (0, n –(N-M)), ----- min(n, M) NC n = 0 o. w. Notation : X ~ H (N, M, n), mean and variance of distribution assuming n ≤ N – M ≤ M, Examples.		

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NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : III		
COURSE NUMBER (PAPER NUMBER) : PAPER : V		
TITLE OF COURSE (NAME OF PAPER) : Continuous Probability Distributions		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Continuous Univariate Distributions: **1.1 Definition of the continuous sample space with illustrations, definition of continuous random variable (r.v.), probability density function (p.d.f.) and 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.** **1.2 Expectation of r.v., expectation of a function of r.v, mean, median, mode, quantiles (partition values), harmonic mean, variance, raw and central moment, skewness, kurtosis, examples.** **1.3 Moment generating function (m.g.f.)Mx(t): definition, properties.** **i) Standardization property Mx (0) =1 ii) Uniqueness property of m.g.f (if exists), (without proof) iii) Effect of change of origin and scale. Generation of raw and central moments. Definition of cumulant generating function.** **1.4 Transformation of continuous univariater.v.: Distribution of Y=g(X) (g is monotonic and non-monotonic), application of m.g.f. in transformation of r.v.** **1.5 Examples and problems.** **Continuous Bivariate Distributions:** **2.1 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.** **2.2 Expectation of g(X,Y), means, variances, covariance, correlation coefficient, conditional expectation, proof of E[E(X/y)]=E(X), conditional**	**To get acquainted with the basic concept of continuous univariate distributions and their mean,variance, m.g.f,and finding distributions of functions of continuous r.vs.** **To get acquainted with the basic concept of continuous bivariate distributions.** **To study the standard continuous probability distributions and their properties.**	**The students are able to get acquainted with the basic concept of continuous univariate distributions and their mean,variance, m.g.f,and finding distributions of functions of continuous r.vs.** **The students are able to find marginal and conditional distributions of a r.v.,means ,variances ,conditional means ,variances etc.** **The students are able to develop problem-solving techniques needed to accurately calculate probabilities. Apply problem-solving techniques to solving real-world events,apply selected probability distributions to solve problems.**

variance, regression as conditional expectation **2.3 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.** **2.4 Transformation of continuous bivariate r.v.s : Distribution of bivaraiter.v.'s using jacobian of transformation.** **2.5 Examples and problems.** **Uniform and Exponential Distribution:** **3.1 Uniform distribution: pd.f,** $f(x) = \frac{1}{b-a} \quad a \le x \le b$ **= 0 elsewhere** **Notation: X~U(a,b), sketch of p.d.f for various values of parameters, c.d.f, mean,** **variance, m.g.f., moments, β1 and β2 coefficients. Distribution of** i) $Y=\frac{X-b}{b-a}$ ii) $Y=\frac{b-X}{b-a}$ **iii) Y=F(x) where F(x) is c.d.f. of any continuous r.v. X.** **3.2 Exponential distribution : p.d.f. (one parameter)** $f(x) = \theta e^{-\theta x} x>0, \theta >0$ $= 0$ **elsewhere** **Notation: X ~ Exp(θ), sketch of p.d.f for various values of parameters, c.d.f, m.g.f, mean, variance, coefficient of variation, moments, β1 and β2 coefficients, median,** **quartiles, lack of memory property, distribution of –(1/θ) logX, –(1/θ) log(1-X), where** **X~U(0,1). Exponential distribution with scale and location parameters.**		

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NAME OF SUBJECT : STATISTICS
SEM I / II / III / IV / V / VI : SEM : III
COURSE NUMBER (PAPER NUMBER) : PAPERVI
TITLE OF COURSE (NAME OF PAPER) : Discrete Probability Distributions and Statistical Methods

COURSE CONTENT	OBJECTIVES	OUTCOME
Standard discrete distributions: **1.1 Poisson distribution: Probability mass function (p.m.f)** **P[X=x] = P(x) = , x = 0, 1, 2, 3----, λ > 0** **= 0 otherwise** **Notation: X ~ P(λ). 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.** **$P[X=x] = P(x) = q^x p$, x=0, 1, 2, ----,0 < p <1, q = 1 - p** **= 0 otherwise** **Notation: X ~ G(p). Mean, variance,**	**Poisson Distribution: Understand in which circumstances Poisson Distribution will occur, and learn the meaning of the parameter. In addition, know how to compute the probability using the PMF, and know the E[X] and Var[X] for Poisson. Also realize the fact that the sum of independent Poisson is still Poisson. Poisson Approximation to Binomial:** **Geometric distribution:Learn the PMF and how to calculate the probability for Geometric, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Geometric. Negative Binomial Distribution: Understand the relationship between Geometric and Negative Binomial, and the difference between Negative Binomial and Binomial. Learn the PMF and how to calculate the probability for Negative Binomial, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Negative Binomial.**	**The students are able to find the probability for poisson,Geometric, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Geometric. Negative Binomial Distribution: Understand the relationship between Geometric and Negative Binomial, and the difference between Negative Binomial and Binomial. Learn the PMF and how to calculate the probability for Negative Binomial, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Negative Binomial.**

distribution function, p.g.f., lack of memory property. **Waiting time distribution: p.m.f.** **$P[Y = y) = p\, q^{y-1}$, $y = 1, 2, 3, ----$** **$= 0$ otherwise** **Mean, variance and p.g.f. by using relation with geometric. Examples.** **1.3 Negative Binomial distribution: p.m.f.** **$P[X=x] = P(x) = \binom{x+r-1}{r-1} p^r q^x$, x = 0, 1, 3, - - - ; r > 0, 0< p <1, q = 1 - p** **=0 otherwise** **Notation: X ~ NB(r, P). 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.** **1.4 Multinomial distribution: p.m.f., m.g.f., means, variances and covariance using m.g.f. marginal distribution.** **Multiple linear regression (for tri-variate case)** **2.1 Plane of regression, Yule's notation, correlation matrix.** **2.2 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).** **2.3 Residual: Definition, order, properties, derivation of mean and variance.** **2.4 Illustrative examples based on the results in 2.3 above.**	**To fit an equation of plane of regression.**	**The students are able to fit an equation of plane of regression.**

Multiple and partial correlations: **3.1 Definition of multiple correlation coefficient $R_{i.jk}$, derivation of formula for multiple correlation coefficient.** **3.2 Properties of multiple correlation coefficient: i) $0 \le R_{i.jk} \le 1$, ii) $R_{i.jk} \ge \mid r_{ij} \mid$, iii) $R_{i.jk} \ge \mid r_{ik} \mid$ for $i=j=k=1, 2, 3$. $i \ne j$, $j \ne k$.** **3.3 Interpretation of i) $R_{i.jk} = 1$ and ii) $R_{i.jk} = 0$** **3.4 Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$** **3.5 Properties of partial correlation coefficient i) $-1 \le r_{ij.k} \le 1$, and ii) $b_{ij.k} * b_{ji.k} = r_{ij.k}^2$.** **Effect of partial correlation coefficient on regression estimate (Larger the regression coefficients better is the regression estimate).** **3.6 Examples and problems.**	**To interpret the values of multiple and partial correlation coefficients.**	**The students are able to interpret the values of multiple and partial correlation coefficients.**

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NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : IV		
COURSE NUMBER (PAPER NUMBER) : PAPER : VII		
TITLE OF COURSE (NAME OF PAPER) : Continuous Probability Distributions and Exact Sampling Distributions		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
1.Gamma, Beta and Normal Distribution: **1.1 Gamma distribution: p.d.f (two Parameters)** $f(x) = \frac{\alpha^{\lambda}}{\Gamma\lambda} e^{-\alpha\lambda} x^{\lambda-1}$, $x>0, \alpha>0, \lambda>0$ $= 0$ elsewhere **Notation : X~G(α,λ), sketch of p.d.f for various values of parameters, special cases i) α =1 ii) λ=1, mean, mode, variance, moments,β1, β2 ,γ1 and γ2 coefficients, additive property, distribution of sum of i.i.d. exponential variates.** **1.2 Beta distribution of first kind: p.d.f** $f(x) = \frac{1}{\beta(m,n)} x^{m-1}(1-x)^{n-1}$, $0<x<1$; $m, n>0$ $= 0$ elsewhere. **Notation : X~β1(m,n), 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).** **1.3 Beta distribution of second kind: p.d.f** $f(x) = \frac{1}{\beta(m,n)} \frac{x^{m-1}}{(1+x)^{n-1}}$, $x>0$; $m, n>0$ $= 0$ elsewhere. **Notation : X~β2(m,n), 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.** **1.4 Normal distribution : p.d.f.:**	**To study various standard continuous probability distributions their properties.** **To study various exact sampling distributions their properties.**	**The students are able to find various measures of standard continuous probability distributions.** **The students are able to identify exact sampling distributions and to find various measures.**

$f(x) = \frac{1}{2\sqrt{2\pi}} e^{\frac{1}{2}\left(\frac{X-\mu}{\sigma}\right)^2}$ $-\infty < x < \infty$ $-\infty < \mu < \infty$ $\sigma > 0$

Notation : $X \sim N(\mu,\sigma^2)$, 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 X2 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 (without proof), illustrations of use of normal distribution in various fields.

Exact Sampling Distributions:

2.1 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 χ2 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 χ2.

2.2 Students t- distribution:

Definition of t- variate with n d.f. in the form

$t = \frac{U}{\sqrt{\frac{\chi^2}{n}}}$ where U ~ N (0,1) and

χ2 is chi-square variate with n d.f. and U and χ2 are independent r.v.s, derivation of p.d.f., sketch of p.d.f for various values of parameters, mean, mode, variance, moments, β1, β2 γ1, γ2 coefficients.

2.3 Snedecor's F- distribution:

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Definition of F- variate with n1 and n2 d.f. as

$F = \frac{\frac{\chi_1^2}{n_1}}{\frac{\chi_2^2}{n_2}}$

where χ_1^2 χ_2^2 and are independent chi-square variates with n_1 and n_2d.f. respectively, mean, mode, variance. Interrelation between t, F and χ2.

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SEM I / II / III / IV / V / VI : SEM : IV		
COURSE NUMBER (PAPER NUMBER) : PAPER : VIII		
TITLE OF COURSE (NAME OF PAPER) : Applied Statistics		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Sampling Theory: **1.1 Definition of population, sample, statistic, parameter, sample survey, census survey.** **Advantages of sample survey over census survey.** **1.2 Methods of sampling: i) Deliberate (purposive) sampling ii) probability sampling and** **iii) Mixed sampling.** **1.3 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 (vi)** **Estimated variance of sample mean. Standard error of sample means, comparison of** **SRSWR and SRSWOR.** **Tests of Hypothesis:** **2.1 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.** **2.2 Large sample tests: Construction of test statistic and identification of its**	**To study different methods of sampling and to distinguish between SRSWOR and SRSWR.** **To make use of various statistical tests based on various statistics.** **To monitor production through many stages of manufacturing. We use the tools of statistical quality control, such as X-bar and R charts, to monitor the quality of many processes and services.**	**The students are able to distinguish between SRSWOR and SRSWR.** **The studenca ts n apply various tests to different problems.** **The students can monitor production through many stages of manufacturing.**
	1. To achieve knowledge about the size, composition, organization and distribution of the population. **2. To describe the past evolution present distribution and future changes in the population of an area.** **3. To enquire the trends of population and its relationships with the different aspects of social organization in an area.** **4. To protect the future demographic evaluation and its probable consequences.**	**The students are able** **1. To achieve knowledge about the size, composition, organization and distribution of the population.** **2. To describe the past evolution present distribution and future changes in the population of an area.** **3. To enquire the trends of population and its relationships with the different aspects of social organization in an area.**

probability distribution. a) Tests for means i) $H_0 : \mu = \mu_0$ ii) $H_0 : \mu_1 = \mu_2$. 11 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.2.3 Small sample tests: If X_1, X_2, ------- X_n is a r.s from $N(\mu, \sigma^2)$ then and S^2 are independently distributed (without proof), construction of test statistic and identification of distribution of test statistic. a) 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). b) 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). c) F- tests: test for equality of population variance. 2.4 Illustrative examples. 3. Statistical Quality Control (SQC): 3.1 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. 3.2 Control charts for variables: Control chart for process average ( ), 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. 3.3 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. 12		4. To protect the future demographic evaluation and its probable consequences.

3.4 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:** **4.1 Introduction and need of vital statistics.** **4.2 Mortality rates: Crude Death Rate (CDR), Specific Death Rate, Standard Death Rate** **4.3 Fertility rates: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rate(ASFR), Total Fertility Rate (TFR).** **4.4 Reproduction rates: Gross Reproduction Rate (GRR), Net Reproduction Rate(NRR).** **4.5 Illustrative examples.**		

D.B.F.DAYANAND COLLEGE OF ARTS AND SCIENCE, SOLAPUR
COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.I		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : I		
COURSE NUMBER (PAPER NUMBER) : PAPER : I		
TITLE OF COURSE (NAME OF PAPER) : Descriptive Statistics-I		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Nature of Data : 1.1 Population and Sample. 1.2 Meaning of primary and secondary data. 1.3 Qualitative data (Attributes) : Nominal Scale and Ordinal scale. 1.4 Quantitative data (Variables): Interval Scale and ratio scale, discrete and continuous variables, raw data. 1.5 Classification of data : Discrete and continuous frequency distribution, inclusive and exclusive methods of classification, cumulative frequency distribution, relative frequency. 1.6 Graphical representation of data: Histogram, frequency polygon, frequency curve and Ogive curves. 1.7 Illustrative Examples.	To acquaint students with some basic statistics. A)To distinguish between i) Population and Sample. ii) primary and secondary data. iii)Qualitative data (Attributes) & Quantitative data (Variables) iv) discrete and continuous variables. B)To prepare Discrete and continuous frequency distribution, and represent with the help of graphs. .	The students are able . A)To distinguish between i) Population and Sample. ii) primary and secondary data. iii)Qualitative data (Attributes) & Quantitative data (Variables) iv) discrete and continuous variables. B)To prepare Discrete and continuous frequency distribution, and represent with the help of graphs.
Measures of Central Tendency : 2.1 Concept of central tendency of statistical data, statistical average, requirements of good statistical average. 2.2 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. 2.3 Geometric Mean (G. M.) : Definition 2.4 Harmonic Mean (H. M.) : Definition 2.5 Relation : A. M. ≥ G. M. ≥ H. M. (Proof for n = 2, positive observations)	To compute various measures of central tendency & to determine them graphically.To identify the proper averages for the given situations.	The students are able to compute various measures of central tendency & to determine them graphically

H.M. A.M.G.M. × = (Proof for n = 2, positive observations) 2.6 Median : Definition, Derivation of formula for grouped frequency distribution. 2.7 Mode : Definition, Derivation of formula for grouped frequency distribution. 2.8 Empirical relation between Mean, Median and Mode. 2.9 Partition Values : Quartiles, Deciles and Percentiles. 2.10 Graphical method of determination of Median, Mode and Partition values. 2.11 Situations where one kind of average is preferable to others. 2.12 Examples to illustrate the concept.		
Measures of Dispersion : 3.1 Concept of dispersion, Absolute and Relative measures of dispersion, Requirements of a good measure of dispersion. 3.2 Range : Definition, Coefficient of range. 3.3 Quartile Deviation (Semi-interquartile range) : Definition, coefficient of Q.D. 3.4 Mean Deviation: Definition, coefficient of M. D., Minimal property of M.D. (Statement only). 3.5 Mean Square Deviation: Definition, Statement and proof of minimal property of M. S. D. 3.6 Variance and Standard Deviation : Definition, Statement and proof of effect of change of origin and scale on S.D. and Variance (for proof take individual data of n observations n xxx ,...., 21 and h Ax d i i − =), S. D. of pooled data (without proof). 3.7 Coefficient of Variation : Definition and use. 3.8 Comparison of absolute and relative measures of dispersion. 3.9 Examples to illustrate the concept.	To compute various measures of dispersion.To distinguish between absolute and relative measures of dispersion.	The students are able to compute various measures of dispersion,and to distinguish between absolute and relative measures of dispersion.
Moments, Skewness and Kurtosis :	To compute raw,central and factorial moments.To know need of	The students are able to compute raw,central and

4.1 Moments : Raw moments (r µ ’) and central moments (r µ) and factorial moments ( ) (r µ ’) for ungrouped and grouped data. 4.2 Effect of change of origin and scale on moments, relation between central and raw moments (up to 4th order), relation between raw and factorial moments (up to 2nd order). 4.3 Sheppard’s correction, need of Sheppard’s correction. 4.4 Skewness: Concept of Skewness of a frequency distribution, Types of Skewness and its interpretation. 4.5 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.	Sheppard’s corrections.To compute measures of skewness and kurtosis. and to interpret them.	factorial moments.To know need of Sheppard’s corrections.To compute measures of skewness and kurtosis. and to interpret them.

D.B.F.DAYANAND COLLEGE OF ARTS AND SCIENCE, SOLAPUR
COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.I		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : I		
COURSE NUMBER (PAPER NUMBER) : PAPER : II		
TITLE OF COURSE (NAME OF PAPER) : Probability and Probability Distributions-I		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Sample Space and Events : 1.1 Concepts of experiments and random experiments. 1.2 Definitions : Sample space, discrete sample space (finite and countably infinite), event, elementary event, compound event. 1.3 Algebra of events (Union, Intersection, complementation) 1.4 Definitions of Mutuality exclusive events, Exhaustive events, impossible 6 events, certain events. 1.5 Power ser IP (Ω) (sample space consisting at most 4 sample points). 1.6 Symbolic representation of given events and description of events in symbolic form. 1.7 Illustrative examples.	To distinguish between random and non random experiments.To find the probabilities of the events.	The students are able to distinguish between random and non random experiments and to find the probabilities of the events.

Probability : 2.1 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. 2.2 Axiomatic definition of probability with reference to a finite and countably infinite sample space. 2.3 Proof of the results : i) P (Φ) = 0 ii) P (Ac) = 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). 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). 2.4 Illustrative examples based on the results in 2.3 above.	To get acquainted with axiomatic definition of probability and proofs of some results and to solve the examples based on these results.	The students are able to solve the examples based on these results.
Conditional Probability and Independence of Events : 3.1 Definition of conditional probability of an event. 3.2 Multiplication theorem for two events P (A ∩ B) = P(A) P (B /A) 3.3 Partition of Sample space 3.4 Idea of Posteriori probability, statement and proof of Bayes theorem, examples on Bayes theorem. 3.5 Concept of Independence of two events. 3.6 Proof of the result that if A and B are independent then, i) A and Bc, ii) Ac and B, iii) Ac and Bc are independent. 3.7 Pairwise and Mutual Independence for three events. 3.8 Simple examples.	To know the concept of conditional probabilities,independence of events,posteriori probability,proofs of some results.	The students are able to know the concept of conditional probabilities,independence of events,posteriori probability,proofs of some results.

Univariate Probability Distribution (Defined on finite and countable infinite sample space): 4.1 Definition of discrete random variables. 4.2 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). 4.3 Probability distribution of function of a random variable. 4.4 Median and Mode of a univariate discrete probability distribution. 4.5 Examples.	To introduce the concept of discrete random variable,it's p.m.f.,c.d.f. and to find median and mode of a random variable.	The students are able to know discrete random variable,it's p.m.f.,c.d.f. and to find median and mode of a random variable.

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NAME OF DEPARTMENT : STATISTICS

To get acquainted with concept of regression, to fit lines of regression by the least square method. regression coefficients and their geometric interpretations , properties & acute angle between the two lines of regression

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.I		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : II		
COURSE NUMBER (PAPER NUMBER) : PAPER : III		
TITLE OF COURSE (NAME OF PAPER) : Descriptive Statistics-II:		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Correlation: 1.1 Concept of Bivariate data. 1.2 Concept of correlation between two variables, types of correlation. 1.3 Scatter diagram, its utility. 1.4 Covariance : Definition, effect of change of origin and scale. 1.5 Karl Pearson's coefficient of correlation (r) : Definition, Computation for ungrouped and grouped data. Properties (with proof) : i) $-1 \leq r \leq 1$ ii) Effect of change of origin & scale. 1.6 Interpretation when r = -1, 0, 1. 1.7 Spearman's rank correlation coefficient : Definition, Computation (for with and without ties). Derivation of the formula for without ties. 1.8 Illustrative Examples.	**To compute correlation coefficient between two variables,& to interpret the results.**	**The students are able to find correlation between two variables and interpret the results.**
Regression : 2.1 Concept of regression, Lines of regression, fitting of lines of regression by the least square method. 2.2 Regression coefficients (byx and xy b) and their geometric interpretations, Properties : i) 2 yxxy bb r =× ii) 1 bb yx xy ≤ × iii) r 2/)b(b yxxy ≥ + iv) Effect of change of origin and scale on regression coefficients. 2.3 Concept of coefficient of determination. 2.4 The point of intersection of two regression lines. 2.5 Derivation of acute angle between the two lines of regression. 2.6 Illustrative Examples.	**To get acquainted with concept of regression, to fit lines of regression by the least square method. regression coefficients and their geometric interpretations , properties & acute angle between the two lines of regression.**	**The students are able to fit lines of regression by the least square method. To find regression coefficients.**

Theory of Attributes : 3.1 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) 3.2 Concept of Consistency, conditions of consistency (upto three attributes) 3.3 Concept of Independence and Association of two attributes. 3.4 Yule's coefficient of association (Q) : Definition, interpretation. 3.5 Coefficient of colligation (Y) : Definition, Interpretation. 3.6 Relation between Q and Y: $Q = 2Y / (1 + Y2)$, $\| Q \| \geq \| Y \|$, $0 \leq \| Y \| \leq \| Q \| \leq 1$. 3.7 Illustrative Examples.	**To analyse the data pertaining to attributes and to interpret the results.**	**The students are able to analyse the data pertaining to attributes and to interpret the results.**
Index Numbers : 4.1 Meaning and utility of index numbers, problems in construction of index numbers. 4.2 Unweighted price and quantity index numbers using : i) Aggregate method ii)Average of relatives method (A. M. and G. M. to be used as average). 4.3 Weighted price and quantity index numbers using aggregate method : Laspeyre's, Paasche's, Fisher's Formulae, cost of living index numbers. 4.4 Tests of Index numbers (time reversal and factor reversal tests). 4.5 Illustrative Examples.	**To use the index numbers to various fields.**	**The students become able to use the index numbers to various fields.**

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COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.I		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : II		
COURSE NUMBER (PAPER NUMBER) : PAPER : IV		
TITLE OF COURSE (NAME OF PAPER) : Probability and Probability Distributions -II		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Mathematical Expectation (Univariate discrete random Variable) : 1.1 Definition of expectation of a discrete random variable, expectation of a function of a discrete random variable. 1.2 Results on expectation : i) E(c) = c , where c is a constant. ii) E(aX+b) = a E(X) + b, where a and b are constants 1.3 Definitions of mean, variance of univariate discrete distributions. Effect of change of origin and scale on mean and variance. 1.4 Definition of raw and central moments and factorial moments upto order 2. 1.5 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. 1.6 Simple Examples.	**To find mean,variance and moments of a discrete random variable..**	**The students can find mean ,variance and moments and also identify the nature of distributions.**
Bivariate Probability Distribution (Defined on finite sample space) : 2.1 Definition of two dimensional discrete random variable, its p.m.f. and distribution function. 2.2 Computation of probabilities of events in bivariate probability distributions. 2.3 Concepts of marginal and conditional probability distributions. 2.4 Independence of two discrete random variables. 2.5 Examples.	**To compute probabilities of events in bivariate probability distribution.**	**The students are able to compute probabilities of events in bivariate probability distribution.**
Mathematical Expectation (Bivariate discrete random variable) :	**To find mathematical expectation ,correlation coefficient.**	**The students are able to find mathematical**

3.1 Definition of expectation in bivariate distributions. 3.2 Theorems on expectation : E(X + Y) and E(XY) (with proofs). 3.3 Expectation and variance of linear combination of two discrete random variables (with proofs). 3.4 Probability generating function of sum of two independent random variables. 3.5 Conditional expectation in bivariate probability distributions. 3.6 Definition of conditional mean and conditional variance in bivariate probability distributions. 3.7 Definition of covariance and correlation coefficient in bivariate probability distributions, distinction between uncorrelated variables and independent variables. 3.8 Examples.		**expectation ,correlation coefficient.**
Some Standard Discrete Probability Distributions (defined on finite sample space): 4.1 Idea of one point, two point distributions and their mean and variance. 4.2 Bernoulli Distribution- p.m.f., mean, variance, distribution of sum of, independent and identically distributed Bernoulli random variables. 4.3 Binomial Distribution – p.m.f pqp nqpCx xnx x n −=<< = === − 1 , 10 where otherrwise , 0 ; ..,0,1,2,....X ,)P(X Notation: X~) ,B(p n , recurrence relation for successive probabilities, computation of probabilities of different events. p.g.f. and hence or otherwise finding mean and variance, Examples. 4.4 Discrete Uniform distribution: p.m.f. otherwise , 0 , ... , , ,X , 1)P(X 321 = === n xxxx n x Finding of mean and variance. Examples. 4.5 Hypergeometric Distribution : p.m.f. MC x N- M C n-x P(x) = ----------------------, x = max (0, n –(N-M)), ----- min(n, M) NC n = 0 o. w. Notation : X ~ H (N, M, n), mean and variance of distribution assuming n ≤ N – M ≤ M, Examples.	**To apply discrete probability distributions in different situations.**	**The students can apply discrete probability distributions in different situations.**

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COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.II
NAME OF SUBJECT : STATISTICS
SEM I / II / III / IV / V / VI : SEM : III
COURSE NUMBER (PAPER NUMBER) : PAPER : V
TITLE OF COURSE (NAME OF PAPER) : Continuous Probability Distributions

COURSE CONTENT	OBJECTIVES	OUTCOME
Continuous Univariate Distributions: **1.1 Definition of the continuous sample space with illustrations, definition of continuous random variable (r.v.), probability density function (p.d.f.) and 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.** **1.2 Expectation of r.v., expectation of a function of r.v, mean, median, mode, quantiles (partition values), harmonic mean, variance, raw and central moment, skewness, kurtosis, examples.** **1.3 Moment generating function (m.g.f.)Mx(t): definition, properties. i) Standardization property Mx (0) =1 ii) Uniqueness property of m.g.f (if exists), (without proof) iii) Effect of change of origin and scale. Generation of raw and central moments. Definition of cumulant generating function.** **1.4 Transformation of continuous univariater.v.: Distribution of Y=g(X) (g is monotonic and non-monotonic), application of m.g.f. in transformation of r.v.** **1.5 Examples and problems.**	**To get acquainted with the basic concept of continuous univariate distributions and their mean,variance, m.g.f,and finding distributions of functions of continuous r.vs.**	**The students are able to get acquainted with the basic concept of continuous univariate distributions and their mean,variance, m.g.f,and finding distributions of functions of continuous r.vs.**
Continuous Bivariate Distributions: **2.1 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.** **2.2 Expectation of g(X,Y), means, variances, covariance, correlation coefficient, conditional expectation, proof of E[E(X/y)]=E(X), conditional**	**To get acquainted with the basic concept of continuous bivariate distributions.**	**The students are able to find marginal and conditional distributions of a r.v.,means ,variances ,conditional means ,variances etc.**

variance, regression as conditional expectation 2.3 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. 2.4 Transformation of continuous bivariate r.v.s : Distribution of bivaraiter.v.'s using jacobian of transformation. 2.5 Examples and problems.		
Uniform and Exponential Distribution: 3.1 Uniform distribution: pd.f, f(x) = $\frac{1}{b-a}$ a ≤ x ≤ b = 0 elsewhere Notation: X~U(a,b), sketch of p.d.f for various values of parameters, c.d.f, mean, variance, m.g.f., moments, β1 and β2 coefficients. Distribution of i) Y=$\frac{X-b}{b-a}$ ii) Y=$\frac{b-X}{b-a}$ iii) Y=F(x) where F(x) is c.d.f. of any continuous r.v. X. 3.2 Exponential distribution : p.d.f. (one parameter) f(x) = θ $e^{-\theta x}$x>0, θ >0 = 0 elsewhere Notation: X ~ Exp(θ), sketch of p.d.f for various values of parameters, c.d.f, m.g.f, mean, variance, coefficient of variation, moments, β1 and β2 coefficients, median, quartiles, lack of memory property, distribution of –(1/θ) logX, –(1/θ) log(1-X), where X~U(0,1). Exponential distribution with scale and location parameters.	To study the standard continuous probability distributions and their properties.	The students are able to develop problem-solving techniques needed to accurately calculate probabilities. Apply problem-solving techniques to solving real-world events,apply selected probability distributions to solve problems.

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COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.II		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : III		
COURSE NUMBER (PAPER NUMBER) : PAPERVI		
TITLE OF COURSE (NAME OF PAPER) : Discrete Probability Distributions and Statistical Methods		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Standard discrete distributions: **1.1 Poisson distribution: Probability mass function (p.m.f)** **P[X=x] = P(x) = , x = 0, 1, 2, 3----, λ > 0** **= 0 otherwise** **Notation: X ~ P(λ). 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.** **P[X=x] =P(x) = q^xp, x=0, 1, 2, ----,0 < p <1, q = 1 - p** **= 0 otherwise** **Notation: X ~ G(p). Mean, variance, distribution function, p.g.f., lack of memory property.** **Waiting time distribution: p.m.f.** **P[Y = y) = p q^{y-1} , y = 1, 2, 3, ----**	**Poisson Distribution: Understand in which circumstances Poisson Distribution will occur, and learn the meaning of the parameter. In addition, know how to compute the probability using the PMF, and know the E[X] and Var[X] for Poisson. Also realize the fact that the sum of independent Poisson is still Poisson. Poisson Approximation to Binomial:** **Geometric distribution:Learn the PMF and how to calculate the probability for Geometric, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Geometric. Negative Binomial Distribution: Understand the relationship between Geometric and Negative Binomial, and the difference between Negative Binomial and Binomial. Learn the PMF and how to calculate the probability for Negative Binomial, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Negative Binomial.**	**The students are able to find the probability for poisson,Geometric, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Geometric. Negative Binomial Distribution: Understand the relationship between Geometric and Negative Binomial, and the difference between Negative Binomial and Binomial. Learn the PMF and how to calculate the probability for Negative Binomial, and notice the Lack of Memory Property. In addition, know the E[X] and Var[X] for Negative Binomial.**

= 0 otherwise **Mean, variance and p.g.f. by using relation with geometric. Examples.** **1.3 Negative Binomial distribution: p.m.f.** **P[X=x] = P(x) =** $\binom{x+r-1}{r-1}p^r q^x$**, x = 0, 1, 3, - - - ; r > 0, 0< p <1, q = 1 - p** **=0 otherwise** **Notation: X ~ NB(r, P). 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.** **1.4 Multinomial distribution: p.m.f., m.g.f., means, variances and covariance using m.g.f. marginal distribution.**		
Multiple linear regression (for tri-variate case) **2.1 Plane of regression, Yule's notation, correlation matrix.** **2.2 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).** **2.3 Residual: Definition, order, properties, derivation of mean and variance.** **2.4 Illustrative examples based on the results in 2.3 above.**	**To fit an equation of plane of regression.**	**The students are able to fit an equation of plane of regression.**

Multiple and partial correlations: **3.1 Definition of multiple correlation coefficient $R_{i.jk}$, derivation of formula for multiple correlation coefficient.** **3.2 Properties of multiple correlation coefficient: i) $0 \le R_{i.jk} \le 1$, ii) $R_{i.jk} \ge \| r_{ij} \|$, iii) $R_{i.jk} \ge \| r_{ik} \|$ for $i=j=k=1, 2, 3$. $i \ne j$, $j \ne k$.** **3.3 Interpretation of i) $R_{i.jk} = 1$ and ii) $R_{i.jk} = 0$** **3.4 Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$** **3.5 Properties of partial correlation coefficient i) $-1 \le r_{ij.k} \le 1$, and ii) $b_{ij.k} * b_{ji.k} = r_{ij.k}^2$.** **Effect of partial correlation coefficient on regression estimate (Larger the regression coefficients better is the regression estimate).** **3.6 Examples and problems.**	**To interpret the values of multiple and partial correlation coefficients.**	**The students are able to interpret the values of multiple and partial correlation coefficients.**

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COURSE OUTCOME

NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.II		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : IV		
COURSE NUMBER (PAPER NUMBER) : PAPER : VII		
TITLE OF COURSE (NAME OF PAPER) : Continuous Probability Distributions and Exact Sampling Distributions		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
1.Gamma, Beta and Normal Distribution: **1.1 Gamma distribution: p.d.f (two Parameters)** $f(x) = \frac{\alpha^{\lambda}}{\Gamma\lambda} e^{-\alpha\lambda} x^{\lambda-1}$, **x>0, α >0, λ>0** **= 0 elsewhere** **Notation : X~G(α,λ), sketch of p.d.f for various values of parameters, special cases** **i) α =1 ii) λ=1, mean, mode, variance, moments,β1, β2 ,γ1 and γ2 coefficients, additive property, distribution of sum of i.i.d. exponential variates.** **1.2 Beta distribution of first kind: p.d.f** $f(x) = \frac{1}{\beta(m,n)} x^{m-1}(1-x)^{n-1}$, **0<x<1; m, n >0** **= 0 elsewhere.** **Notation : X~β1(m,n), 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).** **1.3 Beta distribution of second kind: p.d.f** $f(x) = \frac{1}{\beta(m,n)} \frac{x^{m-1}}{(1+x)^{n-1}}$ **, x>0 ; m, n >0** **= 0 elsewhere.** **Notation : X~β2(m,n), 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.** **1.4 Normal distribution : p.d.f.:**	**To study various standard continuous probability distributions their properties.**	**The students are able to find various measures of standard continuous probability distributions.**

$f(x) = \frac{1}{2\sqrt{2\pi}} e^{\frac{1}{2}\left(\frac{X-\mu}{\sigma}\right)^2}$ $-\infty < x < \infty$ $-\infty < \mu < \infty$ $\sigma > 0$ **Notation : $X \sim N(\mu,\sigma^2)$, 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 X2 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 (without proof), illustrations of use of normal distribution in various fields.**		
Exact Sampling Distributions: **2.1 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 χ2 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 χ2.** **2.2 Students t- distribution:** **Definition of t- variate with n d.f. in the form** $t = \frac{U}{\sqrt{\frac{\chi^2}{n}}}$ **where U ~ N (0,1) and** **χ2 is chi-square variate with n d.f. and U and χ2 are independent r.v.s, derivation of p.d.f., sketch of p.d.f for various values of parameters, mean, mode, variance, moments, β1, β2 γ1, γ2 coefficients.** **2.3 Snedecor's F- distribution:** **10** **Definition of F- variate with n1 and n2 d.f. as** $F = \frac{\frac{\chi_1^2}{n_1}}{\frac{\chi_2^2}{n_2}}$ **where χ_1^2 χ_2^2 and are independent chi-square variates with n_1 and n_2d.f. respectively, mean, mode, variance. Interrelation between t, F and χ2.**	**To study various exact sampling distributions their properties.**	**The students are able to identify exact sampling distributions and to find various measures.**

D.B.F.DAYANAND COLLEGE OF ARTS AND SCIENCE, SOLAPUR
COURSE OUTCOME
NAME OF DEPARTMENT : STATISTICS

B.A. / B.Sc. / M.A. / M.Sc. : B.Sc.II		
NAME OF SUBJECT : STATISTICS		
SEM I / II / III / IV / V / VI : SEM : IV		
COURSE NUMBER (PAPER NUMBER) : PAPER : VIII		
TITLE OF COURSE (NAME OF PAPER) : Applied Statistics		
COURSE CONTENT	**OBJECTIVES**	**OUTCOME**
Sampling Theory: **1.1 Definition of population, sample, statistic, parameter, sample survey, census survey.** **Advantages of sample survey over census survey.** **1.2 Methods of sampling: i) Deliberate (purposive) sampling ii) probability sampling and** **iii) Mixed sampling.** **1.3 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 (vi)** **Estimated variance of sample mean. Standard error of sample means, comparison of** **SRSWR and SRSWOR.**	**To study different methods of sampling and to distinguish between SRSWOR and SRSWR.**	**The students are able to distinguish between SRSWOR and SRSWR.**
Tests of Hypothesis: **2.1 Notion of hypothesis, null and alternative hypothesis, simple and composite** **hypothesis, test statistic, critical region,**	**To make use of various statistical tests based on various statistics.**	**The students can apply various tests to different problems.**

idea of one and two tailed test, type I and type II errors, level of significance, p-value. 2.2 Large sample tests: Construction of test statistic and identification of its probability distribution. a) Tests for means i) H0 : μ = μ0 ii) H0 : μ1 = μ2. 11 b) Tests for proportion: i) H0 : P0 = P1 ii) H0 : P1 = P2. c) Tests for population correlation coefficient: i) H0: ρ = ρ0 ii) H0: ρ1 = ρ2, using Fisher's Z transformation.2.3 Small sample tests: If X1, X2, ------- Xn is a r.s from N(μ, σ2) then and S2 are independently distributed (without proof), construction of test statistic and identification of distribution of test statistic. a) t-tests for means: i) H0: μ = μ0 (σ is unknown), ii)H0: μ1 = μ2 (σ1 = σ2 is unknown) unpaired t test. iii) H0: μ1 = μ2 (paired t test). b) χ2 -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). c) F- tests: test for equality of population variance. 2.4 Illustrative examples.		
3. Statistical Quality Control (SQC): 3.1 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. 3.2 Control charts for variables: Control chart for process average ( ), 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. 3.3 Control charts for attributes: Defects, defectives, fraction defective,	**To monitor production through many stages of manufacturing. We use the tools of statistical quality control, such as X-bar and R charts, to monitor the quality of many processes and services.**	**The students can monitor production through many stages of manufacturing.**

control chart for **fraction defectives (P-chart) for fixed sample size and unknown standards, construction, working of chart, revised control limits.** **12** **3.4 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: **4.1 Introduction and need of vital statistics.** **4.2 Mortality rates: Crude Death Rate (CDR), Specific Death Rate, Standard Death Rate** **4.3 Fertility rates: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rate(ASFR), Total Fertility Rate (TFR).** **4.4 Reproduction rates: Gross Reproduction Rate (GRR), Net Reproduction Rate(NRR).** **4.5 Illustrative examples.**	**1. To achieve knowledge about the size, composition, organization and distribution of the population.** **2. To describe the past evolution present distribution and future changes in the population of an area.** **3. To enquire the trends of population and its relationships with the different aspects of social organization in an area.** **4. To protect the future demographic evaluation and its probable consequences.**	**The students are able** **1. To achieve knowledge about the size, composition, organization and distribution of the population.** **2. To describe the past evolution present distribution and future changes in the population of an area.** **3. To enquire the trends of population and its relationships with the different aspects of social organization in an area.** **4. To protect the future demographic evaluation and its probable consequences.**