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 : 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)** $= \frac{1}{b-a}$ **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) =** $\theta e^{-\theta x}$ **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.**		

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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,**	**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 Ri.jk, derivation of formula for multiple correlation coefficient.** **3.2 Properties of multiple correlation coefficient: i) 0 ≤ Ri.jk≤ 1, ii) Ri.jk ≥ | rij |, iii) Ri.jk ≥ | rik | for i=j=k=1, 2, 3. i≠j, j≠k.** **3.3 Interpretation of i) Ri.jk =1 and ii) Ri.jk = 0** **3.4 Definition of partial correlation coefficient rij.k, derivation of formula for rij.k** **3.5 Properties of partial correlation coefficient i) -1≤ rij.k≤ 1, and ii) bij.k * bji.k = rij.k2.** **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 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.** **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:** **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.**		

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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) 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, 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.**		