Teaching Plan

Month	Period	Topic / sub- topic to be taught S.Y.B.Sc Sem- III Paper-I
September	7	**1. Negative Binomial Distribution**: Probability mass function (p.m.f.) Notation: Graphical nature of p.m.f., negative binomial distribution as a waiting time distribution, moment generating function(MGF), cumulant generating function(CGF), mean, variance, skewness, kurtosis(recurrence relation between moments is not expected), additive property of NB(k,p). Relation between geometric distribution and negative binomial distribution. Poisson approximation to negative binomial distribution. Real life situations.
October	10	**2. Multinomial Distribution:** Probability mass function (p.m.f.) Joint MGF , use of MGF to obtain means, variances, covariances, total correlation coefficients, variance – covariance matrix, rank of variance – covariance matrix and its interpretation, additive property of multinomial distribution, univariate marginal distribution, distribution of , conditional distribution of given conditional distribution of given real life situations and applications.

November	5	**3. Truncated Distributions:** Concept of truncated distribution, truncation to the right, left and on both sides. Binomial distribution left truncated at (value zero is discarded), its p.m.f., mean and variance. Poisson distribution left truncated at (value zero is discarded), its p.m.f., mean and variance. Real life situations and applications.
December	14	**4 Time Series:** **4.1** Meaning and utility of time series, components of time series: trend, seasonal variations, cyclical variations, irregular (error) fluctuations or noise. **4.2** Exploratory data analysis: Time series plot to (i) check any trend and seasonality in the time series (ii) identify the nature of trend . **4.3** Methods of trend estimation and smoothing: (i) moving average, (ii) linear, parabolic, exponential, Parato curve fitting by least squares principle (iii) exponential smoothing. **4.4** Choosing parameters for smoothing and forecasting. **4.5** Forecasting based on exponential smoothing. **4.6** Measurement of seasonal variations: i) simple average method, ii) ratio to moving average method, iii) ratio to trend where linear trend is calculated by method of least squares.(Numerical examples with heavy computations are to be asked preferably in practicals).

		4.7 Fitting of autoregressive model **4.8** Case studies of real life Time Series: Price index series, share price index series, economic time series: temperature and rainfall time series, wind speed time series, pollution levels.

Month	Period	Topic / sub- topic to be taught S.Y.B.Sc Sem- III Paper-II
September	10	**1. Continuous Univariate Distributions:** **1.1** Continuous sample space: Definition, illustrations. Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f. (without proof), probabilities of events related to random variable. **1.2** Expectation of continuous r.v., expectation of function of r.v. , mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis, mean deviation about mean. **1.3** Moment generating function (MGF): Definition, properties. Cumulant generating function (CGF): Definition. **1.4** Mode, partition values : quartiles( ), deciles, percentiles. **1.5** Probability distribution of function of r. v. : using i) Jacobian of transformation for monotonic function and one-to-one, on to functions, ii) Distribution function , iii) M.G.F.

October	9	**2. Continuous Bivariate Distributions:** **2.1** Continuous bivariate random vector or variable ( ): Joint p. d. f., joint c. d. f, properties (without proof), probabilities of events related to random variables (events in terms of regions bounded by regular curves, circles, straight lines). Marginal and conditional distributions. **2.2** Expectation of r.v.(X,Y), expectation of function of r.v. joint moments, conditional mean, conditional variance, egression as a conditional expectation. Theorems on expectation: i) are independent, generalization to k variables. (statement only proof not expected). **2.3** Independence of random variables and also its extension to random variables. **2.4** Moment generating function (MGF): , properties, MGF of marginal distribution of random variables(r.v.s.), properties i) if X and Y are independent r.v.s., ii) if X and Y are independent r.v.s. **2.5** Probability distribution of transformation of bivariate r. v.

November	17	**3. Standard Univariate Continuous Distributions:** **3.1 Uniform or Rectangular Distribution:** Probability density function (p.d.f.) Notation : p. d. f., sketch of p. d. f., c. d. f., mean, variance, symmetry, MGF. Distributions of i) ,ii) ,iii) where is the c. d. f. of continuous r. v. . Application of the result to model sampling. **3.2 Normal Distribution:** Probability density function (p. d. f.) { √ () Notation: p. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, variance, MGF, CGF, central moments, cumulants, skewness, kurtosis, mode, quartiles, points of inflexion of probability curve, mean deviation, additive property, probability distribution of standard normal variable (S.N.V.), and independent normal variates. Probability distribution of ̄, the mean of n . r. v s., computations of normal probabilities using normal probability integral tables. Central limit theorem (CLT) for r.v.s. with finite positive variance(statement only), its illustration for Poisson and Binomial distributions.(Box-Muller transformation and normal probability plot to be covered in practicals) **3.3 Exponential Distribution:** Probability density function (p. d. f.) Notation : Nature of density curve, interpretation of α as a interarrival rate of custermers joining the queue and as mean, mean, variance, MGF, CGF, skewness, kurtosis, c.d.f., graph of c.d.f., lack of memory property, quartiles( ), mean deviation about mean,

		distribution of sum of two i.i.d exponential random variables. Distribution of and with exponential random variables.

Month	Period	Topic / sub- topic to be taught S.Y.B.Sc Sem- IV Paper-I
Feburary	14	**1. Tests of Significance:** **1.1** Random sample from a distribution **1.2 Statistic and Parameter**. Sampling distribution of a statistic, standard error of a statistic with illustrations. **Statistical Inference**: Introduction to problem of Estimation and testing of hypothesis. Estimator and estimate. Unbiased estimator (definition and simple illustrations only). Point and interval estimation. Statistical hypothesis, null and alternative hypothesis, simple and composite hypothesis, one sided and two sided alternative hypothesis, critical region, and error, level of significance, . Two sided confidence interval. Tests of hypotheses using i) critical region approach, approach and iii) confidence interval approach. **1.3** Tests for population means (large sample / approximate tests): i) against , , . (variance known) ii) against , , . (variances known) iii) Construction of two sided confidence interval for and **1.4** Tests for population proportions: i) against ii) against iii) Construction of two sided confidence interval
March	8	**2. Multiple Linear Regression Model:** **2.1** Definition of multiple correlation coefficient Derivation of the expression for multiple correlation coefficient. Properties

		of multiple correlation coefficient. i) 0 ≤ ≤ 1 ii) ≥ min{ , }. **2.2** Interpretation of coefficient of multiple determination as i) proportion of variation explained by the linear regression ii) = 1 and iii) = 0. **2.3** Partial correlation coefficient: Definition and derivation of partial correlation coefficient and Property of partial correlation coefficient (-1 ≤ ≤ 1).(Statement only) **2.4** Notion of multiple linear regression. Yule's notation (trivariate case) (statement only). Fitting of regression plane of Y on and , by the method of least squares; obtaining normal equations, solution of normal equations. Definition and interpretation of partial regression coefficients and . (relations between partial regression coefficients and multiple correlations on are not expected). Residual: Definition, order, derivation of variance, properties. Finding multiple and partial correlation coefficients if (X_1, X_2, X_3) ~> MD(n, P_1, P_2 ,P_3)
April	8	**3. Demography:** **3.1** Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio. **3.2** Death/Mortality rates: Crude death rate, specific (age, sex etc.) death rate, standardized

		death rate (direct and indirect), infant mortality rate. **3.3** Fertility/Birth rate: Crude birth rate, general fertility rate, specific (age, sex etc.) fertility rates, total fertility rate. **3.4** Growth/Reproduction rates : Gross reproduction rate, net reproduction rate. .(Numerical examples with heavy computations are to be asked preferably in practicals). **3.5** Interpretations of different rates, uses and applications. **3.6** Trends in vital rates as revealed in the latest census.
May	6	**4. Queuing Model:** Introduction to quening model. as an application of exponential distribution, Poisson distribution and geometric distribution. Kendall's notation Inter arrival rate ( ), service rate ( ), traffic intensity (=),queue disciplines. Probability distribution of number of customers in queue, average queue length, average waiting time in: i) queue, ii) system.(without derivations) statement of Little's formula / relations.

Month	Period	Topic / sub- topic to be taught S.Y.B.Sc Sem- IV Paper-II
Feburary		1. **Gamma Distribution: (04 L)** Notation: Nature of probability curve, special cases: i) , ii) ,MGF, CGF, moments, cumulants, skewness, kurtosis, mode, additive property. Distribution of sum of i.i.d. exponential variables. Relation between distribution function of Poisson and Gamma variates.
March	11	**2. Chi-square Distribution:** Definition of chisquare r.v. as a sum of squares of i.i.d. standard normal variables. Derivation of the p.d.f. of Chi-square variable with n degrees of freedom (d.f.) using MGF. Notation: Mean, variance, MGF, CGF, central moments skewness, kurtosis, mode, additive property. Use of chi-square tables for calculations of probabilities. Normal approximation: √(statement only) Distribution of ̄ and Σ ̄ for a random sample from a normal distribution using orthogonal transformation, independence of ̄ and .

April	5	**3. Student's distribution:** Definition of r.v. with n d.f. in the form of √, where and is chi-square with n d.f., where are independent random variables. Notation: t_n Derivation of the p.d.f of distribution, nature of probability curve, mean, variance, moments, mode. Use of t-tables for calculations of probabilities, statement of normal approximation.
May	6	**4. Snedecore's distribution:** Definition of r.v. with n_1 and n_2 d.f. as = where & are independent chi-square variables with and d.f. Notation: Derivation of the p.d.f, nature of probability curve, mean, variance, moments, mode. Distribution of ,use of tables for calculation of probabilities. Interrelationship between Chi-square, and distributions.
June	10	**5. Test of Hypothesis:** **5.1 Tests based on chi-square distribution**: a) Test for independence of two attributes arranged in contingency table(with Yate's correction) (to be covered in practical only) b) Test for independence of two attributes arranged in contingency table, Mc Nemar's

		test (to be covered in practical only) c) Test for goodness of fit. (to be covered in practical only) d) Test for variance (Ho: against one-sided and two-sided alternatives i) for known mean , ii) for unknown mean. **5.2 Tests based on distribution**: a) Tests for population means: (i) Single sample with unknown variance and two sample for unknown equal variances tests for one-sided and two-sided alternatives. (ii) two sided confidence interval for population mean and difference of means of two independent normal populations. b) Paired t-test for one-sided and two-sided alternatives. **5.3 Test based on distribution**: Test for *:* against one-sided and two-sided alternatives when i) means are known and ii) means are unknown.