Teaching Plan

Month	Period	Topic / sub- topic to be taught S.Y.B.Sc Sem- I
July	6	**1. Standard Discrete Distributions:** **1.1.Negative Binomial Distribution: Notation:** X ~> NB (k, p).(extra 2) P.m.f. : P(X = x) = $\binom{x+k-1}{x} p^k q^x$; x=0,1,2,..... 0 < p < 1, q = 1 – p = 0 , otherwise Nature of p.m.f. negative binomial distribution as a waiting time distribution. M.G.F., C.G.F., mean, variance, skewness, kurtosis (recurrence relation between Moments is not expected). Relation between geometric and negative binomial Distribution. Poisson approximation to negative binomial distribution. real life Situations.
Augeust	12	**1.2. Multinomial distribution:** Probability mass function (p. m. f.) P(X1=x1, X2=x2,...., Xk=xk)=n! $\frac{p1^{x1} p2^{x2} \ldots pk^{xk}}{x1!x2!\ldots xk!}$; xi=0,1,…,n;i=1,2,….k.;x1+x2+x3+….+xk=n;p1+p2+…+pk=1;0<pi<1 Notation : $(X_1, X_2, , X_k) \sim MD(n, p_1, p_2, , p_k)$, $X \sim MD(n, p)$ L L where $X = (X_1, X_2, \text{L}, X_k)$, $p = (p_1, p_2, \text{L}, p_k)$. Joint MGF of $(\ ) X_1, X_2, \text{L}, X_k$ use of MGF to obtain means, variances, covariances, total correlation coefficients, multiple and partial correlation coefficients for k= 3, univariate marginal distribution, distribution of $X_i + X_j$, conditional distribution of X_i given $X_i + X_j = r$, variance – covariance matrix, rank of variance – covariance matrix and its interpretation and real life situations and applications. **1.3.Truncated Distributions:** Concept of Truncated distribution, truncation to the right, left and on both sides. Its p.m.f., mean, variance. Poisson distribution P(m) left truncated at X=0 (valueZero is discarded), its p.m.f. , mean, variance. Real life situations and Applications.

		Binomial distribution B(n, p) left truncated at X=0 (value zero is discarded),
Sep.	18	**2. Time Series:** 2.1 Meaning and utility of time series, Components of time series**:** trend, seasonal Variations, cyclical variations, irregular (error) fluctuations or noise. 2.2 Exploratory data analysis: Time series plot to (i) check any trend, seasonality in The time series (ii) learn how to capture trend. 2.3 Methods of trend estimation and smoothing: (i) moving average, (ii) curve fitting By least square principle, (iii) exponential smoothing. 2.4 Measurement of seasonal variations : i) simple average method, ii) ratio to moving average method, iii) ratio to trend where trend is calculated by method Of least squares. 2.5 Choosing parameters for smoothing and forecasting. 2.6 Forecasting based on exponential smoothing. 2.7 Double exponential smoothing i.e. Holt-Winters method 2.8 Fitting of autoregressive model AR (1), plotting of residuals.
Oct.	6	2.9 Data Analysis of Real Life Time Series: Price index series, share price series, economic time series, sales tax series, market price of daily consumables, weather related time series: temperature and rainfall time series, wind speed time series, pollution levels. **3. Fundamentals of R-Software:** 3.1 Introduction to R, features of R, starting and ending R session, getting help in R, R commands and case sensitivity. 3.2 Vectors and vector arithmetic a) creation of vectors using functions c, seq, rep b) Arithmetic operations on vectors using operators +, - , * , / , ^ . c) Numerical functions: log10, log, sort, max, min, unique, range, length, var, prod, sum, summary, fivenum etc. d) accessing vectors 3.3 Data frames : creation using data.frame, subset and transform commands. 3.4 Resident data sets : Accession and summary 3.5 p, q, d, r functions.

Teaching Plan

Month	Period	Topic / sub- topic to be taught S.Y.B.Sc Sem- II
		1. Multiple Linear Regression Model: 1.1 Definition of multiple correlation coefficient $R_{Y.X_1X_2}$. Derivation of the Expression for the multiple correlation coefficient. Properties of multiple correlation coefficient i) 0 1 $0 \leq R_{Y..X1\ X2} \leq 1$, ii) $R_{Y.X1X2} \geq \min\{r_{YX1}, r_{YX2}\}$. 1.2 Interpretation of coefficient of multiple determination $R^2_{Y.X1X2}$ as i) proportion of variation explained by the linear regression ii) $R^2_{Y.X1X2}=1$ ii) $R^2_{Y.X1X2}=0$ 1.3 Definition of partial correlation coefficient $r_{YX1.X2}$ and $r_{YX2.X1}$ 1.4 Notion of multiple linear regression, Yule's notation (trivariate case). 1.5 Fitting of regression plane of Y on X_1 and X_2, $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$, by method of least squares; obtaining normal equations, solutions of normal equations. 1.6 Residuals : Definition, order, derivation of variance, properties. 1.7 Definition and interpretation of partial regression coefficient**s** $b_{YX1.X2}$ and $b_{YX2.X1}$ 1.8 Properties of partial correlation coefficient: i) $-1 \leq r_{YX1.X2} \leq 1$ and $-1 \leq r_{YX2.X1} \leq 1$ ii) $b_{YX_1.\ X_2} b_{YX_2.\ X_1} = r^2_{YX_1.\ X_2}$
Nov.	12	**2. Tests of Hypotheses:**

		2.1 Statistics and parameters, statistical inference: problem of estimation and testing of hypothesis. Estimator and estimate. Unbiased estimator (definition and illustrations only). Statistical hypothesis, null and alternative hypothesis, Simple and composite hypothesis, one sided and two sided alternative hypothesis, critical region, type I error, type II error, power of the test, level of significance, p-value. Two sided confidence interval, finding probabilities of type I error and type II error when critical regions are specified.
Dec.	18	2.2 Tests for mean of $N(\mu, \sigma^2)$ known, using critical region approach i) $H_0 : \mu = \mu_0$ against $H_1 : \mu \neq \mu_0$, $H_1 : \mu > \mu_0$, $H_1 : \mu < \mu_0$, ii) $H_0 : \mu_1 = \mu_2$ Against $H_1 : \mu_1 \neq \mu_2$, $H_1 : \mu_1 > \mu_2$, $H_1 : \mu_1 < \mu_2$. Two sided confidence Intervals for μ and $\mu_1 - \mu_2$. 2.3 Tests Based on Normal Approximation: Using central limit theorem (using critical region approach and p value approach). Tests for population proportion P : i) $H_0 : P = P_0$ against $H_1 : P \neq P_0$, $H_1 : P > P_0$, $H_1 : P < P_0$ ii) $H_0 : P_1 = P_2$ against $H_1 : P_1 \neq P_2$, $H_1 : P_1 > P_2$, $H_1 : P_1 < P_2$. Two sided confidence intervals for P and $P_1 - P_2$.
Jan	6	**3. Tests of hypothesis using R-Software:** 2.1 Drawing a sample from population using SRSWR, SRSWOR. 2.2 Tests: Z test, t test, F test and tests for proportions **4. Demography:** 4.1 Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio. 4.2 Death/Mortality rates: Crude death rate, specific (age, sex etc.) death rate, standardized death rate (direct and indirect), infant mortality rate. 4.3 Fertility/Birth rate: Crude birth rate, general fertility rate, specific (age, sex etc.) fertility rates, total fertility rate. 4.4 Growth/Reproduction rates : Gross reproduction rate, net reproduction rate. 4.5 Interpretations of different rates, uses and applications. 4.6 Trends in vital rates as revealed in the latest census.

Feb.	6	**5.Queueing Model:** M/M/1: FIFO as an application of exponential distribution, Poisson distribution and geometric distribution : Inter arrival rate (λ), service rate (μ), traffic intensity ($\rho = \lambda / \mu < 1$), queue discipline, probability distribution of number of customers in queue, average queue length, average waiting time in: i) queue, ii) system. random