Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for S. Y. B. Sc. STATISTICS

Semester	Paper Code	Title of Paper	No. of Credits
III	STAT2301	Statistical Techniques- I	3
	STAT2302	Continuous Probability Distributions-I	3
	STAT2303	Practical-I	2
IV	STAT2401	Statistical Techniques- II	3
	STAT2402	Continuous Probability Distributions-II	3
	STAT2403	Practical-II	2

SYLLABUS(CBCS) FOR S. Y. B. Sc. STATISTICS (w.e. from June, 2020)

Academic Year 2020-2021

Class : **S.Y. B. Sc. (Semester- III)**
Paper Code: **STAT2301**
Paper : **I** Title of Paper : Statistical Techniques- I
Credit : 3credits No. of lectures: 48

The main objective of this course is to acquaint students with the basic concepts of discrete distributions defined on countably infinite sample space and concepts of Index Number and Time Series.

A) Learning Objectives:

1. The main objective of this course is to understand concept of some discrete distributions and truncated distribution with real life situations.
2. Know the relations among the different distributions.
3. Study of various index numbers and utilites with real life situations.
4. To fit the appropriate time series model that can be used.

B) Learning Outcome:

Students should be able to:

1. Understand discrete distributions with real life situations.
2. Learn Negative and multinomial distributions.
3. Learn truncated distributions
4. Learn the concept of index numbers and time series.

1. Standard Discrete Distributions: (22 L)

1.1 Negative Binomial Distribution:

Probability mass function (p.m.f.)

$$P(X = x) = \binom{x+k-1}{x} p^k q^x \quad ; \quad x = 0,1,2,\ldots \; ; 0 < p < 1 \; ; q = 1 - p \; ; k > 0$$
$$= 0 \quad ; \quad otherwise.$$

Notation: $X \sim NB(k, p)$.

Nature of probability curve, 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.

1.2 Multinomial Distribution: Probability mass function (p.m.f.)

$$P(X_1 = x_1, X_2 = x_2, \ldots, X_k = x_k) = \frac{n!\, {p_1}^{x_1} {p_2}^{x_2} \ldots {p_k}^{x_k}}{x_1!\, x_2! \ldots x_k!} \quad ; \quad x_i = 0,1,2,\ldots, n - \sum_{1}^{i-1} x_r,$$
$$i = 1,2,\ldots,k$$
$$x_1 + x_2 + \cdots + x_k = n;$$
$$0 < p_i < 1;\ i = 1,2,\ldots,k;$$
$$p_1 + p_2 + \cdots + p_k = 1;$$
$$= 0 \quad ; otherwise.$$

$$Notation: (X_1, X_2, \ldots, X_k) \sim MD(n, p_1, p_2, \ldots, p_k),\ \underline{X} \sim MD(n, \underline{p}),$$
$$where\ \underline{X} = (X_1, X_2, \ldots, X_k), \quad \underline{p} = (p_1, p_2, \ldots, p_k).$$

Joint MGF of $(X_1, X_2, \ldots, X_k)$, 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 $Xi + Xj$, conditional distribution of Xi given $Xj = r$, conditional distribution of Xi given $Xi + Xj = r$, real life situations and applications.

1.3 Truncated Distributions:

Concept of truncated distribution, truncation to the right, left and on both sides. Binomial distribution left truncated at $X = 0$ (value zero is discarded), its p.m.f., mean & variance.

Poisson distribution left truncated at $X = 0$ (value zero is discarded), its p.m.f., mean & variance. Real life situations and applications.

2 Index Numbers: (07L)

2.1 Introduction.

2.2 Definition and Meaning.

2.3 Problems/considerations in the construction of index numbers.

2.4 Simple and weighted price index numbers based on price relatives. **(For practical only)**

2.5 Simple and weighted price index numbers based on aggregates. **(For practical only)**

2.6 Laspeyre's, Paasche's and Fisher's Index numbers.

2.7 Consumer price index number: Considerations in its construction. Methods of construction of consumer price index number - (i) family budget method (ii) aggregate expenditure method.

2.8 Shifting of base, splicing, deflating, purchasing power. **(For practical only)**

2.9 Description of the BSE sensitivity and similar index numbers.

3 Time Series: (14L)

3.1 Meaning and utility of time series, components of time series: trend, seasonal variations, cyclical variations, irregular (error) fluctuations.

3.2 Exploratory data analysis: Time series plot to (i) check any trend & seasonality in the time series (ii) capture trend.

3.3 Methods of trend estimation and smoothing: (i) moving average, (ii) curve fitting by least square principle , (iii) exponential smoothing.

3.4 Choosing parameters for smoothing and forecasting.

3.5 Forecasting based on exponential smoothing.

3.6 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. **(For practical only)**

3.7 Fitting of autoregressive model $AR\ (p)$, where $p = 1,2$.

3.8 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.

4 Chebychev's Inequality: (5L)

4.1 For discrete and continuous distribution.

4.2 Examples and problems on Binomial, Normal and exponential distribution.

Refernce Books:

1. Brockwell P. J. and Davis R. A. (2003), Introduction to Time Series and Forecasting (Second Edition), Springer Texts in Statistics

2. Chatfield C. (2001), The Analysis of Time Series An Introduction, Chapman and Hall / CRC, Texts in Statistical Science .

3. Goon A. M., Gupta, M. K. and Dasgupta, B. (1986), Fundamentals of Statistics, Vol. 2, World Press, Kolkata.

4. Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, (Eleventh Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi , 110002 .

5. Gupta, S. C. and Kapoor V. K. (2007), Fundamentals of Applied Statistics (Fourth Edition), Sultan Chand and Sons, New Delhi.

6. Gupta, S. P. (2002), Statistical Methods (Thirty First Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.

7. Mukhopadhya Parimal (1999), Applied Statistics, New Central Book Agency, Pvt. Ltd. Kolkata

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SYLLABUS(CBCS) FOR S. Y. B. Sc. STATISTICS (w.e. from June, 2020)

Academic Year 2020-2021

Class : **S.Y. B. Sc. (Semester- III)**
Paper Code: **STAT2302**
Paper : **II** Title of Paper : **CONTINUOUS PROBABILITY DISTRIBUTIONS-I**
Credit : 3credits No. of lectures: 48

A) Learning Objectives:

1. The main objective of this course is to understand concept of continuous distributions with real life situations.
2. To identify the appropriate probability model that can be used.
3. Find various measures of r.v. and probabilities using its probability distributions.
4. Know the relations among the different distributions.
5. Understand the concept of transformation of univariate and bivariate continuous random variables.

B) Learning Outcome:

Students should be able to:

1. Understand continuous distributions with real life situations.
2. Learn uniform, Normal, exponential and Gamma distributions.
3. Learn Bivariate distributions
4. Learn the relations among the different distributions
5. Learn the concept of transformation of continuous random variables which help to study derived distributions.

TOPICS/CONTENTS:

UNIT 1: Functions and Properties of functions. (04 L)

Definition of function, Continuous function, Monotonic function, One to one function, On to function, Inverse function.

UNIT 2: Continuous Univariate Distributions (10 L)

2.1 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.

2.2 Expectation of continuous r.v., expectation of function of r.v. E[g(X)], mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis.

2.3 Moment generating function (M.G.F.): Definition and properties, cumulant generating function (C. G. F.): definition**,** properties.

2.4 Mode, median, quartiles.

2.5 Probability distribution of function of r. v. : Y = g(X) using

i) Jacobian of transformation for g(.) monotonic function and one-to-one, on to functions,

ii) Distribution function for Y = $\mathbf{X^2}$, Y = |X| etc.,

iii) M.G.F. of g(X).

UNIT 3: Continuous Bivariate Distributions: (12 L)

3.1 Continuous bivariate random vector or variable (X, Y): Joint p. d. f. , joint c. d. f , properties (without proof), probabilities of events related to r.v. (events in terms of regions bounded by regular curves, circles, straight lines). Marginal and conditional distributions

3.2 Expectation of r.v., expectation of function of r.v. E[g(X, Y)], joint moments, Cov (X,Y), Corr (X, Y), conditional mean, conditional variance, E[E(X|Y = y)] = E(X), regression as a conditional expectation.

3.3 Independence of r. v. (X, Y) and its extension to k dimensional r. v. Theorems on expectation: i) E(X + Y) = E(X) + E(Y), (ii) E(XY) = E(X) E(Y), if X and Y are independent, generalization to k variables. E(aX + bY + c), Var (aX + bY + c).

3.4 M.G.F. : $M_{X,Y}(t_1 , t_2)$, properties, M.G.F. of marginal distribution of r. v.s., properties,

i) $M_{X,Y}(t_1 , t_2) = M_X(t_1,0)\, M_Y(0,t_2)$, if X and Y are independent r. v.s.

ii) $M_{X+Y}(t) = M_{X,Y}(t , t)$.

iii) $M_{X+Y}(t) = M_X(t)\, M_Y(t)$ if X and Y are independent r.v.s.

3.5 Probability distribution of transformation of bivariate r. v. $U = \phi_1(X ,Y)$,

$V = \phi_2(X ,Y)$

UNIT 4: Standard Univariate Continuous Distributions: (22 L)

4.1 Uniform or Rectangular Distribution:

Probability density function (p.d.f.) $f(x) = \begin{cases} \frac{1}{b-a} & a \le x \le b \\ 0 & \end{cases}$

Notation : X ~ U[a, b] .

p. d. f., sketch of p. d. f., c. d. f., mean, variance, symmetry.

Distribution of i) $\frac{X-a}{b-a}$ ii) $\frac{b-X}{b-a}$ iii) Y=F(X), where F(X) is the c.d.f. of continuous r.v. X.

Application of the result to model sampling. (Distributions of X + Y, X – Y, XY and X/Y are not expected.)

4.2 Normal Distribution:

Probability density function (p. d. f.)

$$f(x)=\begin{cases}\frac{1}{\sigma\sqrt{2\pi}}e^{\frac{1}{-2\sigma^2}(x-\mu)^2} & ;-\infty<x<\infty;-\infty<\mu<\infty;\sigma>0\\ 0 & ;\quad otherwise\end{cases}$$

p. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, variance, M.G.F., C.G.F., central moments, cumulants, β_1, β_2, γ_1, γ_2, median, mode, quartiles, mean deviation, additive property, computations of normal probabilities using normal probability integral tables, probability distribution of : i) $\frac{X-\mu}{\sigma}$ standard normal variable (S.N.V.), ii) aX + b, iii) aX + bY + c, iv) X^2, where X and Y are independent normal variates. Probability distribution of $\overline{X}$, the mean of n i.i.d. $N(\mu,\sigma^2)$ r.v.s. Statement and proof of central limit theorem (CLT) for i. i. d. r. v. s with finite positive variance. (Proof should be using M.G.F.) Its illustration for Poisson and Binomial distributions.

4.3 Exponential Distribution

Probability density function (p. d. f.) $f(x)=\begin{cases}\alpha e^{-\alpha x};x\geq 0;\alpha>0\\ 0 \quad ;\quad otherwise\end{cases}$

Notation : X ~ Exp(α) .

Nature of p. d. f., density curve, interpretation of α as rate and 1/α as mean, variance, M.G.F., C.G.F., c.d.f., graph of c.d.f., lack of memory property, median, quartiles. Distribution of min(X, Y) with X, Y i. i. d. exponential r. v. s.

4.4 Gamma Distribution:

Probability density function (p. d. f.) $f(x)=\begin{cases}\frac{\alpha^2}{\Gamma\lambda}x^{\lambda-1}e^{-\alpha x};x\geq 0;\alpha>0\\ 0 \quad ;\quad otherwise\end{cases}$

Notation : $X \sim G(\alpha, \lambda)$.

Nature of probability curve, special cases: i) α=1 , ii) λ= 1, M.G.F., C.G.F., moments, cumulants, β_1, β_2, γ_1, γ_2, mode, additive property. Distribution of sum of n i. i. d. Gamma variates.

Books Recommended:

1. Mukhopadhya Parimal (1999), Applied Statistics, New Central Book Agency, Pvt. Ltd. Kolkata
2. Hogg, R. V. and Craig, A. T. , Mckean J. W. (2012), Introduction to Mathematical Statistics (Tenth Impression), Pearson Prentice Hall.
3. Gupta S. C. &Kapoor V.K.: (2002), Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
4. Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
5. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York
6. Goon, A.M., Gupta M.K. and Dasgupta B: (1986), Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
7. Meyer, P. L., Introductory Probability and Statistical Applications, Oxford and IBH Publishing Co. New Delhi.
8. Mood, A. M., Graybill F. A. and Bose, F. A. (1974), Introduction to Theory of Statistics (Third Edition, Chapters II, IV, V, VI), McGraw - Hill Series G A 276
9. Ross, S. (2003), A first course in probability (Sixth Edition), Pearson Education publishers , Delhi, India.

SYLLABUS(CBCS) FOR S. Y. B. Sc. STATISTICS (w.e. from June, 2020)

Academic Year 2020-2021

Class : **S.Y. B. Sc. (Semester- III)**
Paper Code: **STAT2303**
Paper : **III** Title of Paper : Statistics Practical-I
Credit : 2credits

Objectives

1. To fit various discrete and continuous distributions, to draw model samples (using R software)
2. Understand the applications of Continuous Uniformdistribution,Exponential distribution,Normal distribution,Bivariate Normal distribution.
3. To study distributions and their applications
4. Know the concept and use of time series

Sr. No.	Title of the experiment
1.	Fitting of negative binomial distribution, plot of observed and expected frequencies
2.	Fitting of normal and exponential distributions, plot of observed and expected frequencies
3.	Applications of negative binomial and multinomial distributions
4.	Applications of normal and exponential distributions
5.	Model sampling from (i) exponential distribution using distribution function, (ii) normal distribution using Box-Muller transformation
7.	Fitting of negative binomial, normal and exponential distributions using R software
8.	Index Numbers
9.	Time series : Estimation and forecasting of trend by fitting of AR (1) model, exponential smoothing, moving averages.
10.	Estimation of seasonal indices by ratio to trend

SYLLABUS(CBCS) FOR S. Y. B. Sc. STATISTICS (w.e. from June, 2020)

Academic Year 2020-2021

Class : **S.Y. B. Sc. (Semester- IV)**
Paper Code: **STAT2401**
Paper : **I** Title of Paper : Statistical Techniques- II
Credit : 3credits No. of lectures: 48

A) Learning Objectives:

The main objective of this course is to acquaint students with the concepts of Statistical Process Control, M/M/1: FIFO Queuing model.

By the end of course students are expected to be able to

1. Identify real life situations where multiple regression can be used.
2. Use of R Software in statistical computing.
3. Understand meaning and use of SPC, construction and working of control charts for variables and attributes.

B) Learning Outcomes:

Students should be able to:

1. Use R Software in statistical computing.
2. Learn Meaning and purpose of SPC.
3. Construct Control charts for Attributes.
4. Construct Control charts for variables.
5. Revise control limits whenever necessary.
6. Apply M/M/1:FIFO Queuing model.

TOPICS/CONTENTS:

UNIT1: Multiple Linear Regression Model (trivariate case) (18L)

1.1 Definition of multiple correlation coefficient $R_{i.jk}$ $i,j,k = 1,2,3.$

.

1.2 Properties of multiple correlation coefficient)

1.2.1) $0 \leq R_{i.jk} \leq 1$ $i,j,k = 1,2,3$

1.2.2) $R_{i.jk} \geq Max\{|r_{ij}|, |r_{ik}|, |r_{ij.k}|, |r_{ik.j}|\}$ for $i \neq j \neq k. i,j,k = 1,2,3$

1.3 Interpretation of

1.3.1) coefficient of multiple determination $R^2_{i.jk}$

1.3.2) $R^2_{1.23} = 1$

1.3.3) $R^2_{1.23} = 0$

1.4 Definition of partial correlation coefficient

1.5 Notion of multiple linear regression Yule's notation $R_{1.23}$

1.6 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 the method of least squares; obtaining normal equations, solutions of normal equations.

1.7 Residuals : Definition, order, derivation of variance, properties.

1.8 Properties of partial regression coefficient

1.8.1) $-1 \leq r_{ij.k} \leq 1$ for i,j,k=1,2,3: $i \neq j \neq k$

1.8.2) $b_{12.3} \times b_{21.3} = r^2_{12.3}$

UNIT 2: Statistical Process Control (18 L)

2.1 Introduction: Meaning and purpose of Statistical Process Control, quality of a product, chance and assignable causes of variation.

2.2 Shewhart's Control chart: Statistical basis of control chart, 3 sigma limits, justification of 3 sigma limits and criteria for detecting lack of control.

2.3 Control charts for variables: Construction of control chart for mean and range when (i) standards are given and (ii) standards are not given. Revised control limits, interpretation from the charts and determination of process mean and standard deviation from the charts.

2.4 Control charts for attributes : Defects, defectives, fraction defective

2.4.1) p - chart

(a) Construction and working of p-chart when subgroup sizes are same and value of the process fraction defective p is specified: control limits, drawing of control chart, plotting of sample fraction defectives. Determination of state of control of the process.

(b) p-chart when subgroups sizes are different and value of the process fraction defective p is not specified with separate control limits, drawing of control chart, plotting sample fraction defectives, determination of state of control of the process. Interpretation of high and low spots.

2.4.2) c- chart

(a) Construction of c-chart **when standard is given**; control limits justification of 3 sigma limits, drawing of control chart, plotting number of defects per unit.

(b) Construction of c chart **when standard is not given**; control limits, explanation for the use of 3 sigma limits, drawing of control chart. Plotting number of defects per unit. Determination of state of control, interpretation of high and low spots in above cases.

UNIT 3: Queuing Model: (6 L)

3.1 Introduction to queuing theory

3.2 Terms used in queuing model.

Queue, Calling Population, Service stations (Or servers), Arrival rate, departure rate, Service discipline.

3.3 M/M/1: FIFO queuing model. An application of exponential distribution, Poisson distribution and geometric distribution: Inter arrival rate (λ), service rate (μ), traffic intensity (ρ), queue discipline, probability distribution of number of customers in queue, average queue length, average waiting time in: i) queue, ii) system.

UNIT 4: Statistical Computing Using R Software (6 L)

4.1 Computation of probability, cumulative probability, quantiles and drawing random samples using p, q, d, r functions (exponential, normal, Gamma, χ^2, t, F distributions)

4.2 Drawing a sample from population using SRSWR, SRSWOR.

4.3 Tests: Z test, t test, F test, proportions test, chi-square test for independents of attributes and goodness of fit.

References:

1. Goon A. M., Gupta, M. K. and Dasgupta, B. (1986), Fundamentals of Statistics, Vol. 2, World Press, Kolkata.
2. Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, (Eleventh Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi , 110002 .
3. Gupta, S. C. and Kapoor V. K. (2007), Fundamentals of Applied Statistics (Fourth Edition), Sultan Chand and Sons, New Delhi.
4. Gupta, S. P. (2002), Statistical Methods (Thirty First Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.
5. Hogg, R. V. and Craig, A. T. , Mckean J. W. (2012), Introduction to Mathematical Statistics (Tenth Impression), Pearson Prentice Hall.
6. Montgomery, D. C. (1983). Statistical Quality Control, John Wiley and Sons, Inc., New York.
7. Duncan A.J. (1974). Quality Control and Industrial Statistics,fourth edition D.B. Taraporewala Sons and Co. Pvt. Ltd., Mumbai.
8. Grant, E. L. and Leavenworth (1980). Statistical Quality Control, fifth edition, Mc-Graw Hill, New Delhi.
9. Taha, H.A. (2007). Operation research: An Introduction, eighth edition, Prentice Hall of India, New Delhi.
10. Kapoor, V. K.(2006). Operations Research, S. Chand and Sons. New Delhi.
11. Vishwas R. Pawgi.Statistical Computing Using R Software.

SYLLABUS(CBCS) FOR S. Y. B. Sc. STATISTICS (w. e. from June, 2020)

Academic Year 2020-2021

Class : **S.Y. B. Sc. (Semester- IV)**
Paper Code: STAT 2402
Paper : **II** Title of Paper : SAMPLING DISTRIBUTIONS AND TESTING OF HYPOTHESIS

Credit : 3credits No. of lectures: 48

A) Learning Objectives:

1.The main objective of this course is to acquaint students with the Exact Sampling Distributions and their applications.
2. Find various measures of r.v. and probabilities using its probability distributions
2. Know the relations among the different distributions
3. To study derived distributions and their applications

B) Learning Outcome:

Students should be able to:

1. Understand Chi-Square distribution, Student's t- distribution, Snedecor's F distribution
2. Compute mean, mode, variance, moments, cumulants for above Distributions
3. Learn Exact Sampling Distributions.
4. Know the relations among the different distributions

TOPICS/CONTENTS:

UNIT 1: Chi-square (χ_n^2) **Distribution:** **(08 L)**

1.1 Definition of χ^2 r. v. as sum of squares of i.i.d. standard normal variables, derivation of p.d.f. of χ^2 with n degrees of freedom (d.f.) using M.G.F., nature of p.d.f. curve, computations of probabilities using tables of χ^2 distribution. mean, variance, M.G.F., C.G.F., central moments, β_1, β_2, γ_1, γ_2, mode, additive property.

1.2 Normal approximation: $\frac{\chi_n^2 - n}{\sqrt{2n}}$ with proof.

1.3 Distribution of $\frac{X}{X+Y}$ and $\frac{X}{Y}$, where X and Y are two independent chi-square random variables.

UNIT 2: Student's t-distribution: (05 L)

2.1 Definition of T r. v. with n d.f. in the form $\frac{U}{\sqrt{\chi_n^2/n}}$ where U $\rightarrow$ N(0, 1) and χ_n^2 is a χ^2 r. v. with n d.f. and U and χ_n^2 are independent r.v.s.

2.2 Derivation of p. d. f., nature of probability curve, mean, variance, moments, mode, use of tables of t-distribution for calculation of probabilities, statement of normal approximation.

UNIT 3: Snedecore's F-distribution: (05 L)

3.1 Definition of F r.v. with n_1 and n_2 d.f. as $F_{n_1,n_2} = \frac{\chi_{n_1}^2/n_1}{\chi_{n_2}^2/n_2}$ where $\chi_{n_1}^2$ and $\chi_{n_2}^2$ are independent chi-square r.v.s. with n_1 and n_2 d.f. respectively.

3.2 Derivation of p.d.f., nature of probability curve, mean, variance, moments, mode.

3.3 Distribution of $1/F_{n_1,n_2}$, use of tables of F-distribution for calculation of probabilities.

3.4 Interrelations among, χ^2, t and F variates.

UNIT 4: Basic concept of Testing of Hypothesis and Sampling Distributions: (10 L)

4.1 Random sample from a distribution as i.i.d. r.v.s. $X_1, X_2,\ldots, X_n$. Statistics and parameters, statistical inference: problem of estimation and testing of hypothesis. Estimator and estimate. Statisical hypothesis, null and alternative hypothesis, one sided and two sided alternative hypothesis, critical region, type I error, type II error, level of significance, p-value. Confidence interval.

4.2 Notion of a statistic as function of $X_1, X_2,\ldots, X_n$ with illustrations.

4.3 Sampling distribution of a statistic. Distribution of sample mean $\bar{x}$ from normal, exponential and gamma distribution, Notion of standard error of a statistic.

4.4 Distribution of $\frac{nS^2}{\sigma^2} = \frac{1}{\sigma^2}\sum_{i=1}^{n}\left(X_i - \overline{X}\right)_2$ for a sample from a normal distribution using orthogonal transformation. Independence $\bar{x}$ of and S^2.

UNIT 5: Test of Hypothesis: (20 L)

5.1 Large Sample Tests (Tests based on Normal distribution) :

a)Z-tests for population means : i) one sample and two sample tests for one-sided and two-sided alternatives, ii) 100(1- α)% two sided confidence interval for population mean (μ) and difference of means ($\mu_1 - \mu_2$) of two independent normal populations.

b)Z-tests for population proportions (Using central limit theorem) : i) one sample and two sample tests for one-sided and two-sided alternatives, ii) 100(1- α)% two sided confidence interval for population proportion (P) and difference of proportions ($P_1 - P_2$) of two independent normal populations.

5.2 Tests based on chi-square distribution:

a) Test for independence of two attributes arranged in 2×2 contingency table. (With Yates' correction). (Problems are not expected)

b) Test for independence of two attributes arranged in r×s contingency table, McNemar's test (Problems are not expected)

c) Test for 'Goodness of Fit'. (Without rounding-off the expected frequencies). (Problems are not expected)

d) Test for $H_0 : \sigma^2 = \sigma_0^2$ against one-sided and two-sided alternatives when i) mean is known, ii) mean is unknown.

5.3 Tests based on t-distribution:

a) t-tests for population means : i) one sample and two sample tests for one-sided and two-sided alternatives, ii) 100(1- α)% two sided confidence interval for population mean (μ) and difference of means ($\mu_1 - \mu_2$) of two independent normal populations.

b) Paired t-test for one-sided and two-sided alternatives.

5.4 Test based on F-distribution:

a) Test for $H_0 : \sigma_1^2 = \sigma_2^2$ against one-sided and two-sided alternatives when i) means are known, ii) means are unknown.

Books Recommended:

1. Barlow R. E. and Proschan Frank: Statistical Theory of Reliability and Life Testing. Holt Rinebart and Winston Inc., New Yark.
2. Sinha S. K.: Reliability and Life Testing, Second Edition, Wiley Eastern Publishers, New Delhi.
3. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
4. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
5. Gupta S. C. &Kapoor V.K: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

SYLLABUS(CBCS) FOR S. Y. B. Sc. STATISTICS (w.e. from June, 2020)

Academic Year 2020-2021

Class : **S.Y. B. Sc. (Semester- IV)**
Paper Code: **STAT2403**
Paper : **III** Title of Paper : Statistics Practical-I
Credit : 2credits

Objectives

By the end of course students are expected to be able to:

1. To compute multiple and partial correlation coefficients, to fit trivariate multiple regression plane, to find residual s. s. and adjusted residual s. s. (using R-software)
2. Compute the expected frequencies and test the goodness of fit.
3. Apply Chebeshev's Inequality for various distributions
4. Construct various control charts
5. Apply large and small sample tests.
6. Project helps students to apply various statistical techniques on data collected by them.

Sr. No.	**Title of the experiment**
1.	Construction Of Variable Control Charts($\bar{X}$, $and\ R\ Chrts$)
2.	Construction Of Attribute Control Charts(p-chart and c-chart)
3.	Test for means and proportions based on normal distribution using R Software.
4.	Test based on t and F distributions using R Software.
5.	Tests based on chi-square distribution (Independence of attributes and Goodness of fit test) using R Software.
6.	Fitting of multiple regression plane and computation of multiple and partial correlation coefficients using R Software.
7.	Computations of probabilities of distributions using R Software.
8.	Project (Project is equivalent to five practicals.)