Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for S. Y. B. Sc. STATISTICS (2022 Pattern)

(With effect from Academic Year 2023-2024)

Name of the Programme : B.Sc. Statistics

Program Code : USST

Class : S.Y.B.Sc.

Semester : IV

Semester	Paper Code	Title of Paper	No. of Credits
IV	USST241	Statistical Techniques- II	3
	USST242	Continuous Probability Distributions-II	3
	USST243	Practical Paper-IV	2

SYLLABUS (CBCS) FOR S. Y. B. Sc. STATISTICS

(w. e. from 2023)

Name of the Programme : B.Sc. Statistics

Program Code : USST

Class : S.Y.B.Sc.

Semester : IV

Course Name : Statistical Techniques – II

Course Code : USST241

No. of Lectures : 48

No of Credits : 3

A) Learning Objectives:

1. Identify real life situations where multiple regression can be used.
2. Acquaint students with the concepts of Statistical Process Control.
3. Construction and working of control charts for variables.
4. Construction and working of control charts for attributes.
5. Application of M/M/1: FIFO Queuing model.
6. Use of R Software in statistical computing.

B) Learning Outcomes:

Students should be able to:

1. Apply multiple regression in real life situations.
2. Use R Software in statistical computing.
3. Learn Meaning and purpose of SPC.
4. Construct Control charts for Attributes.
5. Construct Control charts for variables.
6. Revise control limits whenever necessary.
7. 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.

Course Outcomes	**Programme Outcomes (POs)**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	3	2			
CO2	3	3	1	3	3	2			
CO3	3	3	1	3	3	2			
CO4	3	3	2	3	3	2			
CO5	3	3	2	3	3	2			
CO6	3	3	3	3	2	2			
CO7	3	3	3	3	3				

Weight: **1** - Partially related **2** - Moderately Related **3** - Strongly related

SYLLABUS (CBCS) FOR S. Y. B. Sc. STATISTICS
(w. e. from 2023)

Name of the Programme : B.Sc. Statistics

Program Code : USST

Class : S.Y.B.Sc.

Semester : IV

Course Name : CONTINUOUS PROBABILITY DISTRIBUTIONS – II

Course Code : USST242

No. of lectures : 48

No. of Credits : 3

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.

3. Know the relations among the different distributions.

4. To study derived distributions and their applications.

5. To apply testing of hypothesis in real life situations.

B) Learning Outcome:

Students should be able to:

1. Understand Chi-Square distribution, Student's t- distribution, Snedecor's F distribution.

2. Compute means, mode, variance, moments, cumulants for above Distributions.

3. Apply Exact Sampling Distributions.

4. Know the relations among the different distributions.

5. Learn to apply testing of hypothesis in real life situations.

TOPICS/CONTENTS:

UNIT 1: Chi-square (χ^2_n) Distribution: **(8 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: (5 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: (5 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.

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	2	1			
CO2	3	3	1	3	2				
CO3	3	3	2	3	2				
CO4	3	3	2	2	1				
CO5	3	3	2	3	3	3			3

Weight: **1** - Partially related **2** - Moderately Related **3** - Strongly related

SYLLABUS (CBCS) FOR S. Y. B. Sc. STATISTICS
(w. e. from June, 2023)

Name of the Programme : B.Sc. Statistics
Program Code : USST
Class : S.Y.B.Sc.
Semester : IV
Course Name : Practical Paper – IV
Course Code : USST243
No. of lectures : 48
No. of Credits : 2

A) Learning Objectives:

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.

B) Learning Outcomes:

Students should be able to:

1. Apply multiple regression in real life situations.
2. Use R Software in statistical computing.
3. Learn Meaning and purpose of SPC.
4. Construct Control charts for Attributes and variables.
5. Analyze practical situations using statistical tests for various population parameters.

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.)

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	3	2			
CO2	3	3	1	3	3	2			
CO3	3	3	1	3	3	2			
CO4	3	3	2	3	3	2			
CO5	3	3	2	3	3	3			

Weight: **1** - Partially related **2** - Moderately Related **3** - Strongly related