Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: STATISTICS

Name of the Course: B.Sc. II (Sem– III & IV)

(Syllabus to be implemented from w.e.f. June 2020)

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Proposed Syllabus for B.Sc. Part – II (CBCS Semester Pattern)

STATISTICS

(To be introduced from June 2020)

Introduction

B.Sc-II (Statistics) CBCS Semester wise pattern to be introduced from June 2020. This syllabus of Statistics carries 300 marks. In semester-III, university examination of theory papers V and VI and in semester-IV, university examination of theory papers VII and VIII. The university examination of practical paper-II and paper-III will be held annually. The distributions of marks are as below.

Semester No.	Paper No.	Title of the Paper	University Exam.	Internal Exam.	Total	Credits
III	Paper- V	Probability Distributions - I	40	10	50	4.0
	Paper-VI	Statistical Methods	40	10	50	
IV	Paper-VII	Probability Distributions - II	40	10	50	4.0
	Paper-VIII	Applied Statistics	40	10	50	
Annual Examination	Practical	Paper –II	40	10	50	4.0
		Paper –III	40	10	50	

Note: Nature of internal examination, passing standard, ATKT and the conversion of marks into grades and credits are as per guidelines of Science Faculty Credit and Grading System.\

Teaching Periods:

1) Total teaching periods for each theory paper is three periods per week
2) Total teaching periods for each practical Paper- II and Paper-III are four periods per week per paper per batch of 16 students.

Duration of University Examinations:

1) For theory Paper – V and Paper – VI: Two hours in semester - III.

2) For theory Paper – VII and Paper – VIII: Two hours in semester – IV.

3) For practical paper – II: Four hours for a batch of 16 students annually.

4) For practical paper – III: Four hours for a batch of 16 students annually.

Semester – III

Statistics Paper – V: Probability Distribution –I

OBJECTIVES:

The main objective of this course is to acquaint students with the basic concepts of discrete distributions defined on countably infinite sample space, continuous univariate and bivariate distributions, transformation of univariate continuous random variable.

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

a) understand concept of discrete and continuous probability distributions with real life situations.

b) distinguish between discrete and continuous distributions.

c) find the various measures of random variable and probabilities using its probability distribution.

d) know the relations among the different distributions.

e) understand the concept of transformation of univariate and bivariate continuous random variable.

CONTENTS:

Unit-1: Discrete Distributions: Poisson, Geometric, Negative Binomial and Multinomial Distribution: (15 hrs.)

Poisson Distribution: p. m. f.

$$P[X = x] = P(x) = \frac{e^{-\lambda}\lambda^{x}}{x!} \qquad x = 0,1,2, \ldots \ldots .0 < p < 1, q = 1 - p$$

$$= 0 \qquad \text{otherwise}$$

Notation: X~P(λ). Mean, variance**,** moment generating function (m. g. f.). Recurrence relation for successive Probabilities, Additive property of Poisson distribution. For X and Y independent random variables conditional distribution of X given X+Y = n. Poisson distribution as a limiting case of Binomial distribution (with proof), Poisson distribution as a limiting case of Hypergeometric distribution (without proof), numerical problems.

Geometric Distribution: p. m. f.

$$[X = x] = P(x) = q^x p \qquad x = 0,1,2, \ldots \ldots .0 < p < 1, q = 1 - p$$

$$= 0 \qquad \text{otherwise}$$

Notation: X~G(p). Mean, Variance, distribution function, m. g. f., Lack of memory property, Waiting time distribution: p. m. f.

$$[Y = y] = P(y) = pq^{y-1} \qquad y = 1,2, \ldots \ldots .0 < p < 1, q = 1 - p$$

$$= 0 \qquad \text{otherwise}$$

Mean, Variance, distribution function, m. g. f. by using relation with geometric. Problems.

Negative Binomial Distribution: p. m. f.

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

$$= 0 \qquad \text{otherwise}$$

Notation X~NB(k, p), Geometric distribution is a particular case of Negative Binomial distribution, Mean, Variance, m. g. f., Recurrence relation for successive probabilities, numerical problems.

Multinomial distribution: definition, pmf

Notation (X_1 , X_2 , . . . , X_k) ~ $MD(n , p_1, p_2 , \ldots , p_k)$, m.g.f., use of m.g.f. to obtain marginal distribution of Xi, means, variances, covariance, correlation coefficient of (X_i, X_j), multiple and partial correlation coefficients (for k = 3).

Unit-2: Continuous Univariate Distributions: (12 hrs.)

Definition of continuous sample space with illustrations, Definition of continuous random variable (r. v.), probability density function (p. d. f.), cumulative distribution function (c. d. f.) and its properties.

Expectation of a r. v., expectation of a function of r. v., mean, median, mode, quartiles, variance, harmonic mean, geometric mean, raw and central moments, problems.

Moments generating function (m. g. f.): definition and properties

(i) Standardization property $M_X(0) = 1$, (ii) Effect of change of origin and scale,

(iii) Uniqueness property of m. g. f., (if exists, statement only). Generation of raw and central moments.

Cumulant generating function (c. g. f.): definition, relations between cumulants and central moments (up to order four). Problems.

Unit-3: Continuous Bivariate Distributions: (10 hrs.)

Definition of bivariate continuous r. v. (X, Y),

Joint p. d. f., c. d. f with properties, marginal and conditional distribution, independence of r. vs., evaluation of probabilities of various regions bounded by straight lines.

Expectation of function of r. vs., means, variances, covariance, correlation coefficient, conditional expectation, regression as conditional expectation if it is linear function of other variable and conditional variance, proof of i) $E(X \pm Y) = E(X) \pm E(Y)$,
ii) $E[E(X/Y)] = E(X)$.

Independence : If X and Y are independent r. vs. then (i) $E(XY) = E(X)\,E(Y)$,

(ii) $M_{x+y}(t) = M_x(t) \times M_y(t)$.

(iii) $M_{x,y}(t_1, t_2) = M_x(t_1, 0) \times M_y(0, t_2)$.

(iv) $M_{x+y}(t, t) = M_x(t, 0) \times M_y(0, t) = M_{x+y}(t)$.

Problems.

Unit-4:: Transformations of a continuous random variable: (8 hrs.)

Transformation of a univariate continuous r. v.: Distribution of $Y = g(X)$, where g is monotonic or non-monotonic functions using (i) Jacobian of transformation, (ii) Distribution function and (iii) m.g.f. methods.

Transformation of a continuous bivariate r. vs.: Distribution of a bivariate r. vs. using Jacobin of transformation. Problems.

References and Recommended Readings

1. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
2. Hogg R. V. and Criag A.T.: Introduction to Mathematical Stat ist ics (Third edition), Macmillan Publishing, New York.
3. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
4. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
5. Dr. Kore B. G. and Dr. Dixit P. G.: "Probability Distributions-I", Nirali Prakashan, Pune.
6. Mood A.M., Graybill F.A.: Introduction to theory of Statistics. (Chapter II, IV, V, VII) and Boes D.C. Tata, McGraw Hill, New Delhi. (Third Edition)
7. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York.

Semester – III

Statistics Paper – VI: Statistical Methods

OBJECTIVES:

The main objective of this course is to acquaint students with the basic concepts of Multiple Linear Regression, Multiple and Partial Correlation, Sampling Theory and Statistical Quality Control by the end of the course students are expected to be able to be:

a) understand the concept of Multiple Linear Regression.

b) understand the concept of Multiple Correlations and Partial Correlation.

c) know the concept of sampling theory.

d) understand the meaning, purpose and use of Statistical Quality Control, construction and working of Shewhart's control charts for variables and attributes

Unit 1: Multiple Linear Regression (for trivariate data only): (10 hrs.)

Concept of multiple linear regression, Plane of regression, Yule's notation, correlation matrix. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation.

Residual: definition, order, properties, derivation of mean and variance, covariance between residuals.

Unit 2: Multiple and Partial Correlation (for trivariate data only): (8 hrs.)

Concept of multiple correlations. Definition of multiple correlation coefficient Ri.jk, derivation of formula for multiple correlation coefficient. Properties of multiple correlation coefficient; i) $0 \leq R_{i.jk} \leq 1$, (ii) $R_{i.jk} > \max\{ |r_{ij}|, |r_{ik}|, |r_{ij.k}|, |r_{ik.j}| \}$

(iii) $R_{i.jk} \geq |r_{ik}|$ i = j =k = 1, 2, 3. $i \neq j$, $i \neq k$. Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$, coefficient of multiple determination $R^2_{ij.k}$

Concept of partial correlation. Definition of partial correlation coefficient rij.k, derivation of formula for rij.k. Properties of partial correlation coefficient; (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} \times b_{ji.k} = r^2_{ij.k}$.

Problems.

Unit 3: Sampling Theory: (15 hrs.)

Definition of population, sample, parameter, statistic, sample survey, census survey. Advantages of sample survey over census survey, estimator, unbiased estimator

Methods of sampling: i) Deliberate (purposive) sampling ii) probability sampling and iii) Mixed sampling.

Simple random sampling without replacement (SRSWOR): Some results :

i) Probability of a specified unit being selected in sample at any given draw is equal to $\frac{1}{N}$.

ii) Probability of a specific unit included in the sample is $\frac{n}{N}$

iii) Probability of drawing a sample of size 'n' from a population of size N units is $\frac{1}{\binom{N}{n}}$

iv) $E(\bar{y}_n) = \bar{Y}_N$

v) E($N\bar{y}_n$) = $\sum Y_i$ = Population total

vi) Var($\bar{y}_n$) = $\frac{(N-n)}{Nn} S^2$

vii) E(s^2) = S^2

viii) Estimated variance of sample mean

Simple random sampling with replacement (SRSWR): Some results : i)

E($\bar{y}_n$) = $\bar{Y}_N$

ii) E($N\bar{y}_n$) = $\sum Y_i$ = Population total

iii) Var($\bar{y}_n$) = $\frac{(N-1)}{Nn} S^2$

iv) E(Sample mean square) = Population variance

v) Estimated variance of sample mean

Standard error of sample means, comparison of SRSWR and SRSWOR.

Unit 4: Statistical Quality Control (SQC): (12 hrs.)

Meaning and purpose of SQC, quality of product, process control, product control,

SPC tools: assignable causes, chance causes.

Shewhart's control chart: construction, working, theoretical basis, 3σ –control limits and lack of control situation.

Control charts for variables: Control chart for process average ($\bar{X}$), 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.

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.

Control chart for number of defects(C-chart): for standards are not given, construction and working of the chart, revised control limits.

References and Recommended Readings

1. Cochran, W.G: Sampling Techniques, Wiley Eastern Ltd., New Delhi.

2. Des Raj: Sampling Theory.

3. Gupta S. C. and Kapoor V. K., "Fundamentals of Applied Statistics", Sultan and Chand, (2010).

4. Dr. Kore B. G. and Dr. Dixit P. G.: "Statistical Methods-I", Nirali Prakashan, Pune.

5. Mukhopadhay, Parimal: Theory and Methods of Survey Sampling, Prentice Hall.

6. Montgomery D. C. (2009). "Introduction to quality Control", Jon Wiley and sons.

7. Sukhatme, P.V. and Sukhatme, B.V.: Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi

Semester – IV

Statistics Paper – VII: Probability Distribution –II

OBJECTIVES:

The main objective of this course is to acquaint students with the Uniform, Exponential, Gamma and Beta, Normal distributions and Exact Sampling distributions.

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

a) know some standard continuous probability distributions with real life situations.

b) distinguish between various continuous distributions.

c) find the various measures of continuous random variable and probabilities using its probability distribution.

d) understand the relations among the different distributions.

e) understand the Chi-Square, t and F distributions with their applications and inter relations.

Unit-1: Uniform and Exponential distribution: (10hrs.)

Uniform Distribution : p. d. f. $f(x) = \frac{1}{b-a}$ $a \leq x \leq b$

$= 0$ otherwise

Notation X~U(a, b), c.d.f., m.g.f., mean, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients. Distribution of (i) (X-a) / (b-a), ii) (b-X) / (b-a), (iii) Y = F(x) where F(x) is c.d.f. of any continuous r.v. Problems.

Exponential distribution: (one parameter),

p.d.f. $(x) = \theta\, e^{-\theta x} \qquad x \geq 0, \theta > 0$

$= \quad 0 \qquad$ otherwise

Notation X~Exp(θ) c.d.f., m.g.f., mean, variance, C.V., moments, β_1, β_2, γ_1 and γ_2 coefficients, median, quartiles, lack of memory property, distribution of Y = – ($\frac{1}{\theta}$) logX where X~ U (0, 1). Exponential distribution with scale and location parameters.

Unit-2: Gamma Distribution and beta distributions: (12hrs.)

2.1: p.d.f. (two parameters)

$$f(x) = \frac{\alpha^{\lambda}}{\Gamma\lambda}\, e^{-\alpha x} x^{\lambda-1} \qquad x > 0, \alpha > 0, \lambda > 0$$

$= \quad 0 \qquad$ otherwise

Notation $X \sim G(\alpha, \lambda)$, special cases i) $\alpha = 1$, $ii)$ $\lambda = 1$, mean mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients, additive property, distribution of sum of i. i. d. exponential variates.

Beta distribution of first kind: p. d. f.

$$(x) = \frac{1}{\beta(m, n)} x^{m-1}(1-x)^{n-1} \qquad 0 < x < 1, \qquad m, n > 0$$

$= \quad 0 \qquad$ otherwise

Notation $X \sim \beta_1(m, n)$ 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).

Beta distribution of second kind: p. d. f.

$$f(x) = \frac{1}{\beta(m, n)} \frac{x^{m-1}}{(1+x)^{m+n}} \qquad x > 0, \qquad m, n > 0$$

$= \quad 0 \qquad$ otherwise

Notation $X \sim \beta_2(m, n)$ mean, harmonic mean, mode, variance, distribution of $(\frac{1}{X})$, relation between beta distribution of first kind and second kind, distribution of X+Y, $(\frac{X}{Y})$ and $(\frac{X}{X+Y})$ where X and Y are independent gamma variate.

Unit-3: Normal distribution: (11 hrs.)

p. d. f.

$$(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-2^{\frac{1}{}\left(\frac{x-\mu}{\sigma}\right)^2}} \qquad -\infty < x < \infty, -\infty < \mu < \infty\ \sigma > 0$$

$$= 0 \qquad \text{otherwise}$$

Notation $X \sim N(\mu, \sigma^2)$ properties of normal curve, mean, median, mode, variance, quartiles, point of inflexion, moments, recurrence relation for central moments, β_1, β_2, γ_1 and γ_2 coefficients, m. g. f. standard normal distribution, additive property, distribution of X^2 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.

Unit-4: Exact Sampling Distributions (12 hrs.)

: Chi-Square distribution: Definition of chi square variate as a sum of square of n i. i. d. standard normal variates, derivation of p.d.f. of chi square distribution with n degrees of freedom using m.g.f., mean, mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients,

m. g. f. additive property, relation with gamma distribution. Normal approximation to chi-square distribution using central limit theorem.

: Student's t- distribution: Definition of student's t variate in the form $t = \frac{U}{\sqrt{\frac{\chi^2}{n}}}$. Where

U~N(0,1) and χ^2 is chi-square variate with n d. f. Derivation of p.d.f., mean, mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients.

Snedecor's F distribution: Definition of F variatewith n_1, n_2 d.f. as a ratio of two independent chi-square variables divided by their respective degrees of freedom. Derivation

of p.d.f., mean, variance and mode. Distribution of $\frac{1}{F}$. Inter relation between t, F and χ^2 .

References and Recommended Readings

1. Trivedi R. S.: Probability and Statistics with Reliability and Computer Science Application, Prentice – Hall of India Pvt. Ltd., New Delhi.
2. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.

3. Hogg R.V. and Criag A.T.: Introduction to Mathematical Stat ist ics (Third edition), Macmillan Publishing, New York.

4. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.

5. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

6. Gupta S. C. & Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.

7. Dr. Kore B. G., Dr. Dixit P. G. and Mr. P. S. Kapre: "Probability Distributions-II", Nirali Prakashan, Pune.

8. Mood A.M., Graybill F.A.: Introduction to theory of Statistics. (Chapter II, IV, V, VII) and Boes D.C. Tata, McGraw Hill, New Delhi. (Third Edition)

9. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York

Semester – IV

Statistics Paper – VII: Applied Statistics

OBJECTIVES:

The main objective of this course is to acquaint students with the concepts of Time Series, Testing of Hypothesis, demography.

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

a) know the concept and use of time series.

b) apply the small sample tests and large sample tests in various situations.

c) understand the need of vital statistics and concept of mortality and fertility.

CONTENTS:

Unit-1: Time Series: (12 hrs.)

Meaning and need of time series analysis, components of time series;

(i) Secular trend (ii) Seasonal Variation (iii) Cyclical Variation (iv) Irregular Variation,

Additive and Multiplicative model, utility of time series.

Measurement of trend: (i) Moving average method (ii) Least square method.

Measurement of seasonal indices by i) simple average method ii) by ratio to moving average method.

Unit 2: Testing of Hypothesis : (16 hrs.)

Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistic, hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, type I and type II errors, Critical region, level of significance, one and two tailed test, power of test. General procedure of testing of hypothesis.

: Large Sample Tests:

a) Tests for means: i) testing of population mean; H_0: $\mu = \mu_0$,

ii) testing equality of population means; H_0: $\mu_1 = \mu_2$

b) Tests for Proportion: i) testing of population Proportion; H_0: $P = P_0$

ii) testing equality of population Proportion; H_0:$P_1 = P_2$

c) test for population correlation: i) H_0: $\rho = \rho_0$ ii) H_0: $\rho_1 = \rho_2$ (by Z-transformation)

: Small sample tests: Definition of Fisher's t- variate,

t - test: a) test for means: i) H_0: $\mu = \mu_0$, ii) H_0: $\mu_1 = \mu_2$, ($\sigma_1 = \sigma_2$), iii) Paired t- test

χ^2 - test: i) test for population variance H_0: $\sigma^2 = \sigma_0^2$(Mean known and unknown),

ii) test for goodness of fit, iii) test for independence of attributes; a) m x n contingency table, b) 2 x 2 contingency table, test statistic with proof. Yate's correction for continuity.

F – test: test for equality of two population variances H_0: $\sigma_1^2 = \sigma_2^2$

Unit 3: Elements of Demography: (10 hrs.)

Introduction and need of vital statistics.

Mortality rates: Crude Death Rate (CDR), Specific Death Rate, Standard Death Rate

Fertility rates: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rate(ASFR), Total Fertility Rate (TFR).

Reproduction rates: Gross Reproduction Rate (GRR), Net Reproduction Rate(NRR).

Interpretation of NRR Illustrative problems

Unit 4: Chebychev's inequality and Central limit theorem (07 hrs.)

Chebychev's inequality for discrete and continuous distribution and problems.

Central limit theorem: Statement and proof (based on mgf) for iid r.vs. with finite variance.

Problems based on Bernoullie, Binomial, Poisson , Geometric and Chi-Square distributions.

References and Recommended Readings

1. Chatfield C. (2004), "The Analysis of Time Series –An Introduction", Chapman & Hall.
2. Gupta S. C. & Kapoor V. K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, New Delhi.
3. Kendall M.G. (1978), "Time Series", Charles Griffin.
4. Dr. Kore B. G. and Dr. Dixit P. G.: "Statistical Methods-II", Nirali Prakashan, Pune.
5. Snedecor G.W. and Cochoran W. G. "Statistical Methods", Lowa State University Press.

Practical Course at B.Sc. Part- II

Objectives:

By the end of course students are expected to:

i. Compute probabilities of standard probability distributions.

ii. Compute the expected frequency and test the goodness of fit.

iii. Drawing random samples from standard probability distributions.

iv. Compute the multiple and partial correlation coefficients.

v . Selection of samples by SRS.

vi. Computation and interpretation of vital statistics.

vii. Construction of control chart.

viii. Obtain results using soft wares like MS-Excel.

PRACTICAL –II

1. Model sampling from of Poisson distribution
2. Model sampling from of Geometric distribution
3. Model sampling from of Negative Binomial distribution
4. Fitting of Poisson distribution and test for goodness of fit.
5. Fitting of Geometric distribution and test for goodness of fit.
6. Fitting of Negative Binomial distribution and test for goodness of fit.(k should be taken to the next integer.)
7. Model sampling from Continuous Uniform distribution.
8. Model sampling from Exponential distribution.
9. Model sampling from Normal distribution.
10. Fitting of Continuous Uniform distribution and test for goodness of fit.
11. Fitting of Exponential distribution and test for goodness of fit.
12. Fitting of Normal distribution and test for goodness of fit.
13. Application of Exponential and Normal distributions.
14. Applications of Poisson distribution.
15. Applications of geometric and negative binomial distributions.
16. Application of multinomial distribution.

Experiments using soft ware's like MS-Excel.

17. Fitting of Poison & Negative Binomial distribution.
18. Fitting of Exponential & Normal distributions.
19. Model sampling from continuous Uniform and Exponential distributions.
20. Model sampling from Normal distribution.

PRACTICAL –III

1. Fitting of straight lines and second degree curves

2. Fitting of curves of type $Y=ab^x$, $Y=aX^b$ and $Y=ae^{bX}$

3. Multiple regressions.

4. Multiple and partial correlation.

5. Large sample tests for means.

6. Large sample tests for proportions.

7. Tests for population correlation coefficients (Using Fisher's Z transformation)

8. Tests based on Chi-square distribution. (for population variance, for goodness of fit)

9. Tests for independence.

10. Tests based on t distribution ($\mu=\mu_0$, $\mu_1=\mu_2$, paired and unpaired)

11. Tests based on F distribution ($\sigma_1^2 = \sigma_2^2$)

12. Construction of $\bar{X}$ and R chart.

13. Construction of P and C chart.

14. Time Series- I (Estimation of trend) i) by moving average ii) by least square method.

15. Time Series- II (Computation of seasonal indices) i) by simple average method

    ii) by ratio to moving average.

16. Simple random sampling (with and without replacement).

17. Demography-I (Mortality Rates)

18. Demography-II (Fertility Rates, Reproduction rates)

Experiments using soft wares like MS-Excel.

19. Fitting of Straight line, parabola, and exponential curves

20. Multiple, partial correlation and partial regression coefficients

Note:

i) Students are allowed to use any type of calculator or computer using any software like MS-Excel for computation in practicals.

ii) Computer printouts are to be attached to the journal.

iii) Student must complete the entire practical to the satisfaction of the teacher concerned.

iv) Student must produce the laboratory journal along with the completion certificate duly signed by Head of Department at the time of practical examination.

Laboratory requirements:

Laboratory should be well equipped with sufficient number of electronic calculators and computers along with necessary software, printers and UPS.

Nature of practical question paper

a) Each practical paper is of 40 marks containing four questions each of 15 marks and student has to solve two questions using any type of calculator or computer software.

b) Five marks are reserved for oral and five marks are reserved for journal for each paper.

c) If computer software is used it should be demonstrated online to the examiner.

d) The duration of practical examination will be of three hours which includes computation work, oral examination and online demonstration.

Equivalence for Theory Papers

Old Syllabus		**New Syllabus**	
Semester No. Paper No.	**Title of the Paper**	**Semester No. Paper No.**	**Title of the Paper**
Sem. III Paper V	**Continuous Probability Distributions**	**Sem. III Paper V**	**Discrete and Continuous Probability Distributions**
Sem. III Paper VI	**Discrete Probability Distributions and Statistical Methods**	**Sem. III Paper VI**	**Statistical Methods**

Sem. IV Paper VII	**Continuous Probability Distributions and Exact Probability Distributions**	**Sem. IV Paper VII**	**Continuous Distributions and Exact Sampling Distributions**
Sem. IV Paper VIII	**Applied Statistics**	**Sem. IV Paper VIII**	**Applied Statistics**