Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

DEPARTMENT OF STATISTICS
Three/Four- Years UG Programme

Department/Subject Specific Core or Major (DSC)

Curriculum, Teaching and Evaluation Structure

for

B. Sc. II Statistics

Semester-III & IV

(Implemented from academic year 2024-25 onwards)

Departmental Teaching and Evaluation scheme
(NEP-Phase-I)
Three/Four- Years UG Programme
Second Year Semester-III & IV

Sr. No.	Course Abbreviation	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
			Semester-III							
1	DSC-V	DSC03STA31	Probability Distributions I	2	-	40	10	-	50	2
2	DSC-VI	DSC03STA32	Statistical Methods	2	-	40	10	-	50	2
3	MIN-V	MIN03STA31	Predictive Modelling	2	-	40	10	-	50	2
4	MIN-VI	MIN03STA32	Hypothesis Testing	2	-	40	10	-	50	2
5	VSC-PR-II	VSC03STA39	Statistical computing using MS-Excel	-	4	-	-	25	25	2
6	DSC-PR-III	DSC03STA39	DSC Statistics Practical III	-	8	-	-	50	50	4
7	MIN-PR-III	MIN03STA39	MIN Statistics Practical III	-	4	-	-	25	25	2
	Semester –III Total			**8**	**16**	**160**	**40**	**100**	**300**	**16**
			Semester-IV							
1	DSC-VII	DSC03STA41	Probability Distributions II	2	-	40	10	-	50	2
2	DSC-VIII	DSC03STA42	Testing of Hypothesis & National Income	2	-	40	10	-	50	2
3	MIN-VII	MIN03STA41	Applied Statistics	2	-	40	10	-	50	2
4	MIN-VIII	MIN03STA42	Sampling Techniques	2	-	40	10	-	50	2
5	VSC-PR-III	VSC03STA49	Introduction to R	-	4	-	-	25	25	2
6	DSC-PR-IV	DSC03STA49	DSC Statistics Practical IV	-	8	-	-	50	50	4
7	MIN-PR-IV	MIN03STA49	MIN Statistics Practical IV	-	4	-	-	25	25	2
	Semester –IV Total			**8**	**16**	**160**	**40**	**100**	**300**	**16**

B. Sc. Part – II Semester -III STATISTICS
DSC-V: DSC03STA31: Probability Distributions-I

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1: Understand some discrete probability distributions and their applications in different fields.

CO2: Compute various statistical measures for continuous univariate and bivariate random variables.

CO3: Understand transformation of continuous univariate and bivariate random variable.

CO4: Compute various generating functions for continuous univariate and bivariate random variables.

Unit	Contents	Hours Allotted
1	**Some Discrete Probability Distributions:** **1.1 Geometric Distribution**: p.m.f, Mean and Variance, Additive property, Recurrence relation for probabilities, Memory less property, examples. **1.2 Negative Binomial Distribution**: p.m.f. with parameters (k, p), Geometric distribution is a particular case of Negative Binomial distribution, Mean, Variance, p. g. f., Additive property, Recurrence relation for successive probabilities, examples. **1.3 Power series distribution:** p.m.f., Mean, Mode, Variance, Binomial, Poisson, Geometric and Negative Binomial distribution as particular cases of power series distribution. **1.4 Multinomial Distribution**: p.m.f., Moment Generating Function, Marginal distribution, Mean, Variance, Covariance, Variance &Covariance matrix, Correlation coefficient, Additive property, Trinomial distribution as particular case of multinomial distribution.	15
2	**Univariate & Bivariate Continuous Random Variables:** **Continuous Univariate Random Variables:** **2.1** Definition: Continuous sample space with illustrations, continuous random variable (r.v.), probability density function (p.d.f.), cumulative distribution function (c.d.f.) and its properties. **2.2** Expectation of r.v., expectation of function of r.v., mean, median, mode, quartiles, variance, harmonic mean, raw and central moments, skewness and kurtosis, examples. **2.3** 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). Raw and central moments using m.g.f. **2.4** Cumulant generating function (c.g.f.): definition, Cumulants, Properties of c.g.f. and relations between cumulants and central moments (up to order four). **2.5** Transformation of univariate continuous r.v.: Distribution of Y=g(X), where g is monotonic or non-monotonic functions using (i) Jacobian method (ii) Distribution function and (iii) M.g.f.	15

	Continuous Bivariate Random Variables:	
	2.6 Definition of bivariate continuous random variable (X, Y), Joint p.d.f., c.d.f with properties, marginal and conditional distribution, independence of random variables, evaluation of probabilities of various regions bounded by straight lines.	
	2.7 Expectation of function of r.v., means, variances, covariance, correlation coefficient, conditional expectation, conditional variance, 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) $E[E(X/Y)] = E(X)$.	
	2.8 If X and Y are independent r.v. then proof of i) $E(XY) = E(X)E(Y)$, ii) $M_{X+Y}(t) = M_X(t) \cdot M_Y(t)$.	
	2.9 Transformation of continuous bivariate random variables: Distribution of bivariate random variables using Jacobin method and examples	

Reference Books:

1. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
2. K.C. Bhuyan: Probability distribution Theory and Statistical Inference, New Central book agency.
3. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II, World Press, Calcutta.
4. Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
5. 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)
6. Parimal Mukhopadhyay: An Introduction to the Theory of Probability, World Scientific Publishing.
7. V. K. Rohatgi, A.K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics, Wiley series in probability and Statistics second edition.
8. Walpole R.E. & Mayer R.H.: Probability & Statistics.

B. Sc. Part – II Semester -III STATISTICS
DSC-VI: DSC03STA32: Statistical Methods

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes - At the end of this course students will be able to:

CO1: Understand the concept of multiple linear regression and residual.

CO2: Understand the concept of multiple correlation and partial correlation.

CO3: Compute simple, weighted index numbers and cost of living index number.

CO4: Apply various methods to remove trend.

Unit	Contents	Hours Allotted
1	**Multiple linear Regression, Multiple and Partial Correlation (for trivariate data only):** **Multiple Linear Regression (for trivariate data only):** **1.1** Concept of multiple linear regression, plane of regression, Yule's notation, correlation matrix. **1.2** Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation. **1.3** Residual: definition, order of residual, properties, derivation of mean, Variance and Covariance between residuals. **Multiple and Partial Correlation:** **1.4** Concept of multiple correlations. **1.5** Definition of multiple correlation coefficient $R_{i.jk}$ and its derivation **1.6** Properties of multiple correlation coefficient, Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$, **1.7** Coefficient of multiple determination $R^2_{i.jk}$. **1.8** Concept of partial correlation, Definition and derivation of partial correlation coefficient $r_{ij.k}$, properties of partial correlation coefficient and examples.	15
2	**Index Number & Time Series** **Index Numbers:** **2.1** Meaning and utility of index numbers, problems in construction of index numbers. **2.2** Types of index numbers: price, quantity and value. **2.3** Unweighted and weighted index numbers using (i)aggregate method, (ii) average of price or quantity relative method (A.M. or G.M. is to be used as an average) **2.4** Index numbers using; Laspeyre's, Paasche's and Fisher's formulae. **2.5** Properties of Fishers index number. **2.6** Tests of index numbers: unit test, time reversal test, factor reversal test. **2.7** Cost of living index number: definition, construction by using (i) Family Budget method (ii) Aggregate expenditure method. **2.8** Shifting of base, splicing and purchasing power of money. **Time Series:** **2.9** Meaning and need of time series analysis, components of time series. **2.10** Additive and Multiplicative model **2.11** Measurement of trend: (i) Moving averages method (ii) Progressive average method (iii) Least square method.	15

Reference Books:

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

2. S. C. Gupta: Fundamentals of Statistics, Himalaya Publishing House, seventh revised & enlarged edition.

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

4. Parimal Mukhopadhyay: An Introduction to the Theory of Probability, World Scientific Publishing.

B. Sc. Part – II Semester -III STATISTICS
DSC-PR-III: DSC03STA39: DSC Statistics Practical III   (Credits: 02)

Course Outcomes - At the end of this course students will be able to:

CO1: Compute probabilities of standard probability distributions, expected frequencies and test the goodness of fit.

CO2: Understand generation of random samples from standard probability distributions.

CO3: Understand the applications and sketch of various discrete and continuous distributions

CO4: Solve the real life problems based on Multiple Regression, Multiple & Partial Correlation, Index Number and Time Series.

Sr. No.	Title of the Experiment
1	Fitting of discrete uniform and binomial distribution
2	Fitting of Poisson and Hypergeometric distribution
3	Fitting of Geometric distribution.
4	Fitting of Negative Binomial distribution.
5	Model sampling from discrete uniform and binomial distribution.
6	Model sampling from Poisson and Hypergeometric distribution
7	Model sampling from Geometric distribution.
8	Model sampling from Negative Binomial distribution.
9	Application of Geometric distribution
10	Application of Negative binomial distribution
11	Application of multinomial distribution
12	Continuous Univariate random variable (Problems: probabilities, pdf cdf, mean, median, mode)
13	Continuous bivariate random variable variable (Problems: probabilities, pdf cdf, mean, median, mode)
14	Multiple Regression (For trivariate data)
15	Multiple and Partial Correlation (For trivariate data)
16	Index Numbers-I (computations of index numbers)
17	Index Numbers-II (tests of adequacy, Shifting of base, cost of living index number.)
18	Time Series
19	Fitting of straight lines, second degree curves
20	Fitting of exponential and power curves

B. Sc. Part – II Semester -IV STATISTICS
DSC-VII: DSC03STA41: Probability Distributions-II

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1: Understand various continuous probability distributions.

CO2: Understand applications of various continuous probability distributions in different fields.

CO3: Compute descriptive statistics, moments, skewness, kurtosis, m. g. f. for continuous distributions.

CO4: Understand the relation between various probability distributions.

Unit	Contents	Hours Allotted
1	**Uniform, Normal, Exponential distribution:** **1.1 Uniform distribution:** p.d.f., nature of curve, c.d.f., m.g.f., mean, variance, moments. 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. and examples. **1.2 Normal distribution**: p.d.f, properties of normal curve, nature of curve, m.g.f., mean, variance, median, mode, mean deviation about mean, moments, cumulants, measures of skewness and kurtosis, Additive property, Definition of standard normal distribution, distribution of linear combination of independent normal variates and examples. **1.3 Exponential distribution:** p.d.f with rate parameter θ, nature of curve, c.d.f., mean, variance, m.g.f., C.V., moments, Cumulants, median, quartiles, lack of memory property, Additive property, distribution of $-(1/\theta) \log(X)$, where $X \sim U(0, 1)$ and examples.	12
2	**Gamma Distribution, Beta distributions and Exact Sampling Distributions:** **2.1 Gamma distribution:** p.d.f. with rate parameter θ and shape parameter n, special case ($\theta = 1$, n =1), m.g.f., mean, variance, mode, moments, cumulants, skewness and kurtosis, additive property, distribution of sum of i.i.d. exponential variates, distribution of X^2 if $X \sim N(0, 1)$ and examples. **2.2 Beta distribution of first kind:** p.d.f. with parameters m and n, mean, variance, H.M., mode, distribution is symmetric when m = n, Uniform distribution as a particular case when m = n = 1, distribution of (1-X) and examples. **2.3 Beta distribution of second kind:** p.d.f. with parameters m and n. mean, variance, H.M., mode, relation between beta distribution of first kind and second kind, distribution of X+Y, X/Y and X/(X+Y) where X and Y are independent gamma variates and examples. **2.4 Chi-Square distribution:** Definition, p.d.f. of chi square distribution with n degrees of freedom, nature of curve, mean,	18

	variance, moments, m.g.f., mode, skewness and kurtosis, additive property and examples.	
	2.5 Student's t- distribution: Definition, p.d.f. with n degrees of freedom, nature of curve, mean, variance, mode, moments, skewness and kurtosis and examples.	
	2.6 Snedecor's F distribution: Definition, p.d.f., nature of curve, mean, variance, mode, reciprocal property, interrelation between t, F and χ^2 variates (without proof) and examples.	

Reference Books:

1. Parimal Mukhopadhyay: An Introduction to the Theory of Probability, World Scientific Publishing.
2. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & sons, New Delhi, Twelfths edition.
3. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
4. 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)

DSC-VIII: DSC03STA42: Testing of Hypothesis & National Income

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1. Understand the basic concepts of testing of hypothesis.

CO2. Distinguish between large and small sample tests.

CO3. Apply small and large sample tests in real life examples.

CO4. Understand the concept of National income.

Unit	Contents	Hours Allotted
1	**1.1 Testing of Hypothesis:** Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistic, hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, One and two tailed test, Critical region, type I and type II errors, level of significance, p-value, power of test. **1.2 Large Sample Tests:** i) General procedure of testing of hypothesis ii) Test for means: Testing population mean H_0: $\mu=\mu_0$ and testing equality of two population means H_0:$\mu_1 = \mu_2$. iii)Test for proportion: Testing population proportion H_0: $P=P_0$ and testing equality of two population proportions H_0:$P_1 = P_2$. iv)Test population correlation coefficient H_0: $\rho=\rho_0$ and testing equality of two population correlation coefficients $H0$:$\rho_1 = \rho_2$ by Fisher's Z transformation. **1.3 Small Sample Tests:** i) Definition of student's t variate, t test for (a) testing population mean $H0$: $\mu=\mu_0$ and testing equality of two population means H_0:$\mu_1=\mu_2$, (b) paired t test, (c) test for population correlation coefficient H_0: $\rho=\rho_0$. ii)Chi square tests: (a)Testing population variance H_0: $\sigma^2 = \sigma_0^2$ (b)Test for goodness of fit. (c)Test for independent of attributes: i) m×n contingency table ii)2×2 contingency table iii) Yate's correction for continuity iii) F test for testing equality of two population variances H_0: $\sigma_1^2 =\sigma_2^2$	15
2	**National Income** i) Definitions of national income by (a) Marshall, (b) Pigou and (c) Fisher. ii) Different concept of national income (a) gross national product (GNP), (b) net national product (NNP). iii) Personal income, disposable income, per capita income, gross domestic product (GDP), national income at market price, national income at factor cost, national income at current prices, national	15

	income at constant prices. iv) Methods of estimation of national income and the difficulties in methods. (a) output method, (b) income method, (c) expenditure method. v) Importance of national income.	

Reference Books:

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

2. E.L. Lehmann, Joseph P. Romano: Testing Statistical Hypothesis

3. Scott Hartshorn: Hypothesis Testing

4. M. K. Jhingan: Macro Economic Theory: Vrinda Publications Pvt. Ltd. New Delhi

5. R. D. Gupta: Keynes Post – Keynesian Economics: Kalyani Publishers, New Delhi.

6. M. L. Sheth: Macro Economics: Lakshmi-Narayan Agarwal education publishers, Agra

7. H. L. Ahuja: Modern Economics: S. Chand publishers, New Delhi.

B. Sc. Part – II Semester -IV STATISTICS

DSC-PR-IV: DSC03STA49: DSC Statistics Practical IV (Credits: 02)

Course Outcomes - At the end of this course students will be able to:
CO1: Understand fitting of various continuous distributions.
CO2: Understand model sampling from various continuous distributions.
CO3: Apply large and small sample tests to real life problems.
CO4: Compute National income by using different methods.

Sr. No.	Title of the Experiment
1	Fitting of continuous uniform distribution
2	Fitting of exponential distribution
3	Fitting of Normal distribution
4	Model sampling from continuous uniform distribution.
5	Model sampling exponential distribution.
6	Model sampling from normal distribution using: (i) Normal table and (ii) Box-Muller transformation
7	Applications of Exponential distribution
8	Applications of Normal distribution
9	Computation of Size and Power of test
10	Large sample tests for means.
11	Large sample tests for proportions.
12	Tests for population correlation coefficients. (Using Fisher's Z transformation.)
13	Tests based on Chi square distribution. (Test for population variance, Test for goodness of fit)
14	Tests based on Chi square distribution. (Tests for independence)
15	Tests based on t distribution (Mean and equality of means)
16	Tests based on t distribution (Paired t test & correlation coefficient)
17	Tests based on F distribution
18	National Income I
19	National Income II
20	Sketch of pdf and cdf of continuous distribution using Ms-Excel

MIN-V: MIN03STA31: Predictive Modelling

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1: Understand the concept of multiple linear regression, multiple & partial correlation & logistic regression.

CO2: Understand and apply multiple regression models & multiple & partial correlation in real life situations.

CO3: Understand concept of time series and its components.

CO4: Learn methods of determination of trend.

Unit	Contents	Hours Allotted
1	**Multiple Linear Regression (for trivariate data only):** **1.1** Concept of multiple linear regression, plane of regression, Yule's notation, correlation matrix. **1.2** Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation. **1.3** Residual: definition, order of residual, Mean & properties. **1.4** Illustrative examples. **Multiple and Partial Correlation:** **1.5** Concept of multiple correlations. **1.6** Definition of multiple correlation coefficient $R_{i.jk}$, Properties of multiple correlation coefficient, Interpretation of $R_{i.jk} = 1$, $R_{i.jk} = 0$ **1.7** Coefficient of multiple determination $R^2_{i.jk}$. **1.8** Concept of partial correlation, Definition of partial correlation coefficient $r_{ij.k}$ & its properties. **1.9** Illustrative examples. **Logistic Regression:** **1.10** Introduction to logistic regression, Difference between linear and logistic regression, Logistic equation, Odds ratio in logistic regression. **1.11** Method of selection of false ratio, interpretation, variable selection method.	20
2	**Introduction of Time Series Analysis:** **2.1** Introduction to Time Series, Definition and uses of time series, Components of time series, Additive and Multiplicative model. **2.2** Methods of determination of trend: Moving Average, Progressive Average, Least Square method. **2.3** Determination of seasonal variation: Simple average method. **2.4** Moving Average Model MA(1) **2.5** Autoregressive Model AR(1)	10

Reference Books:
1. D.C. Montgomery: Introduction to linear regression analysis.
2. D.C. Montgomery: Introduction to Time series analysis and forecasting
3. Gupta S. C. & Kapoor V.K.: Fundamentals of Applied Statistics, Sultan Chand & sons, New Delhi, Twelfths edition.
4. L. Pardoe: Applied Regression modelling.
5. Chatterjee: Handbook of regression analysis.
6. Jimfrost, MS: Regression Analysis.
7. Montogomery: Introduction to time series analysis and forecasting

MIN-VI: MIN03STA32: Hypothesis Testing

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:
CO1. Understand concept of testing of hypothesis.
CO2: Develop test procedures for testing of hypothesis.
CO3. Apply large sample tests in real life examples.
CO4: Implement appropriate small sample tests for real life testing of hypothesis problems.

Unit	Contents	Hours Allotted
1	**Large Sample Tests:** **1.1** Concept of normal distribution and its properties. **1.2** Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistic, hypothesis, Simple and composite hypothesis, Null and alternative hypothesis, One and two tailed test, Critical region, type I and type II errors, level of significance, p value, power of test. i) General procedure of testing of hypothesis. ii)Test for means: Testing population mean H_0: $\mu=\mu_0$ and testing equality of two population means H_0: $\mu_1 = \mu_2$. iii)Test for proportion: Testing population proportion H_0: $P=P_0$ and testing equality of two population proportions H_0:$P_1 = P_2$. iv)Testing population correlation coefficient H_0: $\rho=\rho_0$ and testing equality of two population correlation coefficients $H0$: $\rho_1 = \rho_2$ by Fisher's Z transformation.	15
2	**Small Sample Tests:** **2.1 Test based on t distribution:** i)Definition of student's t variate, Sketch of student t distribution ii)t test for testing H_0: $\mu=\mu_0$, H_0: $\mu_1 = \mu_2$, paired t test. **2.2 Test based on Chi square distribution:** i)Definition of Chi square variate, Sketch of chi square distribution. ii)Test for population variance H_0: $\sigma^2 = \sigma_0^2$. iii)Test for goodness of fit. iv)Test for independent of attributes: a) m×n contingency table b) 2×2 contingency table c) Yate's correction for continuity **2.3 Test based on F distribution:** i)Definition of Snedecor's F variate, Sketch of F distribution. ii)F test for testing equality of two population variances H_0: $\sigma_1^2 =\sigma_2^2$	15

Reference Books:

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

2. Kulkarni, M. B. Ghatpande, S. B. and Gore, S. D.: "Common Statistical Tests", Satyajeet Prakashan, Pune – 11029.

3. Rohatgi V. K.: Statistical Inference.

4. Rohatgi V. K.: An Introduction to Probability Theory and Mathematical Statistics.

5. Gupta, S. P.: "Statistical Methods", Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.

6. Mukhopadhyay Parimal: "Mathematical Statistics", New Central Book Agency, Pvt. Ltd. Calcutta.

B. Sc. Part – II Semester -III STATISTICS
MIN-PR-III: DSC03STA39: DSC Statistics Practical III

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1: Understand and apply multiple regression models, multiple & partial correlation & logistic regression in real life situations.

CO2: Apply various methods of estimation of trend and seasonality.

CO3. Apply large sample tests in real life examples.

CO4: Implement appropriate small sample tests for real life testing of hypothesis problems.

Sr. No.	Title of Practical
1	Multiple Linear Regression
2	Multiple & Partial Correlation
3	Logistic regression
4	Estimation of trend
5	Estimation of seasonality
6	Large sample test for means.
7	Large sample test for Proportions.
8	Tests for population correlation coefficients. (Using Fisher's Z transformation)
9	Tests based on Chi square distribution-I
10	Tests based on Chi square distribution-II
11	Tests based on t distribution ($\mu = \mu_0$, $\mu_1 = \mu_2$, paired t test)
12	Tests based on F distribution ($\sigma_1^2 = \sigma_2^2$)

B. Sc. Part – II Semester -IV STATISTICS
MIN-VII: MIN03STA41: Applied Statistics

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1: Compute simple and weighted Index numbers.

CO2: Understand the use of index number and concept of cost of living.

CO3: Understand meaning and purpose of statistical quality control.

CO4: Construct various types of control charts for quality control problems.

Unit	Contents	Hours Allotted
1	**Index Numbers:** **1.1** Meaning and utility of index numbers, problems in construction of index numbers. **1.2** Types of index numbers: price, quantity and value. **1.3** Unweighted and weighted index numbers using (i)aggregate method, (ii) average of price or quantity relative method (A.M. or G.M. is to be used as an average) **1.4** Index numbers using Laspeyre's, Paasche's and Fisher's formula. **1.5** Properties of Fisher's index number. **1.6** Tests of index number: unit test, time reversal test, factor reversal test. **1.7** Cost of living index number: Definition, Construction by using (i) Family Budget method (ii) Aggregate expenditure method. **1.8** Shifting of base, splicing and purchasing power of money.	15
2	**Statistical Quality Control:** **2.1** Meaning and purpose of S.Q.C., Process control, Product control, chance causes, assignable causes, Seven SPC tools, Shewhart's control chart: construction &working, lack of control situation. **2.2** Control charts for variables (Statement only): control chart for mean, control chart for range, construction and working of mean & range charts for unknown standards. **2.3** Control charts for Attributes: Defects, defectives, fraction defective, control chart for fraction defective (p-chart) for fixed sample size and unknown standards, construction and working, Control charts for number of defects (C-chart) for unknown standards, construction and working	15

Reference Books:

1. Gupta V.K. & Kapoor S.C.: Fundamentals of Applied Statistics, Sultan &Chand

2. S. C. Gupta: Fundamentals of Statistics, Himalaya Publishing House, seventh revised & enlarged edition.

3. Introduction to quality Control: Montgomery D. C.

4. Quality Control and Industrial statistics: Duncan A J

5. Index Number: Walter A. Shewhart

B. Sc. Part – II Semester -IV STATISTICS

MIN-VIII: MIN03STA42: Sampling Techniques

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of the course students will be able to:

CO1: Understand basic concepts of sample survey.
CO2: Understand and use probability sampling methods.
CO3: Find appropriate sample size in various methods.
CO4: Apply various sampling methods to real life problems.

Unit	Contents	Hours Allotted
1	**Sampling Survey:** **1.1** Population, Sample, Sampling unit, Sampling frame, Sampling method, Census method. **1.2** Advantages and disadvantages of sampling methods. **1.3** Principles of sampling survey, Principal steps in sample survey. **1.4** Designing a questionnaire, Characteristics of good Questionnaire. **1.5** Sampling and non-sampling errors. **1.6** Determination of sample size: Cochran's & Sterling's formula.	12
2	**Methods of Sampling:** **2.1 Probability Sampling:** a) SRS: Simple random sampling from finite population of size N with replacement (SRSWR) and without replacement (SRSWOR): Definitions, population mean and population total as parameters. Following results with proof. i. In SRSWOR, the probability of a specified unit being selected in sample at any given draw is equal to 1/N. ii. In SRSWOR, the probability of a specific unit included in the sample is n/N. iii. In SRSWOR, the probability of drawing a sample of size 'n' from a population of size N units is $\frac{1}{\binom{N}{n}}$ iv. In SRSWR, the probability of a specific unit included in the sample is $(1 - \frac{1}{N})^n$ v. In SRSWR, the probability of drawing a sample of size 'n' from a population of size N units is $\frac{1}{N^n}$ b) statement of unbiased estimator of population means and its variance under SRSWR & SRSWOR **2.2 Stratified random sampling:** Definition, Mean and Variance, sample size determination of ith stratum under equal allocation, proportional allocation and optimum allocation and its variance. **2.3 Non-Probability Sampling:**	18

| | Judgment sampling, Sequential sampling, Quota sampling, Snowball sampling, Purposive sampling, Convenience Sampling

2.4 Mixture of Probability Sampling:
   Systematic sampling and Cluster Sampling: Concept, Mean and Variance | |

Reference Books:

1. Gupta V.K. & Kapoor S.C.: Fundamentals of Applied Statistics- Sultan &Chand
2. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
3. W. G. Cochran- Sampling Techniques, Wiley Publication third edition.
4. Sukhatme P.V. and Sukhatme, B.V.: Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
5. Des Raj: Sampling Theory.
6. Daroga Singh and Choudhary F.S.: Theory and Analysis of Sample Survey Designs, Wiley Eastern Ltd., New Delhi.
7. Murthy, M.N: Sampling Methods, Indian Statistical Institute, Kolkata.
8. Mukhopadhyay Parimal: Theory and Methods of Survey Sampling, Prentice Hall.

B. Sc. Part – II Semester -IV STATISTICS
MIN-PR-IV: MIN03STA49: MIN Statistics Practical IV (Credits: 02)

Course Outcomes - At the end of this course students will be able to:
CO1: Compute different simple and weighted index number.
CO2: Construct various control charts for variables and attributes.
CO3: Understand basic concepts of sample survey.
CO4: Apply different methods of sampling in real life.

Sr. No.	Title of Practical
1	Index Numbers-Average relative method & Aggregate method
2	Index Number- Laspeyre's, Paasche's & Fisher's Formulae
3	Index Numbers-Tests of adequacy, cost of living index number, Shifting of base and splicing
4	Construction of R and $\bar{X}$ charts.
5	Construction of P and C charts.
6	Determination of Sample Size.
7	Simple Random Sampling (SRSWR & SRSWOR).
8	Stratified Random Sampling.

Case study (05 Marks): Selection of problem, Formulation of questionnaire, Appropriate method of sampling, Determination of sample size, Selection of sample.

B. Sc. Part – II Semester -III STATISTICS
VSC PR-II (VSC03STA39) (Credit 02)
Course Title: Statistical Computing Using MS-Excel

Course Outcomes - At the end of this course, students will be able to:
CO1: Understand basic knowledge of MS-Excel.
CO2: Edit data using conditional formatting.
CO3: Understand the use of functions & formulae on Excel spreadsheet & analyse the
data using pivot table & pivot charts.
CO4: Understand the use of functions of Excel for fitting of discrete distributions.

Unit	Contents
1	**1.1** Review of introduction to Ms excel, data analysis tool pack. **1.2 Functions** -Count if, sum if average if, average ifs, if error. **1.3 Conditional formatting:** Apply Advanced Conditional Formatting and Filtering: - Create custom conditional formatting rules, create conditional formatting rules that use formulas, Manage conditional formatting rules. **1.4 Time series** –Linear forecasting, Exponential smoothing forecasting. **1.5 Pivot Table and Pivot charts** -. Create PivotTables, modify field selections and options, create slicers, Group PivotTable data, add calculated fields, Format data Create and Manage, Pivot Charts: - Create Pivot Charts, manipulate options in existing Pivot Charts, apply styles to Pivot Charts, Drill down into PivotChart details.
2	**2.1 Fitting and Model Sampling of given distribution By Using Ms Excel:** Discrete uniform distribution, binomial distribution, hypergeometric distribution, Poisson distribution, Geometric distribution and Negative binomial distribution, Exponential distribution, Normal distribution.

B. Sc. Part – II Semester -III STATISTICS
VSC PR- II (VSC03STA39) (Credit 02)
Course Title: Statistical Computing Using MS-Excel

Sr. No.	Title of the Experiment
1.	Data Formats and Validation and Pivot table
2.	Fitting of Discrete uniform and Binomial distribution.
3.	Fitting of Hypergeometric and Poisson distribution.
4.	Fitting of Geometric and Negative Binomial distribution.
5.	Fitting of Exponential and Normal distribution.
6.	Model Sampling from Discrete uniform and Binomial distribution.
7.	Model Sampling from Hypergeometric and Poisson distribution.
8.	Model Sampling from Geometric and Negative Binomial distribution.
9.	Model Sampling from Exponential and Normal distribution.
10.	Sketching of p.m.f. and c.d.f. for discrete distributions in MS-EXCEL.

Reference Books:
1. M.L. Humphrey Excel for Beginners
2. Paul McFedries Microsoft Excel 2019 Formulas and Functions.
3. Joseph Schmuller Statistical Analysis with Excel.
4. Jordan Goldmiere Advanced Excel Essentials
5. Alan Murray- Advanced Excel success
6. Greg Harvey Excel 2019 dummies.

B. Sc. Part – II Semester -III STATISTICS
VSC-PR-III(VSC03STA49) (Credit 02)
Course Title: Introduction to R

Theory: 30 hrs.   **Marks-50**   **(Credits: 02)**

Course Outcomes: At the end of this course students will be able to:
CO1: Understand basics of R programming.
CO2: Know various built-in functions in R.
CO3: Evaluate various descriptive statistics measures using R.
CO4: Apply different parametric tests using R.

Unit	Contents	Hours Allotted
1	**1.1**Installation and introduction to R, History, Character sets. **1.2Data Input/ Output:** **a) Creation of vector using commands:** Combine (c), scan, cbind, rbind, seq, rep, edit, sort, length, which, order. **b) Creation of data frame using commands:** data.frame, dimension of data frame, extraction of elements of data frame, rbind, cbind functions, rowSums, colSums, rowMeans, colMeans, subset, attach, detach, apply functions. **1.3Object identification:** is.na, is.numeric, is.character, is.matrix, is.vector, is.null, is.factor, as. functions. **1.4Matrix manipulation**: Creation of Matrix, Transpose, Addition, Subtraction, Multiplication, Determinant, Inverse of matrix, Rank of matrix, Diagonal matrix, Zero matrix, Common matrix. **1.5Import and export data:** read.table, read.csv, file.choose, write.table, write.csv. **1.6Operators**: Arithmetic, Relational, Logical, Assignment and Special operators	10
2	**2.1Basic built-in function**: Math function, character function, statistical probability, other statistical function. **2.2Diagrammatic representation of data**: simple bar diagram, Sub – divided simple bar diagram, pie diagram. **2.3Graphical representation of data**: Histogram, frequency polygon, Ogive curves, Scatter Plot, Boxplot. **2.4Exploratory data analysis:** Descriptive statistics, p.d.f, c.d.f, Random number generation, Correlation, Regression. **2.5Testing of Hypothesis**: z.test, prop.test, t.test, var.test, cor.test, chisq.test.	10

Sr. No.	Title of Practical
1	Data Input-Output
2	Matrix manipulation & Operators
3	Graphical Representation
4	Diagrammatic Representation
5	Descriptive Statistics
6	Parametric tests
7	Fitting of discrete distribution
8	Model sampling from discrete distribution
9	Fitting of continuous distribution
10	Model sampling from continuous distribution

Remark: In fitting and model sampling from distributions, cover all the distributions which are learnt in theory syllabus up to SEM IV.

Reference Books:

1. Crawley, M. J. (2006): Statistics - An introduction using R. John Wiley, London 32
2. Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015): Statistics using R, second edition. Narosa Publishing House, New Delhi.
3. Verzani, J. (2005): Using R for Introductory Statistics, Chapman and Hall /CRC Press, New York

Assessment Structure

Structure of Question Paper

Nature of Theory Question Paper

Instructions:

1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Use of scientific calculator is allowed.

Time: 2-hour   **Total Marks: 40**

Question Number	Marks
Q.1. Choose correct alternative.	(8x1=8)
Q.2 Attempt any two. i) ii) iii)	(8x2=16)
Q.3. Attempt any four. a) b) c) d) e) f)	(4x4=16)

Internal Evaluation

Semester	Evaluation	Marks
III/IV	1. Unit test 2. Multiple choice questions/Assignment	10 10

Nature of practical papers:

1. Practical examination is of 25 marks.
2. Each practical question paper must contain three questions each carry 10 marks.
3. Each question should contain two bits from different units.
4. Student should attempt any two questions.
5. Complete and certified journal is of 3 marks and oral will be of 2 marks.

Evaluation Pattern for practical Course:

Marks Distribution of Practical (LAB) course

Course	Experimental work	Journal assessment	Seminar/ Mini Project	Total Marks
Major	45	05	-	50
Minor / VSC	20	05	-	25