

B.Sc. (STATISTICS)

DETAILED FRAME WORK

&

SYLLABUS

(For candidates admitted from 2013 –14 onwards)

(CBCS Pattern)

**B.SC STATISTICS (CBCS – Pattern)
CURRICULUM FRAME WORK**

S.No	SEM	Study Component	Title of the paper	Lecturer		Max.Mark			Credit
				Theory	Practical	In	Ex	Total	
1	I	Language	Language – Paper I	6	-	25	75	100	3
2		English	English – Paper I	6	-	25	75	100	3
3		Core I	Descriptive Statistics	4	-	15	60	75	3
4		Core II	Probability and Random Variables	4	-	15	60	75	3
		Core	Core Practical - I	-	3	-	-	-	-
5		Allied	Mathematics -I	6	-	25	75	100	5
		Soft Skill - I	*****						3
		NME- I	*****	2(1+1)					2
Total								450	22
6	II	Language	Language – Paper II	6	-	25	75	100	3
7		English	English – Paper II	6	-	25	75	100	3
8		Core III	Distribution Theory - I	4	-	15	60	75	3
9		Core IV	Matrix Algebra	4	-	15	60	75	3
		Core	Core Practical - I	-	3	20	30	50	2
10		Allied	Mathematics -II	6	-	25	75	100	5
		Soft Skill - II	*****						3
		NME- II	*****	2(1+1)					2
Total								500	24
11	III	Language	Language – Paper III	6	-	25	75	100	3
12		English	English – Paper III	6	-	25	75	100	3
13		Core V	Distribution Theory - II	4	-	15	60	75	3
14		Core VI	Demography	4	-	15	60	75	3
		Core	Core Practical - II	-	3	-	-	-	-
15		Allied	Programming In C++	4	2	15	60	75	4
			EVS	2(1+1)					2
Total								425	18
16	IV	Language	Language – Paper IV	6	-	25	75	100	3
17		English	English – Paper IV	6	-	25	75	100	3
18		Core VII	Statistical Inference - I	4	-	15	60	75	3
19		Core V III	Operations Research - I	4	-	15	60	75	3
		Core	Core Practical - II	-	3	20	30	50	2
20		Allied	Numerical Methods	4	-	15	60	75	4
		Allied	Allied Practical		2	20	30	50	2
		Soft Skill - III	Personality Enrichment	2(1+1)					3
Total								525	23

S.No	SEM	Study Component	Title of the paper	Lecturer		Max.Mark			Credit
				Theory	Practical	In	Ex	Total	
21	V	Core IX	Statistical Inference - II	5	-	15	60	75	3
22		Core X	Design of Experiments	5	-	15	60	75	3
23		Core XI	Applied Statistics	5	-	15	60	75	3
24		Core XII	Operations Research -II	6	-	15	60	75	3
25		Core Elective I	Data Analysis using R	1	4	40	60	100	5
		Core	Core Practical - III (Calculator Based)	-	4	40	60	100	4
		Soft Skill - IV	Computing Skill						3
Total								500	24
26	VI	Core - XIII	Sampling Techniques	4	-	15	60	75	3
27		Core -XIV	SQC & Reliability	4	-	15	60	75	3
28		Core - XV	Regression Analysis	4	-	15	60	75	3
29		Core -XVI	Stochastic Processes	5	-	15	60	75	3
30		Core Elective II	Data Analysis using SPSS	5	-	40	60	100	5
31		Core Elective III/ Project	Actuarial Statistics	5	-	25	75	100	5
		Core	Core Practical IV (Calculator Based)	-	4	40	60	100	4
		Value addition course	*****						2
Total								600	28

TOTAL NUMBER OF PAPERS:

Papers	Marks
LANGUAGES	400
ENGLISH	400
ALLIED	400
CORE ELECTIVE	300
CORE (THEORY + PRACTICAL)	1500
Total	3000

CORE PAPER I
DESCRIPTIVE STATISTICS

Credits: 3

(4 hrs/week)

Objective: To introduce basic statistical concepts.

UNIT 1:

Definition- scope of statistical methods and their limitations - Collection of data -Primary and secondary sources - nominal, ordinal, ratio and interval scale.

UNIT 2:

Classification and Tabulation – Diagrammatic and graphical representation - Bar diagrams – Pie diagram – Histogram – Ogives, Lorenz curves.

UNIT 3:

Measures of location, dispersion, moments and measure of skewness and kurtosis for both grouped and ungrouped data.

UNIT 4:

Simple correlation and regression : Introduction – Scatter diagram – Karl Pearson’s coefficient of correlation – Properties of correlation coefficients - Spearman’s rank correlation – Simple regression – Properties of regression coefficients

UNIT 5:

Fundamental set of frequencies, consistency of data, conditions for consistency, contingency table, association of attributes - measures of associations – Yule’s coefficient of association – coefficient of colligation.

Note: Simple numerical problems from Units 3, 4 & 5 may be asked in sections A & B only.

BOOKS FOR STUDY:

1. Freund, J.E. (2002): Mathematical Statistics with applications, Pearson Education.
2. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.
3. Gupta, S.P.(2005): Statistical Methods, Sultan Chand & Sons Pvt. Ltd. New Delhi.
4. Pillai, R.S.N and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd. New Delhi.
5. Sharma, J.K. (2009): Business Statistics , 2nd edition, Pearson Education.

BOOKS FOR REFERENCE:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1991): Fundamentals of Statistics - Volume 1, World press, Calcutta.
2. Kapoor, J.N. and Saxena, H.C. (2002): Mathematical Statistics, S. Chand & Sons Pvt. Ltd., New Delhi.

CORE PAPER II
PROBABILITY AND RANDOM VARIABLES

Credits: 3

(4 hrs/week)

Objective: To introduce the basic concepts in probability.

UNIT 1:

Random experiment, sample point, sample space, Classical and relative frequency approach to probability, Axiomatic approach to probability. Addition theorem of probability – simple problems. Boole's inequality.

UNIT 2:

Conditional probability, independence of events, multiplication theorem. Baye's theorem and its applications - simple problems.

UNIT 3:

Random variable - discrete and continuous, distribution functions, probability mass function, probability density function and their properties. Joint – marginal and conditional distributions - conditional expectation - conditional variance - stochastic independence - correlation coefficient- simple problems

UNIT 4:

Mathematical Expectation - addition theorem and multiplication theorem - Properties of expectation - Variance of a random variable and its properties. Measures of location, dispersion, skewness and kurtosis for discrete and continuous variables. Chebychev's inequality-simple problems

UNIT 5:

Moment generating function, characteristic function, Cumulant generating function – their properties – simple problems. Statement of uniqueness theorem - Definition of convergence in probability, convergence in distribution, and Weak Law of Large Numbers – Statement and meaning of Central Limit theorem.

BOOKS FOR STUDY:

1. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
3. Mood, A.M., Graybill, F.A. and Boes, D.C. (1974): Introduction to theory of Statistics, McGraw Hill.
4. Parson, Modern Probability Theory

BOOKS FOR REFERENCE:

1. Rohatgi, V.K. and Saleh, A.K.Md.E. (2002): An introduction to probability and Statistics, John Wiley and Sons.
2. Sanjay Arora & Bansilal (1989): New Mathematical statistics, Meerat Publications, New Delhi.

**CORE PAPER III
DISTRIBUTION THEORY I**

Credits: 3

(4 hrs/week)

Objective: To introduce various probability distributions and their applications

UNIT 1:

Discrete Uniform distribution – mean – Variance – First Four Moment – M.G.F – P.G.F; Bernoulli distribution & Binomial distribution – Mean – Variance – Mode – M.G.F – P.G.F- CGF; Characteristic Function- Recurrence formula – additive property.

UNIT 2:

Poisson distribution – Mean – Variance – Mode – M.G.F – P.G.F- CGF; Characteristic function – Recurrence formula – Additive Property – approximation of Binomial distribution to Poisson.

UNIT 3:

Geometric Distribution – Mean – Variance – Recurrence Formula – Memory less property – M.G.F – P.G.F; Negative Binomial distribution – Mean – Variance – M.G.F – Recurrence Formula – P.G.F – Reproductive Property.

UNIT 4:

Hyper-geometric distribution – Mean – Variance – approximation to binomial distribution - Multinomial Distribution – M.G.F.- correlation.

UNIT 5:

Continuous Uniform - Mean – Variance – M.G.F – Characteristic function – Normal Distribution – Mean – Variance – First Four Moments – Mode – Skewness – Kurtosis – M.G.F – CGF-characteristic function – Linear Combination of Normal Variates – Reproductive Property.

BOOKS FOR STUDY :

1. Gupta, S.C. and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.
2. Sanjay Arora and Bansilal (1989): New mathematical Statistics, Meerat publications, Satya Prakashan, New Delhi.

BOOKS FOR REFERENCE :

1. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
2. Mood, A.M., Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of statistics, International student ed., McGraw Hill 4th edition, Academic Press.
3. Rohatgi, V.K. and Saleh, A.K. (2001): An introduction to probability and Statistics, John Wiley and Sons.

**CORE PAPER IV
MATRIX ALGEBRA**

Credits : 3

(4 hrs/week)

Objective: To acquaint students with some fundamental notions and techniques that are required for pursuing core areas of statistics.

UNIT 1(Matrix algebra):

Matrices – Operations on Matrices. Various types of Matrices. Trace of square matrix.

UNIT 2 (Inversion):

Singular & Non – singular Matrices. Inverse of a Matrix and its properties. Rank of a Matrix – Properties. Method of Matrix inversion.

UNIT 3 : (Linear Equations)

Linear Equations –Types- Non-homogeneous and homogeneous -consistency – solution by cramer’s rule and matrix method

UNIT 4 (Eigen values & vectors):

Characteristic equation, Eigen roots & vector – Properties. Cayley – Hamilton Theorem. Matrix inversion by CH Theorem.

UNIT 5 (Quadratic Forms):

Quadratic forms : Definition– Types – linear transformations-Reduction of QFs to canonical forms – Congruent and Lagrange reductions – Index and Signature of QFs.

Note: Simple numerical problems from all the units may be asked in sections A & B only.

BOOKS FOR STUDY :

1. Gupta, S. C (1978), An Introduction to Matrices, Sultan Chand and Sons, New Delhi.
2. Shanthi Naryanan (1993), A Text Book Matrices, Sultan and Chand and Sons, Delhi.
3. Vashishta Theory of Matrices

BOOKS FOR REFERENCE :

1. Aggarwal, R.S. (1987) : A text book on Matrices, 4th edition, S.Chand & Company (pvt) Ltd.
2. Hohn, F. E (1971), Elementary Matrix Algebra, Second Edition, Amerind Publishing Company, New Delhi.

**CORE PRACTICAL I
BASED ON CORE PAPERS – I & IV**

Credits: 2

(3 hrs/week)

Objective: To develop computing skills in solving statistical problems.

NOTE:

Internal Marks : 20 Marks,

External examination : 30 marks.

Candidates are to answer any three questions from five questions.

1. Construction of univariate and bivariate distributions with samples of size not exceeding 200.
2. Diagrammatic and graphical representation of data and frequency distribution.
3. Cumulative frequency distribution – Ogives – Lorenz curve.
4. Measure of location and dispersion. (Absolute and relative)
5. Curve fitting by the method of least squares.
(i) $y=ax + b$ (ii) $y=ax^2 + bx + c$ (iii) $y=ae^{bx}$
6. Computation of correlation coefficient and regression lines for raw and grouped data.
Rank correlation coefficient.
7. Construction of contingency table and testing the consistency of data.
8. Computation of various measures of associations of attributes.
9. Rank of a matrix of order $p \times q$ ($p, q < 4$).
10. Inverse of a non singular matrix – by
 - i. Sweepout method
 - ii. Cayley Hamilton theorem
11. Solution to system of linear equations.
12. Determination of characteristic roots and characteristic vectors of second and third order square matrices.

CORE PAPER V
DISTRIBUTION THEORY - II

Credits: 3

(4 hrs/week)

Objective: To introduce different continuous distributions and their applications.

UNIT 1:

Beta, Gamma, Cauchy, Exponential – Mean – Variance – M.G.F – distribution function – Properties (Both one & two Parameter).

UNIT 2:

Log normal, Pareto, Weibull, Laplace, Logistic distributions: Definition, Mean, variance, M.G.F – properties.

UNIT 3:

Sampling distributions – Sampling distributions of Chi-Square– derivation of its pdf, mgf – first four moments- properties – applications. Distribution of sample mean and variance from normal population.

UNIT 4:

Sampling distributions – Definition of t statistic - derivation of its pdf - first four moments – applications.

Definition of F statistic - derivation of its pdf – mean and variance – applications.
Inter relationship between t, F and Chi-square, Properties and applications.

UNIT 5:

Order statistics – distribution of first, n^{th} and i^{th} order statistics – joint distribution of r^{th} and s^{th} order statistics - distribution of median and range –simple problems.

BOOKS FOR STUDY :

1. Gupta,S.C.and Kapoor,V.K.(2002): Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.
2. Sanjay Arora and Bansilal (1989): New mathematical Statistics, Meerat Publications,Satya Prakashan , New Delhi.

BOOKS FOR REFERENCE :

1. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
2. Mood, A.M., Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of statistics, International student ed., McGraw Hill 4th edition, Academic Press.
3. Rohatgi, V.K. and Saleh, A.K.(2001): An introduction to probability and Statistics, John Wiley and Sons.

CORE PAPER VI DEMOGRAPHY

Credits: 3

(4 hrs/week)

Objective: To familiarize students about various demographic factors that contributes to population change and concepts of Vital statistics.

UNIT 1:

Demography: Definition and Meaning, Demographic determinants of population change: births, deaths, migrants, marriages – measures of population change: arithmetic, geometric and logistic measures – Age and sex structure - population pyramid –demographic cycle

Data Sources: Salient features - Census, Civil Registration System, Sample Registration system, National Family Health Survey – Errors in demographic data

UNIT 2:

Mortality: Need to study mortality - measures of mortality: Crude Death Rate, Age-specific Death Rate, Cause Specific Death Rate- Direct and Indirect Standardization of Rates - merits and demerits-Mortality at Birth - Infant Mortality Rate - Different approaches to estimating Infant Mortality Rate- neonatal mortality rate- perinatal mortality rate- Simple problems with these rates

UNIT 3:

Life Tables: Life Tables – Meaning, Significance, Structure and Components, Construction – relationships between the functions of a life table- force of mortality - central mortality rate-current and cohort life tables- structure and components of Abridged Life Tables

UNIT 4 :

Fertility and Reproduction: Need to study Fertility - Approaches to measure Fertility - Cohort Fertility and Period fertility, Crude Birth Rate, General Fertility Rate, Age Specific Fertility Rate, Total Fertility Rate

Fecundity: Meaning - Measures of Reproduction – Gross Reproduction Rate, Net Reproduction Rate - Simple problems with these rates.

UNIT 5:

Population estimation and projection: intercensal estimates, postcensal estimates and projection - mathematical method: Linear, exponential, logarithmic and logistic, Gompertz curves - component method

BOOKS FOR STUDY:

1. Gupta, S.C and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.
2. RamKumar, R. (1986): Technical Demography, Wiley Eastern Limited.
3. Pathak, K.B. and Ram, F. (1992): Techniques of Demographic Analysis, Himalaya publishing House
4. www.censusindia.gov.in and www.rchiips.org

BOOKS FOR REFERENCE:

1. Cox. P. (1959): Demography, Cambridge University Press.
2. Goon, A.M. Gupta, M.K. and Dasgupta, B. (1980): An outline of Statistical theory, Vol. II, 6th revised ed., World Press limited, Calcutta.
3. Shrivastava, O.S. (1995): Demography and Population Studies, Vikas Publishing society.

ALLIED II – PAPER I PROGRAMMING IN C++

Credits: 4

(4 hrs/week)

Objective: To impart programming skills using C++.

UNIT 1:

Object-Oriented programming – advantages of OOP over procedure oriented programming – OOP language. What is C++? – features and applications of C++ - Source code and object code – C++ compilers – Features of iostream.h – Comments – Input/Output using cin/cout, gets/puts , getchar/putchar and getc/putc.

UNIT2:

Character set – Tokens - Keywords – Variables (identifiers) - Declaration and initialization of variables – Reference variables – Constants (string, numeric, character and symbolic constants). Arithmetic operators – Relational operator – Logical operator – Assignment operator – Increment and decrement operators – mathematical functions.

UNIT3:

If statement – if...else statement – switch statement – while statement – do...while statement – for statement – break statement – continue statement – simple programs. Arrays – one dimensional array – Two dimensional arrays – strings – simple problems. Defining a function – Advantages of using a function – main function – return statement – Function overloading. Structures.

UNIT 4:

Class- General form of a class declaration – Creating objects – Accessing class members – Defining member functions outside/inside the class – Arrays within a class – Memory allocation for objects – Arrays of objects. Constructors and Destructors.

UNIT-5:

Operator Overloading and Type conversions .Inheritance - Single Inheritance - Multilevel Inheritance - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance.

NOTE: Students should be trained in writing Statistical Programs (mean , Median , variance , skewness , kurtosis , correlation , regression – only for Raw data .Matrix manipulation – addition, multiplication, trace and transpose). Programs can be asked in section C from the above list.

BOOKS FOR STUDY:

1. Balaguruswamy, E. (2001): Programming in C++ , Tata McGraw Hill Publishing Company Ltd. , NewDelhi.
2. Venugopal, K.R., Rajkumar Buyya and Ravishankar, T. (2006): Mastering C++, Tata McGraw Hill Publishing Company Ltd. , NewDelhi.

BOOK FOR REFERENCE:

1. Hubbard, J. (1996): Programming with C++ , Schaum's Outline series, McGraw Hill.

**CORE PAPER VII
STATISTICAL INFERENCE - I**

Credits: 3

(4 hrs/week)

Objective: To equip the students with various methods of estimation.

UNIT 1:

Point Estimation – Problem of Point Estimation – Properties of estimators – Consistency and Efficiency of an estimator. Sufficiency of a statistic – Neyman factorization theorem – simple problems.

UNIT 2:

Unbiasedness – Properties, MVUE, BLUE, Rao-Blackwell theorem – Sufficiency, Cramer Rao inequality - simple problems.

UNIT 3:

Methods of estimation: Method of moments, Method of Maximum Likelihood, Method of Minimum chi square, Method of modified minimum chi-square, Method of minimum variance – properties of estimators obtained by these methods - simple problems.

UNIT 4:

Interval Estimation – Confidence Interval for proportions, mean(s), variance and variance ratio based on chi square, student's t, F and Normal distributions.

UNIT 5:

Tests of significance: concepts, tests based on normal, t, F and Chi Square.

Note: No numerical problems should be asked from units 4 & 5.

BOOKS FOR STUDY:

1. Gupta, S.C. and Kapoor, V.K. (2002) . Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
3. Mood, A.M., Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of statistics, International student ed., McGraw Hill.

BOOKS FOR REFERENCE:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): An outline of Statistical theory, Volume I, 6th revised ed., World Press limited, Calcutta.
2. Rohatgi, V.K. and Saleh, A.K.Md.E.(2002): An Introduction to Probability and Statistics, Wiley Eastern.
3. Speigal, M.R.(1982): Theory and problems of probability and statistics, Schaum's outline series, McGraw Hill.

**CORE PAPER VIII
OPERATIONS RESEARCH - I**

Credits: 3

(4 hrs/week)

Objective: To equip the students with the knowledge of decision making.

UNIT 1:

Introduction to OR- Linear programming problem – Formulation of LPP – Solving the LPP by graphical method – Solving the LPP by simplex method (degeneracy), Big M - Simple problems.

UNIT 2:

Introduction- ingredients of decision making problem, process and environment, decision under certainty, decision under uncertainty –Maximin, Minimax criterion, Maximax, Minimin criterion, Laplace criterion and Horwicz criterion.

UNIT 3:

Decision under risk –Expected Monetary Value (EMV), Expected Opportunity Loss (EOL) and Expected value of Perfect Information (EVPI).

Decision tree analysis- steps in decision tree analysis – advantages- simple problems.

UNIT 4:

Game Theory – Two person zero sum games, the maximin & minimax principle, Mixed strategies, Graphical solution of $2 \times n$ and $n \times 2$ games, Dominance property.

UNIT 5:

Sequencing Problem –Introduction - ‘n’ jobs through 2 machines, ‘n’ jobs through 3 machines, ‘n’ jobs on m machines, two jobs on ‘m’ machines.

Note: Question paper can have 60% numerical problems and 40% theory questions.

BOOKS FOR STUDY:

1. Sharma, J.K. (2009). Business Statistics, second edition , Pearson Education.
2. Kanthi Swarup, Gupta, P.K. and Manmohan (2003): Operations Reasearch . Sultan Chand & Sons.

BOOKS FOR REFERENCE:

1. Taha, H.A. (2006): Operations Research, 7th edition, Collier MacMillan.

CORE PRACTICAL II
BASED ON CORE PAPERS – V, VI & VII

Credits: 3

(3 hrs/week)

Objective: To give hands on training for inferential problems.

NOTE:

Internal Marks : 20 Marks,

External examination : 30 marks.

Candidates are to answer any three questions from five questions.

1. Fitting of Binomial, Poisson and Normal Distributions.
2. Estimation of parameters by method of moments (discrete and continuous distributions).
3. Estimation of parameters by method of maximum likelihood (discrete and continuous distributions).
4. Confidence intervals based on Normal, t, F and chi-square statistic.
5. Asymptotic and exact tests of significance with regard to population proportion(s), mean(s), variance, ratio of variances and coefficient of correlation, regression coefficients.
6. Independence tests by contingency tables of order $p \times q$ ($p, q=5$)
7. Construction of population pyramid
8. Computation of Mortality and fertility rates.
9. Construction of life tables.
10. Fitting of growth curves- logistic, Gompertz.

ALLIED II – PAPER II
NUMERICAL METHODS

Credits: 4

(4 hrs/week)

Objective: To impart the knowledge of numerical techniques.

UNIT 1:

Finite differences – forward and backward differences operators E and delta, and their basic properties – interpolation with equal intervals – Newton's forward and backward differences formulae - simple problems.

UNIT 2:

Interpolation with unequal intervals – divided differences and their properties – Newton's divided differences formula – Lagrange's formula- simple problems.

UNIT 3:

Central difference interpolation formula – Gauss forward and backward differences formulae – Stirling's, Bessel's, Everett's central difference formula.

UNIT 4:

Inverse interpolation – Lagrange's method – simple problems – Solution to transcendental equations – bisection and Newton Raphson's method, Horner's method and Stirling's approximation. Solution to system of linear equations – Gauss elimination, Gauss Seidel method and

UNIT 5:

Numerical differentiation – Numerical differentiation upto 2nd order only - simple problems. Numerical integration – trapezoidal rule – Simpson's one third and three eighth rule – simple problems.

Note: 50% theory and 50% numerical problems can be asked.

BOOK FOR STUDY:

1. Balasubramanian : Numerical Mathematics, Vol. I and II

BOOKS FOR REFERENCE:

1. Gupta, P.P. and Malik, G.S. (2006): Calculus of finite differences and numerical analysis, 34th edition, Krishna publishers.
2. Kandasamy, P. (2009) : Numerical Methods, 4th edition S. Chand & Sons.
3. Sastry, S.S. (2007): Introductory method of numerical analysis, 4th edition, Prentice Hall of India.

ALLIED II – PRACTICAL
(Based on Allied II papers I and II)

Credits: 2

(2 hrs/week)

Objective: To train the students to have an exposure in writing a programming language.

NOTE : Internal - 20 marks and External - 30 marks

Duration of the Examination: Three hours.

Two questions have to be set with internal choice, one from each unit.

Each carries 20 marks.

Write and test run the program in C++ for the following problems.

UNIT : I

1. Find the Mean and Median of ungrouped data.
2. Find the Mean and Standard Deviation of ungrouped data.
3. Form the frequency distribution with k classes given N observations (k known).
4. Find the Skewness and Kurtosis of an empirical distribution.
5. Regression and correlation coefficients.
6. Counting number of characters (vowels/consonants) in a given word.
7. Checking if a given word is a palindrome.
8. Generation of Fibonacci series.

UNIT: 2

1. Matrix addition and subtractions.
2. Matrix multiplication.
3. Inverse of a square matrix and solution of simultaneous equations.
4. Fitting of Binomial and Poisson distribution for the given frequency distribution and test the goodness of fit.
5. Single and two sample 't' test, paired 't' test given a set of n observations.
6. F-test for testing the equality of two population variances given a set of n observations.
7. Numerical integration by Trapezoidal, Simpson's 1/3 and 3/8th rule
8. Solution of polynomial equations by Newton Raphson method.

CORE PAPER IX
STATISTICAL INFERENCE II

Credits: 3

(5 hrs/week)

Objective: To explain the parametric and non-parametric tests with illustrative examples.

UNIT 1:

Testing of Hypothesis – Statistical Hypothesis – Simple and composite hypothesis, Null and alternative Hypothesis, Two types of errors, critical region, power of a test, Most powerful test – Neymann-Pearson lemma – Simple problems based on Binomial, Poisson, Uniform, Normal & exponential distributions.

UNIT 2:

Uniformly Most Powerful Tests – Power function and power curve – one parameter exponential family, Monotone likelihood Ratio property, UMP tests for the parameters of univariate Normal and Exponential distributions.

UNIT 3:

Likelihood Ratio Test (LRT) : Definition of LRT - Properties of LRT tests (Statements only) – LRT for the mean and LRT of the variance of univariate normal population – Test for equality of means of 2 independent univariate normal populations with common unknown variance – Test for equality of variances of 2 independent univariate normal populations.

UNIT 4:

Non-Parametric tests – sign test, Wilcoxon signed rank test, Median test, Mann-Whitney U test, Runs test- for randomness, Kolmogorov-Smirnov one sample and two sample tests and Kruskal-Wallis test.

UNIT 5:

Basic ideas on decision theory – Loss functions – Risk functions–Prior distributions – Bayes' Risk - simple problems based on Bayes' estimation.

Sequential Probability Ratio Test – Definition and properties of SPRT without proof, OC and ASN for Binomial, Poisson & Normal distributions – simple problems.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Daniel, W.W. (2005): A foundation for Analysis in health Sciences, John Wiley and Sons.
2. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.

3. Hogg, R.V. and Craig, A.T. (1972): Introduction to Mathematical Statistics, third edition, Academic Press, USA.
4. Rohatagi, V.K. (1976): An Introduction to Probability and Statistics, John Wiley & Sons. (for unit 5- Section 8.8 only)

BOOKS FOR REFERENCE:

1. Beaumont, G.P. (1980): Intermediate mathematical Statistics, Chapman and Hall, New York.
2. Gibbons, J. D. (1971): Nonparametric Statistical inference, McGraw- Hill Kogakusha ltd., New Delhi.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B.(1980): An outline of Statistical theory, Volume I, 6th revised edition, World Press limited, Calcutta.
4. Mood, A.M., Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of statistics, International student edition, McGraw Hill.

CORE PAPER X
DESIGN OF EXPERIMENTS

Credits: 3

(5 hrs/week)

Objective: To enable students to understand the principles of design and analysis of experiments.

UNIT 1:

Principles of Experimentation: Replication, Randomization and Local Control; Size of experimental unit; Methods of determination of experimental units – Maximum curvature methods - Fairfield Smith's variance law.

UNIT 2:

Analysis of Variance – Cochran's Theorem (Statement only), one-way, two-way classification (without interaction); Multiple range tests – Newman-Keuls test, Least significance difference test, Duncan's multiple range test & Tukey's test; Transformations – Square root, angular and log transformations.

UNIT 3:

Completely Randomized design (CRD) and its analysis; Randomized Block Design (RBD) and its analysis; analysis of RBD with more than one but equal number of observations per cell; Latin Square Design (LSD) and its analysis.

UNIT 4:

Missing plot technique – Meaning, Least square method of estimating (one /two) missing observations in RBD and LSD; Analysis of covariance technique in CRD and in RBD with least square estimates only.

UNIT 5:

Factorial experiments – Definition of 2^2 , 2^3 and 3^2 factorial experiments and their analysis; Principles of confounding – Partial and Complete confounding in 2^3 design; Split plot design in RBD layout and its analysis.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Dass, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments, Wiley Eastern, New Delhi.
2. Gupta, S.C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Federer, W.T. (1955): Experimental Design, Oxford & IBH publishing Co., New Delhi
2. Montgomery, D.C. (2005): Design and Analysis of Experiments, 5th edition, John Wiley and Sons inc.

3. Mukhopadhyay, P. (2005): Applied Statistics, Books and allied pvt ltd., Kolkata.
4. Snedecor, G.W. and Cochran, W.G. (1989): Statistical Methods, 8th edition, Iowa State University Press.

**CORE PAPER XI
APPLIED STATISTICS**

Credits : 3

(5 hrs/week)

Objective : To discuss the applications of statistical tools in business and economics.

UNIT 1:

Time series – Concept – Components of time Series – Additive and multiplicative models – Measurement of trend – Moving average method – Least square method.

UNIT 2:

Measurement of seasonal variations – Simple average method – Ratio to trend method – Ratio to moving average method – Link relative method – Variate Difference method

UNIT 3:

Business forecasting – role of forecasting in Business – steps in forecasting – methods of forecasting – exponential smoothing, regression with time series data. Box-Jenkins methodology – steps only.

UNIT 4:

Index Numbers – uses, classification of index numbers – Problems in the construction of index numbers – Methods of constructing index numbers – Unweighted index numbers – weighted index numbers, quantity index numbers and cost of living index numbers.

Fixed and chain base index numbers- base shifting, splicing and deflating of index numbers – Optimum test for index numbers – Time reversal test – factor reversal test.

UNIT 5:

Official Statistics: Statistical System in India CSO, NSSO and National Statistical Commission (NSC) and its functions – Present structure of the Indian statistical system – Functions of a statistical system – Agricultural statistics – Industrial statistics – Trade statistics – Labour statistics – transport and Communication statistics.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Gupta, S.P (1999): Statistical Methods, Sultan Chand, New Delhi.
2. Kapoor, V.K and Gupta, S. C (2008): Fundamentals of Applied statistics, Sultan Chand & Sons, New Delhi.

BOOKS FOR REFERENCE:

1. Agarwal, B.L. (1988): Basic Statistics, Wiley Eastern Ltd. New Delhi.
2. Croxton, F.E and Cowden, D.J (1984): Applied general statistics, Prentice Hall of India.
3. Hanke, J.E. and Wichern, D.W. (2007): Business Forecasting, eighth edition, Pearson education, Asia.
4. Website-www.mospi.nic.in

**CORE PAPER XII
OPERATIONS RESEARCH - II**

Credits : 3

(6 hrs/week)

Objective: Training the students to use optimization techniques for solving decision making problems.

UNIT 1:

LPP - Duality theory, writing a dual of a primal problem, solution of a LPP using its dual problem. Dual Simplex.

UNIT 2:

Transportation problem - obtaining initial basic feasible solutions by North west corner rule, least cost method, Vogel's approximation method - optimal solution by MODI method, degeneracy(concept only), maximization in transportation - Unbalanced transportation problem.

UNIT 3:

Assignment problem – - balanced & unbalanced assignment problem- optimal solution by Hungarian method – maximization in assignment - prohibited assignments -Traveling salesman problem.

UNIT 4:

Network analysis by CPM / PERT: Basic concepts – constraints in Network – construction of the network – Time calculations – Concepts of slack and float in network – Finding optimum project duration and minimum project cost

UNIT 5:

Replacement – Introduction – Replacement of equipment/asset that deteriorates gradually – Replacement policy when value of money does not change with time – Replacement policy when value of money changes with time – Replacement of equipment that fails suddenly – Individual replacement policy – group replacement policy.

Note: Question paper can have 60% numerical problems and 40% theory questions.

BOOKS FOR STUDY:

1. Kanthi Swarup, Gupta, P.K. and Manmohan (2003): Operations Research . Sultan Chand & Sons

BOOKS FOR REFERENCE:

1. Taha, H.A. (2006): Operations Research, 7th edition, Collier MacMillan.
2. Hillier, F.S. and Liberman, G.J. (1980): Introduction to operations research, 3rd ed.
3. Sundaresan, V., Ganapathy Subramanian, K.S. and Ganesan, K. (2000): Resource Management Techniques, A.R. Publications, Tamil Nadu.

**CORE ELECTIVE I
DATA ANALYSIS USING R
(COMPUTER BASED)**

Credits: 5

(5 hrs/week)

Objective: To impart programming skills using R LANGUAGE.

Maximum - 100 marks (Internal: 40 marks & External: 60 marks)

Candidates are to answer any 4 out of 6 questions and all questions carry equal marks.

1. Diagrams – Simple bar, Pie diagram, Multiple bar diagram(clustered), Subdivided (stacked bar).
2. Frequency distribution – Univariate (categorical data, quantitative data), Bivariate (cross tabulation).
3. Graphs – Histogram, Box- Whiskers plot.
4. Measures of location, dispersion, skewness and kurtosis
5. Correlation coefficient - Scatter diagram, Karl-Pearson's and Spearman's rank correlation.
6. Simple Linear Regression
7. Multiple Linear Regression
8. Parametric tests – mean(s) and variance(s) (upto two populations)
9. Chi-square test for goodness of fit
10. Chi-square test for independent samples
11. ANOVA – one way and two way.
12. Nonparametric tests for one sample and Paired data - Sign test & Wilcoxon signed rank test
13. Nonparametric tests for two independent samples - Median test and Wilcoxon Mann Whitney test
14. Test for Randomness
15. Kolmogorov Smirnov one sample and two sample test
16. Kruskal Wallis test

Books for Study:

1. Sudha G. Purohit, Sharad D. Gore and Shilaja R. Desmukh (2009), **Statistics Using R Language**, Narosa, Chennai.
2. Brian S Everitt, Torsten Hothorn (2009), **A Handbook of Statistical Analyses Using R**, Chapman & Hall/CRC, Second edition, England.
3. John Verzani (2009), **Using R for Introductory Statistics**, Chapman & Hall/CRC, Ebook/pdf., UK.

CORE PRACTICAL III
(CALCULATOR BASED)

Credits : 4

(4 hrs/week)

Objective : To enhance computing skills.

NOTE:

Maximum: 100 marks

Internal marks: 40 & External Marks: 60

Duration of Examination: Three Hours.

Five Questions are to be set without omitting any topic

Candidates are to answer any three questions without omitting any topic.

All questions carry equal marks.

Statistical Inference II:

1. Type I and Type II errors calculations – Binomial, Poisson & Normal distributions.
2. Most Powerful tests – Bernoulli, Poisson & Normal distributions.
3. Power Curves – Binomial, Poisson & Normal distributions.
4. Nonparametric tests – sign test, Wilcoxon signed rank test, median test, Mann-Whitney test, run test, Kolmogorov-Smirnov one sample and two sample tests and Kruskal-Wallis test.

Design of Experiments:

5. ANOVA – one & two way classification,
6. Analysis of CRD, RBD, LSD, their efficiencies, Missing plot techniques in RBD & LSD.
7. Analysis of covariance - one way classification with one concomitant variable.
8. Analysis of factorial experiments – 2^2 , 2^3 , with and without confounding and 3^2 factorial experiments.

Applied Statistics:

9. Fitting of trend polynomials by method of least squares – linear, quadratic, exponential.
10. Methods of measuring trend – semi averages, moving average.
11. Measurement of seasonal variation – simple average, ratio to trend, ratio to moving average and link relative methods.
12. Measurement of random component – variate difference method.
13. Construction of Index numbers - Laspeyre's, Paasche's, Bowley's, Fisher's and Marshall-Edgeworth index numbers.
14. Fixed and Chain base index numbers, Cost of living numbers.
15. Base shifting, splicing and deflating of index numbers.

CORE PAPER XIII
SAMPLING TECHNIQUES

Credits : 3

(4 hrs/week)

Objective : To introduce various sampling Designs and develop problem solving Skills for comparing the efficiencies of different sampling designs.

UNIT 1:

Design – Organization and execution of sample surveys – principal steps in sample survey – Pilot survey – principles of sample survey – sampling and non-sampling errors – advantages of sampling over complete census – limitations of sampling.

UNIT 2:

Sampling from finite population – simple random sampling with and without replacement – unbiased estimate of the mean, variance of the estimate of the mean, finite population correction – estimation of standard error from a sample – determination of sample size

UNIT 3:

Stratified random sampling – properties of the estimates - unbiased estimates of the mean and variance of the estimates of the mean-optimum and proportional allocations – relative precision of a stratified sampling and simple random sampling – estimation of gain in precision in stratified sampling.

UNIT 4:

Systematic sampling – estimate of mean and variance of the estimated mean – comparison of simple and stratified with systematic random sampling

UNIT 5:

Ratio estimators: Definition – bias – variance of the ratio estimator – Comparison with mean per unit. Difference estimator – Regression estimator: Comparison with mean per unit. PPS sampling – concept only – cumulative method and Lahiri method.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Cochran, W.G. (1984): Sampling techniques, Wiley Eastern Ltd.
2. Daroga Singh, & Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs, Wiley Eastern.
3. Mukhopadhyay, P. (2005): Theory and methods of Survey Sampling, Prentice - Hall of India, New Delhi.
- 4.

BOOKS FOR REFERENCE:

1. Des Raj (1976): Sampling theory, Tata McGraw Hill. Kapoor, V.K. & Gupta, S.C. (2008): Fundamentals of Applied Statistics, Sultan Chand and Sons.
2. Murthy, M.N. (1967): Sampling theory and methods, Statistical Publishing Society, Calcutta.
3. Sampath, S. (2000): Sampling theory and methods, Narosa Publishing House
4. Sukhatme, P.V. *et al* (1984): Sample survey methods and its applications, Indian Society of Agricultural Statistics, New Delhi.
5. Kish, L. (1995): Survey Sampling, Wiley Classics Library edition.

CORE PAPER XIV
STATISTICAL QUALITY CONTROL AND RELIABILITY

Credits : 3

(4 hrs/week)

Objective : To provide the basic knowledge of quality control techniques and reliability concepts.

UNIT 1:

Need for Statistical Quality Control techniques in Industry – Causes of Quality variation – seven dimensions of quality - control charts – Use of the Shewhart – control chart – Specification and tolerance limits – 3sigma limits – warning limits –application of theory of runs in quality control – Introduction to 6σ concepts.

UNIT 2:

Control chart for variables: \bar{X} chart – R chart – purpose, construction and their interpretation. Control chart for attributes: p chart – np chart – c chart – Construction and their interpretation.

UNIT 3:

Acceptance sampling plans for attributes: Producer's risk and consumer's risk –concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN –single sampling plan and double sampling plans – OC, ASN, AOQ, ATI curves for single and double sampling plans.

UNIT 4:

Variable sampling plans- Sigma known and sigma unknown - determination of n and k for one-sided specification – OC curve.

Sequential sampling plan – Sequential Probability Ratio Test – OC, ASN function-working rule – binomial population only.

UNIT 5:

Reliability: Concepts of reliability – hazard rate – MTTF – Bath tub curve – Failure time distribution – Exponential and Weibull distributions – Reliability of series , parallel and standby systems.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Gupta, R.C. (2003): Statistical Quality Control, Khanna Publication, New Delhi.
2. Kapoor, V.K. and Gupta, S.C. (2007): Fundamentals of applied statistics, Sultan Chand & Sons.
3. Mahajan, M. (1994): Statistical Quality Control.
4. Veerajan T.(2003): Probability, Statistics and Random Processes, Second edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

BOOKS FOR REFERENCE:

1. Grant, E.L. and Leavenworth, R.S.(1988): Statistical Quality Control, 6th edition, McGraw Hill.
2. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, Wiley Eastern.

**CORE PAPER XV
REGRESSION ANALYSIS**

Credits : 3

(4 hrs/week)

Objective : To introduce regression models applicable to real life situation.

UNIT 1:

Partial and multiple correlation coefficients, relationships among simple, multiple and partial correlation coefficients – biserial correlation coefficients.

UNIT 2:

Simple linear regression model: Description of the data model – estimation of parameters by least square method and test of hypothesis – index of fit – predicted values and standard errors – evaluation of fit – analysis of residuals.

UNIT 3:

Effect of outliers in simple regression – model, adequacy and residual plots – deletion of data points – transformation of variables – transformation to achieve linearity – transformation to stabilize variance – removal of heterogeneity – principles of weighted least squares.

UNIT 4:

Multiple linear regression: Description of the Data model – properties of least squares estimators – predicted values and standard errors in multiple regression – generalized least squares.

UNIT 5:

Inference on GLM: Test of hypothesis on the linear model – Assumption about the explanatory variable – testing a subset of regression coefficient equals to zero – testing of equality of regression coefficients.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Kapoor, V.K. & Gupta, S.C. (2007): Fundamentals of mathematical statistics, Sultan Chand and Sons
2. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003): Introduction to linear regression analysis, third edition, John Wiley and Sons, Inc.

BOOKS FOR REFERENCE:

1. Draper, N.R. and Smith, H. (2003): Applied Regression Analysis, third edition, John Wiley and Sons, Inc.
2. Johnston, J. (1984): Econometric methods, third edition, McGraw-Hill International.

**CORE PAPER XVI
STOCHASTIC PROCESSES**

Credits : 3

(5 hrs/week)

Objective : To expose the students to the applicability of various aspects of Stochastic Processes.

UNIT 1:

Definition of stochastic process, classification of stochastic process according to time parameter space and state space-examples of stochastic process. Concept of Stationary and independent increment process.

UNIT 2:

Markov chain – definitions and examples – higher transition probabilities – Chapman – Kolmogorov equations (discrete) - simple problems only.

UNIT 3:

Poisson Process – Postulates – Properties – Related distributions – exponential, uniform, geometric and negative binomial distributions.

UNIT 4:

Pure Birth Process – Yule-Furry process – Birth and Death Process – Immigration - Emigration processes.

UNIT 5:

Queuing Theory – Introduction – elements of a queuing system –operating characteristics of a queuing system- classification of queuing models – definitions of transient state and steady state. Poisson models – detailed study of the M/M/1:∞/FIFO, and M/M/1:N/FIFO.

BOOK FOR STUDY:

1. Medhi, J. (2009): Stochastic Process, New age International, 3rd edition chapter 1(1.5,) Chapter 2(2.1, 2.2), chapter 3(3.1, 3.2, 3.3.3, 3.4), chapter10(10.1,10.2).
2. Veerarajan, T. (2003): Probability, Statistics and Random Processes, Second edition, Tata McGraw-Hill Publishing Company Ltd. , New Delhi.

BOOKS FOR REFERENCE:

1. Feller, W (1972), **Introduction to Probability Theory and its Applications, Volume I**, Wiley Eastern Ltd, New York.
2. Karlin, S. and Taylor, H.M. (1975): A First course in Stochastic Processes, Academic Press, New York.
3. Ross, S.M. (1983): Stochastic Processes, John Wiley and Sons, New York.

**CORE ELECTIVE II
DATA ANALYSIS USING SPSS**

Credits : 5

(5 hrs/week)

Objective : To orient the students to do data analysis using SPSS.

1. Diagrams – Simple bar, Pie diagram, Multiple bar diagram(clustered), Subdivided (stacked bar).
2. Frequency distribution – Univariate (categorical data, quantitative data), Bivariate (cross tabulation).
3. Graphs – Histogram, Box- Whiskers plot.
4. Measures of location, dispersion, skewness and kurtosis
5. Correlation coefficient - Scatter diagram, Karl-Pearson's and Spearman's rank correlation.
6. Simple Linear Regression
7. Multiple Linear Regression
8. Parametric tests – mean(s) and variance(s) (upto two populations)
9. Chi-square test for goodness of fit
10. Chi-square test for independent samples
11. ANOVA – one way and two way.
12. Nonparametric tests for one sample and Paired data - Sign test & Wilcoxon signed rank test
13. Nonparametric tests for two independent samples - Median test and Wilcoxon Mann Whitney test
14. Test for Randomness
15. Kolmogorov Smirnov one sample and two sample test
16. Kruskal Wallis test

BOOKS FOR STUDY:

1. George, D. and Mallery, P. (2006): SPSS for windows step by step 6th edition. Version 13.0, Pearson Education.
2. Pal, N. and Sarkar, S. (2005): Statistics- Concepts and applications, Prentice Hall India.

BOOKS FOR REFERENCE:

1. Clifford E. Lunneborg (2000): Data analysis by Resampling: concepts and applications, Duxbury Thompson learning, Australia.
2. Jeremy J. Foster (2001): Data Analysis using SPSS for Windows. New Edition. Versions 8-10. Sage publications. London.

**CORE ELECTIVE III
ACTUARIAL STATISTICS**

Credits : 5

(5 hrs/week)

Objective : To familiarize students with the concepts of Vital statistics. To enable students to understand the Actuarial concepts.

UNIT 1:

Elements of simple & compound interest - nominal rate of interest $i^{(m)}$ and effective rate of interest i – Force of interest δ - relationship between different rates of interest- expression for δ by use of calculus - relationship between nominal and effective rates of interest - present value – varying rates of interest – equation of value – equated time – simple discount – discount & discounted value.

UNIT 2:

Annuities – immediate annuity – annuity due – perpetuity - deferred annuities - present values, accumulated amounts of annuities. Increasing and decreasing annuities.

UNIT 3:

Redemption of Loans – Amortization and Sinking Funds - Average Yield of interest on the Life Fund of an insurance office. Simple Problems.

UNIT 4:

Premiums; general principles, natural premiums, office & net premiums, loading for expenses with and without profit premiums, adequacy of premiums, relative consistency. Simple Problems.

UNIT 5:

Policy values - retrospective and prospective policies; Surplus – sources of surplus, distribution of surplus.

Note: Question paper can have 50% numerical problems and 50% theory questions.

BOOKS FOR STUDY:

1. Dixit, S.P. , Modi, C.S., Joshi, R.V.(2000): Mathematical Basis of life Assurance, IC-81 (Published by Insurance Institute of India, Bombay - 400001).
2. Frank Ayers, J.R. (1983): Theory and problems of mathematics of finance, Schaum's outline series, McGraw-Hill book company, Singapore.

BOOKS FOR REFERENCE:

1. Donald, D.W.A. (1975): Compound Interest and Annuities certain, Heinemann, London.
2. Zima, P. and Brown, R.L. (2005): Theory and problems of mathematics of finance, 2nd edition, Tata McGraw - Hill.

CORE PRACTICAL V

(Calculator based)

Credits : 3

(3 hrs/week)

Objective: To enhance computing skills.

NOTE:

Maximum	: 75 marks
Internal marks	: 15
External Marks	: 60
Duration of Examination	: Three Hours.

Five Questions are to be set without omitting any topic.

Candidates are to answer any three questions without omitting any topic.

All questions carry equal marks.

(Outline of the exercises to be carried out)

STATISTICAL QUALITY CONTROL:

1. Control charts for attributes and variables-x-bar, R-chart, p, np, and C- charts.
2. OC, AOQ, ATI curves for single sampling plan.

SAMPLING:

1. Drawing random samples of size not exceeding 25 from Binomial, Poisson, Uniform, Cauchy, Normal and Exponential distribution with known mean and variance using random number tables.
2. Simple random sampling with and without replacement-estimation of population mean and variance.
3. Stratified random sampling-estimation of mean and variance under proportional allocation and optimum allocation, gain due to stratification.
4. Systematic sampling-estimation of mean and variance.
5. Ratio estimation-estimation for population mean and total based on simple random sampling only.
6. Regression method of estimation-estimation for population mean and total (simple random sampling only)
7. Probability proportional to size sampling-cumulative total method, Lahiri's method.

REGRESSION ANALYSIS:

1. Multiple and Partial correlation coefficient.
2. Simple Linear regression model.

ALLIED II – PAPER I
MATHEMATICAL STATISTICS – I

Credits: 4

(4 hrs/week)

Objective: To introduce the basic statistical concepts.

UNIT 1:

Concept of sample space – Events, definition of Probability (classical, statistical & axiomatic) – addition and multiplication law of probability (for two events only) –independence – conditional probability – Bayes’ theorem - simple problems.

UNIT 2:

Random variables – discrete and continuous – distribution function – joint probability function – marginal and conditional distributions – independent random variables - simple problems.

UNIT 3:

Mathematical Expectation – addition and multiplication theorem – moments – Moment generating function – their properties. Chebychev’s inequality - simple problems.

UNIT 4:

Correlation and regression – Rank correlation coefficient - simple problems.

UNIT 5:

Standard Distributions – Binomial, Poisson, Normal – mean, variance and mgf.

Note: Numerical problems from unit 4 should not be asked in the question paper as this paper has a practical component.

BOOK FOR STUDY:

1. Gupta, S.C. and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Arora, S. and Bansilal, (1989): New mathematical Statistics , Meerat Publications, Satya Prakashan , New Delhi
2. Hogg, R.V., McKean, J.W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.

ALLIED II – PAPER II
MATHEMATICAL STATISTICS – II

Credits: 4

(4 hrs/week)

Objective: To introduce the basics concepts of statistical inference.

UNIT 1:

Exact sampling distribution: Chi square – definition – derivation of pdf, mgf, additive property. t and F – definition – derivation of pdf's – mean and variance.

UNIT 2:

Point estimation – properties of estimators – Neyman Fisher Factorization theorem, Rao-Blackwell theorem – Cramer-Rao inequality.

UNIT 3:

Methods of estimation – maximum likelihood, moments. Interval estimation – Confidence Interval for mean(s) , variance and ratio of variance based on Normal, t , Chi-square and F.

UNIT 4:

Test of significance – null and alternative hypothesis – type I and type II errors, power of the test, critical region - Standard Error – Large sample tests.

UNIT 5:

Exact test based on t, Chi-square and F distribution with respect to population mean(s) and variance(s). Test of independence of attributes based on contingency table – Goodness of fit tests based on Chi-square.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOK FOR STUDY:

1. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Arora, S. and Bansilal (1989): New mathematical Statistics, Meerat Publications, Satya Prakashan , New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.

**PRACTICALS FOR ALLIED
MATHEMATICAL STATISTICS I & II**

Credits : 2

(3 hrs/week)

Objective : To familiarize the students with applications of statistical tools.

NOTE : Use of scientific calculators may be permitted for Mathematical Statistics practical examination . Statistical and Mathematical tables are to be provided to the students at the examination hall.

Internal: 20 marks and **External:** 30 Marks

1. Graphical representation of data and frequency distribution.
2. Cumulative frequency distribution – Ogives – Lorenz curve.
3. Measure of location and dispersion(absolute and relative).
4. Fitting of Binomial, Poisson and Normal distributions and tests of goodness of fit.
5. Computation of correlation coefficient and regression lines for raw and grouped data.
Rank correlation coefficient.
6. Asymptotic and exact tests of significance with regard to population proportion(s), mean(s), variance and ratio of variances.
7. Confidence Interval based on Normal, t, F and Chi-square statistic.

ALLIED II – PAPER I
STATISTICAL METHODS AND THEIR APPLICATIONS – I

Credits: 4

(4 hrs/week)

Objective: To introduce the basic concepts in Statistics.

UNIT 1:

Nature and scope of statistical methods and their limitations – Classification, tabulation and diagrammatic representation of various type of statistical data – Frequency curve and Ogives – graphical determination of median and mode.

UNIT 2 :

Measures of location – arithmetic mean, median, mode – merits and demerits - simple problems.

UNIT 3:

Measures of dispersion-Range, mean deviation, quartile deviation, standard deviation, coefficient of variation, skewness and kurtosis - simple problems.

UNIT 4:

Probability of an event – addition and multiplication theorem for two events – Independence of events – conditional probability – Bayes’ theorem - simple problems.

UNIT 5:

Concept of random variable – mathematical expectation – mean and variance – Moment generating function - simple problems. Standard distributions: Binomial, Poisson – mean and variance, Normal distribution – properties only - simple problems.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Gupta, S.P. (2005): Statistical Methods, Sultan Chand and Sons.
2. Pillai, R.S.N. and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): An outline of Statistical theory Vol. I, 6th revised edition, World Press.

ALLIED PAPER II
STATISTICAL METHODS AND THEIR APPLICATIONS – II

Credits: 4

(4 hrs/week)

Objective: The emphasis is solely upon the application understanding and practice of statistical methods.

UNIT 1:

Correlation – Scatter diagram – Rank correlation coefficient – Regression lines – linear prediction – simple problems.

UNIT 2:

Concept of Sampling Distribution – standard error – type I and type II errors- level of significance - critical region.

UNIT 3:

Large sample tests – mean(s) and proportion(s) - simple problems.

UNIT 4:

Test of significance based on t, Chi-square and F distributions with respect to mean(s) and variance(s) – Test of independence in contingency table – Test of goodness of fit - simple problems.

UNIT 5:

Principle of scientific experiments – Randomization, replication and local control. Basic designs – CRD, RBD, LSD (layout and ANOVA table).

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Gupta, S.P. (2005): Statistical Methods, Sultanchand and Sons.
2. Pillai, R.S.N and Bagavathi, V. (2003): Statistics. S.Chand and Company Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): An outline of Statistical theory Volume I, 6th revised edition, World Press.

**PRACTICALS FOR ALLIED
STATISTICAL METHODS AND THEIR APPLICATIONS I & II**

Credits: 2

(3 hrs/week)

Objective: To enhance computing skills by analyzing data using various statistical techniques.

NOTE : Use of scientific calculators may be permitted for Statistical methods and their applications practical examination. Statistical and Mathematical tables are to be provided to the students at the examination hall.

Internal: 20 marks and **External:** 30 Marks

1. Construction of univariate and bivariate frequency distributions with samples of size not exceeding 200.
2. Diagrammatic and graphical representation of various statistical data and frequency distributions.
3. Cumulative frequency distribution – Ogives.
4. Computation of various measures of location, dispersion (absolute and relative), moments, skewness and kurtosis.
5. Computation of correlation coefficient and regression lines for raw and grouped data. Rank correlation coefficient.
6. Fitting of Binomial, Poisson and Normal distributions and tests of goodness of fit.
7. Large sample tests - mean(s) and proportion(s)
8. Exact tests of significance based on t, Chi-square and F distributions with regard to population proportion(s), mean(s), variance and coefficient of correlation.
9. Analysis of CRD, RBD and LSD.

**NON – MAJOR ELECTIVE – I
FIRST SEMESTER
DATA ANALYSIS –I**

Credits: 2

2 hrs/week

Objective:

1. To highlight the application of statistics in various fields.
2. To impact knowledge of basic concepts of statistics.
3. To bring out the importance of statistical data analysis for better decision making.

UNIT 1:

Definition of statistics, application and limitations. Types of variables – qualitative and quantitative.

UNIT 2:

Collection of data – Primary and secondary data. Methods of collecting primary data – direct and indirect interview method, mailed questionnaire method. Methods of collecting secondary data – Published and Unpublished sources.

UNIT 3:

Classification of data – types – chronological, geographical, qualitative and quantitative. Presentation of data , Tabulation of data – rules of tabulation, types and parts of table. Diagrams – Types of diagrams – Simple Bar chart – Multiple bar charts – Pie diagram.

BOOKS FOR STUDY:

1. Gupta, S.P. (1999): Statistical Methods, sultan chand, New Delhi.
2. Pillai, R.S.N and Bagavathi, V.(2003): Statistics, s.Chand and company Ltd. New Delhi.

**NON – MAJOR ELECTIVE – II
FIRST SEMESTER
DATA ANALYSIS –II**

Credits: 2

2 hrs/week

UNIT 1:

Nature and scope of marketing research: market research process – problem identification – two case studies, marketing research frame work – two case studies.

UNIT 2:

Questionnaire construction, Scale of measurement – Methods of Scale construction, Paired comparison, Ranking, Ordered category sorting – Rating technique.

UNIT 3:

Mini project – market survey and data collection (of sample size 50) – Univariate data analysis and report preparation and communicating the research finding.

BOOKS FOR STUDY:

1. Gupta, S.P. (1999): Statistical Methods, sultan chand, New Delhi.
2. Majumdar.R. (2005): Marketing research, New age International (P) Ltd.

**QUESTION PAPER PATTERN FOR UNDER GRADUATE COURSE
(BOTH MAJOR AND ALLIED)**

Time: 3 hours

Maximum Marks: 60

PART A

(10x1 = 10 marks)

Answer any **TEN** questions out of **TWELVE**.
Atleast two questions from each unit.

PART B

(5x4 = 20 marks)

Answer any **FIVE** questions out of **SEVEN**
Atleast one questions from each unit.

PART C

(3x10 = 30 marks)

Answer any **THREE** questions out of **FIVE**.
Atleast one questions from each unit.