Kumaun University Nainital

Department of Statistics

B. Sc. Semester system course structure:

1. *The course work shall be divided into six semesters with three papers in each semester.*
2. *Each paper in a semester will be of **80 marks** out of which **60 marks** for theory and **20 marks** are allotted for internal assessment (written test or assignments or both)*
3. *Each theory paper shall consists of **section A:** 20% of total marks (12 marks; one question of 12 parts; multiple choice, one word/one sentence answer, fill in the blanks, true- false; all parts will be compulsory), **section B:** 40% of total marks (24 marks, one question of 06 parts; any 04 have to be attempted with short answer) and **section C**: 40% of total marks; (24 marks, 04 questions, any two have to be attempted with long answer).*
4. *Question paper shall cover the whole syllabus.*
5. *Practical in each semester will be of total **60 marks**, which includes 15 marks from sessional, attendance, practical records etc.*
6. *Practical examination will be evaluated by both external and internal examiner.*
7. *The duration of theory shall be **03 hrs.***

SEMESTERWISE DISTRIBUTION OF PAPERS WITH MARKS

SEMESTER I

PAPER I: PROBABILITY THEORY -I **MM: 60**

Introduction, Short History, Basic Terminology, Mathematical (or classical or 'a priori') Probability-limitations of Mathematical Probability, Statistical (or Empirical) Probability-Limitations of Empirical Probability, Subjective Probability, Mathematical Tools: Preliminary Notions of Sets-Sets and Elements of Sets, Operations on sets, Algebra of sets., Axiomatic approach to probability-Random Experiment, Sample Space and Elementary Events, Event, Acceptable Assignment of Probabilities, Natural Assignment of Probabilities, Axiomatic Probability, Algebra of Events. Some Theorems on Probability-Addition theorem of Probability, Extension of Addition theorem of Probability to n Events, Boole's Inequality, Conditional Probability , Multiplication Theory of Probability, Independent Events, Multiplication theorem of Probability for Independent Events-Extension of Multiplication theorem of Probability to n Events, Pair Wise Independent Events-Mutually Independent Events, Probability of Occurrence of At Least One of the Events. Bayes' Theorem, Geometrical Probability

PAPER II: PROBABILITY THEORY –II **MM: 60**

Random variables: discrete and continuous, Distribution functions, Probability Mass function and probability density function. Joint distribution of two random variables- marginal and conditional distribution, Independence of two random variables, Expectation-theorem on expectation of sum of random variables and product of independent random variables, Conditional Expectation . Moments and Moment Generating function,Characteristic Function Chebychev's inequality, Weak Law of Large numbers and Central Limit Theorem (without proof).

PAPER III: STATISTICAL METHODS-I MM:60

Statistical data, frequency table, graphical representation, Measures of Location and measures of dispersion, Moments, Factorial moments, Skewness and Kurtosis, Association of attributes and contingency tables. Method of least squares and curve fitting .

PAPER IV: PRACTICAL BASED ON PAPER I, II & III
MAX MARKS: 60 (45+15).

SEMESTER II

PAPER I: STATISTICAL METHODS-II M M:60

Correlation-Introduction, Meaning of Correlation, Scatter diagram, Karl Pearson's Coefficient of Correlation- Limits for Correlation Coefficient, Assumptions Underlying Karl Pearson's Correlation Coefficient, Calculation of the Correlation coefficient for a Bivariate Frequency Distribution, Probable Error of Correlation Coefficient, Rank Correlation-spearman's Rank Correlation Coefficient, Tied or Repeated Ranks, repeated Ranks (continued).
Regression-Introduction, Linear regression- obtaining lines of Regression, Regression Coefficients, Properties of Regression Coefficients, Angle between Two Lines of Regression, Standard Error of Estimate or Residual Variance, Correlation Coefficient between Observed and Estimated Values.
Correlation Ratio, Intra-class Correlation, Multiple and Partial Correlation- Yule's Notation, Plane of Regression, Properties of Residuals- Variance of the Residual, Coefficient of Multiple Correlation- Properties of Multiple Correlation Coefficient, Coefficient of Partial Correlation.

PAPER II: THEORETICAL DISTRIBUTIONS: DISCRETE AND CONTINUOUS
MAX MARKS: MM 60

DISCRETE: Binomial, Poisson, Geometric, Hyper Geometric, Negative-Binomial, Rectangular distributions with properties and goodness of fit
CONTINUOUS: Uniform, Normal, Log Normal, Exponential, Gamma and Beta distributions with properties and goodness of fit
Bivariate Normal Distribution- Moment Generating Function of Bivariate Normal Distribution, Marginal Distributions of Bivariate Normal Distribution, Conditional Distributions of Bivariate Normal Distribution

PAPER III: APPLIED STATISTICS M M:60

Index Number and their uses, Methods of constructing Index numbers, Types of Index numbers, Tests for index numbers, cost of living index numbers, Deflation and Splicing of Index numbers Time series analysis –components and methods for their measurement, Vital statistics –birth, death and fertility rates, gross and net reproduction rates , elements of life table

PAPER IV: PRACTICAL BASED ON PAPER I, II AND III
MAX MARKS:60 (45+15)

Books recommended for semester I & II

1. Fundamentals of Statistics Vol-I : Goon Gupta Dasgupta
2. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor
3. Mathematical Statistics: Kapoor & Saxena
4. Mathematical Statistics: OP Gupta & BD Gupta
5. Fundamentals of Statistics Vol-II : Goon Gupta Dasgupta
6. Fundamentals of Applied Statistics: SC Gupta & VK Kapoor

SEMESTER III

PAPER I: NUMERICAL ANALYSIS MM:60

Finite differences: Definition of Δ AND E, Relationship between Δ AND E, Properties of operators Δ AND E with problems.
Interpolation: Interpolation for equal and unequal interval – Newton's forward and backward formula, Lagrange's interpolation formula, Newton's divided difference formula, Central difference formula, Newton- Gauss forward and backward formula, Stirling & Bessel's formula- Derivation and problems
Numerical integration - Trapezoidal rule, Simpson's rule and Weddle's rule.

PAPER II: SAMPLE SURVEY AND TECHNIQUES MM:60

Introduction, Type of Sampling- Purposive sampling, Probability Sampling, Parameter and Statistic-Sampling Distribution of a Statistic, Standard Error, Sampling vs complete enumeration, sampling units and frame, sampling and non-sampling errors, precision and efficiency of sampling estimators. Simple random sampling-Simple random sampling with and without replacement, Methods to draw a simple random sample, estimation of population mean and proportion by this method. Stratified random sampling-proportional and optimum allocation. Systematic sampling, Ratio and Regression methods of estimation in simple random sampling

PAPER III: EXACT SAMPLING DISTRIBUTIONS MM:60

Chi-square (χ^2) Distribution:Introduction, Derivation of the Chi-square (χ^2) Distribution, M.G.F. of Chi-square distribution, Cumulant Generating Function of χ^2-Distribution, Limiting From of χ^2-Distribution, Characteristic Function of χ^2-Distribution, Mode and Skewness of χ^2-Distribution, Additive Property of χ^2-Variates, Chi-square Probability Curve
Student's 't' Distribution- Derivation of Student's t-distribution, fisher's 't', Distribution of Fisher's 't', Constants of t-distribution, Limiting Form of t-distribution, Graph of t-distribution, Critical Values of t
F-distribution- Derivation of Snedecor's F-distribution, Constants of F-distribution, Mode and Points of Inflexion of F-distribution
Relation Between t and F Distributions, Relation Between F and χ^2 Distributions, Fisher's z-Distribution

PAPER IV:PRACTICAL BASED ON PAPER I,II & III

MAX MARKS:60(45+15)

SEMESTER IV

PAPER I: STATISTICAL INFERENCE-I MM:60

Point Estimation: Introduction- Estimators and Estimate, Characteristics/Properties of Estimators- Unbiasedness, Consistency, Efficieny- Most Efficient Estimator, Minimum Variance Unbiased (MVU) Estimators, Sufficiency- Factorisation Theorem (Neymann), Invariance property of Sufficient Estimator, Fisher-Neyman Criterion for Sufficient Estimator, Methods of Estimation- Method of Maximum Likelihood Estimation, Properties of Maximum Likelihood Estimators, Method of Minimum Variance, Method of Moments, Method of Least Squares, Method of minimum Chi-Square

Interval Estimation: Confidence Interval and Confidence limits- concept of best confidence intervals, Confidence Intervals for Large Samples.

PAPER II: STATISTICAL INFERENCE-II MM:60

Introduction, Statistical Hypothesis-Simple and Composite, Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Two types of Error, Level of Significance, Power of the Test, Steps in Solving Testing of Hypothesis Problem, Optimum Test Under Different Situations- Most power test (MP Test), Uniformly Most Powerful Test (UMP Test), Neyman J. and Pearson, E.S. Lemma- Unbiased Test and Unbiased Critical Region, Optimum Regions and Sufficient Statistics, Likelihood Ratio Test- Properties of Likelihood Ratio Test

PAPER III: TESTING OF SIGNIFICANCE MM:60

Tests of Significance for Large Samples: Sampling of Attributes- Test of Significance for Single Proportion, Test of Significance for Difference of Proportions, Sampling of Variables- Unbiased Estimate for Population Mean(μ) and Variance (σ^2), Standard Error of Sample Mean, Test of Significance for Single Mean, Test of Significance for Difference of Means, Test of Significance the Difference of Standard Deviations

Applications of Chi-square Distribution- Inferences About a Population Variance, Goodness of Fit Test, Test of Independence of Attributes-Contingency Tables, Yate's Correction (for 2*2 Contingency Table), Brandt and Snedecor Formula for 2*k Contingency Table, χ^2-test of Homogeneity of Correlation Coefficients, Bartlett's Test for Homogeneity of Several Independent Estimates of the Same Population Variance.

Applications of t-distribution- t-test for Single Mean, t-test for Difference of Means, Paired t-test for Difference of Means, t-test for Testing the Significance of an Observed Sample Correlation Coefficient, t-test for Testing the Significance of an Observed Regression Coefficient, t-test for Testing the Significance of an Observed Partial Correlation Coefficient,

Applications of F-Distribution- F-test for Equality of Two Population Variances, F-test for Testing the Significance of an Observed Multiple Correlation Coefficient, F-test for Testing the Significance of an Observed Sample Correlation Ratio, F-test for Testing the Linearity of Regression, F-test for Equality of Several Means

Applications of Z-transformation

PAPER IV:PRACTICAL BASED ON PAPER I,II & III

MAX MARKS:60 (45+15)

Books recommended for semester III & IV

1. Fundamentals of Statistics Vol-I : Goon Gupta Dasgupta
2. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor
3. Mathematical Statistics: Kapoor & Saxena
4. Mathematical Statistics: OP Gupta & BD Gupta
5. Fundamentals of Statistics Vol-II: Goon Gupta Dasgupta
6. Fundamentals of Applied Statistics: SC Gupta & VK Kapoor
7. Sampling Techniques: WG Cochran
8. Design & Methods of Sample Surveys: Daroga Singh & FS Chaudhary
9. Numerical Analysis: Goyal & Gupta

SEMESTER V

PAPER I: ANALYSIS OF VARIANCE MM:60

Introduction and Definition, Causes of Variation

Classification of ANOVA:

One way classification with one observation per cell: Layout, Mathematical model, Sum of squares for various causes of variation, Expected value of Sum of Squares, Degrees of freedom for Sum of Squares, ANOVA Table and Testing Significance on the basis of the table

One way classification with 'm' observations per cell: Mathematical model, Sum of squares for various causes of variation, Expected value of Sum of Squares, Degrees of freedom for Sum of Squares, ANOVA Table and Testing Significance on the basis of the table

Two way classification with one observation per cell: Mathematical model, Sum of squares for various causes of variation, Expected value of Sum of Squares, Degrees of freedom for Sum of Squares, ANOVA Table and Testing Significance on the basis of the table

Two way classification with 'm' observation per cell: Mathematical model, Sum of squares for various causes of variation, Expected value of Sum of Squares, Degrees of freedom for Sum of Squares, ANOVA Table and Testing Significance on the basis of the table

PAPER II: DESIGN OF EXPERIMENT MM:60

DESIGN OF EXPERIMENT: Principles of design of experiments-Replication Randomization and Local control and their importance in Design Theory, Completely randomized design- Layout, Statistical Analysis and Efficiency Comparisons with other designs, Randomized Block Design- Layout, Statistical Analysis and Efficiency Comparisons with other designs and Latin Square Design-Layout, Statistical Analysis and Efficiency Comparisons with other designs . Missing plot techniques-Analysis of Designs with missing Observations

PAPER III: MULTIVARIATE ANALYSIS MM:60

Multivariate Normal Distribution: Density function**,** Derivation and properties of Multivariate Normal Distribution, Maximum likelihood estimators of its parameters, Linear Combination, Marginal and Conditional distributions, MGF of Multivariate Normal Distribution, Distribution of sample mean and sample Co-variance matrix(without proof).
Multiple Linear Regression: Multiple Linear regression model, Least square estimation of parameters and Test of hypothesis in a Linear model.

PAPER IV: PRACTICAL BASED ON PAPER I, II & III
MAX MARKS: 60 (45+15)

SEMESTER VI

PAPER I: QUALITY CONTROL MM:60
Quality, Elements of Quality Control and its uses, Process Control and Product Control 3 σ limits,
Control Charts for variables: :Control Charts for Mean:($\bar{X}$,R) & ($\bar{X}, \sigma$) Charts-Setting the Control Limits both when standards are given and when standards are not given, Checking the Control of a process
Control Charts for Range and Standard Deviation: R & σ -Charts-Setting the Control Limits both when standards are given and when standards are not given, Checking the Control of a process
Control charts for attributes: p(Fraction Defective), d(Number of Defectives) & c(number of defects) charts-Setting the Control Limits both when standards are given and when standards are not given, Checking the Control of a process
Sampling inspection by attributes- Single and Double sampling plans, producer's and consumer's risk, OC, ASN, AOQL and LTPD of sampling plans.

PAPER II: NON PARAMETRIC METHODS MM:60

Order statistics and their distributions
Nonparametric tests: Introduction and comparison with Parametric Tests,
The Single-Sample Case- The Chi-Square Goodness-of-Fit Test, The Kolmogorov-Smirnov One-Sample Test, The One-Sample Runs Test for Randomness
The Case of One Sample, Two Measures or Paired Replicates-The Sign Test, The Wilcoxon Signed Ranks Test
Two Independent Samples-The Chi-Square Test for Two Independent Samples, The Median Test, The Wilcoxon-Mann-Whitney Test, The Kolmogorov-Smirnov Two-Sample Test,

PAPER III: COMPUTER METHODS MM:60
Computer system- Block Diagram of a computer, Machine and High Level Language, Interpreter and Compiler,

Flow charts-Symbols used and their functions, simple examples, **constants and variables**, **arithmetic expression**-hierarchy of use
Fortran language : Input Output statements, Control statements, Subscripted variables, Functions and Subroutines-Syntax and examples , **Simple computer programs for statistical methods.**

PAPER IV: PRACTICAL BASED ON PAPER I, II & III
MAX MARKS: 60 (45+15)

Books recommended for semester V & VI

1. Fundamentals of Statistics Vol-I : Goon Gupta Dasgupta
2. Fundamentals of Applied Statistics: SC Gupta & VK Kapoor
3. Fundamentals of Statistics Vol-II : Goon Gupta Dasgupta
4. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor
5. Non Parametric Statistics for the Behavioural Sciences: Sidney Siegel & Nathan Castallan Jr.
6. Multivariate Analysis- Theory & Applications : KC Bhuyan
7. Programming with Fortran: V Rajaraman