# Kumaun University Nainital

## Department of Statistics

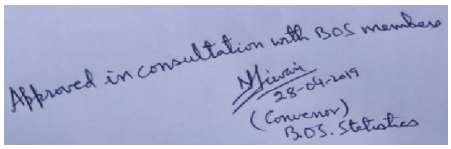
## *B.A . /B. Sc. Semester system course structure:*

*1. The course work shall be divided into six semesters with two papers in each semester.*

*2. Each paper in a semester will be of **100 marks** out of which **80 marks** for theory and **20 marks** are allotted for internal assessment (written test or assignments or both).*

3. *Practical in each semester will be of total **100 marks**, which includes 20 marks from sessional, attendance, practical records etc.*

| SEMESTER | PAPER No. | TITLE OF PAPER | M.M. |
|---|---|---|---|
| I | I | PROBABILITY THEORY | 80 + 20 = 100 |
| | II | STATISTICAL METHODS | 80 + 20 = 100 |
| | III | **PRACTICAL** BASED ON PAPER I & II | 80 + 20 = 100 |
| II | I | THEORETICAL DISTRIBUTIONS: DISCRETE AND CONTINUOUS | 80 + 20 = 100 |
| | II | APPLIED STATISTICS | 80 + 20 = 100 |
| | III | **PRACTICAL** BASED ON PAPER I & II | 80 + 20 = 100 |
| III | I | STATISTICAL INFERENCE | 80 + 20 = 100 |
| | II | SAMPLING TECHNIQUES | 80 + 20 = 100 |
| | III | **PRACTICAL** BASED ON PAPER I & II | 80 + 20 = 100 |
| IV | I | SAMPLING DISTRIBUTIONS AND THEIR RELATED TESTS OF SIGNIFICANCE | 80 + 20 = 100 |
| | II | ANALYSIS OF VARIANCE, DESIGN OF EXPERIMENT AND OFFICIAL STATISTICS | 80 + 20 = 100 |
| | III | **PRACTICAL** BASED ON PAPER I & II | 80 + 20 = 100 |
| V | I | NUMERICAL ANALYSIS | 80 + 20 = 100 |
| | II | MULTIVARIATE ANALYSIS AND NONPARAMETRIC METHODS | 80 + 20 = 100 |
| | III | **PRACTICAL** BASED ON PAPER I & II | 80 + 20 = 100 |
| VI | I | STATISTICAL QUALITY CONTROL | 80 + 20 = 100 |
| | II | COMPUTER PROGRAMMING AND EDUCATIONAL STATISTICS | 80 + 20 = 100 |
| | III | **PRACTICAL** BASED ON PAPER I & II | 80 + 20 = 100 |
| | | **GRAND TOTAL** | **1800** |



## SEMESTERWISE DISTRIBUTION OF PAPERS

## SEMESTER I

## PAPER I: PROBABILITY THEORY

**Unit I:** Introduction: Brief History, Basic Terminology, and 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– Elements of Sets, Operations on sets, Algebra of sets.Axiomatic approach to probability-Random Experiment, Sample Space and Elementary Events, Acceptable assignment of probabilities, Natural assignment of probabilities, Axiomatic Probability, Algebra of Events.

**Unit II:**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.

**Unit III:**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. Transformation of random variables.Expectation-theorem on expectation of sum of random variables and product of independent random variables,Conditional Expectation.

**Unit IV:**Moments and Moment Generating function,Cumulant Generating Function, Characteristic Function, Uniqueness and Inversion Theorems (without proof).Chebyshev's inequality, Weak Law of Large numbers(without proof) and Central Limit Theorem (without proof).

## PAPER II: STATISTICAL METHODS

**Unit I:**Definition and Scope of Statistics. Statistical data: Qualitative & Quantitative. Scales of measurement: Nominal, Ordinal, Interval and Ratio. Organisation of Data, Collection of Data, Diagrammatic and Graphical representation of Data. Consistency and independence of data with special reference to attributes.

**Unit II:**Measures of Location (Mathematical and Positional). Measures of dispersion, Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Root Mean Square Deviation, Coefficient of Variation, Moments, Factorial moments, Skewness and Kurtosis. Sheppard's corrections and Charlier's Check.

**Unit III:** Meaning of Correlation, Scatter diagram, Karl Pearson's Coefficient of Correlation. Assumptions Underlying Karl Pearson's Correlation Coefficient. Correlation coefficient for a Bivariate Frequency Distribution. Probable Error of Correlation Coefficient. Rank Correlation. Linear regression, Properties of Regression Coefficients. Standard Error of Estimate and Residual

Variance, Correlation Coefficient between Observed and Estimated Values, $R^2$, Principle of least squares and curve fitting.

**Unit IV:** 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 (Tri-Variate).

## PAPER III: PRACTICAL BASED ON PAPER I & II

## Recommended Books:


1. An Introduction to Probability and Statistics: A. K. Md. E. Salah and V. K. Rohatgi
2. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor
3. Fundamentals of Statistics Vol-I: A.M. Goon, M. K. Gupta and B. Dasgupta.
4. New Mathematical Statistics: Bansi Lal and S. Arora.
5. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor
6. Basic Statistics: B. L. Aggarwal
7. Programmed Statistics: B. L. Aggarwal
8. An Introduction to Theory of Statistics: G. Udny, M.G, Kendal


# SEMESTER II

## PAPER I: THEORETICAL DISTRIBUTIONS: DISCRETE AND CONTINUOUS

**Unit I:** Bernoulli distribution and its moments. Binominal distribution: Moments, recurrence relation for the moments, moment generating function (m.g.f), additive property, characteristic function (c.f), cumulants, probability generating function (p.g.f) and recurrence relation for the probabilities of Binominal distribution. Poisson Distribution: Poisson distribution as a limiting case of Binomial distribution, moments, mode, recurrence relation for moments, m.g.f., c.f., cumulants and p.g.f. of Poisson distribution, additive property of independent Poisson variates. Negative Binominal distribution: m.g.f. and p.g.f., deduction of moments of negative binominal distribution.

**Unit II:**Discrete uniform distribution. Geometric distribution: Lack of memory, moments and m.g.f. Hypergeometric distribution: Mean and variance. Continuous uniform distribution: Moments, m.g.f., characteristic function and mean deviation.

**Unit III:**Normal distribution as a limiting form of binominal distribution, chief characteristics of Normal distribution; mode, median, m.g.f., c.g.f. and moments of Normal Distribution, A linear combination of independent normal variates, points of inflexion, mean deviation about mean, area property of Normal distribution, importance and fitting of normal distribution.

**Unit IV:**Gamma distribution: m.g.f., c.g.f., additive property. Beta distribution of first and second kind, Moments (Mean and Variance). Exponential Distribution: m.g.f., moments, lack of memory. Log Normal and Cauchy distribution. Order statistics:Introduction, Distribution of the rth order statistic, smallest and largest order statistics.

## PAPER II: APPLIED STATISTICS

**Unit I:**Economic Time Series: Definition, components of time series- trend, seasonal , cyclic and irregular components with their illustrations.Additive and multiplicative models, determination of trend- graphic method, semi-averages method, method of curve fitting by principle of least squares, moving average method. Analysis of seasonal fluctuations, construction of seasonal indices using method of simple averages, ratio to trend method, ratio to moving average method and link relative method.

**Unit II:**Index Numbers: Definition, problems involved in the construction of index numbers, calculation of index numbers-simple aggregate method, weighted aggregates method, simple average of price relatives, weighted average of price relatives, link relatives, chain indices, value index numbers, price and quantity index numbers, Laspeyre's, Paasche's, Marshall-Edgeworth and Fisher's index numbers.

**Unit III:**Time and factor reversal tests of index numbers, consumer price index number and its uses. Base shifting, splicing and deflating of index numbers.

**Unit IV:**Vital statistics: Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates. Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR–birth, death and fertility rates, gross and net reproduction rates, elements of life table.

## PAPER III: PRACTICAL BASED ON PAPER I & II

## Recommended Books:


1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor
2. Mathematical Statistics: Kapoor and Saxena
3. Mathematical Statistics: O. P. Gupta and B. D. Gupta
4. New Mathematical Statistics: Bansi Lal and S. Arora
5. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor
6. Fundamentals of Statistics Vol-II: A.M. Goon, M. K. Gupta and B. Dasgupta.
7. Applied Statistics: P. Mukhopadhyay.

## SEMESTER III

## PAPER I: STATISTICAL INFERENCE

**Unit I:**Point Estimation: Introduction, Estimators and Estimate. Characteristics/Properties of Estimators: Unbiasedness, Consistency, Efficiency- Most Efficient Estimator, Minimum Variance Unbiased (MVU) Estimators, Sufficiency- Factorisation Theorem (Neyman), Invariance property of Sufficient Estimator, Fisher-Neyman Criterion for Sufficient Estimator. Cramer-Rao inequality and MVB estimators.

**Unit II:**Methods of Estimation: Method of Moments, Method of minimum Chi-square, Method of Maximum Likelihood Estimation, Properties of Maximum Likelihood Estimators, Method of Minimum Variance, Method of Least Squares, Basic idea of Bayes Estimators.

**Unit III:**Testing of Hypothesis: Statistical Hypothesis-Simple and Composite, Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Two types of Errors, 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 and Pearson Lemma and its application in testing simple Vs Simple hypothesis, Likelihood Ratio Test- Properties of Likelihood Ratio Test and its solution for testing simple hypothesis against simple alternative hypothesis.

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

## PAPER II: SAMPLING TECHNIQUES

**Unit I:**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.

**Unit II:**Simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination.

**Unit III:**Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum, Neyman allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision, post stratification and its performance. Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates (N = nk). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend.

**Unit IV:**Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size), variances of these estimates and estimates of these variances, variances in terms of correlation coefficient for regression method of estimation and their comparison with SRS.

## PAPER III: PRACTICAL BASED ON PAPER I & II

### Recommended Books:


1. Fundamentals of Statistics. Vol.II: A. M. Goon, M. K. Gupta and B. Dasgupta.
2. Applied Statistics: P. Mukhopadhyay.
3. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor
4. Sampling Techniques: W. G. Cochran
5. Sampling Theory: Des Raj and Chandok
6. Sample Theory of Surveys with Applications: V. G. Panse and P. V. Sukhatme.
7. Sampling Techniques: Daroga Singh and F. S. Chaudhary
8. Survey Sampling: P. Mukhopadhyay


## SEMESTER IV

## PAPER I: SAMPLING DISTRIBUTIONS AND THEIR RELATED TESTS OF SIGNIFICANCE

**Unit I:**Random sample, parameter and statistic, sampling distribution of a statistic. Sampling distribution of Mean in Normal Population. Exact sampling distribution: Definition and derivation of *p.d.f.* of $\chi^2$ with n degrees offreedom (d.f.) using *m.g.f.*, nature of $\chi^2$curve for different degrees of freedom, mean,variance, *m.g.f.*, cumulant generating function, mode, additive property and limiting form of$\chi^2$distribution.

**Unit II:**Exact sampling distributions-Student's tand Fishers t-distribution, Derivation of its *p.d.f.*, nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution. Snedecore's F-distribution: Derivation of *p.d.f.*, Probability curve with different degreesof freedom, mean, variance and mode. Distribution of 1/F ($n_1$,$n_2$). Relationship between t, Fand $\chi^2$ distributions.

**Unit III:**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($\mu$) and Variance ($\sigma^2$), 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, Test of Independence of Attributes-Contingency Tables, Yate's Correction (for 2 X 2 Contingency Table)- Fisher's Exact test, Brandt and Snedecor Formula for 2Xk Contingency Table.

**Unit IV:**Test of Significance for Small Samples: Test for Single Variance, $\chi^2$-test of Homogeneity of Correlation Coefficients, Bartlett's Test for Homogeneity of Several Independent Estimates of the Same Population Variance. 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. 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 Linearity of Regression. Applications of Z-transformation.

## PAPER II: ANALYSIS OF VARIANCE, DESIGN OF EXPERIMENT AND OFFICIAL STATISTICS

**Unit I:** Introduction to Analysis of Variance (ANOVA) and Definition,Causesof Variation Classification of ANOVA, One way classification with one observation per cell, One way classification with 'm' observations per cell, 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 related tests of significance ~~Testing Significance on the basis of the table.~~

**Unit II:**Design of Experiments: Introduction, need and principles of design of experiments-Replication, Randomization and Local control and their importance in Design Theory.

**Unit III:**Completely randomized design- Layout, Statistical Analysis and Efficiency Comparisons with other designs. Randomized Block Design- Layout, Statistical Analysis and Efficiency Comparisons with other designs. Latin Square Design-Layout, Statistical Analysis and Efficiency Comparisons with other designs. Missing plot techniques-Analysis of Designs with missing Observations.

**Unit IV:**Indian Statistical System: Present official Statistical System in India, Methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics on the topics- population, agriculture, industry, trade, price, labour and employment, transport and communication, banking and finance.

## PAPER III: PRACTICAL BASED ON PAPER I & II

**RECOMMENDED BOOKS:**


1. Design and Analysis of Experiments: M. N. Das and N. C. Giri.
2. Fundamentals of Statistics. Vol.II: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Applied Statistics: P. Mukhopadhyay.
4. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor
5. Sampling Techniques: W. G. Cochran
6. Sampling Theory: Des Raj and Chandok
7. Sample Theory of Surveys with Applications: V. G. Panse and P. V. Sukhatme.
8. Sampling Techniques: Daroga Singh and F. S. Chaudhary
9. Survey Sampling: P. Mukhopadhyay
10. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
11. http://mospi.nic.in

## SEMESTER V

## PAPER I:NUMERICAL ANALYSIS

**Unit I:**Finite differences: Definition of Δ and E operators, Relationship between Δ and E, Properties of operators Δ and E with their associated mathematical problems.

**Unit II:**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,

**Unit III:**Stirling & Bessel's formula- Derivation and problems based on these formulae.

**Unit IV:** Numerical integration - Trapezoidal rule, Simpson's rule and Weddle's rule and numerical problems based on these rules.

## PAPER II: MULTIVARIATE ANALYSIS AND NONPARAMETRIC METHODS

**Unit I:** Bivariate Normal Distribution- Moment Generating Function of Bivariate Normal Distribution, Marginal Distributions of Bivariate Normal Distribution, Conditional Distributions of Bivariate Normal Distribution.

**Unit II:** Multivariate Normal Distribution:Density function**,** Derivation and properties of Multivariate Normal Distribution,Linear Combination, Marginal and Conditional distributions, MGF of Multivariate Normal Distribution.Distribution of sample mean and sample Co-variance matrix (without proof), Maximum likelihood estimators of its parameters.

**Unit III:** Theory of Linear estimation, Estimiability of linear parametric functions, Multiple Linear Regression Model, Least square estimation of parameters. Test of hypothesis in a linear model.

**Unit IV:** 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, and The Kolmogorov-Smirnov Two-Sample Test.

## PAPER III: PRACTICAL BASED ON PAPER I & II

## RecommendedBooks:


1. An Introduction to Multivariate Statistical Analysis: T. W. Anderson
2. Multivariate Analysis: A. M. Kshirsagar.

3. Multivariate Analysis- Theory & Applications: K. C.Bhuyan
4. Nonparametric Statistical Inference: J. D.Gibbonsand S. Chakraborty.
5. Linear Estimation and Design of Experiment: D. D. Joshi.
6. Introductory Methods of Numerical Analysis: S. S. Sastry
7. Numerical Analysis: Bhupendra Singh
8. Numerical Analysis: Goyal & Gupta

## SEMESTER VI

## PAPER I: STATISTICAL QUALITY CONTROL

**Unit I:**Introduction to Statistical Quality Control, Elements of Quality Control and its uses, Process Control and Product Control, 3-σ control limits.

**Unit II:** Control Charts for variables:Control Charts for Mean:( $\bar{X}$, R) & ($\bar{X}$, 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 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.

**Unit III:** 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.

**Unit IV:** 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: COMPUTER PROGRAMMING AND EDUCATIONAL STATISTICS

**Unit I:**Basics of Computer: Introduction, origin, development, uses and limitation of computers. Types of computers, computer structure, input-unit, CPU, output unit, secondary storage, High Level and low-level languages, compiler and interpreter. Computer Arithmetic: Floating point representation of numbers, arithmetic operations with normalized floating-point numbers. Number systems- Binary, decimal, octal and hexadecimal number systems and their conversions into each other. Binary arithmetic's, (Addition, subtraction, multiplication & division).

**Unit II:**Flow charts and Algorithm: Concepts of flow chart, algorithm and programming. Flow charts and algorithms for the following: Mean, Standard Deviation, Coefficient of Correlation, Straight line fitting. Trapezoidal rule, Simpson's 1/3 and 3/8th rules.

**Unit III:** Basics of C Language**.** Simple Statistical Operations using C Programming.

**Unit IV:** Scaling individual test items in terms of difficulty, sigma scaling, Z score and Z-scaling, standard scores, normalized scores, T-scores, uses of T-scores, comparison of T-scores and standard scores, percentile scores, scaling of rankings in terms of normal probability curve, Reliability of Test scores, methods of determining test reliability, validity of test scores, methods of calculation of validity.

## PAPER III: PRACTICAL BASED ON PAPER I & II

## RecommendedBooks:


1. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor
2. Fundamentals of Statistics, Vol. I & II: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Applied Statistics: P. Mukhopadhyay.
4. Computer Fundamentals: P. K. Sinha
5. Let Us C: YashwantKanitkar.