DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

Entrance Syllabus for 1- year Masters programme in Statistics Under NEP 2020 of the year 2026.

UNIT I : Introduction to Statistics: Primary and secondary data, different methods of collection of primary data with merits and demerits. Sources of secondary data. Classification: meaning, objectives, types of classifications, Formation of discrete and continuous frequency distributions.
Types of Diagrams - simple, multiple, component, percentage bar diagrams and pie diagrams with simple illustrations. Graphs: Types of Graphs - Histogram, frequency Polygon, frequency curve and Ogives, simple problems, location of mode, median and partition values from the graphs. Difference between diagrams and graphs.

UNIT II: Central Tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean and their important properties. Empirical relation between mean median and mode. Dispersion: Measures of dispersion. Absolute and relative measures of dispersion. Range, Quartile deviation, Mean deviation and standard deviation with relative measures - definition, merits and demerits and their important properties.

UNIT III: Partition Values, Moments-Meaning and their inter-relations with properties- problems on ungrouped and grouped data, factorial moments, Shephard's correction for moments. Relationship between raw and central moments.
Skewness and Kurtosis: Definition, objectives and types of skewness, explanation of positive and negative skewness. Measure of skewness based on moment. Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness. Simple problems. Kurtosis: Definition and types of kurtosis. Explanation of types of kurtosis. Difference between skewness and kurtosis.

UNIT IV: Bivariate Data: Concept of correlation and its types. Scatter diagram method and product moment method of studying correlation. Properties of a correlation coefficient (limits of the correlation coefficient, effect of change of origin and scale). Concept of rank correlation, derivation of Spearman's rank correlation coefficient and its limits.
Regression: Regression curve and regression equation, linear &nonlinear regression, lines of regression, regression coefficients and properties, angle between two lines of regression. correlation coefficient from two lines of regression, correlation vs regression. Principle of least squares and fitting of polynomials and exponential curves.

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UNIT V: Methods of collection of official statistics. Introduction and definition of vital Statistics, Measurement of population, rate and ratio of vital events. Chandrasekharan-Deming .Dependency ratio. Accuracy of age data on sex and age: Whipple's and Myer's indices

Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates. Stationary and Stable population, Central Mortality Rates and Force of Mortality. Life(Mortality) Tables: Assumption, description, construction of Life Tables and Uses of Life Tables.

Measurements of Fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR), Relation between CBR, GFR and TFR. Dandekars Binomial and Poisson Models, William Brass Model.

UNIT VI: Random experiment Events, Operations of events, Concept of equally likely, mutually exclusive and Exhaustive events. Definition of Probability: Classical, Relative frequency and Axiomatic approaches. Discrete Probability Space, Properties of Probability under Set Theory Approach, Independence of Events, Conditional Probability, Total and Compound Probability theorems, Bayes theorem and its applications. Random Variables . Discrete and Continuous, Probability Mass Function (pmf) and Probability density function (pdf), Cumulative distribution function (cdf) with properties, Joint distribution of two random variables, Jacobian Transformation for one and two variables with illustrations, Marginal and Conditional distributions, Independence of random variables.

UNIT-VII: Discrete Probability distributions: Characteristic properties of Binomial distribution, Poisson distribution, Negative binomial distribution and. Geometric distribution. Normal distribution: mean, variance and mgf. Properties of Normal curve, simple problems on Normal distribution including area problems, Normal distribution as a limiting case of binomial distribution, Gamma and Beta distribution: Definition moments and properties of Gamma distribution.

UNIT VIII: Simple random sampling (SRS) with and without replacement. Merits and demerits of Simple random sampling (SRS). Methods of selecting SRS. Estimation of mean and variance. Stratified random sampling: Need for stratification. Principles of stratification. Advantages of stratified sampling over simple random sampling. Estimation of mean and variance. Proportion and equal allocation: Allocation of sample size under proportional and equal allocation and variance under this allocation.

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UNIT IX : Operations Research (OR): Introduction to Operations Research, its Development, characteristics and scope. Linear programming: Basic solution, basic feasible solution, non-feasible solution and optimum solution. Concept of Convex set, graphical method of solving LPP, Standard form of LPP. Simplex Method: Iterative nature of simplex method, basic computational details of simplex algorithm and summary. Concept of duality.Transportation Problem (TP): Balanced and unbalanced Transportation Problem, Mathematical formulation and tabular representation. Methods for finding initial basic feasible solution: North West Corner Rule, Lowest Cost Entry, Vogel's Approximation method. Modified Distribution method to find the optimal solution. Assignment problem: Balanced and unbalanced Assignment Problem, Hungarian method to find optimal assignment.

UNIT X : Non- Parametric Inference: Introduction, Advantages and disadvantages of non- parametric tests. Sign Test-one sample and two samples: assumptions, applications and importance. Median test assumptions: applications and importance. Wilcoxon-Signed rank test- one sample and two samples,assumptions, applications and importance , Wilcoxon –Mann Whitney test :assumptions, applications and importance. Test of randomness based on total number of runs: assumptions, applications and importance.

UNIT-XI: Properties of good estimators .Methods of Estimation: Maximum likelihood Estimation (MLE), method of moments, method of minimum chi-square, and method of least square, properties and applications.
Complete statistic, Minimum variance unbiased estimator (MVUE), Factorization theorem (statement and applications) with examples. Rao-Blackwell statement and applications, Cramer-Rao inequality statement and applications.

UNIT-XII: Design of Experiments: Introduction, Terminology in experimental designs. Experiment, Experimental unit, Experimental Error, Treatments, Blocks, Replication, Precision, Yield, Uniformity Trials. Principles of Experimental Design: Randomization, Replication and Local control. Completely Randomized Design (CRD): layout, analysis, advantages and disadvantages. Randomized Block Design (RBD): layout, analysis, advantages and disadvantages of RBD over CRD. Latin Square Design (LSD) layout, analysis of mxm LSD for one observation per experimental unit; advantages and disadvantages. Single missing observation analysis for LSD and RBD. Relative efficiency of LSD over RBD & CRD.

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UNIT-XIII: Systematic Sampling: types of systematic sampling, Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of linear trend.

Ratio and Regression methods of Estimation: Variance of the estimates, Ratio and regression estimator in stratified random sampling. Comparison among regression, ratio and simple unbiased estimates.

UNIT-XIV: Sampling distributions: Chi-square distribution: derivation, constants, conditions, yates' correction, grouping when individual frequency are small, properties and applications. Mean and variance through moment generating function, Limiting case and additive property of chi-square distribution. Relation of Chi-square distribution with the other related distributions. F distribution: constants, mode, point of inflexion, properties .Relation of F distribution with the t and Chi-square distributions.

Linear models; Gauss Markov set up, Model classification, Normal equations and least squares estimates, Estimation of error variance, estimation with correlated observations, Tests of linear hypotheses, estimable linear hypotheses, confidence intervals and prediction intervals, Generalized F test, generalized t test. Experimental Design models; point estimation, Re-parameterization, Variance and Covariance of estimable function, testing of hypotheses, Regression models. Simple linear and multiple regression fit of polynomials, Analysis of covariance, estimation and testing, o n e way model with one covariance, two-way model with two covariance.

UNIT-XV: Algebra of Matrices, trace of a matrix, tr(AB)= tr(BA), types of matrices: symmetric, skew symmetric, Hermitian, Skew-Hermitian, idempotent, nilpotent, orthogonal and Unitary matrices. Inverse of square matrix, Inverse of partitioned matrices. Rank of matrix, Cayley-Hamilton Theorem. Eigen values and Eigen vectors.

Linear equations, solution of homogenous and non-homogenous equations. Vector spaces, basis and Dimensions. Linear Transformations and their matrix representation. Inner product spaces, orthogonal and orthonormal basis.

Limit, Continuity, uniform continuity of functions of one variable, the algebra of continuous functions, monotonic functions, types of discontinuities, infinite limits and limits at infinity. Differentiability, Rolle's Theorem, Mean Value Theorems, Riemann sum and integral (simple problems). Functions of several variables. Limit and continuity of functions of several variables.

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UNIT-XVI:

Methods of solving LPP: Two-phase method and Extreme point theorems; Revised Simplex Method, Assignment Problems: balanced and unbalanced Assignment Problems, Hungarian method. Duality in Linear programming problem, Duality theorems: Weak duality theorem, Optimality criterion theorem, Unboundedness theorem, Fundamental theorem of duality, Complementary Slackness theorem and Complementary Slackness conditions and their applications. Dual Simplex Method.

Introduction to game theory. Strategy and its types. Decision Making in the face of competition, payoff matrix , two– person zero sum games. Maximin and Minimax principle. Games with pure and mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions of 2x2 payoff matrices. Dominance principle, finding solutions of 2 x m and mx2 type games, Equivalence between game theory and linear programming problem.