V. B. S. Purvanchal University, Jaunpur
Statistics Syllabus
(BA / BSc)

**BA / BSc Statistics (First Year)**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Papers</th>
<th>Theoretical / Practical / Viva-voce / Assignment</th>
<th>Maximum Marks</th>
<th>Duration (Hours)</th>
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<tbody>
<tr>
<td>1</td>
<td>Probability</td>
<td>Theoretical</td>
<td>50</td>
<td>3</td>
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<tr>
<td>2</td>
<td>Probability Distribution &amp; Numerical Analysis</td>
<td>Theoretical</td>
<td>50</td>
<td>3</td>
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<td>3</td>
<td>Statistical Method</td>
<td>Theoretical</td>
<td>50</td>
<td>3</td>
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<tr>
<td>4</td>
<td>Practical</td>
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**BA / BSc Statistics (Second Year)**

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<tbody>
<tr>
<td>1</td>
<td>Statistical Inference</td>
<td>Theoretical</td>
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<td>3</td>
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<tr>
<td>2</td>
<td>Survey Sampling</td>
<td>Theoretical</td>
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<td>3</td>
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<td>3</td>
<td>Analysis of Variance and Design of Experiment</td>
<td>Theoretical</td>
<td>50</td>
<td>3</td>
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<tr>
<td>4</td>
<td>Practical</td>
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**BA/BSc Statistics (Third Year)**

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<tr>
<td>1</td>
<td>Non Parametric Methods and Regression Analysis</td>
<td>Theoretical</td>
<td>75</td>
<td>3</td>
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<tr>
<td>2</td>
<td>Applied Statistics</td>
<td>Theoretical</td>
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<td>3</td>
<td>Operation Research</td>
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<tr>
<td>4</td>
<td>Practical</td>
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<td>75</td>
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BA / BSc (First Year)

Paper – I: Probability

UNIT – I

UNIT – II
Random variables – discrete and continuous, probability mass function (pmf) and probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, marginal and conditional distributions.

UNIT – III
Independence of random variables. Expectation of a random variable (rv) and its properties, expectation of sum of random variables and product of independent random variables, conditional expectation.

UNIT – IV
Moments, moment generating function (m.g.f.) & their properties, continuity theorem for m.g.f. (without proof). Chebyshev’s inequality. Weak law of large numbers and Central Limit Theorem for a sequence of independently and identically distributed random variables and their applications.

References:
Paper – II: Probability Distributions and Numerical Analysis

UNIT – I

UNIT - II
Distributions of function of random variables: Distribution of sum, product and quotient of two Variable. Reproductive property of standard distributions. $\chi^2$ (chi-square), $t$ and $F$ distributions (Central cases only) and their limiting forms. Bivariate normal distribution and its properties.

UNIT – III

UNIT – IV
Numerical Integration: Derivation of general quadrature formula for equidistant ordinates. Derivation of trapezoidal, Simpson’s $\frac{1}{3}$rd and $\frac{3}{8}$th rules. Weddle’s rule. Real roots of a numerical equation by method of iteration.

References:
3. Freeman: Finite Differences.
Paper - III: Statistical Methods

UNIT-I
Concept of statistical population, Attributes and variables (discrete and Continuous). Different types of scales – nominal, ordinal, ratio and interval. Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency. Secondary data. scrutiny of data for internal consistency and detection of errors of recording. Ideas of cross validation. Presentation of data: classification, tabulation, diagrammatic & graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representations, histogram, frequency polygon and ogives. Stem and Leaf plot. Box Plot.

UNIT-II

UNIT-III
Correlation and regression, rank Correlation (Spearman’s and Kendall’s measure), Intra-class correlation, correlation ratio. Partial and Multiple Correlation & Multiple Regression for Tri-variate data.

UNIT-IV
Attributes- Notion and terminology, contingency table, class frequencies, and ultimate class frequencies, consistency. Association of attributes, Independence, Measure of association for 2x2 table. Chi-square, Karl Pearson’s and Tschuprow’s coefficient of association. Contingency tables with ordered categories.

References:
PRACTICAL

The practical examination will be based on papers I, II & III and will cover the following experiments. List of Practical Experiments

1. Graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives. Stem and Leaf Plot, Box Plot.
2. Calculation of measures of location.
3. Calculation of measures of dispersion.
4. Calculation of moments, measures of skewness and measures of Kurtosis.
5. Fitting of curves by method of least squares.
6. Determination of regression lines and calculation of correlation coefficient – grouped and ungrouped data.
7. Calculation of correlation ratios, rank and intra-class correlation coefficients.
8. Calculation of multiple and partial correlation coefficients for three variables.
10. Construction of forward difference tables and divided difference tables.
11. Interpolation by Newton’s forward difference formula for equal intervals and calculation of error.
12. Interpolation by Newton’s divided difference formula for unequal intervals. Calculation of error.
14. Approximate integration (Trapezoidal rule, Simpson’s one-third rules, Simpson’s three-eighth rule), Weddle’s rule.
15. Real roots of numerical equation by method of iteration.
16. Other practical’s based on Paper II and Paper III
BA / BSc (Second Year)

Paper I: Statistical Inference

UNIT – I

UNIT – II
Sufficient Statistics, Cramer-Rao inequality and its use in finding MVU estimators. Statistical Hypothesis (simple and composite). Testing of hypothesis. Type I and Type II errors, significance level, p-values, power of a test. Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.

UNIT – III
Neyman-Pearson’s lemma and its applications for finding most powerful tests for simple hypothesis against simple alternative. Tests based on t, F, Z and X^2(Chi Square) distributions.

UNIT-IV
Likelihood ratio tests and their reduction to standard tests. Large sample tests, variance – stabilizing transformations. Interval estimation, Pivotal quantity and its use in finding confidence intervals, concept of best confidence intervals.

References:
1. Hogg & Craig: Mathematical Statistics
Paper II: Survey Sampling

UNIT – I

UNIT-II
Stratified random sampling. Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard errors of the usual estimators when these allocations are used. Gain in precision due to stratification. Role of sampling cost in the sample allocation. Minimization of variance for fixed cost. Systematic sampling: estimation of population mean and population total, standard errors of these estimators.

UNIT-III
Regression and ratio methods of estimation in simple random sampling. Cluster sampling with equal and unequal clusters. Estimators of population mean and their mean square error.

UNIT-IV
Double sampling in ratio method of estimation. Two-stage sampling with equal first stage units: estimator of population mean and its variance, Multi-stage sampling with examples (definition only). Non-sampling errors.

References:
2. Sukhatme, Sukhatme, Sukhatme & Asok: Sampling Theory of Surveys with applications
3. Murthy, M. N.: Sampling theory
Paper III: Analysis of Variance and Design of Experiment

UNIT-I
Analysis of Variance. One-way classification. Assumptions regarding model. Two-way classification with equal number of observations per cell. Duncan’s multiple comparison test. Analysis of covariance.

UNIT-II
Principles of Design of experiments: Randomization, Replication and local control. Choice of size and type of a plot using uniformity trials. CRD, Randomized block design. Concept and definition of efficiency of design. Comparison of efficiency between CRD and RBD.

UNIT – III
Latin square Design, Lay-out, ANOVA table. Comparison of efficiencies between LSD and RBD; LSD and CRD. Missing plot technique: estimation of missing plots by minimizing error sum of squares in RBD and LSD with one or two missing observations.

UNIT-IV
Factorial Experiments: general description of factorial experiments; $2^2$, $2^3$ and $2^k$ factorial experiments arranged in RBD and LSD. Definition of main effects and interactions in $2^k$ and $2^3$ factorial experiments. Preparation of ANOVA by Yates procedure. Estimates and tests for main and interaction effects (Analysis without confounding).

References:
1. Cochran and Cox: Experimental Design
2. Kempthorne: Design of Experiments
3. Federer: Experimental Designs
PRACTICAL

The practical examination will be based on papers I, II and III and will cover the following experiments:

List of Practical Experiments

1. Fitting of Binomial, Poisson and Normal distributions to observed data and testing of goodness of fit.
2. Testing of independence of attributes in m x n contingency table and calculation of measures of association.
3. \( t \) – test for (i) \( \mu = \mu_0 \) (ii) \( \mu_1 = \mu_2 \) (iii) \( \alpha = \alpha_0 \) (iv) \( \beta = \beta_0 \) (v) \( \rho = 0 \) (vi) \( \rho_{12..3} = 0 \)
4. \( F \)-test for (i) \( \sigma_1^2 = \sigma_2^2 \) (ii) \( \rho_{1.23} = 0 \)
5. Fisher’s Z-transformation and its use in testing (i) \( \rho_1 = \rho_2 \) (ii) \( \rho_1 = \rho_2 = \ldots = \rho_k \) (iii) \( \rho = \rho_0 \)
6. Calculation of power curve for the test of \( \mu = \mu_0 \) against \( \mu \neq \mu_0 \) for a normal distribution with known variance.
7. Large sample tests.
8. Analysis of variance in one-way and two-way classification (with and without interaction terms).
10. Analysis of variance in RBD and LS design with one or two missing observations.
11. Drawing a simple random sample with the help of table of random numbers.
13. Stratified random sampling for population mean (proportional and optimum allocation).
15. Factorial Experiment Practical.
16. Other practical’s based on Paper I, Paper II and Paper III.
BA / BSc (Third Year)

Paper 1: Non-parametric Methods and Regression Analysis

UNIT – I
Multivariate normal distributions, marginal and conditional distribution, Moment Generating and Characteristics functions, Maximum likelihood estimation of mean vector and co-variance matrix, independence and joint sufficiency of these estimates. Distribution of linear combination of components of multi normal variate.

UNIT – II
Order Statistics. Distributions of minimum, rth and maximum order statistic. Joint distribution of rth and sth order statistics (in continuous case) Distribution of sample range & sample median, for uniform and exponential distributions. Confidence interval of quantiles of order p, tolerance and coverages.

UNIT – III

UNIT – IV
Linear regression model of full rank, Least squares theory. Estimation of parameters-OLSE and MLE of $\beta$ and test of hypotheses. R2 and adjusted R2. ANOVA table for regression,

References:
2. Gibbons, J.D.: Non-parametric statistical inference
5. Johnston: Econometric Methods
6. Anderson: Introduction to Multivariate Statistical Analysis, Chaps 1,2 & 3
Paper II: Applied Statistics

UNIT – I
Time series, its different components, illustrations, additive and multiplicative models, determination of trend, growth curves, analysis of seasonal fluctuations, construction of seasonal indices. Idea of Correlogram & Periodogram. Index number – its definition, application of index number, price relative and quantity or volume relatives, link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyre’s, Paashe’s and Fisher’s index number, time and factor reversal tests of index numbers, consumer price index.

UNIT – II
Educational Statistics: Scaling procedures – scaling of test items, test scores, rating of qualitative answers and judgements. Test theory, linear models, parallel tests, true score, reliability and validity of tests. Tetra-choric, bi-serial and point bi-serial correlation coefficients.

UNIT – III

UNIT – IV
Control charts for variables and attributes, modified control charts, group control charts, CUSUM charts, V mask. Sampling inspection by attributes – single and double sampling plans. Producer’s and consumer’s risk, OC, ASN, ATI functions AOQL and LTPD of sampling plans. Sampling inspection by variables – simple cases.

References:
2. Draper & Smith: Applied Regression Analysis
3. Burr: Industrial Quality Control
4. Wetherill and Brown: Statistical Quality Control
7. Siya Ram: Applied Statistics
Paper III: Operations Research

UNIT – I

UNIT – II
Queueing Models – M/M/1, M/M/C models waiting time distribution for M/M/1, Little’s formulae. M/G/1 Queueing system, cost profit models in queueing theory.

UNIT – III

UNIT – IV

References:
PRACTICAL

The practical examination will be based on papers I, II and III and will cover the following experiments:

List of Practical Experiments

1. Practical based on run test, median test, randomness, Wilcoxon signed rank tests, Kolmogorov-Smirnov’s test.
2. Practical based on Time series and index number.
3. Practical based on different reliability and validity test.
4. Practical based on measures of fertility and mortality, GRR and NRR.
5. Practical based on construction of life table.
6. Practical based on Quality control charts $\bar{x}$, $R$, $\sigma$ charts.
7. Practical based on LPP-Simplex method, Graphical method, Big-M method.
8. Practical based on Transportation problem and Assignment problem
9. Practical based on Network analysis -CPM and PERT.