Annexure-IV

Dr. Shakuntala Misra National Rehabilitation University,

Lucknow, Uttar Pradesh, 226017

DEPARTMENT OF MATHEMATICS AND STATISTICS

SYLLABUS FOR UNDERGRADUATE (UG) STATISTICS

As per Undergraduate (UG) Programmes Regulation-2024

Bachelor of Science (B.Sc.)

(Statistics as a major/minor subject)

(Academic Year 2025-26 and onwards)

BoS Meeting held on 28/07/2025

SUBJECT PREREQUISITES

To study this subject, a student must have the subject Mathematics in class 12 equivalent.

PROGRAMME OUTCOMES (POs)

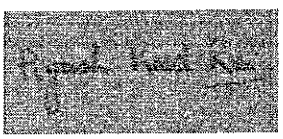
Students with Degree in B.Sc. (with Statistics) should have knowledge of different concepts and fundamentals of Statistics and the ability to apply this knowledge in various fields of industry/Organization. They may pursue their future career in the field of Statistics and Research.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completing B.Sc. (with Statistics), the student should have:

- Knowledge of different concepts, principles, methodologies and tools (skills) of Statistics.
- Ability to collect, tabulate, represent graphically, analyze and interpret data/information by using appropriate statistical tools.
- Ability to identify and solve a wide range of problems in real life/industry related to Statistics.
- Familiarity with computational techniques and statistical software, like MS Excel and SPSS, for mathematical and statistical computation.
- Capability to use appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication and bio-statistics.
- Ability to compete with industrial/private sector demand in the field of data analysis, marketing survey, etc., professionally and pursue their future career in the field of Statistics.
- Ability to develop original thinking for formulating new problems and providing their solutions.

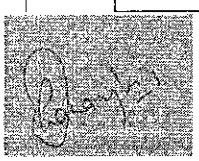
As a result, they will be able to pursue higher studies or research in the field of Statistics.

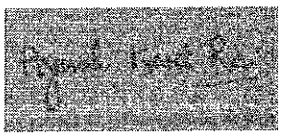


COURSE STRUCTURE

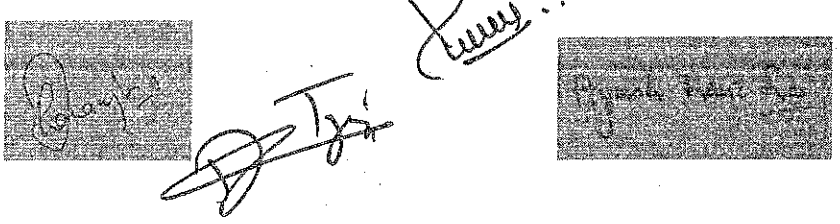
B.Sc. (STATISTICS AS MAJOR/MINOR SUBJECT)

Year	Course Code	Paper Title	Theory/Practical	Credits
	SEMESTER -I			
I	BSTAT101	Descriptive Statistics (Univariate) and Theory of Probability-I	Theory (Maj/Min)	02
	BSTAT102	Descriptive Data Analysis Lab (Univariate)	Practical (Maj/Min)	01
	OTHER MAJOR/MINOR SUBJECT-I			03
	OTHER MAJOR/MINOR SUBJECT-II			03
	SEC-I			03
	AEC-I			02
	VAC-I			03
	BSTAT103 (MDC-1)	Statistical Techniques for Data Analysis Using MS Excel	Multi-Disciplinary Course	03
	TOTAL CREDIT OF SEMESTER-I = 20 CREDITS			





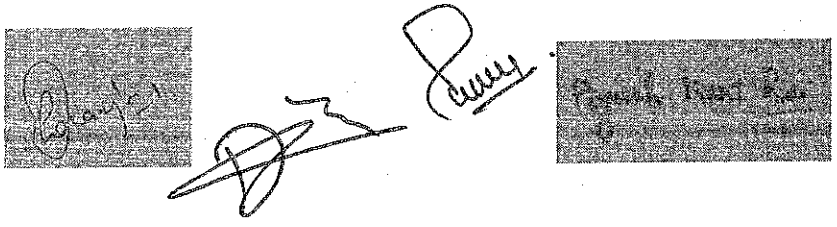
	SEMESTER -II			
	BSTAT104	Descriptive Statistics (Bivariate) and Theory of Probability II	Theory (Maj/Min)	02
	BSTAT105	Descriptive Data Analysis Lab (Bivariate)	Practical (Maj/Min)	01
	OTHER MAJOR/MINOR SUBJECT-I			03
	OTHER MAJOR/MINOR SUBJECT-II			03
	SEC-II			03
	AEC-II			02
	VAC-II			03
	BSTAT106 (MDC-2)	Statistical Techniques for Data Analysis Using SPSS	Multi-Disciplinary Course	03
	TOTAL CREDIT OF SEMESTER-II = 20 CREDITS			



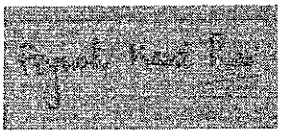
	SEMESTER -III			
	BSTAT201	Probability and Sampling Distributions	Theory (Maj/Min)	03
	BSTAT202	Lab based on theory papers	Practical (Maj/Min)	01
	OTHER MAJOR/MINOR SUBJECT-I			04
	OTHER MAJOR/MINOR SUBJECT-II			04
	SEC-III			03
	AEC-III			02
	BSTAT203 MDC-3	Probability Distribution and Testing of Hypothesis using SPSS	Multi-Disciplinary Course	03
	TOTAL CREDIT OF SEMESTER III - 20 CREDITS			

II

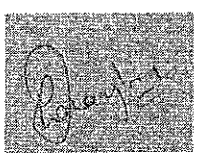
	SEMESTER -IV			
	BSTAT204	Sampling Techniques	Theory (Maj/Min)	02
	BSTAT205	Inferential Statistics	Theory (Maj/Min)	02
	BSTAT206	Lab based on theory papers	Practical (Maj/Min)	02
	OTHER MAJOR/MINOR SUBJECT-I			06
	OTHER MAJOR/MINOR SUBJECT-II			06
	AEC-III			02
	TOTAL CREDIT OF SEMESTER IV - 20 CREDITS			

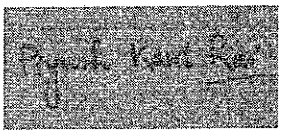


	SEMESTER -V			
III	**BSTAT301**	Multivariate Analysis and Non-parametric test	Theory	02
	BSTAT302	Analysis of Variance and Design of Experiments	Theory	02
	BSTAT303	Multivariate Analysis and Non-parametric test Lab	Practical	01
	BSTAT304	Design of Experiment Lab	Practical	01
	BSTAT305 (Minor for Other Faculty Students)	Basic Analysis of Variance and Design of Experiment	Theory	04
	OTHER MAJOR SUBJECT			06
	SUMMER INTERNSHIP		To be done in the summer term of the second year.	04**
	TOTAL CREDIT OF SEMESTER V - 20 CREDITS			

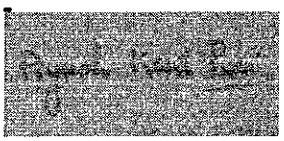


	SEMESTER -VI			
	BSTAT306	Applied Statistics	Theory	03
	BSTAT307	Operations Research	Theory	03
	BSTAT308	Applied Statistics Lab	Practical	01
	BSTAT309	Operations Research Lab	Practical	01
	BSTAT310 (Minor for Other Faculty Students)	Basic Optimization Theory	Theory	04
	OTHER MAJOR SUBJECT			08
	TOTAL CREDIT OF SEMESTER VI - 20 CREDITS			

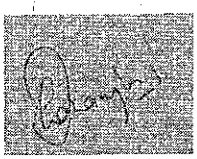




	SEMESTER -VII			
IV	**BSTAT401**	Mathematical Analysis	Theory	03
	BSTAT402	Advanced Statistical Methods for Data Analysis	Theory	03
	BSTAT403	Advanced Sampling Techniques	Theory	03
	BSTAT404	Advanced Probability Theory	Theory	03
	BSTAT405	Lab based on theory papers	Practical	02
	BSTAT406	Lab based on M.S. Excel	Practical	02
	BSTAT408 (Minor for Other Faculty Students)	Basic Sampling Techniques	Theory	04
	TOTAL CREDIT OF SEMESTER-VII = 20 CREDITS			



SEMESTER -VIII			
BSTAT409	Advanced Statistical Inference	Theory	03
BSTAT410	Advanced Multivariate Analysis	Theory	03
BSTAT411	Statistical Quality Control and Reliability	Theory	03
BSTAT412	Regression Analysis and Econometrics	Theory	03
BSTAT413	Lab based on theory papers	Practical	02
BSTAT414	Lab based on SPSS	Practical	02
BSTAT415 (Minor for Other Faculty Students)	Official Statistics and Population Studies	Theory	04
TOTAL CREDIT OF SEMESTER-VIII = 20 CREDITS			

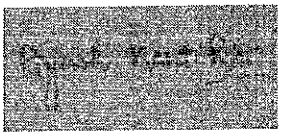


OR

The student who secures a minimum 75% marks upto sixth semester (i.e. up to III year)

	SEMESTER -VII			
IV	**BSTAT401**	Mathematical Analysis	Theory	03
	BSTAT402	Advanced Statistical Methods for Data Analysis	Theory	03
	BSTAT403	Advanced Sampling Techniques	Theory	03
	BSTAT404	Advance Probability Theory	Theory	03
	BSTAT405	Lab based on theory papers	Practical	02
	BSTAT406	Lab based on M.S. Excel	Practical	02
	BSTAT 407	Research Project		06* (Will be evaluated in semester-viii)
	BSTAT408 (Minor for Other Faculty Students)	Basic Sampling Techniques	Theory	04
		TOTAL CREDIT OF SEMESTER-VII = 20 CREDITS		

SEMESTER -VIII			
BSTAT409 **OR** **BSTAT410** **OR** **BSTAT411** **OR** **BSTAT412**	Advanced Statistical Inference OR Advanced Multivariate Analysis OR Statistical Quality Control and Reliability OR Regression Analysis and Econometrics	Theory	03
BSTAT413	Lab based on theory papers	Practical	01
BSTAT407	Research Project		06*+06*= 12*
BSTAT415 (Minor for Other Faculty Students)	Official Statistics and Population Studies	Theory	04
TOTAL CREDIT OF SEMESTER-VIII = 20 CREDITS			



SEMESTER I

BSTAT101: DESCRIPTIVE STATISTICS (UNIVARIATE) AND THEORY OF PROBABILITY-I — 2 CREDITS

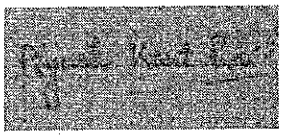
Course Objectives: The objective of this course is to provide a comprehensive understanding of various statistical methodologies. The course covers foundational statistical concepts, including measures of central tendency and dispersion and probability theory. These methodologies are crucial for analyzing, interpreting, and making informed decisions based on data.

Course Specific Outcomes: On completing this course a student will have:

- Knowledge of Statistics, its scope and its importance in various fields.
- Ability to understand concepts of sample vs. population and the difference between different types of data.
- Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.
- Ability to describe data with measures of central tendency and measures of dispersion.
- Ability to understand measures of skewness and kurtosis and their utility and significance.
- Ability to understand the concept of probability along with basic laws and axioms of probability.
- Ability to understand the terms mutually exclusive and independent and their relevance.
- Ability to identify the appropriate method (i.e. union, intersection, conditional, etc.) for solving a problem.
- Ability to apply basic probability principles to solve real-life problems.
- Ability to understand the concept of a random variable (discrete and continuous) and the concept of the probability distribution.

UNIT I: Introduction to Statistics, Meaning of Statistics, Importance of Statistics, Scope of Statistics in Industry, Introduction and contribution of Indian Scholars in Statistics. Statistical population, Attributes and Variables (Discrete and Continuous), Different types of scales – Nominal, Ordinal, Ratio and Interval, Primary data, Secondary data.

UNIT II: 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 III: Measures of Central tendency and Dispersion and their properties, Merits and Demerits of these Measures. Moments and Factorial moments, Shephard's correction for moments, Measures of Skewness and Kurtosis and their significance, Measures based on quartiles.

UNIT IV: Random experiment, Trial, Sample point and Sample space, Events, Operations of events, 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.

References:

David, S. (1994): Elementary Probability, Cambridge University Press.

Dudewicz, E.J. and Mishra, S.N. (2008): Modern Mathematics Statistics, Wiley.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013): Fundamental of Statistics, Vol I, World Press, Kolkata.

Gupta, S.C. and Kapoor, V.K. (2020): Fundamentals of Mathematical Statistics (12th ed.), Sultan Chand and Sons.

Lipschutz, S., Lipson, M. L. and Jain, K. (2010): Schaum's Outline of Probability. McGraw Hill.

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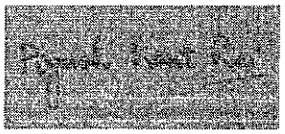
Meyer, P. (2017): Introductory Probability and Statistical Applications, Oxford & IBH Publishing.

Mood A.M., Graybill F.A. and Boes D.C. (2007): Introduction to the Theory of Statistics, Tata McGraw-Hill.

Mukhopadhyay, P. (1996): Mathematical Statistics, New Delhi, New Central Book Agency Pvt. Ltd.

Parzen, E.S. (1992): Modern Probability Theory and its Applications. Wiley.

Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang Book Society and Cambridge Univ. Press.



BSTAT102: DESCRIPTIVE DATA ANALYSIS LAB (UNIVARIATE) 1 CREDIT

Course Objectives: The objective of this course is to provide a practical understanding of statistical concepts including Bayes theorem of probability, conditional probability, measures of central tendency and dispersion, and Probability theory which are crucial for analysing, interpreting, and making informed decisions based on data.

Course Specific Outcomes: On completing this course a student will have:

- Ability to represent/summarize the data/information using appropriate Graphical methods, including common graphical tools (such as boxplots, histograms and stem and leaf plots) and also to draw inferences from these graphs
- Acquire the knowledge to identify the situation to apply the appropriate measure of central tendency as per the nature and need of the data and draw meaningful conclusions regarding the behaviour of the data.
- Acquire the knowledge to identify the situation to apply appropriate measure of dispersion as per the nature and need of the data and draw meaningful conclusions regarding the heterogeneity of the data.
- Ability to measure skewness and kurtosis of data and define their significance.
- Acquire the knowledge to compute conditional probabilities based on Bayes Theorem.

List of Practical

1. Problems based on graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives, Stem and Leaf Plot, Box Plot.
2. Problems based on calculation of Measures of Central Tendency.
3. Problems based on calculation of Measures of Dispersion.
4. Problems based on calculation of Moments, Measures of Skewness and Kurtosis.
5. Computation of conditional probabilities based on Bayes theorem.
6. Some more Practical based on theory.

References:

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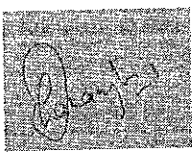
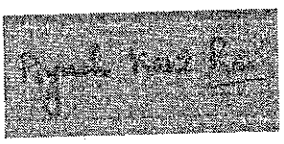




BSTAT103 (MDC1): STATISTICAL TECHNIQUES FOR DATA ANALYSIS USING MS EXCEL **3 CREDITS**

Course Objectives: The objective of this course is to make students software-friendly which will help them to go in corporate field as well as in govt. sector. Students will gain foundational as well as advanced knowledge of MS Excel including detailed understanding of statistical measures and interpretation in this course, would be beneficial in future aspects.

Course Specific Outcomes: On completing this course a student will have:

- Knowledge of Statistics, its scope and importance in various fields.
- Ability to understand concepts of sample vs. population and difference between different types of data.
- Knowledge of methods for summarizing data sets, including common graphical tools
- Ability to analyze measures of central tendency and measures of dispersion using Excel.
- Ability to understand and measure skewness and kurtosis and their utility and significance using Excel.
- Ability to analyse the relationship between two variables using Excel.
- Ability to understand the concept of random variables (discrete and continuous

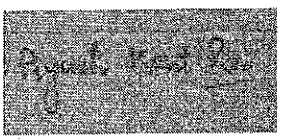
UNIT I: Introduction to Statistics, Importance of Statistics, Scope of Statistics in Industry, Statistical population, Attributes and Variables (Discrete and Continuous), Different types of scales – Nominal, Ordinal, Ratio and Interval, Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency, Secondary data.

UNIT II: Presentation of data through Excel: 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 III: Measures of Central Tendency and Dispersion through Excel and their properties, Merits and Demerits of these Measures. Measures of Skewness and Kurtosis and their significance, Measures based on quartiles.

UNIT IV: Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of Correlation, Spearman's Rank Correlation. Simple linear regression, principle of least squares and Properties of Regression coefficients using Excel.

References:



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Freund R.J. and Wilson W.J. (2003): Statistical Methods, Academic Press.

Narosa. Lipschutz, S., Lipson, M. L. and Jain, K. (2010): Schaum's Outline of Probability. McGraw Hill Education Pvt. Ltd.

Meyer, P. (2017): Introductory Probability and Statistical Applications, Oxford & IBH Publishing Co. Pvt. Ltd.

Panneerselvam, R. (2024): Business Statistics Using Excel: A Complete Course in Data Analytics. Taylor & Francis Group.

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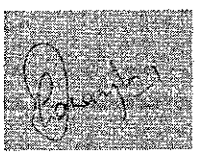
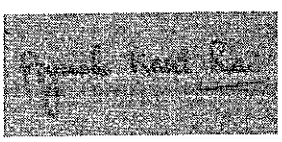




SEMESTER II

BSTAT104: DESCRIPTIVE STATISTICS (BIVARIATE) AND THEORY OF PROBABILITY-II **2 CREDITS**

Course Objectives: The objective of this course is to develop skills in bivariate data analysis and a detailed understanding of probability. Knowledge of the method of least squares for curve fitting, correlation, and simple linear regression, and performance of correlation and regression analysis would help them to resolve and analyse real-life problems.

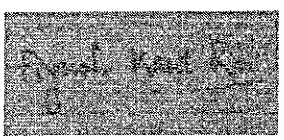
Course Specific Outcomes: On completing this course, a student will have:

- Knowledge of the method of least squares for curve fitting to theoretically describe experimental data with a function or equation and to find the parameters associated with the model.
- Knowledge of the concepts of correlation and simple linear regression, and perform correlation and regression analysis.
- Ability to interpret results from correlation and regression.
- Ability to compute and interpret rank correlation.
- Ability to understand the concept of qualitative data and its analysis.
- Knowledge of PMF, PDF, MGF, and some important inequalities.
- Ability to identify the application correlation and regression statistics in real-life problems.

UNIT I: Bivariate data, Principles of least squares, Most plausible values, Meaning of curve fitting, Fitting of straight line, parabola, logarithmic, power curves and other simple forms by method of least squares, Bi-variate frequency table, Correlation, Types of relationships, Scatter diagram, Karl-Pearson's, Correlation Coefficient and its properties.

UNIT II: Rank correlation and its coefficient (Spearman and Kendall Measures), Regression analysis through both types of regression equations for X and Y variables. Attributes: Notion and Terminology, Contingency table, Class frequencies and Ultimate class frequencies, Consistency, Association of Attributes, Independence, Measures of association for 2X2 table, Chi-square, Karl Pearson's Coefficient of Association.

UNIT III: 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, Independence of random variables.



Expectation of a random variable and its properties, Expectation of the sum of random variables and product of independent random variables, Conditional expectation and related problems.

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 for a sequence of independently and identically distributed random variables and their applications. (Statement Only)

References:

David, S. (1994): Elementary Probability, Cambridge University Press.

David, H.A. (1981). Order Statistics (2nd ed.), New York: John Wiley.

Dudewicz, E.J. and Mishra, S.N. (2008).Modern Mathematics Statistics, Wiley.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamentals of Statistics, Vol I, World Press, Kolkata.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamentals of Statistics, Vol II, World Press, Kolkata.

Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics (12th ed.), Sultan Chand and Sons.

Miller, I. and Miller, M. (2013). John E. Freund's Mathematical Statistics with Applications, Pearson Education, Asia.

Meyer, P. (2017). Introductory Probability and Statistical Applications (2nd ed.), New Delhi, Oxford & IBH Publishing Co. Pvt. Ltd.

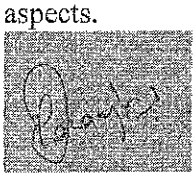
Mood A.M., Graybill F.A. and Boes D.C. (2007). Introduction to the Theory of Statistics (3rd ed.), New Delhi, Tata McGraw Hill Publishing Co. ltd.

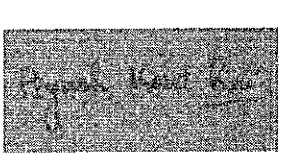
Mukhopadhyay, P. (1996). Mathematical Statistics, New Delhi, New Central Book Agency Pvt. Ltd.

Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.

BSTAT105: DESCRIPTIVE DATA ANALYSIS LAB (BIVARIATE) 1 CREDIT

Course Objectives: The objective of this course is to provide practical knowledge of bivariate data analysis, fitting of curves, regression analysis, etc. This course would be beneficial in future aspects.





Course Specific Outcomes: On completing this course, a student will have:

- Ability to deal with problems based on the fitting of curves by the Method of least squares, fitting of straight-line, second-degree polynomial, power curve, exponential curve, etc.
- Ability to deal with problems based on the determination of Regression lines and the calculation of the Correlation coefficient – grouped and ungrouped data.
- Ability to deal with problems based on determination of Rank correlation.

List of Practical

1. Problems based on fitting of curves by the Method of least squares, e.g., fitting of straight-line, second-degree polynomial, power curve, exponential curve, etc.
2. Problems based on determination of Regression lines and calculation of Correlation coefficient – grouped and ungrouped data.
3. Problems based on determination of Rank correlation.
4. Some more Practicals based on theory.

References:

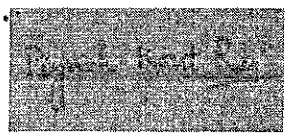
As suggested for paper code BSTAT104.

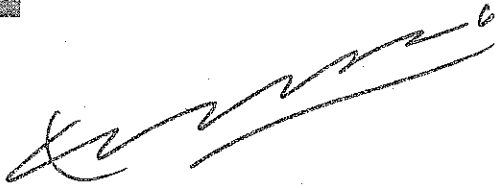
BSTAT106 (MDC-2): STATISTICAL TECHNIQUES FOR DATA ANALYSIS USING SPSS **3 CREDITS**

Course Objectives: The objective of this course is to make students software-friendly, which will help them to go into the corporate field as well as in the government. sector. Students will gain foundational as well as advanced knowledge of SPSS, including a detailed understanding of statistical measures and interpretation in this course, which would be beneficial in future aspects.

Course Specific Outcomes: On completing this course a student will have:

- Knowledge of IBM SPSS, its scope and importance in various fields.
- Ability to understand concepts of Scale and difference between different types of data.
- Knowledge of methods for summarizing data sets, including common graphical tools
- Ability to analyze measures of central tendency and measures of dispersion using SPSS.
- Ability to understand measure of skewness and kurtosis and their utility and significance using SPSS.





- Ability to understand correlation and regression analysis and their utility and significance using SPSS.

UNIT I: Introduction to Statistics, Importance of Statistics, Scope of Statistics in Industry, 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.

UNIT II: Presentation of data through SPSS: 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 using SPSS.

UNIT III: Measures of Central Tendency and Dispersion through Excel and their properties, Merits and Demerits of these Measures. Measures of Skewness and Kurtosis and their significance, Measures based on quartiles using SPSS.

UNIT IV: Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of Correlation, Spearman's Rank Correlation. Simple linear regression, principle of least squares and Properties of Regression coefficients using SPSS.

References:

David, S. (1994): Elementary Probability, Cambridge University Press.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013): Fundamental of Statistics, Vol I, World Press.

Freund R.J. and Wilson W.J. (2003): Statistical Methods, Academic Press.

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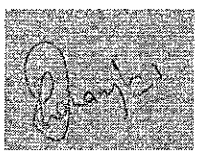
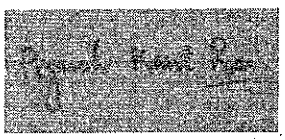
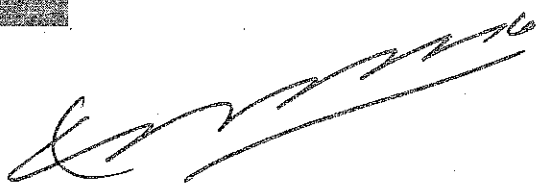






SEMESTER III

BSTAT201: PROBABILITY AND SAMPLING DISTRIBUTIONS **3 CREDITS**

Course Objectives: The objective of this course is to develop a detailed understanding of probability distributions and Sampling distributions, which would help them to resolve and analyse real-life problems.

Course Specific Outcomes: On completing this course, a student will have:

- Ability to understand the concept of qualitative data and its analysis.
- Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
- Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.

UNIT I: Bernoulli distribution, Binomial distribution, Poisson distribution (as limiting case of Binomial distribution), Hypergeometric, Geometric, and Negative Binomial and Discrete Uniform Distribution

UNIT II: Normal distribution and its properties, Standard Normal variate, Normal distribution as a limiting case of Binomial distribution, fitting of Normal distribution.

UNIT III: Multinomial distributions, fitting of Binomial, Poisson. Continuous Uniform distributions, Exponential, Gamma, Beta distributions and Cauchy distributions.

UNIT IV: Random sample from a distribution, parameter, statistic, and standard error. Sampling distributions of sample mean, sample variance, t, chi-square and F (Central and Non-central) (elementary properties only)

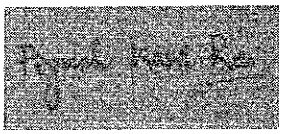
References:

David, S. (1994): Elementary Probability, Cambridge University Press.

Dudewicz, E.J. and Mishra, S.N. (2008). Modern Mathematics Statistics, Wiley.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamentals of Statistics, Vol I, World Press, Kolkata.

Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics (12th ed.), Sultan Chand and Sons.



Johnson, S. and Kotz, S. (1972). Distribution in Statistics Vol. I-II & III, Houghton and Mifflin.

Miller, I. and Miller, M. (2013). John E. Freund's Mathematical Statistics with Applications, Pearson Education, Asia.

Meyer, P. (2017). Introductory Probability and Statistical Applications (2nd ed.), New Delhi, Oxford & IBH Publishing Co. Pvt. Ltd.

Mood A.M., Graybill F.A. and Boes D.C. (2007). Introduction to the Theory of Statistics (3rd ed.), New Delhi, Tata McGraw-Hill Publishing Co. Ltd.

Mukhopadhyay, P. (1996). Mathematical Statistics, New Delhi, New Central Book Agency Pvt. Ltd.

Lipschutz, S., Lipson, M. L. and Jain, K. (2010).Schaum's Outline of Probability. McGraw Hill Education Pvt. Ltd, New Delhi.

Pitman, J. (1993). Probability. Narosa Publishing House.

Rohatgi, V.K. and Saleh, A.E. (2008).An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.

BSTAT202: LAB BASED ON THEORY PAPERS **1 CREDITS**

Course Objectives: The objective of the course is to impart necessary knowledge about the practical aspects of probability distributions and their applications.

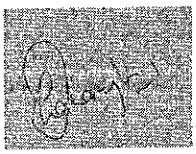
Course Specific Outcomes: On completing this course, a student will have:

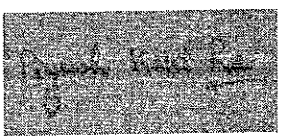
- Ability to fit Discrete Probability Distributions.
- Ability to fit Continuous Probability Distributions.
- Ability to deal with problems based on Discrete Probability Distributions.
- Ability to deal with problems based on Continuous Probability Distributions.

List of Practical:

1. Problems based on Discrete Probability Distributions.
2. Problems based on Continuous Probability Distributions.

References:





As suggested for the paper code BSTAT201.

BSTAT203 (MDC-3): Probability Distribution and Testing of Hypothesis using SPSS

3 CREDITS

Course Objectives: The objective of the course is to impart necessary knowledge about elementary probability distributions and testing of hypotheses to students of different undergraduate programmes. Starting with the basic terminology of probability distribution and hypothesis testing, to real-life problems from business and social phenomena.

Course Specific Outcomes: After culmination of this course, a student shall be:

- able to understand different probability distributions.
- able to describe data with the perspective of basic discrete and continuous probability distributions.
- able to solve real-life problems from business and social phenomena.
- able to test the statistical hypothesis using Parametric tests.

UNIT I: Introduction to Probability, Basic terminology, random variable, Concept of discrete and continuous random variables. Probability mass function, probability density functions and their properties. Marginal and Conditional distributions.

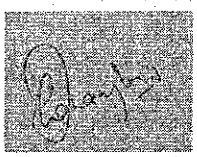
UNIT II: Standard discrete distributions: Bernoulli distribution, Binomial distribution, Poisson distribution, Geometric distribution and their fitting.

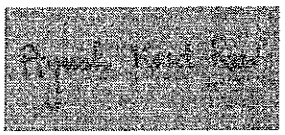
UNIT III: Standard continuous distributions: Normal distribution and its properties, Standard normal distribution, real life problem based on Normal distribution.

UNIT IV: Basics of testing of hypothesis: Formulation of Hypothesis, Null and Alternative hypotheses, critical region, type-I error, type-II error, power of the test, level of significance, two-tailed test, concept of p-value. Hypothesis testing procedure Parametric tests: Testing population mean, population proportion and variance of a single population using SPSS

UNIT V: Testing the differences in means and proportions of two independent populations.

Cross tabulation, Chi-square tests for Goodness of fit, test for independence using SPSS





References

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Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013): Fundamentals of Statistics, Vol I, World Press, Kolkata

Mood, A.M, Graybill, F.A. and Boes, D.C. (2017): Introduction to the Theory of Statistics, Third Edition, McGraw-Hill

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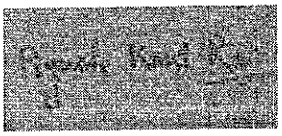


SEMESTER IV

BSTAT204: SAMPLING TECHNIQUES **2 CREDITS**

Course Objectives: The important concepts of sample, population, and sampling techniques, etc., in this paper will introduce the students to detailed concepts of sampling survey, which would be helpful in drawing gainful insights about the population.

Course Specific Outcomes: On completing this course, a student will have:

- Ability to understand the concept of sampling and how it is different from complete enumeration.
- Knowledge of various probability and non-probability sampling methods, along with estimates of population parameters
- Ability to identify the situations where the various sampling techniques shall be used.
- Knowledge of sampling and non-sampling errors.
- Knowledge of regression and ratio methods of estimation in simple random sampling (SRS).

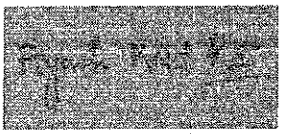
UNIT I: Universe, population and sample, sampling vs. complete enumeration, sampling units and frame, precision and efficiency of estimators, Simple Random sampling with and without replacement, use of random number tables in selection of simple random sample, Estimation of population mean and proportion, derivation of expression for variance of these estimators, estimation of variances, sample size determination.

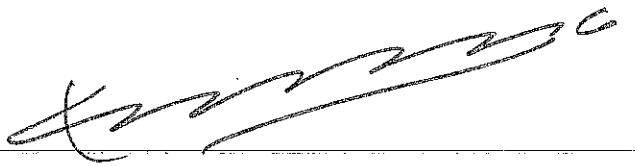
UNIT II: Stratified random sampling, Problem of allocation: equal, proportional and optimum (Neyman), Derivation of the expressions for the standard errors of the usual estimators when these allocations are used, gain in precision due to stratification, role of sampling cost in the sample allocation, minimization of variance for fixed cost, Systematic sampling: estimation of population mean and population total, standard errors of these estimators.

UNIT-III: Regression method of estimation, Ratio methods of estimation in simple random sampling, Cluster sampling with equal clusters, estimation of population mean and their mean square error.

UNIT IV: Double sampling, Two-stage sampling with equal first stage units: estimation of population means and its variance, multi-stage sampling with examples (definition only). Non-sampling errors.

References:





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Cochran, W.G. (2008). Sampling Techniques, Wiley India.

Des Raj. (1976). Sampling Theory. Tata McGraw Hill, New York.

DesRaj and Chandhok, P. (1998). Sample Survey Theory, Narosa Publishing House.

Mukhopadyay, P. (2007). Survey Sampling. Narosa Publisher, New Delhi.

Murthy, M. N. (1977). Sampling Theory and Statistical Methods. Statistical Pub. Society, Kolkata.

Singh, D. and Choudhary, F.S. (1977). Theory and Analysis of Sample Survey Designs. New Age

Sukhatme, P.V. and Sukhatme, B.V. (1970). Sampling Theory Surveys with Applications, Iowa State University Press.

Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. & Asok, C. (1984): Sampling Theories of Survey with Applications, IOWA State University Press and ISAS.

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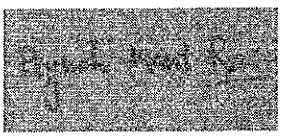
BSTAT205: INFERENTIAL STATISTICS **2 CREDITS**

Course Objectives: This course will enable students to gain knowledge of inferential statistics. Knowledge of point estimation, interval estimation, testing of hypotheses, etc., will provide basic knowledge of this paper, which would be very helpful in the field of research, as well as competitive exams and the corporate sector.

Course Specific Outcomes: On completing this course, a student will have:

- Ability to understand the difference between parameter & statistic and standard error & standard deviation.
- Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.
- Ability to understand and practice various methods of estimation of parameters.
- Knowledge of terms like null and alternative hypotheses, two-tailed and one-tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p-value etc.
- Ability to understand the concept of MP, UMP and UMPU tests



- Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one-sample and two-sample tests).

UNIT I: Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Problems and examples, Method of Maximum Likelihood and properties of maximum likelihood estimators (without proof)

UNIT II: Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters. Cramer-Rao inequality and its use in finding Minimum Variance Unbiased estimators (MVUE), Interval estimation.

UNIT III: Testing of hypotheses: Statistical hypotheses and their classifications, Type I and Type II errors, significance level, p-value, power of a test, Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests, Neyman-Pearson's lemma and its applications (simple vs. simple).

UNIT IV: Test of significance: Large sample tests for proportions and means (i) for one sample (ii) for two samples, Small sample tests based on t, F, and Chi-square distributions. Test of the Correlation Coefficient.

References:

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Freedman, D., Pisani, R. and Purves, R. (2014). Statistics. 4th Edition. Norton & Comp.

Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I. , Kolkata, The World Press.

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Kenney, J.F. and Keeping, E.S. (1947). Mathematics of Statistics. Part I. Chapman & Hall.

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Tanner, M. (1990). An Investigation for a Course in Statistics. McMillan, New York.

Tanur, J.M. (1989) Statistics. A Guide to the Unknown, Duxbury Press.

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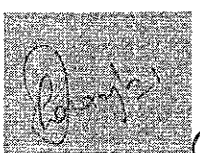
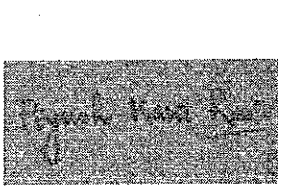




BSTAT206: LAB BASED ON THEORY PAPAERS **2 CREDITS**

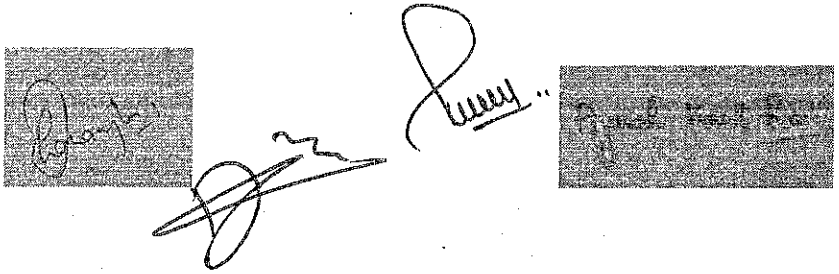
Course Objectives: This paper will provide the practical application of above theoretical paper. The practical application of determination of sample size, sample selection, application of various sampling techniques like SRS, Stratified sampling, two-stage sampling, two phase sampling etc., Formulation of hypothesis to application of suitable tests and their results' interpretation will help them to enhance technical aspects of mind.

Course Specific Outcomes: On completing this course, a student will have:

- Ability to draw a simple random sample with the help of table of random numbers.
- Ability to estimate population means and variance in simple random sampling.
- Ability to deal with problems based on Stratified random sampling for population means.
- Ability to deal with problems based on Systematic random sampling.
- Ability to deal with problems based on Ratio and regression estimation of population mean.
- Ability to specify Null and Alternate Hypothesis.
- Ability to conduct test of significance.
- Knowledge about Fisher's Z-transformation and its use in testing
- Ability to deal with problems based on large sample tests.
- Ability to deal with problems based on exact sampling distribution.

List of Practical:

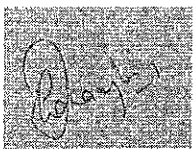
1. Problems based on drawing a simple random sample with the help of table of random numbers.
2. Problems based on estimation of population means and variance in simple random sampling.
3. Problems based on Stratified random sampling for population means (proportional and optimum allocation).
4. Problems based on Systematic random sampling
5. Problems based on two stage sampling



6. Problems based on Ratio method of estimation and Regression method of estimation of population mean and total.
7. Problems based on t – test.
8. Problems based on F-test.
9. Problems based on the Chi-square test.
10. Problems based on Fisher's Z-transformation and its use in testing
11. Problems based on the calculation of the power curve.
12. Problems based on large sample tests.
13. Some more Practicals based on theory.

References:

As suggested for paper code BSTAT203 & BSTAT204.



Self Declaration Form For Selection of MDC

1. Name of the Student.....
2. Enrollment No.....
3. Father's Name.....
4. Course/Semester.....
5. Mobile No.....
6. 12th Pass- with stream and Name of the Subject

7. Slect Any One Paper From- The following As Multidisciplianry Course (MDC) Run by Different Department:

Sr No.	Paper Name	Paper Code	Department Name
I.	Basics of Physics-	MDCPH-101	Physics
II.	Fundamental Chemistry-I	MDCCY-101	Chemistry
III.	Statistical Techniques for Data Analysis Using MS Excel	BSTAT103(MDC-1)	Mathmetics & Statistics
IV.	Fundamental of Information Technology	MDCIT-101	IT
V.	Contemporary Issues in Indian Economy-I	--------	Economic
VI.	Major Concepts in Politcal Science	--------	Political Science
VII.	Indian Culture and Knowledge System(From Early Times to 1950 AD)	--------	History
VIII.	Understanding Society and Social Institutions	--------	Sociology
IX.	हिन्दी के बहुआयामी प्रयोग	--------	हिन्दी एवं अन्य भारतीय भाषा विभाग
X.	History of English Literature	--------	English
XI.	Foundation Learning of Art Forms	--------	Fine Arts

08-Name of the Slected Subject From the Above List.....

Name of the Student

Signature with Date