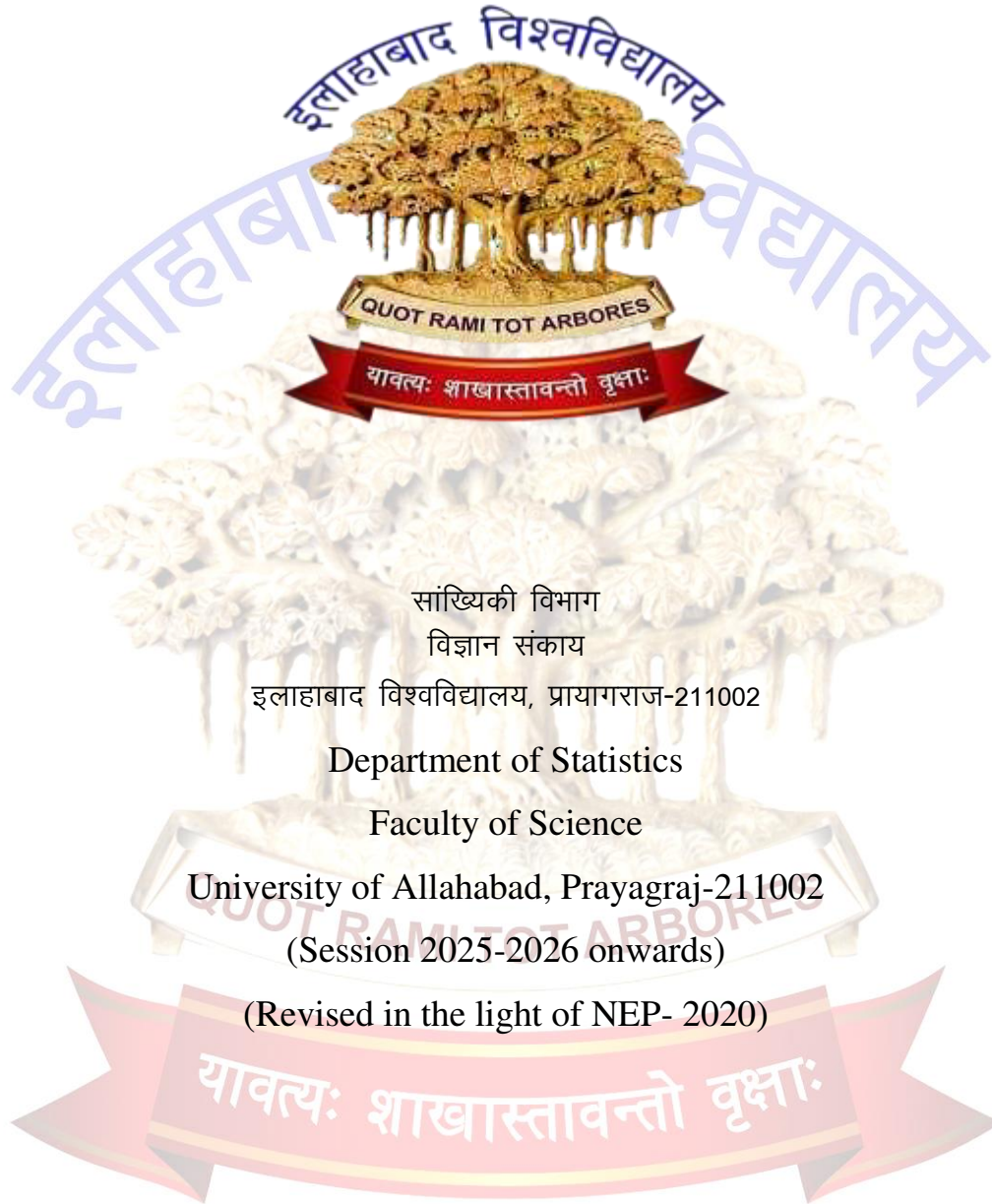


Learning Outcome Based Curriculum of
4Years (H)-Bachelor in Statistics (BA/B.Sc)

अधिगम प्रतिफल आधारित

4- वर्षीय स्नातक इन सांख्यिकी



सांख्यिकी विभाग

विज्ञान संकाय

इलाहाबाद विश्वविद्यालय, प्रायागराज-211002

Department of Statistics

Faculty of Science

University of Allahabad, Prayagraj-211002

(Session 2025-2026 onwards)

(Revised in the light of NEP- 2020)

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Prologue

About the Department:

The Statistics wing, under the Department of Mathematics, was started in 1968 with the initiative of Prof. H. C. Khare, then acting Head of the Department of Mathematics. The wing became operational immediately, with the first batch of B.Sc. I and M.Sc. previous students enrolling simultaneously. Soon, Mr. C. C. Pant was appointed in the Wing, and he primarily taught Statistics courses; other courses such as Numerical analysis and Econometrics were taught by faculty members from the Departments of Mathematics and Economics. In 1974, Dr. Samir K. Bhattacharya, Dr. Ram C. Tiwari and Dr. G. S. Pandey were appointed as regular teachers of Statistics and the Statistics wing continued to operate under the leadership of Prof. Bhattacharya. Professor Bhattacharya was the first Professor of Statistics, who became the Head of combined Department of Mathematics and Statistics in the year 1989 and continued till 1995 (till his death). In 1981, Dr. Anoop Chaturvedi joined as a faculty member of the Department, followed by Dr. S. Lalitha in 1986. Mr. Vishnu Kumar Srivastava, Mr. R.N. Verma, Mr. Raj Kumar Srivastava, Dr. Ajit Chaturvedi and Dr. Anup Kumar also served the department for a shorter period.



On August 21, 2000, the Department was established as a separate entity from Mathematics, with Dr. G. S. Pandey appointed as the first Head of Department, alongside Dr. Anoop Chaturvedi and Dr. S. Lalitha as faculty members. The department also attained the research calibre by the effort of Prof. Anoop Chaturvedi.

Many research projects including

- (i) Control Charts for Auto correlated Observations on Grid
- (ii) Sustainable Development: A Mathematical Model
- (iii) Joint Big Data project could be successfully completed.

The Department offers courses for Undergraduate, Postgraduate degrees, and a Doctoral program leading to a Ph.D. degree. The UG and PG students are provided a broad

foundation and training in statistical theory and applications. Such training has enabled them to earn jobs in government including civil services, Indian Statistical Services etc., all branches of industry, and academia. The Department has a well-equipped computer laboratory with modern computing facilities. The students are provided rigorous training of statistical computing and various statistical software. Presently, this is the first time in history of the Department when there are six faculty members with specialization in different areas of statistics such as Sampling Techniques, Reliability Theory, Bayesian Statistics, Order Statistics, Quality Control, Sequential Analysis, Survival Analysis, Mathematical Demography, Biostatistics and Stochastic Modelling. The Department also provides statistical support to various interdisciplinary branches as per their research needs.

Learning Outcomes Descriptors and Programme Outcomes (P.O.) for Undergraduate Certificate (Level 4.5)

Undergraduate Certificate: The certificate (in a field of learning or a disciplinary area) qualifies students who can apply technical and theoretical concepts and specialized knowledge and skills in a broad range of contexts to undertake skilled or paraprofessional work and/or to pursue further study/learning at higher levels.

Descriptor	Knowledge and understanding: The graduates should be able to demonstrate the acquisition of:
P.O. 1.	knowledge of facts, concepts, principles, theories, and processes in broad multidisciplinary learning contexts within the chosen fields of learning in broad multidisciplinary learning,
P.O. 2.	understanding of the linkages between the learning areas within and across the chosen fields of study,
P.O. 3.	procedural knowledge required for performing skilled or paraprofessional tasks associated with the chosen fields of learning.
Descriptor	General, technical and professional skills required to perform and accomplish tasks: The graduates should be able to demonstrate the acquisition of:
P.O. 4.	a range of cognitive and technical skills required for accomplishing assigned tasks relating to the chosen fields of learning in the context of broad multidisciplinary contexts.
P.O. 5.	cognitive skills required to identify, analyse and synthesize information from a range of sources.
P.O. 6.	cognitive and technical skills required for selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches to solving problems associated with the chosen fields of learning.
Descriptor	Application of knowledge and skills: The graduates should be able to demonstrate the ability to:
P.O. 7.	apply the acquired operational or technical and theoretical knowledge, and a range of cognitive and practical skills to select and use basic methods, tools, materials, and information to generate solutions to specific problems relating to the chosen fields of learning.
Descriptor	Generic learning outcomes: The graduates should be able to demonstrate the ability to:
P.O. 8.	listen carefully, read texts related to the chosen fields of study analytically, and present information in a clear and concise manner to different groups/audiences.
P.O. 9.	express thoughts and ideas effectively in writing and orally and present the results/findings of the experiments carried out in a clear and concise manner to different groups.
P.O. 10.	meet one's own learning needs relating to the chosen fields of learning.
P.O. 11.	pursue self-directed and self-managed learning to upgrade the knowledge and skills required for a higher level of education and training.
P.O. 12.	gather and interpret relevant quantitative and qualitative data to identify problems,

P.O. 13.	critically evaluate principles and theories associated with the chosen fields of learning.
P.O. 14.	make judgment and take decisions, based on analysis of data and evidence, for formulating responses to issues/problems associated with the chosen fields of learning, requiring the exercise of some personal responsibility for action and outputs/outcomes.
Descriptor	Constitutional, humanistic, ethical, and moral values: The graduates should be able to demonstrate the willingness to:
P.O. 15.	practice constitutional, humanistic, ethical, and moral values in one's life, and practice these values in real-life situations,
P.O. 16.	put forward convincing arguments to respond to the ethical and moral issues associated with the chosen fields of learning.
Descriptor	Employability and job-ready skills, and entrepreneurship skills and capabilities/ qualities and mindset: The graduates should be able to demonstrate the acquisition of:
P.O. 17.	knowledge and a basket of essential skills, required to perform effectively in a defined job relating to the chosen fields of study,
P.O. 18.	ability to exercise responsibility for the completion of assigned tasks and for the outputs of own work, and to take some responsibility for group work and output as a member of the group.
Descriptor	Credit requirements
P.O. 19.	The successful completion of the first year (two semesters) of the undergraduate programme of minimum 40 credit hours followed by an exit 4-credit skills-enhancement course,
Descriptor	Entry requirements
P.O. 20.	Certificate obtained after successful completion of Grade 12 or equivalent state of education.
P.O. 21.	Admission to the first year of the undergraduate programme will be open to those who have met the entrance requirements, including specified levels of attainment, in the programme admission regulations. Admission will be based on the evaluation of documentary evidence (including the academic record and/or evidence relating to the assessment and validation of prior learning outcomes) of the applicant's ability to pursue an undergraduate programme of study.

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Learning Outcomes Descriptors and Programme Outcomes (P.O.) for Undergraduate Diploma (Level 5)

Undergraduate Diploma: The diploma (in a field of learning or a disciplinary area) qualifies students who can apply specialized knowledge in a range of contexts to undertake advanced skilled or paraprofessional work and/or to pursue further learning/study at higher levels.

Descriptor	Knowledge and understanding: The graduates should be able to demonstrate the acquisition of:
P.O. 1.	theoretical and technical knowledge in broad multidisciplinary contexts within the chosen fields of learning,
P.O. 2.	deeper knowledge and understanding of one of the learning areas and its underlying principles and theories,
P.O. 3.	procedural knowledge required for performing skilled or paraprofessional tasks associated with the chosen fields of learning.
Descriptor	Skills required to perform and accomplish tasks: The graduates should be able to demonstrate the acquisition of:
P.O. 4.	cognitive and technical skills required for performing and accomplishing complex tasks relating to the chosen fields of learning,
P.O. 5.	cognitive and technical skills required to analyse and synthesize ideas and information from a range of sources and act on information to generate solutions to specific problems associated with the chosen fields of learning.
Descriptor	Application of knowledge and skills: The graduates should be able to demonstrate the ability to:
P.O. 6.	apply the acquired specialized or theoretical knowledge, and a range of cognitive and practical skills to gather quantitative and qualitative data,
P.O. 7.	select and apply basic methods, tools, materials, and information to formulate solutions to problems related to the chosen field(s) of learning.
Descriptor	Generic learning outcomes: The graduates should be able to demonstrate the ability to:
P.O. 8.	listen carefully, read texts related to the chosen fields of learning analytically, and present complex information in a clear and concise manner to different groups/audiences,
P.O. 9.	communicate in writing and orally the information, arguments, and results of the experiments and studies conducted accurately and effectively to specialist and non-specialist audiences.
P.O. 10.	meet one's own learning needs relating to the chosen field(s) of learning, work/vocation, and an area of professional practice,
P.O. 11.	pursue self-paced and self-directed learning to upgrade knowledge and skills required for pursuing a higher level of education and training.
P.O. 12.	critically evaluate the essential theories, policies, and practices by following a scientific approach to knowledge development.
P.O. 13.	make judgement and take decision, based on the analysis and evaluation of information, for determining solutions to a variety of unpredictable problems associated with the chosen fields of learning, taking responsibility for the nature and quality of outputs.
Descriptor	Constitutional, humanistic, ethical, and moral values: The graduates should be able to demonstrate the willingness and ability to:

P.O. 14.	embrace the constitutional, humanistic, ethical, and moral values, practice these values in life, and take a position regarding these values,
P.O. 15.	formulate arguments in support of actions to address issues relating the ethical and moral issues relating to the chosen fields of learning, including environmental and sustainable development issues, from multiple perspectives.
Descriptor	Employability and job-ready skills, and entrepreneurship skills and capabilities/ qualities and mindset: The graduates should be able to demonstrate the acquisition of knowledge and essential skill sets that are necessary to:
P.O. 16.	take up job/employment relating to the chosen fields of study or professional practice requiring the exercise of full personal responsibility for the completion of tasks and for the outputs of own work, and full responsibility for the group task/ work as a member of the group/team.
P.O. 17.	exercise self-management within the guidelines of study and work contexts.
P.O. 18.	supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.
Descriptor	Credit requirements
P.O. 19.	The successful completion of the first two years (four semesters) of the undergraduate programme involving a minimum of 80 credit hours followed by an exit 4-credit skills-enhancement course
Descriptor	Entry requirements
P.O. 20.	Continuation of study or lateral entry in the second year of the undergraduate programme will be possible for those who have met the entrance requirements, including specified levels of attainment, specified in the programme regulations. The continuation of the study will be based on the evaluation of documentary evidence (including the academic record and/or evidence relating to the assessment and certification of prior learning) of the applicant's ability to pursue an undergraduate programme of study. Lateral entry into the programme of study at NHEQF level 5 will be based on the validation of prior learning outcomes achieved, including those achieved outside of formal learning or through learning and training in the workplace or in the community, through continuing professional development activities, or through independent/self-directed learning activities

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Learning Outcomes Descriptors and Programme Outcomes (P.O.) for a Bachelor's degree (Level 5.5)

Bachelor's degree: The bachelor's degree qualifies students who can apply a broad and coherent body of knowledge and skills in a range of contexts to undertake professional work and/or for further learning.

Descriptor	Knowledge and understanding: The graduates should be able to demonstrate the acquisition of:
P.O. 1.	comprehensive, factual, theoretical, and specialized knowledge in broad multidisciplinary contexts with depth in the underlying principles and theories relating to one or more fields of learning.
P.O. 2.	knowledge of the current and emerging issues and developments within the chosen field(s) of learning.
P.O. 3.	procedural knowledge required for performing and accomplishing professional tasks associated with the chosen fields of learning.
Descriptor	General, technical and professional skills required to perform and accomplish tasks: The graduates should be able to demonstrate the acquisition of:
P.O. 4.	cognitive and technical skills required for performing and accomplishing complex tasks relating to the chosen fields of learning.
P.O. 5.	cognitive and technical skills required to evaluate and analyze complex ideas,
P.O. 6.	cognitive and technical skills required to generate solutions to specific problems associated with the chosen fields of learning.
Descriptor	Application of knowledge and skills: The graduates should be able to demonstrate the ability to:
P.O. 7.	apply the acquired specialized technical or theoretical knowledge, and cognitive and practical skills to gather and analyze quantitative/qualitative data to assess the appropriateness of different approaches to solving problems,
P.O. 8.	employ the right approach to generate solutions to problems related to the chosen fields of learning.
Descriptor	Generic learning outcomes: The graduates should be able to demonstrate the ability to:
P.O. 9.	listen carefully, to read text related to the chosen fields of learning analytically and present complex information in a clear and concise manner to different groups/audiences.
P.O. 10.	communicate in writing and orally the constructs and methodologies adopted for the studies undertaken relating to the chosen fields of learning,
P.O. 11.	make coherent arguments to support the findings/results of the study undertaken to specialist and non-specialist audiences.
P.O. 12.	meet one's own learning needs relating to the chosen field(s) of learning,
P.O. 13.	pursue self-paced and self-directed learning to upgrade knowledge and skills that will help adapt to changing demands of the workplace and pursue higher level of education and training.
P.O. 14.	critically evaluate evidence for taking actions to generate solutions to specific problems associated with the chosen fields of learning based on

	empirical evidence.
P.O. 15.	make judgement and take decisions based on the analysis and evaluation of information for formulating responses to problems, including real-life problems,
P.O. 16.	exercise judgement across a broad range of functions based on empirical evidence, for determining personal and/or group actions to generate solutions to specific problems associated with the chosen fields of learning.
Descriptor	Constitutional, humanistic, ethical, and moral values: The graduates should be able to demonstrate the willingness and ability to:
P.O. 17.	Embrace constitutional, humanistic, ethical, and moral values, and practice these values in life.
P.O. 18.	identify ethical issues related to the chosen fields of study,
P.O. 19.	formulate coherent arguments about ethical and moral issues, including environmental and sustainable development issues, from multiple perspectives.
P.O. 20.	follow ethical practices in all aspects of research and development, including avoiding unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
Descriptor	Employability and job-ready skills, and entrepreneurship skills and capabilities/ qualities and mindset: The graduates should be able to demonstrate the acquisition of:
P.O. 21.	knowledge and essential skills set and competence that are necessary to take up a professional job relating to the chosen field of learning and professional practice,
P.O. 22.	entrepreneurship skills and mindset required for setting up and running an economic enterprise or pursuing self-employment requiring the exercise of full personal responsibility for the outputs of own work, and full responsibility for the output of the group,
P.O. 23.	the ability to exercise management and supervision in the contexts of work or study activities involving unpredictable work processes and working environments.

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Learning Outcomes Descriptors and Programme Outcomes for a Bachelor's degree (Honours/ Honours with Research) or the Post-Graduate Diploma (Level 6)

Bachelor's degree (Honours): Prepare individuals who can apply a body of knowledge in a specific context to undertake professional work and for research and further learning.

Bachelor's degree (Honours with Research): Prepare individuals who can apply an advanced body of knowledge in a range of contexts to undertake professional work and apply specialized knowledge and skills for research and scholarship, and/or for further learning relating to the chosen field(s) of learning, work/vocation, or professional practice.

Post-Graduate Diploma: The Post-Graduate Diploma qualifies students who can apply a body of advanced knowledge and skills in a range of contexts to undertake professional or highly skilled work and/or further learning.

Descriptor	Knowledge and understanding: The graduates should be able to demonstrate the acquisition of:
P.O. 1.	advanced knowledge about a specialized field of enquiry, with depth in one or more fields of learning within a broad multidisciplinary/interdisciplinary context.
P.O. 2.	a coherent understanding of the established methods and techniques of research and enquiry applicable to the chosen fields of learning.
P.O. 3.	an awareness and knowledge of the emerging developments and issues in the chosen fields of learning,
P.O. 4.	procedural knowledge required for performing and accomplishing professional tasks associated with the chosen fields of learning.
Descriptor	General, technical and professional skills required to perform and accomplish tasks: The graduates should be able to demonstrate the acquisition of:
P.O. 5.	a range of cognitive and technical skills required for performing and accomplishing complex tasks relating to the chosen fields of learning,
P.O. 6.	cognitive and technical skills relating to the established research methods and techniques,
P.O. 7.	cognitive and technical skills required to evaluate complex ideas and undertake research and investigations to generate solutions to real-life problems,
P.O. 8.	generate solutions to complex problems independently, requiring the exercise of full personal judgement, responsibility, and accountability for the output of the initiatives taken as a practitioner.
Descriptor	Application of knowledge and skills: The graduates should be able to demonstrate the ability to:
P.O. 9.	apply the acquired advanced technical and/or theoretical knowledge and a range of cognitive and practical skills to analyze the quantitative and qualitative data gathered drawing on a wide range of sources for identifying problems and issues relating to the chosen fields of learning,
P.O. 10.	apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems.
Descriptor	Generic learning outcomes: The graduates should be able to

	demonstrate the ability to:
P.O. 11.	listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/ audiences,
P.O. 12.	communicate technical information and explanations, and the findings/ results of the research studies relating to specialized fields of learning,
P.O. 13.	present in a concise manner one's views on the relevance and applications of the findings of research and evaluation studies in the context of emerging developments and issues.
P.O. 14.	meet own learning needs relating to the chosen fields of learning,
P.O. 15.	pursue self-paced and self-directed learning to upgrade knowledge and skills that will help accomplish complex tasks and pursue a higher level of education and research.
	The graduates should be able to demonstrate:
P.O. 16.	a keen sense of observation, enquiry, and capability for asking relevant/ appropriate questions,
P.O. 17.	the ability to problematize, synthesize and articulate issues and design research proposals,
P.O. 18.	the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships,
P.O. 19.	the capacity to develop appropriate tools for data collection,
P.O. 20.	the ability to plan, execute and report the results of an experiment or investigation,
P.O. 21.	the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in own research work, regardless of the funding authority or field of study,
P.O. 22.	examine and assess the implications and consequences of emerging developments and issues relating to the chosen fields of study based on empirical evidence.
P.O. 23.	make judgement in a range of situations by critically reviewing and consolidating evidence,
P.O. 24.	exercise judgement based on evaluation of evidence from a range of sources to generate solutions to complex problems, including real-life problems, associated with the chosen field(s) of learning requiring the exercise of full personal responsibility and accountability for the initiatives undertaken and the outputs/outcomes of own work as well as of the group as a team member.
Descriptor	Constitutional, humanistic, ethical, and moral values: The graduates should be able to demonstrate the willingness and ability to:
P.O. 25.	Embrace and practice constitutional, humanistic, ethical, and moral values in life.
P.O. 26.	adopt objective, unbiased, and truthful actions in all aspects of work related to the chosen field(s) of learning and professional practice.
P.O. 27.	present coherent arguments in support of relevant ethical and moral issues.
P.O. 28.	participate in actions to address environmental and sustainable

	development issues.
P.O. 29.	follow ethical practices in all aspects of research and development, including avoiding unethical practices such as fabrication, falsification, or misrepresentation of data or committing plagiarism.
Descriptor	Employability and job-ready skills, and entrepreneurship skills and capabilities/ qualities and mindset: The graduates should be able to demonstrate the acquisition of knowledge and skill sets required for:
P.O. 30.	adapting to the future of work and to the demands of the fast pace of technological developments and innovations that drive a shift in employers' demands for skills, particularly with respect to the transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes.
P.O. 31.	managing complex technical or professional activities or projects, requiring the exercise of full personal responsibility for the output of own work as well as for the outputs of the group as a member of the group/team.
P.O. 32.	exercising supervision in the context of work having unpredictable changes.
Credit requirements	Successful completion of the 4-year (eight semesters) undergraduate programme involving a minimum of 160 credits, with a minimum of 40 credits each at level 4.5, 5, 5.5, and 6 of the NHEQF. A 1-year/2-semester Post-Graduate Diploma programme builds on a 3-year/6-semester bachelor's degree and requires a minimum of 40 credits for individuals who have completed a Bachelor's programme.
Entry requirements	An individual seeking admission to the bachelor's degree (Honours/ Honours with Research) in a specified field of learning would normally have completed all requirements of the relevant 3-year Bachelor's degree. (After completing the requirements of a 3-year bachelor's degree, candidates who meet a minimum 75% marks or its equivalent grade will be allowed to continue studies in the fourth year of the undergraduate programme leading to the bachelor's degree (Honours with Research)). Continuation of undergraduate programme leading to the bachelor's degree (Honours/ Honours with Research) will be open to those who have met the entrance requirements, including specified levels of attainment, in the programme admission regulations. Continuation of the programme of study will be based on the evaluation of documentary evidence (including the academic record and/or evidence relating to the assessment and certification of prior learning) of the applicant's ability to pursue study during the fourth year (semesters 7 & 8) of the 4-year Bachelor's degree (Honours/ Honours with Research) programme. Lateral entry into the programme of study at NHEQF level 6 will be based on the validation of prior learning outcomes, including those achieved outside of formal learning or through learning and training in the workplace, through continuing professional development activities, or through independent/self-directed/self-managed learning activities.

Program Specific Outcome of UG course

PSO-1: Core knowledge:

Acquire core knowledge of the basic concepts of statistics which include the major areas of probability theory, probability distributions, distribution theory, statistical inference, survey sampling, designs of experiments, applied statistics, mathematical methods, non- parametric inference and operations research.

PSO-2: Practical skills:

Practical exercises done will enable students to analyze and interpret data and also to draw valid conclusions. This will enable students to face real time applications.

PSO-3: Mathematical foundation:

Possess strong mathematical skills needed for theoretical statistical reasoning, proof techniques, derivations, etc.

PSO-4: Problem-solving & modeling:

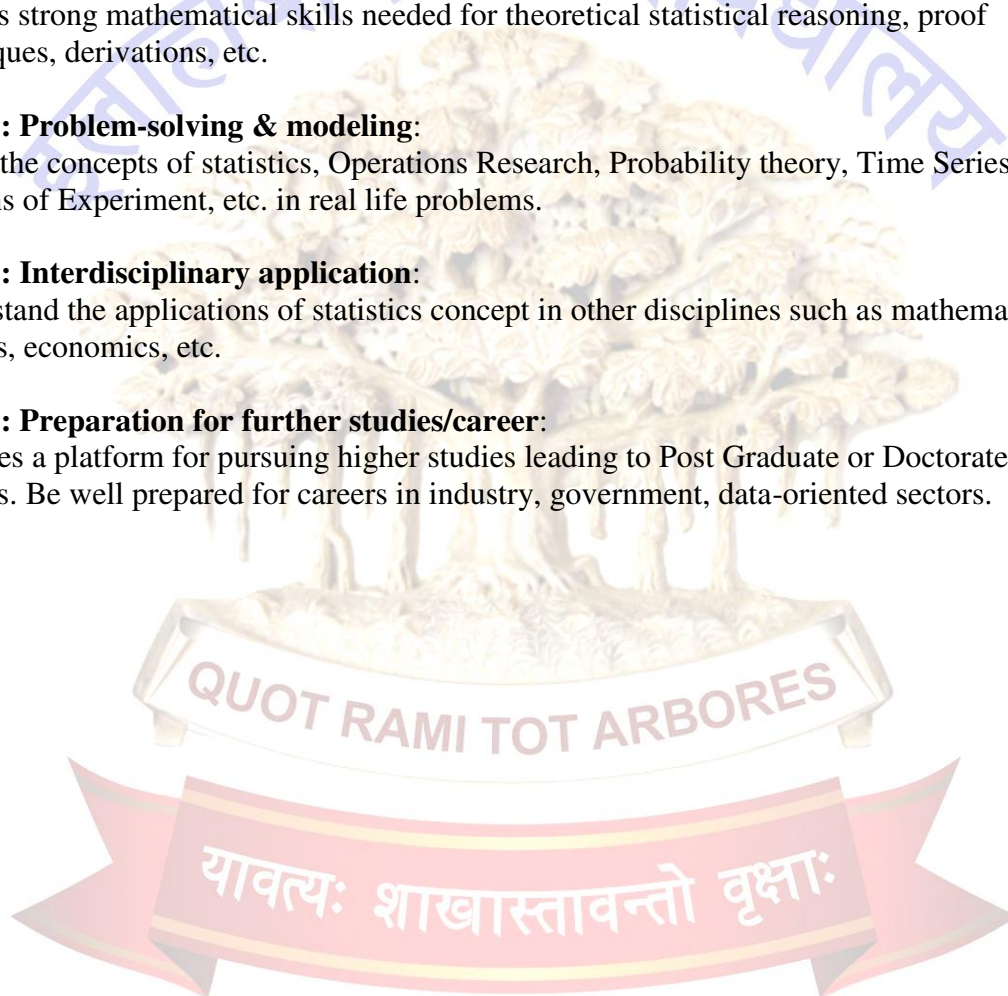
Apply the concepts of statistics, Operations Research, Probability theory, Time Series, Designs of Experiment, etc. in real life problems.

PSO-5: Interdisciplinary application:

Understand the applications of statistics concept in other disciplines such as mathematics, physics, economics, etc.

PSO-6: Preparation for further studies/career:

Provides a platform for pursuing higher studies leading to Post Graduate or Doctorate degrees. Be well prepared for careers in industry, government, data-oriented sectors.



DEPARTMENT OF STATISTICS
UNIVERSITY OF ALLAHABAD
B.A. /B.Sc.(H). STATISTICS
(4 Year Program under NEP)
To be effective from 2025-26
Course Outline (Major Subjects)
Semester-wise

1st Semester

Paper	Theory (Credit /Marks)	Practical (Credit/ Marks)	Maximum Credit/ Marks
Statistical Methods-I	3/ 45 Ext.+30 Int.=75	1/15 Ext.+10 Int.=25	4/100
Probability Theory-I	3/ 45 Ext.+30 Int.=75	1/15 Ext.+10 Int.=25	4/100

2nd Semester

Paper	Theory (Credit /Marks)	Practical (Credit/ Marks)	Maximum Credit/ Marks
Statistical Methods-II	3/ 45 Ext.+30 Int.=75	1/15 Ext.+10 Int.=25	4/100
Probability Theory-II	3/ 45 Ext.+30 Int.=75	1/15 Ext.+10 Int.=25	4/100

QUOT RAMI TOT ARBORES

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(U.G. Semester I)**Course Information****Statistical Methods - I****Course Objectives**

- Introduce students to the fundamental principles of statistical analysis, focusing on populations, samples, and different scales of measurement.
- Help students understand and apply techniques for classifying data into quantitative, qualitative, time series, cross-sectional, and multivariate types.
- Teach the process of constructing frequency tables with one or more factors of classification, and the basics of using computer applications for data management.
- Develop skills in representing data graphically through various methods such as bar charts, pie charts, histograms, frequency polygons, ogives, and box plots.
- Train students in calculating and interpreting measures of central tendency.

Syllabus

Unit	Course Content	Hours of Teaching
I	Introduction, scope, limitations, and misuses of Statistics. Introduction to Statistical concepts: Understanding statistical populations and samples, scales of measurement: nominal, ordinal, interval, and ratio. Classification of data: quantitative vs. qualitative data. Types of data: primary, secondary, time series, cross-sectional, longitudinal, and multivariate data.	[10]
II	Construction of tables with one or more classification factors. Frequency distributions and cumulative frequency distributions. Graphical representations: bar charts, pie charts, histograms, frequency polygons, ogives, and box plots. One-dimensional, two-dimensional, and multidimensional visualizations.	[10]
III	Concepts and measures of central tendency: mean (A.M., G.M., H.M.), median, mode, quartiles, along with their applications, merits, and demerits.	[10]
IV	Origin of computers; Computer generations; Importance of computers; Hardware components: CPU, Memory, Input Output devices. Mouse navigation tool. Operating system: History, Windows operating System-Interface; File management; Input output services. Software: Introduction to System software; Application software: Word processing software – Microsoft Office Word, Spreadsheet software – Microsoft Office Excel, Presentation software – Microsoft Office PowerPoint (Interface of all three application software, File handling, Editing, Formatting, and final output) Excel as a database software: Cell referencing, Concept of list, Manipulation of data, Data sorting and filtering, Naming of cells,	[15]

	Functions specifically Numeric/Mathematical functions, Statistical functions, Logical functions, and Lookup functions; Statistical analysis using Excel – Descriptive statistics, Curve fitting, Correlation, and Regression analysis; Excel graphs. Basics of the Internet and its application in communication.	
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Texts / Reference Books

1. Goon, A.M., M.K. Gupta and B. Dasgupta (2013): Fundamentals of statistics, vol I, World Press, Calcutta.
2. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
3. Weatherburn C.E. (1961): A first course of Mathematical statistics, Cambridge University press.
4. Sinha, P.K. (2010): Computer fundamentals, University Science press.

Course Outcomes

CO1: Understand and explain the fundamental concepts of statistics, including its scope, limitations, and misuses; differentiate between statistical populations and samples, and describe various scales of measurement such as nominal, ordinal, interval, and ratio.

CO2: Classify different types of data including primary, secondary, time series, cross-sectional, longitudinal, multivariate, quantitative, and qualitative data; construct tables and frequency distributions for effective data organization and representation.

CO3: Create and interpret graphical representations such as bar charts, pie charts, histograms, frequency polygons, ogives, and box plots; visualize one-dimensional, two-dimensional, and multidimensional data effectively.

CO4: Compute and analyze statistical measures of central tendency such as arithmetic mean, geometric mean, harmonic mean, median, mode, and quartiles; evaluate their applications, advantages, and limitations in data analysis.

CO5: Demonstrate understanding of computer fundamentals including the evolution of computers, hardware components, and operating systems; perform essential tasks using Windows OS and Microsoft Office applications like Word, Excel, and PowerPoint.

CO6: Apply Excel for data handling and statistical analysis using functions such as numeric, statistical, logical, and lookup; perform tasks including cell referencing, data sorting/filtering, descriptive statistics, correlation, regression, and graph creation; explain basic internet concepts and their applications in communication.

COs	PO2	PO3	PO6	PO14	PSO1	PSO2	PSO3	PSO7
CO1	✓	✓			✓	✓		
CO2			✓			✓		
CO3	✓	✓				✓	✓	
CO4	✓		✓	✓				✓
CO5		✓	✓	✓	✓		✓	✓
CO6		✓	✓	✓	✓		✓	✓

Probability Theory-I**Course Information**

	Theory	Practical	Cumulative
Credits /	[3] /	[1] /	[4] /
Marks	[45 (External)+ 30 (Internal)]	[15 (External)+ 10 (Internal)]	[100]

Course Objectives:

- To introduce the fundamental concepts of probability and its application in real-life and theoretical problems.
- To develop the mathematical framework for understanding random variables and probability distributions.
- To teach students how to model uncertainty using random variables, expectations, and distribution.
- To introduce students to transformations of variables.

Syllabus

Unit	Course Content	Hours of Teaching
I	[Random experiments, sample space, events, algebra of events, definitions of probability, probability spaces, relationship of axiomatic and classical probability, role of frequency ratios, properties of probability measure, subadditivity, Boole's inequality.]	[12]
II	[Probability of union of events, matching problem, repeated birthday problem, occupancy problem, conditional probability and associated probability space, Bayes theorem, independence of events.]	[12]
III	[Random variables as functions, induced probability measure via inverse mapping, induced probability distribution, distribution functions and their properties, probability mass function (pmf) of discrete random variables, probability density function (pdf) of continuous random variables,.]	[10]
IV	[Random vector, marginal and conditional distributions, independence of random variables]	[11]

Texts / Reference Books

- Hogg, R.V., Tanis, E.A. and Rao J.M.: Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
- Miller, Irwin and Miller, Marylees: John E. Freund's Mathematical Statistics with Applications, Pearson Education, Asia.
- Myer, P.L.: Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.
- S. C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics.
- V. K. Rohatgi and E. Saleh, An Introduction to the Probability and Statistics.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Understand and apply the foundational principles of probability theory to a variety of contexts.
- Analyze events using conditional probability, independence, and Bayes' theorem.
- Define, classify, and manipulate discrete and continuous random variables and their associated functions.
- Compute mathematical expectations, variances, and use generating functions.
- Solve real-world problems involving uncertainty using the tools of probability theory.

Course Outcomes (COs)	PO-2	PO-3	PO-6	PO-7	PO-12	PSO-1	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓		✓	✓		✓	✓	✓		✓
CO-2		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓		✓	✓	✓	✓	
CO-4		✓	✓	✓	✓	✓	✓	✓		✓
CO-5	✓		✓	✓	✓	✓	✓	✓	✓	✓

यावत्यः शाखास्तावन्तो वृक्षाः

(U.G. Semester II)**Course Information****Statistical Methods-II****Course Objectives**

- Introduce students to measures of dispersion, coefficient of variation, moments, skewness, and kurtosis, along with their applications in data analysis.
- Train students in correlation and regression techniques, including simple and nonlinear regression, correlation measures, and the method of least squares.
- Provide understanding of multivariate data analysis through multiple regression and multiple/partial correlation, and categorical data analysis using association measures.
- Familiarize students with the basics of R, R Studio, and R Commander for statistical computing, data handling, and transformation.
- Develop practical skills in graphical representation, descriptive statistics, correlation, regression, and problem-solving using R on real or simulated datasets.

Syllabus

Unit	Course Content	Hours of Teaching
I	Measures of dispersion: range, mean deviation, quartile deviation, variance, and standard deviation. Absolute and relative measures of dispersion, the coefficient of variation. Concepts of moments, skewness, and kurtosis, with practical applications.	[10]
II	Simple linear regression, method of least squares, correlation coefficient, correlation ratio, intraclass correlation, rank correlation, and fitting of some nonlinear curves.	[10]
III	Multivariate data: Multiple regression, multiple and partial correlation for three variables. Analysis of Categorical Data: consistency, independence, and association of attributes, coefficient of contingency.	[15]
IV	R - Statistical package: Basics of R, R Studio, and R Commander; Creation of data files; Import export of data files; Transformation of data; Graphical representation of data using R; Descriptive statistics using R.	[10]

Texts / Reference Books

1. Goon, A.M., M.K. Gupta and B. Dasgupta (2013): Fundamentals of statistics, vol I, World Press, Calcutta.
2. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
3. Weatherburn C.E. (1961): A first course of Mathematical statistics, Cambridge University press.
4. Sinha, P.K. (2010): Computer fundamentals, University Science press.

5. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, 2009. A Beginner's Guide to R, Springer.

Course Outcomes

CO1: Explain and calculate various measures of dispersion including range, mean deviation, quartile deviation, variance, and standard deviation, and differentiate between absolute and relative measures such as the coefficient of variation.

CO2: Understand and apply the concepts of moments, skewness, and kurtosis to describe the shape and characteristics of data distributions.

CO3: Perform simple linear regression analysis using the method of least squares and interpret correlation coefficients, including Pearson's correlation, correlation ratio, intraclass correlation, and rank correlation.

CO4: Apply methods for fitting nonlinear curves to data and understand their practical uses.

CO5: Analyze multivariate data using multiple regression and partial correlation for three variables; evaluate categorical data through tests of consistency, independence, association of attributes, and coefficient of contingency.

CO6: Demonstrate proficiency in the basics of the R statistical package (R Studio, R Commander); create and manage data files, perform data transformations, produce graphical data representations, and execute descriptive statistical analyses using R.

COs	PO2	PO3	PO6	PO7	PO12	PSO1	PSO4	PSO6	PSO8
CO1	✓	✓			✓	✓		✓	
CO2	✓	✓	✓			✓		✓	
CO3		✓		✓	✓	✓		✓	
CO4	✓		✓			✓			
CO5	✓	✓	✓	✓	✓		✓		✓
CO6	✓	✓		✓	✓	✓			✓

यावत्यः शाखास्तावन्तो वृक्षाः

(Probability Theory-II)**Course Information**

	Theory	Practical	Cumulative
Credits / Marks	[3] / [45 (External)+ 30 (Internal)]	[1] / [15 (External)+ 10 (Internal)]	[4] / [100]

Course Objectives:

- To provide a foundational understanding of probability and their distribution and their applications.
- To develop students' skills in working with distributions, limit theorems, and convergence of random variables.
- To familiarize students with both discrete and continuous probability distributions commonly used in statistics and applied sciences.

Syllabus

Unit	Course Content	Hours of Teaching
I	[Mathematical Expectation and Functions of Random Variables, Mathematical expectation, moments, factorial moments, moment generating function, probability generating function.]	[12]
II	[Expectation of jointly distributed random variables, marginal and conditional expectation, correlation, Chebyshev's inequality, Markov's inequality, functions of random variables.]	[12]
III	[Bernoulli distribution, binomial distribution, Poisson distribution, derivation of Poisson distribution as a limiting case of binomial distribution, geometric distribution, negative binomial distribution, hypergeometric distribution, Multinomial distribution.]	[11]
IV	[Uniform distribution, normal distribution and its relationship with the binomial and Poisson distribution, Cauchy distribution, bivariate normal distribution and its marginal and conditional distributions.]	[10]

Texts / Reference Books

- Gun, A.M., Gupta, M.K. and Dasgupta, B. (2003): An Outline of Statistical Theory, Vol. I, 4th Edn. World Press, Kolkata.
- Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. John Wiley and Sons.
- Hogg, R.V. and Tanis, E.A. (2009): A Brief Course in Mathematical Statistics. Pearson Education.
- Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics. Tata McGraw-Hill Pub. Co. Ltd.
- Fundamentals of Mathematical Statistics, S. C. Gupta & V.K. Kapoor.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Understand and distinguish between various modes of convergence.
- Apply CLT and inequalities in solving probability problems.
- Identify and apply commonly used discrete and continuous probability distributions in in real-world contexts.

Course Outcomes (COs)	P.O.2	P.O.3	P.O.6	P.O.7	P.O.12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓			✓		✓	✓	
CO2		✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓		✓	✓

