

DDU GORAKHPUR UNIVERSITY, GORAKHPUR
DEPARTMENT OF MATHEMATICS AND STATISTICS



Syllabus

based on

National Education Policy- 2020

under

Choice Based Credit System (CBCS)

for

Ph. D. COURSE WORK

in

STATISTICS

(Effective from Session 2024-2025)

Course Work for Ph. D. Statistics Students Based on CBCS

The course Work for Ph. D. Statistics will be spread in only one semester (six months).

Objectives

- 01.** To develop critical thinking ability about the fundamental aspects of statistics.
- 02.** Imparting knowledge in research work in various emerging fields of statistics and its applications.
- 03.** Train the students with statistical theories, methods and computational techniques for carrying out scientific investigations independently or collaboratively in a subarea of statistics and data science

Subject Prerequisites

To study this subject a student must had the subject(s) Statistics in class PG/UG Honors with Research.

Programme Outcomes (POs)

- PO1.** Knowledge in the topics required for undertaking specialized research in various fields of Statistics.
- PO2.** Identification of unsolved relevant problem in a specific field.
- PO3.** Articulating ideas and strategies for addressing a research problem.
- PO4.** Undertaking original research on a particular topic.
- PO5.** Effectively communicating research, through journal publications and conference presentations to the mathematics community.
- PO6.** Disseminating research to a broader audience.
- PO7.** Understand the role of pure and applied mathematics in various fields of Statistics.

Program Specific Outcomes (PSOs)

After successful completion of this program, students will

- PSO 1.** have a solid foundation in Statistical Theory and Methodology.
- PSO 2.** be able to communicate the major tenets of statistics, explain their work orally and identify areas of future research areas in statistics.
- PSO 3.** gain a holistic understanding of data collection, management, processing, analysis and interpretation.
- PSO 4.** become proficient in the use of statistical software and writing program code to address complex statistical computations.
- PSO 5.** be able to design and present an original work of research at the leading edge of the statistics discipline.
- PSO 6.** be able to identify and articulate strategies for dealing with ethical issues that may arise.
- PSO 7.** attain mastery of broad-based knowledge in social work and specific knowledge relevant to their own research interests, including theories and methods of intervention.
- PSO 8.** be able to explain some elementary statistical courses independently

DDU Gorakhpur University, Gorakhpur

Department of Mathematics and Statistics

Course Work for Ph. D. (Statistics) Program

Every student admitted for the Ph. D. program in Statistics will be required to pass a one semester (six months) course work of minimum 12 credits. The division of this 12 credits course work is in three papers/courses. Paper/Course I based on Research and Publication Ethics (02 credits) and Paper/Course II based on Research Methodology (05 credits) courses are compulsory for all Ph. D. students of Mathematics. Paper/Course III which is compulsory one based on Innovative Research Approaches in Statistics (05 credits) courses is research theme- specific courses. The course work of statistics is as follows:

Course Nature	Paper/ Course	Course Code	Course Title	Credit
Compulsory Course				
Research and Publication Ethics Course	I	RPE- 600	Research and Publication Ethics	1+1
				2 Credits
Compulsory Course				
Research Methodology Course	II	STAT- 601	Research Methodology	5+0
				5 Credits
Compulsory Course				
Innovative Research Approaches Course	III	STAT- 602	Innovative Research Approaches in Statistics	5+0
				5 Credits
Thesis				Non-Credit
Total				12 Credits

Note: The division of theory and internal marks of each paper will be decided by University (as per common ordinance for examination and assessment).

COURSE CONTENTS

Compulsory Course

Course Code	Paper/Course	Course Title	Total Credit
RPE- 600	I	Research and Publication Ethics	1+1

Course Objectives: This course is designed to enable students to

1. identify and discuss the issues and concepts salient to the research process.
2. identify and discuss the fundamental knowledge of basics of philosophy of research.
3. identify and discuss the tools/techniques for research.
4. the knowledge internet and its uses in research work.
5. familiar with the MS word, MS-Excel, Power Point and LaTeX.

UNIT I

Theory: Philosophy and Ethics, Introduction to Philosophy: definition, nature, scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgment and reactions. Scientific Conduct, Research ethics, research Intellectual honesty and research integrity. Copyright, scientific misconduct: falsification, fabrication, and Plagiarism (FFP), Redundant Publication: duplication and overlapping publication salami slicing. Selective reporting, and misrepresentation of data.

UNIT II

Theory: Publication Ethics: definition, introduction, and importance Best practice standard setting initiative and guidelines: COPE, WAME, etc. Conflict and interest, Publication misconduct definition, concept, problems that lead to unethical behaviour and vice versa, type, Violation of publication ethics, authorship and contributor-ship, Predatory publisher and journals, Avoiding Plagiarism. Preparing documents for MoUs, Confidentiality Agreements.

UNIT III

Practice: Open access publication and initiatives SHERPA/ROMEEO online resource to check publisher copyright and self-archiving policies, Software tool to identify predatory publication developed by SPPU Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc, Publication Misconduct, Subject Specific Ethical Issues FFP, authorship Complaints and appeals: examples and fraud from India and abroad. Software tools: Use of plagiarism software like Turnitin, Urkund, and other open-source software tools.

UNIT IV

Practice: Database and research metrics. Indexing database, Citation database: Web of Science, Scopus, etc. Research metrics: Impact factor of Journal as per journal citation report, SNIP, SJR, IPP, Cite Score Metrics: h-index, g-index, 1-10 index, altmetrics.

Books Recommended:

1. Bird, A (2006). Philosophy of Science. Routledge.
2. Macintyre, Alasdair (1967) A short history of Ethics, London
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
4. National Academy of Sciences, national Academy of Engineering and Institute of Medicine (2009) On Being A Scientist: A guide to Responsible conduct in Research. Third Edition. National Academics Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it important? National Institute of Environmental Health Sciences, 1-10. Retrieved from <http://www.nichs.nih.gov/research/resources/bioethics/whatis/index.cfm>
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489 (7415), 179. <https://doi.org/10.1038/489179a>
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019) ISBN:978-81-939482-1-7. http://www.insaindia.org/res_in/pdf/Ethics_Book.pdf

Course Outcomes: After the completion of the course, the student shall be able to

- CO 1. explain key research concepts and issues.
- CO 2. have good understanding of publication ethics and scientific conduct.
- CO 3. have awareness about indexing and citation databases, open access publications and various research metrics like citations, h-index, Impact Factor etc.

Compulsory Course

Course Code	Paper/Course	Course Title	Total Credit
STAT- 601	II	Research Methodology	5+0

Objectives: This course is designed to enable students to

1. identify and discuss the issues and concepts salient to the research process.
2. identify and discuss the fundamental knowledge of basics of philosophy of science and ethics, research integrity, publication ethics.
3. identify and discuss the plagiarism tools for a valid and ethical research report.
4. familiar with the MS word, MS-Excel, Power Point and LaTeX.

UNIT I

Foundation and Planning of Research: Origin of Research, objectives of research, motivation and necessity of research, Steps in Research, types of research, research approaches, significance and relevance of research, conditions for good research and criteria of good research. What is Research Problem?, selection of research problem for research, formulation of the selected research problems, choosing the research area, identification of research problem and solving research problems, pure and applied research, role of a research supervisor in research.

UNIT II

Interpretation and Report Writing: Techniques of interpretation in the field of research work undertaken, writing a synopsis, writing a research proposal, writing a research paper/article, chapter writing, writing a Ph.D. thesis, Review Articles, Proof reading, Keywords and Phrases, bibliography, referencing, Mathematical subject Classifications(MSC) and indexing, short communication, fast track communication of a research paper, Plagiarism prevention, Poster/Oral presentation of research papers, Invited talks of a conference/ workshop.

UNIT III

Literature Review: Literature review, review of published article and books in the field of research work undertaken, Importance of Literature review in defining a problem, including literature in research proposal, survey and peer review process, identifying gap areas from literature review; Major Research areas, Journals, Publication, Necessity of Account in Google Scholar, Research Gate, Scopus, Web of Science and ORCID in research, Conferences and Status of Research in the field of Sciences.

Intellectual Property Rights (IPR): An introduction; IP as a global indicator of innovations, Role of IPR in economic and cultural developments, Types of IPR, Patents, Copyrights.

UNIT IV

Tools/Techniques for Research: Introduction of Internet, use of WWW, using search engines and advanced search tools, Email, MS-Word, MS-Excel, Power Point, LaTeX, Beamer in research work. Introduction of Mathematical software: Mathematica /MATLAB / Maple / Scilab / Sage Math / R programming / Python. Introduction of Math SciNet, ISTOR and other online journals.

UNIT V

Mathematical Computing Software R/Python for Research: Introduction of computer programming, Data Types, Variables, basic operators, Boolean values, loops, logical operations, Functions, Data Processing, package, the object orientated approach: classes methods, objects, the standard objective features, Exception Handling, working with files, Basic mathematical calculation such as differentiation, integration, etc.

Books Recommended:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International, 418p.
3. Day, R.A., 1992. How to write and publish a Scientific paper, Cambridge University Press.
4. Fink, A., 2009. Conducting Research Literature Reviews: From the internet to paper. Sage Publications.
5. Saxena, V.P., 2013. Lecture Notes on Research Methodology. Indra Publishing House.
6. P.K. Sinha & Priti Sinha, Computer Fundamentals, BPB Publications.
7. Dilip Datta, LaTeX in 24 Hours: A Practical Guide for Scientific Writing, Springer (2017).
8. Introduction to Information Technology, ITL Education Solutions, Pearson Education.
9. Introduction to Computer Science, ITL Education Solutions, Pearson Education.
10. George Grätzer, More Math Into LaTeX, 4th Edition, Springer (2016).
11. Amos R. Omondi, Mark Ng'ang'a, and Ryan Marvin, Python Fundamentals: A Practical Guide for Learning Python, Complete with Real-world Projects for You to Explore, PAKCT Publishing (2019).
12. Sinha, S.C. and Dhiman, A.K., Research Methodology, Ess Publication (2002).
13. Garrett Golemund Hands-On Programming with R: Write Your Own Functions and Simulations, O'Reilly Publication (2014).
14. Eric Matthes, Python Crash Course, William Pollock 2016.

Course Outcomes: After the completion of the course, the student shall be able to

CO 1. understand the basics of this course.

CO 2. explain key research concepts and issues.

CO 3. understand some advanced computing tools and techniques for graphical representation of data in their research work.

Compulsory Course

Course Code	Paper/Course	Course Title	Total Credit
STAT- 602	III	Innovative Research Approaches in Statistics	5+0

Course Objectives: The paper of Innovative Research Approaches in Statistics is introduced to Ph.D. Course work for the study of basic concepts of statistics. The main objective of this paper is to prepare the students for research in the field of statistics.

Unit-I

Brief review of probability and distribution theory of uni-dimensional random variable. Multi-dimensional random variables (random vectors): Joint, marginal, and conditional distribution functions; Independence; Moments and moment generating function; characteristic function, Conditional mean and conditional variance; Some examples of conditional expectations.

Unit-II

Discrete and absolutely continuous distributions; Bernoulli, binomial, geometric, negative binomial, hypergeometric, Poisson, uniform, exponential, gamma, Weibull, beta, Cauchy, log-normal, logistic, double exponential, normal. Multinomial and multivariate normal distributions. Distribution of functions of random variables including order statistics.

Unit-III

Introduction to Parametric Models and Problems of Statistical Inference. Completeness and bounded completeness, Score function, Statistic(s), Sufficient statistics, factorization theorem (proof for discrete case only), Likelihood function and statistics, minimal sufficient statistics, Lehman-Scheffe criterion for obtaining minimal sufficient statistics, Completeness of sufficient statistics, Cramer Rao inequality for biased and unbiased estimators, Minimum variance unbiased estimation, necessary and sufficient condition, Rao-Blackwell and Lehman - Scheffe theorem, Properties of M.L. estimators.

Unit-IV

Testing hypothesis: Notion of hypothesis testing, critical function, size and power of a test, MP and UMP tests, Randomized and Non-randomized tests, Neyman-Pearson Lemma, Optimal test for simple hypothesis concerning one parameter. MLR property. Testing one sided composite in MLR models.

Unit-V

Confidence Estimation: Interval estimation for single unknown parameter, Confidence regions, Confidence bounds, Uniformly most accurate confidence intervals and uniformly most accurate unbiased confidence intervals, Correspondence between testing of hypothesis and confidence Interval estimation.

Suggested Readings:

1. Gupta, S.C. and Kapoor, V.K.: Fundamental of Mathematical Statistics.
2. Johnson, N. L., Kotz, S., & Balakrishnan, N. (1994). Continuous Univariate Distributions-vol. 1 (2nd ed.). New York: John Wiley and Sons.
3. Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). Continuous Univariate Distributions- 2 (2nd ed.). New York: John Wiley and Sons.
4. Mukhopadhyay, N.: Probability and Statistics, Marcel Dekkar, Inc., NY, USA, 2000.
5. Rohatgi, V.K., Md. E. Saleh, A. K.: An Introduction to Probability and Statistics, John Wiley & Sons, 2011.
6. Casella, G., & Berger, R.(1990). Statistical Inference. Belmont: Duxbury Press.
7. Goon,Gupta,& Dasgupta :An Outline of Statistical Theory Vol-I,II,World press Pvt Ltd
8. Kale,B.K.(1999): A First Course on Parametric Inference, Narosa Publication House, New Delhi
9. Mood,A.M.,Graybill,F.A.& Boes,D.C. :Introduction to the Theory of Statistics, Tata McGraw Hill
10. Mukhopadhyay, N.: Probability and Statistics, Marcel Dekkar, Inc., NY, USA, 2000.
11. Rohatgi, V.K., Md. E. Saleh, A. K.: An Introduction to Probability and Statistics, John Wiley & Sons, 2011.
12. Zacks,S. Parametric Statistical Inference, Pargamon Press

Course Outcomes: After completing the course, the student shall be able to

- CO 1. understand the basics of this course.
- CO 2. understand the use of this course in different field of statistics.
- CO 3. think and develop new ideas in this course.