

COURSES OF STUDIES

Ph.D. COURSEWORK (STATISTICS), 2023-24

Choice Based Credit System
(Passed in the BOS meeting 05.07.2023)



**P.G. DEPARTMENT OF STATISTICS
SAMBALPUR UNIVERSITY
JYOTI VIHAR, SAMBALPUR
ODISHA
768019**

**POST GRADUATE DEPARTMENT OF STATISTICS
SAMBALPUR UNIVERSITY, JYOTI VIHAR
BURLA- 768019, ODISHA**

OUTLINE OF COURSE STRUCTURE

Ph.D. COURSEWORK IN STATISTICS (Session: 2023-2024)

**Ph.D. COURSEWORK IN STATISTICS-2023-24
STRUCTURE OF THE COURSE**

SEMESTER – I (January-June)	Title of Paper	Credit Hours (Hrs Semester)
STATS 611	Probability Theory and Stochastic Processes	4 CH(40-48 Hrs)
STATS 612(A)	Statistical Inference (Theory Elective)	4 CH(40-48 Hrs)
STATS 613	Research Methodology	4 CH(40-48 Hrs)
STATS 614	Field Studies	4 CH(40-48 Hrs)
STATS 615	Review of Research Paper published in referred Journals i) Review Report – 2CH ii) Seminar - 2CH	4 CH
STATS 616	Research & Publication Ethics	2 CH
	Total	22 CH

The electives will be chosen from the schedule-A.

ELECTIVES

The Statistics students will choose any one elective from the following:

- A. STATISTICAL INFERENCE**
- B. STOCHASTIC INFERENCE**
- C. ADVANCED STOCHASTIC PROCESSES**
- D. QUEING THEORY**

Objective:- In probability theory and related fields, a stochastic or random process is a mathematical object usually defined as a sequence of random variables, where the index of the sequence has the interpretation of time. Stochastic processes are widely used as mathematical models of systems and phenomena that appear to vary in a random manner.

Outcome:- The topic Infer the concepts of the random experiment and probability for proving the Bayes theorem, computing complex event probabilities and independence of multiple events. It helps to Understand & Interpret the concept of random variable, the probability distribution function, probability density function and operations on single random variable to derive the moments. It also helps us to Understand & Utilize the joint distribution and density function for operations on multiple random variables.

- I. Sigma field, Borel field, Measurable space, Product space, additive set function, Measure and Probability space, Induced measure and distribution function.
 - II. Independence of sequence of events and random variables, multiplication properties, random allocation of balls into cells, Borel-Cantelli theorem and characterization of independence, Tail sigma field, 0-1 law, Different types of convergence and its applications.
 - III. Random walk, Gambler's Ruin Problem, Markov Chains:- Definition, Transition Problem, classification of states, Recurrence, Examples of Recurrence Markov Chain.
 - IV Birth and Death Process:
General birth and death process, Poisson Process, Differential equations of birth and death process
Martingales: - Definition and examples, upper Martingales, Super martingale and sub-Martingales, optimal sampling theorem, Martingale convergence theorem.
1. Bhat, B.R. (1985): Modern probability theory (Wiley).
 2. Billingsley, P. (1986): Probability and measure (Wiley).
 3. Feller, W. (1969): Introduction to probability theory and applications, Vol . II (Wiley)
 4. Rohatgi, V.K. (1976): Introduction to theory of probability and mathematical Statistics (Wiley).
 5. H.G. Tucker (1967): A graduate course in probability theory (AP)
 6. Y.S. Chow and H Teicher(1979): Probability theory (Springer-Verlag),
 7. Karlin, S and Taylor, H.M (1975): A First Course in Stochastic Processes. Academic Press.
 8. Hoel, P.G., Port, S.C. and Stone, C.J. (1972): Introduction to Stochastic Processes, Houghton Mifflin & Co.
 9. Medhi, J. (1982): Stochastic Processes, Wiley Eastern.
 10. Parzen, E. (1962): Stochastic Processes, Holden-Day.

ELECTIVE PAPERS

STATS 612 (A) STATISTICAL INFERENCE

4 CH

Objective:-The main objective of statistical inference is to predict the uncertainty of the sample or sample to sample variations. This offers a range of values for the real values of the given population samples. It depends on the three forms that are essential for estimating the values of inferential data; these are: Point Estimation & Interval Estimation.

Outcome:-While descriptive statistics summarize the characteristics of a data set, inferential statistics help you come to conclusions and make predictions based on your data. When you have collected data from a sample, you can use inferential statistics to understand the larger population from which the sample is taken.

- I. Experimental family of distribution, Sufficient Statistics, Rao Blackwell theorem and its applications, Convex Functions, Complete family of distribution, Bayes Theorem, Unbiased estimation, Uniformly Minimum Variance, Unbiased estimators, Information inequalities of chi square parameter and multiparameter cases.
- II. Large sample comparison of estimators, Consistent and efficient Estimators , Asymptotic Efficiency .
- III. Minimum Likelihood Estimators, Uniparameter and Multiparameter Cases, Bayes estimation, Minimum Estimation, Admissible estimators.
- IV. Neyman and Pearsonian Test, Sequential Probability Ratio Test and its properties, Likelihood Ratio Test and its application .

Books Recommended

1. Theory of Point Estimation : E.L Lehman
2. Statistical Inference : S. Jacks
3. Sequential Analysis: A. Wald
4. Testing of Hypothesis : E.L Lehman

STATS 612 (B) STOCHASTIC INFERENCE

4CH

Objective:-In the field of statistics, a stochastic approach means to input different values to a given random variable in order to develop a probabilistic distribution where patterns can be identified.

Outcome:-In probability theory and related fields, a stochastic or random process is a mathematical object usually defined as a sequence of random variables, where the index of the sequence has the interpretation of time.

- I. Introduction to stochastic process, Markov Chain, Birth and Death process, Martingale, Brownian Motion .
- II. Large sample theory for discrete parameter stochastic process, Estimation, Efficiency test for simple hypothesis, Large sample tests, optimal asymptotic test.
- III. Large sample theory for continuous stochastic process, Ito process, MLE for Ito type process, the linear case, least square estimation, study of consistency and efficiency, testing of simple hypothesis.
- IV. M/M/1 , M/G/1 , G/M/1 Queue , MLE in a single server queue, Large sample inference from a single server queue, Rate of convergence , Estimation of traffic intensity .

BOOK RECOMMENDED

1. Statistical inference for stochastic processes. I.V Basawa and BLS Prakasa Rao. AP.1980
2. Statistical inference for Markov Processes. P.Billingsley . The Chicago university press,1961
3. Fundamentals of Queueing theory. D.Gross and C.M Harris. Willey. New York.1985. Second edition
4. A First course in Stochastic process. S. Karlin and H.M Tayer.

STATS 612 (C) ADVANCED STOCHASTIC PROCESSES

4CH

- I. Renewal Theory, Examples, Renewal equations and elementary renewal theorem, study of residual life time, discrete time renewal theory.
- II. Martingales: Definitions with examples, optimal sampling theorem, martingale convergence theorem.
Branching processes: Galton-Watson branching processes, probability of ultimate extinction.
- III. Brownian motion: Joint probability for Brownian motion by martingale methods.
- IV. Stationary processes: Wise sense and weak sense stationary, mean square distance, mean square error prediction, prediction of covariance, stationary processes.

BOOK RECOMMENDED

1. A first course in stochastic processes by S.Karlin and H.M.Taylor.
2. Stochastic processes: J.Medhi.
3. Elements of Applied Stochastic processes: U.N.Bhat, John Willey.

STATS 612 (D) QUEUING THEORY

4CH

Objective:-Queueing theory is the mathematical study of waiting lines, or queues. A queueing model is constructed so that queue lengths and waiting time can be predicted. Queueing theory is generally considered a branch of operations research because the results are often used when making business decisions about the resources needed to provide a service.

Outcome:-Queueing theory in operation research examines the entire system of standing in line, including factors such as customer arrival rate, number of servers, number of customers, waiting room capacity, average service completion time, and queueing discipline. The rules of the queue, such as whether it operates on a first-in-first-out, last-in-first-out, prioritised, or serve-in-random-order basis, are referred to as queueing discipline.

- I. The general queueing problem, Characteristics of queueing process, Deterministic queueing models, Poisson and Exponential distribution, Steady state solution, M/M/1 model, Measures of effectiveness, Waiting time distribution, Little's formula.
- II. Single server queue with truncation(M/M/1/K), Transient behaviour of M/M/1 queue, busy period, Simple Markovian queue- M/M/C and M/M/C/K, Erlang's formula, Steady state rules for M/M/ ∞ queue, finite source queue, state dependent service.
- III. Advances Markovian models- M(x)/M/1, M/M(y)/1, models and $E_K/M/1, M/E_K/1$, new networking.
- IV. Queueing models with general arrival and service pattern- M/G/1, The Pollaczek-Khintchine formula, departure point, steady state system size probability, prove that G1/M/1 queue, Some simulations.

BOOK RECOMMENDED:

1. Queueing Theory: Gross and Harris
2. Stochastic Process: J.Medhi

Objective:- Research methodology simply refers to the practical “how” of a research study. More specifically, it’s about how a researcher systematically designs a study to ensure valid and reliable results that address the research aims, objectives and research questions.

Outcome:- It involves the techniques and procedures used to identify, collect, analyze, and interpret data to answer research questions or solve research problems. Moreover, They are philosophical and theoretical frameworks that guide the research process.

- I. Application of statistical concept/ procedures. Data, diagrammatic representation of data. Probability, Measure of Central Tendency, Measure of Dispersion, Skewness and Kurtosis, Normal Distribution, Simple Correlation, Regression Analysis, Sampling: Simple Random Sampling, Stratified Random Sampling, Systematic Sampling.
- II. Testing of hypothesis tests, X^2 (chi square), F and T test: Analysis of Variance, covariance, principal component analysis; Experimental design: completely randomized block design, randomized block design, Latin square design. One-Way Analysis of Variance, Two-Way Analysis of Variance, follow up tests: Non parametric procedures; Writing of research reports.
- III. Windows and/or Linux operating system; Programming fundamentals: basics of a high-level programming language C: Editing, compiling and running a program-storing data: Elementary numerical methods (as per requirement of the subject). Plotting graph: Preparing paper type using Latex.
- IV. Learning software packages SPSS

BOOKS RECOMMENDED:

1. Research Methodology C.R. Kothari
2. Fundamentals of Mathematical Statistics; S.C. Gupta
3. Programming in C; Balguruswami

STATS 616 RESEARCH AND PUBLICATION ETHICS

2CH

Course Title:

- **Research and Publication ethics:** Course for awareness about publication ethics and Publication misconduct.
- **Course Level:** 2 Credit Course(30 Hrs)
- **Eligibility:** M.Phil ,Ph.D students and interested faculty members (It will made available to post graduate students at later date).
- **Fees:** As per university Rules
- **Faculty:** Interdisciplinary Studies

- **Qualifications Of Faculty Members of the Course: Ph.D in relevant subject areas having more than 10 years' of teaching experience.**

About the Course

Course Code: CPE-RPE

Over View

- This Course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and Citations databases, open access publications, research metrics (citations, h-index, impact factor etc) and plagiarism tools will be introduced in this course.

Pedagogy

- Classroom Teaching, Guest lectures, group discussion and practical sessions.

Evaluation

- Continuous Assessment will be done through tutorials, assignments, quizzes and group discussions. Weightage will be given for active participation. Final End examination will be conducted at the end of the course.

Course Structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit Title	Teaching Hours
Theory		
RPE-01	Philosophy & Ethics	4
RPE-02	Scientific Conduct	4
RPE-03	Publication Ethics	7
PRACTICE		
RPE-04	Open Access Publishing	4
RPE-05	Publication Misconduct	4
RPE-06	Databases and Research Metrics	7
	TOTAL	30

Syllabus in Detail

THEORY

- **RPE 01:- PHILOSOPHY AND ETHICS(3 Hrs)**
 1. Introduction to Philosophy:-Definition, Nature and scope, Concept, Branches.
 2. Ethics:- Definition, Moral Philosophy, Nature of moral judgement and reactions .
- **RPE 02:- SCIENTIFIC CONDUCT(5 Hrs)**
 1. Ethics with respect to science and research.
 2. Intellectual honesty and research integrity.
 3. Scientific misconducts:- Falsification, Fabrication and Plagiarism(FFP)
 4. Redundant Publications:- Duplicate and overlapping publications, salami slicing .
 5. Selective reporting and misrepresentation of data.
- **RPE 03:- PUBLICATION ETHICS(7 Hrs)**
 - 1.Publication ethics:- Definition, Introduction and importance.
 2. Best Practices/ Standards setting initiatives and guidelines:- COPE,WAME etc.
 3. Conflicts of interest.

4. Publication Misconduct:- Definition, concepts, problems that lead to unethical behaviour , types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals .
7. Predatory publishers and journals

PRACTICE

RPE-04 :-OPEN ACCESS PUBLISHING(4 Hrs)

1. Open access publication and initiatives
2. SHERPA/ROMEO Online resource to check publisher copyright and self- archiving policies.
3. Software tool to identify predatory publication published by SPPU
4. Journal finder/journal suggestion tools i.e JANE, Elsevier journal finder, springer journal suggester etc.

RPE-05:-PUBLICATION MISCONDUCT(4 Hrs)

A. Group Discussion(2 Hrs)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of Interest
3. Complaints and appeals:-Examples and fraud from India and abroad

B. Software Tools(2 Hrs)

Use of plagiarism software like Turintin, Urkund, and other open tool software tools

RPE-06:- DATABASES AND RESEARCH METRICS(7 Hrs)

A. Databases(4Hrs)

1. Indexing Databases
2. Citation Databases:- Web of Science, Scopus etc.

B. Research Metrics(3Hrs)

1. Impact factor of journal as per journal citation report, SNIP, SJR, IPP
2. Metrics:- h-index, g-index, i-10 index, almetrics

BOOKS RECOMMENDED

Bird, A. (2006). Philosophy of Science. Routledge.

MacIntyre, Alasdair (1967) A Short History of Ethics. London. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865 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 Academies Press. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from <https://www.nichs.nih.gov/research/resources/bioethics/whatis/index.cfm> Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>

Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019), ISBN:978-81-939482-1-7. <http://www.insaindia.res.in/pdf/Ethics> Book.pdf