

Trinity Press.

- Payer T.A. (1982). *Introduction to simulation*, McGraw Hill.

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**COMMON POOL OF GENERIC ELECTIVES (GE) COURSES
OFFERED BY DEPARTMENT OF STATISTICS (SEMESTER-VIII)
CATEGORY-VI**

GENERIC ELECTIVE COURSE-8A: ORDER STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Order Statistics	4	3	0	1	Class XII Pass with Mathematics	Knowledge of statistical distributions and stochastic processes

Learning Objectives

The learning objective of this course is:

- To make the students aware of the properties and applications of order statistics.

Learning Outcomes:

After completion of this course, students should have developed a clear understanding of:

- Find joint, marginal, and conditional distributions of order statistics in the continuous and discrete cases.
- Find the distribution of sample range and other systematic statistics in case of sampling from an arbitrary continuous population and, in particular, from some specific continuous distributions such as uniform and exponential.
- Understand the Markov Chain property of order statistics in the continuous case.
- Understand the distribution-free bounds for moments of order statistics and of the range.
- Derive the recurrence relations and identities for moments of order statistics drawn from an arbitrary population (discrete or continuous), as well as from some specific distributions.
- Learn how to obtain distribution-free confidence intervals for population quantile and

distribution-free tolerance intervals for population distributions based on order statistics

SYLLABUS OF GE-8a

Theory

UNIT I

(15 hours)

Introduction

Introduction to order statistics. Basic distribution theory. Joint and marginal distributions of order statistics in the continuous case. Distribution of the range, median and other systematic statistics, Examples based on some specific continuous distributions.

UNIT II

(10 hours)

Conditional distribution of order statistics

Conditional distributions. Order statistics as a Markov Chain. Order statistics for a discrete parent. Examples based on some specific discrete distributions.

UNIT III

(10 hours)

Moments of order statistics

Moments of order statistics. Need of Recurrence relations and identities for moments of order statistics. Recurrence's relations and identities for single and product moments of order statistics from an arbitrary distribution. Recurrence relations for single and product moments of order statistics from some specific distributions.

UNIT IV

(10 hours)

Distribution-free intervals of order statistics

Distribution-free confidence intervals for population quantiles and distribution-free tolerance intervals. Distribution-free bounds for moments of order statistics and of the range.

PRACTICAL/LABWORK--(30hours)

List of Practical:

1. Problem solving using joint, marginal and conditional distributions of order statistics for some specific continuous distributions.
2. Distribution-free confidence intervals for population quantiles for various distributions.
3. Calculating Means, variances, and covariances by using exact expressions for the moment of order statistics for some specific continuous distribution.
4. Problems based on Markov Chain property of order statistics in the continuous case.
5. Distribution of sample range and other systematic statistics in sampling from different distributions.
6. Conditional distribution of order statistics in sampling from different distributions.
7. Calculating exact moments of order statistics by using recurrence relations for arbitrary continuous distributions.
8. Calculating exact moments of order statistics by using recurrence relations for some specific distributions.
9. Distribution-free confidence intervals for population quantiles for various distributions.

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

ESSENTIAL READINGS

- David, H. A. and Nagaraja, H. N. (2003). *Order Statistics*, 3rd ed., John Wiley & Sons.

SUGGESTIVE READINGS:

- Arnold, B.C., Balakrishnan, N. and Nagaraja H.N. (2008). *A First Course in Order Statistics*, SIAM Publishers.
- Arnold, B.C. and Balakrishnan, N. (1989). *Relations, Bounds and Approximations for Order Statistics*, Vol. 53, Springer-Verlag.
- Ahsanullah, M., Nevzorav, V.B. and Shakil, M. (2013). *An Introduction to Order Statistics*, *Atlantis Studies in Probability and Statistics*, Vol. III. Atlantis Press.
- Shahbaz, M.Q., Ahsanullah, M., Shahbaz, S.H. and Al-Zahrani, B.M. (2016). *Ordered Random variables: Theory and Applications*. Springer.

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GENERIC ELECTIVE COURSE–8B: STATISTICS INFINANCE
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Statistics in Finance	4	3	0	1	Class XII pass with Mathematics.	Basic knowledge of Calculus, Probability theory and Financial markets

Learning Objectives

The learning objectives include:

- To study the Financial Statistics which deals primary and secondary financial markets and the mathematical models used by these markets?
- To study to deal with the risks in financial markets

Learning Outcomes:

After completing this course, students should have developed a clear understanding of:\

- Primary financial markets and their products such as equity, bonds and cash deposits
- Secondary financial markets and their products such as futures, forwards and options (American and European)
- Applications of stochastic models to price various secondary financial markets products.
- Hedging techniques

SYLLABUS OF GE-8B

Theory

UNIT I

(12 hours)

Theory of interest rates

Theory of interest rates- Simple and compound interest, Nominal and effective rates of interest, interest rates of varying frequencies, continuous rates, accumulation and discount factors, relationship between interest rates and discount rates, present value, future value.

Unit II

(14 hours)

Project appraisal and investment performance

Project appraisal and investment performance- Net present value, IRR, effect of taxation, Valuation of securities-fixed asset securities, related assets, perpetuities, bonds, coupon rates, bond-pricing formula.

Unit III

(14 hours)

Introduction to derivative pricing

An introduction to derivative pricing- arbitrage, futures and forwards, European options- Call and put, put call parity, volatility, Black-Scholes option pricing formula, binomial model of option pricing. Hedging- delta, gamma and theta.

PRACTICAL/LABWORK–(30hours)

List of Practical:

1. Relationship between various interest and discount rates
2. Calculation of present values and future values of cashflows
3. To compute NPV and to obtain IRR of the investments.
4. To compute bond price and yields
5. To verify “no arbitrage” principle.
6. To price future/ forward contracts
7. To price options using Black–Scholes formula.
8. Pricing of options using discrete time models.
9. Call-put parity for options.
10. Application of Greeks to hedge investment portfolios.

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

ESSENTIAL READINGS

- David, G.L. (2015). Investment Science, Oxford University Press (South Asian edition).
- John C. Hull and Sankarshan Basu (2018) (10th edition) Options, Future and other derivatives, Pearson Indian edition

SUGGESTIVE READINGS:

- Franke, J., Hardle, W.K. and Hafner, C.M. (2019- softcover published and eBook published). *Statistic of Financial Markets: An Introduction*, 3rd Ed., Springer Publications.
- Garrett S.J. (2013) An introduction to the mathematics of Finance: A deterministic approach, 2nd edition, Elsevier
- Ambrose Lo (2018): Derivative Pricing: A problem-based primer, Chapman & Hall

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**GENERIC ELECTIVE COURSE–8C: INTRODUCTION TO
RELIABILITY THEORY**
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to Reliability Theory	4	3	0	1	Class XII Pass with Mathematics	Knowledge of Probability Distribution and Statistical Inference

Learning Objectives

The learning objectives include:

- To describe the theoretical aspects of reliability along with their application area.
- To determine the growth in the mean life and/or the reliability of units during their research, engineering and development phase.

Learning Outcomes:

After completing this course, students should be able to:

- Understand the Concept of Reliability, Maintainability and Availability.
- Understand the various estimation procedures of reliability function(s).
- Calculate Reliability of series and parallel systems.

SYLLABUS OF GE-8c
Theory
UNIT I
(10 hours)
Reliability measures

Definition of Components, systems and coherent systems. Reliability functions, hazard rate function, reverse hazard rate function, residual lifetime, inactivity time, mean residual lifetime function, mean inactivity time, reliability bounds, cut and path sets.

UNIT II
(08 hours)
Common life time distributions

Common lifetime distributions and their properties (Exponential, Weibull and Gamma), scale model, proportional hazard rate model, proportional reverse hazard rate model, MTTF, Bathtub failure rate, reliability importance of components.

UNIT III
(12 hours)
Estimation of reliability functions

Various methods of reliability estimation (Classical); of some common lifetime distributions, Reliability estimation under complete and various censored samples. Stress-Strength reliability: concepts and its estimation for exponential and Weibull, k-out-of-n (exponential) and its application.

UNIT IV

(15hours)

Reliability systems and ageing

Reliability of series/parallel systems: introduction, series systems with identical components. Different types of redundancy. Notions of Ageing: Different ageing classes, ageing properties of common lifetime distributions, closure properties of different ageing classes under formation of coherent structures.

PRACTICAL/LABWORK–(30hours)

List of Practical:

1. Calculation of reliability function and its estimates
2. Calculation of hazard rate for various models.
3. Calculation of stress-strength reliability.
4. Various reliability and hazard rate plots.
5. Behavior of reliability estimates corresponding to sample size.
6. Practical on ageing.
7. Other relevant problems.

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

ESSENTIAL READINGS:

- Sinha, S.K. (1986): Reliability and Life testing; Wiley Eastern.

SUGGESTIVE READINGS:

- Barlow, R.E. and Proschan F. (1981): Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.
- Lawless, J.F. (2011): Statistical Models and Methods for Life Time Data, 2nd edition; John Wiley.
- Bain L.J. and Max Engelhardt (1991): Statistical Analysis of Reliability and Life Testing Models; Marcel Dekker.

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