

### Discipline-Specific Elective (DSE) Course 4b: Order Statistics

Structure 1: PG Curricular Structure with only Course Work  
 Structure 2: PG Curricular Structure with Course Work + Research  
 Structure 3: PG Curricular Structure with Research only

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the Course (if any)
		Lecture (45 Hours)	Tutorial (15 Hours)	Practical (00 Hours)		
<b>DSE 4b: Order Statistics</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>NIL</b>	<b>NIL</b>

#### Course Objectives:

- To make the students aware of the properties and applications of order statistics, record values and generalized order statistics.

**Course Learning Outcomes:** On successful completion of the course, students will be able to:

- Find the basic distribution theory of order statistics in both continuous and discrete cases, including the distributions of the sample range and other systematic statistics.
- Learn how to obtain distribution-free confidence intervals for population quantiles and distribution-free tolerance intervals for population distributions based on order statistics.
- Understand the distribution-free bounds for moments of order statistics and of the range.
- Derive the recurrence relations and identities for the moments of order statistics obtained from arbitrary (discrete or continuous) populations and from selected specific distributions.
- Find the distributions of order statistics for independent but non-identically distributed random variables and learn about the joint and marginal distributions of order statistics from a sample containing a single outlier.
- Learn about the basic concepts of record values and generalized order statistics.

#### Unit I (12 Hours)

Introduction to order statistics, Basic distribution theory, Joint and marginal distributions of order statistics in the continuous case, Distribution of the range and other systematic statistics, Conditional distributions, Order statistics as a Markov Chain, Order statistics for a discrete parent, Examples based on discrete and continuous distributions.

**Unit II (12 Hours)**

Distribution-free confidence intervals for population quantiles and distribution-free tolerance intervals, Distribution-free bounds for moments of order statistics and of the range, Approximations to moments in terms of the quantile function and its derivatives.

**Unit III (10 Hours)**

Moments of order statistics, Recurrence relations and identities for moments of order statistics from an arbitrary distribution, Recurrence relations for moments of order statistics from some specific distributions.

**Unit IV (11 Hours)**

Order statistics for independently and not identically distributed variates. Order statistics from a sample containing a single outlier. Concepts of record values and generalized order statistics.

**Tutorial:**

Tutorial sessions will include at least one activity such as group discussion/presentation/problem solving exercise based on the material covered in the lectures along with scholastic work related to the conceptual understanding of the subject.

**Essential Readings:**

1. Arnold B.C., Balakrishnan N. and Nagaraja H.N. (1998): *Records*. John Wiley & Sons.
2. Arnold, B. C., Balakrishnan, N. and Nagaraja H.N. (2008). *A First Course in Order Statistics*, SIAM Publishers.
3. David, H. A. & Nagaraja, H. N. (2003). *Order Statistics*, John Wiley & Sons.
4. Shahbaz, M.Q., Ahsanullah, M., Shahbaz, S.H. & Al-Zahrani, B.M. (2016). *Ordered Random variables: Theory and Applications*, Springer.

**Suggested Readings:**

1. Ahsanullah, M. (1995): *Record Statistics*, Nova Science Publishers.
2. Ahsanullah, M. (2004): *Record Values-Theory and Applications*, University Press of America.
3. Ahsanullah, M., Nevzorav, V.B. and Shakil, M. (2013). *An Introduction to Order Statistics*, Atlantis Press.
4. Arnold, B.C. & Balakrishnan, N. (1989). *Relations, Bounds and Approximations for Order Statistics*, Vol. 53, Springer.
5. Gibbons, J.D. & Chakraborti, S. (2021). *Nonparametric Statistical Inference*, Chapman & Hall/CRC Press.
6. Kamps, U. (1995): *A Concept of Generalized Order Statistics*. B.G. Teubner, Stuttgart.