

Discipline Specific Elective (DSE) Course 2b: Non-Parametric Inference

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the course (if any)
		Lecture (45 Hours)	Tutorial (00 Hours)	Practical (30 Hours)		
DSE 2b: Non-Parametric Inference	4	3	0	1	NIL	NIL

Course Objectives:

- Develop the ability to learn the fundamentals of the most relevant nonparametric techniques for statistical inference.

Course Learning Outcomes: After successful completion of this course, student will be able to:

- Solve hypothesis testing problems where the conditions for the traditional parametric inferential tools to be applied are not fulfilled.
- Build nonparametric density estimates.

Unit I (11 Hours)

Review of order statistics, Distribution-free statistics over a class, counting statistics, ranking statistics, Statistics utilizing counting and ranking, One sample and two sample U-statistics, Asymptotic distribution of U-statistics, point estimation. Estimators associated with distribution free test statistics, Exact small-sample and asymptotic properties of the Hodges-Lehmann location estimators.

Unit II (11 Hours)

Tests based on length of the longest run, runs up and down, Kolmogorov-Smirnov two sample statistic. Rank order statistics: Correlation between ranks and variate values, One sample, paired sample and two sample problems, Linear rank tests, distribution properties of linear rank statistics.

Unit III (11 Hours)

Tests for equality of k independent samples: Kruskal-Wallis one way ANOVA test, Measures of Association for bivariate samples: Kendall's Tau coefficient, Spearman's coefficient of Rank correlation, relations between R and T; $E(R)$, τ and ρ .

Unit IV (12 Hours)

Measures of association in multiple classifications: Friedman's two-way ANOVA by ranks in a $k \times n$ table, the Coefficient of Concordance of k sets of rankings of n objects, the Coefficient of Concordance of k sets of incomplete rankings, Kendall's Tau coefficient for partial correlation.

Essential Readings:

1. Gibbons, J.D. and Chakraborti, S. (2021). *Nonparametric Statistical Inference*, CRC Press.
2. Hettmansperger, T.P. (1984). *Statistical inference Based on Ranks*, John Wiley & Sons.
3. Randles, R.H. and Wolfe, D.A. (1979). *Introduction to the Theory of Nonparametric Statistics*, John Wiley & Sons.

Suggested Readings

1. David, H.A. and Nagaraja, H.N. (2003). *Order Statistics*, John Wiley & Sons.
2. Rohatgi, V.K. and Saleh, A.K.Md.E. (2005). *An Introduction to Probability and Statistics*, John Wiley & Sons.
3. Siegel, S. and John, J.S.N. (2010). *Nonparametric Statistics for the Behavioral Sciences*, McGraw-Hill

List of Practicals:

1. Point estimation. Estimators associated with distribution free test statistics.
2. Kolmogorov-Smirnov one and two sample statistic.
3. Correlation between ranks and variate values
4. One sample, paired sample and two sample problems.
5. Kruskal-Wallis one way ANOVA test.
6. Kendall's Tau coefficient.
7. Spearman's coefficient of Rank correlation, relations between R and T ; $E(R)$, τ and τ .
8. Friedman's two-way ANOVA by ranks in a $k \times n$ table.
9. Coefficient of Concordance of k sets of rankings of n objects.
10. Coefficient of Concordance of k sets of incomplete rankings.