# Statistical Inference - Video course

## COURSE OUTLINE

**Point Estimation:** Parametric point estimation, unbiasedness, consistency, efficiency, method of moments and maximum likelihood, lower bounds for the variance of an estimator, Frechet-Rao-Cramer, Bhattacharya, Chapman-Robbins-Kiefer inequalities. Sufficiency, minimal sufficiency, Factorization Theorem, Rao-Blackwell Theorem, completeness, Lehmann-Scheffe Theorem, UMVUE, Basu's Theorem, invariance, best equivariant estimators,

**Testing of Hypotheses:** Tests of hypotheses, simple and composite hypotheses, types of error, Neyman-Pearson Lemma, families with monotone likelihood ratio, UMP, UMP unbiased and UMP invariant tests. Likelihood ratio tests - applications to one sample and two sample problems, Chi-square tests. Wald's sequential probability ratio test.

**Interval estimation:** methods for finding confidence intervals, shortest length confidence intervals.

## COURSE DETAIL

| Module No. | Topic/s | Lectures |
|---|---|---|
| 1 | **Introduction and Motivation** | 1 |
| 2 | **Basic concepts of point estimation:** unbiasedness, consistency and efficiency of estimators, examples. | 1 |
| 3 | **Finding Estimators:** method of moments and maximum likelihood estimators, properties of maximum likelihood estimators, problems. | 3 |
| 4 | **Lower Bounds for the Variance:** Frechet-Rao-Cramer, Bhattacharya, Chapman-Robbins-Kiefer inequalities, generalization of Frechet-Rao-Cramer to higher dimensions, problems. | 4 |
| 5 | **Data Reduction:** Sufficiency, Factorization Theorem, Rao-Blackwell Theorem, minimal sufficiency, completeness, Lehmann-Scheffe Theorem, applications in deriving uniformly minimum variance estimators, Ancillary statistics, Basu's Theorem,problems. | 6 |
| 6 | **Invariance:** Best equivariant estimators, problems. | 2 |
| 7 | **Bayes and Minimax Estimation:** Concepts and applications. | 3 |
| 8 | **Testing of Hypotheses:** Basic concepts, simple and composite hypotheses, critical region, types of error, most powerful test, Neyman-Pearson Lemma, | 2 |

NP-TEL

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**http://nptel.iitm.ac.in**

Mathematics

**Pre-requisites:**

Probability Theory

**Additional Reading:**

1. Theory of Point Estimation by E.L. Lehmann & G. Casella
2. Testing Statistical Hypotheses by E.L. Lehmann

**Coordinators:**

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| | applications. | |
| 9 | **Tests for Composite Hypotheses:** Families with monotone likelihood ratio, uniformly most powerful tests, applications. | 3 |
| 10 | **Unbiasedness:** Unbiased tests, similarity and completeness, UMP unbiased tests. | 3 |
| 11 | **Likelihood Ratio Tests** - applications to one sample and two sample problems. | 3 |
| 12 | **Invariant Tests** | 2 |
| 13 | **Contingency Tables & Chi-square tests.** | 2 |
| 14 | **Wald's sequential probability ratio test.** | 2 |
| 15 | **Interval estimation:** methods for finding confidence intervals, shortest length confidence intervals, problems. | 3 |

**References:**


1. An Introduction to Probability and Statistics by V.K. Rohatgi & A.K. Md. E. Saleh.
2. Statistical Inference by G. Casella & R.L. Berger.
3. A First Course on Parametric Inference by B.K. Kale
4. Modern Mathematical Statsitics by E.J. Dudewicz & S.N. Mishra
5. Introduction to the Theory of Statistics by A.M. Mood, F.A. Graybill and D.C. Boes