Statistical Inference 1

Official Program - English Translation

Master's Degree: Probability, Statistics and Applications

Semester: 1

Course Unit: UEF12

Course Title: Statistical Inference 1

Credits: 5

Coefficient: 3

Course Objectives

To learn how to construct estimators, study their performance, and compare them. To construct statistical tests and draw appropriate conclusions from them.

Recommended Prerequisites

Probability, Linear Algebra, and Analysis 1, 2, 3, and 4.

Chapter 1: Sampling, Associated Distributions and Experimental Designs

Fundamental definitions: population, sample, parameter vs. statistic.
Methods of data collection in a sample.
Why use a sample instead of the entire population?
Types of sampling.
Experimental designs.
Sampling distributions of the sample mean, a proportion, the difference between two means, and the variance.
Applications of the Central Limit Theorem.

Chapter 2: Point Estimation

Fundamental concepts: parametric vs. nonparametric estimation; definition of a point estimator; random variables vs. estimators; unknown parameters.
Estimation methods: Maximum Likelihood Method; introductory example; likelihood function; log-likelihood function; likelihood functions for common models; Maximum Likelihood Estimator (MLE); Method of Moments.
The original program also contains the abbreviations “LFGN et LFGN, EM”; these are preserved because the source does not make them explicit enough to translate reliably.
Properties of estimators: bias; asymptotic bias; variance; efficiency; admissibility; consistency; completeness; sufficiency; convergence in probability; convergence in mean of order k.
Usual estimators: quantitative case - mean, variance, and standard deviation; qualitative case - unknown proportion.
Fisher Information and Score: efficiency, completeness.
Cramér-Rao-Fréchet-Darmois bound (CRFD), and ESBVM as written in the original program.

Chapter 3: Confidence Interval Estimation

Point estimation vs. confidence interval estimation.
Confidence level and risk level.
Construction of confidence intervals: confidence interval for a mean (sigma known or unknown); confidence interval for a variance; confidence interval for a proportion.
Influence of sample size on precision.
Determination of the optimal sample size for a given estimation problem.

Chapter 4: Introduction to Statistical Tests

Objectives of statistical tests.
Null and alternative hypotheses.
Types of tests.
Neyman-Pearson method.
Critical and acceptance regions.
Significance level.
Type I and Type II errors.
Power of a test.
Decision table.
Steps involved in carrying out a statistical test.
Statistical tables for the Normal distribution, Student's t-distribution, Chi-square distribution, and Fisher-Snedecor distribution.
Parametric tests:
(a) Tests concerning a mean, a variance, and a proportion.
(b) Tests concerning the difference between two means, the difference between two variances, and the difference between two proportions.

Assessment Method

Continuous assessment: 40%
Final examination: 60%

Bibliography

1. Saporta, G. (2011). *Probabilités, analyse des données et statistique*. Éditions Technip, Paris.
2. Held, L. & Sabanés Bové, D. (2020). *Likelihood and Bayesian Inference: With Applications in Biology and Medicine*, 2nd ed. Springer.
3. Li, B. & Babu, G.J. (2019). *A Graduate Course on Statistical Inference*. Springer Texts in Statistics.
4. Wasserman, L. (2004, reprinted 2013). *All of Statistics: A Concise Course in Statistical Inference*. Springer Texts in Statistics.