

M2S1 PROBABILITY AND STATISTICS II

COURSE OBJECTIVES

The objectives of this course are

- to revise elementary concepts and techniques encountered in M1S
- to extend knowledge of the theory of probability and random variables
- to introduce new techniques for carrying out probability calculations
- to motivate the use of statistical inference in practical data analysis
- to study elementary concepts and techniques in statistical methodology
- to provide an introduction to subsequent statistics courses

SYLLABUS

CHAPTER 1. Key Concepts in Probability Theory: Definitions, Terminology, Notation

Events and the sample space; Operations in set Theory; The probability function; The axioms of probability; Conditional probability; The Theorem of Total Probability; Bayes Theorem; Counting Techniques.

CHAPTER 2. Random Variables and Probability Distributions

Discrete random variables; Continuous random variables; Expectations and their properties; Functions of random variables; Joint probability distributions; Marginal and conditional distributions; Multivariate Transformations; Sums of random variables, convolutions; Order Statistics; Generating Functions.

CHAPTER 3. Discrete Probability Distributions

Discrete uniform distribution; Bernoulli distribution; Binomial distribution; Poisson distribution, the Poisson process. Geometric distribution; Negative binomial distribution; Hypergeometric distribution; Connections between discrete distributions.

CHAPTER 4. Continuous Probability Distributions

Continuous uniform distribution; Exponential distribution; Gamma distribution; Beta distribution; Normal distribution and related results; the Central Limit Theorem. Related continuous distributions - Chi-squared distribution, Student-t distribution, Cauchy distribution, F distribution, Weibull distribution, logistic distribution, lognormal distribution. Multivariate extensions of continuous distributions; the multivariate normal distribution; Connections between continuous distributions.

CHAPTER 5. Probability Results and Limit Theorems

Bounds on probabilities based on moments; Bounds on expected values; Modes of stochastic convergence; convergence in probability, convergence in distribution.

CHAPTER 6. Introduction to Statistical Analysis

Statistical summaries; Sampling distributions; Estimation; method of moments, maximum likelihood; Properties of estimators. Introduction to hypothesis testing.