UCLouvain

lsinc1211

2024

Probability and Statistics

5.00 credits	30.0 h + 30.0 h	Q2

This learning unit is not open to incoming exchange students!

Language :	French
Place of the course	Charleroi
Prerequisites	The necessary mathematical concepts are - first-order logic, - set theory, - To analyse : functions of one or more real variables: derivation and integration limits, sequences and series. In terms of competence, it is necessary that students know how to perform a demonstration and can manipulate mathematical language in a formal way. Prerequisites: LSINC1111, LSINC1112 and LSINC1113 *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	The aim here is to obtain for the student a deep and exact understanding of the fundamental concepts as well as training in probabilistic and statistical reasoning. The mathematical formalism is simplified but present. It is a question of using measurement theory in an intuitive way to extend the concept of counting towards an analytical definition of the laws of probability. The basic subject of the calculation of probabilities is introduced by a few hours of descriptive statistics (processing of a table of numbers, calculation of mean, variance, etc.) which give rise to practical exercises with R. The necessary principles of probability for an introduction to inferential statistics are also defined. Particular emphasis will be placed on basic techniques, namely parameter estimation and hypothesis testing.
Learning outcomes	**At the end of this learning unit, the student is able to :** • to produce descriptive statistics and • to pose a hypothesis test and solve it, in order to interpret the reality masked by the dataset, • in function, to use the R language wisely to manipulate their data, • use the foundations of combinatorial analysis and probability calculation to determine the probabilities associated with different events, • to use the foundations of functional analysis, linear algebra and discrete mathematics to determine the probability laws of random phenomena, • to manipulate the usual theoretical laws to explain behaviors, • manipulate the laws associated with random variables studied simultaneously.
Evaluation methods	The final mark out of 20 is obtained at the end of an individual written examination, partly on a machine.
Teaching methods	Theoretical lecture (30h), accompanied by exercise sessions (30h)
Content	**I Descriptive statistics 1** 1 Univariate descriptive statistics 1.1 Analysis conditions 1.2 Graphical representations 1.3 Numerical characteristics . 2 Bivariate descriptive statistics 2.1 Analysis conditions 2.2 Graphical representations 2.3 The notion of link between two variables 2.4 Linear regression **II Probabilities** 3 Combinatorial analysis 3.1 The Fundamental Counting Principle 3.2 The notion of arrangement

	3.3 The notion of permutation 3.4 The notion of combination 4 The calculation of probabilities 4.1 Fundamental set and event 4.2 An event is a set 4.3 Three axioms as a starting point 4.4 Probabilities on finite sets 4.5 Conditional probability 4.6 Independence 5 Random variables 5.1 Basic definitions 5.2 Discrete random variables 5.3 Continuous random variables 5.4 Generating function and Laplace transform 6 Usual probability laws 6.1 Bernoulli random variable 6.2 Binomial random variable 6.3 Poisson random variable 6.4 Geometric random variable 6.5 Negative binomial random variable 6.6 Hypergeometric random variable 6.7 Discrete uniform random variable 6.8 Continuous uniform random variable 6.9 Normal random variable 6.10 Exponential random variable 6.11 Erlang random variable 6.12 Approximation of a binomial distribution 6.13 Generating function and Laplace transform 7 Simultaneous random variables 7.1 Linked random variables: distribution 7.2 Independent random variables 7.3 Sum of random variables 7.4 Conditional distributions 7.5 Limit theorems **III Inferential statistics** 8 Estimation theory 8.1 Point estimate 8.2 Estimation by confidence interval 9 Hypothesis testing 9.1 General principle 9.2 Tests on means 9.3 Variance tests 9.4 Chi-square test **Appendix IV** A Introduction to R Software A.1 Installation and discovery of the R software A.2 First step with R software A.3 The vector class A.4 The matrix class A.5 The data.frame class A.6 Data under R
Other infos	This course is based on various basic works in statistics and probability, and in particular on F. Bertrand and M. Maumy-Bertrand. Introduction to statistics with R. Dunod, 2010, chapters 1 to 8 by S.M. Ross. Introduction to probability. Translation of the seventh American edition. Polytechnic and University Presses Romandes, 2009 and finally, on the following book: M. Lejeune. Statistical. theory and its applications. Second edition. Springer, 2010.
Faculty or entity in charge	SINC

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Computer Science	SINC1BA	5	LSINC1111 AND LSINC1112	🔍