UCL Université catholique de Louvain

LFSAB1105

2016-2017

Probability and statistics

4.0 credits	30.0 h + 30.0 h	1q

Teacher(s) :	El Ghouch Anouar ; von Sachs Rainer ;
Language :	Anglais
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=FSAB1105
Prerequisites :	LFSAB1101 et LFSAB1102 or equivalent courses *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 course presents the fundamental concepts of probability and statistics that allow the student to solve the basic problems encountered in engineering and to acquire the prerequisites to follow more advanced courses.
Aims :	Contribution of the course to the program objectives: Regarding the learning outcomes of the program of Bachelor in Engineering, this course contributes to the development and the acquisition of the following learning outcomes: -- LO 1.1, 1.2 -- LO 2.3, 2.4, 2.6, 2.7 -- LO 4.1, 4.2, 4.3, 4.4 In virtue of the reference Learning outcomes (LO) of the program 'Master in Actuarial Sciences' , this activity will allow the student to have acquired -- Primarily the following AAs: AA1.1, AA1.2, AA1.3, AA2.4 -- Secondarily the following AAs: AA1.7, AA2.3 Specific learning outcomes of the course: More precisely, at the end of the course the students will be able to -- Use a scientific approach to extract reliable information from sampled data -- understand and know how to apply in various situations the basic concepts of probability and statistical inference -- develop simple probabilistic or empirical models for given observed phenomena and integrate these models into simulations -- evaluate and judge the credibility of a condition or a model -- present the results of an analysis including its level of uncertainty *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods :	Written individual exam of typically 3 hours duration, to evaluate the understanding of the treated concepts and techniques (exercises and theory, in form of multiple choice and open questions). Each student disposes of his own formular of 2 pages which summaries the essential equations. The APP receives a grade which counts for ~20% of the exam.
Teaching methods :	The course is made of several types of activities: -- oral presentations of the methodological concepts based on examples coming from the engineering world. -- exercise sessions (APE) where the student will be able to apply systematically the concepts presented in the course on well chosen examples. -- case studies (APP) where the student will be able to apply the statistical tools to real world data using software like Matlab or R. The pedagogical approach encourages the student to work personally and have an active participation during the course.
Content :	Foundations of probability : --

	Notion of and elementary calculus of probabilities; event, basic formulae for calculating probabilities, conditional probabilities, Bayes theorem, independence. -- Random variables: discrete and continuous random variables, probability distribution, distribution function, quantiles, expected values, variance, moments of k-th order. -- Classical probability laws: Bernoulli, binomial, Poisson, uniform, normal, exponential, gamma, ' -- Bivariate random vectors: bivariate distribution, marginal and conditional distribution, conditional expectation and variance, independence of random variables, covariance and correlation. -- Transformation of random variables: expectation, variance and distribution of functions of random variables, linear combinations of common random variables. Foundations of statistical inference : -- Point estimation and fitting of distributions: definition, quality of an estimator (bias, mean squared error), method of moment estimation, maximum likelihood method, least-squares method. -- Limit theorems: Central Limit Theorem, Law of Large Numbers; -- Confidence intervals: definition, construction using the method of pivotal functions, asymptotic confidence intervals. -- Hypothesis tests: concepts of hypotheses, general development of a test statistic and a decision rule, type 1 and type 2 error, p-value, Tests and confidence intervals for one or two samples in a normal population and for one or two proportions. Statistical methods in engineering : -- Exploratory data analysis: mean, variance, standard deviation, median, interquartile range, correlation, Graphical summary of data: histogram, box plot' -- Analysis of Variance (one factor ANOVA): fixed model, as generalisation of a two-sample mean test. -- (Simple) Linear regression: least squares estimation, interpretation, tests and confidence intervals for the parameters, prediction, measures of goodness-of-fit, analysis of residuals.
Bibliography :	Transparencies (made available on iCampus) Additional documentation (on iCampus): Glossary, tables, distributions, an introduction into MatLab, etc. Reference book : "Mathematical Statistics with applications", D. Wackerly, W. Mendenhall III, R. Scheaffer.
Other infos :	Required knowledges: mathematical analysis and calculus (differentiation and integration), matrix notation basic knowledge of MATLAB.
Faculty or entity in charge:	BTCI

Programmes / formations proposant cette unité d'enseignement (UE)

Intitulé du programme	Sigle	Credits	Prerequis	Acquis d'apprentissage
Bachelor in Engineering	FSA1BA	4	LFSAB1101 **and** LFSAB1102	🔍
Master [120] in Actuarial Science	ACTU2M	4	-	🔍
Master [120] in Environmental Science and Management	ENVI2M	4	-	🔍