Faculty of Economics and Business Administration

COURSE (MODULE) DESCRIPTION

Course title	Code
Statistical Theory	

Staff	Department
Coordinator: Dr Anh Nguyen **Other(s):** Dr Povilas Lastauskas	Faculty of Economics and Business Administration

Study cycle	Course type
First (Bachelor's)	Compulsory

Form of implementation	Period of implementation	Language of instruction
Face-to-face	Semester 1 and 2	English

Requirements for student	
Prerequisites:	**Additional requirements (if any):**

Number of ECTS credits	Student's workload	Contact hours	Individual work
10	260	73.5	188

Purpose of the course and competences developed		
This course aims to provide theoretical knowledge of both the frequentist and the Bayesian approaches to statistics to apply then in statistical analysis of data for the study of economic and social problems.		
Learning outcomes (learning outcomes of the programme)	**Teaching methods**	**Assessment methods**
To be in possession of a good grasp of the elementary tools of descriptive statistics; should understand elementary principles of probability and statistical theory; should be competent in applying basic methods of statistical inference as well as Bayesian approach to statistics. (1.2)	Lectures and lecture notes, tutorials. .	Written examination and homework.
Find relevant data, evaluate its quality, conduct statistical analysis using modern software packages and prepare a final report using scientific typesetting tools. (3.4)	Lectures and lecture notes, tutorials, labs, and independent statistical project.	
Expand own understanding, knowledge and skills working on problem sets independently (5.1)	Individual homework assignments.	
The ability to work in teams delivering an empirical project (4.1)	Group homework assignments.	

Course themes	Contact / Individual work: time and assignments								
	Lectures	Tutorials	Seminars	Practical classes	Laboratory work	Practice	Contact hours	Individual work	Assignments due date
FALL semester									
Review of Statistical Science	2						2	5	
Descriptive Statistics	2						2	5	
Probability: events, outcomes and sample space; Venn diagrams; unions, intersections and complements; simple combinatorial formulae for sampling with and without replacement; random variables	4	2					6	10	
Probability distributions: univariate discrete and continuous distributions; probability mass functions; cumulative distribution functions and probability density functions; expectations, variances and higher moments; Bernoulli trials and the Binomial distribution; Uniform and Normal distributions; Chi-squared, t and F distributions	6	2					8	20	Individual homework 1 Emphasis on combinatorial basics of probability, probability distributions and densities. MM chapters 2-3, Appendices B and C. LM chapter 2.
Sample statistics: the concept of an estimator; unbiasedness and efficiency; sampling distributions, Law of Large Numbers and Central Limit Theorem	6						6	20	
Estimation and Inference: point and confidence interval estimation and hypothesis testing; null and alternative hypotheses; critical regions; one-tailed and two-tailed tests; Type I and Type II errors; power functions	4	2					6	15	Tutorial on simulating data, Monte-Carlo sampling methods, inferential exercises.
Bivariate Regression: ordinary least squares, conditional expectations function, tests of significance, sampling distributions of regression coefficients	6	2					8	20	Group homework 2. Work on hypothesis tesing and estimation. MM chapters 12-13, 14.1-14.4. LM chapters 5-7. Tutorial on running simple regressions, interpreting results, conducting hypothesis testing.
SPRING semester									
Review session	1.5								
The Basics of Bayesian Inference: Logic, Probability, and Uncertainty	4	2					6	20	Tutorial on R and its use for

									Bayesian inference.
Bayesian Inference for Discrete Random Variables	4	2					6	20	
Continuous Random Variables	2	2					4	10	Individual homework 3 Bolstad chapters 6-7.
Bayesian Inference for Proportions and Normal Means	10	2					12	25	
Bayesian Linear Regression	4	2					6	18	Group homework 4 Bolstad chapters 8, 11, 14.
Total	55.5	18					**72**	**188**	

Assessment strategy	Share in %	Time of assessment	Assessment criteria
Written exam	60%	End of spring semester	Exam questions include the topics covered in the course lectures and discussions. It is necessary to answer 10 questions, each of which is evaluated by 1 point: • 1 point (excellent) evaluates the answer, giving a detailed and clear answer to a question based not only on lecture material but also on its own, substantiated reasoning. • The 0.5 point (well) evaluates the answer in detail, but not very accurately. • A score of 0.25 (weak) is considered the answer to be vague or incomplete, with several major errors. • 0 points (unsatisfactory) no answer or it's completely wrong.
Four (individual and group) homework Assignments	40%	During the course	Each assignment will include 10 problems to be solved at home. Each problem is evaluated by 1 point using the evaluation criteria above.

Author	Published in	Title	Issue No. or Volume	Publishing house or Internet site
Required reading				
Lecture notes and slides as well as online resources will be made available to all students. Selected chapters from LM, MM and Bolstad are compulsory.				
R J Larsen and M L Marx (Referred to as LM)	2011	An Introduction to Mathematical Statistics and its Applications	5th Edition	Pearson
I Miller and M Miller (Referred to as MM)	2012	John E. Freund's Mathematical Statistics with Applications	8th Edition	Pearson
William M. Bolstad	2004	Introduction to Bayesian Statistics		Wiley
Supplementary reading (text books)				
James V Stone	2013	Bayes' Rule: A tutorial Introduction to Bayesian Analysis		Sebtel Press
D.S.Sivia and	2006	Data Analysis: A Bayesian		Oxford

J.Skilling		Tutorial		University Press