RTU Course "Probability Theory and Mathematical Statistics"

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General data

Code	DMS212
Course title	Probability Theory and Mathematical Statistics
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Oksana Pavļenko
Academic staff	Kārlis Šadurskis Andrejs Matvejevs Nataļja Budkina Aija Pola Māris Buiķis Marija Dobkeviča Daina Pūre Vaira Buža Jolanta Goldšteine Jeļena Mihailova
Volume of the course: parts and credits points	1 part, 2.0 Credit Points, 3.0 ECTS credits
Language of instruction	LV, EN
Annotation	Study course provides students with understanding of the basic concepts of probability theory, the most important methods of calculating probabilities of events, random variables and their applications, characteristics of random variables and the most popular distributions. Students are taught the basics of mathematical statistics: to process and evaluate the received information (samples), evaluate the most important indicators and interpret the results. The basic principles of constructing confidence intervals and testing hypotheses are shown; as well as estimation of the closeness of the relationship between the two variables; and construction of a linear one-factor regression with the Ordinary Least Squares method. Such knowledge is useful for the analysis of real-life data in various specialties.
Goals and objectives of the course in terms of competences and skills	The goal of this study course is to acquaint students with the basic principles of probability theory and mathematical statistics and necessary mathematical apparatus. The tasks of the study course are: 1. To give understanding of the regularities of random phenomena that appear when they are repeated en masse. 2. To provide an insight into the basic tasks of mathematical statistics and the possibility to use the apparatus of probability theory to solve them.
Structure and tasks of independent studies	The study course provides an independent homework performance for each topic considered in practical work.
Recommended literature	Obligāta/Obligatory: Lekciju un praktisko nodarbību materiāli kursa e-studiju vietnē (ORTUS). /Materials for lessons in e-learning system (Ortus). Papildus/Additional: 1. M.Baron. Probability and Statistics for Computer Scientists. CRC Press, 2014. 2. E.Vasermanis, D.Šķiltere Varbūtību teorija un matemātiskā statistika. "Izglītības soļi", Rīga, 2003. 3. O.Pavļenko, K.Šadurskis. Varbūtību teorija un matemātiskā statistika. Lekciju konspekts. RTU, 2011. 4. O.Pavļenko, K.Šadurskis. Varbūtību teorija un matemātiskā statistika. Praktiskie darbi. RTU, 2011. 5. J.Smotrovs. Varbūtību teorija un matemātiskā statistika I. R:Zvaigzne ABC,2004. 6. J.Smotrovs. Varbūtību teorija un matemātiskā statistika II. R:Zvaigzne ABC,2007. 7. I.Arhipova, S.Bāliņa Statistika ekonomikā un biznesā. Datorzinību centrs, 2006. 8. O.Krastiņš. Varbūtību teorija un matemātiskā statistika. R:Zvaigzne,1985. 9. M.Buiķis,J.Carkovs,B.Siliņa. Varbūtību teorija un matemātiskās statistikas elementi.-Zvaigzne, 1996.
Course prerequisites	Calculus.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Sample space, events, algebra of events. Classical definition of probability, Geometric probability, probability axioms.	2	1	1	3
Practical class. Operations with events. Combinatorics. Classical scheme.	2	2	1	5
Conditional probability, total probability and Bayes' formula. Bernoulli scheme, limit theorems for Bernoulli scheme.	2	2	1	3
Practical class. Conditional probability, total probability and Bayes' formula. Bernoulli scheme.	2	4	1	5
Discrete random variables. Distribution law of discrete random variable, expectation, variance, their properties.	2	2	1	3

Practical class. Test. Random events.	2	2	0	4
Special distributions of discrete random variables.	2	2	1	3
Practical class. Construction of distribution law for discrete random variable. Expected value, variance, functions of discrete random variables.	2	2	1	5
Continuous random variables. Cumulative distribution function, probability density function. Covariance, correlation coefficient. Expected value, variance, skewness, kurtosis.	2	2	1	3
Practical class. Distribution and probability density function. Expected value, variance, standard dviation, moments, skewness, kurtosis.	2	3	1	5
Important continuous distributions. The law of large numbers. Central limit theorem.	2	4	1	3
Practical class. Test. Random variables.	2	2	0	4
Elements and principal problems of mathematical statistics. Data visualisation. Statistical estimates. Confidence intervals.	2	2	1	3
Practical class. Graphical representation of distributions. Statistical estimates. Problems about confidence intervals ofexpected value and variance.	2	2	1	5
Hypoteses testing. Correlation. Linear regression. Least squares.	2	2	1	4
Practical class. Hypoteses testing about expected value and variance. Analysis of correlation. Linear regression and forecasting.	2	2	1	5
Tutorials.	6	4	1	0
Final exam.	2	0	2	0
Total:	40	40	17	63

Learning outcomes and assessment

Learning outcomes	Assessment methods
Is able to formulate events and calculate probabilities within the classical scheme, apply conditional probabilities, combinatorial formulas, the total probability formula, the Bayesian formula, the Bernoulli scheme and its limit theorems.	Problems included in test 1 and in the exam (homework or e-test are possible).
Knows the main facts about discrete random variables, are able to compile and use distribution laws, numerical characteristics of discrete random variables.	Problems included in test 2 and in the exam (homework or e-test are possible).
Knows the main facts about continuous random variables, the cumulative distribution function, the distribution density function, numerical characteristics of continuous random variables.	Problems included in test 2 and in the exam (homework or e-test are possible).
Knows the basic principles of statistical analysis, are able to determine the point and interval estimates of the main measures; perform graphical analysis of the distribution with frequency polygon, histogram and ogive.	Problems included in the exam (homework or e-test are possible).
Knows the basics of statistical hypotheses testing, are able to formulate and test simple hypotheses about mean, variance and standard deviation.	Problems included in the exam (homework or e-test are possible).
Is able to estimate the closeness of the relationship between two statistical variables; construct a simple linear regression equation and use it for forecasting	Problems included in the exam (homework or e-test are possible).

Evaluation criteria of study results

Criterion	%
1.test	15
2.test	15
4 e-tests (Ortuss) or homework (if not given, then 25% for each previous test)	20
Exam	50
Total:	100

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	2.0	1.0	1.0	0.0		*	