STUDY PROGRAMME DESCRIPTION

Title of the study programme	State code of the study programme
Data Science	6211AX004

Official name of the awarding institution	Language(s) of instruction
Vilnius University, Faculty of Mathematics and Informatics	English

Kind of study	Study cycle	Level of qualification under the Lithuanian Qualification Framework
University studies	Second	Seventh

Mode of studies; Length of the study programme (in years)	Study programme volume in credits	Total student's workload (in hours)	Contact hours	Self-study hours
Full-time (1.5)/ part-time (2.5)	90	2400	522	1878

Study area	Study field	Branch of study field
Mathematical sciences	Statistics	-

Qualification degree/Professional qualification awarded
Master of Mathematical Sciences

Chair of the study programme committee	Contact information
Assoc. prof. dr. Rūta Levulienė Department of Statistical Analysis	ruta.levuliene@mif.vu.lt

Accrediting body	Period of accreditation
Study Quality Assurance Centre	Until upcoming evaluation

Aim of the study programme
To prepare internationally recognized professionals in data science who expertly utilize the up-to-date knowledge of data analysis in developing and application of advanced mathematical (statistical) models for private and public institutions for planning, management, forecasting, and evaluation of their activities.

Content of the study programme: course unit groups	Distinctive features of the study programme
Statistics: *-- **Compulsory** --* • Functional Data Analysis • Multivariate Statistics • Data Mining • Parametric and Nonparametric Statistics • Big Data Analysis *-- **Optional** --* • Sample Surveys • Bayesian Statistics **Econometrics:** *-- **Optional** --* • Panel Data Econometrics • Multivariate Time Series and Financial Econometrics • Microeconomic Analysis • Game Theory	It is the only master's level Data Science programme in the Baltic states comprising a set of advanced courses in Econometrics, Informatics and Mathematical Statistics. Students can participate in ERASMUS and other international students' exchange programmes with leading universities in the fields of data analysis and econometrics. Lecturers are actively involved in research at the international level with an extensive experience in applied projects.

• Modern Mathematical Economics **Informatics:** ***--Optional –*** • Multidimensional Data Visualization • Digital Image Processing • Deep Learning	

Admission requirements	Recognition of prior learning
The documents to be submitted: https://mif.vu.lt/lt3/en/admission/master-studies/modelling-and-data-analysis#programme-specific-requirements Decision upon applicant's admission is made after the interview.	The formal and informal education is recognized and validated in accordance with the general regulations of Vilnius University.

Access to further studies
Graduates of the Programme can choose doctoral studies in Data Analysis, Data Science, Econometrics and/or Statistics in Lithuania or in foreign countries.

Employability
The analytical modelling, planning, and forecasting work opportunities at various levels are open for Masters in Data Science in: research centres; central banks, various ministries, and other public sector institutions; innovative startups; financial institutions in private sector (e.g. pension funds, stock exchanges, insurance companies, commercial banks); consulting firms; the analysis and planning units of business enterprises.

Teaching and learning methods	Assessment methods
Lectures, seminars, exercises, laboratory work, projects, self-study.	The examination committee evaluates the final defence of the master's thesis. Other course units are evaluated mostly based on a cumulative basis with the final examination having the largest weight.

Study programme generic competencies developed		Study programme learning outcomes (graduates will be able to)	
1.	Ability to solve nonstandard theoretical and empirical problems creatively	1.1	analyse formally, systemize, and generalize;
		1.2	solve problems creatively;
		1.3	link theoretical models with empirical problems;
		1.4	apply the theory at an advanced level to the analysis of specific situations.
2.	Ability to critically analyse and correctly apply the results presented in the scientific literature	2.1	evaluate the latest scientific issues in the field;
		2.2	analyse and systemize articles and other scientific literature critically;
		2.3.	learn using the latest literature constantly.
3.	Ability to organize applied research and realize it using interdisciplinary knowledge	3.1	apply the main stages of empirical research of data science;
		3.2	formulate tasks;
		3.3	position the mathematical modelling process and the results in a more general interdisciplinary research framework;
		3.4	present the results of research concisely and clearly;
		3.5	synthesize knowledge of statistics, mathematics, data science and other fields for the solution of theoretical and practical tasks.
Study programme subject specific competencies developed		**Study programme learning outcomes**	
4.	Know and understand at advanced level the problems and principles of Data Science	4.1	explain static and dynamic models and their analysis methods;
		4.2	interpret the underlying probabilistic laws and statistical principles used for the stochastic models;
		4.3	apply relevant estimation methods of models

		4.4	apply the algorithms of machine learning and artificial intelligence.
5.	Comprehend various methodologies of data analysis and apply them in practice	5.1	apply properly and compare the results of classical and Bayesian methods;
		5.2	apply Monte Carlo simulations and appropriately invoke the bootstrap-based procedures in the research;
		5.3	apply and use properly algorithms of machine learning and artificial intelligence.
6.	Prepare raw empirical data for the analysis and professionally operate the data analysis software	6.1	identify errors, cleanse, and prepare (large) datasets for the statistical analysis;
		6.2	use the standard statistical software and write the codes required for non-standard problems (such as non-standard estimation, bootstrap, etc.).
7.	Analyse big data	7.1	create and maintain statistical models;
		7.2	investigate the dynamics of financial markets and estimate financial risks;
		7.3	create and maintain algorithms of machine learning and artificial intelligence.
8.	Evaluate the adequacy of statistical models and modify the models appropriately	8.1	describe and apply in practice statistical principles of checking the adequacy of empirical models;
		8.2	interpret various model adequacy tests for the identification of potential problems;
		8.3	extend or modify models to specific needs, select or derive necessary estimators, adapt the hypothesis tests to study relevant problems, etc.;
		8.4	analytically investigate the statistical properties of modified (non-standard) stochastic models and situations.
9.	Understand the principles of advanced statistical inference theory solving theoretical and practical problems of statistics	9.1	prove the consistency of standard tests and investigate their asymptotic efficiency.
		9.2	investigate the power of statistical tests and properties of empirical significance in finite samples;
		9.3	know not only the theory of parametric and non-parametric statistical inference under the standard classical assumptions but also principles of bootstrap and its alternative procedures.
10.	Compare and critically evaluate the results of statistical modelling and machine learning	10.1	analyse the results of machine learning and compare them with the results of statistical modelling;
		10.2	critically evaluate differences between machine learning and statistical modelling and choose the most appropriate solution for the problem considered.

STUDY PLAN (full-time studies)
(COURSE UNITS RELATION TO COMPETENCES AND LEARNING OUTCOMES)

Code	Course units	Credits	Student's workload	Contact hours	Self-study hours	Competences																																			
						Generic competences												Subject-specific competences																							
						1.				2.			3.					4.				5.		6.		7.			8.				9.			10.							
						Learning outcomes																																					
						1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	5.1	5.2	5.3	6.1	6.2	7.1	7.2	7.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	10.1	10.2			
1st YEAR		60	**1600**	**490**	**1110**																																				
SEMESTER 1		**30**	**800**	**252**	**548**																																				
Compulsory course units		***20***	***550***	***168***	***382***																																				
	Multivariate Statistics	*5*	*150*	*42*	*108*	x	x	x			x			x		x	x	x	x	x										x	x	x								
	Data Mining	*5*	*150*	*42*	*108*	x	x			x	x	x									x			x	x		x		x									x	x	
	Parametric and Nonparametric Statistics	*5*	*125*	*42*	*83*	x	x	x	x			x		x		x	x	x	x			x	x			x				x	x	x	x	x	x	x				
	Natural Language and Speech Processing	*5*	*125*	*42*	*83*	x	x	x			x	x		x		x	x				x			x					x											
Optional course units		***10***	***250***	***84***	***166***																																				
	Bayesian Methods	*5*	*125*	*42*	83		x	x	x				x	x	x	x	x		x			x	x							x	x	x								
	Panel Data Econometrics	*5*	*125*	*42*	*83*		x			x	x		x			x	x	x		x			x		x					x	x									
	Modern Mathematical Economics	*5*	*125*	*42*	*83*	x	x	x	x		x	x					x	x	x	x																				
	Digital Image Processing	*5*	*125*	*42*	*83*																x			x	x				x											
	Microeconomic Analysis	*5*	*150*	*42*	*108*	x	x		x	x	x		x	x	x		x	x		x								x												
	Large Language Models	*5*	*125*	*42*	*83*	x	x					x		x							x			x					x											
SEMESTER 2		**30**	**800**	**238**	**562**																																				
Compulsory course units		***15***	***425***	***112***	***313***																																				
	Functional Data Analysis	*5*	*175*	*42*	*133*	x	x	x	x	x	x	x		x	x	x	x											x					x	x	x	x	x		
	Big Data Analysis	*10*	*250*	*70*	*180*	x	x	x													x			x	x		x		x			x					x	x		
Optional course units		***15***	***375***	***126***	***249***																																				
	Game Theory	*5*	*125*	*42*	*83*	x	x	x	x	x	x	x		x			x	x		x																				
	Sample Surveys	*5*	*125*	*42*	83	x	x	x			x			x		x	x	x	x	x		x			x	x				x	x			x	x	x				
	Deep Learning	*5*	*125*	*42*	*83*	x	x	x	x												x			x	x	x	x		x											
	Multivariate Time Series and Financial Econometrics	*5*	*125*	*42*	*83*																							x			x	x	x							
	Multidimensional Data Visualization	*5*	*125*	*42*	*83*	x	x	x	x				x	x							x			x	x		x		x									x		
2nd YEAR		**30**	**800**	**32**	**768**																																				
SEMESTER 3																																									
Compulsory course units		***30***	***800***	***32***	***768***																																				
	Master thesis seminar	*5*	*150*	*18*	*132*	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		x	x	x	x	
Master thesis or (and) final exams																																									
	Master thesis (branch: statistics)	*25*	*650*	*14*	*636*	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		x	x	x	x	

STUDY PLAN (part-time studies)
PLAN 1

		Credits	Student's workload	Contact hours	Self-study hours
YEAR I		**35**	**975**	**280**	**695**
SEMESTER 1		**15**	**425**	**126**	**299**
Compulsory course units (modules)		**15**	**425**	**126**	**299**
	Multivariate Statistics	5	150	42	108
	Parametric and Nonparametric Statistics	5	125	42	83
	Data Mining	5	150	42	108
SEMESTER 2		**20**	**550**	**154**	**396**
Compulsory course units (modules)		**15**	**425**	**112**	**313**
	Functional Data Analysis	5	175	42	133
	Big Data Analysis	10	250	70	180
Optional course units (modules)		**5**	**125**	**42**	**83**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
YEAR II		**35**	**885**	**214**	**671**
SEMESTER 3		**15**	**375**	**126**	**249**
Compulsory course units (modules)		**5**	**125**	**42**	**83**
	Natural Language and Speech Processing	5	125	42	83
Optional course units (modules)		**10**	**250**	**84**	**166**
	Bayesian Methods	5	125	42	83
	Panel Data Econometrics	5	125	42	83
	Modern Mathematical Economics	5	125	42	83
	Digital Image Processing	5	125	42	83
	Microeconomic Analysis	5	150	42	108
	Large Language Models	5	125	42	83
SEMESTER 4		**20**	**510**	**88**	**422**
Master thesis		**10**	**260**	**4**	**256**
	Scientific Research (project of master thesis, branch: statistics)	10	260	4	256
Optional course units (modules)		**10**	**250**	**84**	**166**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
Year III		**20**	**540**	**28**	**512**

SEMESTER 5		**20**	**540**	**28**	**512**
Compulsory course units (modules)		**5**	**150**	**18**	**132**
	Master Thesis Seminar	5	150	18	132
Master thesis		**15**	**390**	**10**	**380**
	Master Thesis (branch: statistics)	15	390	10	380

STUDY PLAN (part-time studies)
PLAN 2

		Credits	**Student's workload**	**Contact hours**	**Self-study hours**
YEAR I		**35**	**925**	**280**	**645**
SEMESTER 1		**15**	**425**	**126**	**299**
Compulsory course units (modules)		**15**	**425**	**126**	**299**
	Multivariate Statistics	5	150	42	108
	Parametric and Nonparametric Statistics	5	125	42	83
	Data Mining	5	150	42	108
SEMESTER 2		**20**	**500**	**154**	**346**
Compulsory course units (modules)		**10**	**250**	**70**	**180**
	Big Data Analysis	10	250	70	180
Optional course units (modules)		**10**	**250**	**84**	**166**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
YEAR II		**35**	**935**	**214**	**721**
SEMESTER 3		**15**	**375**	**126**	**249**
Compulsory course units (modules)		**5**	**125**	**42**	**83**
	Natural Language and Speech Processing	5	125	42	83
Optional course units (modules)		**10**	**250**	**84**	**166**
	Bayesian Methods	5	125	42	83
	Panel Data Econometrics	5	125	42	83
	Modern Mathematical Economics	5	125	42	83
	Digital Image Processing	5	125	42	83
	Microeconomic Analysis	5	150	42	108
	Large Language Models	5	125	42	83
SEMESTER 4		**20**	**560**	**88**	**472**
Compulsory course units (modules)		**5**	**175**	**42**	**133**
	Functional Data Analysis	5	175	42	133

Master thesis		**10**	**260**	**4**	**256**
	Scientific Research (project of master thesis, branch: statistics)	10	260	4	256
Optional course units (modules)		**5**	**125**	**42**	**83**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
YEAR III		**20**	**540**	**28**	**512**
SEMESTER 5		**20**	**540**	**28**	**512**
Compulsory course units (modules)		**5**	**150**	**18**	**132**
	Master Thesis Seminar	5	150	18	132
Master thesis		**15**	**390**	**10**	**380**
	Master Thesis (branch: statistics)	15	390	10	380

STUDY PLAN (part-time studies)
PLAN 3

		Credits	**Student' s workload**	**Contact hours**	**Self-study hours**
YEAR I		**35**	**950**	**280**	**670**
SEMESTER 1		**15**	**400**	**126**	**274**
Compulsory course units (modules)		**5**	**150**	**42**	**108**
	Multivariate Statistics	5	150	42	108
Optional course units (modules)		**10**	**250**	**84**	**166**
	Bayesian Methods	5	125	42	83
	Panel Data Econometrics	5	125	42	83
	Modern Mathematical Economics	5	125	42	83
	Digital Image Processing	5	125	42	83
	Microeconomic Analysis	5	150	42	108
	Large Language Models	5	125	42	83
SEMESTER 2		**20**	**550**	**154**	**396**
Compulsory course units (modules)		**15**	**375**	**112**	**313**
	Functional Data Analysis	5	175	42	133
	Big Data Analysis	10	250	70	180
Optional course units (modules)		**5**	**125**	**42**	**83**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*

YEAR II		**35**	**910**	**214**	**696**
SEMESTER 3		**15**	**400**	**126**	**274**
Compulsory course units (modules)		**15**	**400**	**126**	**274**
	Data Mining	5	150	42	108
	Parametric and Nonparametric Statistics	5	125	42	83
	Natural Language and Speech Processing	5	125	42	83
SEMESTER 4		**20**	**510**	**88**	**422**
Master thesis		**10**	**260**	**4**	**256**
	Scientific Research (project of master thesis, branch: statistics)	10	260	4	256
Optional course units (modules)		**10**	**250**	**84**	**166**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
	Large Language Models	5	125	42	83
YEAR III		**20**	**540**	**28**	**512**
SEMESTER 5		**20**	**540**	**28**	**512**
Compulsory course units (modules)		**5**	**150**	**18**	**132**
	Master Thesis Seminar	5	150	18	132
Master thesis		**15**	**390**	**10**	**380**
	Master Thesis (branch: statistics)	15	390	10	380

STUDY PLAN (part-time studies)
PLAN 4

		Credits	**Student' s workload**	**Contact hours**	**Self-study hours**
YEAR I		**35**	**900**	**280**	**620**
SEMESTER 1		**15**	**400**	**126**	**274**
Compulsory course units (modules)		**5**	**150**	**42**	**108**
	Multivariate Statistics	5	150	42	108
Optional course units (modules)		**10**	**250**	**84**	**166**
	Bayesian Methods	5	125	42	83
	Panel Data Econometrics	5	125	42	83
	Modern Mathematical Economics	5	125	42	83
	Digital Image Processing	5	125	42	83
	Microeconomic Analysis	5	150	42	108
SEMESTER 2		**20**	**500**	**154**	**346**
Compulsory course units (modules)		**10**	**250**	**70**	**180**

	Big Data Analysis	10	250	70	180
Optional course units (modules)		**10**	**250**	**84**	**166**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
YEAR II		**35**	**960**	**214**	**746**
SEMESTER 3		**15**	**400**	**126**	**274**
Compulsory course units (modules)		**15**	**400**	**126**	**274**
	Data Mining	5	150	42	108
	Parametric and Nonparametric Statistics	5	125	42	83
	Natural Language and Speech Processing	5	125	42	83
SEMESTER 4		**20**	**560**	**88**	**472**
Compulsory course units (modules)		**5**	**175**	**42**	**133**
	Functional Data Analysis	5	175	42	133
Master thesis		**10**	**260**	**4**	**256**
	Scientific Research (project of master thesis, branch: statistics)	10	260	4	256
Optional course units (modules)		**5**	**125**	**42**	**83**
	Game Theory	5	125	42	83
	Sample Surveys	5	125	42	83
	Deep Learning	5	125	42	83
	Multidimensional Data Visualization	5	125	42	83
	Multivariate Time Series and Financial Econometrics	5	125	42	*83*
YEAR III		**20**	**540**	**28**	**512**
SEMESTER 5		**20**	**540**	**28**	**512**
Compulsory course units (modules)		**5**	**150**	**18**	**132**
	Master Thesis Seminar	5	150	18	132
Master thesis		**15**	**390**	**10**	**380**
	Master Thesis (branch: statistics)	15	390	10	380