Course description

Course title	Course code
Non-Life Insurance Models	

Lecturer	Department where the course is delivered
Gabija Liaudanskaitė	Department of Mathematical Analysis Faculty of Mathematics and Informatics Naugarduko St. 24, LT-03225 Vilnius, Lithuania

Cycle		Type of course
First		Compulsory

Mode of delivery	Semester or period when the course is delivered	Language of instruction
Face-to-face	3rd year, spring semester	English

Prerequisites and corequisites	
Prerequisites: mathematical analysis, probability theory	**Corequisites (if any):**

Number of ECTS credits	Student's workload	Contact hours	Individual work hours
5	144	48	96

Course objectives: program competencies to be developed		
• To get acquainted with the theoretical models that are used to describe the non-life insurance business, • to develop the ability to apply these models for practical purposes, • to develop abstract thinking, • to acquire skills to use a programming language to solve insurance problems, • to develop the ability to work individually.		
Learning outcomes **At the end of the course a student should:**	**Learning methods**	**Assessment methods**
- Be able to apply the main concepts of insurance theory (the insurer, the insured, risk, expected loss, the coefficient of risk aversion, utility function, premium, reinsurance, the probability of ruin, etc.). - Be able to analyze the main characteristics of the discrete-time risk model and the classical risk model. - Be able to derive and explain the main formulas and procedures for the calculation of the characteristics of these models.	Lectures, individual reading of compulsory literature	Homework assignments, midterm exam, final exam
- Be able to estimate and find all critical characteristics of discrete-time and classical risk models. - Be able to analyze the properties of the main probability distribution classes describing claims and losses in the insurance business.	Discussion lecture, model-based analysis	Homework assignments, midterm exam, final exam
- Be able to choose the appropriate model describing non-life insurance business. - Be able to analyze the possibility to describe data by the theoretical model. - Be able to make decisions on the impact of the model characteristics for the business development.	Presentation of individual and collective readiness	Homework assignments

Course content	Contact hours				Individual work hours and assignments
	Lectures	Seminars	**Total contact hours**	**Individual work hours**	**Assignments**
1. Review of probability theory: probability space, random variables, cumulative distribution function, density function, moment generating function, probability generating function, sums of independent random variables, common examples of discrete and continuous distributions.	2	2	**4**	**8**	Solve homework problems, review the slides, analyze assigned literature.
2. Utility theory: the expected utility criterion, Jensen's inequality, types of utility functions.	2	1	**3**	**6**	Solve homework problems, review the slides, analyze assigned literature.
3. Principles of premium calculation: properties of premium principles, examples of premium principles.	2	1	**3**	**6**	Solve homework problems, review the slides, analyze assigned literature.
4. The collective risk model: the model, deriving aggregate claims distributions, expected value, variance, and moment generating function using conditional probabilities and conditional expectations.	2	1	**3**	**6**	Solve homework problems, review the slides, analyze assigned literature.
5. Reinsurance, recursive calculation of aggregate claims: types of reinsurance, the Panjer recursion formula.	2	1	**3**	**6**	Solve homework problems, review the slides, analyze assigned literature.
Midterm exam	3		**3**	**6**	Prepare for the midterm exam.
6. Discrete-time risk model: components of the model, calculation of ruin probability, finite time ruin probability, Lundberg inequality, solution of recursive formulas.	6	4	**10**	**20**	Solve homework problems, review the slides, analyze assigned literature.
7. Classical risk model: components of the model, Poisson process, compound Poisson process, ruin probability, net profit condition, the equilibrium coefficient, Lundberg inequality.	10	6	**16**	**32**	Solve homework problems, review the slides, analyze assigned literature.
Final exam	3		**3**	**6**	Prepare for the final exam.
Total	**32**	**16**	**48**	**96**	

Assessment strategy	Weight	Time of assessment	Criteria
General assessment strategy. A 10-point rating system is applied. It is possible to get 30 points for the midterm exam and 50 points for the final exam. Additional 20 points can be collected for homework assignments. All collected points are added and divided by 10.			
Midterm exam	30%	During the semester	In this exam, students are tested on the material from the first 5 topics of the syllabus. The exam consists of three problems: • the first problem is from the utility theory (10 points), • the second one is from the collective risk model and premium calculation (10 points), • and the third one is from the reinsurance and recursive calculation of aggregate claims (10 points). Each problem has several parts a), b), c), etc. Each part (e.g., a) part) is assessed as 100% if there are no mistakes, 50% if the solution is logically correct, but incomplete, and 0% if there is no solution or the solution is illogical.
Final exam	50%	At the end of the semester	In this exam, students are tested on the material from the discrete-time risk model and classical risk model. The exam consists of two problems: • the first problem is from the discrete-time risk model (20 points), • the second one is from the classical risk model (30 points). Each problem has several parts a), b), c), etc. Each part (e.g., a) part) is assessed as 100% if there are no mistakes, 50% if the solution is logically correct, but incomplete, and 0% if there is no solution or the solution is illogical.
Homework assignments	20%	During the semester	There are 10 homework assignments during the semester. Each assignment is worth 2 points.

Author	Publication year	Title	Volume and/or publication number	Publication place and publisher
Required reading				
J. Šiaulys	2013	Discrete-time risk model (lecture notes)		
J. Šiaulys	2014	Classical risk model (lecture notes)		
D.C.M. Dickson	2016	Insurance Risk and Ruin	2nd ed	Cambridge University Press
Additional reading				
R. Kaas, M. Goovaerts, J. Dhaene, M. Denuit	2009	Modern Actuarial Risk Theory	2nd ed	Springer
T. Mikosch	2009	Non-Life Insurance Mathematics	2nd ed	Springer