Course description

Course title	Course code
Risk theory	

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

Cycle	Type of course
Second	Compulsory

Mode of delivery	Semester or period when the course is delivered	Language of instruction
Face-to-face	2nd semester (Spring)	English

Prerequisites and corequisites	
Prerequisites: Basic knowledge of mathematical analysis and probability theory, initial knowledge on the risk models.	**Corequisites (if any):**

Number of ECTS credits allocated	Student's workload	Contact hours	Individual work hours
5	125	40	85

Course objectives: program competences to be developed		
This course is a continuation of non-life insurance course. The goal of this course is to acquaint the students with the so-called risk renewal (or E. Sparre Andersen's) model. This model is often considered the last year in the scientific literature because of its broad application possibilities. Study focuses on the possibility of application of this model in the insurance practice. In order to develop a deep understanding of this theoretic model abstract thinking is developed as well as the ability to estimate suitable the model parameters, the ability to find and examine the known results individually and the ability to discuss with teachers and colleagues, using mathematical and insurance concepts.		
Learning objectives. At the end of the course a student should:	**Learning methods**	**Assessment methods**
- Be able to analyze all components of the renewal risk model, together with the basic dynamical characteristics of such a model; - Be able to derive the formulas and procedures for calculation of these characteristics.	Lecture, case analysis	Written exam
- Be able to apply the basic formulas and procedures for the estimate and finding the model characteristics; - Be able to analyze the basic probability distributions classes describing the random claims and the inter-occurrence times;	Problematic lecture, demonstration, analysis of the model examples.	Written exam
- Be able to find individually the suitable material to solving the problem;	Debates, demonstrations,	Presentation

- Be able to apply new research results and methods for finding critical characteristics of the model; - Be able to select the suitable version of renewal risk model for the existing data; - Be able to select the optimal strategy to find or evaluate different model characteristic; - Be able to make decisions on the impact of the model characteristics for the business development.	preparation of individual and group readiness.	

Course content: breakdown of the course	**Contact hours**					**Individual work hours and assignments**	
	Lectures	Practical training			**Total contact hours**	**Individual work hours**	**Assignments**
Components of the risk renewal model	1	1			**2**	**2**	Learn the introductory subsection of syllabus, solve the homework.
Counting renewal process, the law of large numbers for counting renewal process	1	1			**2**	**4**	Learn the subsection “The strong law of large numbers for renewal process” of syllabus, solve the homework.
Expectation of the counting renewal process, elementary renewal theorem	2	2			**4**	**6**	Learn the subsection “Expectation of renewal counting process” of syllabus, solve the homework.
Renewal equations for quantities related to the renewal process. Residual life process, age process.	2	2			**4**	**6**	Learn the subsection “Renewal equations” of syllabus, solve the homework.
Smith’s and Blackwell’s theorems for solutions of the renewal equation.	1	2			**3**	**6**	Solve the required exercises, study the recommended reading to prepare a presentation.
Higher order moments and the central limit theorem for renewal counting process.	1	2			**3**	**6**	Solve the required exercises, study the recommended reading to prepare a presentation.
Presentation of readiness		2			**2**		
The first interim exam		2			**2**	**12**	Review the first part of the course, analyze a few standard cases of the renewal process
The total claim amount process and its characteristics (mean, variance, the Laplace-Stieltjes transform, the central limit theorem)	1	2			**3**	**6**	Learn the subsection “Total claim amount process” of syllabus, solve the homework.
Classical premium calculation principles	1	2			**3**	**4**	Learn the subsection “Premium calculation principles” of syllabus, solve the homework.
Ruin probability and net profit condition for the risk renewal process	2				**2**	**6**	Study a supplementary reading, prepare a presentation.
Lundberg’s inequality for the risk renewal model	1	2			**3**	**4**	Learn the suitable subsection of syllabus, solve the homework.

Asymptotic formulas for the ruin probability in the risk renewal model	1	2			**3**	**11**	Study a supplementary reading, prepare a presentation.
Presentation of readiness		2			**2**		
The second interim exam	2				**2**	**12**	Repeat the second part of the course, analyze a few standard cases of the risk renewal models
Total	**16**	**24**			**40**	**85**	

Assessment strategy	**Weight**	**Time of assessment**	**Criteria**
General assessment strategy. A 10 point rating system is applied. It is possible to get 40 points for the first midterm exam. The same holds for the second midterm exam. Additional 20 points can be collected for an individual or group self-study presentation. All collected points are added and divided by 10.			
The first midterm exam	40%	During the semester	In this exam, students are tested on the material from the first half of the semester. Typically, the exam consists of one easy theoretical question (5 points), one hard theoretical question (10 points), and a long multi-stage exercise in which a particular case of the renewal process must be considered (25 points). To answer an easy theoretical question, a student should formulate a definition, theorem, or explain some concept. The answer to this question is assessed strictly: *the student knows the appropriate definition or concept (5 points); the student does not know the appropriate definition or concept (0 points).* The hard theoretical question involves the proof of some assertion known from the syllabus. Given proof is assessed in a standard way: *the student has not started proving the statement (0 points); the statement remains unproven, but the student has made a few correct steps of the proof (1-4 points); the assertion has been proved with large defects (5-6 points); the proof of the statement was presented with minor deficiencies (7-8 points); the proof of the statement was presented without any defects, all important places of the proof are fully explained (9-10 points).* A long multi-stage exercise usually consists of five parts. In each of these parts, a student needs to find some characteristic of the same discrete time risk model. Each part of the exercise is assessed in points from 0 to 5 in a standard way: *the student has not tried to find the desired model characteristic (0 points); while searching for the required the student has made several essential errors (1-2 points); while finding the desired characteristic, the student made a few minor, e.g., arithmetic, errors (3-4 points); the student correctly found the desired characteristic of the model, all calculations and derivations are correct and accurate (5 points).*
The second midterm exam	40%	At the end of the semester	In this exam, students are tested on the material from the second half of the semester. The second midterm exam's composition and assessment are similar to the composition and the assessment of the first midterm exam.
Presentation	20%	During the semester	At the beginning of the semester, all students in groups or individually receive a task for readiness. When the agreed time comes, students present the work done. One presentation takes 15-30 minutes. The topics are coordinated with the students. Most of the topics relate to the additional reading materials.

Author	Publication year	Title	Volume and/or number of publication	Publication place and publisher
Required reading				
J. Šiaulys	2012	Risk theory in insurance (lecture notes)		
T. Mikosch	2009	Non-Life Insurance Mathematics, 2nd Ed.		Springer
Recommended reading				
S.I. Resnick	1992	Adventures in Stochastic Processes		Boston, Birkhauser
F. Spitzer	1986	Principles of Random Walk		Berlin, Springer
A. Gut	1988	Stopped Random Walks		Berlin, Springer
P. Embrechts, C. Klüppelberg, T. Mikosch	1997	Modeling Extremal Events		Springer