Annotation of the course "Actuarial calculations"

Mark Kelbert

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Credits	6
Contact hours	80
Selt-study hours	148
Course	1

Higher School of Economics
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Actuarial calculations Course within the Program "Statistical Modelling and Actuarial Science",
modules 3 and 4
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Mondays 14 pm - 16 pm.

Course title: Actuarial calculations

Course pre-requisites: Calsulus, Mathematical Statistics, Probability Theory,
Linear Algebra, Insurance Mathematics

<u>Course type:</u> Elective

<u>Abstract:</u>
    Apart from the introduction into the standard actuarial theory, this course handles various methods of solving popular problems of life insurance that are relevant for actuarial practice, for instance, the Tiele equations in Markovian environment, CLT for order statistics in Demography, analysis of mortgate-link or index-linked insurance policies. In addition to basic topics which are compatible with official material of actuarial education in UK and other parts of the world, the course contains important material on topics that are relevant for recent insurance and actuarial developments including the credibility theory, reserving, ranking of risks in life-insurance, modelling dependencies and the use of generalized linear models, as well as phase-type distributions with an eye on applications to the life insurance. The second part of the course concentrates on the different aspects of non-life insurance, it handles various methods of solving popular problems of non-live insurance that are relevant for actuarial practice, for instance, the rating of automobile insurance policies, premium principles and evaluation of contingencies in advanced ruin models. All methods, considered in this course, require only few assumptions about the probabilistic properties of the model, from which the data is obtained. The course refects the state-of-the-art in actuarial risk theory. In addition to basic topics which are compatible with official material of actuarial education in UK and other parts of the world, the course contains important material on topics that are relevant for recent insurance and actuarial developments including the credibility theory, reserving, ranking of risks, modelling dependencies and the use of generalized linear models, as well as phase-type distributions with an eye on applications to the non-life insurance. The mathematical background assumed is on a level such as acquired in the bachelors programs in quantitative economics or mathematical statistics: Calculus, Probablity Theory, Mathematical Statistics, Linear Algebra and Insurance Mathematics.

<u>Course Outline and Plan</u>
In total there will be 36 hours of lectures and 44 seminars. During lectures we will cover new material. Seminars will mostly be dedicated to theoretical questions, applications and further method discussions. You are recommended to spend 148 hours on independent study for this course.

Learning objectives and expected outcomes
The aim of this course is to provide the skills for basic actuarial calculations both in life and non-life insurance as well as understanding the basic principles behind these calculations. This course is highly theoretical and the greater focus is on mathematics behind the algorithms, not on obtaining data from Internet and not on software implementation. However, an important objective is operational knowledge of the studied techniques, say the use of actuarial tables, hence there will be a practical side to the course as well. By the end of the course students will have a broad view of applications, including the most recent and state-of-the-art developments in actuarial science.

Learning Outcomes:
1. Understanding and ability to present/describe the methods studied in this course in mathematical terms
2. Application of these methods to problems/examples
3. Understanding the limitations and benefits related to using of different actuarial techniques
4. Implementing methods studied in the course with Mathematica and/or statistical software
5. Efficient work in groups

Course outline:

- Background of Actuarial Mathematics

- Ordering risks

- Premium principles and risk measures

- Population dynamics and epidemiology

- Actuarial calculations: single life

- Actuarial calculatiolations: multiple lives

- The Individual risk models

- Collective risk models

- Bonus-malus models

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- Insurance portfolio

- Credibility Theory

- Insurance and reinsurance

- Phase-type distributions

- Matrix-analytic methods

- Insurance portfolio

- Elementary ruin theory

- Ruin problems for Lévy processes

Course plan:

Topics	Lecture Hours	Seminar Hours
Life Insurance	8	12
Credibility theory	6	6
Matrix models	10	10
Ruin theory	12	16;
Total	36	44

Reading list and other information resources

1. Kelbert M., Insurance Mathematics in Problems and Examples, M.: MCCME, 2019

2. Mikosch T., Non-Life Insurance Mathematics, Springer, 2004

3. Asmussen S., Albrecher H., Ruin Probabilities, Singapore, World Scientific, 2010

4. Embrecht P., Klúppelberg C., Mikosch T., Modeling Extremal Events for Insurance and Finance, Springer, 2012

5. Gerber H.U., Life Insurance Mathematics, Springer-Verlag, Berlin, 1990

6. Kaas R., Goovaert M., Dhaene J., Denuit M., Modern Actuarial Risk Theory, Springer, 2008

7. Dickson, D. C. Actuarial mathematics for life contingent risks / D. C. M. Dickson, M. R. Hardy, H. R. Waters. –Cambridge University Press, 2010

8. Dickson, D. C. Solutions manual for actuarial mathematics for life contingent risks / D. C. M. Dickson, M. R. Hardy, H. R. Waters. -Cambridge University Press, 2012

9. Dickson D.C., Insurance and Ruin, Cambridge University Press, 2005