

Course guide

200619 - EA - Actuarial Statistics

Last modified: 15/06/2023

Unit in charge: School of Mathematics and Statistics
Teaching unit: 1004 - UB - (ENG)Universitat de Barcelona.

Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: ANA MARIA PÉREZ MARÍN

Others: Segon quadrimestre:
ANA MARIA PÉREZ MARÍN - A

PRIOR SKILLS

Students should have previous knowledge of calculus of probability, random variables, probability distributions and characteristics of probability distributions (means, variances, etc.). It is also recommended to have prior knowledge in algebra of events.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

5. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.
6. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
7. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
8. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.
Translate to english
9. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
10. CE-7. Ability to understand statistical and operations research papers of an advanced level. Know the research procedures for both the production of new knowledge and its transmission.
11. CE-9. Ability to implement statistical and operations research algorithms.

Transversal:

1. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
2. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
3. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
4. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

The course is organized in weekly theoretical lessons where the student has to participate once he has studied some materials that have been delivered in advance. Exercises and practical cases will be solved by using the computer.

LEARNING OBJECTIVES OF THE SUBJECT

Regarding knowledge

- To learn how to calculate death probabilities (or survival probabilities) as the core of rating in life insurance. This calculation is carried out for individuals (individual insurance) and groups of individuals (collective insurance).
- To learn how to calculate the claim probability as the core of rating in general insurance by modelling the number of claims and the total cost of claims, and calculate the ruin probability
- To learn the applications of insurance data analytics, in connection with pricing, risk management, fraud detection, prediction of the CLV (customer lifetime value) and personalized marketing campaigns in insurance.
- To learn how to manage big insurance data sets, specifically in connection with usage-based motor insurance policies based on telematics information (UBI).

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Hours small group	15,0	12.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

PART 1. Life Insurance Statistics

Description:

Lesson 1. Introduction

- Hypothesis of the biometric model
- Basic variables and functions
- Concepts of population theory
- Temporal and deferred probabilities
- Force of mortality
- Life expectation
- Life tables

Lesson 2. Probabilities for multiple lifes

- Joint-life and last-survivor probabilities
- Temporal and deferred probabilities

Lesson 3. Fundamentals of life insurance pricing

- Calculating the APV of individual policies
- Calculating the APV os collective poliies

Lesson 4. Mortality laws and survival analysis

- Mortality laws
- Survival models for censored information

Full-or-part-time: 30h

Theory classes: 30h



Section 2. Non-life insurance statistics

Description:

Lesson 1. Introduction

- Modelling the claim frequency
- Modelling the claim severity
- Model selection and validation

Lesson 2. Insurance data analytics

- Analysing claim rates for different types of insureds
- Applications on pricing
- Fraud detection
- Calculating the CLV

Lesson 3. Usage based insurance (UBI) and management of telematics information

- Usage-based-insurance (UBI)
- Managing big data sets of telematics information in real time in UBI

Full-or-part-time: 30h

Theory classes: 30h

GRADING SYSTEM

Continuous assessment:

Three practical activities should be resolved by the student. These activities are addressed to assess the student's skill in the application of the concepts developed during the course. Each practical activity has an weight of 33.3% in the final grade.

Final examination system:

A final exam consists of five-six exercises to resolve.



BIBLIOGRAPHY

Basic:

- Macdonald, A.S.; Cairns, A.J.G.; Gwilt, P.A. & Miller, K.A.. "An international comparison of recent trends in population mortality". British actuarial journal [on line]. N. 4, 1998, 3-141 [Consultation: 12/05/2020]. Available on: <http://sumaris.cbuc.es/cgis/revista.cgi?issn=13573217>.
- Renshaw, A. E.; Haberman, S. "Dual modelling and select mortality". Insurance, mathematics and economics [on line]. 19, 1997, 105-126 [Consultation: 15/05/2020]. Available on: <https://www.sciencedirect.com/journal/insurance-mathematics-and-economics/vol/19/issue/2>.
- Ayuso, Mercedes. Estadística actuarial vida. Barcelona: Publicacions i Edicions de la Universitat de Barcelona, 2007. ISBN 8447531309.
- Kaas, Rob ... [et al.]. Modern actuarial risk theory [on line]. New York: Kluwer Academic Publishers, 2001 [Consultation: 28/06/2023]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/b109818>. ISBN 0306476037.
- Sarabia Alegría, José María; Gómez Déniz, Emilio; Vázquez Polo, Francisco J. Estadística actuarial : teoría y aplicaciones. Madrid: Pearson Prentice Hall, 2007. ISBN 9788420550282.
- Bowers, Newton L. Actuarial mathematics. 2nd ed. London: The Society of Actuaries, 1997. ISBN 938959468.
- Jong, Piet de; Heller, Gillian Z. Generalized linear models for insurance data [on line]. Cambridge: Cambridge University Press, 2008 [Consultation: 28/06/2023]. Available on: <https://www-cambridge-org.recursos.biblioteca.upc.edu/core/books/generalized-linear-models-for-insurance-data/851EB0898C6C7DB4FEA2D542371145C2>. ISBN 9780521879149.
- Charpentier, A.. Computational actuarial science with R. 2015. ISBN 1466592591.
- Boucher, J. P. Pérez-Marín, A. M. and Santolino, M. (2013). "Pay-as-you-drive insurance: the effect of the kilometers on the risk of accident". Anales del instituto de actuarios españoles [on line]. 19, 2013, p. 135-154 [Consultation: 28/06/2023]. Available on: https://actuarios.org/wp-content/uploads/2017/02/anales2013_6.pdf.
- Frees, Edward W. Regression modeling with actuarial and financial applications [on line]. Cambridge: Cambridge University Press, 2010 [Consultation: 28/06/2023]. Available on: <https://www-cambridge-org.recursos.biblioteca.upc.edu/core/books/regression-modeling-with-actuarial-and-financial-applications/25C768AB6FFE4FAD5F2AD725D8643C18>. ISBN 9780521135962.
- Spedicato, G. A. (2013). "The lifecontingencies Package: Performing Financial and Actuarial Mathematics Calculations in R". Journal of statistical software [on line]. 2013, vol. 55, Issue 10 [Consultation: 28/06/2023]. Available on: https://www.researchgate.net/publication/265215670_The_lifecontingencies_Package_Performing_Financial_and_Actuarial_Mathematics_Calculations_in_R.

RESOURCES

Hyperlink:

- Software R. Software de lliure distribució.
Disponible a: <http://www.r-project.org>