Actuarial Statistics

Academic Year: (2023 / 2024) **Review date: 26-04-2023**

Department assigned to the subject: Statistics Department

Coordinating teacher: ALBARRAN LOZANO, IRENE

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

OBJECTIVES

The ultimate objective of this course is to provide the student knowledge and understanding of the basic concepts and applications of the theory of probability and Statistical Inference required for the control and risk analysis in the areas of insurance and finance.

Specific responsibilities: to acquire knowledge and understanding to:

1. Analyze data from one and two variables.
2. Explain concepts of probability and resolve problems of probability.
3. Use models of random variables, and unideminsionales bidimesionales.
4. Know and apply the Central Limit Theorem.
5. Explain the basic concepts of sampling.
6. Deduct point estimators for the mean, the variance and the proportion of a population.
7. Estimate using confidence intervals the mean, the variance and the proportion of a population.
8. Explain the basic concepts of hypothesis contrast.
9. Perform basic contrasts for one or two normal populations, binomial or Poisson.
10. Perform contrasts of goodness of fit.
11. Make contingency tables and apply contrasts of independence of two classification criteria.
12. Learn how to apply all the previous statistical methods with the help of statistical software.

Transferable skills:

1. Capacity for synthesis and analysis.
2. Knowledge of the use of statistical software.
3. Resolution of problems.
4. Team work.
5. Critical reasoning.
6. Oral and written communication.

DESCRIPTION OF CONTENTS: PROGRAMME

The content of the program has been structured into three blocks:

The Block I (point 1), devoted to the descriptive statistics, whose aim is to provide the student knowledge and understanding of the basic concepts of descriptive statistics of data sets univariate and bivariate analyzes. These concepts include measures of centralization, dispersion and form, basic graphics as histograms and boxplots, and scatter diagrams correlating with correlation coefficients and with linear regression.

In the Block II (points 2,3 and 4), dedicated to the probability and ramdom variables, we will provide the student with knowledge of probability and one-dimensional random variables and its moments, with emphasis on the binomial distributions, negative binomial, geometric, Poisson, Pareto, uniform, normal, log-normal, Student's t test, chi-square, gamma, exponential, Weibull and beta. There are knowledge and understanding of dimensional variables, and basic concepts, as well as on linear combinations of random variables. Concludes with the study of the Central Limit Theorem.

In the Block III (points 5-6), dedicated to the Statistical inference, introduces the concept of sampling distribution to derive conclusions on one (or two) population (s) unknown (s). This target is achieved by means of the calculation of intervals of confidence, the parametric hypothesis contrast for one or two populations, and the nonparametric hypothesis contrast hypothesis of goodness of fit and independence. There becomes special emphasis on the concepts of p-value and potency of the contrast

of hypothesis introduced. The last topic is related to Simulation (Monte Carlo and bootstrap methods) and applications.

Each topic exercises must be conducted using the R software.

PROGRAM

Topic 1: Introduction. Descriptive statistics.
1.1. Probability and Statistics in the areas of insurance and finance.
1.2. Descriptive statistics for univariate and bivariate data.
1.3. Measures of centralization, dispersion and form, basic graphics as histograms and boxplots, and diagrams of dispersion.
1.4. Correlation and linear regression.
1.5. Examples in R.

Topic 2: Concepts of probability.
2.1. Review of concepts of probability.
2.2. Conditional probability and Bayes theorem.
2.3. Examples in R.

Topic 3: Random variables.
3.1. One-dimensional random variables.
3.2. Discrete and continuous random variables.
3.3. Random vectors. Transformations of random variables.
3.4. Central limit theorem.
3.5. Convolution.
3.6. Two dimensional Variables and related concepts.
3.7. Jointly distributed random variables and conditional distributions.
3.8. Concept of independence
3.9. Examples in R.

Topic 4: Useful probability distributions in actuarial practice.
4.1. Geometric, negative binomial, binomial distributions, Poisson distribution.
4.2. Pareto, uniform, normal, log-normal, Student, Chi-square, exponential, gamma t beta and Weibull distribition.
4.3. Examples in R.

Topic 5: Review of statistical inference and its actuarial and financial implementation.
5.1. Point estimation and confidence intervals.
5.2. Parametric and nonparametric hypothesis contrasts.
5.3. Examples in R.

Topic 6: Simulation.
6.1. Explain the concepts simulation. Monte Carlo simulation.
6.2. Simulate both discrete and continuous random variables.
6.3. Estimate the number of simulations needed to obtain an estimate with a given error and a given degree of confidence.
6.4. Bootstrap method. Use the bootstrap method to estimate properties (e.g. the mean squared error) of an estimator.
6.5. Examples in R.

LEARNING ACTIVITIES AND METHODOLOGY

THEORY (4 ECTS):
Theoretical classes with material of available support in the Web (collection guides / slides and exercises, basic bibliographical material and complementary material to study in depth those topics in which they are more interested). There will develop the fundamental theoretical and practical concepts of the subject that the pupil must acquire, and exercises will be solved on the part of the teacher, encouraging the active participation of the students in the resolution of the same ones (both of individual form and in team(equipment)).

PRACTICES (2 ECTS):
Classes of problem solving on the part of the pupils. Computer practices in computer rooms. Oral presentations and discussions.

ASSESSMENT SYSTEM

In ordinary exams: the 50% of the final grade will be obtained through a final review of evaluation of the acquired knowledge. The remaining 50% will be the result of continuously evaluating the student's ability to assimilate the knowledge and skills acquired to solve problems, perform practical work of data analysis and to expose the results you get. It is necesary to obtain a minimum of 5 points (out of a total of 10) in the final exam in order to add the remaining 50%.

In extraordinary exams: the most favorable criteria will be applyed between the continuous assessment system and 100% of the final exam.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- BEAN, M.A. Probability: the Science of Uncertainty (with applications in investments, insurance, and engineering)., Brooks/Cole, 2001
- CHARPENTIER, A. Computational Actuarial Science with R, Chapman and Hall/CRC, 2015
- DALGAARD, P. Introductory statistics with R, Springer , 2008
- GIBBONS, J.D. and CHAKRABORTI, S. Nonparametric Statistical Inference, Marcel Dekker, Inc.: New York, 1992
- HOSSACK, I.B., POLLARD, J.H. y ZEHNWIRTH, B. Introductory Statistics with Applications in General Insurance., Cambridge University Press., 1983
- LEHMANN, E.L. Nonparametrics, Holden-Day, Inc., San Francisco, 1975

ADDITIONAL BIBLIOGRAPHY

- DAYKIN, C.D., PENTOKÄINEN, T., y PESONEN, E. Practical Risk Theory for actuaries., Chapman and Hall. 1996..
- KAMMEN, D.M. y HASSENZAHL, D.M. Should We Risk It?, Princeton University Press. 1999..
- KLUGMAN, S.A., PANJER, H.H., WILLMOT, G.E. Loss Models: From Data to Decision., John Wiley and Sons, 2008..
- NEWBOLD, P. Statistics for Business and Economics., Prentice Hall. 1988..
- STRAUB, E. Non-Life Insurance Mathematics., Springer-Verlag. 1988..