Evaluation of Risk

Learning objectives

Quantifying, forecasting and managing risks are primary activities in the actuarial profession and, more generally, in the 'toolbox' of competences required for a professional career in economics and finance.

The module aims at providing students with some mathematical/statistical/computing tools designed for risk measurement and management in non-life insurance and in financial markets.

The module begins with a theoretical part (non-life insurance pricing, collective risk model, statistical analysis of extreme events). This is followed by practical activities with Matlab software, based on real-world datasets from insurance (loss distributions) and finance (market returns).

Contents

The module is organized in three parts:

1. collective risk modeling, risk pricing and risk reserving for non-life insurance, reinsurance;
2. statistical analysis of extreme events: theory and applications to risk estimation;

Detailed program

Part I: Non-life insurance pricing and reserving

1.1 Introduction to collective risk modeling, claim frequency and loss amount.
1.2 Risk premium, rating factors and key ratios used in non-life insurance pricing.

1.2 Distribution of the total claim cost and loss reserves.

1.3 Reinsurance: definition, purposes, impact on loss reserves.

Part II: Risk and extreme events

2.1 Basic concepts of statistical Extreme Value Theory (EVT). Classical EVT and applications (estimation of the return period and return level of extreme events). Conditional EVT and applications (upper tail estimation for loss distributions).

2.2 Insurance applications of conditional EVT with the “peaks over threshold” -POT- method: estimation of tail risk measures (VaR, CVaR) and pricing of XL reinsurance contracts.

2.3 Pareto tail distributions and tail index estimation with semi-parametric methods.

Part III: Matlab laboratories

How to use and program Matlab functions for:

- exploratory data analysis;
- non-parametric tests of randomness for time series of financial/insurance data;
- parametric estimation (POT) of extreme distributions and related risk measures (VaR, CVaR);
- pricing of an XL reinsurance contract with alternative methods (empirical, POT, semi-parametric).

Prerequisites

Basic knowledge of descriptive statistics, probability distributions, statistical inference.

Being familiar with Matlab is an asset, but is not compulsory. An introduction to Matlab is given in the first laboratory, and can be adjusted to the students' needs.

Teaching methods

The module consists of 5 ects (=35 hours), divided in lectures (24 hours) and laboratories (11 hours).

In addition, there are one/two seminars presented by professional actuaries and insurance experts.

Assessment methods

Assessment methods aim at verifying that students:

1. have understood the logic behind different statistical methods and are able to associate each method to the
appropriate problems/data structures;
2. are trained in statistical methods in view of analyzing a real-world dataset and getting reasonable conclusions;
3. are able to interpret the output of a Matlab analysis and to detect possible data issues.

Assessment methods focus on problem solving and critical interpretations of statistical results, rather than mathematical formulae.

Assessment is based on a written exam, consisting of:

- a numerical exercise concerning loss reserving and reinsurance;
- an open question related to the description of a statistical methodology (assumptions, applications, strengths and weaknesses);
- the interpretation of a Matlab output, consisting of the outcome of a statistical analysis performed on a real-world insurance dataset.

The final grade is the result of a global evaluation of the competences acquired by students in each of the above areas.

Textbooks and Reading Materials

The main source of course material is the e-learning platform, where students can find all the materials they need to prepare for the exam, in particular:

- lecture notes
- exercises with solutions
- a guide to Matlab and the statistical library EVIM for extreme value analysis;
- slides of seminars presented by insurance experts.

Students may wish to look into the following additional references:


Semester

Spring.
Teaching language

Italian.