## REVSTAT – Statistical Journal,
## Volume 14, N.º 2 – abril 2016

Este Volume da **REVSTAT, Volume 14, N.º 2 - abril 2016**, apresenta sete artigos científicos:

**ESTIMATION ASPECTS OF THE MICHAELIS–MENTEN MODEL**
Authors*: Thomas L. Toulias* and *Christos P. Kitsos.*

**SKEWNESS INTO THE PRODUCT OF TWO NORMALLY DISTRIBUTED VARIABLES AND THE RISK CONSEQUENCES**
Authors*: Amilcar Oliveira, Teresa A. Oliveira* and *Antonio Seijas-Macias.*

**FRACTAL BASED CANCER MODELLING**
Authors: *Milan Stehlík, Philipp Hermann* and *Orietta Nicolis.*

**RISK ANALYSIS AND RETROSPECTIVE UNBALANCED DATA**
Authors: *Francesca Pierri, Elena Stanghellini* and *Nicoló Bistoni.*

**MODELING NON-LIFE INSURANCE PRICE FOR RISK WITHOUT HISTORICAL INFORMATION**
Authors*: Filipe Charters de Azevedo, Teresa A. Oliveira* and *Amilcar Oliveira.*

**EXTREME VALUE ANALYSIS — A BRIEF OVERVIEW WITH AN APPLICATION TO FLOW DISCHARGE RATE DATA IN A HYDROMETRIC STATION IN THE NORTH OF PORTUGAL**
Authors*: Helena Penalva, Sandra Nunes* and *M. Manuela Neves.*

**NON-STATIONARY MODELLING OF EXTREME TEMPERATURES IN A MOUNTAINOUS AREA OF GREECE**
Authors*: Chrys Caroni* and *Dionysia Panagoulia*
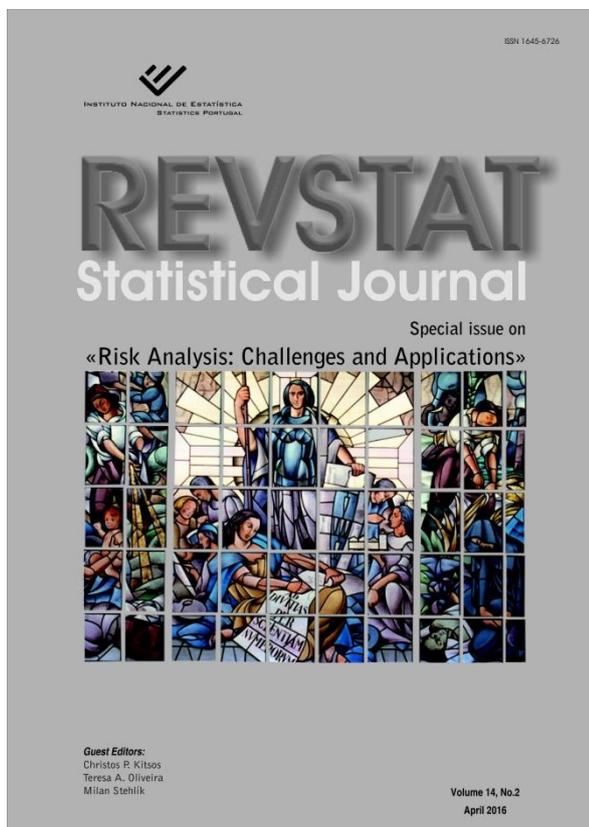


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A **REVSTAT-STATISTICAL JOURNAL**, é publicada exclusivamente em Inglês com periodicidade trimestral.

O presente volume **REVSTAT: Volume 14, No.2 - abril 2016** é dedicado ao tema "Risk Analisys: Challenges and Applications" e contém sete artigos, cujos resumos, originais em inglês, se apresentam de seguida:

### ESTIMATION ASPECTS OF THE MICHAELIS–MENTEN MODEL

Authors*: Thomas L. Toulias* and *Christos P. Kitsos*

This paper studies the Michaelis–Menten model (MM), which plays an important role in pharmacokinetics, from a theoretical as well as a computational point of view. An analytical method for the nonlinear least squares estimation of the MM is introduced. It is proved that the MM model has not a unique parameter estimation (through the nonlinear least squares), and there is not a unique optimal experimental design and might not have a unique D-optimal design. An iterative process, based on the Sequential approach, is also introduced and tested on various data sets for the MM model. A different approach is also discussed which provides an initial estimate that increases the convergence rate of the Fully Sequential approach. Several examples demonstrate the provided methods.

### SKEWNESS INTO THE PRODUCT OF TWO NORMALLY DISTRIBUTED VARIABLES AND THE RISK CONSEQUENCES

Authors*: Amilcar Oliveira, Teresa A. Oliveira* and *Antonio Seijas-Macias*

The analysis of skewness is an essential tool for decision-making since it can be used as an indicator on risk assessment. It is well known that negative skewed distributions lead to negative outcomes, while a positive skewness usually leads to good scenarios and consequently minimizes risks. In this work the impact of skewness on risk analysis will be explored, considering data obtained from the product of two normally distributed variables. In fact, modelling this product using a normal distribution is not a correct approach once skewness in many cases is different from zero. By ignoring this, the researcher will obtain a model understating the risk of highly skewed variables and moreover, for too skewed variables most of common tests in parametric inference cannot be used. In practice, the behaviour of the skewness considering the product of two normal variables is explored as a function of the distributions parameters: mean, variance and inverse of the coefficient variation. Using a measurement error model, the consequences of skewness presence on risk analysis are evaluated by considering several simulations and visualization tools using R software

### FRACTAL BASED CANCER MODELLING

Authors: *Milan Stehlík, Philipp Hermann* and *Orietta Nicolis.*

Fractal hypothesis is both challenging and technical issue of mammary cancer. We conduct a simple discrimination on the basis of box-counting dimension. Moreover, we discuss on statistical distributions of fractal dimensions for both mammary cancer and mastopathy. Thereby, we detect significant differences in the underlying distribution between the two groups. A multifractal analysis on the basis of a wavelet based approach has been conducted. Discussion on alternative cancer therapy and cancer prevention is provided.

**RISK ANALYSIS AND RETROSPECTIVE UNBALANCED DATA**

Authors: *Francesca Pierri, Elena Stanghellini* and *Nicoló Bistoni*

This paper considers three different techniques applicable in the context of credit scoring when the event under study is rare and therefore we have to cope with unbalanced data. Logistic regression for matched case-control studies, logistic regression for a random balanced data sample and logistic regression for a sample balanced by ROSE (Random OverSampling Examples, Lunardon, Menardi and Torelli, 2014) are tested. We applied the methods to real data: balance sheets indicators of small and medium-sized enterprises and their legal status are considered. The event of interest is the opening of insolvency proceedings of bankruptcy.

**MODELING NON-LIFE INSURANCE PRICE FOR RISK WITHOUT HISTORICAL INFORMATION**

Authors*: Filipe Charters de Azevedo, Teresa A. Oliveira* and *Amilcar Oliveira*

How should an insurer price a risk for which there is no history? This work intends to show, step by step, which main mechanisms are needed to capture the tariff model of another insurance company minimizing the risk involved. The document generally deals with the price-making mechanisms in non-life insurance through the GLM regression models — Generalized Linear Model, more precisely the Poisson, Gamma and Tweedie

models. Given the complexity of the application of these models in experimental design, it is studied a simpler way to characterize the rate, namely considering the Box–Cox transformation with SUR — Seemingly Unrelated Regression. An orthogonal experimental design to collect information is also presented as well as an application of these methods in the motor industry considering different companies.

**EXTREME VALUE ANALYSIS — A BRIEF OVERVIEW WITH AN APPLICATION TO FLOW DISCHARGE RATE DATA IN A HYDROMETRIC STATION IN THE NORTH OF PORTUGAL**

Authors*: Helena Penalva, Sandra Nunes* and *M. Manuela Neves*

Extreme value theory is dedicated to characterise the behaviour of the extreme observations. The interest is then focused in the tails of the underlying distribution. It is important to test for the adequate shape of the tail, because it influences the estimation of parameters of extreme or even rare events. The aim of this work is to present a brief overview on several tests and parameter estimation procedures available in the literature. They will be applied to daily mean flow discharge rate values in the hydrometric station of Fragas da Torre in the river Paiva, collected from 1946/47 to 2005/06.

**NON-STATIONARY MODELLING OF EXTREME TEMPERATURES IN A MOUNTAINOUS AREA OF GREECE**

Authors*: Chrys Caroni* and *Dionysia Panagoulia*

The generalised extreme value (GEV) distribution is often fitted to environmental time series of extreme values such as annual maxima and minima of temperatures. It is often necessary to allow the distribution's parameters to depend on time or other covariates (non-stationary GEV). Increasingly, model fitting within the GAMLSS framework is being used as an alternative approach. A case study is presented of temperature extremes in a mountainous area of Greece divided into nine zones by

altitude. Model fitting supported non-stationary GEV models for temperature with the location parameter depending linearly on year and zone, showing the expected dependence on altitude along with an increasing trend in annual maxima and declining trend in annual minima. The scale parameter for maxima depended on zone, with greater variability at higher altitudes. The scale parameter for minima increased over time. Fitting non-stationary Inverse Gaussian, Lognormal and Gamma distributions within the GAMLSS framework identified the same dependence on zone and year. There was little difference in goodness of fit of the various distributions.

Em 2003 o Instituto Nacional de Estatística iniciou o lançamento da revista científica **REVSTAT-STATISTICAL JOURNAL**, publicada em Inglês com periodicidade semestral, e com um prestigiado corpo editorial de índole internacional, que veio substituir a *Revista de Estatística* editada em Português de 1996 a 2002, também pelo Instituto. A partir de 2016 a **REVSTAT – Statistical Journal** passa a ter periodicidade trimestral

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