Probability, Statistics, and applications

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Several investigations have been carried out in 2013, involving different fields, as outlined below.

Economy (see [1]).
Using the estimated unatantum costs of compliance with the legislation on transparency, the study attempts to extrapolate empirical evidence on the impact of the different fulfillments that have to be faced on total unatantum and ongoing costs and on the existence of economies of scale. Even if the sample is small, the study shows that, in terms of impact on operating costs, the unatantum costs represent on average 0.56 per cent of the total operating costs, while the ongoing costs represent the 0.27 per cent. The activities inherent to improving the quality of information affect the total costs of unatantum and the total ongoing costs, on average far more than organization and internal controls activities: 66 per cent compared to 33 per cent for the unatantum costs, and 62 per cent compared to 30 per cent for ongoing ones, even if the phenomenon varies to a large extent among banks. The study suggests the existence of economies of scale in regulatory compliance. On the basis of the results of the economies of scale, on average, by doubling the number of current accounts the unatantum costs of compliance should increase approximately by 70 per cent. This would thus indicate that the banks could reduce their (average) costs by increasing the number of current accounts. It is likely that heavy normative activity will spur substantial consolidation of small banks or outsourcing of the compliance activities. Another implication is that regulation in an early stage of the product life cycle, when the rate of output is low, involves relatively greater compliance costs than regulation in a later stage. It is however to be expected, that the actual economies of scale be higher. The proxy used underestimates the total output of compliance, not taking into account the number of mortgages and other products that are important for the purposes of transparency. The results provide a preliminary indication about the relationship between the strength of the scale economies and the bank size. In particular, doubling the number of current accounts would increase total compliance costs by approximately 57 per cent, 62 per cent and 78 per cent for, respectively, small, medium and large banks. Apparently, smaller banks exhibit a higher potential of scale economies compared to larger banks. The work obtains results that are similar to those achieved by similar studies in literature. The study presents a number of limitations associated with the small sample size and the absence of data needed to construct proxies of the output of compliance.

Natural Extremes (see [2,3]).
Multivariate extremes occur in several hydrologic and water resources problems. Despite their practical relevance, the real-life decision making as well as the number of designs based on an explicit treatment of multivariate variables is yet limited as compared to univariate analysis. A first problem arising when working in a multidimensional context is the lack of a "natural" definition of extreme values: essentially, this is due to the fact that different concepts of multivariate order and failure regions are possible. Also, in modeling multivariate extremes, central is the issue of dependence between the variables involved: again, several approaches are possible. A further practical problem is represented by the construction of multivariate Extreme Value models suitable for applications: the task is indeed difficult from a mathematical point of view. In addition, the calculation of multivariate Return Periods, quantiles, and design events, which represent quantities of utmost interest in applications, is rather tricky. In these works we show how the use of Copulas may help in dealing with (and, possibly, solving) these problems.

Return Period (see [4,5]).
The concept of Return Period is fundamental for the design and the assessment of many engineering works. In a multivariate framework, several approaches are available to its definition, each one yielding different solutions. In these works we outline a probabilistically consistent theoretical framework for the calculation of Return Periods in a multi-dimensional environment, based on survival Copulas and the corresponding survival Kendall's measures. This approach solves

the problems raised in previous publications concerning the coherent foundation of the notion of Return Period in a multivariate setting. As an illustration, practical hydrological applications are presented.

Assessment of droughts (see [6]).
Droughts, like floods, are extreme expressions of the river flow dynamics. Here droughts are intended as episodes during which the streamflow is below a given threshold, and are described as multivariate events characterized by two variables: average intensity and duration. In this work we introduce the new concept of Dynamic Return Period, formulated using the theory of Copulas, and calculated via a Survival Kendall's approach. We show how it can be used (i) to monitor the temporal evolution of a drought event, and (ii) to perform real time assessment. In addition, a randomization strategy is introduced, in order to get rid of repeated measurements, which may adversely affect the statistical analysis of the available data, as well as the calculation of the return periods of interest: a practical example is shown, involving the fit of the drought duration distribution. The case study of the Po river basin dynamics (Northern Italy) is used as an illustration.

Maritime Engineering (see [7]).
A frequent statistical problem in many coastal and off-shore engineering situations is to estimate the probability of structural failure expressed in terms of Return Period and Design Quantile. Typically, an univariate analysis is carried out to quantify the risk of failure. However, coastal and off-shore structures typically fail because of the occurrence of a critical combination of all the variables at play in a sea storm: thus, it may be important to consider the joint occurrence of dangerous conditions. The work outlines an original approach, exploiting Copulas, in order to provide a consistent framework for the calculation of bivariate Return Periods and Design Quantiles, which can be generalized to the multivariate case.

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