Scientific highlights in 2012

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Abstract
This short note highlights my scientific contributions in 2012. Three main research topics are addressed: Copulas, High dimensional statistical learning and Extreme-value analysis.

1 Copulas
Copula provides a relevant tool to build multivariate probability laws, from fixed marginal distributions and required degree of dependence. From Sklar’s Theorem, the dependence properties of a continuous multivariate distribution can be entirely summarized, independently of its margins, by a copula. I have introduced a new family of copulas defined from matrices [1]. The family is generated by a basis of univariate functions and a matrix determining the symmetry and dependence property of the copulas. I also proposed a new family of multivariate copulas built from products of bivariate copulas [2]. The estimation is performed using a message passing algorithm.

2 High dimensional statistical learning
I have proposed a parametrization of the Gaussian mixture model for classification purposes. It is assumed that the high-dimensional data live in subspaces with intrinsic dimensions smaller than the dimension of the original space and that the data of different classes live in different subspaces with different intrinsic dimensions. New high-dimensional data classifiers are introduced on the basis of this model and a R package is provided [3, 4]. The use of kernel methods permits to extend the classifiers to the non-Gaussian framework [5, 6].

I also developed dimension reduction methods for high dimensional regression problems [7], see [8, 9] for an application to the estimation of dominant physical parameters for leakage variability in 32nanometer CMOS.
3 Extreme-value analysis

The decay of the survival function is driven by a real parameter called the extreme-value index. When this parameter is positive, the survival function is said to be heavy-tailed. I focused on the situation where a covariate is recorded simultaneously the variable of interest. In this case, the extreme-value index and the extreme quantile depend on the covariate [10]. It may be the case in hydrology for instance, see [11, 12] for an application to the study of extreme rainfalls. The case of a functional covariate is investigated in [13, 14].

When this parameter is negative, the survival function vanishes above its right end point. The estimation of this endpoint is addressed in [15, 16, 17]. The conditional case is referred to as frontier estimation and is investigated in [18].

If this parameter is zero, then the survival function decreases to zero at an exponential rate. An important part of my work is dedicated to the study of such distributions [19] For instance, in reliability, the distributions of interest are included in a semi-parametric family whose tails are decreasing exponentially fast. These so-called Weibull-tail distributions include Gaussian, gamma, exponential and Weibull distributions, among others.

References


