Scientific highlights in 2012

Stéphane Girard

Inria Grenoble Rhône-Alpes & LJK (team MISTIS).

655, avenue de l'Europe, Montbonnot. 38334 Saint-Ismier Cedex, France

Stephane.Girard@inria.fr

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 matrice 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 developped 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 focussed 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

[1] C. Amblard, S. Girard, and L. Menneteau. Algebraic properties of copulas defined from matrices. In *Workshop on Copulae in Mathematical and Quantitative Finance*, Cracovie, Pologne, juillet 2012.

[2] G. Mazo, F. Forbes, and S. Girard. Augmented cumulative distribution networks for multivariate extreme value modelling. In *5th International Conference of the ERCIM WG on computing and statistics*, Oviedo, Spain, décembre 2012.

[3] L. Bergé, C. Bouveyron, and S. Girard. HDclassif: An R package for model-based clustering and discriminant analysis of high-dimensional data. *Journal of Statistical Software*, 46(6):1–29, 2012.

[4] L. Bergé, C. Bouveyron, and S. Girard. HDclassif: An R package for model-based clustering and discriminant analysis of high-dimensional data. In *1ères Rencontres R*, Bordeaux, juillet 2012.

[5] C. Bouveyron, M. Fauvel, and S. Girard. Kernel discriminant analysis and clustering with parsimonious gaussian process models. In *ICML workshop on Object, functional and structured data : towards next generation kernel-based methods*, Edinburgh, Scotland, juin 2012.

[6] C. Bouveyron, M. Fauvel, and S. Girard. Processus gaussiens parcimonieux pour la classification générative de données hétérogènes. In *44èmes Journées de Statistique organisées par la Société Française de Statistique*, Bruxelles, Belgique, mai 2012.

[7] J. Saracco, M. Chavent, B. Liquet, V. Kuentz, T.M.N. Nguyen, and S. Girard. Régression inverse par tranches sur flux de données. In *44èmes Journées de Statistique organisées par la Société Française de Statistique*, Bruxelles, Belgique, mai 2012.

[8] S. Joshi, A. Lombardot, P. Flatresse, C. D'Agostino, A. Juge, E. Beigne, and S. Girard. Statistical estimation of dominant physical parameters for leakage variability in 32nanometer CMOS under supply voltage variations. *Journal of Low Power Electronics*, 8:113–124, 2012.

[9] S. Joshi, A. Lombardot, M. Belleville, E. Beigne, and S. Girard. Statistical leakage estimation in 32nm CMOS considering cells correlations. In *11th IEEE conference on Faible Tension Faible Consommation*, Paris, juin 2012.

[10] A. Daouia, L. Gardes, and S. Girard. On kernel smoothing for extremal quantile regression. In *5th International Conference of the ERCIM WG on computing and statistics*, Oviedo, Spain, décembre 2012.

[11] J. Carreau, D. Ceresetti, E. Ursu, S. Anquetin, J.D. Creutin, L. Gardes, S. Girard, and G. Molinié. Evaluation of classical spatial-analysis schemes of extreme rainfall. *Natural Hazards and Earth System Sciences*, 12:3229–3240, 2012.

[12] J. El-Methni, L. Gardes, and S. Girard. Estimation de l'espérance conditionnelle des pertes extrêmes dans le cas de lois à queues lourdes en présence d'une covariable. In *44èmes Journées de Statistique organisées par la Société Française de Statistique*, Bruxelles, Belgique, mai 2012.

[13] L. Gardes and S. Girard. Functional kernel estimators of large conditional quantiles. *Electronic Journal of Statistics*, 6:1715–1744, 2012.

[14] L. Gardes and S. Girard. Functional kernel estimators of conditional extreme quantiles. In *7èmes Journées de Statistique Fonctionnelle et Opératorielle*, Montpellier, juin 2012.

[15] S. Girard, A. Guillou, and G. Stupfler. Estimating an endpoint with high order moments in the Weibull domain of attraction. *Statistics and Probability Letters*, 82:2136–2144, 2012.

[16] S. Girard, A. Guillou, and G. Stupfler. Estimating an endpoint with high order moments. *Test*, 21:697–729, 2012.

[17] S. Girard, A. Guillou, and G. Stupfler. Estimation de point terminal dans le domaine d'attraction de weibull par une méthode des moments d'ordre élevé. In *44èmes Journées de Statistique organisées par la Société Française de Statistique*, Bruxelles, Belgique, mai 2012.

[18] A. Daouia, L. Gardes, and S. Girard. Nadaraya's estimates for large quantiles and free disposal support curves. In I. Van Keilegom and P. Wilson, editors, *Exploring research frontiers in contemporary statistics and econometrics*, pages 1–22. Springer, 2012.

[19] J. El Methni, L. Gardes, S. Girard, and A. Guillou. Estimation of extreme quantiles from heavy and light tailed distributions. *Journal of Statistical Planning and Inference*, 142(10):2735–2747, 2012.