SOCIETY OF ACTUARIES

2014 Enterprise Risk Management Symposium
Sept. 29 - Oct. 1, 2014, Chicago, IL

A New Approach to Assess Model Risk in High Dimensions

By Carole Bernard* and Steven Vanduffel[†‡]

Actuaries
Risk is Opportunity.℠

A New Approach to Assess Model Risk in High Dimensions

Carole Bernard* and Steven Vanduffel†‡

January 18, 2014

Abstract

A central problem for regulators and risk managers concerns the evaluation of the risk of an aggregate portfolio $S = \sum_{i=1}^{d} X_i$. This problem is mainly a numerical issue once the joint distribution of $(X_1, X_2, \ldots, X_d)$ is completely specified. Unfortunately, while the marginal distributions of the risks X_i are often known, their interaction (dependence) is usually either unknown or only partially known, implying that any computed risk measure of S is subject to model uncertainty.

Previous academic research has mainly focused on the maximum and the minimum possible values of a given risk measure of S, in the case that only the marginal distributions are known. This approach leads to wide bounds as all information on the dependence is ignored.

In this paper we integrate in a natural way available information on the multivariate dependence and we provide easy-to-compute bounds on the risk measure at hand. We observe that incorporating the information of a well fitted multivariate model may, or may not, lead to much tighter bounds, a feature that also depends on the risk measure used. We illustrate this point by showing that the Value-at-Risk at a very high confidence level (as used in Basel II) is typically prone to very high model risk, even if one knows the multivariate distribution almost everywhere.

Our results allow to determine which risk measures can benefit from adding dependence information (i.e., leading to more narrow bounds), and thus for which the development of accurate multivariate models is a meaningful task.

Key-words: Model Risk, VaR, TVaR, variance, tail dependence, tail correlation.

*Corresponding author : Carole Bernard, Department of Statistics and Actuarial Science at the University of Waterloo (email: c3bernar@uwaterloo.ca).

†Steven Vanduffel, Department of Economics and Political Sciences at Vrije Universiteit Brussel (VUB). (e-mail: steven.vanduffel@vub.ac.be).

‡C. Bernard gratefully acknowledges support from the Natural Sciences and Engineering Research Council of Canada, the Humboldt Research Foundation and the hospitality of the chair of mathematical statistics of Technische Universität München where the paper was completed. S. Vanduffel acknowledges the financial support of the BNP Paribas Fortis Chair in Banking.