Early Detection of Change and Updating VaR for High Volatility Multivariate Portfolios

Ashis SenGupta

Department of Statistics, University of California, Riverside, USA and
Applied Statistics Unit, Indian Statistical Institute, Kolkata, INDIA

Abstract

The term volatility refers to the variability of financial returns, which may change from time to time. In the modeling and forecasting of returns, e.g. from stock indices, stock prices and exchange rates, volatility is used at various points of the analysis. Due to the initiation of the open market and the emergence of international players in our domestic financial horizon, these returns have been experiencing high volatility previously not encountered. This has necessitated early detection of change-point in price distributions. Online optimal decision rules are presented for such early detection as using distributions in the exponential family. It is proven that a well designed multivariate portfolio consisting of suitably correlated profiles can achieve this detection at an earlier stage compared to univariate decision rules applied independently. This important feature is shown to persist even for portfolios with high coefficient of variation. However, the test is not robust against the popular volatilty models such as the family of stable distributions. In general these families do not possess any analytical closed form for their probability density functions. This leads to the complexity of inference involving the parameters of such distributions. We overcome this problem by appealing to the area of probability distributions for directional data. First, methods of construction of probability distributions for such data are presented. This is a challenging problem leading to that of deriving distributions on smooth manifolds, such as those on the torus and the hypertorus. Then, it is shown how elegant methods for directional data can be exploited to derive crucial inference procedures for high volatility distributions. As an example, universal CAN estimators of the index (shape / characteristic exponent) parameter of some families of bivariate high volatility distributions are presented. The use of DDSTAP, a statistical package for directional data, developed by the speaker is also demonstrated for detection of change-point retrospectively. Once the change-point is detected, the estimation of Value at Risk, VaR, is of substantial importance. We briefly discuss this aspect also in the framework of high volatility models. The above methods are exemplified through several real-life financial data sets. Finally, several interesting and important problems for future research in this context are exposed.