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SYNOPSIS

TITLE Finite Gaussian mixtures in market risk assessment

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Key words: Finite Gaussian mixtures, Value at Risk, Expected Shortfall, backtesting, confidence intervals.

Purpose of your paper:
The aim of the paper is to show both theoretically and empirically that finite Gaussian mixtures provide an accurate, yet parsimonious model for the point and interval estimation of market risk measures.

Synopsis:
Value at Risk (VaR) is the most commonly used market risk measure, as it summarizes in only one figure the exposure to several risk factors. Expected Shortfall (ES) corrects its limitations and the Basel Committee is in the process of adopting it as the new standard. Both measures can be estimated under different models for the loss –or asset returns- distribution, the empirical and the Normal distributions being the most commonly used, known as Historical Simulation (HS) and Delta-Normal (DN). While using the empirical distribution requires no additional assumptions and is easy to implement, the HS approach exhibits other shortcomings. Meanwhile, the Normality assumption is usually taken for granted, but it is not realistic due to skewness and excess kurtosis observed in the actual behavior of asset returns. Therefore, many flexible models have been proposed as an alternative, but even being more precise, their implementation is generally not straightforward.
In this work we fit finite Gaussian mixtures to the distribution of asset returns, obtain expressions to estimate the usual market risk metrics and compare their performance against HS and DN through backtesting. The evidence shows that the resulting model is flexible and accurate for market risk assessment.
Moreover, VaR and ES are estimated pointwise, without any reference to the uncertainty of the estimation. From a statistical viewpoint, VaR is a quantile and ES is –for a continuous loss- a conditional expectation of the loss distribution and both are themselves random variables. Any point estimator is only as good as its precision; therefore any risk estimation should be accompanied with some indication of its precision. One contribution of this work is the construction of confidence intervals for the estimators of both metrics under HS, DN and Gaussian mixtures.
The usefulness of the intervals is twofold. At first instance we contribute to the ongoing backtesting debate showing that it is equivalent to backtest VaR or ES and building the confidence interval. Secondly, it is possible to assess the precision of the risk model from the very first estimation, without having to wait on collecting a big sample of risk figures (Basel Committee suggests 250 risk estimations before backtesting). This may provide an early warning about the performance of the model. We show examples based on LatinAmerican assets.

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