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Statistical Methods for High-Multivariate Financial Time Series

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Abstract

This thesis brings together some new univariate and multivariate models and techniques to estimate volatility and risk measures for financial instruments as for example real, global defined portfolios.

In the first part, we concentrate on the univariate analysis. We propose two different volatility estimation approaches: nonparametric ARCH(1) modeling within the local likelihood framework and a new class of GARCH-type models with tree-structured multiple thresholds. The second approach relies on the idea of a binary tree where every terminal node parameterizes a (local) GARCH model for a partition cell of the predictor space. We derive supporting asymptotic results and we investigate on simulated and real data the better predictive potential and the better performance of the volatility estimates in comparison with the ones from a classical analysis (for example local regression and GARCH(1,1)).

The second part of this thesis deals with the main problem of finding computationally feasible and well performing strategies to estimate volatility for (very) high-dimensional, asynchronized multivariate financial time series. We propose a synchronization technique which takes into account the fact that information continues to flow for closed markets while others are still open. We also propose a functional gradient descent algorithm (FGD), a recent technique from the area of machine learning. Our FGD algorithm is computationally feasible in multivariate problems with dozens up to thousands of individual return series. These new methods potentially increase the predictive performance of any reasonable model such as for example constant conditional correlation GARCH-type models. Since multivariate analysis is generally important for analyzing time-changing portfolios and for better portfolio predictions (even when the portfolio weights are time-constant), synchronization and FGD are valuable techniques for a variety of problems with multivariate financial data.