A New Solution for Finance - Stable Family Models

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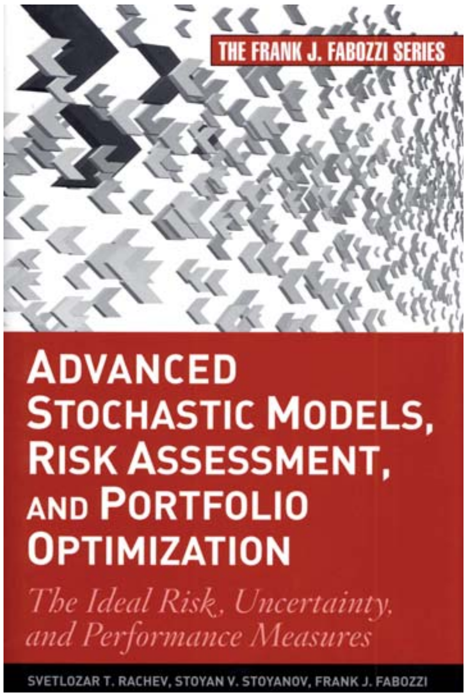
Central to financial modeling is the assumption about the return distribution of assets. Conventional approaches to modeling asset returns are based either on a historical or a Gaussian distribution for returns. There is overwhelming empirical evidence suggesting that neither approach adequately captures the behavior of asset prices and returns. The historical model is bounded by the extent of the available observations and the properties of the Gaussian distribution model are such that it cannot capture extreme returns that have been observed in real-world financial markets. In order to overcome the inadequacy of these models, we have suggested alternative return distribution models in our research papers. More specifically, we have proposed modeling asset returns using stable family models which includes the stable Paretian model, tempered stable model, and fractional stable model. We applied these models in finance to the areas of risk management, portfolio optimization, funds management, financial products pricing, and strategic trading optimization.

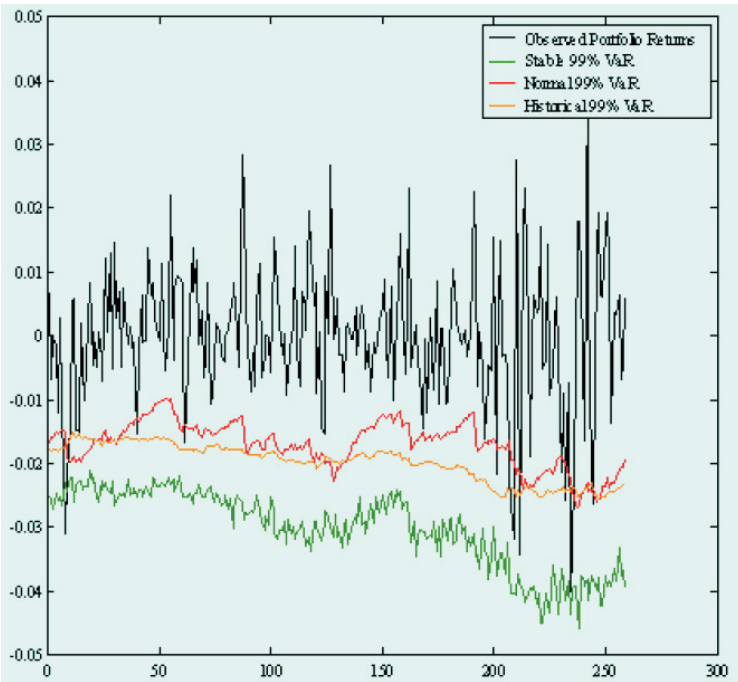
We introduce a practical alternative to Gaussian risk factor distributions based on Svetlozar Rachev's book coauthored with Stefan Mittnik, *Stable Paretian Models in Finance*, and called the Stable Distribution Framework. In contrast to normal or Gaussian distributions, stable distributions capture the fat tails and the asymmetries of real-world risk factor distributions. In addition, we make use of copulas, a generalization of overly restrictive linear correlation models, to account for the dependencies between risk factors during extreme events, and multivariate ARCH-type processes with stable innovations to account for another stylized fact observed for asset returns: joint volatility clustering. We demonstrate that the application of these techniques results in more accurate modeling of extreme risk event probabilities, and consequently delivers more accurate risk measures for both trading and risk management.

Using these superior models, commonly used measures of risk used by institutional investors such as value-at-risk (VaR) become a much more accurate measure of downside risk. More importantly stable expected tail loss (SETL) can be accurately calculated and used as a more informative measure of market risk and credit risk for portfolios and trading positions. Along with being a superior risk measure, SETL enables an elegant approach to portfolio optimization via convex optimization that can be solved using standard scalable linear programming software. In our research, we demonstrate that SETL portfolio optimization yields superior risk-adjusted returns relative to what is known as the mean-variance or Markowitz efficient portfolios.

Finally, in our research, we introduce an alternative performance measure tools for evaluating professional asset managers: the stable tail adjusted return ratio (STARR), which is a generalization of the well-known Sharpe ratio with the stable distribution framework.

We also present a new approach for using fractional stable models to compute VaR by using high-frequency data based on the requirement of finding day-trading





strategies. Our approach is a parametric model using an ARMA(1,1)-GARCH(1,1) model where the tail events are modelled using the fractional stable model. Using high-frequency data for the German DAX Index, the VaR estimates from this approach are compared to those of a standard nonparametric estimation method that captures the empirical distribution function, and with models where tail events are modeled using Gaussian distribution and fractional Gaussian noise. The results suggest that the proposed parametric approach yields superior predictive performance.

We introduce an alternative class of tempered stable distributions which we call modified tempered stable (MTS) distribution model. The model is sufficiently flexible in describing the skewness and kurtosis of asset returns and has all moments that are finite.

The Lévy process derived from the MTS distribution is included in the class of regular Lévy processes of exponential (RLPE). Furthermore, we obtain the MTS distribution applying the exponential tilting to the symmetric MTS distribution. Based on the MTS model, we introduced an enhanced GARCH model, namely the MTS-GARCH model, by applying MTS innovations to the classical GARCH model. As a result, the MTS-GARCH time series model for stock returns explains the volatility clustering phenomenon, the leverage effect, and both conditional skewness and leptokurtosis. The risk-neutral measure is obtained by applying a change of measure to the MTS distribution. The MTS-GARCH model is a more realistic model than the normal-GARCH model.

Currently, we are researching optimal intraday trading strategies (which calls for the application of sophisticated data mining methods), analyzing performance of fund of funds, studying dynamic risk measures and asset/liability management, and building an early warning system for bankruptcy. In addition, we are doing research on behavioral finance, for example, investigating the equity premium puzzle.