

# **Beyond Value at Risk**

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## **Abstract**

Market turmoil and periods of high volatility tend to undermine standard portfolio risk models, which are predicated on the assumption of conditional normality. These models do not account for the extreme events that account for a substantial share of portfolio loss.

We develop a portfolio risk model that uses high-frequency data to forecast the loss surface, which is the set of loss distributions at future time horizons. Standard risk measures, including volatility, value at risk and expected shortfall, can be derived from the loss surface. Our model takes account of distributional asymmetry, heavy tails, variable volatility and serial correlation. In particular, it addresses the risk due to extreme events. A key feature of the model is a careful analysis of the temporal aspects of risk, which enables us to use shorter-horizon data to forecast risk at longer horizons.

Loss-surface-implied forecasts of value at risk and expected shortfall substantially outperform 23-day half-life conditionally normal forecasts in long-horizon out-of-sample tests on a diverse set of US equity portfolios.

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