Statistical methods for robust financial decision making

Robust financial decisions are based on reliable statistical models and take uncertainty into account. Currently, there is a tendency toward weaker model assumptions. Specifically, there is a growing literature in which full knowledge of the distribution of model variables is replaced by knowledge of some of its moments, typically the mean, variance, skewness and kurtosis. In this thesis, we propose two statistical methods to accurately estimate multivariate skewness and kurtosis and show how to obtain the worst-case risk having these moments.

The first statistical method is the coskewness shrinkage estimator (Boudt et al., 2018), which accurately estimates the skewness of a linear combination of random variables by taking into account its multivariate structure. This is done by optimally combining the observed sample moments with several structured estimators. We show that the accuracy increases drastically, and we demonstrate the benefits in an application to asset allocation.

The second contribution is the nearest comoment estimator (Boudt et al., 2019). This estimator jointly improves the covariance, coskewness and cokurtosis by exploiting the presence of a lower-dimensional latent factor structure in the data. Doing so yields a coherent way to estimate the higher-order moments and makes it possible to identify the latent factor loadings.

The improved moment estimators affect any application that relies on their input. One such application is obtaining an upper bound for the distortion risk measure of a risk distribution with given moments (Cornilly et al., 2018). We are able to characterise the distribution yielding the worst-case risk value, which is useful in quantifying the uncertainty on the risk of a specific distribution.

Moreover, when only the mean is known, any distortion risk measure and its concavation are equivalent when looking at worst-case scenarios; both yield the same worst-case value (Cornilly and Vanduffel, 2019). For Value-at-Risk and its concavation Tail Value-at-Risk, this equivalence also holds under additional higher moment information.

References

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