A New Dynamic Clustering Approach to Tail-analysis: Application to Portfolio Optimization and Network Centrality

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We illustrate an iterative clustering procedure to generate non-overlapping groups of a one-dimensional variable, i.e. asset gross return. The procedure works under the assumption that the gross return distribution is generated by a log-normal mixture of homogeneous groups of returns and we focus on the left distribution of the return. The number of groups is not determined a priori but rather endogenously by the iterative procedure, stops when the solution to a specific second-degree polynomial equation does not exist.

We use this approach to study a measure for portfolio risk management by extending the Markowitz mean-variance framework to include the left-hand tail effects of asset returns.

Two risk dimensions are captured: asset covariance risk along risk in left-hand tail similarity and volatility. This is done thanks to the informative set on the left-hand tail distributions of asset returns obtained from the adaptive clustering procedure. This set allows a left tail similarity and left tail volatility to be defined, thereby yielding the definition of a left-tail-covariance-like matrix. The convex combination of the two covariance matrices generates a 'two-dimensional' risk that, when applied to portfolio selection, provides a measure of its systemic vulnerability due to the asset centrality. Minimizing these combined risks reduces losses and increases profits, with low variability in the profit and loss distribution. The portfolio selection compares favourably with some competing approaches. An empirical analysis is made using exchange traded fund (ETF) prices in the period January 2006–February 2018.