Andreas Steiner Consulting GmbH
Training & Courses
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Network-Based Portfolio Construction: Building a Peripheral Risk Parity Portfolio

Program Description: This on-day course gives an introduction to network and graph theory concepts useful in portfolio construction and then applies them step-by-step to build a peripheral risk parity stock strategy. All methods are illustrated with example calculations in Excel. Participants will receive an Excel add-in that performs more sophisticated calculations without programming.

Target Audience: Intermediate to experienced investment professionals, risk managers, investment analysts, quantitative analysts, portfolio managers, IT professionals, product developers, institutional investors

Materials: Participants will receive the slides presented, spreadsheets containing example calculations, important papers in PDF format and an Excel add-in for certain calculations.

Introduction

- Networks and graph theory as mathematical disciplines
- Early applications of networks and graphs in finance and macroeconomics
- Networks and graphs in the context of Machine Learning, Data Science

Session 1: Introduction to Graph Theory and Network Analysis

- Graphs as network models: edge lists, adjacency and incidence matrices, graphical representations of graphs
- Properties of graphs: network topologies, centralization, paths
- Properties of nodes: centrality measures (degree, betweenness, closeness, eigenvector)
- The minimum spanning tree

Session 2: Replacing the Correlation Matrix with a Graph

- The network model of modern portfolio theory: correlation matrix
- Empirical and conceptual issues with correlation matrices
- Interpreting correlations as distance
- Other distance measures (Euclidian, Manhattan, Chebyshev)
- Calculating minimum spanning trees from a correlation matrix
- Defining peripheral and central assets based on the minimum spanning tree

Session 3: Risk Parity with Peripheral and Central Assets

- Risk parity as equal-contribution to volatility
- Inverse volatility allocation as robust risk parity

- Implementing risk parity for stocks: data, data cleansing (missing observations), parameter decisions (window size, half-life), estimators (exponentially-weighted correlations and volatilities)
- Tilting the risk parity allocations towards peripheral stocks
    - Weighted covariance matrix from diagonalized centrality measures and their ranks
    - Changing category weights using shrinkage
- Implementing peripheral tilts with other strategies than risk parity
- Implementing the “pure” peripheral portfolio

Session 4: Strategy Backtesting and Analysis

- Backtesting and cross-validation
    - In-sample versus out-of-sample
    - k-fold cross-validation, leave-one-out cross-validation
    - Scenario analysis: identifying multivariate stress scenarios, conditioning variables, upside/downside analysis
- Understanding the peripheral characteristics: factor analysis
- Turnover analysis
- Comparison with other strategies: no-information, market-cap weighted, robust risk parity, minimum variance

Course Conclusion

- Review of key concepts, discussion
- Ideas for further refinements