Improving Portfolio Optimization by Clustering Assets

Keywords: Portfolio optimization, Machine Learning, Clustering, Data Analysis

Project description:
- Classical mean-variance theory is based on the assumption that an investor cares only about the mean and covariance structure of asset returns.
- Hence the estimation (and inversion) of the covariance matrix is crucial in determining an optimal portfolio.
- This is problematic because:
  - For large asset universes the estimation and inversion of the covariance matrix is infeasible, due to high matrix dimension and highly correlated assets.
  - Further crucial information (e.g. balance sheet data) about future asset returns may not be incorporated in the mean and covariance structure of asset returns (historical data).
- Clustering methods may be able to resolve the aforementioned problems:
  - Grouping assets into clusters creates several (smaller) sub-asset universes where classical portfolio optimization methods may be applicable. ("Intra-Cluster Optimization")
  - Correlation of cluster returns should be weak and therefore classical portfolio optimization methods may be applicable on a cluster level. ("Inter-Cluster Optimization").
  - Balance Sheet information can naturally be included into the clustering of assets.
- The goal of this is IDP is twofold:
  - Implement and evaluate different clustering methods applied to a large asset universe.
  - Implement and evaluate different portfolio optimization methods applied to the clustered asset universe.

What we are looking for:
- Strong analytical and communication skills
- Keen interest in mathematical finance and applications of machine learning methods in finance
- Basic knowledge of standard portfolio optimization methods
- Proficient programming skills in Python

What we offer:
- Expertise in quantitative finance and clustering
- Experience with IDPs
- Regular meetings and input from your supervisors
- Opportunity to present your results to our partners from the industry
- Opportunity to continue your work as a working student after your IDP has finished.

Interested?
Please send an e-mail with CV, academic transcript and your preference for this project to florian.brueck@tum.de and michel.kschonnek@tum.de.

Questions?
In case of any IDP-related questions, please contact Florian Brück or Michel Kschonnek (see above for e-mail address).