

Graph Analysis of Stock Correlation Networks

Student: Tajudeen Safeek Ahmed

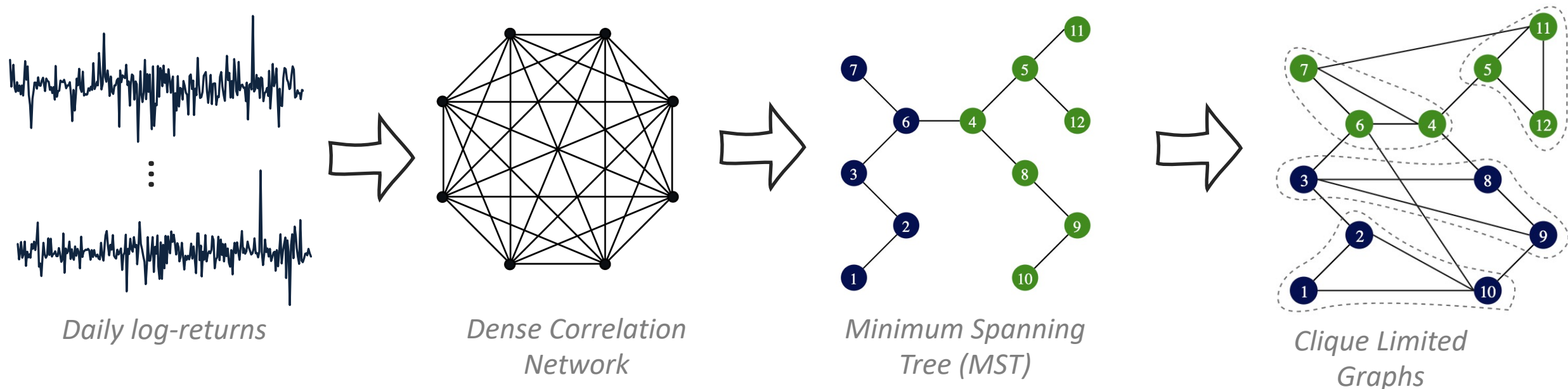
Supervisor: Assoc Prof Anwitaman Datta

Project Objectives

This paper aims to carry out a comparative study of the two stock market crashes (during 2008 and 2020) using a graph-theoretical approach and discuss the applications of network analysis in portfolio management. A novel filtering method is introduced to improve information-complexity trade-off.

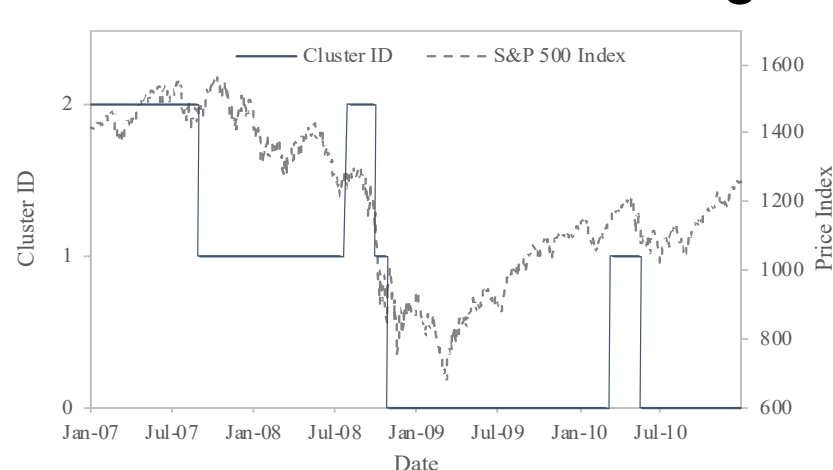
Building Stock Correlation Networks

Stock correlation network of S&P 500 stocks are built based on pairwise correlations where the nodes are individual stocks and edges are distances based on correlation coefficients. A new filtering method called Clique-Limited Graphs (CLG) which limits the number of cliques per node is proposed. It systematically retains relevant edges that enables the computation of more representative clusters in the market network. It is also flexible, unlike the MST which suffers from significant information loss.

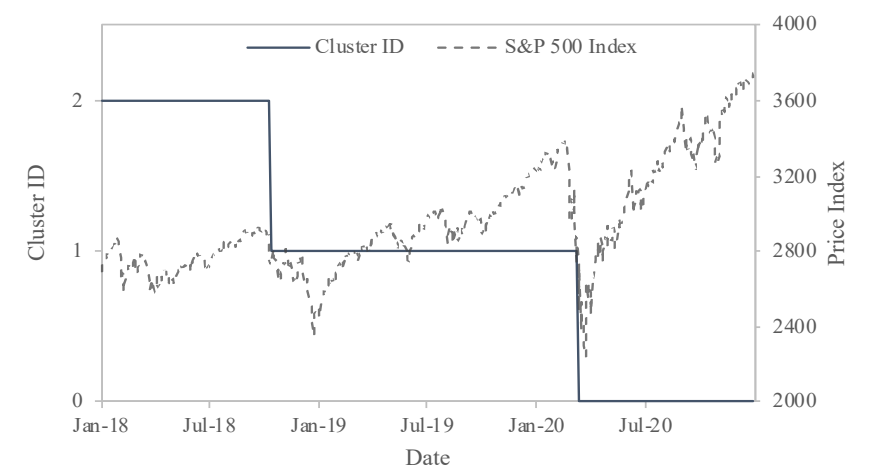


Dynamic Networks

Dynamic networks are constructed from a rolling-window of correlations between sub-portfolios (clusters of stocks detected on filtered networks). K-means clustering is used to cluster networks along time axis. Stock market crash during 2020 was more “orderly” than that during 2008. Momentary changes do not significantly alter the market network. Identifying significant changes in the market network can help to inform portfolio management.



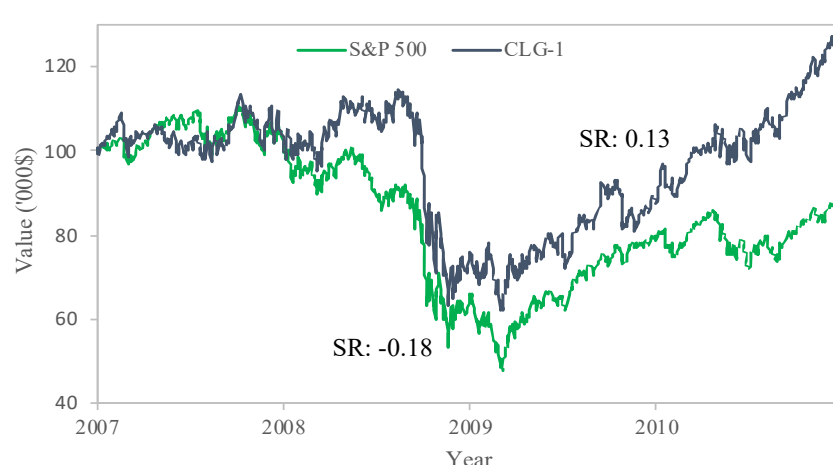
Periods of Network Stability during 2007-10



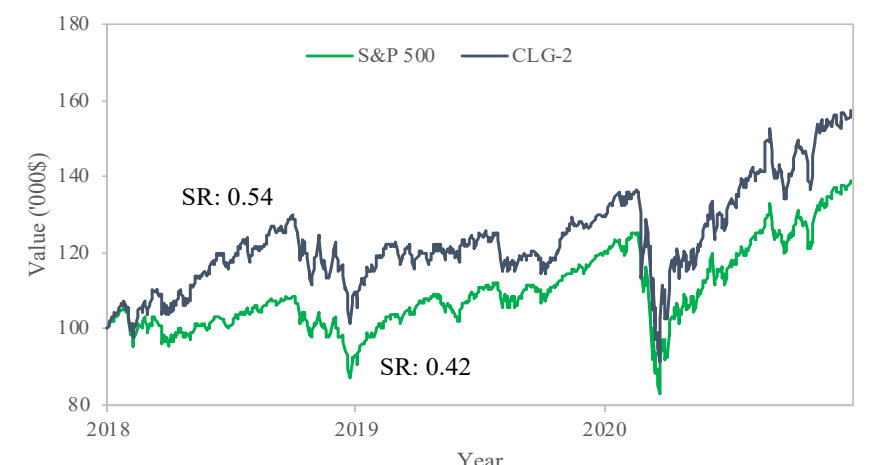
Periods of Network Stability during 2018-20

Portfolio Applications

A market portfolio can be constructed using a subset of stocks selected based on different centrality measures in the clusters of CLG networks. Portfolios constructed using closeness centrality and optimised using mean-variance analysis outperformed the market during both periods – 2007-10 and 2018-2020.



Portfolio performance (2007-10)



Portfolio performance (2018-20)