Updates Since Last Week

Done Last Week

- Adding some metrics for the number of clusters
- Adding code for co-occurrence network of graph
- Adjusting graph visualizations

Next Week Plans

- Start working on the Kalmann approach to exploit the graph structure
- try DDTW by considering time intervals relevant to a news article

Enhancing Equity Predictions Using Informational Signals

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Github repo: https://github.com/bour278/info-signal-analysis

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General Overview

- 🎯 **Target**: Enhance equity predictions using informational signals
- 🛠️ **Methods/Tools**: - Derivative Dynamic Time Warping (DDTW) - Louvain/Leiden Community Clustering - Kalman Filtering - Markov Random Fields

General Overview

1

DATA COLLECTION

- Kaggle
- Github
- Web Scraping

2

EDA

- Correlation between news and prices jump
- Optimal number of clusters

3

MODELS

- DDTW distance graph
- Co-occurrence matrix
- Kalmann Filtering

4

VISUALIZATION

- Network Clusters
- Time-series Clusters
- Prediction vs Enhanced Prediction using confidence bands

5

METRICS

- Cut metric / modularity for clustering
- Inter/Intra cluster variance
- MSE for enhanced predictions

Data Sources

- **Kaggle:** Daily OHLC data for US-based equities

Date	Open	High	Low	Close	Volume	OpenInt
1984-09-07	0.42388	0.42902	0.41874	0.42388	23220030	0
1984-09-10	0.42388	0.42516	0.41366	0.42134	18022532	0

Data Sources

- **Github:** Reuters Financial Dataset

```
-- Samsung aims to double its smartphone sales in Africa in 2014
--
-- Wed Nov 13, 2013 2:29am EST
-- http://www.reuters.com/article/2013/11/13/us-africa-samsung-idUSBRE9AC08620131113



 CAPE TOWN  (Reuters) - Samsung Electronics expects to supply half of the smartphones sold in Africa
 this year and aims to double these sales on the continent in 2014, an executive said.
```

Data Sources

- **Scraping:** New York Times News Archive

```
Chadwick Boseman Played Black Icons, Found Fame With ‘Black Panther’
11:20 PM ET
--------------------------------------------------------------------------------
Japan
Abe Will Resign as Japan’s Prime Minister, Citing His Health
10:17 PM ET
--------------------------------------------------------------------------------
Politics
Thousands March on National Mall, Continuing Racial-Justice Push
10:11 PM ET
--------------------------------------------------------------------------------
```

Background information - DDTW

```
Input: Two time series S and T
Output: Distance between S and T

Compute the first derivative of S and T
Initialize the matrix D with zeros
For i = 1 to length(S)
    For j = 1 to length(T)
        Compute the distance between the i-th element of S and the j-th element of T
        If i > 1 and j > 1
            D[i,j] = distance + min(D[i-1,j], D[i,j-1], D[i-1,j-1])
        Else
            D[i,j] = distance
Return D[length(S), length(T)]
```

Background information - DDTW

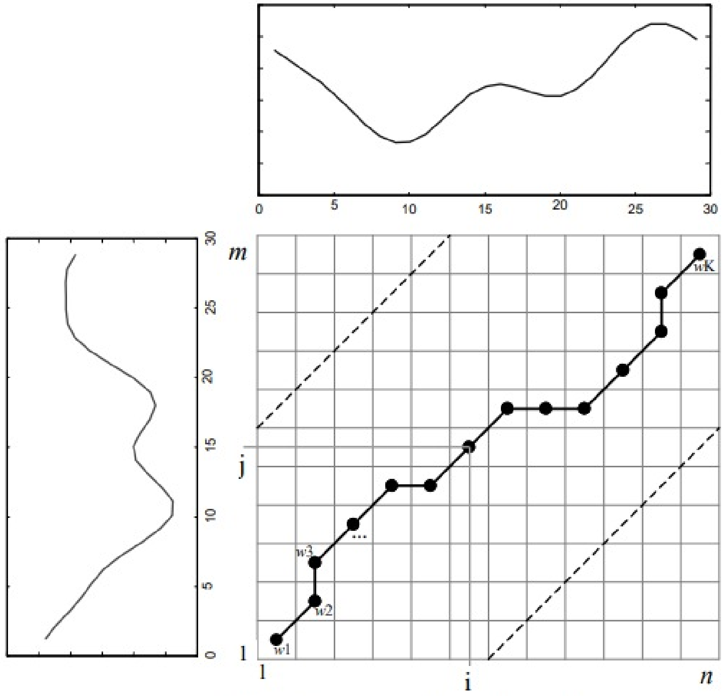
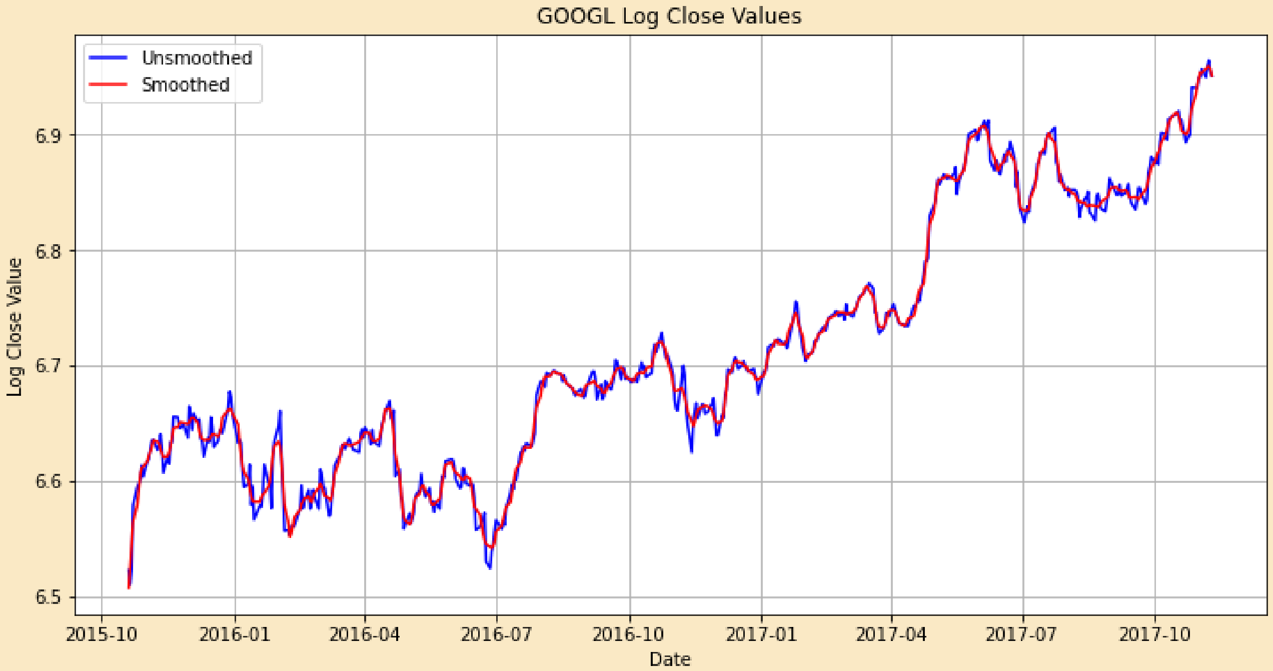


Figure 3: An example warping path.

Methodology - Pre-Processing

- **Savitzky-Golay Filtering:** removing noise from historical time series data using polynomial interpolation at a fixed-length window



Methodology - DDTW Clustering

- **DDTW:** algorithm finding shortest path distance between 2 time series using dynamic programming approach
- **Graph Representation** Adjacency matrix is built from pairwise DDTW distances between each pair of equities

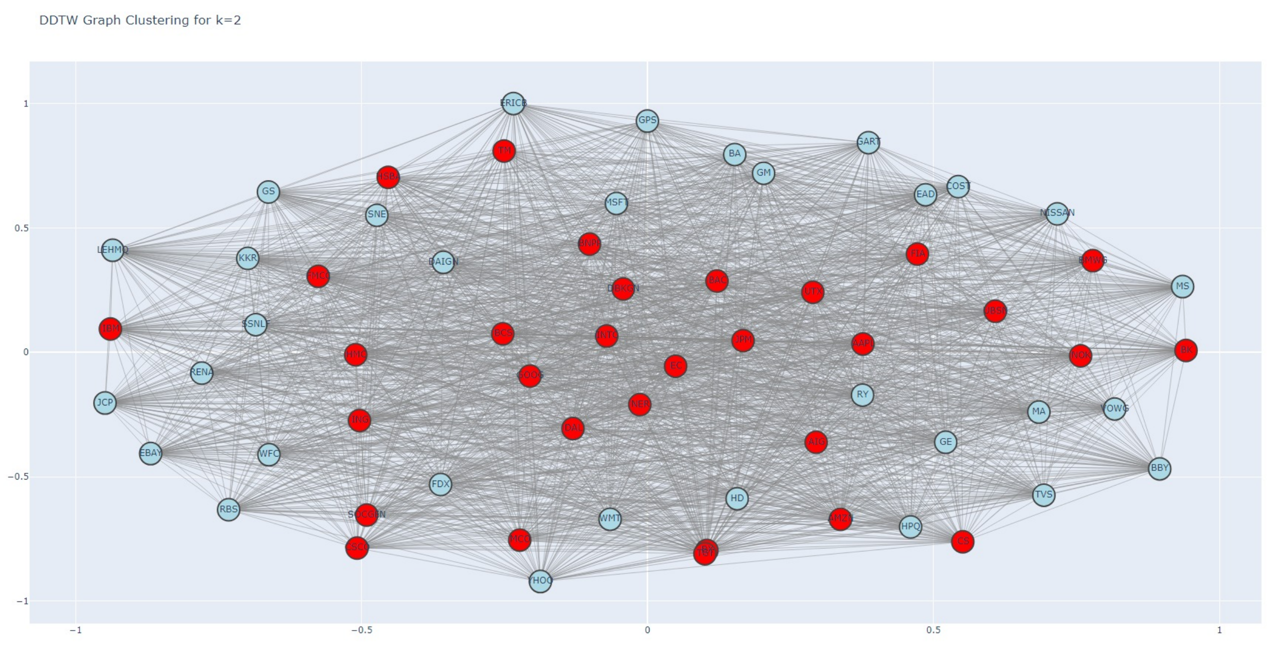
Methodology - DDTW Metrics

- **k-means optimal number of clusters:** For this case, we used the *silhouette score method* to computer the optimal number *k* of clusters. The best *k* was achieved at *k=2*.
- **inter-variance of numner of the graph** Metric to determine how efficient the clustering method computed by $\frac{\sum_i^K n_i||c_i - \bar{x}||^2}{K}$ where c_i represent the centroid of the i^{th} cluster and $\bar{x}$ is the global mean of the graph.

Methodology - News Co-occurrence

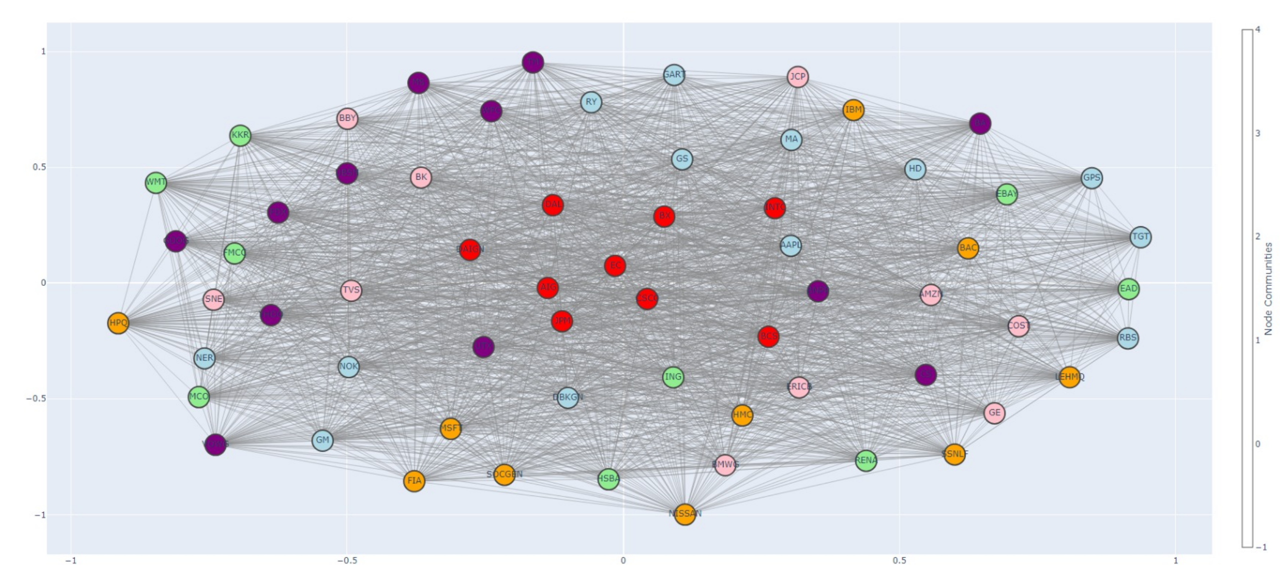
- **News co-occurence matrix:** Matrix A where $A_{i,j}$ corresponds to the number of news articles where stock i appeared with stock j.
- **Louvain Clustering** Community detection algorithm that helps retrieve clusters in a graph and does not require setting the optimal number of clusters before running the algorithm.

Results - Log Close Graph Cluster



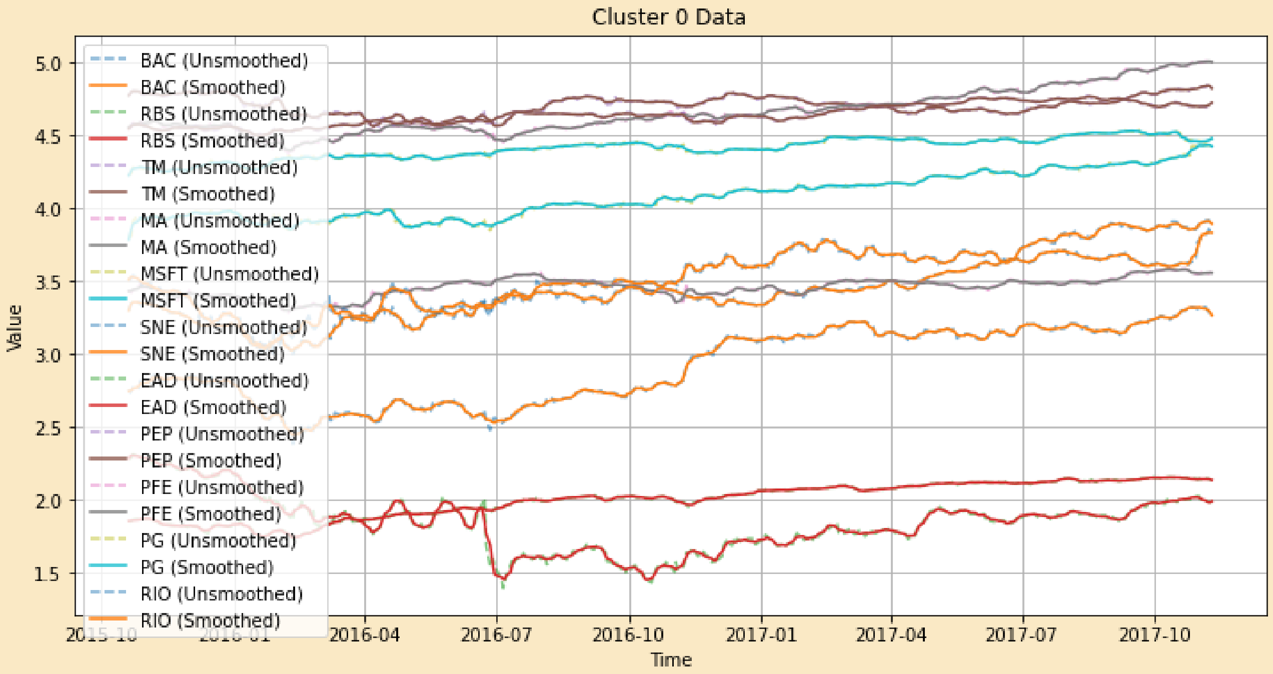
[rendered HTML for the graph](#)

Results - Log Close Graph Cluster

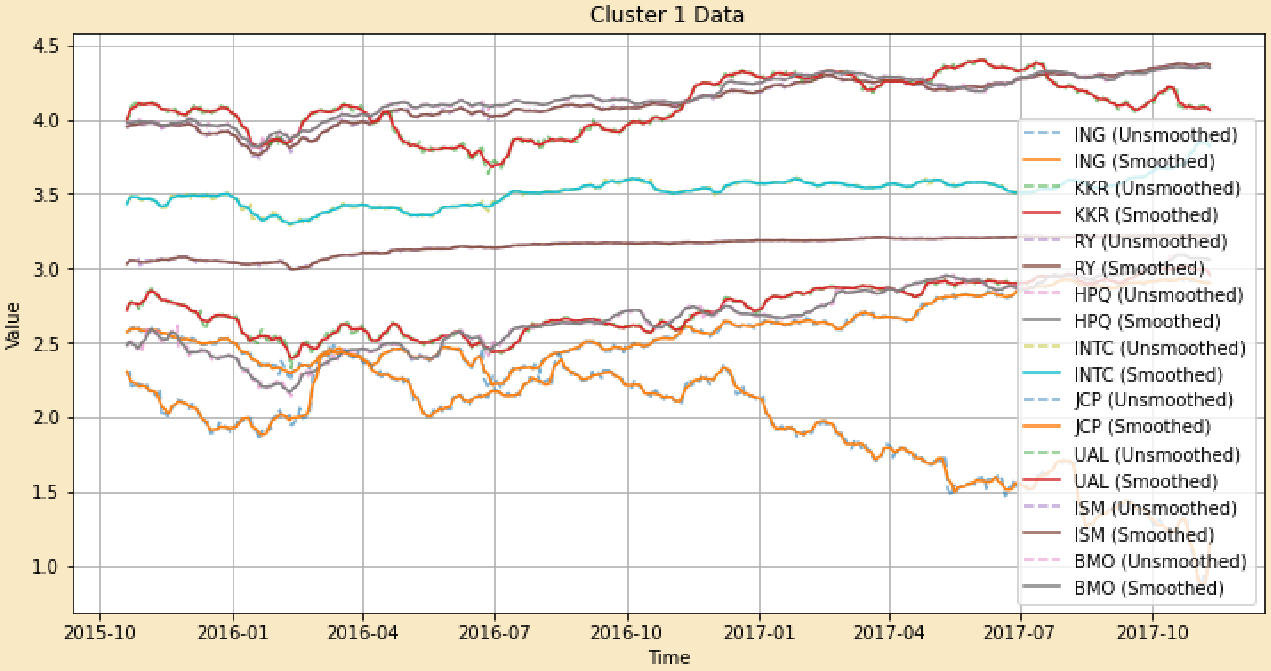


rendered HTML for the graph

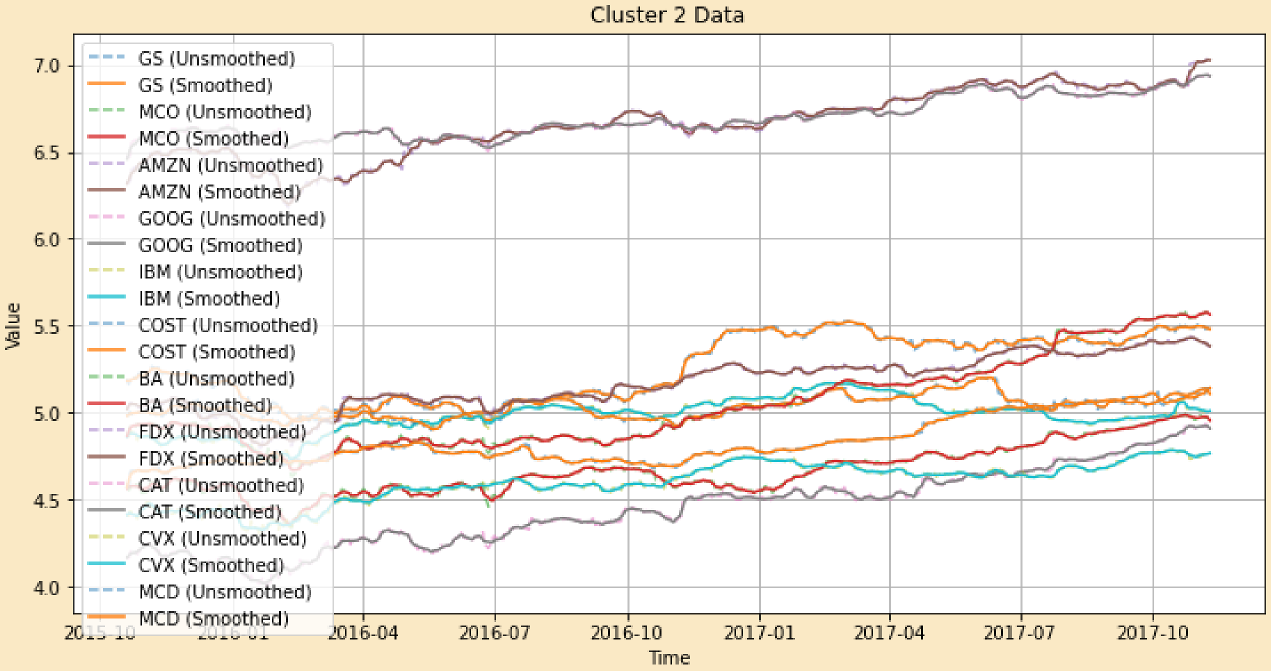
Results - Time Series Cluster 0



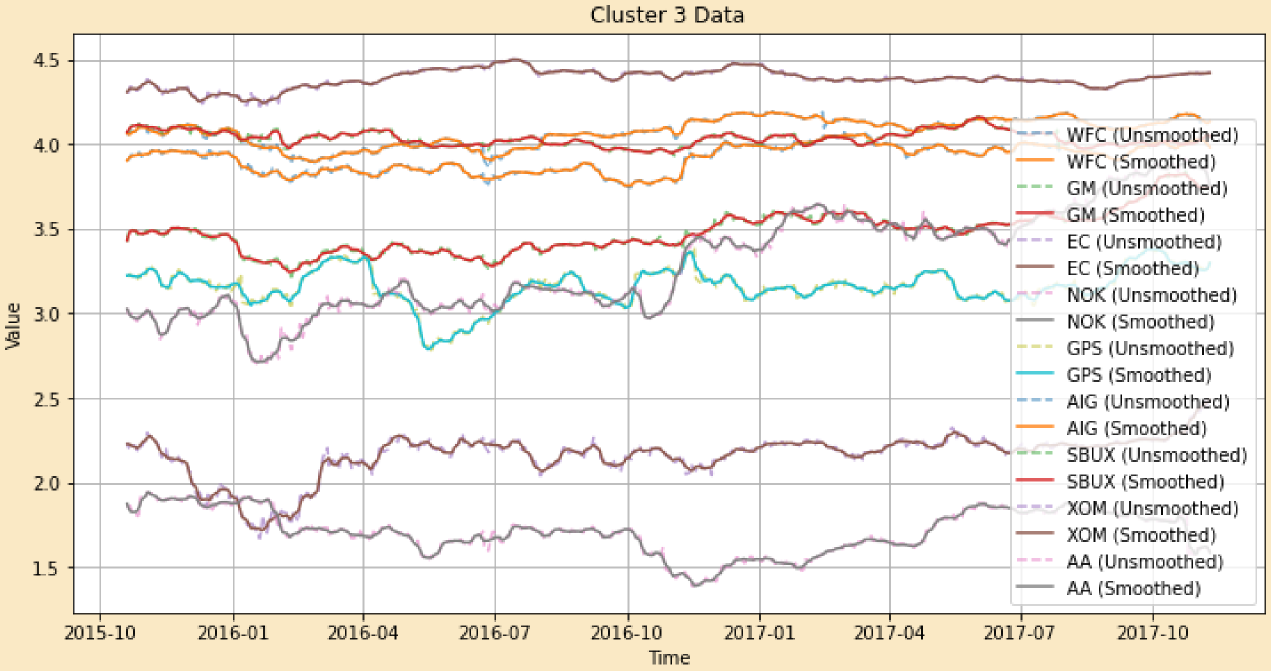
Results - Time Series Cluster 1



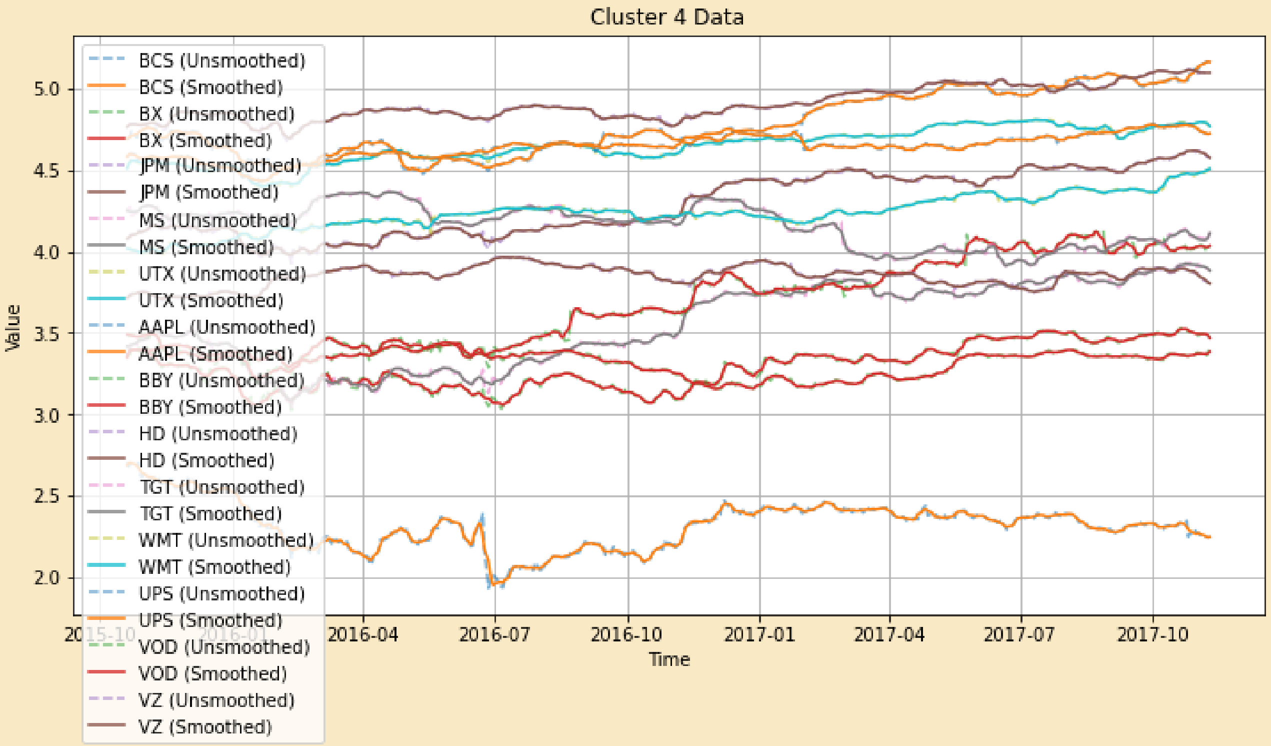
Results - Time Series Cluster 2



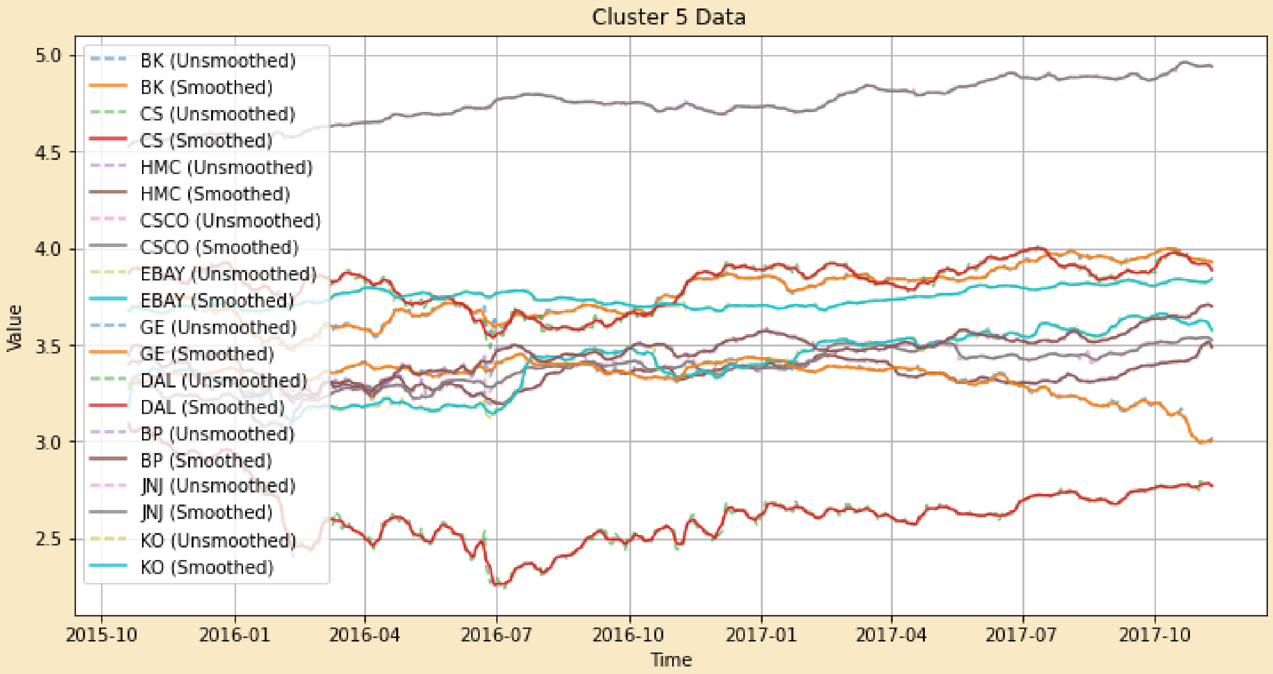
Results - Time Series Cluster 3



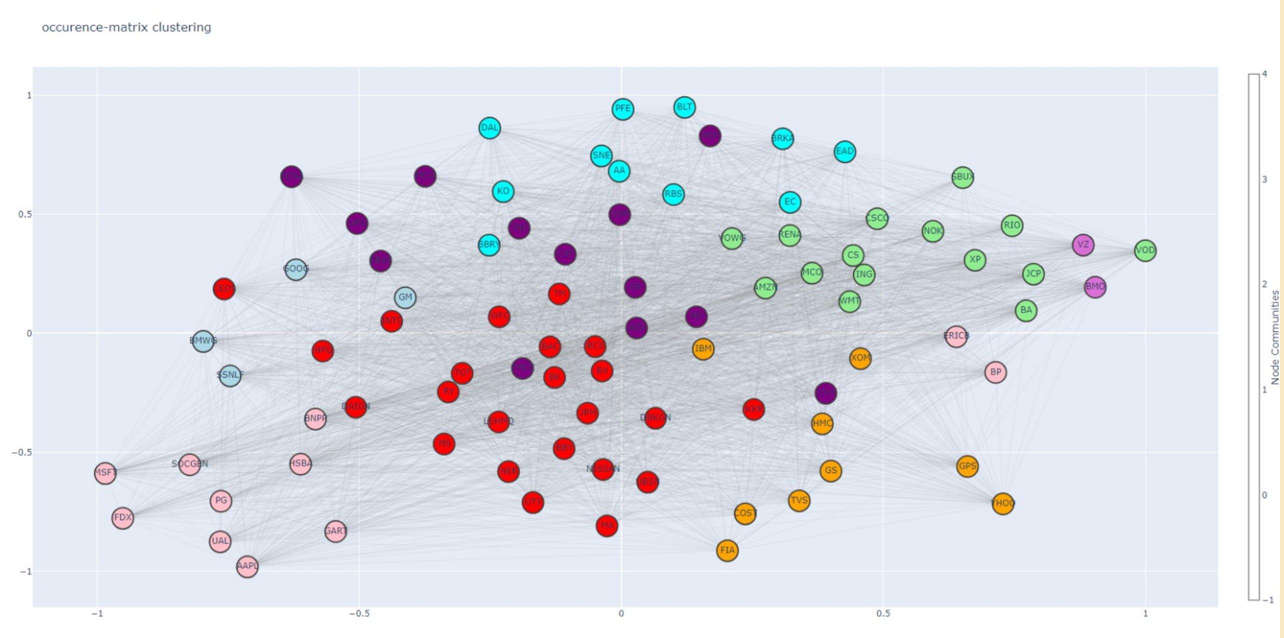
Results - Time Series Cluster 4



Results - Time Series Cluster 5



Results - Co-occurrence Network



rendered HTML for the graph

Limitations (More to be found ⏳)

- Limited tick data
- Computationally expensive to build graphs for long-time series