Overview of Clustering

2022/5/6

Gakushuin University

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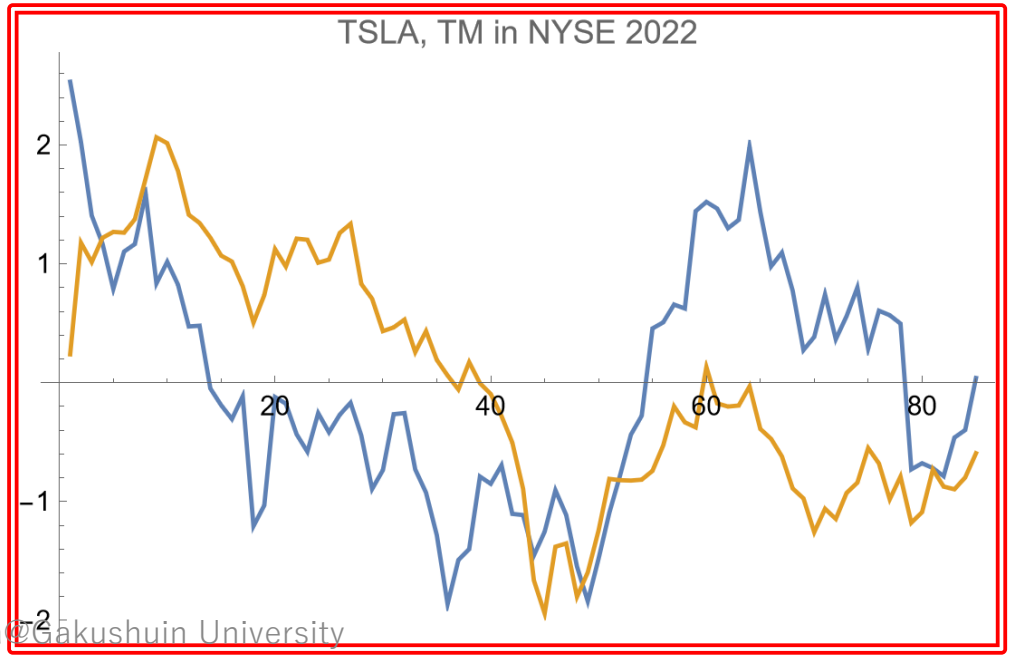
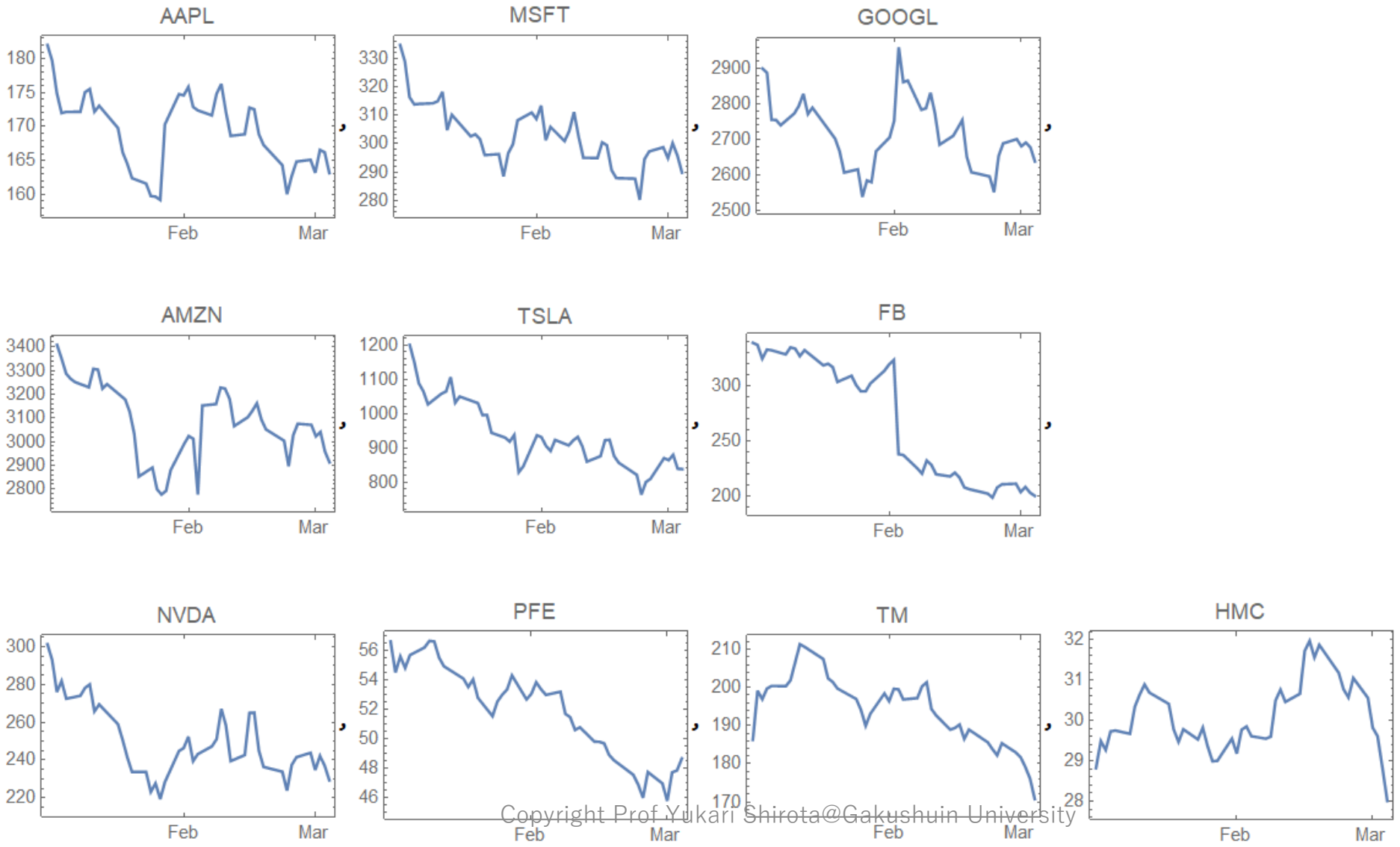
Stock Price Movement

- Currency is different
- Original scale is different
- Sometimes stock division occur

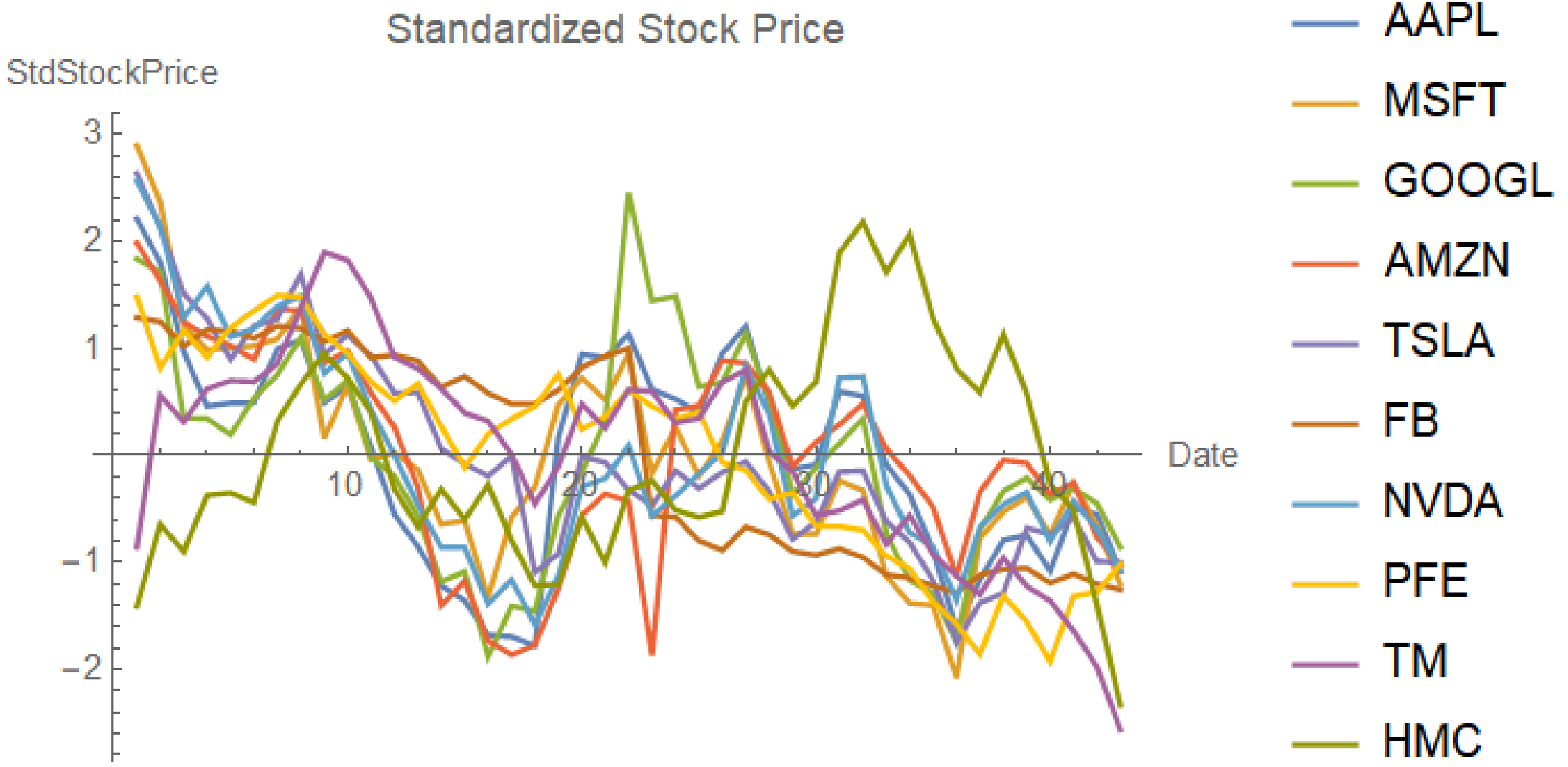
-> STANDARDIZATION is needed for COMPARISON



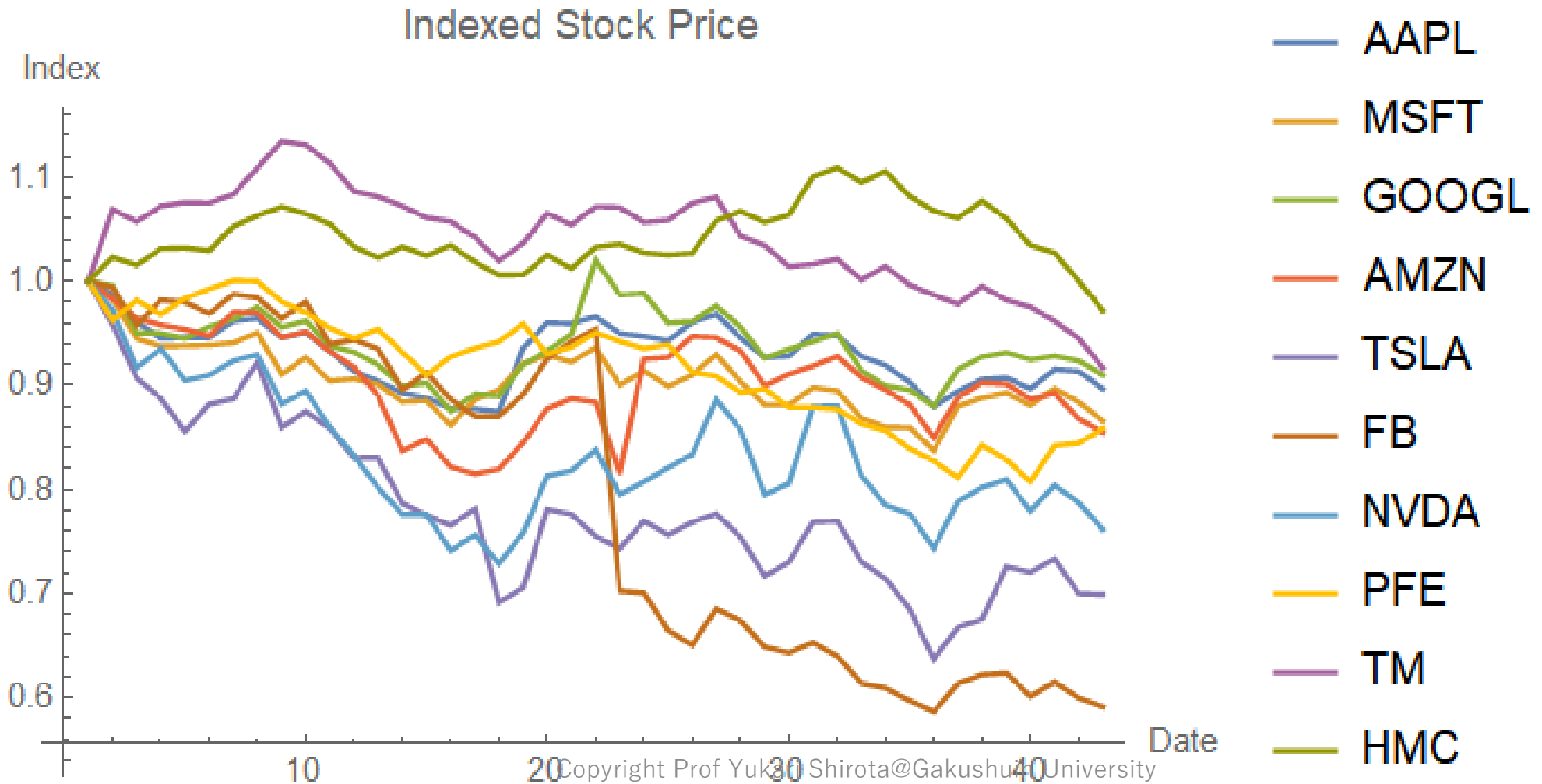
NYSE　Stock Price 2022/01/03/ to 03/04



Standardized Stock Price Movement



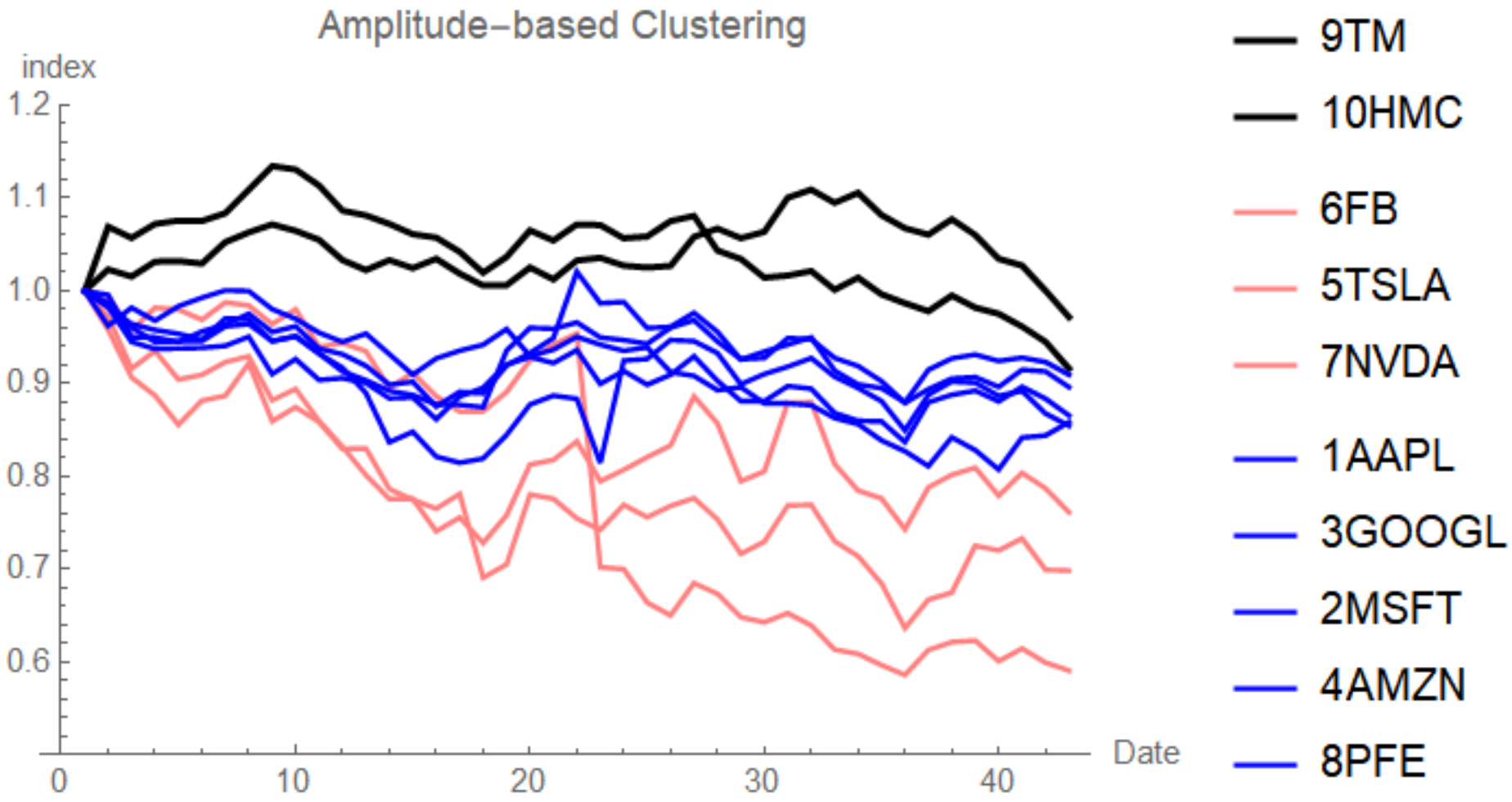
Indexed Stock Price Movement with the first one being 1



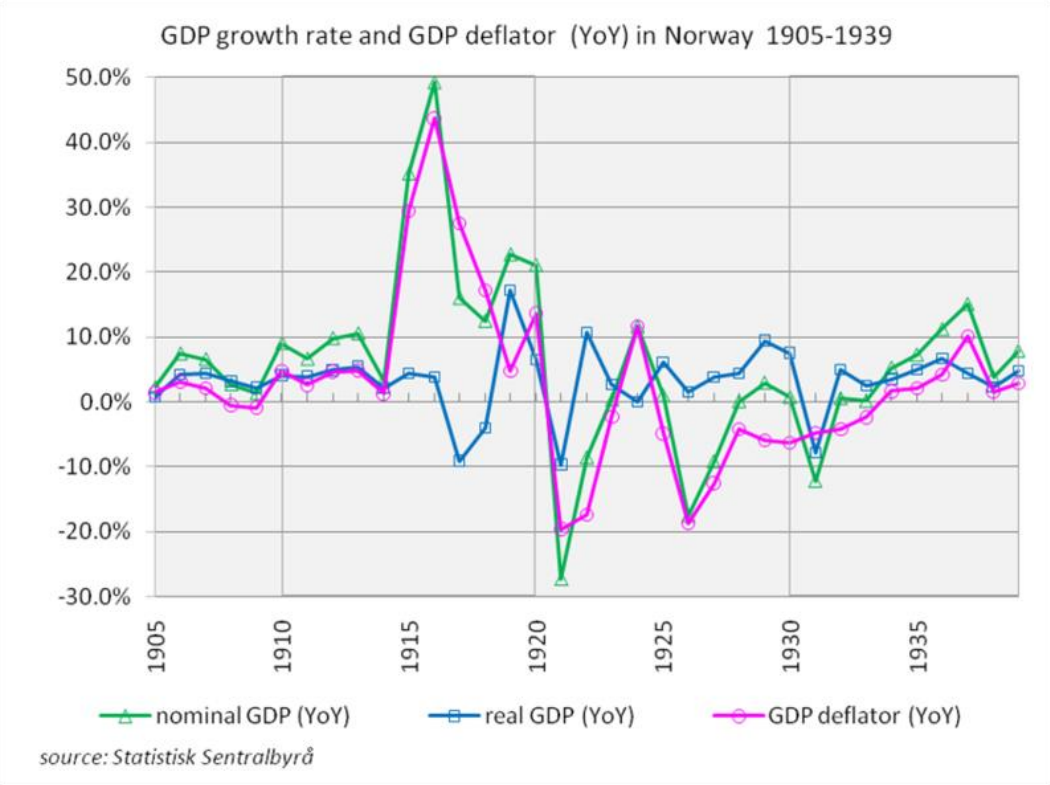
Another Requirement

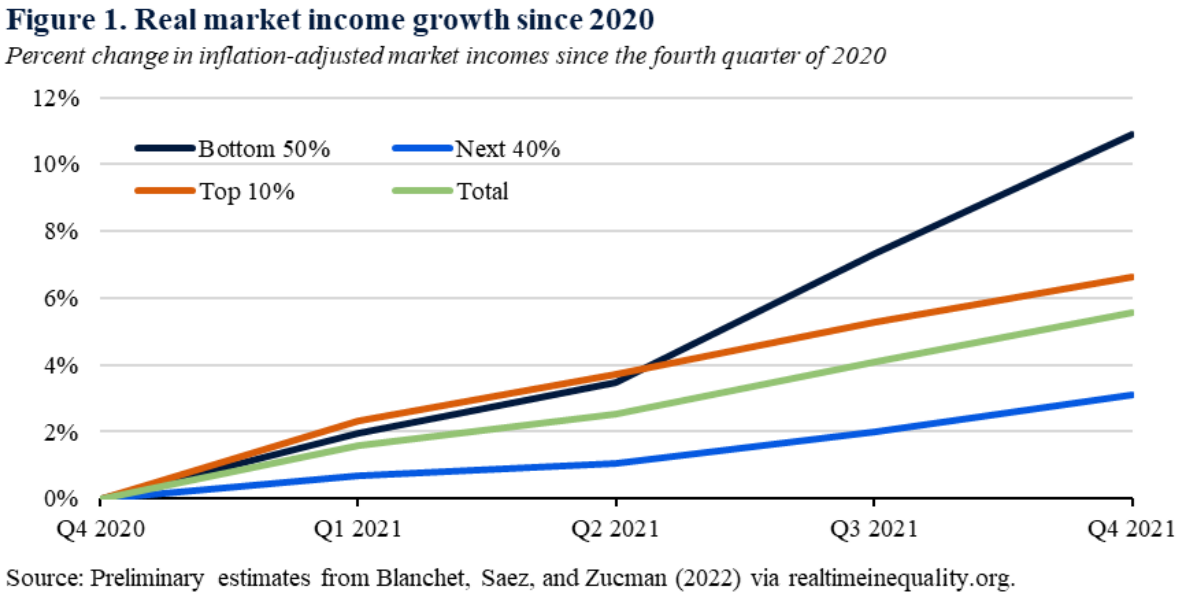
- We want to compare the growth rate/amplitude

Amplitude-based Clustering k=3



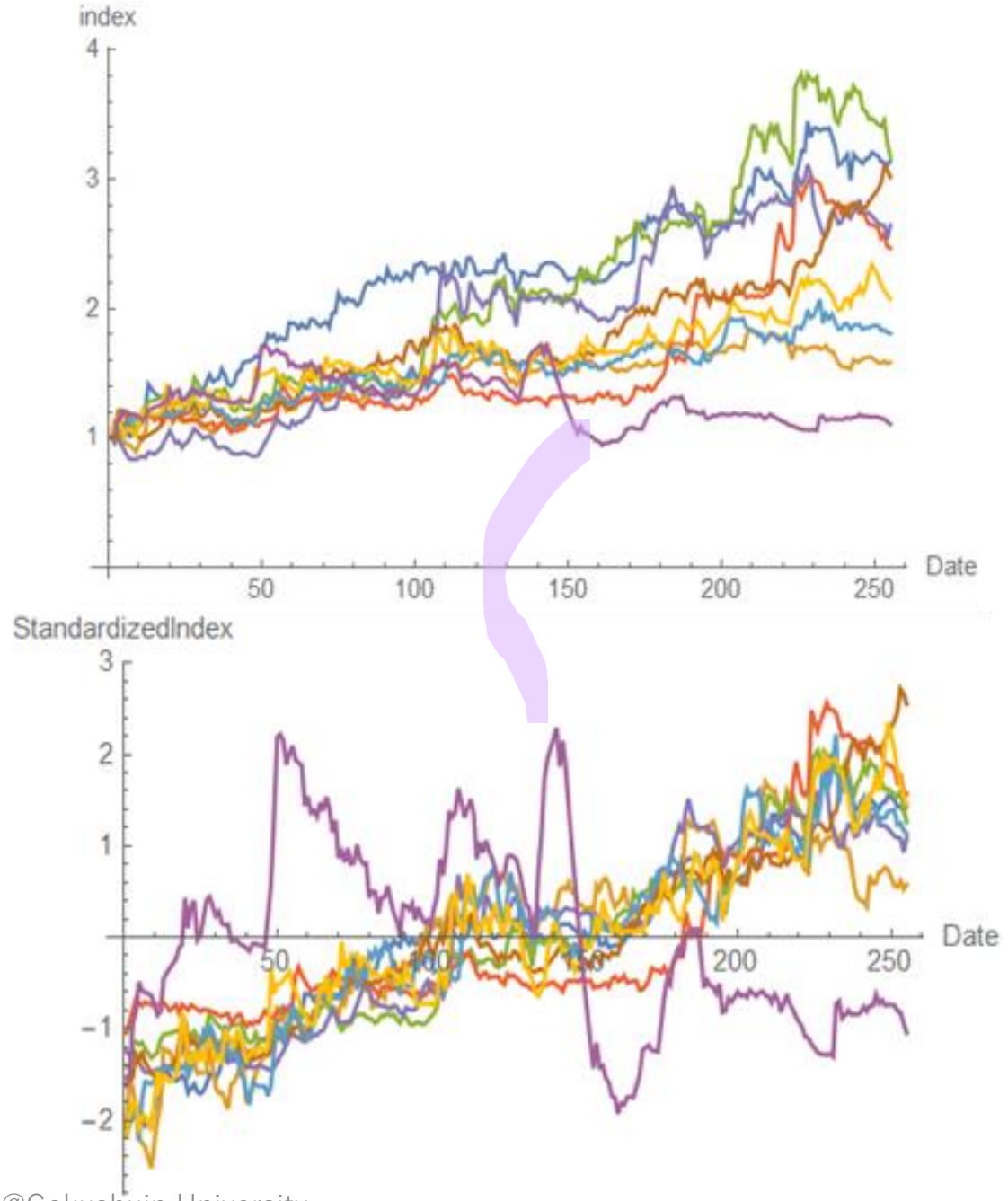
Application sample of Amplitude-based : GDP growth ratio, Economic growth





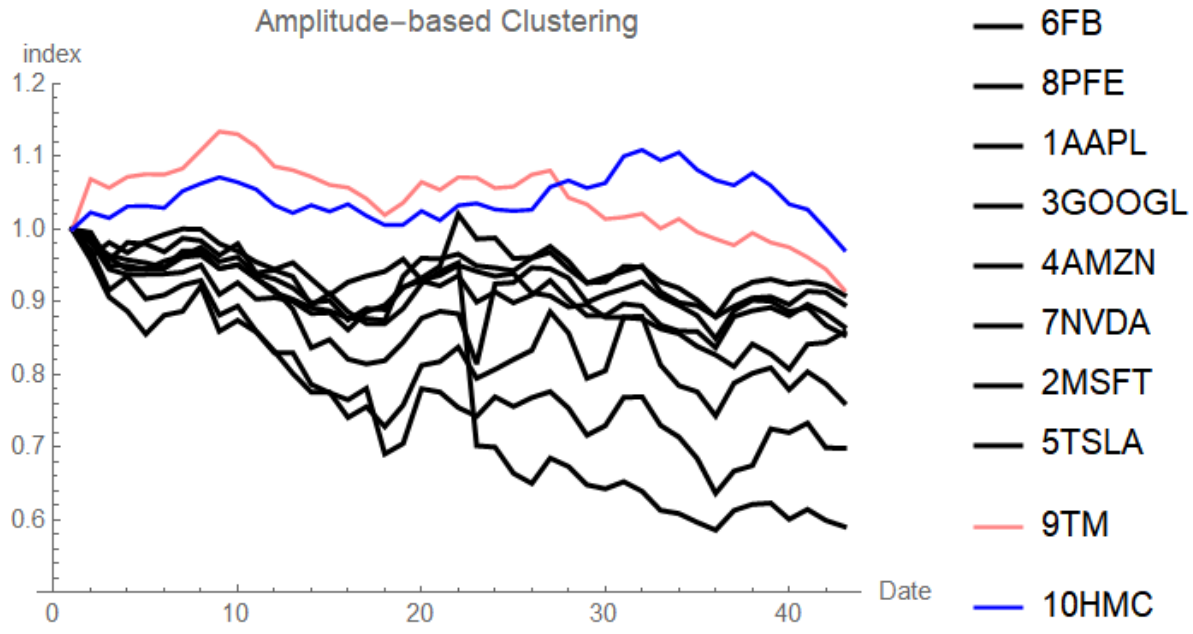
Lack of Ampl. Info.

- Standardization makes a small fluctuation
  that with a large variance
- No amplitude info.

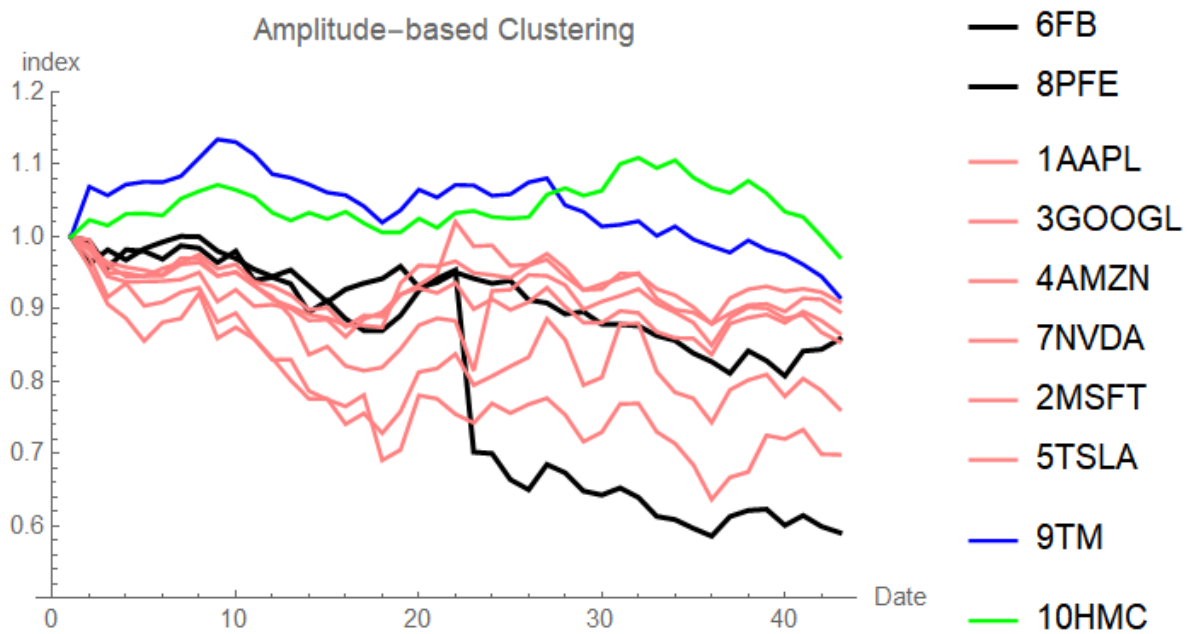


HRP's Clustering
It does not meet our requirements.

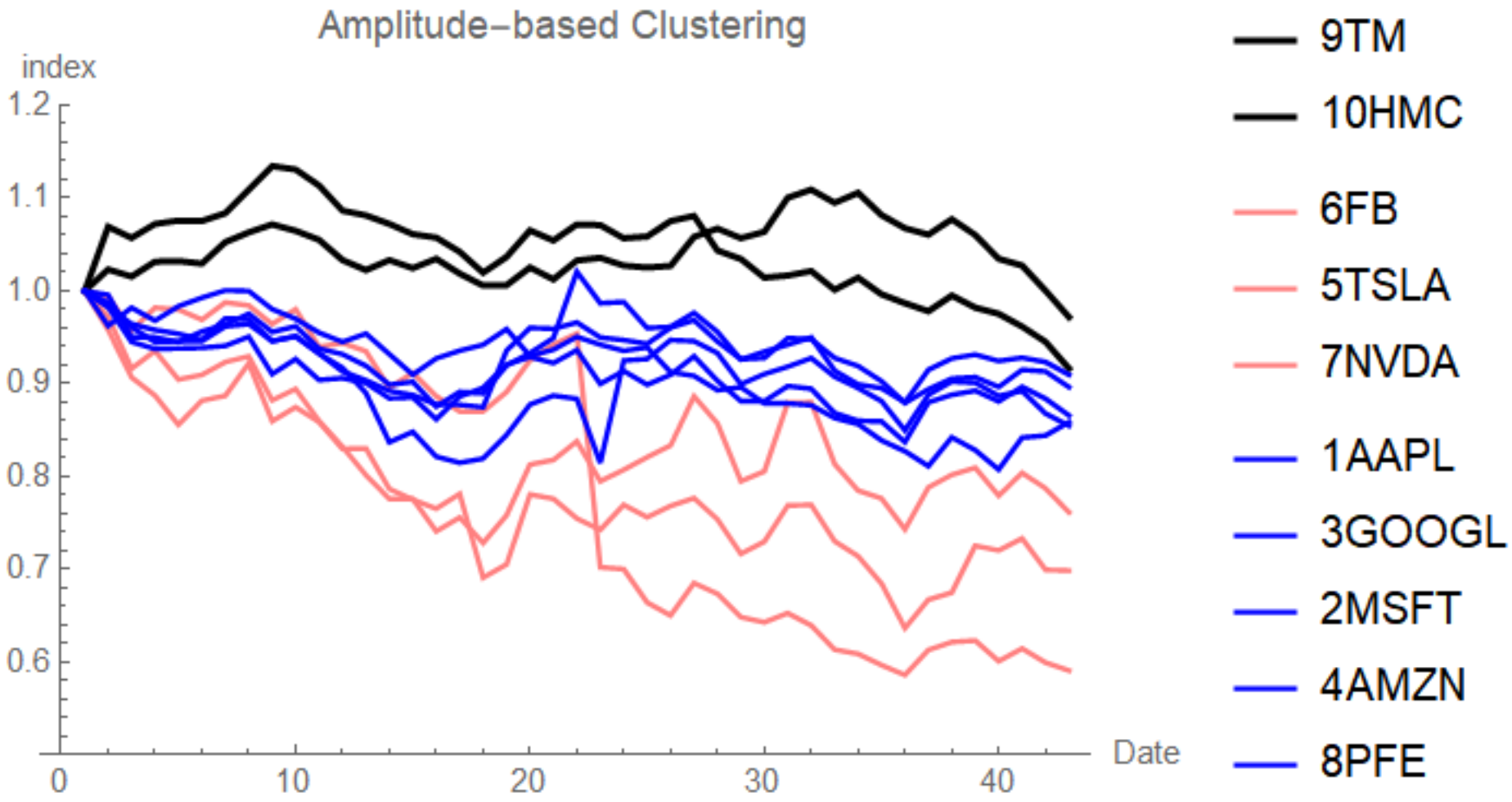
K=3



K=4



Amplitude-based Clustering k=3



Contents of Standardization Problem

1. Standardization Requirement
2. Comparison by Standardized Stock Price Sequences
3. Standardization Problem : Lack of Amplitude Info.
4. Amplitude-based Clustering
   - Algorithm and Distance
   - Advantages
5. Conclusion

Our Requirement

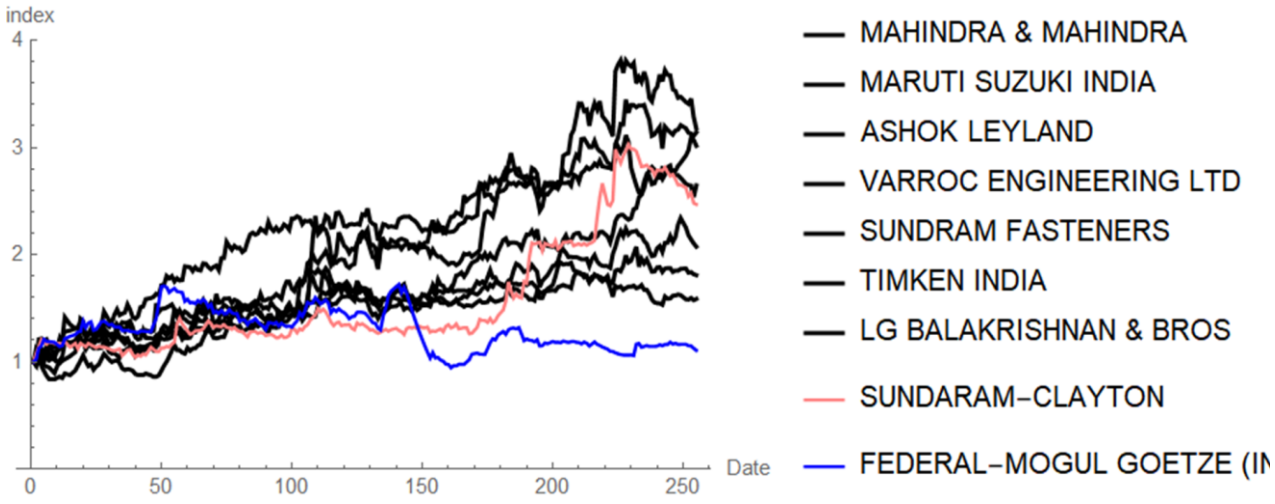
- Focus on growth rates
- Keeping amplitude info., conduct clustering
- How about k-Shape ?
  NO because input data standardization is needed
- k-Shape and DTW
  suppose almost same scaling
- We cannot use the existing clustering methods
- Developed a new one “Amplitude-based clustering”

Amplitude-Based Time Series Data Clustering Method

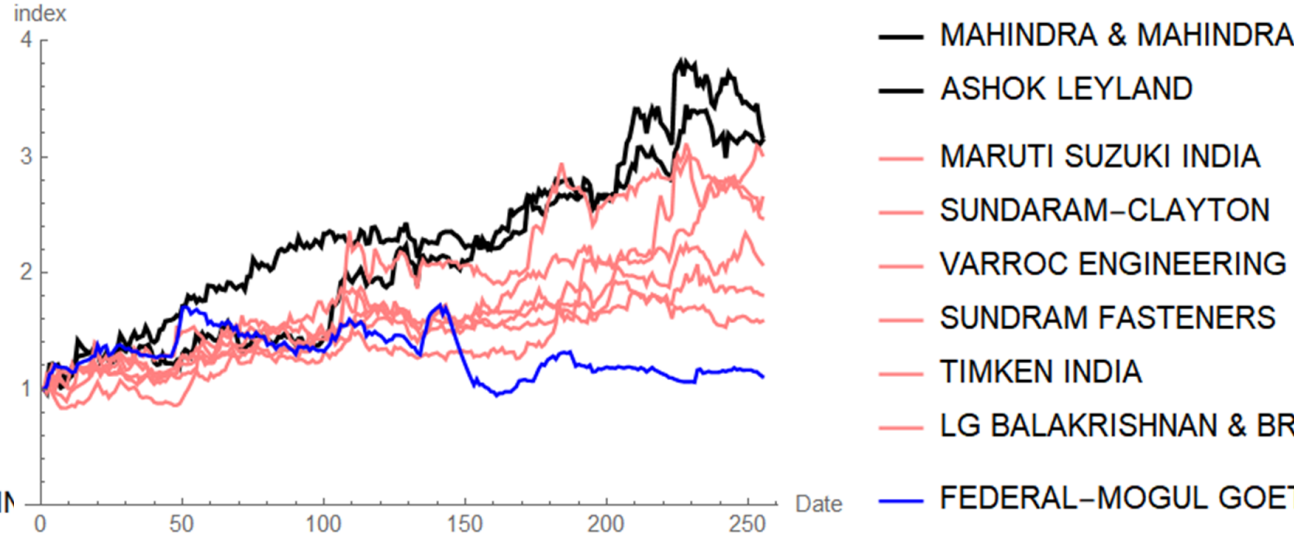
- **Y. Shirota, and B. Chakraborty,** “Amplitude-Based Time Series Data Clustering Method," ***Gakushuin Economics Papers,*** **vol. 59, no. 2, 2022.**

Which is a result we wanted ?

HRP clustering



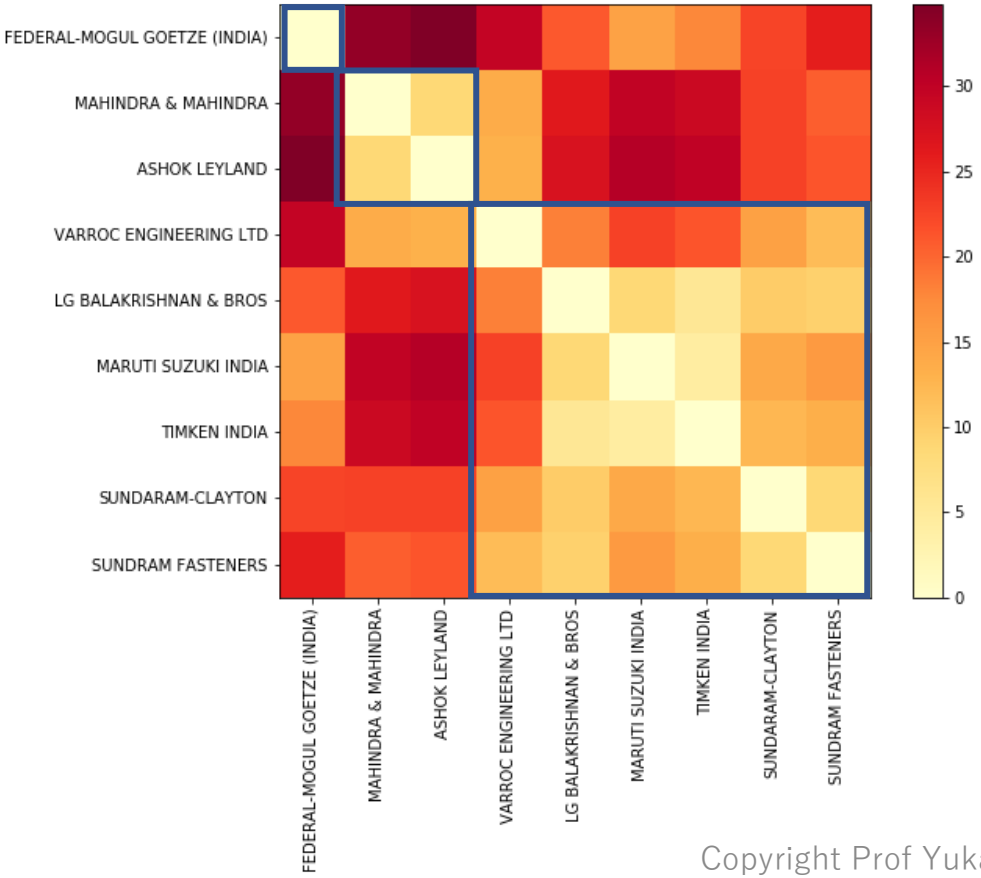
Amplitude-based clustering



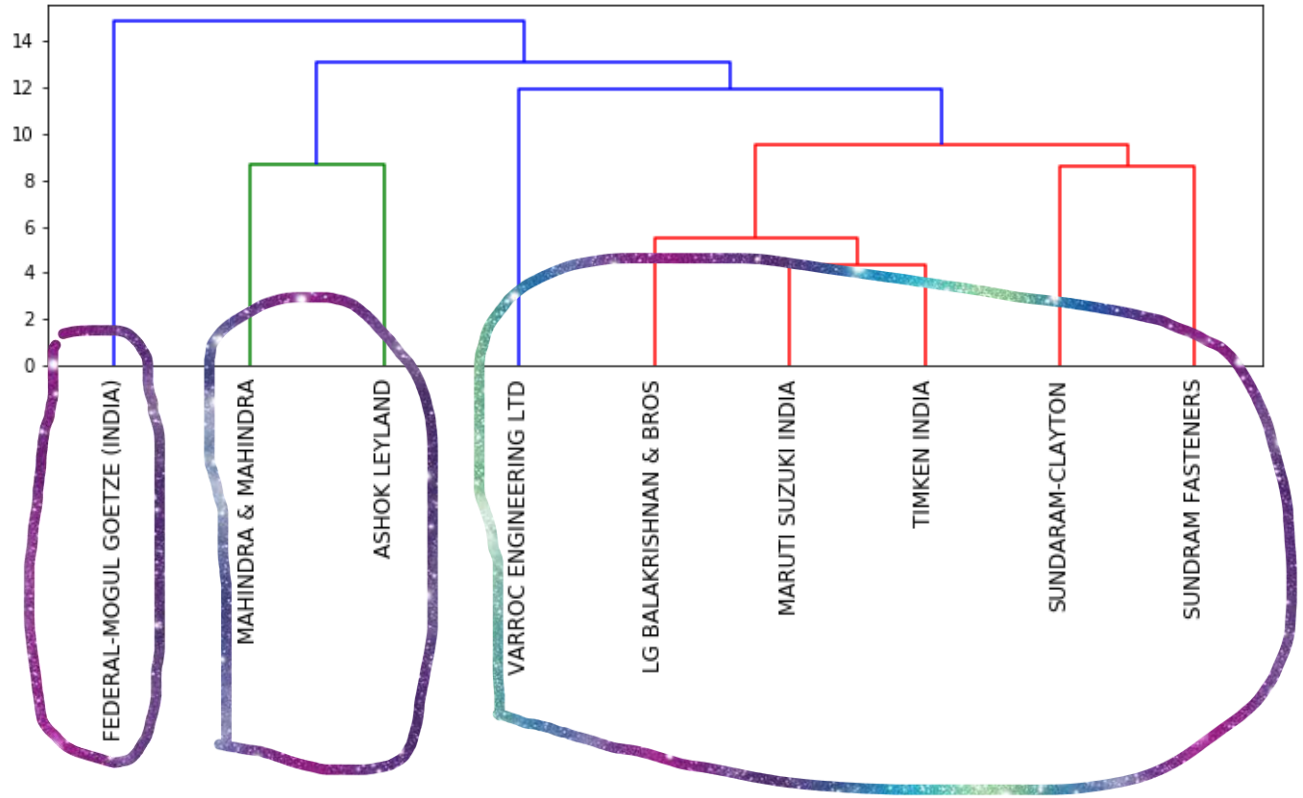
Because it uses standard deviations

Amplitude-based clustering result

Distance matrix



Dendrogram



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Amplitude-based clustering Algorithm (1) Hierarchical clustering

Euclidean distance between i, j

- $ED_{i,j} = \sqrt{\sum_{k=1}^{T}\left(G_{i,k} - G_{j,k}\right)^2}$

$G_{j,k}$ is the index data of j-th company on k-th day.

T is the number of days.

Euclidean distance of distance

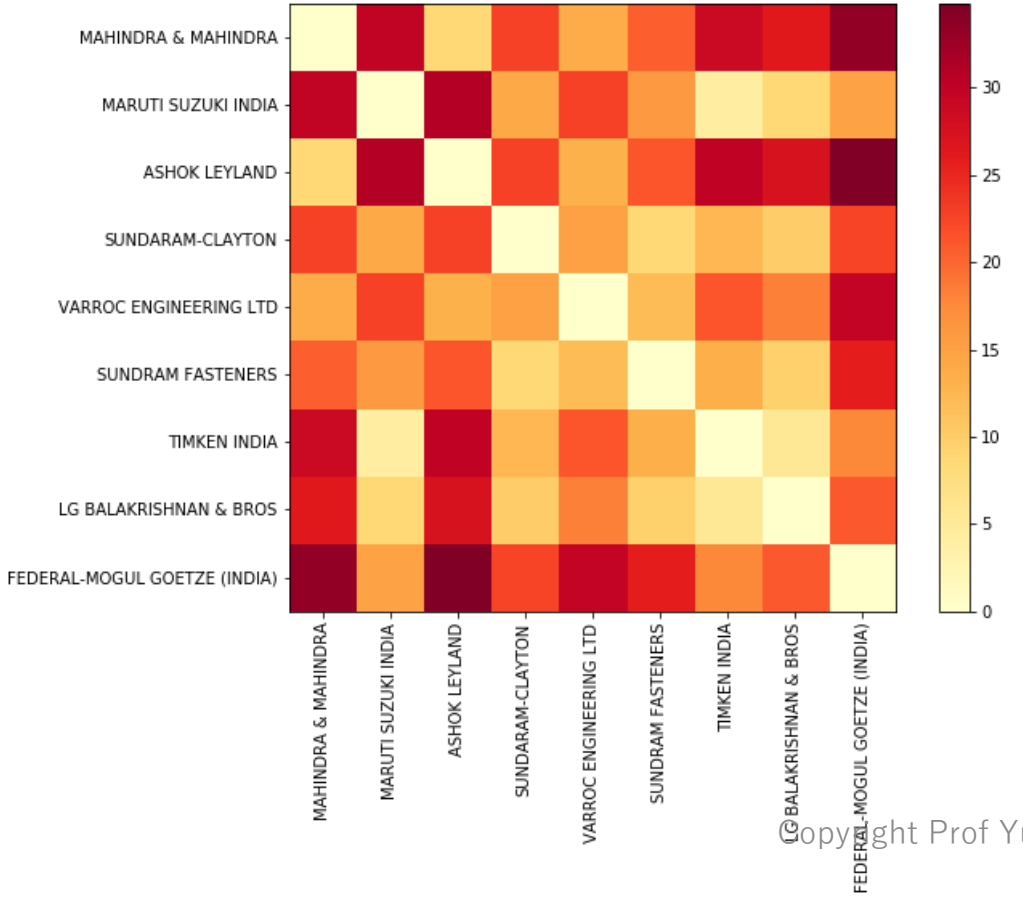
- $\widetilde{ED}_{i,j} = \sqrt{\sum_{n=1}^{N}\left(ED_{n,i} - ED_{n,j}\right)^2}$

N is the number of companies.

Q: How about just using Euclidean distances ?
A: Cannot obtain the good result.
Distance of distance includes the whole company data

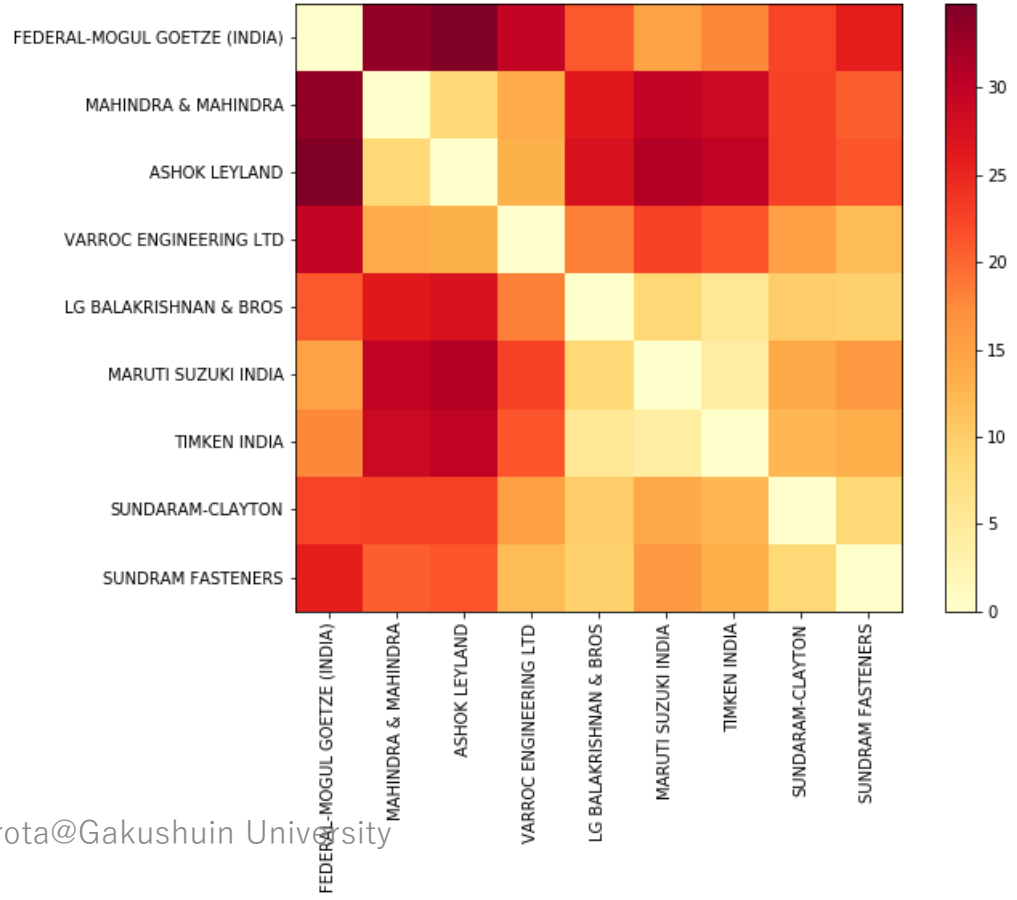
Amplitude-based clustering Algorithm (2) Serialization (Diagonalization)

BEFORE



AFTER

Change the company order for diagonalization



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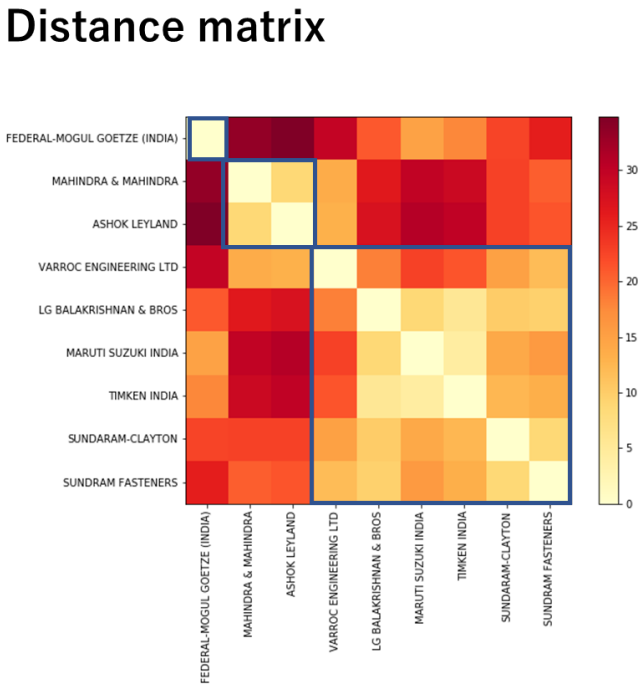
Advantages of Amplitude-based Clustering

- High performance company makes one cluster
- Other than the extraordinary companies, Interested in the middle large cluster
- In other words, remove the top group and the tail group
- Serialization (quasi-diagonalization) Effect
- We can divide the middle large cluster into several groups.



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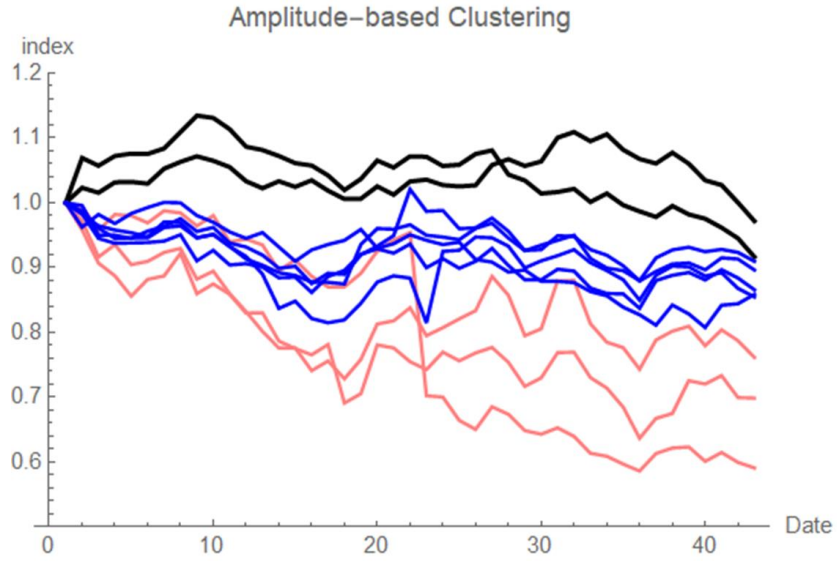
Summary
Amplitude-based clustering



- Keeping amplitude info., compare the movement patterns
- Application fields: economics/stock growth comparison
- Then cannot use k-Shape because of data standardization
- Very simple algorithm, but helpful in real data analyses.
- SEE ALSO

Y. Shirota, T. Sakura, and B. Chakraborty, "世界自動車製造業2014年度株価成長の時系列分析," ***Gakushuin Economics Papers,*** **vol. 59, no. 2, 2022.**