5th Malaysia Statistics Conference
29 November 2017
Sasana Kijang, Bank Negara Malaysia
2017
MyStats 2017
From Data to Knowledge : The Journey

Statistical standard, methodology and application in data management and usage

Network Topology of Economic Sectors

Gan Siew Lee

Presentation Flow

- Focus of Research

- Highlights

- Research Methodology

- Results and Discussion

- Conclusions and Future Research

Focus of Research

Approaches

- Multivariate time series (MVTS) representation of economic sector.

- Minimal spanning tree (MST) to filter the information presented in a vector correlation matrix.

Highlights

- In the current practice, stock is represented by univariate time series (UVTS) of its closing price.

- According to the literatures (e.g., Duellmann *et al*., 2006; Fasnacht and Louberge, 2007; Ferreira and Gama, 2010; Roy and Sakar, 2013), it is important to analyze economic sectors for investment decisions and portfolio management.

Highlights

- The existing method (e.g.: Zhang et al., 2011 and Cheong et al., 2012) is by representing sector by UVTS of its index related to closing price and not by MVTS of p components each of which is a UVTS of stock's closing price.

- The problem is how to measure the similarity among sectors (MVTS) which might have different number of stocks (number of components in MVTS).
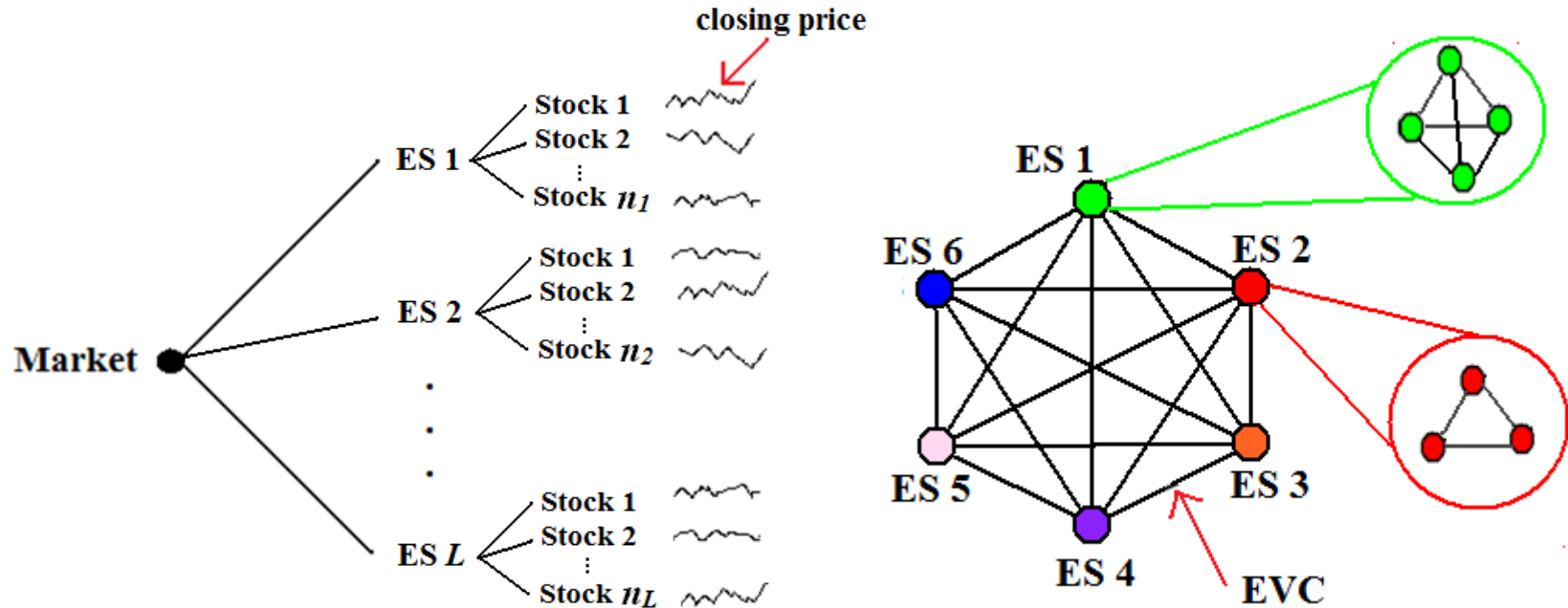
Economic Sectors Network Construction

- Current practice
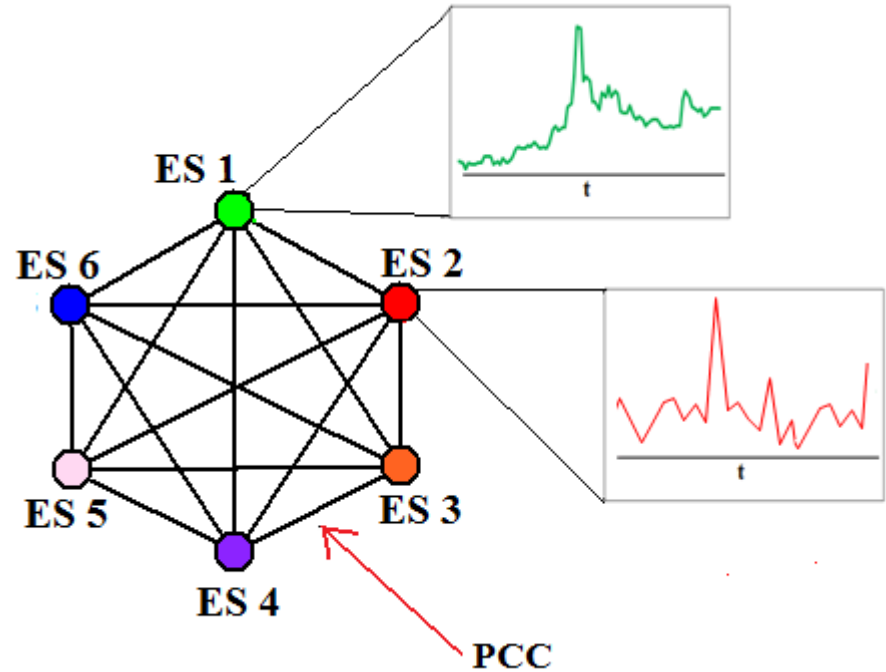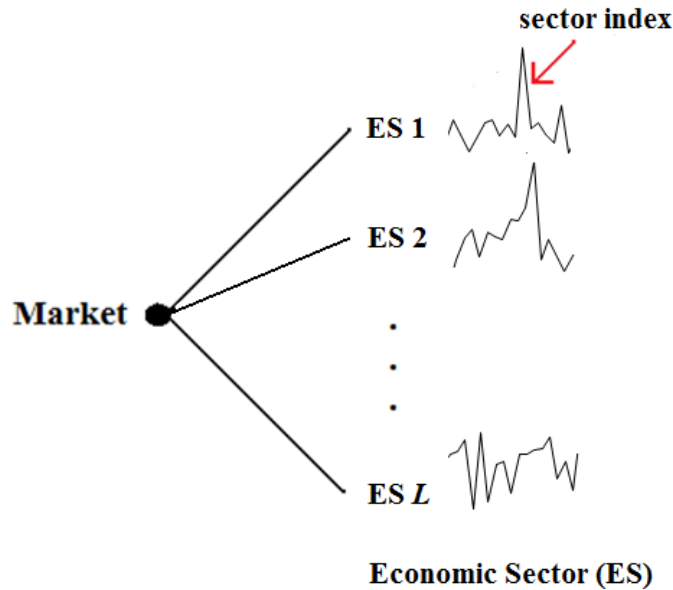
Economic Sector (ES)

Economic Sectors Network Construction

- Research scenario

Economic Sectors Network Construction

- Escoufier vector coefficient (EVC) (Escoufier, 1973) between economic sectors E_k and E_l is,

$$RV_{kl} = \frac{Tr(\mathbf{S}_{kl}\mathbf{S}_{lk})}{\sqrt{Tr(\mathbf{S}_{kk}^2)Tr(\mathbf{S}_{ll}^2)}}$$

Economic Sectors Network Construction

- Distance between economic sectors E_k and E_l is,

$$\delta_{kl} = \sqrt{2\left(1 - RV_{kl}\right)}$$

Results and Discussion

Illustrative example:

New York Stock Exchange (NYSE)

     1515 stocks → 63 SICs (Standard Industrial Classification)

     Dec 16, 2004 – Nov 21, 2014

Results and Discussion

Table 1. Industry sector, color, number of SICs number and number of stocks.

No.	Industry Sector	Color		Number of SICs	Number of Stocks
1	Mining	Red	🔴	4	115
2	Construction	Cyan	🔵	3	28
3	Manufacturing	Yellow	🟡	20	469
4	Transportation, Communication, Electric, Gas & Sanitary Services	Green	🟢	8	187
5	Wholesale Trade	Magenta	🟣	2	33
6	Retail Trade	Black	⚫	8	78
7	Finance, Insurance & Real Estate	Purple	🟣	7	490
8	Services	Orange	🟠	10	110
9	Public Administration	Blue	🔵	1	5
	TOTAL				1515

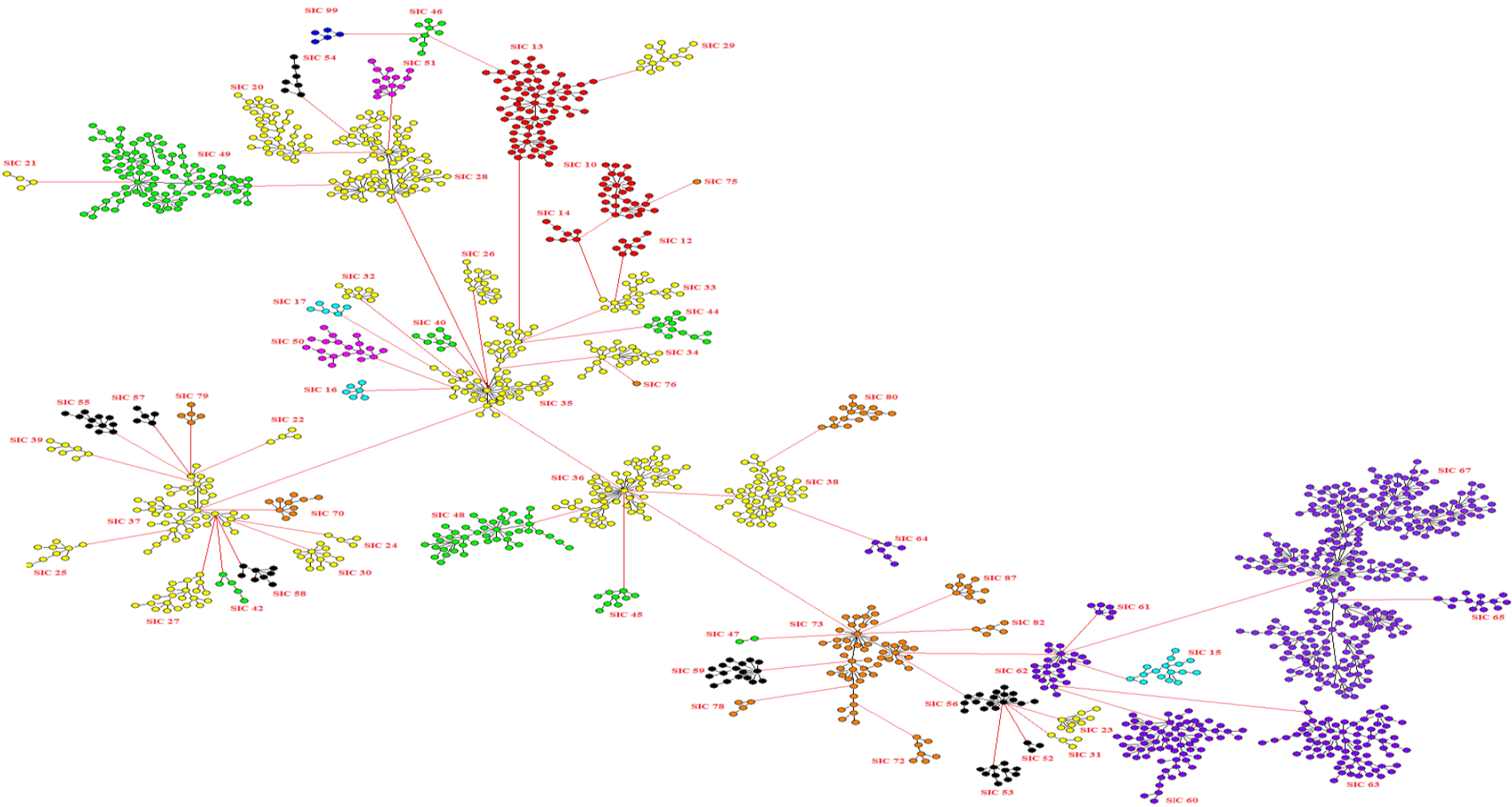# Results and Discussion

Figure 1. Minimal spanning tree of 63 SICs
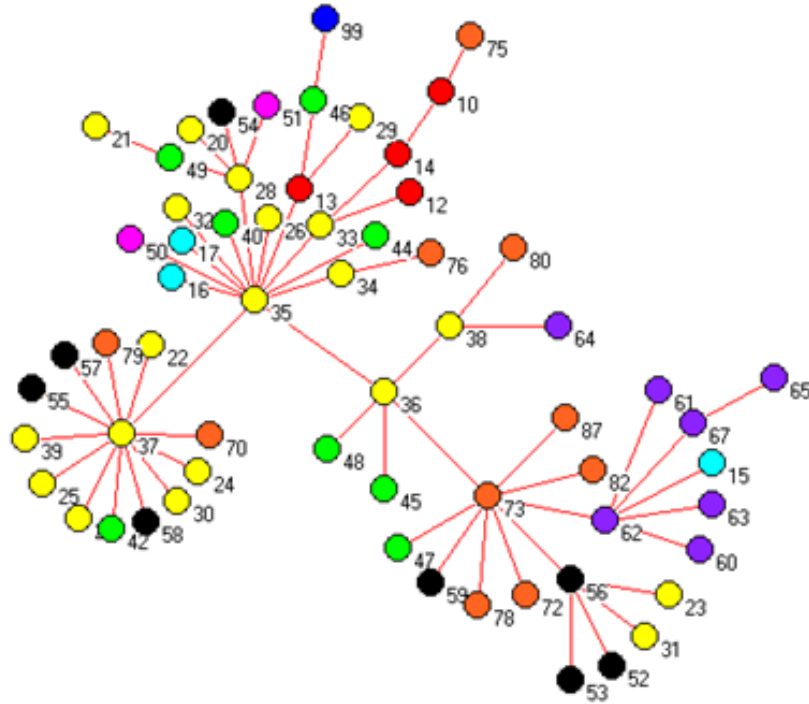
The most important SICs:

(i)   SIC 35 (Industrial and Commercial Machinery and Computer Equipment),
(ii) SIC 37 (Transportation Equipment),
(iii) SIC 36 (Electronic and other Electrical Equipment and Components except Computer Equipment), and
(iv) SIC 28 (Chemicals and Allied Products).

Results and Discussion

- **Figure 2.** Topological structure of inter and intra SICs

Results and Discussion

The closest pair of stocks between
- SIC 35 and SIC 37 are ITW (Illinois Tool Works Inc.) and HON (Honeywell International Inc.).
- SIC 35 and SIC 36 are ITW and EMR (Emerson Electric Company).
- SIC 35 and SIC 28 are DOV (Dover Corporation) and PPG (PPG Industries Inc.).

ITW, EMR, DOV and PPG are the constituents of S&P500 dividend aristocrats index in 2015.

Conclusions

- MVTS representation of economic sector.

- Economic sectors network

  - topological structure of economic sectors
  - topological structure of individual stocks within each sector
  - particular important stocks.

Future Research

- To generalize the similarity between two economic sectors : p and q stocks, respectively; each stock is represented by its OHLC prices.