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Analysis of the Behavior of the 10th Legislative Yuan by using SVD

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Abstract

With votes on n bills of m legislators, we can put the results into a mxn matrix M. Then we apply the SVD. The SVD will have decomposed the original matrix into three matrices: **a left singular vectors matrix**, **a singular values matrix** (letting singular values o decrease when become larger), and **a right singular vectors matrix**. The left singular vectors represent the contribution of each **legislator** to the overall variability of the voting records, while the right ones represent the contribution of each **bill**. And the singular values represent the amount of variability captured by each singular vector.

In this research, we take M_2 (only keep the first two singular vectors and singular values) and M_3 to make approximations to the original matrix M.

Problem description

(1) How to process the data?

With votes on n bills of m legislators, the results every legislator makes may vary. Not only "for" or "against", but they can also be absent or abstain in many ways. After obtaining the results of the votes, it is hard for us to process this kind of big data.

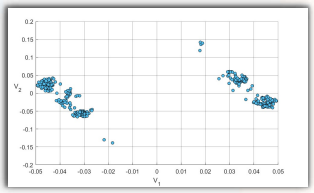
(2) What's the relation between the votes of legislators?

The seats for each political party in the 10th Legislative Yuan is as follow: DPP(54.8%), KMT(33.6%), TPP(5%), NPP(2.6%), NONE(4%).

However, the relation between these ratios and voting results is complex. Party-affiliated and non-affiliated members may reach consensus sometimes and voting results may not be entirely controlled by the party.

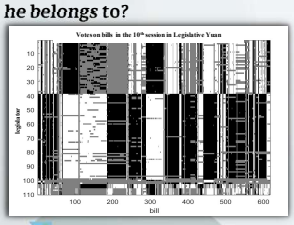
(3) Why do the chart we derive from the right singular vectors matrix [Fig. 2] separates obviously?

Since "bills" are intuitively considered as objects that are neutral, we are curious if the phenomenon can be explained.



[Fig. 2]

(4) How does a legislator do if he has got an opinion that against to the party *he belongs* to?



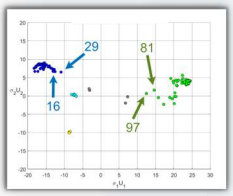
[Fig. 4]

In the Legislative Yuan, there is often a "party consensus" where political parties determine their stance. Legislators may be required to follow this consensus, but it is not difficult for us to find out from the data that not every member in the same party always cast the same vote. [Fig. 4]

Results and discussion

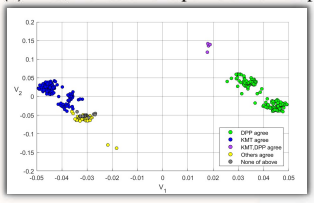
(1) We found out that to classify the results into **1**(for), **-1**(against) and **0**(others) is a perfect way. It is easy for us to tell that there are some similar rows which mean that these legislators may probably be in the same political party, further, we can calculate the products of two rows vectors to find out the relation between any two of the legislators.

(2) Not surprisingly, the voting behavior between members in different parties, especially the DPP and the KMT, separate far away in the chart (Fig.1), which means that they usually stand on different sides. Also, some points (legislators with random label 19, 29, 81, 97...etc.) appear to break away from the party he belongs to. Additionally, we can tell that the points represent the KMT gather closer than the DPP.



[Fig. 1]

(3) First, we color the points with respect to which party vote " for " the most [Fig. 3]. We found out that it is true that a party will vote "for" for bills that has same characteristic, but interestingly, if we put them into 3D, both the two parties separate into two groups respectively. We will give a possible explanation to this phenomenon, that is there might be some inner group in parties.



[Fig. 3]

(4) No matter in which party, it is not always possible for each member to vote in the same way, each legislator will still have their own ideas. From our research results, we can see that when legislators have different stances about bills from their own party, the KMT legislators will choose to vote against the party directly (expressing their own ideas clearly) ; while the DPP legislator choose to abstain or be absent to avoid casting the vote with same opinions from the party.

Conclusions

The insights gained from this analysis of voting records may have practical implications for understanding the dynamics of legislative decision-making. For example, we can identify **groups of legislators who tend to vote together** or certain bills that tend to be supported or opposed by specific subsets of the legislators. This information could be used to inform policy-making or to **help analysis the outcomes of future votes**.

One potential application of this is in the analysis of voting records in local government bodies, such as city councils or school boards. By applying SVD to these datasets, we can identify patterns and relationships that may be specific to local political contexts and use the results to inform policy decisions and improve the effectiveness of local governance.

Reference

[1] Lawrence E. Spence , Arnold J. Insel , Stephen H. Friedberg, Pearson New International Edition, Elementary Linear Algebra: A Matrix Approach, Second Edition