



Passenger volume investigation of Taipei MRT by Google PageRank.

Shao-Chun Hung (洪紹鈞), Yi-Ting Tsao (曹怡婷), Chih-Ping Chang(張芷蘋)

Department of Mathematics, National Taiwan Normal University, Taiwan (shaojun5861@gmail.com)

Advisor: Prof. Shih-Feng Hsieh (謝世峰)

Abstract:

First-time visitors to Taipei often face difficulties in planning their itineraries. Therefore, we want to find out the popularity of different stations during various time periods. To achieve this, we developed a recommendation system for Taipei MRT stations, utilizing publicly available data from Taipei MRT and the government. Applying the principles of Markov chains and the scoring mechanism of Google PageRank to develop a novel Taipei MRT Station Attraction Recommendation System. We hope that this system will help Taipei visitors easily decide on their travel destinations.

Problem Description:

We used [chart 1- \(i\)](#) to analyze the popularity of each station, but the data was too large and detailed to sort out like [Table 1](#). The table with a large amount of data would be segmented into smaller tables with a reduced data volume ([chart 1- \(ii\)](#)). Then, we transformed the data unit from an hour to a day, and put the daily data into the matrix ([chart 1- \(iii\)](#)) with headers are the names of the MRT stations. If there was any “0” row, it would result in getting the properly PageRank difficultly. Therefore, we used [chart 1- \(iv\)](#) to solve the problem in the matrix. Then, we got the Markov matrix ([chart 1- \(v\)](#)) through the operation of MATLAB. This became the direction for us to create a recommendation system. Finally, we utilized the “eig()” command to identify an eigenvector, which represents the PageRank we are seeking for, corresponding to eigenvalue “1”.([chart 1- \(vi\)](#))

Date	Time	Outset	terminal	Passenger Volume
2021/12/31	00:00	G07 (公館)	G02 (新店區公所)	41
2021/12/31	00:00	G07 (公館)	G03 (七張)	36
2021/12/31	00:00	G07 (公館)	G04 (大坪林)	55
2021/12/31	00:00	G07 (公館)	G05 (景美)	48
2021/12/31	00:00	G07 (公館)	G06 (萬隆)	37
2021/12/31	00:00	G07 (公館)	G07 (公館)	14
2021/12/31	00:00	G07 (公館)	G08 (台電大樓)	18
2021/12/31	00:00	G07 (公館)	G09 (古亭)	29
2021/12/31	00:00	G07 (公館)	G10 (中正紀念堂)	4
2021/12/31	00:00	G07 (公館)	G11 (小南門)	11

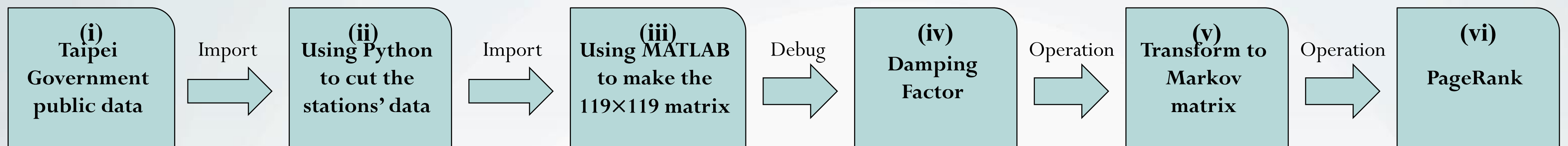
Table 1. The partial passenger volume of **green line** on December.

Chart 1. Taipei MRT PageRank calculate process.

Results and Discussion:

	17:00 ~ 00:00	All Day
BL09 (江子翠)	0.0220	0.0097
BL10 (龍山寺)	0.0350	0.0092
BL11 (西門)	0.0372	0.0081
BL13 (善導寺)	0.0264	0.0076
BL14 (忠孝新生)	0.0250	0.0075
BL16 (忠孝敦化)	0.0221	0.0068
BL17 (國父紀念館)	0.0222	0.0066
BL18 (市政府)	0.0302	0.0063

Table 2. The partial PageRank of **blue line** on December 31, 2021.

- Compare two different periods on 12/31. Take **Blue Line** for example.

Results :

- We found that the station most people went to wasn't BL10 ~ BL18.
- When the time is narrowed down to 17:00-00:00 (BL09 ~ BL18), PageRank increases significantly.
- Although everyone will go to Taipei 101 (BL18) on New Year's Eve, the PageRank of BL18 is not the highest of all day.

- Application

Outset	R10 (台北車站)	G07 (公館)	G12 (西門)
Terminal (most popular)	BL03 (土城)	G02 (新店區公所)	G03 (七張)
Outset	BL07 (板橋)	R03 (台北101)	R28 (淡水)
Terminal (most popular)	O10 (中山國小)	G02 (新店區公所)	R08 (中正紀念堂)

Table 4. The highest ratio of specific station during the Qingming long weekend.

- The recommendation system will suggest the stations with the highest PageRank to those tourists who lack travel planning.
- The recommendation is to proceed to the next station with the highest exit rate from the current station.(Table 4.)
- We can use Figure 1 to recommend people some good viewpoints.

	Lunar New Year	Weekday
G02 (新店區公所)	0.0131	0.0142
G03 (七張)	0.0145	0.0149
G06 (萬隆)	0.0132	0.0123
G07 (公館)	0.0129	0.0113
G08 (台電大樓)	0.0128	0.0113
G09 (古亭)	0.0129	0.0115
G10 (中正紀念堂)	0.0130	0.0114
G11 (小南門)	0.0137	0.0127

Table 3. The partial PageRank of **green line** on Lunar New Year and weekday.

- Compare Lunar New Year and weekday. Take **Green Line** for example.

Results :

- Many office workers choose to live near G02 ~ G03 due to the lower rent and convenient transportation.
- There are more people at G03 ~ G10 during the Lunar New Year is because of tourists from other cities and counties who come to eat, shop, and enjoy performances.

Taipei MRT Recommendation System
Which station is your outset?
Tapei Station.(R10)
The most people would like to go next is ...
Tucheng Station.(BL03)

Figure 1. Imitate Taipei Recommend System's user interface

Conclusion:

- Recommend popular attractions in Taipei for specific holidays.
- Program a route for those who travel to Taipei for the first time.
- People who live in Taipei could avoid rush hour.

Promotion:

- Analyze the entire airport flow of people.
- Create an application to let people have some good choice.

Reference:

- <https://yuanyu.idv.tw/2007/06/22/google-pagerank>
- <https://m.xuite.net/blog/coke750101/coketech/20152583> (Google PageRank)
- <https://data.gov.tw/dataset/128506>
- <https://www.metro.taipei/cp.aspx?n=FF31501BEBDD0136>
- Elementary Linear Algebra- A Matrix Approach (Lawrence Spence, Arnold Insel etc.)

