Analysis of Operating Patterns of the Public Bicycle Sharing System in the Twin Cities, Minnesota

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Introduction

- Various advantages of being flexible, cost-effective and environmental
- Imbalance in the distribution of bicycles has still been observed as a common issue
- Necessary to learn the operating patterns of PBS system
Data collection

- Become regularly operational on June 10, 2010
- Approximately 3,500 bicycles distributed over more than 200 stations
Data collection

- **Trip Information**
  From 4th April to 6th November in 2016
  432,275 trips throughout this year

- **Geographical Data**
  202 stations in the PBS system at the end of 2016

A final total of 429,291 trips’ information from 202 stations remained, accounting for approximately 99.31% of the original dataset.
Global Patterns

- Daily patterns occur periodically
- Three using peaks on weekdays
- Only one using peak on weekends
Global Patterns

- Median of the duration of the trips is 12 minutes, and the mode is 5 minutes.
- The duration of 84% trips is less than 30 minutes.
Spatial-Temporal Patterns

- The difference of the numbers between the flow-in trips and the flow-out trips of the stations
  \[ N_i = N_{i,in} - N_{i,out} \]

- Kernel density analysis
- Show the state of aggregation of the stations which share similar characteristics, specifically, similar difference of trips’ numbers
Spatial-Temporal Patterns

- **WEEKDAY 7:00-9:00**
- **WEEKDAY 11:00-13:00**
- **WEEKDAY 16:00-18:00**
- **WEEKEND 12:00-14:00**
Community Analysis

- The system itself will be converted to an oriented network: stations are nodes and trips are weighted edges.
- Communities of stations will be obtained to find the spatial aggregation of the system at a given time scale.
- A simple and fast algorithm called the Louvain algorithm.

Community Analysis

Community distribution of the stations during the observed period
Community Analysis

Community and trips distribution: WEEKDAY 7:00-9:00
Community Analysis

Community and trips distribution: WEEKDAY 11:00-13:00
Community Analysis

Community and trips distribution: WEEKDAY 16:00-18:00
Community Analysis

Community and trips distribution: WEEKEND 12:00-14:00
Conclusion

- Three usage peaks of the PBS system occur in the morning, noon and afternoon on weekdays.
- People use public bicycles mostly for short-time trips.
- Typical spatial temporal patterns.
- Community analysis show that the PBS system can be divided into several groups depending on the time scale and period. The communities are corresponding to the geographical partitioning of the studied area.
Thank you!

Questions?

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