

ANALYZING THE SPATIAL HETEROGENEITY OF TIME SERIES CHARACTERISTICS IN MOBILE PHONE DATA

Kuan-Ying Hsu¹, Bo-Cheng Lin*²

¹ Graduate Student, Department of Real Estate and Built Environment, National Taipei University

² Assistant Professor, Department of Real Estate and Built Environment, National Taipei University

Population movement data can be collected efficiently by mobile phone data. Mobile phone data are always aggregated into a spatiotemporal unit for personal privacy protection. The spatiotemporally aggregated mobile phone data implies population flow patterns and regularities. For instance, areas with active business trade often attract crowds during evenings and holidays. Moreover, different age groups exhibit distinct visitation patterns to various facilities. Understanding the needs of different age groups is crucial in urban facility planning to enhance functionality and improve quality of life. The study aims to extract time-series features of different age groups as human flow characteristics and explore the spatiotemporal clustering characteristics of mobile users in Taipei City. The study aims to represent the inherent patterns of human flow aggregation hidden in the data by extracting time-series features. Eight features are extracted, such as the time intervals during a day when human flow aggregations occur, the duration of aggregations, the intensity of gatherings, etc. Understanding the differences in these features among different age groups can provide insights into population movement patterns across various demographics.

Time series decomposition separates time series into trend, seasonal, and residual, which is applied to eliminate random fluctuations and obtain periodic time series suitable for further analysis. In this study, time series data is derived from aggregated person count changes, representing variations in the number of mobile users within each geographical grid unit during a day. A Python package named tsfresh is used for time series data analysis, efficiently extracting nearly 800 high-quality features. Each time series feature is extracted for different age groups, representing phenomena related to human flow. To explore the relationship between land use categories and the time-series features of population flow, spatial autocorrelation is used for advanced analysis. This research contributes to urban planning and resource allocation, enhancing the quality of urban life for different age groups. By understanding the spatiotemporal patterns of human flow aggregation and the influence of regional factors, decision-makers can make informed decisions in facility planning and urban development.

Keywords: Mobile phone data, Human dynamic, Spatial Autocorrelation, Time-series feature