Harnessing Mobile Geo location: Uncovering Consumer Visitation Patterns and Insights

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Background and Motivation

The emergence of mobile device GPS has revolutionized spatial analysis, providing copious data to examine human movement and behaviours across locales. Studying this location-based data can benefit diverse sectors, from retail and marketing to logistics and urban planning, by uncovering visitation patterns to inform enhanced operations, tailored strategies, and infrastructure improvements. With proper methodologies and ethics, mobile device GPS data offers an important tool to incorporate data-driven innovations that enrich societal experiences.

Data and Methods

The research utilized a robust methodology to analyse a large dataset of over 3.8 million mobile device GPS data points from Grantham, UK. Exploratory data analysis using descriptive statistics and visualizations established an initial scrutiny into the data and revealed patterns relevant for further study.

Following this, movement analysis techniques included heatmaps to visualize activity peaks, time series plots to draw insights about the daily mobility rhythms, clustering algorithms like K-Means and DBSCAN to discern areas of concentrated activity, and trajectory modelling to uncover frequent mobility paths. Predictive modelling was done using LSTM networks to forecast locations. Folium mapping provided additional insights on user movements and assisted in anticipating their future activities.

Key Findings

The exploratory analysis revealed Group I had the highest visit frequency while Group A had the highest income levels, indicating potential mobility and spending power differences. Analysis of daily and monthly rhythms aligned with routine activities.

Movement analysis using heatmaps exposed consistent activity peaks for Groups H and I during weekday mornings and evenings, revealing commute patterns. Time series plots highlighted pronounced morning and evening mobility spikes. Location and time-based clustering revealed areas and periods of concentrated activity, uncovering community hubs. Trajectory analysis (Figure 1) highlighted frequently traversed paths, unveiling ingrained mobility habits. Clustering uncovered distinct spatial behaviours within demographic segments.

Folium mapping (Figure 2) provided granular spatial visualization of activity hotspots and individual movement trajectories. LSTM modelling captured inherent mobility dynamics but distance-based time series analysis using ARIMA faced challenges with geographic coordinates.

The integration of diverse analytical techniques provided a detailed examination of human mobility intricacies tied to location, time, income, demographics, and preferences. The research demonstrated the remarkable potential of ethical and considered GPS data mining to generate nuanced insights to inform policies, spaces, and systems that align with on-ground mobility needs and trends.

Value of the research

By harnessing the immense richness of GPS data through considered analysis, this research strongly demonstrates how technology and statistical methods can promote a deeper understanding of human spaces to drive progress. It highlights the remarkable potential of geo spatial data to enhance innovation and social good through ethical, balanced utilization focused on human needs. The analytical framework and findings meaningfully contribute to realizing this potential while advancing knowledge, moving us towards more responsive and enlightened communities. As emerging data sources and computing capabilities continue to expand, this research crucially charts an exciting path where technology, statistical models, and human needs intersect to shape an enhanced collective future.

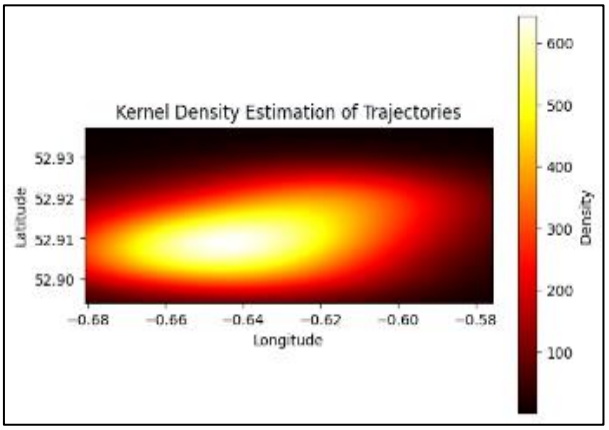

Figure 1: Kernel Density Estimation of Trajectories

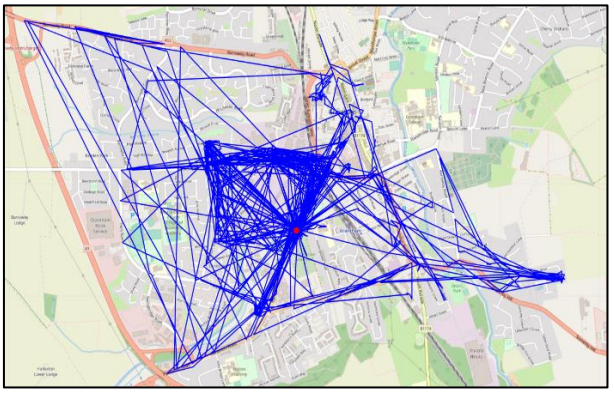

Figure 2: Folium Map: Trajectory for a single User ID