ShelterSight: Optimising Homeless Shelter Operations in Toronto

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Background

Homelessness presents a significant challenge in Toronto, affecting around 9,000 individuals on any given night. Each year, homelessness imposes a $7B cost on Canadian society, representing the immense human, social and economic challenges that stem from not having a place to call home. In response to this crisis, the Canadian government is investing $2.2B over 10 years to improve shelters and services for the homeless. This substantial investment highlights the need for strategic, data-driven approaches to ensure this funding is used effectively.

Objective

This project aimed to develop a machine learning model capable of predicting shelter demands in response to the dynamic and fluctuating needs of the homeless population in Toronto. This model will be used to improve operational efficiency, ensuring that shelters can respond to changes in demand and reduce the number of people on the streets each night.

Approach and Methodology

Datasets: Used various datasets, including the Daily Shelter & Overnight Service Occupancy, Government of Canada Historical Climate Data, New Housing Price Index, and others.
Model Development: Utilized a two-step LSTM (Long Short-Term Memory) modeling approach which included:

- **Clustering and Geospatial Analysis:** Applied clustering algorithms to categorize shelters based on location and feature similarity, enhancing model accuracy by tailoring predictions to specific groups.
- **Initial Demand Forecasting:** Employed an LSTM model to predict the base-level shelter demands, incorporating the location-based clustering.
- **Forecast Adjustment:** Adjusted forecasts based on additional data features and correlation analysis, addressing unique shelter traits and trends.

Key Findings and Results

The Adjusted Geospatial Multivariate LSTM model significantly outperformed baseline models (Random Forest, Autoregressive, and Prophet models) in predicting shelter demands. The novel model achieved a lower mean squared error (MSE) and mean absolute error (MAE).

Future Work

- **Community Impact Analysis:** To evaluate the model's effectiveness on reducing homelessness
- **Geographic Expansion:** To adapt and scale the model for use in other urban areas
- **Real-Time Analysis:** To dynamically update predictions based on live data

Conclusion

This research has yielded a robust tool, the Adjusted Geospatial Multivariate LSTM, that promises to improve how Toronto manages shelter demands. Its adoption by shelter managers and policymakers could be a crucial step toward resolving urban homelessness.