Shelter Occupancy & Capacity as a Public Service System

Students in Data Science and Statistics

Introduction

Toronto's shelter and overnight service system is a critical public service that supports thousands of people each night. These services operate under complex and dynamic conditions: fluctuating demand, capacity constraints, seasonal pressures, and differing service models across programs and populations. When occupancy approaches capacity, the system becomes less resilient to shocks and more difficult to manage operationally.

Administrative data collected through the City's shelter management systems offers an opportunity to better understand how operational pressure evolves over time, where bottlenecks occur, and how capacity is utilized across programs and locations. By analyzing this data, data scientists can help inform evidence-based strategies to improve planning, responsiveness, and system stability.

Challenge

This case is intentionally designed to focus on Toronto's homelessness support through analysis of daily operational data from Toronto's shelter and overnight services system in 2024 and 2025. Your task is to assess system pressure, capacity utilization, and operational risk across programs over time, and to propose data-driven recommendations to improve how the system is managed.

Participants are encouraged to think of this dataset as a panel of programs observed daily, and to design analyses that reflect real-world operational decision-making. The goal is to understand where the system is most strained, how pressure differs across populations served, and what operational insights can be drawn from these patterns.

Possible analytical directions include, but are not limited to:

- Identifying service sectors that consistently operate near or at full capacity.
- Comparing average occupancy levels to peak occupancy events to assess system resilience.
- Assessing the extent to which temporary capacity losses (e.g., unavailable beds or rooms) contribute to system strain.
- Simulating operational scenarios, such as modest increases in demand or capacity, to explore how close the system is to critical thresholds.
- Temporal patterns: Examine daily and seasonal trends in occupancy and capacity utilization.
- Measure variability in occupancy and capacity availability to detect programs that are more operationally fragile.

Teams should translate their findings into clear, data-driven recommendations for improving operational planning, capacity buffering, or service coordination within the shelter system.

Usage

The City of Toronto can use insights from this analysis to inform short-term operational planning and longer-term capacity management decisions. Understanding where and when shelter services experience the greatest strain can help planners prioritize investments, anticipate risk during peak demand periods, and design a more resilient service system.

More broadly, this project demonstrates how administrative data can be used to support evidence-based decision-making in public services, highlighting the role of data science in improving the reliability and effectiveness of essential social infrastructure.

Deliverables

- **Code Submission:** All scripts or notebooks. Must be well-organized, executable, and reproducible. Include a README.md file and a fully executed Jupyter Notebook (.ipynb) or RMarkdown file (.rmd)
- **Presentation Slides (maximum 15 slides):** Focus on problem framing, data insights, model approach, key results, and impact.

- **Video Presentation** (**maximum 6 minutes**): A narrated walkthrough of presentation slides and/or an optional demo or dashboard. Judges will view this first. Should simulate a live presentation and. All team members are encouraged (but not required) to participate. Must include:
    - Problem overview
    - Data approach
    - Model explanation
    - Key results
    - Final insights

Submissions may include other materials that support reproducibility.

Award Categories

- **Best Overall Project**

- **Best Visualizations:** Awarded to the team that produces the most clear and informative visualizations of shelter occupancy and capacity data, making system pressure and operational dynamics easy to understand for non-technical audiences.

- **Best Insights:** Awarded to the team that uncovers the most meaningful and actionable insights about how Toronto's shelter system is operating and where improvements could enhance resilience and service availability.

- **Best Model:** Awarded to the team that develops the most rigorous and interpretable analytical model, such as a capacity-pressure index or scenario-based simulation, that supports real-world operational decision-making.