Capacity and Utilization analysis of Toronto shelter(2024)*

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This paper analyzes 2024 data on shelter occupancy and capacity in Toronto to assess the city's ability to meet the needs of its homeless population. The findings reveal that most shelters operate at or near full capacity, with some reaching 100% occupancy. This highlights a growing demand for emergency shelter services and raises concerns about the city's capacity to support vulnerable groups. Understanding these trends is critical for developing policies that can better address homelessness and improve the allocation of social services in urban settings.

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*A GitHub Repository containing all data, R code, and other files used in this investigation is located here: https://github.com/eason1218/Toronto_Shetler.git

1 Introduction

Homelessness remains a significant social issue in many urban centers, and Toronto is no exception. The city's shelter system serves as a critical component in providing relief to its homeless population. However, the increasing demand for these services, coupled with limited capacity, has highlighted potential gaps in Toronto's ability to address this growing crisis. A comprehensive understanding of shelter utilization is essential to inform policies that can better support vulnerable populations.

This paper analyzes Toronto's 2024 shelter occupancy and capacity data, focusing on the relationship between bed availability and occupancy rates. The study aims to evaluate whether the current shelter infrastructure meets the needs of homeless individuals and families in the city. The investigation identifies occupancy relative to the date, place, and size of the shelter. Despite the critical role shelters play, there remains a clear gap in understanding how different factors affect shelter capacity and utilization. This study seeks to fill that gap by providing a detailed data analysis and identifying potential areas for improvement in Toronto's shelter system.

The findings show that most shelters operate near or at full capacity, underscoring the urgent need for expanded services. These results are crucial for informing future social policies aimed at mitigating homelessness, particularly in rapidly growing urban environments like Toronto.

Concerning the structure of this paper, Section 2 includes an overview and visualization of the data; Section 3 includes a discussion of the results; and Section A includes supplementary information.

2 Data

2.1 Overview

The dataset used in this analysis is from The "Daily Shelter & Overnight Service Usage" page, this website offers daily data on the occupancy and capacity of Toronto's shelter system, including how many shelter beds are being used and the total available capacity, updated every day except on weekends and holidays. The variables or measurements included in this analysis are "Bed Based Capacity", which refers to Occupancy is measured by the number of beds, typically for programs with shared sleeping areas; "Room Based Capacity" to occupancy is

measured by the number of rooms, usually for family programs or hotel-based programs where rooms are not shared between households.

Another dataset called "toronto-shelter-system-flow" also includes data about Toronto shelters. Still, it is more focused on the characteristics of people living in shelters, not the macro data so I did not choose it.

The project is structure base on Rohan's principes (Wickham et al. 2019a), and used the **R** programming language (R Core Team 2023), the `tidyverse` (Wickham et al. 2019b) package were used to simulate the dataset and generate tests for it. The `opendatatoronto` (Gelfand 2022) and `tidyverse` (Wickham et al. 2019b) packages were then applied in order to download the raw Toronto Public shelter dataset. Next, the `tidyverse` package (Wickham et al. 2019b) was used to clean the raw dataset and test the cleaned dataset. The `knitr` packages help illustrate the sample data (Xie 2024)

2.2 Measurement

It focuses on capturing daily occupancy, vacancy, and capacity data through a system snapshot taken at 4 a.m. each day. This approach ensures consistent, up-to-date information on the availability and usage of shelter services.

Table 1: Table: Sample of cleaned occupancy data

Occupancy Date	Occupancy Rate (Beds)	Occupancy Rate (Rooms)	Location Name	Actual Bed Capacity	Sector
2024-01-01	NA	100	COSTI Hotel Program Dixon	NA	Families
2024-01-01	NA	100	COSTI Hotel Program Dixon	NA	Mixed Adult
2024-01-01	100	NA	COSTI Reception Centre	8	Mixed Adult
2024-01-01	NA	100	COSTI Uptown Hotel Program	NA	Families
2024-01-01	NA	100	COSTI Uptown Hotel Program	NA	Families

Table 1 show a sample of cleaned occupancy data, Since the statistical record formats of different shelters are different, each row contains different information marked as NA, but this does not negatively affect the analysis.

2.3 analysis

After loading the dataset using the R programming language (R Core Team 2023) and the `here` package (Müller 2020), the `tidyverse` (Wickham et al. 2019b) package was used to generate graphs. In doing so, R code was adapted from (Alexander 2023).
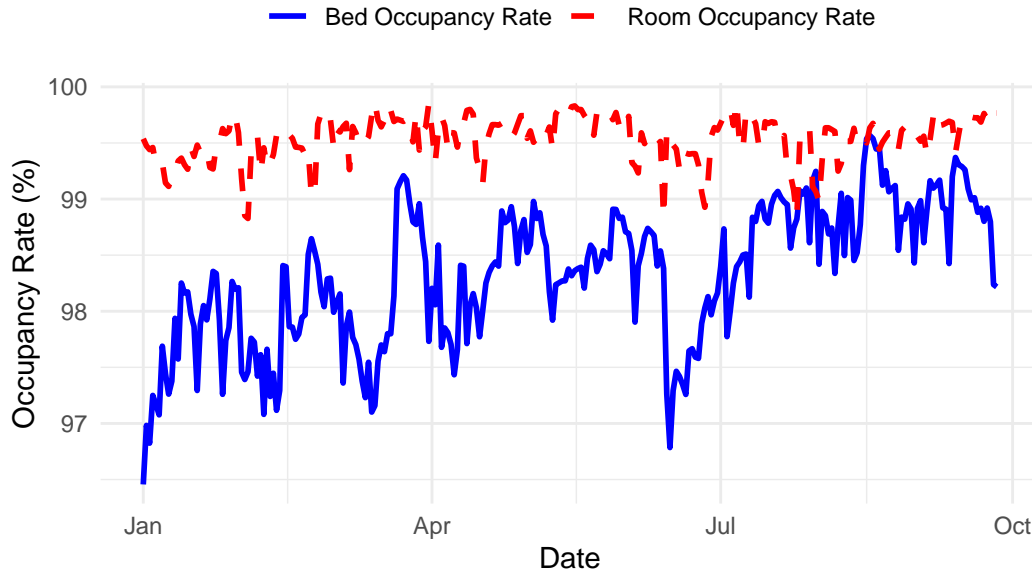

Figure 1: Bed and Room Occupancy Rates in Shelters Over Time

Figure 1 shows the occupancy rates for beds and rooms in the shelter system over time. The blue line represents the bed occupancy rate, while the red line represents the room occupancy rate. Overall, the room occupancy rate (red) is higher and more stable, staying close to 100%. In contrast, the bed occupancy rate (blue) shows more fluctuations, generally between 98% and 99%.
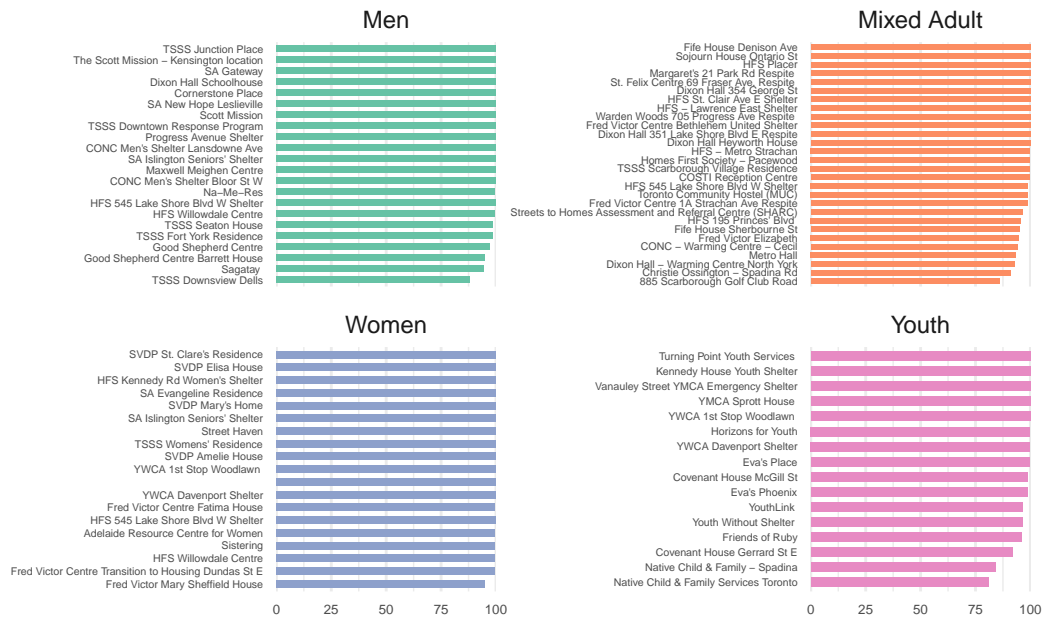
Figure 2: Scatter Plot of Bed Capacity vs. Occupancy Rate

Figure 2 displays the average occupancy rate across various shelters, categorized by sector: Men, Women, Mixed Adults, and Youth. The X-axis represents the occupancy rate percentage (Occupancy Rate %), ranging from 0% to 100%, while the Y-axis lists the shelter locations (Location), showing the names of several shelters. Each horizontal blue bar corresponds to the average occupancy rate of a specific shelter. Most shelters have an occupancy rate close to 100%, indicating that their beds are almost fully or completely occupied. A few shelters have occupancy rates below 75%, showing that they have relatively lower bed utilization.
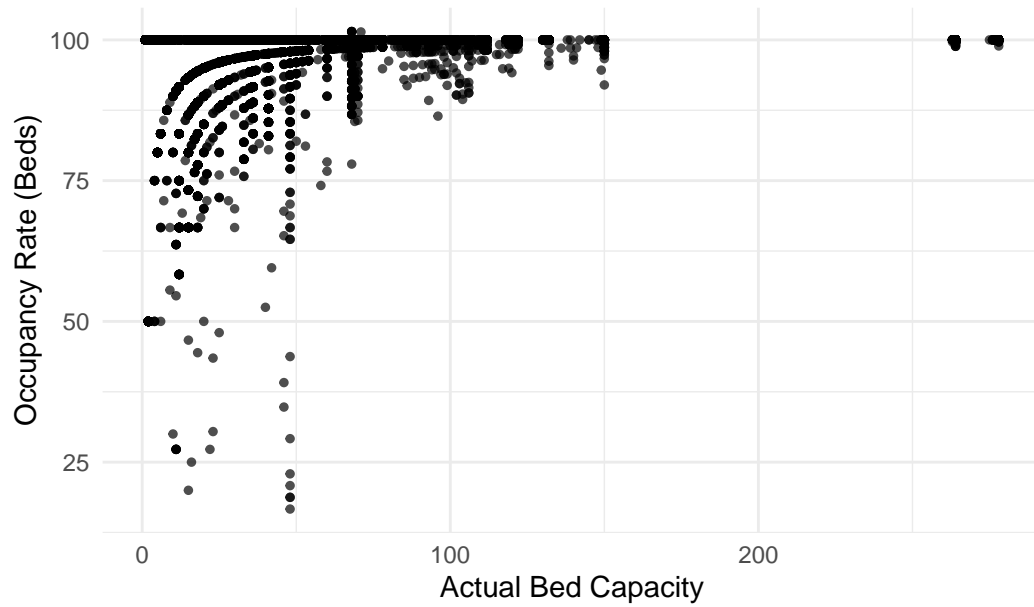
Figure 3: Scatter Plot of Bed Capacity vs. Occupancy Rate

Figure 3 shows the relationship between bed capacity and occupancy rate across shelters. The X-axis represents bed capacity, and the Y-axis represents occupancy rate (%). Most shelters have an occupancy rate close to 100%, with bed capacities mainly below 100, indicating that many shelters are near full capacity. In some cases, shelters even exceed their available beds.

3 Discussion

3.1 First discussion point

The data in Figure 1 highlights the consistently high demand for shelter services in Toronto. The stable room occupancy rate near 100% suggests that rooms, typically reserved for families or those requiring more privacy, are in greater demand. This is likely due to the more permanent or semi-permanent sheltering needs of these groups. The high demand for such spaces underscores the need for expanded resources that cater to families and vulnerable individuals who prioritize long-term stability.

On the other hand, the fluctuations in bed occupancy rates imply a more dynamic use of shelter services. Beds, often allocated in shared living spaces, are likely occupied by individuals facing short-term or emergency shelter needs. Factors such as weather conditions (e.g., colder months driving up demand), economic changes, or local crises could be contributing to this variability. This fluctuation in bed occupancy indicates that the shelter system must remain flexible to accommodate rapid changes in demand.

From a policy perspective, the findings call for a dual approach to addressing homelessness. On one hand, the stability in room occupancy suggests the need for more permanent housing solutions, especially for families. On the other hand, the fluctuating bed occupancy points to the importance of scalable, emergency response systems that can expand in times of crisis, ensuring that shelters are adequately prepared for demand surges.

3.2 Second discussion point

Figure 2 reveals that across all sectors—Men, Women, Mixed Adults, and Youth. Both show a sobering picture of Toronto's shelter system, with most facilities operating at or near full capacity—this level of demand points to a systemic issue that extends beyond shelter availability to broader socioeconomic challenges. The high occupancy rates reflect not just a lack of shelters but also underline key drivers of homelessness, such as inadequate affordable housing, mental health challenges, unemployment, and other economic pressures.

The shelters operating below 75% capacity may indicate inefficiencies in resource allocation or barriers to accessibility. These disparities raise critical questions: Are some shelters harder to access due to location or transportation issues? Are the services provided in certain shelters of lower quality, causing individuals to avoid them? These issues suggest that future interventions should not only focus on increasing shelter capacity but also on improving the quality and accessibility of services across all shelters to ensure a more equitable distribution of resources.

3.3 Third discussion point

Figure 3 reveals that larger shelters—those with capacities of over 100 beds—tend to operate at higher efficiency, maintaining near 100% occupancy. This observation suggests the presence of economies of scale in shelter management, where larger shelters are able to provide more comprehensive services and cater to a broader range of needs. These shelters likely benefit from centralized resources, better staffing, and more organized operations, which improve their ability to serve more individuals effectively.

However, this observation also raises concerns about the experience of those residing in large shelters. While efficiency is important, overcrowded conditions can negatively impact the quality of life for shelter residents. Future policy should strike a balance between scaling up shelters to meet demand and ensuring that the conditions in these shelters remain humane and conducive to recovery and long-term stability. There should also be investment in smaller shelters that cater to specific groups, such as women, youth, or individuals with mental health challenges, providing them with targeted support that large, generalized shelters might not be able to offer.

3.4 Weaknesses and next steps

Weaknesses
There may be significant geographic disparities in the availability and occupancy rates of shelters across different areas of Toronto, which could lead to imbalanced resource allocation(Jadidzadeh and Kneebone 2023). Some areas with higher homeless populations may have fewer shelters, placing additional strain on these facilities and causing them to operate at full capacity or beyond. Conversely, areas with a larger number of shelters may see lower utilization rates, meaning resources may not be fully utilized in those regions. Future research should delve deeper into the geographical distribution of shelters in Toronto and assess how geographic factors influence the ability of homeless individuals to access shelter services.

Next steps
Shelter utilization is influenced not only by the availability of beds and rooms but also by the conditions of the shelters, the quality of services provided, and the specific needs and preferences of homeless individuals. By conducting interviews with shelter users and staff, it would be possible to uncover the complex reasons behind fluctuating occupancy rates(Ranasinghe and Valverde 2006). Future research should incorporate qualitative data, such as user feedback and service quality assessments, to develop more comprehensive solutions to homelessness.

A Appendix

A.1 Dataset and Graph Sketches

Sketches depicting both the desired dataset and the graphs generated in this analysis are available in the GitHub Repository.

A.2 Data Cleaning

The data cleaning process involved selecting some columns of useful: occupancy date, bed and room occupancy rates, location name, actual bed capacity, and sector. To improve clarity, the column "CAPACITY_ACTUAL_BED" is renamed to "Actual Bed Capacity".

A.3 Attribution Statement

"Contains information licensed under the Open Government Licence – Toronto" (City of Toronto 2024).

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