

Occupancy Rates of Toronto Shelters in 2021

Bonnie Yam

Introduction

A common misconception is that people choose to be homeless, but it is often out of their control. Recent economic issues of high inflation and mass layoffs consequently push more people to become homeless. More than 8,000 people are homeless in Toronto (City of Toronto, n.d.), and many of them are turned away by shelters due to the unavailability of beds or rooms. As a result, these homeless people seek shelter in public transit, fast food restaurants, or hospitals, especially for reasons to stay warm during the winter season. Motivated by raising awareness of the need for more safe shelter spaces in Toronto, I will study the dataset about the daily occupancy and capacity of Toronto shelters in 2021, reported by the Shelter, Support and Housing Administration (SSHA). This research paper aims to investigate when each shelter program is more likely to have a high occupancy rate, and whether the occupancy rate is significantly different between shelter programs.

Problem Formulation

Shelters are classified either as emergency or transitional. An emergency program can be accessed by anyone who experiences homelessness, whereas a transitional program requires a referral. Each program's capacity is either measured in beds or rooms. A bed-based program has common sleeping areas, whereas a room-based program restricts different households from sharing the same sleeping room. The dataset consists of 169 unique shelter programs, but 168 shelter programs are examined in this research because one did not specify its program model.

Before conducting quantitative analysis using statistical tests, exploratory data analysis was first performed to observe the total number of service users and the trends of occupancy rates over the months of 2021. Boxplots were created to visualize the sample variability of occupancy rates between different program shelters for each capacity type (bed vs. room). The Welch t-test was employed to determine whether the means of occupancy rates between emergency and transitional shelter programs are statistically different in each capacity type.

Exploratory Data Analysis

As shown in Figure 1, the number of homeless people using the emergency program service is noticeably higher than the transitional program for each capacity type in 2021. There were about 770,000 emergency users in a bed-based program and more than 1,200,000 emergency users in a room-based program. The number of transitional service users was at most 200,000 or less. The reason for this significant difference is most likely due to the strict requirement of having a referral to get access to the transitional shelter program.

An interesting observation is that rooms were more popular than beds for emergency programs, but it is the opposite for transitional programs. Despite this finding, the total number of users in rooms was higher than using beds. This leads to the assumption that homeless people prefer a private sleeping space without sharing it with strangers.

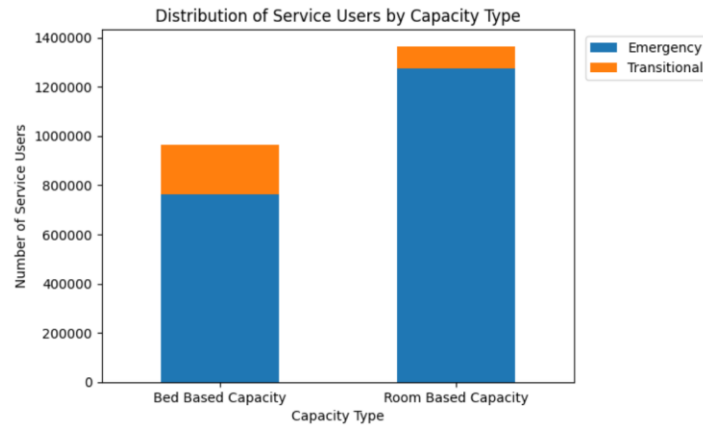


Figure 1. A stacked bar chart about the number of emergency and transitional service users in each capacity type.

There are a lot of variations in the bed occupancy rates throughout 2021 (see the line chart on the left in Figure 2). Notice that there is a drop in occupancy for both emergency and transitional programs in July. At that time, there may not be a desperate need for shelter because the environmental temperature is often warm/hot, and July is not part of the rainy season in Toronto. However, it is surprising to see another drop in mid-January, which is in winter. The emergency program's occupancy rate was around 96% during the last four months of the year, but it peaked at 98% in February and March. The transitional program's highest occupancy rate was 94%, which took place in November and near the end of December.

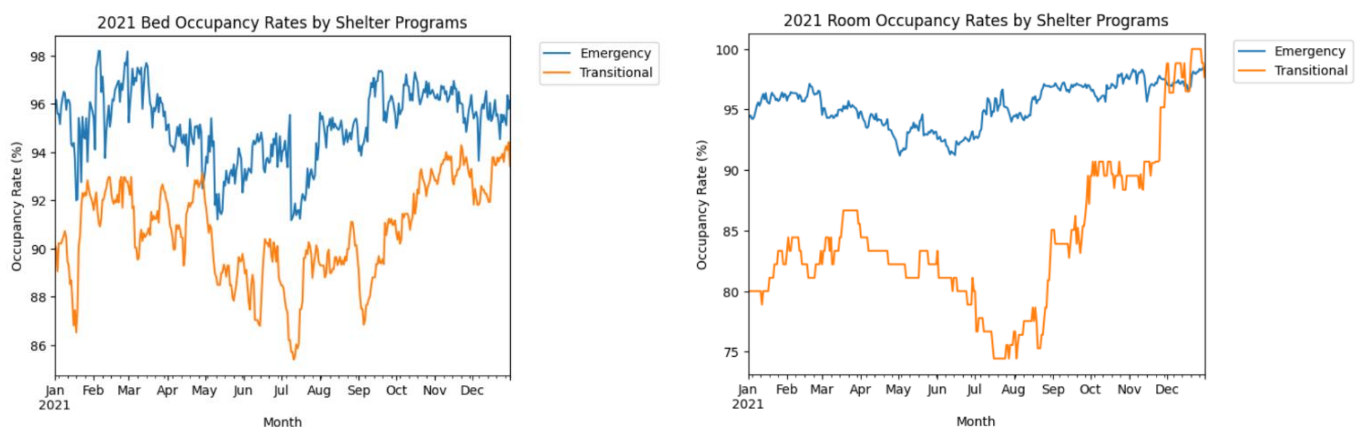


Figure 2. Line charts of emergency and transitional occupancy rates throughout 2021 for each capacity type.

Unlike the bed-based programs, the emergency program occupancy rate was mostly steady around 95% throughout the year (see the line chart on the right in Figure 2). The occupancy rate of the transitional program varies between 80% and 87% for the first three months, but then gradually decreased till August. Then it sharply increased and surpassed the emergency program occupancy rate in November and December.

In both line charts, the transitional program occupancy rate is mainly lower than the emergency program occupancy rate, except for the last two months of the year for room-based capacity. This is supported by the findings in Figure 1 that the number of emergency service users was much greater than transitional service users. Although there was a decline in bed-based emergency, bed-based transitional, and room-based transitional program occupancy rates in summer, the occupancy rate remained high. The lowest occupancy rate for bed-based and room-based programs was about 85% and 74% respectively. Thus, there may not be a clear relationship between the month of the year and the occupancy rate at Toronto shelters. Regardless of the season, homeless people hope to find a proper and comfortable place to sleep.

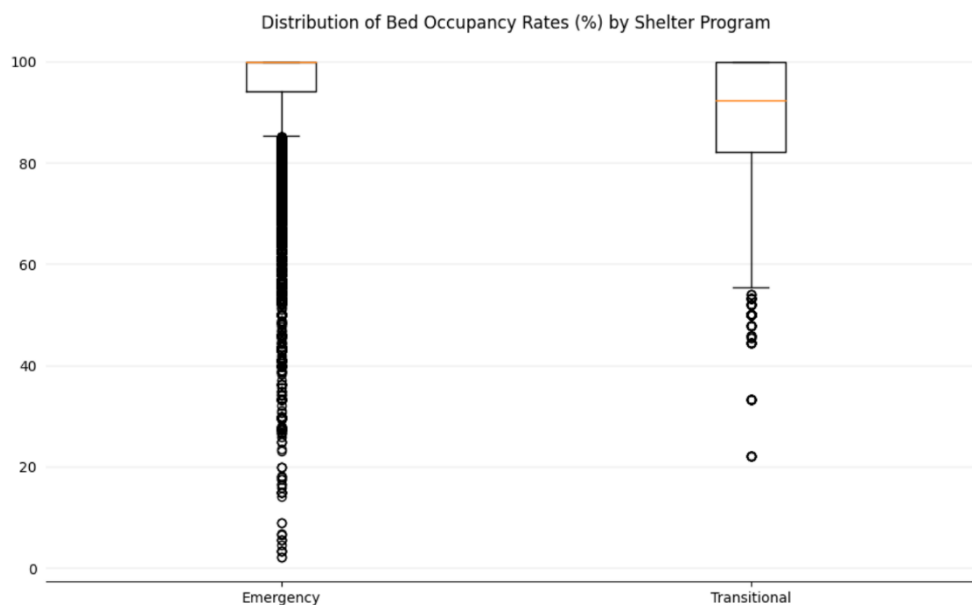


Figure 3. Boxplot of bed-based emergency and transitional occupancy rates

Bed-based Emergency Program	
<i>Min</i>	2.27%
<i>Max</i>	100%
<i>25th percentile</i>	94.12%
<i>Median</i>	100%
<i>75th percentile</i>	100%
<i>IQR</i>	5.88%

Bed-based Transitional Program	
<i>Min</i>	22.22%
<i>Max</i>	100%
<i>25th percentile</i>	82.14%
<i>Median</i>	92.31%
<i>75th percentile</i>	100%
<i>IQR</i>	17.86%

Figure 4. Summary statistics of bed-based emergency and transitional programs occupancy rates

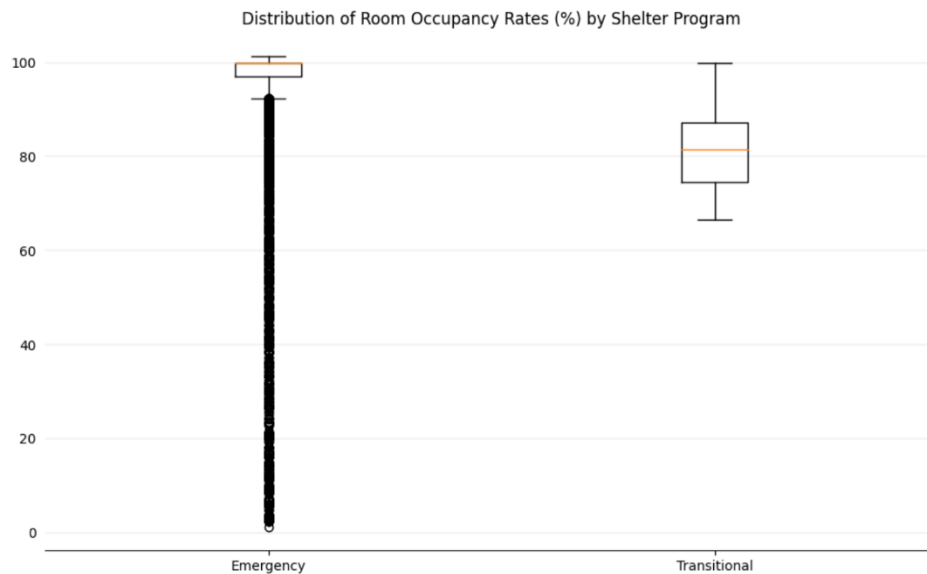


Figure 5. Boxplot of room-based emergency and transitional occupancy rates

Room-based Emergency Program	
<i>Min</i>	1.2%
<i>Max</i>	101.41%
<i>25th percentile</i>	96.97%
<i>Median</i>	100%
<i>75th percentile</i>	100%
<i>IQR</i>	3.03%

Room-based Transitional Program	
<i>Min</i>	66.67%
<i>Max</i>	100%
<i>25th percentile</i>	74.6%
<i>Median</i>	81.48%
<i>75th percentile</i>	87.3%
<i>IQR</i>	12.7%

Figure 6. Summary statistics of room-based emergency and transitional programs occupancy rates

According to the summary statistics of the occupancy rates shown in Figures 4 and 6, the bed-based emergency, bed-based transitional, and room-based transitional programs have met 100% occupancy rate. Surprisingly, the room-based emergency program's highest occupancy rate was 101.41%. There were four incidents when the number of occupied rooms was greater than their availability. This might be either a data entry error, or a rare case when the shelter offered an extra room that was not usually served for an overnight service.

Emergency programs have a long trail of outliers in their occupancy rate boxplots, as shown on the left of Figures 3 and 5. Based on these outliers, there were several occasions when more than 50% of beds or rooms were available. Both bed-based and room-based emergency programs have similar summary statistics (found on the left of Figures 4 and 6) with minor differences. They have a very small interquartile range, which is located above 94%. In addition, their median, 75th percentile, and maximum value is equivalent to 100%. Hence, emergency programs were often full. Transitional programs had relatively high occupancy rates but were not as frequent as emergency programs. As visualized on the right of Figures 3 and 5, transitional

programs have a wider interquartile range, which is located above 80% for the bed-based capacity or between 74% and 88% for the room-based capacity.

T-test Analysis

Two Welch t-tests were performed to compare the following:

1. the means of bed occupancy rates between emergency and transitional programs and
2. the means of room occupancy rates between emergency and transitional programs.

For the first t-test, the t-statistic is about 36.79 and the p-value is approximately close to 0. Similarly, for the second t-test, the t-statistic is about 31.71 and the p-value is approximately close to 0. At a significance level of $\alpha = 0.05$, there is strong evidence that the means of bed occupancy rates between emergency and transitional programs are statistically significant. Additionally, the means of room occupancy rates between emergency and transitional programs are statistically significant. This opens the possibility that emergency shelter programs are more likely to have a higher occupancy rate than transitional shelter programs, which is visualized in the graphs from the exploratory data analysis.

Although meaningful insights were drawn from the t-tests, it is crucial to note that there are extreme outliers in the boxplots shown in Figures 3 and 5, especially for the emergency programs. Unlike the mean, the median is resistant to outliers. However, t-tests compare the means between the two groups. As a result, there is a risk that the statistical analysis gets impacted by the outliers. For future work, the capping method can be executed to handle outliers before proceeding to the t-test.

Conclusion

The exploratory data analysis and Welch t-test help draw comparisons among emergency and transitional shelter programs for bed-based and room-based capacity. There is no obvious pattern of which months emergency and transitional programs reach a high occupancy. However, with support from the graphs and results of the t-test regarding the statistical difference between the means of emergency and transitional programs occupancy rates, there is a likelihood that emergency programs have a higher occupancy rate. In response to this demand, more emergency programs should be offered in Toronto to raise opportunities for accessing indoor spaces with simple accommodations for unhoused individuals.

References

City of Toronto. (n.d.). Progress on Supportive Housing. In *Housing & Homelessness Research & Reports*. Retrieved from <https://www.toronto.ca/city-government/data-research-maps/research-reports/housing-and-homelessness-research-and-reports/>

Shelter, Support and Housing Administration. (2021). *Daily Shelter & Overnight Service Occupancy & Capacity*. [Dataset]. Retrieved from <https://open.toronto.ca/dataset/daily-shelter-overnight-service-occupancy-capacity/>