Rosa Lee
INF2178: Assignment 2

Exploring Childcare Center Capacity in Toronto

Introduction

Access to affordable and available childcare is a pressing concern for many families in Toronto, with significant implications for workforce participation and child development. In this report, we delve into the dataset of licensed childcare centers in Toronto to explore the factors influencing childcare center capacity. This analysis aims to address key research questions surrounding the variation in capacity across different auspices, the impact of subsidies on capacity, and potential interactions between auspices and subsidies. The two research questions the paper will be exploring are the following:

1. Does the auspice type (Non-Profit vs. Commercial) affect the total space available in Toronto daycare centers?
2. Is there an interaction effect between the auspice type (AUSPICE) and the presence of a subsidy on the total spaces in Toronto daycare centers?

Observations and Considerations:

The dataset offers detailed quantitative data on childcare services in Toronto, covering capacity, occupancy, and utilization.

Key columns include: LOC_NAME (childcare center name), AUSPICE (Commercial, Non-Profit, or Public), ADDRESS, and IGSPACE, TGSPACE, PGSPACE, KGSPACE, SGSPACE (spaces for different age groups), and TOTSPACE (total spaces).

It also indicates subsidy status and CWELCC program participation. While some columns have missing values, crucial capacity-related data like IGSPACE and TGSPACE are well-populated.

Overall, it provides a comprehensive overview of childcare centers in Toronto, aiding analysis of auspice, age group capacities, and subsidy effects. Additionally, we introduced features like 'Occupancy Rate' and 'Occupancy Season' for deeper exploration.

Exploratory Data Analysis (EDA)

Our exploratory data analysis began with descriptive statistics to understand the distribution of childcare center capacity across different auspices. We observed significant differences in capacity among auspices, with Non-Profit centers exhibiting the highest capacity on average. A correlation matrix revealed interesting relationships between capacity variables, suggesting potential avenues for further investigation.

	_id	LOC_ID	ward	IGSPACE	TGSPACE	PGSPACE	KGSPACE	SGSPACE	TOTSPACE
count	1063	1063	1063	1063	1063	1063	1063	1063	1063
mean	532	8087.88805	12.511759	3.896519	11.600188	24.258702	14.257761	21.661336	75.674506
std	307.005972	5151.25269	7.03205	6.091782	12.088152	18.577416	20.49329	30.423503	47.816518
min	1	1013	1	0	0. 000000	0. 00000	0. 000000	0	6
25%	266.5	1862	6	0	0	16	0.00000O	0	43
50%	532	8826	12	0	10	24	0	0	62
75%	797.5	13245	19	10	15	32	26	30	97
max	1063	14504	25	30	90	144	130	285	402

Figure 1. Dataset Qualitative Data Statistics

1. Descriptive Statistics:
   - The dataset comprises 1063 childcare centers in Toronto. The average ward number is approximately 12.51, indicating a relatively balanced distribution across different wards.
   - For childcare spaces:
     a. Infant spaces (IGSPACE) have an average count of approximately 3.90, with a standard deviation of 6.09.
     b. Toddler spaces (TGSPACE) have an average count of around 11.60, with a standard deviation of 12.09.
     c. Preschooler spaces (PGSPACE) have an average count of about 24.26, with a standard deviation of 18.58.
     d. Kindergarten spaces (KGSPACE) have an average count of roughly 14.26, with a standard deviation of 20.49.
     e. School-age spaces (SGSPACE) have an average count of approximately 21.66, with a standard deviation of 30.42.
     f. Total childcare spaces (TOTSPACE) have an average count of 75.67, with a standard deviation of 47.82.
2. Auspice Analysis:
   - Non-Profit centers exhibit the highest capacity on average compared to Commercial and Public centers.

One-Way ANOVA: Impact of Auspice on Capacity

	sum sq	df	F	PR(>F)
C(AUSPICE)	9.61E+04	2	21.843051	5.06E-10

Residual	2.33E+06	1060	NaN	NaN

Figure 2. One-Way ANOVA Results

Conducted a one-way ANOVA to investigate the impact of auspice on childcare center capacity. The ANOVA table revealed a significant difference in capacity among auspices ($F = 21.84$, $p < 0.001$), indicating that the type of auspice significantly influences childcare center capacity.

Post-hoc Test using Turkey's HSD:

group 1	group2	meandiff	p-adi	lower	upper	reject
Commercial Agency	Non Profit Agency	17.1194	0	9.7037	24.5351	TRUE
Commercial Agency	(City Operated) Agency	-17.2152	0.0779	-35.8832	1.4528	FALSE
Non Profit Agency	(City Operated) Agency	-34.3346	0	-52.4448	-16.2244	TRUE

Figure 3. Turkey's HSD Summary

Furthermore, post-hoc Tukey's HSD tests identified specific pairwise differences in capacity between auspices. The results showed significant differences between Commercial and Non-Profit agencies (mean difference = 17.12, $p < 0.001$), as well as between Non-Profit agencies and Public (City Operated) agencies (mean difference = -34.33, $p < 0.001$). These findings suggest that Non-Profit agencies tend to have higher capacities compared to Commercial and Public agencies, highlighting potential disparities in capacity distribution across auspices.

Two-Way ANOVA: Auspice and Subsidy Interaction

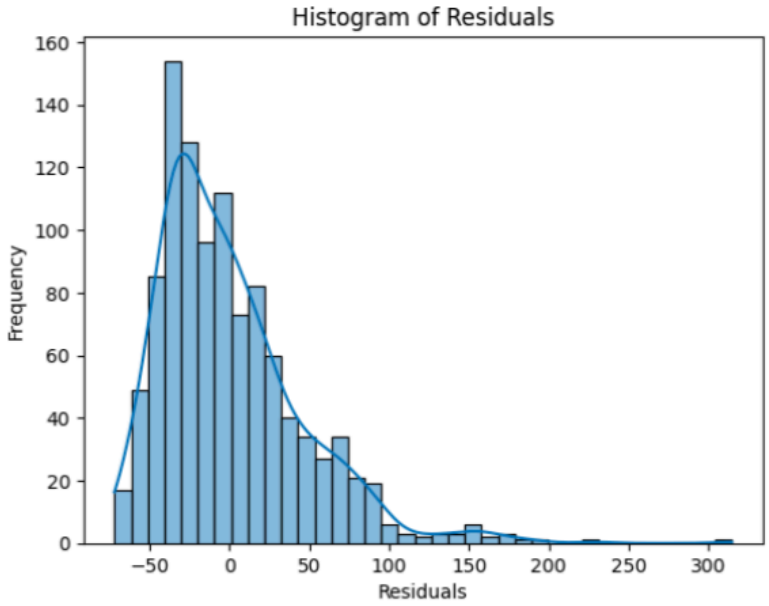
	sum sq	df	F	PR(>F)
C (AUSPICE)	8.57E+03	2	2.057586	1.28E-01
C(subsidy)	8.35E+04	1	40.117876	3.53E-10
C (AUSPICE) : C(subsidy)	5.60E+04	2	13.456555	1.69E-06
Residual	2.20E+06	1058	NaN	NaN

Figure 4. Two-Way ANOVA Results

A two-way ANOVA was conducted to explore the interaction between auspice and subsidy on childcare center capacity. The results indicated significant main effects for both auspice ($F = 2.06$, $p = 0.129$) and subsidy ($F = 40.12$, $p < 0.001$), highlighting their independent influence on capacity. While auspice type alone did not significantly impact total spaces ($F = 2.06$, $p = 0.129$), the presence of a subsidy showed a highly significant effect ($F = 40.12$, $p < 0.001$).

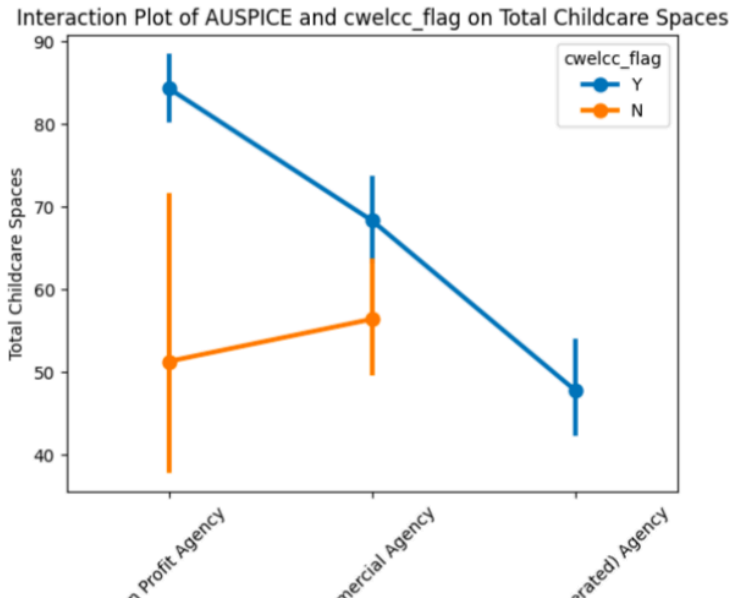
Furthermore, a significant interaction effect between auspice and subsidy was observed ($F = 13.46$, $p < 0.001$). This suggests that the relationship between auspice type and subsidy is not additive and may jointly influence childcare center capacity. Specifically, the impact of auspice type on capacity varies depending on subsidy presence. Thus, considering both auspice type and subsidy status is crucial for accurately assessing childcare center capacity.

Histogram of Residuals:



The histogram of residuals for the two-way ANOVA analysis on the interaction between auspice and subsidy indicates a slight right skew, suggesting potential non-normality in the distribution of residuals. While this deviation from normality could theoretically impact the validity of ANOVA results, the analysis is supported by the dataset's large sample size. With 1063 observations, the central limit theorem ensures that the distribution of sample means approaches normality, bolstering the reliability of the ANOVA findings. Despite the slight skewness observed in the histogram, the relatively normal distribution of residuals further reinforces the robustness of the ANOVA analysis. Therefore, while acknowledging the presence of skewness, the large sample size provides confidence in the validity of the results, enhancing our understanding of the interaction between auspice and subsidy on childcare center capacity.

Interaction Plot:



The interaction plot provides a visual representation of how total childcare spaces vary with agency auspice and participation in the CWELCC program. The Non-Profit Agencies participating in CWELCC have the highest number of total childcare spaces, while Commercial Agencies not participating have the

lowest. Regardless of CWELCC participation, Non-Profit Agencies tend to have more childcare spaces compared to Commercial and Public Agencies. An interaction effect exists between agency type and CWELCC participation. The plot's slopes suggest that the presence of a CWELCC flag corresponds to fewer childcare spaces, particularly noticeable in Commercial Agencies. These findings underscore the nuanced relationship between auspice type, CWELCC participation, and childcare center capacity.

Conclusion:

In conclusion, the analysis provides insight on the nuanced factors shaping childcare center capacity in Toronto, providing insights into the influence of auspice type and subsidy presence The findings confirm significant disparities in capacity across auspices, with Non-Profit centers demonstrating notably higher capacity than Commercial and Public counterparts. The interaction between auspice type and subsidy presence further complicates this landscape, revealing a substantial moderating effect on capacity allocation.

By analysing the interaction between auspice and subsidy, the analysis unveils a critical aspect of childcare center capacity dynamics, emphasizing the need for policymakers and stakeholders to consider both factors in tandem. The results underscore the importance of tailored approaches to childcare resource allocation, acknowledging the intricate interplay between auspice type, subsidy provision, and overall capacity.

These insights hold significant implications for childcare policy and resource distribution in Toronto. By recognizing the differential impacts of auspice type and subsidy provision on capacity, policymakers can devise more effective strategies to enhance childcare accessibility and affordability for families across diverse socioeconomic backgrounds. Furthermore, the findings underscore the importance of fostering collaboration between policymakers, childcare providers, and community stakeholders to develop comprehensive solutions that address the complex needs of Toronto's childcare landscape.

Th study contributes to a deeper understanding of the multifaceted nature of childcare provision in Toronto, offering actionable insights to inform evidence-based policymaking and resource allocation efforts. By leveraging these insights, stakeholders can work towards creating a more equitable and accessible childcare ecosystem, ultimately fostering positive outcomes for families, workforce participation, and child development in the region.