Housing Unaffordability in Toronto

Investigating the impacts of various factors on housing unaffordability

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Introduction:

Toronto, renowned for its dynamic cultural environment, now finds itself in the midst of a severe housing crisis. The city that was once an accessible area for all sorts of opportunities is grappling with escalating housing insecurities and unaffordability. This crisis, deeply entrenched in the city's socio-economic fabric, stands in stark contrast to the notion of housing as a fundamental human right. At the core of this crisis is the government's neoliberal approach, which has effectively commodified housing, transforming it into a lucrative asset for short-term rentals. Dominated by powerful real estate magnates and landlords, this market shift has profound implications. It disproportionately impacts the city's most vulnerable groups, including low-income and racialized communities, intensifying issues like homelessness and gentrification. This phenomenon underscores a troubling dichotomy where a minority prospers at the cost of the broader community, highlighting severe social and spatial inequalities. To understand the intricacies of this crisis, we embark on a comprehensive analysis using a variety of linear regression models. These models will explore the correlation between various factors such as the average Airbnb price in neighborhoods and the percentage of households needing core housing. Further, we'll delve into how these rental prices relate to households burdened with high shelter costs, unsuitable housing conditions, or those in need of major repairs. Additionally, we will examine how neighborhood crime rates influence housing affordability. Lastly, the relationship between mortgage burdens and excessive shelter costs will be examined.

Unfortunately, current economic conditions, including high interest rates, play a significant role in exacerbating this crisis by hindering housing supply generation and severely increasing the cost of mortgages. This dire situation necessitates a closer look at the need for social housing and regulatory measures. Strategies like Inclusionary Zoning, Land Value Taxation (LVT), Short-Term Rental Municipal Accommodation Tax, and Public-Private Partnerships could be pivotal in mitigating homelessness and gentrification. This crisis extends beyond economic impacts, as it is an issue that has severe effects on individuals' mental health and their sense of community belonging. The stress and uncertainty associated with housing instability take a toll on the well-being of Toronto's residents, eroding the fabric of its diverse communities.

In conducting this study, ethical considerations in utilizing key data sources such as Statistics Canada Census, Airbnb data, and City of Toronto Open Data will be discussed. Our comprehensive study aims to dissect the various factors contributing to the housing unaffordability in Toronto, particularly in the context of differing Airbnb pricing across neighborhoods. The findings from this study are expected to guide policy decisions, foster the development of equitable housing solutions, and shape a more inclusive urban landscape in Toronto. The ultimate goal is to answer a crucial question: How can we make Toronto a city that is equitable and inclusive for all its residents?

Alarming statistics:

To comprehensively illustrate the escalating severity of Toronto's housing crisis, we developed a polynomial regression model (Graph 1). This advanced machine learning tool is adept at predicting non-linear trends, a critical feature for analyzing complex housing market dynamics. Our model's time series analysis, spanning from 1990 to the projected values for 2023 and 2024, reveals a deeply concerning trend: Toronto's average total rent has been rising at an exponential and unsustainable rate.

For 2023, the model forecasts a rent increase of 4.9%, escalating further to a 5.5% increase in 2024. These predicted hikes significantly outpace the Bank of Canada's acceptable inflation range of 1-3%, underscoring the disproportionate escalation of housing costs. To put this into perspective, the average total rent in Toronto was CAD$ 755 in 1996, soaring to CAD$ 1,536 by 2020 – a staggering 103% increase (Canada Mortgage and Housing Corporation, 2023). In contrast, median household incomes lagged considerably behind; they grew from CAD$ 49,405 in 1996 to CAD$ 84,000 in 2020, marking only a 70% increase (Statistics Canada, 2016, 2021). This discrepancy of 30% between income growth and rent escalation over the 24-year period starkly highlights the widening gap between earnings and housing affordability in Toronto.
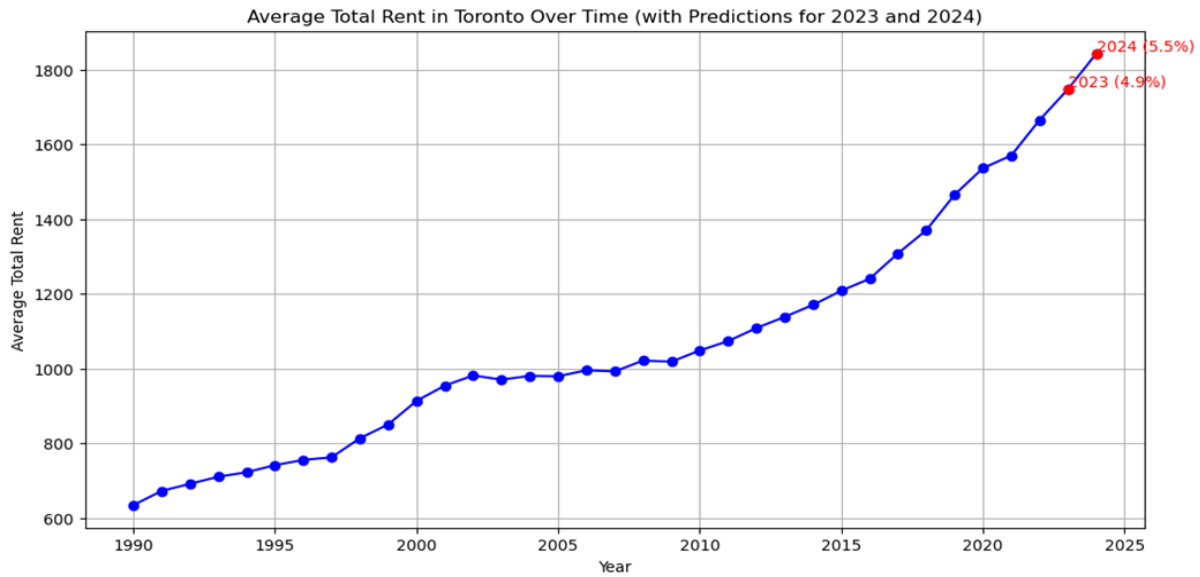
Graph 1: Average Total Rent in Toronto from 1990-2024. Source: CHMC

OLS Model:

In our study, we applied an ordinary least squares linear regression to analyze the relationship between the percentage of households in core housing need and the average Airbnb price across various neighborhoods in Toronto. We began by standardizing the neighborhood names in the Census data and the Airbnb data, allowing us to merge and focus on 119 common neighborhoods identified in both datasets. The results of this regression analysis are quite telling. The R-squared value, which measures the proportion of variance in the dependent variable that can be explained by the independent variable, was found to be 0.162. This suggests that approximately 16.2% of the variation in average Airbnb prices across these neighborhoods can be attributed to differences in the percentage of households in core housing need. While this indicates a moderate relationship, it's not overwhelmingly strong. The Adjusted R-squared value, at 0.154, is slightly lower. This adjustment accounts for the number of predictors in the model, providing a more accurate reflection of the relationship within the context of our dataset. A critical aspect of our findings is the model's statistical significance, as indicated by the F-statistic and the p-value. The F-statistic stands at 22.55, and the model yields a very small p-value of 5.85×10^{-6}, which is substantially lower than the conventional significance level of 0.05. This strongly suggests that the observed relationship between the core housing need percentage and average Airbnb prices is unlikely to be a result of random chance. Moreover, the 95% Confidence Interval for the Core

Housing Need Percentage coefficient ranges from -6.28 to -2.58, which is also important to assess the significance of our findings.
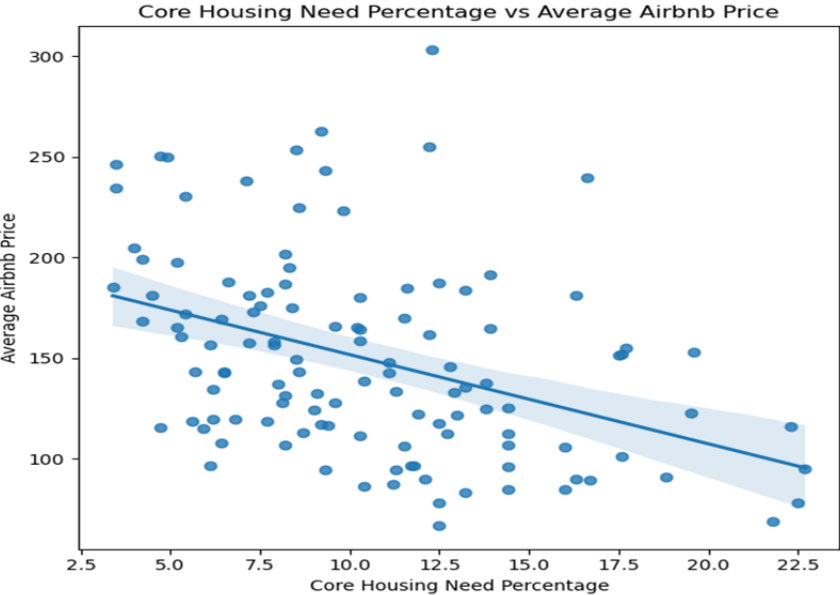
Graph 2: OLS of % of individuals in need of core housing vs Average Airbnb prices in each neighborhood. Source: Census & Airbnb

To deepen our understanding, we identified five neighborhoods that align closely with the line of best fit in our regression model. These neighborhoods are particularly interesting for further study.

Neighborhood	Core Housing Need Percentage	Average Airbnb Price	Distance to Line
Yonge-Eglinton	5.40%	$171.75	0.077
Thorncliffe Park	22.70%	$94.82	0.136
Broadview North	11.10%	$148.06	0.268
Stonegate-Queensway	6.40%	$169.55	0.415
Bayview Village	13.20%	$135.26	0.5

Table 1: Neighborhoods closest to line of best fit of OLS model: Source Census & Airbnb

It is important to note that in our continued analysis using an ordinary least squares linear regression, we also examined the relationship between average Airbnb prices and the proportion of households in Toronto neighborhoods that spend 30% or more of their income on shelter costs, live in 'not suitable' housing, or need major repairs. However, unlike our previous

analyses, this particular model did not yield statistically significant results. Therefore, we cannot confidently draw any conclusions or present findings regarding this specific aspect of Toronto's housing market. However, it is unfortunate to note that 45% of households in Toronto, representing 522,150 units, are struggling with these three housing challenges.

Social Housing & Homelessness:

In the third quarter of 2023, the City of Toronto faced a significant challenge in addressing its housing crisis. There were 7,660 new or reactivated applications added to the social housing waitlist, yet the city managed to accommodate only 616 households. This disparity indicates that for every household provided with social housing, there were 12 others still in need of affordable shelter. Alarmingly, these numbers have been on the rise, and the data for the fourth quarter of 2023 has yet to be included, suggesting that the situation may be even more dire. Graph 3 below shows the stagnant state of the Social Housing waitlist of Toronto from 2018 to 2023 Q3.

This housing shortfall is further highlighted by the findings of the City of Toronto's "Street Needs Assessment" from 2021, which reported an average of over 7,000 people experiencing homelessness in Toronto every night. Compounding this issue is the revelation from Inside Airbnb in 2023 that 45% of their listings, amounting to 8,730 units, have been unoccupied for the past 12 months. If these vacant units could be utilized for housing, they could potentially accommodate a significant portion of the homeless population, assuming the recorded numbers accurately represent the entire homeless demographic and that it has remained constant over the past two years.

Moreover, the economic aspect of this crisis cannot be overlooked. In 2019, prior to the pandemic, the rental wage necessary to afford housing in Toronto was already at $33.7 per hour, according to Macdonald (2019). This figure is more than double the minimum wage of $14 per hour at that time, highlighting the widening gap between income and housing affordability in the city.
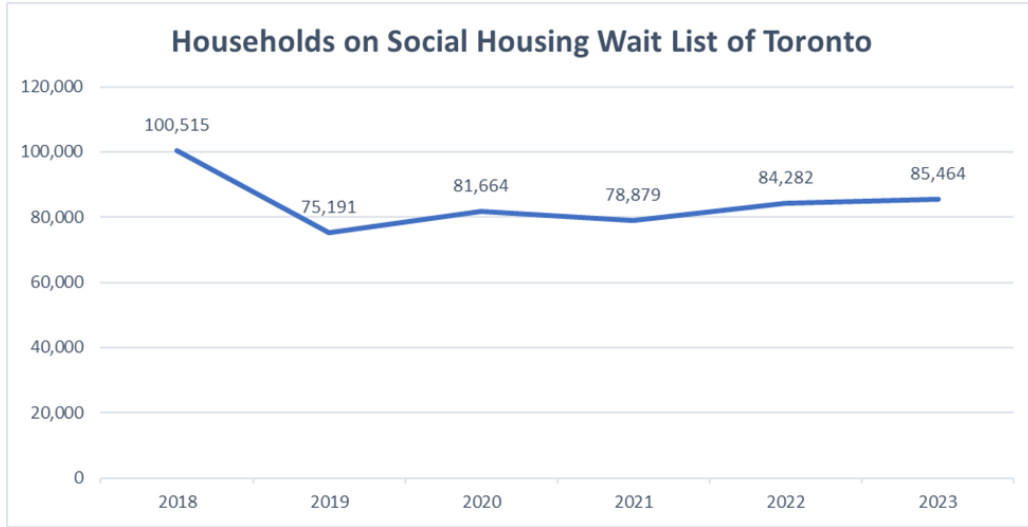
Graph 3: Social Housing Wait List from 2018-2023. Source: City of Toronto

Mortgages vs Housing Affordability

Graph 4: Housing Affordability vs Having a Mortgage. Data Source: Census

The relationship between mortgages and housing affordability in Toronto is a critical factor in the city's affordability crisis. During the pandemic we saw a significant increase in housing prices which was primarily due to the low lending rates of loans from the major banks of Canada. After the pandemic the inflation rates increased primarily due to the low lending rate which forced the Bank of Canada to start increasing the mortgage rate faster than we have seen in the last two decades. With this spike, a lot of household owners and renters have seen a spike

in their cost of living. Graph 3, compares the percentage of households spending more than 30 percent of their income on shelter cost in a neighbourhood with the percentage of households with a mortgage. The trend line in the plot indicates that there seems to be a positive correlation which indicates that mortgages have definitely been a huge burden for home owners lately in Toronto.

Summary Output for Ordinary Least Squares Resgression Model Predicting the Total Count of Households Spending > 30% of Income on Shelter using the Total Count of Households with a Mortgage in a Neighbourhood

Regression Statistics	
Multiple R	0.579054964
R Square	0.335304652
Adjusted R Square	0.331043784
Standard Error	1342.19755
Observations	158

ANOVA

	df	SS	MS	F	Significance F
Regression	1	141766762.2	141766762.2	78.69398481	1.58942E-15
Residual	156	281033105.1	1801494.263		
Total	157	422799867.2			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	1298.063958	250.1470357	5.18920384	6.48523E-07	803.9516436	1792.176273
Total owner households with a mortgage	0.929708532	0.104803563	8.870963015	1.58942E-15	0.722691363	1.136725701

Table 2: OLS Model of Affordability vs Mortgage. Data Source: Census

To check the validity of the relationship presented in the scatter plot above, we developed a simple linear regression model which helps us predict the number of households in a neighborhood that spend more than 30 percent of their income on shelter cost given the number of households with a mortgage. Table 2 outputs the summary of our model which helps us determine the strength of the relation. From the regression statistics table, we see that the multiple R value is roughly 0.6, which indicates that there is a moderate relationship between the two variables. Further down, the ANOVA test has a p-value which is less than the significance level of 0.05, which indicates that there is statistical evidence that suggests that the independent variable in this model is linearly related to the response variable. The third table in the summary output provides the estimates for the coefficients of the model and the T test statistic and p-value to determine significance of the results. From this, we see that the coefficient for the total owner households with a mortgage is positive and the corresponding p-values is less than 0.05, which indicates we have statistical evidence that supports the idea neighbourhoods with higher count of houses with a mortgage tend to have higher count of households that spend more than 30 percent

of their income on sheltered related costs. This result aligns with the scatter plot above and provides statistical significance. Overall, this should shed some light on a major factor in the housing unaffordability crisis related to mortgages. The policy makers should definitely consider reducing the burden of mortgages by reducing the interest rates or implement stricter measures of stress tests when lending out mortgages.

Crime rates vs Housing Affordability

The relationship between crime rates and housing affordability in neighbourhoods is a key factor that has a significant influence on the socio economic landscape of a city like Toronto with a large population. High crime rates have a profound impact on the affordability of housing, affecting housing values, housing suitability and overall the desirability of a person to move into a neighbourhood. Understanding the relationship of crime and housing affordability requires a multivariate analysis which is crucial for policy makers to determine the necessary changes required to control and stabilize housing affordability in Toronto.

Top 10 Neighbourhoods with Highest Total Crime Rates in Toronto

Neighbourhoods	Assault	%	Auto Theft	%	Break and Enter	%	Robbery	%	Theft Over	%	Grand Total
West Humber-Clairville	2756	28%	4563	46%	1333	13%	796	8%	541	5%	9989
Moss Park	5330	63%	359	4%	1472	17%	1114	13%	177	2%	8452
Downtown Yonge East	4833	64%	317	4%	1169	16%	1001	13%	211	3%	7531
Yonge-Bay Corridor	4806	68%	226	3%	1055	15%	646	9%	387	5%	7120
York University Heights	3306	48%	1431	21%	1182	17%	657	9%	383	6%	6959
Wellington Place	4458	66%	384	6%	1283	19%	416	6%	221	3%	6762
Kensington-Chinatown	3825	60%	324	5%	1394	22%	562	9%	255	4%	6360
NSA	3249	58%	646	11%	504	9%	998	18%	225	4%	5622
West Hill	3806	68%	414	7%	706	13%	581	10%	85	2%	5592
Annex	2688	51%	323	6%	1494	28%	427	8%	327	6%	5259

Top 10 Neighbourhoods with Lowest Total Crime Rates in Toronto

Neighbourhoods	Assault	%	Auto Theft	%	Break and Enter	%	Robbery	%	Theft Over	%	Grand Total
Avondale	468	56%	149	18%	114	14%	61	7%	45	5%	837
Humber Heights-Westmount	328	40%	219	27%	187	23%	59	7%	30	4%	823
Centennial Scarborough	424	52%	157	19%	159	19%	57	7%	21	3%	818
Old East York	458	56%	99	12%	162	20%	71	9%	25	3%	815
Markland Wood	261	35%	191	25%	192	25%	87	12%	23	3%	754
Yonge-St.Clair	307	43%	101	14%	244	34%	33	5%	33	5%	718
Maple Leaf	314	45%	191	27%	128	18%	45	6%	22	3%	700
Guildwood	413	62%	66	10%	107	16%	66	10%	16	2%	668
Woodbine-Lumsden	368	57%	67	10%	140	22%	43	7%	25	4%	643
Lambton Baby Point	309	54%	110	19%	112	20%	29	5%	12	2%	572

Table 3: Top/Bottom 10 Neighbourhoods by Crime Rates. Data Source: Crime Indicators Toronto

Prior to studying the relationship of crime and housing affordability, it is important to see the trends of crime rates in the city. The data set we used for our analysis was the major crime

indicators reported by the Toronto police department, accessed from their open data portal.From this dataset, we see a clear increase in the assault and auto theft rates in the last decade. On the other hand, we see a decrease in break and enter and robbery rates while the theft over $5000 rates seem to have stayed stable. All rates saw a slight dip in rates during the 2019 to 2021 which is interesting to consider knowing the dynamic of the word during that time period.

Looking further into the crime data we can see the distribution of crime throughout the neighbourhoods. Table 3 showcases the neighbourhoods with the highest and lowest crime rates in Toronto and their distribution of the major crime indicators. From this visual, we see that neighbourhoods with higher counts of crime rates seem to be somewhat clustered such that higher count neighbourhoods are mostly located near the downtown area of Toronto. The percentage of the crime indicators also indicates that the crime rates in the highest and lowest rated neighborhoods are predominantly distributed in the count of assaults. Overall, this indicates that there is a spatial relation between the crime rates, hence it makes sense to look at housing affordability metrics of each neighbourhood to determine if there is truly any relationship between crime and housing affordability.

To analyze the neighbourhoods that are most commonly affected by the crime rates and housing affordability, we sourced several metrics for neighbourhood housing affordability from the 2021 Statistics Canada census dataset. The neighbourhoods we analyzed were predefined by Statistics Canada which is a federal government agency. There were a total of 158 neighbourhoods defined in the data set. In particular, we wanted to look into whether any combination of the major crime indicators are related to the housing unaffordability metrics. In order to determine the relationships, we determined the correlation of several housing metrics with the major crime indicators. Since the neighbourhoods vary in size and population, we normalized the data for equal weightage to be assigned to each neighbourhood in the analysis.

Correlation Coefficients Between Crime Indicators and Housing Affordability Metrics
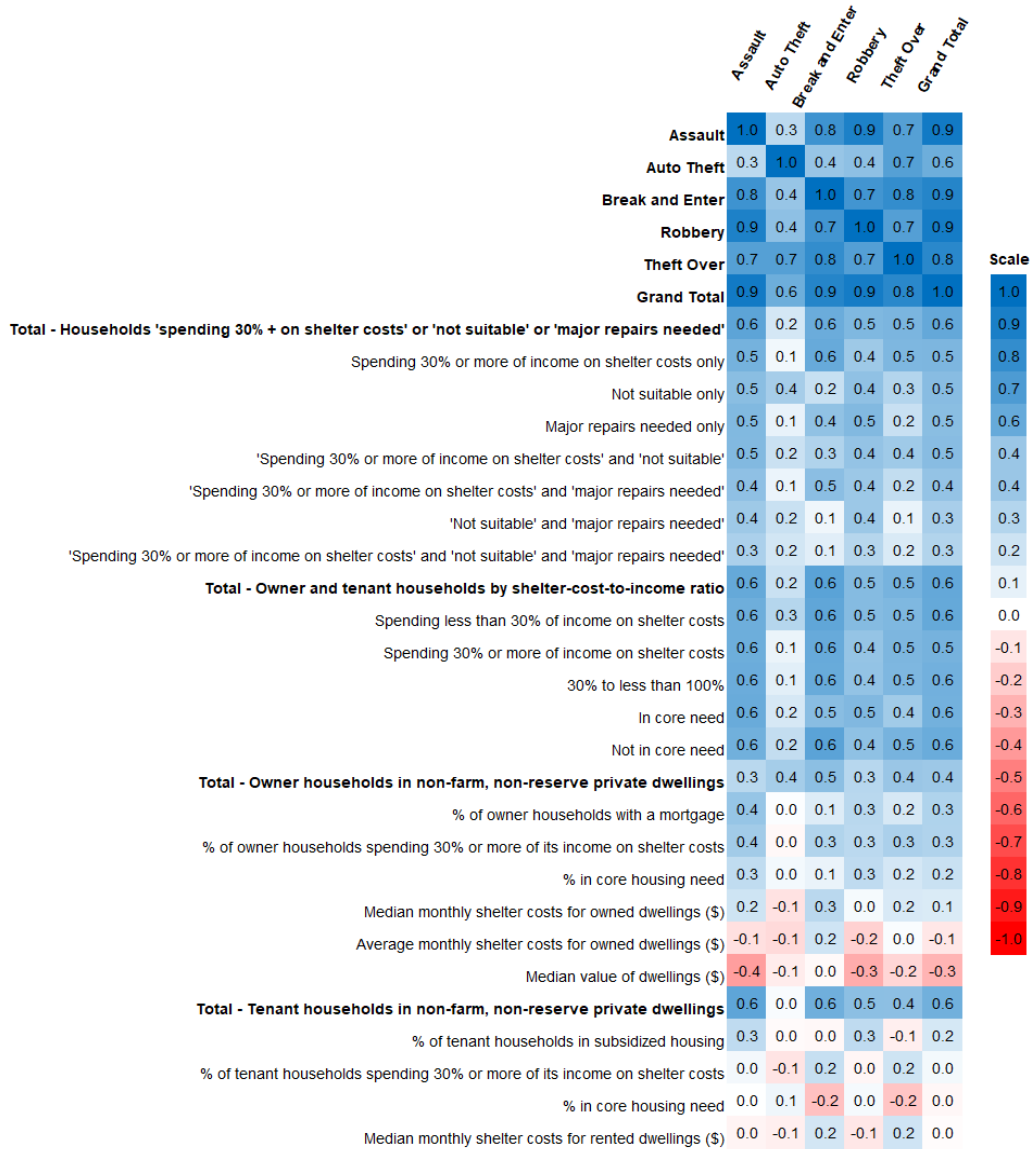
	Assault	Auto Theft	Break and Enter	Robbery	Theft Over	Grand Total
Assault	1.0	0.3	0.8	0.9	0.7	0.9
Auto Theft	0.3	1.0	0.4	0.4	0.7	0.6
Break and Enter	0.8	0.4	1.0	0.7	0.8	0.9
Robbery	0.9	0.4	0.7	1.0	0.7	0.9
Theft Over	0.7	0.7	0.8	0.7	1.0	0.8
Grand Total	0.9	0.6	0.9	0.9	0.8	1.0
Total - Households 'spending 30% + on shelter costs' or 'not suitable' or 'major repairs needed'	0.6	0.2	0.6	0.5	0.5	0.6
Spending 30% or more of income on shelter costs only	0.5	0.1	0.6	0.4	0.5	0.5
Not suitable only	0.5	0.4	0.2	0.4	0.3	0.5
Major repairs needed only	0.5	0.1	0.4	0.5	0.2	0.5
'Spending 30% or more of income on shelter costs' and 'not suitable'	0.5	0.2	0.3	0.4	0.4	0.5
'Spending 30% or more of income on shelter costs' and 'major repairs needed'	0.4	0.1	0.5	0.4	0.2	0.4
'Not suitable' and 'major repairs needed'	0.4	0.2	0.1	0.4	0.1	0.3
'Spending 30% or more of income on shelter costs' and 'not suitable' and 'major repairs needed'	0.3	0.2	0.1	0.3	0.2	0.3
Total - Owner and tenant households by shelter-cost-to-income ratio	0.6	0.2	0.6	0.5	0.5	0.6
Spending less than 30% of income on shelter costs	0.6	0.3	0.6	0.5	0.5	0.6
Spending 30% or more of income on shelter costs	0.6	0.1	0.6	0.4	0.5	0.5
30% to less than 100%	0.6	0.1	0.6	0.4	0.5	0.6
In core need	0.6	0.2	0.5	0.5	0.4	0.6
Not in core need	0.6	0.2	0.6	0.4	0.5	0.6
Total - Owner households in non-farm, non-reserve private dwellings	0.3	0.4	0.5	0.3	0.4	0.4
% of owner households with a mortgage	0.4	0.0	0.1	0.3	0.2	0.3
% of owner households spending 30% or more of its income on shelter costs	0.4	0.0	0.3	0.3	0.3	0.3
% in core housing need	0.3	0.0	0.1	0.3	0.2	0.2
Median monthly shelter costs for owned dwellings ($)	0.2	-0.1	0.3	0.0	0.2	0.1
Average monthly shelter costs for owned dwellings ($)	-0.1	-0.1	0.2	-0.2	0.0	-0.1
Median value of dwellings ($)	-0.4	-0.1	0.0	-0.3	-0.2	-0.3
Total - Tenant households in non-farm, non-reserve private dwellings	0.6	0.0	0.6	0.5	0.4	0.6
% of tenant households in subsidized housing	0.3	0.0	0.0	0.3	-0.1	0.2
% of tenant households spending 30% or more of its income on shelter costs	0.0	-0.1	0.2	0.0	0.2	0.0
% in core housing need	0.0	0.1	-0.2	0.0	-0.2	0.0
Median monthly shelter costs for rented dwellings ($)	0.0	-0.1	0.2	-0.1	0.2	0.0

Scale: 1.0, 0.9, 0.8, 0.7, 0.6, 0.4, 0.4, 0.3, 0.2, 0.1, 0.0, -0.1, -0.2, -0.3, -0.4, -0.5, -0.6, -0.7, -0.8, -0.9, -1.0

Table 4: Crime Indicators vs Affordability Metrics. Data Source: Crime Indicators Toronto & Census

The results of the correlation analysis are presented in the correlogram in table 4. Note that the Pearson's correlation coefficient measures the strength of a linear relation between two variables. It can range from -1, which indicates a negative relationship, to 1, which indicates a positive relationship. At first glance of this chart, we see that a lot of the unaffordability metrics seem to have a positive relation with the major crime indicators although there are some which are stronger than others. For instance, we see that neighborhoods with households that spend more than 30 percent of their income on shelter cost, or not suitable or need major repairs tend to

have a higher rate of crime rates. In particular, households that spend more than 30 percent of their income have a high positive correlation at around 0.5 to 0.6 with almost all the major crime indicators including assault, break and enter, robbery and theft rates. Further down the chart, we also see that neighbourhoods with higher median dwelling value have a moderate negative correlation with the neighbourhood assault and robbery rates at which the correlation coefficient ranges from -0.3 to -0.4. This indicates that neighbourhoods with higher median dwelling value tend to somewhat have a lower count of assaults and robbery rates. We also see a positive moderate correlation between the percentage of tenants in subsidized housing with assault and robbery rates. This indicates that neighbourhoods with higher percentage of tenants in subsidized housing tend to somewhat have a lower count of assaults and robbery rates.

In contrast, we also see some surprising metrics that don't seem to be directly related to the crime rates. For instance, median shelter cost of owned dwelling is not significantly related to any of the major crime indicators. Also the number of people in core housing or not in core housing need is strongly related in both directions, which negates the relation. These results could be due other factors that need to be considered along with these variables to truly have a strong relation which would be expected but this is out of the scope of this analysis and would require further data for validation.

Summary Output for Multivariate Linear Model Predicting Total Count of Households Spending > 30% of Income on Shelter using the Crime Indicators of a Neighbourhood

Regression Statistics	
Multiple R	0.682407883
R Square	0.465680519
Adjusted R Square	0.451711382
Standard Error	1215.128508
Observations	158

ANOVA

	df	SS	MS	F	Significance F
Regression	4	196889661.6	49222415.4	33.33638485	5.50237E-20
Residual	153	225910205.6	1476537.292		
Total	157	422799867.2			

|	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	1789.20143	186.0872703	9.614851286	2.05943E-17	1421.569221	2156.833639
Assault	1.337495627	0.237763526	5.625318784	8.57991E-08	0.867772308	1.807218945
Break and Enter	1.371117167	0.693842514	1.976121583	0.049939192	0.000368616	2.741865717
Robbery	4.081922193	1.313914441	3.106687974	0.00225563	1.486165549	6.677678837
Theft Over	2.172066021	2.181108064	0.995854381	0.320893272	-2.136909947	6.481041989

Table 5: MLR Model of Crime Rates vs Affordability. Source: Crime Indicators Toronto & Census

To check the validity of the high correlations discussed above, we ran some regression models to further understand the strength and reproducibility of correlation of the variables. In particular, we ran a multivariate linear regression model with the major crime indicators as the independent variables and the count of households for each neighborhood that spend more than 30 percent of their income on shelter cost as the response variables. Table 5 outputs the summary of this linear model. In this model, we only included the major crime indicators that were highly correlated with the response variable in this case. From the summary of the regression statistics, we see that the multiple R and R squared values for the model are all near the value of 0.5 which indicates that the model's input variables are collectively and individually moderately related to the response variable. In particular, the multiple R value is near 0.7 and higher than the r squared value which indicates that collectively, assaults, break and enter, robbery and theft over rates help predict the count of households spending more than 30 percent of their income. The ANOVA summary further indicates the validity of the model since the p-value is less than the commonly used significance level of 0.05. This indicates that at least one of the major crime indicators has a significant linear relationship with the count for each neighbourhood of the households spending more than 30 percent of their income on shelter. The third table in the summary provides the estimated coefficient for each input crime indicator in the model and their individual T-test statistics and the p-value which indicates the significance of the result. In particular, we see that the p-values for the assault rates and robbery rates are statistically significant when we compare to the significance level of 0.05. The corresponding coefficient for the assault rates is positive, which indicates that controlling the other crime indicators, neighbourhoods with high assault rates tend to have a higher count of the households spending more than 30 percent of their income on shelter. Also, the model coefficient for robbery rates is positive, which indicates that controlling the other crime indicators, neighbourhoods with higher robbery rates tend to have a higher count of the households spending more than 30 percent of their income on shelter. Overall, this model gives us confidence to support the correlation coefficient from the correlogram above because correlation measures the strength and direction of the linear relationship and this regression model helps us get a better understanding of the statistical significance of the results.

With the analysis conducted above, we realized that there is a strong relationship between crime rates and housing affordability. In particular, we have statistical evidence that states that

assault rates and robbery rates seem to have a relationship with the count of households in neighbourhoods that use more than 30 percent of their income on housing related costs. Now, the only thing left in this analysis is to determine which parts of Toronto have a housing unaffordability crisis due to crime rates.

Assault Rates vs Households Spending more than 30 Percent on Shelter Related Costs in Toronto
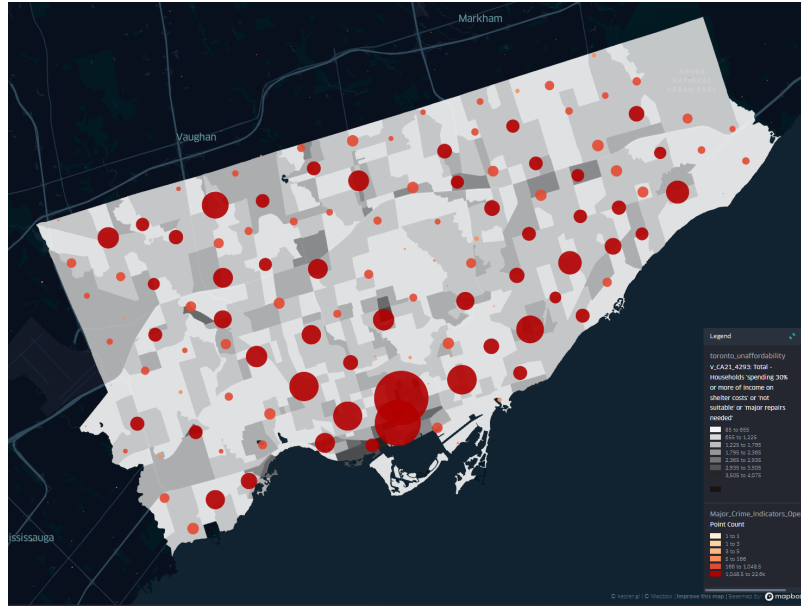
Map 1: Assault Rates vs Affordability. Data Source: Crime Indicators Toronto & Census

Robbery Rates vs Households Spending more than 30 Percent on Shelter Related Costs in Toronto
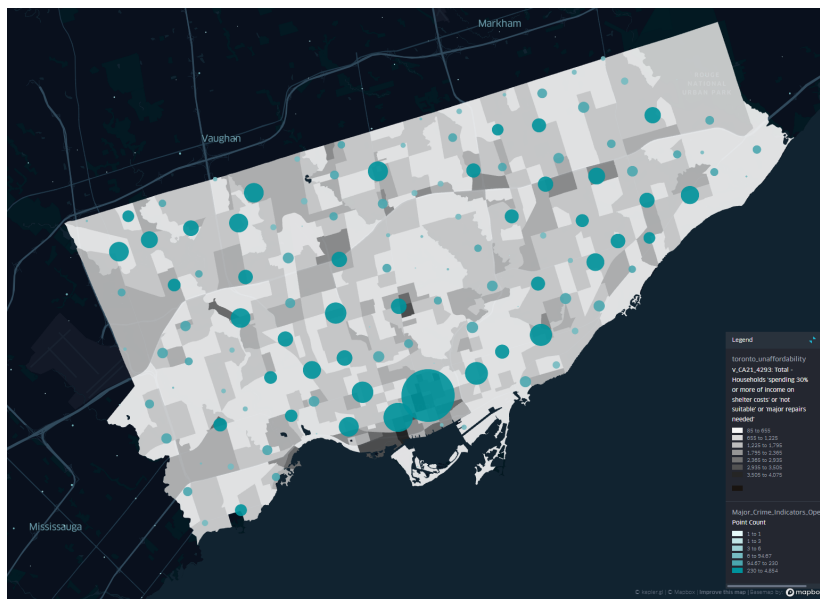
Map 2: Robbery Rates vs Affordability. Data Source: Crime Indicators Toronto & Census

Map 1 and 2 compare the count of the households that spend more than 30 percent of their income on shelter related costs with the assault rates and the robbery rates respectively. The darker the color of the neighbourhood scaling from white to black, the higher the count of the households that spend more than 30 percent of their income on shelter related costs. The larger the size of the cluster (red for assault rates and blue for robbery rates), the higher the rate of crime rates in their respective maps. With this in mind, we see that there seems to be a somewhat of a correlation between housing unaffordability and crime rates. Particularly, there seems to be more householding in the downtown region that spend more than 30 percent of their income on shelter related costs compared to the rest of the city, which is expected since that region is known for its expensive housing and cost of living. Within this region, we also see higher rates of robbery and assault rates as expected from our analysis above. So we can say with some confidence that housing affordability of Toronto neighbourhoods is definitely affected by various crime indicators like assault and robbery counts. This sparks a conversation for the authorities to consider implementing policies to control crime rates as they have some linkage to the housing affordability crisis in Toronto.

Challenges and Initiatives in Toronto's Social Housing

In order to know how the City of Toronto addresses the current status and challenges of social housing projects in Toronto, this section uses findings from multiple recent sources to discuss the current social housing projects and their challenges. This section also explores city and federal efforts to address Toronto's housing challenges and the constraints they face.

1. HousingTO 2020-2030 Action Plan: Toronto City Council's recently revised HousingTO 2020-2030 Action Plan marks a key step forward in affordable housing for the city. The revised plan increases its goal from an initial 40,000 units of rent-controlled housing to 65,000 units by 2030 (Teles, 2023). The significant revision is intended to address the city's housing shortage in a diverse approach that includes 6,500 units of rent-adjusted income housing, 41,000 units of affordable housing and 17,500 units of rent-controlled market housing. The plan also includes strategies to develop 51 sites, with a further 40 potential sites under investigation. This proactive

approach is part of a broader strategy to increase affordable housing and reshape its ownership to prioritize public and nonprofit entities (Teles, 2023).

2. Federal Government's Support in Rapid Housing: The Federal government has also significantly contributed to Toronto's rapid housing efforts, as evidenced by their support for developing 40 affordable housing units at 11 Brock Avenue and over 60 units at 4201 – 4203 Kingston Road (CMHC, 2023). This support is a crucial part of a collaborative effort with the city to address Toronto's urgent housing needs, focusing on vulnerable groups like seniors, Indigenous people, and those experiencing homelessness or mental health issues (CMHC, 2023).

3. Housing Now program: In 2019, the City of Toronto launched a project called the 'Housing Now Program, ' a major initiative to develop affordable housing using city-owned land. The plan has allocated 21 major transit-oriented sites, 10 of which have been rezoned, and six of which have completed market provision (City of Toronto, 2023). The scheme aims to deliver 10,000 affordable homes by 2030, representing one-third of the total homes delivered. These homes are designed to be affordable to many households, including low- and moderate-income households (City of Toronto, 2023). The City of Toronto has committed more than $1.3 billion in land value, capital funding, and financial incentives to the program, making it one of the most significant financial investments in housing underway today (City of Toronto, 2023). However, the Housing Now program still faces some challenges. Macroeconomic factors such as the COVID-19 pandemic, sharp increases in construction costs and interest rates, labour shortages and global supply chain disruptions have impacted the program.

4. Seven-year Housing Plan: The Toronto City Council approved a sweeping housing plan to create 65,000 rental units over the next seven years, underscoring the city's commitment to solving the affordable housing crisis. However, this estimated $36 billion initiative faces significant financial challenges as the city currently lacks the necessary budget (McAllister & Marchesan, 2023). Mayor Olivia Chow stressed the urgency of the plan and acknowledged the need to address funding gaps. The current financing of the program ensures the delivery of 4,455 homes, but a significant portion, 60,545 homes, will still require an estimated $2.86 to $31.5 billion over seven years (McAllister & Marchesan, 2023). The City Council voted 24 to 1 on the project, demonstrating strong support for the plan. However, Bradford expressed concern about

the city's lack of expertise in large-scale real estate development, stressing the importance of working with market builders (McAllister & Marchesan, 2023).

In conclusion, the city of Toronto has proposed several social housing projects in response to housing issues, including but not limited to the HousingTO 2020-2030 action plan, federal support for rapid housing, and the Housing Now program. While these initiatives demonstrate the city's strong commitment to solving problems and increasing the supply of affordable housing, they face significant challenges, such as financial constraints and the complexities of urban development. Therefore, the success of these plans depends on coordinated action by all levels of government and departments, and the adoption of more comprehensive and innovative solutions that ensure that all groups work together.

Housing need vs Airbnb price

With the rise of short-term rental platforms, the Toronto real estate market has ushered in a new factor that interacts with various other economic and social factors. In this part, we will use Airbnb's data to explore its relationship with the Toronto neighbourhood housing market. The visualization below examines this data through geospatial mapping of Airbnb prices across the city, providing a unique perspective on the impact of short-term rentals on urban life.
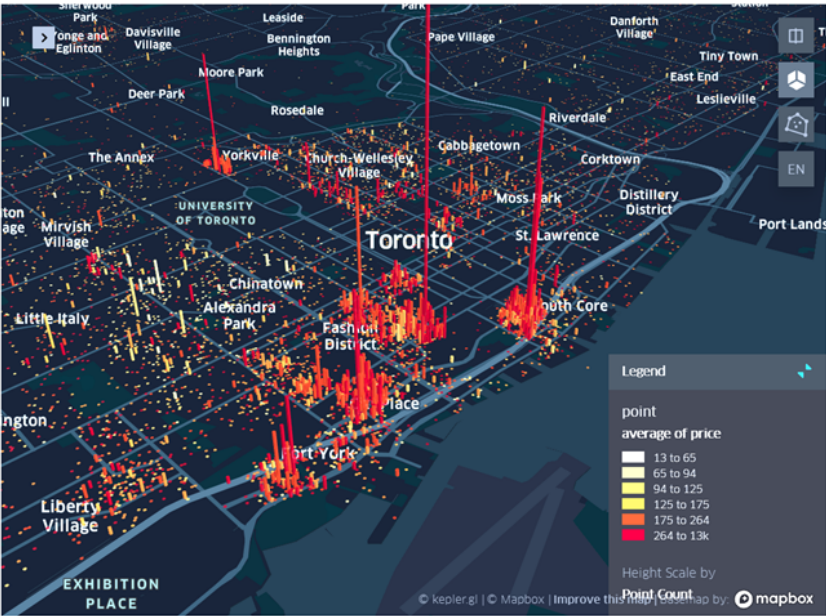

Figure 1: Airbnb listings scaled by the average price. Source: Inside Airbnb

This visual uses colour gradients and height scales to represent price ranges: dark blue represents the lowest price (CAD 13 to 65), rising through lighter blue, orange and red tones, to bright red representing the highest price (CAD 264 to 13k). Lakefront areas, particularly around the South Core and Exhibition Center, show tall red spikes that indicate higher average Airbnb rental prices, indicating higher premiums in waterfront areas. To explore further, we compared the average rental price obtained from CMHC with the average Airbnb price (daily), focusing on the waterfront neighbourhood because it is the most popular on Airbnb.
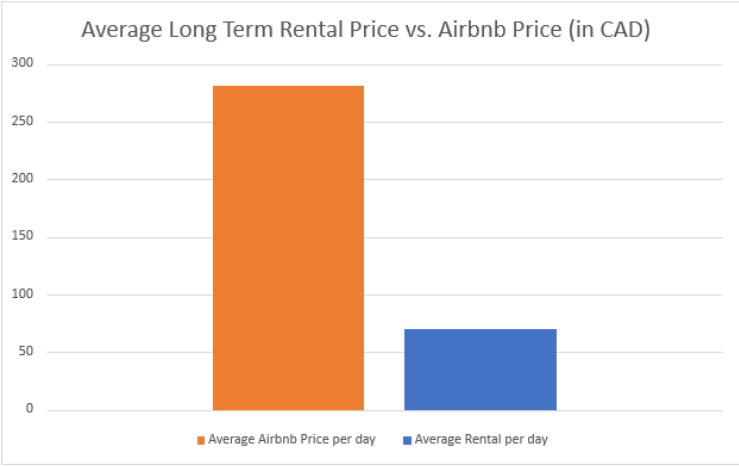
Figure 2: 2022 Average Long-Term Rental Price vs. Airbnb Price, sourced from CMHC & Inside Airbnb

Based on Figure 2, we can tell that the Average price for Airbnb (Orange Bar) is much higher than the Average price for long-term rentals. Thus, it can represent that the profit margin of short-term rentals is much higher than that of long-term rentals, which will lead many landlords to choose to list their properties as short-term rentals rather than enter the long-term rental market. This will lead to an imbalance in Toronto's normal rental market and may be accompanied by price increases and other problems.

However, the City of Toronto will not let this happen quickly. In this case, they have listed five strict regulations to restrain the overgrowth of Toronto's short-term rental market:

1. Short-term is defined as any rental period less than 28 days
2. You are only allowed short-term rentals for your principal residence (no investment properties)
3. Short-term rentals are limited to 180 nights per year

4. There is a 4% tax that must be paid on rent

5. You must register with the city and pay an annual $50 registration fee

(Source: Skyviewsuites, Link)

In summary, the data shows that there is a significant difference between Airbnb and long-term rental prices in Toronto, especially in the high-demand lakefront area. This suggests that short-term rental profitability may incentivize landlords to favor Airbnb over long-term rentals, potentially disrupting the traditional rental market. However, the City of Toronto has implemented regulations to mitigate this imbalance to maintain a stable housing market.

Ethical Considerations

In the process of our study and research, it is important to include ethical considerations about big data. In the case of studying the Toronto real estate market, we will focus on the ethical issues that may arise from the use of big data in urban planning and housing development, particularly in the areas of privacy protection, bias and fairness in data use, and transparency in decision-making processes.

Privacy issues: The impact of big data on privacy includes risks such as high-tech analysis and group privacy issues, so we need a more comprehensive concept of data protection and stricter privacy protection (Bormida, 2021).

Bias and fairness: Ensuring fairness in data collection and analysis is critical to preventing the perpetuation of social inequalities, including addressing biases embedded in data-driven decision-making (Bomida, 2021). In our cases, we need to pay special attention to biases related to housing market analysis and urban planning and to reduce these biases as much as possible.

Transparency: The algorithms we use for data analysis using big data models need to have transparency, ensuring that individuals understand how their data is used and have the ability to challenge decisions based on this data (Bomida, 2021).

Data protection: Compliance with strict data protection regulations and ethical AI principles is necessary. This involves using artificial intelligence and big data in a way that is consistent with society's values, prioritizing human well-being, and avoiding harm to every group (Bormida, 2021).

To conclude, ethical considerations are crucial in our study of the Toronto real estate market. In this case, we must comply with strict data protection legislation to ensure our approach is compliant.

Conclusion

To conclude our findings, our polynomial regression model demonstrated an alarming escalation in housing costs, significantly outpacing income growth, with a projected increase in rent of 4.9% in 2023 and 5.5% in 2024. These figures exceed the Bank of Canada's standard inflation range, underscoring a severe issue in housing affordability. Furthermore, our study employing linear regression models revealed a substantial impact of short-term rental services like Airbnb on the long-term housing market. We identified a strong negative correlation between Airbnb pricing and the prevalence of core housing needs among households. In more affluent neighborhoods with higher average Airbnb prices, fewer households needed core housing, and the opposite trend was observed in less affluent areas. This pattern of economic inequality was particularly evident in neighborhoods such as Yonge-Eglinton, Thorncliffe Park, Broadview North, Stonegate-Queensway, and Bayview Village.

Our analysis of mortgages and their effect on housing affordability showcased the impact of the recent interest rate hikes on the affordability of housing. From the scatter plot and the simple linear regression model we saw a positive correlation between the number of households spending more than 30 percent of their income on shelter cost and the number of households that have a mortgage in a given neighbourhood. This indicated that household owners that currently have a mortgage are facing a tough time with affording their house. It should be a key factor that the policy makers should consider to reduce the unaffordability crisis in Toronto.

The correlogram and the multiple linear regression model used to predict housing affordability given the various crime indicators for a neighbourhood revealed a positive correlation. This indicated neighborhoods with higher crime rates tend to have a higher unaffordability crisis. In particular, the model demonstrated that assault rates and robbery rates were more closely related to this phenomena. The maps for the crime rates both portrayed the results and also indicated that the downtown area of Toronto was significantly impacted by the

crime rates. This should shed some light on a not so obvious correlation and should be a key factor that should be controlled to reduce the affordability crisis.

In response to Toronto's housing crisis, the City of Toronto has taken several measures, such as the HousingTO 2020-2030 Action Plan, the Housing Now Program, and the Seven-Year Housing Plan, as well as seeking support from the federal government, which demonstrates the City's commitment to solving the problem. However, financial constraints, macroeconomic factors and the complexity of urban development pose significant challenges to these initiatives. At the same time, the rise of short-term rental platforms has further complicated the issue. The wide disparity between Airbnb and long-term rental prices, particularly in the Lakeshore region, suggests that the profitability of short-term rentals may be disrupting the traditional rental market.

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