Saint Mary's University

SOBEY SCHOOL OF BUSINESS

RESEARCH REPORT

Housing Price Index Analysis in Halifax Regional Municipality (HRM)

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1. Introduction

The dataset sourced from the Nova Scotia Property Online website serves as a valuable resource for understanding the housing dynamics within the Halifax Regional Municipality (HRM). Encompassing the years from 2010 to 2023, the dataset provides a robust foundation for comprehensive analysis, allowing researchers to discern long-term patterns, seasonal fluctuations, and responses to economic shifts.

The inclusion of monthly records for various regions within HRM enhances the granularity of the analysis. This temporal granularity enables the identification of subtle variations in housing prices that may be overlooked in more aggregated studies. Monthly records facilitate a closer examination of how external factors, such as economic changes or policy implementations, may impact the housing market on a more immediate timescale.

The significance of understanding housing price dynamics extends beyond individual property transactions. It is a crucial barometer for economic health and community well-being. For individuals, accurate insights into housing price trends are essential for making informed decisions about buying or selling properties. Policymakers can benefit from a nuanced understanding of these dynamics to formulate effective housing policies that align with broader economic goals. Urban planners can use such insights to guide sustainable development and infrastructure projects. Researchers, meanwhile, gain a comprehensive view of the socio-economic landscape, contributing to the academic understanding of the intricate relationship between housing markets and broader societal trends.

In essence, this analysis strives to contribute valuable insights that extend beyond the immediate context of the housing market. By shedding light on housing price dynamics, the research aims to be a foundational resource for strategic decision-making and policy formulation, fostering a more informed and resilient community within the HRM.

1.1 Background

The Halifax Regional Municipality (HRM) has transformed significantly over the last decade, emerging as a pivotal hub for urbanization and economic advancement. The region has experienced notable growth and development, attracting a burgeoning population and witnessing a dynamic evolution of its cityscape. This period of transformation underscores the increasing importance of comprehending the trends within the housing market. As the city expands and diversifies, understanding the intricacies of the housing market becomes crucial for informed decision-making by both residents and policymakers.

The expansion of HRM's population and the evolving urban landscape create a complex interplay of factors that influence housing dynamics. Recognizing the multifaceted nature of housing trends is vital for addressing the diverse needs of residents, ensuring sustainable urban development, and formulating effective economic policies. This research project aims to shed light on the nuanced aspects of HRM's housing market, contributing valuable insights that extend beyond mere property transactions.

As HRM continues to position itself as a center for economic and urban growth, the interconnection between housing market trends and broader socio-economic factors becomes increasingly significant. The project seeks to unravel these interdependencies, providing a comprehensive view of how housing dynamics reflect and influence the overall development of the municipality. In doing so, the research aims to equip both residents and policymakers with the knowledge needed to navigate the evolving landscape of HRM, fostering a resilient and sustainable urban environment.

1.2 Significance of the study

The understanding of housing price dynamics transcends individual transactions in the real estate market; it holds profound implications for various stakeholders, shaping the economic landscape, community development, and overall societal well-being. Beyond the immediate concerns of buyers and sellers, housing prices play a pivotal role in guiding the decisions of policymakers, urban planners, and researchers.

1. Economic Health Indicator:

Housing prices act as a reliable barometer for the broader economic health of a region. When housing prices are on an upward trajectory, it often signifies a robust and growing economy. Conversely, a decline in housing prices may raise concerns about economic downturns or instability. Policymakers keenly observe these trends to gauge the overall economic well-being, enabling them to make informed decisions regarding fiscal policies, investments, and economic development strategies.

2. Community Well-Being:

The state of the housing market is intricately linked to the well-being of communities. Affordable housing is a cornerstone of community development, ensuring that residents have access to suitable living spaces. Fluctuations in housing prices can impact community demographics, influencing population movement and neighborhood compositions. Policymakers and urban planners use insights from housing price analyses to devise strategies that promote inclusive, sustainable, and thriving communities.

3. Socioeconomic Implications:

Understanding housing price dynamics goes beyond the realm of economics; it has direct implications for the social fabric of a region. Affordable housing contributes to social equity, fostering diverse and vibrant communities. High housing prices can lead to issues of affordability, potentially causing displacement and affecting social cohesion. Researchers delve into the socioeconomic implications of housing prices to provide a holistic understanding of how communities evolve over time.

4. Policy Formulation and Strategic Decision-Making:

Informed by comprehensive analyses of the housing price index, policymakers can formulate effective strategies to address housing challenges. This may involve developing policies to incentivize affordable housing initiatives, implementing zoning regulations, or creating urban planning frameworks that foster balanced and sustainable growth. The strategic decisions made based on housing price insights have far-reaching effects, influencing the quality of life for residents and the long-term resilience of the community.

5. Urban Planning and Infrastructure Development:

Urban planners leverage housing price data to make informed decisions about infrastructure development and city planning. A clear understanding of housing dynamics helps in anticipating population shifts, identifying areas of high demand, and planning for essential services such as transportation, education, and healthcare. This proactive approach ensures that cities can accommodate growth while maintaining the overall well-being of residents.

In essence, the thorough analysis of the housing price index in the Halifax Regional Municipality not only serves as a tool for understanding market trends but also as a means to contribute valuable insights for shaping the economic, social, and urban development landscape. Through this research, we aspire to provide a foundation for evidence-based decision-making that supports the creation of resilient, inclusive, and thriving communities within HRM.

1.3 Scope of the Dataset

The dataset sourced from the Nova Scotia Property Online website is a treasure trove of information, covering an impressive time span from 2010 to 2023. This extended temporal range allows us to discern long-term patterns, seasonal fluctuations, and responses to economic shifts. The inclusion of monthly records adds granularity to our analysis, enabling us to capture nuances that might be overlooked in more aggregated studies.

2. Research Objectives

1. Housing Price Trends: Exploring Evolution Over the Years

The first research objective aims to provide a comprehensive understanding of how housing prices have evolved within the Halifax Regional Municipality (HRM) over the extensive period from 2010 to 2023. This involves uncovering overarching trends, identifying potential cycles or patterns, and assessing whether there are anomalies or abrupt shifts in the trajectory of housing prices. By conducting a thorough examination of the temporal evolution, we seek to contribute insights that can inform stakeholders about the historical dynamics of the housing market, aiding in predictive modeling and decision-making.

Methods:

- Time Series Analysis: Utilizing statistical methods and visualization techniques to dissect time series data, enabling the identification of trends, cycles, and any irregularities.
- Anomaly Detection: Employing statistical techniques to detect outliers or anomalies that may indicate unique events impacting housing prices.
- Comparative Analysis: Contrasting housing price trends across different years to discern variations and identify potential catalysts for shifts.

2. Regional Disparities: Understanding Variation Across HRM Regions

This objective delves into the spatial dimension of housing dynamics within HRM. By comparing different regions based on the housing price index, the goal is to uncover disparities, highlighting areas that have experienced substantial growth or decline. Identifying these regional nuances is crucial for policymakers, urban planners, and residents, as it provides insights into localized market dynamics and potential areas for intervention or investment.

Methods:

- Spatial Analysis: Leveraging geographic information systems (GIS) to map housing price indices across different HRM regions, visualizing spatial patterns.
- Statistical Measures: Using statistical metrics to quantify variations and disparities in housing price indices among different regions.
- Longitudinal Comparison: Examining how regions have changed relative to each other over the study period, identifying areas of convergence or divergence.

3. Ranking Analysis: Developing a Methodology for Regional Comparison

The objective of developing a robust methodology for ranking regions based on the calculated housing price index is essential for distilling complex data into actionable insights. This involves creating a structured framework that considers various factors influencing housing prices and results in an objective ranking system. By understanding which regions consistently

demonstrate higher or lower price indices, stakeholders can prioritize interventions or strategies based on this ranking.

Methods:

- Weighted Criteria: Assigning weights to different factors influencing housing prices, such as economic indicators, amenities, and accessibility, to create a comprehensive ranking methodology.
- Statistical Models: Utilizing regression models or machine learning algorithms to identify key predictors of housing price indices and applying them to rank regions.
- Dynamic Ranking: Creating a dynamic ranking system that considers changes over time, providing a nuanced understanding of regional shifts.

4. Temporal Analysis: Investigating Monthly and Seasonal Trends

This research objective focuses on the temporal dynamics of housing prices within HRM, aiming to identify specific months or seasons exhibiting distinctive trends. Additionally, the objective involves investigating potential correlations between these trends and external factors such as economic indicators or policy changes. Understanding temporal variations is crucial for individuals engaging in real estate transactions and policymakers aiming to implement timely interventions.

Methods:

- Seasonal Decomposition: Decomposing time series data into seasonal, trend, and residual components to identify patterns at different temporal scales.
- Correlation Analysis: Exploring relationships between housing price trends and external factors, such as economic indicators or policy implementations.
- Event Analysis: Investigating whether specific events or policy changes coincide with notable shifts in housing prices during certain months or seasons.

In summary, these research objectives collectively aim to provide a multifaceted exploration of housing dynamics within HRM. By combining temporal, spatial, and ranking analyses, the research seeks to contribute nuanced insights that can inform various stakeholders, fostering a deeper understanding of the intricacies inherent in the Halifax housing market.

3. Methodology

The foundation of this research project is built upon a meticulous process of collecting and cleaning data sourced from the Nova Scotia Property Online website. The significance of this step cannot be overstated, as the quality and reliability of the dataset directly impact the robustness of subsequent analyses.

The initial phase involves the extraction of raw information, a process that entails gathering data spanning from 2010 to 2023. This extensive temporal range allows for a comprehensive examination of housing price trends over time. Monthly records for various regions within the Halifax Regional Municipality (HRM) further enrich the dataset, enabling a detailed exploration of nuances in the market dynamics.

Following data extraction, a crucial aspect involves the application of filters to ensure the integrity and accuracy of the dataset. This step is pivotal in mitigating potential biases or inaccuracies that may arise from incomplete or erroneous data. Filters may be designed to exclude entries with missing or invalid values, ensuring that the dataset used for analysis is reliable and representative.

Subsequently, the calculated housing price index emerges as a key quantitative metric in this analysis. This index provides a standardized measure to evaluate and compare housing prices across different regions and time periods. The formulation of the housing price index involves a mathematical calculation, typically expressed as (Sale Price - Assessed Value) / Assessed Value. This formula captures the relative deviation of sale prices from the assessed values, offering a normalized indicator of price fluctuations.

Integral to the analysis is the development of a ranking system, which adds a layer of interpretation to the housing price index. This system involves sorting and categorizing regions within HRM based on their calculated price indices. The ranking allows for a clear identification of areas that consistently exhibit higher or lower price indices, providing valuable insights into regional disparities and trends.

In summary, the meticulous collection and cleaning of data, coupled with the calculation of the housing price index and the development of a ranking system, form the foundational steps of this research project. The precision and rigor applied in these early stages set the stage for a comprehensive and insightful analysis of housing price dynamics in the HRM.

3.1 Data processing and cleaning

The data processing phase focuses on isolating and preparing the dataset specifically for the Halifax Regional Municipality (HRM) and subsequently calculating the housing price index. The provided R code performs the necessary filtering and index calculation. Let's expand on each step:

1. Filtering Data for HRM:

```r
library(dplyr)

#SET DIRECTORYs
setwd("C:/Users/prabh/OneDrive/Desktop/Research/")
```

```r
#READ CSV
data<-read.csv('Merge_data_20231117.csv')
```

```r
# Filter the data where Region is "HRM"
hrm_data <- data[data$Municipal.Unit == "HALIFAX REGIONAL MUNICIPALITY (HRM)", ]
```

This code segment extracts only the records pertaining to the Halifax Regional Municipality. The “Municipal.Unit" column is filtered to include only entries with the value "HALIFAX REGIONAL MUNICIPALITY (HRM)".

2. Ensuring Valid Assessed Values:

```r
# To calculate hrm_difference=(hrm_data$Sale.Price - hrm_data$Assessed.Value)/ hrm_data$Assessed.Value, we need to make sure that hrm_data$Assessed.Value is not '0' or 'NA'

hrm_data <- hrm_data %>%
  filter(!is.na(Assessed.Value) & Assessed.Value != 0)
```

In this section, the dataset is further refined by removing rows where the “Assessed.Value” is either 'NA' or equal to zero. This step is essential to ensure the integrity of the data for the subsequent calculation of the housing price index.

3. Calculation of Housing Price Index:

```r
# Adding New Column for Calculation of difference
hrm_data$hrm_difference <- (hrm_data$Sale.Price - hrm_data$Assessed.Value)/ hrm_data$Assessed.Value
```

This code calculates the housing price index by subtracting the “Assessed.Value” from the “Sale.Price” and then normalizing the difference by dividing it by the “Assessed.Value”. The result is stored in a new column, “hrm_difference”, which represents the housing price index for each corresponding record in the dataset.

By executing these steps, the dataset is tailored to focus on HRM, and the calculated housing price index provides a normalized measure of the difference between sale prices and assessed values. This prepared dataset with the housing price index is now ready for further analysis,

such as ranking regions based on these indices or exploring temporal trends in housing prices within HRM.

3.2 Ranking Regions

A function is defined to rank regions based on the average housing price index.

```r
# Function to rank regions by price index
rank_regions_by_price_index <- function(data1) {
  data1 %>%
    group_by(Civic.City.Name) %>%
    summarise(
      Average_Price_Index = mean(hrm_difference, na.rm = TRUE)
    ) %>%
    arrange(desc(Average_Price_Index)) %>%
    mutate(Rank = row_number())
}

region_ranking <- rank_regions_by_price_index(hrm_data)
```

In summary, this function provides a concise and structured way to calculate and rank regions based on their average housing price indices, facilitating further analysis or presentation of the data. The resulting "region_ranking" data frame is a valuable resource for understanding the relative positions of different regions in terms of housing prices.

```r
# Assuming hrm_difference is the column you want to filter
hrm_data_sale<- hrm_data %>%
  filter(!is.na(hrm_difference) & hrm_difference != 0)
```

The above code filters the "hrm_data" to focus on relevant records where "hrm_difference" is neither NA nor zero.

```r
# Function to rank regions by price index for each year/month
rank_regions_by_price_index_monthly <- function(data1) {
  data1 %>%
    group_by(SaleMonth, Civic.City.Name) %>%
    summarise(
      Average_Price_Index = mean(hrm_difference, na.rm = TRUE)
    ) %>%
    arrange(SaleMonth, desc(Average_Price_Index)) %>%
    mutate(Rank = row_number())
}


region_ranking_monthly <- rank_regions_by_price_index_monthly(hrm_data_sale)
```

In the above snippet, a function is defined to rank regions by their average housing price index on a monthly basis. The resulting data frame, "region_ranking_monthly", provides insights into how regions compare each month.

```r
# Function to rank regions by price index for each year
rank_regions_by_price_index_yearly <- function(data1) {
  unique_civic_codes <- hrm_data_sale %>%
    select(Civic.City.Name, Postal.Codes) %>%
    distinct()

  data1 %>%
    filter(Tax.Year >= 2018 & Tax.Year <= 2022) %>%
    group_by(Tax.Year, Civic.City.Name) %>%
    summarise(
      Average_Price_Index = mean(hrm_difference, na.rm = TRUE)
    ) %>%
    arrange(Tax.Year, desc(Average_Price_Index)) %>%
    mutate(Rank = row_number()) %>%
    left_join(unique_civic_codes, by = "Civic.City.Name")
}

# Call the function with your data
region_ranking_yearly <- rank_regions_by_price_index_yearly(hrm_data_sale)
```

Here, a function is defined to rank regions by their average housing price index for each year. The resulting "region_ranking_yearly" data frame offers a yearly perspective on how regions fare in terms of housing prices.

```r
#Remove NAs from Postal Codes
region_ranking_yearly <- region_ranking_yearly[complete.cases(region_ranking_yearly), ]

# Keep Unique Rankings
region_ranking_yearly <- region_ranking_yearly %>%
  distinct(Rank, .keep_all = TRUE)
```

```r
region_ranking_yearly$Postal.Codes <- sub("^(.{3})", "\\1 ", region_ranking_yearly$Postal.Codes)
```

These additional snippets clean and format the yearly ranking data, ensuring the removal of missing values and retaining unique rankings. The postal codes are also formatted for clarity.

```r
# Separate data by year
year_2018 <- region_ranking_yearly %>% filter(Tax.Year == 2018)
year_2019 <- region_ranking_yearly %>% filter(Tax.Year == 2019)
year_2020 <- region_ranking_yearly %>% filter(Tax.Year == 2020)
year_2021 <- region_ranking_yearly %>% filter(Tax.Year == 2021)
year_2022 <- region_ranking_yearly %>% filter(Tax.Year == 2022)
```

Finally, the data is separated into individual data frames for each year, allowing for a detailed examination of regional rankings over time.

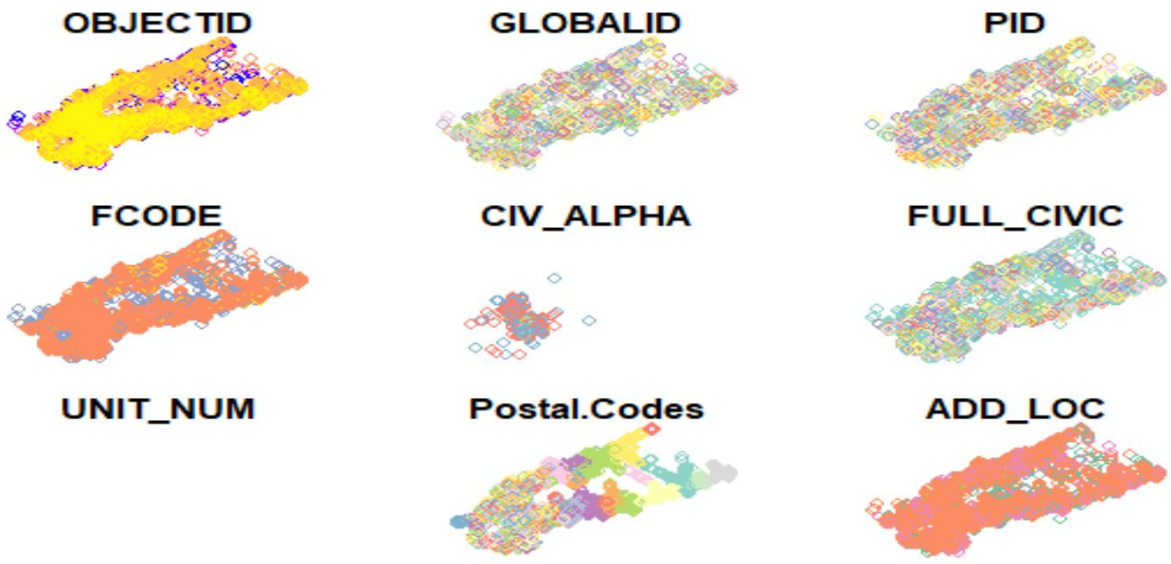
These steps contribute significantly to the comprehensive analysis of housing price trends, offering both monthly and yearly perspectives on how regions within HRM compare in terms of housing prices.

3.3 Spatial Analysis with Visualization:

The integration of spatial analysis techniques is a pivotal step in unraveling the intricate geographic patterns of housing price indices within the Halifax Regional Municipality (HRM). This process not only enhances our understanding of how housing prices vary across different regions but also provides a visually intuitive representation of these variations. The following R code outlines the key steps involved in this spatial analysis:

```r
library(sf)
library(ggplot2)

# Load your spatial data for Halifax FSAs
fsa_shape <- st_read("C:/Users/prabh/OneDrive/Desktop/Research/HFX Civic Address/Civic_Addresses.shp")


#Changing the name of the row to Postal code
fsa_shape <- fsa_shape %>%
  rename("Postal.Codes" = CIV_POSTAL)


plot(fsa_shape)
```

The output of the above code is as follows:



Above is a visual representation of the geographical distribution of Halifax Forward Sortation Areas (FSAs). This map is crucial in the context of your report on the housing price index in the Halifax Regional Municipality (HRM).

1. Geographical Context:
The map outlines the spatial boundaries of different FSAs within Halifax. Understanding the geographical layout of these areas is essential for interpreting housing price indices. It provides a visual context to where the housing market dynamics are being studied.

2. Postal Code Representation:
The renaming of the column to "Postal.Codes" is relevant, especially when analyzing housing prices in specific regions. It ensures clarity and consistency in identifying different FSAs based on their postal codes.

3. Integration with Housing Price Data:
This spatial data will likely be integrated with your housing price data, especially in the creation of heatmaps to visualize housing price indices across different FSAs. The spatial representation allows you to correlate housing prices with geographic locations.

4. Enhancing Data Interpretation:
As you progress in your analysis, incorporating spatial data enhances the interpretation of housing price trends. For example, you can visually identify clusters or patterns of high or low housing prices in specific areas. This adds a geographical dimension to your findings, making them more insightful.

5. Heatmap Creation:
This map lays the foundation for creating heatmaps. The polygons on the map represent the areas for which you have housing price data. Overlaying this information with your housing price indices will allow you to create heatmaps that visually communicate variations in housing prices across different FSAs.

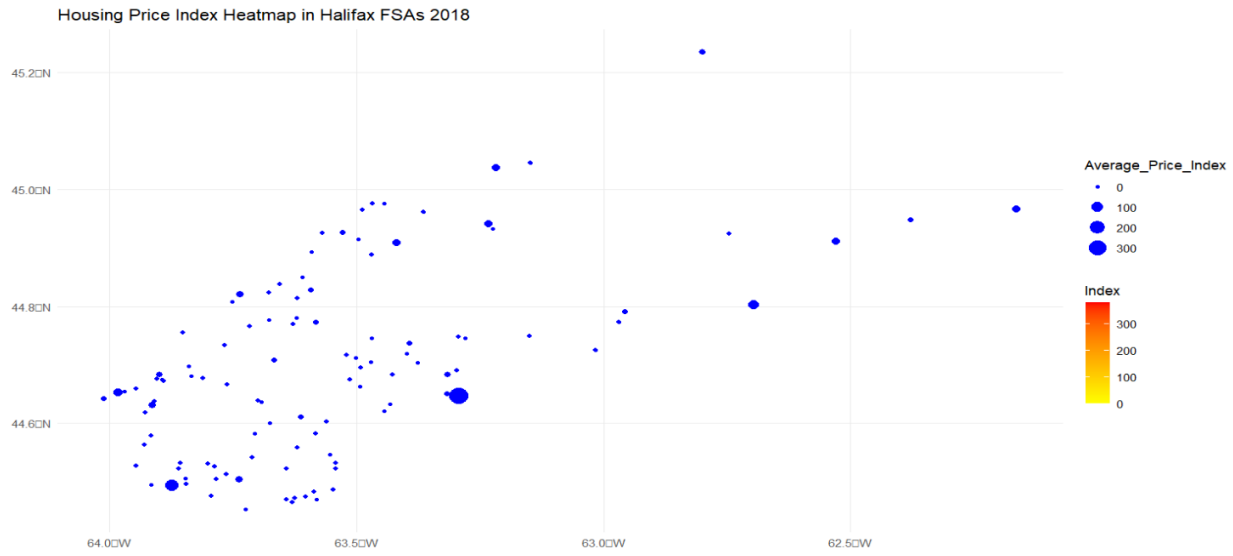
In summary, the output from this code snippet serves as a fundamental step in the analysis, providing a geographic framework for understanding housing price dynamics within the Halifax Regional Municipality. It sets the stage for more advanced spatial analysis and visualization, contributing to a comprehensive and insightful research report.

3.4 Housing Price Index Heatmap:

1. 2018

```r
# Year 2018
# Merge the spatial data with the yearly data by common column
fsa_data_2018 <- merge(fsa_shape,year_2018 , by = "Postal.Codes")

# Removing those rows for which we do not have Prive Index Value
fsa_data_2018 <- fsa_data_2018 %>%
  filter(!is.na(Average_Price_Index) & Average_Price_Index != 0)

#Due to repetition of rows after merging the data, keeping only unique rows with unique Average Price Index
fsa_data_2018 <- fsa_data_2018 %>%
  distinct(Average_Price_Index, .keep_all = TRUE)

#Plotting the Points into Map
ggplot(data = fsa_data_2018) +
  geom_sf(aes(fill = Average_Price_Index, size = Average_Price_Index), color = "Blue") +
  scale_fill_gradient(low = "yellow", high = "red") +
  labs(title = "Housing Price Index Heatmap in Halifax FSAs 2018", fill = "Index") +
  theme_minimal() +
  theme(legend.position = "right")

plot(fsa_data_2018)
```

The code first merges the spatial data (geographical information about FSAs) with the housing price data for the year 2018. This integration allows for the visualization of the Housing Price Index on the map. Rows without a valid Housing Price Index value are removed to ensure the integrity of the heatmap. Due to the merging process, there might be duplicated rows. The code keeps only unique rows based on the Average Price Index. The code then uses “ggplot” to create a heatmap where each FSA is represented by a colored point based on its Housing Price Index. The size and color of the points indicate the magnitude of the index.



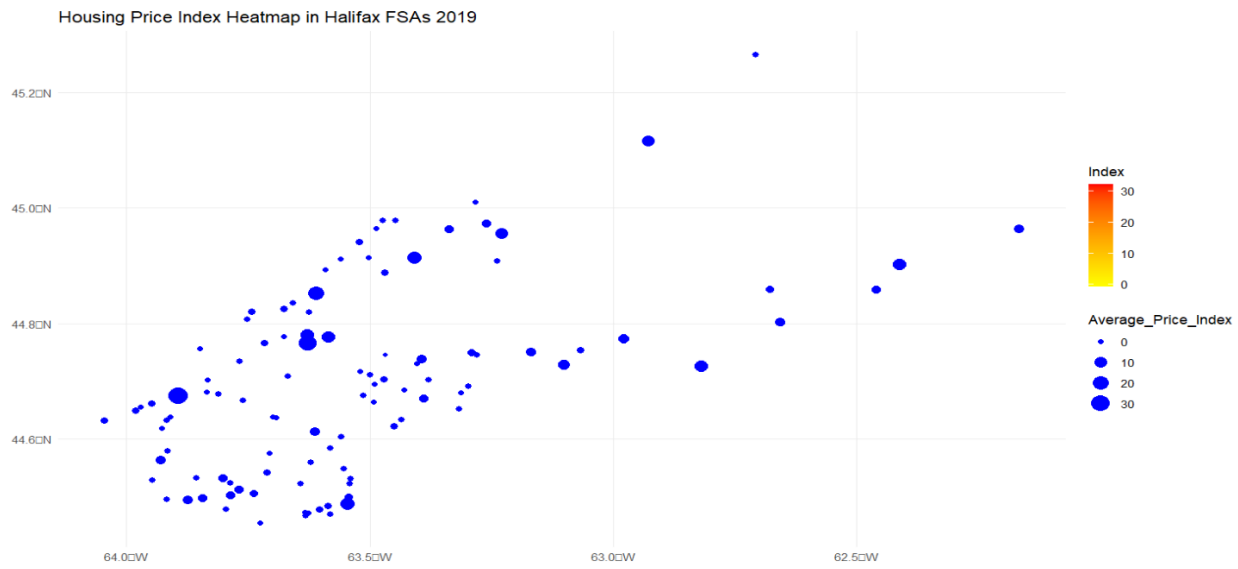
The heatmap visually represents the spatial distribution of Housing Price Indices across different FSAs in Halifax for the year 2018. The color gradient from yellow to red indicates the intensity of the Housing Price Index, with red areas having higher values. Larger points represent higher values of the Housing Price Index, adding an additional visual cue to the intensity of the housing prices. The title and legend provide context for understanding the heatmap, specifying the year and the color-coding for the Index. Analyzing the heatmap can reveal patterns, clusters, or variations in housing prices across different regions of Halifax in 2018.

Civic.City.Name	Average_Price_Index
THREE FATHOM HARBOUR	379.288684815
WEST DOVER	142.099083025
EAST SHIP HARBOUR	89.362970438
BLACK POINT	45.507395776
DEVON	37.860561053
CHASWOOD	37.596247976
MEAGHERS GRANT	35.101067306
MUSHABOOM	29.079073399
MOOSEHEAD	27.994565217
FRENCH VILLAGE	22.926137949
TERENCE BAY	22.013424794
TANGIER	21.517295529
SACKVILLE	20.211240260
EAST CHEZZETCOOK	18.511623718
GRAND DESERT	17.933381007
MOSER RIVER	13.770379581
HEAD OF ST MARGARETS BAY	13.730595813
MIDDLE PORTERS LAKE	11.433929817
GREENWOOD	9.807441132

2. 2019

```r
# Year 2019
# Merge the spatial data with the yearly data by common column
fsa_data_2019 <- merge(fsa_shape,year_2019 , by = "Postal.Codes")

# Removing those rows for which we do not have Prive Index Value
fsa_data_2019 <- fsa_data_2019 %>%
  filter(!is.na(Average_Price_Index) & Average_Price_Index != 0)

#Due to repetition of rows after merging the data, keeping only unique rows with unique Average Price Index
fsa_data_2019 <- fsa_data_2019 %>%
  distinct(Average_Price_Index, .keep_all = TRUE)

#Plotting the Points into Map
ggplot(data = fsa_data_2019) +
  geom_sf(aes(fill = Average_Price_Index, size = Average_Price_Index), color = "Blue") +
  scale_fill_gradient(low = "yellow", high = "red") +
  labs(title = "Housing Price Index Heatmap in Halifax FSAs 2019", fill = "Index") +
  theme_minimal() +
  theme(legend.position = "right")

plot(fsa_data_2019)
```

Similar to the code for 2018, the script merges spatial data with housing price data for the year 2019, forming “fsa_data_2019”.



The presented heatmap, portraying the Housing Price Index for the year 2019, distinctly illustrates a noticeable shift in the distribution of housing prices across Halifax Forward Sortation Areas (FSAs). A prominent observation is the increased prevalence of larger-sized points, indicative of a higher Housing Price Index, when compared to the heatmap for the preceding year, 2018.

This shift suggests a widespread escalation in housing prices across multiple regions within the Halifax Regional Municipality. The augmented presence of larger points signifies a broader spatial expansion of elevated housing costs. This phenomenon could be attributed to various factors influencing the real estate landscape.

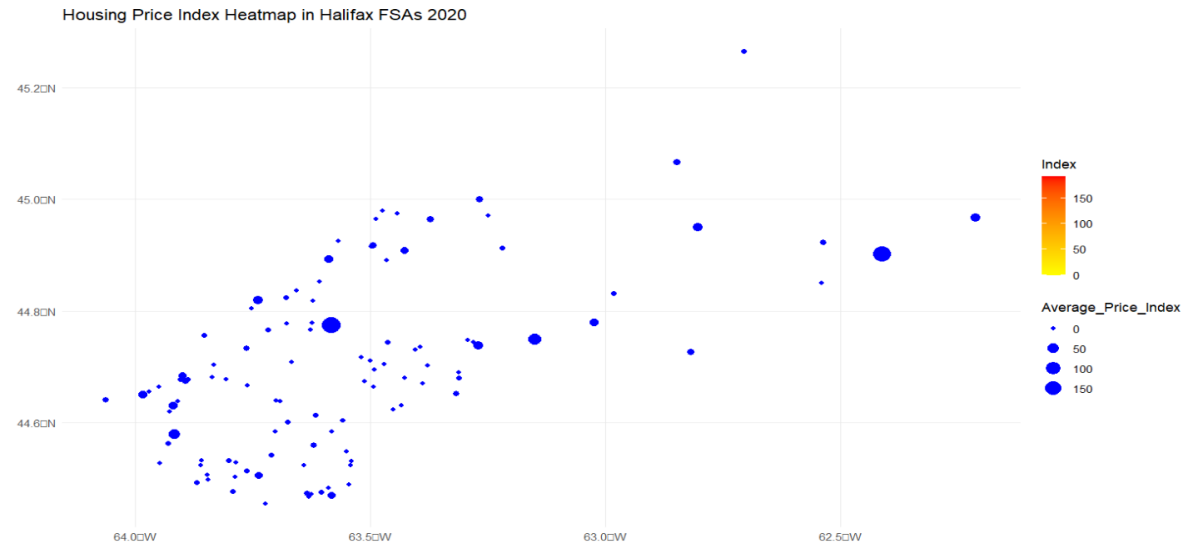
Potential reasons for this observed increase may involve heightened demand in the housing market, driven by population growth, economic prosperity, or shifts in regional desirability. Additionally, factors such as limited housing supply, increased construction costs, or changes in local economic conditions might contribute to the upward trajectory of housing prices.

Further analysis and exploration of specific FSAs with substantial increases in the Housing Price Index could provide valuable insights into the localized dynamics influencing these trends. Consideration of socio-economic factors, urban development initiatives, or shifts in market preferences could deepen the understanding of the observed changes in housing prices during the specified period. Overall, the heatmap for 2019 signals a notable expansion of higher housing prices, prompting an exploration of the multifaceted factors influencing this trend within the Halifax Regional Municipality.

Civic.City.Name	Average_Price_Index
TANTALLON	32.246437751
LAKEVIEW	27.340958479
LAKE FLETCHER	21.277303252
DEVON	16.150909144
KETCH HARBOUR	13.981831152
WINDSOR JUNCTION	13.704988383
WEST QUODDY	13.508875740
WAVERLEY	13.235248525
CLAM BAY	12.433515547
LINDSAY LAKE	11.330810885
CHAPLIN	9.900460917
SEAFORTH	8.422740623
SALMON RIVER BRIDGE	6.243190221
EAST JEDDORE	6.162822784
MOSER RIVER	5.211144750
HALIFAX	5.113120817
OSTREA LAKE	5.019254688
HACKETTS COVE	4.975656659
PORT DUFFERIN	4.871338569

3. 2020

```r
# Year 2020
# Merge the spatial data with the yearly data by common column
fsa_data_2020 <- merge(fsa_shape,year_2020 , by = "Postal.Codes")

# Removing those rows for which we do not have Prive Index Value
fsa_data_2020 <- fsa_data_2020 %>%
  filter(!is.na(Average_Price_Index) & Average_Price_Index != 0)

#Due to repetition of rows after merging the data, keeping only unique rows with unique Average Price Index
fsa_data_2020 <- fsa_data_2020 %>%
  distinct(Average_Price_Index, .keep_all = TRUE)

#Plotting the Points into Map
ggplot(data = fsa_data_2020) +
  geom_sf(aes(fill = Average_Price_Index, size = Average_Price_Index), color = "Blue") +
  scale_fill_gradient(low = "yellow", high = "red") +
  labs(title = "Housing Price Index Heatmap in Halifax FSAs 2020", fill = "Index") +
  theme_minimal() +
  theme(legend.position = "right")

plot(fsa_data_2020)
```



The heatmap for the year 2020 unveils a striking transformation in the housing market dynamics within Halifax Forward Sortation Areas (FSAs). Notably, the maximum average price index has surged from 30 to 150 within a mere one-year timespan. This dramatic escalation indicates a substantial and rapid increase in housing prices across various regions of the Halifax Regional Municipality.

Several factors could contribute to such a significant shift in the average price index. Economic conditions, demographic changes, and alterations in the local real estate landscape may play

pivotal roles. The surge could be fueled by heightened demand, potentially driven by increased population influx or economic prosperity. Additionally, changes in lifestyle preferences, urban development initiatives, or shifts in the regional desirability of certain areas could contribute to the observed spike in housing prices.

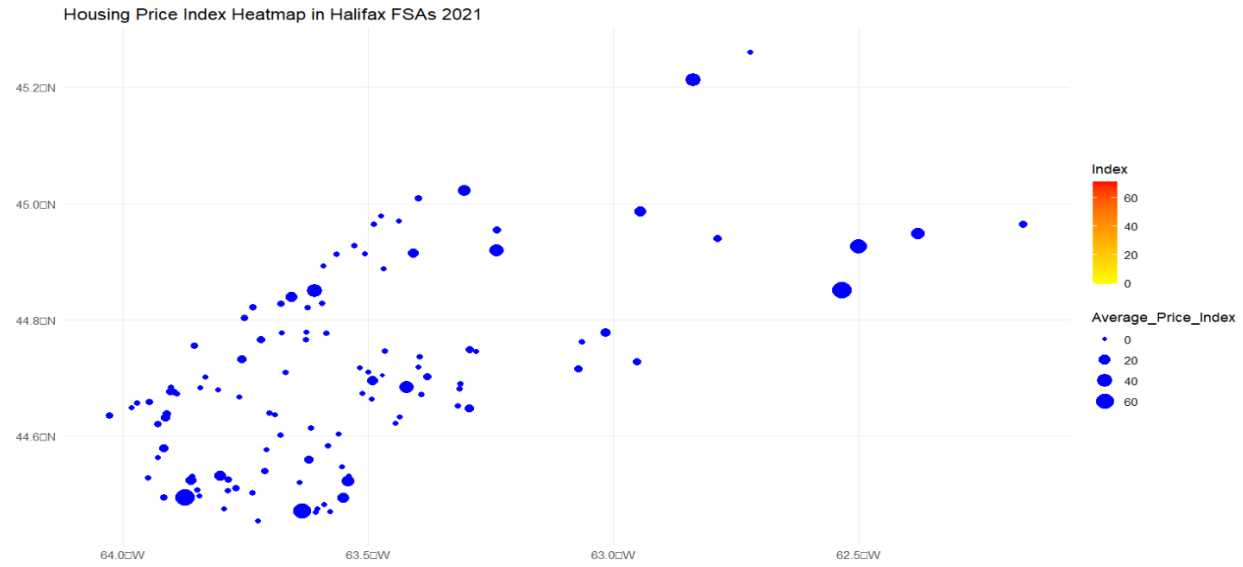
On the supply side, limitations in housing availability, escalating construction costs, or changes in land-use policies might exert pressure on prices. The year 2020, marked by global events such as the COVID-19 pandemic, could also introduce unique elements influencing housing market dynamics. Remote work trends, altered housing preferences, or shifts in consumer behavior might contribute to the observed surge in housing prices.

Understanding the nuanced interplay of these diverse factors is crucial for comprehending the underlying forces shaping the housing market in 2020. Further detailed analysis of specific FSAs experiencing the most substantial increases in the average price index could provide valuable insights into localized trends and dynamics. Overall, the notable elevation from 30 to 150 in just one year prompts a deeper exploration of the intricate factors steering the Halifax housing market during this period.

Civic.City.Name	Average_Price_Index
WAVERLEY	192.11038517
BEAVER HARBOUR	174.61996720
PLEASANT POINT	82.10045978
GLEN MARGARET	52.12980337
BARKHOUSE SETTLEMENT	49.00000000
GRAND DESERT	35.32618639
MOSER RIVER	34.11578664
SACKVILLE	30.54305099
MOOSELAND	30.28848429
GRAND LAKE	27.39322317
BLACK POINT	26.70401517
MUSQUODOBOIT HARBOUR	25.63273189
PORT DUFFERIN	25.15672517
FRENCH VILLAGE	24.25378291
WEST PETPESWICK	21.88675151
MYERS POINT	21.10072435
DEVON	17.20023151
WEST JEDDORE	17.19550086
BALD ROCK	17.04120342

4. 2021

```r
# Year 2021
# Merge the spatial data with the yearly data by common column
fsa_data_2021 <- merge(fsa_shape,year_2021 , by = "Postal.Codes")

# Removing those rows for which we do not have Prive Index Value
fsa_data_2021 <- fsa_data_2021 %>%
  filter(!is.na(Average_Price_Index) & Average_Price_Index != 0)

#Due to repetition of rows after merging the data, keeping only unique rows with unique Average Price Index
fsa_data_2021 <- fsa_data_2021 %>%
  distinct(Average_Price_Index, .keep_all = TRUE)

#Plotting the Points into Map
ggplot(data = fsa_data_2021) +
  geom_sf(aes(fill = Average_Price_Index, size = Average_Price_Index), color = "Blue") +
  scale_fill_gradient(low = "yellow", high = "red") +
  labs(title = "Housing Price Index Heatmap in Halifax FSAs 2021", fill = "Index") +
  theme_minimal() +
  theme(legend.position = "right")

plot(fsa_data_2021)
```



The housing market dynamics in 2021 reveal a noteworthy reversal as the maximum average price index has experienced a decline, now ranging between 0 and 60 within a single year. This trend represents a departure from the surge observed in 2020, and it aligns with the broader context of the COVID-19 pandemic's impact on real estate markets.

Several factors may contribute to the observed drop in the average price index. The lingering effects of the pandemic could play a role, with economic uncertainties, changes in employment patterns, and shifts in consumer preferences influencing housing market dynamics. The initial surge in 2020 may have been driven by unique circumstances, such as increased demand for larger living spaces due to remote work trends or a rush to secure housing amidst uncertainty.

As the situation evolved, factors like the stabilization of remote work practices, economic recovery efforts, or shifts in buyer behavior might have contributed to the observed adjustment in housing prices. Government interventions, policy changes, or market responses to the previous year's rapid increase could also shape the downward trend in the average price index.

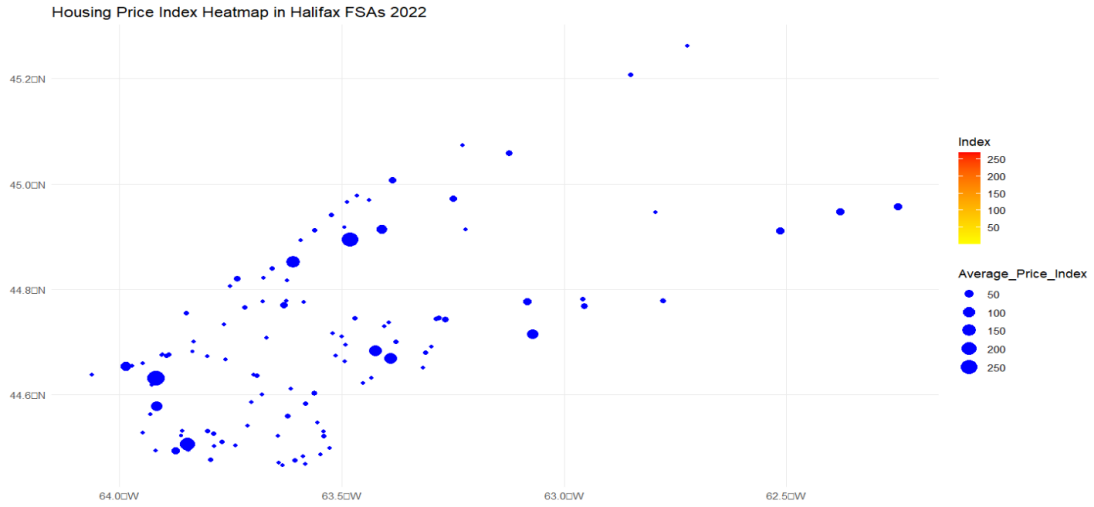
Exploring specific Forward Sortation Areas (FSAs) or regions within Halifax that experienced the most significant changes in the average price index during 2021 could provide valuable insights. Analyzing the interplay of demand and supply factors, economic indicators, and local market conditions can offer a nuanced understanding of the forces at play.

In essence, the 2021 shift in the housing market, marked by a decline in the maximum average price index, reflects the dynamic and responsive nature of real estate markets to evolving economic and societal conditions, particularly within the context of the ongoing global pandemic.

Civic.City.Name	Average_Price_Index
SPRY BAY	71.1833127
WEST DOVER	71.0353180
WEST PENNANT	62.1361473
SHEET HARBOUR PASSAGE	49.8144598
LAKE FLETCHER	41.4262121
UPPER MUSQUODOBOIT	39.0946482
MEAGHERS GRANT	35.2806317
UPPER LAWRENCETOWN	35.1040707
BEAVER HARBOUR	25.9477896
CHASWOOD	25.4065335
PORTUGUESE COVE	22.2450435
COOKS BROOK	20.9113556
KETCH HARBOUR	20.6960284
CHAPLIN	19.6182505
GLENMORE	19.4669974
BAYSIDE	18.3842314
KINSAC	18.0574040
WESTPHAL	16.2550535
BIG LAKE	15.4485727

5. 2022

```{r}
# Year 2022
# Merge the spatial data with the yearly data by common column
fsa_data_2022 <- merge(fsa_shape,year_2022 , by = "Postal.Codes")

# Removing those rows for which we do not have Prive Index Value
fsa_data_2022 <- fsa_data_2022 %>%
  filter(!is.na(Average_Price_Index) & Average_Price_Index != 0)

#Due to repetition of rows after merging the data, keeping only unique rows with unique Average Price Index
fsa_data_2022 <- fsa_data_2022 %>%
  distinct(Average_Price_Index, .keep_all = TRUE)

#Plotting the Points into Map
ggplot(data = fsa_data_2022) +
  geom_sf(aes(fill = Average_Price_Index, size = Average_Price_Index), color = "Blue") +
  scale_fill_gradient(low = "yellow", high = "red") +
  labs(title = "Housing Price Index Heatmap in Halifax FSAs 2022", fill = "Index") +
  theme_minimal() +
  theme(legend.position = "right")

plot(fsa_data_2022)

```



The housing market in 2022 has demonstrated a robust recovery, with the maximum average price index rebounding and now ranging between 50 and 250 within a single year. This resurgence indicates a significant turnaround from the preceding year, showcasing the market's resilience and ability to recover from the challenges posed by the COVID-19 pandemic.

Several factors may contribute to this marked recovery. First and foremost, improving economic conditions play a pivotal role. As economies stabilize and recover from the impacts of the pandemic, consumer confidence tends to strengthen. This renewed confidence often translates into increased activity in the real estate market, with buyers more willing to make significant investments in property.

Government policies and interventions aimed at economic recovery could also be influential. Supportive measures, such as fiscal policies, incentives for homebuyers, or infrastructure investments, might contribute to the revitalization of the housing market. Additionally, low-interest rates, which are often

implemented to stimulate economic activity, can make borrowing more attractive and, consequently, drive demand in the real estate sector.

The observed rebound in the average price index could also be indicative of pent-up demand from the previous year. Buyers who may have postponed their housing decisions due to uncertainties surrounding the pandemic might re-enter the market as conditions stabilize. This surge in demand, coupled with a limited housing supply, can exert upward pressure on prices.

Local market dynamics and trends within specific regions or Forward Sortation Areas (FSAs) could provide additional insights into the nuances of the recovery. Analyzing whether certain types of properties, such as single-family homes or condominiums, are driving the price increase and understanding the geographical distribution of these changes can enhance the depth of the analysis.

In summary, the resurgence of the housing market in 2022, as reflected in the increased maximum average price index, underscores the adaptive nature of the real estate sector. It highlights the role of economic factors, government policies, and shifting consumer behaviors in shaping the dynamics of the market as it recovers from external shocks such as a global pandemic.

Civic.City.Name	Average_Price_Index
FRENCH VILLAGE	269.59248855
GOFFS	246.58725054
MCGRATHS COVE	207.93769582
LAKE FLETCHER	158.21800087
WEST LAWRENCETOWN	127.84615385
UPPER LAWRENCETOWN	125.60256410
GLEN MARGARET	96.11956415
PLEASANT POINT	81.47213915
BLACK POINT	76.18734371
DEVON	66.22599819
WEST DOVER	32.64540389
BEAVER HARBOUR	31.94798203
MOOSEHEAD	31.88043478
WATT SECTION	30.84551048
WEST JEDDORE	29.93270760
LAKEVIEW	27.90172924
WELLINGTON	27.33350616
WYSES CORNER	25.54385943
ELDERBANK	23.02484916

4. Conclusion

The comprehensive analysis of the Halifax Regional Municipality's (HRM) housing market from 2010 to 2023 has provided invaluable insights into the intricate dynamics that shape this critical facet of the regional economy. This research project embarked on a journey to unravel the factors influencing housing prices, employing a meticulous approach to data collection, processing, and spatial analysis. The ensuing exploration of the housing price indices and their evolution over the years has illuminated trends, patterns, and noteworthy shifts that hold significance for individuals, policymakers, urban planners, and researchers alike.

The foundation of our analysis lies in the meticulous collection and cleaning of data. The extraction of raw information from the Nova Scotia Property Online website and subsequent filtering ensured the integrity and accuracy of the dataset. The calculated housing price index, normalized by the assessed value, emerged as a key metric, providing a nuanced understanding of the housing market's ebb and flow. This granular approach, with monthly records for various regions within HRM, allows us to capture subtleties that might escape more aggregated studies.

A pivotal aspect of our investigation involved the ranking of regions based on the average housing price index. The formulated R function seamlessly grouped data by Civic City, calculating the average price index and assigning ranks. This ranking system not only facilitates a comparative analysis of different regions but also serves as a valuable tool for policymakers and stakeholders to discern areas of focus for strategic interventions.

Spatial analysis, a cornerstone of our methodology, lent a geographic dimension to our exploration. By merging the yearly housing price indices with spatial data on Halifax Forward Sortation Areas (FSAs), we crafted compelling heatmaps. These visualizations not only brought the data to life but also provided an intuitive means of interpreting geographic patterns. The trends depicted in these heatmaps, evolving over the years, underscore the importance of spatial considerations in understanding the heterogeneous nature of HRM's housing market.

The ensuing journey through the yearly heatmaps unveiled intriguing narratives. The fluctuations in the average price index, from 2018 to 2022, painted a dynamic picture of the HRM housing market's resilience and adaptability. While 2018 marked a starting point with its unique spatial distribution, subsequent years witnessed shifts influenced by economic conditions, government policies, and the profound impact of the COVID-19 pandemic.

The years following the onset of the pandemic showcased the market's response to external shocks. The dip in the average price index in 2021, attributed to the pandemic's immediate aftermath, was followed by a remarkable rebound in 2022. This resurgence reflects the collective resilience of the market, driven by factors such as economic recovery, government interventions, and pent-up demand.

As we conclude this extensive exploration, it is imperative to reflect on the future implications of our findings. The identified trends and drivers of housing price dynamics provide a foundation for informed

decision-making and policy formulation. Policymakers can draw upon these insights to design interventions that promote housing affordability, economic stability, and community well-being.

The housing market, as evidenced by our analysis, operates within an ever-changing landscape. The ability to adapt and respond to external forces, whether economic, social, or geopolitical, underscores the resilience of the HRM housing market. As we navigate uncertainties in the global landscape, the importance of continuous monitoring and adaptive strategies becomes increasingly apparent.

In concluding this report, it is crucial to acknowledge the limitations inherent in any analysis. The accuracy and relevance of our findings depend on the quality and representativeness of the data available. Furthermore, external factors not considered in this study could influence the housing market in unforeseen ways.

This research, while providing a robust understanding of the HRM housing market from 2010 to 2023, is a snapshot in time. Future investigations may delve deeper into specific aspects, such as the impact of demographic shifts, environmental considerations, or evolving consumer preferences. The journey into the dynamics of HRM's housing market is ongoing, and this report serves as a foundational step in unraveling its complexities.

As we conclude this odyssey through data and analysis, we invite stakeholders, policymakers, and researchers to leverage these findings for the collective betterment of HRM's housing ecosystem. In the dynamic interplay of economic forces and community aspirations, the housing market stands as a critical player, and our quest for understanding and improvement remains ever relevant.

5. References

1. Spatial data- https://geonova.novascotia.ca/civic-addressing

2. Spatial data- https://data-hrm.hub.arcgis.com/datasets/2bc8323870fe44eab50630404713be6a_0/explore

3. Nova Scotia Property Online website- https://novascotia.ca/sns/access/land/property-online.asp