

# Impact of rezoning on socio-economic distribution in New York City

Performing a racial equity analysis to measure the change in diversity index over ten years in five such rezoned neighbourhoods and predicting the risk of gentrification in proposed neighbourhoods.

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# Index

## Impact of rezoning on socio-economic distribution in New York City

### Hypothesis

#### Null Hypothesis:

Rezoning in New York City has no effect on racial distribution.

#### Alternative Hypothesis:

Rezoning in New York City increases Racial Inequity, pushing long-time residents outside of their neighbourhoods

## Acknowledgement

This is to acknowledge all those without whom this project would not have been complete. Firstly, we are extremely grateful to our Professor, Stanislav Sobolevsky, who gave his immense support, helping us to refine our project.

Secondly, we'd like to express our deepest thanks to the learning opportunities provided by CUSP.

## 01

### Introduction

#### Page 1

This section gives an overview of the research.. It describes Urban Displacement, Rezoning, and the History of Diversity in the city of New York.

## 02

### Background and Motivation

#### Page 1

This section, states the purpose of your study, methods used to conduct the analysis

## 03

### Data Summary

#### Page 2

Discussing the source, relevance and ethics of the data sets selected for the research.

## 04

### Data Analysis and Visualization

#### Page 3 – 9

Quantitative analysis with line graphs representing the temporal change in the Diversity Index of each neighbourhood.

Quantitative analysis using diversity pies for each neighbourhood for 2001 and 2019.

Quantitative analysis of the Education and Median income of the neighbourhood over the span of ten years.

A comparative study using quantitative as well as qualitative analysis of Jerome Avenue and Gowanus.

Hypothesis testing of Density, Education and Per Capita income for all neighborhoods

## 05

### Conclusion: Discussion and Findings

#### Page 10

Research Findings and Discussion Quantitative analysis of demographic data to conduct temporal analysis of diversity Index, education and median income. Quantitatively

## 06

### Way Forward

#### Page 11

### Roles:

Vaidehi – Topic Leader, Qualitative Analysis, Turning Findings into Final PDF format

Jeff – Primary Data Coding for Data Analysis including Curation and Visualization

Howard – Primary Data Coding for Data Analysis including Curation and Visualization

Yaman – Data Coding for Data Analysis including Curation and Visualization and Hypothesis Testing Analysis

Matthew – Supplemental Data Coding for Data Analysis, Qualitative Analysis, Document Editing

All – Interpretation of Findings

# Introduction

## Abstract

CCity governments often characterize rezoning in favourable terms, but studies have shown that these proposals often have negative socio-economic consequences. We, therefore, sought to explore the effects of rezoning in seven New York City neighbourhoods. We investigated race, education, and income changes between 2009 and 2019 using quantitative analysis.

Our quantitative results indicate statistically insignificant changes in race and education over time but statistically significant changes in income. We concluded that these quantitative changes cannot be used to predict negative impacts of rezoning in future rezoned neighborhoods.

However, qualitative analysis is incongruous with these findings, as local experiences suggest that rezoning is economically and racially exclusionary. It is important that further studies be conducted to elucidate the effects of rezoning on the socio-economic profiles of neighbourhoods.

## Background and Motivation

### Rezoning

Rezoning has the potential to be a catalyst in urban development by incentivizing improvements in distressed neighbourhoods, increasing affordable housing units, and fostering economic development in the affected areas. However, it also has the potential to drive out longtime residents by creating unaffordable and untenable living conditions in the neighbourhoods. Upzoning, downzoning, and land-use changes can impact the residential capacity of the neighbourhoods and their real estate prices, resulting in changes in local demographics. It is therefore imperative that precautionary measures be taken and rigorous analysis is conducted to understand the impact of rezoning and its potential negative socio-economic consequences. While it is impossible to predict exactly how, and to what extent, rezoned neighbourhoods will change, clues from the past can be used to estimate the future development patterns in these affected areas.

## Research Questions

Does Rezoning create increased socio-economic disparity in New York City, in terms of race, education, and income levels in affected neighborhoods?

### Objective

#### **Primary Quantitative:**

- Measuring the risk of displacement in rezoned neighbourhoods disaggregated by race/ethnic group, education level, and per capita income levels:
  - Evaluate the change in racial composition over time
  - Evaluate the change in educational composition over time
  - Evaluate the change in per capita income over time

#### **Qualitative: Desk Research:**

- How rezoning has affected the lives of residents in the rezoned neighbourhoods outside of the findings readily available from the data

### Limitations

1. Inconsistencies were observed in the labelling of race and segregation of categories. The major issue was the lack of a proper definition of each category, especially Hispanic/Latino.
- 2.. Lack of racial information in real estate data, education as well as median income data prevented us from being able to measure how the costs and benefits of such an action are distributed across racial/ethnic groups

# O3

## Data Summary

The primary data source for the project was the American Community Survey (ACS) 5-year estimate data for census tracts in New York City. We utilized ACS data profiles for race, education, and income statistics, which provide population counts and percentages for each category.

For racial diversity, the population percentages for 8 non-overlapping racial categories were considered. These percentages were then used to create a Simpson's diversity index for each census tract. For education, an average categorical educational composition was created for each neighborhood each year. For income, the per capita income for individuals over 16 years old was calculated for each neighborhood each year.

While the data provides statistics about sensitive information such as race, education level, and income, all of the data is aggregated and hence the ethical concerns in using this data are limited. However, it should be noted that as a sample survey, the data does suffer from non-response bias, where certain vulnerable sections of the community might not be reachable and hence underrepresented in the data. Similarly, other sections might be overrepresented.

## References

- 1.<https://www.census.gov/library/stories/2021/08/2020-united-states-population-more-racially-ethnically-diverse-than-2010.html>
- 2.<https://www.urbandisplacement.org/gentrification-explained>
- 3.<https://metropolitics.org/When-Measurement-Matters-Displacement-Gentrification-Residential-Mobility.html>
- 4.[https://www.urban.org/research/publication/guide-measuring-neighborhood-change-understand-and-prevent-displacement/view/full\\_report](https://www.urban.org/research/publication/guide-measuring-neighborhood-change-understand-and-prevent-displacement/view/full_report)
- 5.<https://www.opportunityatlas.org>
- 6.NYC Rezoning Commitments Tracker (<https://morr.maps.arcgis.com>)
- 7.<https://www.census.gov/library/stories/2021/08/2020-united-states-population-more-racially-ethnically-diverse-than-2010.html>

# Quantitative Analysis

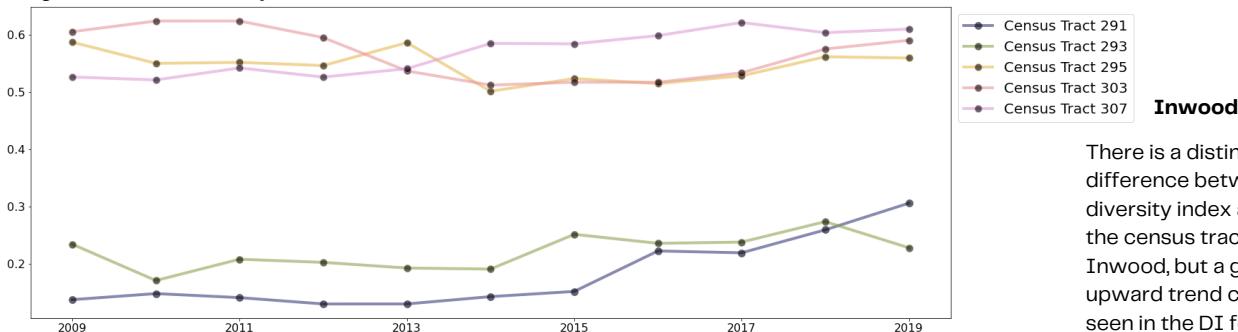
## Diversity Index

We use the Diversity Index (DI) to measure the probability that two people chosen at random will be from different racial and ethnic groups. The DI is bounded between 0 and 1. A value of 0 indicates that everyone in the population has the same racial and ethnic characteristics. A value close to 1 indicates that almost everyone in the population has different racial and ethnic characteristics. We also used K-S hypothesis testing to determine statistical significance between the DI of each neighborhood (across all tracts) in 2009 vs. 2019. We used a 95% confidence interval to determine statistical significance.

## Diversity Pie Charts

These pie charts show the racial composition of the neighbourhoods for the years 2009 and 2019 helping us compare and analyse the change in demographic compositions over 10 years. The analysis could help us consider how the anticipated racial composition of the new development would influence existing patterns. We also used K-S hypothesis testing to determine statistical significance between the demographic composition of each neighborhood (across all tracts) in 2009 vs. 2019. We used a 95% confidence interval to determine statistical significance.

Figure 1 – Inwood : Diversity Index



There is a distinct difference between the diversity index across all the census tracts in Inwood, but a general upward trend can be seen in the DI for each tract. There is no statistical significance between the demographic composition in 2009 vs. 2019.

Figure 2 – Inwood: Diversity Pie 2009

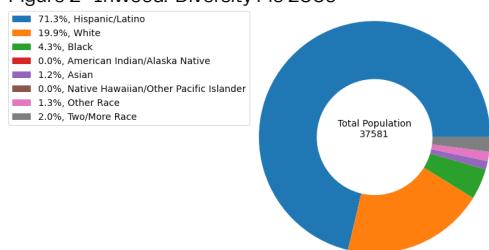
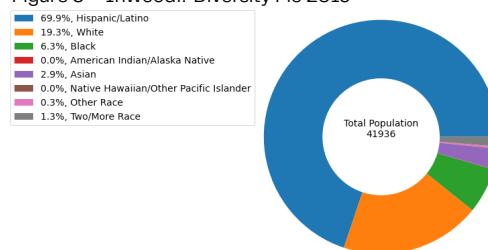
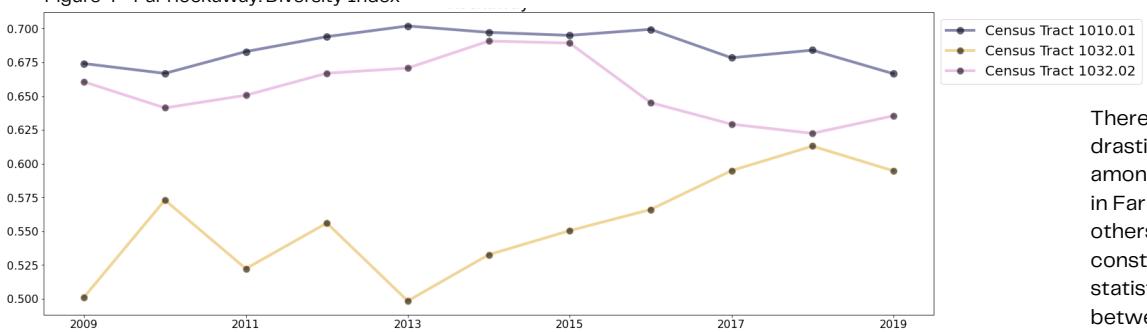


Figure 3 – Inwood: Diversity Pie 2019



Far Rockaway

Figure 4 – Far Rockaway: Diversity Index



There appears to be a drastic upward trend in DI amongst one of the tracts in Far Rockaway, while the others remained primarily constant. There is no statistical significance between the demographic composition in 2009 vs. 2019.

Figure 5– Far Rockaway Diversity Pie 2009

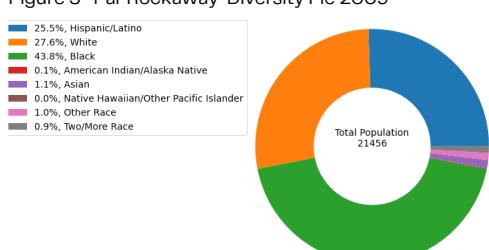
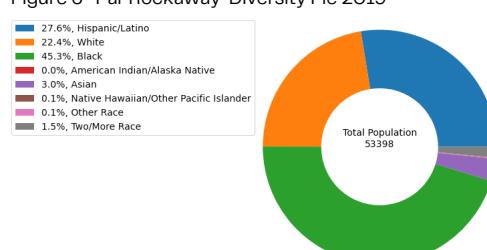
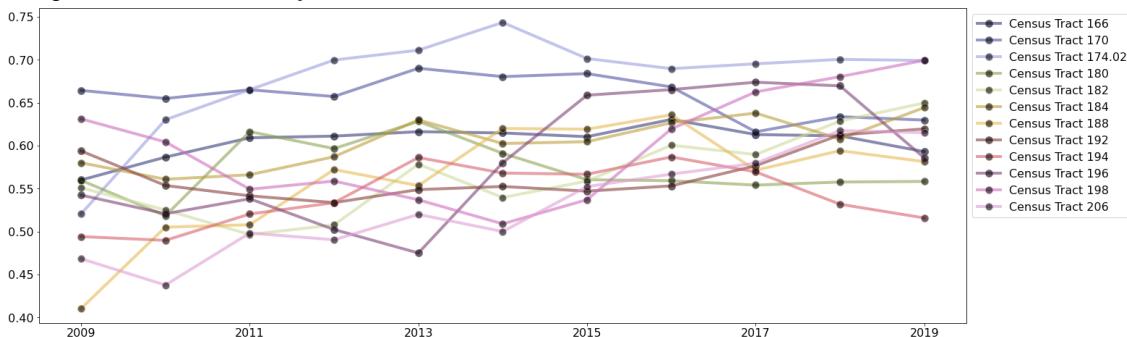


Figure 6– Far Rockaway Diversity Pie 2019



# Quantitative Analysis

Figure 7- East Harlem: Diversity Index



## East Harlem

There appears to be a general upward trend amongst all of the tracts in East Harlem. There is statistical significance between the demographic composition in 2009 vs. 2019.

Hispanic/Latino and Black alone categories markedly decreased, while White alone and Asian alone categories markedly increased.

Figure 8- East Harlem Diversity Pie 2009

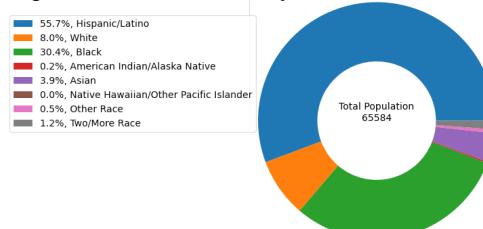
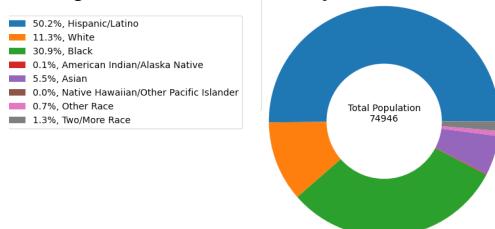


Figure 9- East Harlem Diversity Pie 2019



## East New York

There appears to be a general stasis amongst all census tracts in East New York. There is no statistical significance between the demographic composition in 2009 vs. 2019.

Figure 10- East New York Diversity Index

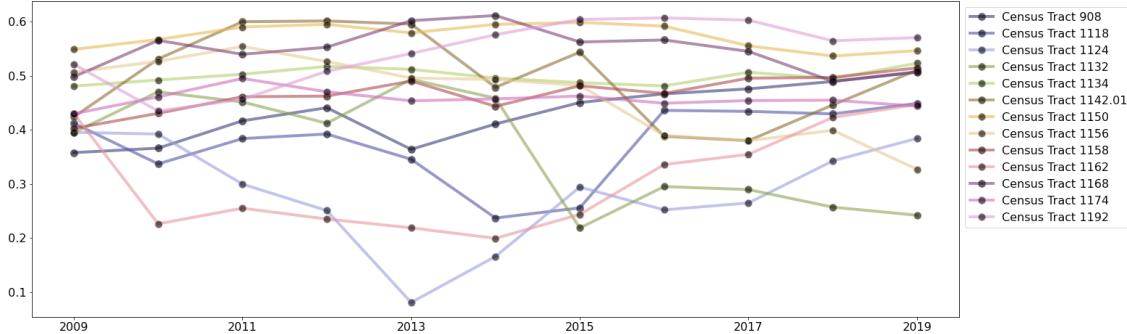
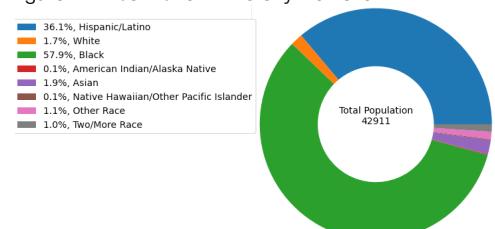


Figure 11- East Harlem Diversity Pie 2009



Figure 12- East Harlem Diversity Pie 2019



## Bay Street

There seems to be a general upward trend amongst both the tracts of Bay Street. There is no statistical significance between the demographic composition in 2009 vs. 2019.

Figure 13- East New York Diversity Index

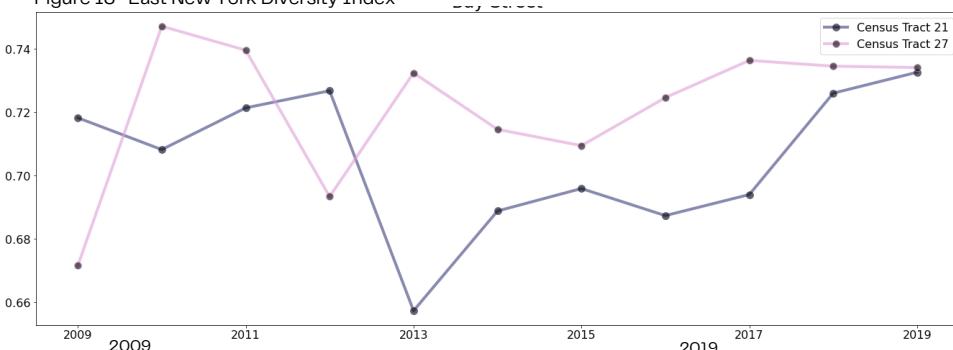
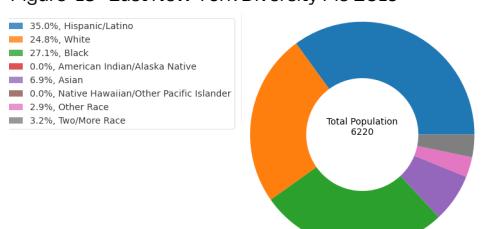


Figure 14- East New York Diversity Pie 2009



Figure 15- East New York Diversity Pie 2019



# Quantitative Analysis

## Education and Median Income

Figure 16- Inwood: Education Composition

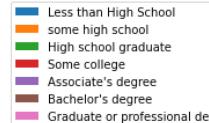
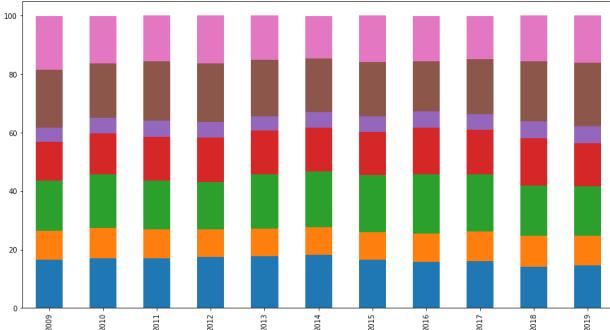


Figure 19- East New York Education Composition

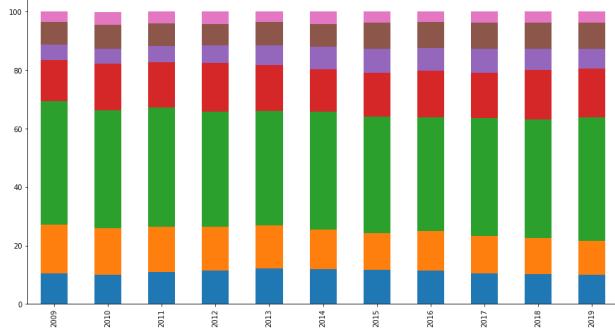


Figure 17- Far Rockaway Education Composition

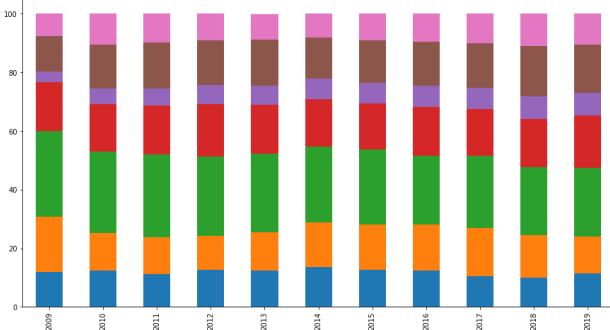


Figure 20- Bay Street Education Composition

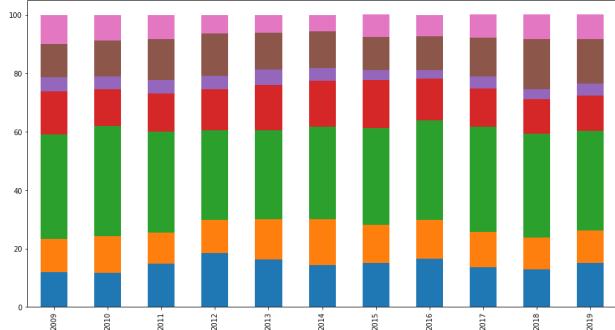
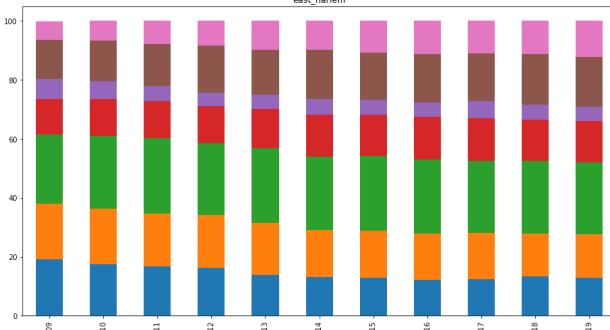


Figure 18- East Harlem Education Composition

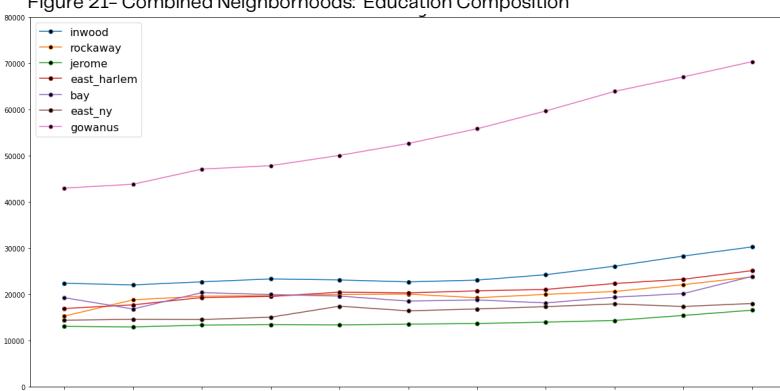


Above are the average educational level compositions for each neighbourhood across the ten year period from 2009 to 2019. Each bar is an amalgamation of the census tracts in their respective neighbourhoods.

From the naked eye, there appear to be two notable trends: residents with bachelor's degrees are increasing, and residents with little to no high school education are decreasing across the neighbourhoods. However, following K-S hypothesis testing at a 95% confidence interval, the only statistically significant changes are the following:

1. In East Harlem, residents with no high school education and associate's degrees decreased while residents with graduate degrees increased
2. In East New York, residents with some school education decreased

Figure 21- Combined Neighborhoods: Education Composition



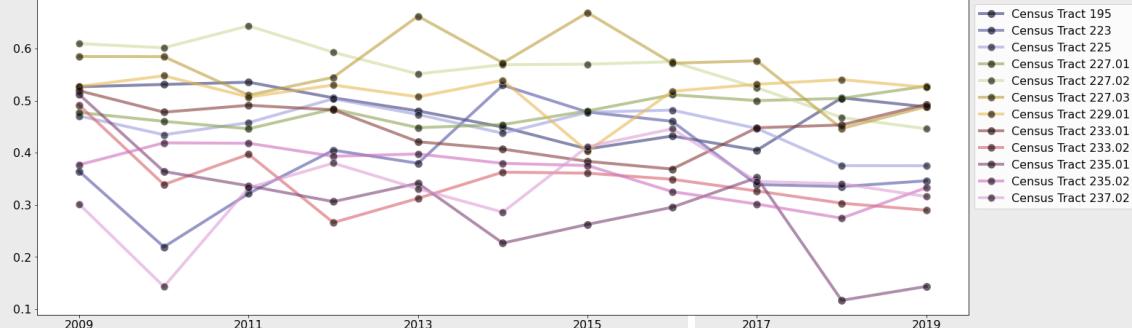
The per capita income graphs indicate a general upward trend in per capita income across the five neighbourhoods, but only two of the five neighbourhoods had statistically significant changes between 2009 and 2019: East Harlem and East New York.

# Comparative Analysis Quantitative

In this section, we will look to compare the trajectories of socio-economic changes in the neighbourhoods of Jerome Avenue and Gowanus as shown via each neighbourhood's quantitative analyses with the via of citizens organizations. These citizens organizations' views demonstrate a qualitative analysis of the existing and proposed rezoning plans for these two neighbourhoods.

## Jerome Introduction

Figure 22- Jerome Diversity Index



A general downward trend in DI is seen amongst all census tracts in the neighbourhood surrounding Jerome Avenue, with tract 235.01 having the most drastic decrease. There is no statistical significance between the demographic composition in 2009 vs. 2019. At the same time, the overall population doubled.

Figure 24 – Jerome Diversity Pie 2009

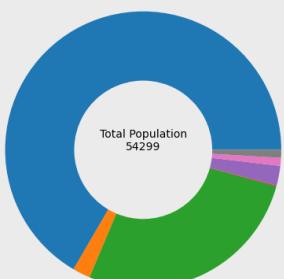
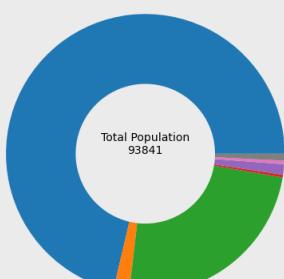
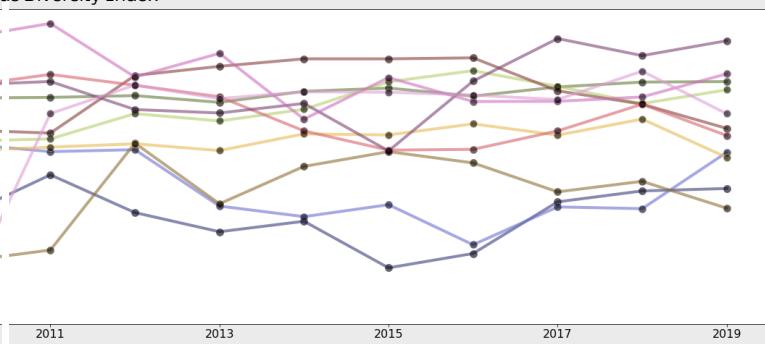


Figure 25 – Jerome Diversity Pie 2019



## Gowanus Conclusion

Figure 23- Gowanus Diversity Index



There appears to be a general stasis in DI across all tracts in the neighborhood of Gowanus. There is no statistical significance between the demographic composition in 2009 vs. 2019. At the same time, the overall population only increased by roughly 2500 persons.

Figure 26 – Gowanus Diversity Pie 2009

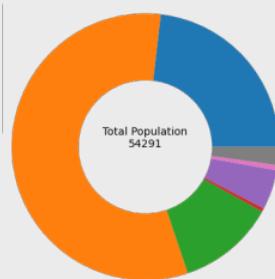
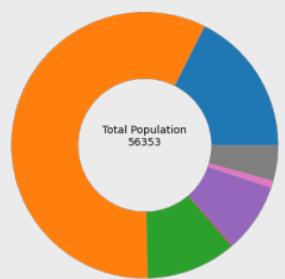


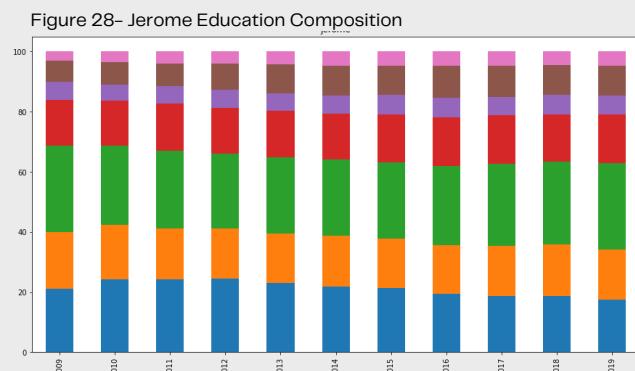
Figure 27 – Gowanus Diversity Pie 2019



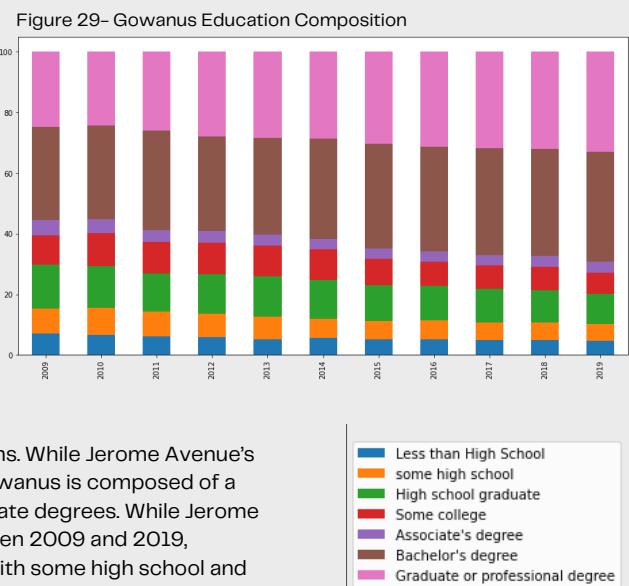
# Comparative Analysis Quantitative

In this section, we will look to compare the trajectories of socio-economic changes in the neighbourhoods of Jerome Avenue and Gowanus as shown via each neighbourhood's quantitative analyses with the via of citizens organizations. These citizens organizations' views demonstrate a qualitative analysis of the existing and proposed rezoning plans for these two neighbourhoods.

## Jerome Education and Income



## Gowanus Education and Income



The two neighbourhoods have vastly different educational compositions. While Jerome Avenue's educational composition is similar to the others, the composition of Gowanus is composed of a considerably higher percentage of residents with bachelor's and graduate degrees. While Jerome had no statistically significant educational composition changes between 2009 and 2019, Gowanus experienced statistically significant decreases in residents with some high school and some college education, and increases in residents with bachelor's and graduate degrees.

Figure 30 - Jerome: Average Per Capita Income

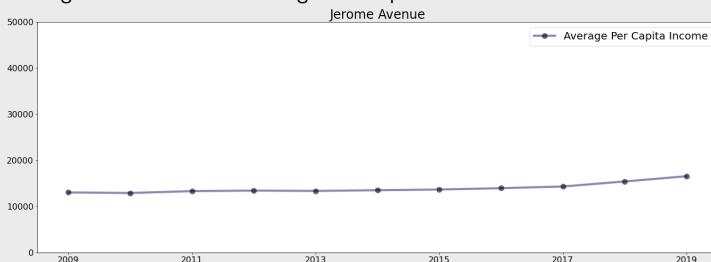
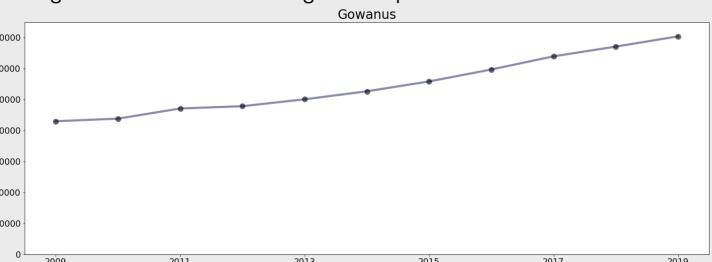


Figure 31 - Gowanus: Average Per Capita Income



# Comparative Analysis Qualitative

In this section, have attempted to analyse qualitatively the impact of rezoning on the neighborhood. We have attempted to understand this by comparing the proposal objectives with user experiences and opinions.

## References

- 1.<https://www1.nyc.gov/site/planning/plans/jerome-ave/jerome-ave.page>
- 2.<https://citylimits.org/2021/10/20/3-years-after-bronx-rezoning-jerome-avenue-auto-shops-under-pressure/>
- 3.[https://www.voiceofgowanus.org/what\\_is\\_the\\_gowanus\\_rezone](https://www.voiceofgowanus.org/what_is_the_gowanus_rezone)
- 4.[https://centerforspatialresearch.github.io/conflict\\_urbanism\\_sp2020/2020/05/07/davis.html](https://centerforspatialresearch.github.io/conflict_urbanism_sp2020/2020/05/07/davis.html)
- 5.<https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/gowanus/proposal-overview-tech-spec-handout.pdf?r=3>
- 6.<https://brooklyn eagle.com/articles/2021/11/10/land-use-committee-oks-gowanus-rezoning-now-heads-to-full-council/>
- 7.<https://www.thecity.nyc/brooklyn/2021/8/8/22615910/gowanus-rezoning-could-make-more-diverse-brooklyn>
- 8.<https://www.fox5ny.com/news/gowanus-rezoning-approved-but-critics-remain>

## Jerome An Overview

Four years of neighbourhood planning preceded Jerome Avenue's rezoning plan, which includes investments in affordable housing construction and preservation as one of its key components. This proposal is part of Housing New York, the Mayor's housing plan to foster a fair and liveable city by increasing and preserving affordable housing.

The proposal aims to address the issue of congestion, lack of residential infrastructure, and lack of pedestrian amenities. Currently, the area does not permit residential infrastructure, and the zoning norms allow only commercial and light industrial uses. Since the rezoning proposal, the city's Department of Housing Preservation and Development has financed 1024 new affordable homes, primarily serving low-income households.

After three years of rezoning, one of the most questioned aspects is that city officials had committed \$15 Million in financial assistance to area merchants facing displacement after the 2018 rezoning plan. However, officials have yet to issue these grants, a City Limits investigation found. As a result, the influx of new housing forced many merchants to evict and has only exacerbated rent concerns for those merchants that remain.

The Rezoning plan of Jerome Avenue has become a classic example of Conflicted Urbanism. Nathan Kensinger of Curbed NY wrote that this proposal has paved the way for upscale development and rapid gentrification of this corridor of the Bronx. In a detailed investigation for 2015–2020 by The Centre of Spatial Research, they concluded that the neighbourhood had experienced excessive speculation in real estate. Property values in the rezoned areas have increased by 241%. Residential properties have witnessed a change in valuation by about 176%. Their research also indicated that approximately 2500 households and businesses were evicted in this area, accounting for about one-third of total evictions in the Bronx.



Source:  
[https://centerforspatialresearch.github.io/conflict\\_urbanism\\_sp2020/2020/05/07/davis.html](https://centerforspatialresearch.github.io/conflict_urbanism_sp2020/2020/05/07/davis.html)

## Gowanus An Overview

A neighborhood development plan was recently approved by the City Council for the neighborhood of Gowanus in Brooklyn. The plan is multi-faceted, focusing on climate resiliency, cleanup of the neighborhood canal, and expansion of housing(citation). The plan seeks to increase the number of housing units available in the neighborhood at both "market rate and...for lower-income New Yorkers,"(citation). Elsewhere, the plan calls for remediation of brownfield sites to repurpose this land for residential and commercial units.

While the plan is promising, especially with respect to expanding affordable housing opportunities(citation), local organizations offer opinions that conflict with the city's proposed rezoning effects. Prior to the proposal's recent approval, representatives from the local civic organization, Voice of Gowanus, argued against the rezoning, with specific concern that the new housing units (to house an expected 30,000 new persons), would add to the critical problem of sewage overflow in the area(citation).

While the new plan promises to allot approximately 3,000 of the proposed 8,000 housing units for low-income residents(citation), Voice of Gowanus expresses concern over adding more housing to the area without addressing the issues of brownfield sites and toxic land and water(citation). According to the Diversity Pie Charts shown, an additional 30,000 new persons would increase the population of the neighborhood by almost 55%. While a considerable allotment of affordable housing units offers the promise of increased diversity and assurance of neighbourhood affordability, Voice of Gowanus offers important counterpoints as to how healthy or safe the area may prove for these new residents.



Source:  
[https://www.voiceofgowanus.org/what\\_is\\_the\\_gowanus\\_rezone](https://www.voiceofgowanus.org/what_is_the_gowanus_rezone)

# Quantitative Analysis

## Hypothesis Testing

"We used K-S hypothesis testing at a 95% confidence interval to compare the distribution across all census tracts in each neighborhood in 2009 with the distribution across all census tracts in each neighborhood in 2019. This helped us determine whether there was a statistically significant change in the distribution over the ten year period."

Figure 32 – Hypothesis Testing Matrix

Neighbourhoods	Diversity Index 2009-2019	Income per Capita 2009-2019
Inwood	statistic= 0.233 pvalue= 0.991	statistic= 0.4 pvalue= 0.688
Far Rockaway	statistic=0.333 pvalue=0.933	statistic= 0.714 pvalue= 0.167
East Harlem	statistic= 0.535 pvalue= 0.032	statistic= 0.607 pvalue= 0.010
East New York	statistic= 0.401 pvalue= 0.182	statistic= 0.637 pvalue= 0.003
Baystreet	statistic= 1.0 pvalue= 0.333	statistic= 0.5 pvalue= 1
Jerome	statistic= 0.321 pvalue= 0.338	statistic= 0.678 pvalue= 0.001
Gowanus	statistic= 0.15 pvalue= 0.978	statistic= 0.688 pvalue= 0.001

Figure 33 – Hypothesis Testing , Comparison Matrix, Diversity

Neighborhood	Hispanic/ Latino	White Alone	Black or African American Alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races
Inwood	0.965	0.991	0.818	0.818	0.108	1	0.025	0.238
Far Rockaway	0.7	0.85	0.533	0.25	0.066	1	0.533	0.4
Jerome	0.104	0.17	0.227	0.991	0.226	1	0.708	0.752
East Harlem	0.684	0.205	0.978	0.934	0.300	1	0.797	0.853
Baystreet	0.333	1	0.333	1	0.333	1	0.333	0.333
East New York	0.492	0.024	0.972	1	0.182	1	0.651	0.288
Gowanus	0.123	0.497	0.273	0.987	0.022	1	0.037	0.006

Figure 34 – Hypothesis Testing , Comparison Matrix, Education

Neighborhood	Less than High School	some high school	High school graduate	Some college	Associate's degree	Bachelor's degree	Graduate or professional degree
Inwood	0.688	0.965	0.818	0.818	0.018	0.818	0.965
Far Rockaway	0.4	0.4	0.7	0.7	0.066	0.533	0.533
Jerome	0.124	0.70	0.795	0.8	0.4240	0.062	0.147
East Harlem	0.012	0.073	0.425	0.230	0.008	0.230	0.003
Baystreet	1	1	1	0.333	1	0.333	1
East New York	0.952	0.938	0.938	0.343	0.397	0.221	0.557
Gowanus	0.0933	0.142	0.142	0.0320	0.223	0.009	0.022

# Conclusion

The basis of our research was the hypothesis that rezoning is an exclusionary phenomenon and leads to socio-economic disparities in racial diversity, education levels, and per capita income in the seven neighbourhoods we studied over the ten year period from 2009 to 2019.

## 05 Discussion and Findings

Three of the four metrics used failed to reject the null hypothesis that rezoning would produce no change in socio-economic disparity across the seven neighborhoods. The diversity index graphs failed to reject the null hypothesis that four or more neighborhoods would produce a statistically significant change in diversity index over the ten year period. The diversity composition charts failed to reject the null hypothesis that four or more neighborhoods would produce a statistically significant change in two or more races over the ten year period. The education graphs failed to reject the null hypothesis that four or more neighborhoods would produce a statistically significant change in two or more educational groups over the ten year period.

However, the per capita income graphs did successfully reject the null hypothesis, as four of the seven neighborhoods showed a statistically significant change over the ten years: Jerome Avenue, East Harlem, East New York, and Gowanus. Full results hypothesis testing can be found in the appendix on page 6.

Quantitative Results for Jerome and Gowanus:

The quantitative analysis of both Jerome and Gowanus have not been statistically significant for analysing the diversity index. The changes for Jerome were insignificant for diversity and educational composition as well. Some statistically significant inferences can be derived from Jerome's per capita income graph, suggesting a slight increase in per capita income after 2017. The analysis for diversity composition education composition and per capita income was statistically significant, suggesting that the neighbourhood is predominantly white and equitable.

Jerome's quantitative results do not inform potential changes in Gowanus, but qualitative analysis might. Gowanus is already experiencing statistically significant phenomena that indicate a gentrifying neighborhood. Can rezoning fix that?

The quantitative results for Jerome Avenue followed the trend of non-statistical significance observed in the other neighborhoods, making it non-conclusionary for predicting potential changes in Gowanus. However, the qualitative results.

Jerome has promised its residents the construction and preservation of affordable housing and 1.5 million reimbursements for displaced commercial business. However, the new residential development has experienced speculation of almost 200 per cent, and reimbursement seems like a lost promise of the past. Gowanus is promising multifaceted climate resiliency, cleanup of neighborhood canal and expansion of affordable housing. Gowanus' statistically significant results already indicate a trend towards gentrification: residents are becoming wealthier, more educated, and only slightly more diverse

# 06 Way Forward

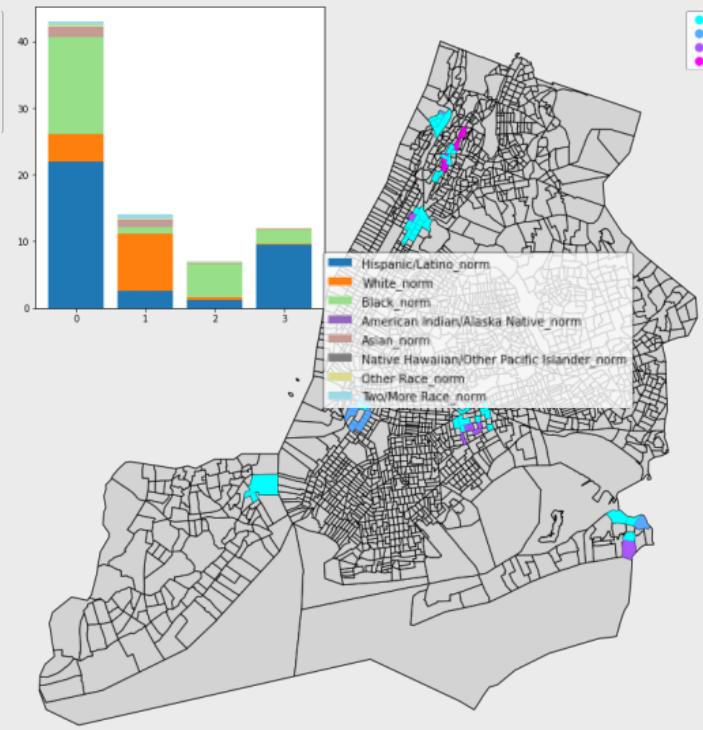
While year to year trends ultimately offered more insights into the socio-economic changes observed in the neighbourhoods, we do believe that future studies should be conducted using unsupervised clustering analysis techniques to observe changes in neighbourhoods over time. As an example, we conducted a racial clustering analysis of the seven neighbourhoods studied for 2010 and 2019. The analysis approximates the distribution of the races normalized by census tract population. Each cluster tells us about the estimated diversity of that census tract location. Therefore, we can understand the impact before and after rezoning initiation. Choosing the right cluster number is important to avoid clusters with repeated characteristics and oversimplification.

It's important to note that while clustering color changes between 2010 and 2019, the data remains constant, following our previous observations of diversity. In general, each neighbourhood is dominated by a specific cluster, but individual census tracts within each neighbourhood can highlight changes in demographics. Cluster analysis can help future rezoning plans by understanding which tracts experienced more of a demographic shift, and what on the street qualitative changes caused this shift.

Figure 35 – Unsupervised Clustering 2010



Figure 36 – Unsupervised Clustering 2019



- Figure 1 – Inwood: Diversity Index
- Figure 2- Inwood: Diversity Pie 2009
- Figure 3 – Inwood: Diversity Pie 2019
- Figure 4 – Far Rockaway: Diversity Index
- Figure 5- Far Rockaway Diversity Pie 2009
- Figure 6- Far Rockaway Diversity Pie 2019
- Figure 7- East Harlem: Diversity Index
- Figure 8- East Harlem Diversity Pie 2009
- Figure 9- East Harlem Diversity Pie 2019
- Figure 10- East New York Diversity Index
- Figure 11- East Harlem Diversity Pie 2009
- Figure 12- East Harlem Diversity Pie 2019
- Figure 13- East New York Diversity Index
- Figure 14- East New York Diversity Pie 2009
- Figure 15- East New York Diversity Pie 2019
- Figure 16- Inwood: Education Composition
- Figure 17- Far Rockaway Education Composition
- Figure 18- East Harlem Education Composition

## List of Figures

- Figure 19- East New York Education Composition
- Figure 20- Bay Street Education Composition
- Figure 21- Combined Neighborhoods: Education Composition
- Figure 22- Jerome Diversity Index
- Figure 23- Gowanus Diversity Index
- Figure 24 – Jerome, Diversity Pie 2009
- Figure 25 – Jerome, Diversity Pie 2019
- Figure 26 – Gowanus, Diversity Pie 2009
- Figure 27 – Gowanus, Diversity Pie 2019
- Figure 28- Jerome Education Composition
- Figure 29- Gowanus Education Composition
- Figure 30 – Jerome: Average Per Capita Income
- Figure 31 – Gowanus: Average Per Capita Income
- Figure 32 – Hypothesis Testing Matrix
- Figure 33 – Hypothesis Testing , Comparison Matrix, Diversity
- Figure 34 – Hypothesis Testing , Comparison Matrix, Education