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MEASURING THE IMPACT OF FLOODING RISK ON AFFECTED HOUSING MARKET



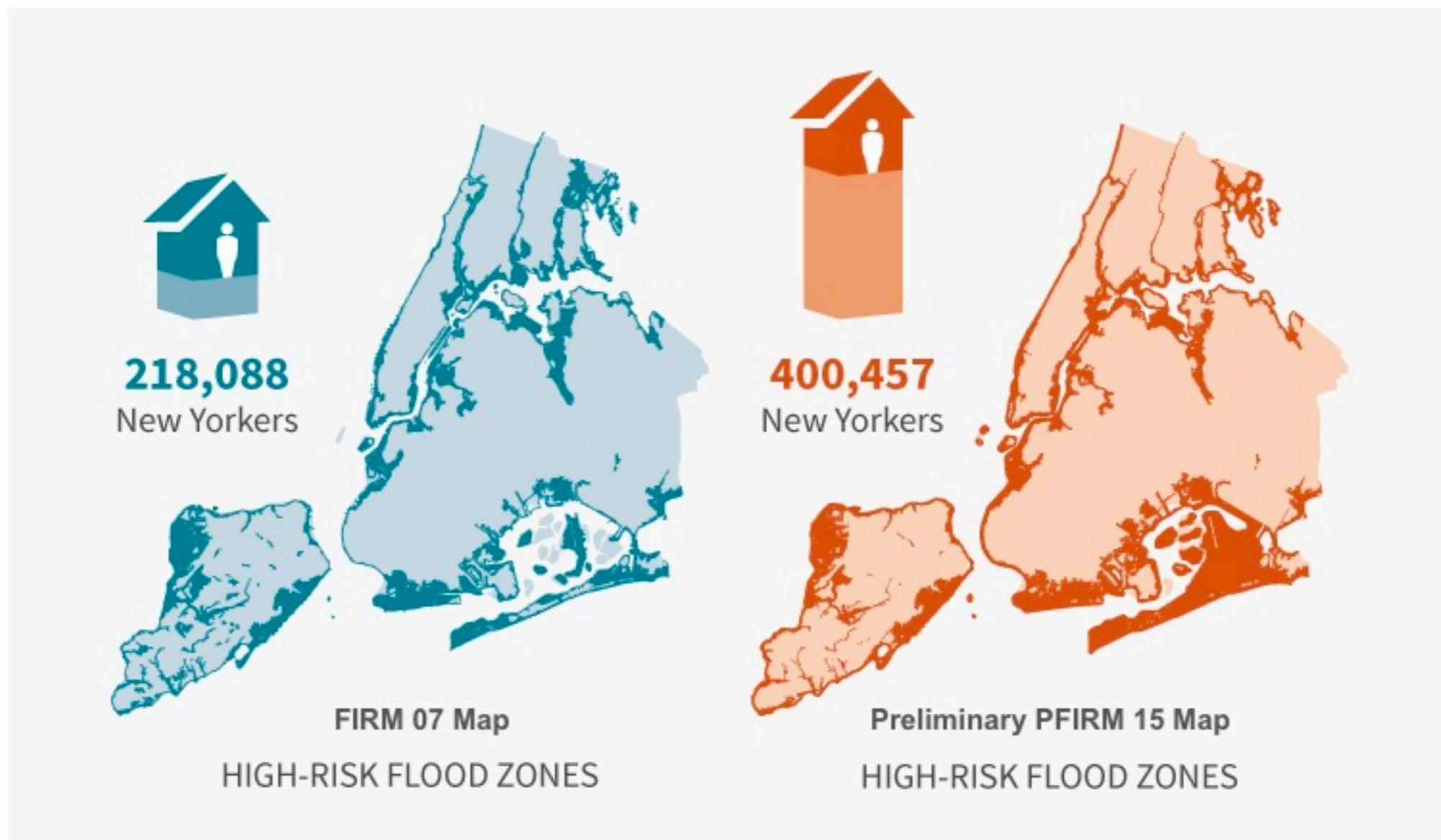
Objective

**observe, analyze, and predict
housing prices in flood zone areas**

- Analyze housing market **trends**
- Predict **future** housing prices in flood zone areas
- Assess impact on **neighboring** non-flood zone areas

Introduction

- 80% properties built before PFIRM15



Recent Studies

① Observation of recent flood resilience

UNC

- Effects of flooding **diminish** 5-6 years after a major flooding hurricane event

CUNY

- Flood risk have impacted **both** damaged and undamaged properties in Sandy hit areas

② Prediction methodology

- **Very little** studies on **predicting** flood zone housing prices and their **impacting** factors
- **StreetEasy**

Data



NYPD



- Crime NYPD complaint
- Felony
- Misdemeanor
- Violation

- Population Density
- Household Income
- Unemployment
- Move in time
- Second Mortgage
- Occupied



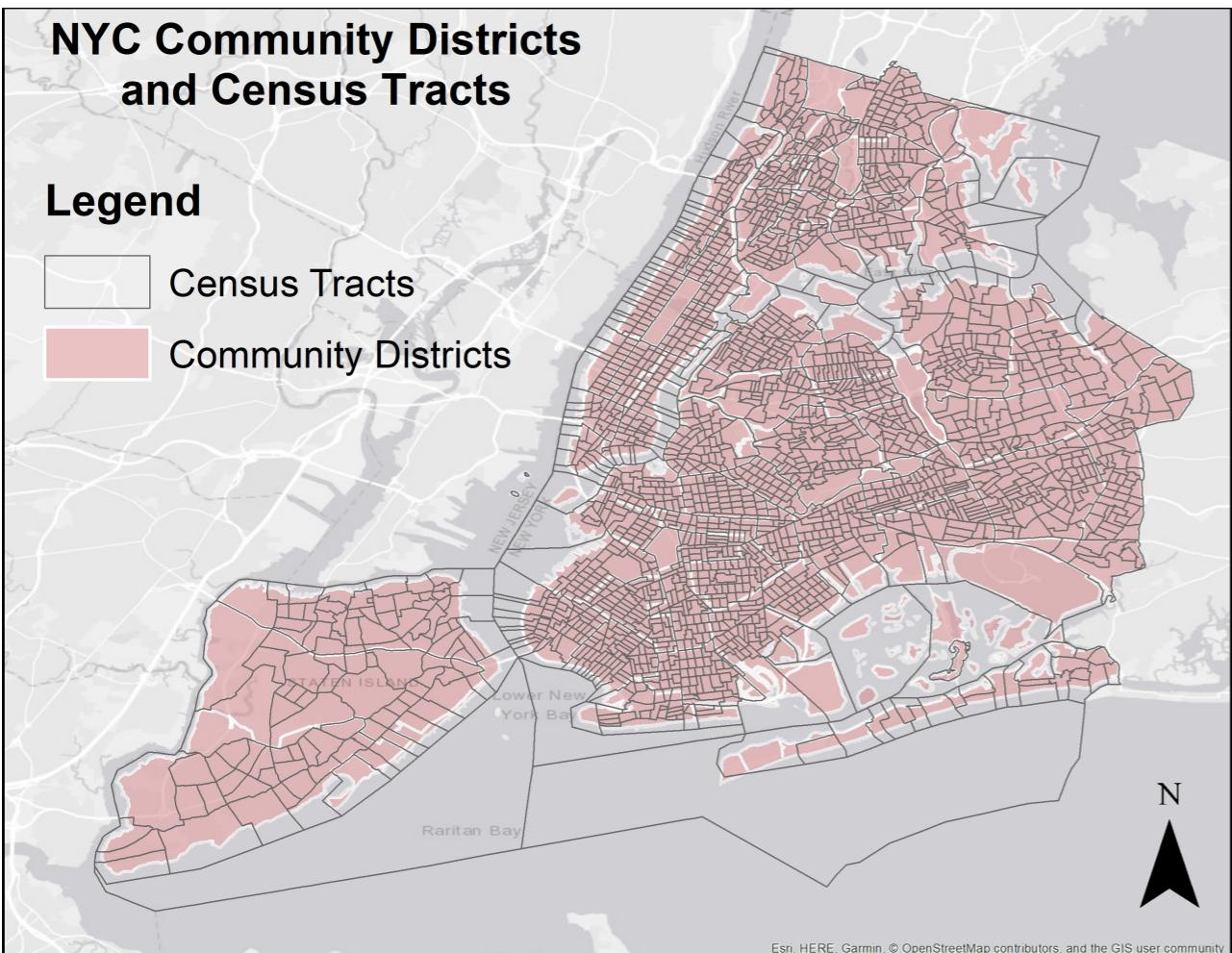
- Housing Total Value
- Square Footage



- Pluto Flood Zone Maps

Data Processing

- Community Districts in NYC
 - Too Large
- Census Tracks in NYC
- Legacy flood map for each census tract
 - FIRM07 - 389 tracts
 - PFIRM15 - 465 tracts
- **Compare FIRM07 and PFIRM15**
Housing market for **flood zone** areas and **non-flood zone** areas in the **same** community district

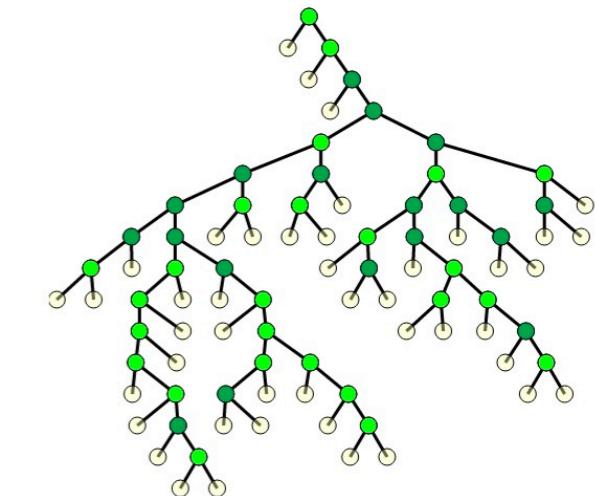


Methodology

1

Z-test

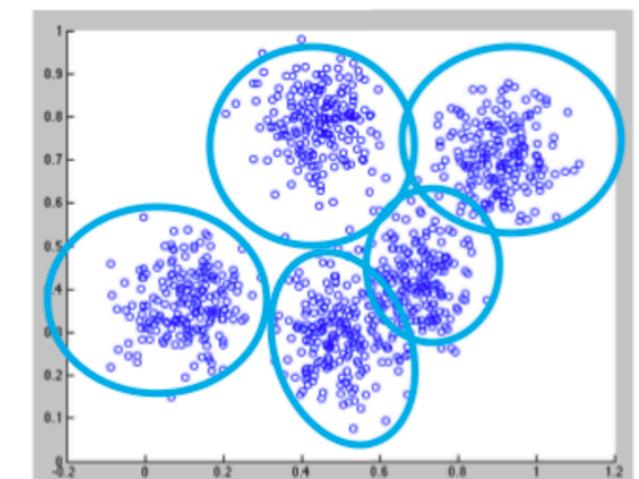
- Housing Price Changes



2

Decision Tree

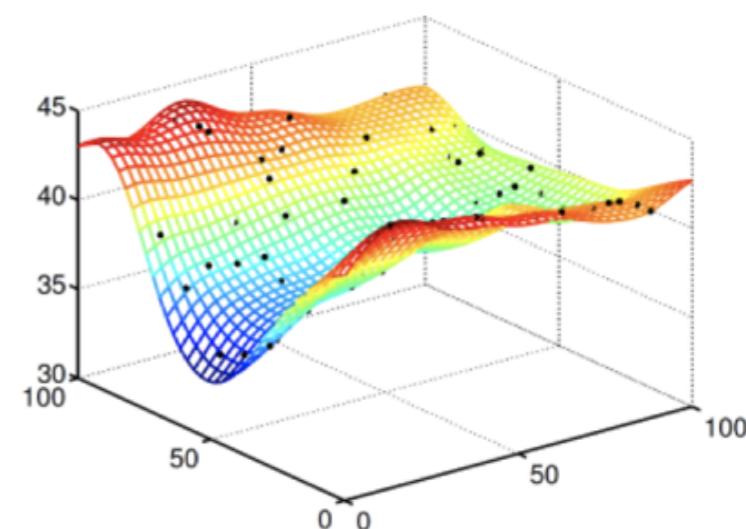
- Feature Importance



3

Clustering

- Housing Price Changes
- Increasing Price Rate



4

Kriging Model

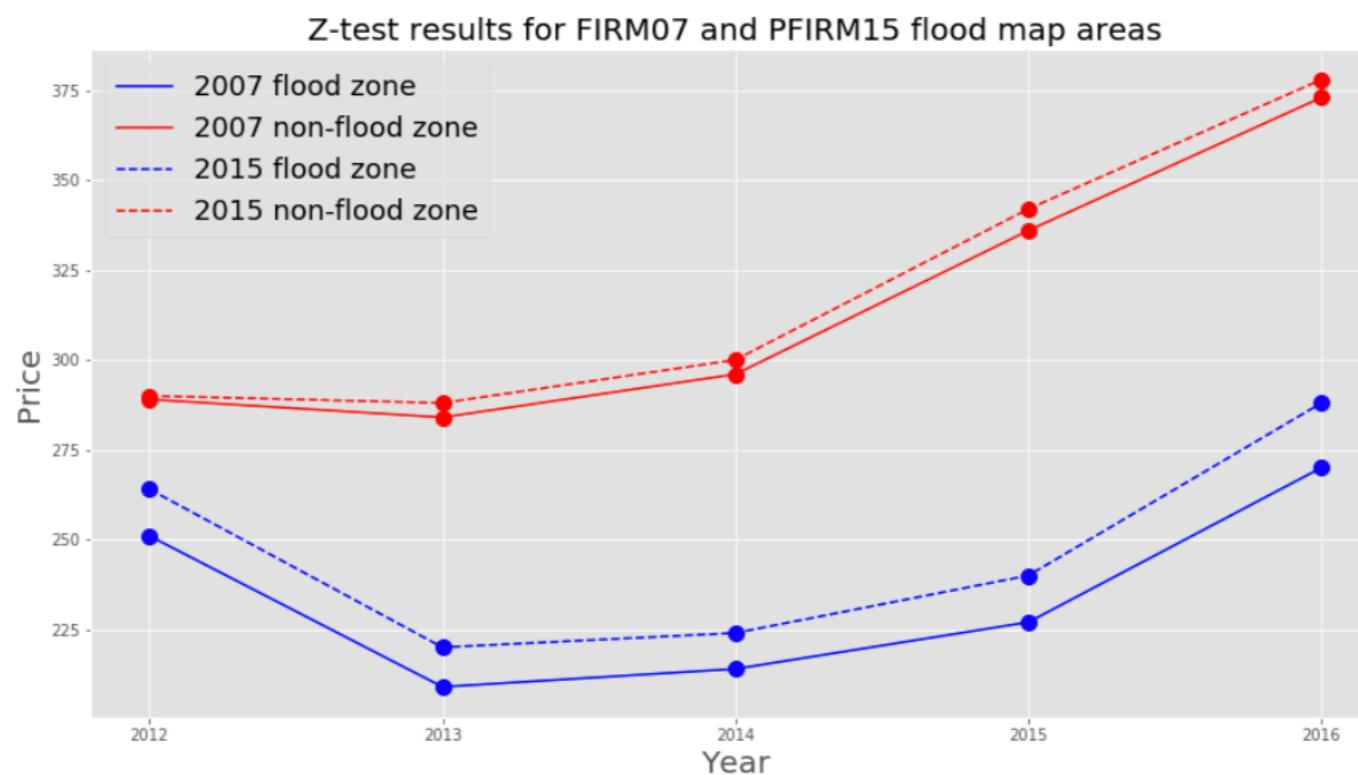
- Predict housing prices
at a certain point

Results

1

Z-test

- **Dummy Variables**
 - 0 = houses in non-flood zone areas
 - 1 = houses in flood zone areas
- **Two Z-tests Implemented**
 - 1) 2012 - 2013
 - 2) 2012 - 2016



Results

1

Z-test

- **Null Hypothesis (H_0)**

the average increasing rate of property value in non-flood zone areas is lower than or equal to the average increasing rate in flood zone areas.

- **Alternative Hypothesis (H_a)**

the average increasing rate of property value in non-flood zone areas is higher than the average increasing rate in flood zone areas.

- **Significance level $\alpha=0.05$**

Results

2

Decision Tree

- 1) Years 2012 - 2013
- 2) Years 2012 - 2016

Feature Importance

| | | |
|---|------------|----------|
| 1 | unemployed | 0.276791 |
| 4 | mortgage | 0.2683 |
| 6 | felony | 0.204121 |
| 0 | density | 0.137622 |
| 3 | occupied | 0.113166 |

Results

2

Decision Tree

- 1) Years 2012 - 2013
- 2) Years 2012 - 2016

Feature Importance

| | | |
|---|------------|----------|
| 1 | unemployed | 0.790593 |
| 5 | movein | 0.209407 |
| 0 | density | 0 |
| 2 | income | 0 |
| 3 | occupied | 0 |

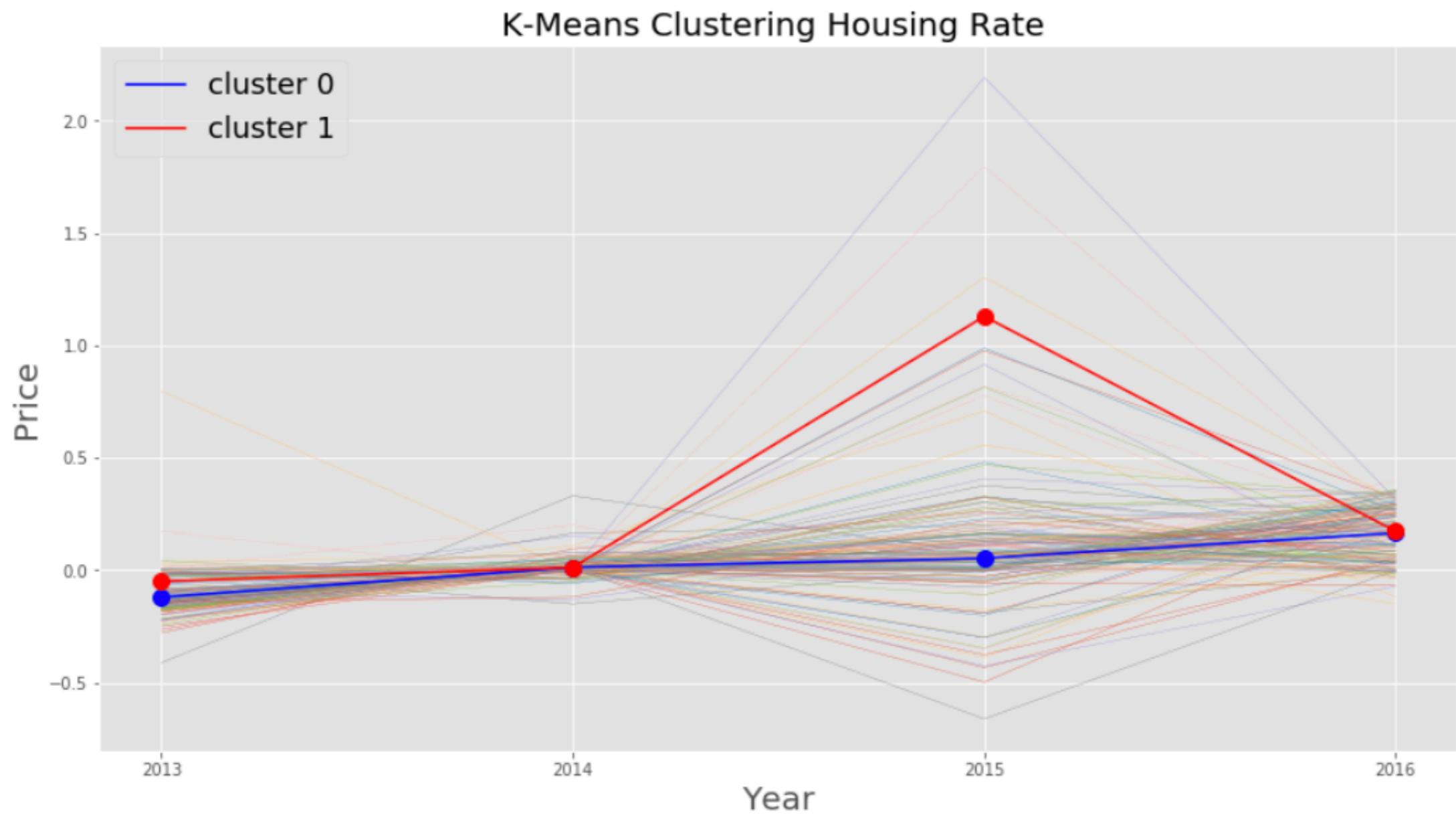
Results

3

Clustering

FIRM07 Housing Rates

PFIRM15 Housing Rates



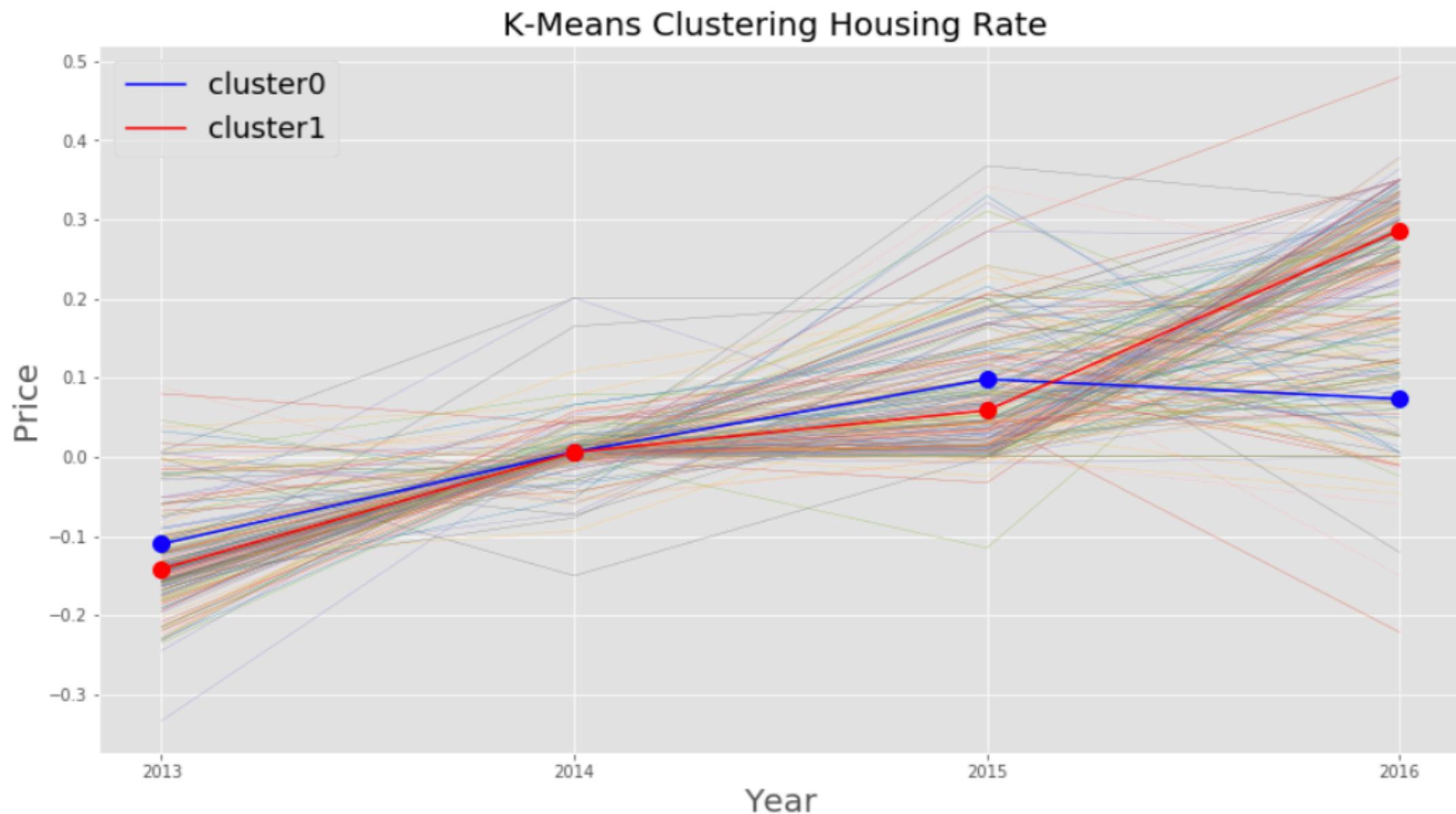
Results

3

Clustering

FIRM07 Housing Rates

PFIRM15 Housing Rates



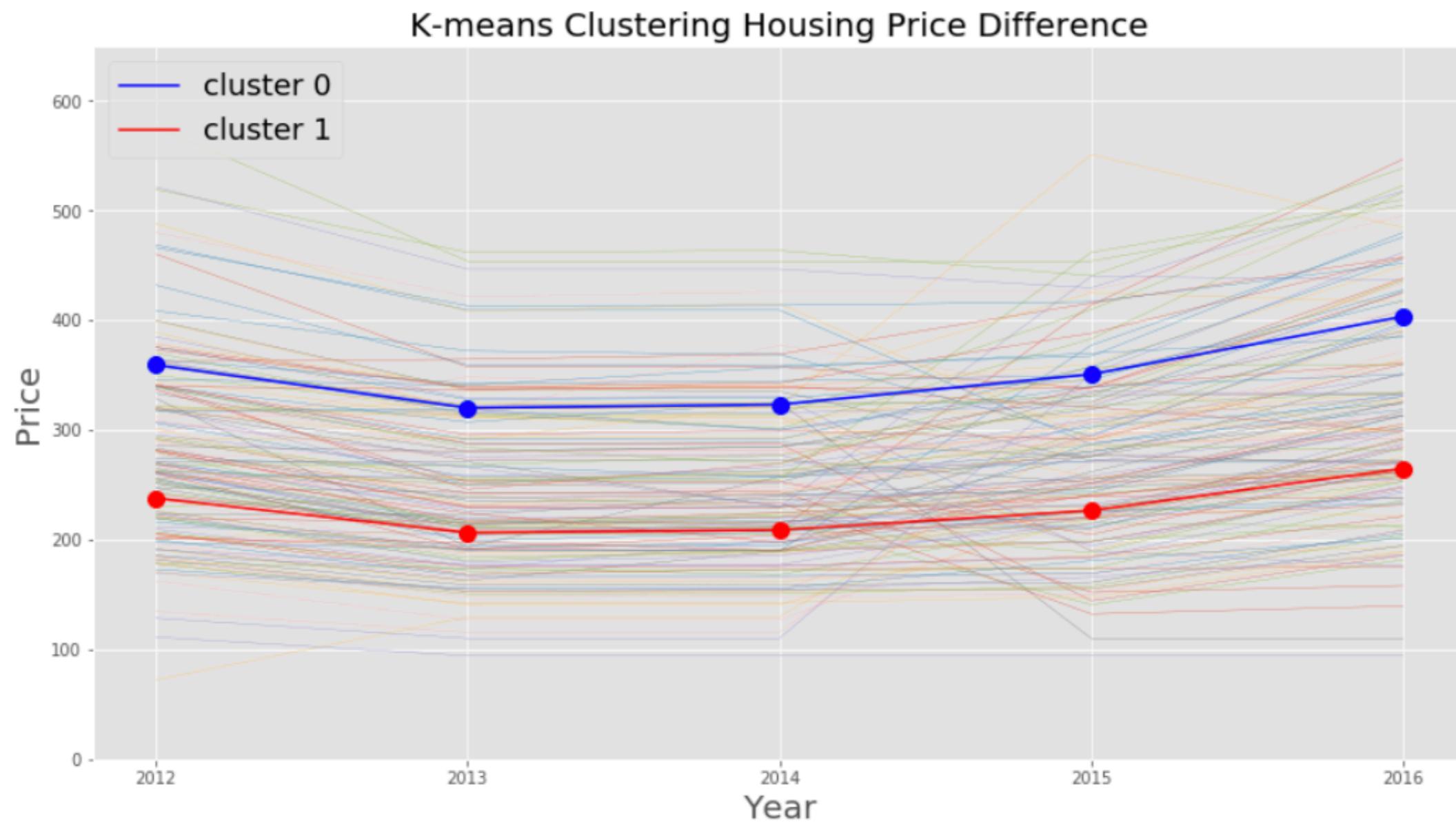
Results

3

Clustering

FIRM07 Price Differences

PFIRM15 Price Differences



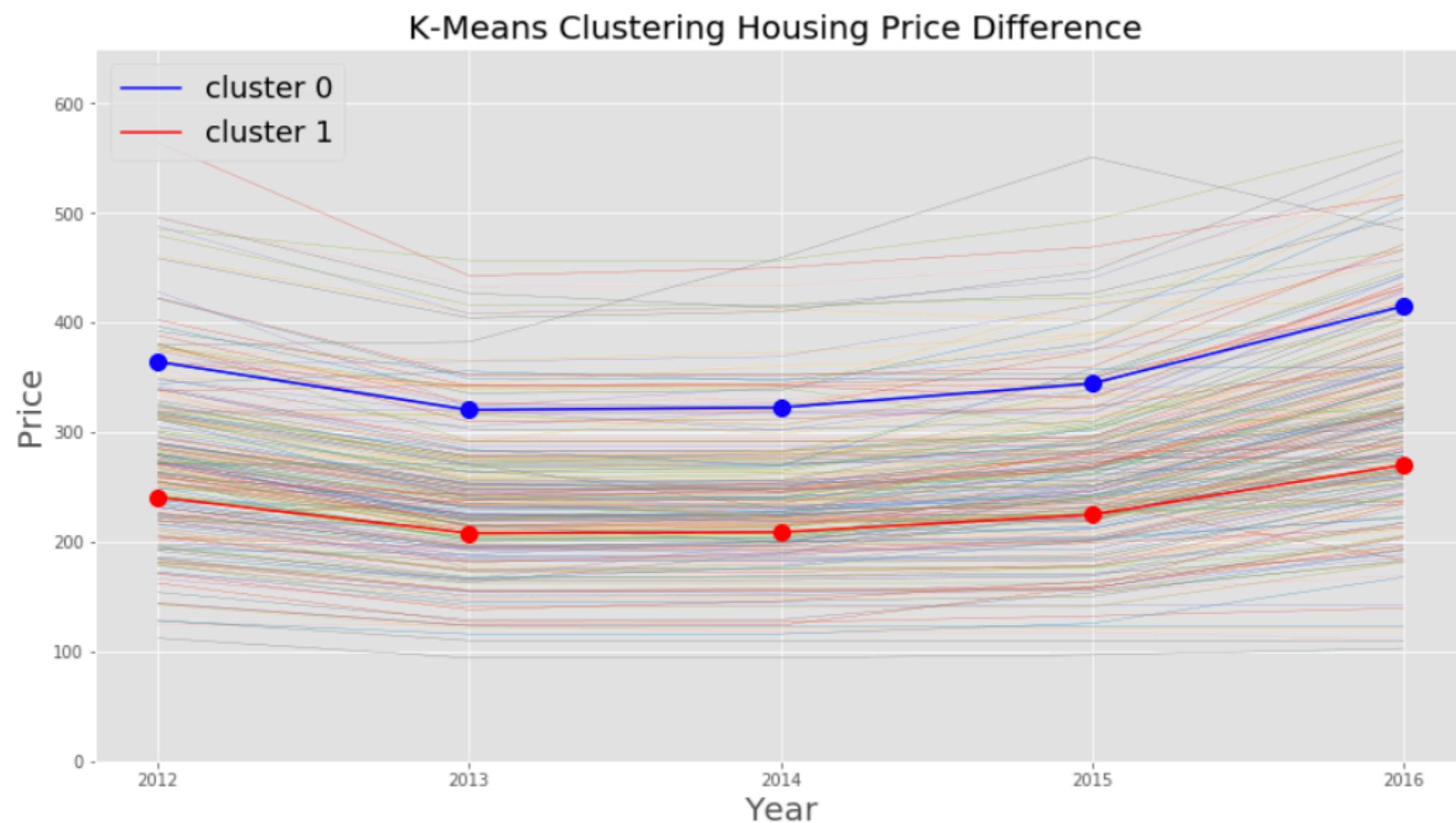
Results

3

Clustering

FIRM07 Price Differences

PFIRM15 Price Differences

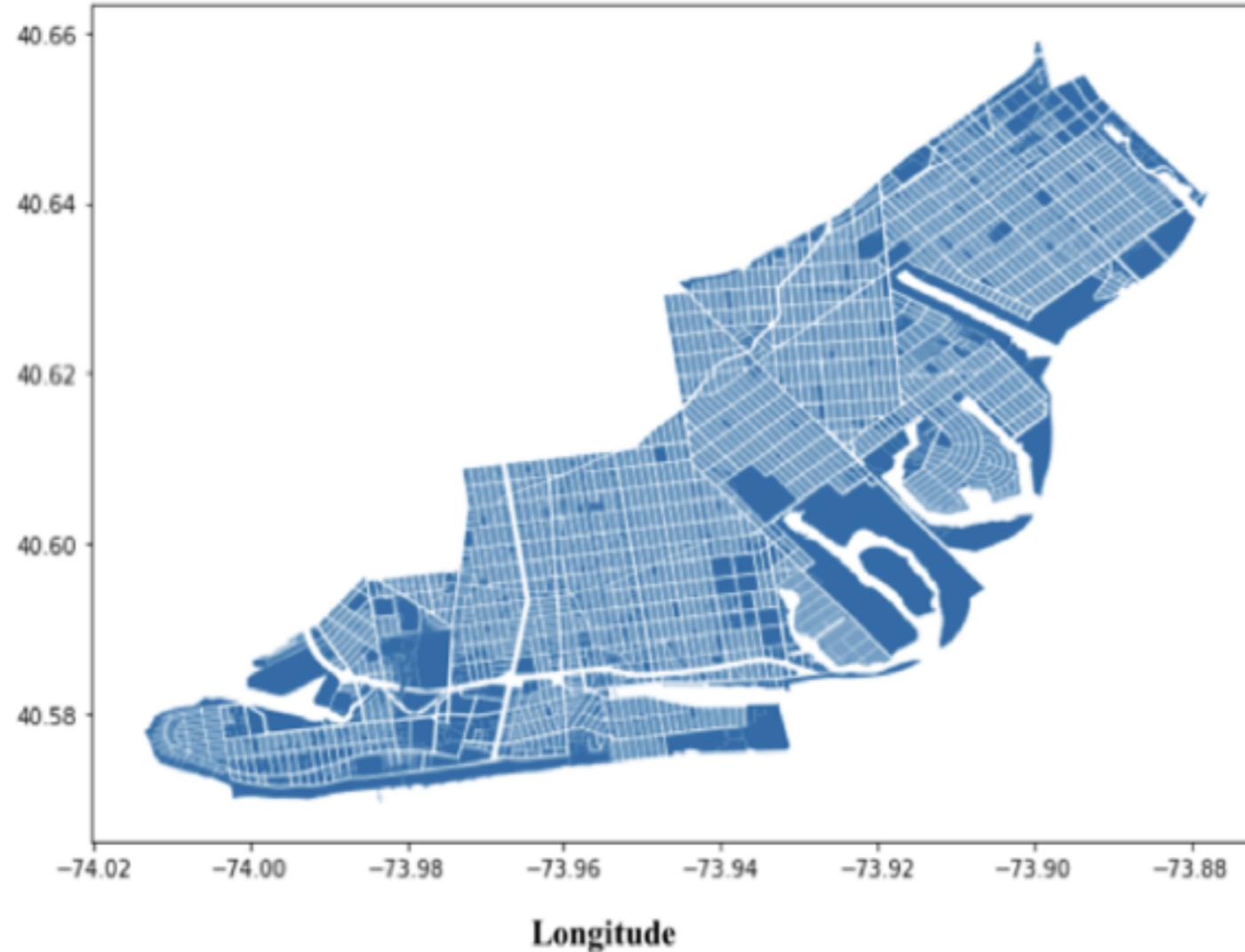


Results

4

Kriging Model

Kriging Housing Price Prediction and Property Change Target Area



Location: **South Brooklyn**

65,782 houses

Results

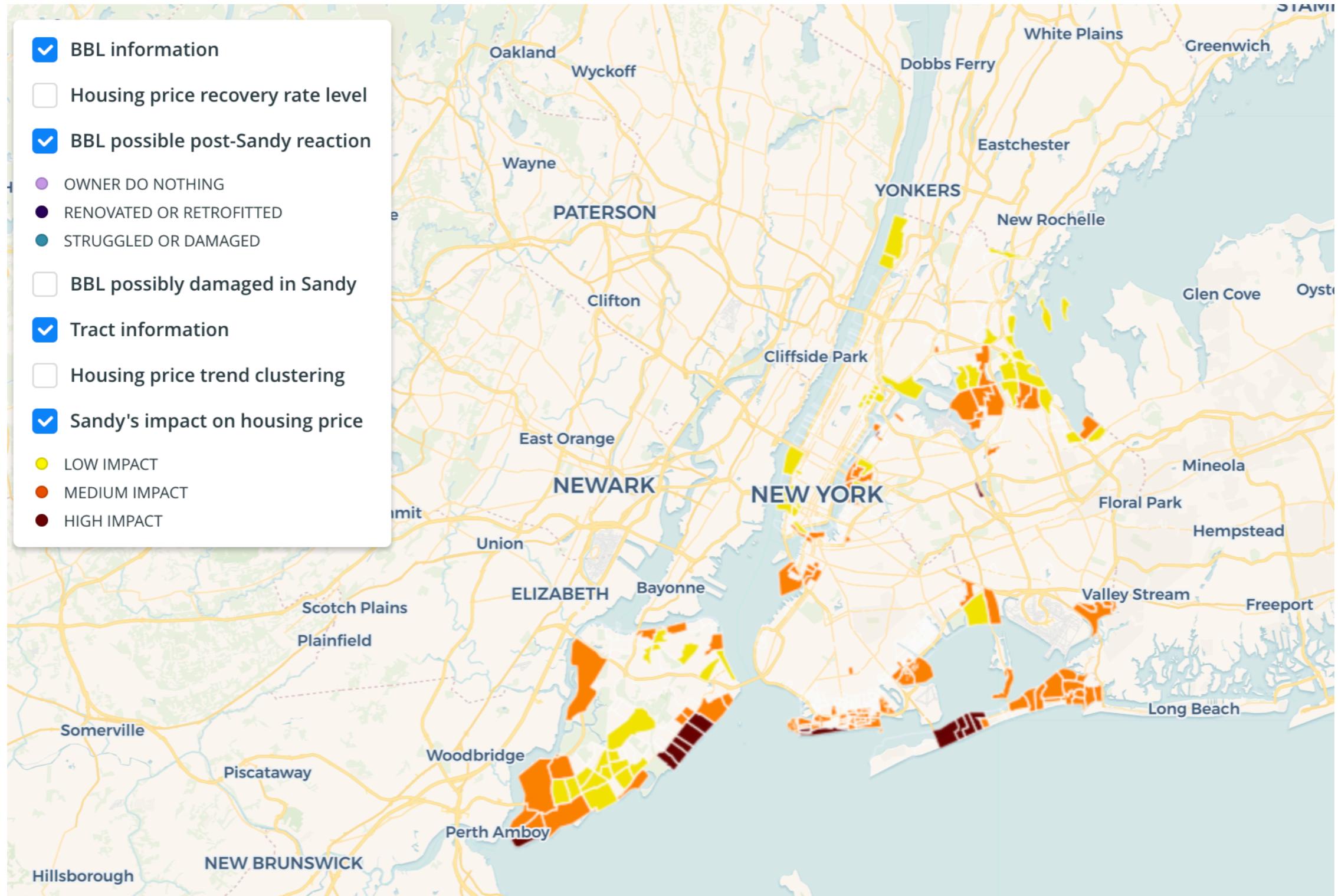
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Kriging Model

| | |
|---|-------|
| Total Rolling Sales in the Area's Flood Zones | 577 |
| % of Houses Possibly Damage in Sandy (Critical) | 5.5% |
| % of Houses Possibly Retrofitted or Renovated | 13.5% |
| % of Houses Struggled or Damaged | 11.4% |
| % of Houses Where Owner Did Nothing | 75% |
| % of Houses Weaker than Neighbors | 10% |
| % of Houses Stronger than Neighbors | 37% |
| % of Houses Neutral than Neighbors | 53% |

7% Mean Error
4% Standard Deviation

Interactive Visualization



Further Studies



1 Use FEMA Flood Insurance Data



2 Feature Importance with Price Correlation



3 Kriging Model with more flood zone areas

QUESTIONS



Sources used for images

Image:

<https://streeteasy.com/blog/hurricane-sandy-nyc-five-years-later-city-builds-where-floods-hit-hardest/>

IMAGE IS FROM THE FAR ROCKAWAYS

[https://www.google.com/url?](https://www.google.com/url?sa=i&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwiAh9Oeqq7cAhVHhOAKHVwkCJsQjRx6BAgBEAU&url=http%3A%2F%2Fwww.octavion)

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[data-using-spark-machine-learning-streaming-and-kafka-api-part-1%2F&psig=AOvVaw2urJxYN9xCGesrMVLQSDHq&ust=1532219059404320](https://www.google.com/url?sa=i&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjOvqeP967cAhUKVN8KHT9tCNgQjRx6BAgBEAU&url=https%3A%2F%2Fmapr.com%2Fdata-using-spark-machine-learning-streaming-and-kafka-api-part-1%2F&psig=AOvVaw2urJxYN9xCGesrMVLQSDHq&ust=1532219059404320)

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