

# An Analysis of AirBnB in Washington, D.C.

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# AirBnB



- Alternative to hotels, hostels, resorts while traveling
- “Belong anywhere”
- You can rent entire home, private room, shared room, or hotel room
- AirBnB first started listing rentals in DC in 2009

# Problem Statement

**Goal:** Find interesting relationships in the data that might be insightful for a traveler, for a homeowner (or host), for an AirBnB decision maker, and maybe even for a District housing regulator.

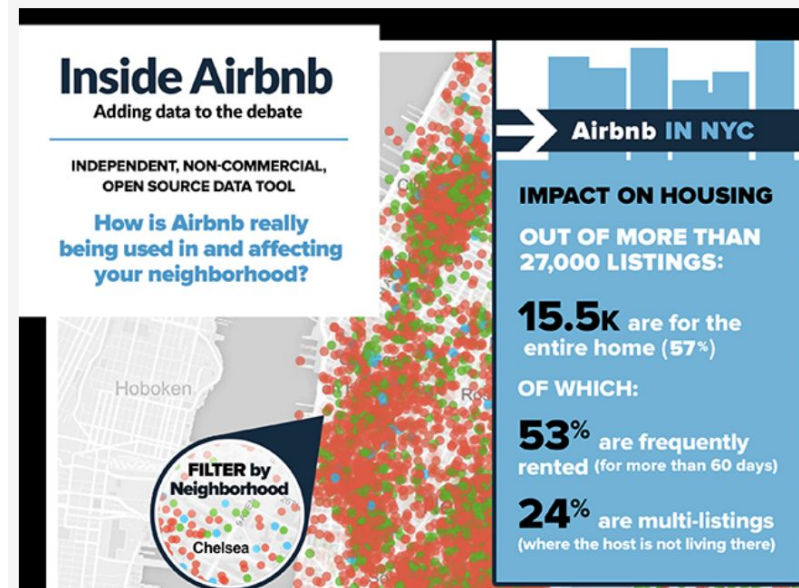
- What overall trends can be found in the data?
- How does AirBnB data relate to major events that have occurred in the nation's capital over the last 10 years?
- What factors are most important in predicting price?
- How might AirBnB data affect the housing landscape?

**Data**

# InsideAirBnB.com

- Houses datasets for AirBnB information on cities across the globe
- Shines a light on the "for worse" side of AirBnB - the disruption it causes to housing and communities
- Updated by its moderators on an irregular basis
- Archived data starting from 2015 on
- Data in this project collected from the site in September 2019

## About Inside Airbnb



# Data

## Listings

- Latitude/longitude, host, room type, price, number of reviews per listing, reviews per month, listings per host, neighborhood, availability for booking, number of listings per host

## Neighborhoods

- 39 Neighborhoods within D.C.
- Geojson of neighborhood coordinates

## Reviews

- 358,000+ reviews left on listings since 2009
- All correspond with listing id
- Written January 2009 - September 2019

## Calendar

- Represents a 'calendar' of prices and listings for each day for the following year (from the time the data was collected)

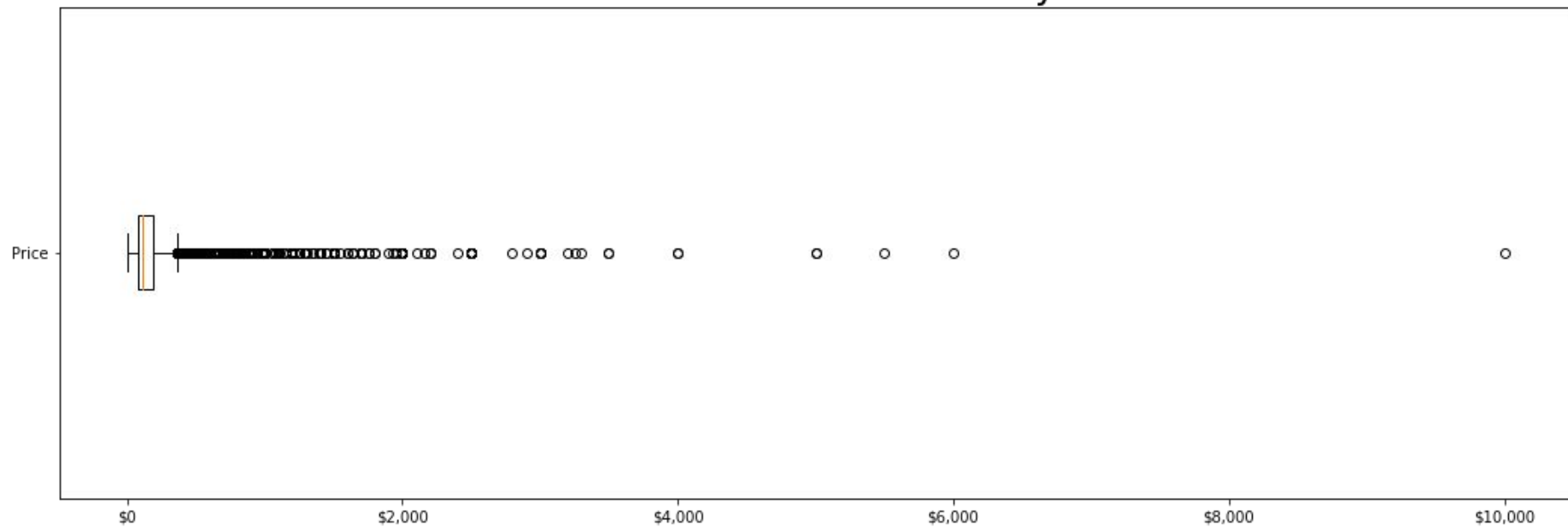


# Analytical Findings

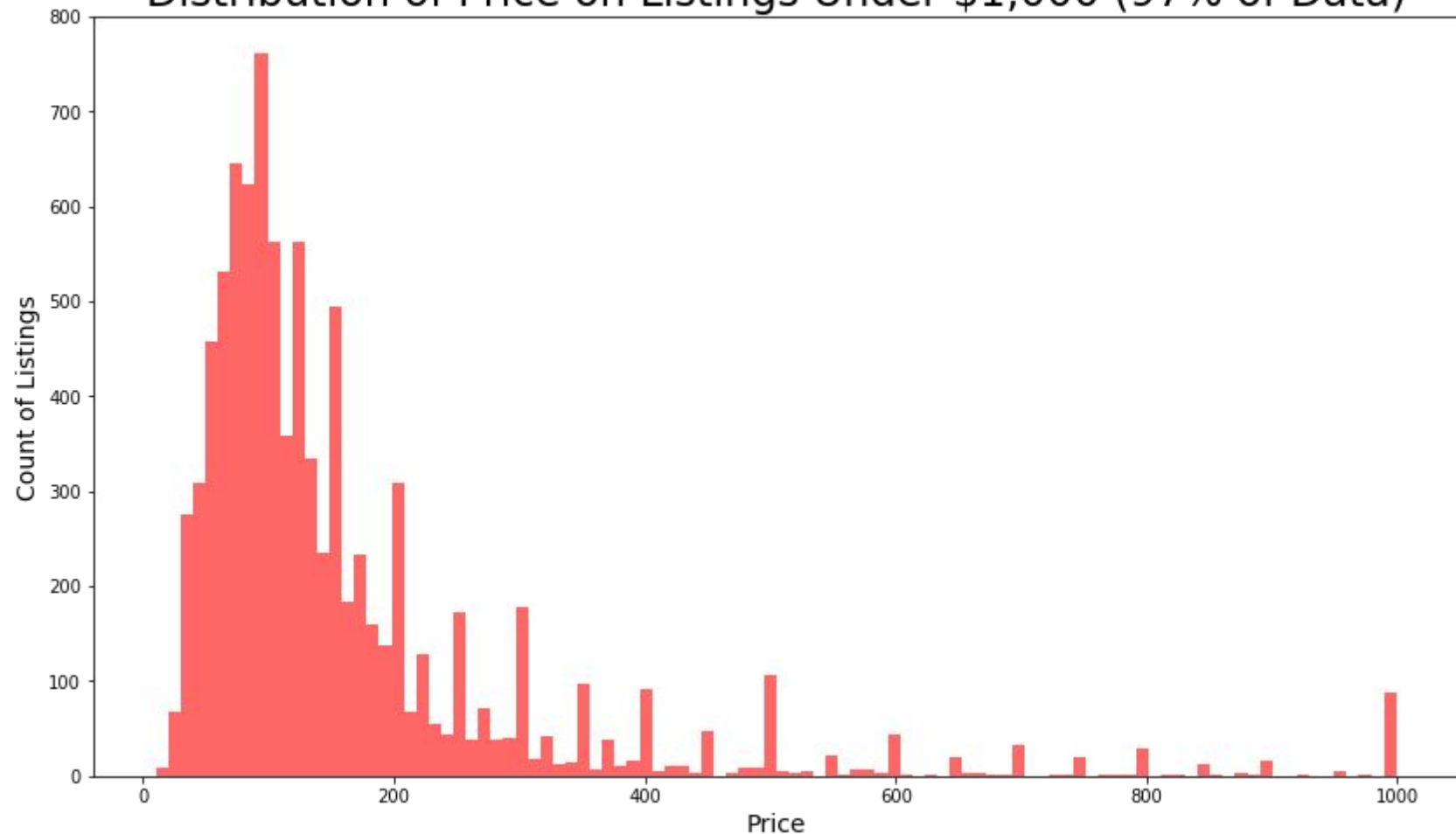
# Initial Findings

- 9,189 unique listings in D.C.
- Average price of all listings is \$197.08
- Prices range from \$10 - \$10,000
- Average number of listings per host is 8.5
- One host has 152 listings
- Listings are available, on average, 127 days out of a year.
- 54% of listings are the sole listing for that host
- 358,268 reviews written
- 19% of all unique listings have never received a review
- Reviews were written in multiple languages
- Average number of reviews that a listing has is 38.9
- Listings receive an average of 2 reviews per month

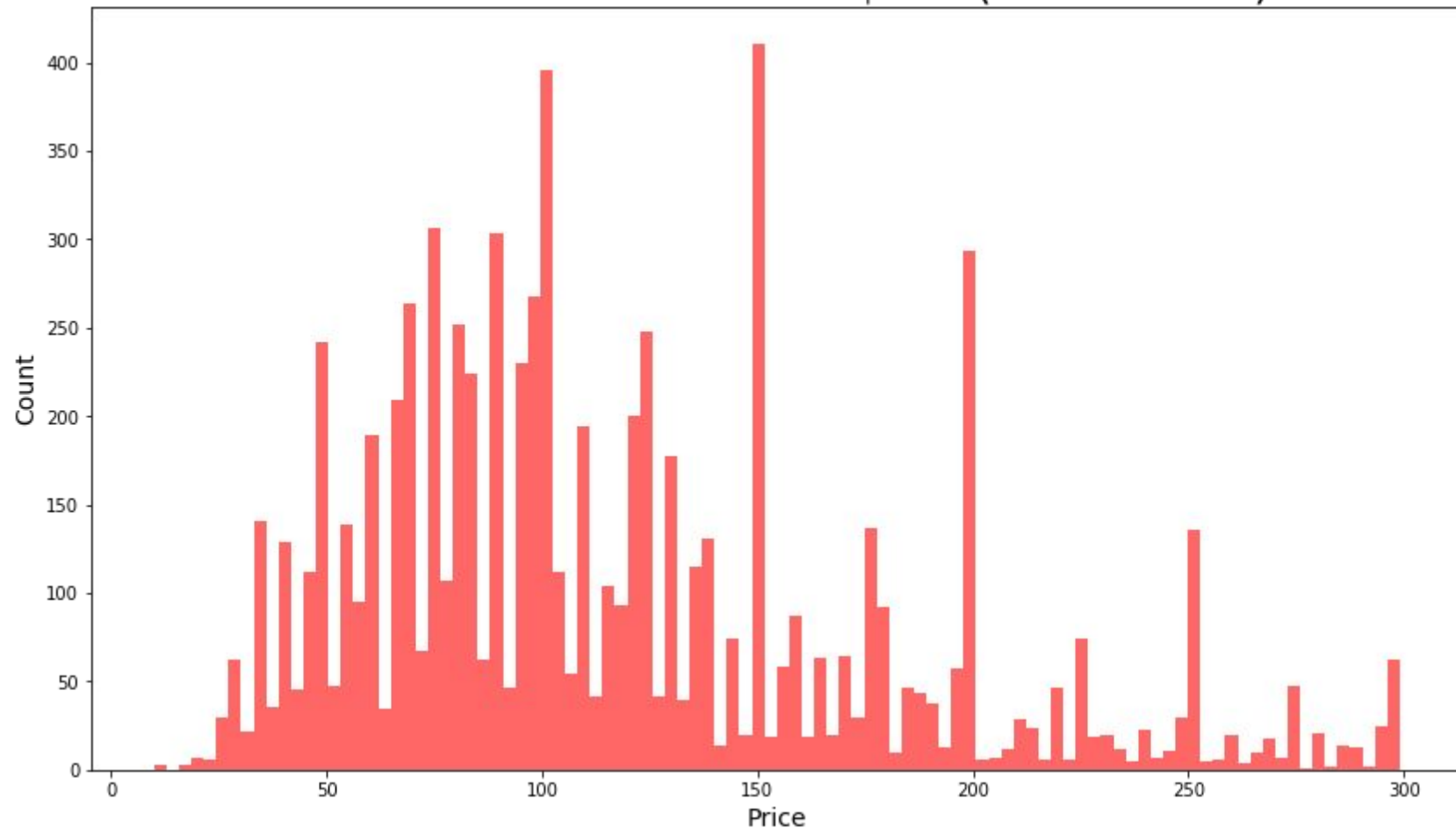
## AirBnB Rental Prices Are Not Normally Distributed



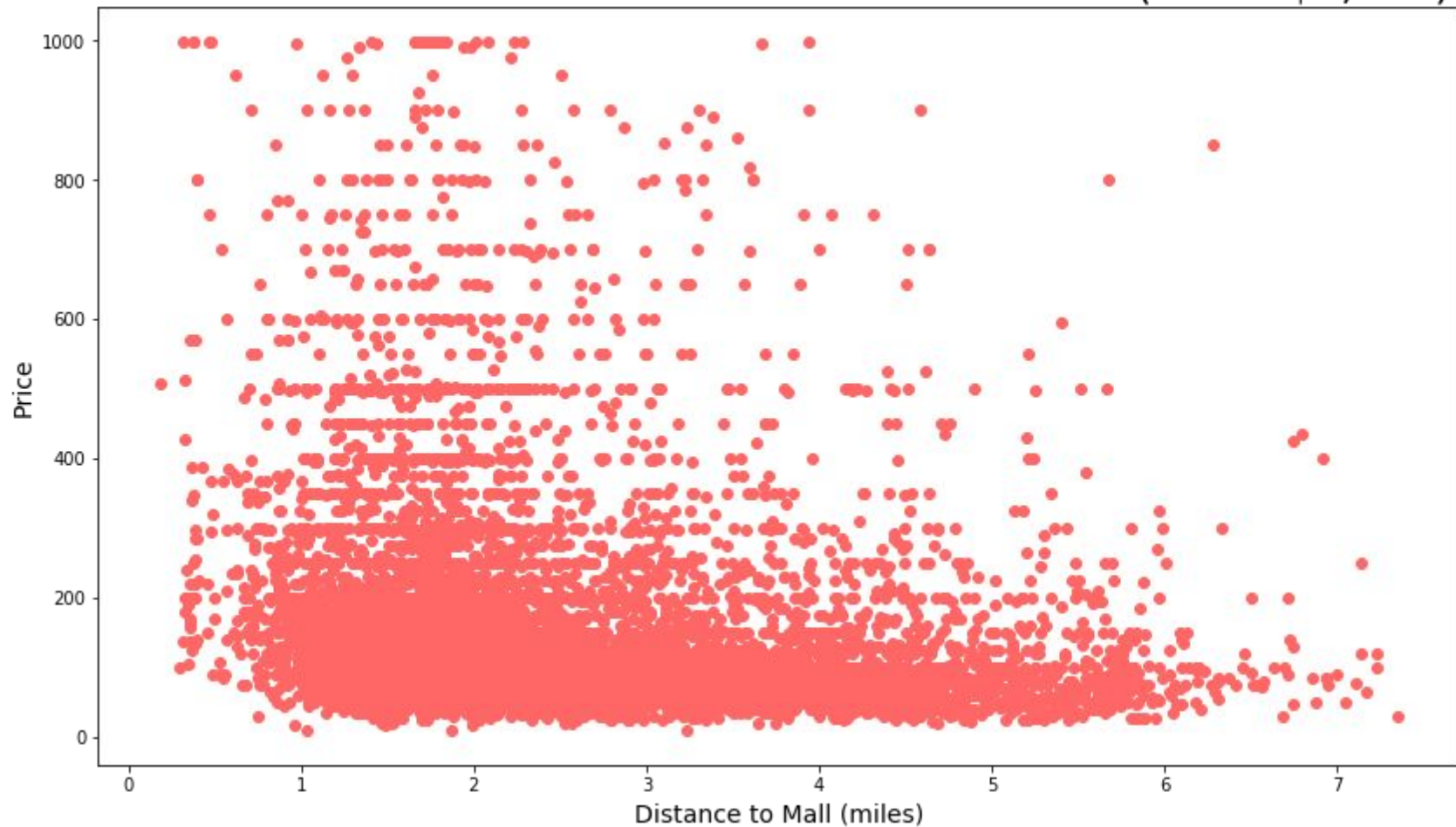
Distribution of Price on Listings Under \$1,000 (97% of Data)



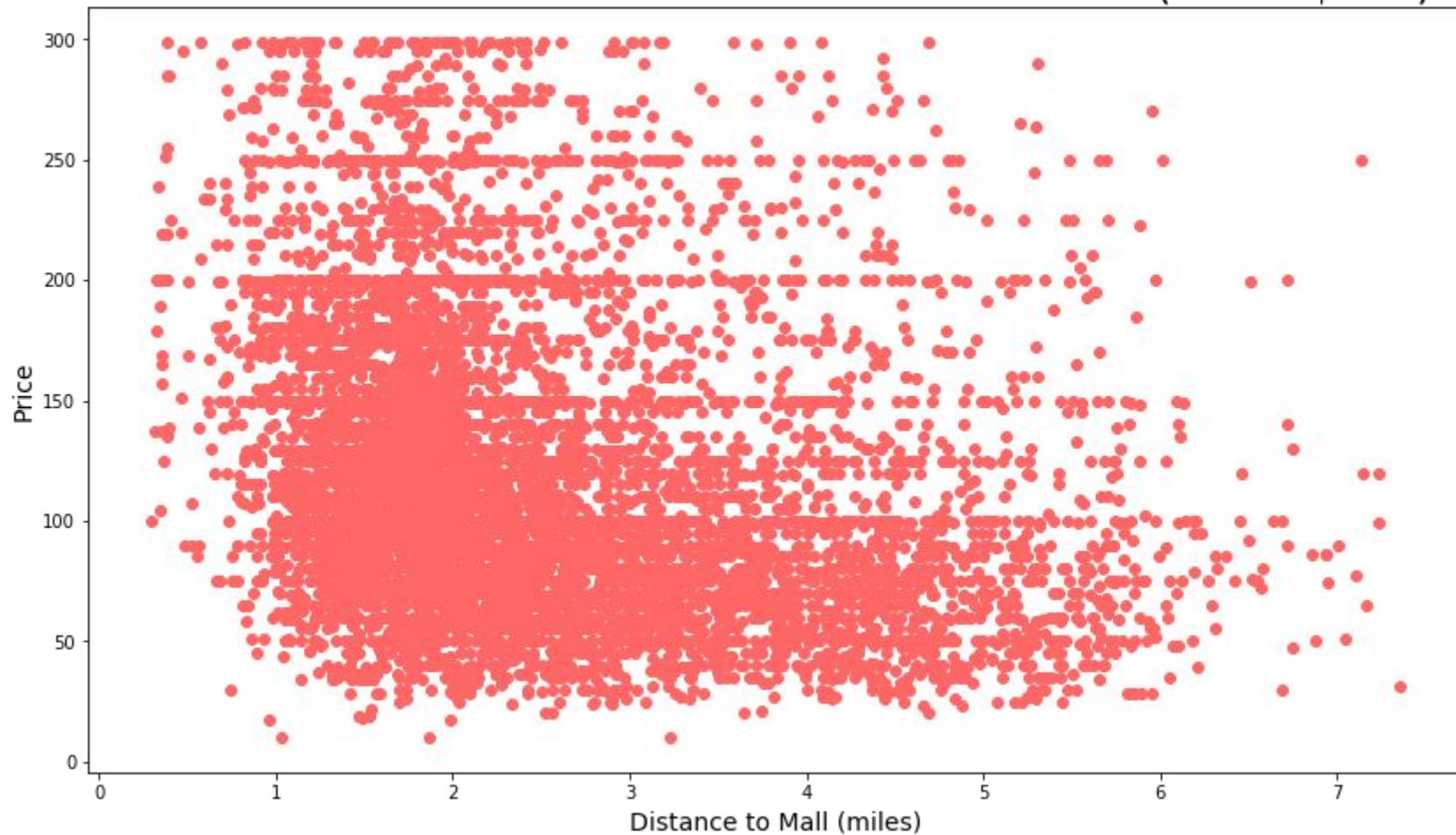
Distribution of Price Under \$300 (86% of Data)



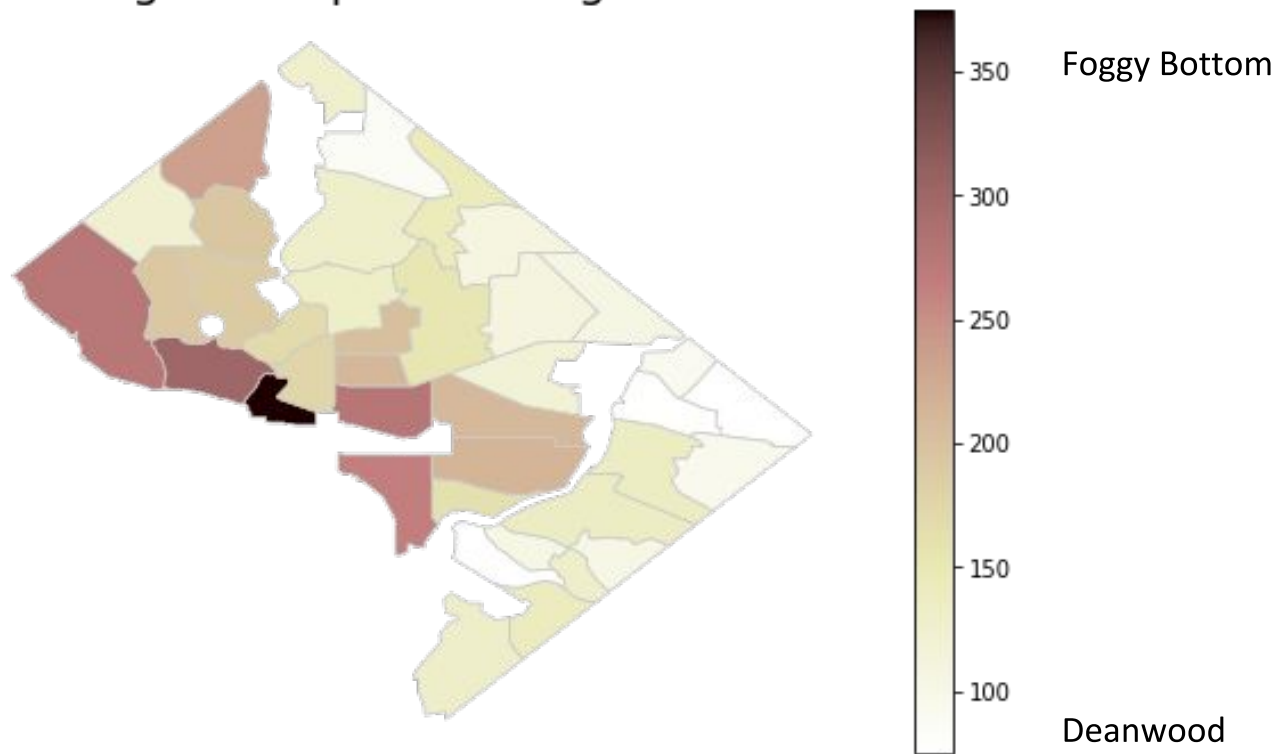
Distance to the National Mall Has Effect on Price (under \$1,000)



Distance to the National Mall Has Affect on Price (under \$300)



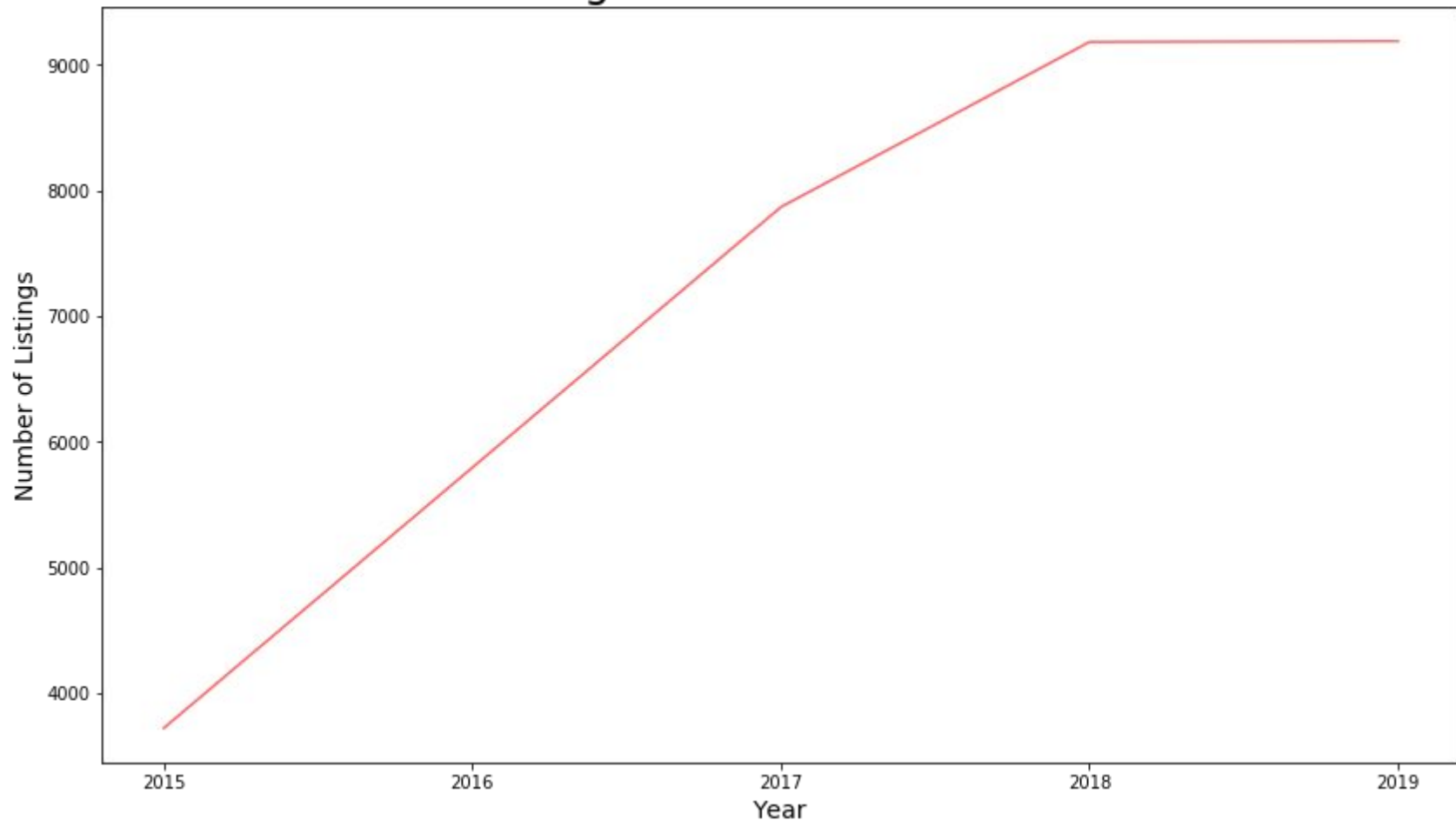
## Average Price per DC Neighborhood



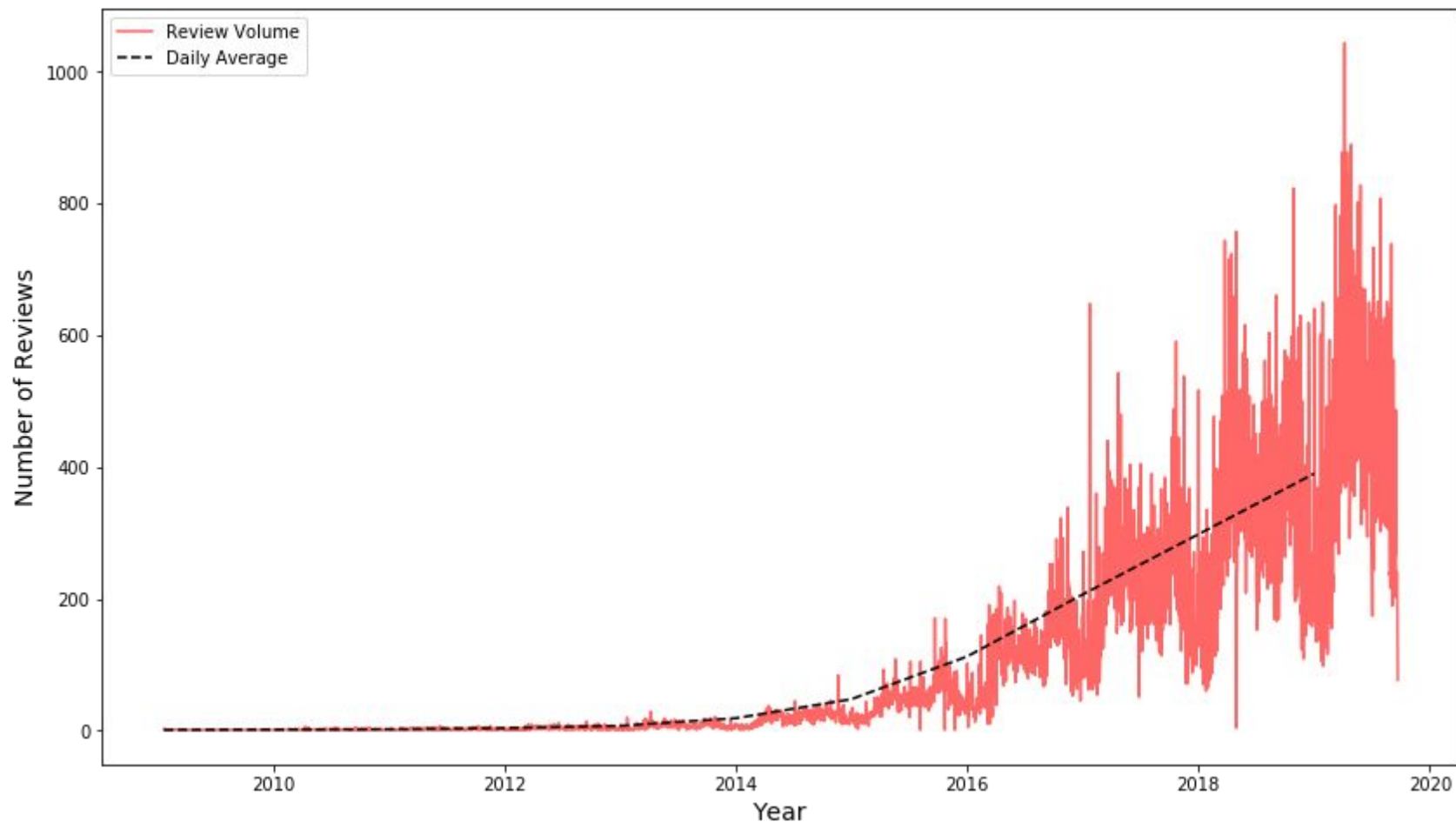


# Major Events in D.C. vs Data

# Number of Listings in D.C. Has Increased Over Time

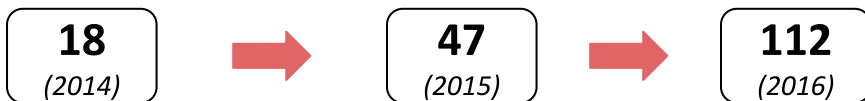


# Number of Reviews Has Increased Over Time



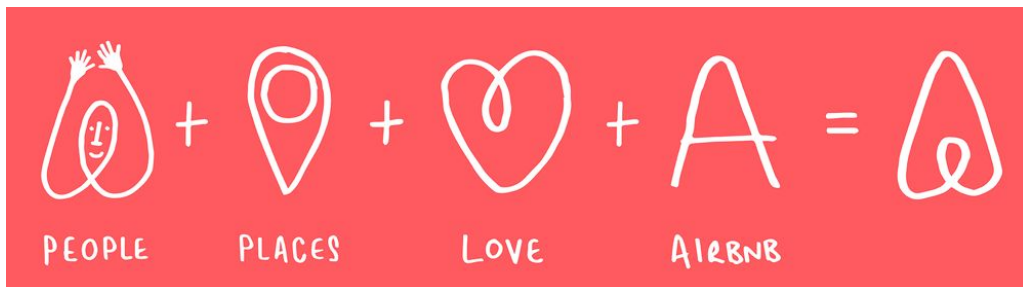
# What happened in 2014?

- Average daily review volume for DC listings increased rapidly:

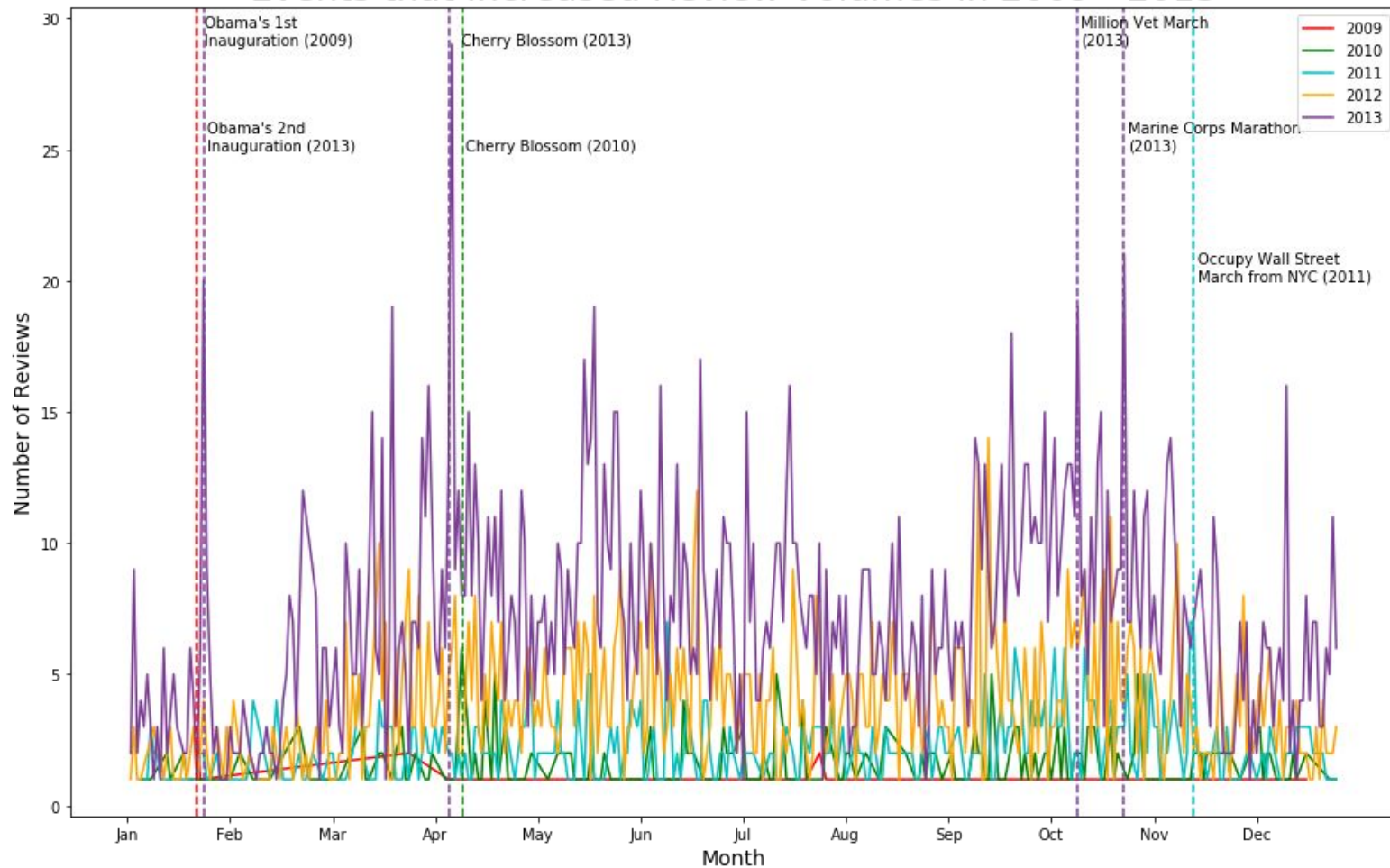


- AirBnB made some changes:

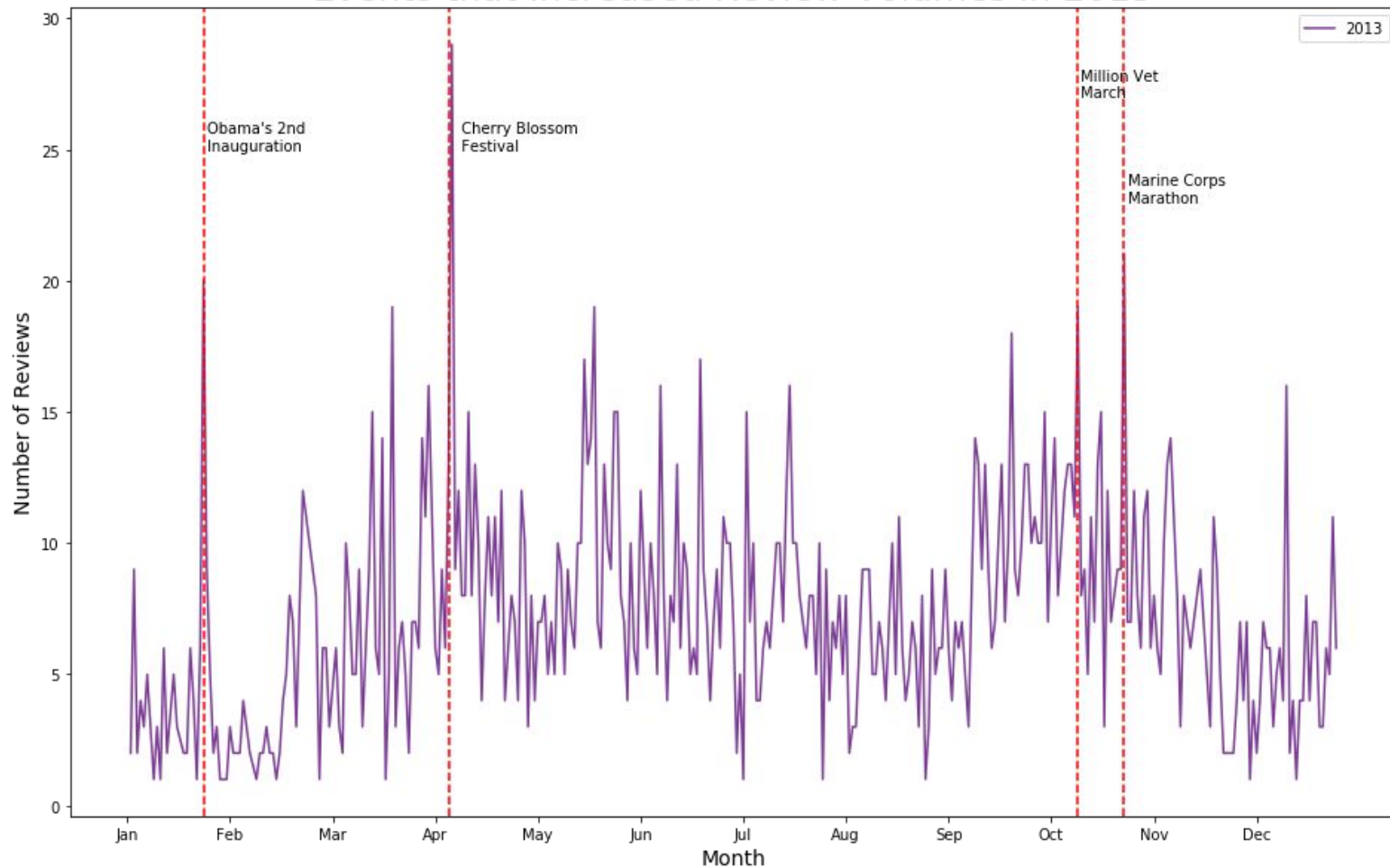
- Logo redesign
- Launched new app
- Improved UX
- Made peace with the law



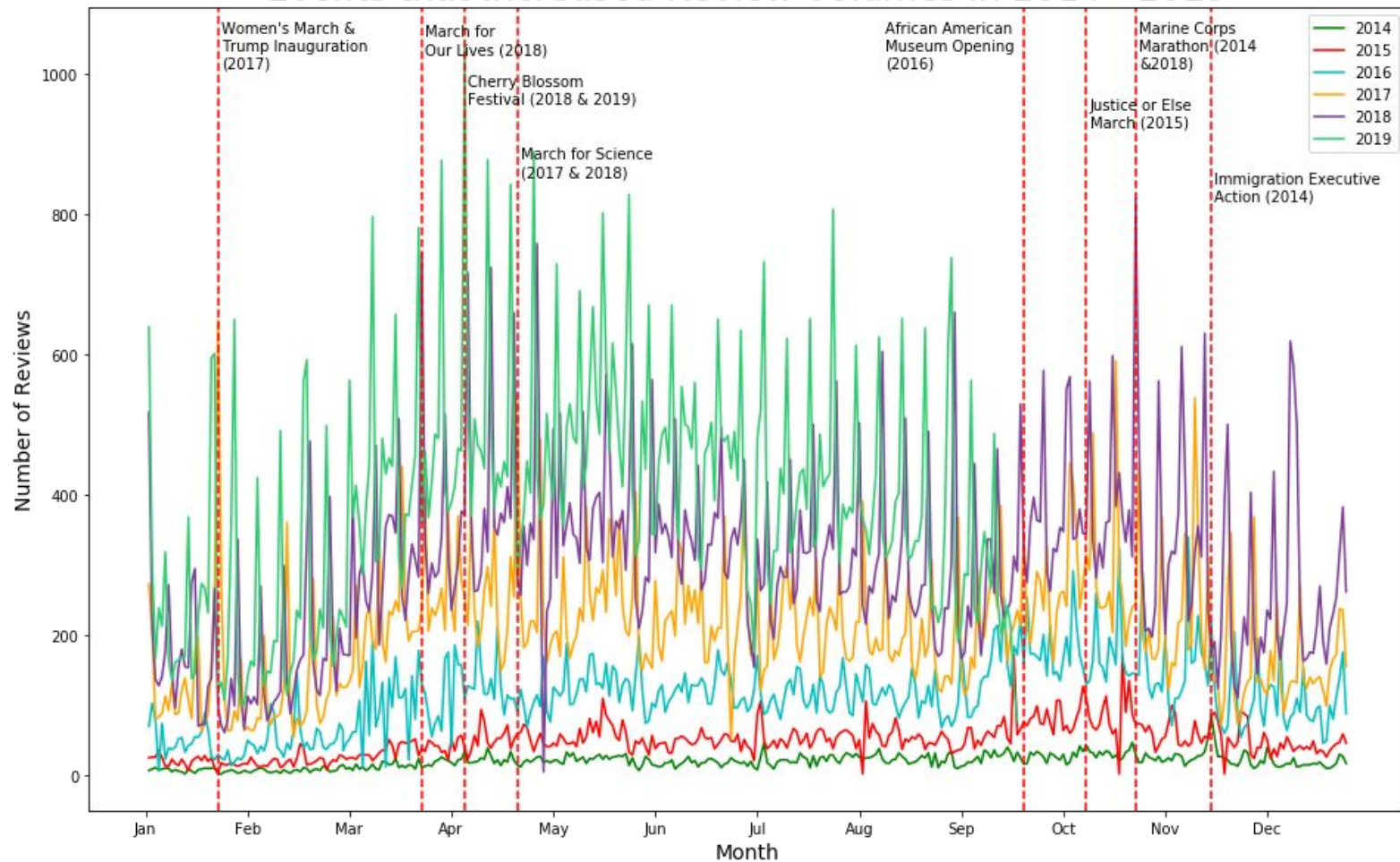
# Events that Increased Review Volumes in 2009 - 2013



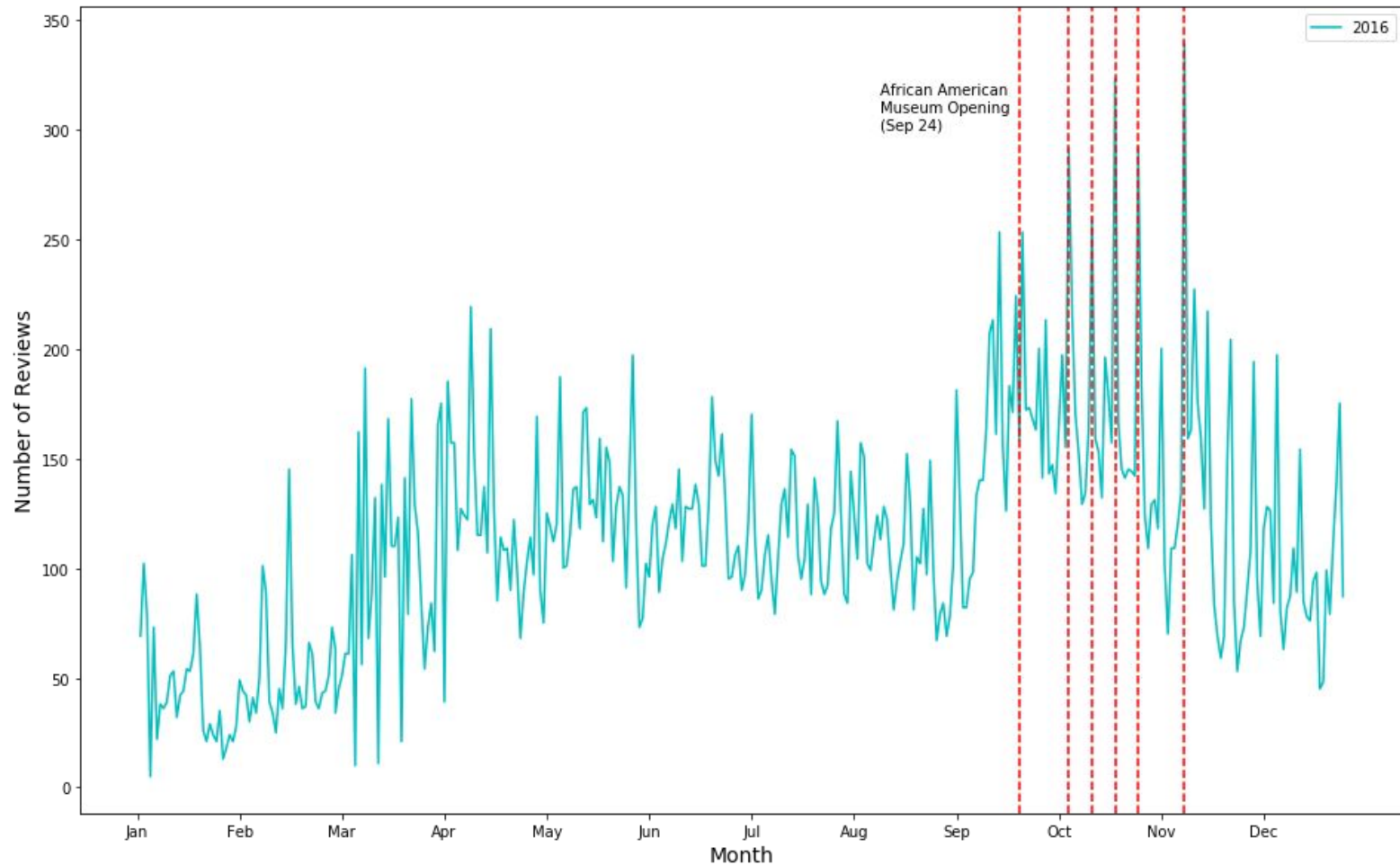
# Events that Increased Review Volumes in 2013



# Events that Increased Review Volumes in 2014 - 2019



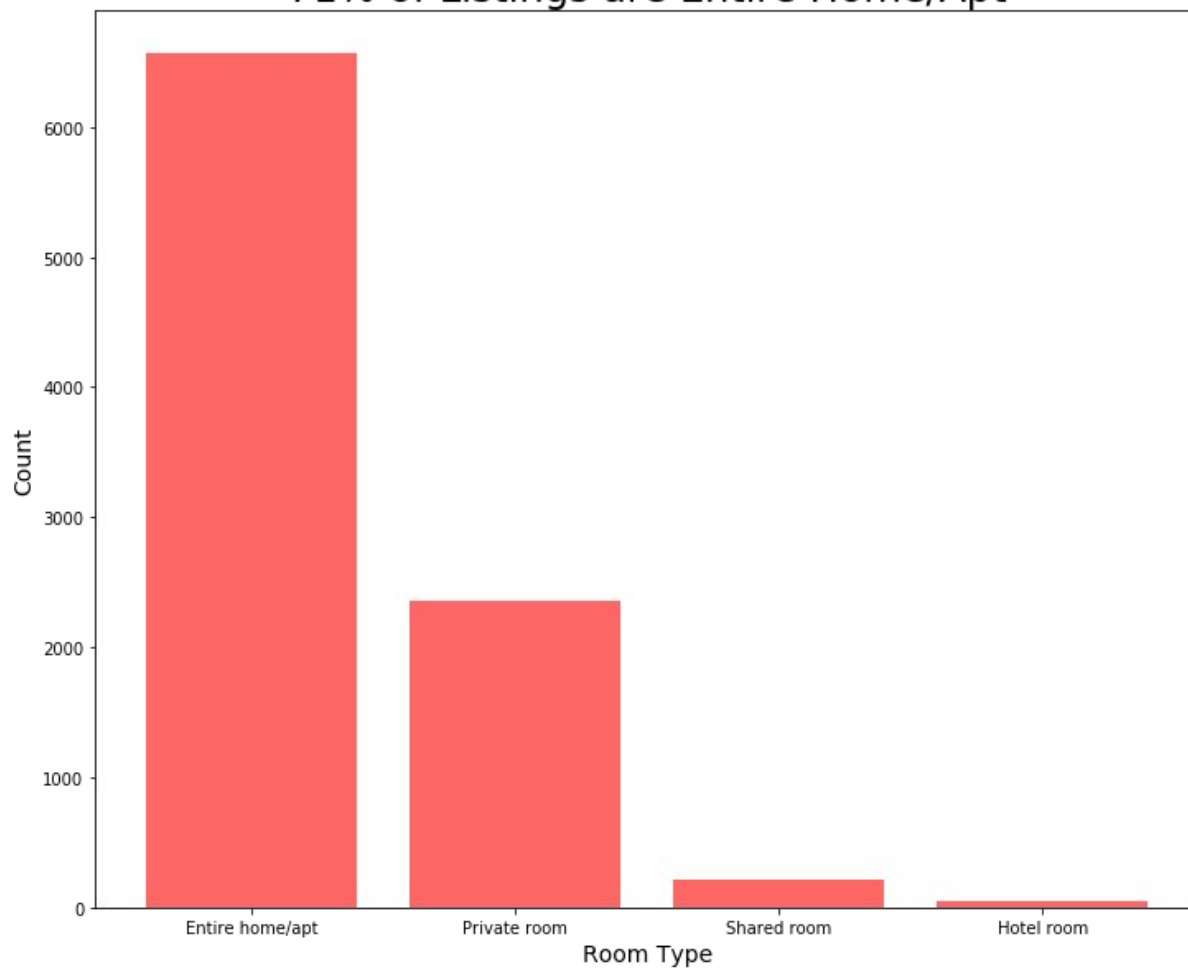
## Events that Increased Review Volumes in 2016





# Housing Regulations

## 71% of Listings are Entire Home/Apt



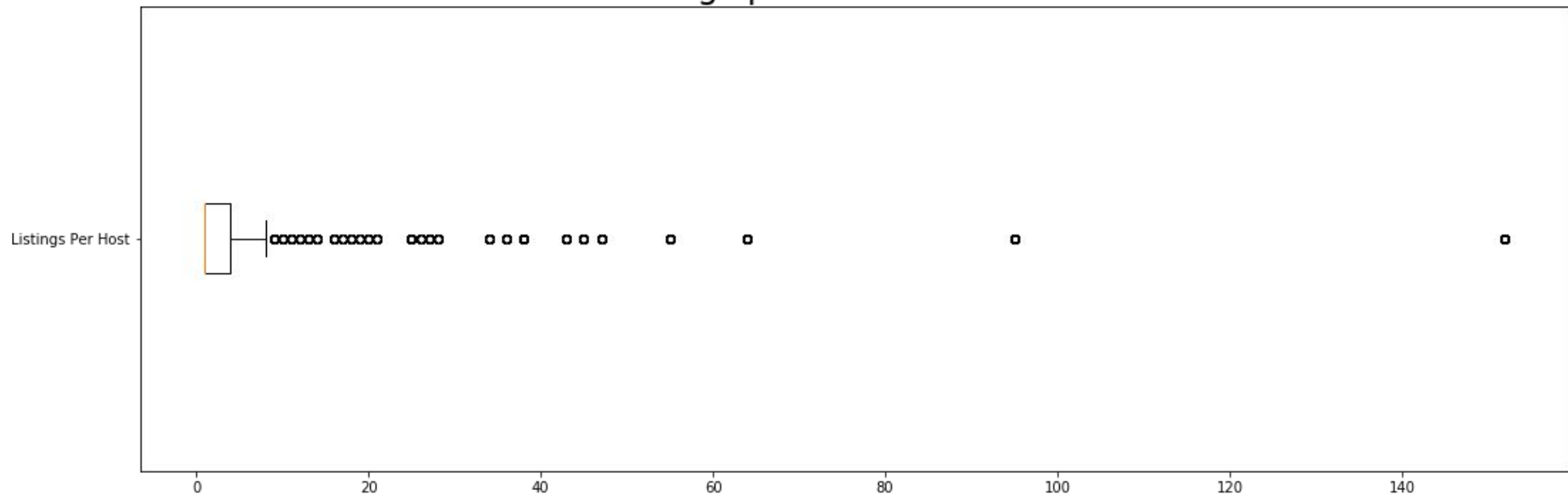
# **AirBnB Has Prompted New Laws in D.C.**

District lawmakers voted unanimously in end of 2018 to restrict short-term rentals to:

- a homeowner's primary residence and
- to limit number of days in a year they can rent their home to 90

Law took effect October 31, 2019 but still no guidelines for property owners

# Listings per Host Distribution



# Zeus

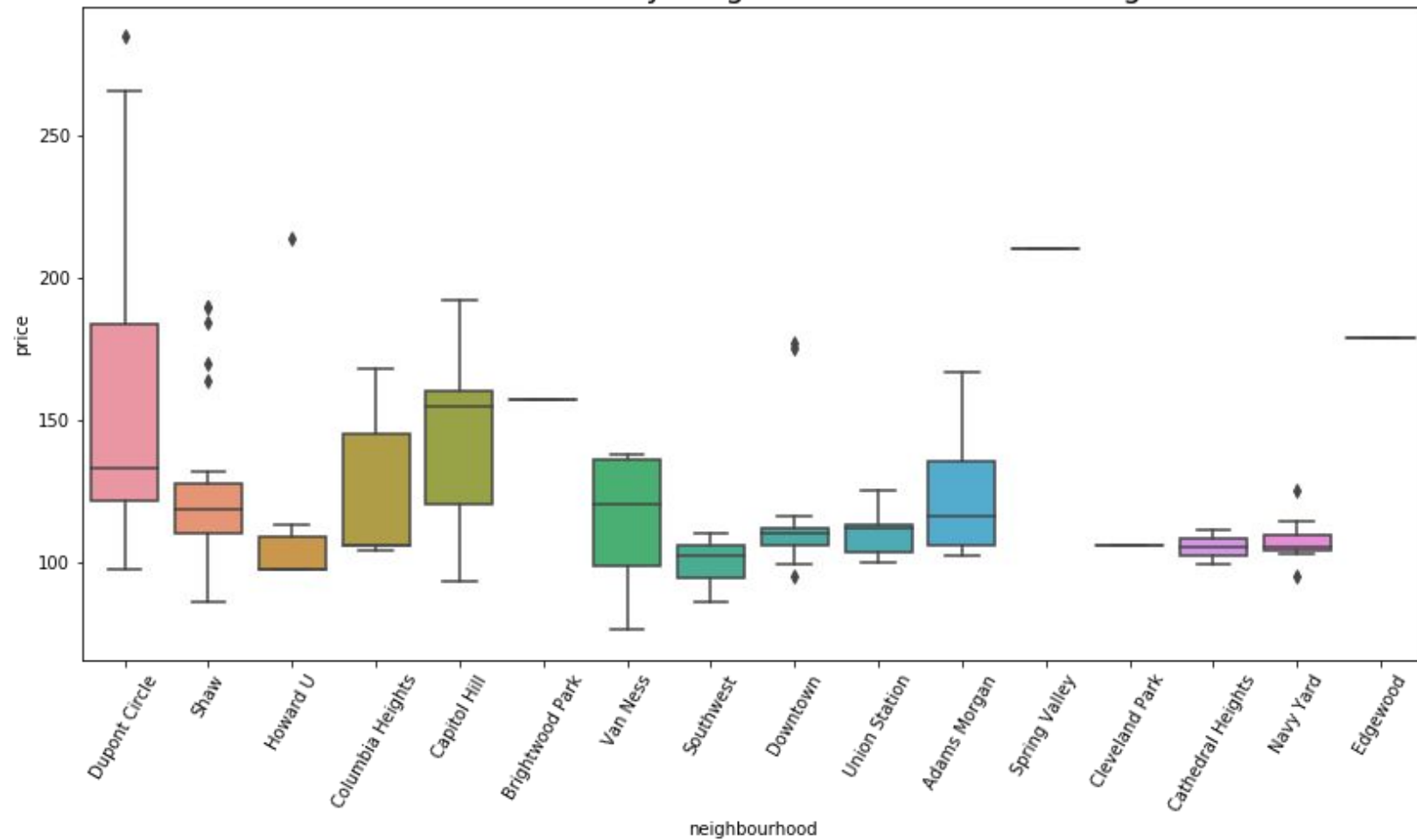
id		name	host_id	host_name	room_type	price	listings_per_host
6919	28668627	1 Bedroom Condo in Dupont Circle	48005494	Zeus	Entire home/apt	206	152
6920	28668727	3BR Townhouse in Logan Circle	48005494	Zeus	Entire home/apt	190	152
6926	28695857	2 Bedroom Place in Great Location	48005494	Zeus	Entire home/apt	141	152
6931	28719542	3BR House in Washington	48005494	Zeus	Entire home/apt	214	152
6952	28835868	2BR Condominium in Washington	48005494	Zeus	Entire home/apt	145	152
6953	28836027	3BR Place in Washington DC	48005494	Zeus	Entire home/apt	184	152
6955	28836732	Charming 2BR Condo in Capital Hill	48005494	Zeus	Entire home/apt	111	152
6956	28836778	1BD Condo near Metro Stations	48005494	Zeus	Entire home/apt	93	152
6989	29008361	3 Bedroom Condo near Metro	48005494	Zeus	Entire home/apt	157	152
7069	29490412	3BR Condominium in Washington	48005494	Zeus	Entire home/apt	160	152
7073	29515669	Spacious Columbia Heights 4BR Townhouse	48005494	Zeus	Entire home/apt	168	152

# The Zeus Analysis

# Zeus' Properties

- All 152 properties are Entire Home or Apartment
- 16 different neighborhoods
- Average Price: \$132.61
- Average Availability: 271 days per year

Price Distribution By Neighborhood for Zeus Listings





Price \* Availability \* Occupancy

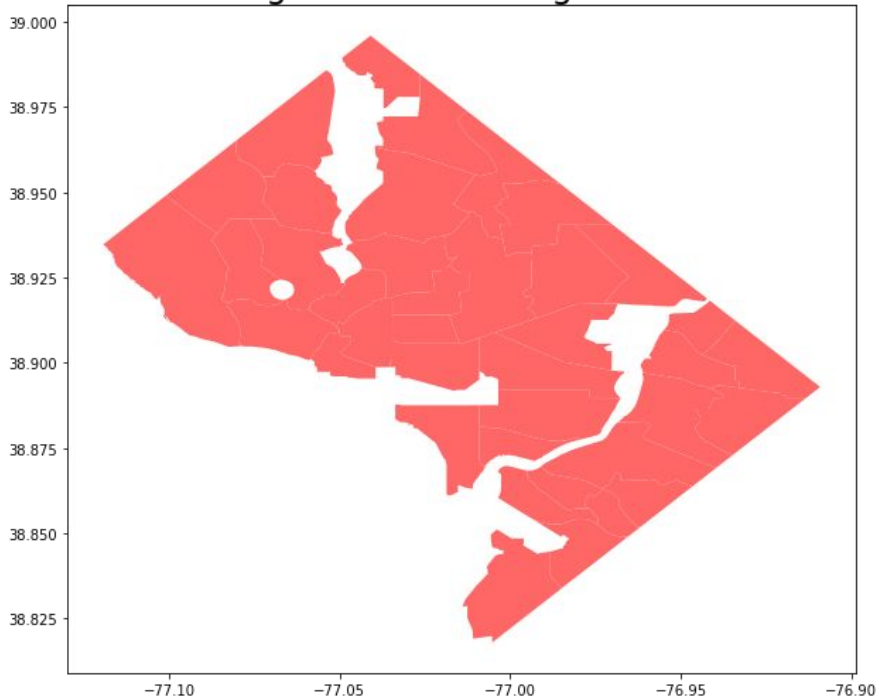
Rate (51.85%) =

**\$2, 726, 732.41**

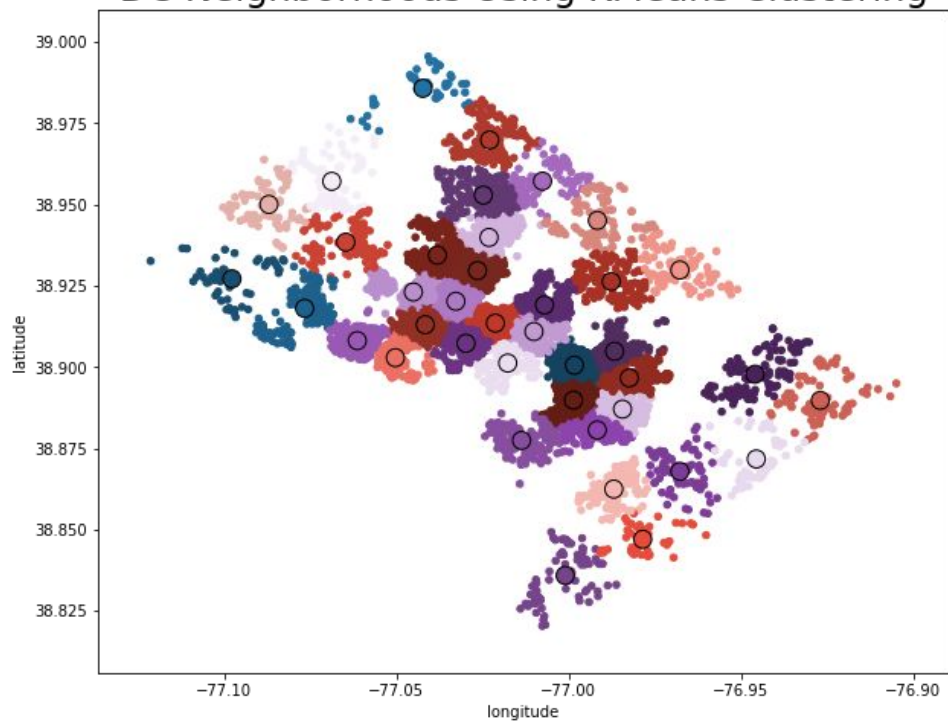
# Models

# KMeans Clustering

## DC Neighborhoods Using GeoPandas



## DC Neighborhoods Using KMeans Clustering



# Predicting Price

## Reviews as Features

XGBoost and CountVectorizer:

$R^2$ : .24

XGBoost and TFIDF:

$R^2$ : .22

## Numeric Features

XGBoost:

$R^2$  and Adjusted  $R^2$ : .693

Important features:

Latitude/Longitudes

Distance to Mall

Neighborhood and Room Type dummies

# Conclusions

**Most Important Lesson Learned:**  
**Ask the right question. Make it specific.**

# Improvements & Next Steps

I could:

- Sentiment analysis on reviews
- Tune models and improve on scores
- Neural net with sentiment analysis
- Look for impact after new DC regulation passed
- Cyclical trends in calendar data
- Look for impact after AirBnB IPO in 2020
- Relationship between review sentiment and major events happening

I will:

- Sentiment analysis on reviews - what are the most common words and can review sentiment predict price?

**Questions?**



# Resources

- InsideAirBnB: <http://insideairbnb.com/get-the-data.html>
- AirBnB timeline: [https://en.wikipedia.org/wiki/Timeline\\_of\\_Airbnb](https://en.wikipedia.org/wiki/Timeline_of_Airbnb)
- Major Events: <https://en.wikipedia.org>
- Regulations:
  - [https://www.washingtonpost.com/local/dc-politics/frustrated-airbnb-hosts-wait-for-dc-to-explain-new-regulations/2019/10/31/88293190-fa83-11e9-8190-6be4deb56e01\\_story.html](https://www.washingtonpost.com/local/dc-politics/frustrated-airbnb-hosts-wait-for-dc-to-explain-new-regulations/2019/10/31/88293190-fa83-11e9-8190-6be4deb56e01_story.html)
  - <https://www.washingtontimes.com/news/2018/nov/13/dc-council-votes-to-limit-airbnb-home-rentals-to-9/>
  - <https://www.pymnts.com/news/regulation/2019/new-regulations-prompt-airbnb-to-yank-boston-listings/>
- AirBnB: <https://www.airbnb.com>
- Occupancy Rate: <https://www.mashvisor.com/blog/airbnb-investment-strategy-washington-dc-real-estate/>