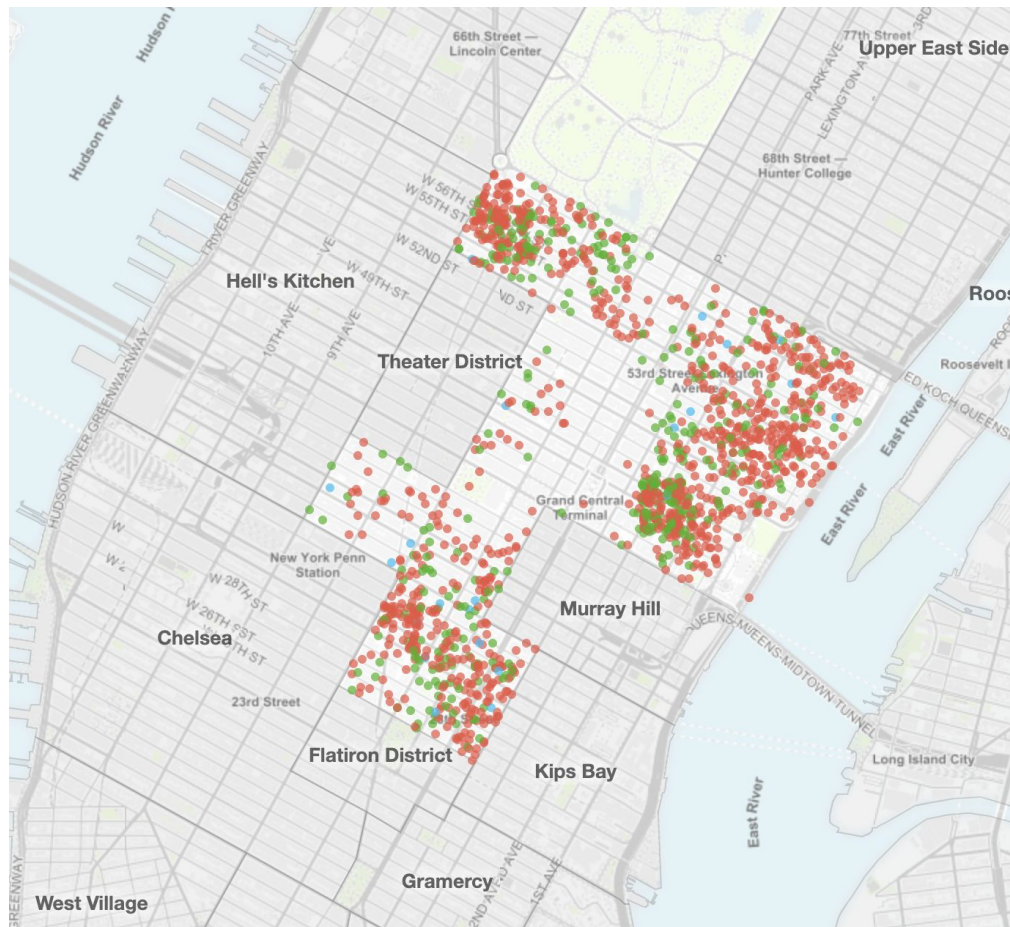# D3M
# Airbnb Project
# -  Host Price

Group 1: Daniel Chin, Wendi Tang, Andrew Liu

# Pt. 1: Identify the Problem

- **Decision Maker:** Host
- **Problem:** How to maximize profit when I have a house/room available for Airbnb?
- **Problem Breakdown:**
  - How can I find the optimal price?
  - How is demand affecting my pricing?
  - Should I consider seasonality in demand to do dynamic pricing?
  - Besides demand, what other factors affect my pricing?
- **Project Scope:**
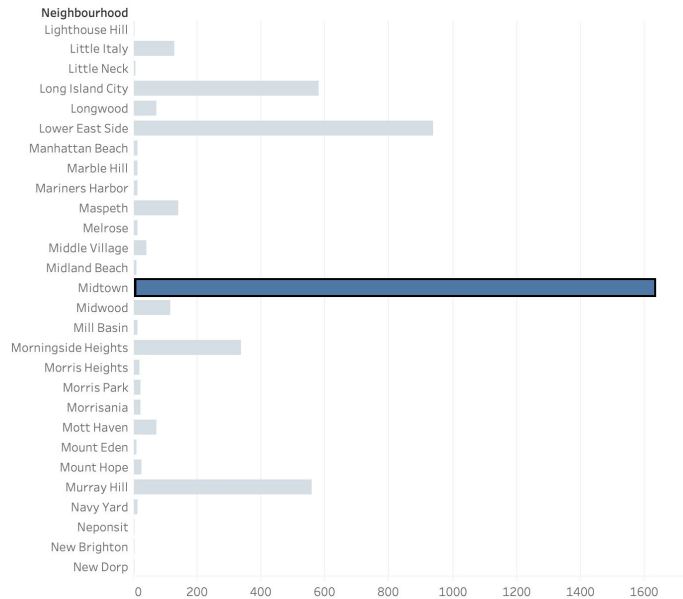  - Midtown, Manhattan (Private Room/Entire House)

# MAP

# Inquiry Background

Our Host-centric question of "How to maximize profit when I have a house/room available for Airbnb", has many different factors that go into determining sales and optimal price such as: location, reviews, features, and etc.

Having explored different measurement options for our analysis, to explore what was feasible and limit other influences on sales, we decided to narrow our analysis scope by location, specifically by neighborhood.

After deciding to narrow down our analysis to the optimal pricing of a single neighborhood, we chose a neighborhood with a large number of listings: **Midtown, Manhattan** (1632 listings)
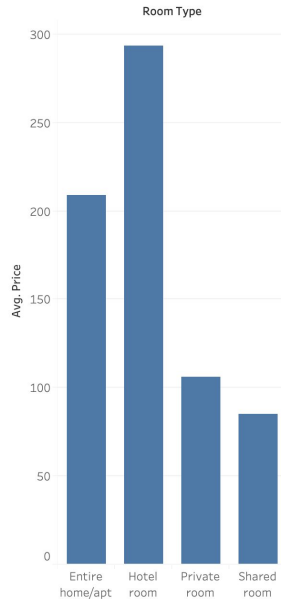
# Data Visualization - Univariate Analysis



Distribution of listings in New York City

- Midtown has one of the highest counts

# Data Visualization - Bivariate Analysis



Room Type vs. Avg Price

- Hotel Room charges the highest
- Shared Room is the cheapest

# Pt. 2: Data-driven Analysis - Demand

# Pt. 2: Data-driven Analysis - Demand

How to estimate Booking Volume?

# Pt. 2: Data-driven Analysis - Demand

How to estimate Booking Volume?

# of reviews

# Pt. 2: Data-driven Analysis - Demand

How to estimate Booking Volume?

# of reviews

Problems:

- biased towards really bad / nice listings

# Pt. 2: Data-driven Analysis - Demand

How to estimate Booking Volume?

# of reviews

Problems:

- biased towards really bad / nice listings

- Needs a parameter: Probability of leaving a review

# Listing ID: 5178

| Week of Date | Sun.. | Mon.. | Tues.. | Date Wed.. | Thur.. | Frid.. | Satu.. |
|---|---|---|---|---|---|---|---|
| February 9, 2020 | | | | | 13 | 14 | 15 |
| February 16, 2020 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| February 23, 2020 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| March 1, 2020 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| March 8, 2020 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| March 15, 2020 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| March 22, 2020 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| March 29, 2020 | 29 | 30 | 31 | 1 | 2 | 3 | 4 |
| April 5, 2020 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| April 12, 2020 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| April 19, 2020 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| April 26, 2020 | 26 | 27 | 28 | 29 | 30 | 1 | 2 |
| May 3, 2020 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| May 10, 2020 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| May 17, 2020 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| May 24, 2020 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| May 31, 2020 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| June 7, 2020 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| June 14, 2020 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| June 21, 2020 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| June 28, 2020 | 28 | 29 | 30 | 1 | 2 | 3 | 4 |
| July 5, 2020 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| July 12, 2020 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| July 19, 2020 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| July 26, 2020 | 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| August 2, 2020 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| August 9, 2020 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| August 16, 2020 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| August 23, 2020 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| August 30, 2020 | 30 | 31 | 1 | 2 | 3 | 4 | 5 |
| September 6, 20.. | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| September 13, 2.. | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| September 20, 2.. | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| September 27, 2.. | 27 | 28 | 29 | 30 | 1 | 2 | 3 |
| October 4, 2020 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| October 11, 2020 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| October 18, 2020 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| October 25, 2020 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| November 1, 2020 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| November 8, 2020 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| November 15, 20.. | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| November 22, 20.. | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| November 29, 20.. | 29 | 30 | 1 | 2 | 3 | 4 | 5 |
| December 6, 2020 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| December 13, 20.. | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| December 20, 20.. | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| December 27, 20.. | 27 | 28 | 29 | 30 | 31 | 1 | 2 |
| January 3, 2021 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| January 10, 2021 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| January 17, 2021 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| January 24, 2021 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| January 31, 2021 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| February 7, 2021 | 7 | 8 | 9 | 10 | 11 | | |

Available
■ False
■ True

Date Day broken down by Date Weekday vs. Date Week. Color shows details about Available. The data is filtered on Listing Id, which keeps 5178.

## Listing ID: 5178

| Week of Date | Sun.. | Mon.. | Tues.. | Wed.. (Date) | Thur.. | Fri.. | Satu.. |
|---|---|---|---|---|---|---|---|
| February 9, 2020 | | | | | 13 | 14 | 15 |
| February 16, 2020 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| February 23, 2020 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| March 1, 2020 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| March 8, 2020 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| March 15, 2020 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| March 22, 2020 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| March 29, 2020 | 29 | 30 | 31 | 1 | 2 | 3 | 4 |
| April 5, 2020 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| April 12, 2020 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| April 19, 2020 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| April 26, 2020 | 26 | 27 | 28 | 29 | 30 | 1 | 2 |
| May 3, 2020 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| May 10, 2020 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| May 17, 2020 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| May 24, 2020 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| May 31, 2020 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| June 7, 2020 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| June 14, 2020 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| June 21, 2020 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| June 28, 2020 | 28 | 29 | 30 | 1 | 2 | 3 | 4 |
| July 5, 2020 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| July 12, 2020 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| July 19, 2020 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| July 26, 2020 | 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| August 2, 2020 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| August 9, 2020 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| August 16, 2020 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| August 23, 2020 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| August 30, 2020 | 30 | 31 | 1 | 2 | 3 | 4 | 5 |
| September 6, 20.. | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| September 13, 2.. | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| September 20, 2.. | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| September 27, 2.. | 27 | 28 | 29 | 30 | 1 | 2 | 3 |
| October 4, 2020 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| October 11, 2020 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| October 18, 2020 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| October 25, 2020 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| November 1, 2020 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| November 8, 2020 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| November 15, 20.. | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| November 22, 20.. | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| November 29, 20.. | 29 | 30 | 1 | 2 | 3 | 4 | 5 |
| December 6, 2020 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| December 13, 20.. | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| December 20, 20.. | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| December 27, 20.. | 27 | 28 | 29 | 30 | 31 | 1 | 2 |
| January 3, 2021 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| January 10, 2021 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| January 17, 2021 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| January 24, 2021 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| January 31, 2021 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| February 7, 2021 | 7 | 8 | 9 | 10 | | | |

Available
■ False
■ True

Date Day broken down by Date Weekday vs. Date Week. Color shows details about Available. The data is filtered on Listing Id, which keeps 5178.

## Listing ID: 5121

| Week of Date | Sun.. | Mon.. | Tues.. | Wed.. (Date) | Thur.. | Fri.. | Satu.. |
|---|---|---|---|---|---|---|---|
| February 9, 2020 | | | | 12 | 13 | 14 | 15 |
| February 16, 2020 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| February 23, 2020 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| March 1, 2020 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| March 8, 2020 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| March 15, 2020 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| March 22, 2020 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| March 29, 2020 | 29 | 30 | 31 | 1 | 2 | 3 | 4 |
| April 5, 2020 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| April 12, 2020 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| April 19, 2020 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| April 26, 2020 | 26 | 27 | 28 | 29 | 30 | 1 | 2 |
| May 3, 2020 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| May 10, 2020 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| May 17, 2020 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| May 24, 2020 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| May 31, 2020 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| June 7, 2020 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| June 14, 2020 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| June 21, 2020 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| June 28, 2020 | 28 | 29 | 30 | 1 | 2 | 3 | 4 |
| July 5, 2020 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| July 12, 2020 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| July 19, 2020 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| July 26, 2020 | 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| August 2, 2020 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| August 9, 2020 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| August 16, 2020 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| August 23, 2020 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| August 30, 2020 | 30 | | 7 | | 2 | 3 | 4 | 5 |
| September 6, 20.. | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| September 13, 2.. | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| September 20, 2.. | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| September 27, 2.. | 27 | 28 | 29 | 30 | 1 | 2 | 3 |
| October 4, 2020 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| October 11, 2020 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| October 18, 2020 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| October 25, 2020 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| November 1, 2020 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| November 8, 2020 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| November 15, 20.. | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| November 22, 20.. | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| November 29, 20.. | 29 | 30 | 1 | 2 | 3 | 4 | 5 |
| December 6, 2020 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| December 13, 20.. | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| December 20, 20.. | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| December 27, 20.. | 27 | 28 | 29 | 30 | 31 | 1 | 2 |
| January 3, 2021 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| January 10, 2021 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| January 17, 2021 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| January 24, 2021 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| January 31, 2021 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| February 7, 2021 | 7 | 8 | 9 | 10 | | | |

Available
■ True

Date Day broken down by Date Weekday vs. Date Week. Color shows details about Available. The data is filtered on Listing Id, which keeps 5121.

## Listing ID: 5099

| Week of Date | Sun.. | Mon.. | Tues.. | Date Wed.. | Thur.. | Frid.. | Satu.. |
|---|---|---|---|---|---|---|---|

Available  
■ False

February 9, 2020 ... 12 13 14 15  
February 16, 2020 16 17 18 19 20 21 22  
February 23, 2020 23 24 25 26 27 28 29  
March 1, 2020 1 2 3 4 5 6 7  
March 8, 2020 8 9 10 11 12 13 14  
March 15, 2020 15 16 17 18 19 20 21  
March 22, 2020 22 23 24 25 26 27 28  
March 29, 2020 29 30 31 1 2 3 4  
April 5, 2020 5 6 7 8 9 10 11  
April 12, 2020 12 13 14 15 16 17 18  
April 19, 2020 19 20 21 22 23 24 25  
April 26, 2020 26 27 28 29 30 1 2  
May 3, 2020 3 4 5 6 7 8 9  
May 10, 2020 10 11 12 13 14 15 16  
May 17, 2020 17 18 19 20 21 22 23  
May 24, 2020 24 25 26 27 28 29 30  
May 31, 2020 31 1 2 3 4 5 6  
June 7, 2020 7 8 9 10 11 12 13  
June 14, 2020 14 15 16 17 18 19 20  
June 21, 2020 21 22 23 24 25 26 27  
June 28, 2020 28 29 30 1 2 3 4  
July 5, 2020 5 6 7 8 9 10 11  
July 12, 2020 12 13 14 15 16 17 18  
July 19, 2020 19 20 21 22 23 24 25  
July 26, 2020 26 27 28 29 30 31 1  
August 2, 2020 2 3 4 5 6 7 8  
August 9, 2020 9 10 11 12 13 14 15  
August 16, 2020 16 17 18 19 20 21 22  
August 23, 2020 23 24 25 26 27 28 29  
August 30, 2020 30 31 1 2 3 4 5  
September 6, 20.. 6 7 8 9 10 11 12  
September 13, 2.. 13 14 15 16 17 18 19  
September 20, 2.. 20 21 22 23 24 25 26  
September 27, 2.. 27 28 29 30 1 2 3  
October 4, 2020 4 5 6 7 8 9 10  
October 11, 2020 11 12 13 14 15 16 17  
October 18, 2020 18 19 20 21 22 23 24  
October 25, 2020 25 26 27 28 29 30 31  
November 1, 2020 1 2 3 4 5 6 7  
November 8, 2020 8 9 10 11 12 13 14  
November 15, 20.. 15 16 17 18 19 20 21  
November 22, 20.. 22 23 24 25 26 27 28  
November 29, 20.. 29 30 1 2 3 4 5  
December 6, 2020 6 7 8 9 10 11 12  
December 13, 20.. 13 14 15 16 17 18 19  
December 20, 20.. 20 21 22 23 24 25 26  
December 27, 20.. 27 28 29 30 31 1 2  
January 3, 2021 3 4 5 6 7 8 9  
January 10, 2021 10 11 12 13 14 15 16  
January 17, 2021 17 18 19 20 21 22 23  
January 24, 2021 24 25 26 27 28 29 30  
January 31, 2021 31 1 2 3 4 5 6  
February 7, 2021 7 8 9 10

Date Day broken down by Date Weekday vs. Date Week. Color shows details about Available. The data is filtered on Listing Id, which keeps 5099.

## Listing ID: 5178

| Week of Date | Sun.. | Mon.. | Tues.. | Date Wed.. | Thur.. | Frid.. | Satu.. |
|---|---|---|---|---|---|---|---|

Available  
■ False  
■ True

Date Day broken down by Date Weekday vs. Date Week. Color shows details about Available. The data is filtered on Listing Id, which keeps 5178.

## Listing ID: 5121

| Week of Date | Sun.. | Mon.. | Tues.. | Date Wed.. | Thur.. | Frid.. | Satu.. |
|---|---|---|---|---|---|---|---|

Available  
■ True

Date Day broken down by Date Weekday vs. Date Week. Color shows details about Available. The data is filtered on Listing Id, which keeps 5121.
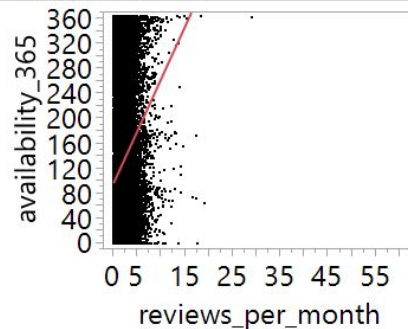
# Pt. 2: Data-driven Analysis - Demand

Summary:

- Use # of reviews + availability trend

# A quick check

Regression between
reviews_per_month and 365_availablity

## Response availability_365

### Regression Plot



### Summary of Fit

| | |
|---|---|
| RSquare | 0.042233 |
| RSquare Adj | 0.042209 |
| Root Mean Square Error | 129.8591 |
| Mean of Response | 118.3047 |
| Observations (or Sum Wgts) | 40749 |

### Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 30299136 | 30299136 | 1796.740 |
| Error | 40747 | 687132677 | 16863.393 | **Prob > F** |
| C. Total | 40748 | 717431813 | | <.0001* |

### Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>|t| |
|---|---|---|---|---|
| Intercept | 96.173567 | 0.828513 | 116.08 | <.0001* |
| reviews_per_month | 16.772086 | 0.39568 | 42.39 | <.0001* |

# Next Steps:

- Work on the algorithm to fit demand
- Predict demand and optimize pricing
- Conclusion and recommendations for optimal pricing strategies

# Thank you!

# Pt. 2: Data-driven Analysis - Seasonality