Airbnb: New York City

IDS - 570

Statistics for Management

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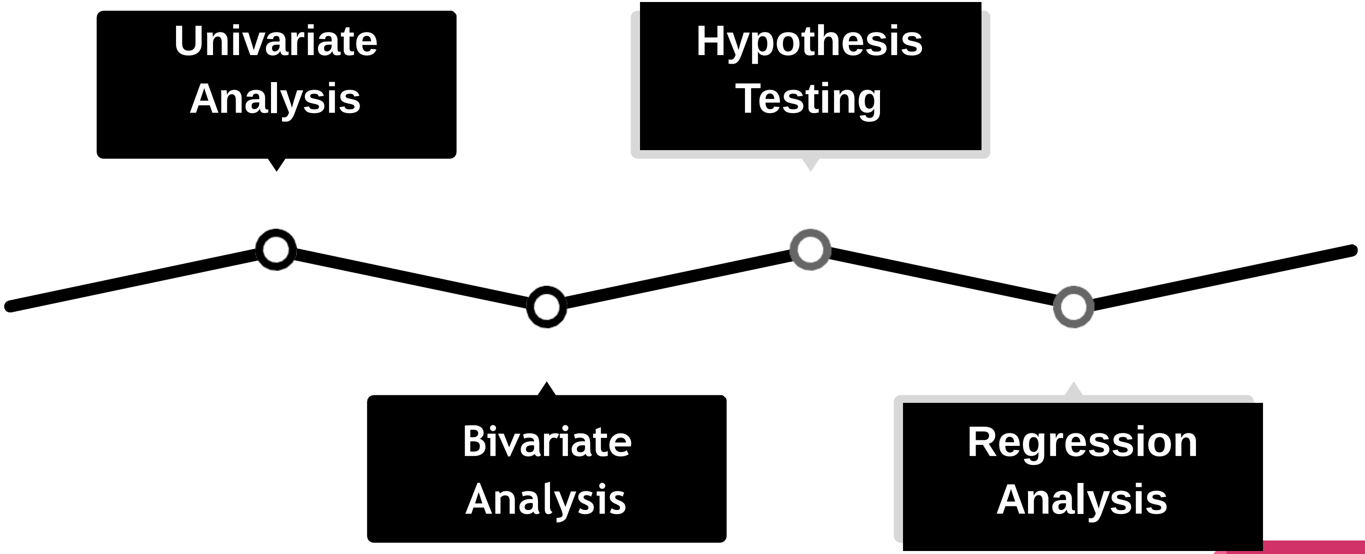
Introduction - Airbnb Company Overview

- Founded in 2008
- Privately owned and operated
- Peer-to-peer online marketplace and homestay network
- People list or rent short-term lodging in residential properties
- Cost of accommodation is set by the property owner
- Receives percentage service fees from both guests and hosts in conjunction with every booking
- Over 2,000,000 listings in 34,000 cities and 191 countries

Methodology Followed



Univariate Analysis

Bivariate Analysis

Hypothesis Testing

Regression Analysis

Airbnb New York City - Dataset Parameters

The variables that were provided with the dataset

- ID
- Name
- Host_ID
- Host_Name
- **Neighborhood_group**
- **Neighborhood**
- Latitude
- Longitude
- **Room_type**
- **Price**
- **Minimum_nights**
- Reviews_per_month
- Calculated_host_listings_count
- Availability
- **Number_of_reviews**
- **Last_review**

Note: The highlighted variables are the ones on which our analysis is based primarily upon.

Assumptions

- Number of Reviews is assumed as the Number of Bookings for Airbnb
- The month value in Last Review Date variable is assumed as the month in which the booking was done

Challenges

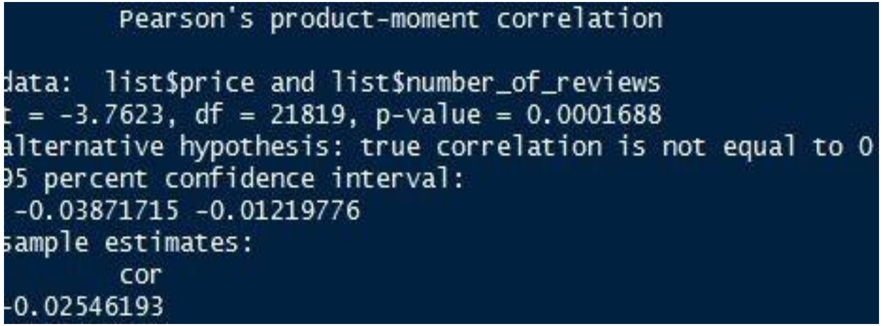
- New York data has large number of rows, so intense data cleaning was required to draw some meaningfulinsights
- Booking data was not explicitly available
- Tourist spot data was not inherently available (the tourist locations were mapped using internet)
- The sentiment of the review (positive / negative) could not be measured

Research Question

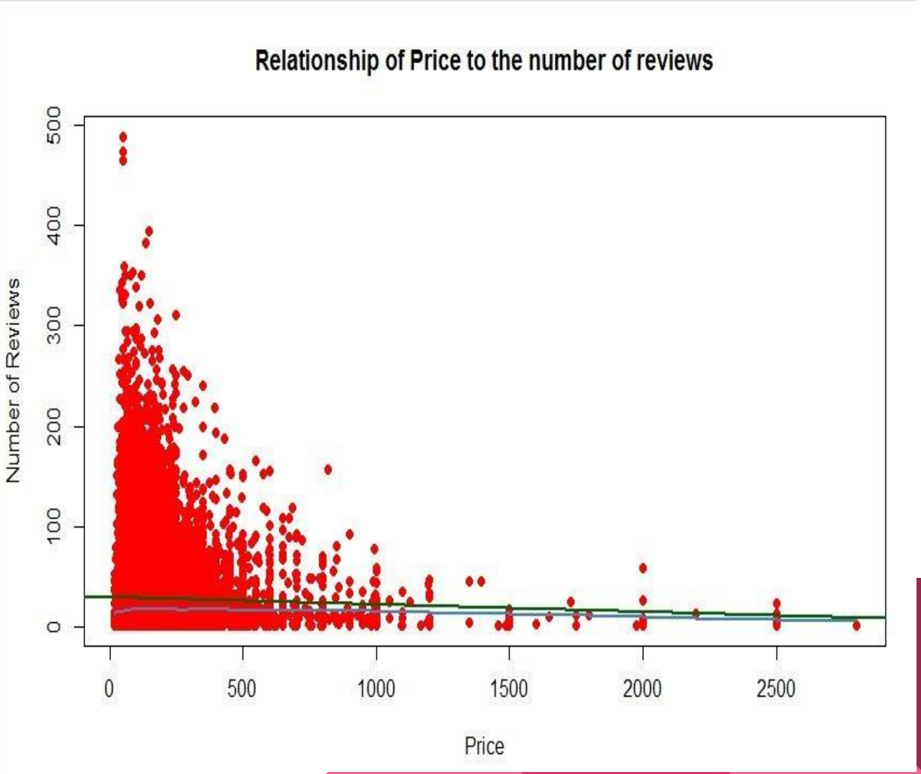
- What are the factors that affect the number of reviews of an airbnb listing in New York City and in what capacity do the factors influence the number of reviews?

Bivariate Analysis w.r.t. Dependent Variable

1. Number of Reviews Vs. Price



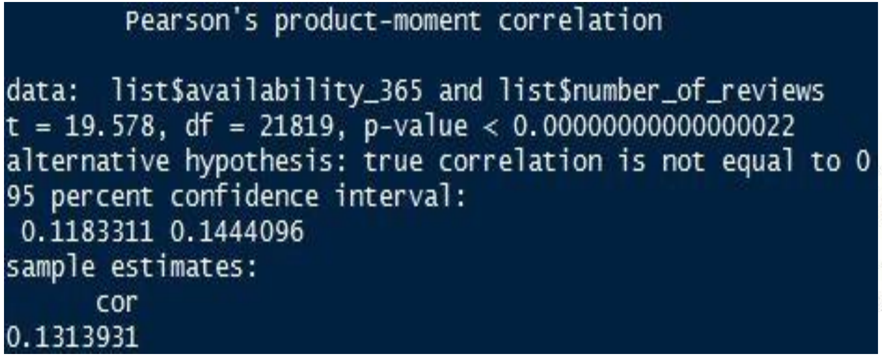
```
        Pearson's product-moment correlation

data:  list$price and list$number_of_reviews
t = -3.7623, df = 21819, p-value = 0.0001688
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.03871715 -0.01219776
sample estimates:
        cor
-0.02546193
```



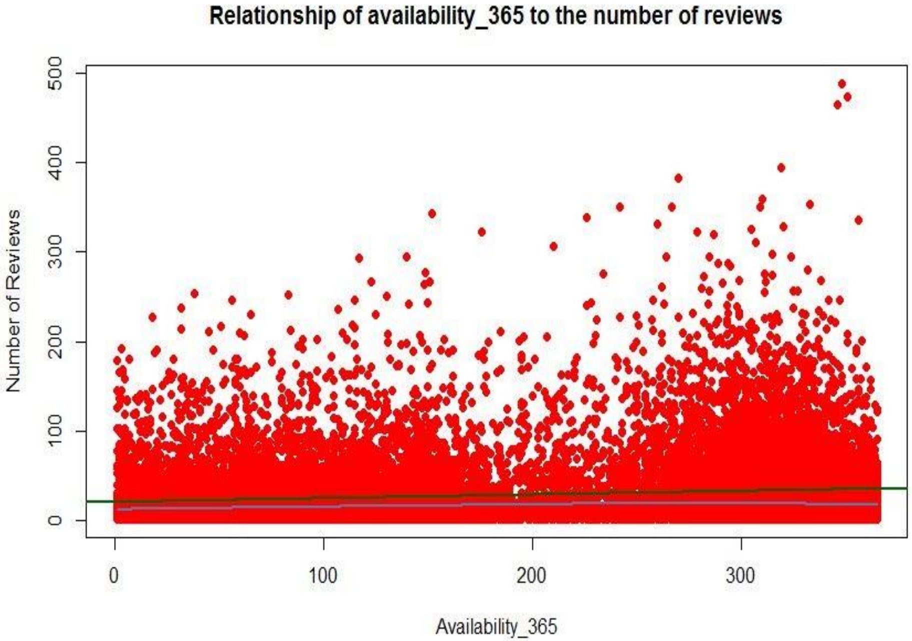
Result: 2% Inverse Correlation

Bivariate Analysis w.r.t. Dependent Variable

2. Number of Reviews Vs. Availability 365



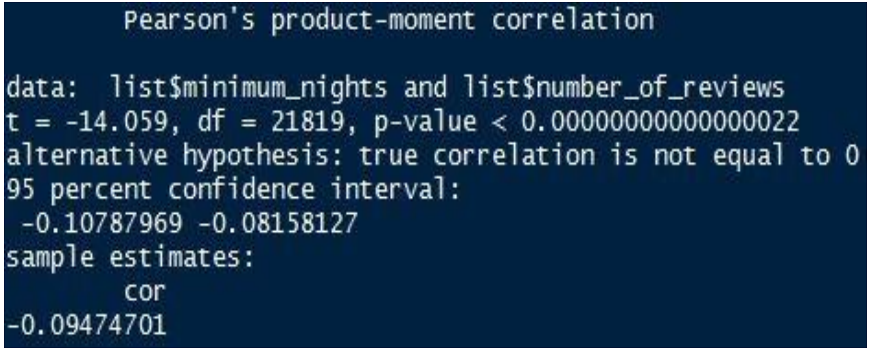
```
        Pearson's product-moment correlation

data:  list$availability_365 and list$number_of_reviews
t = 19.578, df = 21819, p-value < 0.00000000000000022
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.1183311 0.1444096
sample estimates:
      cor
0.1313931
```



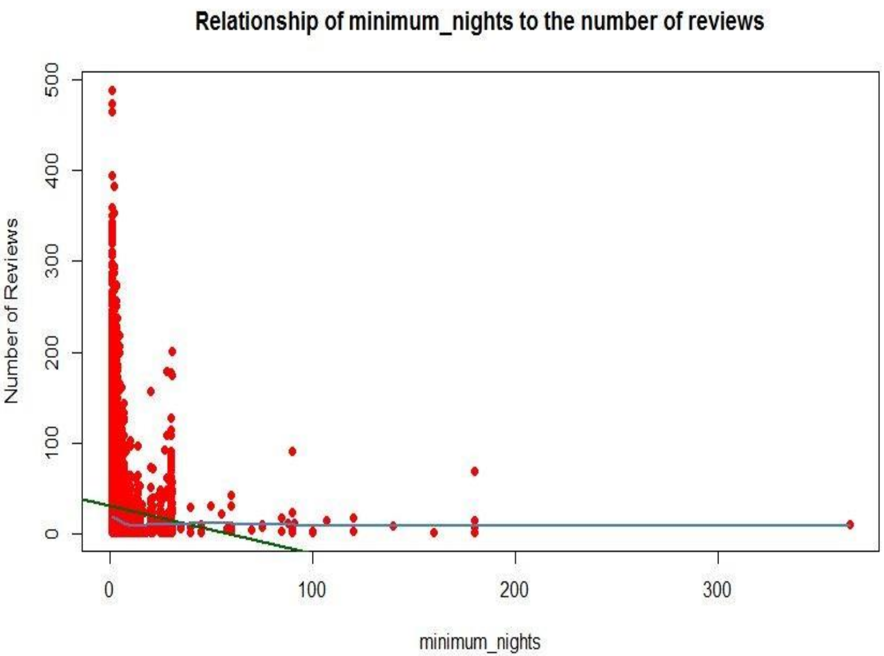
<u>Result:</u> 13% Positive Correlation

Bivariate Analysis w.r.t. Dependent Variable

3. Number of Reviews Vs. Minimun_nights



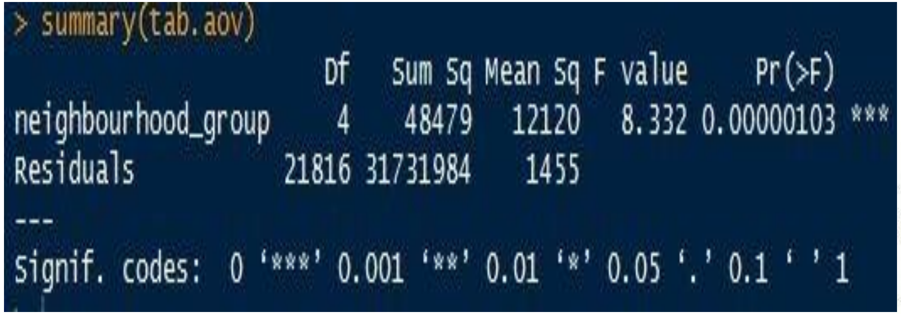
```
        Pearson's product-moment correlation

data:  list$minimum_nights and list$number_of_reviews
t = -14.059, df = 21819, p-value < 0.0000000000000022
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.10787969 -0.08158127
sample estimates:
        cor
-0.09474701
```



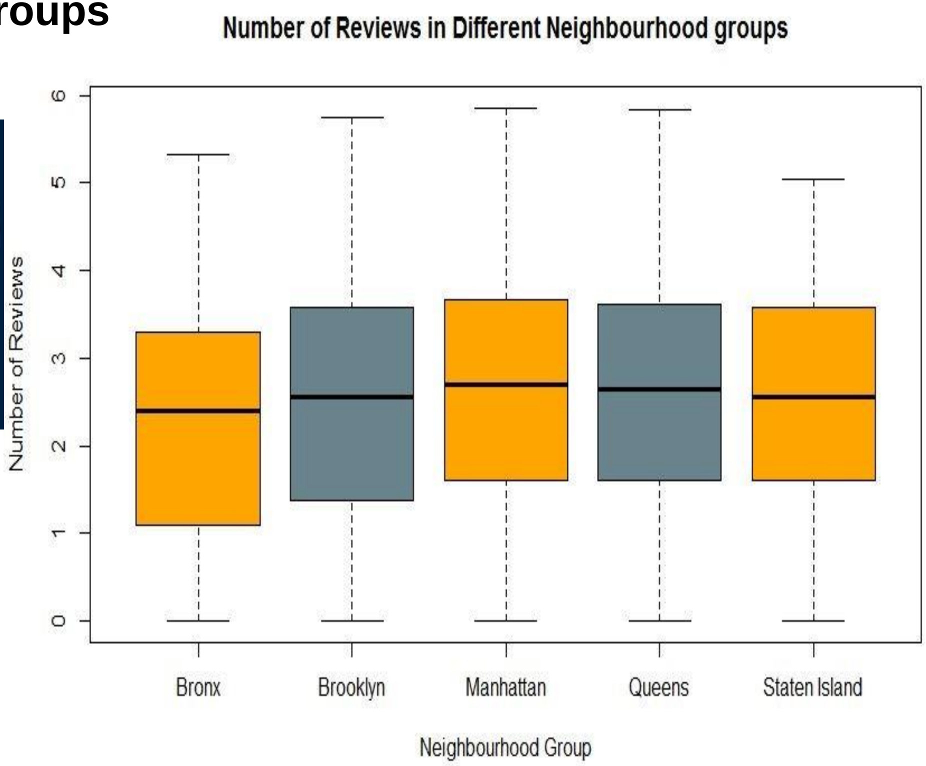
Result: 9% Inverse Correlation

Bivariate Analysis w.r.t. Dependent Variable

4. Number of Reviews Vs. Neighborhood_Groups



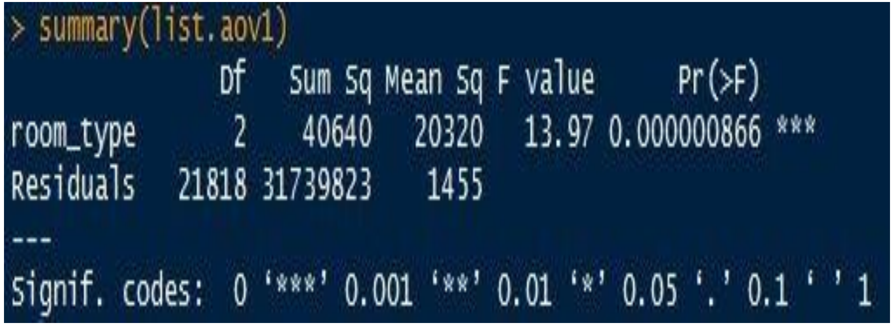
```
> summary(tab.aov)
                       Df   Sum Sq Mean Sq F value     Pr(>F)    
neighbourhood_group     4    48479   12120   8.332 0.00000103 ***
Residuals           21816 31731984    1455                       
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```



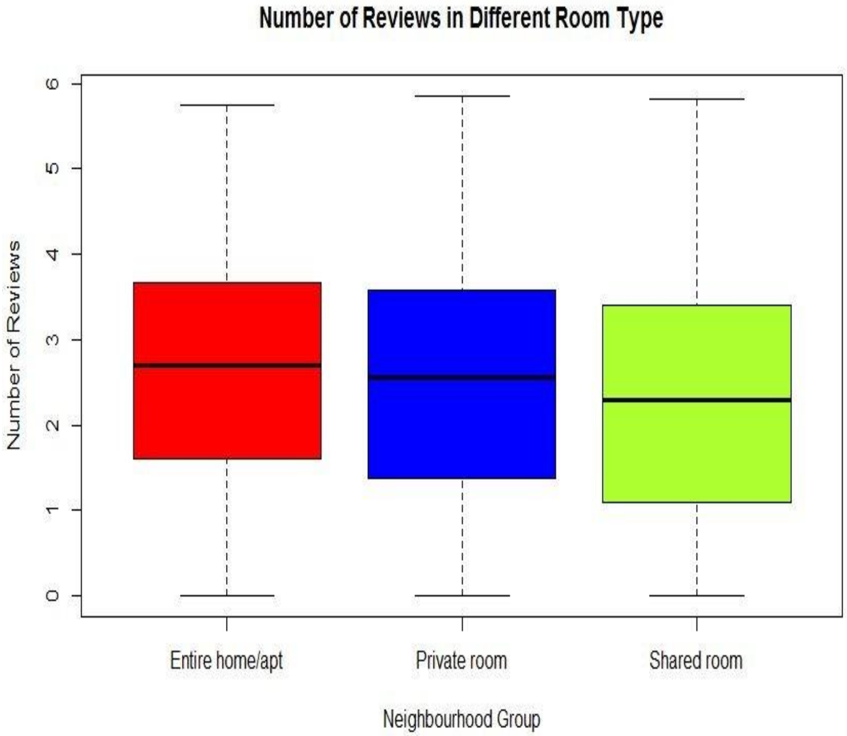
Result: Number of Reviews are dependent on Neighborhood Groups

Bivariate Analysis w.r.t. Dependent Variable

5. Number of Reviews Vs. Room Type



```
> summary(list.aov1)
               Df   Sum Sq Mean Sq F value      Pr(>F)    
room_type       2    40640   20320   13.97 0.000000866 ***
Residuals   21818 31739823    1455                        
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```



<u>Result:</u> Number of Reviews are dependent on Room Types

Hypotheses

- The number of reviews of an Airbnb listing in New York City is higher for a listing at lower price

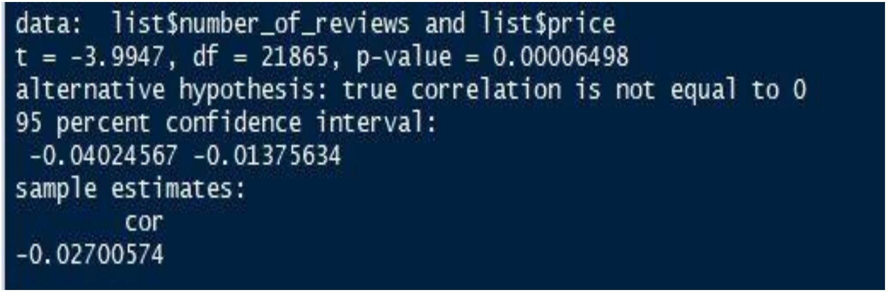
- The number of reviews is higher for the listings hosted in Fall or Summer season

- The number of reviews for a listing is higher for a neighborhood situated in the vicinity of a tourist destination

Hypothesis-1 Analysis

Hypothesis 1 - The number of reviews of an Airbnb listing in New York City is higher for a listing at lower price

- Initially, price and number of reviews did not display a strong correlation.
- For deeper analysis, price was further sub - categorised



```
data:  list$number_of_reviews and list$price
t = -3.9947, df = 21865, p-value = 0.00006498
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.04024567 -0.01375634
sample estimates:
        cor
-0.02700574
```

Price Range	Price Category
Price<=$100	Economic
$100< Price <=$300	Deluxe
Price >$300	Luxury

Hypothesis-1 Analysis (Cont.)

Significant Results of Hypothesis testing on different price categories:

For Deluxe and Economic price categories:

a) The correlation coefficient for the price category = **Deluxe** and Neighborhood group = **Staten Island** is -0.2493094

b) The correlation coefficient for the price category = **Economic** and Neighborhood group = **Staten Island** is -0.1029916

- Economic and Deluxe price category in Staten Island Neighborhood group, the number of reviews are decreasing with increased prices

For Luxury price category:

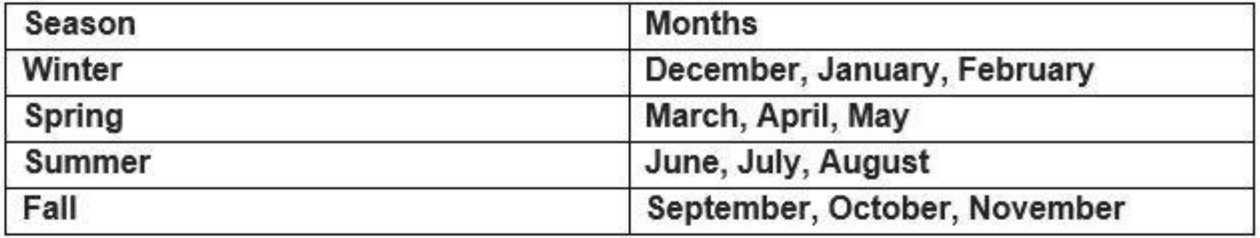
a) The correlation coefficient for the price category = **Luxury** and Neighborhood group = **Bronx** is around 1

- For Luxury category rooms, the customers are not price centric. Therefore, the number of reviews and price are directly proportional

Hypothesis-2 Analysis

Hypothesis 2 - The number of reviews is higher for the listings hosted in Fall or Summer season

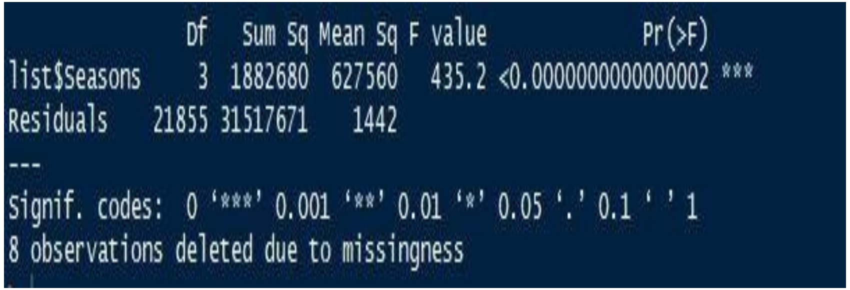
- To analyze the hypothesis, months are divided into seasons as following:



Season	Months
Winter	December, January, February
Spring	March, April, May
Summer	June, July, August
Fall	September, October, November

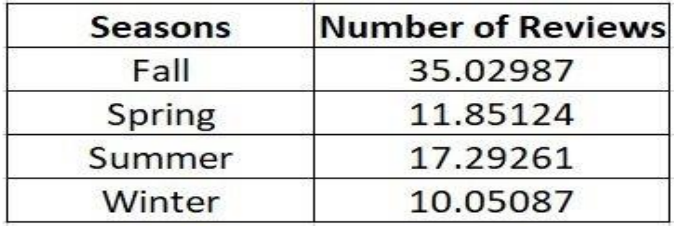
Hypothesis-2 (Cont.)

- **ANOVA test between number of reviews and seasons:**
  The number of reviews is dependent on the change in seasons

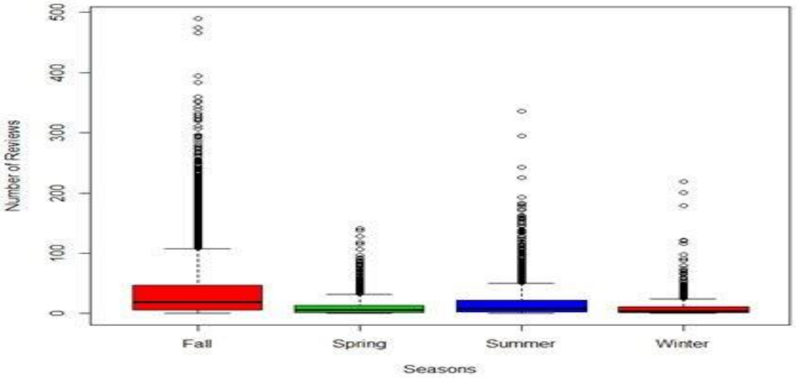


```
                Df   Sum Sq Mean Sq F value              Pr(>F)
list$Seasons     3  1882680  627560   435.2 <0.0000000000000002 ***
Residuals    21855 31517671    1442
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
8 observations deleted due to missingness
```

- **Peak booking season in New York**



Seasons	Number of Reviews
Fall	35.02987
Spring	11.85124
Summer	17.29261
Winter	10.05087

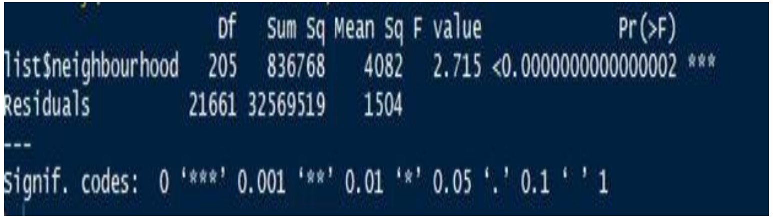


<u>Conclusion:</u> Maximum bookings for Airbnb listings are observed for holiday seasons i.e. Fall and Summer

Hypothesis-3 Analysis

Hypothesis 3 - The number of reviews of a listing in a neighborhood is higher if the neighborhood is a tourist destination.

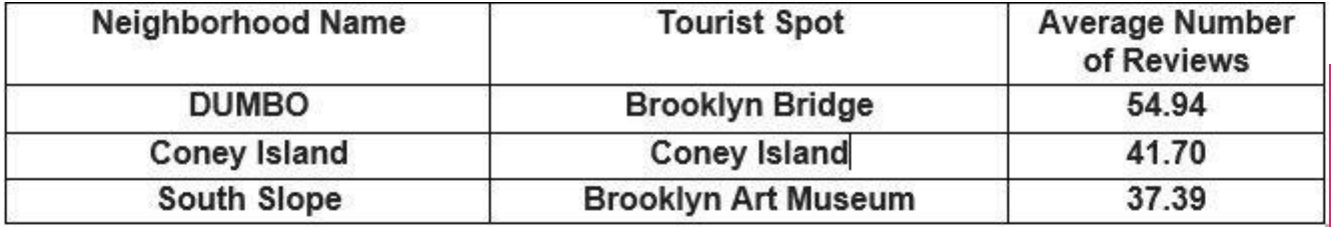
- ANOVA test between number of reviews and neighborhood:
  The number of reviews change with the change in neighborhood



```
                      Df   Sum Sq Mean Sq F value              Pr(>F)    
list$neighbourhood   205   836768    4082   2.715 <0.0000000000000002 ***
Residuals          21661 32569519    1504                               
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

To analyze the number of reviews of a listing near a tourist destination:

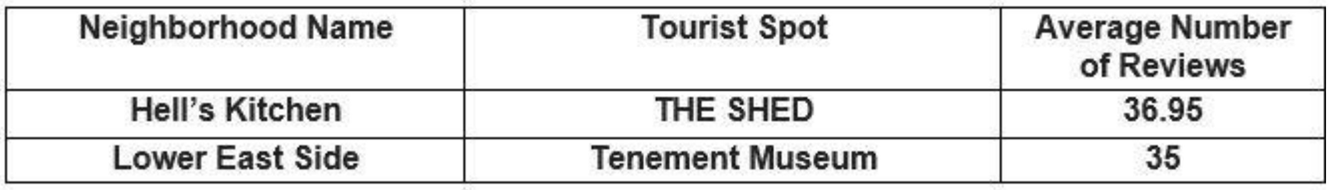
- **Neighborhood Group – Brooklyn** (Top 3 results)**:**



Neighborhood Name	Tourist Spot	Average Number of Reviews
DUMBO	Brooklyn Bridge	54.94
Coney Island	Coney Island	41.70
South Slope	Brooklyn Art Museum	37.39

Hypothesis-3 (Cont.)

- **Neighborhood Group - Manhattan:**



Neighborhood Name	Tourist Spot	Average Number of Reviews
Hell’s Kitchen	THE SHED	36.95
Lower East Side	Tenement Museum	35

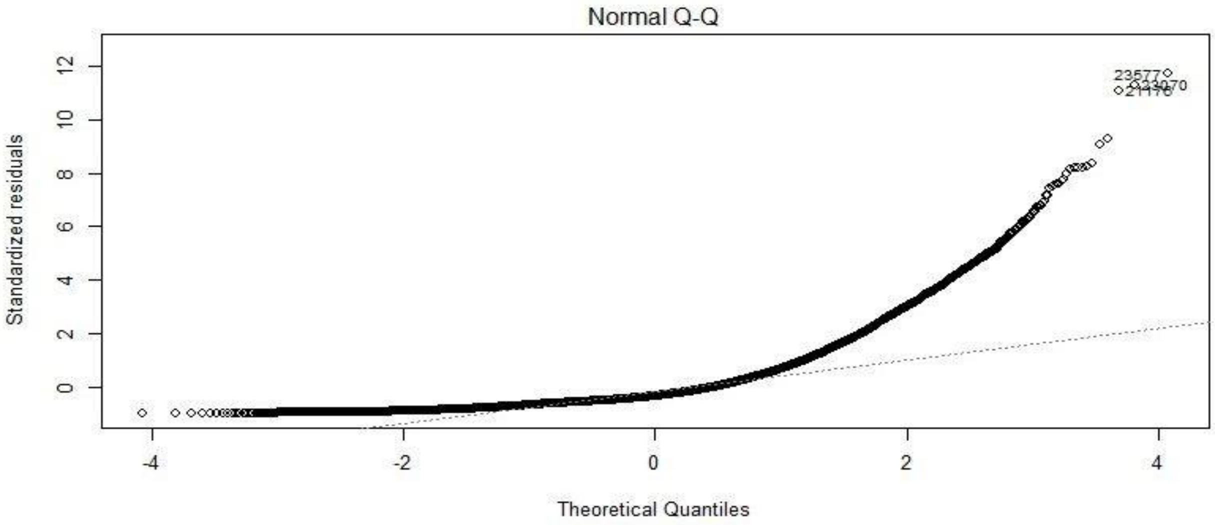
Conclusion:

The number of reviews for a listing is higher for a neighborhood situated in the vicinity of a tourist destination.

*tourist spot data searched on the internet.

Linear Regression Modelling

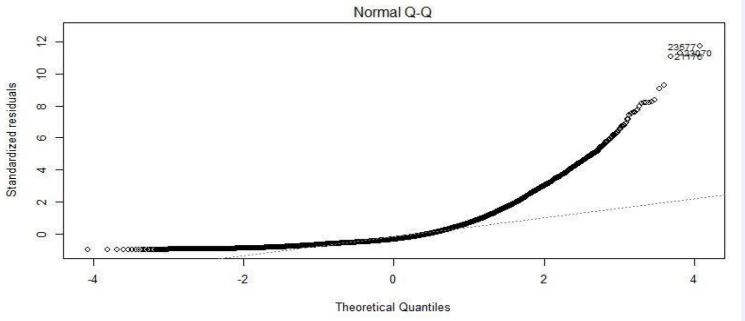
Model - 1: Number of Reviews Vs Numeric Independent Variables



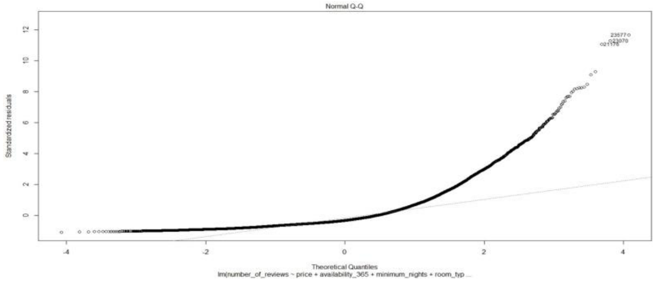
- Adjusted R-squared value is 2.87%
- Factor columns to be added to improve model

Model - 2

Number of reviews vs Independent Numeric variables and Factors like Neighborhood group ,Room type



Model 1

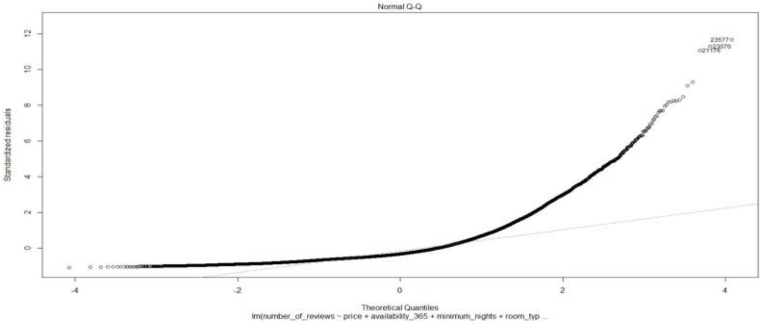


Model 2

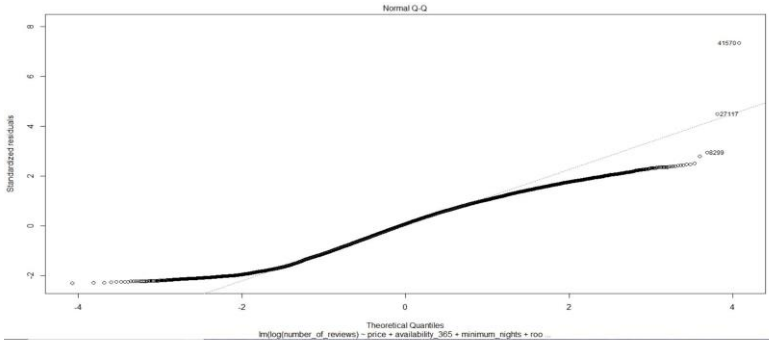
- Enhanced Model 1 by introducing factors in the Linear Model
  - Factors like Neighborhood group, Room Type
- Fitness of Linear Model increased from 2.87 to 3.61%

Model - 3

Log transformation of number of reviews



Model 2

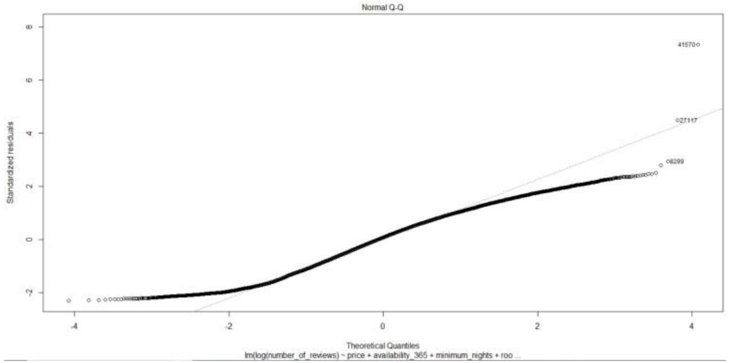


Model 3

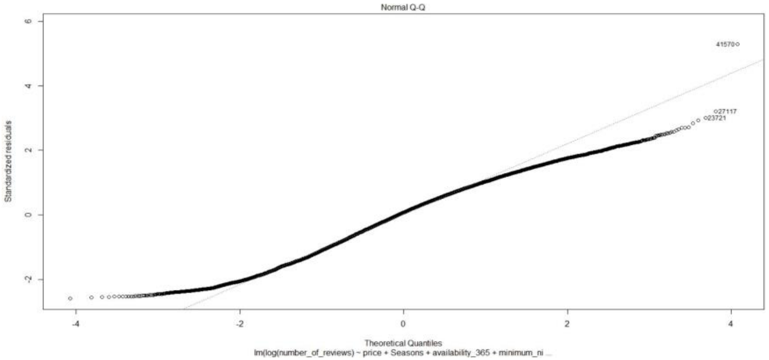
- Log transformation of dependent variable i.e. number_of_reviews
- Model fitness improved to 4.45% from 3.6%

Model - 4

Converting last_review into factor called Seasons(based on months)



Model 3

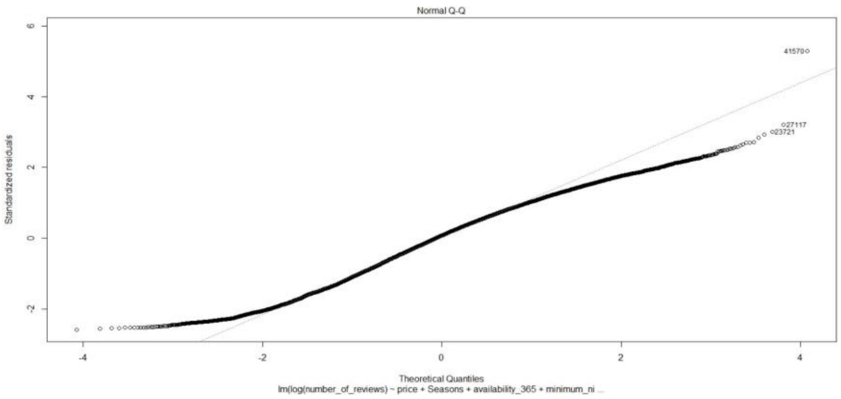


Model 4

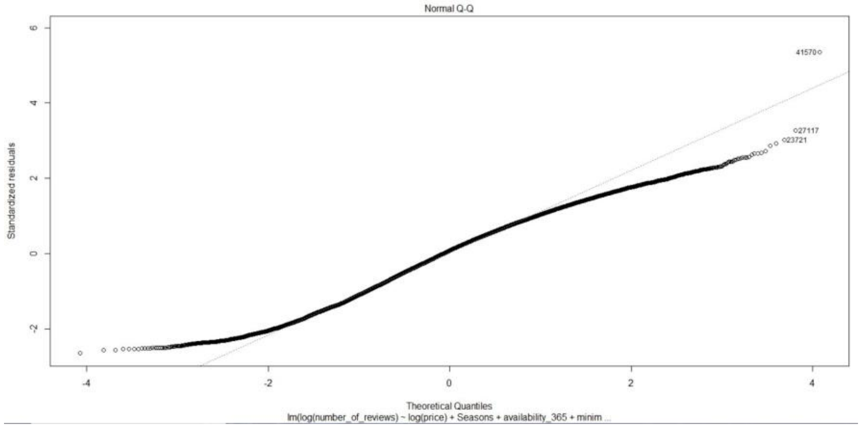
- Seasons factor column introduced with levels - Fall, Winter, Spring, Summer
- Model fitness drastically improved from 4.45% to 12.48 %

Model - 5

Log Transformation of Price



Model 4

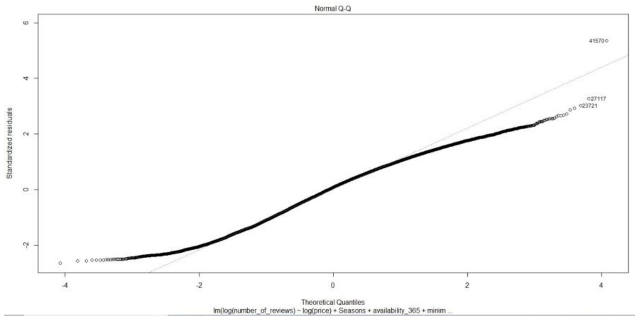


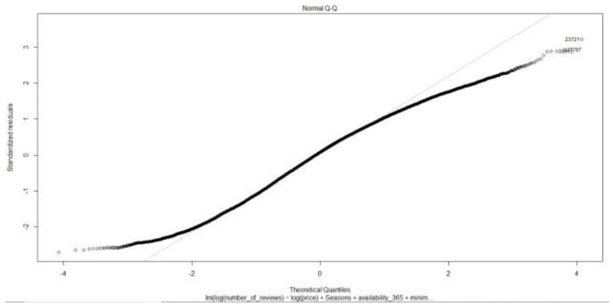
Model 5

- Factored price into 3 categories - Economic, Deluxe, Luxury
  - Fitness increased marginally from 12.48% to 12.50%
- Log of price produced better results

Model - 6

Adding Minimum Nights Cat as a factor





- Model fitness increased from 12.5% in Model 5 to 13.8% in Model 6
- Removed outliers for model 7
    - Adjusted R-squared value decreased
    - Model 6 finalised as **BEST LINEAR MODEL**

*** Model fitness increased by 379.83% from 2.876% for model 1 to 13.88% for model 6**

Effect of Linear Regression onHypothesis-1

- Number of reviews will increase with the decrease in the price of a listing

- In the final model,coefficient of the independent variable **Price** (i.e. log(price) is -0.25149562 which decreased by 0.24 w.r.t. the first model

- Keeping all the other independent variables constant; **if the log(price) increases by 1, the log(number of reviews) will decreaseby 0.25149562**

- **Inference:** Number of reviews and price of a listing are inversely proportional

Effect of Linear Regression onHypothesis-2

- Number of reviews will change with the change in the season when the listing was hosted

- In the final model, coefficient of Season = “Fall” is 0.94785556 and Season= “Summer” is 0.31570821

- Keeping all the other independent variables constant; **if the hosting in Fall increases by 1, the log(number of reviews) will increase by0.947**

- Inference: Number of reviews of a listing is higher in Fall and Summer (Holiday seasons) in comparison to Winter and Spring

Effect of Linear Regression onHypothesis-3

- The number of reviews across different neighborhoods is not the same
- In the final model, the coefficient of neighborhood = “Brooklyn” is 0.30664352
- Keeping all the other independent variables constant; **the average difference in log(number of reviews) for a listing in Brooklyn as compared to a listing not in Brooklyn is 0.30664352**
- Inference: Number of reviews for a listing is higher when it is in a neighborhood situated in the vicinity of a tourist destination

Recommendations

- Airbnb should facilitate customers with discounts and offers during off seasons

- Airbnb should focus more on improving the service quality rather than decreasing the price for a Luxuryhosting

Thank You