G2M Insight For Cab Investment Firm

Exploratory Data Analysis

LISUM02
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Agenda

- ❑ Executive Summary
- ❑ Problem Statement
- ❑ Methodology
- ❑ Tools Used
- ❑ Data Preparation
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- ❑ Hypothesis Results
- ❑ Forecast
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Executive Summary

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- This report was commissioned to summarize my findings to the client, XYZ company, for the best Cab company to invest in.
- This report focuses on two Cab companies - Yellow Cab and Pink Cab.
- An extensive Exploratory Data Analysis supported with Hypothesis Testing and Forecasting methodologies were utilized for this study.

Recommendation:

According to the data and two-year forecasts, Yellow Cab has been identified to perform better in terms of:

- ✓  High daily number of trips on any given day
- ✓  Higher Market share on most Cities
- ✓ ★★★ Better Customer Retention
- ✓  Higher Profitability

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Problem Statement

The Client

XYZ is a private firm in US. Due to remarkable growth in the Cab Industry in last few years and multiple key players in the market, XYZ is planning to invest in Cab industry and as per their Go-to-Market (G2M) strategy, they want to understand the market before taking final decision.

XYZ has provided multiple data sets that contains information on two cab companies. Each data set provided represents different aspects of the customer profile. XYZ is interested in using the actionable insights obtained to help them identify the right company to make their investment.

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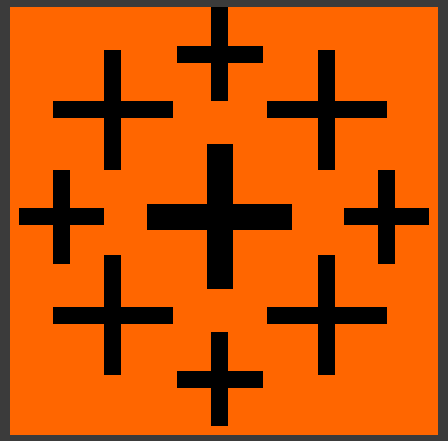
Methodology

-  Exploratory Data Analysis (EDA)
-  Hypothesis Testing
-  Forecasting

Tools Used



Tableau

Python

Data Preparation

- Four data sets that contains information on Two cab companies had been provided.
- Each data set represents different aspects of the customer profile.
- Time period of data is from 02nd January 2016 until 31st December 2018.

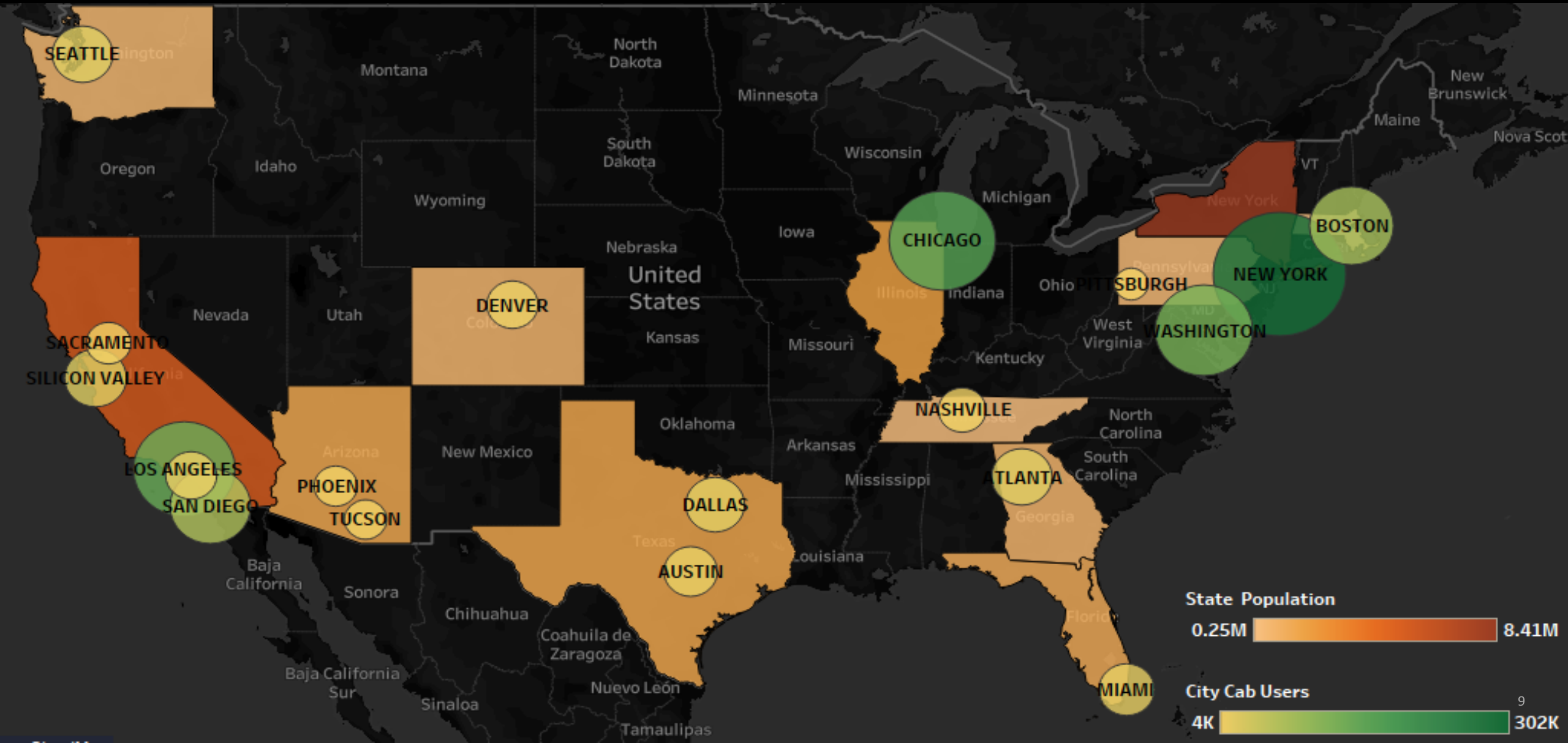
- Master Dataset was created by inner joining:
  - Cab_Data.csv: Includes details of transaction for both cab companies.
  - Customer_ID.csv: Mapping table that contains a unique identifier which links the customer's demographic details.
  - Transaction_ID.csv: Mapping table that contains transaction to customer mapping and payment mode.

The fourth Dataset, City.csv has been left out as it does not provide information about daily trips for both Cab companies.

Schema of Master Dataset

EDA
Key Insights

Population and Cab Users



Daily Trips (2016 - 2018)

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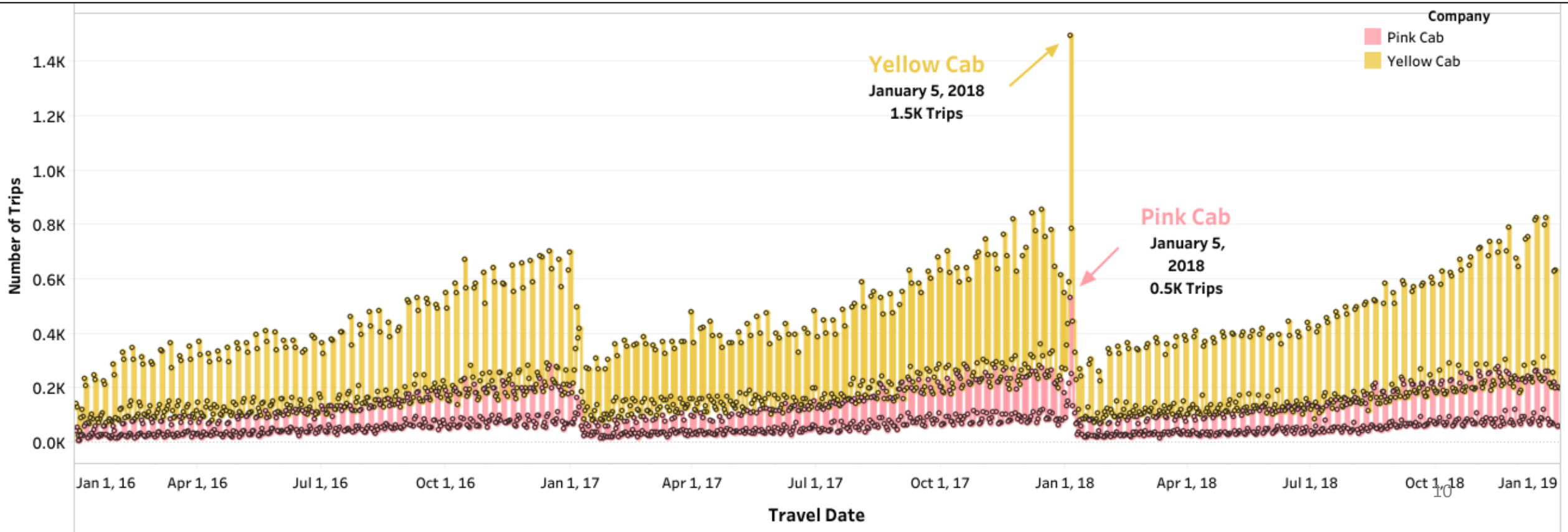
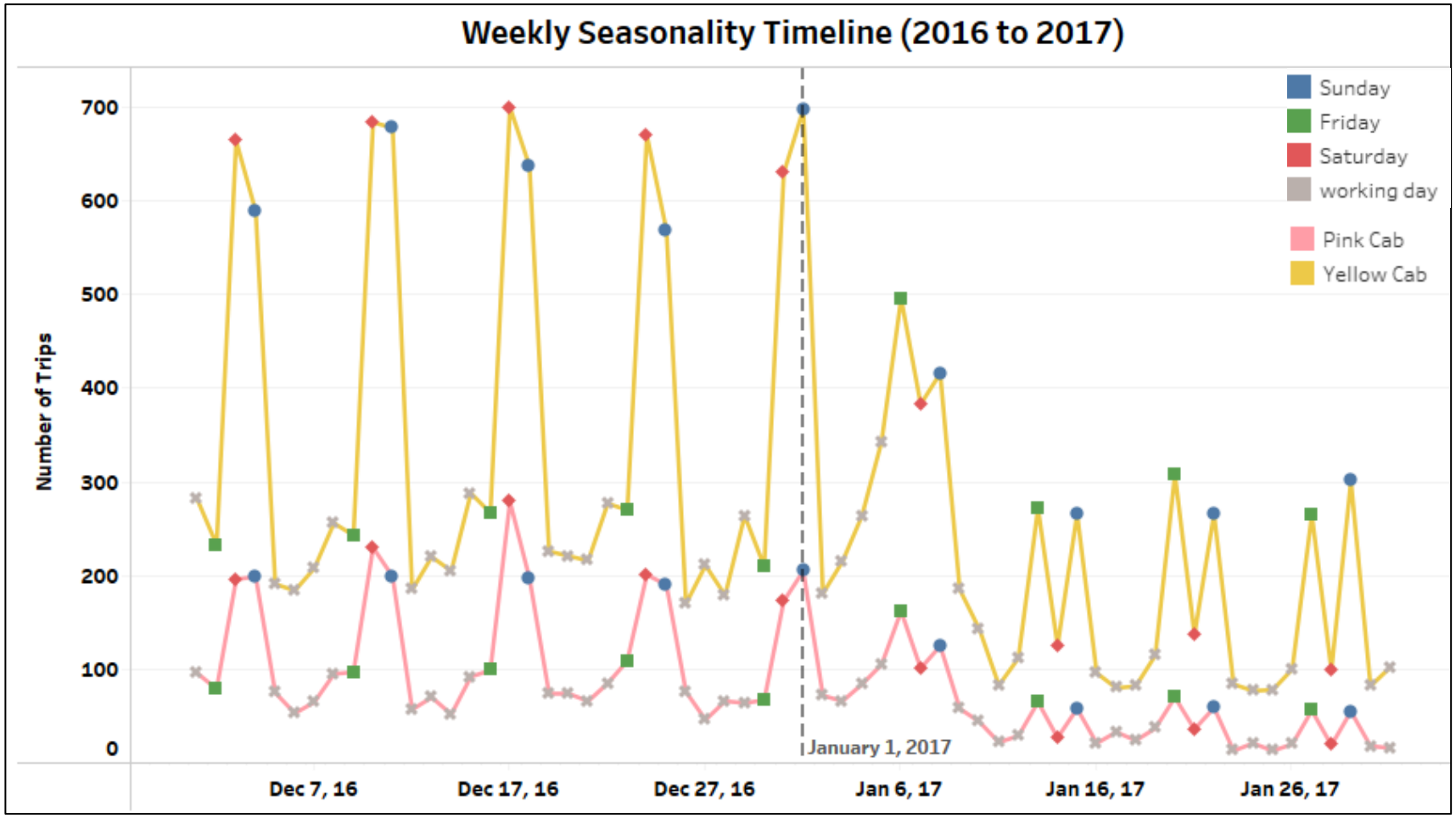
- Same trip pattern for both companies.
- Yellow Cab has highest trips every single day.
- Jan 5th, 2018, saw the highest number of trips for both cab companies.
- Beginning of every year, the trips are very low.
- Conversely, at the end of the year, trips are very high.



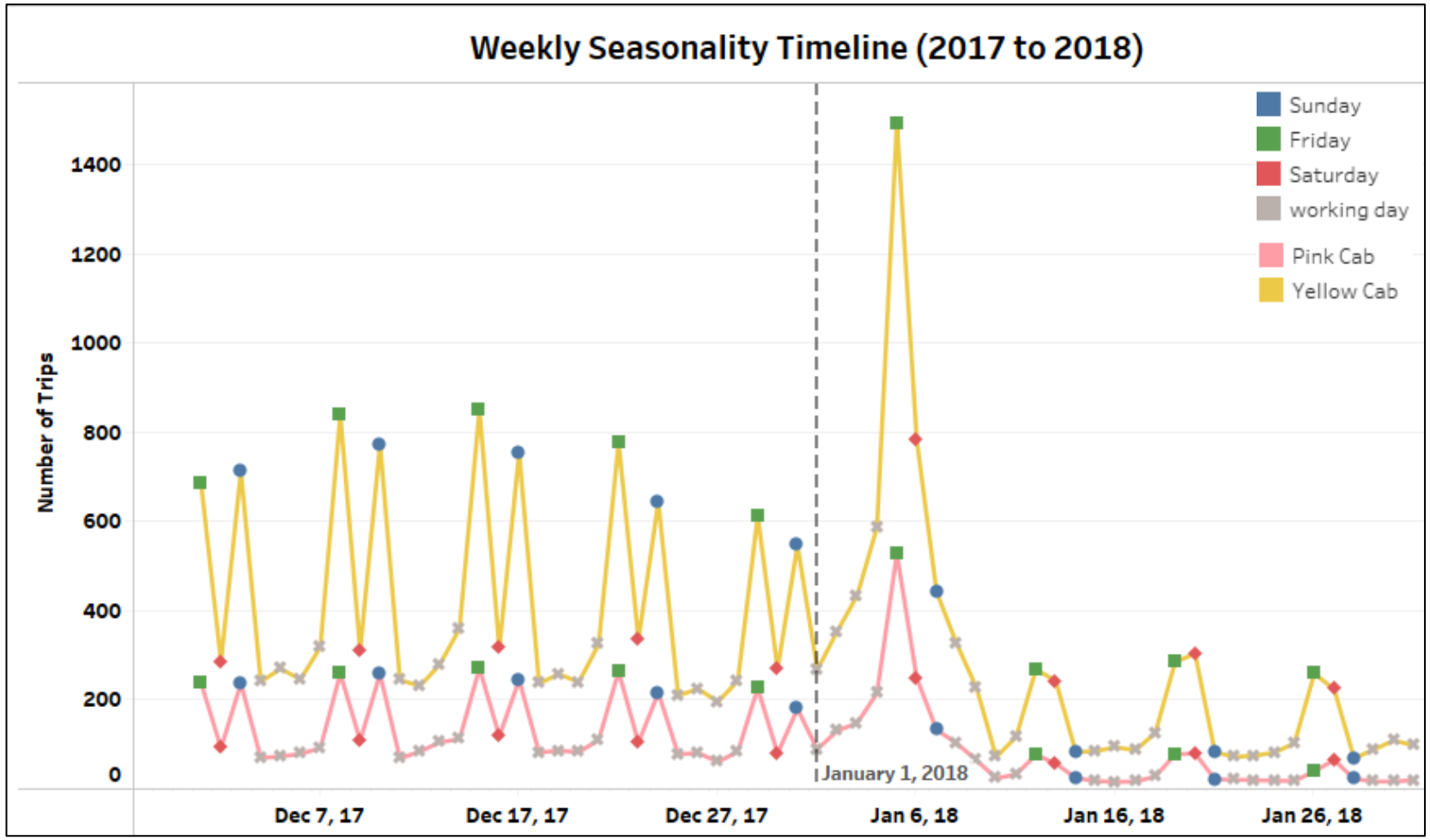
Weekly Seasonality (2016 - 2017)



- Low trips on Friday, and higher trips on Saturday and Sunday in 2016.
- Pattern changes in 2017, where higher trips on Friday, then lowers on Saturday and high again on Sunday.

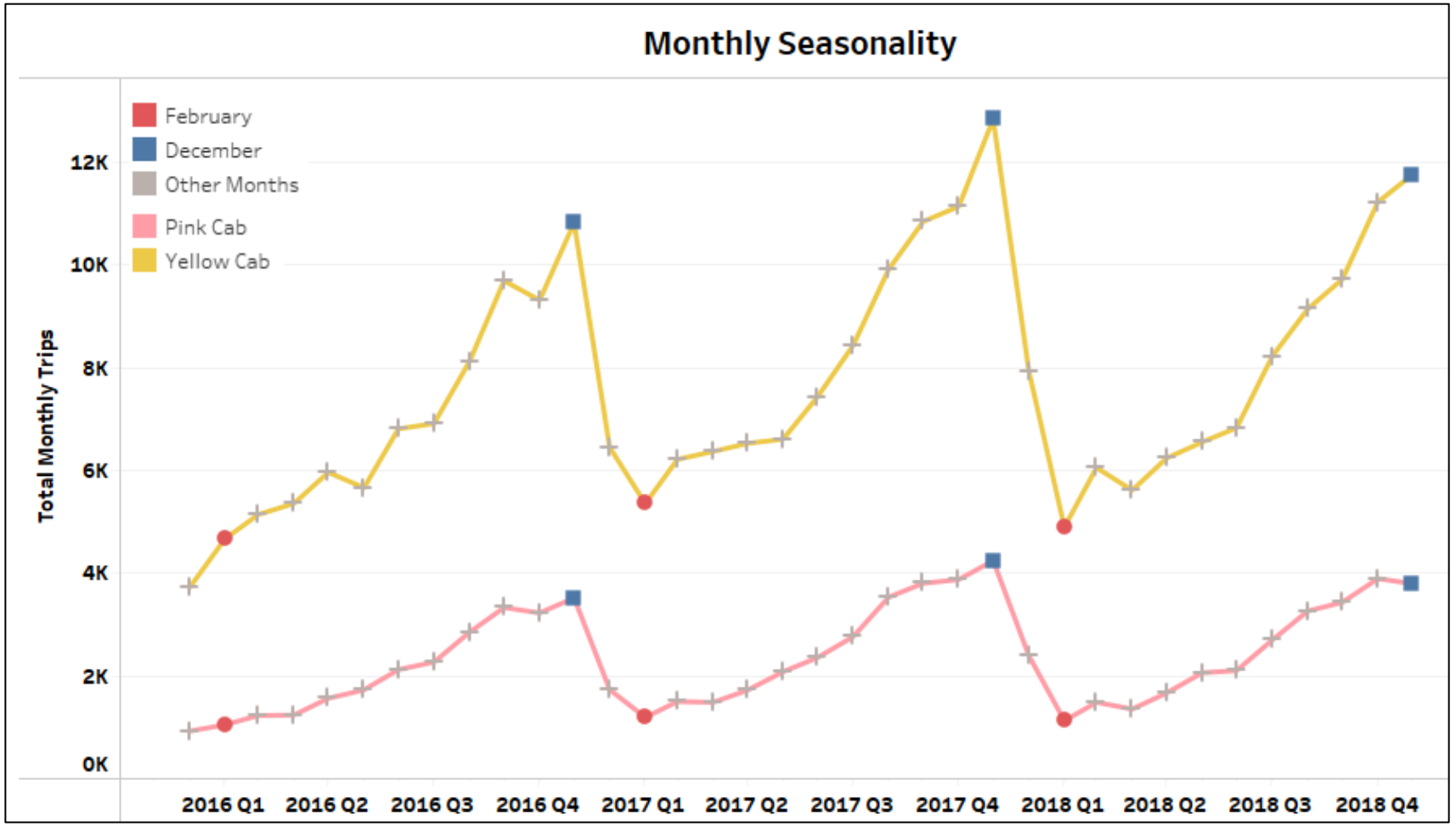
Weekly Seasonality (2017 - 2018)

- In 2017, weekly seasonality changes again.
- High trips on Friday, then lower trips on Saturday, followed by even lower trips on Sunday



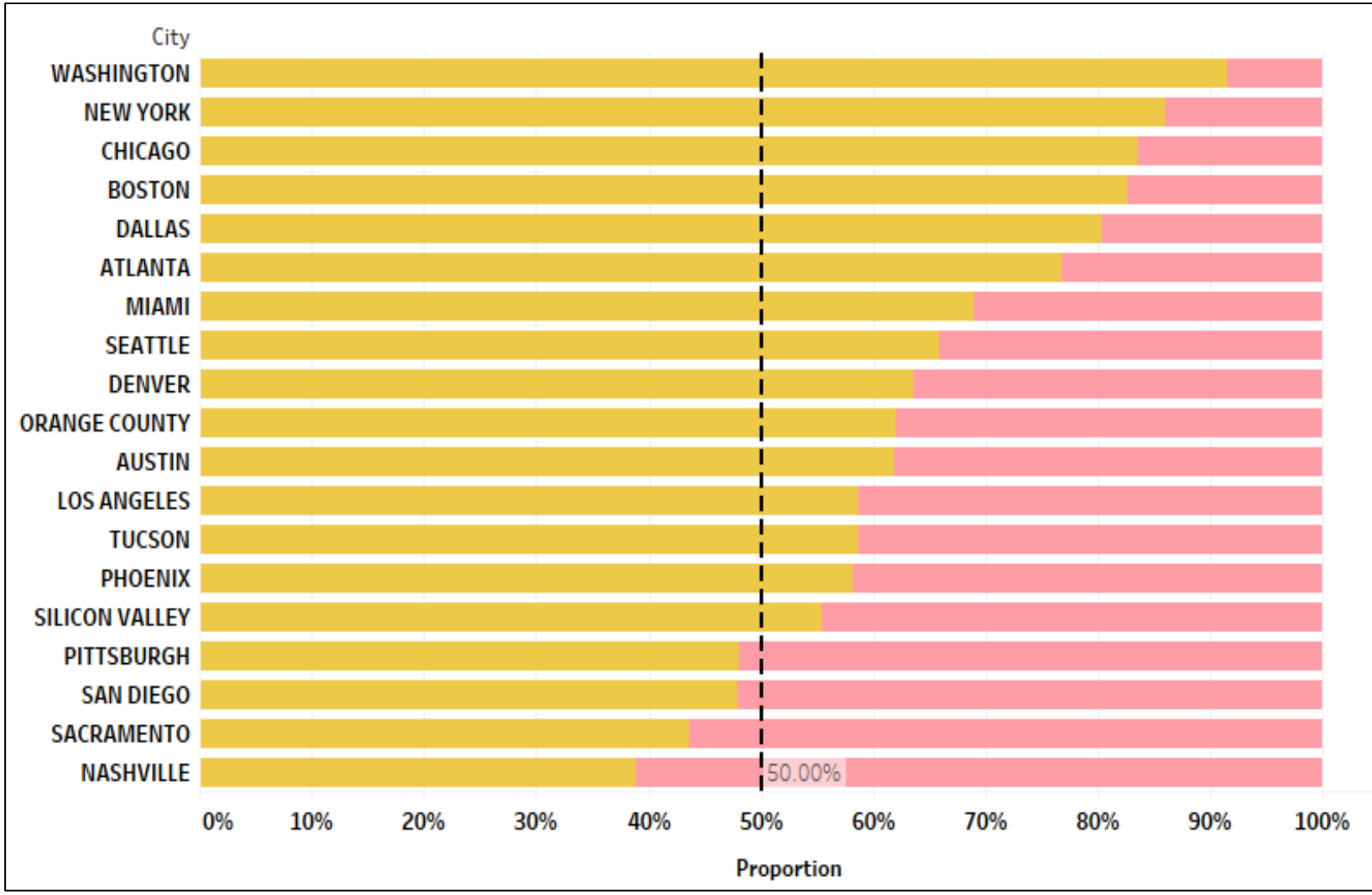
Monthly Seasonality

- Highest trips in December
- Lowest Trips in February.



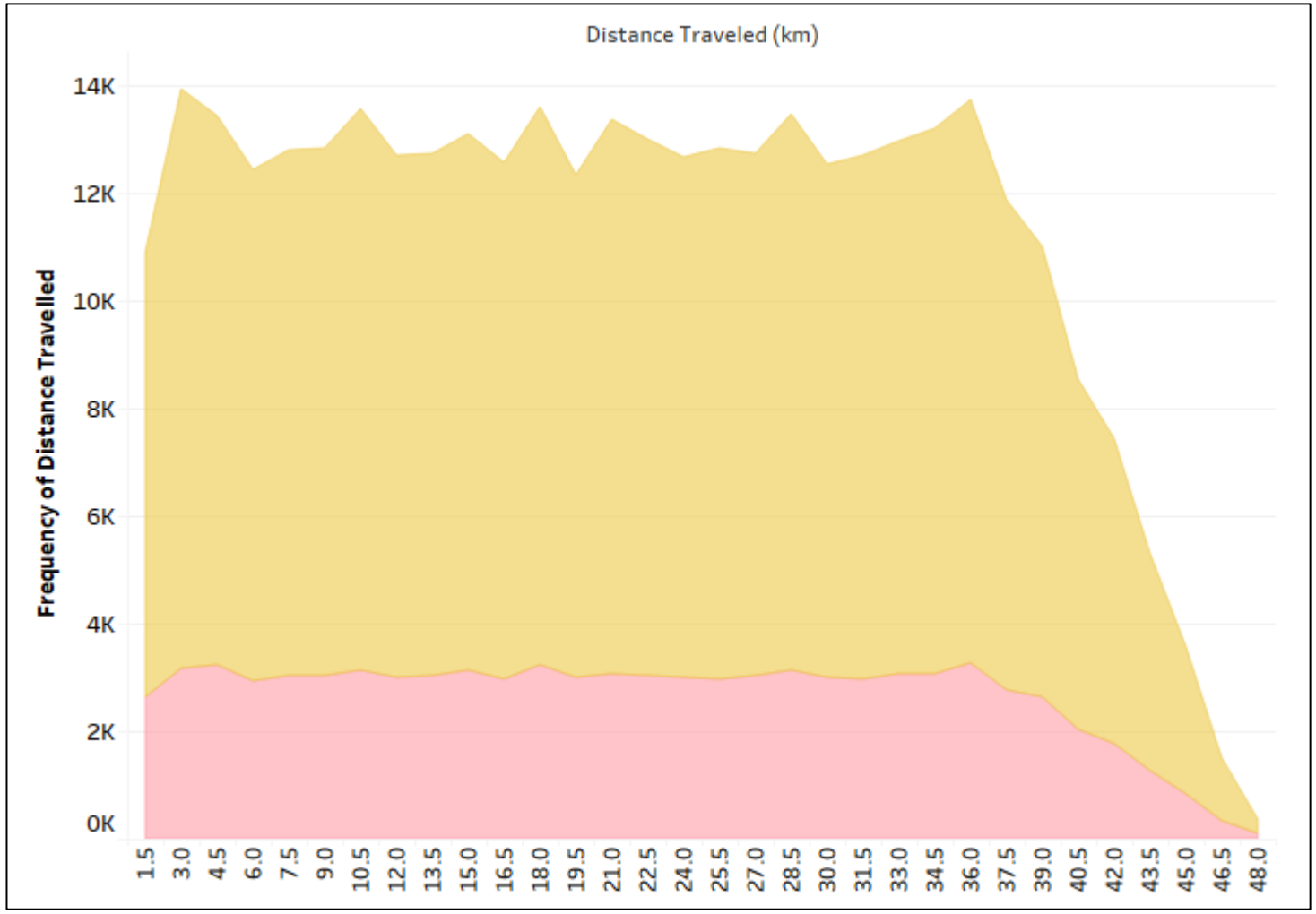
Market Share by City

- Market share of Yellow Cab higher across majority of the Cities.
- Pink Cab has higher market share on few cities - Nashville, Sacramento, San Diego, Pittsburgh.



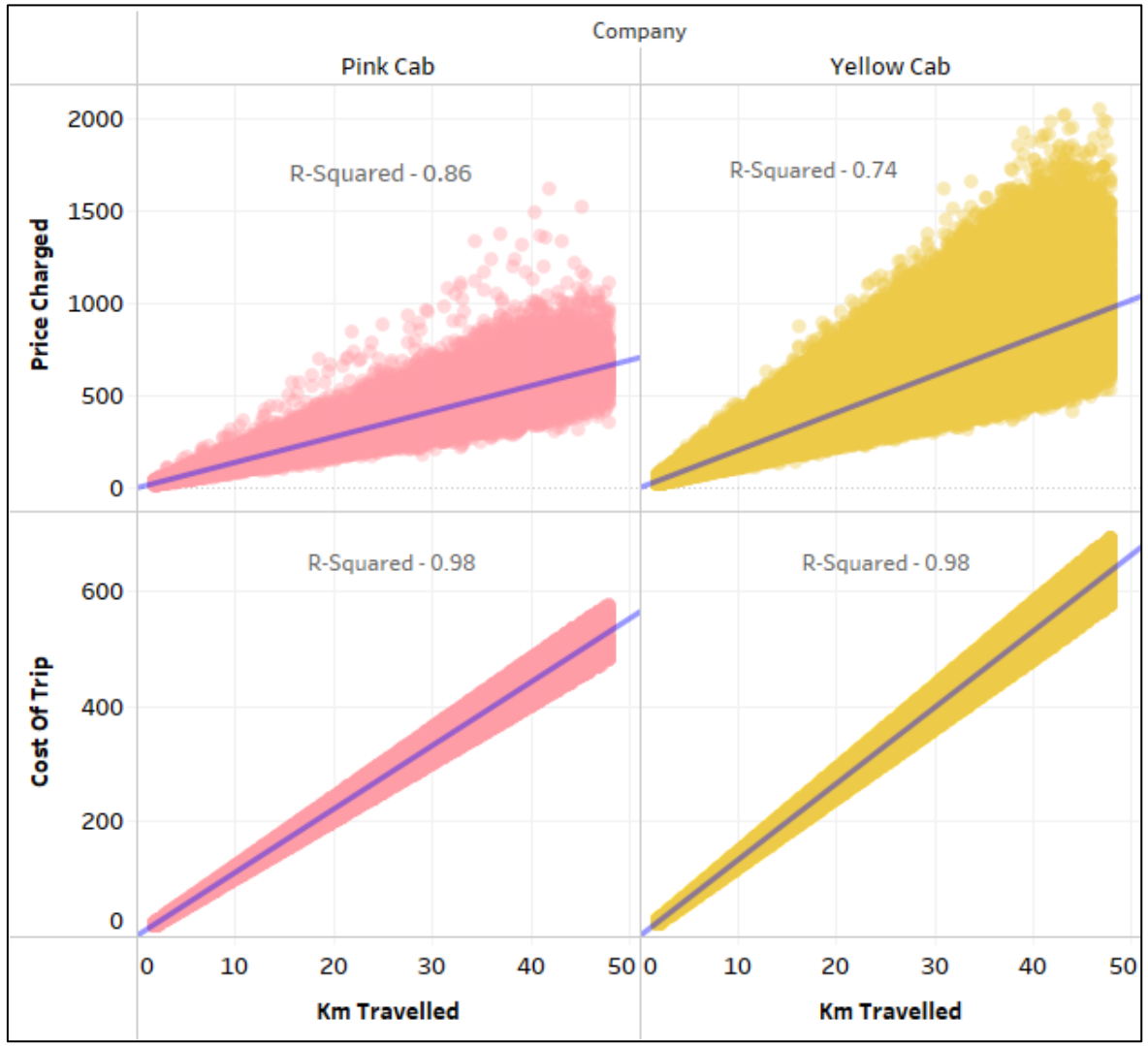
Frequency of Distance Traveled

- Distance travelled remain uniform for both Cab companies.
- Trips that involves travelling more than 36 km are rarer.



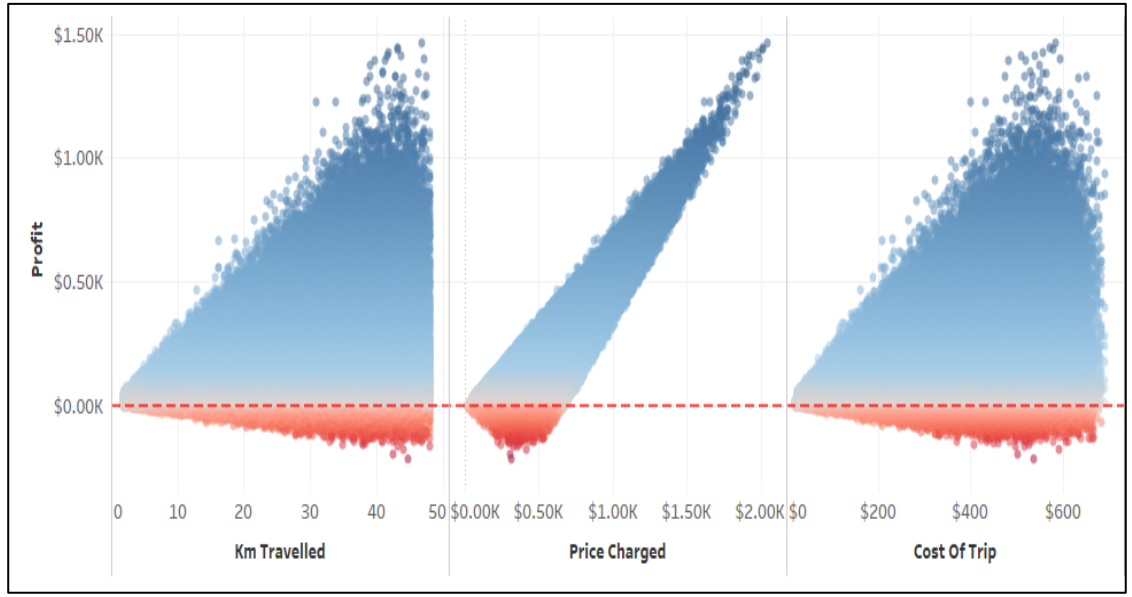
Distance vs Revenue & Expense

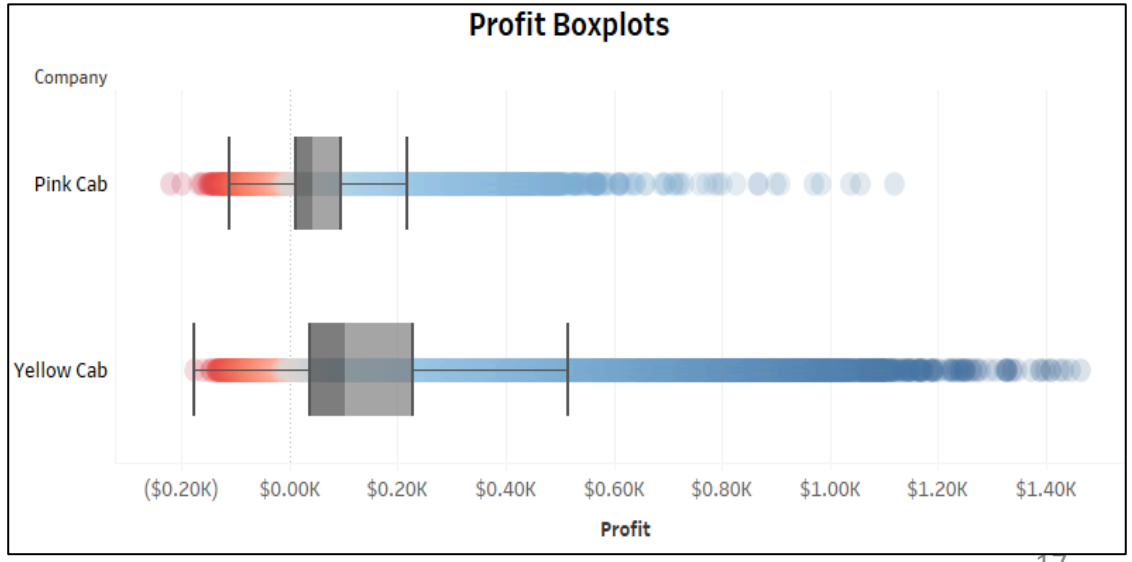
- High Correlation between Distance traveled and Cab Expenses.
- Correlation between Distance and Cab Revenue less compared to Cost of Trip.
- Signifies other factors involved in determining prices charged to customers apart from distance traveled.



Profit

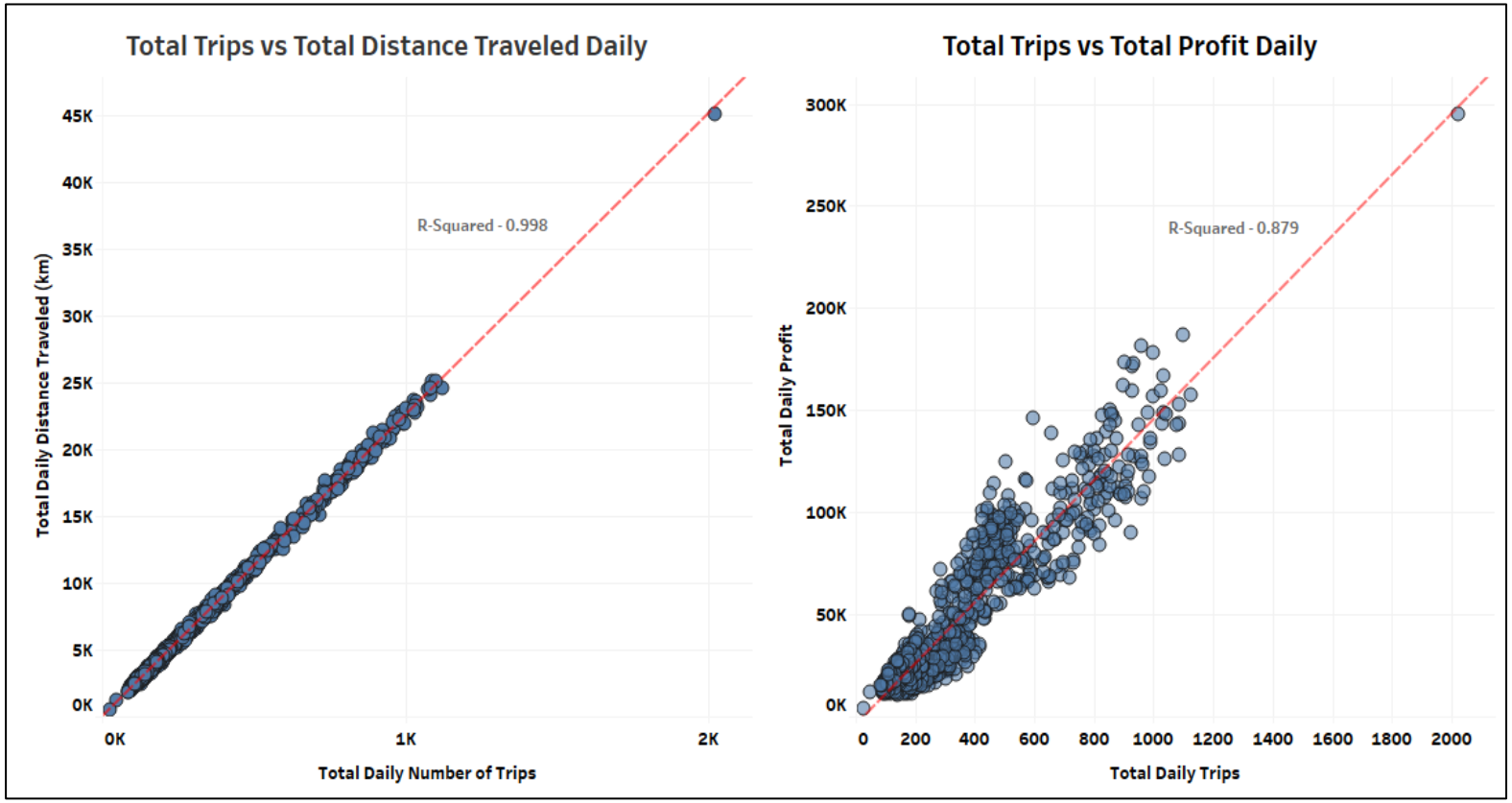
- Profit = Price Charged – Cost of Trip.
- Profit more correlated with Price Charged.
- Profit varies at low Price charges but varies less as Price Charges increases.
- Heteroscedasticity increases with increase in distance traveled. Same pattern for Cost of Trip.
- Significant trips did not end in Profit.
- Median Profit for Yellow Cab higher than Pink Cab.



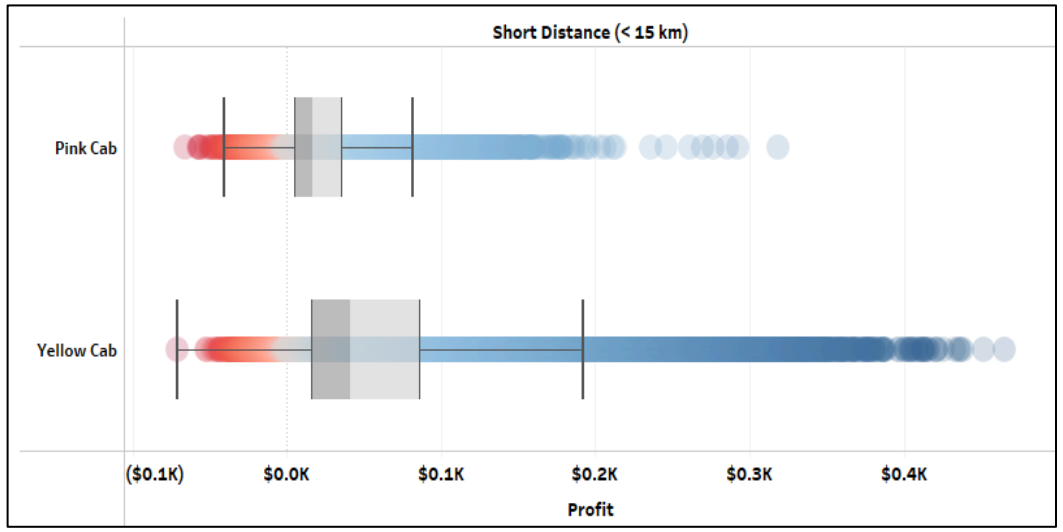


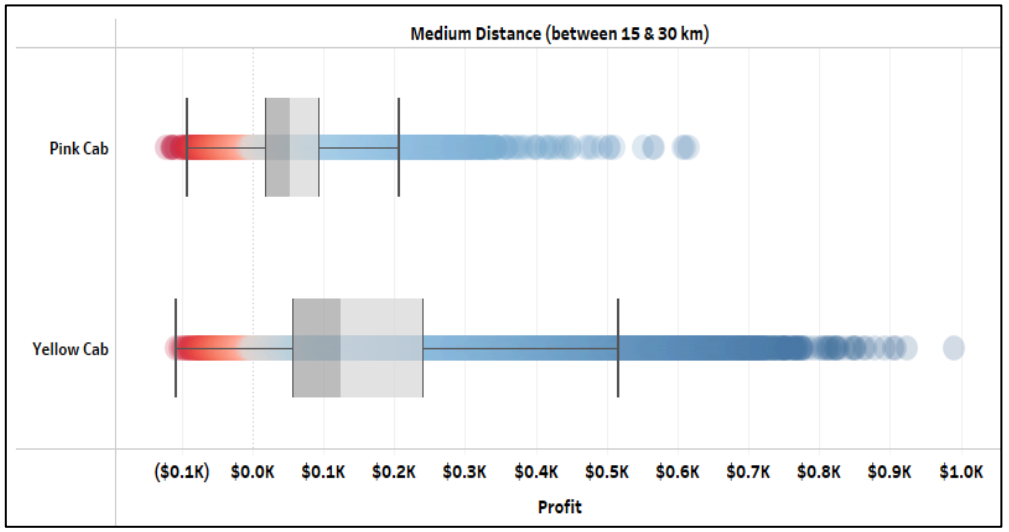
Key Performance Indicator (KPI)

- Previous slides show the relations between Profit and Cab's Fares and Expenses.
- Both Cab fares and Expenses depend on distance traveled.
- There is a **perfect correlation between daily total trips and Daily total Distance traveled.**
- Moreover, **daily total trips also have a strong correlation with total daily profit**.
- Therefore, the **number of trips a cab company travels** in a day can determine the **company's financial performance**.

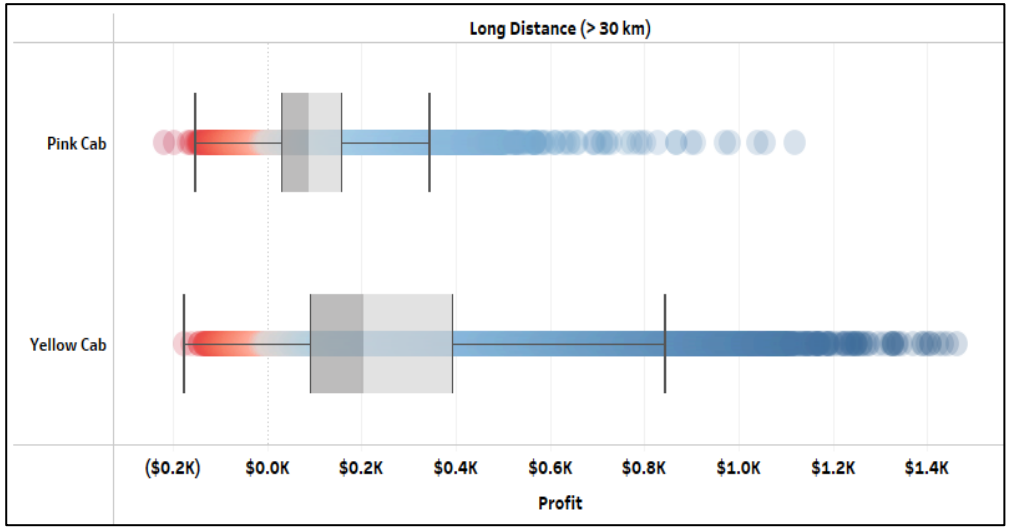


Profit by Trip Type



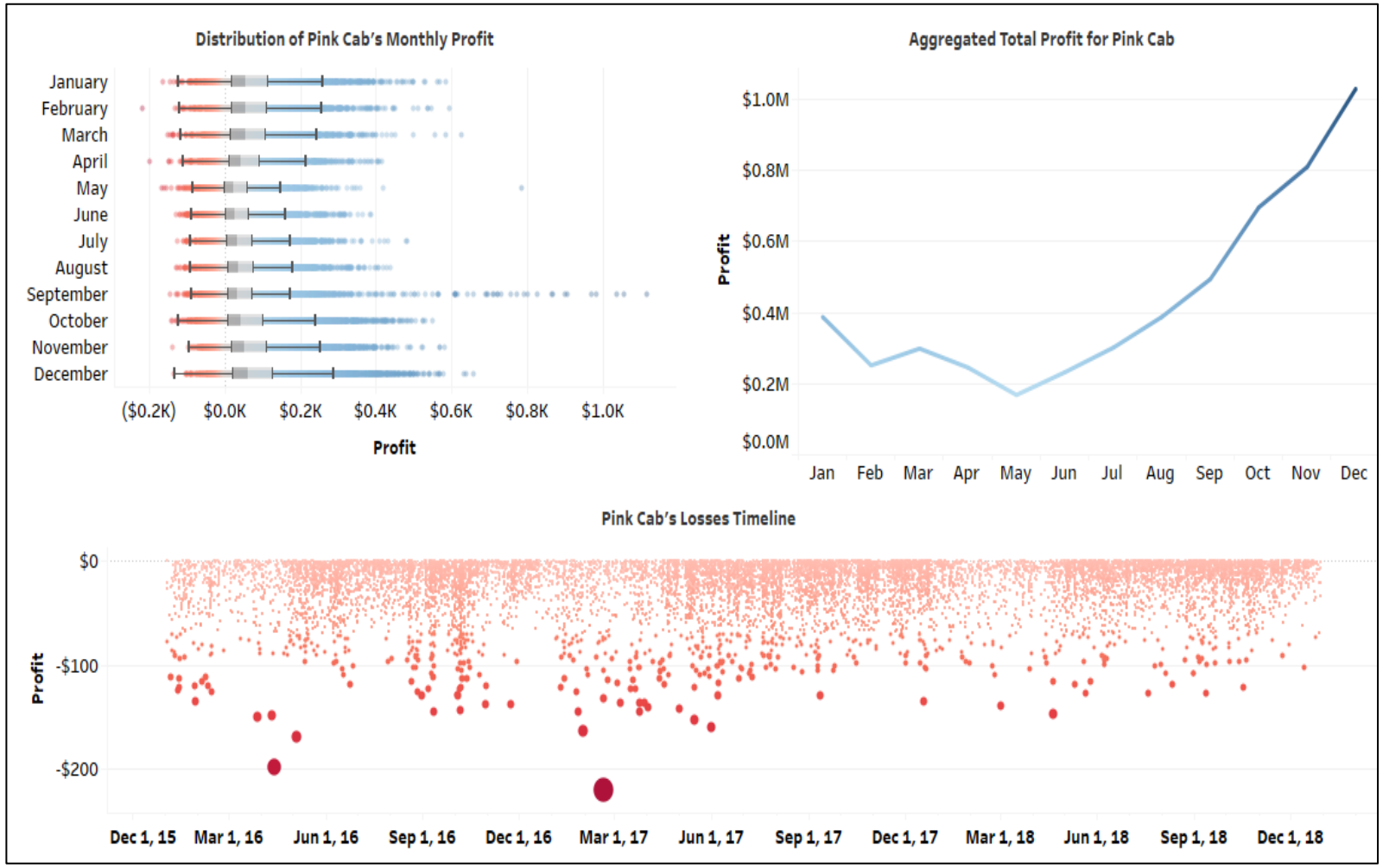


- Trips has been split into three categories based on distance.
- Across all kinds of trips, Yellow Cab makes higher median Profit compared to Pink Cab.



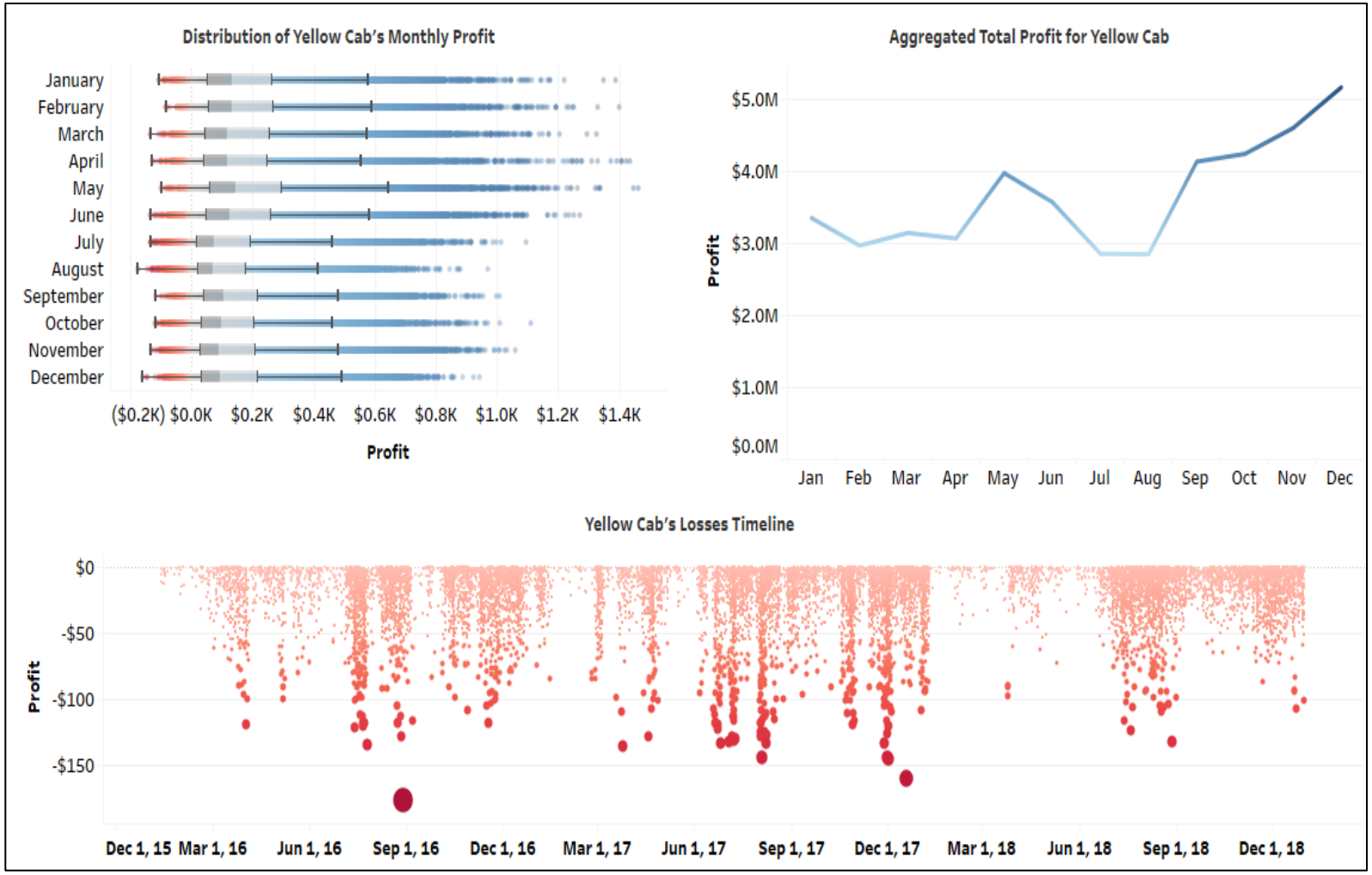
Pink Cab – Profit Analysis

- Month likely associated with Profit.
- Median Profit lowest in May for Pink Cab and highest during December.
- Higher Profit outliers for month of September.
- Total Profit highest in December (2016 to 2018).
- Trip that ended in highest loss of $220 made in February 2017, followed by $199 in April 2016.



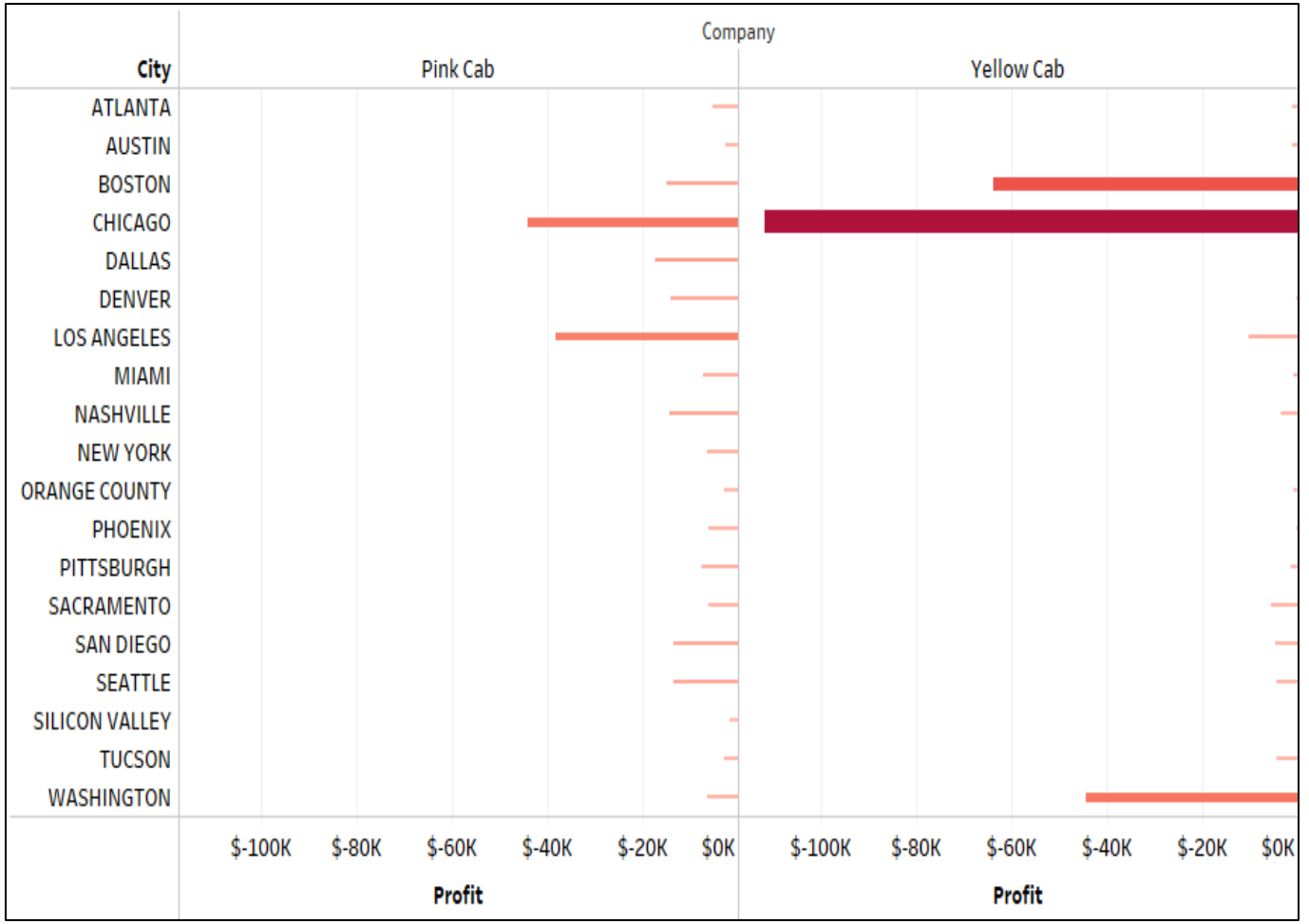
Yellow Cab – Profit Analysis

- Yellow Cab profit significantly higher across all months compared to its rival.
- Median Profit lowest during July and August.
- Highest Total Profit in December (2016 to 2018),
- Trip that ended in high loss of $177 made in August 2016, followed by $166 on December 2017.



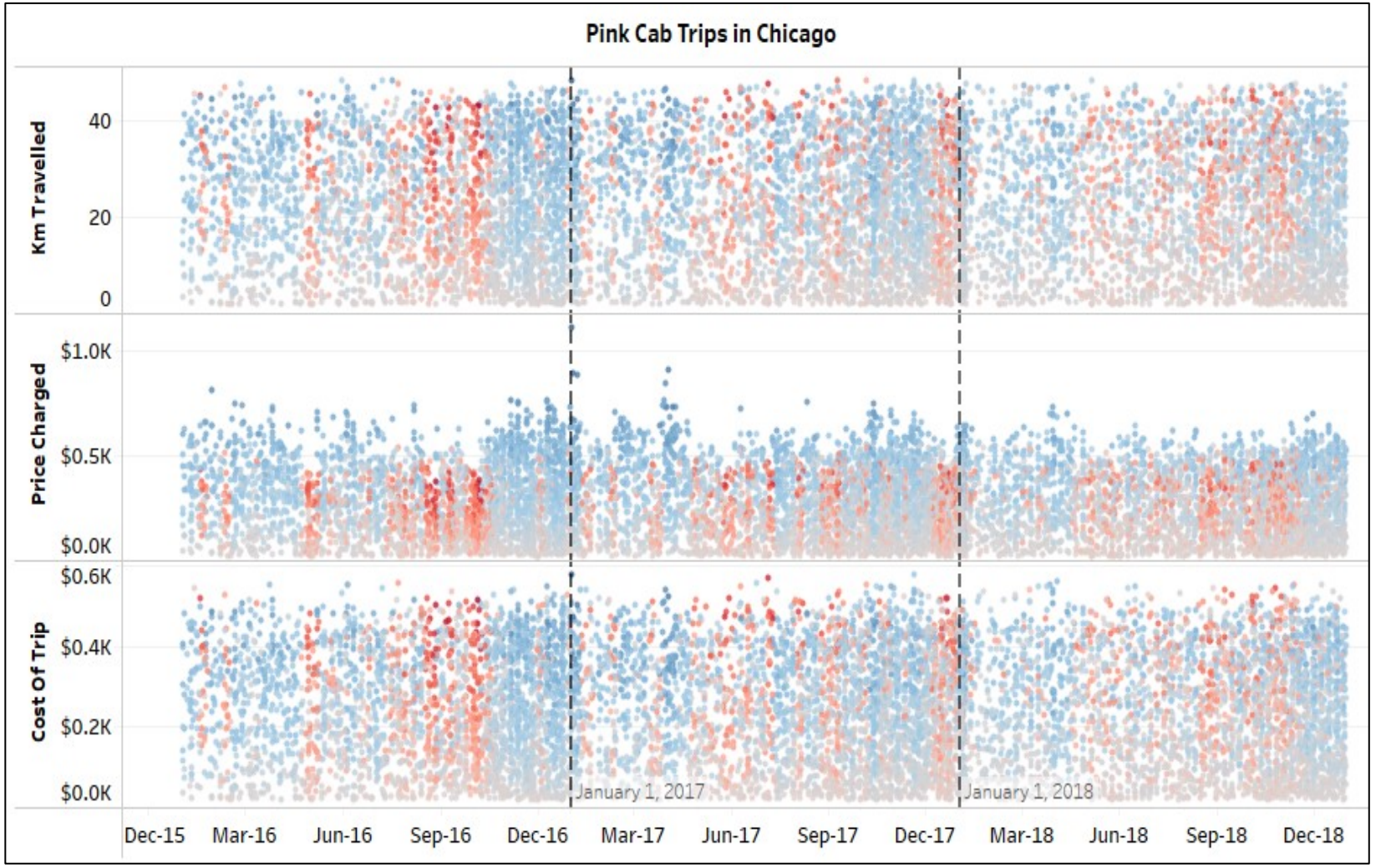
Loses by City

- Yellow Cab makes highest total loses in **Chicago**, followed by **Boston** and **Washington**.
- Pink Cab makes highest total loses in **Chicago** and **Los Angeles**.



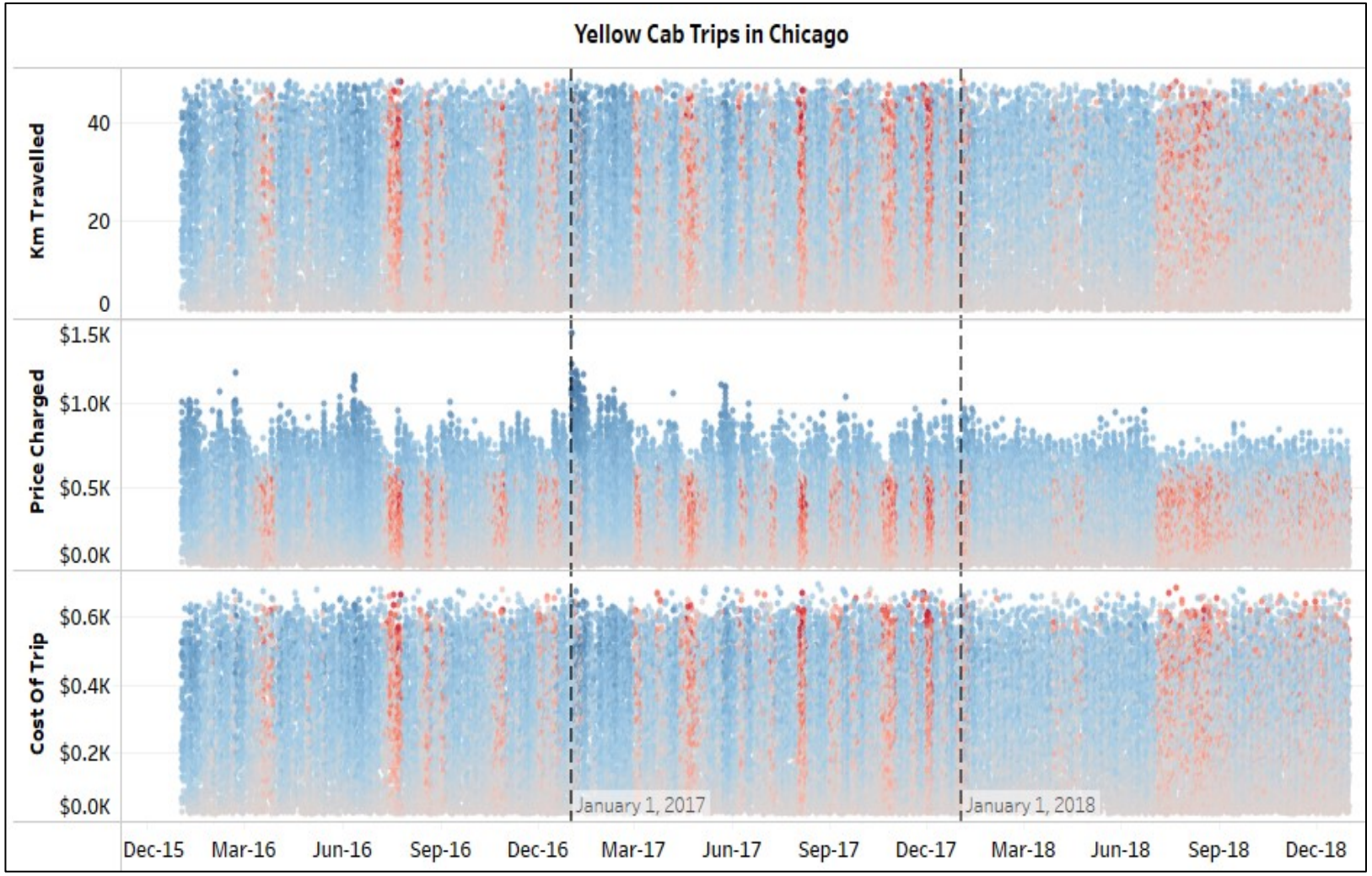
Analyzing Chicago Non-Profitable Trips – Pink Cab

- Red bands represents trips that did not make profit (Loss).
- Cab expenses was higher than Cab revenue for non-profitable trips.
- In 2016, consistent non-profitable trips made during month of April, July, August, September, October.
- In 2017 and 2018, although several non-profitable trips were made across many months, they are less in comparison with the year 2016.



Analyzing Chicago Non-Profitable Trips – Yellow Cab

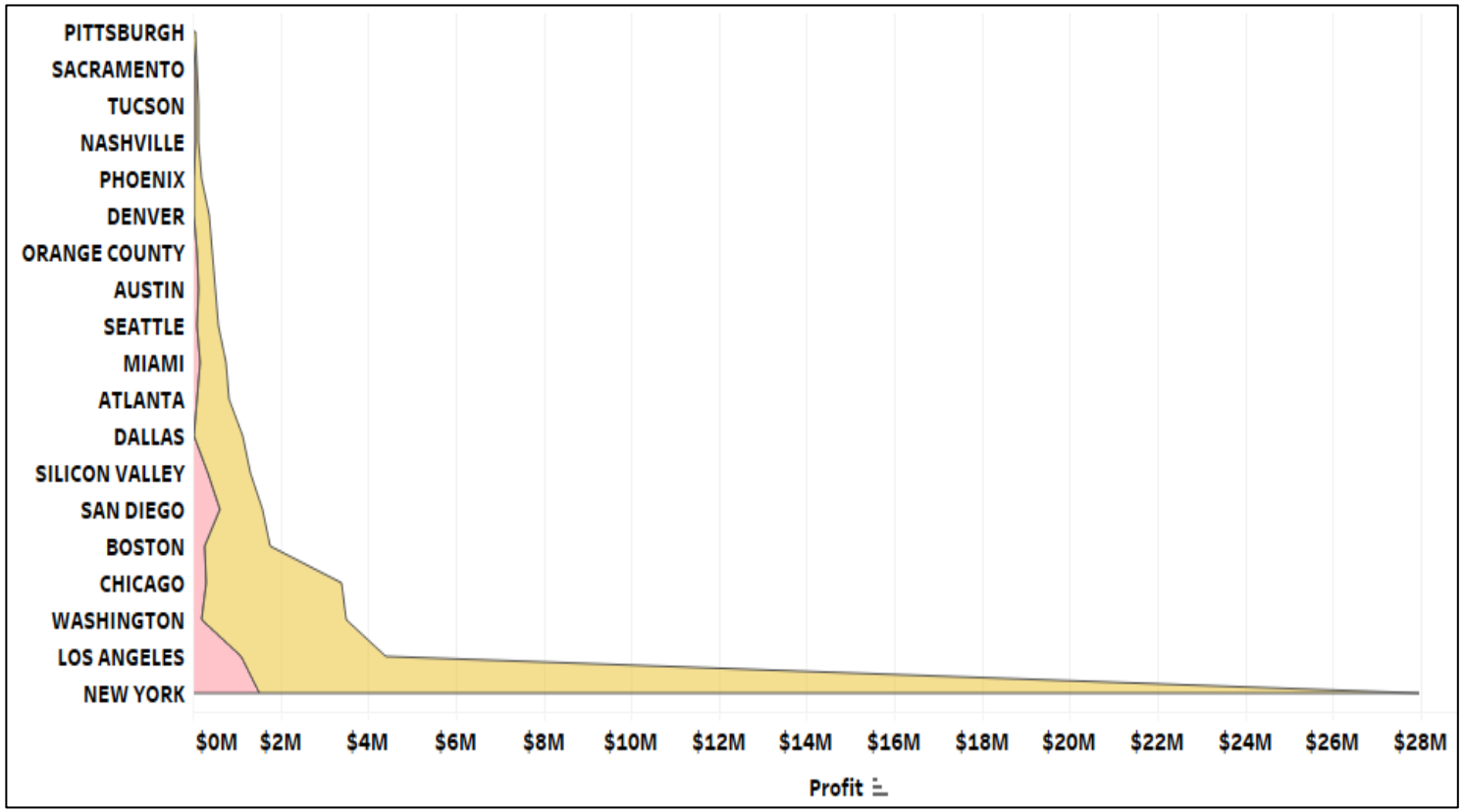
- For Yellow Cab, July and August has highest number of non-profitable trips across all years.
- 2017 saw highest number of non-profitable trips across many months and 2018 saw the lowest number of non-profitable trips compared to other years.



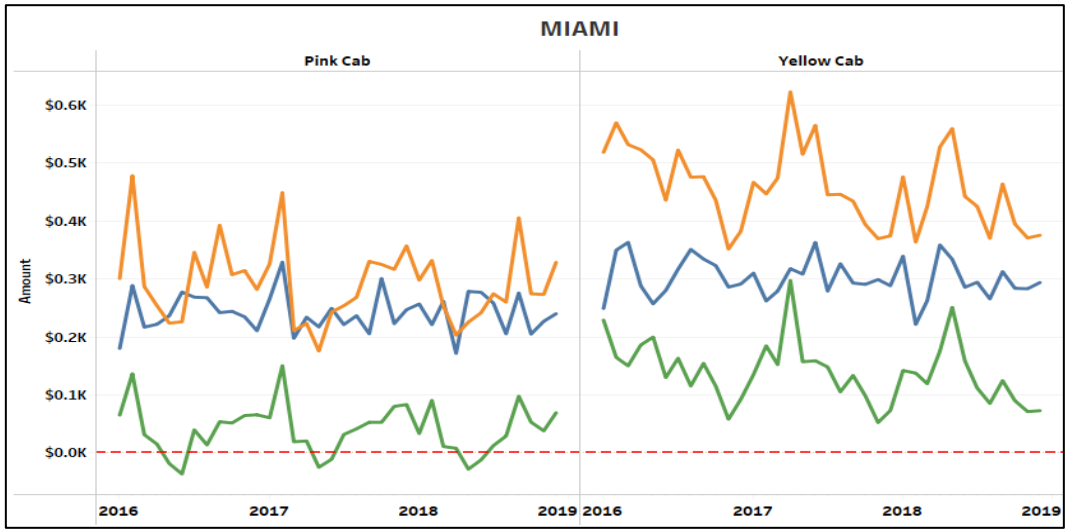
Profit by City (2016 to 2018)

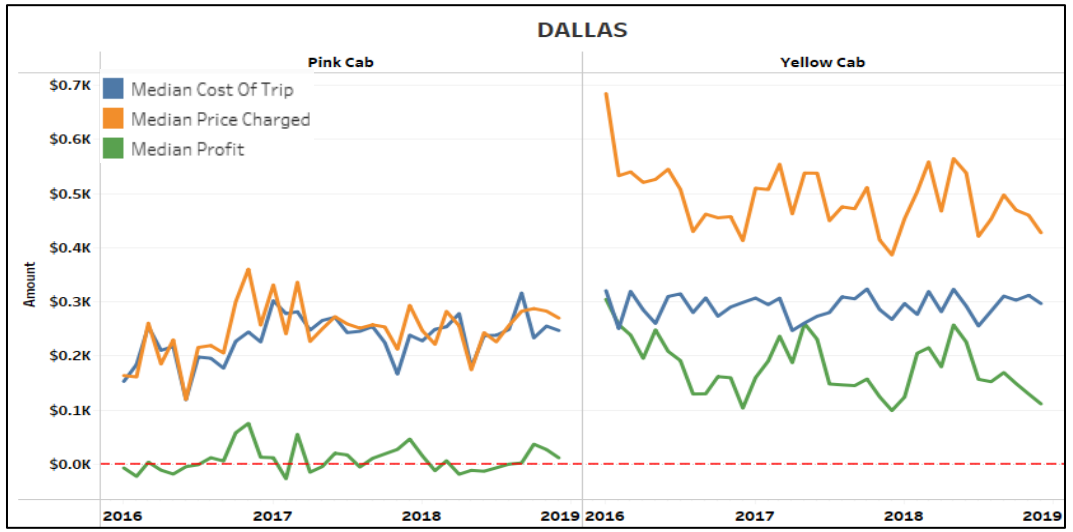
- Yellow Cab's total Profit outperforms Pink Cab across all cities.

- Highest total profit for both Cab companies is in New York.

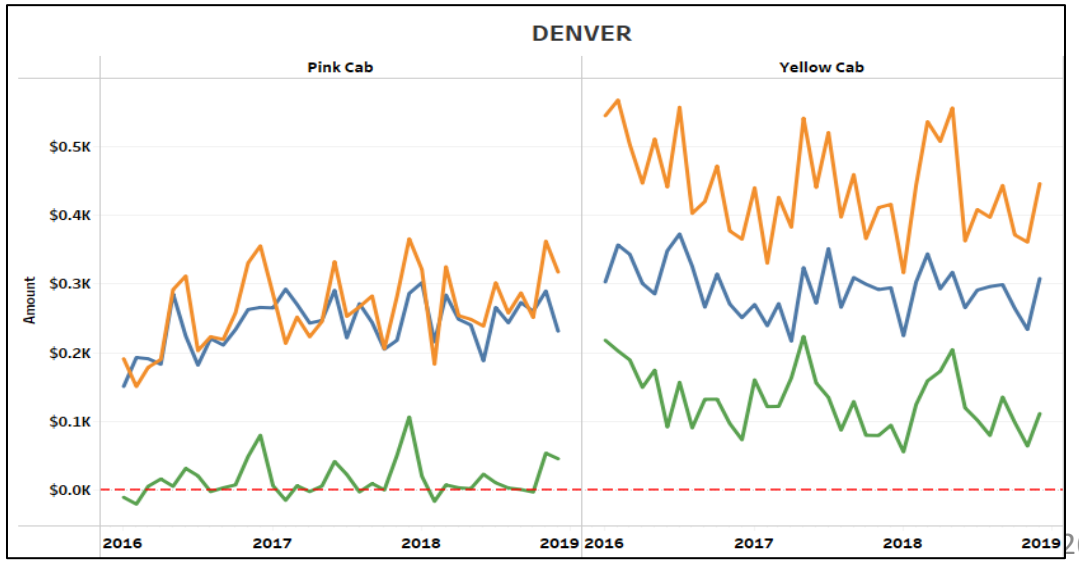


Monthly Timeline of Trips (1)



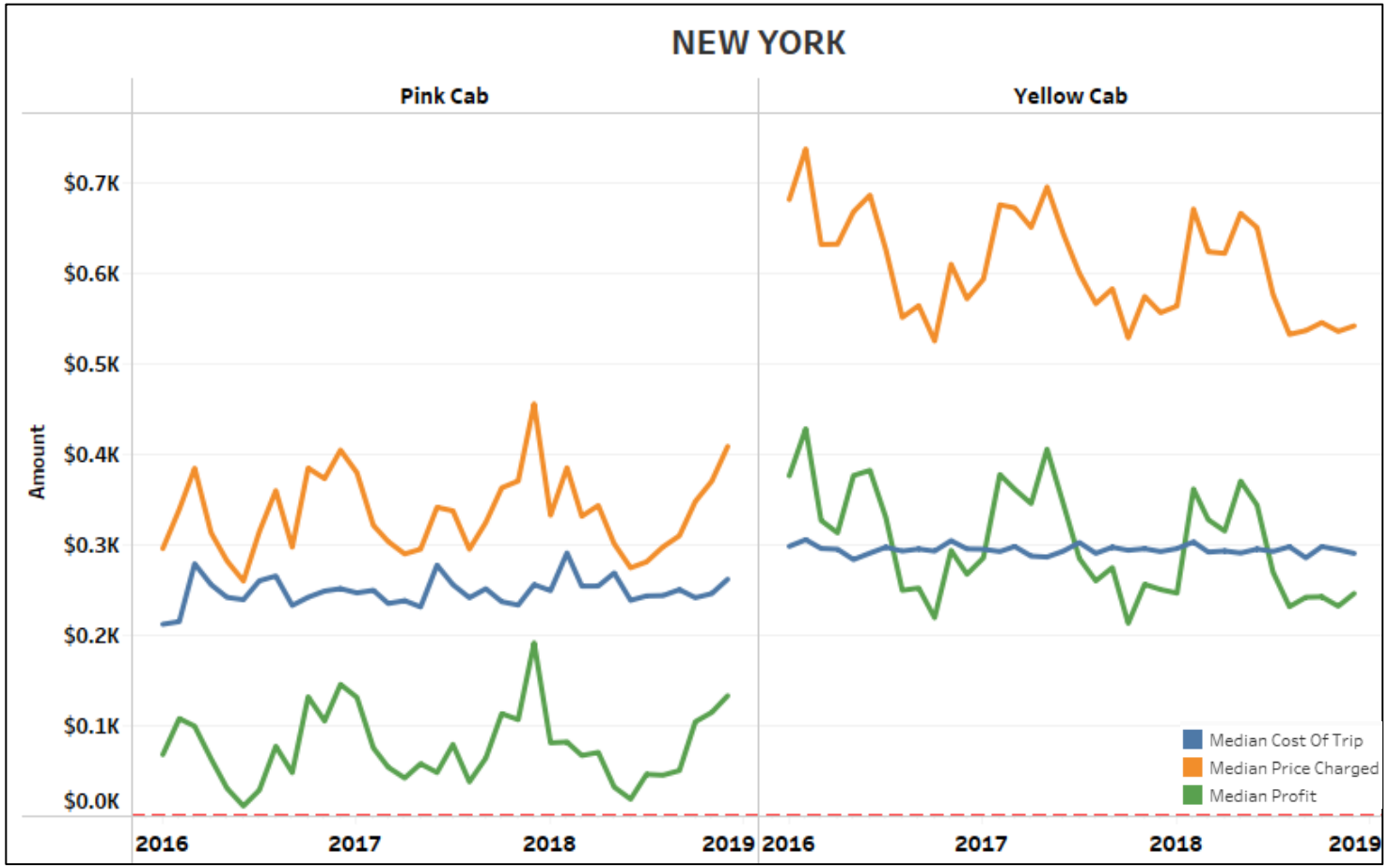


- The plots illustrates median monthly prices from 2016 to 2018 across selected cities.
- In general, Yellow Cab's expenses is relatively higher than Pink Cab's.
- In the above cities, Pink Cab's median profits for some months has been consistently in loss.
- Yellow Cab's Profit is comparatively much higher than Pink Cab.



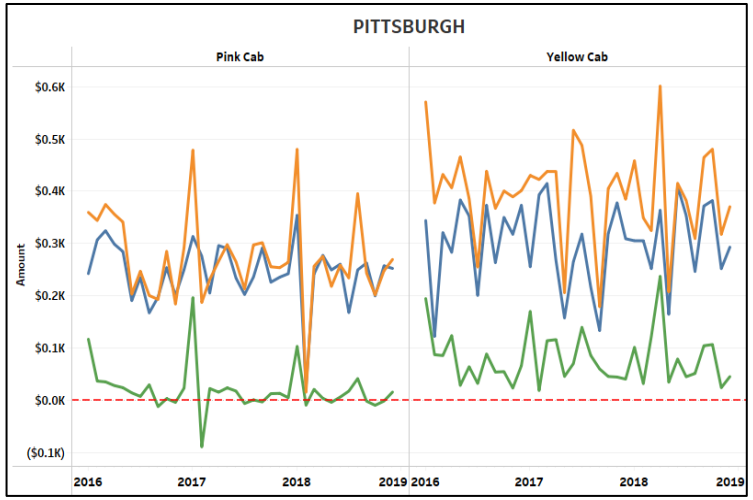
Monthly Timeline of Trips (2)

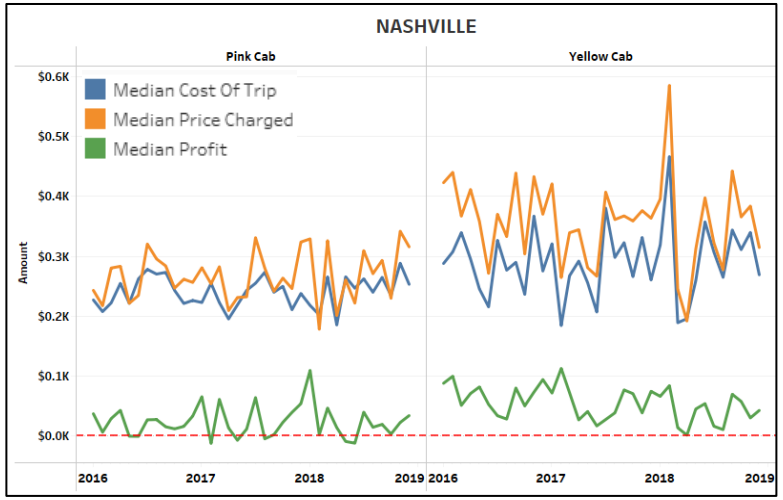
- In New York City, although the Cab expense is similar in other cities, Yellow Cab charges significantly higher Cab Fares.
- Hence, Yellow Cab makes the highest profit in New York compared to any other city.
- Comparatively, Pink Cab charges very low Cab fares to its customers.

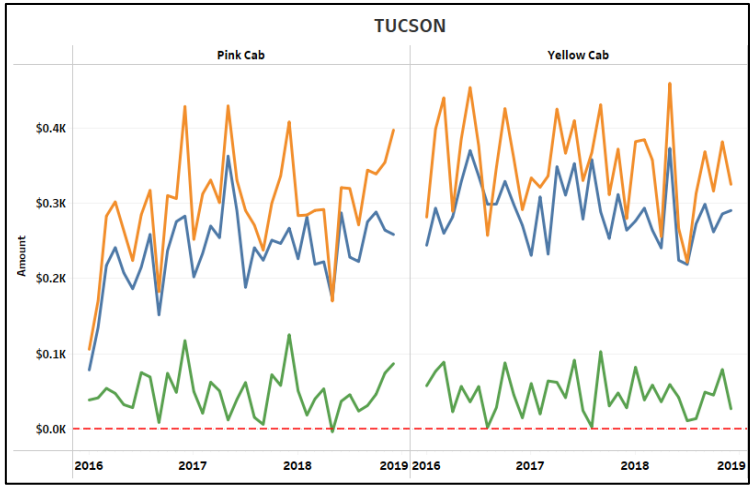


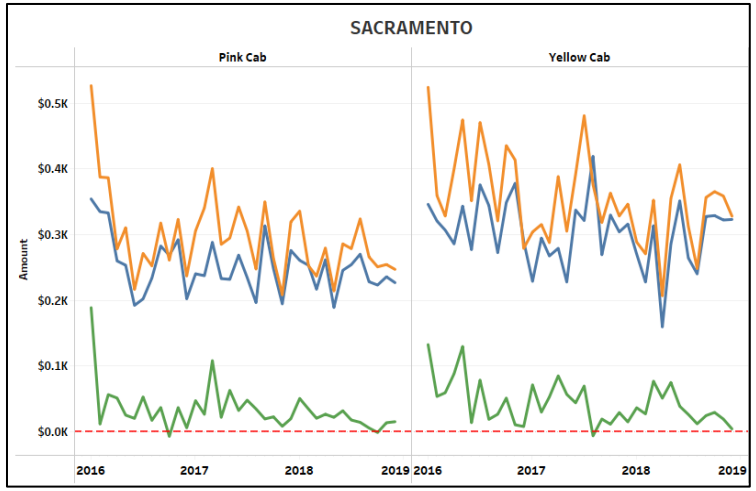
Monthly Timeline of Trips (3)

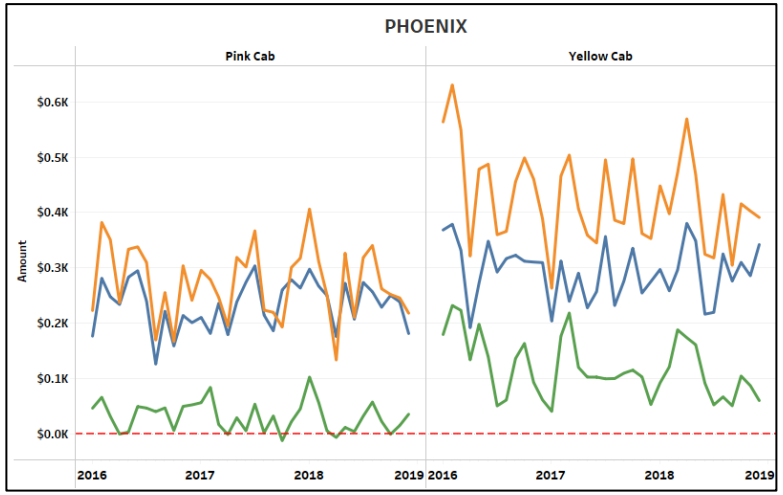
In some cities, both companies seems to have non-seasonal fluctuating cab fares and expenses.







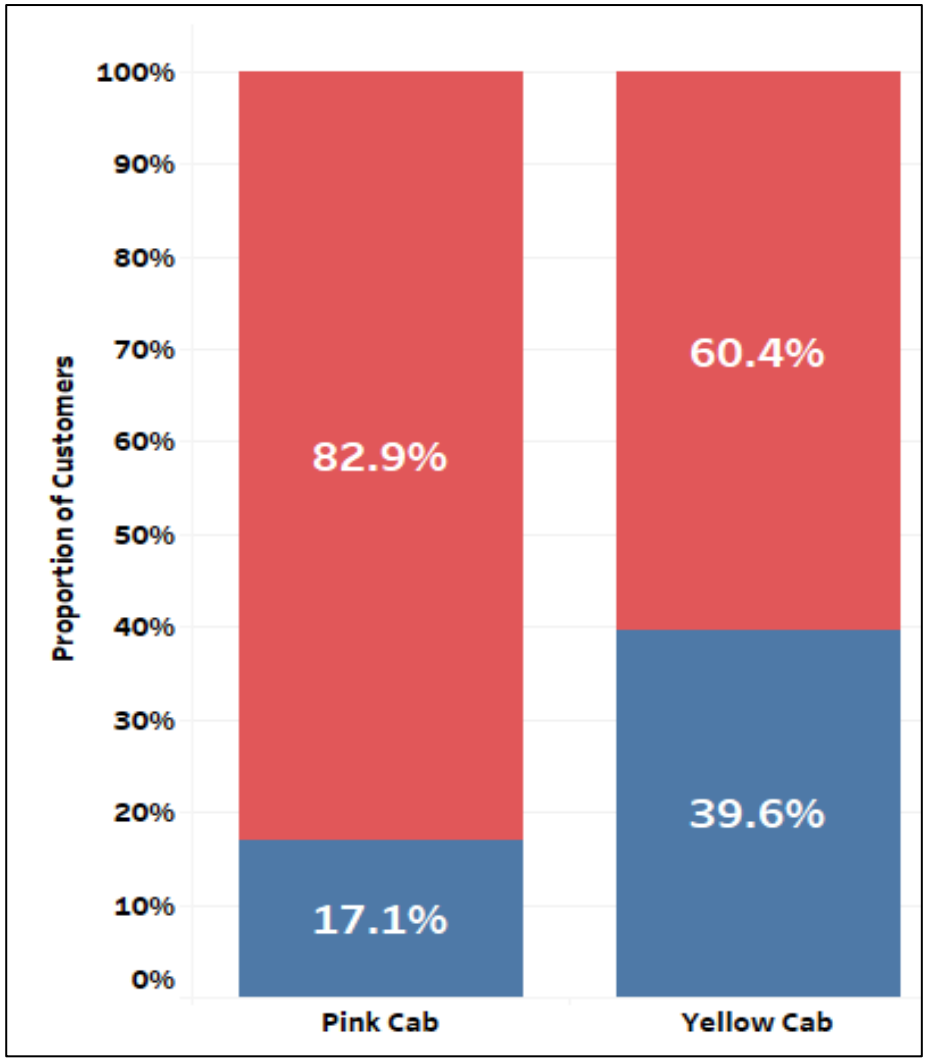




Loyal Customers

- The plots illustrates the proportion of most loyal customer's who has used a Cab service at least five times.

- Overall, Yellow Cab has the highest proportion of loyal customer's by about 40%.



Loyal Customers by City

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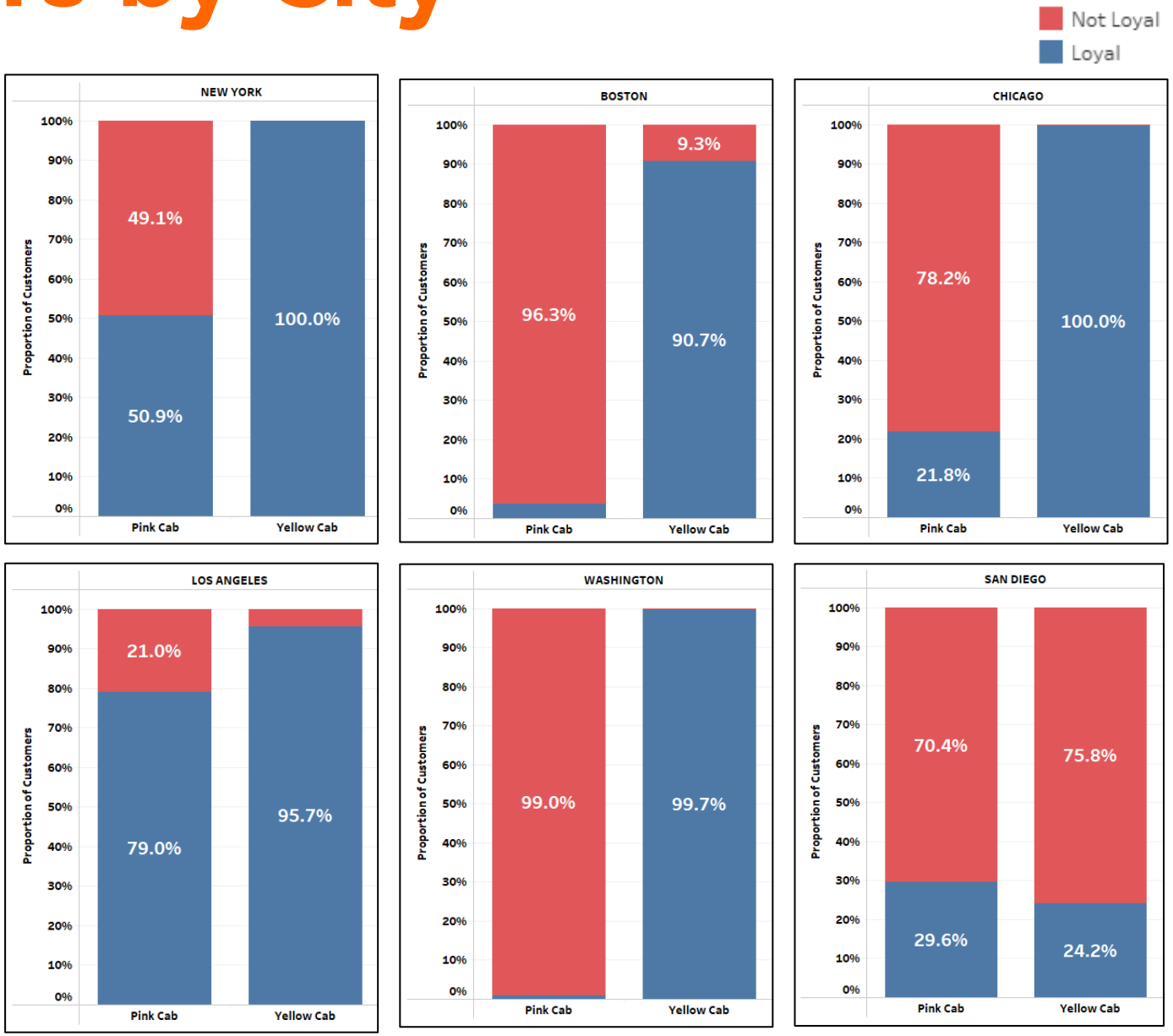
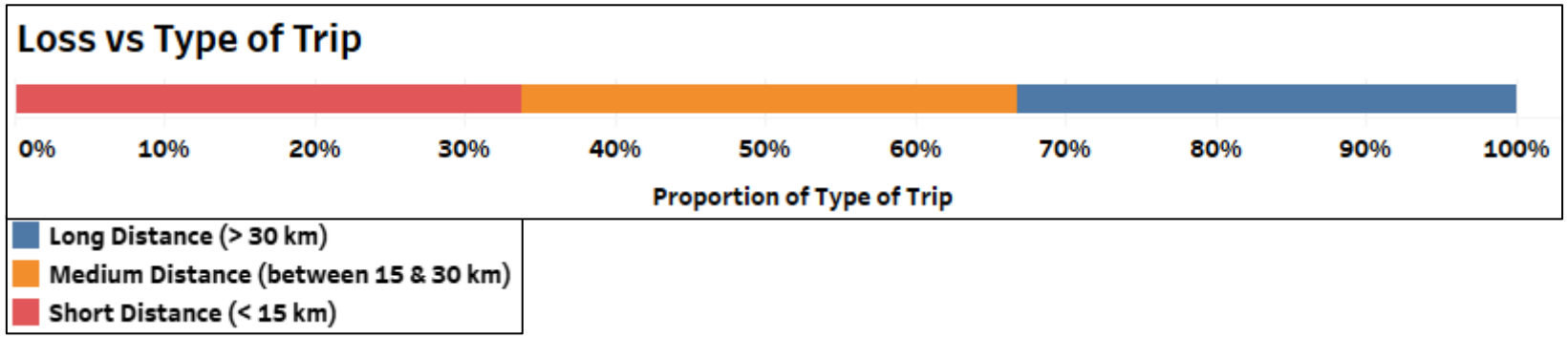
- Yellow Cab has the highest loyal customers in New York, Boston, Chicago, Los Angeles and Washington.
- Although lower than its rival, Pink Cab has significant loyal customers in Los Angeles, followed by New York.
- Only in San Diego, Pink Cab has comparatively higher loyal customers compared to its rival, at about 30%.



Hypothesis 1:

Is there any association between Profit being at a loss and the type of trip?



- **H0: There is no association between Loss and type of trip.**
- **H1: There is an association between loss and type of trip.**

Test Utilized : Chi-squared test

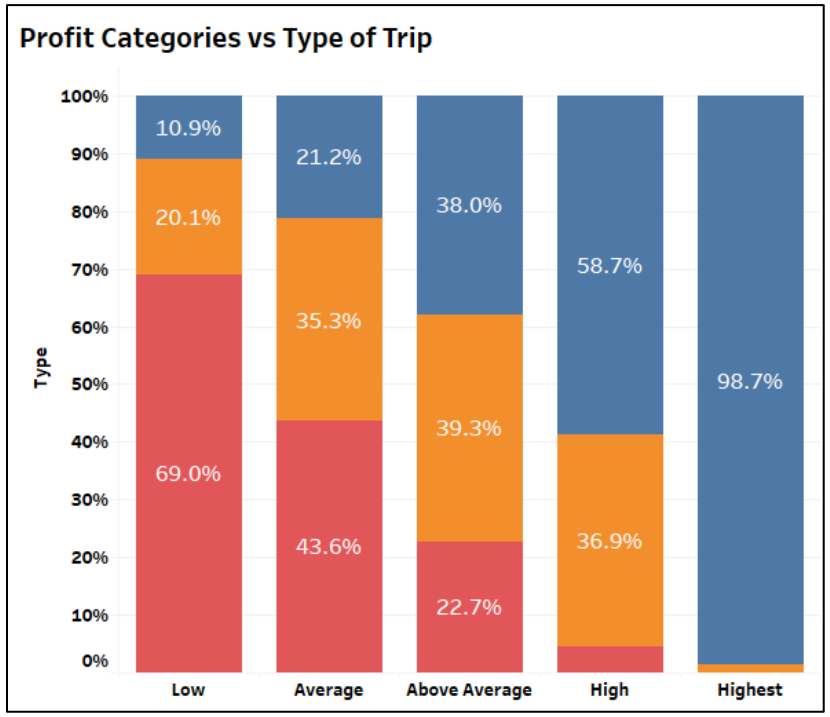
Alpha: **0.05**

P-Value: **1.0**

Verdict: If the Null Hypothesis is true, **the probability that the observed number of trips is the same as the expected number of trips from a randomly sampled data is 100%**. Therefore, as the P-value is higher than the alpha value, **we fail to reject the null hypothesis**. There is **no association between Loss and type of trip**.

Hypothesis 2:

Is there any association between Profit and the type of trip?



Profit Levels:

- Low Profit: < $30
- Average Profit: Between $30 and $85
- Above Average Profit: Between $85 and $200
- High Profit: $200 and $800
- Highest Profit: > $800

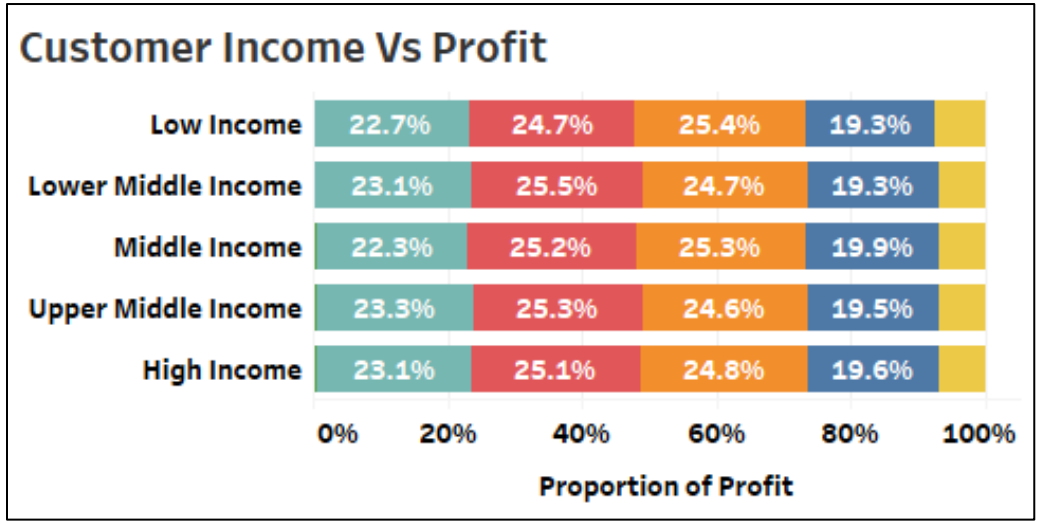
➢**H0: There is no association between Profit and type of trip.**
➢**H1: There is an association between Profit and type of trip.**

Test Utilized : Chi-squared test
Alpha: **0.05**
P-Value: **0.0**

Verdict: If the Null Hypothesis is true, **the probability that the observed number of type of trips is the same as the expected number of type of trips for each profit category from a randomly sampled data is 0%**. Therefore, as the P-value is lower than the alpha value, **we reject the null hypothesis**. There **is association between Profit and type of trip**.

Hypothesis 3:

Is there any association between Profit and Customer income level?



Monthly Income Levels:

- Low Income: < $2670
- Lower Middle Income: Between $2670 and $4451
- Middle Income: Between $ 4451 and $8903
- Upper Middle Income : $ 8903 and $20,030
- High Income : > $ 20,030

- **H0: There is no association between Customer Income and Profit.**
- **H1: There is an association between Customer Income and Profit.**

Test Utilized : Chi-squared test

Alpha: **0.05**

P-Value: **0.0**

Verdict: P-value is **statistically significant** since **P-value is lower than the alpha.** Therefore, we can **reject the null hypothesis.** There is an **association between Profit and Customer income level**.

Hypothesis 4:

Is there an association between City and Profit?

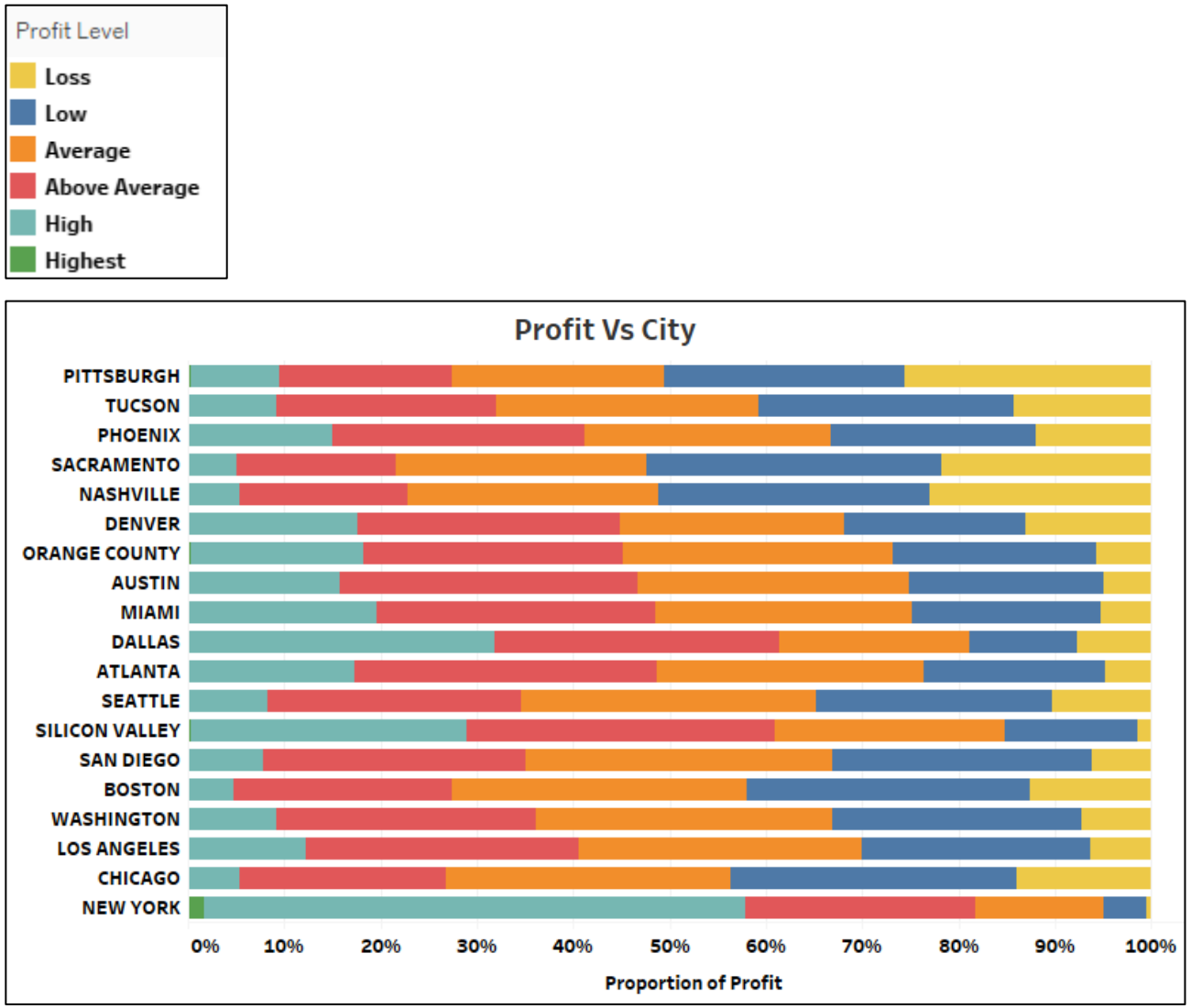
- **H0: There is no association between City and Profit.**
- **H1: There is an association between City and Profit.**

Test Utilized : Chi-squared test

Alpha: **0.05**

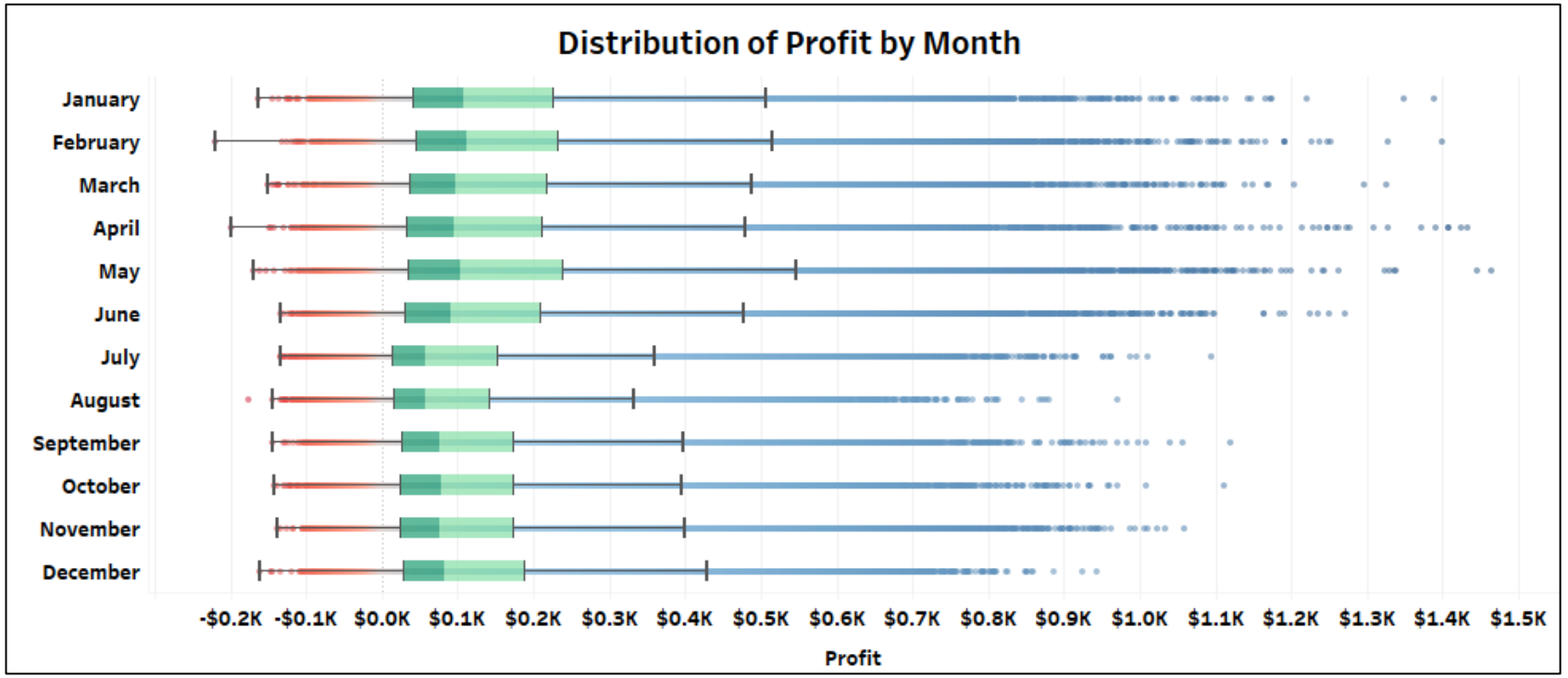
P-Value: **0.0**

Verdict: P-value is **statistically significant** since **P-value is lower than the alpha.** Therefore, we can **reject the null hypothesis.** There is an **association between Profit and City**.



Hypothesis 5:

Does Profit vary by Month?



- **H0: No difference in median profit across months**
- **H1: At least one month has different median profit from other months.**

Test Utilized : Kruskal-Wallis H-test

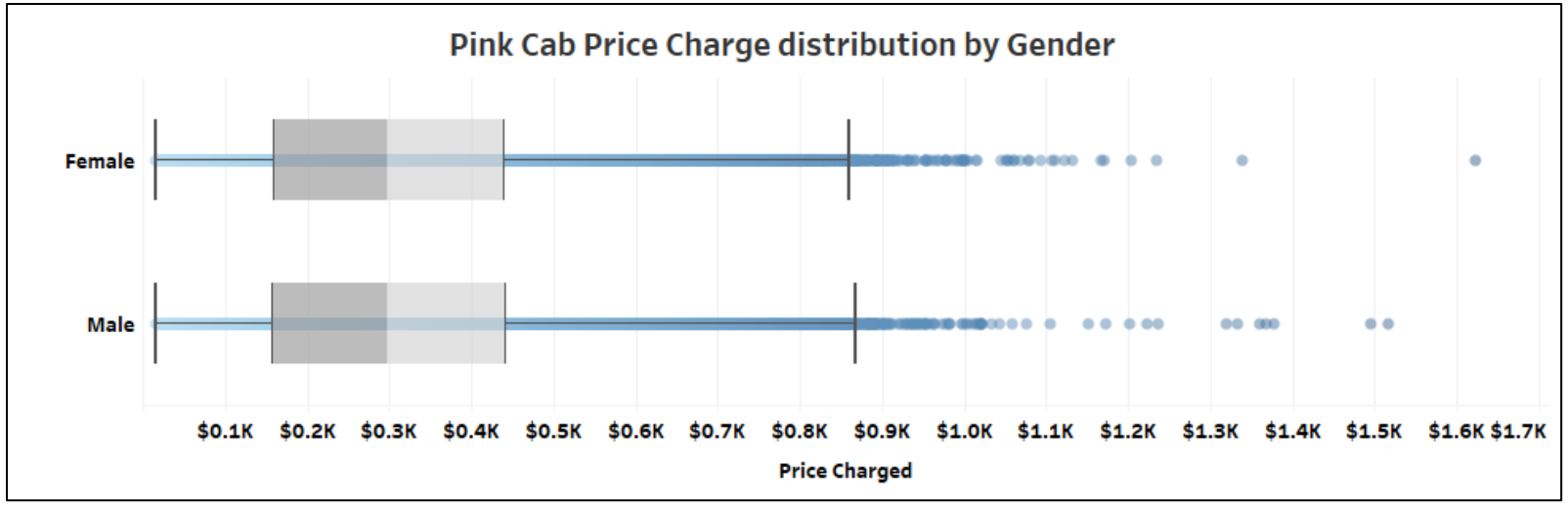
Alpha: **0.05**

P-Value: **0.0**

Verdict: If the null hypothesis is true, the probability of obtaining median profit such as shown here **will be 0%.** Since the P-value is lower than the alpha, **we reject the null hypothesis** in favor of the alternative hypothesis. **Median profit do change at least for one month.**

Hypothesis 6.1:

Does Pink Cab charge its customer differently based on gender?



- **H0: No difference in median price charged among gender**
- **H1: There is a difference in median price charged among gender.**

Test Utilized : Mood's median test

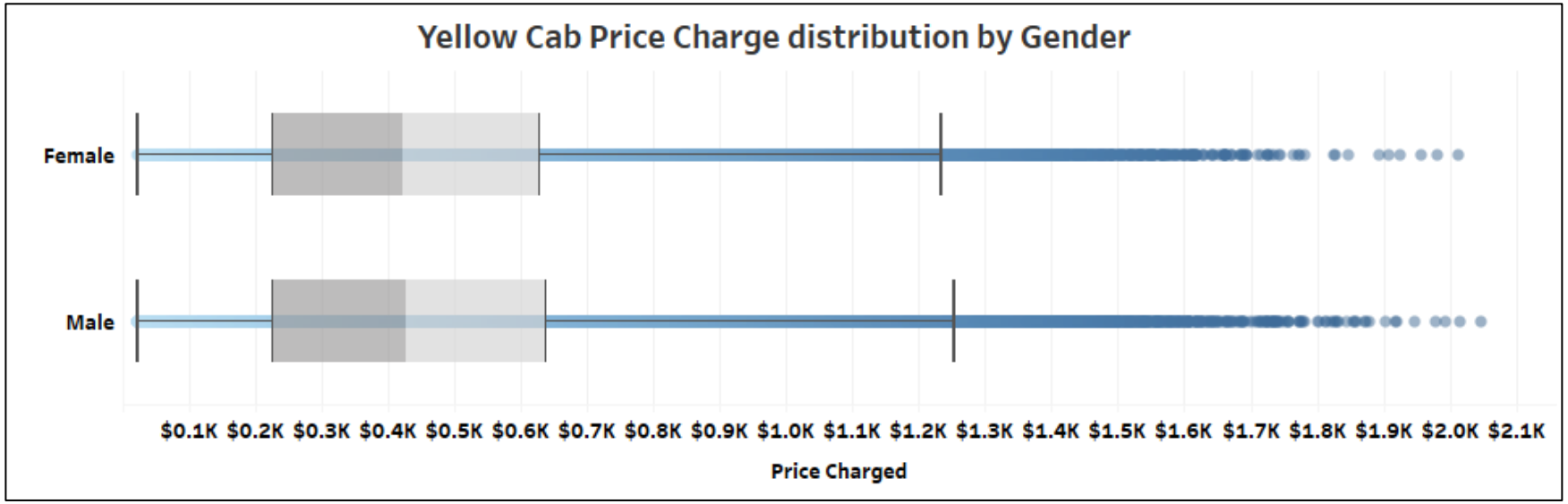
Alpha: **0.05**

P-Value: **0.278**

Verdict: If the null hypothesis is true, the probability of obtaining median price charged such as shown here **will be 27.8%.** Since the P-value is higher than the alpha, **we fail to reject the null hypothesis** in favor of the alternative hypothesis. **Median price charged remains the same for Pink Cab's customers regardless of gender.**

Hypothesis 6.2:

Does Yellow Cab charge its customer differently based on gender?



- **H0: No difference in median price charged among gender**
- **H1: There is a difference in median price charged among gender.**

Test Utilized : Mood's median test

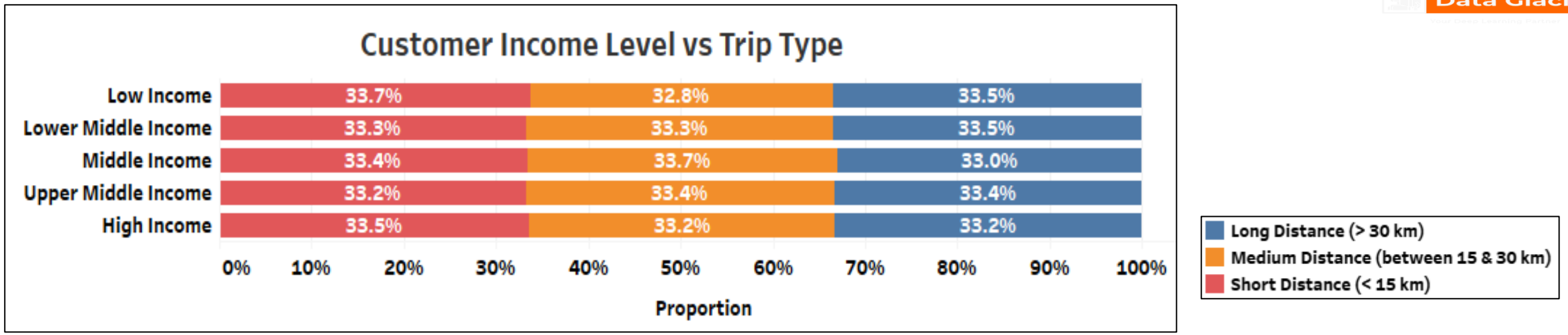
Alpha: **0.05**

P-Value: **0.0**

Verdict: If the null hypothesis is true, the probability of obtaining median price charged such as shown here **will be 0%.** Since the P-value is lower than the alpha, **we reject the null hypothesis** in favor of the alternative hypothesis. **Median price charged is different for Yellow Cab's customers based on gender.**

Hypothesis 7:

Is there an association between Customer Income Level and Type of Distance traveled?



- **H0: There is no association between Customer Income and Distance Traveled.**
- **H1: There is an association between Customer Income and Distance Traveled.**

Test Utilized : Chi-squared test

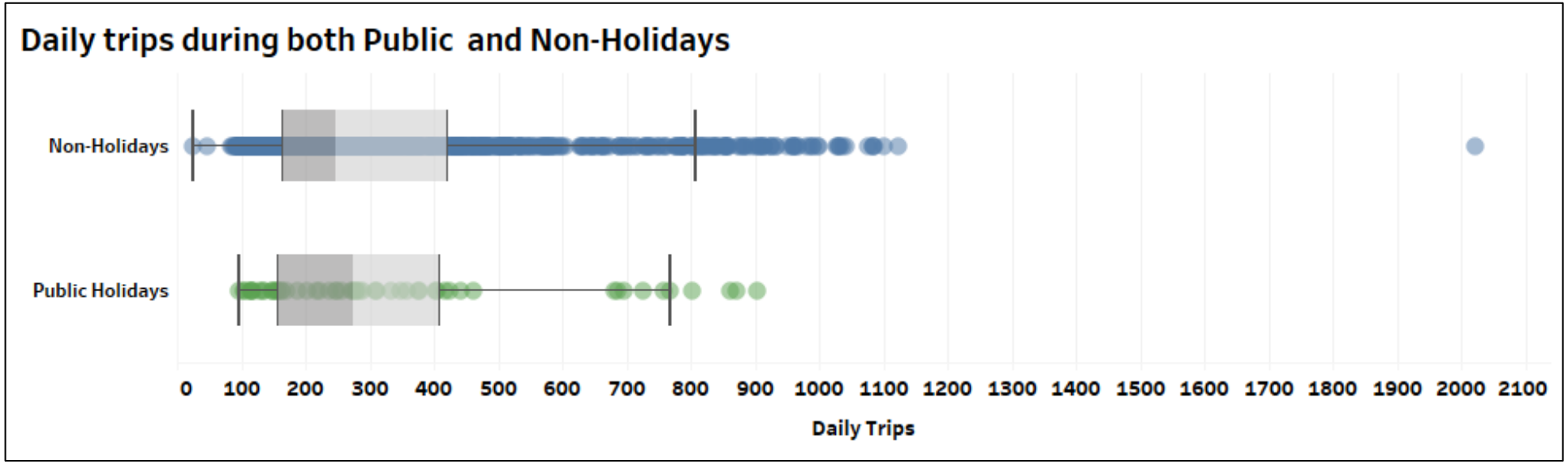
Alpha: **0.05**

P-Value: **0.427**

Verdict: P-value is **statistically insignificant** since **P-value is higher than the alpha.** Therefore, we **cannot reject the null hypothesis.** There is no **association between Customer Income and Distance Traveled**.

Hypothesis 8:

Does Public Holidays affect daily number of trips?



- **H0: No difference in median daily trips during both types of days.**
- **H1: There is a difference in median daily trips during both types of days.**

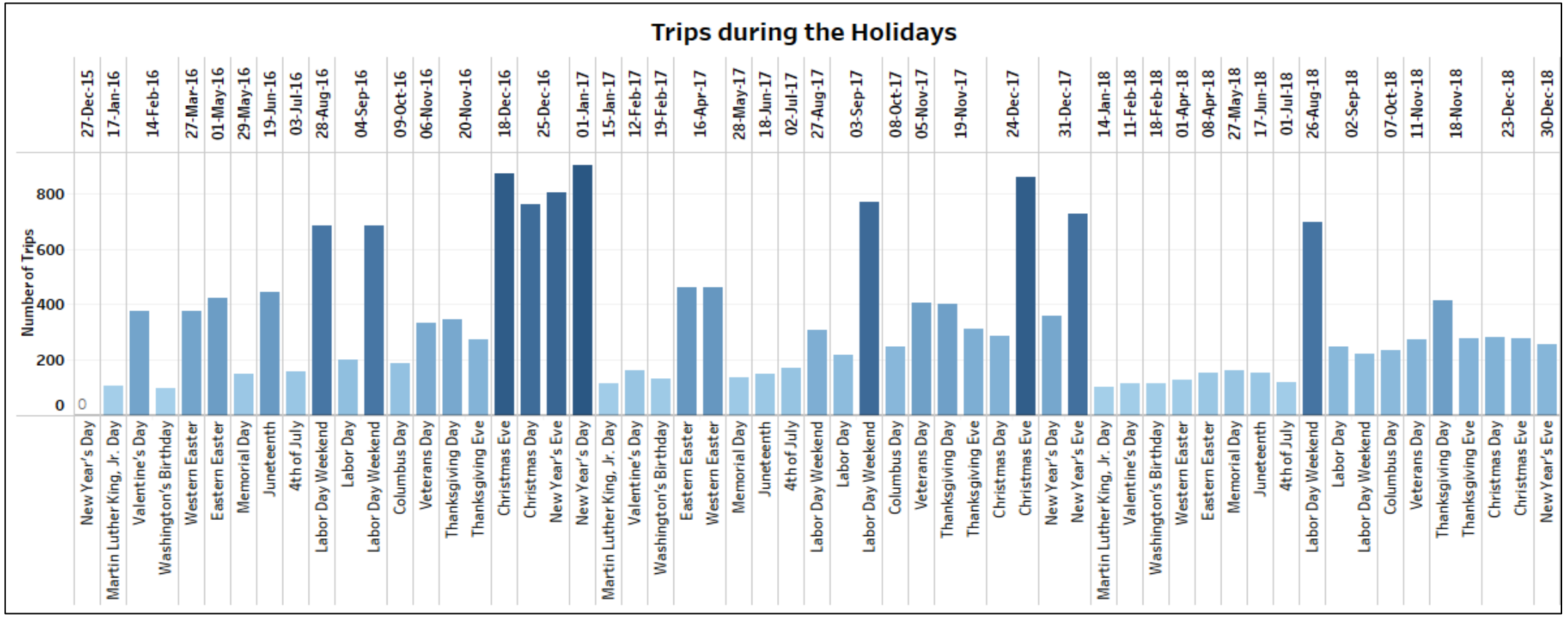
Test Utilized : Mood's median test

Alpha: **0.05**

P-Value: **0.403**

Verdict: If the null hypothesis is true, the probability of obtaining the results of median daily trips such as shown here **is 40.3%.** Since the P-value is higher than the alpha, **we fail to reject the null hypothesis** in favor of the alternative hypothesis. **There is no significant difference in median trips on both types of days.**

Trips during Public Holidays



- The **lowest trips** during public holidays for all three years were on **Martin Luther King Jr. Day** and **Washington's Birthday.**
- During Public Holidays, customers **travel the most** during **Labor Day Weekend**, followed by **Christmas Eve** and **New Year's Eve**.
- In 2016, there were almost no trips on New Year's Day according to the data. But New Year's Day in 2017 is observed to have a high spike in trips. In 2018, trips on this day has reduced significantly.

Forecasting

Forecasting Daily Number of Trips for the Next Two Years

Forecasting Strategy

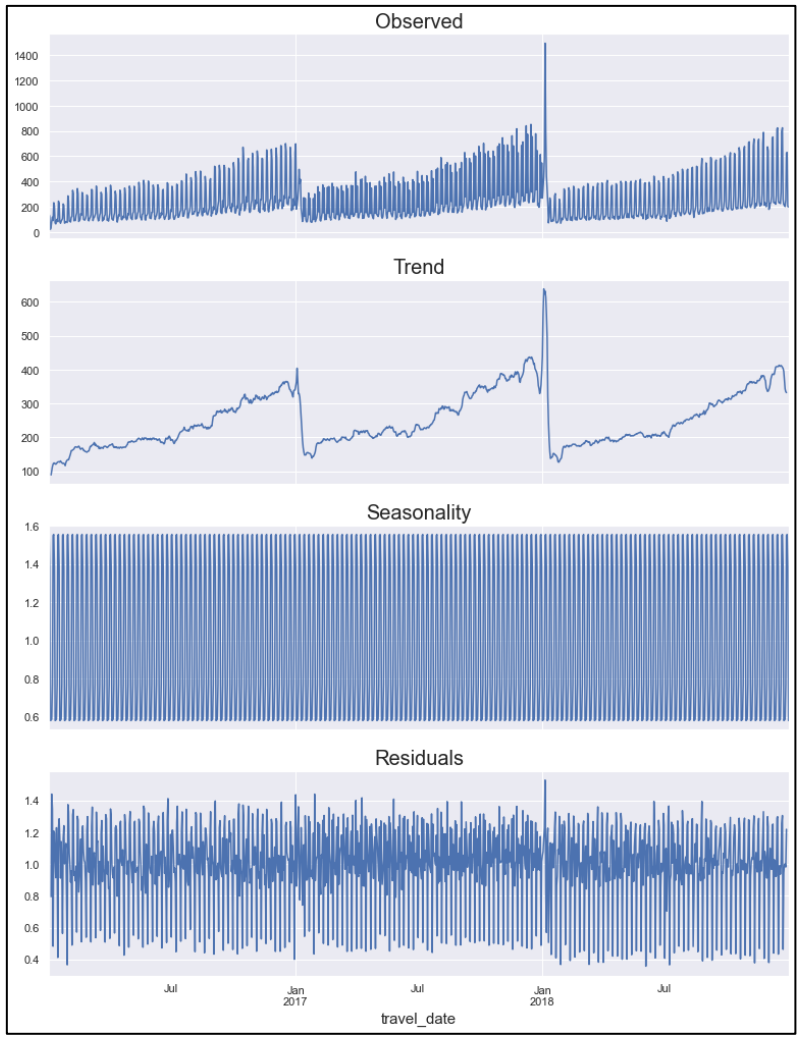
Goal: **Forecast Individual Company's Daily Number of Trips**
Model Used: **Facebook Prophet** PROPHET
Evaluation Metric: **Root Mean Squared Error (RMSE)**
Problem Type: **Supervised Learning**

Steps Involved:

1. Initially **decomposing** Daily Trip Time Series.
2. Analyze **Auto Correlation and Partial-Auto Correlation Plots**.
3. Create 'n' **lags as independent variables**.
4. **Split** the time series into **Train and Test sets**. Test set will be for a period of **last 90 days**.
5. Train Prophet Model **using only Train set**.
6. **Evaluate model performance** by comparing predictions with Test set.
7. Train on the whole dataset and **forecast daily trips for next two years**.
8. Compare forecasts of both Cab companies.

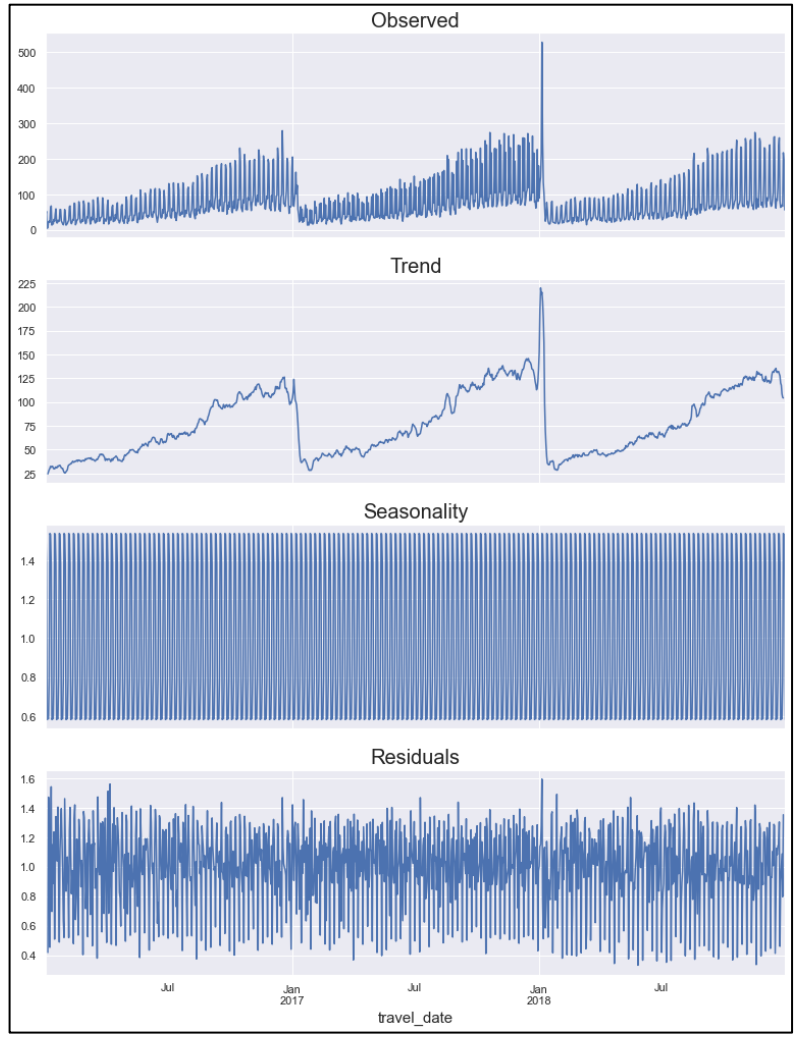
Daily Trips Time Series Decomposition

Yellow Cab



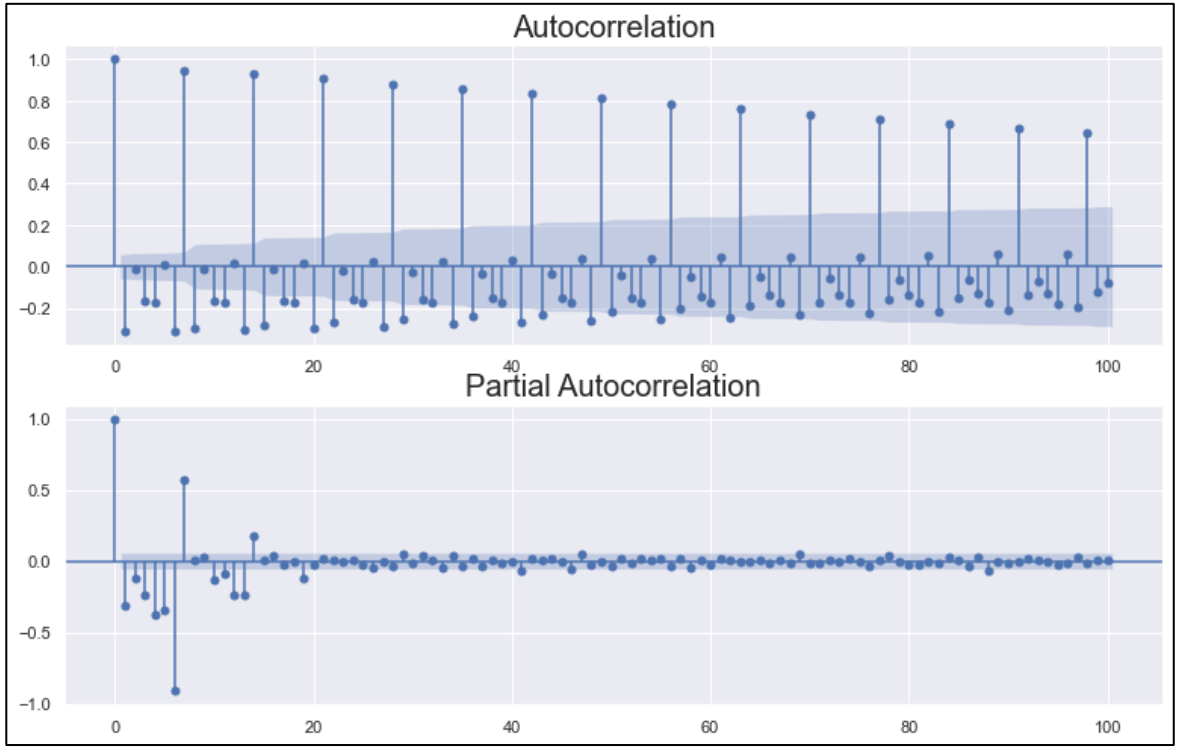
- The plots illustrates a breakdown of Daly trip time series into **trend, seasonal** and **residuals (error)** components.
- **Multiplicative model** used due non-constant monthly and yearly seasonality.
- **Trend:** Noticeable upward month-wise trend but the annual trend seems constant for both companies.
- **Seasonality**: Constant seasonality across all weeks.
- **Residuals**: No noticeable pattern.

Pink Cab

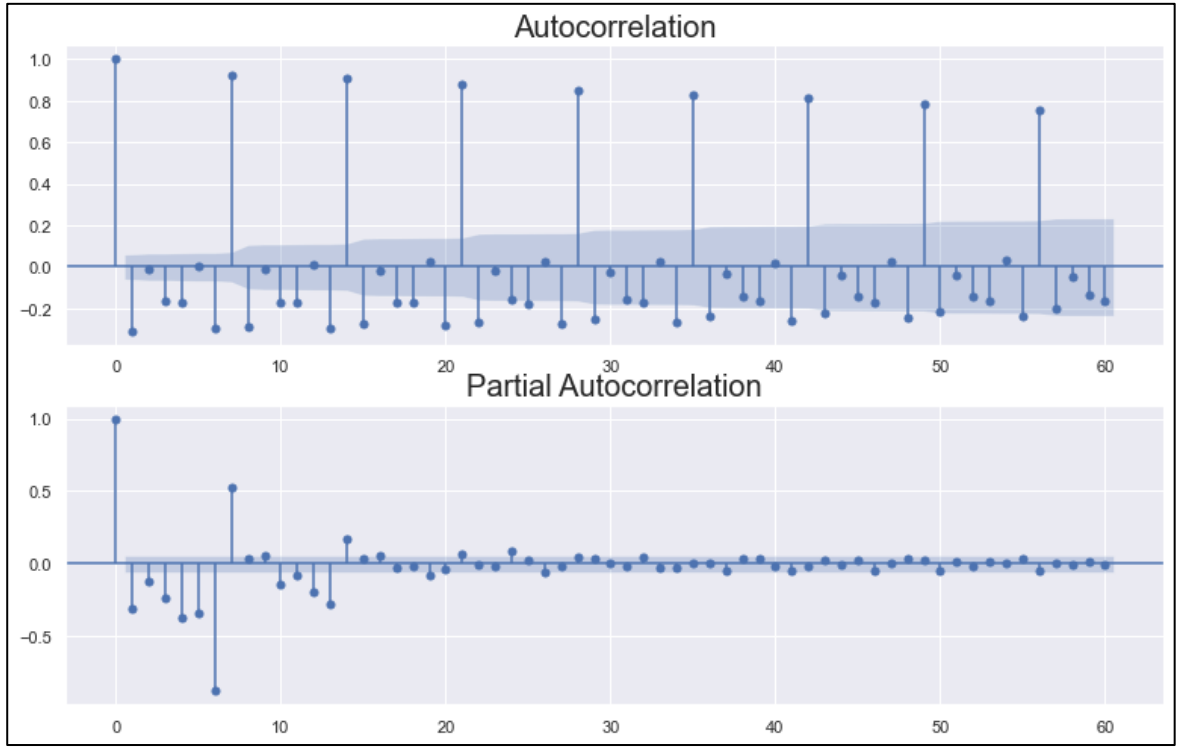


ACF & PACF

Yellow Cab



Pink Cab



- Both time series were differenced one time to make the series stationary.
- High auto correlation with the 7th lag, illustrating that the number of trips at present is correlated with the number of trips within the past week (7 days).

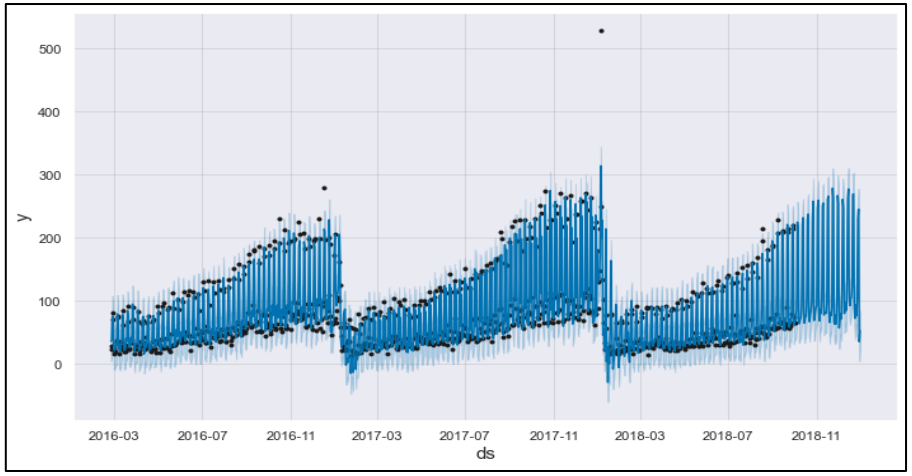
Model Training

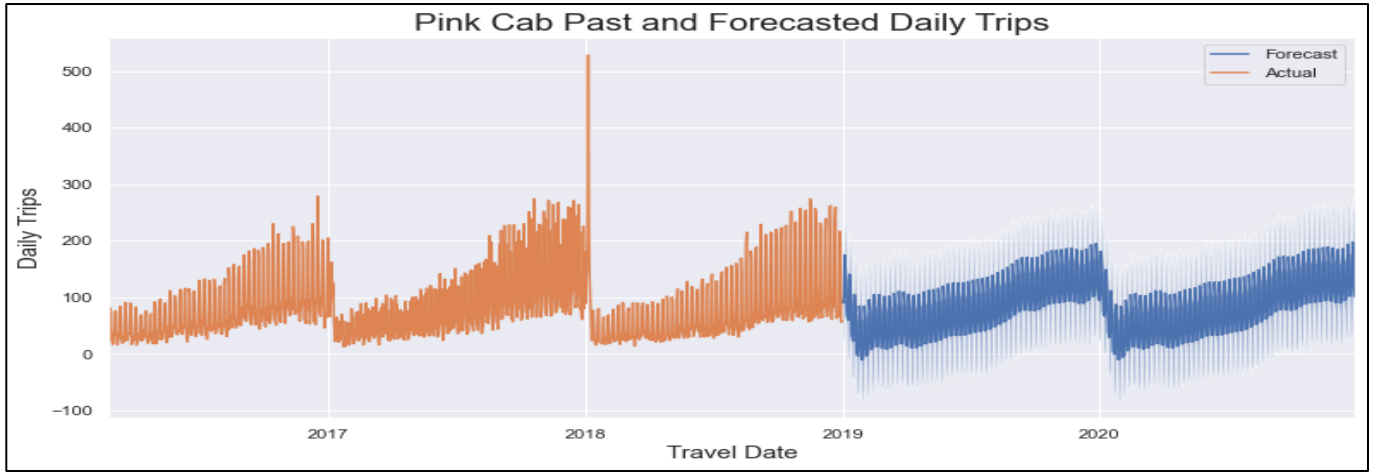
- Created **lags** as independent variables by differencing 54 days.
- Additionally, extracted **day, month, week, etc**. as additional independent variables.
- Data split into train (**01/01/2016 to 14/10/2018**) and test (**15/10/2018 to 31/12/2018**) sets.

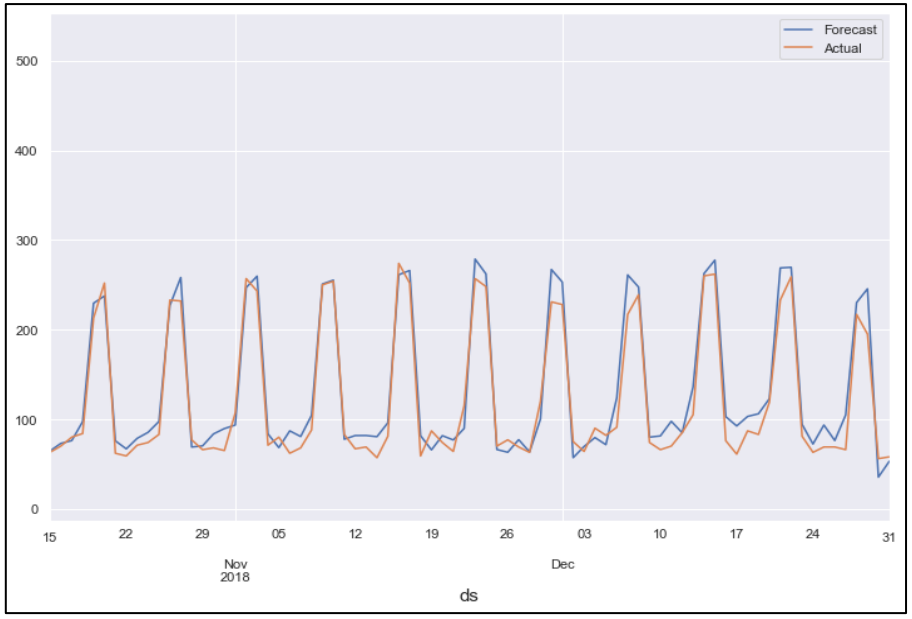
	ds	y	year	month	week	date	day_of_week	t-54	t-53	t-52	...	t-10	t-9	t-8	t-7	t-6	t-5	t-4	t-3	t-2	t-1
0	2016-02-25	29	2016	2	8	25	3	41.0	52.0	4.0	...	14.0	18.0	27.0	28.0	32.0	79.0	65.0	23.0	19.0	23.0
1	2016-02-26	24	2016	2	8	26	4	52.0	4.0	6.0	...	18.0	27.0	28.0	32.0	79.0	65.0	23.0	19.0	23.0	29.0
2	2016-02-27	81	2016	2	8	27	5	4.0	6.0	23.0	...	27.0	28.0	32.0	79.0	65.0	23.0	19.0	23.0	29.0	24.0
3	2016-02-28	70	2016	2	8	28	6	6.0	23.0	24.0	...	28.0	32.0	79.0	65.0	23.0	19.0	23.0	29.0	24.0	81.0
4	2016-02-29	25	2016	2	9	29	0	23.0	24.0	21.0	...	32.0	79.0	65.0	23.0	19.0	23.0	29.0	24.0	81.0	70.0

Training Dataset

Model Evaluation – Pink Cab





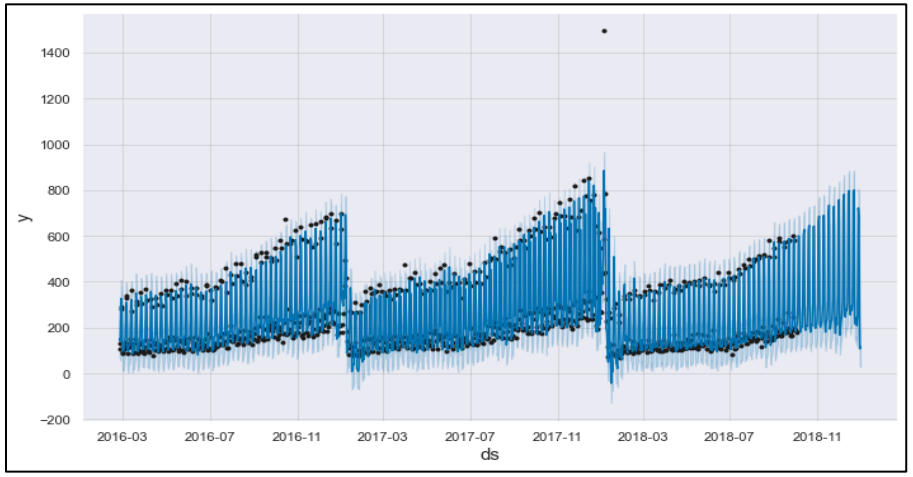


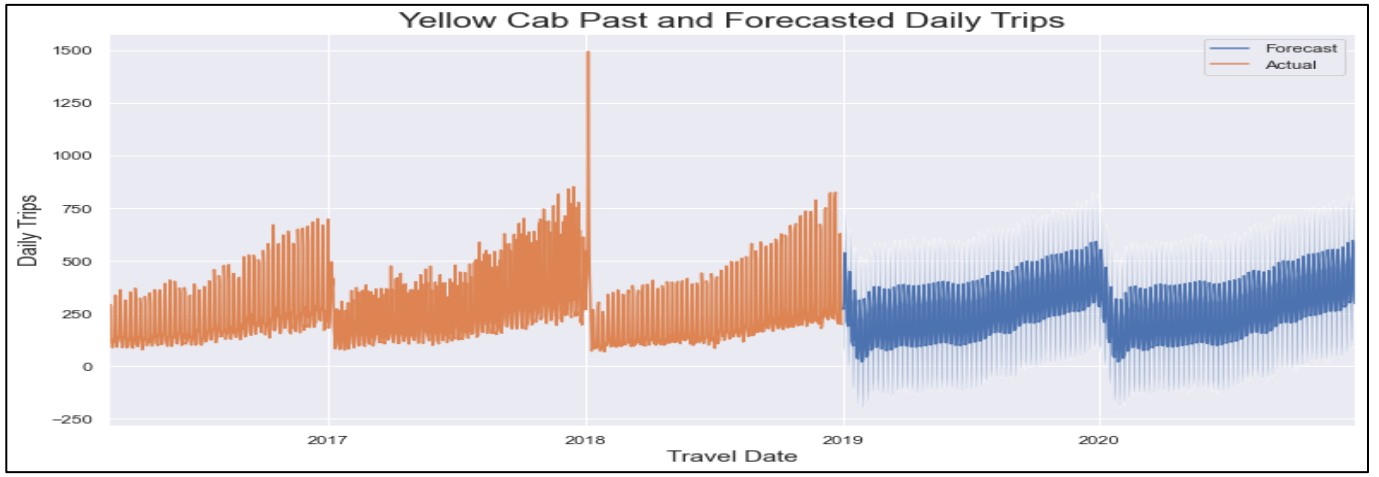
- **RMSE** = 17.62 days
- **Mean Test trips** = 79.69 trips
- **Model Accuracy** = 88.36%

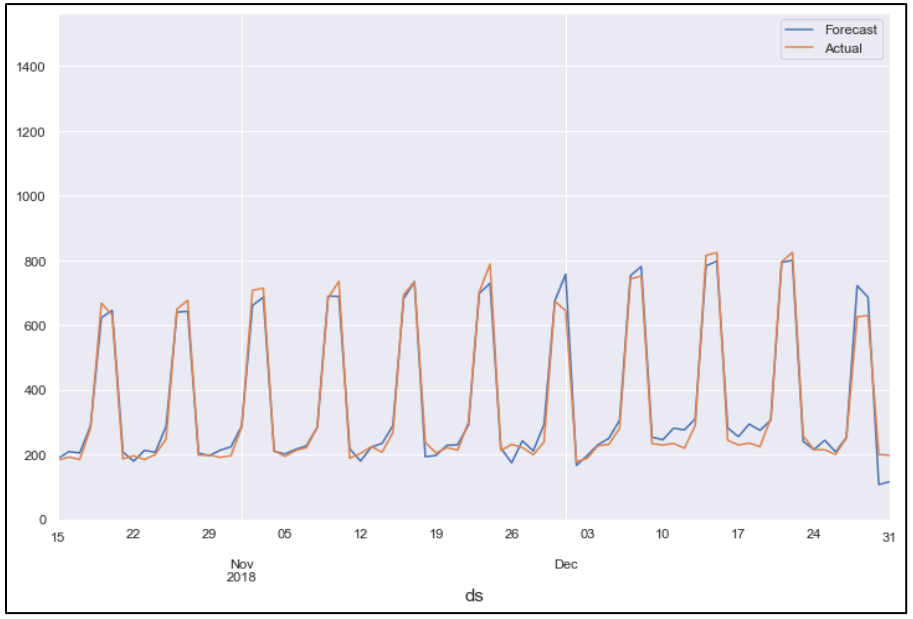
The predicted line approximately follows the same pattern as the test set. The model seems to **over predict** trips on all days.

Forecasting for the next two years seems to illustrate same trend as before.

Model Evaluation – Yellow Cab







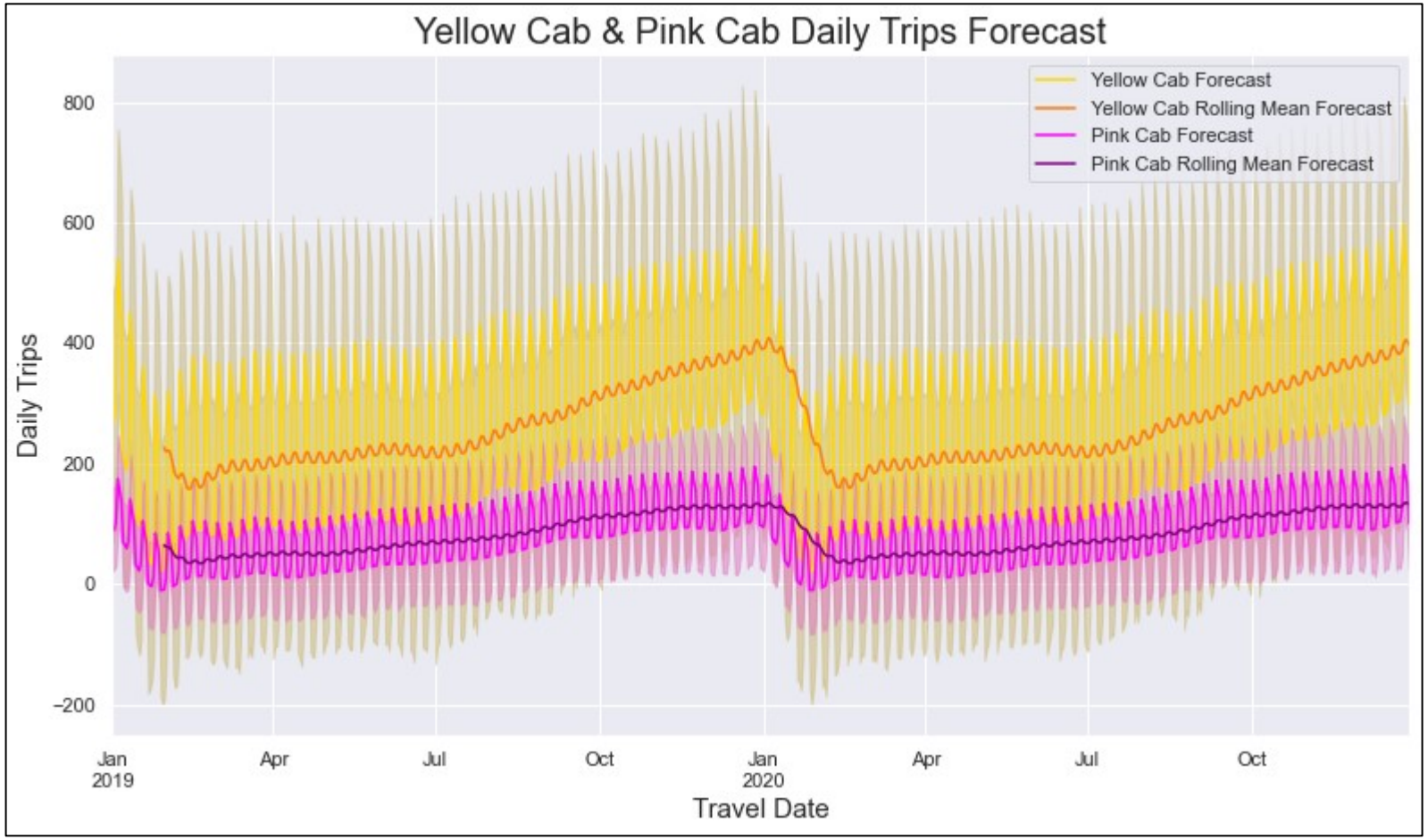
- **RMSE** = 32.5 trips
- **Mean Test trips** = 256.67 trips
- **Model Accuracy** = 93.42%

The predicted line nearly follows the same pattern as the test set, much better than **Pink Cab's** forecasts. The model also seems to have a better accuracy.

Forecasting for the next two years seems to illustrate same trend as before.

Forecast Comparison

- The plots depicts the forecasts made by the model for the next two years (2019 to 2020).
- The confidence intervals of Yellow Cabs are wider compared to Pink Cabs.
- When comparing both forecasts side by side, we can see Yellow Cab company is projected to still lead in daily trips compared to its rival.



Conclusion

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To conclude, based on the extensive EDA, hypothesis testing, and forecasting done on the datasets provided, I highly recommend XYZ to invest in Yellow Cab for the following reasons:

- ✓ Higher market share across all cities, especially in New York.
- ✓ Higher number of trips every single day.
- ✓ Despite losses during specific months, Yellow Cab still outperforms Profit wise.
- ✓ Higher customer loyalty.
- ✓ Forecasts for next two years shows Yellow Cab will still outperform its rival every single day.

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Your Deep Learning Partner

Thank You!