Exploratory Data Analysis

G2M Insights for Cab Investment Firm

26 June, 2021

Agenda

Executive Summary

Problem Statement

Approach

EDA

EDA Summary

Recommendations

Description

1. XYZ is a private equity firm in US. Due to remarkable growth in US Cab industry in last few years and multiple key players in the market, It is planning to invest in a Cab industry.
2. Providing right actionable insights to help XYZ firm in identifying right company for investment.
3. There are 2 Cab companies: a) Yellow Cab b) Pink Cab.
4. The analysis include, Data Understanding, Data Visualizations, Creating multiple hypothesis, Building models and finding the best fit model based on accuracy.

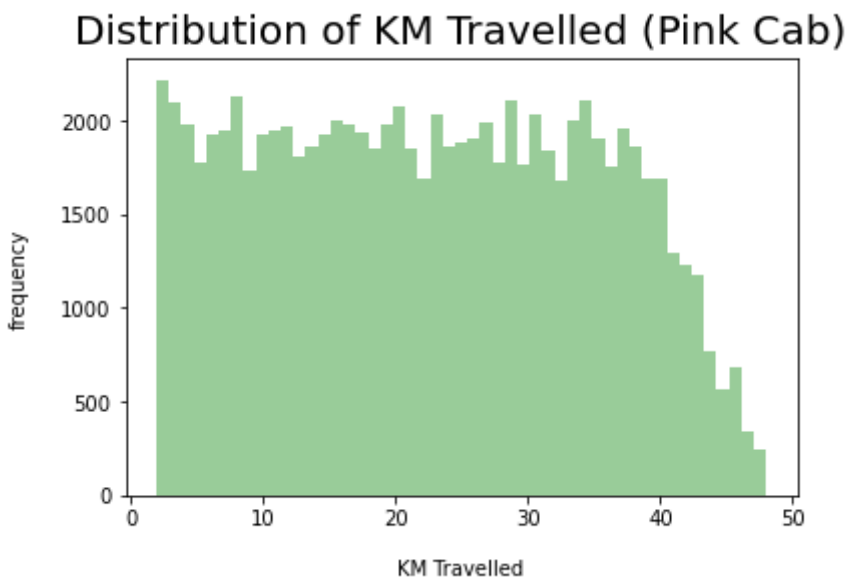
Data Preparation

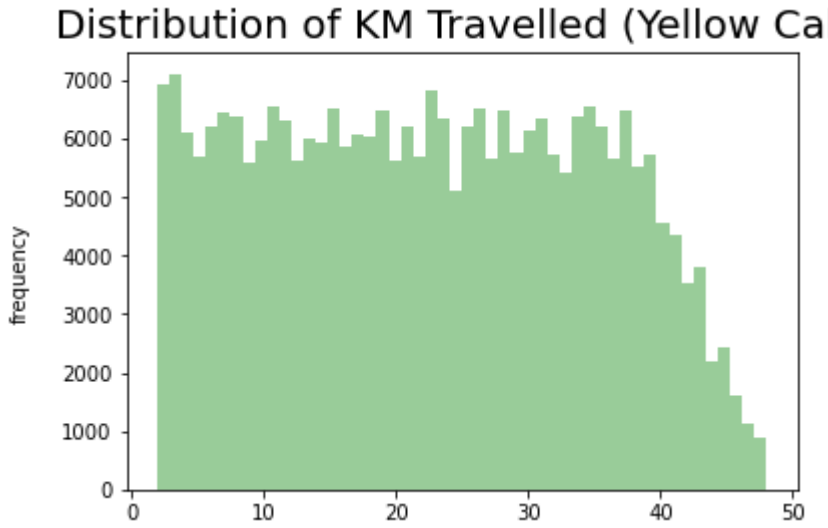
There are 4 datasets:

1. Cab_data.csv → It contains the transactions of the 2 Cab companies.
2. Customer_ID.csv → It contains the customer's demographic details.
3. Transaction_ID.csv → It contains the customer's transactions and payment mode details.
4. City.csv → It consists of full list of US cities, their population and number of cab users.

Exploratory Data Analysis.

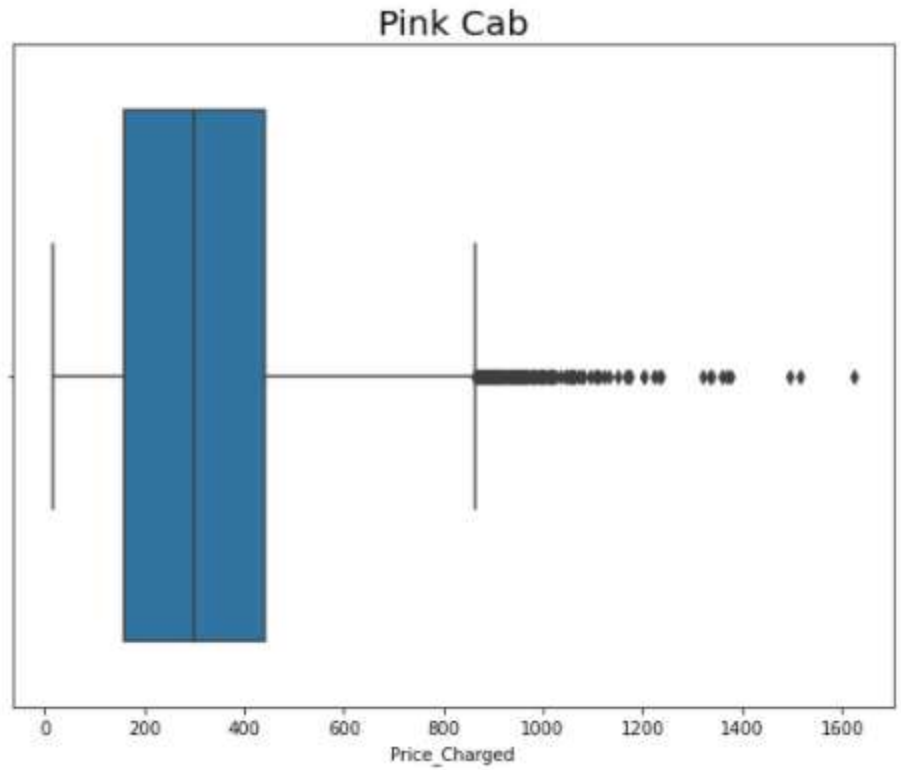
Distribution of KM Travelled for both Cabs:

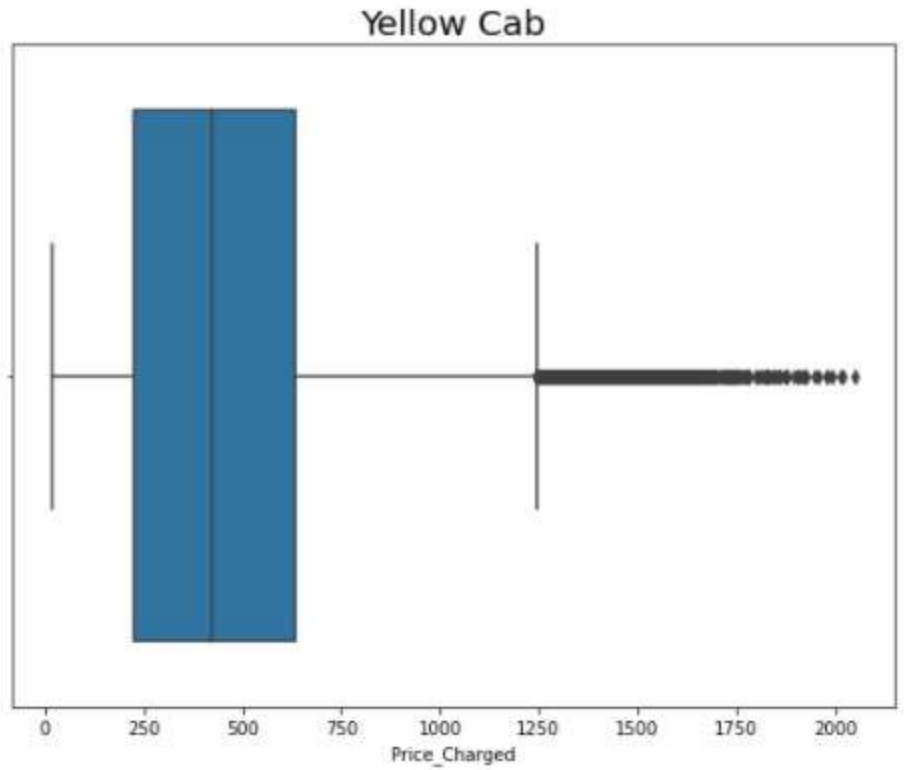




- From the above graphs, we can see that for both Pink and Yellow Cab most of the rides are in the range of approximately 2 to 48 KM.

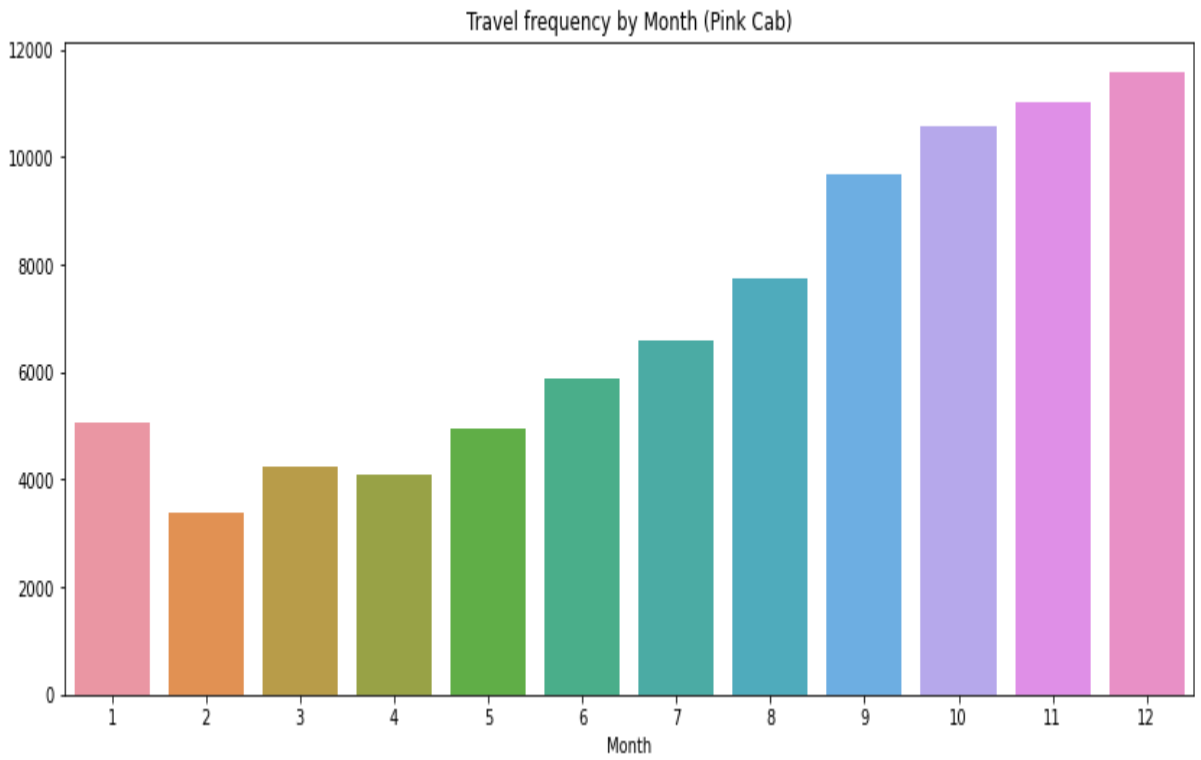
Distribution of Price Charged for both Cabs:

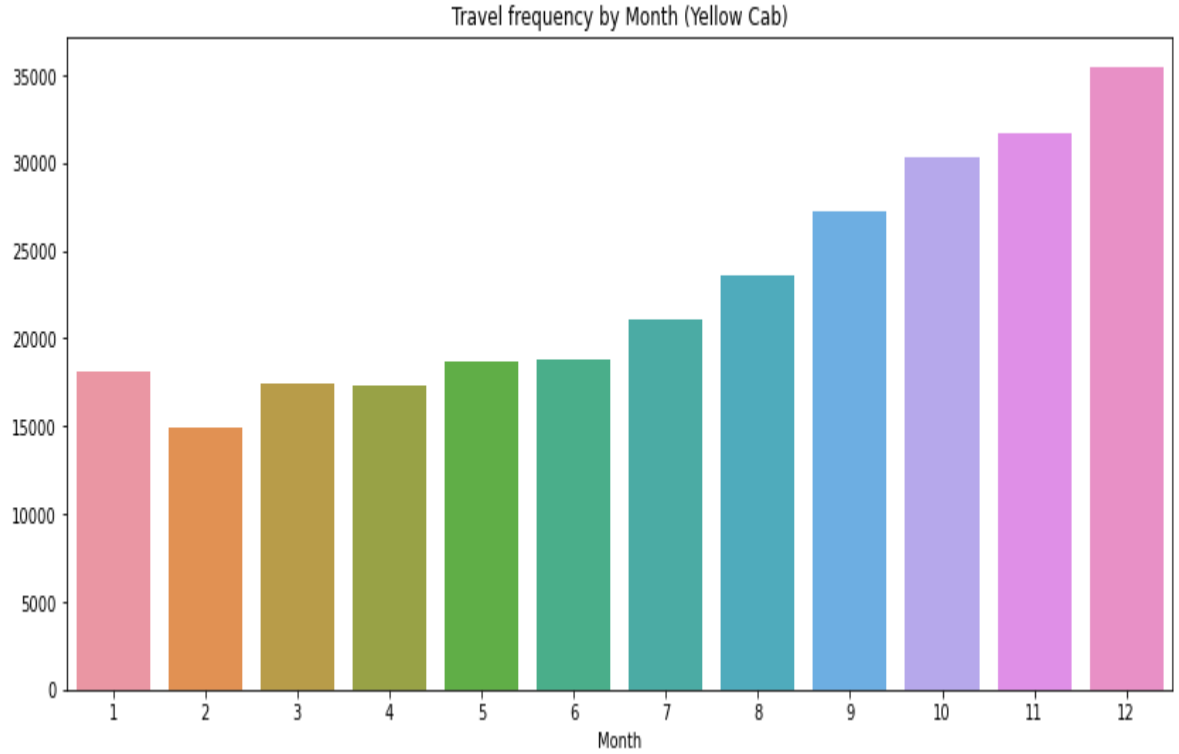




- The Price Charge range for Yellow cab is more than the Pink cab.
- The outliers are due to use of high-end cars.

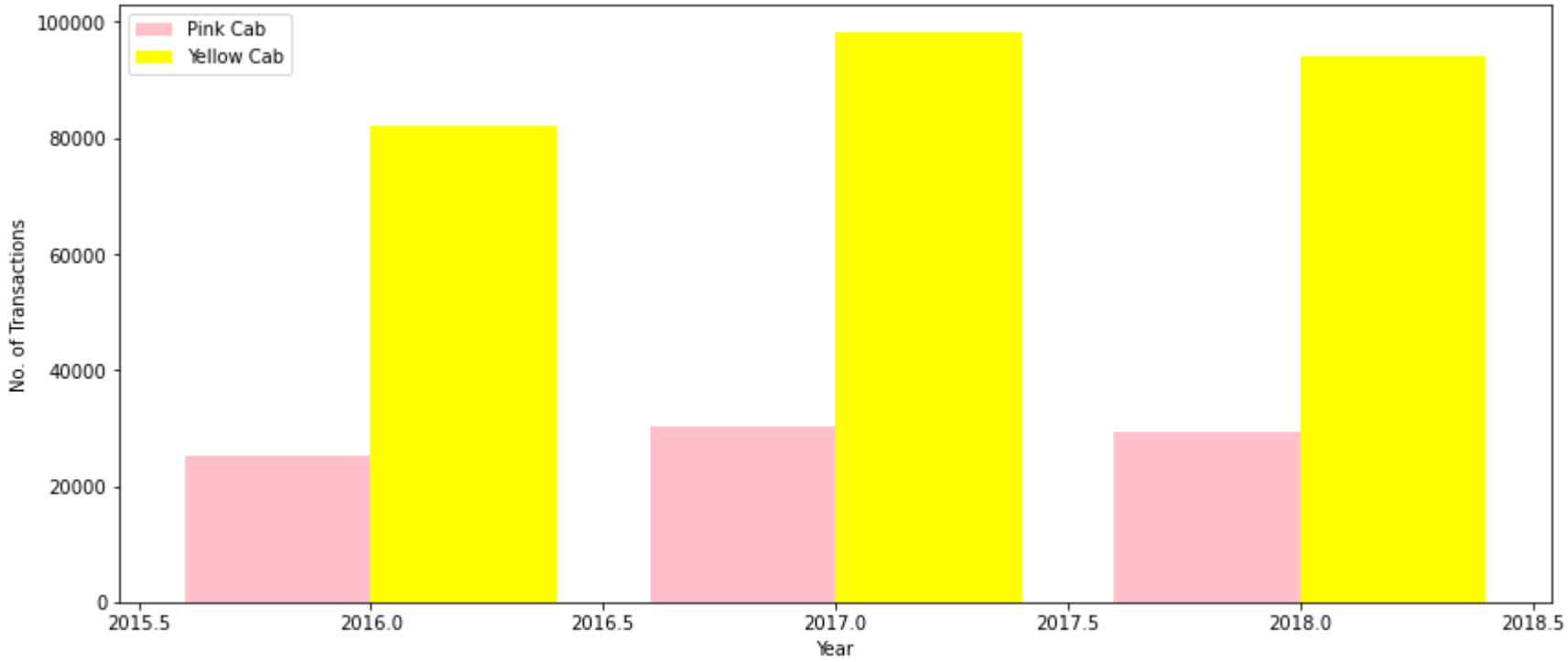
Travel Frequency per Month:





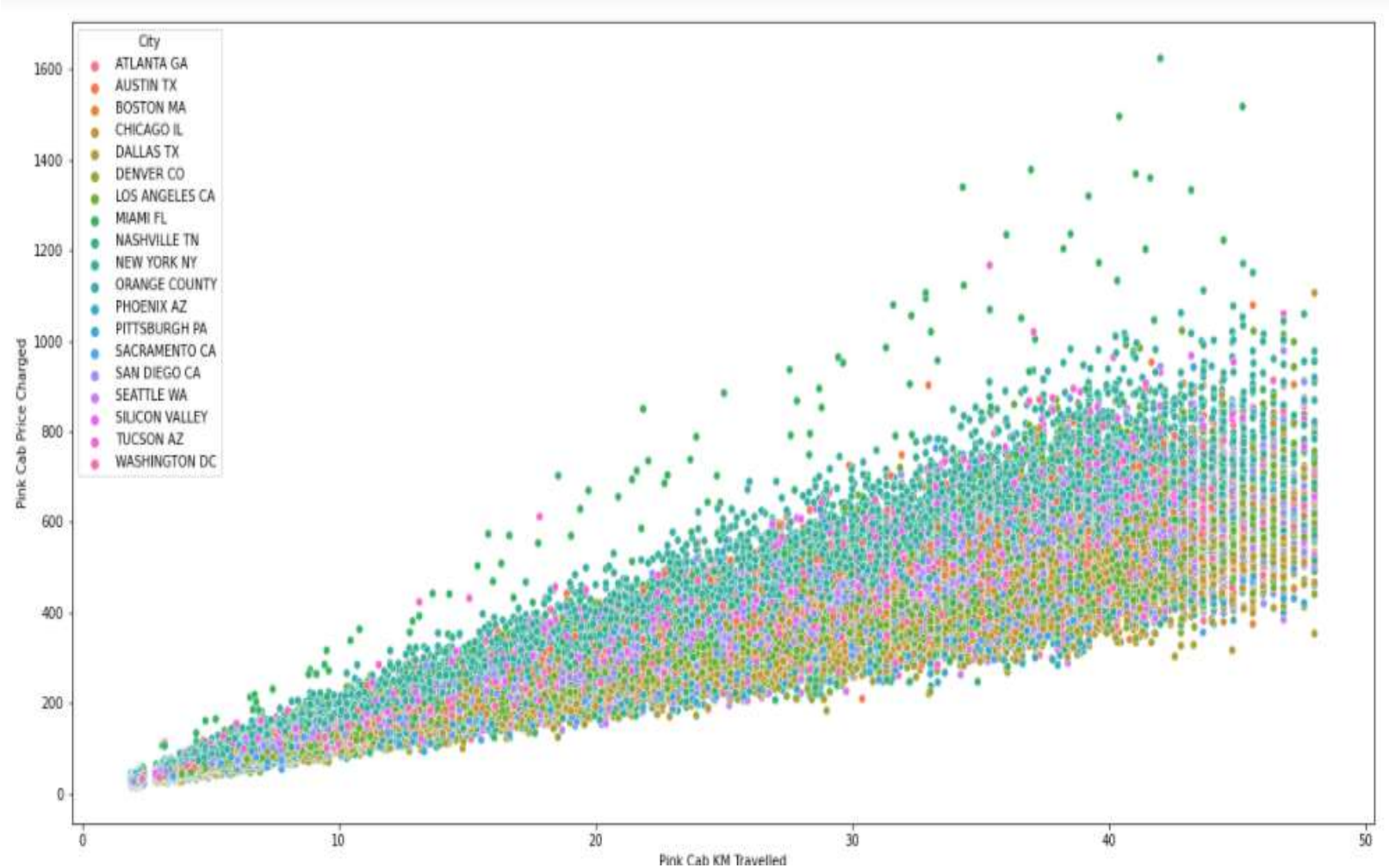
- Yellow Cab has higher travels (35000) in the month of December which is the holiday season compared to Pink Cab (11000).

Transaction per Year for both Cabs:



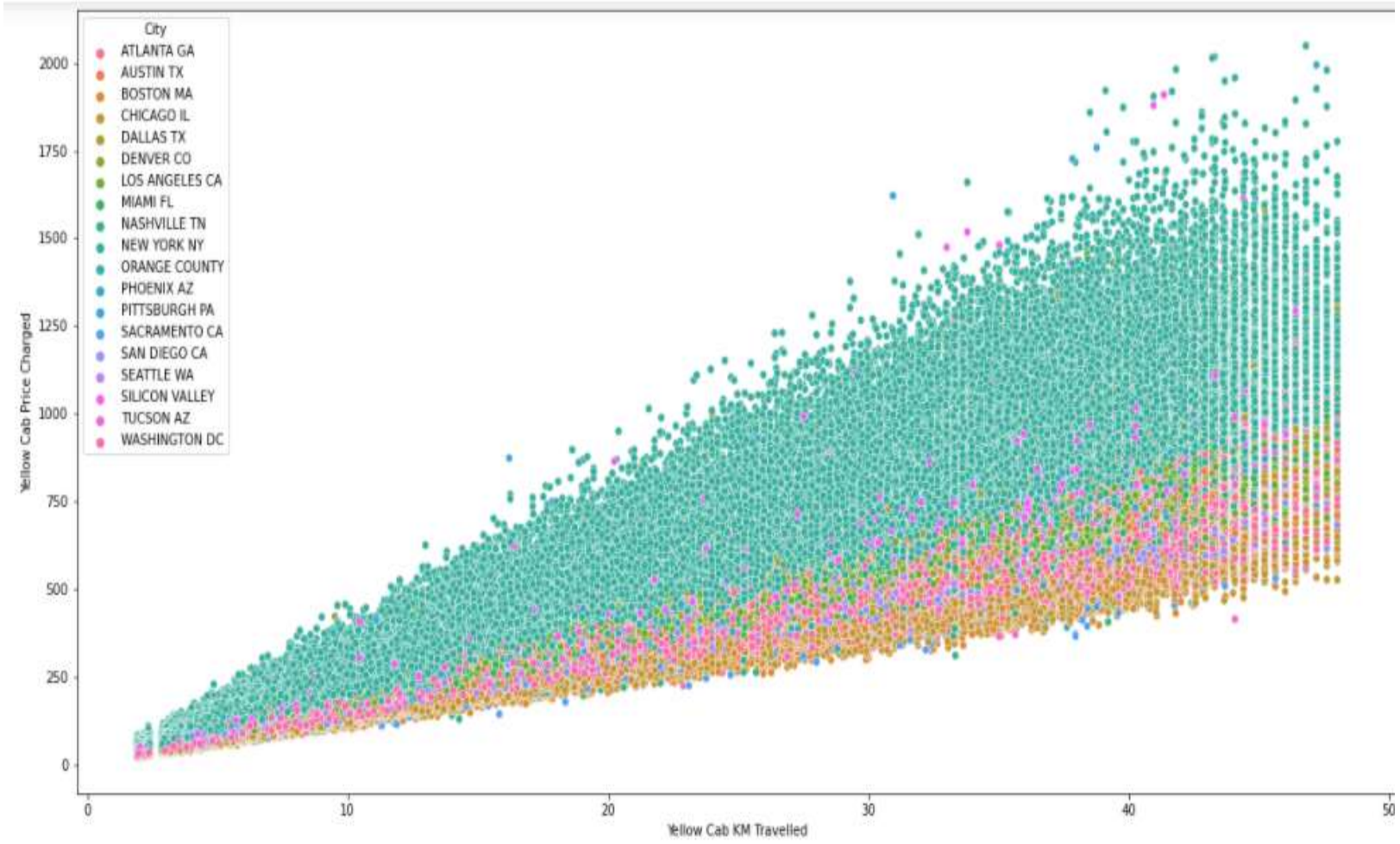
- From the graph it shows that on yearly basis no. of transactions for Yellow cab is higher than Pink cab.

Pink Cab: Price Charged per KM per City



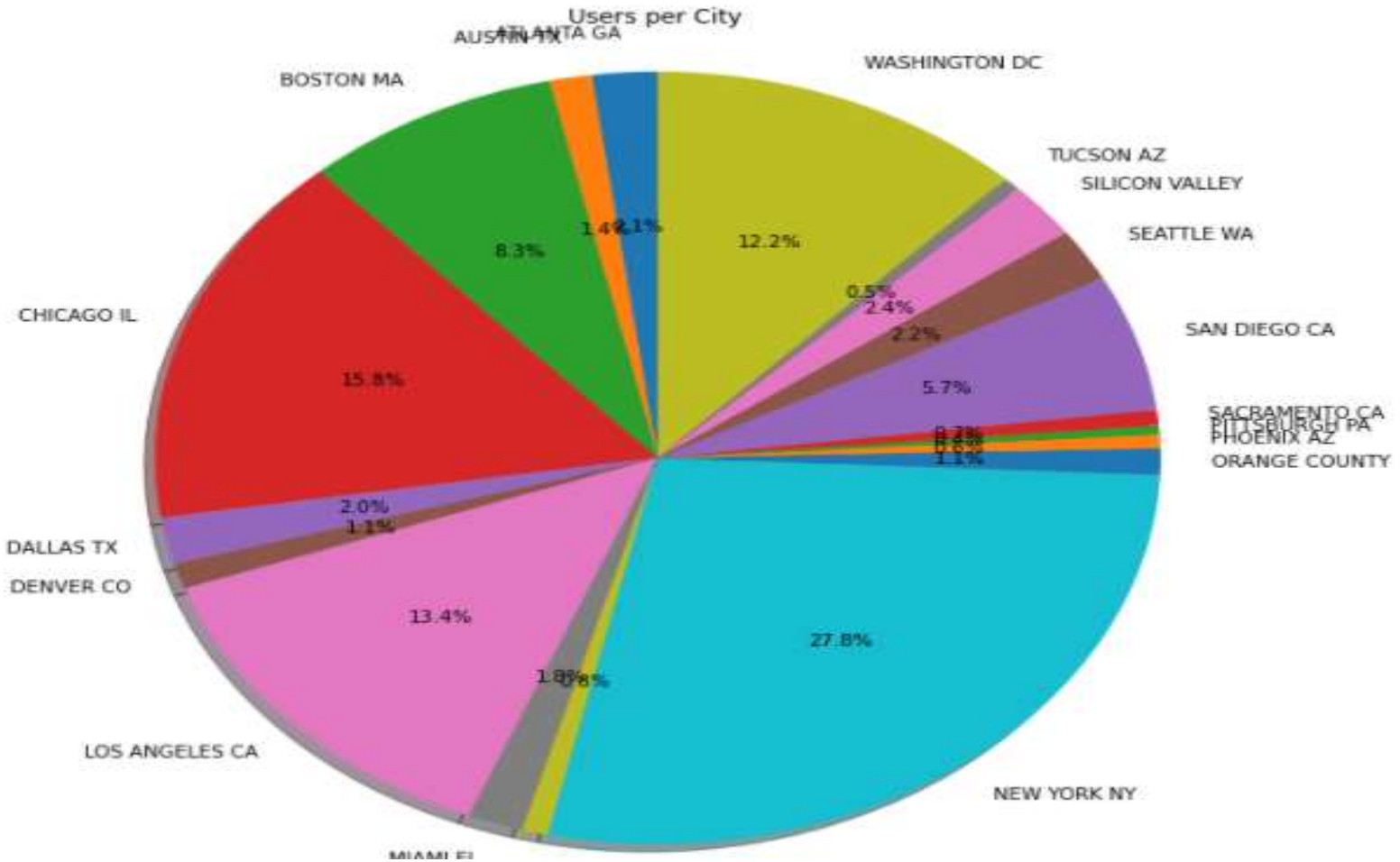
- For Pink cab all the cities have the same increase in price charge with increase in distance

Yellow Cab: Price Charged per KM per City



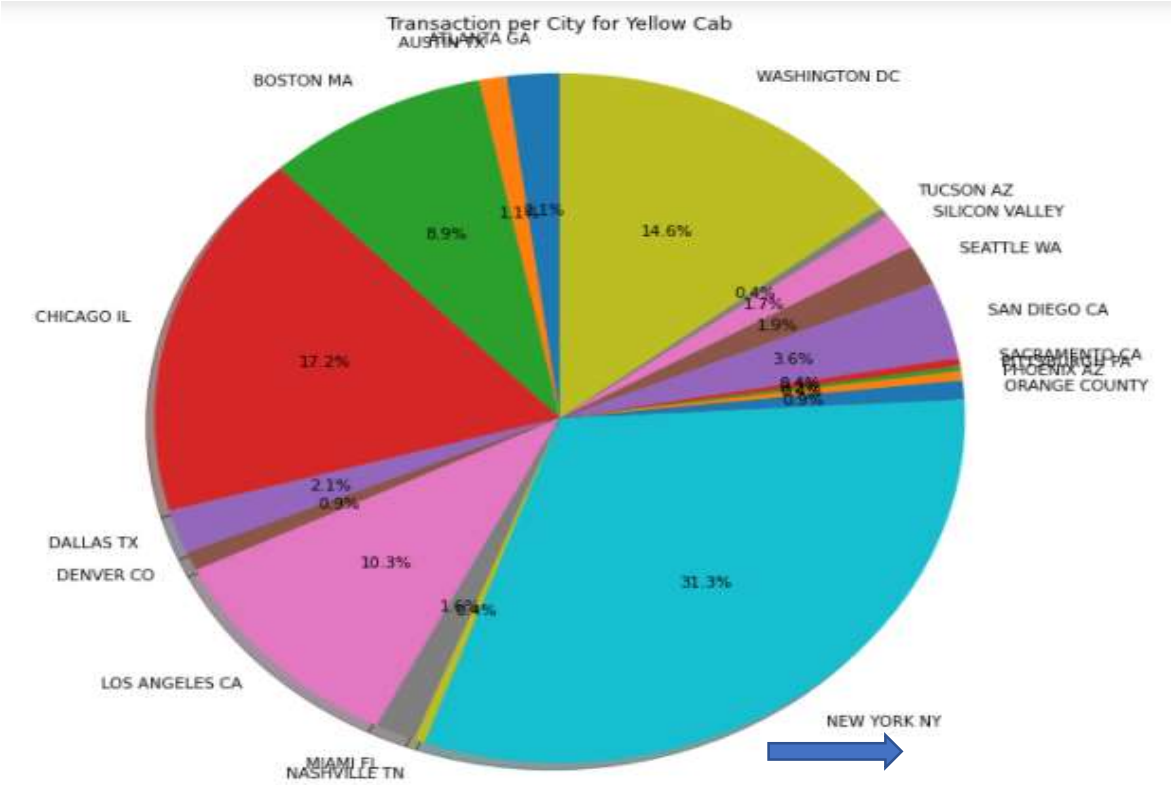
- In New York City the Price charged for Yellow Cab is more in comparison to the other cities

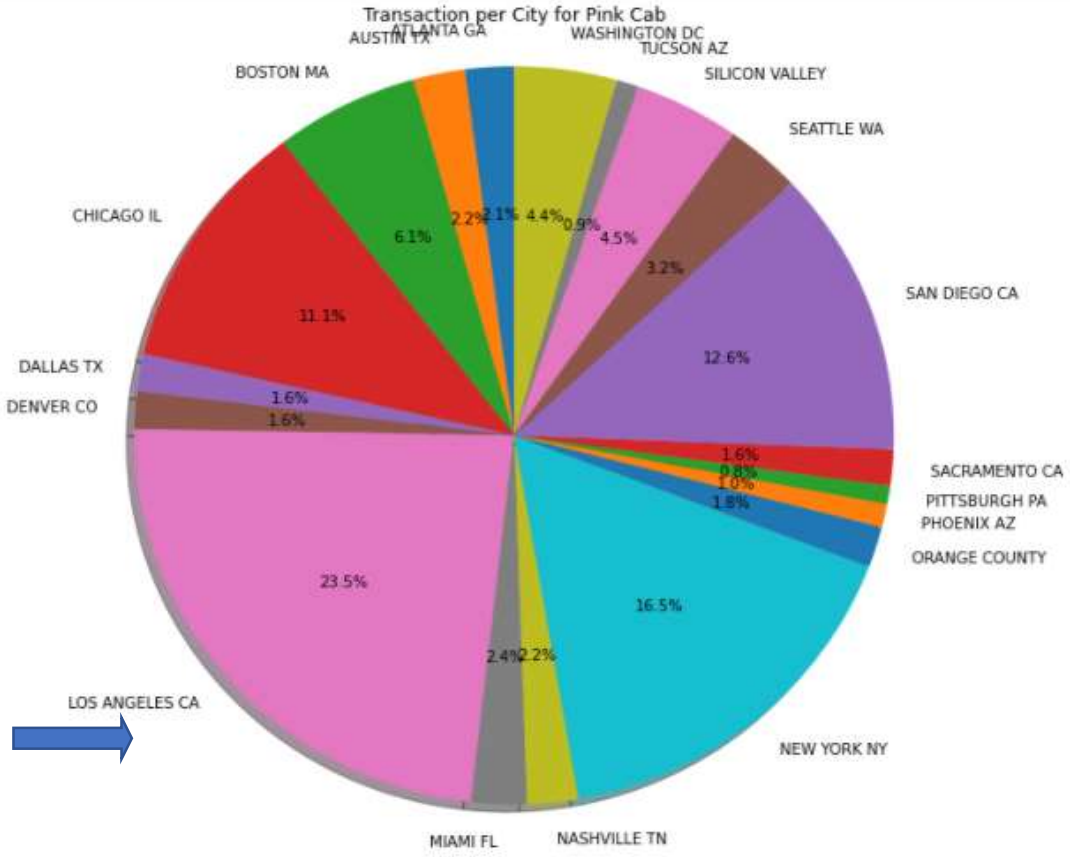
Cab Users per City:



- **New York City has the highest Cab users with 28% followed by Chicago with 16% and Los Angeles with 13%**

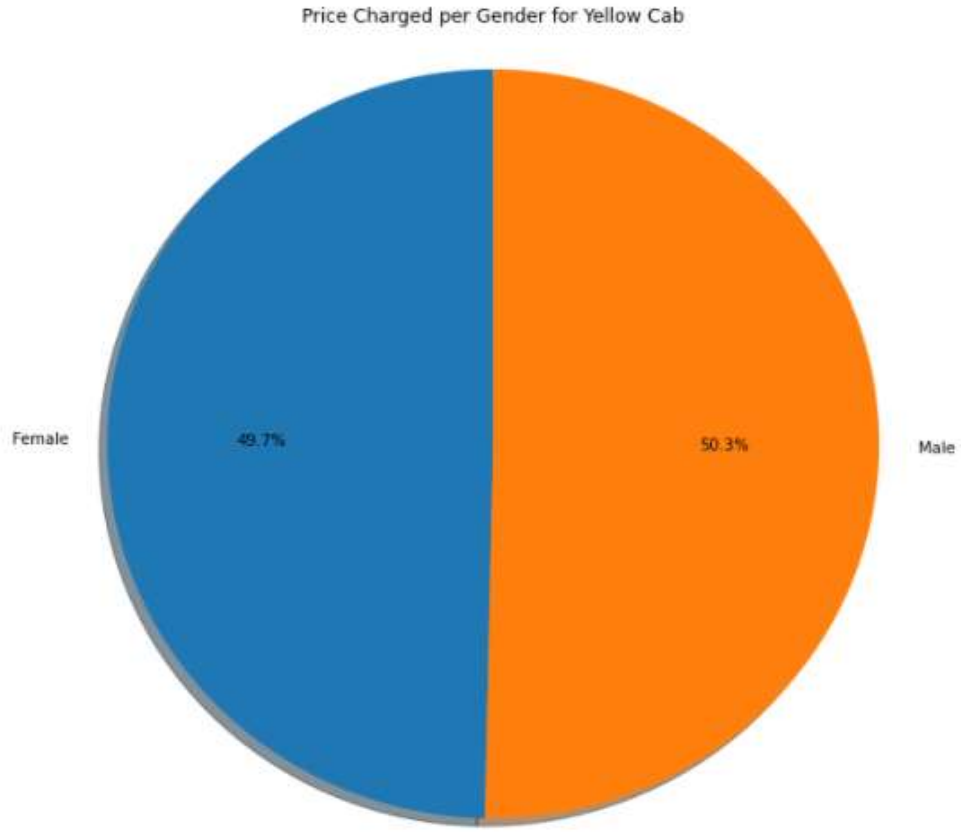
Transaction per City for both Cabs:

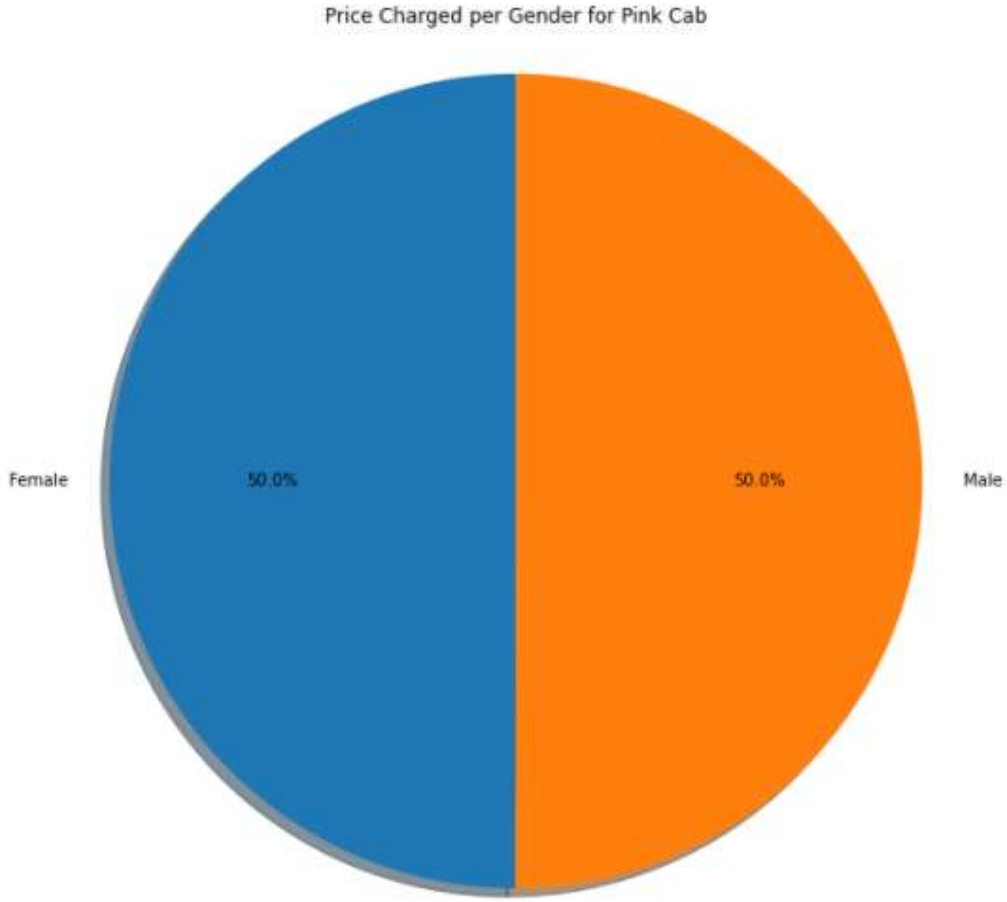




- Transaction for Yellow Cab is highest in New York City(31%) and New York City has the highest Cab Users of 28% as per the previous slide.
- Transaction for Pink Cab is highest in Los Angeles City.

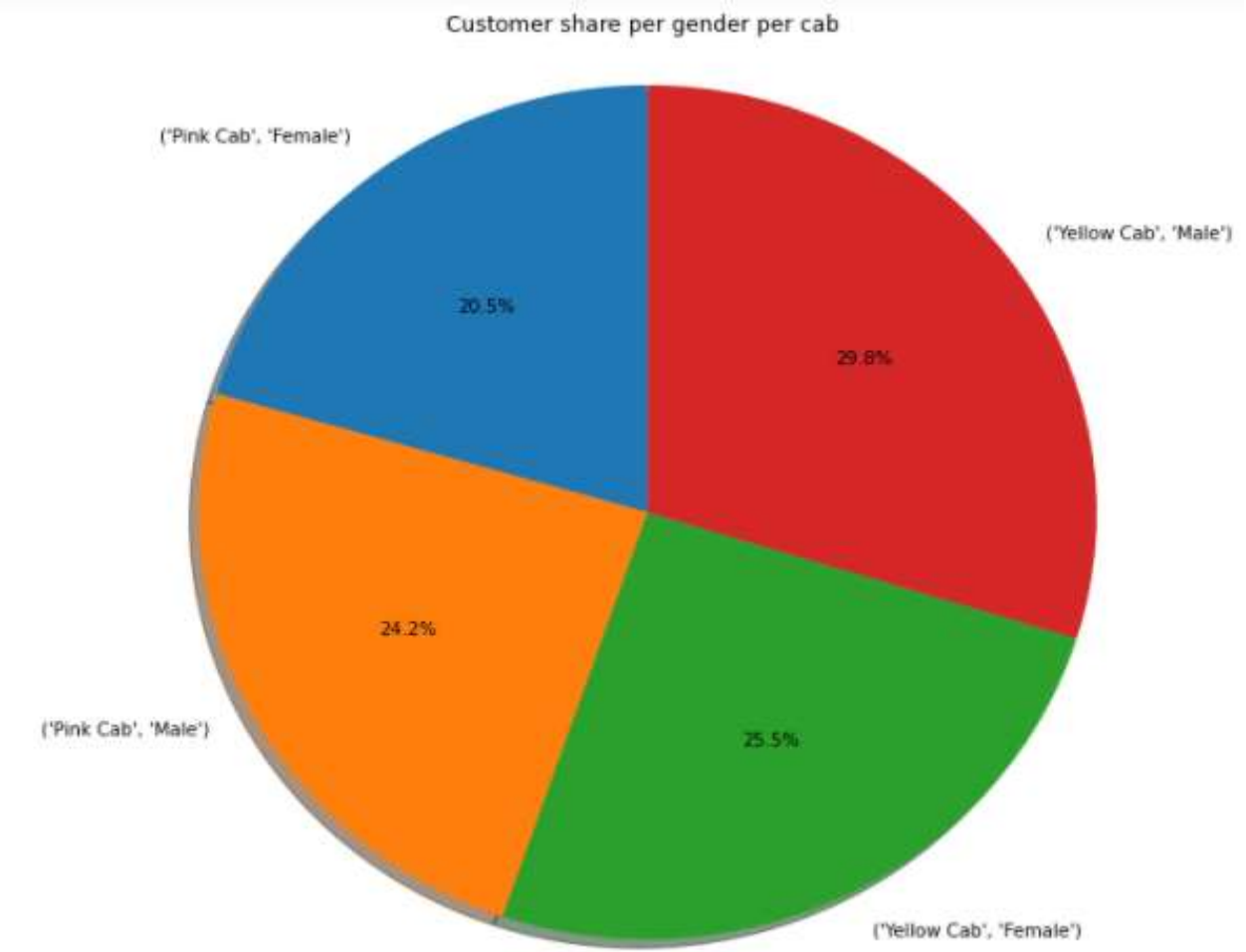
Price Charged per Gender for both Cabs:





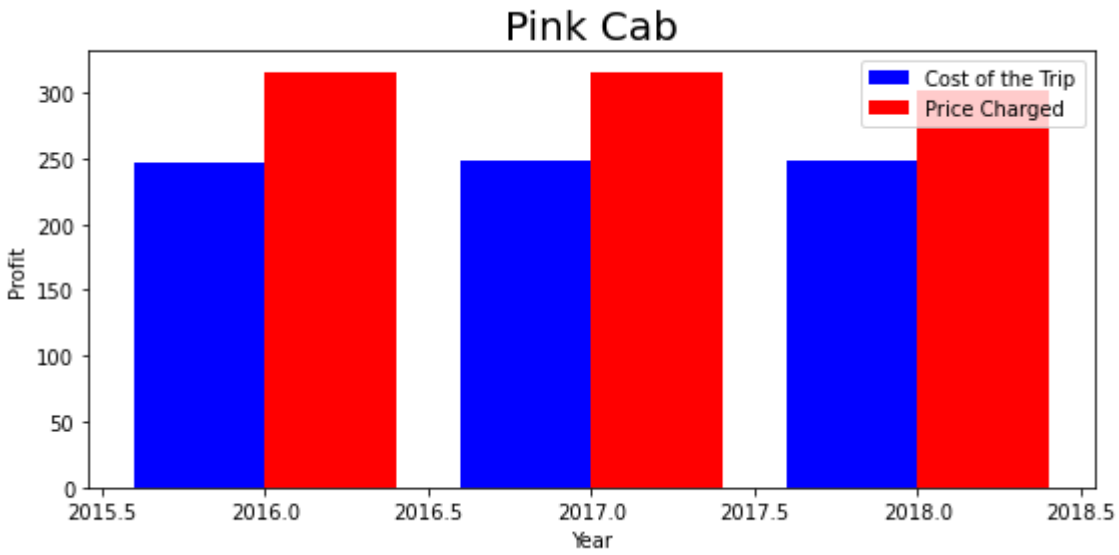
- Yellow Cab charge less from Female Customers whereas Pink Cab charges same for both Male and Female Customers.

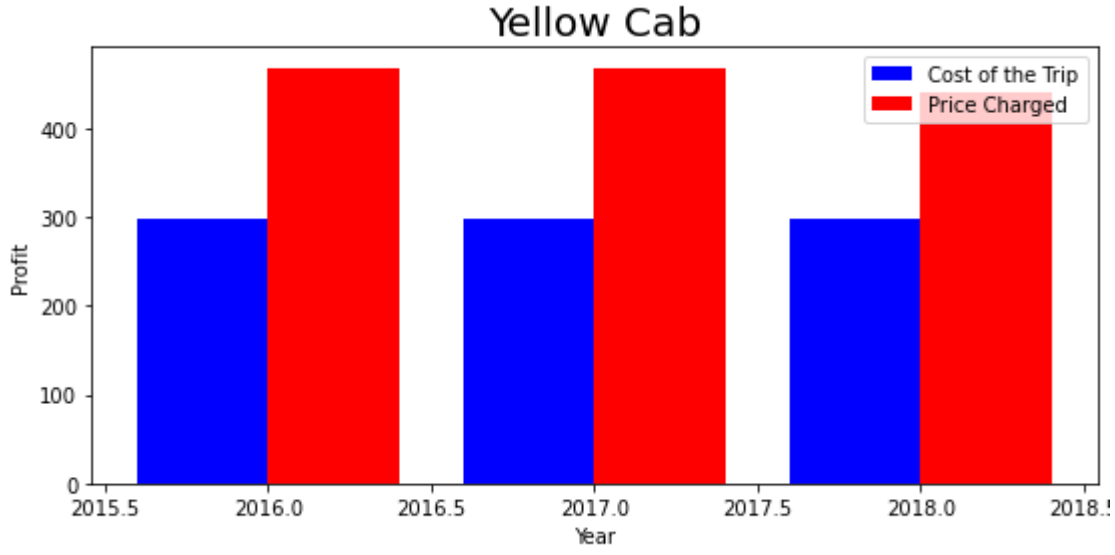
Customer Share per Gender for both Cabs:



- Female Customers in Yellow Cab(25.5%) is higher compared to Pink Cab (20.5%)

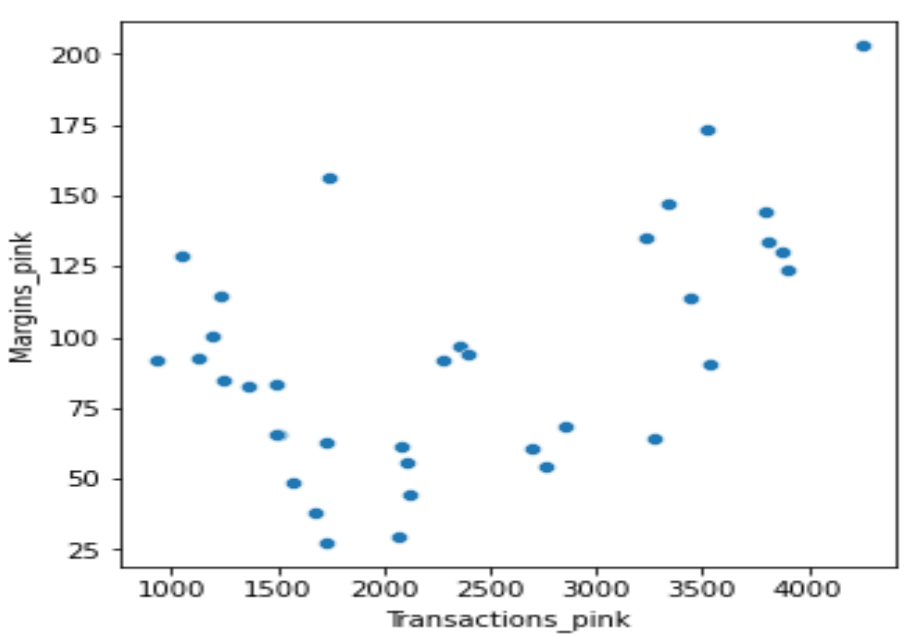
Profit Margin per year for both Cabs:

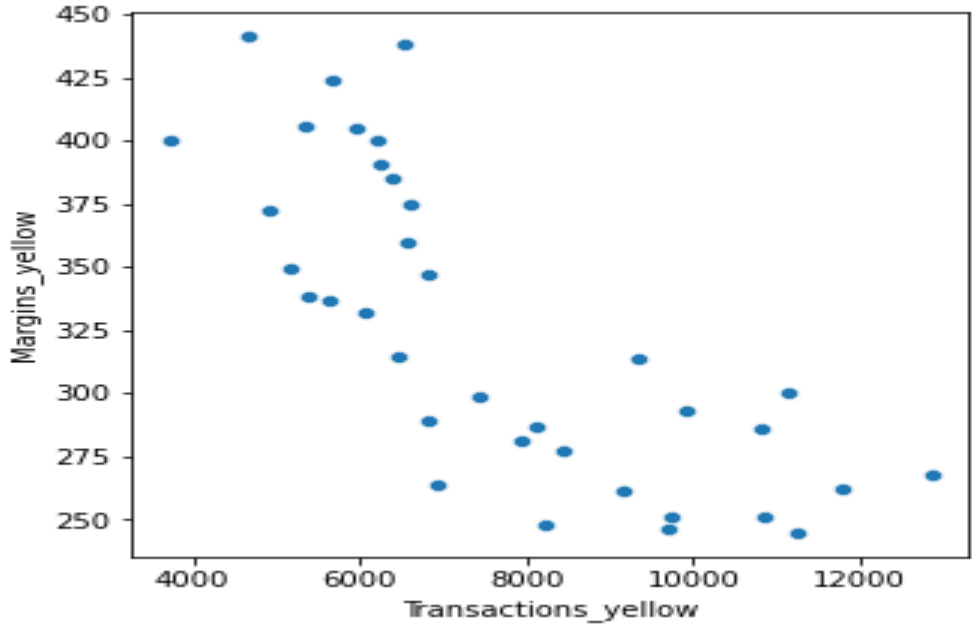




- From the Graphs, it shows that the Yellow cab has a higher Profit Margin (Price Charged - Cost of Trip) compared to Pink cab.

Margins per Transactions:





- Margins: Price Charged – Cost of Trip
- Pink Cabs increase margins with increase in number of Transactions.
- Yellow Cab decrease Margins with the increase in Transaction.

Exploratory Data Analysis Summary

Pink Cab

- Rides are in the range of approximately 2 to 48 KM.
- Price Charge range from 150 to 450 dollars.
- In December which is the holiday season, no. of travels was around 11000.
- Transaction per year:
  - 2016: 20000 – 40000
  - 2017: 20000 – 40000
  - 2018: 20000 – 40000
- All the cities have the same increase in price charge with increase in distance.

Yellow Cab

- Rides are in the range of approximately 2 to 48 KM.
- Price Charge range from 250 to 600 dollars.
- In December which is the holiday season, no. of travels was around 35000.
- Transaction per year:
  - 2016: 80000 – 100000
  - 2017: 80000 – 100000
  - 2018: 80000 – 100000
- In New York City the Price charged for Yellow Cab is more in comparison to the other cities.

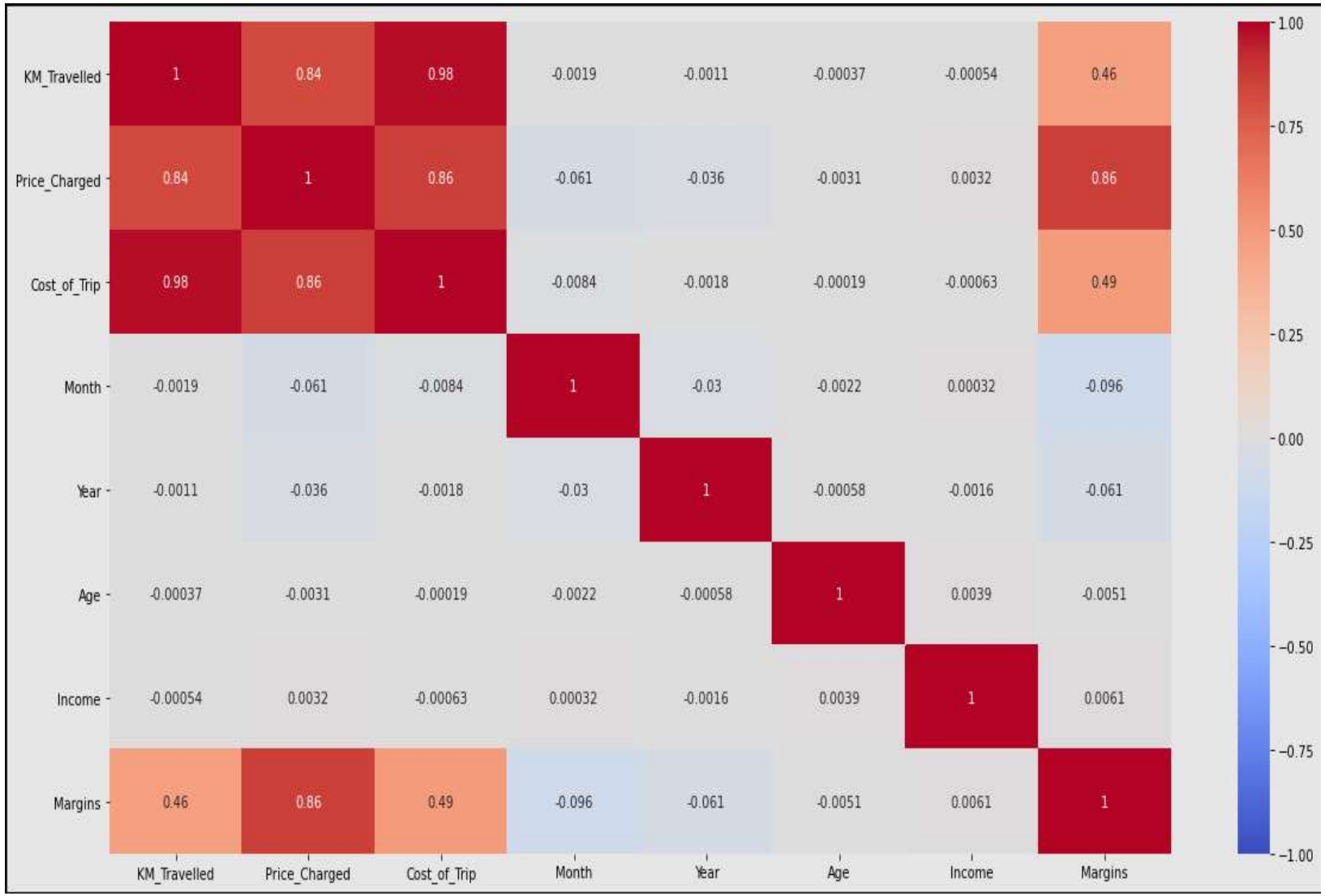
Pink Cab

- Pink Cab charges same for both Male and Female Customers.
- Female customers are around 20.5% out of the total Customers.
- Profit Margin is low each year (2016-2018) compared to Yellow Cab.
- Pink Cabs increase margins with increase in number of Transactions.

Yellow Cab

- Yellow Cab charge less from Female Customers.
- Female customers are around 25.5% out of the total Customers.
- Profit Margin is high each year (2016-2018) compared to Pink Cab.
- Yellow Cab decrease Margins with the increase in Transaction.

Correlation:



- As per the graph, there is a positive correlation between Margin & Price Charged

Hypothesis Testing

- **Hypothesis** : **Margin remain the same regarding Gender for both Yellow Cab & Pink Cab.**

  - Pink Cab: There is no difference in Margin between Male and Female customers.

```
print('P value is ', p_value)
```

```
37480 47231
We accept null hypothesis that there is no difference
P value is  0.11515305900425798
```

  - Yellow Cab: There is difference in Margin between Male and Female customers.

```
print('P value is ', p_value)
```

```
116000 158681
We accept alternate hypothesis that there is a statistical difference
P value is  6.060473042494144e-25
```

- **Hypothesis** : **Margin remain the same for all Age group for both Yellow Cab & Pink Cab.**

  - Pink Cab: There is no difference in Margin for all Age group.

```
print('P value is ', p_value)
```

```
71228 13483
We accept null hypothesis that theres no difference
P value is  0.3281748754798163
```

  - Yellow Cab: There is difference in Margin for people older than 50 years.

```
print('P value is ', p_value)
```

```
231480 43201
We accept alternate hypothesis that theres a difference
P value is  6.4942568177993685e-09
```

Building Predictive Models using Linear Regression, Decision Tree and Random Forest.

- **Hypothesis**: **There is difference in margins for Card payer and Cash payers.**

  - There is no difference in Margin regarding mode of Payment for both Yellow & Pink Cab.

Pink Cab:

```
print('P value is ', p_value)
```

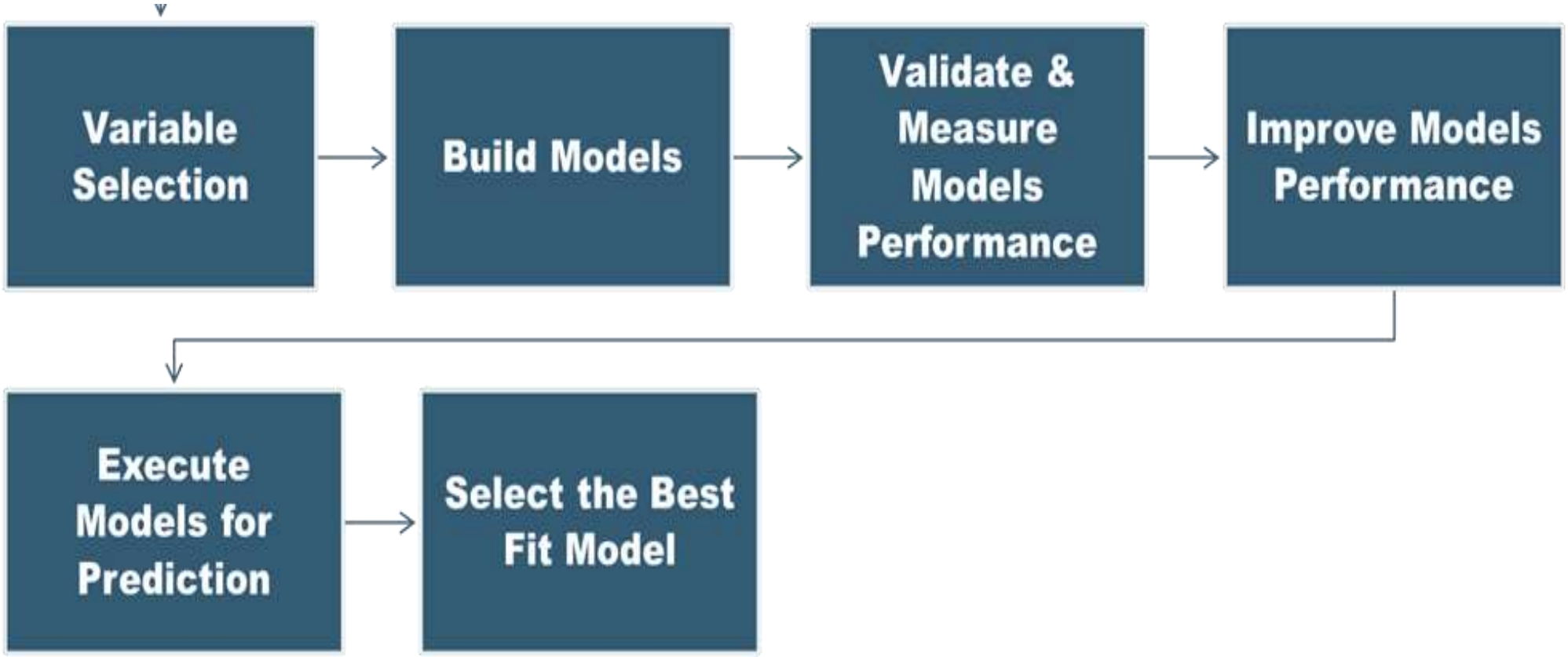
```
We accept null hypothesis that theres no difference
P value is  0.7900465828793288
```

Yellow Cab:

```
print('P value is ', p_value)
```

```
We accept null hypothesis that there is no statistical difference
P value is  0.29330606382985325
```

Model Building steps



Correlation:

Pink Cab

Yellow Cab

- From the correlation graph, we can see KM travelled is correlated with Price Charged followed by Cost of trip.
- Year, Month, Age, Income are not correlated.

Model1: Linear Regression

- Linear Regression is a method for predicting target value and attempts to model the linear relationship between target and one or more predictors.
- In our dataset, Price Charge is the target value and all the other variables are predictors.

Splitting the data into a training set (75%), and test set (25%).

Yellow Cab

```
X_train.info()
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 192276 entries, (10033146, 559, 'NEW YORK NY') to (10194745, 58301, 'BOSTON MA')
Data columns (total 6 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   KM_Travelled        192276 non-null  float64
 1   Cost_of_Trip        192276 non-null  float64
 2   Month               192276 non-null  int64
 3   Year                192276 non-null  int64
 4   Age                 192276 non-null  int64
 5   Income_(USD/Month)  192276 non-null  int64
dtypes: float64(2), int64(4)
memory usage: 24.8+ MB
```

```
X_test.info()
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 82405 entries, (10263934, 7987, 'LOS ANGELES CA') to (10226996, 3195, 'CHICAGO IL')
Data columns (total 6 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   KM_Travelled        82405 non-null  float64
 1   Cost_of_Trip        82405 non-null  float64
 2   Month               82405 non-null  int64
 3   Year                82405 non-null  int64
 4   Age                 82405 non-null  int64
 5   Income_(USD/Month)  82405 non-null  int64
dtypes: float64(2), int64(4)
```

Pink Cab

```
X_train.info()
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 59297 entries, (10400049, 1517, 'NEW YORK NY') to (10085754, 13379, 'SILICON VALLEY')
Data columns (total 6 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   KM_Travelled        59297 non-null  float64
 1   Cost_of_Trip        59297 non-null  float64
 2   Month               59297 non-null  int64
 3   Year                59297 non-null  int64
 4   Age                 59297 non-null  int64
 5   Income_(USD/Month)  59297 non-null  int64
dtypes: float64(2), int64(4)
memory usage: 17.6+ MB
```

```
X_test.info()
<class 'pandas.core.frame.DataFrame'>
MultiIndex: 25414 entries, (10184224, 46628, 'SACRAMENTO CA') to (10158114, 8037, 'LOS ANGELES CA')
Data columns (total 6 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   KM_Travelled        25414 non-null  float64
 1   Cost_of_Trip        25414 non-null  float64
 2   Month               25414 non-null  int64
 3   Year                25414 non-null  int64
 4   Age                 25414 non-null  int64
 5   Income_(USD/Month)  25414 non-null  int64
```

Model2: Decision Tree

- **Decision tree** builds regression models in the form of a tree structure. It breaks down a dataset into smaller and smaller subsets while at the same time an associated decision tree is incrementally developed.
- The final result is a tree with decision nodes and leaf nodes.
- The topmost decision node in a tree which corresponds to the best predictor for the target value (Price Charged).

Model3: Random Forest

- A **Random Forest** operates by constructing several **Decision trees.**
- A prediction from the **Random Forest** is an average of the predictions produced by the **Decision trees** in the forest.

Base Model:

Yellow Cab

Dep. Variable:	Price_Charged	R-squared:	0.745
Model:	OLS	Adj. R-squared:	0.745
Method:	Least Squares	F-statistic:	1.336e+05
Date:	Sun, 14 Mar 2021	Prob (F-statistic):	0.00
Time:	09:57:32	Log-Likelihood:	-1.7581e+06
No. Observations:	274681	AIC:	3.516e+06
Df Residuals:	274674	BIC:	3.516e+06
Df Model:	6		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	2.774e+04	700.786	39.591	0.000	2.64e+04	2.91e+04
KM_Travelled	20.3282	0.198	102.704	0.000	19.940	20.716
Cost_of_Trip	-0.0052	0.015	-0.346	0.729	-0.034	0.024
Month	-5.5016	0.080	-68.649	0.000	-5.659	-5.345
Year	-13.7343	0.347	-39.532	0.000	-14.415	-13.053
Age	-0.0835	0.022	-3.780	0.000	-0.127	-0.040
Income_(USD/Month)	0.0002	3.49e-05	4.746	0.000	9.73e-05	0.000

Omnibus:	51903.377	Durbin-Watson:	0.652
Prob(Omnibus):	0.000	Jarque-Bera (JB):	122747.976

Pink Cab

Dep. Variable:	Price_Charged	R-squared:	0.863
Model:	OLS	Adj. R-squared:	0.863
Method:	Least Squares	F-statistic:	8.871e+04
Date:	Sun, 14 Mar 2021	Prob (F-statistic):	0.00
Time:	09:57:34	Log-Likelihood:	-4.7693e+05
No. Observations:	84711	AIC:	9.539e+05
Df Residuals:	84704	BIC:	9.539e+05
Df Model:	6		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.515e+04	584.885	25.903	0.000	1.4e+04	1.63e+04
KM_Travelled	13.4824	0.165	81.834	0.000	13.160	13.805
Cost_of_Trip	0.0295	0.015	1.985	0.047	0.000	0.059
Month	1.5216	0.069	21.950	0.000	1.386	1.657
Year	-7.5169	0.290	-25.924	0.000	-8.085	-6.949
Age	-0.0400	0.018	-2.185	0.029	-0.076	-0.004
Income_(USD/Month)	3.423e-05	2.9e-05	1.181	0.238	-2.26e-05	9.11e-05

Omnibus:	28936.298	Durbin-Watson:	0.887
Prob(Omnibus):	0.000	Jarque-Bera (JB):	273333.925

As per Base Model:

- Cost of Trip, Month, Year, Age, Income are significant variable for **Yellow Cab** which are the best predictors for Price Charged.
- Cost_of_Trip, Year, Age, Income are significant variable for **Pink Cab** which are the best predictors for Price Charged. Month is not considered significant.

Best Fit Model: RMSE Value & Accuracy

- **RMSE or root mean square error** measures the error which is Prediction values – Actual values.
- **Lower the RMSE value the better is the Model.**

RMSE values & Accuracy for Yellow Cab

	Train	Test
Linear Regression	145.4599	146.1994
Decision Tree	107.3967	109.4580
Random Forest	77.2731	78.4734

	Accuracy
Linear Regression	74.43906127028283%
Decision Tree	86.11582117196697%
Random Forest	92.85776861169764%

RMSE values & Accuracy for Pink Cab

	Train	Test
Linear Regression	67.2351	67.9136
Decision Tree	80.7492	84.4882
Random Forest	57.4761	59.7556

	Accuracy
Linear Regression	86.06270464033021%
Decision Tree	79.66683587364297%
Random Forest	89.78196675241622%

As per the above RMSE data and Accuracy, Random Forest Model is the best fit model for further deployment.

Interpreting Random Forest Model: Cost of Trip, Month, Year, Age, Income are the best predictors for Price Charged.

Recommendation

- **Transaction per year**: For Yellow Cab Transaction per year from 2016 to 2018 is almost double than Pink Cab.
- **Margin per Gender**: For Yellow Cab there is difference in Margin between Male and Female Customers due to which Female Customer percentage is higher in Yellow Cab in comparison to Pink Cab.
- **Profit Margin**: For Yellow Cab the Profit Margin is higher per year from 2016 to 2018 in comparison to Pink Cab.
- **Margin per Age**: In Yellow Cab there is difference in Margin for people older than 50 yrs, whereas in Pink Cab there is no difference in Margin of all age group.
- Yellow Cab **decreases Margins with the increase in Transaction**, hence for Yellow Cab the travel frequency during the Month of December which is the holiday season is 3 times more than Pink Cab.
- Customers for Yellow Cab is highest in New York City which has the highest Cab Users of 28%.

On the basis of the above points, Yellow Cab is recommended for investment.

Thank You