# NYC_taxi_prediction

September 25, 2018

```
In [1]: import numpy as np
        import pandas as pd
        import seaborn as sns
        import matplotlib.pyplot as plt
```

```
In [2]: from sklearn.linear_model import LinearRegression
        from sklearn import metrics
```

```
In [3]: data = pd.read_csv("./train.csv", sep=",")
```

```
In [4]: data.head()
```

```
Out[4]:                              key  fare_amount          pickup_datetime  \
        0    2009-06-15 17:26:21.0000001          4.5  2009-06-15 17:26:21 UTC
        1    2010-01-05 16:52:16.0000002         16.9  2010-01-05 16:52:16 UTC
        2   2011-08-18 00:35:00.00000049          5.7  2011-08-18 00:35:00 UTC
        3    2012-04-21 04:30:42.0000001          7.7  2012-04-21 04:30:42 UTC
        4  2010-03-09 07:51:00.000000135          5.3  2010-03-09 07:51:00 UTC

           pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
        0        -73.844311        40.721319         -73.841610         40.712278
        1        -74.016048        40.711303         -73.979268         40.782004
        2        -73.982738        40.761270         -73.991242         40.750562
        3        -73.987130        40.733143         -73.991567         40.758092
        4        -73.968095        40.768008         -73.956655         40.783762

           passenger_count
        0                1
        1                1
        2                2
        3                1
        4                1
```

```
In [5]: data.shape
```

```
Out[5]: (55423856, 8)
```

## 0.1 Data Cleaning Process

- Remove all the rows with NaN's.
- Remove all the rows with 0 values in each of the columns.
- Compute the 99.9 percentile and 0.1 percentile values for each of the latitudes and longitudes.
- Remove all the rows with values lying outside the above limits.
- Remove all the rows with fare amount <= 0 and also fare amount >= 150USD (~99th percentile)
- Remove all the rows with passengers >= 7 (~99th percentile)

```
In [6]: missing_data = data[data["dropoff_longitude"].isnull() & data["dropoff_latitude"].isnul
```

```
In [7]: missing_data.shape
```

```
Out[7]: (376, 8)
```

```
In [8]: missing_data_inds = []
        missing_data_inds += missing_data.index.tolist()
```

```
In [9]: zero_pickup_longitude = data[(data["pickup_longitude"]==0)]
        zero_pickup_longitude.shape
```

```
Out[9]: (1055693, 8)
```

```
In [10]: missing_data_inds += zero_pickup_longitude.index.tolist()
```

```
In [11]: zero_pickup_latitude = data[(data["pickup_latitude"]==0)]
         zero_pickup_latitude.shape
```

```
Out[11]: (1052158, 8)
```

```
In [12]: missing_data_inds += zero_pickup_latitude.index.tolist()
```

```
In [13]: zero_dropoff_longitude = data[(data["dropoff_longitude"]==0)]
         zero_dropoff_longitude.shape
```

```
Out[13]: (1052745, 8)
```

```
In [14]: missing_data_inds += zero_dropoff_longitude.index.tolist()
```

```
In [15]: zero_dropoff_latitude = data[(data["dropoff_latitude"]==0)]
         zero_dropoff_latitude.shape
```

```
Out[15]: (1049666, 8)
```

```
In [16]: missing_data_inds += zero_dropoff_latitude.index.tolist()
```

```
In [17]: zero_fare_amount = data[(data["fare_amount"]==0)]
         zero_fare_amount.shape
```

```
Out[17]: (1380, 8)

In [18]: missing_data_inds += zero_fare_amount.index.tolist()

In [19]: zero_passenger_count = data[(data["passenger_count"]==0)]
         zero_passenger_count.shape

Out[19]: (195416, 8)

In [20]: missing_data_inds += zero_passenger_count.index.tolist()

In [21]: len(missing_data_inds)

Out[21]: 4407434

In [22]: missing_data_inds = list(set(missing_data_inds))

In [23]: len(missing_data_inds)

Out[23]: 1296797

In [24]: data_without_na_zero = data.drop(missing_data_inds)
         data_without_na_zero.shape

Out[24]: (54127059, 8)

In [25]: data_without_na_zero["fare_amount"].min()

Out[25]: -300.0

In [26]: data_without_na_zero["fare_amount"].max()

Out[26]: 93963.36

In [27]: data_without_na_zero = data_without_na_zero[data_without_na_zero["fare_amount"] >= 0]
         data_without_na_zero.shape

Out[27]: (54124853, 8)

In [28]: data_without_na_zero.describe()

Out[28]:         fare_amount  pickup_longitude  pickup_latitude  dropoff_longitude  \
         count  5.412485e+07      5.412485e+07     5.412485e+07       5.412485e+07
         mean   1.133736e+01     -7.391647e+01     4.069292e+01      -7.391484e+01
         std    2.085949e+01      7.863656e+00     7.508195e+00       7.890859e+00
         min    1.000000e-02     -3.442060e+03    -3.492264e+03      -3.442025e+03
         25%    6.000000e+00     -7.399228e+01     4.073652e+01      -7.399158e+01
         50%    8.500000e+00     -7.398209e+01     4.075335e+01      -7.398059e+01
         75%    1.250000e+01     -7.396826e+01     4.076754e+01      -7.396528e+01
         max    9.396336e+04      3.457626e+03     3.408790e+03       3.457622e+03
```

```
              dropoff_latitude  passenger_count
       count      5.412485e+07     5.412485e+07
       mean       4.069177e+01     1.691539e+00
       std        7.639962e+00     1.315083e+00
       min       -3.493652e+03     1.000000e+00
       25%        4.073551e+01     1.000000e+00
       50%        4.075383e+01     1.000000e+00
       75%        4.076839e+01     2.000000e+00
       max        3.537133e+03     2.080000e+02
```

```
In [29]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["pickup_longitude"]
         data_without_na_zero.shape
```

```
Out[29]: (54070729, 8)
```

```
In [30]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["pickup_longitude"]
         data_without_na_zero.shape
```

```
Out[30]: (54033114, 8)
```

```
In [31]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["pickup_latitude"]
         data_without_na_zero.shape
```

```
Out[31]: (53979080, 8)
```

```
In [32]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["pickup_latitude"]
         data_without_na_zero.shape
```

```
Out[32]: (53925120, 8)
```

```
In [33]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["dropoff_longitude
         data_without_na_zero.shape
```

```
Out[33]: (53871230, 8)
```

```
In [34]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["dropoff_longitude
         data_without_na_zero.shape
```

```
Out[34]: (53817358, 8)
```

```
In [35]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["dropoff_latitude"]
         data_without_na_zero.shape
```

```
Out[35]: (53763545, 8)
```

```
In [36]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["dropoff_latitude"]
         data_without_na_zero.shape
```

```
Out[36]: (53709782, 8)
```

```
In [37]: data_without_na_zero.describe()
```

```
Out[37]:         fare_amount  pickup_longitude  pickup_latitude  dropoff_longitude  \
         count  5.370978e+07      5.370978e+07     5.370978e+07       5.370978e+07
         mean   1.115886e+01     -7.397560e+01     4.075098e+01      -7.397462e+01
         std    2.065172e+01      3.376065e-02     2.631170e-02       3.230815e-02
         min    1.000000e-02     -7.404253e+01     4.063956e+01      -7.417725e+01
         25%    6.000000e+00     -7.399227e+01     4.073667e+01      -7.399156e+01
         50%    8.500000e+00     -7.398211e+01     4.075340e+01      -7.398063e+01
         75%    1.250000e+01     -7.396842e+01     4.076751e+01      -7.396558e+01
         max    9.396336e+04     -7.314683e+01     4.085129e+01      -7.374761e+01

                dropoff_latitude  passenger_count
         count      5.370978e+07     5.370978e+07
         mean       4.075138e+01     1.691163e+00
         std        2.965752e-02     1.313808e+00
         min        4.060696e+01     1.000000e+00
         25%        4.073585e+01     1.000000e+00
         50%        4.075391e+01     1.000000e+00
         75%        4.076836e+01     2.000000e+00
         max        4.088127e+01     2.080000e+02
```

```
In [38]: data_without_na_zero = data_without_na_zero[((data_without_na_zero["passenger_count"]<
         data_without_na_zero.shape
```

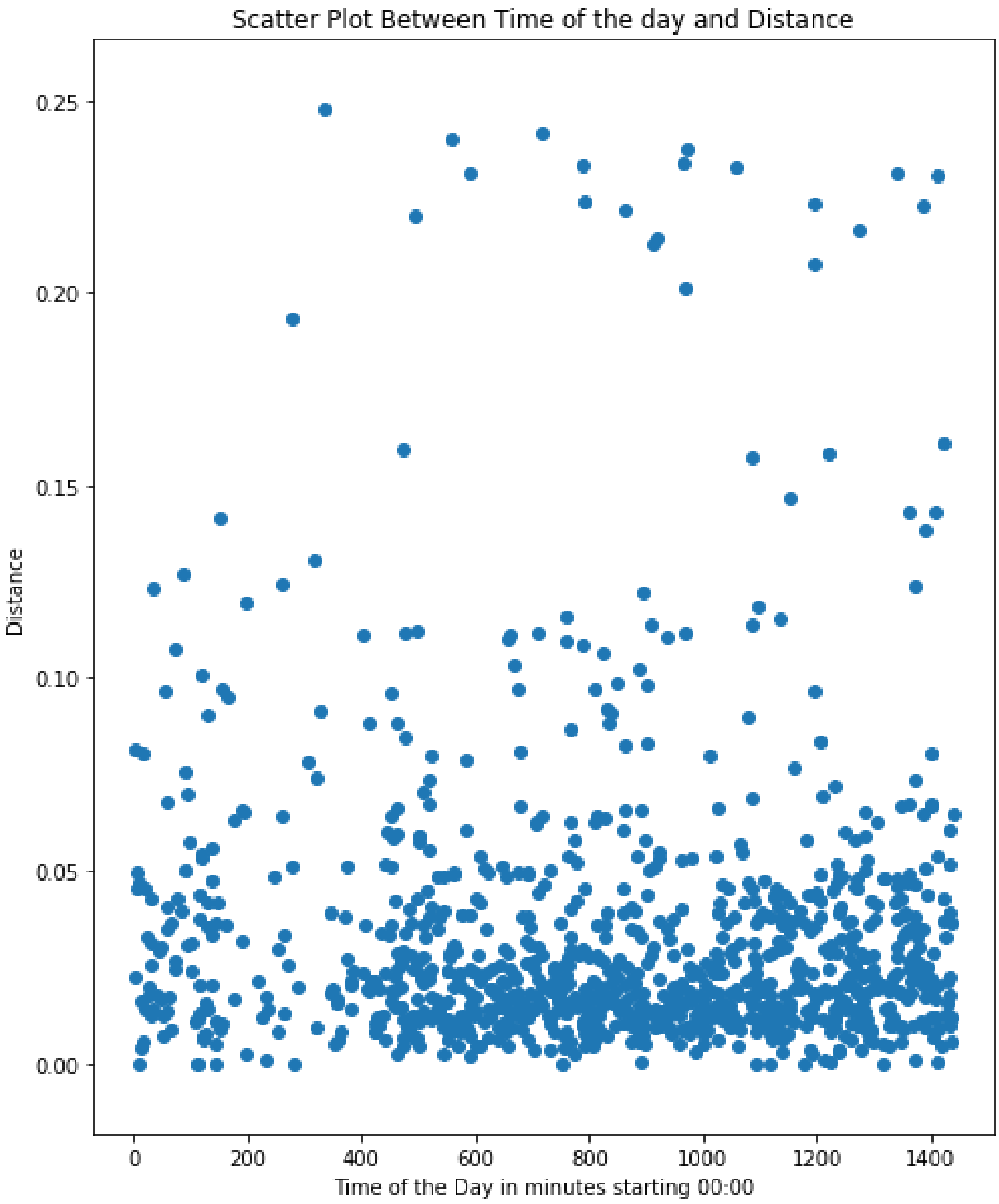
```
Out[38]: (53709737, 8)
```

```
In [39]: data_without_na_zero["distance"] = np.sqrt(((data_without_na_zero["dropoff_latitude"]
```

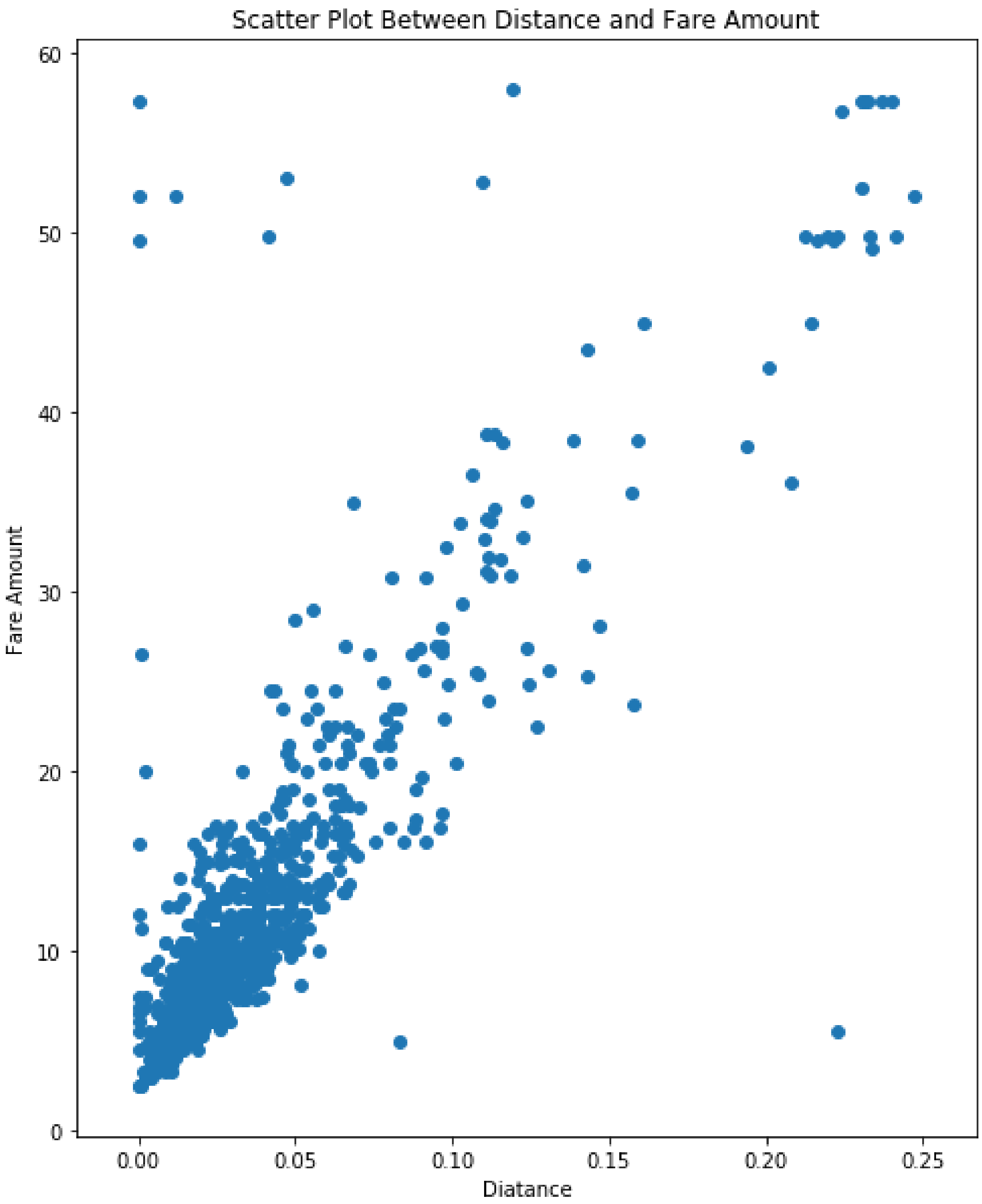
```
In [40]: data_without_na_zero.describe()
```

```
Out[40]:         fare_amount  pickup_longitude  pickup_latitude  dropoff_longitude  \
         count  5.370974e+07      5.370974e+07     5.370974e+07       5.370974e+07
         mean   1.115885e+01     -7.397560e+01     4.075098e+01      -7.397462e+01
         std    2.065172e+01      3.376064e-02     2.631170e-02       3.230814e-02
         min    1.000000e-02     -7.404253e+01     4.063956e+01      -7.417725e+01
         25%    6.000000e+00     -7.399227e+01     4.073667e+01      -7.399156e+01
         50%    8.500000e+00     -7.398211e+01     4.075340e+01      -7.398063e+01
         75%    1.250000e+01     -7.396842e+01     4.076751e+01      -7.396558e+01
         max    9.396336e+04     -7.314683e+01     4.085129e+01      -7.374761e+01

                dropoff_latitude  passenger_count      distance
         count      5.370974e+07     5.370974e+07  5.370974e+07
         mean       4.075138e+01     1.691073e+00  3.342670e-02
         std        2.965753e-02     1.307034e+00  3.717777e-02
         min        4.060696e+01     1.000000e+00  0.000000e+00
         25%        4.073585e+01     1.000000e+00  1.280780e-02
         50%        4.075391e+01     1.000000e+00  2.173874e-02
         75%        4.076836e+01     2.000000e+00  3.838472e-02
         max        4.088127e+01     7.000000e+00  8.462889e-01
```

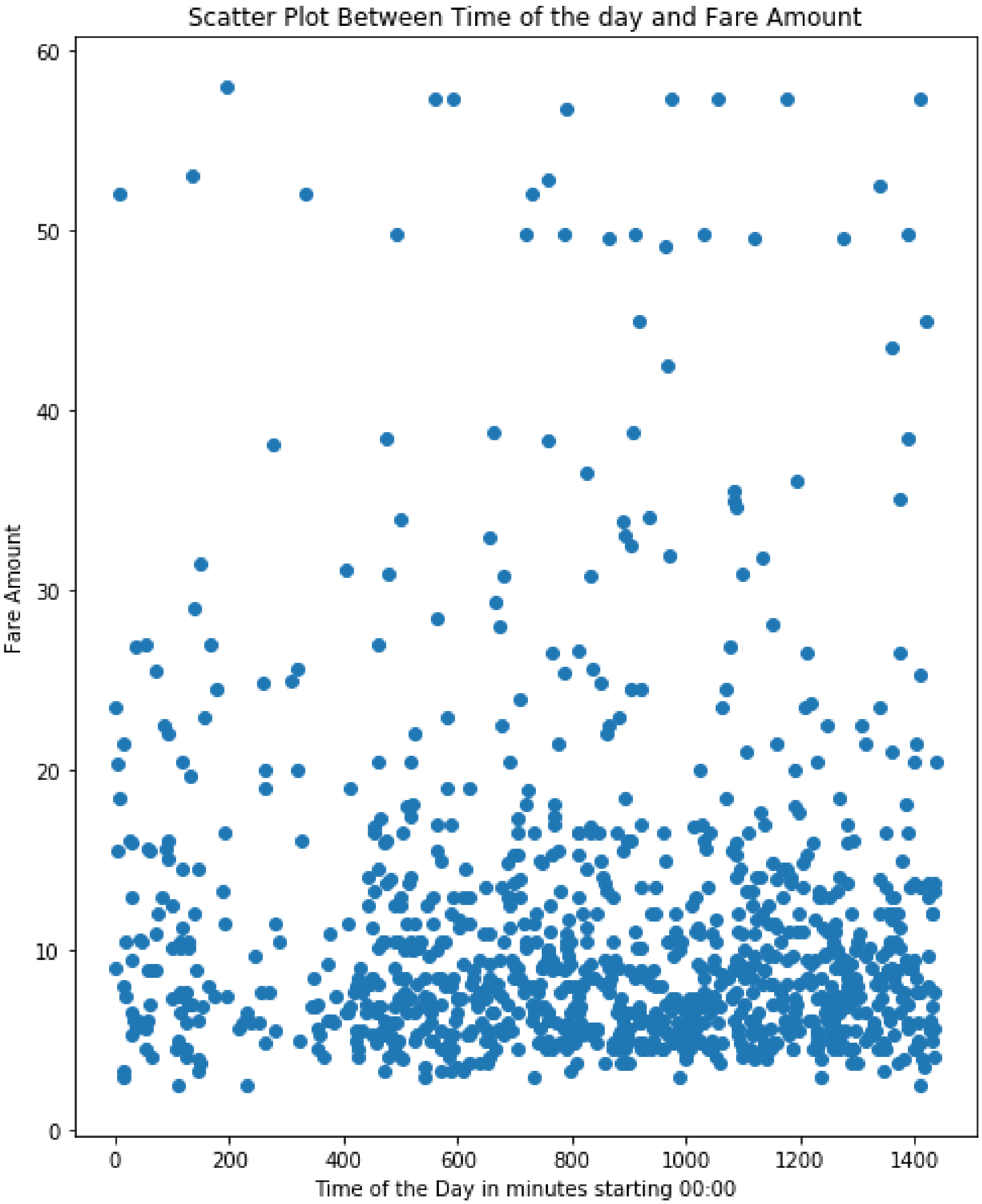
```
In [41]: data_without_na_zero = data_without_na_zero[data_without_na_zero["fare_amount"] <= 15
         data_without_na_zero.shape

Out[41]: (53708886, 9)

In [42]: corr_distace_fare = data_without_na_zero["distance"].corr(data_without_na_zero["fare_

In [43]: corr_distace_fare

Out[43]: 0.883698656384901

In [44]: data_without_na_zero['pickup_datetime'] = data_without_na_zero['pickup_datetime'].str
         data_without_na_zero.shape

Out[44]: (53708886, 9)

In [45]: data_without_na_zero['pickup_datetime'] = pd.to_datetime(data_without_na_zero['pickup_

In [46]: data_without_na_zero["time_of_day"] = (data_without_na_zero.pickup_datetime.dt.hour*6
         data_without_na_zero["time_of_day"].shape

Out[46]: (53708886,)

In [47]: corr_time_distance = data_without_na_zero["time_of_day"].corr(data_without_na_zero["di
         corr_time_distance

Out[47]: -0.029261452842436277

In [48]: corr_time_fare = data_without_na_zero["time_of_day"].corr(data_without_na_zero["fare_
         corr_time_fare

Out[48]: -0.01576489060431111

In [49]: plt.figure(figsize=(8,10))
         plt.xlabel("Time of the Day in minutes starting 00:00")
         plt.ylabel("Distance")
         plt.title("Scatter Plot Between Time of the day and Distance")
         plt.scatter(data_without_na_zero["time_of_day"][:1000], data_without_na_zero["distanc
         plt.show()
```



In [50]:
```
plt.figure(figsize=(8,10))
plt.xlabel("Diatance")
plt.ylabel("Fare Amount")
plt.title("Scatter Plot Between Distance and Fare Amount")
plt.scatter(data_without_na_zero["distance"][:1000], data_without_na_zero["fare_amoun
plt.show()
```



```
In [51]: plt.figure(figsize=(8,10))
         plt.xlabel("Time of the Day in minutes starting 00:00")
         plt.ylabel("Fare Amount")
         plt.title("Scatter Plot Between Time of the day and Fare Amount")
         plt.scatter(data_without_na_zero["time_of_day"][:1000], data_without_na_zero["fare_amo
         plt.show()
```



```
In [52]: data_without_na_zero["hour"] = data_without_na_zero.pickup_datetime.dt.hour
         data_without_na_zero["day"] = data_without_na_zero.pickup_datetime.dt.day
         data_without_na_zero["day_of_week"] = data_without_na_zero.pickup_datetime.dt.weekday
         data_without_na_zero["month"] = data_without_na_zero.pickup_datetime.dt.month
```

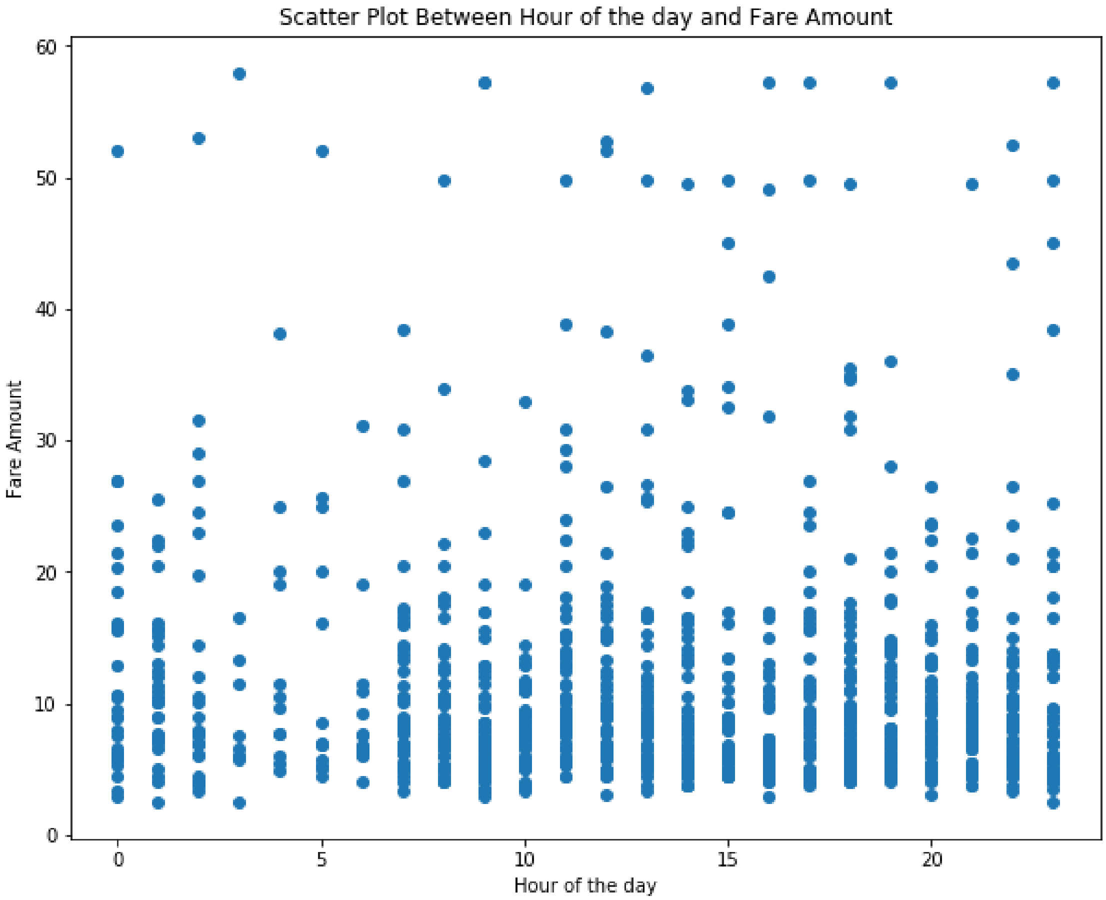
```
In [53]: data_without_na_zero.head()
```

Out[53]:

```
                             key  fare_amount     pickup_datetime  \
0    2009-06-15 17:26:21.0000001          4.5 2009-06-15 17:26:21
1    2010-01-05 16:52:16.0000002         16.9 2010-01-05 16:52:16
2   2011-08-18 00:35:00.00000049          5.7 2011-08-18 00:35:00
3    2012-04-21 04:30:42.0000001          7.7 2012-04-21 04:30:42
4  2010-03-09 07:51:00.000000135          5.3 2010-03-09 07:51:00

   pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
0        -73.844311        40.721319         -73.841610         40.712278
1        -74.016048        40.711303         -73.979268         40.782004
2        -73.982738        40.761270         -73.991242         40.750562
3        -73.987130        40.733143         -73.991567         40.758092
4        -73.968095        40.768008         -73.956655         40.783762

   passenger_count  distance  time_of_day  hour  day  day_of_week  month
0                1  0.009436         1046    17   15            0      6
1                1  0.079696         1012    16    5            1      1
2                2  0.013674           35     0   18            3      8
3                1  0.025340          270     4   21            5      4
4                1  0.019470          471     7    9            1      3
```

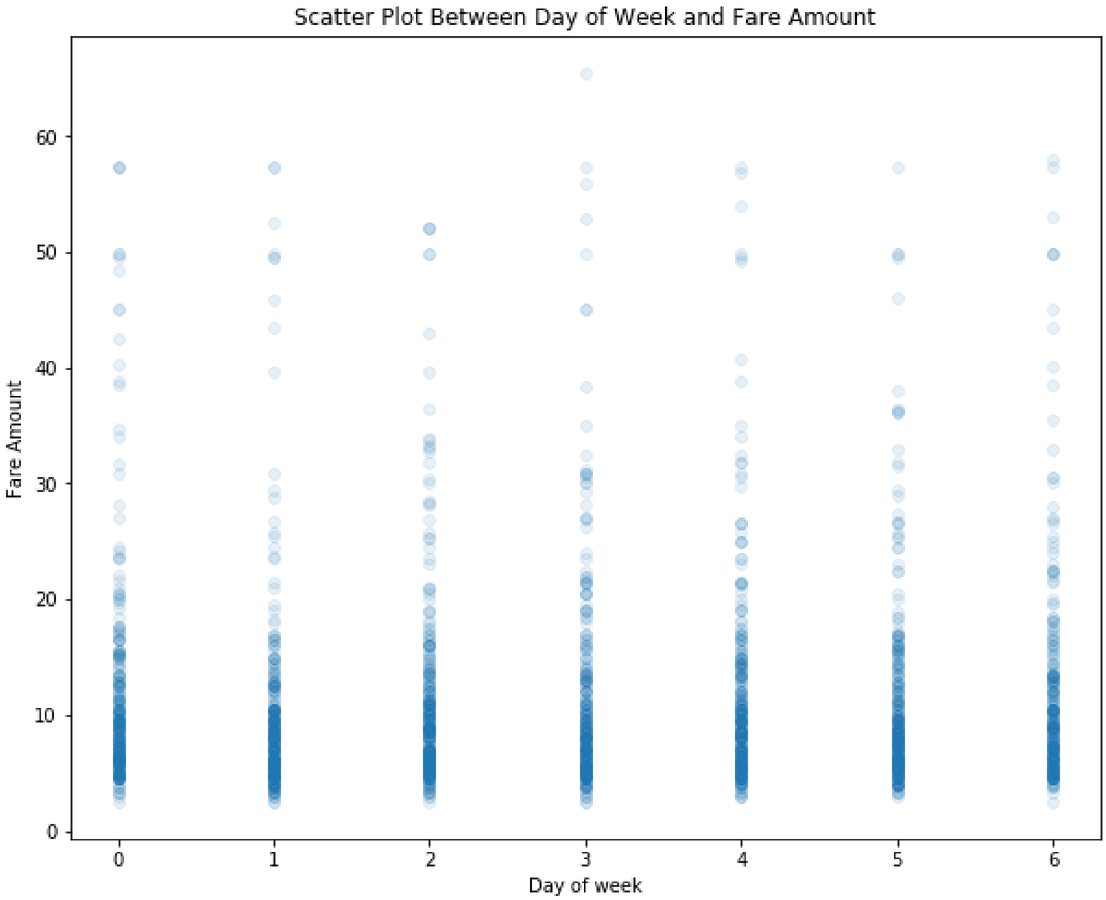
In [54]:

```
plt.figure(figsize=(10,8))
plt.xlabel("Hour of the day")
plt.ylabel("Fare Amount")
plt.title("Scatter Plot Between Hour of the day and Fare Amount")
plt.scatter(data_without_na_zero["hour"][:1000], data_without_na_zero["fare_amount"][
plt.show()
```



- We observe that the prices of the cabs are high either during the late night and early mornings or during the peak office hours.

In [55]:
```
plt.figure(figsize=(10,8))
plt.xlabel("Day of week")
plt.ylabel("Fare Amount")
plt.title("Scatter Plot Between Day of Week and Fare Amount")
plt.scatter(data_without_na_zero["day_of_week"][:2000], data_without_na_zero["fare_amo
plt.show()
```



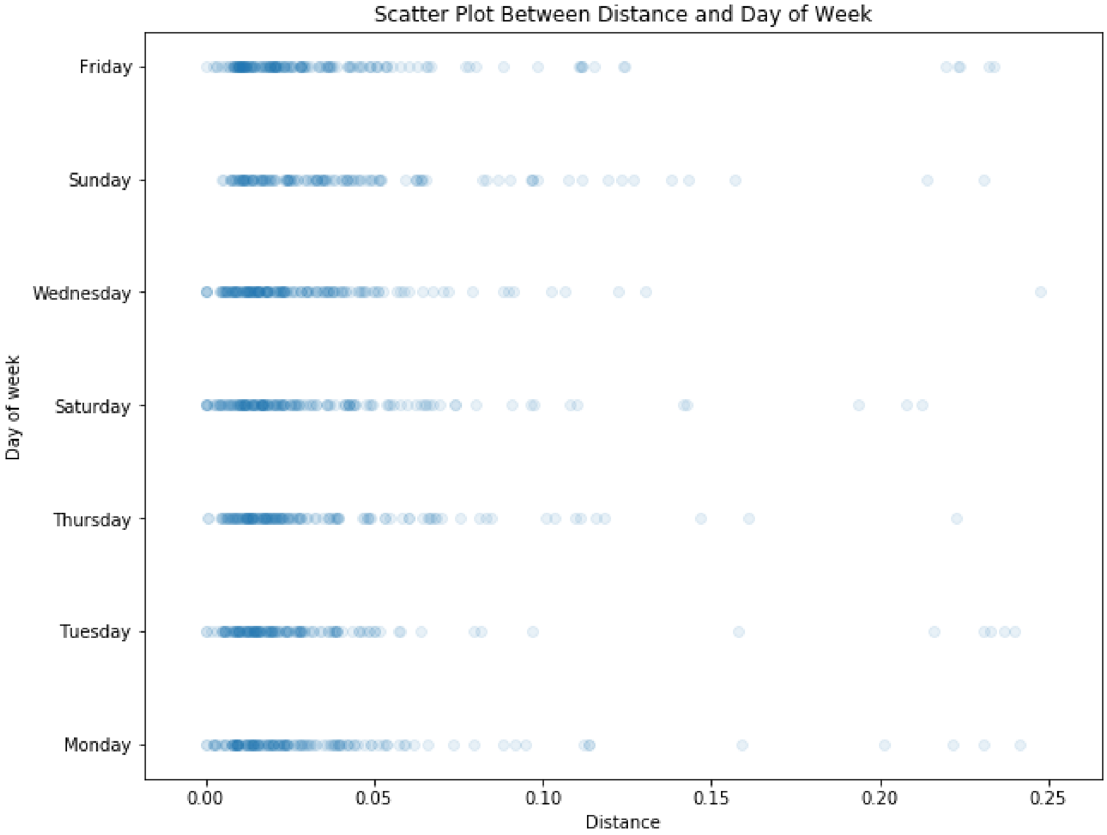
```
In [56]: data_without_na_zero["day_of_week"] = data_without_na_zero.pickup_datetime.dt.day_name
```

```
In [57]: data_without_na_zero.head()
```

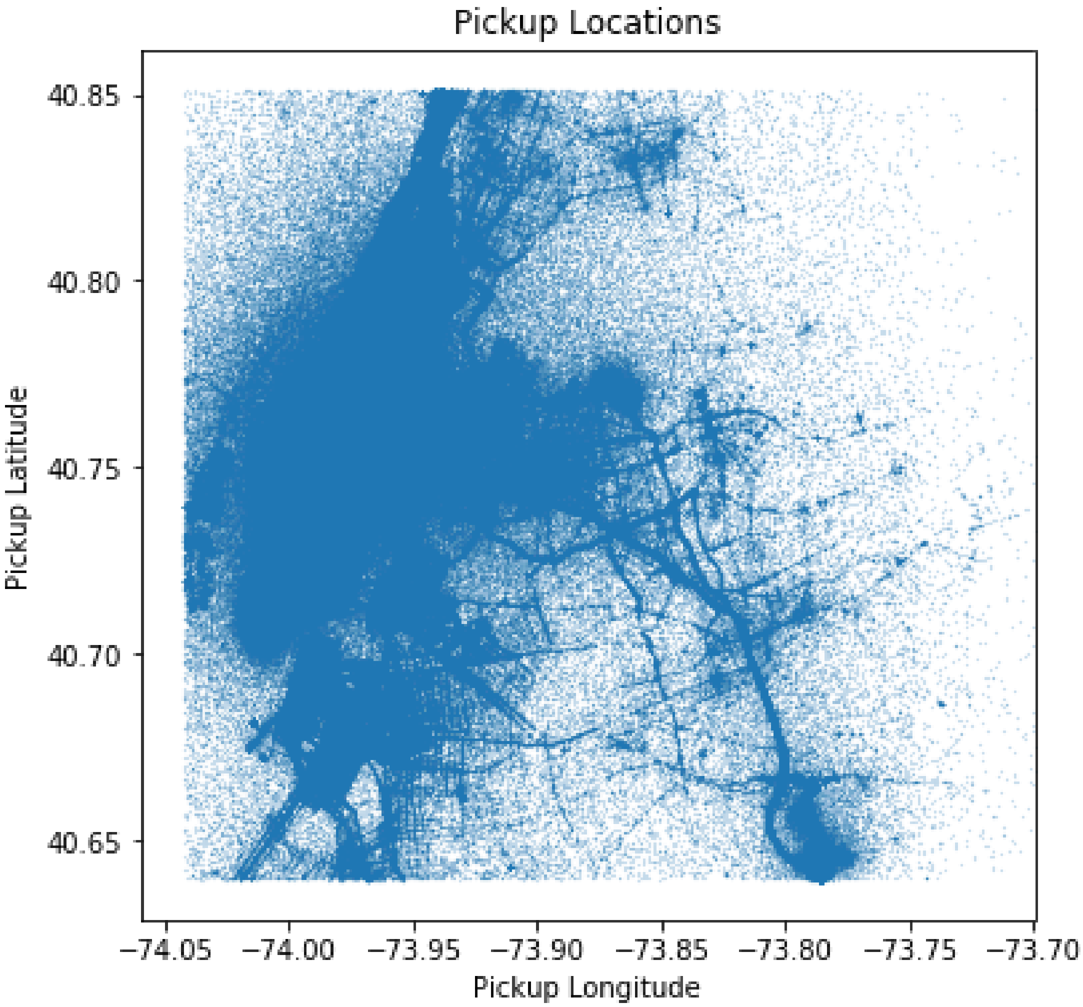
```
Out[57]:                                key  fare_amount     pickup_datetime  \
         0    2009-06-15 17:26:21.0000001          4.5 2009-06-15 17:26:21
         1    2010-01-05 16:52:16.0000002         16.9 2010-01-05 16:52:16
         2   2011-08-18 00:35:00.00000049          5.7 2011-08-18 00:35:00
         3    2012-04-21 04:30:42.0000001          7.7 2012-04-21 04:30:42
         4  2010-03-09 07:51:00.000000135          5.3 2010-03-09 07:51:00

            pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
         0        -73.844311        40.721319         -73.841610         40.712278
         1        -74.016048        40.711303         -73.979268         40.782004
         2        -73.982738        40.761270         -73.991242         40.750562
         3        -73.987130        40.733143         -73.991567         40.758092
         4        -73.968095        40.768008         -73.956655         40.783762

            passenger_count  distance  time_of_day  hour  day day_of_week  month
```

```
0                  1  0.009436        1046     17    15       Monday      6
1                  1  0.079696        1012     16     5      Tuesday      1
2                  2  0.013674          35      0    18     Thursday      8
3                  1  0.025340         270      4    21     Saturday      4
4                  1  0.019470         471      7     9      Tuesday      3
```

```
In [58]: plt.figure(figsize=(10,8))
         plt.xlabel("Distance")
         plt.ylabel("Day of week")
         plt.title("Scatter Plot Between Distance and Day of Week")
         plt.scatter(data_without_na_zero["distance"][:1000], data_without_na_zero["day_of_weel
         plt.show()
```

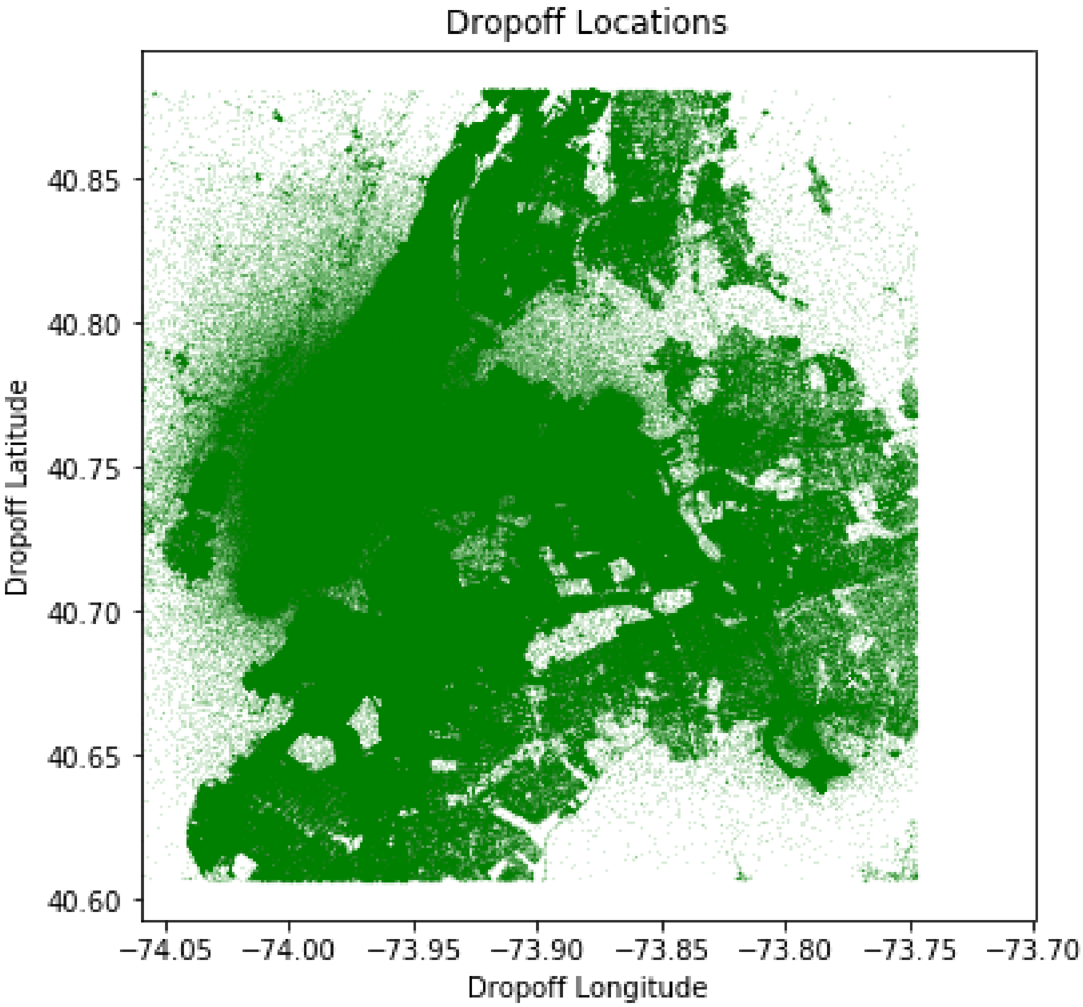


```
In [125]: plt.figure(figsize=(6,6))
          plt.xlabel("Pickup Longitude")
          plt.ylabel("Pickup Latitude")
          plt.title("Pickup Locations")
          plt.xlim(-74.06,-73.7)
          plt.scatter(data_without_na_zero["pickup_longitude"], data_without_na_zero["pickup_la
          plt.show()
```



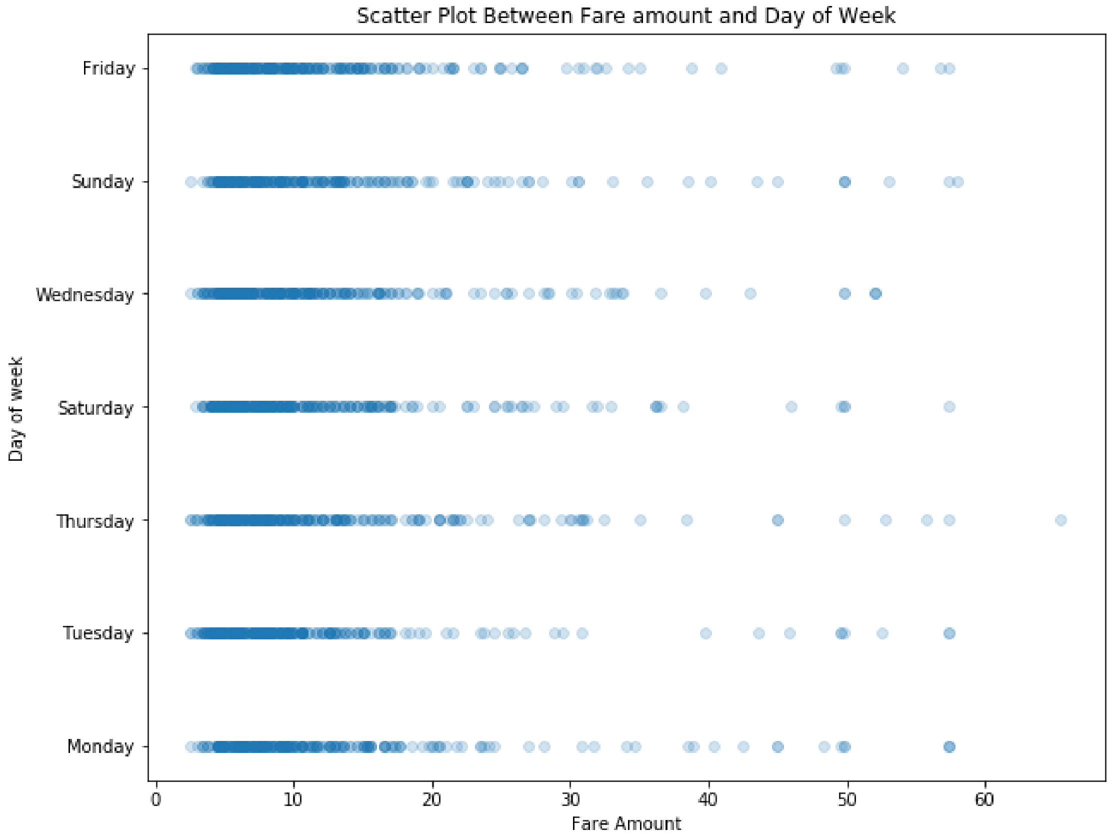
- We observe that most of the pickups are from Manhatten and Queens most of which includes airport pickups

```
In [124]: plt.figure(figsize=(6,6))
          plt.xlabel("Dropoff Longitude")
          plt.ylabel("Dropoff Latitude")
          plt.title("Dropoff Locations")
          plt.xlim(-74.06,-73.7)
          plt.scatter(data_without_na_zero["dropoff_longitude"], data_without_na_zero["dropoff_
          plt.show()
```



- We observe that the drop off locations are distributed throughout all the Boroughs of NYC

```
In [61]: plt.figure(figsize=(10,8))
         plt.xlabel("Fare Amount")
         plt.ylabel("Day of week")
         plt.title("Scatter Plot Between Fare amount and Day of Week")
         plt.scatter(data_without_na_zero["fare_amount"][:2000], data_without_na_zero["day_of_
         plt.show()
```



```
In [62]: test_data = pd.read_csv("./test.csv", sep=",")

In [63]: test_data.head()

Out[63]:                            key          pickup_datetime  pickup_longitude  \
         0  2015-01-27 13:08:24.0000002  2015-01-27 13:08:24 UTC        -73.973320
         1  2015-01-27 13:08:24.0000003  2015-01-27 13:08:24 UTC        -73.986862
         2  2011-10-08 11:53:44.0000002  2011-10-08 11:53:44 UTC        -73.982524
         3  2012-12-01 21:12:12.0000002  2012-12-01 21:12:12 UTC        -73.981160
         4  2012-12-01 21:12:12.0000003  2012-12-01 21:12:12 UTC        -73.966046

            pickup_latitude  dropoff_longitude  dropoff_latitude  passenger_count
         0        40.763805         -73.981430         40.743835                1
         1        40.719383         -73.998886         40.739201                1
         2        40.751260         -73.979654         40.746139                1
         3        40.767807         -73.990448         40.751635                1
         4        40.789775         -73.988565         40.744427                1

In [64]: data_without_na_zero["day_of_week"] = data_without_na_zero.pickup_datetime.dt.weekday

In [65]: data_without_na_zero.head()
```

```
Out[65]:                           key  fare_amount     pickup_datetime  \
         0    2009-06-15 17:26:21.0000001          4.5 2009-06-15 17:26:21
         1    2010-01-05 16:52:16.0000002         16.9 2010-01-05 16:52:16
         2   2011-08-18 00:35:00.00000049          5.7 2011-08-18 00:35:00
         3    2012-04-21 04:30:42.0000001          7.7 2012-04-21 04:30:42
         4  2010-03-09 07:51:00.000000135          5.3 2010-03-09 07:51:00

            pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
         0        -73.844311        40.721319         -73.841610         40.712278
         1        -74.016048        40.711303         -73.979268         40.782004
         2        -73.982738        40.761270         -73.991242         40.750562
         3        -73.987130        40.733143         -73.991567         40.758092
         4        -73.968095        40.768008         -73.956655         40.783762

            passenger_count  distance  time_of_day  hour  day  day_of_week  month
         0                1  0.009436         1046    17   15            0      6
         1                1  0.079696         1012    16    5            1      1
         2                2  0.013674           35     0   18            3      8
         3                1  0.025340          270     4   21            5      4
         4                1  0.019470          471     7    9            1      3
```

```
In [66]: # train_data = data_without_na_zero[:10000000]
```

```
In [67]: # target = train_data['fare_amount']
         # features = train_data.drop(['fare_amount','pickup_datetime','key'], axis=1)
```

```
In [68]: # X_train, X_test, y_train, y_test = train_test_split(features, target, test_size=.2)
```

```
In [69]: # model = LinearRegression()
         # model.fit(features, target)
```

```
In [70]: # pred = model.predict(X_test)
```

- Below are the co-efficients for different features in the model

```
In [71]: # model.coef_
```

```
In [72]: # np.sqrt(metrics.mean_squared_error(y_test, pred))
```

```
In [73]: # X_train.head()
```

```
In [74]: test_data.describe()
```

```
Out[74]:        pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
         count       9914.000000      9914.000000        9914.000000       9914.000000
         mean         -73.974722        40.751041         -73.973657         40.751743
         std            0.042774         0.033541           0.039072          0.035435
         min          -74.252193        40.573143         -74.263242         40.568973
         25%          -73.992501        40.736125         -73.991247         40.735254
         50%          -73.982326        40.753051         -73.980015         40.754065
```

```
75%         -73.968013       40.767113        -73.964059         40.768757
max         -72.986532       41.709555        -72.990963         41.696683

       passenger_count
count      9914.000000
mean          1.671273
std           1.278747
min           1.000000
25%           1.000000
50%           1.000000
75%           2.000000
max           6.000000
```

```
In [75]: test_data["distance"] = np.sqrt(((test_data["dropoff_latitude"] - test_data["pickup_la
```

```
In [76]: test_data.head()
```

```
Out[76]:                            key          pickup_datetime  pickup_longitude  \
         0  2015-01-27 13:08:24.0000002  2015-01-27 13:08:24 UTC        -73.973320
         1  2015-01-27 13:08:24.0000003  2015-01-27 13:08:24 UTC        -73.986862
         2  2011-10-08 11:53:44.0000002  2011-10-08 11:53:44 UTC        -73.982524
         3  2012-12-01 21:12:12.0000002  2012-12-01 21:12:12 UTC        -73.981160
         4  2012-12-01 21:12:12.0000003  2012-12-01 21:12:12 UTC        -73.966046

            pickup_latitude  dropoff_longitude  dropoff_latitude  passenger_count  \
         0        40.763805         -73.981430         40.743835                1
         1        40.719383         -73.998886         40.739201                1
         2        40.751260         -73.979654         40.746139                1
         3        40.767807         -73.990448         40.751635                1
         4        40.789775         -73.988565         40.744427                1

            distance
         0  0.021554
         1  0.023180
         2  0.005870
         3  0.018649
         4  0.050631
```

```
In [77]: test_data['pickup_datetime'] = test_data['pickup_datetime'].str.replace(" UTC", "")
         test_data['pickup_datetime'] = pd.to_datetime(test_data['pickup_datetime'], format='%
         test_data["time_of_day"] = (test_data.pickup_datetime.dt.hour*60) + test_data.pickup_c
         test_data["time_of_day"].shape
```

```
Out[77]: (9914,)
```

```
In [78]: test_data["hour"] = test_data.pickup_datetime.dt.hour
         test_data["day"] = test_data.pickup_datetime.dt.day
         test_data["day_of_week"] = test_data.pickup_datetime.dt.weekday
         test_data["month"] = test_data.pickup_datetime.dt.month
```

```
In [79]: test_data.shape
```

```
Out[79]: (9914, 13)
```

```
In [80]: test_data.head()
```

```
Out[80]:                            key     pickup_datetime  pickup_longitude  \
         0  2015-01-27 13:08:24.0000002 2015-01-27 13:08:24        -73.973320
         1  2015-01-27 13:08:24.0000003 2015-01-27 13:08:24        -73.986862
         2  2011-10-08 11:53:44.0000002 2011-10-08 11:53:44        -73.982524
         3  2012-12-01 21:12:12.0000002 2012-12-01 21:12:12        -73.981160
         4  2012-12-01 21:12:12.0000003 2012-12-01 21:12:12        -73.966046

            pickup_latitude  dropoff_longitude  dropoff_latitude  passenger_count  \
         0        40.763805         -73.981430         40.743835                1
         1        40.719383         -73.998886         40.739201                1
         2        40.751260         -73.979654         40.746139                1
         3        40.767807         -73.990448         40.751635                1
         4        40.789775         -73.988565         40.744427                1

            distance  time_of_day  hour  day  day_of_week  month
         0  0.021554          788    13   27            1      1
         1  0.023180          788    13   27            1      1
         2  0.005870          713    11    8            5     10
         3  0.018649         1272    21    1            5     12
         4  0.050631         1272    21    1            5     12
```

```
In [81]: # x_test = test_data.drop(['pickup_datetime','key'], axis=1)

In [82]: # submission_pred = model.predict(x_test)

In [83]: # submission_pred

In [84]: # df = pd.DataFrame()

In [85]: # df["key"] = test_data["key"]

In [86]: # df["fare_amount"] = submission_pred

In [87]: # df.head()

In [88]: # df.to_csv("vr_linear_regression.csv", sep=",", index=False)
```

```
In [122]: train_data = data_without_na_zero[:10000000]
          target = train_data['fare_amount']
          features = train_data.drop(['fare_amount','pickup_datetime','key','time_of_day','day
          model = LinearRegression()
          model.fit(features, target)
          model.coef_
```

```
Out[122]: array([ 1.12453903e+01,  3.79198031e+00, -9.42194372e-01, -1.51826049e+01,
                   3.41778331e-02,  2.09508519e+02,  1.14840604e-02, -3.61266877e-02,
                   3.62673991e-02])
```

```
In [127]: features.columns
```

```
Out[127]: Index(['pickup_longitude', 'pickup_latitude', 'dropoff_longitude',
                 'dropoff_latitude', 'passenger_count', 'distance', 'hour',
                 'day_of_week', 'month'],
                dtype='object')
```

```
In [90]: x_test = test_data.drop(['pickup_datetime','key','time_of_day','day'], axis=1)
         submission_pred = model.predict(x_test)
         submission_pred
```

```
In [91]: df = pd.DataFrame()
         df["key"] = test_data["key"]
         df["fare_amount"] = submission_pred
         df.to_csv("vr_linear_regression.csv", sep=",", index=False)
```

```
In [92]: # from sklearn.ensemble import RandomForestRegressor
         # rf = RandomForestRegressor(n_estimators = 15)
         # rf.fit(features, target)
```

```
In [93]: # rf.feature_importances_
```

```
In [94]: # rf_5_preds = rf.predict(x_test)
```

```
In [95]: # df = pd.DataFrame()
         # df["key"] = test_data["key"]
         # df["fare_amount"] = rf_5_preds
         # df.to_csv("vr_Randomforest_regression.csv", sep=",", index=False)
```

```
In [96]: # from sklearn.svm import SVR
         # clf = SVR()
         # clf.fit(features, target)
```

```
In [97]: # from sklearn.neural_network import MLPRegressor
         # mlp = MLPRegressor(hidden_layer_sizes=(50,), activation='relu', solver='adam', lear
         # mlp.fit(features, target)
```

```
In [98]: # nn_preds = mlp.predict(x_test)
```

```
In [99]: # df = pd.DataFrame()
         # df["key"] = test_data["key"]
         # df["fare_amount"] = nn_preds
         # df.to_csv("vr_mlp_regressor.csv", sep=",", index=False)
```

```
In [100]: # target = (target - target.mean())/target.std()
In [101]: # features = (features - features.mean())/features.std()
```

```
In [102]: # rf = RandomForestRegressor(n_estimators = 10)
          # rf.fit(features, target)
```

```
In [103]: # x_test = (x_test - x_test.mean())/x_test.std()
```

```
In [104]: # x_test.head()
```

```
In [105]: # preds = rf.predict(x_test)
```

```
In [106]: # preds
```

```
In [107]: # preds = (preds*train_data["fare_amount"].std()) + train_data["fare_amount"].mean()
```

```
In [108]: # preds
```

```
In [109]: # df = pd.DataFrame()
          # df["key"] = test_data["key"]
          # df["fare_amount"] = preds
          # df.to_csv("vr_Randomforest_regression_v2.csv", sep=",", index=False)
```

```
In [115]: train_data = data_without_na_zero[:10000000]
          target = train_data['fare_amount']
          features = train_data.drop(['fare_amount','pickup_datetime','key','time_of_day','day
```

```
In [116]: target = (target - target.mean())/target.std()
          features = (features - features.mean())/features.std()
```

```
In [117]: import lightgbm as lgbm
          lgbm_train_data = lgbm.Dataset(features, target, silent=True)
          params = {
                  'boosting_type': 'gbdt', 'objective': 'regression','learning_rate': 0.005,
                  'reg_alpha': 1, 'reg_lambda': 0.001, 'metric': 'rmse'}
          model = lgbm.train(params, train_set=lgbm_train_data, num_boost_round=1000)
```

```
In [120]: x_test = test_data.drop(['pickup_datetime','key','time_of_day','day'], axis=1)
          x_test = (x_test - x_test.mean())/x_test.std()
          lgbm_preds = model.predict(x_test)
          lgbm_preds = (lgbm_preds*train_data["fare_amount"].std()) + train_data["fare_amount"
          print(lgbm_preds)
```

```
[ 8.99233897  9.34311555  5.3696885  ... 42.87808188 18.23889502
  6.92615164]
```

```
In [121]: df = pd.DataFrame()
          df["key"] = test_data["key"]
          df["fare_amount"] = lgbm_preds
          df.to_csv("vr_lgbm_v2.csv", sep=",", index=False)
```