lab_1

October 31, 2023

Aim: Predict the price of the Uber ride from a given pickup point to the agreed drop-off location.
Name: Yash Ghorpade
Div: BE-A
Roll No: B211046

[2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
```

[3]:
```
df = pd.read_csv('uber - uber.csv')
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200000 entries, 0 to 199999
Data columns (total 9 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   Unnamed: 0         200000 non-null  int64
 1   key                200000 non-null  object
 2   fare_amount        200000 non-null  float64
 3   pickup_datetime    200000 non-null  object
 4   pickup_longitude   200000 non-null  float64
 5   pickup_latitude    200000 non-null  float64
 6   dropoff_longitude  199999 non-null  float64
 7   dropoff_latitude   199999 non-null  float64
 8   passenger_count    200000 non-null  int64
dtypes: float64(5), int64(2), object(2)
memory usage: 13.7+ MB
```

[4]:
```
df.shape
```

[4]:
```
(200000, 9)
```

[5]:
```
df.head()
```

[5]:
```
   Unnamed: 0                          key  fare_amount          pickup_datetime  \
0    24238194  2015-05-07 19:52:06                  7.5  2015-05-07 19:52:06 UTC
```

1	27835199	2009-07-17 20:04:56	7.7	2009-07-17 20:04:56 UTC
2	44984355	2009-08-24 21:45:00	12.9	2009-08-24 21:45:00 UTC
3	25894730	2009-06-26 8:22:21	5.3	2009-06-26 08:22:21 UTC
4	17610152	2014-08-28 17:47:00	16.0	2014-08-28 17:47:00 UTC

```
   pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude\ 0
          -73.999817        40.738354         -73.999512 40.723217
1         -73.994355        40.728225         -73.994710         40.750325
2         -74.005043        40.740770         -73.962565         40.772647
3         -73.976124        40.790844         -73.965316         40.803349
4         -73.925023        40.744085         -73.973082         40.761247

   passenger_count
0                1
1                1
2                1
3                3
4                5
```

[6]:

```
df.head(7)
```

[6]:

```
   Unnamed: 0                          key  fare_amount          pickup_datetime  \
0    24238194  2015-05-07 19:52:06                  7.5  2015-05-07 19:52:06 UTC
1    27835199  2009-07-17 20:04:56                  7.7  2009-07-17 20:04:56 UTC
2    44984355  2009-08-24 21:45:00                 12.9  2009-08-24 21:45:00 UTC
3    25894730   2009-06-26 8:22:21                  5.3  2009-06-26 08:22:21 UTC
4    17610152  2014-08-28 17:47:00                 16.0  2014-08-28 17:47:00 UTC
5    44470845   2011-02-12 2:27:09                  4.9  2011-02-12 02:27:09 UTC
6    48725865   2014-10-12 7:04:00                 24.5  2014-10-12 07:04:00 UTC

   pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
0        -73.999817        40.738354         -73.999512         40.723217
1        -73.994355        40.728225         -73.994710         40.750325
2        -74.005043        40.740770         -73.962565         40.772647
3        -73.976124        40.790844         -73.965316         40.803349
4        -73.925023        40.744085         -73.973082         40.761247
5        -73.969019        40.755910         -73.969019         40.755910
6        -73.961447        40.693965         -73.871195         40.774297

   passenger_count
0                1
1                1
2                1
3                3
4                5
5                1
6                5
```

[7]:

```
df.isnull()
```

[7]:

```
        Unnamed: 0    key  fare_amount  pickup_datetime  pickup_longitude  \
0            False  False        False            False             False
1            False  False        False            False             False
2            False  False        False            False             False
3            False  False        False            False             False
4            False  False        False            False             False
...            ...    ...          ...              ...               ...
199995       False  False        False            False             False
199996       False  False        False            False             False
199997       False  False        False            False             False
199998       False  False        False            False             False
199999       False  False        False            False             False

        pickup_latitude  dropoff_longitude  dropoff_latitude  passenger_count
0                 False              False             False            False
1                 False              False             False            False
2                 False              False             False            False
3                 False              False             False            False
4                 False              False             False            False
...                 ...                ...               ...              ...
199995            False              False             False            False
199996            False              False             False            False
199997            False              False             False            False
199998            False              False             False            False
199999            False              False             False            False

[200000 rows x 9 columns]
```

[8]:

```
df.dropna(inplace=True)
df.drop(columns=["Unnamed: 0", "key"], inplace=True)
df.head()
```

[8] :

```
   fare_amount          pickup_datetime  pickup_longitude  pickup_latitude  \
0          7.5  2015-05-07 19:52:06 UTC        -73.999817        40.738354
1          7.7  2009-07-17 20:04:56 UTC        -73.994355        40.728225
2         12.9  2009-08-24 21:45:00 UTC        -74.005043        40.740770
3          5.3  2009-06-26 08:22:21 UTC        -73.976124        40.790844
4         16.0  2014-08-28 17:47:00 UTC        -73.925023        40.744085

   dropoff_longitude  dropoff_latitude  passenger_count
0         -73.999512         40.723217                1
1         -73.994710         40.750325                1
2         -73.962565         40.772647                1
3         -73.965316         40.803349                3
4         -73.973082         40.761247                5
```

[9]:

```
df.isnull().sum()
```

```
[9] : fare_amount          0
      pickup_datetime      0
      pickup_longitude     0
      pickup_latitude      0
      dropoff_longitude    0
      dropoff_latitude     0
      passenger_count      0
      dtype: int64
```

```
[10]: df.dtypes
```

```
[10] : fare_amount          float64
       pickup_datetime       object
       pickup_longitude     float64
       pickup_latitude      float64
       dropoff_longitude    float64
       dropoff_latitude     float64
       passenger_count        int64
       dtype: object
```

```
[11]: df.pickup_datetime = pd.to_datetime(df.pickup_datetime)
      df.dtypes
```

```
[11] : fare_amount                        float64
       pickup_datetime     datetime64[ns, UTC]
       pickup_longitude                   float64
       pickup_latitude                    float64
       dropoff_longitude                  float64
       dropoff_latitude                   float64
       passenger_count                      int64
       dtype: object
```

```
[12]: df
      df = df.assign(hour = df.pickup_datetime.dt.hour,
      day = df.pickup_datetime.dt.day,
      month = df.pickup_datetime.dt.month,
      year = df.pickup_datetime.dt.year,
      dayofweek = df.pickup_datetime.dt.dayofweek)
```

```
[13]: df
```

```
[13] :         fare_amount           pickup_datetime  pickup_longitude  \
       0               7.5 2015-05-07 19:52:06+00:00        -73.999817
       1               7.7 2009-07-17 20:04:56+00:00        -73.994355
       2              12.9 2009-08-24 21:45:00+00:00        -74.005043
       3               5.3 2009-06-26 08:22:21+00:00        -73.976124
       4              16.0 2014-08-28 17:47:00+00:00        -73.925023
       …               …                        …               …
```

```
199995           3.0  2012-10-28 10:49:00+00:00         -73.987042
199996           7.5  2014-03-14 01:09:00+00:00         -73.984722
199997          30.9  2009-06-29 00:42:00+00:00         -73.986017
199998          14.5  2015-05-20 14:56:25+00:00         -73.997124
199999          14.1  2010-05-15 04:08:00+00:00         -73.984395

        pickup_latitude  dropoff_longitude  dropoff_latitude  passenger_count  \
0             40.738354         -73.999512         40.723217                1
1             40.728225         -73.994710         40.750325                1
2             40.740770         -73.962565         40.772647                1
3             40.790844         -73.965316         40.803349                3
4             40.744085         -73.973082         40.761247                5
...                 ...                ...               ...              ...
199995        40.739367         -73.986525         40.740297                1
199996        40.736837         -74.006672         40.739620                1
199997        40.756487         -73.858957         40.692588                2
199998        40.725452         -73.983215         40.695416                1
199999        40.720077         -73.985508         40.768793                1

        hour  day  month  year  dayofweek
0         19    7      5  2015          3
1         20   17      7  2009          4
2         21   24      8  2009          0
3          8   26      6  2009          4
4         17   28      8  2014          3
...      ...  ...    ...   ...        ...
199995    10   28     10  2012          6
199996     1   14      3  2014          4
199997     0   29      6  2009          0
199998    14   20      5  2015          2
199999     4   15      5  2010          5

[199999 rows x 12 columns]
```

[14]:
```python
df = df.drop(["pickup_datetime"], axis =1)
df
```

[14]:
```
        fare_amount  pickup_longitude  pickup_latitude  dropoff_longitude  \
0               7.5        -73.999817        40.738354         -73.999512
1               7.7        -73.994355        40.728225         -73.994710
2              12.9        -74.005043        40.740770         -73.962565
3               5.3        -73.976124        40.790844         -73.965316
4              16.0        -73.925023        40.744085         -73.973082
...             ...               ...              ...                ...
199995          3.0        -73.987042        40.739367         -73.986525
199996          7.5        -73.984722        40.736837         -74.006672
199997         30.9        -73.986017        40.756487         -73.858957
```

```
199998      14.5  -73.997124        40.725452         -73.983215
199999      14.1  -73.984395        40.720077         -73.985508

        dropoff_latitude  passenger_count  hour  day  month  year  dayofweek
0              40.723217                1    19    7      5  2015          3
1              40.750325                1    20   17      7  2009          4
2              40.772647                1    21   24      8  2009          0
3              40.803349                3     8   26      6  2009          4
4              40.761247                5    17   28      8  2014          3
...                  ...              ...   ...  ...    ...   ...        ...
199995         40.740297                1    10   28     10  2012          6
199996         40.739620                1     1   14      3  2014          4
199997         40.692588                2     0   29      6  2009          0
199998         40.695416                1    14   20      5  2015          2
199999         40.768793                1     4   15      5  2010          5

[199999 rows x 11 columns]
```

[16]:

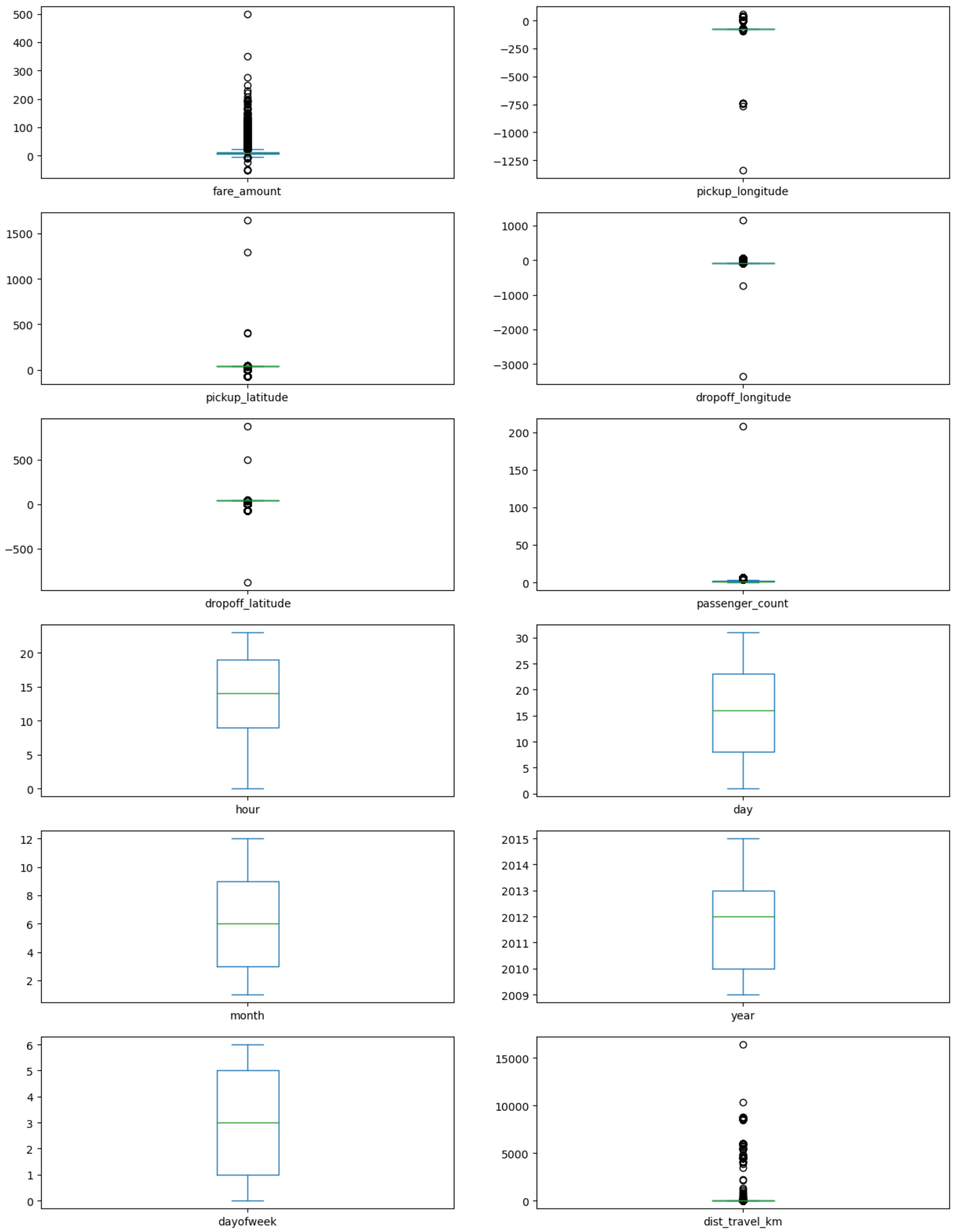
```python
from math import *

def distance_formula(longitude1, latitude1, longitude2, latitude2):
    travel_dist = []

    for pos in range (len(longitude1)):

        lon1, lan1, lon2, lan2 = map(radians, [longitude1[pos], latitude1[pos], longitude2[pos], latitude2[pos]])
        dist_lon = lon2 - lon1
        dist_lan = lan2 - lan1
        a = sin(dist_lan/2)**2 + cos(lan1) * cos(lan2) * sin(dist_lon/2)**2

        #radius of earth = 6371
        c = 2 * asin(sqrt(a)) * 6371
        travel_dist.append(c)

    return travel_dist
```

[17]:

```python
df['dist_travel_km'] = distance_formula(df.pickup_longitude.to_numpy(), df.pickup_latitude.to_numpy(), df.dropoff_longitude.to_numpy(),df.dropoff_latitude.to_numpy())
```

[18]:

```python
df.plot(kind = "box",subplots = True,layout = (6,2),figsize=(15,20))
#Boxplot to check the outliers
plt.show()
```



[21]:

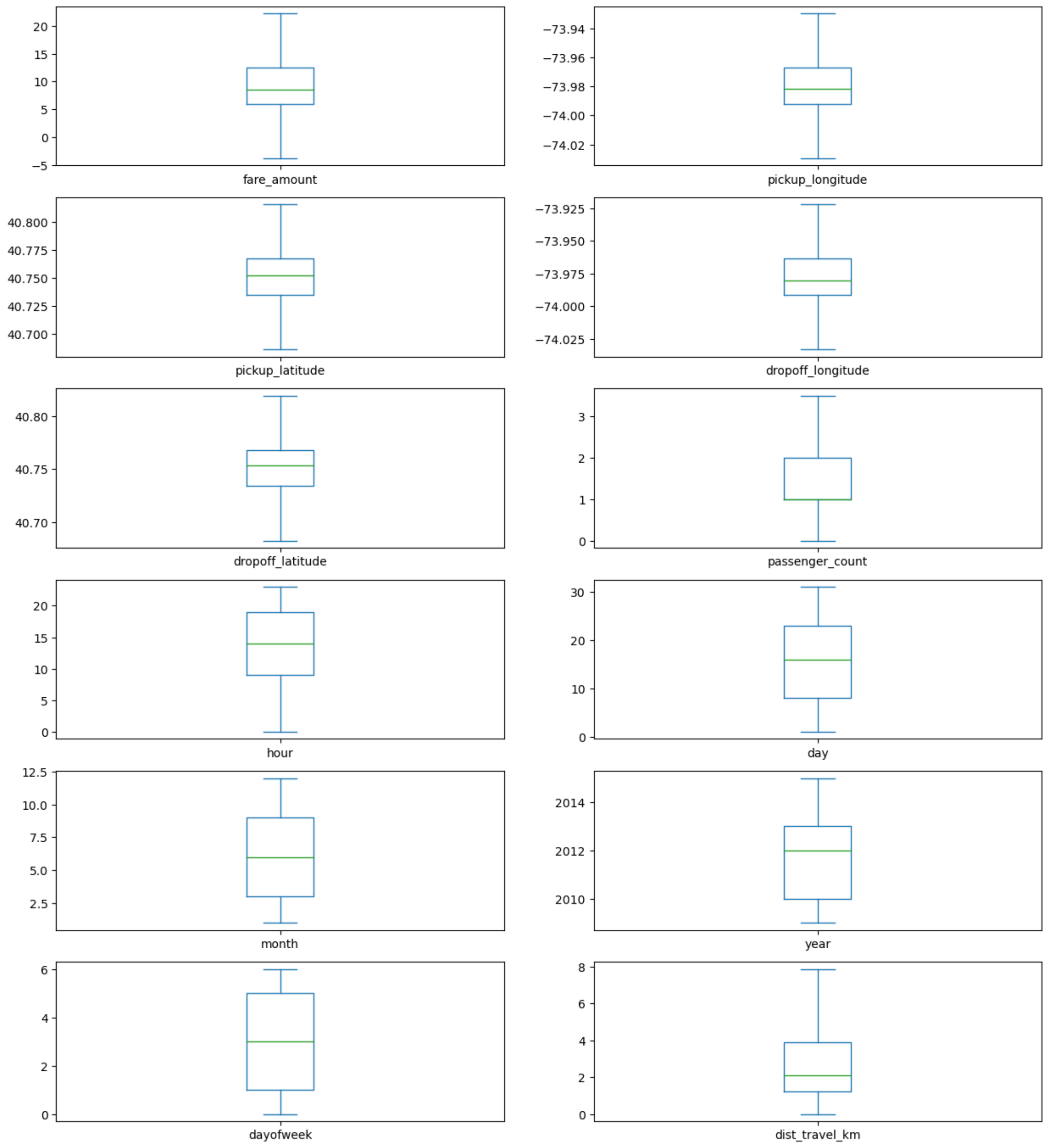
```
def remove_outlier(df1 , col):
    Q1 = df1[col].quantile(0.25)
    Q3 = df1[col].quantile(0.75)
    IQR = Q3 - Q1
    lower_whisker = Q1-1.5*IQR
    upper_whisker = Q3+1.5*IQR
    df[col] = np.clip(df1[col] , lower_whisker , upper_whisker)
    return df1

def treat_outliers_all(df1 , col_list):
    for c in col_list:
        df1 = remove_outlier(df , c)
    return df1
```

[22]:

```
df = treat_outliers_all(df , df.iloc[: , 0::])
```

[23]:

```
df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20))
plt.show()
```



[24]:
```
corr = df.corr()
corr
```

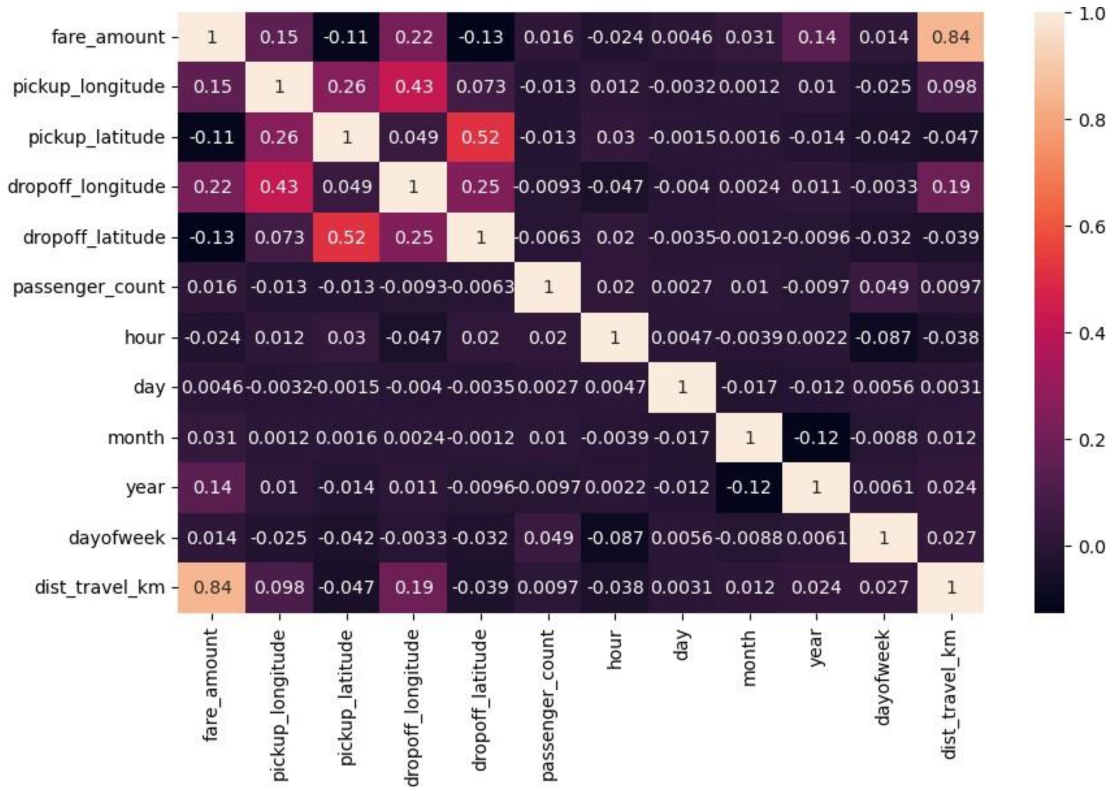
[24] :
```
                   fare_amount  pickup_longitude  pickup_latitude  \
fare_amount           1.000000          0.154053        -0.110857
pickup_longitude      0.154053          1.000000         0.259496
pickup_latitude      -0.110857          0.259496         1.000000
dropoff_longitude     0.218681          0.425622         0.048887
dropoff_latitude     -0.125874          0.073313         0.515736
passenger_count       0.015798         -0.013202        -0.012879
```

```
hour                  -0.023605          0.011590         0.029691
day                    0.004552         -0.003194        -0.001544
month                  0.030815          0.001168         0.001561
year                   0.141271          0.010193        -0.014247
dayofweek              0.013664         -0.024645        -0.042304
dist_travel_km         0.844369          0.098074        -0.046825

                   dropoff_longitude  dropoff_latitude  passenger_count  \
fare_amount                 0.218681         -0.125874         0.015798
pickup_longitude            0.425622          0.073313        -0.013202
pickup_latitude             0.048887          0.515736        -0.012879
dropoff_longitude           1.000000          0.245670        -0.009304
dropoff_latitude            0.245670          1.000000        -0.006329
passenger_count            -0.009304         -0.006329         1.000000
hour                       -0.046560          0.019765         0.020260
day                        -0.004008         -0.003498         0.002699
month                       0.002392         -0.001191         0.010353
year                        0.011347         -0.009595        -0.009743
dayofweek                  -0.003337         -0.031932         0.048542
dist_travel_km              0.186533         -0.038873         0.009729

                       hour       day     month      year  dayofweek  \
fare_amount       -0.023605  0.004552  0.030815  0.141271   0.013664
pickup_longitude   0.011590 -0.003194  0.001168  0.010193  -0.024645
pickup_latitude    0.029691 -0.001544  0.001561 -0.014247  -0.042304
dropoff_longitude -0.046560 -0.004008  0.002392  0.011347  -0.003337
dropoff_latitude   0.019765 -0.003498 -0.001191 -0.009595  -0.031932
passenger_count    0.020260  0.002699  0.010353 -0.009743   0.048542
hour               1.000000  0.004664 -0.003924  0.002162  -0.086956
day                0.004664  1.000000 -0.017358 -0.012165   0.005609
month             -0.003924 -0.017358  1.000000 -0.115860  -0.008785
year               0.002162 -0.012165 -0.115860  1.000000   0.006116
dayofweek         -0.086956  0.005609 -0.008785  0.006116   1.000000
dist_travel_km    -0.038348  0.003080  0.011626  0.024270   0.027066

                   dist_travel_km
fare_amount              0.844369
pickup_longitude         0.098074
pickup_latitude         -0.046825
dropoff_longitude        0.186533
dropoff_latitude        -0.038873
passenger_count          0.009729
hour                    -0.038348
day                      0.003080
month                    0.011626
year                     0.024270
dayofweek                0.027066
```

```
dist_travel_km             1.000000
```

[25]:
```
fig,axis = plt.subplots(figsize = (10,6))
sns.heatmap(df.corr(),annot = True)
```

[25]:
```
<Axes: >
```



[26]:
```
df_x =␣
↪df[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_latitude','passenger_
df_y = df['fare_amount']
```

[27]:
```
x_train, x_test, y_train, y_test = train_test_split(df_x, df_y, test_size=0.46,␣
↪random_state=46)
```

[28]:
```
df
```

[28]:
```
        fare_amount  pickup_longitude  pickup_latitude  dropoff_longitude  \
0              7.50        -73.999817        40.738354         -73.999512
1              7.70        -73.994355        40.728225         -73.994710
2             12.90        -74.005043        40.740770         -73.962565
3              5.30        -73.976124        40.790844         -73.965316
4             16.00        -73.929787        40.744085         -73.973082
```

```
...            ...         ...        ...          ...
199995        3.00  -73.987042  40.739367   -73.986525
199996        7.50  -73.984722  40.736837   -74.006672
199997       22.25  -73.986017  40.756487   -73.922036
199998       14.50  -73.997124  40.725452   -73.983215
199999       14.10  -73.984395  40.720077   -73.985508

        dropoff_latitude  passenger_count  hour  day  month  year  dayofweek  \
0              40.723217              1.0    19    7      5  2015          3
1              40.750325              1.0    20   17      7  2009          4
2              40.772647              1.0    21   24      8  2009          0
3              40.803349              3.0     8   26      6  2009          4
4              40.761247              3.5    17   28      8  2014          3
...                  ...              ...   ...  ...    ...   ...
199995         40.740297              1.0    10   28     10  2012          6
199996         40.739620              1.0     1   14      3  2014          4
199997         40.692588              2.0     0   29      6  2009          0
199998         40.695416              1.0    14   20      5  2015          2
199999         40.768793              1.0     4   15      5  2010          5

        dist_travel_km
0             1.683323
1             2.457590
2             5.036377
3             1.661683
4             4.475450
...                ...
199995        0.112210
199996        1.875050
199997        7.865091
199998        3.539715
199999        5.417783

[199999 rows x 12 columns]
```

[29]:
```
from sklearn.linear_model import LinearRegression
```

[30]:
```
reg = LinearRegression()
```

[31]:
```
reg.fit(x_train, y_train)
```

[31]:
```
LinearRegression()
```

[32]:
```
y_pred_lin = reg.predict(x_test)
print(y_pred_lin)
```

```
[ 9.71080842  7.93130063  9.03773769 ... 10.20762805  9.54503729
  5.97704907]
```

```
[33]: from sklearn.ensemble import RandomForestRegressor
```

```
[38]: rf = RandomForestRegressor(n_estimators=10)
      rf.fit(x_train,y_train)
```

```
[38]: RandomForestRegressor(n_estimators=10)
```

```
[39]: y_pred_rf = rf.predict(x_test)
      print(y_pred_rf)
```

```
[11.65  5.65  8.85 ...  8.9  10.48  5.35]
```

```
[40]: cols = ['Model', 'RMSE', 'R-Squared']
```

```
[41]: result_tabulation = pd.DataFrame(columns = cols)
```

```
[42]: from sklearn import metrics
      from sklearn.metrics import r2_score
      reg_RMSE = np.sqrt(metrics.mean_squared_error(y_test, y_pred_lin))
      reg_squared = r2_score(y_test, y_pred_lin)
      full_metrics = pd.Series({'Model': "Linear Regression", 'RMSE' : reg_RMSE,␣
       ↪'R-Squared' : reg_squared})
```

```
[43]: result_tabulation = result_tabulation._append(full_metrics, ignore_index = True)
```

```
[44]: result_tabulation
```

```
[44]:                Model      RMSE  R-Squared
      0  Linear Regression  2.741174   0.744953
```

```
[45]: rf_RMSE = np.sqrt(metrics.mean_squared_error(y_test, y_pred_rf))
      rf_squared = r2_score(y_test, y_pred_rf)
      full_metrics = pd.Series({'Model': "Random Forest ", 'RMSE':rf_RMSE,␣
       ↪'R-Squared': rf_squared})
```

```
[46]: result_tabulation = result_tabulation._append(full_metrics, ignore_index = True)
```

```
[47]: result_tabulation
```

```
[47]:                Model      RMSE  R-Squared
      0  Linear Regression  2.741174   0.744953
      1     Random Forest   2.526872   0.783272
```

```
[ ]:
```