## #Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks:

1. Pre-process the dataset.
2. Identify outliers.
3. Check the correlation.
4. Implement linear regression and random forest regression models.
5. Evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset

```
#Importing the required libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

#importing the dataset
df  = pd.read_csv("uber.csv")
```

### 1. Pre-process the dataset.

```
df.head()
```

```
   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 08:22:21          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
```

```
df.info() #To get the required information of the dataset
```

```
<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
```

```
df.columns #TO get number of columns in the dataset
```

```
Index(['Unnamed: 0', 'key', 'fare_amount', 'pickup_datetime',
       'pickup_longitude', 'pickup_latitude', 'dropoff_longitude',
       'dropoff_latitude', 'passenger_count'],
      dtype='object')
```

```
df = df.drop(['Unnamed: 0', 'key'], axis= 1) #To drop unnamed column
as it isn't required
```

```
df.head()
```

```
   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

df.shape #To get the total (Rows,Columns)

(200000, 7)

df.dtypes #To get the type of each column

fare_amount          float64
pickup_datetime       object
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
dtype: object

df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200000 entries, 0 to 199999
Data columns (total 7 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   fare_amount        200000 non-null  float64
 1   pickup_datetime    200000 non-null  object
 2   pickup_longitude   200000 non-null  float64
 3   pickup_latitude    200000 non-null  float64
 4   dropoff_longitude  199999 non-null  float64
 5   dropoff_latitude   199999 non-null  float64
 6   passenger_count    200000 non-null  int64
dtypes: float64(5), int64(1), object(1)
memory usage: 10.7+ MB

df.describe() #To get statistics of each columns

         fare_amount  pickup_longitude  pickup_latitude
dropoff_longitude  \
count  200000.000000     200000.000000    200000.000000
199999.000000
mean       11.359955        -72.527638        39.935885         -
72.525292
std         9.901776         11.437787         7.720539
13.117408
min       -52.000000      -1340.648410       -74.015515       -
3356.666300
25%         6.000000        -73.992065        40.734796         -
73.991407
```

```
50%         8.500000        -73.981823        40.752592         -
73.980093
75%        12.500000        -73.967153        40.767158         -
73.963659
max       499.000000         57.418457      1644.421482
1153.572603
```

```
       dropoff_latitude  passenger_count
count     199999.000000    200000.000000
mean          39.923890         1.684535
std            6.794829         1.385997
min         -881.985513         0.000000
25%           40.733823         1.000000
50%           40.753042         1.000000
75%           40.768001         2.000000
max          872.697628       208.000000
```

### Filling Missing values

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

```
fare_amount          0
pickup_datetime      0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    1
dropoff_latitude     1
passenger_count      0
dtype: int64
```

```
df['dropoff_latitude'].fillna(value=df['dropoff_latitude'].mean(),inpl
ace = True)
df['dropoff_longitude'].fillna(value=df['dropoff_longitude'].median(),
inplace = True)
```

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

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

```
df.dtypes
```

```
fare_amount          float64
pickup_datetime       object
pickup_longitude     float64
pickup_latitude      float64
```

```
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
dtype: object
```

### Column pickup_datetime is in wrong format (Object). Convert it to DateTime Format

```
df.pickup_datetime = pd.to_datetime(df.pickup_datetime,
errors='coerce')

df.dtypes
```

```
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
```

### To segregate each time of date and time

```
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)

df.head()
```

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

   dropoff_longitude  dropoff_latitude  passenger_count  hour  day
month  \
0         -73.999512         40.723217                1    19    7
5
1         -73.994710         40.750325                1    20   17
7
2         -73.962565         40.772647                1    21   24
8
3         -73.965316         40.803349                3     8   26
```

```
6
4         -73.973082         40.761247                5    17   28
8

   year  dayofweek
0  2015          3
1  2009          4
2  2009          0
3  2009          4
4  2014          3
```

```
# drop the column 'pickup_daetime' using drop()
# 'axis = 1' drops the specified column

df = df.drop('pickup_datetime',axis=1)

df.head()
```

```
   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


   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
```

```
df.dtypes
```

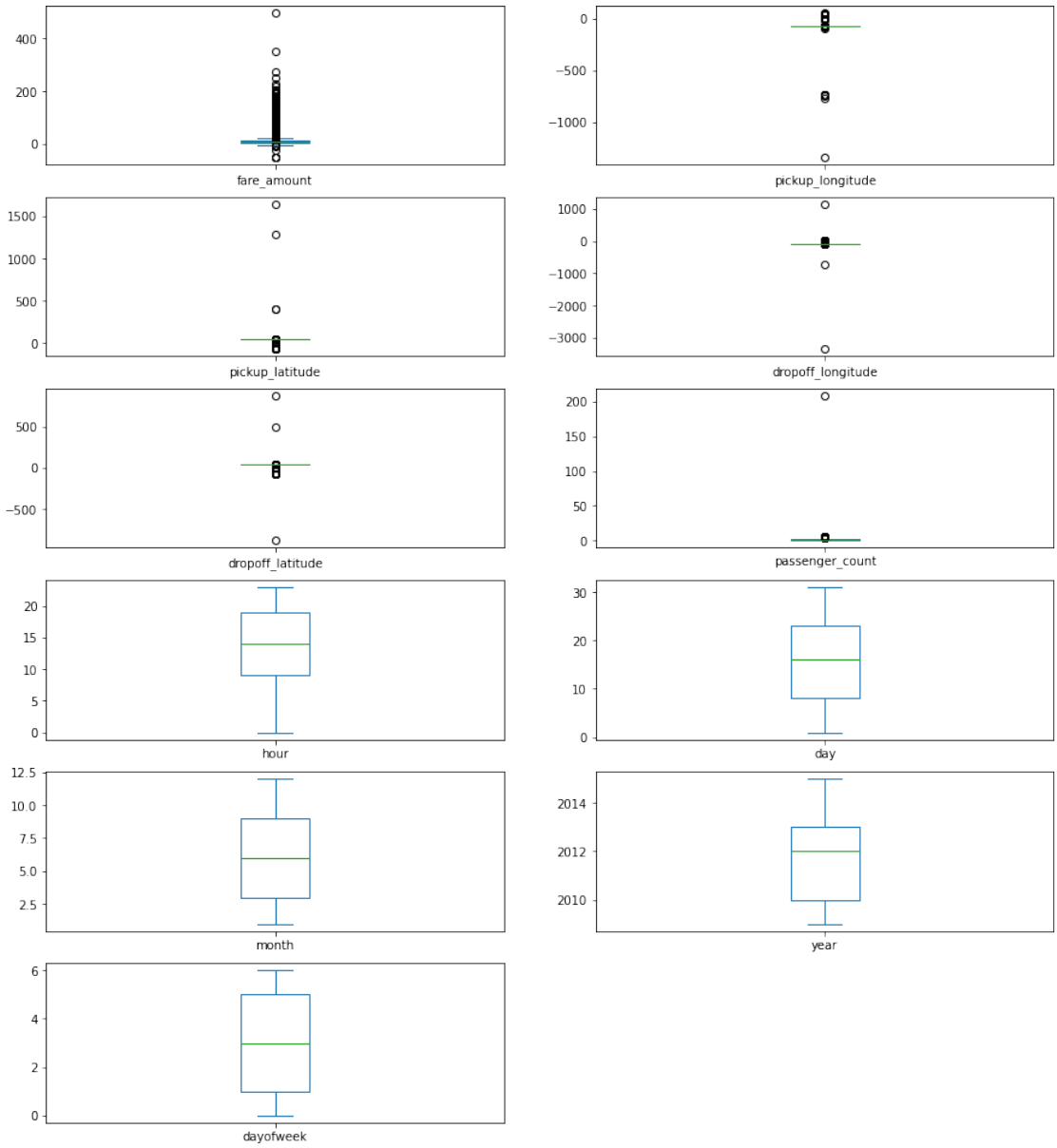
```
fare_amount          float64
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
```

```
dropoff_latitude     float64
passenger_count        int64
hour                   int64
day                    int64
month                  int64
year                   int64
dayofweek              int64
dtype: object
```

## Checking outliers and filling them

```
df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20))
#Boxplot to check the outliers
```

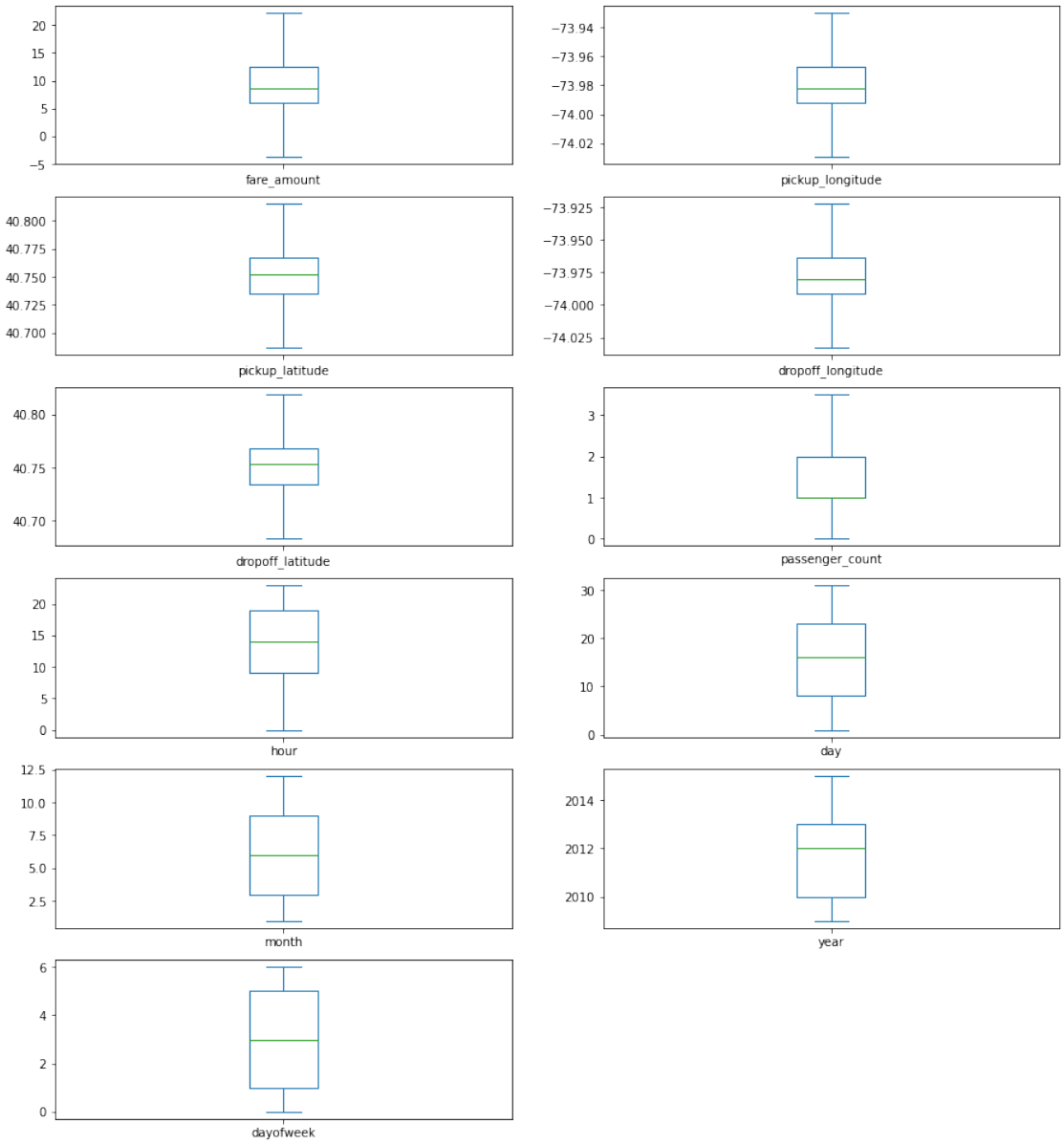
```
fare_amount            AxesSubplot(0.125,0.787927;0.352273x0.0920732)
pickup_longitude     AxesSubplot(0.547727,0.787927;0.352273x0.0920732)
pickup_latitude        AxesSubplot(0.125,0.677439;0.352273x0.0920732)
dropoff_longitude    AxesSubplot(0.547727,0.677439;0.352273x0.0920732)
dropoff_latitude       AxesSubplot(0.125,0.566951;0.352273x0.0920732)
passenger_count      AxesSubplot(0.547727,0.566951;0.352273x0.0920732)
hour                   AxesSubplot(0.125,0.456463;0.352273x0.0920732)
day                  AxesSubplot(0.547727,0.456463;0.352273x0.0920732)
month                  AxesSubplot(0.125,0.345976;0.352273x0.0920732)
year                 AxesSubplot(0.547727,0.345976;0.352273x0.0920732)
dayofweek              AxesSubplot(0.125,0.235488;0.352273x0.0920732)
dtype: object
```




```
#Using the InterQuartile Range to fill the values
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
```

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

df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20))
#Boxplot shows that dataset is free from outliers
```

```
fare_amount            AxesSubplot(0.125,0.787927;0.352273x0.0920732)
pickup_longitude     AxesSubplot(0.547727,0.787927;0.352273x0.0920732)
pickup_latitude        AxesSubplot(0.125,0.677439;0.352273x0.0920732)
dropoff_longitude    AxesSubplot(0.547727,0.677439;0.352273x0.0920732)
dropoff_latitude       AxesSubplot(0.125,0.566951;0.352273x0.0920732)
passenger_count      AxesSubplot(0.547727,0.566951;0.352273x0.0920732)
hour                   AxesSubplot(0.125,0.456463;0.352273x0.0920732)
day                  AxesSubplot(0.547727,0.456463;0.352273x0.0920732)
month                  AxesSubplot(0.125,0.345976;0.352273x0.0920732)
year                 AxesSubplot(0.547727,0.345976;0.352273x0.0920732)
dayofweek              AxesSubplot(0.125,0.235488;0.352273x0.0920732)
dtype: object
```




```
#pip install haversine
import haversine as hs  #Calculate the distance using Haversine to
calculate the distance between to points. Can't use Eucladian as it is
for flat surface.
travel_dist = []
for pos in range(len(df['pickup_longitude'])):
        long1,lati1,long2,lati2 = [df['pickup_longitude']
[pos],df['pickup_latitude'][pos],df['dropoff_longitude']
[pos],df['dropoff_latitude'][pos]]
        loc1=(lati1,long1)
        loc2=(lati2,long2)
        c = hs.haversine(loc1,loc2)
        travel_dist.append(c)
```

```
print(travel_dist)
df['dist_travel_km'] = travel_dist
df.head()
```

```
IOPub data rate exceeded.
The notebook server will temporarily stop sending output
to the client in order to avoid crashing it.
To change this limit, set the config variable
`--NotebookApp.iopub_data_rate_limit`.

Current values:
NotebookApp.iopub_data_rate_limit=1000000.0 (bytes/sec)
NotebookApp.rate_limit_window=3.0 (secs)
```

| | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitude | passenger_count | hour | day | month | year | dayofweek | dist_travel_km |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.5 | -73.999817 | 40.738354 | -73.999512 | 40.723217 | 1.0 | 19 | 7 | 5 | 2015 | 3 | 1.683325 |
| 1 | 7.7 | -73.994355 | 40.728225 | -73.994710 | 40.750325 | 1.0 | 20 | 17 | 7 | 2009 | 4 | 2.457593 |
| 2 | 12.9 | -74.005043 | 40.740770 | -73.962565 | 40.772647 | 1.0 | 21 | 24 | 8 | 2009 | 0 | 5.036384 |
| 3 | 5.3 | -73.976124 | 40.790844 | -73.965316 | 40.803349 | 3.0 | 8 | 26 | 6 | 2009 | 4 | 1.661686 |
| 4 | 16.0 | -73.929786 | 40.744085 | -73.973082 | 40.761247 | 3.5 | 17 | 28 | 8 | 2014 | 3 | 4.116088 |

```
#Uber doesn't travel over 130 kms so minimize the distance
df= df.loc[(df.dist_travel_km >= 1) | (df.dist_travel_km <= 130)]
print("Remaining observastions in the dataset:", df.shape)
```

```
Remaining observastions in the dataset: (200000, 12)
```

```
#Finding inccorect latitude (Less than or greater than 90) and
longitude (greater than or less than 180)
incorrect_coordinates = df.loc[(df.pickup_latitude > 90) |
(df.pickup_latitude < -90) |
                               (df.dropoff_latitude > 90) |
(df.dropoff_latitude < -90) |
                               (df.pickup_longitude > 180) |
(df.pickup_longitude < -180) |
                               (df.dropoff_longitude > 90) |
(df.dropoff_longitude < -90)
                                ]

df.drop(incorrect_coordinates, inplace = True, errors = 'ignore')

df.head()
```

```
   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        -73.929786        40.744085         -73.973082


   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


   dist_travel_km
0        1.683325
1        2.457593
```

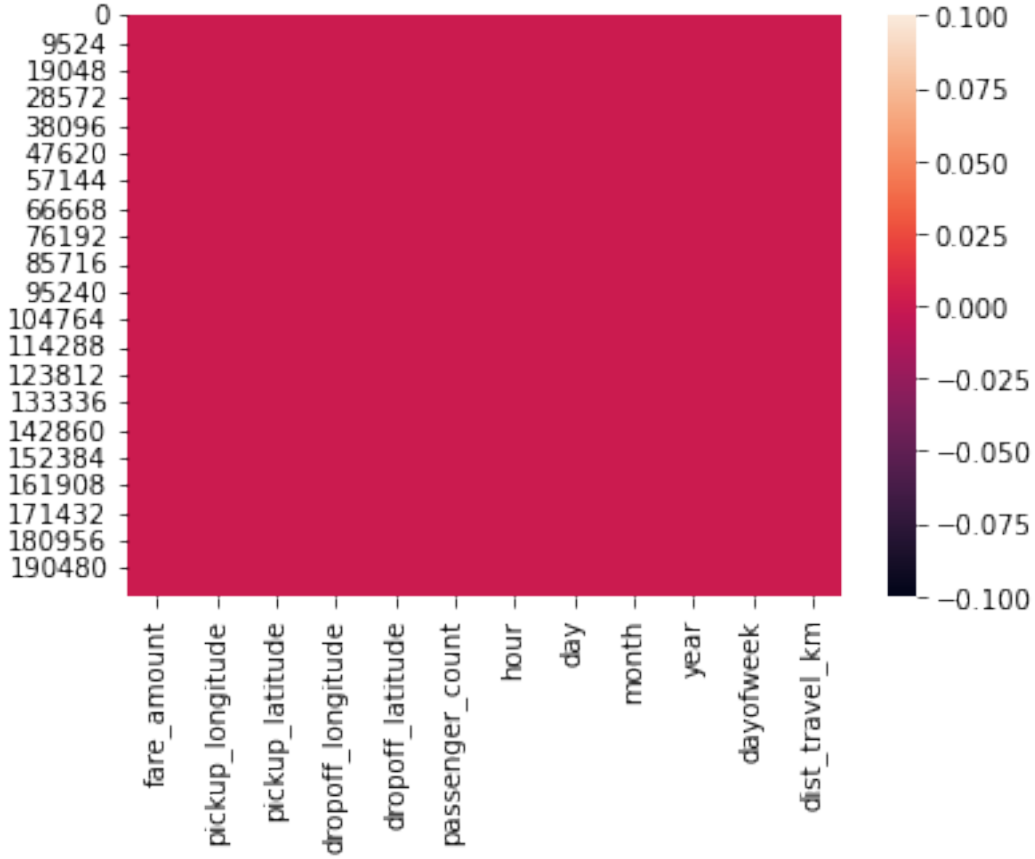
```
2         5.036384
3         1.661686
4         4.116088
```

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

```
fare_amount          0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
hour                 0
day                  0
month                0
year                 0
dayofweek            0
dist_travel_km       0
dtype: int64
```

```
sns.heatmap(df.isnull()) #Free for null values
```

```
<AxesSubplot:>
```




```
corr = df.corr() #Function to find the correlation
```

```
corr
```

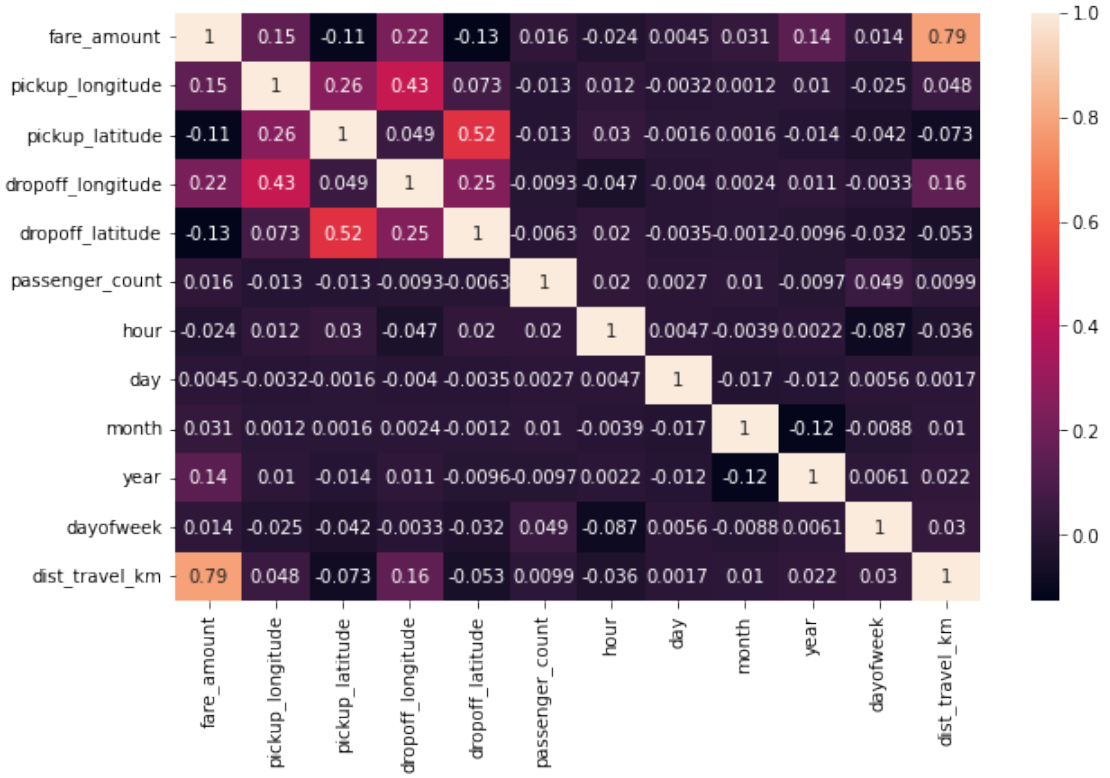
| | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitude | passenger_count | hour | day | month | year | dayofweek | dist_travel_km |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fare_amount | 1.000000 | 0.154069 | -0.110842 | 0.218675 | -0.125898 | 0.015778 | -0.023623 | 0.004534 | 0.030817 | 0.141277 | 0.013652 | 0.786385 |
| pickup_longitude | 0.154069 | 1.000000 | 0.259497 | 0.425619 | 0.073290 | -0.013213 | 0.011579 | -0.003204 | 0.001169 | 0.010198 | -0.024652 | 0.048446 |
| pickup_latitude | -0.110842 | 0.259497 | 1.000000 | 0.048889 | 0.515714 | -0.012889 | 0.029681 | -0.001553 | 0.001562 | -0.014243 | -0.042310 | -0.073362 |
| dropoff_longitude | 0.218675 | 0.425619 | 0.073290 | 1.000000 | 0.245667 | -0.009303 | -0.046558 | 0.019783 | 0.002391 | 0.011346 | -0.003336 | 0.155191 |
| dropoff_latitude | -0.125898 | 0.073290 | 0.515714 | 0.245667 | 1.000000 | -0.006308 | -0.004007 | -0.003479 | -0.001193 | -0.009603 | -0.031919 | -0.052701 |
| passenger_count | 0.015778 | -0.013213 | -0.012889 | -0.009303 | -0.006308 | 1.000000 | 0.020274 | 0.002712 | 0.010351 | -0.009749 | 0.048550 | 0.009884 |
| hour | -0.023623 | 0.011579 | 0.029681 | -0.046558 | 0.019783 | 0.020274 | 1.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| day | 0.004534 | -0.003204 | -0.001553 | -0.004007 | -0.003479 | 0.002712 | 0.000000 | 1.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| month | 0.030817 | 0.001169 | 0.001562 | 0.002391 | -0.001193 | 0.010351 | 0.000000 | 0.000000 | 1.000000 | 0.000000 | 0.000000 | 0.000000 |
| year | 0.141277 | 0.010198 | -0.014243 | 0.011346 | -0.009603 | -0.009749 | 0.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 | 0.000000 |
| dayofweek | 0.013652 | -0.024652 | -0.042310 | -0.003336 | -0.031919 | 0.048550 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 |
| dist_travel_km | 0.786385 | 0.048446 | -0.073362 | 0.155191 | -0.052701 | 0.009884 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 1.000000 |

```
dropoff_longitude -0.046558 -0.004007  0.002391  0.011346  -0.003336

dropoff_latitude   0.019783 -0.003479 -0.001193 -0.009603  -0.031919

passenger_count    0.020274  0.002712  0.010351 -0.009749   0.048550

hour               1.000000  0.004677 -0.003926  0.002156  -0.086947

day                0.004677  1.000000 -0.017360 -0.012170   0.005617

month             -0.003926 -0.017360  1.000000 -0.115859  -0.008786

year               0.002156 -0.012170 -0.115859  1.000000   0.006113

dayofweek         -0.086947  0.005617 -0.008786  0.006113   1.000000

dist_travel_km    -0.035708  0.001709  0.010050  0.022294   0.030382
```

```
                   dist_travel_km
fare_amount              0.786385
pickup_longitude         0.048446
pickup_latitude         -0.073362
dropoff_longitude        0.155191
dropoff_latitude        -0.052701
passenger_count          0.009884
hour                    -0.035708
day                      0.001709
month                    0.010050
year                     0.022294
dayofweek                0.030382
dist_travel_km           1.000000
```

```
fig,axis = plt.subplots(figsize = (10,6))
sns.heatmap(df.corr(),annot = True) #Correlation Heatmap (Light values
means highly correlated)
```

```
<AxesSubplot:>
```




### Dividing the dataset into feature and target values

```
x =
df[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_
latitude','passenger_count','hour','day','month','year','dayofweek','d
ist_travel_km']]

y = df['fare_amount']
```

### Dividing the dataset into training and testing dataset

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(x,y,test_size = 0.33)
```

### Linear Regression

```
from sklearn.linear_model import LinearRegression
regression = LinearRegression()

regression.fit(X_train,y_train)

LinearRegression()

regression.intercept_ #To find the linear intercept

3683.734379131267

regression.coef_ #To find the linear coeeficient

array([ 2.54690644e+01, -7.25031311e+00,  2.01910609e+01, -
1.81689799e+01,
```

```
       6.49318535e-02,  8.88740039e-03,  3.96976218e-03,
6.07701750e-02,
       3.64995448e-01, -3.34018868e-02,  1.84796864e+00])
```

```
prediction = regression.predict(X_test) #To predict the target values
```

```
print(prediction)
```

```
[ 6.92808422  5.50169187  7.29033891 ...  7.34427831 11.48600676
  8.04489363]
```

```
y_test
```

```
23033      8.0
166557     4.5
188533     8.0
175085     7.5
69692     11.4
          ...
22917      8.1
42396     12.9
25947      8.0
66067      8.5
20658      8.5
Name: fare_amount, Length: 66000, dtype: float64
```

### Metrics Evaluation using R2, Mean Squared Error, Root Mean Sqared Error

```
from sklearn.metrics import r2_score
```

```
r2_score(y_test,prediction)
```

```
0.6640797581905353
```

```
from sklearn.metrics import mean_squared_error
```

```
MSE = mean_squared_error(y_test,prediction)
```

```
MSE
```

```
9.92519776977491
```

```
RMSE = np.sqrt(MSE)
```

```
RMSE
```

```
3.15042818832217
```

### Random Forest Regression

```
from sklearn.ensemble import RandomForestRegressor
```

```
rf = RandomForestRegressor(n_estimators=100) #Here n_estimators means
number of trees you want to build before making the prediction
```

```
rf.fit(X_train,y_train)
```

```
y_pred = rf.predict(X_test)

y_pred
```

### Metrics evaluatin for Random Forest

```
R2_Random = r2_score(y_test,y_pred)

R2_Random

MSE_Random = mean_squared_error(y_test,y_pred)

MSE_Random

RMSE_Random = np.sqrt(MSE_Random)

RMSE_Random
```