```
import numpy as np
import pandas as pd
import math
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns

df = pd.read_csv("Uber.csv")

df
```

```
        Unnamed: 0                            key  fare_amount  \
0         24238194    2015-05-07 19:52:06.0000003          7.5
1         27835199    2009-07-17 20:04:56.0000002          7.7
2         44984355   2009-08-24 21:45:00.00000061         12.9
3         25894730    2009-06-26 08:22:21.0000001          5.3
4         17610152  2014-08-28 17:47:00.000000188         16.0
...            ...                            ...          ...
199995    42598914   2012-10-28 10:49:00.00000053          3.0
199996    16382965    2014-03-14 01:09:00.0000008          7.5
199997    27804658   2009-06-29 00:42:00.00000078         30.9
199998    20259894    2015-05-20 14:56:25.0000004         14.5
199999    11951496   2010-05-15 04:08:00.00000076         14.1

                pickup_datetime  pickup_longitude  pickup_latitude  \
0       2015-05-07 19:52:06 UTC        -73.999817        40.738354
1       2009-07-17 20:04:56 UTC        -73.994355        40.728225
2       2009-08-24 21:45:00 UTC        -74.005043        40.740770
3       2009-06-26 08:22:21 UTC        -73.976124        40.790844
4       2014-08-28 17:47:00 UTC        -73.925023        40.744085
...                         ...               ...              ...
199995  2012-10-28 10:49:00 UTC        -73.987042        40.739367
199996  2014-03-14 01:09:00 UTC        -73.984722        40.736837
199997  2009-06-29 00:42:00 UTC        -73.986017        40.756487
199998  2015-05-20 14:56:25 UTC        -73.997124        40.725452
199999  2010-05-15 04:08:00 UTC        -73.984395        40.720077

        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
...                   ...               ...              ...
199995         -73.986525         40.740297                1
199996         -74.006672         40.739620                1
199997         -73.858957         40.692588                2
199998         -73.983215         40.695415                1
199999         -73.985508         40.768793                1
```

```
[200000 rows x 9 columns]
```

```
df.shape
```

```
(200000, 9)
```

```
df.head()
```

```
   Unnamed: 0                            key  fare_amount  \
0    24238194    2015-05-07 19:52:06.0000003          7.5
1    27835199    2009-07-17 20:04:56.0000002          7.7
2    44984355   2009-08-24 21:45:00.00000061         12.9
3    25894730    2009-06-26 08:22:21.0000001          5.3
4    17610152  2014-08-28 17:47:00.000000188         16.0

           pickup_datetime  pickup_longitude  pickup_latitude  \
0  2015-05-07 19:52:06 UTC        -73.999817        40.738354
1  2009-07-17 20:04:56 UTC        -73.994355        40.728225
2  2009-08-24 21:45:00 UTC        -74.005043        40.740770
3  2009-06-26 08:22:21 UTC        -73.976124        40.790844
4  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.tail()
```

```
        Unnamed: 0                            key  fare_amount  \
199995    42598914  2012-10-28 10:49:00.00000053          3.0
199996    16382965   2014-03-14 01:09:00.0000008          7.5
199997    27804658  2009-06-29 00:42:00.00000078         30.9
199998    20259894   2015-05-20 14:56:25.0000004         14.5
199999    11951496  2010-05-15 04:08:00.00000076         14.1

                pickup_datetime  pickup_longitude  pickup_latitude  \
199995  2012-10-28 10:49:00 UTC        -73.987042        40.739367
199996  2014-03-14 01:09:00 UTC        -73.984722        40.736837
199997  2009-06-29 00:42:00 UTC        -73.986017        40.756487
199998  2015-05-20 14:56:25 UTC        -73.997124        40.725452
199999  2010-05-15 04:08:00 UTC        -73.984395        40.720077

        dropoff_longitude  dropoff_latitude  passenger_count
199995         -73.986525         40.740297                1
199996         -74.006672         40.739620                1
199997         -73.858957         40.692588                2
```

```
199998          -73.983215          40.695415                   1
199999          -73.985508          40.768793                   1
```

```
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
```

1.Pre-process the dataset

```
# Find Total Number Of Missing Values
df.isnull().sum()
```

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

```
#dropping rows with missing values
df.dropna(inplace = True)
```

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

```
Unnamed: 0           0
key                  0
fare_amount          0
pickup_datetime      0
pickup_longitude     0
pickup_latitude      0
```

```
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
dtype: int64
```

```
df.head()
```

```
   Unnamed: 0                            key  fare_amount  \
0    24238194    2015-05-07 19:52:06.0000003          7.5
1    27835199    2009-07-17 20:04:56.0000002          7.7
2    44984355   2009-08-24 21:45:00.00000061         12.9
3    25894730    2009-06-26 08:22:21.0000001          5.3
4    17610152  2014-08-28 17:47:00.000000188         16.0

           pickup_datetime  pickup_longitude  pickup_latitude  \
0  2015-05-07 19:52:06 UTC        -73.999817        40.738354
1  2009-07-17 20:04:56 UTC        -73.994355        40.728225
2  2009-08-24 21:45:00 UTC        -74.005043        40.740770
3  2009-06-26 08:22:21 UTC        -73.976124        40.790844
4  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
```

```
#converting datatype of column "pickup_datetime" from object to
DateTime
df["pickup_datetime"] = pd.to_datetime(df["pickup_datetime"])
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 199999 entries, 0 to 199999
Data columns (total 9 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   Unnamed: 0         199999 non-null  int64
 1   key                199999 non-null  object
 2   fare_amount        199999 non-null  float64
 3   pickup_datetime    199999 non-null  datetime64[ns, UTC]
 4   pickup_longitude   199999 non-null  float64
 5   pickup_latitude    199999 non-null  float64
 6   dropoff_longitude  199999 non-null  float64
 7   dropoff_latitude   199999 non-null  float64
 8   passenger_count    199999 non-null  int64
dtypes: datetime64[ns, UTC](1), float64(5), int64(2), object(1)
memory usage: 15.3+ MB
```

df.dtypes

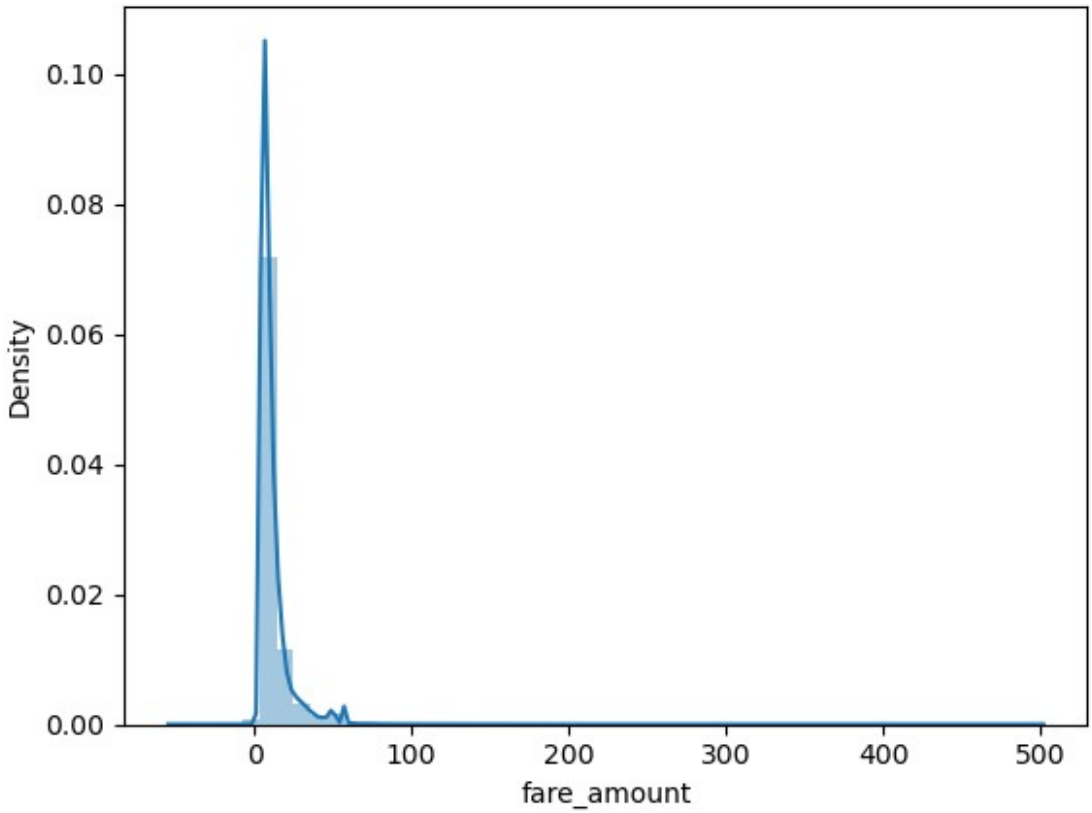
```
df.describe()
```

```
         Unnamed: 0    fare_amount  pickup_longitude  pickup_latitude
\
count  1.999990e+05  199999.000000     199999.000000    199999.000000

mean   2.771248e+07      11.359892        -72.527631        39.935881

std    1.601386e+07       9.901760         11.437815         7.720558

min    1.000000e+00     -52.000000      -1340.648410       -74.015515

25%    1.382534e+07       6.000000        -73.992065        40.734796

50%    2.774524e+07       8.500000        -73.981823        40.752592

75%    4.155535e+07      12.500000        -73.967154        40.767158

max    5.542357e+07     499.000000         57.418457      1644.421482


       dropoff_longitude  dropoff_latitude  passenger_count
count      199999.000000     199999.000000    199999.000000
mean          -72.525292         39.923890         1.684543
std            13.117408          6.794829         1.385995
min         -3356.666300       -881.985513         0.000000
25%           -73.991407         40.733823         1.000000
50%           -73.980093         40.753042         1.000000
75%           -73.963658         40.768001         2.000000
max          1153.572603        872.697628       208.000000
```

2.Identify outliers

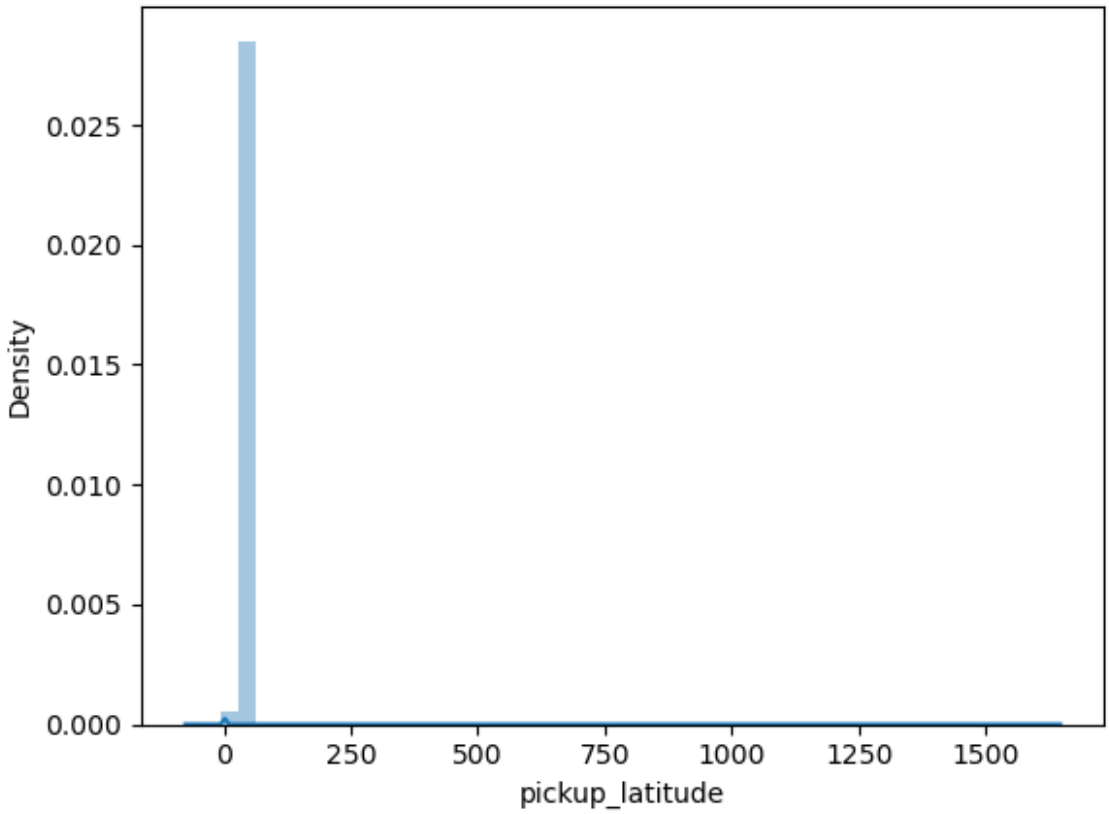
```
# OUTLIER: An object that deviates significantly from rest of the
objects

# data visualization
# plotting distribution plot

import warnings
warnings.filterwarnings("ignore")
sns.distplot(df['fare_amount'])
```

```
<Axes: xlabel='fare_amount', ylabel='Density'>
```



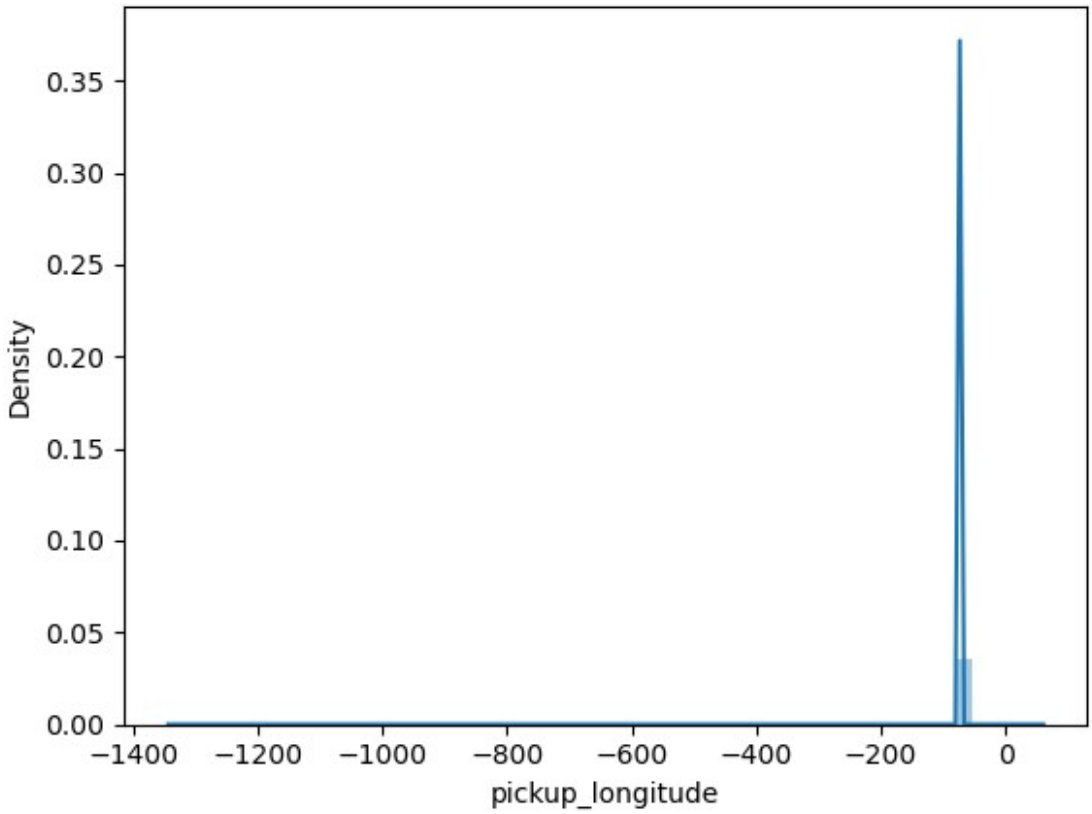

```
sns.distplot(df['pickup_latitude'])
```

```
<Axes: xlabel='pickup_latitude', ylabel='Density'>
```



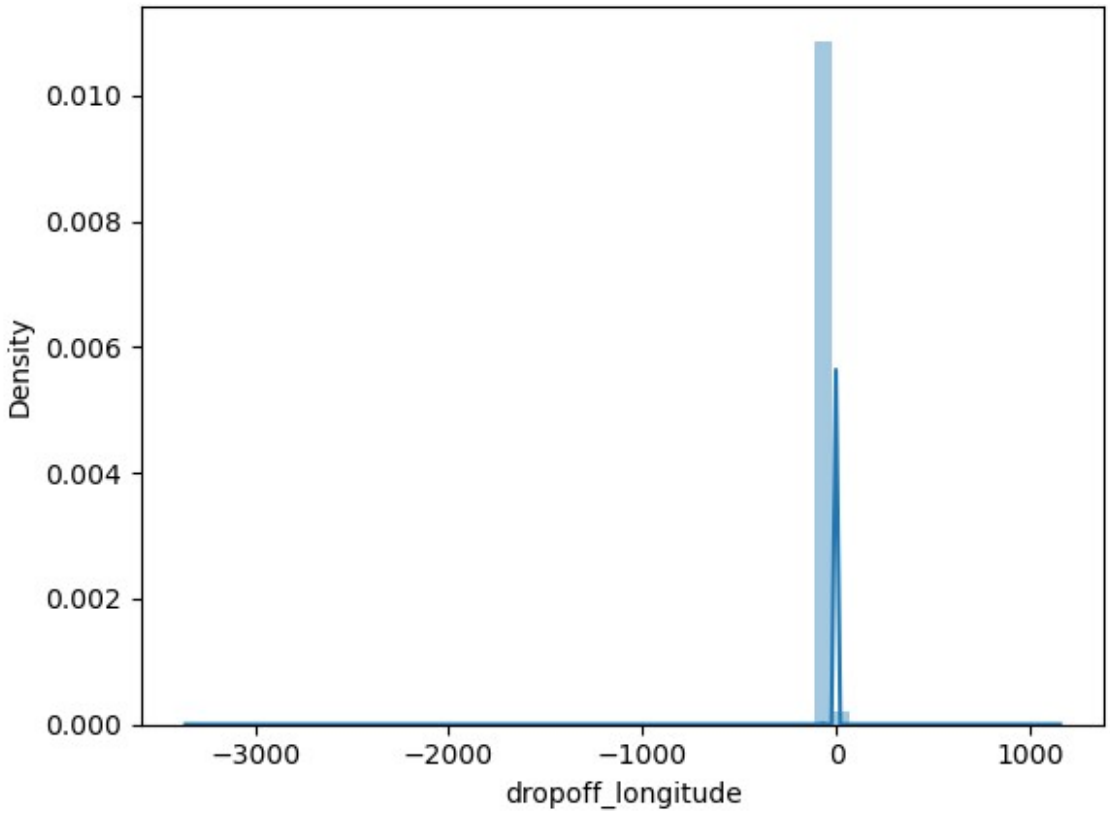

```
sns.distplot(df['pickup_longitude'])
```

```
<Axes: xlabel='pickup_longitude', ylabel='Density'>
```



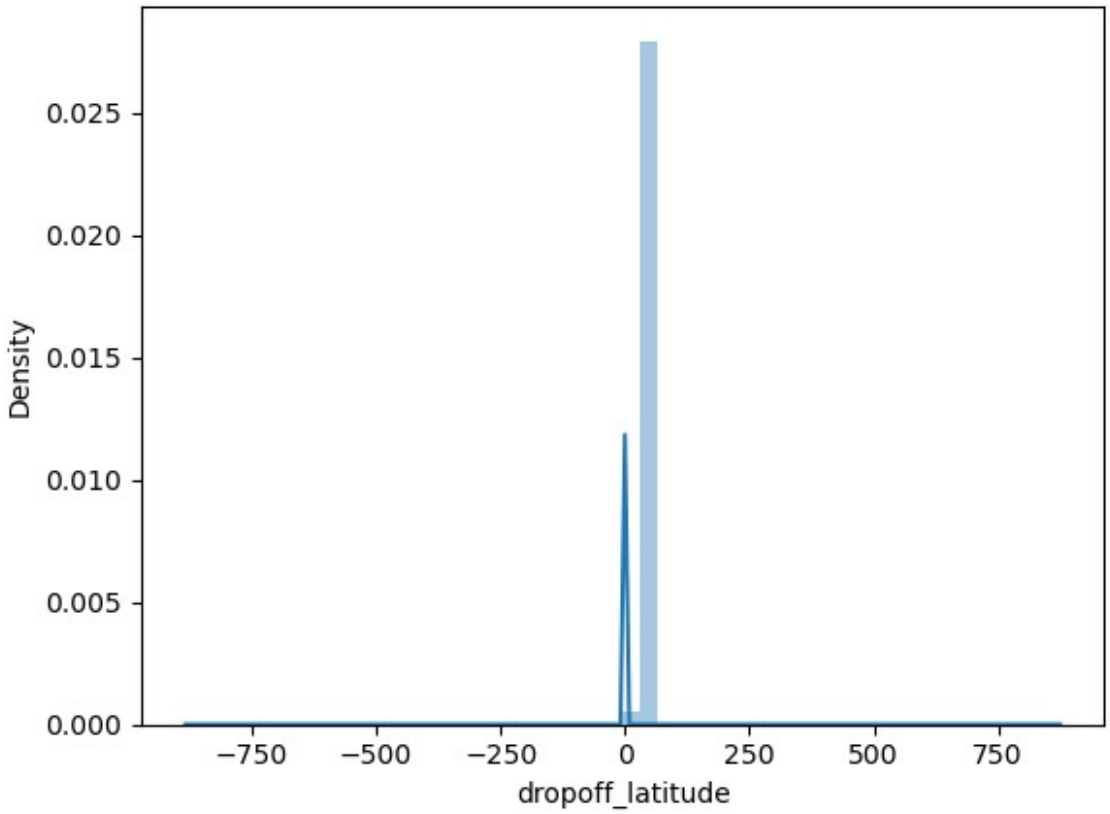

```
sns.distplot(df['dropoff_longitude'])
```

```
<Axes: xlabel='dropoff_longitude', ylabel='Density'>
```




```
sns.distplot(df['dropoff_latitude'])
```

```
<Axes: xlabel='dropoff_latitude', ylabel='Density'>
```




```
#creating a function to identify outliers

def find_outliers_IQR(df):
   q1 = df.quantile(0.25)
   q3 = df.quantile(0.75)
   IQR = q3-q1
   outliers = df[((df<(q1-1.5*IQR)) | (df>(q3+1.5*IQR)))]
   return outliers

#getting outlier details for column "fair_amount" using the above
function

outliers = find_outliers_IQR(df["fare_amount"])
print("number of outliers: "+ str(len(outliers)))
print("max outlier value: "+ str(outliers.max()))
print("min outlier value: "+ str(outliers.min()))
outliers
```

```
number of outliers: 17166
max outlier value: 499.0
min outlier value: -52.0

6          24.50
30         25.70
34         39.50
```

```
39        29.00
48        56.80
          ...
199976    49.70
199977    43.50
199982    57.33
199985    24.00
199997    30.90
Name: fare_amount, Length: 17166, dtype: float64
```

```
#you can also pass two columns as argument to the function (here
"passenger_count" and "fair_amount")

outliers = find_outliers_IQR(df[["passenger_count","fare_amount"]])
outliers
```

```
        passenger_count  fare_amount
0                   NaN          NaN
1                   NaN          NaN
2                   NaN          NaN
3                   NaN          NaN
4                   5.0          NaN
...                 ...          ...
199995              NaN          NaN
199996              NaN          NaN
199997              NaN         30.9
199998              NaN          NaN
199999              NaN          NaN

[199999 rows x 2 columns]
```

```
#upper and lower limit which can be used for capping of outliers

upper_limit = df['fare_amount'].mean() + 3*df['fare_amount'].std()
print(upper_limit)
lower_limit = df['fare_amount'].mean() - 3*df['fare_amount'].std()
print(lower_limit)
```

```
41.06517154774142
-18.345388448825922
```

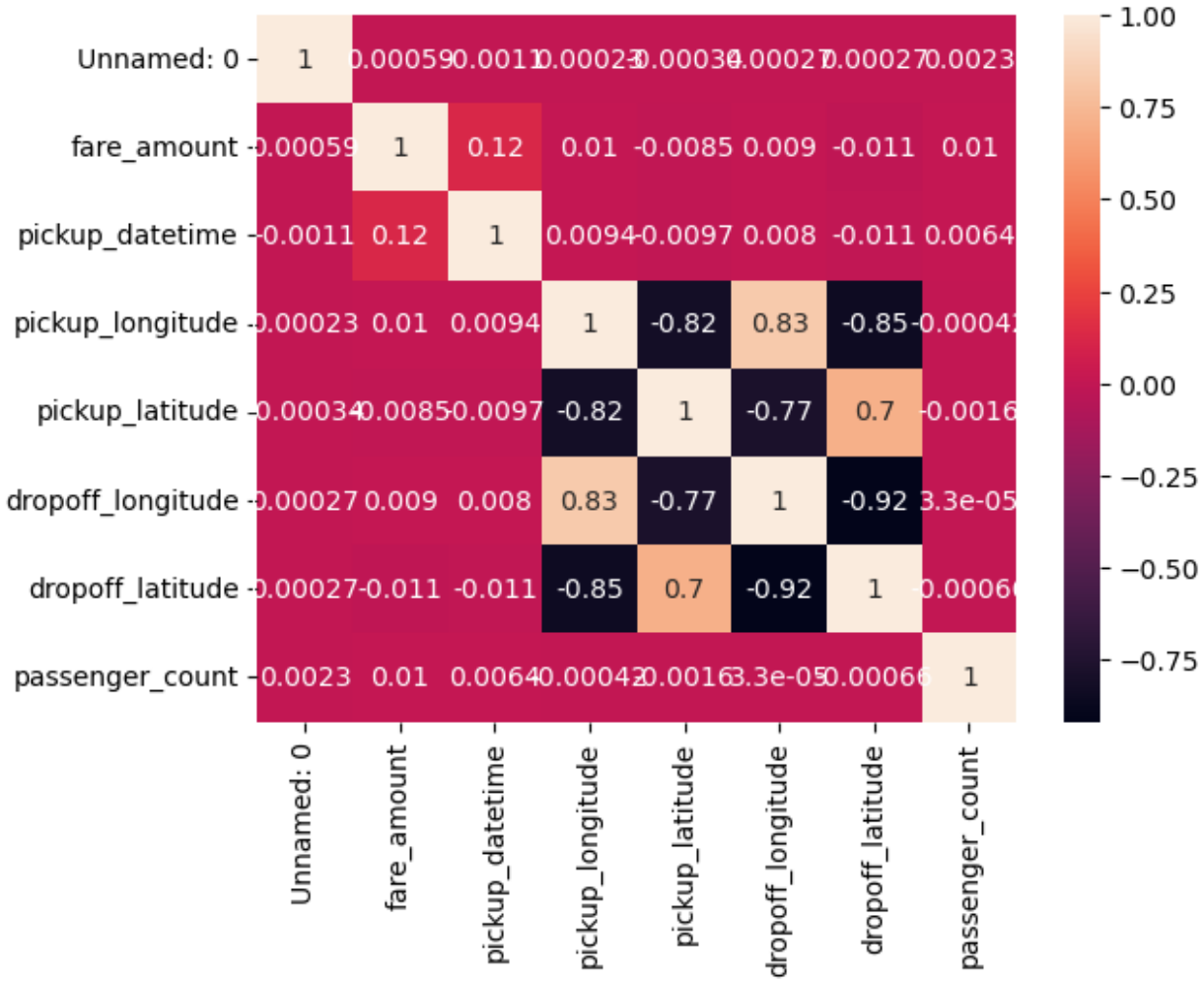
```
df = df.drop(["key"], axis = 1)
df
```

```
        Unnamed: 0  fare_amount           pickup_datetime
pickup_longitude  \
0         24238194          7.5 2015-05-07 19:52:06+00:00        -
73.999817
1         27835199          7.7 2009-07-17 20:04:56+00:00        -
73.994355
2         44984355         12.9 2009-08-24 21:45:00+00:00        -
```

```
74.005043
3         25894730           5.3 2009-06-26 08:22:21+00:00         -
73.976124
4         17610152          16.0 2014-08-28 17:47:00+00:00         -
73.925023
...            ...           ...                        ...
...
199995    42598914           3.0 2012-10-28 10:49:00+00:00         -
73.987042
199996    16382965           7.5 2014-03-14 01:09:00+00:00         -
73.984722
199997    27804658          30.9 2009-06-29 00:42:00+00:00         -
73.986017
199998    20259894          14.5 2015-05-20 14:56:25+00:00         -
73.997124
199999    11951496          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         40.695415
1
199999        40.720077         -73.985508         40.768793
1

[199999 rows x 8 columns]
```

3.Check the correlation

```
#creating a correlation matrix

corrMatrix = df.corr()
sns.heatmap(corrMatrix, annot=True)
plt.show()
```




```
#splitting column "pickup_datetime" into 5 columns: "day", "hour",
"month", "year", "weekday"
#for a simplified view

import calendar
df['day']=df['pickup_datetime'].apply(lambda x:x.day)
df['hour']=df['pickup_datetime'].apply(lambda x:x.hour)
df['month']=df['pickup_datetime'].apply(lambda x:x.month)
df['year']=df['pickup_datetime'].apply(lambda x:x.year)
df['weekday']=df['pickup_datetime'].apply(lambda x:
```

```
calendar.day_name[x.weekday()])
df.drop(['pickup_datetime'],axis=1,inplace=True)

#label encoding (categorical to numerical)

df.weekday =
df.weekday.map({'Sunday':0,'Monday':1,'Tuesday':2,'Wednesday':3,'Thurs
day':4,'Friday':5,'Saturday':6})

df.head()
```

```
   Unnamed: 0  fare_amount  pickup_longitude  pickup_latitude  \
0    24238194          7.5        -73.999817        40.738354
1    27835199          7.7        -73.994355        40.728225
2    44984355         12.9        -74.005043        40.740770
3    25894730          5.3        -73.976124        40.790844
4    17610152         16.0        -73.925023        40.744085

   dropoff_longitude  dropoff_latitude  passenger_count  day  hour
month  \
0         -73.999512         40.723217                1    7    19
5
1         -73.994710         40.750325                1   17    20
7
2         -73.962565         40.772647                1   24    21
8
3         -73.965316         40.803349                3   26     8
6
4         -73.973082         40.761247                5   28    17
8

   year  weekday
0  2015        4
1  2009        5
2  2009        1
3  2009        5
4  2014        4
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 199999 entries, 0 to 199999
Data columns (total 12 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   Unnamed: 0         199999 non-null  int64
 1   fare_amount        199999 non-null  float64
 2   pickup_longitude   199999 non-null  float64
 3   pickup_latitude    199999 non-null  float64
 4   dropoff_longitude  199999 non-null  float64
 5   dropoff_latitude   199999 non-null  float64
```

```
 6   passenger_count    199999 non-null  int64
 7   day                199999 non-null  int64
 8   hour               199999 non-null  int64
 9   month              199999 non-null  int64
 10  year               199999 non-null  int64
 11  weekday            199999 non-null  int64
dtypes: float64(5), int64(7)
memory usage: 19.8 MB
```

```
#splitting the data into train and test

from sklearn.model_selection import train_test_split

#independent variables (x)

x=df.drop("fare_amount", axis=1)
x
```

```
        Unnamed: 0  pickup_longitude  pickup_latitude
dropoff_longitude  \
0         24238194        -73.999817        40.738354          -
73.999512
1         27835199        -73.994355        40.728225          -
73.994710
2         44984355        -74.005043        40.740770          -
73.962565
3         25894730        -73.976124        40.790844          -
73.965316
4         17610152        -73.925023        40.744085          -
73.973082
...            ...               ...              ...                .
..
199995    42598914        -73.987042        40.739367          -
73.986525
199996    16382965        -73.984722        40.736837          -
74.006672
199997    27804658        -73.986017        40.756487          -
73.858957
199998    20259894        -73.997124        40.725452          -
73.983215
199999    11951496        -73.984395        40.720077          -
73.985508

        dropoff_latitude  passenger_count  day  hour  month  year
weekday
0              40.723217                1    7    19      5  2015
4
1              40.750325                1   17    20      7  2009
5
2              40.772647                1   24    21      8  2009
```

```
1
3               40.803349                3   26     8       6  2009
5
4               40.761247                5   28    17       8  2014
4
...                   ...              ...  ...   ...     ...   ...
...
199995          40.740297                1   28    10      10  2012
0
199996          40.739620                1   14     1       3  2014
5
199997          40.692588                2   29     0       6  2009
1
199998          40.695415                1   20    14       5  2015
3
199999          40.768793                1   15     4       5  2010
6

[199999 rows x 11 columns]
```

```
#dependent variable (y)

y=df["fare_amount"]

x_train,x_test,y_train,y_test =
train_test_split(x,y,test_size=0.2,random_state=101)

x_train.head()
```

```
        Unnamed: 0  pickup_longitude  pickup_latitude
dropoff_longitude  \
80768     37342228        -73.983703        40.725752          -
73.972000
111783    34052804        -73.961175        40.760667          -
73.976507
24615     52939040        -73.947784        40.783111          -
73.955408
46932     20073661        -73.980596        40.733797          -
73.972092
86655     28423842        -73.963035        40.758380          -
73.987877

        dropoff_latitude  passenger_count  day  hour  month  year
weekday
80768           40.793888                1   22     1       2  2009
0
111783          40.747570                1    7    14       3  2009
6
24615           40.779405                1   17    11       3  2011
4
```

```
46932          40.747297                  1   15     7      1  2010
5
86655          40.745477                  2   28    19      6  2014
6

x_test.head()

        Unnamed: 0  pickup_longitude  pickup_latitude
dropoff_longitude  \
13588     50390912        -73.982810        40.771687         -
73.977065
29803     36549000        -73.991985        40.725763         -
73.995762
138265    41414868        -73.985730        40.767882         -
73.998525
82856     41011702        -73.973200        40.748100         -
73.973500
162747     5744097        -74.007432        40.716580         -
73.986858

        dropoff_latitude  passenger_count  day  hour  month  year
weekday
13588          40.763200                1   25    22      6  2013
2
29803          40.759797                1   20    20      2  2011
0
138265         40.760667                1   20    14     10  2013
0
82856          40.748200                1   17    18     11  2011
4
162747         40.761328                1   10    22      2  2009
2

y_train.head()

80768     19.7
111783     7.7
24615      4.5
46932      4.5
86655     10.0
Name: fare_amount, dtype: float64

y_test.head()

13588      5.5
29803     11.3
138265     6.5
82856     18.1
162747    11.3
Name: fare_amount, dtype: float64
```

```
print(x_train.shape)
print(x_test.shape)
print(y_test.shape)
print(y_train.shape)
```

```
(159999, 11)
(40000, 11)
(40000,)
(159999,)
```

4.Implementing linear regression and random forest regression models

```
from sklearn.linear_model import LinearRegression
lrmodel = LinearRegression()
lrmodel.fit(x_train, y_train)
```

```
LinearRegression()
```

```
predictedvalues = lrmodel.predict(x_test)
```

```
#Calculating the value of RMSE for Linear Regression

from sklearn.metrics import mean_squared_error
lrmodelrmse = np.sqrt(mean_squared_error(predictedvalues, y_test))
print("RMSE value for Linear regression is", lrmodelrmse)
```

```
RMSE value for Linear regression is 9.806686634823958
```

```
# prediction

pred = lrmodel.predict(x_test)
print("hh", pred)
lrmodel.predict(x_test)
```

```
hh [11.89387011 10.28756723 12.69400122 ... 10.92911584 13.03189145
  9.67477074]
```

```
array([11.89387011, 10.28756723, 12.69400122, ..., 10.92911584,
       13.03189145,  9.67477074])
```

```
from sklearn import metrics

# R2 score

#Calculating the value of R2 for Linear Regression
metrics.r2_score(y_test,predictedvalues)
```

```
0.016807427084618354
```

5. Evaluate the models and compare their respective scores like R2, RMSE, etc.

```
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, r2_score

# Assuming 'df' is your original DataFrame
# Use only the top 20 rows
df_top20 = df.head(20)

# Select features and target
X = df_top20.drop(columns=['passenger_count'])  # Features
y = df_top20['passenger_count']  # Target variable

# Split data into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Create and fit the Random Forest Regressor model
rfrmodel = RandomForestRegressor(n_estimators=100, random_state=101)
rfrmodel.fit(x_train, y_train)
```

```
RandomForestRegressor(random_state=101)
```

```
# Make predictions
rfrmodel_pred = rfrmodel.predict(x_test)

# Calculate RMSE
rfrmodel_rmse = np.sqrt(mean_squared_error(y_test, rfrmodel_pred))
print("RMSE value for Random Forest regression is:", rfrmodel_rmse)
```

```
RMSE value for Random Forest regression is: 0.7077428911688198
```

```
# Calculate R² score
rfrmodel_r2 = r2_score(y_test, rfrmodel_pred)
print("R² value for Random Forest regression is:", rfrmodel_r2)
```

```
R² value for Random Forest regression is: -1.0036
```