#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

In [1]:

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

In [2]:

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

1. Pre-process the dataset.

In [3]:

```
df.head()
```

Out[3]:

	Unnamed: 0	key	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_
0	24238194	2015-05-07 19:52:06.0000003	7.5	2015-05-07 19:52:06 UTC	-73.999817	40.738354	-73.999512	40
1	27835199	2009-07-17 20:04:56.0000002	7.7	2009-07-17 20:04:56 UTC	-73.994355	40.728225	-73.994710	40
2	44984355	2009-08-24 21:45:00.00000061	12.9	2009-08-24 21:45:00 UTC	-74.005043	40.740770	-73.962565	40
3	25894730	2009-06-26 08:22:21.0000001	5.3	2009-06-26 08:22:21 UTC	-73.976124	40.790844	-73.965316	40
4	17610152	2014-08-28 17:47:00.000000188	16.0	2014-08-28 17:47:00 UTC	-73.925023	40.744085	-73.973082	40

In [4]:

```
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
```

In [5]:

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

Out[5]:

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

In [6]:

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

In [7]:

```
df.head()
```

Out[7]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count
0	7.5	2015-05-07 19:52:06 UTC	-73.999817	40.738354	-73.999512	40.723217	1
1	7.7	2009-07-17 20:04:56 UTC	-73.994355	40.728225	-73.994710	40.750325	1
2	12.9	2009-08-24 21:45:00 UTC	-74.005043	40.740770	-73.962565	40.772647	1
3	5.3	2009-06-26 08:22:21 UTC	-73.976124	40.790844	-73.965316	40.803349	3
4	16.0	2014-08-28 17:47:00 UTC	-73.925023	40.744085	-73.973082	40.761247	5

In [8]:

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

Out[8]:

```
(200000, 7)
```

In [9]:

```
df.dtypes #To get the type of each column
```

Out[9]:

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

In [10]:

```
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
```

In [11]:

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

Out[11]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count
count	200000.000000	200000.000000	200000.000000	199999.000000	199999.000000	200000.000000
mean	11.359955	-72.527638	39.935885	-72.525292	39.923890	1.684535
std	9.901776	11.437787	7.720539	13.117408	6.794829	1.385997
min	-52.000000	-1340.648410	-74.015515	-3356.666300	-881.985513	0.000000
25%	6.000000	-73.992065	40.734796	-73.991407	40.733823	1.000000
50%	8.500000	-73.981823	40.752592	-73.980093	40.753042	1.000000
75%	12.500000	-73.967154	40.767158	-73.963658	40.768001	2.000000
max	499.000000	57.418457	1644.421482	1153.572603	872.697628	208.000000

Filling Missing values

In [12]:

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

Out[12]:

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

In [13]:

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

In [14]:

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

Out[14]:

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

In [15]:

```
df.dtypes
```

Out[15]:

```
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

In [16]:

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

In [17]:

```
df.dtypes
```

Out[17]:

```
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

In [18]:

```
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)
```

In [19]:

```
df.head()
```

Out[19]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count	hour
0	7.5	2015-05-07 19:52:06+00:00	-73.999817	40.738354	-73.999512	40.723217	1	19
1	7.7	2009-07-17 20:04:56+00:00	-73.994355	40.728225	-73.994710	40.750325	1	20
2	12.9	2009-08-24 21:45:00+00:00	-74.005043	40.740770	-73.962565	40.772647	1	21
3	5.3	2009-06-26 08:22:21+00:00	-73.976124	40.790844	-73.965316	40.803349	3	8
4	16.0	2014-08-28 17:47:00+00:00	-73.925023	40.744085	-73.973082	40.761247	5	17

In [20]:

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

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

In [21]:

```
df.head()
```

Out[21]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count	hour	day	month	ye
0	7.5	-73.999817	40.738354	-73.999512	40.723217	1	19	7	5	20
1	7.7	-73.994355	40.728225	-73.994710	40.750325	1	20	17	7	20
2	12.9	-74.005043	40.740770	-73.962565	40.772647	1	21	24	8	20
3	5.3	-73.976124	40.790844	-73.965316	40.803349	3	8	26	6	20
4	16.0	-73.925023	40.744085	-73.973082	40.761247	5	17	28	8	20

In [22]:

```
df.dtypes
```

Out[22]:

```
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
```

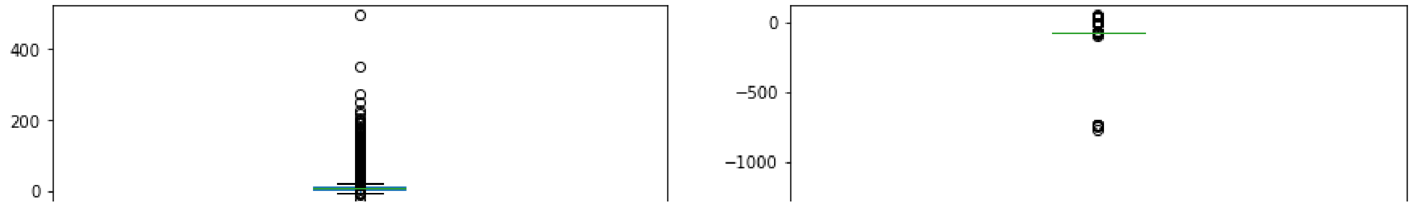
Checking outliers and filling them

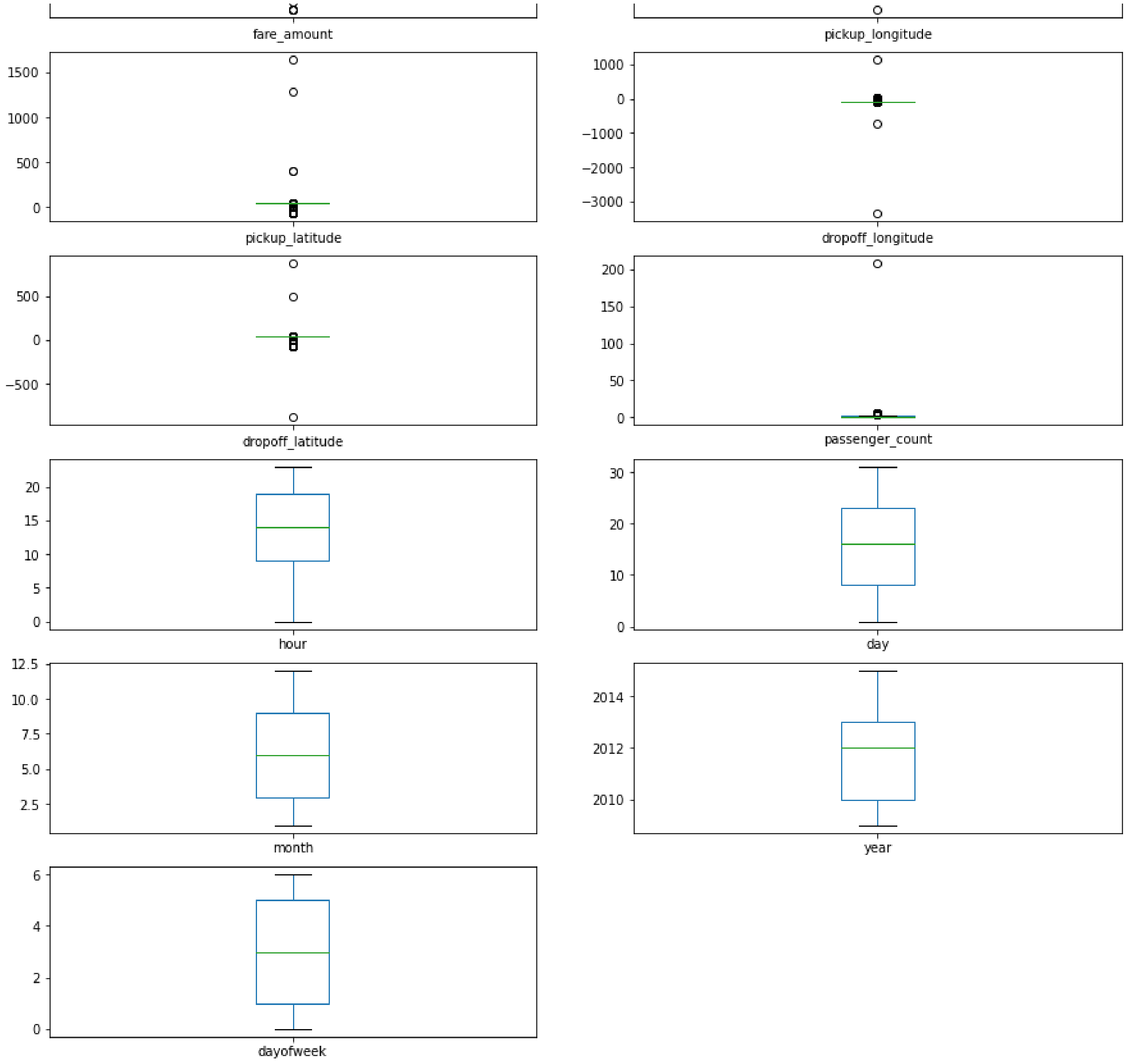
In [23]:

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

Out[23]:

```
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
```





In [24]:

```
#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
```

In [25]:

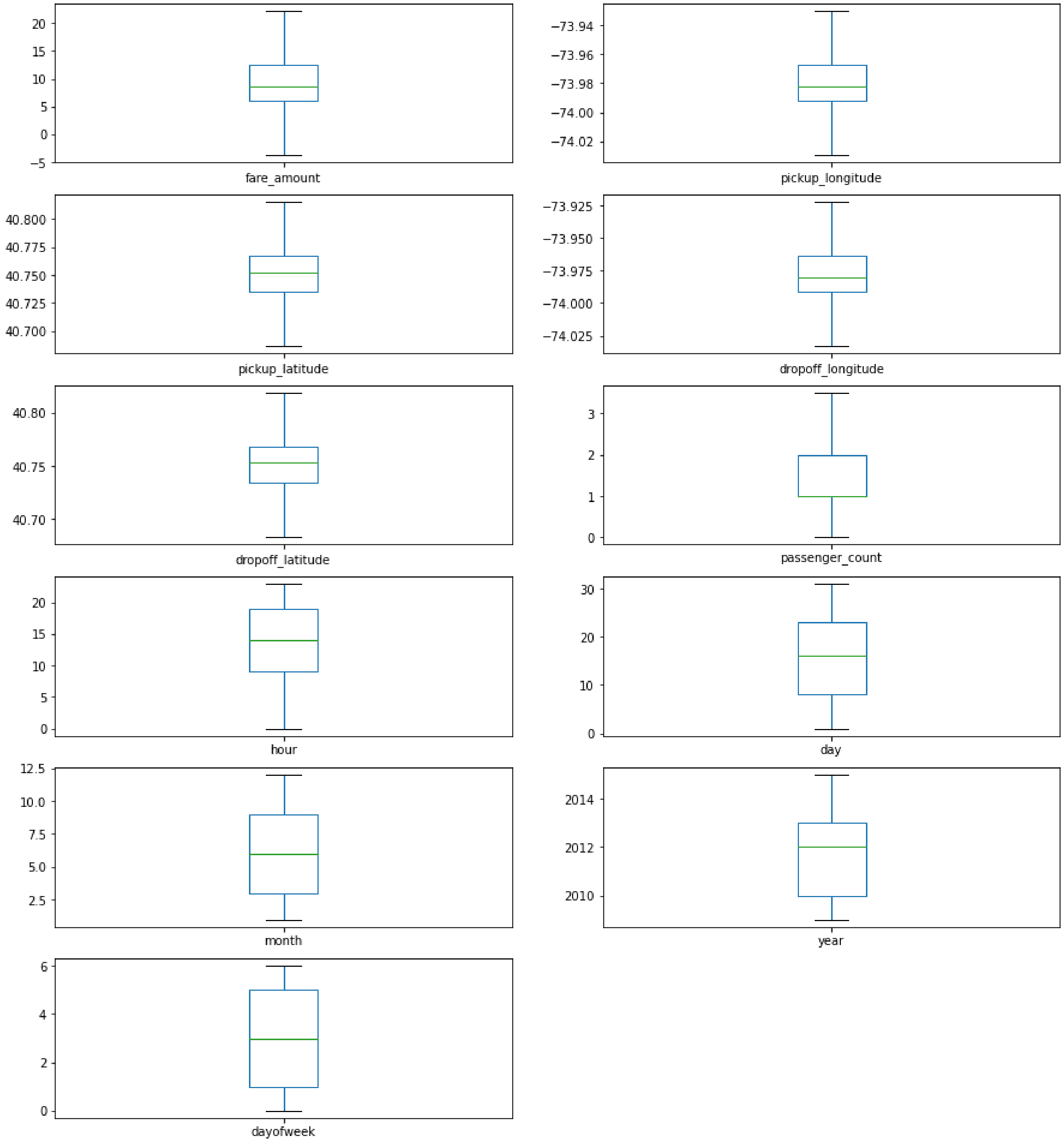
```
df = treat_outliers_all(df , df.iloc[: , 0::])
```

In [26]:

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

Out[26]:

```
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
```



In [27]:

```
#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)
```

Out[27]:

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

In [28]:

```
#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)
```

In [29]:

```
#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)
                                    ]
```

In [30]:

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

In [31]:

```
df.head()
```

Out[31]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count	hour	day	month	ye
0	7.5	-73.999817	40.738354	-73.999512	40.723217	1.0	19	7	5	20
1	7.7	-73.994355	40.728225	-73.994710	40.750325	1.0	20	17	7	20

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count	hour	day	month	ye
2	12.9	-74.005043	40.740770	-73.962565	40.772647	1.0	21	24	8	20
3	5.3	-73.976124	40.790844	-73.965316	40.803349	3.0	8	26	6	20
4	16.0	-73.929786	40.744085	-73.973082	40.761247	3.5	17	28	8	20

In [32]:

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

Out[32]:

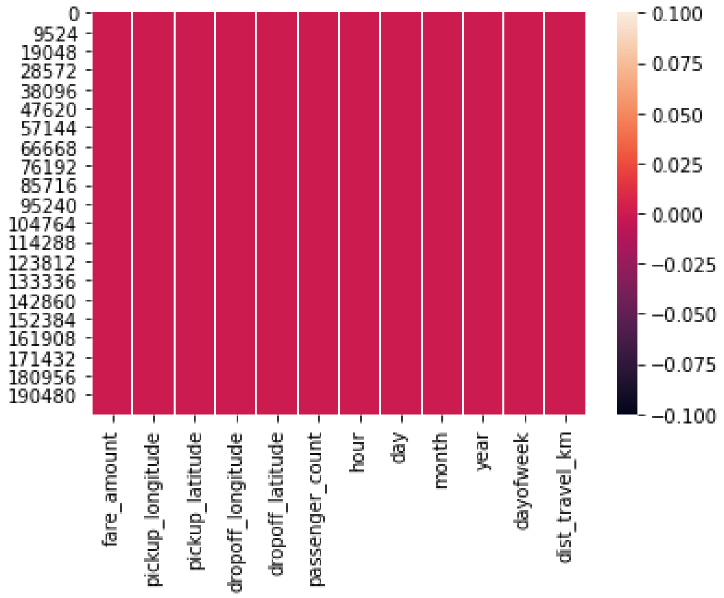
```
fare_amount          0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
hour                 0
day                  0
month                0
year                 0
dayofweek            0
dist_travel_km       0
dtype: int64
```

In [33]:

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

Out[33]:

```
<AxesSubplot:>
```



In [34]:

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

In [35]:

```
corr
```

Out[35]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count	ho
fare_amount	1.000000	0.154069	-0.110842	0.218675	-0.125898	0.015778	0.0236
pickup_longitude	0.154069	1.000000	0.259497	0.425619	0.073290	-0.013213	0.0115

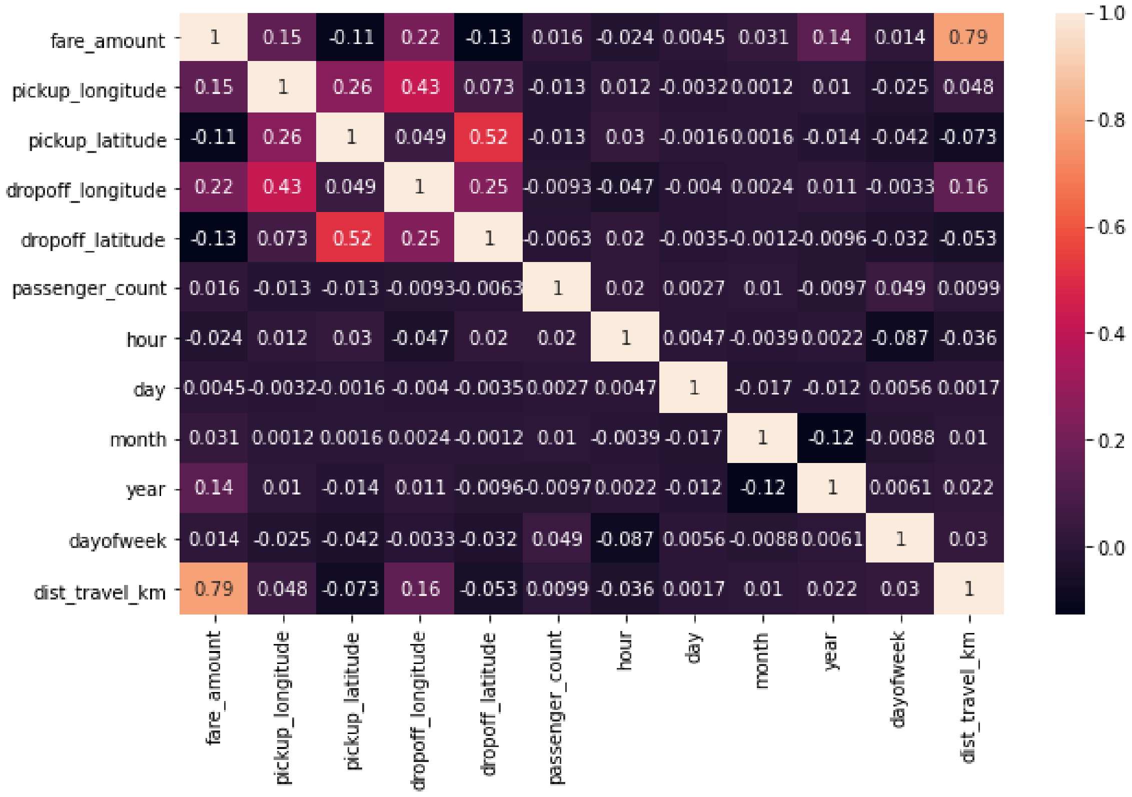
	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count	ho
pickup_latitude	-0.110842	0.259497	1.000000	0.048889	0.515714	-0.012889	0.0296
dropoff_longitude	0.218675	0.425619	0.048889	1.000000	0.245667	-0.009303	0.0465
dropoff_latitude	-0.125898	0.073290	0.515714	0.245667	1.000000	-0.006308	0.0197
passenger_count	0.015778	-0.013213	-0.012889	-0.009303	-0.006308	1.000000	0.0202
hour	-0.023623	0.011579	0.029681	-0.046558	0.019783	0.020274	1.0000
day	0.004534	-0.003204	-0.001553	-0.004007	-0.003479	0.002712	0.0046
month	0.030817	0.001169	0.001562	0.002391	-0.001193	0.010351	0.0039
year	0.141277	0.010198	-0.014243	0.011346	-0.009603	-0.009749	0.0021
dayofweek	0.013652	-0.024652	-0.042310	-0.003336	-0.031919	0.048550	0.0869
dist_travel_km	0.786385	0.048446	-0.073362	0.155191	-0.052701	0.009884	0.0357

In [36]:

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

Out[36]:

```
<AxesSubplot:>
```



Dividing the dataset into feature and target values

In [182]:

```
x = df[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_latitude','pass
enger_count','hour','day','month','year','dayofweek','dist_travel_km']]
```

In [183]:

```
y = df['fare_amount']
```

Dividing the dataset into training and testing dataset

In [184]:

```
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

In [185]:

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

In [186]:

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

Out[186]:

```
LinearRegression()
```

In [80]:

```
regression.intercept_ #To find the linear intercept
```

Out[80]:

```
2640.1356169149753
```

In [187]:

```
regression.coef_ #To find the linear coeeficient
```

Out[187]:

```
array([ 2.54805415e+01, -7.18365435e+00,  1.96232986e+01, -1.79401980e+01,
        5.48472723e-02,  5.32910041e-03,  4.05930990e-03,  5.74261856e-02,
        3.66574831e-01, -3.03753790e-02,  1.84233728e+00])
```

In [188]:

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

In [189]:

```
print(prediction)
```

```
[ 5.47848314 10.11016249 12.19490542 ...  7.11952609 20.2482979
  8.82791961]
```

In [190]:

```
y_test
```

Out[190]:

```
155740     4.90
47070     10.00
116192    14.50
164589     6.50
154309    11.30
          ...
76552      7.70
27926     10.90
38972      6.50
```

```
38972      6.50
120341    22.25
178449     8.10
Name: fare_amount, Length: 66000, dtype: float64
```

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

In [191]:

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

In [192]:

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

Out[192]:

```
0.6651880468683617
```

In [193]:

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

In [194]:

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

In [195]:

```
MSE
```

Out[195]:

```
9.961516917717704
```

In [196]:

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

In [197]:

```
RMSE
```

Out[197]:

```
3.156187085348032
```

Random Forest Regression

In [198]:

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

In [199]:

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

In [200]:

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

Out[200]:

```
RandomForestRegressor()
```

In [201]:

```
y_pred = rf.predict(X_test)
```

In [202]:

```
y_pred
```

Out[202]:

```
array([ 5.714 , 10.285 , 12.68  , ...,  6.338 , 19.4685,  7.712 ])
```

Metrics evaluatin for Random Forest

In [210]:

```
R2_Random = r2_score(y_test,y_pred)
```

In [211]:

```
R2_Random
```

Out[211]:

```
0.7948374920410631
```

In [205]:

```
MSE_Random = mean_squared_error(y_test,y_pred)
```

In [206]:

```
MSE_Random
```

Out[206]:

```
6.104112397417331
```

In [207]:

```
RMSE_Random = np.sqrt(MSE_Random)
```

In [208]:

```
RMSE_Random
```

Out[208]:

```
2.4706501972997574
```