# #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 (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 |
|---|---|---|---|---|---|---|
| **0** | 24238194 | 2015-05-07 19:52:06.0000003 | 7.5 | 2015-05-07 19:52:06 UTC | -73.999817 | 40.738354 |
| **1** | 27835199 | 2009-07-17 20:04:56.0000002 | 7.7 | 2009-07-17 20:04:56 UTC | -73.994355 | 40.728225 |
| **2** | 44984355 | 2009-08-24 21:45:00.00000061 | 12.9 | 2009-08-24 21:45:00 UTC | -74.005043 | 40.740770 |
| **3** | 25894730 | 2009-06-26 08:22:21.0000001 | 5.3 | 2009-06-26 08:22:21 UTC | -73.976124 | 40.790844 |
| **4** | 17610152 | 2014-08-28 17:47:00.000000188 | 16.0 | 2014-08-28 17:47:00 UTC | -73.925023 | 40.744085 |

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
```

In [7]:
```
df.head()
```

Out[7]:

| | fare_amount | pickup_datetime | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitu |
|---|---|---|---|---|---|---|
| **0** | 7.5 | 2015-05-07 19:52:06 UTC | -73.999817 | 40.738354 | -73.999512 | 40.723 |
| **1** | 7.7 | 2009-07-17 20:04:56 UTC | -73.994355 | 40.728225 | -73.994710 | 40.750 |
| **2** | 12.9 | 2009-08-24 21:45:00 UTC | -74.005043 | 40.740770 | -73.962565 | 40.772 |
| **3** | 5.3 | 2009-06-26 08:22:21 UTC | -73.976124 | 40.790844 | -73.965316 | 40.803 |
| **4** | 16.0 | 2014-08-28 17:47:00 UTC | -73.925023 | 40.744085 | -73.973082 | 40.761 |

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 | passen |
|---|---|---|---|---|---|---|
| **count** | 200000.000000 | 200000.000000 | 200000.000000 | 199999.000000 | 199999.000000 | 2000 |
| **mean** | 11.359955 | -72.527638 | 39.935885 | -72.525292 | 39.923890 | |
| **std** | 9.901776 | 11.437787 | 7.720539 | 13.117408 | 6.794829 | |
| **min** | -52.000000 | -1340.648410 | -74.015515 | -3356.666300 | -881.985513 | |
| **25%** | 6.000000 | -73.992065 | 40.734796 | -73.991407 | 40.733823 | |
| **50%** | 8.500000 | -73.981823 | 40.752592 | -73.980093 | 40.753042 | |
| **75%** | 12.500000 | -73.967154 | 40.767158 | -73.963658 | 40.768001 | |
| **max** | 499.000000 | 57.418457 | 1644.421482 | 1153.572603 | 872.697628 | 2 |

## 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 = T
```

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_latitu |
|---|---|---|---|---|---|---|
| **0** | 7.5 | 2015-05-07 19:52:06+00:00 | -73.999817 | 40.738354 | -73.999512 | 40.7232 |
| **1** | 7.7 | 2009-07-17 20:04:56+00:00 | -73.994355 | 40.728225 | -73.994710 | 40.7503 |
| **2** | 12.9 | 2009-08-24 21:45:00+00:00 | -74.005043 | 40.740770 | -73.962565 | 40.7726 |
| **3** | 5.3 | 2009-06-26 08:22:21+00:00 | -73.976124 | 40.790844 | -73.965316 | 40.8033 |
| **4** | 16.0 | 2014-08-28 17:47:00+00:00 | -73.925023 | 40.744085 | -73.973082 | 40.7612 |

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_cc |
|---|---|---|---|---|---|---|
| **0** | 7.5 | -73.999817 | 40.738354 | -73.999512 | 40.723217 | |
| **1** | 7.7 | -73.994355 | 40.728225 | -73.994710 | 40.750325 | |
| **2** | 12.9 | -74.005043 | 40.740770 | -73.962565 | 40.772647 | |
| **3** | 5.3 | -73.976124 | 40.790844 | -73.965316 | 40.803349 | |
| **4** | 16.0 | -73.925023 | 40.744085 | -73.973082 | 40.761247 | |

In [22]:

```
df.dtypes
```

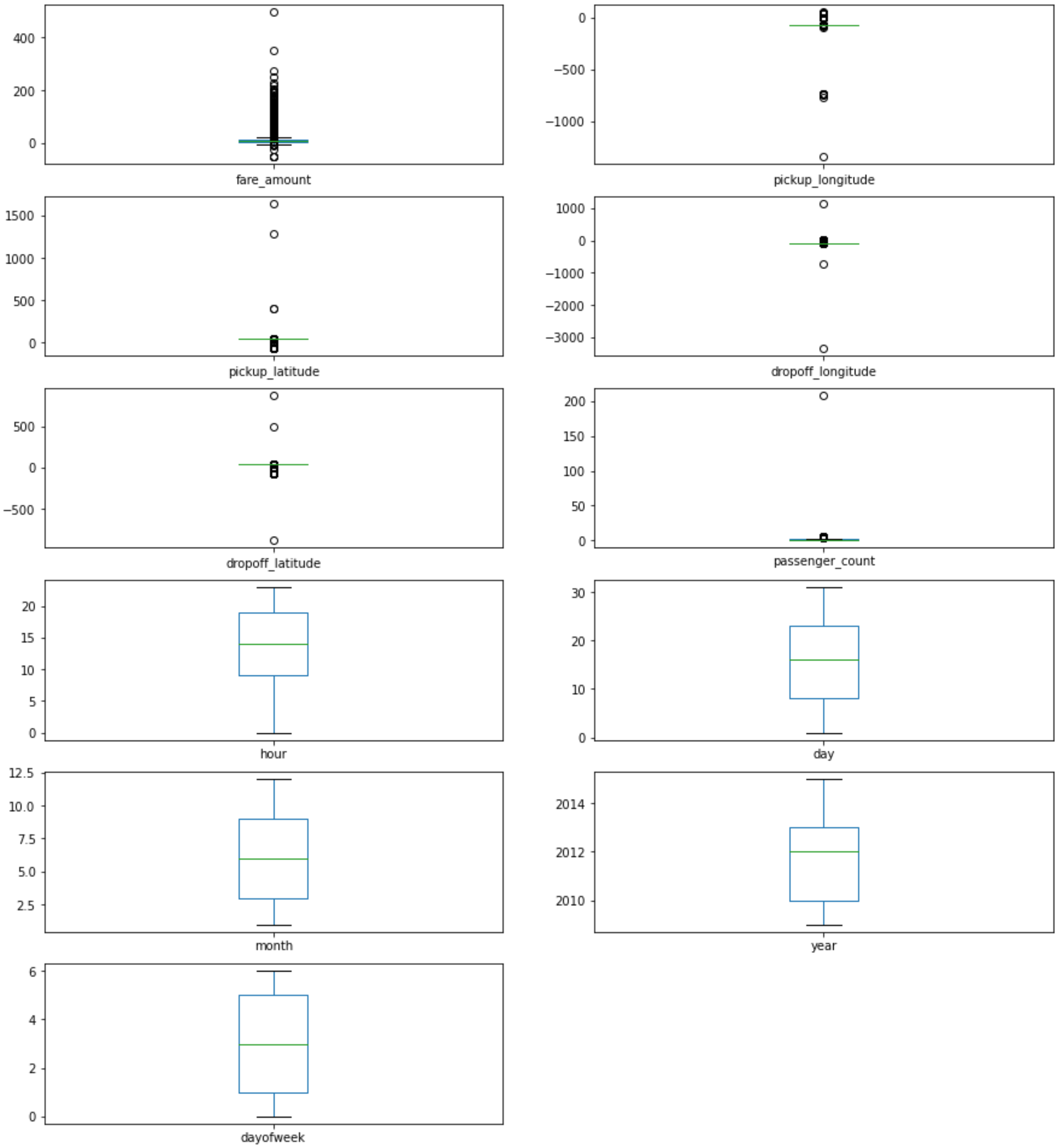
Out[22]:

```
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
```

```
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]:

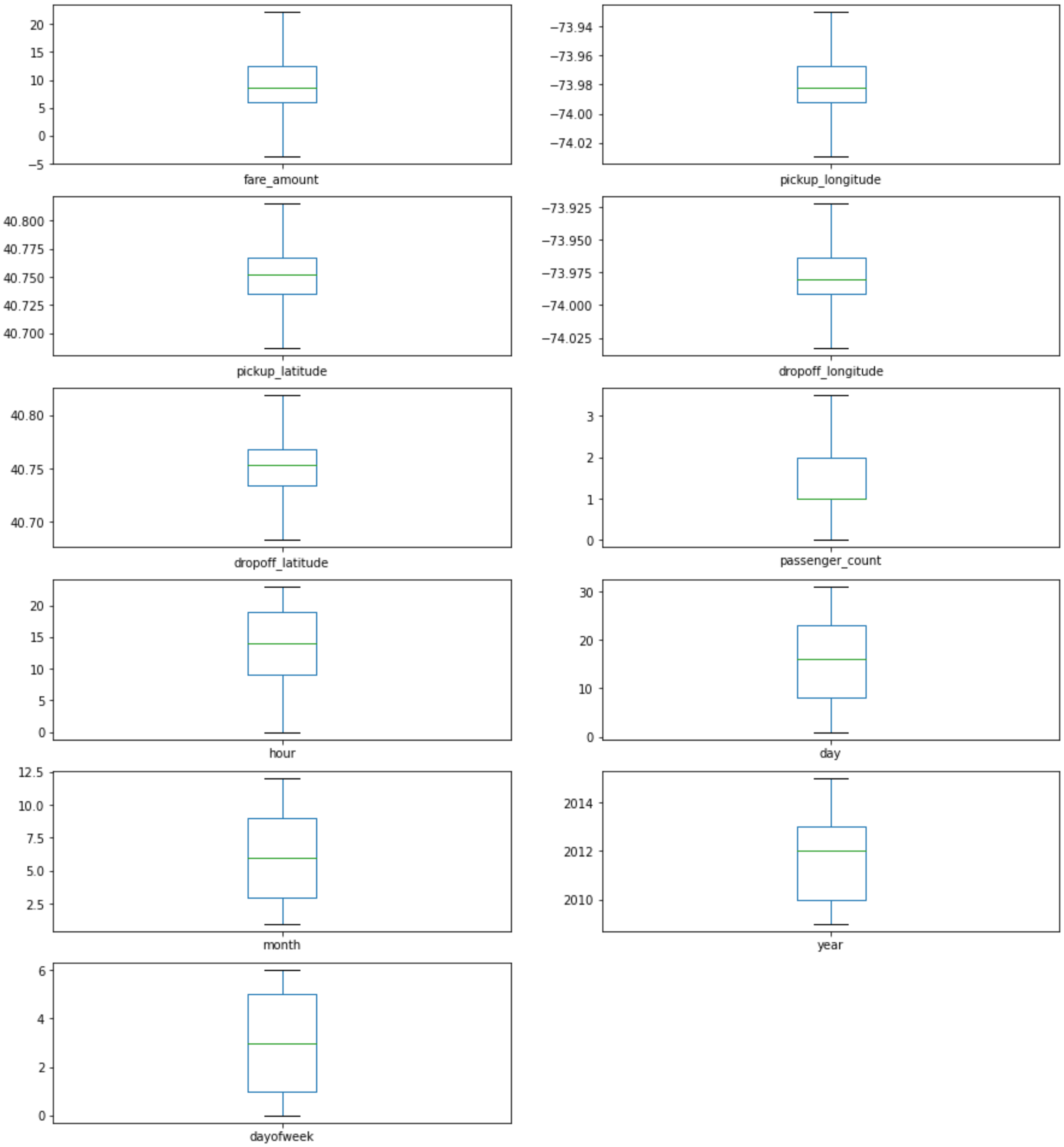
```
#Using the InterQuartile Range to fill the values
def remove_outlier(df1 , col):
    Q1 = df1[col].quantile(0.25)
    Q3 = df1[col].quantile(0.75)
    IQR = Q3 - Q1
    lower_whisker = Q1-1.5*IQR
    upper_whisker = Q3+1.5*IQR
    df[col] = np.clip(df1[col] , lower_whisker , upper_whisker)
    return 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 sho
```

```
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
travel_dist = []
for pos in range(len(df['pickup_longitude'])):
        long1,lati1,long2,lati2 = [df['pickup_longitude'][pos],df['pickup_latitud
        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_c |
|---|---|---|---|---|---|---|
| **0** | 7.5 | -73.999817 | 40.738354 | -73.999512 | 40.723217 | |
| **1** | 7.7 | -73.994355 | 40.728225 | -73.994710 | 40.750325 | |
| **2** | 12.9 | -74.005043 | 40.740770 | -73.962565 | 40.772647 | |
| **3** | 5.3 | -73.976124 | 40.790844 | -73.965316 | 40.803349 | |
| **4** | 16.0 | -73.929786 | 40.744085 | -73.973082 | 40.761247 | |

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
incorrect_coordinates = df.loc[(df.pickup_latitude > 90) |(df.pickup_latitude < -
                                   (df.dropoff_latitude > 90) |(df.dropoff_latitu
                                   (df.pickup_longitude > 180) |(df.pickup_longit
                                   (df.dropoff_longitude > 90) |(df.dropoff_longi
                                    ]
```

In [30]:

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

In [31]:
```
df.head()
```

Out[31]:

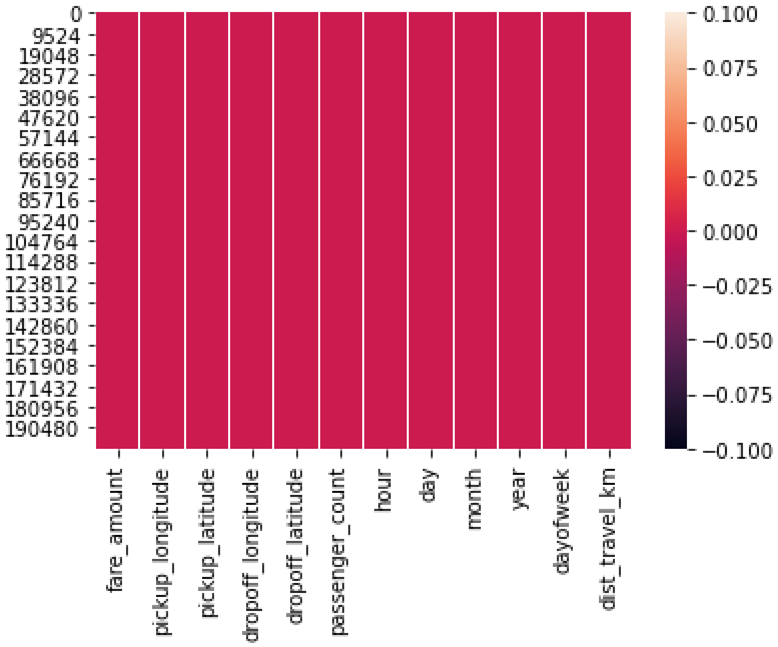
| | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitude | passenger_cc |
|---|---|---|---|---|---|---|
| **0** | 7.5 | -73.999817 | 40.738354 | -73.999512 | 40.723217 | |
| **1** | 7.7 | -73.994355 | 40.728225 | -73.994710 | 40.750325 | |
| **2** | 12.9 | -74.005043 | 40.740770 | -73.962565 | 40.772647 | |
| **3** | 5.3 | -73.976124 | 40.790844 | -73.965316 | 40.803349 | |
| **4** | 16.0 | -73.929786 | 40.744085 | -73.973082 | 40.761247 | |

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
```

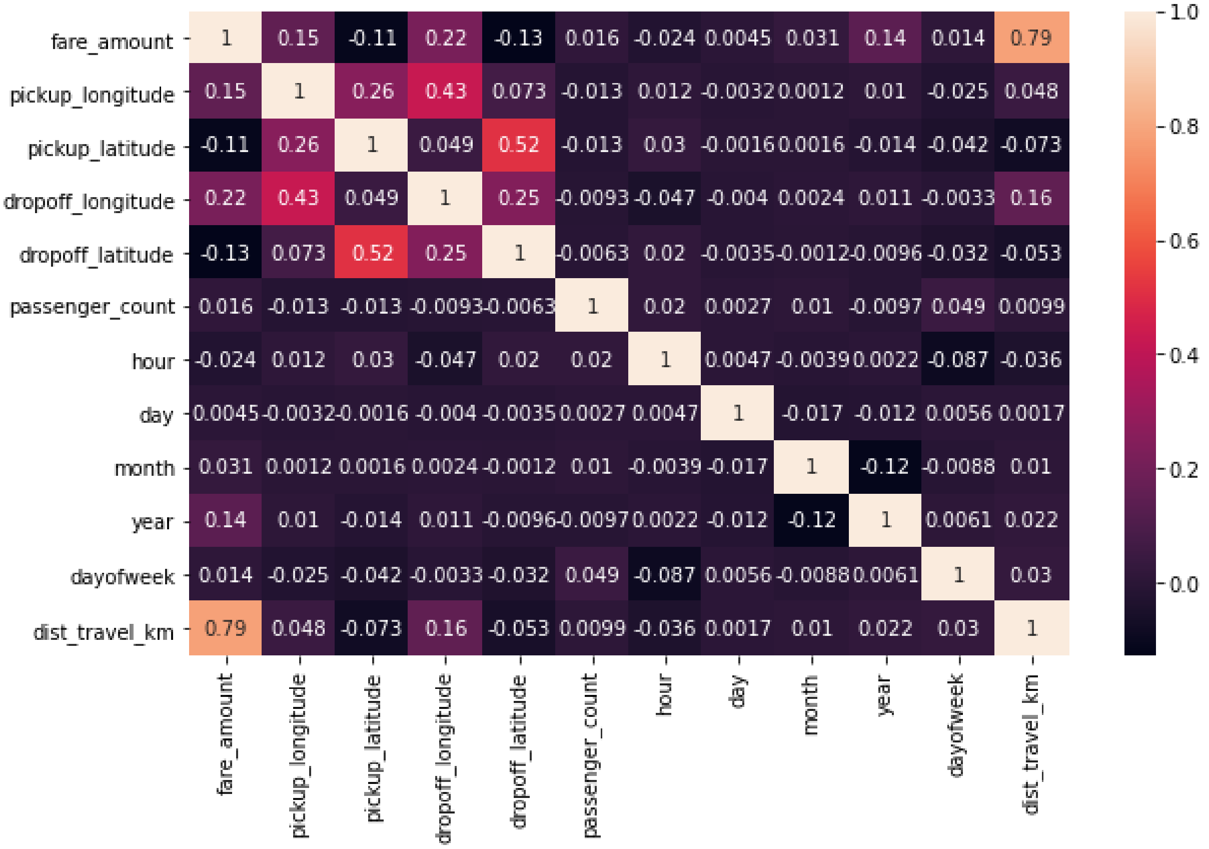
In [35]:
```
corr
```

Out[35]:

| | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitud |
|---|---|---|---|---|---|
| **fare_amount** | 1.000000 | 0.154069 | -0.110842 | 0.218675 | -0.12589 |
| **pickup_longitude** | 0.154069 | 1.000000 | 0.259497 | 0.425619 | 0.07329 |
| **pickup_latitude** | -0.110842 | 0.259497 | 1.000000 | 0.048889 | 0.51571 |
| **dropoff_longitude** | 0.218675 | 0.425619 | 0.048889 | 1.000000 | 0.24566 |
| **dropoff_latitude** | -0.125898 | 0.073290 | 0.515714 | 0.245667 | 1.00000 |
| **passenger_count** | 0.015778 | -0.013213 | -0.012889 | -0.009303 | -0.00630 |
| **hour** | -0.023623 | 0.011579 | 0.029681 | -0.046558 | 0.01978 |
| **day** | 0.004534 | -0.003204 | -0.001553 | -0.004007 | -0.00347 |
| **month** | 0.030817 | 0.001169 | 0.001562 | 0.002391 | -0.00119 |
| **year** | 0.141277 | 0.010198 | -0.014243 | 0.011346 | -0.00960 |
| **dayofweek** | 0.013652 | -0.024652 | -0.042310 | -0.003336 | -0.03191 |
| **dist_travel_km** | 0.786385 | 0.048446 | -0.073362 | 0.155191 | -0.05270 |

In [36]:
```
fig,axis = plt.subplots(figsize = (10,6))
sns.heatmap(df.corr(),annot = True) #Correlation Heatmap (Light values means high
```

Out[36]:
```
<AxesSubplot:>
```



| | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitude | passenger_count | hour | day | month | year | dayofweek | dist_travel_km |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fare_amount | 1 | 0.15 | -0.11 | 0.22 | -0.13 | 0.016 | -0.024 | 0.0045 | 0.031 | 0.14 | 0.014 | 0.79 |
| pickup_longitude | 0.15 | 1 | 0.26 | 0.43 | 0.073 | -0.013 | 0.012 | -0.0032 | 0.0012 | 0.01 | -0.025 | 0.048 |
| pickup_latitude | -0.11 | 0.26 | 1 | 0.049 | 0.52 | -0.013 | 0.03 | -0.0016 | 0.0016 | -0.014 | -0.042 | -0.073 |
| dropoff_longitude | 0.22 | 0.43 | 0.049 | 1 | 0.25 | -0.0093 | -0.047 | -0.004 | 0.0024 | 0.011 | -0.0033 | 0.16 |
| dropoff_latitude | -0.13 | 0.073 | 0.52 | 0.25 | 1 | -0.0063 | 0.02 | -0.0035 | -0.0012 | -0.0096 | -0.032 | -0.053 |
| passenger_count | 0.016 | -0.013 | -0.013 | -0.0093 | -0.0063 | 1 | 0.02 | 0.0027 | 0.01 | -0.0097 | 0.049 | 0.0099 |
| hour | -0.024 | 0.012 | 0.03 | -0.047 | 0.02 | 0.02 | 1 | 0.0047 | -0.0039 | 0.0022 | -0.087 | -0.036 |
| day | 0.0045 | -0.0032 | -0.0016 | -0.004 | -0.0035 | 0.0027 | 0.0047 | 1 | -0.017 | -0.012 | 0.0056 | 0.0017 |
| month | 0.031 | 0.0012 | 0.0016 | 0.0024 | -0.0012 | 0.01 | -0.0039 | -0.017 | 1 | -0.12 | -0.0088 | 0.01 |
| year | 0.14 | 0.01 | -0.014 | 0.011 | -0.0096 | -0.0097 | 0.0022 | -0.012 | -0.12 | 1 | 0.0061 | 0.022 |
| dayofweek | 0.014 | -0.025 | -0.042 | -0.0033 | -0.032 | 0.049 | -0.087 | 0.0056 | -0.0088 | 0.0061 | 1 | 0.03 |
| dist_travel_km | 0.79 | 0.048 | -0.073 | 0.16 | -0.053 | 0.0099 | -0.036 | 0.0017 | 0.01 | 0.022 | 0.03 | 1 |

## Dividing the dataset into feature and target values

```
In [182]: x = df[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_latitu
```

```
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
          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 t
```

```
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
```