Experiment 1:

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 [133]:
```
#Importing the required libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

In [134]:
```
#importing the dataset
df = pd.read_csv("uber.csv")
```

1. Pre-process the dataset.

In [135]:
```
df.head()
```

Out[135]:

	Unnamed: 0	key	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropo
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 [136]:
```
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 [137]:
```
df.columns #TO get number of columns in the dataset
```

Out[137]:
```
Index(['Unnamed: 0', 'key', 'fare_amount', 'pickup_datetime',
       'pickup_longitude', 'pickup_latitude', 'dropoff_longitude',
       'dropoff_latitude', 'passenger_count'],
      dtype='object')
```

In [138]:
```
df = df.drop(['Unnamed: 0', 'key'], axis= 1) #To drop unnamed column as it isn't requ
```

In [139]:
```
df.shape #To get the total (Rows,Columns)
```

Out[139]:
```
(200000, 7)
```

In [140]:
```
df.dtypes #To get the type of each column
```

Out[140]:
```
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 [141]:
```
df.pickup_datetime = pd.to_datetime(df.pickup_datetime)
```

In [142]:
```
df.dtypes
```

Out[142]:
```
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
```

Filling Missing values

In [143]:
```
df.isnull().sum()
```

Out[143]:
```
fare_amount          0
pickup_datetime      0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    1
dropoff_latitude     1
passenger_count      0
dtype: int64
```

In [144]:
```
df['dropoff_latitude'].fillna(value=df['dropoff_latitude'].mean(),inplace = True)
df['dropoff_longitude'].fillna(value=df['dropoff_longitude'].median(),inplace = True)
```

In [145]:
```
df.isnull().sum()
```

Out[145]:
```
fare_amount          0
pickup_datetime      0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
dtype: int64
```

To segregate each time of date and time

In [146]:
```
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)
```

Here we are going to use Heversine formula to calculate the distance between two points and journey, using the longitude and latitude values.

Heversine formula hav(θ) = sin**2(θ/2).

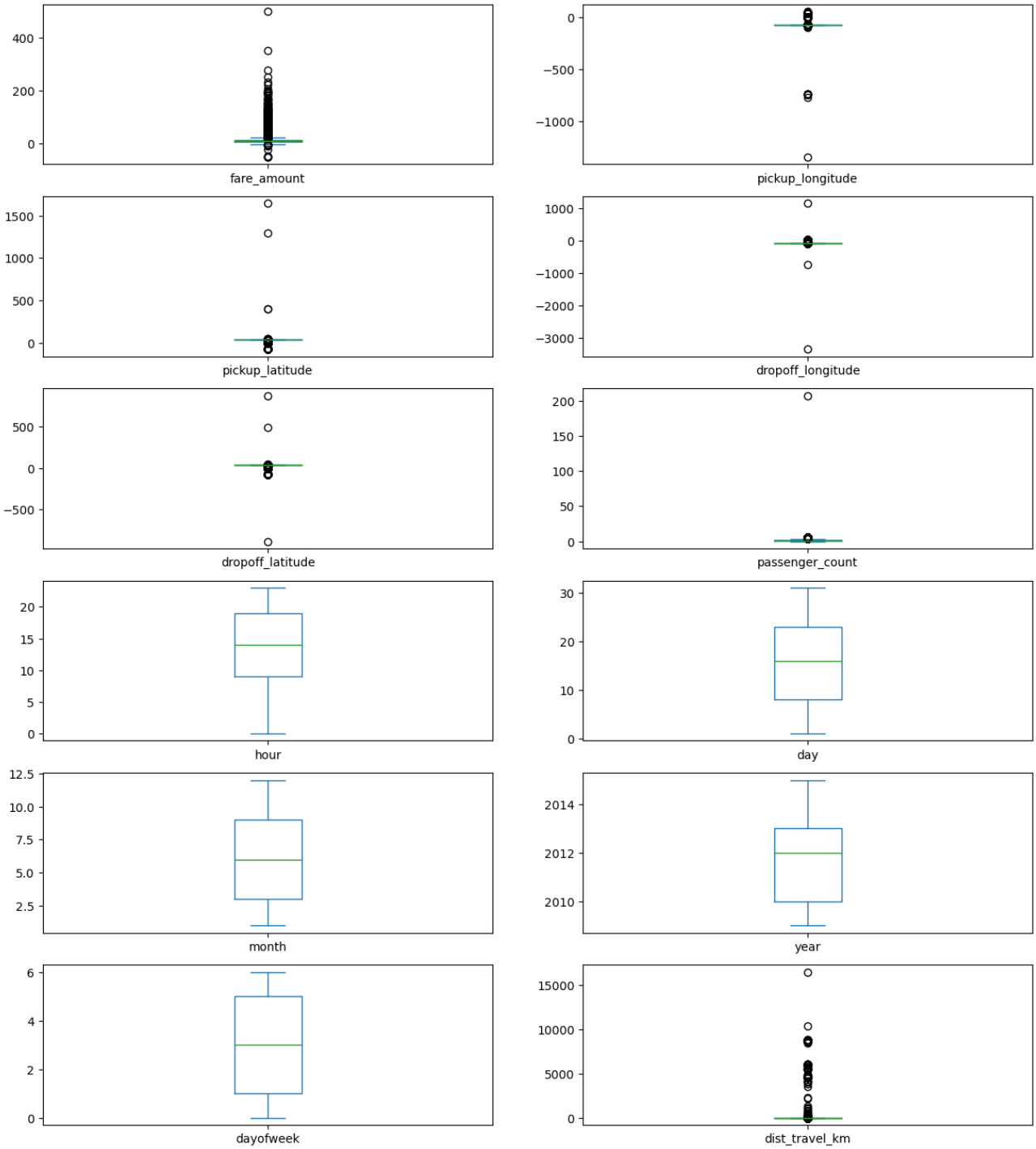
In [147]:
```
from math import *
# function to calculate the travel distance from the longitudes and latitudes
def distance_transform(longitude1, latitude1, longitude2, latitude2):
 travel_dist = []

 for pos in range(len(longitude1)):
    long1,lati1,long2,lati2 = map(radians,[longitude1[pos],latitude1[pos],longitude2[
    dist_long = long2 - long1
    dist_lati = lati2 - lati1
    a = sin(dist_lati/2)**2 + cos(lati1) * cos(lati2) * sin(dist_long/2)**2
    c = 2 * asin(sqrt(a))*6371
    travel_dist.append(c)

 return travel_dist
```

In [148]:
```
df['dist_travel_km'] = distance_transform(df['pickup_longitude'].to_numpy(),
 df['pickup_latitude'].to_numpy(),
 df['dropoff_longitude'].to_numpy(),
 df['dropoff_latitude'].to_numpy()
 )
```

Checking outliers and filling them

In [149]:
```
df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20)) #Boxplot to chec
```

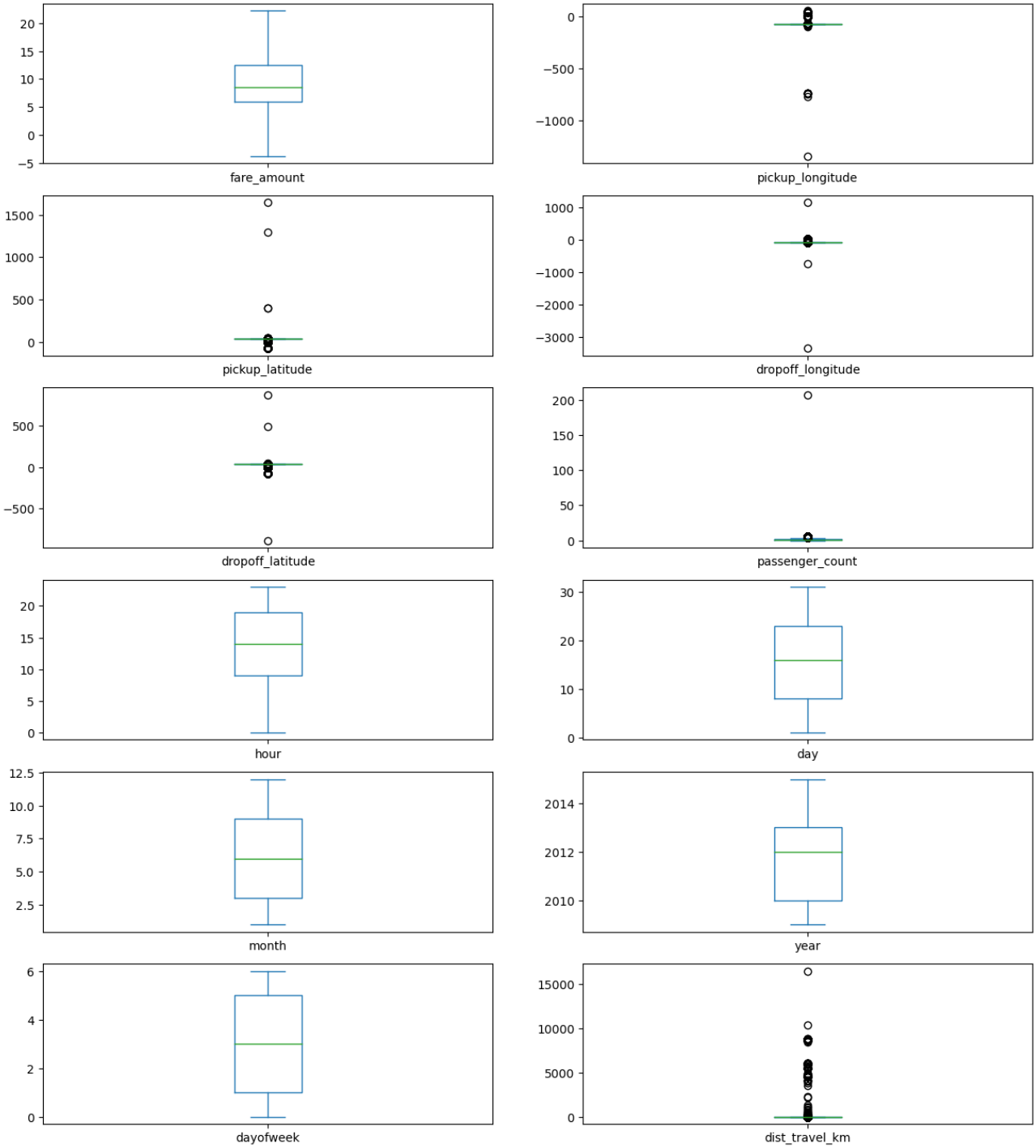
Out[149]:
```
fare_amount            Axes(0.125,0.786098;0.352273x0.0939024)
pickup_longitude     Axes(0.547727,0.786098;0.352273x0.0939024)
pickup_latitude        Axes(0.125,0.673415;0.352273x0.0939024)
dropoff_longitude    Axes(0.547727,0.673415;0.352273x0.0939024)
dropoff_latitude       Axes(0.125,0.560732;0.352273x0.0939024)
passenger_count      Axes(0.547727,0.560732;0.352273x0.0939024)
hour                   Axes(0.125,0.448049;0.352273x0.0939024)
day                  Axes(0.547727,0.448049;0.352273x0.0939024)
month                  Axes(0.125,0.335366;0.352273x0.0939024)
year                 Axes(0.547727,0.335366;0.352273x0.0939024)
dayofweek              Axes(0.125,0.222683;0.352273x0.0939024)
dist_travel_km       Axes(0.547727,0.222683;0.352273x0.0939024)
dtype: object
```



In [150]:
```
#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 [151]:
```
df = treat_outliers_all(df , df.iloc[: , 0::])
df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20)) #Boxplot shows t
```

Out[151]:
```
fare_amount          Axes(0.125,0.786098;0.352273x0.0939024)
pickup_longitude     Axes(0.547727,0.786098;0.352273x0.0939024)
pickup_latitude      Axes(0.125,0.673415;0.352273x0.0939024)
dropoff_longitude    Axes(0.547727,0.673415;0.352273x0.0939024)
dropoff_latitude     Axes(0.125,0.560732;0.352273x0.0939024)
passenger_count      Axes(0.547727,0.560732;0.352273x0.0939024)
hour                 Axes(0.125,0.448049;0.352273x0.0939024)
day                  Axes(0.547727,0.448049;0.352273x0.0939024)
month                Axes(0.125,0.335366;0.352273x0.0939024)
year                 Axes(0.547727,0.335366;0.352273x0.0939024)
dayofweek            Axes(0.125,0.222683;0.352273x0.0939024)
dist_travel_km       Axes(0.547727,0.222683;0.352273x0.0939024)
dtype: object
```



In [152]:
```
#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, 13)
```

In [153]:
```
#Finding inccorect latitude (Less than or greater than 90) and longitude (greater tha
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)
 ]
```

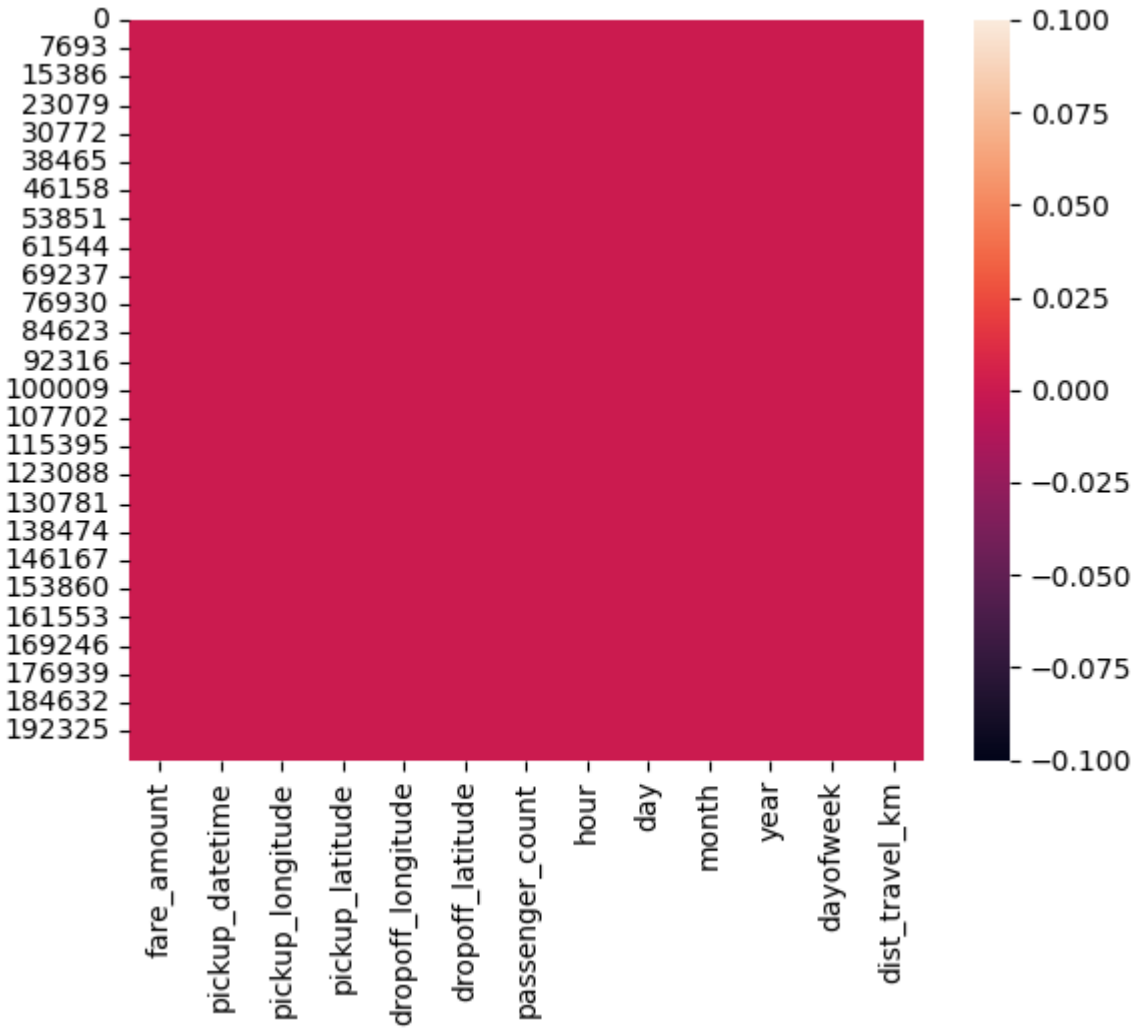
In [154]:
```
df.drop(incorrect_coordinates, inplace = True, errors = 'ignore')
```

In [155]:
```
df.isnull().sum()
```

Out[155]:
```
fare_amount          0
pickup_datetime      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 [156]:
```
sns.heatmap(df.isnull()) #Free for null values
```

Out[156]: <Axes: >



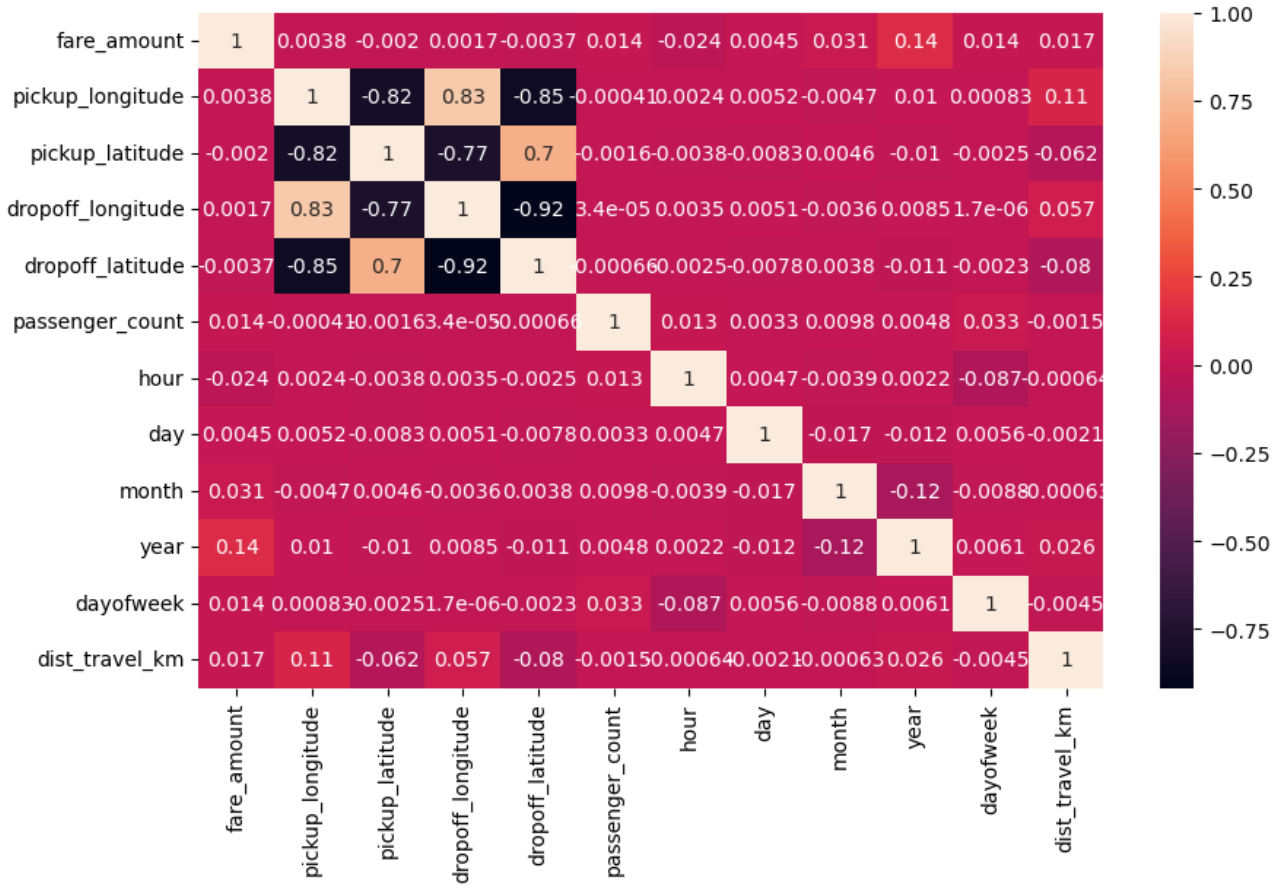
In [157]:
```
corr = df.corr() #Function to find the correlation
corr
```

Out[157]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	pas
fare_amount	1.000000	0.003760	-0.002028	0.001691	-0.003668	
pickup_longitude	0.003760	1.000000	-0.816461	0.833026	-0.846324	
pickup_latitude	-0.002028	-0.816461	1.000000	-0.774787	0.702367	
dropoff_longitude	0.001691	0.833026	-0.774787	1.000000	-0.917010	
dropoff_latitude	-0.003668	-0.846324	0.702367	-0.917010	1.000000	
passenger_count	0.013624	-0.000414	-0.001560	0.000034	-0.000659	
hour	-0.023623	0.002433	-0.003822	0.003478	-0.002544	
day	0.004534	0.005184	-0.008264	0.005056	-0.007835	
month	0.030817	-0.004665	0.004625	-0.003606	0.003818	
year	0.141277	0.009966	-0.010233	0.008467	-0.011239	
dayofweek	0.013652	0.000825	-0.002455	0.000002	-0.002335	
dist_travel_km	0.016683	0.105581	-0.062436	0.056717	-0.079944	

In [158]:
```
fig,axis = plt.subplots(figsize = (10,6))
sns.heatmap(df.corr(),annot = True) #Correlation Heatmap (Light values means highly c
```

Out[158]: <Axes: >



Dividing the dataset into feature and target values

In [159]:
```
x = df[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_latitude','
        'year','dayofweek','dist_travel_km']]
```

In [160]:
```
y = df['fare_amount']
```

Dividing the dataset into training and testing dataset

In [161]:
```
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)
```

In [162]:
```
from sklearn.linear_model import LinearRegression
regression = LinearRegression()
```

Linear Regression

In [163]:
```
regression.fit(X_train,y_train)
```

Out[163]:
```
▾ LinearRegression
LinearRegression()
```

In [164]:
```
regression.intercept_ #To find the linear intercept
```

Out[164]:
```
-863.8586819825009
```

In [165]:
```
regression.coef_ #To find the linear coeeficient
```

Out[165]:
```
array([ 2.02576598e-03, -6.70690390e-03, -5.27278620e-03,  1.06491298e-03,
        4.90290922e-02, -1.72581765e-02,  5.87424424e-03,  7.95287778e-02,
        4.34148089e-01,  2.46256060e-02,  1.56765583e-04])
```

In [166]:
```
prediction = regression.predict(X_test) #To predict the target values
print(prediction)
```

```
[10.48765575  9.99408559  9.23822956 ...  9.48220877 11.35566485
 10.50627068]
```

In [167]:
```
y_test
```

Out[167]:
```
153516    12.0
172012     6.5
110449     3.7
155824     5.3
67598      7.5
          ...
128785    14.5
99002      4.1
33585      9.3
53027      7.5
43861      7.5
Name: fare_amount, Length: 66000, dtype: float64
```

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

In [168]:
```
from sklearn.metrics import r2_score
```

In [169]:
```
r2_score(y_test,prediction)
```

Out[169]:
```
0.02159207927055906
```

In [170]:
```
from sklearn.metrics import mean_squared_error
```

In [171]:
```
MSE = mean_squared_error(y_test,prediction)
MSE
```

Out[171]:
```
29.22254510774845
```

In [172]:
```
RMSE = np.sqrt(MSE)
RMSE
```

Out[172]:
```
5.40578811162151
```

Random Forest Regression

In [173]:
```
from sklearn.ensemble import RandomForestRegressor
```

In [174]:
```
rf = RandomForestRegressor(n_estimators=100) #Here n_estimators means number of trees
```

In [175]:
```
rf.fit(X_train,y_train)
```

Out[175]:
```
RandomForestRegressor
RandomForestRegressor()
```

In [176]:
```
y_pred = rf.predict(X_test)
y_pred
```

Out[176]:
```
array([13.935,  4.562,  4.008, ...,  8.397,  8.   ,  7.688])
```

Metrics evaluatin for Random Forest

In [177]:
```
R2_Random = r2_score(y_test,y_pred)
R2_Random
```

Out[177]:
```
0.8176883409288362
```

In [178]:
```
MSE_Random = mean_squared_error(y_test,y_pred)
MSE_Random
```

Out[178]:
```
5.445183514973592
```

In [179]:
```
RMSE_Random = np.sqrt(MSE_Random)
RMSE_Random
```

Out[179]:
```
2.3334917002152786
```