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BE A Computer

RMDSSOE, Warje, Pune

Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform the 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 Libraries

In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import haversine as hs
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error,root_mean_squared_error
```

Loading The Dataset

In [2]:

```
df = pd.read_csv('./Datasets/uber.csv')
df
```

Out[2]:

	Unnamed: 0	key	fare_amount	pickup_datetime	pickup
0	24238194	2015-05-07 19:52:06.0000003	7.5	2015-05-07 19:52:06 UTC	
1	27835199	2009-07-17 20:04:56.0000002	7.7	2009-07-17 20:04:56 UTC	
2	44984355	2009-08-24 21:45:00.00000061	12.9	2009-08-24 21:45:00 UTC	
3	25894730	2009-06-26 08:22:21.0000001	5.3	2009-06-26 08:22:21 UTC	
4	17610152	2014-08-28 17:47:00.000000188	16.0	2014-08-28 17:47:00 UTC	
...	...	...	...	...	
199995	42598914	2012-10-28 10:49:00.00000053	3.0	2012-10-28 10:49:00 UTC	
199996	16382965	2014-03-14 01:09:00.0000008	7.5	2014-03-14 01:09:00 UTC	
199997	27804658	2009-06-29 00:42:00.00000078	30.9	2009-06-29 00:42:00 UTC	
199998	20259894	2015-05-20 14:56:25.0000004	14.5	2015-05-20 14:56:25 UTC	
199999	11951496	2010-05-15 04:08:00.00000076	14.1	2010-05-15 04:08:00 UTC	

200000 rows × 9 columns

In [3]:

```
df.head()
```

Out[3]:

	Unnamed: 0	key	fare_amount	pickup_datetime	pickup_longi
0	24238194	2015-05-07 19:52:06.0000003	7.5	2015-05-07 19:52:06 UTC	-73.99
1	27835199	2009-07-17 20:04:56.0000002	7.7	2009-07-17 20:04:56 UTC	-73.99
2	44984355	2009-08-24 21:45:00.00000061	12.9	2009-08-24 21:45:00 UTC	-74.00
3	25894730	2009-06-26 08:22:21.0000001	5.3	2009-06-26 08:22:21 UTC	-73.97
4	17610152	2014-08-28 17:47:00.000000188	16.0	2014-08-28 17:47:00 UTC	-73.92

In [4]:

```
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
```

In [5]:
```
df.columns
```

Out[5]:
```
Index(['Unnamed: 0', 'key', 'fare_amount', 'pickup_datetime',
       'pickup_longitude', 'pickup_latitude', 'dropoff_longitude',
       'dropoff_latitude', 'passenger_count'],
      dtype='object')
```

Data Preprocessing

In [6]:
```
df = df.drop(['Unnamed: 0', 'key'], axis = 1)
```

In [7]:
```
df.shape
```

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

In [8]:
```
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 [9]:
```
df.describe()
```

Out[9]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dr
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	-73.967154	40.767158	-73.963658	
max	499.000000	57.418457	1644.421482	1153.572603	

In [10]:

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

Out[10]:

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

In [11]:

```
df.dtypes
```

Out[11]:

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

In [12]:

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

In [13]:

```
df.dtypes
```

Out[13]:

```
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
```

In [14]:

```
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 [15]:

```
df.head()
```

Out[15]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_l
0	7.5	2015-05-07 19:52:06+00:00	-73.999817	40.738354	-7
1	7.7	2009-07-17 20:04:56+00:00	-73.994355	40.728225	-7
2	12.9	2009-08-24 21:45:00+00:00	-74.005043	40.740770	-7
3	5.3	2009-06-26 08:22:21+00:00	-73.976124	40.790844	-7
4	16.0	2014-08-28 17:47:00+00:00	-73.925023	40.744085	-7

In [16]:

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

Out[16]:

```
fare_amount          float64
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
hour                   int32
day                    int32
month                  int32
year                   int32
dayofweek              int32
dtype: object
```

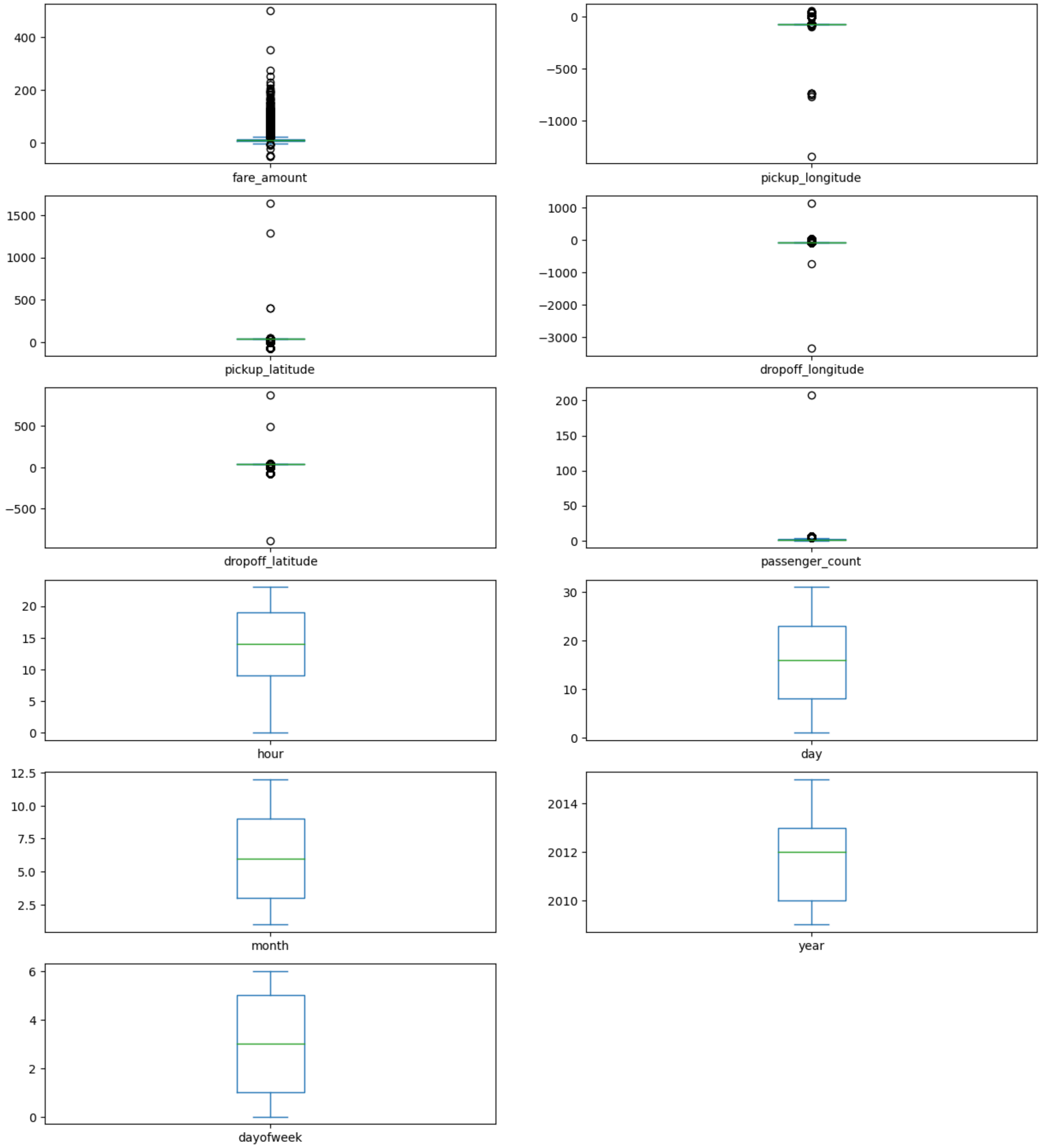
Exploratory Data Analysis

In [17]:

```
df.plot(kind = "box",subplots = True,layout = (7,2),
        figsize=(15,20))
```

Out[17]:

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



In [18]:

```
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 [19]:

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

In [20]:

```
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[20]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_
0	7.5	-73.999817	40.738354	-73.999512	40
1	7.7	-73.994355	40.728225	-73.994710	40
2	12.9	-74.005043	40.740770	-73.962565	40
3	5.3	-73.976124	40.790844	-73.965316	40
4	16.0	-73.929786	40.744085	-73.973082	40

In [21]:

```
df= df.loc[(df.dist_travel_km >= 1) | (df.dist_travel_km <= 130)]
print('Observations left in the dataset:', df.shape)
```

```
Observations left in the dataset: (199999, 12)
```

In [22]:

```
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 [23]:

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

```
/tmp/ipykernel_9936/1102255182.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/
stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df.drop(incorrect_coordinates, inplace = True,
```

In [24]:

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

Out[24]:

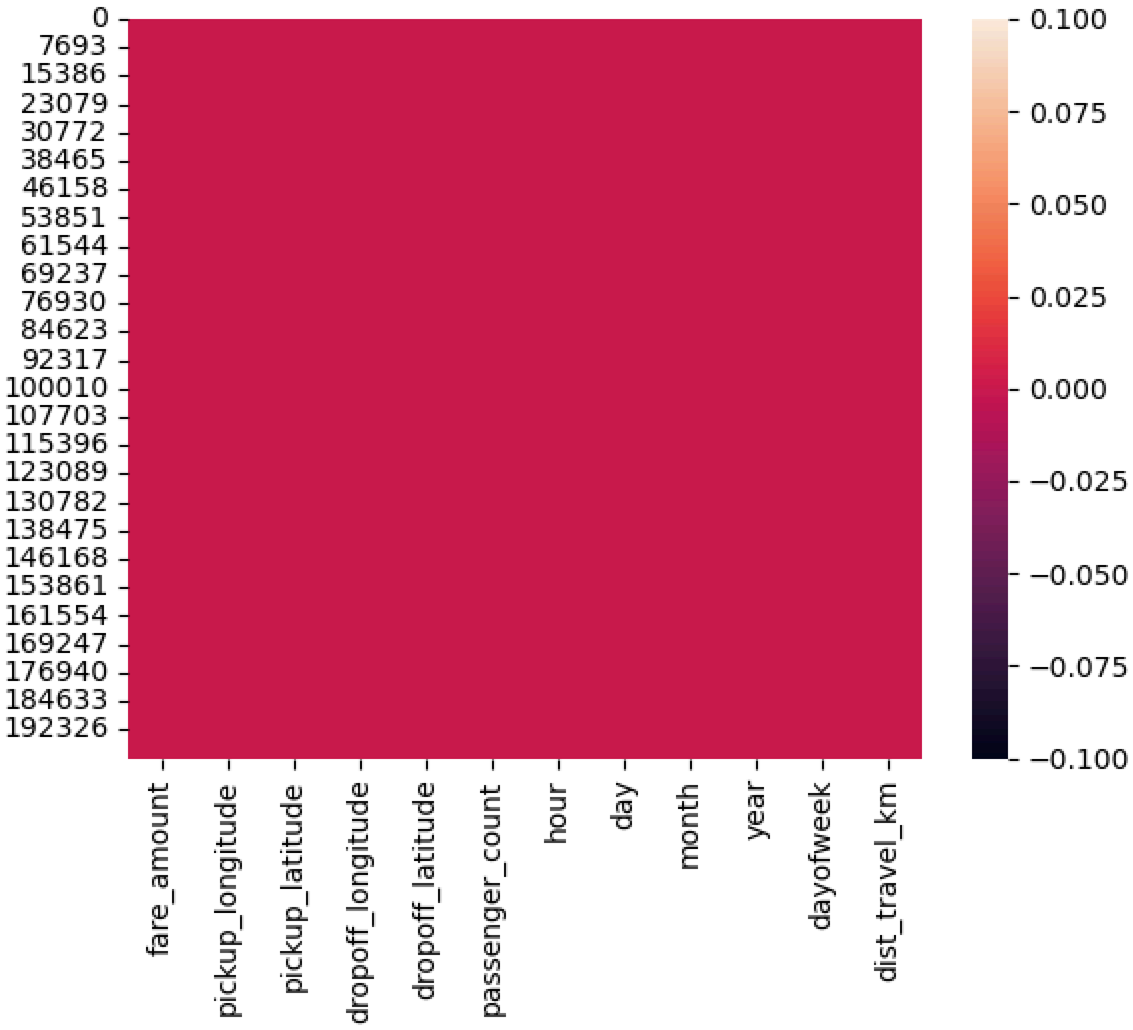
```
fare_amount          0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
hour                 0
day                  0
month                0
year                 0
dayofweek            0
dist_travel_km       0
dtype: int64
```

In [25]:

```
sns.heatmap(df.isnull())
```

Out[25]:

```
<AxesSubplot: >
```



In [26]:

```
corr = df.corr()
corr
```

Out[26]:

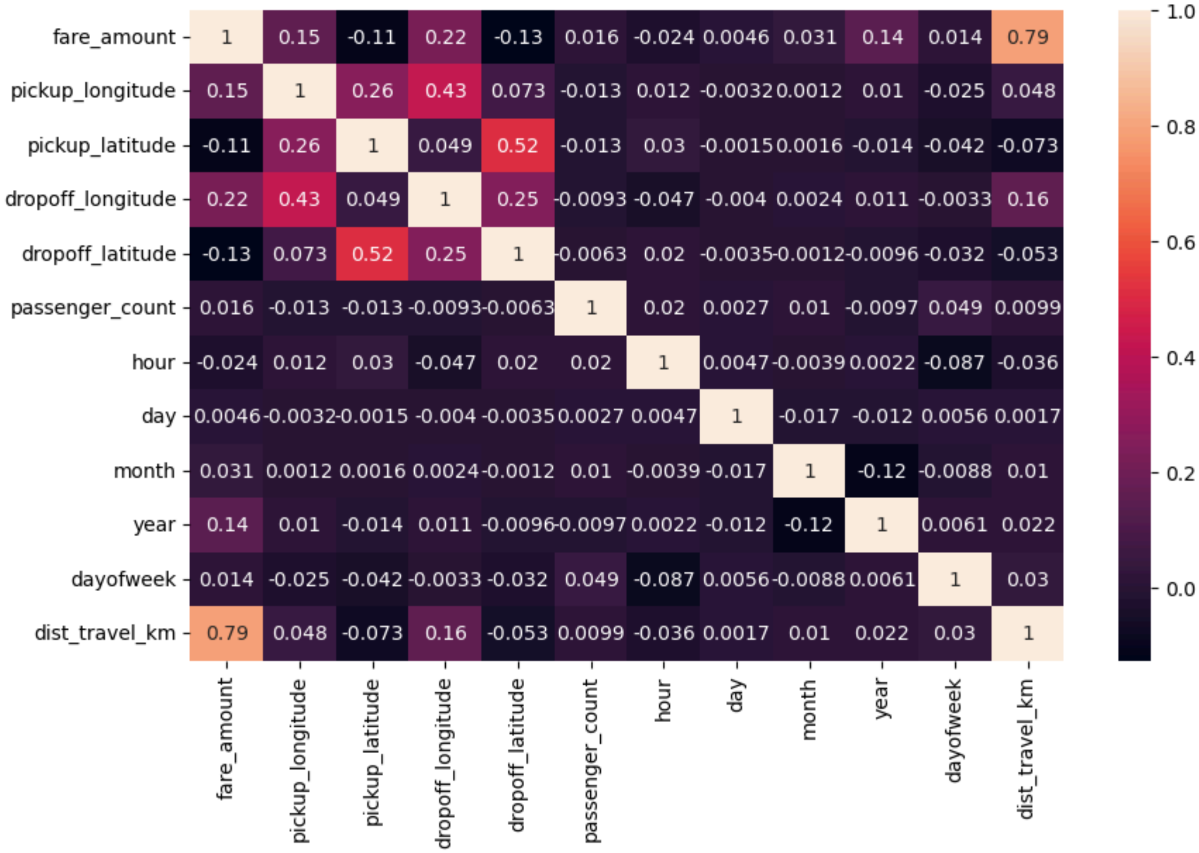
	fare_amount	pickup_longitude	pickup_latitude	dropoff_lon
fare_amount	1.000000	0.154056	-0.110856	0.
pickup_longitude	0.154056	1.000000	0.259492	0.
pickup_latitude	-0.110856	0.259492	1.000000	0.
dropoff_longitude	0.218681	0.425622	0.048889	1.
dropoff_latitude	-0.125874	0.073309	0.515736	0.
passenger_count	0.015798	-0.013202	-0.012879	-0.
hour	-0.023605	0.011590	0.029691	-0.
day	0.004552	-0.003194	-0.001544	-0.
month	0.030815	0.001168	0.001561	0.
year	0.141271	0.010193	-0.014247	0.
dayofweek	0.013664	-0.024645	-0.042304	-0.
dist_travel_km	0.786381	0.048423	-0.073385	0.

In [27]:

```
fig,axis = plt.subplots(figsize = (10,6))
sns.heatmap(df.corr(),annot = True)
```

Out[27]:

```
<AxesSubplot: >
```



Model Building

In [28]:
```
x = df[['pickup_longitude','pickup_latitude','dropoff_longitude',
        'dropoff_latitude','passenger_count','hour','day','month',
        'year', 'dayofweek', 'dist_travel_km']]
y = df['fare_amount']
```

In [29]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size = 0.33)
regression = LinearRegression()
regression.fit(x_train,y_train)
```

Out[29]:
```
▾ LinearRegression

LinearRegression()
```

In [30]:
```
regression.intercept_
```

Out[30]:
```
3585.8686042826635
```

In [31]:
```
regression.coef_
```

Out[31]:
```
array([ 2.46377325e+01, -7.24173762e+00,  1.99549436e+01, -1.77813074e+01,
        7.45718748e-02,  6.04580961e-03,  3.82138679e-03,  5.97910556e-02,
        3.66386047e-01, -3.53130194e-02,  1.84231391e+00])
```

In [32]:
```
prediction = regression.predict(x_test)
print('Prediction for x:\n', prediction,'\n')
print('Fare Amount test data:\n', y_test)
```

```
Prediction for x:
 [ 8.99684627  8.50609529  8.71473635 ... 16.54063476  8.05126891
 10.6073353 ]

Fare Amount test data:
 183608    10.1
77052      7.5
21817      8.1
7539       5.0
126373     8.9
          ...
85178     14.1
166232     6.1
122619    20.5
199866     5.5
43914     19.5
Name: fare_amount, Length: 66000, dtype: float64
```

In [33]:
```
print('R2 Score:\n',r2_score(y_test, prediction))
```

```
R2 Score:
 0.6646138168810347
```

In [34]:
```
MSE = mean_squared_error(y_test, prediction)
print('Mean Squared Error:\n', MSE)
```

```
Mean Squared Error:
 9.927481375335919
```

In [35]:
```
RMSE = root_mean_squared_error(y_test, prediction)
print('Root Mean Squared Error:\n', RMSE)
```

```
Root Mean Squared Error:
 3.150790595284923
```

In [36]:
```
rf = RandomForestRegressor(n_estimators=100)
rf.fit(x_train, y_train)
```

Out[36]:
```
▾  RandomForestRegressor  ⓘ ?

RandomForestRegressor()
```

Results

In [37]:
```
y_pred = rf.predict(x_test)
print('Predictions for Fare Amount:\n', y_pred)
```

```
Predictions for Fare Amount:
 [ 8.782    9.705    8.0947 ... 17.314    6.78    11.53   ]
```

In [38]:
```
R2_Random = r2_score(y_test, y_pred)
print('Random R2 Score:\n', R2_Random)
```

```
Random R2 Score:
 0.7948958964943291
```

In [39]:
```
MSE_Random = mean_squared_error(y_test, y_pred)
print('Random Mean Squared Error:\n', MSE_Random)
```

```
Random Mean Squared Error:
 6.071112258179303
```

In [40]:
```
RMSE_Random = root_mean_squared_error(y_test, y_pred)
print('Random Root Mean Squared Error:\n', RMSE_Random)
```

```
Random Root Mean Squared Error:
 2.463962714445838
```