In [90]:

```
#import libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import warnings
import sklearn
import seaborn as sns
!pip install haversine
```

```
Requirement already satisfied: haversine in c:\users\dell\appdata\local\progr
ams\python\python310\lib\site-packages (2.8.0)
```

In [91]:

```
#import data
data = pd.read_csv("uber.csv")
```

In [92]:

```
data
```

Out[92]:

| | Unnamed: 0 | key | fare_amount | pickup_datetime | pickup_longitude | pickup_l |
|---|---|---|---|---|---|---|
| **0** | 24238194 | 2015-05-07 19:52:06.0000003 | 7.5 | 2015-05-07 19:52:06 UTC | -73.999817 | 40. |
| **1** | 27835199 | 2009-07-17 20:04:56.0000002 | 7.7 | 2009-07-17 20:04:56 UTC | -73.994355 | 40. |
| **2** | 44984355 | 2009-08-24 21:45:00.00000061 | 12.9 | 2009-08-24 21:45:00 UTC | -74.005043 | 40. |
| **3** | 25894730 | 2009-06-26 08:22:21.0000001 | 5.3 | 2009-06-26 08:22:21 UTC | -73.976124 | 40. |
| **4** | 17610152 | 2014-08-28 17:47:00.000000188 | 16.0 | 2014-08-28 17:47:00 UTC | -73.925023 | 40. |
| **...** | ... | ... | ... | ... | ... | |
| **199995** | 42598914 | 2012-10-28 10:49:00.00000053 | 3.0 | 2012-10-28 10:49:00 UTC | -73.987042 | 40. |
| **199996** | 16382965 | 2014-03-14 01:09:00.0000008 | 7.5 | 2014-03-14 01:09:00 UTC | -73.984722 | 40. |
| **199997** | 27804658 | 2009-06-29 00:42:00.00000078 | 30.9 | 2009-06-29 00:42:00 UTC | -73.986017 | 40. |
| **199998** | 20259894 | 2015-05-20 14:56:25.0000004 | 14.5 | 2015-05-20 14:56:25 UTC | -73.997124 | 40. |
| **199999** | 11951496 | 2010-05-15 04:08:00.00000076 | 14.1 | 2010-05-15 04:08:00 UTC | -73.984395 | 40. |

200000 rows × 9 columns

In [93]:

```
#Create a data copy
df = data.copy()
```

In [94]:

```
#Print data
df=df.head(8000)
```

In [95]:

```
#Get Info
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8000 entries, 0 to 7999
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Unnamed: 0         8000 non-null   int64  
 1   key                8000 non-null   object 
 2   fare_amount        8000 non-null   float64
 3   pickup_datetime    8000 non-null   object 
 4   pickup_longitude   8000 non-null   float64
 5   pickup_latitude    8000 non-null   float64
 6   dropoff_longitude  8000 non-null   float64
 7   dropoff_latitude   8000 non-null   float64
 8   passenger_count    8000 non-null   int64  
dtypes: float64(5), int64(2), object(2)
memory usage: 562.6+ KB
```

In [96]:

```
#pickup_datetime is not in required data format
df["pickup_datetime"] = pd.to_datetime(df["pickup_datetime"])
```

In [97]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8000 entries, 0 to 7999
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype              
---  ------             --------------  -----              
 0   Unnamed: 0         8000 non-null   int64              
 1   key                8000 non-null   object             
 2   fare_amount        8000 non-null   float64            
 3   pickup_datetime    8000 non-null   datetime64[ns, UTC]
 4   pickup_longitude   8000 non-null   float64            
 5   pickup_latitude    8000 non-null   float64            
 6   dropoff_longitude  8000 non-null   float64            
 7   dropoff_latitude   8000 non-null   float64            
 8   passenger_count    8000 non-null   int64              
dtypes: datetime64[ns, UTC](1), float64(5), int64(2), object(1)
memory usage: 562.6+ KB
```

In [98]:
```
#Statistics of data
df.describe()
```

Out[98]:

| | Unnamed: 0 | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_l |
|---|---|---|---|---|---|---|
| **count** | 8.000000e+03 | 8000.000000 | 8000.000000 | 8000.000000 | 8000.000000 | 8000. |
| **mean** | 2.769486e+07 | 11.442829 | -72.674559 | 39.981164 | -72.635342 | 39. |
| **std** | 1.595445e+07 | 10.467626 | 12.665719 | 6.006576 | 10.007892 | 6. |
| **min** | 4.800000e+02 | 2.500000 | -748.016667 | -74.009697 | -75.350437 | -73. |
| **25%** | 1.402794e+07 | 6.000000 | -73.992066 | 40.735101 | -73.991471 | 40. |
| **50%** | 2.764842e+07 | 8.500000 | -73.981504 | 40.752477 | -73.979967 | 40. |
| **75%** | 4.127959e+07 | 12.500000 | -73.967069 | 40.766865 | -73.963482 | 40. |
| **max** | 5.542169e+07 | 350.000000 | 40.770667 | 41.366138 | 40.761672 | 41. |

In [99]:
```
#Number of missing values
df.isnull().sum()
```

Out[99]:
```
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
```

In [100]:
```
numeric_df = df.select_dtypes(include=[np.number])
correlation_matrix = numeric_df.corr()
correlation_matrix
```

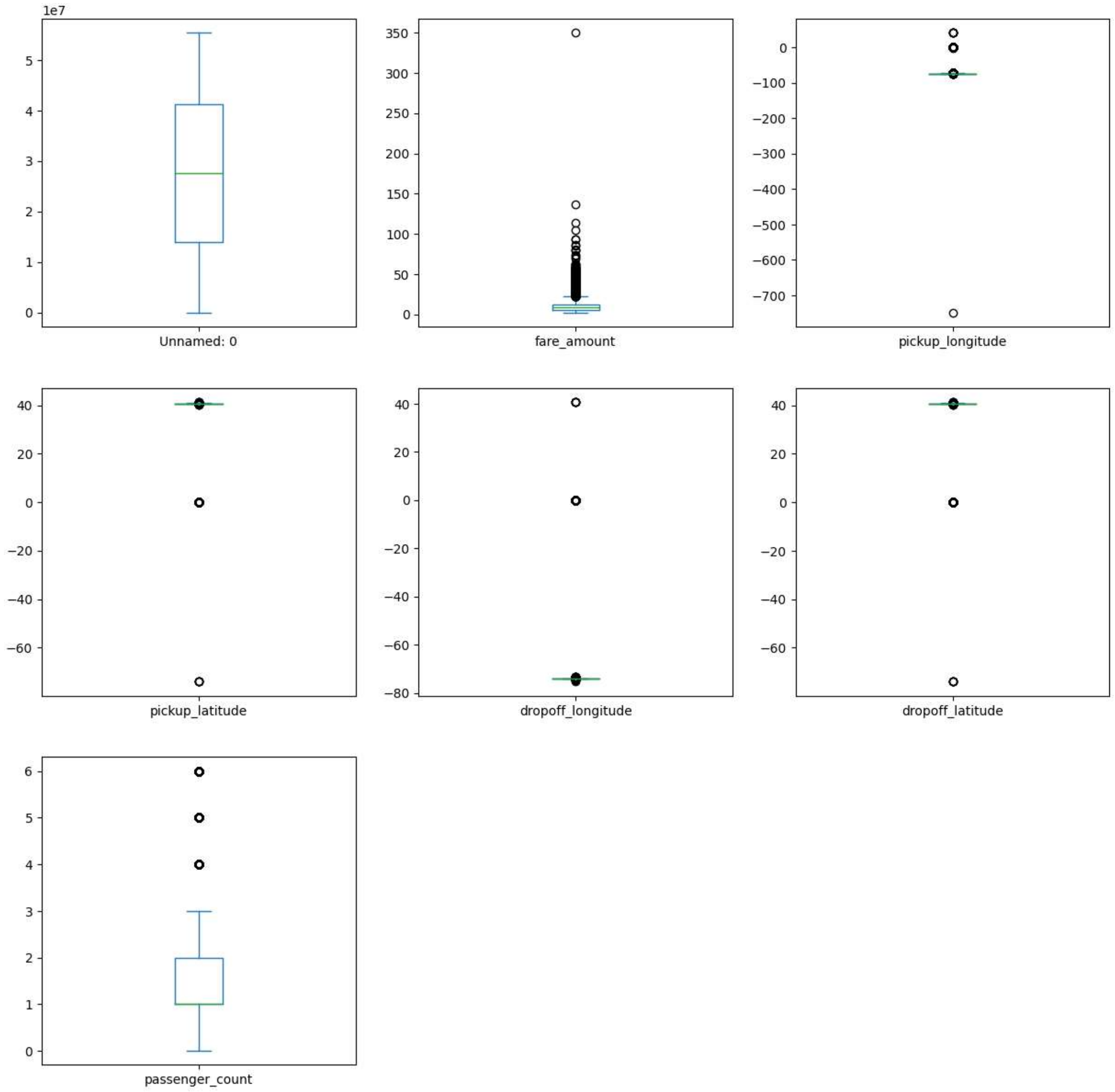
Out[100]:

| | Unnamed: 0 | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude |
|---|---|---|---|---|---|
| **Unnamed: 0** | 1.000000 | 0.005721 | 0.013433 | -0.025790 | 0.026929 |
| **fare_amount** | 0.005721 | 1.000000 | 0.037397 | -0.037727 | 0.047430 |
| **pickup_longitude** | 0.013433 | 0.037397 | 1.000000 | -0.773625 | 0.758229 |
| **pickup_latitude** | -0.025790 | -0.037727 | -0.773625 | 1.000000 | -0.934771 |
| **dropoff_longitude** | 0.026929 | 0.047430 | 0.758229 | -0.934771 | 1.000000 |
| **dropoff_latitude** | -0.025677 | -0.042101 | -0.743899 | 0.959730 | -0.978593 |
| **passenger_count** | 0.009653 | -0.012580 | 0.010977 | -0.013181 | 0.012631 |

In [101]:
```
#Drop the rows with missing values
df.dropna(inplace=True)
```

In [102]:
```
df.plot(kind="box", subplots=True, layout = (4,3),figsize=(15,20))
```

Out[102]:
```
Unnamed: 0              AxesSubplot(0.125,0.712609;0.227941x0.167391)
fare_amount          AxesSubplot(0.398529,0.712609;0.227941x0.167391)
pickup_longitude     AxesSubplot(0.672059,0.712609;0.227941x0.167391)
pickup_latitude         AxesSubplot(0.125,0.511739;0.227941x0.167391)
dropoff_longitude    AxesSubplot(0.398529,0.511739;0.227941x0.167391)
dropoff_latitude     AxesSubplot(0.672059,0.511739;0.227941x0.167391)
passenger_count          AxesSubplot(0.125,0.31087;0.227941x0.167391)
dtype: object
```



In [103]:

```
def remove_outlier(df1, col):
    if df1[col].dtype in [int, float]:
        Q1= df1[col].quantile(0.25)
        Q2=df1[col].quantile(0.50)

        Q3=df1[col].quantile(0.75)

        IQR = Q3-Q1

        lower_whisker = Q1-1.5*IQR

        upper_whisker= Q3+1.5*IQR
        print("col=",col, "Q1=",Q1,"Q2=", Q2,"Q3=",Q3)
        df1[col] = np.clip(df1[col], lower_whisker, upper_whisker)
    else:
        print(f"Column {col} is not numeric and cannot calculate quantiles.")
    return df1

def treat_outliers_all(df1, col_list):

    print("col_list",col_list)

    for c in col_list:

        df1 = remove_outlier(df1, c)

    return df1
df= treat_outliers_all(df, df.columns)
```

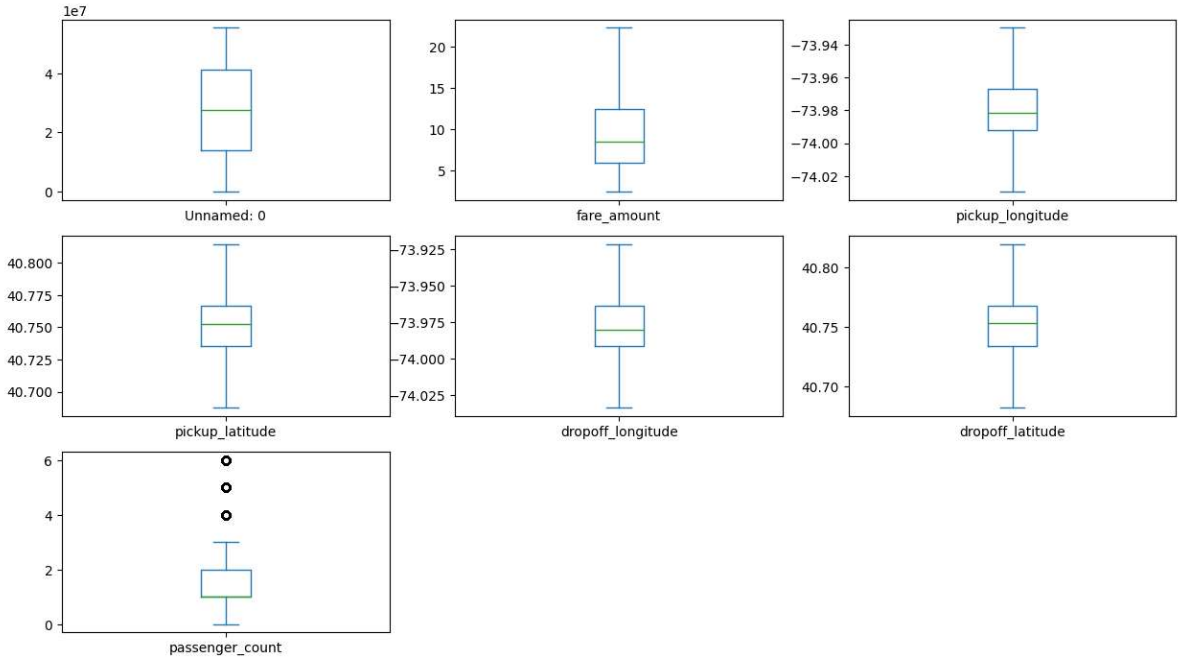
```
col_list Index(['Unnamed: 0', 'key', 'fare_amount', 'pickup_datetime',
       'pickup_longitude', 'pickup_latitude', 'dropoff_longitude',
       'dropoff_latitude', 'passenger_count'],
      dtype='object')
Column Unnamed: 0 is not numeric and cannot calculate quantiles.
Column key is not numeric and cannot calculate quantiles.
col= fare_amount Q1= 6.0 Q2= 8.5 Q3= 12.5
Column pickup_datetime is not numeric and cannot calculate quantiles.
col= pickup_longitude Q1= -73.992066 Q2= -73.981504 Q3= -73.96706922595214
col= pickup_latitude Q1= 40.73510125 Q2= 40.7524765 Q3= 40.766865
col= dropoff_longitude Q1= -73.99147124999999 Q2= -73.97996679028321 Q3= -73.
9634815
col= dropoff_latitude Q1= 40.733695 Q2= 40.753132 Q3= 40.768231
Column passenger_count is not numeric and cannot calculate quantiles.
```

In [104]:

```
df.plot(kind="box" ,subplots= True , layout=(7,3), figsize=(15,20))
```

Out[104]:

```
Unnamed: 0              AxesSubplot(0.125,0.786098;0.227941x0.0939024)
fare_amount          AxesSubplot(0.398529,0.786098;0.227941x0.0939024)
pickup_longitude     AxesSubplot(0.672059,0.786098;0.227941x0.0939024)
pickup_latitude         AxesSubplot(0.125,0.673415;0.227941x0.0939024)
dropoff_longitude    AxesSubplot(0.398529,0.673415;0.227941x0.0939024)
dropoff_latitude     AxesSubplot(0.672059,0.673415;0.227941x0.0939024)
passenger_count         AxesSubplot(0.125,0.560732;0.227941x0.0939024)
dtype: object
```



In [105]:

```
#Check the missing values now
df.isnull().sum()
```

Out[105]:

```
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
```

In [106]:

```
#Time to apply learning models

from sklearn.model_selection import train_test_split
```

In [107]:

```
#Take x as predictor variable
x = df.drop("fare_amount", axis = 1)
#And y as target variable
y = df['fare_amount']
```

In [108]:

```
#Necessary to apply model
x['pickup_datetime'] = pd.to_numeric(pd.to_datetime(x['pickup_datetime']))
x = x.loc[:, x.columns.str.contains('^Unnamed')]
```

In [109]:

```
import haversine as hs

# Define a function to calculate the haversine distance
def haversine_distance(row):
    loc1 = (row['pickup_latitude'], row['pickup_longitude'])
    loc2 = (row['dropoff_latitude'], row['dropoff_longitude'])
    return hs.haversine(loc1, loc2)

# Apply the function to each row and create a new column
df['dist_travel_km'] = df.apply(haversine_distance, axis=1)

# Print the distances and display the DataFrame
print(df['dist_travel_km'])
print(df.head())
```

```
0        1.683325
1        2.457593
2        5.036384
3        1.661686
4        4.131933
          ...
7995    11.792129
7996     1.714758
7997     0.990416
7998     5.714015
7999     0.920174
Name: dist_travel_km, Length: 8000, dtype: float64
   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+00:00        -73.999817        40.738354
1 2009-07-17 20:04:56+00:00        -73.994355        40.728225
2 2009-08-24 21:45:00+00:00        -74.005043        40.740770
3 2009-06-26 08:22:21+00:00        -73.976124        40.790844
4 2014-08-28 17:47:00+00:00        -73.929574        40.744085

   dropoff_longitude  dropoff_latitude  passenger_count  dist_travel_km
0         -73.999512         40.723217                1        1.683325
1         -73.994710         40.750325                1        2.457593
2         -73.962565         40.772647                1        5.036384
3         -73.965316         40.803349                3        1.661686
4         -73.973082         40.761247                5        4.131933
```

In [110]:

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, ran
```

In [111]:

```
from sklearn.linear_model import LinearRegression
```

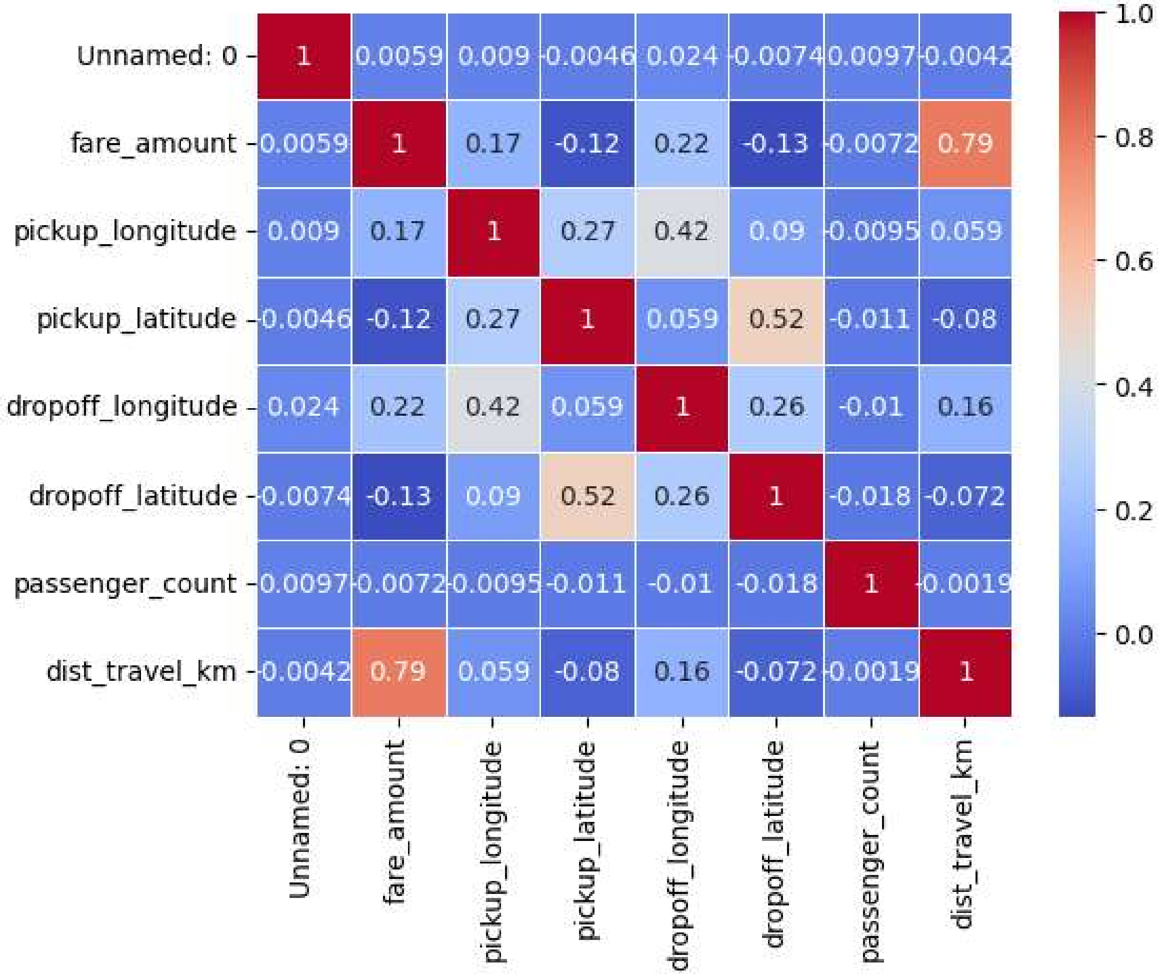
In [112]:

```
correlation_matrix = df.corr()

# Print the correlation matrix
print(correlation_matrix)
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', linewidths=0.5)
```

```
                   Unnamed: 0  fare_amount  pickup_longitude  pickup_latitude  
\
Unnamed: 0           1.000000     0.005938          0.008992        -0.004565
fare_amount          0.005938     1.000000          0.165482        -0.115839
pickup_longitude     0.008992     0.165482          1.000000         0.272431
pickup_latitude     -0.004565    -0.115839          0.272431         1.000000
dropoff_longitude    0.023527     0.223993          0.415318         0.059101
dropoff_latitude    -0.007352    -0.134131          0.090473         0.518721
passenger_count      0.009653    -0.007241         -0.009506        -0.010992
dist_travel_km      -0.004231     0.794487          0.058659        -0.079959

                   dropoff_longitude  dropoff_latitude  passenger_count  \
Unnamed: 0                  0.023527         -0.007352         0.009653
fare_amount                 0.223993         -0.134131        -0.007241
pickup_longitude            0.415318          0.090473        -0.009506
pickup_latitude             0.059101          0.518721        -0.010992
dropoff_longitude           1.000000          0.260177        -0.010252
dropoff_latitude            0.260177          1.000000        -0.018341
passenger_count            -0.010252         -0.018341         1.000000
dist_travel_km              0.157602         -0.072390        -0.001882

                   dist_travel_km
Unnamed: 0              -0.004231
fare_amount              0.794487
pickup_longitude         0.058659
pickup_latitude         -0.079959
dropoff_longitude        0.157602
dropoff_latitude        -0.072390
passenger_count         -0.001882
dist_travel_km           1.000000

C:\Users\Dell\AppData\Local\Temp\ipykernel_12836\1932690646.py:1: FutureWarni
ng: The default value of numeric_only in DataFrame.corr is deprecated. In a f
uture version, it will default to False. Select only valid columns or specify
the value of numeric_only to silence this warning.
  correlation_matrix = df.corr()
```

Out[112]:

```
<AxesSubplot: >
```



|  | Unnamed: 0 | fare_amount | pickup_longitude | pickup_latitude | dropoff_longitude | dropoff_latitude | passenger_count | dist_travel_km |
|---|---|---|---|---|---|---|---|---|
| Unnamed: 0 | 1 | 0.0059 | 0.009 | -0.0046 | 0.024 | -0.0074 | 0.0097 | -0.0042 |
| fare_amount | 0.0059 | 1 | 0.17 | -0.12 | 0.22 | -0.13 | -0.0072 | 0.79 |
| pickup_longitude | 0.009 | 0.17 | 1 | 0.27 | 0.42 | 0.09 | -0.0095 | 0.059 |
| pickup_latitude | -0.0046 | -0.12 | 0.27 | 1 | 0.059 | 0.52 | -0.011 | -0.08 |
| dropoff_longitude | 0.024 | 0.22 | 0.42 | 0.059 | 1 | 0.26 | -0.01 | 0.16 |
| dropoff_latitude | -0.0074 | -0.13 | 0.09 | 0.52 | 0.26 | 1 | -0.018 | -0.072 |
| passenger_count | 0.0097 | -0.0072 | -0.0095 | -0.011 | -0.01 | -0.018 | 1 | -0.0019 |
| dist_travel_km | -0.0042 | 0.79 | 0.059 | -0.08 | 0.16 | -0.072 | -0.0019 | 1 |

In [113]:
```
lrmodel = LinearRegression()
lrmodel.fit(x_train, y_train)
```

Out[113]:
```
▾ LinearRegression

LinearRegression()
```

In [127]:
```
print(lrmodel.intercept_)
print(lrmodel.coef_)
```

```
10.13702658872479
[1.80835081e-10]
```

In [114]:
```
#Prediction
predict = lrmodel.predict(x_test)
```

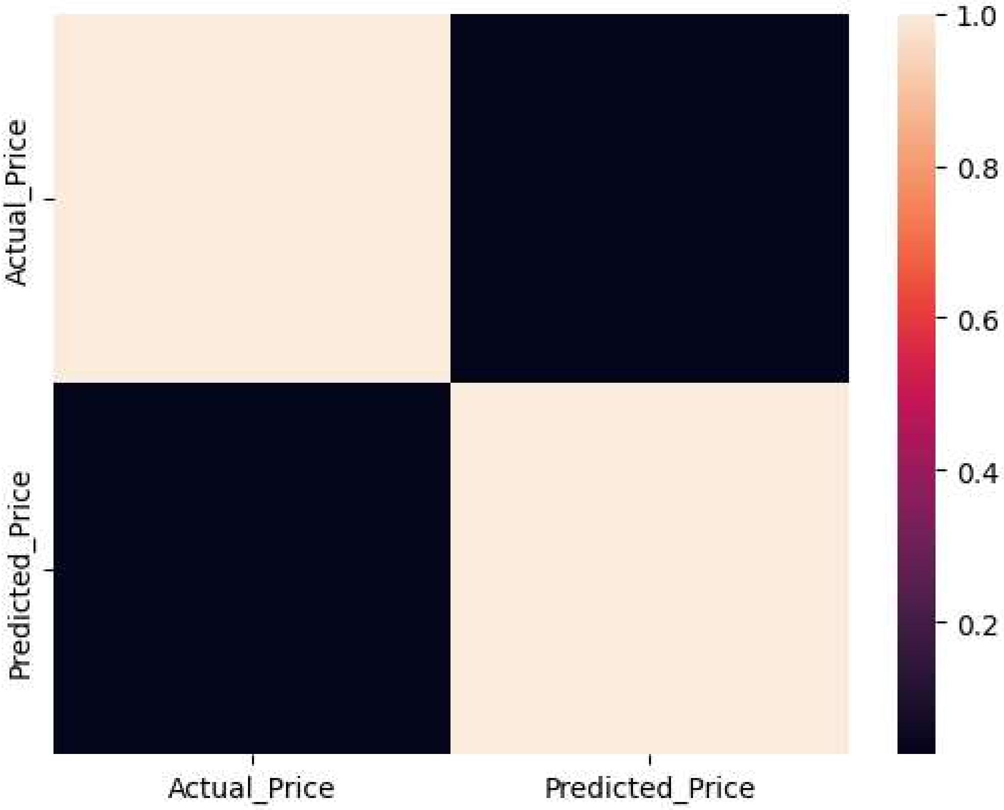
In [133]:

```
comparison=pd.DataFrame({"Actual_Price":y_test,"Predicted_Price":predict})
print(comparison.reset_index().drop(["index"],axis=1))
sns.heatmap(comparison.corr())
```

```
      Actual_Price  Predicted_Price
0              7.0        10.143457
1             11.3        10.144738
2              4.5        10.139688
3              6.5        10.142855
4              5.5        10.143302
...            ...              ...
1595           7.0        10.140242
1596           9.5        10.146518
1597           9.7        10.140564
1598           4.5        10.146202
1599           8.9        10.143957

[1600 rows x 2 columns]
```

Out[133]:

```
<AxesSubplot: >
```



In [115]:

```
#Check Error
from sklearn.metrics import mean_squared_error, mean_absolute_error
from sklearn.metrics import r2_score
predict = lrmodel.predict(x_test)
lr_r2 = r2_score(y_test, predict)
lrmodelrmse = np.sqrt(mean_squared_error(predict, y_test))
mse = mean_squared_error(y_test, predict)
print(f"Mean Squared Error (MSE): {mse:.2f}")
mae = mean_absolute_error(y_test, predict)
print(f"Mean Absolute Error (MAE): {mae:.2f}")
print("Linear Regression R2:", lr_r2)
print("RMSE error for the model is ", lrmodelrmse)
```

```
Mean Squared Error (MSE): 28.68
Mean Absolute Error (MAE): 4.33
Linear Regression R2: -0.00204461954986912
RMSE error for the model is  5.355275698890742
```

In [116]:

```
#Let's Apply Random Forest Regressor
from sklearn.ensemble import RandomForestRegressor
rfrmodel = RandomForestRegressor(n_estimators = 100, random_state = 101)
```

In [117]:

```
#Fit the Forest
rfrmodel.fit(x_train, y_train)
rfrmodel_pred = rfrmodel.predict(x_test)
```

In [118]:

```
#Errors for the forest

rf_r2 = r2_score(y_test, rfrmodel_pred)
rfrmodel_rmse = np.sqrt(mean_squared_error(rfrmodel_pred, y_test))
print("Random Forest Regression R2:", rf_r2)
print("RMSE value for Random Forest is:",rfrmodel_rmse)
mse = mean_squared_error(y_test, rfrmodel_pred)
print(f"Mean Squared Error (MSE): {mse:.2f}")
mae = mean_absolute_error(y_test, rfrmodel_pred)
print(f"Mean Absolute Error (MAE): {mae:.2f}")
```

```
Random Forest Regression R2: -0.5489964251584396
RMSE value for Random Forest is: 6.658302336824492
Mean Squared Error (MSE): 44.33
Mean Absolute Error (MAE): 5.18
```

In [119]:

```
print(rfrmodel_pred)
print(predict)
```

```
[ 9.156  10.074   9.01   ...  7.467   8.4095 13.493 ]
[10.14345698 10.14473803 10.13968762 ... 10.14056434 10.1462023
 10.14395714]
```