FLIGHT TICKET PRICE PREDICTION

The main objective of this machine learning project is to build and compare different regression models to accurately predict flight ticket prices. The goal is to develop a reliable model that estimates ticket prices based on various features such as airline, departure time, duration, number of stops, and booking time. This model will help both passengers and airlines make informed pricing decisions, optimize ticket purchases, and improve market transparency.

FEATURES

The various features of the cleaned dataset are explained below:

1. **Airline:** The name of the airline company is stored in the airline column. It is a categorical feature having 6 different airlines.
2. **Flight:** Flight stores information regarding the plane's flight code. It is a categorical feature.
3. **Source City:** City from which the flight takes off. It is a categorical feature having 6 unique cities.
4. **Departure Time:** This is a derived categorical feature obtained created by grouping time periods into bins. It stores information about the departure time and have 6 unique time labels.
5. **Stops:** A categorical feature with 3 distinct values that stores the number of stops between the source and destination cities.
6. **Arrival Time:** This is a derived categorical feature created by grouping time intervals into bins. It has six distinct time labels and keeps information about the arrival time.
7. **Destination City:** City where the flight will land. It is a categorical feature having 6 unique cities.
8. **class1:** A categorical feature that contains information on seat class1; it has two distinct values: Business and Economy.
9. **Duration:** A continuous feature that displays the overall amount of time it takes to travel between cities in hours.
10. **Days Left:** This is a derived characteristic that is calculated by subtracting the trip date by the booking date.
11. **Price:** Target variable stores information of the ticket price.

IMPORT DATASET

In [ ]:
```
import pandas as pd
```

In [ ]:
```
df = pd.read_csv('/content/drive/MyDrive/main project/Clean_Dataset.csv')
df
```

Out[ ]:

	Unnamed: 0	airline	flight	source_city	departure_time	stops	arrival_time	dest
0	0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	
1	1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	
2	2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	
3	3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	
4	4	Vistara	UK-963	Delhi	Morning	zero	Morning	
...	...	...	...	...	...	...	...	
300148	300148	Vistara	UK-822	Chennai	Morning	one	Evening	
300149	300149	Vistara	UK-826	Chennai	Afternoon	one	Night	
300150	300150	Vistara	UK-832	Chennai	Early_Morning	one	Night	
300151	300151	Vistara	UK-828	Chennai	Early_Morning	one	Evening	
300152	300152	Vistara	UK-822	Chennai	Morning	one	Evening	

300153 rows × 12 columns

DATA PREPROCESSING

In [ ]:
```
df.head(1)
```

Out[ ]:

	Unnamed: 0	airline	flight	source_city	departure_time	stops	arrival_time	destination_
0	0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mur

In [ ]:
```
df.tail(1)
```

Out[ ]:

	Unnamed: 0	airline	flight	source_city	departure_time	stops	arrival_time	destina
300152	300152	Vistara	UK-822	Chennai	Morning	one	Evening	H

In [ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300153 entries, 0 to 300152
Data columns (total 12 columns):
 #   Column            Non-Null Count   Dtype  
---  ------            --------------   -----  
 0   Unnamed: 0        300153 non-null  int64  
 1   airline           300153 non-null  object 
 2   flight            300153 non-null  object 
 3   source_city       300153 non-null  object 
 4   departure_time    300153 non-null  object 
 5   stops             300153 non-null  object 
 6   arrival_time      300153 non-null  object 
 7   destination_city  300153 non-null  object 
 8   class1            300153 non-null  object 
 9   duration          300153 non-null  float64
 10  days_left         300153 non-null  int64  
 11  price             300153 non-null  int64  
dtypes: float64(1), int64(3), object(8)
memory usage: 27.5+ MB
```

In [ ]:
```
df.ndim
```

Out[ ]:
```
2
```

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

Out[ ]:
```
(300153, 12)
```

In [ ]:
```
df.index
```

Out[ ]:
```
RangeIndex(start=0, stop=300153, step=1)
```

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

Out[ ]:

	Unnamed: 0	duration	days_left	price
count	300153.000000	300153.000000	300153.000000	300153.000000
mean	150076.000000	12.221021	26.004751	20889.660523
std	86646.852011	7.191997	13.561004	22697.767366
min	0.000000	0.830000	1.000000	1105.000000
25%	75038.000000	6.830000	15.000000	4783.000000
50%	150076.000000	11.250000	26.000000	7425.000000
75%	225114.000000	16.170000	38.000000	42521.000000
max	300152.000000	49.830000	49.000000	123071.000000

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

Out[ ]:
```
Index(['Unnamed: 0', 'airline', 'flight', 'source_city', 'departure_time',
       'stops', 'arrival_time', 'destination_city', 'class1', 'duration',
       'days_left', 'price'],
      dtype='object')
```

In [ ]:
```
df.duplicated().sum()
```

Out[ ]:
```
0
```

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

Out[ ]:

	0
Unnamed: 0	0
airline	0
flight	0
source_city	0
departure_time	0
stops	0
arrival_time	0
destination_city	0
class1	0
duration	0
days_left	0
price	0

dtype: int64

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

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

Out[ ]:
```
Index(['airline', 'flight', 'source_city', 'departure_time', 'stops',
       'arrival_time', 'destination_city', 'class1', 'duration', 'days_left',
       'price'],
      dtype='object')
```

DATA VISUALIZATION

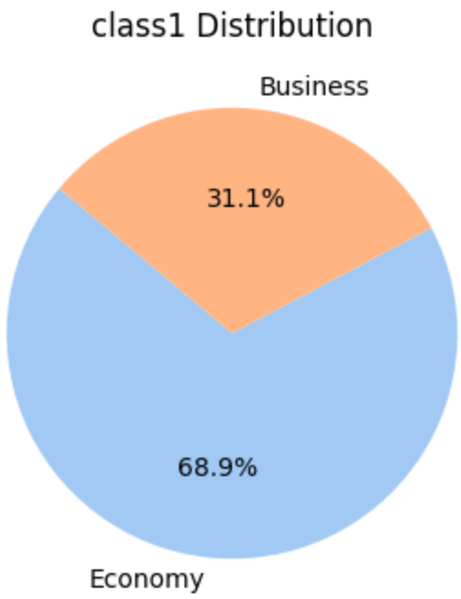
In [ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

In [ ]:
```
df_max_price = df.groupby('airline')['price'].max().reset_index()

plt.figure(figsize=(8, 4))
sns.barplot(x='airline', y='price', data=df_max_price,color='green')
plt.xlabel('Airline')
plt.ylabel('Maximum Price')
plt.title('Maximum Price by Airline')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```

In [ ]:
```
class1_distribution = df['class1'].value_counts()

plt.figure(figsize=(8, 4))
plt.pie(class1_distribution, labels=class1_distribution.index, autopct='%1.1f%%', s
plt.title('class1 Distribution')
plt.show()
```



In [ ]:
```
df_max_price = df.groupby(['airline', 'class1'])['price'].max().reset_index()

plt.figure(figsize=(9, 6))
sns.barplot(y='airline', x='price', hue='class1', data=df_max_price, palette='virid
plt.ylabel('Airline and class1')
plt.xlabel('Maximum Price')
plt.title('Maximum Price by Airline and class1')
plt.tight_layout()
plt.show()
```

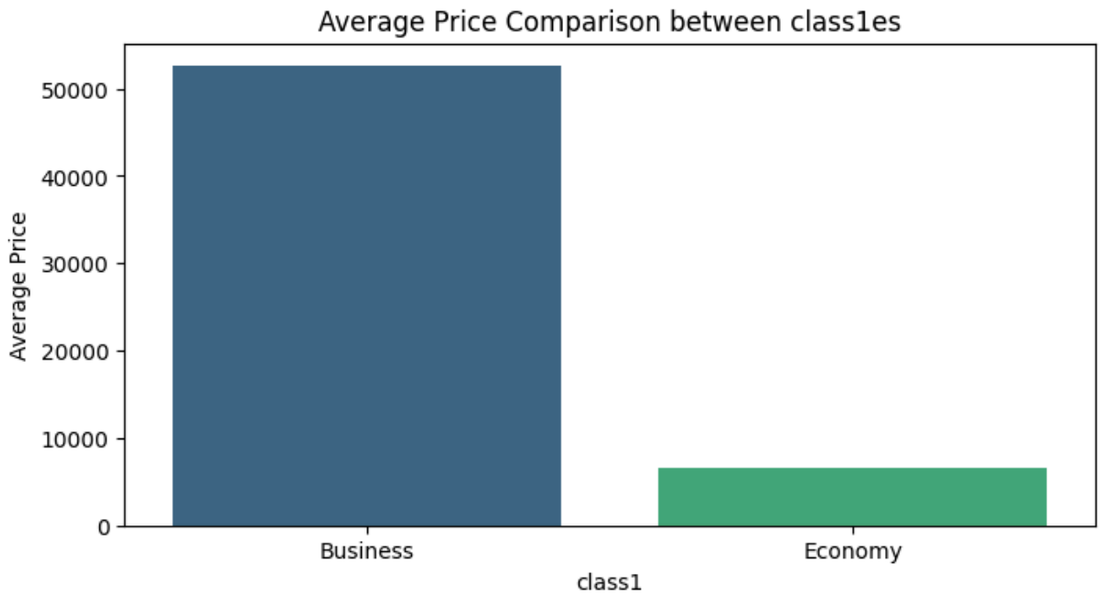
In [ ]:
```
average_prices = df.groupby('class1')['price'].mean().reset_index()

plt.figure(figsize=(8, 4))
sns.barplot(x='class1', y='price', data=average_prices, palette='viridis')
plt.xlabel('class1')
plt.ylabel('Average Price')
plt.title('Average Price Comparison between class1es')
plt.show()
```

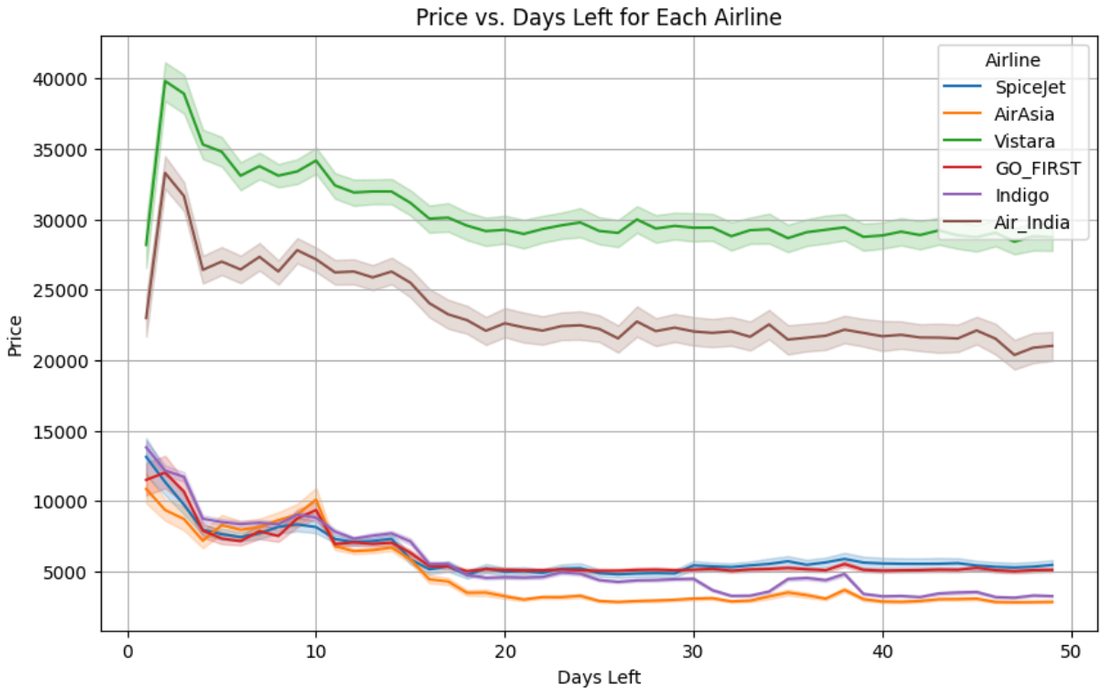
```
<ipython-input-19-ecbcff92ae9d>:4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.1
4.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.barplot(x='class1', y='price', data=average_prices, palette='viridis')
```



In [ ]:
```
plt.figure(figsize=(10, 6))
sns.lineplot(data=df, x='days_left', y='price', hue='airline')
plt.xlabel('Days Left')
plt.ylabel('Price')
plt.title('Price vs. Days Left for Each Airline')
plt.legend(title='Airline')
plt.grid(True)
plt.show()
```



Feature Encoding

In [ ]:
```
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder
```

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

Out[ ]:

	0
airline	object
flight	object
source_city	object
departure_time	object
stops	object
arrival_time	object
destination_city	object
class1	object
duration	float64
days_left	int64
price	int64

dtype: object

AIRLINE

In [ ]:
```
df['airline'].value_counts()
```

Out[ ]:

airline	count
Vistara	127859
Air_India	80892
Indigo	43120
GO_FIRST	23173
AirAsia	16098
SpiceJet	9011

dtype: int64

In [ ]:
```
one1 = OneHotEncoder(sparse_output=False)
one1.fit(df[['airline']])
one1_output = one1.transform(df[['airline']])
```

In [ ]:
```
one1.get_feature_names_out()
```

Out[ ]:
```
array(['airline_AirAsia', 'airline_Air_India', 'airline_GO_FIRST',
       'airline_Indigo', 'airline_SpiceJet', 'airline_Vistara'],
      dtype=object)
```

In [ ]:
```
new_airline = pd.DataFrame(one1_output , columns=one1.get_feature_names_out())

new_airline = new_airline.reset_index(drop=True)
df = df.reset_index(drop=True)

df = pd.concat([df,new_airline],axis=1)
```

In [ ]:
```
df.drop('airline',axis=1,inplace=True)
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	source_city	departure_time	stops	arrival_time	destination_city	class1	durat
0	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy	2

FLIGHT

In [ ]:
```
df['flight'].value_counts()
```

Out[ ]:

flight	count
UK-706	3235
UK-772	2741
UK-720	2650
UK-836	2542
UK-822	2468
...	...
SG-9923	1
6E-6474	1
6E-865	1
G8-705	1
G8-107	1

1561 rows × 1 columns

dtype: int64

In [ ]:
```
la1 = LabelEncoder()
la1.fit(df['flight'])
df['flight'] = la1.transform(df['flight'])
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	source_city	departure_time	stops	arrival_time	destination_city	class1	durat
0	1408	Delhi	Evening	zero	Night	Mumbai	Economy	2

SOURCE_CITY

In [ ]:
```
df['source_city'].value_counts()
```

Out[ ]:

source_city	count
Delhi	61343
Mumbai	60896
Bangalore	52061
Kolkata	46347
Hyderabad	40806
Chennai	38700

dtype: int64

In [ ]:
```
one2 = OneHotEncoder(sparse_output=False)
one2.fit(df[['source_city']])
one2_output = one2.transform(df[['source_city']])
```

In [ ]:
```
one2.get_feature_names_out()
```

Out[ ]:
```
array(['source_city_Bangalore', 'source_city_Chennai',
       'source_city_Delhi', 'source_city_Hyderabad',
       'source_city_Kolkata', 'source_city_Mumbai'], dtype=object)
```

In [ ]:
```
new_source_city = pd.DataFrame(one2_output , columns=one2.get_feature_names_out())

new_source_city = new_source_city.reset_index(drop=True)
df = df.reset_index(drop=True)

df = pd.concat([df,new_source_city],axis=1)
```

In [ ]:
```
df.drop('source_city',axis=1,inplace=True)
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	departure_time	stops	arrival_time	destination_city	class1	duration	days_lef
0	1408	Evening	zero	Night	Mumbai	Economy	2.17	

1 rows × 21 columns

DAPARTURE_TIME

In [ ]:
```
df['departure_time'].value_counts()
```

Out[ ]:

departure_time	count
Morning	71146
Early_Morning	66790
Evening	65102
Night	48015
Afternoon	47794
Late_Night	1306

dtype: int64

In [ ]:
```
one3 = OneHotEncoder(sparse_output=False)
one3.fit(df[['departure_time']])
one3_output = one3.transform(df[['departure_time']])
```

In [ ]:
```
one3.get_feature_names_out()
```

Out[ ]:
```
array(['departure_time_Afternoon', 'departure_time_Early_Morning',
       'departure_time_Evening', 'departure_time_Late_Night',
       'departure_time_Morning', 'departure_time_Night'], dtype=object)
```

In [ ]:
```
new_departure_time = pd.DataFrame(one3_output , columns=one3.get_feature_names_out(

new_departure_time = new_departure_time.reset_index(drop=True)
df = df.reset_index(drop=True)

df = pd.concat([df,new_departure_time],axis=1)
```

In [ ]:
```
df.drop('departure_time',axis=1,inplace=True)
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	stops	arrival_time	destination_city	class1	duration	days_left	price	airline_
0	1408	zero	Night	Mumbai	Economy	2.17	1	5953	

1 rows × 26 columns

STOPS

In [ ]:
```
df['stops'].value_counts()
```

Out[ ]:

stops	count
one	250863
zero	36004
two_or_more	13286

dtype: int64

In [ ]:
```
one4 = OneHotEncoder(sparse_output=False)
one4.fit(df[['stops']])
one4_output = one4.transform(df[['stops']])
```

In [ ]:
```
one4.get_feature_names_out()
```

Out[ ]:
```
array(['stops_one', 'stops_two_or_more', 'stops_zero'], dtype=object)
```

In [ ]:
```
new_stops = pd.DataFrame(one4_output , columns=one4.get_feature_names_out())

new_stops = new_stops.reset_index(drop=True)
df = df.reset_index(drop=True)

df = pd.concat([df,new_stops],axis=1)
```

In [ ]:
```
df.drop('stops',axis=1,inplace=True)
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	arrival_time	destination_city	class1	duration	days_left	price	airline_AirAsia
0	1408	Night	Mumbai	Economy	2.17	1	5953	0.0

1 rows × 28 columns

ARRIVAL_TIME

In [ ]:
```
one5 = OneHotEncoder(sparse_output=False)
one5.fit(df[['arrival_time']])
one5_output = one5.transform(df[['arrival_time']])
```

In [ ]:
```
one5.get_feature_names_out()
```

Out[ ]:
```
array(['arrival_time_Afternoon', 'arrival_time_Early_Morning',
       'arrival_time_Evening', 'arrival_time_Late_Night',
       'arrival_time_Morning', 'arrival_time_Night'], dtype=object)
```

In [ ]:
```
new_arrival_time = pd.DataFrame(one5_output , columns=one5.get_feature_names_out())

new_arrival_time = new_arrival_time.reset_index(drop=True)
df = df.reset_index(drop=True)

df = pd.concat([df,new_arrival_time],axis=1)
```

In [ ]:
```
df.drop('arrival_time',axis=1,inplace=True)
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	destination_city	class1	duration	days_left	price	airline_AirAsia	airline_Air_I
0	1408	Mumbai	Economy	2.17	1	5953	0.0	

1 rows × 33 columns

DESTINATION_CITY

In [ ]:
```
df['destination_city'].value_counts()
```

Out[ ]:

destination_city	count
Mumbai	59097
Delhi	57360
Bangalore	51068
Kolkata	49534
Hyderabad	42726
Chennai	40368

dtype: int64

In [ ]:
```
one6 = OneHotEncoder(sparse_output=False)
one6.fit(df[['destination_city']])
one6_output = one6.transform(df[['destination_city']])
```

In [ ]:
```
one6.get_feature_names_out()
```

Out[ ]:
```
array(['destination_city_Bangalore', 'destination_city_Chennai',
       'destination_city_Delhi', 'destination_city_Hyderabad',
       'destination_city_Kolkata', 'destination_city_Mumbai'],
      dtype=object)
```

In [ ]:
```
new_destination_city = pd.DataFrame(one6_output , columns=one6.get_feature_names_ou

new_destination_city = new_destination_city.reset_index(drop=True)
df = df.reset_index(drop=True)

df = pd.concat([df,new_destination_city],axis=1)
```

In [ ]:
```
df.drop('destination_city',axis=1,inplace=True)
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	class1	duration	days_left	price	airline_AirAsia	airline_Air_India	airline_GO_F
0	1408	Economy	2.17	1	5953	0.0	0.0	

1 rows × 38 columns

class1

In [ ]:
```
df['class1'].value_counts()
```

Out[ ]:

class1	count
Economy	206666
Business	93487

dtype: int64

In [ ]:
```
la2 = LabelEncoder()
la2.fit(df['class1'])
df['class1'] = la2.transform(df['class1'])
```

In [ ]:
```
df.head(1)
```

Out[ ]:

	flight	class1	duration	days_left	price	airline_AirAsia	airline_Air_India	airline_GO_FIR
0	1408	1	2.17	1	5953	0.0	0.0	

1 rows × 38 columns

In [ ]:
```
for col in df.columns:
    if df[col].dtype not in [float, int]:
        print("Object found!!")
        break
else:
    print("All are correct")
```

```
All are correct
```

CORRELATION

In [ ]:
```
cor = df.corr()['price']
cor
```

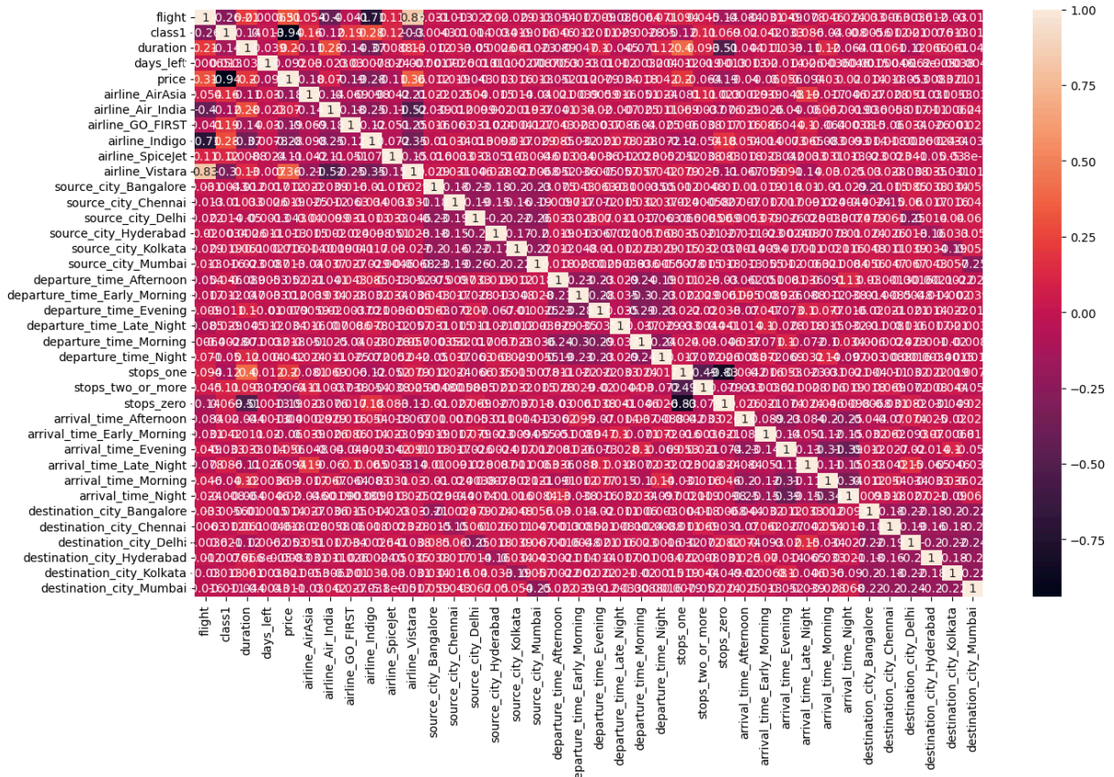
Out[ ]:

	price
flight	0.305888
class1	-0.937860
duration	0.204222
days_left	-0.091949
price	1.000000
airline_AirAsia	-0.176188
airline_Air_India	0.070041
airline_GO_FIRST	-0.194179
airline_Indigo	-0.280882
airline_SpiceJet	-0.114019
airline_Vistara	0.360816
source_city_Bangalore	0.011702
source_city_Chennai	0.018742
source_city_Delhi	-0.043282
source_city_Hyderabad	-0.012828
source_city_Kolkata	0.016127
source_city_Mumbai	0.013206
departure_time_Afternoon	-0.051968
departure_time_Early_Morning	-0.012232
departure_time_Evening	0.007946
departure_time_Late_Night	-0.033768
departure_time_Morning	0.018199
departure_time_Night	0.041768
stops_one	0.199913
stops_two_or_more	-0.064248
stops_zero	-0.187277
arrival_time_Afternoon	-0.040258
arrival_time_Early_Morning	-0.060449
arrival_time_Evening	0.056408
arrival_time_Late_Night	-0.093602
arrival_time_Morning	0.030379
arrival_time_Night	0.020344
destination_city_Bangalore	0.014050
destination_city_Chennai	0.018473
destination_city_Delhi	-0.052527
destination_city_Hyderabad	-0.008292
destination_city_Kolkata	0.020956
destination_city_Mumbai	0.010533

dtype: float64

In [ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

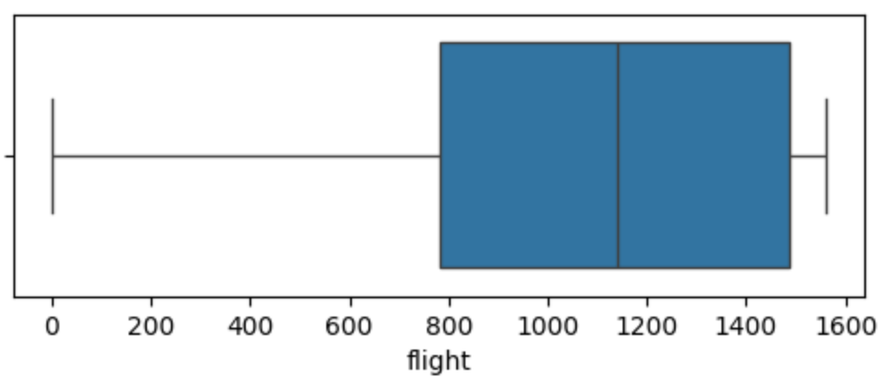
In [ ]:
```
plt.figure(figsize=(15,9))
sns.heatmap(df.corr(),annot=True)
plt.show()
```

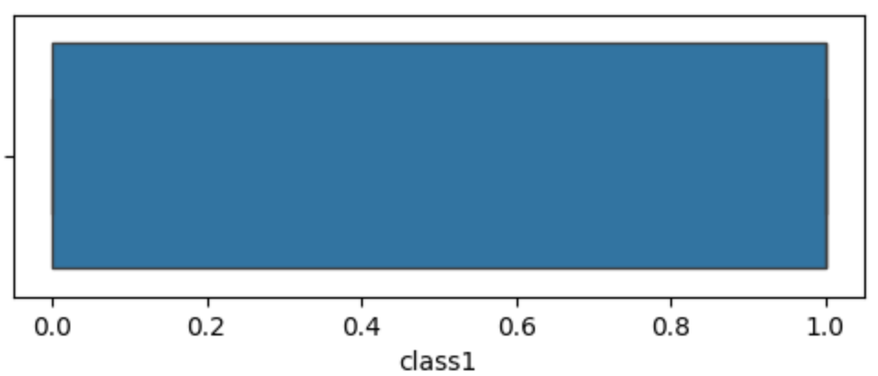


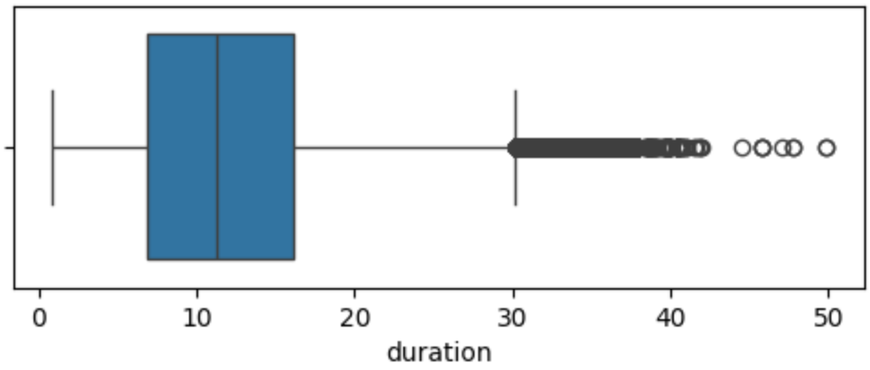
OUTLIERS

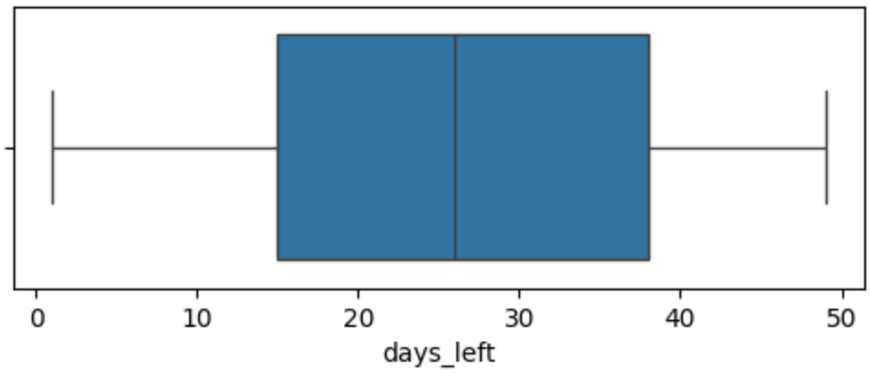
In [ ]:
```
import seaborn as sns
import matplotlib.pyplot as plt
```

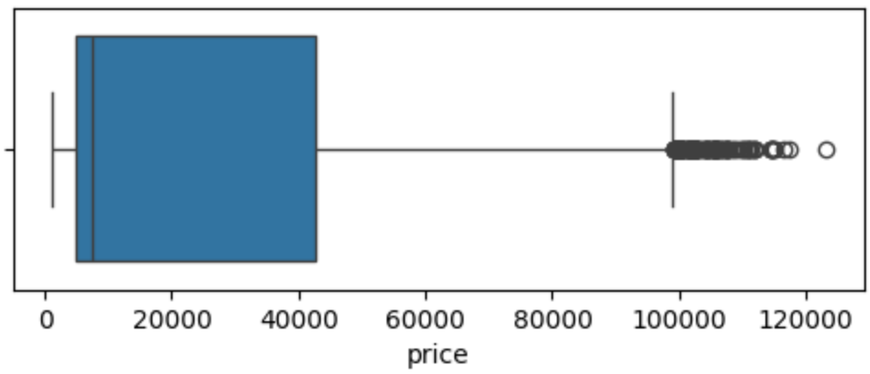
In [ ]:
```
for col in df.columns:
  plt.figure(figsize=(6,2))
  sns.boxplot(x=df[col])
  plt.show()
```

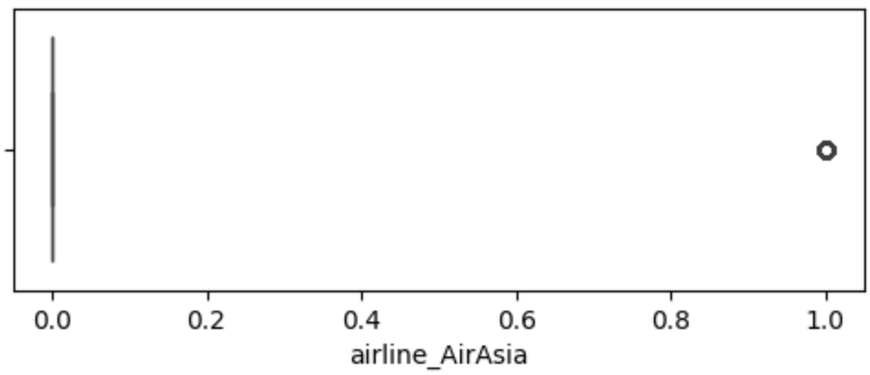


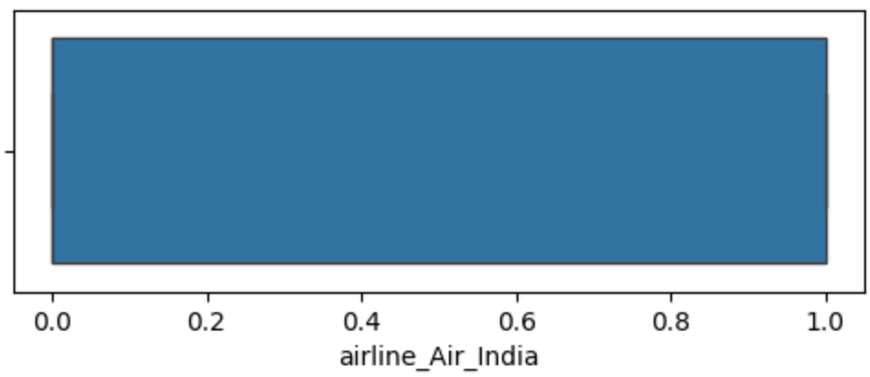



0
10
20
30
40
50
duration


0
10
20
30
40
50
days_left


0
20000
40000
60000
80000
100000
120000
price


0.0
0.2
0.4
0.6
0.8
1.0
airline_AirAsia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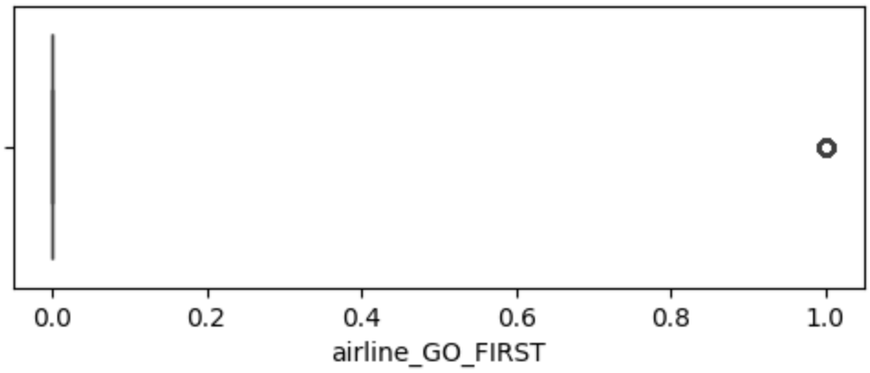
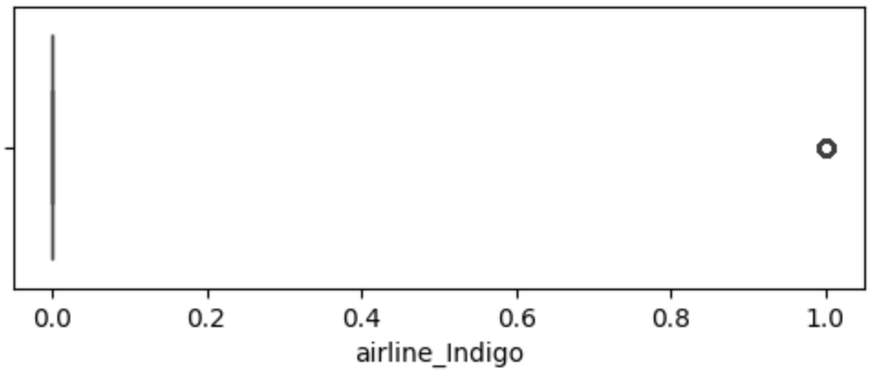
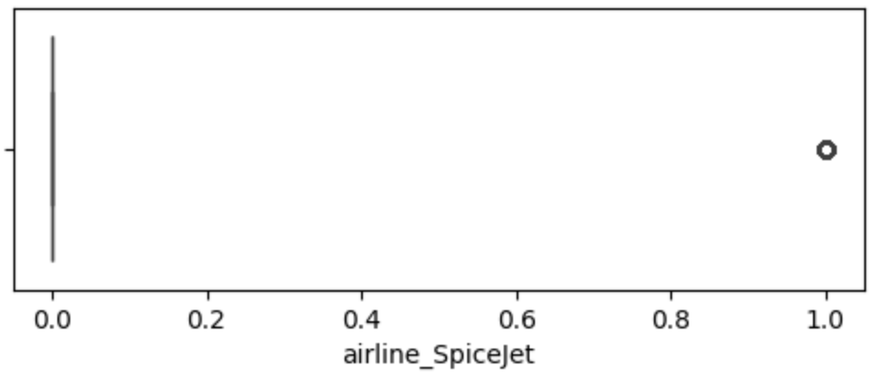
0.2
0.4
0.6
0.8
1.0
airline_Air_India


0.0
0.2
0.4
0.6
0.8
1.0
airline_GO_FIRST


0.0
0.2
0.4
0.6
0.8
1.0
airline_Indigo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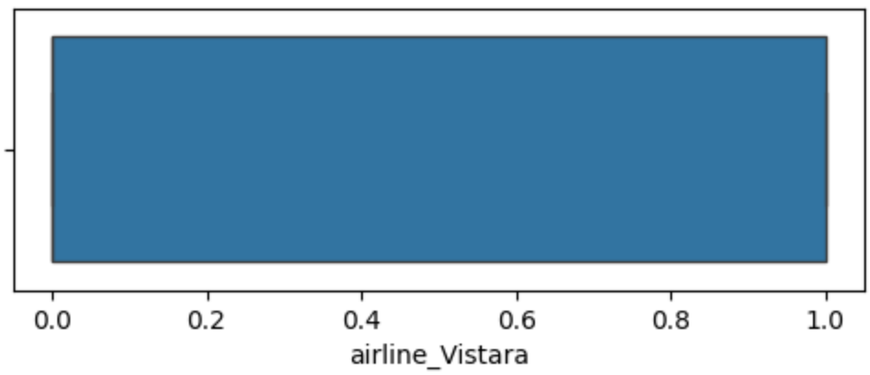
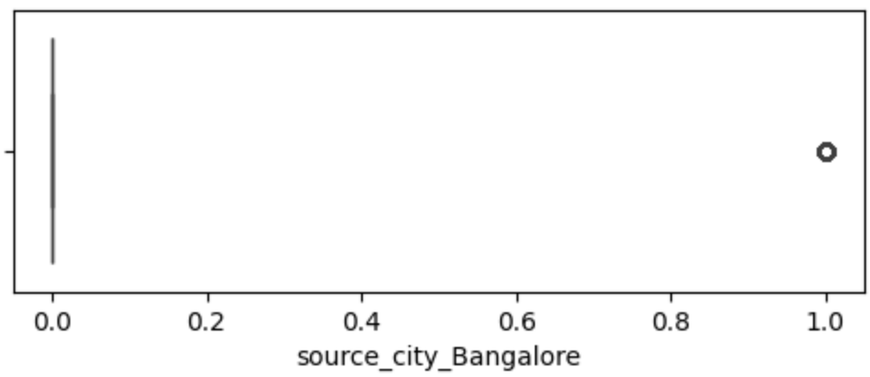
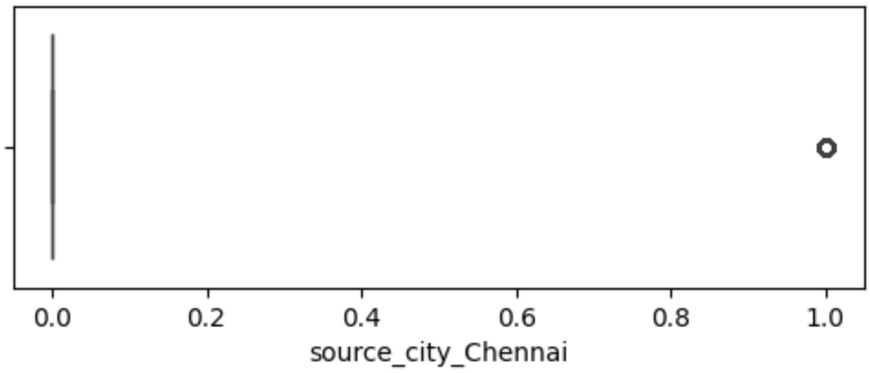
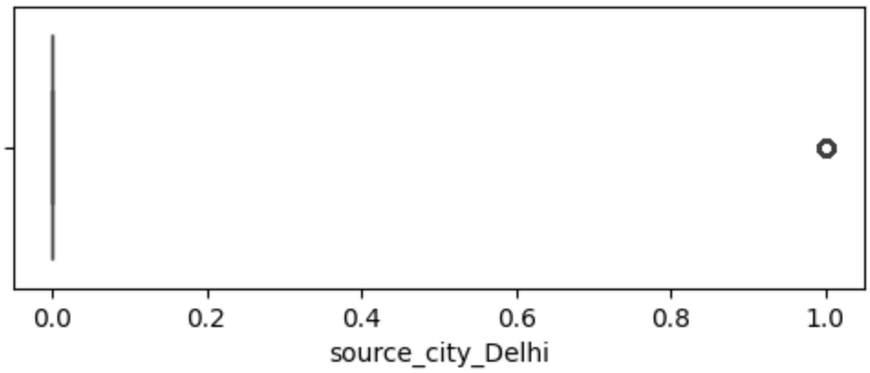
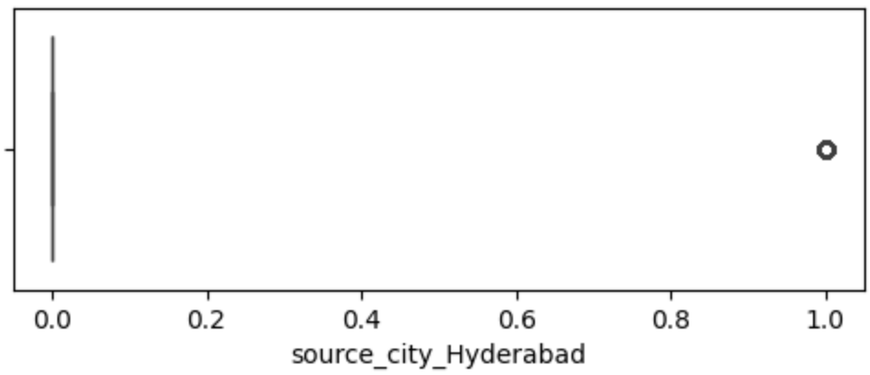
0.2
0.4
0.6
0.8
1.0
airline_SpiceJet

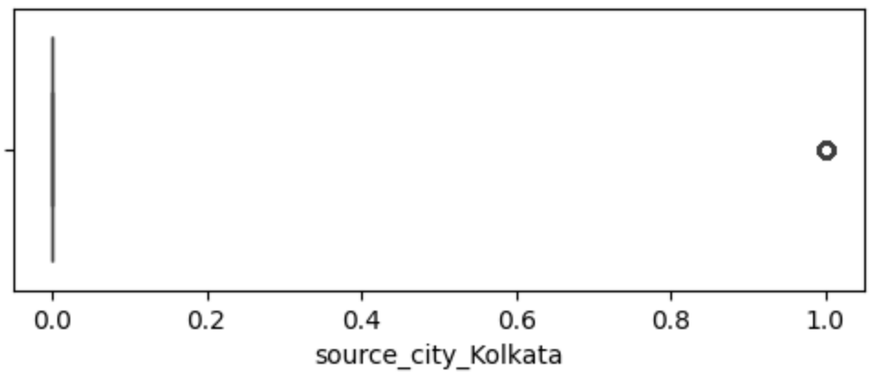

0.0
0.2
0.4
0.6
0.8
1.0
airline_Vistara

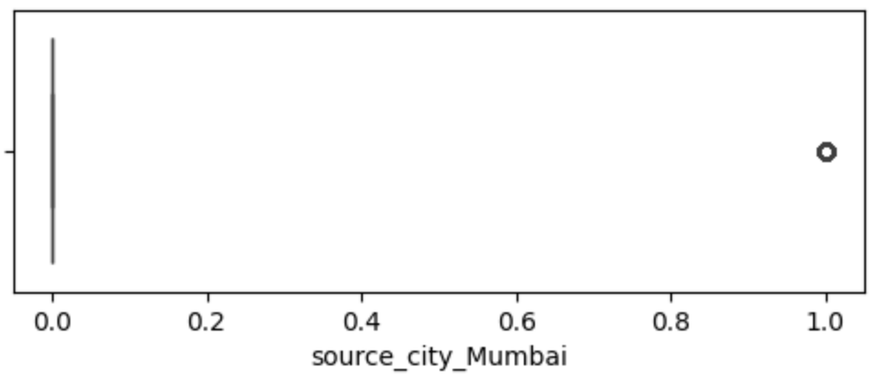

0.0
0.2
0.4
0.6
0.8
1.0
source_city_Bangalore


0.0
0.2
0.4
0.6
0.8
1.0
source_city_Chennai


0.0
0.2
0.4
0.6
0.8
1.0
source_city_Delhi


0.0
0.2
0.4
0.6
0.8
1.0
source_city_Hyderabad


0.0
0.2
0.4
0.6
0.8
1.0
source_city_Kolkata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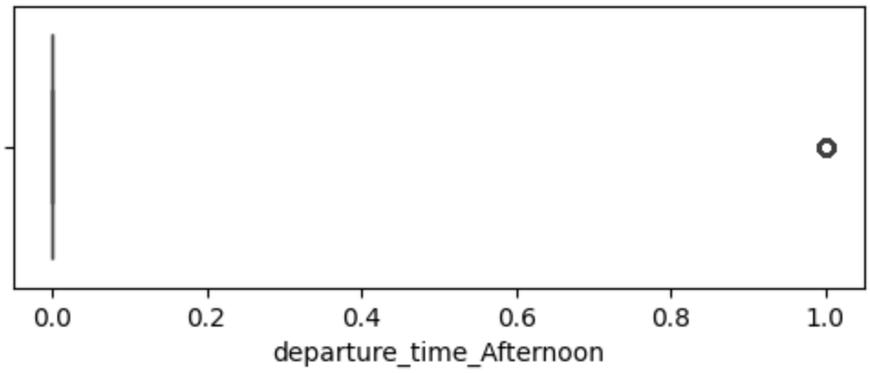
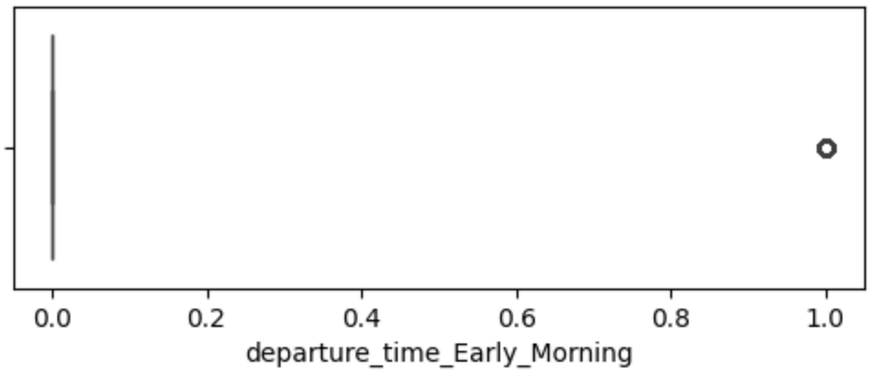
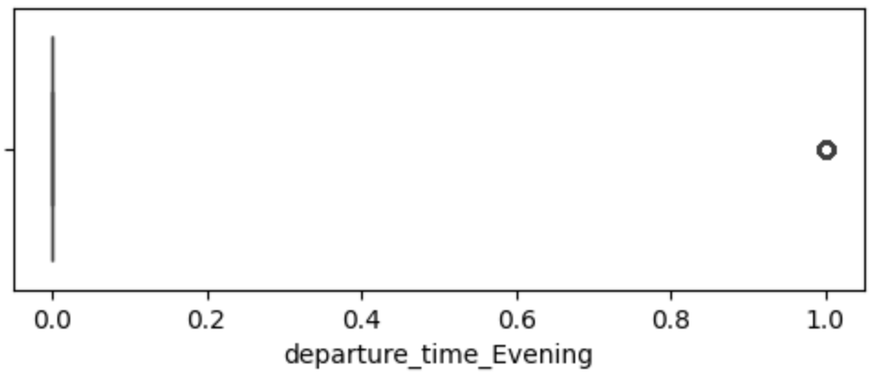
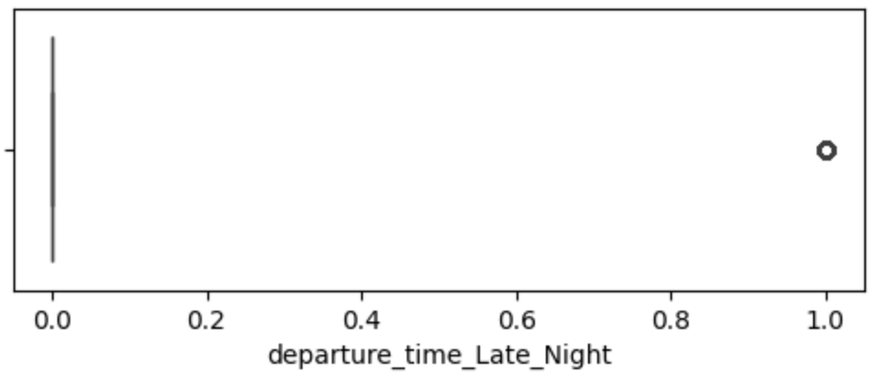
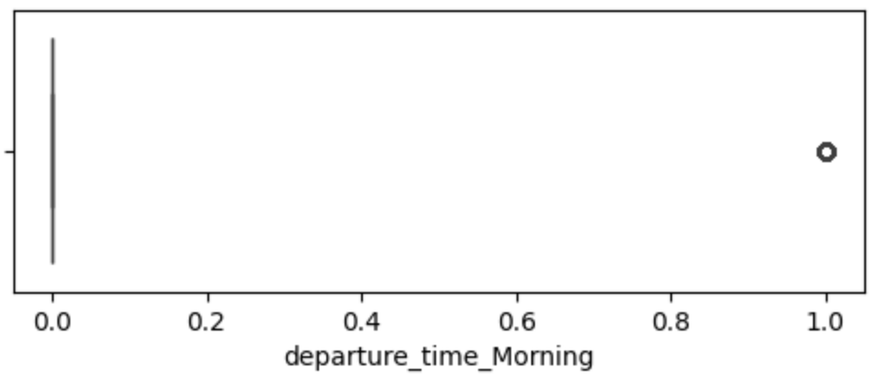
0.2
0.4
0.6
0.8
1.0
source_city_Mumbai

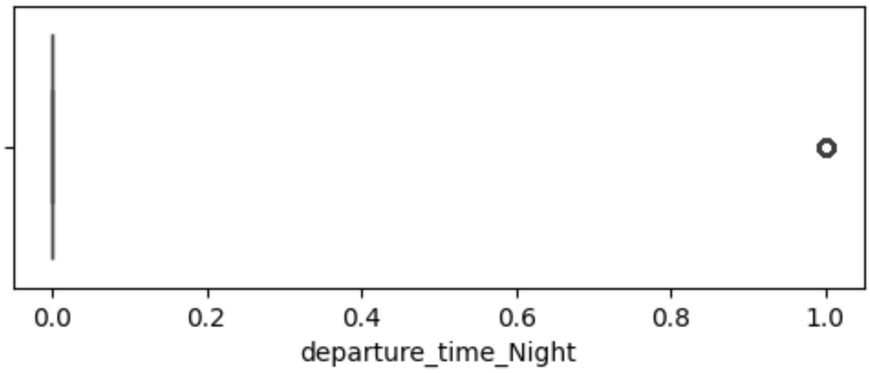

0.0
0.2
0.4
0.6
0.8
1.0
departure_time_Afternoon

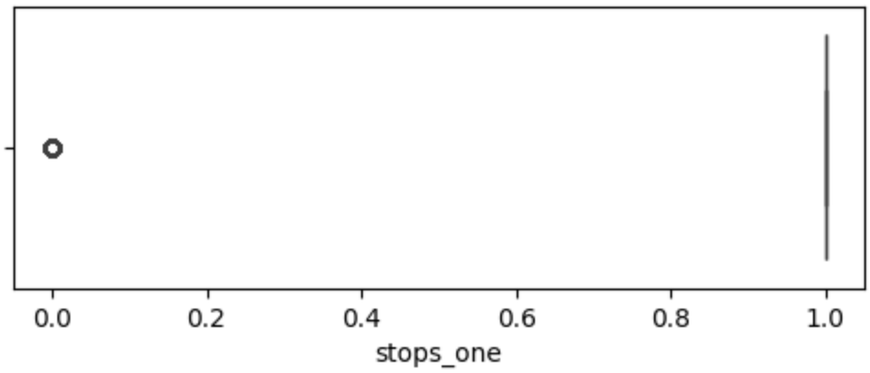

0.0
0.2
0.4
0.6
0.8
1.0
departure_time_Early_Morning

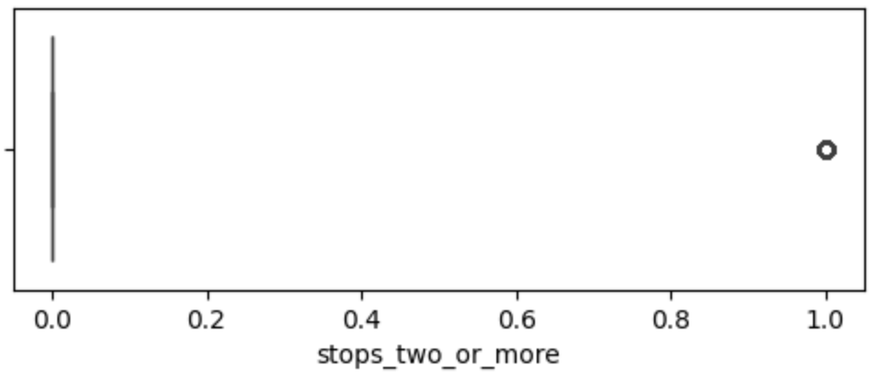

0.0
0.2
0.4
0.6
0.8
1.0
departure_time_Evening

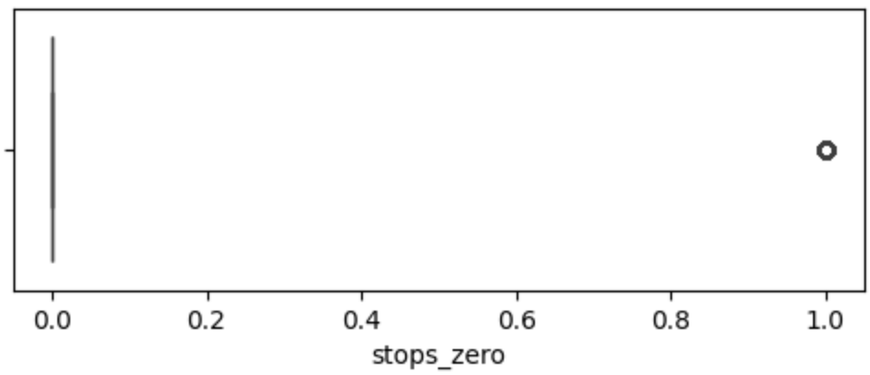

0.0
0.2
0.4
0.6
0.8
1.0
departure_time_Late_Night

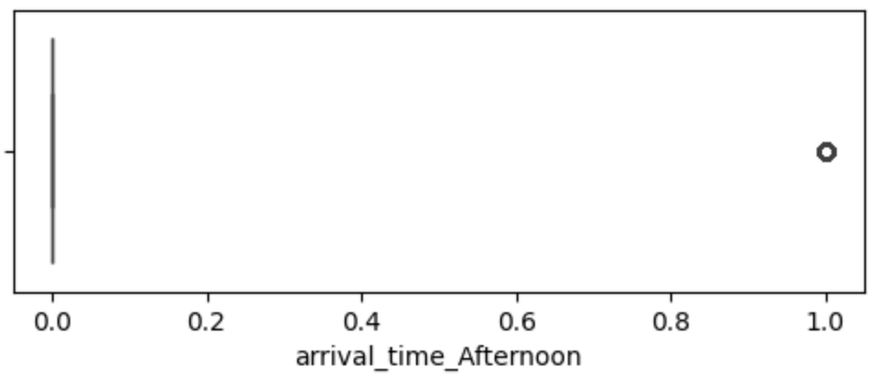

0.0
0.2
0.4
0.6
0.8
1.0
departure_time_Morning

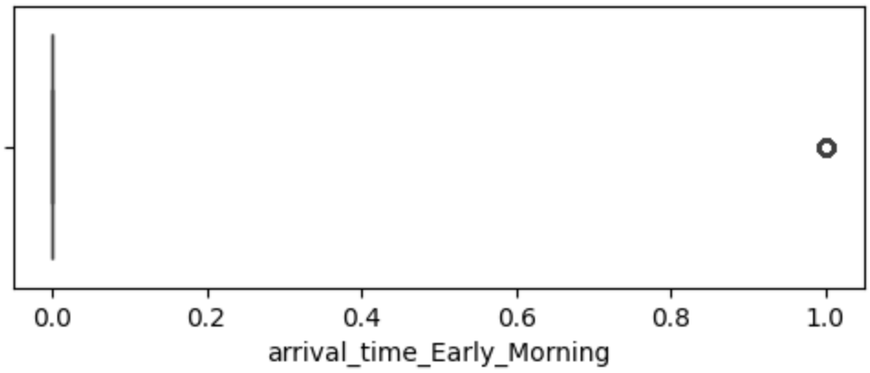

0.0
0.2
0.4
0.6
0.8
1.0
departure_time_Night

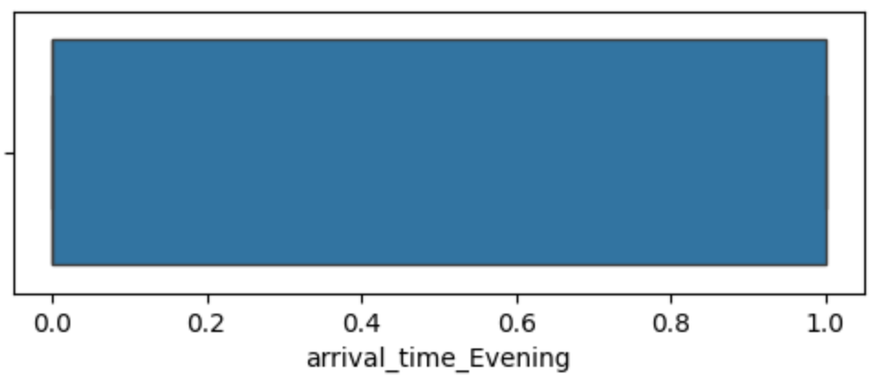

0.0
0.2
0.4
0.6
0.8
1.0
stops_one

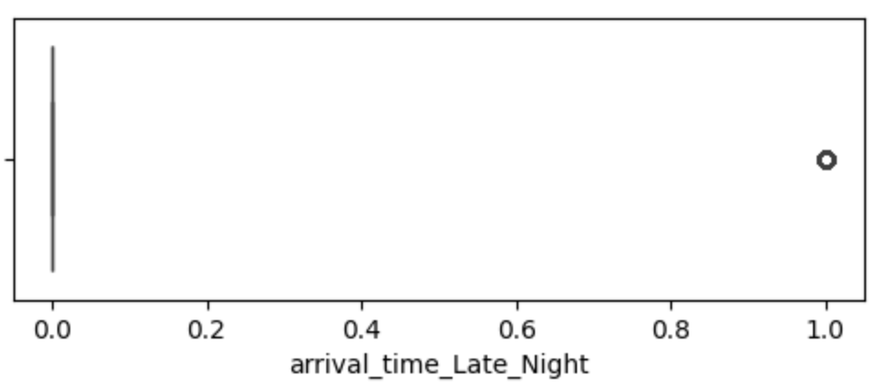

0.0
0.2
0.4
0.6
0.8
1.0
stops_two_or_more

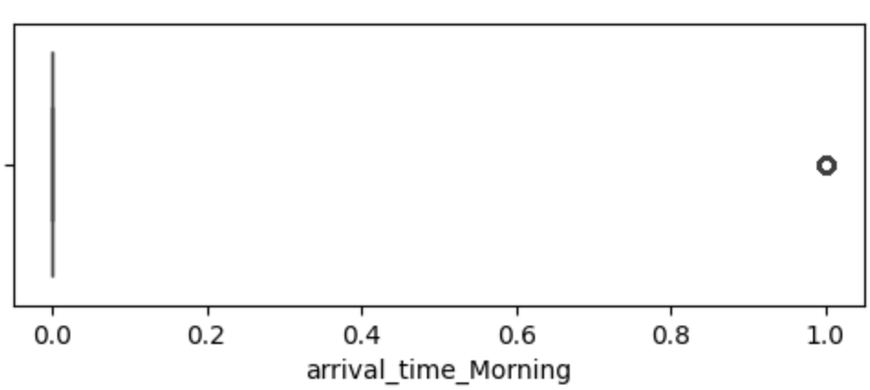

0.0
0.2
0.4
0.6
0.8
1.0
stops_zero

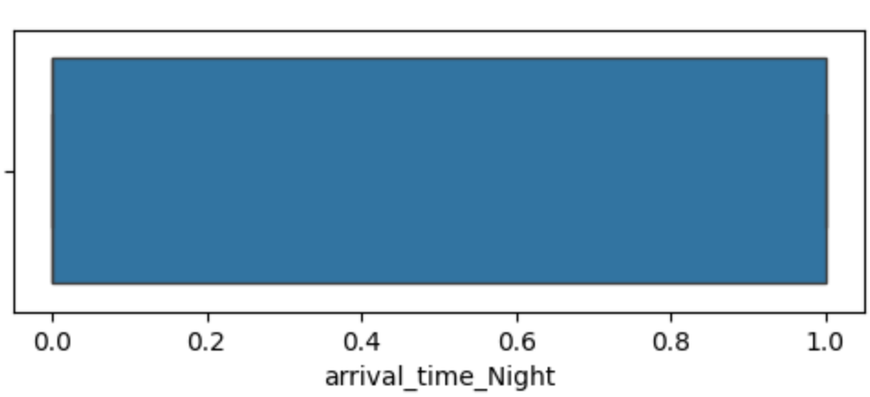

0.0
0.2
0.4
0.6
0.8
1.0
arrival_time_Afternoon

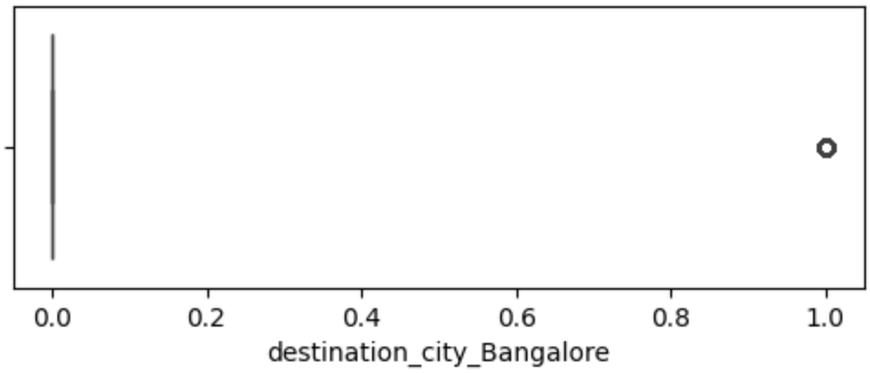

0.0
0.2
0.4
0.6
0.8
1.0
arrival_time_Early_Morning

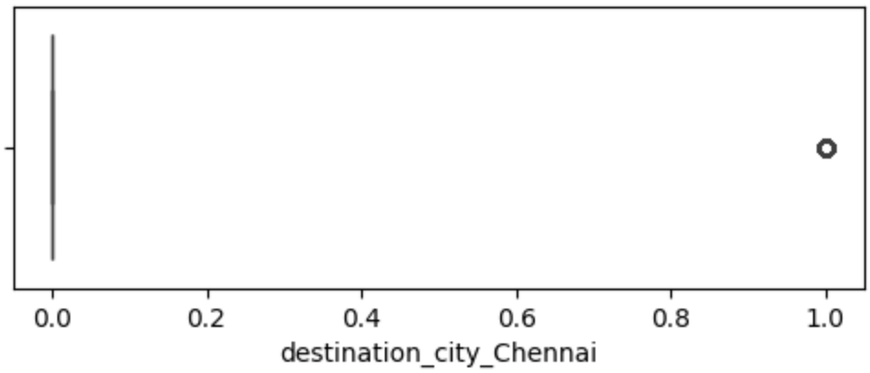

0.0
0.2
0.4
0.6
0.8
1.0
arrival_time_Evening

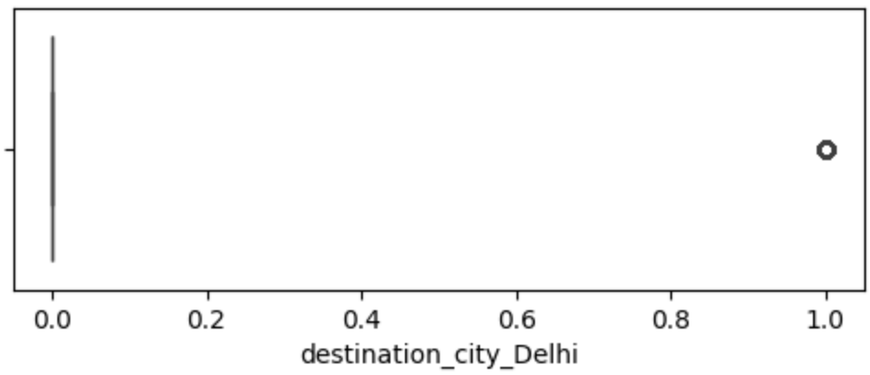

0.0
0.2
0.4
0.6
0.8
1.0
arrival_time_Late_Night

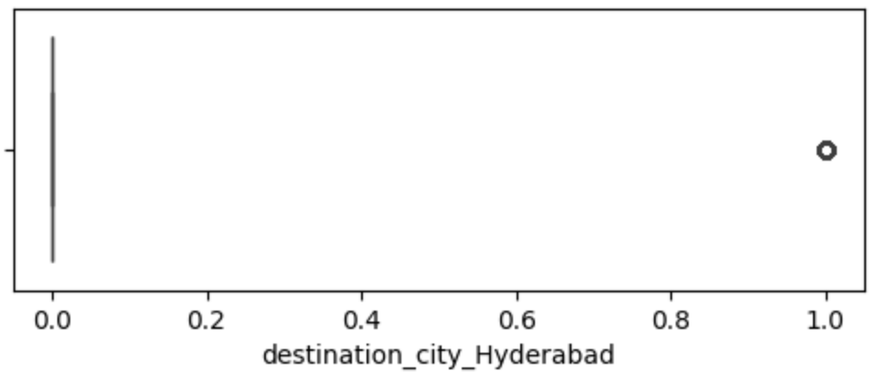

0.0
0.2
0.4
0.6
0.8
1.0
arrival_time_Morning

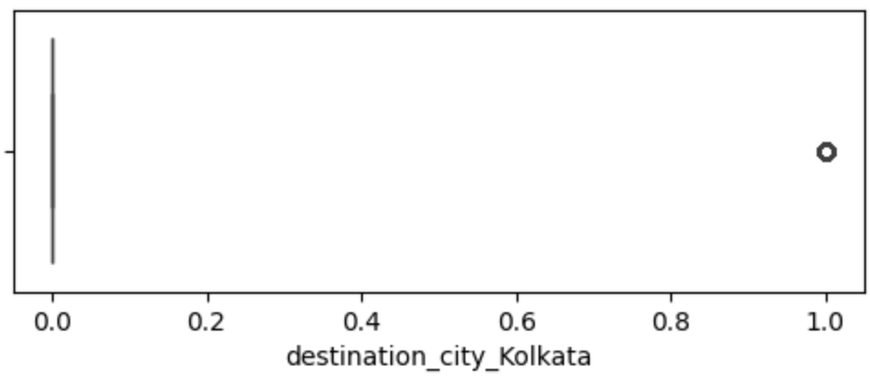

0.0
0.2
0.4
0.6
0.8
1.0
arrival_time_Night

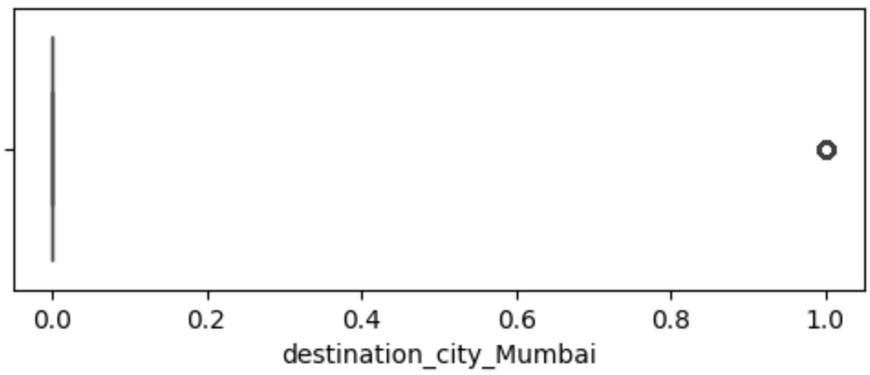

0.0
0.2
0.4
0.6
0.8
1.0
destination_city_Bangalore


0.0
0.2
0.4
0.6
0.8
1.0
destination_city_Chennai


0.0
0.2
0.4
0.6
0.8
1.0
destination_city_Delhi


0.0
0.2
0.4
0.6
0.8
1.0
destination_city_Hyderabad


0.0
0.2
0.4
0.6
0.8
1.0
destination_city_Kolkata



In [ ]:
```
Q1 = df['duration'].quantile(0.25)
Q3 = df['duration'].quantile(0.75)
IQR = Q3 - Q1

print('lower quartile         = ',Q1)
print('upper quartile         = ',Q3)
print('interquartile range    = ',IQR)

print('---'*50)

lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

outliers = df[(df['duration'] < lower_bound) | (df['duration'] > upper_bound)]
```

```
lower quartile         =  6.83
upper quartile         =  16.17
interquartile range    =  9.340000000000002
------------------------------------------------------------------------------------------
------------------------------------------------------------------
```

- Currently, the longest commercial nonstop flight is around 19 hours, and no aircraft is capable of flying 50 hours nonstop due to fuel, crew, and passenger limitations.

In [ ]:
```
data = df[(df['duration'] >=19)]
data
```

Out[ ]:

	flight	class1	duration	days_left	price	airline_AirAsia	airline_Air_India	airline_G
35	1460	1	23.17	1	12150	0.0	0.0	
36	1470	1	24.17	1	12150	0.0	0.0	
41	744	1	19.08	1	12150	0.0	1.0	
42	748	1	22.83	1	12150	0.0	1.0	
43	857	1	26.42	1	12150	0.0	1.0	
...	...	...	...	...	...	...	...	
300137	1492	0	25.83	49	51457	0.0	0.0	
300138	1486	0	26.33	49	51457	0.0	0.0	
300139	1488	0	26.42	49	51457	0.0	0.0	
300145	716	0	23.08	49	51345	0.0	1.0	
300146	722	0	26.83	49	51345	0.0	1.0	

55620 rows × 38 columns

DATA SPLIT

In [ ]:
```
x = data.drop('price',axis=1)
y = data['price']
```

SCALING

In [ ]:
```
from sklearn.preprocessing import StandardScaler
```

In [ ]:
```
sd = StandardScaler()
sd.fit(x)
x = sd.transform(x)
```

TRAIN-TEST SPLIT

In [ ]:
```
from sklearn.model_selection import train_test_split
```

In [ ]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=42)
```

MODEL BUILDING

KNN MODEL

In [ ]:
```
from sklearn.neighbors import KNeighborsRegressor
```

In [ ]:
```
from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint
```

In [ ]:
```
import matplotlib.pyplot as plt
```

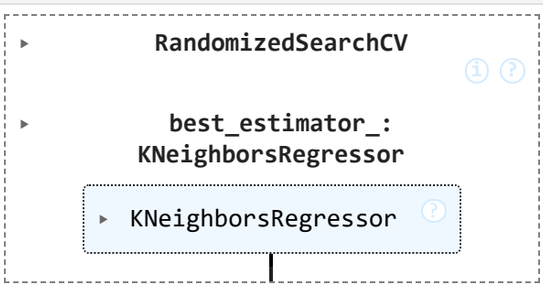
RANDOMSEARCH CV

In [ ]:
```
hyperknn = KNeighborsRegressor()
```

In [ ]:
```
parameter = {'n_neighbors':randint(2,11),
             'weights':['uniform', 'distance'],
             'algorithm' : ['auto', 'ball_tree', 'kd_tree', 'brute'],
             'leaf_size':randint(2,11),
             'metric':['euclidean', 'manhattan', 'minkowski'],
             }
```

In [ ]:
```
Randomcv = RandomizedSearchCV(hyperknn,param_distributions=parameter,cv=5,scoring='
Randomcv.fit(x_train,y_train)
```

Out[ ]:



In [ ]:
```
print(Randomcv.best_params_)
print(Randomcv.best_score_)
```

```
{'algorithm': 'kd_tree', 'leaf_size': 3, 'metric': 'manhattan', 'n_neighbors': 3, 'w
eights': 'distance'}
0.9659009249040966
```

MODEL BUILDING

In [ ]:
```
new_hyp_knn = KNeighborsRegressor(algorithm = 'ball_tree', leaf_size = 2, metric =
new_hyp_knn.fit(x_train,y_train)
```

Out[ ]:
```
KNeighborsRegressor(algorithm='ball_tree', leaf_size=2, metric='manhatta
n',
                    n_neighbors=8, weights='distance')
```

In [ ]:
```
pred_hpp_knn = new_hyp_knn.predict(x_test)
pred_hpp_knn
```

Out[ ]:
```
array([54023.37447441,  4146.00109253, 69631.5492607 , ...,
       39499.        ,  8550.3625563 , 11646.92975207])
```

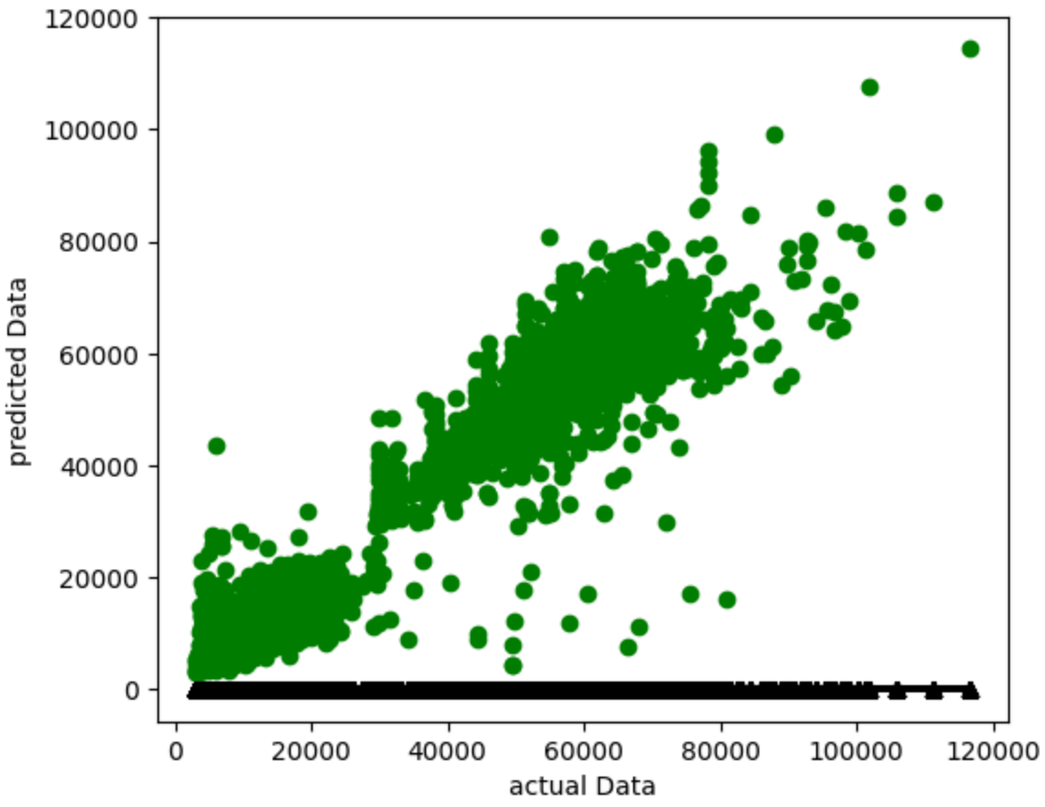
MODEL EVALUATION

In [ ]:
```
from sklearn.metrics import r2_score,mean_absolute_error,mean_squared_error,root_me
```

In [ ]:
```
print('r2_score : ',r2_score(y_test,pred_hpp_knn))
print('mean_absolute_error : ',mean_absolute_error(y_test,pred_hpp_knn))
print('mean_squared_error : ',mean_squared_error(y_test,pred_hpp_knn))
print('root_mean_squared_error : ',root_mean_squared_error(y_test,pred_hpp_knn))
```

```
r2_score :  0.9706277269790697
mean_absolute_error :  1709.801683358281
mean_squared_error :  15217865.587607985
root_mean_squared_error :  3901.0082783311273
```

In [ ]:
```
plt.figure(figsize=(6,5))
plt.scatter(y_test,pred_hpp_knn,color='g')
plt.plot([y_test.min(),y_test.max()],[y_test.min(),y_test.max()],'k--',lw=2,marker=
plt.xlabel('actual Data')
plt.ylabel('predicted Data')
plt.show()
```



DECISION TREE MODEL

RANDOMSEARCH CV

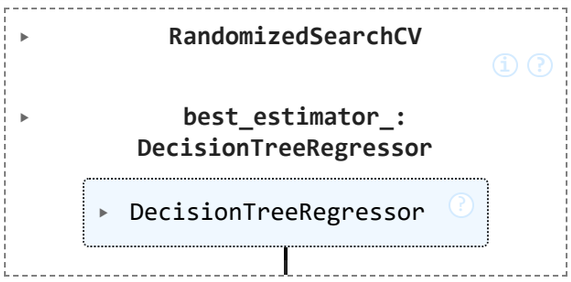
In [ ]:
```
from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint
from sklearn.tree import DecisionTreeRegressor
```

In [ ]:
```
hyperdt =  DecisionTreeRegressor()
```

In [ ]:
```
parameter_dt = {'criterion':["squared_error", "friedman_mse", "absolute_error","poi
                'splitter':["best", "random"],
                'max_depth':randint(3,11),
                'min_samples_split':randint(2,11),
                'min_samples_leaf':randint(2,11),
                'max_features':randint(1,11),
                }
```

In [ ]:
```
random_dt = RandomizedSearchCV(hyperdt,param_distributions=parameter_dt,cv=5,scorin
random_dt.fit(x_train,y_train)
```

Out[ ]:



In [ ]:
```
print(random_dt.best_params_)
print(random_dt.best_score_)
```

```
{'criterion': 'absolute_error', 'max_depth': 6, 'max_features': 10, 'min_samples_lea
f': 2, 'min_samples_split': 7, 'splitter': 'best'}
0.8801049930243885
```

MODEL BUILDING

In [ ]:
```
model_dt_hyper = DecisionTreeRegressor(criterion = 'squared_error', max_depth = 8,
model_dt_hyper.fit(x_train,y_train)
```

Out[ ]:

```
DecisionTreeRegressor
DecisionTreeRegressor(max_depth=8, max_features=7, min_samples_leaf=8,
                      min_samples_split=4)
```

In [ ]:
```
new_dt_model = model_dt_hyper.predict(x_test)
new_dt_model
```

Out[ ]:
```
array([34865.76952823, 21116.18563512, 56122.56972955, ...,
       56122.56972955,  5712.45454545,  8007.95254721])
```

MODEL EVALUATION

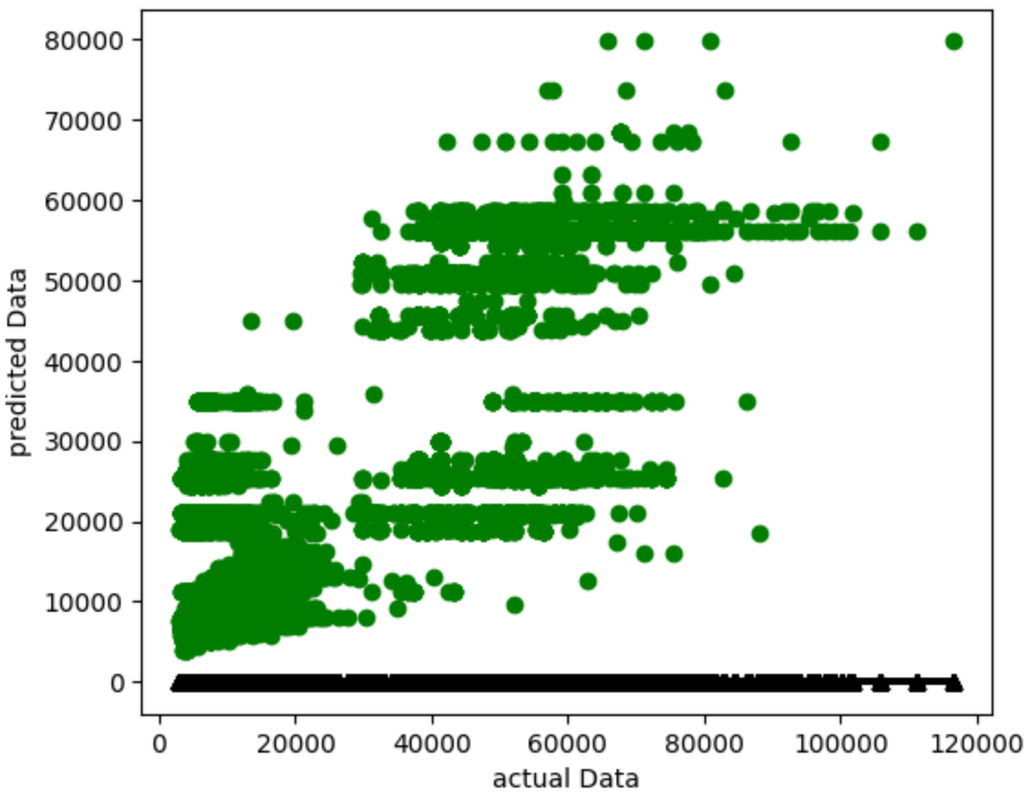
In [ ]:
```
from sklearn.metrics import r2_score,mean_absolute_error,mean_squared_error,root_me
```

In [ ]:
```
print('r2_score : ',r2_score(y_test,new_dt_model))
print('mean_absolute_error : ',mean_absolute_error(y_test,new_dt_model))
print('mean_squared_error : ',mean_squared_error(y_test,new_dt_model))
print('root_mean_squared_error : ',root_mean_squared_error(y_test,new_dt_model))
```

```
r2_score :  0.6255953305804944
mean_absolute_error :  9931.562146803311
mean_squared_error :  193980218.36916682
root_mean_squared_error :  13927.678139918615
```

In [ ]:
```
plt.figure(figsize=(6,5))
plt.scatter(y_test,new_dt_model,color='g')
plt.plot([y_test.min(),y_test.max()],[y_test.min(),y_test.max()],'k--',lw=2,marker=
plt.xlabel('actual Data')
```

```
plt.ylabel('predicted Data')
plt.show()
```



SVM MODEL

RANDOMSEARCH CV

In [ ]:
```
from sklearn.metrics import r2_score,mean_absolute_error,mean_squared_error,root_me
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint
from sklearn.svm import SVR
```

In [ ]:
```
hyp_svm = SVR()
```

In [ ]:
```
parameter_svm = {
    'kernel': ['linear', 'rbf'],
    'gamma': ['scale', 'auto'],
    'C': randint(1, 6),
    'shrinking': [True, False]
}
```

In [ ]:
```
random_sv = RandomizedSearchCV(hyp_svm,param_distributions=parameter_svm,cv=2,scori
random_sv.fit(x_train,y_train)
```

Out[ ]:

▸ **RandomizedSearchCV**

▸ **best_estimator_: SVR**

▸ SVR

In [ ]:
```
print(random_sv .best_params_)
print(random_sv .best_score_)
```

```
{'C': 4, 'gamma': 'auto', 'kernel': 'linear', 'shrinking': False}
0.9149327532795113
```

MODEL BUILDING

In [ ]:
```
hyper_svm = SVR(C = 5, gamma = 'scale', kernel = 'linear', shrinking = True)
hyper_svm.fit(x_train,y_train)
```

Out[ ]:
```
SVR
SVR(C=5, kernel='linear')
```

In [ ]:
```
new_svm_pred = hyper_svm.predict(x_test)
new_svm_pred
```

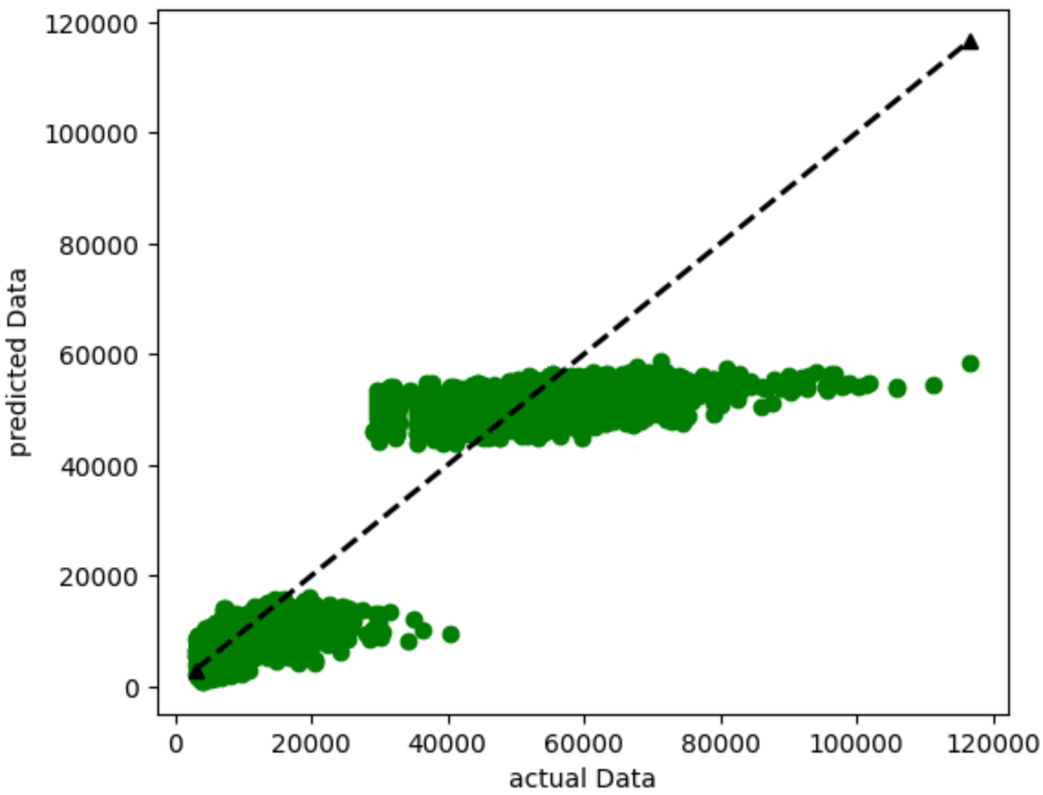
Out[ ]:
```
array([52597.99947246,  4052.7576754 , 50196.9139743 , ...,
       47438.51395615,  2780.7743189 , 10320.45578905])
```

MODEL EVAUATION

In [ ]:
```
print('r2_score : ',r2_score(y_test,new_svm_pred))
print('mean_absolute_error : ',mean_absolute_error(y_test,new_svm_pred))
print('mean_squared_error : ',mean_squared_error(y_test,new_svm_pred))
print('root_mean_squared_error : ',root_mean_squared_error(y_test,new_svm_pred))
```

```
r2_score :  0.9189440567743654
mean_absolute_error :  4183.991034196682
mean_squared_error :  41995335.131384596
root_mean_squared_error :  6480.380785986623
```

In [ ]:
```
plt.figure(figsize=(6,5))
plt.scatter(y_test,new_svm_pred,color='g')
plt.plot([y_test.min(),y_test.max()],[y_test.min(),y_test.max()],'k--',lw=2,marker=
plt.xlabel('actual Data')
plt.ylabel('predicted Data')
plt.show()
```



ADABOOST MODEL

RANDOMSEARCH CV

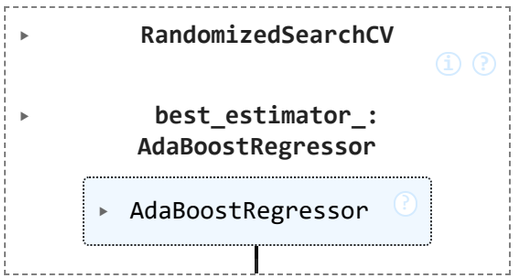
In [ ]:
```
from sklearn.ensemble import AdaBoostRegressor
from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint,uniform
from sklearn.tree import DecisionTreeRegressor
```

In [ ]:
```
hyper_ada = AdaBoostRegressor()
```

In [ ]:
```
parameter_ada = {'n_estimators':randint(1,101),
       'learning_rate':uniform(0.01,0.98),
       'loss':['linear', 'square', 'exponential'],
       'random_state':randint(1,43)}
```

In [ ]:
```
random_ada = RandomizedSearchCV(hyper_ada,param_distributions=parameter_ada,cv=5,sc
random_ada.fit(x_train,y_train)
```

Out[ ]:



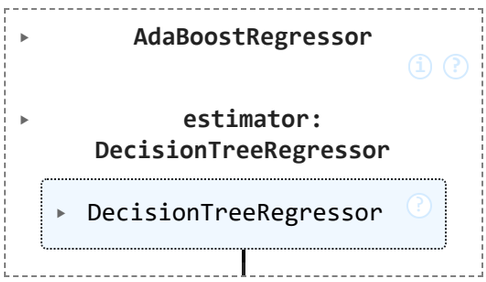
In [ ]:
```
print(random_ada.best_params_)
print(random_ada.best_score_)
```

```
{'learning_rate': 0.322149238698357, 'loss': 'exponential', 'n_estimators': 7, 'rand
om_state': 37}
0.9356412992562921
```

MODEL BUILDING

In [ ]:
```
new_ada_model=AdaBoostRegressor(estimator=DecisionTreeRegressor(max_depth=6),learni
new_ada_model.fit(x_train,y_train)
```

Out[ ]:



In [ ]:
```
new_pred_ada = new_ada_model.predict(x_test)
new_pred_ada
```

Out[ ]:
```
array([56479.60490694,  5580.87220714, 64655.83742633, ...,
       44233.38996929,  5568.38480663, 12891.74739864])
```

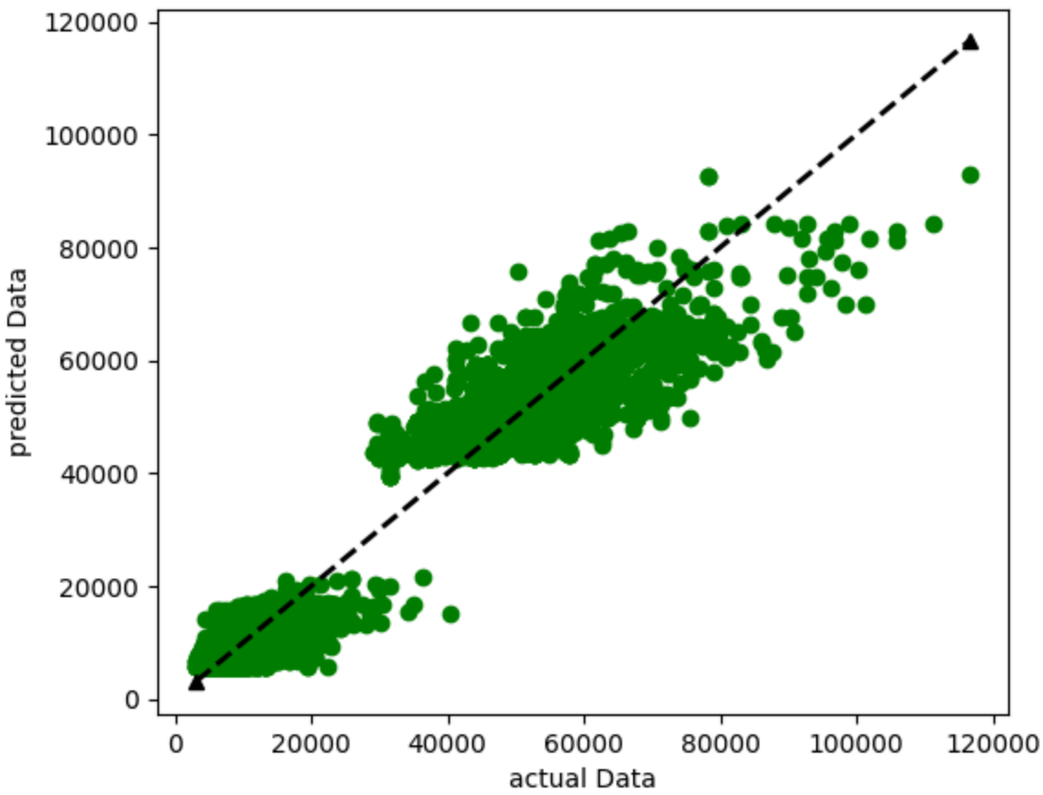
MODEL EVALUATION

In [ ]:
```
print('r2_score : ',r2_score(y_test,new_pred_ada))
print('mean_absolute_error : ',mean_absolute_error(y_test,new_pred_ada))
print('mean_squared_error : ',mean_squared_error(y_test,new_pred_ada))
print('root_mean_squared_error : ',root_mean_squared_error(y_test,new_pred_ada))
```

```
r2_score :  0.9560814017998567
mean_absolute_error :  3174.046750170575
mean_squared_error :  22754361.697839584
root_mean_squared_error :  4770.153215342206
```

In [ ]:
```
plt.figure(figsize=(6,5))
plt.scatter(y_test,new_pred_ada,color='g')
plt.plot([y_test.min(),y_test.max()],[y_test.min(),y_test.max()],'k--',lw=2,marker=
plt.xlabel('actual Data')
```

```
plt.ylabel('predicted Data')
plt.show()
```



LINEAR REGRESSOR MODEL

RANDOMSEARCH CV

In [ ]:
```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score,mean_absolute_error,mean_squared_error,root_me
from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint
```

In [ ]:
```
hypr_lr = LinearRegression()
```

In [ ]:
```
parameter_lr = {'fit_intercept':[True,False],'positive':[True,False],'copy_X':[True
```

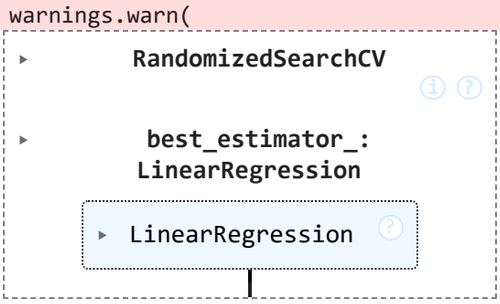
In [ ]:
```
random_lr = RandomizedSearchCV(hypr_lr,parameter_lr,cv=5,scoring='r2')
random_lr.fit(x_train,y_train)
```

```
/usr/local/lib/python3.11/dist-packages/sklearn/model_selection/_validation.py:528:
FitFailedWarning:
15 fits failed out of a total of 50.
The score on these train-test partitions for these parameters will be set to nan.
If these failures are not expected, you can try to debug them by setting error_score
='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
15 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.11/dist-packages/sklearn/model_selection/_validation.
py", line 866, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.11/dist-packages/sklearn/base.py", line 1389, in wrap
per
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.11/dist-packages/sklearn/linear_model/_base.py", line
640, in fit
    self.coef_ = optimize.nnls(X, y)[0]
                 ^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.11/dist-packages/scipy/optimize/_nnls.py", line 93, i
n nnls
    raise RuntimeError("Maximum number of iterations reached.")
RuntimeError: Maximum number of iterations reached.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
/usr/local/lib/python3.11/dist-packages/sklearn/model_selection/_search.py:1108: Use
rWarning: One or more of the test scores are non-finite: [            nan -8.2377136
9e+04 -8.23771369e+04 -8.23771369e+04
  9.26822122e-01             nan  9.26822122e-01  9.26822122e-01
 -8.23771369e+04             nan]
  warnings.warn(
```

Out[ ]:



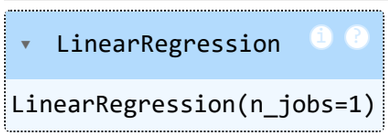
In [ ]:
```
print(random_lr.best_params_)
print(random_lr.best_score_)
```

```
{'copy_X': False, 'fit_intercept': True, 'n_jobs': 2, 'positive': False}
0.926822122055496
```

MODEL BUILDING

In [ ]:
```
new_model_lr = LinearRegression(copy_X = True, fit_intercept = True, n_jobs = 1, po
new_model_lr.fit(x_train,y_train)
```

Out[ ]:



In [ ]:
```
pred_lr_new = new_model_lr.predict(x_test)
pred_lr_new
```

Out[ ]:
```
array([55835.79016189,  1188.08581846, 54253.25558688, ...,
       46841.49754834,  1318.63811307, 10513.64679576])
```

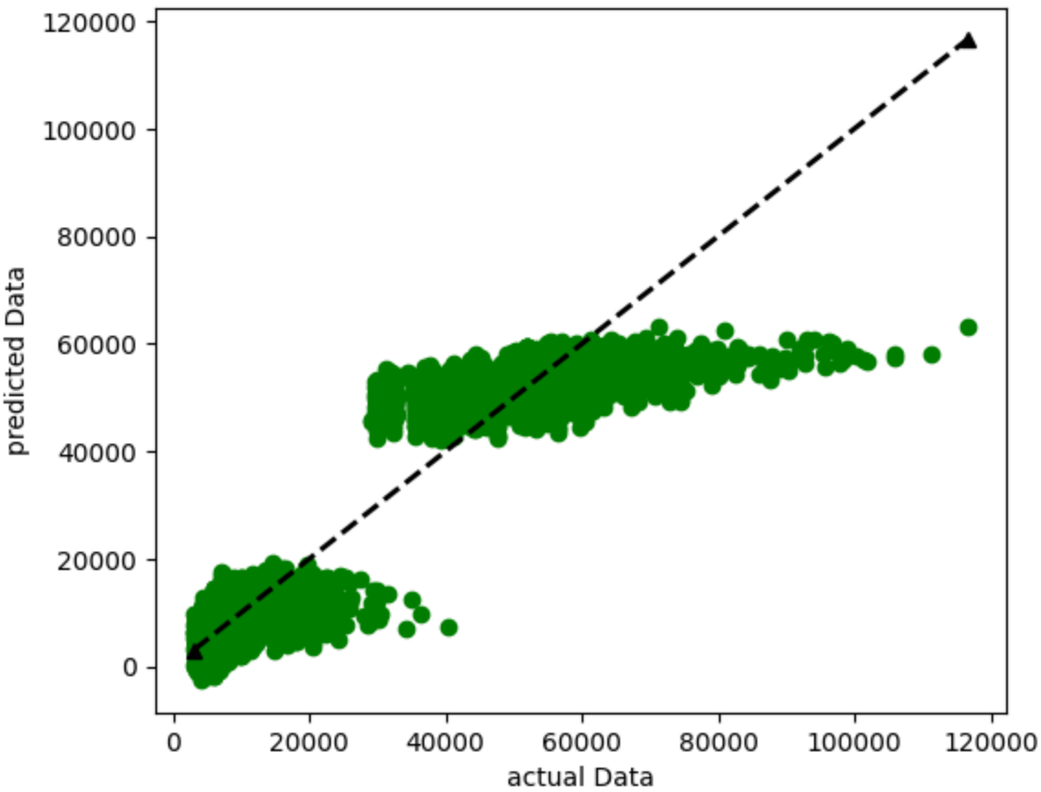
MODEL EVALUATION

In [ ]:
```
print('r2_score : ',r2_score(y_test,pred_lr_new))
print('mean_absolute_error : ',mean_absolute_error(y_test,pred_lr_new))
```

```
print('mean_squared_error : ',mean_squared_error(y_test,pred_lr_new))
print('root_mean_squared_error : ',root_mean_squared_error(y_test,pred_lr_new))
```

```
r2_score :  0.924306221446182
mean_absolute_error :  4345.006691782274
mean_squared_error :  39217181.013854146
root_mean_squared_error :  6262.362255080278
```

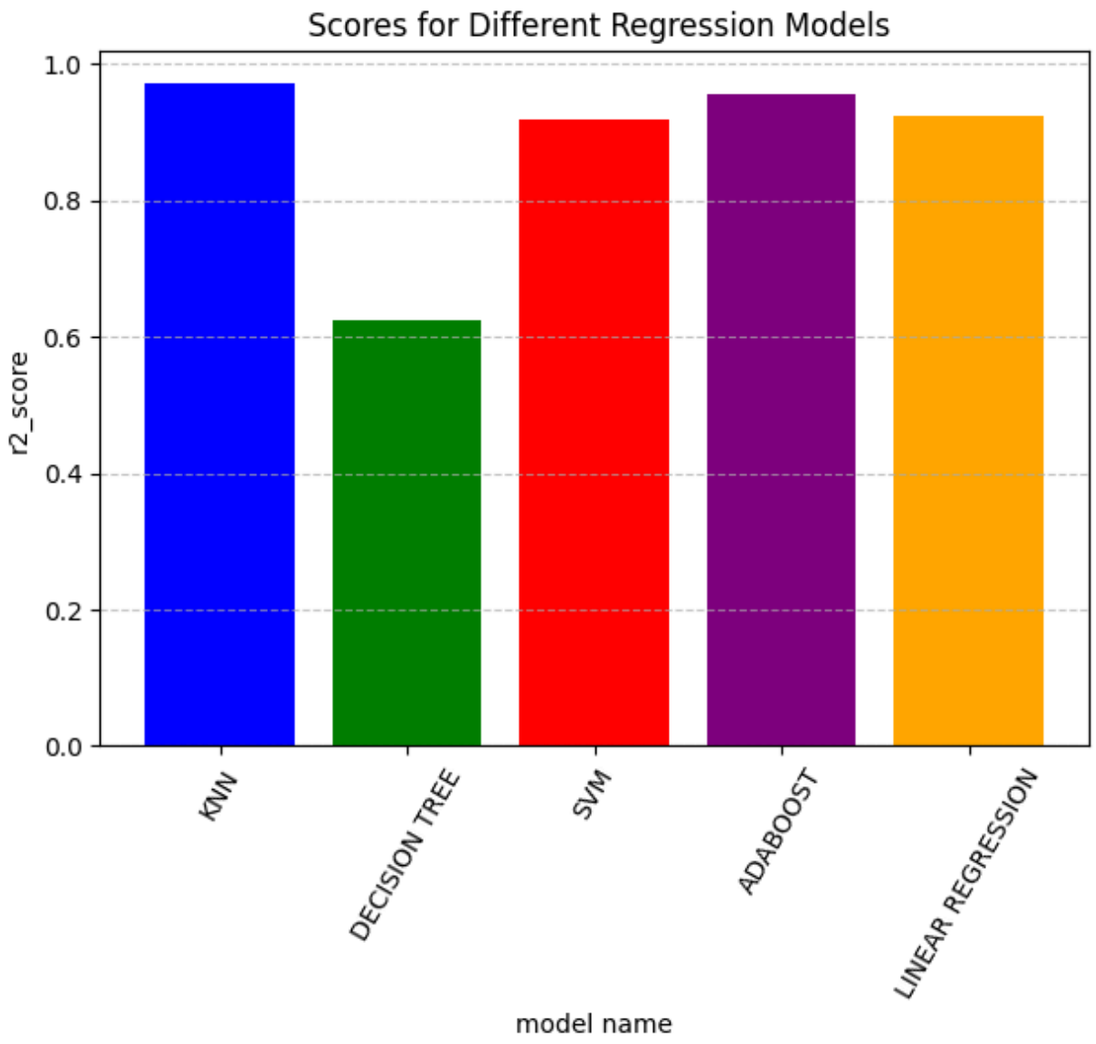
In [ ]:
```
plt.figure(figsize=(6,5))
plt.scatter(y_test,pred_lr_new,color='g')
plt.plot([y_test.min(),y_test.max()],[y_test.min(),y_test.max()],'k--',lw=2,marker=
plt.xlabel('actual Data')
plt.ylabel('predicted Data')
plt.show()
```



VISUALIZE MODEL COMPARISON

In [ ]:
```
KNNR2 = r2_score(y_test,pred_hpp_knn)
DTR2 = r2_score(y_test,new_dt_model)
SVRR2 = r2_score(y_test,new_svm_pred)
ADAR2 = r2_score(y_test,new_pred_ada)
LRR2 = r2_score(y_test,pred_lr_new)
```

In [ ]:
```
visual=['KNN','DECISION TREE','SVM','ADABOOST','LINEAR REGRESSION']
result=[KNNR2,DTR2,SVRR2,ADAR2,LRR2]
plt.bar(visual,result,color = ['blue', 'green', 'red', 'purple', 'orange'])
plt.xlabel('model name')
plt.ylabel('r2_score')
plt.title(' Scores for Different Regression Models')
plt.tight_layout()
plt.xticks(rotation=60)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.show()
```



Conclusion:

In this analysis, we aimed to predict flight ticket price using a dataset containing various features related to flights.**The KNN model**, achieving an **accuracy of 97%,** emerged as the bestperforming model for predicting.

gui

In [ ]:
```
import pickle

pickle.dump(new_hyp_knn, open('model.sav', 'wb'))
```

In [ ]:
```
import pickle

pickle.dump(sd, open('scale.sav', 'wb'))
```

In [ ]:
```
import pickle

pickle.dump(one1, open('airline.sav', 'wb'))
pickle.dump(one2, open('source_city.sav', 'wb'))
pickle.dump(one3, open('departire_time.sav', 'wb'))
pickle.dump(one4, open('stop.sav', 'wb'))
pickle.dump(one5, open('arrival_time.sav', 'wb'))
pickle.dump(one6, open('destination_city.sav', 'wb'))
pickle.dump(la2, open('class1.sav', 'wb'))
pickle.dump(la1, open('flight.sav', 'wb'))
```