Final Project

May 29, 2024

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import plotly.express as px
from sklearn.preprocessing import LabelEncoder
from scipy.stats import skew, norm
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split,KFold, cross_val_score
from sklearn.metrics import mean_absolute_error , r2_score
from sklearn.pipeline import make_pipeline
from sklearn.linear_model import LinearRegression , Ridge , Lasso, RidgeCV
from sklearn.preprocessing import OneHotEncoder ,RobustScaler
import warnings
from sklearn.preprocessing import StandardScaler
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
from sklearn.metrics import mean_squared_error
from sklearn.svm import SVR

warnings.filterwarnings("ignore")
```

[2]:
```
flights = pd.read_csv('Flight_Fare.csv')
flights
```

[2]:

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

```
        arrival_time destination_city     class  duration  days_left  price
0              Night           Mumbai   Economy      2.17          1   5953
1            Morning           Mumbai   Economy      2.33          1   5953
2      Early_Morning           Mumbai   Economy      2.17          1   5956
3          Afternoon           Mumbai   Economy      2.25          1   5955
4            Morning           Mumbai   Economy      2.33          1   5955
…                  …              …        …         …        …
300148       Evening        Hyderabad  Business     10.08         49  69265
300149         Night        Hyderabad  Business     10.42         49  77105
300150         Night        Hyderabad  Business     13.83         49  79099
300151       Evening        Hyderabad  Business     10.00         49  81585
300152       Evening        Hyderabad  Business     10.08         49  81585

[300153 rows x 12 columns]
```

[3]:
```
flights.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   class             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
```

[4]:
```
flights.drop(columns = ['Unnamed: 0'], inplace = True)
```

[5]:
```
flights
```

[5]:
```
         airline   flight source_city departure_time stops   arrival_time  \
0       SpiceJet  SG-8709       Delhi        Evening  zero          Night
1       SpiceJet  SG-8157       Delhi  Early_Morning  zero        Morning
2        AirAsia   I5-764       Delhi  Early_Morning  zero  Early_Morning
3        Vistara   UK-995       Delhi        Morning  zero      Afternoon
4        Vistara   UK-963       Delhi        Morning  zero        Morning
…          …       …          …              …      …             …
```

```
300148   Vistara   UK-822     Chennai        Morning   one        Evening
300149   Vistara   UK-826     Chennai      Afternoon   one          Night
300150   Vistara   UK-832     Chennai  Early_Morning   one          Night
300151   Vistara   UK-828     Chennai  Early_Morning   one        Evening
300152   Vistara   UK-822     Chennai        Morning   one        Evening

       destination_city     class  duration  days_left  price
0                Mumbai   Economy      2.17          1   5953
1                Mumbai   Economy      2.33          1   5953
2                Mumbai   Economy      2.17          1   5956
3                Mumbai   Economy      2.25          1   5955
4                Mumbai   Economy      2.33          1   5955
…                   …         …         …        …     …
300148        Hyderabad  Business     10.08         49  69265
300149        Hyderabad  Business     10.42         49  77105
300150        Hyderabad  Business     13.83         49  79099
300151        Hyderabad  Business     10.00         49  81585
300152        Hyderabad  Business     10.08         49  81585

[300153 rows x 11 columns]
```

[6]:
```
new_columns = []
for c in flights.columns:
    new_columns.append(c.replace(' ', '_'))

flights.columns = new_columns

flights.head()
```

[6]:
```
    airline   flight source_city departure_time stops   arrival_time  \
0  SpiceJet  SG-8709       Delhi        Evening  zero          Night
1  SpiceJet  SG-8157       Delhi  Early_Morning  zero        Morning
2   AirAsia   I5-764       Delhi  Early_Morning  zero  Early_Morning
3   Vistara   UK-995       Delhi        Morning  zero      Afternoon
4   Vistara   UK-963       Delhi        Morning  zero        Morning

  destination_city    class  duration  days_left  price
0           Mumbai  Economy      2.17          1   5953
1           Mumbai  Economy      2.33          1   5953
2           Mumbai  Economy      2.17          1   5956
3           Mumbai  Economy      2.25          1   5955
4           Mumbai  Economy      2.33          1   5955
```

[7]:
```
flights.drop(columns = ['flight'], inplace = True)
```

[8]:
```
column_list = flights.columns.tolist()
```

```
print(column_list)
```

```
['airline', 'source_city', 'departure_time', 'stops', 'arrival_time',
'destination_city', 'class', 'duration', 'days_left', 'price']
```

[9]:
```
flights
```

[9]:
```
         airline source_city departure_time stops   arrival_time  \
0       SpiceJet       Delhi        Evening  zero          Night
1       SpiceJet       Delhi  Early_Morning  zero        Morning
2        AirAsia       Delhi  Early_Morning  zero  Early_Morning
3        Vistara       Delhi        Morning  zero      Afternoon
4        Vistara       Delhi        Morning  zero        Morning
…          …          …             …   …             …
300148   Vistara     Chennai        Morning   one        Evening
300149   Vistara     Chennai      Afternoon   one          Night
300150   Vistara     Chennai  Early_Morning   one          Night
300151   Vistara     Chennai  Early_Morning   one        Evening
300152   Vistara     Chennai        Morning   one        Evening

       destination_city     class  duration  days_left  price
0                Mumbai   Economy      2.17          1   5953
1                Mumbai   Economy      2.33          1   5953
2                Mumbai   Economy      2.17          1   5956
3                Mumbai   Economy      2.25          1   5955
4                Mumbai   Economy      2.33          1   5955
…                  …       …       …         …    …
300148        Hyderabad  Business     10.08         49  69265
300149        Hyderabad  Business     10.42         49  77105
300150        Hyderabad  Business     13.83         49  79099
300151        Hyderabad  Business     10.00         49  81585
300152        Hyderabad  Business     10.08         49  81585

[300153 rows x 10 columns]
```

[10]:
```
exchange_rate = 0.012

flights['dollars'] = (flights['price'] * exchange_rate)
```

[11]:
```
flights
```

[11]:
```
         airline source_city departure_time stops   arrival_time  \
0       SpiceJet       Delhi        Evening  zero          Night
1       SpiceJet       Delhi  Early_Morning  zero        Morning
2        AirAsia       Delhi  Early_Morning  zero  Early_Morning
3        Vistara       Delhi        Morning  zero      Afternoon
4        Vistara       Delhi        Morning  zero        Morning
…          …          …             …   …             …
```

```
300148   Vistara     Chennai        Morning   one        Evening
300149   Vistara     Chennai      Afternoon   one          Night
300150   Vistara     Chennai  Early_Morning   one          Night
300151   Vistara     Chennai  Early_Morning   one        Evening
300152   Vistara     Chennai        Morning   one        Evening

       destination_city     class  duration  days_left  price  dollars
0                Mumbai   Economy      2.17          1   5953   71.436
1                Mumbai   Economy      2.33          1   5953   71.436
2                Mumbai   Economy      2.17          1   5956   71.472
3                Mumbai   Economy      2.25          1   5955   71.460
4                Mumbai   Economy      2.33          1   5955   71.460
…                   …       …        …          …     …       …
300148        Hyderabad  Business     10.08         49  69265  831.180
300149        Hyderabad  Business     10.42         49  77105  925.260
300150        Hyderabad  Business     13.83         49  79099  949.188
300151        Hyderabad  Business     10.00         49  81585  979.020
300152        Hyderabad  Business     10.08         49  81585  979.020

[300153 rows x 11 columns]
```

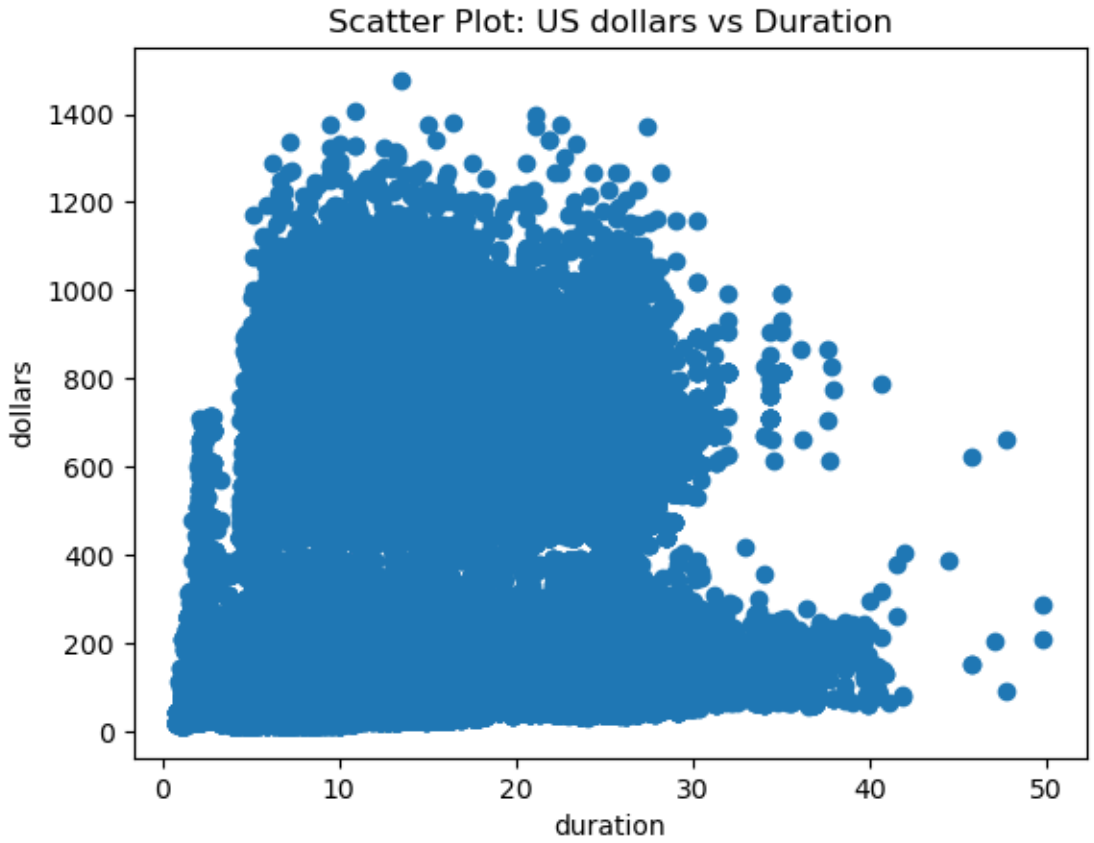
[12]:
```
flights.drop(columns = ['price'], inplace = True)
```

[13]:
```
flights
```

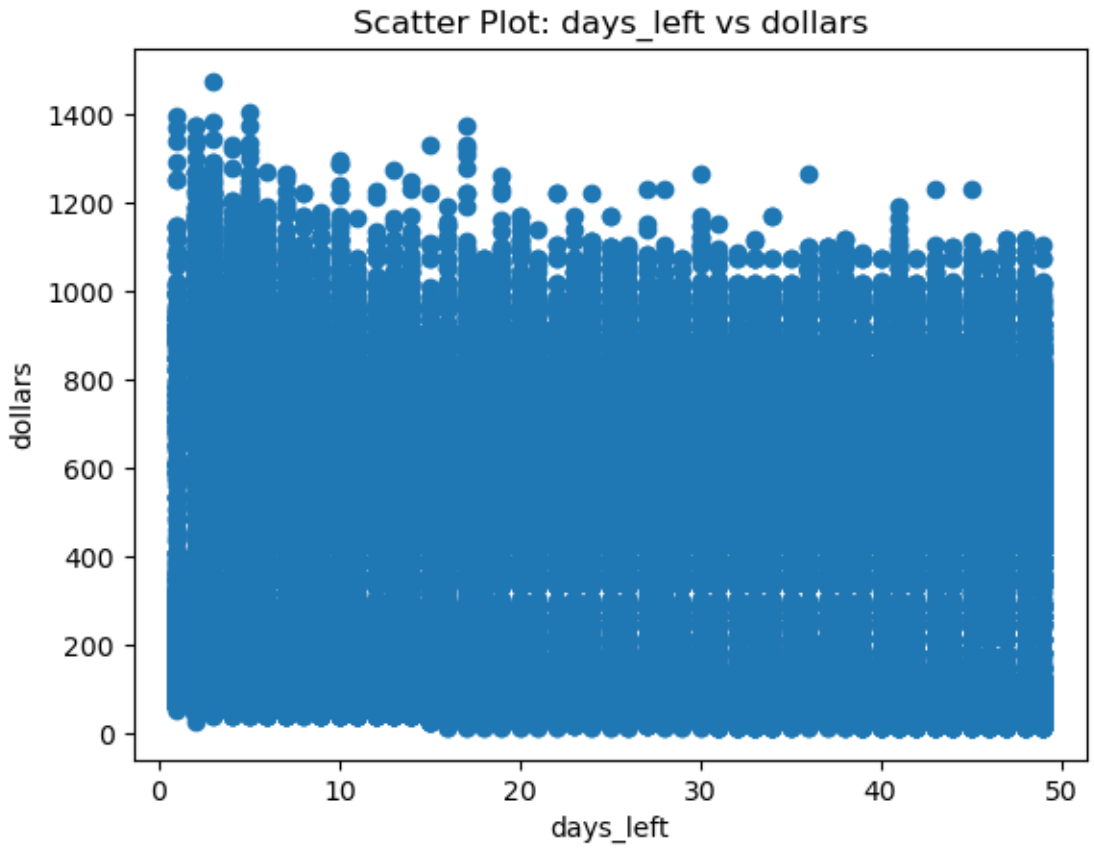
[13]:
```
         airline source_city departure_time stops   arrival_time  \
0       SpiceJet       Delhi        Evening  zero          Night
1       SpiceJet       Delhi  Early_Morning  zero        Morning
2        AirAsia       Delhi  Early_Morning  zero  Early_Morning
3        Vistara       Delhi        Morning  zero      Afternoon
4        Vistara       Delhi        Morning  zero        Morning
…          …          …              …   …             …
300148   Vistara     Chennai        Morning   one        Evening
300149   Vistara     Chennai      Afternoon   one          Night
300150   Vistara     Chennai  Early_Morning   one          Night
300151   Vistara     Chennai  Early_Morning   one        Evening
300152   Vistara     Chennai        Morning   one        Evening

       destination_city     class  duration  days_left  dollars
0                Mumbai   Economy      2.17          1   71.436
1                Mumbai   Economy      2.33          1   71.436
2                Mumbai   Economy      2.17          1   71.472
3                Mumbai   Economy      2.25          1   71.460
4                Mumbai   Economy      2.33          1   71.460
…                   …       …        …          …       …
300148        Hyderabad  Business     10.08         49  831.180
300149        Hyderabad  Business     10.42         49  925.260
```

```
300150        Hyderabad  Business     13.83          49  949.188
300151        Hyderabad  Business     10.00          49  979.020
300152        Hyderabad  Business     10.08          49  979.020

[300153 rows x 10 columns]
```

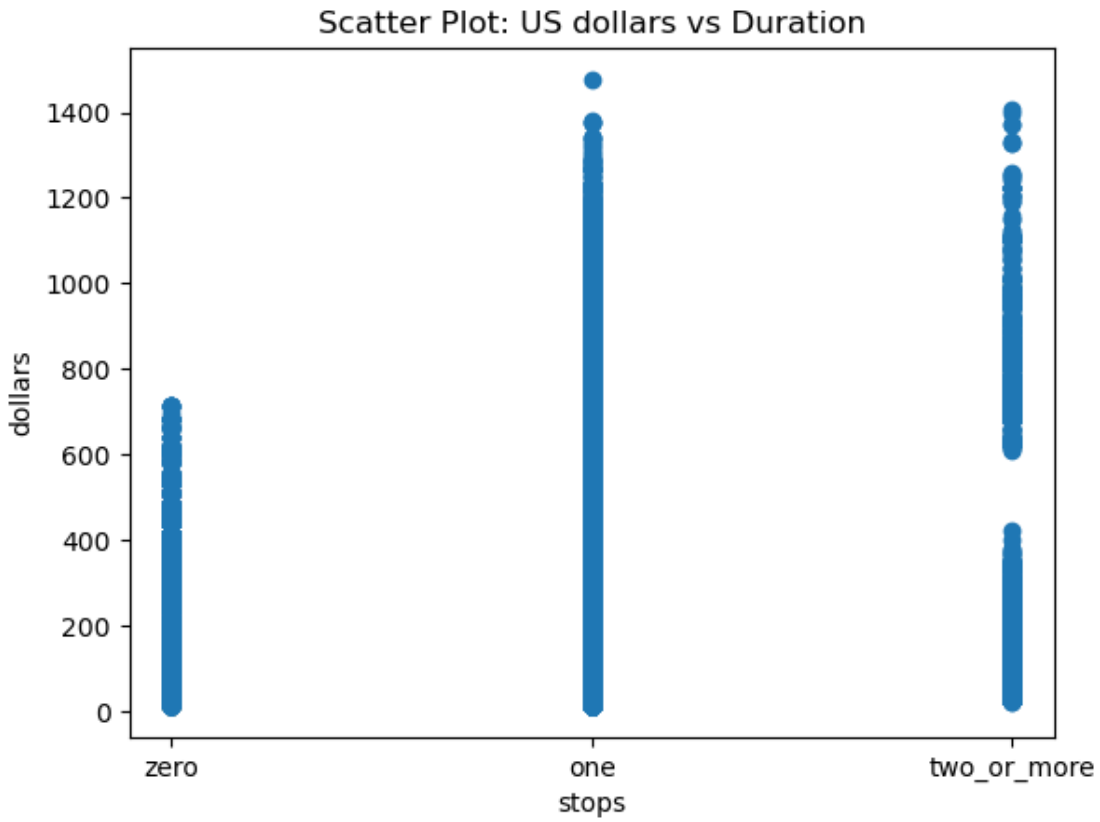
[14]:
```
# Scatterplot
plt.scatter(flights['duration'],flights['dollars'])
plt.xlabel('duration')
plt.ylabel('dollars')
plt.title('Scatter Plot: US dollars vs Duration')
plt.show()
```



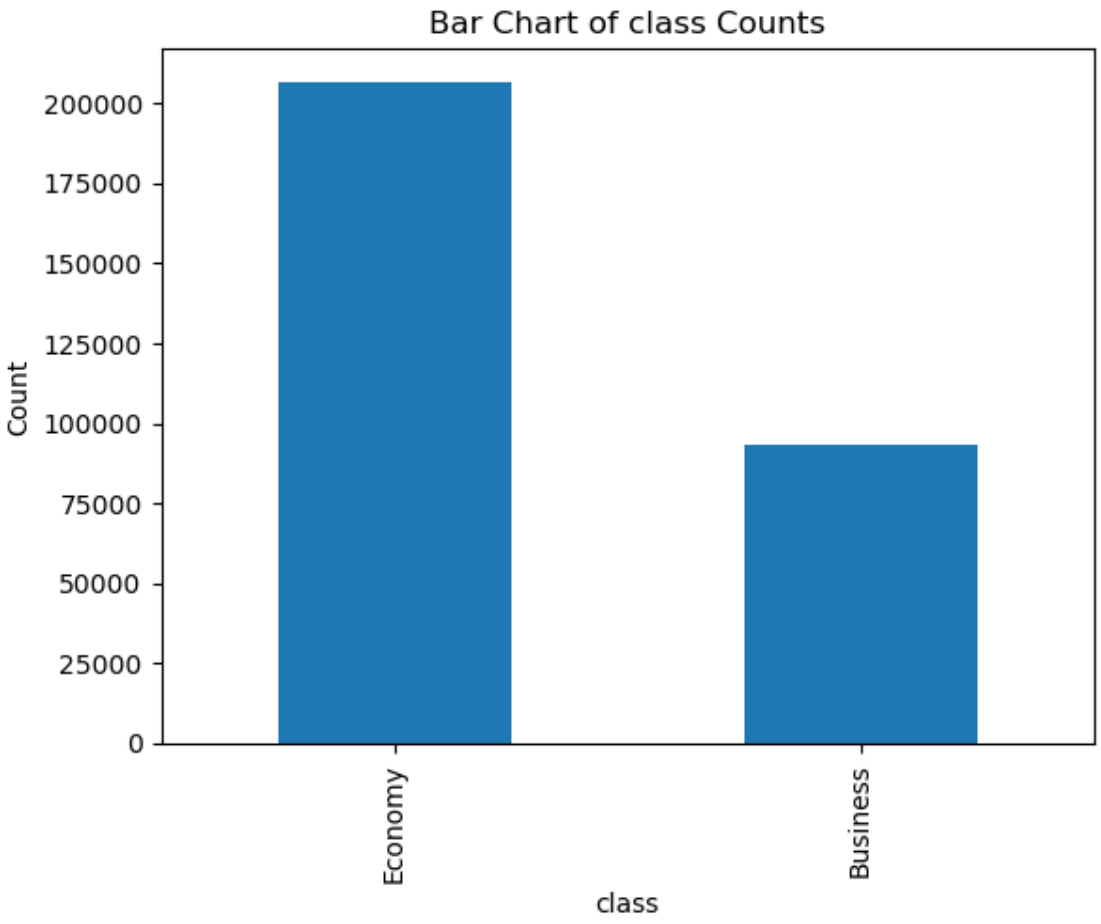
[15]:
```
plt.scatter(flights['days_left'],flights['dollars'])
plt.xlabel('days_left')
plt.ylabel('dollars')
plt.title('Scatter Plot: days_left vs dollars')
plt.show()
```



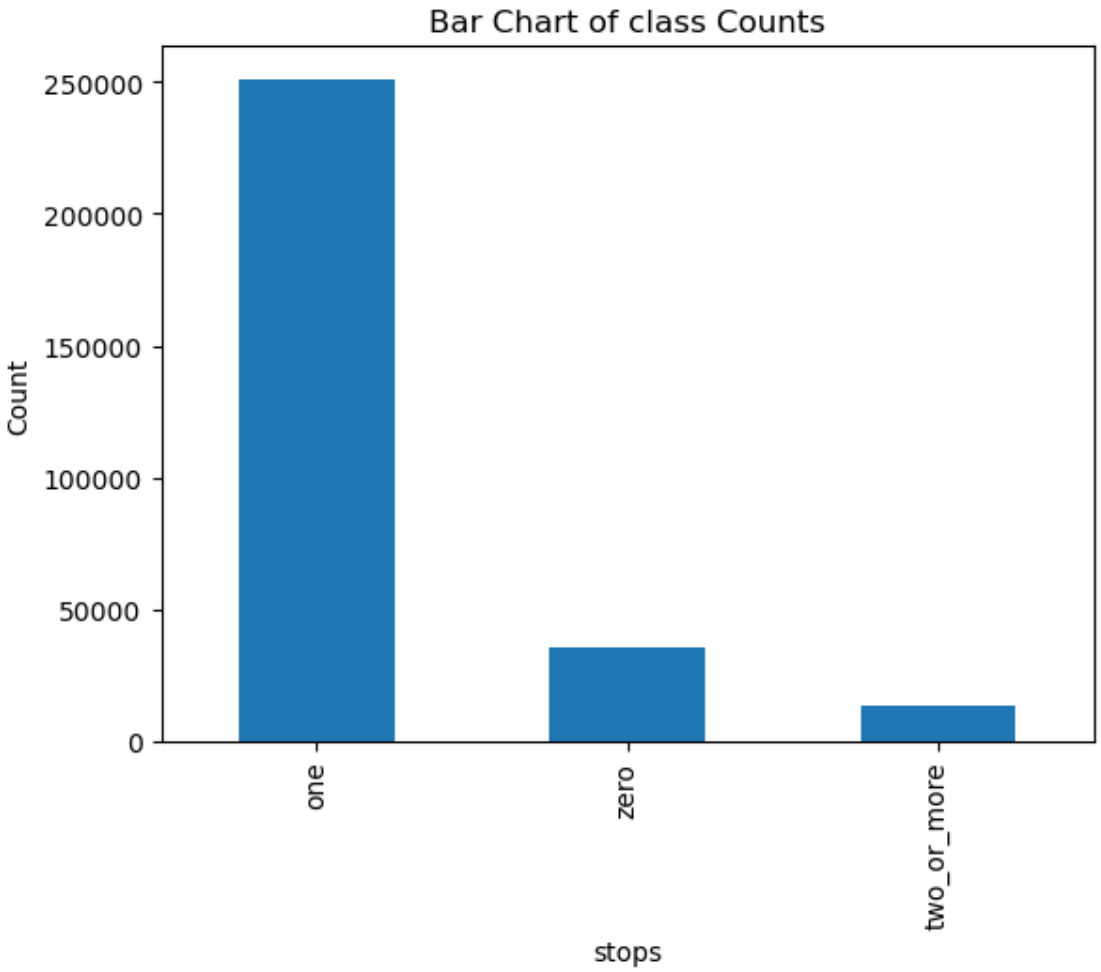
[16]:
```
plt.scatter(flights['stops'],flights['dollars'])
plt.xlabel('stops')
plt.ylabel('dollars')
plt.title('Scatter Plot: US dollars vs Duration')
plt.show()
```



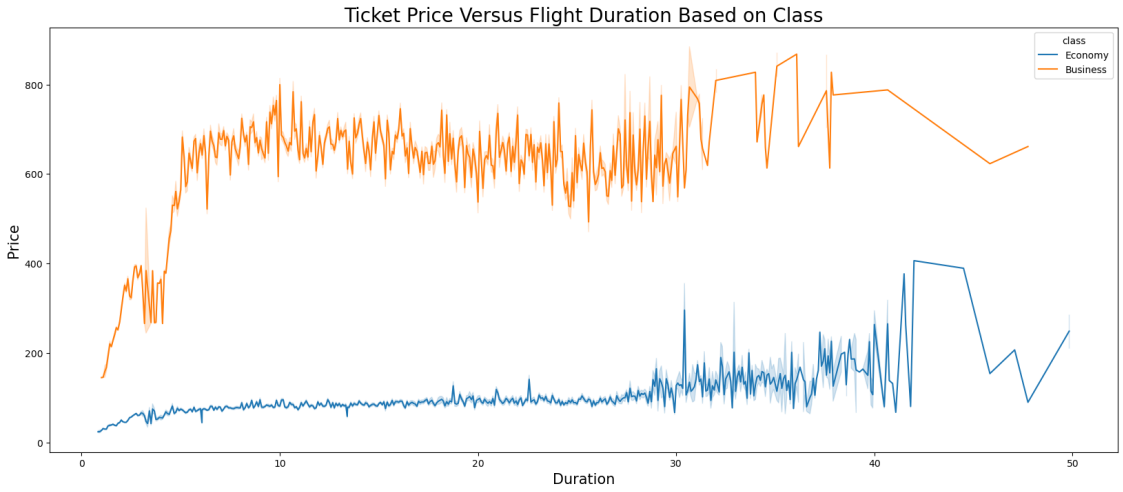
[17]:
```
counts = flights['class'].value_counts()

# Create bar chart
counts.plot(kind='bar')

# Add labels and title
plt.xlabel('class')
plt.ylabel('Count')
plt.title('Bar Chart of class Counts')

# Show the plot
plt.show()
```



[18]:
```
counts = flights['stops'].value_counts()

# Create bar chart
counts.plot(kind='bar')

# Add labels and title
plt.xlabel('stops')
plt.ylabel('Count')
plt.title('Bar Chart of class Counts')

# Show the plot
plt.show()
```



[19]:
```
plt.figure(figsize=(20,8))
sns.lineplot(data=flights,x='duration',y='dollars',hue = 'class')
plt.title('Ticket Price Versus Flight Duration Based on Class',fontsize=20)
plt.xlabel('Duration',fontsize=15)
plt.ylabel('Price',fontsize=15)
plt.show()
```



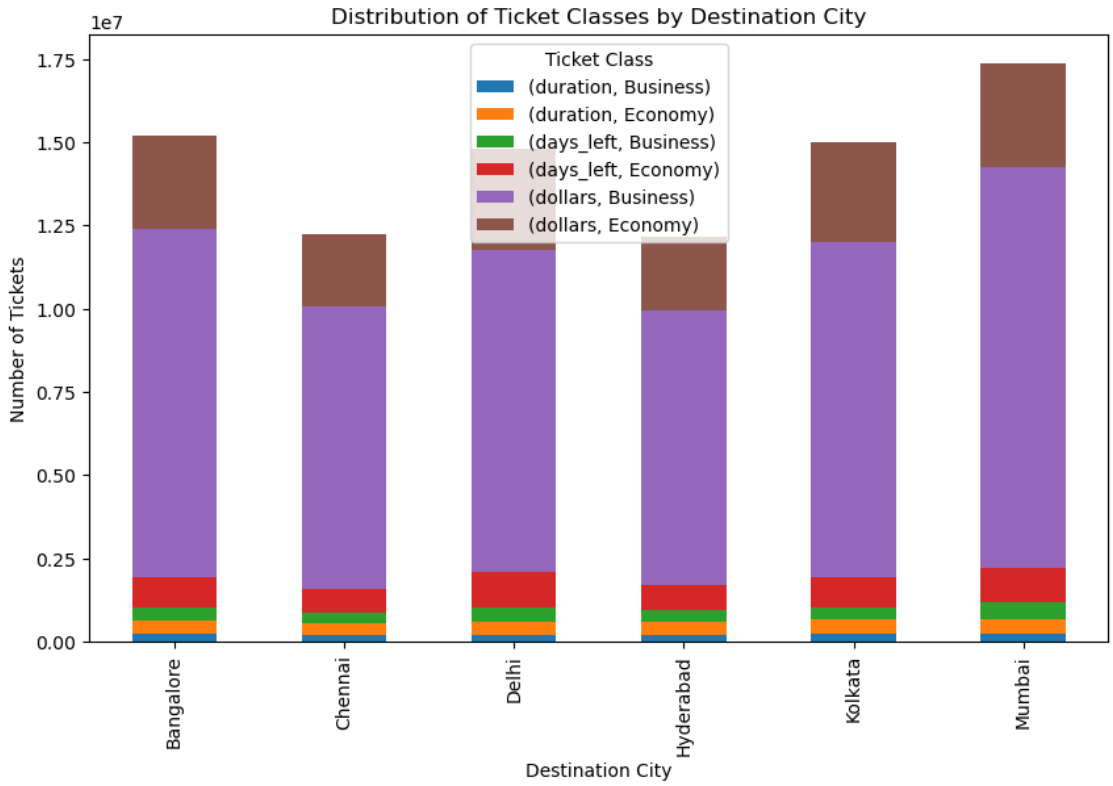
[20]:
```
grouped_data = flights.groupby(['destination_city', 'class']).sum().unstack()
grouped_data
```

[20]:
```
                                                          airline  \
class                                                    Business
destination_city
Bangalore         Air_IndiaAir_IndiaAir_IndiaAir_IndiaAir_IndiaV…
Chennai           Air_IndiaVistaraAir_IndiaAir_IndiaAir_IndiaAir…
Delhi             Air_IndiaAir_IndiaAir_IndiaAir_IndiaVistaraVis…
Hyderabad         Air_IndiaAir_IndiaVistaraVistaraAir_IndiaAir_I…
Kolkata           Air_IndiaAir_IndiaVistaraAir_IndiaAir_IndiaAir…
Mumbai            Air_IndiaAir_IndiaAir_IndiaAir_IndiaAir_IndiaV…

                                                                  \
class                                                      Economy
destination_city
Bangalore         SpiceJetAirAsiaVistaraVistaraVistaraVistaraVis…
Chennai           SpiceJetVistaraVistaraIndigoIndigoAir_IndiaAir…
Delhi             VistaraVistaraGO_FIRSTIndigoIndigoAir_IndiaAir…
Hyderabad         VistaraIndigoIndigoIndigoAir_IndiaAir_IndiaAir…
Kolkata           GO_FIRSTGO_FIRSTIndigoIndigoGO_FIRSTGO_FIRSTIn…
Mumbai            SpiceJetSpiceJetAirAsiaVistaraVistaraVistaraVi…

                                                        source_city  \
class                                                      Business
destination_city
Bangalore         DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Chennai           DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Delhi             MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…
Hyderabad         DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
```

```
Kolkata           DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Mumbai            DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…

                                                                  \
class                                                      Economy
destination_city
Bangalore         DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Chennai           DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Delhi             MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…
Hyderabad         DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Kolkata           DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Mumbai            DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…

                                                  departure_time  \
class                                                   Business
destination_city
Bangalore         EveningNightNightEveningEveningEveningEveningE…
Chennai           NightEveningEveningNightEveningEveningEveningE…
Delhi             EveningNightEveningEveningEveningEveningNightN…
Hyderabad         EveningNightNightEveningEveningNightEveningNig…
Kolkata           NightEveningEveningNightEveningNightEveningNig…
Mumbai            EveningEveningEveningNightEveningEveningNightE…

                                                                  \
class                                                      Economy
destination_city
Bangalore         Early_MorningMorningMorningMorningAfternoonEve…
Chennai           Early_MorningEarly_MorningAfternoonMorningAfte…
Delhi             MorningEveningEveningEveningAfternoonEveningNi…
Hyderabad         MorningMorningMorningAfternoonMorningMorningEv…
Kolkata           Early_MorningEveningEarly_MorningEarly_Morning…
Mumbai            EveningEarly_MorningEarly_MorningMorningMornin…

                                                        stops  \
class                                                  Business
destination_city
Bangalore         zerozerooneoneoneonezerooneonezerooneoneoneone…
Chennai           zerozerooneoneoneoneoneoneoneoneoneoneonetw…
Delhi             zerozerooneonezerozerooneoneoneoneoneonezeroon…
Hyderabad         zerozerozerozerooneoneoneoneoneoneoneoneone…
Kolkata           zerozerozerooneoneoneoneoneoneoneoneoneoneo…
Mumbai            zerozerooneoneonezerooneoneonezerooneoneoneone…

                                                                  \
class                                                      Economy
destination_city
Bangalore         zerozerozerozerozerozerozerozerozerozeroze…
```

```
Chennai           zerozerozerozerozerozerozerozerooneoneoneoneze…
Delhi             zerozerozerozerozerozerozerozerooneoneonezerozero…
Hyderabad         zerozerozerozerozerozerooneoneonezerozerozerozero…
Kolkata           zerozerozerozerooneoneoneoneonezerozerozerozeroze…
Mumbai            zerozerozerozerozerozerozerozerozerozerozeroze…

                                                        arrival_time  \
class                                                       Business
destination_city
Bangalore         NightLate_NightAfternoonAfternoonMorningEvenin…
Chennai           NightNightEarly_MorningNightEarly_MorningMorni…
Delhi             NightNightMorningNightNightNightAfternoonEveni…
Hyderabad         EveningNightNightEveningAfternoonEarly_Morning…
Kolkata           NightEveningEveningMorningMorningAfternoonNigh…
Mumbai            EveningNightNightNightNightNightAfternoonEveni…

                                                                    \
class                                                        Economy
destination_city
Bangalore         MorningAfternoonMorningMorningEveningEveningNi…
Chennai           MorningMorningEveningMorningAfternoonMorningAf…
Delhi             AfternoonEveningNightNightAfternoonNightNightN…
Hyderabad         AfternoonAfternoonMorningAfternoonMorningMorni…
Kolkata           Early_MorningNightMorningMorningEarly_MorningE…
Mumbai            NightMorningEarly_MorningAfternoonMorningAfter…

                   duration            days_left                dollars  \
class              Business    Economy  Business  Economy      Business
destination_city
Bangalore         221787.05  393992.87    415745   914504  1.046375e+07
Chennai           197240.94  341223.79    341263   709130  8.465924e+06
Delhi             193921.23  409122.21    428920  1072687  9.640890e+06
Hyderabad         204660.31  367096.68    355120   755934  8.275319e+06
Kolkata           228157.72  426431.74    380447   901871  1.004807e+07
Mumbai            235404.20  449137.32    485034  1044749  1.204781e+07


class                Economy
destination_city
Bangalore         2769368.280
Chennai           2168616.888
Delhi             3049506.048
Hyderabad         2198188.560
Kolkata           3004862.592
Mumbai            3108814.164
```

[21]:
```
grouped_data.plot(kind='bar', stacked=True, figsize=(10, 6))

# Add labels and title
plt.xlabel('Destination City')
plt.ylabel('Number of Tickets')
plt.title('Distribution of Ticket Classes by Destination City')

# Show plot
plt.legend(title='Ticket Class')
plt.show()
```



[22]:
```
df = flights.groupby(['airline', 'class']).sum().unstack()
df
```

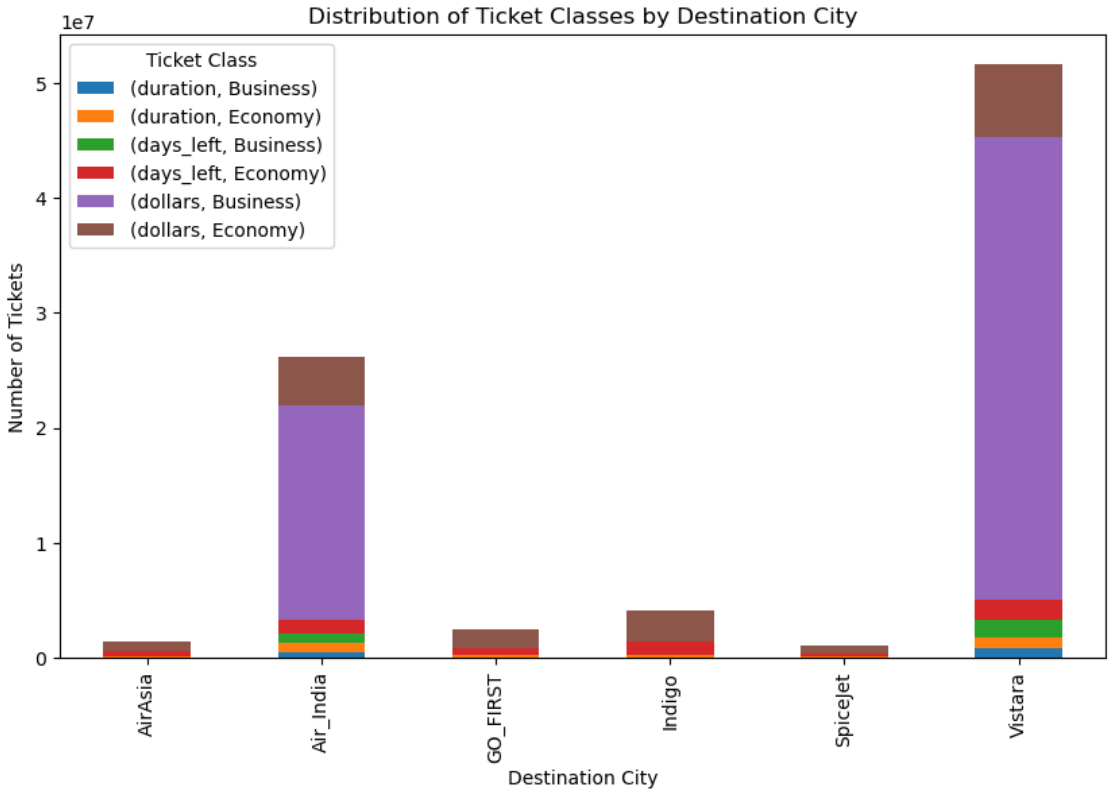
[22]:
```
                                                source_city  \
class                                                  Business
airline
AirAsia                                                  NaN
Air_India  DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
GO_FIRST                                                 NaN
Indigo                                                   NaN
SpiceJet                                                 NaN
```

```
Vistara    DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…

                                                                  \
class                                                      Economy
airline
AirAsia    DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Air_India  DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
GO_FIRST   DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Indigo     DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
SpiceJet   DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…
Vistara    DelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiDelhiD…

                                              departure_time  \
class                                               Business
airline
AirAsia                                                  NaN
Air_India  EveningEveningEveningNightEveningNightEveningN…
GO_FIRST                                                 NaN
Indigo                                                   NaN
SpiceJet                                                 NaN
Vistara    EveningNightEveningEveningEveningEveningEvenin…

                                                                  \
class                                                      Economy
airline
AirAsia    Early_MorningEveningEveningMorningEveningEarly…
Air_India  Early_MorningEarly_MorningEveningEarly_Morning…
GO_FIRST   Early_MorningAfternoonAfternoonMorningEarly_Mo…
Indigo     Early_MorningMorningAfternoonMorningMorningEve…
SpiceJet   EveningEarly_MorningEveningEveningEveningEveni…
Vistara    MorningMorningMorningMorningAfternoonAfternoon…

                                                        stops  \
class                                                 Business
airline
AirAsia                                                  NaN
Air_India  zerozerooneoneoneoneoneoneoneoneoneoneoneon…
GO_FIRST                                                 NaN
Indigo                                                   NaN
SpiceJet                                                 NaN
Vistara    zeroonezerooneoneoneoneoneoneoneoneoneoneon…

                                                                  \
class                                                      Economy
airline
AirAsia    zerooneoneoneonezerooneoneonezerooneoneonezero…
Air_India  zerozerooneoneoneoneoneoneoneoneoneoneoneon…
```

```
GO_FIRST   zerozerozerozerooneoneoneoneoneoneonezeroze…
Indigo     zerozerozerozerozerozerozerooneoneoneoneoneone…
SpiceJet   zerozerozerooneoneoneonezerozerozerooneoneoneo…
Vistara    zerozerozerozerozerozerooneoneoneoneonezeroone…

                                                arrival_time  \
class                                               Business
airline
AirAsia                                                  NaN
Air_India  EveningNightNightNightNightAfternoonEveningMor…
GO_FIRST                                                 NaN
Indigo                                                   NaN
SpiceJet                                                 NaN
Vistara    NightAfternoonNightNightMorningNightMorningNig…

                                                             \
class                                                 Economy
airline
AirAsia    Early_MorningEarly_MorningMorningAfternoonEarl…
Air_India  MorningMorningNightAfternoonMorningMorningMorn…
GO_FIRST   MorningEveningEveningAfternoonEveningNightMorn…
Indigo     MorningAfternoonEveningMorningMorningEveningNi…
SpiceJet   NightMorningNightNightMorningAfternoonMorningM…
Vistara    AfternoonMorningAfternoonMorningEveningEvening…

                                              destination_city  \
class                                                Business
airline
AirAsia                                                  NaN
Air_India  MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…
GO_FIRST                                                 NaN
Indigo                                                   NaN
SpiceJet                                                 NaN
Vistara    MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…

                                                                duration  \
class                                                 Economy   Business
airline
AirAsia    MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…        NaN
Air_India  MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…  481459.50
GO_FIRST   MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…        NaN
Indigo     MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…        NaN
SpiceJet   MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…        NaN
Vistara    MumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumbaiMumb…  799711.95

                     days_left                  dollars
class        Economy   Business    Economy      Business      Economy
```

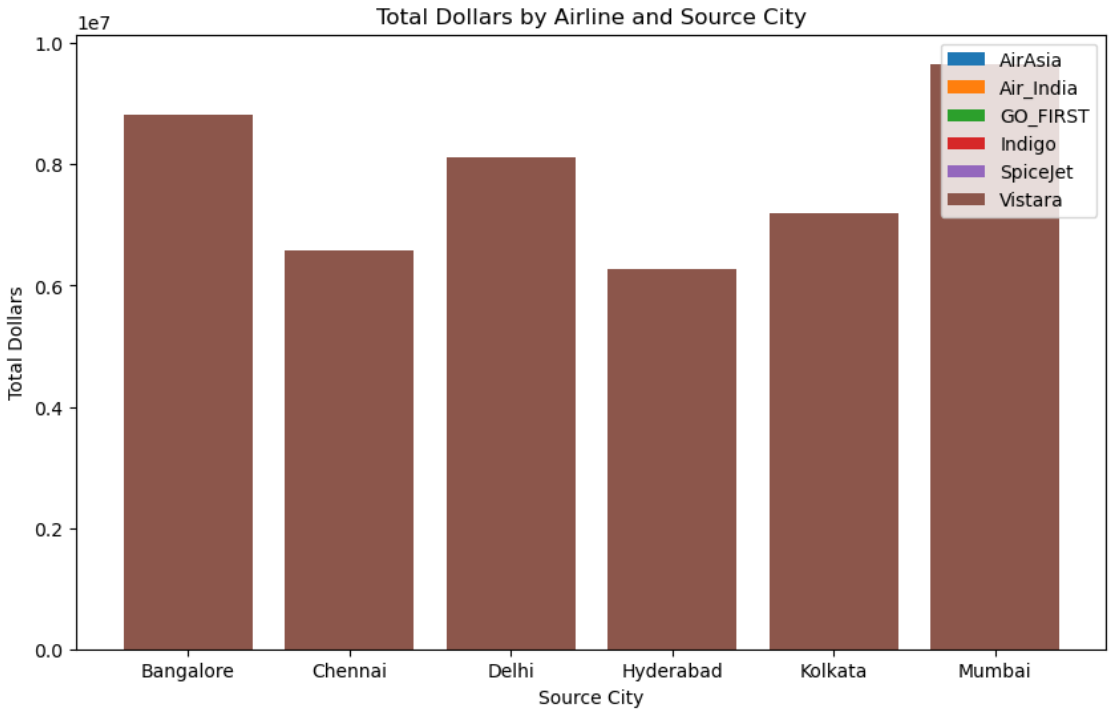
```
airline
AirAsia     143943.72        NaN   446481.0           NaN   790297.068
Air_India   772709.10   830615.0  1231926.0  1.860620e+07  4212154.344
GO_FIRST    202888.42        NaN   635645.0           NaN  1571687.664
Indigo      249888.88        NaN  1132517.0           NaN  2754962.484
SpiceJet    113356.28        NaN   217371.0           NaN   668177.784
Vistara     904218.21  1575914.0  1734935.0  4.033557e+07  6302077.188
```

[23]:
```
df.plot(kind='bar', stacked=True, figsize=(10, 6))

# Add labels and title
plt.xlabel('Destination City')
plt.ylabel('Number of Tickets')
plt.title('Distribution of Ticket Classes by Destination City')

# Show plot
plt.legend(title='Ticket Class')
plt.show()
```



[24]:
```
airlines = flights.groupby(['airline', 'source_city'])['dollars'].sum().
↪reset_index()
```

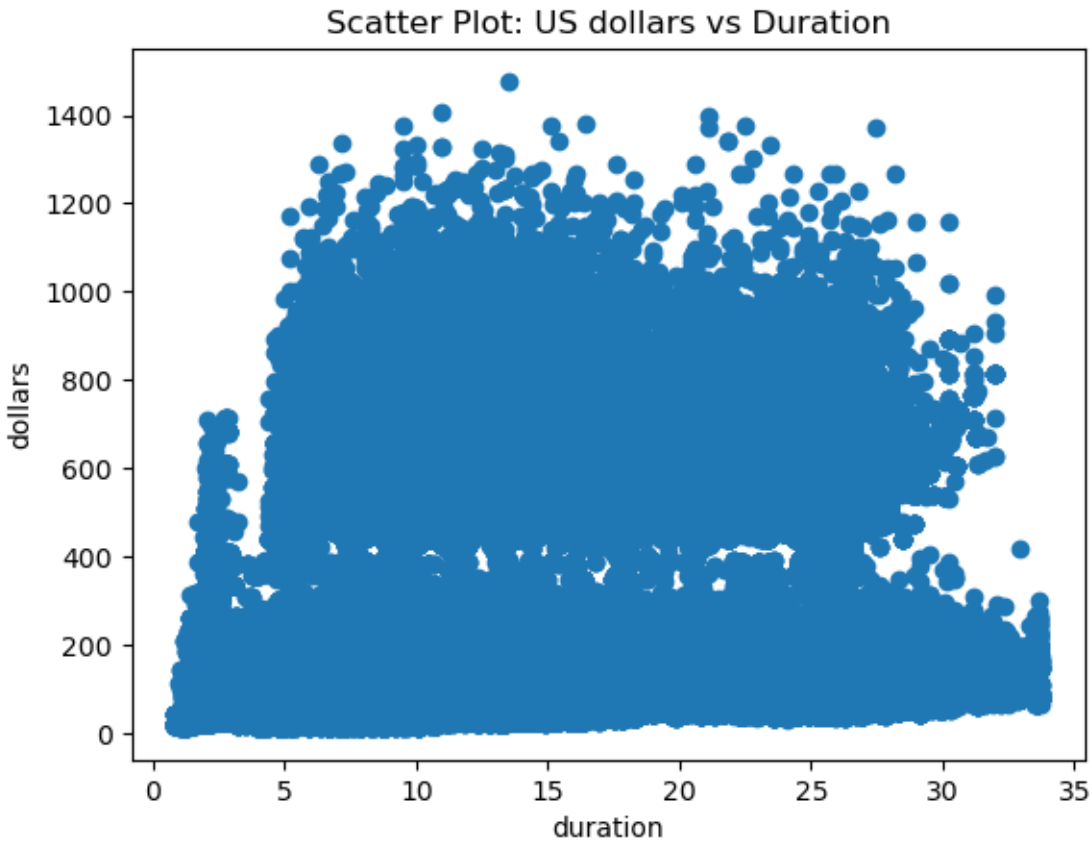
```
# Create a bar plot
plt.figure(figsize=(10, 6))
for airline in airlines['airline'].unique():
    subset = airlines[airlines['airline'] == airline]
    plt.bar(subset['source_city'], subset['dollars'], label=airline)

plt.xlabel('Source City')
plt.ylabel('Total Dollars')
plt.title('Total Dollars by Airline and Source City')
plt.legend()
plt.show()
```



[25]:
```
from scipy.stats import zscore

# Calculate Z-scores
flights['Z_Score'] = zscore(flights['duration'])

# Filter outliers
df_filtered = flights[flights['Z_Score'].abs() <= 3]
df_filtered
```

[25]:
```
          airline source_city departure_time stops   arrival_time  \
0       SpiceJet       Delhi        Evening  zero          Night
1       SpiceJet       Delhi  Early_Morning  zero        Morning
2        AirAsia       Delhi  Early_Morning  zero  Early_Morning
3        Vistara       Delhi        Morning  zero      Afternoon
4        Vistara       Delhi        Morning  zero        Morning
…          …         …             …   …            …
300148   Vistara     Chennai        Morning   one        Evening
300149   Vistara     Chennai      Afternoon   one          Night
300150   Vistara     Chennai  Early_Morning   one          Night
300151   Vistara     Chennai  Early_Morning   one        Evening
300152   Vistara     Chennai        Morning   one        Evening

       destination_city     class  duration  days_left  dollars   Z_Score
0                Mumbai   Economy      2.17          1   71.436 -1.397531
1                Mumbai   Economy      2.33          1   71.436 -1.375284
2                Mumbai   Economy      2.17          1   71.472 -1.397531
3                Mumbai   Economy      2.25          1   71.460 -1.386407
4                Mumbai   Economy      2.33          1   71.460 -1.375284
…                  …        …        …         …       …       …
300148        Hyderabad  Business     10.08         49  831.180 -0.297695
300149        Hyderabad  Business     10.42         49  925.260 -0.250421
300150        Hyderabad  Business     13.83         49  949.188  0.223718
300151        Hyderabad  Business     10.00         49  979.020 -0.308819
300152        Hyderabad  Business     10.08         49  979.020 -0.297695

[299431 rows x 11 columns]
```

[26]:
```
plt.scatter(df_filtered['duration'],df_filtered['dollars'])
plt.xlabel('duration')
plt.ylabel('dollars')
plt.title('Scatter Plot: US dollars vs Duration')
plt.show()
```



[27]:
```
df_filtered.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 299431 entries, 0 to 300152
Data columns (total 11 columns):
 #   Column            Non-Null Count   Dtype  
---  ------            --------------   -----  
 0   airline           299431 non-null  object 
 1   source_city       299431 non-null  object 
 2   departure_time    299431 non-null  object 
 3   stops             299431 non-null  object 
 4   arrival_time      299431 non-null  object 
 5   destination_city  299431 non-null  object 
 6   class             299431 non-null  object 
 7   duration          299431 non-null  float64
 8   days_left         299431 non-null  int64  
 9   dollars           299431 non-null  float64
 10  Z_Score           299431 non-null  float64
dtypes: float64(3), int64(1), object(7)
memory usage: 27.4+ MB
```

[28]:
```
flights.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300153 entries, 0 to 300152
Data columns (total 11 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   airline           300153 non-null  object
 1   source_city       300153 non-null  object
 2   departure_time    300153 non-null  object
 3   stops             300153 non-null  object
 4   arrival_time      300153 non-null  object
 5   destination_city  300153 non-null  object
 6   class             300153 non-null  object
 7   duration          300153 non-null  float64
 8   days_left         300153 non-null  int64
 9   dollars           300153 non-null  float64
 10  Z_Score           300153 non-null  float64
dtypes: float64(3), int64(1), object(7)
memory usage: 25.2+ MB
```

[29]:
```
flight_status = df_filtered.drop(['Z_Score'], axis = True)
```

[30]:
```
flight_status
```

[30]:

	airline	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days_left	dollars
0	SpiceJet	Delhi	Evening	zero	Night	Mumbai	Economy	2.17	1	71.436
1	SpiceJet	Delhi	Early_Morning	zero	Morning	Mumbai	Economy	2.33	1	71.436
2	AirAsia	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy	2.17	1	71.472
3	Vistara	Delhi	Morning	zero	Afternoon	Mumbai	Economy	2.25	1	71.460
4	Vistara	Delhi	Morning	zero	Morning	Mumbai	Economy	2.33	1	71.460
…	…	…	…	…	…	…	…	…	…	…
300148	Vistara	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	49	831.180
300149	Vistara	Chennai	Afternoon	one	Night	Hyderabad	Business	10.42	49	925.260
300150	Vistara	Chennai	Early_Morning	one	Night	Hyderabad	Business	13.83	49	949.188
300151	Vistara	Chennai	Early_Morning	one	Evening					
300152	Vistara	Chennai	Morning	one	Evening					

```
300151        Hyderabad  Business     10.00          49  979.020
300152        Hyderabad  Business     10.08          49  979.020

[299431 rows x 10 columns]
```

[31]:
```
num_nans = flight_status.isna().sum()
num_nans
```

[31]:
```
airline             0
source_city         0
departure_time      0
stops               0
arrival_time        0
destination_city    0
class               0
duration            0
days_left           0
dollars             0
dtype: int64
```

[32]:
```
flight_pred = pd.DataFrame(flight_status)

# Separate features (X) and target variable (y)
X = flight_status[['airline', 'source_city', 'departure_time', 'stops',␣
 ↪'arrival_time', 'destination_city', 'class', 'duration', 'days_left']]
y = flight_status['dollars']

# Split the dataset into training and testing sets (80% train, 20% test)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

# Display the shapes of the training and testing sets
print("Shapes of training and testing sets:")
print("X_train:", X_train.shape)
print("X_test:", X_test.shape)
print("y_train:", y_train.shape)
print("y_test:", y_test.shape)
```

```
Shapes of training and testing sets:
X_train: (239544, 9)
X_test: (59887, 9)
y_train: (239544,)
y_test: (59887,)
```

[33]:
```
# Define the preprocessing steps for numerical and categorical data
numeric_features = ['duration', 'days_left']
numeric_transformer = StandardScaler()
```

```
categorical_features = ['airline', 'source_city', 'departure_time', 'stops',␣
 ↪'arrival_time', 'destination_city', 'class']
categorical_transformer = OneHotEncoder(drop='first')

# Combine the preprocessing steps
preprocessor = ColumnTransformer(
    transformers=[
        ('num', numeric_transformer, numeric_features),
        ('cat', categorical_transformer, categorical_features)
    ])

# Create a pipeline that first transforms the data, then fits the model
model_pipeline = Pipeline(steps=[
    ('preprocessor', preprocessor),
    ('regressor', LinearRegression())
])
# Train the model
model_pipeline.fit(X_train, y_train)

# Make predictions on the test set
y_pred = model_pipeline.predict(X_test)

# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f"Mean Squared Error: {mse}")
print(f"R^2 Score: {r2}")
```

```
Mean Squared Error: 6608.2335637394
R^2 Score: 0.9105275221250047
```

[34]:
```
df2 = flights
column=['airline','source_city','departure_time','stops','arrival_time','destination_city','cl

df2[column] = df2[column].apply(LabelEncoder().fit_transform)
x=df2.drop(['dollars'],axis=1)
y=df2['dollars']

x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.
 ↪2,random_state=42)
print('x_train size',x_train.shape)
print('y_train size',y_train.shape)
print('x_test size',x_test.shape)
print('y_test size',y_test.shape)
```

```
x_train size (240122, 10)
y_train size (240122,)
```

```
x_test size (60031, 10)
y_test size (60031,)
```

[35]:
```
from sklearn.ensemble import RandomForestRegressor
model = RandomForestRegressor(random_state=42)
model.fit(x_train, y_train)

y_pred2 = model.predict(x_test)

mse = mean_squared_error(y_test, y_pred2)
r2 = r2_score(y_test, y_pred2)

print("Random Forest Regression Results:")
print(f"Mean Squared Error: {mse}")
print(f"R^2 Score: {r2}")
```

```
Random Forest Regression Results:
Mean Squared Error: 1118.4422787940296
R^2 Score: 0.9849326336371773
```

[36]:
```
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error
svm_model = SVR(kernel='linear')
svm_model.fit(x_train, y_train)
y_pred3 = svm_model.predict(x_test)
mse = mean_squared_error(y_test, y_pred3)
r3 = r2_score(y_test, y_pred3)
print("Mean Squared Error:", mse)
print(f"R^2 Score: {r3}")
```

```
Mean Squared Error: 7557.682114415242
R^2 Score: 0.8981848527807508
```

[37]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import Lasso
from sklearn.metrics import mean_squared_error, r2_score

lasso_model = Lasso(alpha=0.1, random_state=42)

lasso_model.fit(x_train, y_train)
y_pred4 = lasso_model.predict(x_test)
mse = mean_squared_error(y_test, y_pred4)
r4 = r2_score(y_test, y_pred4)
print("Mean Squared Error:", mse)
print(f"R^2 Score: {r4}")
```

```
Mean Squared Error: 7084.74906922515
```

```
R^2 Score: 0.9045560849775951
```

[ ]: