DSC680 Sri R Sankaranarayanan

Applied Data Science - Project 2 (week 5 - 7)

Web Scraping - Airline Price Analysis

July 2022

In [8]:
```
!pip install selenium
```

```
Requirement already satisfied: selenium in c:\users\rengs\appdata\roaming\p
ython\python38\site-packages (4.3.0)
Requirement already satisfied: trio-websocket~=0.9 in c:\users\rengs\appdat
a\roaming\python\python38\site-packages (from selenium) (0.9.2)
Requirement already satisfied: trio~=0.17 in c:\users\rengs\appdata\roaming
\python\python38\site-packages (from selenium) (0.21.0)
Requirement already satisfied: urllib3[secure,socks]~=1.26 in c:\users\reng
s\appdata\roaming\python\python38\site-packages (from selenium) (1.26.10)
Requirement already satisfied: sniffio in c:\users\rengs\appdata\roaming\py
thon\python38\site-packages (from trio~=0.17->selenium) (1.2.0)
Requirement already satisfied: outcome in c:\users\rengs\appdata\roaming\py
thon\python38\site-packages (from trio~=0.17->selenium) (1.2.0)
Requirement already satisfied: async-generator>=1.9 in c:\users\rengs\appda
ta\roaming\python\python38\site-packages (from trio~=0.17->selenium) (1.10)
Requirement already satisfied: cffi>=1.14 in c:\users\rengs\appdata\roaming
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Requirement already satisfied: attrs>=19.2.0 in c:\users\rengs\appdata\roam
ing\python\python38\site-packages (from trio~=0.17->selenium) (21.4.0)
Requirement already satisfied: idna in c:\users\rengs\appdata\roaming\pytho
n\python38\site-packages (from trio~=0.17->selenium) (3.3)
Requirement already satisfied: sortedcontainers in c:\users\rengs\appdata\r
oaming\python\python38\site-packages (from trio~=0.17->selenium) (2.4.0)
Requirement already satisfied: wsproto>=0.14 in c:\users\rengs\appdata\roam
ing\python\python38\site-packages (from trio-websocket~=0.9->selenium) (1.
1.0)
Requirement already satisfied: PySocks!=1.5.7,<2.0,>=1.5.6 in c:\users\reng
s\appdata\roaming\python\python38\site-packages (from urllib3[secure,socks]
~=1.26->selenium) (1.7.1)
Requirement already satisfied: pyOpenSSL>=0.14 in c:\users\rengs\appdata\ro
aming\python\python38\site-packages (from urllib3[secure,socks]~=1.26->sele
nium) (22.0.0)
Requirement already satisfied: cryptography>=1.3.4 in c:\users\rengs\appdat
a\roaming\python\python38\site-packages (from urllib3[secure,socks]~=1.26->
selenium) (37.0.4)
Requirement already satisfied: certifi in c:\users\rengs\appdata\roaming\py
thon\python38\site-packages (from urllib3[secure,socks]~=1.26->selenium) (2
022.6.15)
Requirement already satisfied: pycparser in c:\users\rengs\appdata\roaming
\python\python38\site-packages (from cffi>=1.14->trio~=0.17->selenium) (2.2
1)
Requirement already satisfied: h11<1,>=0.9.0 in c:\users\rengs\appdata\roam
ing\python\python38\site-packages (from wsproto>=0.14->trio-websocket~=0.9-
>selenium) (0.13.0)
```

```
WARNING: Ignoring invalid distribution -rllib3 (c:\programdata\anaconda3
\lib\site-packages)
WARNING: Ignoring invalid distribution -rapt (c:\programdata\anaconda3\li
b\site-packages)
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b\site-packages)
WARNING: Ignoring invalid distribution - (c:\programdata\anaconda3\lib\si
te-packages)
```

Using Python Selenium and latest chrome driver for Web Scraping

In [2]:

```python
from time import sleep, strftime
from random import randint
import pandas as pd
from selenium import webdriver
from selenium.webdriver.common.keys import Keys
import smtplib
from email.mime.multipart import MIMEMultipart

# Change this to your own chromedriver path!
chromedriver_path = 'C:/ProgramData/Google Chrome/chromedriver.exe'

driver = webdriver.Chrome(executable_path=chromedriver_path) # This will

driver.maximize_window() # For maximizing window
driver.implicitly_wait(20) # gives an implicit wait for 20 seconds

sleep(2)
```

```
<ipython-input-2-c727342d0168>:12: DeprecationWarning: executable_path has
been deprecated, please pass in a Service object
  driver = webdriver.Chrome(executable_path=chromedriver_path) # This will
open the Chrome window
```

First search in Kayak.com for Flight tickets from Dallas, USA to Chennai, India (my Native)

In [5]:

```python
Kayak='https://www.kayak.com/flights/DFW-MAA/2022-08-23/2022-08-30?sort=
driver.get(Kayak)
sleep(3)
```

In [6]:

```python
# This is what I used to define the "Cheapest" button

cheap_results = '//a[@data-code = "price"]'
```

In [7]:
```
driver.find_element("xpath", '//a[@data-code = "price"]')


```

Out[7]:
```
<selenium.webdriver.remote.webelement.WebElement (session="d35ad25ddd5025c5
90d4ff72262a9f8c", element="706be657-d056-41e7-917a-9efb73091c73")>
```

In [8]:
```
# Loading more results to maximize the scraping

def load_more():
    try:
        more_results = '//a[@class = "moreButton"]'
        driver.find_element("xpath", more_results).click()
        # Printing these notes during the program helps me quickly check
        print('sleeping.....')
        sleep(randint(45,60))
    except:
        pass
```

In [9]:

```python
def page_scrape():
    """This function takes care of the scraping part"""

    xp_sections = '//*[@class="section duration"]'
    sections = driver.find_elements("xpath", xp_sections)
    sections_list = [value.text for value in sections]
    section_a_list = sections_list[::2] # This is to separate the two fl
    section_b_list = sections_list[1::2] # This is to separate the two f


    if section_a_list == []:
        raise SystemExit

    # I'll use the letter A for the outbound flight and B for the inboun
    a_duration = []
    a_section_names = []
    for n in section_a_list:
        # Separate the time from the cities
        a_section_names.append(''.join(n.split()[2:5]))
        a_duration.append(''.join(n.split()[0:2]))
    b_duration = []
    b_section_names = []
    for n in section_b_list:
        # Separate the time from the cities
        b_section_names.append(''.join(n.split()[2:5]))
        b_duration.append(''.join(n.split()[0:2]))

    xp_dates = '//div[@class="section date"]'
    dates = driver.find_elements("xpath", xp_dates)
    dates_list = [value.text for value in dates]
    a_date_list = dates_list[::2]
    b_date_list = dates_list[1::2]
    # Separating the weekday from the day
    a_day = [value.split()[0] for value in a_date_list]
    a_weekday = [value.split()[1] for value in a_date_list]
    b_day = [value.split()[0] for value in b_date_list]
    b_weekday = [value.split()[1] for value in b_date_list]

    # getting the prices
    xp_prices = '//a[@class="booking-link"]/span[@class="price option-te
    prices = driver.find_elements("xpath", xp_prices)
    prices_list = [price.text.replace('$','') for price in prices if pri
    prices_list = list(map(int, prices_list))

    # the stops are a big list with one leg on the even index and second
    xp_stops = '//div[@class="section stops"]/div[1]'
    stops = driver.find_elements("xpath", xp_stops)
    stops_list = [stop.text[0].replace('n','0') for stop in stops]
    a_stop_list = stops_list[::2]
    b_stop_list = stops_list[1::2]

    xp_stops_cities = '//div[@class="section stops"]/div[2]'
    stops_cities = driver.find_elements("xpath", xp_stops_cities)
    stops_cities_list = [stop.text for stop in stops_cities]
    a_stop_name_list = stops_cities_list[::2]
    b_stop_name_list = stops_cities_list[1::2]

    # this part gets me the airline company and the departure and arrival
    xp_schedule = '//div[@class="section times"]'
    schedules = driver.find_elements("xpath", xp_schedule)
    hours_list = []
    carrier_list = []
    for schedule in schedules:
        hours_list.append(schedule.text.split('\n')[0])
        carrier_list.append(schedule.text.split('\n')[1])
    # split the hours and carriers, between a and b legs
    a_hours = hours_list[::2]
    a_carrier = carrier_list[::2]
    b_hours = hours_list[1::2]
    b_carrier = carrier_list[1::2]


    cols = (['Out Day', 'Out Time', 'Out Weekday', 'Out Airline', 'Out Ci
            'Return Day', 'Return Time', 'Return Weekday', 'Return Airli
            'Price'])

    flights_df = pd.DataFrame({'Out Day': a_day,
                               'Out Weekday': a_weekday,
                               'Out Duration': a_duration,
                               'Out Cities': a_section_names,
                               'Return Day': b_day,
                               'Return Weekday': b_weekday,
                               'Return Duration': b_duration,
                               'Return Cities': b_section_names,
                               'Out Stops': a_stop_list,
                               'Out Stop Cities': a_stop_name_list,
                               'Return Stops': b_stop_list,
                               'Return Stop Cities': b_stop_name_list,
                               'Out Time': a_hours,
                               'Out Airline': a_carrier,
                               'Return Time': b_hours,
                               'Return Airline': b_carrier,
                               'Price': prices_list})[cols]

    flights_df['timestamp'] = strftime("%Y%m%d-%H%M") # so we can know wh
    return flights_df
```

In [17]:

```python
def start_kayak(city_from, city_to, date_start, date_end):
    """City codes - it's the IATA codes!
    Date format -  YYYY-MM-DD"""

    kayak = ('https://www.kayak.com/flights/' + city_from + '-' + city_t
             '/' + date_start + '-flexible/' + date_end + '-flexible?sor
    driver.get(kayak)
    sleep(randint(8,10))

    # sometimes a popup shows up, so we can use a try statement to check
    try:
        xp_popup_close = '//button[contains(@id,"dialog-close") and conta
        driver.find_elements("xpath", xp_popup_close)[5].click()

        app.run_server(debug=True, use_reloader=False)

    except Exception as e:
        pass
    sleep(randint(60,95))
    print('loading more.....')

#     load_more()

    print('starting first scrape.....')
    df_flights_best = page_scrape()
    df_flights_best['sort'] = 'best'
    sleep(randint(60,80))

    # Let's also get the lowest prices from the matrix on top
    matrix = driver.find_elements("xpath", '//*[contains(@id,"FlexMatrix
    matrix_prices = [price.text.replace('$','') for price in matrix]
    matrix_prices = list(map(int, matrix_prices))
    matrix_min = min(matrix_prices)
    matrix_avg = sum(matrix_prices)/len(matrix_prices)

    print('switching to cheapest results.....')
    cheap_results = '//a[@data-code = "price"]'
    driver.find_element("xpath", cheap_results).click()
    sleep(randint(60,90))
    print('loading more.....')

#     load_more()

    print('starting second scrape.....')
    df_flights_cheap = page_scrape()
    df_flights_cheap['sort'] = 'cheap'
    sleep(randint(60,80))

    print('switching to quickest results.....')
    quick_results = '//a[@data-code = "duration"]'
    driver.find_element("xpath", quick_results).click()
    sleep(randint(60,90))
    print('loading more.....')

#     load_more()

```

```
    print('starting third scrape.....')
    df_flights_fast = page_scrape()
    df_flights_fast['sort'] = 'fast'
    sleep(randint(60,80))

    # saving a new dataframe as an excel file. the name is custom made to
    final_df = df_flights_cheap.append(df_flights_best).append(df_flight
    final_df.to_excel('search_backups//{}_flights_{}-{}_from_{}_to_{}.xls


    print('saved df.....')

    # We can keep track of what they predict and how it actually turns ou
    xp_loading = '//div[contains(@id,"advice")]'
    loading = driver.find_element("xpath", xp_loading).text
    xp_prediction = '//span[@class="info-text"]'
    prediction = driver.find_element("xpath", xp_prediction).text
    print(loading+'\n'+prediction)

    # sometimes we get this string in the loading variable, which will co
    # just change it to "Not Sure" if it happens
    weird = '¯\\_(ツ)_/¯'
    if loading == weird:
        loading = 'Not sure'

    username = 'rengsankar1986@gmail.com'
    password = 'xxxxxxx' #   masking for confidentiality

    server = smtplib.SMTP('smtp.outlook.com', 587)
    server.ehlo()
    server.starttls()
    server.login(username, password)
    msg = ('Subject: Flight Scraper\n\n\
Cheapest Flight: {}\nAverage Price: {}\n\nRecommendation: {}\n\nEnd of me
    message = MIMEMultipart()
    message['From'] = 'rengsankar1986@gmail.com'
    message['to'] = 'rengsankar1986@gmail.com'
    server.sendmail('rengsankar1986@gmail.com', 'rengsankar1986@gmail.co
    print('sent email.....')
```

Now let's get ready to get the results for Vacation right after the last day of the course :)

In [18]:
```

city_from = input('From which city? ')
city_to = input('Where to? ')
date_start = input('departure date? (YYYY-MM-DD format only)')
date_end = input('Return when? (YYYY-MM-DD format only) ')

for n in range(0,5):
    start_kayak(city_from, city_to, date_start, date_end)
    print('iteration {} was complete @ {}'.format(n, strftime("%Y%m%d-%H%


    # Wait 4 hours
    sleep(60*60*4)
    print('sleep finished.....')
```

```
From which city? DFW
Where to? MAA
departure date? (YYYY-MM-DD format only)2022-08-13
Return when? (YYYY-MM-DD format only) 2022-0828
loading more.....
starting first scrape.....

An exception has occurred, use %tb to see the full traceback.

SystemExit
```

I am planning to run the above in iteration using time series analysis, append the data to an excel and then perform EDA as below, then Visualize them for understanding the factors contributing to the Airline price. This will give me good idea on when to book the flight and what is reasonable price between certain given destinations.

Importing Libraries for EDA

In [1]:
```
import numpy as np # linear algebra
import pandas as pd # data processing

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) th
# You can also write temporary files to /kaggle/temp/, but they won't be
```

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
sns.set_theme(style="darkgrid")
```

In [3]:
```
## Testing Web Scraped dataset from Kaggle for Data Analysis

df = pd.read_csv('C:\SRINATH\Bellevue\DSC680\Project 2\Data\Clean_Datase
df.head()
```

Out[3]:

	Unnamed: 0	airline	flight	source_city	departure_time	stops	arrival_time	destination_ci
0	0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumb
1	1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumb
2	2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumb
3	3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumb
4	4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumb

In [4]:
```
df.describe()
```

Out[4]:

	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 [5]:
```
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   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
```

In [6]:
```
df.shape
```

Out[6]:
```
(300153, 12)
```

Data Cleaning

In [7]:
```
df.isnull().sum()
```

Out[7]:
```
Unnamed: 0          0
airline             0
flight              0
source_city         0
departure_time      0
stops               0
arrival_time        0
destination_city    0
class               0
duration            0
days_left           0
price               0
dtype: int64
```

In [8]:
```
df.drop(['Unnamed: 0'],inplace = True,axis=1)
df.head()
```

Out[8]:

	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class
0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy
1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy
2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy
3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumbai	Economy
4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumbai	Economy

Data Visualization on the Web Scraped Data

In [9]:
```
column=[column for column in df.columns if df[column].dtype=='object']
column
```

Out[9]:
```
['airline',
 'flight',
 'source_city',
 'departure_time',
 'stops',
 'arrival_time',
 'destination_city',
 'class']
```

In [10]:
```
categorical = df[column]
```

In [11]:
```
categorical.head()
```

Out[11]:

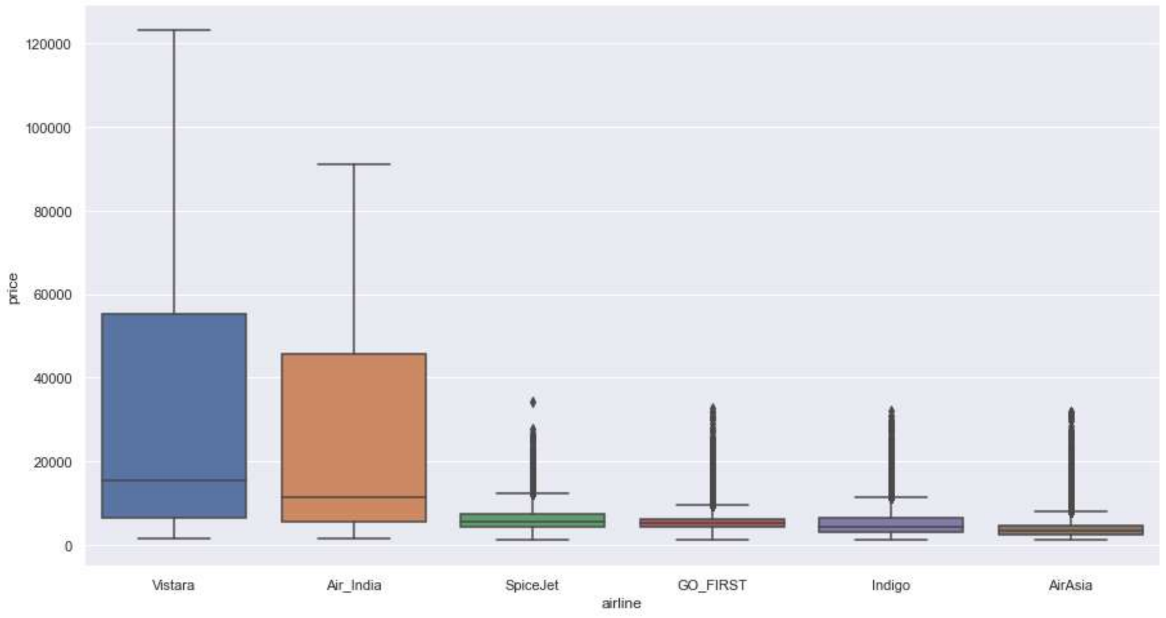
	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class
0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy
1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy
2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy
3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumbai	Economy
4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumbai	Economy

In [12]:
```
categorical['airline'].value_counts()
```

Out[12]:
```
Vistara      127859
Air_India     80892
Indigo        43120
GO_FIRST      23173
AirAsia       16098
SpiceJet       9011
Name: airline, dtype: int64
```

In [13]:
```
plt.figure(figsize=(15,8))
sns.boxplot(x='airline',y='price',data=df.sort_values('price',ascending=
```

Out[13]:
```
<AxesSubplot:xlabel='airline', ylabel='price'>
```



In [14]:
```
categorical['source_city'].value_counts()
```

Out[14]:
```
Delhi        61343
Mumbai       60896
Bangalore    52061
Kolkata      46347
Hyderabad    40806
Chennai      38700
Name: source_city, dtype: int64
```

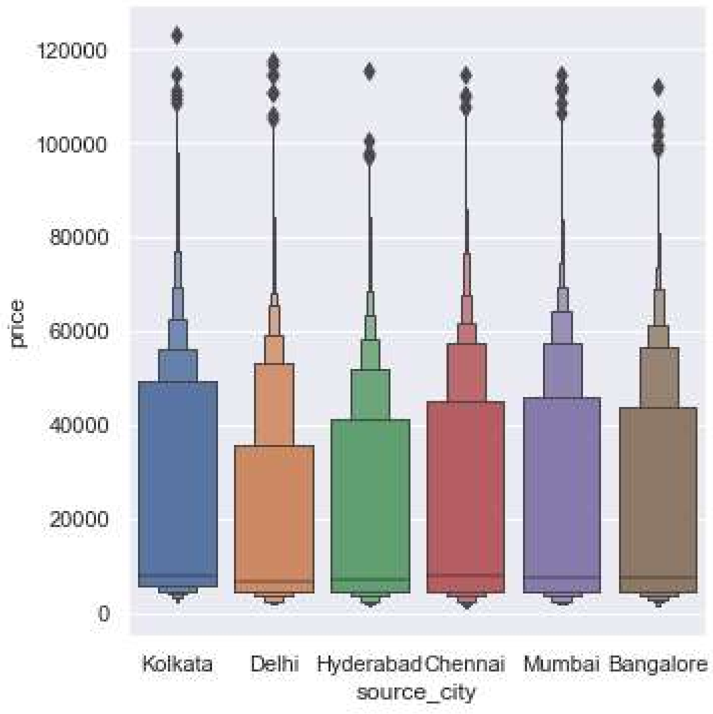
In [15]:

```
plt.figure(figsize=(15,15))
sns.catplot(x='source_city',y='price',data=df.sort_values('price',ascendi
```

Out[15]:

```
<seaborn.axisgrid.FacetGrid at 0x15a474fb940>

<Figure size 1080x1080 with 0 Axes>
```



Conclusion

The idea is to learn and perform web scraping using Python – this humble attempt of finding the best possible Flight deals is personal milestone and I would like to leverage this to other areas like home search sites, web scrape review sites and then perform sentimental analysis.

Future Uses:-

I would like to integrate with Twilio to send text messages instead of emails, improvise the search using multiple inputs, schedule the program using bots or other schedulers for advanced more sophisticated results. I would also like to expand the web scraping to other similar sites with minimal changes to the Python program. I would also like to perform the best possible suggestions on the flight price using RIPPER and Q-Learning algorithms

In [ ]:

```

```