380s25_hw01

January 29, 2025

1 CSC380 Homework 1 Problem 2: Data Analysis and Visualization

Overview This homework will familiarize you with the basic steps involved in reading, analyzing, and visualizing data. We will use the Starbucks Nutrition Dataset which itemizes most of the food and drink (12oz) options available at the Starbucks coffee chain. To simplify things we have processed the data for you into a JSON file distributed with the homework (filename: starbucks.json). We will be using the Pandas library to load and manipulate data. I briefly introduced all of the Pandas functionality that will need in class and additional links are provided inline below.

The problem has a maximum score of 70 points.

Installing Pandas To install any python library just type:

!pip3 install "library name"

Or, if you are using Anaconda then type:

!conda install "library name"

The cell below can be used to install Pandas. Or you can do it on the command line.

[1]:
```
# Uncomment and run the line below to install Pandas using pip
#!pip3 install pandas

# Uncomment and run the line below to install Pandas using Anaconda
#!conda install pandas
```

[2]:
```
import pandas as pd
```

1.1 Problem 1 : Basic Operations and Stats from the dataset

Download the data "starbucks.json" and load it to create a Pandas DataFrame.

What is a python DataFrame ? - https://www.geeksforgeeks.org/python-pandas-dataframe/

Hint : Check out the read_json function - https://www.w3schools.com/python/pandas/pandas_json.asp

[3]:
```
starbucks_df = pd.read_json("starbucks.json")
starbucks_df
```

[3]:

	Beverage_category	Beverage	Beverage_prep	Calories	Total Fat (g)	Trans Fat (g)	Saturated Fat (g)	Sodium (mg)	Total Carbohydrates (g)	Cholesterol (mg)	Dietary Fibre (g)	Sugars (g)
0	Coffee	Brewed Coffee	Plain	5	0.1	0.0	0.0	0	10	0	0	0
1	Classic Espresso Drinks	Caff Latte	Nonfat Milk	130	0.3	0.2	0.0	5	150	19	0	18
2	Classic Espresso Drinks	Caff Latte	2% Milk	190	7.0	3.5	0.2	30	170	19	0	17
3	Classic Espresso Drinks	Caff Latte	Soymilk	150	5.0	0.5	0.0	0	130	13	1	8
4	Classic Espresso Drinks	Caff Mocha (Without Whipped Cream)	Nonfat Milk	220	2.5	1.5	0.0	5	125	43	2	34
..	…	…	…	…	…	…	…	…	…	…	…	…
68	Frappuccino Light Blended Coffee	Java Chip	Nonfat Milk	220	4.0	3.0	0.0	0	240	43	2	39
69	Frappuccino Blended Crme	Strawberries & Crme (Without Whipped Cream)	Nonfat Milk	230	0.2	0.1	0.0	0				
70	Frappuccino Blended Crme	Strawberries & Crme (Without Whipped Cream)	Whole Milk	260	4.0	2.0	0.1	10				
71	Frappuccino Blended Crme	Strawberries & Crme (Without Whipped Cream)	Soymilk	240	2.0	0.2	0.0	0				
72	Frappuccino Blended Crme	Vanilla Bean (Without Whipped Cream)	Nonfat Milk	240	0.1	0.1	0.0	5				

```
69                    190                53                 0          52
70                    190                53                 0          52
71                    180                51                 1          49
72                    230                56                 0          55

    Protein (g)  Vitamin A (fDV)  Vitamin C (fDV)  Calcium (fDV)  Iron (fDV)  \
0           1.0             0.00             0.00           0.00        0.00
1          13.0             0.20             0.00           0.40        0.00
2          12.0             0.20             0.02           0.40        0.00
3          10.0             0.15             0.00           0.40        0.15
4          13.0             0.20             0.00           0.35        0.25
..          …                …                …              …           …
68          5.0             0.06             0.00           0.10        0.25
69          4.0             0.08             0.06           0.15        0.04
70          4.0             0.06             0.06           0.15        0.04
71          3.0             0.04             0.06           0.15        0.08
72          5.0             0.08             0.00           0.15        0.00

    Caffeine (mg)
0             330
1             150
2             150
3             150
4             175
..            …
68            105
69              0
70              0
71              0
72              0

[73 rows x 18 columns]
```

Printing the entire dataframe looks cumbersome. How can we look at the first and last **two** rows of a dataframe?

Check out .head() and .tail() - https://www.tutorialspoint.com/python_pandas/python_pandas_basic_functiona

What are the first two and last two rows on the dataframe?

[4]:
```
starbucks_df.head(2)
```

[4]:
```
         Beverage_category       Beverage Beverage_prep  Calories  \
0                   Coffee  Brewed Coffee         Plain         5
1  Classic Espresso Drinks    Caff Latte   Nonfat Milk       130

   Total Fat (g)  Trans Fat (g)  Saturated Fat (g)  Sodium (mg)  \
0            0.1            0.0                0.0            0
1            0.3            0.2                0.0            5
```

```
   Total Carbohydrates (g)  Cholesterol (mg)  Dietary Fibre (g)  Sugars (g)  \
0                       10                 0                  0           0
1                      150                19                  0          18

   Protein (g)  Vitamin A (fDV)  Vitamin C (fDV)  Calcium (fDV)  Iron (fDV)  \
0          1.0              0.0              0.0            0.0         0.0
1         13.0              0.2              0.0            0.4         0.0

   Caffeine (mg)
0            330
1            150
```

[5]:
```
starbucks_df.tail(2)
```

[5]:
```
             Beverage_category                                    Beverage  \
71  Frappuccino  Blended Crme  Strawberries & Crme (Without Whipped Cream)
72  Frappuccino  Blended Crme          Vanilla Bean (Without Whipped Cream)

   Beverage_prep  Calories  Total Fat (g)  Trans Fat (g)  Saturated Fat (g)  \
71       Soymilk       240            2.0            0.2                0.0
72   Nonfat Milk       240            0.1            0.1                0.0

    Sodium (mg)  Total Carbohydrates (g)  Cholesterol (mg)  Dietary Fibre (g)  \
71            0                      180                51                  1
72            5                      230                56                  0

    Sugars (g)  Protein (g)  Vitamin A (fDV)  Vitamin C (fDV)  Calcium (fDV)  \
71          49          3.0             0.04             0.06           0.15
72          55          5.0             0.08             0.00           0.15

    Iron (fDV)  Caffeine (mg)
71        0.08              0
72        0.00              0
```

How can we access just a column of a dataset in pandas? https://cmdlinetips.com/2020/04/3-ways-to-select-one-or-more-columns-with-pandas/.

It is okay if while printing you only see first and last few element and dots in between; this is Python's way of summarizing the output.

Print the column 'Beverage_prep'

[6]:
```
starbucks_df["Beverage_prep"]
```

[6]:
```
0           Plain
1     Nonfat Milk
2         2% Milk
3         Soymilk
```

```
4     Nonfat Milk
         …
68    Nonfat Milk
69    Nonfat Milk
70     Whole Milk
71        Soymilk
72    Nonfat Milk
Name: Beverage_prep, Length: 73, dtype: object
```

One goal of data science is to use data in order to answer questions. This is done in an automated way, without us having to manually go through the data. Let's try answering some simple questions about Starbucks' menu items.

1.1.1 a. On an average, how much caffeine does a starbucks drink have?

Hint: Checkout the math functions of a pandas dataframe.

https://erikrood.com/Python_References/pandas_column_average_median_final.html

[7]:
```
starbucks_df["Caffeine (mg)"].mean()
```

[7]:
```
np.float64(95.75342465753425)
```

1.1.2 b. What is the *typical* (median) amount of caffeine in a starbucks drink?

[8]:
```
starbucks_df["Caffeine (mg)"].median()
```

[8]:
```
np.float64(100.0)
```

1.1.3 c. What is the maximum amount of caffeine you can find at starbucks in its drinks?

[9]:
```
starbucks_df["Caffeine (mg)"].max()
```

[9]:
```
np.int64(330)
```

1.1.4 d. What is the least amount of caffeine you can find at starbucks in its drinks?

[10]:
```
starbucks_df["Caffeine (mg)"].min()
```

[10]:
```
np.int64(0)
```

1.2 Problem 2 : Pie Chart

Let's explore the dataset we have a bit more further

1.2.1 a. What are the different type of Drinks (ie Beverage Category)that Starbucks has? How much of each?

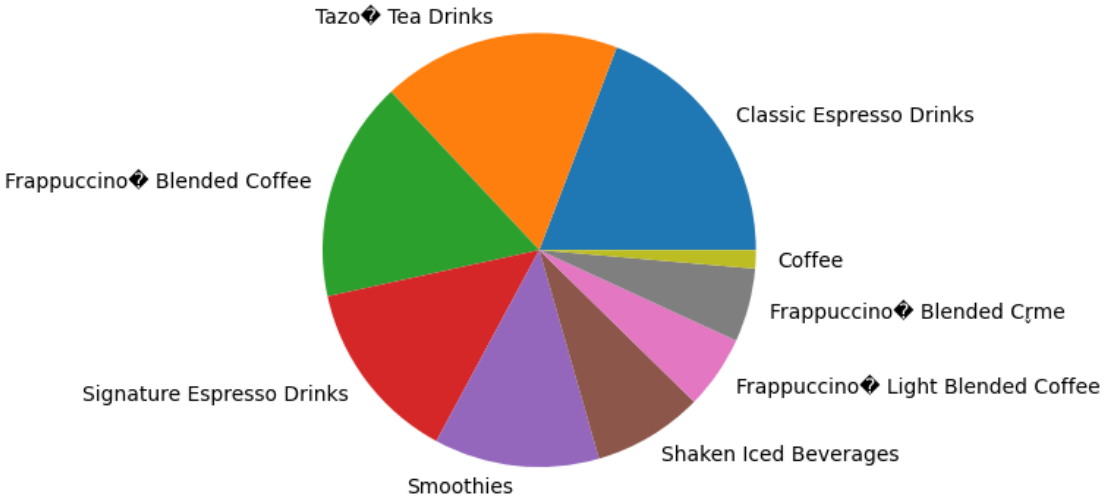
Hint - Checkout pandas value_counts() function.

[11]:
```
#print the different beverage category and how much of each here

starbucks_df["Beverage_category"].value_counts()
```

[11]:
```
Beverage_category
Classic Espresso Drinks              14
Tazo  Tea Drinks                     13
Frappuccino  Blended Coffee          12
Signature Espresso Drinks            10
Smoothies                             9
Shaken Iced Beverages                 6
Frappuccino  Light Blended Coffee     4
Frappuccino  Blended Crme             4
Coffee                                1
Name: count, dtype: int64
```

Let's make these more appealing. Plot these as a pie chart

[12]:
```
import matplotlib.pyplot as plt

beverage_category_counts = starbucks_df["Beverage_category"].value_counts()
labels = beverage_category_counts.keys()
sizes = beverage_category_counts

fig, ax = plt.subplots()
ax.pie(sizes, labels=labels)

plt.show()
```



1.3 Problem 3 : Bar Chart

Suppose you have a very calorie conscious friend. But they really like to get the drinks at Starbucks. As a budding Data Scientist, you want to help them out.

1.3.1 a. What is the drink with the least amount of calories at Starbucks?

Hint : Check this out ==> https://www.interviewqs.com/ddi-code-snippets/rows-cols-python

[13]:
```
#you can print the entire row or just the name

starbucks_df["Beverage"][starbucks_df["Calories"] == starbucks_df["Calories"].
 ↪min()]
```

[13]:
```
25    Tazo  Tea
Name: Beverage, dtype: object
```

But they are quickly bored of this drink. I mean, it's only natural.

So, let's recommend them a beverage category instead.

First let's find on an average how much calories do each beverage category have?

Hint - Checkout groupby function. The first example in this page is what we are trying to do. https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.groupby.html

[14]:
```
starbucks_df[["Beverage_category", "Calories"]].groupby("Beverage_category").
 ↪mean()
```

[14]:

Beverage_category	Calories
Classic Espresso Drinks	162.500000
Coffee	5.000000
Frappuccino Blended Coffee	272.500000
Frappuccino Blended Crme	242.500000
Frappuccino Light Blended Coffee	160.000000
Shaken Iced Beverages	106.666667
Signature Espresso Drinks	281.000000
Smoothies	282.222222
Tazo Tea Drinks	203.076923

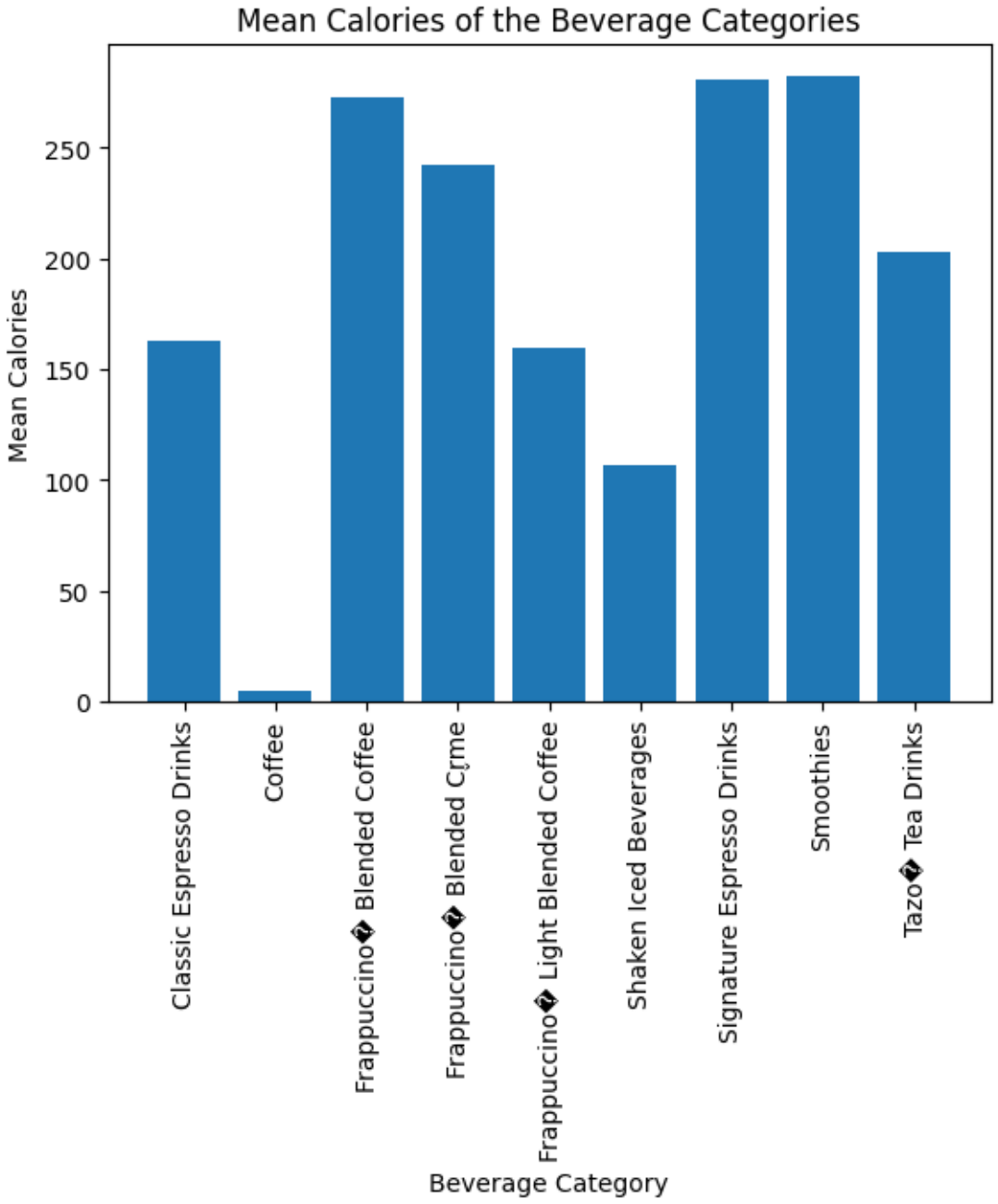
1.3.2 b. Plot a bar Graph

Let's make this visually appealing by plotting a bar graph, where the height of the bar plot is average amount of calories.

Hint : Check this out -> https://benalexkeen.com/bar-charts-in-matplotlib/

[20]:
```
data = starbucks_df[["Beverage_category", "Calories"]].
 ↪groupby("Beverage_category").mean()
categories = data.index.tolist()
```

```
means = data["Calories"]

fig, ax = plt.subplots()
ax.bar(categories, means)
ax.set_xlabel("Beverage Category")
ax.set_ylabel("Mean Calories")
ax.set_title("Mean Calories of the Beverage Categories")
plt.xticks(rotation=90)
plt.show()
```



1.3.3 By looking at the graph, which beverage category has the least average calories?

[22]:
```
print('Coffee')
```

```
Coffee
```

Let's keep looking

1.3.4 By looking at the graph, which beverage category has the second least average calories?

[23]:
```
print('Shaken Iced Beverages')
```

```
Shaken Iced Beverages
```

This gives us some idea of how many calories to expect in each beverage category. But we know from our previous classes that taking just the mean is not a good representation of how the values are spread. In this case, while the average is useful, we need to know how it is spread across various drinks within a beverage category.

1.3.5 What is the standard deviation of calories within each beverage categories?

Standard deviation is a concept we haven't yet covered in class (as of 1/22). But its idea is simple: similar to the range of the data we saw, it measures the "spread" of the data.

Hint: try replacing the aggregate function after groupby() from mean() to std().

[24]:
```
starbucks_df[["Beverage_category", "Calories"]].groupby("Beverage_category").
↪std()
```

[24]:

Beverage_category	Calories
Classic Espresso Drinks	71.649521
Coffee	NaN
Frappuccino Blended Coffee	36.711405
Frappuccino Blended Crme	12.583057
Frappuccino Light Blended Coffee	42.426407
Shaken Iced Beverages	18.618987
Signature Espresso Drinks	71.561939
Smoothies	13.017083
Tazo Tea Drinks	87.405627

If you get a nan for Coffee in the above cell, just add .fillna(0) at the end. To read more about fillna(0) - https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.DataFrame.fillna.html

Else skip the below cell

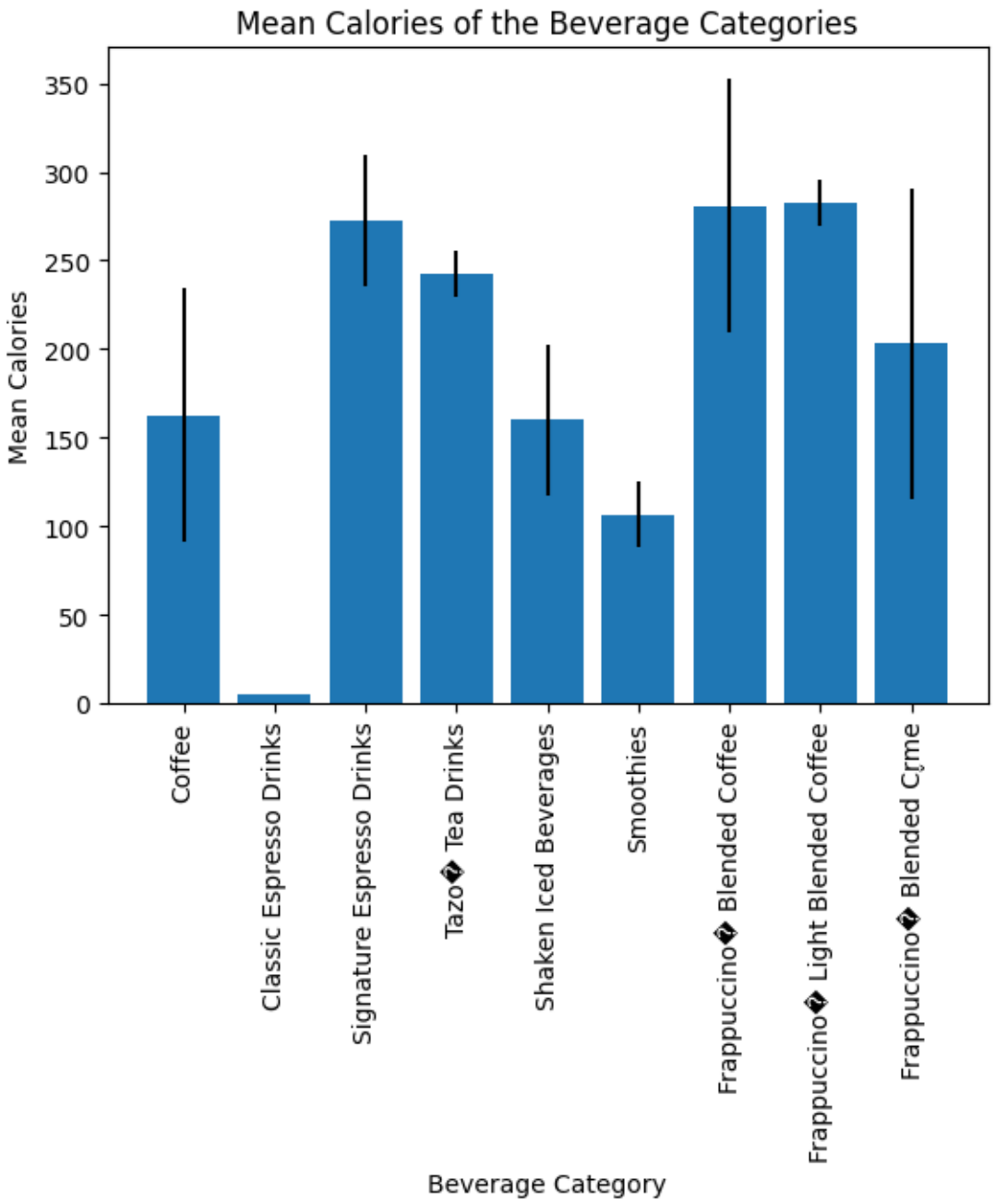
[25]:
```
starbucks_df[["Beverage_category", "Calories"]].groupby("Beverage_category").
  ↪std().fillna(0)
```

[25]:

Beverage_category	Calories
Classic Espresso Drinks	71.649521
Coffee	0.000000
Frappuccino Blended Coffee	36.711405
Frappuccino Blended Crme	12.583057
Frappuccino Light Blended Coffee	42.426407
Shaken Iced Beverages	18.618987
Signature Espresso Drinks	71.561939
Smoothies	13.017083
Tazo Tea Drinks	87.405627

Now Let's incorporate this info into the bar chart as well. We want a bar chart where there is 1 bar for each beverage category, the height is average calories, and error bars representing +/- sample standard deviation. Hint: go back to https://benalexkeen.com/bar-charts-in-matplotlib/

[27]:
```
data = starbucks_df[["Beverage_category", "Calories"]].
  ↪groupby("Beverage_category").mean()
categories = starbucks_df["Beverage_category"].unique()
means = data["Calories"]
std = starbucks_df[["Beverage_category", "Calories"]].
  ↪groupby("Beverage_category").std().fillna(0)["Calories"]

fig, ax = plt.subplots()
ax.bar(categories, means, yerr = std)
ax.set_xlabel("Beverage Category")
ax.set_ylabel("Mean Calories")
ax.set_title("Mean Calories of the Beverage Categories")
plt.xticks(rotation=90)
plt.show()
```



Look how easy it is to understand that many numbers when visualised well!

Awesome work so far!!

1.4 Problem 4 : Scatter plot

Now another friend of yours, who absolutely loves Caffeine came to you for a recommendation.They want to know what are the top drinks with the most Caffeine in Starbucks. They would like to know how much sugar each of them may have too, since they would like to reduce that.They don't

like numbers much,so we want to present this to them in a attractive way. Let's start by sorting the DataFrame based on Caffeine

Hint: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.sort_values.html

[37]:
```
starbucks_df.sort_values("Caffeine (mg)", ascending=False)
```

[37]:

	Beverage_category	Beverage	Beverage_prep	Calories	Total Fat (g)	Trans Fat (g)	Saturated Fat (g)	Sodium (mg)	Total Carbohydrates (g)	Cholesterol (mg)	Dietary Fibre (g)	Sugars (g)	Protein (g)	Vitamin A (fDV)	Vitamin C (fDV)	Calcium (fDV)
0	Coffee	Brewed Coffee	Plain	5	0.1	0.0	0.0	0	10	0	0	0	1.0	0.00	0.00	0.00
10	Classic Espresso Drinks	Caff Americano	Plain	15	0.0	0.0	0.0	0	15	3	0	0				
4	Classic Espresso Drinks	Caff Mocha (Without Whipped Cream)	Nonfat Milk	220	2.5	1.5	0.0	5	125	43	2					
6	Classic Espresso Drinks	Caff Mocha (Without Whipped Cream)	Soymilk	230	7.0	2.0	0.0	0	105	37	3					
5	Classic Espresso Drinks	Caff Mocha (Without Whipped Cream)	2% Milk	260	8.0	4.5	0.2	25	140	42	2					
..	…	…	…	…	…	…	…	…	…	…	…					
52	Smoothies	Strawberry Banana Smoothie	Soymilk	290	2.0	0.4	0.0	5	120	58	8					
69	Frappuccino Blended Crme	Strawberries & Crme (Without Whipped Cream)	Nonfat Milk	230	0.2	0.1	0.0	0	190	53	0					
70	Frappuccino Blended Crme	Strawberries & Crme (Without Whipped Cream)	Whole Milk	260	4.0	2.0	0.1	10	190	53	0					
71	Frappuccino Blended Crme	Strawberries & Crme (Without Whipped Cream)	Soymilk	240	2.0	0.2	0.0	0	180	51	1					
72	Frappuccino Blended Crme	Vanilla Bean (Without Whipped Cream)	Nonfat Milk	240	0.1	0.1	0.0	5	230	56	0					

```
10           0          1.0              0.00              0.00           0.02
4           34         13.0              0.20              0.00           0.35
6           26         11.0              0.10              0.00           0.35
5           34         13.0              0.15              0.02           0.35
..         …          …                 …                 …              …
52          40         16.0              0.02              1.00           0.10
69          52          4.0              0.08              0.06           0.15
70          52          4.0              0.06              0.06           0.15
71          49          3.0              0.04              0.06           0.15
72          55          5.0              0.08              0.00           0.15

    Iron (fDV)  Caffeine (mg)
0         0.00            330
10        0.00            225
4         0.25            175
6         0.40            175
5         0.25            175
..         …              …
52        0.08              0
69        0.04              0
70        0.04              0
71        0.08              0
72        0.00              0

[73 rows x 18 columns]
```

What are the top 10 **drinks** with the most caffeine in them?

Hint : Remember.head() from earlier. Use that.

[38]:
```
top10_Caf_Drink = starbucks_df.sort_values("Caffeine (mg)", ascending=False).
↪head(10)
top10_Caf_Drink
```

[38]:
```
          Beverage_category                                    Beverage  \
0                    Coffee                                Brewed Coffee
10  Classic Espresso Drinks                              Caff Americano
4   Classic Espresso Drinks       Caff Mocha (Without Whipped Cream)
6   Classic Espresso Drinks       Caff Mocha (Without Whipped Cream)
5   Classic Espresso Drinks       Caff Mocha (Without Whipped Cream)
38    Shaken Iced Beverages   Iced Brewed Coffee (With Classic Syrup)
2   Classic Espresso Drinks                             Caff Latte
3   Classic Espresso Drinks                             Caff Latte
1   Classic Espresso Drinks                             Caff Latte
8   Classic Espresso Drinks  Vanilla Latte (Or Other Flavoured Latte)

   Beverage_prep  Calories  Total Fat (g)  Trans Fat (g)  Saturated Fat (g)  \
0          Plain         5            0.1            0.0                0.0
```

```
10         Plain        15            0.0            0.0                0.0
4     Nonfat Milk      220            2.5            1.5                0.0
6         Soymilk      230            7.0            2.0                0.0
5         2% Milk      260            8.0            4.5                0.2
38          Plain       90            0.1            0.0                0.0
2         2% Milk      190            7.0            3.5                0.2
3         Soymilk      150            5.0            0.5                0.0
1     Nonfat Milk      130            0.3            0.2                0.0
8         2% Milk      250            6.0            3.5                0.2

    Sodium (mg)  Total Carbohydrates (g)  Cholesterol (mg)  Dietary Fibre (g)  \
0             0                       10                 0                  0
10            0                       15                 3                  0
4             5                      125                43                  2
6             0                      105                37                  3
5            25                      140                42                  2
38            0                        5                21                  0
2            30                      170                19                  0
3             0                      130                13                  1
1             5                      150                19                  0
8            25                      150                37                  0

    Sugars (g)  Protein (g)  Vitamin A (fDV)  Vitamin C (fDV)  Calcium (fDV)  \
0            0          1.0             0.00             0.00           0.00
10           0          1.0             0.00             0.00           0.02
4           34         13.0             0.20             0.00           0.35
6           26         11.0             0.10             0.00           0.35
5           34         13.0             0.15             0.02           0.35
38          21          0.3             0.00             0.00           0.00
2           17         12.0             0.20             0.02           0.40
3            8         10.0             0.15             0.00           0.40
1           18         13.0             0.20             0.00           0.40
8           35         12.0             0.20             0.02           0.35

    Iron (fDV)  Caffeine (mg)
0         0.00            330
10        0.00            225
4         0.25            175
6         0.40            175
5         0.25            175
38        0.00            165
2         0.00            150
3         0.15            150
1         0.00            150
8         0.00            150
```

We don't really care about the other nutritions at this point. Let's just print what is needed.

[39]:
```
top10_Caf_Drink[['Beverage','Sugars (g)','Caffeine (mg)']]
```

[39]:

	Beverage	Sugars (g)	Caffeine (mg)
0	Brewed Coffee	0	330
10	Caff Americano	0	225
4	Caff Mocha (Without Whipped Cream)	34	175
6	Caff Mocha (Without Whipped Cream)	26	175
5	Caff Mocha (Without Whipped Cream)	34	175
38	Iced Brewed Coffee (With Classic Syrup)	21	165
2	Caff Latte	17	150
3	Caff Latte	8	150
1	Caff Latte	18	150
8	Vanilla Latte (Or Other Flavoured Latte)	35	150

Oops, why does the same drink keep repeating but with different calories and caffeine? Give yourself a minute before reading the next line for the answer.

Yes, they are prepared differently. Let's add that too, since it is relevent information

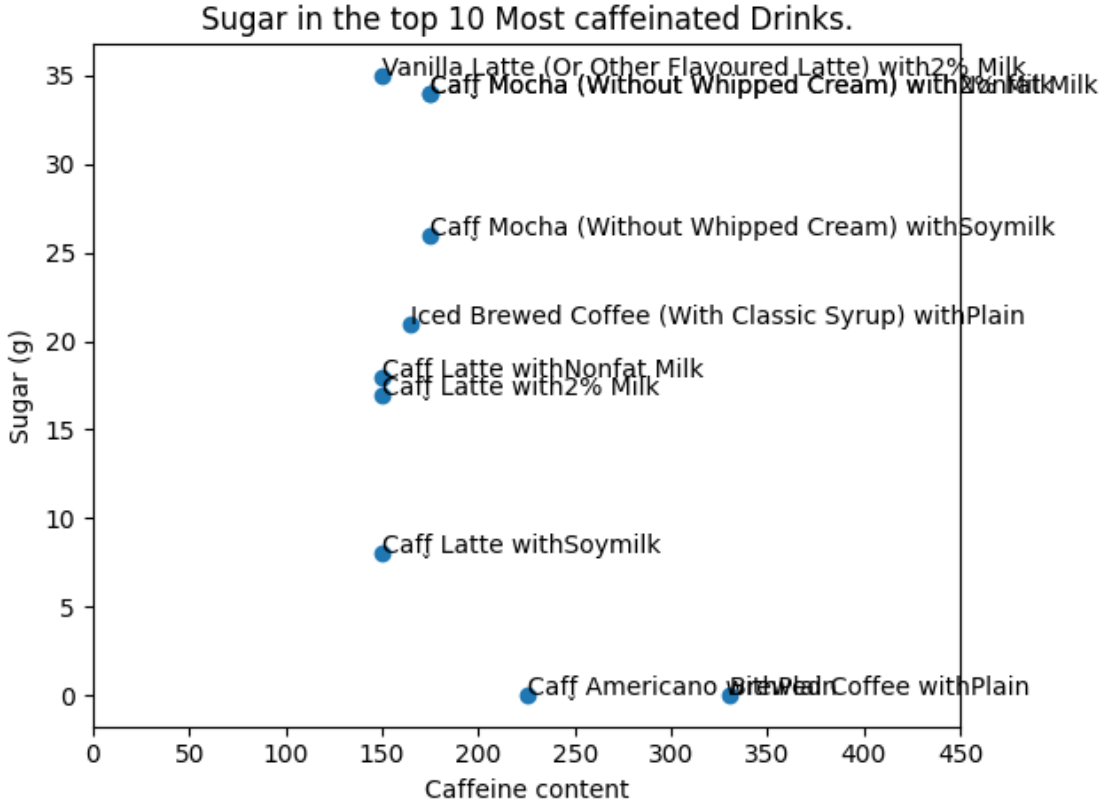
[40]:
```
top10_Caf_Drink[['Beverage','Beverage_prep','Sugars (g)','Caffeine (mg)']]
```

[40]:

	Beverage	Beverage_prep	Sugars (g)	Caffeine (mg)
0	Brewed Coffee	Plain	0	330
10	Caff Americano	Plain	0	225
4	Caff Mocha (Without Whipped Cream)	Nonfat Milk	34	175
6	Caff Mocha (Without Whipped Cream)	Soymilk	26	175
5	Caff Mocha (Without Whipped Cream)	2% Milk	34	175
38	Iced Brewed Coffee (With Classic Syrup)	Plain	21	165
2	Caff Latte	2% Milk	17	150
3	Caff Latte	Soymilk	8	150
1	Caff Latte	Nonfat Milk	18	150
8	Vanilla Latte (Or Other Flavoured Latte)	2% Milk	35	150

Now that we have the beverages with the prep, sugar and caffeine,we need to show this to our friend. Let's plot them as a need scatter plot. Caffeine on x, Sugars on y.

[42]:
```
x = top10_Caf_Drink["Caffeine (mg)"].tolist()
y = top10_Caf_Drink["Sugars (g)"].tolist()

beverages = top10_Caf_Drink['Beverage'].to_list()
beverage_prep = top10_Caf_Drink['Beverage_prep'].to_list()
labels = [ str(beverages[i]) + ' with' + str(beverage_prep[i]) for i in␣
 ↪range(len(top10_Caf_Drink))]

#insert your code here to plot the graph here
plt.scatter(x, y)

plt.xlabel("Caffeine content")
plt.ylabel("Sugar (g)")
plt.title("Sugar in the top 10 Most caffeinated Drinks.")

axes = plt.gca()
axes.set_xlim([0,450])

for i, txt in enumerate(labels):
    plt.annotate(txt, (x[i], y[i]))

plt.tight_layout()
plt.show()
```



Nice work!!

2 Conclusion

In this assignment, we were able to download a dataset, load it as a pandas dataframe, explore the dataset with basic statistical functions and visulaise many specifc examples to answer relevent queries from the topic.

Congragulations!!