Project-1-Group-6 **How Do We Like our Caffeine?**

Bekhem Horne
Han Le
Japhet Mwamba
Sajid Anjum

Table of Contents

I. INTRODUCTION: This project is an analysis of a wide variety of caffeinated drinks on the market and their caffeine contents. Caffeine is one of the most popular and addictive drugs on the market, and even though it is not classified as a drug, most of us depend on a source of caffeine regularly to get energy throughout the day. The FDA[1] recommends not exceeding 400mg of caffeine a day as exceeding this number can cause numerous health issues such as tremors, irregular heartbeats or murmurs, restlessness, trouble sleeping, and increased anxiety. Most people have an average caffeine consumption of 70mg, 54% of which is from coffee and 33% from teas.[2] Our goal in this project is to analyze the distributions of caffeine, calories, and volume in this sample data set, and to see if there are any major relationships between these three variables. In addition, we would like to identify the type and nature of beverages with very high caffeine content and a number of calories. Lastly, we would like to do a brand analysis on some of the major brands represented in this data set.

II. INTIAL DATASET: Our data set was found on Kaggle [3] and consists of a list of a variety of caffeinated drinks of six different types: Coffee, energy drinks, energy shots, sodas, teas, and caffeinated water. This is a sample of some of the data from our data set:

Drink Name	Volume (ml)	Calories	Caffeine (mg)	Type	Caffeine per 100 ml	Calories per 100 ml	Calorie level	Brand
Costa Coffee	256.993715	0	277	Coffee	107.784737	0.000000	Diet	Other
28 Black Energy Drink	250.191810	125	80	Energy Drinks	31.975467	49.961667	Regular	Other
Spike Energy Double Shot	125.983110	0	350	Energy Shots	277.815018	0.000000	Regular	Other
Red Bull Simply Cola	250.191810	0	32	Soft Drinks	12.790187	0.000000	Diet	Other
PG Tips Black Tea	200.508330	0	50	Tea	24.936620	0.000000	Regular	Other
Perrier Energize	250.191810	35	99	Water	39.569641	13.989267	Regular	Other

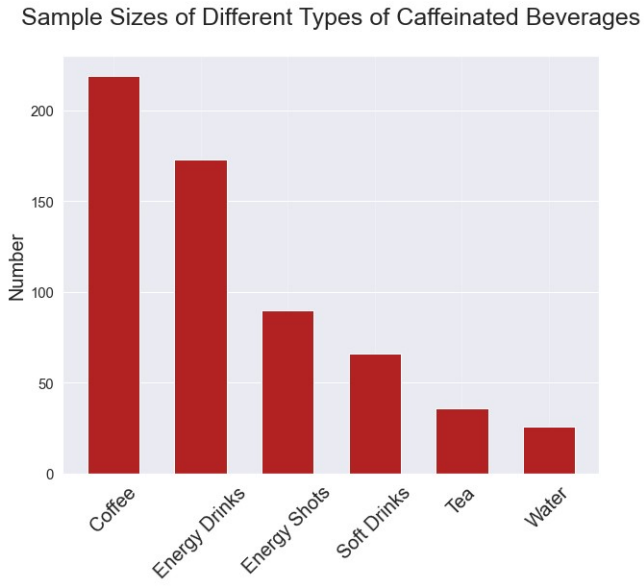
[1] https://www.fda.gov/consumers/consumer-updates/spilling-beans-how-much-caffeine-too-much

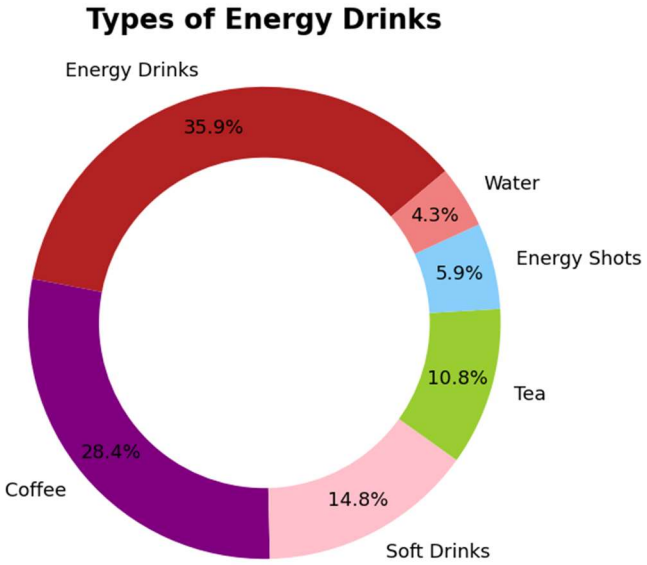
[2] https://www.mhc.wa.gov.au/media/1223/caffeine-the-facts-booklet.pdf

[3] https://www.kaggle.com/datasets/heitornunes/caffeine-content-of-drinks

Our data set was quite clean in its original form. We did not have a single missing value. However, we did add several columns to help us better analyze the data. We created two new columns for the density of caffeine (mg per 100 ml) and for the density of calories (per 100 ml). We also divided our caffeinated drinks into a diet section and a regular section, and we organized the drinks into five major brands and other brands.

The donut chart and bar chart below shows the six major types of caffeinated beverages in our analysis of 610 drinks. Coffee and Energy Drinks combined makeup almost 64.3% of the total data, while, a little unexpectedly, caffeinated water makes up about 5% of the sample.

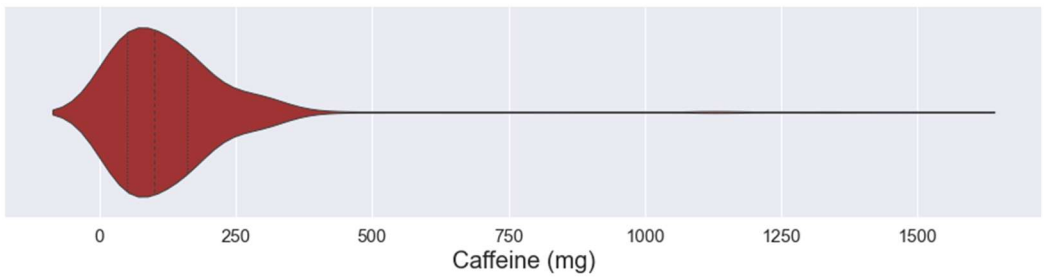


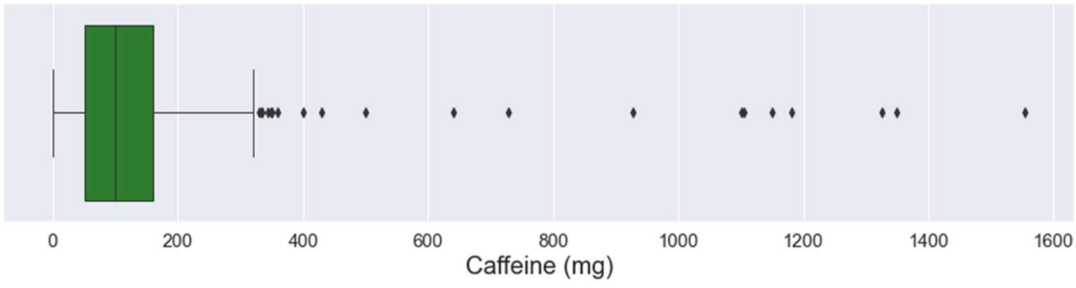


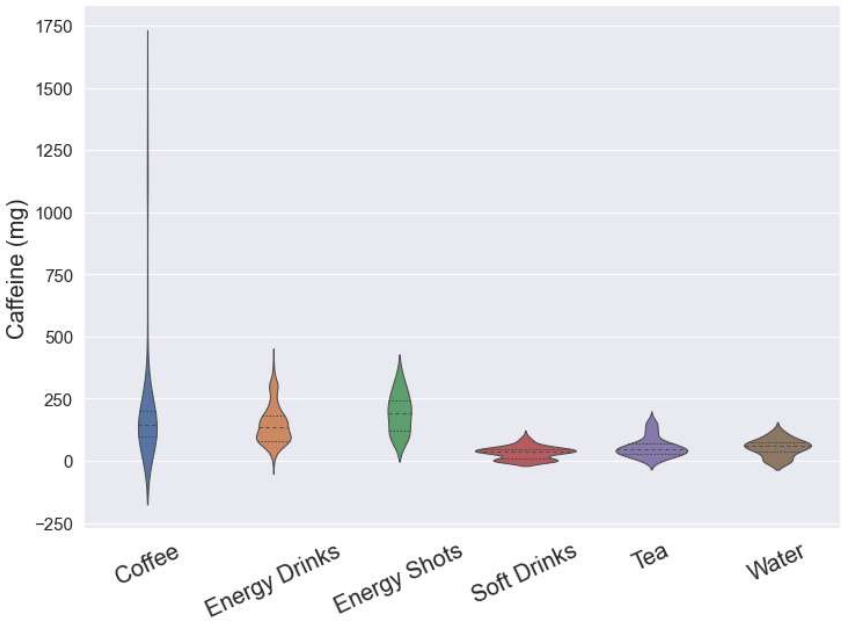
III. Distribution of Caffeine, Calories, and Volume:

i. Caffeine

The volume plot on the right shows the distribution of caffeine in our dataset. We notice successive quartiles of 50, 100, and 160 mg, followed by a really long spine and a maximum of 1555 mg. A boxplot reveals that the majority of the data points in the

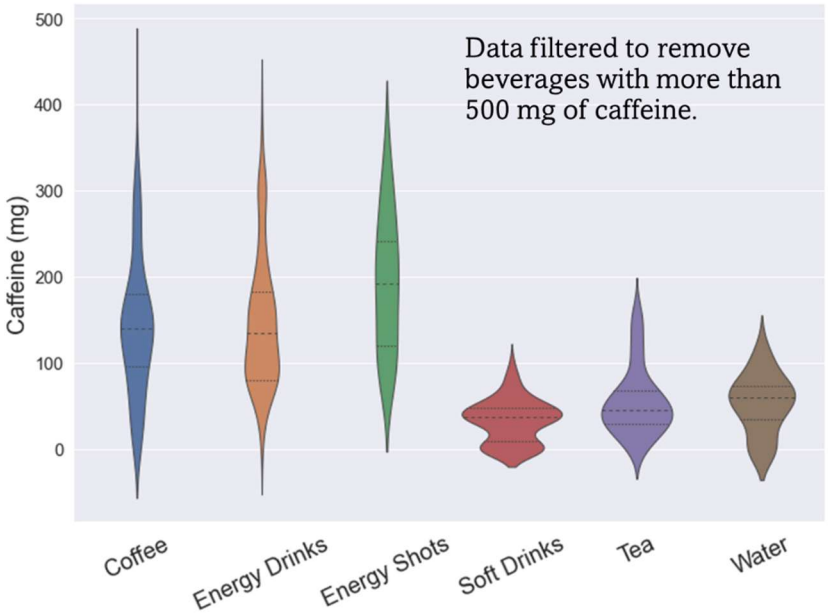






long spine are outliers. Before we filtered our data set to remove the outliers, we made a violin plot by type of drink to see the distribution of caffeine within the type of drink in the data set. Surprise! It seems that almost all of the outliers are types of coffee. Coffee is the only beverage which you can order with more than 500 mg of caffeine, all the way up to almost 1750 mg. We then filtered out these outliers to better compare the different distributions of caffeine.

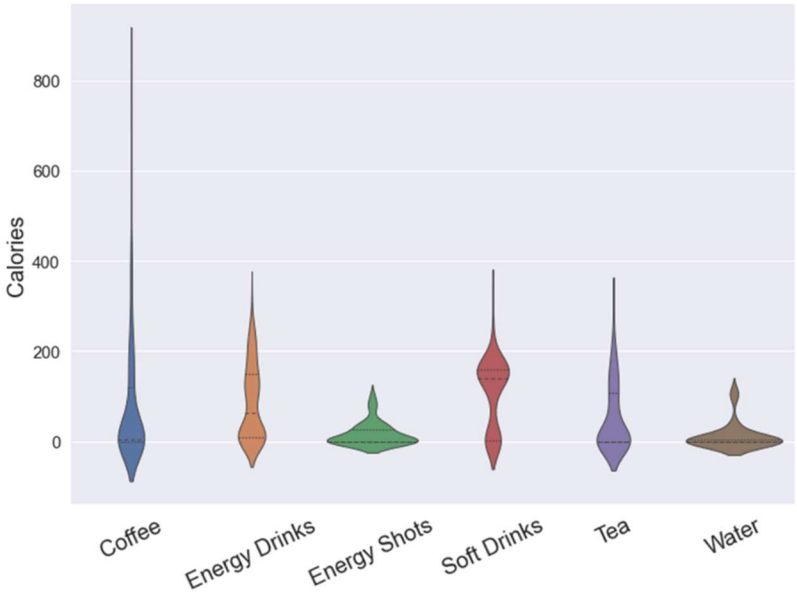
We now notice that the distributions break down neatly into two categories. Coffee, energy drinks, and energy shots have wider distributions and far greater maxima than soft drinks, teas, and waters. We also notice that the soft drinks category has a bimodal distribution with a second mode at 0. This is because many soft drinks are sold without any caffeine at all. In conclusion, we recommend that if you need to wake up, you should be drinking coffees, energy drinks, or energy shots, while if you need a mild buzz, you should be drinking soft drinks, teas, or caffeinated waters. In addition, you should be very careful drinking coffee as a few have enough caffeine to send you to the emergency room. You might think that perhaps the strongest coffees are just very large in size. However, some quick analysis shows that you would be incorrect. The most extreme coffee beverages have a much higher density of caffeine per 100 ml than they do caffeine. Not only that, these beverages are all diet drinks with 0 calories and are sold in standard and innocuous looking 12 fluid ounce packaging. Below is a table of those outliers.



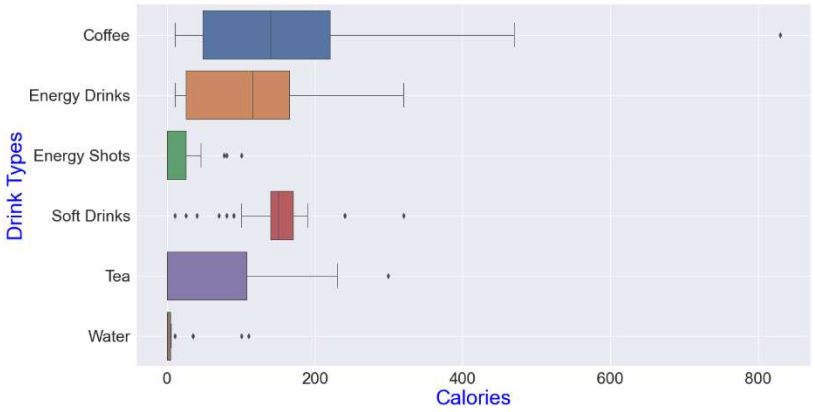
	drink	Volume (ml)	Calories	Caffeine (mg)	type	caffeine_per_100ml	calories_per_100ml	diet	brand
0	Black Label Brewed Coffee	354.882	0	1555	Coffee	438.173816	0.000000	Diet	Other
1	Very Strong Coffee	354.882	0	1350	Coffee	380.408136	0.000000	Diet	Other
2	Devils Brew Extreme Caffeine Coffee	354.882	0	1325	Coffee	373.363541	0.000000	Diet	Other
3	Taft Coffee (EU)	354.882	0	1182	Coffee	333.068457	0.000000	Diet	Other
4	High Voltage Coffee (AU)	354.882	0	1150	Coffee	324.051375	0.000000	Diet	Other
5	Black Insomnia Coffee	354.882	0	1105	Coffee	311.371104	0.000000	Diet	Other

ii. **Calories**

We made a violin plot comparing the calories within different types of caffeinated beverages. The coffees tend to stand out once more. It would be tempting to conclude that the coffees with the highest calories are also those with the highest caffeine, but as we saw earlier, this is just now the case. We also notice that every single type of beverage has a mode or second mode around zero. This is because so many caffeinated beverages are diet beverages.



On the right are boxplots created after filtering out diet coffees, energy drinks, and soft drinks. We defined diet drinks as any coffee, energy drink, or soft drink less than 10 calories. We did not apply this definition to energy shots, teas, or waters as most of those drinks tend to be very low calorie.

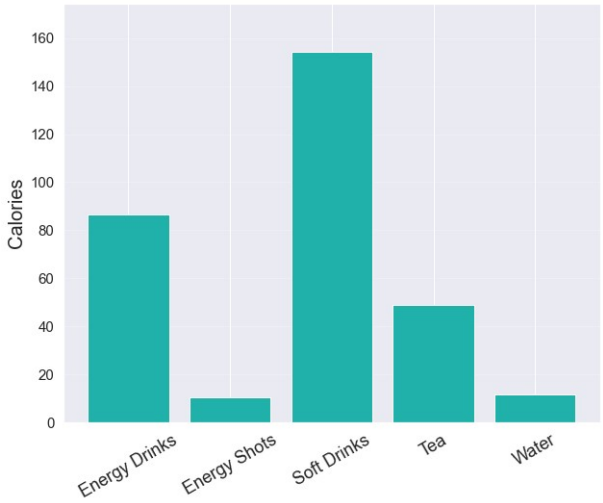


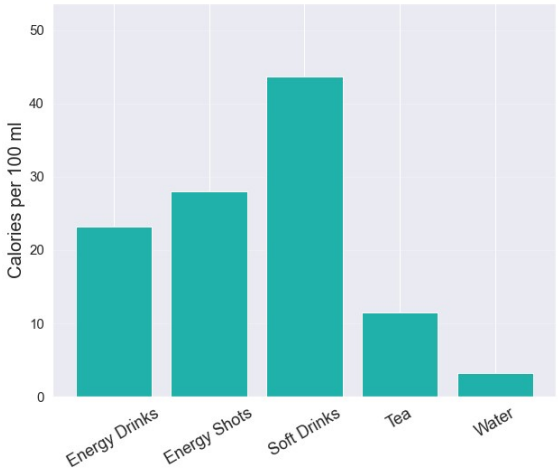
Some observations:

a. Coffee is no longer so rogue, with only one outlier (Arby's Jamocha Shake with 830 calories).
b. Soft Drink outliers are weirdly symmetric, with some having really low calories and some very high. This means that you never know what you are going to get with soft drinks.

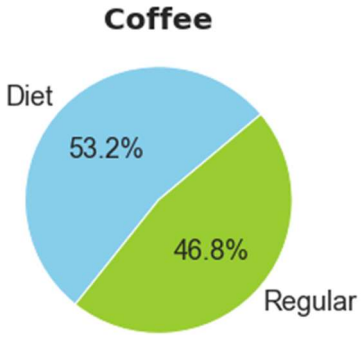
After filtering the distributions for outliers, we can make graphs of mean calories and mean caloric density to help you decide which categories are great if you are watching your caloric intake but choose not to drink diet drinks.

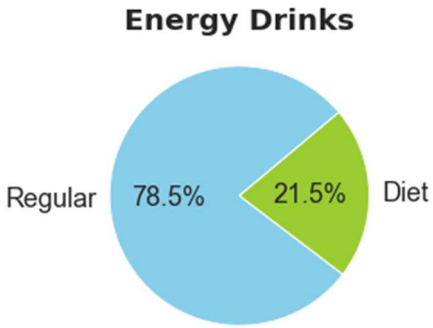
These bar charts are presented on the right.

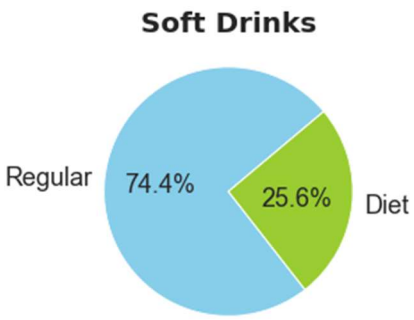




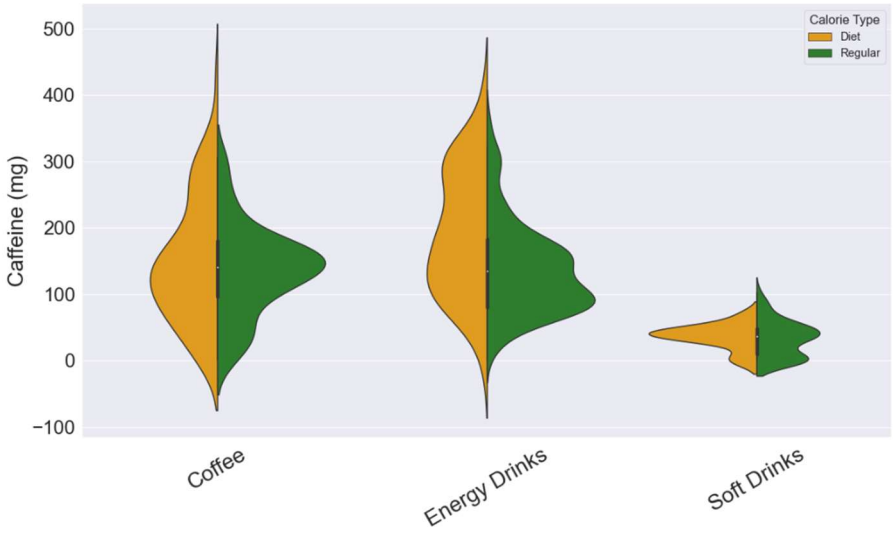
We also analyzed the distributions of caffeine in diet versus regular soft drinks. Again, we only chose the following three categories as we did not divide the remaining three into diet and regular for reasons mentioned earlier.







The first thing we notice is that diet drinks make up only one quarter of energy drinks and soft drinks, but more than half of all coffees. This is not surprising as many coffees are served black with no additives. Next, we made violin plots to see what the different distributions looked like:



We notice that the distributions are not all that dissimilar, especially given our limited sample sizes. Perhaps it would be a good idea to do a TTest to determine the likelihood of whether the distributions of diet and regular caffeinated beverages share the same parent distribution.

First, we did a TTest to determine whether the combined distributions of the three caffeinated beverages categories were the same.

H_0: The distributions of caffeine in diet versus regular caffeinated beverages are from the same parent distribution

H_a: The distributions of caffeine in diet versus regular caffeinated beverages are not from the same parent distribution

The results are on the right. At a 1% chance of error, we can easily reject the null and conclude that the two distributions are not the same.

All Categories	Mean Caffeine (mg)	Variance Caffeine (mg)
Diet	145.27	9784.57
Regular	114.33	5450.19

Test-Statistic: 3.4293 P-Value: 0.0007

However, since our data was already broken down by type, we decided to run the TTest for each separate category. H_0 and H_a remained the same. The results are in the tables to the right and below:

Coffee	Mean Caffeine (mg)	Variance Caffeine (mg)
Diet	149.62	8624.76
Regular	135.86	4401.72

Test-Statistic: 1.087 P-Value: 0.278

Soft Drinks	Mean Caffeine (mg)	Variance Caffeine (mg)
Diet	36.52	348.72
Regular	32.70	717.12

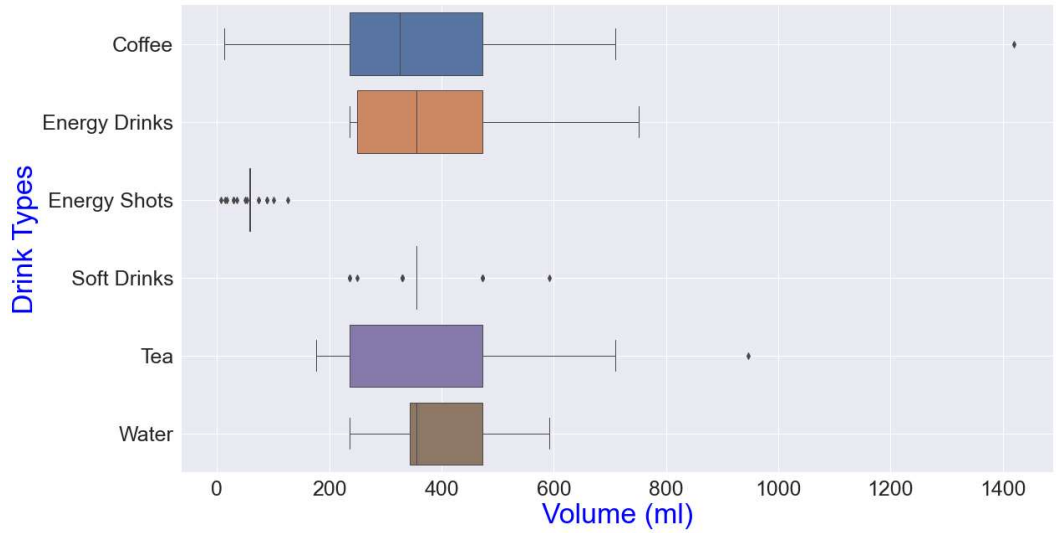
Test-Statistic: 0.751 P-Value: 0.456

It turns out that only the caffeine distributions of diet energy drinks and regular energy drinks are not similar. For coffee and soft drinks, we are not able to conclude that the difference in distributions is statistically significant because the error for making this claim would be very high (27.8% and 45.6% respectively).

Energy Drinks	Mean Caffeine (mg)	Variance Caffeine (mg)
Diet	190.91	8689.47
Regular	136.10	4520.56

Test-Statistic: 3.772 P-Value: 0.00037

iii. Volume We made boxplots of the variation of the volume of drinks within the six different categories. This is the graph.



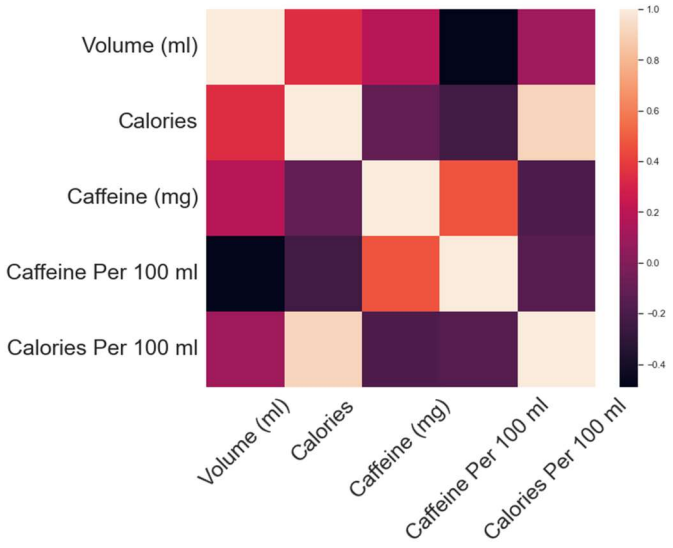
We notice that once more, coffee has a single outlier. It is not the same as the calories outlier, surprisingly, but a giant 48 oz bottle of iced coffee. We also notice that energy shots tend to cluster around the 58 ml (2 oz mark), confirming their "shots" label, and energy drinks tend to cluster around the 355 ml or 12 oz mark, showing that most soft drinks sampled probably came from 12 oz cans. Then, just as we did with caffeine and calories, we filtered our data set for volume outliers so that we would have a clean data set ready for regression analysis.

IV. REGRESSIONS: We began our regression analysis by calculating the correlations between the five numerical columns in our extended data frame. Below is the heatmap and table we generated:

	Volume (ml)	Calories	Caffeine (mg)	Caffeine Per 100 ml	Calories Per 100 ml
Volume (ml)	1.000000	0.344554	0.189190	-0.490511	0.103493
Calories	0.344554	1.000000	-0.107022	-0.232220	0.909358
Caffeine (mg)	0.189190	-0.107022	1.000000	0.467557	-0.185042
Caffeine Per 100 ml	-0.490511	-0.232220	0.467557	1.000000	-0.157923
Calories Per 100 ml	0.103493	0.909358	-0.185042	-0.157923	1.000000

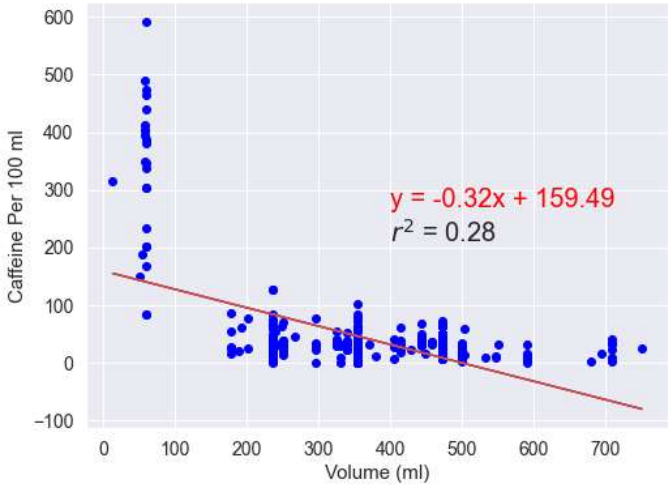
We noticed that there are strong negative or positive correlations between three sets of variables:

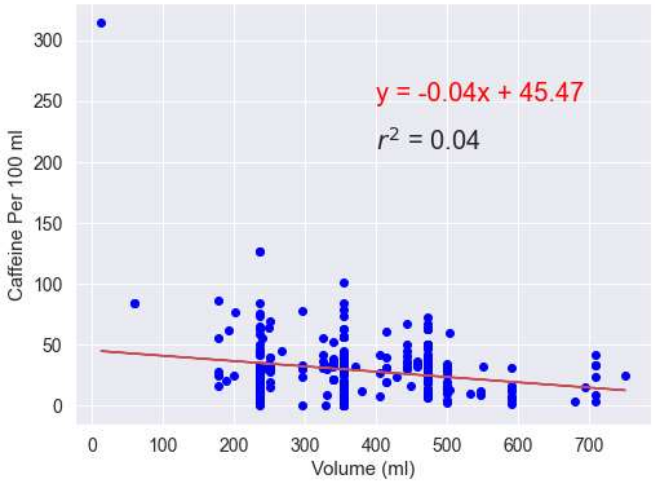
a. Caffeine per 100 ml versus Volume (ml)
b. Calories versus Volume (ml)
c. Calories versus Calories per 100 ml



Caffeine (mg/100ml) Versus Volume

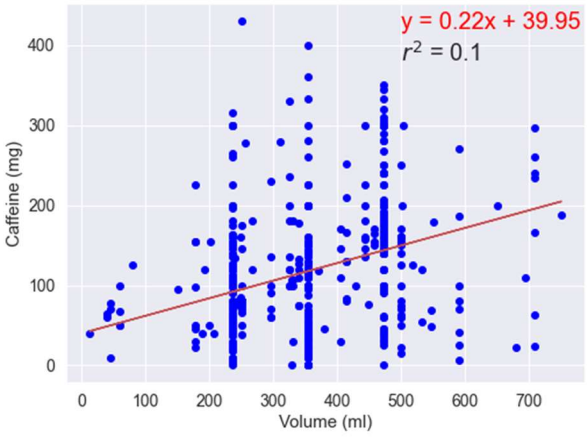
Data filtered to remove energy shots





Caffeine (mg) Versus Volume (ml)

Data filtered to remove energy shots

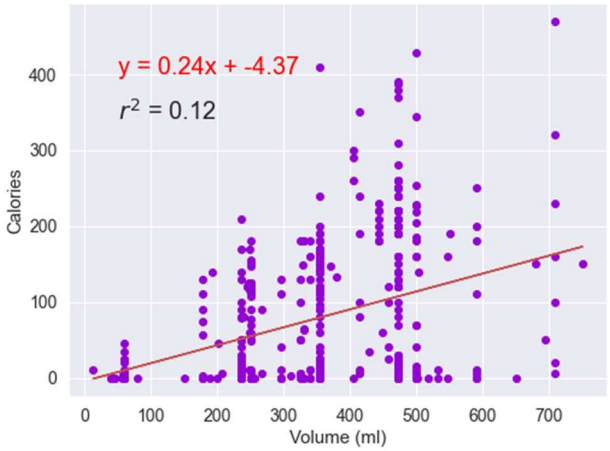


The graph on the left is a linear model to find how the density of caffeine varies with volume. We see a weak correlation of $r^2 = 0.28$, but even this is misleading because the vertical column of blue dots at 58 ml seems to be skewing the results. From our volume analysis, we know that this is actually energy shots. Thus, we should filter out energy shots for a more realistic model. The filtered model is the graph on the left, and now the correlation is $r^2 = 0.04$, which is almost nonexistent. What this means is that larger drinks don't have a higher caffeine density, but they probably just have more caffeine, and we did not notice this effect earlier because the energy shots were

messing up our data set. We tested this hypothesis by doing another regression of just caffeine versus volume with no energy shots. Sadly, the correlation was still $r^2 = 0.1$. It turns out that volume is not a good predictor of either caffeine or the density of caffeine.

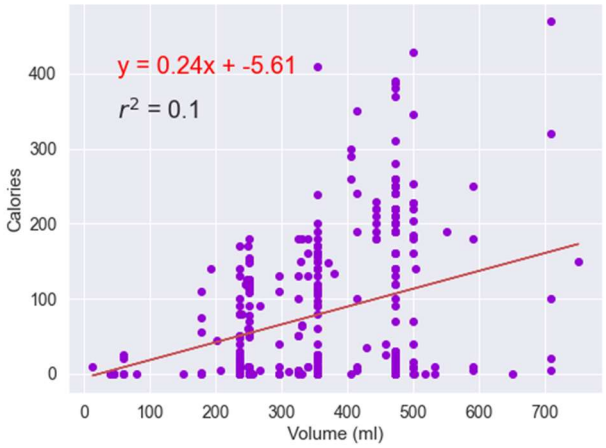
Next, we tried to model the relationship between calories and volume.

Calories versus Volume (ml)



Calories versus Volume (ml)

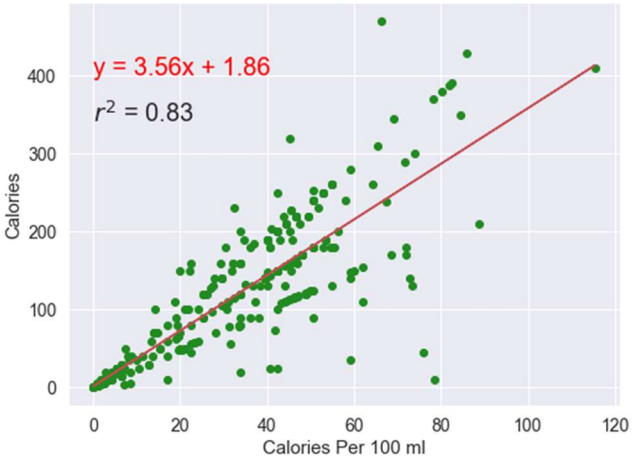
Data filtered to only include coffee and energy drinks



Again, we see that the correlation between calories and volume $(r^2 = 0.12)$ is very weak. Not only that, we see that the scatter in our data set is increasing with volume, which does not satisfy the conditions for using a linear regression model. We thought we might see a little more structure if we filtered our data set to include only coffees and energy drinks because we explicitly filtered out diet drinks in those two categories. However, the correlation became even worse $(r^2 = 0.1)$. Surprisingly, there is absolutely no relationship between the size of a drink and the number of calories it contains, even after we removed all diet drinks, which we earlier defined as drinks having fewer than 10 calories.

Or last linear model was created to find a relationship between total caffeine and caffeine density. Would high caffeine density drinks have more caffeine, or would they just be smaller? Since our earlier analysis revealed that volume and caffeine have a very weak relationship, this would imply that caffeine density is a very good predictor of total caffeine. It turns out that this is true. The $r^2 = 0.83$ in the linear model means that 83% of the variation in calories in a drink can be predicted by the density of calories in the drink.

Calories versus Calories per 100 ml



V. TOP TEN AND LOWEST TEN TYPE BREAKDOWN:

We chose to perform a further analysis of our six types of caffeinated drinks to see what the structure of each type would be. This showed many interesting groupings, as well as found outliers within our data.

Coffee's top ten had the maximum amount of caffeine offered out of all six types at almost 1650mg of caffeine. This is expected due to the many ways coffee can be brewed. Since our data set also has different volumes listed, we discovered that for coffee the number one most caffeinated "drink" is the caffeine measurements of Black Label Brewed Coffee in the bag. Coffee top milligram grouping was shown to be at the 1200-1000mg range with four out of the top ten plateauing at this mark. The lowest ten for coffee had a steady decline, this is where we located our Decaf options within our coffee dataset. The decline was gradual, from 20mg to 1.75mg of caffeine.

Water's top and lowest ten had far more common groupings, the top ten had three groups within the 100mg, 70mg, and 60mg, with the number one most caffeinated drink having 120mg of caffeine which took us by surprise being that it is water. Waters dataset became more interesting when observing the ten lowest caffeinated options, with a range of 50mg to 0mg. Water's lowest ten was split down the middle with five outliers showing 0mg of caffeine.

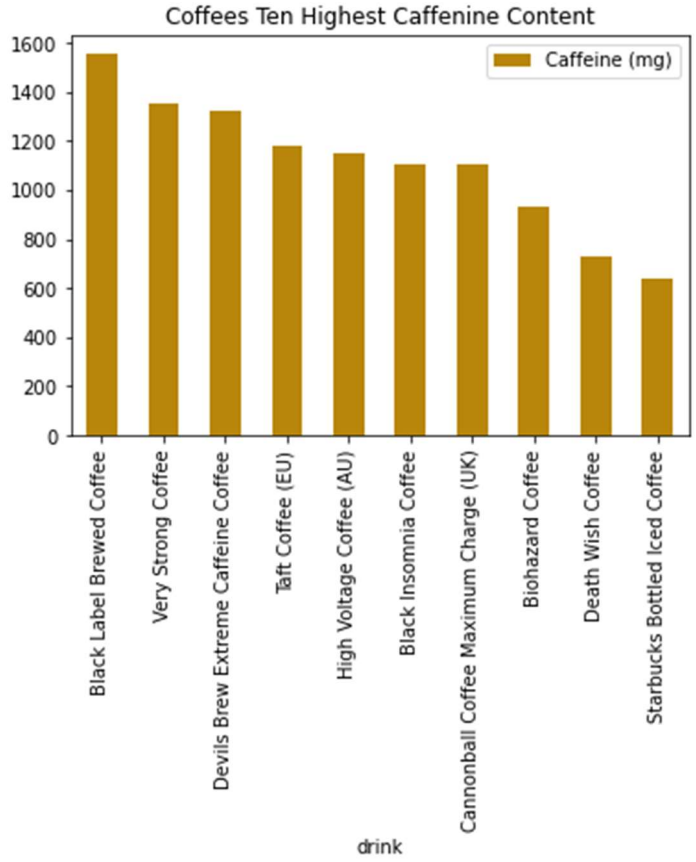
Tea and water's top and lowest ten had some similarities as far as ranges of caffeine and the slope of the charts. Both had a caffeine max range of 160-120mg max. Teas also had two main clusters of caffeine plateaus at 150mg and again at 110mg.

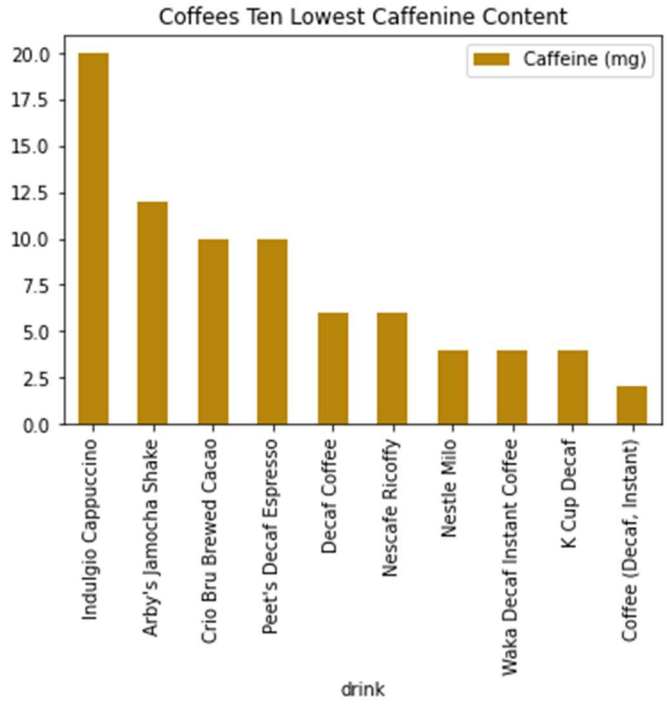
Energy Shots tens showed the least amount of change in the caffeine content, ranging from 350mg to 75mg with main clusters through the highest and lowest. Further proving that caffeine shots are the most efficient source of caffeine.

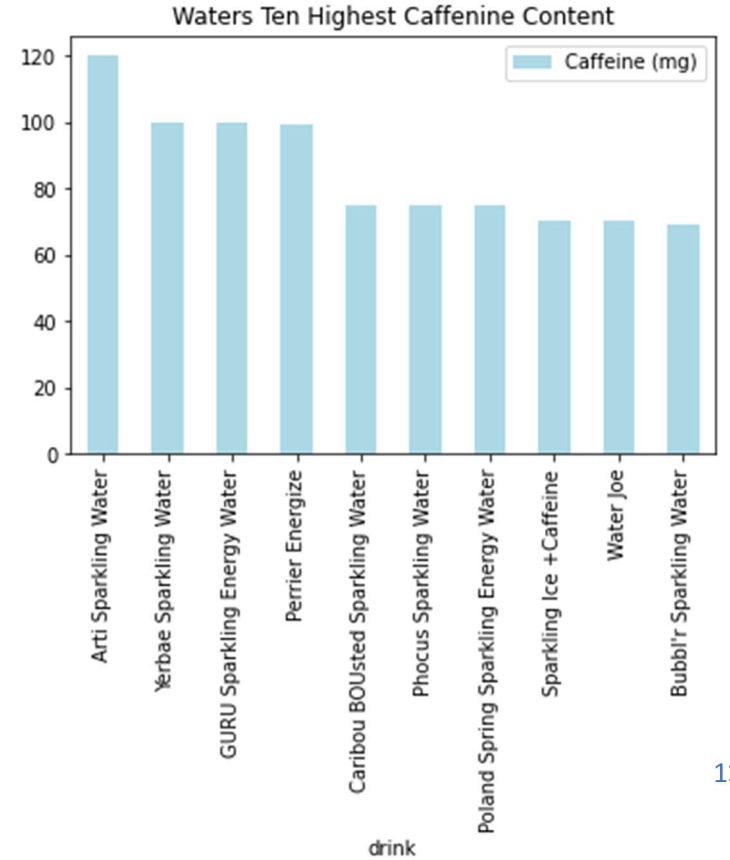
Soft drinks bar charts of tens were interesting, the max caffeine value only being at 100mg and the ten lowest all being 0mg due to the many non-caffeinated drinks in our data set for soft drinks.

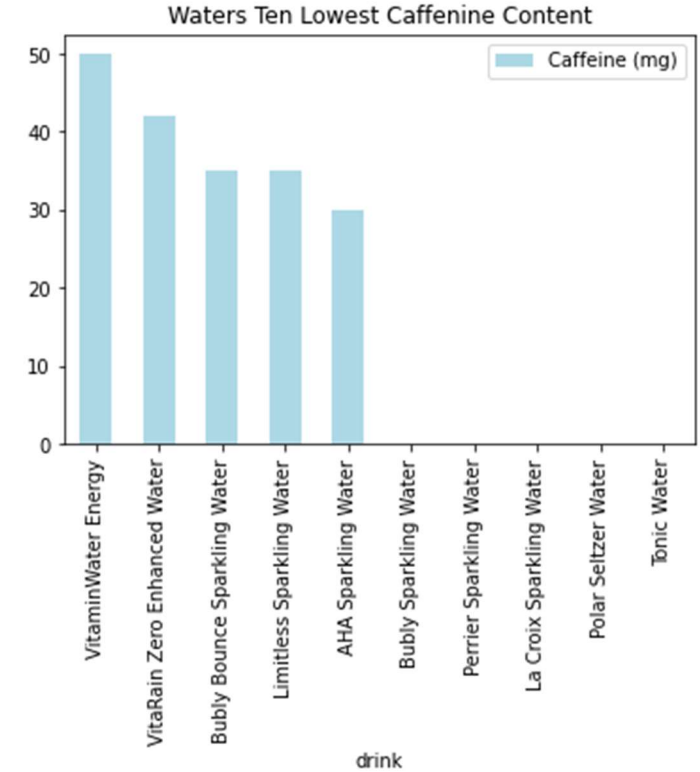
Energy Drinks was the last bar chart created for the top and lowest ten. A close second in caffeine content to coffee, with the number one spot having 400mg of caffeine which is the max amount anyone should consume in a day. The decline of this graph is very minimal with the highest range at 400mg to 300mg, only a 100mg difference.

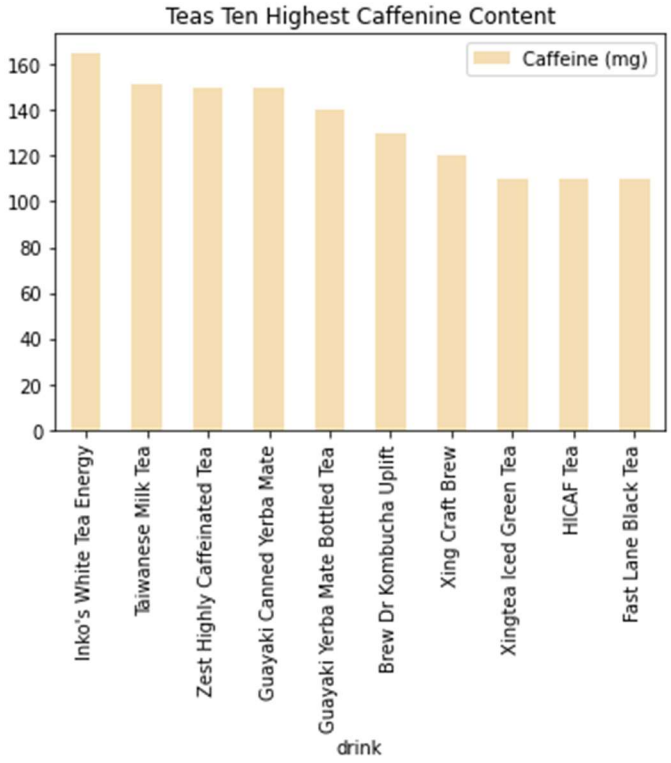
Below are our graphs:

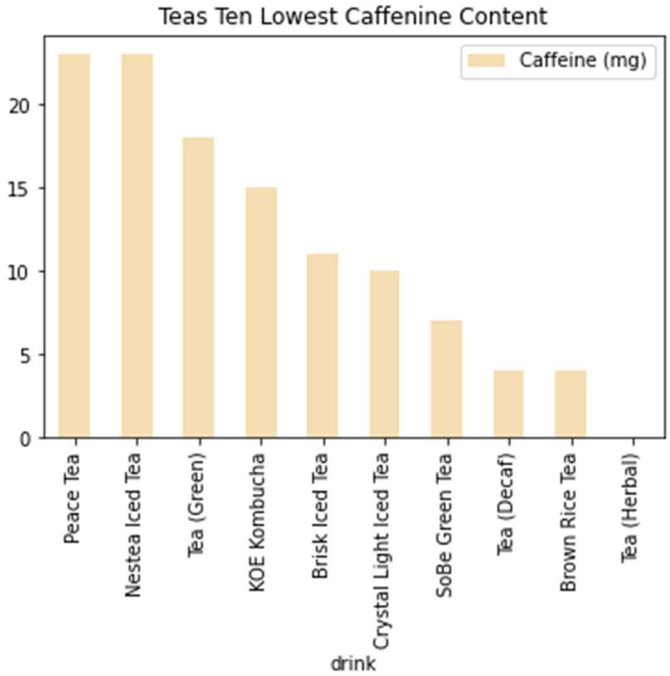

Coffees Ten Highest Caffenine Content
Caffeine (mg)
1600
1400
1200
1000
800
600
400
200
0
Black Label Brewed Coffee
Very Strong Coffee
Devils Brew Extreme Caffeine Coffee
Taft Coffee (EU)
High Voltage Coffee (AU)
Black Insomnia Coffee
Cannonball Coffee Maximum Charge (UK)
Biohazard Coffee
Death Wish Coffee
Starbucks Bottled Iced Coffee
drink

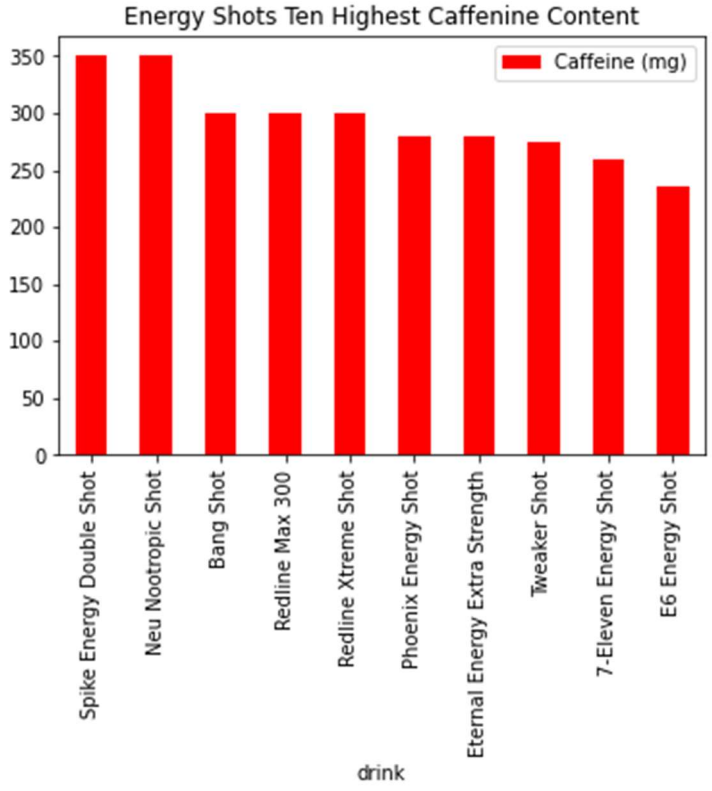

Coffees Ten Lowest Caffenine Content
Caffeine (mg)
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Indulgio Cappuccino
Arby's Jamocha Shake
Crio Bru Brewed Cacao
Peet's Decaf Espresso
Decaf Coffee
Nescafe Ricoffy
Nestle Milo
Waka Decaf Instant Coffee
K Cup Decaf
Coffee (Decaf, Instant)
drink

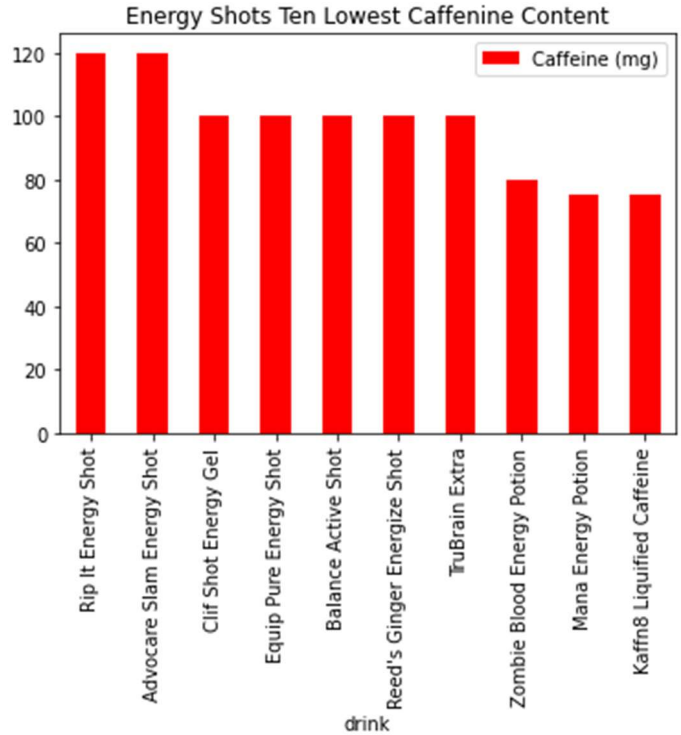

Waters Ten Highest Caffenine Content
Caffeine (mg)
120
100
80
60
40
20
0
Arti Sparkling Water
Yerbae Sparkling Water
GURU Sparkling Energy Water
Perrier Energize
Caribou BOUsted Sparkling Water
Phocus Sparkling Water
Poland Spring Sparkling Energy Water
Sparkling Ice +Caffeine
Water Joe
Bubbl'r Sparkling Water
drink

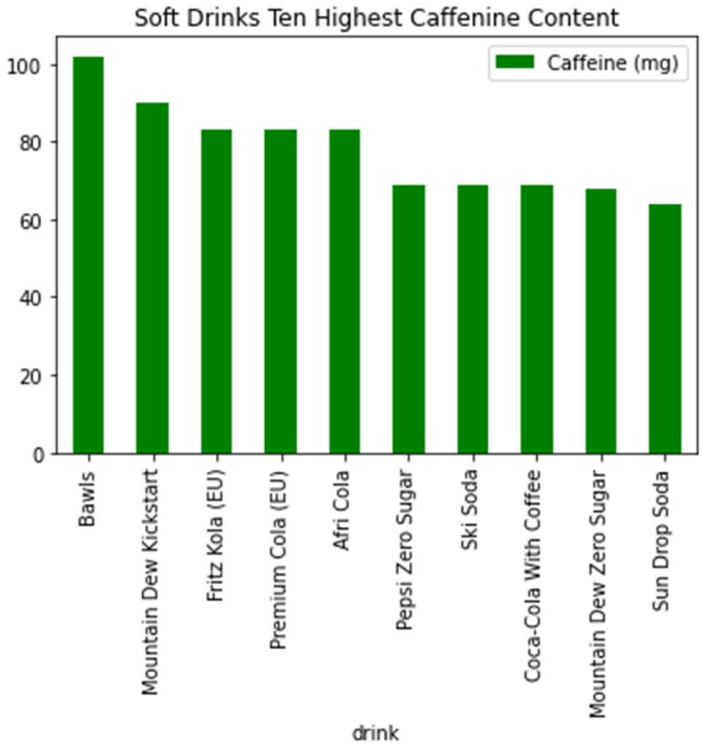

Waters Ten Lowest Caffenine Content
Caffeine (mg)
50
40
30
20
10
0
VitaminWater Energy
VitaRain Zero Enhanced Water
Bubly Bounce Sparkling Water
Limitless Sparkling Water
AHA Sparkling Water
Bubly Sparkling Water
Perrier Sparkling Water
La Croix Sparkling Water
Polar Seltzer Water
Tonic Water
drink

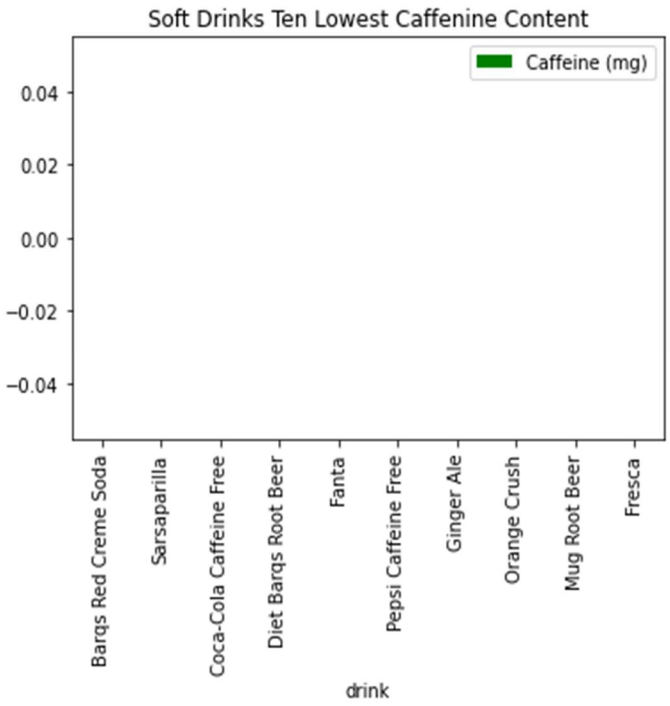

Teas Ten Highest Caffenine Content
Caffeine (mg)
160
140
120
100
80
60
40
20
0
Inko's White Tea Energy
Taiwanese Milk Tea
Zest Highly Caffeinated Tea
Guayaki Canned Yerba Mate
Guayaki Yerba Mate Bottled Tea
Brew Dr Kombucha Uplift
Xing Craft Brew
Xingtea Iced Green Tea
HICAF Tea
Fast Lane Black Tea
drink

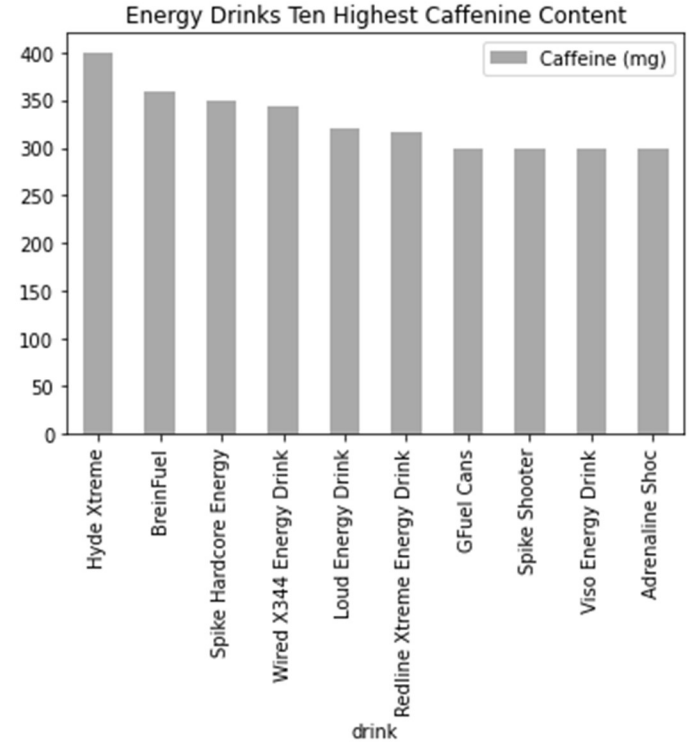

Teas Ten Lowest Caffenine Content
Caffeine (mg)
20
15
10
5
0
Peace Tea
Nestea Iced Tea
Tea (Green)
KOE Kombucha
Brisk Iced Tea
Crystal Light Iced Tea
SoBe Green Tea
Tea (Decaf)
Brown Rice Tea
Tea (Herbal)
drink

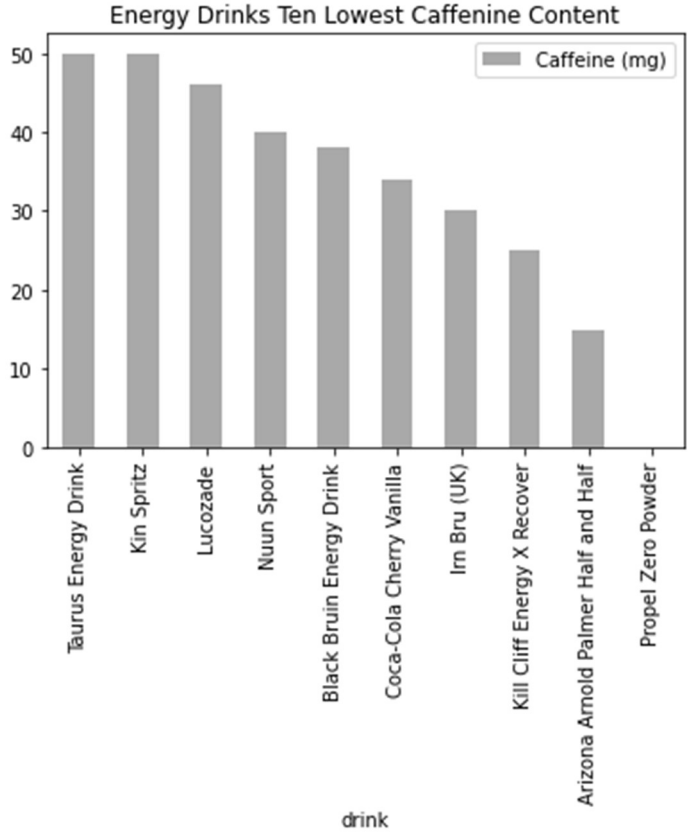

Energy Shots Ten Highest Caffenine Content
Caffeine (mg)
350
300
250
200
150
100
50
0
Spike Energy Double Shot
Neu Nootropic Shot
Bang Shot
Redline Max 300
Redline Xtreme Shot
Phoenix Energy Shot
Eternal Energy Extra Strength
Tweaker Shot
7-Eleven Energy Shot
E6 Energy Shot
drink


Energy Shots Ten Lowest Caffenine Content
Caffeine (mg)
120
100
80
60
40
20
0
Rip It Energy Shot
Advocare Slam Energy Shot
Clif Shot Energy Gel
Equip Pure Energy Shot
Balance Active Shot
Reed's Ginger Energize Shot
TruBrain Extra
Zombie Blood Energy Potion
Mana Energy Potion
Kaffn8 Liquified Caffeine
drink


Soft Drinks Ten Highest Caffenine Content
Caffeine (mg)
100
80
60
40
20
0
Bawls
Mountain Dew Kickstart
Fritz Kola (EU)
Premium Cola (EU)
Afri Cola
Pepsi Zero Sugar
Ski Soda
Coca-Cola With Coffee
Mountain Dew Zero Sugar
Sun Drop Soda
drink


Soft Drinks Ten Lowest Caffenine Content
Caffeine (mg)
0.04
0.02
0.00
−0.02
−0.04
Barqs Red Creme Soda
Sarsaparilla
Coca-Cola Caffeine Free
Diet Barqs Root Beer
Fanta
Pepsi Caffeine Free
Ginger Ale
Orange Crush
Mug Root Beer
Fresca
drink

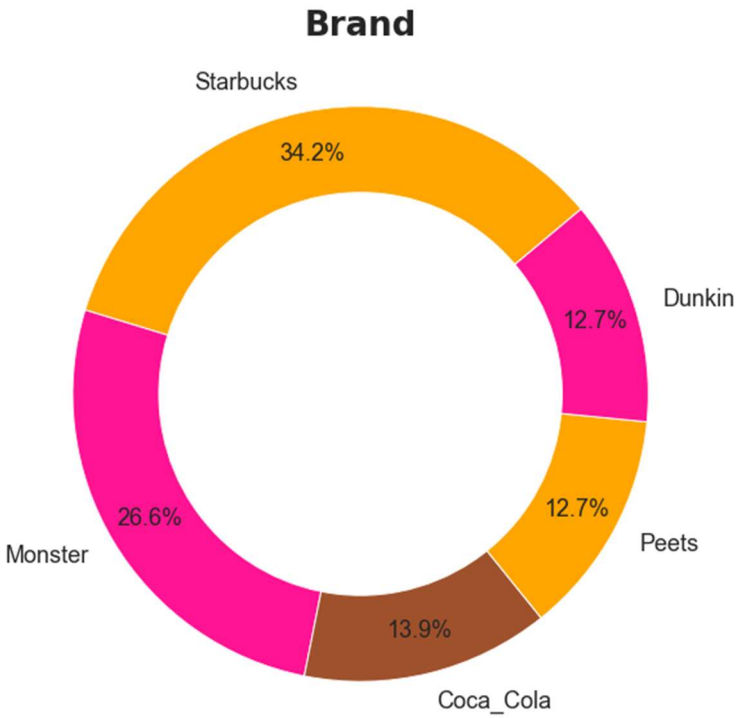

Energy Drinks Ten Highest Caffenine Content
Caffeine (mg)
400
350
300
250
200
150
100
50
0
Hyde Xtreme
BreinFuel
Spike Hardcore Energy
Wired X344 Energy Drink
Loud Energy Drink
Redline Xtreme Energy Drink
GFuel Cans
Spike Shooter
Viso Energy Drink
Adrenaline Shoc
drink


Energy Drinks Ten Lowest Caffenine Content
Caffeine (mg)
50
40
30
20
10
0
Taurus Energy Drink
Kin Spritz
Lucozade
Nuun Sport
Black Bruin Energy Drink
Coca-Cola Cherry Vanilla
Irn Bru (UK)
Kill Cliff Energy X Recover
Arizona Arnold Palmer Half and Half
Propel Zero Powder
drink

VI. BRAND ANALYSIS

Our team decided to analyze further the caffeine content of some popular brands we found on the dataset, including Peets, Starbucks, Dunkin, Coca-Cola, and Monster. The analysis will show how the drinks vary by caffeine content and density among different brands. We want to ensure we get the best bang for our buck!

We analyzed 79 different drinks, representing 13% of the data set. And among those drinks, 34% were Starbucks, Peets, and Dunkin, 13% each, and 14% Coca-Cola. And the rest of the data (26%) were from Monster.



Out of the 10 Peets products, Peets' Brewed Coffee is the most caffeinated drink, with 267mg caffeine for a 473 drink (approximately 16 Fl oz). On the other hand, Coffee Expresso and Decaf Expresso have the least amount of caffeine at 70mg and 10mg, respectively. However, their sizes are only 1/10 of other drinks (44 ml vs. 473 ml). Hence, we did another analysis with caffeine density comparing how much caffeine is contained in 100 ml (about 3.38 oz) of each drink to have more accurate results as drinks come in varied sizes. At 157 mg of caffeine per 100 ml, Peet's Coffee Expresso has the highest caffeine content per 100ml of the Peet products. Brewed Coffee is the second highest at 56mg, approximately three times less than Expresso. The caffeine content in other drinks ranges from 140 mg to 170 mg for their 473 ml size, 30mg to 35 mg per 100 ml.

In [34]:
```
df2peet_sorted=df2peet.sort_values(by="Caffeine (mg)", ascending = False)
df2peet_sorted
```

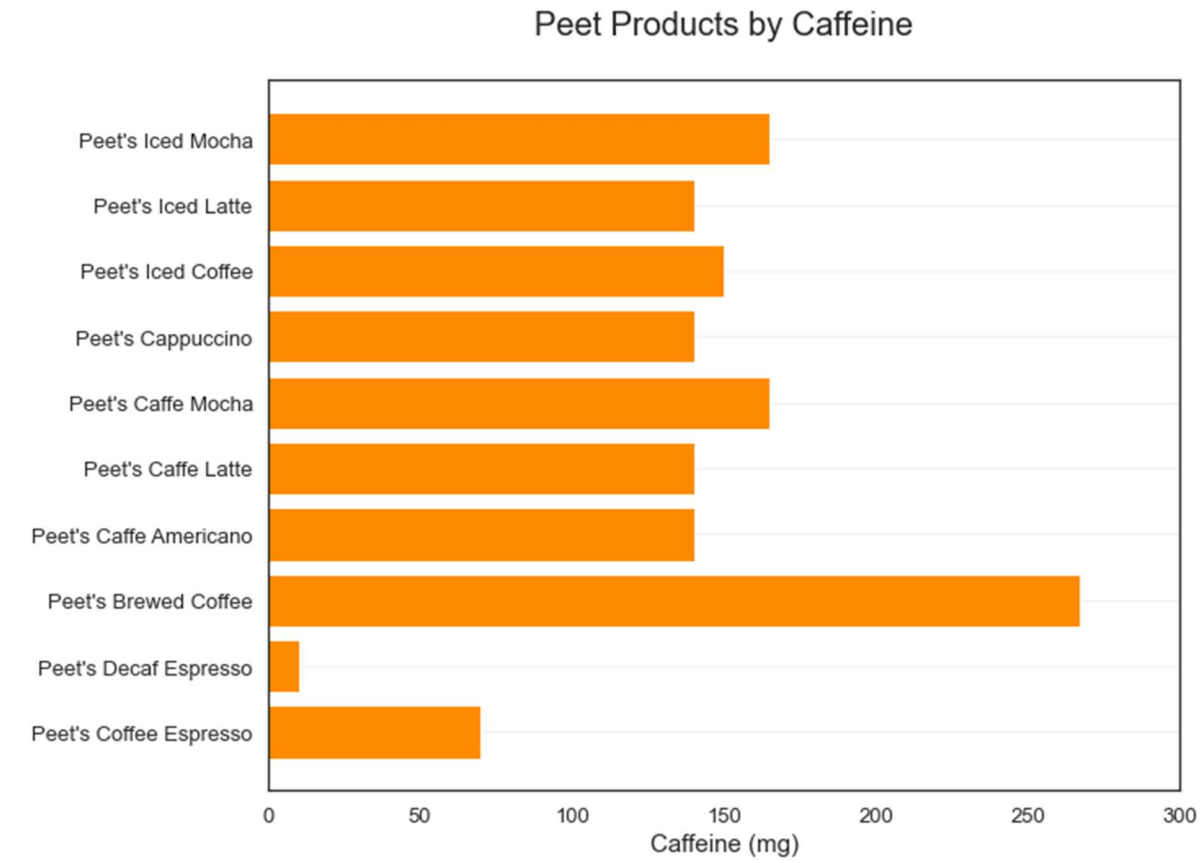
Out[34]:

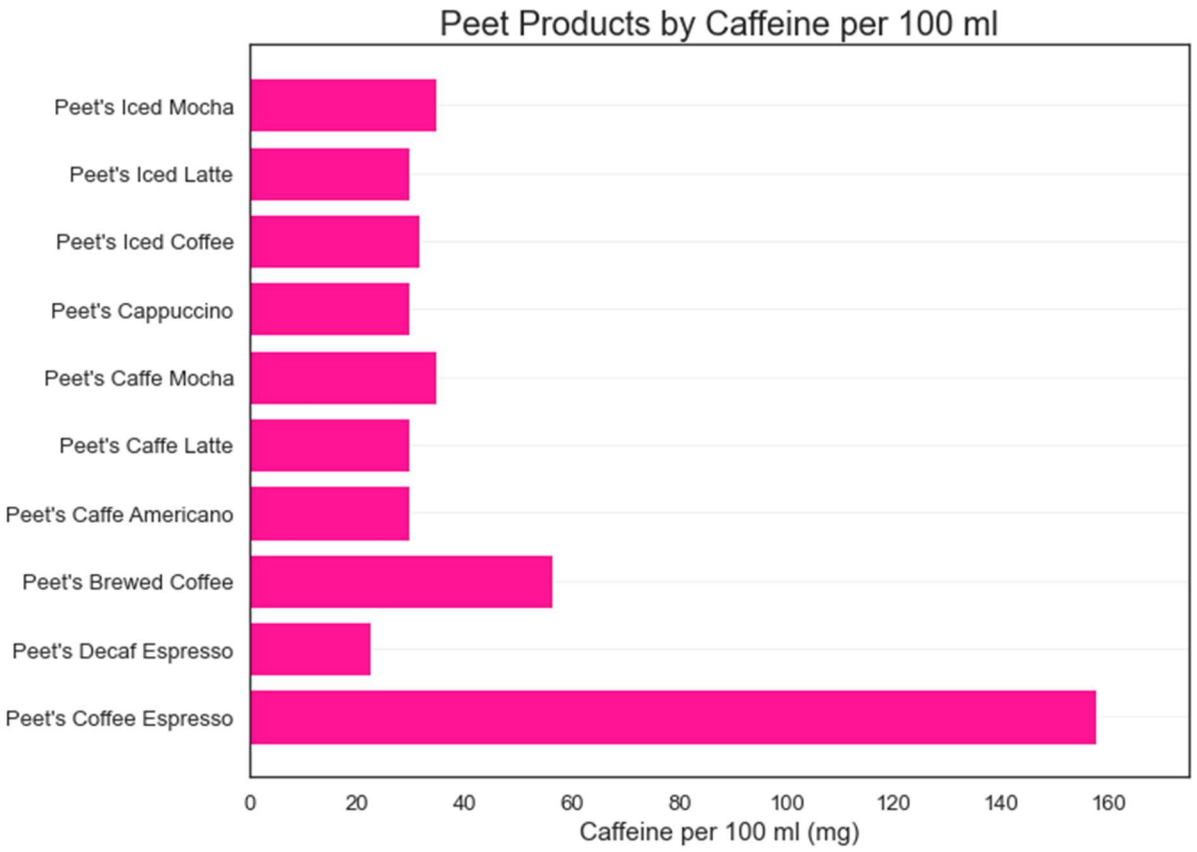
	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
49	Peet's Brewed Coffee	473.17600	5	267	Coffee	56.427207	1.056689	Peets
52	Peet's Caffe Mocha	473.17600	390	165	Coffee	34.870746	82.421763	Peets
56	Peet's Iced Mocha	473.17600	310	165	Coffee	34.870746	65.514734	Peets
54	Peet's Iced Coffee	473.17600	0	150	Coffee	31.700678	0.000000	Peets
50	Peet's Caffe Americano	473.17600	10	140	Coffee	29.587299	2.113379	Peets
51	Peet's Caffe Latte	473.17600	190	140	Coffee	29.587299	40.154192	Peets
53	Peet's Cappuccino	473.17600	140	140	Coffee	29.587299	29.587299	Peets
55	Peet's Iced Latte	473.17600	120	140	Coffee	29.587299	25.360542	Peets
24	Peet's Coffee Espresso	44.36025	0	70	Coffee	157.798930	0.000000	Peets
25	Peet's Decaf Espresso	44.36025	0	10	Coffee	22.542704	0.000000	Peets

In [35]:
```
df2peet_sorted2=df2peet.sort_values(by="Caffeine_per_100ml", ascending = False)
df2peet_sorted2
```

Out[35]:

	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
24	Peet's Coffee Espresso	44.36025	0	70	Coffee	157.798930	0.000000	Peets
49	Peet's Brewed Coffee	473.17600	5	267	Coffee	56.427207	1.056689	Peets
52	Peet's Caffe Mocha	473.17600	390	165	Coffee	34.870746	82.421763	Peets
56	Peet's Iced Mocha	473.17600	310	165	Coffee	34.870746	65.514734	Peets
54	Peet's Iced Coffee	473.17600	0	150	Coffee	31.700678	0.000000	Peets
50	Peet's Caffe Americano	473.17600	10	140	Coffee	29.587299	2.113379	Peets
51	Peet's Caffe Latte	473.17600	190	140	Coffee	29.587299	40.154192	Peets
53	Peet's Cappuccino	473.17600	140	140	Coffee	29.587299	29.587299	Peets
55	Peet's Iced Latte	473.17600	120	140	Coffee	29.587299	25.360542	Peets
25	Peet's Decaf Espresso	44.36025	0	10	Coffee	22.542704	0.000000	Peets


Peet Products by Caffeine
Peet's Iced Mocha
Peet's Iced Latte
Peet's Iced Coffee
Peet's Cappuccino
Peet's Caffe Mocha
Peet's Caffe Latte
Peet's Caffe Americano
Peet's Brewed Coffee
Peet's Decaf Espresso
Peet's Coffee Espresso
0
50
100
150
200
250
300
Caffeine (mg)


Peet Products by Caffeine per 100 ml
Peet's Iced Mocha
Peet's Iced Latte
Peet's Iced Coffee
Peet's Cappuccino
Peet's Caffe Mocha
Peet's Caffe Latte
Peet's Caffe Americano
Peet's Brewed Coffee
Peet's Decaf Espresso
Peet's Coffee Espresso
0
20
40
60
80
100
120
140
160
Caffeine per 100 ml (mg)

Among the 27 Starbucks products we analyzed, The Bottled Iced Coffee has 640 mg of caffeine in its 48 fl oz bottle, the highest level among other Starbucks products. It exceeds the recommended 400 mg per day for healthy young adults by the Food and Drug Administration (FDA). However, when it comes to the caffeine density per 100 ml (3 fl oz), Starbucks 2x Coffee Pod ranks number 1, containing 110 mg of caffeine per 100 ml, the highest among the products, and 1.5 times higher than the second drink, Canned Nitro Brew at 72mg. Most Starbucks products stay from 25 mg to 50 mg per 100 ml, and the bottom four drinks have the lowest caffeine level of less than 15mg per 100ml, including Refreshers Canned, Refreshers, Pink Drink, and Decaf Coffee.

37]:
```
#Sort Starbucks drink by Caffeine content

df2starbucks_sorted1=df2starbucks.sort_values(by="Caffeine (mg)", ascending=False)
df2starbucks_sorted1
```

Out[37]:

	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
29	Starbucks Bottled Iced Coffee	1419.52800	240	640	Coffee	45.085409	16.907028	Starbucks
64	Starbucks Grande Coffee	473.17600	5	310	Coffee	65.514734	1.056689	Starbucks
66	Starbucks Nitro Cold Brew Coffee	473.17600	5	280	Coffee	59.174599	1.056689	Starbucks
151	Starbucks 2X Coffee Pods	236.58800	0	260	Coffee	109.895684	0.000000	Starbucks
107	Starbucks Canned Nitro Cold Brew	325.30850	0	235	Coffee	72.239121	0.000000	Starbucks
65	Starbucks Iced Americano	473.17600	15	225	Coffee	47.551017	3.170068	Starbucks
329	Starbucks Triple Shot Energy	443.60250	210	225	Energy Drinks	50.721085	47.339679	Starbucks
60	Starbucks Grande Caffe Americano	473.17600	15	225	Coffee	47.551017	3.170068	Starbucks
58	Starbucks Cold Brew Coffee	473.17600	5	205	Coffee	43.324260	1.056689	Starbucks
68	Starbucks Pumpkin Cream Cold Brew	473.17600	250	185	Coffee	39.097503	52.834463	Starbucks
106	Starbucks Bottled Cold Brew	325.30850	50	180	Coffee	55.332092	15.370026	Starbucks
62	Starbucks Grande Caffe Mocha	473.17600	370	175	Coffee	36.984124	78.195006	Starbucks
152	Starbucks Cordusio Mocha	236.58800	130	155	Coffee	65.514734	54.947842	Starbucks
63	Starbucks Grande Cappuccino	473.17600	140	150	Coffee	31.700678	29.587299	Starbucks
61	Starbucks Grande Caffe Latte	473.17600	190	150	Coffee	31.700678	40.154192	Starbucks
57	Starbucks Caramel Macchiato	473.17600	250	150	Coffee	31.700678	52.834463	Starbucks
154	Starbucks Via Ready Brew	236.58800	0	135	Coffee	57.061220	0.000000	Starbucks
72	Starbucks Doubleshot Energy	443.60250	220	135	Coffee	30.432651	49.593950	Starbucks
108	Starbucks Cold & Crafted	325.30850	50	135	Coffee	41.499069	15.370026	Starbucks
98	Starbucks Iced Espresso Classics	354.88200	190	125	Coffee	35.222976	53.538923	Starbucks
8	Starbucks Doubleshot Espresso	192.22775	140	120	Coffee	62.425950	72.830276	Starbucks
16	Starbucks Bottled Frappuccino	405.15695	300	110	Coffee	27.149972	74.045379	Starbucks
153	Starbucks Verismo Coffee Pods	236.58800	0	60	Coffee	25.360542	0.000000	Starbucks
508	Starbucks Refreshers Canned	354.88200	90	50	Soft Drinks	14.089190	25.360542	Starbucks
69	Starbucks Refreshers	473.17600	70	45	Coffee	9.510203	14.793650	Starbucks
67	Starbucks Pink Drink	473.17600	140	45	Coffee	9.510203	29.587299	Starbucks
59	Starbucks Decaf Coffee	473.17600	0	25	Coffee	5.283446	0.000000	Starbucks

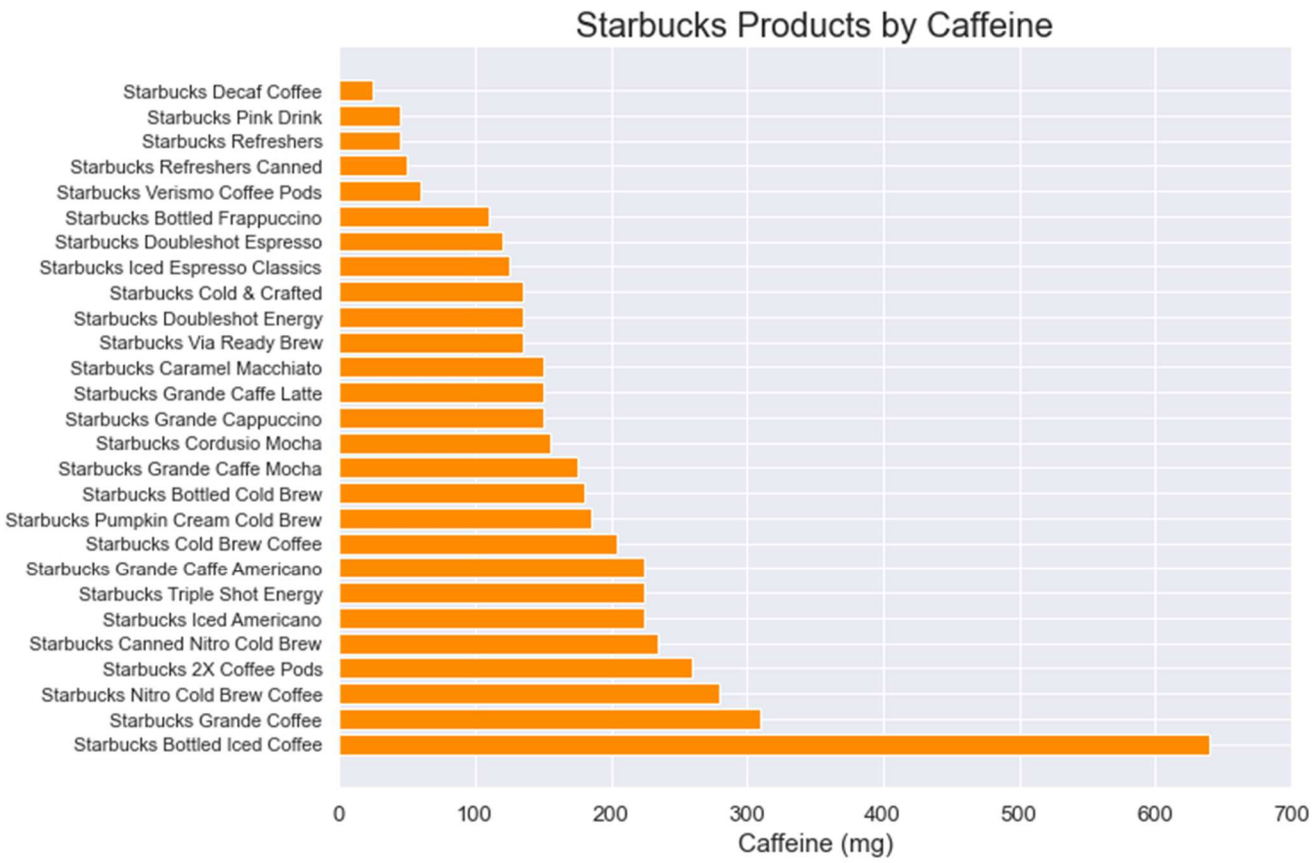
In [39]:

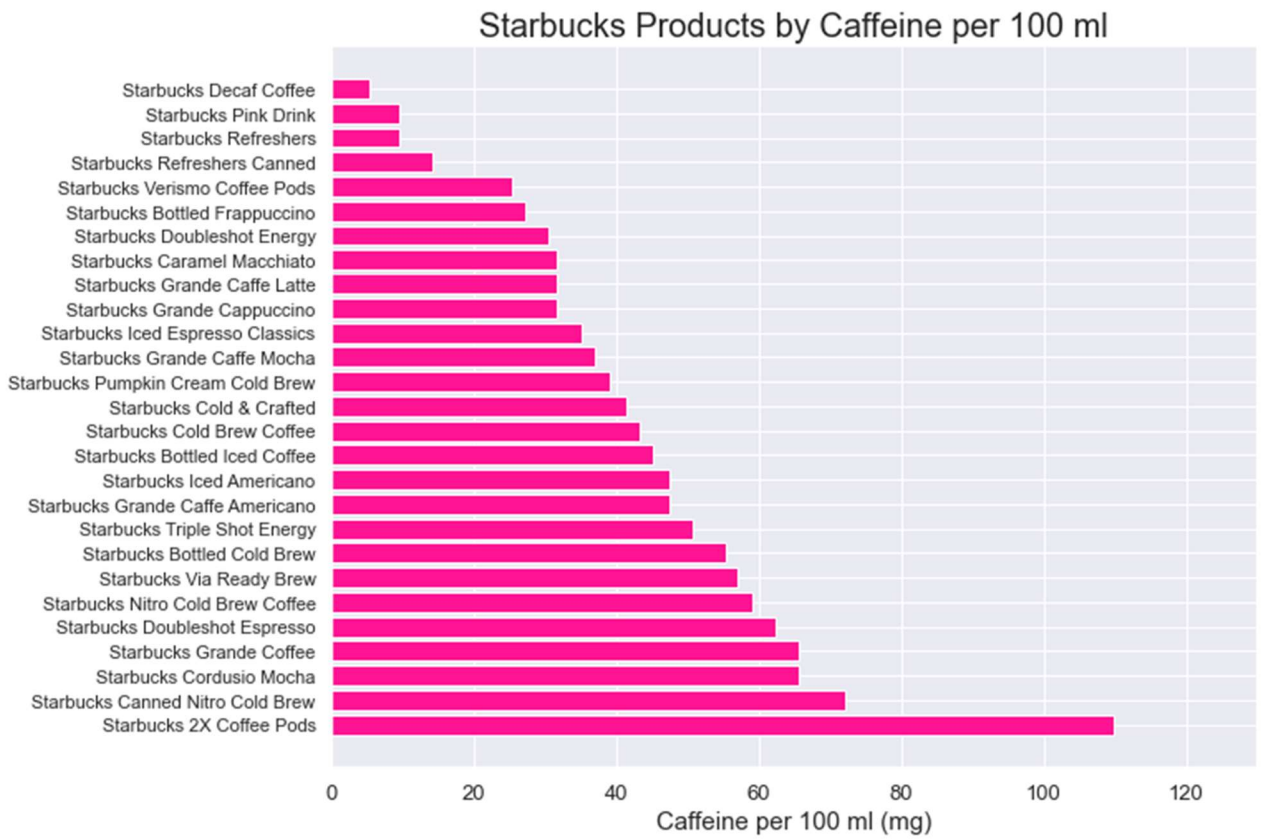
```
#Sort Starbucks drink by Caffeine density (Caffeine per 100 ml)

df2starbucks_sorted2=df2starbucks.sort_values(by="Caffeine_per_100ml", ascending=False)
df2starbucks_sorted2
```

Out[39]:

	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
151	Starbucks 2X Coffee Pods	236.58800	0	260	Coffee	109.895684	0.000000	Starbucks
107	Starbucks Canned Nitro Cold Brew	325.30850	0	235	Coffee	72.239121	0.000000	Starbucks
152	Starbucks Cordusio Mocha	236.58800	130	155	Coffee	65.514734	54.947842	Starbucks
64	Starbucks Grande Coffee	473.17600	5	310	Coffee	65.514734	1.056689	Starbucks
8	Starbucks Doubleshot Espresso	192.22775	140	120	Coffee	62.425950	72.830276	Starbucks
66	Starbucks Nitro Cold Brew Coffee	473.17600	5	280	Coffee	59.174599	1.056689	Starbucks
154	Starbucks Via Ready Brew	236.58800	0	135	Coffee	57.061220	0.000000	Starbucks
106	Starbucks Bottled Cold Brew	325.30850	50	180	Coffee	55.332092	15.370026	Starbucks
329	Starbucks Triple Shot Energy	443.60250	210	225	Energy Drinks	50.721085	47.339679	Starbucks
60	Starbucks Grande Caffe Americano	473.17600	15	225	Coffee	47.551017	3.170068	Starbucks
65	Starbucks Iced Americano	473.17600	15	225	Coffee	47.551017	3.170068	Starbucks
29	Starbucks Bottled Iced Coffee	1419.52800	240	640	Coffee	45.085409	16.907028	Starbucks
58	Starbucks Cold Brew Coffee	473.17600	5	205	Coffee	43.324260	1.056689	Starbucks
108	Starbucks Cold & Crafted	325.30850	50	135	Coffee	41.499069	15.370026	Starbucks
68	Starbucks Pumpkin Cream Cold Brew	473.17600	250	185	Coffee	39.097503	52.834463	Starbucks
62	Starbucks Grande Caffe Mocha	473.17600	370	175	Coffee	36.984124	78.195006	Starbucks
98	Starbucks Iced Espresso Classics	354.88200	190	125	Coffee	35.222976	53.538923	Starbucks
63	Starbucks Grande Cappuccino	473.17600	140	150	Coffee	31.700678	29.587299	Starbucks
61	Starbucks Grande Caffe Latte	473.17600	190	150	Coffee	31.700678	40.154192	Starbucks
57	Starbucks Caramel Macchiato	473.17600	250	150	Coffee	31.700678	52.834463	Starbucks
72	Starbucks Doubleshot Energy	443.60250	220	135	Coffee	30.432651	49.593950	Starbucks
16	Starbucks Bottled Frappuccino	405.15695	300	110	Coffee	27.149972	74.045379	Starbucks
153	Starbucks Verismo Coffee Pods	236.58800	0	60	Coffee	25.360542	0.000000	Starbucks
508	Starbucks Refreshers Canned	354.88200	90	50	Soft Drinks	14.089190	25.360542	Starbucks
69	Starbucks Refreshers	473.17600	70	45	Coffee	9.510203	14.793650	Starbucks
67	Starbucks Pink Drink	473.17600	140	45	Coffee	9.510203	29.587299	Starbucks
59	Starbucks Decaf Coffee	473.17600	0	25	Coffee	5.283446	0.000000	Starbucks


Starbucks Products by Caffeine
Starbucks Decaf Coffee
Starbucks Pink Drink
Starbucks Refreshers
Starbucks Refreshers Canned
Starbucks Verismo Coffee Pods
Starbucks Bottled Frappuccino
Starbucks Doubleshot Espresso
Starbucks Iced Espresso Classics
Starbucks Cold & Crafted
Starbucks Doubleshot Energy
Starbucks Via Ready Brew
Starbucks Caramel Macchiato
Starbucks Grande Caffe Latte
Starbucks Grande Cappuccino
Starbucks Cordusio Mocha
Starbucks Grande Caffe Mocha
Starbucks Bottled Cold Brew
Starbucks Pumpkin Cream Cold Brew
Starbucks Cold Brew Coffee
Starbucks Grande Caffe Americano
Starbucks Triple Shot Energy
Starbucks Iced Americano
Starbucks Canned Nitro Cold Brew
Starbucks 2X Coffee Pods
Starbucks Nitro Cold Brew Coffee
Starbucks Grande Coffee
Starbucks Bottled Iced Coffee
0
100
200
300
400
500
600
700
Caffeine (mg)


Starbucks Products by Caffeine per 100 ml
Starbucks Decaf Coffee
Starbucks Pink Drink
Starbucks Refreshers
Starbucks Refreshers Canned
Starbucks Verismo Coffee Pods
Starbucks Bottled Frappuccino
Starbucks Doubleshot Energy
Starbucks Caramel Macchiato
Starbucks Grande Caffe Latte
Starbucks Grande Cappuccino
Starbucks Iced Espresso Classics
Starbucks Grande Caffe Mocha
Starbucks Pumpkin Cream Cold Brew
Starbucks Cold & Crafted
Starbucks Cold Brew Coffee
Starbucks Bottled Iced Coffee
Starbucks Iced Americano
Starbucks Grande Caffe Americano
Starbucks Triple Shot Energy
Starbucks Bottled Cold Brew
Starbucks Via Ready Brew
Starbucks Nitro Cold Brew Coffee
Starbucks Doubleshot Espresso
Starbucks Grande Coffee
Starbucks Cordusio Mocha
Starbucks Canned Nitro Cold Brew
Starbucks 2X Coffee Pods
0
20
40
60
80
100
120
Caffeine per 100 ml (mg)

Looking at the 10 Dunkin' drinks, we noticed that caffeine levels vary from 63mg to 297 mg. The top four with the highest caffeine content have at least 210mg per drink, led by Iced Coffee. The next group is in the range of 100mg to 200mg. Iced Tea has the least caffeine, which makes sense compared to coffee drinks. And the Extra Charge Coffee has the highest caffeine density at 60mg per 100ml. Per the Dunkin' company, Extra Charged Coffee packs 20% more caffeine than classic Hot and Iced Coffee. The extra caffeine is extracted from the coffee bean before the roasting process to keep the same flavor for the product. The second and the third are Dunkin' Shot in Dark and Brewed Coffee at 56 and 51mg, respectively. Others stay lower than 50mg per 100 ml.

In [45]:
```
df2dunkin_sorted2=df2dunkin.sort_values(by="Caffeine_per_100ml", ascending = False)
df2dunkin_sorted2
```

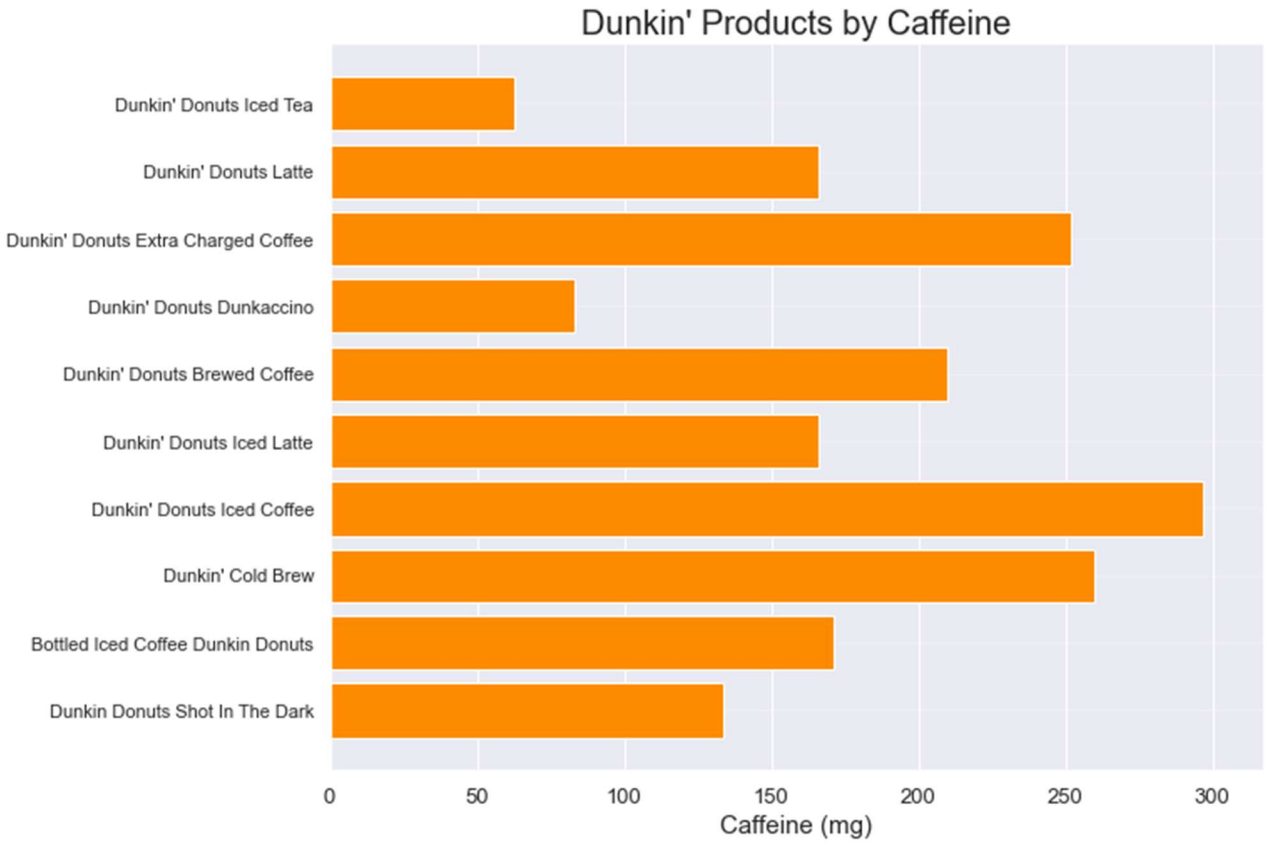
Out[45]:

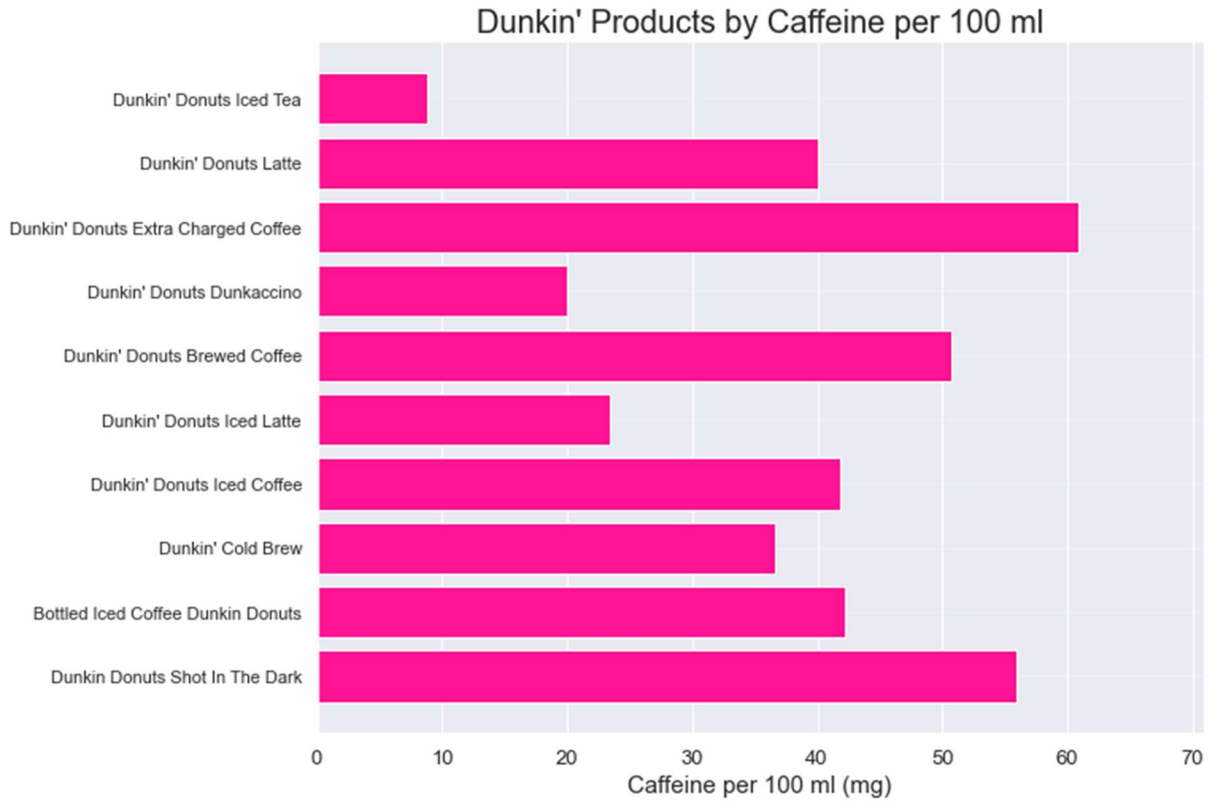
	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
78	Dunkin' Donuts Extra Charged Coffee	414.02900	10	252	Coffee	60.865302	2.415290	Dunkin
6	Dunkin Donuts Shot In The Dark	239.54535	80	134	Coffee	55.939303	33.396599	Dunkin
76	Dunkin' Donuts Brewed Coffee	414.02900	5	210	Coffee	50.721085	1.207645	Dunkin
15	Bottled Iced Coffee Dunkin Donuts	405.15695	260	171	Coffee	42.205866	64.172662	Dunkin
32	Dunkin' Donuts Iced Coffee	709.76400	20	297	Coffee	41.844895	2.817838	Dunkin
79	Dunkin' Donuts Latte	414.02900	100	166	Coffee	40.093810	24.152898	Dunkin
31	Dunkin' Cold Brew	709.76400	5	260	Coffee	36.631895	0.704460	Dunkin
33	Dunkin' Donuts Iced Latte	709.76400	100	166	Coffee	23.388056	14.089190	Dunkin
77	Dunkin' Donuts Dunkaccino	414.02900	350	83	Coffee	20.046905	84.535141	Dunkin
531	Dunkin' Donuts Iced Tea	709.76400	230	63	Tea	8.876190	32.405137	Dunkin

In [68]:
```
df2dunkin_sorted1=df2dunkin.sort_values(by="Caffeine (mg)", ascending = False)
df2dunkin_sorted1
```

Out[68]:

	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
32	Dunkin' Donuts Iced Coffee	709.76400	20	297	Coffee	41.844895	2.817838	Dunkin
31	Dunkin' Cold Brew	709.76400	5	260	Coffee	36.631895	0.704460	Dunkin
78	Dunkin' Donuts Extra Charged Coffee	414.02900	10	252	Coffee	60.865302	2.415290	Dunkin
76	Dunkin' Donuts Brewed Coffee	414.02900	5	210	Coffee	50.721085	1.207645	Dunkin
15	Bottled Iced Coffee Dunkin Donuts	405.15695	260	171	Coffee	42.205866	64.172662	Dunkin
33	Dunkin' Donuts Iced Latte	709.76400	100	166	Coffee	23.388056	14.089190	Dunkin
79	Dunkin' Donuts Latte	414.02900	100	166	Coffee	40.093810	24.152898	Dunkin
6	Dunkin Donuts Shot In The Dark	239.54535	80	134	Coffee	55.939303	33.396599	Dunkin
77	Dunkin' Donuts Dunkaccino	414.02900	350	83	Coffee	20.046905	84.535141	Dunkin
531	Dunkin' Donuts Iced Tea	709.76400	230	63	Tea	8.876190	32.405137	Dunkin


Dunkin' Products by Caffeine
Dunkin' Donuts Iced Tea
Dunkin' Donuts Latte
Dunkin' Donuts Extra Charged Coffee
Dunkin' Donuts Dunkaccino
Dunkin' Donuts Brewed Coffee
Dunkin' Donuts Iced Latte
Dunkin' Donuts Iced Coffee
Dunkin' Cold Brew
Bottled Iced Coffee Dunkin Donuts
Dunkin Donuts Shot In The Dark
0
50
100
150
200
250
300
Caffeine (mg)


Dunkin' Products by Caffeine per 100 ml
Dunkin' Donuts Iced Tea
Dunkin' Donuts Latte
Dunkin' Donuts Extra Charged Coffee
Dunkin' Donuts Dunkaccino
Dunkin' Donuts Brewed Coffee
Dunkin' Donuts Iced Latte
Dunkin' Donuts Iced Coffee
Dunkin' Cold Brew
Bottled Iced Coffee Dunkin Donuts
Dunkin Donuts Shot In The Dark
0
10
20
30
40
50
60
70
Caffeine per 100 ml (mg)

As demonstrated below, among the 21 items we analyzed from Monster, Java Monster 300 appears to contain the same “Energy Brand” as regular Monster. But the coffee extract adds approximately 40 mg of caffeine, making Java Monster the most caffeinated drink among the products in the sample, followed by Mega Monster Energy Drink at 240 mg, Monster Max, and Java Monster at 200mg. Most Monster drinks contain more than 130mg of caffeine but stay below 200mg. At the same time, Java Monster 300also has the highest caffeine content at 67mg per 100ml. A big Monster group remains at 100ml; the lowest is at 25mg.

```
In [53]:
1 df2monster_sorted2=df2monster.sort_values (by="Caffeine_per_100ml",ascending= False)
2 df2monster_sorted2
```

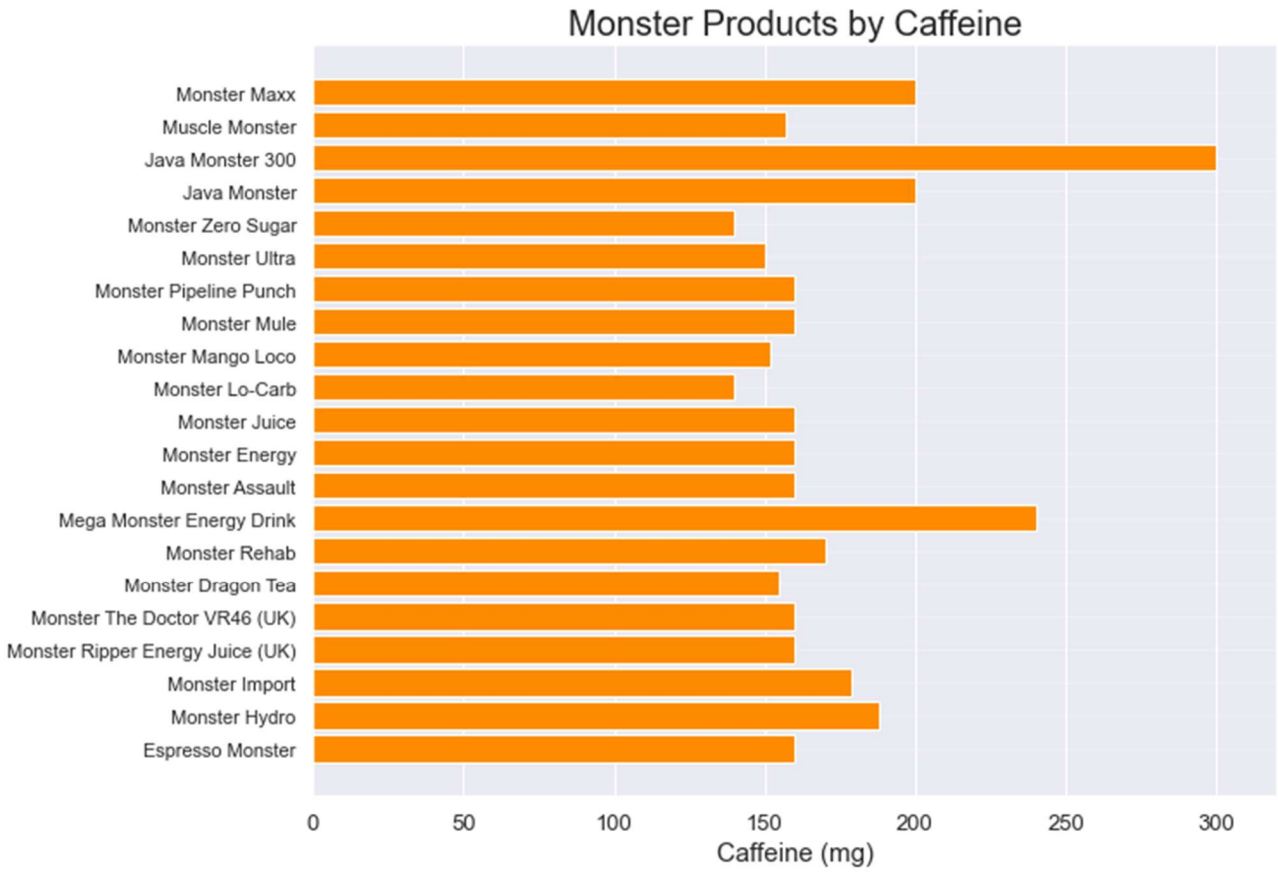
Out[53]:

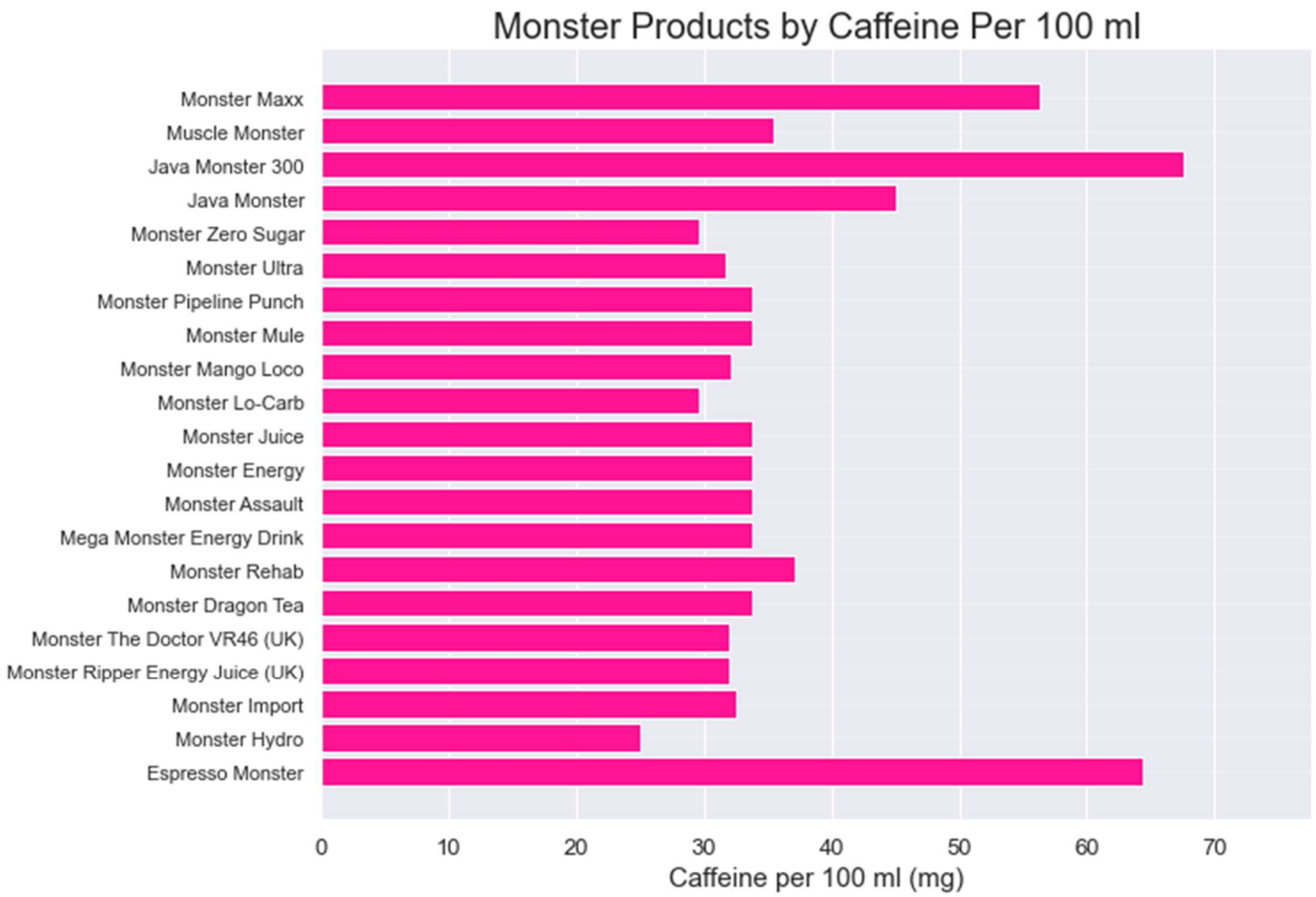
	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
18	Java Monster 300	443.602500	200	300	Energy Drinks	67.628113	45.085409	Monster
0	Espresso Monster	248.417400	170	160	Coffee	64.407727	68.433210	Monster
20	Monster Maxx	354.882000	160	200	Energy Drinks	56.356761	45.085409	Monster
17	Java Monster	443.602500	220	200	Energy Drinks	45.085409	49.593950	Monster
6	Monster Rehab	458.389250	25	170	Energy Drinks	37.086385	5.453880	Monster
19	Muscle Monster	443.602500	180	157	Energy Drinks	35.392046	40.576868	Monster
10	Monster Juice	473.176000	160	160	Energy Drinks	33.814057	33.814057	Monster
14	Monster Pipeline Punch	473.176000	190	160	Energy Drinks	33.814057	40.154192	Monster
8	Monster Assault	473.176000	210	160	Energy Drinks	33.814057	44.380949	Monster
9	Monster Energy	473.176000	210	160	Energy Drinks	33.814057	44.380949	Monster
13	Monster Mule	473.176000	210	160	Energy Drinks	33.814057	44.380949	Monster
5	Monster Dragon Tea	458.389250	40	155	Energy Drinks	33.814057	8.726208	Monster
7	Mega Monster Energy Drink	709.764000	320	240	Energy Drinks	33.814057	45.085409	Monster
2	Monster Import	550.067100	190	179	Energy Drinks	32.541484	34.541241	Monster
12	Monster Mango Loco	473.176000	240	152	Energy Drinks	32.123354	50.721085	Monster
4	Monster The Doctor VR46 (UK)	500.087885	219	160	Energy Drinks	31.994376	43.792303	Monster
3	Monster Ripper Energy Juice (UK)	500.087885	185	160	Energy Drinks	31.994376	36.993498	Monster
15	Monster Ultra	473.176000	10	150	Energy Drinks	31.700678	2.113379	Monster
16	Monster Zero Sugar	473.176000	10	140	Energy Drinks	29.587299	2.113379	Monster
11	Monster Lo-Carb	473.176000	30	140	Energy Drinks	29.587299	6.340136	Monster
1	Monster Hydro	751.166900	150	188	Energy Drinks	25.027727	19.968931	Monster

In [52]:
```
df2monster_sorted1=df2monster.sort_values (by="Caffeine (mg)",ascending= False)
df2monster_sorted1
```

Out[52]:

	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
18	Java Monster 300	443.602500	200	300	Energy Drinks	67.628113	45.085409	Monster
7	Mega Monster Energy Drink	709.764000	320	240	Energy Drinks	33.814057	45.085409	Monster
20	Monster Maxx	354.882000	160	200	Energy Drinks	56.356761	45.085409	Monster
17	Java Monster	443.602500	220	200	Energy Drinks	45.085409	49.593950	Monster
1	Monster Hydro	751.166900	150	188	Energy Drinks	25.027727	19.968931	Monster
2	Monster Import	550.067100	190	179	Energy Drinks	32.541484	34.541241	Monster
6	Monster Rehab	458.389250	25	170	Energy Drinks	37.086385	5.453880	Monster
14	Monster Pipeline Punch	473.176000	190	160	Energy Drinks	33.814057	40.154192	Monster
13	Monster Mule	473.176000	210	160	Energy Drinks	33.814057	44.380949	Monster
0	Espresso Monster	248.417400	170	160	Coffee	64.407727	68.433210	Monster
9	Monster Energy	473.176000	210	160	Energy Drinks	33.814057	44.380949	Monster
8	Monster Assault	473.176000	210	160	Energy Drinks	33.814057	44.380949	Monster
4	Monster The Doctor VR46 (UK)	500.087885	219	160	Energy Drinks	31.994376	43.792303	Monster
3	Monster Ripper Energy Juice (UK)	500.087885	185	160	Energy Drinks	31.994376	36.993498	Monster
10	Monster Juice	473.176000	160	160	Energy Drinks	33.814057	33.814057	Monster
19	Muscle Monster	443.602500	180	157	Energy Drinks	35.392046	40.576868	Monster
5	Monster Dragon Tea	458.389250	40	155	Energy Drinks	33.814057	8.726208	Monster
12	Monster Mango Loco	473.176000	240	152	Energy Drinks	32.123354	50.721085	Monster
15	Monster Ultra	473.176000	10	150	Energy Drinks	31.700678	2.113379	Monster
11	Monster Lo-Carb	473.176000	30	140	Energy Drinks	29.587299	6.340136	Monster
16	Monster Zero Sugar	473.176000	10	140	Energy Drinks	29.587299	2.113379	Monster





The last brand we performed an analysis on was Coca-Cola. Among all the 11 Coca-Cola drinks in this sample, Coca-Cola Energy has the most caffeine content at 114 mg per 354ml (12fl oz) drink, followed by Coca-Cola With Coffee at 69mg. Others stay at 34mg except for the Coca-Cola Caffeine free which does not contain caffeine. This is 3 to 5 times less than coffee. With the same can size at 355ml, Coca-Cola Energy has the highest caffeine level per 100 ml at 32mg, followed by Coca-Cola With Coffee with 19 mg per 100ml. Others are at 10 mg.

In [49]:
```
df2coca_cola_sorted1=df2coca_cola.sort_values(by="Caffeine (mg)", ascending= False)
df2coca_cola_sorted1
```

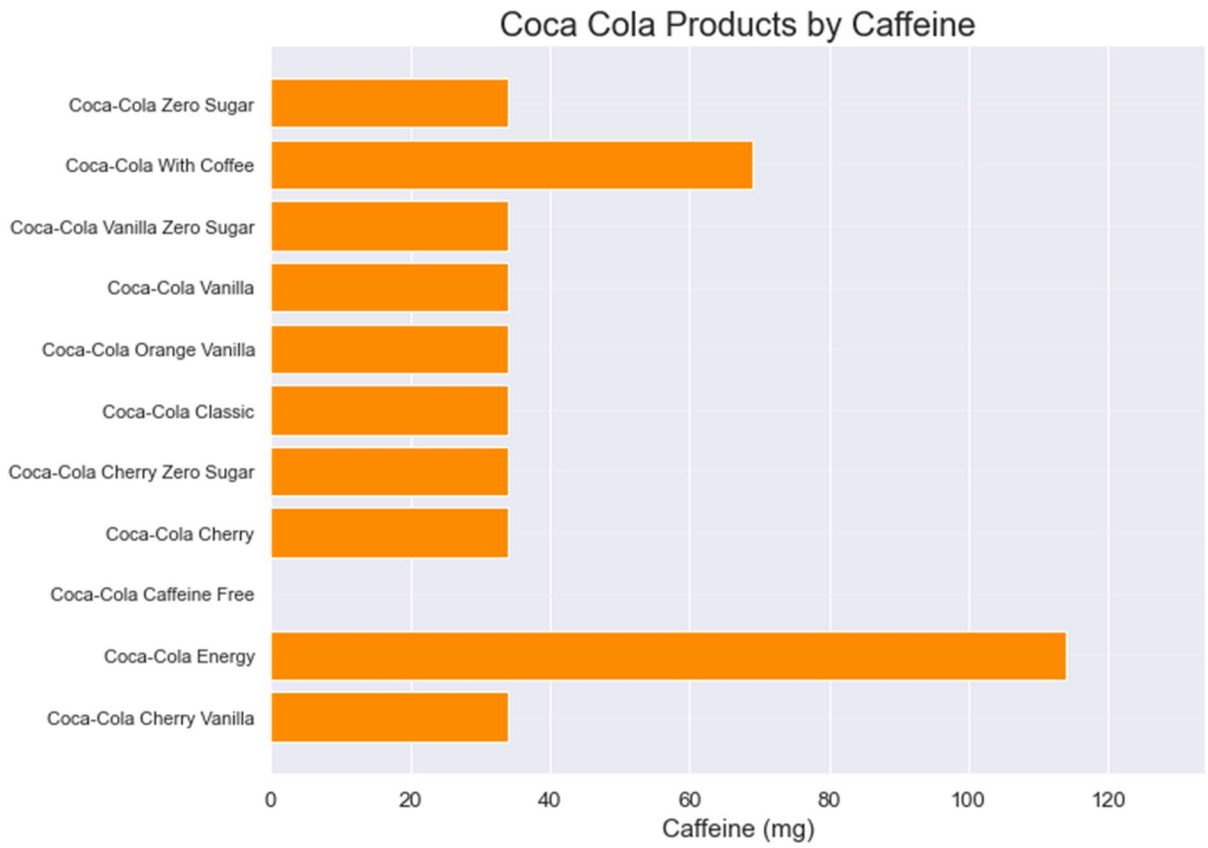
Out[49]:

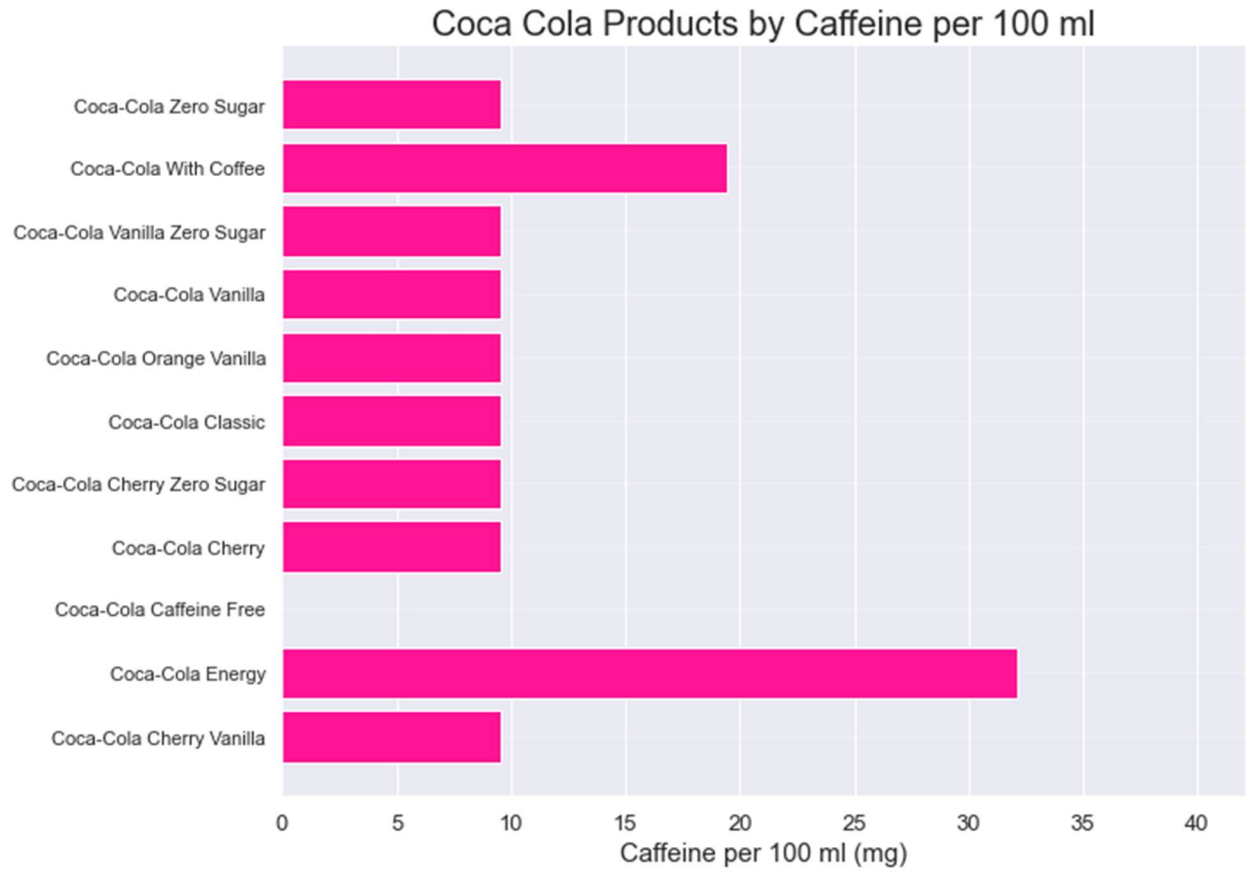
	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
1	Coca-Cola Energy	354.882	140	114	Energy Drinks	32.123354	39.449733	Coca_Cola
9	Coca-Cola With Coffee	354.882	70	69	Soft Drinks	19.443082	19.724866	Coca_Cola
0	Coca-Cola Cherry Vanilla	354.882	140	34	Energy Drinks	9.580649	39.449733	Coca_Cola
3	Coca-Cola Cherry	354.882	150	34	Soft Drinks	9.580649	42.267571	Coca_Cola
4	Coca-Cola Cherry Zero Sugar	354.882	0	34	Soft Drinks	9.580649	0.000000	Coca_Cola
5	Coca-Cola Classic	354.882	140	34	Soft Drinks	9.580649	39.449733	Coca_Cola
6	Coca-Cola Orange Vanilla	354.882	140	34	Soft Drinks	9.580649	39.449733	Coca_Cola
7	Coca-Cola Vanilla	354.882	150	34	Soft Drinks	9.580649	42.267571	Coca_Cola
8	Coca-Cola Vanilla Zero Sugar	354.882	0	34	Soft Drinks	9.580649	0.000000	Coca_Cola
10	Coca-Cola Zero Sugar	354.882	0	34	Soft Drinks	9.580649	0.000000	Coca_Cola
2	Coca-Cola Caffeine Free	354.882	140	0	Soft Drinks	0.000000	39.449733	Coca_Cola

In [50]:
```
df2coca_cola_sorted2=df2coca_cola.sort_values(by="Caffeine_per_100ml", ascending= False)
df2coca_cola_sorted2
```

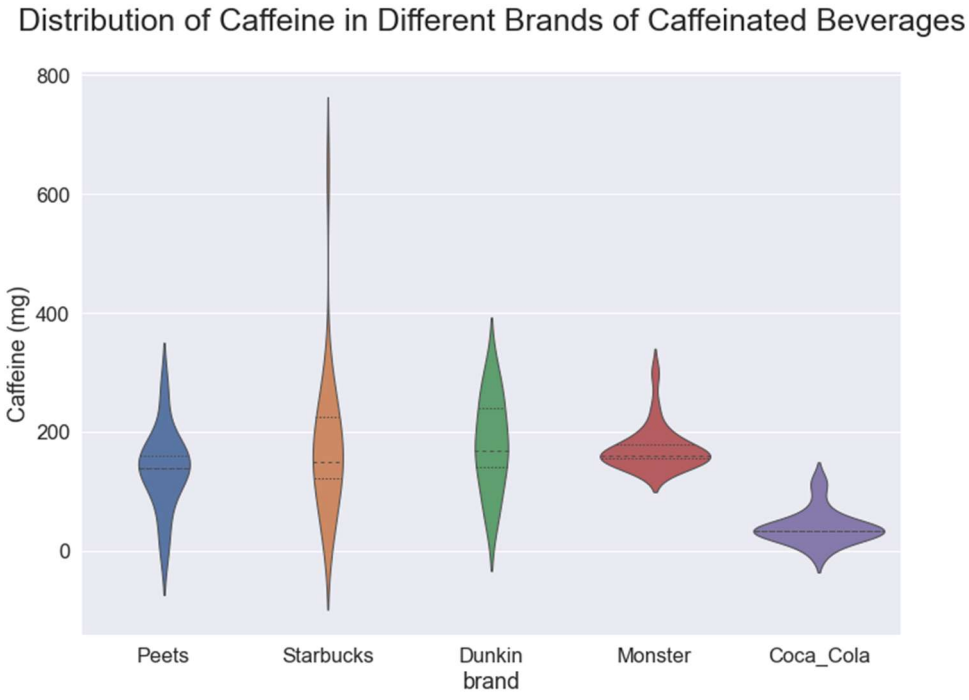
Out[50]:

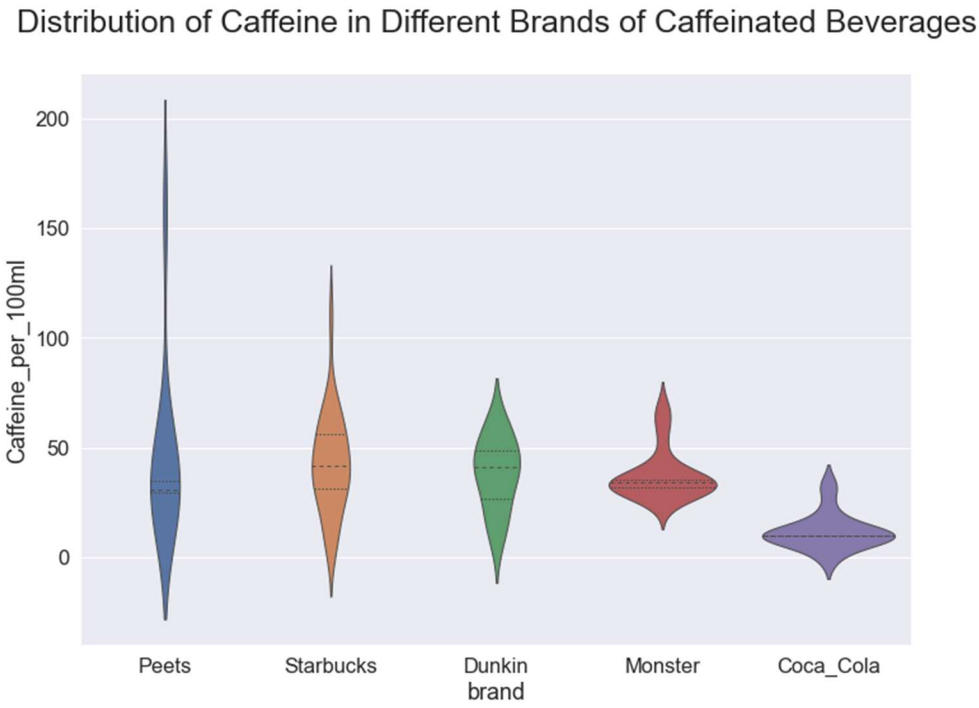
	drink	Volume (ml)	Calories	Caffeine (mg)	type	Caffeine_per_100ml	Calories_per_100ml	brand
1	Coca-Cola Energy	354.882	140	114	Energy Drinks	32.123354	39.449733	Coca_Cola
9	Coca-Cola With Coffee	354.882	70	69	Soft Drinks	19.443082	19.724866	Coca_Cola
0	Coca-Cola Cherry Vanilla	354.882	140	34	Energy Drinks	9.580649	39.449733	Coca_Cola
3	Coca-Cola Cherry	354.882	150	34	Soft Drinks	9.580649	42.267571	Coca_Cola
4	Coca-Cola Cherry Zero Sugar	354.882	0	34	Soft Drinks	9.580649	0.000000	Coca_Cola
5	Coca-Cola Classic	354.882	140	34	Soft Drinks	9.580649	39.449733	Coca_Cola
6	Coca-Cola Orange Vanilla	354.882	140	34	Soft Drinks	9.580649	39.449733	Coca_Cola
7	Coca-Cola Vanilla	354.882	150	34	Soft Drinks	9.580649	42.267571	Coca_Cola
8	Coca-Cola Vanilla Zero Sugar	354.882	0	34	Soft Drinks	9.580649	0.000000	Coca_Cola
10	Coca-Cola Zero Sugar	354.882	0	34	Soft Drinks	9.580649	0.000000	Coca_Cola
2	Coca-Cola Caffeine Free	354.882	140	0	Soft Drinks	0.000000	39.449733	Coca_Cola


Coca Cola Products by Caffeine
Coca-Cola Zero Sugar
Coca-Cola With Coffee
Coca-Cola Vanilla Zero Sugar
Coca-Cola Vanilla
Coca-Cola Orange Vanilla
Coca-Cola Classic
Coca-Cola Cherry Zero Sugar
Coca-Cola Cherry
Coca-Cola Caffeine Free
Coca-Cola Energy
Coca-Cola Cherry Vanilla
0
20
40
60
80
100
120
Caffeine (mg)


Coca Cola Products by Caffeine per 100 ml
Coca-Cola Zero Sugar
Coca-Cola With Coffee
Coca-Cola Vanilla Zero Sugar
Coca-Cola Vanilla
Coca-Cola Orange Vanilla
Coca-Cola Classic
Coca-Cola Cherry Zero Sugar
Coca-Cola Cherry
Coca-Cola Caffeine Free
Coca-Cola Energy
Coca-Cola Cherry Vanilla
0
5
10
15
20
25
30
35
40
Caffeine per 100 ml (mg)

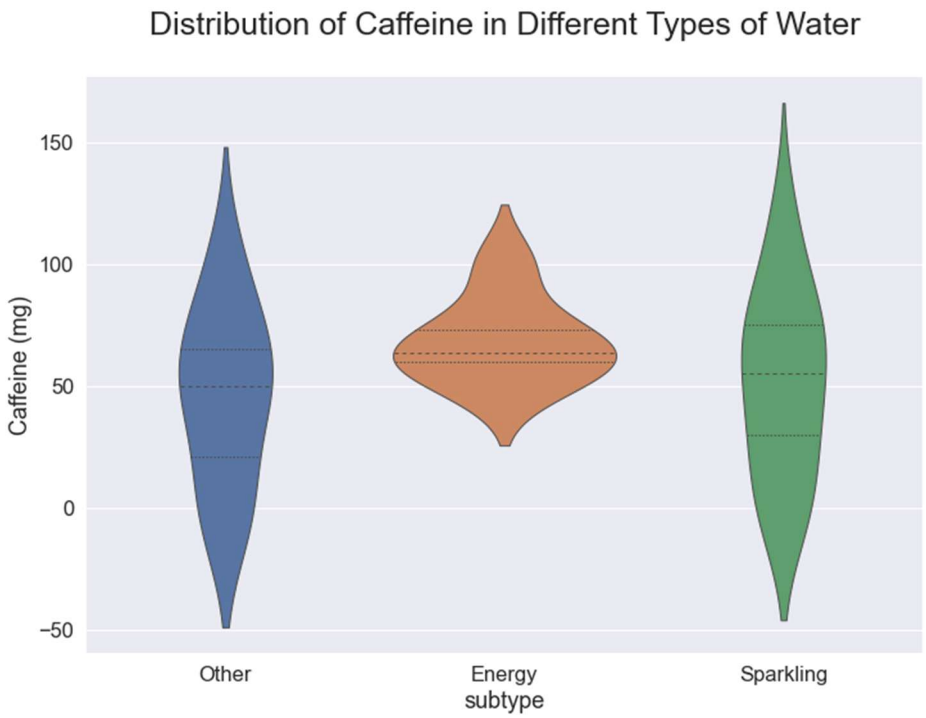
In order to have an overall review of how the products of the 5 brands compare with each other, we put all the 79 drinks data on the same violin plot as below.

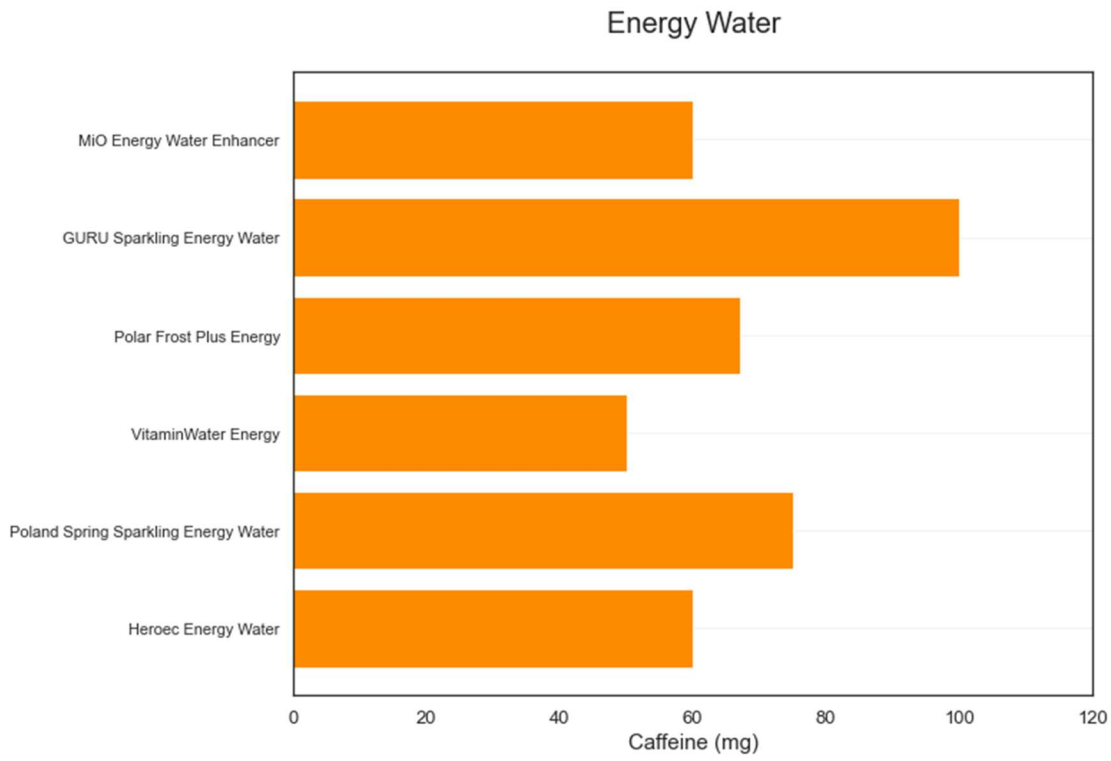


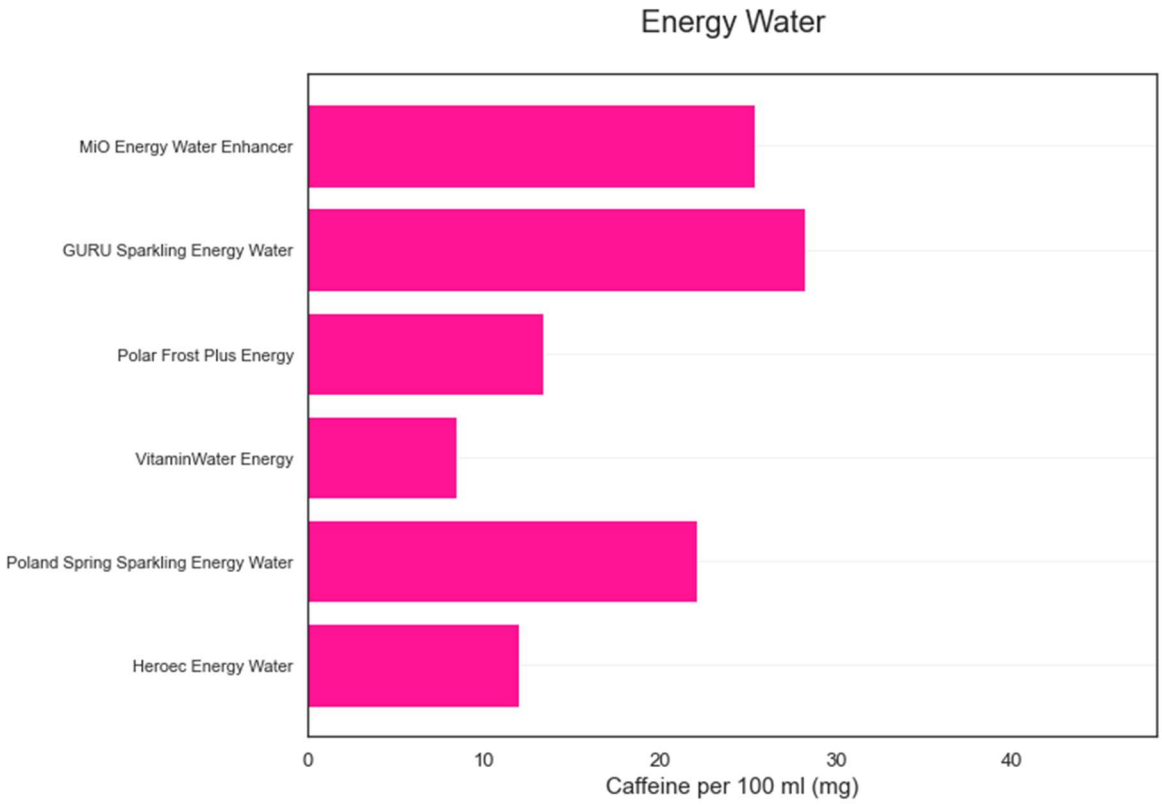


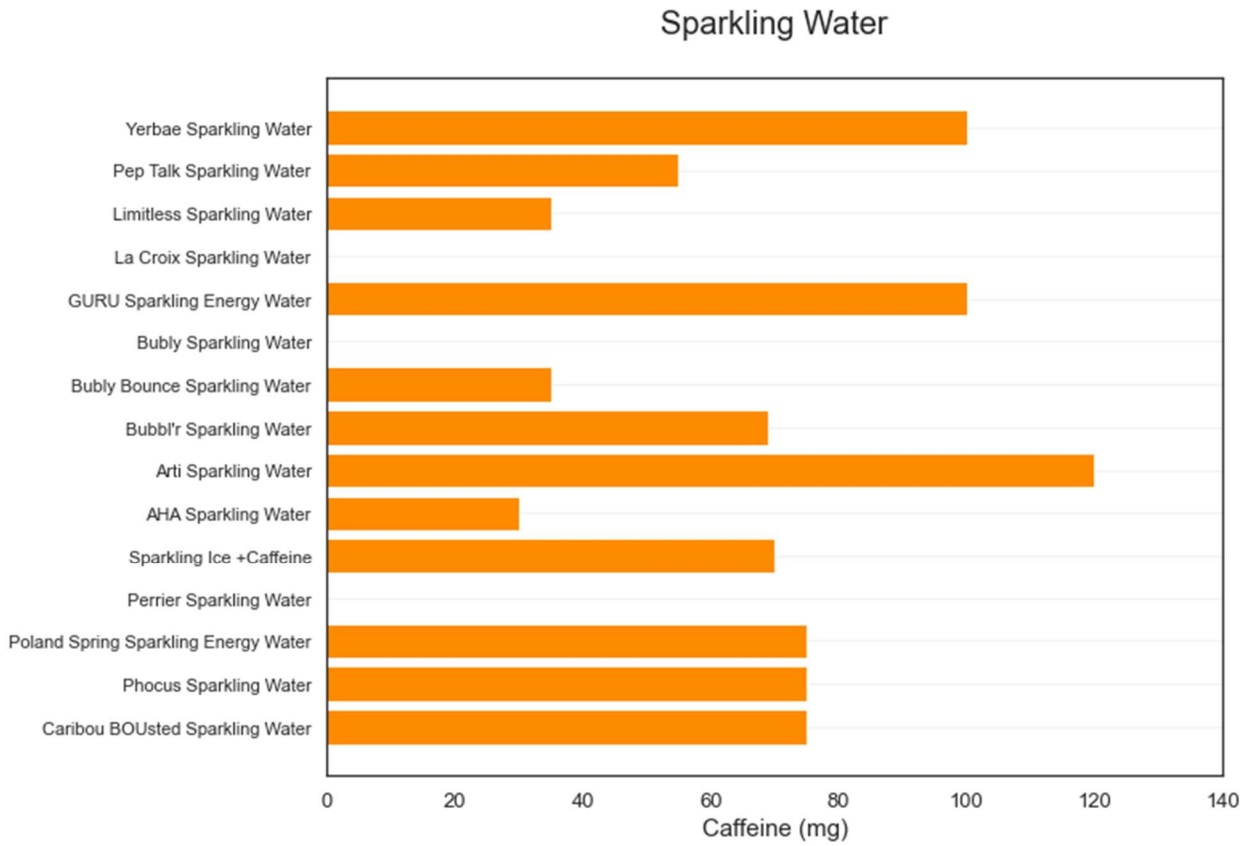
Peets, Starbucks, and Dunkin have much more elongated distribution than the other two groups, and Starbucks has the most extended spine with the Bottled Iced Coffee at 640 ml. In other words, we observed coffee brands (Peets, Starbucks, and Dunkin) have broader caffeine distribution compared to soft drinks (Coca-Cola) and energy drinks (Monster). If you want a strong buzz, coffee is your best bet. And the median of the Peets, Starbucks, Dunkin, and Monster are close to each other and higher than Coca-Cola, which makes sense as soft drinks tend to have less caffeine than coffee and energy drink.

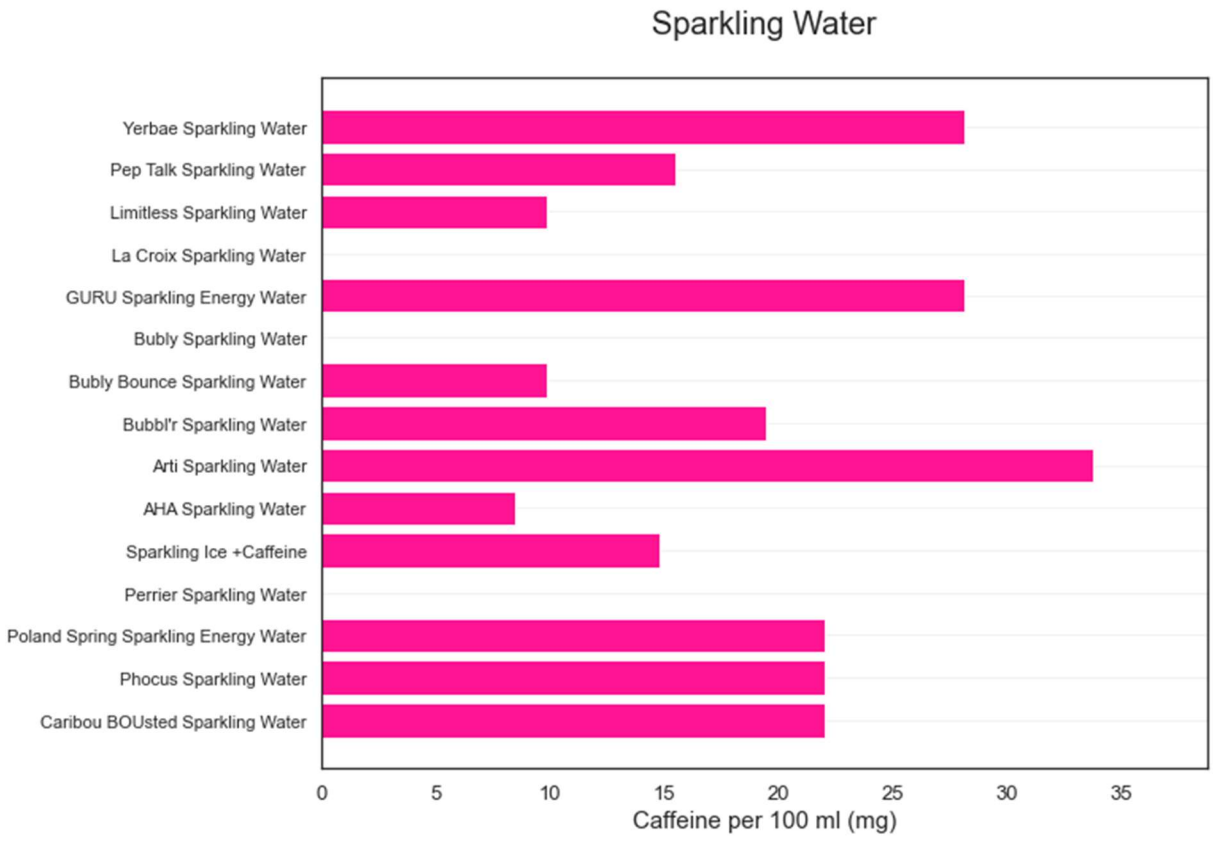
During our review, it was interesting that some types of water contain caffeine, so we decided to look further into this drink. Based on the dataset, we used the "group by" code to group off water into Energy Water, Sparkling Water, and Other types of water. It seems like Energy water contains varied caffeine levels from 50mg to 100mg per bottle, and per 100 ml, the level ranges from 8 to 28 ml, much lower than coffee, energy drink, and soft drinks. Among the sparkling water drinks, some do not have caffeine, and most have a caffeine content ranging from 30 to 120 mg per bottle. The caffeine content per 100 ml ranges from 8 to 34 mg.



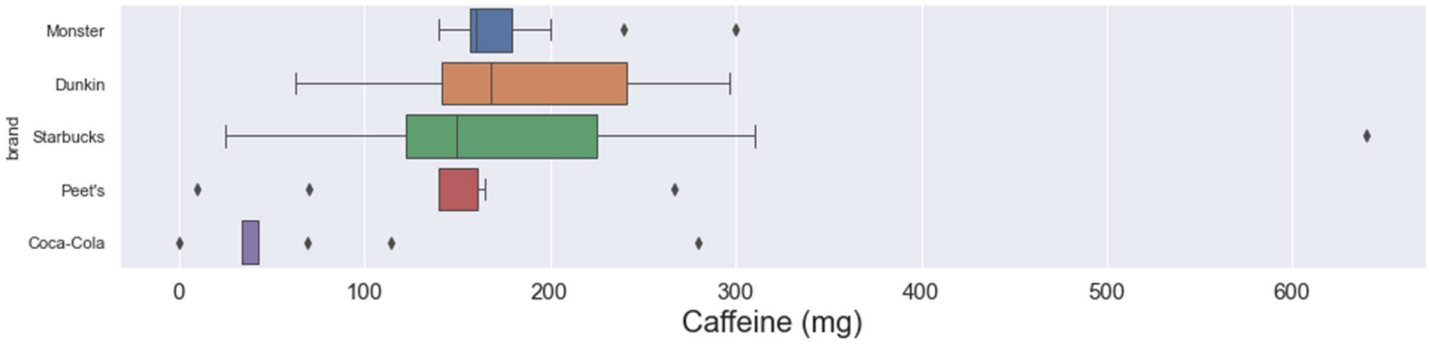

Energy Water
MiO Energy Water Enhancer
GURU Sparkling Energy Water
Polar Frost Plus Energy
VitaminWater Energy
Poland Spring Sparkling Energy Water
Heroec Energy Water
0
20
40
60
80
100
120
Caffeine (mg)


Energy Water
MiO Energy Water Enhancer
GURU Sparkling Energy Water
Polar Frost Plus Energy
VitaminWater Energy
Poland Spring Sparkling Energy Water
Heroec Energy Water
0
10
20
30
40
Caffeine per 100 ml (mg)


Sparkling Water
Yerbae Sparkling Water
Pep Talk Sparkling Water
Limitless Sparkling Water
La Croix Sparkling Water
GURU Sparkling Energy Water
Bubly Sparkling Water
Bubly Bounce Sparkling Water
Bubbl'r Sparkling Water
Arti Sparkling Water
AHA Sparkling Water
Sparkling Ice +Caffeine
Perrier Sparkling Water
Poland Spring Sparkling Energy Water
Phocus Sparkling Water
Caribou BOUsted Sparkling Water
0
20
40
60
80
100
120
140
Caffeine (mg)


Sparkling Water
Yerbae Sparkling Water
Pep Talk Sparkling Water
Limitless Sparkling Water
La Croix Sparkling Water
GURU Sparkling Energy Water
Bubly Sparkling Water
Bubly Bounce Sparkling Water
Bubbl'r Sparkling Water
Arti Sparkling Water
AHA Sparkling Water
Sparkling Ice +Caffeine
Perrier Sparkling Water
Poland Spring Sparkling Energy Water
Phocus Sparkling Water
Caribou BOUsted Sparkling Water
0
5
10
15
20
25
30
35
Caffeine per 100 ml (mg)

VII. T-Tests for Caffeine Distributions within brands: We would like to conduct a T-Test to see if the distributions of caffeine among the various brands are similar or different. First, we made boxplots of the caffeine distributions to check for outliers.



The distributions of Peet's and Coca-Cola seem rather weird, so we decided to focus on comparing Monster, Dunkin, and Starbucks. We did three T-Tests comparing the three brands to each other with the following hypotheses:

H_0: The distributions of caffeine in the sample sizes of the two brands are from the same parent distribution.

H_a: The distributions of caffeine in the sample sizes of the two brands are not from the same parent distribution.

These are the results:

T-Test Comparisons	Test Statistic	P-Value
Monster and Starbucks	-0.407	0.69
Monster and Dunkin	-0.805	0.51
Dunkin and Starbucks	-0.678	0.62

We notice that all three comparisons have a very high P-value, which means that there is no evidence to conclude that there is any difference between the distributions of caffeine among the three drink brands. This means that most major brands offer a very similar variety of caffeinated beverages when it comes to the amount of caffeine in the caffeinated drink.

VIII. CONCLUSIONS

a. The caffeinated beverage with the widest distribution of caffeine is coffee. In fact, coffees are also sold in a very wide range of calories and many different volumes.
b. The best predictor of caffeine in a caffeinated beverage is the density of caffeine (mg/100 ml). The volume of a beverage is a lousy indicator of both the amount of caffeine in the beverage and the number of calories the beverage has.
c. The distribution of caffeine in diet and regular energy drinks is the same only for coffees and soft drinks. Diet energy drinks have almost twice as much caffeine in them as regular energy drinks.
d. Based on the sample of some common brands we chose, we observed that coffee brands (Peets, Starbucks, Dunkin') have the widest caffeine distribution. This again confirms that coffee is your best option if you want many options
e. Our brand analysis shows that major brands like Monster, Starbucks, and Dunkin' have very similar distributions of caffeine once outliers have been removed. Coffees differ because they do tend to serve customers with very large caffeine needs.

IX. LIMITATIONS AND FURTHER RESEARCH

a. Our primary limitation was our data set. We have no way of knowing how the data was chosen or how comprehensive it is. None of our statistical models will be meaningful if this data set represents a small or biased sample of caffeinated beverages.
b. We don't have sales figures, so we do not know which brands or which types are the most relevant. If very few people buy energy shots or water, should we give those types of equal weight in our analyses?
c. The sample sizes for most brands were very small so we had to limit our brand analysis to a few major brands. It turns out that the caffeinated beverage market is heavily varied. Again, since we don't have sales figures, we do not know how meaningful many of the smaller brands are.

We strongly recommend obtaining a data set with sales and location data to make this analysis better.