main

February 15, 2026

1 Market Gap Analysis: Sugar Trap

[2]:
```
import pandas as pd
import matplotlib.pyplot as plt
import plotly.express as px
import seaborn as sns
import numpy as np
import re
from collections import Counter
```

1.0.1 Task 1

Data Cleaning

[3]:
```
# Bring the function to properly clean the data

def wrangle(filepath):
  df = pd.read_csv(filepath, sep="\t", low_memory=False)

  # Select the snacks
  snacks = df[df["categories_tags"].str.contains("Snack", case=False,␣
 ↪na=False)].copy()

  #drop the columns with > 20% missing
  max_drop = int(len(snacks) * 0.20)
  snacks.drop(columns=snacks.columns[snacks.isna().sum() > max_drop],␣
 ↪inplace=True)

  # drop code, url & time columns
  snacks.drop(columns=[
    "code", "url", "created_t", "created_datetime", "last_modified_t",
    "last_modified_datetime", "last_modified_by", "last_updated_t",␣
 ↪"last_updated_datetime"
], inplace=True)

  # drop duplicate country & categorie columns
```

```
snacks.drop(columns=["categories", "categories_tags", "countries",␣
↪"countries_tags", "main_category", "states", "states_tags"], inplace=True)

# drop the ingredients and serving columns
snacks.drop(columns=[ "ingredients_tags", "ingredients_analysis_tags",␣
↪"serving_size", "serving_quantity"], inplace=True)


# Replace missing product & country names with "Unknown"
snacks["product_name"]=snacks["product_name"].fillna("Unknown")
snacks["countries_en"]=snacks["countries_en"].fillna("Unknown")

# Replace nutriscore_grade's missing vale with unknown
snacks["nutriscore_grade"]=snacks["nutriscore_grade"].fillna("unknown")

# replace missing nova_group(food_processed) with the most common value (mode)
snacks["nova_group"]=snacks["nova_group"].fillna(snacks["nova_group"].
↪mode()[0])

# reomve rows with energy_kcal_100g > 900
snacks = snacks[snacks["energy-kcal_100g"] <= 900]

# reomve rows with energy_100g > 4000
snacks = snacks[snacks["energy_100g"] <= 4000]

# reomve rows with fat_100g > 100
snacks = snacks[snacks["fat_100g"] <= 100]

# Saturated Fat must be <= Total Fat
# This removes rows where the math doesn't add up
snacks = snacks[snacks["saturated-fat_100g"] <= snacks["fat_100g"]]

# reomve rows with carbohydrates_100g > 100
snacks=snacks[snacks["carbohydrates_100g"] <= 100]

# reomve rows with sugars_100g > 100
snacks=snacks[snacks["sugars_100g"] <= 100]

# reomve rows with fiber_100g > 40
snacks = snacks[snacks["fiber_100g"] <= 40]

# reomve rows with proteins_100g > 100
snacks = snacks[snacks["proteins_100g"] <= 100]

# reomve rows with salt_100g > 100
snacks= snacks[snacks["salt_100g"] <= 100]
```

```
    # reomve rows with fruits-vegetables-nuts-estimate-from-ingredients_100g > 100
    snacks = snacks[snacks["fruits-vegetables-nuts-estimate-from-ingredients_100g"] <= 100]

    # reomve rows with nutrition-score-fr_100g < -15 or > 40
    snacks = snacks[(snacks["nutrition-score-fr_100g"] >= -15) & (snacks["nutrition-score-fr_100g"] <= 40)]

    # handle na values for categoies_en for snacks and convert to lowercase
    snacks["categories_en"] = snacks["categories_en"].fillna("").str.lower()

    snacks = snacks.reset_index(drop=True)

    return snacks
```

[ ]:
```
df = wrangle("dataset/dataset_vs.csv")
df.head()
```

[ ]:

	creator	product_name	categories_en	countries_en	ingredients_text	additives_n	nutriscore_score	nutriscore_grade	nova_group	pnns_groups_1	…	fat_100g
0	openfoodfacts-contributors	Madeleines ChocoLait	snacks,sweet snacks,biscuits and cakes,cakes,c…	France	Farine de blÃ© 27%, chocolat au lait 18% (sucr…	6.0	20.0	e	4.0	Sugary snacks	…	24.0
1	openfoodfacts-contributors	Farandole de madeleine	snacks,sweet snacks,biscuits and cakes,cakes,c…	Brazil	Madeleines ChocoNoir - Madeleines nappÃ©es de …	6.0	9.0	c	4.0	Sugary snacks	…	16.7
2	openfoodfacts-contributors	Multi Patents Collagen Peptides	snacks,sweet snacks,biscuits and cakes,cakes,m…	France	Multi Collagen Complex, Hydrolyzed Bovine Coll…	0.0	-1.0	a	3.0	Sugary snacks	…	0.0
3	openfoodfacts-contributors	Peanut Brittle	snacks,sweet snacks,confectioneries	France	Sugar, glucose syrup, peanuts (30%)	0.0	22.0	e	4.0	Sugary snacks	…	3.9
4	openfoodfacts-contributors	madeleine Bijou ChocoPÃ©pites	snacks,sweet snacks,biscuits and cakes,cakes,m…	France	Farine de _blÃ©_, pÃ©pites de chocolat 18% (su…	8.0	21.0	e	4.0	Sugary snacks	…	25.0

```
  saturated-fat_100g carbohydrates_100g  sugars_100g fiber_100g  \
0               6.00                54.0        31.00        1.4
1               6.48                35.2         1.85       18.5
2               0.00                 0.0         9.09        0.0
3               2.50                72.1        51.50        1.9
4               5.00                55.0        32.00        2.5

   proteins_100g  salt_100g  sodium_100g  \
0            6.4       0.48        0.192
1           37.0       0.88        0.352
2           90.9       0.00        0.000
3            7.7       0.00        0.000
4            5.8       0.63        0.252

   fruits-vegetables-nuts-estimate-from-ingredients_100g  \
0                                          16.250000
1                                           1.750000
2                                           0.251116
3                                          30.000000
4                                           9.000000

   nutrition-score-fr_100g
0                     20.0
1                      9.0
2                     -1.0
3                     22.0
4                     21.0

[5 rows x 27 columns]
```

[5]:
```
df.isna().sum()
```

[5]:
```
creator                                                  0
product_name                                             0
categories_en                                            0
countries_en                                             0
ingredients_text                                         0
additives_n                                              0
nutriscore_score                                         0
nutriscore_grade                                         0
nova_group                                               0
pnns_groups_1                                            0
pnns_groups_2                                            0
states_en                                                0
nutrient_levels_tags                                     0
completeness                                             0
main_category_en                                         0
```

```
energy-kcal_100g                                          0
energy_100g                                               0
fat_100g                                                  0
saturated-fat_100g                                        0
carbohydrates_100g                                        0
sugars_100g                                               0
fiber_100g                                                0
proteins_100g                                             0
salt_100g                                                 0
sodium_100g                                               0
fruits-vegetables-nuts-estimate-from-ingredients_100g     0
nutrition-score-fr_100g                                   0
dtype: int64
```

[6]:
```
df.describe()
```

[6]:
```
       additives_n  nutriscore_score   nova_group  completeness  \
count  6803.000000       6803.000000  6803.000000   6803.000000
mean      3.774805         18.204763     3.708952      0.493666
std       4.381723          8.278771     0.700288      0.115646
min       0.000000        -11.000000     1.000000      0.300000
25%       1.000000         13.000000     4.000000      0.400000
50%       2.000000         19.000000     4.000000      0.500000
75%       5.000000         24.000000     4.000000      0.500000
max      33.000000         40.000000     4.000000      1.100000

       energy-kcal_100g  energy_100g     fat_100g  saturated-fat_100g  \
count       6803.000000  6803.000000  6803.000000         6803.000000
mean         421.074466  1761.450272    20.041990            6.446830
std          133.058792   556.972617    14.886777            7.260919
min            0.000000     0.000000     0.000000            0.000000
25%          360.000000  1510.000000     9.680000            1.670000
50%          440.000000  1841.000000    18.000000            4.170000
75%          500.000000  2092.000000    28.220000            8.850000
max          857.142857  3586.000000    78.570000           60.000000

       carbohydrates_100g  sugars_100g   fiber_100g  proteins_100g  \
count         6803.000000  6803.000000  6803.000000    6803.000000
mean            54.469000    25.277056     4.002548       7.677708
std             22.232529    20.671163     4.346045       7.753652
min              0.000000     0.000000     0.000000       0.000000
25%             42.480000     4.780000     0.200000       3.330000
50%             60.000000    24.140000     3.300000       6.060000
75%             70.000000    39.290000     5.710000       9.090000
max            100.000000   100.000000    40.000000      90.900000

         salt_100g  sodium_100g  \
```

```
count  6803.000000  6803.000000
mean      0.988809     0.395518
std       1.171314     0.468406
min       0.000000     0.000000
25%       0.285000     0.114000
50%       0.760000     0.304000
75%       1.250000     0.500000
max      46.300000    18.500000

       fruits-vegetables-nuts-estimate-from-ingredients_100g  \
count                                        6803.000000
mean                                           20.875597
std                                            30.886777
min                                             0.000000
25%                                             0.000000
50%                                             5.208333
75%                                            24.216380
max                                           100.000000

       nutrition-score-fr_100g
count              6803.000000
mean                 18.204763
std                   8.278771
min                 -11.000000
25%                  13.000000
50%                  19.000000
75%                  24.000000
max                  40.000000
```

[7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6803 entries, 0 to 6802
Data columns (total 27 columns):
 #   Column                                                 Non-Null Count
Dtype
---  ------                                                 --------------
-----
 0   creator                                                6803 non-null
object
 1   product_name                                           6803 non-null
object
 2   categories_en                                          6803 non-null
object
 3   countries_en                                           6803 non-null
object
 4   ingredients_text                                       6803 non-null
object
```

```
 5   additives_n                                              6803 non-null
float64
 6   nutriscore_score                                         6803 non-null
float64
 7   nutriscore_grade                                         6803 non-null
object
 8   nova_group                                               6803 non-null
float64
 9   pnns_groups_1                                            6803 non-null
object
 10  pnns_groups_2                                            6803 non-null
object
 11  states_en                                                6803 non-null
object
 12  nutrient_levels_tags                                     6803 non-null
object
 13  completeness                                             6803 non-null
float64
 14  main_category_en                                         6803 non-null
object
 15  energy-kcal_100g                                         6803 non-null
float64
 16  energy_100g                                              6803 non-null
float64
 17  fat_100g                                                 6803 non-null
float64
 18  saturated-fat_100g                                       6803 non-null
float64
 19  carbohydrates_100g                                       6803 non-null
float64
 20  sugars_100g                                              6803 non-null
float64
 21  fiber_100g                                               6803 non-null
float64
 22  proteins_100g                                            6803 non-null
float64
 23  salt_100g                                                6803 non-null
float64
 24  sodium_100g                                              6803 non-null
float64
 25  fruits-vegetables-nuts-estimate-from-ingredients_100g  6803 non-null
float64
 26  nutrition-score-fr_100g                                  6803 non-null
float64
dtypes: float64(16), object(11)
memory usage: 1.4+ MB
```

1.0.2 Task 2

Assigning Categories

[8]:
```
def assign_category(row):
    # 1. Setup search text (Combine Category + Product Name)
    # We handle missing values (NaN) by treating them as empty strings
    cat_text = str(row['categories_en']).lower() if␣
 ↪isinstance(row['categories_en'], str) else ""
    name_text = str(row['product_name']).lower() if␣
 ↪isinstance(row['product_name'], str) else ""

    # normalize hyphens and combine
    t = (cat_text + " " + name_text).replace("-", " ")


    # LEVEL 1: Non Snack / Liquid / Meals
    # beverages
    if any(x in t for x in ['beverage', 'drink', 'juice', 'soda', 'water',␣
 ↪'tea', 'coffee', 'milk', 'latte']):
        return "Beverages"

    # supplements
    if any(x in t for x in ['supplement', 'vitamin', 'protein powder',␣
 ↪'capsule', 'whey']):
        return "Supplements"

    # meals & fresh food (lunch items)
    if any(x in t for x in ['pizza', 'sandwich', 'salad', 'meal', 'quiche',␣
 ↪'burger', 'pasta', 'soup', 'noodle']):
        return "Meals & Sandwiches"


    # LEVEL 2: High Protein & Fruits
    # Meat & Seafood
    if any(x in t for x in ['jerky', 'meat', 'beef', 'pork', 'chicken', 'fish',␣
 ↪'seafood', 'salami', 'ham', 'sausage', 'tuna']):
        return "Meat & Seafood"

    # Fruit & Veggie Snacks
    if any(x in t for x in ['apple compote', 'applesauce', 'fruit based',␣
 ↪'dried fruit', 'raisin', 'prune', 'apricot', 'vegetable', 'berry',␣
 ↪'seaweed']):
        return "Fruit & Veggie Snacks"

    # Nuts & Seeds
```

```
    if any(x in t for x in ['nut', 'seed', 'pistachio', 'almond', 'cashew',␣
↪'peanut', 'pecan', 'walnut', 'hazelnut', 'trail mix']):
        return "Nuts & Seeds"

    # Dairy & Fridge
    if any(x in t for x in ['dairy', 'yogurt', 'yoghurt', 'cheese', 'pudding',␣
↪'cream', 'refrigerated', 'butter']):
        return "Dairy & Fridge"


    # LEVEL 3: Salty
    # Chips & Popcorn
    if any(x in t for x in ['popcorn', 'chip', 'crisp', 'puff', 'fries',␣
↪'tortilla', 'corn snack', 'pretzel', 'doritos', 'pringles']):
        return "Chips & Popcorn"


    # LEVEL 4: Sweet
    # Breakfast & Cereal
    if any(x in t for x in ['cereal', 'muesli', 'oatmeal', 'oat', 'flake',␣
↪'breakfast', 'granola', 'porridge']):
        return "Breakfast & Cereals"

    # Bars
    if 'bar' in t:
        return "Energy & Cereal Bars"

    # Biscuits & Cakes
    if any(x in t for x in ['biscuit', 'cookie', 'cake', 'wafer', 'pastry',␣
↪'pie', 'tart', 'brownie', 'muffin', 'doughnut', 'waffle', 'macaron',␣
↪'madeleine', 'croissant']):
        return "Biscuits & Cakes"

    # Chocolates & Candies
    if any(x in t for x in ['chocolate', 'cocoa', 'candy', 'candies', 'gummi',␣
↪'gummy', 'marshmallow', 'confection', 'sweet', 'bonbon', 'jelly', 'fudge']):
        return "Chocolates & Candies"


    # LEVEL 5: The Fallbacks
    # Savory/Salty Misc
    if any(x in t for x in ['cracker', 'salty', 'salted', 'appetizer']):
        return "Savory & Salty Misc"

    # Plant-Based Misc
    if 'plant based' in t:
```

```
        return "Plant-Based Misc"

    # If it is just "Snacks" or "Other"
    return "Other Snacks"
```

[9]:
```
df['high_level_category'] = df.apply(assign_category, axis=1)

# Check the distribution
print(df['high_level_category'].value_counts())
```

```
high_level_category
Biscuits & Cakes         1142
Nuts & Seeds             1080
Chips & Popcorn           836
Beverages                 715
Chocolates & Candies      691
Fruit & Veggie Snacks     444
Other Snacks              433
Dairy & Fridge            382
Meat & Seafood            336
Meals & Sandwiches        300
Savory & Salty Misc       163
Breakfast & Cereals       162
Energy & Cereal Bars      111
Supplements                 8
Name: count, dtype: int64
```

1.0.3 Task 3

Data Visualtion of protein against suagars with high level catgories as hue

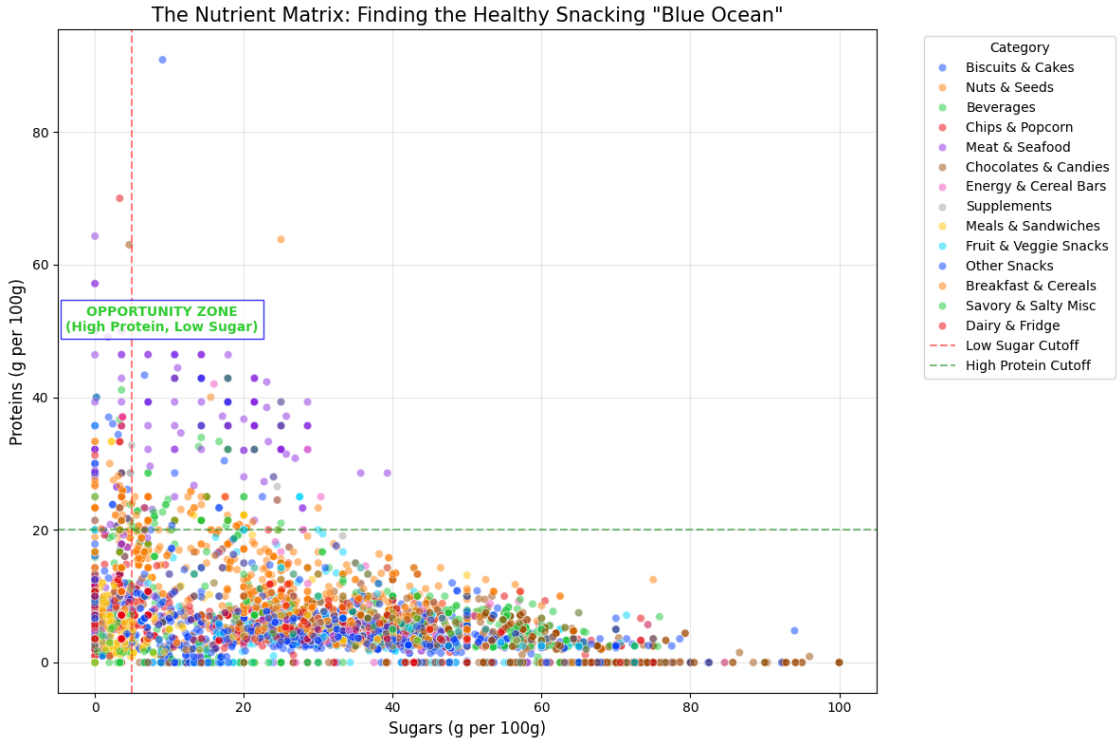
The intractive visualization can be found at here

Threshold for the quadrant

- **Sugar:** 5g per 100g is considered healthy from the NHS UK to be in a snack
- **Protein:** 20g per 100g and above considered to have High Protein according to the European Commission

[19]:
```
import matplotlib.pyplot as plt
import seaborn as sns

# get rid of outliers for better visualization
plot_df = df[
    (df['sugars_100g'] >= 0) &
    (df['sugars_100g'] <= 100) &
    (df['proteins_100g'] >= 0) &
    (df['proteins_100g'] <= 100)
].copy()
```

```
# defination of quadrants
HIGH_PROTEIN_THRESHOLD = 20  # in grams
LOW_SUGAR_THRESHOLD = 5      # in grams

# 3. Create the Plot
plt.figure(figsize=(12, 8))

# Main Scatter plot
sns.scatterplot(
    data=plot_df,
    x='sugars_100g',
    y='proteins_100g',
    hue='high_level_category',
    alpha=0.5,                  # transparency
    palette='bright'
)

# draw the Quadrant Lines
plt.axvline(x=LOW_SUGAR_THRESHOLD, color='red', linestyle='--', alpha=0.5,␣
 ↪label='Low Sugar Cutoff')
plt.axhline(y=HIGH_PROTEIN_THRESHOLD, color='green', linestyle='--', alpha=0.5,␣
 ↪label='High Protein Cutoff')

# highlight the The Opportunity Zone
# Top-Left Quadrant: Low Sugar (< 5g) AND High Protein (> 20g)
plt.text(
    x=LOW_SUGAR_THRESHOLD+8 / 2,
    y=HIGH_PROTEIN_THRESHOLD + 30,
    s="OPPORTUNITY ZONE\n(High Protein, Low Sugar)",
    color='limegreen',
    weight='bold',
    ha='center',
    bbox=dict(facecolor='white', alpha=0.8, edgecolor='blue')
)

# 6. Formatting
plt.title('The Nutrient Matrix: Finding the Healthy Snacking "Blue Ocean"',␣
 ↪fontsize=15)
plt.xlabel('Sugars (g per 100g)', fontsize=12)
plt.ylabel('Proteins (g per 100g)', fontsize=12)
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left', title="Category")
plt.grid(True, alpha=0.3)
plt.tight_layout()

plt.show()
```



[11]:
```
# Get the counts of each category in the Opportunity Zone
top_left_quandrant = plot_df[
    (plot_df['sugars_100g'] < 5) &
    (plot_df['proteins_100g'] > 20)
]
top_right_quandrant = plot_df[
    (plot_df['sugars_100g'] >= 5) &
    (plot_df['proteins_100g'] > 20)
]
bottom_left_quandrant = plot_df[
    (plot_df['sugars_100g'] < 5) &
    (plot_df['proteins_100g'] <= 20)
]
bottom_right_quandrant = plot_df[
    (plot_df['sugars_100g'] >= 5) &
    (plot_df['proteins_100g'] <= 20)
]
print("Top-Left Quadrant (Opportunity Zone) Total Count:",␣
 ↪len(top_left_quandrant))
print("Top-Right Quadrant Total Count:", len(top_right_quandrant))
print("Bottom-Left Quadrant Total Count:", len(bottom_left_quandrant))
print("Bottom-Right Quadrant Total Count:", len(bottom_right_quandrant))
```

```
Top-Left Quadrant (Opportunity Zone) Total Count: 214
```

```
Top-Right Quadrant Total Count: 284
Bottom-Left Quadrant Total Count: 1491
Bottom-Right Quadrant Total Count: 4814
```

[12]:
```
# create a "safe sugar" column to avoid dividing by zero (0 -> 0.1)
df['safe_sugar'] = df['sugars_100g'].replace(0, 0.1)

# calculate the ratio
df['protein_sugar_ratio'] = df['proteins_100g'] / df['safe_sugar']

df.head()
```

[12]:

	creator	product_name	categories_en	countries_en	ingredients_text	additives_n	nutriscore_score	nutriscore_grade	nova_group	pnns_groups_1	…	sugars_100g	fiber_100g	proteins_100g	salt_100g	sodium_100g
0	openfoodfacts-contributors	Madeleines ChocoLait	snacks,sweet snacks,biscuits and cakes,cakes,c…	France	Farine de blÃ© 27%, chocolat au lait 18% (sucr…	6.0	20.0	e	4.0	Sugary snacks	…	31.00	1.4	6.4	0.48	0.192
1	openfoodfacts-contributors	Farandole de madeleine	snacks,sweet snacks,biscuits and cakes,cakes,c…	Brazil	Madeleines ChocoNoir - Madeleines nappÃ©es de …	6.0	9.0	c	4.0	Sugary snacks	…	1.85	18.5	37.0	0.88	0.352
2	openfoodfacts-contributors	Multi Patents Collagen Peptides	snacks,sweet snacks,biscuits and cakes,cakes,m…	France	Multi Collagen Complex, Hydrolyzed Bovine Coll…	0.0	-1.0	a	3.0	Sugary snacks	…	9.09	0.0	90.9	0.00	0.000
3	openfoodfacts-contributors	Peanut Brittle	snacks,sweet snacks,confectioneries	France	Sugar, glucose syrup, peanuts (30%)	0.0	22.0	e	4.0	Sugary snacks	…	51.50	1.9	7.7	0.00	0.000
4	openfoodfacts-contributors	madeleine Bijou ChocoPÃ©pites	snacks,sweet snacks,biscuits and cakes,cakes,m…	France	Farine de _blÃ©_, pÃ©pites de chocolat 18% (su…	8.0	21.0	e	4.0	Sugary snacks	…	32.00	2.5	5.8	0.63	0.252

```
   fruits-vegetables-nuts-estimate-from-ingredients_100g  \
0                                          16.250000
1                                           1.750000
2                                           0.251116
3                                          30.000000
4                                           9.000000

   nutrition-score-fr_100g  high_level_category  safe_sugar  \
0                     20.0     Biscuits & Cakes       31.00
1                      9.0     Biscuits & Cakes        1.85
2                     -1.0     Biscuits & Cakes        9.09
3                     22.0         Nuts & Seeds       51.50
4                     21.0     Biscuits & Cakes       32.00

   protein_sugar_ratio
0             0.206452
1            20.000000
2            10.000000
3             0.149515
4             0.181250

[5 rows x 30 columns]
```

[13]:
```
df.to_csv("snacks.csv", index=False)
```

1.0.4 Task 4

Recommendation of the minimum protein and maximum sugar per 100g to be used to break into the market

[14]:
```
mask_meat_sea =df["high_level_category"] == "Meat & Seafood"

meat_protein_mean =df[mask_meat_sea]["proteins_100g"].mean()
meat_sugar_mean = df[mask_meat_sea]["sugars_100g"].mean()

print(f"Average Protein in Meat & Seafood Snacks: {meat_protein_mean:.2f} g/
  ↪100g")
print(f"Average Sugar in Meat & Seafood Snacks: {meat_sugar_mean:.2f} g/100g")
```

```
Average Protein in Meat & Seafood Snacks: 20.96 g/100g
Average Sugar in Meat & Seafood Snacks: 16.00 g/100g
```

The Recommendation

> **Based on the data, the biggest market opportunity is in Meat & Seafood, specifically targeting products with more than 37g of protein and less than 1.6g of sugar.**

[15]:
```
# Craete the "Opportunity Zone" for Meat & Seafood
# Getting the products that are already hitting the high-performance targets.

opportunity_zone = df[
    (df["high_level_category"] == "Meat & Seafood") &
    (df["proteins_100g"] > 20) &
    (df["sugars_100g"] < 5)
]

# get the average specs of these of the protein and sugar
avg_protein = opportunity_zone["proteins_100g"].mean()
avg_sugar = opportunity_zone["sugars_100g"].mean()

# print the Insight
print(f"CATEGORY: Meat & Seafood")
print(f"TARGET PROTEIN: {avg_protein:.1f}g")
print(f"TARGET SUGAR: {avg_sugar:.1f}g")
print("-" * 30)
print(f"RECOMMENDATION TEXT:")
print(f"Based on the data, the biggest market opportunity is in Meat & Seafood,␣
 ↪specifically targeting products with more than {avg_protein:.0f}g of protein␣
 ↪and less than {avg_sugar:.1f}g of sugar.")
```

```
CATEGORY: Meat & Seafood
TARGET PROTEIN: 36.7g
TARGET SUGAR: 1.6g
------------------------------
RECOMMENDATION TEXT:
Based on the data, the biggest market opportunity is in Meat & Seafood,
specifically targeting products with more than 37g of protein and less than 1.6g
of sugar.
```

1.0.5 Task 5

[16]:
```
# get list of opportunity zone ingredients
ingredients_list = opportunity_zone["ingredients_text"].to_list()

# define protein keywords
protein_map = {
    'beef': 'Beef',
    'pork': 'Pork',
    'bacon': 'Pork',
    'salami': 'Pork',
    'turkey': 'Turkey',
    'chicken': 'Chicken',
    'soy': 'Soy',
    'egg': 'Eggs',
    'cheese': 'Cheese',
```

```
    'milk': 'Cheese/Dairy',
    'whey': 'Cheese/Dairy',
    'morue': 'Fish'
}


found_ingredients = []

for text in ingredients_list:
    text = text.lower()
    #removes contents in brackets
    clean_text = re.sub(r'\([^)]*\)', '', text)

    # get unique sources in this product
    product_sources = set()
    for keyword, category in protein_map.items():
        if keyword in clean_text:
            product_sources.add(category)

    found_ingredients.extend(list(product_sources))

# count and print
counts = Counter(found_ingredients).most_common(3)

print("--- STORY 5 RESULT ---")
print("Top 3 Protein Drivers found in the text:")
for i, (source, count) in enumerate(counts, 1):
    print(f"{i}. {source} (Found in {count} products)")
```

```
--- STORY 5 RESULT ---
Top 3 Protein Drivers found in the text:
1. Beef (Found in 19 products)
2. Soy (Found in 13 products)
3. Pork (Found in 12 products)
```

1.0.6 Task 6

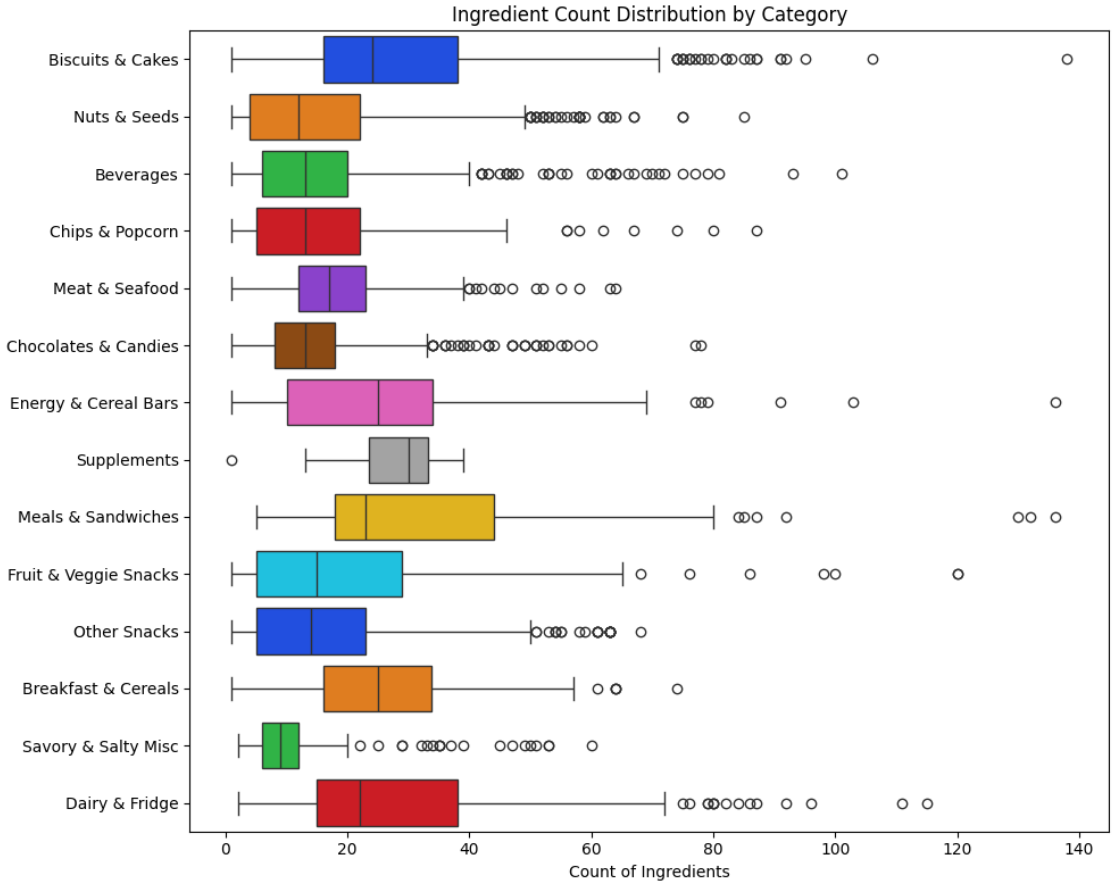
I created a new metric called **ingredient_count** to measure how processed each category is.

Key Insight: > "Meat & Seafood" products are significantly 'cleaner' than the competition, with median ~12 ingredients per package, compared to Energy Bars which median ~25 ingredients.

Why this matters: Modern health consumers are moving away from "Ultra-Processed Foods" (UPFs). By recommending a Meat/Seafood snack, we are not just selling "High Protein"; we are selling "Simple, Real Food"—a powerful marketing narrative that Energy Bar competitors cannot claim.

[17]:
```
def count_ingredients(text):
    if pd.isna(text) or text == "":
        return 0
    # split by comma to get a rough count
    return len(str(text).split(','))

# apply to the main df
df['ingredient_count'] = df['ingredients_text'].apply(count_ingredients)

# create the visualization
fig = px.box(
    df,
    x="high_level_category",
    y="ingredient_count",
    color="high_level_category",
    title="Complexity Analysis: Number of Ingredients per Category",
    labels={"ingredient_count": "Number of Ingredients (Lower is Cleaner)",␣
 ↪"high_level_category": "Category"},
    height=500
)

fig.show()
```

[23]:
```
# This is mainly done to show the chart in the pdf for some reason plotly␣
 ↪cannot be renedered on the pdf
plt.figure(figsize=(10, 8))

sns.boxplot(
    data=df,
    y="high_level_category",
    x="ingredient_count",
    palette="bright",
    hue="high_level_category",
    legend=False
)

plt.title("Ingredient Count Distribution by Category")
plt.xlabel("Count of Ingredients")
plt.ylabel("")

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


Ingredient Count Distribution by Category
Biscuits & Cakes
Nuts & Seeds
Beverages
Chips & Popcorn
Meat & Seafood
Chocolates & Candies
Energy & Cereal Bars
Supplements
Meals & Sandwiches
Fruit & Veggie Snacks
Other Snacks
Breakfast & Cereals
Savory & Salty Misc
Dairy & Fridge
0
20
40
60
80
100
120
140
Count of Ingredients