McDonald's Menu Nutritional Analysis

December 18, 2024

1 Nutritional Analysis of McDonald's Menu Items

1.0.1 Data Analysis and Visualization Report

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To start, we load the required libraries and read the dataset.

[1]:
```
# Import necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
sns.set(style="whitegrid")
plt.rcParams['figure.figsize'] = (10, 6)
```

[34]:
```
# Load the dataset
df = pd.read_csv("Nutrical Dataset.csv")
```

[35]:
```
# Display the first few rows
print("Data Preview:")
print(df.head())
```

```
Data Preview:
    Category                                 Item    Serving Size  Calories  \
0  Breakfast                  Egg McMuffin  4.8 oz (136 g)       300
1  Breakfast              Egg White Delight  4.8 oz (135 g)       250
2  Breakfast               Sausage McMuffin  3.9 oz (111 g)       370
3  Breakfast      Sausage McMuffin with Egg  5.7 oz (161 g)       450
4  Breakfast  Sausage McMuffin with Egg Whites  5.7 oz (161 g)       400

   Calories from Fat  Total Fat  Total Fat (% Daily Value)  Saturated Fat  \
0                120       13.0                         20            5.0
1                 70        8.0                         12            3.0
2                200       23.0                         35            8.0
3                250       28.0                         43           10.0
4                210       23.0                         35            8.0

   Saturated Fat (% Daily Value)  Trans Fat  …  Carbohydrates  \
```

```
0                            25        0.0  …             31
1                            15        0.0  …             30
2                            42        0.0  …             29
3                            52        0.0  …             30
4                            42        0.0  …             30

   Carbohydrates (% Daily Value)  Dietary Fiber  \
0                             10              4
1                             10              4
2                             10              4
3                             10              4
4                             10              4

   Dietary Fiber (% Daily Value)  Sugars  Protein  Vitamin A (% Daily Value)  \
0                             17       3       17                         10
1                             17       3       18                          6
2                             17       2       14                          8
3                             17       2       21                         15
4                             17       2       21                          6

   Vitamin C (% Daily Value)  Calcium (% Daily Value)  Iron (% Daily Value)
0                          0                       25                    15
1                          0                       25                     8
2                          0                       25                    10
3                          0                       30                    15
4                          0                       25                    10

[5 rows x 24 columns]
```

[10]:
```
# Basic dataset information
print("\nDataset Information:")
print(df.info())
```

```
Dataset Information:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 260 entries, 0 to 259
Data columns (total 24 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   Category                      260 non-null    object
 1   Item                          260 non-null    object
 2   Serving Size                  260 non-null    object
 3   Calories                      260 non-null    int64
 4   Calories from Fat             260 non-null    int64
 5   Total Fat                     260 non-null    float64
 6   Total Fat (% Daily Value)     260 non-null    int64
 7   Saturated Fat                 260 non-null    float64
```

```
 8   Saturated Fat (% Daily Value)  260 non-null    int64
 9   Trans Fat                      260 non-null    float64
 10  Cholesterol                    260 non-null    int64
 11  Cholesterol (% Daily Value)    260 non-null    int64
 12  Sodium                         260 non-null    int64
 13  Sodium (% Daily Value)         260 non-null    int64
 14  Carbohydrates                  260 non-null    int64
 15  Carbohydrates (% Daily Value)  260 non-null    int64
 16  Dietary Fiber                  260 non-null    int64
 17  Dietary Fiber (% Daily Value)  260 non-null    int64
 18  Sugars                         260 non-null    int64
 19  Protein                        260 non-null    int64
 20  Vitamin A (% Daily Value)      260 non-null    int64
 21  Vitamin C (% Daily Value)      260 non-null    int64
 22  Calcium (% Daily Value)        260 non-null    int64
 23  Iron (% Daily Value)           260 non-null    int64
dtypes: float64(3), int64(18), object(3)
memory usage: 48.9+ KB
None
```

[11]:
```
# Check for missing values
print("\nMissing Values Summary:")
print(df.isnull().sum())
```

```
Missing Values Summary:
Category                        0
Item                            0
Serving Size                    0
Calories                        0
Calories from Fat               0
Total Fat                       0
Total Fat (% Daily Value)       0
Saturated Fat                   0
Saturated Fat (% Daily Value)   0
Trans Fat                       0
Cholesterol                     0
Cholesterol (% Daily Value)     0
Sodium                          0
Sodium (% Daily Value)          0
Carbohydrates                   0
Carbohydrates (% Daily Value)   0
Dietary Fiber                   0
Dietary Fiber (% Daily Value)   0
Sugars                          0
Protein                         0
Vitamin A (% Daily Value)       0
Vitamin C (% Daily Value)       0
```

```
Calcium (% Daily Value)          0
Iron (% Daily Value)             0
dtype: int64
```

2. Data Preprocessing Ensure the dataset is clean for analysis.

[12]:
```
# Drop rows with missing values
df_cleaned = df.dropna()
```

[13]:
```
# Verify missing values are handled
print("\nMissing Values After Cleaning:")
print(df_cleaned.isnull().sum())
```

```
Missing Values After Cleaning:
Category                         0
Item                             0
Serving Size                     0
Calories                         0
Calories from Fat                0
Total Fat                        0
Total Fat (% Daily Value)        0
Saturated Fat                    0
Saturated Fat (% Daily Value)    0
Trans Fat                        0
Cholesterol                      0
Cholesterol (% Daily Value)      0
Sodium                           0
Sodium (% Daily Value)           0
Carbohydrates                    0
Carbohydrates (% Daily Value)    0
Dietary Fiber                    0
Dietary Fiber (% Daily Value)    0
Sugars                           0
Protein                          0
Vitamin A (% Daily Value)        0
Vitamin C (% Daily Value)        0
Calcium (% Daily Value)          0
Iron (% Daily Value)             0
dtype: int64
```

[14]:
```
# Display summary statistics
print("\nStatistical Summary:")
print(df_cleaned.describe())
```

```
Statistical Summary:
          Calories  Calories from Fat   Total Fat  Total Fat (% Daily Value)  \
count   260.000000         260.000000  260.000000                 260.000000
```

mean	368.269231	127.096154	14.165385	21.815385
std	240.269886	127.875914	14.205998	21.885199
min	0.000000	0.000000	0.000000	0.000000
25%	210.000000	20.000000	2.375000	3.750000
50%	340.000000	100.000000	11.000000	17.000000
75%	500.000000	200.000000	22.250000	35.000000
max	1880.000000	1060.000000	118.000000	182.000000

	Saturated Fat	Saturated Fat (% Daily Value)	Trans Fat	Cholesterol	\
count	260.000000	260.000000	260.000000	260.000000	
mean	6.007692	29.965385	0.203846	54.942308	
std	5.321873	26.639209	0.429133	87.269257	
min	0.000000	0.000000	0.000000	0.000000	
25%	1.000000	4.750000	0.000000	5.000000	
50%	5.000000	24.000000	0.000000	35.000000	
75%	10.000000	48.000000	0.000000	65.000000	
max	20.000000	102.000000	2.500000	575.000000	

	Cholesterol (% Daily Value)	Sodium	…	Carbohydrates	\
count	260.000000	260.000000	…	260.000000	
mean	18.392308	495.750000	…	47.346154	
std	29.091653	577.026323	…	28.252232	
min	0.000000	0.000000	…	0.000000	
25%	2.000000	107.500000	…	30.000000	
50%	11.000000	190.000000	…	44.000000	
75%	21.250000	865.000000	…	60.000000	
max	192.000000	3600.000000	…	141.000000	

	Carbohydrates (% Daily Value)	Dietary Fiber	\
count	260.000000	260.000000	
mean	15.780769	1.630769	
std	9.419544	1.567717	
min	0.000000	0.000000	
25%	10.000000	0.000000	
50%	15.000000	1.000000	
75%	20.000000	3.000000	
max	47.000000	7.000000	

	Dietary Fiber (% Daily Value)	Sugars	Protein	\
count	260.000000	260.000000	260.000000	
mean	6.530769	29.423077	13.338462	
std	6.307057	28.679797	11.426146	
min	0.000000	0.000000	0.000000	
25%	0.000000	5.750000	4.000000	
50%	5.000000	17.500000	12.000000	
75%	10.000000	48.000000	19.000000	
max	28.000000	128.000000	87.000000	

```
       Vitamin A (% Daily Value)  Vitamin C (% Daily Value)  \
count                 260.000000                 260.000000
mean                   13.426923                   8.534615
std                    24.366381                  26.345542
min                     0.000000                   0.000000
25%                     2.000000                   0.000000
50%                     8.000000                   0.000000
75%                    15.000000                   4.000000
max                   170.000000                 240.000000

       Calcium (% Daily Value)  Iron (% Daily Value)
count                260.000000            260.000000
mean                  20.973077              7.734615
std                   17.019953              8.723263
min                    0.000000              0.000000
25%                    6.000000              0.000000
50%                   20.000000              4.000000
75%                   30.000000             15.000000
max                   70.000000             40.000000

[8 rows x 21 columns]
```

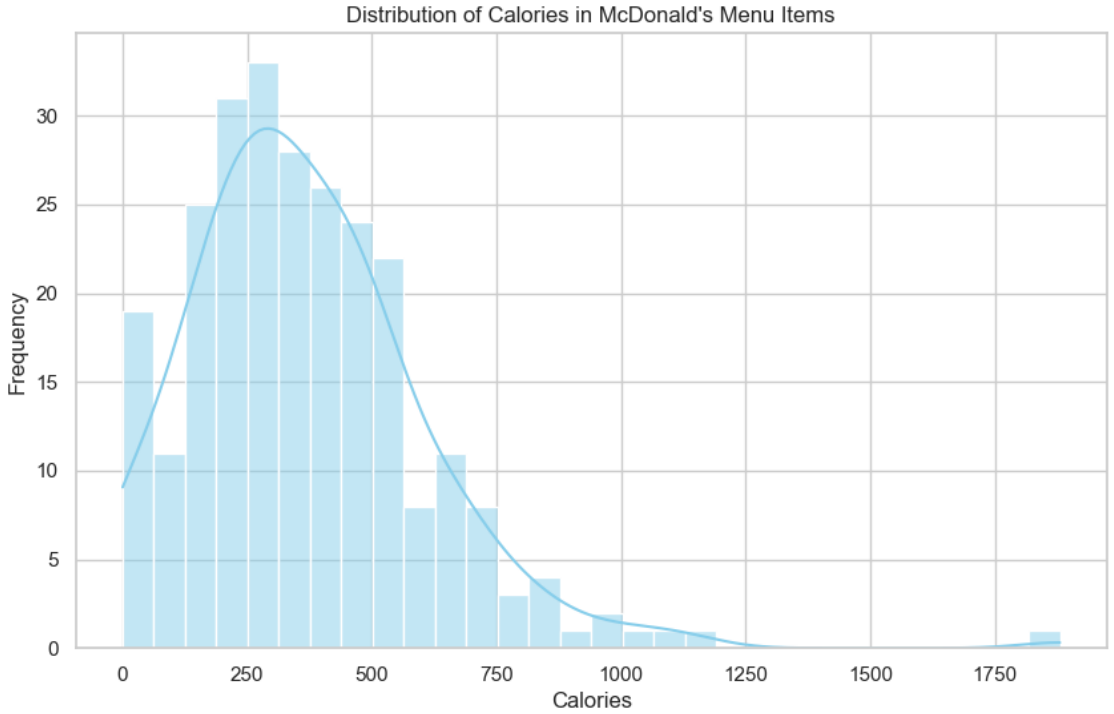
[15]:
```
# Rename columns if necessary for consistency
df_cleaned.columns = [col.strip().lower().replace(" ", "_") for col in␣
 ↪df_cleaned.columns]

print("\nRenamed Columns:")
print(df_cleaned.columns)
```

```
Renamed Columns:
Index(['category', 'item', 'serving_size', 'calories', 'calories_from_fat',
       'total_fat', 'total_fat_(%_daily_value)', 'saturated_fat',
       'saturated_fat_(%_daily_value)', 'trans_fat', 'cholesterol',
       'cholesterol_(%_daily_value)', 'sodium', 'sodium_(%_daily_value)',
       'carbohydrates', 'carbohydrates_(%_daily_value)', 'dietary_fiber',
       'dietary_fiber_(%_daily_value)', 'sugars', 'protein',
       'vitamin_a_(%_daily_value)', 'vitamin_c_(%_daily_value)',
       'calcium_(%_daily_value)', 'iron_(%_daily_value)'],
      dtype='object')
```

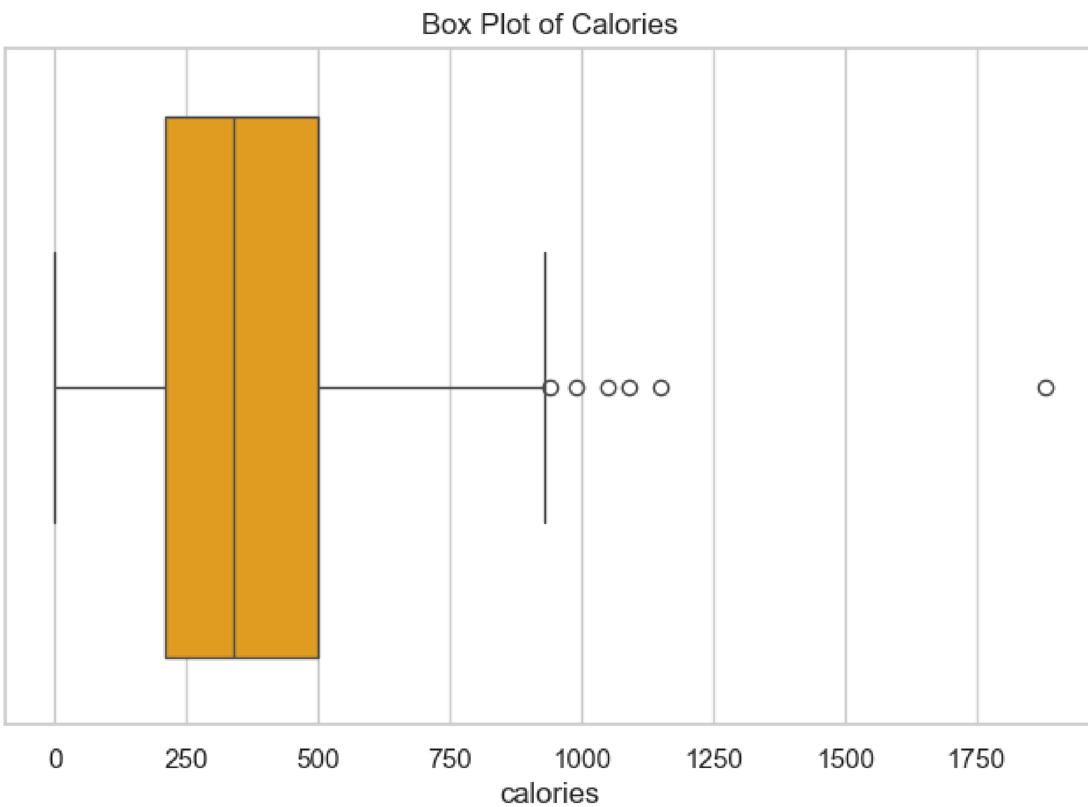
2 Exploratory Data Analysis (EDA)

2.0.1 Analyze calorie distribution, nutritional components (fat, protein, carbohydrates), and patterns.

[16]:
```
# Plot the calorie distribution
plt.figure(figsize=(10, 6))
sns.histplot(df_cleaned['calories'], kde=True, bins=30, color='skyblue')
plt.title("Distribution of Calories in McDonald's Menu Items")
plt.xlabel("Calories")
plt.ylabel("Frequency")
plt.show()
```



[17]:
```
# Boxplot to identify outliers in calories
plt.figure(figsize=(8, 5))
sns.boxplot(x=df_cleaned['calories'], color='orange')
plt.title("Box Plot of Calories")
plt.show()
```



[18]:

```
# Pairplot to compare macronutrients (calories, fat, protein, carbs)
selected_cols = ['calories', 'total_fat', 'protein', 'carbohydrates']
sns.pairplot(df_cleaned[selected_cols], diag_kind='kde', palette='muted')
plt.suptitle("Pairplot of Nutritional Content", y=1.02)
plt.show()
```

```
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1513: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=vector, **plot_kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1513: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=vector, **plot_kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1513: UserWarning: Ignoring `palette` because no
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  func(x=vector, **plot_kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1513: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
```

```
  func(x=vector, **plot_kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=x, y=y, **kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
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packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
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packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
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C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
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C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=x, y=y, **kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=x, y=y, **kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=x, y=y, **kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
  func(x=x, y=y, **kwargs)
C:\Users\vrajd\AppData\Local\Programs\Python\Python313\Lib\site-
packages\seaborn\axisgrid.py:1615: UserWarning: Ignoring `palette` because no
`hue` variable has been assigned.
```
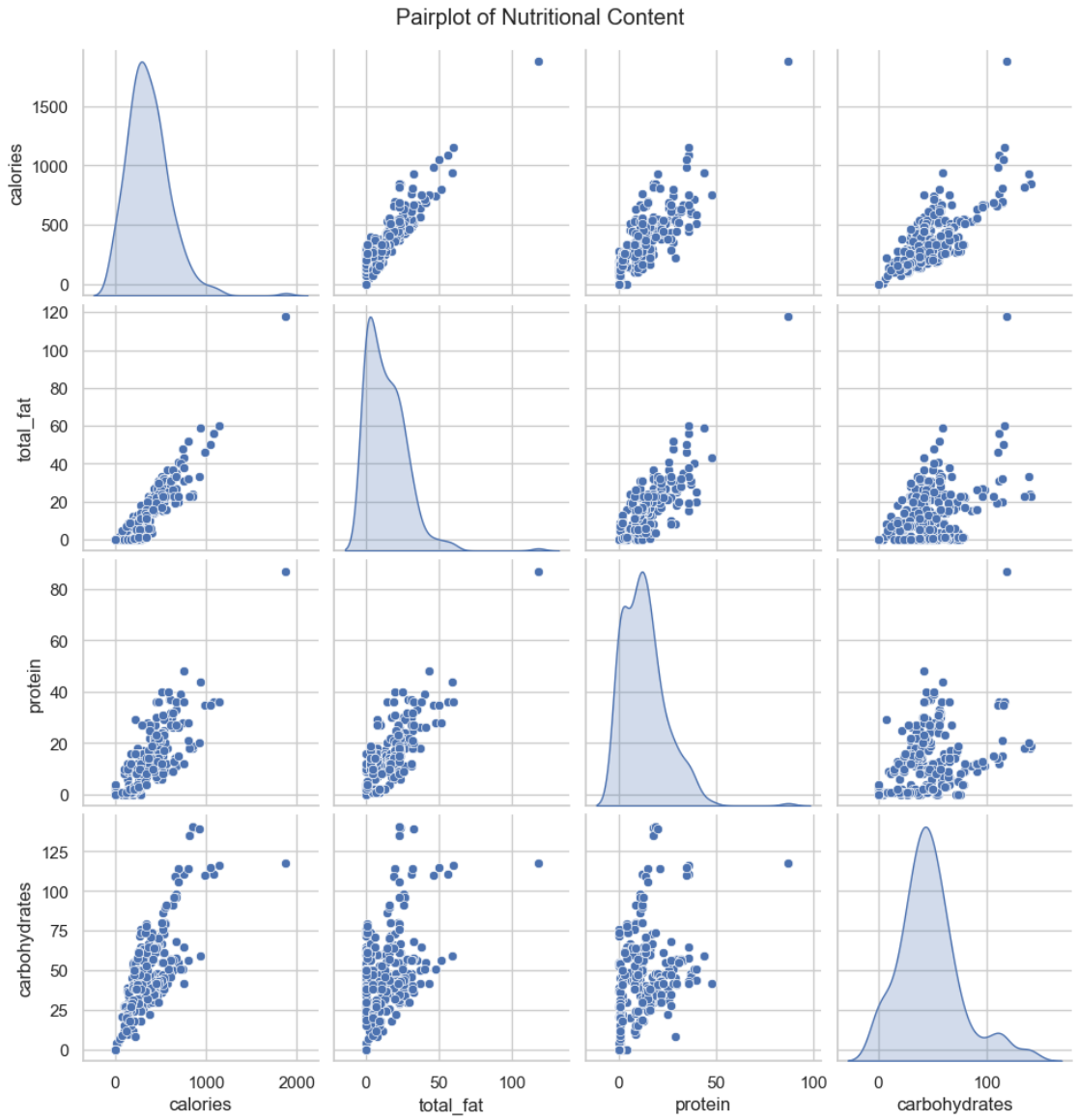
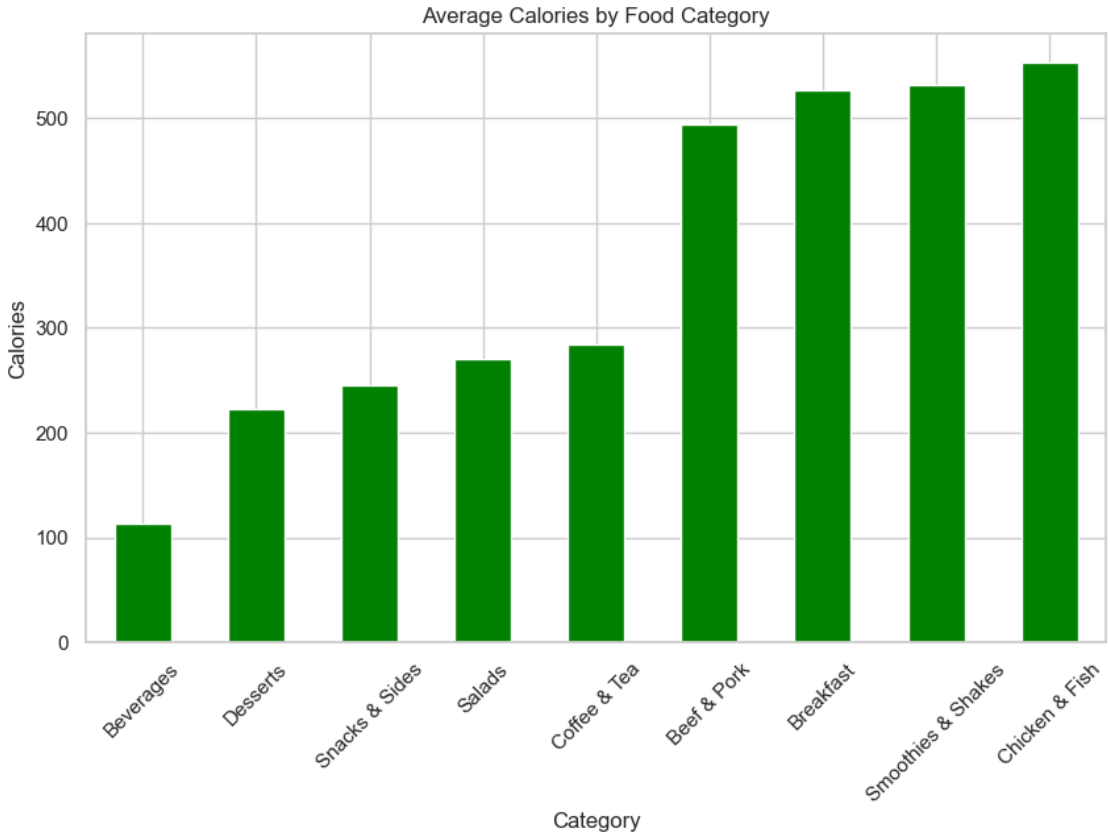

```
func(x=x, y=y, **kwargs)
```



[19]:
```
# Group by category and calculate average nutritional content
if 'category' in df_cleaned.columns:
    category_stats = df_cleaned.groupby('category')[['calories', 'total_fat',␣
 ↪'protein', 'carbohydrates']].mean()
    print("\nAverage Nutritional Content by Category:")
    print(category_stats)

    # Bar plot to compare average calories per category
    plt.figure(figsize=(10, 6))
    category_stats['calories'].sort_values().plot(kind='bar', color='green')
```

```
    plt.title("Average Calories by Food Category")
    plt.ylabel("Calories")
    plt.xlabel("Category")
    plt.xticks(rotation=45)
    plt.show()
else:
    print("Category column not found in the dataset.")
```

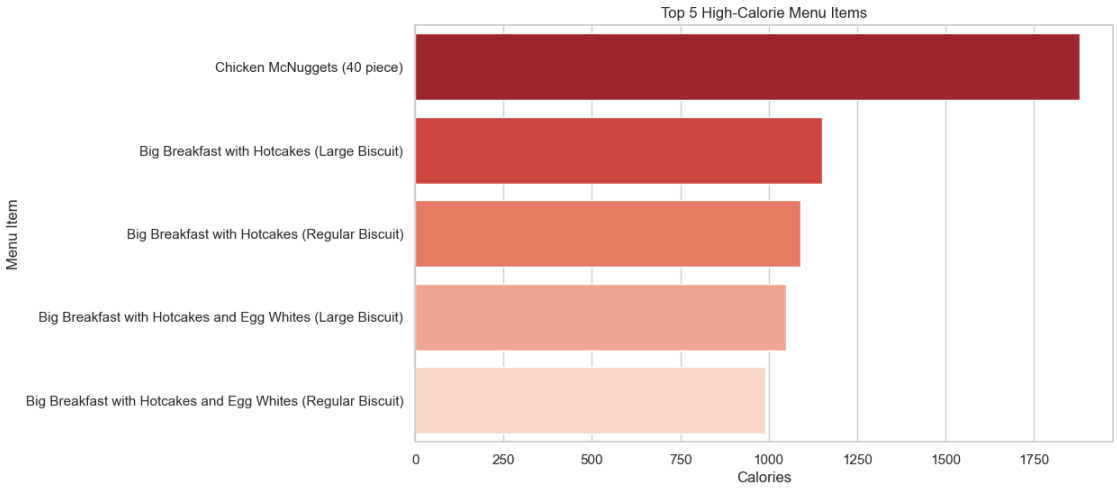
```
Average Nutritional Content by Category:
                     calories  total_fat    protein  carbohydrates
category
Beef & Pork        494.000000  24.866667  27.333333      40.133333
Beverages          113.703704   0.092593   1.333333      28.814815
Breakfast          526.666667  27.690476  19.857143      49.761905
Chicken & Fish     552.962963  26.962963  29.111111      49.074074
Coffee & Tea       283.894737   8.021053   8.863158      44.526316
Desserts           222.142857   7.357143   4.000000      34.857143
Salads             270.000000  11.750000  19.833333      21.666667
Smoothies & Shakes 531.428571  14.125000  10.857143      90.428571
Snacks & Sides     245.769231  10.538462   8.384615      29.153846
```



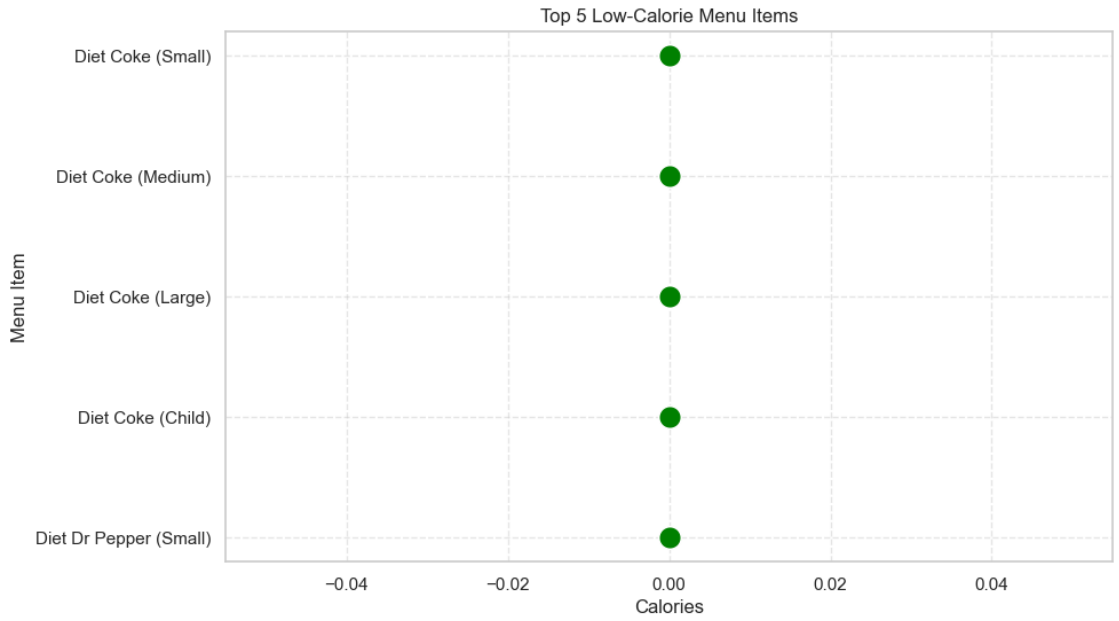
[22]:
```
# Top 5 items with highest calories
highest_calories = df_cleaned.nlargest(5, 'calories')
print("\nTop 5 High-Calorie Items:")
print(highest_calories[['item', 'calories']])

# Top 5 items with lowest calories
lowest_calories = df_cleaned.nsmallest(5, 'calories')
print("\nTop 5 Low-Calorie Items:")
print(lowest_calories[['item', 'calories']])

# Plot highest calorie items
plt.figure(figsize=(10, 6))
sns.barplot(x='calories', y='item', hue='item', data=highest_calories,␣
 ↪palette='Reds_r', legend=False)
plt.title("Top 5 High-Calorie Menu Items")
plt.xlabel("Calories")
plt.ylabel("Menu Item")
plt.show()

# Top 5 items with lowest calories
lowest_calories = df_cleaned.nsmallest(5, 'calories')
print("\nTop 5 Low-Calorie Items:")
print(lowest_calories[['item', 'calories']])

# Dot plot for lowest calorie items
plt.figure(figsize=(10, 6))
sns.scatterplot(x='calories', y='item', data=lowest_calories, color='green',␣
 ↪s=200, marker='o')

plt.title("Top 5 Low-Calorie Menu Items")
plt.xlabel("Calories")
plt.ylabel("Menu Item")
plt.grid(True, linestyle='--', alpha=0.5)  # Add a light grid for better␣
 ↪visibility
plt.show()
```

```
Top 5 High-Calorie Items:
                                                item  calories
82                          Chicken McNuggets (40 piece)      1880
32          Big Breakfast with Hotcakes (Large Biscuit)      1150
31        Big Breakfast with Hotcakes (Regular Biscuit)      1090
34  Big Breakfast with Hotcakes and Egg Whites (La…      1050
33  Big Breakfast with Hotcakes and Egg Whites (Re…       990

Top 5 Low-Calorie Items:
                        item  calories
```

```
114       Diet Coke (Small)         0
115      Diet Coke (Medium)         0
116       Diet Coke (Large)         0
117       Diet Coke (Child)         0
122  Diet Dr Pepper (Small)         0
```

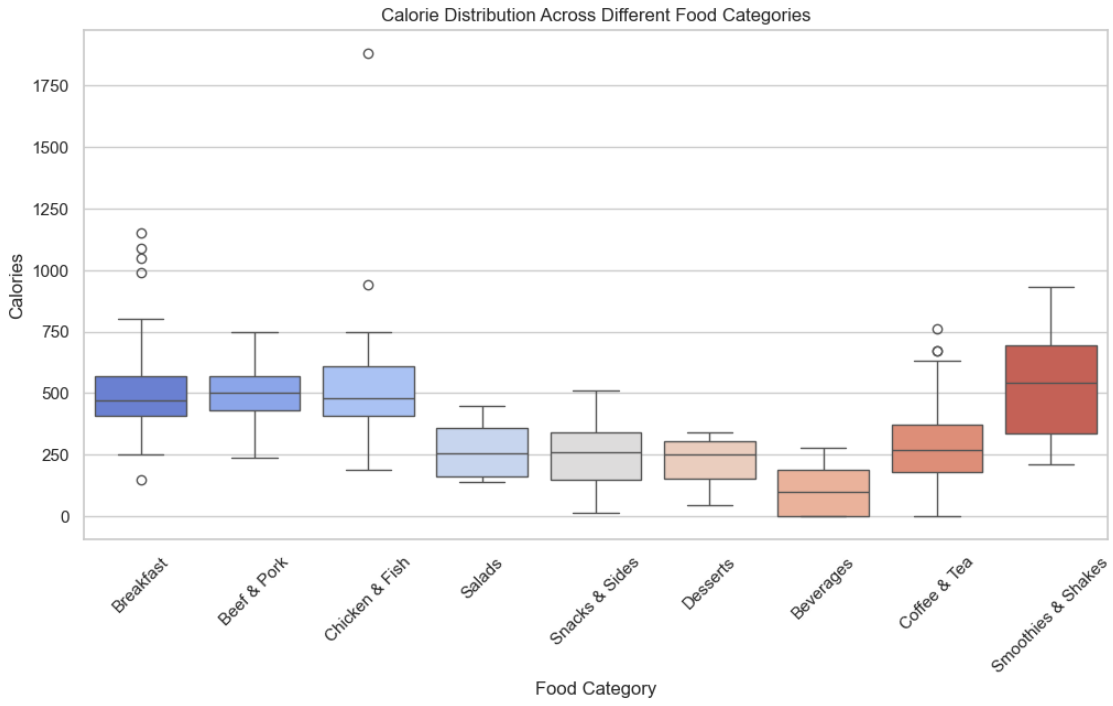



```
Top 5 Low-Calorie Items:
                      item  calories
114       Diet Coke (Small)         0
115      Diet Coke (Medium)         0
116       Diet Coke (Large)         0
117       Diet Coke (Child)         0
122  Diet Dr Pepper (Small)         0
```

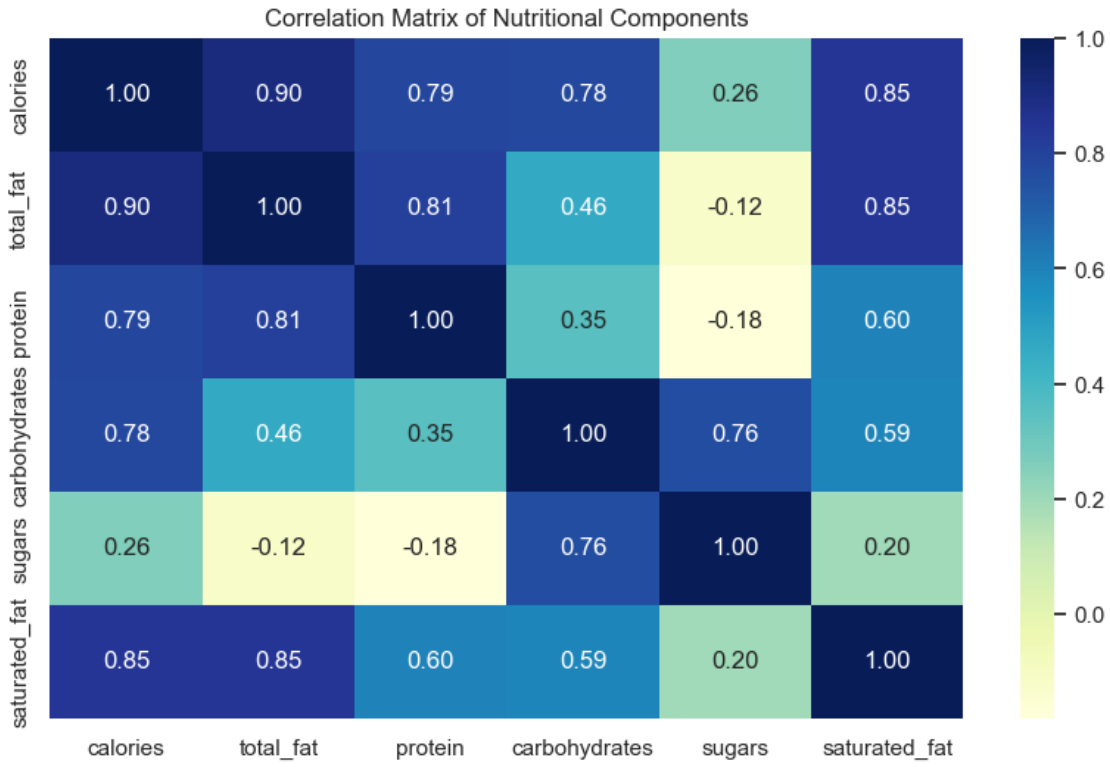


[23]:
```
# Check if 'category' exists in the dataset
if 'category' in df_cleaned.columns:
    plt.figure(figsize=(12, 6))
    sns.boxplot(x='category', y='calories', data=df_cleaned, palette='coolwarm')
    plt.title("Calorie Distribution Across Different Food Categories")
    plt.xlabel("Food Category")
    plt.ylabel("Calories")
    plt.xticks(rotation=45)
    plt.show()
else:
    print("The column 'category' does not exist in the dataset.")
```

```
C:\Users\vrajd\AppData\Local\Temp\ipykernel_15468\4285863095.py:4:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.

  sns.boxplot(x='category', y='calories', data=df_cleaned, palette='coolwarm')
```



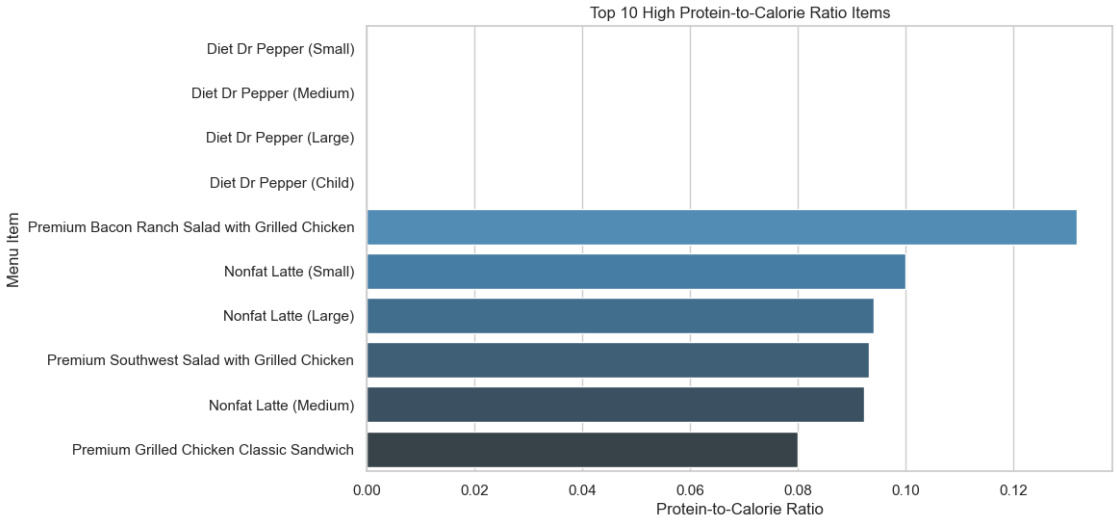
[24]:
```
# Select relevant numerical columns for correlation
nutritional_columns = ['calories', 'total_fat', 'protein', 'carbohydrates',␣
 ↪'sugars', 'saturated_fat']

# Check if all columns exist in the dataset
nutritional_columns = [col for col in nutritional_columns if col in df_cleaned.
 ↪columns]

# Compute the correlation matrix
correlation_matrix = df_cleaned[nutritional_columns].corr()

# Heatmap
plt.figure(figsize=(10, 6))
sns.heatmap(correlation_matrix, annot=True, cmap='YlGnBu', fmt=".2f")
plt.title("Correlation Matrix of Nutritional Components")
plt.show()
```



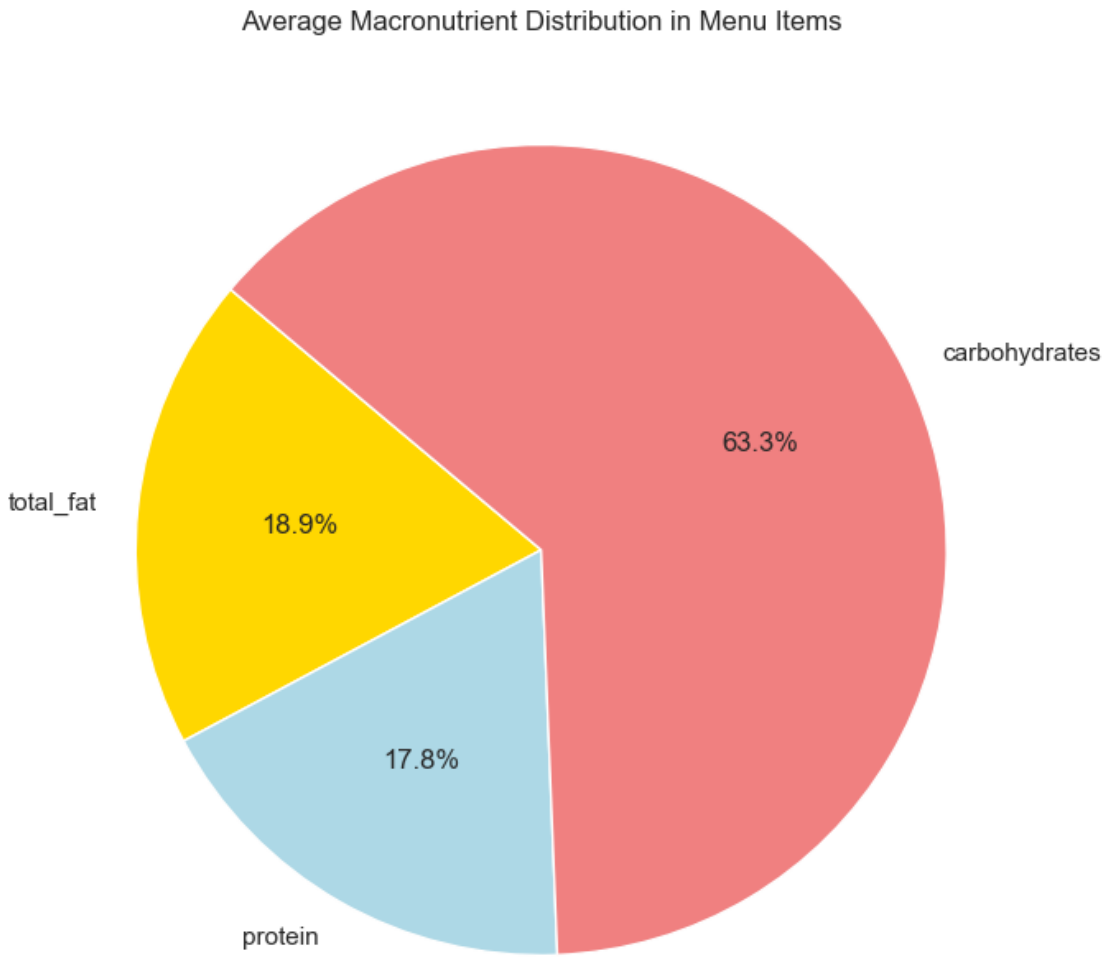
[28]:
```
# Add a new column for protein-to-calorie ratio
df_cleaned['protein_calorie_ratio'] = df_cleaned['protein'] /␣
 ↪df_cleaned['calories']

# Top 10 items with highest protein-to-calorie ratio
top_protein_ratio = df_cleaned.nlargest(10, 'protein_calorie_ratio')

# Plot
plt.figure(figsize=(10, 6))
sns.barplot(x='protein_calorie_ratio', y='item', data=top_protein_ratio,␣
 ↪palette='Blues_d')
plt.title("Top 10 High Protein-to-Calorie Ratio Items")
plt.xlabel("Protein-to-Calorie Ratio")
plt.ylabel("Menu Item")
plt.show()
```

```
C:\Users\vrajd\AppData\Local\Temp\ipykernel_15468\1135039467.py:9:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `y` variable to `hue` and set `legend=False` for the same
effect.
```

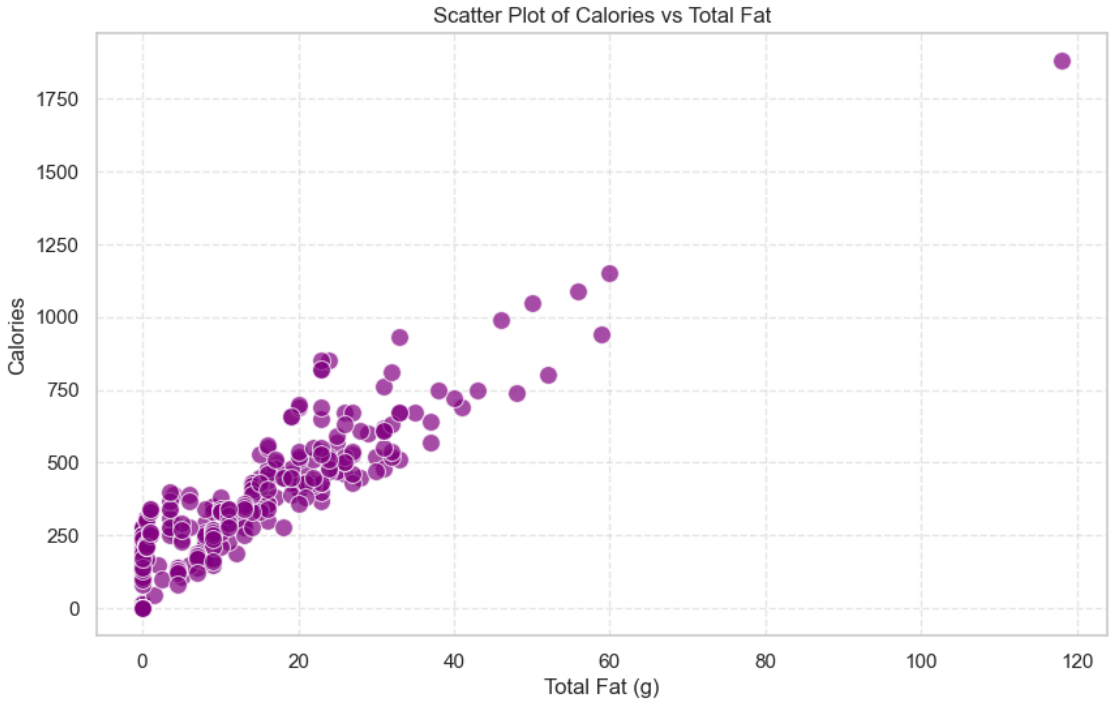
```
  sns.barplot(x='protein_calorie_ratio', y='item', data=top_protein_ratio,
palette='Blues_d')
```



[29]:
```
# Calculate average values for fat, protein, and carbs
macronutrients = df_cleaned[['total_fat', 'protein', 'carbohydrates']].mean()

# Pie chart
plt.figure(figsize=(8, 8))
plt.pie(macronutrients, labels=macronutrients.index, autopct='%1.1f%%',␣
  ↪startangle=140, colors=['gold', 'lightblue', 'lightcoral'])
plt.title("Average Macronutrient Distribution in Menu Items")
plt.show()
```



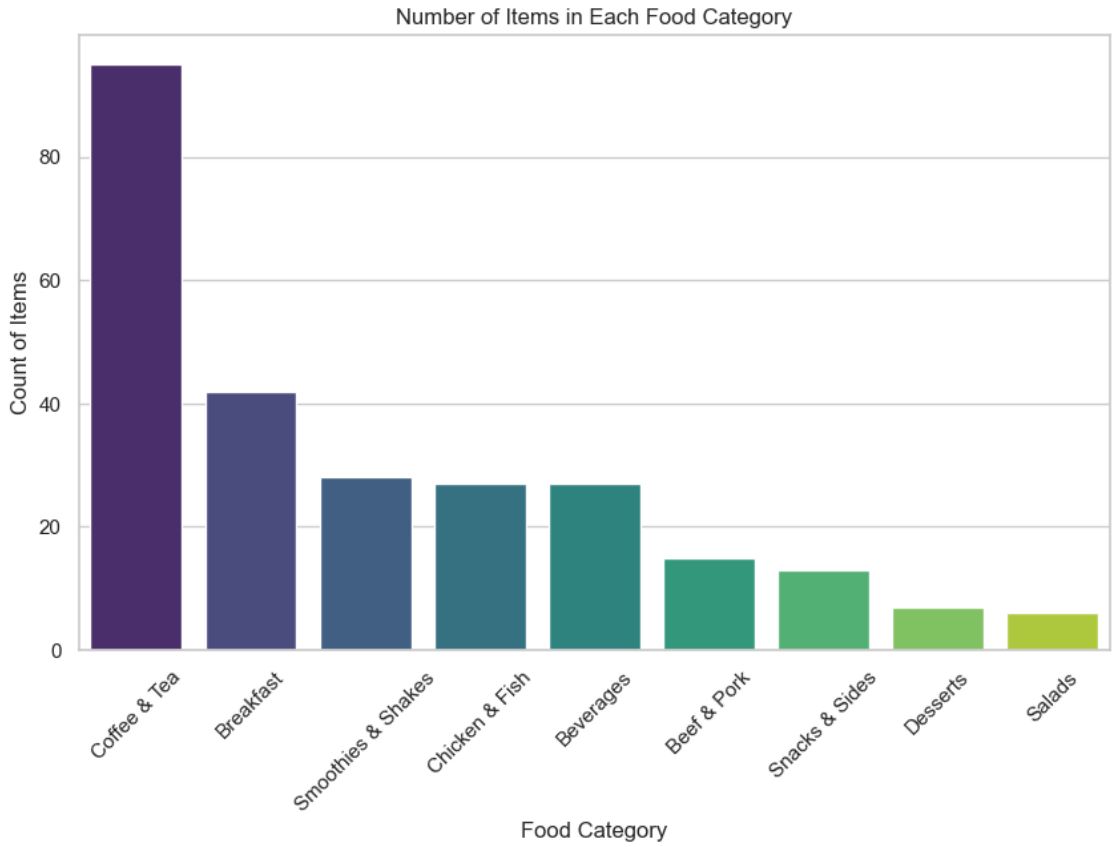
[30]:
```
# Scatter plot
plt.figure(figsize=(10, 6))
sns.scatterplot(x='total_fat', y='calories', data=df_cleaned, color='purple',␣
↪s=100, alpha=0.7)
plt.title("Scatter Plot of Calories vs Total Fat")
plt.xlabel("Total Fat (g)")
plt.ylabel("Calories")
plt.grid(True, linestyle='--', alpha=0.5)
plt.show()
```



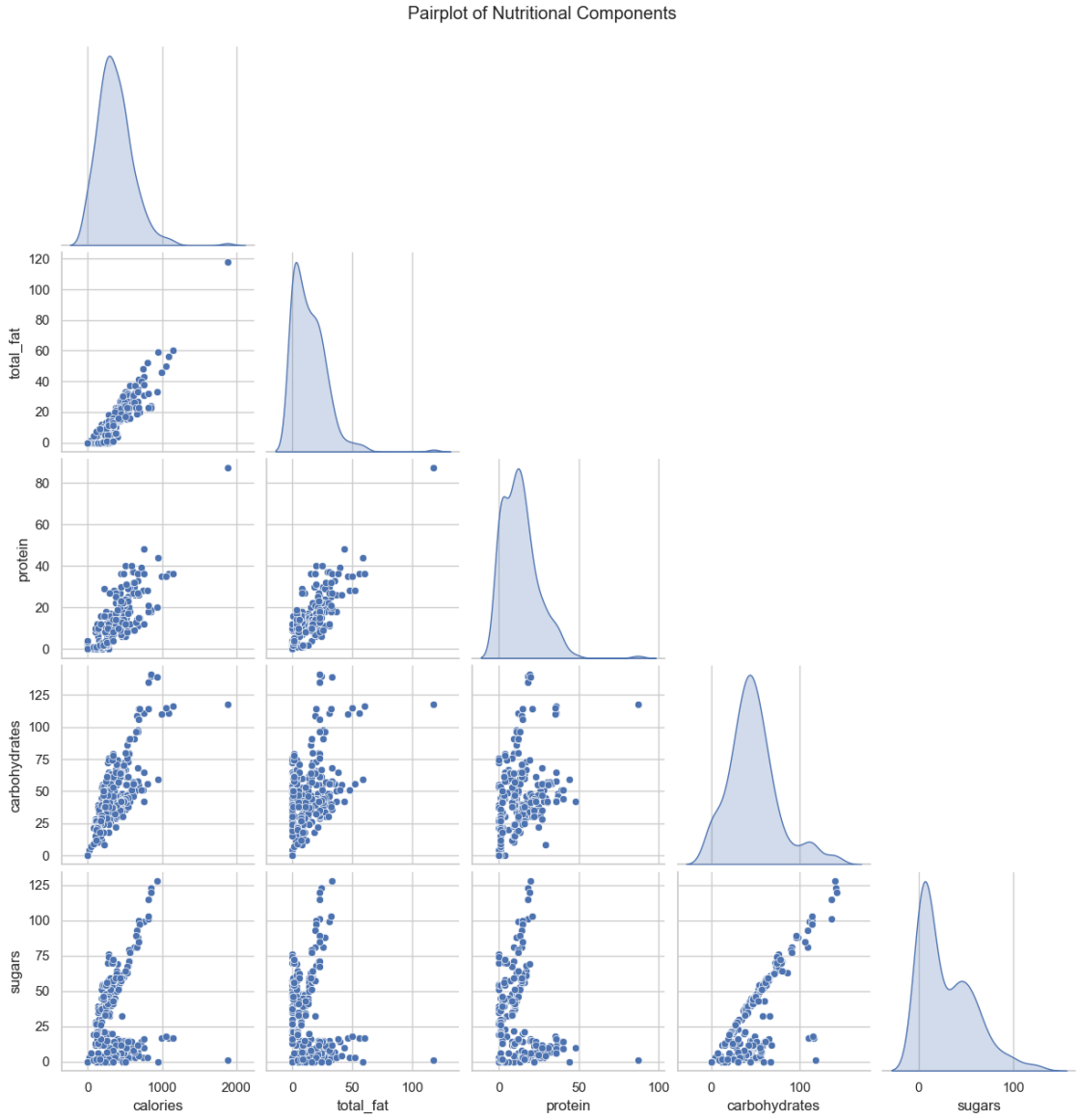
[31]:
```
# Check if 'category' exists
if 'category' in df_cleaned.columns:
    # Count the number of items per category
    category_counts = df_cleaned['category'].value_counts()

    # Plot bar chart
    plt.figure(figsize=(10, 6))
    sns.barplot(x=category_counts.index, y=category_counts.values,␣
 ↪palette='viridis')
    plt.title("Number of Items in Each Food Category")
    plt.xlabel("Food Category")
    plt.ylabel("Count of Items")
    plt.xticks(rotation=45)
    plt.show()
else:
    print("The column 'category' does not exist in the dataset.")
```

```
C:\Users\vrajd\AppData\Local\Temp\ipykernel_15468\3027878221.py:8:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in
v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same
effect.
```

```
  sns.barplot(x=category_counts.index, y=category_counts.values,
palette='viridis')
```

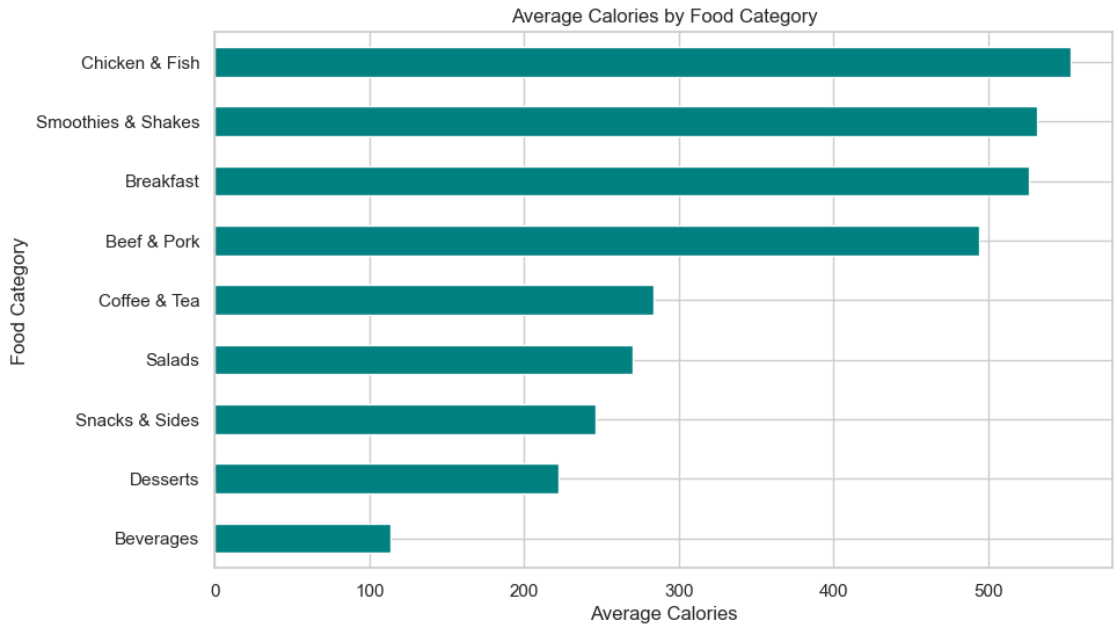


[32]:
```
# Pairplot for selected macronutrients
nutritional_cols = ['calories', 'total_fat', 'protein', 'carbohydrates',␣
 ↪'sugars']

# Filter for existing columns
nutritional_cols = [col for col in nutritional_cols if col in df_cleaned.
 ↪columns]

# Pairplot
sns.pairplot(df_cleaned[nutritional_cols], diag_kind='kde', corner=True)
plt.suptitle("Pairplot of Nutritional Components", y=1.02)
plt.show()
```



[33]:
```
if 'category' in df_cleaned.columns:
    # Calculate average calories per category
    avg_calories_by_category = df_cleaned.groupby('category')['calories'].
↪mean().sort_values()

    # Horizontal bar chart
    plt.figure(figsize=(10, 6))
    avg_calories_by_category.plot(kind='barh', color='teal')
    plt.title("Average Calories by Food Category")
    plt.xlabel("Average Calories")
    plt.ylabel("Food Category")
```

```
    plt.show()
else:
    print("The column 'category' does not exist in the dataset.")
```



3 Recommendations for McDonald's

1. **Increase Protein-Rich Options**:
   - Offer more high-protein, low-calorie items like grilled chicken, salads, and plant-based proteins.
2. **Reduce Saturated Fat**:
   - Reformulate recipes to use healthier oils or reduce fatty components.
3. **Low-Calorie Alternatives**:
   - Introduce smaller portion sizes or low-calorie versions of popular items.
4. **Transparency and Education**:
   - Clearly display nutritional information to help customers make informed choices.

[ ]: