



Search



Market Basket Analysis





Search

Import Libraries

```
import pandas as pd
import numpy as np
from mlxtend.frequent_patterns import
apriori, association_rules
import random
from collections import Counter
import sys
import locale
```



MSR.





```
# Set locale to handle Turkish characters
locale.setlocale(locale.LC_ALL, 'tr_TR.UTF-8')

# Read the original dataset with proper encoding
market_data = pd.read_excel("Market_Price_Comparison_2025.xlsx")

# Remove leading and trailing spaces from column names
market_data.columns = market_data.columns.str.strip()

# Drop unnecessary columns
market_data = market_data.drop(columns=['Supermarket A Info', 'Supermarket B Info'])
```

market_data

Category	Supermarket A Product	Supermarket A Price	Supermarket B Product	Supermarket B Price	Price Difference	Percentage Difference
0	basic_food	Reis Yeşil Mercimek 1 Kg	129.95	Reis Yeşil Mercimek 1 Kg	191.95	62.00
1	basic_food	Hasata Yozgat Sultanı Yeşil Mercimek 1 Kg	135.95	Hasata Yozgat Sultanı Yeşil Mercimek 1 kg	99.90	36.05
2	basic_food	Reis Kırmızı Mercimek 1 Kg	140.95	Reis Kırmızı Mercimek 1 Kg	140.95	0.00
3	basic_food	Reis San Mercimek 1 Kg	222.95	Reis San Mercimek 1 Kg	222.95	0.00
4	basic_food	Reis Royal Beluga Mercimeği 500 G	182.95	Reis Royal Beluga Mercimeği 500 Gr	182.95	0.00
...
1335	basic_food	Heinz Hot Chilli Sos 245 G	84.95	Heinz Hot Chilli Sos 245 Gr	84.90	0.05
1336	basic_food	Kühne Teriyaki Sos 250 Ml	144.95	Kühne Teriyaki Sos 250 ml	146.90	1.95
1337	healthy_living	Kikkoman Organik Soya Sosu 150 Ml	304.95	Kikkoman Organik Soya Sosu 150 ml	324.90	19.95
1338	basic_food	Tat Hardal 230 G	79.95	Tat Hardal 230 G	59.93	20.02
1339	basic_food	Hasata Kırşehir Koçbaşı Nohut 1 Kg	119.95	Hasata Kırşehir Koçbaşı Nohut 1 kg	89.90	30.05

1340 rows × 7 columns





Part 1: Simulate Customer Shopping Baskets

```
print("Part 1: Generating Customer Shopping Baskets...")

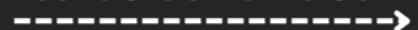
# Create a list of all products with their categories
all_products = []
product_categories = {}
for idx, row in market_data.iterrows():
    category = row['Category']
    product_categories[row['Supermarket A Product']] = category
    product_categories[row['Supermarket B Product']] = category
    all_products.extend([(row['Supermarket A Product'], category),
                         (row['Supermarket B Product'], category)])

# Calculate product frequencies for probability weighting
product_freq = Counter([p[0] for p in all_products])
total_products = len(all_products)
product_probs = {prod: count/total_products for prod, count in product_freq.items()}

# Define common category combinations (e.g., breakfast items, cleaning supplies)
category_combinations = {
    'breakfast': ['breakfast_products', 'dairy_products', 'bakery'],
    'cleaning': ['cleaning_detergent', 'paper_cosmetics'],
    'snacks': ['snacks', 'beverages'],
    'cooking': ['basic_food', 'meat_poultry_fish', 'fruit_vegetables'],
    'health': ['healthy_living', 'dairy_products']
}
```



to be continued





Part 1: Simulate Customer Shopping Baskets

```
# Generate 10,000 customer baskets
n_customers = 10000
baskets = []

for _ in range(n_customers):
    # Generate basket size (min 1, max 25, average 5)
    basket_size = min(25, max(1, int(np.random.normal(5, 2)))) 

    # Decide on a shopping theme (20% chance of themed basket)
    if random.random() < 0.2:
        # Select a random theme
        theme = random.choice(list(category_combinations.keys()))
        categories = category_combinations[theme]

        # Get products from these categories
        theme_products = [p[0] for p in all_products if p[1] in categories]
        if theme_products:
            # Select products based on theme
            basket = random.choices(
                theme_products,
                weights=[product_probs[p] for p in theme_products],
                k=min(basket_size, len(theme_products)))
    )


```



to be continued
----->



Part 1: Simulate Customer Shopping Baskets

```
else:  
    # Fallback to regular selection if no theme products  
    basket = random.choices(  
        list(product_probs.keys()),  
        weights=list(product_probs.values()),  
        k=basket_size  
    )  
else:  
    # Regular basket selection  
    basket = random.choices(  
        list(product_probs.keys()),  
        weights=list(product_probs.values()),  
        k=basket_size  
    )  
  
baskets.append(basket)  
  
# Save the baskets to Excel  
try:  
    # Convert baskets to DataFrame  
    basket_data = []  
    for i, basket in enumerate(baskets):  
        for item in basket:  
            basket_data.append({  
                'Basket_ID': i + 1,  
                'Item': item,  
                'Category': product_categories.get(item, 'Unknown')  
            })
```



to be continued





Part 1: Simulate Customer Shopping Baskets

```
basket_df = pd.DataFrame(basket_data)

# Save as Excel file
basket_df.to_excel('customer_baskets.xlsx', index=False, engine='openpyxl')
print("\nCustomer baskets have been saved to 'customer_baskets.xlsx'")

except Exception as e:
    print(f"\nError saving to Excel: {str(e)}")
    # Fallback to CSV if Excel fails
    basket_df.to_csv('customer_baskets.csv', index=False, encoding='utf-8')
    print("Customer baskets have been saved to 'customer_baskets.csv'")


# Display basket statistics and sample contents
print("\nBasket Statistics:")
print(f"Total number of baskets: {len(baskets)}")
print(f"Average basket size: {np.mean([len(basket) for basket in baskets]):.2f} items")
print(f"Minimum basket size: {min([len(basket) for basket in baskets])} items")
print(f"Maximum basket size: {max([len(basket) for basket in baskets])} items")

# Show 5 sample baskets
print("\nSample Baskets (5 random examples):")
sample_indices = np.random.choice(len(baskets), 5, replace=False)
for idx, basket_idx in enumerate(sample_indices, 1):
    print(f"\nBasket {idx}:")
    print(f"Number of items: {len(baskets[basket_idx])}")
    print("Items:")
    for item in baskets[basket_idx]:
        print(f" - {item}")

# Show most common items across all baskets
print("\nMost Common Items in All Baskets:")
all_items = [item for basket in baskets for item in basket]
item_counts = Counter(all_items)
for item, count in item_counts.most_common(10):
    print(f"{item}: {count} times")
```





Part 1: Simulate Customer Shopping Baskets

```
Customer baskets have been saved to 'customer_baskets.xlsx'
```

Basket Statistics:

Total number of baskets: 10000

Average basket size: 4.54 items

Minimum basket size: 1 items

Maximum basket size: 12 items

Sample Baskets (5 random examples):

Basket 1:

Number of items: 1

Items:

- Knorr Baharat Serisi Pul Biber 65 G

Basket 2:

Number of items: 1

Items:

- Sinangil Un 1 Kg

Basket 3:

Number of items: 3

Items:

- Lipton Earl Grey Dökme Çay 1000 G
- Lipton Ice Tea Limon Pet 1 L
- Master Nut İç Yer Fıstığı Tuzlu 160 G

Basket 4:

Number of items: 5

Items:

- Activex Antibakteriyel Hassas Islak Havlu 50'li
- Activia Doğal Probiyotikli Ananaslı Yoğurt 4x100 g
- Maxi Bulmaca Cilt
- Ülker Çokomel Marshmallow Çilekli 36 G
- La Vache Qui Rit 16lı Üçgen Peynir 200g

Basket 5:

Number of items: 3

Items:

- Hero Goodies Muz Kakao Meyve Bar 30 G
- Reis Kırmızı Mercimek 1 Kg
- Hipp 1 Organik Keçi Sütü Bazlı Bebek Sütü 400 G

Most Common Items in All Baskets:

İçim İcimino Laktozsuz Kakaolu Süt 180 Ml: 181 times

City Farm Organik Tahin 350 G: 140 times

City Farm Organik Keçiboynuzu Pekmezi 450 G: 134 times

Ülker Dido Gold Süt Reçeli Tadında Çikolatalı Gofret 36 G: 109 times

Pınar Labne 180 G: 96 times

Dove Sülfatsız Saç Bakım Şampuanı Breakage Remedy 350 ml: 96 times

Elidor Superblend Serum Saç Bakım Kremi Esmer Parlaklık E Vitamini Chia Tohumu Yağı Keratin 350 ml: 93 times

Knorr Çitir Pane Harcı 90 G: 88 times

Çiğ Badem Kg: 86 times

Ülker Çokomel Marshmallow Sade 36 G: 83 times

A		B	
1	Basket_ID	Item	Category
2	1	Reis Köftelik Bulgur 1 Kg	basic_food
3	1	Wella Koleston Naturals Saç Boyası 71 Küllü Kumral	paper_cosmetics
4	2	Eker Supangle 150 G	dairy_products
5	2	Bahçıvan Dilimli Tost Peyniri 500 Gr	dairy_products
6	2	Sek Çiftlik Kaymaksız Yoğurt 1200 G	dairy_products
7	2	Sek Tam Yağlı Beyaz Peynir 800 Gr	dairy_products
8	3	Pakmaya Karamelli Puding 84 G	basic_food
9	3	Eti Kombo Lokmalık 84G	snacks
10	3	Elidor Sıvı Saç Bakım Kremi Anında Onarıcı 200 ml	paper_cosmetics
11	4	Eker Sakızlı Muhallebi 150 G	dairy_products
12	5	Glade Hava Tazeleyici Jel Mini Jel Lavanta Ferahlığı 70g	cleaning_detergent
13	5	Ülker Kakaolu Bisküvi 125 Gr	snacks
14	5	Pastavilla Dirsek Makarna 500g	basic_food
15	6	Hipp Organik Sebzeli Tavuklu Erişte 220 G	baby_products
16	6	Macromax Easy Temizlik Seti	home_life
17	7	Fellas Vegan Protein Bar Muz & Kakao 40 G	healthy_living
18	7	Bulmaca Dergisi	home_life
19	7	Gliss Blonde Perfector Onarıcı Mor Şampuan 250 ml	paper_cosmetics
20	7	Lipton Ice Tea Mango Kutu 330 ml	beverages

customer_baskets.xlsx





Part 2: Convert to Transaction Format and Apply Apriori

```
print("\nPart 2: Analyzing Association Rules...")

# Convert baskets to one-hot encoded format
unique_products = list(set([item for basket in baskets for item in basket]))
basket_df = pd.DataFrame([[1 if item in basket else 0 for item in unique_products]
                           for basket in baskets],
                           columns=unique_products)

# Convert to boolean type to avoid deprecation warning
basket_df = basket_df.astype(bool)

# Calculate item frequencies
item_frequencies = basket_df.sum() / len(basket_df)
print("\nItem Frequencies by Category (top 5 items per category):")
for category in market_data['Category'].unique():
    category_items = [item for item in item_frequencies.index if product_categories.get(item) == category]
    if category_items:
        print(f"\n{category}:")
        print(item_frequencies[category_items].sort_values(ascending=False).head())

# Select only the most common items (top 200) to reduce memory usage
top_items = item_frequencies.nlargest(200).index
basket_df_reduced = basket_df[top_items]

print(f"\nAnalyzing {len(top_items)} most common items...")
```



to be continued
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Part 2: Convert to Transaction Format and Apply Apriori

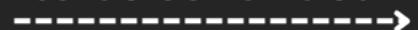
```
# Apply Apriori algorithm with lower support threshold
# Support threshold: items must appear in at least 0.05% of baskets
# Confidence threshold: rules must be correct at least 5% of the time
frequent_itemsets = apriori(basket_df_reduced,
                             min_support=0.0005, # Lowered to 0.05%
                             use_colnames=True,
                             max_len=3) # Limit itemset size to 3 items

print(f"\nNumber of frequent itemsets found: {len(frequent_itemsets)}")

if len(frequent_itemsets) > 0:
    # Show the frequent itemsets with their categories
    print("\nFrequent Itemsets (sorted by support):")
    itemsets_with_categories = []
    for idx, row in frequent_itemsets.iterrows():
        items = list(row['itemsets'])
        categories = [product_categories.get(item, 'Unknown') for item in items]
        itemsets_with_categories.append({
            'items': items,
            'categories': categories,
            'support': row['support']
        })
```



to be continued





Part 2: Convert to Transaction Format and Apply Apriori

```
# Sort by support and show top 20
itemsets_with_categories.sort(key=lambda x: x['support'], reverse=True)
for idx, itemset in enumerate(itemsets_with_categories[:20], 1):
    print(f"\nCombination {idx}:")
    print("Items:", ', '.join(itemset['items']))
    print("Categories:", ', '.join(itemset['categories']))
    print(f"Support: {itemset['support']:.2%}")

# Generate association rules with lower confidence threshold
rules = association_rules(frequent_itemsets,
                           metric="confidence",
                           min_threshold=0.05) # 5% confidence threshold

print(f"\nNumber of association rules found: {len(rules)})"

if len(rules) > 0:
    # Sort rules by lift to find the most interesting ones
    rules = rules.sort_values('lift', ascending=False)
```





Part 2: Convert to Transaction Format and Apply Apriori

Part 2: Analyzing Association Rules...

Item Frequencies by Category (top 5 items per category):

basic_food:

```
Knorr Çitir Pano Harcı 90 G      0.0092
Ulker Potibör Bisküvi Çifte Kavrulmuş 175 Gr  0.0052
Bağdat Hindistan Cevizi 50 G       0.0049
Bağdat Mahlep 30 G                0.0045
Duru Kepekli Pilavlık Bulgur 1 Kg   0.0045
dtype: float64
```

ready_meals_frozen_products:

```
Superfresh Falafel 450 G          0.0037
Superfresh Patates Kroket 450 G    0.0032
Feast Parmak Patates 1 Kg         0.0031
Pınar Piliç Kroket 430 G          0.0029
Pınar Gürme Burger 450 G          0.0029
dtype: float64
```

meat_poultry_fish:

```
Banvit Piliç Schnitzel 300 Gr     0.0058
Banvit Piliç Schnitzel 300 G       0.0047
Gurvita İliqli Kemik Suyu Sade 320 Ml  0.0047
Banvit Piliç Schnitzel 700 Gr     0.0046
Banvit Piliç Nuget 300 Gr         0.0043
dtype: float64
```

healthy_living:

```
City Farm Organik Keçi boynuzu Pekmezci 450 G  0.0135
City Farm Organik Tahin 350 G                  0.0092
Heinz Organik Ketçap 580 G                     0.0056
Glutensiz Ada Kahveli Kurabiye 100 G          0.0046
Naturiga Organik Karnıyarık Otu Tohumu Tozu 100 G 0.0027
dtype: float64
```

bakery:

```
Uno Grissuno Yulaflı Karabuğdaylı 150 G  0.0051
Uno Grissuno Kepekli 150 G                 0.0045
Uno Firmanız Taa Buğday 450 G              0.0044
Fıstıklı Baklava Kg                         0.0027
İhe Tost Ekmekçi 670G                      0.0027
dtype: float64
```

fruit_vegetables:

```
Ayva Kg           0.0049
Semizotu Adet    0.0045
Maydanız Adet    0.0040
Nane Adet        0.0037
Karpuz Kg        0.0037
dtype: float64
```

paper_cosmetics:

```
Okey Zero Kayganlaştırıcı Jel 100 ml      0.0089
Elidor Superblend Serum Saç Bakım Kremi Esmer Parlaklık & Vitamini Chia Tohumu Yağı Keratin 350 ml 0.0088
Dove Sulfatsız Saç Bakım Şampuanı Breakage Remedy 350 ml      0.0065
Clear Women Hyaluron Nem Terapisi Şampuan 350 ml            0.0055
Golden Rose Color Expert Nail Lacquer No:84                   0.0053
dtype: float64
```

cleaning_detergent:

```
Porçoz Kireç Çözücü Sprey 750 Ml          0.0046
Pril Sıvı Elde Bulaşık Yıkama Deterjanı Adana Portakalı 1350 ml  0.0039
Fairy Platinum Hijyen 500 ml Sıvı Bulaşık Deterjanı          0.0038
Porçoz Lavabo Açıci Granül 2x50 G        0.0037
Fairy Power Sprey 500 ml                    0.0037
dtype: float64
```

baby_products:

```
Uni Baby Aktif Islak Mendil 72'li          0.0037
Milupa Çocuk Devam Sütü İcime Hazır 200 ml 6'lı Paket 1 Yaş  0.0032
Milupa Çocuk Devam Sütü İcime Hazır 200 Ml 6'lı Paket 1 Yaş+ 0.0038
Hipp Babysanft El Yıkama Kopüğü 250 Ml      0.0029
Uni Baby Aktif Islak Mendil 72li             0.0028
dtype: float64
```

home_life:

```
Maxi Spor                           0.0058
Dergi Festivali                      0.0049
Araştırmacı Çocuk Dergisi          0.0048
Evinim                               0.0048
Faber Castell 4 Kırmızı Kopya Boya Kalemi 0.0038
dtype: float64
```

electronics:

```
Sinbo SSM-2550 Tost Makinesi          0.0020
Philips Narenciye Sıkacağı HR2738/00  0.0015
Sinbo SSM2550 Tost Makinesi          0.0013
Philips Hr2738 Narenciye Sıkacağı    0.0012
dtype: float64
```

pet_shop:

```
Dreamies Peynirli Kedi Odul Mamasi 60 G  0.0038
Dreamies Ördekli Kedi Odul Mamasi 60 G  0.0038
Dreamies Tavuklu Kedi Odul Mamasi 60 G  0.0026
Dreamies Somonlu Kedi Odul Mamasi 60 G  0.0026
Perfect Fit Yavru Tavuklu Kuru Mama 750 G 0.0023
dtype: float64
```

beverages:

```
İçim Ayran 2 L                      0.0045
Ahmad Tea Ceylon Dökme Çay 200 G     0.0042
Lipton Ice Tea Limon Kutu 330 ml     0.0041
Sek Probiyotik Orman Meyveli Kefir 250 Ml 0.0041
Dimes Mango Aromalı İçecek 1 Litre    0.0040
dtype: float64
```

dairy_products:

```
İçim İçinino Laktozsuz Kakaolu Süt 180 Ml  0.0182
Eker Efsane Yogurt 350 G                 0.0088
Pınar Protein Kahveli Süt 500 Ml          0.0077
Sek Çiftlik Kaymaksız Yogurt 450 G        0.0077
Eker Keskek 150 G                        0.0076
dtype: float64
```

snacks:

```
Ulker Çokomel Marshmallow Çilekli 36 G    0.0102
Ulker Dido Gold Süt Reçeli Tadında Çikolatalı Gofret 36 G  0.0094
Çiğ Badem Kg                            0.0094
Eti Çanga Gold 45 g                      0.0086
Ulker Çokomel Marshmallow Sade 36 G        0.0085
dtype: float64
```

breakfast_products:

```
Balparmak Yayla Çiçek Balı 460 G  0.0050
Balparmak Yayla Çiçek Balı 850 G  0.0044
Balparmak Çam Balı 850 G          0.0043
Koska Cevizli Helva Kg            0.0039
Fiskobirlik Fındık Ezmesi 180 G  0.0027
dtype: float64
```

ice_cream:

```
Algida Maras Usulü Sade Kap Dondurma 185 ml 0.0031
Algida Maras Usulü Sade Dondurma Cup 185 ml 0.0031
Golf Royal Gourmet Yaz Ferahlığı - Bursa Şeftali 850 Ml 0.0027
Twix 50 ml                             0.0023
Algida Maras Usulü Kesme Dondurma 650 ml 0.0022
dtype: float64
```



Part 2: Convert to Transaction Format and Apply Apriori

Analyzing 200 most common items...

Number of frequent itemsets found: 275

Frequent Itemsets (sorted by support):

Combination 1:

Items: içim içimino Laktozsuz Kakaolu Süt 180 Ml
Categories: dairy_products
Support: 1.82%

Combination 2:

Items: City Farm Organik Keçiboynuzu Pekmezi 450 G
Categories: healthy_living
Support: 1.35%

Combination 3:

Items: Ülker Çökmez Marshmallow Çilekli 36 G
Categories: snacks
Support: 1.02%

Combination 4:

Items: Ülker Dido Gold Süt Reçeli Tadında Çikolatalı Gofret 36 G
Categories: snacks
Support: 0.94%

Combination 5:

Items: Çiğ Badem Kg
Categories: snacks
Support: 0.94%

Combination 6:

Items: Knorr Çitir Pane Harcı 90 G
Categories: basic_food
Support: 0.92%

Combination 7:

Items: City Farm Organik Tahin 350 G
Categories: healthy_living
Support: 0.92%

Combination 8:

Items: Okey Zero Kayganlaştırıcı Jel 100 ml
Categories: paper_cosmetics
Support: 0.89%

Combination 9:

Items: Elidor Superblend Serum Saç Bakım Kremi Esmer Parlaklık E Vitamini Chia Tohumu Yağı Keratin 350 ml
Categories: paper_cosmetics
Support: 0.88%

Combination 10:

Items: Eti Canga Gold 45 g
Categories: snacks
Support: 0.86%

Combination 11:

Items: Ülker Çökmez Marshmallow Sade 36 G
Categories: snacks
Support: 0.85%

Combination 12:

Items: Eker Efsane Yoğurt 350 G
Categories: dairy_products
Support: 0.80%

Combination 13:

Items: Pınar Protein Kahveli Süt 500 Ml
Categories: dairy_products
Support: 0.77%

Combination 14:

Items: Sek Çiftlik Kaymaksız Yoğurt 450 G
Categories: dairy_products
Support: 0.77%

Combination 15:

Items: Eker Keskül 150 G
Categories: dairy_products
Support: 0.76%

Combination 16:

Items: Tahsildaroğlu Taze Kaşar Peyniri 400 Gr
Categories: dairy_products
Support: 0.74%

Combination 17:

Items: Sek Quark Yaban Mersini 140 G
Categories: dairy_products
Support: 0.73%

Combination 18:

Items: Pınar Protein Kahveli süt 500 ml
Categories: dairy_products
Support: 0.73%

Combination 19:

Items: Tahsildaroğlu Gurme Ezine Beyaz Peynir Gold 450 G
Categories: dairy_products
Support: 0.73%

Combination 20:

Items: Nestle Damak Ala Beyaz Gofret 30 g
Categories: snacks
Support: 0.72%

Number of association rules found: 105



Part 3: Present and Explain Rules

```
if len(rules) > 0:  
    # Sort rules by lift to find the most interesting ones  
    rules = rules.sort_values('lift', ascending=False)  
  
    # Convert frozensets to readable strings before saving  
    rules['antecedents'] = rules['antecedents'].apply(lambda x: ', '.join(list(x)))  
    rules['consequents'] = rules['consequents'].apply(lambda x: ', '.join(list(x)))  
  
    # Part 3: Present and Explain Rules  
    print("\nPart 3: Top 5 Most Meaningful Association Rules:")  
    print("\nRule Analysis and Business Recommendations:")  
  
    # Select top 5 rules  
    top_rules = rules.head(5)  
  
    for idx, rule in top_rules.iterrows():  
        # Get the items from the converted strings  
        antecedents = rule['antecedents'].split(', ')  
        consequents = rule['consequents'].split(', ')  
        confidence = rule['confidence']  
        lift = rule['lift']  
        support = rule['support']  
  
        # Get categories for antecedents and consequents  
        antecedent_categories = [product_categories.get(item, 'Unknown') for item in antecedents]  
        consequent_categories = [product_categories.get(item, 'Unknown') for item in consequents]
```





Part 3: Present and Explain Rules

```
print(f"\nRule {idx + 1}:")
print(f"If {rule['antecedents']} ({', '.join(antecedent_categories)})")
print(f"Then {rule['consequents']} ({', '.join(consequent_categories)})")
print(f"Support: {support:.2%}")
print(f"Confidence: {confidence:.2%}")
print(f"Lift: {lift:.2f}")

# Business recommendations based on the rule
print("\nBusiness Recommendations:")
print("1. Cross-Promotion Strategy:")
print(f"    - Place {rule['antecedents']} and {rule['consequents']} in close proximity")
print(f"    - Create bundle offers combining these products")

print("2. Pricing Strategy:")
print(f"    - Consider dynamic pricing for {rule['antecedents']} to increase sales of {rule['consequents']} ")
print(f"    - Use {rule['antecedents']} as loss leaders to drive sales of {rule['consequents']} ")

print("3. Marketing Strategy:")
print(f"    - Target customers who buy {rule['antecedents']} with promotions for {rule['consequents']} ")
print(f"    - Create email campaigns highlighting the complementary nature of these products")

print("4. Inventory Management:")
print(f"    - Ensure {rule['consequents']} are well-stocked when {rule['antecedents']} are on promotion")
print(f"    - Monitor stock levels of both products to prevent out-of-stock situations")

# Save the rules to a CSV file with proper encoding
try:
    # Save as Excel file instead of CSV for better character handling
    rules.to_excel('association_rules.xlsx', index=False, engine='openpyxl')
    print("\nAssociation rules have been saved to 'association_rules.xlsx'")
except Exception as e:
    print(f"\nError saving to Excel: {str(e)}")
    # Fallback to CSV if Excel fails
    rules.to_csv('association_rules.csv', index=False, encoding='utf-8')
    print("Association rules have been saved to 'association_rules.csv'")

else:
    print("\nNo association rules found with current confidence threshold.")
    print("Consider lowering the confidence threshold further or analyzing the frequent itemsets directly.")
```





Part 3: Present and Explain Rules

1st Rule

İçim Yarım Yağlı Üçgen Peynir 100 G → Pınar Protein Kakaolu Süt 500 Ml



Part 3: Top 5 Most Meaningful Association Rules:

Rule Analysis and Business Recommendations:

Rule 100:

If İçim Yarım Yağlı Üçgen Peynir 100 G (dairy_products)

Then Pınar Protein Kakaolu Süt 500 Ml (dairy_products)

Support: 0.06%

Confidence: 10.91%

Lift: 16.04

Business Recommendations:

1. Cross-Promotion Strategy:

- Place İçim Yarım Yağlı Üçgen Peynir 100 G and Pınar Protein Kakaolu Süt 500 Ml in close proximity
- Create bundle offers combining these products

2. Pricing Strategy:

- Consider dynamic pricing for İçim Yarım Yağlı Üçgen Peynir 100 G to increase sales of Pınar Protein Kakaolu Süt 500 Ml
- Use İçim Yarım Yağlı Üçgen Peynir 100 G as loss leaders to drive sales of Pınar Protein Kakaolu Süt 500 Ml

3. Marketing Strategy:

- Target customers who buy İçim Yarım Yağlı Üçgen Peynir 100 G with promotions for Pınar Protein Kakaolu Süt 500 Ml
- Create email campaigns highlighting the complementary nature of these products

4. Inventory Management:

- Ensure Pınar Protein Kakaolu Süt 500 Ml are well-stocked when İçim Yarım Yağlı Üçgen Peynir 100 G are on promotion
- Monitor stock levels of both products to prevent out-of-stock situations



Part 3: Present and Explain Rules

2nd Rule

Pınar Protein Kakaolu Süt 500 Ml → İçim Yarım Yağlı Üçgen Peynir 100 G



Rule 101:

If Pınar Protein Kakaolu Süt 500 Ml (dairy_products)
Then İçim Yarım Yağlı Üçgen Peynir 100 G (dairy_products)

Support: 0.06%
Confidence: 8.82%
Lift: 16.04

Business Recommendations:

1. Cross-Promotion Strategy:
 - Place Pınar Protein Kakaolu Süt 500 Ml and İçim Yarım Yağlı Üçgen Peynir 100 G in close proximity
 - Create bundle offers combining these products
2. Pricing Strategy:
 - Consider dynamic pricing for Pınar Protein Kakaolu Süt 500 Ml to increase sales of İçim Yarım Yağlı Üçgen Peynir 100 G
 - Use Pınar Protein Kakaolu Süt 500 Ml as loss leaders to drive sales of İçim Yarım Yağlı Üçgen Peynir 100 G
3. Marketing Strategy:
 - Target customers who buy Pınar Protein Kakaolu Süt 500 Ml with promotions for İçim Yarım Yağlı Üçgen Peynir 100 G
 - Create email campaigns highlighting the complementary nature of these products
4. Inventory Management:
 - Ensure İçim Yarım Yağlı Üçgen Peynir 100 G are well-stocked when Pınar Protein Kakaolu Süt 500 Ml are on promotion
 - Monitor stock levels of both products to prevent out-of-stock situations



Part 3: Present and Explain Rules

3rd Rule

Balparmak Yayla Çiçek Balı 850 G



Sek Çiftlik Kaymaksız Yoğurt 450 G



Rule 82:

If Balparmak Yayla Çiçek Balı 850 G (breakfast_products)

Then Sek Çiftlik Kaymaksız Yoğurt 450 G (dairy_products)

Support: 0.05%

Confidence: 11.36%

Lift: 14.76

Business Recommendations:

1. Cross-Promotion Strategy:

- Place Balparmak Yayla Çiçek Balı 850 G and Sek Çiftlik Kaymaksız Yoğurt 450 G in close proximity
- Create bundle offers combining these products

2. Pricing Strategy:

- Consider dynamic pricing for Balparmak Yayla Çiçek Balı 850 G to increase sales of Sek Çiftlik Kaymaksız Yoğurt 450 G
- Use Balparmak Yayla Çiçek Balı 850 G as loss leaders to drive sales of Sek Çiftlik Kaymaksız Yoğurt 450 G

3. Marketing Strategy:

- Target customers who buy Balparmak Yayla Çiçek Balı 850 G with promotions for Sek Çiftlik Kaymaksız Yoğurt 450 G
- Create email campaigns highlighting the complementary nature of these products

4. Inventory Management:

- Ensure Sek Çiftlik Kaymaksız Yoğurt 450 G are well-stocked when Balparmak Yayla Çiçek Balı 850 G are on promotion
- Monitor stock levels of both products to prevent out-of-stock situations



Part 3: Present and Explain Rules

4th Rule

Sek Çiftlik Kaymaksız Yoğurt 450 G → Balparmak Yayla Çiçek Balı 850 G



Rule 83:

If Sek Çiftlik Kaymaksız Yoğurt 450 G (dairy_products)

Then Balparmak Yayla Çiçek Balı 850 G (breakfast_products)

Support: 0.05%

Confidence: 6.49%

Lift: 14.76

Business Recommendations:

1. Cross-Promotion Strategy:

- Place Sek Çiftlik Kaymaksız Yoğurt 450 G and Balparmak Yayla Çiçek Balı 850 G in close proximity
- Create bundle offers combining these products

2. Pricing Strategy:

- Consider dynamic pricing for Sek Çiftlik Kaymaksız Yoğurt 450 G to increase sales of Balparmak Yayla Çiçek Balı 850 G
- Use Sek Çiftlik Kaymaksız Yoğurt 450 G as loss leaders to drive sales of Balparmak Yayla Çiçek Balı 850 G

3. Marketing Strategy:

- Target customers who buy Sek Çiftlik Kaymaksız Yoğurt 450 G with promotions for Balparmak Yayla Çiçek Balı 850 G
- Create email campaigns highlighting the complementary nature of these products

4. Inventory Management:

- Ensure Balparmak Yayla Çiçek Balı 850 G are well-stocked when Sek Çiftlik Kaymaksız Yoğurt 450 G are on promotion
- Monitor stock levels of both products to prevent out-of-stock situations



Part 3: Present and Explain Rules

5th Rule

Eti Canga Gold 45 g → Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g



Rule 79:

If Eti Canga Gold 45 g (snacks)

Then Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g (snacks)

Support: 0.05%

Confidence: 5.81%

Lift: 13.84

Business Recommendations:

1. Cross-Promotion Strategy:

- Place Eti Canga Gold 45 g and Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g in close proximity
- Create bundle offers combining these products

2. Pricing Strategy:

- Consider dynamic pricing for Eti Canga Gold 45 g to increase sales of Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g
- Use Eti Canga Gold 45 g as loss leaders to drive sales of Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g

3. Marketing Strategy:

- Target customers who buy Eti Canga Gold 45 g with promotions for Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g
- Create email campaigns highlighting the complementary nature of these products

4. Inventory Management:

- Ensure Eti Karam 45 Kakaolu Antep FistıklıÇilekli Bitter Çikolata 60 g are well-stocked when Eti Canga Gold 45 g are on promotion
- Monitor stock levels of both products to prevent out-of-stock situations

Association rules have been saved to 'association_rules.xlsx'



Other Association Rules

	A antecedents	B consequents	C cedent	D sequent	E sup	F support	G confidence	H lift	I presentativ	J leverage	K conviction	L angs_met	M jaccard	N certainty	kulczyński
2	İçim Yarım Yağlı Üçgen Peynir 100 G	Pınar Protein Kakaolu Süt 500 Ml	0.0055	0.0068	0.0006	0.109091	16.04278		1	0.000563	1.114816	0.942852	0.051282	0.102991	0.098663
3	Pınar Protein Kakaolu Süt 500 Ml	İçim Yarım Yağlı Üçgen Peynir 100 G	0.0068	0.0055	0.0006	0.088235	16.04278		1	0.000563	1.090742	0.944086	0.051282	0.083193	0.098663
4	Balparmak Yayla Çiçek Balı 850 G	Sek Çiftlik Kaymaksız Yoğurt 450 G	0.0044	0.0077	0.0005	0.113636	14.75797		1	0.000466	1.119518	0.93636	0.043103	0.106758	0.089286
5	Sek Çiftlik Kaymaksız Yoğurt 450 G	Balparmak Yayla Çiçek Balı 850 G	0.0077	0.0044	0.0005	0.064935	14.75797		1	0.000466	1.064739	0.939474	0.043103	0.060803	0.089286
6	Eti Canga Gold 45 g	Eti Karam 45 Kakaolu Antep FıstıklıÇilekli	0.0086	0.0042	0.0005	0.05814	13.84275		1	0.000464	1.057269	0.935808	0.04065	0.054167	0.088594
7	Eti Karam 45 Kakaolu Antep FıstıklıÇilekli Bitter	Eti Canga Gold 45 g	0.0042	0.0086	0.0005	0.119048	13.84275		1	0.000464	1.125373	0.931673	0.04065	0.111406	0.088594
8	İçim Taze Peynir 180 G	Ünal Örgü Peyniri Kg	0.0065	0.0056	0.0005	0.076923	13.73626		1	0.000464	1.077267	0.933266	0.043103	0.071725	0.083104
9	Ünal Örgü Peyniri Kg	İçim Taze Peynir 180 G	0.0056	0.0065	0.0005	0.089286	13.73626		1	0.000464	1.090902	0.932422	0.043103	0.083327	0.083104
10	Eti Canga Gold 45 g	Tadım Kokteyl 180 G	0.0086	0.0044	0.0005	0.05814	13.21353		1	0.000462	1.057057	0.932338	0.04	0.053977	0.085888
11	Tadım Kokteyl 180 G	Eti Canga Gold 45 g	0.0044	0.0086	0.0005	0.113636	13.21353		1	0.000462	1.118503	0.928405	0.04	0.105948	0.085888
12	İçim Şef 18 Yağlı Krema 200 Ml	Sek Çikolatalı Pastörize Süt 200 Ml	0.0064	0.0071	0.0006	0.09375	13.20423		1	0.000555	1.095614	0.93022	0.046512	0.08727	0.089129
13	Sek Çikolatalı Pastörize Süt 200 Ml	İçim Şef 18 Yağlı Krema 200 Ml	0.0071	0.0064	0.0006	0.084507	13.20423		1	0.000555	1.085317	0.930876	0.046512	0.07861	0.089129
14	Tahsildaroğlu Gurme Ezine Beyaz Peynir 450 G	Eker Sütlaç 150 G	0.0056	0.0068	0.0005	0.089286	13.13025		1	0.000462	1.090573	0.929043	0.042017	0.08305	0.081408
15	Eker Sütlaç 150 G	Tahsildaroğlu Gurme Ezine Beyaz Peynir	0.0068	0.0056	0.0005	0.073529	13.13025		1	0.000462	1.073321	0.930165	0.042017	0.068312	0.081408
16	Ünal Örgü Peyniri Kg	Tikveşli Krema 200 Ml	0.0056	0.0069	0.0005	0.089286	12.93996		1	0.000461	1.090463	0.927916	0.041667	0.082958	0.080875
17	Tikveşli Krema 200 Ml	Ünal Örgü Peyniri Kg	0.0069	0.0056	0.0005	0.072464	12.93996		1	0.000461	1.072088	0.929131	0.041667	0.06724	0.080875
18	Sek Çikolatalı Pastörize Süt 200 Ml	Pınar Süt 200 Ml	0.0071	0.0055	0.0005	0.070423	12.8041		1	0.000461	1.069841	0.928492	0.041322	0.065282	0.080666
19	Pınar Süt 200 Ml	Sek Çikolatalı Pastörize Süt 200 Ml	0.0055	0.0071	0.0005	0.090909	12.8041		1	0.000461	1.09219	0.926998	0.041322	0.084408	0.080666
20	İçim Süzme Yoğurt 900 G	Sek Quark Yaban Mersini 140 G	0.0059	0.0073	0.0005	0.084746	11.60901		1	0.000457	1.084617	0.919284	0.03937	0.078015	0.076619
21	Sek Quark Yaban Mersini 140 G	İçim Süzme Yoğurt 900 G	0.0073	0.0059	0.0005	0.068493	11.60901		1	0.000457	1.067196	0.92058	0.03937	0.062965	0.076619
22	Eker Keşkül 150 G	Tikveşli Krema 200 Ml	0.0076	0.0069	0.0006	0.078947	11.44165		1	0.000548	1.078223	0.919589	0.043165	0.072548	0.082952
23	Tikveşli Krema 200 Ml	Eker Keşkül 150 G	0.0069	0.0076	0.0006	0.086957	11.44165		1	0.000548	1.086914	0.918941	0.043165	0.079964	0.082952
24	Eti Canga Gold 45 g	Nestle Damak Ala Beyaz Gofret 30 g	0.0086	0.0072	0.0007	0.081395	11.30491		1	0.000638	1.08077	0.91945	0.046358	0.074733	0.089309
25	Nestle Damak Ala Beyaz Gofret 30 g	Eti Canga Gold 45 g	0.0072	0.0086	0.0007	0.097222	11.30491		1	0.000638	1.098166	0.918154	0.046358	0.089391	0.089309

association_rules.xlsx



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Thankyou

