Title: Group 6

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Analysis of Purchasing Trend for Regork Customers in the Mid-Level Income Groups.

Introduction.

The Business Problem:

To identify and evaluate the purchasing trends of the 50-74k (mid-income) income demographics, which will allow us to offer the right discount coupons for the products that are commonly purchased.

This will also help us in strategically formulating campaigns and distribution of coupons to customers by studying the demographics in relation with the purchase pattern of most bought and bought-together products.

How we addressed the problem?

We performed basic Exploratory Data Analysis on the "CompleteJourney Dataset" to identify which income-range generates the most sales.

We narrowed down on the middle income groups responsible for the most sales. We looked at the total sales by department, and identified the highest and lowest sales-generating departments.

We then analyzed some demographics within this income-range and performed Market Basket Analysis on the entire products data and created rules to help us identify the most frequently bought together products.

Our Analysis and Proposed Solution:

From our analysis, we observe that sales were primarily generated by the 50-74K income group followed by 35-49K and 75-99K income-ranges. This indicated that the population belonging to these three income groups were the ones making the most purchases from Regork.

We then zeroed in on the income range "50-74K" and did a department-wise analysis which showed that "Grocery" is the topmost revenue generating department for Regork, accounting for almost 50% of the total sales. We also identified the top-10 and bottom-10 departments (except Grocery) that were generating revenue.

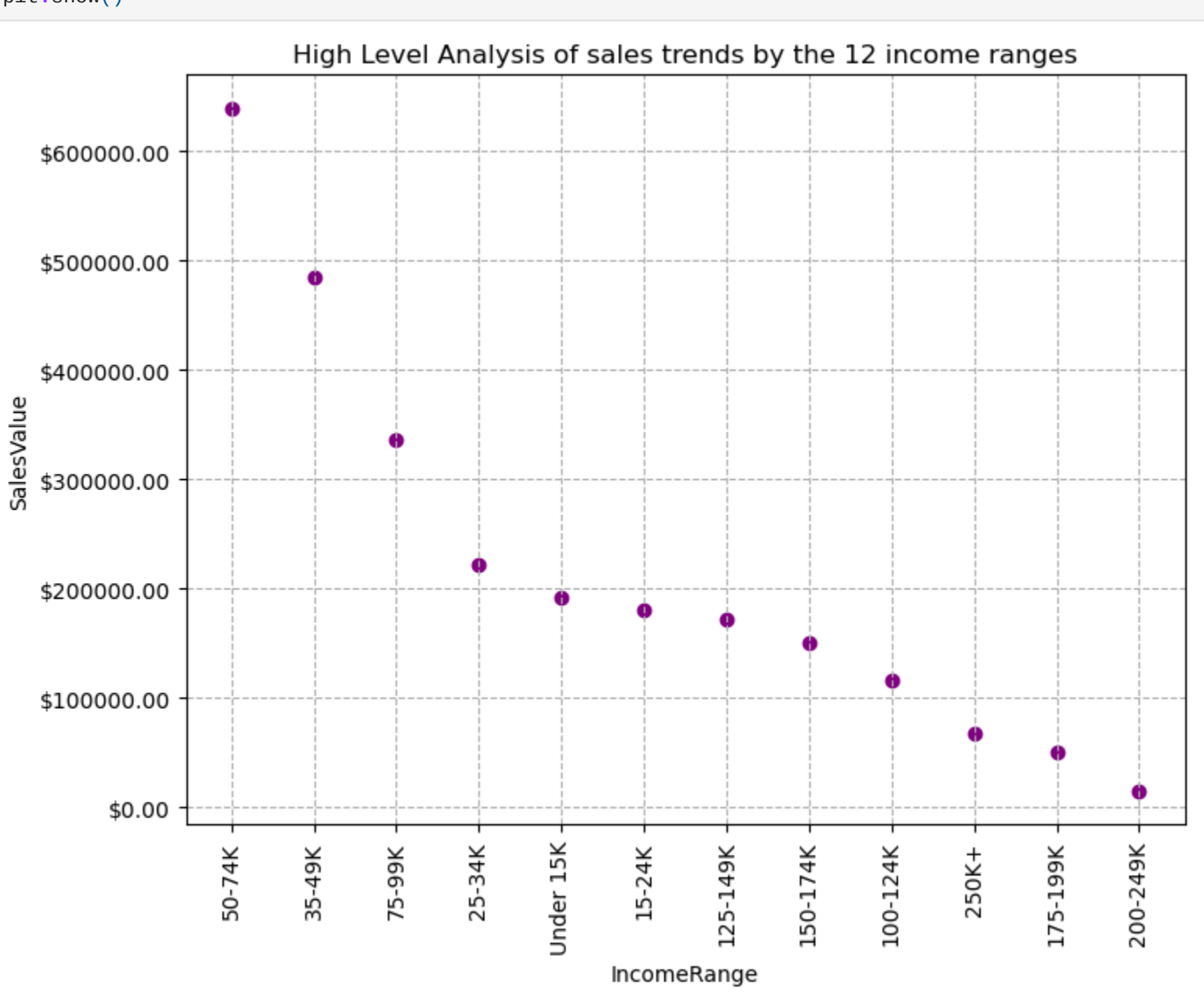
Customer demographic analysis shows that the most active customers buying Groceries from Regork are aged between 45 and 54 who are homeowners and with no kids.

Using the rules identified from Market Basket Analysis, we can create the right product bundles and give appropriate discounts and coupons on the same.

In [17]:
```
import pandas as pd
pd.options.mode.chained_assignment = None
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

import pandas as pd
from completejourney_py import get_data
```

In [18]:
```
cj_data = get_data()

transactions = cj_data['transactions']
products = cj_data['products']
coupons = cj_data['coupons']
campaigns = cj_data['campaigns']
demographics = cj_data['demographics']
campaign_descriptions = cj_data['campaign_descriptions']
coupon_redemptions = cj_data['coupon_redemptions']
```

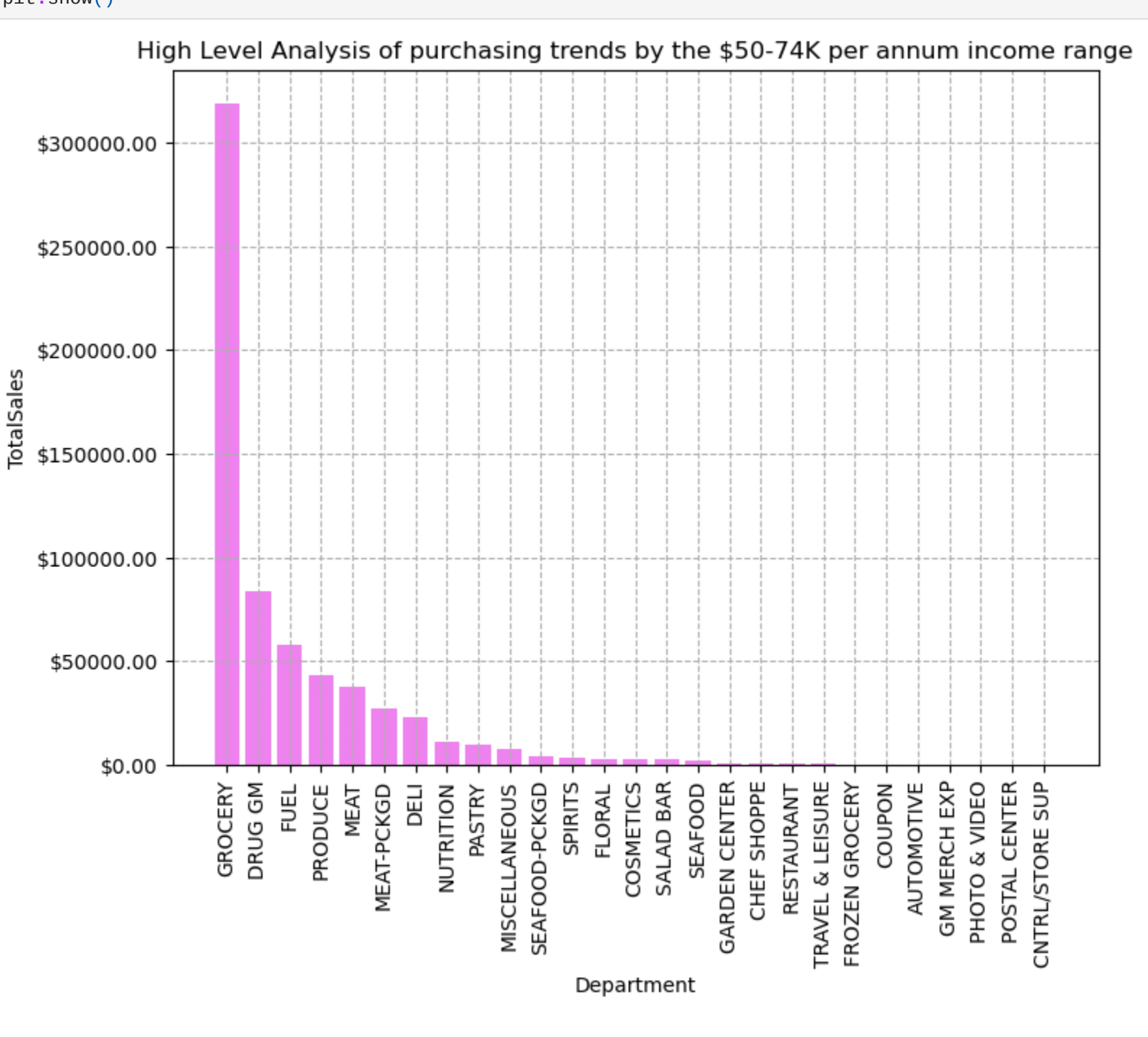
In [19]:
```
df1 = transactions.merge(products, how = 'inner', on = 'product_id')
df1 = df1.merge(demographics, how = 'inner', on = "household_id")
df_final1 = df1.groupby(['income'], as_index = False).agg({'sales_value' : sum}).sort_values(by = 'sales_value', ascending = False)
df_final1

import matplotlib.pyplot as plt
import matplotlib.ticker as mtick

fig = plt.figure()
ax = fig.add_axes([0,0,1,1])

income = df_final1['income']
sales_value = df_final1['sales_value']

ax.scatter(income, sales_value, color = 'purple')
ax.set_ylabel('SalesValue')
ax.set_xlabel('IncomeRange')
ax.set_title('High Level Analysis of sales trends by the 12 income ranges')
ax.yaxis.set_major_formatter('${x:1.2f}')
ax.grid(linestyle = 'dashed')
plt.xticks(rotation = 90)

plt.show()
```



Overall Sales trend per department for income range "50-74K"

Based on the above graph, we decided to dive deeper into this income range. We mapped the sales for the income group "50-74K" for each department to better understand their purchasing patterns. We identified that the "Grocery" department contributed towards more than 50% of the overall sales followed by the "Drug GM" department.

In [20]:
```
df2 = transactions.merge(products, how = 'inner', on = 'product_id')
df2 = df2.merge(demographics, how = 'inner', on = "household_id").query("income == '50-74K'")
df_final2 = df2.groupby(['department'], as_index = False).agg({'sales_value' : sum}).sort_values(by = 'sales_value', ascending = False)
df_final2

import matplotlib.pyplot as plt
import matplotlib.ticker as mtick

fig = plt.figure()
ax = fig.add_axes([0,0,1,1])

department = df_final2['department']
sales_value = df_final2['sales_value']


ax.bar(department, sales_value, color = 'Violet')
ax.set_ylabel('TotalSales')
ax.set_xlabel('Department')
ax.set_title('High Level Analysis of purchasing trends by the $50-74K per annum income range')
ax.yaxis.set_major_formatter('${x:1.2f}')
ax.grid(linestyle = 'dashed')
plt.xticks(rotation = 90)
plt.show()
```



Intermediate Level Analysis of Departments

Overall Sales Analysis for top-10 and bottom-10 departments (except Grocery)

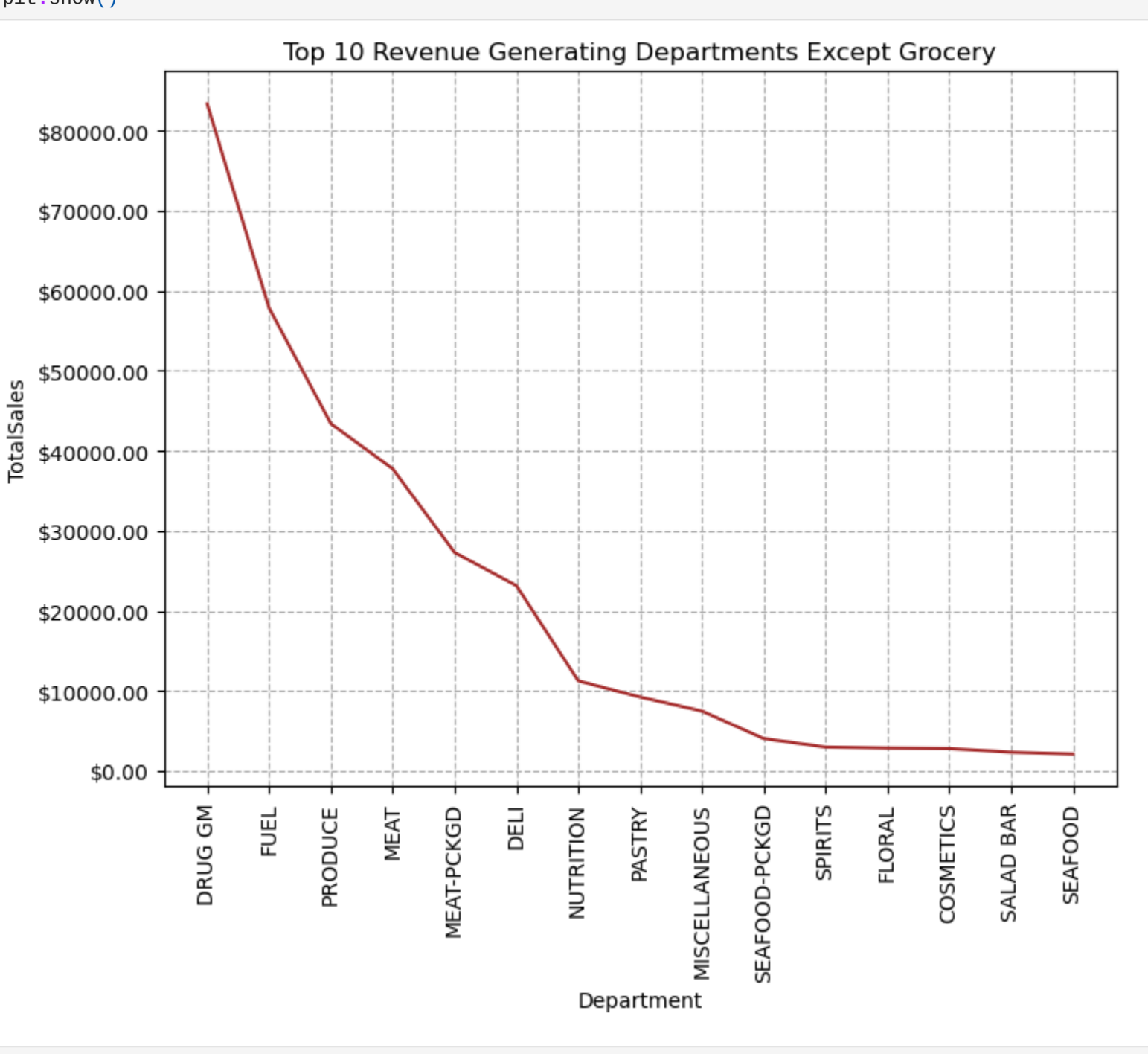
After studying the above plot, we realized that due to the high sales under the Grocery department, the scale was getting skewed and we weren't able to properly observe the sales trend for the lowest revenue-generating 11 departments. To better accommodate this, we have broken down the graph into the below 2 plots to individually study the top-10 and bottom-10 departments (excluding Grocery).

In [21]:
```
df3 = transactions.merge(products, how = 'inner', on = 'product_id')
df3 = df3.merge(demographics, how = 'inner', on = "household_id").query("income == '50-74K'")
df3 = df3.query("department != 'GROCERY'")
df_final3 = df3.groupby(['department'], as_index = False).agg({'sales_value' : sum}).sort_values(by = 'sales_value', ascending = False)
df_final3 = df_final3.head(15)
df_final3
```

Out[21]:

	department	sales_value
6	DRUG GM	83353.15
9	FUEL	57874.74
19	PRODUCE	43410.30
12	MEAT	37764.83
13	MEAT-PCKGD	27316.63
5	DELI	23174.38
15	NUTRITION	11279.97
16	PASTRY	9246.25
14	MISCELLANEOUS	7500.38
23	SEAFOOD-PCKGD	4061.07
24	SPIRITS	3005.06
7	FLORAL	2873.53
3	COSMETICS	2820.12
21	SALAD BAR	2364.61
22	SEAFOOD	2128.69

In [22]:
```
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])

department = df_final3['department']
sales_value = df_final3['sales_value']


ax.plot(department, sales_value, color = 'brown')
ax.set_ylabel('TotalSales')
ax.set_xlabel('Department')
ax.set_title('Top 10 Revenue Generating Departments Except Grocery')
ax.yaxis.set_major_formatter('${x:1.2f}')
ax.grid(linestyle = 'dashed')
plt.xticks(rotation = 90)
plt.show()
```

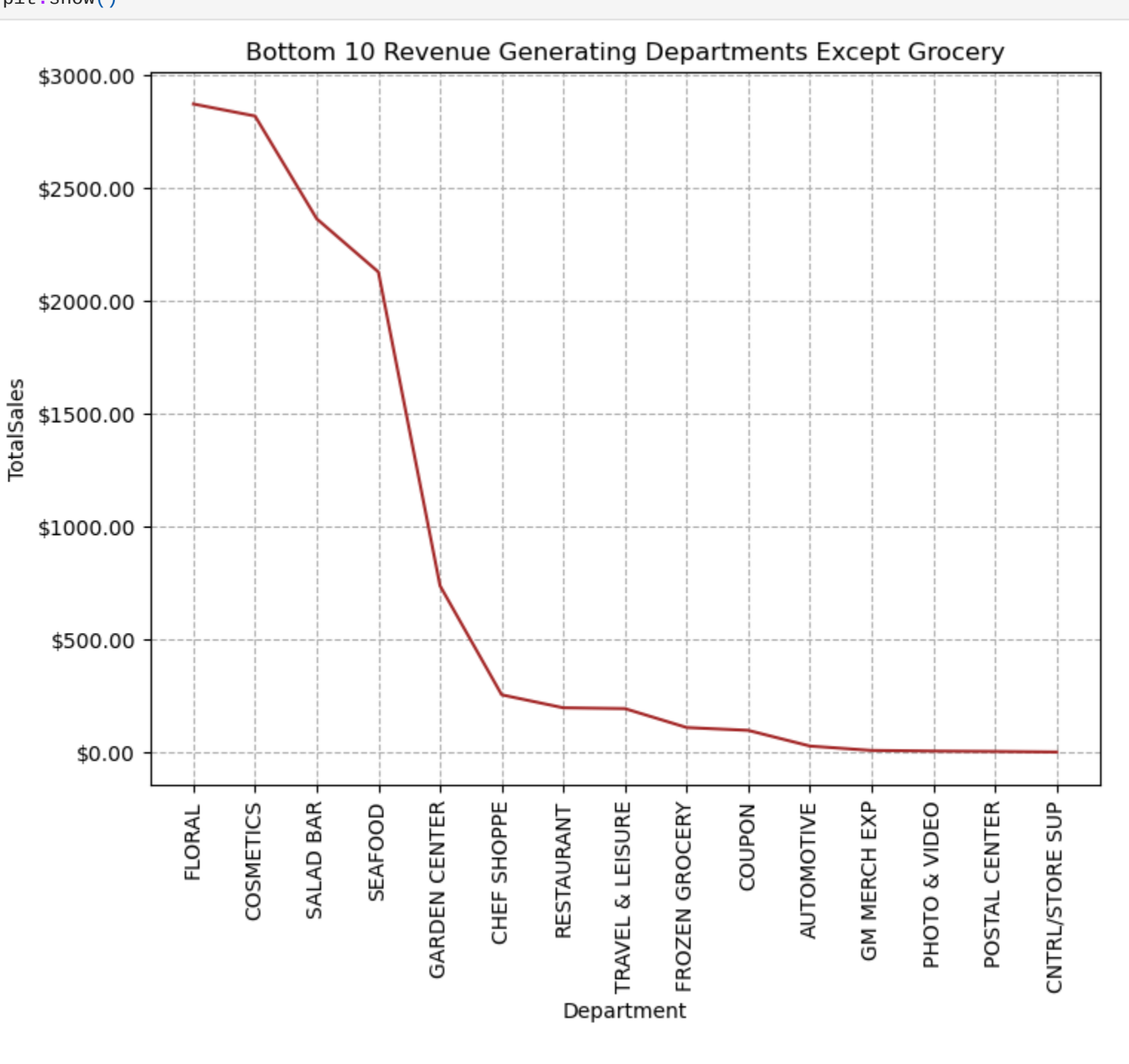


In [23]:
```
df4 = transactions.merge(products, how = 'inner', on = 'product_id')
df4 = df4.merge(demographics, how = 'inner', on = "household_id").query("income == '50-74K'")
df4 = df4.query("department != 'GROCERY'")
df_final4 = df4.groupby(['department'], as_index = False).agg({'sales_value' : sum}).sort_values(by = 'sales_value', ascending = False)
df_final4 = df_final4.tail(15)
df_final4
```

Out[23]:

	department	sales_value
7	FLORAL	2873.53
3	COSMETICS	2820.12
21	SALAD BAR	2364.61
22	SEAFOOD	2128.69
10	GARDEN CENTER	737.35
1	CHEF SHOPPE	253.66
20	RESTAURANT	196.03
25	TRAVEL & LEISURE	192.40
8	FROZEN GROCERY	108.62
4	COUPON	95.86
0	AUTOMOTIVE	26.32
11	GM MERCH EXP	6.94
17	PHOTO & VIDEO	4.11
18	POSTAL CENTER	2.49
2	CNTRL/STORE SUP	0.00

In [24]:
```
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])

department = df_final4['department']
sales_value = df_final4['sales_value']


ax.plot(department, sales_value, color = 'brown')
ax.set_ylabel('TotalSales')
ax.set_xlabel('Department')
ax.set_title('Bottom 10 Revenue Generating Departments Except Grocery')
ax.yaxis.set_major_formatter('${x:1.2f}')
ax.grid(linestyle = 'dashed')
plt.xticks(rotation = 90)
plt.show()
```



In-Depth Customer Demographic Analysis

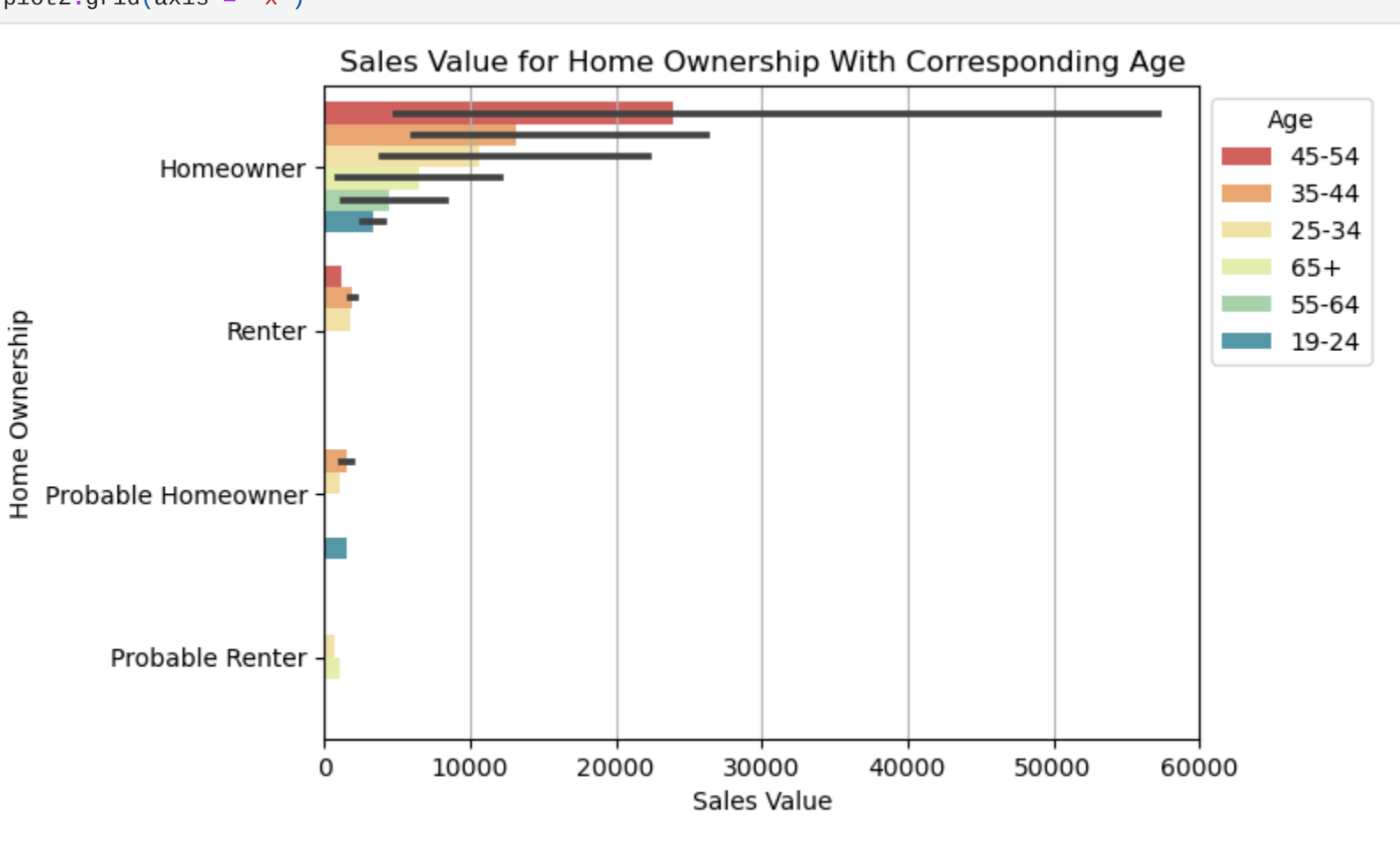
To dive deeper into the $50-74K income range and uncover insights on the purchases made by them, we plotted the below graph to identify specific demographic based on their age, homeowner status, and count of kids.

In [25]:
```
df5 = transactions.merge(products, how = 'inner', on = 'product_id')
df5 = df5.query("department == 'GROCERY'")
df5 = df5.groupby(['household_id'], as_index = False).agg({'basket_id' : "nunique", 'sales_value': sum}).sort_values(by = 'sales_value', ascending =
df5 = df5.merge(demographics, how = 'inner', on = 'household_id').query("home_ownership != 'NA'")
df5 = df5.query("income == '50-74K'")
df5 = df5.groupby(['age', 'home_ownership', 'kids_count'], as_index = False).agg({'basket_id' : "nunique", 'sales_value': sum}).sort_values(by = 'sa
df5
```

Out[25]:

	age	home_ownership	kids_count	basket_id	sales_value
18	45-54	Homeowner	0	36	73428.97
10	35-44	Homeowner	0	16	32645.78
3	25-34	Homeowner	0	11	27066.83
26	65+	Homeowner	0	6	12074.01
20	45-54	Homeowner	2	6	11235.09
19	45-54	Homeowner	1	6	8359.51
23	55-64	Homeowner	0	4	8356.32
5	25-34	Homeowner	2	3	7659.39
13	35-44	Homeowner	3+	4	7656.76
12	35-44	Homeowner	2	3	6871.04
11	35-44	Homeowner	1	4	5620.77
0	19-24	Homeowner	0	2	4039.92
4	25-34	Homeowner	1	3	3942.22
6	25-34	Homeowner	3+	4	3913.08
24	55-64	Homeowner	1	3	3603.67
21	45-54	Homeowner	3+	2	2826.29
1	19-24	Homeowner	1	1	2585.85
16	35-44	Renter	1	1	2095.53
14	35-44	Probable Homeowner	0	1	1851.45
9	25-34	Renter	0	1	1791.43
17	35-44	Renter	2	1	1747.89
2	19-24	Probable Homeowner	0	1	1545.59
25	55-64	Homeowner	3+	1	1296.03
22	45-54	Renter	0	1	1210.09
15	35-44	Probable Homeowner	2	1	1183.29
28	65+	Probable Renter	1	1	1084.23
7	25-34	Probable Homeowner	1	1	1083.70
27	65+	Homeowner	1	1	931.69
8	25-34	Probable Renter	0	1	735.23

In [26]:
```
plot2 = sns.barplot(data = df5, x = 'sales_value', y = 'home_ownership', hue = 'age', orient = 'h')
plot2.set(xlabel = 'Sales Value', ylabel = 'Home Ownership', title = 'Sales Value for Home Ownership With Corresponding Age')
plot2.legend(title = 'Age', bbox_to_anchor=(1, 1), loc = 'upper left')
plot2.grid(axis = 'x')
```



Exploratory Data Analysis Part 2

In-Depth Market Basket Analysis

To dive even deeper into the $50-74K income group making Grocery purchases, belonging to age-group as 45-54, homeowners with 0 kids, and uncover their purchasing trends we have individually identified the top 20 most frequently bought items by married and unmarried people fitting this demographic group by using market basket analysis.

In [27]:
```
df6 = transactions.merge(demographics, how = 'inner', on = 'household_id')
df6 = df6.merge(products, how = 'inner', on = 'product_id')
df6 = df6.query("income == '50-74K'")
df6 = df6.query("kids_count == '0'")
df6 = df6.query("home_ownership == 'Homeowner'")
df6 = df6.query("age == '45-54'")
df6 = df6.query("household_size == '1'")
df6 = df6.query("sales_value != '0.00'")
df6
```

Out[27]:

	household_id	store_id	basket_id	product_id	quantity	sales_value	retail_disc	coupon_disc	coupon_match_disc	week	...	marital_status	household_size	household_comp
68	2341	335	34141765421	1095275	3	1.50	0.00	0.0	0.0	30	...	Unmarried	1	1 Adult No Kids
109	1595	384	32074827317	1095275	4	2.00	0.00	0.0	0.0	10	...	Unmarried	1	1 Adult No Kids
110	1595	384	32760626128	1095275	8	4.00	0.00	0.0	0.0	16	...	Unmarried	1	1 Adult No Kids
160	771	359	35386657523	1095275	1	0.50	0.00	0.0	0.0	35	...	Unmarried	1	1 Adult No Kids
161	771	359	35486310496	1095275	1	0.50	0.00	0.0	0.0	35	...	Unmarried	1	1 Adult No Kids
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
825240	1001	3131	41429516853	10287852	1	1.60	0.00	0.0	0.0	53	...	Unmarried	1	1 Adult No Kids
825241	1001	3131	41429516853	12785200	1	3.49	0.00	0.0	0.0	53	...	Unmarried	1	1 Adult No Kids
825242	1001	3131	41429516853	15781342	1	1.50	0.99	0.0	0.0	53	...	Unmarried	1	1 Adult No Kids
825243	1001	3131	41429516853	15978400	1	1.00	0.00	0.0	0.0	53	...	Unmarried	1	1 Adult No Kids
825244	1001	3131	41429516853	16772915	1	1.50	1.99	0.0	0.0	53	...	Unmarried	1	1 Adult No Kids

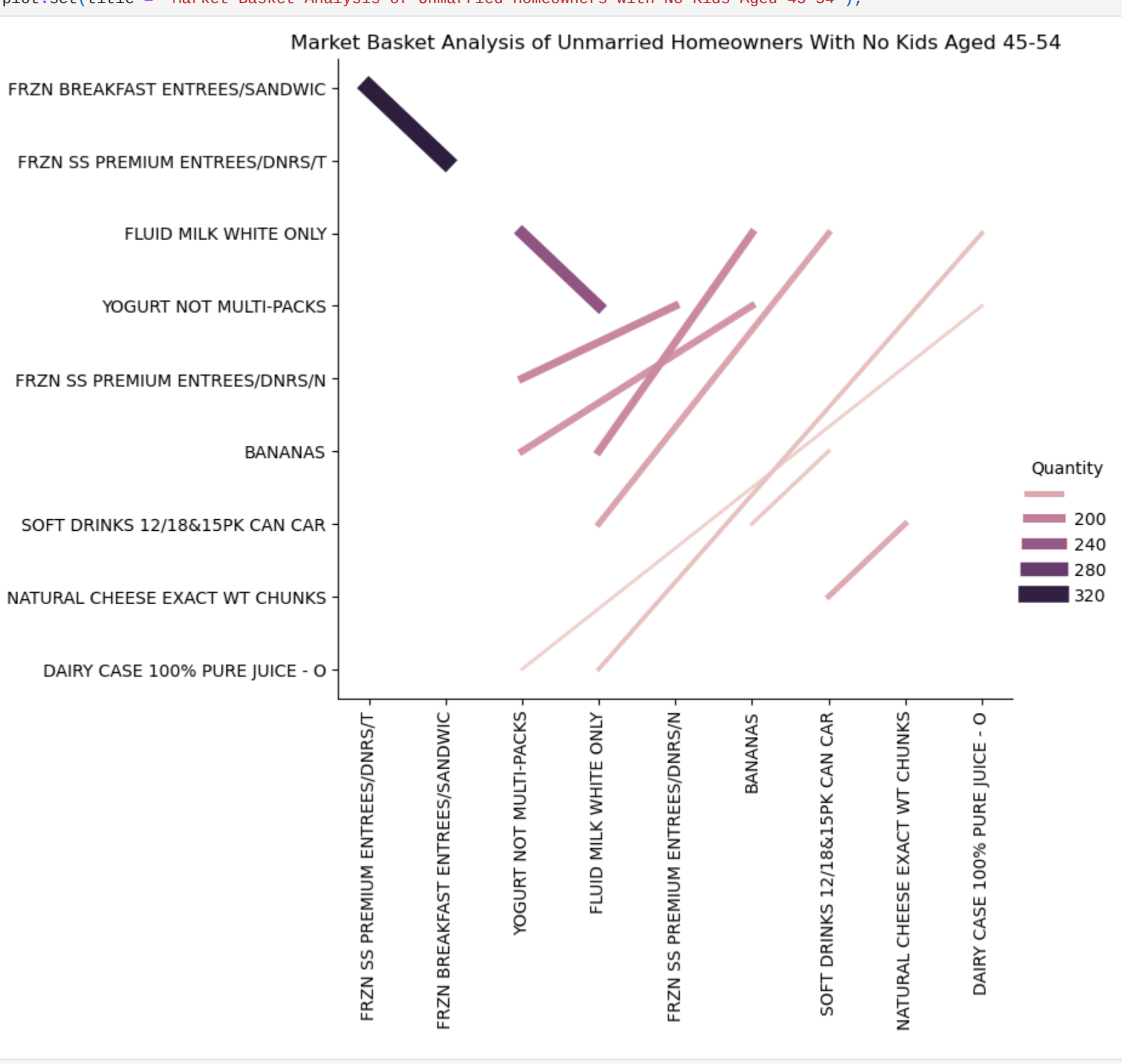
19936 rows × 24 columns

In [28]:
```
df7 = df6[['basket_id', 'product_type']]

mba_unmarried = df7.merge(df7, how = 'inner', on = 'basket_id')
mba_unmarried = mba_unmarried.query('product_type_x != product_type_y')
mba_unmarried = mba_unmarried.groupby(['product_type_x','product_type_y'], as_index = False)
mba_unmarried = mba_unmarried.count()
mba_unmarried = mba_unmarried.sort_values('basket_id', ascending = False)

mba_unmarried_final = mba_unmarried[0:20]
mba_unmarried_final
```

Out[28]:

	product_type_x	product_type_y	basket_id
48037	FRZN BREAKFAST ENTREES/SANDWIC	FRZN SS PREMIUM ENTREES/DNRS/T	324
50239	FRZN SS PREMIUM ENTREES/DNRS/T	FRZN BREAKFAST ENTREES/SANDWIC	324
43947	FLUID MILK WHITE ONLY	YOGURT NOT MULTI-PACKS	247
138286	YOGURT NOT MULTI-PACKS	FLUID MILK WHITE ONLY	247
50104	FRZN SS PREMIUM ENTREES/DNRS/N	YOGURT NOT MULTI-PACKS	190
138309	YOGURT NOT MULTI-PACKS	FRZN SS PREMIUM ENTREES/DNRS/N	190
43158	FLUID MILK WHITE ONLY	BANANAS	188
7545	BANANAS	FLUID MILK WHITE ONLY	188
138149	YOGURT NOT MULTI-PACKS	BANANAS	177
8075	BANANAS	YOGURT NOT MULTI-PACKS	177
118027	SOFT DRINKS 12/18&15PK CAN CAR	FLUID MILK WHITE ONLY	164
43834	FLUID MILK WHITE ONLY	SOFT DRINKS 12/18&15PK CAN CAR	164
77934	NATURAL CHEESE EXACT WT CHUNKS	SOFT DRINKS 12/18&15PK CAN CAR	158
118196	SOFT DRINKS 12/18&15PK CAN CAR	NATURAL CHEESE EXACT WT CHUNKS	158
32870	DAIRY CASE 100% PURE JUICE - O	FLUID MILK WHITE ONLY	138
43316	FLUID MILK WHITE ONLY	DAIRY CASE 100% PURE JUICE - O	138
117843	SOFT DRINKS 12/18&15PK CAN CAR	BANANAS	131
7964	BANANAS	SOFT DRINKS 12/18&15PK CAN CAR	131
33343	DAIRY CASE 100% PURE JUICE - O	YOGURT NOT MULTI-PACKS	123
138248	YOGURT NOT MULTI-PACKS	DAIRY CASE 100% PURE JUICE - O	123

In [29]:
```
sns.set_palette(palette = "Spectral", n_colors = None, desat = None, color_codes = True)
plot = sns.relplot(data = mba_unmarried_final, x = "product_type_y", y = "product_type_x", hue = 'basket_id', size = 'basket_id', kind = "line", asp
plot._legend.texts[0].set_text("")
plot._legend.set_title('Quantity')
plot.set(title = 'Market Basket Analysis of Unmarried Homeowners With No Kids Aged 45-54');
```



In [30]:
```
df8 = transactions.merge(demographics, how = 'inner', on = 'household_id')
df8 = df8.merge(products, how = 'inner', on = 'product_id')
df8 = df8.query("income == '50-74K'")
df8 = df8.query("kids_count == '0'")
df8 = df8.query("home_ownership == 'Homeowner'")
df8 = df8.query("age == '45-54'")
df8 = df8.query("household_size == '2'")
df8 = df8.query("sales_value != '0.00'")
df8
```

Out[30]:

	household_id	store_id	basket_id	product_id	quantity	sales_value	retail_disc	coupon_disc	coupon_match_disc	week	...	marital_status	household_size	household_comp
173	1509	429	31242547057	1095275	2	1.00	0.0	0.0	0.0	2	...	Married	2	2 Adults No Kids
174	1509	429	31355982106	1095275	2	1.00	0.0	0.0	0.0	3	...	Married	2	2 Adults No Kids
175	1509	362	31540761398	1095275	3	1.50	0.0	0.0	0.0	4	...	Married	2	2 Adults No Kids
176	1509	429	31623627344	1095275	2	1.00	0.0	0.0	0.0	5	...	Married	2	2 Adults No Kids
177	1509	429	31699252341	1095275	3	1.50	0.0	0.0	0.0	6	...	Married	2	2 Adults No Kids
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
825071	2094	333	33433190292	13381286	1	3.99	0.0	0.0	0.0	23	...	Married	2	2 Adults No Kids
825072	2094	333	33957173155	6979060	1	5.44	0.0	0.0	0.0	28	...	Married	2	2 Adults No Kids
825074	2094	333	40618663240	900218	1	2.99	0.0	0.0	0.0	45	...	Married	2	2 Adults No Kids
825075	2094	333	41352106093	15717291	1	0.89	0.1	0.0	0.0	52	...	Married	2	2 Adults No Kids
825076	2094	333	41453283359	1002026	1	3.59	0.0	0.0	0.0	53	...	Married	2	2 Adults No Kids

26109 rows × 24 columns

In [31]:
```
df9 = df8[['basket_id', 'product_type']]

mba_married = df9.merge(df9, how = 'inner', on = 'basket_id')
mba_married = mba_married.query('product_type_x != product_type_y')
mba_married = mba_married.groupby(['product_type_x','product_type_y'], as_index = False)
mba_married = mba_married.count()
mba_married = mba_married.sort_values('basket_id', ascending = False)

mba_married_final = mba_married[0:20]
mba_married_final
```

Out[31]:

	product_type_x	product_type_y	basket_id
68581	FLUID MILK WHITE ONLY	YOGURT NOT MULTI-PACKS	316
218015	YOGURT NOT MULTI-PACKS	FLUID MILK WHITE ONLY	316
12371	BANANAS	FLUID MILK WHITE ONLY	255
67581	FLUID MILK WHITE ONLY	BANANAS	255
217838	YOGURT NOT MULTI-PACKS	BANANAS	246
13016	BANANAS	YOGURT NOT MULTI-PACKS	246
68412	FLUID MILK WHITE ONLY	SHREDDED CHEESE	206
182065	SHREDDED CHEESE	FLUID MILK WHITE ONLY	206
67905	FLUID MILK WHITE ONLY	FRZN SS PREMIUM ENTREES/DNRS/N	192
80056	FRZN SS PREMIUM ENTREES/DNRS/N	FLUID MILK WHITE ONLY	192
28068	CANNED CAT FOOD (9 LIVES/FRISK	FRZN MEAT ALTERNATIVES	184
78772	FRZN MEAT ALTERNATIVES	CANNED CAT FOOD (9 LIVES/FRISK	184
67881	FLUID MILK WHITE ONLY	FRZN BAGGED VEGETABLES - PLAIN	173
73593	FRZN BAGGED VEGETABLES - PLAIN	FLUID MILK WHITE ONLY	173
68261	FLUID MILK WHITE ONLY	PREMIUM	171
152422	PREMIUM	FLUID MILK WHITE ONLY	171
28071	CANNED CAT FOOD (9 LIVES/FRISK	FRZN SS PREMIUM ENTREES/DNRS/N	170
79947	FRZN SS PREMIUM ENTREES/DNRS/N	CANNED CAT FOOD (9 LIVES/FRISK	170
51567	DAIRY CASE 100% PURE JUICE - O	FLUID MILK WHITE ONLY	168
182626	SHREDDED CHEESE	YOGURT NOT MULTI-PACKS	168

In [33]:
```
sns.set_palette(palette = "Spectral", n_colors = None, desat = None, color_codes = True)
plot = sns.relplot(data = mba_married_final, x = "product_type_y", y = "product_type_x", hue = 'basket_id', size = 'basket_id', kind = "line", aspec
plot._legend.texts[0].set_text("")
plot._legend.set_title('Quantity')
plot.set(title = 'Market Basket Analysis of Married Homeowners With No Kids Aged 45-54');
```

Summary

Problem Statement

Our problem statement is to identify trends in the purchasing of products by people belonging to $50-74K income group, specifically in Grocery department, to help Regork make better data-driven decisions for this target group.

Problem Addressal

* We have used the completejourney dataset which includes the transactions, the demographics and the products data.

* We have employed plots and data visualization libraries to depict interesting results that will help Regork enhance their sales by streamlining their marketing and campaigning strategy with effective use of coupons, discounts, and combo offers.

Interesting Insights

* We see from our analysis that sales were primarily generated by the "50-74K" income group followed by the income groups "35-49K" and "75-99K". This indicated that the people from these three income groups were the ones who were making the most purchases from Regork.

* We identified that Grocery sales are the ones driving the maximum sales within the 50-74K income groups and generating the most revenue. We also identified some of the under-performing departments such as Postal Center and Photo & Video.

* We then identified that people aged between 45-54, who own homes and have no kids are the ones driving the majority of these sales.

* Using the trends identified via Market Basket Analysis, we noted that breakfast items such as Sandwiches, Yogurt, Entrees etc. are the most frequently bought items.

Our Proposal

We propose the following points to help increase Regork's profits:

* Increased marketing directed towards mid-level income groups can help boost sales.

* Some of the under-performing departments such as Postal Center, Photo & Video etc. can be benefited with better targeted promotions and coupon offerings.

* Increased offers such as combos, discounts etc. on frequently bought breakfast items can help increase sales and profits.

Limitations

* Data quality issues - Some of the data that we wanted to use such as marital status had 'NA' data within it. A dataset without such 'NA' data would've led to much more accurate insights and led to the discovery of more interesting facts.

* Coupon & Demographic link - It would have been easier if there was a direct relation between coupon and demographics. This is one area we can explore further to identify which income groups redeemed most coupons.

* Location data in demographics - Having the location data of the demographics we tested upon would've been nice to help uncover the purchasing trend location-wise. Once we have that data, we can build on top of this report to better target customers based on their location.

In [ ]: