Quantium Virtual Internship - Retail Strategy and Analytics - Task 1

In [1]:
```
import pandas as pd
import numpy as np

import seaborn as sns
import matplotlib.pyplot as plt

import re ## For data cleaning of string variables
```

In [2]:
```
purchase = pd.read_csv('QVI_purchase_behaviour.csv')
transaction = pd.read_excel('QVI_transaction_data.xlsx')
```

In [3]:
```
transaction['DATE'] = pd.to_datetime(transaction['DATE'], unit='D', origin='1899-12-30')
```

In [4]:
```
purchase.head()
```

Out[4]:

	LYLTY_CARD_NBR	LIFESTAGE	PREMIUM_CUSTOMER
0	1000	YOUNG SINGLES/COUPLES	Premium
1	1002	YOUNG SINGLES/COUPLES	Mainstream
2	1003	YOUNG FAMILIES	Budget
3	1004	OLDER SINGLES/COUPLES	Mainstream
4	1005	MIDAGE SINGLES/COUPLES	Mainstream

In [5]:
```
transaction.head()
```

Out[5]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0
1	2019-05-14	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3
2	2019-05-20	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2	2.9
3	2018-08-17	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5	15.0
4	2018-08-18	2	2426	1038	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.8

- Let us look more into both dataframes and check for missing values or duplicate values

In [6]:
```
purchase.isna().sum()
```

Out[6]:
```
LYLTY_CARD_NBR      0
LIFESTAGE           0
PREMIUM_CUSTOMER    0
dtype: int64
```

In [7]:
```
transaction.isna().sum()
```

Out[7]:
```
DATE              0
STORE_NBR         0
LYLTY_CARD_NBR    0
TXN_ID            0
PROD_NBR          0
PROD_NAME         0
PROD_QTY          0
TOT_SALES         0
dtype: int64
```

In [8]:
```
purchase.duplicated().sum()
```

Out[8]:
```
0
```

In [9]:
```
transaction.duplicated().sum()
```

Out[9]:
```
1
```

In [10]:
```
transaction[transaction.duplicated()]
```

Out[10]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES
124845	2018-10-01	107	107024	108462	45	Smiths Thinly Cut Roast Chicken 175g	2	6.0

- There are no missing values in `purchase` and `transaction` dataframe

- There are no missing values in `purchase` and `transaction` dataframe.
- But we have one duplicate value in `trasaction` dataframe, we would drop this duplicate.

In [11]:
```
transaction.drop_duplicates(inplace=True)
```

In [12]:
```
transaction.duplicated().sum()  # Dropped the duplicates
```

Out[12]:
```
0
```

In [13]:
```
purchase.head(2)
```

Out[13]:

	LYLTY_CARD_NBR	LIFESTAGE	PREMIUM_CUSTOMER
0	1000	YOUNG SINGLES/COUPLES	Premium
1	1002	YOUNG SINGLES/COUPLES	Mainstream

In [14]:
```
transaction.head(2)
```

Out[14]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0
1	2019-05-14	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3

- It can be observed that both dataframes have, `LYLTY_CARD_NBR` as a common column
- We would use this column to perform a join to form merged both dataframes into one.

In [15]:
```
df = transaction.merge(purchase, on='LYLTY_CARD_NBR', how='left')

df.head()
```

Out[15]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES	LIFESTAGE	PREMIUM_CU
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0	YOUNG SINGLES/COUPLES	
1	2019-05-14	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3	MIDAGE SINGLES/COUPLES	
2	2019-05-20	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2	2.9	MIDAGE SINGLES/COUPLES	
3	2018-08-17	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5	15.0	MIDAGE SINGLES/COUPLES	
4	2018-08-18	2	2426	1038	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.8	MIDAGE SINGLES/COUPLES	

In [16]:
```
df.isna().sum()
```

Out[16]:
```
DATE              0
STORE_NBR         0
LYLTY_CARD_NBR    0
TXN_ID            0
PROD_NBR          0
PROD_NAME         0
PROD_QTY          0
TOT_SALES         0
LIFESTAGE         0
PREMIUM_CUSTOMER  0
dtype: int64
```

- After merging we do not have any missing values.
- But we also need to check for consistency of datatypes of all the columns.

In [17]:
```
df.dtypes
```

Out[17]:
```
DATE              datetime64[ns]
STORE_NBR                  int64
LYLTY_CARD_NBR             int64
TXN_ID                     int64
PROD_NBR                   int64
PROD_NAME                 object
PROD_QTY                   int64
TOT_SALES                float64
LIFESTAGE                 object
PREMIUM_CUSTOMER          object
dtype: object
```

In [18]:
```
df['PROD_NBR'].nunique()
```

Out[18]: 114

In [19]:
```
df['PROD_NAME'].nunique()
```

Out[19]: 114

In [20]:
```
df['STORE_NBR'].nunique()
```

Out[20]: 272

In [21]:
```
df['TXN_ID'].nunique()
```

Out[21]: 263127

- `PROD_NBR` and `PROD_NAME` are referring to same variable, we will drop `PROD_NBR` as `PROD_NAME` does a better job on this.
- We can also extract different features from `DATE` column.
- We also need to rename the columns to interpretable names.

In [22]:
```
df.head()
```

Out[22]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES	LIFESTAGE	PREMIUM_CU
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0	YOUNG SINGLES/COUPLES	
1	2019-05-14	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3	MIDAGE SINGLES/COUPLES	
2	2019-05-20	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2	2.9	MIDAGE SINGLES/COUPLES	
3	2018-08-17	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5	15.0	MIDAGE SINGLES/COUPLES	
4	2018-08-18	2	2426	1038	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.8	MIDAGE SINGLES/COUPLES	

In [23]:
```
df['Year'] = df['DATE'].dt.year   # Year
df['Month'] = df['DATE'].dt.strftime('%B')     # Month Name
df['Day of week'] = df['DATE'].dt.strftime('%A')      # Day Name

df['Quarter'] = df['DATE'].dt.quarter      # Quarter of the year
```

In [24]:
```
df.head(2)
```

Out[24]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES	LIFESTAGE	PREMIUM_CUS
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0	YOUNG SINGLES/COUPLES	P
1	2019-05-14	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3	MIDAGE SINGLES/COUPLES	

In [25]:
```
df = df.drop('PROD_NBR', axis=1) # Dropping 'PROD_NBR' column
```

In [26]:
```
df.head(2)
```

Out[26]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NAME	PROD_QTY	TOT_SALES	LIFESTAGE	PREMIUM_CUSTOMER	Year
0	2018-10-17	1	1000	1	Natural Chip Compny SeaSalt175g	2	6.0	YOUNG SINGLES/COUPLES	Premium	2018
1	2019-05-14	1	1307	348	CCs Nacho Cheese 175g	3	6.3	MIDAGE SINGLES/COUPLES	Budget	2019

In [27]:
```
df.rename(columns={'DATE':'Date', 'STORE_NBR':'Store Number', 'LYLTY_CARD_NBR':'Loyalty Card Number',
                   'TXN_ID':'Transaction ID', 'PROD_NAME':'Product Name', 'PROD_QTY':'Quantity',
                   'TOT_SALES':'Total Sales', 'LIFESTAGE':'Family and Life Stage',
                    'PREMIUM_CUSTOMER':'Shopping Behavior and Preferences'}, inplace=True)
```

In [28]:
```
order = ['Transaction ID','Loyalty Card Number','Family and Life Stage','Date',
         'Shopping Behavior and Preferences','Year','Month','Day of week','Quarter',
         'Store Number','Product Name','Quantity', 'Total Sales' ]

len(order)
```

Out[28]: 13

In [29]:
```
df = df[order]

df.head()
```

Out[29]:

	Transaction ID	Loyalty Card Number	Family and Life Stage	Date	Shopping Behavior and Preferences	Year	Month	Day of week	Quarter	Store Number	Product Name	Quantity	Tota Sale
0	1	1000	YOUNG SINGLES/COUPLES	2018-10-17	Premium	2018	October	Wednesday	4	1	Natural Chip Compny SeaSalt175g	2	6.
1	348	1307	MIDAGE SINGLES/COUPLES	2019-05-14	Budget	2019	May	Tuesday	2	1	CCs Nacho Cheese 175g	3	6.
2	383	1343	MIDAGE SINGLES/COUPLES	2019-05-20	Budget	2019	May	Monday	2	1	Smiths Crinkle Cut Chips Chicken 170g	2	2.
3	974	2373	MIDAGE SINGLES/COUPLES	2018-08-17	Budget	2018	August	Friday	3	2	Smiths Chip Thinly S/Cream&Onion 175g	5	15.
4	1038	2426	MIDAGE SINGLES/COUPLES	2018-08-18	Budget	2018	August	Saturday	3	2	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.

In [30]:
```
#df.to_csv('final_data.csv',index=False)
```

Unveiling Insights: A Deep Dive into the Data

Exploratory Data Analysis

In [31]:
```
df = pd.read_csv('final_data.csv', parse_dates=['Date'])
```

In [32]:
```
df.head()
```

Out[32]:

	Transaction ID	Loyalty Card Number	Family and Life Stage	Date	Shopping Behavior and Preferences	Year	Month	Day of week	Quarter	Store Number	Product Name	Quantity	Tota Sale
0	1	1000	YOUNG SINGLES/COUPLES	2018-10-17	Premium	2018	October	Wednesday	4	1	Natural Chip Compny SeaSalt175g	2	6.
1	348	1307	MIDAGE SINGLES/COUPLES	2019-05-14	Budget	2019	May	Tuesday	2	1	CCs Nacho Cheese 175g	3	6.
2	383	1343	MIDAGE SINGLES/COUPLES	2019-05-20	Budget	2019	May	Monday	2	1	Smiths Crinkle Cut Chips Chicken 170g	2	2.
3	974	2373	MIDAGE SINGLES/COUPLES	2018-08-17	Budget	2018	August	Friday	3	2	Smiths Chip Thinly S/Cream&Onion 175g	5	15.
4	1038	2426	MIDAGE SINGLES/COUPLES	2018-08-18	Budget	2018	August	Saturday	3	2	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.

In [33]:
```
df.dtypes
```

Out[33]:
```
Transaction ID                           int64
Loyalty Card Number                      int64
Family and Life Stage                   object
Date                            datetime64[ns]
Shopping Behavior and Preferences       object
Year                                     int64
Month                                   object
Day of week                             object
Quarter                                  int64
Store Number                             int64
Product Name                            object
Quantity                                 int64
Total Sales                            float64
dtype: object
```

Data Exploration and Feature Engineering

In [34]:
```
for i in list(df.columns):
    print(f'Number of unique Categories in {i}: {df[i].nunique()}')
```

```
Number of unique Categories in Transaction ID: 263127
Number of unique Categories in Loyalty Card Number: 72637
Number of unique Categories in Family and Life Stage: 7
Number of unique Categories in Date: 364
Number of unique Categories in Shopping Behavior and Preferences: 3
Number of unique Categories in Year: 2
Number of unique Categories in Month: 12
Number of unique Categories in Day of week: 7
Number of unique Categories in Quarter: 4
Number of unique Categories in Store Number: 272
Number of unique Categories in Product Name: 114
Number of unique Categories in Quantity: 6
Number of unique Categories in Total Sales: 112
```

- Too many unique categories in `Transaction ID` and `Loyalty Card Number`.
- Let us analyze them at the end.

Before going to any other column, let us look deeper into `Product Name` column and extract different features from it, such as, Company Name, Weight of the product, Type of the product and other such features.

This would help us in performing better analysis.

In [35]:
```
value_counts = pd.DataFrame(df['Product Name'].value_counts().reset_index())
pd.set_option('display.max_rows', None)  # Set the option to display all rows
print(value_counts[['index']])
pd.reset_option('display.max_rows')  # Reset the option to its default value
```

```
                                  index
0      Kettle Mozzarella   Basil & Pesto 175g
1    Kettle Tortilla ChpsHny&Jlpno Chili 150g
2    Cobs Popd Swt/Chlli &Sr/Cream Chips 110g
3      Tyrrells Crisps     Ched & Chives 165g
4              Cobs Popd Sea Salt  Chips 110g
5                Kettle 135g Swt Pot Sea Salt
6               Tostitos Splash Of  Lime 175g
```

Infuzions Thai SweetChili PotatoMix 110g
Smiths Crnkle Chip Orgnl Big Bag 380g
Thins Potato Chips Hot & Spicy 175g
Kettle Sensations Camembert & Fig 150g
Doritos Corn Chips Cheese Supreme 170g
Pringles Barbeque 134g
Doritos Corn Chip Mexican Jalapeno 150g
Kettle Sweet Chilli And Sour Cream 175g
Smiths Crinkle Chips Salt & Vinegar 330g
Thins Chips Light& Tangy 175g
Dorito Corn Chp Supreme 380g
Pringles Sweet&Spcy BBQ 134g
Infuzions BBQ Rib Prawn Crackers 110g
Tyrrells Crisps Lightly Salted 165g
Kettle Sea Salt And Vinegar 175g
Doritos Corn Chip Southern Chicken 150g
Twisties Chicken270g
Twisties Cheese Burger 250g
Grain Waves Sweet Chilli 210g
Pringles SourCream Onion 134g
Doritos Corn Chips Nacho Cheese 170g
Cobs Popd Sour Crm &Chives Chips 110g
Kettle Original 175g
Pringles Original Crisps 134g
Cheezels Cheese 330g
Kettle Honey Soy Chicken 175g
Kettle Tortilla ChpsBtroot&Ricotta 150g
Tostitos Smoked Chipotle 175g
Infzns Crn Crnchers Tangy Gcamole 110g
Smiths Crinkle Original 330g
Kettle Tortilla ChpsFeta&Garlic 150g
Infuzions SourCream&Herbs Veg Strws 110g
Kettle Sensations Siracha Lime 150g
Old El Paso Salsa Dip Chnky Tom Ht300g
Doritos Corn Chips Original 170g
Doritos Mexicana 170g
Twisties Cheese 270g
Thins Chips Seasonedchicken 175g
Old El Paso Salsa Dip Tomato Med 300g
Pringles Mystery Flavour 134g
Grain Waves Sour Cream&Chives 210G
Pringles Chicken Salt Crips 134g
Thins Chips Salt & Vinegar 175g
Pringles Slt Vingar 134g
Old El Paso Salsa Dip Tomato Mild 300g
Kettle Sensations BBQ&Maple 150g
Pringles Sthrn FriedChicken 134g
Tostitos Lightly Salted 175g
Doritos Cheese Supreme 330g
Kettle Chilli 175g
Smiths Chip Thinly Cut Original 175g
Snbts Whlgrn Crisps Cheddr&Mstrd 90g
Natural Chip Co Tmato Hrb&Spce 175g
Burger Rings 220g
Natural ChipCo Sea Salt & Vinegr 175g
CCs Tasty Cheese 175g
RRD SR Slow Rst Pork Belly 150g
Smiths Thinly Cut Roast Chicken 175g
RRD Sweet Chilli & Sour Cream 165g
Woolworths Cheese Rings 190g
CCs Original 175g
RRD Honey Soy Chicken 165g
Smith Crinkle Cut Mac N Cheese 150g
WW Supreme Cheese Corn Chips 200g
Infuzions Mango Chutny Papadums 70g
RRD Chilli& Coconut 150g
Smiths Crinkle Cut Snag&Sauce 150g
Red Rock Deli Sp Salt & Truffle 150G
CCs Nacho Cheese 175g
WW Original Corn Chips 200g
Red Rock Deli Thai Chilli&Lime 150g
Woolworths Mild Salsa 300g
Smiths Crinkle Cut Chips Barbecue 170g
WW Original Stacked Chips 160g
Smiths Crinkle Cut Chips Chicken 170g
WW Sour Cream &OnionStacked Chips 160g
Smiths Crinkle Cut Chips Chs&Onion170g
Cheetos Chs & Bacon Balls 190g
RRD Salt & Vinegar 165g
RRD Lime & Pepper 165g
Smiths Chip Thinly S/Cream&Onion 175g
Doritos Salsa Mild 300g
Smiths Crinkle Cut Tomato Salsa 150g

```
90          WW D/Style Chip     Sea Salt 200g
91     Natural Chip        Compny SeaSalt175g
92      GrnWves Plus Btroot & Chilli Jam 180g
93           WW Crinkle Cut      Chicken 175g
94   Smiths Thinly       Swt Chli&S/Cream175G
95    Smiths Crinkle Cut  Chips Original 170g
96     Natural ChipCo      Hony Soy Chckn175g
97   Red Rock Deli SR    Salsa & Mzzrlla 150g
98    Smiths Crinkle Cut  Salt & Vinegar 170g
99       RRD Steak &         Chimuchurri 150g
100                Cheezels Cheese Box 125g
101       Smith Crinkle Cut   Bolognese 150g
102          Doritos Salsa       Medium 300g
103                      Cheetos Puffs 165g
104    Thins Chips         Originl saltd 175g
105    Smiths Chip Thinly  CutSalt/Vinegr175g
106  Smiths Crinkle Cut  French OnionDip 150g
107     Red Rock Deli Chikn&Garlic Aioli 150g
108  Sunbites Whlegrn    Crisps Frch/Onin 90g
109               RRD Pc Sea Salt     165g
110           Woolworths Medium   Salsa 300g
111    NCC Sour Cream &    Garden Chives 175g
112           French Fries Potato Chips 175g
113         WW Crinkle Cut      Original 175g
```

- In `Product Names`, it can be observed that first part of the string is the company's name or `Brand`.
- Let us make another column, named `Brand` to have this part.
- Similarly, we have different aspects such as `Flavor Descriptions`, `Product Type` and `Size/Weight Description` of the product
- Let us make separate columns for these.

- Many `Product Name`s have some form of "Chips" in it, like ; "Tortilla", "Crisps" or "Chip"
- Let us make a separate column called `Product Type` which would store the type aspect of the product

In [36]:
```
import pandas as pd

# Define regular expressions for each category
brand_names = r"(Kettle|Cobs|Tyrrells|Smiths|Thins|Doritos|Pringles|Grain Waves|Cheezels|Tostitos|Infuzions|Twi
flavor_descriptions = r"(Mozzarella Basil & Pesto|Tortilla ChpsHny&Jlpno Chili|Popd Swt/Chlli &Sr/Cream Chips|C

product_types = r"(Chips|Crisps|Salsa|Dip|Puffs|Salsa & Mzzrlla|Balls|Corn|Ring|Chutny|Frch/Onin|Tortilla|Chip)

# Extract the categories using regular expressions
df['Brand Name'] = df['Product Name'].str.extract(brand_names, expand=False)
df['Flavor Description'] = df['Product Name'].str.extract(flavor_descriptions, expand=False)
df['Product Type'] = df['Product Name'].str.extract(product_types, expand=False)

# Extract Size/Weight
df['Size/Weight'] = df['Product Name'].str.extract(r'(\d+\w+)')

# Filling any NaN values with an appropriate placeholder if needed
df = df.fillna('Other')

# Display the modified DataFrame
df.head()
```

Out[36]:

	Transaction ID	Loyalty Card Number	Family and Life Stage	Date	Shopping Behavior and Preferences	Year	Month	Day of week	Quarter	Store Number	Product Name	Quantity	Tota Sale
0	1	1000	YOUNG SINGLES/COUPLES	2018-10-17	Premium	2018	October	Wednesday	4	1	Natural Chip Compny SeaSalt175g	2	6.
1	348	1307	MIDAGE SINGLES/COUPLES	2019-05-14	Budget	2019	May	Tuesday	2	1	CCs Nacho Cheese 175g	3	6.
2	383	1343	MIDAGE SINGLES/COUPLES	2019-05-20	Budget	2019	May	Monday	2	1	Smiths Crinkle Cut Chips Chicken 170g	2	2.
3	974	2373	MIDAGE SINGLES/COUPLES	2018-08-17	Budget	2018	August	Friday	3	2	Smiths Chip Thinly S/Cream&Onion 175g	5	15.
4	1038	2426	MIDAGE SINGLES/COUPLES	2018-08-18	Budget	2018	August	Saturday	3	2	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.

In [37]:
```
df['Product Type'].value_counts()
```

Out[37]:
```
Other       137847
Chips        37268
Corn         22063
Chip         18424
Salsa        18094
Crisps       12607
Tortilla      9580
Ring          3080
Chutny        1507
Balls         1479
Puffs         1448
Dip           1438
Name: Product Type, dtype: int64
```

- Let us look deeper into the catergories, to make sure that we have not misclassified.

In [38]:
```
df[df['Product Type'] == 'Corn'][['Product Name']].value_counts()
```

Out[38]:
```
Product Name
Doritos Corn Chips  Cheese Supreme 170g    3217
Doritos Corn Chip Mexican Jalapeno 150g    3204
Dorito Corn Chp     Supreme 380g           3185
Doritos Corn Chip Southern Chicken 150g    3172
Doritos Corn Chips  Nacho Cheese 170g      3160
Doritos Corn Chips  Original 170g          3121
WW Supreme Cheese   Corn Chips 200g        1509
WW Original Corn    Chips 200g             1495
dtype: int64
```

- It can be observed that all `Product Types` with 'Corn' as values are actually `Chips`
- So, we will change the `Product Types` for 'Corn' into 'chips'
- Similar is true for `Product Type` 'Chip' and 'Crisps'

In [39]:
```
df['Product Type'] = np.where(df['Product Type'].isin(['Corn','Chip','Crisps']), 'Chips', df['Product Type'])
```

In [40]:
```
df['Product Type'].value_counts()
```

Out[40]:
```
Other       137847
Chips        90362
Salsa        18094
Tortilla      9580
Ring          3080
Chutny        1507
Balls         1479
Puffs         1448
Dip           1438
Name: Product Type, dtype: int64
```

Now, there is no confusion in Chips because of names. Let us check it for other categories too.

In [41]:
```
df[df['Product Type'] == 'Salsa'][['Product Name']].value_counts()
```

Out[41]:
```
Product Name
Old El Paso Salsa   Dip Chnky Tom Ht300g    3125
Old El Paso Salsa   Dip Tomato Med 300g     3114
Old El Paso Salsa   Dip Tomato Mild 300g    3085
Woolworths Mild     Salsa 300g              1491
Doritos Salsa Mild  300g                    1472
Smiths Crinkle Cut  Tomato Salsa 150g       1470
Red Rock Deli SR    Salsa & Mzzrlla 150g    1458
Doritos Salsa       Medium 300g             1449
Woolworths Medium   Salsa 300g              1430
dtype: int64
```

- First three Product Names are actually referring to `Product Type` , 'Dip'.
- Let us recategorise them.

In [42]:
```
df['Product Type'] = np.where(df['Product Name'].isin(['Old El Paso Salsa   Dip Chnky Tom Ht300g', 'Old El Paso
                                                       'Old El Paso Salsa   Dip Tomato Mild 300g ']), 'Dip', df[
```

In [43]:
```
df['Product Type'].value_counts()   # Reconfirming changes
```

Out[43]:
```
Other       137847
Chips        90362
Salsa        11855
Tortilla      9580
Dip           7677
Ring          3080
Chutny        1507
Balls         1479
Puffs         1448
Name: Product Type, dtype: int64
```

- It was also oberved in `Brand Name` column that brand `RRD` and `Red Rock Deli` refer to same brand. Let us change `RRD` ---> `Red Rock Deli` for more interpretability.

In [44]:
```
df['Brand Name'] = np.where(df['Brand Name'] == 'RRD', 'Red Rock Deli', df['Brand Name'])
df['Brand Name'] = np.where(df['Brand Name'] == 'WW', 'Woolworths', df['Brand Name'])
df['Brand Name'] = np.where(df['Brand Name'] == 'Snbts', 'Sunbites', df['Brand Name'])
```

In [45]:
```
df['Brand Name'].value_counts()
```

Out[45]:
```
Kettle             41288
Smiths             28859
Pringles           25102
Doritos            24962
Other              21015
Red Rock Deli      17779
Woolworths         14757
Thins              14075
Infuzions          11057
Cobs                9693
Tostitos            9471
Twisties            9454
Old El Paso         9324
Tyrrells            6442
Grain Waves         6272
Cheezels            4603
CCs                 4551
Sunbites            1576
Natural Chip Co     1572
Burger Rings        1564
NCC                 1419
Name: Brand Name, dtype: int64
```

- Other categories have been correctly classified.

Hence, above is the final cleaned, feature engineered data. We would save the above into as `cleaned_data.csv` to perform Exploratory Data Analysis and gain deeper insights on our data.

In [46]:
```
df.to_csv("cleaned_data.csv", index=False)
```

Exploratory Data Analysis

In [47]:
```
df.head()
```

Out[47]:

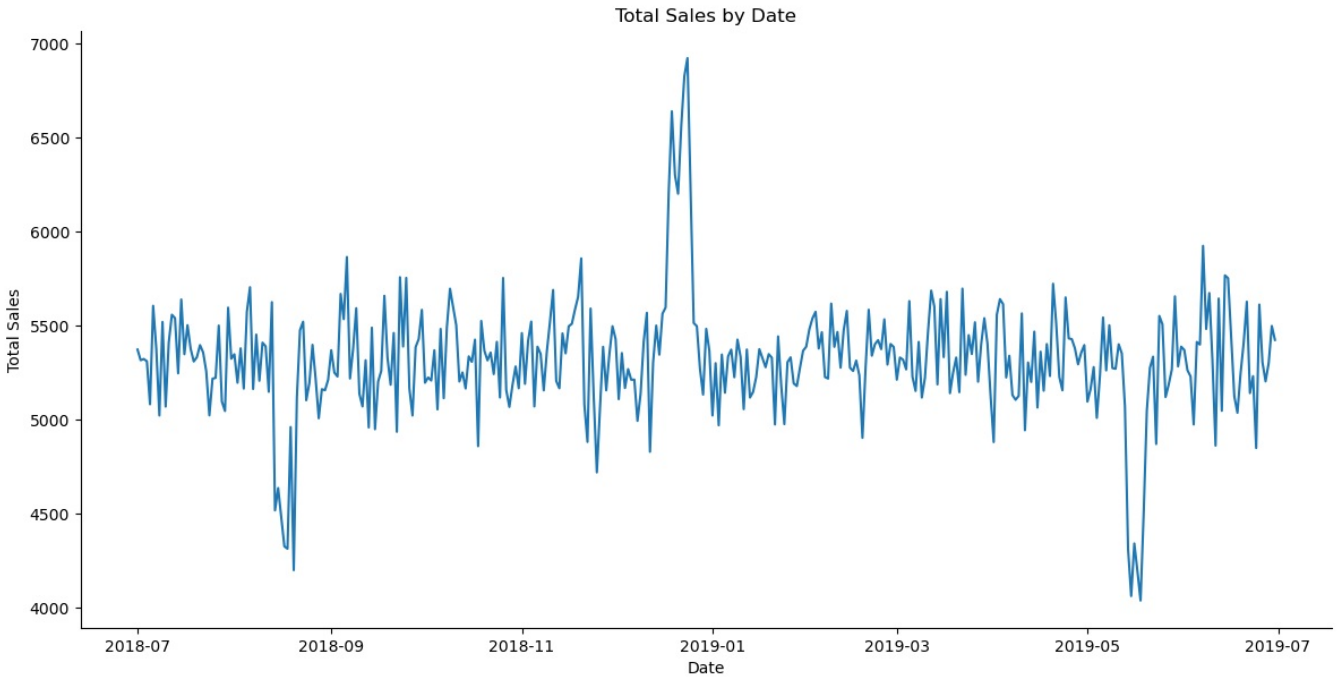
	Transaction ID	Loyalty Card Number	Family and Life Stage	Date	Shopping Behavior and Preferences	Year	Month	Day of week	Quarter	Store Number	Product Name	Quantity	Tota Sale
0	1	1000	YOUNG SINGLES/COUPLES	2018-10-17	Premium	2018	October	Wednesday	4	1	Natural Chip Compny SeaSalt175g	2	6.
1	348	1307	MIDAGE SINGLES/COUPLES	2019-05-14	Budget	2019	May	Tuesday	2	1	CCs Nacho Cheese 175g	3	6.
2	383	1343	MIDAGE SINGLES/COUPLES	2019-05-20	Budget	2019	May	Monday	2	1	Smiths Crinkle Cut Chips Chicken 170g	2	2.
3	974	2373	MIDAGE SINGLES/COUPLES	2018-08-17	Budget	2018	August	Friday	3	2	Smiths Chip Thinly S/Cream&Onion 175g	5	15.
4	1038	2426	MIDAGE SINGLES/COUPLES	2018-08-18	Budget	2018	August	Saturday	3	2	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.

In [48]:
```
df.columns
```

Out[48]:
```
Index(['Transaction ID', 'Loyalty Card Number', 'Family and Life Stage',
       'Date', 'Shopping Behavior and Preferences', 'Year', 'Month',
       'Day of week', 'Quarter', 'Store Number', 'Product Name', 'Quantity',
       'Total Sales', 'Brand Name', 'Flavor Description', 'Product Type',
       'Size/Weight'],
      dtype='object')
```

Let us look at `Total Sales` by `Date` and see dates to observe any pattern.

In [49]:
```
sales_by_date = pd.DataFrame(df.groupby('Date')['Total Sales'].sum().reset_index())

sns.relplot(x='Date', y='Total Sales', data=sales_by_date, kind='line', height=6, aspect=2)
plt.title('Total Sales by Date')
plt.show()
```



- There are two dips and one peak in total sales.
- Let us look deeper into these

In [50]:
```
sales_by_date[sales_by_date['Total Sales'] == sales_by_date['Total Sales'].max()]
```

Out[50]:

	Date	Total Sales
176	2018-12-24	6923.0

- Sales by date were highest on `2018-12-24` which is the day before Christmas, which makes sense as a lot of people would buy Snacks for their guests, relatives or friends for Christmas.

In [51]:
```
sales_by_date[sales_by_date['Total Sales'] < 4500]   ## As sales below are 4500 are mimimas
```

Out[51]:

	Date	Total Sales
46	2018-08-16	4476.60
47	2018-08-17	4324.55
48	2018-08-18	4312.00
50	2018-08-20	4198.20
316	2019-05-14	4310.45
317	2019-05-15	4060.30
318	2019-05-16	4340.05
319	2019-05-17	4192.45
320	2019-05-18	4036.50

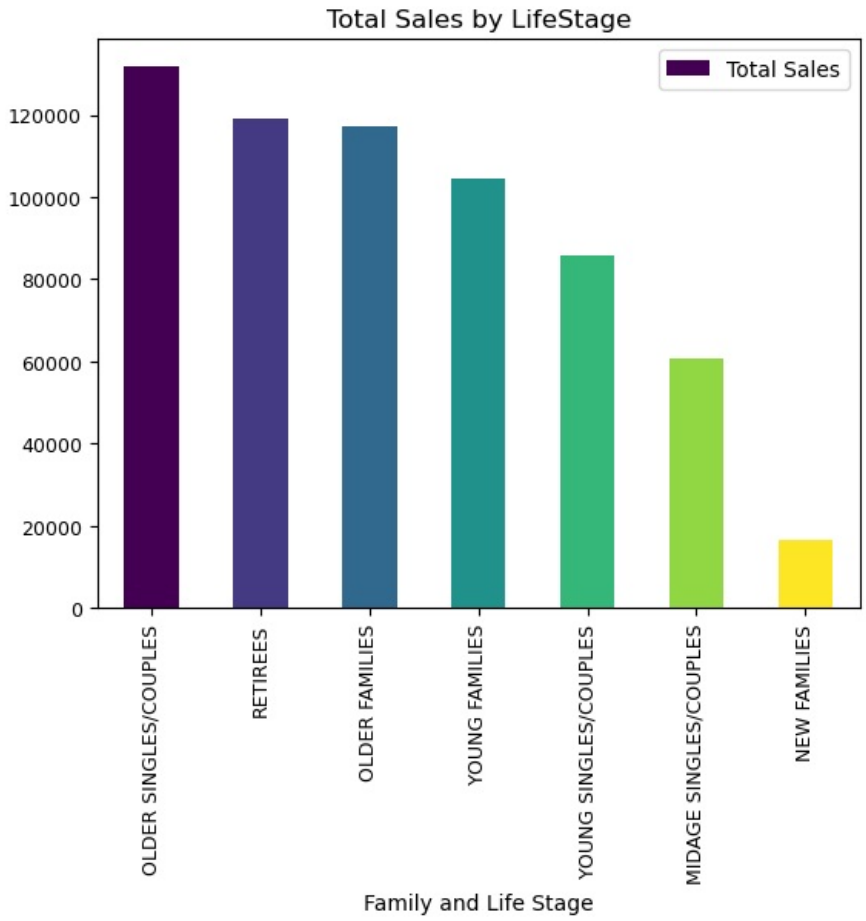
- It can be observed that `Total Sales` were not that good in `Mid-August` (2019) and `Mid-May` (2018) days.
- There might be a reason for it, we will look deeper into this later.

Let's us try to answer some questions:

1. `Who spends the most on chips (total sales), describing customers by lifestage and how premium their general purchasing behaviour is?`
2. `How many customers are in each segment?`
3. `How many chips are bought per customer by segment?`
4. `What's the average chip price by customer segment?`

In [52]:
```
# Let us answer first question and look more into LifeStage

filtered = df[df['Product Type'] == 'Chips']  # Only chips customers
first = pd.DataFrame(filtered.groupby(['Family and Life Stage'])['Total Sales'].sum().reset_index()
                     .sort_values(by='Total Sales', ascending=False))

colors = plt.cm.viridis(np.linspace(0, 1, len(first)))    # plt.cm.viridis colormap to create a gradient of col

first.plot.bar(x='Family and Life Stage', y='Total Sales', fontsize='9', color=colors)
plt.title('Total Sales by LifeStage')
```

Out[52]:
```
Text(0.5, 1.0, 'Total Sales by LifeStage')
```



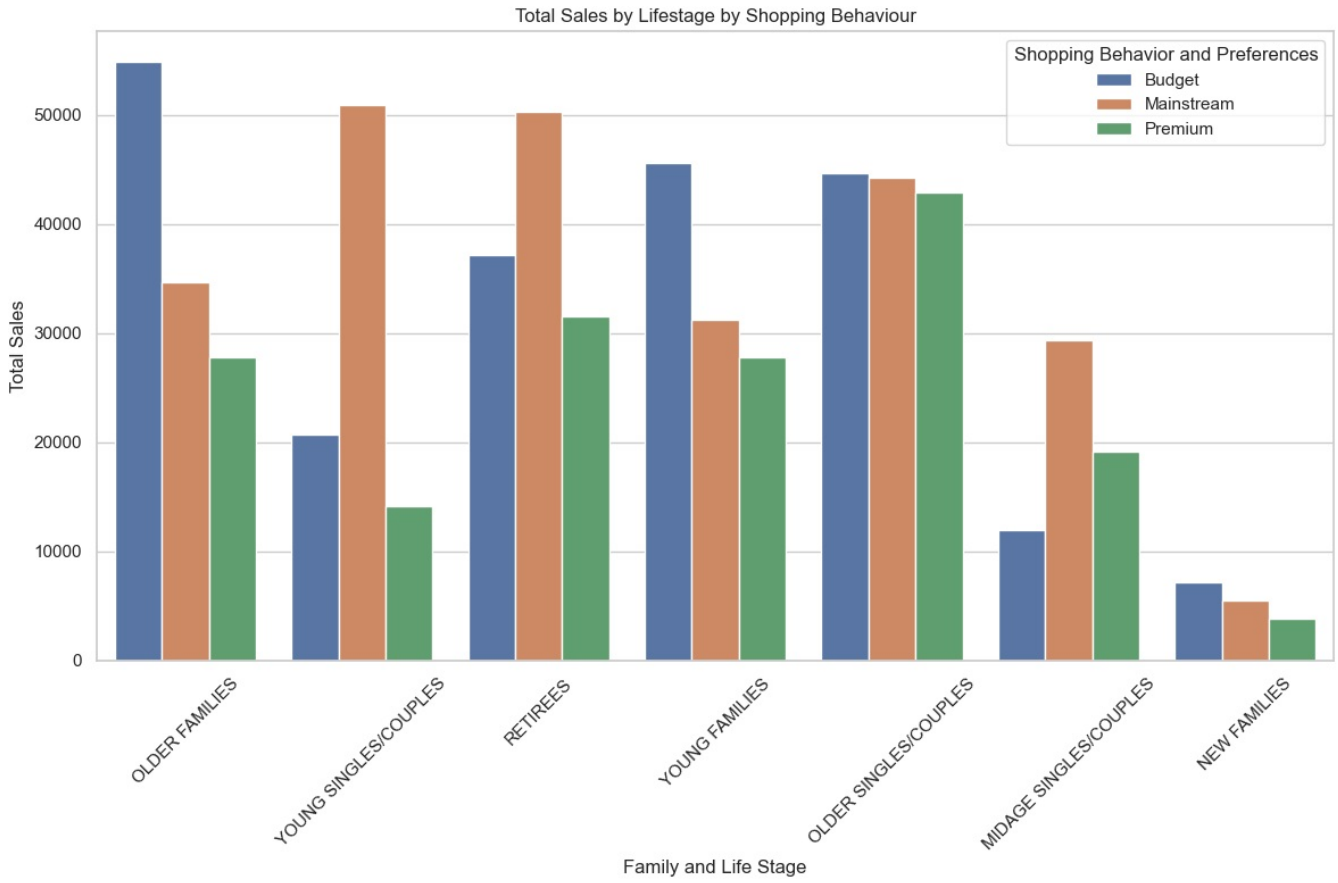
- `Older Couples and Singles` are doing maximum sales, followed by `Retirees` and `Older Families`
- Major sales have been done by senior customers.

In [53]:
```
first = pd.DataFrame(filtered.groupby(['Shopping Behavior and Preferences'])['Total Sales'].sum().reset_index()
                     .sort_values(by='Total Sales', ascending=False))

colors = plt.cm.viridis(np.linspace(0, 1, len(first)))    # plt.cm.viridis colormap to create a gradient of col

first.plot.bar(x='Shopping Behavior and Preferences', y='Total Sales', fontsize='9', color=colors)
plt.title('Total Sales by Shopping Behaviour and Preferences')
```

Out[53]:
```
Text(0.5, 1.0, 'Total Sales by Shopping Behaviour and Preferences')
```

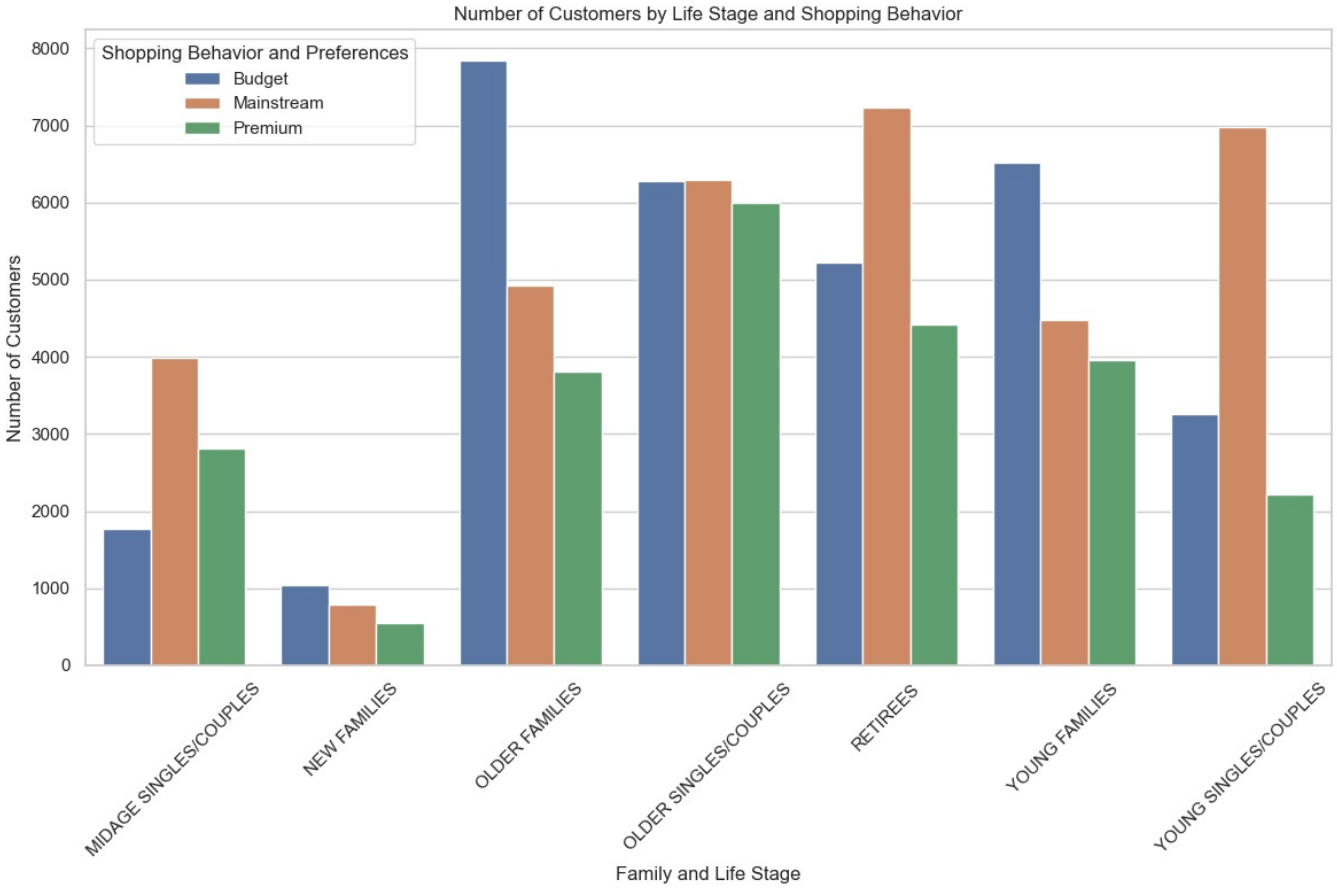
- `Mainstream` customers are the ones with maximum total sales followed by `Budget` and `Premium`.
- Let us combine both `Life stage` and `Shopping behaviour and Preferences` aspect.

In [54]:
```
first = pd.DataFrame(filtered.groupby(['Family and Life Stage','Shopping Behavior and Preferences'])['Total Sal
                     .sort_values(by='Total Sales', ascending=False))

# Set the plot style
sns.set(style="whitegrid")

# Create a single plot for all 21 combinations
plt.figure(figsize=(12, 8))
ax = sns.barplot(x='Family and Life Stage', y='Total Sales', hue='Shopping Behavior and Preferences', data=firs

# Set plot labels and title
ax.set_xlabel('Family and Life Stage')
ax.set_ylabel('Total Sales')
ax.set_title('Total Sales by Lifestage by Shopping Behaviour')

# Rotate x-axis labels
plt.xticks(rotation=45)

# Show the plot
plt.legend(title='Shopping Behavior and Preferences')
plt.tight_layout()
plt.show()
```



- Lowest `Total Sales` have been in `New Families`
- `Older Families` with `Budget` behaviour have the highest total sales, followed by `Young Singles/ Couples` in `Mainstream` shopping behaviour and `Retirees` in `Mainstream` shopping behaviour.
- `Older Singles/Couples` are the highest total sales in `Premium` shopping behaviour.

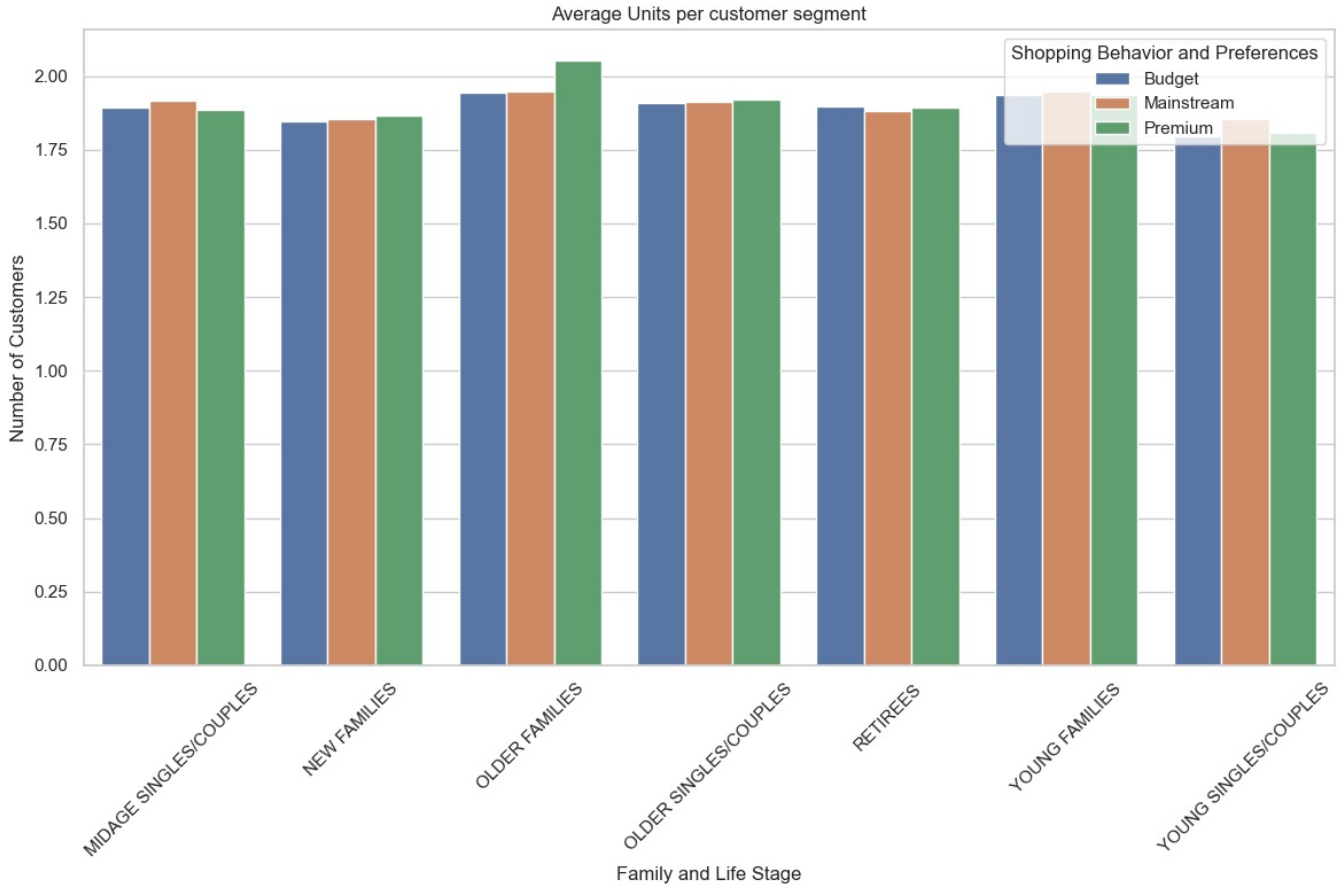
In [55]:
```
## How many customers are in each segment?

filtered = df[df['Product Type'] == 'Chips']  # Only chips customers
second = pd.DataFrame(filtered.groupby(['Family and Life Stage','Shopping Behavior and Preferences']).size().re

# Set the plot style
sns.set(style="whitegrid")

# Create a count plot
plt.figure(figsize=(12, 8))
ax = sns.barplot(x='Family and Life Stage', y='Count', hue='Shopping Behavior and Preferences', data=second)

# Set plot labels and title
ax.set_xlabel('Family and Life Stage')
ax.set_ylabel('Number of Customers')
ax.set_title('Number of Customers by Life Stage and Shopping Behavior')

# Rotate x-axis labels
plt.xticks(rotation=45)

# Show the plot
plt.legend(title='Shopping Behavior and Preferences')
plt.tight_layout()
plt.show()
```



- Lowest `Count` have been in `New Families` which makes sense as they might not consume chips very often yet.
- `Older Families` with `Budget` behaviour have the highest count, followed by `Retirees` in `Mainstream` shopping behaviour and `Younf Singles/Couples` in `Mainstream` shopping behaviour.
- `Older Singles/Couples` are the highest count in `Premium` shopping behaviour.

This is pretty similar to total sales. Let us look deeper into `Average Units per customer segment`.

In [56]:
```
## Average Units per Customer Segment

third = pd.DataFrame(filtered.groupby(['Family and Life Stage','Shopping Behavior and Preferences'])['Quantity'

# Set the plot style
sns.set(style="whitegrid")

# Create a count plot
plt.figure(figsize=(12, 8))
ax = sns.barplot(x='Family and Life Stage', y='Quantity', hue='Shopping Behavior and Preferences', data=third)

# Set plot labels and title
ax.set_xlabel('Family and Life Stage')
ax.set_ylabel('Number of Customers')
ax.set_title('Average Units per customer segment')

# Rotate x-axis labels
plt.xticks(rotation=45)

# Show the plot
plt.legend(title='Shopping Behavior and Preferences')
plt.tight_layout()
plt.show()
```



- `Older Families` and `Young Families` tend to buy more units of chips compared to `New Families`
- `New Families` have the lowest average units bought.

In [57]:
```
df.columns
```

Out[57]:
```
Index(['Transaction ID', 'Loyalty Card Number', 'Family and Life Stage',
       'Date', 'Shopping Behavior and Preferences', 'Year', 'Month',
       'Day of week', 'Quarter', 'Store Number', 'Product Name', 'Quantity',
       'Total Sales', 'Brand Name', 'Flavor Description', 'Product Type',
       'Size/Weight'],
      dtype='object')
```

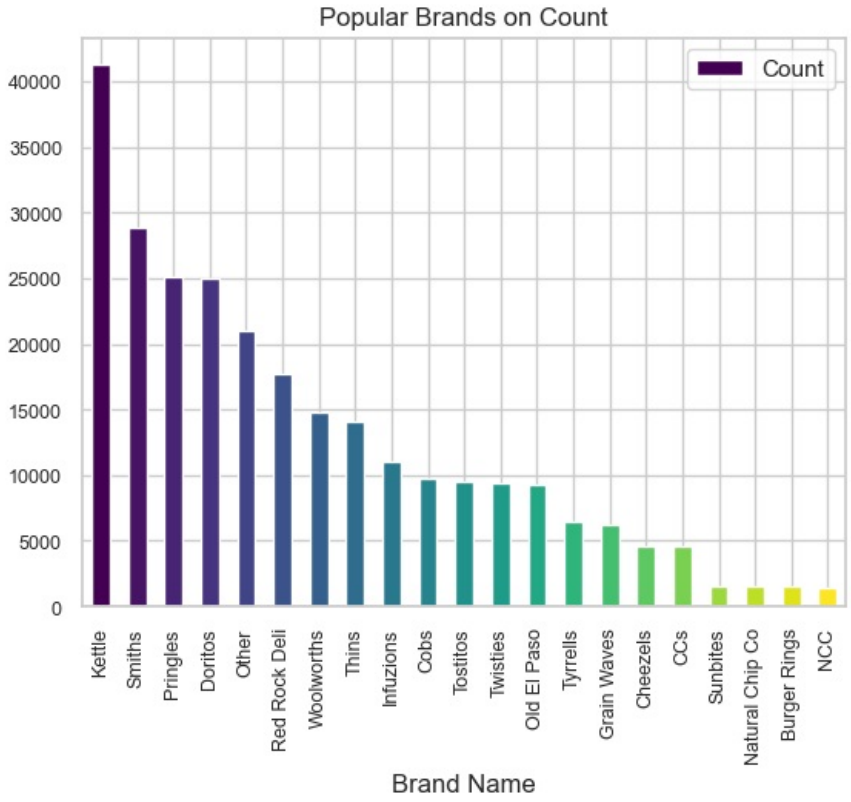
In [58]:
```
df.head()
```

Out[58]:

	Transaction ID	Loyalty Card Number	Family and Life Stage	Date	Shopping Behavior and Preferences	Year	Month	Day of week	Quarter	Store Number	Product Name	Quantity	Tota Sale
0	1	1000	YOUNG SINGLES/COUPLES	2018-10-17	Premium	2018	October	Wednesday	4	1	Natural Chip Compny SeaSalt175g	2	6.
1	348	1307	MIDAGE SINGLES/COUPLES	2019-05-14	Budget	2019	May	Tuesday	2	1	CCs Nacho Cheese 175g	3	6.
2	383	1343	MIDAGE SINGLES/COUPLES	2019-05-20	Budget	2019	May	Monday	2	1	Smiths Crinkle Cut Chips Chicken 170g	2	2.
3	974	2373	MIDAGE SINGLES/COUPLES	2018-08-17	Budget	2018	August	Friday	3	2	Smiths Chip Thinly S/Cream&Onion 175g	5	15.
4	1038	2426	MIDAGE SINGLES/COUPLES	2018-08-18	Budget	2018	August	Saturday	3	2	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.

In [59]:
```
popular_brand = pd.DataFrame(df['Brand Name'].value_counts().reset_index().rename(columns={'index':'Brand Name'

colors = plt.cm.viridis(np.linspace(0, 1, len(popular_brand)))    # plt.cm.viridis colormap to create a gradien

plt.figure(dpi=1000)
popular_brand.plot.bar(x='Brand Name', y='Count', fontsize='9', color=colors)
plt.title('Popular Brands on Count')
```

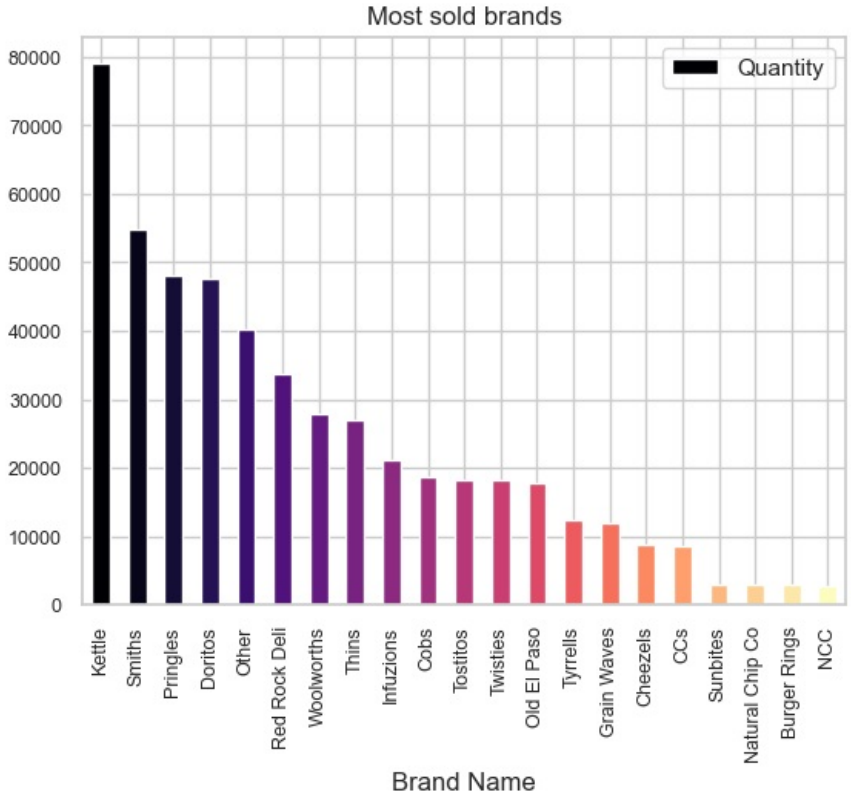
Out[59]:
```
Text(0.5, 1.0, 'Popular Brands on Count')
<Figure size 6400x4800 with 0 Axes>
```



- `Kettle` is the most popular brand on the basis of counts, followed by `Smiths`, `Pringles` and `Doritos`

In [60]:
```
most_sold_brands = pd.DataFrame(df.groupby('Brand Name')['Quantity'].sum().reset_index()).sort_values(by='Quant

colors = plt.cm.magma(np.linspace(0, 1, len(most_sold_brands)))    # plt.cm.viridis colormap to create a gradie

plt.figure(dpi=1000)
most_sold_brands.plot.bar(x='Brand Name', y='Quantity', fontsize='9', color=colors)
plt.title('Most sold brands')
```

Out[60]:
```
Text(0.5, 1.0, 'Most sold brands')
<Figure size 6400x4800 with 0 Axes>
```

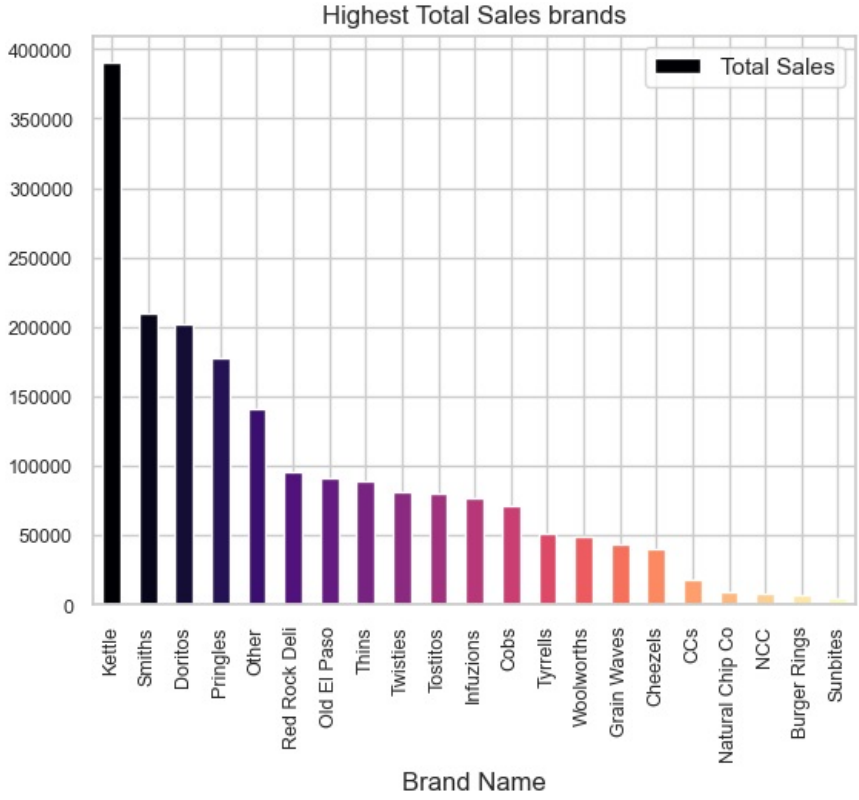


- `Kettle` is the most popular brand on the basis of quantities, followed by `Smiths`, `Pringles` and `Doritos`
- Basically, there is `similar pattern in number of quantities sold as well as brand popularity`.

Let us see if similar pattern follows in total sales too.

In [61]:
```
most_sales_brands = pd.DataFrame(df.groupby('Brand Name')['Total Sales'].sum().reset_index()).sort_values(by='T

colors = plt.cm.magma(np.linspace(0, 1, len(most_sales_brands)))    # plt.cm.viridis colormap to create a gradi

plt.figure(dpi=1000)
most_sales_brands.plot.bar(x='Brand Name', y='Total Sales', fontsize='9', color=colors)
plt.title('Highest Total Sales brands')
```

Out[61]:
```
Text(0.5, 1.0, 'Highest Total Sales brands')
<Figure size 6400x4800 with 0 Axes>
```



- `Kettle` is the most popular brand on the basis of quantities sold, total sales and popularity, followed by `Smiths`, `Pringles` and `Doritos`

In [62]:
```
df.columns
```

Out[62]:
```
Index(['Transaction ID', 'Loyalty Card Number', 'Family and Life Stage',
       'Date', 'Shopping Behavior and Preferences', 'Year', 'Month',
       'Day of week', 'Quarter', 'Store Number', 'Product Name', 'Quantity',
       'Total Sales', 'Brand Name', 'Flavor Description', 'Product Type',
       'Size/Weight'],
      dtype='object')
```

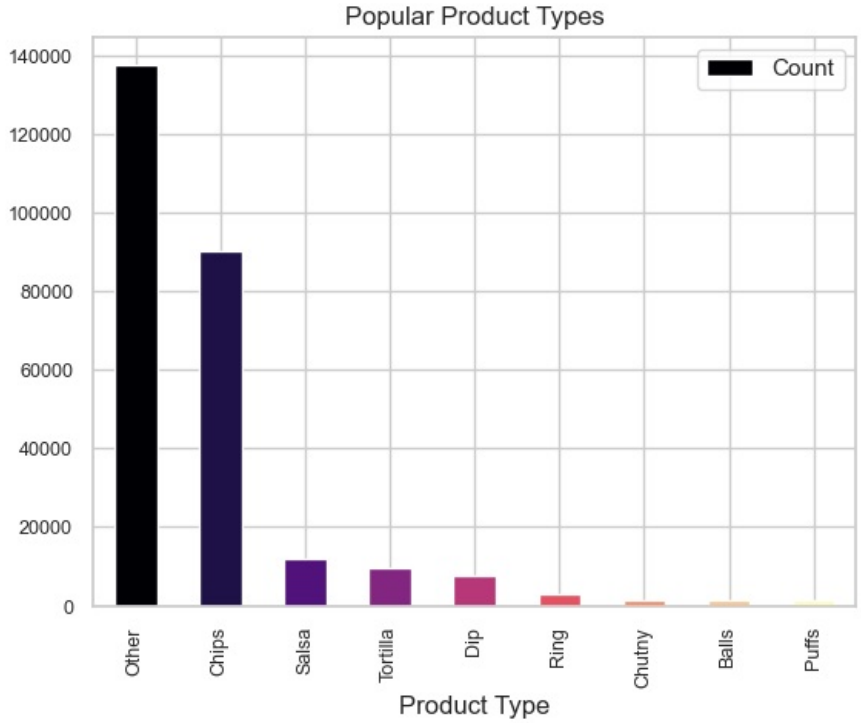
In [76]:
```
weekly_sales = pd.DataFrame(df.groupby(['Day of week'])['Total Sales'].sum().reset_index()).sort_values(by='Tota
pd.set_option('display.max_rows', None)  # Set the option to display all rows
print(weekly_sales)
pd.reset_option('display.max_rows')  # Reset the option to its default value
```

```
  Day of week  Total Sales
3      Sunday    283229.10
0      Friday    279521.30
6   Wednesday    277876.40
2    Saturday    275612.60
1      Monday    274959.95
4    Thursday    272565.65
5     Tuesday    270644.00
```

- There is `no significant difference in average total sales in any day of week`.
- Similar is true for `Total Sales` of any day of week.

In [81]:
```
popular_product_type = pd.DataFrame(df['Product Type'].value_counts().reset_index()).rename(columns={'index':'P

colors = plt.cm.magma(np.linspace(0, 1, len(popular_product_type)))    # plt.cm.viridis colormap to create a gra

plt.figure(dpi=1000)
popular_product_type.plot.bar(x='Product Type', y='Count', fontsize='9', color=colors)
plt.title('Popular Product Types')
```

Out[81]:
```
Text(0.5, 1.0, 'Popular Product Types')
<Figure size 6400x4800 with 0 Axes>
```



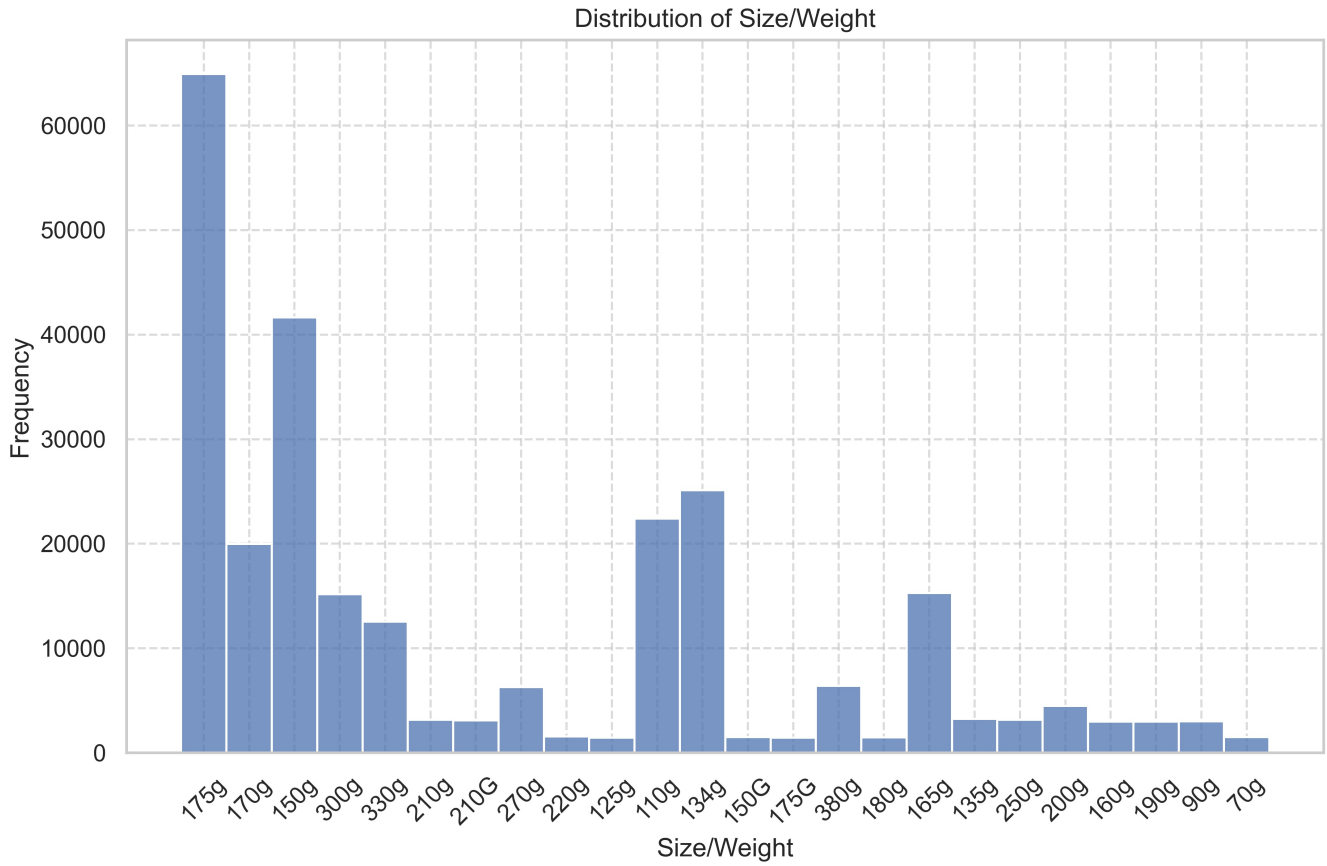
- In the named product types, `Chips` is the most popular followed by `Salsa` and `Tortilla`

In [84]:
```
df.head()
```

Out[84]:

	Transaction ID	Loyalty Card Number	Family and Life Stage	Date	Shopping Behavior and Preferences	Year	Month	Day of week	Quarter	Store Number	Product Name	Quantity	Tota Sale
0	1	1000	YOUNG SINGLES/COUPLES	2018-10-17	Premium	2018	October	Wednesday	4	1	Natural Chip Compny SeaSalt175g	2	6.
1	348	1307	MIDAGE SINGLES/COUPLES	2019-05-14	Budget	2019	May	Tuesday	2	1	CCs Nacho Cheese 175g	3	6.
2	383	1343	MIDAGE SINGLES/COUPLES	2019-05-20	Budget	2019	May	Monday	2	1	Smiths Crinkle Cut Chips Chicken 170g	2	2.
3	974	2373	MIDAGE SINGLES/COUPLES	2018-08-17	Budget	2018	August	Friday	3	2	Smiths Chip Thinly S/Cream&Onion 175g	5	15.
4	1038	2426	MIDAGE SINGLES/COUPLES	2018-08-18	Budget	2018	August	Saturday	3	2	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.

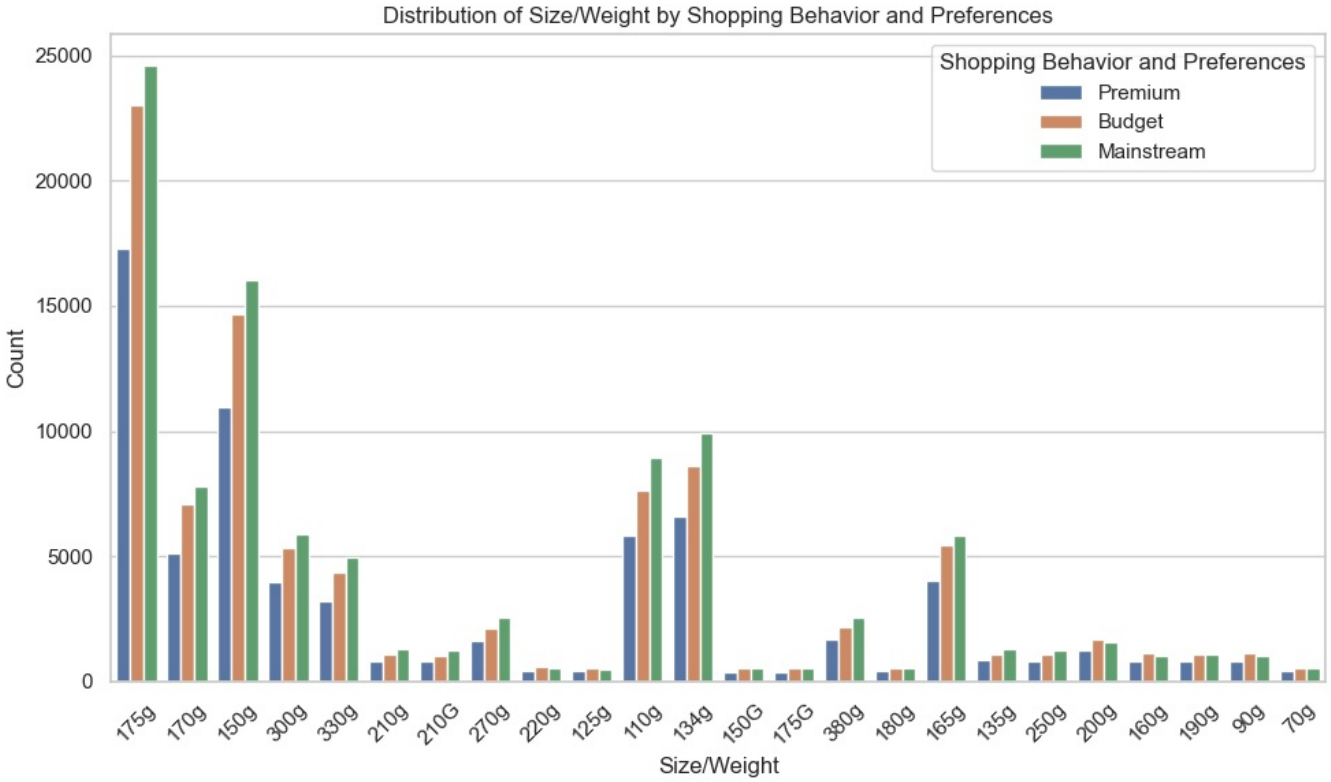
In [100…
```
# Set the figure size and DPI
plt.figure(figsize=(10, 6), dpi=500)

# Create a histogram using Matplotlib
sns.histplot(df['Size/Weight'], kde=False)  # You can enable the KDE for a smoother distribution curve

# Customize the plot appearance
plt.title('Distribution of Size/Weight')
plt.xlabel('Size/Weight')
plt.ylabel('Frequency')
plt.xticks(rotation=45)
plt.grid(True, linestyle='--', alpha=0.7)

# Show the plot
plt.show()
```



- `175g` packets are the most frequent, followed by `150g`, `134g` and `110g`

In [102…

```
import seaborn as sns
import matplotlib.pyplot as plt

# Assuming you have a DataFrame named df with "Shopping behavior and Preferences" and "Size/Weight" columns

# Set the figure size and style
plt.figure(figsize=(10, 6))
sns.set(style="whitegrid")

# Create a count plot with "Size/Weight" on the x-axis and hue by "Shopping behavior and Preferences"
sns.countplot(x='Size/Weight', hue='Shopping Behavior and Preferences', data=df)

# Customize the plot appearance
plt.title('Distribution of Size/Weight by Shopping Behavior and Preferences')
plt.xlabel('Size/Weight')
plt.ylabel('Count')

# Rotate x-axis labels for better visibility
plt.xticks(rotation=45)

# Show the plot
plt.legend(title='Shopping Behavior and Preferences')
plt.tight_layout()
plt.show()
```



- `175g` is the most popular `Size/Weight` in all Shopping Behaviour and Preferences.