In [57]:
```
#!pip install --user matplotlib
#!pip install --user seaborn

#!pip install --user ipywidgets
#!pip install --user jupyterlab-hide-code
```

```
Requirement already satisfied: jupyterlab-hide-code in c:\python312\lib\site-packages (3.6.3)
```

In [2]:
```
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
import numpy as np
```

■ Marketing Analytics Report

The objective: To explore the relationship between customer behavior, campaign performance and various customer characteristics. Specifically, investigate the influence of factors like income, demographics, family situations (kids, marital status etc) on spending patterns, campaign responses, and overall customer engagement. The results of this analysis will be helpful in our understanding of how to effectively reach and engage with different customer audience.

/ First Look at the Data

- Columns/Variables
- Dataset dimensions
- Missing values
- Descriptive statistics

In [3]:
```
mydata = pd.read_csv('marketing analytics/ifood_df.csv')
print(f'Dataset dimensions: {mydata.shape}')
```

```
Dataset dimensions: (2205, 39)
```

In [4]:
```
mydata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2205 entries, 0 to 2204
Data columns (total 39 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Income               2205 non-null   float64
 1   Kidhome              2205 non-null   int64  
 2   Teenhome             2205 non-null   int64  
 3   Recency              2205 non-null   int64  
 4   MntWines             2205 non-null   int64  
 5   MntFruits            2205 non-null   int64  
 6   MntMeatProducts      2205 non-null   int64  
 7   MntFishProducts      2205 non-null   int64  
 8   MntSweetProducts     2205 non-null   int64  
 9   MntGoldProds         2205 non-null   int64  
 10  NumDealsPurchases    2205 non-null   int64  
 11  NumWebPurchases      2205 non-null   int64  
 12  NumCatalogPurchases  2205 non-null   int64  
 13  NumStorePurchases    2205 non-null   int64  
 14  NumWebVisitsMonth    2205 non-null   int64  
 15  AcceptedCmp3         2205 non-null   int64  
 16  AcceptedCmp4         2205 non-null   int64  
 17  AcceptedCmp5         2205 non-null   int64  
 18  AcceptedCmp1         2205 non-null   int64  
 19  AcceptedCmp2         2205 non-null   int64  
 20  Complain             2205 non-null   int64  
 21  Z_CostContact        2205 non-null   int64  
 22  Z_Revenue            2205 non-null   int64  
 23  Response             2205 non-null   int64  
 24  Age                  2205 non-null   int64  
 25  Customer_Days        2205 non-null   int64  
 26  marital_Divorced     2205 non-null   int64  
 27  marital_Married      2205 non-null   int64  
 28  marital_Single       2205 non-null   int64  
 29  marital_Together     2205 non-null   int64  
 30  marital_Widow        2205 non-null   int64  
 31  education_2n Cycle   2205 non-null   int64  
 32  education_Basic      2205 non-null   int64  
 33  education_Graduation 2205 non-null   int64  
 34  education_Master     2205 non-null   int64  
 35  education_PhD        2205 non-null   int64  
 36  MntTotal             2205 non-null   int64  
 37  MntRegularProds      2205 non-null   int64  
 38  AcceptedCmpOverall   2205 non-null   int64  
dtypes: float64(1), int64(38)
memory usage: 672.0 KB
```

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

Out[5]:

	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts	MntGoldProds
0	58138.0	0	0	58	635	88	546	172	88	88
1	46344.0	1	1	38	11	1	6	2	1	6
2	71613.0	0	0	26	426	49	127	111	21	42
3	26646.0	1	0	26	11	4	20	10	3	5
4	58293.0	1	0	94	173	43	118	46	27	15

5 rows × 39 columns

In [6]:
```
round(mydata.describe(), 2).T
```

Out[6]:

	count	mean	std	min	25%	50%	75%	max
Income	2205.0	51622.09	20713.06	1730.0	35196.0	51287.0	68281.0	113734.0
Kidhome	2205.0	0.44	0.54	0.0	0.0	0.0	1.0	2.0
Teenhome	2205.0	0.51	0.54	0.0	0.0	0.0	1.0	2.0
Recency	2205.0	49.01	28.93	0.0	24.0	49.0	74.0	99.0
MntWines	2205.0	306.16	337.49	0.0	24.0	178.0	507.0	1493.0
MntFruits	2205.0	26.40	39.78	0.0	2.0	8.0	33.0	199.0
MntMeatProducts	2205.0	165.31	217.78	0.0	16.0	68.0	232.0	1725.0
MntFishProducts	2205.0	37.76	54.82	0.0	3.0	12.0	50.0	259.0
MntSweetProducts	2205.0	27.13	41.13	0.0	1.0	8.0	34.0	262.0
MntGoldProds	2205.0	44.06	51.74	0.0	9.0	25.0	56.0	321.0
NumDealsPurchases	2205.0	2.32	1.89	0.0	1.0	2.0	3.0	15.0
NumWebPurchases	2205.0	4.10	2.74	0.0	2.0	4.0	6.0	27.0
NumCatalogPurchases	2205.0	2.65	2.80	0.0	0.0	2.0	4.0	28.0
NumStorePurchases	2205.0	5.82	3.24	0.0	3.0	5.0	8.0	13.0
NumWebVisitsMonth	2205.0	5.34	2.41	0.0	3.0	6.0	7.0	20.0
AcceptedCmp3	2205.0	0.07	0.26	0.0	0.0	0.0	0.0	1.0
AcceptedCmp4	2205.0	0.07	0.26	0.0	0.0	0.0	0.0	1.0
AcceptedCmp5	2205.0	0.07	0.26	0.0	0.0	0.0	0.0	1.0
AcceptedCmp1	2205.0	0.06	0.25	0.0	0.0	0.0	0.0	1.0
AcceptedCmp2	2205.0	0.01	0.12	0.0	0.0	0.0	0.0	1.0
Complain	2205.0	0.01	0.09	0.0	0.0	0.0	0.0	1.0
Z_CostContact	2205.0	3.00	0.00	3.0	3.0	3.0	3.0	3.0
Z_Revenue	2205.0	11.00	0.00	11.0	11.0	11.0	11.0	11.0
Response	2205.0	0.15	0.36	0.0	0.0	0.0	0.0	1.0
Age	2205.0	51.10	11.71	24.0	43.0	50.0	61.0	80.0
Customer_Days	2205.0	2512.72	202.56	2159.0	2339.0	2515.0	2688.0	2858.0
marital_Divorced	2205.0	0.10	0.31	0.0	0.0	0.0	0.0	1.0
marital_Married	2205.0	0.39	0.49	0.0	0.0	0.0	1.0	1.0
marital_Single	2205.0	0.22	0.41	0.0	0.0	0.0	0.0	1.0
marital_Together	2205.0	0.26	0.44	0.0	0.0	0.0	1.0	1.0
marital_Widow	2205.0	0.03	0.18	0.0	0.0	0.0	0.0	1.0
education_2n Cycle	2205.0	0.09	0.29	0.0	0.0	0.0	0.0	1.0
education_Basic	2205.0	0.02	0.15	0.0	0.0	0.0	0.0	1.0
education_Graduation	2205.0	0.50	0.50	0.0	0.0	1.0	1.0	1.0
education_Master	2205.0	0.17	0.37	0.0	0.0	0.0	0.0	1.0
education_PhD	2205.0	0.22	0.41	0.0	0.0	0.0	0.0	1.0
MntTotal	2205.0	562.76	575.94	4.0	56.0	343.0	964.0	2491.0
MntRegularProds	2205.0	518.71	553.85	-283.0	42.0	288.0	884.0	2458.0
AcceptedCmpOverall	2205.0	0.30	0.68	0.0	0.0	0.0	0.0	4.0

/ First Observations

- Dataset dimensions: (2205, 39)
- No missing values

- Education level is *one-hot* encoded in several variables
- *Kidhome* vs *Teenhome* variables are independent from each other
- *Z_CostContact* and *Z_Revenue* variables are identical across all customers and can be dropped
- *Age* and *Income* variables are found in absolute numbers (not ranges)

/ Feature Engineering and Data Transformation

- Drop *Z_CostContact* and *Z_Revenue* variables
- Create a new variable *Education* by cobining multiple Education level variables into one
- Create *Age_Range* variable based on *Age*
- Create *Income_Range* variable based on *Income*

In [7]:
```
mydata = mydata.drop(['Z_CostContact', 'Z_Revenue'], axis=1)
```

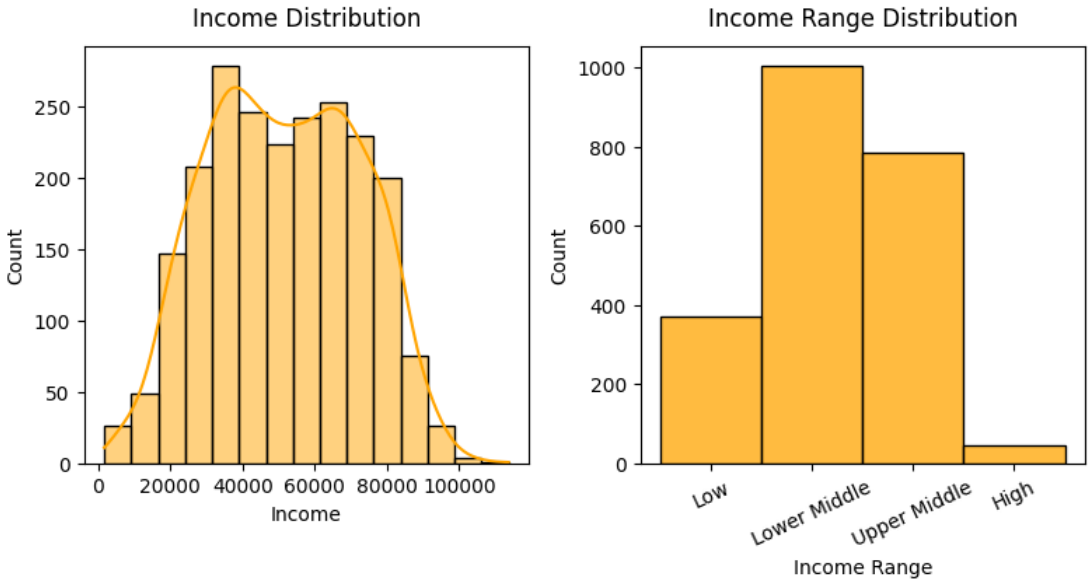
In [8]:
```
# creating age categories to convert Age to Age Ranges
age_categories = [
    (24, 39, '24-39'),
    (40, 54, '40-54'),
    (55, 74, '55-74'),
    (75, 150, '75+')
]

def categorize_age(age):
    for age_range in age_categories:
        if age_range[0] <= age <= age_range[1]:
            return age_range[2]


mydata['Age_Range'] = mydata['Age'].apply(categorize_age)
```

In [9]:
```
# creating income categories to convert Income to Income Ranges
income_categories = {
    'Low': (0, 30000),
    'Lower Middle': (30001, 60000),
    'Upper Middle': (60001, 90000),
    'High': (90001, 1000000)
}

def categorize_income(income):
    for category, (min_income, max_income) in income_categories.items():
        if min_income <= income <= max_income:
            return category

mydata['Income_Range'] = mydata['Income'].apply(categorize_income)
```

▲ Getting to Know the Customers

In [10]:
```
# Income and Income Range Distribution

custom_order = ['Low', 'Lower Middle', 'Upper Middle', 'High']
mydata['Income_Range'] = pd.Categorical(mydata['Income_Range'], categories=custom_order, ordered=True)

fig, axes = plt.subplots(1, 2, figsize=(8, 4))

order = ['Low', 'Lower Middle', 'Upper Middle', 'High']

income_data = mydata['Income']
hist1 = sns.histplot(data=income_data, bins=15, kde=True, color='orange', ax=axes[0])
hist1.set_title('Income Distribution', y=1.02, fontsize=12)
hist1.set_xlabel('Income')

mydata_sorted = mydata.sort_values(by='Income_Range')
hist2 = sns.histplot(data=mydata_sorted, x='Income_Range', color='orange', bins=15, ax=axes[1])
hist2.set_title('Income Range Distribution', y=1.02, fontsize=12)
hist2.set_xlabel('Income Range')

plt.tight_layout()
plt.xticks(rotation=25)
plt.show()
```

```
mean_income = income_data.mean()
median_income = income_data.median()
std_dev = income_data.std()

print(f"Mean Income: {round(mean_income, 2)}")
print(f"Median Income: {round(median_income, 2)}")
print(f"Standard Deviation: {round(std_dev, 2)}")
```




```
Mean Income: 51622.09
Median Income: 51287.0
Standard Deviation: 20713.06
```

In [11]:
```
mydata['Income_Range'].value_counts()
```

Out[11]:
```
Income_Range
Lower Middle    1004
Upper Middle     786
Low              370
High              45
Name: count, dtype: int64
```

In [12]:
```
# Convert to percentage:
total_counts = mydata['Income_Range'].value_counts()
percentage = pd.DataFrame((total_counts / total_counts.sum()) * 100)
rounded_percentage = round(percentage, 2)
rounded_percentage.rename(columns={'Income_Range': 'Percentage'}, inplace=True)
rounded_percentage
```

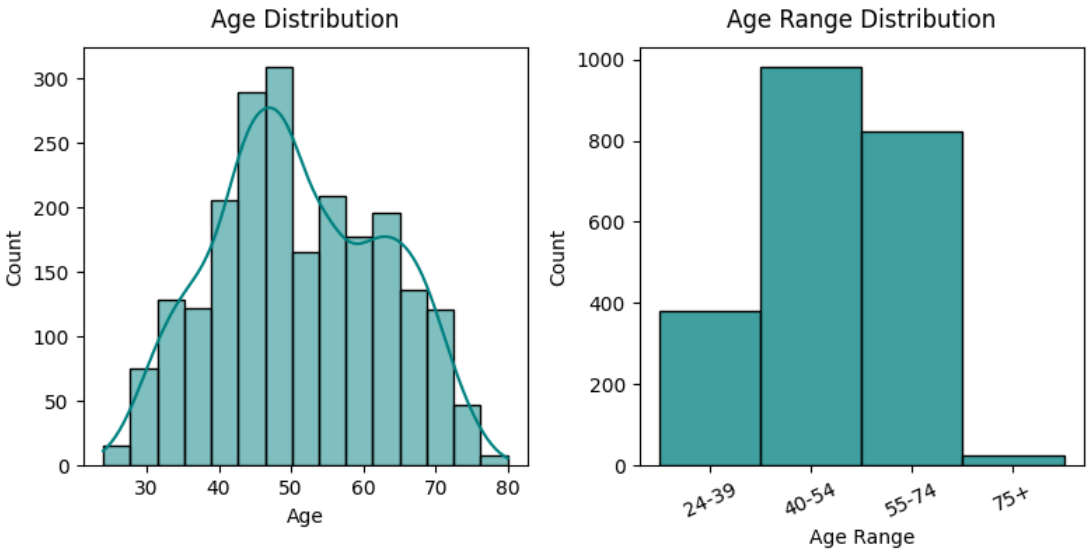
Out[12]:

Income_Range	count
Lower Middle	45.53
Upper Middle	35.65
Low	16.78
High	2.04

Middle Class Rules: Most customers out of the total of 2205 come from the Lower Middle (~ 45%) and Upper Middle (~ 36%) class households. This makes for ~ 81% of all customers.

In [13]:
```
# Age and Age Range distribution

fig, axes = plt.subplots(1, 2, figsize=(8, 4))

age_data = mydata['Age']
hist1 = sns.histplot(data=age_data, bins=15, kde=True, color='teal', ax=axes[0])
hist1.set_title('Age Distribution', y=1.02, fontsize=12)
hist1.set_xlabel('Age')
```

```
mydata_sorted = mydata.sort_values(by='Age_Range')
hist2 = sns.histplot(data=mydata_sorted, x='Age_Range', color='teal', bins=15, ax=axes[1])
hist2.set_title('Age Range Distribution', y=1.02, fontsize=12)
hist2.set_xlabel('Age Range')

plt.tight_layout()
plt.xticks(rotation=25)
plt.show()

mean_age = age_data.mean()
median_age= age_data.median()
std_dev = age_data.std()

print(f"Mean Age: {round(mean_age,  2)}")
print(f"Median Age: {round(median_age, 2)}")
print(f"Standard Deviation: {round(std_dev, 2)}")
```




```
Mean Age: 51.1
Median Age: 50.0
Standard Deviation: 11.71
```

In [14]:
```
mydata['Age_Range'].value_counts()
```

Out[14]:
```
Age_Range
40-54    981
55-74    822
24-39    379
75+       23
Name: count, dtype: int64
```

In [15]:
```
total_counts = mydata['Age_Range'].value_counts()
percentage = pd.DataFrame((total_counts / total_counts.sum()) * 100)
rounded_percentage = round(percentage, 2)
rounded_percentage.rename(columns={'Age_Range': 'Customers, %'}, inplace=True)
rounded_percentage
```

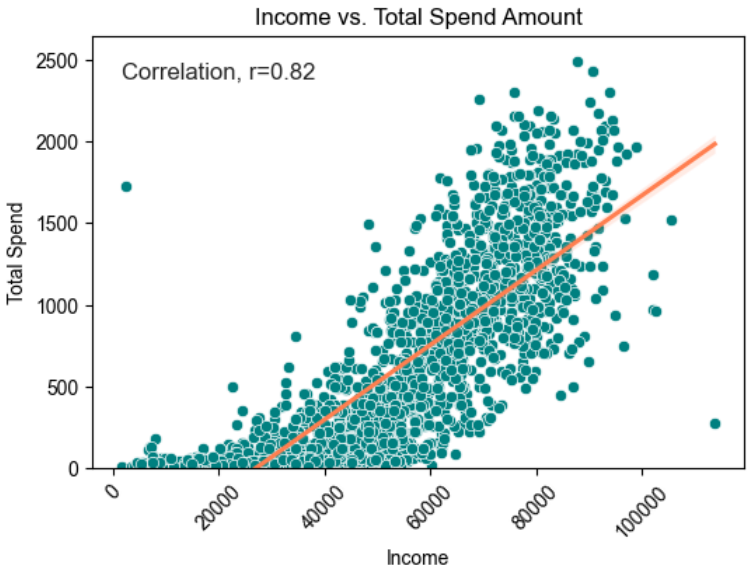
Out[15]:

Age_Range	count
40-54	44.49
55-74	37.28
24-39	17.19
75+	1.04

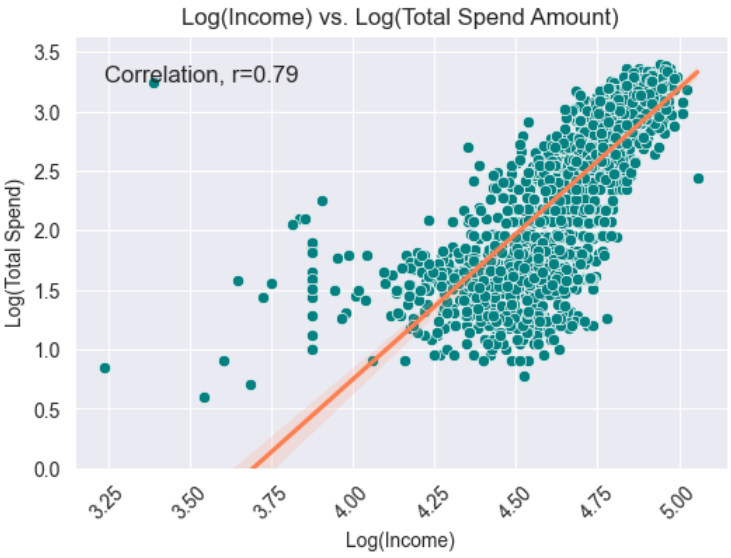
Middle Age Rules: Most customers out of the total of 2205 come from the 40-54 yo (~ 44%) and 55-74 yo (~ 37%) age groups. This makes for ~ 82% of all customers.

▲ Who Spends Most

In [16]:
```
plt.figure(figsize=(6, 4))
sns.scatterplot(x=mydata['Income'], y=mydata['MntTotal'], color='teal')
sns.regplot(x=mydata['Income'], y=mydata['MntTotal'], scatter=False, color='coral')
sns.set_style('darkgrid')

plt.xlabel('Income')
plt.ylabel('Total Spend')
plt.title('Income vs. Total Spend Amount')
plt.xticks(rotation=45)

correlation = round(mydata['MntTotal'].corr(mydata['Income']), 2)
correlation_text = f"Correlation, r={correlation}"

# Limit the y-axis range to not go below 0
plt.ylim(0, None)

plt.text(mydata['Income'].min(), mydata['MntTotal'].max(), correlation_text, fontsize=12, ha='left', va='top')
plt.show()
```

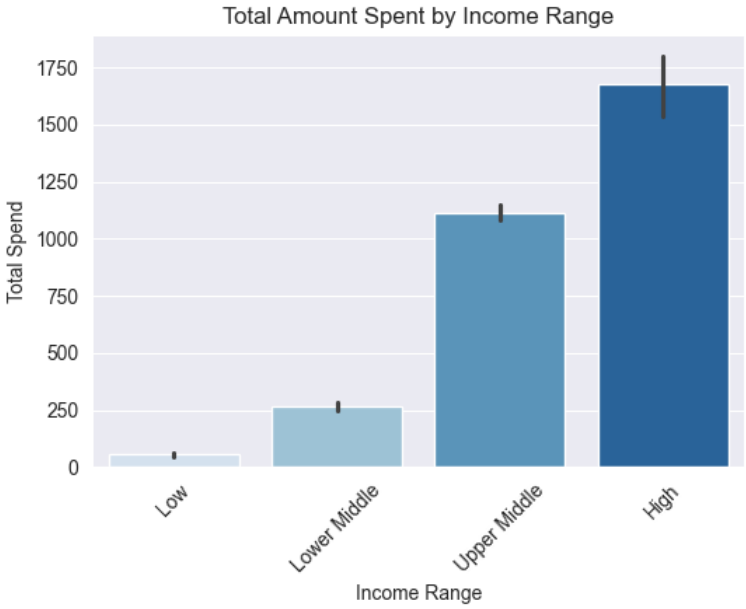


In [17]:
```
plt.figure(figsize=(6, 4))

x = np.log10(np.array(mydata['Income']))
y = np.log10(np.array(mydata['MntTotal']))

sns.scatterplot(x=x, y=y, color='teal')
sns.regplot(x=x, y=y,  scatter=False, color='coral')
sns.set_style('darkgrid')

correlation = round(np.corrcoef(x[1:], y[1:])[0, 1], 2)
correlation_text = f"Correlation, r={correlation}"

plt.text(min(x), max(y), correlation_text, fontsize=12, ha='left', va='top')
plt.ylim(0, None)


plt.xlabel('Log(Income)')
plt.ylabel('Log(Total Spend)')
plt.title('Log(Income) vs. Log(Total Spend Amount)')
plt.xticks(rotation=45)

plt.show()
```



In [18]:
```
# mean spending by Income Range

order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True). \
    reset_index()['Income_Range']. \
    values

plt.figure(figsize=(6, 4))
sns.barplot(x=mydata['Income_Range'], y=mydata['MntTotal'], palette='Blues', order=order)
sns.set_style('darkgrid')

plt.xlabel('Income Range')
plt.ylabel('Total Spend')
plt.title('Total Amount Spent by Income Range')
plt.xticks(rotation=45)
plt.show()

print('Total Amount Spent by Income Range', round(mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True), 2))

print('')

print('REMINDER: Income Range Definition\n',
      mydata.groupby(by='Income_Range').agg(
          min_income=('Income', 'min'),
          max_income=('Income', 'max')
      ).sort_values(by='min_income', ascending=True)
)
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3190674393.py:3: FutureWarning: The default of observed=False is deprecated an
d will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ado
pt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3190674393.py:10: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntTotal'], palette='Blues', order=order)
```




```
Total Amount Spent by Income Range              MntTotal
Income_Range
Low                 55.19
Lower Middle       267.41
Upper Middle      1115.33
High              1674.33

REMINDER: Income Range Definition
               min_income  max_income
Income_Range
Low                1730.0     29999.0
Lower Middle      30015.0     60000.0
Upper Middle      60033.0     90000.0
High              90226.0    113734.0
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3190674393.py:19: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  print('Total Amount Spent by Income Range', round(mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3190674393.py:26: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  mydata.groupby(by='Income_Range').agg(
```

More Money, More Spend: Surprise! People who have more money spend more! There is a strong positive correlation between the Income of the household and the Money Spend overall ($r = 0.82$) With a polynomial fit, the correlation coefficient is slightly smaller, ($r = 0.79$).

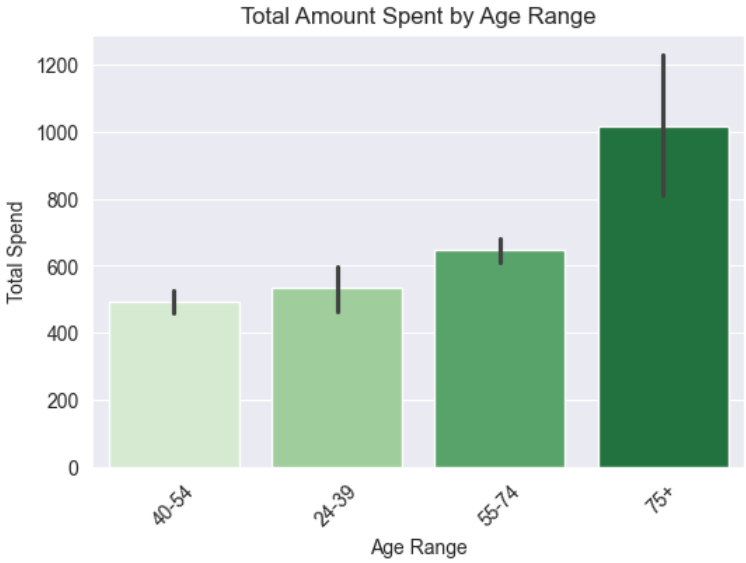
In [19]:
```
# plt.figure(figsize=(6, 4))
# sns.scatterplot(x=mydata['Age'], y=mydata['MntTotal'], color='teal')
# sns.regplot(x=mydata['Age'], y=mydata['MntTotal'], scatter=False, color='coral')
# plt.xlabel('Age')
# plt.ylabel('Total Spend')
# plt.title('Age vs. Total Spend Amount')
# plt.xticks(rotation=45)

# correlation = round(mydata['MntTotal'].corr(mydata['Age']), 2)
# correlation_text = f"Correlation, r={correlation}"

# # Limit the y-axis range to not go below 0
# plt.ylim(0, None)

# plt.text(mydata['Age'].min(), mydata['MntTotal'].max(), correlation_text, fontsize=12, ha='left', va='top')
# plt.show()
```

In [20]:
```
order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True). \
    reset_index()['Age_Range'].values
order
```

Out[20]: array(['40-54', '24-39', '55-74', '75+'], dtype=object)

In [21]:
```
# plotting average spend by Age_Range

plt.figure(figsize=(6, 4))
sns.barplot(x=mydata['Age_Range'], y=mydata['MntTotal'], palette='Greens', order = order)
sns.set_style('darkgrid')

plt.xlabel('Age Range')
plt.ylabel('Total Spend')
plt.title('Total Amount Spent by Age Range')
plt.xticks(rotation=45)
plt.show()

print(round(mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True)), 2)
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\452898771.py:4: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntTotal'], palette='Greens', order = order)
```




```
           MntTotal
Age_Range
40-54         493.0
24-39         534.0
55-74         647.0
75+          1017.0 2
```

Frugal 40-54: Curiously, people in the 40-54 yo age category spend the least (493). People who are 24-39 yo spend more (534) than those who are 40-54 yo. The 75+ yo age group spends the most but remember they are relatively small group compared to the rest

▲ Generational Product Spending

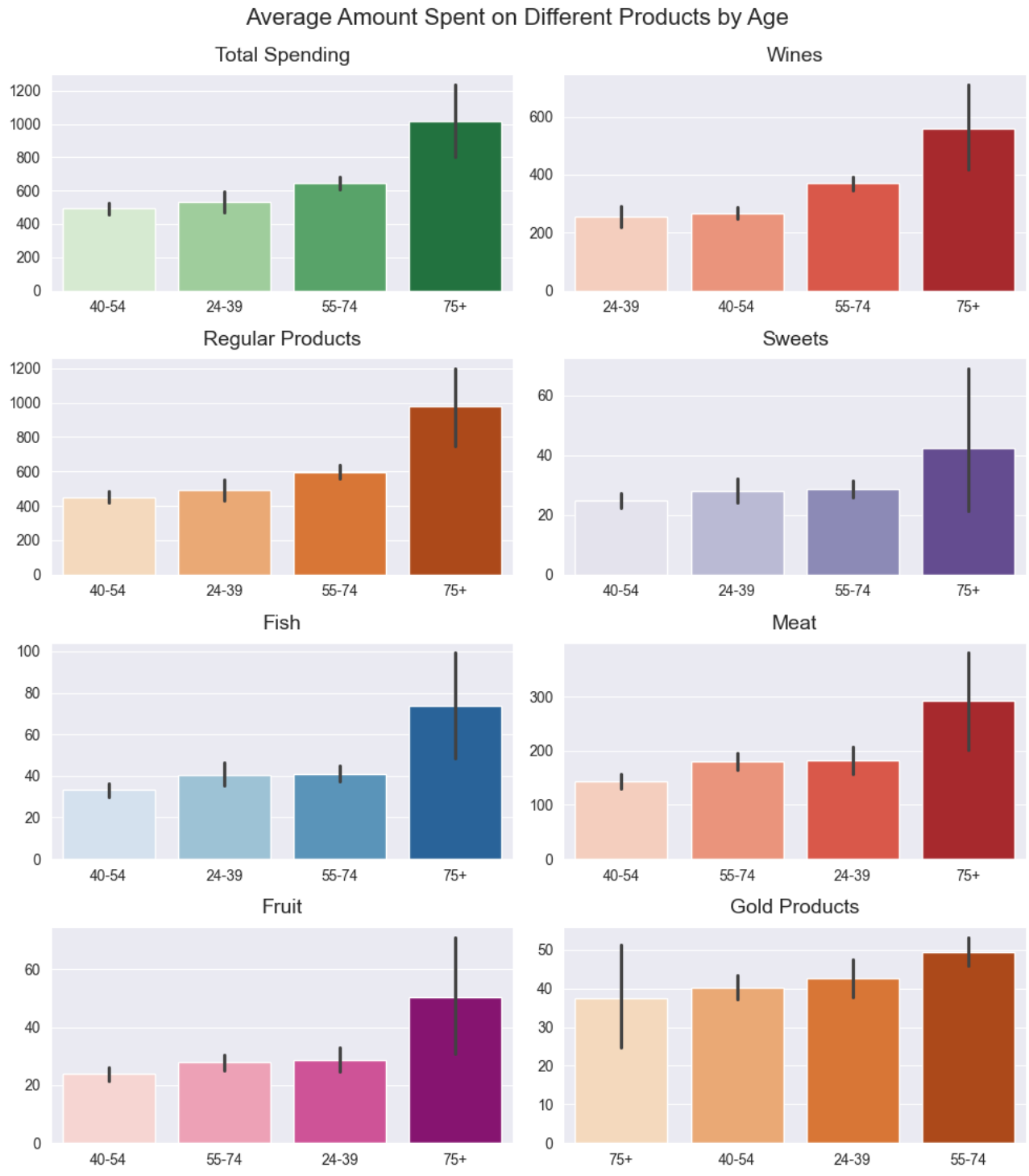
In [22]:
```
order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True). \
    reset_index()['Age_Range'].values
```

In [23]:
```
# Create subplots

fig, axes = plt.subplots(4, 2, figsize=(10, 11))

# Define palettes for each subplot
palettes = ['Greys', 'Blues', 'Oranges', 'Greens', 'Reds', 'YlOrBr', 'RdPu', 'Purples']

# Plot 1: Total Spending
```

```
order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True). \
    reset_index()['Age_Range'].values

sorted_total = mydata.sort_values(by='MntTotal')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntTotal'], order=order, palette=palettes[3], ax=axes[0, 0])
sns.set_style('whitegrid')
axes[0, 0].set_title('Total Spending', y=1.02, fontsize=14)

# Plot 2: Wines

order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntWines']]. \
    sort_values(by='MntWines', ascending = True). \
    reset_index()['Age_Range'].values

sorted_wines = mydata.sort_values(by='MntWines')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntWines'], order=order, palette=palettes[4], ax=axes[0, 1])
sns.set_style('whitegrid')

axes[0, 1].set_title('Wines', y=1.02, fontsize=14)

# Plot 3: Regular Products

order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntRegularProds']]. \
    sort_values(by='MntRegularProds', ascending = True). \
    reset_index()['Age_Range'].values

sorted_regular = mydata.sort_values(by='MntRegularProds')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntRegularProds'], order=order, palette=palettes[2], ax=axes[1, 0])
sns.set_style('whitegrid')

axes[1, 0].set_title('Regular Products', y=1.02, fontsize=14)

# Plot 4: Sweet Products

order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntSweetProducts']]. \
    sort_values(by='MntSweetProducts', ascending = True). \
    reset_index()['Age_Range'].values

sorted_sweet = mydata.sort_values(by='MntSweetProducts')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntSweetProducts'], order=order, palette=palettes[7], ax=axes[1, 1])
sns.set_style('whitegrid')

axes[1, 1].set_title('Sweets', y=1.02, fontsize=14)

# Plot 5: Fish Products
order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntFishProducts']]. \
    sort_values(by='MntFishProducts', ascending = True). \
    reset_index()['Age_Range'].values

sorted_fish = mydata.sort_values(by='MntFishProducts')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntFishProducts'], order=order, palette=palettes[1], ax=axes[2, 0])
sns.set_style('whitegrid')

axes[2, 0].set_title('Fish', y=1.02, fontsize=14)

# Plot 6: Meat Products

order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntMeatProducts']]. \
    sort_values(by='MntMeatProducts', ascending = True). \
    reset_index()['Age_Range'].values

sorted_meat = mydata.sort_values(by='MntMeatProducts')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntMeatProducts'], order=order, palette=palettes[4], ax=axes[2, 1])
sns.set_style('whitegrid')

axes[2, 1].set_title('Meat', y=1.02, fontsize=14)

# Plot 7: Fruits

order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntFruits']]. \
    sort_values(by='MntFruits', ascending = True). \
    reset_index()['Age_Range'].values
```

```
sorted_fruits = mydata.sort_values(by='MntFruits')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntFruits'], order=order, palette=palettes[6], ax=axes[3, 0])
sns.set_style('whitegrid')

axes[3, 0].set_title('Fruit', y=1.02, fontsize=14)

# Plot 8: Gold Products

order = mydata.groupby(by='Age_Range'). \
    mean(numeric_only=True)[['MntGoldProds']]. \
    sort_values(by='MntGoldProds', ascending = True). \
    reset_index()['Age_Range'].values


sorted_gold = mydata.sort_values(by='MntGoldProds')
sns.barplot(x=mydata['Age_Range'], y=mydata['MntGoldProds'], order=order, palette=palettes[2], ax=axes[3, 1])
sns.set_style('whitegrid')

axes[3, 1].set_title('Gold Products', y=1.02, fontsize=14)

for ax in axes.ravel():
    ax.set_xlabel('')
    ax.set_ylabel('')

# Adjust the layout and labels
plt.tight_layout()
plt.suptitle("Average Amount Spent on Different Products by Age", y=1.02, fontsize=16)
plt.show()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:16: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntTotal'], order=order, palette=palettes[3], ax=axes[0, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:28: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntWines'], order=order, palette=palettes[4], ax=axes[0, 1])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:41: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntRegularProds'], order=order, palette=palettes[2], ax=axes[1, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:54: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntSweetProducts'], order=order, palette=palettes[7], ax=axes[1, 1])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:66: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntFishProducts'], order=order, palette=palettes[1], ax=axes[2, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:79: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntMeatProducts'], order=order, palette=palettes[4], ax=axes[2, 1])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:92: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntFruits'], order=order, palette=palettes[6], ax=axes[3, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1645650147.py:106: FutureWarning:

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

  sns.barplot(x=mydata['Age_Range'], y=mydata['MntGoldProds'], order=order, palette=palettes[2], ax=axes[3, 1])
```



In [24]:
```
# # Define the product categories
# categories = [
#     "MntTotal",
#     "MntWines",
#     "MntRegularProds",
#     "MntSweetProducts",
#     "MntFishProducts",
#     "MntMeatProducts",
#     "MntFruits",
#     "MntGoldProds"
# ]

# # Define the product categories and their corresponding names
# category_names = {
#     "MntTotal": "Total Spending",
#     "MntWines": "Wines",
#     "MntRegularProds": "Regular Products",
```

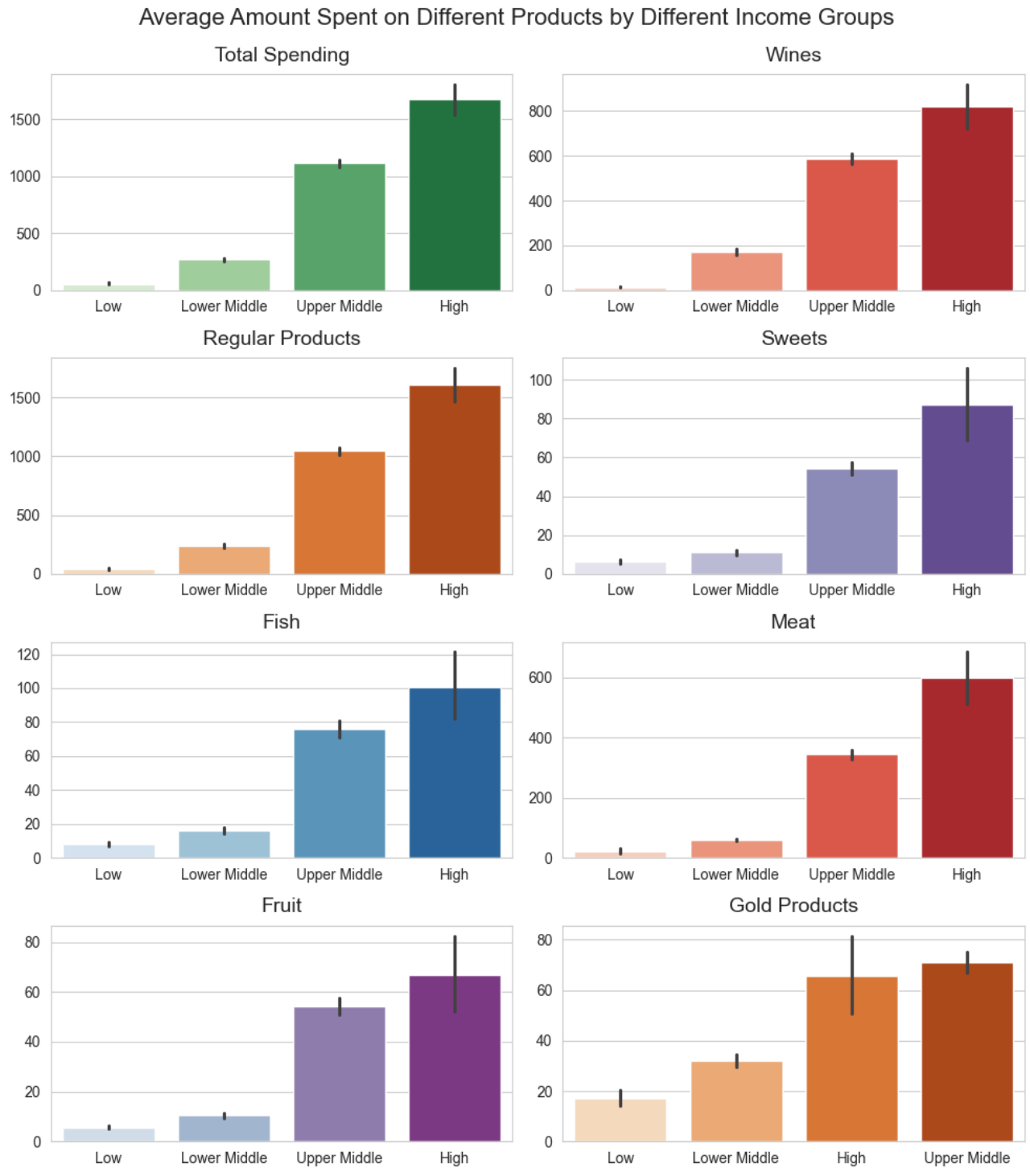
```
#     "MntSweetProducts": "Sweet Products",
#     "MntFishProducts": "Fish Products",
#     "MntMeatProducts": "Meat Products",
#     "MntFruits": "Fruits",
#     "MntGoldProds": "Gold Products"
# }

# # Calculate and add the results for each category
# for category in categories:
#     # Get the category name from the dictionary
#     category_name = category_names.get(category, "N/A")

#     mean_by_age_range = mydata.groupby('Age_Range')[category]. \
#         mean(numeric_only=True). \
#         reset_index(). \
#         rename(columns={category: category_name})

#     # Sort the results by the mean spending values
#     mean_by_age_range = mean_by_age_range.sort_values(by=category_name, ascending=True)

#     print(round(mean_by_age_range, 2))
#     print("\n")
```

In [25]:

```
# Create subplots
fig, axes = plt.subplots(4, 2, figsize=(10, 11))

# Define palettes for each subplot
palettes = ['Greens', 'Greens', 'Oranges', 'Reds', 'Purples', 'BuPu', 'Blues', 'Reds']

# Plot 1: Total Spending
order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntTotal']]. \
    sort_values(by='MntTotal', ascending = True). \
    reset_index()['Income_Range'].values

sorted_total = mydata.sort_values(by='MntTotal')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntTotal'], order=order,  palette=palettes[0], ax=axes[0, 0])
sns.set_style('whitegrid')

axes[0, 0].set_title('Total Spending', y=1.02, fontsize=14)

# Plot 2: Wines
order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntWines']]. \
    sort_values(by='MntWines', ascending = True). \
    reset_index()['Income_Range'].values

sorted_wines = mydata.sort_values(by='MntWines')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntWines'], order=order,  palette=palettes[3], ax=axes[0, 1])
sns.set_style('whitegrid')

axes[0, 1].set_title('Wines', y=1.02, fontsize=14)

# Plot 3: Regular Products

order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntRegularProds']]. \
    sort_values(by='MntRegularProds', ascending = True). \
    reset_index()['Income_Range'].values

sorted_regular = mydata.sort_values(by='MntRegularProds')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntRegularProds'], order=order,  palette=palettes[2], ax=axes[1, 0])
axes[1, 0].set_title('Regular Products', y=1.02, fontsize=14)
sns.set_style('whitegrid')


# Plot 4: Sweet Products

order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntSweetProducts']]. \
    sort_values(by='MntSweetProducts', ascending = True). \
    reset_index()['Income_Range'].values

sorted_sweet = mydata.sort_values(by='MntSweetProducts')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntSweetProducts'], order=order,  palette=palettes[4], ax=axes[1, 1])
sns.set_style('whitegrid')

axes[1, 1].set_title('Sweets', y=1.02, fontsize=14)

# Plot 5: Fish Products
```

```
order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntFishProducts']]. \
    sort_values(by='MntFishProducts', ascending = True). \
    reset_index()['Income_Range'].values

sorted_fish = mydata.sort_values(by='MntFishProducts')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntFishProducts'], order=order,  palette=palettes[6], ax=axes[2, 0])
sns.set_style('whitegrid')

axes[2, 0].set_title('Fish', y=1.02, fontsize=14)

# Plot 6: Meat Products

order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntMeatProducts']]. \
    sort_values(by='MntMeatProducts', ascending = True). \
    reset_index()['Income_Range'].values

sorted_meat = mydata.sort_values(by='MntMeatProducts')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntMeatProducts'], order=order,  palette=palettes[3], ax=axes[2, 1])
sns.set_style('whitegrid')

axes[2, 1].set_title('Meat', y=1.02, fontsize=14)

# Plot 7: Fruits

order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntFruits']]. \
    sort_values(by='MntFruits', ascending = True). \
    reset_index()['Income_Range'].values

sorted_fruits = mydata.sort_values(by='MntFruits')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntFruits'], order=order,  palette=palettes[5], ax=axes[3, 0])
sns.set_style('whitegrid')

axes[3, 0].set_title('Fruit', y=1.02, fontsize=14)

# Plot 8: Gold Products

order = mydata.groupby(by='Income_Range'). \
    mean(numeric_only=True)[['MntGoldProds']]. \
    sort_values(by='MntGoldProds', ascending = True). \
    reset_index()['Income_Range'].values

sorted_gold = mydata.sort_values(by='MntGoldProds')
sns.barplot(x=mydata['Income_Range'], y=mydata['MntGoldProds'], order=order,  palette=palettes[2], ax=axes[3, 1])
sns.set_style('whitegrid')

axes[3, 1].set_title('Gold Products', y=1.02, fontsize=14)

for ax in axes.ravel():
    ax.set_xlabel('')
    ax.set_ylabel('')

# Adjust the layout and labels
plt.tight_layout()
plt.suptitle("Average Amount Spent on Different Products by Different Income Groups", y=1.02, fontsize=16)
plt.show()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:8: FutureWarning: The default of observed=False is deprecated an
d will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ado
pt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:14: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntTotal'], order=order,  palette=palettes[0], ax=axes[0, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:20: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:26: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntWines'], order=order,  palette=palettes[3], ax=axes[0, 1])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:33: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:39: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntRegularProds'], order=order,  palette=palettes[2], ax=axes[1, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:46: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:52: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntSweetProducts'], order=order,  palette=palettes[4], ax=axes[1, 1])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:59: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:65: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntFishProducts'], order=order,  palette=palettes[6], ax=axes[2, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:72: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:78: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntMeatProducts'], order=order,  palette=palettes[3], ax=axes[2, 1])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:85: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:91: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntFruits'], order=order,  palette=palettes[5], ax=axes[3, 0])
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:98: FutureWarning: The default of observed=False is deprecated a
nd will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ad
opt the future default and silence this warning.
  order = mydata.groupby(by='Income_Range'). \
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2281347281.py:104: FutureWarning:

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

  sns.barplot(x=mydata['Income_Range'], y=mydata['MntGoldProds'], order=order,  palette=palettes[2], ax=axes[3, 1])
```



In [26]:
```
# # Define the product categories
# categories = [
#     "MntTotal",
#     "MntWines",
#     "MntRegularProds",
#     "MntSweetProducts",
#     "MntFishProducts",
#     "MntMeatProducts",
#     "MntFruits",
#     "MntGoldProds"
# ]

# # Define the product categories and their corresponding names
# category_names = {
#     "MntTotal": "Total Spending",
#     "MntWines": "Wines",
#     "MntRegularProds": "Regular Products",
```

```
#     "MntSweetProducts": "Sweets",
#     "MntFishProducts": "Fish",
#     "MntMeatProducts": "Meat",
#     "MntFruits": "Fruit",
#     "MntGoldProds": "Gold Products"
# }

# # Calculate and add the results for each category
# for category in categories:
#     # Get the category name from the dictionary
#     category_name = category_names.get(category, "N/A")

#     mean_by_income_range = mydata.groupby('Income_Range')[category]. \
#         mean(numeric_only=True). \
#         reset_index(). \
#         rename(columns={category: category_name})

#     # Sort the results by the mean spending values
#     mean_by_income_range = mean_by_income_range.sort_values(by=category_name, ascending=True)

#     print(round(mean_by_income_range, 2))
#     print("\n")
```

In [27]:
```
# plt.figure(figsize=(6, 4))
# sns.scatterplot(x=mydata['Age'], y=mydata['MntWines'], color='teal')
# sns.regplot(x=mydata['Age'], y=mydata['MntWines'], scatter=False, color='coral')
# plt.xlabel('Age')
# plt.ylabel('Amount Spent on Wine')
# plt.title('Age vs. Amount Spent on Wine')
# plt.xticks(rotation=45)

# correlation = round(mydata['MntWines'].corr(mydata['Age']), 2)
# correlation_text = f"Correlation, r={correlation}"

# # Limit the y-axis range to not go below 0
# plt.ylim(0, None)

# plt.text(mydata['Age'].min(), mydata['MntWines'].max(), correlation_text, fontsize=12, ha='left', va='top')
# plt.show()
```

Income Factor: In general, the amount of money people spend corresponds to their income bracket (Low < Lower Middle < Upper Middle < High). That is, people with more money spend more overall and in most product categories: Fish, Meat, Fruit, Sweets, Regular Products, and Wine. The pattern was only disrupted in case of **GOLD** products where High Income household customers **were not** in the lead (Upper Middle Class was). REMINDER: There are more LOWER MIDDLE customers but on average they spend **MUCH** less than their Upper Middle Class neighbors

Age Factor: On average, people in the 75+ yo age category spend the most whereas the customers from the 40-54 yo age range spend the least

Wine: There was a very consistent increase in the amount of money spend on Wine across all 4 age groups. 25-39 < 40-54 < 55-74 < 75+.

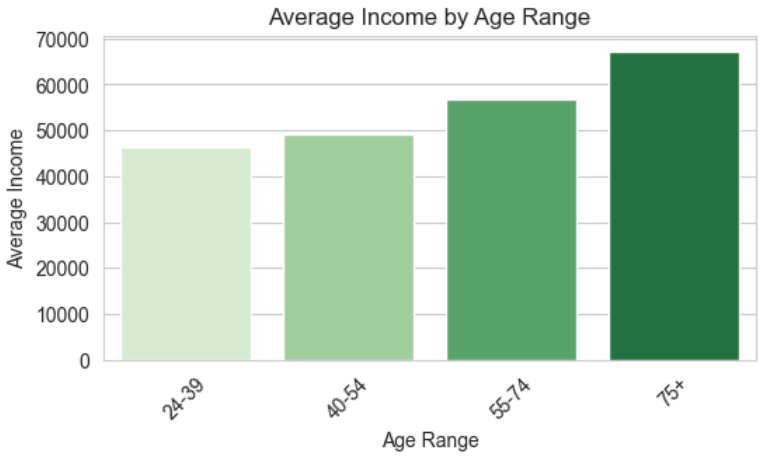
Meat and Fruit: The two leading spenders in these product are 75+ and 25-39 yo groups

Gold: The age pattern for spenders on GOLD products is very different from other product categories. The two leading spenders in GOLD products are 55-74 yo and 25-39 yo age groups, followed by the 40-54 yo group.

In [28]:
```
# Income as a function of Age Range

average_income_by_age = mydata.groupby('Age_Range')['Income'].mean().reset_index().sort_values(by='Income', ascending=True)

plt.figure(figsize=(6, 3))
sns.barplot(data=average_income_by_age, x='Age_Range', y='Income', palette='Greens')
sns.set_style('whitegrid')


# Customize the chart
plt.title("Average Income by Age Range")
plt.xlabel("Age Range")
plt.ylabel("Average Income")
```

```
plt.xticks(rotation=45)


plt.show()
round(average_income_by_age, 2)
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2736571892.py:6: FutureWarning:

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

  sns.barplot(data=average_income_by_age, x='Age_Range', y='Income', palette='Greens')
```



Out[28]:

	Age_Range	Income
0	24-39	46260.68
1	40-54	49016.94
2	55-74	56766.24
3	75+	67237.22

In [29]:
```
correlation = round(mydata['Age'].corr(mydata['Income']), 2)
print(f'Correlation between Age and Income: {correlation}')
```

```
Correlation between Age and Income: 0.21
```

Income by Age Range: In general, older customers come from the households with higher income brackets (there is hope!). At the same time, the linear correlation between Age and Income is relatively week at ~0.21

In [30]:
```
mydata['Total_Kids'] = mydata['Kidhome'] + mydata['Teenhome']
```

In [31]:
```
def replace_non_zero_with_one(col):
    new_col = [1 if i != 0 else 0 for i in col]
    return new_col
```

In [32]:
```
# income_data = mydata['Income']

# hist = sns.histplot(data=income_data, bins=15, kde=True, color='teal')

# plt.xlabel('Income')
# plt.xticks(rotation=25)
# plt.ylabel('Frequency')
# plt.title('Income Distribution')
# plt.show()

# # Calculate descriptive statistics
# mean_income = income_data.mean()
# median_income = income_data.median()
# std_dev = income_data.std()

# print(f"Mean Income: {round(mean_income,  2)}")
# print(f"Median Income: {round(median_income, 2)}")
# print(f"Standard Deviation: {round(std_dev, 2)}")

# mydata['Income'].describe()
```

In [33]:
```
def create_binary_column(df, column_name):
    new_column_name = 'binary_' + column_name
    df[new_column_name] = df[column_name].apply(lambda x: 1 if x != 0 else 0)
    return df
```

/ Marketing Campaign Analysis - Success Rate

In [34]:
```
# Overal Campaign Acceptance Rate, i.e percentage of customers who accepted at least one campaign
people_accepted = mydata[(mydata['AcceptedCmpOverall'] > 0)]
total_people_accepted = (mydata['AcceptedCmpOverall'] > 0).sum()
total_people = len(mydata)
overall_acceptance_rate = round(total_people_accepted/total_people*100, 2)

print(f'Total People: {total_people}')
print(f'Total People Accepted: {total_people_accepted}')
print(f'Overall Campaign Acceptance Rate: {overall_acceptance_rate}%')
```

```
Total People: 2205
Total People Accepted: 458
Overall Campaign Acceptance Rate: 20.77%
```

In [35]:
```
# creating a list of variables that have Campaign success info
campaign_accepted = [
    'AcceptedCmp1',
    'AcceptedCmp2',
    'AcceptedCmp3',
    'AcceptedCmp4',
    'AcceptedCmp5'
]
```

In [36]:
```
#  creating a function to calculate campaign success rate
def campaign_success(df, campaign_accepted):
    campaign_success_rates = []
    for camp in campaign_accepted:
        success_rate = (df[camp] != 0).sum() / len(df[camp]) * 100
        campaign_number = camp[-1]
        success_rate_campaign = campaign_number, (df[camp] != 0).sum(), round(success_rate, 2)
        campaign_success_rates.append(success_rate_campaign)

    return campaign_success_rates
```

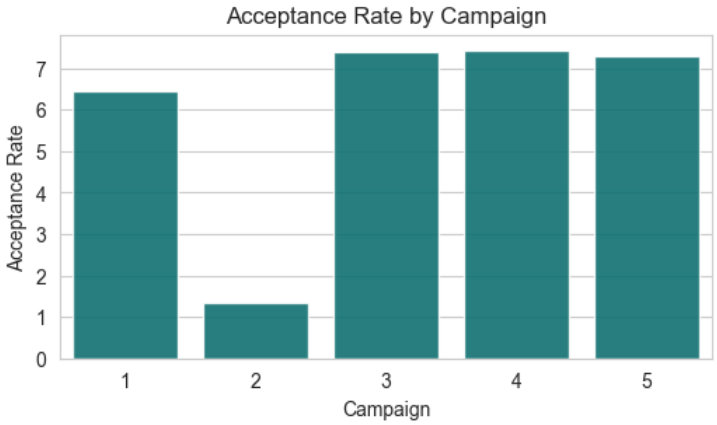
In [37]:
```
campaign_success_rates = campaign_success(mydata, campaign_accepted)
```

In [38]:
```
campaign_success_rates = pd.DataFrame(campaign_success_rates, columns=['Campaign', 'Number Accepted', 'Acceptance Rate'])
campaign_success_rates
```

Out[38]:

	Campaign	Number Accepted	Acceptance Rate
0	1	142	6.44
1	2	30	1.36
2	3	163	7.39
3	4	164	7.44
4	5	161	7.30

In [39]:
```
data = campaign_success_rates
plt.figure(figsize=(6, 3))
sns.barplot(data=data, x='Campaign', y='Acceptance Rate', color = 'teal', alpha=0.9)

plt.xlabel('Campaign')
plt.ylabel('Acceptance Rate')
plt.title('Acceptance Rate by Campaign')
plt.show()
```



Individual Campaign Success: Campaign 2 was the least successfull (1.36% acceptance rate). The most successful was Campaign 4 (7.44% acceptance rate) closely followed by Campaign 3 (7.39%) and Campaign 5 (7.3%)

Overall Campaign Success:

- Total number of people: 2205
- Number of people who accepted at least one campaign: 458
- Percentage of people who accepted at least one campaign: 20.77%

/ Marketing Campaign Analysis - Customers

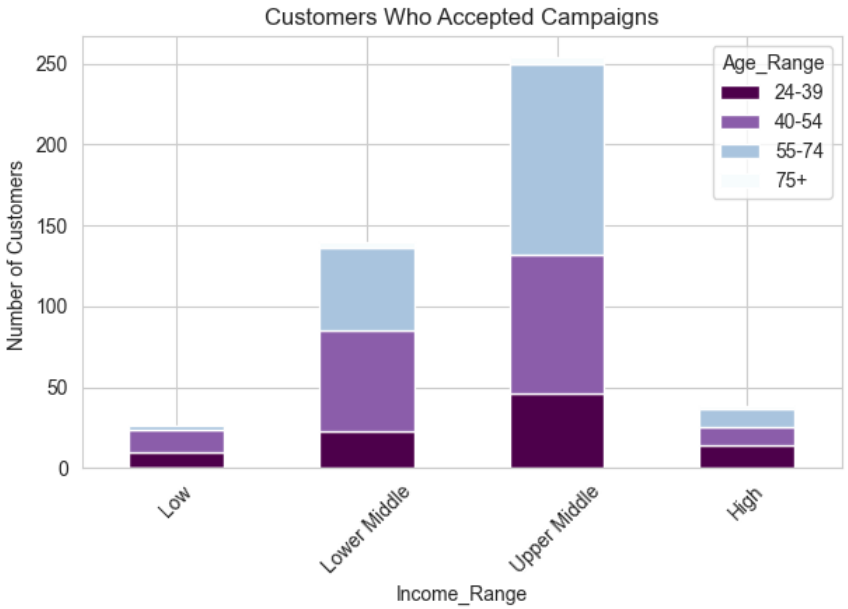
In [40]:
```
# Age_Range and Income_Range of those accepted
people_accepted.groupby(['Age_Range', 'Income_Range']).size()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1696811186.py:2: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  people_accepted.groupby(['Age_Range', 'Income_Range']).size()
```

Out[40]:
```
Age_Range  Income_Range
24-39      Low             10
           Lower Middle    23
           Upper Middle    46
           High            14
40-54      Low             14
           Lower Middle    62
           Upper Middle    86
           High            11
55-74      Low              2
           Lower Middle    51
           Upper Middle   118
           High            12
75+        Low              0
           Lower Middle     4
           Upper Middle     4
           High             1
dtype: int64
```

In [41]:
```
# Count the number of Age_Range groups for each Income_Range
counts = people_accepted.groupby(['Income_Range', 'Age_Range']).size().unstack()

# Create the bar plot
ax = counts.plot(kind='bar', stacked=True, figsize=(7, 4), cmap='BuPu_r')
sns.set_style('darkgrid')
plt.title('Customers Who Accepted Campaigns')
plt.xlabel('Income_Range')
plt.ylabel('Number of Customers ')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2597124660.py:2: FutureWarning: The default of observed=False is deprecated an
d will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ado
pt the future default and silence this warning.
  counts = people_accepted.groupby(['Income_Range', 'Age_Range']).size().unstack()
```



Upper Class Customers more responsive: More Upper Middle Class customers responded to the market campaigns than the Lower Middle Class customers (remember, there are more lower middle class than upper middle class customers)

In [42]:
```
def count_values(df):
    for col in df.columns:
        breakdown = df[col].value_counts()
        if len(breakdown) < 10:
            print(f'{col}')
            print(breakdown)
            print()
```

▲ Total Spend Analysis: Income

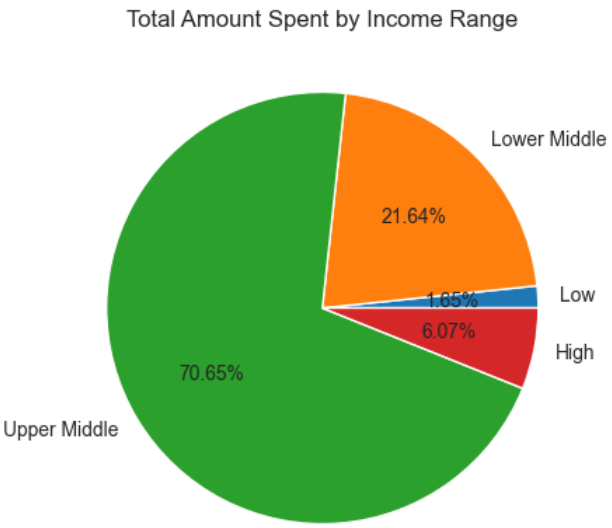
In [43]:
```
# calculate total amount spent for each income_range
Income_Range_Group_Total = mydata.groupby(by='Income_Range'). \
    sum(numeric_only=True)[['MntTotal']].  \
    sort_values(by='Income_Range', ascending=True)

# convert to percentages and add it as a new column to the dataframe
Income_Range_Group_Total['Percentage']=round((Income_Range_Group_Total/Income_Range_Group_Total.sum())*100, 2)
Income_Range_Group_Total = Income_Range_Group_Total.rename(columns={'MntTotal': 'Total Amount Spent'})


#display the dataframe
Income_Range_Group_Total
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3583613872.py:2: FutureWarning: The default of observed=False is deprecated an
d will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ado
pt the future default and silence this warning.
  Income_Range_Group_Total = mydata.groupby(by='Income_Range'). \
```

Out[43]:

Income_Range	Total Amount Spent	Percentage
Low	20420	1.65
Lower Middle	268479	21.64
Upper Middle	876652	70.65
High	75345	6.07

In [44]:
```
# create a pie chart of the total amount spent by different Income_Ranges
plt.figure(figsize=(5, 5))
plt.pie(Income_Range_Group_Total['Total Amount Spent'], labels=Income_Range_Group_Total.index, autopct='%1.2f%%')
plt.title('Total Amount Spent by Income Range')
plt.show()
```



Uper Middle Class rules even more: Customers from the Upper Middle class are responsible for 70.65% of the total amount spent

▲ Total Spend Analysis: Middle class spenders - Age Factor

In [45]:
```
Income_Range_Age_Range_Group_Total = mydata.groupby(by=['Income_Range', 'Age_Range']). \
    sum(numeric_only=True)[['MntTotal']].  \
    sort_values(by=['Income_Range', 'Age_Range'], ascending=True)

Income_Range_Age_Range_Group_Total = Income_Range_Age_Range_Group_Total.rename(columns={'MntTotal': 'Total Amount Spent'})
Income_Range_Age_Range_Group_Total
```

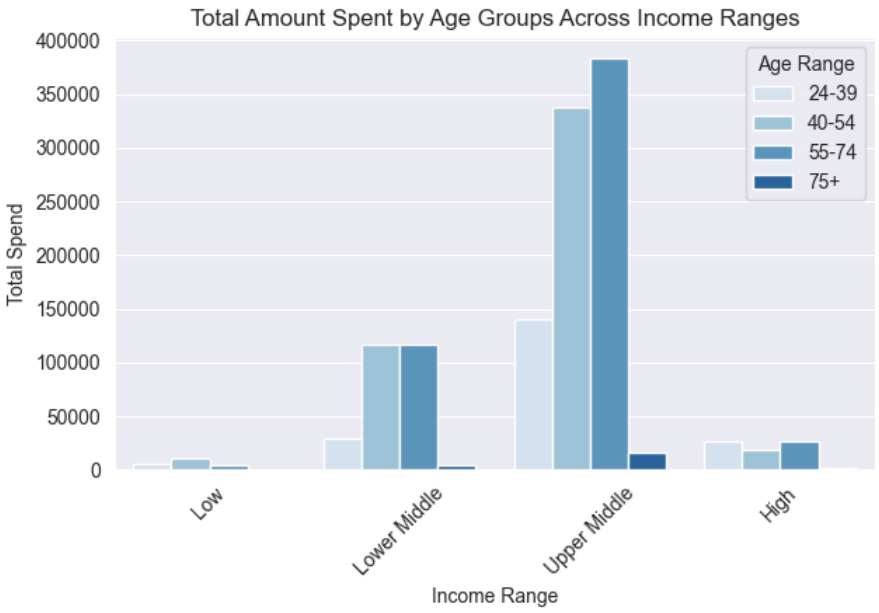
```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3552564000.py:1: FutureWarning: The default of observed=False is deprecated an
d will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to ado
pt the future default and silence this warning.
  Income_Range_Age_Range_Group_Total = mydata.groupby(by=['Income_Range', 'Age_Range']). \
```

Out[45]:

Income_Range	Age_Range	Total Amount Spent
Low	24-39	5877
	40-54	10388
	55-74	4155
	75+	0
Lower Middle	24-39	29665
	40-54	116806
	55-74	117114
	75+	4894
Upper Middle	24-39	139700
	40-54	337481
	55-74	383341
	75+	16130
High	24-39	27195
	40-54	18649
	55-74	27129
	75+	2372

In [46]:
```
Income_Range_Age_Range_Group_Total = mydata.groupby(['Income_Range', 'Age_Range'])['MntTotal'].sum().reset_index()

plt.figure(figsize=(7, 4))
sns.barplot(data=Income_Range_Age_Range_Group_Total, x='Income_Range', y='MntTotal', hue='Age_Range', palette='Blues')
plt.xlabel('Income Range')
plt.ylabel('Total Spend')
plt.title('Total Amount Spent by Age Groups Across Income Ranges')
plt.xticks(rotation=45)
plt.legend(title='Age Range', loc='upper right')
plt.show()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\1015440441.py:1: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  Income_Range_Age_Range_Group_Total = mydata.groupby(['Income_Range', 'Age_Range'])['MntTotal'].sum().reset_index()
```



Middle Age Spenders: In both Upper Middle class and Lower Middle class, the age groups 40-54 yo and 55-74 yo contribute the most to the total amount spent by customers

In [47]:
```
from IPython.display import Image
Image(filename="marketing analytics/Noosha.jpg")
```

Out[47]:

▲ Additional Data Exploring

In [48]:
```
from ipywidgets import interact
import plotly.graph_objects as go
from plotly.subplots import make_subplots
```

In [49]:
```
import plotly.express as px
from plotly.offline import iplot
```

In [50]:
```
mydata.columns
```

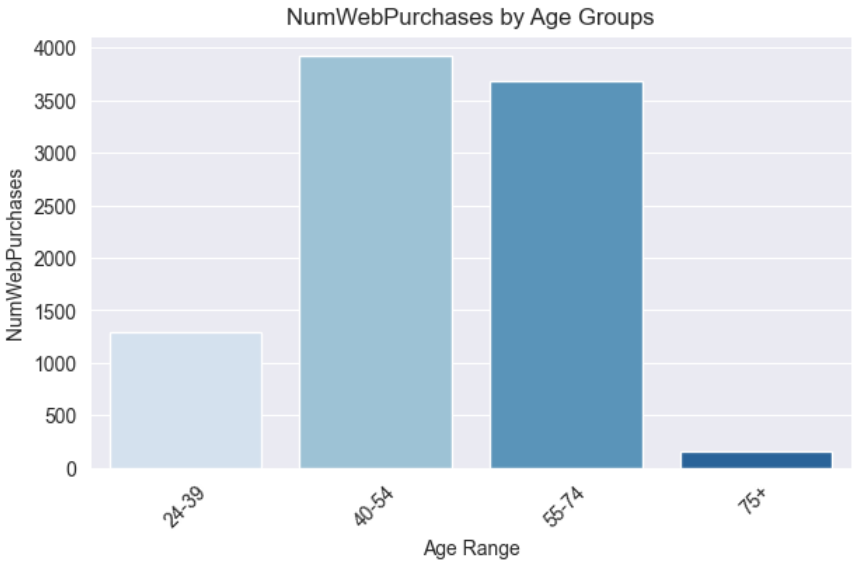
Out[50]:
```
Index(['Income', 'Kidhome', 'Teenhome', 'Recency', 'MntWines', 'MntFruits',
       'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
       'MntGoldProds', 'NumDealsPurchases', 'NumWebPurchases',
       'NumCatalogPurchases', 'NumStorePurchases', 'NumWebVisitsMonth',
       'AcceptedCmp3', 'AcceptedCmp4', 'AcceptedCmp5', 'AcceptedCmp1',
       'AcceptedCmp2', 'Complain', 'Response', 'Age', 'Customer_Days',
       'marital_Divorced', 'marital_Married', 'marital_Single',
       'marital_Together', 'marital_Widow', 'education_2n Cycle',
       'education_Basic', 'education_Graduation', 'education_Master',
       'education_PhD', 'MntTotal', 'MntRegularProds', 'AcceptedCmpOverall',
       'Age_Range', 'Income_Range', 'Total_Kids'],
      dtype='object')
```

In [51]:
```
valid_x_columns = [col for col in mydata.columns if mydata[col].nunique() < 10]
valid_y_columns = ['AcceptedCmpOverall', 'AcceptedCmp1', 'AcceptedCmp2', 'AcceptedCmp3', 'AcceptedCmp4', \
'AcceptedCmp5', 'NumDealsPurchases', 'NumWebPurchases', 'NumCatalogPurchases', 'NumStorePurchases', \
                  'NumWebVisitsMonth',  'Recency', 'MntWines', 'MntFruits',
       'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
       'MntFruits', 'MntGoldProds', 'MntRegularProds']

@interact
def bar_plot(x=valid_x_columns, y=valid_y_columns):
    mydata[x] = mydata[x].astype(str)
    grouped_data = mydata.groupby(x)[y].mean().reset_index()
    fig = px.bar(grouped_data, x=x, y=y, title=f'{y.title()} vs {x.title()}')
    fig.update_layout(width=500, height=500)
    fig.show()
```

```
interactive(children=(Dropdown(description='x', options=('Kidhome', 'Teenhome', 'AcceptedCmp3', 'AcceptedCmp4'…
```

In [52]:
```
Income_Range_Age_Range_Group_Total = mydata.groupby(['Age_Range'])['NumWebPurchases'].sum().reset_index()

plt.figure(figsize=(7, 4))
sns.barplot(data=Income_Range_Age_Range_Group_Total, x='Age_Range', y='NumWebPurchases', palette='Blues')
plt.xlabel('Age Range')
plt.ylabel('NumWebPurchases')
plt.title('NumWebPurchases by Age Groups')
plt.xticks(rotation=45)
plt.show()
```

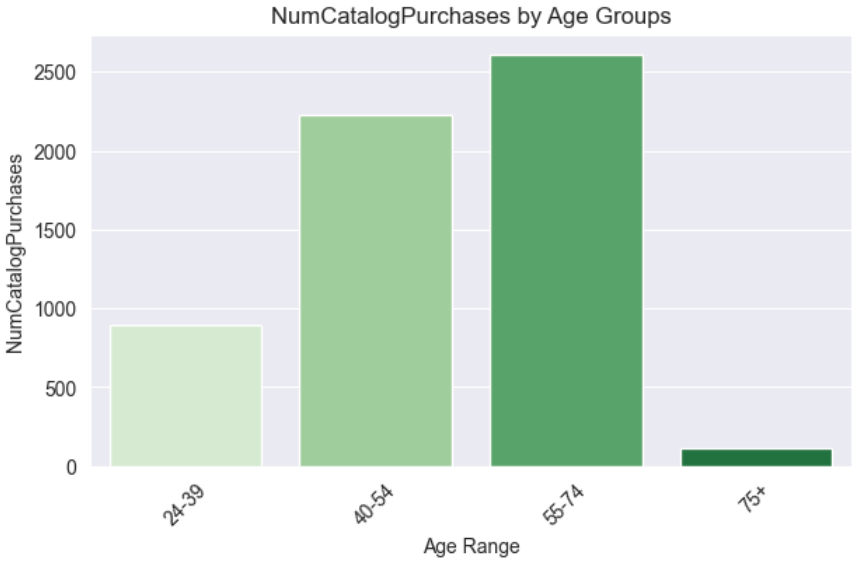
```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\16405816.py:4: FutureWarning:


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



In [53]:
```
Income_Range_Age_Range_Group_Total = mydata.groupby(['Age_Range'])['NumCatalogPurchases'].sum().reset_index()

plt.figure(figsize=(7, 4))
sns.barplot(data=Income_Range_Age_Range_Group_Total, x='Age_Range', y='NumCatalogPurchases', palette='Greens')
plt.xlabel('Age Range')
```

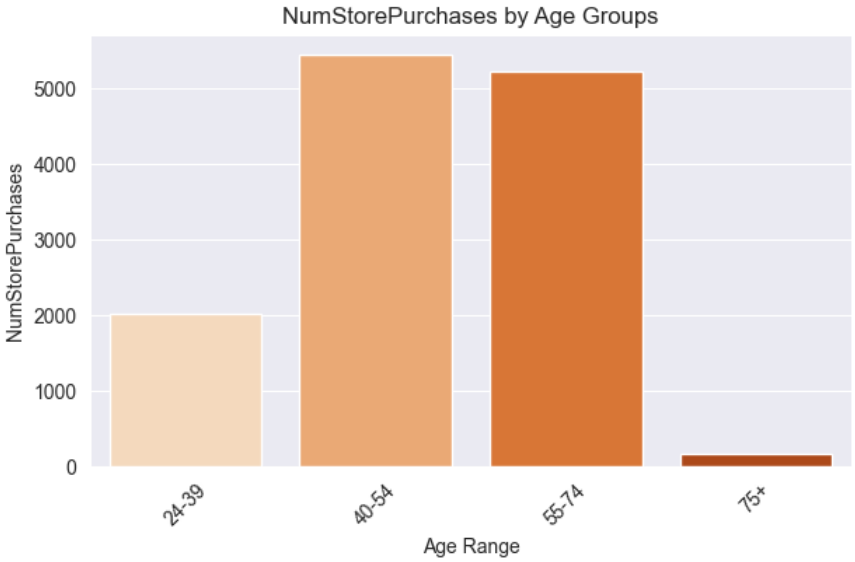
```
plt.ylabel('NumCatalogPurchases')
plt.title('NumCatalogPurchases by Age Groups')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\2076410714.py:4: FutureWarning:


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



In [54]:
```
Income_Range_Age_Range_Group_Total = mydata.groupby(['Age_Range'])['NumStorePurchases'].sum().reset_index()

plt.figure(figsize=(7, 4))
sns.barplot(data=Income_Range_Age_Range_Group_Total, x='Age_Range', y='NumStorePurchases', palette='Oranges')
plt.xlabel('Age Range')
plt.ylabel('NumStorePurchases')
plt.title('NumStorePurchases by Age Groups')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\LLANA\AppData\Local\Temp\ipykernel_7388\3500105192.py:4: FutureWarning:


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


NumStorePurchases by Age Groups
NumStorePurchases
5000
4000
3000
2000
1000
0
24-39
40-54
55-74
75+
Age Range