Load the CSV into Pandas Dataframe

In [7]:

```
import pandas as pd
df = pd.read_excel("C:/Users/JOSH/Desktop/60 Days Challenge/Project 6/marketing_campaign_dataset.xlsx")
```

Inspect column names, null values, and data types

In [8]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200005 entries, 0 to 200004
Data columns (total 15 columns):
 #   Column            Non-Null Count   Dtype  
---  ------            --------------   -----  
 0   Campaign_ID       200005 non-null  int64  
 1   Company           200005 non-null  object 
 2   Campaign_Type     200005 non-null  object 
 3   Target_Audience   200005 non-null  object 
 4   Duration          200005 non-null  object 
 5   Channel_Used      200005 non-null  object 
 6   Conversion_Rate   200005 non-null  float64
 7   Acquisition_Cost  200005 non-null  int64  
 8   ROI               200005 non-null  float64
 9   Location          200005 non-null  object 
 10  Date              200005 non-null  int64  
 11  Clicks            200005 non-null  int64  
 12  Impressions       200005 non-null  int64  
 13  Engagement_Score  200005 non-null  int64  
 14  Customer_Segment  200005 non-null  object 
dtypes: float64(2), int64(6), object(7)
memory usage: 22.9+ MB
```

In [9]:

```
df.head()
```

Out[9]:

	Campaign_ID	Company	Campaign_Type	Target_Audience	Duration	Channel_Used	Conversion_Rate	Acquisition_Cost	ROI	Location	Date	C
0	1	Innovate Industries	Email	Men 18-24	30 days	Google Ads	0.04	16174	6.29	Chicago	44197	
1	2	NexGen Systems	Email	Women 35-44	60 days	Google Ads	0.12	11566	5.61	New York	44228	
2	3	Alpha Innovations	Influencer	Men 25-34	30 days	YouTube	0.07	10200	7.18	Los Angeles	44256	
3	4	DataTech Solutions	Display	All Ages	60 days	YouTube	0.11	12724	5.55	Miami	44287	
4	5	NexGen Systems	Email	Men 25-34	15 days	YouTube	0.05	16452	6.50	Los Angeles	44317	

In [10]:

```
df.isnull().sum()
```

Out[10]:

```
Campaign_ID         0
Company             0
Campaign_Type       0
Target_Audience     0
Duration            0
Channel_Used        0
Conversion_Rate     0
Acquisition_Cost    0
ROI                 0
Location            0
Date                0
Clicks              0
Impressions         0
Engagement_Score    0
Customer_Segment    0
dtype: int64
```

In [11]:

```
df.nunique()
```

Out[11]:

```
Campaign_ID         200005
Company                  5
Campaign_Type            5
Target_Audience          5
Duration                 4
Channel_Used             6
Conversion_Rate         15
Acquisition_Cost     15001
ROI                    601
Location                 5
Date                   365
Clicks                 901
Impressions           9001
Engagement_Score        10
Customer_Segment         5
dtype: int64
```

Data Cleaning and Preprocessing

In [12]:

```
# Convert date
df['Date'] = pd.to_datetime(df['Date'])
```

In [13]:

```
# Standardize Strings
df['Company'] = df['Company'].str.strip().str.title()
```

In [14]:

```
# Drop Duplicates
df.drop_duplicates(inplace=True)
```

In [15]:

```
# Outlier Detection using IQR
Q1 = df['Clicks'].quantile(0.25)
Q3 = df['Clicks'].quantile(0.75)
IQR = Q3 - Q1
df = df[~((df['Clicks'] < Q1 - 1.5 * IQR)) | (df['Clicks'] > (Q3 + 1.5 * IQR))]
print(IQR)
```

```
450.0
```

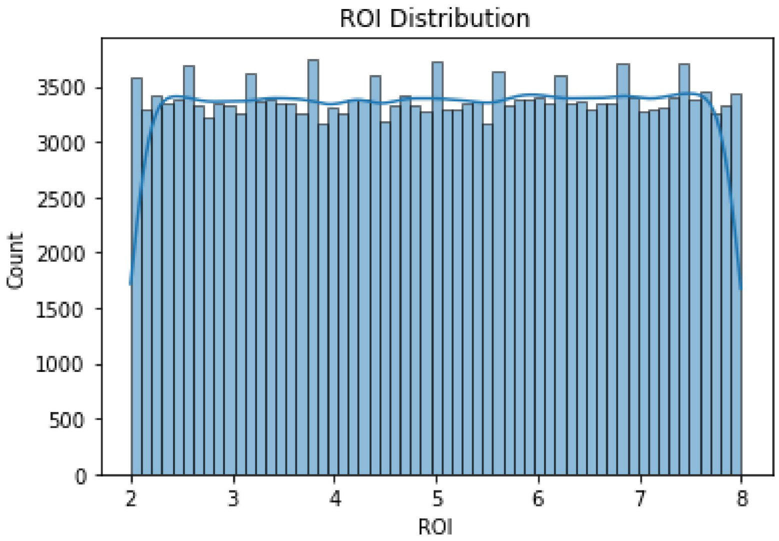
Exploratory Data Analysis

In [16]:

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

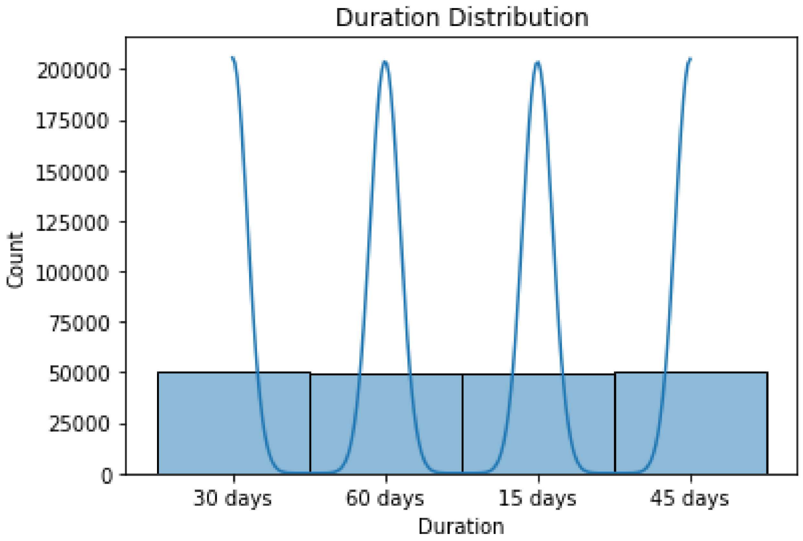
In [17]:

```
# ROI Distribution

sns.histplot(df['ROI'], kde=True)
plt.title("ROI Distribution")
plt.show()
```



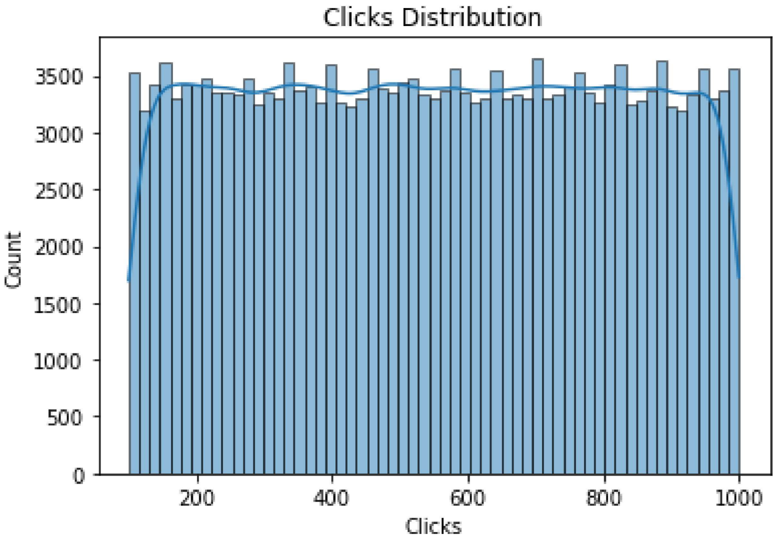
In [18]:

```
# Duration Distribution

sns.histplot(df['Duration'], kde=True)
plt.title("Duration Distribution")
plt.show()
```



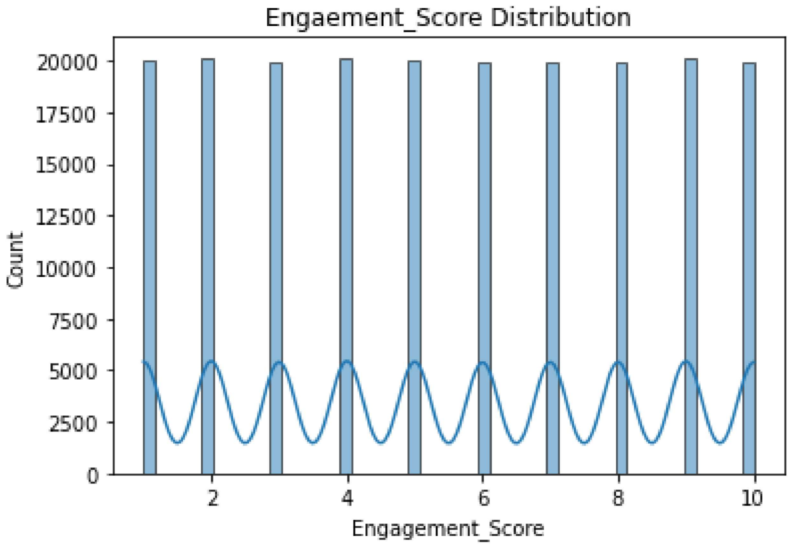
In [19]:

```
# Clicks Distribution

sns.histplot(df['Clicks'], kde=True)
plt.title("Clicks Distribution")
plt.show()
```



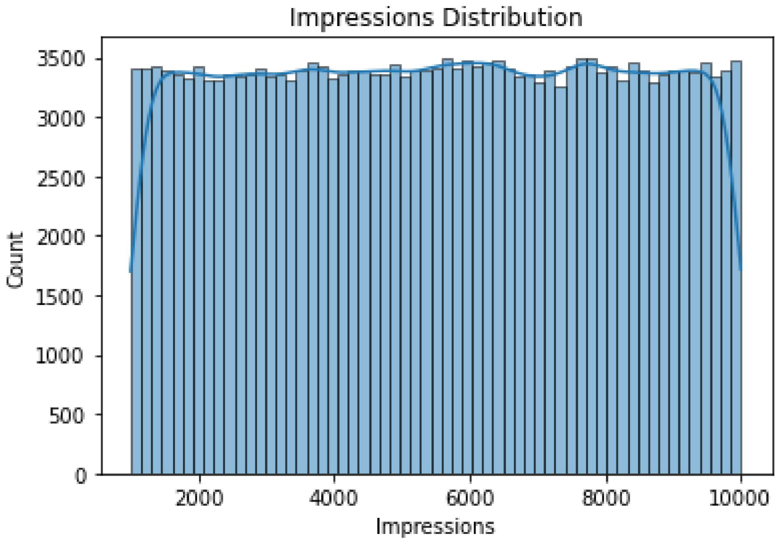
In [22]:

```
# Engagement Score Distribution

sns.histplot(df['Engagement_Score'], kde=True)
plt.title("Engaement_Score Distribution")
plt.show()
```



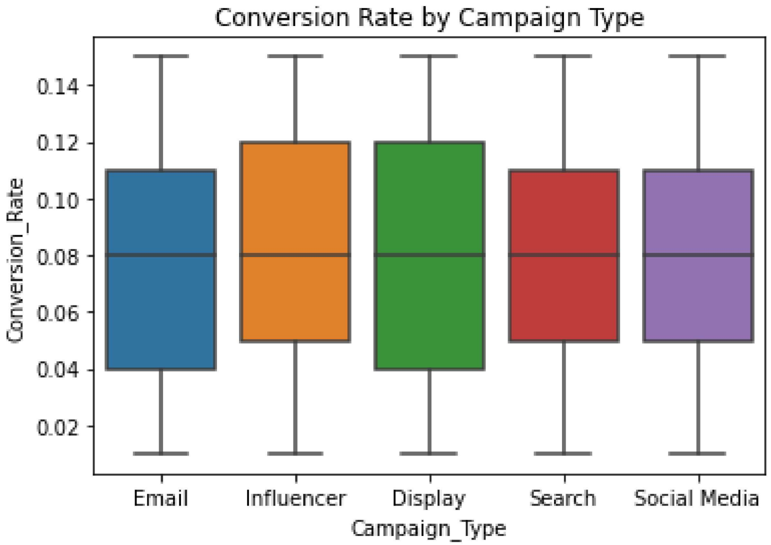
In [20]:

```python
# Impression Distribution

sns.histplot(df['Impressions'], kde=True)
plt.title("Impressions Distribution")
plt.show()
```



In [24]:

```
# Conversion Rate by Campaign Type

sns.boxplot(x='Campaign_Type', y='Conversion_Rate', data=df)
plt.title("Conversion Rate by Campaign Type")
plt.show()
```



Campaign Performance Metrics

In [25]:

```
df['CTR'] = df['Clicks'] / df['Impressions']
df['CostPerClick'] = df['Acquisition_Cost'] / df['Clicks']
df['Profit'] = (df['ROI'] * df['Acquisition_Cost']) - df['Acquisition_Cost']


# Sort by Highest ROI
top_campaigns = df.sort_values(by='ROI', ascending=False).head(10)
print(top_campaigns)
```

```
        Campaign_ID             Company Campaign_Type Target_Audience  \
182656       182657   Alpha Innovations        Search       Men 18-24   
83445         83446   Alpha Innovations        Search     Women 35-44   
73036         73037      Nexgen Systems         Email       Men 18-24   
140372       140373  Datatech Solutions    Influencer        All Ages   
104050       104051   Alpha Innovations       Display       Men 25-34   
3231           3232   Alpha Innovations       Display     Women 25-34   
132599       132600            Techcorp    Influencer     Women 35-44   
119321       119322      Nexgen Systems        Search       Men 18-24   
50501         50502  Datatech Solutions  Social Media     Women 35-44   
98646         98647            Techcorp        Search       Men 25-34   

       Duration Channel_Used  Conversion_Rate  Acquisition_Cost  ROI  \
182656  60 days     Facebook             0.03             19250  8.0   
83445   15 days        Email             0.04             18956  8.0   
73036   45 days      YouTube             0.03             15354  8.0   
140372  45 days      YouTube             0.14              5090  8.0   
104050  15 days   Google Ads             0.07             14503  8.0   
3231    30 days    Instagram             0.01             12759  8.0   
132599  60 days     Facebook             0.11             14171  8.0
```

Channel, Audience & Segment Insights

In [26]:

```
channel_perf = df.groupby('Channel_Used')[['Conversion_Rate', 'Engagement_Score', 'Acquisition_Cost']].mean().reset_

print(channel_perf)
```

```
  Channel_Used  Conversion_Rate  Engagement_Score  Acquisition_Cost
0        Email         0.080282          5.487842      12526.387809
1     Facebook         0.079990          5.503748      12510.768617
2   Google Ads         0.080181          5.493989      12528.245036
3    Instagram         0.079886          5.489039      12491.760002
4      Website         0.080182          5.508828      12487.842001
5      YouTube         0.079890          5.484802      12481.570688
```

In [27]:

```
segment_perf = df.groupby(['Customer_Segment', 'Campaign_Type'])[['ROI', 'Conversion_Rate']].mean().reset_index()
print(segment_perf)
```

```
       Customer_Segment Campaign_Type       ROI  Conversion_Rate
0          Fashionistas       Display  5.010629         0.080438
1          Fashionistas         Email  5.017613         0.078997
2          Fashionistas    Influencer  4.999372         0.080138
3          Fashionistas        Search  4.991934         0.079619
4          Fashionistas  Social Media  4.985792         0.079778
5               Foodies       Display  5.020454         0.080068
6               Foodies         Email  4.999942         0.079950
7               Foodies    Influencer  5.016447         0.079968
8               Foodies        Search  5.007132         0.080229
9               Foodies  Social Media  4.976968         0.081078
10    Health & Wellness       Display  4.993587         0.080515
11    Health & Wellness         Email  4.990531         0.079283
12    Health & Wellness    Influencer  5.008931         0.080068
13    Health & Wellness        Search  5.027652         0.080081
14    Health & Wellness  Social Media  4.994954         0.079774
15  Outdoor Adventurers       Display  5.016483         0.079795
16  Outdoor Adventurers         Email  4.962716         0.079771
17  Outdoor Adventurers    Influencer  5.000002         0.080673
18  Outdoor Adventurers        Search  5.013733         0.080383
```

Time & Location Trends

In [28]:

```
df['Month'] = df['Date'].dt.to_period('M')
df['Week'] = df['Date'].dt.isocalendar().week
```

In [29]:

```
monthly_trend = df.groupby('Month')[['ROI', 'Conversion_Rate']].mean()
print(monthly_trend)
```

```
              ROI  Conversion_Rate
Month
1970-01  5.002416         0.080069
```

In [30]:

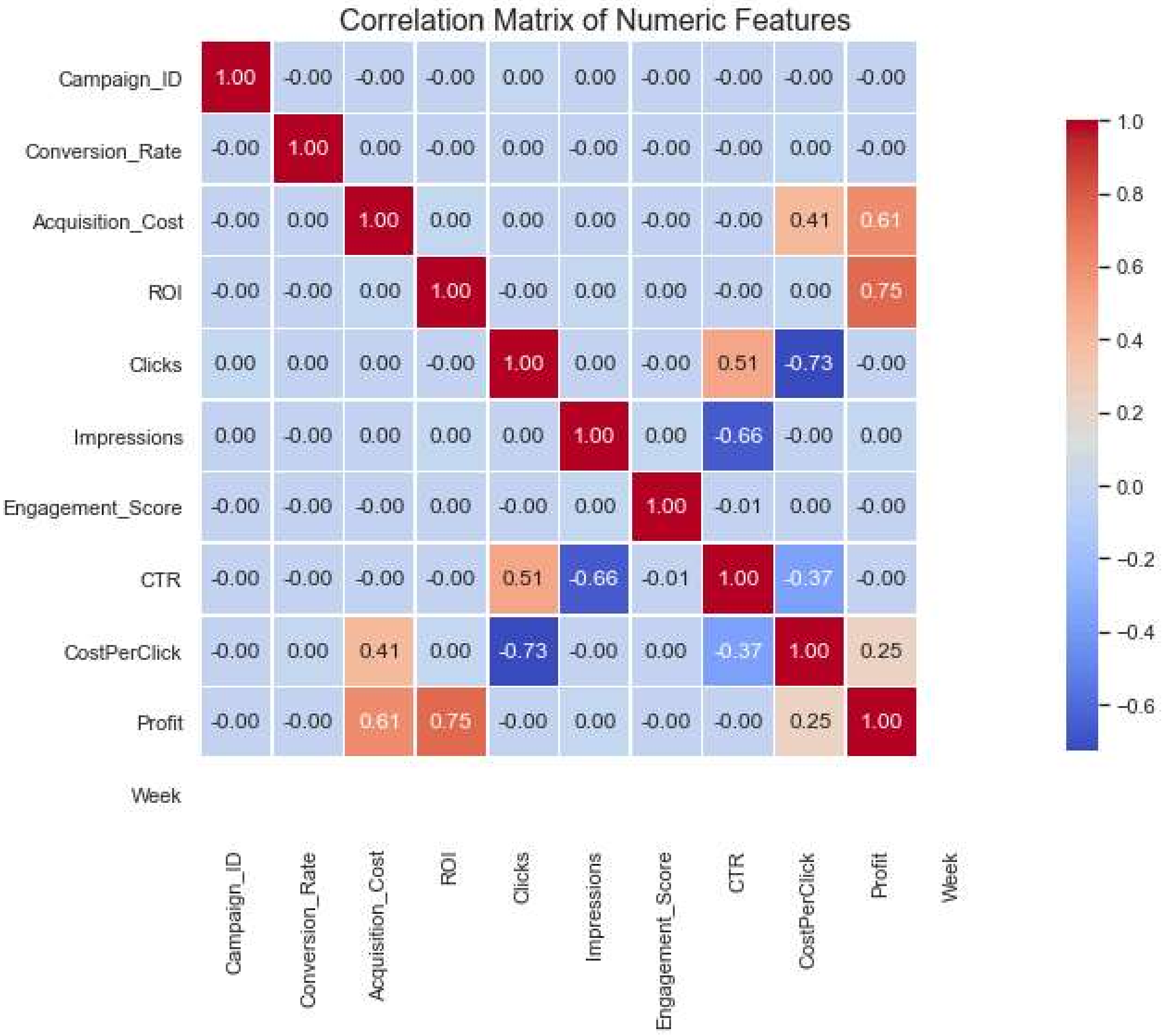
```
location_perf = df.groupby('Location')[['ROI', 'Conversion_Rate', 'Engagement_Score']].mean()
print(location_perf)
```

```
                  ROI  Conversion_Rate  Engagement_Score
Location
Chicago      5.001555         0.080131          5.505061
Houston      5.007174         0.079949          5.514578
Los Angeles  5.010876         0.080013          5.488823
Miami        5.012282         0.080047          5.495766
New York     4.980185         0.080203          5.469257
```

Correlation & Feature Relationships

In [31]:

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

sns.set(style='whitegrid', palette='muted')

numeric_df = df.select_dtypes(include=['number'])
corr_matrix = numeric_df.corr()
plt.figure(figsize=(12, 8))
heatmap = sns.heatmap(
    corr_matrix,
    annot=True,
    fmt=".2f",
    cmap='coolwarm',
    square=True,
    linewidths=0.5,
    cbar_kws={"shrink": 0.8}
)
plt.title('Correlation Matrix of Numeric Features', fontsize=16)
plt.tight_layout()
plt.show()
```



Correlation Matrix of Numeric Features

	Campaign_ID	Conversion_Rate	Acquisition_Cost	ROI	Clicks	Impressions	Engagement_Score	CTR	CostPerClick	Profit	Week
Campaign_ID	1.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	
Conversion_Rate	-0.00	1.00	0.00	-0.00	0.00	-0.00	-0.00	-0.00	0.00	-0.00	
Acquisition_Cost	-0.00	0.00	1.00	0.00	0.00	0.00	-0.00	-0.00	0.41	0.61	
ROI	-0.00	-0.00	0.00	1.00	-0.00	0.00	0.00	-0.00	0.00	0.75	
Clicks	0.00	0.00	0.00	-0.00	1.00	0.00	-0.00	0.51	-0.73	-0.00	
Impressions	0.00	-0.00	0.00	0.00	0.00	1.00	0.00	-0.66	-0.00	0.00	
Engagement_Score	-0.00	-0.00	-0.00	0.00	-0.00	0.00	1.00	-0.01	0.00	-0.00	
CTR	-0.00	-0.00	-0.00	-0.00	0.51	-0.66	-0.01	1.00	-0.37	-0.00	
CostPerClick	-0.00	0.00	0.41	0.00	-0.73	-0.00	0.00	-0.37	1.00	0.25	
Profit	-0.00	-0.00	0.61	0.75	-0.00	0.00	-0.00	-0.00	0.25	1.00	
Week											

Grouped & Segmented KPI Insights

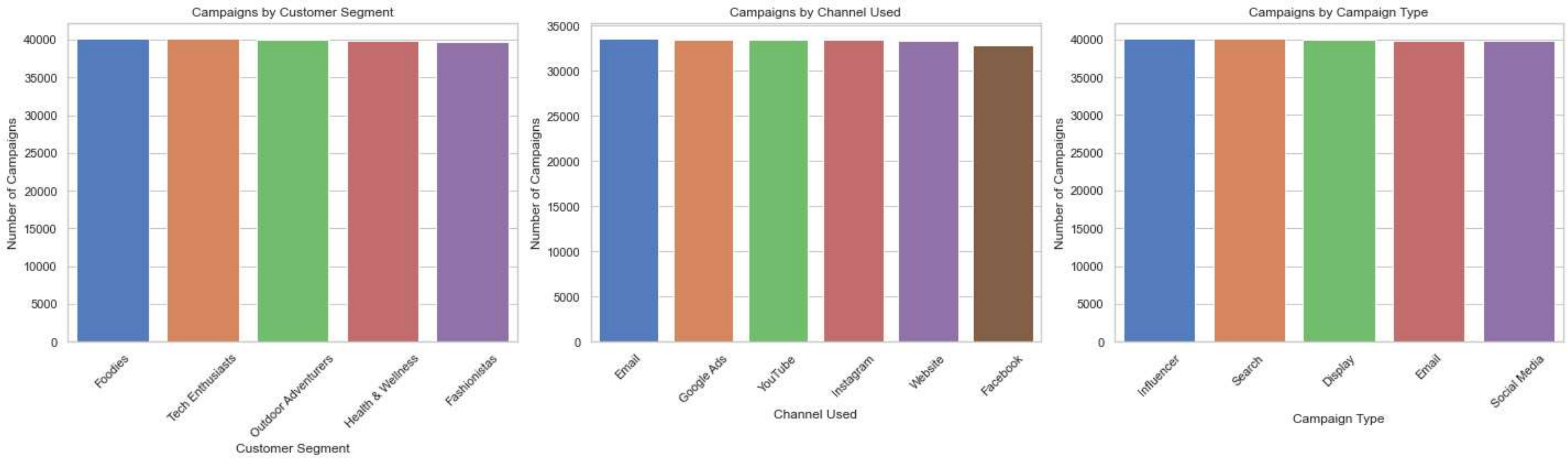
In [32]:

```
pivot = df.pivot_table(values='ROI', index='Customer_Segment', columns='Campaign_Type', aggfunc='mean')
print(pivot)
```

```
Campaign_Type          Display     Email  Influencer    Search  Social Media
Customer_Segment
Fashionistas          5.010629  5.017613    4.999372  4.991934      4.985792
Foodies               5.020454  4.999942    5.016447  5.007132      4.976968
Health & Wellness     4.993587  4.990531    5.008931  5.027652      4.994954
Outdoor Adventurers   5.016483  4.962716    5.000002  5.013732      5.004172
Tech Enthusiasts      4.990761  5.001103    5.030037  5.001296      4.997202
```

In [35]:

```python
# Set Seaborn Theme
sns.set(style="whitegrid", palette="muted")

# Create a figure with 3 subplots
fig, axs = plt.subplots(1, 3, figsize=(20, 6))

# 1. Bar Chart: Campaign Count by Customer Segement
sns.countplot(data=df, x='Customer_Segment',
              order=df['Customer_Segment'].value_counts().index, ax=axs[0])
axs[0].set_title('Campaigns by Customer Segment')
axs[0].set_xlabel('Customer Segment')
axs[0].set_ylabel('Number of Campaigns')
axs[0].tick_params(axis='x', rotation=45)

# 2. Bar Chart: Campaign Count by Channel Used
sns.countplot(data=df, x='Channel_Used',
              order=df['Channel_Used'].value_counts().index, ax=axs[1])
axs[1].set_title('Campaigns by Channel Used')
axs[1].set_xlabel('Channel Used')
axs[1].set_ylabel('Number of Campaigns')
axs[1].tick_params(axis='x', rotation=45)

# 3. Bar Chart: Campaign Count by Campaign Type
sns.countplot(data=df, x='Campaign_Type',
              order=df['Campaign_Type'].value_counts().index, ax=axs[2])
axs[2].set_title('Campaigns by Campaign Type')
axs[2].set_xlabel('Campaign Type')
axs[2].set_ylabel('Number of Campaigns')
axs[2].tick_params(axis='x', rotation=45)

# Adjust Layout
plt.tight_layout()
plt.show()
```



In [57]:

```
df.to_csv('Marketing Campaign.csv', index=False)
```