```python
import pandas as pd

df = pd.read_csv("marketing_data.csv")
df.head()
```

```
      ID  Year_Birth   Education Marital_Status      Income   Kidhome  
\
0   1826        1970  Graduation       Divorced  $84,835.00         0

1      1        1961  Graduation         Single  $57,091.00         0

2  10476        1958  Graduation        Married  $67,267.00         0

3   1386        1967  Graduation       Together  $32,474.00         1

4   5371        1989  Graduation         Single  $21,474.00         1


   Teenhome Dt_Customer  Recency  MntWines  ...  NumStorePurchases  \
0         0     6/16/14        0       189  ...                  6
1         0     6/15/14        0       464  ...                  7
2         1     5/13/14        0       134  ...                  5
3         1     5/11/14        0        10  ...                  2
4         0      4/8/14        0         6  ...                  2

   NumWebVisitsMonth  AcceptedCmp3  AcceptedCmp4  AcceptedCmp5
AcceptedCmp1  \
0                  1             0             0             0
0
1                  5             0             0             0
0
2                  2             0             0             0
0
3                  7             0             0             0
0
4                  7             1             0             0
0

   AcceptedCmp2  Response  Complain  Country
0             0         1         0       SP
1             1         1         0       CA
2             0         0         0       US
3             0         0         0      AUS
4             0         1         0       SP

[5 rows x 28 columns]
```

```python
print(df.columns.tolist())
```

```
['ID', 'Year_Birth', 'Education', 'Marital_Status', ' Income ',
'Kidhome', 'Teenhome', 'Dt_Customer', 'Recency', 'MntWines',
'MntFruits', 'MntMeatProducts', 'MntFishProducts', 'MntSweetProducts',
'MntGoldProds', 'NumDealsPurchases', 'NumWebPurchases',
'NumCatalogPurchases', 'NumStorePurchases', 'NumWebVisitsMonth',
'AcceptedCmp3', 'AcceptedCmp4', 'AcceptedCmp5', 'AcceptedCmp1',
'AcceptedCmp2', 'Response', 'Complain', 'Country']
```

```
df.columns = df.columns.str.strip()
```

```
df[['Dt_Customer', 'Income']].info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2240 entries, 0 to 2239
Data columns (total 2 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   Dt_Customer  2240 non-null   object
 1   Income       2216 non-null   object
dtypes: object(2)
memory usage: 35.1+ KB
```

```
df['Dt_Customer'] = pd.to_datetime(df['Dt_Customer'],
format="%m/%d/%y")
```

```
df['Income'] = df['Income'].replace('[\$,]', '',
regex=True).astype(float)
```

```
df[['Dt_Customer', 'Income']].info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2240 entries, 0 to 2239
Data columns (total 2 columns):
 #   Column       Non-Null Count  Dtype         
---  ------       --------------  -----         
 0   Dt_Customer  2240 non-null   datetime64[ns]
 1   Income       2216 non-null   float64       
dtypes: datetime64[ns](1), float64(1)
memory usage: 35.1 KB
```

```
df['Income'] = df.groupby(['Education', 'Marital_Status'])
['Income'].transform(
    lambda x: x.fillna(x.mean())
)
```

```
df['Income'].isna().sum()
```

```
np.int64(0)
```

```
print("Education:", df['Education'].unique())
print("Marital_Status:", df['Marital_Status'].unique())
```

```
Education: ['Graduation' 'PhD' '2n Cycle' 'Master' 'Basic']
Marital_Status: ['Divorced' 'Single' 'Married' 'Together' 'Widow'
'YOLO' 'Alone' 'Absurd']
```

```
valid_statuses = ['Single', 'Married', 'Divorced', 'Together',
'Widow']

df['Marital_Status'] = df['Marital_Status'].apply(
    lambda x: x if x in valid_statuses else 'Other'
)

df['Marital_Status'].unique()
```

```
array(['Divorced', 'Single', 'Married', 'Together', 'Widow', 'Other'],
      dtype=object)
```

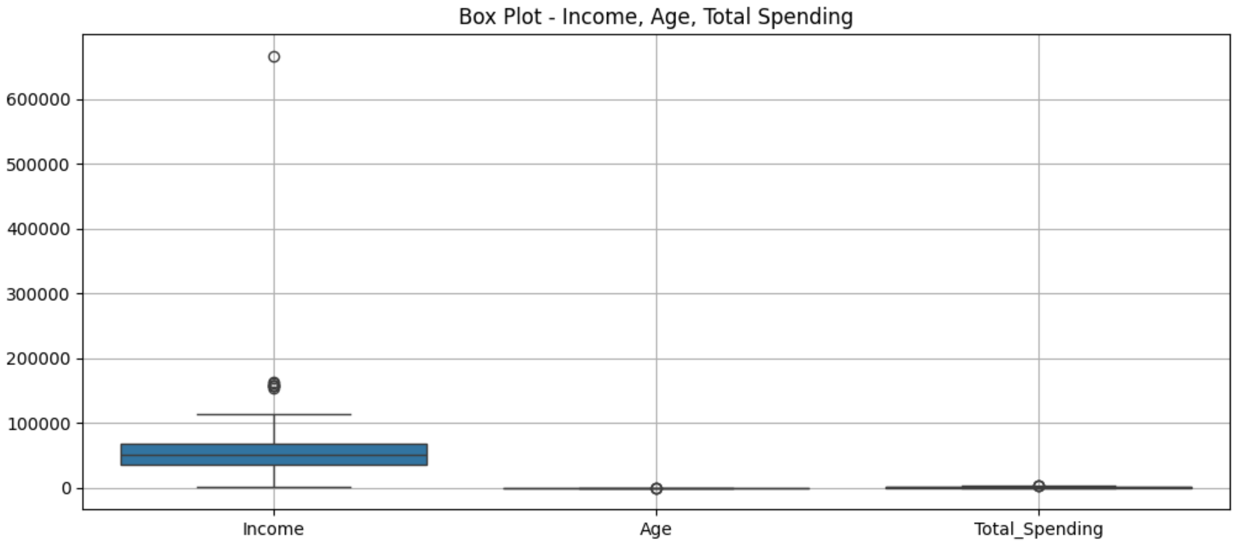
```
df['Total_Children'] = df['Kidhome'] + df['Teenhome']

df['Age'] = 2014 - df['Year_Birth']

spend_cols = ['MntWines', 'MntFruits', 'MntMeatProducts',
              'MntFishProducts', 'MntSweetProducts', 'MntGoldProds']

df['Total_Spending'] = df[spend_cols].sum(axis=1)

df[['Total_Children', 'Age', 'Total_Spending']].head()
```

```
   Total_Children  Age  Total_Spending
0               0   44            1190
1               0   53             577
2               1   56             251
3               2   47              11
4               1   25              91
```

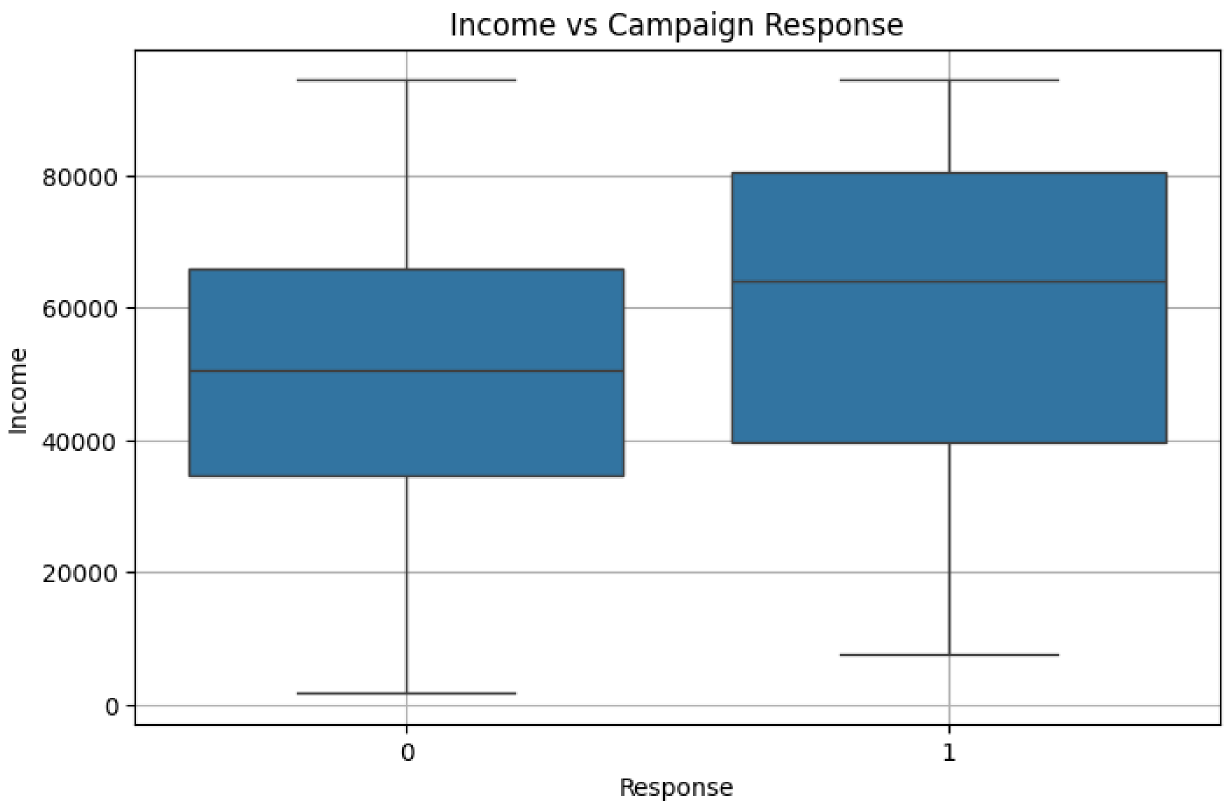
```
df['Total_Purchases'] = df['NumWebPurchases'] +
df['NumCatalogPurchases'] + df['NumStorePurchases']

df[['NumWebPurchases', 'NumCatalogPurchases', 'NumStorePurchases',
'Total_Purchases']].head()
```

```
   NumWebPurchases  NumCatalogPurchases  NumStorePurchases
Total_Purchases
0                4                    4                  6
14
1                7                    3                  7
17
2                3                    2                  5
10
3                1                    0                  2
3
4                3                    1                  2
6
```

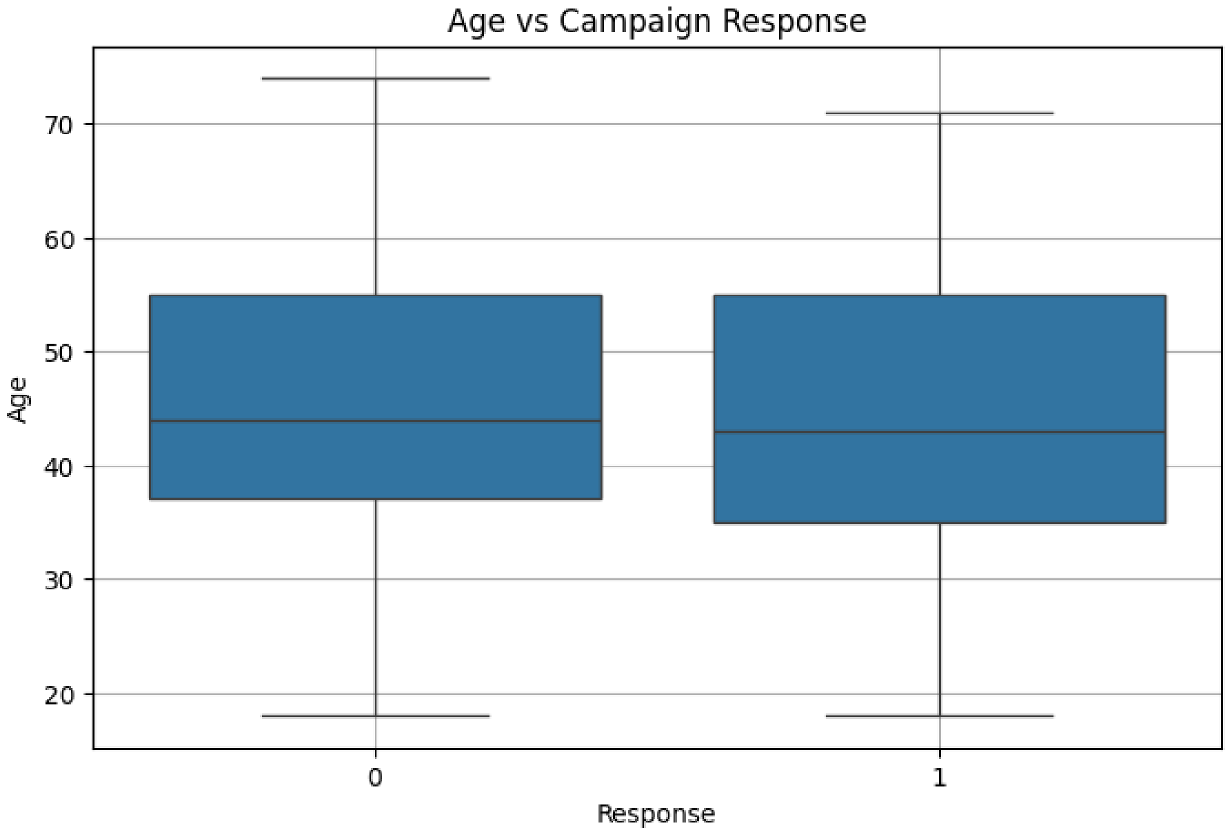
```
import seaborn as sns
import matplotlib.pyplot as plt

plt.figure(figsize=(12, 5))
sns.boxplot(data=df[['Income', 'Age', 'Total_Spending']])
plt.title('Box Plot - Income, Age, Total Spending')
plt.grid(True)
plt.show()
```



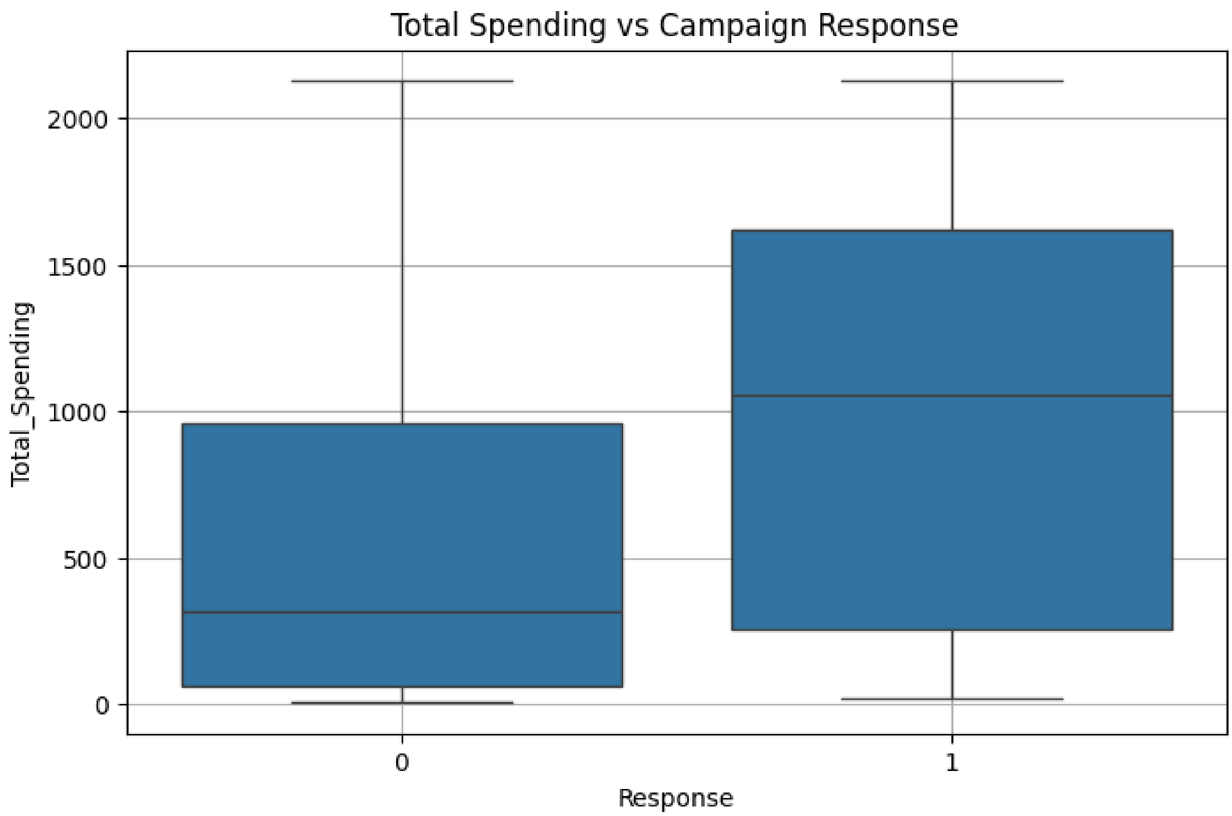
```
income_cap = df['Income'].quantile(0.99)
df['Income'] = df['Income'].apply(lambda x: min(x, income_cap))

df = df[(df['Age'] >= 18) & (df['Age'] <= 90)]

spend_cap = df['Total_Spending'].quantile(0.99)
df.loc[:, 'Total_Spending'] = df['Total_Spending'].apply(lambda x:
min(x, spend_cap))

plt.figure(figsize=(8, 5))
sns.boxplot(x='Response', y='Income', data=df)
plt.title('Income vs Campaign Response')
plt.grid(True)
plt.show()
```



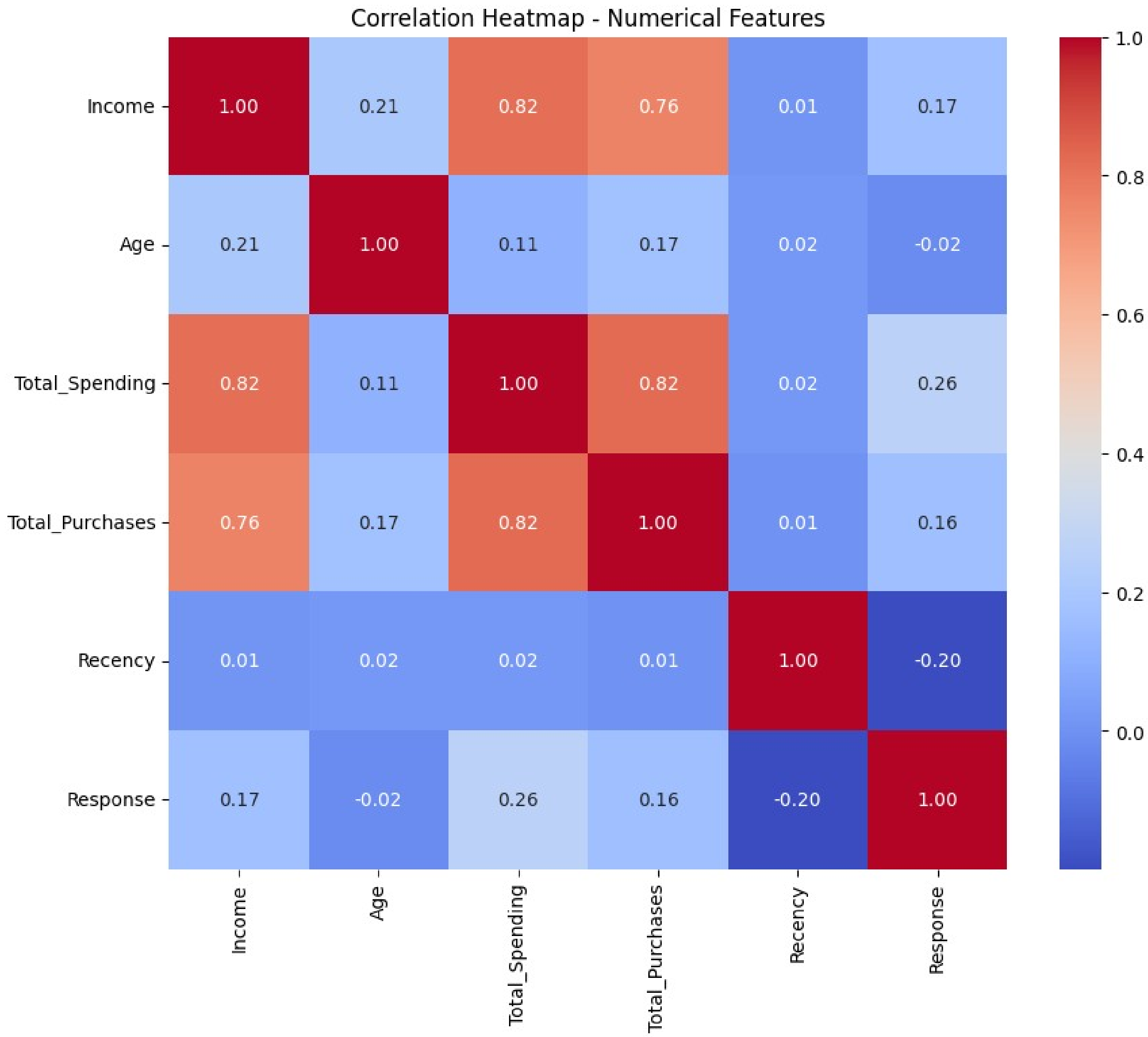
```python
plt.figure(figsize=(8, 5))
sns.boxplot(x='Response', y='Age', data=df)
plt.title('Age vs Campaign Response')
plt.grid(True)
plt.show()
```



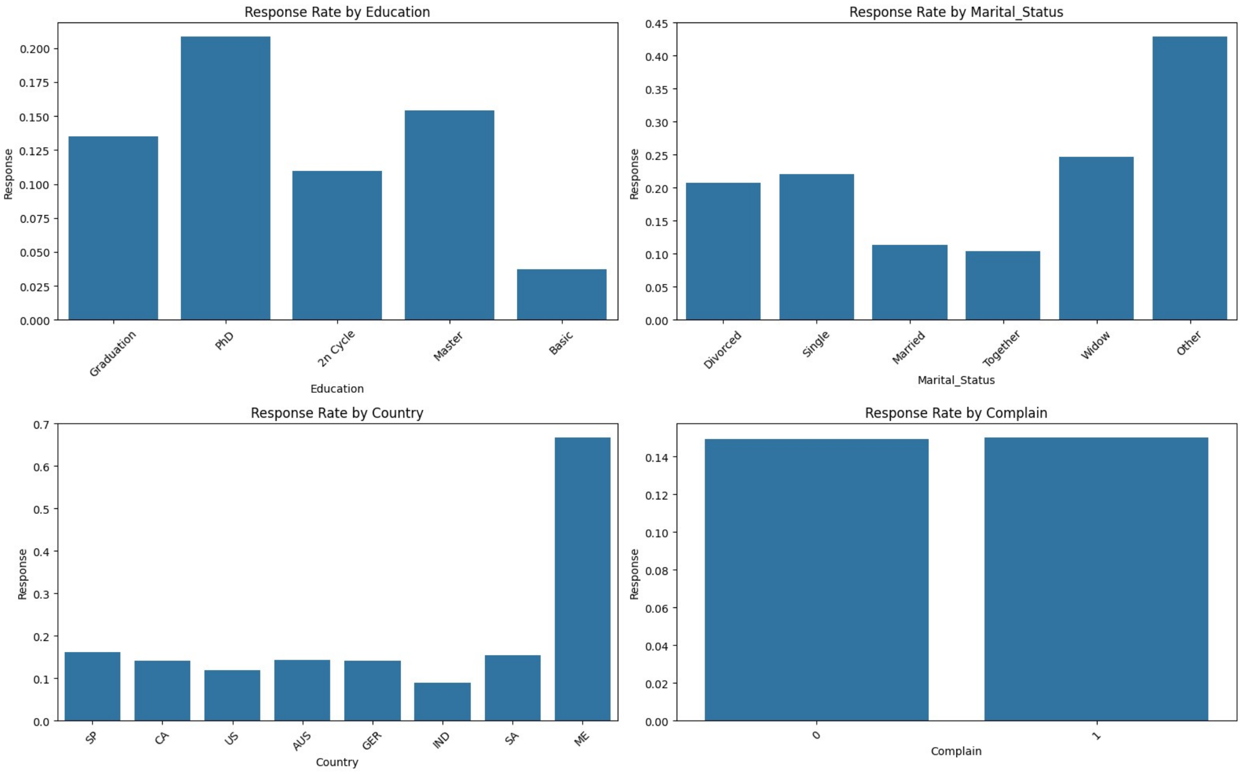
```
plt.figure(figsize=(8, 5))
sns.boxplot(x='Response', y='Total_Spending', data=df)
plt.title('Total Spending vs Campaign Response')
plt.grid(True)
plt.show()
```



```
plt.figure(figsize=(10, 8))
numerical_cols = ['Income', 'Age', 'Total_Spending',
'Total_Purchases', 'Recency', 'Response']
corr = df[numerical_cols].corr()

sns.heatmap(corr, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Heatmap - Numerical Features')
plt.show()
```



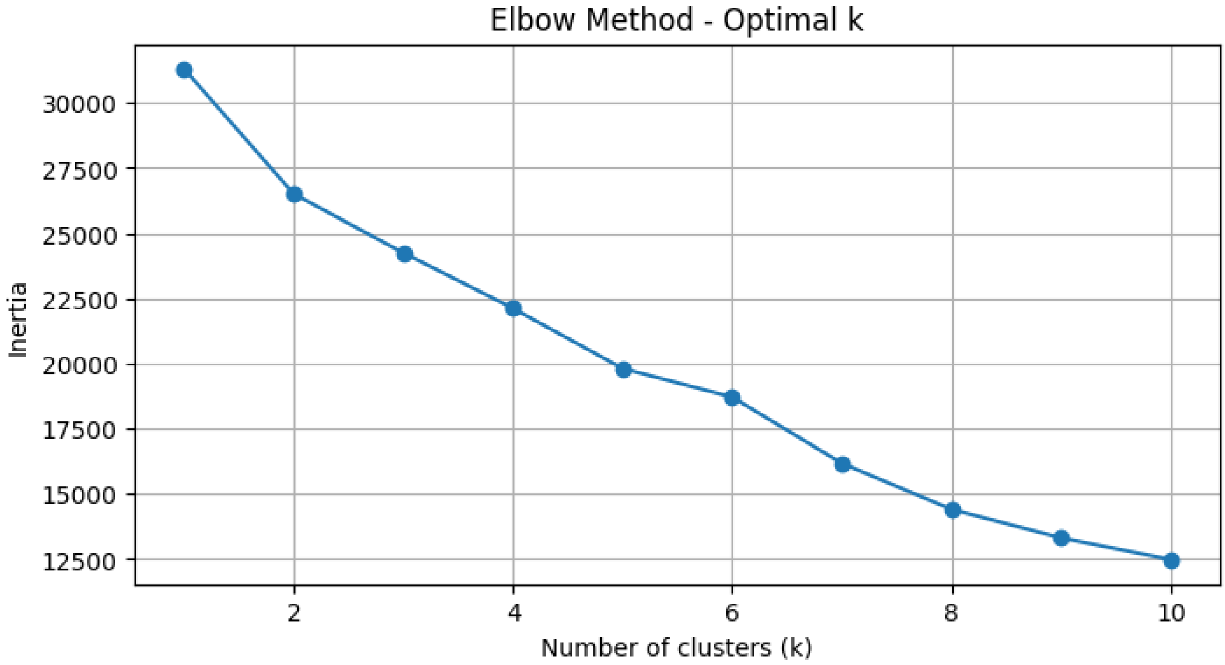
```
categorical_cols = ['Education', 'Marital_Status', 'Country',
'Complain']

plt.figure(figsize=(16, 10))

for i, col in enumerate(categorical_cols, 1):
    plt.subplot(2, 2, i)
    sns.barplot(data=df, x=col, y='Response', estimator='mean',
errorbar=None)
    plt.xticks(rotation=45)
    plt.title(f'Response Rate by {col}')

plt.tight_layout()
plt.show()
```



```
features = ['Income', 'Age', 'Total_Spending', 'Total_Purchases',
'Recency', 'Education', 'Marital_Status']

df_model = pd.get_dummies(df[features], drop_first=True)

df_model.head()

    Income  Age  Total_Spending  Total_Purchases  Recency
Education_Basic  \
0  84835.0   44          1190.0               14        0
False
1  57091.0   53           577.0               17        0
False
2  67267.0   56           251.0               10        0
False
3  32474.0   47            11.0                3        0
False
4  21474.0   25            91.0                6        0
False

   Education_Graduation  Education_Master  Education_PhD  \
0                  True             False          False
1                  True             False          False
2                  True             False          False
3                  True             False          False
4                  True             False          False
```

```
   Marital_Status_Married  Marital_Status_Other  Marital_Status_Single
\
0                   False                 False                  False

1                   False                 False                   True

2                    True                 False                  False

3                   False                 False                  False

4                   False                 False                   True


   Marital_Status_Together  Marital_Status_Widow
0                    False                 False
1                    False                 False
2                    False                 False
3                     True                 False
4                    False                 False
```

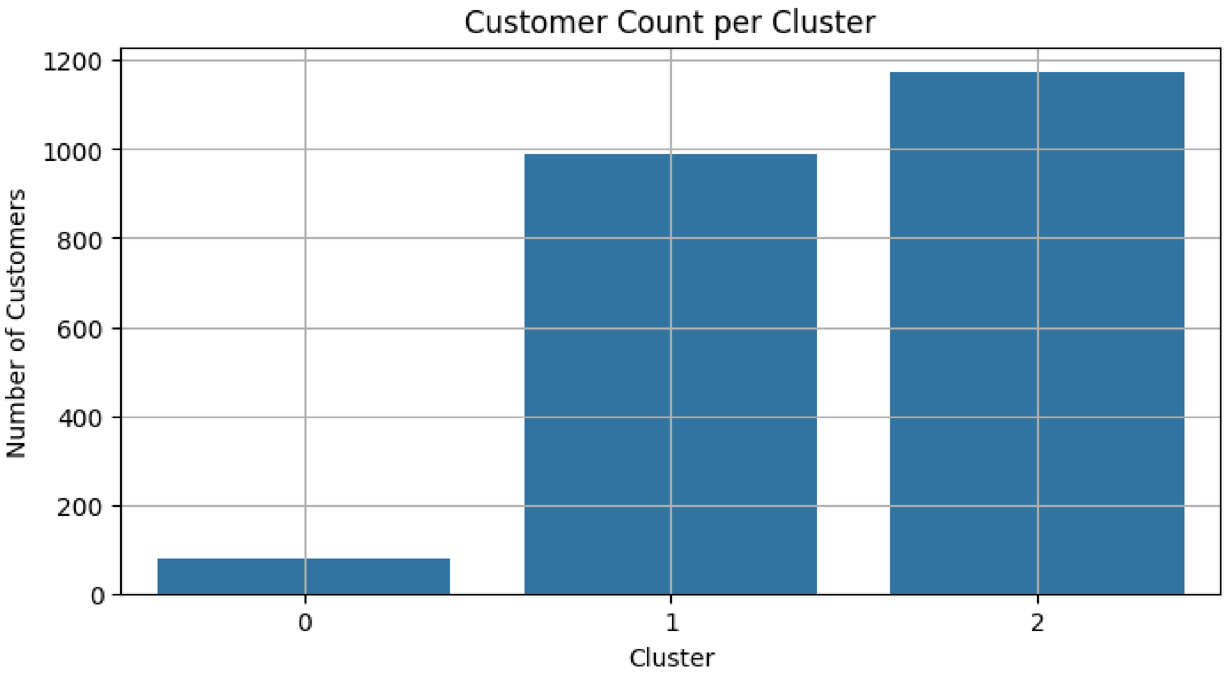
```python
from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
scaled_data = scaler.fit_transform(df_model)

from sklearn.cluster import KMeans
import matplotlib.pyplot as plt

inertia = []

for k in range(1, 11):
    kmeans = KMeans(n_clusters=k, random_state=42, n_init=10)
    kmeans.fit(scaled_data)
    inertia.append(kmeans.inertia_)

plt.figure(figsize=(8, 4))
plt.plot(range(1, 11), inertia, marker='o')
plt.title('Elbow Method - Optimal k')
plt.xlabel('Number of clusters (k)')
plt.ylabel('Inertia')
plt.grid(True)
plt.show()
```



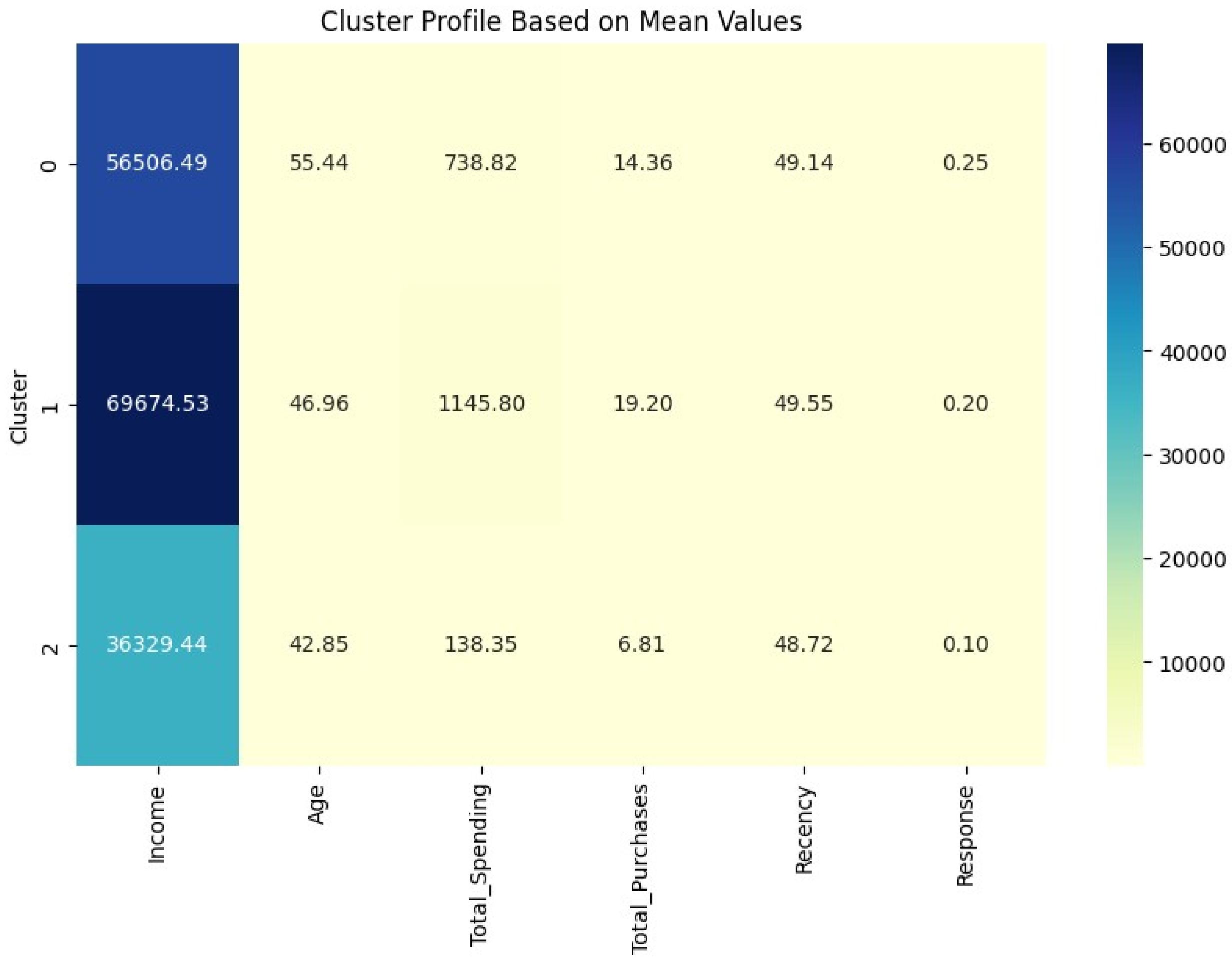
```
kmeans_final = KMeans(n_clusters=3, random_state=42, n_init=10)
df.loc[:, 'Cluster'] = kmeans_final.fit_predict(scaled_data)

print(df['Cluster'].value_counts())
```

```
Cluster
2    1172
1     988
0      77
Name: count, dtype: int64
```

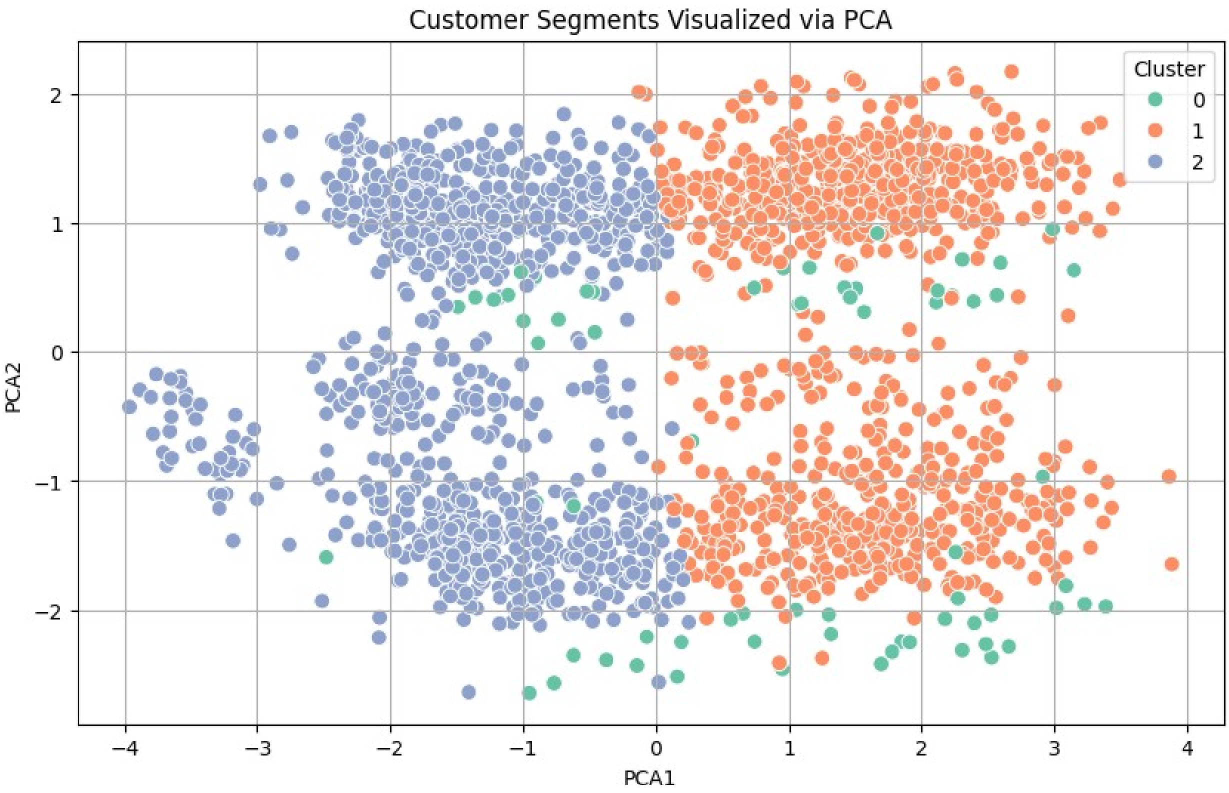
```
import seaborn as sns
import matplotlib.pyplot as plt

plt.figure(figsize=(8, 4))
sns.countplot(data=df, x='Cluster')
plt.title('Customer Count per Cluster')
plt.xlabel('Cluster')
plt.ylabel('Number of Customers')
plt.grid(True)
plt.show()
```



```
profile_cols = ['Income', 'Age', 'Total_Spending', 'Total_Purchases',
'Recency', 'Response']
cluster_profile = df.groupby('Cluster')[profile_cols].mean().round(2)

import pandas as pd
import matplotlib.pyplot as plt

import seaborn as sns
import matplotlib.pyplot as plt
import pandas as pd

import seaborn as sns

import matplotlib.pyplot as plt

plt.figure(figsize=(10, 6))
sns.heatmap(cluster_profile, annot=True, cmap='YlGnBu', fmt=".2f")
plt.title("Cluster Profile Based on Mean Values")
plt.ylabel("Cluster")
plt.show()
```



```python
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt

pca = PCA(n_components=2)
pca_components = pca.fit_transform(scaled_data)

pca_df = pd.DataFrame(data=pca_components, columns=['PCA1', 'PCA2'])
pca_df['Cluster'] = df['Cluster'].values

plt.figure(figsize=(10, 6))
sns.scatterplot(data=pca_df, x='PCA1', y='PCA2', hue='Cluster',
palette='Set2', s=60)
plt.title("Customer Segments Visualized via PCA")
plt.grid(True)
plt.show()
```



```
df.to_csv("segmented_customers.csv", index=False)
print("Export complete. File saved as segmented_customers.csv")
```

```
Export complete. File saved as segmented_customers.csv
```