Marketing Analytics

In [1]:
```
#importing libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import missingno as msno
```

In [2]:
```
df=pd.read_csv('marketing_campaign.csv')
df
```

Out[2]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	...	NumWebVisitsM
0	5524	1957	Graduation	Single	58138.0	0	0	09-04-2012	58	635	...	
1	2174	1954	Graduation	Single	46344.0	1	1	03-08-2014	38	11	...	
2	4141	1965	Graduation	Together	71613.0	0	0	21-08-2013	26	426	...	
3	6182	1984	Graduation	Together	26646.0	1	0	02-10-2014	26	11	...	
4	5324	1981	PhD	Married	58293.0	1	0	19-01-2014	94	173	...	
...	...	...	...	...	...	...	...	...	...	...	...	
2235	10870	1967	Graduation	Married	61223.0	0	1	13-06-2013	46	709	...	
2236	4001	1946	PhD	Together	64014.0	2	1	06-10-2014	56	406	...	
2237	7270	1981	Graduation	Divorced	56981.0	0	0	25-01-2014	91	908	...	
2238	8235	1956	Master	Together	69245.0	0	1	24-01-2014	8	428	...	
2239	9405	1954	PhD	Married	52869.0	1	1	15-10-2012	40	84	...	

2240 rows × 29 columns

Data cleaning through excel

- Fixed all the columns by using text to column function
- Fixed Dt_Customer column which is in the mixed format of 09-04-2012 and 03/08/2014 and changed to format of dd-mm-yyyy

Descriptive Statistics

Columns in the dataset

In [3]:
```
df.columns
```

Out[3]:
```
Index(['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', 'Complain', 'Z_CostContact', 'Z_Revenue', 'Response'],
      dtype='object')
```

In [4]:
```
column_profile = df.dtypes.to_frame(name="Data Type")
column_profile["Null Values"] = df.isnull().sum()
column_profile["Unique Values"] = df.nunique()
null_perc=(df.isnull().sum()/len(df))*100

# Display the column profiling in a readable format
print(column_profile)
print('\n\nNull Value Percentage:\n ',null_perc)
```

```
                    Data Type  Null Values  Unique Values
ID                      int64            0           2240
Year_Birth              int64            0             59
Education              object            0              5
Marital_Status         object            0              8
Income                float64           24           1974
Kidhome                 int64            0              3
Teenhome                int64            0              3
Dt_Customer            object            0            663
Recency                 int64            0            100
MntWines                int64            0            776
MntFruits               int64            0            158
MntMeatProducts         int64            0            558
MntFishProducts         int64            0            182
MntSweetProducts        int64            0            177
MntGoldProds            int64            0            213
NumDealsPurchases       int64            0             15
NumWebPurchases         int64            0             15
NumCatalogPurchases     int64            0             14
NumStorePurchases       int64            0             14
NumWebVisitsMonth       int64            0             16
AcceptedCmp3            int64            0              2
AcceptedCmp4            int64            0              2
AcceptedCmp5            int64            0              2
AcceptedCmp1            int64            0              2
AcceptedCmp2            int64            0              2
Complain                int64            0              2
Z_CostContact           int64            0              1
Z_Revenue               int64            0              1
Response                int64            0              2


Null Value Percentage:
  ID                      0.000000
Year_Birth              0.000000
Education               0.000000
Marital_Status          0.000000
Income                  1.071429
Kidhome                 0.000000
Teenhome                0.000000
Dt_Customer             0.000000
Recency                 0.000000
MntWines                0.000000
MntFruits               0.000000
MntMeatProducts         0.000000
MntFishProducts         0.000000
MntSweetProducts        0.000000
MntGoldProds            0.000000
NumDealsPurchases       0.000000
NumWebPurchases         0.000000
NumCatalogPurchases     0.000000
NumStorePurchases       0.000000
NumWebVisitsMonth       0.000000
AcceptedCmp3            0.000000
AcceptedCmp4            0.000000
AcceptedCmp5            0.000000
AcceptedCmp1            0.000000
AcceptedCmp2            0.000000
Complain                0.000000
Z_CostContact           0.000000
Z_Revenue               0.000000
Response                0.000000
dtype: float64
```

- Income has 24 null values which is of ~1.1%. Dropping the null values
- Change the Dt_Customer datatype to datetime format

In [5]:
```
df = df.dropna(subset=['Income'])
df['Dt_Customer'] = pd.to_datetime(df['Dt_Customer'],dayfirst=True)
```

```
C:\Users\mohit\AppData\Local\Temp\ipykernel_22872\1059083906.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ve
rsus-a-copy
  df['Dt_Customer'] = pd.to_datetime(df['Dt_Customer'],dayfirst=True)
```

In [6]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 2216 entries, 0 to 2239
Data columns (total 29 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   ID                   2216 non-null   int64
 1   Year_Birth           2216 non-null   int64
 2   Education            2216 non-null   object
 3   Marital_Status       2216 non-null   object
 4   Income               2216 non-null   float64
 5   Kidhome              2216 non-null   int64
 6   Teenhome             2216 non-null   int64
 7   Dt_Customer          2216 non-null   datetime64[ns]
 8   Recency              2216 non-null   int64
 9   MntWines             2216 non-null   int64
 10  MntFruits            2216 non-null   int64
 11  MntMeatProducts      2216 non-null   int64
 12  MntFishProducts      2216 non-null   int64
 13  MntSweetProducts     2216 non-null   int64
 14  MntGoldProds         2216 non-null   int64
 15  NumDealsPurchases    2216 non-null   int64
 16  NumWebPurchases      2216 non-null   int64
 17  NumCatalogPurchases  2216 non-null   int64
 18  NumStorePurchases    2216 non-null   int64
 19  NumWebVisitsMonth    2216 non-null   int64
 20  AcceptedCmp3         2216 non-null   int64
 21  AcceptedCmp4         2216 non-null   int64
 22  AcceptedCmp5         2216 non-null   int64
 23  AcceptedCmp1         2216 non-null   int64
 24  AcceptedCmp2         2216 non-null   int64
 25  Complain             2216 non-null   int64
 26  Z_CostContact        2216 non-null   int64
 27  Z_Revenue            2216 non-null   int64
 28  Response             2216 non-null   int64
dtypes: datetime64[ns](1), float64(1), int64(25), object(2)
memory usage: 519.4+ KB
```

- Null values are removed and Dt_Customer column datatype was changed to Datetime format

Checking duplicates

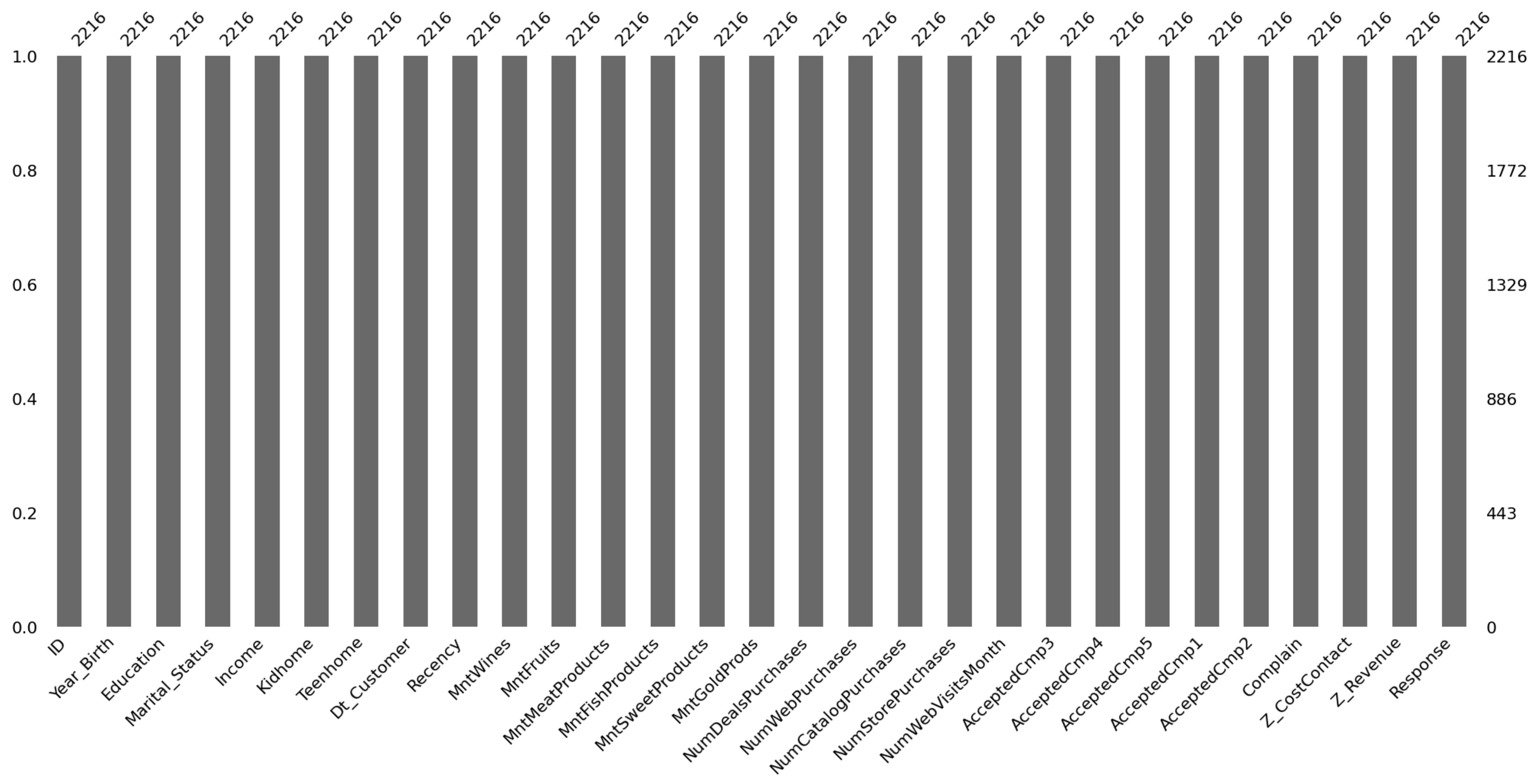
In [7]:
```
df.duplicated().sum()
```

Out[7]:
```
0
```

- No duplicates in the dataset

In [8]:
```
msno.bar(df)
```

Out[8]:
```
<Axes: >
```



In [9]:
```
df.describe(include='all')
```

Out[9]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency
count	2216.000000	2216.000000	2216	2216	2216.000000	2216.000000	2216.000000	2216	2216.000000
unique	NaN	NaN	5	8	NaN	NaN	NaN	NaN	NaN
top	NaN	NaN	Graduation	Married	NaN	NaN	NaN	NaN	NaN
freq	NaN	NaN	1116	857	NaN	NaN	NaN	NaN	NaN
mean	5588.353339	1968.820397	NaN	NaN	52247.251354	0.441787	0.505415	2013-07-11 23:50:54.151624704	49.012635
min	0.000000	1893.000000	NaN	NaN	1730.000000	0.000000	0.000000	2012-01-08 00:00:00	0.000000
25%	2814.750000	1959.000000	NaN	NaN	35303.000000	0.000000	0.000000	2013-01-19 00:00:00	24.000000
50%	5458.500000	1970.000000	NaN	NaN	51381.500000	0.000000	0.000000	2013-07-11 00:00:00	49.000000
75%	8421.750000	1977.000000	NaN	NaN	68522.000000	1.000000	1.000000	2013-12-31 00:00:00	74.000000
max	11191.000000	1996.000000	NaN	NaN	666666.000000	2.000000	2.000000	2014-12-06 00:00:00	99.000000
std	3249.376275	11.985554	NaN	NaN	25173.076661	0.536896	0.544181	NaN	28.948352

11 rows × 29 columns

Feature Engineering

In [10]:
```python
fe_data=df.copy()
```

In [11]:
```python
#Feature: Total Spending
spending_columns = ['MntWines', 'MntFruits', 'MntMeatProducts','MntFishProducts', 'MntSweetProducts', 'MntGoldProds']
fe_data['Total_Spending'] = fe_data[spending_columns].sum(axis=1)

#Feature: Total Purchases
purchase_columns = ['NumDealsPurchases', 'NumWebPurchases','NumCatalogPurchases', 'NumStorePurchases']
fe_data['Total_Purchases'] = fe_data[purchase_columns].sum(axis=1)

#Children in household
fe_data['Children_in_Household'] = fe_data['Kidhome'] + fe_data['Teenhome']

#Avg spending by each customer
fe_data['Avg_Spending'] = fe_data['Total_Spending'] / fe_data['Total_Purchases']
```

In [12]:
```python
last_recorded_date = fe_data['Dt_Customer'].max()
# Calculate "Days Registered" as the difference between the last recorded date and the customer's registration date
fe_data['Days_Registered'] = (last_recorded_date - fe_data['Dt_Customer']).dt.days

#Feature: Frequency of Purchases
fe_data['Frequency_of_Purchases'] = fe_data['Total_Purchases'] / fe_data['Days_Registered']

fe_data
```

Out[12]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	...	Complain	Z_Co
0	5524	1957	Graduation	Single	58138.0	0	0	2012-04-09	58	635	...	0	
1	2174	1954	Graduation	Single	46344.0	1	1	2014-08-03	38	11	...	0	
2	4141	1965	Graduation	Together	71613.0	0	0	2013-08-21	26	426	...	0	
3	6182	1984	Graduation	Together	26646.0	1	0	2014-10-02	26	11	...	0	
4	5324	1981	PhD	Married	58293.0	1	0	2014-01-19	94	173	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
2235	10870	1967	Graduation	Married	61223.0	0	1	2013-06-13	46	709	...	0	
2236	4001	1946	PhD	Together	64014.0	2	1	2014-10-06	56	406	...	0	
2237	7270	1981	Graduation	Divorced	56981.0	0	0	2014-01-25	91	908	...	0	
2238	8235	1956	Master	Together	69245.0	0	1	2014-01-24	8	428	...	0	
2239	9405	1954	PhD	Married	52869.0	1	1	2012-10-15	40	84	...	0	

2216 rows × 35 columns

Customer Segmentation using RFM Analysis

In [13]:
```
#RFM-analysis
rfm_df=fe_data[['ID','Recency','Frequency_of_Purchases','Avg_Spending']].copy()
rfm_df
```

Out[13]:

	ID	Recency	Frequency_of_Purchases	Avg_Spending
0	5524	58	0.025747	64.680000
1	2174	38	0.048000	4.500000
2	4141	26	0.044492	36.952381
3	6182	26	0.123077	6.625000
4	5324	94	0.059190	22.210526
...	...	...	...	...
2235	10870	46	0.033272	74.500000
2236	4001	56	0.360656	20.181818
2237	7270	91	0.060317	65.315789
2238	8235	8	0.072785	36.652174
2239	9405	40	0.014066	15.636364

2216 rows × 4 columns

In [14]:
```
rfm_df['R_rank'] = rfm_df['Recency'].rank(ascending=False)
rfm_df['F_rank'] = rfm_df['Frequency_of_Purchases'].rank(ascending=True)
rfm_df['M_rank'] = rfm_df['Avg_Spending'].rank(ascending=True)

# normalizing the rank of the customers
rfm_df['R_rank_norm'] = (rfm_df['R_rank']/rfm_df['R_rank'].max())*100
rfm_df['F_rank_norm'] = (rfm_df['F_rank']/rfm_df['F_rank'].max())*100
rfm_df['M_rank_norm'] = (rfm_df['F_rank']/rfm_df['M_rank'].max())*100
```

In [15]:
```
rfm_df['RFM_Score'] = 0.15*rfm_df['R_rank_norm']+0.28*rfm_df['F_rank_norm']+0.57*rfm_df['M_rank_norm']
rfm_df['RFM_Score']*=0.05
rfm_df=rfm_df.round(2)

rfm_df[['ID','RFM_Score']]
```

Out[15]:

	ID	RFM_Score
0	5524	2.09
1	2174	3.79
2	4141	3.75
3	6182	4.63
4	5324	3.68
...	...	...
2235	10870	2.90
2236	4001	4.51
2237	7270	3.72
2238	8235	4.53
2239	9405	1.24

2216 rows × 2 columns

- The customers with score > 4.5 => Top Customers
- The customers with score > 4 => High Value Customers
- The customers with score > 3 => Medium Value Customers
- The customers with score >1.6 => Low Value Customers

In [17]:
```
rfm_df["Customer_segment"] = np.where(rfm_df['RFM_Score'] >
                                      4.5, "Top Customers",
                                      (np.where(
                                        rfm_df['RFM_Score'] > 4,
                                        "High value Customer",
                                        (np.where(
    rfm_df['RFM_Score'] > 3,
                             "Medium Value Customer",
                                    np.where(rfm_df['RFM_Score'] > 1.6,
                                    'Low Value Customers', 'Lost Customers'))))))
```

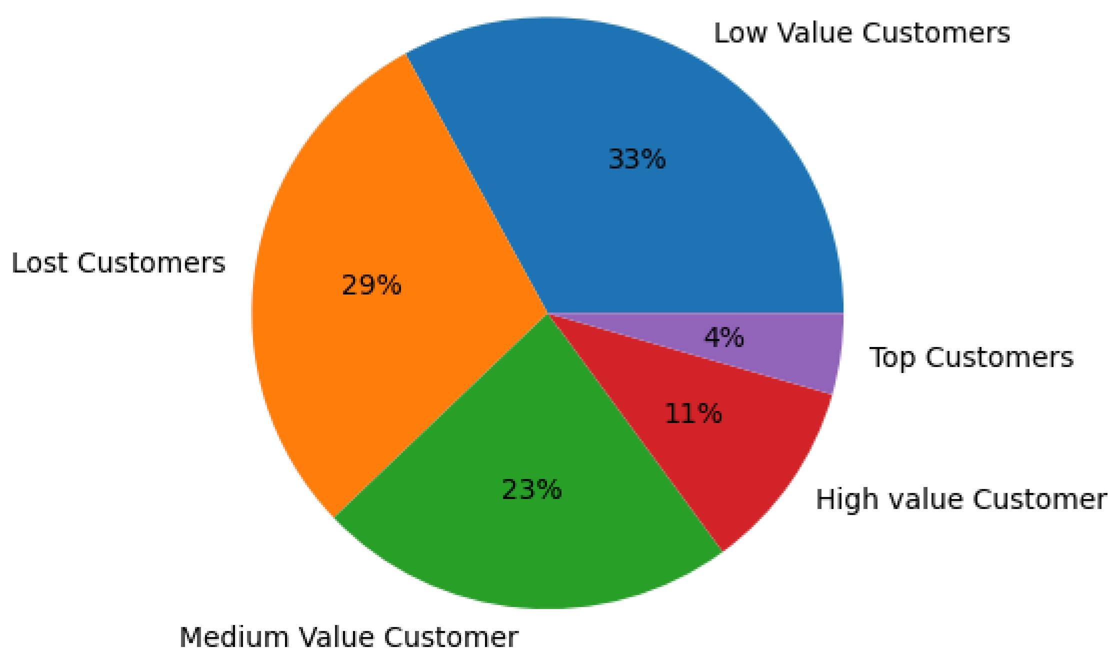
In [19]:
```
rfm_df[['ID', 'RFM_Score', 'Customer_segment']]
```

Out[19]:

	ID	RFM_Score	Customer_segment
0	5524	2.09	Low Value Customers
1	2174	3.79	Medium Value Customer
2	4141	3.75	Medium Value Customer
3	6182	4.63	Top Customers
4	5324	3.68	Medium Value Customer
...	...	...	...
2235	10870	2.90	Low Value Customers
2236	4001	4.51	Top Customers
2237	7270	3.72	Medium Value Customer
2238	8235	4.53	Top Customers
2239	9405	1.24	Lost Customers

2216 rows × 3 columns

In [20]:
```
plt.pie(rfm_df.Customer_segment.value_counts(),
        labels=rfm_df.Customer_segment.value_counts().index,
        autopct='%.0f%%')
plt.show()
```


Low Value Customers
Lost Customers
Top Customers
High value Customer
Medium Value Customer