deadahlila-marketingcampaign-1

August 8, 2023

[1]:
```python
import pandas as pd
import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
import warnings
warnings.filterwarnings('ignore')
```

[2]:
```python
df = pd.read_csv('marketing_campaign_data.csv')
```

[3]:
```python
pd.set_option('display.max_columns', None)
df.head()
```

[3]:
```
   Unnamed: 0    ID  Year_Birth Education Marital_Status      Income  Kidhome  \
0           0  5524        1957        S1         Lajang  58138000.0        0
1           1  2174        1954        S1         Lajang  46344000.0        1
2           2  4141        1965        S1     Bertunangan  71613000.0        0
3           3  6182        1984        S1     Bertunangan  26646000.0        1
4           4  5324        1981        S3        Menikah  58293000.0        1

   Teenhome Dt_Customer  Recency  MntCoke  MntFruits  MntMeatProducts  \
0         0  04-09-2012       58   635000      88000           546000
1         1  08-03-2014       38    11000       1000             6000
2         0  21-08-2013       26   426000      49000           127000
3         0  10-02-2014       26    11000       4000            20000
4         0  19-01-2014       94   173000      43000           118000

   MntFishProducts  MntSweetProducts  MntGoldProds  NumDealsPurchases  \
0           172000             88000         88000                  3
1             2000              1000          6000                  2
2           111000             21000         42000                  1
3            10000              3000          5000                  2
4            46000             27000         15000                  5

   NumWebPurchases  NumCatalogPurchases  NumStorePurchases  NumWebVisitsMonth  \
0                8                   10                  4                  7
```

```
1              1                  1                  2                  5
2              8                  2                 10                  4
3              2                  0                  4                  6
4              5                  3                  6                  5

   AcceptedCmp3  AcceptedCmp4  AcceptedCmp5  AcceptedCmp1  AcceptedCmp2  \
0             0             0             0             0             0
1             0             0             0             0             0
2             0             0             0             0             0
3             0             0             0             0             0
4             0             0             0             0             0

   Complain  Z_CostContact  Z_Revenue  Response
0         0              3         11         1
1         0              3         11         0
2         0              3         11         0
3         0              3         11         0
4         0              3         11         0
```

[4]:
```
df_num = df.select_dtypes(include = 'number')
df_cat = df.select_dtypes(exclude = 'number')
print(df_num.columns)
print(df_cat.columns)
```

```
Index(['Unnamed: 0', 'ID', 'Year_Birth', 'Income', 'Kidhome', 'Teenhome',
       'Recency', 'MntCoke', 'MntFruits', 'MntMeatProducts', 'MntFishProducts',
       'MntSweetProducts', 'MntGoldProds', 'NumDealsPurchases',
       'NumWebPurchases', 'NumCatalogPurchases', 'NumStorePurchases',
       'NumWebVisitsMonth', 'AcceptedCmp3', 'AcceptedCmp4', 'AcceptedCmp5',
       'AcceptedCmp1', 'AcceptedCmp2', 'Complain', 'Z_CostContact',
       'Z_Revenue', 'Response'],
      dtype='object')
Index(['Education', 'Marital_Status', 'Dt_Customer'], dtype='object')
```

[5]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2240 entries, 0 to 2239
Data columns (total 30 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   Unnamed: 0           2240 non-null   int64
 1   ID                   2240 non-null   int64
 2   Year_Birth           2240 non-null   int64
 3   Education            2240 non-null   object
 4   Marital_Status       2240 non-null   object
 5   Income               2216 non-null   float64
 6   Kidhome              2240 non-null   int64
```

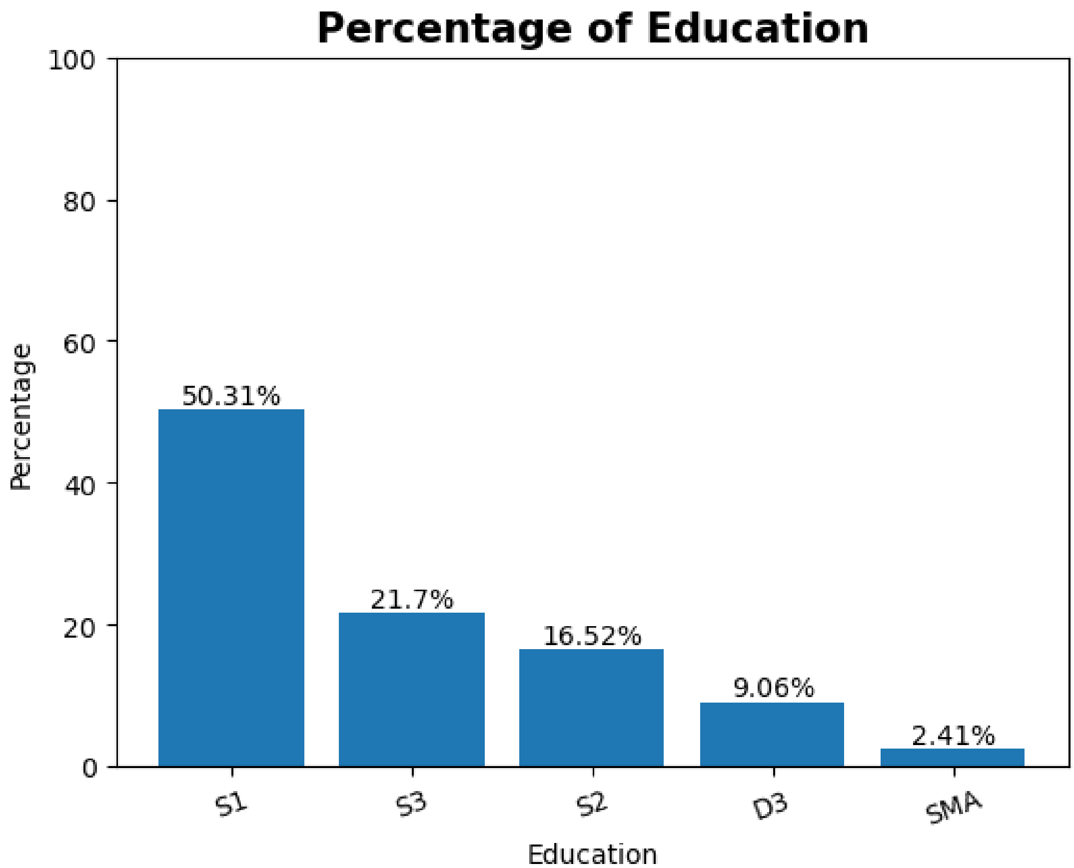
```
 7   Teenhome             2240 non-null   int64
 8   Dt_Customer          2240 non-null   object
 9   Recency              2240 non-null   int64
 10  MntCoke              2240 non-null   int64
 11  MntFruits            2240 non-null   int64
 12  MntMeatProducts      2240 non-null   int64
 13  MntFishProducts      2240 non-null   int64
 14  MntSweetProducts     2240 non-null   int64
 15  MntGoldProds         2240 non-null   int64
 16  NumDealsPurchases    2240 non-null   int64
 17  NumWebPurchases      2240 non-null   int64
 18  NumCatalogPurchases  2240 non-null   int64
 19  NumStorePurchases    2240 non-null   int64
 20  NumWebVisitsMonth    2240 non-null   int64
 21  AcceptedCmp3         2240 non-null   int64
 22  AcceptedCmp4         2240 non-null   int64
 23  AcceptedCmp5         2240 non-null   int64
 24  AcceptedCmp1         2240 non-null   int64
 25  AcceptedCmp2         2240 non-null   int64
 26  Complain             2240 non-null   int64
 27  Z_CostContact        2240 non-null   int64
 28  Z_Revenue            2240 non-null   int64
 29  Response             2240 non-null   int64
dtypes: float64(1), int64(26), object(3)
memory usage: 525.1+ KB
```

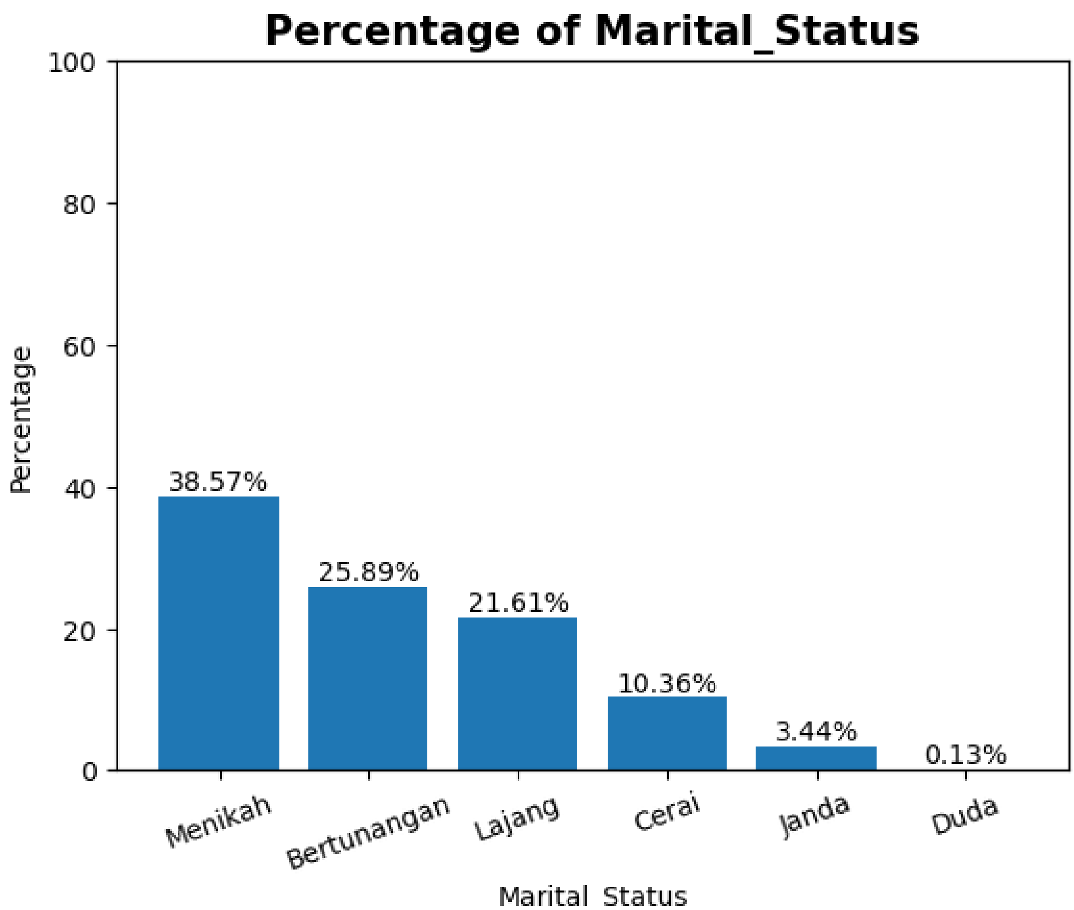
[8]:

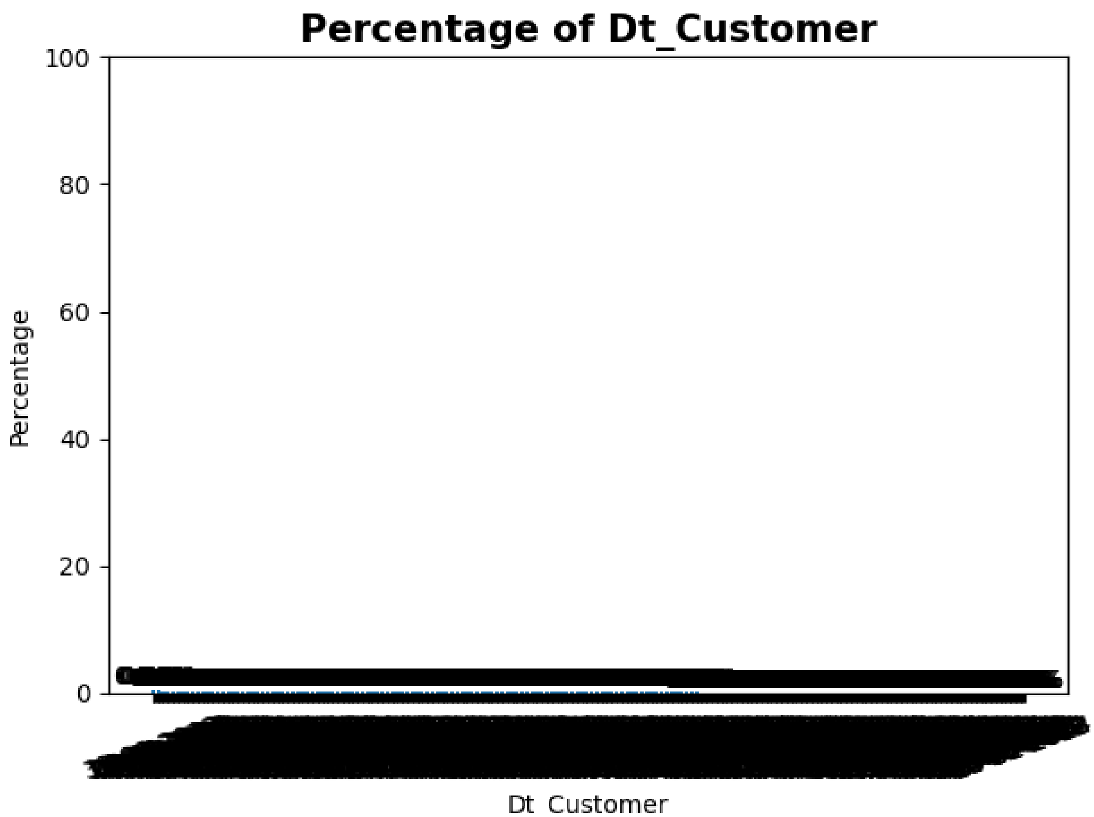
```
cat_var=df.select_dtypes(exclude='number')

#Calculate the percentage of each categorical variable
for column in cat_var:
  counts = df[column].value_counts()
  percent = round((counts / len(df)) * 100,2)

#Create the bar plot
  fig, ax = plt.subplots()
  ax.bar(counts.index, percent)
  ax.set_xlabel(column)
  ax.set_ylabel('Percentage')
  ax.set_ylim(0,100)
  ax.set_title(f'Percentage of {column}', fontweight='bold', fontsize=15)

#Add percentage
  for i in range(len(percent)):
    value = round(percent[i],2)
    label = f'{value}%'
    plt.text(i, percent[i], label, ha ='center', va='bottom')
    plt.xticks(rotation=20)
```

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

[8]: <function matplotlib.pyplot.show(close=None, block=None)>




Percentage of Marital_Status
100
80
60
40
20
0
Percentage
38.57%
25.89%
21.61%
10.36%
3.44%
0.13%
Menikah
Bertunangan
Lajang
Cerai
Janda
Duda
Marital_Status



[6]:
```
#create total accepted campaign
df['Total_Acc_Cmp'] =␣
↪df['AcceptedCmp1']+df['AcceptedCmp2']+df['AcceptedCmp3']+df['AcceptedCmp4']+df['AcceptedCmp

#create total purchases feature
df['Total_Purchases'] =␣
↪df['NumDealsPurchases']+df['NumWebPurchases']+df['NumCatalogPurchases']+df['NumStorePurchas

#create total spend feature
df['Total_Spent'] =␣
↪df['MntCoke']+df['MntFishProducts']+df['MntFruits']+df['MntMeatProducts']+df['MntSweetProdu

#create ammount of children feature
df['NumChildren'] = df['Kidhome']+df['Teenhome']
```

[7]:
```
def safe_div(x,y):
    if y == 0:
        return 0
    return x / y
```

```
df['conversion_rate'] = df.apply(lambda x:␣
 ↪safe_div(x['Total_Purchases'],x['NumWebVisitsMonth']), axis=1)
```

[8]:
```
from datetime import date

df['Dt_Collected'] = date.today()
df['Dt_Collected'] = pd.to_datetime(df['Dt_Collected'])
df['Dt_Customer'] = pd.to_datetime(df['Dt_Customer'])

df['Dt_Days_Customer'] = df['Dt_Collected'] - df['Dt_Customer']
df['Dt_Days_Customer'] = df['Dt_Days_Customer'].dt.days
```

0.1 Conversion Rate Analysis Based On Income, Spending And Age

[9]:
```
df['Age'] = 2023 - df['Year_Birth']

#group age
age_list=[]
for i in df['Age']:
    if i >= 0 and i <= 4:
        group = 'Balita'
    elif i >= 5 and i <= 12:
        group = 'Children'
    elif i >= 13 and i <= 17:
        group = 'Teenager'
    elif i >= 18 and i <= 24:
        group = 'Young_Adult'
    elif i >= 25 and i <= 39:
        group = 'Adult'
    elif i >= 40 and i <= 59:
        group = 'Middle Aged'
    else:
        group = 'Senior Citizen'
    age_list.append(group)
df['Age_Group'] = age_list
```

0.2 Conversion Rate Based on Age

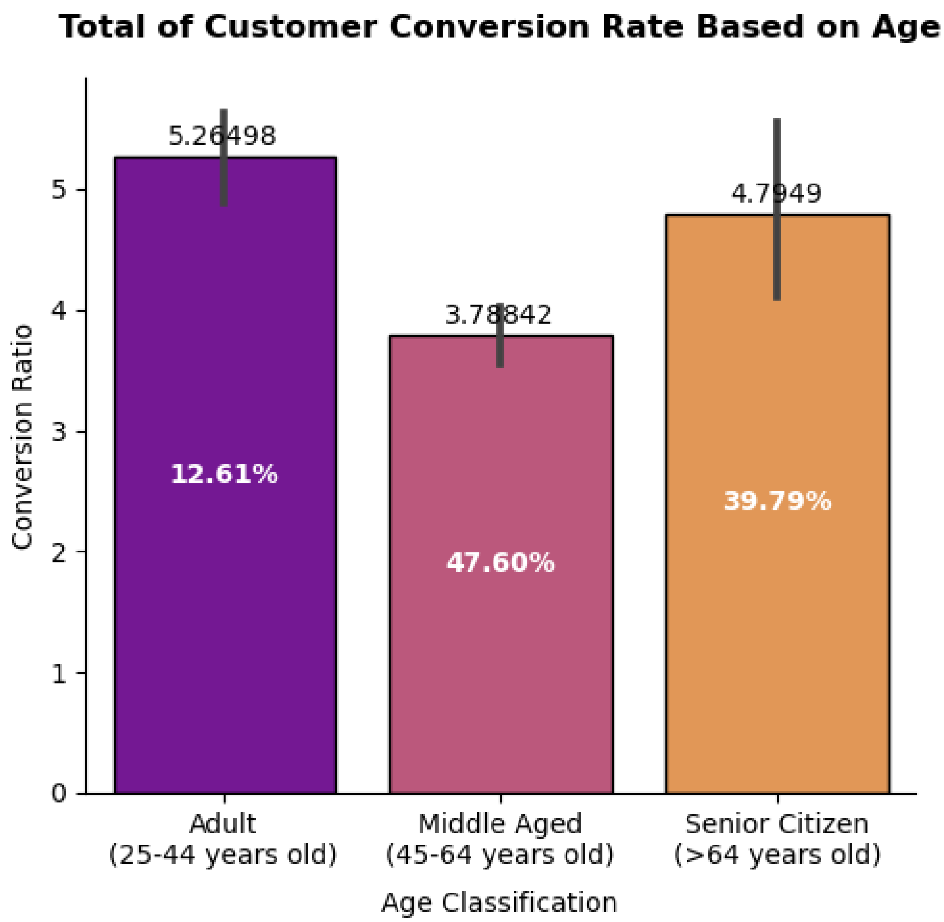
[10]:
```
df_agg = df.groupby('Age_Group').agg({'conversion_rate':'sum'}).reset_index()
df_agg['sum_cvr'] = df_agg['conversion_rate'].sum()
df_agg['percentage'] = round((df_agg['conversion_rate']/df_agg['sum_cvr'])*100,␣
 ↪2)
df_agg
```

[10]:

	Age_Group	conversion_rate	sum_cvr	percentage
0	Adult	1241.880201	9845.297974	12.61

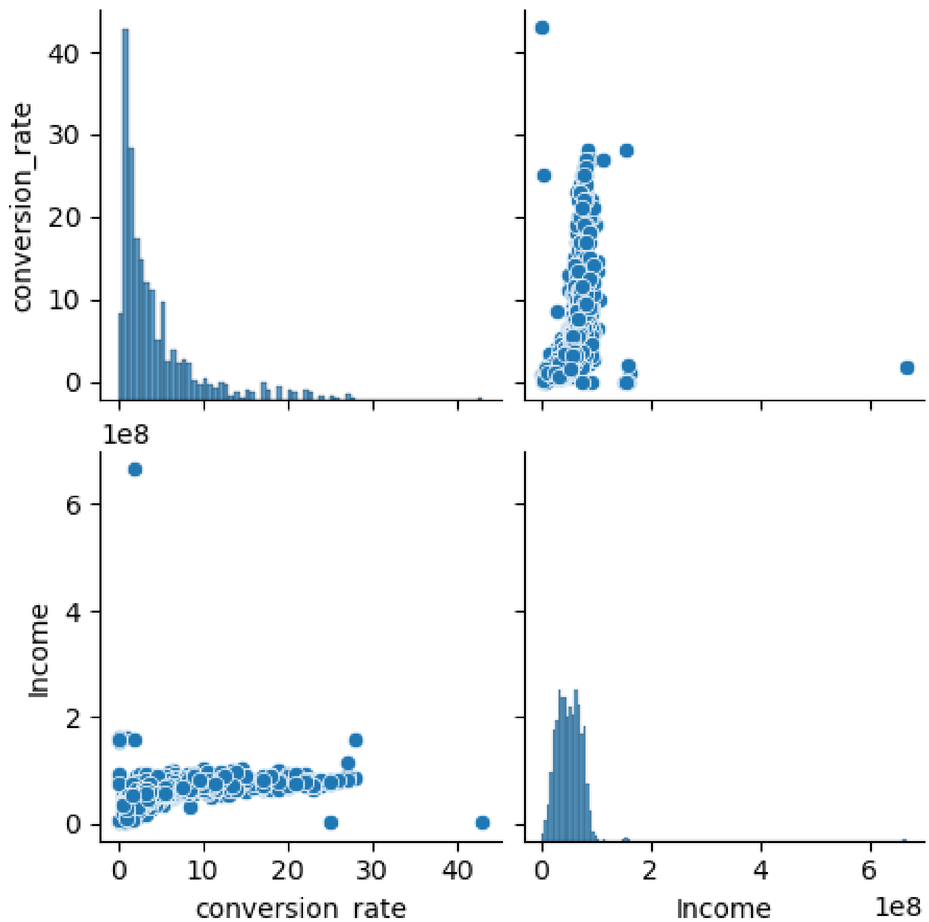
```
1     Middle Aged      4686.275919  9845.297974       47.60
2  Senior Citizen      3917.141855  9845.297974       39.79
```

[14]:
```
fig, ax = plt.subplots(figsize=(5, 5))
plt.title("Total of Customer Conversion Rate Based on Age", fontsize=12,␣
↪color='black', weight='bold', pad=15)
sns.barplot(x='Age_Group', y='conversion_rate', data=df, edgecolor='black',␣
↪palette='plasma')

plt.ylabel('Conversion Ratio')
plt.xlabel('Age Classification', labelpad=8)
plt.xticks(np.arange(3), ['Adult\n(25-44 years old)', 'Middle Aged\n(45-64␣
↪years old)', 'Senior Citizen\n(>64 years old)'])

plt.bar_label(ax.containers[0], padding=2)
plt.bar_label(ax.containers[0], ['12.61%', '47.60%', '39.79%'],␣
↪label_type='center', color='white', weight='bold')

sns.despine()
plt.tight_layout()
plt.savefig('customer_cvr.png')
```

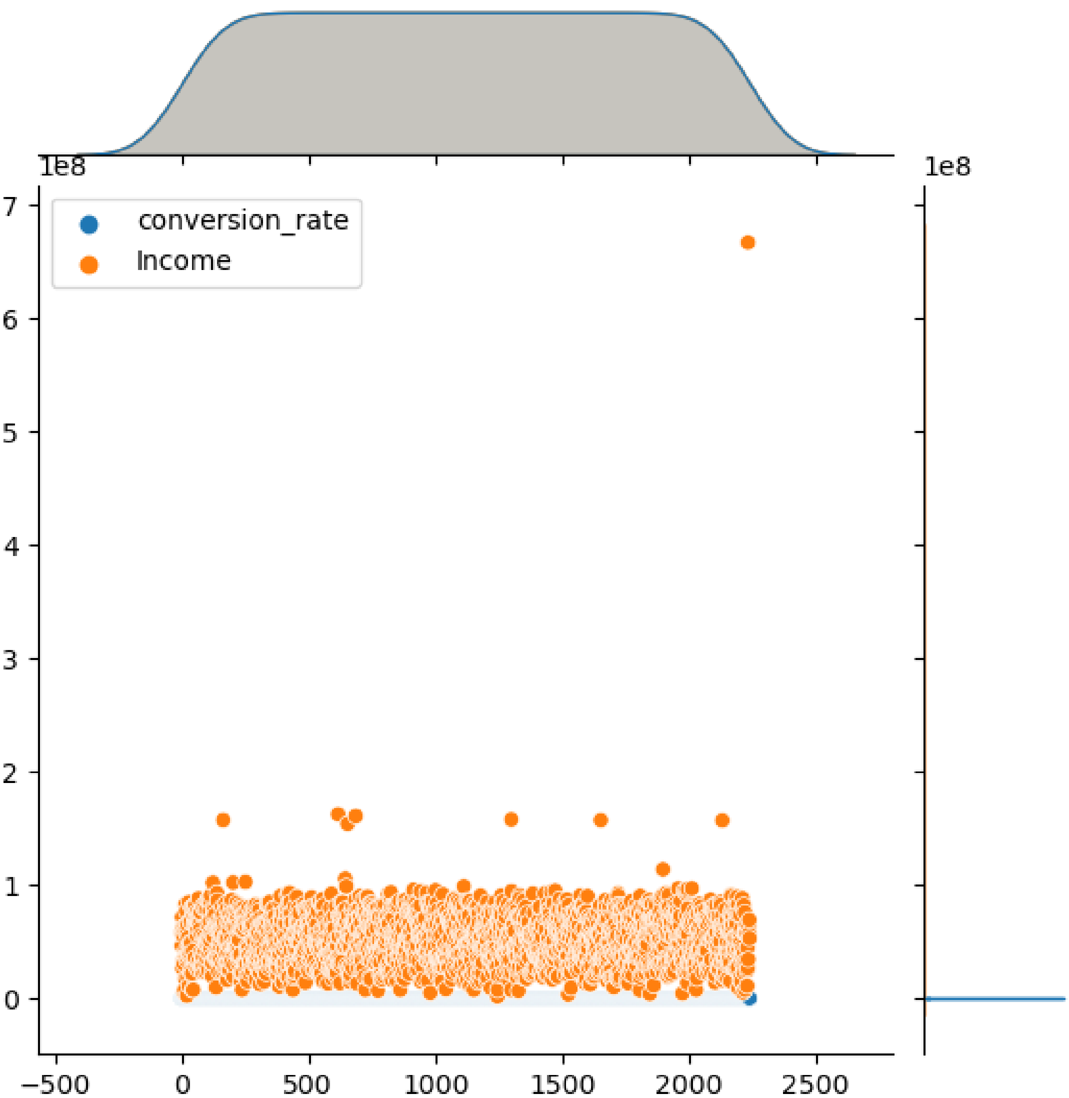


0.3 Conversion Rate Based on Income

[15]:
```
# Memilih kolom yang diperlukan
data = df[['conversion_rate', 'Income']]

# Membuat scatter plot matrix
sns.pairplot(data)

# Menampilkan plot
plt.show()
```



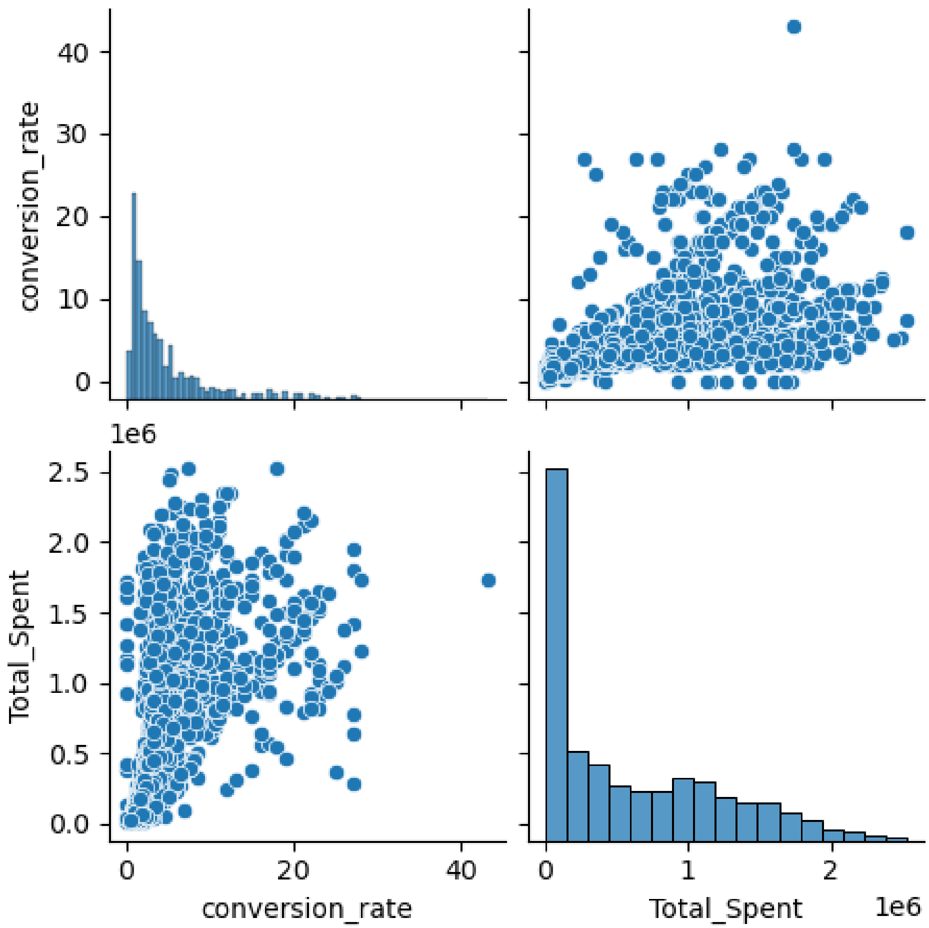
[16]:
```python
# Memilih kolom yang diperlukan
data = df[['conversion_rate', 'Income']]

# Membuat scatter plot matrix
sns.jointplot(data)

# Menampilkan plot
plt.show()
```



0.3.1 Conversion Rate Based on Spending

[17]:
```
#create total spend feature
df['Total_Spent'] =␣
  ↪df['MntCoke']+df['MntFishProducts']+df['MntFruits']+df['MntMeatProducts']+df['MntSweetProdu


# Memilih kolom yang diperlukan
data = df[['conversion_rate', 'Total_Spent']]

# Membuat scatter plot matrix
sns.pairplot(data)
```

```
# Menampilkan plot
plt.show()
```



0.4 Data Cleaning & Preprocessing

[11]:
```
df_copy = df.copy()
```

[12]:
```
df_copy.isna().sum()
```

[12]:
```
Unnamed: 0            0
ID                    0
Year_Birth            0
Education             0
Marital_Status        0
Income               24
Kidhome               0
```

```
Teenhome                0
Dt_Customer             0
Recency                 0
MntCoke                 0
MntFruits               0
MntMeatProducts         0
MntFishProducts         0
MntSweetProducts        0
MntGoldProds            0
NumDealsPurchases       0
NumWebPurchases         0
NumCatalogPurchases     0
NumStorePurchases       0
NumWebVisitsMonth       0
AcceptedCmp3            0
AcceptedCmp4            0
AcceptedCmp5            0
AcceptedCmp1            0
AcceptedCmp2            0
Complain                0
Z_CostContact           0
Z_Revenue               0
Response                0
Total_Acc_Cmp           0
Total_Purchases         0
Total_Spent             0
NumChildren             0
conversion_rate         0
Dt_Collected            0
Dt_Days_Customer        0
Age                     0
Age_Group               0
dtype: int64
```

0.5 Handle Missing Value

[13]:
```
#Handle Missing Value
df_copy['Income'] = df_copy['Income'].fillna(df_copy['Income'].median())
```

[14]:
```
#create ammount of children feature
df_copy['Number_Children'] = df['Kidhome']+df['Teenhome']
```

0.6 Drop data

[15]:
```
#Drop data
df_copy.
 ↪drop(['AcceptedCmp1','AcceptedCmp2','AcceptedCmp3','AcceptedCmp4','AcceptedCmp5',
                ␣
 ↪'NumDealsPurchases','NumWebPurchases','NumCatalogPurchases','NumStorePurchases',
                ␣
 ↪'MntCoke','MntFishProducts','MntFruits','MntMeatProducts','MntSweetProducts',␣
 ↪'MntGoldProds',
                'Kidhome','Teenhome', 'Response'], inplace=True, axis=1)
```

[16]:
```
df_copy.drop(['Unnamed: 0', 'ID', 'Year_Birth', 'Z_CostContact', 'Z_Revenue',␣
 ↪'Dt_Collected', 'NumChildren'], inplace=True, axis=1)
```

[17]:
```
df_copy.Marital_Status
```

[17]:
```
0            Lajang
1            Lajang
2        Bertunangan
3        Bertunangan
4           Menikah
           …
2235        Menikah
2236    Bertunangan
2237          Cerai
2238    Bertunangan
2239        Menikah
Name: Marital_Status, Length: 2240, dtype: object
```

[18]:
```
df_copy['Marital_Status'] = df_copy['Marital_Status'].replace('Cerai', 'Single')
df_copy['Marital_Status'] = df_copy['Marital_Status'].replace('Janda', 'Single')
df_copy['Marital_Status'] = df_copy['Marital_Status'].replace('Duda', 'Single')
df_copy['Marital_Status'] = df_copy['Marital_Status'].replace('Lajang',␣
 ↪'Single')
df_copy.head(5)
```

[18]:
```
  Education Marital_Status      Income Dt_Customer  Recency  \
0        S1         Single  58138000.0  2012-04-09       58
1        S1         Single  46344000.0  2014-08-03       38
2        S1    Bertunangan  71613000.0  2013-08-21       26
3        S1    Bertunangan  26646000.0  2014-10-02       26
4        S3        Menikah  58293000.0  2014-01-19       94

   NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
0                  7         0              0               25      1617000
1                  5         0              0                6        27000
```

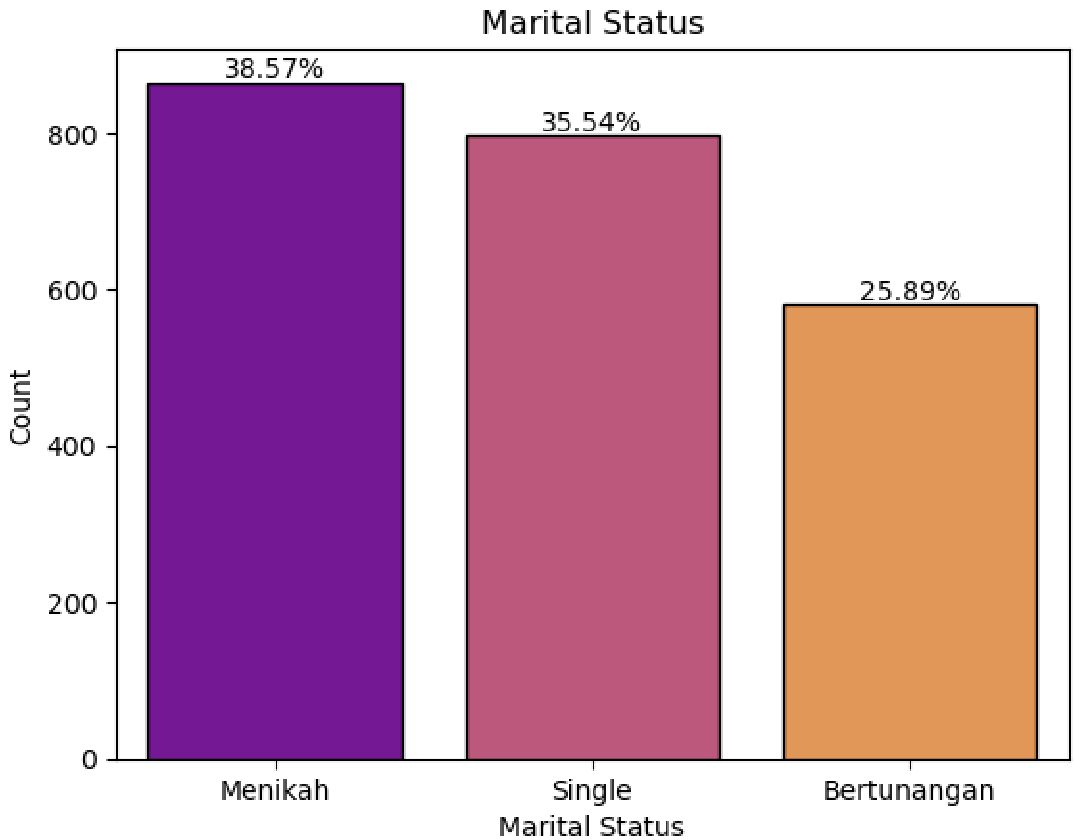
```
2                    4          0              0                21        776000
3                    6          0              0                 8         53000
4                    5          0              0                19        422000

   conversion_rate  Dt_Days_Customer  Age       Age_Group  Number_Children
0         3.571429              4131   66  Senior Citizen                0
1         1.200000              3285   69  Senior Citizen                2
2         5.250000              3632   58     Middle Aged                0
3         1.333333              3225   39           Adult                1
4         3.800000              3481   42     Middle Aged                1
```

[19]:
```python
df_copy.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2240 entries, 0 to 2239
Data columns (total 15 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   Education         2240 non-null   object
 1   Marital_Status    2240 non-null   object
 2   Income            2240 non-null   float64
 3   Dt_Customer       2240 non-null   datetime64[ns]
 4   Recency           2240 non-null   int64
 5   NumWebVisitsMonth 2240 non-null   int64
 6   Complain          2240 non-null   int64
 7   Total_Acc_Cmp     2240 non-null   int64
 8   Total_Purchases   2240 non-null   int64
 9   Total_Spent       2240 non-null   int64
 10  conversion_rate   2240 non-null   float64
 11  Dt_Days_Customer  2240 non-null   int64
 12  Age               2240 non-null   int64
 13  Age_Group         2240 non-null   object
 14  Number_Children   2240 non-null   int64
dtypes: datetime64[ns](1), float64(2), int64(9), object(3)
memory usage: 262.6+ KB
```

[20]:
```python
counts = df_copy['Marital_Status'].value_counts()
percent = round((counts / len(df_copy)) * 100, 2)
sns.barplot(x=counts.index, y=counts.values, edgecolor='black',␣
 ↪palette='plasma')

# Menampilkan persentase pada plot
for i, count in enumerate(counts):
    plt.text(i, count, f'{percent[i]}%', ha='center', va='bottom')

plt.title('Marital Status')
plt.xlabel('Marital Status')
```

```
plt.ylabel('Count')
plt.show()
```



0.7 Handle Duplicated Data

[30]:
```
df_copy[df_copy.duplicated(keep='last')].head(5)
```

[30]:
```
   Education Marital_Status      Income Dt_Customer  Recency  \
8         S3    Bertunangan  30351000.0  2013-06-06       19
15        S3         Single  82800000.0  2012-11-24       23
17        S1    Bertunangan  37760000.0  2012-08-31       20
23        S3        Menikah  65324000.0  2014-11-01        0
24        S1    Bertunangan  40689000.0  2013-03-18       69

    NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
8                   9         0              0                6        46000
15                  3         0              2               26      1315000
17                  7         0              0               13       317000
23                  4         0              0               20       544000
```

```
24                   8          0               0                20       444000

    conversion_rate  Dt_Days_Customer  Age      Age_Group  Number_Children
8          0.666667              3708   49    Middle Aged                1
15         8.666667              3902   77 Senior Citizen                0
17         1.857143              3987   77 Senior Citizen                0
23         5.000000              3195   69 Senior Citizen                1
24         2.500000              3788   72 Senior Citizen                1
```

[31]:
```
df_copy[df_copy.duplicated(keep='first')].head(10)
```

[31]:
```
    Education Marital_Status      Income Dt_Customer  Recency  \
83         S2    Bertunangan  38620000.0  2013-11-05       56
179        D3        Menikah  78497000.0  2013-01-12       44
281        S1    Bertunangan  51369000.0  2012-10-25       84
282        S1    Bertunangan  37760000.0  2012-08-31       20
363        S3        Menikah  37717000.0  2012-11-23       31
383        D3        Menikah  35688000.0  2012-08-22       94
408        S3    Bertunangan  30351000.0  2013-06-06       19
421        S1        Menikah  30096000.0  2014-05-22       30
443        S1         Single  30279000.0  2012-12-30       13
463        S1        Menikah  80124000.0  2014-06-26       47

     NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
83                   3         0              0               11       318000
179                  2         0              1               25       978000
281                  8         0              0               16       576000
282                  7         0              0               13       317000
363                  9         0              0                4        25000
383                  8         0              0               16       211000
408                  9         0              0                6        46000
421                  6         0              0                6        45000
443                  8         0              0                5        37000
463                  1         0              1               19      1495000

     conversion_rate  Dt_Days_Customer  Age      Age_Group  Number_Children
83          3.666667              3556   60 Senior Citizen                0
179        12.500000              3853   72 Senior Citizen                0
281         2.000000              3932   47    Middle Aged                1
282         1.857143              3987   77 Senior Citizen                0
363         0.444444              3903   45    Middle Aged                1
383         2.000000              3996   50    Middle Aged                3
408         0.666667              3708   49    Middle Aged                1
421         1.000000              3358   40    Middle Aged                1
443         0.625000              3866   34          Adult                1
463        19.000000              3323   60 Senior Citizen                0
```

[32]:
```
df_copy[df_copy.duplicated(keep=False)].head(10)
```

[32]:
```
   Education Marital_Status      Income Dt_Customer  Recency  \
8         S3     Bertunangan  30351000.0  2013-06-06       19
15        S3          Single  82800000.0  2012-11-24       23
17        S1     Bertunangan  37760000.0  2012-08-31       20
23        S3         Menikah  65324000.0  2014-11-01        0
24        S1     Bertunangan  40689000.0  2013-03-18       69
29        S3         Menikah  84618000.0  2013-11-22       96
30        S2          Single  10979000.0  2014-05-22       34
31        S2     Bertunangan  38620000.0  2013-11-05       56
38        S1          Single  42429000.0  2014-11-02       99
39        S3          Single  48948000.0  2013-01-02       53

    NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
8                   9         0              0                6        46000
15                  3         0              2               26      1315000
17                  7         0              0               13       317000
23                  4         0              0               20       544000
24                  8         0              0               20       444000
29                  2         0              1               26      1672000
30                  5         0              0                8        30000
31                  3         0              0               11       318000
38                  5         0              0                7        67000
39                  6         0              1               24       902000

    conversion_rate  Dt_Days_Customer  Age       Age_Group  Number_Children
8          0.666667              3708   49     Middle Aged                1
15         8.666667              3902   77  Senior Citizen                0
17         1.857143              3987   77  Senior Citizen                0
23         5.000000              3195   69  Senior Citizen                1
24         2.500000              3788   72  Senior Citizen                1
29        13.000000              3539   58     Middle Aged                0
30         1.600000              3358   34           Adult                0
31         3.666667              3556   60  Senior Citizen                0
38         1.400000              3194   50     Middle Aged                1
39         4.000000              3863   80  Senior Citizen                0
```

[33]:
```
df_copy = df_copy.drop_duplicates(keep = 'first')
```

[34]:
```
df_copy.head(2)
```

[34]:
```
  Education Marital_Status      Income Dt_Customer  Recency  \
0        S1          Single  58138000.0  2012-04-09       58
1        S1          Single  46344000.0  2014-08-03       38

   NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
```

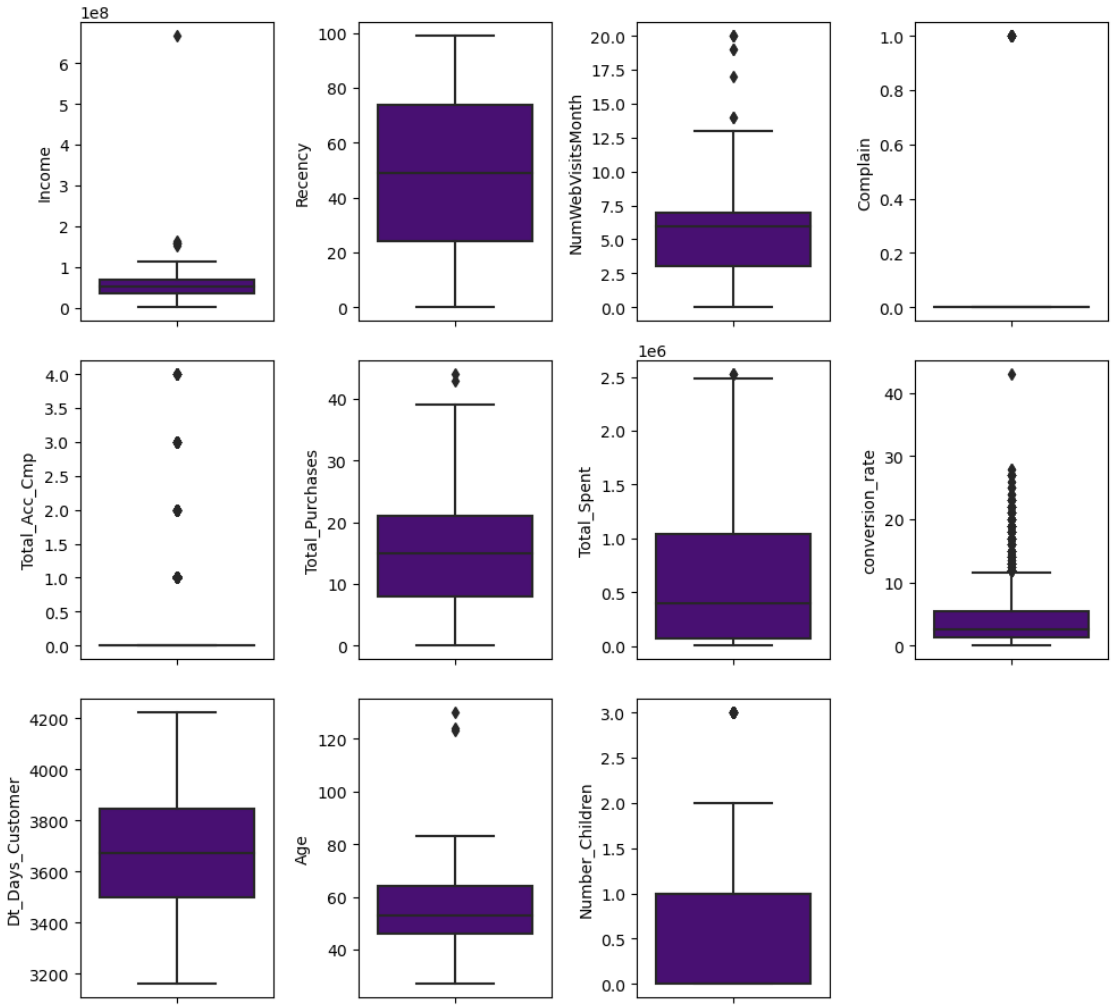
```
0                  7         0              0               25      1617000
1                  5         0              0                6        27000

   conversion_rate  Dt_Days_Customer  Age       Age_Group  Number_Children
0         3.571429              4131   66  Senior Citizen                0
1         1.200000              3285   69  Senior Citizen                2
```

0.8 Handle Outlier

[21]:
```python
df_copy_num = df_copy.select_dtypes(include = 'number')
df_copy_cat = df_copy.select_dtypes(exclude = 'number')
print(df_copy_num.columns)
print(df_copy_cat.columns)
```

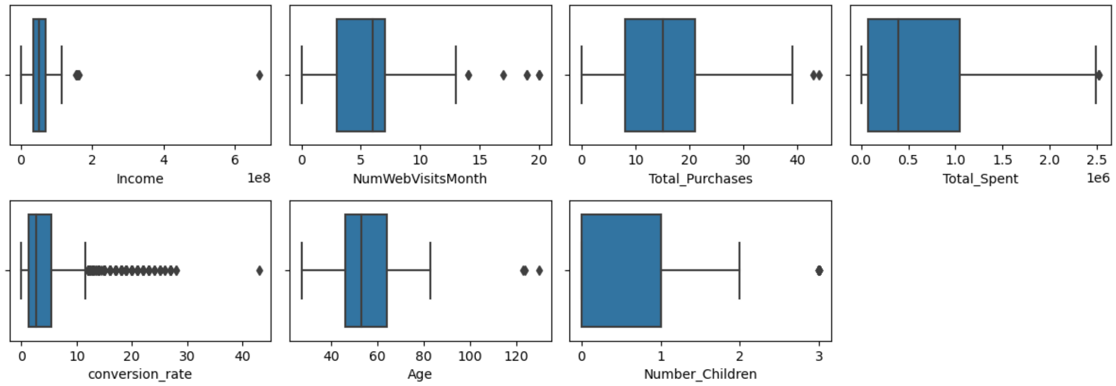
```
Index(['Income', 'Recency', 'NumWebVisitsMonth', 'Complain', 'Total_Acc_Cmp',
       'Total_Purchases', 'Total_Spent', 'conversion_rate', 'Dt_Days_Customer',
       'Age', 'Number_Children'],
      dtype='object')
Index(['Education', 'Marital_Status', 'Dt_Customer', 'Age_Group'],
dtype='object')
```

[22]:
```python
features = df_copy_num.columns
plt.figure(figsize= (10,15))
for i in range(len(features)):
    plt.subplot(5, 4, i+1)
    sns.boxplot(y = df_copy[features[i]], color ='indigo', orient='v')
    plt.tight_layout()
```



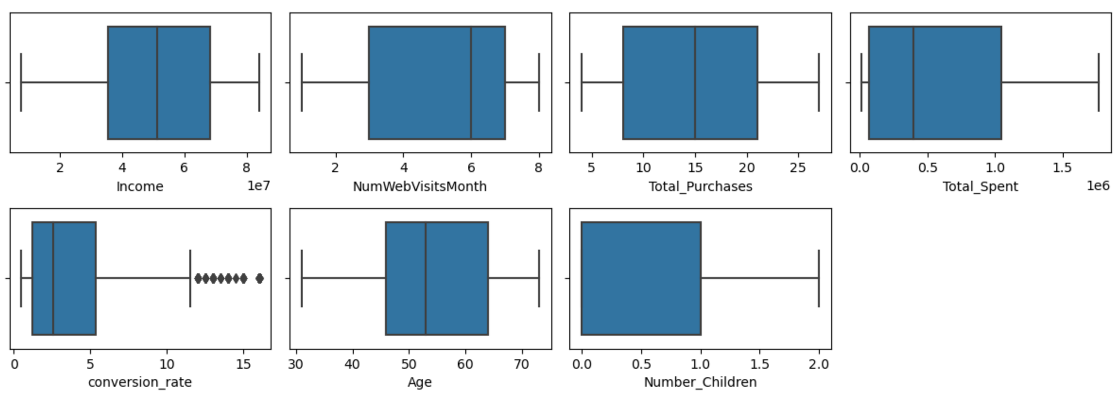

```
[23]: outliers = df_copy[['Income', 'NumWebVisitsMonth', 'Total_Purchases',␣
       ↪'Total_Spent', 'conversion_rate', 'Age', 'Number_Children']]
```

```
[24]: cols = outliers.columns

      plt.figure(figsize=(12,8))
      for i, column in enumerate (df_copy[cols].columns, 1):
          plt.subplot(4,4,i)
          sns.boxplot(data=df_copy[cols], x=df_copy[column])
          plt.tight_layout()
```



[25]:
```python
for col in cols:
    high_cut = df_copy[col].quantile(q=0.95)
    low_cut= df_copy[col].quantile(q=0.01)
    df_copy.loc[df_copy[col]>high_cut,col]=high_cut
    df_copy.loc[df_copy[col]<low_cut,col]=low_cut
```

[26]:
```python
cols = outliers.columns

plt.figure(figsize=(12,8))
for i, column in enumerate (df_copy[cols].columns, 1):
    plt.subplot(4,4,i)
    sns.boxplot(data=df_copy[cols], x=df_copy[column])
    plt.tight_layout()
```



[27]:
```python
df_copy.head()
```

[27]:
```
  Education Marital_Status      Income Dt_Customer  Recency  \
0        S1         Single  58138000.0  2012-04-09       58
1        S1         Single  46344000.0  2014-08-03       38
```

```
2        S1    Bertunangan  71613000.0  2013-08-21       26
3        S1    Bertunangan  26646000.0  2014-10-02       26
4        S3        Menikah  58293000.0  2014-01-19       94

   NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
0                  7         0              0               25    1617000.0
1                  5         0              0                6      27000.0
2                  4         0              0               21     776000.0
3                  6         0              0                8      53000.0
4                  5         0              0               19     422000.0

   conversion_rate  Dt_Days_Customer  Age       Age_Group  Number_Children
0         3.571429              4131   66  Senior Citizen                0
1         1.200000              3285   69  Senior Citizen                2
2         5.250000              3632   58     Middle Aged                0
3         1.333333              3225   39           Adult                1
4         3.800000              3481   42     Middle Aged                1
```

0.9 Encoding

[28]:
```
df_copy_enc = df_copy.copy()
```

[29]:
```
# label encoding Education
MappingEducation = {
    'SMA' : 0,
    'D3' : 1,
    'S1' : 2,
    'S2' : 3,
    'S3' : 4
}

df_copy_enc['Education'] = df_copy_enc['Education'].map(MappingEducation)
```

[30]:
```
for i in ['Marital_Status','Age_Group']:
  onehots = pd.get_dummies(df_copy_enc[i],prefix='enc')
  df_copy_enc=df_copy_enc.join(onehots)
```

[31]:
```
df_copy_enc = df_copy_enc.drop(['Marital_Status','Age_Group'],axis=1)
```

[32]:
```
df_final = df_copy_enc[['Recency', 'Total_Purchases', 'Total_Spent',␣
 ↪'Dt_Days_Customer', 'Age']]
```

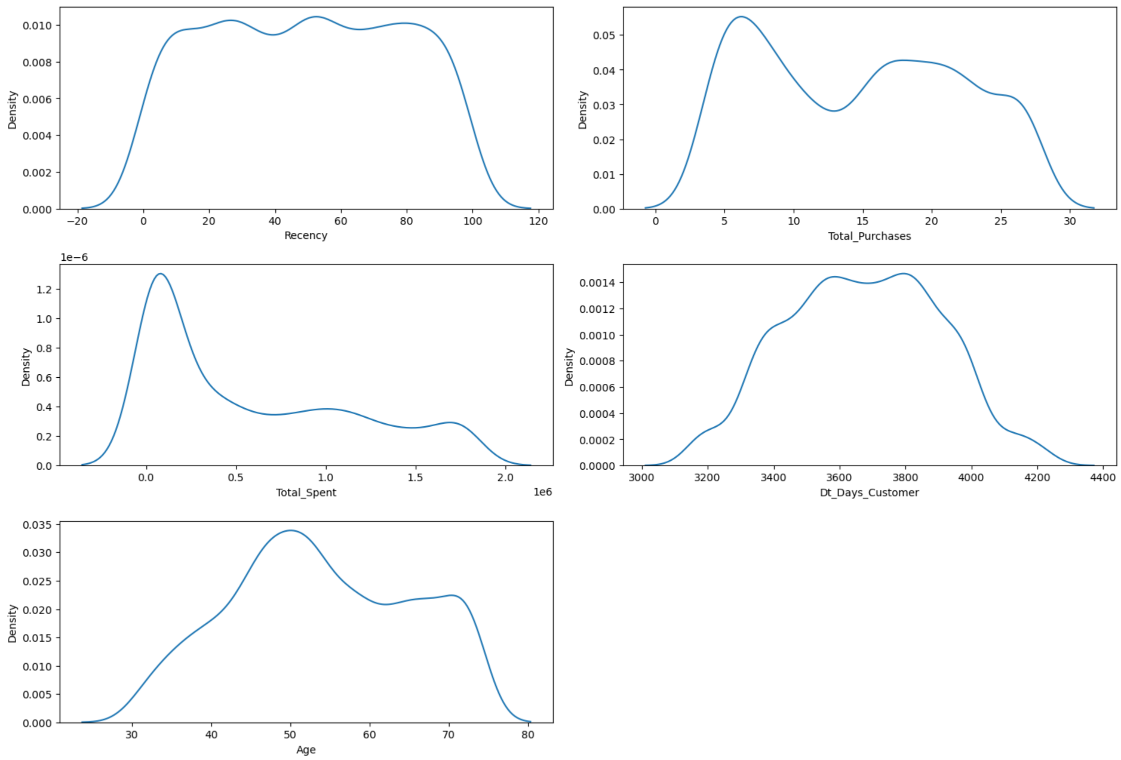
[33]:
```
df_final.describe()
```

[33]:
```
             Recency  Total_Purchases   Total_Spent  Dt_Days_Customer  \
count  2240.000000      2240.000000  2.240000e+03       2240.000000
```

```
mean      49.109375         14.732143  5.940284e+05        3672.043304
std       28.962453          7.360654  5.749063e+05         232.229893
min        0.000000          4.000000  1.300000e+04        3160.000000
25%       24.000000          8.000000  6.875000e+04        3500.750000
50%       49.000000         15.000000  3.960000e+05        3673.000000
75%       74.000000         21.000000  1.045500e+06        3845.250000
max       99.000000         27.000000  1.772300e+06        4223.000000

               Age
count  2240.000000
mean     53.989732
std      11.409209
min      31.000000
25%      46.000000
50%      53.000000
75%      64.000000
max      73.000000
```

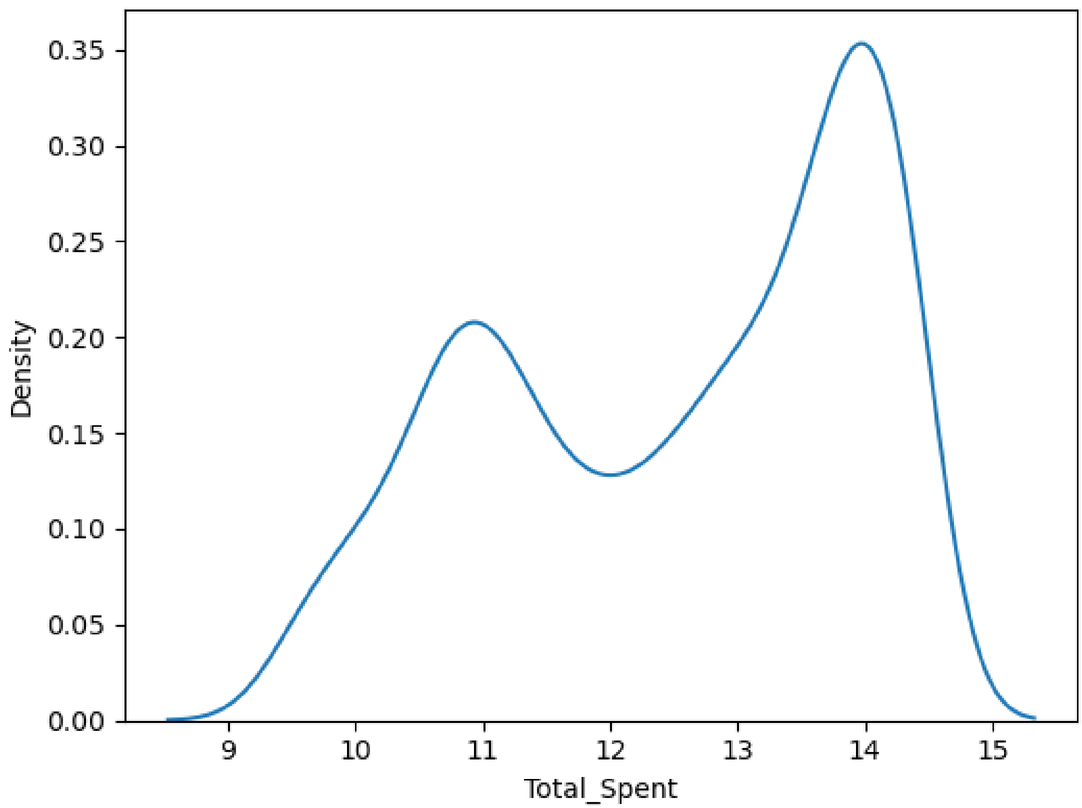
0.10 Transformation

[34]:
```
cols = df_final.columns

plt.figure(figsize= (15, 20))
for i in range(len(cols)):
    plt.subplot(6, 2, i+1)
    sns.kdeplot(x = df_final[cols[i]])
    plt.tight_layout()
```




```
[35]: #Log Transformasi
      df_final['log_TotalSpent'] = np.log(df_final['Total_Spent'])
      sns.kdeplot(np.log(df_final['Total_Spent']))
```

[35]: <Axes: xlabel='Total_Spent', ylabel='Density'>



[36]:
```
df_final = df_final.drop(columns='Total_Spent')
```

[37]:
```
df_final.head()
```

[37]:

	Recency	Total_Purchases	Dt_Days_Customer	Age	log_TotalSpent
0	58	25	4131	66	14.296083
1	38	6	3285	69	10.203592
2	26	21	3632	58	13.561908
3	26	8	3225	39	10.878047
4	94	19	3481	42	12.952761

0.11 Scalling

[38]:
```
from sklearn.preprocessing import StandardScaler, MinMaxScaler
col_name = list(df_final.columns)

mm = MinMaxScaler()
df_std = mm.fit_transform(df_final)
df_std = pd.DataFrame(df_std, columns=col_name)
df_std.sample(10)
```

[38]:
```
         Recency  Total_Purchases  Dt_Days_Customer       Age  log_TotalSpent
1755  0.424242         0.260870          0.591722  0.309524        0.218234
1815  0.808081         0.043478          0.473189  0.214286        0.148703
2153  0.303030         0.478261          0.624647  0.547619        0.607927
939   0.080808         0.826087          0.427093  0.404762        0.840946
98    0.444444         0.913043          0.651929  0.976190        0.879041
2101  0.636364         1.000000          0.186265  1.000000        0.878624
84    0.181818         1.000000          0.267168  0.119048        0.832494
720   0.010101         0.521739          0.674506  0.642857        0.876318
2237  0.919192         0.652174          0.296331  0.261905        0.927497
1813  0.686869         0.347826          0.644403  0.000000        0.966332
```

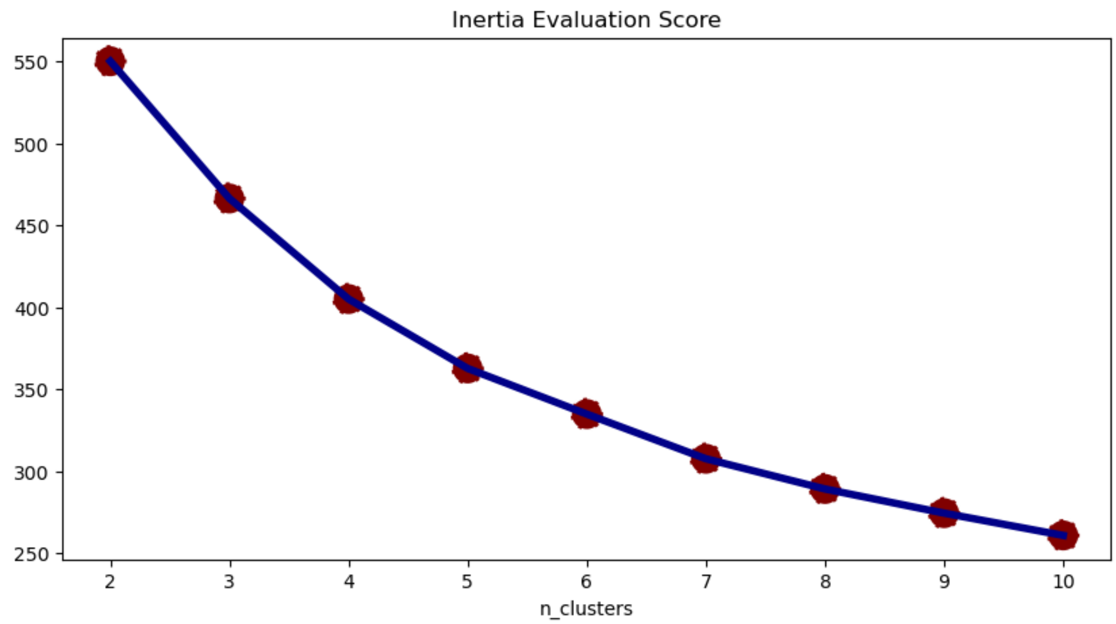
[39]:
```python
df_std.describe()
```

[39]:
```
           Recency  Total_Purchases  Dt_Days_Customer          Age  \
count  2240.000000      2240.000000       2240.000000  2240.000000
mean      0.496054         0.466615          0.481696     0.547375
std       0.292550         0.320028          0.218467     0.271648
min       0.000000         0.000000          0.000000     0.000000
25%       0.242424         0.173913          0.320555     0.357143
50%       0.494949         0.478261          0.482596     0.523810
75%       0.747475         0.739130          0.644638     0.785714
max       1.000000         1.000000          1.000000     1.000000

       log_TotalSpent
count     2240.000000
mean         0.618985
std          0.298746
min          0.000000
25%          0.338856
50%          0.695098
75%          0.892620
max          1.000000
```

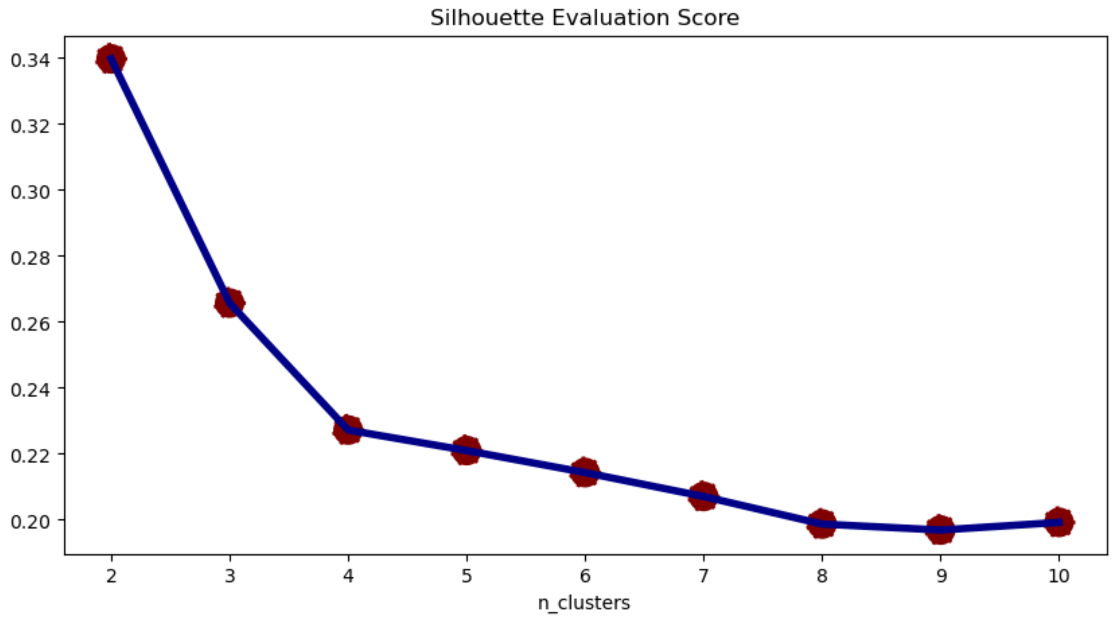
0.12 Modelling

[40]:
```python
#Inertia
from sklearn.cluster import KMeans
inertia = []

for i in range(2, 11):
    kmeans = KMeans(n_clusters=i, random_state=0)
    kmeans.fit(df_std)
    inertia.append(kmeans.inertia_)
```

```
plt.figure(figsize=(10, 5))
plt.title('Inertia Evaluation Score')
sns.lineplot(x=range(2, 11), y=inertia, color='#000087', linewidth = 4)
sns.scatterplot(x=range(2, 11), y=inertia, s=300, color='#800000', 
 ↪linestyle='--')
plt.xlabel('n_clusters')
plt.show()
```



[41]:
```
from sklearn.metrics import silhouette_score

range_n_clusters = list(range(2,11))
arr_silhouette_score_euclidean = []
for i in range_n_clusters:
    kmeans = KMeans(n_clusters=i).fit(df_std)
    preds = kmeans.predict(df_std)
    score_euclidean = silhouette_score(df_std, preds, metric='euclidean')
    arr_silhouette_score_euclidean.append(score_euclidean)

fig, ax = plt.subplots(figsize=(10, 5))
plt.title('Silhouette Evaluation Score')
sns.lineplot(x=range(2,11), y=arr_silhouette_score_euclidean, color='#000087',
 ↪linewidth = 4)
sns.scatterplot(x=range(2,11), y=arr_silhouette_score_euclidean, s=300,
 ↪color='#800000',  linestyle='--')
plt.xlabel('n_clusters')
plt.show()
```



[42]:
```
df_std_cluster = df_std.copy()
df_cluster = df_std.copy()

kmeans = KMeans(n_clusters=4, random_state=0).fit(df_std)
df_std_cluster['clusters'] = kmeans.labels_
df_cluster['clusters'] = kmeans.labels_
```

[43]:
```
df_cluster.sample(10)
```

[43]:
```
       Recency  Total_Purchases  Dt_Days_Customer       Age  log_TotalSpent  \
901   0.464646         0.304348          0.448730  0.523810        0.559147
1802  0.858586         0.260870          0.552211  0.976190        0.540257
580   0.646465         0.478261          0.739417  0.428571        0.570832
151   0.969697         0.652174          0.146754  0.547619        0.725578
1376  0.262626         0.695652          0.320790  0.404762        0.695098
1836  0.121212         0.913043          0.426152  0.523810        0.893881
562   0.121212         0.956522          0.497648  0.500000        0.836892
1151  0.969697         0.869565          0.779868  0.666667        0.960422
908   0.949495         0.086957          0.234243  0.428571        0.333614
959   0.484848         0.521739          0.553151  0.833333        0.676271

      clusters
901          3
1802         3
580          1
151          1
```

```
1376        0
1836        0
562         0
1151        1
908         3
959         1
```

[44]:
```python
df_cluster.isna().sum()
```

[44]:
```
Recency             0
Total_Purchases     0
Dt_Days_Customer    0
Age                 0
log_TotalSpent      0
clusters            0
dtype: int64
```

[45]:
```python
from sklearn.decomposition import PCA
pca = PCA(n_components=2)

pca.fit(df_std)
pcs = pca.transform(df_std)

df_pca = pd.DataFrame(data = pcs, columns = ['PC 1', 'PC 2'])
df_pca['clusters'] = df_cluster['clusters']
df_pca.sample(10)
```

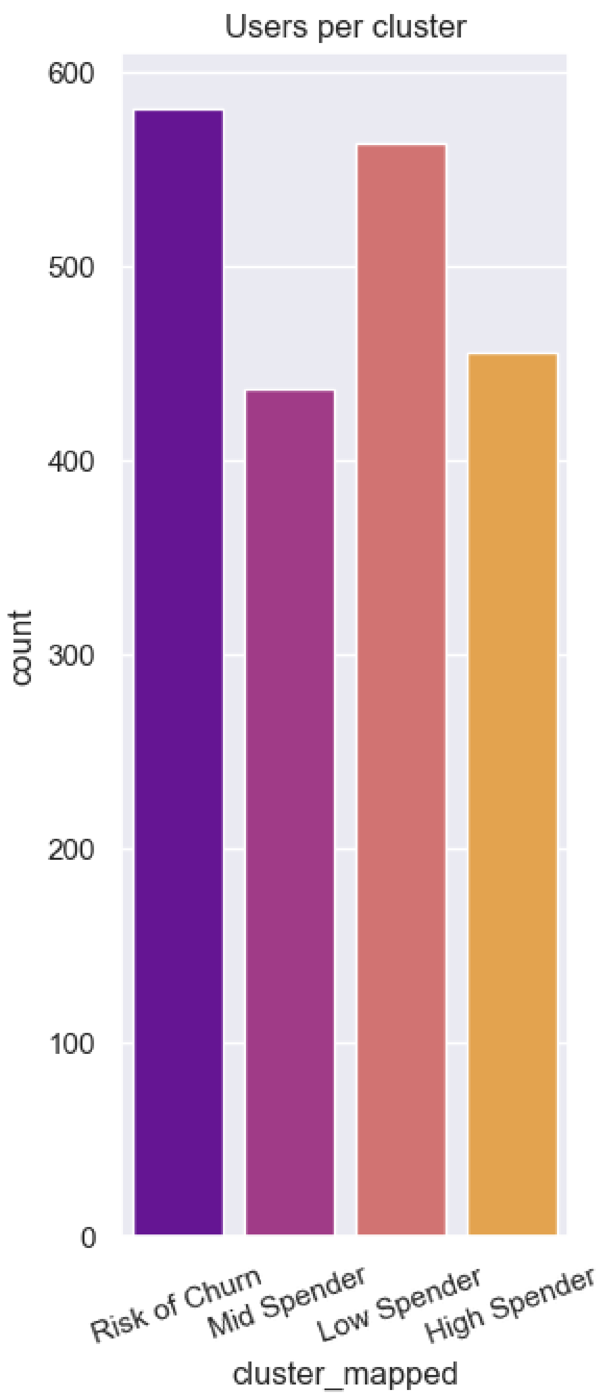
[45]:

	PC 1	PC 2	clusters
2081	-0.134196	0.480227	1
1697	0.020823	0.212362	1
204	0.516697	0.256971	3
984	-0.551000	-0.310294	0
1166	0.441773	-0.342310	2
609	-0.285423	0.337087	1
1730	0.437591	-0.114573	2
626	-0.358230	0.049722	1
690	-0.405670	0.507884	1
1622	-0.325039	0.265383	1

[46]:
```python
map_cluster = {
    0 : 'Low Spender',
    1 : 'Risk of Churn',
    2 : 'Mid Spender',
    3 : 'High Spender'
}

df_pca['cluster_mapped'] = df_pca['clusters'].map(map_cluster)
```

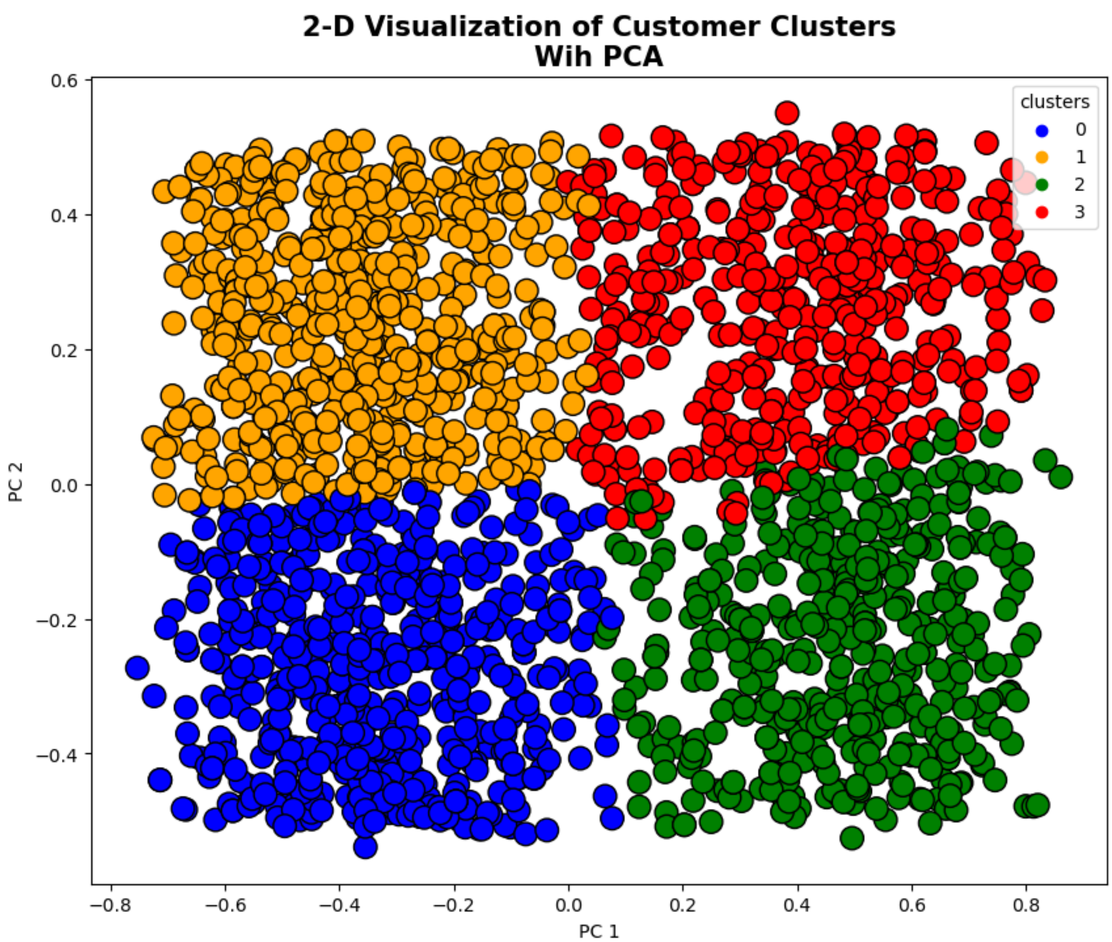
[76]:
```
sns.countplot(x=df_pca['cluster_mapped'], palette='plasma')
plt.title('Users per cluster')
plt.xticks(rotation=20)
```

[76]:
```
(array([0, 1, 2, 3]),
 [Text(0, 0, 'Risk of Churn'),
  Text(1, 0, 'Mid Spender'),
  Text(2, 0, 'Low Spender'),
  Text(3, 0, 'High Spender')])
```



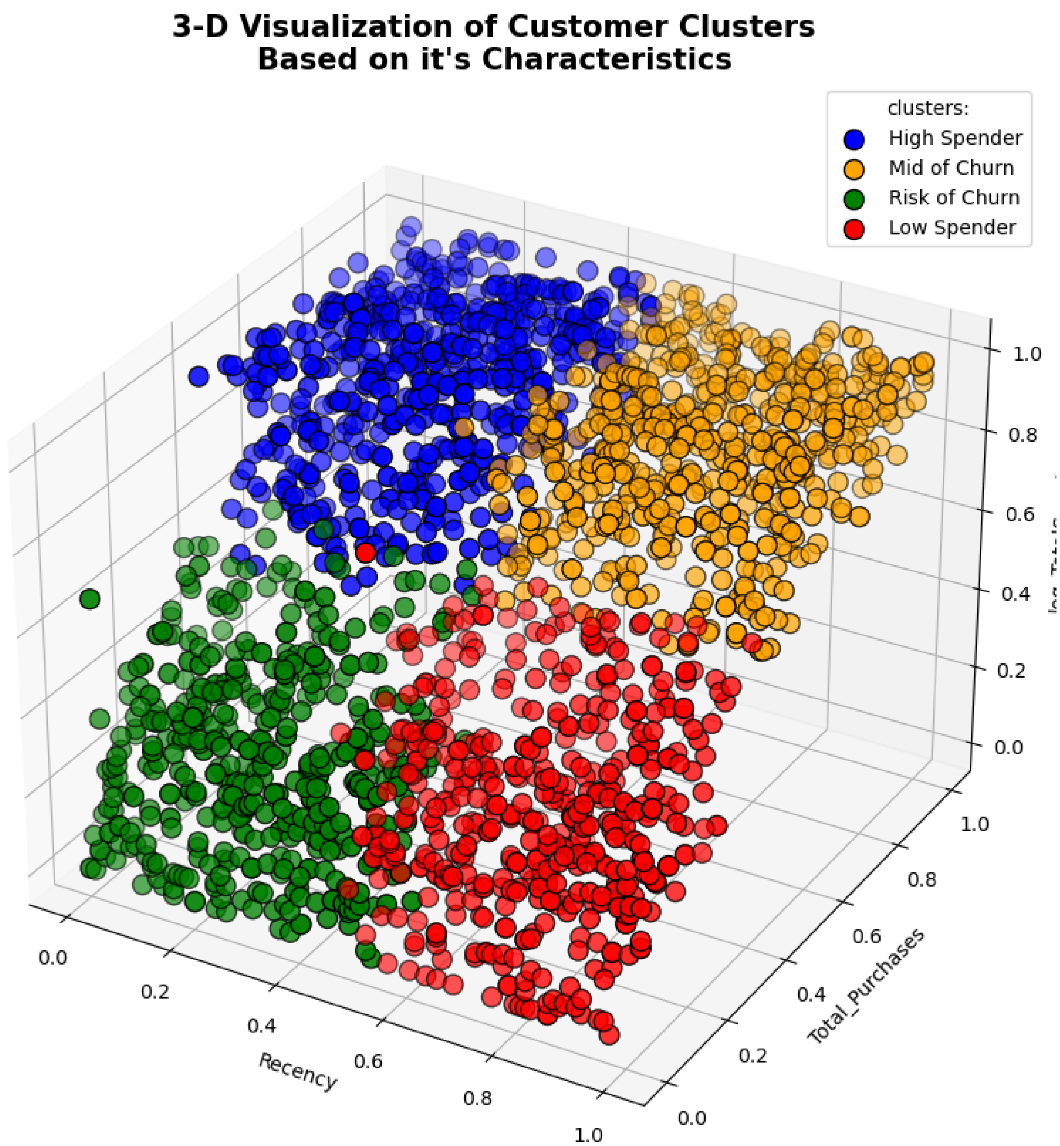
[47]:
```
fig, ax = plt.subplots(figsize=(10,8))
plt.title("2-D Visualization of Customer Clusters\nWih PCA", fontsize=15,␣
 ↪weight='bold')
sns.scatterplot(
    x="PC 1", y="PC 2",
```

```
    hue="clusters",
    edgecolor='black',
    #linestyle='--',
    data=df_pca,
    palette=['blue','orange','green','red'],
    s=160,
    ax=ax
);
```



[48]:
```
fig = plt.figure(figsize=(15,10))
ax = fig.add_subplot(111, projection='3d')
plt.title("3-D Visualization of Customer Clusters\nBased on it's␣
 ↪Characteristics", fontsize=15, weight='bold')
ax.scatter(df_cluster['Recency'][df_cluster.clusters == 0],␣
 ↪df_cluster['Total_Purchases'][df_cluster.clusters == 0],␣
 ↪df_cluster['log_TotalSpent'][df_cluster.clusters == 0], c='blue', s=100,␣
 ↪edgecolor='black', label='High Spender')
```

```
ax.scatter(df_cluster['Recency'][df_cluster.clusters == 1],␣
↪df_cluster['Total_Purchases'][df_cluster.clusters == 1],␣
↪df_cluster['log_TotalSpent'][df_cluster.clusters == 1], c='orange', s=100,␣
↪edgecolor='black', label='Mid of Churn')
ax.scatter(df_cluster['Recency'][df_cluster.clusters == 2],␣
↪df_cluster['Total_Purchases'][df_cluster.clusters == 2],␣
↪df_cluster['log_TotalSpent'][df_cluster.clusters == 2], c='green', s=100,␣
↪edgecolor='black', label='Risk of Churn')
ax.scatter(df_cluster['Recency'][df_cluster.clusters == 3],␣
↪df_cluster['Total_Purchases'][df_cluster.clusters == 3],␣
↪df_cluster['log_TotalSpent'][df_cluster.clusters == 3], c='red', s=100,␣
↪edgecolor='black', label='Low Spender')
plt.xlabel('Recency')
plt.ylabel('Total_Purchases')
ax.set_zlabel('log_TotalSpent')
plt.legend(title='clusters:')
plt.show()
```



1 Customer Personality Analysis For Marketing Retargeting

[49]:
```
display(df_cluster.groupby('clusters').agg(['mean','median', 'max', 'min']))
```

```
           Recency                                  Total_Purchases           \
              mean    median       max       min             mean    median
clusters
0         0.231426  0.232323  0.505051  0.000000         0.712815  0.695652
1         0.737640  0.727273  1.000000  0.454545         0.716818  0.695652
2         0.250098  0.242424  0.585859  0.000000         0.135925  0.130435
```

```
3          0.749756  0.767677  1.000000  0.404040        0.166813  0.130435

                            Dt_Days_Customer                                \
               max       min              mean    median       max       min
clusters
0          1.000000  0.26087          0.501478  0.511759  0.998119  0.000941
1          1.000000  0.26087          0.526298  0.533396  1.000000  0.000941
2          0.478261  0.00000          0.440279  0.423330  1.000000  0.000000
3          0.521739  0.00000          0.440449  0.436500  1.000000  0.002822

               Age                          log_TotalSpent                     \
              mean    median  max  min           mean    median       max
clusters
0          0.579926  0.571429  1.0  0.0       0.847887  0.871194  1.000000
1          0.611517  0.619048  1.0  0.0       0.860460  0.881111  1.000000
2          0.438221  0.428571  1.0  0.0       0.296491  0.297127  0.709955
3          0.532114  0.500000  1.0  0.0       0.343623  0.332085  0.988997


               min
clusters
0          0.570832
1          0.555098
2          0.000000
3          0.000000
```

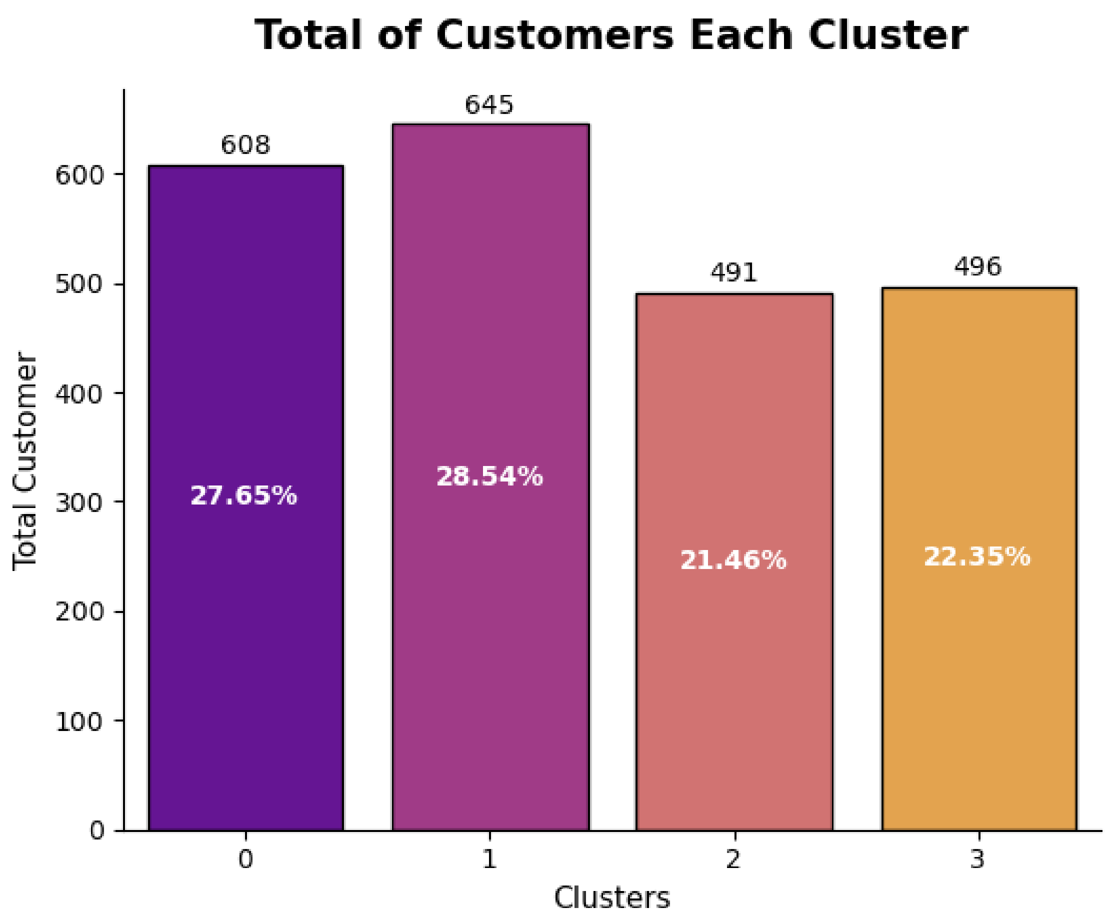
[50]:
```python
df_intp = df_cluster.groupby('clusters').agg({'Recency':'count'}).reset_index()
df_intp = df_intp.rename(columns={'Recency':'total_customers'})
df_intp['jmlh_cust'] = df_intp['total_customers'].sum()
df_intp['persentage'] = round((df_intp['total_customers']/
 ↪df_intp['jmlh_cust'])*100, 2)
df_intp
```

[50]:

	clusters	total_customers	jmlh_cust	persentage
0	0	608	2240	27.14
1	1	645	2240	28.79
2	2	491	2240	21.92
3	3	496	2240	22.14

[51]:
```python
fig, ax = plt.subplots(figsize=(6, 5))
plt.title("Total of Customers Each Cluster", fontsize=15, color='black',␣
 ↪weight='bold', pad=15)
sns.barplot(x='clusters', y='total_customers', data=df_intp, edgecolor='black',␣
 ↪palette='plasma')

plt.xlabel('Clusters', fontsize=11)
plt.ylabel('Total Customer', fontsize=11)
```

```
plt.bar_label(ax.containers[0], padding=2)
plt.bar_label(ax.containers[0], ['27.65%', '28.54%', '21.46%', '22.35%'],␣
↪label_type='center', color='white', weight='bold')

sns.despine()
plt.tight_layout()
```

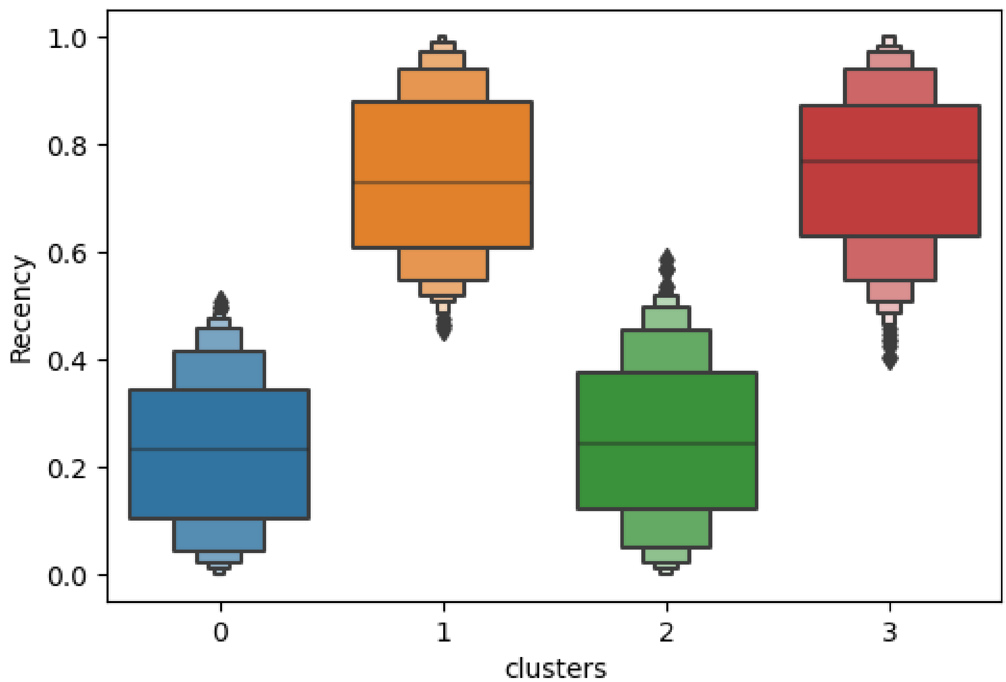


1.0.1 Total Spending/Cluster

[52]:
```
df1 = df_cluster.copy()
dff = df1.columns.drop('clusters')
```

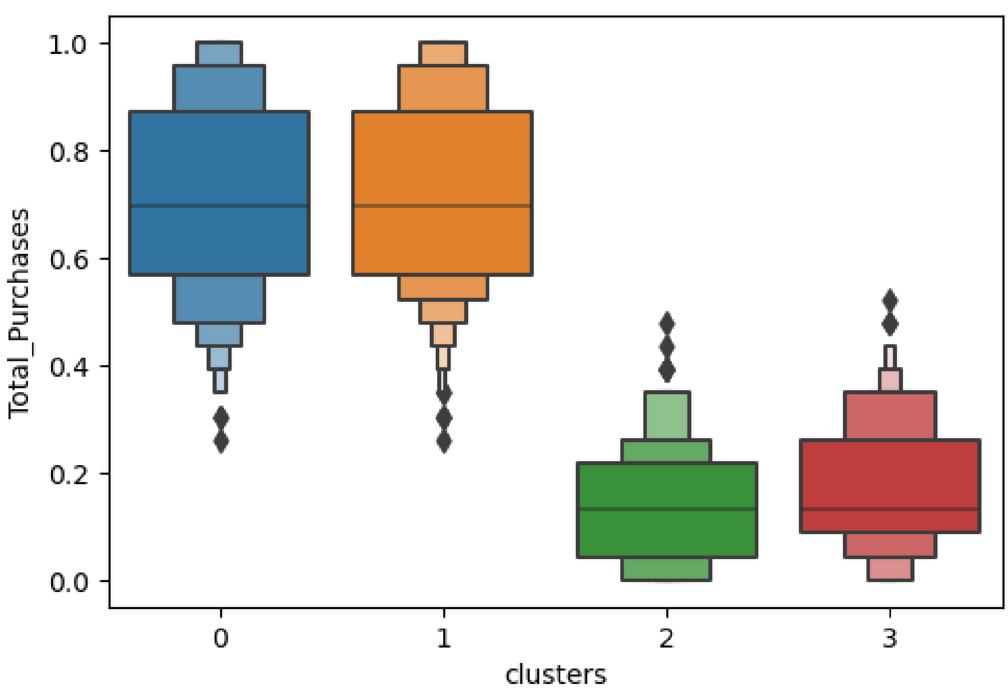
[53]:
```
plt.figure(figsize= (6, 4))
sns.boxenplot(x=df_cluster['clusters'], y=df_cluster['Recency'])
```

[53]: <Axes: xlabel='clusters', ylabel='Recency'>



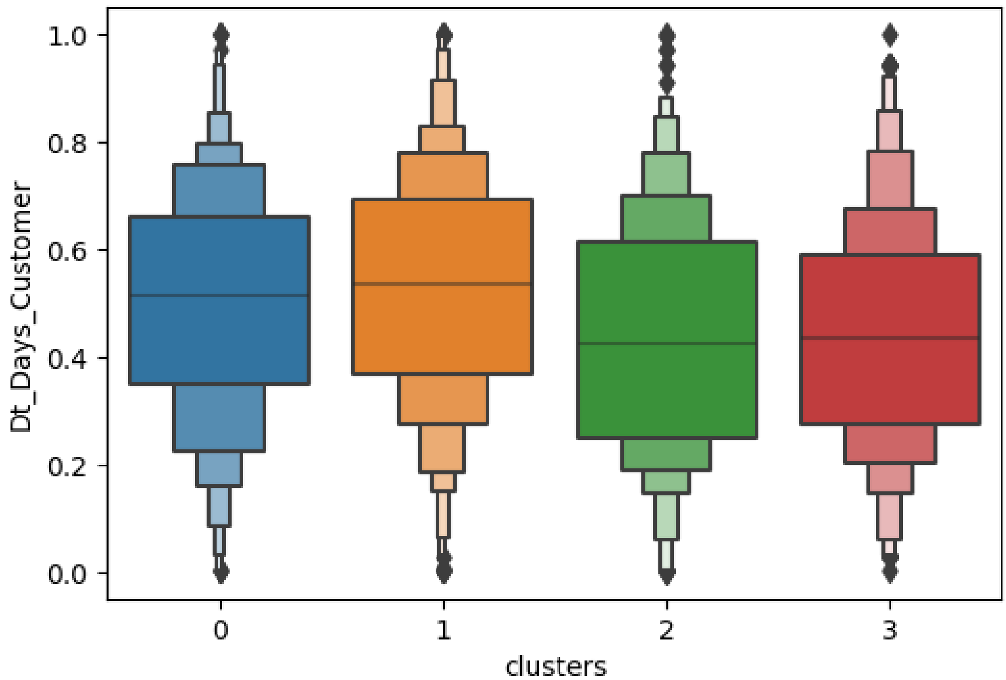

```
[54]: plt.figure(figsize= (6, 4))
      sns.boxenplot(x=df_cluster['clusters'], y=df_cluster['Total_Purchases'])
```

```
[54]: <Axes: xlabel='clusters', ylabel='Total_Purchases'>
```



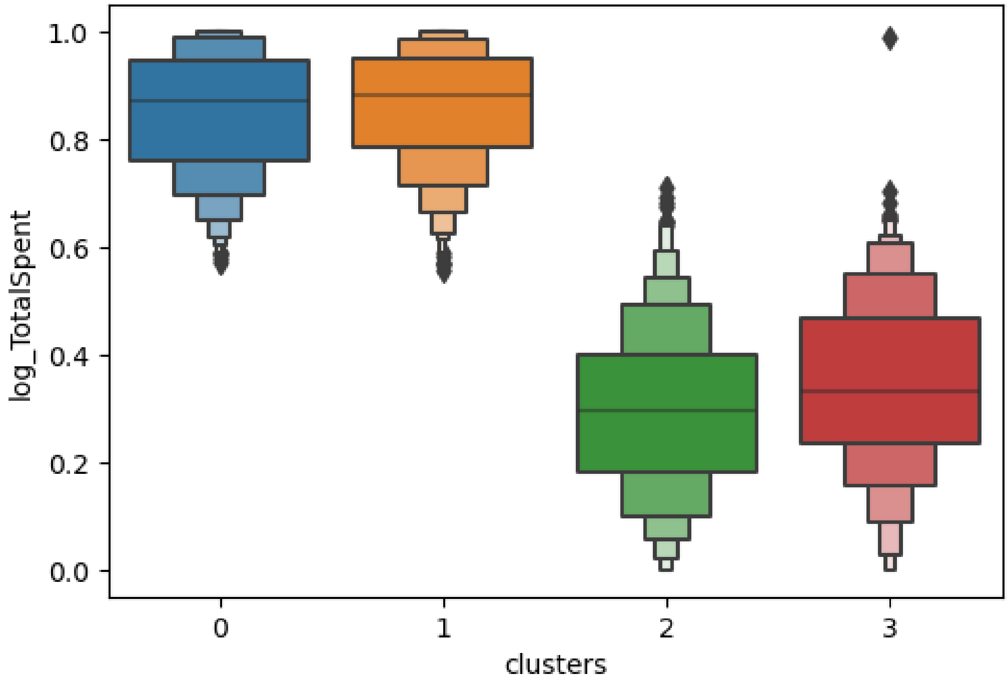
[55]:
```
plt.figure(figsize= (6, 4))
sns.boxenplot(x=df_cluster['clusters'], y=df_cluster['Dt_Days_Customer'])
```

[55]: <Axes: xlabel='clusters', ylabel='Dt_Days_Customer'>



[56]:
```
plt.figure(figsize= (6, 4))
sns.boxenplot(x=df_cluster['clusters'], y=df_cluster['log_TotalSpent'])
```

[56]: <Axes: xlabel='clusters', ylabel='log_TotalSpent'>



[57]:
```
df_copy['Clusters'] = kmeans.labels_
df_copy.head()
```

[57]:
```
  Education Marital_Status      Income Dt_Customer  Recency  \
0        S1         Single  58138000.0  2012-04-09       58
1        S1         Single  46344000.0  2014-08-03       38
2        S1     Bertunangan  71613000.0  2013-08-21       26
3        S1     Bertunangan  26646000.0  2014-10-02       26
4        S3        Menikah  58293000.0  2014-01-19       94

   NumWebVisitsMonth  Complain  Total_Acc_Cmp  Total_Purchases  Total_Spent  \
0                  7         0              0               25    1617000.0
1                  5         0              0                6      27000.0
2                  4         0              0               21     776000.0
3                  6         0              0                8      53000.0
4                  5         0              0               19     422000.0

   conversion_rate  Dt_Days_Customer  Age      Age_Group  Number_Children  \
0         3.571429              4131   66  Senior Citizen                0
1         1.200000              3285   69  Senior Citizen                2
2         5.250000              3632   58    Middle Aged                0
3         1.333333              3225   39          Adult                1
4         3.800000              3481   42    Middle Aged                1
```

	Clusters
0	1
1	2
2	0
3	2
4	1

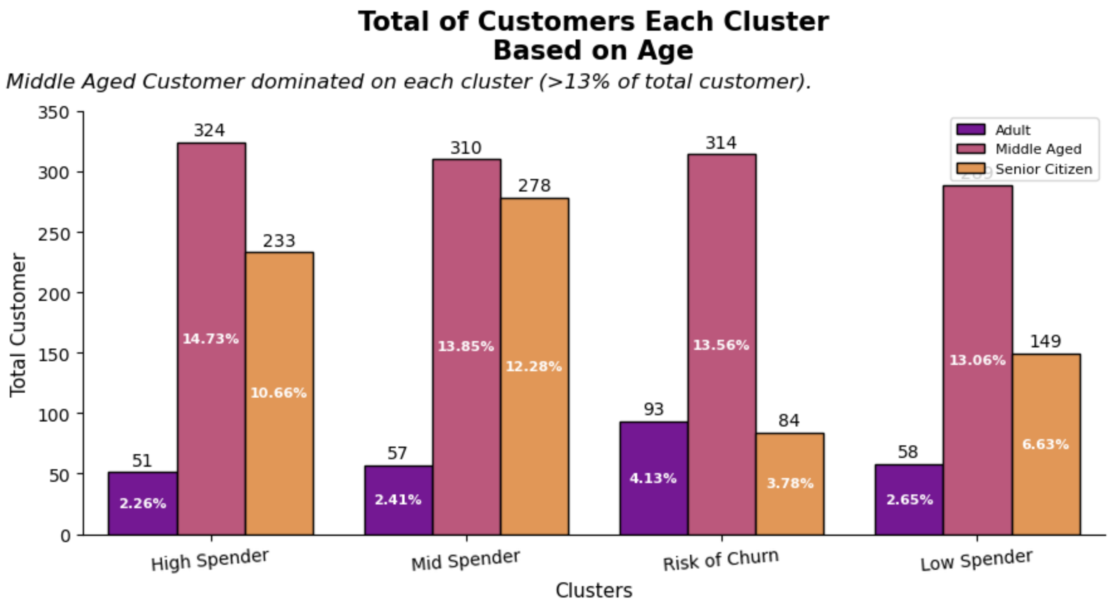
[58]:
```
age_cluster = df_copy.groupby(['Clusters', 'Age_Group']).agg({'Education':
↪'count'}).reset_index()
age_cluster = age_cluster.rename(columns={'Education':'Total_Cust'})
age_cluster['sum_cust'] = age_cluster['Total_Cust'].sum()
age_cluster['percentage'] = round((age_cluster['Total_Cust']/
↪age_cluster['sum_cust'])*100, 2)
age_cluster
```

[58]:

	Clusters	Age_Group	Total_Cust	sum_cust	percentage
0	0	Adult	51	2240	2.28
1	0	Middle Aged	324	2240	14.46
2	0	Senior Citizen	233	2240	10.40
3	1	Adult	57	2240	2.54
4	1	Middle Aged	310	2240	13.84
5	1	Senior Citizen	278	2240	12.41
6	2	Adult	93	2240	4.15
7	2	Middle Aged	314	2240	14.02
8	2	Senior Citizen	84	2240	3.75
9	3	Adult	58	2240	2.59
10	3	Middle Aged	289	2240	12.90
11	3	Senior Citizen	149	2240	6.65

[59]:
```
fig, ax = plt.subplots(figsize=(9, 5))
plt.title("Total of Customers Each Cluster\nBased on Age", fontsize=15,␣
↪color='black', weight='bold', pad=30)
sns.barplot(x='Clusters', y='Total_Cust', data=age_cluster, hue='Age_Group',␣
↪edgecolor='black', palette='plasma')
plt.text(x=-0.8, y=370, s="Middle Aged Customer dominated on each cluster (>13%␣
↪of total customer).", fontsize=12, fontstyle='italic')
plt.xlabel('Clusters', fontsize=11)
plt.xticks(np.arange(4), ['High Spender', 'Mid Spender', 'Risk of Churn', 'Low␣
↪Spender'], rotation=5)
plt.ylabel('Total Customer', fontsize=11)
plt.ylim(0, 350)
plt.legend(prop={'size':8}, loc='best')
plt.bar_label(ax.containers[0], padding=2)
plt.bar_label(ax.containers[1], padding=2)
plt.bar_label(ax.containers[2], padding=2)
plt.bar_label(ax.containers[0], ['2.26%', '2.41%', '4.13%', '2.65%'],␣
↪label_type='center', color='white', weight='bold', fontsize=8)
```

```
plt.bar_label(ax.containers[1], ['14.73%', '13.85%', '13.56%', '13.06%'],
    label_type='center', color='white', weight='bold', fontsize=8)
plt.bar_label(ax.containers[2], ['10.66%', '12.28%', '3.78%', '6.63%'],
    label_type='center', color='white', weight='bold', fontsize=8)
sns.despine()
plt.tight_layout()
```



2 Sumamary

1. High Spender

- This group is dominated by middle aged (45-54 years old) who are predominantly married and have 1 child.
- there are 563 customers (27.65% of total customers) on this group.
- Customers on this group have `high average recency (25 days)` and `high average of total purchases (70 items)` it means they are frequent shoppers and `they spend a lot on our platform (around IDR 9M/year)`
- This group has a high conversion rate.

2. mid spender

- Dominated by middle aged (13.85%) who are predominantly married and have 1 child.
- there are 581 customers (28.54% of total customers) on this group
- Customers on this group have `high average recency (78 days)` and `high average of total purchases (70 items)` and `they spend a lot on our platform (around IDR 9M/year)`

3. Risk of Churn

- there are 437 customers (22.35% of total customers) on this group
- Dominated by middle aged (13.85%) who are predominantly married and have 1 child.
- Customers on this group have `high average recency (25 days)` and `high average of total purchases (15 items)` and `they spend a lot on our platform (around IDR 2.7M/year)`

4. Low Spender

- there are 455 customers (21.46% of total customers) on this group
- Dominated by middle aged (13.85%) who are predominantly married and have 1 child.
- Customers on this group have `high average recency (70 days)` and `high average of total purchases (16 items)` and `they spend a lot on our platform (around IDR 3M/year)`

Recommendations 1. Keep monitoring transactions and retention of the High Spender group, Focus on improving service so that this group group does not churn. 2. For the Mid Spender group, further analysis can be done on how to increase transactions by providing more personalized recommendations, as well as deeper analysis on how to optimize promos in this segment and keep shopping on our platform. 3. For the Low Spender group, further analysis can also be done on how to increase the conversion rate of visits to transactions, They have a fairly high recency but do not make transactions. This can be caused by products or prices that do not match.

[135]:
```
print('Total Spent of High Spender: '+str(df_copy[df_copy['Clusters']==0].
 ↪Total_Spent.sum()))
print('Total Spent of Mid Spender: '+str(df_copy[df_copy['Clusters']==1].
 ↪Total_Spent.sum()))
print('Total Spent of Risk of Churn: '+str(df_copy[df_copy['Clusters']==2].
 ↪Total_Spent.sum()))
print('Total Spent of Low Spender: '+str(df_copy[df_copy['Clusters']==3].
 ↪Total_Spent.sum()))
print('Total Spent: '+str(545880250+588456250+32527500+44894850))
```

```
Total Spent of High Spender: 545880250.0
Total Spent of Mid Spender: 588456250.0
Total Spent of Risk of Churn: 32527500.0
Total Spent of Low Spender: 44894850.0
Total Spent: 1211758850
```

Potential Impact (Quantitative): - If we keep prioritize on Customer Groups/Clusters and they do not turn to churn, we still have potential GMV around `IDR 1.2B/year` (High Spender: 545m/year; Mid Spender: 588M/year;

High-Valued Customer=IDR 670M/year; Low-Valued Customer=IDR 46M/year; Low-Valued Frequent Customer=IDR 604M/year; Low-Valued Customer=IDR 47M/year)