campaign-data-set-eda

September 3, 2024

[ ]:
```
import numpy as np
import pandas as pd
import scipy.stats as stats
from scipy.stats import normaltest
from scipy.stats import chi2
from scipy.stats import chi2_contingency
import matplotlib.pyplot as plt
import seaborn as sns
```

[ ]:
```
# 1. Basic data cleaning and exploration:
# Loading Data from google drive.

df1=pd.read_csv("/content/drive/MyDrive/Data sets/campaign - campaign.csv")
```

[ ]:
```
df1.shape
```

[ ]:
```
(2239, 27)
```

[ ]:
```
df1.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	MntFruits	MntMeatProducts	\
0	0	6/16/14	0	189	104	379	
1	0	6/15/14	0	464	5	64	
2	1	5/13/14	0	134	11	59	
3	1	5/11/14	0	10	0	1	
4	0	4/8/14	0	6	16	24	

	MntFishProducts	MntSweetProducts	MntGoldProds	NumDealsPurchases	\
0	111	189	218	1	
1	7	0	37	1	

```
2               15                2            30                1
3                0                0             0                1
4               11                0            34                2

   NumWebPurchases  NumCatalogPurchases  NumStorePurchases  NumWebVisitsMonth  \
0                4                    4                  6                  1
1                7                    3                  7                  5
2                3                    2                  5                  2
3                1                    0                  2                  7
4                3                    1                  2                  7

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

   Complain Country
0         0      SP
1         0      CA
2         0      US
3         0     AUS
4         0      SP
```

[ ]:
```
df1.describe()
```

[ ]:
```
                ID   Year_Birth      Kidhome     Teenhome      Recency  \
count   2239.000000  2239.000000  2239.000000  2239.000000  2239.000000
mean    5590.444841  1968.802144     0.443948     0.506476    49.121036
std     3246.372471    11.985494     0.538390     0.544555    28.963662
min        0.000000  1893.000000     0.000000     0.000000     0.000000
25%     2827.500000  1959.000000     0.000000     0.000000    24.000000
50%     5455.000000  1970.000000     0.000000     0.000000    49.000000
75%     8423.500000  1977.000000     1.000000     1.000000    74.000000
max    11191.000000  1996.000000     2.000000     2.000000    99.000000

          MntWines    MntFruits  MntMeatProducts  MntFishProducts  \
count  2239.000000  2239.000000      2239.000000      2239.000000
mean    304.067441    26.307727       167.016525        37.538633
std     336.614830    39.781468       225.743829        54.637617
min       0.000000     0.000000         0.000000         0.000000
25%      24.000000     1.000000        16.000000         3.000000
50%     174.000000     8.000000        67.000000        12.000000
75%     504.500000    33.000000       232.000000        50.000000
max    1493.000000   199.000000      1725.000000       259.000000
```

```
       MntSweetProducts  MntGoldProds  NumDealsPurchases  NumWebPurchases  \
count       2239.000000   2239.000000        2239.000000      2239.000000
mean          27.074587     44.036177           2.324252         4.085306
std           41.286043     52.174700           1.932345         2.779240
min            0.000000      0.000000           0.000000         0.000000
25%            1.000000      9.000000           1.000000         2.000000
50%            8.000000     24.000000           2.000000         4.000000
75%           33.000000     56.000000           3.000000         6.000000
max          263.000000    362.000000          15.000000        27.000000

       NumCatalogPurchases  NumStorePurchases  NumWebVisitsMonth  \
count          2239.000000        2239.000000        2239.000000
mean              2.662796           5.791425           5.316213
std               2.923542           3.251149           2.427144
min               0.000000           0.000000           0.000000
25%               0.000000           3.000000           3.000000
50%               2.000000           5.000000           6.000000
75%               4.000000           8.000000           7.000000
max              28.000000          13.000000          20.000000

       AcceptedCmp3  AcceptedCmp4  AcceptedCmp5  AcceptedCmp1  AcceptedCmp2  \
count   2239.000000   2239.000000   2239.000000   2239.000000   2239.000000
mean       0.072800      0.074587      0.072800      0.064314      0.013399
std        0.259867      0.262782      0.259867      0.245367      0.115001
min        0.000000      0.000000      0.000000      0.000000      0.000000
25%        0.000000      0.000000      0.000000      0.000000      0.000000
50%        0.000000      0.000000      0.000000      0.000000      0.000000
75%        0.000000      0.000000      0.000000      0.000000      0.000000
max        1.000000      1.000000      1.000000      1.000000      1.000000

          Complain
count  2239.000000
mean      0.009379
std       0.096412
min       0.000000
25%       0.000000
50%       0.000000
75%       0.000000
max       1.000000
```

[ ]:
```
df1.isnull().sum()
```

[ ]:
```
ID                   0
Year_Birth           0
Education            0
Marital_Status       0
Income               0
```

```
Kidhome                0
Teenhome               0
Dt_Customer            0
Recency                0
MntWines               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
Country                0
dtype: int64
```

[ ]:
```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2239 entries, 0 to 2238
Data columns (total 27 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   ID                   2239 non-null   int64
 1   Year_Birth           2239 non-null   int64
 2   Education            2239 non-null   object
 3   Marital_Status       2239 non-null   object
 4   Income               2239 non-null   object
 5   Kidhome              2239 non-null   int64
 6   Teenhome             2239 non-null   int64
 7   Dt_Customer          2239 non-null   object
 8   Recency              2239 non-null   int64
 9   MntWines             2239 non-null   int64
 10  MntFruits            2239 non-null   int64
 11  MntMeatProducts      2239 non-null   int64
 12  MntFishProducts      2239 non-null   int64
 13  MntSweetProducts     2239 non-null   int64
 14  MntGoldProds         2239 non-null   int64
 15  NumDealsPurchases    2239 non-null   int64
```

```
 16  NumWebPurchases      2239 non-null   int64
 17  NumCatalogPurchases  2239 non-null   int64
 18  NumStorePurchases    2239 non-null   int64
 19  NumWebVisitsMonth    2239 non-null   int64
 20  AcceptedCmp3         2239 non-null   int64
 21  AcceptedCmp4         2239 non-null   int64
 22  AcceptedCmp5         2239 non-null   int64
 23  AcceptedCmp1         2239 non-null   int64
 24  AcceptedCmp2         2239 non-null   int64
 25  Complain             2239 non-null   int64
 26  Country              2239 non-null   object
dtypes: int64(22), object(5)
memory usage: 472.4+ KB
```

[ ]:
```
df1['Year_Birth'].unique()
```

[ ]:
```
array([1970, 1961, 1958, 1967, 1989, 1954, 1947, 1979, 1959, 1981, 1969,
       1977, 1960, 1966, 1976, 1965, 1956, 1975, 1971, 1986, 1972, 1974,
       1990, 1987, 1984, 1968, 1955, 1983, 1973, 1978, 1952, 1962, 1964,
       1982, 1963, 1957, 1980, 1945, 1949, 1948, 1953, 1946, 1985, 1992,
       1944, 1951, 1988, 1950, 1994, 1993, 1991, 1893, 1996, 1995, 1899,
       1943, 1941, 1940, 1900])
```

[ ]:
```
df1.sample(10)
```

[ ]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	\
48	340	1970	Graduation	Divorced	$72,967.00	0	
1202	3598	1972	Graduation	Married	$62,710.00	0	
1263	1045	1965	Graduation	Together	$52,117.00	0	
556	5991	1949	Master	Married	$48,150.00	0	
428	11056	1974	Graduation	Married	$72,099.00	0	
0	1826	1970	Graduation	Divorced	$84,835.00	0	
1492	10704	1969	Graduation	Single	$54,803.00	0	
1538	2544	1951	Master	Divorced	$57,530.00	0	
1857	1612	1981	PhD	Single	$nan	1	
327	9701	1988	Graduation	Together	$41,883.00	1	

	Teenhome	Dt_Customer	Recency	MntWines	MntFruits	MntMeatProducts	\
48	1	12/15/12	1	158	35	179	
1202	1	5/23/13	53	441	35	83	
1263	1	8/16/12	55	112	10	107	
556	1	6/8/13	24	173	2	39	
428	0	10/27/12	18	546	91	410	
0	0	6/16/14	0	189	104	379	
1492	1	8/21/12	65	404	0	92	
1538	1	10/12/13	68	50	1	27	
1857	0	5/31/13	82	23	0	15	

```
327          0     3/19/13       13         32          34                41

      MntFishProducts  MntSweetProducts  MntGoldProds  NumDealsPurchases  \
48                  0                 0           125                  2
1202                7                29            11                  4
1263               30                 0            20                  2
556                 3                 2            47                  3
428               119                 0            22                  1
0                 111               189           218                  1
1492               28                27           142                  2
1538                6                 7             1                  1
1857                0                 2             7                  2
327                73                16           116                  3

      NumWebPurchases  NumCatalogPurchases  NumStorePurchases  \
48                  7                    2                  8
1202                4                    2                 12
1263                5                    2                  4
556                 5                    1                  4
428                 3                    4                 10
0                   4                    4                  6
1492                6                    2                  9
1538                1                    1                  4
1857                3                    0                  3
327                 4                    2                  3

      NumWebVisitsMonth  AcceptedCmp3  AcceptedCmp4  AcceptedCmp5  \
48                    5             1             0             0
1202                  4             0             0             0
1263                  7             0             0             0
556                   7             0             0             0
428                   1             0             0             0
0                     1             0             0             0
1492                  4             0             0             0
1538                  1             0             0             0
1857                  6             0             0             0
327                   7             0             0             0

      AcceptedCmp1  AcceptedCmp2  Complain Country
48               0             0         0     GER
1202             0             0         0      SP
1263             0             0         0      SP
556              0             0         0     GER
428              0             0         0      SP
0                0             0         0      SP
1492             0             0         0      SP
1538             0             0         0     IND
```

```
1857              0              0          0      AUS
327               0              0          0       CA
```

[ ]:
```
pd.set_option('display.max_columns', None)
```

[ ]:
```
df1['Income']
```

[ ]:
```
0       $84,835.00
1       $57,091.00
2       $67,267.00
3       $32,474.00
4       $21,474.00
           ...
2234    $66,476.00
2235    $31,056.00
2236    $46,310.00
2237    $65,819.00
2238    $94,871.00
Name: Income, Length: 2239, dtype: object
```

[ ]:
```
# Replace $ sign

df1['Income'] = df1['Income'].str.replace('$', '').str.replace(',', '').
 ↪astype(float)
df1['Income']
```

[ ]:
```
0       84835.0
1       57091.0
2       67267.0
3       32474.0
4       21474.0
          ...
2234    66476.0
2235    31056.0
2236    46310.0
2237    65819.0
2238    94871.0
Name: Income, Length: 2239, dtype: float64
```

[ ]:
```
df1['spendings'] =␣
 ↪df1['MntWines']+df1['MntFruits']+df1['MntMeatProducts']+df1['MntFishProducts']+df1['MntSwee
df1['spendings']
```

[ ]:
```
0       1190
1        577
2        251
3         11
```

```
4         91
         …
2234     689
2235      55
2236     309
2237    1383
2238    1078
Name: spendings, Length: 2239, dtype: int64
```

[ ]:
```
df1['Age'] = 2023 - df1['Year_Birth']
df1['Age']
```

[ ]:
```
0       53
1       62
2       65
3       56
4       34
        ..
2234    47
2235    46
2236    47
2237    45
2238    54
Name: Age, Length: 2239, dtype: int64
```

[ ]:
```
df1['Marital_case']=df1['Marital_Status'].replace({"Divorced":'Alone','Single':
 ↪'Alone','Married':'Couple','Together':'Couple','Absurd':'Alone','Widow':
 ↪'Alone','YOLO':"Alone"})
df1['Marital_case']
```

[ ]:
```
0        Alone
1        Alone
2       Couple
3       Couple
4        Alone
         …
2234     Alone
2235    Couple
2236     Alone
2237    Couple
2238    Couple
Name: Marital_case, Length: 2239, dtype: object
```

[ ]:
```
df1['Having_kids'] = np.where(df1['Kidhome']+ df1['Teenhome'] > 0, 'YES', "NO")
df1['Having_kids']
```

[ ]:
```
0        NO
1        NO
2       YES
3       YES
4       YES
       ...
2234    YES
2235    YES
2236    YES
2237     NO
2238    YES
Name: Having_kids, Length: 2239, dtype: object
```

[ ]:
```
df1[['Income','spendings','Age']].describe()
```

[ ]:
```
              Income    spendings          Age
count    2215.000000  2239.000000  2239.000000
mean    51969.861400   606.041090    54.197856
std     21526.320095   602.274089    11.985494
min      1730.000000     5.000000    27.000000
25%     35284.000000    69.000000    46.000000
50%     51373.000000   396.000000    53.000000
75%     68487.000000  1046.000000    64.000000
max    162397.000000  2525.000000   130.000000
```

[ ]:
```
mean_income = df1['Income'].mean()
mean_spendings = df1['spendings'].mean()
mean_age = df1['Age'].mean()
print(f"Mean Income: {mean_income}")
print(f"Mean Spendings: {mean_spendings}")
print(f"Mean Age: {mean_age}")
```

```
Mean Income: 51969.861399548536
Mean Spendings: 606.0410897722197
Mean Age: 54.19785618579723
```

[ ]:
```
df1['Income_bracket'] = 'Above mean'
df1.loc[df1['Income'] < mean_income, 'Income_bracket'] = 'Below mean'
df1['Income_bracket']
```

[ ]:
```
0       Above mean
1       Above mean
2       Above mean
3       Below mean
4       Below mean
           ...
2234    Above mean
```

```
2235    Below mean
2236    Below mean
2237    Above mean
2238    Above mean
Name: Income_bracket, Length: 2239, dtype: object
```

1 Are people with lower income are more attracted towards campaign or simply put accept more campaigns. (create two income brackets one below median , other above median income and create a column which tells if they have ever accepted any campaign)

[ ]:
```
df1['EverAcceptedCampaign'] =␣
 ↪(df1[['AcceptedCmp1','AcceptedCmp2','AcceptedCmp3','AcceptedCmp4','AcceptedCmp5']]␣
 ↪==1).any(axis=1)
df1['EverAcceptedCampaign']
```

[ ]:
```
0       False
1        True
2       False
3       False
4        True
        …
2234    False
2235    False
2236    False
2237    False
2238     True
Name: EverAcceptedCampaign, Length: 2239, dtype: bool
```

[ ]:
```
contingency_table = pd.crosstab(df1['EverAcceptedCampaign'],␣
 ↪df1['Income_bracket'])
contingency_table
```

[ ]:
```
Income_bracket        Above mean  Below mean
EverAcceptedCampaign
False                        770        1006
True                         345         118
```

[ ]:
```
chi2_stat, p_value, dof, expected = chi2_contingency(contingency_table)
print(f"Chi-squared Statistic: {chi2_stat}")
print(f"P-value: {p_value}")
print(f"Degrees of Freedom: {dof}")
print("Expected Frequencies:")
```

```
print(expected)
```

```
Chi-squared Statistic: 141.37659987264502
P-value: 1.3310467690679514e-32
Degrees of Freedom: 1
Expected Frequencies:
[[884.43054935 891.56945065]
 [230.56945065 232.43054935]]
```

[ ]:
```
if p_value < 0.05:
    print("There is a significant association between EverAcceptedCampaign and␣
 ↪Income_bracket.")
else:
    print("There is no significant association between EverAcceptedCampaign and␣
 ↪Income_bracket.")
```

```
There is a significant association between EverAcceptedCampaign and
Income_bracket.
```

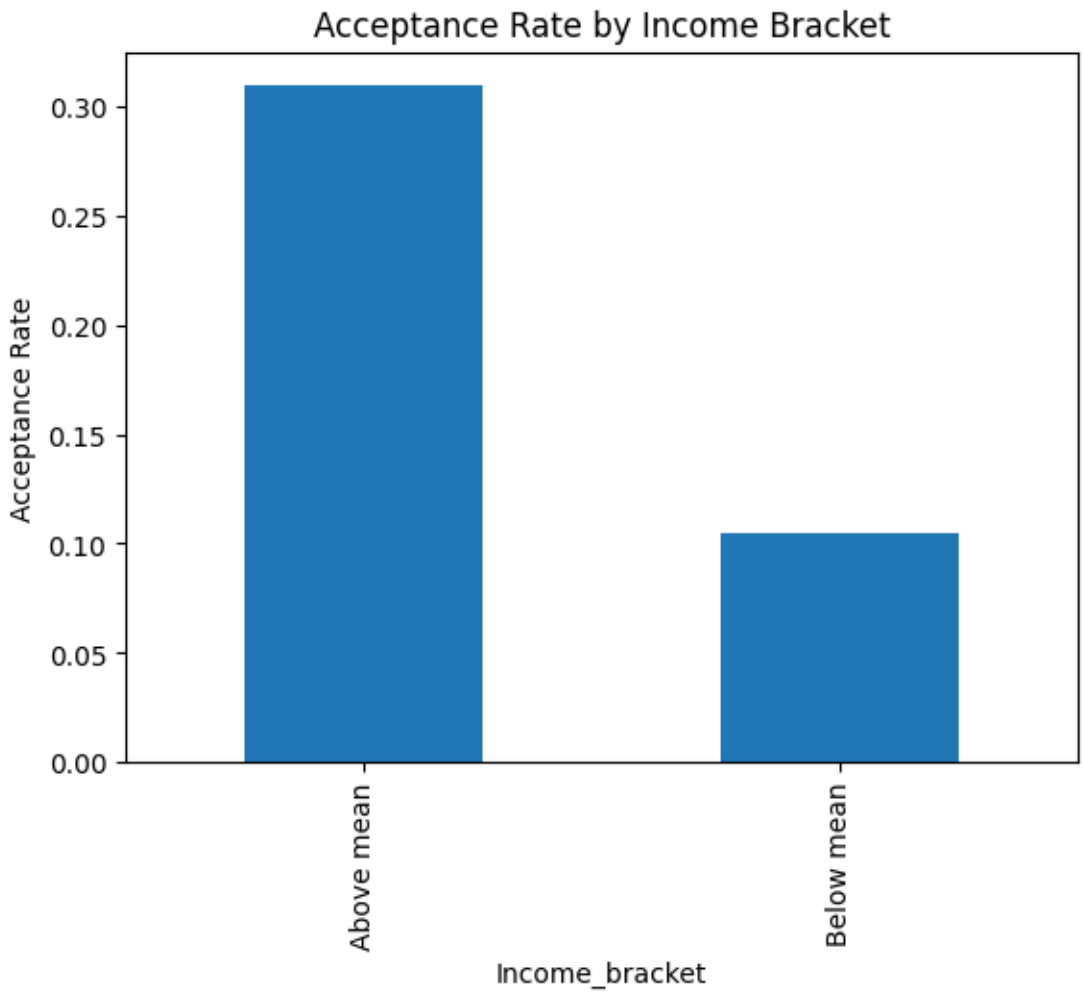
[ ]:
```
acceptance_rate = df1.groupby('EverAcceptedCampaign')['Income_bracket'].
 ↪value_counts(normalize=True)
acceptance_rate
```

[ ]:
```
EverAcceptedCampaign  Income_bracket
False                 Below mean        0.566441
                      Above mean        0.433559
True                  Above mean        0.745140
                      Below mean        0.254860
Name: proportion, dtype: float64
```

[ ]:
```
acceptance_rate = df1.groupby('Income_bracket')['EverAcceptedCampaign'].mean()
acceptance_rate
```

[ ]:
```
Income_bracket
Above mean    0.309417
Below mean    0.104982
Name: EverAcceptedCampaign, dtype: float64
```

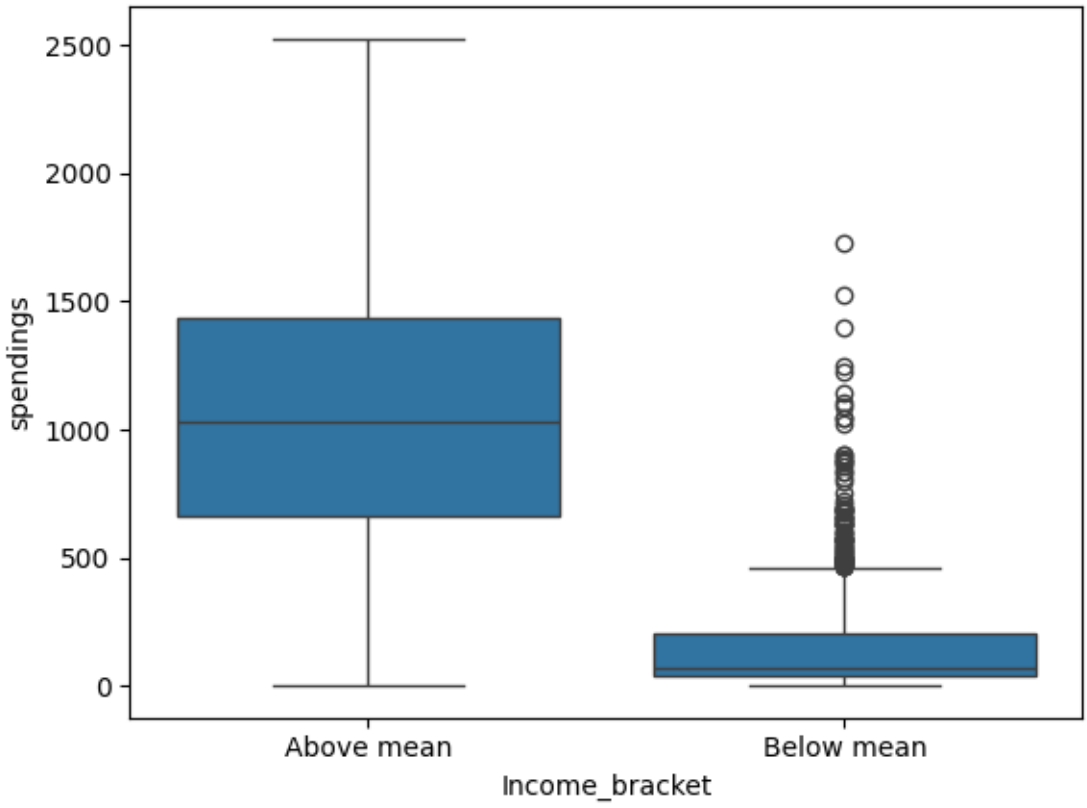
[ ]:
```
# Using bar chart
acceptance_rate.plot(kind='bar')
plt.xlabel('Income_bracket')
plt.ylabel('Acceptance Rate')
plt.title('Acceptance Rate by Income Bracket')
plt.show()
```



2 Do higher income people spend more (take in account spending in all categories together)

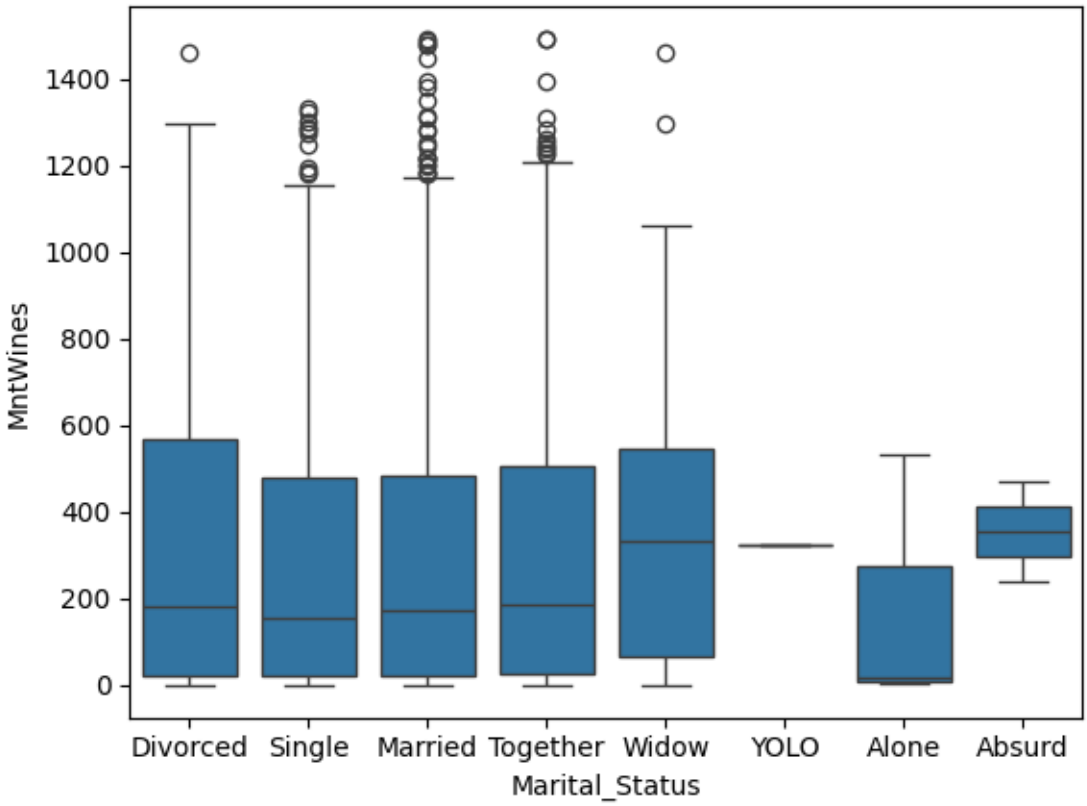
```
[ ]: plt.scatter(df1['Income'],df1['spendings'])
     plt.xlabel('Income')
     plt.ylabel('Spendings')
     plt.title('Income vs Spendings')
     plt.show()
```

[ ]:
```
sns.boxplot(x='Income_bracket',y='spendings',data=df1)
plt.show()
```

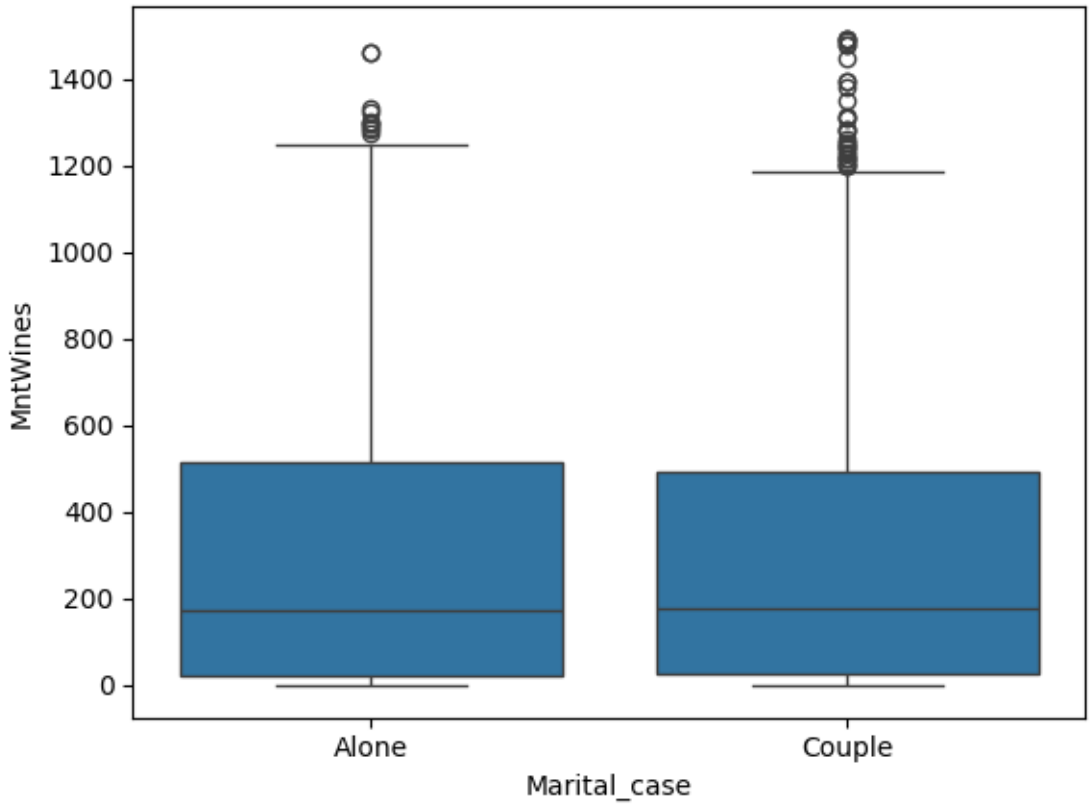


3 Do couples spend more or less money on wine than people living alone (set 'Married','Together':'In couple' and 'Divorced','Single','Absurd','Widow','YOLO':'Alone')

[ ]:
```
sns.boxplot(x='Marital_Status',y='MntWines',data=df1)
plt.show()
```



[ ]:
```
sns.boxplot(x='Marital_case',y='MntWines',data=df1)
plt.show()
```



[ ]:
```
Alone = df1[df1['Marital_case'] == 'Alone']['MntWines']
Couple = df1[df1['Marital_case'] == 'Couple']['MntWines']
```

[ ]:
```
f_statistic, p_value = stats.f_oneway(Alone, Couple)
print(f"F-statistic: {f_statistic}")
print(f"P-value: {p_value}")
```

```
F-statistic: 0.07356354253693509
P-value: 0.7862422428080872
```

[ ]:
```
if p_value < 0.05:
    print("There is a significant difference in MntWines between Alone and␣
 ↪Couple marital status groups.")
else:
    print("There is no significant difference in MntWines between Alone and␣
 ↪Couple marital status groups.")
```

```
There is no significant difference in MntWines between Alone and Couple marital
status groups.
```

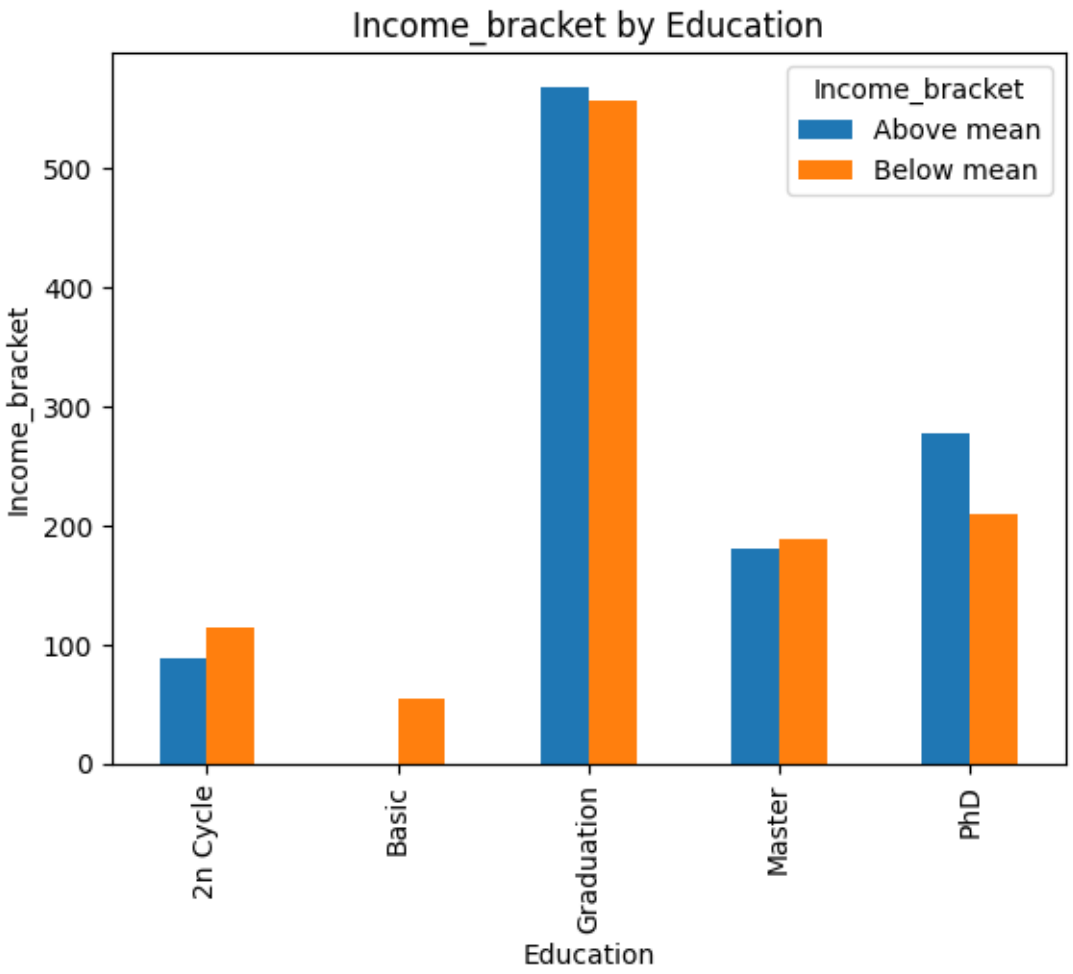
4 Is income of customers dependent on their education

[ ]:
```
# Is income of customers dependent on their education

contingency_table = pd.crosstab(df1['Education'], df1['Income_bracket'])
contingency_table
```

[ ]:
```
Income_bracket  Above mean  Below mean
Education
2n Cycle                88         115
Basic                    0          54
Graduation             569         557
Master                 181         189
PhD                    277         209
```

[ ]:
```
# Using bar chart
contingency_table.plot(kind='bar')
plt.xlabel('Education')
plt.ylabel('Income_bracket')
plt.title('Income_bracket by Education')
plt.show()
```



[ ]:
```
chi2_stat, p_value, dof, expected = chi2_contingency(contingency_table)
print(f"Chi-squared Statistic: {chi2_stat}")
print(f"P-value: {p_value}")
print(f"Degrees of Freedom: {dof}")
print("Expected Frequencies:")
print(expected)
```

```
Chi-squared Statistic: 67.37130728725926
P-value: 8.140599452247758e-14
Degrees of Freedom: 4
Expected Frequencies:
[[101.09200536 101.90799464]
 [ 26.89146941  27.10853059]
 [560.73693613 565.26306387]
 [184.25636445 185.74363555]
 [242.02322465 243.97677535]]
```

[ ]:
```
if p_value < 0.05:
    print("There is a significant association between Education and␣
 ↪Income_bracket.")
else:
    print("There is no significant association between Education and␣
 ↪Income_bracket.")
```

```
There is a significant association between Education and Income_bracket.
```