```python
In [49]: import numpy as np
         import pandas as pd
         import matplotlib.pyplot as plt
         import seaborn as sns
         import datetime
```

```python
In [50]: df=pd.read_csv("marketing_data.csv")
```

```python
In [51]: df
```

Out[51]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	...	NumStorePurchases	NumWebVisitsMonth	AcceptedCmp3	AcceptedCmp4	A
0	1826	1970	Graduation	Divorced	$84,835.00	0	0	6/16/14	0	189	...	6	1	0	0	
1	1	1961	Graduation	Single	$57,091.00	0	0	6/15/14	0	464	...	7	5	0	0	
2	10476	1958	Graduation	Married	$67,267.00	0	1	5/13/14	0	134	...	5	2	0	0	
3	1386	1967	Graduation	Together	$32,474.00	1	1	5/11/14	0	10	...	2	7	0	0	
4	5371	1989	Graduation	Single	$21,474.00	1	0	4/8/14	0	6	...	2	7	1	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
2235	10142	1976	PhD	Divorced	$66,476.00	0	1	3/7/13	99	372	...	11	4	0	0	
2236	5263	1977	2n Cycle	Married	$31,056.00	1	0	1/22/13	99	5	...	3	8	0	0	
2237	22	1976	Graduation	Divorced	$46,310.00	1	0	12/3/12	99	185	...	5	8	0	0	
2238	528	1978	Graduation	Married	$65,819.00	0	0	11/29/12	99	267	...	10	3	0	0	
2239	4070	1969	PhD	Married	$94,871.00	0	2	9/1/12	99	169	...	4	7	0	1	

2240 rows × 28 columns

```python
In [52]: df.shape
Out[52]: (2240, 28)
```

```python
In [53]: df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2240 entries, 0 to 2239
Data columns (total 28 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   ID                   2240 non-null   int64
 1   Year_Birth           2240 non-null   int64
 2   Education            2240 non-null   object
 3   Marital_Status       2240 non-null   object
 4    Income              2216 non-null   object
 5   Kidhome              2240 non-null   int64
 6   Teenhome             2240 non-null   int64
 7   Dt_Customer          2240 non-null   object
 8   Recency              2240 non-null   int64
 9   MntWines             2240 non-null   int64
 10  MntFruits            2240 non-null   int64
 11  MntMeatProducts      2240 non-null   int64
 12  MntFishProducts      2240 non-null   int64
 13  MntSweetProducts     2240 non-null   int64
 14  MntGoldProds         2240 non-null   int64
 15  NumDealsPurchases    2240 non-null   int64
 16  NumWebPurchases      2240 non-null   int64
 17  NumCatalogPurchases  2240 non-null   int64
 18  NumStorePurchases    2240 non-null   int64
 19  NumWebVisitsMonth    2240 non-null   int64
 20  AcceptedCmp3         2240 non-null   int64
 21  AcceptedCmp4         2240 non-null   int64
 22  AcceptedCmp5         2240 non-null   int64
 23  AcceptedCmp1         2240 non-null   int64
 24  AcceptedCmp2         2240 non-null   int64
 25  Response             2240 non-null   int64
 26  Complain             2240 non-null   int64
 27  Country              2240 non-null   object
dtypes: int64(23), object(5)
memory usage: 490.1+ KB
```

```python
In [54]: df.rename({' Income ':'Income'},axis=1,inplace=True)
```

Check for null values

```python
In [55]: df.isna().sum()
Out[55]:
ID                     0
Year_Birth             0
Education              0
Marital_Status         0
Income                24
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
Response               0
Complain               0
Country                0
dtype: int64
```

```python
In [56]: df.dropna(inplace=True)
```

```python
In [57]: df.info()
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2216 entries, 0 to 2239
Data columns (total 28 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   object
 5   Kidhome              2216 non-null   int64
 6   Teenhome             2216 non-null   int64
 7   Dt_Customer          2216 non-null   object
 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  Response             2216 non-null   int64
 26  Complain             2216 non-null   int64
 27  Country              2216 non-null   object
dtypes: int64(23), object(5)
memory usage: 502.1+ KB
```

Variable transformation

```python
In [58]: # change income to float
         # Dt_customer to datetime
         df['Income'] = df['Income'].str.replace("[$,]","").astype(float)

C:\Users\DELL\AppData\Local\Temp\ipykernel_19588\968687995.py:3: FutureWarning: The default value of regex will change from True to False in a future version.
  df['Income'] = df['Income'].str.replace("[$,]","").astype(float)
```

```python
In [59]: df['Dt_Customer'].head()
Out[59]:
0    6/16/14
1    6/15/14
2    5/13/14
3    5/11/14
4     4/8/14
Name: Dt_Customer, dtype: object
```

```python
In [60]: df['Dt_Customer']=pd.to_datetime(df['Dt_Customer'])
```

```python
In [61]: df.info()
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2216 entries, 0 to 2239
Data columns (total 28 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  Response             2216 non-null   int64
 26  Complain             2216 non-null   int64
 27  Country              2216 non-null   object
dtypes: datetime64[ns](1), float64(1), int64(23), object(3)
memory usage: 502.1+ KB
```

```python
In [62]: df.head()
```

Out[62]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	...	NumStorePurchases	NumWebVisitsMonth	AcceptedCmp3	AcceptedCmp4	Accepte
0	1826	1970	Graduation	Divorced	84835.0	0	0	2014-06-16	0	189	...	6	1	0	0	
1	1	1961	Graduation	Single	57091.0	0	0	2014-06-15	0	464	...	7	5	0	0	
2	10476	1958	Graduation	Married	67267.0	0	1	2014-05-13	0	134	...	5	2	0	0	
3	1386	1967	Graduation	Together	32474.0	1	1	2014-05-11	0	10	...	2	7	0	0	
4	5371	1989	Graduation	Single	21474.0	1	0	2014-04-08	0	6	...	2	7	1	0	

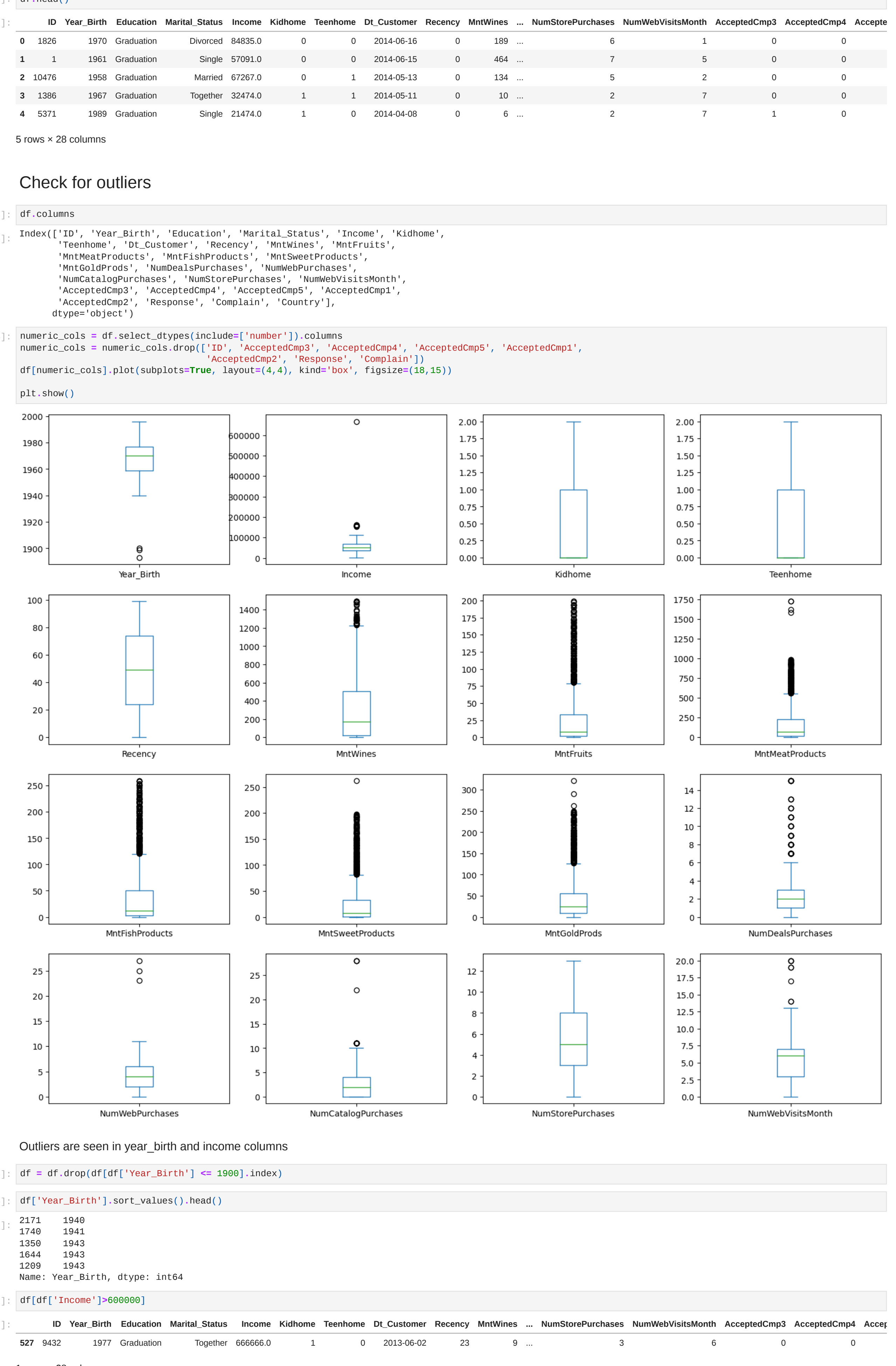
5 rows × 28 columns

Check for outliers

```python
In [63]: df.columns
Out[63]: 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', 'Response', 'Complain', 'Country'],
      dtype='object')
```

```python
In [64]: numeric_cols = df.select_dtypes(include=['number']).columns
         numeric_cols = numeric_cols.drop(['ID', 'AcceptedCmp3', 'AcceptedCmp4', 'AcceptedCmp5', 'AcceptedCmp1',
                                           'AcceptedCmp2', 'Response', 'Complain'])
         df[numeric_cols].plot(subplots=True, layout=(4,4), kind='box', figsize=(18,15))

         plt.show()
```



Outliers are seen in year_birth and income columns

```python
In [65]: df = df.drop(df[df['Year_Birth'] <= 1900].index)
```

```python
In [66]: df['Year_Birth'].sort_values().head()
Out[66]:
2171    1940
1740    1941
1350    1943
1644    1943
1209    1943
Name: Year_Birth, dtype: int64
```

```python
In [67]: df[df['Income']>600000]
```

Out[67]:

	ID	Year_Birth	Education	Marital_Status	Income	Kidhome	Teenhome	Dt_Customer	Recency	MntWines	...	NumStorePurchases	NumWebVisitsMonth	AcceptedCmp3	AcceptedCmp4	Accep
527	9432	1977	Graduation	Together	666666.0	1	0	2013-06-02	23	9	...	3	6	0	0	

1 rows × 28 columns

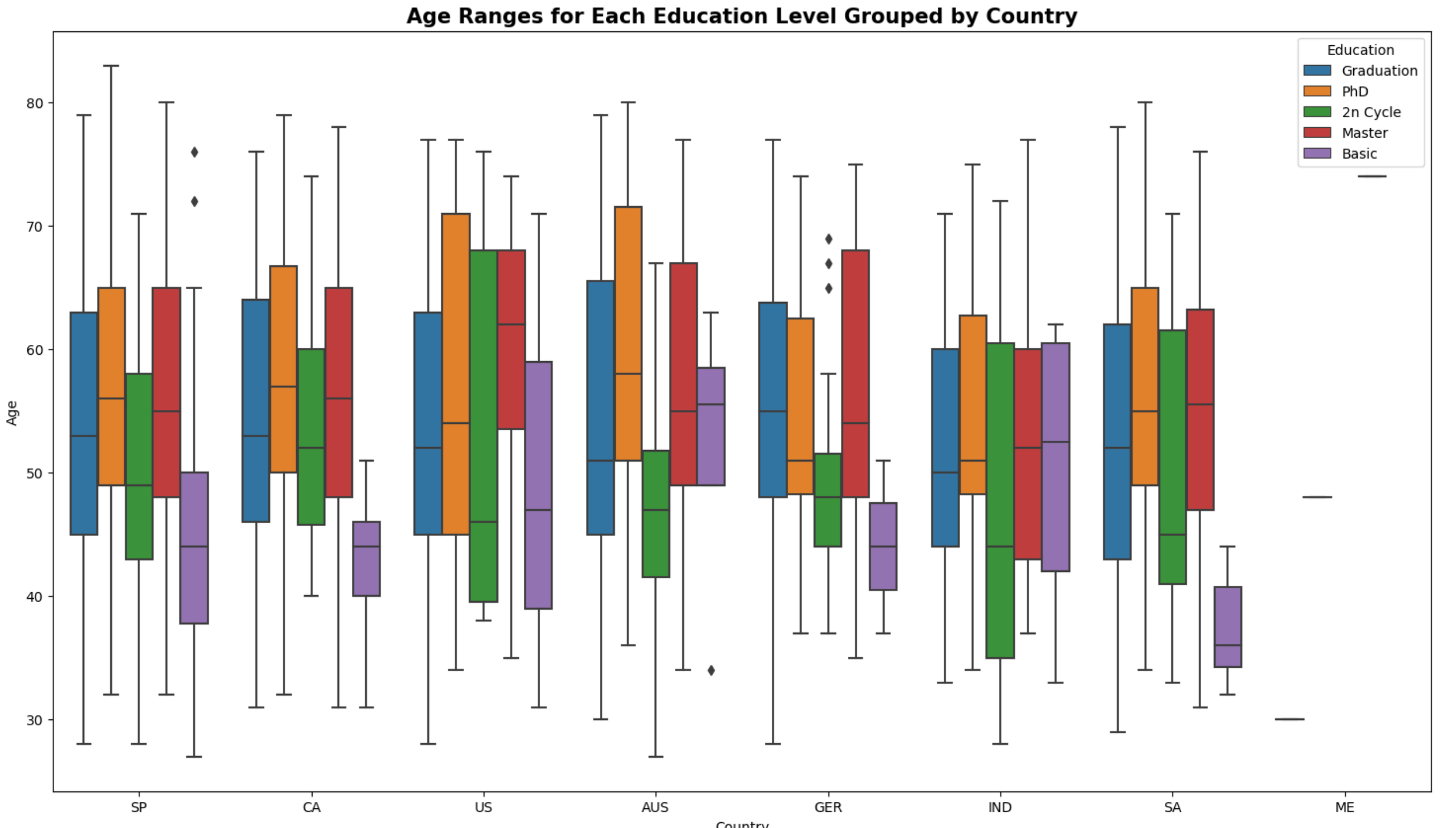
```python
In [68]: df = df.drop(df[df['Income'] > 600000].index)
```

```python
In [69]: df['Income'].sort_values()
Out[69]:
1466      1730.0
961       2447.0
1291      3502.0
663       4023.0
14        4428.0
          ...
325     157146.0
2204    157243.0
853     157733.0
497     160803.0
731     162397.0
Name: Income, Length: 2212, dtype: float64
```

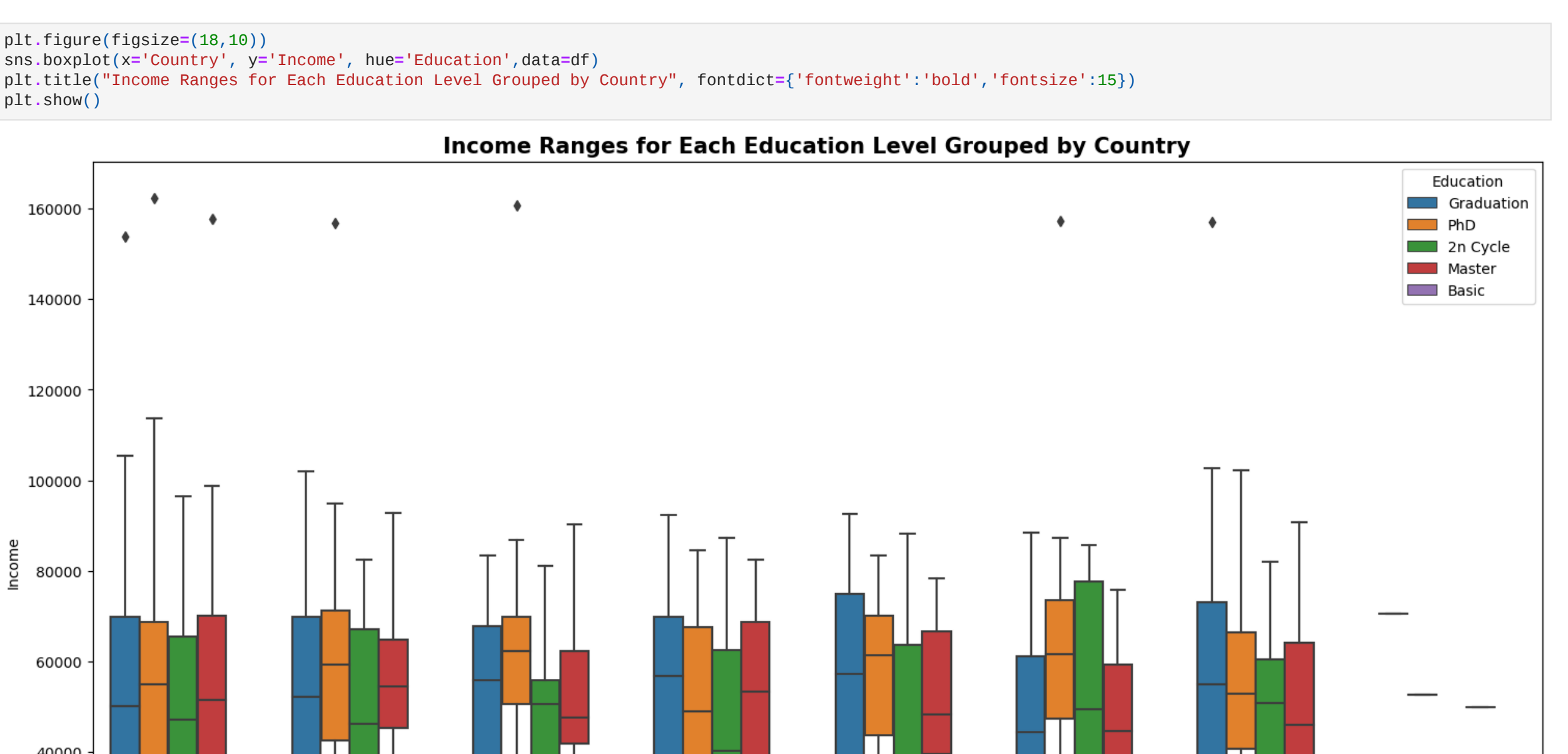
```python
In [70]: # lets check education and marital status columns
         df['Education'].value_counts()
Out[70]:
Graduation    1115
PhD            480
Master         365
2n Cycle       198
Basic           54
Name: Education, dtype: int64
```

```python
In [71]: df['Age'] = datetime.datetime.now().year - df['Year_Birth']
```

```python
In [72]: plt.figure(figsize=(18,10))
         sns.boxplot(x='Country', y='Age', hue='Education',data=df)
         plt.title("Age Ranges for Each Education Level Grouped by Country", fontdict={'fontweight':'bold','fontsize':15})
         plt.show()
```




```python
In [73]: plt.figure(figsize=(18,10))
         sns.boxplot(x='Country', y='Income', hue='Education',data=df)
         plt.title("Income Ranges for Each Education Level Grouped by Country", fontdict={'fontweight':'bold','fontsize':15})
         plt.show()
```




```python
In [74]: education_map = {"Graduation":"Undergraduate", "2n Cycle":"Master", "PhD":"PhD", "Basic":"Basic", "Master":"Master"}

         df['New_Education'] = df['Education'].map(education_map, na_action='ignore')
```

```python
In [75]: df['New_Education'].value_counts(dropna=False)
Out[75]:
Undergraduate    1115
Master            563
PhD               480
Basic              54
Name: New_Education, dtype: int64
```

```python
In [76]: df['Education'].value_counts(dropna=False)
Out[76]:
Graduation    1115
PhD            480
Master         365
2n Cycle       198
Basic           54
Name: Education, dtype: int64
```

```python
In [77]: df['Marital_Status'].value_counts()
Out[77]:
Married     857
Together    571
Single      470
Divorced    231
Widow        76
Alone         3
YOLO          2
Absurd        2
Name: Marital_Status, dtype: int64
```

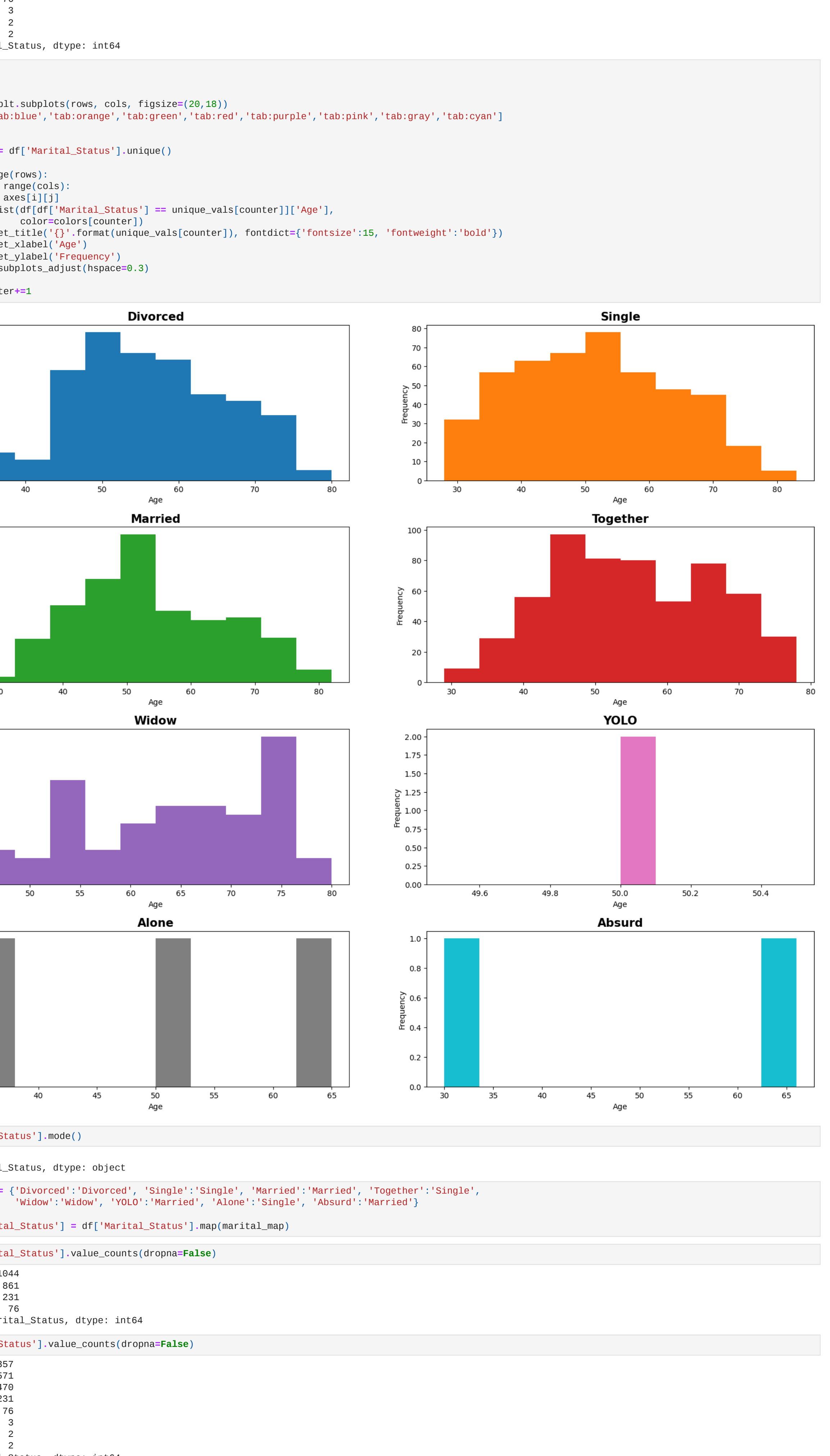
```python
In [78]: rows = 4
         cols = 2

         fig, axes = plt.subplots(rows, cols, figsize=(20,18))
         colors = ['tab:blue','tab:orange','tab:green','tab:red','tab:purple','tab:pink','tab:gray','tab:cyan']

         counter = 0
         unique_vals = df['Marital_Status'].unique()

         for i in range(rows):
             for j in range(cols):
                 ax = axes[i][j]
                 ax.hist(df[df['Marital_Status'] == unique_vals[counter]]['Age'],
                         color=colors[counter])
                 ax.set_title('{}'.format(unique_vals[counter]), fontdict={'fontsize':15, 'fontweight':'bold'})
                 ax.set_xlabel('Age')
                 ax.set_ylabel('Frequency')
                 plt.subplots_adjust(hspace=0.3)

                 counter+=1
```




```python
In [79]: df['Marital_Status'].mode()
Out[79]:
0    Married
Name: Marital_Status, dtype: object
```

```python
In [80]: marital_map = {'Divorced':'Divorced', 'Single':'Single', 'Married':'Married', 'Together':'Single',
                        'Widow':'Widow', 'YOLO':'Married', 'Alone':'Single', 'Absurd':'Married'}

         df['New_Marital_Status'] = df['Marital_Status'].map(marital_map)
```

```python
In [81]: df['New_Marital_Status'].value_counts(dropna=False)
Out[81]:
Single      1044
Married      861
Divorced     231
Widow         76
Name: New_Marital_Status, dtype: int64
```

```python
In [82]: df['Marital_Status'].value_counts(dropna=False)
Out[82]:
Married     857
Together    571
Single      470
Divorced    231
Widow        76
Alone         3
YOLO          2
Absurd        2
Name: Marital_Status, dtype: int64
```

```python
In [83]: df.corr()
```

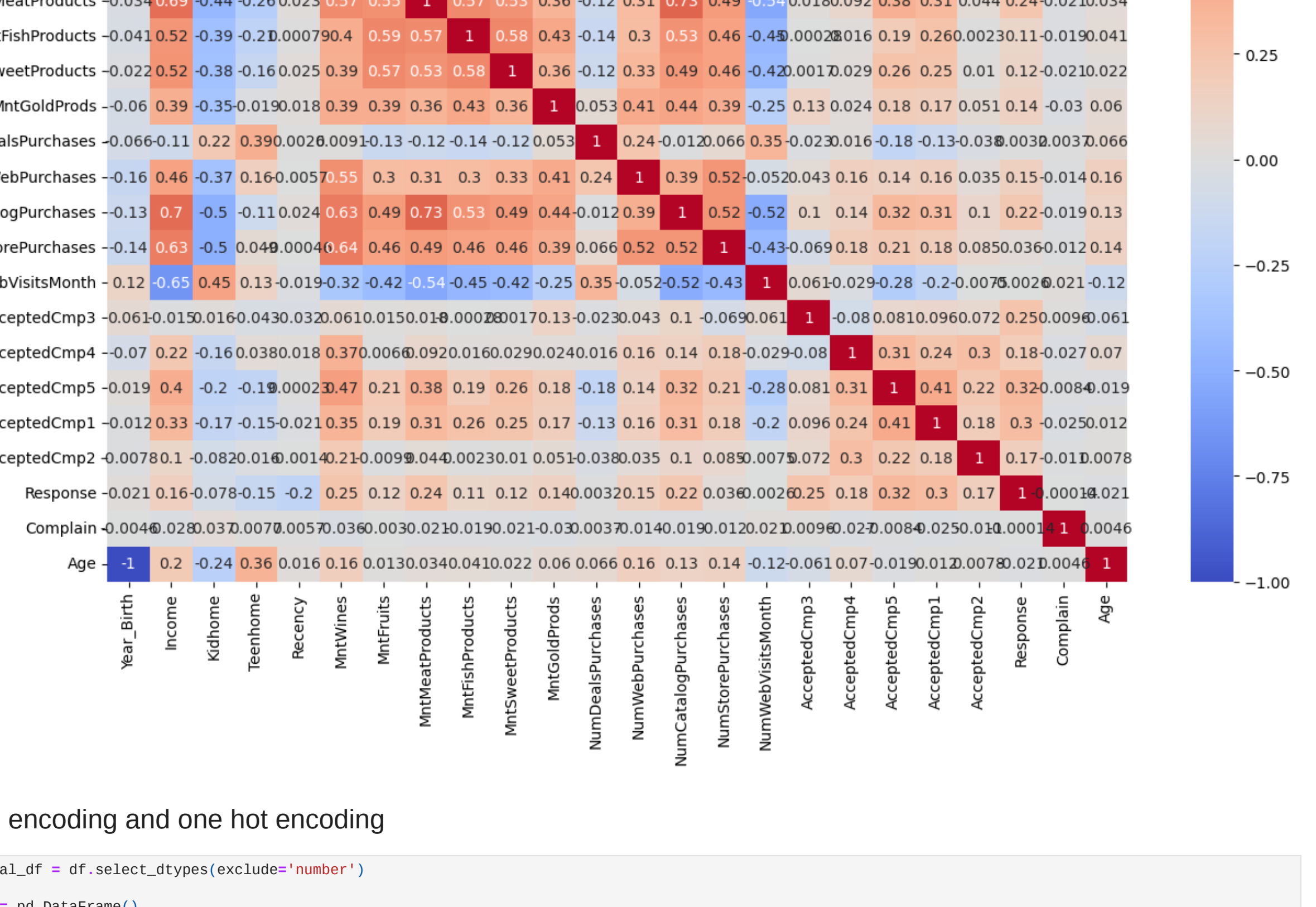
Out[83]:

	ID	Year_Birth	Income	Kidhome	Teenhome	Recency	MntWines	MntFruits	MntMeatProducts	MntFishProducts	...	NumStorePurchases	NumWebVisitsMonth
ID	1.000000	0.005086	0.000905	0.000971	-0.003508	-0.044147	-0.018906	0.010008	-0.003706	-0.022405	...	-0.011733	-0.008610
Year_Birth	0.005086	1.000000	-0.199977	0.237497	-0.361932	-0.019584	-0.164615	-0.013447	-0.033622	-0.041154	...	-0.138998	0.120282
Income	0.000905	-0.199977	1.000000	-0.514523	0.034565	0.007965	0.688209	0.507354	0.692279	0.520040	...	0.631424	-0.650257
Kidhome	0.000971	0.237497	-0.514523	1.000000	-0.039066	0.010623	-0.497203	-0.373258	-0.439031	-0.388643	...	-0.501863	0.447258
Teenhome	-0.003508	-0.361932	0.034565	-0.039066	1.000000	0.014392	0.003945	-0.175905	-0.261134	-0.205235	...	0.049212	0.130985
Recency	-0.044147	-0.019584	0.007965	0.010623	0.014392	1.000000	0.015981	-0.005257	0.022914	0.000788	...	-0.000460	-0.018965
MntWines	-0.018906	-0.164615	0.688209	-0.497203	0.003945	0.015981	1.000000	0.385844	0.568081	0.396915	...	0.640219	-0.321616
MntFruits	0.010008	-0.013447	0.507354	-0.373258	-0.175905	-0.005257	0.385844	1.000000	0.546740	0.593038	...	0.459875	-0.417741
MntMeatProducts	-0.003706	-0.033622	0.692279	-0.439031	-0.261134	0.022914	0.568081	0.546740	1.000000	0.572986	...	0.486349	-0.539194
MntFishProducts	-0.022405	-0.041154	0.520040	-0.388643	-0.205235	0.000788	0.396915	0.593038	0.572986	1.000000	...	0.457885	-0.446151
MntSweetProducts	-0.004381	-0.021516	0.523599	-0.377843	-0.163107	0.025244	0.389583	0.571474	0.534624	0.583484	...	0.455150	-0.422289
MntGoldProds	-0.008013	-0.059779	0.388299	-0.354922	-0.018579	0.018148	0.391461	0.393459	0.357556	0.426299	...	0.390693	-0.245973
NumDealsPurchases	-0.040849	-0.066156	-0.108207	0.216594	0.386805	0.002591	0.009117	-0.134191	-0.121128	-0.143147	...	0.065635	0.345623
NumWebPurchases	-0.017232	-0.162265	0.459265	-0.372327	0.162239	-0.005680	0.553663	0.302301	0.306841	0.299428	...	0.515756	-0.051589
NumCatalogPurchases	-0.000404	-0.125656	0.696589	-0.504598	-0.112477	0.024197	0.634237	0.485611	0.733787	0.532241	...	0.517887	-0.522023
NumStorePurchases	-0.011733	-0.138998	0.631424	-0.501863	0.049212	-0.000460	0.640219	0.459875	0.486349	0.457885	...	1.000000	-0.433813
NumWebVisitsMonth	-0.008610	0.120282	-0.650257	0.447258	0.130985	-0.018965	-0.321616	-0.417741	-0.539194	-0.446151	...	-0.433813	1.000000
AcceptedCmp3	-0.035668	0.061097	-0.015152	0.016135	-0.042797	-0.032361	0.061360	0.014644	0.018416	-0.000276	...	-0.069455	0.061084
AcceptedCmp4	-0.023692	-0.070035	0.219633	-0.162111	0.038168	0.017520	0.373349	0.006598	0.091677	0.016058	...	0.177705	-0.028969
AcceptedCmp5	-0.004441	0.019025	0.395569	-0.204582	-0.190119	0.000233	0.472889	0.208990	0.375252	0.194793	...	0.214249	-0.276097
AcceptedCmp1	-0.017989	-0.011941	0.327524	-0.174261	-0.145198	-0.021147	0.351610	0.192417	0.313379	0.261712	...	0.178462	-0.195200
AcceptedCmp2	-0.014901	-0.007821	0.104036	-0.081911	-0.015633	-0.001429	0.206309	-0.009924	0.043549	0.002322	...	0.085146	-0.007483
Response	-0.021112	0.020937	0.161387	-0.077901	-0.154402	-0.200114	0.246320	0.123007	0.237966	0.108135	...	0.035563	-0.002625
Complain	0.031839	-0.004602	-0.027900	0.037067	0.007746	0.005713	-0.036420	-0.002956	-0.021017	-0.019098	...	-0.011947	0.020820
Age	-0.005086	-1.000000	0.199977	-0.237497	0.361932	0.019584	0.164615	0.013447	0.033622	0.041154	...	0.138998	-0.120282

25 rows × 25 columns

```python
In [84]: fig = plt.figure(figsize=(15,10))

         corr = df.drop('ID', axis=1).corr()
         sns.heatmap(corr, annot=True, cmap='coolwarm')
Out[84]: <AxesSubplot:>
```



ordinal encoding and one hot encoding

```python
In [86]: categorical_df = df.select_dtypes(exclude='number')

         dummy_df = pd.DataFrame()
         for col in categorical_df.columns:
             dummy = pd.get_dummies(categorical_df[col], prefix=col)
             dummy_df = pd.concat([dummy_df, dummy], axis=1)

         df = pd.concat([df, dummy_df], axis=1)
         df.drop(categorical_df.columns, axis=1, inplace=True)
```

```python
In [87]: df.info()
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2212 entries, 0 to 2239
Data columns (total 43 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   ID                        2212 non-null   int64
 1   Year_Birth                2212 non-null   int64
 2   Income                    2212 non-null   float64
 3   Kidhome                   2212 non-null   int64
 4   Teenhome                  2212 non-null   int64
 5   Recency                   2212 non-null   int64
 6   MntWines                  2212 non-null   int64
 7   MntFruits                 2212 non-null   int64
 8   MntMeatProducts           2212 non-null   int64
 9   MntFishProducts           2212 non-null   int64
 10  MntSweetProducts          2212 non-null   int64
 11  MntGoldProds              2212 non-null   int64
 12  NumDealsPurchases         2212 non-null   int64
 13  NumWebPurchases           2212 non-null   int64
 14  NumCatalogPurchases       2212 non-null   int64
 15  NumStorePurchases         2212 non-null   int64
 16  NumWebVisitsMonth         2212 non-null   int64
 17  AcceptedCmp3              2212 non-null   int64
 18  AcceptedCmp4              2212 non-null   int64
 19  AcceptedCmp5              2212 non-null   int64
 20  AcceptedCmp1              2212 non-null   int64
 21  AcceptedCmp2              2212 non-null   int64
 22  Response                  2212 non-null   int64
 23  Complain                  2212 non-null   int64
 24  Age                       2212 non-null   int64
 25  Education_2n Cycle        2212 non-null   uint8
 26  Education_Basic           2212 non-null   uint8
 27  Education_Graduation      2212 non-null   uint8
 28  Education_Master          2212 non-null   uint8
 29  Education_PhD             2212 non-null   uint8
 30  Education_2n Cycle        2212 non-null   uint8
 31  Education_Basic           2212 non-null   uint8
 32  Education_Graduation      2212 non-null   uint8
 33  Education_Master          2212 non-null   uint8
 34  Education_PhD             2212 non-null   uint8
 35  Marital_Status_Absurd     2212 non-null   uint8
 36  Marital_Status_Alone      2212 non-null   uint8
 37  Marital_Status_Divorced   2212 non-null   uint8
 38  Marital_Status_Married    2212 non-null   uint8
 39  Marital_Status_Single     2212 non-null   uint8
 40  Marital_Status_Together   2212 non-null   uint8
 41  Marital_Status_Widow      2212 non-null   uint8
 42  Marital_Status_YOLO       2212 non-null   uint8
dtypes: float64(1), int64(24), uint8(18)
memory usage: 488.2 KB
```

```python
In [ ]:
```

```python
In [ ]:
```