In [1]:

```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
import seaborn as sns
```

In [2]:

```
df = pd.read_csv('loan_data.csv')
```

In [3]:

```
df.head(10)
```

Out[3]:

	ID	Income	Term	Balance	Debt	Score	Default
0	567	17500.0	Short Term	1460.0	272.0	225.0	False
1	523	18500.0	Long Term	890.0	970.0	187.0	False
2	544	20700.0	Short Term	880.0	884.0	85.0	False
3	370	21600.0	Short Term	920.0	0.0	NaN	False
4	756	24300.0	Short Term	1260.0	0.0	495.0	False
5	929	22900.0	Long Term	1540.0	1229.0	383.0	False
6	373	20400.0	Short Term	1200.0	0.0	556.0	False
7	818	24600.0	Short Term	1470.0	0.0	301.0	False
8	284	26500.0	Long Term	720.0	1866.0	243.0	False
9	621	25400.0	Short Term	1130.0	0.0	729.0	True

In [4]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 856 entries, 0 to 855
Data columns (total 7 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   ID       856 non-null    int64  
 1   Income   856 non-null    float64
 2   Term     856 non-null    object 
 3   Balance  856 non-null    float64
 4   Debt     856 non-null    float64
 5   Score    836 non-null    float64
 6   Default  856 non-null    bool   
dtypes: bool(1), float64(4), int64(1), object(1)
memory usage: 41.1+ KB
```

In [5]:

```
df.isnull().sum()
```

Out[5]:

```
ID          0
Income      0
Term        0
Balance     0
Debt        0
Score      20
Default     0
dtype: int64
```

In [6]:

```
df
```

Out[6]:

	ID	Income	Term	Balance	Debt	Score	Default
0	567	17500.0	Short Term	1460.0	272.0	225.0	False
1	523	18500.0	Long Term	890.0	970.0	187.0	False
2	544	20700.0	Short Term	880.0	884.0	85.0	False
3	370	21600.0	Short Term	920.0	0.0	NaN	False
4	756	24300.0	Short Term	1260.0	0.0	495.0	False
...	...	...	...	...	...	...	...
851	71	30000.0	Long Term	1270.0	3779.0	52.0	True
852	932	42500.0	Long Term	1550.0	0.0	779.0	False
853	39	36400.0	Long Term	1830.0	3032.0	360.0	True
854	283	42200.0	Long Term	1500.0	2498.0	417.0	False
855	847	30800.0	Long Term	1190.0	2355.0	177.0	True

856 rows × 7 columns

In [7]:

```
df[df.isna().any(axis=1)]
```

Out[7]:

	ID	Income	Term	Balance	Debt	Score	Default
3	370	21600.0	Short Term	920.0	0.0	NaN	False
20	673	23500.0	Short Term	790.0	0.0	NaN	False
36	36	18500.0	Short Term	980.0	354.0	NaN	True
61	643	21300.0	Short Term	680.0	364.0	NaN	False
86	83	18400.0	Short Term	510.0	0.0	NaN	False
162	839	20700.0	Short Term	980.0	0.0	NaN	False
221	477	21500.0	Short Term	1300.0	1858.0	NaN	True
338	539	21600.0	Long Term	1180.0	738.0	NaN	False
357	714	20000.0	Short Term	1050.0	0.0	NaN	False
361	364	20800.0	Short Term	1030.0	115.0	NaN	False
383	224	21800.0	Short Term	730.0	345.0	NaN	False
388	429	17300.0	Short Term	1080.0	0.0	NaN	False
483	218	24300.0	Long Term	1280.0	0.0	NaN	False
535	748	44300.0	Long Term	1300.0	0.0	NaN	False
563	199	44200.0	Short Term	920.0	0.0	NaN	False
589	886	41400.0	Short Term	1140.0	0.0	NaN	False
615	971	35300.0	Short Term	790.0	1479.0	NaN	False
631	970	40200.0	Long Term	1040.0	0.0	NaN	False
642	683	38200.0	Short Term	1610.0	0.0	NaN	False
753	529	61700.0	Short Term	1450.0	3933.0	NaN	False

In [8]:

```
df.shape
```

Out[8]:

```
(856, 7)
```

drop the 20 columns that have NaN scores as it probably wont affect the data since there are 856 rows

In [9]:

```
df = df[~df.isna().any(axis=1)]
```

In [10]:

```
for column in df:
    unique_vals = np.unique(df[column])
    nr_vals = len(unique_vals)
    if nr_vals < 11:
        print(f'The number of values in features "{column}" are {nr_vals}; {unique_v
    else:
        print(f'The number of values in features "{column}" are {nr_vals}')
```

```
The number of values in features "ID" are 836
The number of values in features "Income" are 328
The number of values in features "Term" are 2; ['Long Term' 'Short Term']
The number of values in features "Balance" are 183
The number of values in features "Debt" are 398
The number of values in features "Score" are 537
The number of values in features "Default" are 2; [False  True]
```

In [11]:

```
df.columns
```

Out[11]:

```
Index(['ID', 'Income', 'Term', 'Balance', 'Debt', 'Score', 'Default'], dtype='objec
t')
```

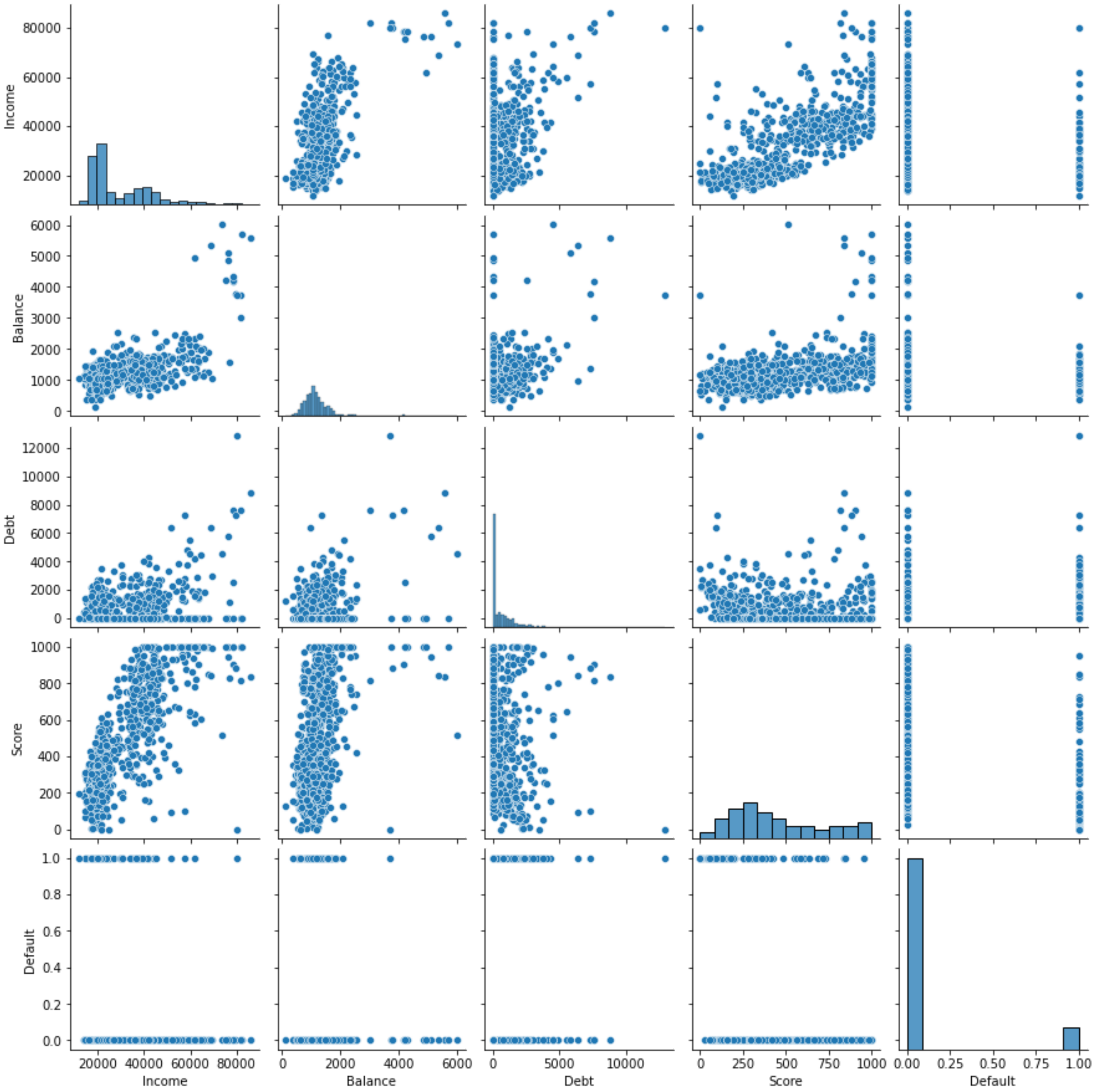
In [12]:

```
sns.pairplot(df[['Income', 'Term', 'Balance', 'Debt', 'Score', 'Default']])
```

```
<__array_function__ internals>:5: RuntimeWarning: Converting input from bool to <cla
ss 'numpy.uint8'> for compatibility.
<__array_function__ internals>:5: RuntimeWarning: Converting input from bool to <cla
ss 'numpy.uint8'> for compatibility.
```

Out[12]:

```
<seaborn.axisgrid.PairGrid at 0x18b52a5edc0>
```



Point 1

In [13]:

```
df.columns
```

Out[13]:

```
Index(['ID', 'Income', 'Term', 'Balance', 'Debt', 'Score', 'Default'], dtype='objec
t')
```

In [14]:

```
df['Default'].value_counts().reset_index(name='counts')
```

Out[14]:

	index	counts
0	False	750
1	True	86

In [15]:

```
df['Income'].min(), df['Income'].max()
```

Out[15]:

```
(11800.0, 86000.0)
```

Range:

- 10,000 - 20,000
- 30,000 - 30,000
- 30,000 - 40,000
- 40,000 - 50,000
- 50,000 - 60,000
- 60,000 - 70,000
- 70,000 +

In [16]:

```
def salary_range(df):
    if df['Income'] <= 20000:
        df['Income Range'] = '10,000 - 20,000'
    elif df['Income'] > 20000 and df['Income'] <= 30000:
        df['Income Range'] = '20,000 - 30,000'
    elif df['Income'] > 30000 and df['Income'] <= 40000:
        df['Income Range'] = '30,000 - 40,000'
    elif df['Income'] > 40000 and df['Income'] <= 50000:
        df['Income Range'] = '40,000 - 50,000'
    elif df['Income'] > 50000 and df['Income'] <= 60000:
        df['Income Range'] = '50,000 - 60,000'
    else:
        df['Income Range'] = '60000+'
    return df
```

In [17]:

```
df = df.apply(salary_range, axis=1)
df.head()
```

Out[17]:

	ID	Income	Term	Balance	Debt	Score	Default	Income Range
0	567	17500.0	Short Term	1460.0	272.0	225.0	False	10,000 - 20,000
1	523	18500.0	Long Term	890.0	970.0	187.0	False	10,000 - 20,000
2	544	20700.0	Short Term	880.0	884.0	85.0	False	20,000 - 30,000
4	756	24300.0	Short Term	1260.0	0.0	495.0	False	20,000 - 30,000
5	929	22900.0	Long Term	1540.0	1229.0	383.0	False	20,000 - 30,000

In [18]:

```
df.columns
```

Out[18]:

```
Index(['ID', 'Income', 'Term', 'Balance', 'Debt', 'Score', 'Default',
       'Income Range'],
      dtype='object')
```

In [19]:

```
defaulters = df.groupby(['Income Range', 'Default']).agg({'Default': 'count'})
defaulters
```

Out[19]:

		Default
Income Range	**Default**	
10,000 - 20,000	**False**	210
	True	26
20,000 - 30,000	**False**	246
	True	35

		Default
Income Range	**Default**	
30,000 - 40,000	**False**	110
	True	16
40,000 - 50,000	**False**	115
	True	5
50,000 - 60,000	**False**	31
	True	2
60000+	**False**	38
	True	2

In [20]:

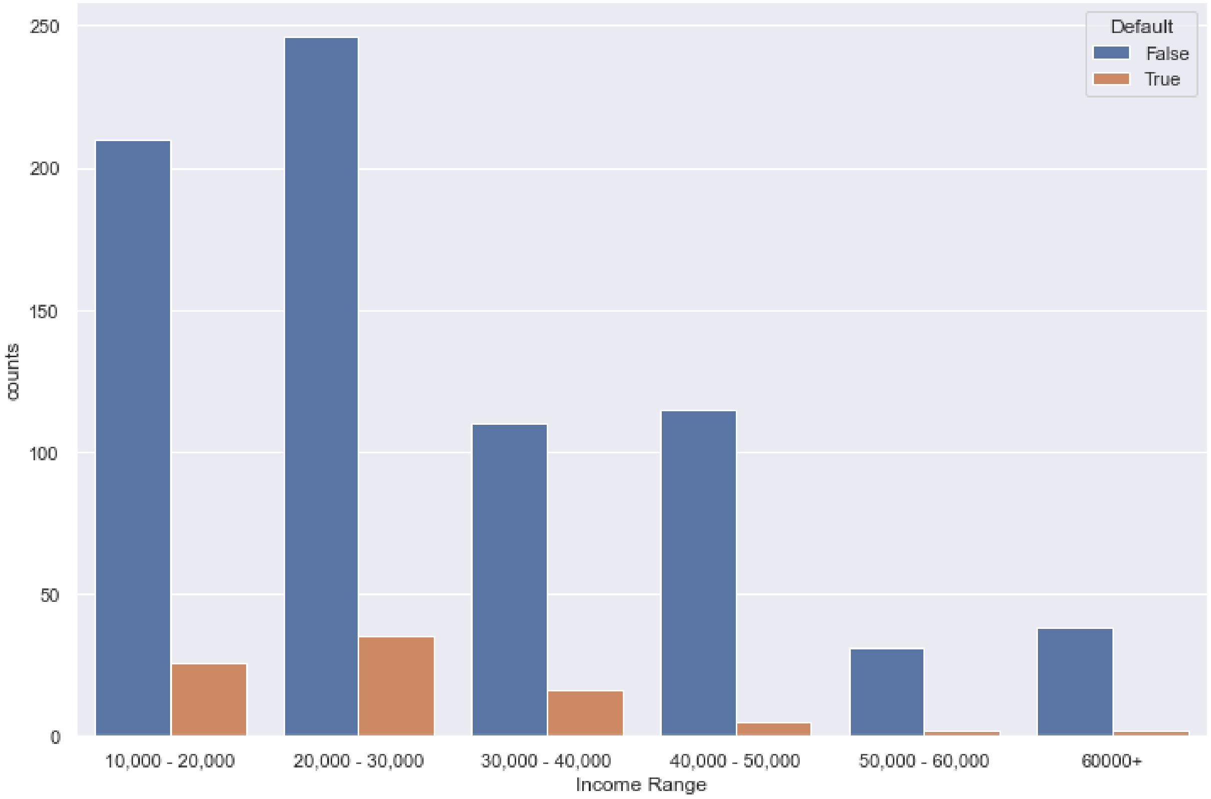
```
graph1 = df[['Income Range', 'Default']].value_counts().reset_index(name='counts').s
graph1
```

Out[20]:

	Income Range	Default	counts
1	10,000 - 20,000	False	210
7	10,000 - 20,000	True	26
0	20,000 - 30,000	False	246
5	20,000 - 30,000	True	35
3	30,000 - 40,000	False	110
8	30,000 - 40,000	True	16
2	40,000 - 50,000	False	115
9	40,000 - 50,000	True	5
6	50,000 - 60,000	False	31
10	50,000 - 60,000	True	2
4	60000+	False	38
11	60000+	True	2

In [21]:

```
sns.set(rc = {'figure.figsize':(12,8)})
chart1= sns.barplot(x='Income Range', y='counts', hue='Default', data=graph1)
```



- The people with a higher salary range tend to default less than the people within the smaller salary range.
- The most defaulters lie in the range of 20,000 - 30,000

Point 2

In [22]:
```
df.columns
```

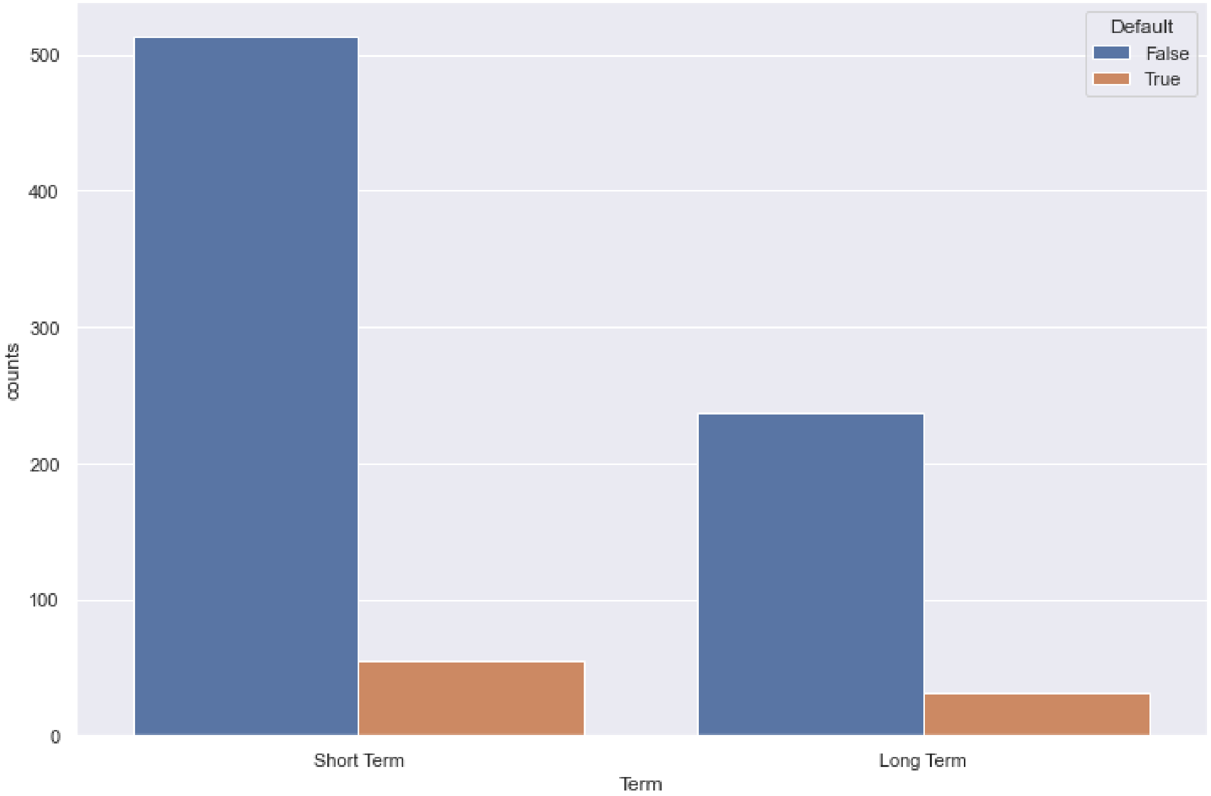
Out[22]:
```
Index(['ID', 'Income', 'Term', 'Balance', 'Debt', 'Score', 'Default',
       'Income Range'],
      dtype='object')
```

In [23]:
```
graph2 = df[['Term', 'Default']].value_counts().reset_index(name='counts')
graph2
```

Out[23]:

	Term	Default	counts
0	Short Term	False	513
1	Long Term	False	237
2	Short Term	True	55
3	Long Term	True	31

In [24]:
```
chart2 =  sns.barplot(x='Term', y='counts', hue='Default', data=graph2)
```



- There are usually more people on short term loans than long term loans
- The ratio of people defaulting on long term is higher than the ratio of people defaulting on short term.

In [25]:

```
short_term_ratio = (graph2['counts'].iloc[2] / graph2['counts'].iloc[0])*100
short_term_ratio.round(2)
```

Out[25]:

```
10.72
```

In [26]:

```
long_term_ratio = (graph2['counts'].iloc[3] / graph2['counts'].iloc[1])*100
long_term_ratio.round(2)
```

Out[26]:

```
13.08
```

Point 3

Score vs Debt

In [27]:

```
sc_vs_db = df[['Debt', 'Score']].sort_values('Score', ascending=True)
sc_vs_db
```

Out[27]:

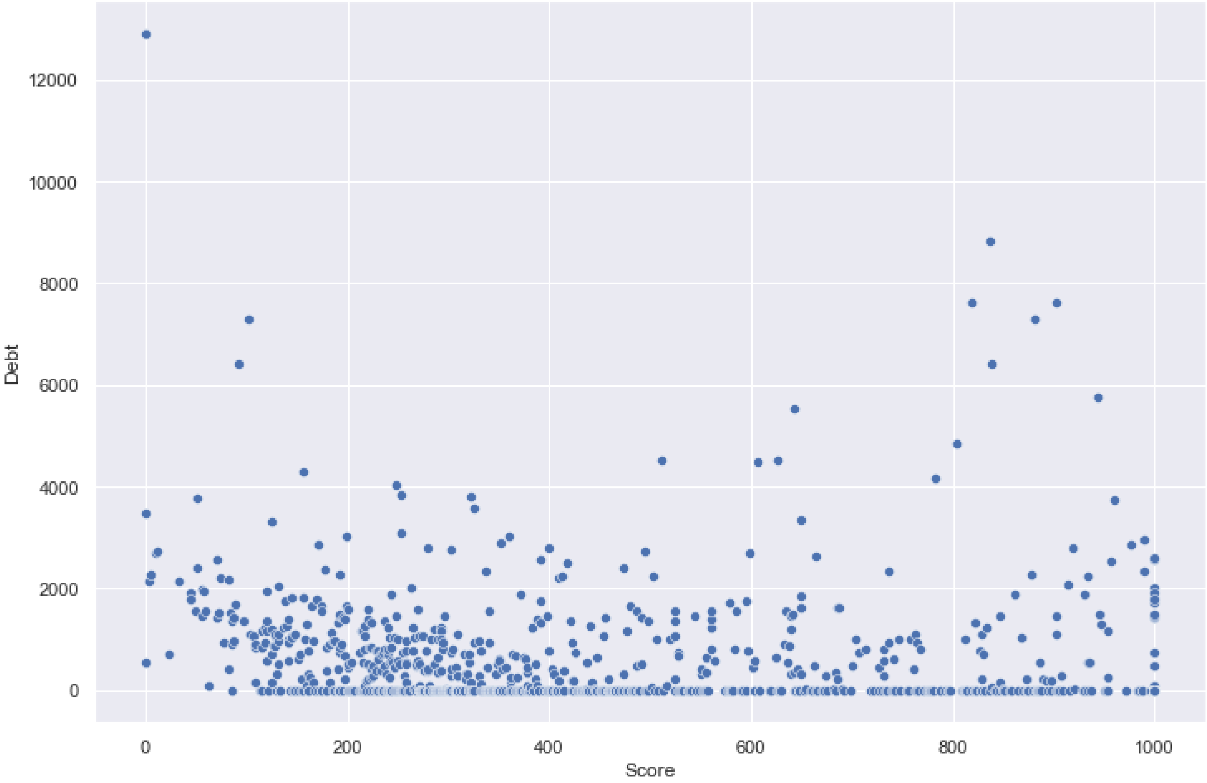
	Debt	Score
277	547.0	0.0
801	12891.0	0.0
482	3470.0	0.0
176	2130.0	4.0
177	2272.0	5.0

	Debt	Score
...	...	...
757	1912.0	1000.0
756	0.0	1000.0
542	1499.0	1000.0
732	1771.0	1000.0
741	2584.0	1000.0

836 rows × 2 columns

In [28]:
```
sns.scatterplot(x='Score', y='Debt', data=sc_vs_db)
```

Out[28]:
```
<AxesSubplot:xlabel='Score', ylabel='Debt'>
```



- There is no strong positive correlation between credit score and debt. However, the people with the highest of debt are the ones with the higher score but generally it is more or less the same across the board

Point 4

Income vs Credit Score

In [29]:
```
inc_vs_cs = df[['Income', 'Score']].sort_values('Income')
inc_vs_cs
```

Out[29]:

	Income	Score
803	11800.0	193.0

	Income	Score
444	13700.0	179.0
419	13800.0	180.0
372	14300.0	63.0
466	14400.0	309.0
...	...	...
801	79900.0	0.0
791	81800.0	1000.0
800	81900.0	818.0
798	82100.0	1000.0
790	86000.0	837.0

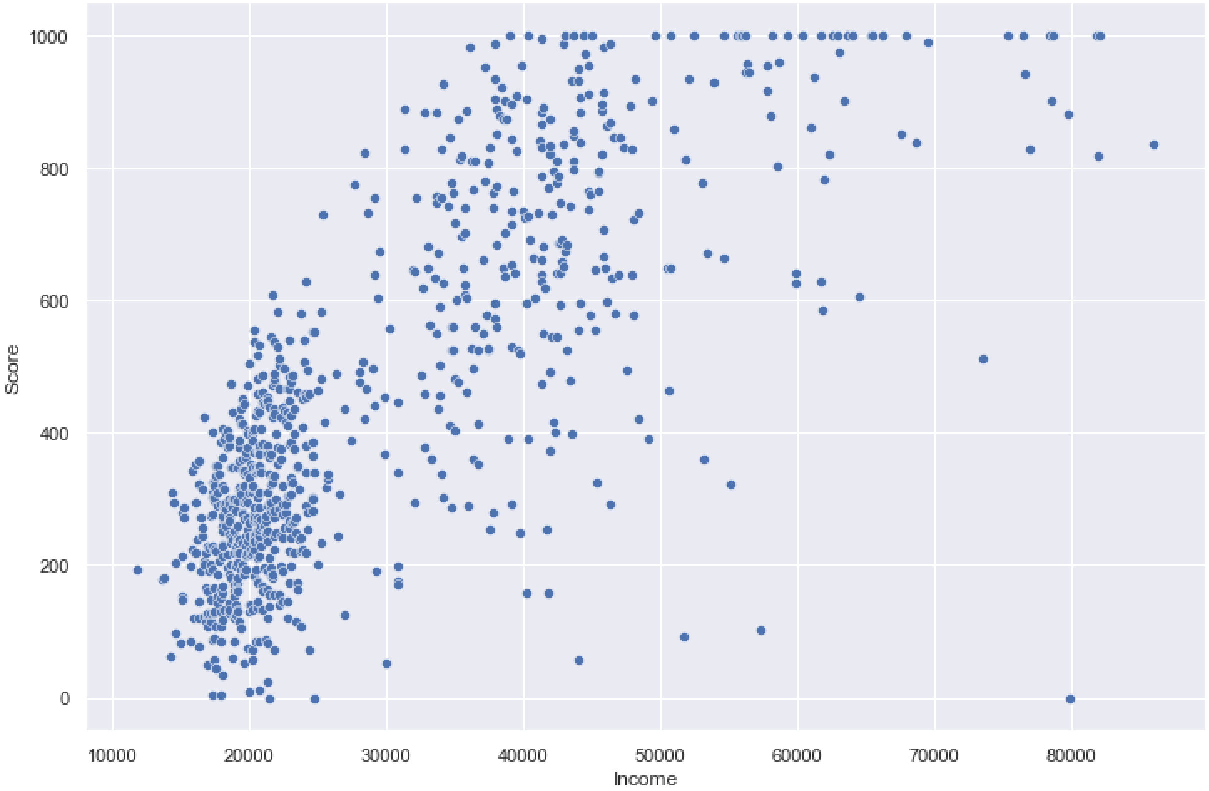
836 rows × 2 columns

In [30]:

```
sns.scatterplot(x='Income', y='Score', data=inc_vs_cs)
```

Out[30]:

```
<AxesSubplot:xlabel='Income', ylabel='Score'>
```



- As the income increases, the credit score increases. The people who have a higher credit score default less.

Credit score vs Default

In [31]:

```
df[['Score', 'Default']]
```

Out[31]:

Score	Default

	Score	Default
0	225.0	False
1	187.0	False
2	85.0	False
4	495.0	False
5	383.0	False
...	...	...
851	52.0	True
852	779.0	False
853	360.0	True
854	417.0	False
855	177.0	True

836 rows × 2 columns

In [32]:

```
df['Score'].min(), df['Score'].max()
```

Out[32]:

```
(0.0, 1000.0)
```

In [33]:

```
def score_range(df):
    if df['Score'] <= 200:
        df['Score Range'] = '0-200'
    elif df['Score'] > 200 and df['Score'] <= 400:
        df['Score Range'] = '200 - 400'
    elif df['Score'] > 400 and df['Score'] <= 600:
        df['Score Range'] = '400 - 600'
    elif df['Score'] > 600 and df['Score'] <= 800:
        df['Score Range'] = '600 - 800'
    else:
        df['Score Range'] = '800-1000'
    return df
```

In [34]:

```
df = df.apply(score_range, axis=1)
df
```

Out[34]:

	ID	Income	Term	Balance	Debt	Score	Default	Income Range	Score Range
0	567	17500.0	Short Term	1460.0	272.0	225.0	False	10,000 - 20,000	200 - 400
1	523	18500.0	Long Term	890.0	970.0	187.0	False	10,000 - 20,000	0-200
2	544	20700.0	Short Term	880.0	884.0	85.0	False	20,000 - 30,000	0-200
4	756	24300.0	Short Term	1260.0	0.0	495.0	False	20,000 - 30,000	400 - 600
5	929	22900.0	Long Term	1540.0	1229.0	383.0	False	20,000 - 30,000	200 - 400
...	...	...	...	...	...	...	...	...	...
851	71	30000.0	Long Term	1270.0	3779.0	52.0	True	20,000 - 30,000	0-200
852	932	42500.0	Long Term	1550.0	0.0	779.0	False	40,000 - 50,000	600 - 800

	ID	Income	Term	Balance	Debt	Score	Default	Income Range	Score Range
853	39	36400.0	Long Term	1830.0	3032.0	360.0	True	30,000 - 40,000	200 - 400
854	283	42200.0	Long Term	1500.0	2498.0	417.0	False	40,000 - 50,000	400 - 600
855	847	30800.0	Long Term	1190.0	2355.0	177.0	True	30,000 - 40,000	0-200

836 rows × 9 columns

In [35]:

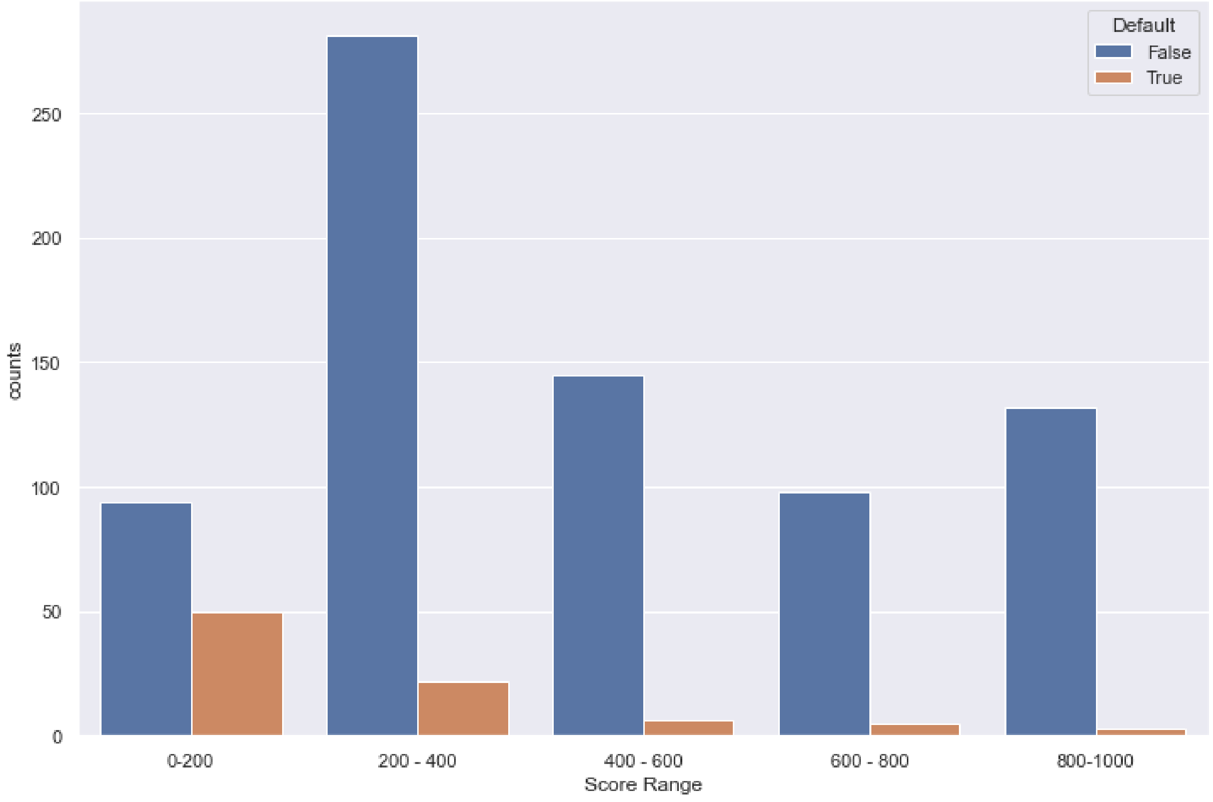
```
graph3 = df[['Score Range', 'Default']].value_counts().reset_index(name='counts').so
graph3
```

Out[35]:

	Score Range	Default	counts
4	0-200	False	94
5	0-200	True	50
0	200 - 400	False	281
6	200 - 400	True	22
1	400 - 600	False	145
7	400 - 600	True	6
3	600 - 800	False	98
8	600 - 800	True	5
2	800-1000	False	132
9	800-1000	True	3

In [36]:

```
chart3 = sns.barplot(x='Score Range', y='counts', hue='Default', data=graph3)
```



- As we said, the people with the higher credit score tend to default less as the people with the lower credit score.