Simple Clustering Exercise

The standard k-means algorithm isn't directly applicable to categorical data. The sample space for categorical data is discrete, and doesn't have a natural origin. An Euclidean distance function on such a space isn't really meaningful. K-modes is a variation of k-means which is suitable for categorical data.

In [2]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import os
from kmodes.kmodes import KModes

plt.style.use('seaborn-deep')

%matplotlib inline
# Eliminates output truncation
pd.options.display.max_columns = 999
# Use seaborn style defaults and set the default figure size
pd.set_option('display.max_rows', None)
# Use seaborn style defaults and set the default figure size
sns.set(rc={'figure.figsize':(11, 6)})

os.chdir('C:\\Users\orion.darley\\Desktop\\ML HW\\')
cwd = os.getcwd()
```

In [3]:

```
def remove_nan_and_zeroes_from_columns(df, variable):
    filtered_df  = df.replace([np.inf, -np.inf], np.nan)
    filtered_df = filtered_df[(filtered_df[variable].notnull()) & (filtered_df[variable] >= 1)]
    return filtered_df
```

Load

In [4]:

```
url = 'https://raw.githubusercontent.com/OrionDarley/Public-Other/master/ecommerce%20clustering/Worksheet%20in%2
df = pd.read_csv(url, error_bad_lines=False)
```

Data Prep

In [5]:

```
print(df.describe())
print('----------------------')
print(df.Interests.value_counts())
print('----------------------')
print(df.Gender.value_counts())
print('----------------------')
print(df.shape)
print(df.isnull().sum())
print(df.info())
```

```
       Unnamed: 0          Age  Annual Income  Total Spending
count  1600.00000  1598.000000    1596.000000     1600.000000
mean    799.50000    37.895494     187.129699     2575.600781
std     462.02453    16.226009    5004.797654     1453.083432
min       0.00000    14.000000    -100.000000     -102.500000
25%     399.75000    28.000000      39.000000     1383.750000
50%     799.50000    35.000000      65.000000     2511.250000
75%    1199.25000    47.000000      81.000000     3843.750000
max    1599.00000   350.000000  200000.000000     5176.250000
----------------------
Entertainment      139
Hiking             137
Travel             132
Reading            131
Yoga               116
Crafts             115
Camping            108
Technology         102
Photography         98
Exercise            97
Music               92
Art                 88
Gaming              71
Strategic games     57
Sports              37
Pets                28
Automobiles         28
Cooking             19
Gardening            5
Name: Interests, dtype: int64
----------------------
female    812
male      788
```

```
Name: Gender, dtype: int64
----------------------
(1600, 6)
Unnamed: 0        0
Gender            0
Age               2
Annual Income     4
Total Spending    0
Interests         0
dtype: int64
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1600 entries, 0 to 1599
Data columns (total 6 columns):
Unnamed: 0        1600 non-null int64
Gender            1600 non-null object
Age               1598 non-null float64
Annual Income     1596 non-null float64
Total Spending    1600 non-null float64
Interests         1600 non-null object
dtypes: float64(3), int64(1), object(2)
memory usage: 75.1+ KB
None
```

In [6]:

```
#Remove data errors, negative values, zeros
df['Annual Income'] = df['Annual Income'].mask(df['Annual Income'] == 200000, 0)
df['Annual Income'] = df['Annual Income'].mask(df['Annual Income'] <= 0, 0)
df['Total Spending'] = df['Total Spending'].mask(df['Total Spending'] <= 0, 0)
df['Age'] = df['Age'].mask(df['Age'] >= 100, 0)
df = remove_nan_and_zeroes_from_columns(df, 'Age')
df = remove_nan_and_zeroes_from_columns(df, 'Annual Income')
df = remove_nan_and_zeroes_from_columns(df, 'Total Spending')
df = df.drop(['Unnamed: 0'],axis = 1)
df.describe()
```

Out[6]:

	Age	Annual Income	Total Spending
count	1583.000000	1583.000000	1583.000000
mean	37.569172	61.943146	2585.615919
std	13.232153	28.755595	1446.813956
min	14.000000	3.000000	51.250000
25%	28.000000	39.000000	1435.000000
50%	35.000000	65.000000	2562.500000
75%	47.000000	81.000000	3843.750000
max	73.000000	158.000000	5176.250000

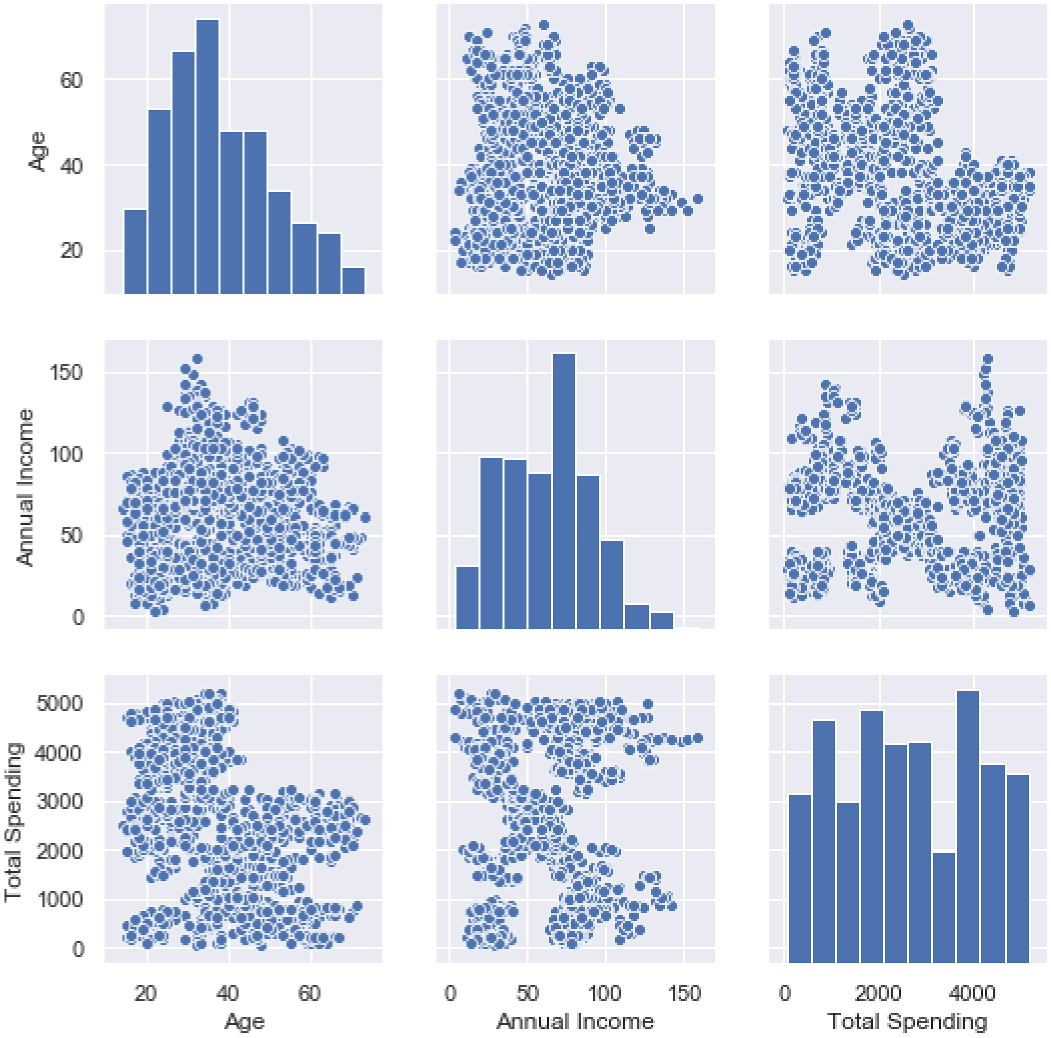
In [7]:

```
dfcat = df[['Gender', 'Interests']]
dfnum = df.drop(['Gender', 'Interests'], axis = 1)
```

EDA

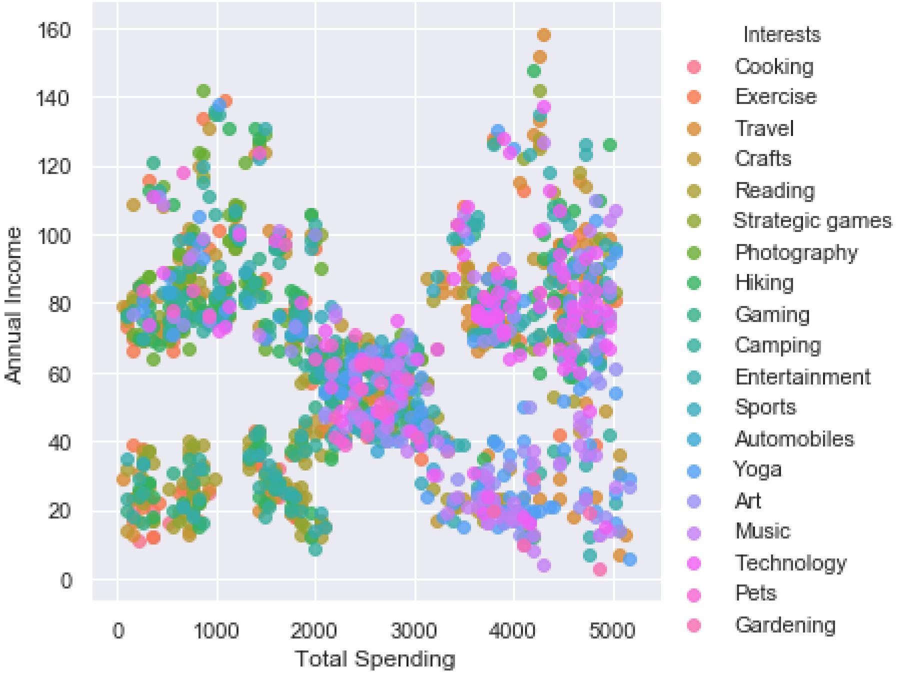
```
In [8]: # Basic correlogram
        sns.pairplot(df)
```

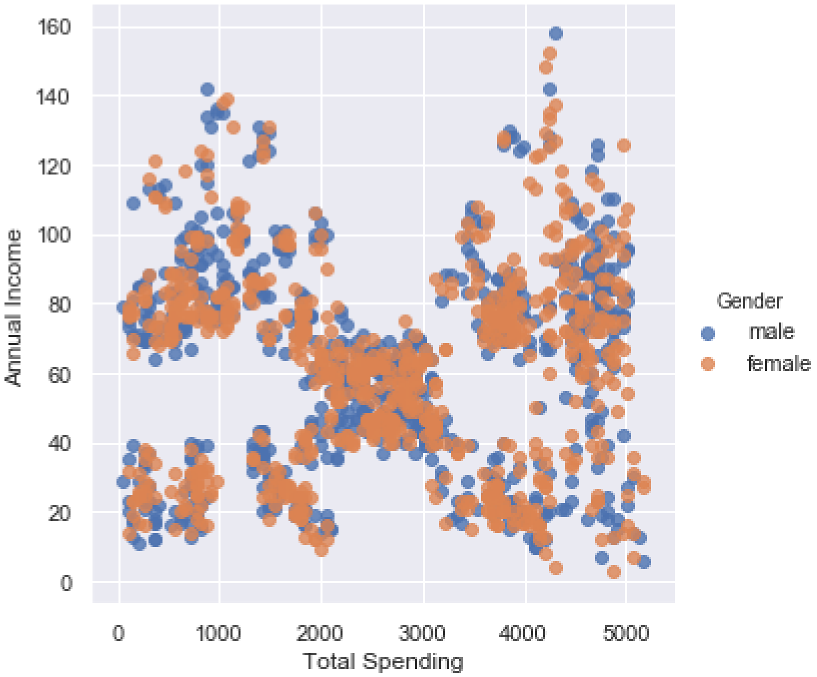
```
Out[8]: <seaborn.axisgrid.PairGrid at 0x263885c8400>
```



```
In [9]: # Use the 'hue' argument to provide a factor variable
        # sns.set(rc={'figure.figsize':(24,15)})
        print(sns.lmplot(x='Total Spending', y="Annual Income", data=df, fit_reg=False, hue='Interests', legend=True))
        print(sns.lmplot(x='Total Spending', y="Annual Income", data=df, fit_reg=False, hue='Gender', legend=True))
        #sns.plt.show()
```

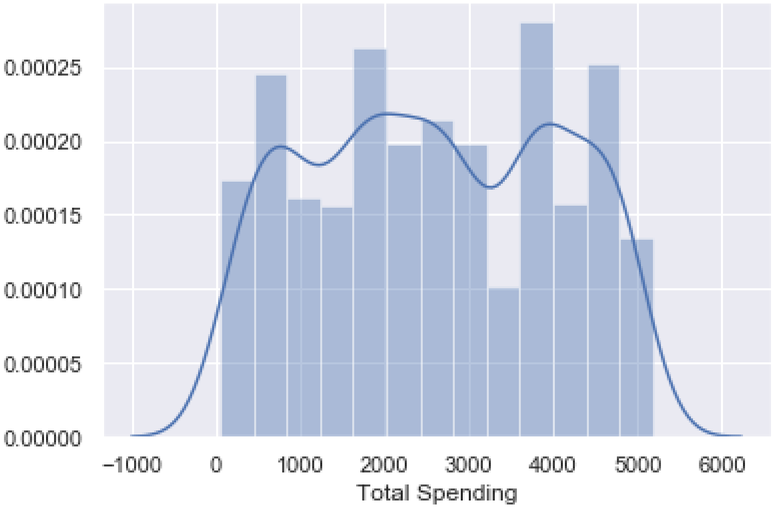
```
<seaborn.axisgrid.FacetGrid object at 0x0000026388DACA20>
<seaborn.axisgrid.FacetGrid object at 0x0000026388BFB2E8>
```





In [10]:
```
print(sns.distplot(df['Total Spending']))
```

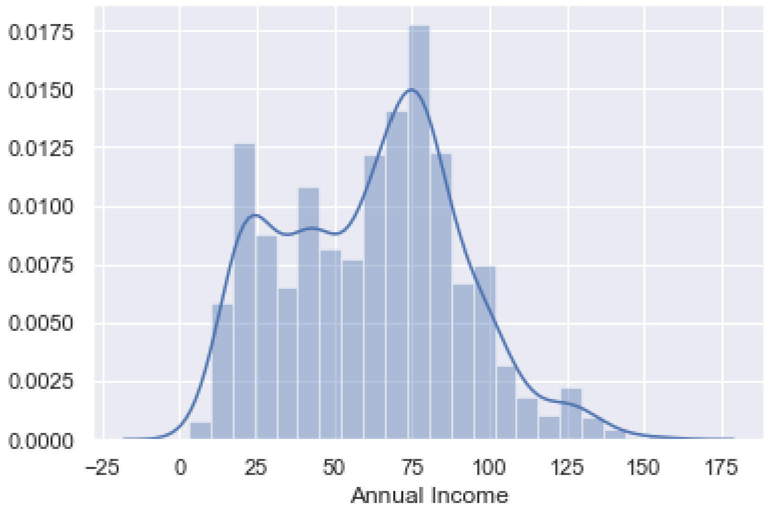
```
AxesSubplot(0.125,0.125;0.775x0.755)
```



In [11]:

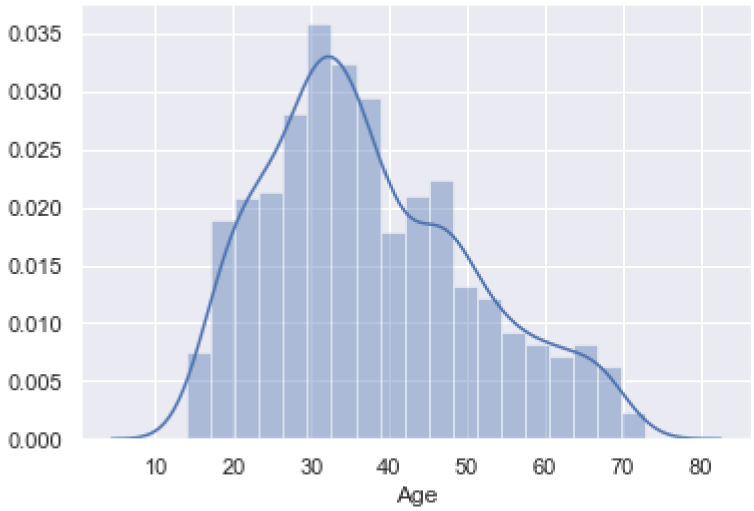
```
print(sns.distplot(df['Annual Income']))
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```



```
In [12]: print(sns.distplot(df['Age']))
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```



More Data Prep

```
In [13]: df_new = df.copy()
         df_new['age_bin'] = pd.cut(df_new['Age'], [0, 20, 30, 40, 50, 60, 70, 80],
                                    labels=['0-20', '20-30', '30-40', '40-50','50-60','60-70','70-80'])
         df_new = df_new.drop('Age',axis = 1)
```

```
In [14]: df_new['income_bin'] = pd.cut(df_new['Annual Income'], [0, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 1
                                    labels=['0-20', '20-30', '30-40', '40-50','50-60','60-70','70-80', '80-90','90-10
                                           '100-110','110-120','120-130', '130-140','140-150','150-160'])
         df_new = df_new.drop('Annual Income',axis = 1)
```

```
In [15]: df_new['spending_bin'] = pd.cut(df_new['Total Spending'], [0, 1000, 2000, 3000, 4000, 5000, 6000],
                                    labels=['0-1000', '1000-2000','2000-3000','3000-4000','4000-5000','5000-6000'])
         df_new = df_new.drop('Total Spending',axis = 1)
```

In [16]:

```
df_new2 = df_new.copy()

from sklearn import preprocessing
le = preprocessing.LabelEncoder()
df_new2 = df_new.apply(le.fit_transform)
df_new2.head(1000)
```

Out[16]:

	Gender	Interests	age_bin	income_bin	spending_bin
0	1	3	1	0	0
1	1	6	2	0	0
2	1	17	5	0	0
3	1	4	5	0	0
4	0	17	4	7	0
6	1	17	3	7	0
7	0	17	4	7	0
8	0	13	5	7	0
9	0	13	4	8	0
10	0	15	4	7	0
11	1	15	3	8	0

In [17]:

```
km_cao = KModes(n_clusters=2, init = "Cao", n_init = 1, verbose=1)
fitClusters_cao = km_cao.fit_predict(df_new2)
fitClusters_cao
```

```
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 0, cost: 4967.0
```

Out[17]:

```
array([1, 0, 1, ..., 0, 0, 1], dtype=uint16)
```

In [18]:

```
clusterCentroidsDf = pd.DataFrame(km_cao.cluster_centroids_)
clusterCentroidsDf.columns = df_new2.columns

# Mode of the clusters
clusterCentroidsDf
```

Out[18]:

	Gender	Interests	age_bin	income_bin	spending_bin
0	0	5	2	12	3
1	1	9	1	11	2

In [19]:

```
km_huang = KModes(n_clusters=2, init = "Huang", n_init = 1, verbose=1)
fitClusters_huang = km_huang.fit_predict(df_new2)
fitClusters_huang
```

```
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 156, cost: 5066.0
Run 1, iteration: 2/100, moves: 0, cost: 5066.0
```

Out[19]:

```
array([0, 0, 0, ..., 0, 0, 0], dtype=uint16)
```

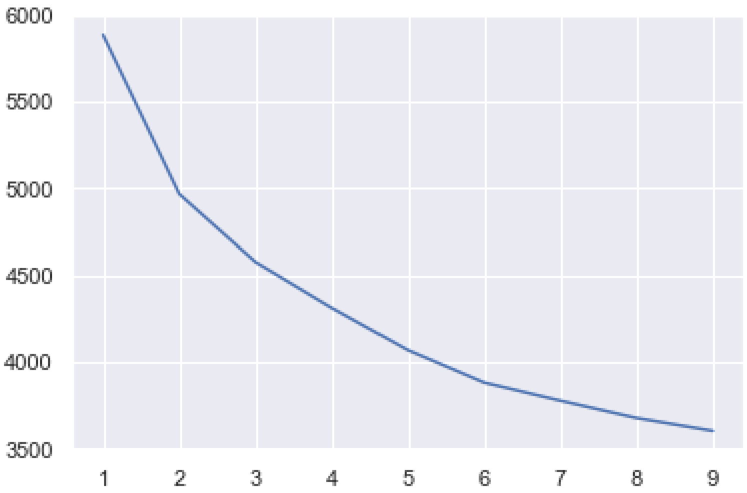
In [20]:

```
cost = []

for num_clusters in list(range(1,10)):
    kmode = KModes(n_clusters=num_clusters, init = "Cao", n_init = 1, verbose=1)
    kmode.fit_predict(df_new2)
    cost.append(kmode.cost_)

y = np.array([i for i in range(1,10,1)])
plt.plot(y,cost)
```

```
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 0, cost: 5884.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 0, cost: 4967.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 0, cost: 4576.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 0, cost: 4312.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 35, cost: 4068.0
Run 1, iteration: 2/100, moves: 0, cost: 4068.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 33, cost: 3881.0
Run 1, iteration: 2/100, moves: 0, cost: 3881.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 29, cost: 3777.0
Run 1, iteration: 2/100, moves: 0, cost: 3777.0
Init: initializing centroids
Init: initializing clusters
```

```
Starting iterations...
Run 1, iteration: 1/100, moves: 89, cost: 3677.0
Run 1, iteration: 2/100, moves: 0, cost: 3677.0
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 87, cost: 3603.0
Run 1, iteration: 2/100, moves: 0, cost: 3603.0
```

```
Out[20]: [<matplotlib.lines.Line2D at 0x2638964c5c0>]
```



```
In [21]: km_cao = KModes(n_clusters=3, init = "Cao", n_init = 1, verbose=1)
         fitClusters_cao = km_cao.fit_predict(df_new2)
         fitClusters_cao
```

```
Init: initializing centroids
Init: initializing clusters
Starting iterations...
Run 1, iteration: 1/100, moves: 0, cost: 4576.0
```

```
Out[21]: array([1, 2, 1, ..., 0, 0, 1], dtype=uint16)
```

Post-processesing & prediction evaluation

In [22]:

```
clustersDf = pd.DataFrame(fitClusters_cao)
clustersDf.columns = ['cluster_predicted']
combinedDf = pd.concat([df_new, clustersDf], axis = 1).reset_index()
combinedDf = combinedDf.drop(['index'], axis = 1)

combinedDf.head()
```

Out[22]:

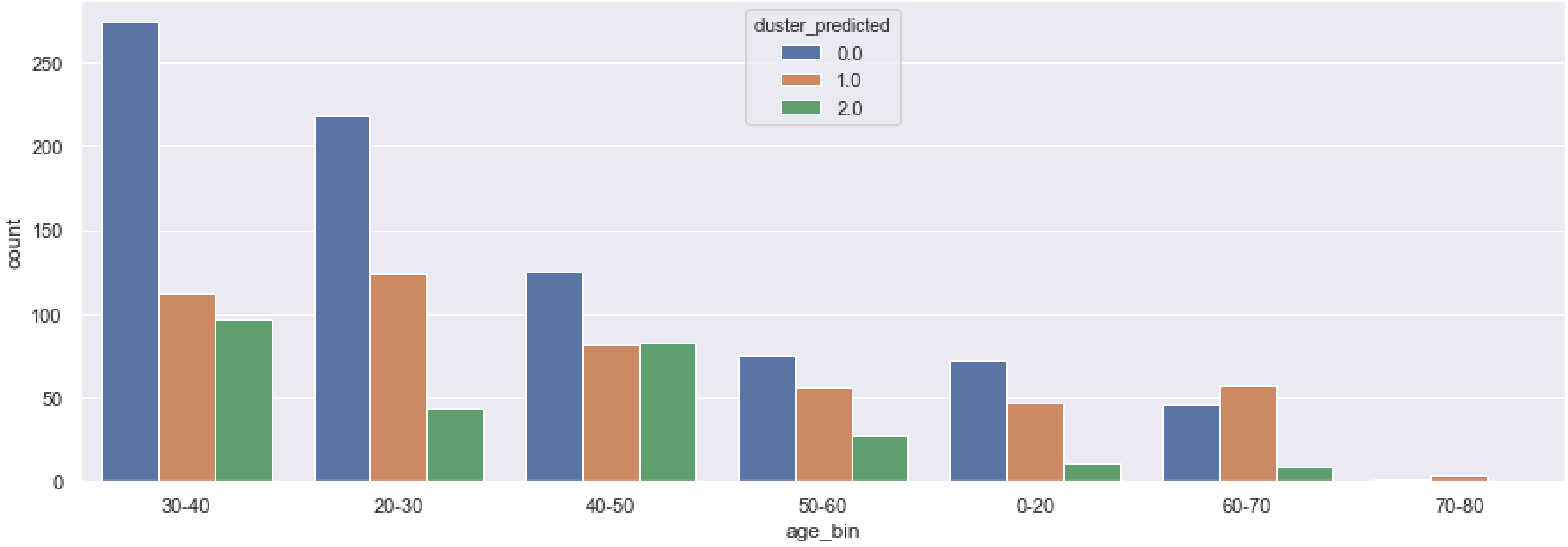
	Gender	Interests	age_bin	income_bin	spending_bin	cluster_predicted
0	male	Cooking	20-30	0-20	0-1000	1.0
1	male	Exercise	30-40	0-20	0-1000	2.0
2	male	Travel	60-70	0-20	0-1000	1.0
3	male	Crafts	60-70	0-20	0-1000	1.0
4	female	Travel	50-60	20-30	0-1000	0.0

In [23]:

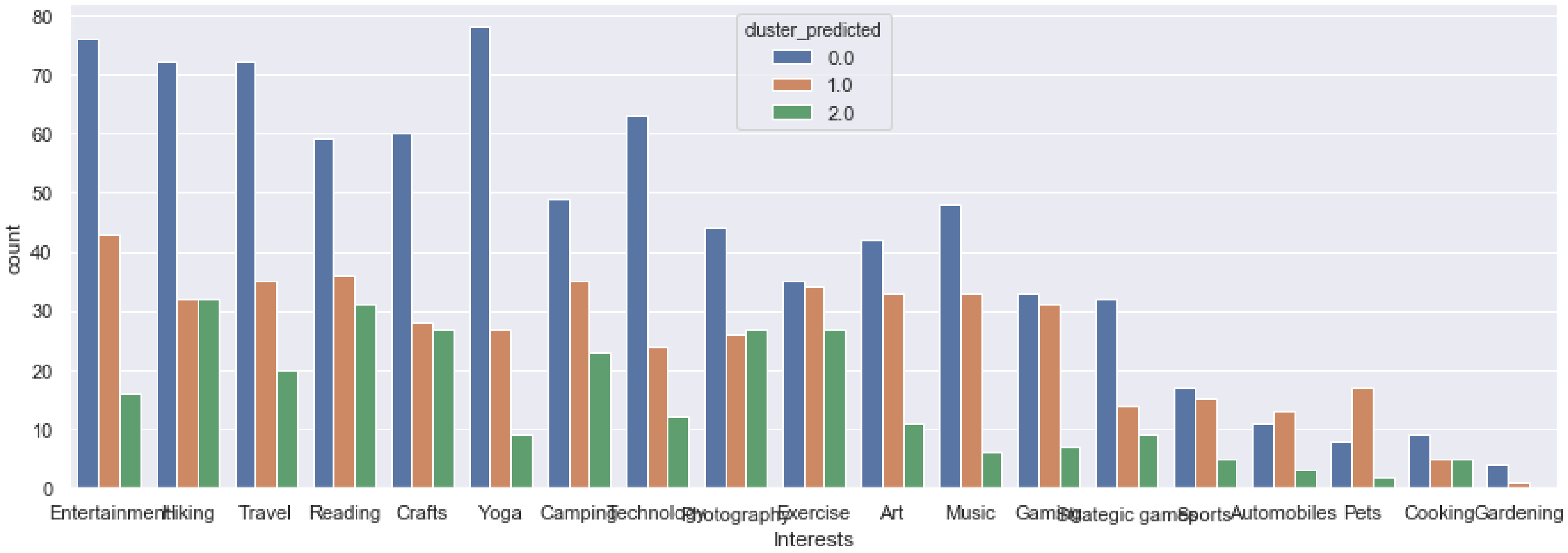
```
cluster_0 = combinedDf[combinedDf['cluster_predicted'] == 0]
cluster_1 = combinedDf[combinedDf['cluster_predicted'] == 1]
cluster_2 = combinedDf[combinedDf['cluster_predicted'] == 2]
```

In [24]:

```
plt.subplots(figsize = (15,5))
sns.countplot(x=combinedDf['age_bin'],order=combinedDf['age_bin'].value_counts().index,hue=combinedDf['cluster_p
plt.show()
```

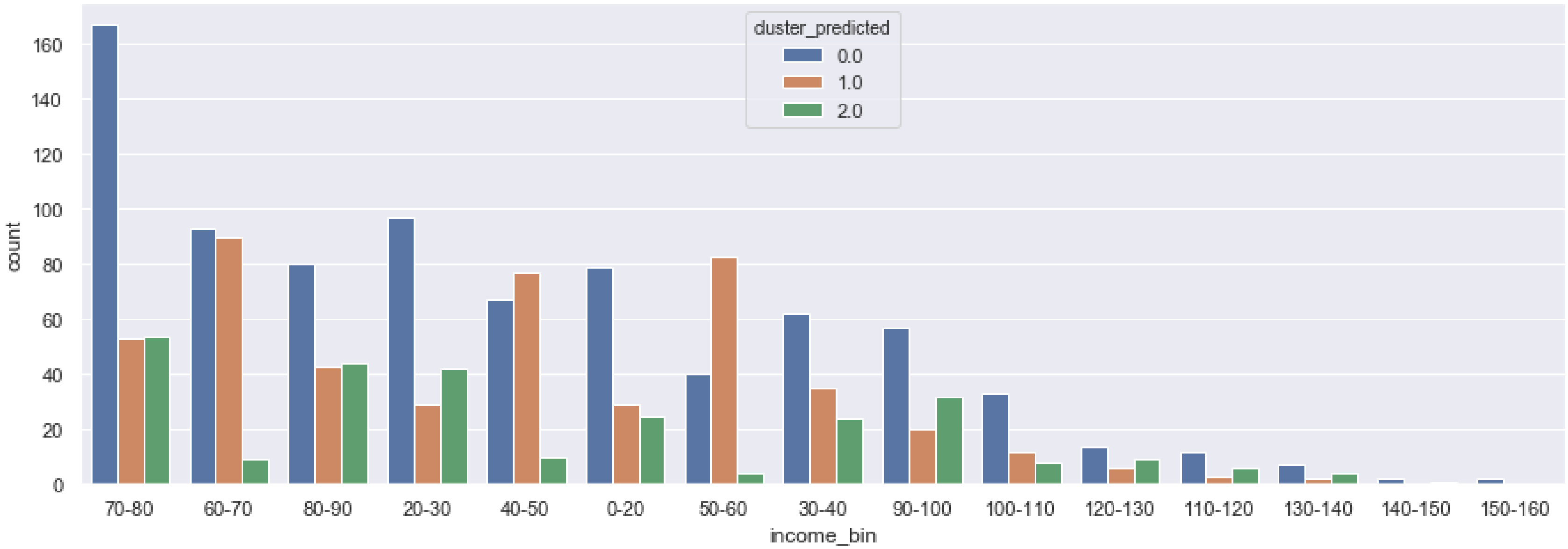


In [25]:
```
plt.subplots(figsize = (15,5))
sns.countplot(x=combinedDf['Interests'],order=combinedDf['Interests'].value_counts().index,hue=combinedDf['clust
plt.show()
```



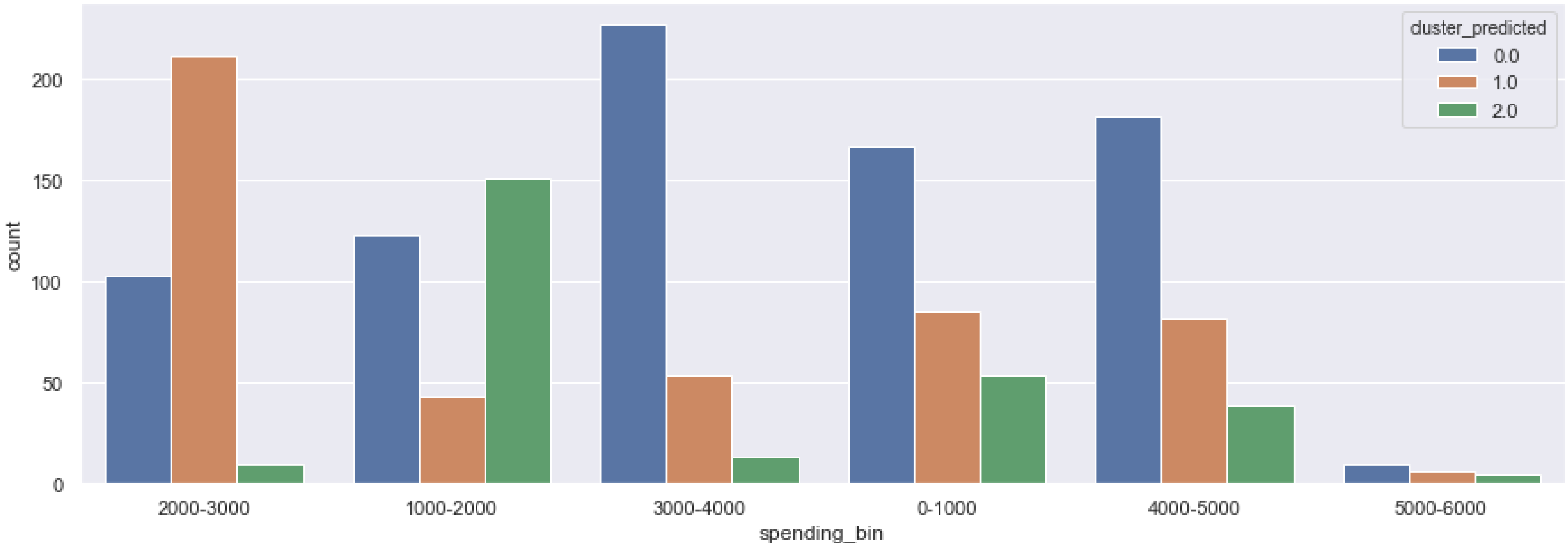
In [26]:

```
plt.subplots(figsize = (15,5))
sns.countplot(x=combinedDf['income_bin'],order=combinedDf['income_bin'].value_counts().index,hue=combinedDf['clu
plt.show()
```



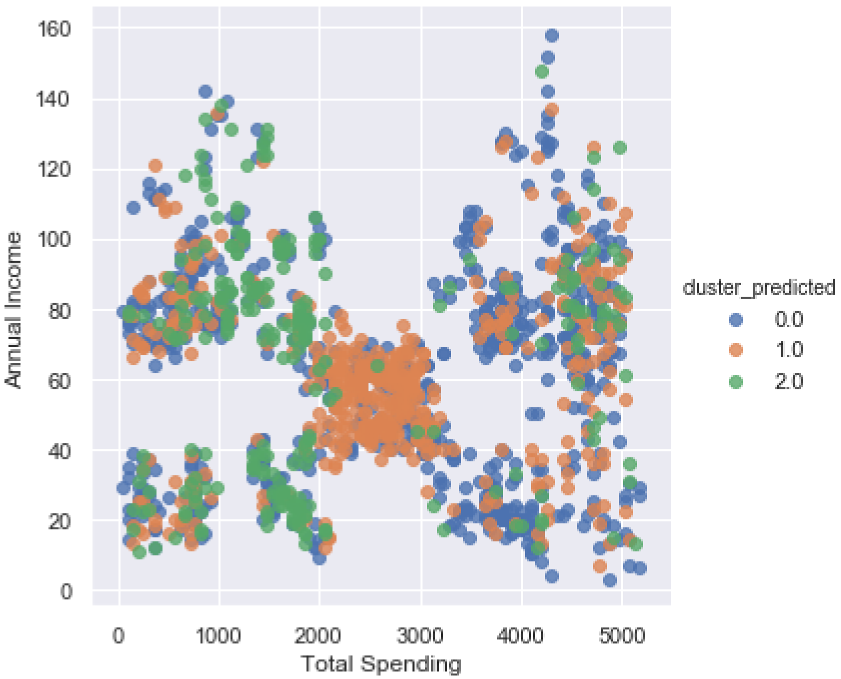
In [27]:

```
plt.subplots(figsize = (15,5))
sns.countplot(x=combinedDf['spending_bin'],order=combinedDf['spending_bin'].value_counts().index,hue=combinedDf[
plt.show()
```



In [31]:
```
combinedDf2 = pd.concat([df, clustersDf], axis = 1).reset_index()
combinedDf2 = combinedDf2.drop(['index'], axis = 1)

combinedDf2.head()

print(sns.lmplot(x='Total Spending', y="Annual Income", data=combinedDf2, fit_reg=False, hue='cluster_predicted'
```

```
<seaborn.axisgrid.FacetGrid object at 0x0000026389AB56D8>
```



In [ ]: