Find whether any country stands out based on their average eating habits using AutoEncoder

Import required libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

Load data

In [2]:
```
df = pd.read_csv('UK_foods.csv', index_col='Unnamed: 0') #Set index_col to the required
```

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 17 entries, Cheese to Confectionery
Data columns (total 4 columns):
England      17 non-null int64
Wales        17 non-null int64
Scotland     17 non-null int64
N.Ireland    17 non-null int64
dtypes: int64(4)
memory usage: 680.0+ bytes
```

In [4]:
```
df.columns
```

Out[4]:
```
Index(['England', 'Wales', 'Scotland', 'N.Ireland'], dtype='object')
```

In [5]:
```
df.head()
```

Out[5]:

	England	Wales	Scotland	N.Ireland
Cheese	105	103	103	66
Carcass_meat	245	227	242	267
Other_meat	685	803	750	586
Fish	147	160	122	93
Fats_and_oils	193	235	184	209

In [6]:
```
df.describe()
```

Out[6]:

	England	Wales	Scotland	N.Ireland
count	17.000000	17.000000	17.000000	17.000000
mean	469.647059	503.941176	460.235294	429.941176
std	452.701466	463.859282	469.595907	479.896014
min	54.000000	64.000000	53.000000	41.000000

	England	Wales	Scotland	N.Ireland
25%	156.000000	175.000000	147.000000	135.000000
50%	253.000000	265.000000	242.000000	209.000000
75%	685.000000	803.000000	566.000000	586.000000
max	1472.000000	1582.000000	1572.000000	1506.000000

Transpose the DataFrame

In [7]:
```
type(df)
```

Out[7]:
```
pandas.core.frame.DataFrame
```

In [8]:
```
type(df['England'])
```

Out[8]:
```
pandas.core.series.Series
```

In [9]:
```
t_df = df.transpose()
```

In [10]:
```
t_df.columns
```

Out[10]:
```
Index(['Cheese', 'Carcass_meat ', 'Other_meat ', 'Fish', 'Fats_and_oils ',
       'Sugars', 'Fresh_potatoes ', 'Fresh_Veg ', 'Other_Veg ',
       'Processed_potatoes ', 'Processed_Veg ', 'Fresh_fruit ', 'Cereals ',
       'Beverages', 'Soft_drinks ', 'Alcoholic_drinks ', 'Confectionery '],
      dtype='object')
```

In [11]:
```
t_df
```

Out[11]:

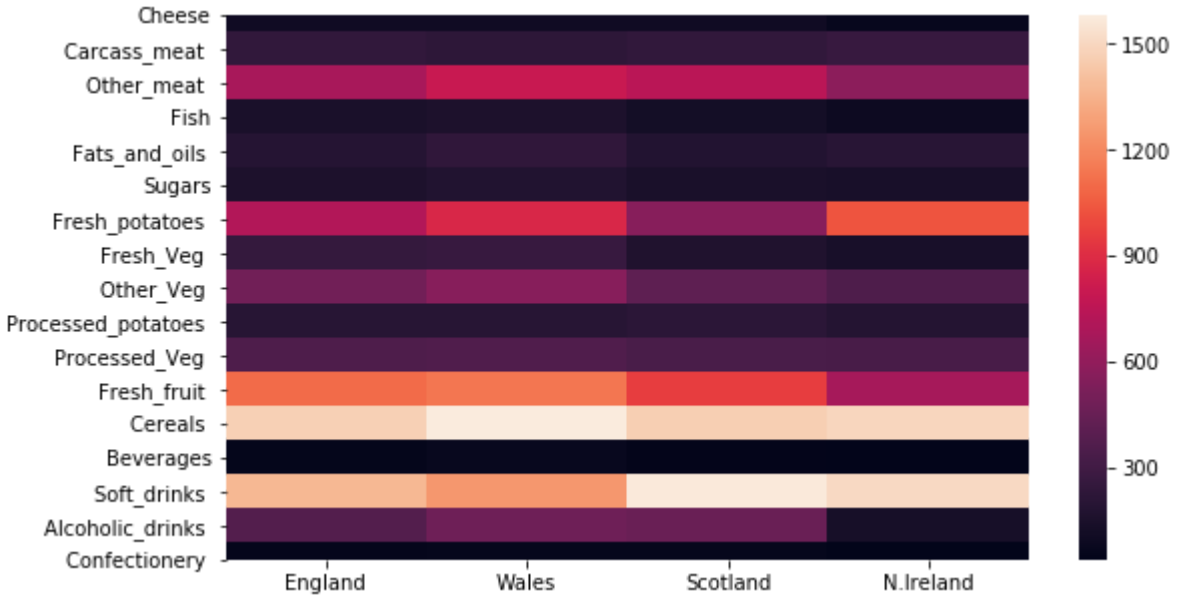
	Cheese	Carcass_meat	Other_meat	Fish	Fats_and_oils	Sugars	Fresh_potatoes	Fresh_Veg	O
England	105	245	685	147	193	156	720	253	
Wales	103	227	803	160	235	175	874	265	
Scotland	103	242	750	122	184	147	566	171	
N.Ireland	66	267	586	93	209	139	1033	143	

In [12]:
```
#t_df = t_df.astype('category')
```

Visulaize data using Heatmap

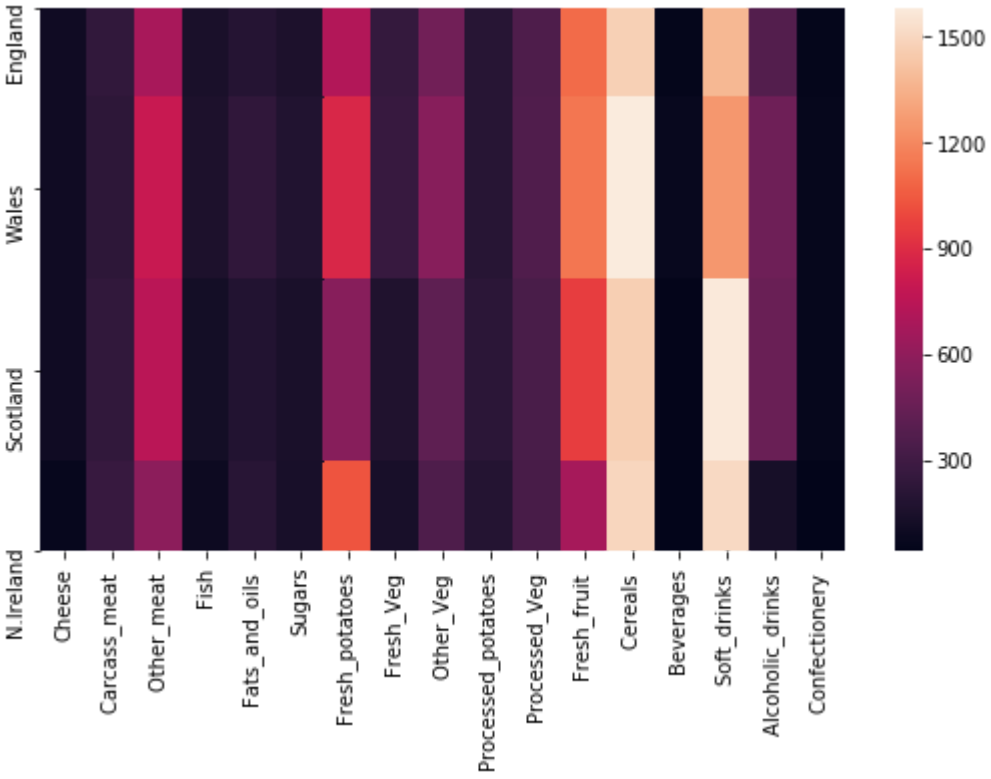
In [13]:
```
plt.figure(figsize=(9,5))
sns.heatmap(df)
```

Out[13]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x15b41b0da08>
```



In [14]:
```
plt.figure(figsize=(9,5))
sns.heatmap(t_df)
```

Out[14]: `<matplotlib.axes._subplots.AxesSubplot at 0x15b49c5f488>`



Import required libraries to create the AutoEncoder

In [15]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import SGD
```

Create an Encoder with the layers as -> 17-8-4-2

In [78]:
```
encoder = Sequential()
```

```
encoder.add(Dense(8, activation='tanh',input_shape=[17]))
encoder.add(Dense(4, activation='tanh',input_shape=[8]))
encoder.add(Dense(2, activation='tanh',input_shape=[4]))
#Input_shape can be excluded after first entry
```

Create a Decoder with the layers as -> 2-4-8-17

In [79]:
```
decoder = Sequential()

decoder.add(Dense(units=4, activation='tanh', input_shape=[2]))
decoder.add(Dense(units=8, activation='tanh', input_shape=[4]))
decoder.add(Dense(units=17, activation='tanh', input_shape=[8]))
```

Combine Encoder & Decoder to form the AutoEncoder

In [80]:
```
autoencoder = Sequential([encoder,decoder])

autoencoder.compile(loss='mse',optimizer=SGD(lr=1.5))
#Instead of adam optimizer, we are using Stochastic Gradient Descent with a learning ra
#Since values are continuous, loss is mse
```

Scale the Dataset

In [81]:
```
from sklearn.preprocessing import MinMaxScaler
```

In [82]:
```
scaler = MinMaxScaler()
```

In [83]:
```
scaled_df = scaler.fit_transform(df.transpose().values) #.values is used to ensure we g
```

In [84]:
```
#Shape should be (4,17)
scaled_df.shape
```

Out[84]:
```
(4, 17)
```

In [85]:
```
scaled_df
```

Out[85]:
```
array([[1.        , 0.45      , 0.4562212 , 0.80597015, 0.17647059,
        0.47222222, 0.32976445, 0.90163934, 0.61860465, 0.33333333,
        0.83870968, 0.92440605, 0.08333333, 0.38461538, 0.37341772,
        0.70588235, 0.56521739],
       [0.94871795, 0.        , 1.        , 1.        , 1.        ,
        1.        , 0.65952891, 1.        , 1.        , 0.48484848,
        1.        , 1.        , 1.        , 1.        , 0.        ,
        1.        , 1.        ],
       [0.94871795, 0.375     , 0.75576037, 0.43283582, 0.        ,
        0.22222222, 0.        , 0.2295082 , 0.29302326, 1.        ,
        0.09677419, 0.6112311 , 0.        , 0.23076923, 1.        ,
        0.95      , 0.91304348],
       [0.        , 1.        , 0.        , 0.        , 0.49019608,
        0.        , 1.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.26666667, 0.        , 0.79113924,
        0.        , 0.        ]])
```

Fit AutoEncoder to scaled data

In [86]:
```
autoencoder.fit(scaled_df,scaled_df,epochs=15)
```

```
Train on 4 samples
Epoch 1/15
4/4 [==============================] - 0s 98ms/sample - loss: 0.4559
Epoch 2/15
4/4 [==============================] - 0s 4ms/sample - loss: 0.2987
Epoch 3/15
4/4 [==============================] - 0s 1000us/sample - loss: 0.2107
Epoch 4/15
4/4 [==============================] - 0s 999us/sample - loss: 0.1746
Epoch 5/15
4/4 [==============================] - 0s 2ms/sample - loss: 0.1599
Epoch 6/15
4/4 [==============================] - 0s 749us/sample - loss: 0.1531
Epoch 7/15
4/4 [==============================] - 0s 1ms/sample - loss: 0.1491
Epoch 8/15
4/4 [==============================] - 0s 753us/sample - loss: 0.1461
Epoch 9/15
4/4 [==============================] - 0s 1ms/sample - loss: 0.1432
Epoch 10/15
4/4 [==============================] - 0s 1ms/sample - loss: 0.1401
Epoch 11/15
4/4 [==============================] - 0s 746us/sample - loss: 0.1365
Epoch 12/15
4/4 [==============================] - 0s 755us/sample - loss: 0.1322
Epoch 13/15
4/4 [==============================] - 0s 749us/sample - loss: 0.1272
Epoch 14/15
4/4 [==============================] - 0s 748us/sample - loss: 0.1213
Epoch 15/15
4/4 [==============================] - 0s 1ms/sample - loss: 0.1149
```

Out[86]: `<tensorflow.python.keras.callbacks.History at 0x15b533eca48>`

Predict reduced dimensionality output from Encoder

In [87]:
```
encoded_2_dim = encoder.predict(scaled_df)
```

In [88]:
```
encoded_2_dim
```

Out[88]:
```
array([[ 0.32416028,  0.83987844],
       [ 0.5911264 ,  0.84721285],
       [-0.3215528 ,  0.8651822 ],
       [-0.72358733,  0.902552  ]], dtype=float32)
```

In [89]:
```
df.transpose().index
```

Out[89]:
```
Index(['England', 'Wales', 'Scotland', 'N.Ireland'], dtype='object')
```

In [90]:
```
t_df.index
```

Out[90]:
```
Index(['England', 'Wales', 'Scotland', 'N.Ireland'], dtype='object')
```

Join the encoded data with country index

In [91]:
```
results = pd.DataFrame(data=encoded_2_dim,index=t_df.index,columns=['C1','C2'])
```

In [92]:
```
results
```

Out[92]:

	C1	C2

	C1	C2
England	**0.324160**	**0.839878**
Wales	**0.591126**	**0.847213**
Scotland	**-0.321553**	**0.865182**
N.Ireland	**-0.723587**	**0.902552**

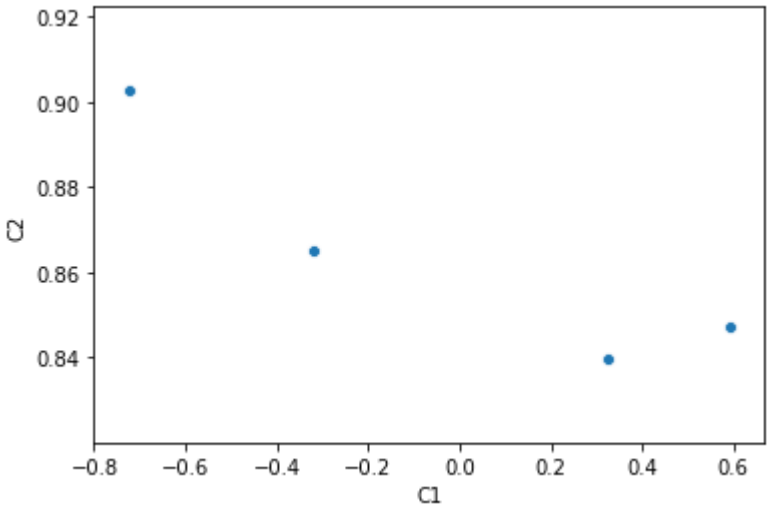
In [93]:
```
results.reset_index()
```

Out[93]:

	index	C1	C2
0	**England**	**0.324160**	**0.839878**
1	**Wales**	**0.591126**	**0.847213**
2	**Scotland**	**-0.321553**	**0.865182**
3	**N.Ireland**	**-0.723587**	**0.902552**

In [100…
```
sns.scatterplot(x='C1',y='C2',data=results)
```

Out[100…
```
<matplotlib.axes._subplots.AxesSubplot at 0x15b5374b288>
```



Note: If the Encoder gives all values as 0 at output, change the activaton function. In above case, I have changed it to 'tanh' instead of 'relu', as 'relu' was returning all values as 0. You can try LeakyReLU as well

In [ ]: