McDonald's case study-Market segmentation

January 29, 2024

[2]:
```
#IMPORTING THE IMPORTANT LIBRARIES
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
!pip install yellowbrick
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: yellowbrick in ./.local/lib/python3.10/site-
packages (1.5)
Requirement already satisfied: matplotlib!=3.0.0,>=2.0.2 in
/usr/local/lib/python3.10/site-packages (from yellowbrick) (3.6.3)
Requirement already satisfied: scipy>=1.0.0 in /usr/local/lib/python3.10/site-
packages (from yellowbrick) (1.9.3)
Requirement already satisfied: scikit-learn>=1.0.0 in
/usr/local/lib/python3.10/site-packages (from yellowbrick) (1.3.1)
Requirement already satisfied: numpy>=1.16.0 in /usr/local/lib/python3.10/site-
packages (from yellowbrick) (1.23.5)
Requirement already satisfied: cycler>=0.10.0 in /usr/local/lib/python3.10/site-
packages (from yellowbrick) (0.11.0)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/site-packages (from
matplotlib!=3.0.0,>=2.0.2->yellowbrick) (1.0.7)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/site-packages (from
matplotlib!=3.0.0,>=2.0.2->yellowbrick) (4.33.3)
Requirement already satisfied: kiwisolver>=1.0.1 in
/usr/local/lib/python3.10/site-packages (from
matplotlib!=3.0.0,>=2.0.2->yellowbrick) (1.4.3)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.10/site-packages (from
matplotlib!=3.0.0,>=2.0.2->yellowbrick) (22.0)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/site-
packages (from matplotlib!=3.0.0,>=2.0.2->yellowbrick) (9.1.1)
Requirement already satisfied: pyparsing>=2.2.1 in
/usr/local/lib/python3.10/site-packages (from
matplotlib!=3.0.0,>=2.0.2->yellowbrick) (3.0.9)
```

```
Requirement already satisfied: python-dateutil>=2.7 in
/usr/local/lib/python3.10/site-packages (from
matplotlib!=3.0.0,>=2.0.2->yellowbrick) (2.8.2)
Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/site-
packages (from scikit-learn>=1.0.0->yellowbrick) (1.2.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/usr/local/lib/python3.10/site-packages (from scikit-learn>=1.0.0->yellowbrick)
(3.1.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/site-
packages (from python-dateutil>=2.7->matplotlib!=3.0.0,>=2.0.2->yellowbrick)
(1.16.0)

[notice] A new release of pip is
available: 23.3 -> 23.3.2
[notice] To update, run:
pip install --upgrade pip
```

[3]:
```
mcdonalds=pd.read_csv("mcdonalds.csv")
```

[4]:
```
mcdonalds.columns
```

[4]:
```
Index(['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap',
       'tasty', 'expensive', 'healthy', 'disgusting', 'Like', 'Age',
       'VisitFrequency', 'Gender'],
      dtype='object')
```

[5]:
```
mcdonalds.shape
```

[5]:
```
(1453, 15)
```

[27]:
```
mcdonalds.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1453 entries, 0 to 1452
Data columns (total 15 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   yummy           1453 non-null   object
 1   convenient      1453 non-null   object
 2   spicy           1453 non-null   object
 3   fattening       1453 non-null   object
 4   greasy          1453 non-null   object
 5   fast            1453 non-null   object
 6   cheap           1453 non-null   object
 7   tasty           1453 non-null   object
 8   expensive       1453 non-null   object
 9   healthy         1453 non-null   object
 10  disgusting      1453 non-null   object
```

```
 11  Like            1453 non-null   object
 12  Age             1453 non-null   int64
 13  VisitFrequency  1453 non-null   object
 14  Gender          1453 non-null   object
dtypes: int64(1), object(14)
memory usage: 170.4+ KB
```

[6]:
```
mcdonalds.describe()
```

[6]:
```
                Age
count  1453.000000
mean     44.604955
std      14.221178
min      18.000000
25%      33.000000
50%      45.000000
75%      57.000000
max      71.000000
```

[28]:
```
print(pd.isnull(mcdonalds).sum())
```

```
yummy             0
convenient        0
spicy             0
fattening         0
greasy            0
fast              0
cheap             0
tasty             0
expensive         0
healthy           0
disgusting        0
Like              0
Age               0
VisitFrequency    0
Gender            0
dtype: int64
```

[ ]:
```
# There are no null values.
```

[7]:
```
mcdonalds.head(5)
```

[7]:

	yummy	convenient	spicy	fattening	greasy	fast	cheap	tasty	expensive	healthy	\
0	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No	
1	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	
2	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	
3	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	

```
4    No        Yes    No       Yes    Yes  Yes   Yes    No        No     Yes

  disgusting Like  Age      VisitFrequency  Gender
0         No   -3   61  Every three months  Female
1         No   +2   51  Every three months  Female
2         No   +1   62  Every three months  Female
3        Yes   +4   69         Once a week  Female
4         No   +2   49        Once a month    Male
```

[ ]:
```
# # From this output we can see that the first respondent is a 61 year old␣
↪female who eats at McDonald's every 3 months and she believes that is not␣
↪yummy, convenient, not spicy, fattening, not greasy, fast, cheap, not tasty,␣
↪expensive,not healthy and not disgusting
```

[8]:
```
mcdonalds.dtypes
```

[8]:
```
yummy             object
convenient        object
spicy             object
fattening         object
greasy            object
fast              object
cheap             object
tasty             object
expensive         object
healthy           object
disgusting        object
Like              object
Age                int64
VisitFrequency    object
Gender            object
dtype: object
```

[25]:
```
mcdonalds['yummy'].value_counts()
```

[25]:
```
Yes    803
No     650
Name: yummy, dtype: int64
```

[26]:
```
mcdonalds['Age'].value_counts()
```

[26]:
```
55    53
60    38
37    37
59    36
57    36
52    36
```

58	35
36	35
49	34
62	34
50	34
32	33
44	32
56	32
64	32
53	31
26	31
24	30
35	30
51	30
47	30
42	30
23	30
39	29
29	28
34	28
30	28
38	27
40	27
31	27
25	26
33	26
61	26
67	26
48	26
43	25
27	25
63	25
54	24
41	23
22	23
65	23
45	22
20	21
46	19
28	18
66	17
21	16
18	16
70	15
69	14
68	13
19	10

```
71     1
Name: Age, dtype: int64
```

[29]:
```
mcdonalds.corr()
```

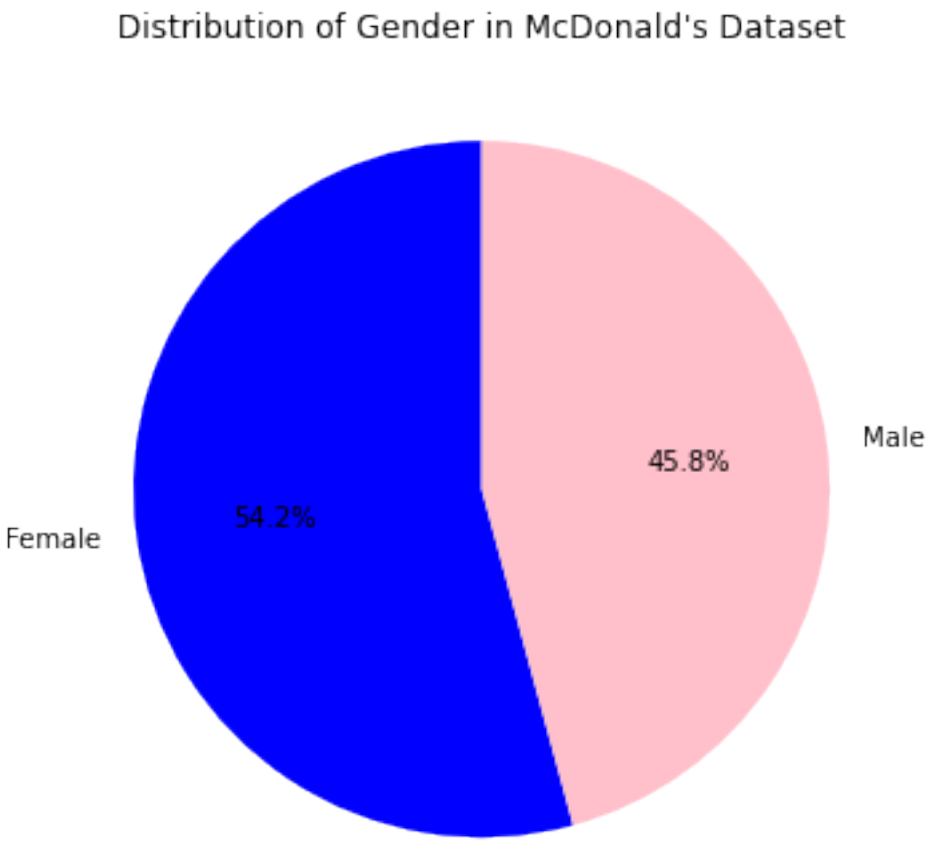
```
/tmp/ipykernel_758/2370541813.py:1: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  mcdonalds.corr()
```

[29]:

	Age
Age	1.0

[30]:
```
# Basic market segmentation with gender as a Variable.
# Count the number of instances for each gender
gender_counts = mcdonalds['Gender'].value_counts()

# Plotting the pie chart
plt.figure(figsize=(6, 6))
plt.pie(gender_counts, labels=gender_counts.index, autopct='%1.1f%%',␣
 ↪startangle=90, colors=['blue', 'pink'])
plt.title('Distribution of Gender in McDonald\'s Dataset')
plt.show()
```



[ ]:
```
# The number of female costumers is more than that of male customers.
```

[10]:
```
# Extracting the columns containing segmentation variables(1-11) and converting␣
↪the data to a matrix containing 0 and 1 instead of YES and NO.
```

[11]:
```
# Extracting columns 1 to 11 and converting to a binary matrix
MD_x = mcdonalds.iloc[:, 0:11]
# Converting values to 0 and 1
MD_x = (MD_x == "Yes").astype(int)

# Calculating and rounding column means to two decimal places
print(np.round(MD_x.mean(), 2))
```

```
yummy         0.55
convenient    0.91
spicy         0.09
fattening     0.87
greasy        0.53
```

```
fast          0.90
cheap         0.60
tasty         0.64
expensive     0.36
healthy       0.20
disgusting    0.24
dtype: float64
```

[12]:
```
# The output indicates that about 55% of the respondents believe that␣
↪McDonald's food is YUMMY, 53 believe that the food at McDonald's is GREASY␣
↪and 36% believes that it is expensive.
```

[13]:
```
# PRINCIPAL COMPONENT ANALYSIS
```

[14]:
```
from sklearn.decomposition import PCA
pca = PCA()
MD_pca = pca.fit_transform(MD_x)

# Extracting relevant information
result_summary = pd.DataFrame({
    'PC': [f'PC{i+1}' for i in range(pca.n_components_)],'Standard deviation':␣
↪pca.explained_variance_**0.5,'Proportion of Variance': pca.
↪explained_variance_ratio_, 'Cumulative Proportion': pca.
↪explained_variance_ratio_.cumsum()
})

# Set the precision for better formatting
pd.set_option("display.precision", 4)

# Display the result summary
print(result_summary)
```

	PC	Standard deviation	Proportion of Variance	Cumulative Proportion
0	PC1	0.7570	0.2994	0.2994
1	PC2	0.6075	0.1928	0.4922
2	PC3	0.5046	0.1330	0.6253
3	PC4	0.3988	0.0831	0.7084
4	PC5	0.3374	0.0595	0.7679
5	PC6	0.3103	0.0503	0.8182
6	PC7	0.2897	0.0438	0.8620
7	PC8	0.2751	0.0395	0.9016
8	PC9	0.2653	0.0368	0.9383
9	PC10	0.2488	0.0324	0.9707
10	PC11	0.2369	0.0293	1.0000

[15]:
```
standard_deviations = pca.explained_variance_**0.5
print("Standard deviations (1, .., p=11):")
```

```
print(np.round(standard_deviations, 1))
```

```
Standard deviations (1, .., p=11):
[0.8 0.6 0.5 0.4 0.3 0.3 0.3 0.3 0.3 0.2 0.2]
```

[16]:
```
# printing the rotation matrix:
column_names = MD_x.columns
rotation_matrix = pd.DataFrame(np.round(pca.components_.T, 2),␣
 ↪columns=column_names)
print(f"Rotation (n x k) = ({MD_x.shape[1]} x {MD_x.shape[1]}):")
print(rotation_matrix)
```

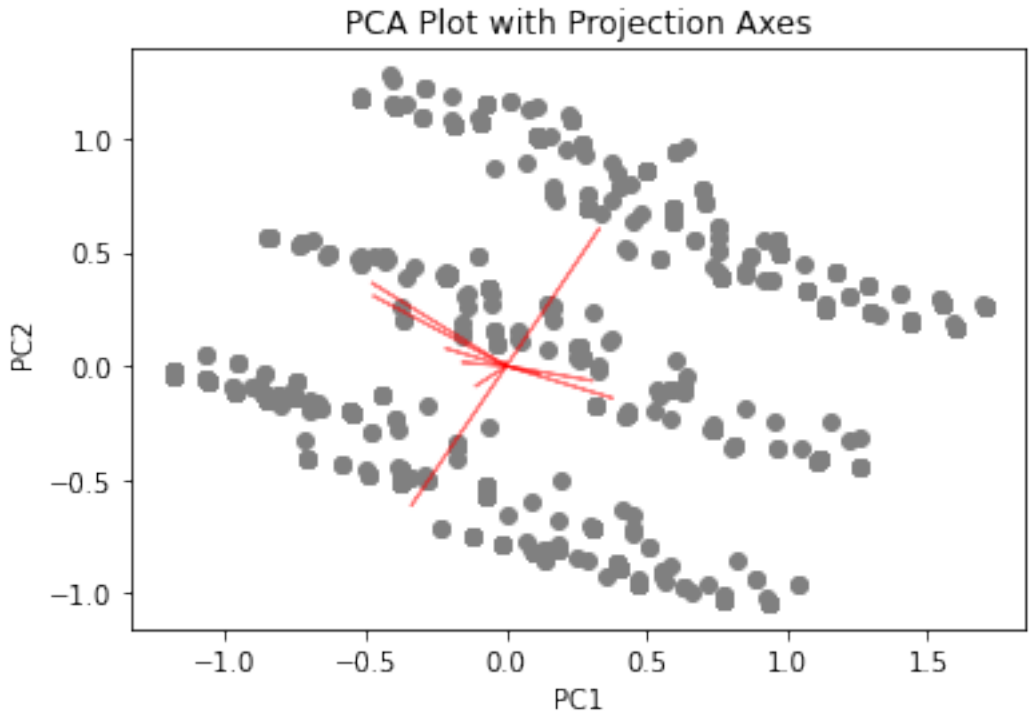
```
Rotation (n x k) = (11 x 11):
    yummy  convenient  spicy  fattening  greasy  fast  cheap  tasty  \
0   -0.48        0.36  -0.30       0.06   -0.31  0.17  -0.28   0.01
1   -0.16        0.02  -0.06      -0.14    0.28 -0.35  -0.06  -0.11
2   -0.01        0.02  -0.04       0.20    0.07 -0.36   0.71   0.38
3    0.12       -0.03  -0.32      -0.35   -0.07 -0.41  -0.39   0.59
4    0.30       -0.06  -0.80       0.25    0.36  0.21   0.04  -0.14
5   -0.11       -0.09  -0.06      -0.10    0.11 -0.59  -0.09  -0.63
6   -0.34       -0.61  -0.15       0.12   -0.13 -0.10  -0.04   0.14
7   -0.47        0.31  -0.29      -0.00   -0.21 -0.08   0.36  -0.07
8    0.33        0.60   0.02       0.07   -0.00 -0.26  -0.07   0.03
9   -0.21        0.08   0.19       0.76    0.29 -0.18  -0.35   0.18
10   0.37       -0.14  -0.09       0.37   -0.73 -0.21  -0.03  -0.17

    expensive  healthy  disgusting
0        0.57    -0.11        0.05
1       -0.02    -0.67       -0.54
2        0.40    -0.08        0.14
3       -0.16    -0.01        0.25
4       -0.00     0.01        0.00
5        0.17     0.24        0.34
6        0.08     0.43       -0.49
7       -0.64     0.08        0.02
8        0.07     0.45       -0.49
9       -0.19    -0.04        0.16
10      -0.07    -0.29       -0.04
```

[17]:
```
# Plotting the data points in the reduced dimensional space
plt.scatter(MD_pca[:, 0], MD_pca[:, 1], color='grey')

# Adding projection axes
for i in range(MD_pca.shape[1]):
    plt.arrow(0, 0, pca.components_[0, i], pca.components_[1, i], color='red',␣
 ↪alpha=0.5)
```

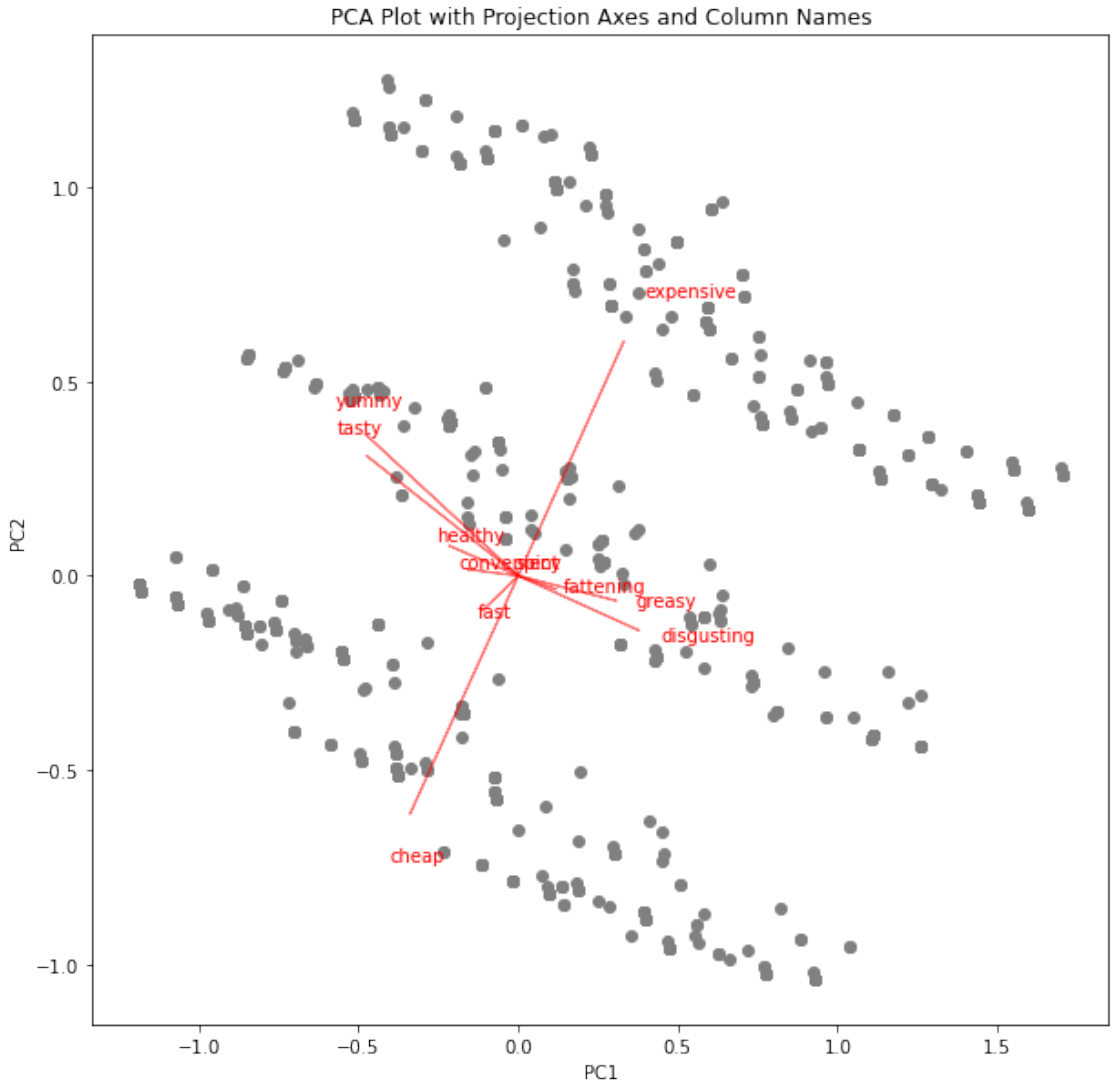
```
plt.xlabel('PC1')
plt.ylabel('PC2')
plt.title('PCA Plot with Projection Axes')
plt.show()
```



[18]:
```
plt.figure(figsize=(10, 10))
# Plotting the data points in the reduced dimensional space
plt.scatter(MD_pca[:, 0], MD_pca[:, 1], color='grey')

# Adding projection axes and annotating with column names
for i in range(MD_pca.shape[1]):
    plt.arrow(0, 0, pca.components_[0, i], pca.components_[1, i], color='red',␣
 ↪alpha=0.5)
    plt.text(pca.components_[0, i] * 1.2, pca.components_[1, i] * 1.2, MD_x.
 ↪columns[i], color='red')

plt.xlabel('PC1')
plt.ylabel('PC2')
plt.title('PCA Plot with Projection Axes and Column Names')
plt.show()
```



[19]:
```
pip install scikit-learn-extra
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: scikit-learn-extra in
./.local/lib/python3.10/site-packages (0.3.0)
Requirement already satisfied: numpy>=1.13.3 in /usr/local/lib/python3.10/site-
packages (from scikit-learn-extra) (1.23.5)
Requirement already satisfied: scipy>=0.19.1 in /usr/local/lib/python3.10/site-
packages (from scikit-learn-extra) (1.9.3)
Requirement already satisfied: scikit-learn>=0.23.0 in
/usr/local/lib/python3.10/site-packages (from scikit-learn-extra) (1.3.1)
Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/site-
packages (from scikit-learn>=0.23.0->scikit-learn-extra) (1.2.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in
```

```
/usr/local/lib/python3.10/site-packages (from scikit-learn>=0.23.0->scikit-
learn-extra) (3.1.0)

[notice] A new release of pip is
available: 23.3 -> 23.3.2
[notice] To update, run:
pip install --upgrade pip
Note: you may need to restart the kernel to use updated packages.
```

[20]:
```python
# Extracting segments using k-means
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import make_pipeline
from sklearn_extra.cluster import KMedoids

# Set a seed for reproducibility
np.random.seed(1234)
cluster_range = [2, 8]

# Performing k-means clustering with ten random restarts
results = {}
for num_clusters in cluster_range:
    kmeans = KMeans(n_clusters=num_clusters, n_init=10, random_state=1234)
    pipeline = make_pipeline(StandardScaler(), kmeans)
    labels = pipeline.fit_predict(MD_x)
    results[num_clusters] = labels

# Relabel segments to be consistent across segmentations
for num_clusters in cluster_range:
    unique_labels = np.unique(results[num_clusters])
    relabeling_dict = {old_label: new_label for new_label, old_label in␣
 ↪enumerate(unique_labels)}
    results[num_clusters] = np.vectorize(relabeling_dict.
 ↪get)(results[num_clusters])
```

[21]:
```python
# Access the results for 2 clusters
labels_2_clusters = results[2]
print("Labels for 2 clusters:", labels_2_clusters)

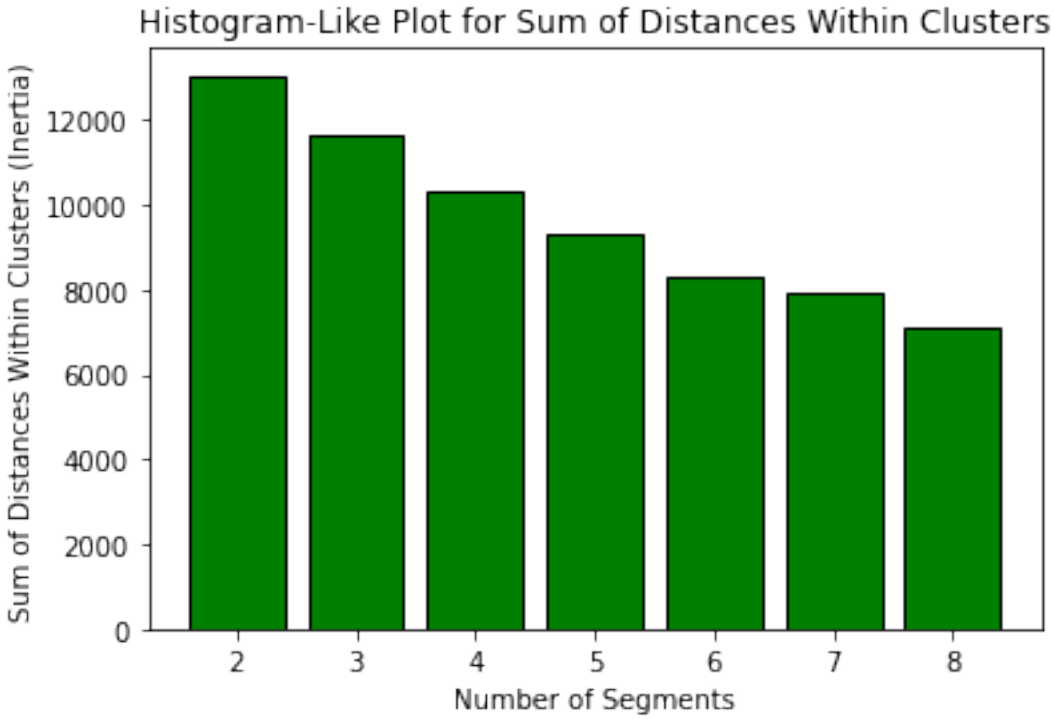
# Access the results for 8 clusters
labels_8_clusters = results[8]
print("Labels for 8 clusters:", labels_8_clusters)
```

```
Labels for 2 clusters: [1 0 0 … 0 0 1]
Labels for 8 clusters: [7 0 6 … 3 5 2]
```

[22]:
```
# Specify the range of cluster numbers
cluster_range = range(2, 9)

# Compute the inertia (sum of distances within clusters) for each number of␣
 ↪clusters
inertia_values = []
for num_clusters in cluster_range:
    kmeans = KMeans(n_clusters=num_clusters, n_init=10, random_state=1234)
    pipeline = make_pipeline(StandardScaler(), kmeans)
    pipeline.fit(MD_x)
    inertia_values.append(pipeline.named_steps['kmeans'].inertia_)

# Plotting the histogram-like plot
plt.bar(cluster_range, inertia_values, color='green', edgecolor='black')
plt.xlabel('Number of Segments')
plt.ylabel('Sum of Distances Within Clusters (Inertia)')
plt.title('Histogram-Like Plot for Sum of Distances Within Clusters')
plt.show()
```



[37]:
```
#Extracting segments-k means

from yellowbrick.cluster import KElbowVisualizer
k_means_model = KMeans()
```

```
visualizer = KElbowVisualizer(k_means_model, k=(1,12)).fit(MD_x)
visualizer.show()
```

```
/usr/local/lib/python3.10/site-packages/sklearn/cluster/_kmeans.py:1416:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
/usr/local/lib/python3.10/site-packages/sklearn/cluster/_kmeans.py:1416:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
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1.4. Set the value of `n_init` explicitly to suppress the warning
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1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
```

```
findfont: Generic family 'sans-serif' not found because none of the following
families were found: Arial, Liberation Sans, Bitstream Vera Sans, sans-serif
findfont: Generic family 'sans-serif' not found because none of the following
families were found: Arial, Liberation Sans, Bitstream Vera Sans, sans-serif
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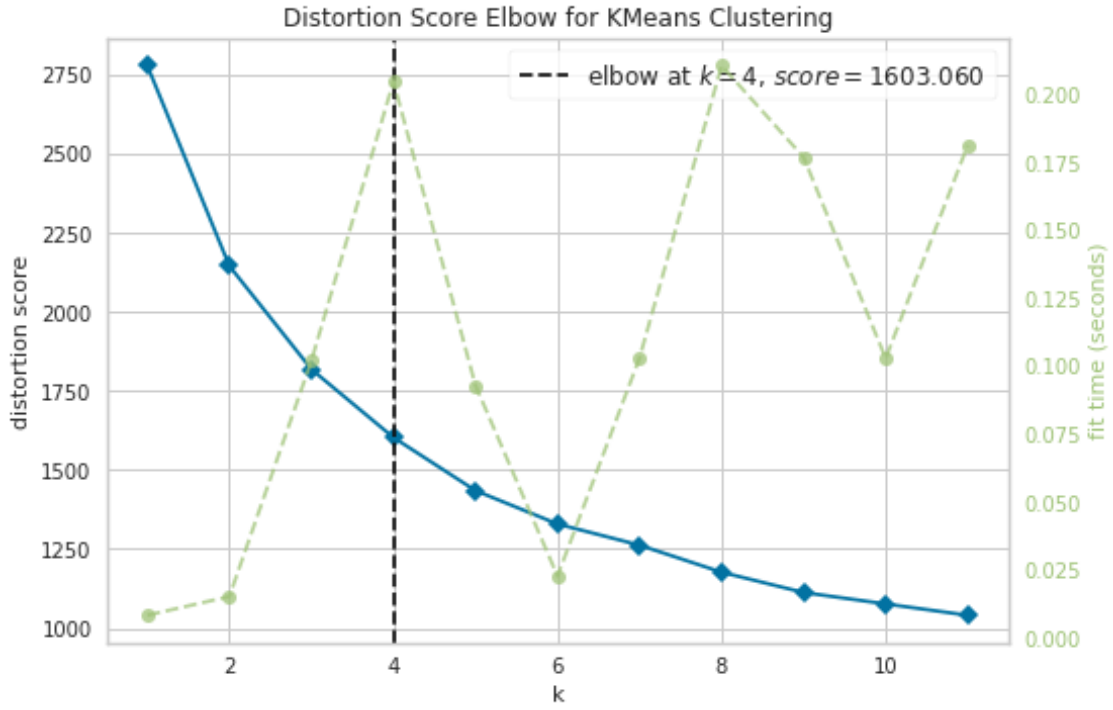

[37]:
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xlabel='k', ylabel='distortion score'>
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