In [103]:

```
import pandas as pd
mcd= pd.read_csv('mcdonalds.csv')
```

In [104]:

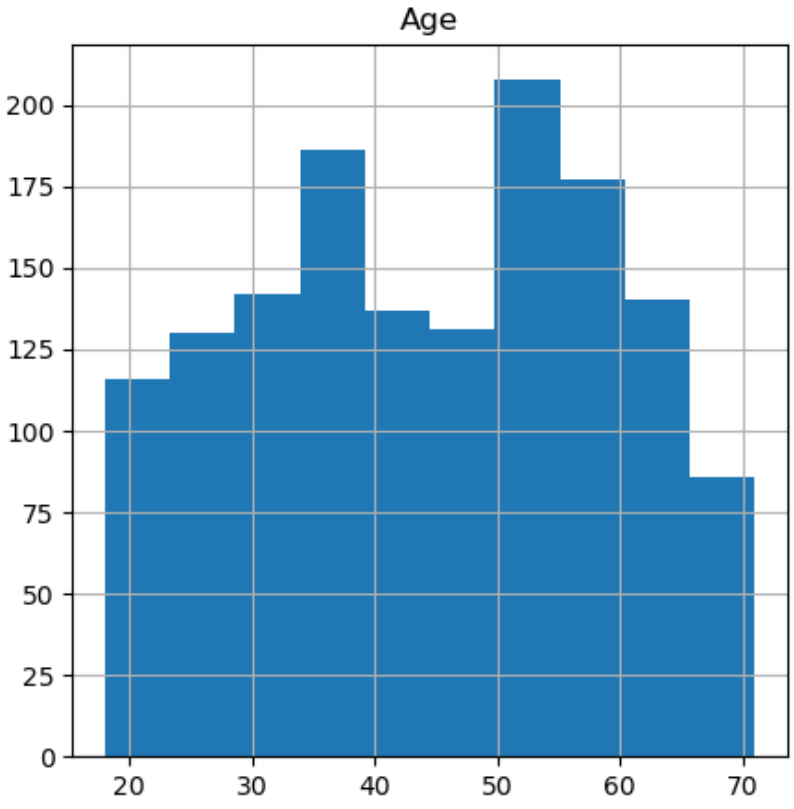
```
column_names = mcd.columns.tolist()
column_names
```

Out[104]:

```
['yummy',
 'convenient',
 'spicy',
 'fattening',
 'greasy',
 'fast',
 'cheap',
 'tasty',
 'expensive',
 'healthy',
 'disgusting',
 'Like',
 'Age',
 'VisitFrequency',
 'Gender']
```

In [105]:

```
import matplotlib.pyplot as plt
mcd.hist(figsize=(5,5))
plt.show()
```



In [106]:

```
mcd.describe()
```

Out[106]:

	Age

	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

In [107]:

```
mcd.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
```

In [108]:

```
mcd.shape
```

Out[108]:

```
(1453, 15)
```

In [109]:

```
mcd.isnull().sum()
```

Out[109]:

```
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
```

In [110]:

```
mcd.head()
```

Out[110]:

	yummy	convenient	spicy	fattening	greasy	fast	cheap	tasty	expensive	healthy	disgusting	Like	Age	VisitFrequency
0	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No	-3	61	Every three months
1	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	+2	51	Every three months
2	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	+1	62	Every three months
3	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	+4	69	Once a week
4	No	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	No	+2	49	Once a month

In [111]:

```
import pandas as pd
import numpy as np
# Select the specified columns and convert to a NumPy array (matrix)
MD_x = mcd.iloc[:, 0:11].to_numpy()

# Convert "Yes" to 1 and other values to 0
MD_x = np.where(MD_x == "Yes", 1, 0)

# Calculate the column means
col_means = np.mean(MD_x, axis=0)

# Round the means to 2 decimal places
rounded_col_means = np.round(col_means, 2)

print("Rounded column means:", rounded_col_means)
```

```
Rounded column means: [0.55 0.91 0.09 0.87 0.53 0.9  0.6  0.64 0.36 0.2  0.24]
```

In [117]:

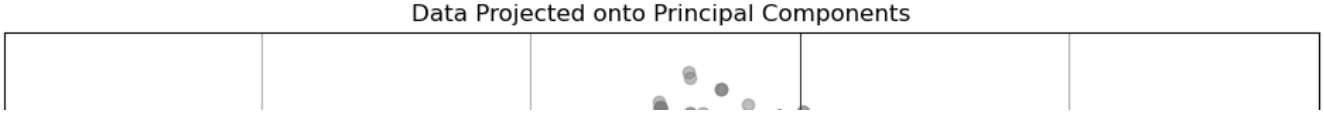
```
import pandas as pd
import numpy as np
from sklearn.decomposition import PCA

# Load the data into a DataFrame
df = pd.read_csv('mcdonalds.csv')  # replace with your actual file path

# Select the specified columns and convert to a NumPy array (matrix)
MD_x = df.iloc[:, 0:11].to_numpy()

# Convert "Yes" to 1 and other values to 0
MD_x = np.where(MD_x == "Yes", 1, 0)

# Perform PCA
pca = PCA()
MD_pca = pca.fit(MD_x)

# Print summary of PCA
explained_variance = pca.explained_variance_ratio_
components = pca.components_

print("Explained variance ratio:")
print(np.round(explained_variance, 2))

print("\nPCA components:")
print(components)
```

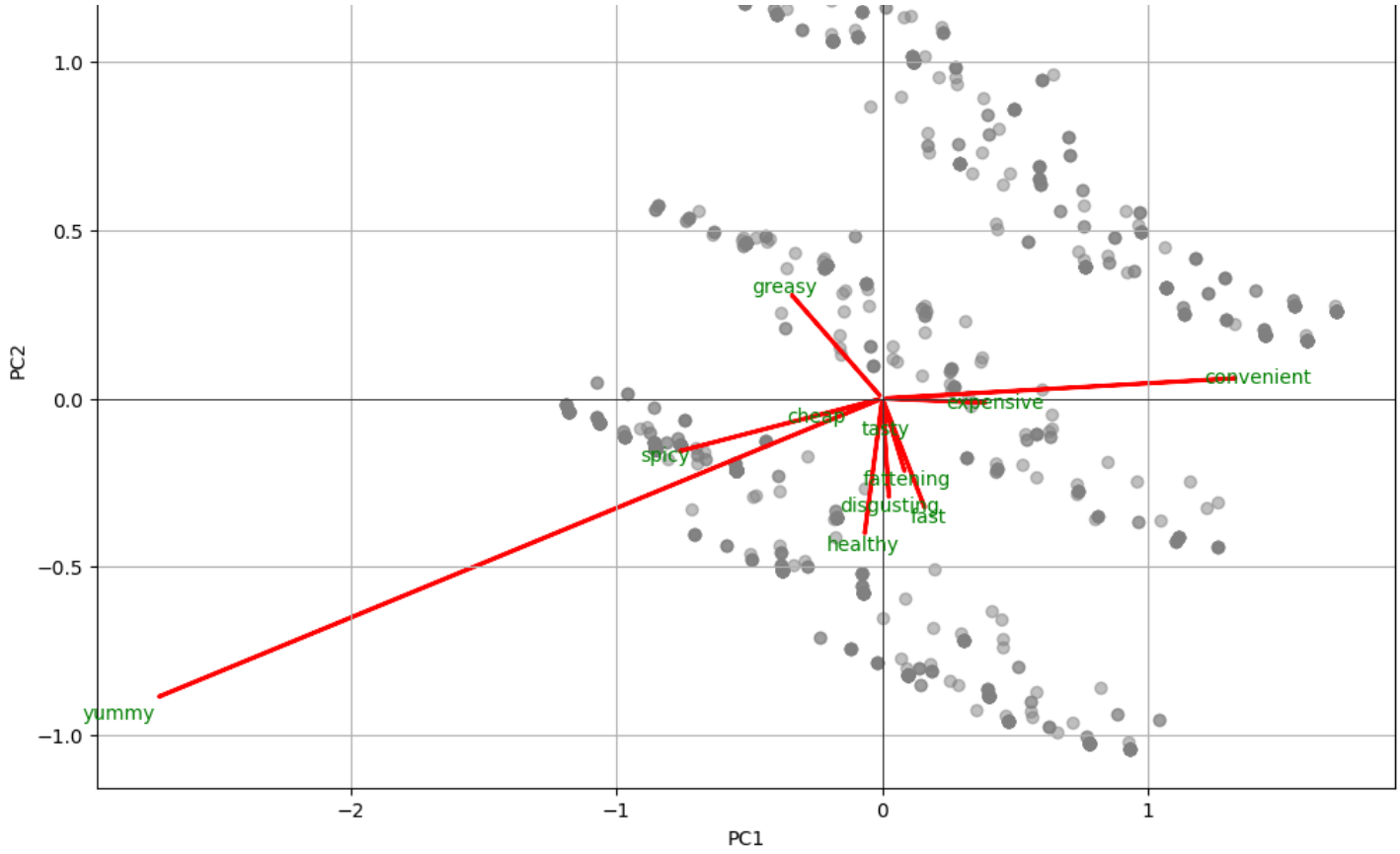
```
Explained variance ratio:
[0.3  0.19 0.13 0.08 0.06 0.05 0.04 0.04 0.04 0.03 0.03]
```

```
PCA components:
[[-0.47693349 -0.15533159 -0.00635636  0.11623168  0.3044427  -0.10849325
  -0.33718593 -0.47151394  0.32904173 -0.21371062  0.37475293]
 [ 0.36378978  0.016414    0.01880869 -0.03409395 -0.06383884 -0.0869722
  -0.61063276  0.3073178   0.60128596  0.07659344 -0.13965633]
 [-0.30444402 -0.0625153  -0.03701866 -0.32235949 -0.80237317 -0.06464172
  -0.14931026 -0.28726479  0.02439661  0.19205128 -0.08857138]
 [ 0.0551622  -0.14242496  0.19761927 -0.35413876  0.2539601  -0.09736269
   0.11895823 -0.00254696  0.06781599  0.76348804  0.36953871]
 [-0.30753507  0.27760805  0.07062017 -0.07340475  0.36139895  0.10793025
  -0.12897259 -0.21089912 -0.00312457  0.28784553 -0.72920859]
 [ 0.17073819 -0.34783006 -0.3550866  -0.40651542  0.20934711 -0.59463206
  -0.10324067 -0.07691443 -0.26134151 -0.17822612 -0.21087805]
 [-0.28051863 -0.05973793  0.70763705 -0.38594277  0.03616962 -0.08684577
  -0.04044934  0.36045348 -0.06838452 -0.34961569 -0.02679159]
 [ 0.01304117 -0.11307868  0.37593402  0.58962241 -0.13824084 -0.62779877
   0.14006047 -0.07279193  0.02953939  0.17630281 -0.16718101]
 [ 0.57240278 -0.01846534  0.40027977 -0.16051227 -0.00284738  0.16619659
   0.07606907 -0.63908592  0.06699639 -0.1855722  -0.07248255]
 [-0.11028437 -0.66581756 -0.07563413 -0.00533813  0.00870725  0.23953197
   0.42808739  0.0791838   0.45439925 -0.03811713 -0.28959188]
 [ 0.04543901 -0.54161635  0.14172992  0.25090987  0.00164229  0.33926454
  -0.48928285  0.01955226 -0.49006853  0.15760765 -0.04066227]]
```

In [63]:

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.decomposition import PCA
from matplotlib.patches import FancyArrowPatch

# Load the data
df = pd.read_csv('mcdonalds.csv')

# Select the features for PCA
features = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap', 'tas
ty', 'expensive', 'healthy', 'disgusting']
MD_x = df[features].applymap(lambda x: 1 if x == 'Yes' else 0).values

# Perform PCA
pca = PCA()
pca.fit(MD_x)

# Project data onto principal components
projected_data = pca.transform(MD_x)

# Create scatter plot
plt.figure(figsize=(12, 8))
plt.scatter(projected_data[:, 0], projected_data[:, 1], c='grey', alpha=0.5)  # Use firs
t two principal components
plt.xlabel('PC1')
plt.ylabel('PC2')
plt.title('Data Projected onto Principal Components')

# Add arrows for principal components
for i, (comp, var) in enumerate(zip(pca.components_, pca.explained_variance_)):
    arrow = FancyArrowPatch((0, 0), (comp[0] * var * 10, comp[1] * var * 10), color='r',
lw=2)  # Scale the arrows by 10
    plt.gca().add_patch(arrow)
    plt.text(comp[0] * var * 10.5, comp[1] * var * 10.5, features[i], color='g', ha='cen
ter', va='center')

plt.grid(True)
plt.axhline(0, color='black', lw=0.5)
plt.axvline(0, color='black', lw=0.5)
plt.show()
```





In [66]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.decomposition import PCA

# Load the data
df = pd.read_csv('mcdonalds.csv')

# Select the features for clustering
features = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap', 'tas
ty', 'expensive', 'healthy', 'disgusting']
MD_x = df[features].applymap(lambda x: 1 if x == 'Yes' else 0).values

# Perform PCA to reduce dimensionality
pca = PCA(n_components=2)
MD_x_pca = pca.fit_transform(MD_x)

# Calculate sum of within-cluster distances for different numbers of clusters
wcss = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, random_state=42)
    kmeans.fit(MD_x_pca)
    wcss.append(kmeans.inertia_)

# Plot the sum of within-cluster distances
plt.figure(figsize=(10, 6))
plt.plot(range(1, 11), wcss, marker='o', linestyle='--')
plt.xlabel('Number of Segments')
plt.ylabel('Sum of Within-Cluster Distances')
plt.title('Elbow Method for Optimal Number of Clusters')
plt.grid(True)
plt.show()
```

```
C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWa
rning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value
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```

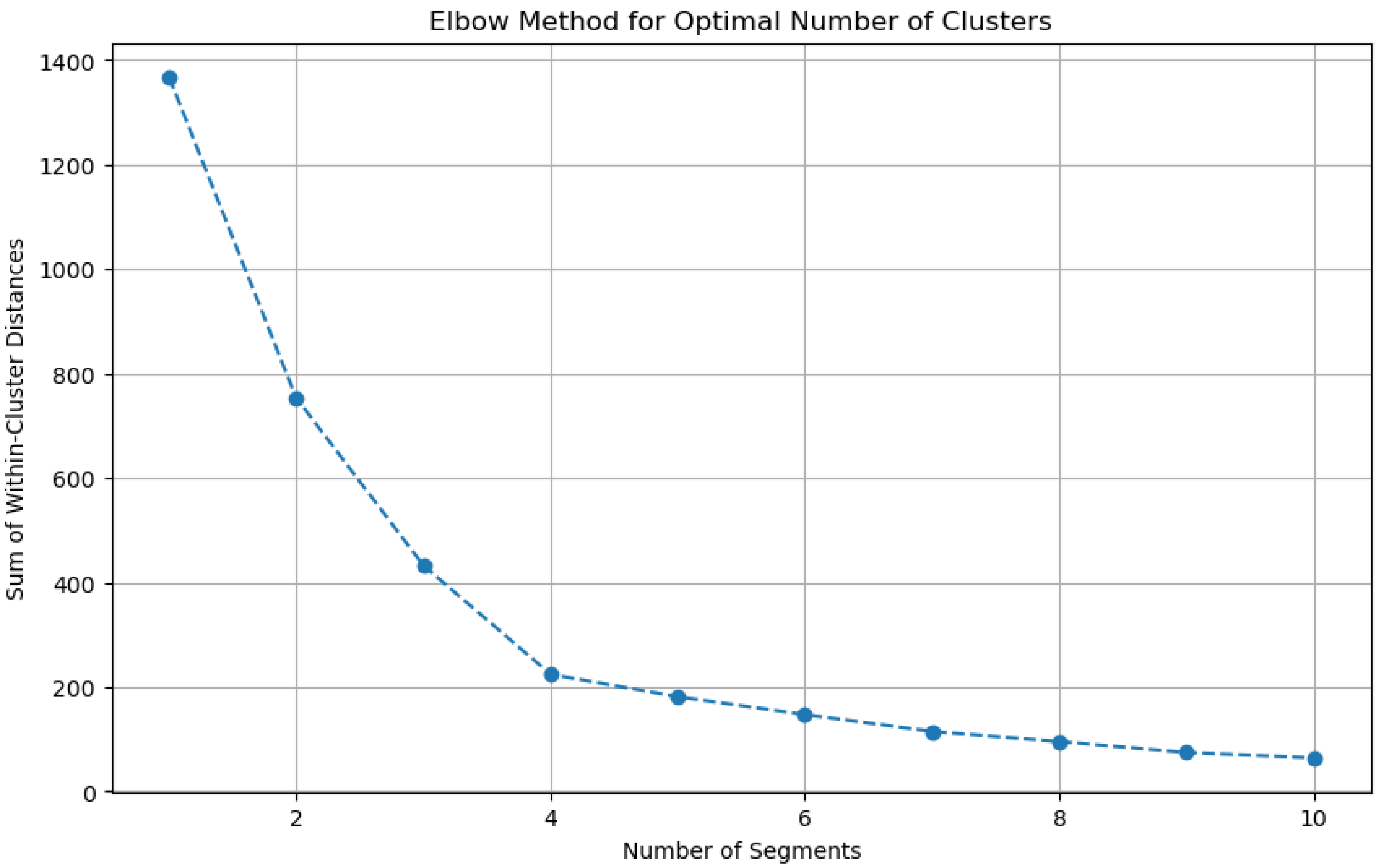

In [67]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.decomposition import PCA
```

```
from sklearn.metrics import adjusted_rand_score
from sklearn.utils import resample

# Set seed for reproducibility
np.random.seed(1234)

# Load the data
df = pd.read_csv('mcdonalds.csv')

# Select the features for clustering
features = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap', 'tas
ty', 'expensive', 'healthy', 'disgusting']
MD_x = df[features].applymap(lambda x: 1 if x == 'Yes' else 0).values

# Perform PCA to reduce dimensionality
pca = PCA(n_components=2)
MD_x_pca = pca.fit_transform(MD_x)

# Function to perform bootstrapping and calculate adjusted Rand index
def boot_flexclust(data, clusters_range, nrep, nboot):
    ari_scores = {k: [] for k in clusters_range}
    for k in clusters_range:
        for _ in range(nrep):
            boot_data = resample(data, n_samples=nboot)
            kmeans1 = KMeans(n_clusters=k, random_state=42)
            kmeans2 = KMeans(n_clusters=k, random_state=24)
            kmeans1.fit(boot_data)
            kmeans2.fit(boot_data)
            ari = adjusted_rand_score(kmeans1.labels_, kmeans2.labels_)
            ari_scores[k].append(ari)
    return ari_scores

# Perform bootstrapping
clusters_range = range(2, 9)
ari_scores = boot_flexclust(MD_x_pca, clusters_range, nrep=10, nboot=100)

# Convert ARI scores to DataFrame for boxplot
ari_df = pd.DataFrame(ari_scores)

# Plot the adjusted Rand index as a boxplot
plt.figure(figsize=(10, 6))
ari_df.boxplot()
plt.xlabel('Number of Segments')
plt.ylabel('Adjusted Rand Index')
plt.title('Global Stability of K-Means Segmentation Solutions')
plt.grid(True)
plt.show()
```

```
C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWa
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C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1436: UserWarn
ing: KMeans is known to have a memory leak on Windows with MKL, when there are less chunk
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READS=1.
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C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWa
rning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value
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  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1436: UserWarn
ing: KMeans is known to have a memory leak on Windows with MKL, when there are less chunk
s than available threads. You can avoid it by setting the environment variable OMP_NUM_TH
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```

```
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s than available threads. You can avoid it by setting the environment variable OMP_NUM_TH
READS=1.
  warnings.warn(
```
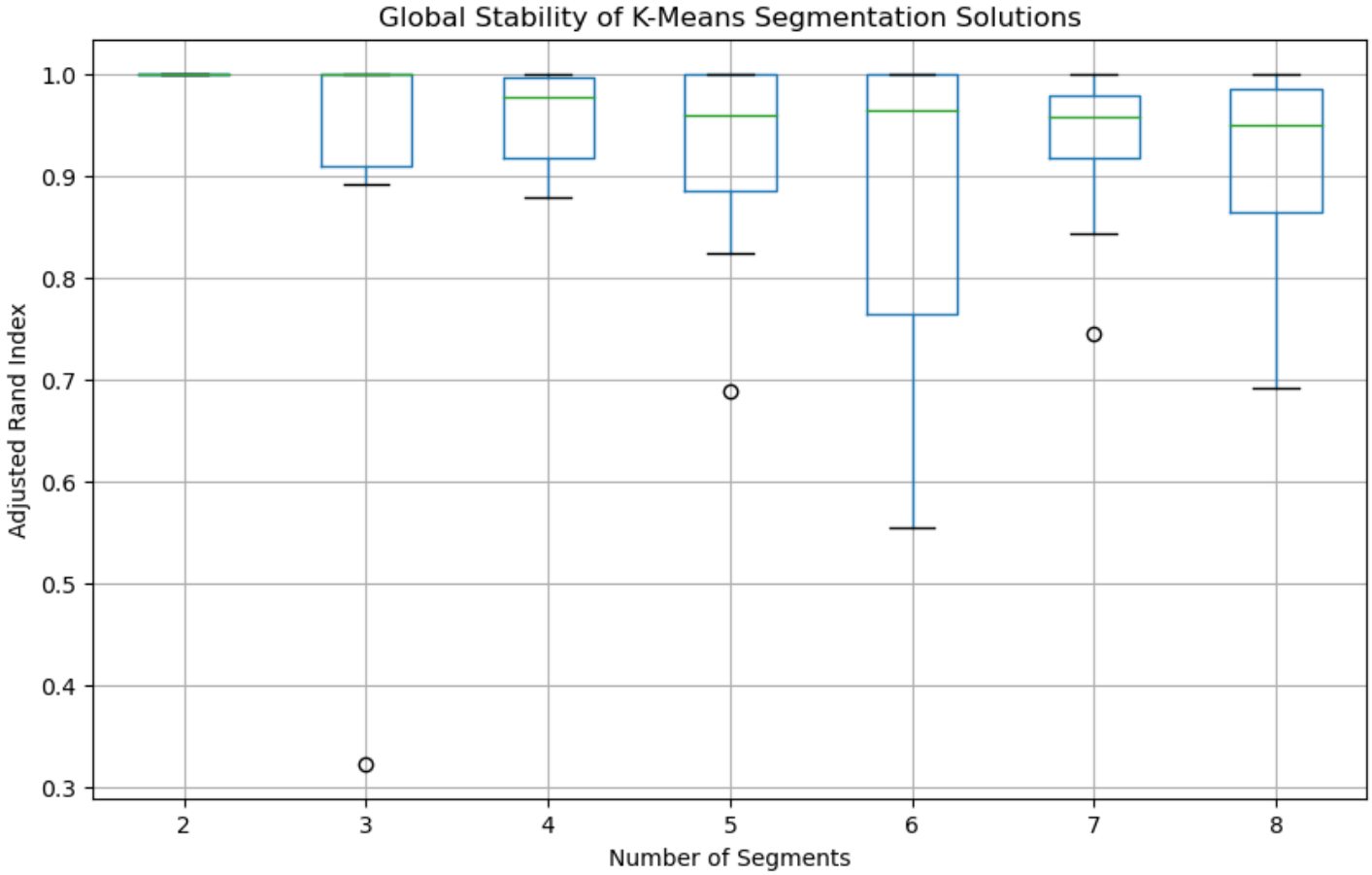
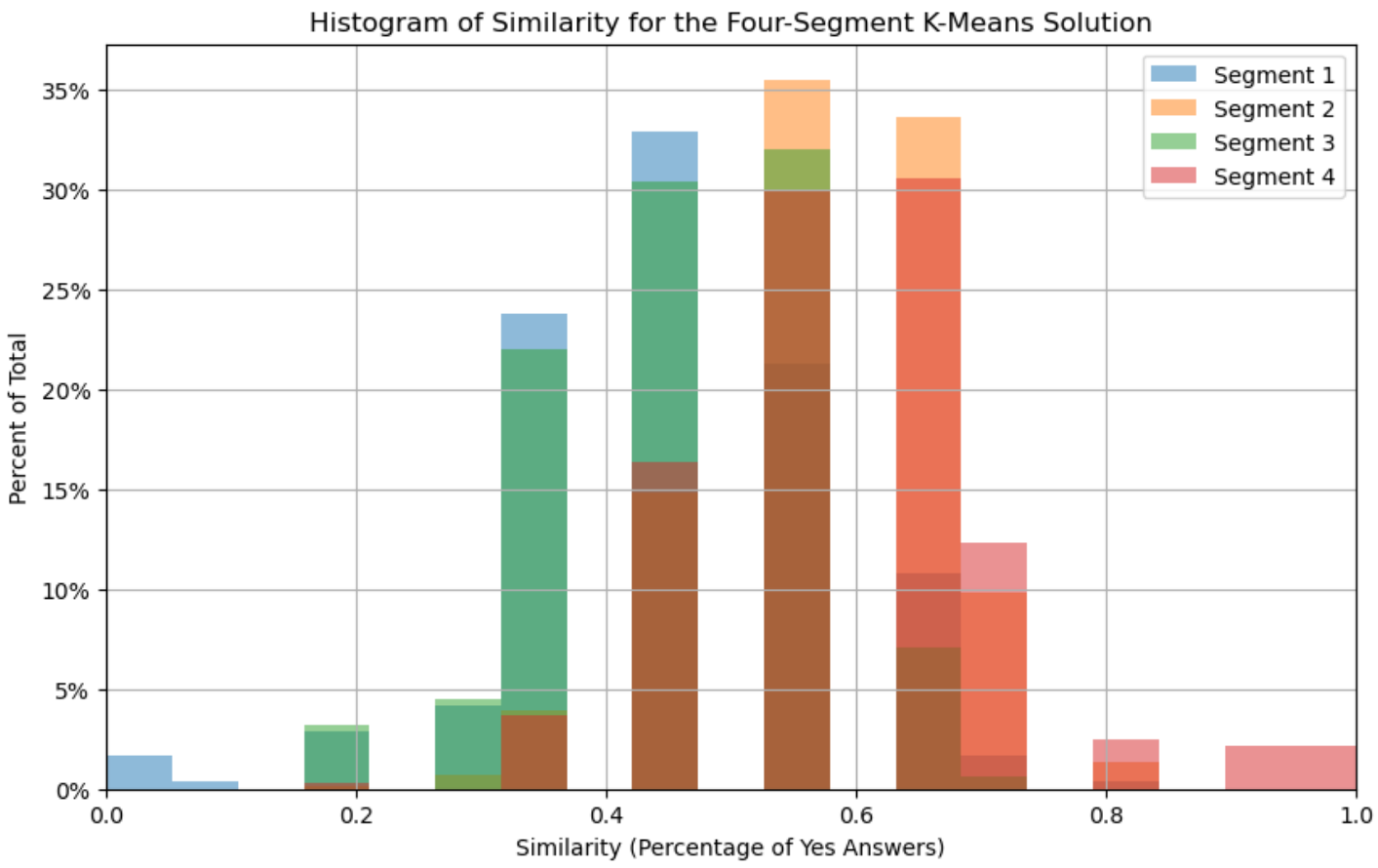



In [69]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.decomposition import PCA

# Load the data
df = pd.read_csv('mcdonalds.csv')

# Select the features for clustering
features = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap', 'tas
ty', 'expensive', 'healthy', 'disgusting']
MD_x = df[features].applymap(lambda x: 1 if x == 'Yes' else 0).values

# Perform k-means clustering with 4 segments
kmeans = KMeans(n_clusters=4, random_state=42)
clusters = kmeans.fit_predict(MD_x)

# Calculate the similarity (percentage of 'Yes' answers) for each segment
similarity = np.mean(MD_x, axis=1)

# Create a histogram of the similarity for each segment
plt.figure(figsize=(10, 6))
for i in range(4):
    segment_similarity = similarity[clusters == i]
    plt.hist(segment_similarity, bins=np.linspace(0, 1, 20), alpha=0.5, label='Segment '
```

```
+ str(i+1), weights=np.ones(len(segment_similarity)) / len(segment_similarity))
plt.gca().yaxis.set_major_formatter(plt.FuncFormatter(lambda y, _: '{:.0%}'.format(y)))
plt.xlim(0, 1)
plt.xlabel('Similarity (Percentage of Yes Answers)')
plt.ylabel('Percent of Total')
plt.title('Histogram of Similarity for the Four-Segment K-Means Solution')
plt.legend()
plt.grid(True)
plt.show()
```

```
C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWa
rning: 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)
```



In [76]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.metrics import adjusted_rand_score

# Load the data
df = pd.read_csv('mcdonalds.csv')

# Select the features for clustering
features = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap', 'tas
ty', 'expensive', 'healthy', 'disgusting']
MD_x = df[features].applymap(lambda x: 1 if x == 'Yes' else 0).values

# Function to calculate SLSA
def calculate_slsa(data, max_segments=8):
    slsa_scores = []
    for k in range(2, max_segments + 1):
        kmeans_1 = KMeans(n_clusters=k, random_state=42).fit(data)
        kmeans_2 = KMeans(n_clusters=k, random_state=43).fit(data)
        score = adjusted_rand_score(kmeans_1.labels_, kmeans_2.labels_)
        slsa_scores.append(score)
    return slsa_scores

# Calculate SLSA scores
```

```python
slsa_scores = calculate_slsa(MD_x)

# Plot SLSA scores
plt.figure(figsize=(10, 6))
plt.plot(range(2, 9), slsa_scores, marker='o')
plt.xlabel('Number of Segments')
plt.ylabel('Segment Level Stability Across Solutions (SLSA)')
plt.title('SLSA Plot from Two to Eight Segments for the Fast Food Data Set')
plt.grid(True)
plt.show()
```

```
C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: 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)
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C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: 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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  super()._check_params_vs_input(X, default_n_init=10)
```
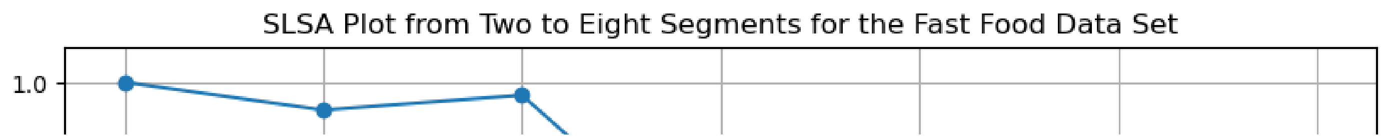
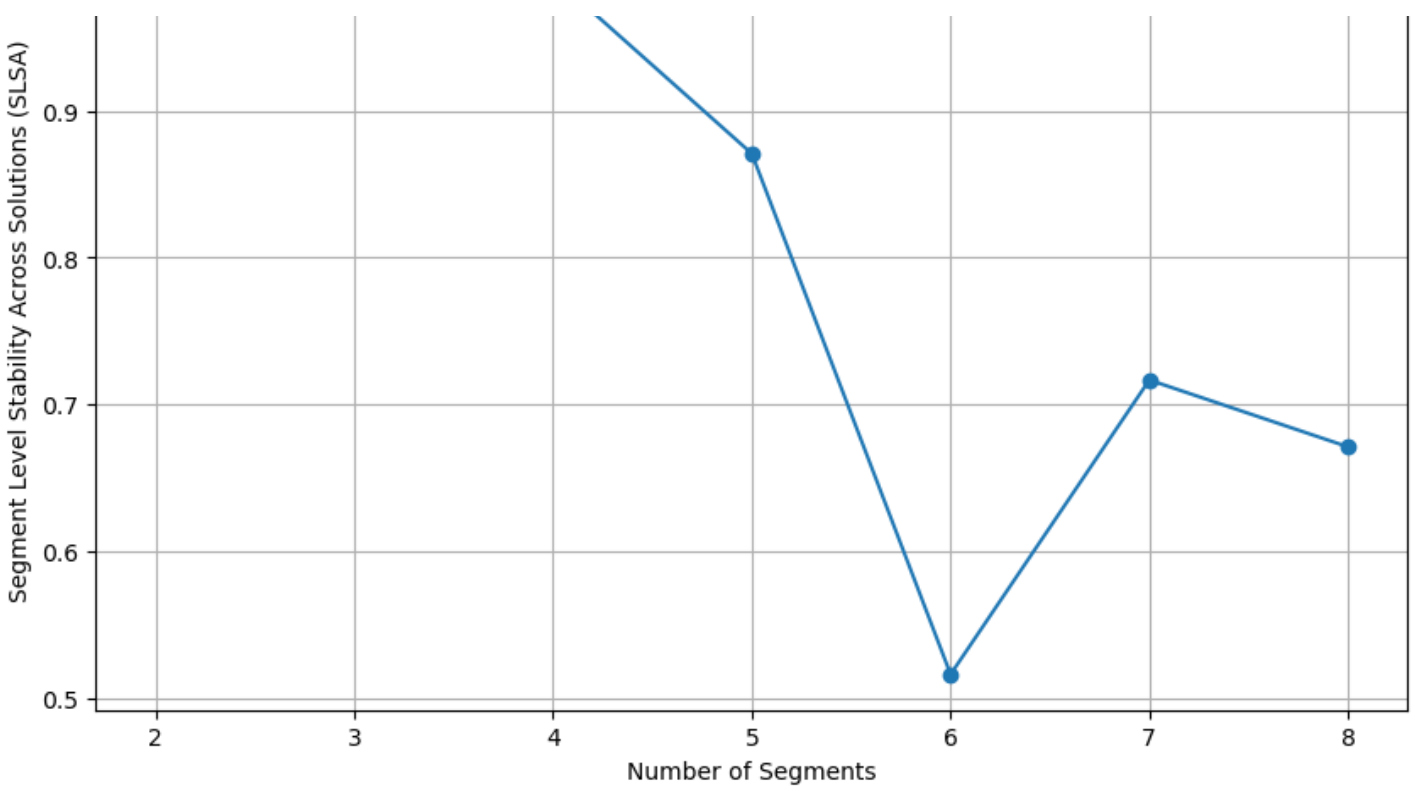





In [79]:

```
pip install numpy scikit-learn hmmlearn
```

```
Requirement already satisfied: numpy in c:\users\vaishanavi\anaconda3\lib\site-packages (
1.24.3)Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: scikit-learn in c:\users\vaishanavi\anaconda3\lib\site-pac
kages (1.3.0)
Collecting hmmlearn
  Obtaining dependency information for hmmlearn from https://files.pythonhosted.org/packa
ges/6b/62/0c7b618eac6f27220baecdfe476259e005c690bf825d02a3cb8e5470bf2c/hmmlearn-0.3.2-cp3
11-cp311-win_amd64.whl.metadata
  Downloading hmmlearn-0.3.2-cp311-cp311-win_amd64.whl.metadata (3.0 kB)
Requirement already satisfied: scipy>=1.5.0 in c:\users\vaishanavi\anaconda3\lib\site-pac
kages (from scikit-learn) (1.11.1)
Requirement already satisfied: joblib>=1.1.1 in c:\users\vaishanavi\anaconda3\lib\site-pa
ckages (from scikit-learn) (1.2.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\vaishanavi\anaconda3\lib\
site-packages (from scikit-learn) (2.2.0)
Downloading hmmlearn-0.3.2-cp311-cp311-win_amd64.whl (125 kB)
   ---------------------------------------- 0.0/125.4 kB ? eta -:--:--
   --------- ------------------------------ 30.7/125.4 kB ? eta -:--:--
   ---------------------------- ---------- 92.2/125.4 kB 1.1 MB/s eta 0:00:01
   ------------------------------------  122.9/125.4 kB 901.1 kB/s eta 0:00:01
   ---------------------------------------- 125.4/125.4 kB 816.6 kB/s eta 0:00:00
Installing collected packages: hmmlearn
Successfully installed hmmlearn-0.3.2
```

In [80]:

```
import numpy as np
from hmmlearn import hmm
from sklearn.mixture import GaussianMixture
from sklearn.model_selection import train_test_split
```

In [82]:

```
# Assuming MD.x is a numpy array
MD_x = np.array(MD_x)  # Replace MD_x with your actual data
np.random.seed(1234)
```

In [83]:

```
results = []
```

```python
for k in range(2, 9):
    best_model = None
    best_score = float('inf')
    for _ in range(10):  # nrep = 10
        model = GaussianMixture(n_components=k, covariance_type='full', random_state=np.
random.randint(10000))
        model.fit(MD_x)
        score = model.aic(MD_x)  # Or use model.bic(MD_x)
        if score < best_score:
            best_score = score
            best_model = model
    results.append((k, best_model, best_score))

# Select the best model based on AIC or BIC
best_k, best_model, best_score = min(results, key=lambda x: x[2])
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[83], line 7
      5 for _ in range(10):  # nrep = 10
      6     model = GaussianMixture(n_components=k, covariance_type='full', random_state=
np.random.randint(10000))
----> 7     model.fit(MD_x)
      8     score = model.aic(MD_x)  # Or use model.bic(MD_x)
      9     if score < best_score:

File ~\anaconda3\Lib\site-packages\sklearn\mixture\_base.py:181, in BaseMixture.fit(self,
X, y)
    155 """Estimate model parameters with the EM algorithm.
    156
    157 The method fits the model ``n_init`` times and sets the parameters with
   (...)
    178     The fitted mixture.
    179 """
    180 # parameters are validated in fit_predict
--> 181 self.fit_predict(X, y)
    182 return self

File ~\anaconda3\Lib\site-packages\sklearn\base.py:1151, in _fit_context.<locals>.decorat
or.<locals>.wrapper(estimator, *args, **kwargs)
   1144     estimator._validate_params()
   1146 with config_context(
   1147     skip_parameter_validation=(
   1148         prefer_skip_nested_validation or global_skip_validation
   1149     )
   1150 ):
-> 1151     return fit_method(estimator, *args, **kwargs)

File ~\anaconda3\Lib\site-packages\sklearn\mixture\_base.py:212, in BaseMixture.fit_predi
ct(self, X, y)
    184 @_fit_context(prefer_skip_nested_validation=True)
    185 def fit_predict(self, X, y=None):
    186     """Estimate model parameters using X and predict the labels for X.
    187
    188     The method fits the model n_init times and sets the parameters with
   (...)
    210         Component labels.
    211     """
--> 212     X = self._validate_data(X, dtype=[np.float64, np.float32], ensure_min_samples
=2)
    213     if X.shape[0] < self.n_components:
    214         raise ValueError(
    215             "Expected n_samples >= n_components "
    216             f"but got n_components = {self.n_components}, "
    217             f"n_samples = {X.shape[0]}"
    218         )

File ~\anaconda3\Lib\site-packages\sklearn\base.py:604, in BaseEstimator._validate_data(s
elf, X, y, reset, validate_separately, cast_to_ndarray, **check_params)
    602         out = X, y
    603 elif not no_val_X and no_val_y:
--> 604     out = check_array(X, input_name="X", **check_params)
```

```
    605 elif no_val_X and not no_val_y:
    606     out = _check_y(y, **check_params)

File ~\anaconda3\Lib\site-packages\sklearn\utils\validation.py:917, in check_array(array, accept_sparse, accept_large_sparse, dtype, order, copy, force_all_finite, ensure_2d, allow_nd, ensure_min_samples, ensure_min_features, estimator, input_name)
    915         array = xp.astype(array, dtype, copy=False)
    916     else:
--> 917         array = _asarray_with_order(array, order=order, dtype=dtype, xp=xp)
    918 except ComplexWarning as complex_warning:
    919     raise ValueError(
    920         "Complex data not supported\n{}\n".format(array)
    921     ) from complex_warning

File ~\anaconda3\Lib\site-packages\sklearn\utils\_array_api.py:380, in _asarray_with_order(array, dtype, order, copy, xp)
    378     array = numpy.array(array, order=order, dtype=dtype)
    379 else:
--> 380     array = numpy.asarray(array, order=order, dtype=dtype)
    382 # At this point array is a NumPy ndarray. We convert it to an array
    383 # container that is consistent with the input's namespace.
    384 return xp.asarray(array)

ValueError: could not convert string to float: 'No'
```

In [84]:

```
import pandas as pd
import numpy as np
from sklearn.preprocessing import OneHotEncoder
from sklearn.mixture import GaussianMixture

# Load the data
file_path = 'mcdonalds.csv'
data = pd.read_csv(file_path)

# Check the first few rows of the data
print(data.head())

# One-hot encode categorical data
encoder = OneHotEncoder(sparse=False)
encoded_data = encoder.fit_transform(data)

# Convert the encoded data to a NumPy array
MD_x = np.array(encoded_data)

# Set the random seed for reproducibility
np.random.seed(1234)

# Fit Gaussian Mixture Models with different numbers of components
results = []
for k in range(2, 9):
    best_model = None
    best_score = float('inf')
    for _ in range(10):  # nrep = 10
        model = GaussianMixture(n_components=k, covariance_type='full', random_state=np.random.randint(10000))
        model.fit(MD_x)
        score = model.aic(MD_x)  # Or use model.bic(MD_x)
        if score < best_score:
            best_score = score
            best_model = model
    results.append((k, best_model, best_score))

# Select the best model based on AIC or BIC
best_k, best_model, best_score = min(results, key=lambda x: x[2])

# Output the result
print(f"Best Model: {best_model} with k = {best_k} and score = {best_score}")
```

```
  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
```

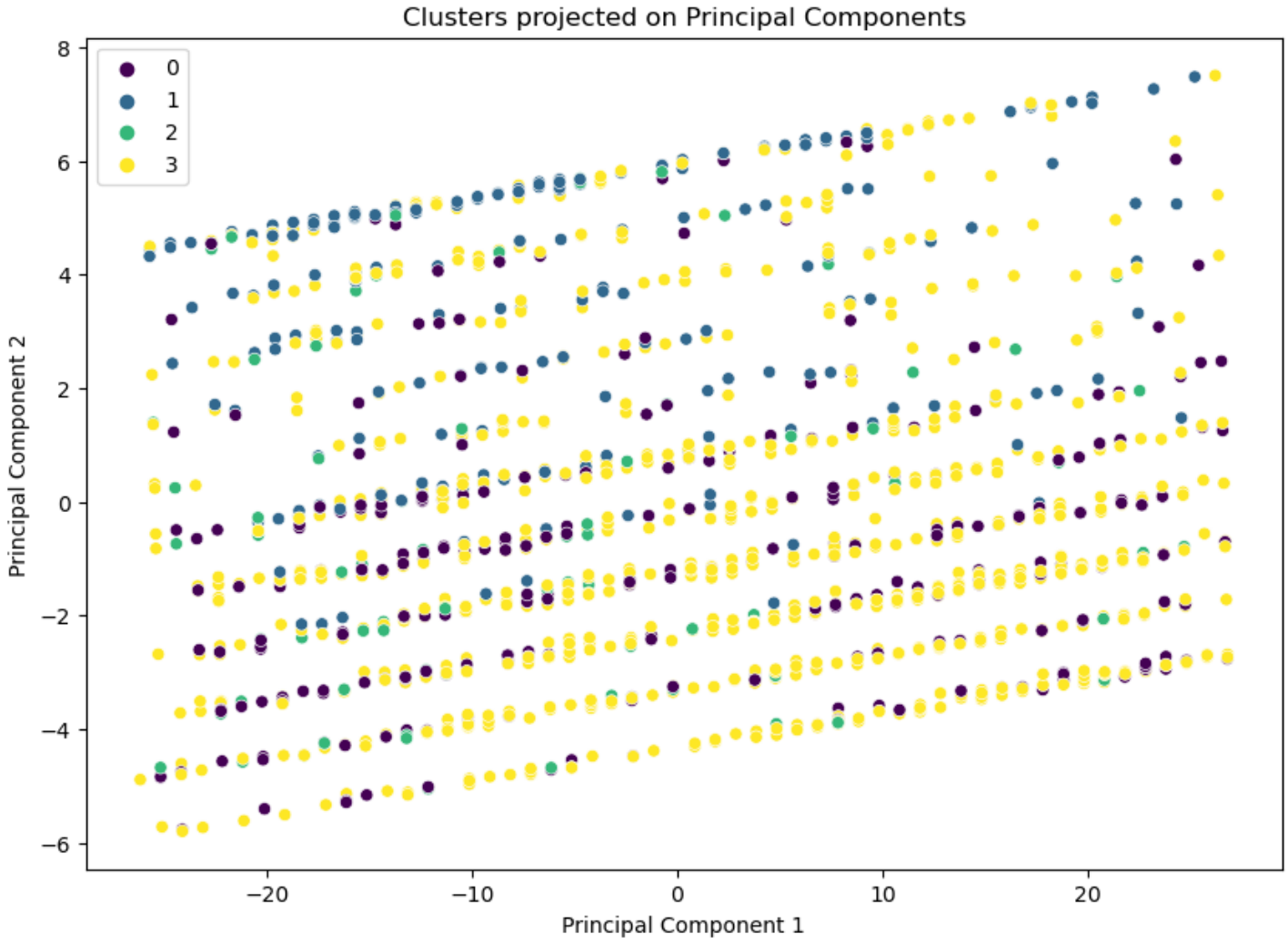
```
C:\Users\VAISHANAVI\anaconda3\Lib\site-packages\sklearn\preprocessing\_encoders.py:972: F
utureWarning: `sparse` was renamed to `sparse_output` in version 1.2 and will be removed
in 1.4. `sparse_output` is ignored unless you leave `sparse` to its default value.
  warnings.warn(
```

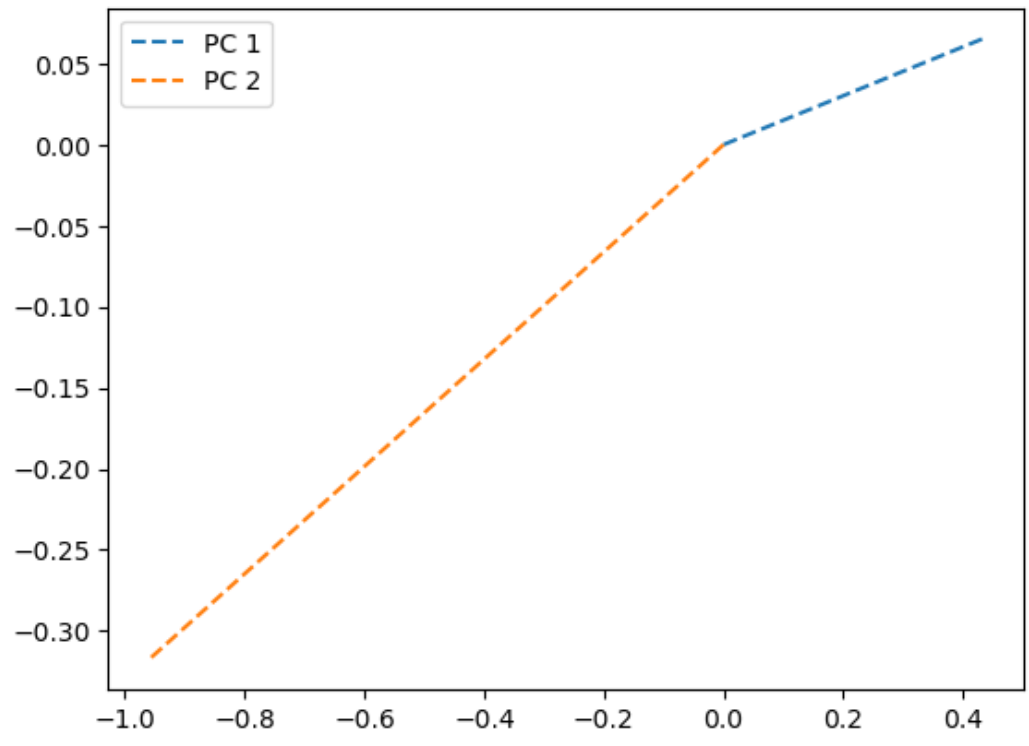
```
Best Model: GaussianMixture(n_components=6, random_state=2576) with k = 6 and score = -79
6050.9011040925
```

In [90]:

```
import pandas as pd
import numpy as np
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.mixture import GaussianMixture

# Load the data
file_path = 'mcdonalds.csv'
data = pd.read_csv(file_path)

# Function to convert Yes/No to 1/0
def binary_to_numeric(df, column):
    df[column] = df[column].map({'Yes': 1, 'No': 0})
    return df

# Convert binary columns
binary_columns = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap'
,
                  'tasty', 'expensive', 'healthy', 'disgusting']
for col in binary_columns:
    data = binary_to_numeric(data, col)

# Convert 'Like' column to numeric values
data['Like'] = data['Like'].str.extract('([-+]?\d+)').astype(int)

# One-hot encode categorical variables
categorical_columns = ['VisitFrequency', 'Gender']
data = pd.get_dummies(data, columns=categorical_columns, drop_first=True)

# Perform PCA
pca = PCA(n_components=2)
pca_result = pca.fit_transform(data)

# Fit Gaussian Mixture Model for clustering
best_k = 4  # Assuming k=4 is chosen as best
model = GaussianMixture(n_components=best_k, covariance_type='full', random_state=1234)
model.fit(data)
labels = model.predict(data)

# Plot clusters on PCA results
plt.figure(figsize=(10, 7))
sns.scatterplot(x=pca_result[:, 0], y=pca_result[:, 1], hue=labels, palette='viridis')
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.title('Clusters projected on Principal Components')
plt.show()

# Overlay principal component axes
# Plotting the principal component vectors
```

```
for i, (comp, var) in enumerate(zip(pca.components_, pca.explained_variance_)):
    comp_scaled = comp * np.sqrt(var) * 3  # scale for better visualization
    plt.plot([0, comp_scaled[0]], [0, comp_scaled[1]], label=f'PC {i+1}', linestyle='--'
)

plt.legend()
plt.show()
```



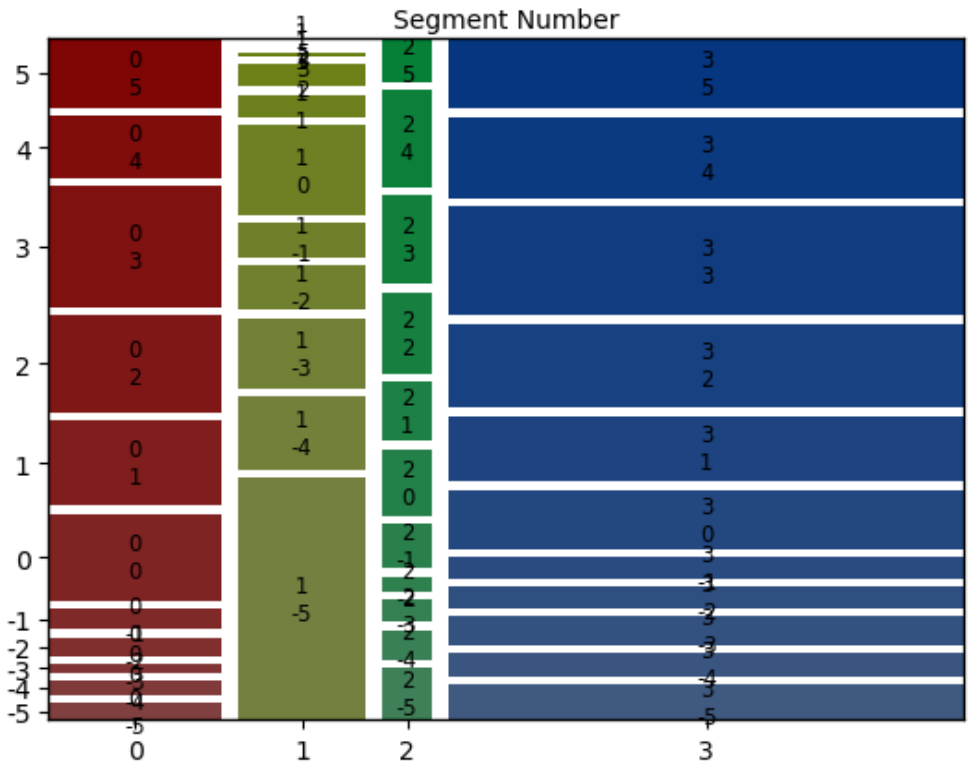


In [91]:

```
import pandas as pd
```

```
import numpy as np
from sklearn.mixture import GaussianMixture
from statsmodels.graphics.mosaicplot import mosaic
import matplotlib.pyplot as plt

# Load the data
file_path = 'mcdonalds.csv'
data = pd.read_csv(file_path)

# Function to convert Yes/No to 1/0
def binary_to_numeric(df, column):
    df[column] = df[column].map({'Yes': 1, 'No': 0})
    return df

# Convert binary columns
binary_columns = ['yummy', 'convenient', 'spicy', 'fattening', 'greasy', 'fast', 'cheap'
,
                  'tasty', 'expensive', 'healthy', 'disgusting']
for col in binary_columns:
    data = binary_to_numeric(data, col)

# Convert 'Like' column to numeric values
data['Like'] = data['Like'].str.extract('([-+]?\d+)').astype(int)

# One-hot encode categorical variables
categorical_columns = ['VisitFrequency', 'Gender']
data = pd.get_dummies(data, columns=categorical_columns, drop_first=True)

# Fit Gaussian Mixture Model for clustering
best_k = 4  # Assuming k=4 is chosen as best
model = GaussianMixture(n_components=best_k, covariance_type='full', random_state=1234)
model.fit(data)
labels = model.predict(data)

# Create a DataFrame with clusters and 'Like' column
mosaic_data = pd.DataFrame({'Cluster': labels, 'Like': data['Like']})

# Create the mosaic plot
mosaic_plot_data = pd.crosstab(mosaic_data['Cluster'], mosaic_data['Like'])

plt.figure(figsize=(10, 7))
mosaic(mosaic_plot_data.stack(), title='', gap=0.02)
plt.xlabel('Segment Number')
plt.show()
```

```
<Figure size 1000x700 with 0 Axes>
```



In [ ]: