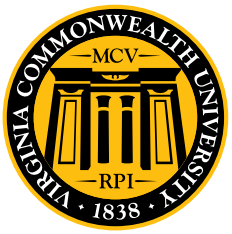


VIRGINIA COMMONWEALTH UNIVERSITY

Statistical analysis and modelling (SCMA 632)

A4c: Multivariate Analysis and Business Analytics Applications: Multidimensional Scaling

FERAH SHAN SHANAVAS RABIYA

V01101398

Date of Submission: 08-07-2024

CONTENTS

Introduction

Multidimensional Scaling (MDS) is a powerful statistical technique used to analyze the similarity or dissimilarity of data points and represent them in a lower-dimensional space. It is particularly useful when dealing with complex datasets where relationships between variables or entities are not directly observable or easily interpretable. In this report, we apply Multidimensional Scaling to a dataset focusing on ice cream preferences. The dataset contains information about individuals' preferences for different companies of ice cream, measured across several attributes or dimensions. By employing MDS, we aim to uncover underlying patterns or similarities in ice cream preferences that may not be apparent in the original data. In the subsequent sections of this report, I will present the results obtained, and provide interpretations that can inform decision-making processes related to ice cream product offerings.

Objectives

- Utilizes Multidimensional Scaling (MDS) to visualize consumer perceptions of ice cream brands.
- Discovers potential market segmentation of ice cream brands with similar appeal.
- Provides strategic insights for marketing strategies, product development, and positioning.
- Enhances competitive advantage by understanding competitors' position and differentiation opportunities.

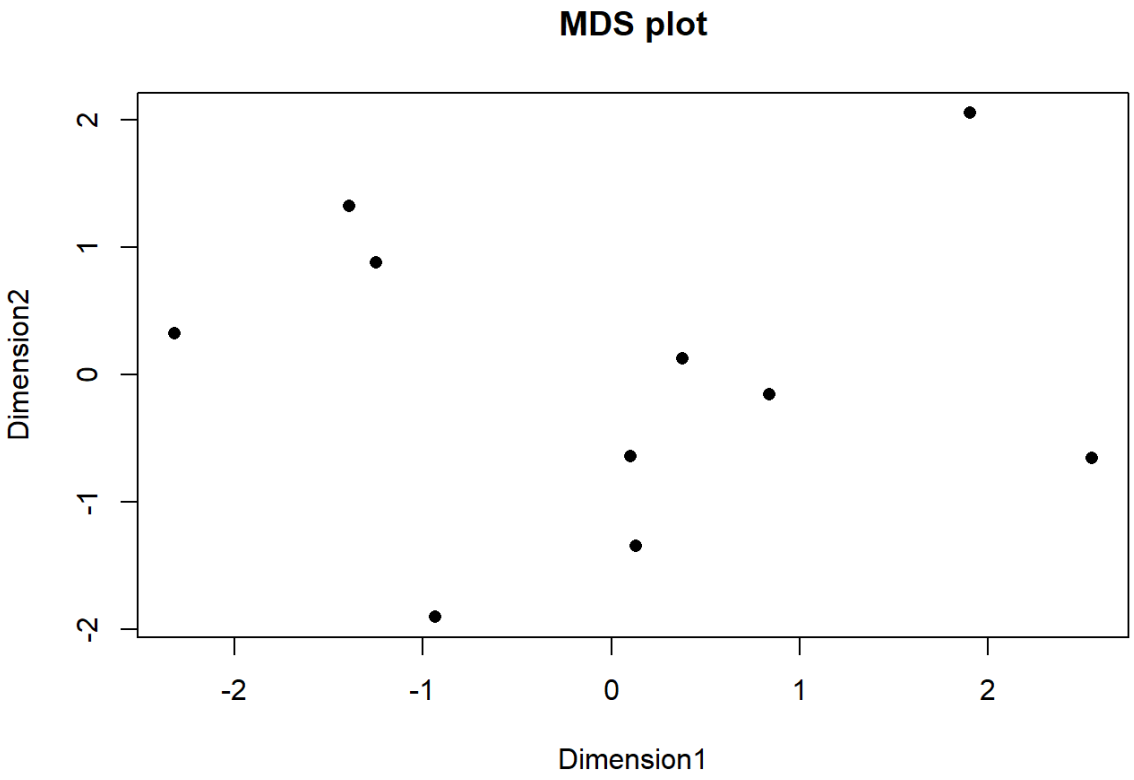
Business Significance

MDS analysis of ice cream brands provides valuable insights for businesses, enabling them to tailor their marketing strategies and product offerings to meet consumer preferences. This helps in strategic positioning, product development, marketing effectiveness, strategic decision making, and brand loyalty and engagement. By understanding consumer perceptions, businesses can create new flavors or formulations that resonate with target audiences, improve marketing ROI, and make informed decisions on pricing, distribution channels, and expansion strategies. Aligning brand perception with consumer expectations fosters stronger brand loyalty and engagement, allowing businesses to build stronger relationships with customers. Overall, MDS analysis empowers businesses to make data-driven decisions that enhance their competitive edge and drive sustainable growth in the dynamic ice cream market.

Results and Interpretation using R

- **Plotting the multidimensional analysis**

```
ice<-subset(icecream_df,select = -c(Brand))
> distance_matrix<-dist(ice)
> mds_result<-cmdscale(distance_matrix,k=2)
> plot(mds_result[,1],mds_result[,2],pch=16,xlab="Dimension1",ylab="Dimens
ion2",main="MDS plot")
```



Interpretation:

The Multidimensional Scaling (MDS) plot is a tool used to visualize ice cream brands based o n their similarities in a multidimensional space. It uses x-axis and y-axis to represent reduced dimensions of the original distance matrix. Brands closer together are perceived as more simil ar, suggesting similar taste, quality, or other criteria. Clusters or groups of points are found, su ggesting similar attributes or consumer preferences. Outliers, appearing far from others, are p erceived differently, suggesting niche brands or unique positioning. The MDS plot can be use d to inform strategic decisions, such as considering differentiation strategies to stand out from competitors or targeting specific consumer segments effectively. By interpreting the MDS plo t, businesses can gain valuable insights into consumer perceptions and competitive dynamics, influencing marketing, product development, and market positioning strategies in the competi tive ice cream market.

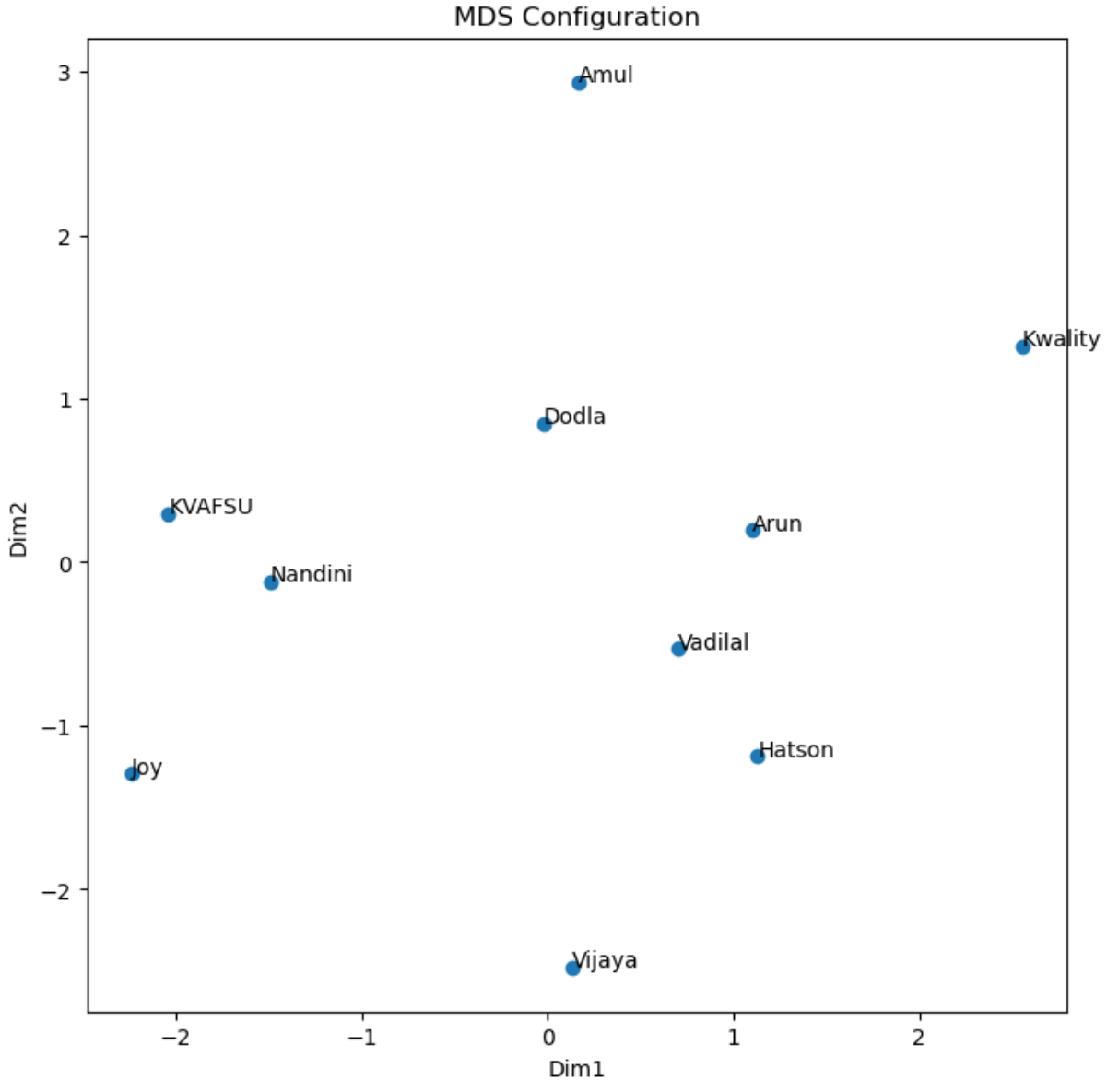
Results and Interpretation using Python

- **Plotting the multidimensional analysis and finding the MDS configuration and st ress value.**

```
mds = MDS(n_components=2, dissimilarity='precomputed')
coords = mds.fit_transform(dissimilarity_matrix)

mds_df = pd.DataFrame(coords, columns=['Dim1', 'Dim2'], index=df['Brand'])

plt.figure(figsize=(8, 8))
plt.scatter(mds_df['Dim1'], mds_df['Dim2'])
for i, brand in enumerate(mds_df.index):
    plt.annotate(brand, (mds_df['Dim1'][i], mds_df['Dim2'][i]))
plt.xlabel('Dim1')
plt.ylabel('Dim2')
plt.title('MDS Configuration')
plt.show()
```



```
print("MDS Configuration:")
print(mds_df)

stress = mds.stress_
print("Stress value:", stress)
```

```
MDS Configuration:
             Dim1      Dim2
Brand
Amul     0.167186  2.935704
Nandini -1.491403 -0.116647
Vadilal  0.704115 -0.531057
Vijaya   0.135736 -2.476463
Dodla   -0.021479  0.846885
Hatson   1.128920 -1.187241
Arun     1.103506  0.198974
Joy     -2.238778 -1.290906
Kwality  2.551616  1.323077
KVAFSU  -2.039419  0.297673

Stress value: 7.407069994373794
```

Interpretation:

The Multidimensional Scaling (MDS) configuration and stress value provide insights into ho w ice cream brands are perceived based on consumer perceptions. The MDS configuration sh ows that brands closer together are perceived more similarly, while those farther apart are per ceived as more distinct. Annotating brands on the plot helps identify clusters or groupings, hig hlighting similarities and differences in consumer perceptions across brands. The stress value (7.407) quantifies how well the distances between points in the MDS plot represent the origin al dissimilarities in the dataset. This analysis can guide marketing campaigns, product develop ment efforts, and strategic decisions aimed at strengthening brand positioning and competitive advantage in the ice cream market.

Recommendation

The report recommends segmentation and targeting specific consumer segments based on the Multidimensional Scaling (MDS) analysis of ice cream brands. Brands clustered together sho uld consider differentiation strategies, such as unique flavors or innovative product formulati ons, to stand out in the market. Strengthening market positioning can be achieved by reinforci ng positive brand attributes and adjusting marketing messaging. New product development sh ould be guided by consumer preferences, addressing market gaps or leveraging emerging tren ds. Continuously monitoring changes in the competitive landscape and comparing the brand's positioning with competitors can identify opportunities for strategic alliances or acquisitions. Enhancing customer engagement strategies based on MDS insights is also recommended. Re gularly reassessing consumer perceptions and brand positioning using MDS or similar analyti cal techniques is recommended to maintain a competitive advantage in the dynamic ice cream market.

R Codes

```
#Do multidimensional scaling and interpret the results.

icecream_df<-read.csv("C:\\Users\\Ferah Shan\\Downloads\\icecream.csv",header=TRUE)
dim(icecream_df)

names(icecream_df)

ice<-subset(icecream_df,select = -c(Brand))
distance_matrix<-dist(ice)

mds_result<-cmdscale(distance_matrix,k=2)

plot(mds_result[,1],mds_result[,2],pch=16,xlab="Dimension1",ylab="Dimension2",main="M
DS plot")
```

Python Codes

```
import pandas as pd
from sklearn.manifold import MDS
import matplotlib.pyplot as plt

df = pd.read_csv("C:\\Users\\Ferah Shan\\Downloads\\icecream.csv")

from scipy.spatial.distance import pdist, squareform
dissimilarity_matrix = squareform(pdist(df.iloc[:, 1:], metric='euclidean'))

mds = MDS(n_components=2, dissimilarity='precomputed')
coords = mds.fit_transform(dissimilarity_matrix)

mds_df = pd.DataFrame(coords, columns=['Dim1', 'Dim2'], index=df['Brand'])

plt.figure(figsize=(8, 8))
plt.scatter(mds_df['Dim1'], mds_df['Dim2'])
for i, brand in enumerate(mds_df.index):
    plt.annotate(brand, (mds_df['Dim1'][i], mds_df['Dim2'][i]))
plt.xlabel('Dim1')
plt.ylabel('Dim2')
plt.title('MDS Configuration')
plt.show()

print("MDS Configuration:")
print(mds_df)

stress = mds.stress_
print("Stress value:", stress)
```

References

1. www.github.com
2. www.geeksforgeeks.com
3. www.datacamp.com