Applying Cluster Analysis in R for Business Segmentation

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2025-12-11

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Why Clustering Matters in Business

Clustering enables companies to discover natural customer or store groups directly from data without predefined labels.

This leads to:

- Stronger **data-driven decision**
- Smarter **resource allocation**
- More **personalized marketing**
- Improved **pricing strategies**

What Is Cluster Analysis?

It is a method that groups similar observations based on selected variables **without predefined labels or a target variable.**

It aims to:

- Maximize within-cluster similarity
- Maximize differences between clusters

Basic Prensiples : Similarity, Dissimilarity, Unsupervised Learning

Clustering Methods in Business Analytics

Main focus – K-Means Clustering

- Most commonly used in business segmentation
- Fast and easy to interpret
- Groups data into *k* clusters based on similarity
- Works well with **balanced, spherical** clusters
- Sensitive to outliers & variable scaling

Choosing the Number of Clusters

Two common evaluation methods:

Elbow Criterion

- Looks at the decrease in within-cluster variation
- “Elbow point” = optimal balance

Silhouette Score

- Measures how well each point fits its cluster
- Higher score = better separation

K-Means: How It Works in R

1️⃣ **Data Preparation**: Scale selected variables → equal contribution

2️⃣ **Choosing *k***: Elbow + Silhouette → best cluster number

3️⃣ **Running K-Means**: Algorithm assigns each point to its nearest cluster center

4️⃣ **Visualization**: Plot clusters in reduced dimensions

5️⃣ **Interpretation**: Translate segments into business insights

Exercise – Store Segmentation with *k*

Objective : Segment retail stores using sales & market variables and interpret business results.

Dataset :

Carseats (from ISLR package)

Required R packages :

```r
install.packages(c("tidyverse", "factoextra", "cluster", "ISLR"))
```

Variables Used for Segmentation :

Sales, CompPrice, Income, Advertising, Population

Exercise – Store Segmentation with *k*

Step 1 — Load Packages & Dataset

Upload CarSeats data

```r
library(ISLR)
library(tidyverse)
library(factoextra)
library(cluster)

data("Carseats")
df <- Carseats
```

Step 2 — Select & Scale Variables :

Scale the variables using k-means so that all variables have the same weight during clustering.

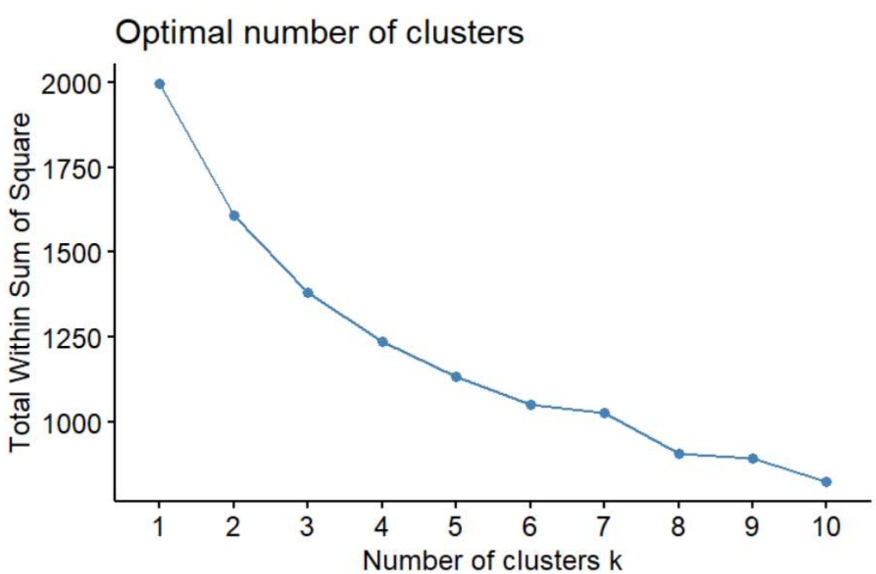
```r
df_scaled <- scale(df[, c("Sales", "CompPrice", "Income", "Advertising",
"Population")])
summary(df_scaled)
```

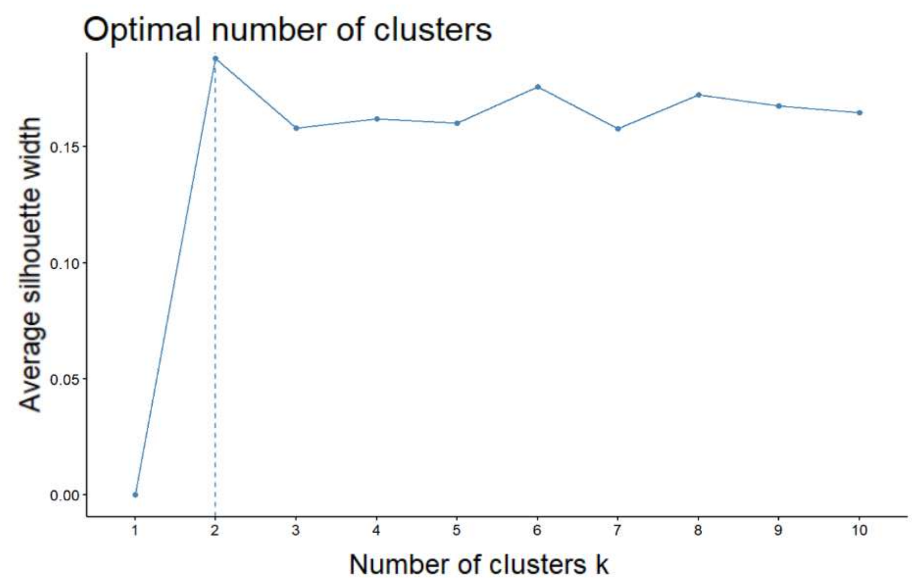
	Sales	CompPrice	Income	Advertising	Population
1	0.709487739	0.84939126	0.15516667	0.65635504	0.07572445
2	1.318528082	-0.91134302	-0.73813596	1.40819356	-0.03284107
3	0.907779944	-0.78091826	-1.20265333	0.50598733	0.02822704
4	-0.034108030	-0.52006873	1.11993351	-0.39621890	1.36494005
5	-1.184911005	1.04502840	-0.16642228	-0.54658661	0.50998655
6	1.173349861	-0.06358207	1.58445087	0.95709045	1.60242713
7	-0.306759811	-0.65049350	1.29859403	-0.99768973	-1.49169030

Step 3 — Evaluate k with Elbow & Silhouette

Using elbow and silhouette plots to determine how many clusters k are appropriate for store segmentation.

```r
fviz_nbclust(df_scaled, kmeans, method = "wss") # Elbow
fviz_nbclust(df_scaled, kmeans, method = "silhouette") # Silhouette
```





Step 4 — Run K-Means with $k = 3$

Run the *k*-means algorithm with the selected number of clusters e.g. $k = 3$ and examine the size and centres of each cluster.

```r
set.seed(123)
k3 <- kmeans(df_scaled, centers = 3, nstart = 25)

k3$size        # cluster sizes
k3$centers     # cluster profiles
```

Step 5 — Compare with $k = 4$ and Silhouette Scores

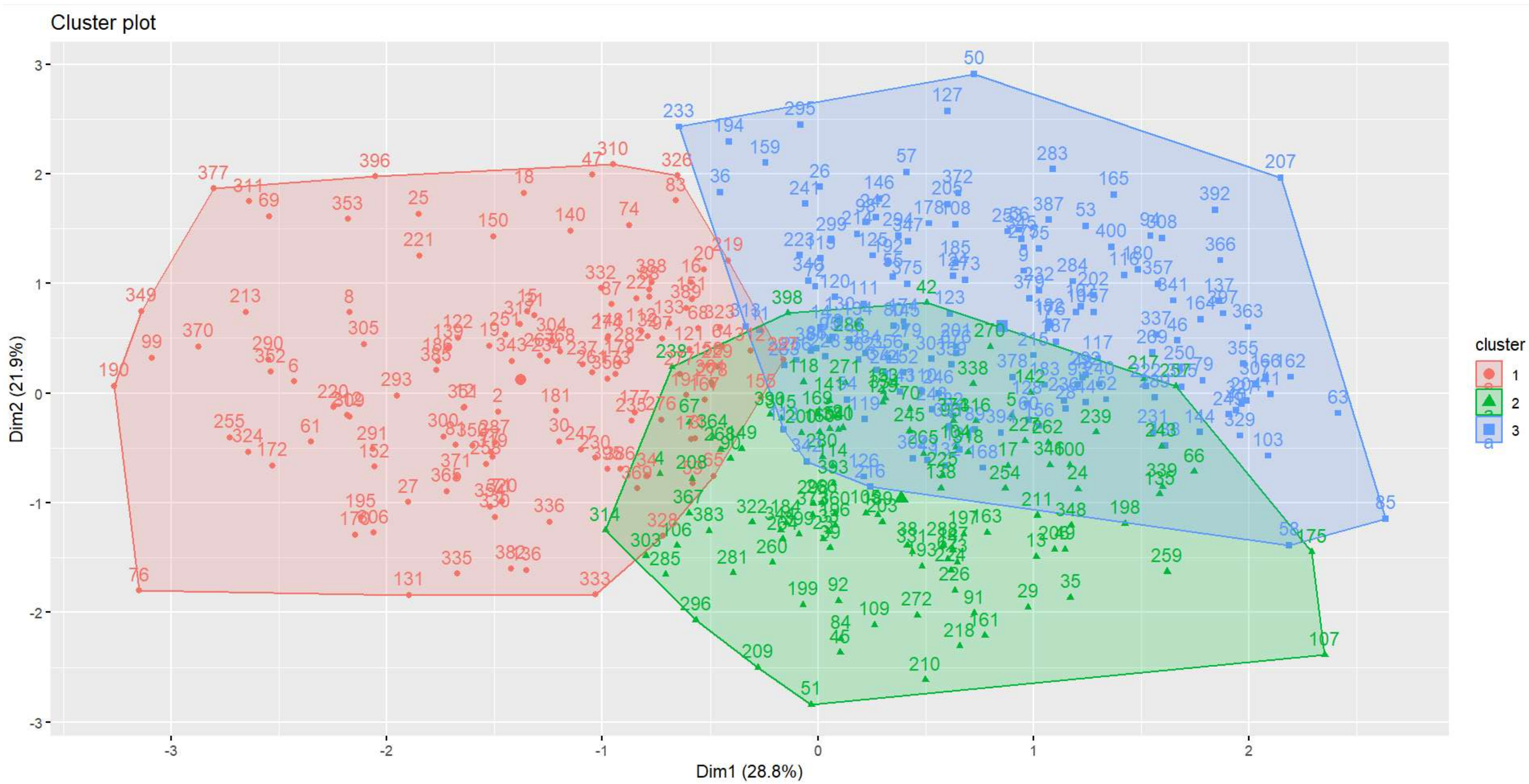
Compare the average silhouette scores for $k = 3$ and $k = 4$ and determine which model provides better cluster separation.

```r
library(cluster)

set.seed(123)
k4 <- kmeans(df_scaled, centers = 4, nstart = 25)

sil3 <- silhouette(k3$cluster, dist(df_scaled))
sil4 <- silhouette(k4$cluster, dist(df_scaled))

mean(sil3[, 3])
mean(sil4[, 3])
```

Step 6 — Visualise the Segments

Visually examine how stores are segmented according to selected variables.

```
fviz_cluster(k3, data = df_scaled)
```


Cluster plot
Dim1 (28.8%)
Dim2 (21.9%)
cluster
1
2
3

Strategic Benefits of Cluster-Based Segmentation

- **Better targeting** & personalized communication
- Smarter **resource allocation** (sales force, budget, inventory)
- **Pricing strategies** tailored to each segment
- Identify **high-potential segments**
- Improved **CRM** & retention performance
- Higher return from **marketing investments**

Technical Summary

What we did :

- Selected 5 business variables
- **Scaled data** for equal contribution
- Found **optimal *k***
- Ran K-Means and assigned stores
- Visualized segments and checked separation

Business Summary

What it means for business :

- Better **targeting** & **resource allocation**
- Stronger **data-driven** decisions
- More effective **pricing** & promotions
- **Growth** opportunities by segment

References

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THANKS