E-commerce platform customers segmentation

Jaime Rubio (40425150)

May 09, 2024

- Data preparation
    - Hierarchical clustering
- RFM analysis
    - Kmeans based on RFM results

Data preparation

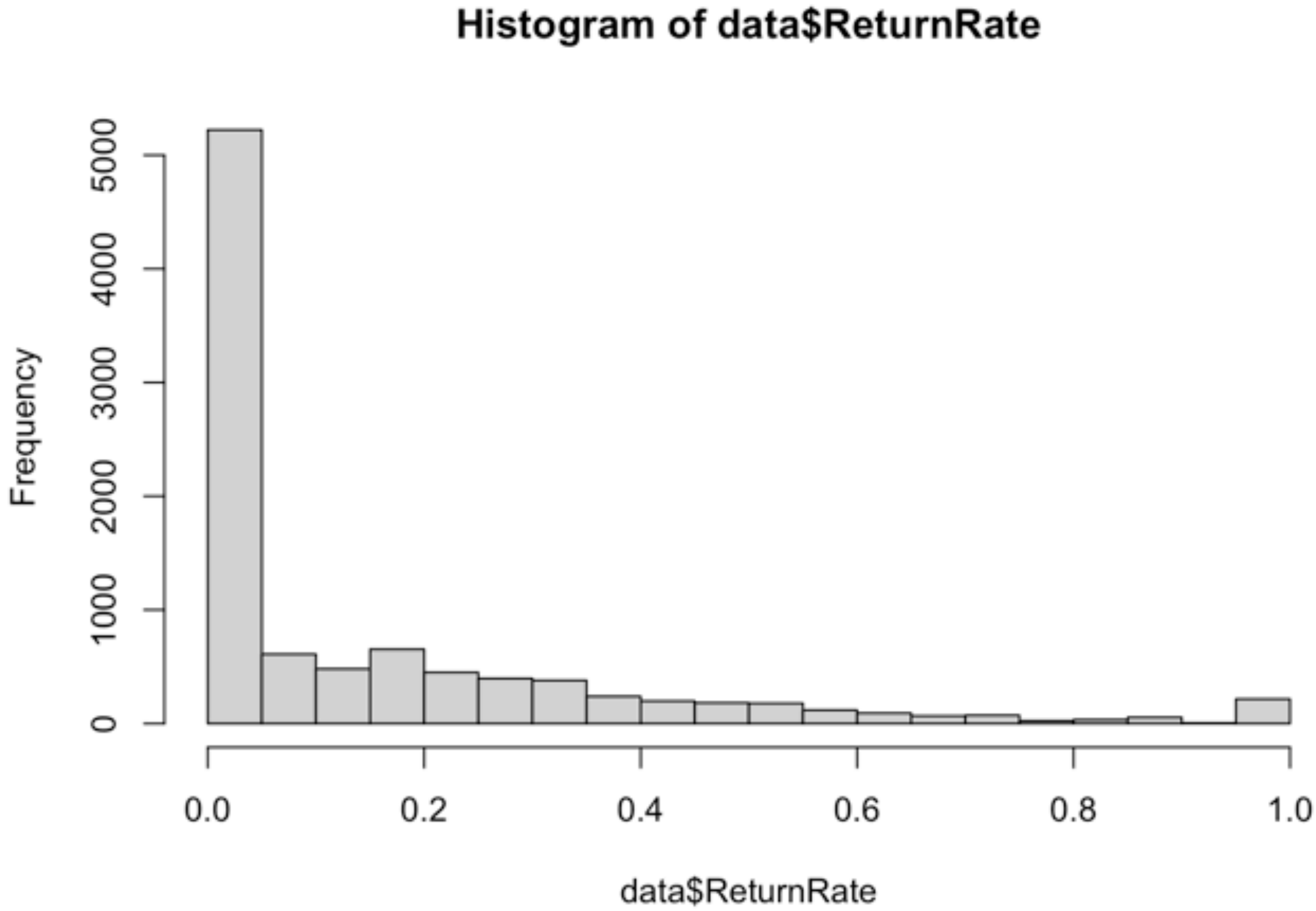
```
#remove observations which purchase was cancelled
data <- subset(data, !startsWith(InvoiceNo, "C"))

#check how many values are higher that 1
filtered_data <- data[data$ReturnRate > 1, ]

# Calculate the percentage of the filtered data set compared to the original datas
et
percentage_higher_than_1 <- (nrow(filtered_data) / nrow(data)) * 100

# Print the percentage
print(percentage_higher_than_1)
```

```
## [1] 1.506361
```

```
#remove rows where returnrate is higher than 1
data <- data[data$ReturnRate <= 1, ]

#convert invocedate into the correct format
data$InvoiceDate <- as.POSIXct(data$InvoiceDate, format = "%Y-%m-%dT%H:%M")

#mutate work levels
data <- data %>%
  mutate(Work = case_when(
    Work == 1 ~ "Health services",
    Work == 2 ~ "Financial services",
    Work == 3 ~ "Sales",
    Work == 4 ~ "Advertising/PR",
    Work == 5 ~ "Education",
    Work == 6 ~ "Industrial Sector",
    Work == 7 ~ "Engineering",
```

```
    Work == 8 ~ "Technology",
    Work == 9 ~ "Retail & Services",
    Work == 10 ~ "Self-Employed",
    Work == 11 ~ "Other"
  ))

#mutate Education levels

data <- data %>%
  mutate(Edcation = case_when(
    Edcation == 1 ~ "High School",
    Edcation == 2 ~ "Undergraduate",
    Edcation == 3 ~ "Postgraduate"
  ))

### Marriage

data <- data %>%
  mutate(Married = case_when(
    Married == 1 ~ "Married",
    Married == 0 ~ "Single"
  ))

##convert categorical variables into factors

data$Work <- as.factor(data$Work)
data$Edcation <- as.factor(data$Edcation)
data$Married <- as.factor(data$Married)
data$ZipCode <- as.factor(data$ZipCode)

## imputation of missing values in customer ID

#create a data set with all missing values
data_na <- data %>%
  filter(is.na(CustomerID))

#filter the original data for non missing values
data <- data %>%
  filter(!is.na(CustomerID))

##same InvoceNo same customer
data_na <- data_na %>%
  group_by(InvoiceNo) %>%
  mutate(CustomerID = cur_group_id())

# join both data sets
data <- bind_rows(data, data_na)


#mode for categorical variables
```

```
get_mode <- function(v) {
  uniqv <- unique(v)
  uniqv[which.max(tabulate(match(v, uniqv)))]
}

#group by customer id w mean for numerical and mode for categorical
new_data <- data %>%
  group_by(CustomerID) %>%
  summarise(Age = mean(Age),
            Work = get_mode(Work),
            Avg_Quantity = mean(Quantity),
            Total_Quantity = sum(Quantity),
            total_value = sum(Quantity * UnitPrice),
            Avg_UnitPrice = mean(UnitPrice),
            Married = get_mode(Married),
            total_invoice = n_distinct(InvoiceNo),
            Avg_ReturnRate = mean(ReturnRate),
            Income = mean(Income),
            Edcation = get_mode(Edcation),
            zipcode = get_mode(ZipCode))%>% filter(
              total_value >= quantile(total_value, 0.025),
              total_value <= quantile(total_value, 0.975),
              Total_Quantity >= quantile(Total_Quantity, 0.025),
              Total_Quantity <= quantile(Total_Quantity, 0.975))

hist(data$ReturnRate)
```

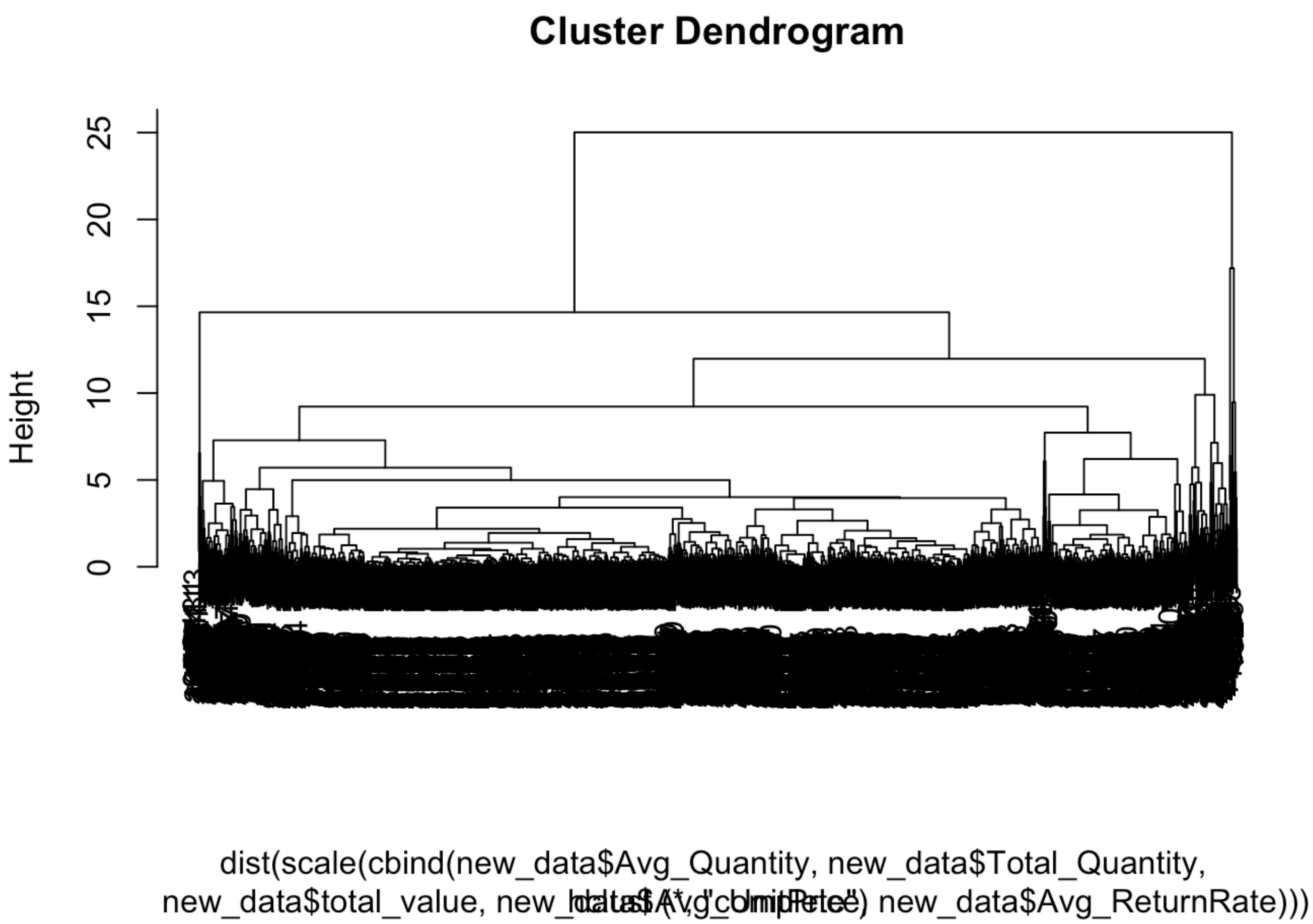


Clustering

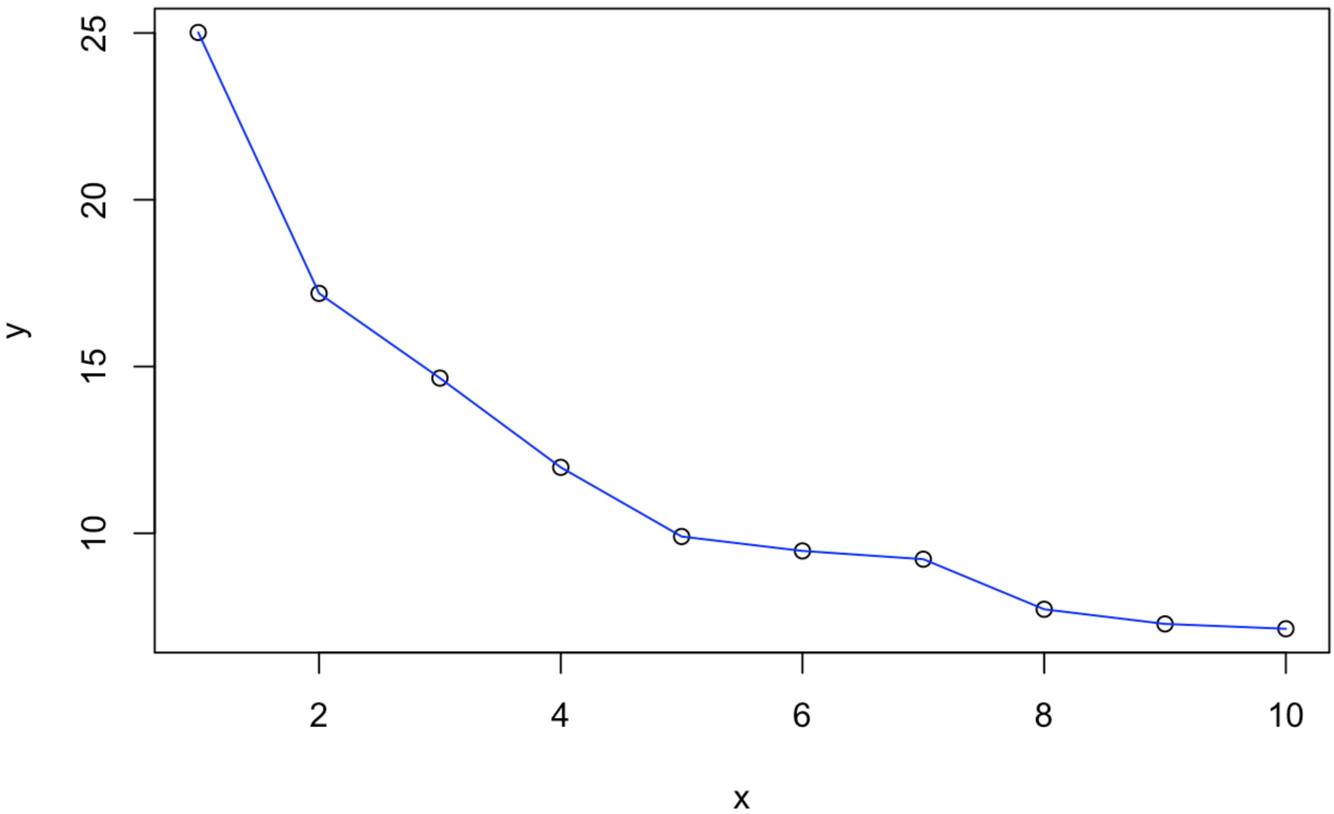
Hierarchical clustering

```
#hierarchical clustering whit 4 linkage methods -----
hclust<- hclust(dist(scale(cbind(new_data$Avg_Quantity, new_data$Total_Quantity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate))), method = "complete")
hclust1<- hclust(dist(scale(cbind(new_data$Avg_Quantity, new_data$Total_Quantity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate))), method = "single")
hclust2<- hclust(dist(scale(cbind(new_data$Avg_Quantity, new_data$Total_Quantity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate))), method = "centroid")
hclust3<- hclust(dist(scale(cbind(new_data$Avg_Quantity, new_data$Total_Quantity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate))), method = "average")
```

```
#different nstart values
nstart_values <- c(10, 50, 100)

x <- c(1:10)

#for complete method---
plot(hclust)
```




```
y <- sort(hclust$height, decreasing = TRUE)[1:10]
plot(x,y); lines(x,y, col= "blue")
```




```r
results <- vector("list", length = 3)
for (i in 1:length(nstart_values)) {
  seg_kmeans <- kmeans(x = data.frame(new_data$Avg_Quantity, new_data$Total_Quanti
ty, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate), center
s = 8, nstart = nstart_values[i])
  results[[i]] <- seg_kmeans
}

# Comparing results
for (i in 1:length(results)) {
  cat("Results for nstart =", nstart_values[i], ":\n")
  print(results[[i]])
  cat("\n")
}
```

```
## Results for nstart = 10 :
## K-means clustering with 8 clusters of sizes 62, 1278, 71, 46, 612, 187, 237, 37
7
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             34.182397              108.951613            108.64871
```

```
## 2           4.345405               5.668232            11.82960
## 3          11.161622              42.591549           175.12662
## 4          30.022314             119.326087           232.29000
## 5           6.099323              14.369281            34.67489
## 6          13.388517              49.074866           104.37406
## 7          25.430058              40.654008            28.10646
## 8           8.704253              28.448276            66.20294
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               1.696336               0.1274866
## 2               3.372286               0.1428583
## 3              19.085038               0.1754068
## 4               3.116224               0.1747545
## 5               4.156557               0.1577674
## 6               3.396130               0.1557103
## 7               1.043599               0.1429953
## 8               5.121569               0.1465778
##
## Clustering vector:
##     [1] 3 5 2 2 2 2 5 6 5 3 2 7 2 4 5 2 2 2 6 8 6 2 5 2 8 2 8 2 2 3 6 4 2 2 2 2
2
##    [38] 6 3 5 8 8 6 2 5 8 2 2 2 2 2 2 2 2 2 2 2 2 5 4 2 8 6 5 2 2 5 3 2 6 5 7 8
7
##    [75] 5 2 8 6 6 5 5 5 2 2 2 3 5 2 6 2 5 8 2 2 6 2 2 5 8 8 8 3 2 2 8 8 2 5 2 2
8
##   [112] 2 8 2 8 5 2 2 2 2 8 2 2 2 2 2 5 2 2 2 2 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 8
2
##   [149] 8 2 2 2 2 5 5 2 5 2 5 2 5 5 5 2 2 2 5 6 5 3 2 2 2 8 8 2 2 2 2 2 2 2 2 5
2
##   [186] 2 6 5 5 5 2 2 1 5 2 2 5 2 5 2 2 2 5 2 5 2 5 5 2 2 5 2 2 5 2 2 2 5 2 3 2
2
##   [223] 2 2 2 2 2 5 2 5 2 2 5 5 5 5 8 2 8 2 3 2 2 2 2 5 6 2 2 2 2 2 2 5 2 2 2 2
2
##   [260] 5 2 2 2 8 2 2 2 2 8 5 2 2 5 2 5 2 2 2 2 2 3 2 3 5 2 2 2 2 5 2 2 2 2 2 2
5
##   [297] 5 2 5 2 2 7 7 5 8 5 2 2 2 8 2 2 2 2 5 2 2 2 5 5 2 3 2 2 2 2 2 2 8 2 2 8
2
##   [334] 2 2 5 5 2 2 2 2 5 5 2 2 2 2 2 8 6 2 2 2 6 5 2 8 2 3 2 2 2 2 5 5 2 8 2 1
8
##   [371] 5 5 5 5 2 2 2 2 2 2 2 5 5 5 2 5 2 5 3 2 2 2 2 2 7 5 8 2 2 2 2 5 5 5 2 2
8
##   [408] 7 2 2 2 2 5 2 8 2 2 7 6 5 2 2 2 2 8 2 2 8 2 8 5 2 2 2 8 8 2 8 5 8 5 3 2
2
##   [445] 2 2 2 7 5 5 2 8 2 2 2 5 5 2 7 2 2 5 2 2 2 6 2 5 5 2 6 2 8 2 8 5 3 2 5 2
2
##   [482] 5 5 5 8 5 2 3 2 7 5 5 6 8 2 8 5 2 8 2 6 8 2 7 8 8 2 2 6 8 5 2 2 2 2 8 5
2
##   [519] 5 2 2 2 2 5 5 2 2 8 2 2 8 2 2 3 8 2 2 5 5 5 5 6 2 5 2 2 5 2 5 2 8 5 2 2
2
##   [556] 5 6 2 8 5 5 2 2 5 2 2 5 5 5 3 2 2 2 2 5 5 6 2 2 2 2 5 5 5 2 5 5 5 5 6 2
2
```

```
##  [593] 5 5 5 2 8 5 8 7 4 2 5 5 2 2 2 2 8 5 5 8 5 3 5 5 2 8 5 2 2 2 2 2 2 5 8 5
5
##  [630] 2 2 8 5 2 2 5 8 5 3 2 8 2 2 5 8 5 3 6 5 5 2 2 8 6 3 6 3 2 5 5 6 5 5 5 5
6
##  [667] 5 2 2 2 1 8 6 7 8 2 2 8 5 5 5 5 2 6 8 7 3 2 2 6 6 2 6 2 5 2 2 2 2 2 5 5
4
##  [704] 8 3 7 7 4 6 8 2 3 1 5 1 2 5 2 6 6 8 6 2 6 8 6 5 8 7 5 2 4 2 6 5 8 8 2 8
5
##  [741] 7 6 5 2 2 8 5 8 2 5 2 6 2 6 5 7 2 1 8 5 8 5 4 5 8 2 2 7 8 5 5 2 6 6 2 5
7
##  [778] 2 2 7 1 5 2 5 5 7 7 8 2 2 6 3 5 2 5 5 2 4 6 8 8 2 6 4 1 8 4 2 5 2 5 2 7
8
##  [815] 5 6 2 6 4 2 2 6 8 2 1 8 2 2 4 8 3 6 4 8 8 6 6 5 7 8 7 5 7 5 5 7 2 5 8 5
2
##  [852] 2 5 8 5 2 2 7 5 1 7 2 6 2 1 8 8 2 8 2 2 2 1 5 5 5 1 6 1 5 1 8 5 2 7 8 2
7
##  [889] 1 2 5 7 5 2 6 2 2 2 2 2 8 5 8 2 2 8 2 5 8 2 6 5 8 6 2 2 2 2 2 8 5 1 2 2
8
##  [926] 8 5 3 5 5 7 8 2 2 5 2 7 8 7 2 8 2 8 5 8 7 4 7 3 2 1 2 6 4 7 2 3 7 2 7 5
2
##  [963] 2 5 2 2 6 8 8 2 6 2 8 2 2 5 1 2 5 2 2 8 2 8 7 5 2 2 2 2 1 8 7 2 1 2 2 5
2
## [1000] 7 2 8 2 7 2 2 5 2 7 2 2 1 5 7 6 8 8 2 5 2 2 2 8 7 5 2 6 2 6 5 2 5 2 2 3
8
## [1037] 4 2 6 7 8 6 5 8 8 2 5 5 2 5 8 7 7 2 5 2 3 2 8 2 2 2 8 2 8 7 7 2 8 5 2 8
7
## [1074] 2 2 5 2 7 5 8 5 5 2 2 5 8 2 5 6 7 2 2 3 7 2 5 2 7 5 2 2 5 4 2 2 5 2 1 1
2
## [1111] 8 7 5 2 5 5 5 2 2 7 2 2 2 8 2 2 8 8 5 2 2 2 7 2 8 2 2 5 8 2 5 2 2 2 2 8
2
## [1148] 5 2 2 8 6 8 5 2 2 2 7 2 2 8 2 2 2 5 7 2 8 5 2 7 2 6 5 7 7 2 7 6 7 2 2 8
8
## [1185] 7 5 5 7 7 5 7 5 6 2 8 8 7 2 5 5 6 5 2 5 5 8 5 2 5 2 2 2 7 2 1 2 8 7 5 2
8
## [1222] 2 8 8 7 2 2 5 2 2 2 7 2 8 2 5 3 2 2 5 2 8 5 6 2 7 2 8 8 6 2 8 2 2 5 7 8
8
## [1259] 2 5 8 2 8 5 2 2 5 2 7 5 2 8 2 2 2 5 2 2 8 5 7 2 2 5 5 6 6 2 2 5 5 2 8 8
4
## [1296] 7 2 2 2 2 7 8 2 2 5 2 5 8 2 2 8 5 5 1 7 6 2 2 2 2 2 2 2 8 3 8 2 2 2 2 7
5
## [1333] 8 5 8 5 8 5 2 7 1 7 2 2 2 8 2 1 8 2 2 2 5 5 8 5 8 6 4 8 7 2 8 8 7 5 7 5
7
## [1370] 5 8 2 2 6 2 5 8 2 3 8 5 3 5 2 8 2 7 5 8 8 5 6 2 8 8 2 5 2 6 5 2 8 2 2 5
2
## [1407] 7 5 8 2 7 5 5 7 2 2 2 2 2 8 6 2 2 2 5 8 2 8 2 6 8 7 6 5 2 7 8 6 7 5 6 4
2
## [1444] 2 7 8 2 8 2 8 5 2 2 2 5 3 5 2 2 7 2 2 8 2 7 4 5 5 2 2 6 8 2 5 5 2 6 5 2
2
## [1481] 2 7 8 8 3 2 5 5 5 5 8 2 2 8 5 5 5 8 2 2 2 5 6 8 6 1 2 2 5 2 2 7 5 7 2 2
2
```

```
## [1518] 2 5 2 2 2 2 2 2 8 5 8 2 2 2 5 5 2 8 2 2 1 5 2 2 2 2 7 1 2 2 2 2 2 5 7 5
8
## [1555] 7 8 2 2 7 5 2 7 2 2 2 5 2 5 4 3 2 2 2 8 8 8 2 2 2 6 7 7 2 2 5 2 1 2 6 2
2
## [1592] 8 5 2 5 5 5 2 6 2 2 2 2 5 4 5 7 6 2 6 2 7 2 7 8 2 8 7 2 2 2 3 2 2 5 5 7
8
## [1629] 1 2 7 8 6 5 6 8 2 2 2 3 2 6 2 6 2 2 5 2 5 2 2 2 2 2 2 2 7 2 2 2 6 2 2 2
2
## [1666] 2 2 8 2 4 2 2 8 8 2 2 2 2 3 6 2 4 2 2 8 2 6 2 5 2 5 6 8 2 6 2 8 8 2 2 2
5
## [1703] 8 2 5 5 5 2 7 2 5 5 7 1 2 1 5 7 3 1 2 7 8 2 2 5 2 7 5 4 6 1 2 8 8 7 2 5
5
## [1740] 6 1 5 3 7 8 8 2 6 2 6 2 5 5 8 6 5 2 2 5 5 8 6 5 8 8 2 2 2 6 8 7 5 2 2 2
2
## [1777] 2 2 2 5 4 6 7 8 5 8 6 6 5 2 2 8 6 2 2 2 2 8 5 2 5 5 2 8 2 2 2 2 5 2 2 2
2
## [1814] 8 2 2 2 2 6 2 2 2 2 2 2 8 7 3 2 5 2 5 6 8 5 2 5 2 2 2 5 7 2 2 3 2 6 8 2
2
## [1851] 2 2 2 7 8 5 2 5 2 5 2 7 7 6 5 7 2 2 2 8 5 2 6 7 5 2 2 2 2 4 7 7 3 5 2 8
5
## [1888] 6 6 2 4 5 5 2 2 2 2 5 5 8 7 8 2 1 2 5 2 2 5 5 2 2 2 8 2 8 8 2 7 6 2 5 7
2
## [1925] 8 5 1 2 5 8 5 8 2 7 5 5 5 7 1 5 2 6 2 7 5 5 8 1 3 2 5 8 2 2 7 2 7 7 8 7
2
## [1962] 2 5 2 2 2 8 5 2 2 3 2 7 2 2 8 5 2 6 2 5 3 2 2 2 7 7 2 7 2 2 2 8 2 2 7 8
2
## [1999] 2 4 4 2 5 6 2 2 6 6 8 5 7 2 2 5 6 8 5 2 8 2 7 7 8 5 2 8 4 2 5 5 5 5 8 2
5
## [2036] 2 2 5 2 5 2 2 2 2 8 2 6 2 2 2 6 2 1 5 2 7 5 2 2 7 6 5 8 2 2 5 2 8 2 5 4
5
## [2073] 5 5 5 8 2 2 8 5 5 5 2 2 2 1 5 8 1 6 5 6 7 8 2 6 2 2 8 1 5 2 2 5 2 2 8 2
5
## [2110] 2 6 2 2 2 2 5 8 2 2 7 2 2 5 5 4 2 6 2 2 2 2 5 5 2 8 2 8 2 2 7 5 2 2 8 6
8
## [2147] 2 8 5 5 8 5 2 2 2 7 2 2 8 2 2 7 5 5 2 2 8 2 2 2 2 2 5 7 8 5 2 2 2 2 2 2 2 5
8
## [2184] 2 2 2 5 2 2 5 8 2 2 8 2 6 2 2 2 2 2 7 6 2 6 2 2 5 2 5 5 2 2 5 2 2 2 5 5
2
## [2221] 2 5 2 4 2 2 2 2 5 2 8 5 7 2 4 5 3 7 7 1 7 2 2 2 2 7 2 2 2 8 7 5 6 2 2 2
5
## [2258] 8 7 2 8 7 5 2 5 2 7 2 2 2 2 5 2 2 1 8 2 5 7 2 8 5 2 6 6 2 2 8 7 8 3 2 1
5
## [2295] 7 7 2 7 2 2 5 5 4 7 2 5 5 8 5 1 8 2 7 2 2 5 6 5 6 1 2 2 2 8 5 2 5 2 4 2
5
## [2332] 5 2 8 5 5 2 7 5 2 2 5 8 2 7 5 6 2 5 6 5 5 8 5 8 8 5 2 2 5 6 5 2 8 2 7 2
2
## [2369] 2 5 2 6 2 2 6 2 2 2 2 2 2 3 2 8 2 8 2 5 2 2 8 2 5 2 8 2 8 2 5 6 2 2 2 5
1
## [2406] 3 5 2 8 2 5 8 4 5 5 5 5 2 2 2 5 2 2 2 7 2 8 2 7 5 5 8 2 8 2 2 6 2 2 2 2
2
```

```
## [2443] 7 7 6 5 6 8 2 5 2 7 2 4 2 2 2 5 8 2 2 8 2 3 5 2 5 8 4 2 8 5 2 7 6 2 2 2
8
## [2480] 6 1 8 2 6 7 5 6 2 5 8 2 5 2 6 2 1 2 7 5 2 8 5 3 2 2 2 2 2 6 2 2 7 5 1 5
2
## [2517] 5 2 1 2 2 2 2 8 1 8 2 5 2 8 8 3 6 2 2 2 5 7 8 2 2 2 8 5 7 7 8 8 2 2 5 2
8
## [2554] 5 5 2 2 4 5 2 5 6 7 7 2 2 2 5 2 5 5 7 2 2 2 2 2 7 8 2 5 2 2 2 5 2 5 6 2
6
## [2591] 2 7 2 6 2 2 5 2 7 2 2 2 8 2 2 7 5 2 2 2 5 2 7 2 5 4 2 5 7 2 5 5 3 5 7 8
5
## [2628] 8 7 6 5 2 3 5 8 8 8 5 8 5 2 1 5 6 2 5 1 8 5 5 5 2 7 6 4 7 5 8 6 7 5 8 6
8
## [2665] 5 2 7 8 2 2 8 3 3 7 2 5 6 7 5 2 2 4 2 5 6 2 5 5 7 3 5 2 2 2 2 5 8 2 2 5
7
## [2702] 2 2 5 2 2 5 8 2 2 6 7 6 2 2 2 2 2 5 2 2 2 8 3 2 2 2 6 8 2 5 2 7 7 2 3 2
2
## [2739] 2 2 7 2 2 2 2 2 2 2 5 2 8 5 2 5 7 6 7 5 2 7 5 2 8 2 2 7 5 2 2 2 2 2 7 2
2
## [2776] 2 8 2 1 2 5 7 6 5 8 2 5 5 5 2 5 5 5 2 7 8 7 2 2 2 2 6 2 5 5 6 7 2 5 2 7
2
## [2813] 2 2 2 1 8 7 5 7 2 2 2 2 2 3 5 2 3 5 8 7 5 2 5 5 2 5 2 2 2 2 2 2 2 7 2 8
5
## [2850] 5 6 1 7 3 5 7 7 8 5 7 2 2 2 2 5 2 6 2 5 2
##
## Within cluster sum of squares by cluster:
## [1] 157993.41 110007.63 213283.07 167846.51  96291.63 126062.73 152693.52
## [8] 175488.73
##  (between_SS / total_SS =  85.6 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 50 :
## K-means clustering with 8 clusters of sizes 191, 1227, 68, 363, 743, 175, 46, 5
7
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             12.360219               47.324607            104.85775
## 2              4.158012                5.358598             11.45873
## 3             10.999074               41.514706            176.40353
## 4              7.246180               23.000000             64.31471
## 5              9.051475               16.939435             30.28202
## 6             25.966610               55.440000             46.51509
## 7             30.022314              119.326087            232.29000
## 8             33.327929              110.175439            115.40544
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               3.552565               0.1490001
```

```
## 2              3.475836              0.1453699
## 3             19.798128              0.1770462
## 4              6.063650              0.1555215
## 5              3.077822              0.1449525
## 6              1.423715              0.1557503
## 7              3.116224              0.1747545
## 8              1.759743              0.1311359
##
## Clustering vector:
##    [1] 3 4 2 2 2 2 4 1 5 3 2 5 2 7 5 2 2 2 1 4 1 2 5 2 4 2 4 2 2 3 1 7 2 2 2 2
2
##   [38] 1 3 5 4 4 1 2 4 4 2 2 2 2 2 2 2 2 2 2 2 2 5 7 2 4 1 5 2 2 5 3 2 1 5 6 4
5
##   [75] 5 2 4 1 1 5 5 4 2 2 2 3 5 2 1 2 5 4 2 2 1 2 2 5 4 4 4 3 2 2 6 4 2 5 2 2
4
##  [112] 2 4 2 4 5 2 2 2 2 4 2 2 2 2 2 5 2 2 2 2 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 1
2
##  [149] 4 2 2 2 2 5 5 2 5 2 5 2 5 5 4 2 2 2 5 1 5 3 2 2 2 4 4 2 2 2 2 2 2 2 2 5
2
##  [186] 2 1 2 5 5 2 2 8 5 2 2 5 2 5 2 2 2 5 2 5 2 5 5 2 2 5 2 2 5 2 2 2 5 2 3 2
2
##  [223] 2 2 2 2 2 5 2 4 2 2 5 4 5 5 4 2 4 2 3 2 2 2 2 5 1 2 2 2 2 2 2 5 2 2 2 2
2
##  [260] 5 2 2 2 4 2 2 2 2 4 4 2 2 5 2 5 2 2 2 2 2 3 2 3 5 2 2 2 2 5 2 2 2 2 2 2
5
##  [297] 5 2 5 2 2 6 6 5 4 5 2 2 2 4 2 2 2 2 5 2 2 2 5 5 2 3 2 2 2 2 2 2 4 2 2 4
2
##  [334] 2 2 2 5 2 2 2 2 5 5 2 2 2 2 2 4 1 2 2 2 1 2 2 4 2 3 2 2 2 2 4 5 2 4 2 8
4
##  [371] 5 5 5 5 2 2 2 2 2 2 2 2 5 5 5 2 5 2 5 3 2 2 2 2 2 5 5 4 2 2 2 2 5 5 5 2 2
4
##  [408] 5 2 2 2 2 5 2 4 2 2 5 1 5 2 2 2 2 4 5 2 4 2 4 5 2 2 2 4 1 2 4 5 4 5 3 2
2
##  [445] 2 2 2 6 5 5 2 4 2 2 2 5 5 2 6 2 2 4 2 2 2 1 2 5 5 2 1 2 4 2 4 5 3 2 5 2
2
##  [482] 5 5 5 4 5 2 3 2 5 5 5 1 4 2 4 5 2 4 2 1 4 2 6 4 4 2 2 1 4 5 2 2 2 2 4 5
2
##  [519] 5 2 2 2 2 5 5 2 2 4 2 2 4 2 2 3 4 2 2 5 5 5 5 1 2 5 2 2 5 2 5 2 4 5 2 2
2
##  [556] 5 1 2 4 5 5 2 2 5 2 2 5 5 5 3 2 2 2 5 5 5 1 2 2 2 2 4 5 5 2 5 5 5 5 1 2
2
##  [593] 5 5 5 2 4 5 4 6 7 2 5 5 2 2 2 2 4 5 5 4 4 3 5 5 2 4 5 2 2 2 2 2 2 5 4 5
5
##  [630] 2 2 4 4 2 2 5 4 5 1 2 4 2 2 5 4 5 3 1 5 5 2 2 4 1 3 1 3 2 5 4 1 5 5 5 4
1
##  [667] 5 2 2 2 8 4 1 6 4 2 2 6 5 5 5 5 2 1 4 5 3 2 2 1 1 2 1 2 5 2 2 2 2 2 5 5
7
##  [704] 4 3 5 6 7 1 1 2 3 8 5 8 2 5 5 1 1 6 1 2 1 4 1 5 4 6 5 2 7 2 1 5 4 1 2 4
5
##  [741] 6 1 5 2 2 6 2 4 2 4 5 1 2 1 5 5 2 8 4 5 6 5 7 5 4 2 2 5 6 5 5 2 1 1 2 5
```

```
5
##  [778] 2 2 5 8 5 2 5 5 5 5 4 2 2 1 3 5 2 5 5 2 7 1 4 4 2 1 7 8 4 7 2 5 2 5 2 6
4
##  [815] 5 1 2 1 7 2 2 1 4 2 8 6 5 2 7 4 3 6 7 4 4 1 1 5 6 4 6 4 5 5 5 5 2 4 6 5
2
##  [852] 2 5 4 5 2 2 6 5 8 6 2 1 2 8 4 1 2 4 2 2 2 8 5 5 5 8 1 8 5 6 6 4 2 5 4 2
5
##  [889] 8 2 5 6 5 2 1 2 2 2 2 2 4 5 4 2 2 4 2 5 6 2 1 5 4 1 2 2 2 2 2 6 5 8 2 2
4
##  [926] 4 5 3 5 5 5 6 2 5 5 2 5 4 6 2 4 2 4 5 4 6 7 5 3 2 6 2 1 7 5 2 3 6 2 5 5
2
##  [963] 2 5 5 2 1 1 6 2 1 2 4 2 2 5 8 2 5 5 2 4 2 4 5 5 2 2 2 2 8 4 5 2 8 2 2 5
2
## [1000] 6 2 4 2 5 2 5 5 2 5 2 2 8 5 6 1 6 6 2 5 2 2 2 4 5 5 2 1 2 1 5 2 5 5 2 3
4
## [1037] 7 2 1 5 4 1 5 4 4 5 5 5 2 5 4 5 5 2 4 2 3 2 4 2 2 2 4 2 4 6 6 2 6 5 2 6
5
## [1074] 2 2 5 2 5 5 4 5 5 2 2 5 4 2 5 1 6 2 2 3 5 2 5 2 6 5 2 2 5 7 2 2 5 2 8 8
2
## [1111] 6 5 5 2 4 5 5 2 2 6 2 2 2 4 2 2 4 4 5 2 2 2 6 2 4 2 2 5 4 2 5 2 2 2 2 4
2
## [1148] 5 2 2 4 1 1 5 2 2 2 5 2 5 6 2 2 2 5 5 2 4 5 2 5 2 1 5 6 5 2 6 1 5 2 2 4
4
## [1185] 5 5 5 5 6 5 5 5 1 2 4 4 6 2 5 5 1 5 2 5 5 4 5 2 5 2 2 2 5 2 8 2 4 6 5 2
4
## [1222] 2 4 4 5 2 2 5 2 2 2 5 2 4 2 5 3 2 2 5 2 4 5 1 2 6 2 4 4 1 2 4 2 2 5 6 6
4
## [1259] 2 5 4 2 4 5 2 2 5 2 5 5 2 4 2 2 2 4 2 2 4 5 2 2 2 5 5 1 6 2 2 4 5 2 4 4
7
## [1296] 6 2 2 2 2 5 4 2 2 5 2 5 4 2 2 6 5 5 8 6 1 2 2 2 2 2 2 2 6 3 4 2 2 2 2 6
5
## [1333] 4 5 4 5 4 5 2 6 8 5 2 2 5 4 2 8 4 2 2 2 5 5 4 5 6 1 7 6 6 2 4 4 5 5 5 5
5
## [1370] 5 1 2 2 1 2 5 4 2 3 4 5 3 5 5 4 2 6 5 4 4 5 1 2 4 4 2 5 5 1 5 2 4 2 2 5
2
## [1407] 5 5 4 2 6 5 4 5 2 5 2 5 2 4 1 2 2 2 4 6 2 4 2 1 4 5 1 5 2 6 4 1 5 5 6 7
2
## [1444] 2 5 4 5 4 2 4 5 2 2 2 5 3 5 2 2 5 2 2 4 5 5 7 5 5 2 2 1 4 5 5 5 2 1 5 2
5
## [1481] 2 6 4 4 3 2 5 5 5 5 6 2 2 4 5 5 5 4 2 2 2 5 1 4 1 8 2 2 5 2 2 5 5 6 2 2
2
## [1518] 2 4 2 2 2 2 2 2 6 5 4 2 2 2 5 5 2 4 2 2 8 5 2 2 2 2 6 8 2 2 2 2 2 5 6 5
4
## [1555] 5 4 2 2 6 5 5 5 2 2 2 5 2 5 7 8 2 2 2 4 4 4 2 2 2 1 2 6 2 2 4 2 8 2 1 2
2
## [1592] 4 5 2 5 5 5 2 1 2 5 2 2 5 7 5 5 1 2 1 2 5 2 6 1 2 4 5 2 2 5 3 2 2 5 5 5
4
## [1629] 8 5 6 6 1 5 1 4 2 2 5 3 2 1 2 1 2 2 5 2 5 2 2 2 2 2 2 2 5 2 2 2 1 2 2 2
2
## [1666] 2 2 4 2 7 2 2 4 4 2 2 2 2 3 1 2 7 2 2 4 2 1 2 5 2 5 1 4 2 1 2 4 6 2 5 5
```

```
5
## [1703] 4 2 5 4 5 2 5 2 5 5 5 8 2 8 5 6 3 8 2 6 4 2 2 5 2 6 5 7 1 8 2 6 6 2 2 4
5
## [1740] 1 8 5 3 6 4 6 2 1 2 1 2 5 5 4 1 5 2 2 5 5 4 1 4 4 4 2 2 2 1 4 5 5 2 2 5
2
## [1777] 2 2 2 5 7 1 5 4 5 4 1 1 5 2 2 4 1 2 2 2 2 4 5 2 5 4 2 4 2 2 2 2 5 2 2 2
2
## [1814] 6 2 2 2 2 1 2 2 2 2 2 2 4 6 8 2 5 2 5 1 4 5 2 5 2 5 2 5 6 2 2 3 2 1 4 2
2
## [1851] 2 2 2 5 4 5 2 5 2 5 2 5 5 1 4 6 2 2 2 6 5 2 1 6 5 2 2 2 5 7 5 5 3 5 2 4
5
## [1888] 1 1 2 7 5 5 2 2 2 2 5 5 4 6 4 2 8 2 5 2 2 5 5 2 2 2 4 5 4 4 2 5 1 5 5 5
2
## [1925] 4 5 8 2 5 4 5 6 2 6 5 5 5 5 8 5 5 1 2 6 5 5 6 8 3 2 5 4 2 2 5 2 6 5 4 6
2
## [1962] 2 5 2 2 2 4 5 2 2 3 2 5 2 2 6 5 2 1 2 5 3 2 2 2 5 6 2 5 2 2 2 4 2 2 5 4
2
## [1999] 5 7 7 2 5 1 2 2 1 1 4 4 6 2 2 5 1 4 5 2 4 2 6 6 6 4 2 4 7 2 5 5 5 5 4 2
5
## [2036] 2 2 5 2 5 2 2 2 2 4 2 1 2 2 2 1 5 6 5 2 6 5 2 2 6 1 5 4 5 5 5 5 4 2 5 7
4
## [2073] 5 5 5 1 2 2 4 5 5 5 2 2 5 8 5 4 6 1 5 1 5 4 2 6 2 2 4 6 5 2 2 5 2 5 6 2
5
## [2110] 2 6 2 2 2 2 5 6 2 2 6 2 2 5 5 7 2 1 2 2 2 2 4 5 2 4 2 4 2 2 5 5 2 2 4 1
4
## [2147] 2 4 5 5 4 5 2 2 2 5 2 2 4 2 2 5 5 5 2 2 4 2 2 2 2 5 6 6 5 2 2 5 2 2 2 5
4
## [2184] 2 2 2 5 2 2 5 4 2 2 4 5 1 2 2 2 2 2 5 1 2 1 2 2 5 2 5 5 2 2 5 2 2 5 5 5
2
## [2221] 2 5 2 7 2 2 2 5 5 2 4 5 6 5 7 5 3 6 5 8 6 2 2 2 2 6 2 2 2 4 2 5 1 2 2 2
5
## [2258] 4 6 2 4 5 5 2 5 2 5 2 2 2 2 5 2 2 8 4 2 5 5 2 4 5 2 1 1 2 2 4 5 4 3 5 8
4
## [2295] 6 5 2 6 2 2 5 5 7 5 2 5 4 4 5 8 4 2 5 2 2 5 1 5 1 8 2 2 2 4 4 2 5 2 7 2
5
## [2332] 5 2 4 5 5 5 6 5 2 2 5 4 2 6 5 1 2 5 1 5 5 6 5 6 6 5 2 2 5 1 4 2 4 2 5 2
2
## [2369] 2 5 2 1 5 2 1 5 2 2 2 2 2 3 2 6 2 4 2 5 2 2 4 2 5 2 6 2 4 2 5 6 2 2 2 5
8
## [2406] 3 5 2 4 2 5 4 7 5 5 5 4 2 2 2 5 2 2 2 6 2 4 2 5 5 5 4 2 4 5 2 1 2 2 2 2
2
## [2443] 6 6 1 5 1 4 2 5 2 5 2 7 2 2 2 5 4 2 2 6 2 3 5 2 5 4 7 2 4 5 2 6 1 2 2 2
1
## [2480] 1 8 6 2 1 5 5 1 2 5 4 2 5 2 6 2 8 2 5 5 2 4 5 3 2 2 2 2 2 1 2 2 6 5 8 5
2
## [2517] 5 2 8 2 2 2 2 4 6 4 2 5 2 4 4 3 1 5 2 2 5 6 4 2 2 2 4 5 5 6 4 6 2 2 4 2
4
## [2554] 5 5 2 2 7 5 2 5 1 5 6 2 2 2 5 2 5 4 5 2 2 2 2 2 6 4 2 5 2 2 2 5 2 5 1 2
1
## [2591] 2 5 2 1 2 2 5 2 6 2 5 2 4 2 2 5 4 2 2 2 5 2 5 2 5 7 2 5 6 2 5 5 3 5 5 6
```

```
5
## [2628] 4 6 1 4 2 3 5 4 4 6 5 4 5 2 8 5 1 2 5 6 4 5 4 5 2 5 1 7 6 5 4 1 5 5 4 1
4
## [2665] 5 2 6 4 2 2 4 3 3 6 5 5 6 5 5 2 2 7 2 5 1 5 5 5 5 3 5 2 2 2 2 5 4 2 2 5
5
## [2702] 2 2 5 2 2 5 4 2 2 1 5 1 2 2 2 2 2 5 2 2 2 4 3 2 2 2 1 1 2 4 2 6 5 2 3 2
2
## [2739] 2 2 6 2 2 2 2 2 2 2 5 5 4 5 2 5 5 6 6 5 2 6 5 2 4 2 2 5 5 2 2 2 2 2 5 2
2
## [2776] 2 6 2 8 2 4 5 1 5 4 5 5 5 5 2 4 5 5 2 2 4 6 2 2 2 2 1 2 5 5 1 6 2 4 2 6
2
## [2813] 2 2 2 8 4 6 5 6 2 2 5 2 2 3 5 2 3 5 4 5 5 2 5 5 2 5 5 5 2 2 2 2 2 5 2 4
5
## [2850] 5 1 8 6 3 5 5 6 4 5 5 2 2 2 2 5 2 1 2 5 2
##
## Within cluster sum of squares by cluster:
## [1] 119383.5 103846.7 206730.0 146454.8 162252.0 141391.3 167846.5 141191.8
##  (between_SS / total_SS =  85.7 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 100 :
## K-means clustering with 8 clusters of sizes 59, 192, 43, 68, 175, 743, 363, 122
7
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             36.994779              110.084746            119.05492
## 2             12.384385               47.520833            104.78490
## 3             25.140149              120.674419            236.00791
## 4             10.999074               41.514706            176.40353
## 5             25.966610               55.440000             46.51509
## 6              9.051475               16.939435             30.28202
## 7              7.246180               23.000000             64.31471
## 8              4.158012                5.358598             11.45873
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               1.754701               0.1357395
## 2               3.545249               0.1486092
## 3               3.208751               0.1728114
## 4              19.798128               0.1770462
## 5               1.423715               0.1557503
## 6               3.077822               0.1449525
## 7               6.063650               0.1555215
## 8               3.475836               0.1453699
##
## Clustering vector:
##    [1] 4 7 8 8 8 8 7 2 6 4 8 6 8 3 6 8 8 8 2 7 2 8 6 8 7 8 7 8 8 4 2 3 8 8 8 8
```

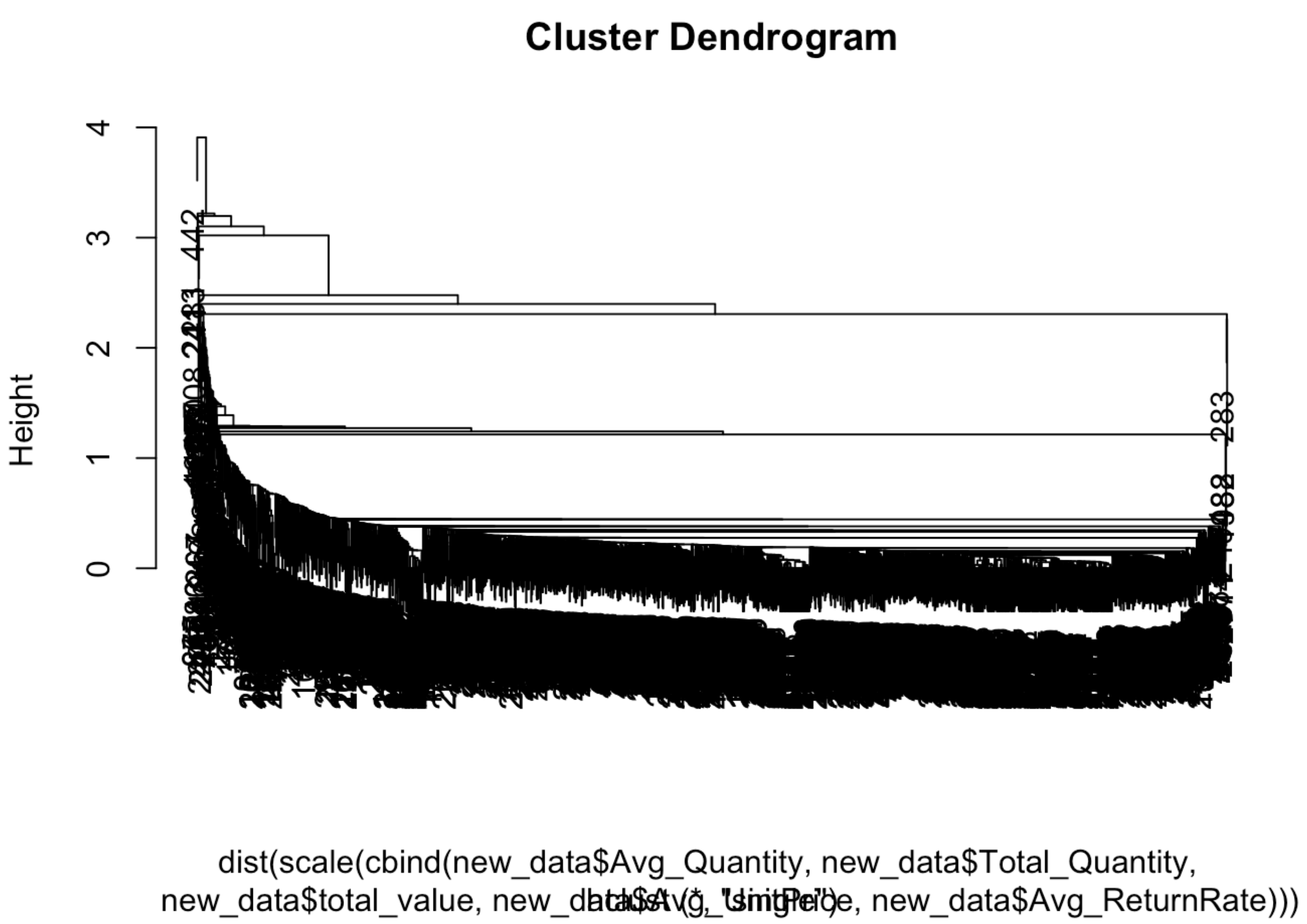
```
8
##    [38] 2 4 6 7 7 2 8 7 7 8 8 8 8 8 8 8 8 8 8 8 8 6 3 8 7 2 6 8 8 6 4 8 2 6 5 7
6
##    [75] 6 8 7 2 2 6 6 7 8 8 8 4 6 8 2 8 6 7 8 8 2 8 8 6 7 7 7 4 8 8 5 7 8 6 8 8
7
##   [112] 8 7 8 7 6 8 8 8 8 7 8 8 8 8 8 6 8 8 8 8 8 6 8 8 8 8 8 8 8 8 8 8 8 8 8 2
8
##   [149] 7 8 8 8 8 6 6 8 6 8 6 8 6 6 7 8 8 8 6 2 6 4 8 8 8 7 7 8 8 8 8 8 8 8 8 6
8
##   [186] 8 2 8 6 6 8 8 1 6 8 8 6 8 6 8 8 8 6 8 6 8 6 6 8 8 6 8 8 6 8 8 8 6 8 4 8
8
##   [223] 8 8 8 8 8 6 8 7 8 8 6 7 6 6 7 8 7 8 4 8 8 8 8 6 2 8 8 8 8 8 8 6 8 8 8 8
8
##   [260] 6 8 8 8 7 8 8 8 8 7 7 8 8 6 8 6 8 8 8 8 8 4 8 4 6 8 8 8 8 6 8 8 8 8 8 8
6
##   [297] 6 8 6 8 8 5 5 6 7 6 8 8 8 7 8 8 8 8 6 8 8 8 6 6 8 4 8 8 8 8 8 8 7 8 8 7
8
##   [334] 8 8 8 6 8 8 8 8 6 6 8 8 8 8 8 7 2 8 8 8 2 8 8 7 8 4 8 8 8 8 7 6 8 7 8 1
7
##   [371] 6 6 6 6 8 8 8 8 8 8 8 6 6 6 8 6 8 6 4 8 8 8 8 8 6 6 7 8 8 8 8 6 6 6 8 8
7
##   [408] 6 8 8 8 8 6 8 7 8 8 6 2 6 8 8 8 8 7 6 8 7 8 7 6 8 8 8 7 2 8 7 6 7 6 4 8
8
##   [445] 8 8 8 5 6 6 8 7 8 8 8 6 6 8 5 8 8 7 8 8 8 2 8 6 6 8 2 8 7 8 7 6 4 8 6 8
8
##   [482] 6 6 6 7 6 8 4 8 6 6 6 2 7 8 7 6 8 7 8 2 7 8 5 7 7 8 8 2 7 6 8 8 8 8 7 6
8
##   [519] 6 8 8 8 8 6 6 8 8 7 8 8 7 8 8 4 7 8 8 6 6 6 6 2 8 6 8 8 6 8 6 8 7 6 8 8
8
##   [556] 6 2 8 7 6 6 8 8 6 8 8 6 6 6 4 8 8 8 6 6 6 2 8 8 8 8 7 6 6 8 6 6 6 6 2 8
8
##   [593] 6 6 6 8 7 6 7 5 3 8 6 6 8 8 8 8 7 6 6 7 7 4 6 6 8 7 6 8 8 8 8 8 8 6 7 6
6
##   [630] 8 8 7 7 8 8 6 7 6 2 8 7 8 8 6 7 6 4 2 6 6 8 8 7 2 4 2 4 8 6 7 2 6 6 6 7
2
##   [667] 6 8 8 8 1 7 2 5 7 8 8 5 6 6 6 6 8 2 7 6 4 8 8 2 2 8 2 8 6 8 8 8 8 8 6 6
3
##   [704] 7 4 6 5 3 2 2 8 4 1 6 1 8 6 6 2 2 5 2 8 2 7 2 6 7 5 6 8 3 8 2 6 7 2 8 7
6
##   [741] 5 2 6 8 8 5 8 7 8 7 6 2 8 2 6 6 8 1 7 6 5 6 3 6 7 8 8 6 5 6 6 8 2 2 8 6
6
##   [778] 8 8 6 1 6 8 6 6 6 6 7 8 8 2 4 6 8 6 6 8 3 2 7 7 8 2 3 1 7 3 8 6 8 6 8 5
7
##   [815] 6 2 8 2 3 8 8 2 7 8 1 5 6 8 3 7 4 5 3 7 7 2 2 6 5 7 5 7 6 6 6 6 8 7 5 6
8
##   [852] 8 6 7 6 8 8 5 6 1 5 8 2 8 1 7 2 8 7 8 8 8 1 6 6 6 1 2 1 6 5 5 7 8 6 7 8
6
##   [889] 1 8 6 5 6 8 2 8 8 8 8 8 7 6 7 8 8 7 8 6 5 8 2 6 7 2 8 8 8 8 8 5 6 1 8 8
7
##   [926] 7 6 4 6 6 6 5 8 6 6 8 6 7 5 8 7 8 7 6 7 5 3 6 4 8 5 8 2 3 6 8 4 5 8 6 6
```

```
8
##  [963] 8 6 6 8 2 2 5 8 2 8 7 8 8 6 1 8 6 6 8 7 8 7 6 6 8 8 8 8 1 7 6 8 1 8 8 6
8
## [1000] 5 8 7 8 6 8 6 6 8 6 8 8 1 6 5 2 5 5 8 6 8 8 8 7 6 6 8 2 8 2 6 8 6 6 8 4
7
## [1037] 3 8 2 6 7 2 6 7 7 6 6 6 8 6 7 6 6 8 7 8 4 8 7 8 8 8 7 8 7 5 5 8 5 6 8 5
6
## [1074] 8 8 6 8 6 6 7 6 6 8 8 6 7 8 6 2 5 8 8 4 6 8 6 8 5 6 8 8 6 3 8 8 6 8 1 1
8
## [1111] 5 6 6 8 7 6 6 8 8 5 8 8 8 7 8 8 7 7 6 8 8 8 5 8 7 8 8 6 7 8 6 8 8 8 8 7
8
## [1148] 6 8 8 7 2 2 6 8 8 8 6 8 6 5 8 8 8 6 6 8 7 6 8 6 8 2 6 5 6 8 5 2 6 8 8 7
7
## [1185] 6 6 6 6 5 6 6 6 2 8 7 7 5 8 6 6 2 6 8 6 6 7 6 8 6 8 8 8 6 8 1 8 7 5 6 8
7
## [1222] 8 7 7 6 8 8 6 8 8 8 6 8 7 8 6 4 8 8 6 8 7 6 2 8 5 8 7 7 2 8 7 8 8 6 5 5
7
## [1259] 8 6 7 8 7 6 8 8 6 8 6 6 8 7 8 8 8 7 8 8 7 6 8 8 8 6 6 2 5 8 8 7 6 8 7 7
3
## [1296] 5 8 8 8 8 6 7 8 8 6 8 6 7 8 8 5 6 6 1 5 2 8 8 8 8 8 8 8 5 4 7 8 8 8 8 5
6
## [1333] 7 6 7 6 7 6 8 5 1 6 8 8 6 7 8 1 7 8 8 8 6 6 7 6 5 2 3 5 5 8 7 7 6 6 6 6
6
## [1370] 6 2 8 8 2 8 6 7 8 4 7 6 4 6 6 7 8 5 6 7 7 6 2 8 7 7 8 6 6 2 6 8 7 8 8 6
8
## [1407] 6 6 7 8 5 6 7 6 8 6 8 6 8 7 2 8 8 8 7 5 8 7 8 2 7 6 2 6 8 5 7 2 6 6 5 3
8
## [1444] 8 6 7 6 7 8 7 6 8 8 8 6 4 6 8 8 6 8 8 7 6 6 1 6 6 8 8 2 7 6 6 6 8 2 6 8
6
## [1481] 8 5 7 7 4 8 6 6 6 6 5 8 8 7 6 6 6 7 8 8 8 6 2 7 2 2 8 8 6 8 8 6 6 5 8 8
8
## [1518] 8 7 8 8 8 8 8 8 5 6 7 8 8 8 6 6 8 7 8 8 1 6 8 8 8 8 5 1 8 8 8 8 8 6 5 6
7
## [1555] 6 7 8 8 5 6 6 6 8 8 8 6 8 6 3 1 8 8 8 7 7 7 8 8 8 2 8 5 8 8 7 8 1 8 2 8
8
## [1592] 7 6 8 6 6 6 8 2 8 6 8 8 6 3 6 6 2 8 2 8 6 8 5 2 8 7 6 8 8 6 4 8 8 6 6 6
7
## [1629] 1 6 5 5 2 6 2 7 8 8 6 4 8 2 8 2 8 8 6 8 6 8 8 8 8 8 8 8 6 8 8 8 2 8 8 8
8
## [1666] 8 8 7 8 3 8 8 7 7 8 8 8 8 4 2 8 3 8 8 7 8 2 8 6 8 6 2 7 8 2 8 7 5 8 6 6
6
## [1703] 7 8 6 7 6 8 6 8 6 6 6 1 8 1 6 5 4 1 8 5 7 8 8 6 8 5 6 3 2 1 8 5 5 8 8 7
6
## [1740] 2 1 6 4 5 7 5 8 2 8 2 8 6 6 7 2 6 8 8 6 6 7 2 7 7 7 8 8 8 2 7 6 6 8 8 6
8
## [1777] 8 8 8 6 3 2 6 7 6 7 2 2 6 8 8 7 2 8 8 8 8 7 6 8 6 7 8 7 8 8 8 8 6 8 8 8
8
## [1814] 5 8 8 8 8 2 8 8 8 8 8 8 8 7 5 1 8 6 8 6 2 7 6 8 6 8 6 8 6 5 8 8 4 8 2 7 8
8
## [1851] 8 8 8 6 7 6 8 6 8 6 8 6 6 2 7 5 8 8 8 5 6 8 2 5 6 8 8 8 6 3 6 6 4 6 8 7
```

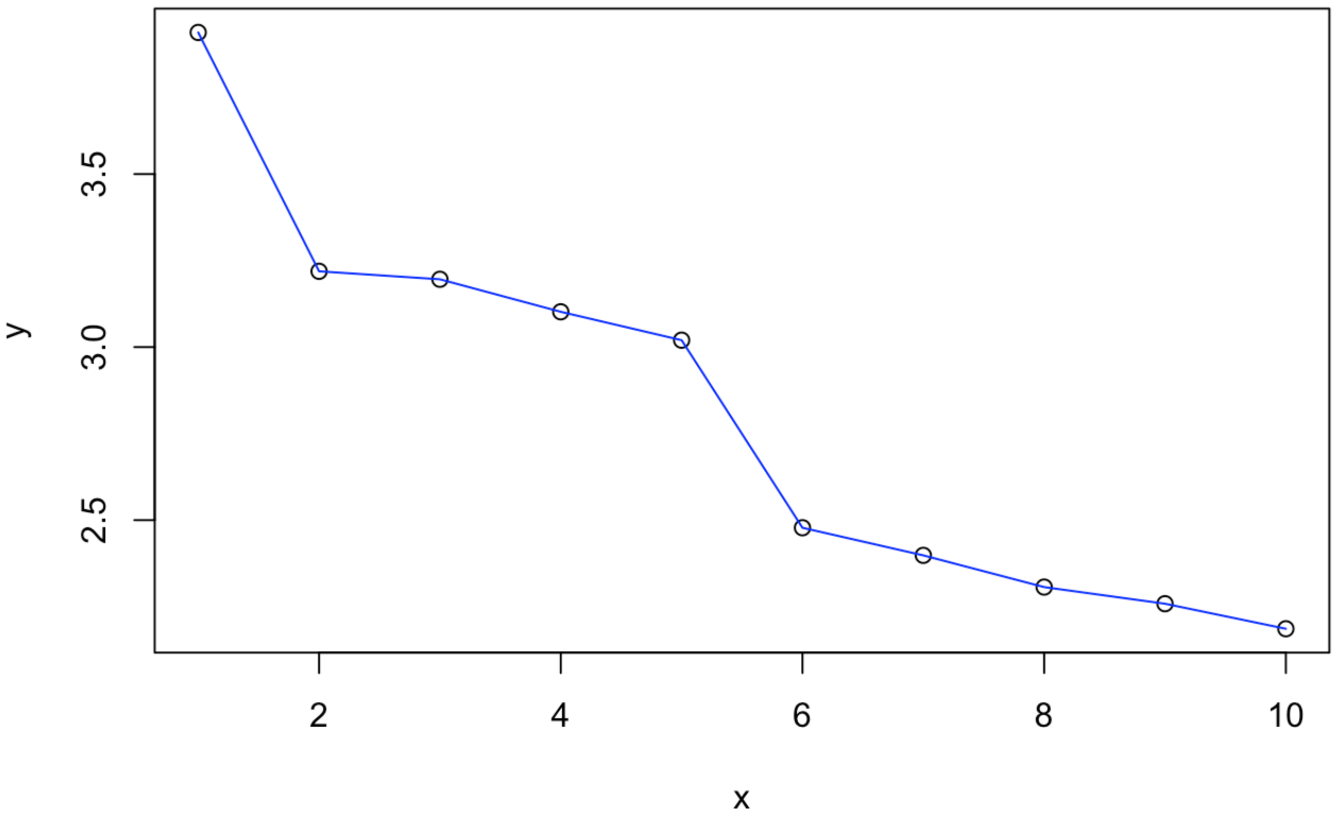
```
6
## [1888] 2 2 8 3 6 6 8 8 8 8 6 6 7 5 7 8 1 8 6 8 8 6 6 8 8 8 7 6 7 7 8 6 2 6 6 6
8
## [1925] 7 6 1 8 6 7 6 5 8 5 6 6 6 6 1 6 6 2 8 5 6 6 5 1 4 8 6 7 8 8 6 8 5 6 7 5
8
## [1962] 8 6 8 8 8 7 6 8 8 4 8 6 8 8 5 6 8 2 8 6 4 8 8 8 6 5 8 6 8 8 8 7 8 8 6 7
8
## [1999] 6 3 1 8 6 2 8 8 2 2 7 7 5 8 8 6 2 7 6 8 7 8 5 5 5 7 8 7 3 8 6 6 6 6 7 8
6
## [2036] 8 8 6 8 6 8 8 8 8 7 8 2 8 8 8 2 6 5 6 8 5 6 8 8 5 2 6 7 6 6 6 6 7 8 6 3
7
## [2073] 6 6 6 2 8 8 7 6 6 6 8 8 6 1 6 7 5 2 6 2 6 7 8 5 8 8 7 5 6 8 8 6 8 6 5 8
6
## [2110] 8 5 8 8 8 8 6 5 8 8 5 8 8 6 6 3 8 2 8 8 8 8 7 6 8 7 8 7 8 8 6 6 8 8 7 2
7
## [2147] 8 7 6 6 7 6 8 8 8 6 8 8 7 8 8 6 6 6 8 8 7 8 8 8 8 6 5 5 6 8 8 6 8 8 8 6
7
## [2184] 8 8 8 6 8 8 6 7 8 8 7 6 2 8 8 8 8 8 6 2 8 2 8 8 6 8 6 6 8 8 6 8 8 6 6 6
8
## [2221] 8 6 8 3 8 8 8 6 6 8 7 6 5 6 3 6 4 5 6 1 5 8 8 8 8 5 8 8 8 7 8 6 2 8 8 8
6
## [2258] 7 5 8 7 6 6 8 6 8 6 8 8 8 8 6 8 8 1 7 8 6 6 8 7 6 8 2 2 8 8 7 6 7 4 6 1
7
## [2295] 5 6 8 5 8 8 6 6 3 6 8 6 7 7 6 1 7 8 6 8 8 6 2 6 2 1 8 8 8 7 7 8 6 8 3 8
6
## [2332] 6 8 7 6 6 6 5 6 8 8 6 7 8 5 6 2 8 6 2 6 6 5 6 5 5 6 8 8 6 2 7 8 7 8 6 8
8
## [2369] 8 6 8 2 6 8 2 6 8 8 8 8 8 4 8 5 8 7 8 6 8 8 7 8 6 8 5 8 7 8 6 5 8 8 8 6
1
## [2406] 4 6 8 7 8 6 7 3 6 6 6 7 8 8 8 6 8 8 8 5 8 7 8 6 6 6 7 8 7 6 8 2 8 8 8 8
8
## [2443] 5 5 2 6 2 7 8 6 8 6 8 3 8 8 8 6 7 8 8 5 8 4 6 8 6 7 3 8 7 6 8 5 2 8 8 8
2
## [2480] 2 1 5 8 2 6 6 2 8 6 7 8 6 8 5 8 1 8 6 6 8 7 6 4 8 8 8 8 8 2 8 8 5 6 1 6
8
## [2517] 6 8 1 8 8 8 8 7 5 7 8 6 8 7 7 4 2 6 8 8 6 5 7 8 8 8 7 6 6 5 7 5 8 8 7 8
7
## [2554] 6 6 8 8 3 6 8 6 2 6 5 8 8 8 6 8 6 7 6 8 8 8 8 8 5 7 8 6 8 8 8 6 8 6 2 8
2
## [2591] 8 6 8 2 8 8 6 8 5 8 6 8 7 8 8 6 7 8 8 8 6 8 6 8 6 3 8 6 5 8 6 6 4 6 6 5
6
## [2628] 7 5 2 7 8 4 6 7 7 5 6 7 6 8 1 6 2 8 6 5 7 6 7 6 8 6 2 1 5 6 7 2 6 6 7 2
7
## [2665] 6 8 5 7 8 8 7 4 4 5 6 6 5 6 6 8 8 3 8 6 2 6 6 6 6 4 6 8 8 8 8 6 7 8 8 6
6
## [2702] 8 8 6 8 8 6 7 8 8 2 6 2 8 8 8 8 8 6 8 8 8 7 4 8 8 8 2 2 8 7 8 5 6 8 4 8
8
## [2739] 8 8 5 8 8 8 8 8 8 8 6 6 7 6 8 6 6 5 5 6 8 5 6 8 7 8 8 6 6 8 8 8 8 8 6 8
8
## [2776] 8 5 8 1 8 7 6 2 6 7 6 6 6 6 8 7 6 6 8 8 7 5 8 8 8 8 2 8 6 6 2 5 8 7 8 5
```

```
8
## [2813] 8 8 8 1 7 5 6 5 8 8 6 8 8 4 6 8 4 6 7 6 6 8 6 6 8 6 6 6 8 8 8 8 8 6 8 7
6
## [2850] 6 2 1 5 4 6 6 5 7 6 6 8 8 8 8 6 8 2 8 6 8
##
## Within cluster sum of squares by cluster:
## [1] 163888.7 121013.6 141812.7 206730.0 141391.3 162252.0 146454.8 103846.7
##  (between_SS / total_SS =  85.7 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
#for single method
plot(hclust1)
```




```
y <- sort(hclust1$height, decreasing = TRUE)[1:10]
plot(x,y); lines(x,y, col= "blue")
```




```
results1 <- vector("list", length = 3)
for (i in 1:length(nstart_values)) {
  seg_kmeans1 <- kmeans(x = data.frame(new_data$Avg_Quantity, new_data$Total_Quant
ity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate), cente
rs = 6, nstart = nstart_values[i])
  results1[[i]] <- seg_kmeans1
}

# Comparing results
for (i in 1:length(results1)) {
  cat("Results for nstart =", nstart_values[i], ":\n")
  print(results1[[i]])
  cat("\n")
  cat("Results for nstart =", nstart_values[i], ":\n")
  cat("tot.withinss:", results1[[i]]$tot.withinss, "\n\n")
}
```

```
## Results for nstart = 10 :
## K-means clustering with 6 clusters of sizes 131, 1449, 334, 154, 740, 62
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
```

```
## 1             33.557189               75.832061             67.06481
## 2              4.876893                6.418219             13.16578
## 3              8.511582               29.140719             78.47461
## 4             12.075180               59.480519            138.69299
## 5             10.230337               22.090541             37.49609
## 6             26.703191              102.725806            228.28145
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               1.519733               0.1389463
## 2               3.438270               0.1445157
## 3               6.424934               0.1495671
## 4               6.302775               0.1515568
## 5               3.221781               0.1534203
## 6               9.493247               0.1832171
##
## Clustering vector:
##     [1] 4 5 2 2 2 2 5 3 5 4 2 5 2 6 5 2 2 2 3 3 4 2 5 2 3 2 3 2 2 4 3 6 2 2 2 2
2
##    [38] 4 4 5 3 3 3 2 5 3 2 2 2 2 2 2 2 2 2 2 2 2 2 6 2 3 4 5 2 2 2 4 2 4 5 1 5
5
##    [75] 5 2 5 3 4 5 5 5 2 2 2 3 5 2 4 2 5 3 2 2 3 2 2 5 3 3 3 6 2 2 5 3 2 5 2 2
3
##   [112] 2 3 2 5 5 2 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3
2
##   [149] 3 2 2 2 2 5 2 2 5 2 5 2 2 2 5 2 2 2 5 4 2 4 2 2 2 3 3 2 2 2 2 2 2 2 2 5
2
##   [186] 2 3 2 2 5 2 2 1 5 2 2 5 2 2 2 2 2 5 2 5 2 5 5 2 2 2 2 2 2 2 2 2 5 2 4 2
2
##   [223] 2 2 2 2 2 2 2 5 2 2 5 5 5 2 3 2 3 2 6 2 2 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2
2
##   [260] 2 2 2 2 3 2 2 2 2 3 5 2 2 5 2 5 2 2 2 2 2 6 2 6 5 2 2 2 2 2 2 2 2 2 2 2
5
##   [297] 5 2 5 2 2 5 5 2 3 5 2 2 2 3 2 2 2 2 5 2 2 2 5 5 2 6 2 2 2 2 2 2 3 2 2 5
2
##   [334] 2 2 2 5 2 2 2 2 5 2 2 2 2 2 2 3 3 2 2 2 4 2 2 3 2 4 2 2 2 2 5 2 2 3 2 1
3
##   [371] 5 5 5 5 2 2 2 2 2 2 2 5 5 2 2 2 2 5 4 2 2 2 2 2 5 5 5 2 2 2 2 2 5 2 2 2
3
##   [408] 5 2 2 2 2 2 2 5 2 2 5 4 5 2 2 2 2 3 2 2 3 2 3 2 2 2 2 3 3 2 5 5 3 5 4 2
2
##   [445] 2 2 2 5 5 5 2 3 2 2 2 2 5 2 5 2 2 5 2 2 2 4 2 5 5 2 3 2 3 2 5 5 4 2 5 2
2
##   [482] 5 5 2 3 2 2 4 2 5 2 5 3 3 2 3 2 2 5 2 4 3 2 5 5 3 2 2 4 5 2 2 2 2 2 3 2
2
##   [519] 2 2 2 2 2 5 5 2 2 3 2 2 3 2 2 4 5 2 2 5 2 5 2 3 2 2 2 2 5 2 5 2 5 5 2 2
2
##   [556] 5 3 2 3 5 2 2 2 5 2 2 2 2 5 4 2 2 2 2 2 5 3 2 2 2 2 5 5 5 2 5 5 5 5 3 2
2
##   [593] 2 5 2 2 5 5 3 1 6 2 5 5 2 2 2 2 3 5 5 5 5 4 2 5 2 3 2 2 2 2 2 2 2 2 3 5
5
##   [630] 2 2 3 5 2 2 5 3 5 4 2 5 2 2 5 3 5 4 4 2 5 2 2 3 4 4 3 4 2 5 5 4 5 5 5 5
```

```
4
##  [667] 5 2 2 2 1 3 4 5 3 2 2 3 5 5 5 5 2 3 3 5 6 2 2 3 3 2 3 2 2 2 2 2 2 2 5 5
6
##  [704] 3 4 5 1 6 4 3 2 4 4 2 4 2 5 2 1 4 3 4 2 4 3 1 5 3 1 5 2 6 2 3 5 3 3 2 3
2
##  [741] 5 1 5 2 2 1 2 3 2 5 2 3 2 4 5 5 2 4 3 5 1 5 6 5 5 2 2 5 3 5 5 2 3 3 2 2
5
##  [778] 2 2 5 4 5 2 5 5 2 5 3 2 2 1 6 2 2 5 5 2 6 4 3 3 2 4 6 6 5 6 2 5 2 2 2 5
3
##  [815] 5 1 2 3 6 2 2 4 3 2 1 5 2 2 6 3 6 1 6 5 5 1 1 5 1 3 5 5 5 5 5 5 2 5 3 5
2
##  [852] 2 5 3 5 2 2 5 5 1 5 2 1 2 4 5 3 2 3 2 2 2 6 5 5 5 1 3 1 2 1 1 5 2 5 3 2
2
##  [889] 1 2 5 5 5 2 3 2 2 2 2 2 3 5 5 2 2 3 2 5 1 2 4 2 3 4 2 2 2 2 2 5 2 4 2 2
3
##  [926] 3 5 4 5 5 5 1 2 2 5 2 5 3 5 2 5 2 3 5 3 5 6 5 4 2 1 2 4 6 5 2 6 5 2 5 5
2
##  [963] 2 5 2 2 3 3 1 2 4 2 5 2 2 2 1 2 5 2 2 3 2 5 5 5 2 2 2 2 4 5 5 2 4 2 2 5
2
## [1000] 1 2 5 2 5 2 2 2 2 5 2 2 4 5 5 4 1 1 2 5 2 2 2 3 5 5 2 3 2 3 5 2 5 2 2 4
3
## [1037] 6 2 1 5 3 3 5 3 3 2 5 5 2 5 3 5 2 2 5 2 4 2 3 2 2 2 3 2 3 1 5 2 1 2 2 1
2
## [1074] 2 2 5 2 5 5 5 5 5 2 2 2 3 2 5 4 1 2 2 4 5 2 5 2 1 5 2 2 2 6 2 2 5 2 4 1
2
## [1111] 5 5 5 2 5 5 5 2 2 5 2 2 2 5 2 2 3 3 5 2 2 2 1 2 5 2 2 2 5 2 5 2 2 2 2 5
2
## [1148] 5 2 2 3 1 3 2 2 2 2 5 2 2 3 2 2 2 5 5 2 5 5 2 5 2 3 2 1 5 2 5 1 2 2 2 3
3
## [1185] 5 5 5 5 5 5 5 2 4 2 3 3 5 2 2 2 4 5 2 5 5 3 5 2 5 2 2 2 5 2 4 2 3 5 5 2
3
## [1222] 2 3 3 5 2 2 5 2 2 2 5 2 3 2 5 4 2 2 5 2 3 5 4 2 1 2 5 3 4 2 3 2 2 2 5 1
5
## [1259] 2 5 3 2 5 5 2 2 2 2 2 2 2 5 2 2 2 5 2 2 5 5 2 2 2 2 5 4 1 2 2 5 5 2 3 5
6
## [1296] 1 2 2 2 2 5 3 2 2 5 2 5 3 2 2 1 5 5 4 1 4 2 2 2 2 2 2 2 5 4 5 2 2 2 2 5
5
## [1333] 3 2 3 5 3 5 2 5 1 5 2 2 2 3 2 4 3 2 2 2 5 2 3 5 1 1 6 5 5 2 3 3 5 2 5 5
2
## [1370] 5 3 2 2 3 2 5 3 2 4 5 2 6 5 2 3 2 5 5 3 5 2 4 2 3 3 2 2 2 4 5 2 3 2 2 5
2
## [1407] 5 2 3 2 5 5 5 5 2 2 2 2 2 3 1 2 2 2 5 1 2 5 2 1 3 2 1 5 2 5 3 1 5 2 1 6
2
## [1444] 2 5 5 2 3 2 5 5 2 2 2 5 4 5 2 2 2 2 2 3 2 5 6 2 2 2 2 4 5 2 5 5 2 3 5 2
2
## [1481] 2 1 5 3 4 2 5 5 2 5 1 2 2 3 5 5 5 3 2 2 2 5 1 5 3 1 2 2 5 2 2 5 2 1 2 2
2
## [1518] 2 5 2 2 2 2 2 2 3 5 5 2 2 2 2 5 2 3 2 2 1 2 2 2 2 2 1 4 2 2 2 2 2 5 5 5
3
## [1555] 5 5 2 2 5 5 2 5 2 2 2 5 2 5 6 4 2 2 2 3 3 5 2 2 2 4 2 5 2 2 5 2 4 2 3 2
```

```
2
## [1592] 3 5 2 5 5 5 2 4 2 2 2 2 5 6 2 2 3 2 3 2 5 2 5 3 2 3 5 2 2 2 6 2 2 5 5 5
3
## [1629] 1 2 1 3 1 5 3 5 2 2 2 4 2 3 2 4 2 2 5 2 5 2 2 2 2 2 2 2 5 2 2 2 1 2 2 2
2
## [1666] 2 2 3 2 6 2 2 3 5 2 2 2 2 4 3 2 6 2 2 3 2 3 2 5 2 2 4 3 2 4 2 3 3 2 2 2
5
## [1703] 5 2 5 5 5 2 5 2 5 5 2 6 2 4 5 5 4 4 2 1 3 2 2 2 2 1 5 6 3 4 2 5 3 2 2 5
2
## [1740] 1 1 5 3 5 5 5 2 1 2 4 2 5 2 3 3 5 2 2 5 5 3 3 5 5 3 2 2 2 1 5 2 5 2 2 2
2
## [1777] 2 2 2 5 6 4 2 3 5 5 3 4 5 2 2 3 3 2 2 2 2 3 5 2 5 5 2 5 2 2 2 2 5 2 2 2
2
## [1814] 3 2 2 2 2 3 2 2 2 2 2 2 3 1 4 2 5 2 5 3 3 5 2 5 2 2 2 5 5 2 2 4 2 3 5 2
2
## [1851] 2 2 2 5 3 5 2 5 2 2 2 5 5 3 5 5 2 2 2 5 5 2 4 1 5 2 2 2 2 6 5 2 4 5 2 3
5
## [1888] 3 3 2 6 5 5 2 2 2 2 5 5 3 1 3 2 4 2 5 2 2 5 5 2 2 2 3 2 3 5 2 5 4 2 5 5
2
## [1925] 3 5 4 2 5 3 5 3 2 5 5 5 5 5 4 2 2 1 2 1 5 2 3 4 4 2 5 3 2 2 5 2 1 5 5 1
2
## [1962] 2 5 2 2 2 3 5 2 2 4 2 5 2 2 3 5 2 1 2 5 6 2 2 2 5 5 2 2 2 2 2 5 2 2 5 3
2
## [1999] 2 6 6 2 2 3 2 2 4 3 5 5 1 2 2 5 3 3 5 2 5 2 1 1 1 5 2 3 6 2 2 5 5 5 3 2
5
## [2036] 2 2 5 2 5 2 2 2 2 3 2 3 2 2 2 4 2 1 5 2 1 5 2 2 5 3 5 3 2 2 5 2 3 2 5 6
5
## [2073] 2 5 5 3 2 2 5 5 5 5 2 2 2 1 5 3 1 4 5 1 2 3 2 1 2 2 3 1 5 2 2 5 2 2 3 2
5
## [2110] 2 1 2 2 2 2 5 5 2 2 5 2 2 5 5 6 2 4 2 2 2 2 5 2 2 3 2 3 2 2 5 5 2 2 3 3
3
## [2147] 2 5 5 2 3 5 2 2 2 5 2 2 3 2 2 2 5 5 2 2 5 2 2 2 2 5 1 5 5 2 2 2 2 2 2 5
5
## [2184] 2 2 2 2 2 2 5 3 2 2 3 2 3 2 2 2 2 2 5 4 2 3 2 2 5 2 5 5 2 2 5 2 2 2 5 5
2
## [2221] 2 5 2 6 2 2 2 2 2 2 5 5 1 2 6 2 4 5 5 4 5 2 2 2 2 5 2 2 2 3 2 5 4 2 2 2
5
## [2258] 3 5 2 3 5 5 2 5 2 5 2 2 2 2 5 2 2 4 3 2 5 2 2 3 5 2 3 4 2 2 5 5 3 4 2 1
5
## [2295] 5 5 2 5 2 2 5 2 6 5 2 5 5 3 2 4 3 2 2 2 2 5 3 5 3 1 2 2 2 5 5 2 5 2 6 2
5
## [2332] 5 2 5 2 5 2 5 2 2 2 2 3 2 1 2 4 2 5 4 5 5 3 5 1 5 5 2 2 5 4 5 2 5 2 5 2
2
## [2369] 2 5 2 3 2 2 4 2 2 2 2 2 2 4 2 3 2 3 2 5 2 2 5 2 5 2 3 2 5 2 5 1 2 2 2 2
4
## [2406] 4 5 2 5 2 5 3 6 5 5 5 5 2 2 2 2 2 2 2 5 2 3 2 5 5 5 3 2 3 2 2 4 2 2 2 2
2
## [2443] 5 5 4 5 3 3 2 5 2 2 2 6 2 2 2 5 5 2 2 1 2 4 2 2 5 3 6 2 5 2 2 5 3 2 2 2
3
## [2480] 3 1 1 2 3 2 5 3 2 5 3 2 5 2 1 2 4 2 5 5 2 3 5 4 2 2 2 2 2 1 2 2 1 2 1 5
```

```
2
## [2517] 5 2 1 2 2 2 2 3 1 5 2 5 2 3 3 4 3 2 2 2 5 5 3 2 2 2 3 5 5 1 5 5 2 2 5 2
3
## [2554] 5 5 2 2 6 5 2 5 3 5 1 2 2 2 5 2 5 5 2 2 2 2 2 2 5 3 2 5 2 2 2 5 2 5 4 2
3
## [2591] 2 5 2 4 2 2 5 2 5 2 2 2 5 2 2 2 5 2 2 2 2 2 5 2 5 6 2 2 5 2 5 5 4 2 2 1
5
## [2628] 3 1 4 5 2 4 5 3 5 3 5 5 5 2 1 2 1 2 5 1 3 5 5 5 2 2 3 6 5 5 5 4 5 5 5 3
3
## [2665] 5 2 1 5 2 2 5 4 4 1 2 5 1 2 5 2 2 6 2 5 3 2 5 5 2 4 5 2 2 2 2 5 3 2 2 2
5
## [2702] 2 2 5 2 2 5 3 2 2 1 5 3 2 2 2 2 2 5 2 2 2 5 4 2 2 2 4 3 2 5 2 1 5 2 4 2
2
## [2739] 2 2 5 2 2 2 2 2 2 2 2 2 3 2 2 5 5 1 1 2 2 5 2 2 3 2 2 5 5 2 2 2 2 2 5 2
2
## [2776] 2 5 2 1 2 5 2 4 2 3 2 5 2 2 2 5 2 5 2 2 3 5 2 2 2 2 3 2 2 2 3 5 2 5 2 1
2
## [2813] 2 2 2 1 5 1 5 5 2 2 2 2 2 6 2 2 4 5 5 5 5 2 2 2 2 5 2 2 2 2 2 2 2 2 2 3
5
## [2850] 5 3 4 5 4 2 2 5 3 5 5 2 2 2 2 5 2 4 2 5 2
##
## Within cluster sum of squares by cluster:
## [1] 254354.4 172570.2 221392.8 261627.3 253138.8 314066.2
##  (between_SS / total_SS =  82.2 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 10 :
## tot.withinss: 1477150
##
## Results for nstart = 50 :
## K-means clustering with 6 clusters of sizes 740, 142, 1419, 57, 137, 375
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             10.979155               22.214865             35.66677
## 2             30.058724               79.690141             79.44380
## 3              4.668089                6.193798             13.00441
## 4             28.678617              110.842105            228.15930
## 5             10.923347               51.708029            146.36314
## 6              8.647979               29.058667             75.06128
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               3.096915               0.1516628
## 2               1.690646               0.1403995
## 3               3.476512               0.1454914
## 4               4.891120               0.1797195
## 5              10.836077               0.1549551
```

```
## 6                5.445593                0.1485293
##
## Clustering vector:
##    [1] 5 1 3 3 3 3 1 6 1 5 3 1 3 4 1 3 3 3 6 6 5 3 1 3 6 3 6 3 3 5 6 4 3 3 3 3
3
##   [38] 5 5 1 6 6 6 3 1 6 3 3 3 3 3 3 3 3 3 3 3 3 3 4 3 6 5 1 3 3 3 5 3 5 1 2 6
1
##   [75] 1 3 1 6 5 1 1 1 3 3 3 5 1 3 5 3 1 6 3 3 6 3 3 1 6 6 6 4 3 3 1 6 3 1 3 3
6
##  [112] 3 6 3 6 1 3 3 3 3 6 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 6
3
##  [149] 6 3 3 3 3 1 3 3 1 3 1 3 3 3 1 3 3 3 1 2 3 5 3 3 3 6 6 3 3 3 3 3 3 3 3 1
3
##  [186] 3 6 3 3 1 3 3 2 1 3 3 1 3 3 3 3 3 1 3 1 3 1 1 3 3 3 3 3 3 3 3 3 1 3 5 3
3
##  [223] 3 3 3 3 3 3 3 1 3 3 1 1 1 1 6 3 6 3 5 3 3 3 3 3 6 3 3 3 3 3 3 1 3 3 3 3
3
##  [260] 3 3 3 3 6 3 3 3 3 6 1 3 3 1 3 1 3 3 3 3 3 4 3 5 1 3 3 3 3 3 3 3 3 3 3 3
1
##  [297] 1 3 1 3 3 1 1 3 6 1 3 3 3 6 3 3 3 3 1 3 3 3 1 1 3 5 3 3 3 3 3 3 6 3 3 6
3
##  [334] 3 3 3 1 3 3 3 3 1 3 3 3 3 3 3 6 6 3 3 3 5 3 3 6 3 5 3 3 3 3 1 3 3 6 3 2
6
##  [371] 1 1 1 1 3 3 3 3 3 3 3 1 1 3 3 3 3 1 5 3 3 3 3 3 1 1 1 3 3 3 3 3 1 3 3 3
6
##  [408] 1 3 3 3 3 3 3 6 3 3 1 5 1 3 3 3 3 6 3 3 6 3 6 3 3 3 3 6 6 3 6 1 6 1 5 3
3
##  [445] 3 3 3 1 1 1 3 6 3 3 3 3 1 3 1 3 3 1 3 3 3 5 3 1 1 3 6 3 6 3 1 1 5 3 1 3
3
##  [482] 1 1 3 6 3 3 5 3 1 3 1 6 6 3 6 3 3 1 3 5 6 3 1 6 6 3 3 5 6 3 3 3 3 3 6 3
3
##  [519] 3 3 3 3 3 1 1 3 3 6 3 3 6 3 3 5 6 3 3 1 3 1 3 6 3 3 3 3 1 3 1 3 1 1 3 3
3
##  [556] 1 6 3 6 1 3 3 3 1 3 3 3 3 1 5 3 3 3 3 3 1 6 3 3 3 3 1 1 1 3 1 1 1 1 5 3
3
##  [593] 3 1 3 3 1 1 6 2 4 3 1 1 3 3 3 3 6 1 1 6 1 5 3 1 3 6 3 3 3 3 3 3 3 3 6 1
1
##  [630] 3 3 6 1 3 3 1 6 1 5 3 1 3 3 1 6 1 5 5 3 1 3 3 6 5 5 6 5 3 1 1 5 1 1 1 1
5
##  [667] 1 3 3 3 2 6 5 1 6 3 3 6 1 1 1 1 3 6 6 1 5 3 3 6 6 3 6 3 3 3 3 3 3 3 1 1
4
##  [704] 6 5 1 2 4 5 6 3 5 2 3 5 3 1 3 2 2 6 5 3 5 6 2 1 6 1 1 3 4 3 6 1 6 6 3 6
3
##  [741] 1 2 1 3 3 2 3 6 3 1 3 6 3 5 1 1 3 2 6 1 2 1 4 1 1 3 3 1 6 1 1 3 6 6 3 3
1
##  [778] 3 3 1 5 1 3 1 1 1 1 6 3 3 2 4 3 3 1 1 3 4 2 6 6 3 5 4 4 6 4 3 1 3 3 3 1
6
##  [815] 1 2 3 6 4 3 3 5 6 3 2 1 3 3 4 6 4 2 4 1 1 2 2 1 2 6 1 1 1 1 1 1 3 1 6 1
3
##  [852] 3 1 6 1 3 3 1 1 2 1 3 2 3 5 1 6 3 6 3 3 3 4 1 1 1 2 6 2 3 2 6 1 3 1 6 3
```

```
1
##  [889] 2 3 1 1 1 3 6 3 3 3 3 3 6 1 1 3 3 6 3 1 2 3 5 3 6 5 3 3 3 3 3 6 3 2 3 3
6
##  [926] 6 1 5 1 1 1 6 3 3 1 3 1 6 1 3 1 3 6 1 6 1 4 1 5 3 2 3 5 4 1 3 4 1 3 1 1
3
##  [963] 3 1 3 3 6 6 6 3 2 3 6 3 3 3 2 3 1 3 3 6 3 1 1 1 3 3 3 3 2 6 1 3 5 3 3 1
3
## [1000] 1 3 6 3 1 3 3 3 3 1 3 3 5 1 1 5 2 2 3 1 3 3 3 6 1 1 3 2 3 6 1 3 1 3 3 5
6
## [1037] 4 3 2 1 6 6 1 6 6 3 1 1 3 1 6 1 3 3 1 3 5 3 6 3 3 3 6 3 6 2 1 3 2 1 3 6
3
## [1074] 3 3 1 3 1 1 1 1 1 3 3 3 6 3 1 2 2 3 3 5 1 3 1 3 1 1 3 3 1 4 3 3 1 3 5 2
3
## [1111] 1 1 1 3 1 1 1 3 3 1 3 3 3 1 3 3 6 6 1 3 3 3 2 3 6 3 3 3 6 3 1 3 3 3 3 6
3
## [1148] 1 3 3 6 2 6 3 3 3 3 1 3 3 6 3 3 3 1 1 3 1 1 3 1 3 2 1 2 1 3 1 2 3 3 3 6
6
## [1185] 1 1 1 1 1 1 1 3 5 3 6 6 1 3 3 3 2 1 3 1 1 6 1 3 1 3 3 3 1 3 5 3 6 1 1 3
6
## [1222] 3 6 6 1 3 3 1 3 3 3 1 3 6 3 1 5 3 3 1 3 6 1 5 3 2 3 6 6 5 3 6 3 3 3 1 6
1
## [1259] 3 1 6 3 1 1 3 3 3 3 1 1 3 1 3 3 3 1 3 3 6 1 3 3 3 1 1 5 2 3 3 1 1 3 6 1
4
## [1296] 2 3 3 3 3 1 6 3 3 1 3 1 6 3 3 2 1 1 2 2 2 3 3 3 3 3 3 3 6 5 6 3 3 3 3 1
1
## [1333] 6 3 6 1 6 1 3 1 2 1 3 3 3 6 3 2 6 3 3 3 1 3 6 1 6 2 4 1 1 3 6 6 1 3 1 1
3
## [1370] 1 6 3 3 6 3 1 6 3 5 1 3 4 1 3 6 3 1 1 6 1 3 5 3 6 6 3 1 3 5 1 3 6 3 3 1
3
## [1407] 1 1 6 3 1 1 1 1 3 3 3 3 3 6 2 3 3 3 1 6 3 6 3 2 6 3 2 1 3 1 6 2 1 3 2 4
3
## [1444] 3 1 6 3 6 3 1 1 3 3 3 1 5 1 3 3 1 3 3 6 3 1 4 3 1 3 3 5 1 3 1 1 3 6 1 3
3
## [1481] 3 2 1 6 5 3 1 1 1 1 2 3 3 6 1 1 1 6 3 3 3 1 2 1 6 2 3 3 1 3 3 1 3 2 3 3
3
## [1518] 3 1 3 3 3 3 3 3 6 1 1 3 3 3 3 1 3 6 3 3 2 3 3 3 3 3 1 5 3 3 3 3 3 1 1 1
6
## [1555] 1 1 3 3 1 1 3 1 3 3 3 1 3 1 4 5 3 3 3 6 6 1 3 3 3 5 3 1 3 3 1 3 2 3 2 3
3
## [1592] 6 1 3 1 1 1 3 2 3 3 3 3 1 4 1 3 6 3 6 3 1 3 1 6 3 6 1 3 3 3 4 3 3 1 1 1
6
## [1629] 2 3 2 6 2 1 6 1 3 3 3 5 3 6 3 5 3 3 1 3 1 3 3 3 3 3 3 3 1 3 3 3 2 3 3 3
3
## [1666] 3 3 6 3 4 3 3 6 6 3 3 3 3 5 6 3 4 3 3 6 3 6 3 1 3 3 5 6 3 5 3 6 6 3 3 3
1
## [1703] 1 3 1 1 1 3 1 3 1 1 1 4 3 5 1 1 5 5 3 2 6 3 3 3 3 2 1 4 6 2 3 6 6 3 3 1
1
## [1740] 2 2 1 5 1 1 6 3 2 3 5 3 1 3 6 6 1 3 3 1 1 6 6 1 1 6 3 3 3 2 6 3 1 3 3 3
3
## [1777] 3 3 3 1 4 5 3 6 1 1 6 2 1 3 3 6 6 3 3 3 3 6 1 3 1 1 3 1 3 3 3 3 1 3 3 3
```

```
3
## [1814] 6 3 3 3 3 6 3 3 3 3 3 3 6 2 5 3 1 3 1 6 6 1 3 1 3 3 3 1 1 3 3 5 3 6 1 3
3
## [1851] 3 3 3 1 6 1 3 1 3 1 3 1 1 6 1 1 3 3 3 1 1 3 5 2 1 3 3 3 3 4 1 3 5 1 3 6
1
## [1888] 6 6 3 4 1 1 3 3 3 3 1 1 6 2 6 3 2 3 1 3 3 1 1 3 3 3 6 3 6 6 3 1 5 3 1 1
3
## [1925] 6 1 2 3 1 6 1 6 3 1 1 1 1 1 2 1 1 2 3 2 1 3 6 5 5 3 1 6 3 3 1 3 6 1 1 2
3
## [1962] 3 1 3 3 3 6 1 3 3 5 3 1 3 3 6 1 3 2 3 1 5 3 3 3 1 1 3 3 3 3 3 1 3 3 1 6
3
## [1999] 3 4 4 3 3 6 3 3 5 6 1 1 2 3 3 1 6 6 1 3 1 3 1 2 2 1 3 6 4 3 1 1 1 1 6 3
1
## [2036] 3 3 1 3 1 3 3 3 3 6 3 6 3 3 3 5 3 2 1 3 1 1 3 3 1 6 1 6 3 3 1 3 6 3 1 4
1
## [2073] 3 1 1 6 3 3 1 1 1 1 3 3 3 2 1 6 2 2 1 2 3 6 3 2 3 3 6 2 1 3 3 1 3 3 6 3
1
## [2110] 3 2 3 3 3 3 1 1 3 3 1 3 3 1 1 4 3 5 3 3 3 3 1 3 3 6 3 6 3 3 1 1 3 3 6 6
6
## [2147] 3 6 1 3 6 1 3 3 3 1 3 3 6 3 3 3 1 1 3 3 1 3 3 3 3 1 2 6 1 3 3 3 3 3 3 1
1
## [2184] 3 3 3 3 3 3 1 6 3 3 6 3 6 3 3 3 3 3 1 5 3 6 3 3 1 3 1 1 3 3 1 3 3 3 1 1
3
## [2221] 3 1 3 4 3 3 3 3 3 3 1 1 2 3 4 3 5 1 1 2 1 3 3 3 3 1 3 3 3 6 3 1 5 3 3 3
1
## [2258] 6 1 3 6 1 1 3 1 3 1 3 3 3 3 1 3 3 5 6 3 1 3 3 6 1 3 2 5 3 3 1 1 6 5 3 2
1
## [2295] 1 1 3 1 3 3 1 3 4 1 3 1 1 6 3 5 6 3 3 3 3 1 6 1 6 2 3 3 3 1 1 3 1 3 4 3
1
## [2332] 1 3 6 3 1 3 1 3 3 3 3 6 3 1 1 5 3 1 5 1 1 6 1 2 6 1 3 3 1 5 1 3 6 3 1 3
3
## [2369] 3 1 3 6 3 3 5 3 3 3 3 3 3 5 3 6 3 6 3 1 3 3 1 3 1 3 6 3 6 3 1 2 3 3 3 3
5
## [2406] 5 1 3 1 3 1 6 4 1 1 1 1 3 3 3 1 3 3 3 1 3 6 3 1 1 1 6 3 6 3 3 5 3 3 3 3
3
## [2443] 1 1 5 1 6 6 3 1 3 3 3 4 3 3 3 1 1 3 3 2 3 5 3 3 1 6 4 3 1 3 3 1 6 3 3 3
6
## [2480] 6 2 2 3 6 1 1 2 3 1 6 3 1 3 2 3 2 3 1 1 3 6 1 5 3 3 3 3 3 2 3 3 2 3 2 1
3
## [2517] 1 3 2 3 3 3 3 6 2 1 3 1 3 6 6 5 6 3 3 3 1 1 6 3 3 3 6 1 1 1 6 1 3 3 1 3
6
## [2554] 1 1 3 3 4 1 3 1 6 1 1 3 3 3 1 3 1 1 1 3 3 3 3 3 1 6 3 1 3 3 3 1 3 1 2 3
6
## [2591] 3 1 3 2 3 3 1 3 1 3 3 3 1 3 3 3 1 3 3 3 1 3 1 3 1 4 3 3 1 3 1 1 5 3 3 2
1
## [2628] 6 1 5 1 3 5 1 6 6 6 1 1 1 3 2 1 2 3 1 2 6 1 1 1 3 3 6 4 1 1 1 5 1 1 6 6
6
## [2665] 1 3 2 6 3 3 6 5 5 2 3 1 2 3 1 3 3 4 3 1 6 3 1 1 3 5 1 3 3 3 3 1 6 3 3 3
1
## [2702] 3 3 1 3 3 1 6 3 3 2 1 2 3 3 3 3 3 1 3 3 3 6 5 3 3 3 5 6 3 1 3 2 1 3 5 3
```

```
3
## [2739] 3 3 1 3 3 3 3 3 3 3 3 3 6 3 3 1 1 2 1 3 3 1 3 3 6 3 3 1 1 3 3 3 3 3 1 3
3
## [2776] 3 1 3 2 3 1 3 5 3 6 3 1 3 3 3 1 3 1 3 3 6 1 3 3 3 3 6 3 3 1 6 1 3 1 3 1
3
## [2813] 3 3 3 2 6 2 1 1 3 3 3 3 3 4 3 3 5 1 6 1 1 3 3 3 3 1 3 3 3 3 3 3 3 1 3 6
1
## [2850] 1 6 5 1 5 3 3 1 6 1 1 3 3 3 3 1 3 5 3 1 3
##
## Within cluster sum of squares by cluster:
## [1] 269419.3 287639.5 161229.3 242192.3 302653.7 212654.4
##  (between_SS / total_SS =  82.2 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 50 :
## tot.withinss: 1475788
##
## Results for nstart = 100 :
## K-means clustering with 6 clusters of sizes 142, 1419, 740, 57, 137, 375
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             30.058724               79.690141             79.44380
## 2              4.668089                6.193798             13.00441
## 3             10.979155               22.214865             35.66677
## 4             28.678617              110.842105            228.15930
## 5             10.923347               51.708029            146.36314
## 6              8.647979               29.058667             75.06128
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               1.690646               0.1403995
## 2               3.476512               0.1454914
## 3               3.096915               0.1516628
## 4               4.891120               0.1797195
## 5              10.836077               0.1549551
## 6               5.445593               0.1485293
##
## Clustering vector:
##    [1] 5 3 2 2 2 2 3 6 3 5 2 3 2 4 3 2 2 2 6 6 5 2 3 2 6 2 6 2 2 5 6 4 2 2 2 2
2
##   [38] 5 5 3 6 6 6 2 3 6 2 2 2 2 2 2 2 2 2 2 2 2 2 4 2 6 5 3 2 2 2 5 2 5 3 1 6
3
##   [75] 3 2 3 6 5 3 3 3 2 2 2 5 3 2 5 2 3 6 2 2 6 2 2 3 6 6 6 4 2 2 3 6 2 3 2 2
6
##  [112] 2 6 2 6 3 2 2 2 2 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 6
2
##  [149] 6 2 2 2 2 3 2 2 3 2 3 2 2 2 3 2 2 2 3 1 2 5 2 2 2 6 6 2 2 2 2 2 2 2 2 3
```

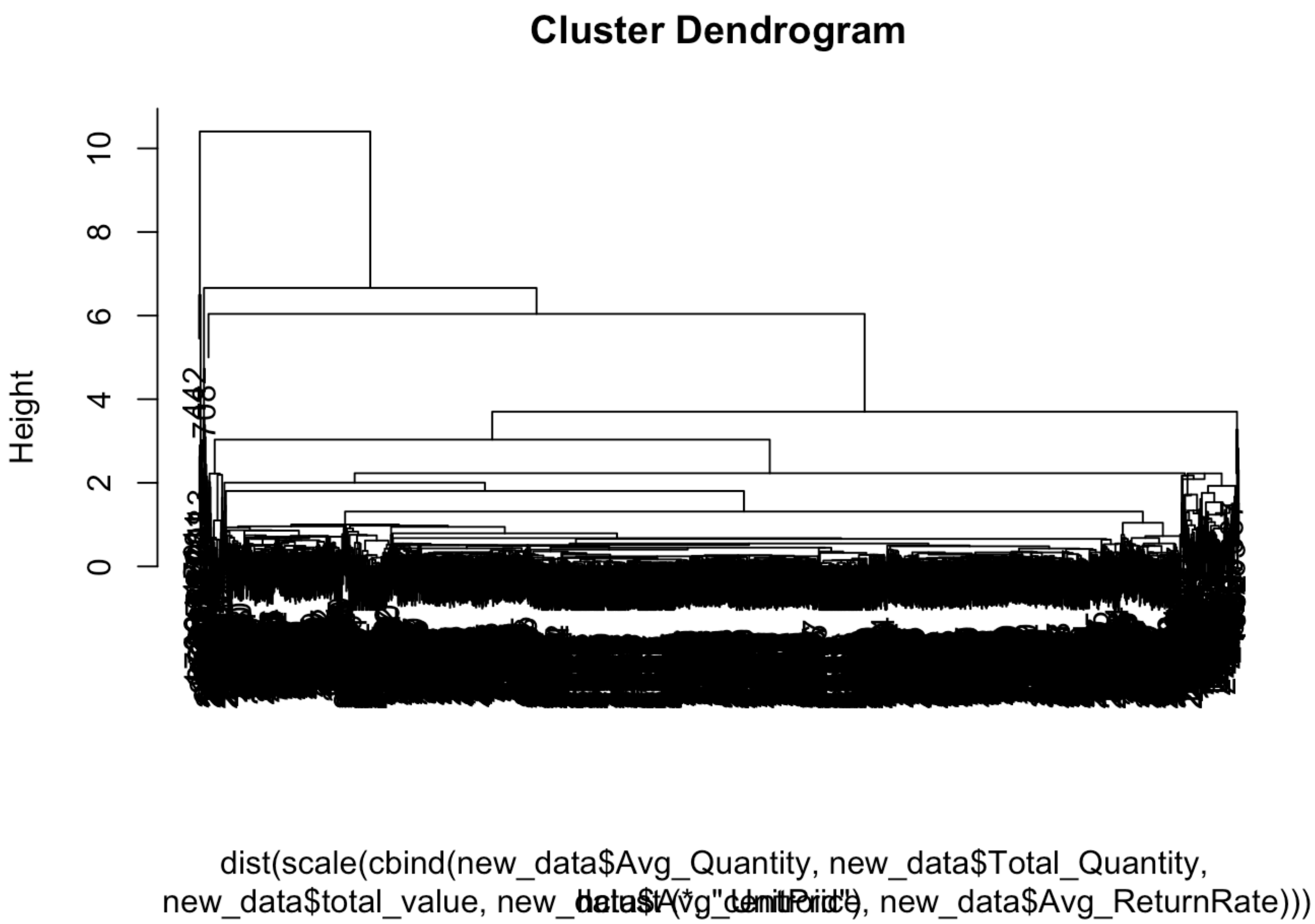
```
2
##  [186] 2 6 2 2 3 2 2 1 3 2 2 3 2 2 2 2 2 3 2 3 2 3 3 2 2 2 2 2 2 2 2 2 3 2 5 2
2
##  [223] 2 2 2 2 2 2 2 3 2 2 3 3 3 3 6 2 6 2 5 2 2 2 2 2 6 2 2 2 2 2 2 3 2 2 2 2
2
##  [260] 2 2 2 2 6 2 2 2 2 6 3 2 2 3 2 3 2 2 2 2 2 4 2 5 3 2 2 2 2 2 2 2 2 2 2 2
3
##  [297] 3 2 3 2 2 3 3 2 6 3 2 2 2 6 2 2 2 2 3 2 2 2 3 3 2 5 2 2 2 2 2 2 6 2 2 6
2
##  [334] 2 2 2 3 2 2 2 2 3 2 2 2 2 2 2 6 6 2 2 2 5 2 2 6 2 5 2 2 2 2 3 2 2 6 2 1
6
##  [371] 3 3 3 3 2 2 2 2 2 2 2 3 3 2 2 2 2 3 5 2 2 2 2 2 3 3 3 2 2 2 2 2 3 2 2 2
6
##  [408] 3 2 2 2 2 2 2 6 2 2 3 5 3 2 2 2 2 6 2 2 6 2 6 2 2 2 2 6 6 2 6 3 6 3 5 2
2
##  [445] 2 2 2 3 3 3 2 6 2 2 2 2 3 2 3 2 2 3 2 2 2 5 2 3 3 2 6 2 6 2 3 3 5 2 3 2
2
##  [482] 3 3 2 6 2 2 5 2 3 2 3 6 6 2 6 2 2 3 2 5 6 2 3 6 6 2 2 5 6 2 2 2 2 2 6 2
2
##  [519] 2 2 2 2 2 3 3 2 2 6 2 2 6 2 2 5 6 2 2 3 2 3 2 6 2 2 2 2 3 2 3 2 3 3 2 2
2
##  [556] 3 6 2 6 3 2 2 2 3 2 2 2 2 3 5 2 2 2 2 2 3 6 2 2 2 2 3 3 3 2 3 3 3 3 5 2
2
##  [593] 2 3 2 2 3 3 6 1 4 2 3 3 2 2 2 2 6 3 3 6 3 5 2 3 2 6 2 2 2 2 2 2 2 2 6 3
3
##  [630] 2 2 6 3 2 2 3 6 3 5 2 3 2 2 3 6 3 5 5 2 3 2 2 6 5 5 6 5 2 3 3 5 3 3 3 3
5
##  [667] 3 2 2 2 1 6 5 3 6 2 2 6 3 3 3 3 2 6 6 3 5 2 2 6 6 2 6 2 2 2 2 2 2 2 3 3
4
##  [704] 6 5 3 1 4 5 6 2 5 1 2 5 2 3 2 1 1 6 5 2 5 6 1 3 6 3 3 2 4 2 6 3 6 6 2 6
2
##  [741] 3 1 3 2 2 1 2 6 2 3 2 6 2 5 3 3 2 1 6 3 1 3 4 3 3 2 2 3 6 3 3 2 6 6 2 2
3
##  [778] 2 2 3 5 3 2 3 3 3 3 6 2 2 1 4 2 2 3 3 2 4 1 6 6 2 5 4 4 6 4 2 3 2 2 2 3
6
##  [815] 3 1 2 6 4 2 2 5 6 2 1 3 2 2 4 6 4 1 4 3 3 1 1 3 1 6 3 3 3 3 3 3 2 3 6 3
2
##  [852] 2 3 6 3 2 2 3 3 1 3 2 1 2 5 3 6 2 6 2 2 2 4 3 3 3 1 6 1 2 1 6 3 2 3 6 2
3
##  [889] 1 2 3 3 3 2 6 2 2 2 2 2 6 3 3 2 2 6 2 3 1 2 5 2 6 5 2 2 2 2 2 6 2 1 2 2
6
##  [926] 6 3 5 3 3 3 6 2 2 3 2 3 6 3 2 3 2 6 3 6 3 4 3 5 2 1 2 5 4 3 2 4 3 2 3 3
2
##  [963] 2 3 2 2 6 6 6 2 1 2 6 2 2 2 1 2 3 2 2 6 2 3 3 3 2 2 2 2 1 6 3 2 5 2 2 3
2
## [1000] 3 2 6 2 3 2 2 2 2 3 2 2 5 3 3 5 1 1 2 3 2 2 2 6 3 3 2 1 2 6 3 2 3 2 2 5
6
## [1037] 4 2 1 3 6 6 3 6 6 2 3 3 2 3 6 3 2 2 3 2 5 2 6 2 2 2 6 2 6 1 3 2 1 3 2 6
2
## [1074] 2 2 3 2 3 3 3 3 3 2 2 2 6 2 3 1 1 2 2 5 3 2 3 2 3 3 2 2 3 4 2 2 3 2 5 1
```

```
2
## [1111] 3 3 3 2 3 3 3 2 2 3 2 2 2 3 2 2 6 6 3 2 2 2 1 2 6 2 2 2 6 2 3 2 2 2 2 6
2
## [1148] 3 2 2 6 1 6 2 2 2 2 3 2 2 6 2 2 2 3 3 2 3 3 2 3 2 1 3 1 3 2 3 1 2 2 2 6
6
## [1185] 3 3 3 3 3 3 3 2 5 2 6 6 3 2 2 2 1 3 2 3 3 6 3 2 3 2 2 2 3 2 5 2 6 3 3 2
6
## [1222] 2 6 6 3 2 2 3 2 2 2 3 2 6 2 3 5 2 2 3 2 6 3 5 2 1 2 6 6 5 2 6 2 2 2 3 6
3
## [1259] 2 3 6 2 3 3 2 2 2 2 3 3 2 3 2 2 2 3 2 2 6 3 2 2 2 3 3 5 1 2 2 3 3 2 6 3
4
## [1296] 1 2 2 2 2 3 6 2 2 3 2 3 6 2 2 1 3 3 1 1 1 2 2 2 2 2 2 2 6 5 6 2 2 2 2 3
3
## [1333] 6 2 6 3 6 3 2 3 1 3 2 2 2 6 2 1 6 2 2 2 3 2 6 3 6 1 4 3 3 2 6 6 3 2 3 3
2
## [1370] 3 6 2 2 6 2 3 6 2 5 3 2 4 3 2 6 2 3 3 6 3 2 5 2 6 6 2 3 2 5 3 2 6 2 2 3
2
## [1407] 3 3 6 2 3 3 3 3 2 2 2 2 2 6 1 2 2 2 3 6 2 6 2 1 6 2 1 3 2 3 6 1 3 2 1 4
2
## [1444] 2 3 6 2 6 2 3 3 2 2 2 3 5 3 2 2 3 2 2 6 2 3 4 2 3 2 2 5 3 2 3 3 2 6 3 2
2
## [1481] 2 1 3 6 5 2 3 3 3 3 1 2 2 6 3 3 3 6 2 2 2 2 3 1 3 6 1 2 2 3 2 2 3 2 1 2 2
2
## [1518] 2 3 2 2 2 2 2 2 6 3 3 2 2 2 2 3 2 6 2 2 1 2 2 2 2 2 3 5 2 2 2 2 2 3 3 3
6
## [1555] 3 3 2 2 3 3 2 3 2 2 2 3 2 3 4 5 2 2 2 6 6 3 2 2 2 5 2 3 2 2 3 2 1 2 1 2
2
## [1592] 6 3 2 3 3 3 2 1 2 2 2 2 3 4 3 2 6 2 6 2 3 2 3 6 2 6 3 2 2 2 4 2 2 3 3 3
6
## [1629] 1 2 1 6 1 3 6 3 2 2 2 5 2 6 2 5 2 2 3 2 3 2 2 2 2 2 2 2 3 2 2 2 1 2 2 2
2
## [1666] 2 2 6 2 4 2 2 6 6 2 2 2 2 5 6 2 4 2 2 6 2 6 2 3 2 2 5 6 2 5 2 6 6 2 2 2
3
## [1703] 3 2 3 3 3 2 3 2 3 3 3 4 2 5 3 3 5 5 2 1 6 2 2 2 2 1 3 4 6 1 2 6 6 2 2 3
3
## [1740] 1 1 3 5 3 3 6 2 1 2 5 2 3 2 6 6 3 2 2 3 3 6 6 3 3 6 2 2 2 1 6 2 3 2 2 2
2
## [1777] 2 2 2 3 4 5 2 6 3 3 6 1 3 2 2 6 6 2 2 2 2 6 3 2 3 3 2 3 2 2 2 2 3 2 2 2
2
## [1814] 6 2 2 2 2 6 2 2 2 2 2 2 6 1 5 2 3 2 3 6 6 3 2 3 2 2 2 3 3 2 2 5 2 6 3 2
2
## [1851] 2 2 2 3 6 3 2 3 2 3 2 3 3 6 3 3 2 2 2 3 3 2 5 1 3 2 2 2 2 4 3 2 5 3 2 6
3
## [1888] 6 6 2 4 3 3 2 2 2 2 3 3 6 1 6 2 1 2 3 2 2 3 3 2 2 2 6 2 6 6 2 3 5 2 3 3
2
## [1925] 6 3 1 2 3 6 3 6 2 3 3 3 3 3 1 3 3 1 2 1 3 2 6 5 5 2 3 6 2 2 3 2 6 3 3 1
2
## [1962] 2 3 2 2 2 6 3 2 2 5 2 3 2 2 6 3 2 1 2 3 5 2 2 2 3 3 2 2 2 2 2 3 2 2 3 6
2
## [1999] 2 4 4 2 2 6 2 2 5 6 3 3 1 2 2 3 6 6 3 2 3 2 3 1 1 3 2 6 4 2 3 3 3 3 6 2
```

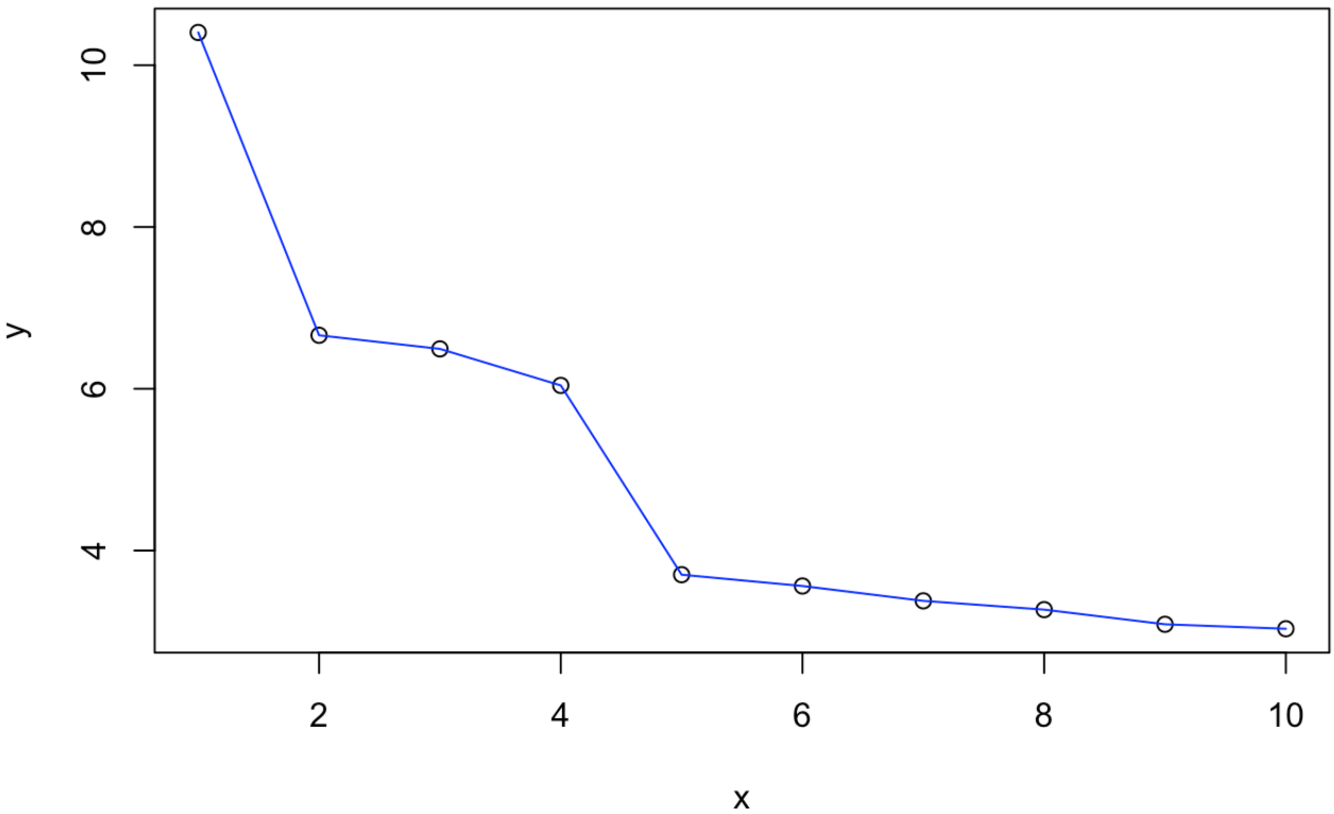
```
3
## [2036] 2 2 3 2 3 2 2 2 2 6 2 6 2 2 2 5 2 1 3 2 3 3 2 2 3 6 3 6 2 2 3 2 6 2 3 4
3
## [2073] 2 3 3 6 2 2 3 3 3 3 2 2 2 1 3 6 1 1 3 1 2 6 2 1 2 2 6 1 3 2 2 3 2 2 6 2
3
## [2110] 2 1 2 2 2 2 3 3 2 2 3 2 2 3 3 4 2 5 2 2 2 2 3 2 2 6 2 6 2 2 3 3 2 2 6 6
6
## [2147] 2 6 3 2 6 3 2 2 2 3 2 2 6 2 2 2 3 3 2 2 3 2 2 2 2 3 1 6 3 2 2 2 2 2 2 3
3
## [2184] 2 2 2 2 2 2 3 6 2 2 6 2 6 2 2 2 2 2 3 5 2 6 2 2 3 2 3 3 2 2 3 2 2 2 3 3
2
## [2221] 2 3 2 4 2 2 2 2 2 2 3 3 1 2 4 2 5 3 3 1 3 2 2 2 2 3 2 2 2 6 2 3 5 2 2 2
3
## [2258] 6 3 2 6 3 3 2 3 2 3 2 2 2 2 3 2 2 5 6 2 3 2 2 6 3 2 1 5 2 2 3 3 6 5 2 1
3
## [2295] 3 3 2 3 2 2 3 2 4 3 2 3 3 6 2 5 6 2 2 2 2 3 6 3 6 1 2 2 2 3 3 2 3 2 4 2
3
## [2332] 3 2 6 2 3 2 3 2 2 2 2 6 2 3 3 5 2 3 5 3 3 6 3 1 6 3 2 2 3 5 3 2 6 2 3 2
2
## [2369] 2 3 2 6 2 2 5 2 2 2 2 2 2 5 2 6 2 6 2 3 2 2 3 2 3 2 6 2 6 2 3 1 2 2 2 2
5
## [2406] 5 3 2 3 2 3 6 4 3 3 3 3 2 2 2 3 2 2 2 3 2 6 2 3 3 3 6 2 6 2 2 5 2 2 2 2
2
## [2443] 3 3 5 3 6 6 2 3 2 2 2 4 2 2 2 3 3 2 2 1 2 5 2 2 3 6 4 2 3 2 2 3 6 2 2 2
6
## [2480] 6 1 1 2 6 3 3 1 2 3 6 2 3 2 1 2 1 2 3 3 2 6 3 5 2 2 2 2 2 1 2 2 1 2 1 3
2
## [2517] 3 2 1 2 2 2 2 6 1 3 2 3 2 6 6 5 6 2 2 2 3 3 6 2 2 2 6 3 3 3 6 3 2 2 3 2
6
## [2554] 3 3 2 2 4 3 2 3 6 3 3 2 2 2 3 2 3 3 3 2 2 2 2 2 3 6 2 3 2 2 2 3 2 3 1 2
6
## [2591] 2 3 2 1 2 2 3 2 3 2 2 2 3 2 2 2 3 2 2 2 3 2 3 2 3 4 2 2 3 2 3 3 5 2 2 1
3
## [2628] 6 3 5 3 2 5 3 6 6 6 3 3 3 2 1 3 1 2 3 1 6 3 3 3 2 2 6 4 3 3 3 5 3 3 6 6
6
## [2665] 3 2 1 6 2 2 6 5 5 1 2 3 1 2 3 2 2 4 2 3 6 2 3 3 2 5 3 2 2 2 2 3 6 2 2 2
3
## [2702] 2 2 3 2 2 3 6 2 2 1 3 1 2 2 2 2 2 3 2 2 2 6 5 2 2 2 5 6 2 3 2 1 3 2 5 2
2
## [2739] 2 2 3 2 2 2 2 2 2 2 2 2 6 2 2 3 3 1 3 2 2 3 2 2 6 2 2 3 3 2 2 2 2 2 3 2
2
## [2776] 2 3 2 1 2 3 2 5 2 6 2 3 2 2 2 3 2 3 2 2 6 3 2 2 2 2 2 6 2 2 3 6 3 2 3 2 3
2
## [2813] 2 2 2 1 6 1 3 3 2 2 2 2 2 4 2 2 5 3 6 3 3 2 2 2 2 3 2 2 2 2 2 2 2 3 2 6
3
## [2850] 3 6 5 3 5 2 2 3 6 3 3 2 2 2 2 3 2 5 2 3 2
##
## Within cluster sum of squares by cluster:
## [1] 287639.5 161229.3 269419.3 242192.3 302653.7 212654.4
##  (between_SS / total_SS =  82.2 %)
```

```
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 100 :
## tot.withinss: 1475788
```

```
## for centroid method

plot(hclust2)
```




```
y <- sort(hclust2$height, decreasing = TRUE)[1:10]
plot(x,y); lines(x,y, col= "blue")
```




```
results2 <- vector("list", length = 3)
for (i in 1:length(nstart_values)) {
  seg_kmeans2 <- kmeans(x = data.frame(new_data$Avg_Quantity, new_data$Total_Quant
ity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate), cente
rs = 5, nstart = nstart_values[i])
  results2[[i]] <- seg_kmeans2
}

# Comparing results
for (i in 1:length(results2)) {
  cat("Results for nstart =", nstart_values[i], ":\n")
  print(results2[[i]])
  cat("\n")
  cat("Results for nstart =", nstart_values[i], ":\n")
  cat("tot.withinss:", results2[[i]]$tot.withinss, "\n\n")
}
```

```
## Results for nstart = 10 :
## K-means clustering with 5 clusters of sizes 752, 1706, 194, 146, 72
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
```

```
## 1              10.34714               26.598404             51.92540
## 2               5.52422                7.966589             15.45670
## 3              10.37049               43.860825            125.46314
## 4              29.63506               79.719178             79.64212
## 5              25.65469               98.638889            221.49819
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               3.916030               0.1513568
## 2               3.373390               0.1459064
## 3               8.735096               0.1489165
## 4               1.701413               0.1387357
## 5               8.715556               0.1931798
##
## Clustering vector:
##    [1] 3 1 2 2 2 2 1 3 2 3 2 2 2 5 1 2 2 2 3 1 3 2 2 2 1 2 1 2 2 3 3 5 2 2 2 2
2
##   [38] 3 3 1 1 1 3 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 5 2 1 3 2 2 2 2 3 2 3 1 4 1
1
##   [75] 1 2 1 3 3 1 2 1 2 2 2 3 1 2 3 2 1 1 2 2 3 2 2 2 1 1 1 5 2 2 1 1 2 2 2 2
1
##  [112] 2 1 2 1 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1
2
##  [149] 1 2 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 2 2 3 2 3 2 2 2 1 1 2 2 2 2 2 2 2 2 2
2
##  [186] 2 3 2 2 1 2 2 4 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 3 2
2
##  [223] 2 2 2 2 2 2 2 1 2 2 1 1 2 2 3 2 1 2 5 2 2 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2
2
##  [260] 2 2 2 2 3 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2 2 5 2 5 2 2 2 2 2 2 2 2 2 2 2 2
2
##  [297] 1 2 1 2 2 1 1 2 1 1 2 2 2 1 2 2 2 2 1 2 2 2 2 1 2 5 2 2 2 2 2 2 1 2 2 1
2
##  [334] 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 3 2 2 2 3 2 2 1 2 3 2 2 2 2 1 2 2 3 2 4
1
##  [371] 1 2 1 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 3 2 2 2 2 2 2 1 1 2 2 2 2 2 1 2 2 2
3
##  [408] 1 2 2 2 2 2 2 1 2 2 2 3 1 2 2 2 2 1 2 2 1 2 1 2 2 2 2 1 1 2 1 1 1 1 3 2
2
##  [445] 2 2 2 1 2 1 2 1 2 2 2 2 1 2 1 2 2 1 2 2 2 3 2 1 1 2 3 2 1 2 1 2 3 2 1 2
2
##  [482] 2 1 2 1 2 2 3 2 1 2 2 3 1 2 1 2 2 1 2 3 1 2 1 1 1 2 2 3 1 2 2 2 2 2 1 2
2
##  [519] 2 2 2 2 2 1 1 2 2 1 2 2 1 2 2 3 1 2 2 1 2 2 2 3 2 2 2 2 2 2 2 2 2 1 2 2 2
2
##  [556] 2 3 2 1 1 2 2 2 2 2 2 2 2 2 3 2 2 2 2 2 1 3 2 2 2 2 1 2 1 2 2 2 2 1 3 2
2
##  [593] 2 1 2 2 1 2 1 4 5 2 2 1 2 2 2 2 1 1 1 1 1 3 2 2 2 1 2 2 2 2 2 2 2 2 1 1
2
##  [630] 2 2 1 1 2 2 2 1 1 3 2 1 2 2 1 1 1 3 3 2 1 2 2 1 3 3 3 3 2 2 1 3 1 1 2 1
3
##  [667] 1 2 2 2 4 1 3 1 1 2 2 1 2 1 1 1 2 3 1 1 5 2 2 3 3 2 3 2 2 2 2 2 2 2 2 1
```

```
5
##  [704] 1 3 1 4 5 3 1 2 5 4 2 4 2 1 2 4 4 1 3 2 3 1 4 2 1 1 1 2 5 2 4 1 1 1 2 1
2
##  [741] 1 4 1 2 2 4 2 1 2 1 2 3 2 3 1 1 2 4 1 2 4 1 5 1 1 2 2 1 1 1 2 2 3 4 2 2
2
##  [778] 2 2 1 4 1 2 2 1 2 1 1 2 2 4 5 2 2 2 2 2 5 4 1 1 2 3 5 5 1 5 2 1 2 2 2 1
1
##  [815] 2 4 2 3 5 2 2 3 1 2 4 1 2 2 5 1 5 4 5 1 1 4 4 1 4 1 1 1 1 1 2 1 2 1 1 1
2
##  [852] 2 2 1 2 2 2 1 1 4 1 2 4 2 3 1 1 2 1 2 2 2 5 1 1 1 4 3 4 2 4 1 1 2 2 1 2
2
##  [889] 4 2 1 1 1 2 3 2 2 2 2 2 1 2 1 2 2 1 2 2 4 2 3 2 3 3 2 2 2 2 2 1 2 4 2 2
1
##  [926] 1 2 3 2 1 2 1 2 2 2 2 2 1 1 2 1 2 1 2 1 1 5 1 3 2 4 2 3 5 1 2 5 1 2 2 1
2
##  [963] 2 1 2 2 4 1 1 2 3 2 1 2 2 2 4 2 2 2 2 1 2 1 1 1 2 2 2 2 4 1 1 2 4 2 2 1
2
## [1000] 1 2 1 2 2 2 2 2 2 2 2 2 3 1 1 3 4 4 2 2 2 2 2 1 1 2 2 4 2 1 2 2 2 2 2 3
1
## [1037] 5 2 4 1 1 3 1 1 1 2 2 1 2 2 1 1 2 2 1 2 5 2 1 2 2 2 1 2 1 4 1 2 4 2 2 4
2
## [1074] 2 2 2 2 1 2 1 1 1 2 2 2 1 2 1 3 4 2 2 3 1 2 2 2 1 1 2 2 2 5 2 2 1 2 3 4
2
## [1111] 1 2 2 2 1 1 2 2 2 1 2 2 2 1 2 2 1 1 2 2 2 2 4 2 1 2 2 2 1 2 1 2 2 2 2 1
2
## [1148] 2 2 2 1 4 1 2 2 2 2 1 2 2 1 2 2 2 1 2 2 1 2 2 2 2 4 2 4 2 2 1 4 2 2 2 1
1
## [1185] 2 1 2 1 1 1 2 2 3 2 1 3 1 2 2 2 3 1 2 2 2 1 1 2 2 2 2 2 1 2 5 2 1 1 2 2
1
## [1222] 2 1 1 2 2 2 1 2 2 2 2 2 1 2 1 3 2 2 1 2 1 2 3 2 4 2 1 1 3 2 1 2 2 2 1 1
1
## [1259] 2 2 1 2 1 1 2 2 2 2 2 2 2 1 2 2 2 1 2 2 1 1 2 2 2 2 2 3 4 2 2 1 1 2 1 1
5
## [1296] 4 2 2 2 2 1 1 2 2 2 2 2 1 2 2 4 1 1 4 4 3 2 2 2 2 2 2 2 1 3 1 2 2 2 2 1
1
## [1333] 1 2 1 2 1 2 2 1 4 1 2 2 2 1 2 4 1 2 2 2 1 2 1 1 1 4 5 1 1 2 1 1 2 2 1 1
2
## [1370] 2 1 2 2 4 2 1 1 2 5 1 2 5 2 2 1 2 1 2 1 1 2 3 2 1 1 2 2 2 3 1 2 3 2 2 1
2
## [1407] 1 2 1 2 1 1 1 2 2 2 2 2 2 1 4 2 2 2 1 1 2 1 2 4 1 2 4 1 2 1 1 4 1 2 4 5
2
## [1444] 2 2 1 2 1 2 1 2 2 2 2 1 3 1 2 2 2 2 2 1 2 2 5 2 2 2 2 3 1 2 2 1 2 3 2 2
2
## [1481] 2 4 1 1 3 2 1 2 2 1 4 2 2 1 2 1 2 1 2 2 2 1 4 1 3 4 2 2 2 2 2 2 2 1 2 2
2
## [1518] 2 1 2 2 2 2 2 2 1 1 1 2 2 2 2 2 2 1 2 2 4 2 2 2 2 2 1 3 2 2 2 2 2 2 1 1
1
## [1555] 1 1 2 2 1 1 2 2 2 2 2 1 2 1 5 3 2 2 2 1 1 1 2 2 2 3 2 1 2 2 1 2 4 2 4 2
2
## [1592] 1 2 2 1 2 2 2 3 2 2 2 2 2 5 2 2 3 2 3 2 1 2 1 1 2 3 1 2 2 2 5 2 2 2 1 2
```

```
1
## [1629] 4 2 4 1 4 1 3 1 2 2 2 5 2 3 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 4 2 2 2
2
## [1666] 2 2 1 2 5 2 2 1 1 2 2 2 2 3 3 2 5 2 2 1 2 4 2 2 2 2 3 1 2 3 2 1 1 2 2 2
1
## [1703] 1 2 1 1 2 2 1 2 2 2 2 5 2 5 1 1 5 3 2 4 1 2 2 2 2 4 1 5 1 4 2 1 1 2 2 1
2
## [1740] 4 4 1 3 1 1 1 2 4 2 3 2 2 2 1 4 2 2 2 2 2 1 3 1 1 1 2 2 2 4 1 2 2 2 2 2
2
## [1777] 2 2 2 1 5 3 2 1 2 1 3 3 1 2 2 1 1 2 2 2 2 1 2 2 1 1 2 1 2 2 2 2 2 2 2 2
2
## [1814] 1 2 2 2 2 3 2 2 2 2 2 2 1 4 3 2 2 2 2 4 1 2 2 1 2 2 2 1 1 2 2 3 2 3 1 2
2
## [1851] 2 2 2 1 1 1 2 2 2 2 2 1 2 3 1 1 2 2 2 1 1 2 3 4 2 2 2 2 2 5 1 2 3 2 2 1
1
## [1888] 3 4 2 5 1 2 2 2 2 2 2 1 1 4 1 2 4 2 2 2 2 2 1 2 2 2 1 2 1 1 2 2 3 2 1 2
2
## [1925] 1 2 4 2 2 1 2 1 2 1 2 2 1 2 4 2 2 4 2 4 1 2 1 3 3 2 2 1 2 2 2 2 1 1 1 4
2
## [1962] 2 2 2 2 2 1 2 2 2 3 2 1 2 2 1 1 2 4 2 1 5 2 2 2 2 1 2 2 2 2 2 1 2 2 2 1
2
## [1999] 2 5 5 2 2 3 2 2 3 1 1 1 4 2 2 2 3 1 2 2 1 2 1 4 4 1 2 1 5 2 2 2 2 1 1 2
2
## [2036] 2 2 2 2 2 2 2 2 2 1 2 4 2 2 2 3 2 4 2 2 1 2 2 2 1 3 2 1 2 2 2 2 1 2 2 5
1
## [2073] 2 1 1 1 2 2 1 1 2 2 2 2 2 4 1 1 4 3 2 4 2 1 2 4 2 2 1 4 2 2 2 1 2 2 1 2
2
## [2110] 2 4 2 2 2 2 1 1 2 2 1 2 2 1 1 5 2 3 2 2 2 2 1 2 2 1 2 1 2 2 2 2 2 2 1 3
1
## [2147] 2 1 1 2 1 1 2 2 2 1 2 2 1 2 2 2 2 2 2 2 1 2 2 2 2 1 4 1 1 2 2 2 2 2 2 1
1
## [2184] 2 2 2 2 2 2 1 1 2 2 1 2 1 2 2 2 2 2 2 3 2 4 2 2 2 2 2 2 2 2 2 2 2 2 1 2
2
## [2221] 2 1 2 5 2 2 2 2 2 2 1 1 4 2 5 2 3 1 2 4 1 2 2 2 2 1 2 2 2 1 2 1 3 2 2 2
2
## [2258] 1 1 2 1 1 2 2 2 2 2 2 2 2 2 1 2 2 3 1 2 1 2 2 1 1 2 4 3 2 2 1 1 1 5 2 4
1
## [2295] 1 2 2 1 2 2 2 2 5 1 2 1 1 1 2 4 1 2 2 2 2 1 3 2 3 4 2 2 2 1 1 2 2 2 5 2
1
## [2332] 2 2 1 2 2 2 1 2 2 2 2 1 2 1 2 3 2 1 3 1 2 1 2 4 1 2 2 2 1 3 1 2 1 2 1 2
2
## [2369] 2 2 2 3 2 2 3 2 2 2 2 2 2 3 2 1 2 1 2 2 2 2 1 2 1 2 1 2 1 2 2 4 2 2 2 2
3
## [2406] 5 2 2 1 2 2 1 5 1 1 2 1 2 2 2 2 2 2 2 2 1 2 1 2 1 2 1 1 2 1 2 2 3 2 2 2 2
2
## [2443] 1 1 3 1 3 1 2 2 2 2 2 5 2 2 2 1 1 2 2 4 2 3 2 2 2 1 5 2 1 2 2 1 3 2 2 2
1
## [2480] 3 4 4 2 1 2 2 3 2 1 1 2 2 2 4 2 4 2 1 1 2 1 2 3 2 2 2 2 2 4 2 2 4 2 4 1
2
## [2517] 2 2 4 2 2 2 2 1 4 1 2 2 2 1 1 3 3 2 2 2 2 2 1 1 2 2 2 1 1 2 1 1 1 2 2 1 2
```

```
1
## [2554] 2 2 2 2 5 2 2 2 3 2 1 2 2 2 1 2 1 1 2 2 2 2 2 2 1 1 2 2 2 2 2 1 2 2 3 2
3
## [2591] 2 2 2 3 2 2 1 2 1 2 2 2 1 2 2 2 1 2 2 2 2 2 2 2 1 5 2 2 1 2 1 1 3 2 2 4
1
## [2628] 1 1 3 1 2 3 2 1 1 1 1 1 2 2 4 2 4 2 2 4 1 1 1 2 2 2 3 5 1 2 1 3 2 2 1 3
1
## [2665] 1 2 4 1 2 2 1 3 3 4 2 2 4 2 2 2 2 5 2 2 3 2 1 2 2 3 1 2 2 2 2 1 1 2 2 2
1
## [2702] 2 2 1 2 2 2 1 2 2 4 2 4 2 2 2 2 2 1 2 2 2 1 3 2 2 2 3 3 2 1 2 4 1 2 3 2
2
## [2739] 2 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 1 4 1 2 2 1 2 2 1 2 2 1 1 2 2 2 2 2 1 2
2
## [2776] 2 1 2 4 2 1 2 3 2 1 2 1 2 2 2 1 2 2 2 2 1 1 2 2 2 2 3 2 2 2 4 1 2 1 2 1
2
## [2813] 2 2 2 4 1 4 1 1 2 2 2 2 2 5 2 2 5 2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1
1
## [2850] 1 3 3 1 3 2 2 1 1 1 1 2 2 2 2 2 2 3 2 1 2
##
## Within cluster sum of squares by cluster:
## [1] 421942.6 298199.4 320358.9 303098.1 352226.5
##  (between_SS / total_SS =  79.6 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 10 :
## tot.withinss: 1695826
##
## Results for nstart = 50 :
## K-means clustering with 5 clusters of sizes 161, 739, 1697, 69, 204
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             29.710687               73.881988             71.67006
## 2              9.614883               25.093369             52.11141
## 3              5.581723                8.017678             15.30493
## 4             26.261759               99.115942            223.87638
## 5             10.872743               48.818627            126.78118
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               1.662493               0.1381651
## 2               4.076984               0.1496542
## 3               3.367038               0.1469543
## 4               8.977743               0.1957062
## 5               8.120159               0.1473854
##
## Clustering vector:
##    [1] 5 2 3 3 3 3 2 5 3 5 3 3 3 4 2 3 3 3 5 2 5 3 3 3 2 3 2 3 3 5 5 4 3 3 3 3
```

```
3
##  [38] 5 5 2 2 2 5 3 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 4 3 1 5 3 3 3 3 5 3 5 2 1 2
2
##  [75] 2 3 2 5 5 2 3 2 3 3 3 5 2 3 5 3 2 2 3 3 5 3 3 3 2 2 2 4 3 3 2 2 3 3 3 3
2
## [112] 3 2 3 2 2 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2
3
## [149] 2 3 3 3 3 3 3 3 3 3 2 3 3 3 2 3 3 3 3 5 3 5 3 3 3 2 2 3 3 3 3 3 3 3 3 3
3
## [186] 3 5 3 3 2 3 3 1 2 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3 5 3
3
## [223] 3 3 3 3 3 3 3 2 3 3 2 2 3 3 2 3 2 3 4 3 3 3 3 3 5 3 3 3 3 3 3 3 3 3 3 3
3
## [260] 3 3 3 3 5 3 3 3 3 2 2 3 3 3 3 3 3 3 3 3 3 3 4 3 4 3 3 3 3 3 3 3 3 3 3 3
3
## [297] 2 3 2 3 3 2 2 3 2 2 3 3 3 2 3 3 3 3 2 3 3 3 3 2 3 4 3 3 3 3 3 3 2 3 3 2
3
## [334] 3 3 3 3 3 3 3 3 2 3 3 3 3 3 3 2 5 3 3 3 5 3 3 2 3 5 3 3 3 3 2 3 3 5 3 1
2
## [371] 2 3 2 3 3 3 3 3 3 3 3 2 2 3 3 3 3 3 5 3 3 3 3 3 3 2 2 3 3 3 3 3 2 3 3 3
2
## [408] 2 3 3 3 3 3 3 2 3 3 3 5 2 3 3 3 3 2 3 3 2 3 2 3 3 3 3 2 2 3 2 2 2 2 5 3
3
## [445] 3 3 3 3 3 2 3 2 3 3 3 3 2 3 2 3 3 2 3 3 3 5 3 2 2 3 5 3 2 3 2 3 5 3 2 3
3
## [482] 3 2 3 2 3 3 5 3 2 3 3 5 2 3 2 3 3 2 3 5 2 3 2 2 2 3 3 5 2 3 3 3 3 3 2 3
3
## [519] 3 3 3 3 3 2 2 3 3 2 3 3 2 3 3 5 2 3 3 2 3 3 3 5 3 3 3 3 3 3 3 3 2 3 3 3
3
## [556] 3 5 3 2 2 3 3 3 2 3 3 3 3 3 5 3 3 3 3 3 2 5 3 3 3 3 2 3 2 3 3 3 3 2 5 3
3
## [593] 3 2 3 3 2 3 2 1 4 3 3 2 3 3 3 3 2 2 2 2 2 5 3 3 3 2 3 3 3 3 3 3 3 3 2 2
3
## [630] 3 3 2 2 3 3 3 2 2 5 3 2 3 3 2 2 2 5 5 3 2 3 3 2 5 5 5 5 3 3 2 5 2 2 3 2
5
## [667] 2 3 3 3 1 2 5 2 2 3 3 2 3 2 2 2 3 5 2 2 4 3 3 5 5 3 5 3 3 3 3 3 3 3 3 2
4
## [704] 2 5 2 1 4 5 2 3 4 1 3 5 3 2 3 1 5 1 5 3 5 2 1 3 2 1 2 3 4 3 1 2 2 2 3 2
3
## [741] 2 1 2 3 3 1 3 2 3 2 3 5 3 5 2 2 3 5 2 3 1 2 4 2 2 3 3 2 1 2 3 3 5 1 3 3
3
## [778] 3 3 2 5 2 3 3 2 3 2 2 3 3 1 4 3 3 3 3 3 4 5 2 2 3 5 4 4 2 4 3 2 3 3 3 2
2
## [815] 2 1 3 5 4 3 3 5 2 3 1 2 3 3 4 2 4 1 4 2 2 1 1 2 1 2 2 2 2 2 3 2 3 2 1 2
3
## [852] 3 3 2 3 3 3 2 2 1 2 3 1 3 5 2 1 3 2 3 3 3 4 2 2 2 1 5 1 3 1 1 2 3 3 2 3
3
## [889] 1 3 2 2 2 3 5 3 3 3 3 3 2 3 2 3 3 2 3 3 1 3 5 3 2 5 3 3 3 3 3 2 3 1 3 3
2
## [926] 2 3 5 3 2 3 1 3 3 2 3 3 2 2 3 2 3 2 3 2 2 4 2 5 3 1 3 5 4 2 3 4 2 3 3 2
```

```
3
##  [963] 3 2 3 3 1 2 1 3 5 3 2 3 3 3 1 3 3 3 3 2 3 2 2 2 3 3 3 3 5 2 2 3 5 3 3 2
3
## [1000] 1 3 2 3 3 3 3 3 3 3 3 3 5 2 2 5 1 1 3 3 3 3 3 2 2 3 3 1 3 1 3 3 3 3 3 5
2
## [1037] 4 3 1 2 2 5 2 2 2 3 3 2 3 3 2 2 3 3 2 3 4 3 2 3 3 3 2 3 2 1 2 3 1 3 3 1
3
## [1074] 3 3 3 3 2 3 2 2 2 3 3 3 2 3 2 5 1 3 3 5 2 3 3 3 1 2 3 3 3 4 3 3 2 3 5 1
3
## [1111] 2 3 3 3 2 2 3 3 3 2 3 3 3 2 3 3 2 2 3 3 3 3 1 3 2 3 3 3 2 3 2 3 3 3 3 2
3
## [1148] 3 3 3 2 1 2 3 3 3 3 2 3 3 2 3 3 3 2 3 3 2 2 3 3 3 1 3 1 3 3 2 1 3 3 3 2
2
## [1185] 3 2 3 2 2 2 3 3 5 3 2 2 2 3 3 3 5 2 3 2 3 2 2 3 3 3 3 3 2 3 4 3 2 2 3 3
2
## [1222] 3 2 2 3 3 3 2 3 3 3 3 3 2 3 2 5 3 3 2 3 2 3 5 3 1 3 2 2 5 3 2 3 3 3 2 1
2
## [1259] 3 3 2 3 2 2 3 3 3 3 3 3 2 3 3 3 2 3 3 2 2 3 3 3 3 3 5 1 3 3 2 2 3 2 2
4
## [1296] 1 3 3 3 3 3 2 3 3 3 3 3 2 3 3 1 2 2 1 1 5 3 3 3 3 3 3 3 2 5 2 3 3 3 3 2
2
## [1333] 2 3 2 3 2 3 3 2 1 2 3 3 3 2 3 5 2 3 3 3 2 3 2 2 1 1 4 2 2 3 2 2 3 3 2 2
3
## [1370] 3 2 3 3 1 3 2 2 3 4 2 3 4 3 3 2 3 2 3 2 2 3 5 3 2 2 3 3 3 5 2 3 2 3 3 2
3
## [1407] 2 3 2 3 2 2 2 3 3 3 3 3 3 2 1 3 3 3 2 2 3 2 3 1 2 3 1 2 3 2 2 1 2 3 1 4
3
## [1444] 3 3 2 3 2 3 2 3 3 3 3 2 5 2 3 3 3 3 3 2 3 3 4 3 3 3 3 5 2 3 3 2 3 5 3 3
3
## [1481] 3 1 2 2 5 3 2 3 3 2 1 3 3 2 3 2 3 2 3 3 3 2 1 2 5 1 3 3 3 3 3 3 3 1 3 3
3
## [1518] 3 2 3 3 3 3 3 3 1 2 2 3 3 3 3 3 3 2 3 3 1 3 3 3 3 3 1 5 3 3 3 3 3 3 2 2
2
## [1555] 2 2 3 3 2 2 3 3 3 3 3 2 3 2 4 5 3 3 3 2 2 2 3 3 3 5 3 2 3 3 2 3 5 3 1 3
3
## [1592] 2 3 3 2 3 3 3 5 3 3 3 3 3 4 3 3 5 3 5 3 2 3 2 2 3 2 2 3 3 3 4 3 3 3 2 3
2
## [1629] 1 3 1 2 1 2 5 2 3 3 3 4 3 5 3 5 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 3 3
3
## [1666] 3 3 2 3 4 3 3 2 2 3 3 3 3 5 5 3 4 3 3 2 3 1 3 3 3 3 5 2 3 5 3 2 2 3 3 3
2
## [1703] 2 3 2 2 3 3 2 3 3 3 3 4 3 5 2 2 5 5 3 1 2 3 3 3 3 1 2 4 2 1 3 2 1 3 3 2
3
## [1740] 1 1 2 5 3 2 2 3 1 3 5 3 3 3 2 1 3 3 3 3 3 2 5 2 2 2 3 3 3 1 2 3 3 3 3 3
3
## [1777] 3 3 3 2 4 5 3 2 2 2 5 5 2 3 3 2 1 3 3 3 3 2 3 3 2 2 3 2 3 3 3 3 3 3 3 3
3
## [1814] 2 3 3 3 3 5 3 3 3 3 3 3 2 1 5 3 3 3 3 1 2 3 3 2 3 3 3 2 2 3 3 5 3 5 2 3
3
## [1851] 3 3 3 2 2 2 3 3 3 3 3 2 3 5 2 2 3 3 3 2 2 3 5 1 3 3 3 3 3 4 2 3 5 3 3 2
```

```
2
## [1888] 5 1 3 4 2 3 3 3 3 3 3 2 2 1 2 3 1 3 3 3 3 3 2 3 3 3 2 3 2 2 3 3 5 3 2 3
3
## [1925] 2 3 5 3 3 2 3 2 3 2 3 3 2 3 5 3 3 1 3 1 2 3 2 5 5 3 3 2 3 3 3 3 2 2 2 1
3
## [1962] 3 3 3 3 3 2 3 3 3 5 3 2 3 3 2 2 3 1 3 2 4 3 3 3 3 2 3 3 3 3 3 2 3 3 3 2
3
## [1999] 3 4 4 3 3 5 3 3 5 2 2 2 1 3 3 3 5 2 3 3 2 3 1 1 1 2 3 2 4 3 3 3 3 2 2 3
3
## [2036] 3 3 3 3 3 3 3 3 3 2 3 1 3 3 3 5 3 1 3 3 1 3 3 3 2 5 3 2 3 3 3 3 2 3 2 4
2
## [2073] 3 2 2 2 3 3 2 2 3 3 3 3 3 1 2 2 1 5 3 1 3 2 3 1 3 3 2 1 3 3 3 2 3 3 2 3
3
## [2110] 3 1 3 3 3 3 2 2 3 3 2 3 3 2 2 4 3 5 3 3 3 3 2 3 3 2 3 2 3 3 3 3 3 3 2 5
2
## [2147] 3 2 2 3 2 2 3 3 3 2 3 3 2 3 3 3 3 3 3 3 2 3 3 3 3 2 1 2 2 3 3 3 3 3 3 2
2
## [2184] 3 3 3 3 3 3 2 2 3 3 2 3 2 3 3 3 3 3 3 5 3 1 3 3 3 3 3 3 3 3 2 3 3 3 2 2
3
## [2221] 3 2 3 4 3 3 3 3 3 3 2 2 1 3 4 3 5 2 3 1 2 3 3 3 3 2 3 3 3 2 3 2 5 3 3 3
3
## [2258] 2 2 3 2 2 3 3 3 3 3 3 3 3 3 2 3 3 5 2 3 2 3 3 2 2 3 1 5 3 3 2 2 2 5 3 1
2
## [2295] 2 3 3 2 3 3 3 3 4 2 3 2 2 2 3 5 2 3 3 3 3 2 5 3 5 1 3 3 3 2 2 3 3 3 4 3
2
## [2332] 3 3 2 3 3 3 2 3 3 3 3 2 3 1 3 5 3 2 5 2 3 2 3 1 2 3 3 3 2 5 2 3 2 3 2 3
3
## [2369] 3 3 3 5 3 3 5 3 3 3 3 3 3 5 3 1 3 2 3 2 3 3 2 3 2 3 2 3 2 3 3 1 3 3 3 3
5
## [2406] 4 3 3 2 3 3 2 4 2 2 3 2 3 3 3 3 3 3 3 2 3 2 3 2 3 2 2 3 2 3 3 5 3 3 3 3
3
## [2443] 2 2 5 2 5 2 3 3 3 3 3 4 3 3 3 2 2 3 3 1 3 5 3 3 3 2 4 3 2 3 3 3 5 3 3 3
2
## [2480] 5 1 1 3 1 3 2 5 3 2 2 3 3 3 1 3 5 3 2 2 3 2 3 5 3 3 3 3 3 1 3 3 1 3 1 2
3
## [2517] 3 3 1 3 3 3 3 2 1 2 3 3 3 2 2 5 5 3 3 3 2 2 2 3 3 3 2 2 3 2 2 2 3 3 2 3
2
## [2554] 2 3 3 3 4 3 3 3 5 3 1 3 3 3 2 3 2 2 3 3 3 3 3 3 2 2 3 3 3 3 3 2 3 3 5 3
5
## [2591] 3 3 3 5 3 3 2 3 2 3 3 3 2 3 3 3 2 3 3 3 3 3 3 3 2 4 3 3 2 3 2 2 5 3 3 1
2
## [2628] 2 1 5 2 3 5 3 2 2 2 2 2 3 3 1 3 1 3 3 1 2 2 2 3 3 3 5 4 2 3 2 5 3 3 2 5
2
## [2665] 2 3 1 2 3 3 2 5 5 1 3 3 1 3 3 3 3 4 3 3 5 3 2 3 3 5 2 3 3 3 3 2 2 3 3 3
2
## [2702] 3 3 2 3 3 3 2 3 3 1 3 1 3 3 3 3 3 2 3 3 3 2 5 3 3 3 5 5 3 2 3 1 2 3 5 3
3
## [2739] 3 3 2 3 3 3 3 3 3 3 3 3 2 3 3 3 2 1 1 3 3 2 3 3 2 3 3 2 2 3 3 3 3 3 2 3
3
## [2776] 3 2 3 1 3 2 3 5 3 2 3 2 3 3 3 2 3 3 3 3 2 2 3 3 3 3 5 3 3 3 1 2 3 2 3 1
```

```
3
## [2813] 3 3 3 1 2 1 2 2 3 3 3 3 3 4 3 3 4 3 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2
2
## [2850] 2 5 5 2 5 3 3 2 2 2 2 3 3 3 3 3 3 5 3 2 3
##
## Within cluster sum of squares by cluster:
## [1] 310536.7 381525.4 303007.4 341124.0 357693.7
##  (between_SS / total_SS =  79.6 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 50 :
## tot.withinss: 1693887
##
## Results for nstart = 100 :
## K-means clustering with 5 clusters of sizes 739, 161, 1697, 204, 69
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1              9.614883               25.093369             52.11141
## 2             29.710687               73.881988             71.67006
## 3              5.581723                8.017678             15.30493
## 4             10.872743               48.818627            126.78118
## 5             26.261759               99.115942            223.87638
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               4.076984               0.1496542
## 2               1.662493               0.1381651
## 3               3.367038               0.1469543
## 4               8.120159               0.1473854
## 5               8.977743               0.1957062
##
## Clustering vector:
##    [1] 4 1 3 3 3 3 1 4 3 4 3 3 3 5 1 3 3 3 4 1 4 3 3 3 1 3 1 3 3 4 4 5 3 3 3 3
3
##   [38] 4 4 1 1 1 4 3 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 5 3 2 4 3 3 3 3 4 3 4 1 2 1
1
##   [75] 1 3 1 4 4 1 3 1 3 3 3 4 1 3 4 3 1 1 3 3 4 3 3 3 1 1 1 5 3 3 1 1 3 3 3 3
1
##  [112] 3 1 3 1 1 3 3 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1
3
##  [149] 1 3 3 3 3 3 3 3 3 3 1 3 3 3 1 3 3 3 3 4 3 4 3 3 3 1 1 3 3 3 3 3 3 3 3 3
3
##  [186] 3 4 3 3 1 3 3 2 1 3 3 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 4 3
3
##  [223] 3 3 3 3 3 3 3 1 3 3 1 1 3 3 1 3 1 3 5 3 3 3 3 3 4 3 3 3 3 3 3 3 3 3 3 3
3
##  [260] 3 3 3 3 4 3 3 3 3 1 1 3 3 3 3 3 3 3 3 3 3 5 3 5 3 3 3 3 3 3 3 3 3 3 3 3
```

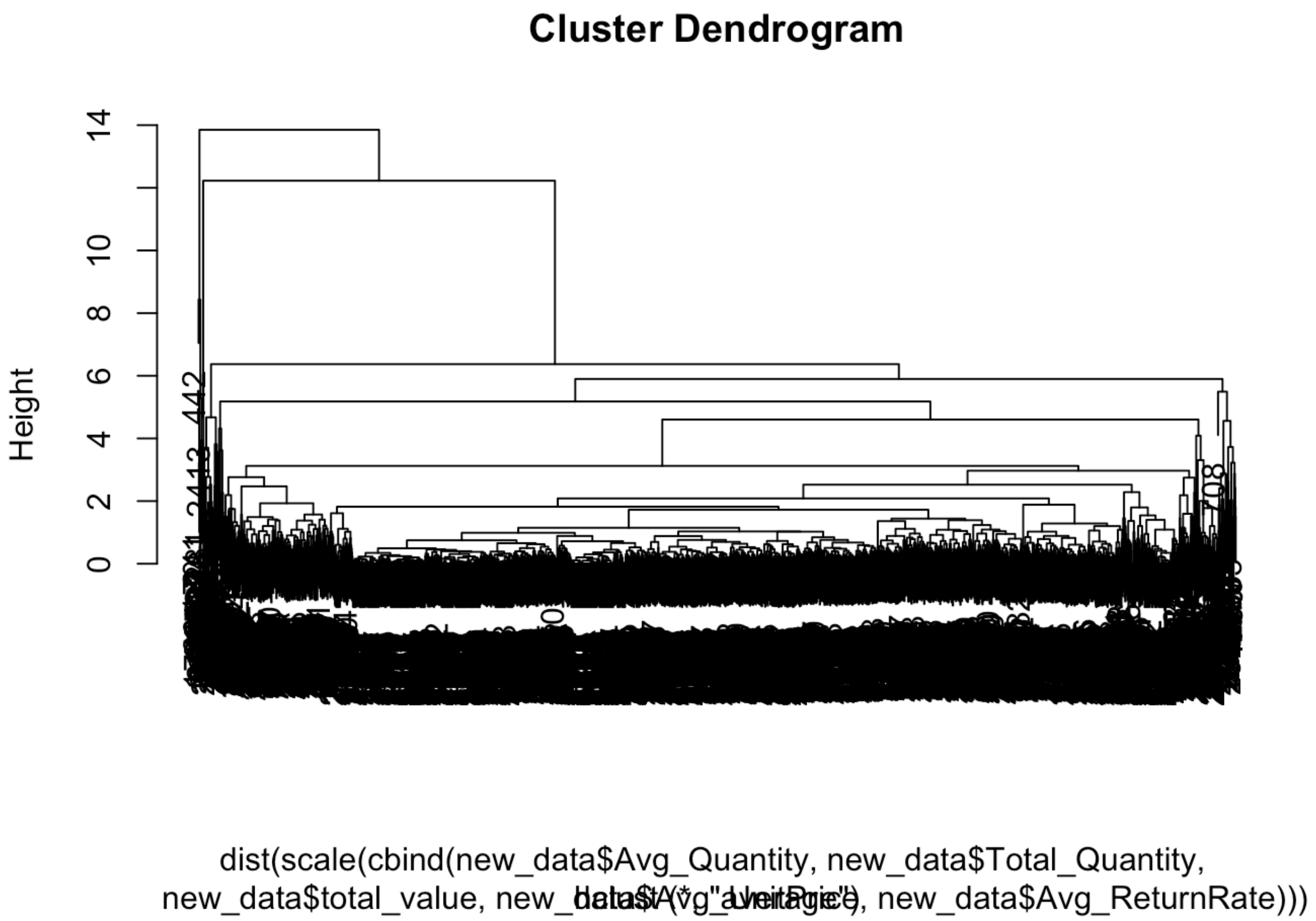
```
3
##   [297] 1 3 1 3 3 1 1 3 1 1 3 3 3 1 3 3 3 3 1 3 3 3 3 1 3 5 3 3 3 3 3 3 1 3 3 1
3
##   [334] 3 3 3 3 3 3 3 3 1 3 3 3 3 3 3 1 4 3 3 3 4 3 3 1 3 4 3 3 3 3 1 3 3 4 3 2
1
##   [371] 1 3 1 3 3 3 3 3 3 3 3 1 1 3 3 3 3 3 4 3 3 3 3 3 3 1 1 3 3 3 3 3 1 3 3 3
1
##   [408] 1 3 3 3 3 3 3 1 3 3 3 4 1 3 3 3 3 1 3 3 1 3 1 3 3 3 3 1 1 3 1 1 1 1 4 3
3
##   [445] 3 3 3 3 3 1 3 1 3 3 3 3 1 3 1 3 3 1 3 3 3 4 3 1 1 3 4 3 1 3 1 3 4 3 1 3
3
##   [482] 3 1 3 1 3 3 4 3 1 3 3 4 1 3 1 3 3 1 3 4 1 3 1 1 1 3 3 4 1 3 3 3 3 3 1 3
3
##   [519] 3 3 3 3 3 1 1 3 3 1 3 3 1 3 3 4 1 3 3 1 3 3 3 4 3 3 3 3 3 3 3 3 1 3 3 3
3
##   [556] 3 4 3 1 1 3 3 3 1 3 3 3 3 3 4 3 3 3 3 3 1 4 3 3 3 3 1 3 1 3 3 3 3 1 4 3
3
##   [593] 3 1 3 3 1 3 1 2 5 3 3 1 3 3 3 3 1 1 1 1 1 4 3 3 3 1 3 3 3 3 3 3 3 3 1 1
3
##   [630] 3 3 1 1 3 3 3 1 1 4 3 1 3 3 1 1 1 4 4 3 1 3 3 1 4 4 4 4 3 3 1 4 1 1 3 1
4
##   [667] 1 3 3 3 2 1 4 1 1 3 3 1 3 1 1 1 3 4 1 1 5 3 3 4 4 3 4 3 3 3 3 3 3 3 3 1
5
##   [704] 1 4 1 2 5 4 1 3 5 2 3 4 3 1 3 2 4 2 4 3 4 1 2 3 1 2 1 3 5 3 2 1 1 1 3 1
3
##   [741] 1 2 1 3 3 2 3 1 3 1 3 4 3 4 1 1 3 4 1 3 2 1 5 1 1 3 3 1 2 1 3 3 4 2 3 3
3
##   [778] 3 3 1 4 1 3 3 1 3 1 1 3 3 2 5 3 3 3 3 3 5 4 1 1 3 4 5 5 1 5 3 1 3 3 3 1
1
##   [815] 1 2 3 4 5 3 3 4 1 3 2 1 3 3 5 1 5 2 5 1 1 2 2 1 2 1 1 1 1 1 3 1 3 1 2 1
3
##   [852] 3 3 1 3 3 3 1 1 2 1 3 2 3 4 1 2 3 1 3 3 3 5 1 1 1 2 4 2 3 2 2 1 3 3 1 3
3
##   [889] 2 3 1 1 1 3 4 3 3 3 3 3 1 3 1 3 3 1 3 3 2 3 4 3 1 4 3 3 3 3 3 1 3 2 3 3
1
##   [926] 1 3 4 3 1 3 2 3 3 1 3 3 1 1 3 1 3 1 3 1 1 5 1 4 3 2 3 4 5 1 3 5 1 3 3 1
3
##   [963] 3 1 3 3 2 1 2 3 4 3 1 3 3 3 2 3 3 3 3 1 3 1 1 1 3 3 3 3 4 1 1 3 4 3 3 1
3
##  [1000] 2 3 1 3 3 3 3 3 3 3 3 3 4 1 1 4 2 2 3 3 3 3 3 1 1 3 3 2 3 2 3 3 3 3 3 4
1
##  [1037] 5 3 2 1 1 4 1 1 1 3 3 1 3 3 1 1 3 3 1 3 5 3 1 3 3 3 1 3 1 2 1 3 2 3 3 2
3
##  [1074] 3 3 3 3 1 3 1 1 1 3 3 3 1 3 1 4 2 3 3 4 1 3 3 3 2 1 3 3 3 5 3 3 1 3 4 2
3
##  [1111] 1 3 3 3 1 1 3 3 3 1 3 3 3 1 3 3 1 1 3 3 3 3 2 3 1 3 3 3 1 3 1 3 3 3 3 1
3
##  [1148] 3 3 3 1 2 1 3 3 3 3 1 3 3 1 3 3 3 1 3 3 1 1 3 3 3 2 3 2 3 3 1 2 3 3 3 1
1
##  [1185] 3 1 3 1 1 1 3 3 4 3 1 1 1 3 3 3 4 1 3 1 3 1 1 3 3 3 3 3 1 3 5 3 1 1 3 3
```

```
1
## [1222] 3 1 1 3 3 3 1 3 3 3 3 3 1 3 1 4 3 3 1 3 1 3 4 3 2 3 1 1 4 3 1 3 3 3 1 2
1
## [1259] 3 3 1 3 1 1 3 3 3 3 3 3 3 1 3 3 3 1 3 3 1 1 3 3 3 3 3 4 2 3 3 1 1 3 1 1
5
## [1296] 2 3 3 3 3 3 1 3 3 3 3 3 1 3 3 2 1 1 2 2 4 3 3 3 3 3 3 3 1 4 1 3 3 3 3 1
1
## [1333] 1 3 1 3 1 3 3 1 2 1 3 3 3 1 3 4 1 3 3 3 1 3 1 1 2 2 5 1 1 3 1 1 3 3 1 1
3
## [1370] 3 1 3 3 2 3 1 1 3 5 1 3 5 3 3 1 3 1 3 1 1 3 4 3 1 1 3 3 3 4 1 3 1 3 3 1
3
## [1407] 1 3 1 3 1 1 1 3 3 3 3 3 3 1 2 3 3 3 1 1 3 1 3 2 1 3 2 1 3 1 1 2 1 3 2 5
3
## [1444] 3 3 1 3 1 3 1 3 3 3 3 1 4 1 3 3 3 3 3 1 3 3 5 3 3 3 3 4 1 3 3 1 3 4 3 3
3
## [1481] 3 2 1 1 4 3 1 3 3 1 2 3 3 1 3 1 3 1 3 3 3 1 2 1 4 2 3 3 3 3 3 3 3 2 3 3
3
## [1518] 3 1 3 3 3 3 3 3 2 1 1 3 3 3 3 3 3 1 3 3 2 3 3 3 3 3 2 4 3 3 3 3 3 3 1 1
1
## [1555] 1 1 3 3 1 1 3 3 3 3 3 1 3 1 5 4 3 3 3 1 1 1 3 3 3 4 3 1 3 3 1 3 4 3 2 3
3
## [1592] 1 3 3 1 3 3 3 4 3 3 3 3 3 5 3 3 4 3 4 3 1 3 1 1 3 1 1 3 3 3 5 3 3 3 1 3
1
## [1629] 2 3 2 1 2 1 4 1 3 3 3 5 3 4 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3
3
## [1666] 3 3 1 3 5 3 3 1 1 3 3 3 3 4 4 3 5 3 3 1 3 2 3 3 3 3 4 1 3 4 3 1 1 3 3 3
1
## [1703] 1 3 1 1 3 3 1 3 3 3 3 5 3 4 1 1 4 4 3 2 1 3 3 3 3 2 1 5 1 2 3 1 2 3 3 1
3
## [1740] 2 2 1 4 3 1 1 3 2 3 4 3 3 3 1 2 3 3 3 3 3 1 4 1 1 1 3 3 3 2 1 3 3 3 3 3
3
## [1777] 3 3 3 1 5 4 3 1 1 1 4 4 1 3 3 1 2 3 3 3 3 1 3 3 1 1 3 1 3 3 3 3 3 3 3 3
3
## [1814] 1 3 3 3 3 4 3 3 3 3 3 3 1 2 4 3 3 3 3 2 1 3 3 1 3 3 3 1 1 3 3 4 3 4 1 3
3
## [1851] 3 3 3 1 1 1 3 3 3 3 3 1 3 4 1 1 3 3 3 1 1 3 4 2 3 3 3 3 3 5 1 3 4 3 3 1
1
## [1888] 4 2 3 5 1 3 3 3 3 3 3 1 1 2 1 3 2 3 3 3 3 3 1 3 3 3 1 3 1 1 3 3 4 3 1 3
3
## [1925] 1 3 4 3 3 1 3 1 3 1 3 3 1 3 4 3 3 2 3 2 1 3 1 4 4 3 3 1 3 3 3 3 1 1 1 2
3
## [1962] 3 3 3 3 3 1 3 3 3 4 3 1 3 3 1 1 3 2 3 1 5 3 3 3 3 1 3 3 3 3 3 3 1 3 3 3 1
3
## [1999] 3 5 5 3 3 4 3 3 4 1 1 1 2 3 3 3 4 1 3 3 1 3 2 2 2 1 3 1 5 3 3 3 3 1 1 3
3
## [2036] 3 3 3 3 3 3 3 3 3 1 3 2 3 3 3 4 3 2 3 3 2 3 3 3 1 4 3 1 3 3 3 3 1 3 1 5
1
## [2073] 3 1 1 1 3 3 1 1 3 3 3 3 3 2 1 1 2 4 3 2 3 1 3 2 3 3 1 2 3 3 3 1 3 3 1 3
3
## [2110] 3 2 3 3 3 3 1 1 3 3 1 3 3 1 1 5 3 4 3 3 3 3 1 3 3 1 3 1 3 3 3 3 3 3 1 4
```

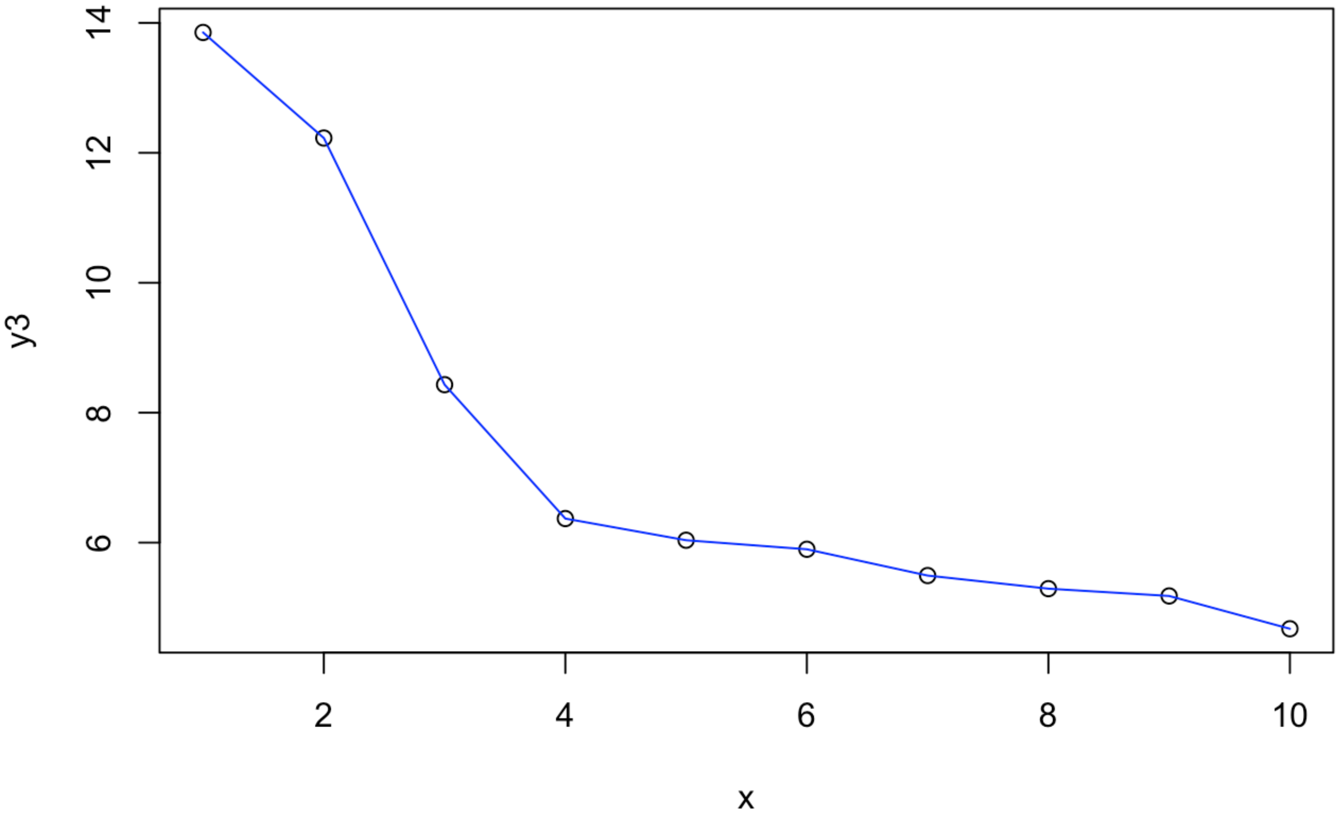
```
1
## [2147] 3 1 1 3 1 1 3 3 3 1 3 3 1 3 3 3 3 3 3 3 1 3 3 3 3 1 2 1 1 3 3 3 3 3 3 1
1
## [2184] 3 3 3 3 3 3 1 1 3 3 1 3 1 3 3 3 3 3 3 4 3 2 3 3 3 3 3 3 3 3 1 3 3 3 1 1
3
## [2221] 3 1 3 5 3 3 3 3 3 3 1 1 2 3 5 3 4 1 3 2 1 3 3 3 3 1 3 3 3 1 3 1 4 3 3 3
3
## [2258] 1 1 3 1 1 3 3 3 3 3 3 3 3 3 1 3 3 4 1 3 1 3 3 1 1 3 2 4 3 3 1 1 1 4 3 2
1
## [2295] 1 3 3 1 3 3 3 3 5 1 3 1 1 1 3 4 1 3 3 3 3 1 4 3 4 2 3 3 3 1 1 3 3 3 5 3
1
## [2332] 3 3 1 3 3 3 1 3 3 3 3 1 3 2 3 4 3 1 4 1 3 1 3 2 1 3 3 3 1 4 1 3 1 3 1 3
3
## [2369] 3 3 3 4 3 3 4 3 3 3 3 3 3 4 3 2 3 1 3 1 3 3 1 3 1 3 1 3 1 3 3 2 3 3 3 3
4
## [2406] 5 3 3 1 3 3 1 5 1 1 3 1 3 3 3 3 3 3 3 1 3 1 3 1 3 1 1 3 1 3 3 4 3 3 3 3
3
## [2443] 1 1 4 1 4 1 3 3 3 3 3 5 3 3 3 1 1 3 3 2 3 4 3 3 3 1 5 3 1 3 3 3 4 3 3 3
1
## [2480] 4 2 2 3 2 3 1 4 3 1 1 3 3 3 2 3 4 3 1 1 3 1 3 4 3 3 3 3 3 2 3 3 2 3 2 1
3
## [2517] 3 3 2 3 3 3 3 1 2 1 3 3 3 1 1 4 4 3 3 3 1 1 1 3 3 3 1 1 3 1 1 1 3 3 1 3
1
## [2554] 1 3 3 3 5 3 3 3 4 3 2 3 3 3 1 3 1 1 3 3 3 3 3 3 1 1 3 3 3 3 3 1 3 3 4 3
4
## [2591] 3 3 3 4 3 3 1 3 1 3 3 3 1 3 3 3 1 3 3 3 3 3 3 3 1 5 3 3 1 3 1 1 4 3 3 2
1
## [2628] 1 2 4 1 3 4 3 1 1 1 1 1 3 3 2 3 2 3 3 2 1 1 1 3 3 3 4 5 1 3 1 4 3 3 1 4
1
## [2665] 1 3 2 1 3 3 1 4 4 2 3 3 2 3 3 3 3 5 3 3 4 3 1 3 3 4 1 3 3 3 3 1 1 3 3 3
1
## [2702] 3 3 1 3 3 3 1 3 3 2 3 2 3 3 3 3 3 1 3 3 3 1 4 3 3 3 4 4 3 1 3 2 1 3 4 3
3
## [2739] 3 3 1 3 3 3 3 3 3 3 3 3 1 3 3 3 1 2 2 3 3 1 3 3 1 3 3 1 1 3 3 3 3 3 1 3
3
## [2776] 3 1 3 2 3 1 3 4 3 1 3 1 3 3 3 1 3 3 3 3 1 1 3 3 3 3 4 3 3 3 2 1 3 1 3 2
3
## [2813] 3 3 3 2 1 2 1 1 3 3 3 3 3 5 3 3 5 3 1 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1
1
## [2850] 1 4 4 1 4 3 3 1 1 1 1 3 3 3 3 3 3 4 3 1 3
##
## Within cluster sum of squares by cluster:
## [1] 381525.4 310536.7 303007.4 357693.7 341124.0
##  (between_SS / total_SS =  79.6 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
```

```
## Results for nstart = 100 :
## tot.withinss: 1693887
```

```r
## for average method

plot(hclust3)
```




```r
y3 <- sort(hclust3$height, decreasing = TRUE)[1:10]
plot(x,y3); lines(x,y3, col= "blue")
```




```
results3 <- vector("list", length = 3)
for (i in 1:length(nstart_values)) {
  seg_kmeans3 <- kmeans(x = data.frame(new_data$Avg_Quantity, new_data$Total_Quant
ity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate), cente
rs = 4, nstart = nstart_values[i])
  results3[[i]] <- seg_kmeans3
}

seg_kmeans3$tot.withinss
```

```
## [1] 1933954
```

```
# Comparing results
for (i in 1:length(results3)) {
  cat("Results for nstart =", nstart_values[i], ":\n")
  print(results3[[i]])
  cat("\n")
  cat("Results for nstart =", nstart_values[i], ":\n")
  cat("tot.withinss:", results3[[i]]$tot.withinss, "\n\n")
}
```

```
## Results for nstart = 10 :
## K-means clustering with 4 clusters of sizes 74, 761, 1746, 289
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             25.056588               95.743243            221.05297
## 2             11.836407               29.561104             52.97485
## 3              5.532533                8.128866             15.92806
## 4             16.849857               59.062284            113.66893
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               9.195324               0.1917935
## 2               3.959407               0.1505239
## 3               3.384698               0.1457553
## 4               5.768671               0.1472687
##
## Clustering vector:
##    [1] 4 2 3 3 3 3 2 4 3 4 3 3 3 1 2 3 3 3 4 2 4 3 3 3 2 3 2 3 3 4 4 1 3 3 3 3
3
##   [38] 4 4 2 2 2 4 3 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 2 4 3 3 3 3 4 3 4 2 2 2
2
##   [75] 3 3 2 4 4 2 3 2 3 3 3 4 2 3 4 3 2 2 3 3 4 3 3 3 2 2 2 1 3 3 2 2 3 3 3 3
2
##  [112] 3 2 3 2 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2
3
##  [149] 2 3 3 3 3 3 3 3 3 3 2 3 3 3 2 3 3 3 3 4 3 4 3 3 3 2 2 3 3 3 3 3 3 3 3 3
3
##  [186] 3 4 3 3 3 3 3 4 2 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3 4 3
3
##  [223] 3 3 3 3 3 3 3 2 3 3 2 2 3 3 2 3 2 3 1 3 3 3 3 3 4 3 3 3 3 3 3 3 3 3 3 3
3
##  [260] 3 3 3 3 4 3 3 3 3 2 2 3 3 3 3 3 3 3 3 3 3 1 3 1 3 3 3 3 3 3 3 3 3 3 3 3
3
##  [297] 2 3 2 3 3 2 2 3 2 3 3 3 3 2 3 3 3 3 3 3 3 3 3 2 3 1 3 3 3 3 3 3 2 3 3 2
3
##  [334] 3 3 3 3 3 3 3 3 2 3 3 3 3 3 3 2 4 3 3 3 4 3 3 2 3 4 3 3 3 3 2 3 3 2 3 4
2
##  [371] 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3 3 4 3 3 3 3 3 3 2 2 3 3 3 3 3 3 3 3 3
2
##  [408] 2 3 3 3 3 3 3 2 3 3 3 4 3 3 3 3 3 2 3 3 2 3 2 3 3 3 3 2 2 3 2 2 2 2 4 3
3
##  [445] 3 3 3 2 3 2 3 2 3 3 3 3 2 3 2 3 3 2 3 3 3 4 3 2 2 3 4 3 2 3 2 3 4 3 2 3
3
##  [482] 3 3 3 2 3 3 1 3 2 3 3 4 2 3 2 3 3 2 3 4 2 3 2 2 2 3 3 4 2 3 3 3 3 3 2 3
3
##  [519] 3 3 3 3 3 2 3 3 3 2 3 3 2 3 3 4 2 3 3 2 3 3 3 4 3 3 3 3 3 3 3 3 2 3 3 3
3
##  [556] 3 4 3 2 2 3 3 3 3 3 3 3 3 4 3 3 3 3 3 2 4 3 3 3 3 2 3 2 3 3 3 3 2 4 3
3
##  [593] 3 2 3 3 2 3 2 2 1 3 3 2 3 3 3 3 2 2 2 2 2 4 3 3 3 2 3 3 3 3 3 3 3 3 2 2
3
```

```
##   [630] 3 3 2 2 3 3 3 2 2 4 3 2 3 3 2 2 3 4 4 3 2 3 3 2 4 4 4 4 3 3 2 4 2 2 3 2
4
##   [667] 2 3 3 3 4 2 4 2 2 3 3 2 3 2 2 2 3 4 2 2 1 3 3 4 4 3 4 3 3 3 3 3 3 3 3 2
1
##   [704] 2 4 2 2 1 4 2 3 1 4 3 4 3 2 3 4 4 2 4 3 4 2 4 3 2 2 2 3 1 3 2 2 2 2 3 2
3
##   [741] 2 4 2 3 3 2 3 2 3 2 3 4 3 4 2 2 3 4 2 3 2 3 1 2 2 3 3 2 2 2 3 3 4 4 3 3
3
##   [778] 3 3 2 4 2 3 3 2 3 2 2 3 3 4 1 3 3 3 3 3 1 4 2 2 3 4 1 1 2 1 3 2 3 3 3 2
2
##   [815] 3 4 3 4 1 3 3 4 2 3 4 2 3 3 1 2 1 4 1 2 2 4 4 2 2 2 2 2 2 2 3 2 3 2 2 2
3
##   [852] 3 3 2 3 3 3 2 2 4 2 3 4 3 4 2 2 3 2 3 3 3 1 2 2 2 4 4 4 3 4 2 2 3 3 2 3
3
##   [889] 4 3 2 2 2 3 4 3 3 3 3 3 2 3 2 3 3 2 3 3 2 3 4 3 2 4 3 3 3 3 3 2 3 4 3 3
2
##   [926] 2 3 4 3 2 3 2 3 3 3 3 3 2 2 3 2 3 2 3 2 2 1 2 4 3 4 3 4 1 2 3 1 2 3 3 2
3
##   [963] 3 2 3 3 4 2 2 3 4 3 2 3 3 3 4 3 3 3 3 2 3 2 2 2 3 3 3 3 4 2 2 3 4 3 3 2
3
##  [1000] 2 3 2 3 3 3 3 3 3 3 3 3 4 2 2 4 2 2 3 3 3 3 3 2 2 3 3 4 3 2 3 3 3 3 3 4
2
##  [1037] 1 3 4 2 2 4 2 2 2 3 3 2 3 3 2 2 3 3 2 3 1 3 2 3 3 3 2 3 2 2 2 3 2 3 3 2
3
##  [1074] 3 3 3 3 2 3 2 2 2 3 3 3 2 3 2 4 2 3 3 4 2 3 3 3 2 2 3 3 3 1 3 3 3 3 4 4
3
##  [1111] 2 3 3 3 2 2 3 3 3 2 3 3 3 2 3 3 2 2 3 3 3 3 2 3 2 3 3 3 2 3 2 3 3 3 3 2
3
##  [1148] 3 3 3 2 4 2 3 3 3 3 2 3 3 2 3 3 3 2 3 3 2 3 3 3 3 4 3 2 3 3 2 4 3 3 3 2
2
##  [1185] 3 3 3 2 2 2 3 3 4 3 2 2 2 3 3 3 4 2 3 3 3 2 2 3 3 3 3 3 2 3 1 3 2 2 3 3
2
##  [1222] 3 2 2 3 3 3 2 3 3 3 3 3 2 3 2 4 3 3 2 3 2 3 4 3 2 3 2 2 4 3 2 3 3 3 2 2
2
##  [1259] 3 3 2 3 2 2 3 3 3 3 3 3 3 2 3 3 3 2 3 3 2 3 3 3 3 3 3 4 4 3 3 2 3 3 2 2
1
##  [1296] 2 3 3 3 3 3 2 3 3 3 3 3 2 3 3 2 2 2 4 2 4 3 3 3 3 3 3 3 2 4 2 3 3 3 3 2
2
##  [1333] 2 3 2 3 2 3 3 2 4 2 3 3 3 2 3 4 2 3 3 3 2 3 2 2 2 4 1 2 2 3 2 2 3 3 2 3
3
##  [1370] 3 2 3 3 4 3 2 2 3 1 2 3 1 3 3 2 3 2 3 2 2 3 4 3 2 2 3 3 3 4 2 3 2 3 3 3
3
##  [1407] 2 3 2 3 2 2 2 3 3 3 3 3 3 2 4 3 3 3 2 2 3 2 3 4 2 3 4 2 3 2 2 4 2 3 4 1
3
##  [1444] 3 3 2 3 2 3 2 3 3 3 3 2 4 3 3 3 3 3 3 2 3 3 1 3 3 3 3 4 2 3 3 3 3 4 3 3
3
##  [1481] 3 2 2 2 4 3 2 3 3 2 2 3 3 2 3 3 3 2 3 3 3 2 4 2 4 4 3 3 3 3 3 3 3 2 3 3
3
##  [1518] 3 2 3 3 3 3 3 3 2 2 2 3 3 3 3 3 3 2 3 3 4 3 3 3 3 3 2 4 3 3 3 3 3 3 2 3
2
```

```
## [1555] 2 2 3 3 2 2 3 3 3 3 3 2 3 2 1 4 3 3 3 2 2 2 3 3 3 4 3 2 3 3 2 3 4 3 4 3
3
## [1592] 2 3 3 2 3 3 3 4 3 3 3 3 3 1 3 3 4 3 4 3 2 3 2 2 3 2 2 3 3 3 1 3 3 3 2 3
2
## [1629] 4 3 2 2 4 3 4 2 3 3 3 1 3 4 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4 3 3 3
3
## [1666] 3 3 2 3 1 3 3 2 2 3 3 3 3 4 4 3 1 3 3 2 3 4 3 3 3 3 4 2 3 4 3 2 2 3 3 3
2
## [1703] 2 3 2 2 3 3 2 3 3 3 3 1 3 4 2 2 1 4 3 2 2 3 3 3 3 2 2 1 4 4 3 2 2 3 3 2
3
## [1740] 4 4 2 4 2 2 2 3 4 3 4 3 3 3 2 4 3 3 3 3 3 2 4 2 2 2 3 3 3 4 2 3 3 3 3 3
3
## [1777] 3 3 3 2 1 4 3 2 3 2 4 4 2 3 3 2 4 3 3 3 3 2 3 3 2 2 3 2 3 3 3 3 3 3 3 3
3
## [1814] 2 3 3 3 3 4 3 3 3 3 3 3 2 2 4 3 3 3 3 4 2 3 3 2 3 3 3 2 2 3 3 4 3 4 2 3
3
## [1851] 3 3 3 2 2 3 3 3 3 3 3 2 3 4 2 2 3 3 3 2 2 3 4 2 3 3 3 3 3 1 2 3 4 3 3 2
2
## [1888] 4 4 3 1 3 3 3 3 3 3 3 2 2 2 2 3 4 3 3 3 3 3 2 3 3 3 2 3 2 2 3 3 4 3 2 3
3
## [1925] 2 3 4 3 3 2 3 2 3 2 3 3 3 3 4 3 3 4 3 2 2 3 2 4 4 3 3 2 3 3 3 3 2 2 2 2
3
## [1962] 3 3 3 3 3 2 3 3 3 1 3 2 3 3 2 2 3 4 3 2 1 3 3 3 3 2 3 3 3 3 3 2 3 3 3 2
3
## [1999] 3 1 1 3 3 4 3 3 4 2 2 2 2 3 3 3 4 2 3 3 2 3 2 2 2 2 3 2 1 3 3 3 3 2 2 3
3
## [2036] 3 3 3 3 3 3 3 3 3 2 3 4 3 3 3 4 3 4 3 3 2 3 3 3 2 4 3 2 3 3 3 3 2 3 3 1
2
## [2073] 3 2 2 2 3 3 2 2 3 3 3 3 3 4 2 2 4 4 3 4 3 2 3 4 3 3 2 2 3 3 3 2 3 3 2 3
3
## [2110] 3 4 3 3 3 3 2 2 3 3 2 3 3 2 2 1 3 4 3 3 3 3 2 3 3 2 3 2 3 3 3 3 3 3 2 4
2
## [2147] 3 2 2 3 2 2 3 3 3 2 3 3 2 3 3 3 3 3 3 3 2 3 3 3 3 2 2 2 2 3 3 3 3 3 3 3
2
## [2184] 3 3 3 3 3 3 2 2 3 3 2 3 4 3 3 3 3 3 3 4 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3
3
## [2221] 3 2 3 1 3 3 3 3 3 3 2 2 2 3 1 3 4 2 3 4 2 3 3 3 3 2 3 3 3 2 3 2 4 3 3 3
3
## [2258] 2 2 3 2 2 3 3 3 3 3 3 3 3 3 2 3 3 4 2 3 2 3 3 2 3 3 4 4 3 3 2 2 2 1 3 4
2
## [2295] 2 3 3 2 3 3 3 3 1 2 3 2 2 2 3 4 2 3 3 3 3 3 4 3 4 4 3 3 3 2 2 3 3 3 1 3
2
## [2332] 3 3 2 3 3 3 2 3 3 3 3 2 3 2 3 4 3 2 4 2 3 2 3 2 2 3 3 3 2 4 2 3 2 3 2 3
3
## [2369] 3 3 3 4 3 3 4 3 3 3 3 3 3 4 3 2 3 2 3 3 3 3 2 3 2 3 2 3 2 3 3 4 3 3 3 3
4
## [2406] 1 3 3 2 3 3 2 1 2 2 3 2 3 3 3 3 3 3 3 2 3 2 3 2 3 3 2 3 2 3 3 4 3 3 3 3
3
## [2443] 2 2 4 2 4 2 3 3 3 3 3 1 3 3 3 2 2 3 3 2 3 4 3 3 3 2 1 3 2 3 3 2 4 3 3 3
2
```

```
## [2480] 4 4 2 3 4 3 3 4 3 2 2 3 3 3 4 3 4 3 2 3 3 2 3 4 3 3 3 3 3 4 3 3 2 3 4 2
3
## [2517] 3 3 4 3 3 3 3 2 4 2 3 3 3 2 2 4 4 3 3 3 3 2 2 3 3 3 2 3 3 2 2 2 3 3 2 3
2
## [2554] 3 3 3 3 1 3 3 3 4 3 2 3 3 3 2 3 2 2 3 3 3 3 3 3 2 2 3 3 3 3 3 3 3 3 4 3
4
## [2591] 3 3 3 4 3 3 2 3 2 3 3 3 2 3 3 3 2 3 3 3 3 3 3 3 2 1 3 3 2 3 2 2 4 3 3 2
3
## [2628] 2 2 4 2 3 4 3 2 2 2 2 2 3 3 4 3 4 3 3 4 2 2 2 3 3 3 4 1 2 3 2 4 3 3 2 4
2
## [2665] 2 3 2 2 3 3 2 1 4 2 3 3 2 3 3 3 3 1 3 3 4 3 2 3 3 4 2 3 3 3 3 2 2 3 3 3
2
## [2702] 3 3 3 3 3 3 2 3 3 4 3 4 3 3 3 3 3 2 3 3 3 2 4 3 3 3 4 4 3 2 3 2 2 3 4 3
3
## [2739] 3 3 2 3 3 3 3 3 3 3 3 3 2 3 3 3 2 4 2 3 3 2 3 3 2 3 3 2 2 3 3 3 3 3 2 3
3
## [2776] 3 2 3 4 3 2 3 4 3 2 3 2 3 3 3 2 3 3 3 3 2 2 3 3 3 3 4 3 3 3 4 2 3 2 3 2
3
## [2813] 3 3 3 4 2 2 2 2 3 3 3 3 3 1 3 3 1 3 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2
2
## [2850] 2 4 4 2 4 3 3 2 2 2 2 3 3 3 3 3 3 4 3 2 3
##
## Within cluster sum of squares by cluster:
## [1] 368717.0 562686.5 320013.5 682536.7
##  (between_SS / total_SS =  76.7 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 10 :
## tot.withinss: 1933954
##
## Results for nstart = 50 :
## K-means clustering with 4 clusters of sizes 74, 1746, 761, 289
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             25.056588               95.743243            221.05297
## 2              5.532533                8.128866             15.92806
## 3             11.836407               29.561104             52.97485
## 4             16.849857               59.062284            113.66893
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               9.195324               0.1917935
## 2               3.384698               0.1457553
## 3               3.959407               0.1505239
## 4               5.768671               0.1472687
##
## Clustering vector:
```

```
##     [1] 4 3 2 2 2 2 3 4 2 4 2 2 2 1 3 2 2 2 4 3 4 2 2 2 3 2 3 2 2 4 4 1 2 2 2 2
2
##    [38] 4 4 3 3 3 4 2 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 3 4 2 2 2 2 4 2 4 3 3 3
3
##    [75] 2 2 3 4 4 3 2 3 2 2 2 4 3 2 4 2 3 3 2 2 4 2 2 2 3 3 3 1 2 2 3 3 2 2 2 2
3
##   [112] 2 3 2 3 2 2 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3
2
##   [149] 3 2 2 2 2 2 2 2 2 2 3 2 2 2 3 2 2 2 2 4 2 4 2 2 2 3 3 2 2 2 2 2 2 2 2 2
2
##   [186] 2 4 2 2 2 2 2 4 3 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 4 2
2
##   [223] 2 2 2 2 2 2 2 3 2 2 3 3 2 2 3 2 3 2 1 2 2 2 2 2 4 2 2 2 2 2 2 2 2 2 2 2
2
##   [260] 2 2 2 2 4 2 2 2 2 3 3 2 2 2 2 2 2 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2
2
##   [297] 3 2 3 2 2 3 3 2 3 2 2 2 2 3 2 2 2 2 2 2 2 2 2 3 2 1 2 2 2 2 2 2 3 2 2 3
2
##   [334] 2 2 2 2 2 2 2 2 3 2 2 2 2 2 2 3 4 2 2 2 4 2 2 3 2 4 2 2 2 2 3 2 2 3 2 4
3
##   [371] 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 2 2 2 4 2 2 2 2 2 2 3 3 2 2 2 2 2 2 2 2 2
3
##   [408] 3 2 2 2 2 2 2 3 2 2 2 4 2 2 2 2 2 3 2 2 3 2 3 2 2 2 2 3 3 2 3 3 3 3 4 2
2
##   [445] 2 2 2 3 2 3 2 3 2 2 2 2 3 2 3 2 2 3 2 2 2 4 2 3 3 2 4 2 3 2 3 2 4 2 3 2
2
##   [482] 2 2 2 3 2 2 1 2 3 2 2 4 3 2 3 2 2 3 2 4 3 2 3 3 3 2 2 4 3 2 2 2 2 2 3 2
2
##   [519] 2 2 2 2 2 3 2 2 2 3 2 2 3 2 2 4 3 2 2 3 2 2 2 4 2 2 2 2 2 2 2 2 3 2 2 2
2
##   [556] 2 4 2 3 3 2 2 2 2 2 2 2 2 2 4 2 2 2 2 2 3 4 2 2 2 2 3 2 3 2 2 2 2 3 4 2
2
##   [593] 2 3 2 2 3 2 3 3 1 2 2 3 2 2 2 2 3 3 3 3 3 4 2 2 2 3 2 2 2 2 2 2 2 2 3 3
2
##   [630] 2 2 3 3 2 2 2 3 3 4 2 3 2 2 3 3 2 4 4 2 3 2 2 3 4 4 4 4 2 2 3 4 3 3 2 3
4
##   [667] 3 2 2 2 4 3 4 3 3 2 2 3 2 3 3 3 2 4 3 3 1 2 2 4 4 2 4 2 2 2 2 2 2 2 2 3
1
##   [704] 3 4 3 3 1 4 3 2 1 4 2 4 2 3 2 4 4 3 4 2 4 3 4 2 3 3 3 2 1 2 3 3 3 3 2 3
2
##   [741] 3 4 3 2 2 3 2 3 2 3 2 4 2 4 3 3 2 4 3 2 3 2 1 3 3 2 2 3 3 3 2 2 4 4 2 2
2
##   [778] 2 2 3 4 3 2 2 3 2 3 3 2 2 4 1 2 2 2 2 2 1 4 3 3 2 4 1 1 3 1 2 3 2 2 2 3
3
##   [815] 2 4 2 4 1 2 2 4 3 2 4 3 2 2 1 3 1 4 1 3 3 4 4 3 3 3 3 3 3 3 2 3 2 3 3 3
2
##   [852] 2 2 3 2 2 2 3 3 4 3 2 4 2 4 3 3 2 3 2 2 2 1 3 3 3 4 4 4 2 4 3 3 2 2 3 2
2
##   [889] 4 2 3 3 3 2 4 2 2 2 2 2 3 2 3 2 2 3 2 2 3 2 4 2 3 4 2 2 2 2 2 3 2 4 2 2
3
```

```
##  [926] 3 2 4 2 3 2 3 2 2 2 2 2 3 3 2 3 2 3 2 3 3 1 3 4 2 4 2 4 1 3 2 1 3 2 2 3
2
##  [963] 2 3 2 2 4 3 3 2 4 2 3 2 2 2 4 2 2 2 2 3 2 3 3 3 2 2 2 2 4 3 3 2 4 2 2 3
2
## [1000] 3 2 3 2 2 2 2 2 2 2 2 2 4 3 3 4 3 3 2 2 2 2 2 3 3 2 2 4 2 3 2 2 2 2 2 4
3
## [1037] 1 2 4 3 3 4 3 3 3 2 2 3 2 2 3 3 2 2 3 2 1 2 3 2 2 2 3 2 3 3 3 2 3 2 2 3
2
## [1074] 2 2 2 2 3 2 3 3 3 2 2 2 3 2 3 4 3 2 2 4 3 2 2 2 3 3 2 2 2 1 2 2 2 2 4 4
2
## [1111] 3 2 2 2 3 3 2 2 2 3 2 2 2 3 2 2 3 3 2 2 2 2 3 2 3 2 2 2 3 2 3 2 2 2 2 3
2
## [1148] 2 2 2 3 4 3 2 2 2 2 3 2 2 3 2 2 2 3 2 2 3 2 2 2 2 4 2 3 2 2 3 4 2 2 2 3
3
## [1185] 2 2 2 3 3 3 2 2 4 2 3 3 3 2 2 2 4 3 2 2 2 3 3 2 2 2 2 2 3 2 1 2 3 3 2 2
3
## [1222] 2 3 3 2 2 2 3 2 2 2 2 2 3 2 3 4 2 2 3 2 3 2 4 2 3 2 3 3 4 2 3 2 2 2 3 3
3
## [1259] 2 2 3 2 3 3 2 2 2 2 2 2 2 3 2 2 2 3 2 2 3 2 2 2 2 2 2 4 4 2 2 3 2 2 3 3
1
## [1296] 3 2 2 2 2 2 3 2 2 2 2 2 3 2 2 3 3 3 4 3 4 2 2 2 2 2 2 2 3 4 3 2 2 2 2 3
3
## [1333] 3 2 3 2 3 2 2 3 4 3 2 2 2 3 2 4 3 2 2 2 3 2 3 3 3 4 1 3 3 2 3 3 2 2 3 2
2
## [1370] 2 3 2 2 4 2 3 3 2 1 3 2 1 2 2 3 2 3 2 3 3 2 4 2 3 3 2 2 2 4 3 2 3 2 2 2
2
## [1407] 3 2 3 2 3 3 3 2 2 2 2 2 2 3 4 2 2 2 3 3 2 3 2 4 3 2 4 3 2 3 3 4 3 2 4 1
2
## [1444] 2 2 3 2 3 2 3 2 2 2 2 3 4 2 2 2 2 2 2 3 2 2 1 2 2 2 2 4 3 2 2 2 2 4 2 2
2
## [1481] 2 3 3 3 4 2 3 2 2 3 3 2 2 3 2 2 2 3 2 2 2 3 4 3 4 4 2 2 2 2 2 2 2 3 2 2
2
## [1518] 2 3 2 2 2 2 2 2 3 3 3 2 2 2 2 2 2 3 2 2 4 2 2 2 2 2 3 4 2 2 2 2 2 2 3 2
3
## [1555] 3 3 2 2 3 3 2 2 2 2 2 3 2 3 1 4 2 2 2 3 3 3 2 2 2 4 2 3 2 2 3 2 4 2 4 2
2
## [1592] 3 2 2 3 2 2 2 4 2 2 2 2 2 1 2 2 4 2 4 2 3 2 3 3 2 3 3 2 2 2 1 2 2 2 3 2
3
## [1629] 4 2 3 3 4 2 4 3 2 2 2 1 2 4 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 4 2 2 2
2
## [1666] 2 2 3 2 1 2 2 3 3 2 2 2 2 4 4 2 1 2 2 3 2 4 2 2 2 2 4 3 2 4 2 3 3 2 2 2
3
## [1703] 3 2 3 3 2 2 3 2 2 2 2 1 2 4 3 3 1 4 2 3 3 2 2 2 2 3 3 1 4 4 2 3 3 2 2 3
2
## [1740] 4 4 3 4 3 3 3 2 4 2 4 2 2 2 3 4 2 2 2 2 2 3 4 3 3 3 2 2 2 4 3 2 2 2 2 2
2
## [1777] 2 2 2 3 1 4 2 3 2 3 4 4 3 2 2 3 4 2 2 2 2 3 2 2 3 3 2 3 2 2 2 2 2 2 2 2
2
## [1814] 3 2 2 2 2 4 2 2 2 2 2 2 3 3 4 2 2 2 2 4 3 2 2 3 2 2 2 3 3 2 2 4 2 4 3 2
2
```

```
## [1851] 2 2 2 3 3 2 2 2 2 2 2 3 2 4 3 3 2 2 2 3 3 2 4 3 2 2 2 2 2 1 3 2 4 2 2 3
3
## [1888] 4 4 2 1 2 2 2 2 2 2 2 3 3 3 3 2 4 2 2 2 2 2 3 2 2 2 3 2 3 3 2 2 4 2 3 2
2
## [1925] 3 2 4 2 2 3 2 3 2 3 2 2 2 2 4 2 2 4 2 3 3 2 3 4 4 2 2 3 2 2 2 2 3 3 3 3
2
## [1962] 2 2 2 2 2 3 2 2 2 1 2 3 2 2 3 3 2 4 2 3 1 2 2 2 2 3 2 2 2 2 2 3 2 2 2 3
2
## [1999] 2 1 1 2 2 4 2 2 4 3 3 3 3 2 2 2 4 3 2 2 3 2 3 3 3 3 2 3 1 2 2 2 2 3 3 2
2
## [2036] 2 2 2 2 2 2 2 2 2 3 2 4 2 2 2 4 2 4 2 2 3 2 2 2 3 4 2 3 2 2 2 2 3 2 2 1
3
## [2073] 2 3 3 3 2 2 3 3 2 2 2 2 2 4 3 3 4 4 2 4 2 3 2 4 2 2 3 3 2 2 2 3 2 2 3 2
2
## [2110] 2 4 2 2 2 2 3 3 2 2 3 2 2 3 3 1 2 4 2 2 2 2 3 2 2 3 2 3 2 2 2 2 2 2 3 4
3
## [2147] 2 3 3 2 3 3 2 2 2 3 2 2 3 2 2 2 2 2 2 2 3 2 2 2 2 3 3 3 3 2 2 2 2 2 2 2
3
## [2184] 2 2 2 2 2 2 3 3 2 2 3 2 4 2 2 2 2 2 2 4 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2
2
## [2221] 2 3 2 1 2 2 2 2 2 2 3 3 3 2 1 2 4 3 2 4 3 2 2 2 2 3 2 2 2 3 2 3 4 2 2 2
2
## [2258] 3 3 2 3 3 2 2 2 2 2 2 2 2 2 3 2 2 4 3 2 3 2 2 3 2 2 4 4 2 2 3 3 3 1 2 4
3
## [2295] 3 2 2 3 2 2 2 2 1 3 2 3 3 3 2 4 3 2 2 2 2 2 4 2 4 4 2 2 2 3 3 2 2 2 1 2
3
## [2332] 2 2 3 2 2 2 3 2 2 2 2 3 2 3 2 4 2 3 4 3 2 3 2 3 3 2 2 2 3 4 3 2 3 2 3 2
2
## [2369] 2 2 2 4 2 2 4 2 2 2 2 2 2 4 2 3 2 3 2 2 2 2 3 2 3 2 3 2 3 2 2 4 2 2 2 2
4
## [2406] 1 2 2 3 2 2 3 1 3 3 2 3 2 2 2 2 2 2 2 3 2 3 2 3 2 2 3 2 3 2 2 4 2 2 2 2
2
## [2443] 3 3 4 3 4 3 2 2 2 2 2 1 2 2 2 3 3 2 2 3 2 4 2 2 2 3 1 2 3 2 2 3 4 2 2 2
3
## [2480] 4 4 3 2 4 2 2 4 2 3 3 2 2 2 4 2 4 2 3 2 2 3 2 4 2 2 2 2 2 4 2 2 3 2 4 3
2
## [2517] 2 2 4 2 2 2 2 3 4 3 2 2 2 3 3 4 4 2 2 2 2 3 3 2 2 2 3 2 2 3 3 3 2 2 3 2
3
## [2554] 2 2 2 2 1 2 2 2 4 2 3 2 2 2 3 2 3 3 2 2 2 2 2 2 3 3 2 2 2 2 2 2 2 2 4 2
4
## [2591] 2 2 2 4 2 2 3 2 3 2 2 2 3 2 2 2 3 2 2 2 2 2 2 2 3 1 2 2 3 2 3 3 4 2 2 3
2
## [2628] 3 3 4 3 2 4 2 3 3 3 3 3 2 2 4 2 4 2 2 4 3 3 3 2 2 2 4 1 3 2 3 4 2 2 3 4
3
## [2665] 3 2 3 3 2 2 3 1 4 3 2 2 3 2 2 2 2 1 2 2 4 2 3 2 2 4 3 2 2 2 2 3 3 2 2 2
3
## [2702] 2 2 2 2 2 2 3 2 2 4 2 4 2 2 2 2 2 3 2 2 2 3 4 2 2 2 4 4 2 3 2 3 3 2 4 2
2
## [2739] 2 2 3 2 2 2 2 2 2 2 2 2 3 2 2 2 3 4 3 2 2 3 2 2 3 2 2 3 3 2 2 2 2 2 3 2
2
```

```
## [2776] 2 3 2 4 2 3 2 4 2 3 2 3 2 2 2 3 2 2 2 2 3 3 2 2 2 2 4 2 2 2 4 3 2 3 2 3
2
## [2813] 2 2 2 4 3 3 3 3 2 2 2 2 2 1 2 2 1 2 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3
3
## [2850] 3 4 4 3 4 2 2 3 3 3 3 2 2 2 2 2 2 4 2 3 2
##
## Within cluster sum of squares by cluster:
## [1] 368717.0 320013.5 562686.5 682536.7
##  (between_SS / total_SS =  76.7 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 50 :
## tot.withinss: 1933954
##
## Results for nstart = 100 :
## K-means clustering with 4 clusters of sizes 74, 289, 1746, 761
##
## Cluster means:
##   new_data.Avg_Quantity new_data.Total_Quantity new_data.total_value
## 1             25.056588               95.743243            221.05297
## 2             16.849857               59.062284            113.66893
## 3              5.532533                8.128866             15.92806
## 4             11.836407               29.561104             52.97485
##   new_data.Avg_UnitPrice new_data.Avg_ReturnRate
## 1               9.195324               0.1917935
## 2               5.768671               0.1472687
## 3               3.384698               0.1457553
## 4               3.959407               0.1505239
##
## Clustering vector:
##    [1] 2 4 3 3 3 3 4 2 3 2 3 3 3 1 4 3 3 3 2 4 2 3 3 3 4 3 4 3 3 2 2 1 3 3 3 3
3
##   [38] 2 2 4 4 4 2 3 4 4 3 3 3 3 3 3 3 3 3 3 3 3 3 1 3 4 2 3 3 3 3 2 3 2 4 4 4
4
##   [75] 3 3 4 2 2 4 3 4 3 3 3 2 4 3 2 3 4 4 3 3 2 3 3 3 4 4 4 1 3 3 4 4 3 3 3 3
4
##  [112] 3 4 3 4 3 3 3 3 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4
3
##  [149] 4 3 3 3 3 3 3 3 3 3 4 3 3 3 4 3 3 3 3 2 3 2 3 3 3 4 4 3 3 3 3 3 3 3 3 3
3
##  [186] 3 2 3 3 3 3 3 2 4 3 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4 3 2 3
3
##  [223] 3 3 3 3 3 3 3 4 3 3 4 4 3 3 4 3 4 3 1 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3
3
##  [260] 3 3 3 3 2 3 3 3 3 4 4 3 3 3 3 3 3 3 3 3 3 1 3 1 3 3 3 3 3 3 3 3 3 3 3 3
3
```

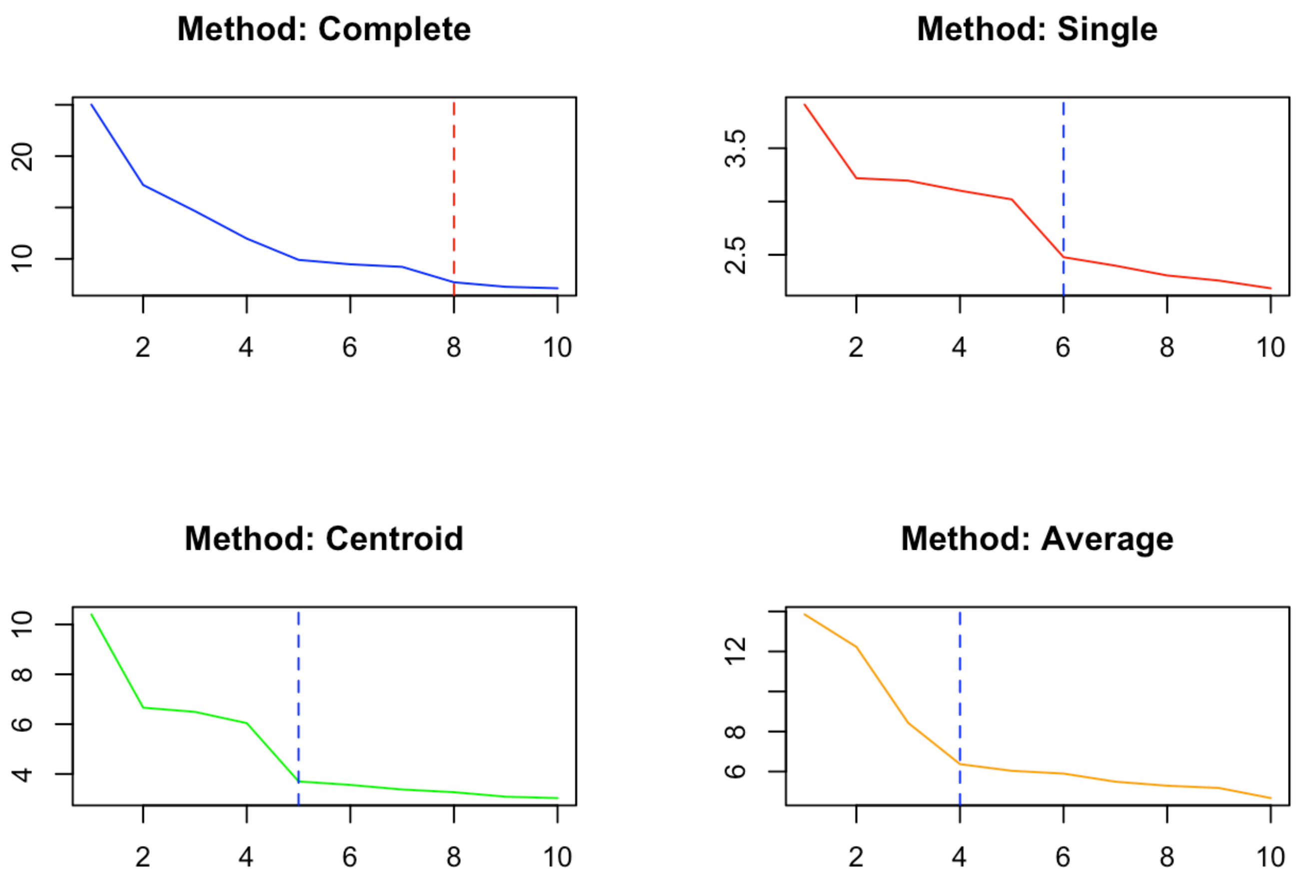
```
##  [297] 4 3 4 3 3 4 4 3 4 3 3 3 3 4 3 3 3 3 3 3 3 3 3 4 3 1 3 3 3 3 3 3 4 3 3 4
3
##  [334] 3 3 3 3 3 3 3 3 4 3 3 3 3 3 4 2 3 3 3 2 3 3 4 3 2 3 3 3 3 4 3 3 4 3 2
4
##  [371] 3 3 3 3 3 3 3 3 3 3 3 4 3 3 3 3 3 3 2 3 3 3 3 3 3 4 4 3 3 3 3 3 3 3 3 3
4
##  [408] 4 3 3 3 3 3 3 4 3 3 3 2 3 3 3 3 3 4 3 3 4 3 4 3 3 3 3 4 4 3 4 4 4 4 2 3
3
##  [445] 3 3 3 4 3 4 3 4 3 3 3 3 4 3 4 3 3 4 3 3 3 2 3 4 4 3 2 3 4 3 4 3 2 3 4 3
3
##  [482] 3 3 3 4 3 3 1 3 4 3 3 2 4 3 4 3 3 4 3 2 4 3 4 4 4 3 3 2 4 3 3 3 3 3 4 3
3
##  [519] 3 3 3 3 3 4 3 3 3 4 3 3 4 3 3 2 4 3 3 4 3 3 3 2 3 3 3 3 3 3 3 3 4 3 3 3
3
##  [556] 3 2 3 4 4 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3 4 2 3 3 3 3 4 3 4 3 3 3 3 4 2 3
3
##  [593] 3 4 3 3 4 3 4 4 1 3 3 4 3 3 3 3 4 4 4 4 4 2 3 3 3 4 3 3 3 3 3 3 3 3 4 4
3
##  [630] 3 3 4 4 3 3 3 4 4 2 3 4 3 3 4 4 3 2 2 3 4 3 3 4 2 2 2 2 3 3 4 2 4 4 3 4
2
##  [667] 4 3 3 3 2 4 2 4 4 3 3 4 3 4 4 4 3 2 4 4 1 3 3 2 2 3 2 3 3 3 3 3 3 3 3 4
1
##  [704] 4 2 4 4 1 2 4 3 1 2 3 2 3 4 3 2 2 4 2 3 2 4 2 3 4 4 4 3 1 3 4 4 4 4 3 4
3
##  [741] 4 2 4 3 3 4 3 4 3 4 3 2 3 2 4 4 3 2 4 3 4 3 1 4 4 3 3 4 4 4 3 3 2 2 3 3
3
##  [778] 3 3 4 2 4 3 3 4 3 4 4 3 3 2 1 3 3 3 3 3 1 2 4 4 3 2 1 1 4 1 3 4 3 3 3 4
4
##  [815] 3 2 3 2 1 3 3 2 4 3 2 4 3 3 1 4 1 2 1 4 4 2 2 4 4 4 4 4 4 4 3 4 3 4 4 4
3
##  [852] 3 3 4 3 3 3 4 4 2 4 3 2 3 2 4 4 3 4 3 3 3 1 4 4 4 2 2 2 3 2 4 4 3 3 4 3
3
##  [889] 2 3 4 4 4 3 2 3 3 3 3 3 4 3 4 3 3 4 3 3 4 3 2 3 4 2 3 3 3 3 3 4 3 2 3 3
4
##  [926] 4 3 2 3 4 3 4 3 3 3 3 3 4 4 3 4 3 4 3 4 4 1 4 2 3 2 3 2 1 4 3 1 4 3 3 4
3
##  [963] 3 4 3 3 2 4 4 3 2 3 4 3 3 3 2 3 3 3 3 4 3 4 4 4 3 3 3 3 2 4 4 3 2 3 3 4
3
## [1000] 4 3 4 3 3 3 3 3 3 3 3 3 2 4 4 2 4 4 3 3 3 3 3 4 4 3 3 2 3 4 3 3 3 3 3 2
4
## [1037] 1 3 2 4 4 2 4 4 4 3 3 4 3 3 4 4 3 3 4 3 1 3 4 3 3 3 4 3 4 4 4 3 4 3 3 4
3
## [1074] 3 3 3 3 4 3 4 4 4 3 3 3 4 3 4 2 4 3 3 2 4 3 3 3 4 4 3 3 3 1 3 3 3 3 2 2
3
## [1111] 4 3 3 3 4 4 3 3 3 4 3 3 3 4 3 3 4 4 3 3 3 3 4 3 4 3 3 3 4 3 4 3 3 3 3 4
3
## [1148] 3 3 3 4 2 4 3 3 3 3 4 3 3 4 3 3 3 4 3 3 4 3 3 3 3 2 3 4 3 3 4 2 3 3 3 4
4
## [1185] 3 3 3 4 4 4 3 3 2 3 4 4 4 3 3 3 2 4 3 3 3 4 4 3 3 3 3 3 4 3 1 3 4 4 3 3
4
```

```
## [1222] 3 4 4 3 3 3 4 3 3 3 3 3 4 3 4 2 3 3 4 3 4 3 2 3 4 3 4 4 2 3 4 3 3 3 4 4
4
## [1259] 3 3 4 3 4 4 3 3 3 3 3 3 3 4 3 3 3 4 3 3 4 3 3 3 3 3 3 2 2 3 3 4 3 3 4 4
1
## [1296] 4 3 3 3 3 3 4 3 3 3 3 3 4 3 3 4 4 4 2 4 2 3 3 3 3 3 3 3 4 2 4 3 3 3 3 4
4
## [1333] 4 3 4 3 4 3 3 4 2 4 3 3 3 4 3 2 4 3 3 3 4 3 4 4 4 2 1 4 4 3 4 4 3 3 4 3
3
## [1370] 3 4 3 3 2 3 4 4 3 1 4 3 1 3 3 4 3 4 3 4 4 3 2 3 4 4 3 3 3 2 4 3 4 3 3 3
3
## [1407] 4 3 4 3 4 4 4 3 3 3 3 3 3 4 2 3 3 3 4 4 3 4 3 2 4 3 2 4 3 4 4 2 4 3 2 1
3
## [1444] 3 3 4 3 4 3 4 3 3 3 3 4 2 3 3 3 3 3 3 4 3 3 1 3 3 3 3 2 4 3 3 3 3 2 3 3
3
## [1481] 3 4 4 4 2 3 4 3 3 4 4 3 3 4 3 3 3 4 3 3 3 4 2 4 2 2 3 3 3 3 3 3 3 4 3 3
3
## [1518] 3 4 3 3 3 3 3 3 4 4 4 3 3 3 3 3 3 4 3 3 2 3 3 3 3 3 4 2 3 3 3 3 3 3 4 3
4
## [1555] 4 4 3 3 4 4 3 3 3 3 3 4 3 4 1 2 3 3 3 4 4 4 3 3 3 2 3 4 3 3 4 3 2 3 2 3
3
## [1592] 4 3 3 4 3 3 3 2 3 3 3 3 3 1 3 3 2 3 2 3 4 3 4 4 3 4 4 3 3 3 1 3 3 3 4 3
4
## [1629] 2 3 4 4 2 3 2 4 3 3 3 1 3 2 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3
3
## [1666] 3 3 4 3 1 3 3 4 4 3 3 3 3 2 2 3 1 3 3 4 3 2 3 3 3 3 2 4 3 2 3 4 4 3 3 3
4
## [1703] 4 3 4 4 3 3 4 3 3 3 3 1 3 2 4 4 1 2 3 4 4 3 3 3 3 4 4 1 2 2 3 4 4 3 3 4
3
## [1740] 2 2 4 2 4 4 4 3 2 3 2 3 3 3 4 2 3 3 3 3 3 4 2 4 4 4 3 3 3 2 4 3 3 3 3 3
3
## [1777] 3 3 3 4 1 2 3 4 3 4 2 2 4 3 3 4 2 3 3 3 3 4 3 3 4 4 3 4 3 3 3 3 3 3 3 3
3
## [1814] 4 3 3 3 3 2 3 3 3 3 3 3 4 4 2 3 3 3 3 2 4 3 3 4 3 3 3 4 4 3 3 2 3 2 4 3
3
## [1851] 3 3 3 4 4 3 3 3 3 3 3 4 3 2 4 4 3 3 3 4 4 3 2 4 3 3 3 3 3 1 4 3 2 3 3 4
4
## [1888] 2 2 3 1 3 3 3 3 3 3 3 4 4 4 4 3 2 3 3 3 3 3 4 3 3 3 4 3 4 4 3 3 2 3 4 3
3
## [1925] 4 3 2 3 3 4 3 4 3 4 3 3 3 3 2 3 3 2 3 4 4 3 4 2 2 3 3 4 3 3 3 3 4 4 4 4
3
## [1962] 3 3 3 3 3 4 3 3 3 1 3 4 3 3 4 4 3 2 3 4 1 3 3 3 3 4 3 3 3 3 3 4 3 3 3 4
3
## [1999] 3 1 1 3 3 2 3 3 2 4 4 4 4 3 3 3 2 4 3 3 4 3 4 4 4 4 3 4 1 3 3 3 3 4 4 3
3
## [2036] 3 3 3 3 3 3 3 3 3 4 3 2 3 3 3 2 3 2 3 3 4 3 3 3 4 2 3 4 3 3 3 3 4 3 3 1
4
## [2073] 3 4 4 4 3 3 4 4 3 3 3 3 3 2 4 4 2 2 3 2 3 4 3 2 3 3 4 4 3 3 3 4 3 3 4 3
3
## [2110] 3 2 3 3 3 3 4 4 3 3 4 3 3 4 4 1 3 2 3 3 3 3 4 3 3 4 3 4 3 3 3 3 3 3 4 2
4
```

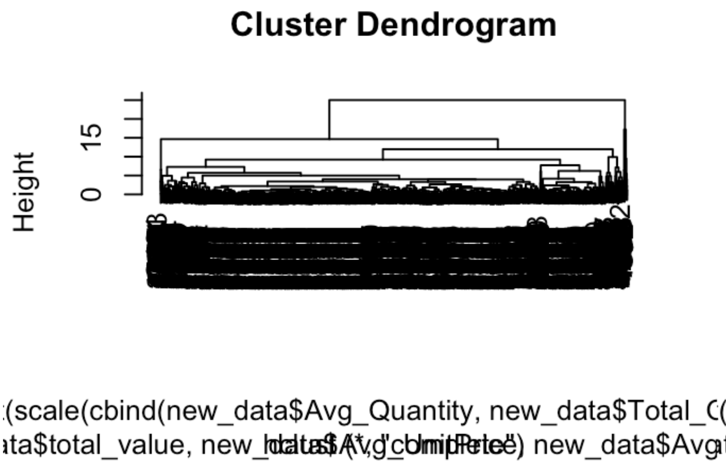
```
## [2147] 3 4 4 3 4 4 3 3 3 4 3 3 4 3 3 3 3 3 3 3 4 3 3 3 3 4 4 4 4 3 3 3 3 3 3 3
4
## [2184] 3 3 3 3 3 3 4 4 3 3 4 3 2 3 3 3 3 3 3 2 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3
3
## [2221] 3 4 3 1 3 3 3 3 3 3 4 4 4 3 1 3 2 4 3 2 4 3 3 3 3 4 3 3 3 4 3 4 2 3 3 3
3
## [2258] 4 4 3 4 4 3 3 3 3 3 3 3 3 3 4 3 3 2 4 3 4 3 3 4 3 3 2 2 3 3 4 4 4 1 3 2
4
## [2295] 4 3 3 4 3 3 3 3 1 4 3 4 4 4 3 2 4 3 3 3 3 3 2 3 2 2 3 3 3 4 4 3 3 3 1 3
4
## [2332] 3 3 4 3 3 3 4 3 3 3 3 4 3 4 3 2 3 4 2 4 3 4 3 4 4 3 3 3 4 2 4 3 4 3 4 3
3
## [2369] 3 3 3 2 3 3 2 3 3 3 3 3 3 2 3 4 3 4 3 3 3 3 4 3 4 3 4 3 4 3 3 2 3 3 3 3
2
## [2406] 1 3 3 4 3 3 4 1 4 4 3 4 3 3 3 3 3 3 3 4 3 4 3 4 3 3 4 3 4 3 3 2 3 3 3 3
3
## [2443] 4 4 2 4 2 4 3 3 3 3 3 1 3 3 3 4 4 3 3 4 3 2 3 3 3 4 1 3 4 3 3 4 2 3 3 3
4
## [2480] 2 2 4 3 2 3 3 2 3 4 4 3 3 3 2 3 2 3 4 3 3 4 3 2 3 3 3 3 3 2 3 3 4 3 2 4
3
## [2517] 3 3 2 3 3 3 3 4 2 4 3 3 3 4 4 2 2 3 3 3 3 4 4 3 3 3 4 3 3 4 4 4 3 3 4 3
4
## [2554] 3 3 3 3 1 3 3 3 2 3 4 3 3 3 4 3 4 4 3 3 3 3 3 3 4 4 3 3 3 3 3 3 3 3 2 3
2
## [2591] 3 3 3 2 3 3 4 3 4 3 3 3 4 3 3 3 4 3 3 3 3 3 3 3 4 1 3 3 4 3 4 4 2 3 3 4
3
## [2628] 4 4 2 4 3 2 3 4 4 4 4 4 3 3 2 3 2 3 3 2 4 4 4 3 3 3 2 1 4 3 4 2 3 3 4 2
4
## [2665] 4 3 4 4 3 3 4 1 2 4 3 3 4 3 3 3 3 1 3 3 2 3 4 3 3 2 4 3 3 3 3 4 4 3 3 3
4
## [2702] 3 3 3 3 3 3 4 3 3 2 3 2 3 3 3 3 3 4 3 3 3 4 2 3 3 3 2 2 3 4 3 4 4 3 2 3
3
## [2739] 3 3 4 3 3 3 3 3 3 3 3 3 4 3 3 3 4 2 4 3 3 4 3 3 4 3 3 4 4 3 3 3 3 3 4 3
3
## [2776] 3 4 3 2 3 4 3 2 3 4 3 4 3 3 3 4 3 3 3 3 4 4 3 3 3 3 2 3 3 3 3 2 4 3 4 3 4
3
## [2813] 3 3 3 2 4 4 4 4 3 3 3 3 3 1 3 3 1 3 4 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4
4
## [2850] 4 2 2 4 2 3 3 4 4 4 4 3 3 3 3 3 3 2 3 4 3
##
## Within cluster sum of squares by cluster:
## [1] 368717.0 682536.7 320013.5 562686.5
##  (between_SS / total_SS =  76.7 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
## Results for nstart = 100 :
```

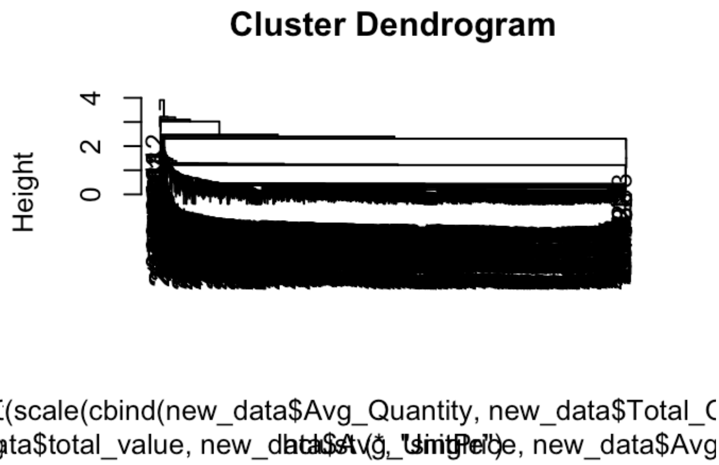
```
## tot.withinss: 1933954
```

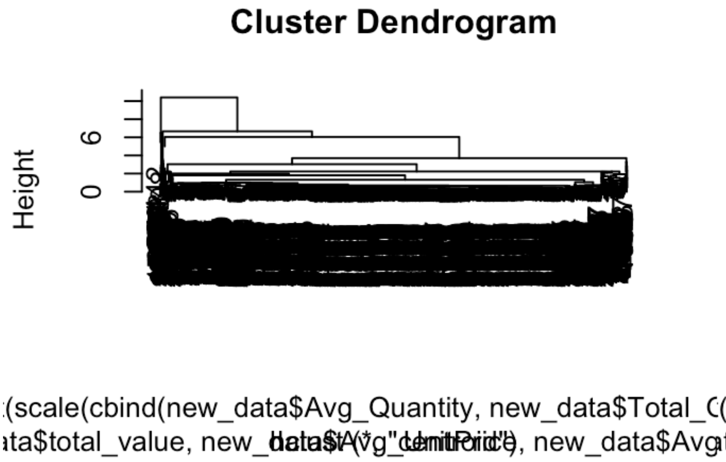
```
optimal_clusters_complete <- 8
optimal_clusters_single <- 6
optimal_clusters_centroid <- 5
optimal_clusters_average <- 4

# Create elbow plots
par(mfrow=c(2,2))

# elbow plot for "complete"
y <- sort(hclust$height, decreasing = TRUE)[1:10]
plot(x, y, type = "l", col = "blue", main = "Method: Complete", xlab = "", ylab =
"")
abline(v = optimal_clusters_complete, col = "red", lty = 2)

# elbow plot for "single"
y1 <- sort(hclust1$height, decreasing = TRUE)[1:10]
plot(x, y1, type = "l", col = "red", main = "Method: Single", xlab = "", ylab = ""
)
abline(v = optimal_clusters_single, col = "blue", lty = 2)

# elbow plot for "centroid"
y2 <- sort(hclust2$height, decreasing = TRUE)[1:10]
plot(x, y2, type = "l", col = "green", main = "Method: Centroid", xlab = "", ylab
= "")
abline(v = optimal_clusters_centroid, col = "blue", lty = 2)

# elbow plot for "average"
y3 <- sort(hclust3$height, decreasing = TRUE)[1:10]
plot(x, y3, type = "l", col = "orange", main = "Method: Average", xlab = "", ylab
= "")
abline(v = optimal_clusters_average, col = "blue", lty = 2)
```

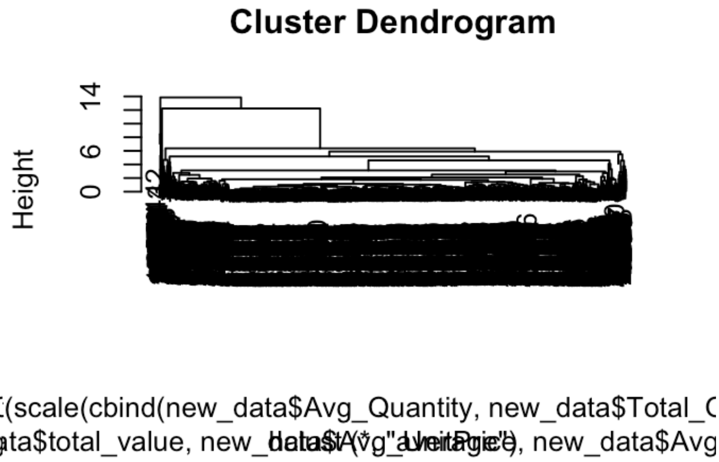



```
#endogram
plot(hclust)
plot(hclust1)
plot(hclust2)
plot(hclust3)
```









Kmeans

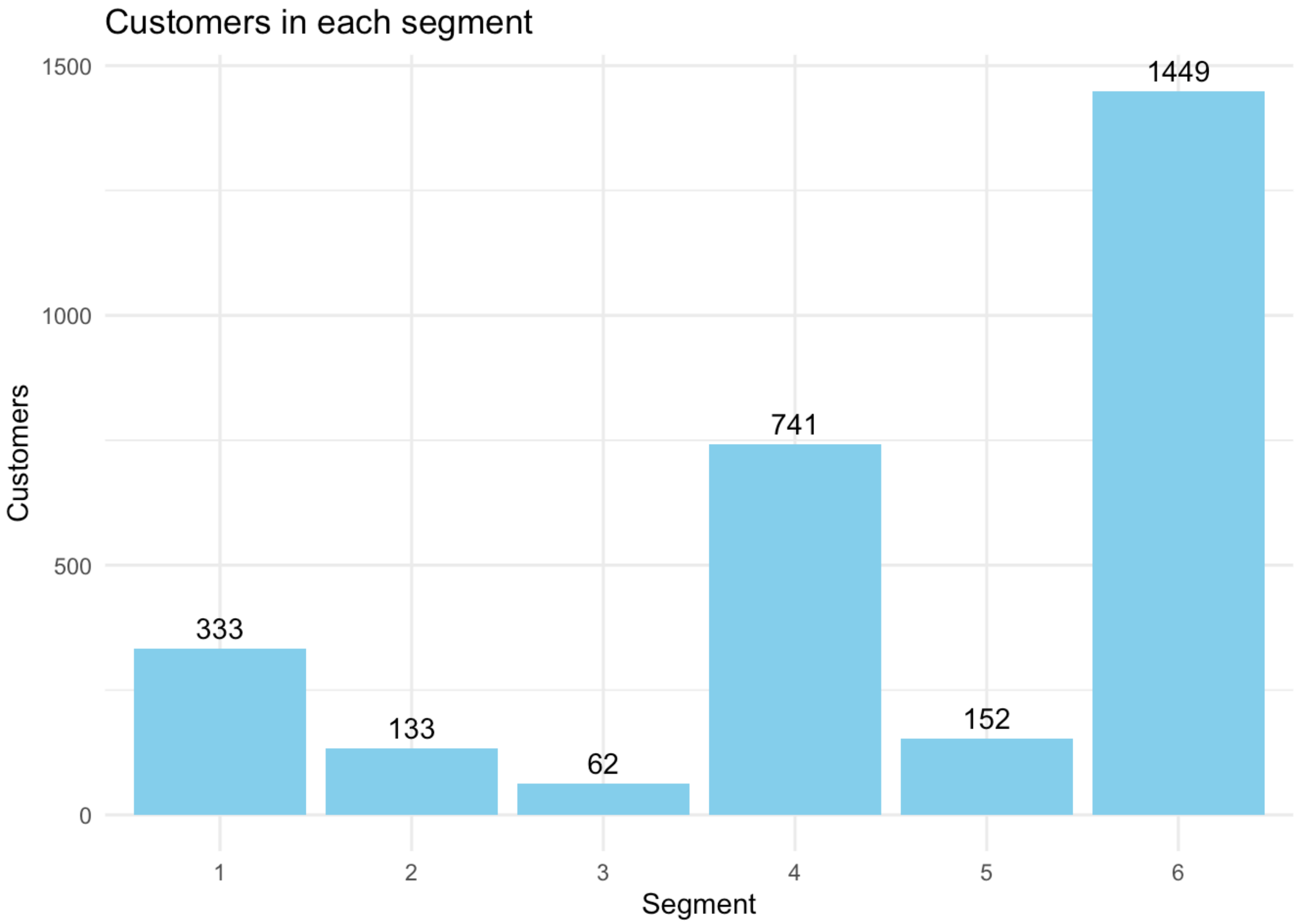
```
##final k mean selection ---


seg_kmeans_final <- kmeans(x = data.frame(new_data$Avg_Quantity, new_data$Total_Qu
antity, new_data$total_value, new_data$Avg_UnitPrice, new_data$Avg_ReturnRate), ce
nters = 6, nstart = 50)
seg_kmeans_final$tot.withinss
```

```
## [1] 1477079
```

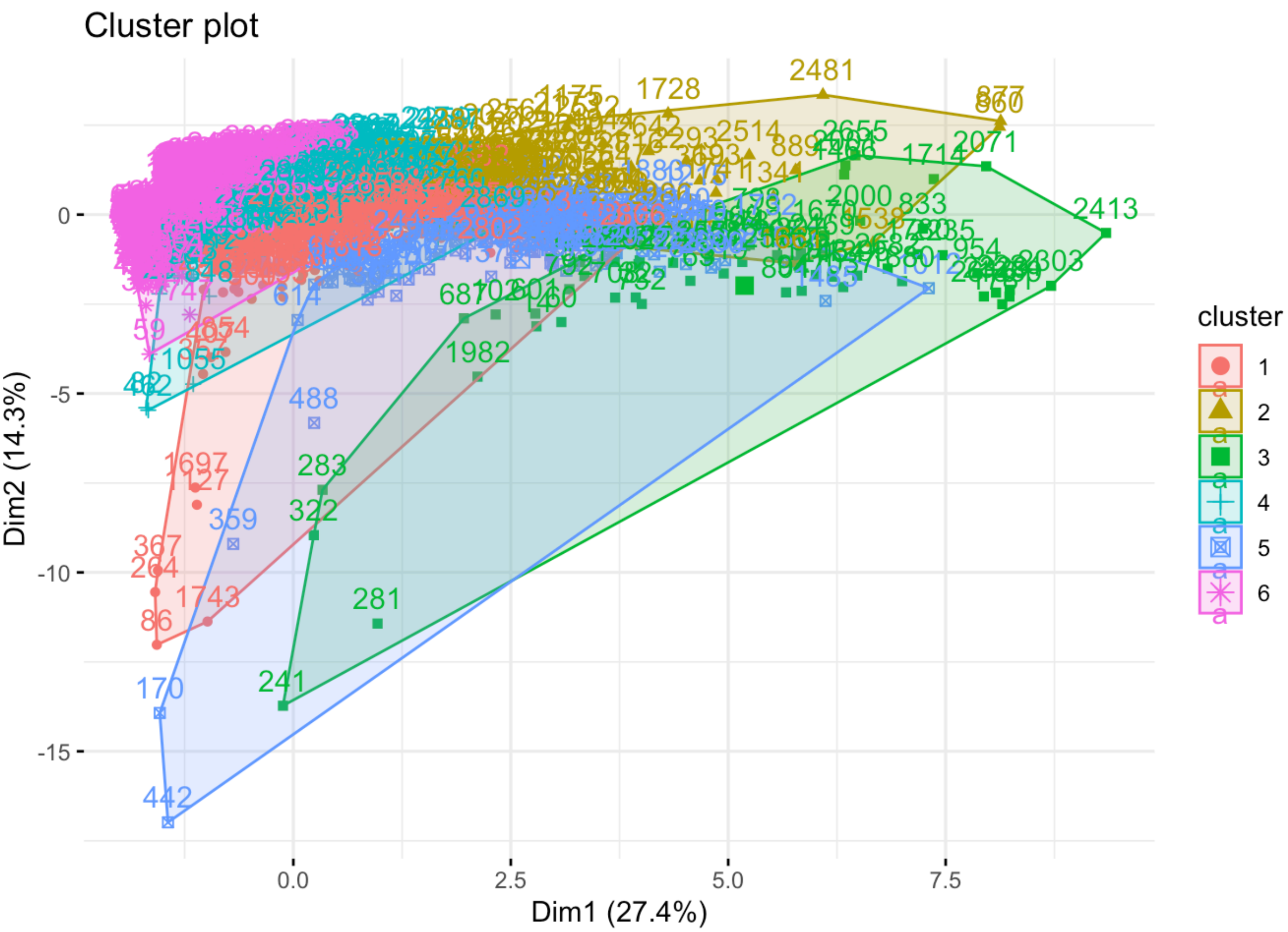
```
segment <- seg_kmeans_final$cluster
segmentation <- cbind(new_data, segment)
table(segmentation$segment)
```

```
##
##    1    2    3    4    5    6
##  333  133   62  741  152 1449
```

```
#visualize the segments
segment_counts <- table(segmentation$segment)
segment_data <- as.data.frame(segment_counts)

names(segment_data) <- c("Segment", "Count")

# Create bar plot
ggplot(segment_data, aes(x = Segment, y = Count)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  geom_text(aes(label = Count), vjust = -0.5) +
  labs(title = "Customers in each segment", x = "Segment", y = "Customers") +
  theme_minimal()
```

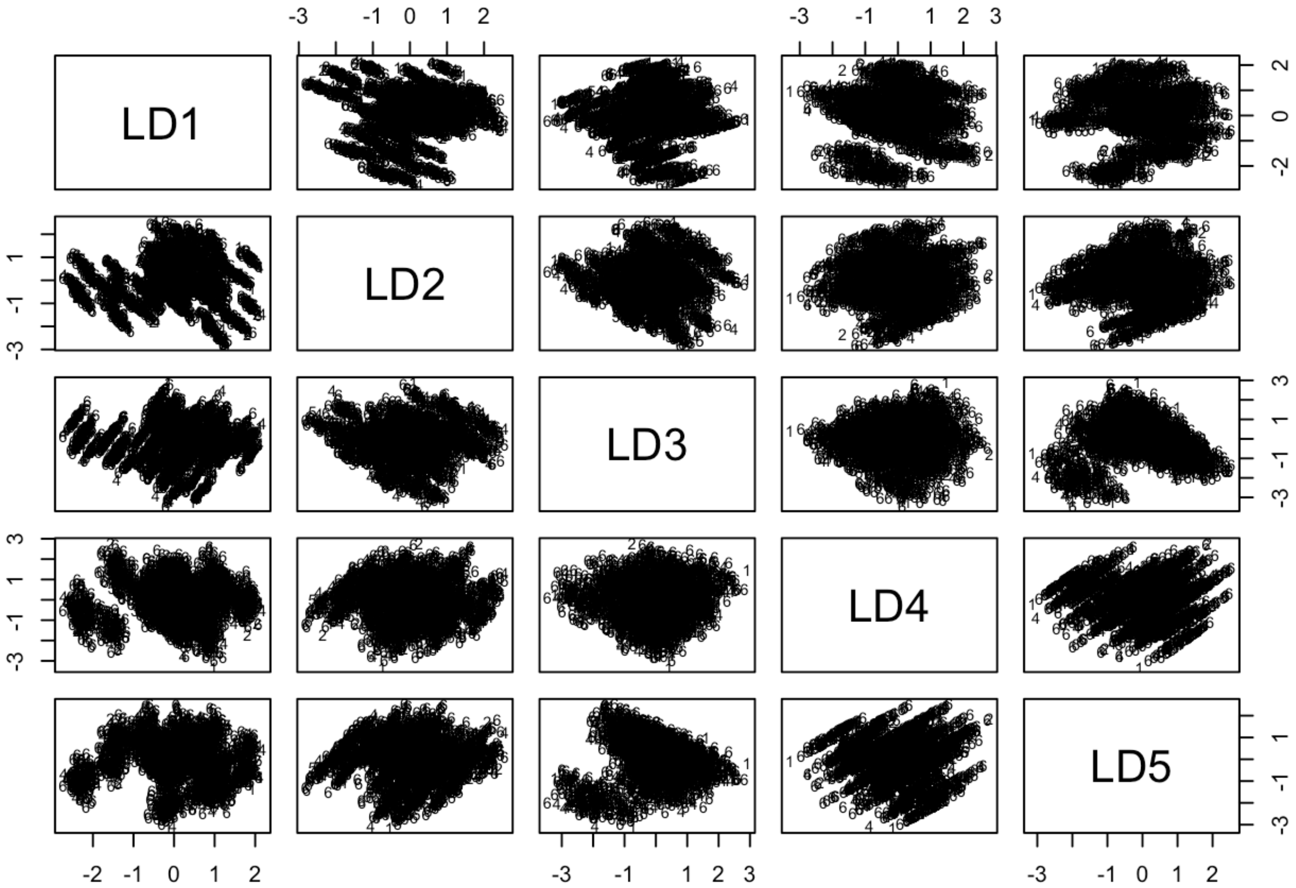



```
library(cluster)
library(factoextra)

new_data_numeric <- new_data[sapply(new_data, is.numeric)]

# clusters visualization
fviz_cluster(seg_kmeans_final, new_data_numeric,
             ggtheme = theme_minimal())
```



LDA (Linear Discriminant Analysis)

```
##duplicate the data set to group the

library(MASS)


segmentation$Work <- as.factor(segmentation$Work)
segmentation$segment <- as.factor(segmentation$segment)

fit <- lda(segment ~ Married + Age + Income + Edcation + Work , data = segmentatio
n)
plot(fit)
```




```
ldapred <- predict(fit, segmentation)

ld <- ldapred$x


anova(lm(ld[,1]~segmentation$segment))
```

	Df <int>	Sum Sq <dbl>	Mean Sq <dbl>	F value <dbl>	Pr(>F) <dbl>
segmentation$segment	5	21.03867	4.207734	4.207734	0.0008197218
Residuals	2864	2864.00000	1.000000	NA	NA

2 rows

```
anova(lm(ld[,2]~segmentation$segment))
```

	Df <int>	Sum Sq <dbl>	Mean Sq <dbl>	F value <dbl>	Pr(>F) <dbl>
segmentation$segment	5	19.57101	3.914202	3.914202	0.001540761

Residuals	2864	2864.00000	1.000000	NA	NA

2 rows

```
anova(lm(ld[,3]~segmentation$segment))
```

	Df <int>	Sum Sq <dbl>	Mean Sq <dbl>	F value <dbl>	Pr(>F) <dbl>
segmentation$segment	5	8.567743	1.713549	1.713549	0.1279808
Residuals	2864	2864.000000	1.000000	NA	NA

2 rows

```
anova(lm(ld[,4]~segmentation$segment))
```

	Df <int>	Sum Sq <dbl>	Mean Sq <dbl>	F value <dbl>	Pr(>F) <dbl>
segmentation$segment	5	7.026431	1.405286	1.405286	0.2190462
Residuals	2864	2864.000000	1.000000	NA	NA

2 rows

```
anova(lm(ld[,5]~segmentation$segment))
```

	Df <int>	Sum Sq <dbl>	Mean Sq <dbl>	F value <dbl>	Pr(>F) <dbl>
segmentation$segment	5	4.292582	0.8585163	0.8585163	0.5082389
Residuals	2864	2864.000000	1.0000000	NA	NA

2 rows

```
pred.seg <- predict(fit)$class


cf<- table(segmentation$segment, ldapred$class)
cf
```

```
##
##         1    2    3    4    5    6
##    1    0    0    0    0    0  333
##    2    0    0    0    0    0  133
##    3    0    0    0    0    0   62
##    4    0    0    0    0    0  741
##    5    0    0    0    0    0  152
##    6    0    0    0    0    0 1449
```

```
#overal accuracy of the predicting model
sum(diag(cf))/nrow(segmentation)
```

```
## [1] 0.504878
```

RFM analysis

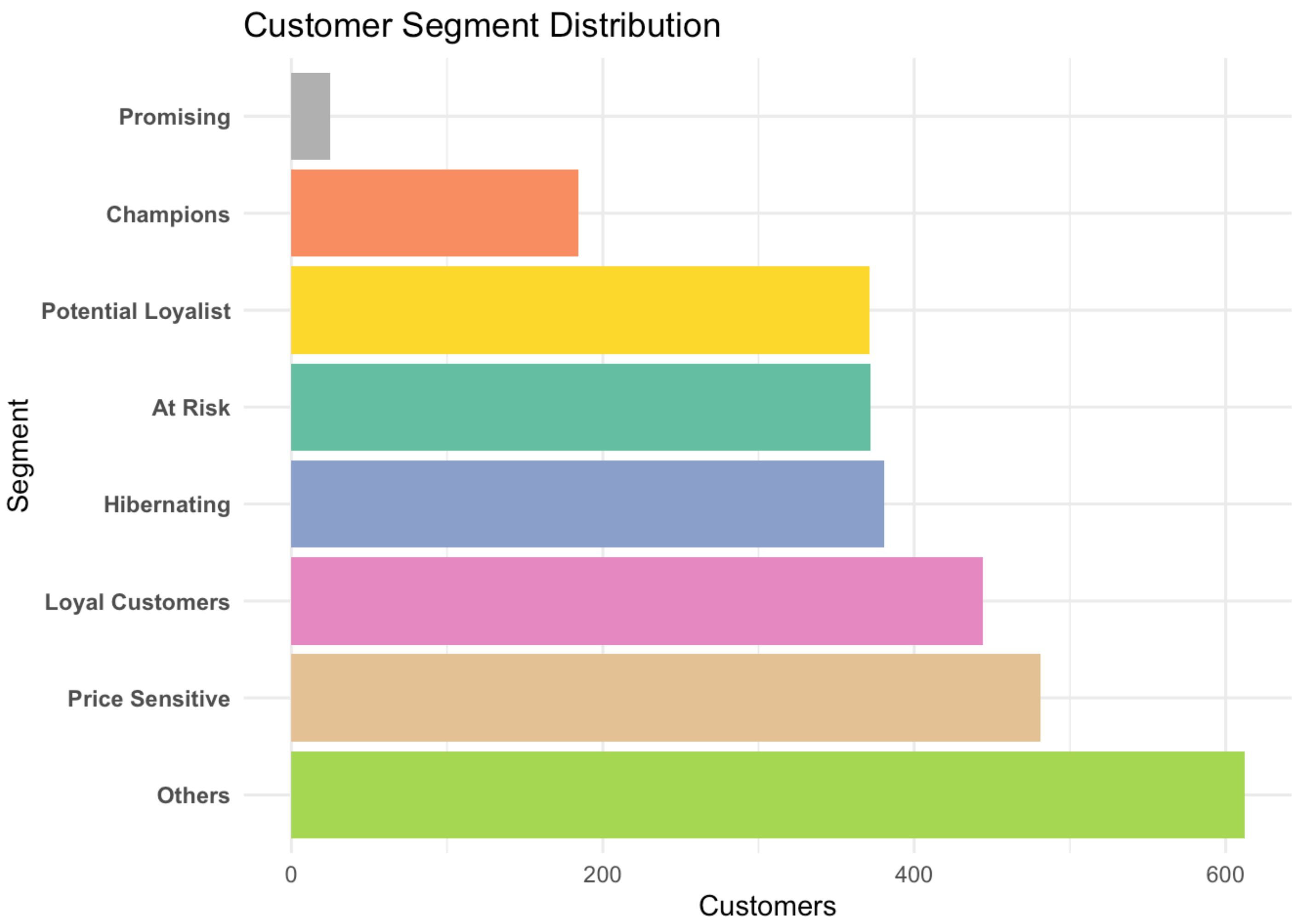
```
data <- data %>%
  mutate(revenue = Quantity * UnitPrice)

rfm <- data

data2 <- data %>%
  filter(!is.na(CustomerID))

rfm <- data %>%
  group_by(CustomerID) %>%
  summarise(
    revenue = sum(revenue),
    number_of_orders = n_distinct(InvoiceNo),
    recency_days = round(as.numeric(difftime(as.POSIXct("2021-11-24 17:06:00 UTC",
format = "%Y-%m-%d %H:%M:%S", tz = "UTC"), max(InvoiceDate), units = "days"))),
    purchase = 1,
    zip_code = get_mode(ZipCode))

groups <- 5

## 5.3 Run RFM Analysis with Independent Sort
rfm$recency_score_indep <- ntile(rfm$recency_days*-1, groups)
rfm$frequency_score_indep <- ntile(rfm$number_of_orders, groups)
rfm$monetary_score_indep <- ntile(rfm$revenue, groups)
rfm$rfm_score_indep <- paste(rfm$recency_score_indep*100 + rfm$frequency_score_ind
ep * 10 + rfm$monetary_score_indep)
rfm$recency_score_seq <- ntile(rfm$recency_days*-1, groups)
r_groups <- NULL; rf_groups <- NULL; temp <- NULL ## Initialize empty matrices

for (r in 1:groups) {
  r_groups[[r]] <- filter(rfm, rfm$recency_score_seq == r)
```

```
  r_groups[[r]]$frequency_score_seq <- ntile(r_groups[[r]]$number_of_orders, group
s)
  for (m in 1:groups) {
    rf_groups[[m]] <- filter(r_groups[[r]], r_groups[[r]]$frequency_score_seq == m
)
    rf_groups[[m]]$monetary_score_seq <- ntile(rf_groups[[m]]$revenue, groups)
    temp <- bind_rows(temp, rf_groups[[m]])
  }
}

rfm_result <- temp[order(temp$CustomerID),]
rfm_result$rfm_score_seq <- paste(rfm_result$recency_score_seq*100 + rfm_result$fr
equency_score_seq * 10 + rfm_result$monetary_score_seq)

## Export RFM Results with Independent and Sequential Sort
#write.csv(rfm_result, "Q:/Marketing Analytics/rfm_results.csv", row.names = FALSE
) ## Name file rfm_result.csv


rfm_result <- data.frame(rfm_result)


##customer segmentation for rfm results
rfm_result <- rfm_result %>%
  mutate(
    Segment2 = case_when(
      recency_score_seq <= 2 & frequency_score_seq >= 4 & monetary_score_seq >= 4
~ "Champions",                 # Best customers
      recency_score_seq <= 3 & frequency_score_seq >= 3 & monetary_score_seq >= 3
~ "Loyal Customers",          # Consistently good customers
      recency_score_seq <= 2 & frequency_score_seq <= 3 & monetary_score_seq <= 3
~ "Potential Loyalist",       # Newer customers with potential
      recency_score_seq >= 4 & frequency_score_seq >= 3 & monetary_score_seq >= 3
~ "At Risk",                  # Good customers at risk of leaving
      recency_score_seq == 1 & frequency_score_seq <= 2 & monetary_score_seq <= 2
~ "New Customers",            # Newest customers
      recency_score_seq <= 3 & frequency_score_seq == 2 & monetary_score_seq == 2
~ "Promising",                # Showing potential but needs nurturing
      recency_score_seq >= 4 & frequency_score_seq <= 2 & monetary_score_seq >= 2
~ "Hibernating",              # Low engagement but still spending
      frequency_score_seq >= 4 & monetary_score_seq <= 2 ~ "Price Sensitive",
# Frequent but low spending
      TRUE ~ "Others"
# Catch-all for any that don't fit above categories
    )
  )

#join rfm table and segmentation table
join <- inner_join(rfm_result, segmentation, by = "CustomerID")
```

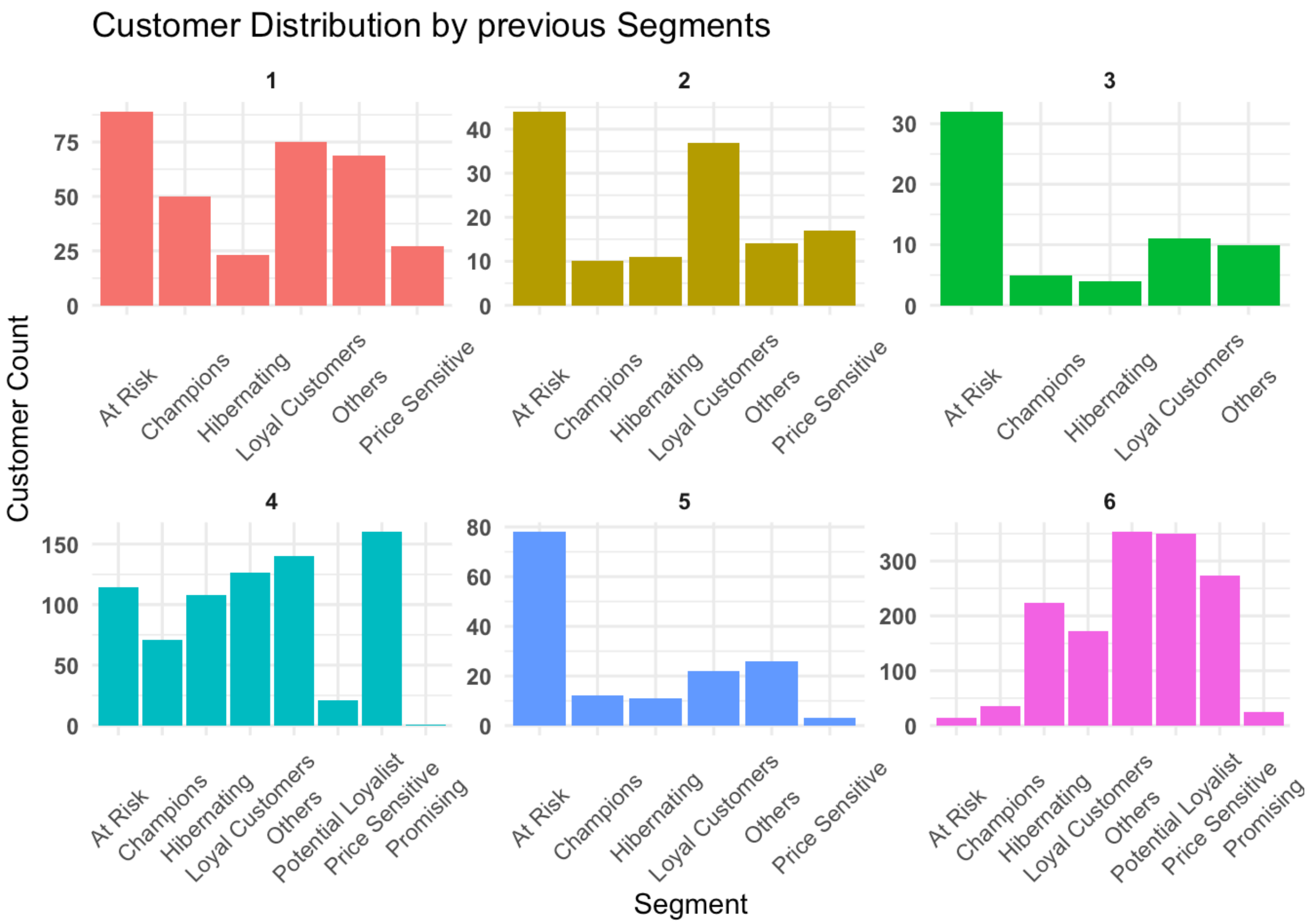
```
segment_counts <- join %>%
  group_by(Segment2) %>%
  summarise(Count = n())


print(segment_counts)
```

```
## # A tibble: 8 × 2
##   Segment2           Count
##   <chr>              <int>
## 1 At Risk              372
## 2 Champions            184
## 3 Hibernating          381
## 4 Loyal Customers      444
## 5 Others               612
## 6 Potential Loyalist   371
## 7 Price Sensitive      481
## 8 Promising             25
```

```
library(ggplot2)



#bar plot of customer segmentation with RFM
ggplot(segment_counts, aes(x = reorder(Segment2, -Count), y = Count, fill = Segmen
t2)) +
  geom_bar(stat = "identity", show.legend = FALSE) +
  theme_minimal() +
  labs(x = "Segment", y = "Customers", title = "Customer Segment Distribution") +
  coord_flip() +
  scale_fill_brewer(palette = "Set2") +
  theme(
    axis.text.y = element_text(face = "bold")
  )
```

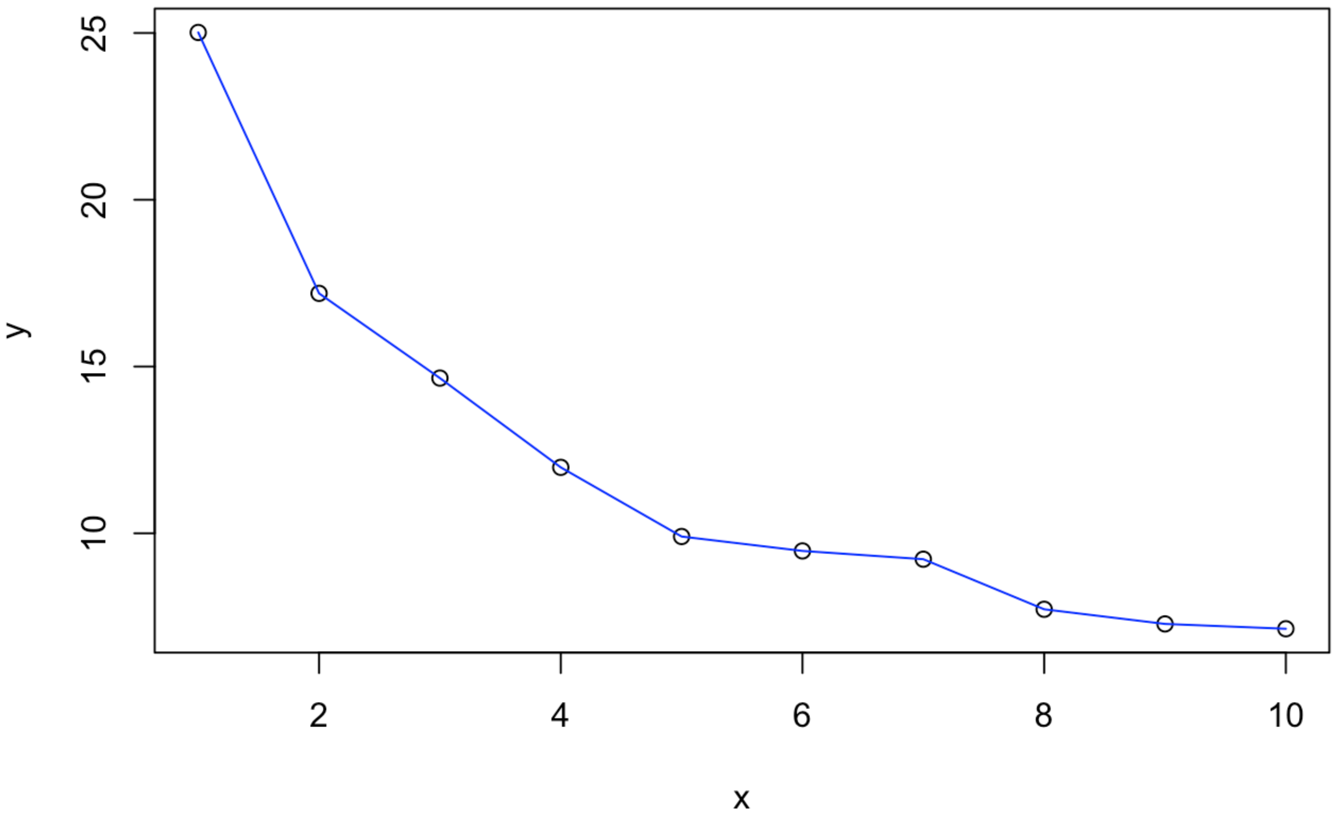



```r
#bar plot of customer combining both types of segmentation done
ggplot(join, aes(x = Segment2, fill = segment)) +
  geom_bar(show.legend = FALSE) +
  theme_minimal() +
  labs(x = "Segment", y = "Customer Count", title = "Customer Distribution by prev
ious Segments") +
  facet_wrap(~ segment, scales = "free") +
  theme(
    strip.text = element_text(face = "bold"),
    axis.text.y = element_text(face = "bold"),
    axis.text.x = element_text(angle = 45, vjust = 0.5)
  )
```

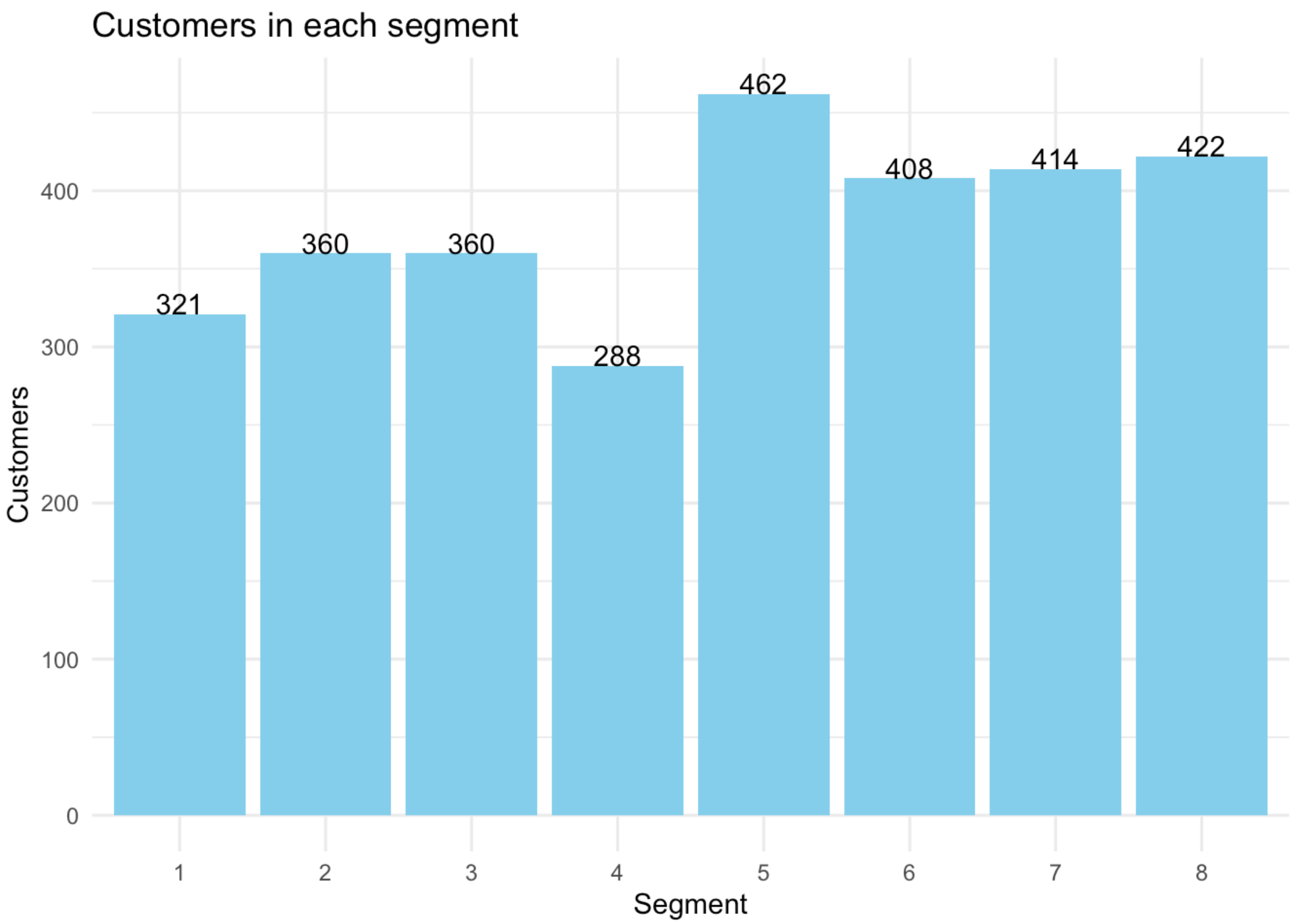


Kmeans based on RFM results

```
hclust4 <- hclust(dist(scale(cbind(rfm_result$recency_score_seq, rfm_result$freque
ncy_score_seq, rfm_result$monetary_score_seq))), method = "complete")

y <- sort(hclust$height, decreasing = TRUE)[1:10]
plot(x,y); lines(x,y, col= "blue")
```




```
kmeans_rfm <- kmeans(x = data.frame(rfm_result$recency_score_seq, rfm_result$frequ
ency_score_seq, rfm_result$monetary_score_seq), centers = 8, nstart = 50)


segmentrfm <- kmeans_rfm$cluster
segmentationrfm <- cbind(rfm_result, segmentrfm)
segment_countsrfm <- table(segmentationrfm$segmentrfm)

segment_datarfm <- as.data.frame(segment_countsrfm)

names(segment_datarfm) <- c("Segment", "Count")


ggplot(segment_datarfm, aes(x = Segment, y = Count)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  geom_text(aes(label = Count), vjust = 0) + # Añadir etiquetas de conteo encima d
e las barras
  labs(title = "Customers in each segment", x = "Segment", y = "Customers") +
  theme_minimal()
```


Customers in each segment
Customers
Segment
0
100
200
300
400
1
2
3
4
5
6
7
8
321
360
360
288
462
408
414
422