Experiment 6
Excercise1

April 21, 2025

[1]:
```
library(ggplot2)
library(dplyr)
library(cluster)
```

```
Attaching package: ‘dplyr’


The following objects are masked from ‘package:stats’:

    filter, lag


The following objects are masked from ‘package:base’:

    intersect, setdiff, setequal, union
```

[2]:
```
set.seed(1)
```

[3]:
```
mall_data <- read.csv("/home/asus/content/Notes/Semester 4/FDN Lab/Experiments/
 ↪Experiment 6/Mall_Customers.csv")
```

[4]:
```
head(mall_data)
summary(mall_data)
```

A data.frame: 6 × 5

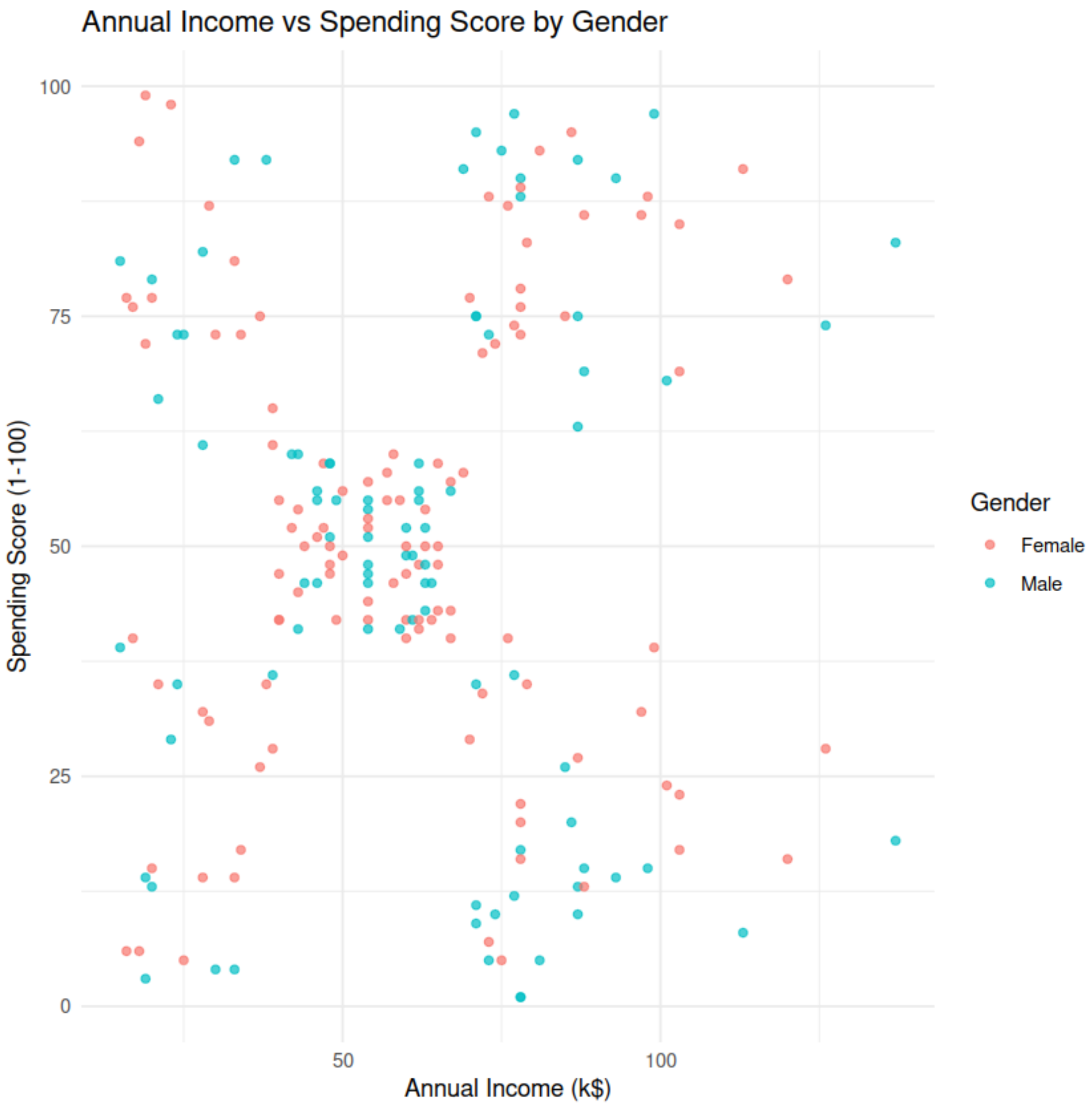
	CustomerID	Gender	Age	Annual.Income..k..	Spending.Score..1.100.
	<int>	<chr>	<int>	<int>	<int>
1	1	Male	19	15	39
2	2	Male	21	15	81
3	3	Female	20	16	6
4	4	Female	23	16	77
5	5	Female	31	17	40
6	6	Female	22	17	76

```
   CustomerID          Gender                Age        Annual.Income..k..
 Min.   :  1.00   Length:200         Min.   :18.00   Min.   : 15.00
```

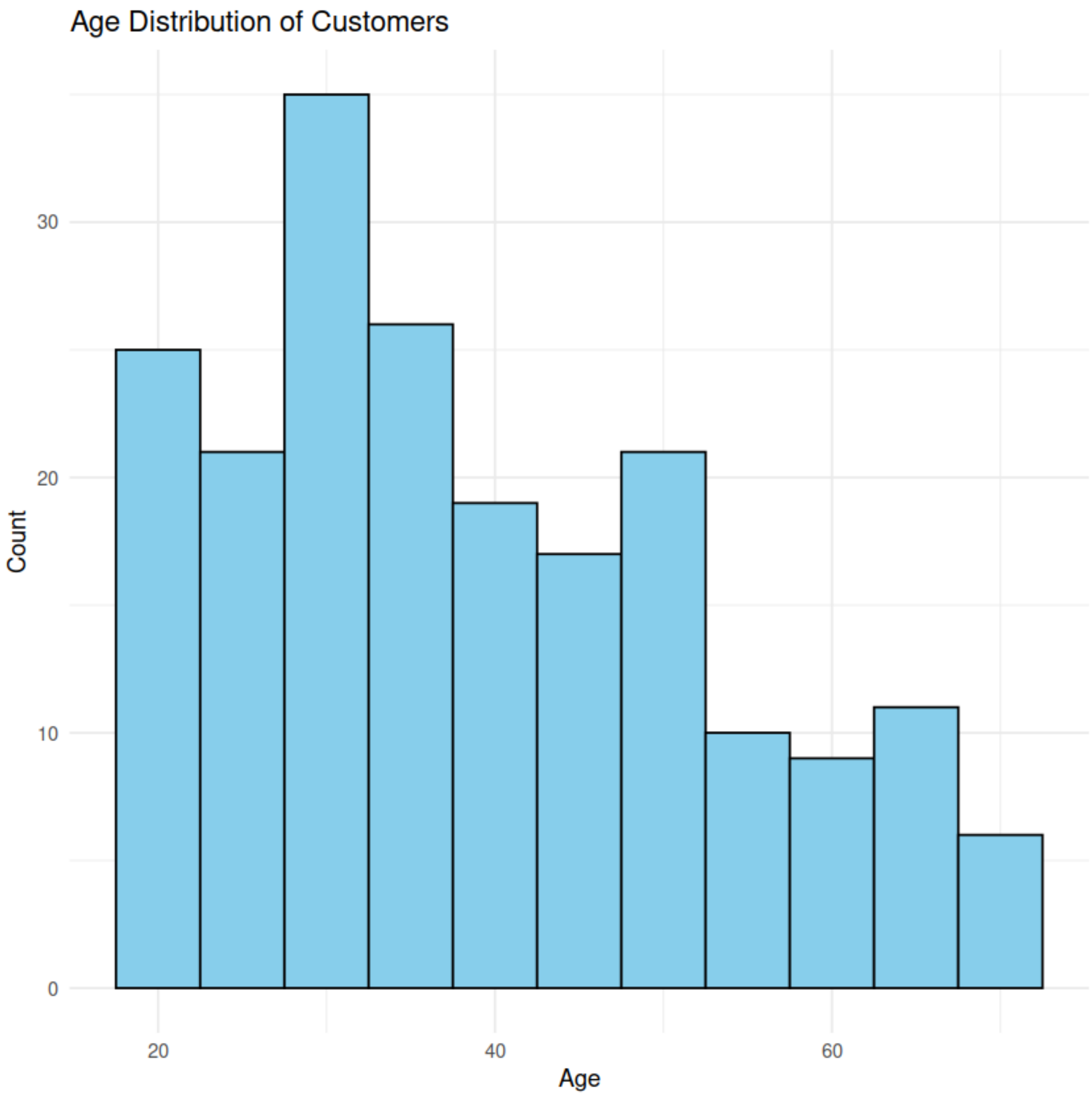
```
1st Qu.: 50.75   Class :character   1st Qu.:28.75   1st Qu.: 41.50
Median :100.50   Mode  :character   Median :36.00   Median : 61.50
Mean   :100.50                      Mean   :38.85   Mean   : 60.56
3rd Qu.:150.25                      3rd Qu.:49.00   3rd Qu.: 78.00
Max.   :200.00                      Max.   :70.00   Max.   :137.00
Spending.Score..1.100.
Min.   : 1.00
1st Qu.:34.75
Median :50.00
Mean   :50.20
3rd Qu.:73.00
Max.   :99.00
```

[5]:
```
colnames(mall_data) <- c("CustomerID", "Gender", "Age", "AnnualIncome",␣
 ↪"SpendingScore")
```

[6]:
```
ggplot(mall_data, aes(x = AnnualIncome, y = SpendingScore)) +
  geom_point(aes(color = Gender), alpha = 0.7) +
  labs(title = "Annual Income vs Spending Score by Gender",
       x = "Annual Income (k$)",
       y = "Spending Score (1-100)") +
  theme_minimal()
```

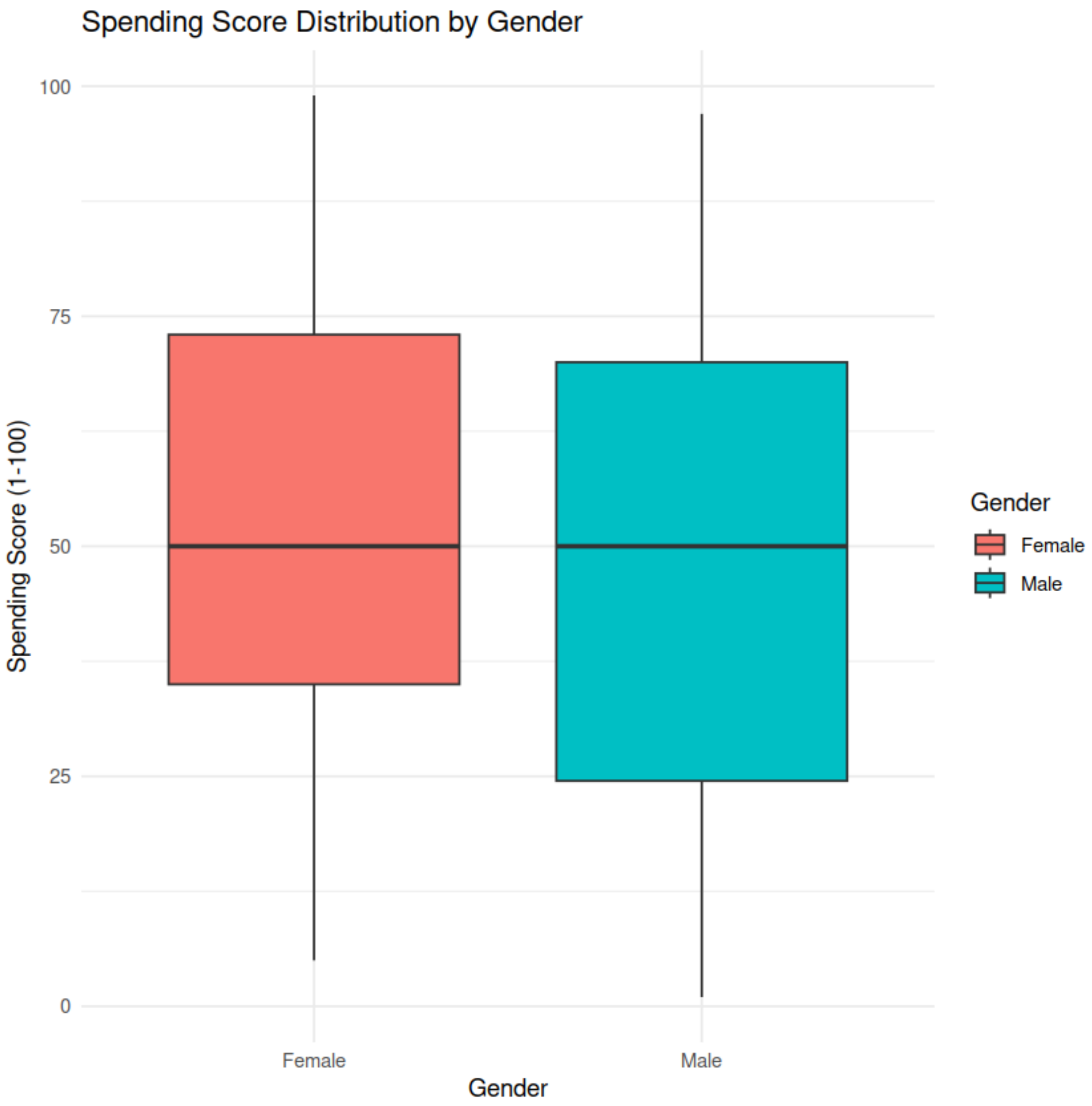


```
[7]: ggplot(mall_data, aes(x = Age)) +
       geom_histogram(binwidth = 5, fill = "skyblue", color = "black") +
       labs(title = "Age Distribution of Customers",
            x = "Age",
            y = "Count") +
       theme_minimal()
```



[8]:

```
ggplot(mall_data, aes(x = Gender, y = SpendingScore, fill = Gender)) +
  geom_boxplot() +
  labs(title = "Spending Score Distribution by Gender",
       y = "Spending Score (1-100)") +
  theme_minimal()
# ===================================
# Part 2
# ===================================
```



[9]:

```r
data_for_clustering <- mall_data[, c("AnnualIncome", "SpendingScore")]
```

[10]:

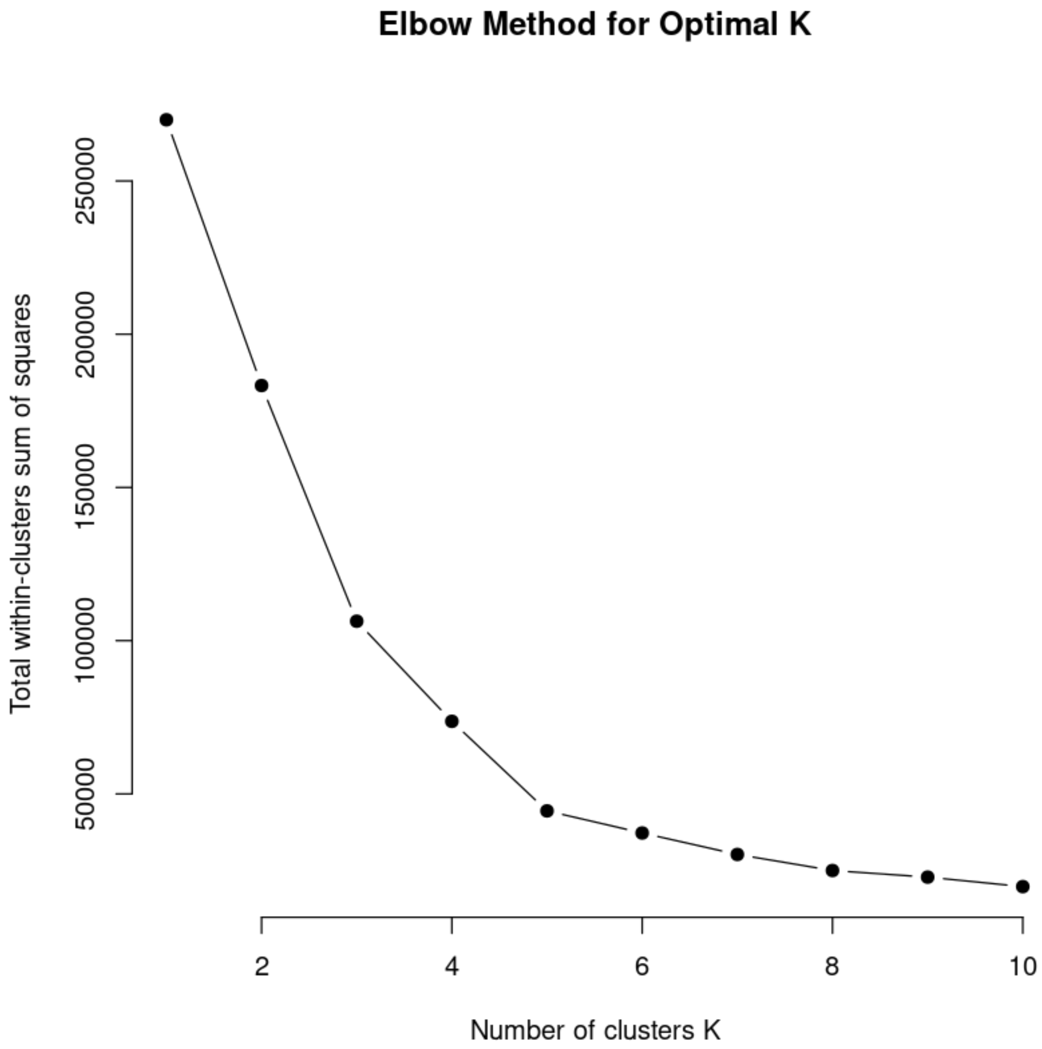
```r
wss <- function(k) {
  kmeans(data_for_clustering, k, nstart = 10)$tot.withinss
}
```

[11]:

```r
k_values <- 1:10
wss_values <- sapply(k_values, wss)
```

[12]:

```r
plot(k_values, wss_values,
     type = "b", pch = 19, frame = FALSE,
     xlab = "Number of clusters K",
     ylab = "Total within-clusters sum of squares",
    main = "Elbow Method for Optimal K")
```



[13]:

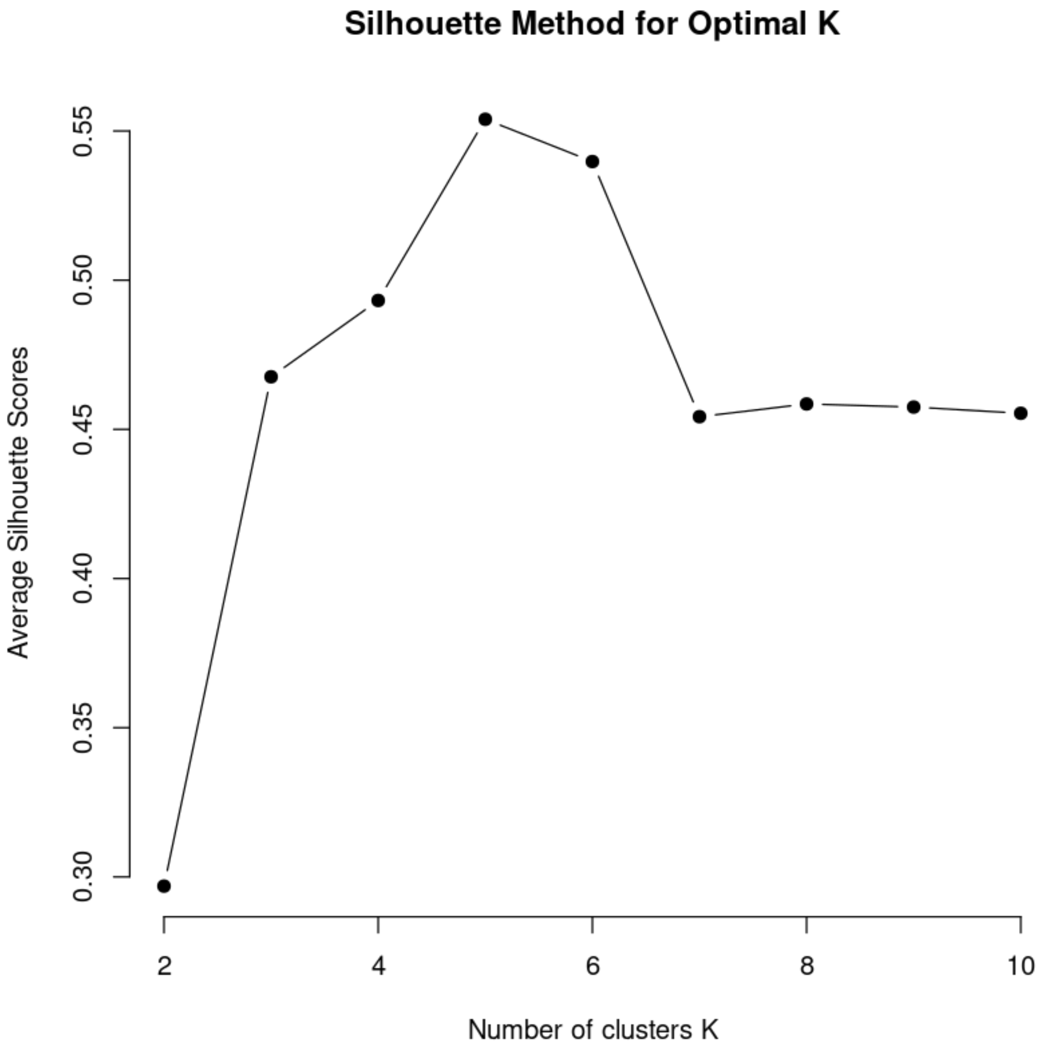
```
avg_sil <- function(k) {
  km.res <- kmeans(data_for_clustering, centers = k, nstart = 25)
  ss <- silhouette(km.res$cluster, dist(data_for_clustering))
  mean(ss[, 3])
}
```

[14]:

```
k_values <- 2:10
avg_sil_values <- sapply(k_values, avg_sil)
```

[15]:

```
plot(k_values, avg_sil_values,
     type = "b", pch = 19, frame = FALSE,
     xlab = "Number of clusters K",
     ylab = "Average Silhouette Scores",
     main = "Silhouette Method for Optimal K")
```



[16]:

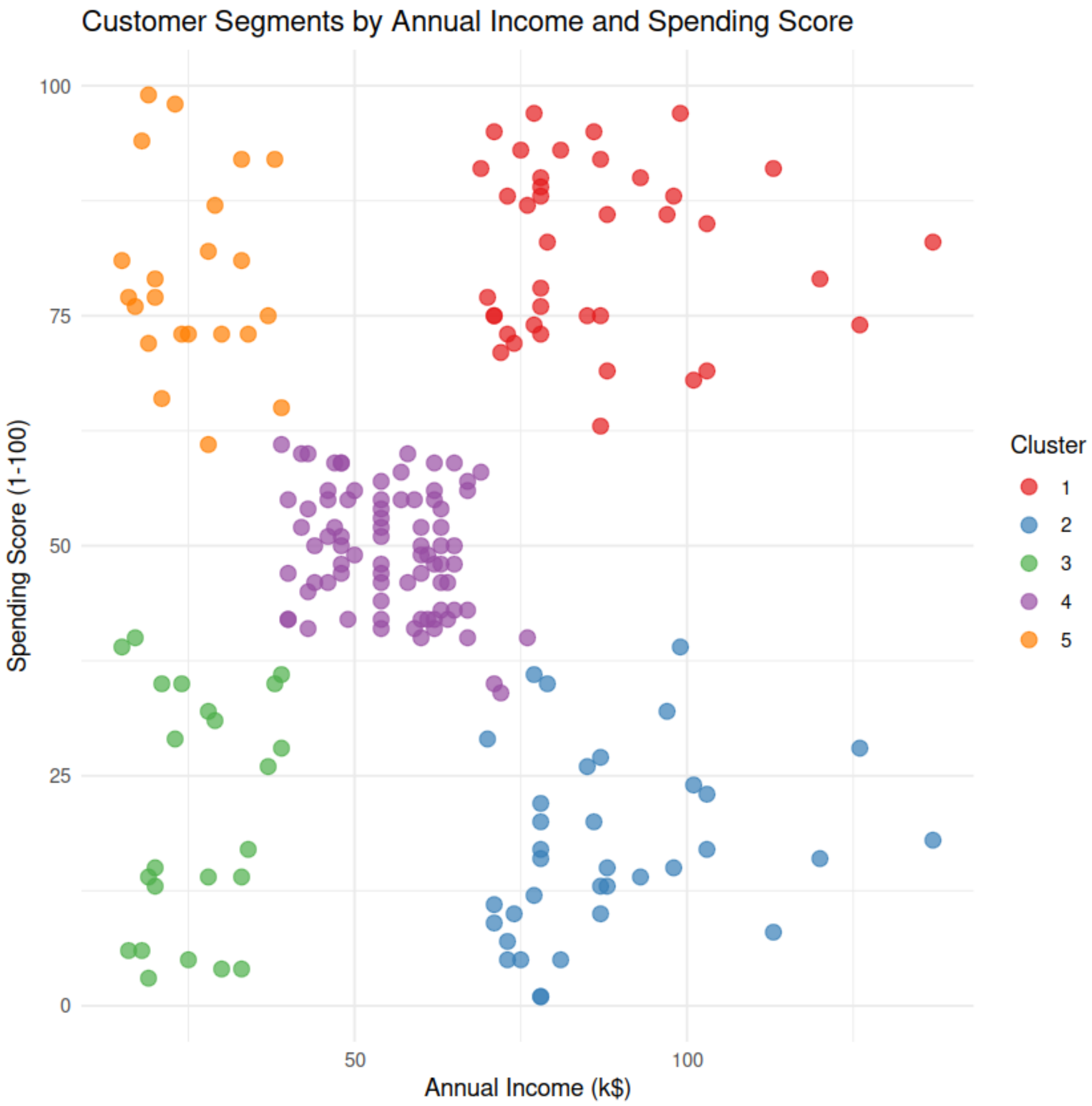
```
final_k <- 5
```

[17]:

```
kmeans_result <- kmeans(data_for_clustering, centers = final_k, nstart = 25)
mall_data$Cluster <- as.factor(kmeans_result$cluster)
```

[18]:

```
ggplot(mall_data, aes(x = AnnualIncome, y = SpendingScore, color = Cluster)) +
  geom_point(size = 3, alpha = 0.7) +
  scale_color_brewer(palette = "Set1") +
  labs(title = "Customer Segments by Annual Income and Spending Score",
       x = "Annual Income (k$)",
       y = "Spending Score (1-100)") +
  theme_minimal()
```



[19]:

```
cluster_stats <- mall_data %>%
  group_by(Cluster) %>%
  summarise(
    Count = n(),
    Avg_Age = mean(Age),
    Avg_Income = mean(AnnualIncome),
    Avg_Spending = mean(SpendingScore),
    Female_Pct = sum(Gender == "Female") / n() * 100
  )
```

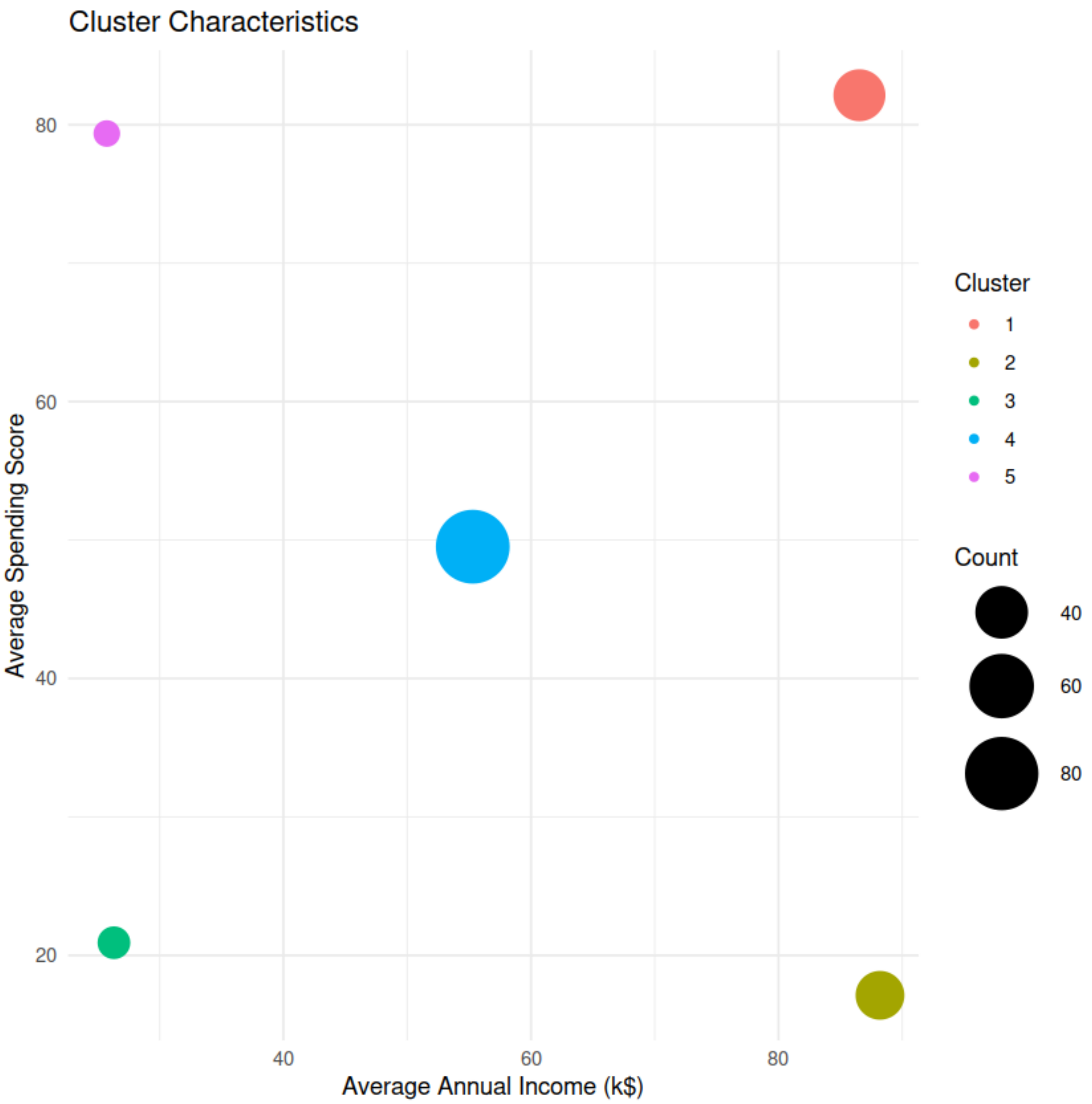
[20]:

```
# Printing Stats
print(cluster_stats)
```

```
# A tibble: 5 × 6
  Cluster Count Avg_Age Avg_Income Avg_Spending Female_Pct
  <fct>   <int>   <dbl>
<dbl>        <dbl>
<dbl>
1 1          39    32.7       86.5         82.1       53.8
2 2          35    41.1       88.2         17.1       45.7
3 3          23    45.2       26.3         20.9       60.9
4 4          81    42.7       55.3         49.5       59.3
5 5          22    25.3       25.7         79.4       59.1
```

[21]:

```
ggplot(cluster_stats, aes(x = Avg_Income, y = Avg_Spending, size = Count, color␣
 ↪= Cluster)) +
  geom_point() +
  scale_size(range = c(5, 15)) +
  labs(title = "Cluster Characteristics",
       x = "Average Annual Income (k$)",
       y = "Average Spending Score") +
  theme_minimal()
```


Cluster Characteristics
Average Spending Score
80
60
40
20
Average Annual Income (k$)
40
60
80
Cluster
1
2
3
4
5
Count
40
60
80