

```
## [149] 3 3 3 1 1 1 3 3 3 3 3 3 2 3 2 3 3 1 3 3 3 2 3 3 3 3 1 3 2 2 3 2 3 3 3 3
## [186] 1 3 3 2 3 1 1 2 3 2 3 3 1 3 3 3 3 2 1 3 2 2 3 3 3 3 3 3 3 3 3 1 3 3 3 3
## [223] 2 3 3 2 1 1 1 3 3 3 2 3 2 3 3 3 3 2 1 2 1 3 3 3 3 1 3 2 3 1 3 3 3 3 3 3
## [260] 3 1 3 1 1 3 1 3 3 3 2 3 3 1 3 3 1 3 3 3 3 3 1 3 3 3 3 1 1 3 1 3 3 3 3 1 2
## [297] 3 3 3 3 3 3 1 1 2 3 1 3 3 3 3 3 3 3 3 1 3 3 3 1 3 3 2 2 3 3 3 2 3 3 2 3 3
## [334] 1 1 2 3 3 3 2 3 3 3 3 3 3 2 1 2 2 3 3 3 3 1 3 3 3 3 1 3 3 2 2 3 2 3 1 2 2
## [371] 3 1 1 3 3 1 3 1 3 2 1 2 2 3 2 3 3 3 3 1 3 3 1 3 2 3 2 2 2 3 3 2 2 3 3 3 2
## [408] 1 3 1 3 1 3 3 1 2 1 3 1 3 2 3 3 3 2 3 2 1 2 3 1 2 2 1 3 3 2 3 3 3 3 3 2 3
## [445] 3 2 2 3 1 2 3 1 1 3 2 3 3 2 3 1 1 1 3 2 2 3 3 2 3 3 3 3 3
##
## Within cluster sum of squares by cluster:
## [1] 61.6511 101.9796 131.2512
## (between_SS / total_SS = 68.8 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"       "
```

there are three clusters has been built at size of 88,95 and 290,each observation will be assigned to one of the three clusters. However, we need to try different numbers of k to track if current numbers of clusters are reasonable.

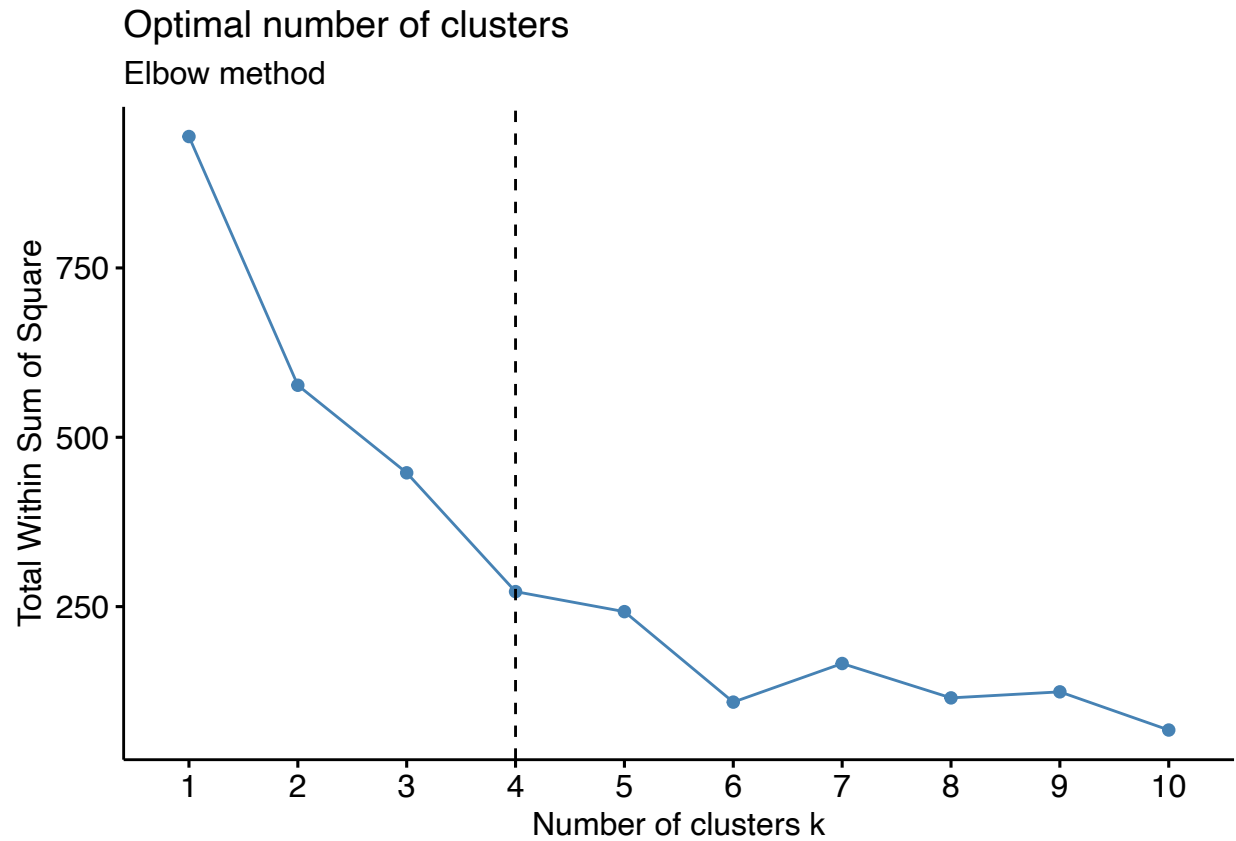
```
#the checking-procedure of numbers of clusters
install.packages("factoextra",repos = "http://cran.us.r-project.org")
```

```
##
## The downloaded binary packages are in
## /var/folders/9c/nwbh32mj6712jzxhv0bx_khc0000gn/T//RtmpVzRWiI/downloaded_packages
```

```
library(factoextra)
```

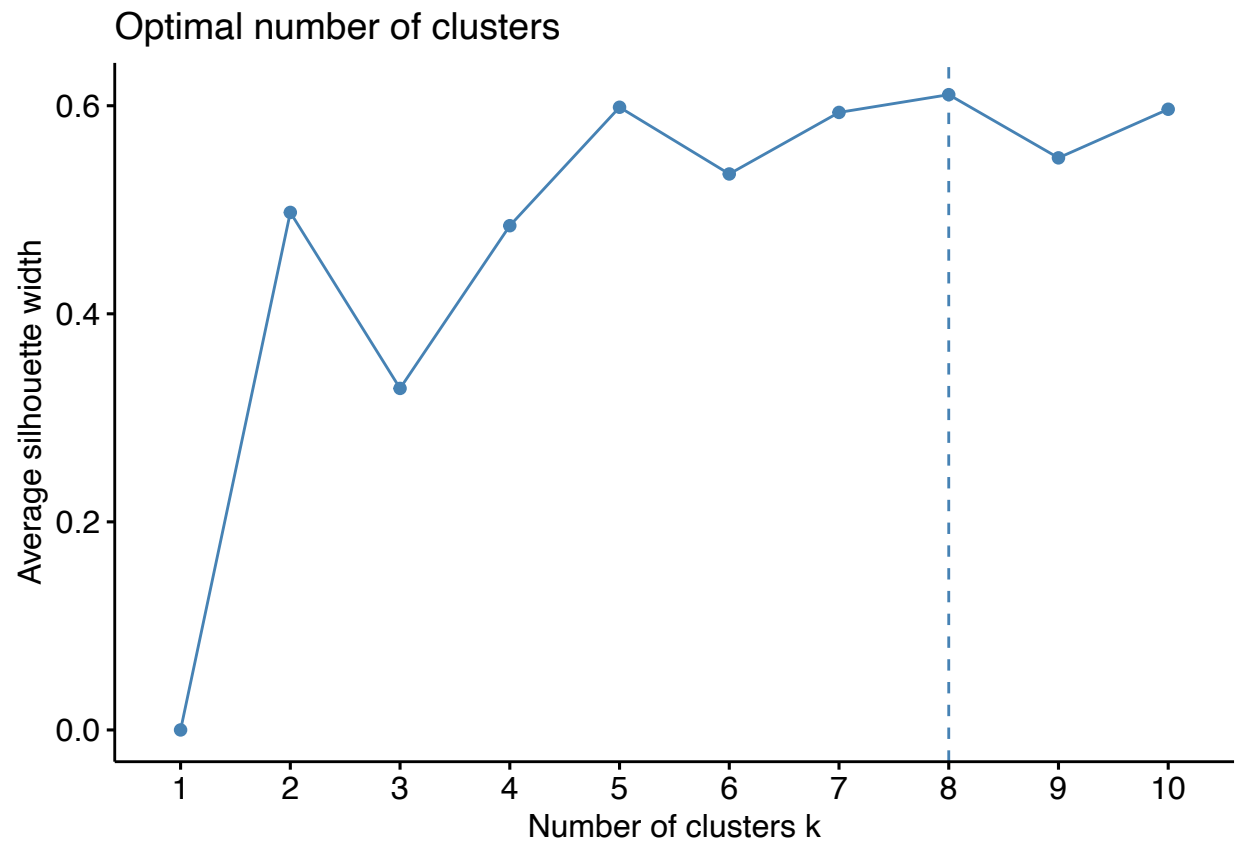
```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
#elbow method
fviz_nbclust(benton_2cols,kmeans,method = "wss") + geom_vline(xintercept = 4, linetype = 2) +
labs(subtitle = "Elbow method")
```

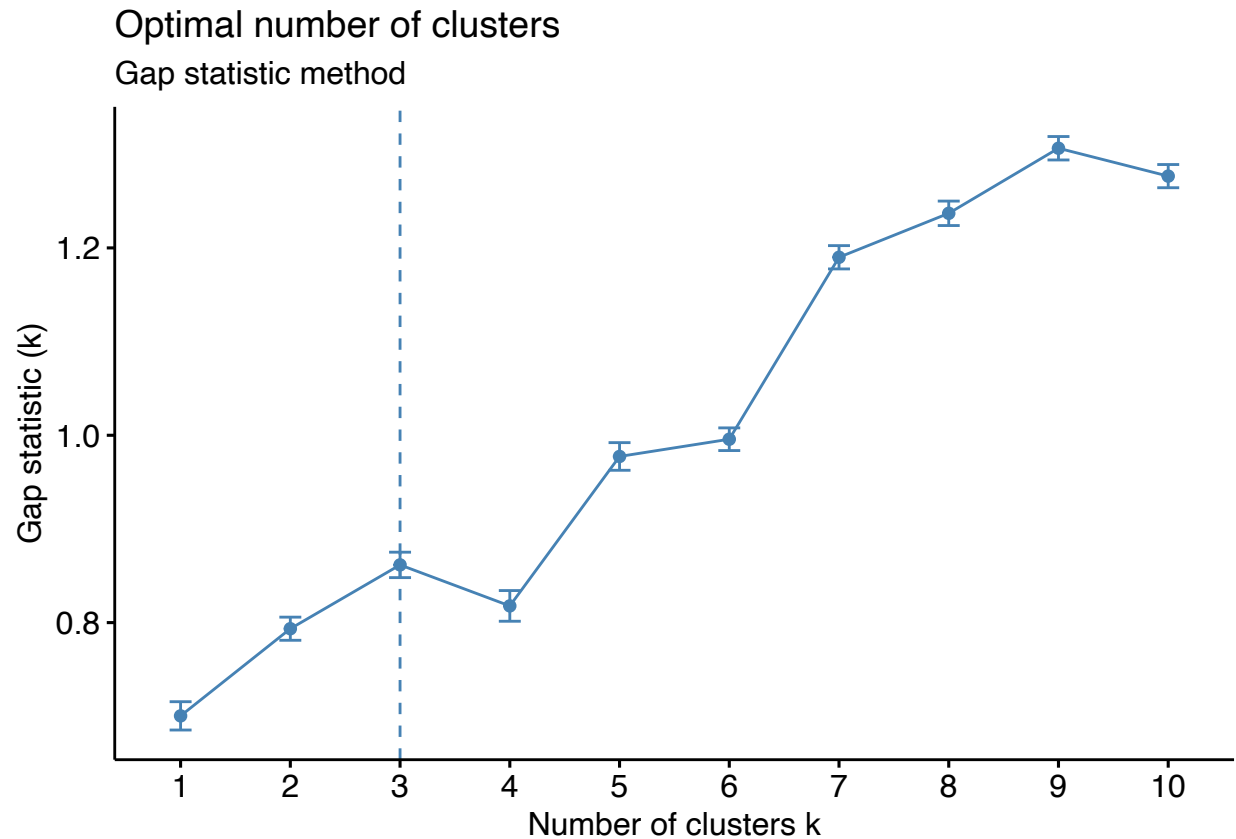


Above the graph, we know how the total within-cluster sum of squares decreases as the number of clusters grows.

```
#silhouette method  
fviz_nbclust(benton_2cols,kmeans,method = "silhouette")
```



```
fviz_nbclust(benton_2cols, kmeans, nstart = 25, method = "gap_stat", nboot = 50)+  
  labs(subtitle = "Gap statistic method")
```



based on three methods to find optimal numbers of clusters, the gap statistic providing a statistical procedure to formalize the elbow/silhouette methods. if we choose 4 as the clusters:

```
km.out <- kmeans(benton_2cols, centers = 4, nstart = 20)
km.out
```

```
## K-means clustering with 4 clusters of sizes 228, 8, 95, 142
```

```
##
```

```
## Cluster means:
```

```
##   sale.dollars retail.price
```

```
## 1  -0.6242211  -0.7146584
```

```
## 2   4.4625923   1.0522449
```

```
## 3  -0.4003964   1.4439516
```

```
## 4   1.0187276   0.1221744
```

```
##
```

```
## Clustering vector:
```

```
##   [1] 3 1 1 3 1 1 4 1 1 1 1 3 4 4 4 1 3 1 3 4 1 2 1 4 3 1 4 1 1 4 4 1 1 1 4 1
```

```
##  [38] 4 1 4 4 1 3 3 1 1 1 4 3 4 4 1 2 1 1 1 3 1 3 1 4 4 1 3 1 4 4 4 1 1 1 1 4 1
```

```
##  [75] 1 1 1 3 1 1 1 3 1 3 1 1 1 1 4 4 1 3 4 4 1 3 3 3 1 1 1 1 3 1 4 1 1 4 1 4 4
```

```
## [112] 1 2 4 1 4 1 1 3 1 3 4 1 4 3 4 1 4 3 3 1 3 1 1 3 3 1 3 3 1 1 4 1 1 3 3 3 4
```

```
## [149] 4 1 1 3 3 3 1 1 1 1 1 1 1 4 1 4 1 1 3 1 1 4 4 1 1 1 1 3 4 4 4 1 4 1 1 1 1
```

```
## [186] 3 4 1 4 1 3 3 4 1 4 1 1 3 1 4 1 1 4 3 1 4 4 1 1 1 1 4 1 1 4 1 1 3 4 1 1 1
```

```
## [223] 2 1 1 4 3 3 3 4 1 1 4 1 4 4 4 1 1 4 3 2 3 1 4 4 1 3 1 2 1 3 1 1 1 1 1 1 1
```

```
## [260] 1 3 4 3 3 1 3 1 1 1 4 4 1 3 1 1 3 1 4 4 1 1 3 1 1 1 4 3 3 1 3 4 1 1 1 3 4
```

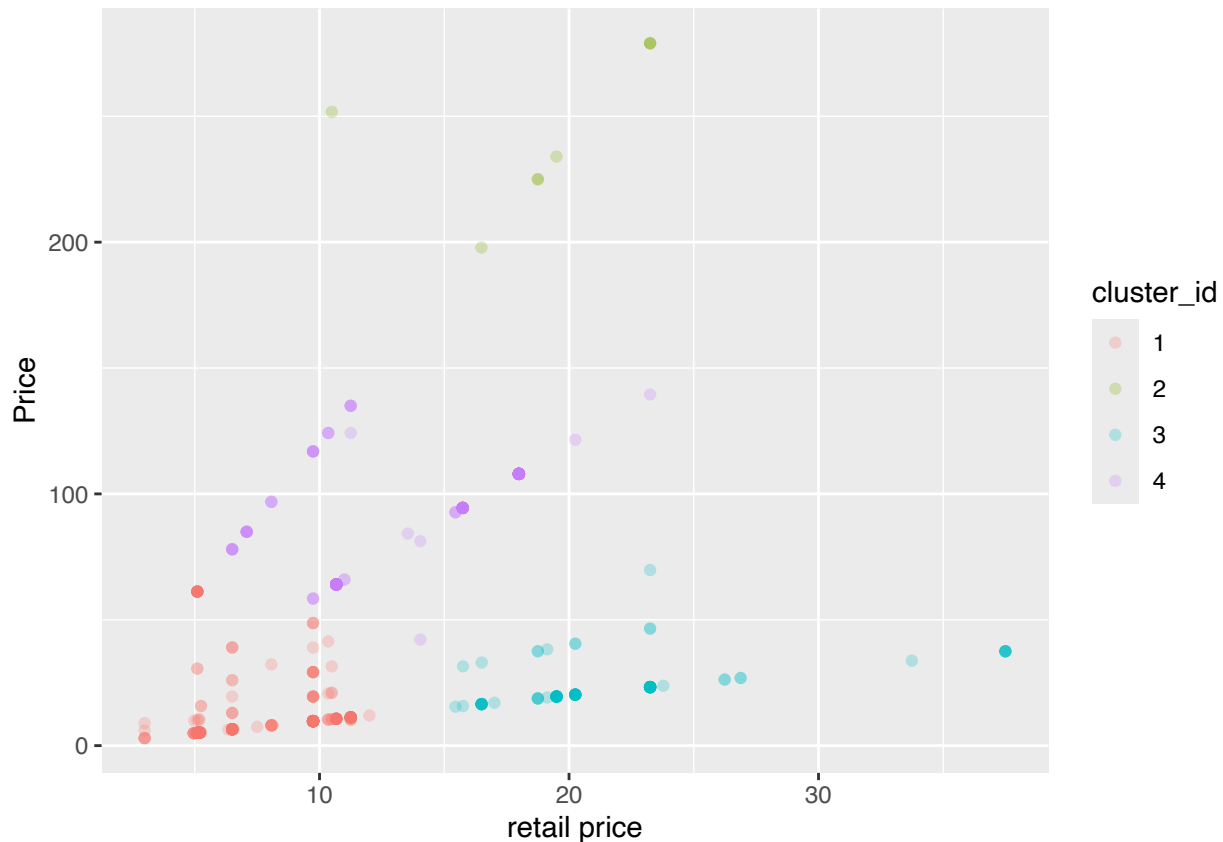
```
## [297] 4 1 1 1 1 1 3 3 4 1 3 1 1 1 1 1 1 1 4 3 1 1 4 3 4 1 4 4 4 1 1 2 1 4 4 1 1
```

```
## [334] 3 3 4 1 1 1 4 4 1 1 1 1 1 4 3 4 4 4 1 1 4 3 4 1 1 1 3 1 1 4 4 1 4 1 3 4 4
```

```
## [371] 1 3 3 1 1 3 1 3 4 2 3 4 4 4 4 1 1 4 1 3 1 4 3 4 4 1 4 4 4 4 1 4 4 1 1 1 4
```

```
## [408] 3 1 3 4 3 4 4 3 4 3 1 3 1 4 1 1 1 4 4 4 3 4 1 3 4 4 3 1 4 4 1 1 1 4 1 4 4
## [445] 1 4 4 1 3 4 1 3 3 1 4 1 1 4 1 3 3 3 1 4 4 4 1 4 1 4 1 1 4
##
## Within cluster sum of squares by cluster:
## [1] 55.311834 6.386165 61.651100 84.393914
## (between_SS / total_SS = 78.0 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"       "
```

```
liquor_benton$cluster_id <- factor(km.out$cluster)
ggplot(liquor_benton, aes(retail.price, sale.dollars, color = cluster_id)) +
  geom_point(alpha = 0.25) +
  xlab("retail price") +
  ylab("Price")
```



change another dimension on the specific county: Johnson, still doing the k clustering

```
johnson_2cols <- liquor_johnson %>% select(sale.dollars, retail.price) %>% scale()
km.out <- kmeans(johnson_2cols, centers = 2, nstart = 50)
km.out
```

```
## K-means clustering with 2 clusters of sizes 5342, 6448
##
```

```

## Cluster means:
##   sale.dollars retail.price
## 1    0.3164674    0.9226085
## 2   -0.2621850   -0.7643571
##
## Clustering vector:
##   [1] 2 2 2 1 2 2 1 2 2 2 1 2 1 1 2 2 2 2 1 2 1 2 1 1 1 1 2 2 2 1 1 2 1 1 2
##  [37] 2 2 2 1 2 2 2 2 2 2 2 2 1 2 1 2 1 1 1 2 2 2 1 1 2 2 2 2 1 1 1 2 2 1 2
##  [73] 1 1 1 2 1 1 1 1 2 2 1 2 1 1 2 1 2 1 1 1 2 1 2 2 2 2 1 1 2 1 1 1 1 1
## [109] 1 1 1 1 2 1 1 2 2 1 2 2 1 1 2 2 2 1 2 2 2 2 1 1 2 1 2 2 2 2 1 2 2 2 1
## [145] 1 2 2 2 2 2 2 2 1 1 1 1 2 2 2 1 1 2 2 1 2 1 2 1 2 1 1 1 1 2 2 1 1 2
## [181] 2 1 1 1 2 2 2 2 2 2 2 1 1 2 2 2 2 1 2 2 1 2 2 2 1 1 2 2 1 2 1 1 2 2 2
## [217] 2 2 1 2 1 1 1 1 2 2 2 1 2 1 2 2 1 2 1 1 1 1 1 1 1 1 2 1 1 1 1 2 2 2 1 1
## [253] 1 1 1 2 1 2 1 2 2 2 1 1 1 1 1 1 1 2 2 1 1 2 2 2 2 1 1 1 1 1 1 1 2 1 1 2 1
## [289] 2 1 2 1 1 2 2 1 2 1 2 2 2 2 2 1 1 2 2 2 2 2 2 1 2 1 1 2 2 1 1 1 2 2 1 1
## [325] 1 1 2 1 1 2 2 2 2 2 2 1 2 1 1 1 2 1 2 1 1 2 1 1 2 1 1 2 2 1 1 1 2 1 2 1
## [361] 2 1 1 1 1 1 2 1 1 1 1 2 1 1 1 2 2 1 2 2 2 2 2 1 1 2 1 2 1 2 2 1 1 2 2 2
## [397] 2 2 1 2 1 2 2 1 1 2 1 1 1 1 1 2 1 2 1 1 2 1 1 1 2 2 1 1 1 2 1 2 2 1 1 1
## [433] 2 2 2 2 1 2 1 2 1 2 1 2 2 1 1 2 1 1 2 1 2 2 2 2 1 1 2 2 1 1 1 1 1 2 1 1
## [469] 2 1 2 1 2 1 1 1 2 2 2 1 2 2 2 1 1 2 2 1 1 2 2 2 2 2 1 2 2 2 2 2 1 1 1 1
## [505] 2 2 2 1 2 2 2 2 1 2 1 2 2 2 1 2 2 2 2 2 1 2 2 2 1 2 1 2 2 2 2 2 1 2 1 1
## [541] 2 1 1 2 1 1 2 1 2 2 2 2 2 1 2 1 2 2 1 2 2 1 2 1 2 1 1 2 1 2 1 2 1 1 1 1
## [577] 2 1 2 2 2 2 2 2 1 2 2 2 1 2 2 2 1 1 2 2 1 1 1 2 1 2 2 2 1 2 1 1 1 2 2 1
## [613] 2 1 1 1 2 1 2 2 1 2 1 2 1 2 2 1 2 2 2 2 2 2 1 1 2 1 1 1 2 1 2 2 2 2 1 2
## [649] 1 2 2 2 2 1 2 1 2 1 1 1 2 1 1 2 2 2 1 1 2 1 1 2 2 2 2 1 1 1 2 2 2 1 2 1 2
## [685] 2 2 1 2 1 2 1 2 1 2 1 1 1 1 2 1 1 2 1 1 1 2 1 2 2 2 2 2 1 2 1 1 1 1 1 2
## [721] 1 2 2 2 1 1 1 1 2 2 2 2 1 1 1 2 2 2 1 1 2 1 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2
## [757] 2 2 2 1 2 2 1 2 1 2 2 2 2 2 1 1 1 1 1 2 2 1 1 2 2 1 1 1 1 1 2 1 2 1 1 2
## [793] 1 2 2 2 2 2 1 2 1 1 2 1 2 1 2 1 2 2 2 1 1 2 1 2 1 1 2 2 2 1 1 2 2 2 2 2
## [829] 2 2 1 1 2 2 1 2 2 2 2 1 2 1 2 2 2 1 2 1 2 1 2 2 1 2 2 2 1 1 2 2 1 2 2 2
## [865] 2 2 2 1 1 1 2 2 2 2 2 1 1 1 2 2 1 2 2 2 2 1 1 2 2 2 2 1 2 1 1 2 2 2 2 1
## [901] 2 2 1 2 1 1 2 1 1 1 1 2 2 1 1 2 2 2 2 1 2 1 1 1 1 2 1 2 1 2 1 1 1 2 1 1
## [937] 2 1 2 1 2 2 1 1 2 1 2 1 1 1 2 2 2 2 2 2 2 2 1 2 1 1 2 1 1 1 1 2 2 1 1 2
## [973] 2 1 2 2 1 1 2 2 2 2 1 1 2 2 2 1 2 2 1 2 1 1 2 2 1 2 2 1 2 1 1 2 2 2 1 2
## [1009] 1 2 2 1 1 2 1 1 2 2 1 2 1 1 1 1 1 2 2 1 2 2 2 1 2 2 1 1 2 1 2 2 2 1 1 2
## [1045] 1 1 2 2 1 2 1 1 2 2 1 2 2 2 1 1 2 2 2 1 2 1 2 1 1 2 2 2 1 2 2 1 1 1 2 1
## [1081] 2 1 1 2 1 2 1 1 2 2 1 2 2 2 2 1 1 2 2 2 2 2 2 1 2 2 2 2 2 1 1 1 1 1 2 2
## [1117] 1 1 1 2 2 2 2 2 2 2 1 2 2 1 1 1 1 1 1 2 2 1 2 2 1 2 2 2 1 2 2 2 2 2 2 1
## [1153] 2 2 2 2 2 1 1 1 2 1 1 1 2 1 1 2 1 1 2 1 2 2 1 2 2 1 2 2 1 2 1 2 1 2 2 2 1
## [1189] 1 1 1 1 2 1 1 1 2 2 2 1 1 1 2 1 2 1 1 2 2 2 1 2 1 2 2 2 2 2 1 2 2 2 1 1
## [1225] 1 2 2 2 1 2 1 1 2 2 1 1 1 2 1 2 2 1 1 1 1 2 1 1 2 1 1 2 1 1 2 1 2 2 2 2 1
## [1261] 2 2 2 1 1 1 1 1 1 1 2 2 2 1 2 2 2 2 2 1 1 1 1 1 1 2 2 2 2 2 2 1 2 1 2 1 1
## [1297] 1 1 1 2 2 2 2 2 2 2 1 2 1 1 1 1 1 1 1 2 1 1 1 2 1 2 2 1 1 1 1 1 2 1 2 1
## [1333] 1 2 2 2 2 2 2 2 2 2 1 1 1 2 2 2 1 1 2 1 1 1 2 2 1 1 1 2 1 2 1 1 1 1 1 2
## [1369] 2 1 2 2 2 1 1 2 1 1 1 2 2 2 2 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 2 1 2 2 2 2 1
## [1405] 1 2 1 1 1 1 1 1 1 1 1 1 1 1 2 2 1 2 2 1 2 1 2 1 1 1 2 2 1 2 2 1 1 2 2 1 1
## [1441] 2 2 2 1 1 1 1 2 1 1 1 2 2 2 1 2 1 2 2 1 2 1 2 1 2 1 1 1 1 1 1 1 2 2 1 2 2
## [1477] 2 1 1 2 1 1 2 2 2 1 2 2 1 1 2 1 1 2 2 2 2 2 2 2 1 1 2 1 1 2 2 1 2 1 2 2
## [1513] 1 1 2 2 2 1 1 2 2 1 1 1 2 2 2 1 1 1 2 1 2 1 2 1 2 2 1 2 2 1 1 2 2 2 2 1
## [1549] 2 2 2 2 2 2 1 1 1 2 1 2 2 2 1 2 2 2 2 2 1 1 1 2 2 1 2 1 1 2 2 1 2 2 2 1
## [1585] 1 2 2 2 2 2 2 2 1 1 2 1 1 2 2 2 1 1 2 2 1 1 1 2 2 1 2 1 1 1 1 1 1 1 2 1 1
## [1621] 2 2 2 2 1 1 2 2 2 2 2 2 1 1 2 1 2 2 1 2 2 1 2 1 2 1 2 2 1 2 1 2 1 2 2 1
## [1657] 1 1 2 2 2 2 1 2 2 2 2 1 1 1 2 2 2 1 2 2 1 1 2 2 2 2 1 2 1 2 1 2 2 2 1 1 2
## [1693] 2 2 2 2 1 2 2 1 1 2 2 2 2 2 2 1 1 1 2 1 2 1 2 1 2 1 1 2 1 1 2 1 1 1 1 1

```

```

## [1729] 1 2 1 2 2 1 2 2 1 2 2 2 1 1 1 1 1 2 2 2 2 1 1 2 1 2 2 1 1 1 2 1 1 2 1 2
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## [1873] 2 1 2 2 1 2 2 2 2 1 1 1 2 2 2 2 1 1 1 2 2 2 2 2 1 1 2 2 2 1 2 1 2 1 1 1
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## [1945] 1 2 2 2 2 2 1 1 1 1 2 1 2 2 1 1 1 2 1 2 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2 2
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## [2377] 2 2 2 2 1 2 2 2 2 1 2 2 2 1 2 1 1 2 1 1 1 1 1 1 2 2 1 1 1 2 2 1 1 1 1 1
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## [2449] 2 2 1 1 2 2 1 2 1 2 1 1 1 2 1 1 1 1 1 1 2 1 1 2 1 1 2 2 2 2 2 2 1 1 1 2
## [2485] 1 1 2 1 1 2 2 1 2 1 2 2 1 2 2 2 1 1 2 1 2 2 1 2 2 2 1 2 2 2 1 1 1 1 2 1 2
## [2521] 2 2 1 1 2 2 1 2 2 2 2 2 1 1 2 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 2 2 2
## [2557] 2 2 1 1 2 1 2 1 2 2 1 2 2 1 1 1 1 2 2 1 2 2 1 1 1 2 1 2 1 2 2 2 2 2 1 1
## [2593] 1 2 2 2 2 1 1 2 2 1 2 1 1 2 2 1 2 1 2 2 2 1 2 1 1 2 2 2 1 1 2 2 2 1 2 2
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## [2665] 1 2 1 1 2 2 2 1 1 2 1 2 2 2 2 2 1 2 1 2 1 2 1 1 2 2 2 2 1 2 2 2 2 2 2 2
## [2701] 1 2 2 2 1 2 2 2 2 2 2 1 2 2 2 1 2 1 2 2 2 1 2 1 1 1 2 2 2 1 2 1 1 1 2 1
## [2737] 2 2 2 1 2 2 2 1 1 2 2 1 1 1 1 1 1 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 1 1
## [2773] 1 1 1 1 1 1 2 1 1 1 1 1 1 1 2 2 1 1 2 2 1 1 2 1 2 1 1 2 1 2 1 2 1 2 1 1 2
## [2809] 2 2 2 1 2 2 1 2 1 2 1 1 2 2 2 2 2 1 2 1 2 1 1 2 2 2 2 1 1 2 1 1 2 1 1 2 1
## [2845] 1 1 1 1 2 2 2 2 1 1 2 1 2 2 2 1 2 1 1 1 2 2 2 2 1 1 2 2 2 1 1 2 1 1 1 2
## [2881] 2 1 2 1 2 1 2 2 1 1 2 2 2 1 2 2 2 1 1 2 2 2 2 2 1 2 1 1 1 1 2 2 1 1 2 1
## [2917] 2 2 1 2 2 2 2 1 1 2 2 2 2 1 1 2 1 2 2 2 1 1 2 2 1 2 2 2 1 1 1 2 2 1 2 1
## [2953] 2 2 1 1 1 2 2 1 2 2 2 2 2 2 2 1 1 1 2 2 1 1 1 1 1 1 2 1 1 2 1 2 2 2 2 1
## [2989] 1 1 1 1 1 1 2 2 2 2 2 2 2 1 2 2 2 2 1 1 1 1 2 2 2 2 1 1 2 1 1 2 2 1 2 1
## [3025] 1 2 2 1 1 2 1 2 1 1 2 1 1 2 1 2 2 2 1 2 2 2 1 2 1 1 2 1 1 1 2 1 2 2 2 1
## [3061] 1 1 1 1 2 2 2 1 2 2 2 2 1 2 2 1 1 1 2 2 2 1 2 1 2 2 1 1 1 1 1 1 1 1 2 1 1
## [3097] 1 2 2 2 1 2 2 2 1 2 2 2 1 2 1 2 2 1 1 1 1 2 1 1 1 1 2 1 1 1 2 2 1 2 2 1
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## [3169] 2 1 2 1 2 1 1 2 2 1 1 2 2 1 1 1 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 2
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## [3241] 2 1 2 2 1 1 1 2 1 2 1 2 2 1 1 2 2 1 1 2 1 2 1 1 1 1 2 2 2 1 1 2 2 2 1 2
## [3277] 2 2 2 1 1 2 2 2 2 2 1 2 2 2 1 2 1 1 2 1 1 2 1 1 2 2 1 1 2 2 2 2 2 1 2 1
## [3313] 2 2 2 2 1 1 1 2 2 2 1 1 1 1 2 1 2 2 1 2 2 2 1 1 2 2 1 1 1 1 2 1 2 1 1 2
## [3349] 2 2 1 2 1 2 2 1 2 1 2 1 1 1 1 1 1 2 1 2 2 1 2 1 2 1 1 2 1 1 1 1 1 2 2 1
## [3385] 1 1 1 2 1 2 1 1 1 2 1 2 1 1 2 1 2 2 1 2 1 2 2 1 1 1 2 1 2 1 2 1 1 1 2 2
## [3421] 2 1 2 2 2 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 1 2 1 1 1 2 2 1 2 2 2 1 1 2 1 1
## [3457] 2 2 2 2 1 2 2 1 2 2 2 1 2 1 2 2 1 2 1 1 1 1 2 1 2 2 2 2 2 2 1 1 1 2 2 2
## [3493] 1 2 2 1 2 2 1 2 2 2 1 1 1 2 2 2 1 1 1 2 1 1 1 1 1 2 1 1 2 2 1 2 2 2 1 2
## [3529] 2 1 2 1 2 1 1 2 1 2 2 1 2 2 1 2 2 2 2 1 1 2 2 2 1 1 2 2 1 1 1 1 2 2 1 2
## [3565] 1 2 1 2 2 2 1 1 1 2 2 2 1 2 1 2 2 1 1 1 1 1 1 2 2 1 1 1 2 1 1 2 2 1 1 1
## [3601] 1 2 1 2 2 2 2 2 1 1 2 2 2 2 1 2 1 2 2 1 2 1 1 1 1 1 1 1 1 2 1 2 1 1 1 1
## [3637] 1 2 2 1 1 1 1 2 2 1 1 2 2 1 1 1 1 1 2 1 1 1 2 1 2 2 1 2 2 1 2 1 2 1 1 2

```

```

## [3673] 1 1 2 2 2 2 1 1 2 1 2 2 2 1 2 2 1 2 1 2 1 1 1 1 2 2 1 1 1 1 2 2 1 2
## [3709] 2 2 1 2 2 2 1 2 2 1 2 1 2 2 2 2 1 2 1 2 1 1 1 1 2 1 2 2 1 1 2 1 1 1
## [3745] 2 2 1 2 2 2 2 1 2 1 1 1 1 1 2 2 2 1 1 2 1 1 2 1 2 1 1 2 2 2 1 1 1 2
## [3781] 1 1 2 2 1 2 1 2 2 2 2 2 2 1 2 2 1 1 2 1 1 2 1 1 1 1 1 1 2 2 2 2 1 1 2 2
## [3817] 2 2 2 2 2 2 2 1 2 2 2 1 1 2 1 1 2 2 2 2 2 1 1 2 1 2 1 1 1 1 2 2 2 2 2 2
## [3853] 1 2 2 2 2 2 2 1 1 2 1 2 1 1 1 1 1 2 2 1 2 2 1 2 2 1 1 2 1 2 1 1 1 1 2 2
## [3889] 2 2 1 2 1 1 1 1 1 2 2 1 1 1 1 2 1 2 2 1 2 2 2 2 2 1 2 2 1 1 2 2 1 1 1 2
## [3925] 2 1 2 2 2 2 2 1 1 1 2 2 1 2 2 1 2 2 1 2 1 2 2 1 2 1 2 1 2 2 2 2 1 2 1 2
## [3961] 2 2 1 2 2 1 1 2 2 2 1 1 1 2 2 1 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 1 1 1 1
## [3997] 1 2 1 2 2 1 1 2 2 1 2 2 2 2 1 2 1 2 1 1 1 1 1 2 1 2 2 1 2 2 2 2 2 1 2 2
## [4033] 2 1 1 2 2 2 2 2 2 2 1 1 1 1 1 2 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1
## [4069] 1 1 2 2 1 2 1 2 1 2 2 2 2 2 2 2 2 1 1 2 1 1 2 2 1 1 1 1 2 2 1 1 1 1 1 1
## [4105] 2 1 2 2 1 1 1 1 1 1 1 2 1 1 1 1 1 2 2 2 2 1 1 1 2 2 2 2 2 1 2 1 2 2 2 1
## [4141] 2 2 2 2 2 1 2 2 2 2 1 1 2 2 1 2 1 2 2 2 1 1 2 2 1 2 1 1 2 1 1 2 2 1 2 1
## [4177] 2 2 1 1 1 1 2 2 2 1 2 2 2 2 2 2 2 2 2 1 2 2 1 2 1 2 1 2 1 1 1 1 1 2 2 2
## [4213] 2 1 2 1 1 1 1 1 1 1 1 2 2 1 1 1 2 1 2 1 2 1 2 2 2 2 2 1 1 1 2 2 2 2 1 2
## [4249] 2 1 2 2 2 1 1 2 1 2 2 2 1 2 2 1 2 1 2 2 1 2 1 2 2 1 2 1 2 1 1 1 2 1 1 2
## [4285] 2 1 2 1 2 2 1 1 2 2 1 1 2 2 2 1 1 2 2 1 1 2 2 2 2 2 2 2 2 1 2 1 2 1 2 1 1
## [4321] 1 2 2 2 2 1 2 1 1 2 1 1 1 2 2 2 1 2 2 1 1 2 2 1 2 2 1 1 2 2 2 2 2 1 2 2
## [4357] 2 1 2 2 1 1 2 1 2 1 2 2 2 1 2 2 1 1 1 1 2 2 2 1 1 2 2 1 2 1 2 2 1 2 2 1
## [4393] 2 1 2 1 2 2 2 1 2 2 1 1 1 1 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 1 2 1 2 1 1 1 1
## [4429] 1 2 2 2 2 2 1 1 1 2 1 2 2 2 2 1 2 1 1 2 1 2 2 2 1 2 2 1 2 1 1 1 2 2 2 1
## [4465] 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2 2 1 2 1 1 2 2 1 2 2 2 2 1 1 1
## [4501] 2 1 1 2 2 2 1 1 1 2 2 2 1 2 2 2 2 2 2 1 2 2 1 2 1 2 2 2 1 1 2 2 1 1 2 2 1
## [4537] 2 1 2 2 1 2 2 1 2 2 2 1 2 2 1 2 2 1 1 2 1 1 2 1 1 1 1 2 2 1 1 2 2 1 1 2 2
## [4573] 1 2 1 1 2 1 1 2 1 2 1 1 2 2 1 2 1 2 1 1 2 1 1 1 2 1 1 1 1 2 1 1 2 1 2 2
## [4609] 2 2 1 1 1 2 1 2 2 2 2 1 2 1 1 1 1 2 2 1 1 2 1 1 1 1 1 2 2 2 2 1 1 1 2 2
## [4645] 2 2 1 1 2 2 2 2 2 2 1 1 2 2 1 2 1 2 1 1 2 1 2 2 1 2 1 1 2 1 2 1 2 2 1 2
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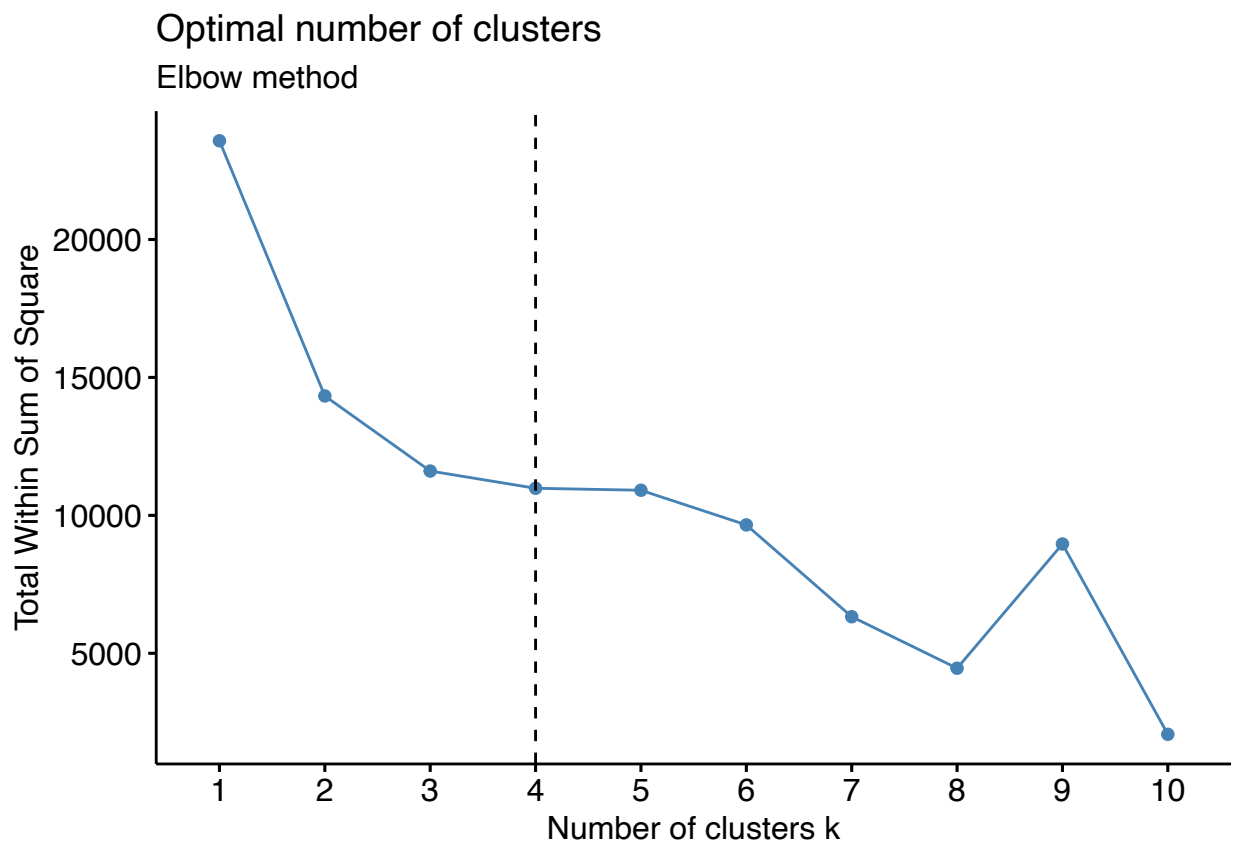
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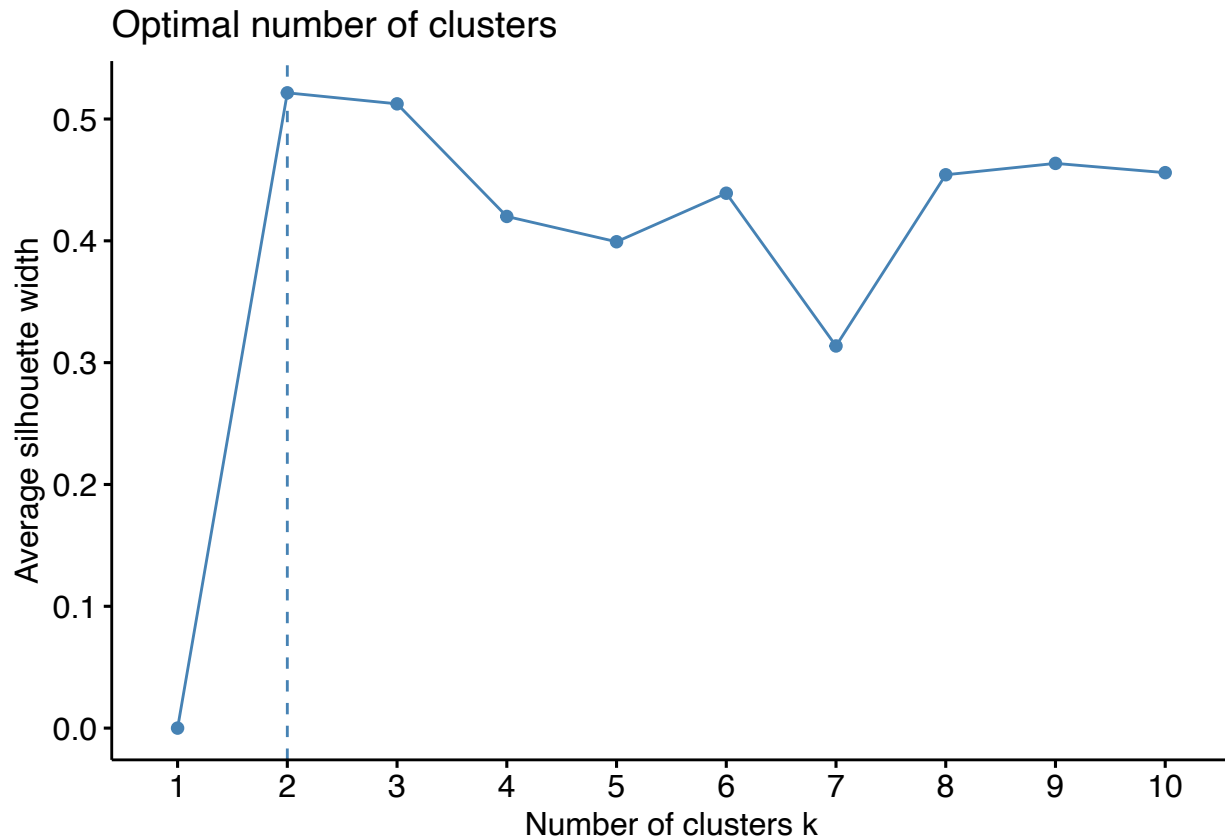
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## [11773] 1 2 1 2 1 2 2 2 1 2 2 2 2 1 1 2 1 2
##
## Within cluster sum of squares by cluster:
## [1] 12975.974 1309.439
## (between_SS / total_SS = 39.4 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
##
fviz_nbclust(johnson_2cols,kmeans,method = "wss") + geom_vline(xintercept = 4, linetype = 2) +
labs(subtitle = "Elbow method")
```



same checking process as the county'benton'

```
fviz_nbclust(johnson_2cols,kmeans,method = "silhouette")
```



```
#change the number of clusters
```

```
km.out <- kmeans(johnson_2cols, centers = 4, nstart = 50)
```

```
km.out
```

```
## K-means clustering with 4 clusters of sizes 3, 5280, 139, 6368
```

```
##
```

```
## Cluster means:
```

```
##   sale.dollars retail.price
```

```
## 1  43.6456753    2.6650347
```

```
## 2   0.1832905    0.9013112
```

```
## 3   4.0089757    1.2695007
```

```
## 4  -0.2600437   -0.7762844
```

```
##
```

```
## Clustering vector:
```

```
##   [1] 4 4 4 2 4 4 2 4 4 4 2 4 2 2 4 4 4 4 2 4 3 4 2 2 2 2 4 4 4 2 4 2 2 4
```

```
##  [37] 4 4 4 2 4 4 4 4 4 4 4 4 2 4 2 4 2 2 2 4 4 4 2 2 4 4 4 4 2 2 2 4 4 2 4
```

```
##  [73] 2 2 2 4 2 2 2 2 4 4 2 4 2 2 4 2 4 2 2 3 4 2 4 4 4 4 2 2 4 2 3 3 2 2
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##
## Within cluster sum of squares by cluster:
## [1] 239.3417 3996.5844 1191.8199 1221.3583
## (between_SS / total_SS = 71.8 %)
##

```

```
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"       "
```

```
liquor_johnson$cluster_id <- factor(km.out$cluster)
ggplot(liquor_johnson, aes(retail.price, sale.dollars, color = cluster_id)) +
  geom_point(alpha = 0.25) +
  xlab("retail price") +
  ylab("Price")
```

