

Simulating Clusters

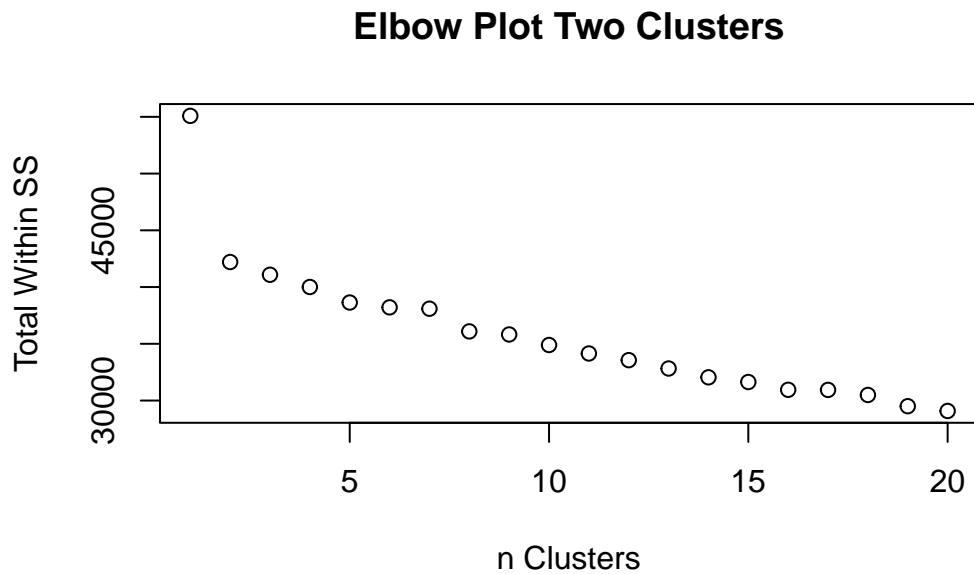
Illustrate what happens in randomly clustered data.

We want to better understand the output we obtained from our actual data. So, see what some ‘idealised’ scenarios for clustered data would look like.

Simulate our data

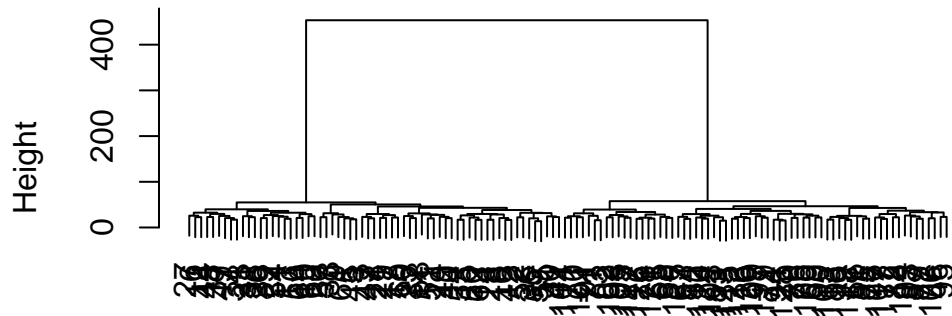
What if there are 2 clusters?

First, we get a noticeable elbow in the elbow plot:



Our dendrogram clearly shows four clusters, too:

Cluster Dendrogram



```
dist(sim)
hclust (*, "ward.D")
```

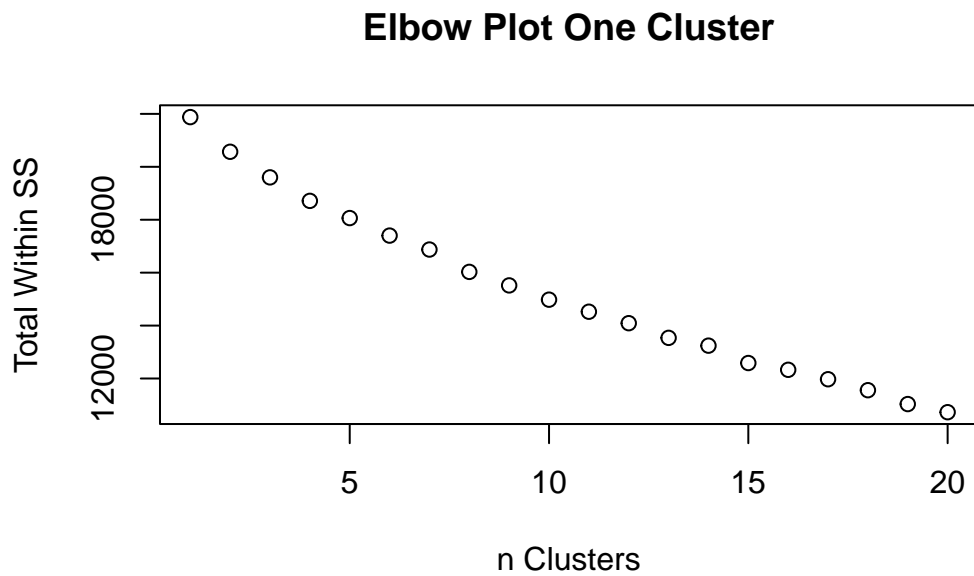
Third, when applying MDS to visualise, we get a nicely separated plot:



What if there is no cluster structure?

First, we don't get an elbow. Instead the within-SS decreases monotonically, showing slight slowing down the further we go - maybe exponential decay?

```
plot(1:20, within, main = "Elbow Plot One Cluster", xlab = "n Clusters", ylab = "Total Within SS")
```



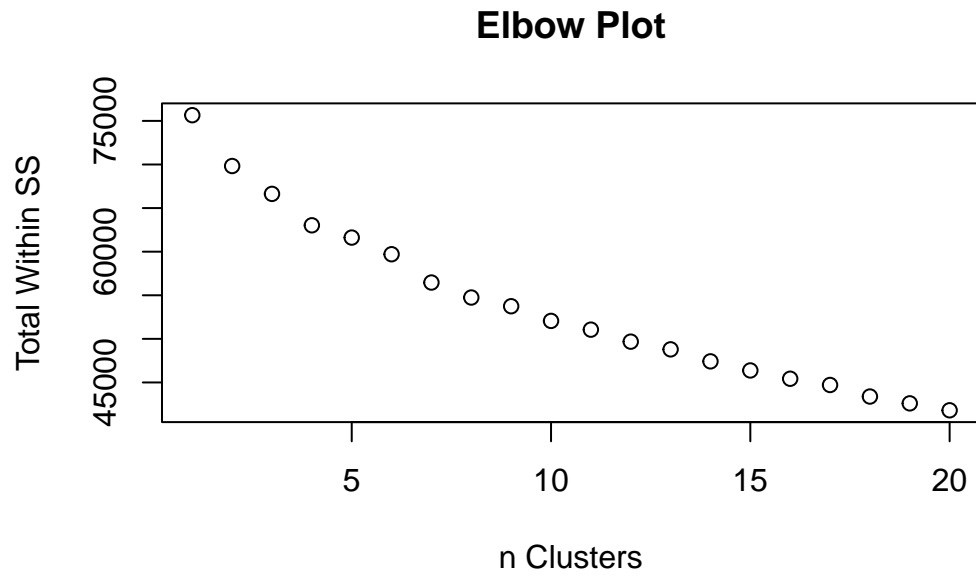
Ward's dendrogram shows a confused multi-layer structure with lots of 'clusters' within clusters with relatively low distance (height) between them:

Similarly, when applying MDS our spatial structure is implausible:

A scatter plot showing the relationship between two dimensions, dim1 (x-axis) and dim2 (y-axis). The x-axis ranges from approximately -12 to 15, and the y-axis ranges from -10 to 10. The plot displays two clusters of data points, labeled c1 and c2. Cluster c1 is represented by red dots and is generally located in the center-left region, with dim1 values between -10 and 5 and dim2 values between -5 and 5. Cluster c2 is represented by teal dots and is more widely distributed, with dim1 values ranging from -12 to 15 and dim2 values ranging from -10 to 10. The two clusters show some overlap in the central region of the plot.

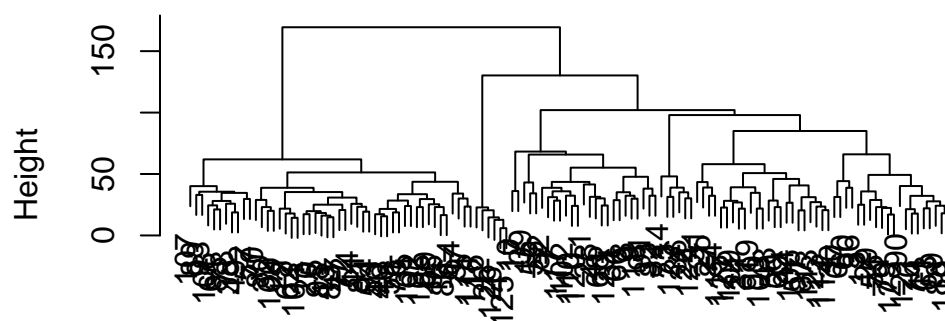
How does our real data look?

First, our elbow diagram lacks any clearly identifiable elbow:



Second, our dendrogram looks suspiciously similar to the random case:

Cluster Dendrogram



```
dist(dist_w1)  
hclust (*, "ward.D")
```

Third, the mds-plot looks conspicuously chaotic:

