

Class 8 Mini project

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It is important to consider scaling your data before analysis such as PCA

For example:

```
colMeans(mtcars)
```

	mpg	cyl	disp	hp	drat	wt	qsec
20.090625	6.187500	230.721875	146.687500	3.596563	3.217250	17.848750	
vs	am	gear	carb				
0.437500	0.406250	3.687500	2.812500				

```
apply(mtcars, 2, sd)
```

	mpg	cyl	disp	hp	drat	wt
6.0269481	1.7859216	123.9386938	68.5628685	0.5346787	0.9784574	
qsec	vs	am	gear	carb		
1.7869432	0.5040161	0.4989909	0.7378041	1.6152000		

```
x<- scale(mtcars)
head(x)
```

	mpg	cyl	disp	hp	drat	
Mazda RX4	0.1508848	-0.1049878	-0.57061982	-0.5350928	0.5675137	
Mazda RX4 Wag	0.1508848	-0.1049878	-0.57061982	-0.5350928	0.5675137	
Datsun 710	0.4495434	-1.2248578	-0.99018209	-0.7830405	0.4739996	
Hornet 4 Drive	0.2172534	-0.1049878	0.22009369	-0.5350928	-0.9661175	
Hornet Sportabout	-0.2307345	1.0148821	1.04308123	0.4129422	-0.8351978	
Valiant	-0.3302874	-0.1049878	-0.04616698	-0.6080186	-1.5646078	
wt	qsec	vs	am	gear		
Mazda RX4	-0.610399567	-0.7771651	-0.8680278	1.1899014	0.4235542	

```

Mazda RX4 Wag      -0.349785269 -0.4637808 -0.8680278  1.1899014  0.4235542
Datsun 710         -0.917004624  0.4260068  1.1160357  1.1899014  0.4235542
Hornet 4 Drive     -0.002299538  0.8904872  1.1160357 -0.8141431 -0.9318192
Hornet Sportabout  0.227654255 -0.4637808 -0.8680278 -0.8141431 -0.9318192
Valiant            0.248094592  1.3269868  1.1160357 -0.8141431 -0.9318192
                           carb
Mazda RX4          0.7352031
Mazda RX4 Wag      0.7352031
Datsun 710          -1.1221521
Hornet 4 Drive      -1.1221521
Hornet Sportabout   -0.5030337
Valiant             -1.1221521

```

```
round(colMeans(x), 2)
```

mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
0	0	0	0	0	0	0	0	0	0	0

Key point: It is usually always a good idea to scale your data before to PCA

Breast Cancer Biopsy Analysis

```

# Save your input data file into your Project directory
fna.data <- "WisconsinCancer.csv"

# Complete the following code to input the data and store as wisc.df
wisc.df <- read.csv(fna.data, row.names=1)

head(wisc.df)

  diagnosis radius_mean texture_mean perimeter_mean area_mean
842302           M       17.99      10.38       122.80    1001.0
842517           M       20.57      17.77       132.90    1326.0
84300903          M       19.69      21.25       130.00    1203.0
84348301          M       11.42      20.38       77.58     386.1
84358402          M       20.29      14.34       135.10    1297.0
843786           M       12.45      15.70       82.57     477.1
                           smoothness_mean compactness_mean concavity_mean concave.points_mean

```

842302	0.11840	0.27760	0.3001	0.14710
842517	0.08474	0.07864	0.0869	0.07017
84300903	0.10960	0.15990	0.1974	0.12790
84348301	0.14250	0.28390	0.2414	0.10520
84358402	0.10030	0.13280	0.1980	0.10430
843786	0.12780	0.17000	0.1578	0.08089
	symmetry_mean fractal_dimension_mean radius_se texture_se perimeter_se			
842302	0.2419	0.07871	1.0950	0.9053
842517	0.1812	0.05667	0.5435	0.7339
84300903	0.2069	0.05999	0.7456	0.7869
84348301	0.2597	0.09744	0.4956	1.1560
84358402	0.1809	0.05883	0.7572	0.7813
843786	0.2087	0.07613	0.3345	0.8902
	area_se smoothness_se compactness_se concavity_se concave.points_se			
842302	153.40	0.006399	0.04904	0.05373
842517	74.08	0.005225	0.01308	0.01860
84300903	94.03	0.006150	0.04006	0.03832
84348301	27.23	0.009110	0.07458	0.05661
84358402	94.44	0.011490	0.02461	0.05688
843786	27.19	0.007510	0.03345	0.03672
	symmetry_se fractal_dimension_se radius_worst texture_worst			
842302	0.03003	0.006193	25.38	17.33
842517	0.01389	0.003532	24.99	23.41
84300903	0.02250	0.004571	23.57	25.53
84348301	0.05963	0.009208	14.91	26.50
84358402	0.01756	0.005115	22.54	16.67
843786	0.02165	0.005082	15.47	23.75
	perimeter_worst area_worst smoothness_worst compactness_worst			
842302	184.60	2019.0	0.1622	0.6656
842517	158.80	1956.0	0.1238	0.1866
84300903	152.50	1709.0	0.1444	0.4245
84348301	98.87	567.7	0.2098	0.8663
84358402	152.20	1575.0	0.1374	0.2050
843786	103.40	741.6	0.1791	0.5249
	concavity_worst concave.points_worst symmetry_worst			
842302	0.7119	0.2654	0.4601	
842517	0.2416	0.1860	0.2750	
84300903	0.4504	0.2430	0.3613	
84348301	0.6869	0.2575	0.6638	
84358402	0.4000	0.1625	0.2364	
843786	0.5355	0.1741	0.3985	
	fractal_dimension_worst			
842302	0.11890			

```

842517          0.08902
84300903        0.08758
84348301        0.17300
84358402        0.07678
843786          0.12440

```

```

diagnosis <- wisc.df[,1]
table (diagnosis)

```

```

diagnosis
B   M
357 212

```

Remove this first ‘diagnosis’ column from the data set as I dont want to pass this to PCA etc.
It is essentially the expert “answer” that we will compare our analysis result to

```

# We can use -1 here to remove the first column
wisc.data <- wisc.df[,-1]
head(wisc.data)

```

	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean
842302	17.99	10.38	122.80	1001.0	0.11840
842517	20.57	17.77	132.90	1326.0	0.08474
84300903	19.69	21.25	130.00	1203.0	0.10960
84348301	11.42	20.38	77.58	386.1	0.14250
84358402	20.29	14.34	135.10	1297.0	0.10030
843786	12.45	15.70	82.57	477.1	0.12780
	compactness_mean	concavity_mean	concave.points_mean	symmetry_mean	
842302	0.27760	0.3001	0.14710	0.2419	
842517	0.07864	0.0869	0.07017	0.1812	
84300903	0.15990	0.1974	0.12790	0.2069	
84348301	0.28390	0.2414	0.10520	0.2597	
84358402	0.13280	0.1980	0.10430	0.1809	
843786	0.17000	0.1578	0.08089	0.2087	
	fractal_dimension_mean	radius_se	texture_se	perimeter_se	area_se
842302	0.07871	1.0950	0.9053	8.589	153.40
842517	0.05667	0.5435	0.7339	3.398	74.08
84300903	0.05999	0.7456	0.7869	4.585	94.03
84348301	0.09744	0.4956	1.1560	3.445	27.23
84358402	0.05883	0.7572	0.7813	5.438	94.44
843786	0.07613	0.3345	0.8902	2.217	27.19

	smoothness_se	compactness_se	concavity_se	concave.points_se	
842302	0.006399	0.04904	0.05373	0.01587	
842517	0.005225	0.01308	0.01860	0.01340	
84300903	0.006150	0.04006	0.03832	0.02058	
84348301	0.009110	0.07458	0.05661	0.01867	
84358402	0.011490	0.02461	0.05688	0.01885	
843786	0.007510	0.03345	0.03672	0.01137	
	symmetry_se	fractal_dimension_se	radius_worst	texture_worst	
842302	0.03003	0.006193	25.38	17.33	
842517	0.01389	0.003532	24.99	23.41	
84300903	0.02250	0.004571	23.57	25.53	
84348301	0.05963	0.009208	14.91	26.50	
84358402	0.01756	0.005115	22.54	16.67	
843786	0.02165	0.005082	15.47	23.75	
	perimeter_worst	area_worst	smoothness_worst	compactness_worst	
842302	184.60	2019.0	0.1622	0.6656	
842517	158.80	1956.0	0.1238	0.1866	
84300903	152.50	1709.0	0.1444	0.4245	
84348301	98.87	567.7	0.2098	0.8663	
84358402	152.20	1575.0	0.1374	0.2050	
843786	103.40	741.6	0.1791	0.5249	
	concavity_worst	concave.points_worst	symmetry_worst		
842302	0.7119	0.2654	0.4601		
842517	0.2416	0.1860	0.2750		
84300903	0.4504	0.2430	0.3613		
84348301	0.6869	0.2575	0.6638		
84358402	0.4000	0.1625	0.2364		
843786	0.5355	0.1741	0.3985		
	fractal_dimension_worst				
842302		0.11890			
842517		0.08902			
84300903		0.08758			
84348301		0.17300			
84358402		0.07678			
843786		0.12440			

Create diagnosis vector for later

```
diagnosis <- as.factor(wisc.df$diagnosis)
```

Explanatory data Analysis

Q1. How many observations are in this dataset?

```
# Count the number of observations in the dataset
num_observations <- nrow(wisc.df)
num_observations
```

```
[1] 569
```

Q2. How many of the observations have a malignant diagnosis?

```
# Count the number of malignant diagnosis
num_malignant <- sum(diagnosis == "M")
num_malignant
```

```
[1] 212
```

Q3. How many variables/features in the data are suffixed with _mean?

```
colnames(wisc.data)
```

```
[1] "radius_mean"           "texture_mean"
[3] "perimeter_mean"        "area_mean"
[5] "smoothness_mean"       "compactness_mean"
[7] "concavity_mean"        "concave.points_mean"
[9] "symmetry_mean"         "fractal_dimension_mean"
[11] "radius_se"             "texture_se"
[13] "perimeter_se"          "area_se"
[15] "smoothness_se"         "compactness_se"
[17] "concavity_se"          "concave.points_se"
[19] "symmetry_se"           "fractal_dimension_se"
[21] "radius_worst"          "texture_worst"
[23] "perimeter_worst"       "area_worst"
[25] "smoothness_worst"      "compactness_worst"
[27] "concavity_worst"       "concave.points_worst"
[29] "symmetry_worst"        "fractal_dimension_worst"
```

```
length(grep("_mean", colnames(wisc.data)))
```

```
[1] 10
```

Principle Component Analysis

```
wisc.pr <- prcomp( wisc.data, scale= T )
summary(wisc.pr)
```

Importance of components:

	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard deviation	3.6444	2.3857	1.67867	1.40735	1.28403	1.09880	0.82172
Proportion of Variance	0.4427	0.1897	0.09393	0.06602	0.05496	0.04025	0.02251
Cumulative Proportion	0.4427	0.6324	0.72636	0.79239	0.84734	0.88759	0.91010
	PC8	PC9	PC10	PC11	PC12	PC13	PC14
Standard deviation	0.69037	0.6457	0.59219	0.5421	0.51104	0.49128	0.39624
Proportion of Variance	0.01589	0.0139	0.01169	0.0098	0.00871	0.00805	0.00523
Cumulative Proportion	0.92598	0.9399	0.95157	0.9614	0.97007	0.97812	0.98335
	PC15	PC16	PC17	PC18	PC19	PC20	PC21
Standard deviation	0.30681	0.28260	0.24372	0.22939	0.22244	0.17652	0.1731
Proportion of Variance	0.00314	0.00266	0.00198	0.00175	0.00165	0.00104	0.0010
Cumulative Proportion	0.98649	0.98915	0.99113	0.99288	0.99453	0.99557	0.9966
	PC22	PC23	PC24	PC25	PC26	PC27	PC28
Standard deviation	0.16565	0.15602	0.1344	0.12442	0.09043	0.08307	0.03987
Proportion of Variance	0.00091	0.00081	0.0006	0.00052	0.00027	0.00023	0.00005
Cumulative Proportion	0.99749	0.99830	0.9989	0.99942	0.99969	0.99992	0.99997
	PC29	PC30					
Standard deviation	0.02736	0.01153					
Proportion of Variance	0.00002	0.00000					
Cumulative Proportion	1.00000	1.00000					

Main “PC score plot”, “PC1 vs PC2 plot”

See what is in our PCA result object:

```
attributes(wisc.pr)
```

```
$names
[1] "sdev"      "rotation"   "center"    "scale"     "x"

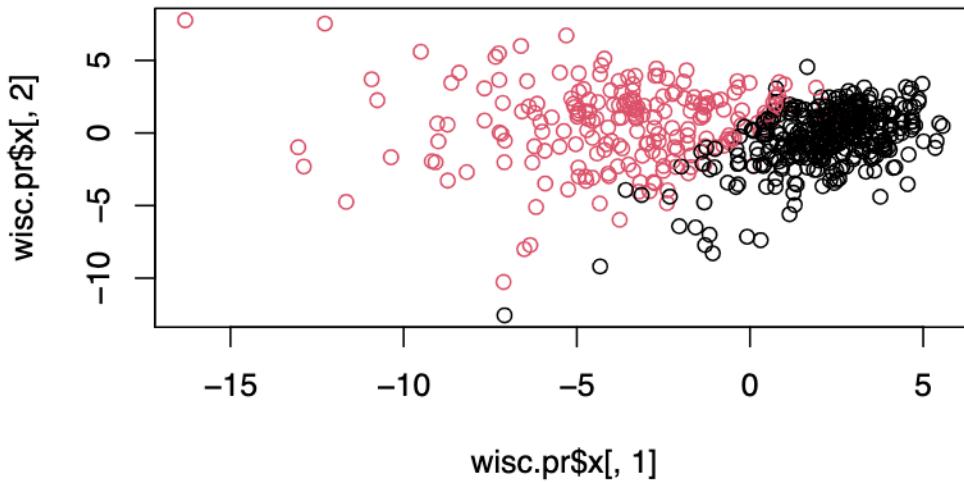
$class
[1] "prcomp"
```

```
head(wisc.pr$x)
```

	PC1	PC2	PC3	PC4	PC5	PC6
842302	-9.184755	-1.946870	-1.1221788	3.6305364	1.1940595	1.41018364
842517	-2.385703	3.764859	-0.5288274	1.1172808	-0.6212284	0.02863116
84300903	-5.728855	1.074229	-0.5512625	0.9112808	0.1769302	0.54097615
84348301	-7.116691	-10.266556	-3.2299475	0.1524129	2.9582754	3.05073750
84358402	-3.931842	1.946359	1.3885450	2.9380542	-0.5462667	-1.22541641
843786	-2.378155	-3.946456	-2.9322967	0.9402096	1.0551135	-0.45064213
	PC7	PC8	PC9	PC10	PC11	PC12
842302	2.15747152	0.39805698	-0.15698023	-0.8766305	-0.2627243	-0.8582593
842517	0.01334635	-0.24077660	-0.71127897	1.1060218	-0.8124048	0.1577838
84300903	-0.66757908	-0.09728813	0.02404449	0.4538760	0.6050715	0.1242777
84348301	1.42865363	-1.05863376	-1.40420412	-1.1159933	1.1505012	1.0104267
84358402	-0.93538950	-0.63581661	-0.26357355	0.3773724	-0.6507870	-0.1104183
843786	0.49001396	0.16529843	-0.13335576	-0.5299649	-0.1096698	0.0813699
	PC13	PC14	PC15	PC16	PC17	
842302	0.10329677	-0.690196797	0.601264078	0.74446075	-0.26523740	
842517	-0.94269981	-0.652900844	-0.008966977	-0.64823831	-0.01719707	
84300903	-0.41026561	0.016665095	-0.482994760	0.32482472	0.19075064	
84348301	-0.93245070	-0.486988399	0.168699395	0.05132509	0.48220960	
84358402	0.38760691	-0.538706543	-0.310046684	-0.15247165	0.13302526	
843786	-0.02625135	0.003133944	-0.178447576	-0.01270566	0.19671335	
	PC18	PC19	PC20	PC21	PC22	
842302	-0.54907956	0.1336499	0.34526111	0.096430045	-0.06878939	
842517	0.31801756	-0.2473470	-0.11403274	-0.077259494	0.09449530	
84300903	-0.08789759	-0.3922812	-0.20435242	0.310793246	0.06025601	
84348301	-0.03584323	-0.0267241	-0.46432511	0.433811661	0.20308706	
84358402	-0.01869779	0.4610302	0.06543782	-0.116442469	0.01763433	
843786	-0.29727706	-0.1297265	-0.07117453	-0.002400178	0.10108043	
	PC23	PC24	PC25	PC26	PC27	
842302	0.08444429	0.175102213	0.150887294	-0.201326305	-0.25236294	
842517	-0.21752666	-0.011280193	0.170360355	-0.041092627	0.18111081	
84300903	-0.07422581	-0.102671419	-0.171007656	0.004731249	0.04952586	
84348301	-0.12399554	-0.153294780	-0.077427574	-0.274982822	0.18330078	
84358402	0.13933105	0.005327110	-0.003059371	0.039219780	0.03213957	
843786	0.03344819	-0.002837749	-0.122282765	-0.030272333	-0.08438081	
	PC28	PC29	PC30			
842302	-0.0338846387	0.045607590	0.0471277407			
842517	0.0325955021	-0.005682424	0.0018662342			
84300903	0.0469844833	0.003143131	-0.0007498749			
84348301	0.0424469831	-0.069233868	0.0199198881			

```
84358402 -0.0347556386 0.005033481 -0.0211951203  
843786     0.0007296587 -0.019703996 -0.0034564331
```

```
plot(wisc.pr$x[,1], wisc.pr$x[,2],  
     col=as.factor(diagnosis))
```



Q4. From your results, what proportion of the original variance is captured by the first principal components (PC1)?

```
# Perform PCA on the data (assuming wisc.data is already prepared)  
pca_result <- prcomp(wisc.data, scale. = TRUE)  
  
# Calculate the proportion of variance captured by PC1  
proportion_pc1 <- (pca_result$sdev[1]^2/sum(pca_result$sdev^2))  
  
# Print the proportion  
proportion_pc1
```

```
[1] 0.4427203
```

Q5. How many principal components (PCs) are required to describe at least 70% of the original variance in the data?

```
# Perform PCA and calculate the number of PCs needed to explain at least 70% of the variance
num_pcs_70 <- which(cumsum((pca_result <- prcomp(wisc.data, scale. = TRUE))$sdev^2 / sum(pca_result$sdev^2) >= 0.7) == 1)

# Print the number of PCs required
num_pcs_70
```

[1] 3

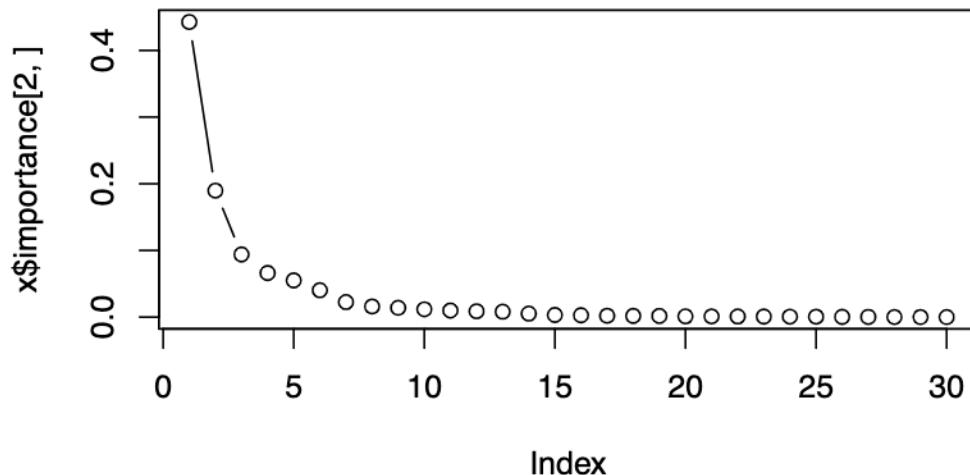
Q6. How many principal components (PCs) are required to describe at least 90% of the original variance in the data?

```
# Perform PCA and calculate the number of PCs needed to explain at least 90% of the variance
num_pcs_90 <- which(cumsum((pca_result <- prcomp(wisc.data, scale. = TRUE))$sdev^2 / sum(pca_result$sdev^2) >= 0.9) == 1)

# Print the number of PCs required
num_pcs_90
```

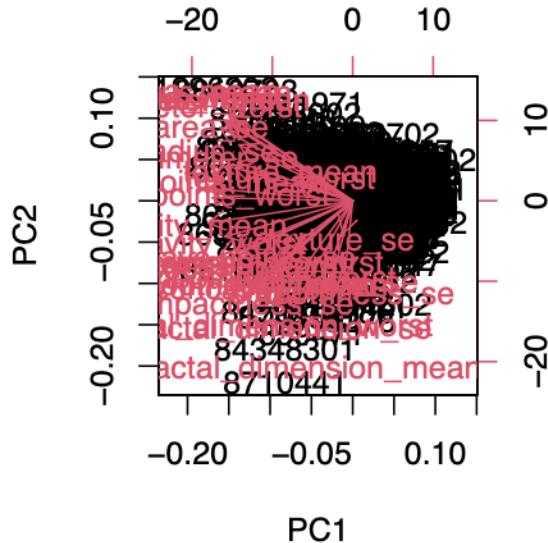
[1] 7

```
x <- summary(wisc.pr)
plot(x$importance[2,], type="b")
```



Q7. What stands out to you about this plot? Is it easy or difficult to understand?
Why?

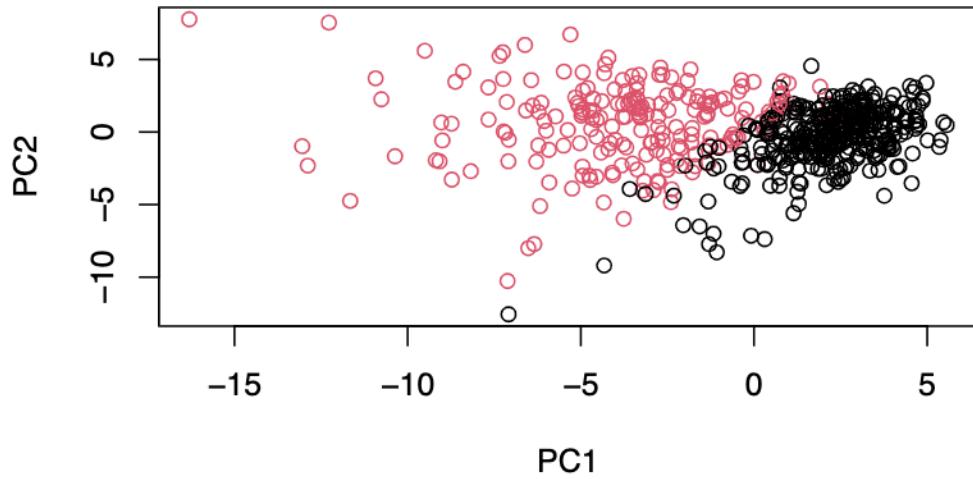
```
pca_result <- prcomp(wisc.data,scale. = TRUE)
biplot(pca_result)
```



The overlapping in the plot stands out. # It can be difficult to interpret due to no visible relationship.

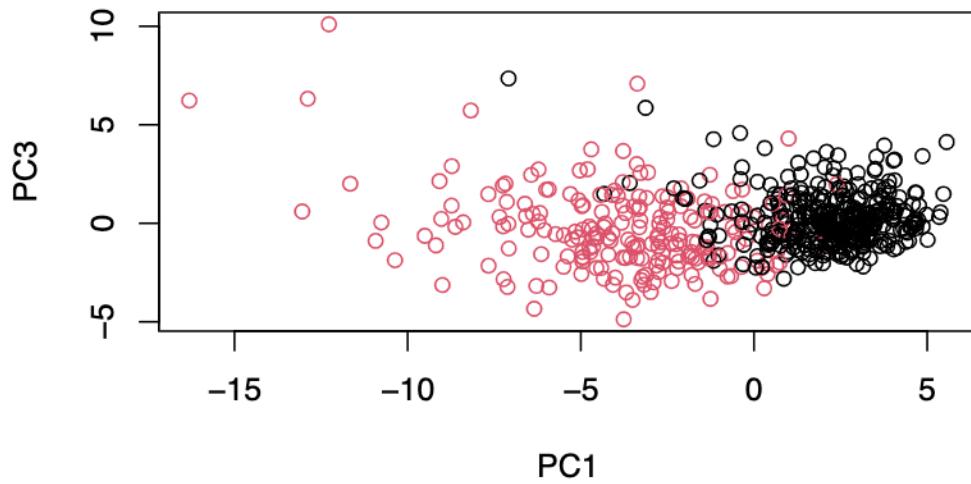
Scatter plot observations by components 1 and 2

```
plot( pca_result$x[, 1], pca_result$x[, 2], col = diagnosis ,
      xlab = "PC1", ylab = "PC2")
```



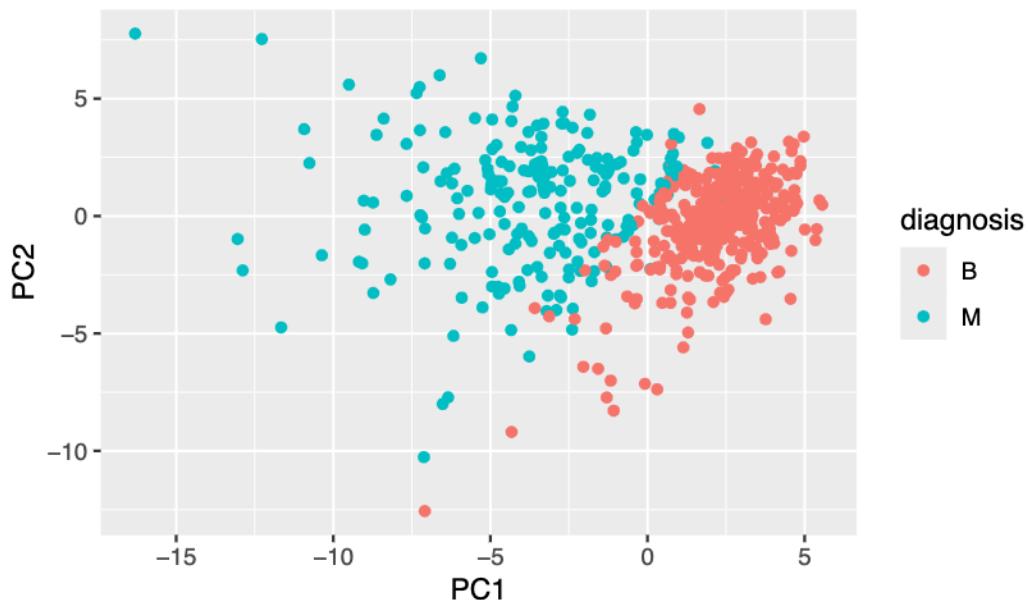
Q8. Generate a similar plot for principal components 1 and 3. What do you notice about these plots?

```
plot(wisc.pr$x[, 1], wisc.pr$x[,3], col = diagnosis,  
      xlab = "PC1", ylab = "PC3")
```



```
# Create a data.frame for ggplot
df <- as.data.frame(wisc.pr$x)
df$diagnosis <- diagnosis
# Load the ggplot2 package
library(ggplot2)
# Make a scatter plot colored by diagnosis
ggplot(df) +
  aes(PC1, PC2, col=diagnosis) +
  geom_point() +
  labs(title = "PCA Scatter Plot of PC1 vs PC2",
       x = "PC1",
       y = "PC2")
```

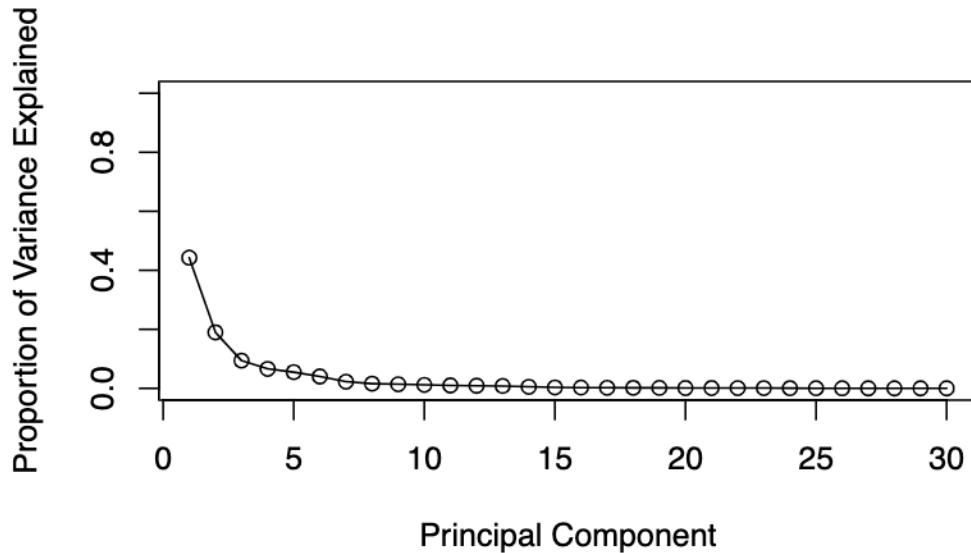
PCA Scatter Plot of PC1 vs PC2



```
# Calculate variance of each component  
pr.var <- wisc.pr$sdev^2  
head(pr.var)
```

```
[1] 13.281608 5.691355 2.817949 1.980640 1.648731 1.207357
```

```
# Variance explained by each principal component: pve  
pve <- pca_result$sdev^2 / sum(pca_result$sdev^2)  
# Plot variance explained for each principal component  
plot(pve, xlab = "Principal Component",  
     ylab = "Proportion of Variance Explained",  
     ylim = c(0, 1), type = "o")
```



Q9. For the first principal component, what is the component of the loading vector (i.e. `wisc.pr$rotation[,1]`) for the feature `concave.points_mean`?

```
# Assuming pca_result is the result of the PCA
loading_concave_points_mean <- pca_result$rotation["concave.points_mean", 1]
loading_concave_points_mean
```

[1] -0.2608538

Q10. What is the minimum number of principal components required to explain 80% of the variance of the data?

```
# Calculate the proportion of variance
pve <- pca_result$sdev^2 / sum(pca_result$sdev^2)
# Calculate cumulative variance
cumulative_variance <- cumsum(pve)
# at least 80% of the variance
num_pcs_80 <- which(cumulative_variance >= 0.80)[1]
num_pcs_80
```

[1] 5

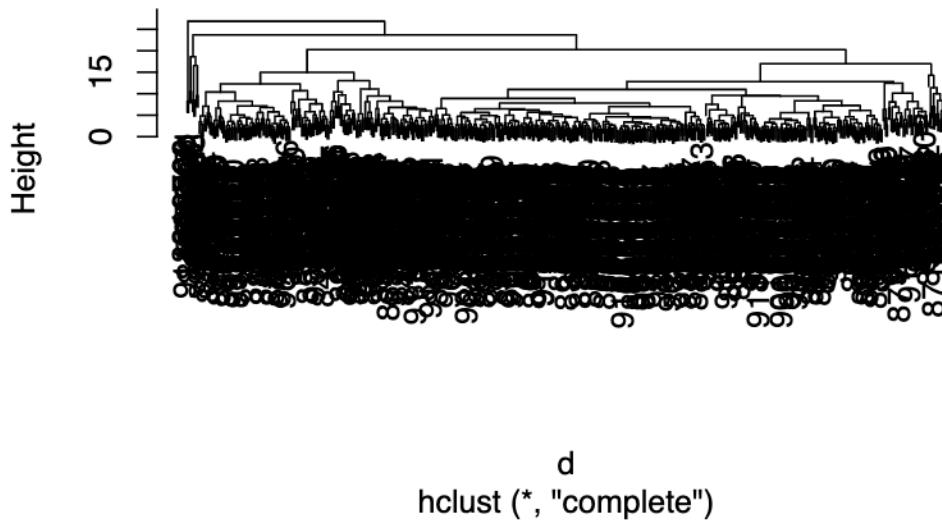
Hierarchical Clustering

```
# Scale the wisc.data data using the "scale()" function  
data.scaled <- scale(wisc.data)  
data.dist <- dist(data.scaled)  
wisc.hclust <- hclust(data.dist, method = "complete")
```

Q11. Using the plot() and abline() functions, what is the height at which the clustering model has 4 clusters?

```
d <- dist(scale(wisc.data))  
hc.raw <- hclust(d)  
plot(hc.raw)
```

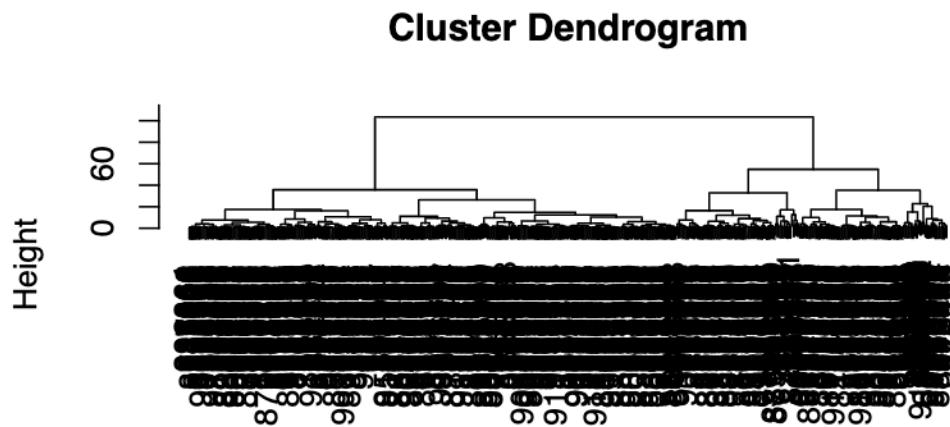
Cluster Dendrogram



Combine PCA and Clustering

Our PCA results were in 'wisc.pr'

```
#distance matrix from PCA result  
d <- dist(wisc.pr$x[,1:3])  
hc <- hclust(d, method= "ward.D2")  
plot(hc)
```

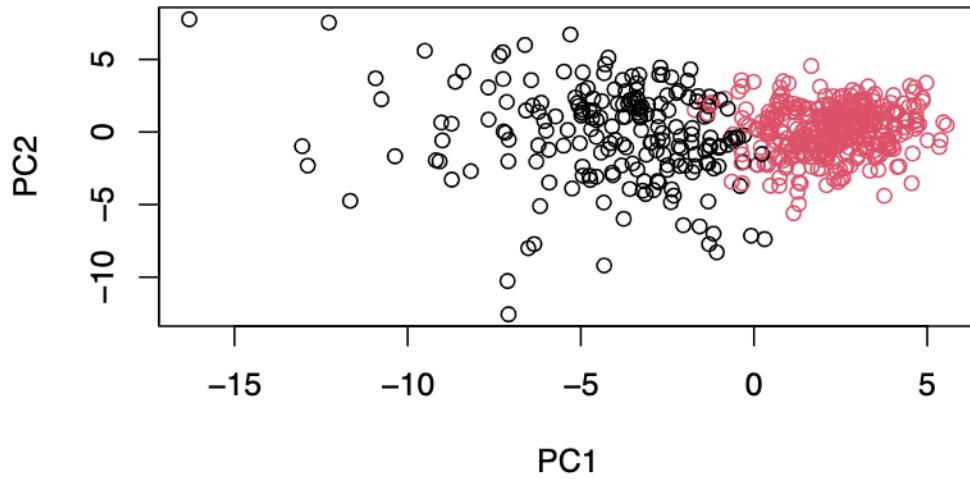


```
d  
hclust (*, "ward.D2")
```

```
grps <- cutree(hc, k=2)
```

Cute tree into two groups

```
plot(wisc.pr$x, col=grps)
```



```
wisc.hclust.clusters <- cutree(wisc.hclust, k=4)
table(wisc.hclust.clusters, diagnosis)
```

	diagnosis	
wisc.hclust.clusters	B	M
1	12	165
2	2	5
3	343	40
4	0	2

```
table(diagnosis, grps)
```

	grps	
diagnosis	1	2
B	24	333
M	179	33

```
table(grps)
```

	grps	
	1	2
203	366	

Q12. Can you find a better cluster vs diagnoses match by cutting into a different number of clusters between 2 and 10?

```
# Initialize results list
results <- lapply(2:10, function(k) {
  clusters <- cutree(wisc.hclust, k)
  table_clusters <- table(clusters, diagnosis)
  accuracy <- sum(apply(table_clusters, 1, max)) / nrow(wisc.data)
  list(clusters = clusters, table = table_clusters, accuracy = accuracy)
})
# Name the results list by cluster count
names(results) <- 2:10
results
```

	\$`2`	\$`2`\$clusters	842302	842517	84300903	84348301	84358402	843786	844359	84458202
1	1	1	1	1	1	1	1	1	1	1
844981	84501001	845636	84610002	846226	846381	84667401	84799002	1	1	1
1	1	1	1	1	1	1	1	1	1	1
848406	84862001	849014	8510426	8510653	8510824	8511133	851509	1	1	1
1	1	1	1	1	1	1	1	1	1	1
852552	852631	852763	852781	852973	853201	853401	853612	1	1	1
1	1	1	1	1	1	1	1	1	1	1
85382601	854002	854039	854253	854268	854941	855133	855138	1	1	1
1	1	1	1	1	1	1	1	1	1	1
855167	855563	855625	856106	85638502	857010	85713702	85715	1	1	1
1	1	1	1	1	1	1	1	1	1	1
857155	857156	857343	857373	857374	857392	857438	85759902	1	1	1
1	1	1	1	1	1	1	1	1	1	1
857637	857793	857810	858477	858970	858981	858986	859196	1	1	1
1	1	1	1	1	1	1	1	1	1	1
85922302	859283	859464	859465	859471	859487	859575	859711	1	1	1
1	1	1	1	1	1	1	1	1	1	1
859717	859983	8610175	8610404	8610629	8610637	8610862	8610908	1	1	1
1	1	1	1	1	1	1	1	1	1	1
861103	8611161	8611555	8611792	8612080	8612399	86135501	86135502	1	1	1
1	1	1	1	1	1	1	1	1	1	1
861597	861598	861648	861799	861853	862009	862028	86208	1	1	1
1	1	1	1	1	1	1	1	1	1	1
86211	862261	862485	862548	862717	862722	862965	862980	1	1	1
1	1	1	1	1	1	1	1	1	1	1

862989	863030	863031	863270	86355	864018	864033	86408
1	1	1	1	1	1	1	1
86409	864292	864496	864685	864726	864729	864877	865128
1	1	1	1	1	1	1	1
865137	86517	865423	865432	865468	86561	866083	866203
1	1	1	1	1	1	1	1
866458	866674	866714	8670	86730502	867387	867739	868202
1	1	1	1	1	1	1	1
868223	868682	868826	868871	868999	869104	869218	869224
1	1	1	1	1	1	1	1
869254	869476	869691	86973701	86973702	869931	871001501	871001502
1	1	1	1	1	1	1	1
8710441	87106	8711002	8711003	8711202	8711216	871122	871149
1	1	1	1	1	1	1	1
8711561	8711803	871201	8712064	8712289	8712291	87127	8712729
1	1	1	1	1	1	1	1
8712766	8712853	87139402	87163	87164	871641	871642	872113
1	1	1	1	1	1	1	1
872608	87281702	873357	873586	873592	873593	873701	873843
1	1	1	1	1	1	1	1
873885	874158	874217	874373	874662	874839	874858	875093
1	1	1	1	1	1	1	1
875099	875263	87556202	875878	875938	877159	877486	877500
1	1	1	1	1	1	1	1
877501	877989	878796	87880	87930	879523	879804	879830
1	1	1	1	1	1	1	1
8810158	8810436	881046502	8810528	8810703	881094802	8810955	8810987
1	1	1	1	2	1	1	1
8811523	8811779	8811842	88119002	8812816	8812818	8812844	8812877
1	1	1	1	1	1	1	1
8813129	88143502	88147101	88147102	88147202	881861	881972	88199202
1	1	1	1	1	1	1	1
88203002	88206102	882488	88249602	88299702	883263	883270	88330202
1	1	1	1	1	1	1	1
88350402	883539	883852	88411702	884180	884437	884448	884626
1	1	1	1	1	1	1	1
88466802	884689	884948	88518501	885429	8860702	886226	886452
1	1	1	1	1	1	1	1
88649001	886776	887181	88725602	887549	888264	888570	889403
1	1	1	1	1	1	1	1
889719	88995002	8910251	8910499	8910506	8910720	8910721	8910748
1	1	1	1	1	1	1	1
8910988	8910996	8911163	8911164	8911230	8911670	8911800	8911834

1	1	1	1	1	1	1	1	1
8912049	8912055	89122	8912280	8912284	8912521	8912909	8913	
1	1	1	1	1	1	1	1	1
8913049	89143601	89143602	8915	891670	891703	891716	891923	
1	1	1	1	1	1	1	1	1
891936	892189	892214	892399	892438	892604	89263202	892657	
1	1	1	1	1	1	1	1	1
89296	893061	89344	89346	893526	893548	893783	89382601	
1	1	1	1	1	1	1	1	1
89382602	893988	894047	894089	894090	894326	894329	894335	
1	1	1	1	1	1	1	1	1
894604	894618	894855	895100	89511501	89511502	89524	895299	
1	1	1	1	1	1	1	1	1
8953902	895633	896839	896864	897132	897137	897374	89742801	
1	1	1	1	1	1	1	1	1
897604	897630	897880	89812	89813	898143	89827	898431	
1	1	1	1	1	1	1	1	1
89864002	898677	898678	89869	898690	899147	899187	899667	
1	1	1	1	1	1	1	1	1
899987	9010018	901011	9010258	9010259	901028	9010333	901034301	
1	1	1	1	1	1	1	1	1
901034302	901041	9010598	9010872	9010877	901088	9011494	9011495	
1	1	1	1	1	1	1	1	1
9011971	9012000	9012315	9012568	9012795	901288	9013005	901303	
1	1	1	1	1	1	1	1	1
901315	9013579	9013594	9013838	901549	901836	90250	90251	
1	1	1	1	1	1	1	1	1
902727	90291	902975	902976	903011	90312	90317302	903483	
1	1	1	1	1	1	1	1	1
903507	903516	903554	903811	90401601	90401602	904302	904357	
1	1	1	1	1	1	1	1	1
90439701	904647	904689	9047	904969	904971	905189	905190	
1	1	1	1	1	1	1	1	1
90524101	905501	905502	905520	905539	905557	905680	905686	
1	1	1	1	1	1	1	1	1
905978	90602302	906024	906290	906539	906564	906616	906878	
1	1	1	1	1	1	1	1	1
907145	907367	907409	90745	90769601	90769602	907914	907915	
1	1	1	1	1	1	1	1	1
908194	908445	908469	908489	908916	909220	909231	909410	
1	1	1	1	1	1	1	1	1
909411	909445	90944601	909777	9110127	9110720	9110732	9110944	
1	1	1	1	1	1	1	1	1

911150	911157302	9111596	9111805	9111843	911201	911202	9112085
1	1	1	1	1	1	1	1
9112366	9112367	9112594	9112712	911296201	911296202	9113156	911320501
1	1	1	1	1	2	1	1
911320502	9113239	9113455	9113514	9113538	911366	9113778	9113816
1	1	1	1	1	1	1	1
911384	9113846	911391	911408	911654	911673	911685	911916
1	1	1	1	1	1	1	1
912193	91227	912519	912558	912600	913063	913102	913505
1	1	1	1	1	1	1	1
913512	913535	91376701	91376702	914062	914101	914102	914333
1	1	1	1	1	1	1	1
914366	914580	914769	91485	914862	91504	91505	915143
1	1	1	1	1	1	1	1
915186	915276	91544001	91544002	915452	915460	91550	915664
1	1	1	1	1	1	1	1
915691	915940	91594602	916221	916799	916838	917062	917080
1	1	1	1	1	1	1	1
917092	91762702	91789	917896	917897	91805	91813701	91813702
1	1	1	1	1	1	1	1
918192	918465	91858	91903901	91903902	91930402	919537	919555
1	1	1	1	1	1	1	1
91979701	919812	921092	921362	921385	921386	921644	922296
1	1	1	1	1	1	1	1
922297	922576	922577	922840	923169	923465	923748	923780
1	1	1	1	1	1	1	1
924084	924342	924632	924934	924964	925236	925277	925291
1	1	1	1	1	1	1	1
925292	925311	925622	926125	926424	926682	926954	927241
1	1	1	1	1	1	1	1
92751							
	1						

```
$`2`$table
      diagnosis
clusters   B   M
  1 357 210
  2   0   2
```

```
$`2`$accuracy
[1] 0.6309315
```

\$`3`

\$`3`\$clusters

842302	842517	84300903	84348301	84358402	843786	844359	84458202
1	1	1	2	1	1	1	1
844981	84501001	845636	84610002	846226	846381	84667401	84799002
1	2	1	1	1	1	1	1
848406	84862001	849014	8510426	8510653	8510824	8511133	851509
1	1	1	1	1	1	1	1
852552	852631	852763	852781	852973	853201	853401	853612
1	1	1	1	1	1	1	1
85382601	854002	854039	854253	854268	854941	855133	855138
1	1	1	1	1	1	1	1
855167	855563	855625	856106	85638502	857010	85713702	85715
1	1	1	1	1	1	1	1
857155	857156	857343	857373	857374	857392	857438	85759902
1	1	1	1	1	1	1	1
857637	857793	857810	858477	858970	858981	858986	859196
1	1	1	1	1	1	1	1
85922302	859283	859464	859465	859471	859487	859575	859711
1	1	1	1	2	1	1	1
859717	859983	8610175	8610404	8610629	8610637	8610862	8610908
1	1	1	1	1	1	2	1
861103	8611161	8611555	8611792	8612080	8612399	86135501	86135502
1	1	1	1	1	1	1	1
861597	861598	861648	861799	861853	862009	862028	86208
1	1	1	1	1	1	1	1
86211	862261	862485	862548	862717	862722	862965	862980
1	1	1	1	1	1	1	1
862989	863030	863031	863270	86355	864018	864033	86408
1	1	1	1	1	1	1	1
86409	864292	864496	864685	864726	864729	864877	865128
1	1	1	1	1	1	1	1
865137	86517	865423	865432	865468	86561	866083	866203
1	1	2	1	1	1	1	1
866458	866674	866714	8670	86730502	867387	867739	868202
1	1	1	1	1	1	1	1
868223	868682	868826	868871	868999	869104	869218	869224
1	1	1	1	1	1	1	1
869254	869476	869691	86973701	86973702	869931	871001501	871001502
1	1	1	1	1	1	1	1
8710441	87106	8711002	8711003	8711202	8711216	871122	871149
2	1	1	1	1	1	1	1
8711561	8711803	871201	8712064	8712289	8712291	87127	8712729

1	1	1	1	1	1	1	1	1
8712766	8712853	87139402	87163	87164	871641	871642	872113	
1	1	1	1	1	1	1	1	1
872608	87281702	873357	873586	873592	873593	873701	873843	
1	1	1	1	1	1	1	1	1
873885	874158	874217	874373	874662	874839	874858	875093	
1	1	1	1	1	1	1	2	1
875099	875263	87556202	875878	875938	877159	877486	877500	
1	1	1	1	1	1	1	1	1
877501	877989	878796	87880	87930	879523	879804	879830	
1	1	1	1	1	1	1	1	1
8810158	8810436	881046502	8810528	8810703	881094802	8810955	8810987	
1	1	1	1	3	1	1	1	1
8811523	8811779	8811842	88119002	8812816	8812818	8812844	8812877	
1	1	1	1	1	1	1	1	1
8813129	88143502	88147101	88147102	88147202	881861	881972	88199202	
1	1	1	1	1	1	1	1	1
88203002	88206102	882488	88249602	88299702	883263	883270	88330202	
1	1	1	1	1	1	1	1	1
88350402	883539	883852	88411702	884180	884437	884448	884626	
1	1	1	1	1	1	1	1	1
88466802	884689	884948	88518501	885429	8860702	886226	886452	
1	1	1	1	1	1	1	1	1
88649001	886776	887181	88725602	887549	888264	888570	889403	
1	1	1	1	1	1	1	1	1
889719	88995002	8910251	8910499	8910506	8910720	8910721	8910748	
1	1	1	1	1	1	1	1	1
8910988	8910996	8911163	8911164	8911230	8911670	8911800	8911834	
1	1	1	1	1	1	1	1	1
8912049	8912055	89122	8912280	8912284	8912521	8912909	8913	
1	1	1	1	1	1	1	1	1
8913049	89143601	89143602	8915	891670	891703	891716	891923	
1	1	1	1	1	1	1	1	1
891936	892189	892214	892399	892438	892604	89263202	892657	
1	1	1	1	1	1	1	1	1
89296	893061	89344	89346	893526	893548	893783	89382601	
1	1	1	1	1	1	1	1	1
89382602	893988	894047	894089	894090	894326	894329	894335	
1	1	1	1	1	1	1	1	1
894604	894618	894855	895100	89511501	89511502	89524	895299	
1	1	1	1	1	1	1	1	1
8953902	895633	896839	896864	897132	897137	897374	89742801	
1	1	1	1	1	1	1	1	1

897604	897630	897880	89812	89813	898143	89827	898431
1	1	1	1	1	1	1	1
89864002	898677	898678	89869	898690	899147	899187	899667
1	1	1	1	1	1	1	1
899987	9010018	901011	9010258	9010259	901028	9010333	901034301
1	1	1	1	1	1	1	1
901034302	901041	9010598	9010872	9010877	901088	9011494	9011495
1	1	1	1	1	1	1	1
9011971	9012000	9012315	9012568	9012795	901288	9013005	901303
1	1	1	1	1	1	1	1
901315	9013579	9013594	9013838	901549	901836	90250	90251
1	1	1	1	1	1	1	1
902727	90291	902975	902976	903011	90312	90317302	903483
1	1	1	1	1	1	1	1
903507	903516	903554	903811	90401601	90401602	904302	904357
1	1	1	1	1	1	1	1
90439701	904647	904689	9047	904969	904971	905189	905190
1	1	1	1	1	1	1	1
90524101	905501	905502	905520	905539	905557	905680	905686
1	1	1	1	1	1	1	1
905978	90602302	906024	906290	906539	906564	906616	906878
1	1	1	1	1	1	1	1
907145	907367	907409	90745	90769601	90769602	907914	907915
1	1	1	1	1	1	1	1
908194	908445	908469	908489	908916	909220	909231	909410
1	1	1	1	1	1	1	1
909411	909445	90944601	909777	9110127	9110720	9110732	9110944
1	1	1	1	1	1	1	1
911150	911157302	9111596	9111805	9111843	911201	911202	9112085
1	1	1	1	1	1	1	1
9112366	9112367	9112594	9112712	911296201	911296202	9113156	911320501
1	1	1	1	1	3	1	1
911320502	9113239	9113455	9113514	9113538	911366	9113778	9113816
1	1	1	1	1	1	1	1
911384	9113846	911391	911408	911654	911673	911685	911916
1	1	1	1	1	1	1	1
912193	91227	912519	912558	912600	913063	913102	913505
1	1	1	1	1	1	1	1
913512	913535	91376701	91376702	914062	914101	914102	914333
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925292	925311	925622	926125	926424	926682	926954	927241

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$`4`$accuracy
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$`5`$accuracy
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      1       1       1       1       1       3       1       1
 85382601   854002   854039   854253   854268   854941   855133   855138
      1       1       1       1       1       3       3       1
 855167   855563   855625   856106   85638502   857010   85713702   85715
      3       1       1       1       1       1       3       1
 857155   857156   857343   857373   857374   857392   857438   85759902
      3       3       3       3       3       1       3       3
 857637   857793   857810   858477   858970   858981   858986   859196
      1       1       3       3       3       3       1       3
 85922302   859283   859464   859465   859471   859487   859575   859711
      1       1       3       3       4       3       1       5
 859717   859983   8610175   8610404   8610629   8610637   8610862   8610908
      1       1       3       3       3       1       2       3
 861103   8611161   8611555   8611792   8612080   8612399   86135501   86135502
      3       1       1       1       3       1       3       1
 861597   861598   861648   861799   861853   862009   862028   86208
      3       1       3       3       3       3       1       1
 86211    862261   862485   862548   862717   862722   862965   862980
      3       3       3       3       3       3       3       3
 862989   863030   863031   863270   86355   864018   864033   86408
      3       1       1       3       1       3       3       3
 86409    864292   864496   864685   864726   864729   864877   865128
      5       3       3       3       3       1       1       3
 865137   86517    865423   865432   865468   86561   866083   866203
      3       1       2       3       3       3       1       3
 866458   866674   866714   8670   86730502   867387   867739   868202
      1       1       3       1       1       3       1       3
 868223   868682   868826   868871   868999   869104   869218   869224
      3       3       1       3       3       3       3       3
 869254   869476   869691   86973701   86973702   869931 871001501 871001502
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872608	87281702	873357	873586	873592	873593	873701	873843	
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875099	875263	87556202	875878	875938	877159	877486	877500	
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8810158	8810436	881046502	8810528	8810703	881094802	8810955	8810987	
1	3	1	3	6	5	1	1	1
8811523	8811779	8811842	88119002	8812816	8812818	8812844	8812877	
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8813129	88143502	88147101	88147102	88147202	881861	881972	88199202	
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88203002	88206102	882488	88249602	88299702	883263	883270	88330202	
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901315	9013579	9013594	9013838	901549	901836	90250	90251
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90524101	905501	905502	905520	905539	905557	905680	905686
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909411	909445	90944601	909777	9110127	9110720	9110732	9110944
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911320502	9113239	9113455	9113514	9113538	911366	9113778	9113816
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911384	9113846	911391	911408	911654	911673	911685	911916
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913512	913535	91376701	91376702	914062	914101	914102	914333

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914366	914580	914769	91485	914862	91504	91505	915143
1	3	1	1	3	1	3	1
915186	915276	91544001	91544002	915452	915460	91550	915664
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915691	915940	91594602	916221	916799	916838	917062	917080
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917092	91762702	91789	917896	917897	91805	91813701	91813702
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918192	918465	91858	91903901	91903902	91930402	919537	919555
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91979701	919812	921092	921362	921385	921386	921644	922296
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922297	922576	922577	922840	923169	923465	923748	923780
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924084	924342	924632	924934	924964	925236	925277	925291
3	3	3	3	3	3	3	3
925292	925311	925622	926125	926424	926682	926954	927241
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92751							
3							

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$`6`$table
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      3 331 39
      4  2  0
      5 12  1
      6  0  2
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$`6`$accuracy
[1] 0.9086116
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      1       2       3       1       1       3       1       1
  848406   84862001   849014   8510426   8510653   8510824   8511133   851509
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85382601	854002	854039	854253	854268	854941	855133	855138
1	1	1	1	1	3	3	1
855167	855563	855625	856106	85638502	857010	85713702	85715
3	1	1	1	1	1	3	1
857155	857156	857343	857373	857374	857392	857438	85759902
3	3	3	3	3	1	3	3
857637	857793	857810	858477	858970	858981	858986	859196
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85922302	859283	859464	859465	859471	859487	859575	859711
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859717	859983	8610175	8610404	8610629	8610637	8610862	8610908
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861103	8611161	8611555	8611792	8612080	8612399	86135501	86135502
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861597	861598	861648	861799	861853	862009	862028	86208
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86211	862261	862485	862548	862717	862722	862965	862980
3	3	3	3	3	3	3	3
862989	863030	863031	863270	86355	864018	864033	86408
3	1	1	3	1	3	3	3
86409	864292	864496	864685	864726	864729	864877	865128
5	3	3	3	3	1	1	3
865137	86517	865423	865432	865468	86561	866083	866203
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866458	866674	866714	8670	86730502	867387	867739	868202
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868223	868682	868826	868871	868999	869104	869218	869224
3	3	1	3	3	3	3	3
869254	869476	869691	86973701	86973702	869931	871001501	871001502
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8710441	87106	8711002	8711003	8711202	8711216	871122	871149
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8712766	8712853	87139402	87163	87164	871641	871642	872113
1	3	3	3	1	3	3	3
872608	87281702	873357	873586	873592	873593	873701	873843
5	1	3	3	1	1	1	3
873885	874158	874217	874373	874662	874839	874858	875093
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875099	875263	87556202	875878	875938	877159	877486	877500
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877501	877989	878796	87880	87930	879523	879804	879830
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8810158	8810436	881046502	8810528	8810703	881094802	8810955	8810987
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8811523	8811779	8811842	88119002	8812816	8812818	8812844	8812877
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8813129	88143502	88147101	88147102	88147202	881861	881972	88199202
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88203002	88206102	882488	88249602	88299702	883263	883270	88330202
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88350402	883539	883852	88411702	884180	884437	884448	884626
3	3	5	3	1	3	3	3
88466802	884689	884948	88518501	885429	8860702	886226	886452
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88649001	886776	887181	88725602	887549	888264	888570	889403
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889719	88995002	8910251	8910499	8910506	8910720	8910721	8910748
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89296	893061	89344	89346	893526	893548	893783	89382601
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894604	894618	894855	895100	89511501	89511502	89524	895299
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8953902	895633	896839	896864	897132	897137	897374	89742801
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89864002	898677	898678	89869	898690	899147	899187	899667
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901034302	901041	9010598	9010872	9010877	901088	9011494	9011495

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9011971	9012000	9012315	9012568	9012795	901288	9013005	901303	
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901315	9013579	9013594	9013838	901549	901836	90250	90251	
5	3	3	1	3	3	3	3	3
902727	90291	902975	902976	903011	90312	90317302	903483	
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90524101	905501	905502	905520	905539	905557	905680	905686	
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907145	907367	907409	90745	90769601	90769602	907914	907915	
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908194	908445	908469	908489	908916	909220	909231	909410	
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909411	909445	90944601	909777	9110127	9110720	9110732	9110944	
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911320502	9113239	9113455	9113514	9113538	911366	9113778	9113816	
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917092	91762702	91789	917896	917897	91805	91813701	91813702	
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918192	918465	91858	91903901	91903902	91930402	919537	919555	
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922297	922576	922577	922840	923169	923465	923748	923780
3	3	3	3	3	3	3	3
924084	924342	924632	924934	924964	925236	925277	925291
3	3	3	3	3	3	3	3
925292	925311	925622	926125	926424	926682	926954	927241
3	3	1	1	1	1	3	1
92751							
3							

\$`7`\$table

	diagnosis	
clusters	B	M
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2	0	3
3	331	39
4	2	0
5	12	1
6	0	2
7	0	2

\$`7`\$accuracy

[1] 0.9086116

\$`8`

\$`8`\$clusters

842302	842517	84300903	84348301	84358402	843786	844359	84458202
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1	3	4	1	2	4	1	1
848406	84862001	849014	8510426	8510653	8510824	8511133	851509
4	1	2	4	4	4	1	2
852552	852631	852763	852781	852973	853201	853401	853612
2	1	1	2	1	4	1	1
85382601	854002	854039	854253	854268	854941	855133	855138
1	1	1	1	1	4	4	1
855167	855563	855625	856106	85638502	857010	85713702	85715
4	1	2	1	1	2	4	1
857155	857156	857343	857373	857374	857392	857438	85759902
4	4	4	4	4	2	4	4
857637	857793	857810	858477	858970	858981	858986	859196

2	1	4	4	4	4	4	1	4
85922302	859283	859464	859465	859471	859487	859575	859711	
1	1	4	4	5	4	2		6
859717	859983	8610175	8610404	8610629	8610637	8610862	8610908	
1	1	4	4	4	2	7		4
861103	8611161	8611555	8611792	8612080	8612399	86135501	86135502	
4	1	2	2	4	2	4		2
861597	861598	861648	861799	861853	862009	862028	86208	
4	1	4	4	4	4	1		2
86211	862261	862485	862548	862717	862722	862965	862980	
4	4	4	4	4	4	4		4
862989	863030	863031	863270	86355	864018	864033	86408	
4	1	1	4	2	4	4		4
86409	864292	864496	864685	864726	864729	864877	865128	
6	4	4	4	4	1	1		4
865137	86517	865423	865432	865468	86561	866083	866203	
4	2	7	4	4	4	1		4
866458	866674	866714	8670	86730502	867387	867739	868202	
1	1	4	1	1	4	1		4
868223	868682	868826	868871	868999	869104	869218	869224	
4	4	1	4	4	4	4		4
869254	869476	869691	86973701	86973702	869931	871001501	871001502	
4	4	1	4	4	4	4		6
8710441	87106	8711002	8711003	8711202	8711216	871122	871149	
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$`8`$table
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  8    0   2

$`8`$accuracy
[1] 0.9086116

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  848406   84862001  849014  8510426  8510653  8510824  8511133  851509
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  4         4         4         4         4         2         4         4
  857637   857793  857810  858477  858970  858981  858986  859196
  2         1         4         4         4         4         1         4
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  859717   859983  8610175  8610404  8610629  8610637  8610862  8610908
  1         1         4         4         4         2         7         4
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\$`9`\$accuracy
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8912049	8912055	89122	8912280	8912284	8912521	8912909	8913
1	4	2	1	4	4	4	4
8913049	89143601	89143602	8915	891670	891703	891716	891923
4	4	7	4	4	4	4	4
891936	892189	892214	892399	892438	892604	89263202	892657

4	4	4	4	5	4	5	4	
89296	893061	89344	89346	893526	893548	893783	89382601	
4	4	4	4	4	4	4	4	4
89382602	893988	894047	894089	894090	894326	894329	894335	
4	4	4	4	4	1	7	4	
894604	894618	894855	895100	89511501	89511502	89524	895299	
4	4	4	1	4	4	4	4	4
8953902	895633	896839	896864	897132	897137	897374	89742801	
1	1	1	1	4	4	4	4	2
897604	897630	897880	89812	89813	898143	89827	898431	
4	2	4	2	4	4	4	4	2
89864002	898677	898678	89869	898690	899147	899187	899667	
4	4	4	4	4	4	4	4	1
899987	9010018	901011	9010258	9010259	901028	9010333	901034301	
2	1	4	4	4	4	4	4	4
901034302	901041	9010598	9010872	9010877	901088	9011494	9011495	
4	4	4	4	4	2	2	2	4
9011971	9012000	9012315	9012568	9012795	901288	9013005	901303	
2	2	1	4	2	2	4	4	
901315	9013579	9013594	9013838	901549	901836	90250	90251	
7	4	4	1	4	4	4	4	4
902727	90291	902975	902976	903011	90312	90317302	903483	
4	4	4	4	4	5	4	4	
903507	903516	903554	903811	90401601	90401602	904302	904357	
1	1	4	4	4	4	4	4	
90439701	904647	904689	9047	904969	904971	905189	905190	
1	4	4	4	4	4	4	4	
90524101	905501	905502	905520	905539	905557	905680	905686	
1	4	4	4	4	4	4	4	
905978	90602302	906024	906290	906539	906564	906616	906878	
4	5	4	4	4	1	4	4	
907145	907367	907409	90745	90769601	90769602	907914	907915	
4	4	4	4	4	4	1	4	
908194	908445	908469	908489	908916	909220	909231	909410	
2	2	4	1	4	4	4	4	
909411	909445	90944601	909777	9110127	9110720	9110732	9110944	
4	4	4	4	4	4	2	4	
911150	911157302	9111596	9111805	9111843	911201	911202	9112085	
4	2	4	2	4	4	4	4	
9112366	9112367	9112594	9112712	911296201	911296202	9113156	911320501	
4	4	4	4	2	9	4	4	
911320502	9113239	9113455	9113514	9113538	911366	9113778	9113816	
4	4	4	4	5	1	4	4	

911384	9113846	911391	911408	911654	911673	911685	911916
4	4	4	4	4	4	4	1
912193	91227	912519	912558	912600	913063	913102	913505
4	4	4	4	4	7	4	1
913512	913535	91376701	91376702	914062	914101	914102	914333
4	4	4	4	2	4	4	4
914366	914580	914769	91485	914862	91504	91505	915143
1	4	2	1	4	1	4	2
915186	915276	91544001	91544002	915452	915460	91550	915664
7	7	4	4	4	1	4	4
915691	915940	91594602	916221	916799	916838	917062	917080
1	4	4	4	1	2	4	4
917092	91762702	91789	917896	917897	91805	91813701	91813702
4	2	4	4	4	4	1	4
918192	918465	91858	91903901	91903902	91930402	919537	919555
4	4	4	4	4	2	4	2
91979701	919812	921092	921362	921385	921386	921644	922296
4	1	4	7	4	1	4	4
922297	922576	922577	922840	923169	923465	923748	923780
4	4	4	4	4	4	4	4
924084	924342	924632	924934	924964	925236	925277	925291
4	4	4	4	4	4	4	4
925292	925311	925622	926125	926424	926682	926954	927241
4	4	1	5	2	2	4	5
92751							
	4						

```
$`10`$table
  diagnosis
clusters   B   M
  1   12  86
  2    0  59
  3    0   3
  4  331  39
  5    0  20
  6    2   0
  7   12   0
  8    0   2
  9    0   2
 10   0   1
```

```
$`10`$accuracy
[1] 0.9103691
```

Q13. Which method gives your favorite results for the same data.dist dataset?
Explain your reasoning.

ward.d2 method reduces cluster variance and allows for more clarity within clusters