Miniproject08_Attempt2.R

Noah

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```
wisc.df <- read.csv("WisconsinCancer.csv", row.names=1)
wisc.data <- wisc.df[,-1]
diagnosis <- factor(wisc.data[,1])
colMeans(wisc.data[,-1])
```

```
##            texture_mean          perimeter_mean               area_mean
##            1.928965e+01            9.196903e+01            6.548891e+02
##         smoothness_mean        compactness_mean          concavity_mean
##            9.636028e-02            1.043410e-01            8.879932e-02
##     concave.points_mean          symmetry_mean  fractal_dimension_mean
##            4.891915e-02            1.811619e-01            6.279761e-02
##               radius_se              texture_se            perimeter_se
##            4.051721e-01            1.216853e+00            2.866059e+00
##                 area_se         smoothness_se          compactness_se
##            4.033708e+01            7.040979e-03            2.547814e-02
##            concavity_se       concave.points_se             symmetry_se
##            3.189372e-02            1.179614e-02            2.054230e-02
##    fractal_dimension_se            radius_worst           texture_worst
##            3.794904e-03            1.626919e+01            2.567722e+01
##         perimeter_worst              area_worst        smoothness_worst
##            1.072612e+02            8.805831e+02            1.323686e-01
##       compactness_worst         concavity_worst    concave.points_worst
##            2.542650e-01            2.721885e-01            1.146062e-01
##          symmetry_worst fractal_dimension_worst
##            2.900756e-01            8.394582e-02
```

```
apply(wisc.data,2,sd)
```

```
##             radius_mean            texture_mean          perimeter_mean
##            3.524049e+00            4.301036e+00            2.429898e+01
##               area_mean         smoothness_mean        compactness_mean
##            3.519141e+02            1.406413e-02            5.281276e-02
##          concavity_mean     concave.points_mean           symmetry_mean
##            7.971981e-02            3.880284e-02            2.741428e-02
##  fractal_dimension_mean               radius_se              texture_se
##            7.060363e-03            2.773127e-01            5.516484e-01
##            perimeter_se                 area_se         smoothness_se
##            2.021855e+00            4.549101e+01            3.002518e-03
##          compactness_se            concavity_se       concave.points_se
##            1.790818e-02            3.018606e-02            6.170285e-03
##             symmetry_se    fractal_dimension_se            radius_worst
```

```
##            8.266372e-03            2.646071e-03            4.833242e+00
##           texture_worst         perimeter_worst              area_worst
##            6.146258e+00            3.360254e+01            5.693570e+02
##        smoothness_worst       compactness_worst         concavity_worst
##            2.283243e-02            1.573365e-01            2.086243e-01
##    concave.points_worst          symmetry_worst fractal_dimension_worst
##            6.573234e-02            6.186747e-02            1.806127e-02
```

```r
wisc.pr <- prcomp(wisc.data[,-1])
summary(wisc.pr)
```

```
## Importance of components:
##                             PC1      PC2      PC3     PC4     PC5     PC6   PC7
## Standard deviation     666.161 85.49544 26.52784 7.38816 6.31187 1.71854 1.347
## Proportion of Variance   0.982  0.01618  0.00156 0.00012 0.00009 0.00001 0.000
## Cumulative Proportion    0.982  0.99822  0.99978 0.99990 0.99999 0.99999 1.000
##                            PC8    PC9   PC10   PC11   PC12   PC13  PC14    PC15
## Standard deviation     0.6079 0.3713 0.2867 0.1618 0.0597 0.0471 0.039 0.02855
## Proportion of Variance 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000 0.00000
## Cumulative Proportion  1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.000 1.00000
##                           PC16    PC17    PC18    PC19     PC20     PC21
## Standard deviation     0.01981 0.01722 0.01381 0.01344 0.009507 0.007602
## Proportion of Variance 0.00000 0.00000 0.00000 0.00000 0.000000 0.000000
## Cumulative Proportion  1.00000 1.00000 1.00000 1.00000 1.000000 1.000000
##                            PC22     PC23     PC24     PC25     PC26     PC27
## Standard deviation     0.005918 0.005557 0.004023 0.003535 0.001925 0.001698
## Proportion of Variance 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
## Cumulative Proportion  1.000000 1.000000 1.000000 1.000000 1.000000 1.000000
##                            PC28      PC29
## Standard deviation     0.001416 0.0008387
## Proportion of Variance 0.000000 0.0000000
## Cumulative Proportion  1.000000 1.0000000
```

```r
biplot(wisc.pr)
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

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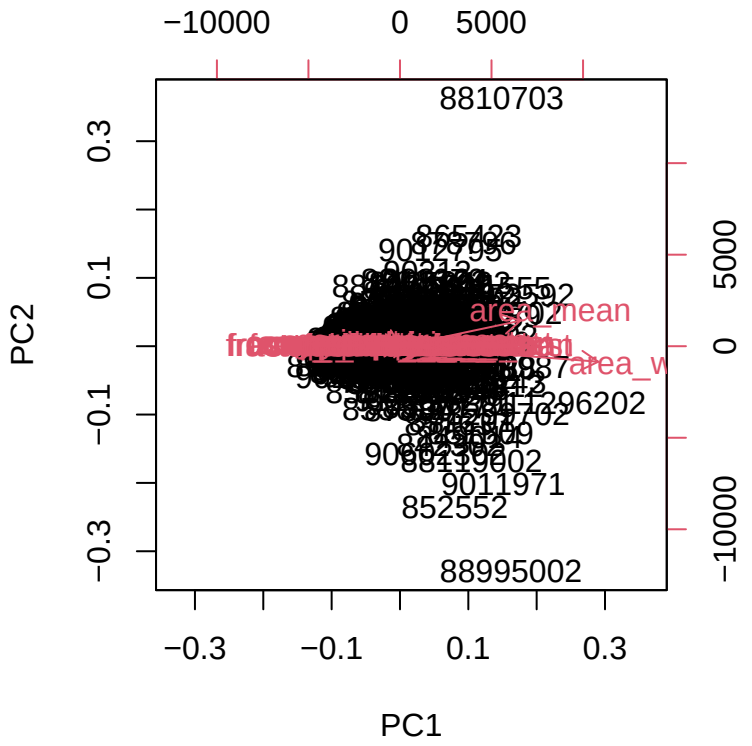
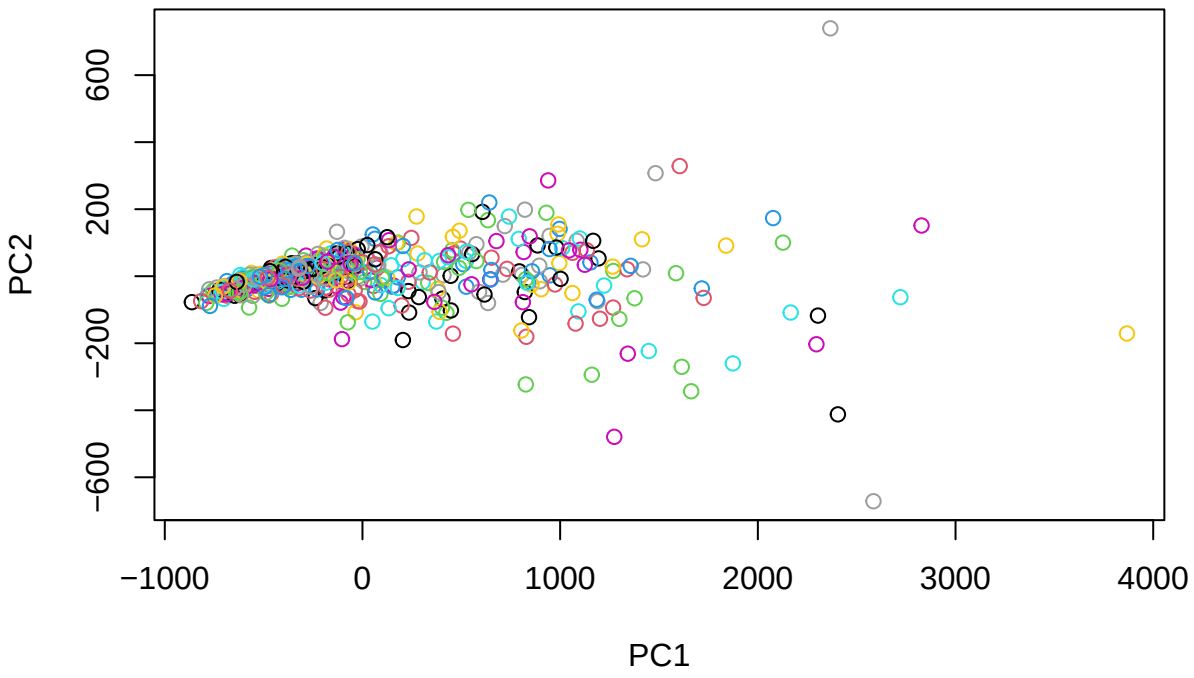
```



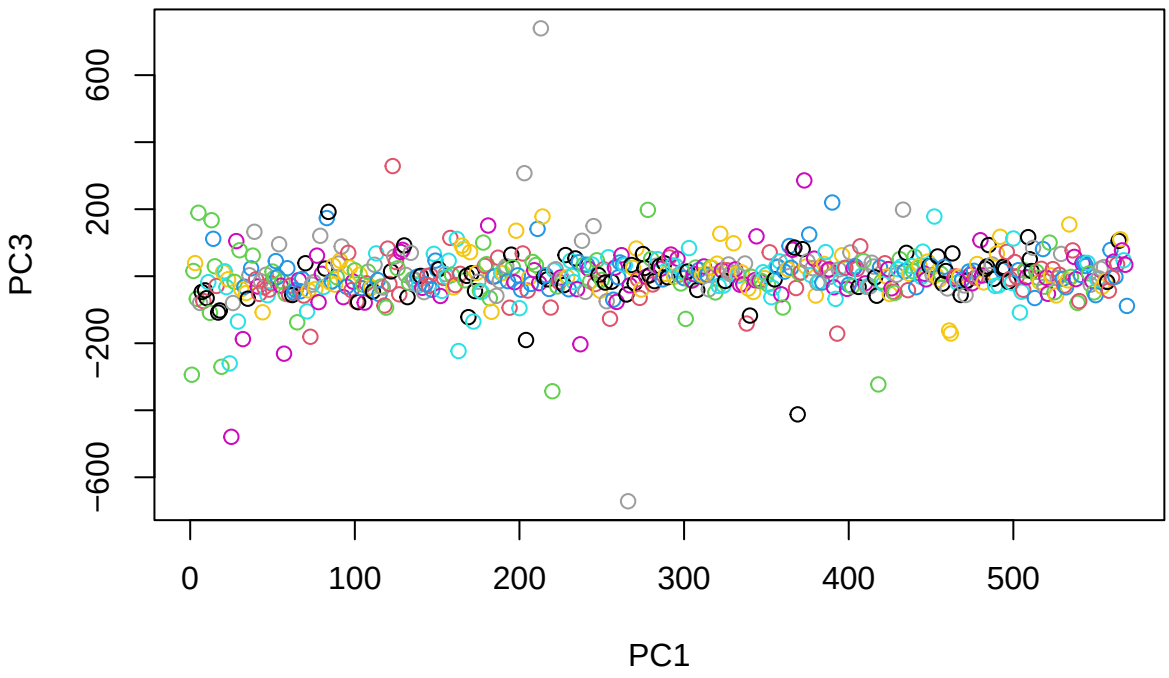

```
plot(wisc.pr$x, col = diagnosis,
     xlab = "PC1", ylab = "PC2")
```




```
plot(wisc.pr$x[, 2 ], col = diagnosis,
     xlab = "PC1", ylab = "PC3")

df <- as.data.frame(wisc.pr$x)
df$diagnosis <- diagnosis

library(ggplot2)
```



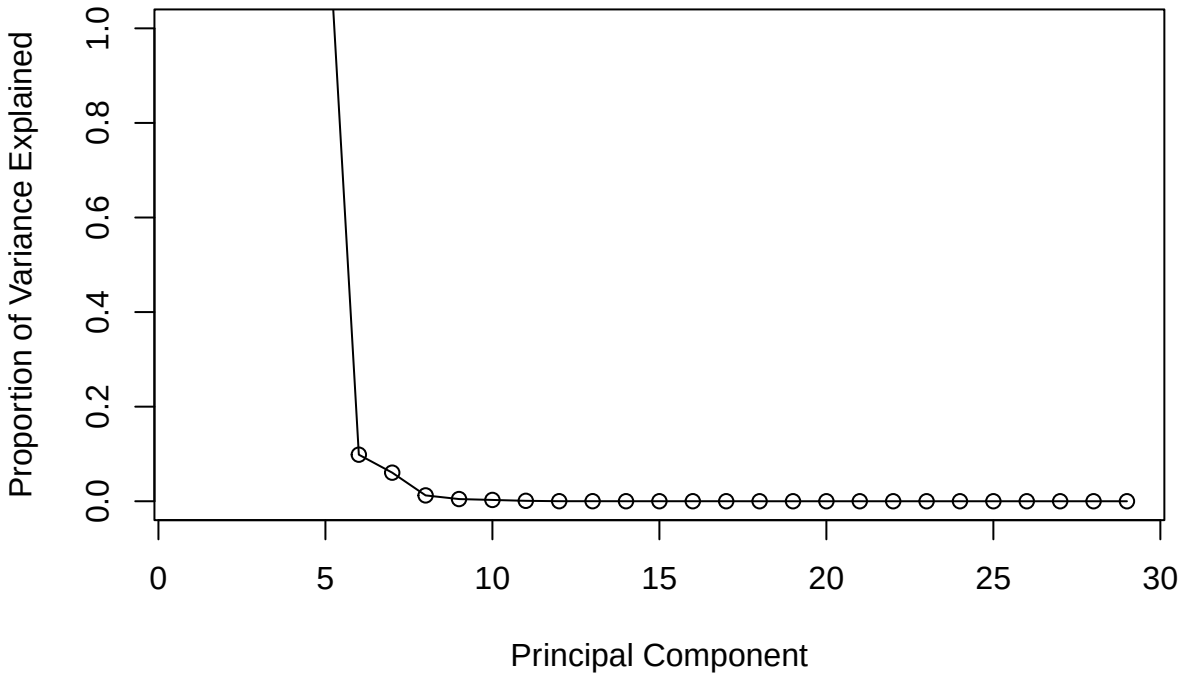

```
ggplot(df) +
  aes(PC1, PC2, col= diagnosis) +
  geom_point()
```

11.75	12.16	12.47	12.86	13.17	13.53	13.82	14.27	14.69	1!
11.76	12.18	12.49	12.87	13.2	13.54	13.85	14.29	14.71	1!
11.8	12.19	12.54	12.88	13.21	13.56	13.86	14.34	14.74	1!
11.81	12.2	12.56	12.89	13.24	13.59	13.87	14.4	14.76	1!
11.84	12.21	12.58	12.9	13.27	13.61	13.88	14.41	14.78	1!
11.85	12.22	12.62	12.91	13.28	13.62	13.9	14.42	14.8	1!
11.87	12.23	12.63	12.94	13.3	13.64	13.94	14.44	14.81	1!
11.89	12.25	12.65	12.95	13.34	13.65	13.96	14.45	14.86	1!
11.9	12.27	12.67	12.96	13.37	13.66	13.98	14.47	14.87	1!
11.93	12.3	12.68	12.98	13.38	13.68	14.02	14.48	14.9	1!
11.94	12.31	12.7	12.99	13.4	13.69	14.03	14.5	14.92	1!
11.95	12.32	12.72	13	13.43	13.7	14.04	14.53	14.95	1!
11.99	12.34	12.75	13.01	13.44	13.71	14.05	14.54	14.96	1!
12	12.36	12.76	13.03	13.45	13.73	14.06	14.58	14.97	1!
12.03	12.39	12.77	13.05	13.46	13.74	14.11	14.59	14.99	1!
12.04	12.4	12.78	13.08	13.47	13.75	14.19	14.6	15	1!
12.05	12.42	12.8	13.11	13.48	13.77	14.2	14.61	15.04	1!
12.06	12.43	12.81	13.14	13.49	13.78	14.22	14.62	15.05	1!
12.07	12.45	12.83	13.15	13.5	13.8	14.25	14.64	15.06	1!

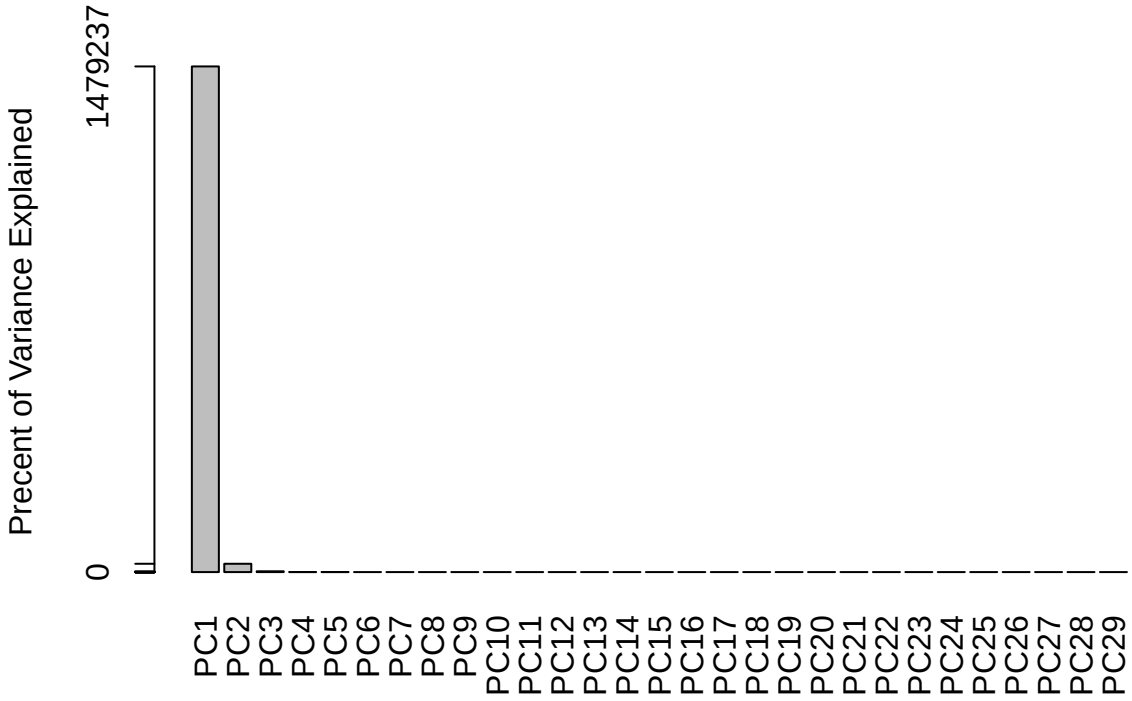
```
pr.var <- wisc.pr$sdev^2
head(pr.var)
```

```
## [1] 4.437711e+05 7.309470e+03 7.037265e+02 5.458498e+01 3.983975e+01
## [6] 2.953395e+00
```

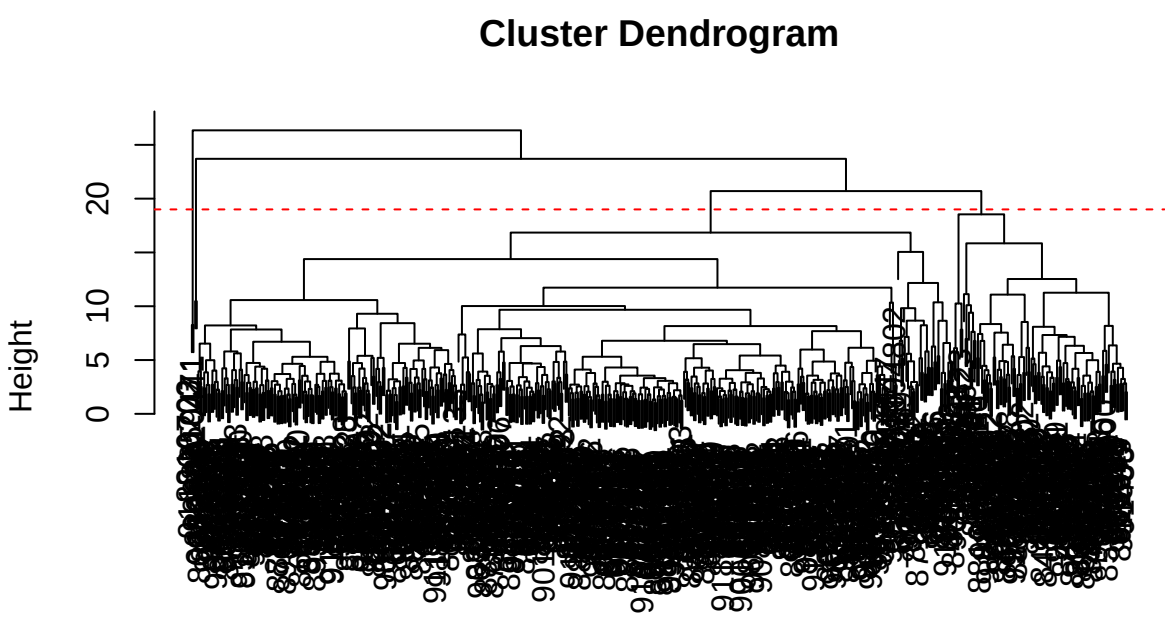
```
pve <- pr.var / 30
plot(pve, xlab = "Principal Component",
     ylab = "Proportion of Variance Explained",
     ylim = c(0, 1), type = "o")
```




```
barplot(pve, ylab = "Precent of Variance Explained",
        names.arg=paste0("PC",1:length(pve)), las=2, axes = FALSE)
axis(2, at=pve, labels=round(pve,2)*100 )
```




```
data.scaled <- scale(wisc.data[,-1])
data.dist <- dist(data.scaled)
wisc.hclust <- hclust(data.dist, method = "complete")
plot(wisc.hclust)
abline(h =19 , col="red", lty=2)
```




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

```
##                     diagnosis
## wisc.hclust.clusters 6.981 7.691 7.729 7.76 8.196 8.219 8.571 8.597 8.598 8.618
##                    1     0     0     0    0     0     0     0     0     0     0
##                    2     1     1     1    1     1     1     1     1     1     1
##                    3     0     0     0    0     0     0     0     0     0     0
##                    4     0     0     0    0     0     0     0     0     0     0
##                     diagnosis
## wisc.hclust.clusters 8.671 8.726 8.734 8.878 8.888 8.95 9 9.029 9.042 9.173
##                    1     0     0     0     0     0    0 0     0     0     0
##                    2     1     1     1     1     1    1 1     0     1     1
##                    3     0     0     0     0     0    0 0     1     0     0
##                    4     0     0     0     0     0    0 0     0     0     0
##                     diagnosis
## wisc.hclust.clusters 9.268 9.295 9.333 9.397 9.405 9.423 9.436 9.465 9.504
##                    1     0     0     0     0     0     0     0     0     0
##                    2     1     1     1     1     1     1     1     1     1
##                    3     0     0     0     0     0     0     0     0     0
##                    4     0     0     0     0     0     0     0     0     0
##                     diagnosis
## wisc.hclust.clusters 9.567 9.606 9.667 9.668 9.676 9.683 9.72 9.731 9.738 9.742
##                    1     0     0     0     0     0     0    0     0     0     0
##                    2     1     1     1     1     1     1    1     0     1     2
```

```
##                     3     0     0     0     0     0     0     0     1     0     0
##                     4     0     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 9.755 9.777 9.787 9.847 9.876 9.904 10.03 10.05 10.08
##                     1     0     0     0     0     0     0     0     0     0
##                     2     1     1     1     1     2     1     1     1     1
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 10.16 10.17 10.18 10.2 10.25 10.26 10.29 10.32 10.44 10.48
##                     1     0     0     0    0     0     0     0     0     0     0
##                     2     1     1     1    1     1     3     1     1     1     2
##                     3     0     0     0    0     0     0     0     0     0     0
##                     4     0     0     0    0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 10.49 10.51 10.57 10.6 10.65 10.66 10.71 10.75 10.8 10.82
##                     1     0     0     0    0     0     0     0     0    0     0
##                     2     2     2     2    1     1     1     1     1    2     1
##                     3     0     0     0    0     0     0     0     0    0     0
##                     4     0     0     0    0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 10.86 10.88 10.9 10.91 10.94 10.95 10.96 10.97 11.04 11.06
##                     1     0     0    0     0     0     0     0     0     0     0
##                     2     1     1    1     1     1     1     1     1     2     3
##                     3     0     0    0     0     0     0     0     0     0     0
##                     4     0     0    0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 11.08 11.13 11.14 11.15 11.16 11.2 11.22 11.25 11.26 11.27
##                     1     1     0     0     0     0    0     0     0     0     0
##                     2     1     2     1     1     1    1     2     1     2     2
##                     3     0     0     0     0     0    0     0     0     0     0
##                     4     0     0     0     0     0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 11.28 11.29 11.3 11.31 11.32 11.33 11.34 11.36 11.37 11.41
##                     1     0     0    0     0     0     0     0     0     0     0
##                     2     1     1    1     1     1     1     2     1     1     2
##                     3     0     0    0     0     0     0     0     0     0     0
##                     4     0     0    0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 11.42 11.43 11.45 11.46 11.47 11.49 11.5 11.51 11.52 11.54
##                     1     1     0     0     0     0     0    0     0     0     0
##                     2     0     2     1     1     1     1    1     1     2     2
##                     3     0     0     0     0     0     0    0     0     0     0
##                     4     0     0     0     0     0     0    0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 11.57 11.6 11.61 11.62 11.63 11.64 11.66 11.67 11.68 11.69
##                     1     0    0     0     0     0     0     0     0     0     0
##                     2     1    3     1     1     1     1     1     1     1     1
##                     3     0    0     0     0     0     0     0     0     0     0
##                     4     0    0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 11.7 11.71 11.74 11.75 11.76 11.8 11.81 11.84 11.85 11.87
##                     1    0     0     0     0     0    0     0     1     0     0
##                     2    1     3     2     2     2    2     1     1     1     1
```

```
##                     3    0     0     0     0     0    0     0     0     0     0
##                     4    0     0     0     0     0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 11.89 11.9 11.93 11.94 11.95 11.99 12 12.03 12.04 12.05
##                     1     0    0     0     0     0     0  0     0     0     0
##                     2     3    1     2     2     1     1  2     1     1     2
##                     3     0    0     0     0     0     0  0     0     0     0
##                     4     0    0     0     0     0     0  0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 12.06 12.07 12.1 12.16 12.18 12.19 12.2 12.21 12.22 12.23
##                     1     0     0    0     0     0     0    0     0     0     0
##                     2     2     1    1     1     3     1    1     2     1     1
##                     3     0     0    0     0     0     0    0     0     0     0
##                     4     0     0    0     0     0     0    0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 12.25 12.27 12.3 12.31 12.32 12.34 12.36 12.39 12.4 12.42
##                     1     0     0    0     0     0     1     0     0    0     0
##                     2     2     2    2     1     1     3     2     1    1     1
##                     3     0     0    0     0     0     0     0     0    0     0
##                     4     0     0    0     0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 12.43 12.45 12.46 12.47 12.49 12.54 12.56 12.58 12.62
##                     1     0     1     1     0     0     0     0     0     0
##                     2     1     1     2     2     1     2     1     1     2
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 12.63 12.65 12.67 12.68 12.7 12.72 12.75 12.76 12.77 12.78
##                     1     0     0     0     1    0     0     0     0     0     0
##                     2     1     1     1     0    1     2     1     2     3     1
##                     3     0     0     0     0    0     0     0     0     0     0
##                     4     0     0     0     0    0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 12.8 12.81 12.83 12.85 12.86 12.87 12.88 12.89 12.9 12.91
##                     1    0     0     1     0     0     0     0     0    0     0
##                     2    1     1     1     1     2     2     2     3    1     1
##                     3    0     0     0     0     0     0     0     0    0     0
##                     4    0     0     0     0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 12.94 12.95 12.96 12.98 12.99 13 13.01 13.03 13.05 13.08
##                     1     0     0     0     0     0  1     0     0     0     0
##                     2     1     1     1     1     1  2     1     1     3     1
##                     3     0     0     0     0     0  0     0     0     0     0
##                     4     0     0     0     0     0  0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 13.11 13.14 13.15 13.16 13.17 13.2 13.21 13.24 13.27 13.28
##                     1     1     0     0     0     1    0     0     0     0     1
##                     2     1     1     1     1     2    2     2     1     2     1
##                     3     0     0     0     0     0    0     0     0     0     0
##                     4     0     0     0     0     0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 13.3 13.34 13.37 13.38 13.4 13.43 13.44 13.45 13.46 13.47
##                     1    0     1     0     0    1     0     0     0     0     0
##                     2    1     0     1     1    1     1     1     1     2     1
```

```
##                     3    0     0     0     0    0     0     0     0     0     0
##                     4    0     0     0     0    0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 13.48 13.49 13.5 13.51 13.53 13.54 13.56 13.59 13.61 13.62
##                     1     0     0    0     0     0     0     0     0     0     0
##                     2     1     1    1     1     1     1     1     2     2     1
##                     3     0     0    0     0     0     0     0     0     0     0
##                     4     0     0    0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 13.64 13.65 13.66 13.68 13.69 13.7 13.71 13.73 13.74 13.75
##                     1     0     0     0     0     0    0     1     1     0     0
##                     2     2     1     2     1     1    1     1     0     1     1
##                     3     0     0     0     0     0    0     0     0     0     0
##                     4     0     0     0     0     0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 13.77 13.78 13.8 13.81 13.82 13.85 13.86 13.87 13.88 13.9
##                     1     0     0    0     1     1     0     1     0     0    0
##                     2     2     1    1     0     0     3     0     2     1    2
##                     3     0     0    0     0     0     0     0     0     0    0
##                     4     0     0    0     0     0     0     0     0     0    0
##                      diagnosis
## wisc.hclust.clusters 13.94 13.96 13.98 14.02 14.03 14.04 14.05 14.06 14.11
##                     1     0     0     0     0     0     0     0     0     0
##                     2     1     1     1     1     1     1     1     1     1
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 14.19 14.2 14.22 14.25 14.26 14.27 14.29 14.34 14.4 14.41
##                     1     0    0     1     1     0     0     0     0    0     0
##                     2     1    1     1     1     2     1     1     1    1     1
##                     3     0    0     0     0     0     0     0     0    0     0
##                     4     0    0     0     0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 14.42 14.44 14.45 14.47 14.48 14.5 14.53 14.54 14.58 14.59
##                     1     0     0     0     0     0    0     0     1     1     0
##                     2     2     1     1     1     1    1     2     0     1     1
##                     3     0     0     0     0     0    0     0     0     0     0
##                     4     0     0     0     0     0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 14.6 14.61 14.62 14.64 14.68 14.69 14.71 14.74 14.76 14.78
##                     1    0     0     0     0     0     0     1     0     0     1
##                     2    1     1     1     2     1     1     0     1     1     0
##                     3    0     0     0     0     0     0     0     0     0     0
##                     4    0     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 14.8 14.81 14.86 14.87 14.9 14.92 14.95 14.96 14.97 14.99
##                     1    0     0     0     1    1     0     1     0     0     0
##                     2    1     1     2     1    0     1     1     1     2     2
##                     3    0     0     0     0    0     0     0     0     0     0
##                     4    0     0     0     0    0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 15 15.04 15.05 15.06 15.08 15.1 15.12 15.13 15.19 15.22
##                     1  0     0     0     1     0    0     0     0     0     1
##                     2  1     1     1     0     1    2     1     1     1     0
```

```
##                     3  0     0     0     0     0    0     0     0     0     0
##                     4  0     0     0     0     0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 15.27 15.28 15.3 15.32 15.34 15.37 15.46 15.49 15.5 15.53
##                     1     0     0    1     1     0     0     2     1    1     1
##                     2     1     1    0     0     1     1     1     0    0     0
##                     3     0     0    0     0     0     0     0     0    0     0
##                     4     0     0    0     0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 15.61 15.66 15.7 15.71 15.73 15.75 15.78 15.85 16.02 16.03
##                     1     0     1    0     0     0     1     2     0     0     1
##                     2     1     0    1     1     1     1     0     1     1     0
##                     3     0     0    0     0     0     0     0     0     0     0
##                     4     0     0    0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 16.07 16.11 16.13 16.14 16.16 16.17 16.24 16.25 16.26
##                     1     0     0     2     0     0     0     1     0     0
##                     2     1     1     0     1     1     1     0     1     1
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 16.27 16.3 16.35 16.46 16.5 16.6 16.65 16.69 16.74 16.78
##                     1     0    0     1     1    0    0     0     0     1     0
##                     2     1    1     0     0    1    1     1     1     0     1
##                     3     0    0     0     0    0    0     0     0     0     0
##                     4     0    0     0     0    0    0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 16.84 17.01 17.02 17.05 17.06 17.08 17.14 17.19 17.2 17.27
##                     1     0     0     1     1     0     0     1     0    1     0
##                     2     1     1     0     0     1     1     0     1    0     1
##                     3     0     0     0     0     0     0     0     0    0     0
##                     4     0     0     0     0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 17.29 17.3 17.35 17.42 17.46 17.47 17.54 17.57 17.6 17.68
##                     1     1    0     0     0     0     1     0     0    1     0
##                     2     0    1     1     1     1     0     1     1    0     1
##                     3     0    0     0     0     0     0     0     0    0     0
##                     4     0    0     0     0     0     0     0     0    0     0
##                      diagnosis
## wisc.hclust.clusters 17.75 17.85 17.91 17.93 17.95 17.99 18.01 18.03 18.05
##                     1     0     0     1     0     0     1     0     0     1
##                     2     1     1     0     1     1     1     1     1     0
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 18.08 18.22 18.25 18.31 18.45 18.46 18.49 18.61 18.63
##                     1     0     0     0     0     0     0     0     0     1
##                     2     1     2     1     2     1     1     1     1     0
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 18.65 18.66 18.77 18.81 18.82 18.94 19 19.02 19.07 19.1
##                     1     1     0     0     0     0     0  0     0     1    1
##                     2     0     1     1     1     1     1  1     1     0    0
```

```
##                     3     0     0     0     0     0     0  0     0     0    0
##                     4     0     0     0     0     0     0  0     0     0    0
##                      diagnosis
## wisc.hclust.clusters 19.16 19.17 19.18 19.19 19.21 19.27 19.4 19.44 19.45 19.53
##                     1     1     1     0     1     0     1    0     1     0     1
##                     2     0     0     1     0     1     0    2     0     1     1
##                     3     0     0     0     0     0     0    0     0     0     0
##                     4     0     0     0     0     0     0    0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 19.55 19.59 19.68 19.69 19.73 19.79 19.8 19.81 19.89 20.09
##                     1     2     1     1     1     1     1    1     0     0     1
##                     2     0     1     0     0     0     0    0     1     1     0
##                     3     0     0     0     0     0     0    0     0     0     0
##                     4     0     0     0     0     0     0    0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 20.13 20.16 20.18 20.2 20.26 20.29 20.31 20.34 20.44 20.47
##                     1     0     0     2    1     1     0     0     1     0     1
##                     2     1     1     0    0     0     1     1     0     1     0
##                     3     0     0     0    0     0     0     0     0     0     0
##                     4     0     0     0    0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 20.48 20.51 20.55 20.57 20.58 20.59 20.6 20.64 20.73 20.92
##                     1     0     0     1     0     1     1    1     0     1     1
##                     2     1     1     0     1     0     0    0     1     0     0
##                     3     0     0     0     0     0     0    0     0     0     0
##                     4     0     0     0     0     0     0    0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 20.94 21.09 21.1 21.16 21.37 21.56 21.61 21.71 21.75 22.01
##                     1     1     1    0     0     0     1     1     1     1     1
##                     2     0     0    1     1     1     0     0     0     0     0
##                     3     0     0    0     0     0     0     0     0     0     0
##                     4     0     0    0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 22.27 23.09 23.21 23.27 23.29 23.51 24.25 24.63 25.22
##                     1     1     1     1     0     1     1     1     1     1
##                     2     0     0     0     1     0     0     0     0     0
##                     3     0     0     0     0     0     0     0     0     0
##                     4     0     0     0     0     0     0     0     0     0
##                      diagnosis
## wisc.hclust.clusters 25.73 27.22 27.42 28.11
##                     1     1     1     0     0
##                     2     0     0     0     0
##                     3     0     0     0     0
##                     4     0     0     1     1
```

```
grps <- cutree(wisc.hclust, k=2)
table(grps)
```

```
## grps
##   1   2
## 567   2
```

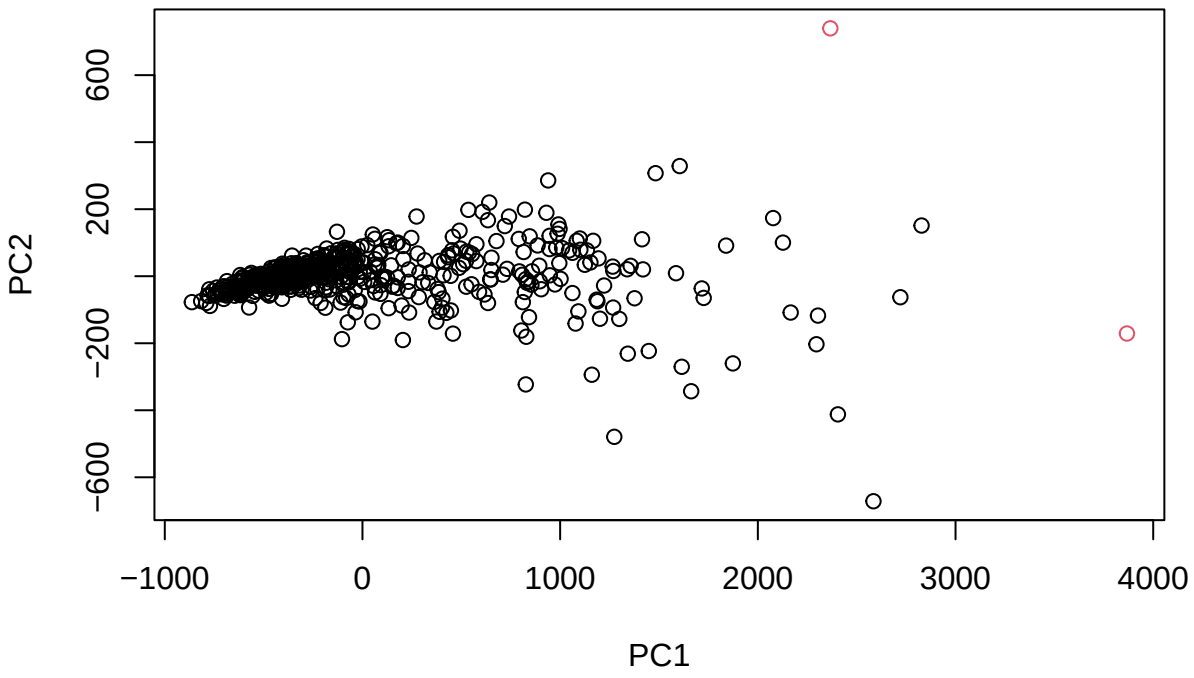
```
table(grps, diagnosis)
```

```
##     diagnosis
## grps 6.981 7.691 7.729 7.76 8.196 8.219 8.571 8.597 8.598 8.618 8.671 8.726
##    1     1     1     1    1     1     1     1     1     1     1     1     1
##    2     0     0     0    0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 8.734 8.878 8.888 8.95 9 9.029 9.042 9.173 9.268 9.295 9.333 9.397 9.405
##    1     1     1     1    1 1     1     1     1     1     1     1     1     1
##    2     0     0     0    0 0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 9.423 9.436 9.465 9.504 9.567 9.606 9.667 9.668 9.676 9.683 9.72 9.731
##    1     1     1     1     1     1     1     1     1     1     1    1     1
##    2     0     0     0     0     0     0     0     0     0     0    0     0
##     diagnosis
## grps 9.738 9.742 9.755 9.777 9.787 9.847 9.876 9.904 10.03 10.05 10.08 10.16
##    1     1     2     1     1     1     1     2     1     1     1     1     1
##    2     0     0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 10.17 10.18 10.2 10.25 10.26 10.29 10.32 10.44 10.48 10.49 10.51 10.57
##    1     1     1    1     1     3     1     1     1     2     2     2     2
##    2     0     0    0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 10.6 10.65 10.66 10.71 10.75 10.8 10.82 10.86 10.88 10.9 10.91 10.94 10.95
##    1    1     1     1     1     1    2     1     1     1    1     1     1     1
##    2    0     0     0     0     0    0     0     0     0    0     0     0     0
##     diagnosis
## grps 10.96 10.97 11.04 11.06 11.08 11.13 11.14 11.15 11.16 11.2 11.22 11.25
##    1     1     1     2     3     2     2     1     1     1    1     2     1
##    2     0     0     0     0     0     0     0     0     0    0     0     0
##     diagnosis
## grps 11.26 11.27 11.28 11.29 11.3 11.31 11.32 11.33 11.34 11.36 11.37 11.41
##    1     2     2     1     1    1     1     1     1     2     1     1     2
##    2     0     0     0     0    0     0     0     0     0     0     0     0
##     diagnosis
## grps 11.42 11.43 11.45 11.46 11.47 11.49 11.5 11.51 11.52 11.54 11.57 11.6
##    1     1     2     1     1     1     1    1     1     2     2     1    3
##    2     0     0     0     0     0     0    0     0     0     0     0    0
##     diagnosis
## grps 11.61 11.62 11.63 11.64 11.66 11.67 11.68 11.69 11.7 11.71 11.74 11.75
##    1     1     1     1     1     1     1     1     1    1     3     2     2
##    2     0     0     0     0     0     0     0     0    0     0     0     0
##     diagnosis
## grps 11.76 11.8 11.81 11.84 11.85 11.87 11.89 11.9 11.93 11.94 11.95 11.99 12
##    1     2    2     1     2     1     1     3    1     2     2     1     1  2
##    2     0    0     0     0     0     0     0    0     0     0     0     0  0
##     diagnosis
## grps 12.03 12.04 12.05 12.06 12.07 12.1 12.16 12.18 12.19 12.2 12.21 12.22
##    1     1     1     2     2     1    1     1     3     1    1     2     1
##    2     0     0     0     0     0    0     0     0     0    0     0     0
##     diagnosis
## grps 12.23 12.25 12.27 12.3 12.31 12.32 12.34 12.36 12.39 12.4 12.42 12.43
##    1     1     2     2    2     1     1     4     2     1    1     1     1
```

```
##    2     0     0     0    0     0     0     0     0     0    0     0     0
##     diagnosis
## grps 12.45 12.46 12.47 12.49 12.54 12.56 12.58 12.62 12.63 12.65 12.67 12.68
##    1     2     3     2     1     2     1     1     2     1     1     1     1
##    2     0     0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 12.7 12.72 12.75 12.76 12.77 12.78 12.8 12.81 12.83 12.85 12.86 12.87
##    1    1     2     1     2     3     1    1     1     2     1     2     2
##    2    0     0     0     0     0     0    0     0     0     0     0     0
##     diagnosis
## grps 12.88 12.89 12.9 12.91 12.94 12.95 12.96 12.98 12.99 13 13.01 13.03 13.05
##    1     2     3    1     1     1     1     1     1     1  3     1     1     3
##    2     0     0    0     0     0     0     0     0     0  0     0     0     0
##     diagnosis
## grps 13.08 13.11 13.14 13.15 13.16 13.17 13.2 13.21 13.24 13.27 13.28 13.3
##    1     1     2     1     1     1     3    2     2     1     2     2    1
##    2     0     0     0     0     0     0    0     0     0     0     0    0
##     diagnosis
## grps 13.34 13.37 13.38 13.4 13.43 13.44 13.45 13.46 13.47 13.48 13.49 13.5
##    1     1     1     1    2     1     1     1     2     1     1     1    1
##    2     0     0     0    0     0     0     0     0     0     0     0    0
##     diagnosis
## grps 13.51 13.53 13.54 13.56 13.59 13.61 13.62 13.64 13.65 13.66 13.68 13.69
##    1     1     1     1     1     2     2     1     2     1     2     1     1
##    2     0     0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 13.7 13.71 13.73 13.74 13.75 13.77 13.78 13.8 13.81 13.82 13.85 13.86
##    1    1     2     1     1     1     2     1    1     1     1     3     1
##    2    0     0     0     0     0     0     0    0     0     0     0     0
##     diagnosis
## grps 13.87 13.88 13.9 13.94 13.96 13.98 14.02 14.03 14.04 14.05 14.06 14.11
##    1     2     1    2     1     1     1     1     1     1     1     1     1
##    2     0     0    0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 14.19 14.2 14.22 14.25 14.26 14.27 14.29 14.34 14.4 14.41 14.42 14.44
##    1     1    1     2     2     2     1     1     1    1     1     2     1
##    2     0    0     0     0     0     0     0     0    0     0     0     0
##     diagnosis
## grps 14.45 14.47 14.48 14.5 14.53 14.54 14.58 14.59 14.6 14.61 14.62 14.64
##    1     1     1     1    1     2     1     2     1    1     1     1     2
##    2     0     0     0    0     0     0     0     0    0     0     0     0
##     diagnosis
## grps 14.68 14.69 14.71 14.74 14.76 14.78 14.8 14.81 14.86 14.87 14.9 14.92
##    1     1     1     1     1     1     1    1     1     2     2    1     1
##    2     0     0     0     0     0     0    0     0     0     0    0     0
##     diagnosis
## grps 14.95 14.96 14.97 14.99 15 15.04 15.05 15.06 15.08 15.1 15.12 15.13 15.19
##    1     2     1     2     2  1     1     1     1     1    2     1     1     1
##    2     0     0     0     0  0     0     0     0     0    0     0     0     0
##     diagnosis
## grps 15.22 15.27 15.28 15.3 15.32 15.34 15.37 15.46 15.49 15.5 15.53 15.61
##    1     1     1     1    1     1     1     1     3     1    1     1     1
##    2     0     0     0    0     0     0     0     0     0    0     0     0
##     diagnosis
```

```
## grps 15.66 15.7 15.71 15.73 15.75 15.78 15.85 16.02 16.03 16.07 16.11 16.13
##    1     1    1     1     1     2     2     1     1     1     1     1     2
##    2     0    0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 16.14 16.16 16.17 16.24 16.25 16.26 16.27 16.3 16.35 16.46 16.5 16.6 16.65
##    1     1     1     1     1     1     1     1    1     1     1    1    1     1
##    2     0     0     0     0     0     0     0    0     0     0    0    0     0
##     diagnosis
## grps 16.69 16.74 16.78 16.84 17.01 17.02 17.05 17.06 17.08 17.14 17.19 17.2
##    1     1     1     1     1     1     1     1     1     1     1     1    1
##    2     0     0     0     0     0     0     0     0     0     0     0    0
##     diagnosis
## grps 17.27 17.29 17.3 17.35 17.42 17.46 17.47 17.54 17.57 17.6 17.68 17.75
##    1     1     1    1     1     1     1     1     1     1    1     1     1
##    2     0     0    0     0     0     0     0     0     0    0     0     0
##     diagnosis
## grps 17.85 17.91 17.93 17.95 17.99 18.01 18.03 18.05 18.08 18.22 18.25 18.31
##    1     1     1     1     1     2     1     1     1     1     2     1     2
##    2     0     0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 18.45 18.46 18.49 18.61 18.63 18.65 18.66 18.77 18.81 18.82 18.94 19 19.02
##    1     1     1     1     1     1     1     1     1     1     1     1  1     1
##    2     0     0     0     0     0     0     0     0     0     0     0  0     0
##     diagnosis
## grps 19.07 19.1 19.16 19.17 19.18 19.19 19.21 19.27 19.4 19.44 19.45 19.53
##    1     1    1     1     1     1     1     1     1    2     1     1     2
##    2     0    0     0     0     0     0     0     0    0     0     0     0
##     diagnosis
## grps 19.55 19.59 19.68 19.69 19.73 19.79 19.8 19.81 19.89 20.09 20.13 20.16
##    1     2     2     1     1     1     1    1     1     1     1     1     1
##    2     0     0     0     0     0     0    0     0     0     0     0     0
##     diagnosis
## grps 20.18 20.2 20.26 20.29 20.31 20.34 20.44 20.47 20.48 20.51 20.55 20.57
##    1     2    1     1     1     1     1     1     1     1     1     1     1
##    2     0    0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 20.58 20.59 20.6 20.64 20.73 20.92 20.94 21.09 21.1 21.16 21.37 21.56
##    1     1     1    1     1     1     1     1     1    1     1     1     1
##    2     0     0    0     0     0     0     0     0    0     0     0     0
##     diagnosis
## grps 21.61 21.71 21.75 22.01 22.27 23.09 23.21 23.27 23.29 23.51 24.25 24.63
##    1     1     1     1     1     1     1     1     1     1     1     1     1
##    2     0     0     0     0     0     0     0     0     0     0     0     0
##     diagnosis
## grps 25.22 25.73 27.22 27.42 28.11
##    1     1     1     1     0     0
##    2     0     0     0     1     1
```

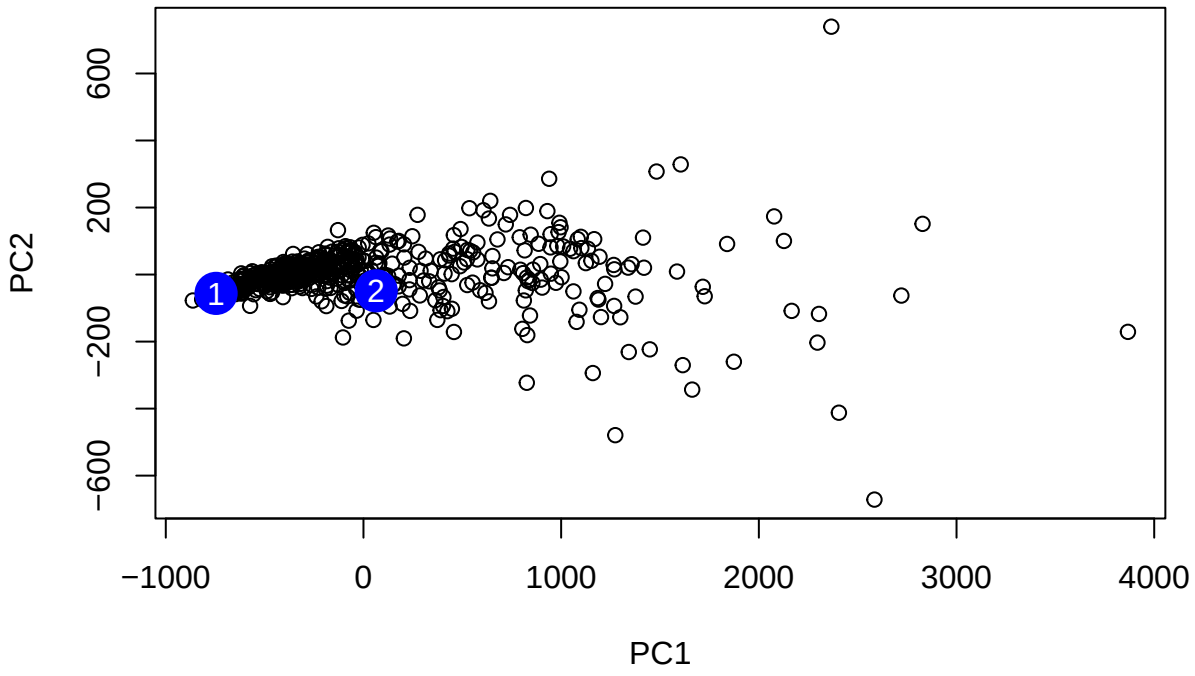
```
plot(wisc.pr$x[,1:2], col=grps)
```




```
url <- "https://tinyurl.com/new-samples-CSV"
new <- read.csv(url)
npc <- predict(wisc.pr, newdata=new)
npc
```

```
##             PC1       PC2       PC3       PC4       PC5       PC6       PC7
## [1,] -745.58228 -56.15114 -21.14308 -3.269575  9.342062  2.265565 -1.156815
## [2,]   64.40863 -48.46994 -15.93951 12.065347 -4.676632 -1.080107 -0.277376
##            PC8        PC9       PC10        PC11        PC12        PC13
## [1,] 0.7563343 -0.1032757  0.0688537 -0.09202633  0.06375044 -0.01669926
## [2,] 0.7260377  0.2276038 -0.7097099 -0.30447319 -0.01883250  0.11744318
##              PC14         PC15         PC16        PC17         PC18
## [1,] -0.023223923  0.009950655 -0.008509815 -0.01948388 -0.007793169
## [2,] -0.007291041 -0.018657551 -0.011000041 -0.02647465  0.000611957
##              PC19         PC20       PC21          PC22         PC23
## [1,] -0.031830403 -0.005101987 0.01845962 -0.0005420926  0.006199072
## [2,]  0.009654825 -0.018181800 0.01048644  0.0088785987 -0.007183325
##              PC24         PC25          PC26         PC27          PC28
## [1,]  0.005901854 -0.005404442 -0.0001697478 -0.003258087 -0.0012304929
## [2,] -0.003020084 -0.003319119 -0.0021016368  0.002101994 -0.0009562871
##              PC29
## [1,] 0.0009908106
## [2,] 0.0008586404
```

```
plot(wisc.pr$x[,1:2])
points(npc[,1], npc[,2], col="blue", pch=16, cex=3)
text(npc[,1], npc[,2], c(1,2), col="white")
```




```
sessionInfo()
```

```
## R version 4.1.2 (2021-11-01)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19043)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United States.1252
## [2] LC_CTYPE=English_United States.1252
## [3] LC_MONETARY=English_United States.1252
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United States.1252
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
## [1] ggplot2_3.3.5
##
```

```
## loaded via a namespace (and not attached):
##  [1] pillar_1.7.0     compiler_4.1.2   highr_0.9        tools_4.1.2
##  [5] digest_0.6.29    evaluate_0.15    lifecycle_1.0.1  tibble_3.1.6
##  [9] gtable_0.3.0     pkgconfig_2.0.3  rlang_1.0.2      cli_3.1.1
## [13] rstudioapi_0.13  yaml_2.3.5       xfun_0.30        fastmap_1.1.0
## [17] withr_2.5.0      stringr_1.4.0    dplyr_1.0.8      knitr_1.37
## [21] generics_0.1.2   vctrs_0.3.8      grid_4.1.2       tidyselect_1.1.2
## [25] glue_1.6.2       R6_2.5.1         fansi_1.0.2      rmarkdown_2.12
## [29] farver_2.1.0     purrr_0.3.4      magrittr_2.0.2   scales_1.1.1
## [33] ellipsis_0.3.2   htmltools_0.5.2  colorspace_2.0-3 labeling_0.4.2
## [37] utf8_1.2.2       stringi_1.7.6    munsell_0.5.0    crayon_1.5.0
```