HW3

Zirui Zhang

2023-03-27

```
library(dplyr)
library(formattable)
```

QUESTION 1

```
mydata = read.table(file="./PCA_data.csv", header=TRUE, row.names=1, sep=",")
mydata.pca = prcomp(mydata, retx=TRUE, center=TRUE, scale=TRUE)
# variable means set to zero, and variances set to one "scale=TRUE"
# PCA scores for each sample store in mydata.pca$x
# loadings stored in mydata.pca$rotation
# square roots of eigenvalues store in mydata.pca$sdev (note that eigenvalues are variances of principa
# variable means stored in mydata.pca$center
# variable standard deviations stored in mydata.pca$scale
sd = mydata.pca$sdev
loadings = mydata.pca$rotation
rownames(loadings) = colnames(mydata)
scores = mydata.pca$x
```

a) Calculate PCA scores using loadings and original math/chem/bio scores, and compare to output PCA scores from the R package prcomp.

```
# calculate PCA scores
mydata_2 =
  mydata%>%
  mutate(math = scale(math) - mean(scale(math)),
         bio = scale(bio) - mean(scale(bio)),
         chem = scale(chem) - mean(scale(chem)))
scores_2 = as.matrix(mydata_2)%*%loadings
head(scores_2, 10)
```

```
##           PC1          PC2        PC3
## 1  -1.6579369  0.571682476  0.2765913
## 2  -2.5759191  0.171154076 -0.3946536
## 3  -1.8500938  0.561523155 -0.3289593
## 4  -2.0029634 -0.279232617  0.2090958
## 5  -1.7019579 -0.553776982  0.5314955
## 6  -1.0237890  0.746472175  0.4269871
## 7  -0.9343334  0.599025432  0.2483663
```

```
## 8  -2.0297283 -0.031871212 -0.1337258
## 9  -2.2666815  0.246059593 -0.2542754
## 10 -2.6579342 -0.005870397 -0.1643718
```

```
# compare with the results from package
head(abs(scores_2-scores)/scores, 10)
```

```
##              PC1           PC2           PC3
## 1  -4.017848e-16  3.884055e-16  8.027895e-16
## 2  -3.448006e-16  8.108359e-16 -4.219738e-16
## 3  -3.600541e-16  1.977163e-16 -3.374956e-16
## 4  -4.434322e-16 -5.963969e-16  5.309639e-16
## 5  -3.913927e-16 -2.004820e-16  2.088866e-16
## 6  -6.506553e-16  1.487293e-16  3.900199e-16
## 7  -7.129509e-16  1.853382e-16  5.587628e-16
## 8  -4.375849e-16 -1.524017e-15 -8.302233e-16
## 9  -3.918409e-16  4.512009e-16 -4.366223e-16
## 10 -3.341612e-16 -2.762959e-14 -1.350868e-15
```

The difference between the two PCA scores are rather small.

b) Calculate percent variance explained of each component.

```
lamda = percent(mydata.pca$sdev^2/sum(mydata.pca$sdev^2))
lamda
```

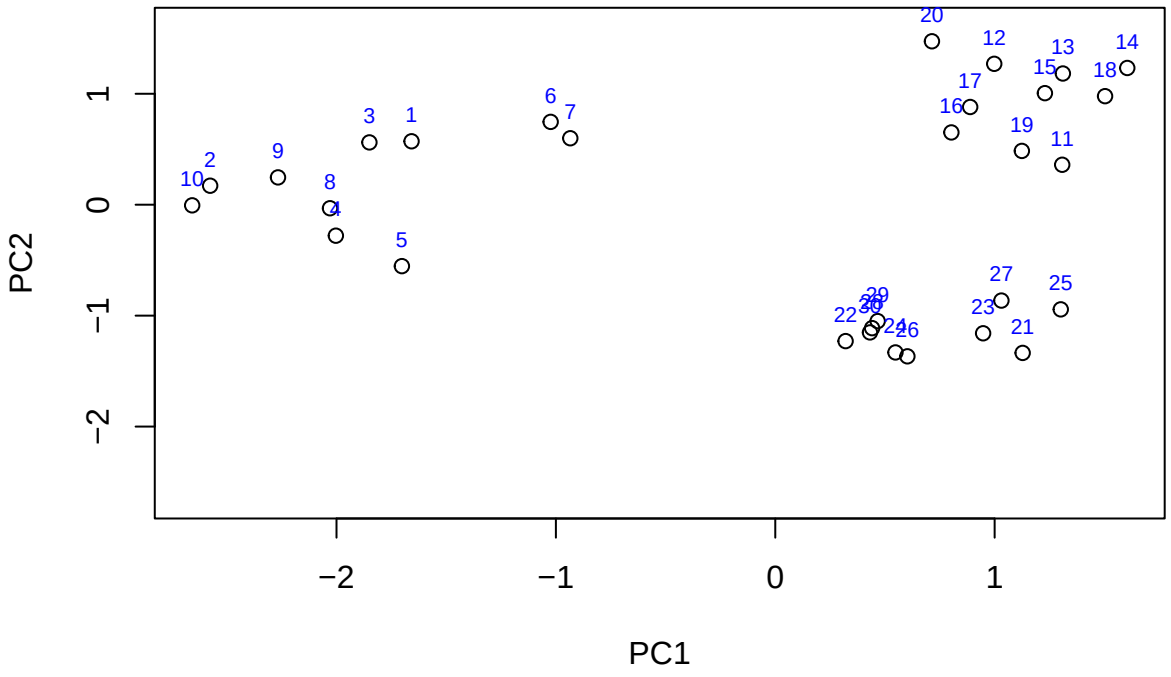
```
## [1] 66.93% 29.71% 3.36%
```

The variance explained by PC1 is 66.93%, by PC2 is 29.71%, by PC3 is 3.36%.

c)

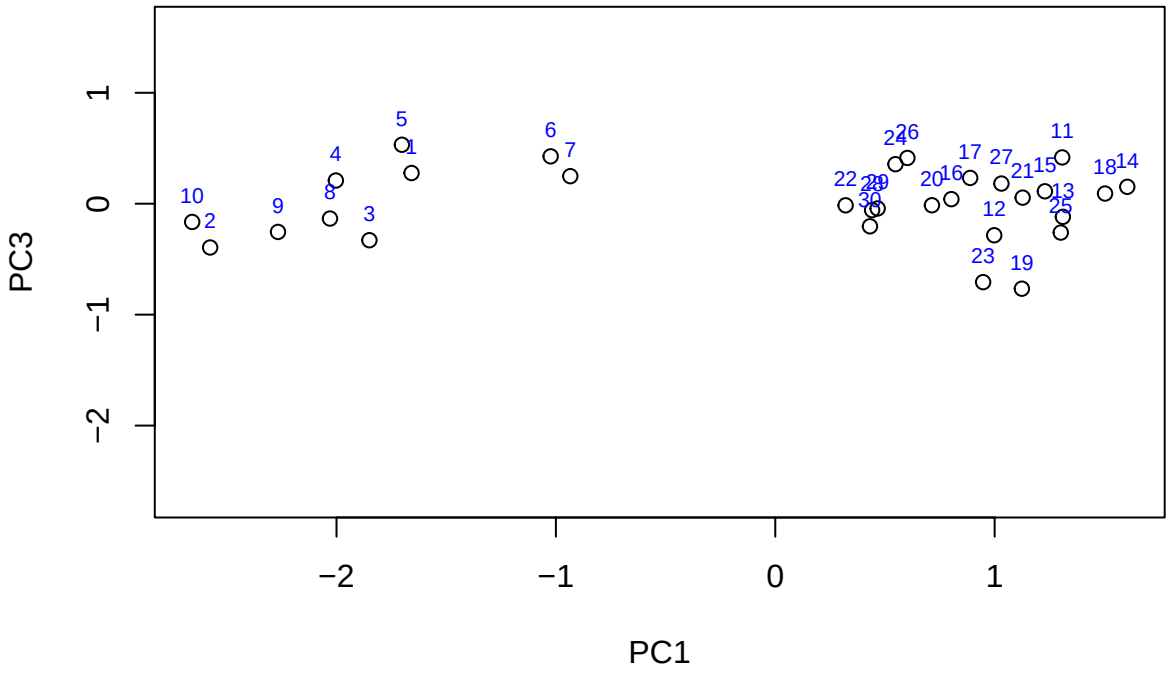
(1) PC1 vs PC2

```
plot(scores[,1:2],
     xlim=c(min(scores[,1:2]),max(scores[,1:2])),
     ylim=c(min(scores[,1:2]),max(scores[,1:2])))
text(scores[,1], scores[,2], rownames(scores), col="blue", cex=0.7, pos=3)
```



(2) PC1 vs PC3

```
plot(scores[,c(1,3)],
     xlim=c(min(scores[,c(1,3)]),max(scores[,c(1,3)])),
     ylim=c(min(scores[,c(1,3)]),max(scores[,c(1,3)])))
text(scores[,1], scores[,3], rownames(scores), col="blue", cex=0.7, pos=3)
```



(3) PC2 vs. PC3.

```
plot(scores[,2:3],
     xlim=c(min(scores[,2:3]),max(scores[,2:3])),
     ylim=c(min(scores[,2:3]),max(scores[,2:3])))
text(scores[,2], scores[,3], rownames(scores), col="blue", cex=0.7, pos=3)
```