hw6 p3

For fractions:

```
library(MASS)
```

R Markdown

```
#import data
data <- read.table("T1-5.DAT")

#set up X
X <- as.matrix(data)[,1:7]
colnames(X) <- c('Wind','radiation','CO','NO','N02','0_3','HC')

n <- length(X[,1])
r <- length(X[1,])
```

(1.b) Determine the proportion of total sample variance due to the first sample principale component.

```
# Compute sample mean and S
Ones <- rep(1,n)
x_sample_mean <- 1/n * t(X)%*%Ones
S <- 1/(n-1) * t(X - Ones%*%t(x_sample_mean))%*%(X - Ones%*%t(x_sample_mean))

# eigens
ev <- eigen(S)
eigen_values <- ev$values
V <- ev$vectors

k <- 3
SS <- sum(diag((S)))
LL <- sum(eigen_values[1:k])
cat( fractions(LL/SS), '=', LL, '/', SS)
```

```
## 0.986968 = 343.9985 / 348.5407
```

```
# We can see the loadings in V
V
```

```
##              [,1]        [,2]        [,3]          [,4]          [,5]
## [1,]  0.010039244  0.07622439  0.03087761  0.9203045748  0.3423859285
## [2,] -0.993199405  0.11615518  0.00659069 -0.0002118679  0.0022391022
## [3,] -0.014062314 -0.09956775 -0.18282641 -0.1382922410  0.6500776063
## [4,]  0.004710175  0.01320423 -0.13021553 -0.3277842624  0.6431560485
## [5,] -0.024255644 -0.15038113 -0.95526318  0.1023719020 -0.2065840405
## [6,] -0.112429558 -0.97335904  0.16981025  0.0632480276 -0.0002935726
## [7,] -0.002340785 -0.02382046 -0.08519558  0.1095073458  0.0619613872
##              [,6]         [,7]
## [1,]  0.011779079 -0.169729925
## [2,]  0.003353218 -0.001781987
## [3,] -0.563893916  0.443577538
## [4,]  0.497513370 -0.462855916
## [5,] -0.009009299 -0.105029951
## [6,]  0.051067254 -0.066992404
## [7,]  0.657012233  0.738019426
```

(1.e) Repeat with the data standarized. Aka, use R instead of S for the analysis.

```
# Com
R <- cor(X)

# eigens
ev_z <- eigen(R)
eigen_values_z <- ev_z$values
V_z <- ev_z$vectors

k <- 3
RR <- sum(diag((R)))
LL_r <- sum(eigen_values_z[1:k])
cat( fractions(LL_r/RR), '=', LL_r, '/', RR, fill=TRUE)
```

```
## 0.7038356 = 4.926849 / 7
```

```
# We can see the loadings in V
eigen_values_z
```

```
## [1] 2.3367826 1.3860007 1.2040659 0.7270865 0.6534765 0.5366888 0.1558989
```

```
V_z
```

```
##            [,1]         [,2]       [,3]         [,4]        [,5]         [,6]
## [1,]  0.2368211  0.278445138  0.6434744  0.172719491  0.56053441 -0.223579220
## [2,] -0.2055665 -0.526613869  0.2244690  0.778136601 -0.15613432 -0.005700851
## [3,] -0.5510839 -0.006819502 -0.1136089  0.005301798  0.57342221 -0.109538907
## [4,] -0.3776151  0.434674253 -0.4070978  0.290503052 -0.05669070 -0.450234781
## [5,] -0.4980161  0.199767367  0.1965567 -0.042428178  0.05021430  0.744968707
## [6,] -0.3245506 -0.566973655  0.1598465 -0.507915905  0.08024349 -0.330583071
## [7,] -0.3194032  0.307882771  0.5410484 -0.143082348 -0.56607057 -0.266469812
##             [,7]
## [1,] -0.24146701
## [2,] -0.01126548
## [3,]  0.58524622
## [4,] -0.46088973
## [5,] -0.33784371
## [6,] -0.41707805
## [7,]  0.31391372
```