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# Description:  MVApcabank  performs a PCA for the Swiss bank notes (bank2.dat)
#               and shows the first three principal components in two-dimensional
#               scatterplots. Additionally, a screeplot of the eigenvalues is
#               displayed.
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# Output:       Two dimensional scatterplots of the first three principal
#               components.
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# Example:      -Swiss bank notes
# ------------------------------------------------------------------------------
# Note: R decomposes matrices differently from other software, and hence some
#       of the eigenvectors can have have different signs. This does not change the
#       results, but it does change the order of the graph by inverting the axes
#       around the origin (not always, and not necessarily all of the axis; it
#       depends on which eigenvectors we choose to plot).
#       In this case, the plots are inverted (compared with plots in some books).

x  = read.table("SwissBank 1.txt")
n  = nrow(x)
#calculates eigenvalues and eigenvectors and sorts them by size
e  = eigen((n - 1) * cov(x) / n)
e1 = e$values

#data multiplied by eigenvectors
x  = as.matrix(x) %*% e$vectors

par(mfrow = c(2, 2))
#plot of the first vs. second PC
plot(x[, 1], x[, 2], pch = c(rep(1, 100), rep(3, 100)),
    col = c(rep("blue", 100), rep("red", 100)),
    xlab = "PC1", ylab = "PC2", main = "First vs. Second PC",
    cex.lab = 1.2, cex.axis = 1.2, cex.main = 1.8)

#plot of the second vs. third PC
plot(x[, 2], x[, 3], pch = c(rep(1, 100), rep(3, 100)),
    col  = c(rep("blue", 100), rep("red", 100)),
    ylim = c(-238.5, -241.5), xlab = "PC2",
    ylab = "PC3", main = "Second vs. Third PC",
    cex.lab = 1.2, cex.axis = 1.2, cex.main = 1.8)

#plot of the first vs. third PC
plot(x[, 1], x[, 3], pch = c(rep(1, 100), rep(3, 100)),
    col  = c(rep("blue", 100), rep("red", 100)),
    ylim = c(-238.5, -241.5), xlab = "PC1", ylab = "PC2",
    main = "First vs. Third PC",
    cex.lab = 1.2, cex.axis = 1.2, cex.main = 1.8)

#plot of the eigenvalues
plot(e1, ylim = c(0, 3), xlab = "Index", ylab = "Lambda",
    main = "Eigenvalues of S",
    cex.lab = 1.2, cex.axis = 1.2, cex.main = 1.8)
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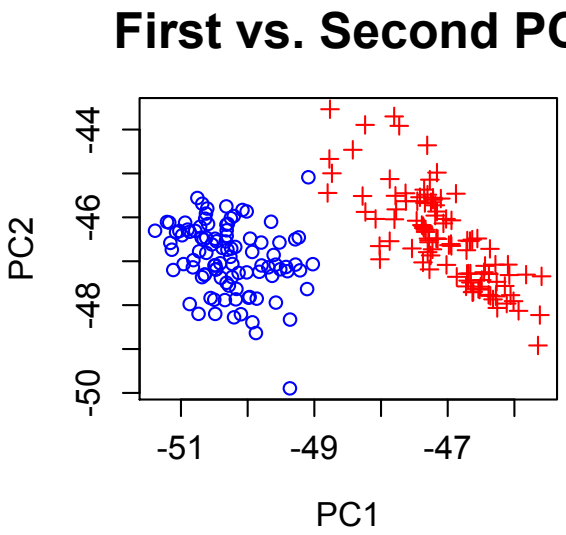
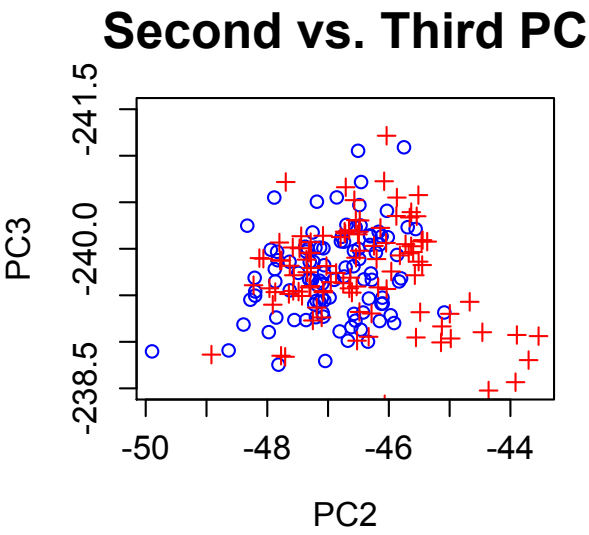
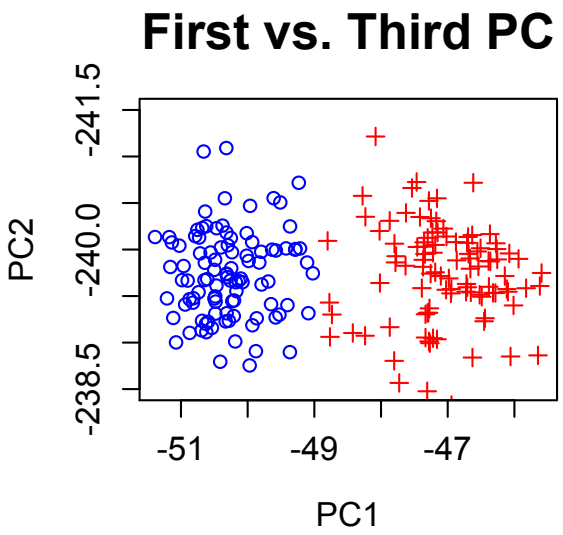
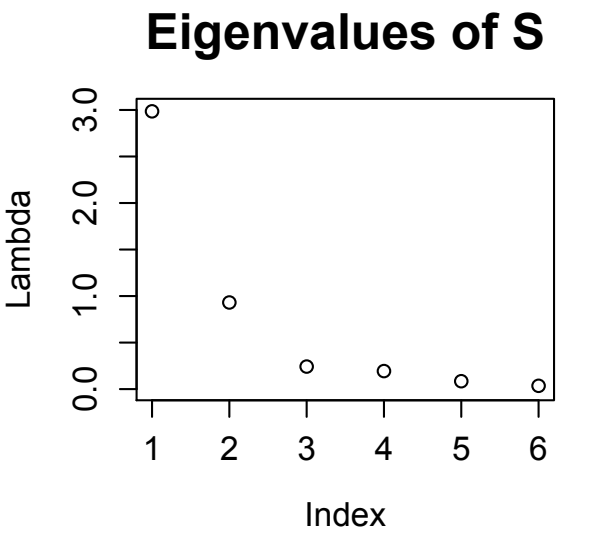

First vs. Second PC
PC2
-44
-46
-48
-50
-51
-49
-47
PC1


Second vs. Third PC
PC3
-241.5
-240.0
-238.5
-50
-48
-46
-44
PC2


First vs. Third PC
PC2
-241.5
-240.0
-238.5
-51
-49
-47
PC1


Eigenvalues of S
Lambda
3.0
2.0
1.0
0.0
1
2
3
4
5
6
Index