Applied Multivariate, Übung 1

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Task 1

```r
A = matrix(c(1,3,5,3,2,0,5,0,4), 3, 3, byrow = TRUE)
eigen(A)$values
eigen(A)$vectors
gamma = eigen(A)$vectors
lambda = diag(eigen(A)$values)
round(gamma %*% lambda %*% t(gamma))
```

Die Eigenwerte sind $\lambda_1 = 8.277780$, $\lambda_2 = 2.496552$ und $\lambda_3 = -3.774332$. Die Eigenvektoren sind

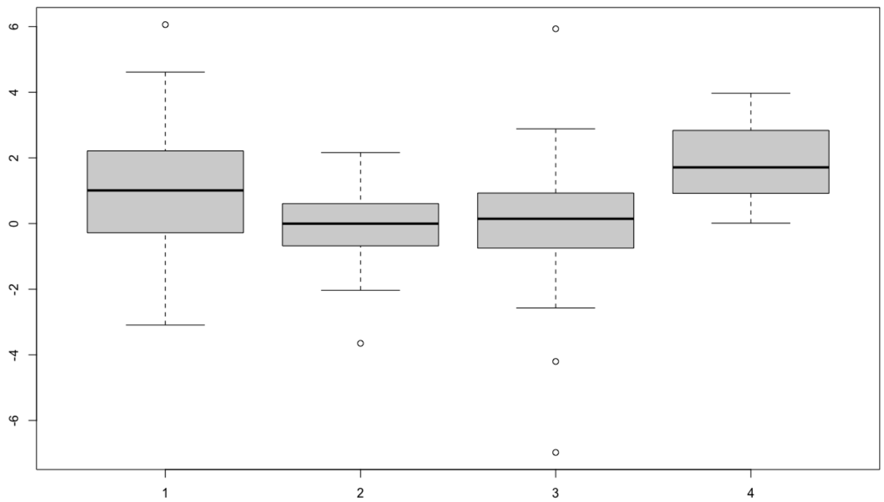
$$v_1 = \begin{pmatrix} -0.6208271 \\ -0.2966783 \\ -0.7256416 \end{pmatrix} \quad v_2 = \begin{pmatrix} -0.1435001 \\ -0.8669793 \\ 0.4772365 \end{pmatrix} \quad v_3 = \begin{pmatrix} 0.7707019 \\ -0.4004110 \\ -0.4956708 \end{pmatrix}$$

Damit

$$\Gamma = \begin{pmatrix} -0.6208271 & -0.1435001 & 0.7707019 \\ -0.2966783 & -0.8669793 & -0.4004110 \\ -0.7256416 & 0.4772365 & -0.4956708 \end{pmatrix} \quad \Lambda = \begin{pmatrix} 8.277780 & 0 & 0 \\ 0 & 2.496552 & 0 \\ 0 & 0 & -3.774332 \end{pmatrix}$$

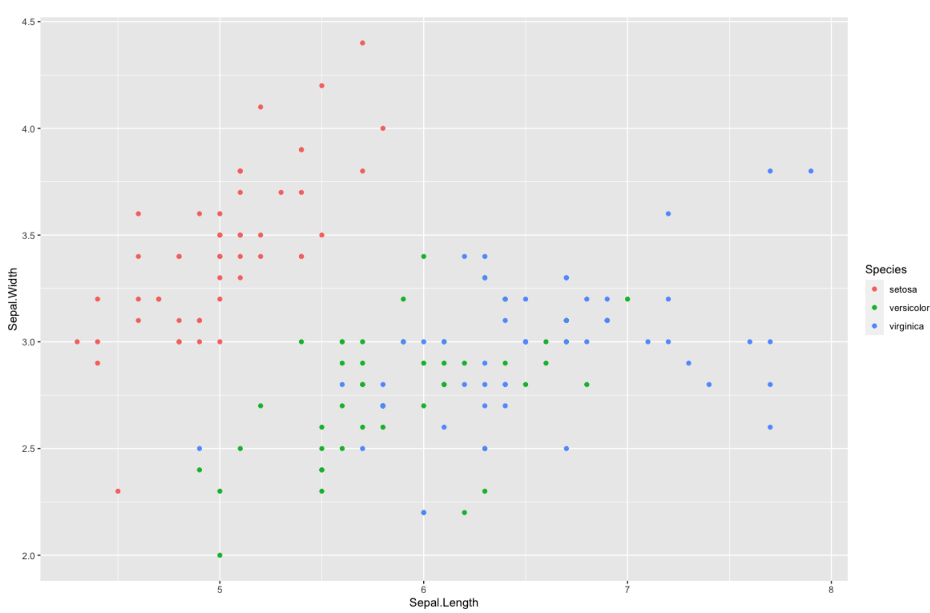
Task 2

```r
B = cbind(rnorm(100, mean = 1, sd = 2),
        rnorm(100),
        rt(100, df = 4),
        runif(100, min = 0, max = 4))
pdf("problem1.2.pdf")
boxplot(B)
dev.off()
```



Task 3

```r
library(ggplot2)
pdf("problem1.3.pdf")
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, color =
    Species)) + geom_point()
dev.off()
cov(iris[,1:4])
```



Und die Kovarianzmatrix ist

$$\mathrm{Cov} = \begin{pmatrix} 0.6856935 & -0.0424340 & 1.2743154 & 0.5162707 \\ -0.0424340 & 0.1899794 & -0.3296564 & -0.1216394 \\ 1.2743154 & -0.3296564 & 3.1162779 & 1.2956094 \\ 0.5162707 & -0.1216394 & 1.2956094 & 0.5810063 \end{pmatrix}$$

Task 4

```r
C = matrix(c(1,3,5,3,2,0,7,1,4,1,1,1), nrow = 4, ncol = 3, byrow = TRUE)
lambda = diag(svd(C)$d)
gamma = svd(C)$u
delta = svd(C)$v
round(gamma %*% lambda %*% t(delta))
```

Liefert

$$\Gamma = \begin{pmatrix} -0.4784969 & 0.85678269 & 0.08203851 \\ -0.2919929 & -0.29035642 & 0.88707192 \\ -0.8106216 & -0.41824208 & -0.40918045 \\ -0.1693322 & 0.08179326 & 0.19734351 \end{pmatrix} \quad \Lambda = \begin{pmatrix} 9.721112 & 0 & 0 \\ 0 & 4.261988 & 0 \\ 0 & 0 & 2.082172 \end{pmatrix}$$

$$\Delta = \begin{pmatrix} -0.7404667 & -0.6710925 & 0.03666106 \\ -0.3085481 & 0.3878909 & 0.86852674 \\ -0.5970822 & 0.6318034 & -0.49428460 \end{pmatrix}$$