

Livestock Breeding and Genomics - Exercise 2

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Problem 1: Matrices in R

In R, matrices are constructed using the function `matrix()`. This function accepts different options. We want to see, how these options work.

Your Task: Construct matrices using the different options to better understand the meaning of the different options.

Parameter data

- data: Specify the different matrix elements

```
matA <- matrix(data = c(1:9), nrow = 3, ncol = 3)
```

- data: without specifying the matrix elements

```
matB <- matrix(nrow = 3, ncol = 3)
```

- data: specifying not all matrix elements

```
matC <- matrix(data = c(1,2,3), nrow = 3, ncol = 3)
```

```
matC2 <- matrix(data = c(1,2,3,4), nrow = 3, ncol = 3)
```

Parameters nrow and ncol

- Leaving out one of both parameters

```
matD <- matrix(data = c(1:9), nrow = 3)
```

```
matE <- matrix(data = c(1:9), ncol = 3)
```

Parameter byrow

```
matF <- matrix(data = c(1:9), nrow = 3, ncol = 3, byrow = TRUE)
```

```
matG <- matrix(data = c(1:9), nrow = 3, ncol = 3, byrow = FALSE)
```

Problem 2: Matrix multiplication in R

In R, matrices can be multiplied using the operator `%*%` or with the functions `crossprod()` or `tcrossprod()`. With `crossprod()` and `tcrossprod()` vectors and matrices can be multiplied directly. The conversion of vectors to matrices is done automatically inside of these functions. The result will always be a matrix. When doing matrix-vector multiplications with `%*%` the vector has to be converted first into a matrix using the function `as.matrix()`.

In a first part of this problem, compare the results of the functions `crossprod()`, `tcrossprod()` and `%*%`.

a) Given are the following matrices

```
matA <- matrix(data = c(1:9), ncol = 3)
matB <- matrix(data = c(2:10), ncol = 3)
```

Find out which matrix multiplication with `%*%` corresponds to the following statement?

```
crossprod(matA,matB)
```

```
##      [,1] [,2] [,3]
## [1,]   20   38   56
## [2,]   47   92  137
## [3,]   74  146  218
```

Alternatively there is the function `tcrossprod()`. Find out which matrix multiplication is executed by

```
tcrossprod(matA, matB)
```

```
##      [,1] [,2] [,3]
## [1,]   78   90  102
## [2,]   93  108  123
## [3,]  108  126  144
```

b) Given is the vector `vecB`

```
vecB <- c(-3,16,1)
```

Multiply the matrix `matA` with the vector `vecB` once using `%*%` and then with the function `crossprod()`.

Hint: a vector can be converted to a matrix using the function `as.matrix()`.

Problem 3: Quantitative Genetics

In a population the following numbers of genotypes were counted for a given genetic locus called *A*.

Genotypes	Numbers
A_1A_1	24
A_1A_2	53
A_2A_2	23

- Compute the genotype frequencies
- Compute the allele frequencies
- Compute the population mean μ under the following assumptions
 - the difference between the genotypic values of the homozygous genotypes is 20 and
 - the genotypic value of the heterozygous genotype is 2.