Working with Vectors and Matrices

Constructing vectors

- Integers from 9 to 17

```
> x<-9:17
> x
```

```
[1]  9 10 11 12 13 14 15 16 17
```

- A sequence of 11 numbers from 0 to 1

```
> y<-seq(0,1,length=11)
> y
```

```
 [1] 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
```

- The same number or the same vector several times

```
> z<-rep(1:2, 5)
> z
```

```
 [1] 1 2 1 2 1 2 1 2 1 2
```

- Combine numbers, vectors or both into a new vector

```
> xz10<-c(x,z,10)
> xz10
```

```
 [1]  9 10 11 12 13 14 15 16 17  1  2  1  2  1  2  1  2  1  2 10
```

Constructing matrices

- Combine rows into a matrix

```
> A<-rbind(1:3, c(1,1,2))
> A
     [,1] [,2] [,3]
[1,]    1    2    3
[2,]    1    1    2
```

- Or columns

```
> B<-cbind(1:3, c(1,1,2))
> B
     [,1] [,2]
[1,]    1    1
[2,]    2    1
[3,]    3    2
```

- Define a matrix from one long vector

```
> C<-matrix(c(1,0,0,1,1,0,1,1,1), nrow=3, ncol=3)
> C
     [,1] [,2] [,3]
[1,]    1    1    1
[2,]    0    1    1
[3,]    0    0    1
```

Can also be done by rows by adding "`, byrow=TRUE`" before the last parenthesis

Index and logical index

- Important for optimal use of **R**
- Example: Define a vector with integers from (-5) to 5 and extract the numbers with absolute value less than 3.

```
> x<- (-5):5
> x
 [1] -5 -4 -3 -2 -1  0  1  2  3  4  5
```

  - by their index in the vector

```
> x[4:8]
[1] -2 -1  0  1  2
```

  - by negative selection (set a minus in front of the indices we don't want)

```
> x[-c(1:3,9:11)]
[1] -2 -1  0  1  2
```

  - A logical vector can be defined by

```
> index<-abs(x)<3
> index
 [1] FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE FALSE
```

  - Now this vector can be used to extract the wanted numbers

```
> x[index]
[1] -2 -1  0  1  2
```

Index and logical index

- This also works for matrices:

```
> A<-matrix((-4):5, nrow=2, ncol=5)
> A
     [,1] [,2] [,3] [,4] [,5]
[1,]   -4   -2    0    2    4
[2,]   -3   -1    1    3    5
> A[A<0]
[1] -4 -3 -2 -1
```

- And for assignments

```
> A[A<0]<-0
> A
     [,1] [,2] [,3] [,4] [,5]
[1,]    0    0    0    2    4
[2,]    0    0    1    3    5
```

- Matrix rows can be selected by

```
> A[2,]
[1] 0 0 1 3 5
```

- and similarly for columns

```
> A[,c(2,4)]
     [,1] [,2]
[1,]    0    2
[2,]    0    3
```

Properties of vectors and matrices

The mode of the vector or matrix detects the type of singles that is stored:

```
> A<-matrix(rep(c(TRUE,FALSE),2),nrow=2)
> B<-rnorm(4)
> C<-matrix(LETTERS[1:9],nrow=3)
> A;B;C
      [,1]  [,2]
[1,]  TRUE  TRUE
[2,] FALSE FALSE
[1]  0.6613129  0.8583421  1.2516685 -1.2147030
     [,1] [,2] [,3]
[1,] "A"  "D"  "G"
[2,] "B"  "E"  "H"
[3,] "C"  "F"  "I"
> mode(A);mode(B);mode(C)
[1] "logical"
[1] "numeric"
[1] "character"
```

Properties of vectors and matrices

Vectors and matrices have *lengths*: The length is the number of elements:

```
> x<-matrix(c(NA,2:12),ncol=3)
> x
     [,1] [,2] [,3]
[1,]   NA    5    9
[2,]    2    6   10
[3,]    3    7   11
[4,]    4    8   12
> length(x[1,])
[1] 3
> length(x)
[1] 12
```

The dimension of a matrix is the number of rows and columns: The number of columns is the second element.

```
> dim(x); dim(x)[2]
[1] 4 3
[1] 3
```

Naming rows and columns in a matrix

We can add names to a matrix with the dimnames() function:

```
> x<-matrix(rnorm(12),nrow=4)
> x
           [,1]       [,2]       [,3]
[1,]  1.5231529 -0.5784787 -0.7314045
[2,] -1.2359829  0.2717685 -0.8343691
[3,]  1.6658531 -0.3012827  0.6278903
[4,] -0.5035843 -0.4158793  0.7975808
> dimnames(x)[[2]]<-paste("data",1:3,sep="")
> dimnames(x)[[1]]<-paste("obs",1:4,sep="")
> x
          data1      data2      data3
obs1  1.5231529 -0.5784787 -0.7314045
obs2 -1.2359829  0.2717685 -0.8343691
obs3  1.6658531 -0.3012827  0.6278903
obs4 -0.5035843 -0.4158793  0.7975808
```

Retrieval:

```
> rownames(x)
[1] "obs1" "obs2" "obs3" "obs4"
> colnames(x)
[1] "data1" "data2" "data3"
```