**Exercise 1.**
Consider the numbers :

$$6.4 \quad 7.8 \quad 0.005 \quad 8.1 \quad 11.2 \quad 18.9 \quad 2.9 \quad 1.3$$

(a) Create a vector `x` containing these numbers.

(b) Find the mean of `x`.

(c) Compute the sum of the values.

(d) Substract the mean from each element of `x`.

(e) Calculate the square roots of the elements of `x`.

(f) Create a vector `y` containing only the elements of `x` which are larger than their square roots.

**Exercise 2.**
Type `n=10` and compare the commands `1:n-1` and `1:(n-1)`.

**Exercise 3.**
Use the `rep` function to produce a vector containing :

(a) the values : $1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4$

(b) the values : $4, 4, 4, 4, 3, 3, 3, 3, 2, 2, 2, 2, 1, 1, 1, 1$

(c) the values : $1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5$

**Exercise 4.**
Consider the two matrices $\mathbf{M_1}$ and $\mathbf{M_2}$ :

$$\mathbf{M_1} = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix} \qquad \mathbf{M_2} = \begin{pmatrix} 3 & 5 & 7 \\ 4 & 6 & 8 \end{pmatrix}$$

(a) Create $\mathbf{M_1}$ and $\mathbf{M_2}$ in `R`.

(b) Multiply $\mathbf{M_1}$ by itself element by element, and by matrix multiplication.

(c) Multiply $\mathbf{M_1}$ by $\mathbf{M_2}$ and multiply the transpose of $\mathbf{M_2}$ by $\mathbf{M_1}$.

(d) Extract the diagonal elements of $\mathbf{M_1}$ and create a square matrix with these elements on the diagonal and 0 elsewhere.

(e) Invert the matrix $\mathbf{M_1}$.

**Exercise 5.**
Consider the data frame `Aids2`, which represents data on 2843 patients diagnosed with AIDS in Australia before July 1, 1991. The data come with the `R` package `MASS` and can be loaded using the following commands:

```
> library(MASS)
> data(Aids2)
> help(Aids2)
> Aids[1:10,]
```

(a) From `Aids2` create a data frame containing only the entries for the state of origin `NSW`, and denote it by `NSW.dat`.

(b) From `NSW.dat` create a data frame containing only the entries for the women.

(c) For this subset of the data calculate the number of women alive at the end of the observation, and compute its percentage.

**Exercise 6.**
The following ten observations, taken during the years 1970-79, are on October snow cover (in millions of square kilometers) for Eurasia :

| Year | Snow Cover |
|---|---|
| 1970 | 6.5 |
| 1971 | 12.0 |
| 1972 | 14.9 |
| 1973 | 10.0 |
| 1974 | 10.7 |
| 1975 | 7.9 |
| 1976 | 21.9 |
| 1977 | 12.5 |
| 1978 | 14.5 |
| 1979 | 9.2 |

(a) Open an external text editor, enter the data and save the file as a plain text file.

(b) Import the data file into `R`.

(c) Plot the snow cover versus the years. Comments ?

(d) Plot a histogram and a boxplot of the snow cover values. Comments ?

(e) Repeat (c) and (d) after taking logarithms of snow cover. Comments ?

**Exercise 7.**
Generate sample of size 100 from the following distribution, compute the mean and the variance of the sample and compare with the values you know from the first part of the course.

(a) Binomial distribution with $n = 50$ and $p = 0.6$.

(b) Poisson distribution with $\lambda = 3$.

(c) Exponential distribution with expectation equal to 5.

(d) Normal distribution with $\mu = -1$ and $\sigma = 0.01$.

(e) Chi-square distribution with 7 degrees of freedom.

(f) Student distribution with 11 degrees of freedom.

**Exercise 8.**
Create a sequence, `x`, from -10 to 10 with spacing 0.5.

(a) Create a vector, `y`, containing the squares of `x`. Make a scatterplot of the two vectors

(b) Reproduce additional scatterplots by changing its arguments, like `type, xlab, ylab, lwd, col,` ...

**Exercise 9.**
Write a function `Fact` to compute the factorial of a number. Trace its evaluation in computing 10!, i.e. `Fact(10)`.

**Exercise 10.**
Write a function `transform` that takes two vector arguments `x` and `power` and produces `x^power` if `power` is non-zero, but produces `log(x)` if `power` is zero.

**Exercise 11.**
Write a recursive function `Fib` to compute Fibonacci numbers, based on the following facts : `Fib(0)` is 0, `Fib(1)` is 1 and otherwise `Fib(n)` is `Fib(n-1)+Fib(n-2)`. Trace its evaluation in computing `Fib(5)`.