**COS-D407.** *Scientific Modeling and Model Validation*

**Hands-on exercises**

**Week 1**

**University of Helsinki, Finland**

**01.11.2021–15.12.2021**

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**Source: https://github.com/christina-bohk-ewald/2021-COS-D407-scientific-modeling-and-model-validation**

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## 1. First steps in R

R is a freely available software environment that enables you to do statistical analysis. Due to R's lively community and many users worldwide, new functions are added almost every day. This allows you to participate in R's increasing functionality and to contribute to it yourself.

### 1.1 Download and update R

You can find R and / or its latest update on the R-project website and download and install it on your computer.

### 1.2 Open and start to work with R

If you have installed R on your computer, you can simply open it and start working. Another option would be to work with R via an integrated development environment (IDE), such as RStudio or IntelliJ. This post on stackexchange gives you a glance on IDEs that are available for R programming. You can have a look at them and try them. However, please note that this decision is completely up to you.

### 1.3 R console and scripts

Operations are performed in the R console (or workspace). You can save the instructions for all your calculations, the R code, in a script. Please do this, and open a new script for week 1 of this course.

### 1.4 Create filepath to your script, data, and results

For an R project, you may have multiple files, e.g., R scripts, input data, and results. To organize these files, it may be helpful to save them in a particular folder of a project. Please create a folder for this course (e.g., course-COS-D407) on your computer and make a filepath to it in R:

```
the_course_COS_D407_path <- c("C:/course-COS-D407")
```

Now, you can also save your new script (e.g., week-1.R) into this new folder *course-COS-D407*.

### 1.5 Set working directory

You can tell R where to find the files you need to work with in a project via setting the working directory to this folder:

```
setwd(the_course_COS_D407_path)
```

### 1.6 R Tutorials and cheatsheets

There are many R tutorials and introductions online. For example, there are the introductions of (1) E. Paradis (2005): *R for Beginners* and of (2) Grolemund and Wickham (2017): *R for Data Science*. Please have a look at them according to your needs.

You may also find useful the RStudio Cheatsheets.

However, note that there is no need to worry; you do not need to know all of R and surely not at once. We will use R in the coming weeks and the best way to learn it is by doing it, step by step, using interesting applications.

### 1.7 Online help

You can find help online for almost any problem in R. Since the R community is so large, there is almost always someone who has had your problem before, and probably provides a solution for it. Websites you may find interesting are, e.g., stackexchange and stackoverflow. Go online and try it!

### 1.8 What else?

It is most important that you know that and how you can get help online, because programming is an adventure and everything will be solved on the way.

## 2. Time for you to explore and play around in R

### 2.1 Create a sequence of numbers from 1 to 10:

```
one_to_ten <- seq(1,10,1)
one_to_ten
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10
```

### 2.2 Save this sequence in your project folder:

```
write.table(one_to_ten,file="one_to_ten.txt")
```

### 2.3 First remove data object one_to_ten and then load it via the txt.file you have just created:

```
remove(one_to_ten)
```

```
## one_to_ten
```

```
one_to_ten <- read.table(file="one_to_ten.txt")
```

```
one_to_ten
```

```
##     x
## 1   1
## 2   2
## 3   3
## 4   4
## 5   5
## 6   6
## 7   7
## 8   8
## 9   9
## 10 10
```

### 2.4 Now you can plot this data object one_to_ten:

```
dev.off()
```

```
pdf(file="sequence-one-to-ten.pdf",width=10, height=10, family="Times", pointsize=24, onefile=TRUE)
```
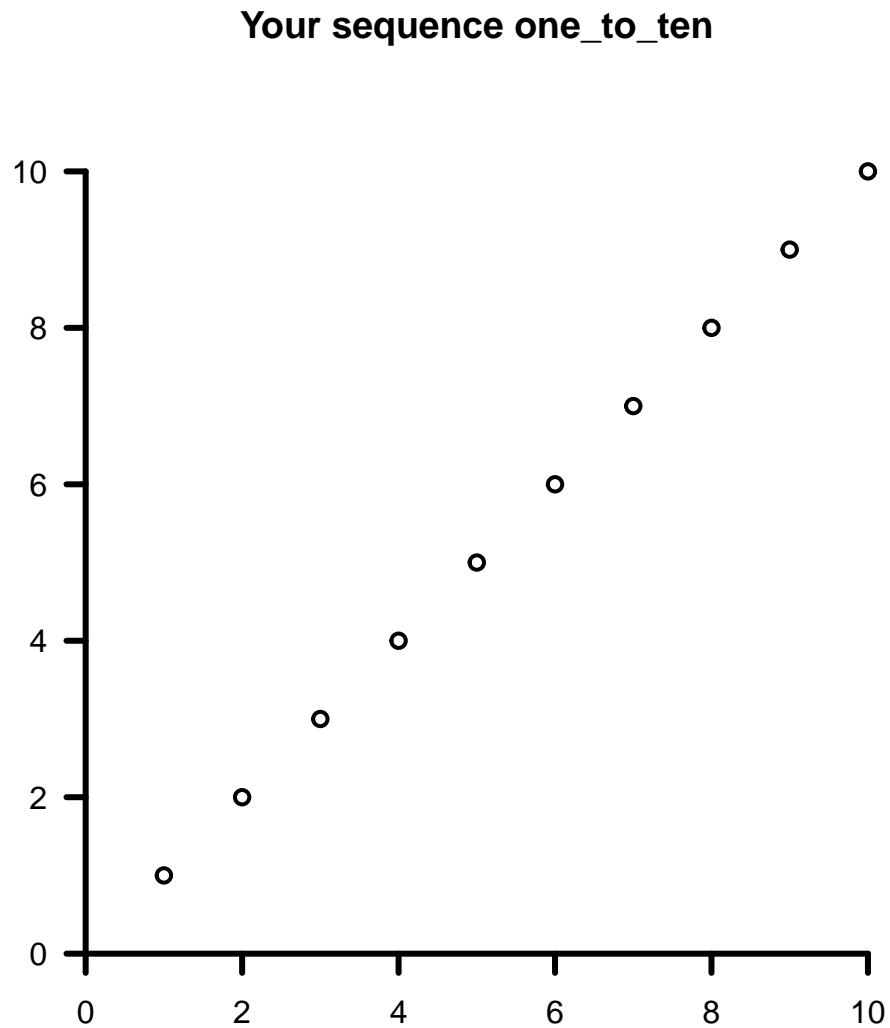
```
par(fig = c(0,1,0,1), las=1, mai=c(0.4,1.2,1.2,0.4))

    plot(x=-100,y=-100,xlim=c(0,10),ylim=c(0,10),xlab="",ylab="",
        main="Your sequence one_to_ten",axes=FALSE)

    axis(side=1,at=seq(0,10,2),labels=TRUE,lwd=3,pos=0)
    axis(side=2,at=seq(0,10,2),labels=TRUE,lwd=3,pos=0)

    points(x=1:10,y=one_to_ten[,1],lwd=2,col="black")
```

```
dev.off()
```

## Your sequence one_to_ten



You can try to make your plot visually more appealing, e.g., by looking into parameters of the function *points*, including, e.g., *col*, *lwd*, and *pch*. What other parameters do you find regarding plotting data in R?

**2.5 You may now want to continue exploring R yourself. . .**