R introduction

start your programming journey in 1 hour

Berry Boessenkool, June 2018 + April 2019

berry-b@gmx.de

github.com/brry/hour

Presentation template generated with `berryFunctions::createPres`

```
print("Hello world!")
```

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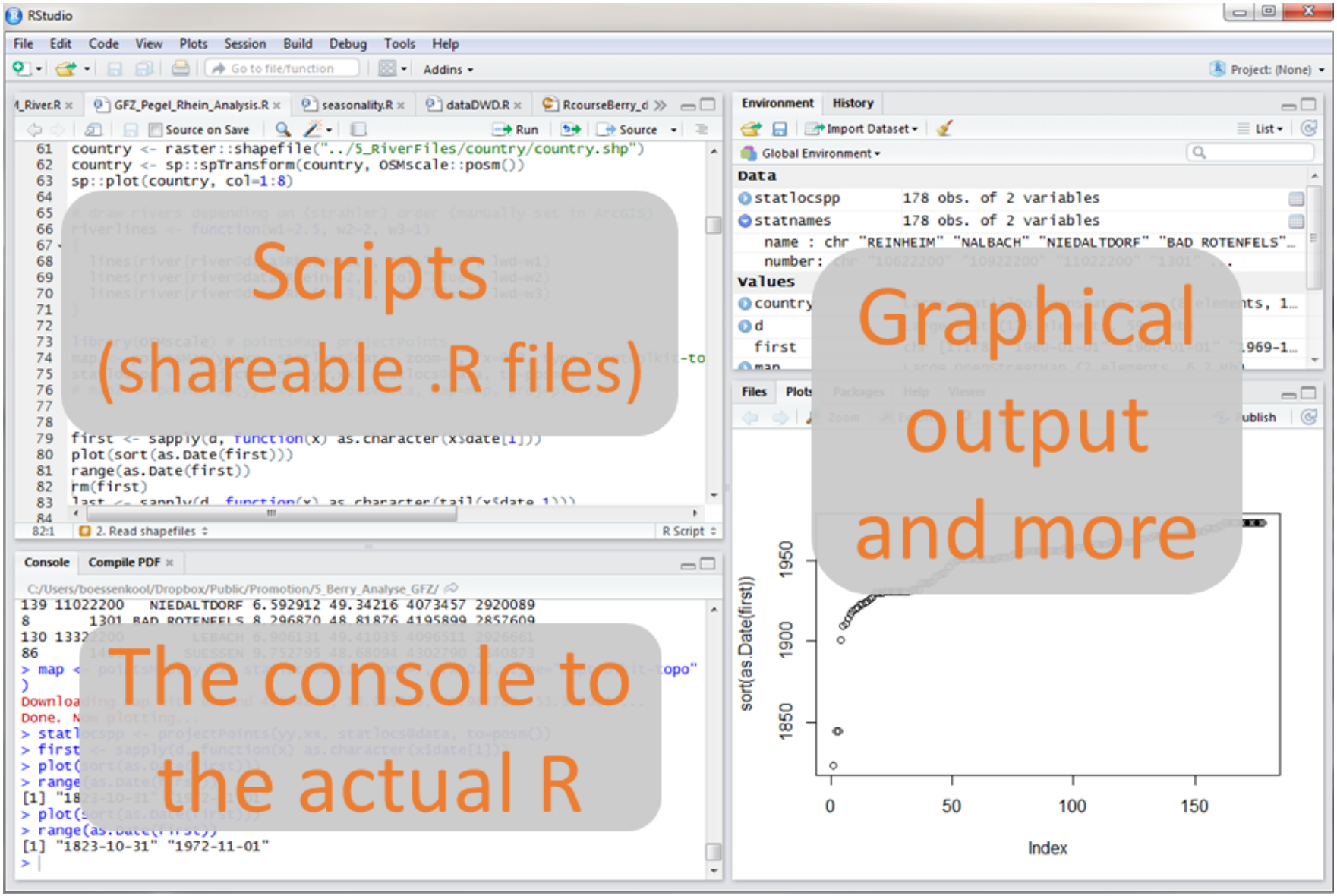
- Don't hesitate to ask the helpers
- If we're proceeding too fast, please interrupt!

Integrated Development Environment (IDE): RStudio



Preparation for the rest of the course

Exercise 1: Set up folder and script

1. With `rightclick on` Raw + `save target as / Download linked file`, download the course material and unzip it into a folder of your choice.
2. Open the `script_intro.R` file with Rstudio.
3. Tell R where to look for data through
   Rstudio: Session - Set Working Directory - To Source File Location
4. Copy the command thus sent to the console into the beginning of the script. This makes it reproducible later on.

```
setwd("C:/path/to/input") # change back- to forwardslashes
```

Get started in R

Get started in R

Exercise 2: R is an awesome calculator

In the console, calculate `21+21` , `7*6` and $\frac{0,3}{4} * \sqrt{313600}$

If you don't know how to compute a square root in R, you can google it!

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nstudents
nstudents > 12
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```
help(read.table)   ;   ?read.table   #   or press F1.
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- Use the documentation to find out settings for the arguments:

```
help(read.table)   ;   ?read.table   #   or press F1.
```

```
clim <- read.table(file="clim.txt", header=TRUE)
```

Reading files into R

Exercise 3: Reading files

1. Read the metadata file into R with the command `read.table`, again assigning it to an object with a good name.
2. You need to set the arguments `file`, `sep`, `header`, `stringsAsFactors`.
   Again: use the documentation to find out what settings are needed!
3. `str(YourObject)` must yield 5 chr (character) columns
4. BONUS: what does `tail(clim)` return?

Solution to exercise 3: Reading files

```
clim <- read.table(file="clim.txt", header=TRUE)
meta <- read.table(file="meta.txt", header=TRUE,
                   sep=";", stringsAsFactors=FALSE)
```

In the slide source code, I created a copy of `clim` with fewer columns to improve printing in the slides. Whenever I use `Clim` with a capital C, you can use your normal object:

```
tail(Clim) # last rows of an object
```

```
##     STATIONS_ID MESS_DATUM QN_3   FX  FM QN_4 RSK
## 545        3987 2019-04-15    1  9.1 3.8    1   0
## 546        3987 2019-04-16    1 12.1 4.4    1   0
## 547        3987 2019-04-17    1 11.7 4.1    1   0
## 548        3987 2019-04-18    1 13.7 4.5    1   0
## 549        3987 2019-04-19    1  9.7 4.3    1   0
## 550        3987 2019-04-20    1  6.7 2.5    1   0
```

Objects: data.frames

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- `DF[1,2:4];`

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Objects: data.frames

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- `read.table` also returns a data.frame
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- `DF[1,2:4]; DF[2, ]; DF[ ,"name"]; DF$name`

Exercise 4: Data.frame indexing

From the climate dataset, obtain:

1. The first 5 values in column 4
2. The column UPM (relative humidity)
3. BONUS 1: The maximum sunshine duration (SDK)
4. BONUS 2: What command do you need to get the number of rows?
5. BONUS 3: What is better and worse in `DF[ ,"name"]` vs `DF[ ,3]`?

Solution to exercise 4: subsetting data.frames

```
clim[1:5, 4]

## [1]  6.4  8.1  8.6  6.6 10.4

Clim$UPM

##  [1] 92.04 99.58 93.38 91.67 89.83 97.04 92.13 92.96 90.42 88.00 86.46 86.75
## [13] 79.13 90.00 98.21 98.17 93.00 87.63 91.83 94.25

max(clim$SDK)  ;   max(clim[ ,"SDK"])

## [1] 15.933
## [1] 15.933

nrow(clim)

## [1] 550
```

`DF[ ,"name"]` is better understandable for humans and still returns the same if the order of the columns is changed. But it needs more typing.

Plotting

General code for scatterplots: `plot(x, y, ...)`

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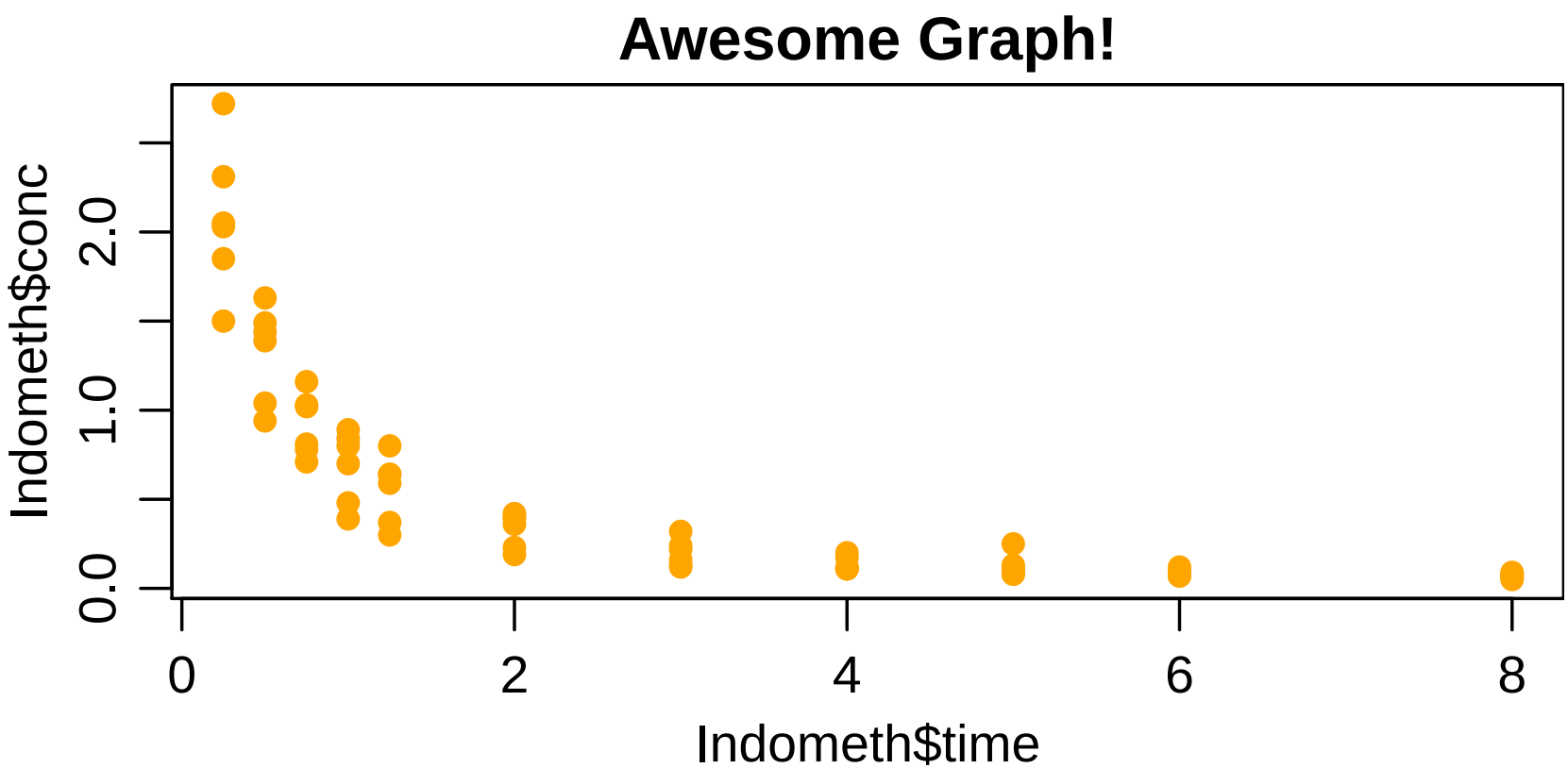
```
plot(x=Indometh$time, y=Indometh$conc,
     col="orange", pch=16, main="Awesome Graph!")
```



Plotting

Please convert the date column with

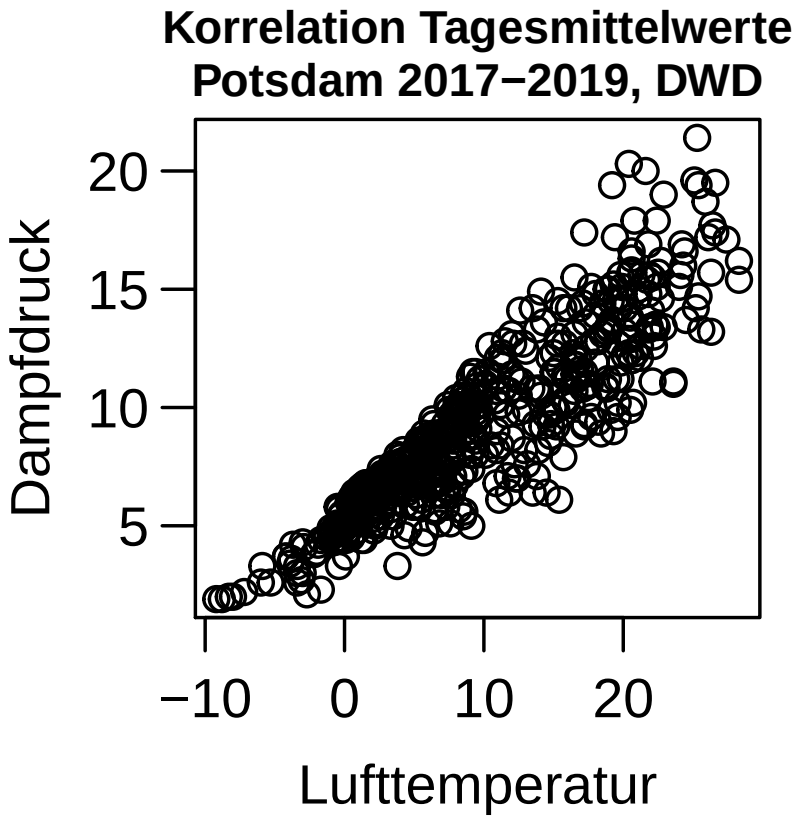
```
clim$MESS_DATUM <- as.Date(clim$MESS_DATUM, format="%Y-%m-%d")
```

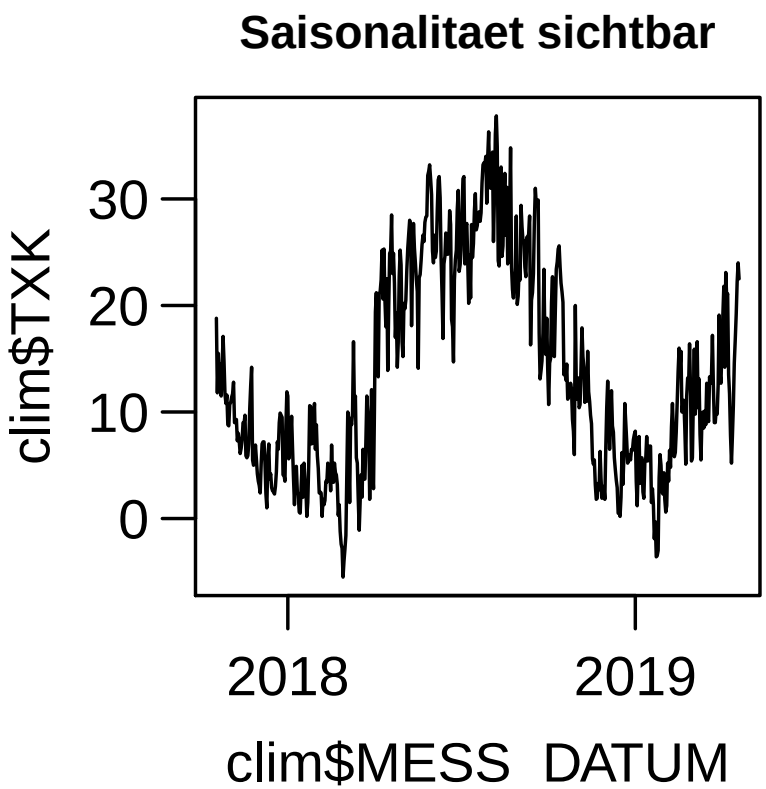
Exercise 5: Scatterplots, line plots

1. Generate a figure with `plot(clim$VPM, clim$TMK)`
2. Improve the axis labels. Use the metadata to figure out the column name meanings.
3. BONUS: Add an informative graph title
4. Plot a time series of the daily temperature maximum. What value do you need to give to the argument `type`? Again, use the documentation of `?plot()` to find out.

Solution to exercise 5: Scatterplots, line plots

```
plot(clim$TMK, clim$VPM, xlab="Lufttemperatur", ylab="Dampfdruck",
     main="Korrelation Tagesmittelwerte\nPotsdam 2017-2019, DWD")
plot(clim$MESS_DATUM, clim$TXK, type="l", main="Saisonalitaet sichtbar")
```

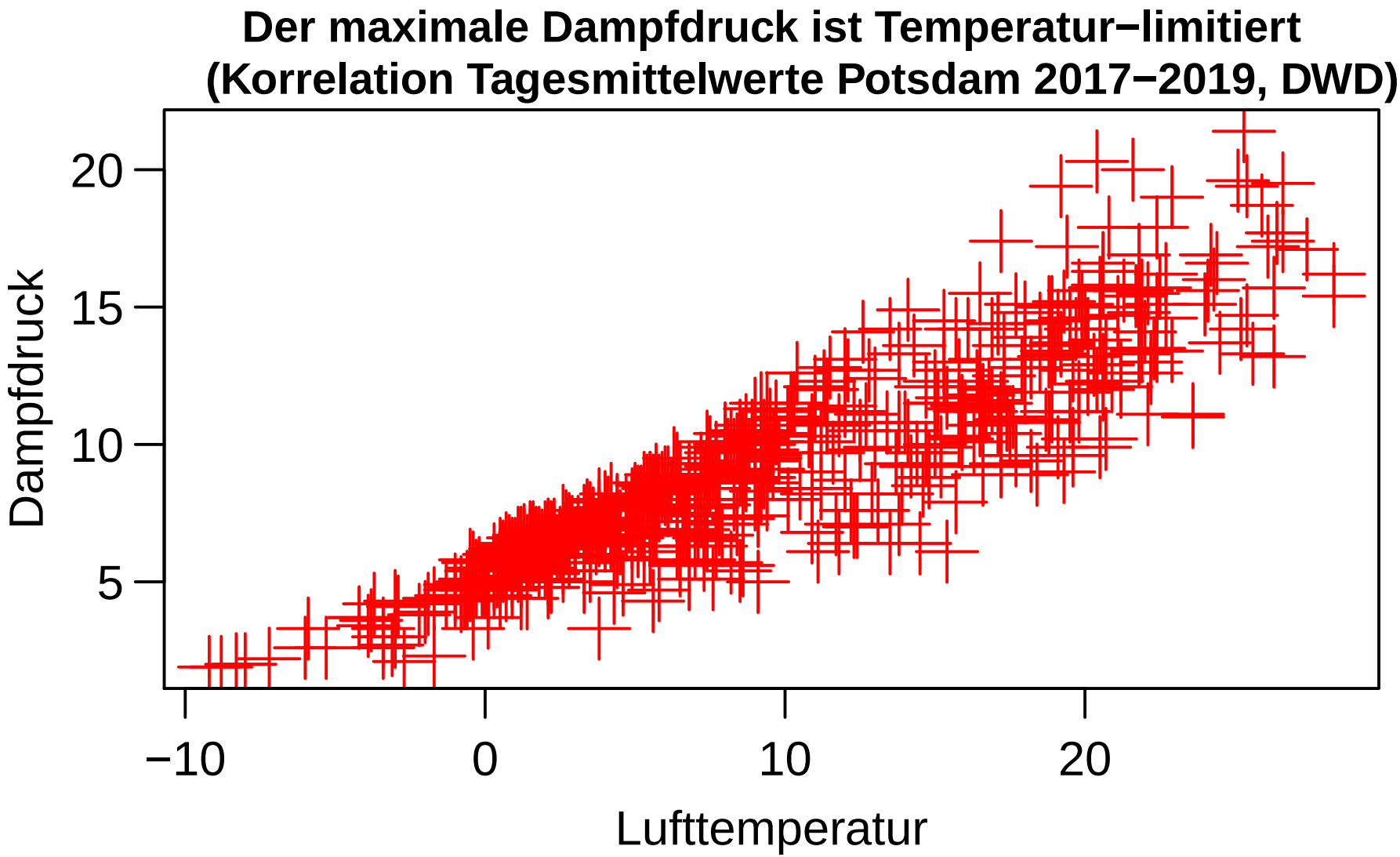




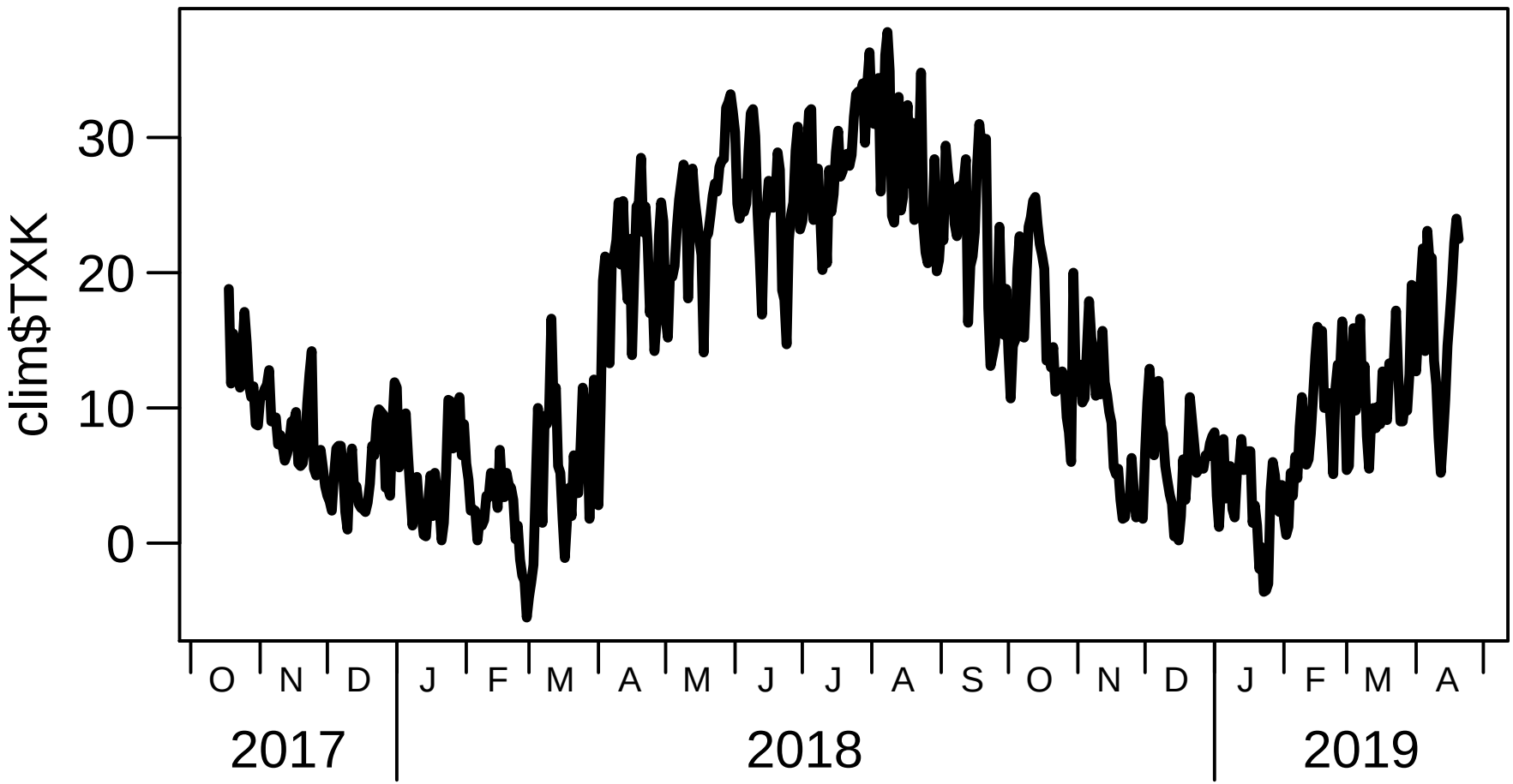
Plotting live demo I

```
par(mar=c(3,3,2,1), mgp=c(1.9,0.7,0))
plot(clim$TMK, clim$VPM, xlab="Lufttemperatur", ylab="Dampfdruck",
     main="Der maximale Dampfdruck ist Temperatur-limitiert
     (Korrelation Tagesmittelwerte Potsdam 2017-2019, DWD)",
     las=1, pch=3, cex=2, col="red", cex.main=0.9)
#
#
# install.packages("berryFunctions")
plot(clim$MESS_DATUM, clim$TXK, type="l", xlab="", xaxt="n", las=1, lwd=3)
berryFunctions::monthAxis()
```

Plotting live demo II



Plotting live demo III



commonly needed plot arguments

```
plot(x, y, # point coordinates
col="lightblue", # point color
pch=0, # point character (symbol)
xlab="My label  [km]", ylab="", # axis labels
main="Graph title", # title
cex=1.8, # character expansion (symbol size)
type="l", # draw lines instead of points
lwd=3, # line width (thickness of lines)
las=1, # label axis style (axis numbers upright)
xaxt="n" # axis type (none to suppress axis)
)
```

Preparing for for loops

Please give your metadata rownames as follows:

```
rownames(meta) <- meta$Par
```

Exercise 6: using objects to subset

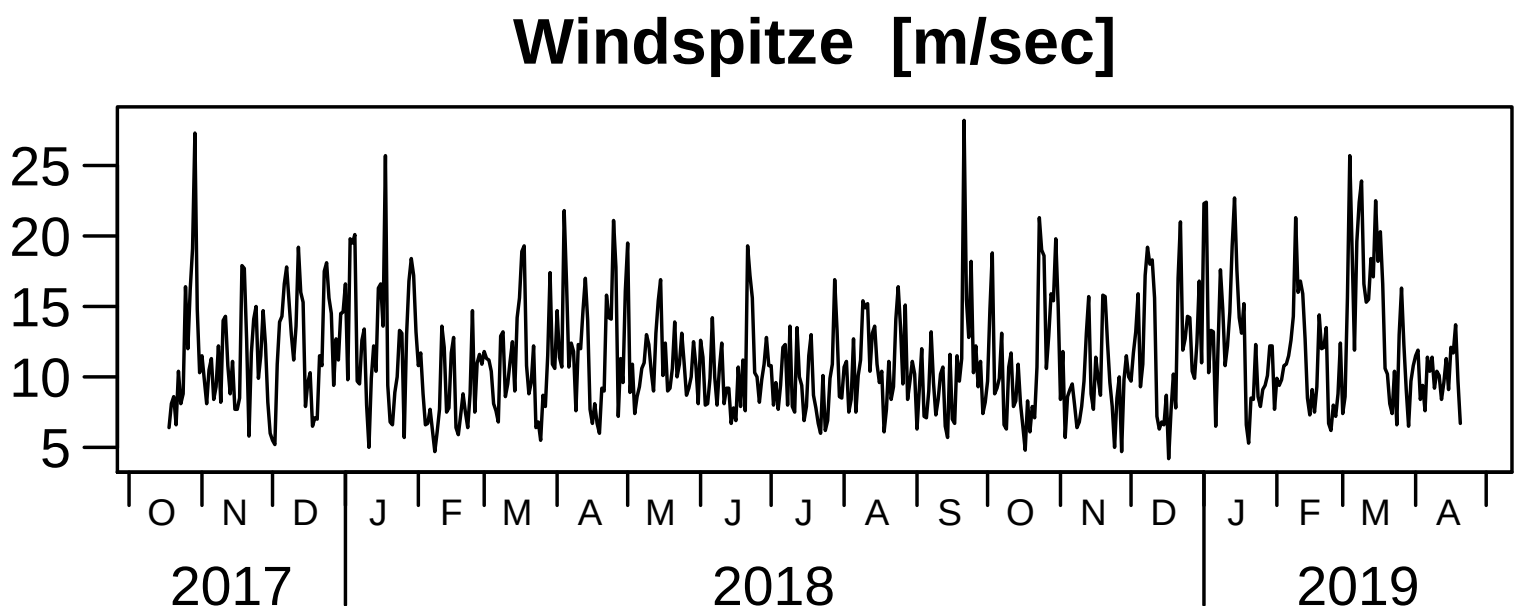
1. Create an object `var` with the character string `"FX"`.
2. Get the meta value for row `var` and column `"Label"`.
3. Plot the `var` column of `clim` as a time series.
4. Use the output from task 2 to give the plot a title.
5. BONUS: make the x-axis nicer by suppressing the default axis (`xaxt="n"`) and adding a monthAxis from the `berryFunctions` package.

Solution to exercise 6: using objects to subset

```
var <- "FX"
meta[var, "Label"]

## [1] "Windspitze  [m/sec]"

plot(clim$MESS_DATUM, clim[,var], type="l", xaxt="n",
     main=meta[var, "Label"], ylab="", xlab="")
berryFunctions::monthAxis()
```



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A for loop creates a variable, sets it to a value, runs some code,

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```
for(var in meta$Par)
{
  plot(clim$MESS_DATUM, clim[,var], type="l", xaxt="n",
       main=meta[var, "Label"], ylab="", xlab="")
  berryFunctions::monthAxis()
}
```

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- Grolemund & Wickham (2017) R for Data Science
- J. Adler (2010): R in a Nutshell
- U. Ligges (2008): Programmieren mit R (German)

Tutorials:

- Microsoft + Datacamp (best course I know of, with login, but free)
- STAT 545
- github.com/brry/course

Reference cards:

- base and advanced cheatsheets from Rstudio
- RefCard by Tom Short & Jonas Stein

The internet:

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The internet:

- StackOverflow for programming questions <– main resource

Feedback

Please fill out the feedback form at

bit.ly/feedbackR

(it only takes a few minutes and helps to improve the course)

Thanks!