

# Statistik und Graphiken mit R

## [Termine 1 & 2]

Miguel Alvarez

28. Februar & 02. März 2023

**▶ Termin 1 & 2**

- ▶ Grundlagen
- ▶ Datentypen

**▶ Termin 3 & 4**

- ▶ Objekten
- ▶ Lesen und Schreiben

**▶ Termin 5 & 6**

- ▶ Statistiken
- ▶ Graphiken (1)

**▶ Termin 7 & 8**

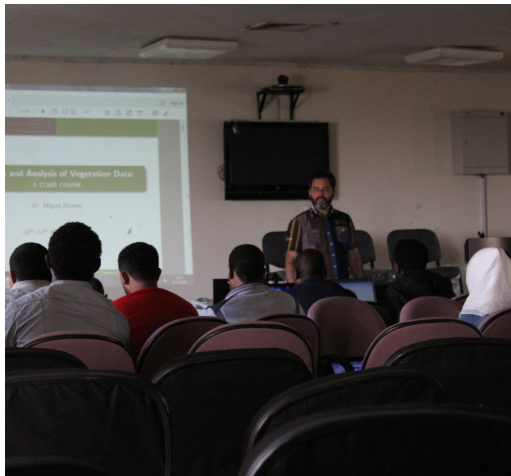
- ▶ Graphiken (2)
- ▶ Fortgeschrittenes Programmieren
- ▶ Abschluss

18:00 – 20:30

Pause 19:15 – 19:30

- ▶ Methoden
  - ▶ Vortrag
  - ▶ Life-Codierung
  - ▶ Übungen

<https://kamapu.github.io/GrundkursR/>



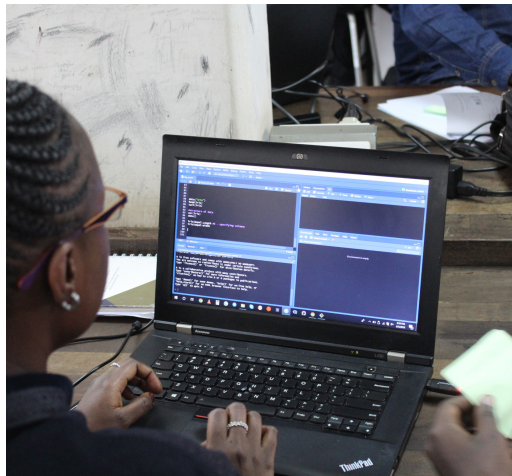
## Miguel Alvarez



- ▶ Vegetationsökologist
- ▶ Data Scientist
- ▶ R-Programmierer
  - ▶ Umwelt und Biodiversität
  - ▶ Geographische Informationssysteme
  - ▶ Datenbanken
  - ▶ Reproduzierbarkeit

## Die Teilnehmer?

- ▶ Warum R?
- ▶ Erwartung von dem Kurs



## Geschichte

- ▶ S (1975)
  - ▶ S-PLUS
  - ▶ TIBCO Spotfire S+
- ▶ R (1992)

**R** ist die kostenlose Alternative zu **S**

Ross Ihaka

Robert Gentleman



## Was ist R?

- ▶ Programmiersprache
  - ▶ Open Source (offene Quelle)
  - ▶ Freeware (kostenlos)
- ▶ Statistische Umgebung
  - ▶ Interface
  - ▶ Terminal
  - ▶ Editoren

<https://www.r-project.org/>


[\[Home\]](#)

**Download**  
CRAN

**R Project**

About R  
Logo  
Contributors  
What's New?  
Reporting Bugs  
Conferences  
Search  
Get Involved: Mailing Lists  
Get Involved: Contributing  
Developer Pages  
R Blog

**R Foundation**

Foundation  
Board  
Members  
Donors  
Donate

**Help With R**

Getting Help

**Documentation**

Manuals  
FAQs  
The R Journal  
Books  
Certification

## The R Project for Statistical Computing

### Getting Started

R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. To [download R](#), please choose your preferred [CRAN mirror](#).

If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

### News

- **R version 4.2.2 (Innocent and Trusting) prerelease versions** will appear starting Friday 2022-10-21. Final release is scheduled for Monday 2022-10-31.
- **R version 4.2.1 (Funny-Looking Kid)** has been released on 2022-06-23.
- **R version 4.1.3 (One Push-Up)** was released on 2022-03-10.
- Thanks to the organisers of useR! 2020 for a successful online conference. Recorded tutorials and talks from the conference are available on the [R Consortium YouTube channel](#).
- You can support the R Foundation with a renewable subscription as a [supporting member](#)

### News via Twitter

The R Foundation Retweeted

**R Contributo...** @R\_Contributo... · Oct 10  
R Contribution Working Group meeting Oct 18, 18:30 - 19:30 UTC

We'll discuss progress on current issues ([github.com/r-devel/rcontr...](https://github.com/r-devel/rcontr...)), including

- Translation hackathons (LatinR, AsiaR)
- Office hours
- Code of conduct

All welcome. Zoom registration:  
[us02web.zoom.us/joining/regist...](https://us02web.zoom.us/joining/regist...)

## Was ist R?

- ▶ Schwerpunkt
  - ▶ Mathematik
  - ▶ Grafiken
- ▶ Kommandozeilen
- ▶ REPL (Read-Eval-Print-Schleife)

```
(5 + 100) * 25
```

```
## [1] 2625
```

```
50/10
```

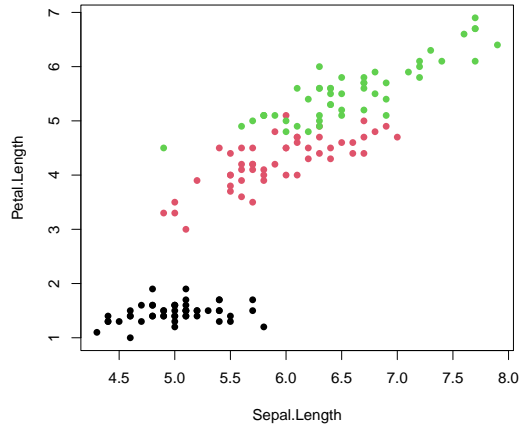
```
## [1] 5
```

```
60 > 15
```

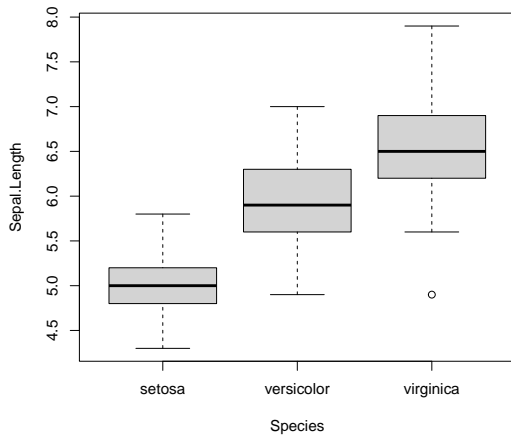
```
## [1] TRUE
```



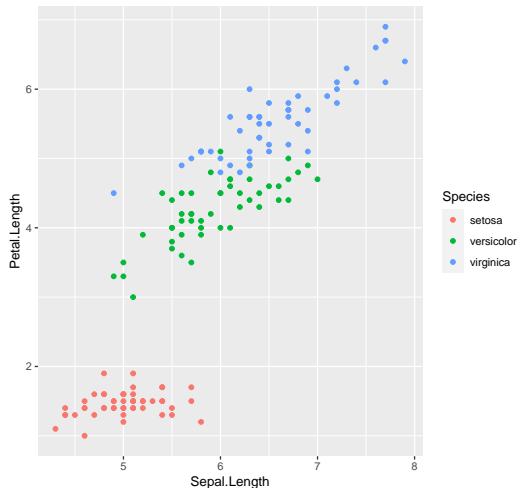
```
plot(iris[ , c("Sepal.Length",
               "Petal.Length")],
     pch = 16, col = iris$Species)
```



```
boxplot(Sepal.Length ~ Species,  
        data = iris)
```



```
library(ggplot2)
ggplot(iris,
      aes(x = Sepal.Length,
          y = Petal.Length,
          color = Species)) +
  geom_point()
```



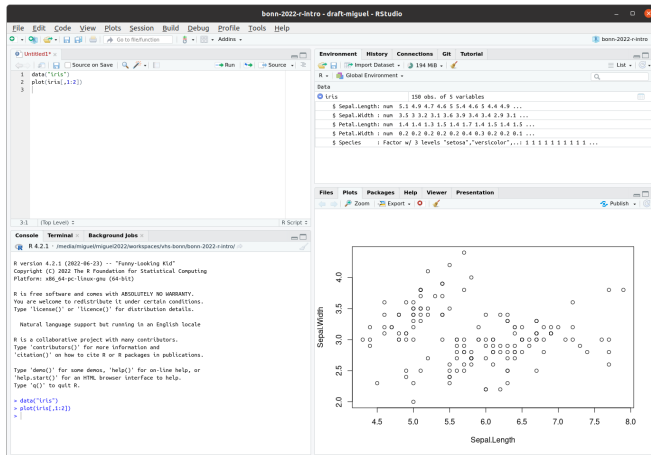
## Warum R?

- ▶ Kostet nichts
- ▶ Steuerung von Analysen
- ▶ Skripten
  - ▶ Protokolle
  - ▶ Reproduzierbarkeit
- ▶ Vielseitig

## Jargon

- ▶ Konsole
- ▶ Sitzung
- ▶ Workspace (Environment)
- ▶ Arbeitsverzeichnis (working directory)
- ▶ Skript
- ▶ Paket (Package)

- ▶ Text Editor
- ▶ IDE (integrated development environment)



## eclipse (StatET)

The screenshot shows the Eclipse IDE running RStudio. The Project Explorer on the left displays a file tree with folders like 'data', 'docs', and 'Folien'. The Editor in the center shows the R code for 'FolienRKurs-12.Rmd', which includes comments about RStudio and R as a calculator, and a plot command. The Console at the bottom shows the R startup message. The right pane displays a scatter plot of Sepal.Length vs. Sepal.Width for the Iris dataset.

```

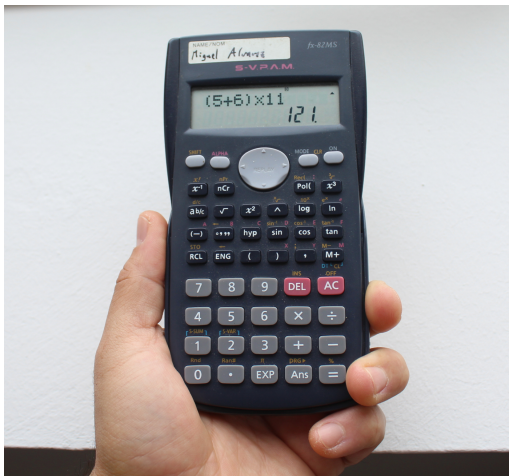
322 *** (r echoFALSE, out_width="0.71\\textwidth")
323 include_graphics("images/Rstudio-screen.png")
324 ***
325
326
327 ## RStudio
328
329 **eclipse (StatET)**
330
331 \\vspace{0.3cm}
332
333 *** (r echoFALSE, out_width="0.71\\textwidth")
334 include_graphics("images/StatET-screen.png")
335 ***
336
337
338 ## R als Taschenrechner
339
340
341 - Mathematische Operatoren
342 - Logische Operatoren
343 - Klammern

```

R [R Console] R / R.J (Oct 16, 2022, 5:45:24 PM) - ... / vhs-bonn/bonn-2022-r-  
R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.  
  
Natural language support but running in an English locale  
  
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.  
  
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.  
  
> data(iris)  
> plot(iris[, 1:2])  
>

Sepal.Width

Sepal.Length



- ▶ Mathematische Operatoren
- ▶ Klammern

$5+6*11$

## [1] 71

$(5+6)*11$

## [1] 121

$(5-6)/11$

## [1] -0.09090909



## Zuweisung

`<-`

Zuweisung von einem Wert zu einem Objekt.

## Konvention

- ▶ Nutze `<-` anstatt `->`
- ▶ Reserviere `=` für Argumente in Funktionen
- ▶ Nutze Leerzeichen für eine bessere Übersicht in Quellcode
- ▶ Nutze Einrückungen für gebrochene Kommandozeilen

## Logische Operatoren

==

!=

&gt;

&gt;=

&lt;

&lt;=

&amp;

|

%in%

!

any()

all()

```
10 > 15
```

```
## [1] FALSE
```

```
10 < 15
```

```
## [1] TRUE
```

## Vektoren

Der Vektor ist die grundlegende Datenstruktur in **R**

- ▶ Länge `length()`
- ▶ Typ `class()`
- ▶ Evtl. Namen `names()`

```
c(1:10)
## [1] 1 2 3 4 5 6 7 8 9 10
rep(5, times = 10)
## [1] 5 5 5 5 5 5 5 5 5 5
LETTERS[1:5]
## [1] "A" "B" "C" "D" "E"
```

## Indexieren

- ▶ Eckige Klammern
- ▶ Index
  - ▶ integer
  - ▶ logical (Bedingung)
  - ▶ character (Namen)

```
# Mit integer
```

```
letters[15]
```

```
## o
```

```
## "o"
```

```
# Mit logischen Werten
```

```
letters[!letters %in% c("a", "b", "c")]
```

```
## d e f g h i j k l m n
```

```
## "d" "e" "f" "g" "h" "i" "j" "k" "l" "m" "n"
```

```
## x y z
```

```
## "x" "y" "z"
```

```
# Mit Namen
```

```
names(letters) <- letters
```

```
letters["m"]
```

```
## m
```

```
## "m"
```

## Datentypen

- ▶ integer
- ▶ numeric
- ▶ logical
- ▶ factor
- ▶ character

```
A <- c(1:10)
is.numeric(A)
## [1] TRUE
```

```
B <- as.character(A)
B
## [1] "1" "2" "3" "4" "5" "6" "7" "8"
is.numeric(B)
## [1] FALSE
```

## Sonderklassen

- ▶ NA
- ▶ NaN
- ▶ NULL
- ▶ Inf
- ▶ -Inf

```
5/0
```

```
## [1] Inf
```

```
log(0)
```

```
## [1] -Inf
```

```
sqrt(-1)
```

```
## Warning in sqrt(-1): NaNs produced
```

```
## [1] NaN
```

## Rückmeldungen

- ▶ Konsolenoutput
- ▶ Nachricht (message)
- ▶ Warnung (warning)
- ▶ Fehlermeldung (error)

Eine Warnung ist nicht zwingend ein Fehler.

```
sqrt(-1)
```

```
## Warning in sqrt(-1): NaNs produced
```

```
## [1] NaN
```

```
5 + "B"
```

```
## Error in 5 + "B": non-numeric argument to bi
```

## Fehlerbehebung

- ▶ Dokumentation
- ▶ Foren
- ▶ Programfehler melden

```
# help()
?mean
# help.search()
??"multinomial"
RSiteSearch("Import")
```



## Regeln für Hilfeanfrage

- ▶ Recherechiere vorher
- ▶ KESS (*keep it simple stupid*)
- ▶ Zeige ein **minimales Beispiel**
- ▶ Bleibe höflich
- ▶ Melde die Endlösung
- ▶ Lerne **markdown**

<https://stackoverflow.com/questions>  
<https://www.markdowntutorial.com/>

The screenshot shows a Stack Overflow page for a question titled "P-values from aov in R". The question is asked 7 years, 1 month ago and modified 6 years, 10 months ago. It has been viewed 2k times. The question text describes a simulation study in R using the `aov` function and difficulty extracting p-values. The user provides R code: `results <- summary(aov(dv={A*B*C*D*E}*Error(subj)/(A*B*C*D)), data = mdata)) # con`. The output shows ANOVA tables for subjects 'E' and 'A'. The user mentions truncating the output and wanting a list of p-values with effect names (A or A:E).

**P-values from aov in R**  
Asked 7 years, 1 month ago · Modified 6 years, 10 months ago · Viewed 2k times

stackoverflow Take this month's Pulse Survey Take the survey

I'm conducting a simulation study in R. Basically, I generate fake data sets and then run an ANOVA on the data using the `aov` function. But I'm having difficulty extracting p-values. Previous questions do not help ([Extract p-value from aov](#)) -- I am running a mixed ANOVA.

First I have an ANOVA:

```
results <- summary(aov(dv={A*B*C*D*E}*Error(subj)/(A*B*C*D)), data = mdata)) # con
```

which generate this output:

```
Error: subj
      Df Sum Sq Mean Sq F value Pr(>F)
E      1 1039157 1039157   0.95  0.334
Residuals 58 63428016 1093586

Error: subj:A
      Df Sum Sq Mean Sq F value Pr(>F)
A      1 1996 1996 0.229  0.641
A:E    1 2294 2294 0.253  0.617
Residuals 58 526389 9076

...
```

I'm truncating the output for space. What I want list of p-values with the effect name (A or A:E). I have halfway succeeded, but it's messy. I can extract the p-values using this `get_p` function that I made.

```
#Function
get_p = function(results,headIf
```

## Weitere Dokumente

- ▶ Demos
  - ▶ `demo()`
- ▶ Beispielssitzungen
  - ▶ `browsevignette()`
  - ▶ `vignette()`
- ▶ Zahlreiche Tutorials

```
demo("graphics")  
vignette("ggplot2-specs")
```

# Vielen Dank!

```
library(fortunes)  
fortune(283)
```

```
##  
## The good way to do it is to include the following comment at the beginning:  
## # This is a holy Script, please edit it not  
## -- Kenn Konstabel (on "... how to protect R Script files from inadvertent  
## editing by users.")  
## R-help (April 2011)
```