The title of the talk can even be much longer than this

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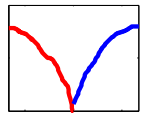
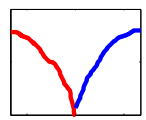
MAGA: The Package to make ANOVA great again

- The package bundles functionalities around the grand topic repeated measures ANOVA.
- Some of the functionalities have not been implemented in R yet. This package aims to fill this void.
- Each core functionality of the package represents a quantlet.
- After presenting the theory and code examples from the package, we will give a short overview of the technical implementation.



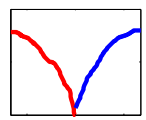
Outline

1. The Ringelmann Effect
2. Repeated Measures ANOVA
   - 2.1 The ANOVA model
   - 2.2 An Advantageous Model
   - 2.3 Confidence Intervals
   - 2.4 Effect Size
3. An Important Requirement
4. Orthogonal Polynomial Contrasts
5. The Package



The Ringelmann Effect

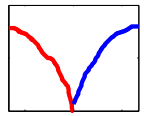
- Maximilian Ringelmann (1861-1931):
  - French professor of agricultural ingeneering
- Work performance depends of number of group size
- Decreasing individual performance with increasing group size
- Example: Pulling weights with different sized groups



The Ringelmann Effect

- The Ringelmann Effect can be investigated with an experimental design
  - Dependent Variable: Indivual performance
  - Independent Variable / Factor: Group size
  - Realization of different factor levels
- For our purpose: Data simulation

Quantlet Data Simulation



Tables

- Simulation function:

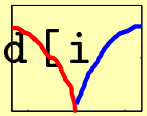
```
sim_ow_rma_data(n, k, means = c(10, 5, 7),
    poly_order = NULL, noise_sd = 10,
    between_subject_sd = 40, NAs = 0)
```

- Simulate deviation between subjects:

```
mean_deviation = rnorm(n, mean = 0, sd =
  between_subject_sd)
ow_rma_data[, 2:(k + 1)] = ow_rma_data[, 2:(k + 1)]
  + mean_deviation
```

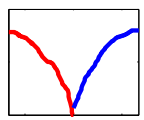
- Simulate noise:

```
    noise = matrix(NA, nrow = n, ncol = k)
    for (i in 1:k) {
    noise[, i] = rnorm(n, mean = 0, sd = noise_sd[i
      ])
    }
```

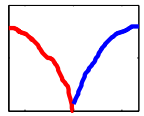
Motivation for Making a Package

- A package bundles together code, data, documentation, and tests
- Makes it easy to share and publish code with others (CRAN, Github via Devtools)
- Loads all relevant functions into the namespace
- Automatically checks and installs dependency if necessary
- Packages allow to document functions, so that they easily be used by others (help function, argument list, etc.)



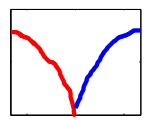
Tools to Create a Package in R

- roxygen2
  - Enables documentation to be written directly into the R script
- devtools
  - Load packages still under development e.g. from Github
- Github
  - A package can be handled like a repository, which enables colloboration
- RStudio
  - Provides many helpful functionalities for creating a package (create, build, check)



Things to consider

- Use function names that speak for themselves and use them consistently.
  - "There are only two hard things in computer science: cache invalidation and naming things." Phil Karlton
- Error handling
  - Make sure that functions are robust regarding violation of the required input, e.g. character vector supplied although a numeric vector is needed. Use if-statements or try().
- Custom error and warning messages
  - stop() interrupts the code and returns an error message
  - warning() executes the code but returns a warning message



Equations

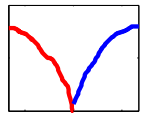
- Equations covering several lines may be written in the *align* environment instead of the older *eqnarray* environment. Only this way it can be ensured, that the colour of the equation and of the according equation numbering match.
- `align*` omits the equation numbering, as does `\notag`.

```
1  \begin{align}
2  4x + 8 &= (3-2)^2\\
3  4x &= -7 \notag \\
4  x &= -\frac{7}{4}
5  \end{align}
```

$$4x + 8 = (3 - 2)^2 \quad (1)$$

$$4x = -7$$

$$x = -\frac{7}{4} \quad (2)$$

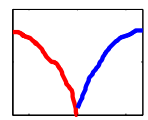


Tables

Title	Title
2.13	1.45
3.14	6.85

Table 1: Include a short, but meaningful caption.

- Follow the Cambridge University Press Style.
- Not more than 2 decimal digits in a column.
- Tables and their captions are to be written in black.



Figures

```
1 \begin{figure}[htb]
2     \begin{center}
3     \includegraphics[
        scale=0.2]{
        Figures/vola}
4     \caption{Include a
         short, but
        meaningful
        caption.}
5     \end{center}
6 \end{figure}
```

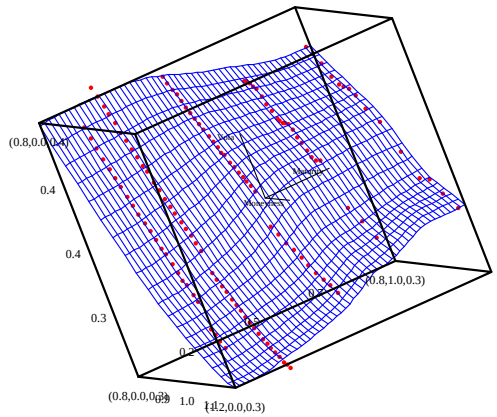
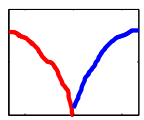


Figure 1: Include a short, but meaningful caption.

The caption is, as in tables, to be written in black and please provide any legend in the caption and not in the graph itself.



Examples

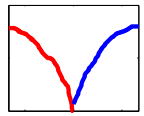
To create an example, use the color `isegreen` and the following structure:

```
\color{isegreen}
\textbf{Example:} Example title

\smallskip
Here you can state your example, which may also include calculations.
\color{black}
```

Example: Example title

Here you can state your example, which may also include calculations.



Subtitles

Subtitles are to be highlighted via bold text and followed by a small skip afterwards (no colon):

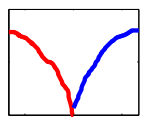
```
\textbf{Subtitle}

\smallskip
Here you can state the
  content according to
  the subtitle.
```

Subtitle

Here you can state the content according to the subtitle.

This may also be applied to state proofs, theorems etc.

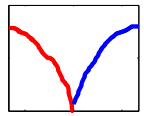


Brackets

- Use the bracket sequence $[\{(a + b = c)\}]$
- Conventional bracket rules represent an exemption of this rule. For example:

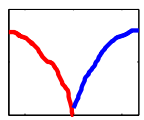
$$Y \sim \mathrm{N}(\mu(X), \sigma(X))$$

- Let LaTeX take care about the correct size by preceding the bracket by `\left` and `\right`.



Rules to write nice slides

- Use `\section{}` and `\subsection{}` to structure your presentation. The section will appear in the upper right corner of your slides.
- You can set up hyperlinks via `\label{LINKNAME}` (reference point) and `\ref{LINKNAME}` (reference).
- Use, if necessary, `\displaystyle` to force LaTeXto display fractions in big font size
- Remember
  - 6-8 lines per slide
  - 8 words per line



- The numbering of any enumeration should match the colour of the corresponding text (preset colour: black). Modifications may be made through the *itemize* environment:

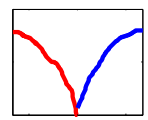
  `\item[\color{isegreen}1.]`

  Itemize items are predefined (blue) and excluded from this rule.
- Use `^{\top}` to write the symbol of transpose, it produces

$$x^{\top} y$$

- Use `\ldots` to write the symbol for three dots, it produces

$$x \in \{1, \ldots, n\}$$

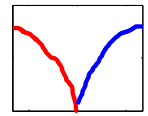


- The commands `\widehat{}` and `\widetilde{}` for a hat or a tilde are to be preferred over the the smaller `\hat` respectively `\tilde` commands:

$$\widehat{Y} \text{ vs. } \hat{Y}$$
$$\widetilde{Y} \text{ vs. } \tilde{Y}$$

- The norm is to be written via `\|`. It produces $\|K\|$
- The $\mathcal{O}$ and $\mathcal{o}$ for convergence may be written via `\mathcal{O}` and `\mbox{\scriptsize $\mathcal{O}$}`.
- The operator for exponential terms with Euler's e as the base is defined by `\exp`:

$$\exp(1) \approx 2.718282$$



- Use `\stackrel{\mathcal{L}}{\rightarrow}` to write the symbol for convergence in distribution and denote the normal distribution by `\operatorname{N}`, this produces

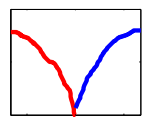
$$X \stackrel{\mathcal{L}}{\rightarrow} \mathrm{N}(0, \sigma^2)$$

- Use `\operatorname{P}` to write the symbol for probability, it produces

$$\mathrm{P}(X = x) = \frac{\exp(-\lambda)\lambda^x}{x!}$$

- Use `\stackrel{\operatorname{as.}}{\sim}` to write the symbol for asymptotic distribution, it produces

$$X \stackrel{\text{as.}}{\sim} \chi^2$$



- Use command `\stackrel{\operatorname{def}}{=}` to write the symbol for definition, it produces

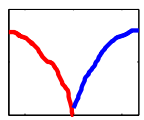
$$X \stackrel{\text{def}}{=} \frac{a}{b}$$

- Use commands `\Re` or `\Im` to write the symbols for the real or imaginary part, it produces

$$X = \Re\{Y\}, Y = \Im\{Z\}$$

- To write the symbols for the minimizing argument, use `\operatorname{arg}\,\underset{x}{\operatorname{min}}`, it produces

$$a = \arg\min_{x}\{f(x)\}$$



- Use `\operatorname{\mathbf{I}}` for the indicator function:

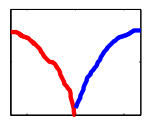
$$\mathbf{I}\{x < 1\}$$

- Use `\log` to write the symbol for the natural logarithm, it produces

$$1 = \log\{exp(1)\}$$

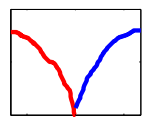
- Use `\operatorname{E}` to write the symbol for expectation, it produces

$$\mathrm{E}[X] = \mu$$



- Use `\hyperlink{labelname}{\beamerbutton{Link Name}}` to jump to other parts of your slides

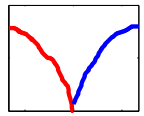
  Link Name



Using `listings` for source

Slides containing a listing also need [containsverbatim] as option.
For 'highlighting' of XploRe keywords see `listing.tex`.

```
1 library("metrics")
2 randomize(10178)
3 z=(uniform(n).>0.5)~(normal(n).<0.5)
```

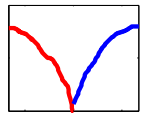



Piecewise Uncovering I

The following example uses $< 1 - 2 >$ commands to piecewise hide and uncover text. $< 1 - 2 >$ makes the first item appear only on slides 1 and 2, $< 2- >$ has the second item visible from slide 2 onwards.

- Itemize environments

(i) First Roman point.



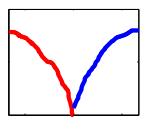
Piecewise Uncovering I

The following example uses $< 1 - 2 >$ commands to piecewise hide and uncover text. $< 1 - 2 >$ makes the first item appear only on slides 1 and 2, $< 2- >$ has the second item visible from slide 2 onwards.

- Itemize environments
- can be uncovered or hidden

(i) First Roman point.

(ii) Second Roman point, uncovered on second slide.

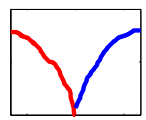


Piecewise Uncovering I

The following example uses $< 1 - 2 >$ commands to piecewise hide and uncover text. $< 1 - 2 >$ makes the first item appear only on slides 1 and 2, $< 2- >$ has the second item visible from slide 2 onwards.

- can be uncovered or hidden
- piecewise.

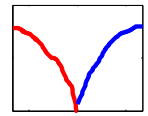
(i) First Roman point.
(ii) Second Roman point, uncovered on second slide.
(iii) Last Roman point.



Piecewise Uncovering II

There is an easier way using \item $<+->$

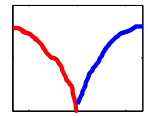
- Itemize environments



Piecewise Uncovering II

There is an easier way using \item <+->

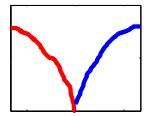
- Itemize environments
- can be uncovered or hidden



Piecewise Uncovering II

There is an easier way using \item <+->

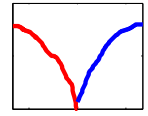
- Itemize environments
- can be uncovered or hidden
- piecewise.



Hiding text. . .

Text on the first slide.

Shown on all slides.

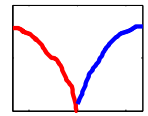


Hiding text. . .

Text on the first slide.
Shown on second and third slide.

- Still shown on 2nd and 3rd slide.

Shown on all slides.



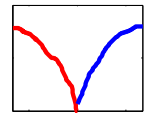
Hiding text. . .

Text on the first slide.
Shown on second and third slide.

- Still shown on 2nd and 3rd slide.

- Shown on slides 3 and 5.

Shown on all slides.

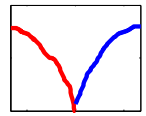


Hiding text. . .

Text on the first slide.

- Shown from slide 4 on.

Shown on all slides.

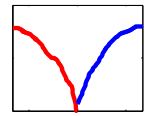


Hiding text. . .

Text on the first slide.

- Shown from slide 4 on.
- Shown on slides 3 and 5.

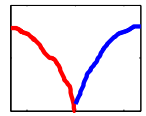
Shown on all slides.



Further Information

Further Information can be found in the LaTeX version of this document, where some more details are explained and important specifications are highlighted.

Suggestions to improve the style or the explanations are welcome!

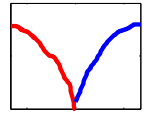


For Further Reading

Tobias Oetiker, Hubert Partl, Irene Hyna and Elisabeth Schlegl
The Not So Short Introduction to LaTeX2e
available on www.ctan.org, 2008

Scott Pakin
The Comprehensive LaTeXSymbol List
available on www.ctan.org, 2008

Frank Mittelbach and Michel Goossens
The LaTeX Companion – 2nd ed.
Addison-Wesley, 2004



For Further Reading

Mark Trettin and Jürgen Fenn

An essential guide to LaTeX2e usage

available on www.ctan.org, 2007

Wikipedia Wiki Books

LaTeX-Wörterbuch: InDeX

available on www.wikipedia.de

Till Tantau

User Guide to the Beamer Class, Version 3.07

available on www.sourceforge.net, 2007