R and \LaTeX: typesetting graphs in a reproducible way

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This talk centers on: How to typeset graphs in a document
  › dynamically,
  › in corresponding style,
  › transparent on calculations performed.
I bring my experiences forward, please bring your wisdom as well!
Introduction

*In hindsight*: if only I knew during my studies what I know now…
I was tossing around spreadsheets and graphs for study reports…
Outline

Overview of techniques

Examples

Possibilities
Software used

- \LaTeX, via LyX
- R, via RStudio
- knitr
- TikZ
About R

› Free open source programming language
› Used in statistics, finance
› Packages for many more applications available
› Connection to other languages possible
› Great plotting features (ggplot2)
Knitr ties R and \LaTeX\ together

› Loading R code in \LaTeX

\begin{verbatim}
Chunk 2
Options
readRcode, warning=TRUE, message=TRUE, tidy=TRUE,
cache=FALSE, echo=FALSE
read_chunk("nitrogen_deposition.R")
read_chunk("eurostat.R")
read_chunk("DutchMotorFuelConsumption.R")
#default options for code chunks
opts_chunk$set(warning=FALSE, message=FALSE, tidy=TRUE,
echo=FALSE, cache=TRUE, dev='tikz', fig.width=5.5,
fig.height=2.5, external=FALSE, sanitize=FALSE,
tidy.opts=list(blank=TRUE, indent=2, width.cutoff=80),
size='small') #fig.height was 2.5 fig.width was 5

Chunk 3
Options
mainNitrogen
\end{verbatim}
Knitr ties R and LaTeX together

› Typesetting plots at the right position in LyX
Knitr ties R and \LaTeX together

Typesetting the R-code used

\[ \Delta Q_{\text{max}} \approx \left| \frac{\partial Q}{\partial x} \right| \Delta x + \left| \frac{\partial Q}{\partial y} \right| \Delta y + \left| \frac{\partial Q}{\partial z} \right| \Delta z + \ldots \]

This and more information on error propagation is written by Fornasini (2009, Ch. 8).

Appendix B  R-code

This appendix displays the R-code used for this report.

```
Chunk 25
Options
codeAll, eval=FALSE, code=readLines("nitrogen_deposition.R")
```

Appendix C  Additional graphs

Additional graphs
Knitr ties R and \LaTeX together

- R-code is executed during the pdf\LaTeX run
Outline

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Examples

Possibilities
Too much data points

NO$_2$ in air

Source: Luchtmeetnet (NL)
Less data points

NO₂ in air

Source: Luchtmeetnet (NL)
Median values

NO$_2$ in air

Source: Luchtmeetnet (NL)
Data from Eurostat on a map
People at risk of poverty or social exclusion

(based on data from Eurostat)
Data on a map
Motor fuels for multiple transport modalities in the Netherlands

Year

Total deliveries (PJ)

Transport modality

Road
Water
Air
Rail
Total

Source: CBS (NL)
Per head of population, index 1985

Motor fuels for multiple transport modalities in the Netherlands

Source: CBS (NL)
Exif data from photos

- R-package exifr can read EXIF data from photos.
- Fun example: automatic photobook generation from a collection of photos.
Stoofperen uitdelen in de buurt
4 november 2020

Het fruit voor de Christmas cake
14 november 2020

Ingrediënten Christmas cake
5 november 2020

Zwaar beslag Christmas cake
15 november 2020
Outline

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Possibilities
Reproducible research

With R, knitr and \LaTeX, one can

- show the reader the true calculations (R-code) performed on data
- quickly recalculate when needed and regenerate report(s) including graphs
- change the layout of graphs quickly without the risk of introducing errors
Better research

› Less redundancy in calculation methods
› Measurement error propagation made easy, and many other packages available from CRAN
› Dynamic connections possible to C++, MatLAB, Python, Fortran, Java, …
› Writing and processing measurement data can be done at once, instead of at the end of a research project
Questions and ideas

› Any ideas from the audience? I am happy to take questions or remarks.

› After this presentation, feel free to find out more or contact me (Vic van Dijk) via setyourtext.com