R language and data analysis: reproducible research

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problem

- Run analysis and get the result
- copy paste it into a file and write up the report.

There is no single document to integrate data analysis with textual representations; i.e. data, code, and text are not linked

problem

- error-prone due to manual work
- tedious jobs to copy and paste
- Graphical User Interface is not recordable
- Tiny change need to redo the whole procedure.
- too many attention are paid to synchronization.

reproducible research

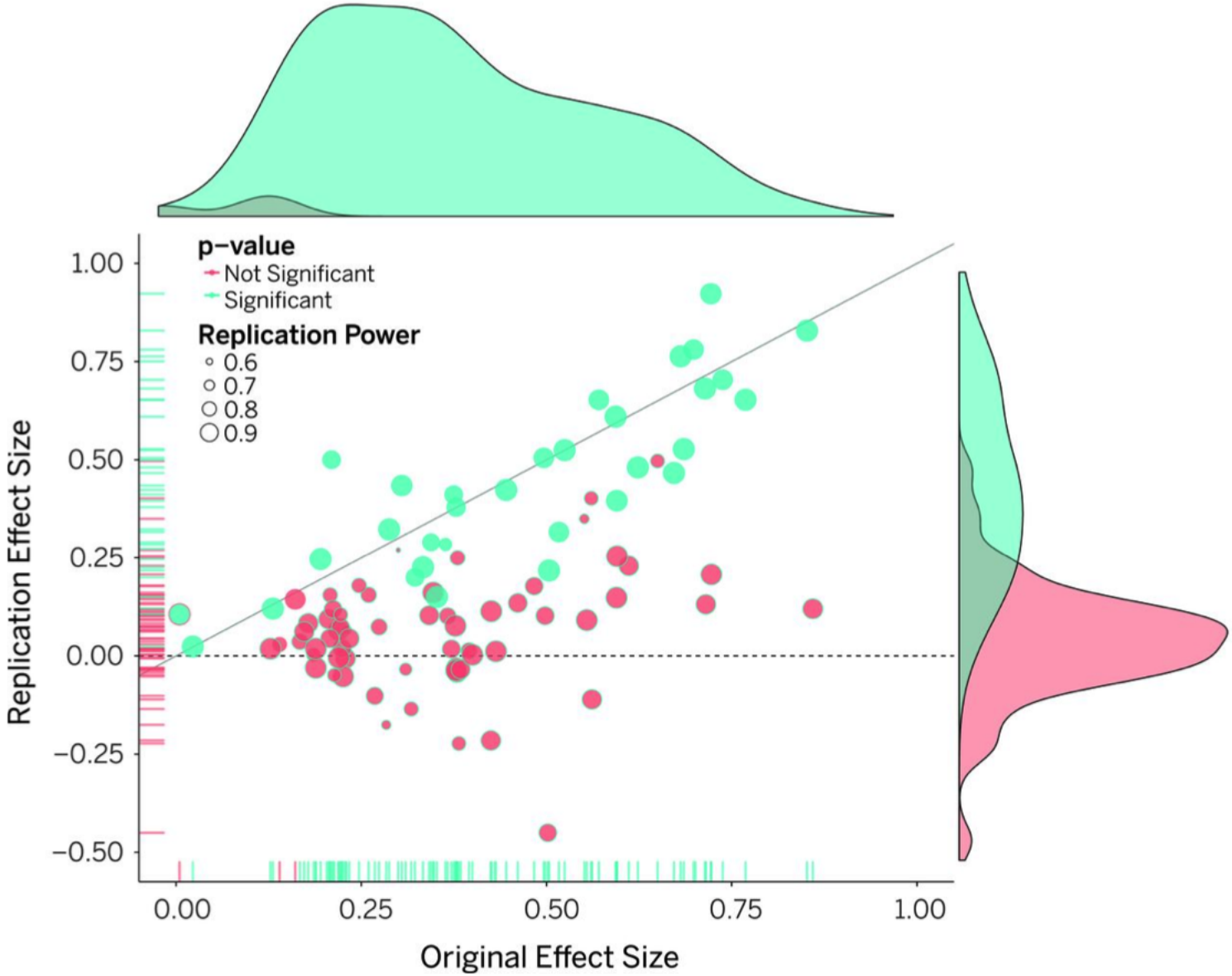
- Reproducibile property of research conclusion

reproducible research

- Reproducibile property of research conclusion
- reproducibility of your own work.

reproducible research

Estimating the reproducibility of psychological science



How Do I Make My Work Reproducible?

- try to submit your homework with this techinique.

literate cons

- Text and code all can make documents difficult to read.
- Can substantially slow down processing of documents.

Literate programming

- conceived by Donald Knuth (Knuth,1984)
- mix the source code and documentation together
- code is divided into text and code “chunks”.
- **weaved** to produce documents and **tangled** to get source code

Literate programming

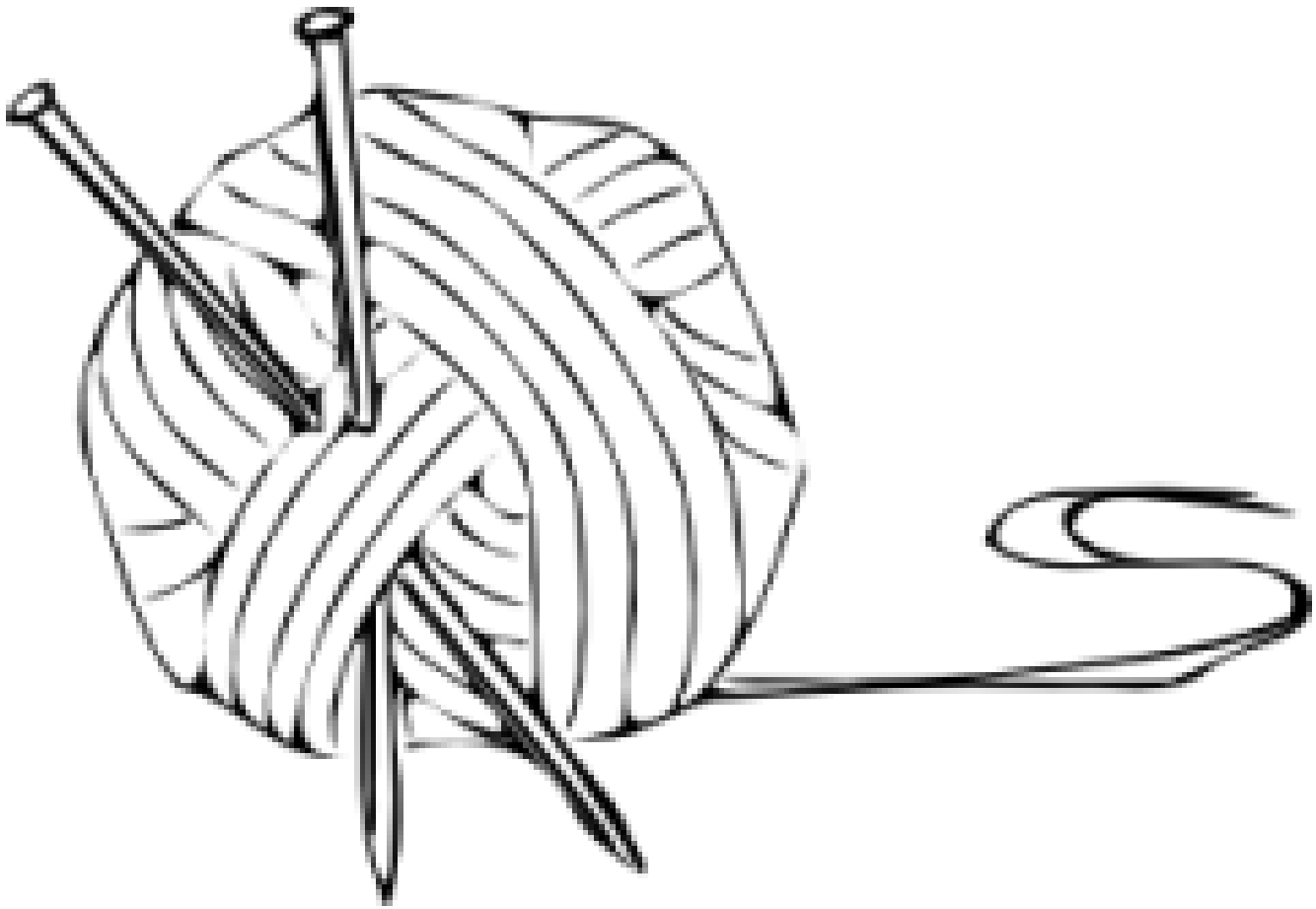
1. itself is only a concept or idea.

- A documentation language
- A programming language

2. S**weave** system (Friedrich Leisch) used LaTeX and R
3. **knit**r supports a variety of documentation languages

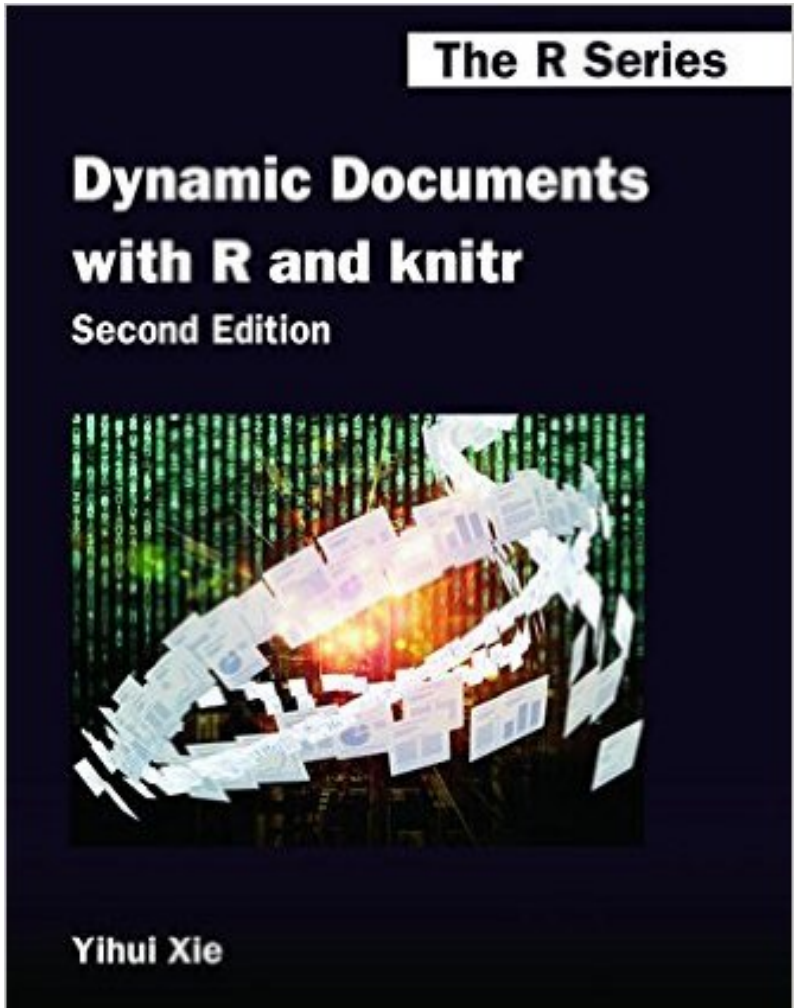
reproducible programming in Rstudio

- Sweave (rstudio->preference->Sweave)
- knitr

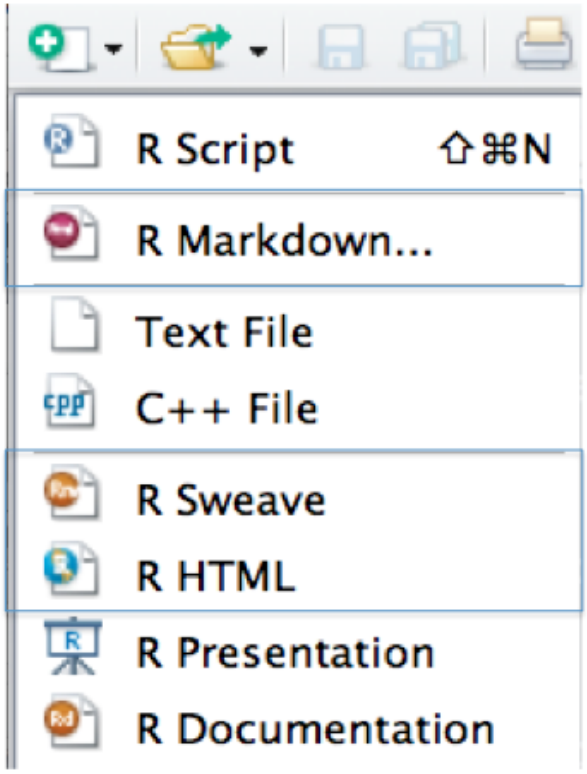


Knitr

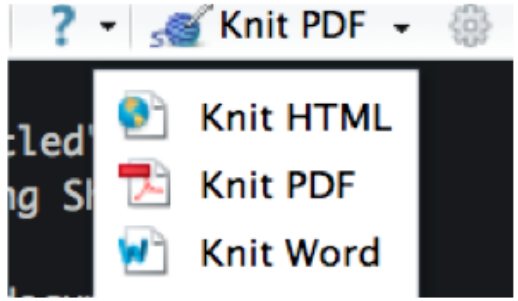
- An R package written by Yihui Xie
- Supports **LaTeX**, **RMarkdown**,and HTML as documentation languages Can export to, do PDF, HTML
- Built right into RStudio for your convenience.



Knitr



Documents

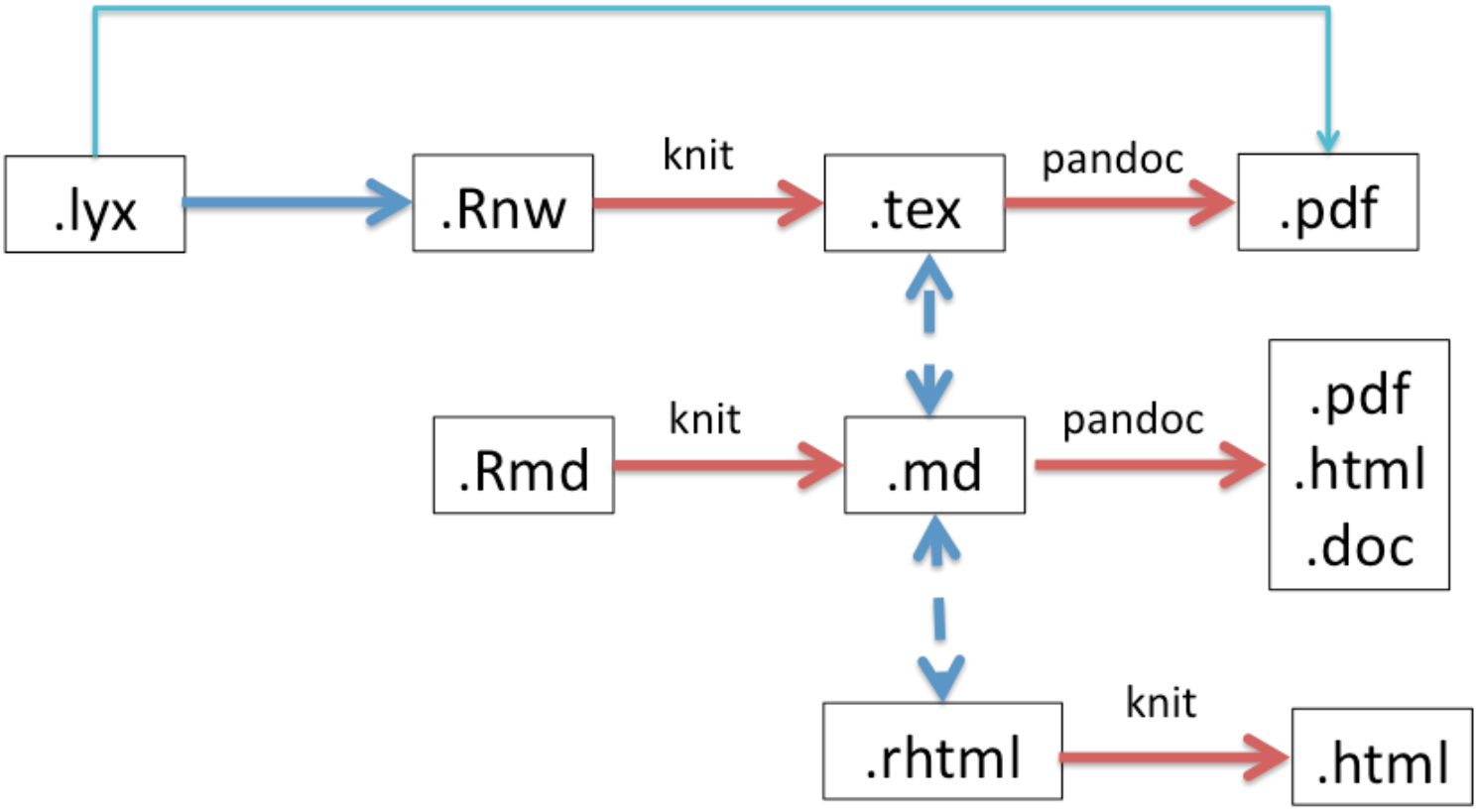


Slides

weave/knit in Rstudio

- Latex
- markdown

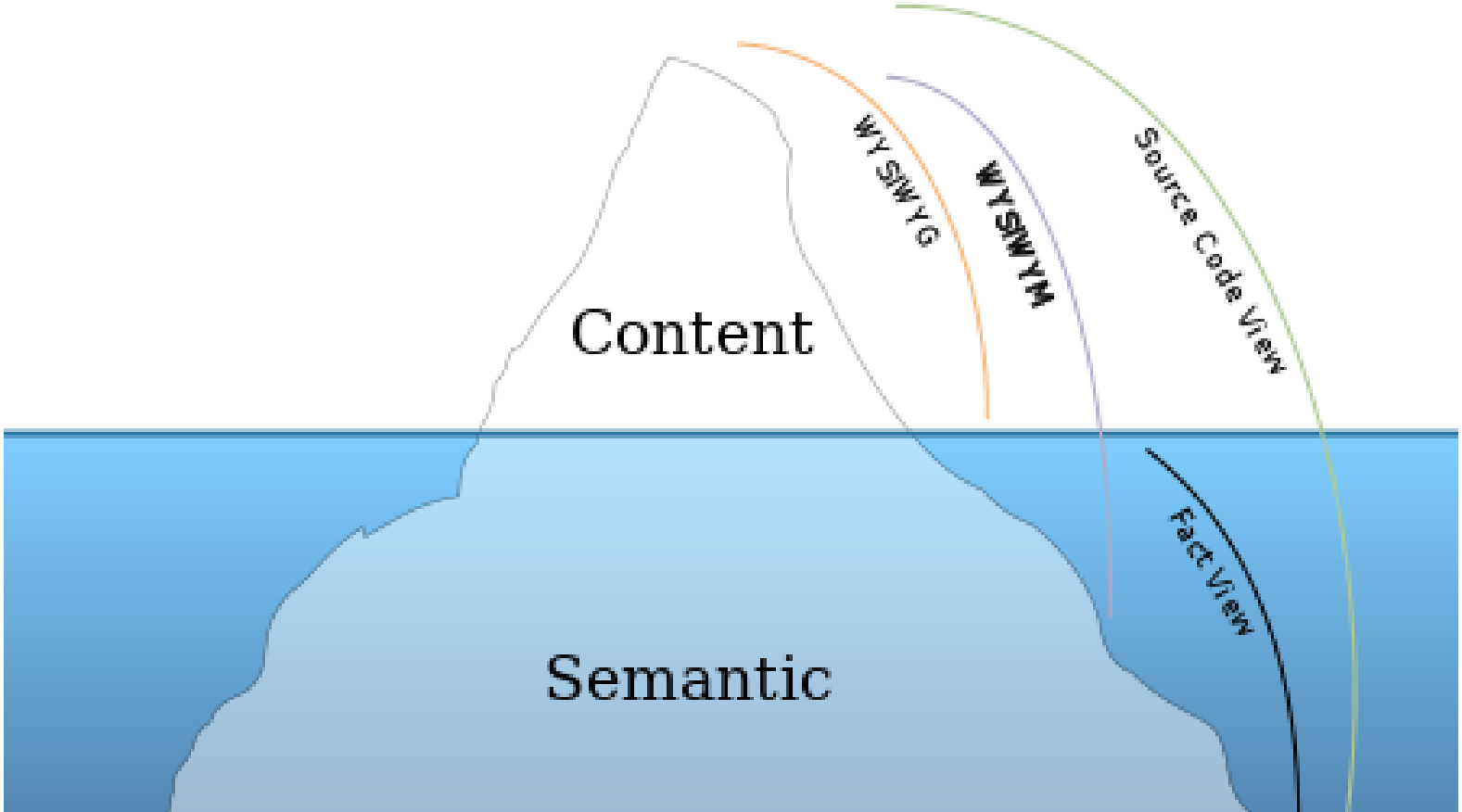
framework


.lyx
.Rnw
knit
.tex
pandoc
.pdf
.Rmd
knit
.md
pandoc
.pdf
.html
.doc
.rhtml
knit
.html

Latex

1. MiKTEX (Windows: `http://miktex.org/`),
2. MacTEX (BasicTeX) (Mac OS: `http://tug.org/mactex/`),
3. TEXLive (Linux: `http://tug.org/texlive/`).

- WYSIWYM: Document Processing
- WYSIWYG: Word Processing



Latex

.Rnw in Rstudio

- example-1.Rnw
- example-1-knitr.Rnw
- knitr-minimal.Rnw

`http://tobi.oetik-er.ch/lshort/lshort.pdf`

lyx

- lyx:`https://www.lyx.org/`
- compatible with knitr after LyX 2.0.3.

combines the power and flexibility of TeX/LaTeX with the ease of use of a graphical interface.

lyx

- knitr-minimal.lyx
- knitr.lyx

Latex/lyx

R code in .Rnw - chunks
- inline

```
##chunk
<<>>=
set.seed(1121)
(x=rnorm(20))
mean(x);var(x)
@
##inline
\Sexpr{pi}
```

lyx: table output

```
<<xtable, results="asis">>=
n <- 100
x <- rnorm(n)
y <- 2*x + rnorm(n)
out <- lm(y ~ x)
library(xtable)
xtable(summary(out)$coef, digits=c(0, 2, 2, 1, 2))
@
```

Latex/lyx

```
result<-summary(with(mtcars,lm(mpg~hp+wt)))
library(knitr)
kable(result$coe)
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	37.2272701	1.5987875	23.284689	0.0000000
hp	-0.0317729	0.0090297	-3.518712	0.0014512
wt	-3.8778307	0.6327335	-6.128695	0.0000011

What is markdown

- A simplified version of “markup” languages
- No special editor required
- Simple, intuitive formatting elements

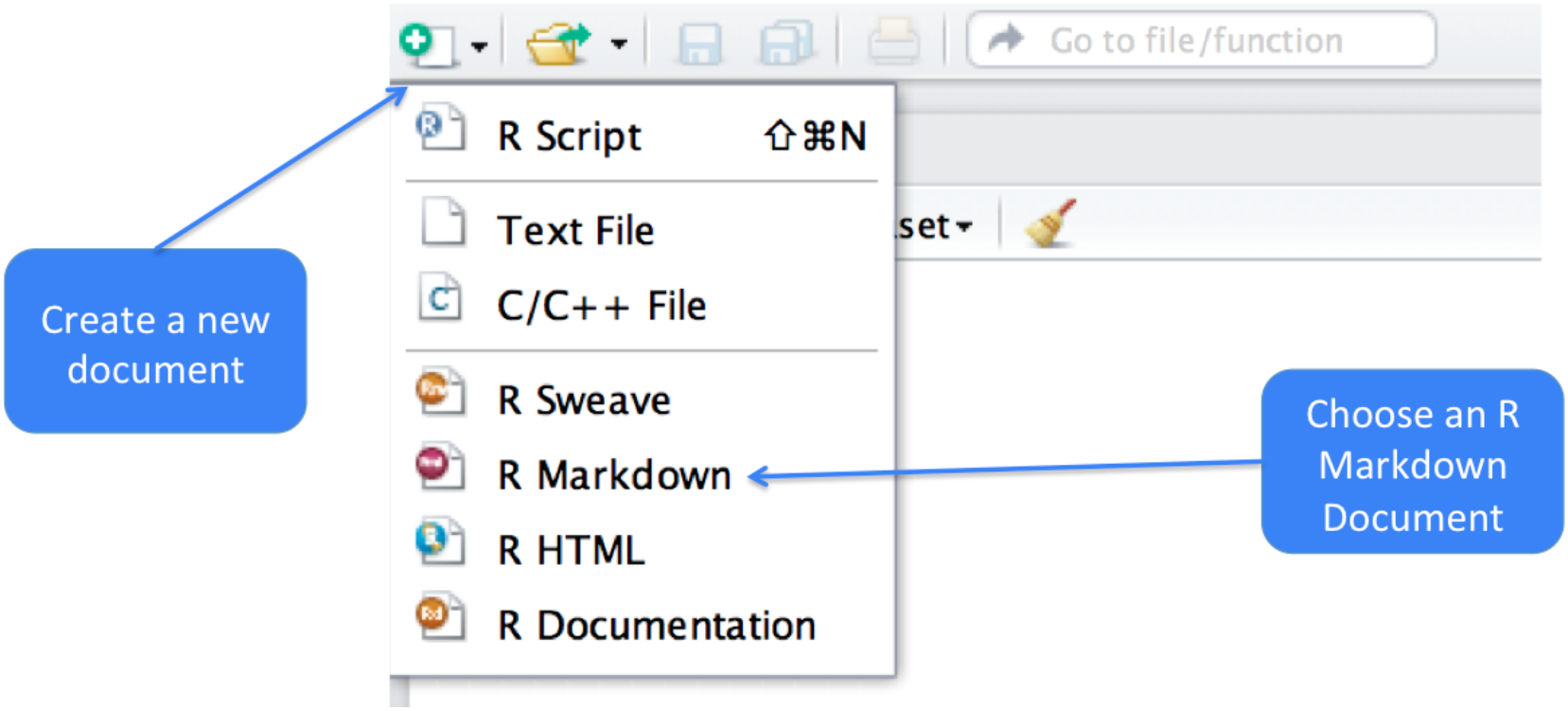
markdown in R: rmarkdown

1. markdown

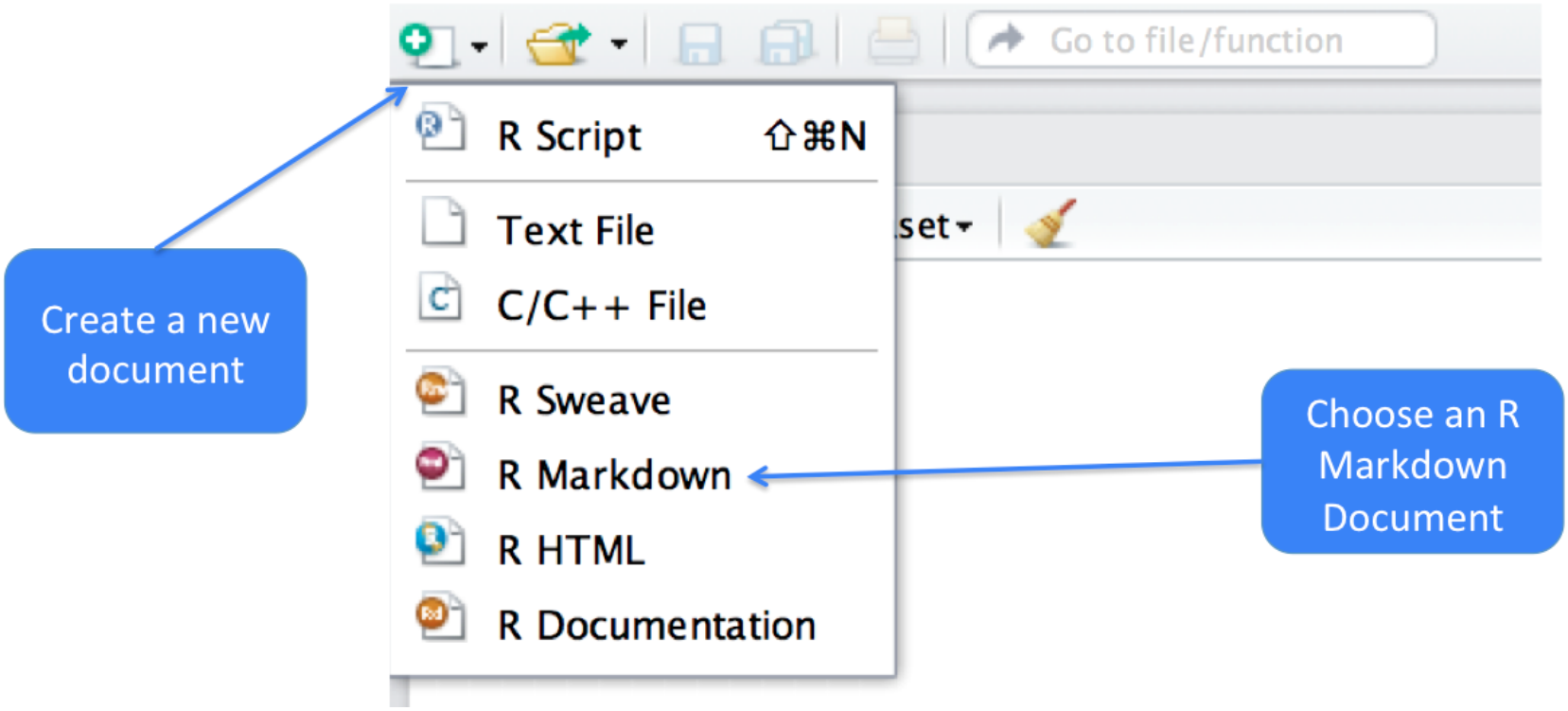
markdown_example.md 2. R code - chunks
- inline

demo.Rmd figure.Rmd

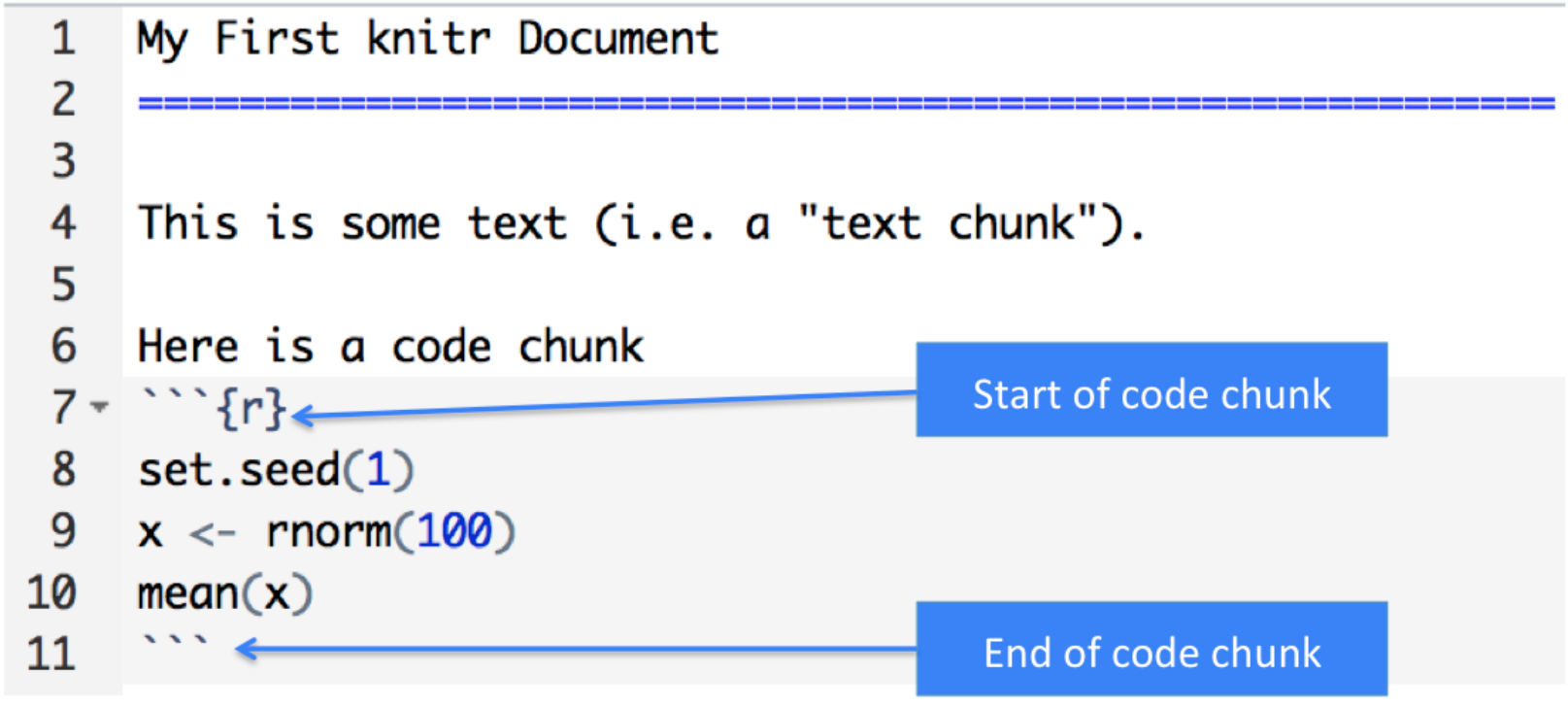
markdown in Rstudio



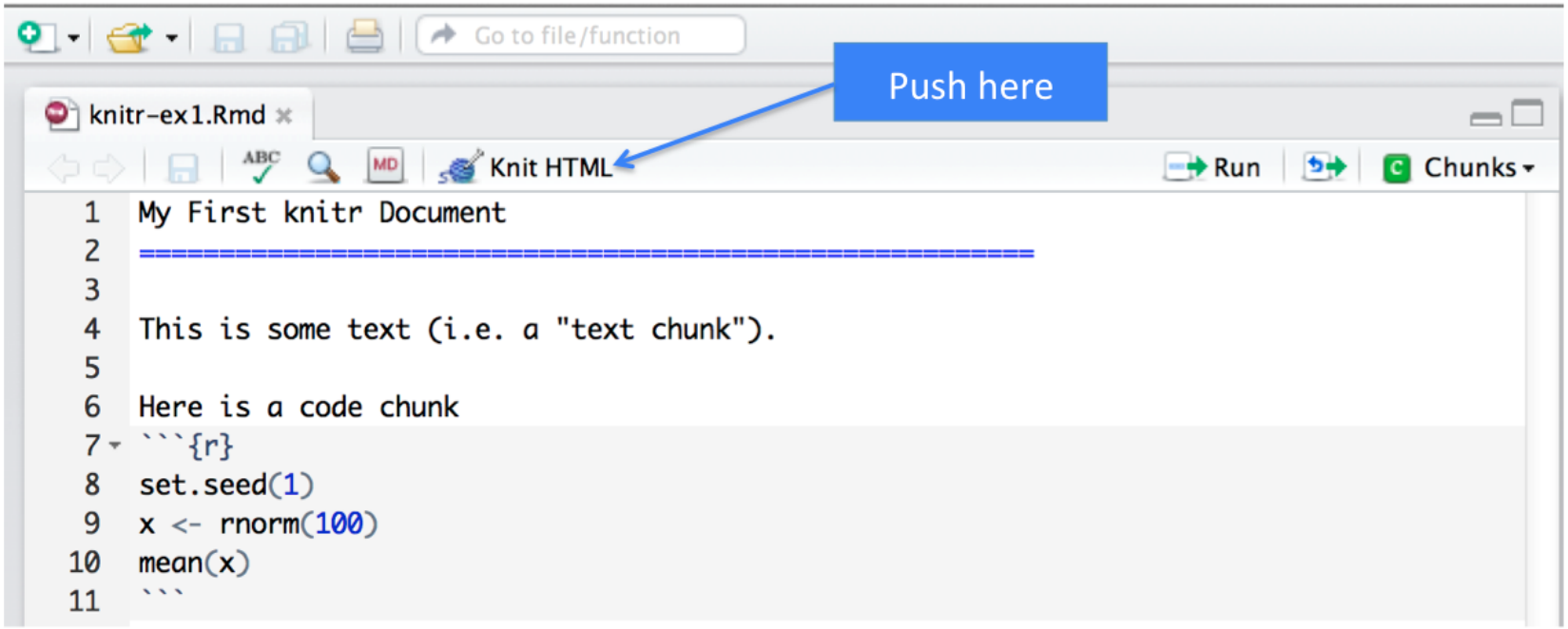
markdown in Rstudio



markdown in Rstudio



markdown in Rstudio



markdown in Rstudio

My First knitr Document

This is some text (i.e. a “text chunk”).

Here is a code chunk

```
set.seed(1)
x <- rnorm(100)
mean(x)
```

Code input

```
## [1] 0.1089
```

Numerical output

markdown in Rstudio

This is some text (i.e. a “text chunk”).

Here is a code chunk

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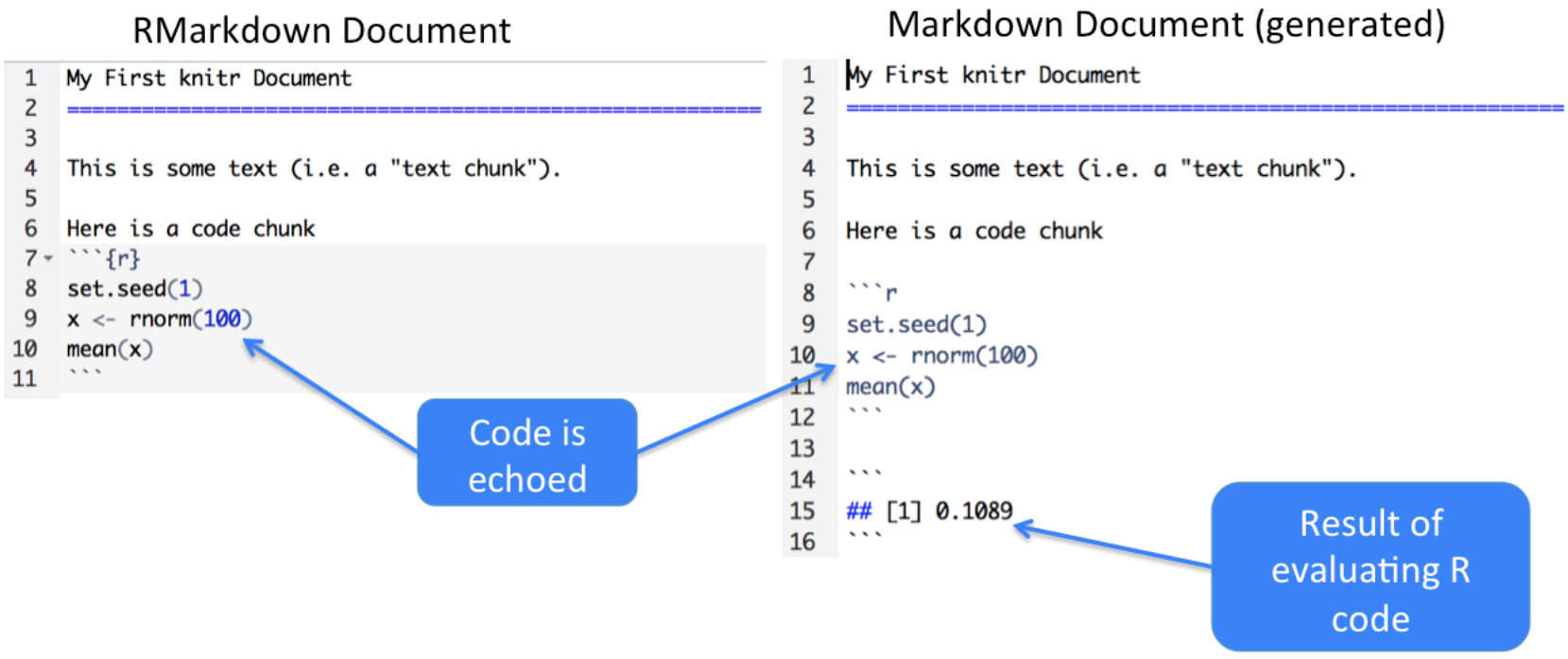
markdown in Rstudio



options

- options
- global options

Option	Effect
`eval`	Results printed when `TRUE`
`echo`	Code printed when `TRUE`
`include`	When `FALSE`, code is evaluated but neither the code nor results are printed.
`cache`	If the code has not changed, the results will be available but not evaluated again in order to save compilation time.
`fig.cap`	Caption text for images. Images will automatically be put into a special figure environment and be given a label based on the chunk label.
`fig.scap`	The short version of the image caption to be used in the list of captions
`out.width`	Width of displayed image
`fig.show`	Controls when images are shown. `'as.is'` prints them when they appear in code and `'hold'` prints them all at the end.
`dev`	Type of image to be printed, such as .png, .jpg, etc.
`engine`	`knitr` can handle code in other languages like Python, BASH, Perl, C++ and SAS.
`prompt`	Specifies the prompt character put before lines of code. If `FALSE`, there will be no prompt.
`comment`	For easier reproducibility, result lines can be commented out.

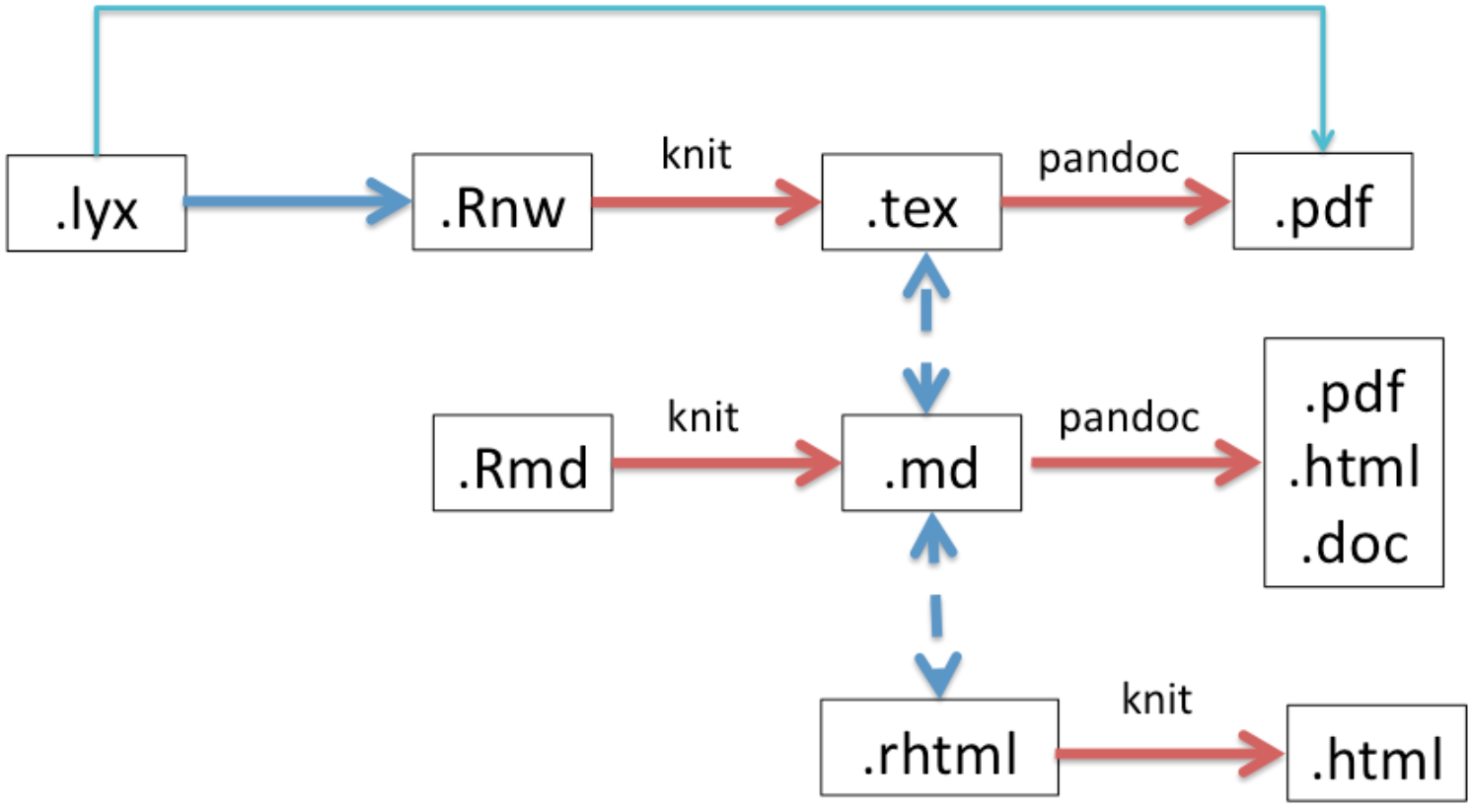
alternative with command

- .Rmd -> .md -> .pdf/.doc/.html
- .Rmd -> .md

```
library(knitr)
library(markdown)
##generate .md file
knit("data_analysis.Rmd")
## generate .html file
knit("data_analysis.Rhtml")
```

alternative with command

- .Rmd -> .md -> .pdf/.doc/.html



alternative with command

- .Rmd -> .md -> .pdf/.doc/.html
- .md -> .pdf/.doc/.html

```
##generate different format from .md file.
pandoc('test.md', format='html')  # HTML
system("pandoc test.md --latex-engine=xelatex -o test.pdf")
pandoc('data_analysis.md', format='docx')  # MS Word

## latex
pandoc('data_analysis.md', format='latex') # LaTeX/PDF
##or
system("pandoc -s test.md -t latex -o test.tex")

## slides
# system("pandoc -s -t slidy test.md -o My_Analysis.html")
system("pandoc -s -t beamer data_analysis.md -o My_Analysis
```

figures in rmarkdown

```
n <- 100
x <- rnorm(n)
par(mfrow=c(1,2), las=1)
for(i in 1:8) {
  y <- i*x + rnorm(n)
  plot(x, y, main=i)
}
```

figures in rmarkdown

```
![](figure.png)
```

figures in rmarkdown

```
library(png)
library(grid)
img <- readPNG("figure/format.png")
grid.raster(img)
```

slidify

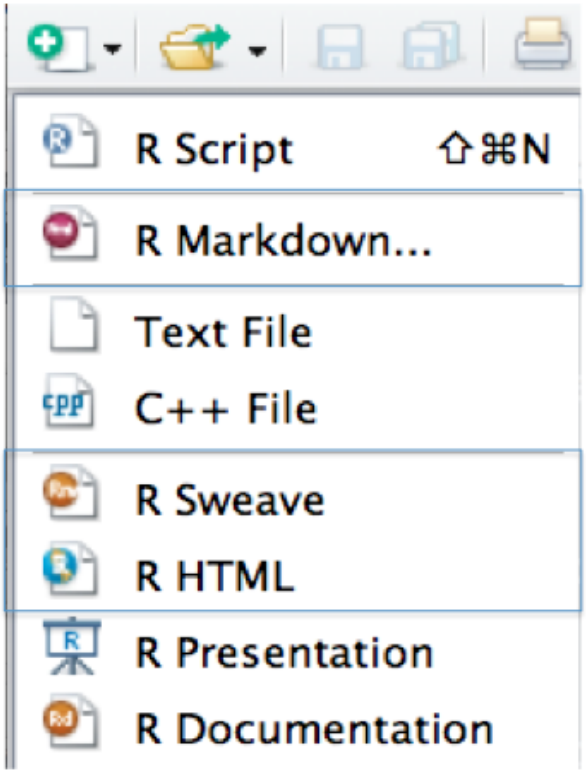
http://slidify.org/start.html

```
library(slidify)
author('Qiang')
```

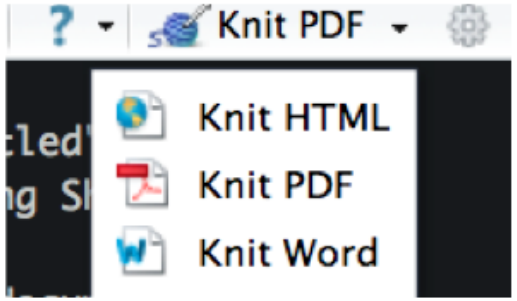
R code in rhtml

```
<!--begin.rcode
set.seed(1121)
(x=rnorm(20))
mean(x);var(x)
    end.rcode-->
```

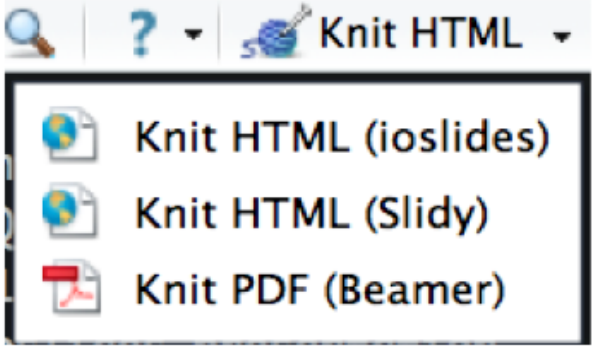
menu



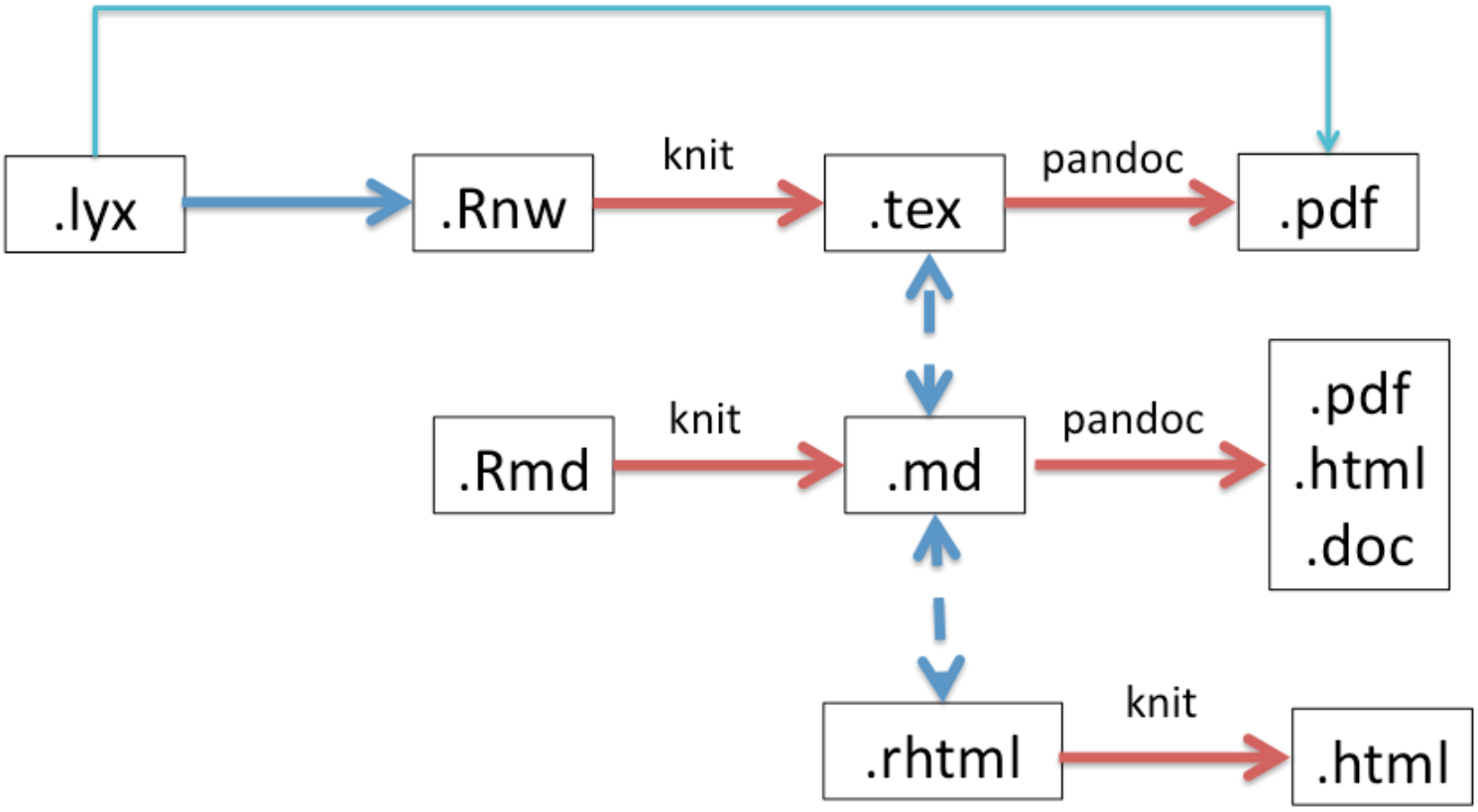
Documents



Slides



framework


.lyx
.Rnw
knit
.tex
pandoc
.pdf
.Rmd
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pandoc
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.doc
.rhtml
knit
.html