

Recherche
Reproductible
(RR)

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Pourquoi?

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Avoir une présence en ligne

Outils pour la diffusion rapide et reproductible de la recherche

Sahir Rai Bhatnagar¹

May 14, 2019

¹<https://github.com/sahirbhatnagar/raqc>

Remerciements

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Final Remarks

- La comité organisateur
- Pierre Racine et Sophie Baillargeon
- Don Knuth (\TeX)
- Friedrich Leisch (Sweave)
- Yihui Xie (knitr)
- Vous



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Avis #1

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- Ceci est une **introduction** aux outils pour la recherche reproductible

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- Ceci est une **introduction** aux outils pour la recherche reproductible
- Le niveau de cet atelier est "intermédiaire" et suppose des connaissances de base en R ainsi que de l'environnement RStudio

Avis #1

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Final Remarks

- Ceci est une **introduction** aux outils pour la recherche reproductible
- Le niveau de cet atelier est "intermédiaire" et suppose des connaissances de base en R ainsi que de l'environnement RStudio
- N'hésitez pas à poser des questions

Avis #2



R Markdown v2



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Je n'ai aucune relation commerciale avec ces logiciels.

Avis #3

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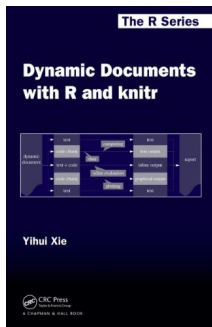
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- Le matériel pour cet atelier est basé sur plusieurs ressources
- Voir ce lien pour une liste complète de références:
<https://github.com/sahirbhatnagar/raqc>
- Une grande partie du contenu de ces diapositives est basée sur ces deux livres:



Eat Your Own Dog Food

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- Ces diapositives sont reproductibles
- Voir `raqc-slides.Rnw`:
<https://github.com/sahirbhatnagar/raqc/tree/master/slides>

Le programme de l'atelier

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- **8h30 à 10h00:** Introduction aux rapports reproductibles avec knitr et RMarkdown
- **10h00 à 10h30:** Pause
- **10h30 à 12h00:**
- **13h30 à 15h00:** Créer un siteweb avec blogdown
- **15h00 à 15h30:** Pause
- **15h30 à 17h:**
- **17h:** Fin de l'atelier

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Recherche Reproductible (RR)

C'est quoi la science?

Recherche Reproductible (RR)

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C'est quoi la science?

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Selon l'American Physical Society:

La science est l'entreprise systématique consistant à rassembler des connaissances sur l'univers et à les organiser et les condenser en lois et **théories vérifiables**...

C'est quoi la science?

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Final Remarks

Selon l'American Physical Society:

La science est l'entreprise systématique consistant à rassembler des connaissances sur l'univers et à les organiser et les condenser en lois et **théories vérifiables**...

Le **succès et la crédibilité de la science** sont fondés sur la volonté des scientifiques **d'exposer leurs idées et leurs résultats** à des **tests indépendants** et à leur **reproduction** par d'autres scientifiques.

RR: Une norme minimale pour vérifier les résultats scientifiques

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RR: Une norme minimale pour vérifier les résultats scientifiques

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Recherche reproductible (RR) dans la science des données

Les données et le code utilisés pour effectuer une constatation sont disponibles et suffisent à un chercheur indépendant pour recréer la constatation.

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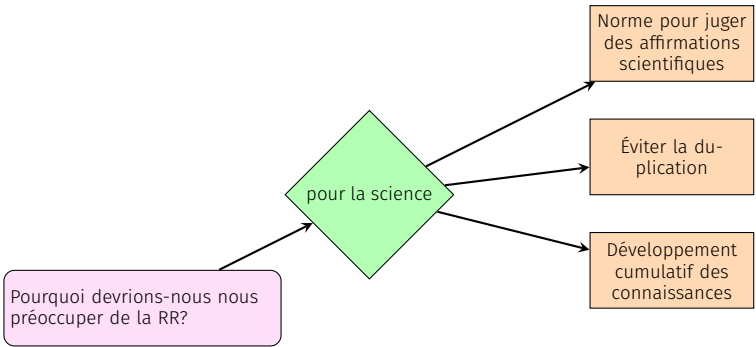
007-sensitivity-
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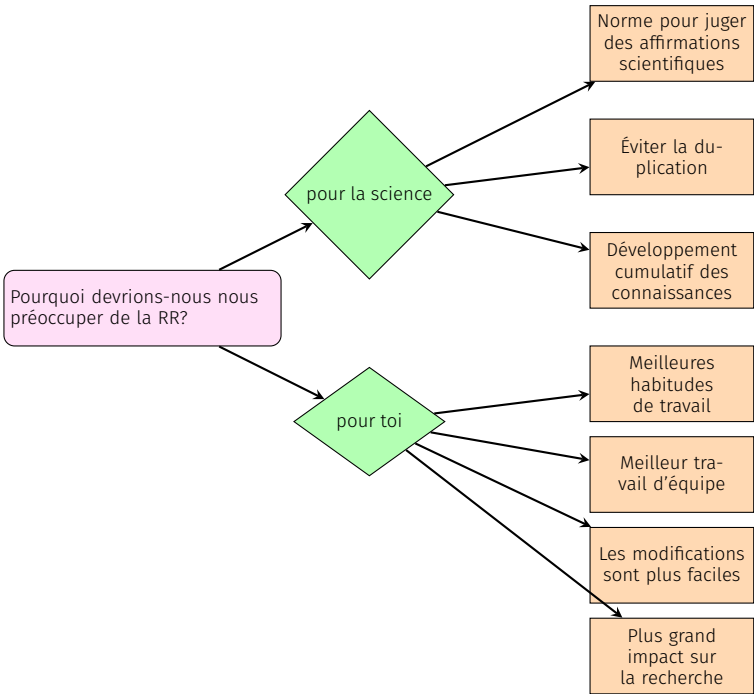
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Un exemple justificatif

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Démo: 001-motivating-example

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Commencer

Outils pour la recherche reproductible²

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Logiciel gratuit et « open source »

- **RStudio**: Créer, gérer, compiler des documents
- **TeX**: langage de balisage pour la composition d'un document
- **R**: Langage d'analyse statistique
- **knitr**: Intègre le code TeX et le code R. La version moderne de **Sweave** du professeur Friedrich Leisch
- **RMarkdown**: Intègre le code Markdown et le code R

²<http://onepager.togaware.com/>

Comparaison

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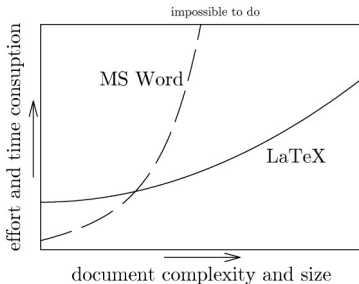


Figure 1: Comparison

- \LaTeX a une plus grande courbe d'apprentissage
- De nombreuses tâches sont très difficiles ou impossibles (la plupart des cas) à effectuer dans MS Word ou Libre Office

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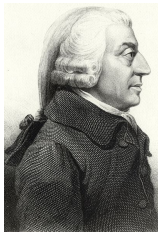


Figure 2: Adam Smith, l'auteur de *The Wealth of Nations* (1776), dans lequel il conceptualise la notion de division du travail

Division du travail

La **composition** et la structuration logique du texte constituent la contribution spécifique de **l'auteur** à la production d'un texte imprimé.

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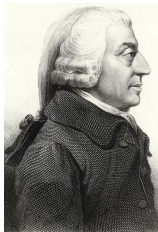


Figure 2: Adam Smith, l'auteur de *The Wealth of Nations* (1776), dans lequel il conceptualise la notion de division du travail

Division du travail

La **composition** et la structuration logique du texte constituent la contribution spécifique de **l'auteur** à la production d'un texte imprimé.

Des questions telles que le choix de la famille de polices, les **en-têtes de section doivent-ils être en caractères gras ou en petites capitales**? Doivent-ils être alignés à gauche ou centrés? Le texte doit-il être justifié ou non? Les notes doivent-elles apparaître au bas de la page ou à la fin? Le texte doit-il être placé dans une colonne ou deux? et ainsi de suite, est l'affaire de la **typographe**

Le génie derrière \LaTeX



Figure 3: The \TeX project was started in 1978 by Donald Knuth (Stanford). He planned for 6 months, but it took him nearly 10 years to complete. Coined the term “Literate programming”: mixture of code and text segments that are “human” readable. Recipient of the Turing Award (1974) and the Kyoto Prize (1996).

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Integrated Development Environment (IDE)

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Integrated Development Environment (IDE)

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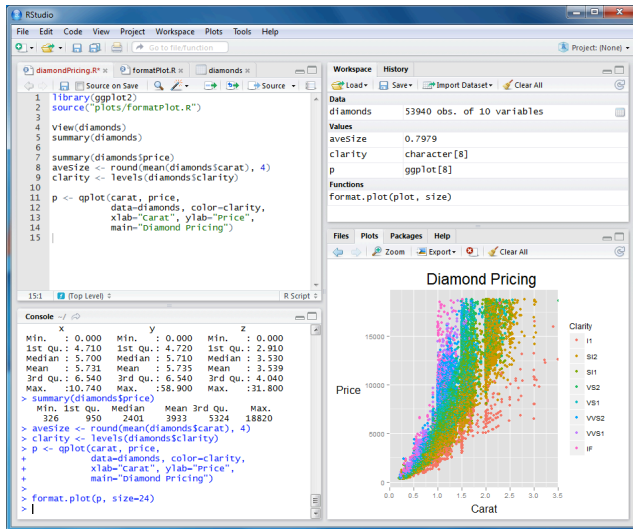
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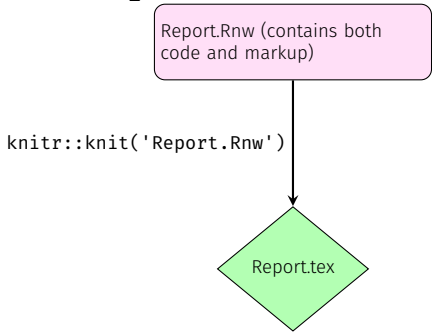
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Demonstrate: Explore RStudio

Que fait knitr

Exemple ~~LaTeX~~ \LaTeX :



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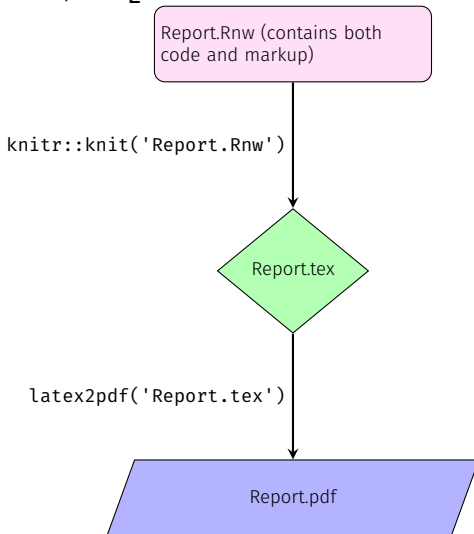
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Que fait knitr

Exemple ~~LaTeX~~ \LaTeX :



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Compiler un document .Rnw

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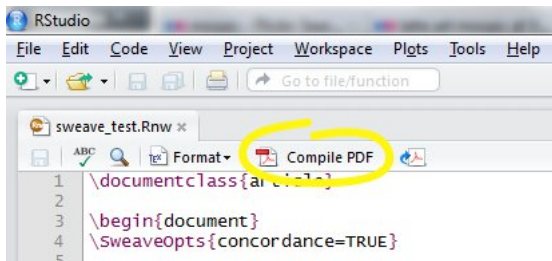
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Les deux étapes de la diapositive précédente peuvent être exécutées en une seule commande:

```
knitr::knit2pdf()
```

ou dans RStudio:



Incorporer le code R

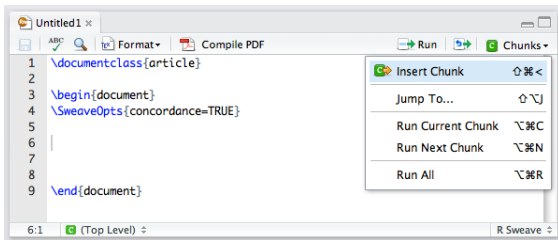
- Insérer le code R dans un **morceau de code** commençant par

<< >>=

et se terminant par

@

Dans RStudio:



Exemple 1

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```
<<example-code-chunk-name, echo=TRUE>>=  
library(magrittr)  
rnorm(50) %>% mean  
@
```

produces

```
library(magrittr)  
rnorm(50) %>% mean  
  
## [1] 0.12
```

Exemple 2

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```
<<example-code-chunk-name2, echo=TRUE, tidy=TRUE>>=  
for(i in 1:5){ (i+3) %>% print}  
@
```

produces

```
for (i in 1:5) {  
  (i + 3) %>% print  
}  
  
## [1] 4  
## [1] 5  
## [1] 6  
## [1] 7  
## [1] 8
```


Example 2.2

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```
<<example-code-chunk-name3, echo=FALSE>>=  
for(i in 1:5){ (i+3) %>% print}  
@
```

produces

```
## [1] 4  
## [1] 5  
## [1] 6  
## [1] 7  
## [1] 8
```

Example 2.3

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```
<<example-code-chunk-name4, echo=FALSE, eval=FALSE>>=  
for(i in 1:5){ (i+3) %>% print}  
@
```

produces

Démo: Essayez vous-même

R output within the text

- Include R output within the text
- We can do that with “S-expressions” using the command `\Sexpr{...}`

Example:

The iris dataset has `\Sexpr{nrow(iris)}` rows and
`\Sexpr{ncol(iris)}` columns

produces

The iris dataset has 150 rows and 5 columns

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Include a Figure

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```
<<lm, fig.cap='Regression',fig.height=3,fig.width=3>>=
plot(mtcars[, c('displ','mpg')])
lm(mpg ~ displ , data = mtcars) %>%
  abline(lwd=2)
@
```

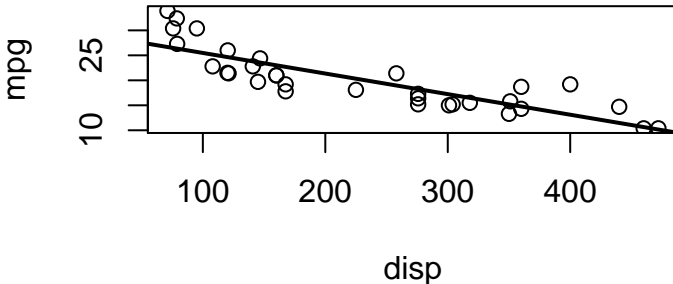


Figure 4: Linear regression

Include a Table

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```
<<table.ex, results='asis'>>=
library(xtable)
iris[1:5,1:5] %>%
xtable(caption='Sample of Iris data') %>%
print(include.rownames=FALSE)
@
```

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.10	3.50	1.40	0.20	setosa
4.90	3.00	1.40	0.20	setosa
4.70	3.20	1.30	0.20	setosa
4.60	3.10	1.50	0.20	setosa
5.00	3.60	1.40	0.20	setosa

Table 1: Sample of Iris data

Markdown: HTML without knowing HTML

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The screenshot displays the RStudio interface with two main panes. The left pane shows the source R Markdown file 'example.Rmd' with line numbers 1 through 20. The right pane shows the 'Preview HTML' window, which renders the document's content.

Source File (example.Rmd):

```
1 Header 1
2 -----
3 This is an R Markdown document. Markdown is a
4 | simple formatting syntax for authoring web pages.
5 Use an asterisk mark, to provide emphasis such as
6 | italics and bold.
7
8 Create lists with a dash:
9 - Item 1
10 - Item 2
11 - Item 3
12
13 You can write `in-line` code with a back-tick.
14 ```
15 Code blocks display
16 with fixed-width font
17 ```
18
19 > Blockquotes are offset
20
```

Preview HTML:

Header 1

This is an R Markdown document. Markdown is a simple formatting syntax for authoring web pages.

Use an asterisk mark, to provide emphasis such as *italics* and **bold**.

Create lists with a dash:

- Item 1
- Item 2
- Item 3

You can write in-line code with a back-tick.

```
Code blocks display
with fixed-width font
```

Blockquotes are offset

R + Markdown = RMarkdown

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chunks.Rmd

Knit HTML

Chunks

```
1 R Code Chunks
2 =====
3
4 With R Markdown, you can insert R code
  chunks including plots:
5
6 ```{r qplot, fig.width=4, fig.height=3,
  | message=FALSE}
7 # quick summary and plot
8 library(ggplot2)
9 summary(cars)
10 qplot(speed, dist, data=cars) +
11     geom_smooth()
12 ```
13
```

RStudio: Preview HTML

Preview: ~/chunks.html

Save As Publish

R Code Chunks

With R Markdown, you can insert R code chunks including plots:

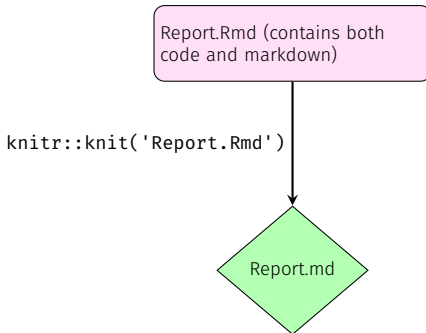
```
# quick summary and plot
library(ggplot2)
summary(cars)
```

##	speed	dist
## Min.	: 4.0	Min. : 2
## 1st Qu.:	12.0	1st Qu.: 26
## Median :	15.0	Median : 36
## Mean :	15.4	Mean : 43
## 3rd Qu.:	19.0	3rd Qu.: 56
## Max.	: 25.0	Max. : 120

```
qplot(speed, dist, data = cars) + geom_smooth()
```

What **r**markdown does

RMarkdown example:



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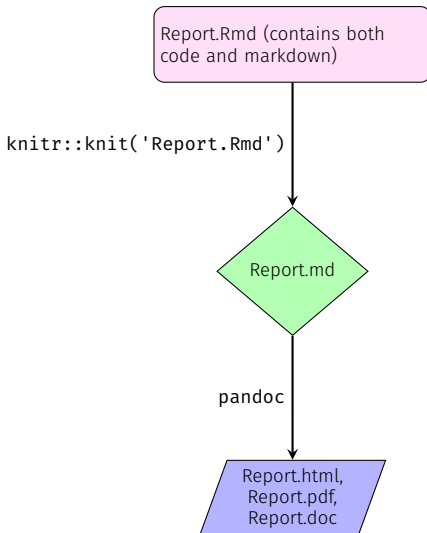
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What rmarkdown does

RMarkdown example:



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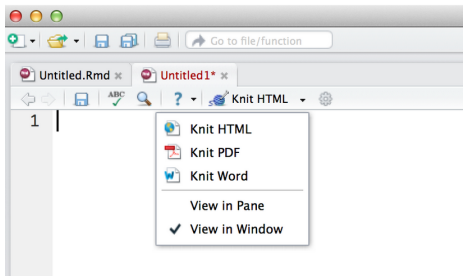
Final Remarks

Compiling a .Rmd document

The two steps on previous slide can be executed in one command:

```
rmarkdown::render()
```

or in RStudio:



How to choose between \LaTeX and Markdown ?

\LaTeX

math/stat symbols
beamer presentations
customized documents
publish to journals,
arXiv

Markdown

quick and easy reports
use javascript libraries
interactive plots
publish to websites

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Minimum Working Example

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<https://github.com/sahirbhatnagar/raqc/tree/master/002-minimum-working-example>

Extracting output from Regression Models

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<https://github.com/sahirbhatnagar/raqc/tree/master/003-model-output>

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<https://github.com/sahirbhatnagar/raqc/tree/master/004-figures>

Beamer Presentations

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<https://github.com/sahirbhatnagar/raqc/tree/master/005-beamer-presentation>

Changing one Parameter in an Analysis

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<https://github.com/sahirbhatnagar/raqc/tree/master/006-sensitivity-analysis-one-parameter>

Changing Many Parameters in an Analysis

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<https://github.com/sahirbhatnagar/raqc/tree/master/007-sensitivity-analysis-many-parameters>

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<https://github.com/sahirbhatnagar/raqc/tree/master/008-large-documents>

HTML Reports

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<https://github.com/sahirbhatnagar/raqc/tree/master/009-rmarkdown>

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<https://github.com/sahirbhatnagar/raqc/tree/master/010-rmarkdown-presentation>

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Opinion: Reproducible research can still be wrong: Adopting a prevention approach

Jeffrey T. Leek^{a,1} and Roger D. Peng^b

^aAssociate Professor of Biostatistics and Oncology and ^bAssociate Professor of Biostatistics,
Johns Hopkins University, Baltimore, MD

computational tools such as knitr, iPython notebook, LONI, and Galaxy (8) have simplified the process of distributing reproducible data analyses.

Always Remember ...

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$$\text{Reproducibility} \propto \frac{1}{\text{copy paste}}$$

Is the juice worth the squeeze?

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