RMarkdown, LaTeX and Lyx

Lecture 4

Hector Rodriguez-Deniz

LaTeX

TeX

- Computer program by Donald Knuth for typesetting text and formulas (1977)

LaTeX

- Predefined professional layout
- You need to write code to create documents (for ex. scientific papers)
- Code is compiled to PDF or PS or other files

LyX

- Graphical interface that allows using mouse instead of writing codes (compare: Word)
- Produces LaTeX code that you can see and compile

LaTeX vs MS Word

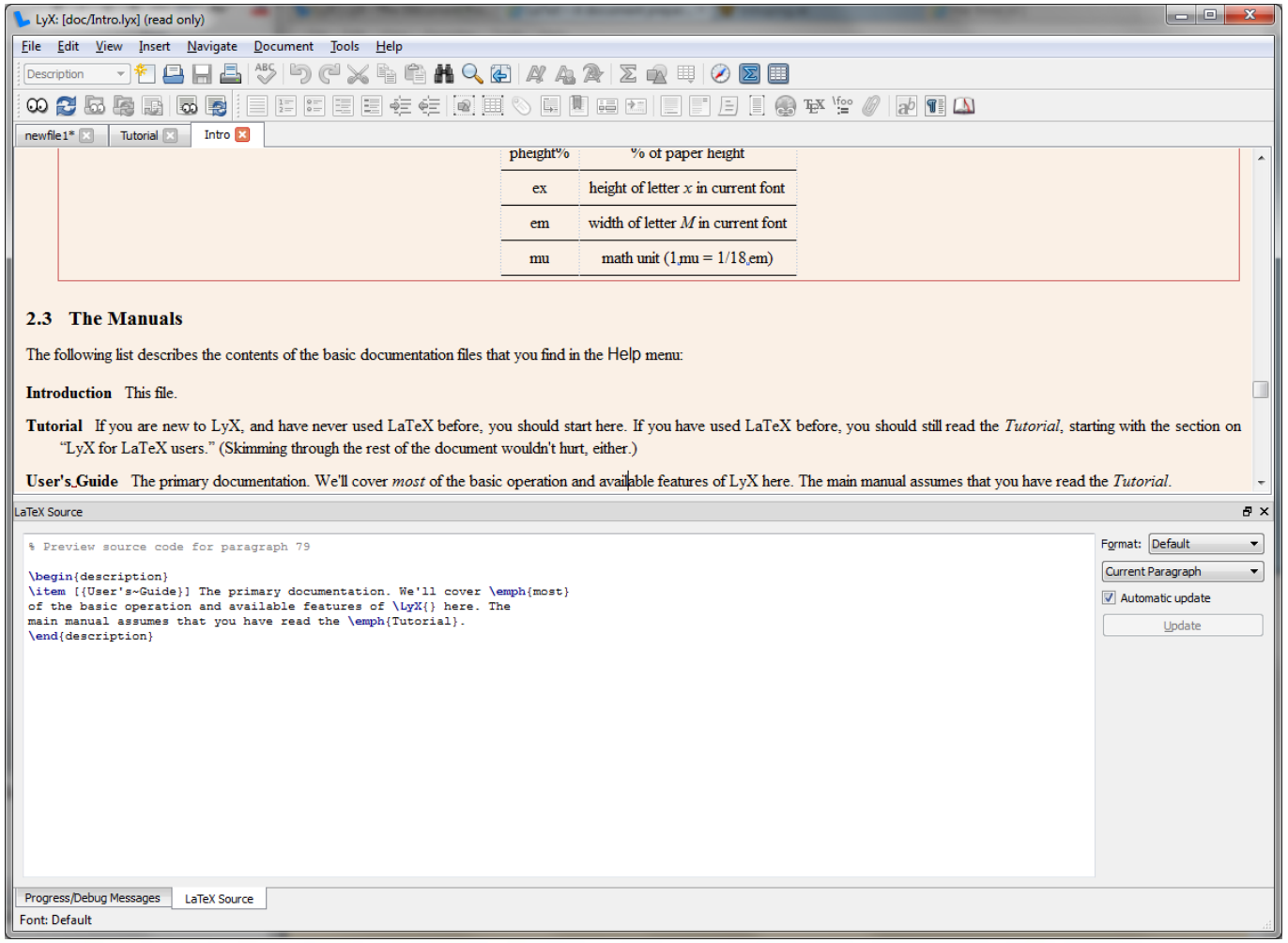
- LaTeX is more often used for writing scientific reports and papers
  - Once publisher provides it's style file, it can be embedded into your TeX file easily (in Word, you need to adjust the style manually →may take hours or days)
  - Formulas can be enumerated and updated automatically (not so easy in Word)
  - There is a flexible citation and referencing function
- Word provides a simple click-forward way

Installing LaTeX and LyX

Windows OS

- Install MikTeX https://miktex.org/
- Install an editor, TeXnicCenter (if you do not plan to use LyX): http://www.texniccenter.org/
- Install LyX if you like graphical interface: http://www.lyx.org/

LyX


LyX: [doc/Intro.lyx] (read only)
File Edit View Insert Navigate Document Tools Help
newfile1* Tutorial Intro
pheight% % of paper height
ex height of letter x in current font
em width of letter M in current font
mu math unit (1 mu = 1/18 em)
2.3 The Manuals
The following list describes the contents of the basic documentation files that you find in the Help menu:
Introduction This file.
Tutorial If you are new to LyX, and have never used LaTeX before, you should start here. If you have used LaTeX before, you should still read the Tutorial, starting with the section on "LyX for LaTeX users." (Skimming through the rest of the document wouldn't hurt, either.)
User's Guide The primary documentation. We'll cover most of the basic operation and available features of LyX here. The main manual assumes that you have read the Tutorial.
LaTeX Source
% Preview source code for paragraph 79
\begin{description}
\item [{User's~Guide}] The primary documentation. We'll cover \emph{most}
of the basic operation and available features of \LyX{} here. The
main manual assumes that you have read the \emph{Tutorial}.
\end{description}
Format: Default
Current Paragraph
Automatic update
Update
Progress/Debug Messages
LaTeX Source
Font: Default

RMarkdown and knitr

- A way to include R code into your reports and let the code be run at the time the document is compiled
  - Reproducible Research
- Multiple outputs: PDF, HTML, DOCX,..
- Slide Presentations, Interactive documents and even Websites can be generated

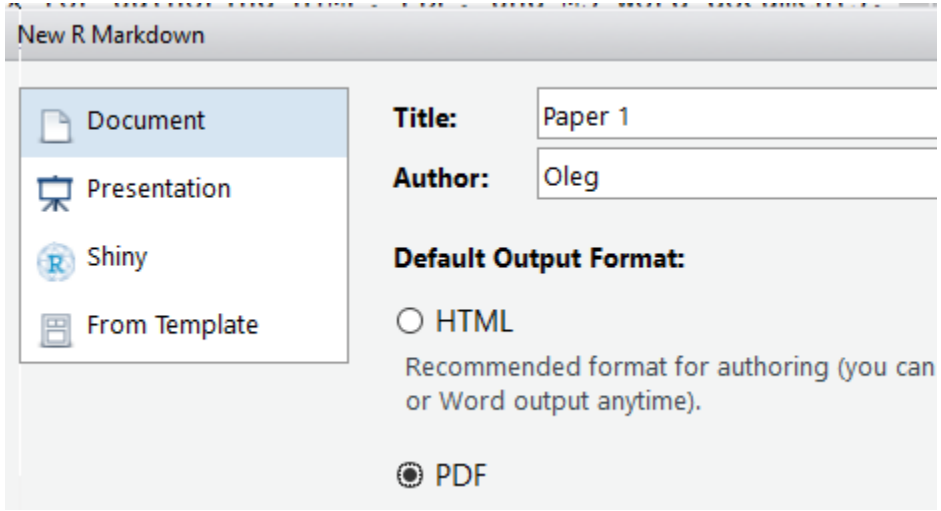
Using Rmarkdown

- Install MikTeX https://miktex.org/, choose ”Complete installation” (not basic)
- Install **rmarkdown**
- Install **knitr** package in R
- File→New File→R Markdown

- Writing papers: install **rticles**

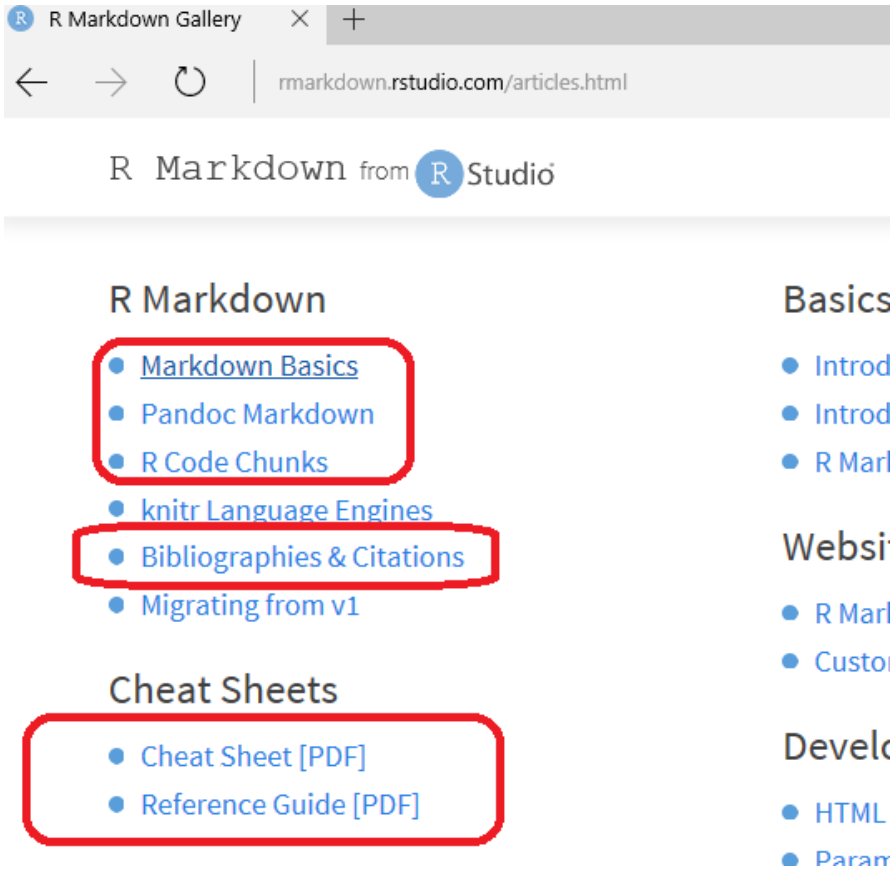
Creating new file

- File→New RMarkdown
  - Select ”From Template” to use a journal template



Getting help

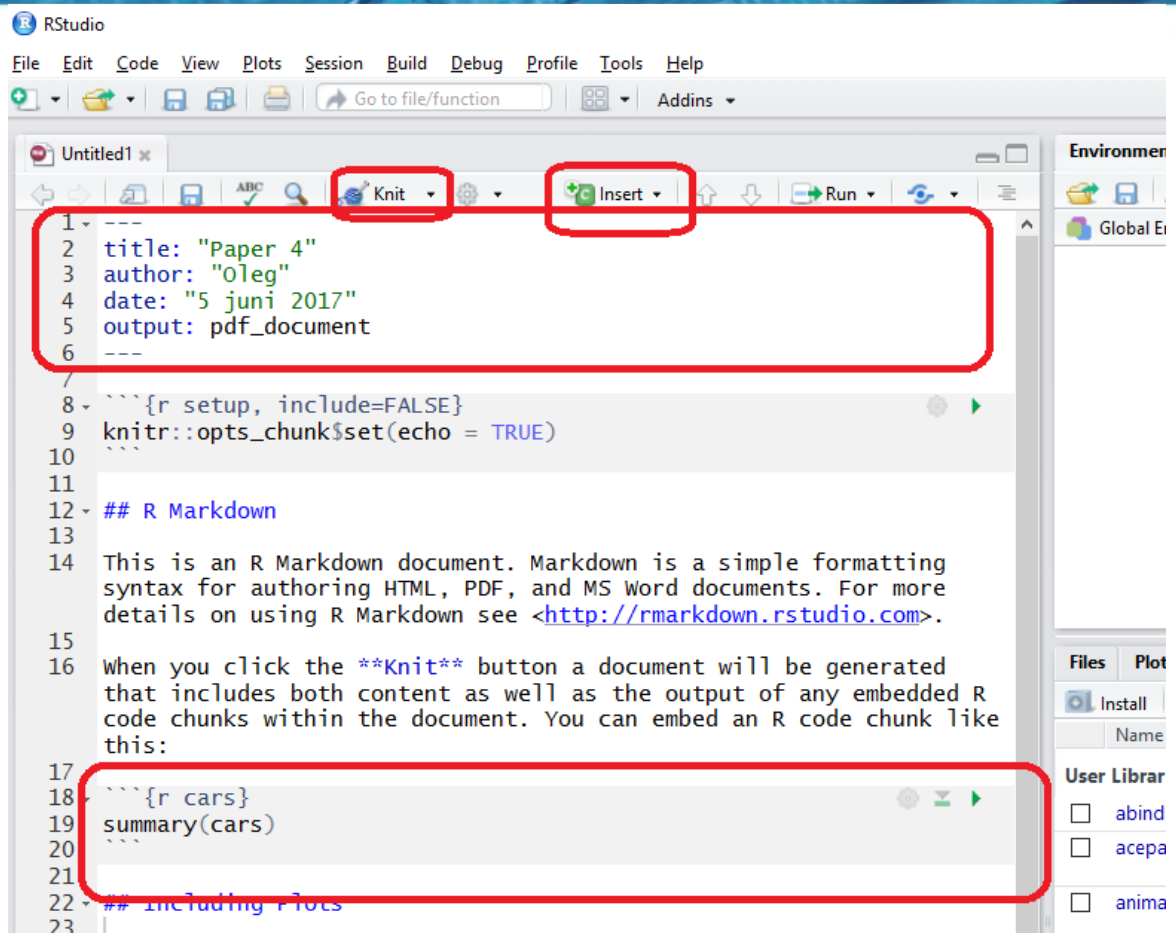
- Help→Cheet sheets→R markdown…
- https://bookdown.org/yihui/rmarkdown/
- http://rmarkdown.rstudio.com/index.html
  - Check ”Get started ” and ”Articles”



Structure of the RMD file

- YAML header
- R code chunks
- Formatted text

- Knit button
- Insert button



YAML header

- **title**
- **subtitle**
- **author**
- **date**
- **output**_type
  - beamer_presentation
  - github_document
  - html_document
  - ioslides_presentation
  - md_document
  - odt_document
  - pdf_document
  - rtf_document
  - slidy_presentation
  - word_document
  - …

```
---
title: "Lab 1, 732A98 Visualization"
author: "Mister X and Miss Y"
date: "5 June 2017"
output: pdf_document
---
```

Text, characters and comments

- New line is ignored→ make a blank line to begin a new line
- Several ”space”s treated as a single one
- Some symbols can not be used in text directly → use * \# \$ \% …
- Comments can be put between <!-- and -->

```
13  Here is my     \* document\*
14  and
15  I can write it in several rows
16
17  I need a empty line if I want to start
18  a new paragraph
19
20  <!-- Here is some comment -->
```

Here is my * document* and I can write it in several rows

I need a empty line if I want to start a new paragraph

Headers and fonts

- Headers:
  - #Main header
    - ##Second level header
      - ….
- Italic: *italic*, bold: **bold**

```
22  # Assignment 1
23  ### Assignment 1.1
24
25  In this assignment, we compute **sparsity** of all *matrices*
26
```

Assignment 1

Assignment 1.1

In this assignment, we compute **sparsity** of all *matrices*

Code chunks

- Write your code between ```{r} and ```

````
11
12  Consider the structure of the data file:
13  ```{r}
14  head(cars)
15  ```
16
````

Consider the structure of the data file:

```r
head(cars)
```

```
##   speed dist
## 1     4    2
## 2     4   10
## 3     7    4
## 4     7   22
## 5     8   16
## 6     9   10
```

Code chunks

- Important options:
  - echo=FALSE: code is not shown in the report
  - eval=TRUE: code is executed
  - include=FALSE: code is executed but not the code nor results are in the report
  - error=FALSE
  - message=FALSE
  - warning=FALSE

````
15
16 ```{r,echo =FALSE,message=FALSE, warning=FALSE}
17 library(TSA)
18 ```
19
````

Code chunks

```
## Assignment 1

Dataset crx.csv contains encrypted information about the customers of a bank and whether each
individual has paid back the loan or not: Given Class: 1=paid back, 0=not paid back

### Q.1

The following variables are selected by the decision tree:

```{r, echo=F}
crx <- read.csv("Z:/732A95_TDDE01/2016/exam/A95/crx.csv", header = TRUE, dec = ".", sep = ",")

#Convert the class the variable from numeric to factor
crx[,"Class"] <- factor(crx[,"Class"])

#Fit the decision tree
library(tree)
treefit1 = tree(Class~., data =crx)
summary(treefit1)
```
```

Assignment 1

Dataset crx.csv contains encrypted information about the customers of a bank and whether each individual has paid back the loan or not: Given Class: 1=paid back, 0=not paid back

Q.1

The following variables are selected by the decision tree:

```
##
## Classification tree:
## tree(formula = Class ~ ., data = crx)
## Variables actually used in tree construction:
## [1] "A9"  "A3"  "A6"  "A15" "A10" "A14"
## Number of terminal nodes:  13
## Residual mean deviance:  0.4827 = 326.8 / 677
## Misclassification error rate: 0.09855 = 68 / 690
```

Code chunks

- Same code chunk with echo=TRUE

Assignment 1

Dataset crx.csv contains encrypted information about the customers of a bank and whether each individual has paid back the loan or not: Given Class: 1=paid back, 0=not paid back

Q.1

The following variables are selected by the decision tree:

```
crx <- read.csv("Z:/732A95_TDDE01/2016/exam/A95/crx.csv", header = TRUE, dec
= ".", sep = ",")

#Convert the class the variable from numeric to factor
crx[,"Class"] <- factor(crx[,"Class"])

#Fit the decision tree
library(tree)
treefit1 = tree(Class~., data =crx)
summary(treefit1)

##
## Classification tree:
## tree(formula = Class ~ ., data = crx)
## Variables actually used in tree construction:
## [1] "A9"  "A3"  "A6"  "A15" "A10" "A14"
## Number of terminal nodes:  13
## Residual mean deviance:  0.4827 = 326.8 / 677
## Misclassification error rate: 0.09855 = 68 / 690
```

Code chunks: figures

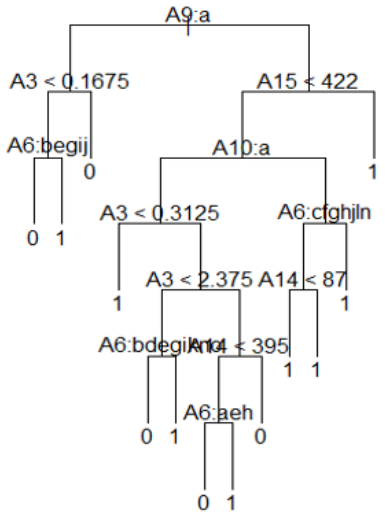
- Important options
  - fig.cap
  - fig.width
  - fig.height
  - fig.align: ’center’, ’left’,’right’
  - fig.show=’hold’

Code chunks: figures

```
42  ### Q.2
43  The tree looks like as follows:
44
45  ```{r, fig.cap="Table 1. Classification tree for
    bank decision", fig.width=4, fig.height=6,
    fig.align='center'}
46  plot(treefit1, type="uniform")
47  text(treefit1)
48  ```
49
```

The tree looks like as follows:

```
plot(treefit1, type="uniform")
text(treefit1)
```



Referencing figures

- Works when save to PDF

```
17
18 ```{r my_plot, fig.cap='\\label{fig:my_plot}Cars data'}
19 plot(cars)
20 ```
21
22 As it is specified in Figure \ref{fig:my_plot}
```

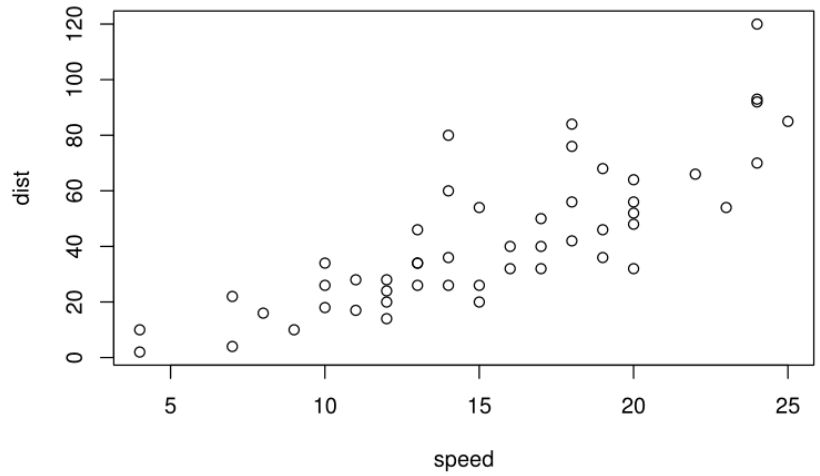


Figure 1: Cars data

As it is specified in Figure 1

Tables

- Use *kable* in package knitr:

````
###Q1
Here is a printout showing the structure of the data:
```{r echo=F}

knitr::kable(
  cars[1:4,], caption = 'Table 1: A table of the first 4 rows of the cars data.'
)

```
````

Q1

Here is a printout showing the structure of the data:

Table 1: A table of the first 4 rows of the cars data.

speed	dist
4	2
4	10
7	4
7	22

Referencing tables

- Works when save to PDF

```
25 ```{r tab1, echo=F}
26 knitr::kable(cars[1:4,], caption="\\label{tab:tab1}. Structure of cars data")
27
28 ```
29
30 As it is specified in Table \ref{tab:tab1},
```

Table 1: . Structure of cars data

speed	dist
4	2
4	10
7	4
7	22

As it is specified in Table 1,

Lists

- Numbered and not numbered
  - Use four spaces to indicate a new level:

```
27  The following steps are performed:
28
29  * We do step 1
30  * We do step 2
31      * We do step 2.1
32          * We do step 2.1.1
33
34  and then the following ones:
35
36  5. We do step 1
37  3. We do step 2
38      i. We do step 2.1
39      ii. We do step 2.2
```

The following steps are performed:

- We do step 1
- We do step 2
  - We do step 2.1
    - We do step 2.1.1

and then the following ones:

5. We do step 1
6. We do step 2
   i. We do step 2.1
   ii. We do step 2.2

Quotations

- Quote by starting line with >

```
41  As it was mentioned in the paper,
42
43  >The best algorithm performing the reduction
44  >can not achieve linear complexity
```

As it was mentioned in the paper,

> The best algorithm performing the reduction can not ac

Formulas

- Formula in the text $...$
- Formula at the new line \[… \]
- No support for enumerated formulas…

```
$Y_i=\phi(X_i, \theta)+ \epsilon_i$
```

$$Y_i = \phi(X_i, \theta) + \epsilon_i$$

Formulas: building blocks

- Subscript: X_i A_{low}
- Superscript: x^2 Y^{t^2}
- Greek letters: \lambda \Phi \phi…
- Comparison: > < = \geq \leq
- Square root: \sqrt{x^3}
- Ratio $\frac{x}{y^2+1}$
- Product $A \cdot B$
- $\hat{Y}$, $\vec{X}$
- Brackets $\left(X^2+1 \right)$ $(X^2 + 1)$
- Series of sums, product: \sum and \prod
  - $Y_i= \sum_{j=1}^{n_i} Y_{ij}/n_i$ $Y_i = \sum_{j=1}^{n_i} Y_{ij}/n_i$
- Integral \int

Images and links

- Web links [text](url)
- Insert image ![caption] (path_to_image)

```
117
118  The following background will be used in the
     visualizations:
119
120  ![Figure 2.Our
     background](C:\Users\olesy12\Pictures\Traning
     1.jpg){width=300 height=200}


121
122  This is a standard background available from [MS
     Office](https://www.office.com) presentations.
```

The following background will be used in the visualizations:

Figure 2.Our background

https://www.office.com
Ctrl-klicka för att följa länk

This is a standard background available from MS Office presentations.

References to sections

1. Mark by a label {#label}
2. Use the label in text

```
125 ## Assignment 1 {#s1}
126
127 Dataset crx.csv contains encrypted information about
    the customers of a bank and whether each individual has
    paid back the loan or not: Given Class: 1=paid back,
    0=not paid back
128
129 ...
130
131 As it was mentioned in [Assignment 1](#s1)
132
```

Assignment 1

Dataset crx.csv contains encrypted information about the customers of a ba
1=paid back, 0=not paid back

...

As it was mentioned in Assignment 1

References

- Create a bib-file describing your references in BibTeX
  - https://en.wikipedia.org/wiki/BibTeX
- Change YAML header to specify:
  - ”bibliography: your_file.bib”
  - Optionally ”cls: your_citation_style”

https://github.com/citation-style-language/styles

- Use [@reference] or @reference to cite

References

- See ”ci.bib” for example

```
129  As it was mentioned in [Assignment 1](#s1)
130
131
132  The statistical inference framework for monotonic regression was
     developed in @barlow. Applications of monotonic regression can be
     found in different areas [@ant]
133
134  #References
135
```

```
2  title: "Lab report 1"
3  author: "Oleg Sysoev"
4  date: "5 june 2017"
5  output:
6    word_document: default
7  bibliography: ci.bib
8  ---
```

The statistical inference framework for monotonic regression was developed in Barlow et al. (1972). Applications of monotonic regression can be found in different areas (Ant-Sahalia and Duarte 2003)

References

Ant-Sahalia, Y., and J. Duarte. 2003. “Nonparametric Option Pricing Under Shape Restrictions.” *Journal of Econometrics* 116: 9–47.

Barlow, R.E., D.J. Bartholomew, J.M. Bremner, and H.D. Brunk. 1972. *Statistical Inference Under Order Restrictions*. New York, NY: Wiley.

LaTeX example

```
\documentclass[12pt]{paper}
\begin{document}
\title{Bootstrap confidence intervals for large-scale multivariate monotonic regression problems}
\author{Oleg Sysoev, Anders Grimvall, Oleg Burdakov }
\maketitle

\begin{abstract}
Monotonic regression (MR) computes a response that is increasing or decreasing with respect to each of explanatory variables...
\end{abstract}

\textbf{Keywords: }Confidence intervals, monotonic regression, bootstrap,
percentile...

\section{Introduction}\label{intro}
...
\end{document}
```

LaTeX example

Bootstrap confidence intervals for large-scale multivariate monotonic regression problems

Oleg Sysoev, Anders Grimvall, Oleg Burdakov

Abstract

Monotonic regression (MR) computes a response that is increasing or decreasing with respect to each of explanatory variables...

Keywords: Confidence intervals, monotonic regression, bootstrap, percentile...

1 Introduction

...

LaTeX: enumerated equations and figures

- To enumerate equations,

```
\begin{equation}
…\label{your_label}
\end{equation}
```

- To enumerate figures, use \includefigure and \label

- To refer, use \ref{your_label}

LaTeX: enumerated equations and figures

```
30  As it is specified in Table \ref{tab:tab1},
31
32  \begin{equation}
33  Y=\alpha_i+\phi_i \label{eq1}
34  \end{equation}
35
36  Equation (\ref{eq1}) states that...
37
38
39  \begin{figure}
40  \includegraphics[height=4.3cm]{C:/Users/Oleg/Pictures/nn.png}
41  \caption{A neural network}
42  \label{nn}
43  \end{figure}
44
45  Figure \ref{nn} shows that
```

LaTeX: enumerated equations and figures

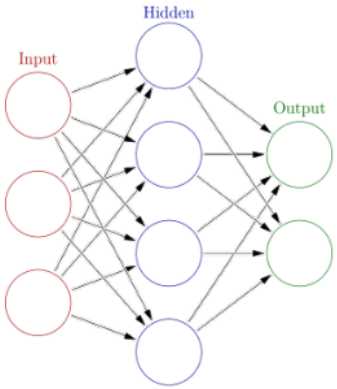


Figure 2: A neural network

As it is specified in Table 1,

$$Y = \alpha_i + \phi_i \tag{2}$$

Equation (2) states that...

Figure 2 shows that

Home reading

- http://rmarkdown.rstudio.com/index.html
- https://en.wikipedia.org/wiki/BibTeX
- https://bookdown.org/yihui/bookdown/

- http://ctan.tug.org/tex-archive/info/lshort/english/lshort.pdf
- http://www.latex-project.org/
- http://www.lyx.org/