Knitr?? What about Sweave?

December 11-12, 2013.

Knitr - the new Sweave

- Sweave original literate programing engine for R (or S) written by Friedrich Leisch
  - still works perfectly well
- knitr re-implementation of sweave written by Yihui Xie
  - homepage: http://yihui.name/knitr/
- minor differences in *.rnw files
- knitr much more flexible
  - much better error handling
  - markdown and html
  - extensible to other languages
- all subsequent examples will refer to knitr

Differences between knitr and Sweave

- no *.sty file to register with kritr
- knitr chunk options are R-expressions
- output code automatically 'pretty printed'
- errors warning rendered directly in document
- graphics
  - grid based graphics render without `print()`
  - multiple graphics per chunk
  - fine grained control of figure environment

Literate Programming

Let us change our traditional attitude to the construction of programs: Instead of imagining that our main task is to instruct a computer what to do, let us concentrate rather on explaining to humans what we want the computer to do.

– Donald E. Knuth, Literate Programming, 1984

Basics

- both knitr and sweave realize literate programming by embedding analysis code directly in source code of final document
- `*.rnw` - 'R-noweb' file
  - contain both latex and embedded R code
- code introduced in 'chunks' or using `\Sexpr{}`
- same basic principles apply to other formats and documents types

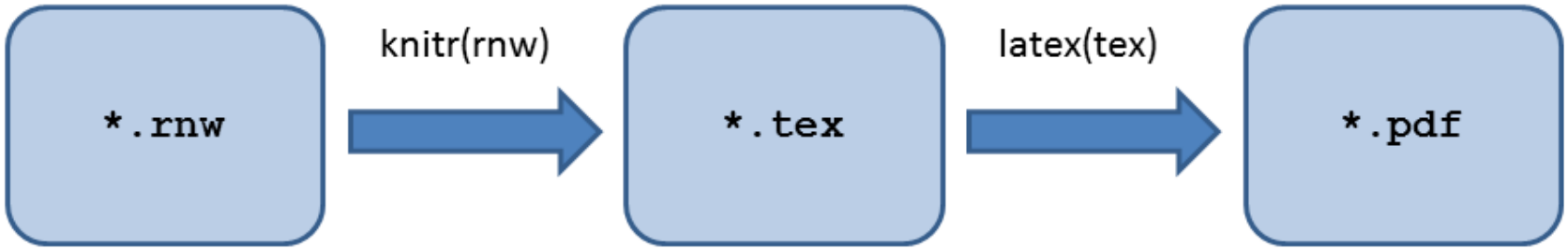
rnw file format and emacs

- ESS supports rnw files - major mode changes depending on location point
  - latex mode outside of chunks
  - ess[S] mode inside of chunks

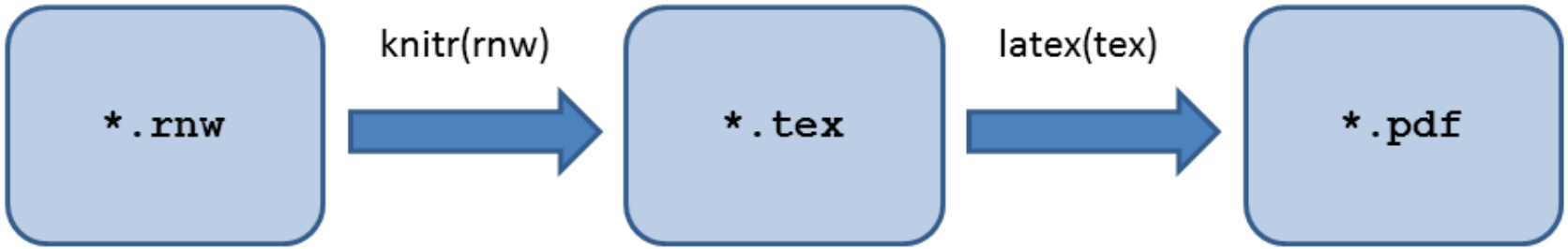
Compiling to pdf

`M-r`	run knitr current buffer (`M-s` to sweave)
`M-S-p`	compile tex file pdf

Compiling to pdf



Compiling to pdf



Chunks

- blocks of R code embedded directly in LaTeX file
- delineated by <<>>= ... @

Example chunk:

```
% latex code
<<>>=
wfdata <- read.csv('whitefish.csv', header=TRUE)
ages <-  unique(wfdata$AGE)
@
% latex code
```

Chunk Options

- chunk options control how sweave/knitr process code and handle results
- of the form:
  - `<<label, option1=foo, option2=bar>>=`
- knitr has many more chunk options than sweave
  - almost too many
  - many overlap with LaTeX
- must be on one line (no line breaks)
- `opts_chunk$set()` can be used to set default value for all subsequent chunks in a document

Common Chunk Options

- `label`
  - first chunk option
  - optional, but highly recommended
- `eval`
  - `TRUE/FALSE` OR numeric vector
  - controls whether code chuck is processed by R interpreter
- `echo`
  - `TRUE/FALSE` OR numeric vector
  - should expression in code chunk appear in rendered document

Common Chunk Options (cont'd)

- `results`
  - one of 'asis', 'hide', 'markup', 'hold'
  - should results of code chunk appear in rendered document
- `include`
  - `TRUE/FALSE`
  - if `include==FALSE` nothing from chunk will be written into document
  - code in chunk is evaluated, not included
  - ideal for figures and analysis code
- `error`, `warning`, `message`
  - `TRUE/FALSE`
  - whether to include or suppress errors, warning or messages in final document

Chunk examples:

Performs an action, no LaTeX returned:

```
<<label=fit_model, include=FALSE>>=
...
@
```

Include LaTeX results from R:

```
<<label=meanTable, results='asis', echo=FALSE>>=
...
@
```

Sexpr{}

- used to insert values inline (mid-sentence)
- cannot contain line breaks
- longer expressions should be defined in preceding chunks

An Example:

```
The value of \pi = \Sexpr{pi}.
```

will render as:

The value of $\pi = 3.1416$.

Tables

- number of packages that render R objects as latex tables
  - xtable (Dahl, 2013)
  - Hmisc (Harrel, 2013)
  - tables (Murdoch, 2013)
- all will render data frames as LaTeX tables
- large number of arguments for flexibility
- support for other R-object differs by package
- admb objects - require custom function to convert to data frame or write latex directly

Tables (cont'd)

Linear Model:

```
<<label=M2, results='asis'>>=
   cap.txt = paste0("Coefficient estimates, standard errors "
                    "and associated p-values for Model 2.")
   xtable(M2, caption = cap.txt, label="tbl:M2")
@
```

Custom Function:

```
%Mortality Summary
<<label=Morttable, results='asis'>>=
Mort.summary(scaa, latex=TRUE)
@
```

Figures

- two different approaches:
  - chunk option `include=TRUE`
  - explicitly create figure in R and figure environment in LaTeX
- handling figures much improved in knitr
  - still too much magic

"Explicit is better than implicit."
– Tim Peters, Zen of Python

Figures - graphicspath

- LaTeX variable \graphicspath{} can be set in the preamble and controls where LaTeX looks for figures
- recommend setting \graphicspath{} in first chunk

graphicspath{}

```
<<label=setup, include=FALSE>>=
library(knitr)
# set global chunk options
fig.path <- 'figures/'
opts_chunk$set(fig.path=fig.path, fig.align='center')
@

\graphicspath{{\Sexpr{fig.path}}}
```

Figures - example chunks

R-chunk

```
<<label=plot_fit, include=FALSE>>=
pdf("LengthAtAge.pdf", height=5, width=5)
plot(wfdata$AGE, wfdata$FLEN, xlab="Age", ylab="Length")
lines(predicted$AGE, predicted$FLEN, col='blue')
dev.off()
@
```

LaTeX

```
\begin{figure}
  \begin{center}
     \includegraphics[width=\textwidth]{LengthAtAge}
  \end{center}
  \caption{Mean size at age ...}
  \label{fig:plot_fit}
\end{figure}
```

Figure and Table Captions

- captions in scientific writing are often verbose
  - numerous embedded values

One way:

```
A <- pi
B <- sqrt(pi)
lake <- 'Lake Huron'
fyear <- 1990
lyear <- 2003

caption <- paste("This is a long figure caption where A = ",
                 round(A,3), " and B = ", round(B,5),
                 " samples where collected from ", lake,
                 " between ", fyear, " and ", lyear, sep="")
```

Figure and Table Captions (cont't)

A another way:

```
A <- pi
B <- sqrt(pi)
lake <- 'Lake Huron'
fyear <- 1990
lyear <- 2003

caption <- "This is a long figure caption where A = %.3f and
           B = %.5f. Samples where collected from %s between
           %i and  %i."

caption <- sprintf(caption, A, B, lake, fyear, lyear)
```

knitr template

- yasnippet template has been provided in workshop configuration
- attempts to provide sensible default styles and options:
  - sets figure directory in both LaTeXand R
  - helper functions
  - running headers and footers
  - cjfas bibliography style
- in emacs create a new `*.rnw` file and type `knitr<TAB>`

Is it worth it?

- depends on:
  - number of reports
  - number of times they need to be recreated or updated
  - report complexity
- personal choice
- definite long-term savings
  - require short term investment

Recap