

Using ESS as R programming environment

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Outline

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 - Prerequisites
- 2 **Working with ESS**
 - First steps
 - Storing R sessions
 - Writing R code
- 3 **ESS in teaching?**
- 4 **Conclusion**

Emacs Speaks Statistics

ESS is an Emacs add-on package, which

- interfaces interactive R (and S, SAS, Stata) sessions to Emacs
- acts as R help browser
- helps writing R files with a special R mode.
- is distributed via CRAN, documentation see [1]

Prerequisites needed

Software to install:

- Emacs (an extensible text editor)

<http://www.gnu.org/software/emacs/>

- ESS

<http://ess.r-project.org/>

- R

<http://cran.r-project.org/>

works on Unix/Linux and Windows (on Windows manual configuration needed), e.g. installing it on Debian/Ubuntu:

```
apt-get install r-base ess emacs
```

Skills:

- knowledge of R syntax
- (at least basic) Emacs skills
- willingness to memorize some keyboard shortcuts

Executing R within Emacs

Type

- `<Alt>x` (this enters the so called Emacs minibuffer commandline)
- followed by `R<Enter>`
- answer question for starting directory (or accept default by just pressing `<Enter>`)
- ... start using R.

Differences to a plain R session

interactive ESS (iESS) mode

- adds syntax coloring
- replaces history mechanism (uses `<Ctrl>-<ArrowUp/Down>`)
- adds `<Tab>` completion¹ for
 - command and variable names
 - named list element names (e.g. columns of dataframes)
- access to help and object list via iESS menu
- help pages appear within Emacs (as new buffers)

¹recent R releases already contain Tab completion

interactive ESS screenshot

The screenshot shows the iESS R environment interface. The main window displays R code and its output. A help menu is overlaid on the right side of the window, listing various commands and their shortcuts.

```

R version 2.6.2 (2008
Copyright (C) 2008 Th
ISBN 3-900051-07-0

R ist freie Software
Sie sind eingeladen,
Tippen Sie 'license()

R ist ein Gemeinshaf
Tippen Sie 'contribut
um zu erfahren, wie R

Tippen Sie 'demo()' f
'help.start()' für ei
Tippen Sie 'q()', um

> if(!exists("baseenv
options(STERM='iESS',
>
> x <- runif(10)
> x
[1] 0.6313364 0.2190
[6] 0.4419986 0.1635
> ls()
[1] "x"
>

```

The help menu lists the following commands and shortcuts:

- What is this? (beta)
- Resynch S completions
- Quit S (C-c C-q)
- Display search list (C-c C-s)
- Display object list (C-c C-x)
- Get help on S object (C-c C-v)
- Enter S command (C-c C-t)
- Attach directory
- Send and move (M-RET)
- Copy command (C-c RET)
- Send command (RET)
- Jump to Error (C-c `)
- Load source file (C-c C-l)
- Edit S Object (C-c C-d)
- Describe (C-h m)
- About
- Send bug report

The status bar at the bottom of the window shows: `-u:*** *R* All (27,2) (iESS [R]: run)---21:14 0.23-----`

Tab Completion screenshot

```

File Edit Options Buffers Tools iESS Complete In/Out Signals Help

Tippen Sie 'contributors()' für mehr Information und 'citation()',
um zu erfahren, wie R oder R packages in Publikationen zitiert werden können.

Tippen Sie 'demo()' für einige Demos, 'help()' für on-line Hilfe, oder
'help.start()' für eine HTML Browserschnittstelle zur Hilfe.
Tippen Sie 'q()', um R zu verlassen.

> if(!exists("baseenv", mode="function")) baseenv <- function() NULL
options(STERM='iESS', editor='emacsclient')
>
> x <- runif(10)
> x
[1] 0.6313364 0.2190514 0.2281211 0.3439662 0.7948196 0.8696724 0.9419038
[8] 0.4419986 0.1635919 0.6614875
> ls()
[1] "x"
> y <- data.frame(coll=c("a","b","c"), col2=c(1,2,3))
> y$col
-u:*** *R* Bot (28,7) (iESS [R]: run)----21:17 0.46-----
Click <mouse-2> on a completion to select it.
In this buffer, type RET to select the completion near point.

Possible completions are:
coll                               col2
-u:%% *Completions* All (1,0) (Completion List)----21:17 0.46-----
Type space to flush; repeat completion command to scroll

```


Session transcripts

ESS can

- save the complete session protocol, with input and output. (Use `*.St` filename)
- reopen and reexecute the `*.St` later step by step
- cleanup mixed input/output to extract the input in copy/paste ready form

Transcript mode Screenshot

```

File Edit Options Buffers Tools ESS-trans Help
What is this? (beta)
Describe (C-h m)
About
Send bug report
Mark cmd group (M-h)
Previous prompt (C-c C-p)
Next prompt (C-c C-n)
Send and move (RET)
Copy command (C-c RET)
Send command (M-RET)
Clean Region
Switch S process (C-c C-s)
R version 2.6.2 (2008
Copyright (C) 2008 Th
ISBN 3-900051-07-0
R ist freie Software
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Tippen Sie 'license()
R ist ein Gemeinshaf
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um zu erfahren, wie R
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'help.start()' für ei
Tippen collSie 'q()',
> if(!exists("baseenv", mode="function")) baseenv <- function() NULL
options(STERM='iESS', editor='emacsclient')
>
> x <- runif(10)
> x
[1] 0.6313364 0.2190514 0.2281211 0.3439662 0.7948196 0.8696724 0.9419038
[8] 0.4419986 0.1635919 0.6614875
> ls()
[1] "x"
> y <- data.frame(coll=c("a","b","c"), col2=c(1,2,3))
> y$coll
[1] a b c
Levels: a b c
> q()
Save workspace image? [y/n/c]: y
Process R finished at Wed Jan 14 21:24:41 2009
-u:%% test.St All (1,0) (ESS Transcript [])---21:26 0.20-----
Wrote /home/alge/Sandbox/stat/agebhard/vortraege/ess-09/ess.tex

```

ESS as R IDE

After opening an `*.R` file Emacs enters ESS Mode:

- adds a custom ESS menu
- activates
 - syntax highlighting
 - automatic indenting (via `<Tab>` key)
 - paren matching
 - object name completion via `<Ctrl><Tab>`
- scans for functions, adds them as shortcuts to menu
- can copy/paste
 - a line
 - a function (containing cursor)
 - a marked region
 - entire file (“buffer” in Emacs terminology)

into an already running iESS R session

ESS mode Screenshots

The top screenshot shows the ESS menu with the following options:

- What is this? (beta)
- Load file (C-c C-l)
- Eval func/para & step (C-c C-c)
- Eval and Go
- ESS Eval
- Motion...
- ESS list...
- ESS Edit
- Start Process
- Switch Process (C-c C-s)
- Describe (C-h m)
- About editing
- Read ESS info
- Send bug report
- Eval buffer (C-c M-b)
- Eval region (C-c M-r)
- Eval function (C-c M-f)
- Eval line (C-c M-j)
- Eval paragraph (C-c M-p)
- Eval chunk
- Eval thread
- About

The bottom screenshot shows the ESS interface with the following code in the editor:

```
myfun <- function(n){
  # some comment
  x <- runif(n)
  # return value
  x
}

f2 <- function(){
  # ...
}
```

The 'Functions' dropdown menu is open, showing 'myfun' and 'f2'.

ESS workflow

When working with R in Emacs via ESS you

- split your Emacs frame into two windows
- edit one (or more) R script file(s) in one window
- have R running in other window
- switch back and forth via ESS menu/buttons/shortcuts while developing/testing/debugging your R functions

The screenshot shows the Emacs ESS environment. The top window is the R script editor, containing the following code:

```
myfun <- function(n){
  # some comment
  x <- runif(n)
  # return value
  x
}
f2 <- function(){
  # ...
}
```

The bottom window is the console, showing the execution of the function and the resulting error message:

```
u: ** test.R Top (6,1) (ESS[S] [R])---21:59 0.26---
> myfun(10)
Fehler: konnte Funktion "myfun" nicht finden
> myfun <- function(n){
+ # some comment
+ x <- runif(n)
+ # return value
+ x
+ }
> myfun(10)
[1] 0.89983238 0.38526582 0.42053472 0.61117391 0.10959451 0.09953263
[7] 0.85749651 0.49220477 0.81034630 0.99692888
>
u: ** *R* Bot (32,17) (iESS [R]: run)---21:59 0.26---
```

ESS in teaching?

Pro:

- ESS provides help via
 - Tab completion!
 - syntax highlighting,
 - paren matching (warns on mismatch)
 - easy R coding via ESS ↔ iESS mode coupling

Con:

- Emacs skills needed (understanding Emacs terminology, e.g. frame/window/buffer)
- Installation on Windows may be challenging (R path has to be manually configured), help available, see [2].

Teaching experiences at Univ. Klagenfurt

R and ESS in statistics courses for math students at Univ. Klagenfurt

- mathematics students get an Emacs introduction (also for use with LaTeX and octave)
- together with an R/ESS basic course during the course “mathematical software”
- R and ESS is used in later statistics courses, ESS use is not obligatory for the students → advanced students partly start really using it.

Conclusion

- powerful tool for R programmers (maybe they are already Emacs users for other reasons (LaTeX, C/Fortran code, ...))
- certainly too complicated for introductory stats course
- worth to be presented to students in higher courses

Links



**[1] Rossini, A. J., Heiberger, R. M., Hornik, K.,
Maechler, M., Sparapani, R. A. and Eglen, S. J.**

ESS - Emacs Speaks Statistics - Manual

<http://ess.r-project.org/ess.pdf>



[2] Vincent Goulet:

Emacs for Windows Modified

[http://vgoulet.act.ulaval.ca/en/ressources/
emacs/windows](http://vgoulet.act.ulaval.ca/en/ressources/emacs/windows)