



# Getting Started in R~Stata

## Notes on Exploring Data

(v. 1.0)

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 <http://dss.princeton.edu/training/>

# What is R/Stata?

## What is R?

- “R is a language and environment for statistical computing and graphics”\*
- R is offered as open source (i.e. free)

## What is Stata?

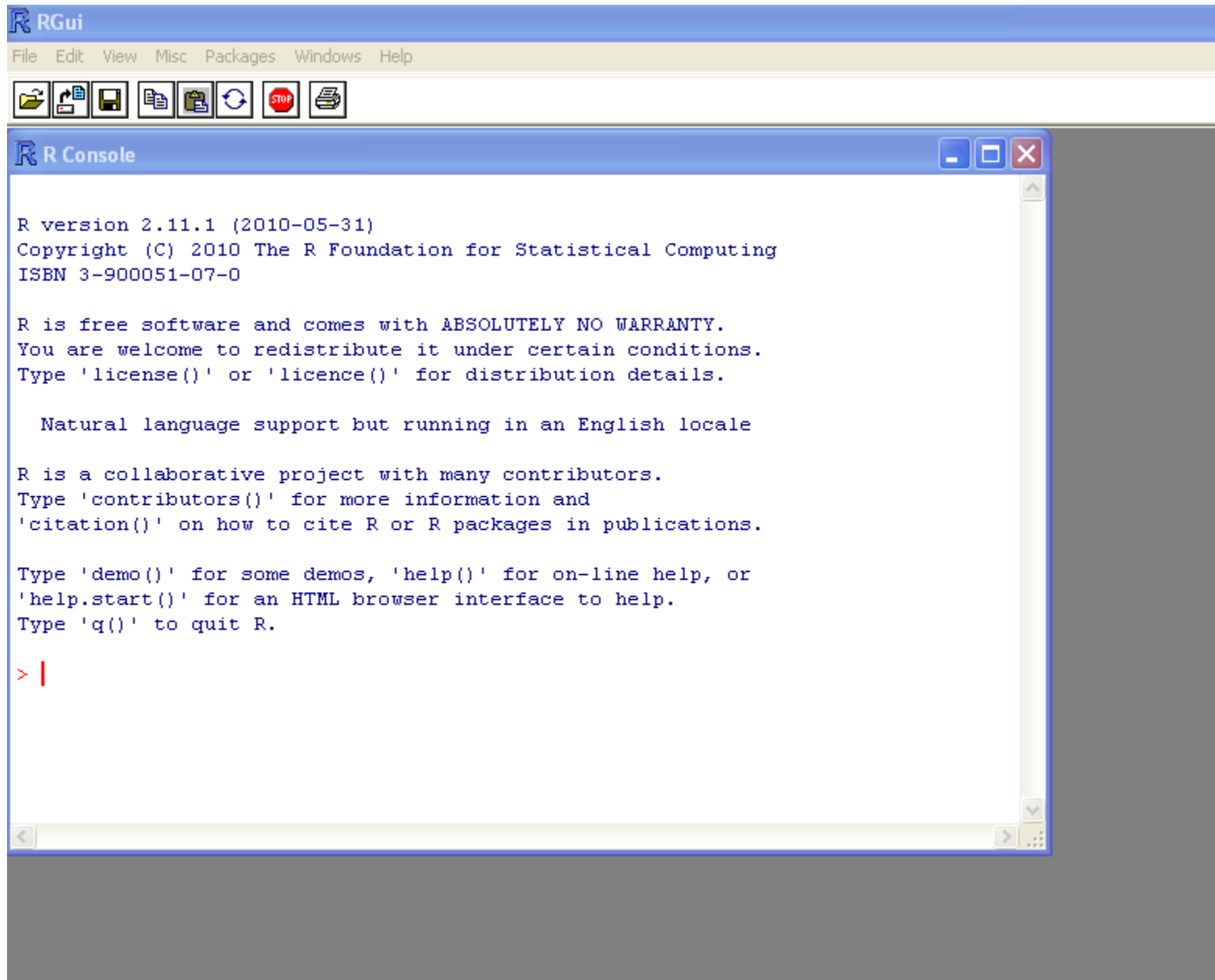
- It is a multi-purpose statistical package to help you explore, summarize and analyze datasets.
- A dataset is a collection of several pieces of information called variables (usually arranged by columns). A variable can have one or several values (information for one or several cases).
- Other statistical packages are SPSS and SAS.

| Features          | Stata  | SPSS  | SAS                        | R                  |
|-------------------|--|---|----------------------------|--------------------|
| Learning curve    | Steep/gradual  | Gradual/flat  | Pretty steep               | Pretty steep       |
| User interface    | Programming/point-and-click                              | Mostly point-and-click  | Programming                | Programming        |
| Data manipulation | Very strong  | Moderate  | Very strong                | Very strong        |
| Data analysis     | Powerful   | Powerful  | Powerful/versatile         | Powerful/versatile |
| Graphics          | Very good  | Very good   | Good                       | Excellent          |
| Cost              | Affordable (perpetual licenses, renew only when upgrade) | Expensive (but not need to renew until upgrade, long term licenses) | Expensive (yearly renewal) | Open source        |

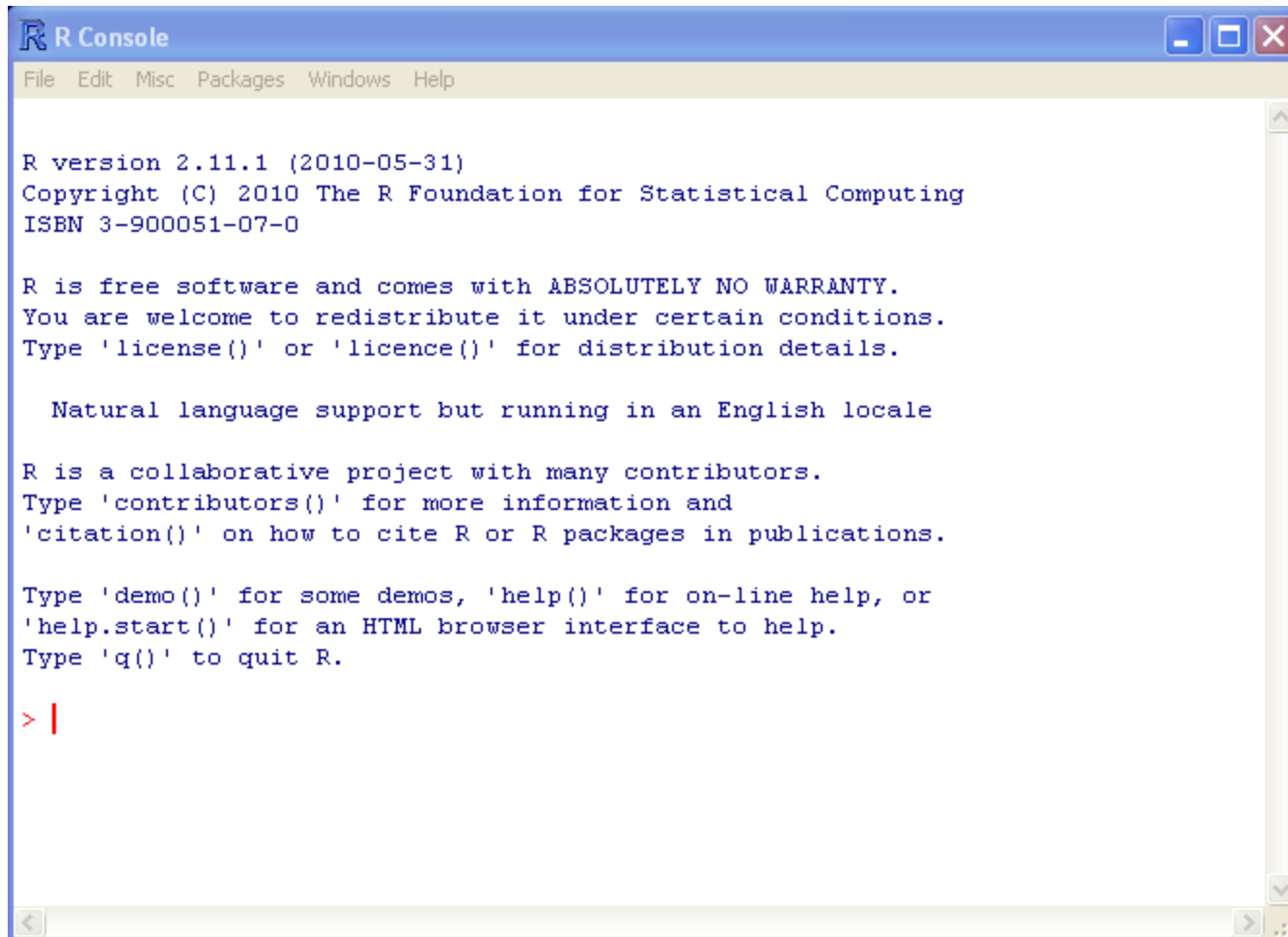
NOTE: The R content presented in this document is mostly based on an early version of Fox, J. and Weisberg, S. (2011) *An R Companion to Applied Regression*, Second Edition, Sage; and from class notes from the ICPSR's workshop *Introduction to the R Statistical Computing Environment* taught by John Fox during the summer of 2010.

\* <http://www.r-project.org/index.html>

# This is the R screen in Multiple-Document Interface (MDI)...



This is the R screen in Single-Document Interface (SDI)...



The image shows a screenshot of the R Console window. The window has a blue title bar with the R logo and the text "R Console". Below the title bar is a menu bar with the following options: File, Edit, Misc, Packages, Windows, and Help. The main area of the window is white and contains the following text:

```
R version 2.11.1 (2010-05-31)
Copyright (C) 2010 The R Foundation for Statistical Computing
ISBN 3-900051-07-0

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

    Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> |
```

The text is displayed in a monospaced font. The prompt character ">" is red, and the cursor is a vertical red line. The window has a standard Windows-style scrollbar on the right side.

# Stata 12/13+ screen

Variables in dataset here



Stata/SE 13.1 - [Results]

File Edit Data Graphics Statistics User Window Help

Review

# Command \_rc

1 cd H:  
2 log using mywork.log  
3 import excel "http://dss.pri...  
4 summarize

Notes:

1. (/v# option or -set maxvar-) 5000 maximum variables

. cd H:  
H:\

. log using mywork.log

name: <unnamed>  
log: H:\mywork.log  
log type: text  
opened on: 14 Apr 2014, 15:28:47

. import excel "http://dss.princeton.edu/training/mydata.xls", sheet("Sheet1") firstrow clear

. summarize

| Variable     | Obs  | Mean      | Std. Dev. | Min      | Max      |
|--------------|------|-----------|-----------|----------|----------|
| Year         | 0    |           |           |          |          |
| CountryName  | 0    |           |           |          |          |
| GDPperca~200 | 4542 | 9482.967  | 11285.24  | 101.5976 | 76319.47 |
| Unemployme~e | 4521 | .0478866  | .0724682  | 0        | .686     |
| Unemployme~b | 4521 | .0366029  | .0544155  | 0        | .546     |
| Unemployme~l | 4521 | .0425112  | .0601523  | 0        | .595     |
| Exportsofg~o | 3661 | 6.49e+10  | 1.64e+11  | 4.50e+07 | 1.78e+12 |
| Importsofg~o | 3661 | 6.43e+10  | 1.74e+11  | 9.42e+07 | 2.20e+12 |
| polityorig~l | 4542 | -.2573756 | 16.28321  | -88      | 10       |
| polity2adj~d | 4498 | 2.409738  | 7.03114   | -10      | 10       |

Output here

History of commands, this window

Variables

| Variable         | Label                     |
|------------------|---------------------------|
| Year             | Year                      |
| CountryName      | Country Name              |
| GDPpercapit...   | GDP per capita, PPP (c... |
| Unemploym...     | Unemployment, femal...    |
| Unemploym...     | Unemployment, male ...    |
| Unemploym...     | Unemployment, total (...) |
| Exportsofgo...   | Exports of goods and s... |
| Importsofgo...   | Imports of goods and ...  |
| polityoriginal   | polity (original)         |
| polity2adjust... | polity2 (adjusted)        |

Properties

Variables

| Name        | Year   |
|-------------|--------|
| Label       | Year   |
| Type        | str109 |
| Format      | %109s  |
| Value Label |        |
| Notes       |        |

Data

Filename

Label

Notes

Variables 10

Observations 4,546

Size 812.42K

Memory 32M

Sorted by

Property of each variable here

Files will be saved here

Write commands here

Command

H:\

CAP NUM OVR

PU/DSS/OTR

| R   | Stata  |
|---|--|
| Working directory   |  |
| <pre>getwd()    # Shows the working directory (wd) setwd("C:/myfolder/data")  # Changes the wd setwd("H:\\myfolder\\data") # Changes the wd</pre>   | <pre>pwd    /*Shows the working directory*/ cd c:\myfolder\data    /*Changes the wd*/ cd "c:\myfolder\stata data" /*Notice the spaces*/</pre>  |
| Installing packages/user-written programs   |  |
| <pre>install.packages("ABC")    # This will install the package --ABC--. A window will pop-up, select a mirror site to download from (the closest to where you are) and click ok.  library(ABC)    # Load the package --ABC-- to your workspace in R</pre>  | <pre>ssc install abc    /*Will install the user-defined program 'abc'. It will be ready to run.  findit abc    /*Will do an online search for program 'abc' or programs that include 'abc'. It also searcher your computer.</pre>                      |
| Getting help  |  |
| <pre>?plot # Get help for an object, in this case for the --plot- function. You can also type: help(plot)  ??regression # Search the help pages for anything that has the word "regression". You can also type: help.search("regression")  apropos("age")    # Search the word "age" in the objects available in the current R session.  help(package=car)    # View documentation in package 'car'. You can also type: library(help="car")  help(DataABC)    # Access codebook for a dataset called 'DataABC' in the package ABC</pre> | <pre>help tab    /* Get help on the command 'tab'*/  search regression    /* Search the keywords for the word 'regression'*/  hsearch regression    /* Search the help files for the work 'regression'. It provides more options than 'search'*/</pre> |

| R  | Stata   |
|--|---|
| Data from *.csv (copy-and-paste)   |   |
| <pre># Select the table from the excel file, copy, go to the R Console and type:  mydata &lt;- read.table("clipboard", header=TRUE,   sep="\t")</pre>  | <pre>/* Select the table from the excel file, copy, go to Stata, in the command line type:  edit  /*The data editor will pop-up and paste the data (Ctrl-V). Select the link for to include variable names</pre>          |
| Data from *.csv  |   |
| <pre># Reading the data directly  mydata &lt;- read.csv("c:\mydata\mydatafile.csv",   header=TRUE)  # The will open a window to search for the *.csv file.  mydata &lt;- read.csv(file.choose(), header = TRUE)</pre>  | <pre>/* In the command line type */  insheet using "c:\mydata\mydatafile.csv"  /* Using the menu */  Go to File-&gt;Import-&gt;"ASCII data created by spreadsheet". Click on 'Browse' to find the file and then OK.</pre> |
| Data from/to *.txt (space , tab, comma-separated)  |   |
| <pre># In the example above, variables have spaces and missing data is coded as '-9'  mydata &lt;- read.table(("C:/myfolder/abc.txt", header=TRUE, sep="\t", na.strings = "-9")  # Export the data  write.table(mydata, file = "test.txt", sep = "\t")</pre> | <pre>/* See insheet above */  infile var1 var2 <b>str7</b> var3 using abc.raw  /* Variables with embedded spaces must be enclosed in quotes */ # Export data  outsheet using "c:\mydata\abc.csv"</pre>                    |

**R****Stata****Data from/to SPSS**

```
library(foreign) # Load package --foreign--

mydata.spss <-
read.spss("http://dss.princeton.edu/training/mydata.sav",
          to.data.frame = TRUE,
          use.value.labels=TRUE,
          use.missings = TRUE)

# Where:
#
# 'to.data.frame' return a data frame.
#
# 'use.value.labels' Convert variables with value
labels into R factors with those levels.
#
# 'use.missings' logical: should information on
user-defined missing values be used to set the
corresponding values to NA.
Source: type ?read.spss

-----

write.foreign(mydata, codefile="test2.sps",
datafile="test2.raw", package="SPSS")

# Provides a syntax file (*.sps) to read the *.raw
data file
```

```
/* Need to install the program 'usespss' (you do
this only once) */

ssc install usespss

/* To read the *.sav type (in one line):

usespss using
http://dss.princeton.edu/training/mydata.sav

/* For additional information type */

help usespss

Note: This does not work with SPSS portable files
(*.por)

-----

/* Stata does not convert files to SPSS. You need
to save the data file as a Stata file version 9
that can be read by SPSS v15.0 or later*/

/* From Stata type: */

saveold mydata.dta /* Saves data to v.9 for SPSS
```



| R  | Stata   |
|--|---|
| Data from/to SAS   |   |
| <pre># To read SAS XPORT format (*.xpt)  library(foreign) # Load package --foreign--  mydata.sas &lt;- read.xport("http://dss.princeton.edu/training/mydata.xpt") # Does not work for files online  mydata.sas &lt;- read.xport("c:/myfolder/mydata.xpt")  # Using package --Hmisc--  library(Hmisc) mydata &lt;- sasxport.get(http://dss.princeton.edu/training/mydata.xpt) # It works  -----  write.foreign(mydata, codefile="test2.sas", datafile="test2.raw", package="SAS")  # Provide a syntax file (*.sas) to read the *.raw data</pre> | <pre>/*If you have a file in SAS XPORT format (*.xpt) you can use 'fdause' (or go to File-&gt;Import). */  fdause "c:/myfolder/mydata.xpt"  /* Type help fdause for more details */  /* If you have SAS installed in your computer you can use the program 'usesas', which you can install by typing: */  ssc install usesas  /* To read the *.sas7bcat type (in one line): */  usesas using "c:\mydata.sas7bdat"  -----  /* You can export a dataset as SAS XPORT by menu (go to File-&gt;Export) or by typing */  fdasave "c:/myfolder/mydata1.xpt"  /* Type help fdasave for more details */</pre> |
| <p><b>NOTE:</b> As an alternative, you can use SAS Universal Viewer (freeware from SAS) to read SAS files and save them as *.csv. Saving the file as *.csv removes variable/value labels, make sure you have the codebook available.</p>   |   |

| R   | Stata   |
|---|---|
| Data from/to Stata  |   |
| <pre> library(foreign) # Load package --foreign--  mydata &lt;- read.dta("http://dss.princeton.edu/training/students.dta")  mydata.dta &lt;- read.dta("http://dss.princeton.edu/training/mydata.dta",         convert.factors=TRUE,         convert.dates=TRUE,         convert.underscore=TRUE,         warn.missing.labels=TRUE)  # Where (source: type ?read.dta) # convert.dates. Convert Stata dates to Date class # convert.factors. Use Stata value labels to create factors? (version 6.0 or later). # convert.underscore. Convert "_" in Stata variable names to "." in R names? # warn.missing.labels. Warn if a variable is specified with value labels and those value labels are not present in the file. ----- write.dta(mydata, file = "test.dta") # Direct export to Stata  write.foreign(mydata, codefile="test1.do", datafile="test1.raw", package="Stata") # Provide a do-file to read the *.raw data </pre> | <pre> /* To open a Stata file go to File -&gt; Open, or type: */  use "c:\myfolder\mydata.dta"  Or  use "http://dss.princeton.edu/training/mydata.dta"  /* If you need to load a subset of a Stata data file type */  use var1 var2 using "c:\myfolder\mydata.dta"  use id city state gender using "H:\Work\Marshall\Fall10\Session1-2\Stata\Students.dta", clear  -----  /* To save a dataset as Stata file got File -&gt; Save As, or type: */  save mydata, replace /*If the first time*/  save, replace /*If already saved as Stata file*/ </pre> |

| R   | Stata  |
|---|--|
| Data from/to R  |  |
| <pre>load("mydata.RData") load("mydata.rda")  /* Add path to data if necessary */  -----  save.image("mywork.RData") # Saving all objects                            to file *.RData  save(object1, object2, file="mywork.rda") # Saving selected objects</pre> | <pre>/* Stata can't read R data files */</pre> |
|   |  |

## Data from ACII Record form

```
mydata.dat <-
read.fwf(file="http://dss.princeton.edu/training/m
ydata.dat",
         width=c(7, -16, 2, 2, -4, 2, -10, 2, -110,
3, -6, 2),
         col.names=c("w", "y", "x1", "x2", "x3", "age",
"sex"),
         n=1090)
```

# Reading ASCII record form, numbers represent the width of variables, negative sign excludes variables not wanted (you must include these).

# To get the width of the variables you must have a codebook for the data set available (see an example below).

# To get the widths for unwanted spaces use the formula:

Start of var(t+1) - End of var(t) - 1

\*Thank you to Scott Kostyshak for useful advice/code.

```
/* Using infix */
```

```
infix var1 1-7 var2 24-25 str2 var3 26-27 var4 32-
33 str2 var5 44-45 var6 156-158 var7 165-166 using
"http://dss.princeton.edu/trainingmydata.dat"
```

```
-----
/* Using infile */
```

```
dictionary using c:\data\mydata.dat {
    _column(1)      var1      %7.2f      " Label for var1 "
    _column(24)     var2      %2f        " Label for var2 "
    _column(26)     str2 var3  %2s        " Label for var3 "
    _column(32)     var4      %2f        " Label for var4 "
    _column(44)     str2 var5  %2s        " Label for var5 "
    _column(156)    str3 var5  %3s        " Label for var6 "
    _column(165)    str2 var5  %2s        " Label for var7 "
}
```

/\*Do not forget to close the brackets and press enter after the last bracket\*/

Save it as mydata.dct

With infile we run the dictionary by typing:

```
infile using c:\data\mydata
```

For other options check  
<http://dss.princeton.edu/training/DataPrep101.pdf>

## Data locations usually available in codebooks

| Var  | Rec | Start | End | Format |
|------|-----|-------|-----|--------|
| var1 | 1   | 1     | 7   | F7.2   |
| var2 | 1   | 24    | 25  | F2.0   |
| var3 | 1   | 26    | 27  | A2     |
| var4 | 1   | 32    | 33  | F2.0   |
| var5 | 1   | 44    | 45  | A2     |
| var6 | 1   | 156   | 158 | A3     |
| var7 | 1   | 165   | 166 | A2     |

## Exploring data

```
str(mydata)      # Provides the structure of the
                  dataset
summary(mydata)  # Provides basic descriptive
                  statistics and frequencies
names(mydata)    # Lists variables in the dataset
head(mydata)     # First 6 rows of dataset
head(mydata, n=10) # First 10 rows of dataset
head(mydata, n= -10) # All rows but the last 10
tail(mydata)     # Last 6 rows
tail(mydata, n=10)  # Last 10 rows
tail(mydata, n= -10) # All rows but the first 10
mydata[1:10, ]    # First 10 rows of the
mydata[1:10,1:3] # First 10 rows of data of the
                  first 3 variables
edit(mydata)     # Open data editor
```

```
describe      /* Provides the structure of the
               dataset*/
summarize     /* Provides basic descriptive
               statistics for numeric data*/
ds            /* Lists variables in the dataset */
list in 1/6   /* First 6 rows */
edit          /* Open data editor (double-click to
               edit*/
browse       /* Browse data */
```

## Missing data

```
sum(is.na(mydata)) # Number of missing in dataset
rowSums(is.na(data)) # Number of missing per
variable
rowMeans(is.na(data))*length(data) # No. of missing
per row
mydata[mydata$age=="& ", "age"] <- NA # NOTE:
Notice hidden spaces.
mydata[mydata$age=="999", "age"] <- NA
The function complete.cases() returns a logical vector
indicating which cases are complete.
# list rows of data that have missing values
mydata[!complete.cases(mydata),]
The function na.omit() returns the object with listwise
deletion of missing values.
# create new dataset without missing data
newdata <- na.omit(mydata)
```

```
tabmiss      /* # of missing. Need to install, type
               scc install tabmiss. Also try findit
               tabmiss and follow instructions */

/* For missing values per observation see the
function 'rowmiss' and the 'egen'
command*/
```

| R  | Stata   |
|--|---|
| Renaming variables   |   |
| <pre> #With reference number as.matrix(colnames(mydata)) names(mydata)[7] &lt;- "new_name"  #Multiple names(mydata)[c(7,8)] &lt;- c("new_name1", "new_name2")  #Without reference numbers names(mydata)[names(mydata) == "old_name"] &lt;- "new_name"  #Using the -plyr- package library(plyr) mydata &lt;- rename(mydata, c("old_name"="new_name"))  #Multiple mydata &lt;- rename(mydata, c("old_name1"="new_name1",                            "old_name2"="new_name2")) </pre> | <pre> edit    /* Open data editor (double-click to edit)  rename oldname newname  rename lastname last rename firstname first rename studentstatus status rename averagescoregrade score rename heightin height rename newspaperreadershiptimeswk read </pre> |
| Variable labels  |   |
| <pre> Use variable names as variable labels </pre>   | <pre> /* Adding labels to variables */  label variable w "Weight" label variable y "Output" label variable x1 "Predictor 1" label variable x2 "Predictor 2" label variable x3 "Predictor 3" label variable age "Age" label variable sex "Gender" </pre>       |

## Value labels

## # Use factor() for nominal data

```
mydata$sex <- factor(mydata$sex, levels = c(1,2),
  labels = c("male", "female"))
```

## # Use ordered() for ordinal data

```
mydata$var2 <- ordered(mydata$var2, levels =
  c(1,2,3,4), labels = c("Strongly agree",
  "Somewhat agree", "Somewhat disagree",
  "Strongly disagree"))
```

```
mydata$var8 <- ordered(mydata$var2, levels =
  c(1,2,3,4), labels = c("Strongly agree",
  "Somewhat agree", "Somewhat disagree",
  "Strongly disagree"))      # Making a copy
of the same variable
```

## /\* Step 1 defining labels \*/

```
label define approve 1 "Approve strongly" 2
  "Approve somewhat" 3 "Disapprove somewhat" 4
  "Disapprove strongly" 5 "Not sure" 6 "Refused"
```

```
label define well 1 "Very well" 2 "Fairly well" 3
  "Fairly badly" 4 "Very badly" 5 "Not sure" 6
  "Refused"
```

```
label define partyid 1 "Party A" 2 "Party B" 3
  "Equally party A/B" 4 "Third party candidates" 5
  "Not sure" 6 "Refused"
```

```
label define gender 1 "Male" 2 "Female"
```

## /\* Step 2 applying labels \*/

```
label values y approve
label values x1 approve
tab x1
d x1
destring x1, replace
label values x1 approve
label values x2 well
label values x3 partyid
tab x3
destring x3, replace ignore(&)
label values x3 partyid
tab x3
label values sex gender
```

```
tab1 y x1 x2 x3 age sex
```

## Creating ids/sequence of numbers

**# Creating a variable with a sequence of numbers or to index**

```
# Creating a variable with a sequence of numbers
from 1 to n (where 'n' is the total number of
observations)
```

```
mydata$id <- seq(dim(mydata)[1])
```

```
# Creating a variable with the total number of
observations
```

```
mydata$total <- dim(mydata)[1]
```

```
/* Creating a variable with a sequence of numbers
from 1 to n per category (where 'n' is the total
number of observations in each category) (1) */
```

```
mydata <- mydata[order(mydata$group),]
idgroup <- tapply(mydata$group, mydata$group,
  function(x) seq(1,length(x),1))
mydata$idgroup <- unlist(idgroup)
```

(1) Thanks to Alex Acs for the code

**/\* Creating a variable with a sequence of numbers or to index \*/**

```
/* Creating a variable with a sequence of numbers
from 1 to n (where 'n' is the total number of
observations) */
```

```
gen id = _n
```

```
/* Creating a variable with the total number of
observations */
```

```
gen total = _N
```

```
/* Creating a variable with a sequence of numbers
from 1 to n per category (where 'n' is the total
number of observations in each category) */
```

```
bysort group: gen id = _n
```

For more info see:

<http://www.stata.com/help.cgi?n>

<http://dss.princeton.edu/training/StataTutorial.pdf>



| R   | Stata   |
|---|---|
| Recoding variables  |   |
| <pre>library(car) mydata\$Age.rec &lt;- recode(mydata\$Age,                         "18:19='18to19';                         20:29='20to29';                         30:39='30to39'")  mydata\$Age.rec &lt;- as.factor(mydata\$Age.rec)</pre>   | <pre>recode age (18 19 = 1 "18 to 19") ///           (20/28 = 2 "20 to 29") ///           (30/39 = 3 "30 to 39") (else=.),           generate(agegroups) label(agegroups)</pre>   |
| Dropping variables  |   |
| <pre>mydata\$Age.rec &lt;- NULL mydata\$var1 &lt;- mydata\$var2 &lt;- NULL</pre>  | <pre>drop var1 drop var1-var10</pre>  |
| Keeping track of your work  |   |
| <pre># Save the commands used during the session  savehistory(file="mylog.Rhistory")  # Load the commands used in a previous session  loadhistory(file="mylog.Rhistory")  # Display the last 25 commands  history()  # You can read mylog.Rhistory with any word   processor. Notice that the file has to have the   extension *.Rhistory</pre> | <pre>/* A log file helps you save commands and output to a text file (*.log) or to a Stata read-only file (*.smcl). The best way is to save it as a text file (*.log)*/  log using mylog.log /*Start the log*/ log close           /*Close the log*/ log using mylog.log, append /*Add to an existing                            log*/ log using mylog.log, replace /*Replace an                            existing log*/  /*You can read mylog.log using any word processor*/</pre> |

## Categorical data: Frequencies/Crosstabs

```

table(mydata$Gender)
table(mydata$Read)
readgender <- table(mydata$Read,mydata$Gender)
prop.table(readgender,1)    # Row proportions
prop.table(readgender,2)    # Col proportions
prop.table(readgender)      # Tot proportions
chisq.test(readgender)      # Do chisq test Ho: no
                             relationship
fisher.test(readgender)     # Do fisher's exact test
                             Ho: no relationship
round(prop.table(readgender,2), 2)  # Round col
                             prop to 2 digits
round(prop.table(readgender,2), 2)  # Round col
                             prop to 2 digits
round(100* prop.table(readgender,2), 2)  # Round
                             col % to 2 digits
round(100* prop.table(readgender,2))  # Round col
                             % to whole numbers
addmargins(readgender)      # Adding row/col margins

#install.packages("vcd")
library(vcd)
assocstats(majorgender)

# NOTE: Chi-sqr = sum (obs-exp)^2/exp
Degrees of freedom for Chi-sqr are (r-1)*(c-1)

# NOTE: Chi-sqr contribution = (obs-exp)^2/exp

# Cramer's V = sqrt(Chi-sqr/N*min)
Where N is sample size and min is a the minimum of
(r-1) or (c-1)

```

```

tab gender    /*Frequencies*/
tab read

tab read gender, col row    /*Crosstabs*/

tab read gender, col row chi2 V

/*Crosstabs where chi2 (The null hypothesis (Ho)
is that there is no relationship) and V (measure
of association goes from 0 to 1)*/

bysort studentstatus: tab read gender, column row

```

| R  | Stata   |
|--|---|
| Categorical data: Frequencies/Crosstabs  |   |
| <pre>install.packages("gmodels") library(gmodels) mydata\$ones &lt;- 1 # Create a new variable of ones  CrossTable(mydata\$Major,digits=2)  CrossTable(mydata\$Major,mydata\$ones, digits=2)  CrossTable(mydata\$Gender,mydata\$ones, digits=2)  CrossTable(mydata\$Major,mydata\$Gender,digits=2, expected=TRUE,dnn=c("Major","Gender"))  CrossTable(mydata\$Major,mydata\$Gender,digits=2, dnn=c("Major","Gender"))  chisq.test(mydata\$Major,mydata\$Gender) # Null hipothesis: no association  # 3-way crosstabs  test &lt;- xtabs(~Read+Major+Gender, data=mydata)  #install.packages("vcd") library(vcd) assocstats(majorgender)</pre> | <pre>tab gender /*Frequencies*/ tab major  tab major gender, col row /*Crosstabs*/  tab major gender, col row chi2 V  /*Crosstabs which chi2 (The null hypothesis (Ho) is that there is no relationship) and V (measure of association goes from 0 to 1)*/  bysort studentstatus: tab gender major, colum row</pre> |

## Descriptive Statistics

```
install.packages("pastecs")

library(pastecs)

stat.desc(mydata)

stat.desc(mydata[,c("Age", "SAT", "Score", "Height",
"Read")])

stat.desc(mydata[,c("Age", "SAT", "Score")],
basic=TRUE, desc=TRUE, norm=TRUE, p=0.95)
stat.desc(mydata[10:14], basic=TRUE, desc=TRUE,
norm=TRUE, p=0.95)
-----
# Selecting the first 30 observations and first 14
variables

mydata2 <- mydata2[1:30,1:14]

# Selection using the --subset--

mydata3 <- subset(mydata2, Age >= 20 & Age <= 30)

mydata4 <- subset(mydata2, Age >= 20 & Age <= 30,
select=c(ID, First, Last, Age))

mydata5 <- subset(mydata2, Gender=="Female" &
Status=="Graduate" & Age >= 30)

mydata6 <- subset(mydata2, Gender=="Female" &
Status=="Graduate" & Age == 30)
```

```
summarize /*N, mean, sd, min, max*/

summarize, detail /*N, mean, sd, min, max,
variance, skewness, kurtosis,
percentiles*/

summarize age, detail

summarize sat, detail
-----
tabstat age sat score heightin read /*Gives the
mean only*/

tabstat age sat score heightin read,
statistics(n, mean, median, sd, var,
min, max)

tabstat age sat score heightin read, by(gender)

tabstat age sat score heightin read,
statistics(mean, median) by(gender)

/*Type help tabstat for a list of all statistics*/
-----
table gender, contents(freq mean age mean score)

tab gender major, sum(sat) /*Categorical and
continuous*/

bysort studentstatus: tab gender major, sum(sat)
```

## Descriptive Statistics

```

mean(mydata) # Mean of all numeric variables, same
using --sapply--('s' for simplify)
mean(mydata$SAT)
with(mydata, mean(SAT))
median(mydata$SAT)

table(mydata$Country) # Mode by frequencies ->
max(table(mydata$Country)) / names(sort(-
table(mydata$Country)))[1]

var(mydata$SAT) # Variance
sd(mydata$SAT) # Standard deviation
max(mydata$SAT) # Max value
min(mydata$SAT) # Min value
range(mydata$SAT) # Range
quantile(mydata$SAT)
quantile(mydata$SAT, c(.3,.6,.9))
fivenum(mydata$SAT) # Boxplot elements. From
  help: "Returns Tukey's five number summary
  (minimum, lower-hinge, median, upper-hinge,
  maximum) for the input data ~ boxplot"
length(mydata$SAT) # Num of observations when a
  variable is specify
length(mydata) # Number of variables when a
  dataset is specify
which.max(mydata$SAT) # From help: "Determines the
  location, i.e., index of the (first) minimum or
  maximum of a numeric vector"
which.min(mydata$SAT) # From help: "Determines the
  location, i.e., index of the (first) minimum or
  maximum of a numeric vector"
stderr <- function(x) sqrt(var(x)/length(x))
incster <- tapply(incomes, statef, stderr)

```

```

summarize /*N, mean, sd, min, max*/
summarize, detail /*N, mean, sd, min, max,
  variance, skewness, kurtosis,
  percentiles*/
summarize age, detail
summarize sat, detail
tabstat age sat score heightin read /*Gives the
  mean only*/
tabstat age sat score heightin read,
  statistics(n, mean, median, sd, var,
  min, max)
/*Type help tabstat for a list of all statistics*/

tabstat age sat score heightin read, by(gender)
tabstat age sat score heightin read,
  statistics(mean, median) by(gender)

table gender, contents(freq mean age mean score)

tab gender major, sum(sat) /*Categorical and
  continuous*/

bysort studentstatus: tab gender major, sum(sat)

```

## Descriptive Statistics

```
# Descriptive statistics by groups using --tapply--
mean <- tapply(mydata$SAT,mydata$Gender, mean)
# Add na.rm=TRUE to remove missing values in the
estimation
sd <- tapply(mydata$SAT,mydata$Gender, sd)
median <- tapply(mydata$SAT,mydata$Gender, median)
max <- tapply(mydata$SAT,mydata$Gender, max)
cbind(mean, median, sd, max)
round(cbind(mean, median, sd, max),digits=1)
t1 <- round(cbind(mean, median, sd, max),digits=1)
t1

# Descriptive statistics by groups using --
  aggregate--

aggregate(mydata[c("Age","SAT")],by=list(sex=mydata
a$Gender), mean, na.rm=TRUE)
aggregate(mydata[c("Age","SAT")],mydata["Gender"],
mean, na.rm=TRUE)
aggregate(mydata,by=list(sex=mydata$Gender), mean,
na.rm=TRUE)
aggregate(mydata,by=list(sex=mydata$Gender,
major=mydata$Major,
status=mydata$Status), mean,
na.rm=TRUE)
aggregate(mydata$SAT,by=list(sex=mydata$Gender,
major=mydata$Major,
status=mydata$Status), mean,
na.rm=TRUE)
aggregate(mydata[c("SAT")],by=list(sex=mydata$Gend
er, major=mydata$Major,
status=mydata$Status), mean,
na.rm=TRUE)
```

```
summarize /*N, mean, sd, min, max*/
summarize, detail /*N, mean, sd, min, max,
variance, skewness, kurtosis,
percentiles*/
summarize age, detail
summarize sat, detail
tabstat age sat score heightin read /*Gives the
mean only*/
tabstat age sat score heightin read,
statistics(n, mean, median, sd, var,
min, max)
/*Type help tabstat for a list of all statistics*/

tabstat age sat score heightin read, by(gender)
tabstat age sat score heightin read,
statistics(mean, median) by(gender)

table gender, contents(freq mean age mean score)

tab gender major, sum(sat) /*Categorical and
continuous*/

bysort studentstatus: tab gender major, sum(sat)
```

## Histograms

```

library(car)
head(Prestige)
hist(Prestige$income)
hist(Prestige$income, col="green")
with(Prestige, hist(income)) # Histogram of income
                                with a nicer title.
with(Prestige, hist(income, breaks="FD",
  col="green")) # Applying Freedman/Diaconis rule
p.120 ("Algorithm that chooses bin widths and
locations automatically, based on the sample
size and the spread of the data"
http://www.mathworks.com/help/toolbox/stats/bqucg6n.html)
box()
hist(Prestige$income, breaks="FD")
# Conditional histograms
par(mfrow=c(1, 2))
hist(mydata$SAT[mydata$Gender=="Female"],
      breaks="FD", main="Female",
      xlab="SAT", col="green")
hist(mydata$SAT[mydata$Gender=="Male"],
      breaks="FD", main="Male",
      xlab="SAT", col="green")
# Braces indicate a compound command allowing
# several commands with 'with'
# command
par(mfrow=c(1, 1))
with(Prestige, {
  hist(income, breaks="FD",
    freq=FALSE, col="green")
  lines(density(income), lwd=2)
  lines(density(income,
    adjust=0.5), lwd=1)
  rug(income)
})

```

```

hist sat
hist sat, normal
hist sat, by(gender)

```

**R****Stata**

## Histograms

```
# Histograms overlaid
```

```
hist(mydata$SAT, breaks="FD", col="green")  
hist(mydata$SAT[mydata$Gender=="Male"],  
      breaks="FD", col="gray",  
      add=TRUE)  
legend("topright", c("Female", "Male"),  
      fill=c("green", "gray"))
```

```
hist sat  
hist sat, normal  
hist sat, by(gender)
```



## Scatterplots

# Scatterplots. Useful to 1) study the mean and variance functions in the regression of y on x p.128; 2) to identify outliers and leverage points.

# plot(x,y)

```
plot(mydata$SAT) # Index plot
plot(mydata$Age, mydata$SAT)
plot(mydata$Age, mydata$SAT, main="Age/SAT",
      xlab="Age", ylab="SAT", col="red")
abline(lm(mydata$SAT~mydata$Age), col="blue")
      # regression line (y~x)
lines(lowess(mydata$Age, mydata$SAT), col="green")
      # lowess line (x,y)
identify(mydata$Age, mydata$SAT,
         row.names(mydata))
```

# On row.names to identify. "All data frames have a row names attribute, a character vector of length the number of rows with no duplicates nor missing values." (source link below).  
 # "Use attr(x, "row.names") if you need an integer value." <http://stat.ethz.ch/R-manual/R-devel/library/base/html/row.names.html>

```
mydata$Names <- paste(mydata$Last, mydata$First)
row.names(mydata) <- mydata$Names
plot(mydata$SAT, mydata$Age)
identify(mydata$SAT, mydata$Age,
         row.names(mydata))
```

twoway scatter y x

twoway scatter sat age, title("Figure 1. SAT/Age")

twoway scatter sat age, mlabel(last)

twoway scatter sat age, mlabel(last) || lfit sat age

twoway scatter sat age, mlabel(last) || lfit sat age  
 || lowess sat age /\* locally weighted  
 scatterplot smoothing \*/

twoway scatter sat age, mlabel(last) || lfit sat age,  
 yline(1800) xline(30)

twoway scatter sat age, mlabel(last) by(major, total)

twoway scatter sat age, mlabel(last) by(major, total)  
 || lfit sat age

/\* Adding confidence intervals \*/

twoway (lfitci sat age) || (scatter sat age)  
 /\*Reverse order shaded area cover dots\*/

twoway (lfitci sat age) || (scatter sat age,  
 mlabel(last))

twoway (lfitci sat age) || (scatter sat age,  
 mlabel(last)), title("SAT scores by  
 age") ytitle("SAT")

twoway scatter sat age, mlabel(last) by(gender,  
 total)

## Scatterplots

```
# Rule on span for lowess, big sample smaller
(~0.3), small sample bigger (~0.7)

library(car)

scatterplot(SAT~Age, data=mydata)

scatterplot(SAT~Age, id.method="identify",
            data=mydata)

scatterplot(SAT~Age, id.method="identify",
            boxplots= FALSE, data=mydata)

scatterplot(prestige~income, span=0.6, lwd=3,
            id.n=4, data=Prestige)

# By groups

scatterplot(SAT~Age|Gender, data=mydata)

scatterplot(SAT~Age|Gender, id.method="identify",
            data=mydata)

scatterplot(prestige~income|type, boxplots=FALSE,
            span=0.75, data=Prestige)

scatterplot(prestige~income|type, boxplots=FALSE,
            span=0.75,
            col=gray(c(0,0.5,0.7)),
            data=Prestige)
```

```
twoway scatter y x

twoway scatter sat age, title("Figure 1. SAT/Age")

twoway scatter sat age, mlabel(last)

twoway scatter sat age, mlabel(last) || lfit sat age

twoway scatter sat age, mlabel(last) || lfit sat age
|| lowess sat age /* locally weighted
scatterplot smoothing */

twoway scatter sat age, mlabel(last) || lfit sat age,
yline(1800) xline(30)

twoway scatter sat age, mlabel(last) by(major, total)

twoway scatter sat age, mlabel(last) by(major, total)
|| lfit sat age

/* Adding confidence intervals */

twoway (lfitci sat age) || (scatter sat age)
/*Reverse order shaded area cover dots*/

twoway (lfitci sat age) || (scatter sat age,
mlabel(last))

twoway (lfitci sat age) || (scatter sat age,
mlabel(last)), title("SAT scores by
age") ytitle("SAT")

twoway scatter sat age, mlabel(last) by(gender,
total)
```

| R   | Stata  |
|---|--|
| Scatterplots (multiple)   |  |
| <pre>scatterplotMatrix(~ prestige + income + education                   + women, span=0.7, id.n=0,                   data=Prestige)  pairs(Prestige)    # Pariwise plots. Scatterplots                   # of all variables in the dataset pairs(Prestige, gap=0, cex.labels=0.9) # gap                   # controls the space between                   # subplot and cex.labels the font                   # size (Dalgaard:186)</pre> | <pre>graph matrix  sat age score heightin read graph matrix  sat age score heightin read, half</pre> |
| 3D Scatterplots   |  |
| <pre>library(car)  scatter3d(prestige ~ income + education, id.n=3,           data=Duncan)</pre>  |  |

## Scatterplots (for categorical data)

```
plot(vocabulary ~ education, data=Vocab)

plot(jitter(vocabulary) ~ jitter(education),
     data=Vocab)

plot(jitter(vocabulary, factor=2) ~
     jitter(education, factor=2),
     data=Vocab)

# cex makes the point half the size, p. 134

plot(jitter(vocabulary, factor=2) ~
     jitter(education, factor=2),
     col="gray", cex=0.5, data=Vocab)

with(Vocab, {
  abline(lm(vocabulary ~
            education), lwd=3, lty="dashed")
  lines(lowess(education,
              vocabulary, f=0.2), lwd=3)
})
```

```
/*Categorical data using mydata.dat and the jitter
option*/
```

```
/*"scatter will add spherical random noise to your
data before plotting if you specify jitter(#),
where # represents the size of the noise as a
percentage of the graphical area. This can be
useful for creating graphs of categorical data
when the data not jittered, many of the points
would be on top of each other, making it
impossible to tell whether the plotted point
represented one or 1,000 observations." Source:
Stata's help page, type: help scatter*/
```

```
/*Use mydata.dat*/
```

```
graph matrix y x1 x2 x3
scatter y x1, jitter(7) title(xyz)
scatter y x1, jitter(7) msize(0.5)
scatter y x1, jitter(13) msize(0.5)
twoway scatter y x1, jitter(13) msize(0.5) || lfit
               y x1
graph matrix x1 x1 x2 x3, jitter(5)
graph matrix y x1 x2 x3, jitter(13) msize(0.5)
graph matrix y x1 x2 x3, jitter(13) msize(0.5)
               half
```

## References/Useful links

- DSS Online Training Section <http://dss.princeton.edu/training/>
- Princeton DSS Libguides <http://libguides.princeton.edu/dss>
- John Fox's site <http://socserv.mcmaster.ca/jfox/>
- Quick-R <http://www.statmethods.net/>
- UCLA Resources to learn and use R <http://www.ats.ucla.edu/stat/R/>
- UCLA Resources to learn and use Stata <http://www.ats.ucla.edu/stat/stata/>
- DSS - Stata [http://dss/online\\_help/stats\\_packages/stata/](http://dss/online_help/stats_packages/stata/)
- DSS - R [http://dss.princeton.edu/online\\_help/stats\\_packages/r](http://dss.princeton.edu/online_help/stats_packages/r)

## References/Recommended books

- *An R Companion to Applied Regression*, Second Edition / John Fox , Sanford Weisberg, Sage Publications, 2011
- *Data Manipulation with R* / Phil Spector, Springer, 2008
- *Applied Econometrics with R* / Christian Kleiber, Achim Zeileis, Springer, 2008
- *Introductory Statistics with R* / Peter Dalgaard, Springer, 2008
- *Complex Surveys. A guide to Analysis Using R* / Thomas Lumley, Wiley, 2010
- *Applied Regression Analysis and Generalized Linear Models* / John Fox, Sage, 2008
- *R for Stata Users* / Robert A. Muenchen, Joseph Hilbe, Springer, 2010
- *Introduction to econometrics* / James H. Stock, Mark W. Watson. 2nd ed., Boston: Pearson Addison Wesley, 2007.
- *Data analysis using regression and multilevel/hierarchical models* / Andrew Gelman, Jennifer Hill. Cambridge ; New York : Cambridge University Press, 2007.
- *Econometric analysis* / William H. Greene. 6th ed., Upper Saddle River, N.J. : Prentice Hall, 2008.
- *Designing Social Inquiry: Scientific Inference in Qualitative Research* / Gary King, Robert O. Keohane, Sidney Verba, Princeton University Press, 1994.
- *Unifying Political Methodology: The Likelihood Theory of Statistical Inference* / Gary King, Cambridge University Press, 1989
- *Statistical Analysis: an interdisciplinary introduction to univariate & multivariate methods* / Sam Kachigan, New York : Radius Press, c1986
- *Statistics with Stata (updated for version 9)* / Lawrence Hamilton, Thomson Books/Cole, 2006