Importing Data Into R

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Data Sets

- The majority of data analysis tasks uses as source data sets stored in a tabular format
- A data set is a bi-dimensional structure (a table)
  - Rows represent observations of a phenomenon
  - Columns contain information obtained for each observation
- The R data structure used to store these tables is the *data frame*
- In the following slides we will see illustrations on how to import data stored in different formats/infra-structures into a R data frame

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Internal R Data Sets

- Any R installation includes many data sets. The list can be obtained doing:

```
data()
```

- Each new package we install may also add new data sets for illustration purposes

```
data(package="DMwR") # data sets from a specific package
data(package = .packages(all.available = TRUE)) # all packages
```

- This type of data sets can be used/loaded using the function `data`

```
data(iris)
head(iris)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
## 4          4.6         3.1          1.5         0.2  setosa
## 5          5.0         3.6          1.4         0.2  setosa
## 6          5.4         3.9          1.7         0.4  setosa
```


The RData file format

- Any data frame (in reality any R object) may be saved in a RData file

```
dat <- data.frame(x=rnorm(10),y=rnorm(10))
save(dat,file="exp.RData")
```

- These data may be loaded back into R later

```
rm(dat)             # remove dat from the computer memory
dat                 # confirming that it was deleted
```

```
## Error in eval(expr, envir, enclos): object 'dat' not found
```

```
load("exp.RData") # load it back from the file
head(dat)         # here it is again!
```

```
##             x          y
## 1  0.07611641 -0.5965060
## 2 -1.56715114 -0.9988497
## 3 -0.11878837  1.0428524
## 4 -0.46173060 -0.6761860
## 5 -1.41758109 -0.1412697
## 6  0.26774836  0.7264043
```

Importing data from text files

- Text files are a frequent way of storing and sharing data sets
  - Rows of the file usually correspond two rows of the data set
  - Values in the columns stored in a single row separated by some special character
- Text files are frequently the easiest way of importing data into R from other tools
- There are many ways to read text files in R. We will use the infra-structure provided by (extra) package `readr`

CSV files

The values on each line are separated by commas

File "x.csv"

```
ID, Name, Age
23424, Ana, 45
11234, Charles, 23
77654, Susanne, 76
```

To read the data into a data frame:

```
library(readr)
dat <- read_csv("x.csv",col_types = "cci")
dat
```

```
## # A tibble: 3 x 3
##   ID    Name      Age
##   <chr> <chr>   <int>
## 1 23424 Ana        45
## 2 11234 Charles    23
## 3 77654 Susanne    76
```

Variations of the CSV format

On countries where the comma is used as a decimal separator it is common to use the semi-colon to separate values

File “y.csv”

```
ID; Name; Grade
23424; Ana; 4,6
11234; Charles; 12,3
77654; Susanne; 15,9
```

Reading this into a data frame:

```
dat <- read_csv2("y.csv", col_types = "ccd")

## Using ',' as decimal and '.' as
grouping mark.  Use read_delim()
for more control.

dat

## # A tibble: 3 x 3
##   ID    Name    Grade
##   <chr> <chr>   <dbl>
## 1 23424 Ana       4.6
## 2 11234 Charles  12.3
## 3 77654 Susanne  15.9
```


Other text formats

File “z.txt”

```
ID Name Age Phone
23424 Ana 40 ???
11234 Charles 12 34567678
77654 Susanne 45 23435567
```

To read this data into a data frame we do:

```
dat <- read_table2("z.txt",na="???",col_types = "ccic")
dat

## # A tibble: 3 x 4
##   ID    Name      Age Phone
##   <chr> <chr>   <int> <chr>
## 1 23424 Ana        40 <NA>
## 2 11234 Charles    12 34567678
## 3 77654 Susanne    45 23435567
```

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Summary on text formats

- Family of functions with similar syntax and parameters
  - `read_table`, `read_table2`,`read_csv`, `read_csv2`, `read_delim`, etc.
- Some of the more relevant parameters

col_types indicates the column types
col_names indicates whether the first line contains the column names
na indicates the character of vector of characters that should be interpreted as unknown values

- The result of these functions is a tibble
- *character encodings* - potential source of problems (check parameter `locale` of the functions)
- Other functions : `read_lines`, `scan` on base R

Importing data from SpreadSheets

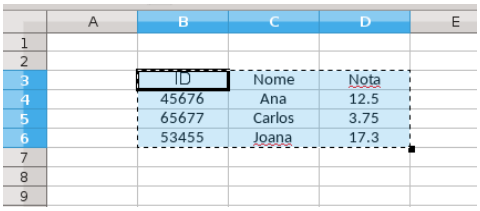
Method 1 - using CSV format

- One way of sending some data into R consists in saving the wanted spreadsheet data on a text file, for instance in format CSV
- And then, inside R, use some of the previously explained methods to import the data into a data frame from the saved text file

Importing data from SpreadSheets

Method 2 - through the *clipboard*

- When we want to import small data tables in a spreadsheet this is the easiest process



	ID	Nome	Nota
4	45676	Ana	12.5
5	65677	Carlos	3.75
6	53455	Joana	17.3

Select the table and do `Edit+Copy`

```
dat <- read.table("clipboard",header=TRUE)
```

```
dat
```

```
##       ID    Nome  Nota
## 1 45676     Ana 12.50
## 2 65677 Carlos  3.75
## 3 53455  Joana 17.30
```


Importing data from SpreadSheets

Method 3 - through package *readxl*

- Package *readxl* includes the function `read_excel`

Example

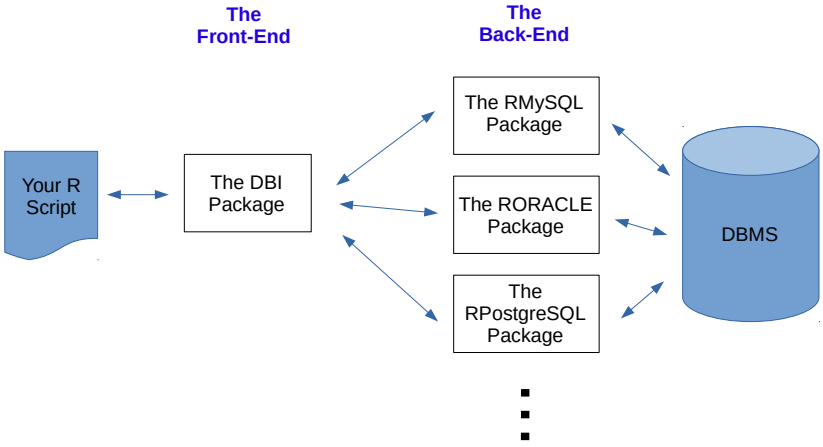
```
library(readxl)
fc <- "c:\\Documents and Settings\\xpto\\My Documents\\calc.xls"
dat <- read_excel(fc,sheet="MayValues")
dat2 <- read_excel(fc,sheet=2)
dat <- read_excel(fc,sheet="MayValues", range="C2:F24")
```

- More info and examples at `https://readxl.tidyverse.org/`

Connecting with Data Bases

The DBI package

- DBI provides a front end interface to DBMS-specific drivers



An Example with MySQL

```
library(DBI)
library(RMySQL)
drv <- dbDriver("MySQL")   # Loading the MySQL driver
con <- dbConnect(drv,dbname="transDB",   # connecting to the DBMS
                 username="myuser",password="mypasswd",
                 host="localhost")

# getting the results of a query as a data frame
data <- dbGetQuery(con,"SELECT * FROM clients")

dbDisconnect(con)   # closing up stuff
dbUnloadDriver(drv)
```

Another Example with Results in Chunks

```
library(DBI)
library(RMySQL)
drv <- dbDriver("MySQL")   # Loading the MySQL driver
con <- dbConnect(drv,dbname="transDB",   # connecting to the DBMS
                 username="myuser",password="mypasswd",
                 host="localhost")

res  <- dbSendQuery(con,"SELECT * FROM transactions")
while (!dbHasCompleted(res)) {
    # get the next 50 records on a data frame
    someData <- fetch(res, n = 50)
    # call some function that handles the current chunck
    process(someData)
}
dbClearResult(res) # clear the results set

dbDisconnect(con)   # closing up stuff
dbUnloadDriver(drv)
```


Other forms of data importation

- Data bases
  - R has interfaces to all major DBMS (packages `DBI`, `RMySQL`, `ROracle`, etc.)
- Other statistical software
  - Importing from Minitab, S-Plus, SPSS, Stata, SAS, etc.
  - Packages `foreign`, `Hmisc`
- Several other formats / software.
- More details / information in the manual *R Data Import/Export* that comes with R