# 2657 Functions

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# Contents

# Part I

# Function Descriptions and Examples

# Chapter 1

# concat.split

The `concat.split` function takes a column with multiple values, splits the values into a list or into separate columns, and returns a new `data.frame`.

## Arguments

- `data`: the source `data.frame`.
- `split.col`: the variable that needs to be split; can be specified either by the column number or the variable name.
- `to.list`: logical; should the split column be returned as a single variable list (named "original-variable_list") or multiple new variables? If `to.list` is `TRUE`, the `mode` argument is ignored and a list of the original values are returned.
- `mode`: can be either `binary` or `value` (where `binary` is default and it recodes values to `1` or `NA`, like Boolean, but without assuming `0` when data is not available).
- `sep`: the character separating each value (defaults to `","`).
- `drop.col`: logical (whether to remove the original variable from the output or not; defaults to `TRUE`).

## Examples

First load some data from a CSV stored at github. The URL is an HTTPS, so we need to use `getURL` from `RCurl`.

```
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
temp = getURL(paste0(baseURL, "data/concatenated-cells.csv"))
concat.test = read.csv(textConnection(temp))
rm(temp)

# How big is the dataset?
dim(concat.test)

## [1] 48  4

# Just show me the first few rows
head(concat.test)
```

```
##     Name     Likes                   Siblings    Hates
## 1   Boyd 1,2,4,5,6 Reynolds , Albert , Ortega     2;4;
## 2  Rufus 1,2,4,5,6  Cohen , Bert , Montgomery 1;2;3;4;
## 3   Dana 1,2,4,5,6                    Pierce       2;
## 4 Carole 1,2,4,5,6 Colon , Michelle , Ballard     1;4;
## 5 Ramona   1,2,5,6           Snyder , Joann ,   1;2;3;
## 6 Kelley   1,2,5,6          James , Roxanne ,     1;4;
```

Notice that the data have been entered in a very silly manner. Let's split it up!

```
# Load the function!
# require(RCurl)
# baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/concat.split.R"))))

# Split up the second column, selecting by column number
head(concat.split(concat.test, 2))
```

```
##     Name     Likes                   Siblings    Hates Likes_1 Likes_2 Likes_3
## 1   Boyd 1,2,4,5,6 Reynolds , Albert , Ortega     2;4;       1       1      NA
## 2  Rufus 1,2,4,5,6  Cohen , Bert , Montgomery 1;2;3;4;       1       1      NA
## 3   Dana 1,2,4,5,6                    Pierce       2;       1       1      NA
## 4 Carole 1,2,4,5,6 Colon , Michelle , Ballard     1;4;       1       1      NA
## 5 Ramona   1,2,5,6           Snyder , Joann ,   1;2;3;       1       1      NA
## 6 Kelley   1,2,5,6          James , Roxanne ,     1;4;       1       1      NA
##   Likes_4 Likes_5 Likes_6
## 1       1       1       1
## 2       1       1       1
## 3       1       1       1
## 4       1       1       1
## 5      NA       1       1
## 6      NA       1       1
```

```
# ... or by name, and drop the offensive first column
head(concat.split(concat.test, "Likes", drop.col=TRUE))
```

```
##     Name                   Siblings    Hates Likes_1 Likes_2 Likes_3 Likes_4
## 1   Boyd Reynolds , Albert , Ortega     2;4;       1       1      NA       1
## 2  Rufus  Cohen , Bert , Montgomery 1;2;3;4;       1       1      NA       1
## 3   Dana                    Pierce       2;       1       1      NA       1
## 4 Carole Colon , Michelle , Ballard     1;4;       1       1      NA       1
## 5 Ramona           Snyder , Joann ,   1;2;3;       1       1      NA      NA
## 6 Kelley          James , Roxanne ,     1;4;       1       1      NA      NA
##   Likes_5 Likes_6
## 1       1       1
## 2       1       1
## 3       1       1
## 4       1       1
## 5       1       1
## 6       1       1
```

```
# The "Hates" column uses a different separator:
head(concat.split(concat.test, "Hates", sep=";", drop.col=TRUE))
```

```
##     Name     Likes                   Siblings Hates_1 Hates_2 Hates_3 Hates_4
## 1   Boyd 1,2,4,5,6 Reynolds , Albert , Ortega      NA       1      NA       1
```

```
## 2  Rufus 1,2,4,5,6  Cohen , Bert , Montgomery       1       1       1       1
## 3   Dana 1,2,4,5,6                      Pierce      NA       1      NA      NA
## 4 Carole 1,2,4,5,6 Colon , Michelle , Ballard       1      NA      NA       1
## 5 Ramona   1,2,5,6           Snyder , Joann ,       1       1       1      NA
## 6 Kelley   1,2,5,6          James , Roxanne ,       1      NA      NA       1
```

```
# Retain the original values
head(concat.split(concat.test, 2, mode="value", drop.col=TRUE))
```

```
##     Name                    Siblings    Hates Likes_1 Likes_2 Likes_3 Likes_4
## 1   Boyd Reynolds , Albert , Ortega     2;4;       1       2      NA       4
## 2  Rufus  Cohen , Bert , Montgomery 1;2;3;4;       1       2      NA       4
## 3   Dana                      Pierce       2;       1       2      NA       4
## 4 Carole Colon , Michelle , Ballard     1;4;       1       2      NA       4
## 5 Ramona           Snyder , Joann ,   1;2;3;       1       2      NA      NA
## 6 Kelley          James , Roxanne ,     1;4;       1       2      NA      NA
##   Likes_5 Likes_6
## 1       5       6
## 2       5       6
## 3       5       6
## 4       5       6
## 5       5       6
## 6       5       6
```

```
# Let,s try splitting some strings... Same syntax
head(concat.split(concat.test, 3, drop.col=TRUE))
```

```
##     Name     Likes    Hates Siblings_1 Siblings_2 Siblings_3
## 1   Boyd 1,2,4,5,6     2;4;   Reynolds     Albert     Ortega
## 2  Rufus 1,2,4,5,6 1;2;3;4;      Cohen       Bert Montgomery
## 3   Dana 1,2,4,5,6       2;     Pierce       <NA>       <NA>
## 4 Carole 1,2,4,5,6     1;4;      Colon   Michelle    Ballard
## 5 Ramona   1,2,5,6   1;2;3;     Snyder      Joann       <NA>
## 6 Kelley   1,2,5,6     1;4;      James    Roxanne       <NA>
```

```
# Split up the "Likes column" into a list variable; retain original column
head(concat.split(concat.test, 2, to.list=TRUE, drop.col=FALSE))
```

```
##     Name     Likes                    Siblings    Hates    Likes_list
## 1   Boyd 1,2,4,5,6 Reynolds , Albert , Ortega     2;4; 1, 2, 4, 5, 6
## 2  Rufus 1,2,4,5,6  Cohen , Bert , Montgomery 1;2;3;4; 1, 2, 4, 5, 6
## 3   Dana 1,2,4,5,6                      Pierce       2; 1, 2, 4, 5, 6
## 4 Carole 1,2,4,5,6 Colon , Michelle , Ballard     1;4; 1, 2, 4, 5, 6
## 5 Ramona   1,2,5,6           Snyder , Joann ,   1;2;3;    1, 2, 5, 6
## 6 Kelley   1,2,5,6          James , Roxanne ,     1;4;    1, 2, 5, 6
```

```
# View the structure of the output for the first 10 rows to verify
# that the new column is a list; note the difference between "Likes"
# and "Likes_list".
str(concat.split(concat.test, 2, to.list=TRUE, drop.col=FALSE)[1:10, c(2, 5)])
```

```
## 'data.frame':    10 obs. of  2 variables:
##  $ Likes     : Factor w/ 5 levels "1,2,3,4,5","1,2,4,5",..: 3 3 3 3 5 5 3 3 3 4
##  $ Likes_list:List of 10
##   ..$ : num  1 2 4 5 6
##   ..$ : num  1 2 4 5 6
```

```
##   ..$ : num  1 2 4 5 6
##   ..$ : num  1 2 4 5 6
##   ..$ : num  1 2 5 6
##   ..$ : num  1 2 5 6
##   ..$ : num  1 2 4 5 6
##   ..$ : num  1 2 4 5 6
##   ..$ : num  1 2 4 5 6
##   ..$ : num  1 2 5
```

## Advanced Usage

It is also possible to use `concat.split` to split multiple columns at once. This can be done in stages, or it can be all wrapped in nested statements, as follows:

```
do.call(cbind, c(concat.test[1],
                 lapply(lapply(2:ncol(concat.test),
                               function(x) concat.test[x]),
                        concat.split, split.col=1, drop=TRUE, sep=";|,")))
```

In the example above (working from the inside of the function outwards):

- First, `lapply(2:ncol(concat.test), ...)` splits the columns of the `data.frame` into a list.
- Second, `lapply(lapply(...))` does the splitting work.
  - Note the use of `sep=";|,"` to match multiple separators on which to split; if further separators are required, they can be specified by using the pipe symbol (`|`) *with no leading or trailing spaces*.
- Finally, `do.call(cbind, ...)` is evaluated last, "binding" the data together by columns. In this case, the data being bound together is the first column from the `concat.test` dataset, and the splitted output of the remaining columns.

Alternatively, a similar approach can be taken using the function `dfcols.list` (see the "Snippets and Tips" section of this manual for the `dfcols.list` function).

```
# Show just the first few lines, Boolean mode
head(do.call(cbind, c(concat.test[1],
                      lapply(dfcols.list(concat.test[-1]),
                             concat.split, split.col=1, drop=TRUE, sep=";|,"))))
```

```
##     Name Likes_1 Likes_2 Likes_3 Likes_4 Likes_5 Likes_6 Siblings_1 Siblings_2
## 1   Boyd       1       1      NA       1       1       1   Reynolds     Albert
## 2  Rufus       1       1      NA       1       1       1      Cohen       Bert
## 3   Dana       1       1      NA       1       1       1     Pierce       <NA>
## 4 Carole       1       1      NA       1       1       1      Colon   Michelle
## 5 Ramona       1       1      NA      NA       1       1     Snyder      Joann
## 6 Kelley       1       1      NA      NA       1       1      James    Roxanne
##   Siblings_3 Hates_1 Hates_2 Hates_3 Hates_4
## 1     Ortega      NA       1      NA       1
## 2 Montgomery       1       1       1       1
## 3       <NA>      NA       1      NA      NA
## 4    Ballard       1      NA      NA       1
## 5       <NA>       1       1       1      NA
## 6       <NA>       1      NA      NA       1
```

```
# Show just the first few lines, value mode
head(do.call(cbind, c(concat.test[1],
                      lapply(dfcols.list(concat.test[-1]),
                             concat.split, split.col=1, drop=TRUE,
                             sep=";|,", mode="value"))))
```

```
##     Name Likes_1 Likes_2 Likes_3 Likes_4 Likes_5 Likes_6 Siblings_1 Siblings_2
## 1   Boyd       1       2      NA       4       5       6   Reynolds     Albert
## 2  Rufus       1       2      NA       4       5       6     Cohen       Bert
## 3   Dana       1       2      NA       4       5       6    Pierce       <NA>
## 4 Carole       1       2      NA       4       5       6     Colon   Michelle
## 5 Ramona       1       2      NA      NA       5       6    Snyder      Joann
## 6 Kelley       1       2      NA      NA       5       6     James    Roxanne
##   Siblings_3 Hates_1 Hates_2 Hates_3 Hates_4
## 1     Ortega      NA       2      NA       4
## 2 Montgomery       1       2       3       4
## 3       <NA>      NA       2      NA      NA
## 4    Ballard       1      NA      NA       4
## 5       <NA>       1       2       3      NA
## 6       <NA>       1      NA      NA       4
```

```
# Show just the first few lines, list output mode
head(do.call(cbind, c(concat.test[1],
                      lapply(dfcols.list(concat.test[-1]),
                             concat.split, split.col=1, drop=TRUE,
                             sep=";|,", to.list=TRUE))))
```

```
##     Name    Likes_list            Siblings_list Hates_list
## 1   Boyd 1, 2, 4, 5, 6 Reynolds, Albert, Ortega       2, 4
## 2  Rufus 1, 2, 4, 5, 6  Cohen, Bert, Montgomery 1, 2, 3, 4
## 3   Dana 1, 2, 4, 5, 6                   Pierce          2
## 4 Carole 1, 2, 4, 5, 6 Colon, Michelle, Ballard       1, 4
## 5 Ramona    1, 2, 5, 6            Snyder, Joann    1, 2, 3
## 6 Kelley    1, 2, 5, 6           James, Roxanne       1, 4
```

## References

See: http://stackoverflow.com/q/10100887/1270695

# Chapter 2

# df.sorter

The `df.sorter` function allows you to sort a `data.frame` by columns or rows or both. You can also quickly subset data columns by using the `var.order` argument.

## Arguments

- `data`: the source `data.frame`.
- `var.order`: the new order in which you want the variables to appear.
  - Defaults to `names(data)`, which keeps the variables in the original order.
  - Variables can be referred to either by a vector of their index numbers or by a vector of the variable name; partial name matching also works, but requires that the partial match identifies similar columns uniquely (see examples).
  - Basic subsetting can also be done using `var.order` simply by omitting the variables you want to drop.
- `col.sort`: the columns *within* which there is data that need to be sorted.
  - Defaults to `NULL`, which means no sorting takes place.
  - Variables can be referred to either by a vector of their index numbers or by a vector of the variable names; full names must be provided.
- `at.start`: Should the pattern matching be from the start of the variable name? Defaults to "TRUE".

  NOTE: If you are sorting both by variables and within the columns, the `col.sort` order should be based on the location of the columns in the *new* `data.frame`, not the original `data.frame`.

## Examples

```
# Load the function!
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/df.sorter.R"))))

# Make up some data
set.seed(1)
dat = data.frame(id = rep(1:5, each=3), times = rep(1:3, 5),
```

```
                measure1 = rnorm(15), score1 = sample(300, 15),
                code1 = replicate(15, paste(sample(LETTERS[1:5], 3),
                                            sep="", collapse="")),
                measure2 = rnorm(15), score2 = sample(150:300, 15),
                code2 = replicate(15, paste(sample(LETTERS[1:5], 3),
                                            sep="", collapse="")))
# Preview your data
dat
```

```
##    id times measure1 score1 code1 measure2 score2 code2
## 1   1     1  -0.6265    145   DAB  -0.7075    299   CEB
## 2   1     2   0.1836    180   DCB   0.3646    224   ECD
## 3   1     3  -0.8356    148   EBA   0.7685    222   DAE
## 4   2     1   1.5953     56   AED  -0.1123    175   DBA
## 5   2     2   0.3295    245   CEB   0.8811    260   DAC
## 6   2     3  -0.8205    198   EBD   0.3981    216   DCA
## 7   3     1   0.4874    234   BCA  -0.6120    300   CEA
## 8   3     2   0.7383     32   CDA   0.3411    179   CAD
## 9   3     3   0.5758    212   EBC  -1.1294    182   BEC
## 10  4     1  -0.3054    120   BED   1.4330    234   CDE
## 11  4     2   1.5118    239   EDB   1.9804    231   CAB
## 12  4     3   0.3898    188   DEB  -0.3672    160   DBE
## 13  5     1  -0.6212    226   DBA  -1.0441    154   EDB
## 14  5     2  -2.2147    159   DAC   0.5697    238   BDE
## 15  5     3   1.1249    152   AED  -0.1351    277   DCE
```

```
# Change the variable order, grouping related columns
# Note that you do not need to specify full variable names,
#    just enough that the variables can be uniquely identified
head(df.sorter(dat, var.order = c("id", "ti", "cod", "mea", "sco")))
```

```
##   id times code1 code2 measure1 measure2 score1 score2
## 1  1     1   DAB   CEB  -0.6265  -0.7075    145    299
## 2  1     2   DCB   ECD   0.1836   0.3646    180    224
## 3  1     3   EBA   DAE  -0.8356   0.7685    148    222
## 4  2     1   AED   DBA   1.5953  -0.1123     56    175
## 5  2     2   CEB   DAC   0.3295   0.8811    245    260
## 6  2     3   EBD   DCA  -0.8205   0.3981    198    216
```

```
# Same output, but with a more awkward syntax
head(df.sorter(dat, var.order = c(1, 2, 5, 8, 3, 6, 4, 7)))
```

```
##   id times code1 code2 measure1 measure2 score1 score2
## 1  1     1   DAB   CEB  -0.6265  -0.7075    145    299
## 2  1     2   DCB   ECD   0.1836   0.3646    180    224
## 3  1     3   EBA   DAE  -0.8356   0.7685    148    222
## 4  2     1   AED   DBA   1.5953  -0.1123     56    175
## 5  2     2   CEB   DAC   0.3295   0.8811    245    260
## 6  2     3   EBD   DCA  -0.8205   0.3981    198    216
```

```
# As above, but sorted by ,times, and then ,id,
head(df.sorter(dat, var.order = c("id", "tim", "cod", "mea", "sco"),
               col.sort = c(2, 1)))
```

```
##    id times code1 code2 measure1 measure2 score1 score2
## 1   1     1   DAB   CEB  -0.6265  -0.7075    145    299
```

```
## 4   2     1   AED   DBA   1.5953  -0.1123     56    175
## 7   3     1   BCA   CEA   0.4874  -0.6120    234    300
## 10  4     1   BED   CDE  -0.3054   1.4330    120    234
## 13  5     1   DBA   EDB  -0.6212  -1.0441    226    154
## 2   1     2   DCB   ECD   0.1836   0.3646    180    224
```

```
# Drop ,measure1, and ,measure2,, sort by ,times,, and ,score1,
head(df.sorter(dat, var.order = c("id", "tim", "sco", "cod"),
               col.sort = c(2, 3)))
```

```
##    id times score1 score2 code1 code2
## 4   2     1     56    175   AED   DBA
## 10  4     1    120    234   BED   CDE
## 1   1     1    145    299   DAB   CEB
## 13  5     1    226    154   DBA   EDB
## 7   3     1    234    300   BCA   CEA
## 8   3     2     32    179   CDA   CAD
```

```
# As above, but using names
head(df.sorter(dat, var.order = c("id", "tim", "sco", "cod"),
               col.sort = c("times", "score1")))
```

```
##    id times score1 score2 code1 code2
## 4   2     1     56    175   AED   DBA
## 10  4     1    120    234   BED   CDE
## 1   1     1    145    299   DAB   CEB
## 13  5     1    226    154   DBA   EDB
## 7   3     1    234    300   BCA   CEA
## 8   3     2     32    179   CDA   CAD
```

```
# Just sort by columns, first by ,times, then by ,id,
head(df.sorter(dat, col.sort = c("times", "id")))
```

```
##    id times measure1 score1 code1 measure2 score2 code2
## 1   1     1  -0.6265    145   DAB  -0.7075    299   CEB
## 4   2     1   1.5953     56   AED  -0.1123    175   DBA
## 7   3     1   0.4874    234   BCA  -0.6120    300   CEA
## 10  4     1  -0.3054    120   BED   1.4330    234   CDE
## 13  5     1  -0.6212    226   DBA  -1.0441    154   EDB
## 2   1     2   0.1836    180   DCB   0.3646    224   ECD
```

```
head(df.sorter(dat, col.sort = c("code1"))) # Sorting by character values
```

```
##    id times measure1 score1 code1 measure2 score2 code2
## 4   2     1   1.5953     56   AED  -0.1123    175   DBA
## 15  5     3   1.1249    152   AED  -0.1351    277   DCE
## 7   3     1   0.4874    234   BCA  -0.6120    300   CEA
## 10  4     1  -0.3054    120   BED   1.4330    234   CDE
## 8   3     2   0.7383     32   CDA   0.3411    179   CAD
## 5   2     2   0.3295    245   CEB   0.8811    260   DAC
```

```
# Pattern matching anywhere in the variable name
head(df.sorter(dat, var.order= "co", at.start=FALSE))
```

```
##   code1 code2 score1 score2
## 1   DAB   CEB    145    299
## 2   DCB   ECD    180    224
## 3   EBA   DAE    148    222
## 4   AED   DBA     56    175
## 5   CEB   DAC    245    260
## 6   EBD   DCA    198    216
```

## To Do

- Add an option to sort ascending or descending—at the moment, not supported.

# Chapter 3

# multi.freq.table

The `multi.freq.table` function takes a data frame containing Boolean responses to multiple response questions and tabulates the number of responses by the possible combinations of answers. In addition to tabulating the frequency (`Freq`), there are two other columns in the output: *Percent of Responses* (`Pct.of.Resp`) and *Percent of Cases* (`Pct.of.Cases`). *Percent of Responses* is the frequency divided by the total number of answers provided; this column should sum to 100%. In some cases, for instance when a combination table is generated and there are cases where a respondent did not select any option, the *Percent of Responses* value would be more than 100%. *Percent of Cases* is the frequency divided by the total number of valid cases; this column would most likely sum to more than 100% when a basic table is produced since each respondent (case) can select multiple answers, but should sum to 100% with other tables.

## Arguments

- `data`: The multiple responses that need to be tabulated.
- `sep`: The desired separator for collapsing the combinations of options; defaults to `""` (collapsing with no space between each option name).
- `boolean`: Are you tabulating boolean data (see `dat` examples)? Defaults to `TRUE`.
- `factors`: If you are trying to tabulate non-boolean data, and the data are not factors, you can specify the factors here (see `dat2` examples).
  - Defaults to `NULL` and is not used when `boolean = TRUE`.
- `NAto0`: Should `NA` values be converted to `0`.
  - Defaults to `TRUE`, in which case, the number of valid cases should be the same as the number of cases overall.
  - If set to `FALSE`, any rows with `NA` values will be dropped as invalid cases.
  - Only applies when `boolean = TRUE`.
- `basic`: Should a basic table of each item, rather than combinations of items, be created? Defaults to `FALSE`.
- `dropzero`: Should combinations with a frequency of zero be dropped from the final table?
  - Defaults to `TRUE`.
  - Does not apply when `boolean = TRUE`.
- `clean`: Should the original tabulated data be retained or dropped from the final table?
  - Defaults to `TRUE`.
  - Does not apply when `boolean = TRUE`.

# Examples

## Boolean Data

```
# Load the function!
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/multi.freq.table.R"))))

# Make up some data
set.seed(1)
dat = data.frame(A = sample(c(0, 1), 20, replace=TRUE),
                 B = sample(c(0, 1, NA), 20,
                            prob=c(.3, .6, .1), replace=TRUE),
                 C = sample(c(0, 1, NA), 20,
                            prob=c(.7, .2, .1), replace=TRUE),
                 D = sample(c(0, 1, NA), 20,
                            prob=c(.3, .6, .1), replace=TRUE),
                 E = sample(c(0, 1, NA), 20,
                            prob=c(.4, .4, .2), replace=TRUE))
# View your data
dat
```

```
##    A  B C  D  E
## 1  0 NA 1 NA  0
## 2  0  1 0  1  0
## 3  1  0 1  1  1
## 4  1  1 0  1  1
## 5  0  1 0  0  0
## 6  1  1 1  1  1
## 7  1  1 0  1  0
## 8  1  1 0  0  1
## 9  1  0 1  1  1
## 10 0  1 0  0  1
## 11 0  1 0  1  1
## 12 0  1 1  0  1
## 13 1  1 0  1  0
## 14 0  1 0  1 NA
## 15 1  0 0  1  0
## 16 0  0 0  0  0
## 17 1  0 0  0  0
## 18 1  1 0  1  0
## 19 0  0 0  0 NA
## 20 1  1 0 NA  0
```

```
# How many cases have "NA" values?
table(is.na(rowSums(dat)))
```

```
##
## FALSE  TRUE
##    16     4
```

```
# Apply the function with all defaults accepted
multi.freq.table(dat)
```

```
##    Combn Freq Weighted.Freq Pct.of.Resp Pct.of.Cases
```

```
## 1           2             2       4.167           10
## 2       A   1             1       2.083            5
## 3       B   1             1       2.083            5
## 4      AB   1             2       4.167            5
## 5       C   1             1       2.083            5
## 6      AD   1             2       4.167            5
## 7      BD   2             4       8.333           10
## 8     ABD   3             9      18.750           15
## 9      BE   1             2       4.167            5
## 10    ABE   1             3       6.250            5
## 11    BCE   1             3       6.250            5
## 12    BDE   1             3       6.250            5
## 13   ABDE   1             4       8.333            5
## 14   ACDE   2             8      16.667           10
## 15 ABCDE   1             5      10.417            5
```

```
# Tabulate only on variables "A", "B", and "D", with a different
# separator, keep any zero frequency values, and keeping the
# original tabulations. There are no solitary "D" responses.
multi.freq.table(dat[c(1, 2, 4)], sep="-", dropzero=FALSE, clean=FALSE)
```

```
##   A B D Freq Combn Weighted.Freq Pct.of.Resp Pct.of.Cases
## 1 0 0 0    3                  3       8.571           15
## 2 1 0 0    1      A           1       2.857            5
## 3 0 1 0    3      B           3       8.571           15
## 4 1 1 0    2    A-B           4      11.429           10
## 5 0 0 1    0      D           0       0.000            0
## 6 1 0 1    3    A-D           6      17.143           15
## 7 0 1 1    3    B-D           6      17.143           15
## 8 1 1 1    5  A-B-D          15      42.857           25
```

```
# As above, but without converting "NA" to "0".
# Note the difference in the number of valid cases.
multi.freq.table(dat[c(1, 2, 4)], NAto0=FALSE,
                 sep="-", dropzero=FALSE, clean=FALSE)
```

```
##   A B D Freq Combn Weighted.Freq Pct.of.Resp Pct.of.Cases
## 1 0 0 0    2                  2       6.061       11.111
## 2 1 0 0    1      A           1       3.030        5.556
## 3 0 1 0    3      B           3       9.091       16.667
## 4 1 1 0    1    A-B           2       6.061        5.556
## 5 0 0 1    0      D           0       0.000        0.000
## 6 1 0 1    3    A-D           6      18.182       16.667
## 7 0 1 1    3    B-D           6      18.182       16.667
## 8 1 1 1    5  A-B-D          15      45.455       27.778
```

```
# View a basic table.
multi.freq.table(dat, basic=TRUE)
```

```
##   Freq Pct.of.Resp Pct.of.Cases
## A   11       22.92           55
## B   13       27.08           65
## C    5       10.42           25
## D   11       22.92           55
## E    8       16.67           40
```

### Non-Boolean Data

```
# Make up some data
dat2 = structure(list(Reason.1 = c("one", "one", "two", "one", "two",
                                   "three", "one", "one", NA, "two"),
                      Reason.2 = c("two", "three", "three", NA, NA,
                                   "two", "three", "two", NA, NA),
                      Reason.3 = c("three", NA, NA, NA, NA,
                                   NA, NA, "three", NA, NA)),
                 .Names = c("Reason.1", "Reason.2", "Reason.3"),
                 class = "data.frame",
                 row.names = c(NA, -10L))
# View your data
dat2
```

```
##    Reason.1 Reason.2 Reason.3
## 1       one      two    three
## 2       one    three     <NA>
## 3       two    three     <NA>
## 4       one     <NA>     <NA>
## 5       two     <NA>     <NA>
## 6     three      two     <NA>
## 7       one    three     <NA>
## 8       one      two    three
## 9      <NA>     <NA>     <NA>
## 10      two     <NA>     <NA>
```

```
# The following will not work.
# The data are not factored.
multi.freq.table(dat2, boolean=FALSE)
```

```
## Error: Input variables must be factors.  Please provide factors using the
## 'factors' argument or convert your data to factor before using function.
```

```
# Factor create the factors.
multi.freq.table(dat2, boolean=FALSE,
                 factors = c("one", "two", "three"))
```

```
##         Combos Freq Weighted.Freq Pct.of.Resp Pct.of.Cases
## 1                1             1       5.882           10
## 8          one   1             1       5.882           10
## 12         two   2             2      11.765           20
## 15    onethree   2             4      23.529           20
## 17    threetwo   2             4      23.529           20
## 22 onethreetwo   2             6      35.294           20
```

```
# And, a basic table.
multi.freq.table(dat2, boolean=FALSE,
                 factors = c("one", "two", "three"),
                 basic=TRUE)
```

```
##    Item Freq Pct.of.Resp Pct.of.Cases
## 1   one    5       29.41           50
## 2   two    6       35.29           60
## 3 three    6       35.29           60
```

## Extended Examples

The following example is based on some data available from the University of Auckland's Student Learning Resources[1].

When the data are read into R, the factor labels are very long, which makes it difficult to see on the screen. Thus, in the first example that follows, the factor levels are first recoded before the multiple frequency tables are created. Additionally, the data for the binary information in the second example was coded in a common `1 = Yes` and `2 = No` format, but we need `0 = No` instead, so we need to do some recoding there too before using the function.

```
# Get the data
library(foreign)
temp = "http://cad.auckland.ac.nz/file.php/content/files/slc/"
computer = read.spss(paste0(temp,
                            "computer_multiple_response.sav"),
                     to.data.frame=TRUE)
rm(temp)
# Preview
dim(computer)
```

```
## [1] 100  20
```

```
names(computer)
```

```
##  [1] "id"       "ms_word"  "ms_excel" "ms_ppt"   "ms_outlk" "ms_pub"
##  [7] "ms_proj"  "ms_acc"   "netscape" "int_expl" "adobe_rd" "endnote"
## [13] "spss"     "quality1" "quality2" "quality3" "quality4" "quality5"
## [19] "quality6" "gender"
```

```
# First, let,s just tabulate the instructor qualities.
#   Extract the relevant columns, and relevel the factors.
instructor.quality =
  computer[, grep("quali", names(computer))]
# View the existing levels.
lapply(instructor.quality, levels)[[1]]
```

```
## [1] "Ability to provide practical examples"
## [2] "Ability to answer questions positively"
## [3] "Ability to clearly explain concepts"
## [4] "Ability to instruct at a suitable pace"
## [5] "Knowledge of software"
## [6] "Humour"
## [7] "Other"
```

```
instructor.quality = lapply(instructor.quality,
                            function(x) { levels(x) =
  list(Q1 = "Ability to provide practical examples",
       Q2 = "Ability to answer questions positively",
       Q3 = "Ability to clearly explain concepts",
       Q4 = "Ability to instruct at a suitable pace",
       Q5 = "Knowledge of Software",
       Q6 = "Humour", Q7 = "Other"); x })
# Now, apply multi.freq.table to the data.
multi.freq.table(data.frame(instructor.quality),
                 boolean=FALSE, basic=TRUE)
```

[1] See: http://www.cad.auckland.ac.nz/index.php?p=spss

```
##   Item Freq Pct.of.Resp Pct.of.Cases
## 1   Q1   47      18.077           47
## 2   Q2   59      22.692           59
## 3   Q3   55      21.154           55
## 4   Q4   43      16.538           43
## 5   Q5    0       0.000            0
## 6   Q6   47      18.077           47
## 7   Q7    9       3.462            9
```

```
list(head(multi.freq.table(data.frame(instructor.quality),
                           boolean=FALSE, sep="-")),
     tail(multi.freq.table(data.frame(instructor.quality),
                           boolean=FALSE, sep="-")))
```

```
## [[1]]
##    Combos Freq Weighted.Freq Pct.of.Resp Pct.of.Cases
## 1      Q1    1             1      0.3846            1
## 21     Q2    3             3      1.1538            3
## 31     Q3    2             2      0.7692            2
## 37     Q4    2             2      0.7692            2
## 39     Q6    3             3      1.1538            3
## 41  Q1-Q2    8            16      6.1538            8
##
## [[2]]
##                 Combos Freq Weighted.Freq Pct.of.Resp Pct.of.Cases
## 133       Q1-Q3-Q6-Q7    1             4       1.538            1
## 141       Q2-Q3-Q4-Q6    4            16       6.154            4
## 151       Q3-Q4-Q6-Q7    1             4       1.538            1
## 161    Q1-Q2-Q3-Q4-Q6    1             5       1.923            1
## 164    Q1-Q2-Q3-Q6-Q7    1             5       1.923            1
## 201 Q1-Q2-Q3-Q4-Q6-Q7    1             6       2.308            1
```

```
# Now. let,s look at the software.
instructors.sw = computer[2:13]
# These columns are coded as 1 = Yes and 2 = No,
#   so, convert to integers, and subtract two, and
#   take the absolute value to convert to binary.
instructors.sw = lapply(instructors.sw,
                        function(x) abs(as.integer(x)-2))
# Apply multi.freq.table
multi.freq.table(data.frame(instructors.sw), basic=TRUE)
```

```
##           Freq Pct.of.Resp Pct.of.Cases
## ms_word     77      13.975           77
## ms_excel    48       8.711           48
## ms_ppt      55       9.982           55
## ms_outlk    52       9.437           52
## ms_pub      19       3.448           19
## ms_proj     21       3.811           21
## ms_acc      57      10.345           57
## netscape    10       1.815           10
## int_expl    84      15.245           84
## adobe_rd    48       8.711           48
## endnote     55       9.982           55
## spss        25       4.537           25
```

```
# The output here is not pretty. To get prettier (or more meaningful)
#   output, provide shorter names for the variables or use just a
```

```
#   meaningful subset of the variables.
list(head(multi.freq.table(data.frame(instructors.sw), sep="-")),
     tail(multi.freq.table(data.frame(instructors.sw), sep="-")))
```

```
## [[1]]
##                                         Combn Freq Weighted.Freq Pct.of.Resp
## 1                 ms_word-ms_excel-ms_ppt-ms_acc    1             4      0.7260
## 2 ms_word-ms_excel-ms_ppt-ms_outlk-ms_pub-ms_acc    1             6      1.0889
## 3                                       int_expl    2             2      0.3630
## 4                                ms_word-int_expl    1             2      0.3630
## 5                          ms_word-ms_ppt-int_expl    1             3      0.5445
## 6                        ms_word-ms_outlk-int_expl    1             3      0.5445
##   Pct.of.Cases
## 1            1
## 2            1
## 3            2
## 4            1
## 5            1
## 6            1
##
## [[2]]
##                                                                      Combn Freq
## 91 ms_word-ms_excel-ms_outlk-ms_pub-ms_proj-int_expl-adobe_rd-endnote-spss    1
## 92           ms_word-ms_excel-ms_ppt-ms_acc-int_expl-adobe_rd-endnote-spss    1
## 93                  ms_word-ms_outlk-ms_acc-int_expl-adobe_rd-endnote-spss    1
## 94           ms_word-ms_ppt-ms_outlk-ms_acc-int_expl-adobe_rd-endnote-spss    1
## 95                    ms_word-ms_pub-ms_acc-int_expl-adobe_rd-endnote-spss    1
## 96                  ms_outlk-ms_proj-ms_acc-int_expl-adobe_rd-endnote-spss    1
##    Weighted.Freq Pct.of.Resp Pct.of.Cases
## 91             9       1.633            1
## 92             8       1.452            1
## 93             7       1.270            1
## 94             8       1.452            1
## 95             7       1.270            1
## 96             7       1.270            1
```

# References

`apply` shortcut for creating the `Combn` column in the output by Justin
See: http://stackoverflow.com/q/11348391/1270695 and http://stackoverflow.com/q/11622660/1270695

# Chapter 4

# RandomNames

The `RandomNames()` function uses data from the *Genealogy Data: Frequently Occurring Surnames from Census 1990–Names Files* web page[1] to generate a `data.frame` with random names.

## The Arguments

- `N`: The number of random names you want. Defaults to 100.
- `cat`: Do you want `"common"` names, `"rare"` names, names with an `"average"` frequency, or some combination of these? Should be specified as a character vector (for example, `c("rare", "common")`). Defaults to `NULL`, in which case all names are used as the sample frame.
- `gender`: Do you want first names from the `"male"` dataset, the `"female"` dataset, or from all available names? Should be specified as a quoted string (for example, `"male"`). Defaults to `NULL`, in which case all available first names are used as the sample frame.
- `MFprob`: What proportion of the sample should be male names and what proportion should be female? Specify as a numeric vector that sums to 1 (for example, `c(.6, .4)`). The first number represents the probability of sampling a `"male"` first name, and the second number represents the probability of sampling a `"female"` name. This argument is not used if only one `gender` has been specified in the previous argument. Defaults to `NULL`, in which case, the probability used is `c(.5, .5)`.
- `dataset`: What do you want to use as the dataset of names from which to sample? A default dataset is provided that can generate over 400 million unique names. See the "*Dataset Details*" section for more information.

## Dataset Details

This function samples from a provided dataset of names. By default, it uses the data from the *Genealogy Data: Frequently Occurring Surnames from Census 1990–Names Files* web page. Those data have been converted to `list` named "`CensusNames1990`" containing three `data.frame`s (named `"surnames"`, `"malenames"`, and `"femalenames"`) and saved as an `.RData` file named `CensusNames.RData`. The data file (approximately 615 kb) can be manually downloaded from Github[2] and loaded to your workspace. The function will perform some basic checking to see if either the `CensusNames.RData` file or the `CensusNames1990` objects are available in your workspace or working directory. If neither is found and an internet connection is active during your R session, the function will offer you the option to automatically download the dataset and add it to your *current* session.

Alternatively, you may provide your own data in a `list` formatted according to the following specifications (see the "`myCustomNames`" data in the "*Examples*" section). *Please remember that R is case sensitive!*

[1] See http://www.census.gov/genealogy/www/data/1990surnames/names_files.html
[2] See: https://github.com/mrdwab/2657-R-Functions/blob/master/data/CensusNames.RData

- This must be a named list with three items: `"surnames"`, `"malenames"`, and `"femalenames"`.
- The contents of each list item is a `data.frame` with at least the following named columns: `"Name"` and `"Category"`.
- Acceptable values for `"Category"` are `"common"`, `"rare"`, and `"average"`.

## Examples

```
# Load the function!
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/random.names.R"))))

# Generate 20 random names
RandomNames(N = 20)
```

```
##    Gender FirstName   Surnames
## 1       M       Jon    Cranmer
## 2       M     Jamal Handelsman
## 3       F  Lashawna      Kolbe
## 4       M    Cletus    Custeau
## 5       F    Lenora      Abbot
## 6       F   Maryann     Mossor
## 7       M Guillermo    Baillio
## 8       M   Zackary  Hovsepian
## 9       M   Horacio     Lagoni
## 10      M     Donny Lamantagne
## 11      M      Seth        Abe
## 12      M      Carl     Sandos
## 13      F    Adelle   Letendre
## 14      M Francesco   Piccione
## 15      M    Lyndon     Rippin
## 16      M    Barney      Detro
## 17      M   Agustin      Mudie
## 18      M    Jayson     Resler
## 19      M    Jarred      Savio
## 20      M    Norris    Aadland
```

```
# Generate a reproducible list of 100 random names with approximately 80% of
#   the names being female names, and 20% being male names.
set.seed(1)
temp <- RandomNames(cat = "common", MFprob = c(.2, .8))
list(head(temp), tail(temp))
```

```
## [[1]]
##   Gender FirstName   Surnames
## 1      F   Mildred     Moring
## 2      F  Gertrude      Duron
## 3      F     Marta      Croom
## 4      F  Angelita  Neuberger
## 5      M    Morris   Gallucci
## 6      F      Enid Barrientos
##
## [[2]]
##     Gender FirstName  Surnames
```

```
## 95       F    Jeanie Toussaint
## 96       F Rosalinda  Beauvais
## 97       F   Blanche Schaeffer
## 98       F      Lena      Hepp
## 99       F    Louisa    Struck
## 100      F    Dorthy    Divito
```

```
table(temp$Gender)
```

```
##
##  F  M
## 84 16
```

```
# Cleanup
rm(.Random.seed, envir=globalenv()) # Resets your seed
rm(temp)

# Generate 10 names from the common and rare categories of names
RandomNames(N = 10, cat = c("common", "rare"))
```

```
##    Gender FirstName  Surnames
## 1       F    Vashti Deschenes
## 2       F    Phoebe   Kampner
## 3       M   Freddie    Banker
## 4       F    Audrie    Walper
## 5       F   Dolores  Jandreau
## 6       F       Liz   Pavlick
## 7       M     Chong  Patellis
## 8       M    Emmitt   Lenahan
## 9       F   Lekisha    Heyman
## 10      M     Danny  Moorhead
```

```
# Error messages
RandomNames(cat = c("common", "rare", "avg"))
```

```
## Error: cat must be either "all", NULL, or a combination of "common", "average",
## or "rare"
```

```
# Generate 10 female names
RandomNames(N = 10, gender = "female")
```

```
##    Gender FirstName     Surnames
## 1       F     Ninfa      Moscato
## 2       F      Chae        Arney
## 3       F  Annmarie         Jens
## 4       F     Ciera      Bassani
## 5       F   Merlene   Ferrandino
## 6       F   Classie       Burnes
## 7       F  Charlott      Onorati
## 8       F      Veda   Carrithers
## 9       F    Imelda Winterholler
## 10      F   Majorie        Devol
```

### Using Your Own Data

As mentioned, it is possible to use your own list of names as the basis for generating the random names (though this is perhaps unnecessary, given the number of random names possible with the provided dataset). The following is an example of how your dataset must be structured. Note that the dataset name in the `dataset` argument is *not* quoted.

```
myCustomNames <- list(
  surnames = data.frame(
    Name = LETTERS[1:26],
    Category = c(rep("rare", 10), rep("average", 10), rep("common", 6))),
  malenames = data.frame(
    Name = letters[1:10],
    Category = c(rep("rare", 4), rep("average", 4), rep("common", 2))),
  femalenames = data.frame(
    Name = letters[11:26],
    Category = c(rep("rare", 8), rep("average", 4), rep("common", 4))))
str(myCustomNames)
```

```
## List of 3
##  $ surnames   :'data.frame': 26 obs. of  2 variables:
##   ..$ Name    : Factor w/ 26 levels "A","B","C","D",..: 1 2 3 4 5 6 7 8 9 10 ...
##   ..$ Category: Factor w/ 3 levels "average","common",..: 3 3 3 3 3 3 3 3 3 3 ...
##  $ malenames  :'data.frame': 10 obs. of  2 variables:
##   ..$ Name    : Factor w/ 10 levels "a","b","c","d",..: 1 2 3 4 5 6 7 8 9 10
##   ..$ Category: Factor w/ 3 levels "average","common",..: 3 3 3 3 1 1 1 1 2 2
##  $ femalenames:'data.frame': 16 obs. of  2 variables:
##   ..$ Name    : Factor w/ 16 levels "k","l","m","n",..: 1 2 3 4 5 6 7 8 9 10 ...
##   ..$ Category: Factor w/ 3 levels "average","common",..: 3 3 3 3 3 3 3 3 1 1 ...
```

```
RandomNames(N = 15, dataset = myCustomNames)
```

```
##    Gender FirstName Surnames
## 1       M         a        X
## 2       M         j        O
## 3       M         i        E
## 4       F         q        W
## 5       M         j        D
## 6       M         g        Z
## 7       F         z        K
## 8       F         r        W
## 9       F         k        J
## 10      F         p        V
## 11      M         a        Q
## 12      F         q        A
## 13      M         d        M
## 14      F         m        H
## 15      F         w        B
```

## References


- Inspired by the online Random Name Generator (http://random-name-generator.info/).
- Uses data from the 1990 US Census (http://www.census.gov/genealogy/www/data/1990surnames/names_files.html)

# Chapter 5

# row.extractor

The `row.extractor` function takes a `data.frame` and extracts rows with the `min`, `median`, or `max` values of a given variable, or extracts rows with specific quantiles of a given variable.

## Arguments

- `data`: the source `data.frame`.
- `extract.by`: the column which will be used as the reference for extraction; can be specified either by the column number or the variable name.
- `what`: options are `min` (for all rows matching the minimum value), `median` (for the median row or rows), `max` (for all rows matching the maximum value), or `all` (for `min`, `median`, and `max`); alternatively, a numeric vector can be specified with the desired quantiles, for instance `c(0, .25, .5, .75, 1)`

## Examples

```
# Load the function!
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/row.extractor.R"))))

# Make up some data
set.seed(1)
dat = data.frame(V1 = 1:50, V2 = rnorm(50),
                 V3 = round(abs(rnorm(50)), digits=2),
                 V4 = sample(1:30, 50, replace=TRUE))
# Get a sumary of the data
summary(dat)
```

```
##        V1             V2               V3              V4
##  Min.   : 1.0   Min.   :-2.215   Min.   :0.000   Min.   : 2.00
##  1st Qu.:13.2   1st Qu.:-0.372   1st Qu.:0.347   1st Qu.: 8.25
##  Median :25.5   Median : 0.129   Median :0.590   Median :13.00
##  Mean   :25.5   Mean   : 0.100   Mean   :0.774   Mean   :14.80
##  3rd Qu.:37.8   3rd Qu.: 0.728   3rd Qu.:1.175   3rd Qu.:20.75
##  Max.   :50.0   Max.   : 1.595   Max.   :2.400   Max.   :29.00
```

```
# Get the rows corresponding to the 'min', 'median', and 'max' of 'V4'
row.extractor(dat, 4)
```

```
##    V1      V2   V3 V4
## 28 28 -1.4708 0.00  2
## 47 47  0.3646 1.28 13
## 29 29 -0.4782 0.07 13
## 11 11  1.5118 2.40 29
## 14 14 -2.2147 0.03 29
## 18 18  0.9438 1.47 29
## 19 19  0.8212 0.15 29
## 50 50  0.8811 0.47 29
```

```
# Get the ,min, rows only, referenced by the variable name
row.extractor(dat, "V4", "min")
```

```
##    V1     V2 V3 V4
## 28 28 -1.471  0  2
```

```
# Get the ,median, rows only. Notice that there are two rows
#    since we have an even number of cases and true median
#    is the mean of the two central sorted values
row.extractor(dat, "V4", "median")
```

```
##    V1      V2   V3 V4
## 47 47  0.3646 1.28 13
## 29 29 -0.4782 0.07 13
```

```
# Get the rows corresponding to the deciles of ,V3,
row.extractor(dat, "V3", seq(0.1, 1, 0.1))
```

```
##    V1       V2   V3 V4
## 10 10 -0.30539 0.14 22
## 26 26 -0.05613 0.29 16
## 39 39  1.10003 0.37 13
## 41 41 -0.16452 0.54 10
## 30 30  0.41794 0.59 26
## 44 44  0.55666 0.70  5
## 37 37 -0.39429 1.06 21
## 49 49 -0.11235 1.22 14
## 34 34 -0.05381 1.52 19
## 11 11  1.51178 2.40 29
```

## To Do

- Add some error checking to make sure a valid `what` is provided.

## References

`which.quantile` function by cbeleites
See: http://stackoverflow.com/q/10256503/1270695

# Chapter 6

# sample.size

The `sample.size` function either calculates the optimum survey sample size when provided with a population size, or the confidence interval of using a certain sample size with a given population. It can be used to generate tables (`data.frame`s) of different combinations of inputs of the following arguments, which can be useful for showing the effect of each of these in sample size calculation.

## The Arguments

- `population`: The population size for which a sample size needs to be calculated.
- `samp.size`: The sample size.
  - This argument is only used when calculating the confidence interval, and defaults to `NULL`.
- `c.lev`: The desired confidence level. Defaults to a reasonable 95%.
- `c.int`: The confidence interval.
  - This argument is only used when calculating the sample size.
  - If not specified when calculating the sample size, defaults to 5% and a message is provided indicating this; this is also the default action if `c.int = NULL`.
- `what`: Should the function calculate the desired sample size or the confidence interval?
  - Accepted values are `"sample"` and `"confidence"` (quoted), and defaults to "`sample`".
- `distribution`: Response distribution. Defaults to 50%, which will give you the largest sample size.

## Examples

```
# Load the function!
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/sample.size.R"))))
# What should our sample size be for a population of 300?
# All defaults accepted.
sample.size(population = 300)
```

```
##   population conf.level conf.int distribution sample.size
## 1        300         95        5           50         169
```

```
# What sample should we take for a population of 300
#   at a confidence level of 97%?
sample.size(population = 300, c.lev = 97)
```

```
##   population conf.level conf.int distribution sample.size
## 1        300         97        5           50         183
```

```
# What about if we change our confidence interval?
sample.size(population = 300, c.int = 2.5, what = "sample")
```

```
##   population conf.level conf.int distribution sample.size
## 1        300         95      2.5           50         251
```

```
# What about if we want to determine the confidence interval
#   of a sample of 140 from a population of 300? A confidence
#   level of 95% is assumed.
sample.size(population = 300, samp.size = 140, what = "confidence")
```

```
##   population conf.level conf.int distribution sample.size
## 1        300         95     6.06           50         140
```

## Advanced Usage

As the function is vectorized, it is possible to easily make tables with multiple scenarios.

```
# What should the sample be for populations of 300 to 500 by 50?
sample.size(population=c(300, 350, 400, 450, 500))
```

```
##   population conf.level conf.int distribution sample.size
## 1        300         95        5           50         169
## 2        350         95        5           50         183
## 3        400         95        5           50         196
## 4        450         95        5           50         207
## 5        500         95        5           50         217
```

```
# How does varying confidence levels or confidence intervals
#   affect the sample size?
sample.size(population=300,
            c.lev=rep(c(95, 96, 97, 98, 99), times = 3),
            c.int=rep(c(2.5, 5, 10), each=5))
```

```
##    population conf.level conf.int distribution sample.size
## 1         300         95      2.5           50         251
## 2         300         96      2.5           50         255
## 3         300         97      2.5           50         259
## 4         300         98      2.5           50         264
## 5         300         99      2.5           50         270
## 6         300         95      5.0           50         169
## 7         300         96      5.0           50         176
## 8         300         97      5.0           50         183
## 9         300         98      5.0           50         193
## 10        300         99      5.0           50         207
## 11        300         95     10.0           50          73
## 12        300         96     10.0           50          78
## 13        300         97     10.0           50          85
## 14        300         98     10.0           50          93
## 15        300         99     10.0           50         107
```

```
# What is are the confidence intervals for a sample of
#   150, 160, and 170 from a population of 300?
sample.size(population=300,
            samp.size = c(150, 160, 170),
            what="confidence")
```

```
##   population conf.level conf.int distribution sample.size
## 1        300         95     5.67           50         150
## 2        300         95     5.30           50         160
## 3        300         95     4.96           50         170
```

Note that the use of `rep()` is required in constructing the arguments for the advanced usage examples where more than one argument takes on multiple values.

## References

See the *2657 Productions News* site for how this function progressively developed[1]. The `sample.size` function is based on the following formulas[2]:

$$ss = \frac{-Z^2 \times p \times (1-p)}{c^2}$$

$$pss = \frac{ss}{1+\frac{ss-1}{pop}}$$

[1] http://news.mrdwab.com/2010/09/10/a-sample-size-calculator-function-for-r/

[2] See: Creative Research Systems. (n.d.). *Sample size formulas for our sample size calculator.* Retrieved from: http://www.surveysystem.com/sample-size-formula.htm. Archived on 07 August 2012 at http://www.webcitation.org/69kNjMuKe.

# Chapter 7

# stringseed.sampling

The `stringseed.sampling` function is designed as a batch sampling function that allows the user to specify any alphanumeric input as the seed *per sample in the batch*.

## The Arguments

- `seedbase`: A vector of seeds to be used for sampling.
- `N`: The "population" from which to draw the sample.
- `n`: The desired number of samples.
- `write.output`: Logical. Should the output be written to a file? Defaults to `FALSE`. If `TRUE`, a csv file is written with the sample "metadata", and a plain text file is written with the details of the resulting sample. The names of the files written are "`Sample frame generated on {date the script was run} .csv`" and "`Samples generated on {date the script was run} .txt`" and will be found in your current working directory.

## Examples

```
# Load the function!
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/stringseed.sampling.R"))))
# We'll use a data.frame with a list of village names, the population,
#   and the desired samples as our columns. The function will use the
#   village names to generate a unique seed for each village before
#   drawing the sample.
myListOfPlaces <- data.frame(
  villageName = c("Melakkal", "Sholavandan", "T. Malaipatti"),
  population = c(120, 130, 140),
  requiredSample = c(30, 25, 12))
myListOfPlaces
```

```
##     villageName population requiredSample
## 1       Melakkal        120             30
## 2   Sholavandan        130             25
## 3 T. Malaipatti        140             12
```

```
stringseed.sampling(seedbase = myListOfPlaces$villageName,
                    N = myListOfPlaces$population,
                    n = myListOfPlaces$requiredSample)
```

```
## $input
##        seedbase populations samplesizes      seeds
## 1      Melakkal         120          30 1331891848
## 2   Sholavandan         130          25  438637044
## 3 T. Malaipatti         140          12 1614276325
##
## $samples
## $samples$Melakkal
##  [1] 108  13  54  96  56 111 110  27 112  84  60  62  22  12  23 117  93  67  79
## [20]  74  65  90  71 113  53  85  40  19  31  18
##
## $samples$Sholavandan
##  [1]  94  14  27  96 102  11  47  18 118  91 120  57  40  89   5 105 116  70 109
## [20]  35  16  90   4  98  30
##
## $samples$`T. Malaipatti`
##  [1] 130 102  20 123  85 104   5 105   7 115  96 120
```

```
# Manual verification of the samples generated for Melakkal village
#   (for which the automatically generated seed was 1331891848)
set.seed(1331891848)
sample(120, 30)
```

```
##  [1] 108  13  54  96  56 111 110  27 112  84  60  62  22  12  23 117  93  67  79
## [20]  74  65  90  71 113  53  85  40  19  31  18
```

```
# What about using the function on a single input?
stringseed.sampling("Santa Barbara", 1920, 100)
```

```
## $input
##        seedbase populations samplesizes     seeds
## 1 Santa Barbara        1920         100 323728098
##
## $samples
##   [1]  129 1869 1170  192  344   18  694 1628  601  874  188  631 1910  605  367
##  [16] 1411  755 1741  489  658  821 1160 1783  150 1556  423  753  416 1510  707
##  [31] 1353 1744  520 1720 1608  990 1235  402 1669 1800  502 1516 1531 1860 1369
##  [46] 1431 1570 1290 1731 1679 1070  931   68 1466 1836  316  815   24 1877 1689
##  [61] 1141  981  279 1605  842 1773 1186 1081   17  661 1104 1668 1180   54 1233
##  [76] 1879 1666  449  838 1167 1157  773 1707  916 1243  492  525 1308 1460  232
##  [91] 1695 1644 1312 1051 1325  545  397 1551  477 1205
```

## References

Ben Bolker[1] recommended the use of the "digest" package to convert a string to a numeric value. See: http://stackoverflow.com/q/10910698/1270695.

[1] Website: http://www.math.mcmaster.ca/~bolker; Stack Overflow profile: http://stackoverflow.com/users/190277/ben-bolker.

# Part II

# The Functions

# Chapter 8

# Where to Get the Functions

The most current source code for the functions described in this document follow.

To load the functions, you can directly source them from the 2657 R Functions page at github: https://github.com/mrdwab/2657-R-Functions

You should be able to load the functions using the following (replace `----------` with the function name[1]):

```
require(RCurl)
baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
source(textConnection(getURL(paste0(baseURL, "scripts/----------.R"))))
```

[1] The "snippets" in Part III of this document can all be loaded from the script `snippets.R`.

# Chapter 9

# concat.split

```
concat.split = function(data, split.col, to.list=FALSE, mode=NULL,
                        sep=",", drop.col=FALSE) {
  # Takes a column with multiple values, splits the values into
  #   separate columns, and returns a new data.frame.
  # --data-- is the source data.frame; --split.col-- is the variable that
  #   needs to be split; --to.list-- is whether the split output should
  #   be added as a single variable list (defaults to "FALSE");
  #   --mode-- can be either --binary-- or --value-- (where --binary-- is
  #   default and it recodes values to 1 or NA); --sep-- is the
  #   character separating each value (defaults to --,--);
  #   and --drop.col-- is logical (whether to remove the original
  #   variable from the output or not.
  #
  # === EXAMPLES ===
  #
  #       dat = data.frame(V1 = c("1, 2, 4", "3, 4, 5",
  #                               "1, 2, 5", "4", "1, 2, 3, 5"),
  #                        V2 = c("1;2;3;4", "1", "2;5",
  #                               "3;2", "2;3;4"))
  #       dat2 = data.frame(V1 = c("Fred, John, Sue", "Jerry, Jill",
  #                                "Sally, Ryan", "Susan, Amos, Ben"))
  #
  #       concat.split(dat, 1)
  #       concat.split(dat, 2, sep=";")
  #       concat.split(dat, "V2", sep=";", mode="value")
  #       concat.split(dat, "V1", mode="binary")
  #       concat.split(dat2, 1)
  #       concat.split(dat2, "V1", drop.col=TRUE)
  #
  # See: http://stackoverflow.com/q/10100887/1270695

  # Check to see if split.col is specified by name or position
  if (is.numeric(split.col)) split.col = split.col
  else split.col = which(colnames(data) %in% split.col)

  # Split the data
  a = as.character(data[ , split.col])
  b = strsplit(a, sep)

  #### LIST ####

  if (isTRUE(to.list)) {
```

```
    varname = paste(names(data[split.col]), "_list", sep="")
    if (suppressWarnings(is.na(try(max(as.numeric(unlist(b)))))) {
      data[varname] = list(lapply(lapply(b, as.character),
                                  function(x) gsub("^\\s+|\\s+$",
                                                   "", x)))
    } else if (!is.na(try(max(as.numeric(unlist(b)))))) {
      data[varname] = list(lapply(b, as.numeric))
    }
    if (isTRUE(drop.col)) data[-split.col]
    else data

  ### SEPARATE COLUMNS ###

  } else if (!isTRUE(to.list)) {
    if (suppressWarnings(is.na(try(max(as.numeric(unlist(b)))))) {
      what = "string"
      ncol = max(unlist(lapply(b, function(i) length(i))))
    } else if (!is.na(try(max(as.numeric(unlist(b)))))) {
      what = "numeric"
      ncol = max(as.numeric(unlist(b)))
    }

    if (identical(what, "string")) {
      temp = as.data.frame(t(sapply(b, `[`, 1:ncol)))
      names(temp) = paste(names(data[split.col]), "_", 1:ncol, sep="")
      temp = apply(temp, 2, function(x) gsub("^\\s+|\\s+$", "", x))
      temp1 = cbind(data, temp)
    } else if (identical(what, "numeric")) {
      temp = lapply(b, as.numeric)
      m = matrix(nrow = nrow(data), ncol = ncol)
      for (i in 1:nrow(data)) {
        m[i, temp[[i]]] = temp[[i]]
      }

      m = setNames(data.frame(m),
                   paste(names(data[split.col]), "_", 1:ncol, sep=""))

      if (is.null(mode) || identical(mode, "binary")) {
        temp1 = cbind(data, replace(m, m != "NA", 1))
      } else if (identical(mode, "value")) {
        temp1 = cbind(data, m)
      }
    }

    if (isTRUE(drop.col)) temp1[-split.col]
    else temp1
  }
}
```

# Chapter 10

# df.sorter

```
df.sorter <- function(data, var.order=names(data),
                      col.sort=NULL, at.start=TRUE ) {
  # Sorts a data.frame by columns or rows or both. Can also subset the
  #   data columns by using --var.order--. Can refer to variables either
  #   by names or number. If referring to variable by number, and sorting
  #   both the order of variables and the sorting within variables,
  #   refer to the variable numbers of the final data.frame.
  #
  # === EXAMPLES ===
  #
  #    library(foreign)
  #    temp = "http://www.ats.ucla.edu/stat/stata/modules/kidshtwt.dta"
  #    kidshtwt = read.dta(temp); rm(temp)
  #    df.sorter(kidshtwt, var.order = c("fam", "bir", "wt", "ht"))
  #    df.sorter(kidshtwt, var.order = c("fam", "bir", "wt", "ht"),
  #              col.sort = c("birth", "famid")) # USE FULL NAMES HERE
  #    df.sorter(kidshtwt, var.order = c(1:4),   # DROP THE WT COLUMNS
  #              col.sort = 3)                   # SORT BY HT1

  if (is.numeric(var.order))
    var.order = colnames(data)[var.order]
  else var.order = var.order

  if (isTRUE(at.start)) {
    x = unlist(lapply(var.order, function(x)
      sort(grep(paste("^", x, sep="", collapse=""),
                names(data), value = TRUE))))
  } else if (!isTRUE(at.start)) {
    x = unlist(lapply(var.order, function(x)
      sort(grep(x, names(data), value = TRUE))))
  }

  y = data[, x]

  if (is.null(col.sort)) {
    y
  } else if (is.numeric(col.sort)) {
    y[do.call(order, y[colnames(y)[col.sort]]), ]
  } else if (!is.numeric(col.sort)) {
    y[do.call(order, y[col.sort]), ]
  }
}
```

# Chapter 11

# multi.freq.table

```
multi.freq.table <- function(data, sep = "", boolean = TRUE, factors = NULL,
                             NAto0 = TRUE, basic = FALSE, dropzero=TRUE,
                             clean=TRUE) {
  # Takes multiple-response data and tabulates it according
  #   to the possible combinations of each variable.
  #
  # === EXAMPLES ===
  #
  #     set.seed(1)
  #     dat = data.frame(A = sample(c(0, 1), 20, replace=TRUE),
  #                      B = sample(c(0, 1), 20, replace=TRUE),
  #                      C = sample(c(0, 1), 20, replace=TRUE),
  #                      D = sample(c(0, 1), 20, replace=TRUE),
  #                      E = sample(c(0, 1), 20, replace=TRUE))
  #   multi.freq.table(dat)
  #   multi.freq.table(dat[1:3], sep="-", dropzero=TRUE)
  #
  # See: http://stackoverflow.com/q/11348391/1270695
  #      http://stackoverflow.com/q/11622660/1270695

  if (!is.data.frame(data)) {
    stop("Input must be a data frame.")
  }

  if (isTRUE(boolean)) {
    CASES = nrow(data)
    RESPS = sum(data, na.rm=TRUE)

    if(isTRUE(NAto0)) {
      data[is.na(data)] = 0
      VALID = CASES
      VRESP = RESPS
    } else if(!isTRUE(NAto0)) {
      data = data[complete.cases(data), ]
      VALID = CASES - (CASES - nrow(data))
      VRESP = sum(data)
    }

    if(isTRUE(basic)) {
      counts = data.frame(Freq = colSums(data),
                          Pct.of.Resp = (colSums(data)/sum(data))*100,
                          Pct.of.Cases = (colSums(data)/nrow(data))*100)
```

```
  } else if (!isTRUE(basic)) {
    counts = data.frame(table(data))
    Z = counts[, c(intersect(names(data), names(counts)))]
    Z = rowSums(sapply(Z, as.numeric)-1)
    if(Z[1] == 0) { Z[1] = 1 }
    N = ncol(counts)
    counts$Combn = apply(counts[-N] == 1, 1,
                         function(x) paste(names(counts[-N])[x],
                                           collapse=sep))
    counts$Weighted.Freq = Z*counts$Freq
    counts$Pct.of.Resp = (counts$Weighted.Freq/sum(data))*100
    counts$Pct.of.Cases = (counts$Freq/nrow(data))*100
    if (isTRUE(dropzero)) {
      counts = counts[counts$Freq != 0, ]
    } else if (!isTRUE(dropzero)) {
      counts = counts
    }
    if (isTRUE(clean)) {
      counts = data.frame(Combn = counts$Combn, Freq = counts$Freq,
                          Weighted.Freq = counts$Weighted.Freq,
                          Pct.of.Resp = counts$Pct.of.Resp,
                          Pct.of.Cases = counts$Pct.of.Cases)
    }
  }
  message("Total cases:     ", CASES, "\n",
          "Valid cases:     ", VALID, "\n",
          "Total responses: ", RESPS, "\n",
          "Valid responses: ", VRESP, "\n")
  counts
} else if (!isTRUE(boolean)) {
  CASES = nrow(data)
  RESPS = length(data[!is.na(data)])
  if (!isTRUE(any(sapply(data, is.factor)))) {
    if (is.null(factors)) {
      stop("Input variables must be factors.
      Please provide factors using the ‚factors‚ argument or
           convert your data to factor before using function.")
    } else {
      data[sapply(data, is.character)] =
        lapply(data[sapply(data, is.character)],
               function(x) factor(x, levels=factors))
    }
  }
  if (isTRUE(basic)) {
    ROWS = levels(unlist(data))
    OUT = table(unlist(data))
    PCT = (OUT/sum(OUT)) * 100
    OUT = data.frame(ROWS, OUT, PCT, row.names=NULL)
    OUT = data.frame(Item = OUT[, 1], Freq = OUT[, 3],
                     Pct.of.Resp = OUT[, 5],
                     Pct.of.Cases = (OUT[, 3]/CASES)*100)
    message("Total cases:     ", CASES, "\n",
            "Total responses: ", RESPS, "\n")
    OUT
  } else if (!isTRUE(basic)) {
    Combos = apply(data, 1, function(x) paste0(sort(x), collapse = sep))
    Weight = as.numeric(rowSums(!is.na(data)))
    OUT = data.frame(table(Combos, Weight))
```

```
      OUT = OUT[OUT$Freq > 0, ]
      OUT$Weight = as.numeric(as.character(OUT$Weight))
      if(OUT$Weight[1] == 0) { OUT$Weight[1] = 1 }
      OUT$Weighted.Freq = OUT$Weight*OUT$Freq
      OUT$Pct.of.Resp = (OUT$Weighted.Freq/RESPS)*100
      OUT$Pct.of.Cases = (OUT[, 3]/CASES)*100
      message("Total cases:     ", CASES, "\n",
              "Total responses: ", RESPS, "\n")
      OUT[-2]
    }
  }
}
```

# Chapter 12

# RandomNames

```
RandomNames <- function(N = 100, cat = NULL, gender = NULL,
                        MFprob = NULL, dataset = NULL) {
  # Generates a "data.frame" of random names with the following columns:
  #   "Gender", "FirstName", and "Surname". All arguments have preset
  #   defaults, so the function can be run simply by typing RandomNames(),
  #   which will generate 100 random male and female names.
  #
  # === EXAMPLES ===
  #
  #     RandomNames()
  #     RandomNames(N = 20)
  #     RandomNames(cat = "common", MFprob = c(.2, .8))
  #
  # See:
  #   - http://www.census.gov/genealogy/www/data/1990surnames/names_files.html
  #   - http://random-name-generator.info/

  if (is.null(dataset)) {
    if (!exists("CensusNames1990", where = 1)) {
      if (isTRUE(list.files(
        pattern = "^CensusNames.RData$") == "CensusNames.RData")) {
        load("CensusNames.RData")
      } else {
        ans = readline("
    CensusNames.RData dataset not found in working directory.
    CensusNames1990 object not found in workspace. \n
    Download and load the dataset now? (y/n) ")
        if (ans != "y")
          return(invisible())
        require(RCurl)
        baseURL = c("https://raw.github.com/mrdwab/2657-R-Functions/master/")
        temp = getBinaryURL(paste0(baseURL, "data/CensusNames.RData"))
        load(rawConnection(temp), envir=.GlobalEnv)
        message("CensusNames1990 data downloaded from \n",
                paste0(baseURL, "data/CensusNames.RData \n"),
                "and added to your workspace\n\n")
        rm(temp, baseURL)
      }
    }
    dataset <- CensusNames1990
  }
  TEMP <- dataset
```

```
  possiblecats <- c("common", "rare", "average")
  if(all(cat %in% possiblecats) == FALSE)
    stop(‚cat must be either "all", NULL,
         or a combination of "common", "average", or "rare"‚)
  possiblegenders <- c("male", "female", "both")
  if (all(gender %in% possiblegenders) == FALSE) {
    stop(‚gender must be either "both", NULL, "male", or "female"‚)
  }
  if (isTRUE(identical(gender, c("male", "female"))) ||
        isTRUE(identical(gender, c("female", "male")))) {
    gender <- "both"
  }
  if (is.null(cat) || cat == "all") {
    surnames <- TEMP[["surnames"]][["Name"]]
    malenames <- paste("M-", TEMP[["malenames"]][["Name"]], sep="")
    femalenames <- paste("F-", TEMP[["femalenames"]][["Name"]], sep="")
  } else {
    surnames <- suppressWarnings(
      with(TEMP[["surnames"]],
           TEMP[["surnames"]][Category == cat, "Name"]))
    malenames <- paste("M-", suppressWarnings(
      with(TEMP[["malenames"]],
           TEMP[["malenames"]][Category == cat, "Name"])), sep="")
    femalenames <- paste("F-", suppressWarnings(
      with(TEMP[["femalenames"]],
           TEMP[["femalenames"]][Category == cat, "Name"])), sep="")
  }

  if (is.null(gender) || gender == "both") {
    if (is.null(MFprob)) MFprob <- c(.5, .5)
    firstnames <- sample(c(malenames, femalenames), N, replace = TRUE,
                         prob = c(rep(MFprob[1]/length(malenames),
                                      length(malenames)),
                                  rep(MFprob[2]/length(femalenames),
                                      length(femalenames))))
  } else if (gender == "female") {
    firstnames <- sample(femalenames, N, replace = TRUE)
  } else if (gender == "male") {
    firstnames <- sample(malenames, N, replace = TRUE)
  }

  Surnames <- sample(surnames, N, replace = TRUE)
  temp <- setNames(data.frame(do.call(rbind, strsplit(firstnames, "-"))),
                   c("Gender", "FirstName"))
  cbind(temp, Surnames)
}
```

# Chapter 13

# row.extractor

```
row.extractor = function(data, extract.by, what="all") {
  # Extracts rows with min, median, and max values, or by quantiles. Values
  #   for --what-- can be "min", "median", "max", "all", or a vector
  #   specifying the desired quantiles. Values for --extract.by-- can be
  #   the variable name or number.
  #
  # === EXAMPLES ===
  #
  #    set.seed(1)
  #    dat = data.frame(V1 = 1:10, V2 = rnorm(10), V3 = rnorm(10),
  #                     V4 = sample(1:20, 10, replace=T))
  #    dat2 = dat[-10,]
  #    row.extractor(dat, 4, "all")
  #    row.extractor(dat1, 4, "min")
  #    row.extractor(dat, "V4", "median")
  #    row.extractor(dat, 4, c(0, .5, 1))
  #    row.extractor(dat, "V4", c(0, .25, .5, .75, 1))
  #
  # "which.quantile" function by cbeleites:
  # http://stackoverflow.com/users/755257/cbeleites
  # See: http://stackoverflow.com/q/10256503/1270695

  if (is.numeric(extract.by)) {
    extract.by = extract.by
  } else if (is.numeric(extract.by) != 0) {
    extract.by = which(colnames(data) %in% "extract.by")
  }

  if (is.character(what)) {
    which.median = function(data, extract.by) {
      a = data[, extract.by]
      if (length(a) %% 2 != 0) {
        which(a == median(a))
      } else if (length(a) %% 2 == 0) {
        b = sort(a)[c(length(a)/2, length(a)/2+1)]
        c(max(which(a == b[1])), min(which(a == b[2])))
      }
    }

    X1 = data[which(data[extract.by] == min(data[extract.by])), ] # min
    X2 = data[which(data[extract.by] == max(data[extract.by])), ] # max
    X3 = data[which.median(data, extract.by), ]                   # median
```

```
    if (identical(what, "min")) {
      X1
    } else if (identical(what, "max")) {
      X2
    } else if (identical(what, "median")) {
      X3
    } else if (identical(what, "all")) {
      rbind(X1, X3, X2)
    }
  } else if (is.numeric(what)) {
    which.quantile <- function (data, extract.by, what, na.rm = FALSE) {

      x = data[ , extract.by]

      if (! na.rm & any (is.na (x)))
        return (rep (NA_integer_, length (what)))

      o <- order (x)
      n <- sum (! is.na (x))
      o <- o [seq_len (n)]

      nppm <- n * what - 0.5
      j <- floor(nppm)
      h <- ifelse((nppm == j) & ((j%%2L) == 0L), 0, 1)
      j <- j + h

      j [j == 0] <- 1
      o[j]
    }
    data[which.quantile(data, extract.by, what), ]           # quantile
  }
}
```

# Chapter 14

# sample.size

```
sample.size <- function(population, samp.size = NULL, c.lev = 95,
                        c.int = NULL, what = "sample", distribution=50) {
  # Returns a data.frame of sample sizes or confidence intervals for
  #   different conditions provided by the following arguments.
  #
  # --> populaton     Population size
  # --> samp.size     Sample size
  # --> c.lev         Confidence level
  # --> c.int         Confidence interval (+/-)
  # --> what          Whether sample size or confidence interval
  #                     is being calculated.
  # --> distribution  Response distribution
  #
  # === EXAMPLES ===
  #
  #   sample.size(300)
  #   sample.size(300, 150, what="confidence")
  #   sample.size(c(300, 400, 500), c.lev=97)

  z = qnorm(.5+c.lev/200)

  if (identical(what, "sample")) {
    if (is.null(c.int)) {
      c.int = 5

      message("NOTE! Confidence interval set to 5.
      To override, set >> c.int << to desired value.\n")

    } else if (!is.null(c.int) == 1) {
      c.int = c.int
    }

    if (!is.null(samp.size)) {
      message("NOTE! >> samp.size << value provided but ignored.
      See output for actual sample size(s).\n")
    }

    ss = (z^2 * (distribution/100) *
      (1-(distribution/100)))/((c.int/100)^2)
    samp.size = ss/(1 + ((ss-1)/population))

  } else if (identical(what, "confidence")) {
```

```
    if (is.null(samp.size)) {
      stop("Missing >> samp.size << with no default value.")
    }
    if (!is.null(c.int)) {
      message("NOTE! >> c.int << value provided but ignored.
      See output for actual confidence interval value(s).\n")
    }

    ss = ((population*samp.size-samp.size)/(population-samp.size))
    c.int = round(sqrt((z^2 * (distribution/100) *
      (1-(distribution/100)))/ss)*100, digits = 2)

  } else if (what %in% c("sample", "confidence") == 0) {
    stop(">> what << must be either -sample- or -confidence-")
  }

  RES = data.frame(population = population,
                   conf.level = c.lev,
                   conf.int = c.int,
                   distribution = distribution,
                   sample.size = round(samp.size, digits = 0))
  RES
}
```

# Chapter 15

# stringseed.sampling

```
stringseed.sampling <- function(seedbase, N, n, write.output = FALSE) {
  # Designed for batch sampling scenarios using alpha-numeric strings as a
  #   --seedbase--. --N-- represents the "population", and --n--, the sample
  #   size needed. A vector is supplied for each argument (or, alternatively,
  #   a data.frame with the required information). Optionally, the function
  #   can write the output of the function to a file.
  #
  # === EXAMPLE ===
  #
  #   stringseed.sampling(seedbase = c("Village 1", "Village 2", "Village 3"),
  #                       N = c(150, 309, 297), n = c(15, 31, 30))
  #
  # See: http://stackoverflow.com/q/10910698/1270695

  require(digest)
  hexval = paste0("0x", sapply(seedbase, digest, "crc32"))
  seeds = type.convert(hexval) %% .Machine$integer.max
  seedbase = as.character(seedbase)

  temp <- data.frame(seedbase, N, n, seeds)
  if (length(seedbase) == 1) {
    set.seed(temp$seeds); sample.list <- sample(temp$N, temp$n)
  } else {
    sample.list <- setNames(
      apply(temp[-1], 1, function(x)
        {set.seed(x[3]); sample(x[1], x[2])} ), temp[, 1])
  }

  temp <- list(
    input = data.frame(seedbase = seedbase, populations = N,
                       samplesizes = n, seeds = seeds),
    samples = sample.list)
  if(isTRUE(write.output)) {
    write.csv(temp[[1]], file=paste("Sample frame generated on",
                                    Sys.Date(), ".csv", collapse=""))
    capture.output(temp[[2]], file=paste("Samples generated on",
                               Sys.Date(), ".txt", collapse=""))
  }
  rm(.Random.seed, envir=globalenv()) # "resets" the seed
  temp
}
```

# Part III

# Snippets and Tips

# Chapter 16

# Snippets

## Load All Scripts and Data Files From Multiple Directories

```
load.scripts.and.data <- function(path, pattern = list(scripts = "*.R$",
                          data = "*.rda$|*.Rdata$"), ignore.case=TRUE) {
  # Reads all the data files and scripts from specified directories. In
  #   general, should only need to specify the directories. Specify
  #   directories without trailing slashes.
  #
  # === EXAMPLE ===
  #
  #    load.scripts.and.data(c("~/Dropbox/Public",
  #                            "~/Dropbox/Public/R Functions"))

  file.sources = list.files(path, pattern=pattern$scripts,
                            full.names=TRUE, ignore.case=ignore.case)
  data.sources = list.files(path, pattern=pattern$data,
                            full.names=TRUE, ignore.case=ignore.case)
  sapply(data.sources, load, .GlobalEnv)
  sapply(file.sources, source, .GlobalEnv)
}
```

## Convert a List of Data Frames Into Individual Data Frames

```
unlist.dfs <- function(data) {
  # Specify the quoted name of the source list.
  q = get(data)
  prefix = paste0(data, "_", 1:length(q))
  for (i in 1:length(q)) assign(prefix[i], q[[i]], envir=.GlobalEnv)
}
```

### Example

*Note that the list name must be quoted.*

```
# Sample data
temp = list(A = data.frame(A = 1:2, B = 3:4),
            B = data.frame(C = 5:6, D = 7:8))
temp
```

```
## $A
##   A B
## 1 1 3
## 2 2 4
##
## $B
##   C D
## 1 5 7
## 2 6 8
```

```
# Remove any files with similar names to output
rm(list=ls(pattern="temp_"))
# The following should not work
temp_1
```

```
## Error: object 'temp_1' not found
```

```
# Split it up!
unlist.dfs("temp")
# List files with the desired pattern
ls(pattern="temp_")
```

```
## [1] "temp_1" "temp_2"
```

```
# View the new files
temp_1
```

```
##   A B
## 1 1 3
## 2 2 4
```

```
temp_2
```

```
##   C D
## 1 5 7
## 2 6 8
```

## Convert a Data Frame Into a List With Each Column Becoming a List Item

```
dfcols.list <- function(data, vectorize = FALSE) {
  # Specify the unquoted name of the data.frame to convert
  if (isTRUE(vectorize)) {
    dat.list = sapply(1:ncol(data), function(x) data[x])
  } else if (!isTRUE(vectorize)) {
    dat.list = lapply(names(data), function(x) data[x])
  }
  dat.list
}
```

### Examples

```
# Sample data
dat = data.frame(A = c(1:2), B = c(3:4), C = c(5:6))
dat
```

```
##   A B C
## 1 1 3 5
## 2 2 4 6
```

```
# Split into a list, retaining data.frame structure
dfcols.list(dat)
```

```
## [[1]]
##   A
## 1 1
## 2 2
##
## [[2]]
##   B
## 1 3
## 2 4
##
## [[3]]
##   C
## 1 5
## 2 6
```

```
# Split into a list, converting to vector
dfcols.list(dat, vectorize=TRUE)
```

```
## $A
## [1] 1 2
##
## $B
## [1] 3 4
##
## $C
## [1] 5 6
```

## Rename an Object in the Workplace

```
mv <- function (a, b) {
  # Source: https://stat.ethz.ch/pipermail/r-help/2008-March/156035.html
  anm = deparse(substitute(a))
  bnm = deparse(substitute(b))
  if (!exists(anm,where=1,inherits=FALSE))
    stop(paste(anm, "does not exist.\n"))
  if (exists(bnm,where=1,inherits=FALSE)) {
    ans = readline(paste("Overwrite ", bnm, "? (y/n) ", sep =  ""))
    if (ans != "y")
      return(invisible())
  }
  assign(bnm, a, pos = 1)
  rm(list = anm, pos = 1)
  invisible()
}
```

### Basic Usage

If there is already an object with the same name in the workplace, the function will ask you if you want to replace the object or not. Otherwise, the basic usage is:

```
# Rename "object_1" to "object_2"
mv(object_1, object_2)
```

## Scrape Data From a Poorly Formatted HTML Page

Reformats a web page using HTML Tidy and uses the XML package to parse the resulting file. Can optionally save the reformatted page.

```
tidyHTML <- function(URL, saveTidy = TRUE) {
  require(XML)
  URL1 = gsub("/", "%2F", URL)
  URL1 = gsub(":", "%3A", URL1)
  URL1 = paste("http://services.w3.org/tidy/tidy?docAddr=",
               URL1, "&indent=on", sep = "")
  Parsed = htmlParse(URL1)
  if (isTRUE(saveTidy)) saveXML(Parsed, file = basename(URL))
  Parsed
}
```

### Example

```
# Set „saveTidy„ to „TRUE„ to save the resulting tidied file
URL <- "http://www.bcn.gob.ni/estadisticas/trimestrales_y_mensuales/siec/datos/4.IMAE.htm"
temp <- tidyHTML(URL, saveTidy = FALSE)
```

## “Rounding in Commerce”

R rounds to even—something that some people might not be accustomed to or comfortable with. For the more commonly known rounding rule, use this `round2` function.

```
round2 <- function(x, n = 0) {
  posneg = sign(x)
  z = abs(x)*10^n
  z = z + 0.5
  z = trunc(z)
  z = z/10^n
  z*posneg
}
```

### Example

```
x = c(1.85, 1.54, 1.65, 1.85, 1.84)
round(x, 1)
```

```
## [1] 1.8 1.5 1.6 1.8 1.8
```

```
round2(x, 1)
```

```
## [1] 1.9 1.5 1.7 1.9 1.8
```

```
round(seq(0.5, 9.5, by=1))
```

```
##  [1]  0  2  2  4  4  6  6  8  8 10
```

```
round2(seq(0.5, 9.5, by=1))
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10
```

### References

Original function: http://www.webcitation.org/68djeLBtJ – see the comments section.
See also: http://stackoverflow.com/questions/12688717/round-up-from-5-in-r/.

## cbind data.frames When the Number of Rows are Not Equal

`cbind()` does not work when trying to combine `data.frame`s with differing numbers of rows. This function takes a `list` of `data.frame`s, identifies how many extra rows are required to make `cbind` work correctly, and does the combining for you.

The function also works with nested lists by first "flattening" them using the `LinearizeNestedList` by Akhil S Bhel. The first time you run the `CBIND()` function, it check your current environment to identify whether `LinearizeNestedList` is already available; if it is not, it will download and load the function from its Gist page. Subsequent calls to the function in the same session will not re-download the function.

```
CBIND <- function(datalist) {
  if ("LinearizeNestedList" %in% ls(envir=.GlobalEnv) == FALSE) {
    require(devtools)
    suppressMessages(source_gist(4205477))
    message("LinearizeNestedList loaded from https://gist.github.com/4205477")
  }
  datalist <- LinearizeNestedList(datalist)
  nrows <- max(sapply(datalist, nrow))
  expandmyrows <- function(mydata, rowsneeded) {
    temp1 = names(mydata)
    rowsneeded = rowsneeded - nrow(mydata)
    temp2 = setNames(data.frame(
      matrix(rep(NA, length(temp1) * rowsneeded),
             ncol = length(temp1))), temp1)
    rbind(mydata, temp2)
  }
  do.call(cbind, lapply(datalist, expandmyrows, rowsneeded = nrows))
}
```

### Examples

```
# Example data
df1 <- data.frame(A = 1:5, B = letters[1:5])
df2 <- data.frame(C = 1:3, D = letters[1:3])
df3 <- data.frame(E = 1:8, F = letters[1:8], G = LETTERS[1:8])
# Try to use cbind directly
cbind(df1, df2, df3)
```

```
## Error: arguments imply differing number of rows: 5, 3, 8
```

```
# Use our new function
CBIND(list(df1, df2, df3))
```

```
##   1.A  1.B 2.C  2.D 3.E 3.F 3.G
## 1   1    a   1    a   1   a   A
## 2   2    b   2    b   2   b   B
## 3   3    c   3    c   3   c   C
## 4   4    d  NA <NA>   4   d   D
## 5   5    e  NA <NA>   5   e   E
## 6  NA <NA>  NA <NA>   6   f   F
## 7  NA <NA>  NA <NA>   7   g   G
## 8  NA <NA>  NA <NA>   8   h   H
```

```
test1 <- list(df1, df2, df3)
str(test1)
```

```
## List of 3
##  $ :'data.frame':    5 obs. of  2 variables:
##   ..$ A: int [1:5] 1 2 3 4 5
##   ..$ B: Factor w/ 5 levels "a","b","c","d",..: 1 2 3 4 5
##  $ :'data.frame':    3 obs. of  2 variables:
##   ..$ C: int [1:3] 1 2 3
##   ..$ D: Factor w/ 3 levels "a","b","c": 1 2 3
##  $ :'data.frame':    8 obs. of  3 variables:
##   ..$ E: int [1:8] 1 2 3 4 5 6 7 8
##   ..$ F: Factor w/ 8 levels "a","b","c","d",..: 1 2 3 4 5 6 7 8
##   ..$ G: Factor w/ 8 levels "A","B","C","D",..: 1 2 3 4 5 6 7 8
```

```
CBIND(test1)
```

```
##   1.A  1.B 2.C  2.D 3.E 3.F 3.G
## 1   1    a   1    a   1   a   A
## 2   2    b   2    b   2   b   B
## 3   3    c   3    c   3   c   C
## 4   4    d  NA <NA>   4   d   D
## 5   5    e  NA <NA>   5   e   E
## 6  NA <NA>  NA <NA>   6   f   F
## 7  NA <NA>  NA <NA>   7   g   G
## 8  NA <NA>  NA <NA>   8   h   H
```

```
test2 <- list(test1, df1)
str(test2)
```

```
## List of 2
##  $ :List of 3
##   ..$ :'data.frame': 5 obs. of  2 variables:
##   .. ..$ A: int [1:5] 1 2 3 4 5
##   .. ..$ B: Factor w/ 5 levels "a","b","c","d",..: 1 2 3 4 5
##   ..$ :'data.frame': 3 obs. of  2 variables:
##   .. ..$ C: int [1:3] 1 2 3
##   .. ..$ D: Factor w/ 3 levels "a","b","c": 1 2 3
##   ..$ :'data.frame': 8 obs. of  3 variables:
##   .. ..$ E: int [1:8] 1 2 3 4 5 6 7 8
##   .. ..$ F: Factor w/ 8 levels "a","b","c","d",..: 1 2 3 4 5 6 7 8
```

```
##   .. ..$ G: Factor w/ 8 levels "A","B","C","D",..: 1 2 3 4 5 6 7 8
##  $ :'data.frame':    5 obs. of  2 variables:
##   ..$ A: int [1:5] 1 2 3 4 5
##   ..$ B: Factor w/ 5 levels "a","b","c","d",..: 1 2 3 4 5
```

```
CBIND(test2)
```

```
##   1/1.A 1/1.B 1/2.C 1/2.D 1/3.E 1/3.F 1/3.G 2.A  2.B
## 1     1     a     1     a     1     a     A   1    a
## 2     2     b     2     b     2     b     B   2    b
## 3     3     c     3     c     3     c     C   3    c
## 4     4     d    NA  <NA>     4     d     D   4    d
## 5     5     e    NA  <NA>     5     e     E   5    e
## 6    NA  <NA>    NA  <NA>     6     f     F  NA <NA>
## 7    NA  <NA>    NA  <NA>     7     g     G  NA <NA>
## 8    NA  <NA>    NA  <NA>     8     h     H  NA <NA>
```

# Generate Random Names With an Online Service

This function uses the random name generator from the *Random Name Generator* website[1]. This is included here mostly for "fun", and to show how we can use form input parameters from some websites in our R scripts.

> **Note**: Since there is no concept of a *seed* at the website from which these names are drawn, you should expect to get different names each time the function is run. If you want more control, but similar functionality, use the `RandomNames()` function instead.

## Arguments

- `number`: How many names do you want?
- `gender`: Specify whether you want `"male"` names, `"female"` names, or `"both"`.
- `type`: Specify whether you want `"common"`, `"average"`, or `"rare"` names.

```
randomNamesOnline <- function(number = 100, gender = "both", type = "rare") {
  gender <- tolower(gender); type <- tolower(type)
  gender <- switch(gender, both = "&g=1", male = "&g=2", female = "&g=3",
            stop("gender" must be either "male", "female", or, "both"))
  type <- switch(type, rare = "&st=3", average = "&st=2", common = "&st=1",
          stop("type" must be either "rare", "average", or "common"))
  tempURL <- paste("http://random-name-generator.info/random/?n=",
                   number, gender, type, sep = "", collapse = "")
  temp <- suppressWarnings(readLines(tempURL))
  temp <- gsub("\t|<li>|</ol>", "", temp[102:(102 + number - 1)])
  temp
}
```

## Examples

```
randomNamesOnline(10)
```

[1] See: http://random-name-generator.info/

```
##  [1] "Rod Casper"        "Elina Escobar"     "Rodrick Vickers"
##  [4] "Alejandra Townes"  "Shad Barela"       "Jackson Thurston"
##  [7] "Darline Greenwood" "Tera Griswold"     "Alonso Deleon"
## [10] "Junko Ferraro"
```

```
randomNamesOnline(10, gender = "both", type = "common")
```

```
##  [1] "Nancy Anderson"   "Jesse Hall"       "Kathleen Flores"  "Larry Reed"
##  [5] "Thomas Rodriguez" "Roger Garcia"     "Linda Henderson"  "Nicole Ward"
##  [9] "Martin Walker"    "Brandon Diaz"
```

```
randomNamesOnline(10, "male", "average")
```

```
##  [1] "Alejandro Becker" "Charles Black"    "Eddie Lewis"      "Alfred Soto"
##  [5] "Joseph Rodriguez" "Eugene Walton"    "Ignacio Jordan"   "Ray Payne"
##  [9] "Orville Wong"     "Edgar Jimenez"
```

## Use strings to set seed when generating a random sample

The `stringseed.basic()` function is a more simplified (but less robust) seed generator and random sampling function, similar to the `stringseed.sampling()` function. Unlike `stringseed.sampling()`, this function does not require loading any extra packages for generating the seed, but uses basic methods such as letter substitutions and basic numeric transformations to create some "noise" before assigning a seed.

The function was originally written for students at the Tata-Dhan Academy (and named `TDASample()`)to help them draw samples during their fieldwork. See the Appendix for a more detailed concept note on how the function works and how it was expected to be used.

```
stringseed.basic <- function(inString, N, n, toFile = FALSE) {
  # Uses string input as the basis for generating seeds before sampling

  if (is.factor(inString)) inString <- as.character(inString)
  if (nchar(inString) <= 3) stop("inString must be > 3 characters")
  string1 <- "jnt3g127rbfeqixkos 586d90pyal4chzmvwu"
  string2 <- "2dyn0uxq ovalrpksieb3fhjw584cm9t7z16g"
  instring <- chartr(string1, string2, tolower(inString))
  t1 <- sd(c(suppressWarnings(sapply(strsplit(instring, ""),
                                     as.numeric))), na.rm = TRUE)
  t2 <- c(sapply(strsplit(instring, " "), nchar))
  t3 <- c(na.omit(sapply(strsplit(instring, ""), match, letters)))
  seed <- floor(sum(t1, sd(t2), mean(t2), prod(fivenum(t3)),
                    mean(t3), sd(t3), na.rm=TRUE))

  set.seed(seed)
  temp0 <- sample(N, n)
  temp1 <- list(SeedUsed = seed, FinalSample = temp0,
                FinalSample_sorted = sort(temp0))

  rm(.Random.seed, envir=globalenv())

  if (isTRUE(toFile)) {
    cat(
      sprintf("\n\n            The sample was drawn on: %s.", Sys.time()), "\n",
      sprintf("                The seed input was: ,%s,", inString), "\n",
      sprintf("The total number of households was: %d.", N), "\n",
```

```
      sprintf(" The desired number of samples was: %d.", n), "\n\n\n",
      file = paste("Sample from", Sys.Date(), ".txt", collapse=""), append = TRUE)
    capture.output(temp1, file = paste("Sample from", Sys.Date(), ".txt", collapse=""),
                   append = TRUE)
  }
  message(
    sprintf("\n\n            The sample was drawn on: %s.", Sys.time()), "\n",
    sprintf("                The seed input was: ¡%s¡", inString), "\n",
    sprintf("The total number of households was: %d.", N), "\n",
    sprintf(" The desired number of samples was: %d.", n), "\n\n\n")
  temp1
}
```

# Chapter 17

# Tips

Many of the following tips are useful for reducing repetitious tasks. They might seem silly or unnecessary with the small examples provided, but they can be *huge* time-savers when dealing with larger objects or larger sets of data.

## Batch Convert Factor Variables to Character Variables

In the example data below, `author` and `title` are automatically converted to factor (unless you add the argument `stringsAsFactor = FALSE` when you are creating the data). What if you forgot and actually needed the variables to be in mode `as.character` instead?

Use `sapply` to identify which variables are currently factors and convert them to `as.character`.

```
dat = data.frame(title = c("title1", "title2", "title3"),
                 author = c("author1", "author2", "author3"),
                 customerID = c(1, 2, 1))
str(dat)
```

```
## 'data.frame':    3 obs. of  3 variables:
##  $ title     : Factor w/ 3 levels "title1","title2",..: 1 2 3
##  $ author    : Factor w/ 3 levels "author1","author2",..: 1 2 3
##  $ customerID: num  1 2 1
```

```
# Left of the equal sign identifies and extracts the factor variables;
#    right converts them from factor to character
dat[sapply(dat, is.factor)] = lapply(dat[sapply(dat, is.factor)],
                                     as.character)
str(dat)
```

```
## 'data.frame':    3 obs. of  3 variables:
##  $ title     : chr  "title1" "title2" "title3"
##  $ author    : chr  "author1" "author2" "author3"
##  $ customerID: num  1 2 1
```

## Using Reduce to Merge Multiple Data Frames at Once

The `merge` function in R only merges two objects at a time. This is usually fine, but what if you had several `data.frames` that needed to be merged?

Consider the following data, where we want to take monthly tables and merge them into an annual table:

```
set.seed(1)
JAN = data.frame(ID = sample(5, 3), JAN = sample(LETTERS, 3))
FEB = data.frame(ID = sample(5, 3), FEB = sample(LETTERS, 3))
MAR = data.frame(ID = sample(5, 3), MAR = sample(LETTERS, 3))
APR = data.frame(ID = sample(5, 3), APR = sample(LETTERS, 3))
```

If we wanted to merge these into a single `data.frame` using `merge`, we might end up creating several temporary objects and merging those, like this:

```
temp_1 = merge(JAN, FEB, all=TRUE)
temp_2 = merge(temp_1, MAR, all=TRUE)
temp_3 = merge(temp_2, APR, all=TRUE)
```

Or, we might nest a whole bunch of `merge` commands together, something like this:

```
merge(merge(merge(JAN, FEB, all=TRUE),
            MAR, all=TRUE),
      APR, all=TRUE)
```

However, that first option requires a lot of unnecessary typing and produces unnecessary objects that we then need to remember to remove, and the second option is not very reader-friendly—try doing a merge like that with, say, 12 `data.frames` if we had an entire year of data!

Use `Reduce` instead, simply specifying all the objects to be merged in a `list`:

```
Reduce(function(x, y) merge(x, y, all=TRUE),
       list(JAN, FEB, MAR, APR))
```

```
##   ID  JAN  FEB  MAR  APR
## 1  2    X    E    R    F
## 2  3 <NA>    F    X    D
## 3  4    V <NA>    M    Q
## 4  5    F    B <NA> <NA>
```

## How Much Memory Are the Objects in Your Workspace Using?

Sometimes you need to just check and see how much memory the objects in your workspace occupy.

```
sort(sapply(ls(), function(x) {object.size(get(x))}))
```

## Convert a Table to a Data Frame

Creating tables are easy and fast, but sometimes, it is more convenient to have the output as a `data.frame`. Get the `data.frame` by nesting the command in `as.data.frame.matrix`.

```
# A basic table
x <- with(airquality, table(cut(Temp, quantile(Temp)), Month))
str(x)
```

```
##  'table' int [1:4, 1:5] 24 5 1 0 3 15 7 5 0 2 ...
##  - attr(*, "dimnames")=List of 2
##   ..$      : chr [1:4] "(56,72]" "(72,79]" "(79,85]" "(85,97]"
##   ..$ Month: chr [1:5] "5" "6" "7" "8" ...
```

```
x
```

```
##          Month
##            5  6  7  8  9
##   (56,72] 24  3  0  1 10
##   (72,79]  5 15  2  9 10
##   (79,85]  1  7 19  7  5
##   (85,97]  0  5 10 14  5
```

```
# The same table as a data.frame
y <- as.data.frame.matrix(x)
str(y)
```

```
## 'data.frame':    4 obs. of  5 variables:
##  $ 5: int  24 5 1 0
##  $ 6: int  3 15 7 5
##  $ 7: int  0 2 19 10
##  $ 8: int  1 9 7 14
##  $ 9: int  10 10 5 5
```

```
y
```

```
##          5  6  7  8  9
## (56,72] 24  3  0  1 10
## (72,79]  5 15  2  9 10
## (79,85]  1  7 19  7  5
## (85,97]  0  5 10 14  5
```

# Part IV

# Appendices

# Appendix A

# Sample Generator for Students at the Tata-Dhan Academy

**Abstract**: This note[1] describes a function written to assist students at the Tata-Dhan Academy to generate random samples in a systematic and reproducible (and, thus, verifiable) manner. A common method for reproducible random samples is to use the *seed* function available in major statistics and data analysis software packages. To minimize researcher bias, even the choice of seed must be justified. The function described in this note obfuscates the seed setting process but still results in output that is reproducible. Furthermore, the seed used for generating the sample is included in the output to allow others to independently validate the results.

Many times, students need to do a pretty straightforward task of taking a random sample of households from a given village to complete their study. There are a lot of random number generators available. For instance, most scientific calculators have a feature to generate random numbers, spreadsheets often have a `RAND()` function, and student statistics or research textbooks may have a random table in their appendix. However, none of these methods are verifiable or reproducible.[2]

Common statistics and data analysis software (for example SPSS, Stata, and R) use the concept of a `seed` with their random number generator. These packages have their own methods for automatically setting a seed so that there are different numbers each time a function that uses a random number generator is run; this number is not readily visible to the end user. Most professional packages will also allow the user to specify the seed, in case they want to make their result reproducible, for instance if they want to share their scripts with another user to verify the output.

Following is a simple example of where using a seed is useful. Using R, we are going to draw a sample of 10 from a population of 50 twice. You'll note that the resulting samples are different. After that, we will set the seed (arbitrarily) to `1` and repeat the exercise.

```
sample(50, 10)
```

```
##  [1]  9 46 20 17 49  2 26 41 16 35
```

```
sample(50, 10)
```

```
##  [1] 15  7 11 28  4 14 40 43 17  8
```

[1] This concept note was written on 10 December 2012 by Ananda Mahto and relates to V1.0 of the `TDASample()` function. Please consider using the `stringseed.basic()` function (which may be more up-to-date) or the `stringseed.sampling()` function (which uses a more robust method for generating seeds). Both can be found at the 2657-R-Functions Github page: https://github.com/mrdwab/2657-R-Functions.

[2] It may seem counter-intuitive to want to reproduce a *random* sequence, but this is sometimes important in research settings. It is not uncommon to hear, for example, a question like "How did you 'randomly' select your sample?"

```
set.seed(1)
sample(50, 10)
```

```
##  [1] 14 19 28 43 10 41 42 29 27  3
```

```
set.seed(1)
sample(50, 10)
```

```
##  [1] 14 19 28 43 10 41 42 29 27  3
```

As can be seen, by using the `set.seed()` function in R, you are able to generate a verifiable sample.

Since there is a choice (in other words, user decision) in selecting a seed, you do still run the risk of introducing bias. An investigator who wants household 46 to be a part of their sample might, for instance, try different seeds until they get a sample that includes 46 in its selection (in this case, `set.seed(3); sample(50, 10)` would include household 46). Also, some people are simply confused by the concept of a seed and do not really want to think about what it is or why it is necessary.

Most of the students at the Tata-Dhan Academy conduct several participatory rural appraisals before getting into more traditional research methods. Of these varied methods, it is expected that the "*social mapping*" exercise would assist them in any subsequent sampling exercises they may need to do for their study. After completing a social mapping exercise, students are generally able to provide a list something like the following:

```
 Household_ID   Head_of_Household
-------------   --------------------
            1   A Umarani
            2   LB Rajkumar
            3   Damodar Jena
          ...   ...
          ...   ...
          118   Madhan Kumar
          119   Ananda Mahto
          120   JAN Vijayabharathi
```

The sampling function presented in this note makes use of this information to help students generate a reproducible random (non-stratified) sample (without replacement) of all the households without having to think about what an appropriate seed would be. The envisaged usage is that the student would enter a string, the population size they are sampling from, and the desired number of samples. The string can be anything, but for the case of reproducible analysis using available data, it is suggested that the string should be the name of the first person and the last person in the village "census" (as illustrated in the example household listing) or the village name. The social mapping exercise would also be the basis for `N` (the total number of households).

## The `TDASample()` Function

The following code can be copied and pasted into an R session to make the function available to the user. For convenience, you should copy and paste the function into a plain text file, save that file to your system as "TDASample.R", and load it by typing `source("--path/to/file--")`. For instance, if you saved the file to a folder called "Scripts" in your "C" drive, you can load it using `source("C:/Scripts/TDASample.R")`. Alternatively, if an internet connection is available, you can load the function by typing: `source("http://ideone.com/plain/BRO66P")`

```
TDASample <- function(inString, N, n, toFile = FALSE) {
    if (is.factor(inString)) inString <- as.character(inString)
    if (nchar(inString) <= 3) stop("inString must be > 3 characters")
```

```
    string1 <- "jnt3g127rbfeqixkos 586d90pyal4chzmvwu"
    string2 <- "2dyn0uxq ovalrpksieb3fhjw584cm9t7z16g"
    instring <- chartr(string1, string2, tolower(inString))
    t1 <- sd(c(suppressWarnings(sapply(strsplit(instring, ""),
                                       as.numeric))), na.rm = TRUE)
    t2 <- c(sapply(strsplit(instring, " "), nchar))
    t3 <- c(na.omit(sapply(strsplit(instring, ""), match, letters)))
    seed <- floor(sum(t1, sd(t2), mean(t2), prod(fivenum(t3)),
                      mean(t3), sd(t3), na.rm=TRUE))

    set.seed(seed)
    temp0 <- sample(N, n)
    temp1 <- list(SeedUsed = seed, FinalSample = temp0,
                  FinalSample_sorted = sort(temp0))

    rm(.Random.seed, envir=globalenv())

    if (isTRUE(toFile)) {
    cat(
        sprintf("\n\n            The sample was drawn on: %s.", Sys.time()), "\n",
        sprintf("                The seed input was: ,%s,", inString), "\n",
        sprintf("The total number of households was: %d.", N), "\n",
        sprintf(" The desired number of samples was: %d.", n), "\n\n\n",
        file = paste("Sample from", Sys.Date(), ".txt", collapse=""), append = TRUE)
    capture.output(temp1, file = paste("Sample from", Sys.Date(), ".txt", collapse=""),
                   append = TRUE)
    }
    message(
        sprintf("\n\n            The sample was drawn on: %s.", Sys.time()), "\n",
        sprintf("                The seed input was: ,%s,", inString), "\n",
        sprintf("The total number of households was: %d.", N), "\n",
        sprintf(" The desired number of samples was: %d.", n), "\n\n\n")
    temp1
}
```

### Function Arguments

- `inString`: A quoted string. The name of the first person and last person from your social mapping result is recommended. For instance, using the example data provided earlier, the `inString` value for this dataset would be `"A Umarani, JAN Vijayabharathi"`.
- `N`: The number of households. From the example above, `N = 120`.
- `n`: The desired number of samples.
- `toFile`: Logical. Should the output of your sample be written to a file? If `toFile = TRUE`, a file named *"Sample from –Date–.txt"* (where date is the current date) will be written to your working directory. The contents of this file will be appended to if further samples are run using the `TDASample()` function.

## Examples

```
TDASample("A Umarani, JAN Vijayabharathi", 120, 30)
```

```
## $SeedUsed
## [1] 171640
##
```

```
## $FinalSample
##  [1]   1  75  49  53 119 105  20  71  55  12  95  62 113  18   2  50  99  22 110
## [20]  46  26  85  15  54  70 118   5  83  78  60
##
## $FinalSample_sorted
##  [1]   1   2   5  12  15  18  20  22  26  46  49  50  53  54  55  60  62  70  71
## [20]  75  78  83  85  95  99 105 110 113 118 119
```

```
# Manual verification. Compare results below with "FinalSample" above
set.seed(187241); sample(120, 30)
```

```
##  [1]  27  23  45  32  14  54  17  56  90 101  70 105 119 118  22  72 107  78 113
## [20] 117  40  69  68  89  61  94  85  62 109  44
```

```
# Was a file written with our output?
list.files(pattern="Sample from")
```

```
## character(0)
```

```
# Nope. Nothing was written. Let,s write the output to a file.
TDASample("A Umarani, JAN Vijayabharathi", 120, 30, toFile=TRUE)
```

```
## $SeedUsed
## [1] 171640
##
## $FinalSample
##  [1]   1  75  49  53 119 105  20  71  55  12  95  62 113  18   2  50  99  22 110
## [20]  46  26  85  15  54  70 118   5  83  78  60
##
## $FinalSample_sorted
##  [1]   1   2   5  12  15  18  20  22  26  46  49  50  53  54  55  60  62  70  71
## [20]  75  78  83  85  95  99 105 110 113 118 119
```

```
# Check again
list.files(pattern="Sample from")
```

```
## [1] "Sample from 2012-12-13 .txt"
```

```
noquote(readLines(list.files(pattern="Sample from")[1]))
```

```
##  [1]
##  [2]
##  [3]             The sample was drawn on: 2012-12-13 15:36:59.
##  [4]                  The seed input was: 'A Umarani, JAN Vijayabharathi'
##  [5]  The total number of households was: 120.
##  [6]   The desired number of samples was: 30.
##  [7]
##  [8]
##  [9] $SeedUsed
## [10] [1] 171640
## [11]
## [12] $FinalSample
## [13]  [1]   1  75  49  53 119 105  20  71  55  12  95  62 113  18   2  50  99  22 110
## [14] [20]  46  26  85  15  54  70 118   5  83  78  60
## [15]
## [16] $FinalSample_sorted
## [17]  [1]   1   2   5  12  15  18  20  22  26  46  49  50  53  54  55  60  62  70  71
## [18] [20]  75  78  83  85  95  99 105 110 113 118 119
## [19]
```

```
# Try a different string,
#   for example a seed based on a village name
TDASample("Melakkal", 120, 30)
```

```
## $SeedUsed
## [1] 6032
##
## $FinalSample
##  [1]  89  35  43  26  60  83  25  75  58 101  40 104   5  30  47  53  28 103  98
## [20]  94  67   7  62  27  42 108  69  29  31  78
##
## $FinalSample_sorted
##  [1]   5   7  25  26  27  28  29  30  31  35  40  42  43  47  53  58  60  62  67
## [20]  69  75  78  83  89  94  98 101 103 104 108
```

## Advanced Example

It is possible to use this in a more sophisticated way, for instance to perform batch sampling provided a `data.frame` with at least the following information:

1. A column containing the information to be used as your `inString`.
2. A column containing the "population" from which to draw a sample.
3. A column containing the desired sample size.

Here is one such dataset:

```
myListOfPlaces <- data.frame(
    villageName = c("Melakkal", "Sholavandan", "T. Malaipatti"),
    population = c(120, 130, 140),
    requiredSample = c(30, 25, 12))
myListOfPlaces
```

```
##     villageName population requiredSample
## 1      Melakkal        120             30
## 2   Sholavandan        130             25
## 3 T. Malaipatti        140             12
```

To batch generate the samples, you can use `lapply()`, specifying the column numbers to be used for each argument. For instance, `inString` is represented by the first column (`x[1]`), `N` by the second (`x[2]`), and `n` by the third (`x[3]`).

```
setNames(apply(myListOfPlaces, 1, function(x)
    TDASample(x[1], as.numeric(x[2]), as.numeric(x[3]))),
         myListOfPlaces[[1]])
```

```
## $Melakkal
## $Melakkal$SeedUsed
## [1] 6032
##
## $Melakkal$FinalSample
##  [1]  89  35  43  26  60  83  25  75  58 101  40 104   5  30  47  53  28 103  98
## [20]  94  67   7  62  27  42 108  69  29  31  78
##
```

```
## $Melakkal$FinalSample_sorted
##  [1]   5   7  25  26  27  28  29  30  31  35  40  42  43  47  53  58  60  62  67
## [20]  69  75  78  83  89  94  98 101 103 104 108
##
##
## $Sholavandan
## $Sholavandan$SeedUsed
## [1] 26909
##
## $Sholavandan$FinalSample
##  [1]  31  39 119  71  56  59  63  49  44 104  24  16  79 107  85  54 125  34 105
## [20]   4  76  47  55  62  48
##
## $Sholavandan$FinalSample_sorted
##  [1]   4  16  24  31  34  39  44  47  48  49  54  55  56  59  62  63  71  76  79
## [20]  85 104 105 107 119 125
##
##
## $`T. Malaipatti`
## $`T. Malaipatti`$SeedUsed
## [1] 482178
##
## $`T. Malaipatti`$FinalSample
##  [1]  75  17   4 107  96  16  68  79  27  99 120  93
##
## $`T. Malaipatti`$FinalSample_sorted
##  [1]   4  16  17  27  68  75  79  93  96  99 107 120
```

## How the Function Works

The function works by using various methods to generate "noise" in your `inString` and ultimately converting your `inString` to a numeric value (though in a somewhat obfuscated manner) that can be used as the seed in R. For instance, at one level, the actual string you input is changed using basic character replacement techniques. Any numeric values in the resulting string are extracted and basic functions (like taking their product, or means, or standard deviation) are applied to add further "noise". Characters are converted to numeric values based on their position in the alphabet, and similar basic functions are applied to them as part of the "formula" for generating the seed. Once the seed is generated, the sample is drawn and displayed in a convenient format that can be used for reporting purposes.

It should be noted that the method of adding "noise" might actually not be noisy enough. At the base is simple character replacement (for example, replacing all instances of "a" with, say, "x"). Thus, using `"ananda"` as your `inString` will result in the same seed as using `"adnana"`; ideally, this would not be the case. There are methods around this, for instance using the `digest` package to convert a string to a `crc32` value and then converting it to a number to use as a seed[3]. However, the function shared here should be fine for most student uses, and has the advantage that no extra R packages are required for the function to run.

[3] A function that uses this approach is "stringseed.sampling" available at https://github.com/mrdwab/2657-R-Functions/blob/master/scripts/stringseed.sampling.R