

Package ‘SSBtools’

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Description Functions used by other packages from Statistics Norway are gathered. General data manipulation functions, and functions for hierarchical computations are included (Langsrud, 2020) <doi:10.13140/RG.2.2.27313.61283>. The hierarchy specification functions are useful within statistical disclosure control.

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URL <https://github.com/statisticsnorway/SSBtools>

BugReports <https://github.com/statisticsnorway/SSBtools/issues>

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Suggests testthat

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R topics documented:

AddLeadingZeros	2
AutoHierarchies	4
AutoSplit	5
CbindIdMatch	6

DimList2Hierarchy	8
DimList2Hrc	9
DummyHierarchy	9
FactorLevCorr	11
FindCommonCells	12
FindDimLists	13
FindTableGroup	14
FormulaSums	15
GaussSuppression	17
HierarchicalGroups	19
HierarchicalWildcardGlobbing	20
Hierarchies2ModelMatrix	22
HierarchiesAndFormula2ModelMatrix	24
Hierarchy2Formula	27
HierarchyCompute	28
HierarchyCompute2	31
HierarchyFix	33
MakeHierFormula	34
Match	35
matlabColon	36
Matrix2list	37
ModelMatrix	38
Number	40
RbindAll	41
Reduce0exact	42
RoundWhole	44
RowGroups	45
SSBtoolsData	46
Stack	47
UniqueSeq	48
Unstack	49
WildcardGlobbing	50
WildcardGlobbingVector	51

Index	52
--------------	-----------

AddLeadingZeros	<i>Add leading zeros to numbers while preserving other text</i>
-----------------	---

Description

This function is created to fix problems caused by a serious bug in Excel. Editing csv files in that program causes leading zeros to disappear.

Usage

```
AddLeadingZeros(
  codes,
  places,
  warningText = NULL,
  viaFactor = TRUE,
  nWarning = 6,
  removeLeadingTrailingWhitespace = TRUE
)
```

Arguments

codes	Character vector
places	Number of places for positive numbers. Minus sign is extra
warningText	When non-NULL, warning will be produced
viaFactor	When TRUE, the algorithm uses factor coding internally.
nWarning	Number of elements to be written before ... in warnings.
removeLeadingTrailingWhitespace	Remove leading and trailing whitespace

Value

Character vector

Author(s)

Øyvind Langsrud

Examples

```
AddLeadingZeros(c("1", "ABC", "12345", " 23", "-8", "45 ", " -9", " Agent ", "007",
  "7 James Bond "), 10)
AddLeadingZeros(c("1", "ABC", "12345", " 23", "-8", "45 ", " -9", " Agent ", "007",
  "7 James Bond "), 4)
AddLeadingZeros(c("1", "ABC", "12345", " 23", "-8", "45 ", " -9", " Agent ", "007",
  "7 James Bond "), 4, removeLeadingTrailingWhitespace = FALSE)
AddLeadingZeros(c("1", "ABC", "12345", " 23", "-8", "45 ", " -9", " Agent ", "007",
  "7 James Bond "), 4, warningText = "string changes")
AddLeadingZeros(c("1", "ABC", "12345", " 23", "-8", "45 ", " -9", " Agent ", "007",
  "7 James Bond "), 4, warningText = "", nWarning = 2)
```

AutoHierarchies

Ensure standardized coding of hierarchies

Description

Automatic convert list of hierarchies coded in different ways to standardized to-from coding

Usage

```
AutoHierarchies(
  hierarchies,
  data = NULL,
  total = "Total",
  hierarchyVarNames = c(mapsFrom = "mapsFrom", mapsTo = "mapsTo", sign = "sign", level
    = "level"),
  combineHierarchies = TRUE,
  unionComplement = FALSE
)

FindHierarchies(data, total = "Total")
```

Arguments

hierarchies	List of hierarchies
data	Matrix or data frame with data containing codes of relevant variables
total	Within AutoHierarchies: Vector of total codes (possibly recycled) used when running Hrc2DimList .
hierarchyVarNames	Variable names in the hierarchy tables as in HierarchyFix
combineHierarchies	Whether to combine several hierarchies for same variable into a single hierarchy
unionComplement	Logical vector as in Hierarchies2ModelMatrix . The parameter is only in use when hierarchies are combined.

Details

Input can be to-from coded hierarchies, hierarchies/dimList as in [sdcTable](#), [TauArgus](#) coded hierarchies or formulas. Automatic coding from data is also supported. Output is on a from ready for input to [HierarchyCompute](#). [FindHierarchies](#) wraps [FindDimLists](#) and [AutoHierarchies](#) into a single function. A single string as hierarchy input is assumed to be a total code. Then, the hierarchy is created as a simple hierarchy where all codes in data sum up to this total. For consistence with [HierarchyCompute](#), the codes "rowFactor" and "colFactor" are unchanged. An empty string is recoded to "rowFactor".

Value

List of hierarchies

Author(s)

Øyvind Langsrud

See Also

[DimList2Hierarchy](#), [Hierarchy2Formula](#).

Examples

```
# First, create different types of input
z <- SSBtoolsData("sprt_emp_withEU")
yearFormula <- c("y_14 = 2014", "y_15_16 = y_all - y_14", "y_all = 2014 + 2015 + 2016")
yearHier <- Formula2Hierarchy(yearFormula)
geoDimList <- FindDimLists(z[, c("geo", "eu")], total = "Europe")[[1]]
geoDimList2 <- FindDimLists(z[, c("geo", "eu")])[[1]]
geoHrc <- DimList2Hrc(geoDimList)
ageHier <- SSBtoolsData("sprt_emp_ageHier")

h1 <- AutoHierarchies(list(age = ageHier, geo = geoDimList, year = yearFormula))
h2 <- AutoHierarchies(list(age = "Y15-64", geo = geoHrc, year = yearHier), data = z,
  total = "Europe")
h3 <- AutoHierarchies(list(age = "Total", geo = geoDimList2, year = "Total"), data = z)
h4 <- FindHierarchies(z[, c(1, 2, 3, 5)])
h5 <- AutoHierarchies(list(age = "Total", geo = "", year = "colFactor"), data = z)
identical(h1, h2)
identical(h3, h4)

FindHierarchies(z[, c("geo", "eu", "age")])
```

AutoSplit

Creating variables by splitting the elements of a character vector without needing a split string

Description

Creating variables by splitting the elements of a character vector without needing a split string

Usage

```
AutoSplit(
  s,
  split = NULL,
  border = "_",
  revBorder = FALSE,
  noSplit = FALSE,
```

```

varNames = paste("var", 1:100, sep = ""),
tryReverse = TRUE
)

```

Arguments

s	The character vector
split	Split string. When NULL (default), automatic splitting without a split string.
border	A split character or an integer (move split) to be used when the exact split position is not unique.
revBorder	When border is integer the split position is moved from the other side.
noSplit	No splitting when TRUE.
varNames	Variable names of the created variables (too many is ok)
tryReverse	When TRUE, the automatic method tries to find more variables by splitting from reversed strings.

Value

A data frame with s as row names.

Author(s)

Øyvind Langsrud

Examples

```

s <- c("A12-3-A-x", "A12-3-B-x", "B12-3-A-x", "B12-3-B-x",
      "A12-3-A-y", "A12-3-B-y", "B12-3-A-y", "B12-3-B-y")
AutoSplit(s)
AutoSplit(s, border="-")
AutoSplit(s, split="-")
AutoSplit(s, border=1)
AutoSplit(s, border=2)
AutoSplit(s, border=2, revBorder=TRUE)
AutoSplit(s, noSplit=TRUE)
AutoSplit(s, varNames=c("A", "B", "C", "D"))

```

CbindIdMatch

Combine several data frames by using id variables to match rows

Description

Combine several data frames by using id variables to match rows

Usage

```
CbindIdMatch(
  ...,
  addName = names(x),
  sep = "_",
  idNames = sapply(x, function(x) names(x)[1]),
  idNames1 = idNames,
  addLast = FALSE
)
```

Arguments

...	Several data frames as several input parameters or a list of data frames
addName	NULL or vector of strings used to name columns according to origin frame
sep	A character string to separate when addName apply
idNames	Names of a id variable within each data frame
idNames1	Names of variables in first data frame that correspond to the id variable within each data frame
addLast	When TRUE addName will be at end

Details

The first data frame is the basis and the other frames will be matched by using id-variables. The default id-variables are the first variable in each frame. Corresponding variables with the same name in first frame is assumed. An id-variable is not needed if the number of rows is one or the same as the first frame. Then the element of idNames can be set to a string with zero length.

Value

A single data frame

Author(s)

Øyvind Langsrud

See Also

[RbindAll](#) (same example data)

Examples

```
zA <- data.frame(idA = 1:10, idB = rep(10 * (1:5), 2), idC = rep(c(100, 200), 5),
  idC2 = c(100, rep(200, 9)), idC3 = rep(100, 10),
  idD = 99, x = round(rnorm(10), 3), xA = round(runif(10), 2))
zB <- data.frame(idB = 10 * (1:5), x = round(rnorm(5), 3), xB = round(runif(5), 2))
zC <- data.frame(idC = c(100, 200), x = round(rnorm(2), 3), xC = round(runif(2), 2))
zD <- data.frame(idD = 99, x = round(rnorm(1), 3), xD = round(runif(1), 2))
CbindIdMatch(zA, zB, zC, zD)
```

```

CbindIdMatch(a = zA, b = zB, c = zC, d = zD, idNames = c("", "idB", "idC", ""))
CbindIdMatch(a = zA, b = zB, c = zC, d = zD, idNames1 = c("", "idB", "idC2", ""))
CbindIdMatch(a = zA, b = zB, c = zC, d = zD, idNames1 = c("", "idB", "idC3", ""))
CbindIdMatch(zA, zB, zC, zD, addName = c("", "bbb", "ccc", "ddd"), sep = ".", addLast = TRUE)
try(CbindIdMatch(X = zA, Y = zA[, 4:5], Z = zC, idNames = NULL)) # Error
CbindIdMatch(X = zA, Y = zA[, 4:5], Z = zD, idNames = NULL)      # Ok since equal NROW or NROW==1
CbindIdMatch(list(a = zA, b = zB, c = zC, d = zD))              # List is alternative input

```

DimList2Hierarchy	<i>DimList2Hierarchy</i>
-------------------	--------------------------

Description

From hierarchy/dimList as in sdcTable to to-from coded hierarchy

Usage

```
DimList2Hierarchy(x)
```

Arguments

x An element of a dimList as in sdcTable

Value

Data frame with to-from coded hierarchy

Author(s)

Øyvind Langsrud

Examples

```

# First generate a dimList element
x <- FindDimLists(SSBtoolsData("sprt_emp_withEU")[, c("geo", "eu")], , total = "Europe")[[1]]

DimList2Hierarchy(x)

```

 DimList2Hrc

DimList2Hrc/Hrc2DimList

Description

Conversion between hierarchies/dimList as in sdcTable and TauArgus coded hierarchies

Usage

```
DimList2Hrc(dimList)
```

```
Hrc2DimList(hrc, total = "Total")
```

Arguments

dimList List of data frames according to the specifications in sdcTable

hrc List of character vectors

total String used to name totals.

Value

See Arguments

Author(s)

Øyvind Langsrud

Examples

```
# First generate dimList
dimList <- FindDimLists(SSBtoolsData("sprt_emp_withEU")[, c("geo", "eu", "age")])
hrc <- DimList2Hrc(dimList)
dimList2 <- Hrc2DimList(hrc)
identical(dimList, dimList2)
```

 DummyHierarchy

Converting hierarchy specifications to a (signed) dummy matrix

Description

A matrix for mapping input codes (columns) to output codes (rows) are created.

Usage

```
DummyHierarchy(
  mapsFrom,
  mapsTo,
  sign,
  level,
  mapsInput = NULL,
  inputInOutput = FALSE,
  keepCodes = mapsFrom[integer(0)],
  unionComplement = FALSE,
  reOrder = FALSE
)
```

Arguments

mapsFrom	Character vector from hierarchy table
mapsTo	Character vector from hierarchy table
sign	Numeric vector of either 1 or -1 from hierarchy table
level	Numeric vector from hierarchy table
mapsInput	All codes in mapsFrom not in mapsTo (created automatically when NULL) and possibly other codes in input data.
inputInOutput	When FALSE all output rows represent codes in mapsTo
keepCodes	To prevent some codes to be removed when inputInOutput = FALSE
unionComplement	When TRUE, sign means union and complement instead of addition or subtraction (see note)
reOrder	When TRUE (FALSE is default) output codes are ordered differently, more similar to a usual model matrix ordering.

Details

The elements of the matrix specify how columns contribute to rows.

Value

A sparse matrix with row and column and names

Note

With unionComplement = FALSE (default), the sign of each mapping specifies the contribution as addition or subtraction. Thus, values above one and negative values in output can occur. With unionComplement = TRUE, positive is treated as union and negative as complement. Then 0 and 1 are the only possible elements in the output matrix.

Author(s)

Øyvind Langsrud

Examples

```
# A hierarchy table
h <- SSBtoolsData("FIFA2018ABCD")

DummyHierarchy(h$mapsFrom, h$mapsTo, h$sign, h$level)
DummyHierarchy(h$mapsFrom, h$mapsTo, h$sign, h$level, inputInOut = TRUE)
DummyHierarchy(h$mapsFrom, h$mapsTo, h$sign, h$level, keepCodes = c("Portugal", "Spain"))

# Extend the hierarchy table to illustrate the effect of unionComplement
h2 <- rbind(data.frame(mapsFrom = c("EU", "Schengen"), mapsTo = "EUandSchengen",
                      sign = 1, level = 3), h)

DummyHierarchy(h2$mapsFrom, h2$mapsTo, h2$sign, h2$level)
DummyHierarchy(h2$mapsFrom, h2$mapsTo, h2$sign, h2$level, unionComplement = TRUE)

#' # Extend mapsInput - leading to zero columns.
DummyHierarchy(h$mapsFrom, h$mapsTo, h$sign, h$level,
              mapsInput = c(h$mapsFrom[!(h$mapsFrom %in% h$mapsTo)], "Norway", "Finland"))
```

FactorLevCorr

*Factor level correlation***Description**

A sort of correlation matrix useful to detect (hierarchical) relationships between the levels of factor variables.

Usage

```
FactorLevCorr(x)
```

Arguments

x Input matrix or data frame containing the variables

Value

Output is a sort of correlation matrix.

Here we refer to n_i as the number of present levels of variable i (the number of unique elements) and we refer to n_{ij} as the number of present levels obtained by crossing variable i and variable j (the number unique rows of $x[,c(i,j)]$).

The diagonal elements of the output matrix contains the number of present levels of each variable ($=n_i$).

The absolute values of off-diagonal elements:

0 when $n_{ij} = n_i * n_j$
 1 when $n_{ij} = \max(n_i, n_j)$

Other values Computed as $(n_i * n_j - n_{ij}) / (n_i * n_j - \max(n_i, n_j))$

So 0 means that all possible level combinations exist in the data and 1 means that the two variables are hierarchically related.

The sign of off-diagonal elements:

positive when $n_i < n_j$

negative when $n_i > n_j$

In cases where $n_i = n_j$ elements will be positive above the diagonal and negative below.

Author(s)

Øyvind Langsrud

Examples

```
x <- rep(c("A", "B", "C"), 3)
y <- rep(c(11, 22, 11), 3)
z <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
zy <- paste(z, y, sep="")
m <- cbind(x, y, z, zy)
FactorLevCorr(m)
```

FindCommonCells

Finding commonCells

Description

Finding lists defining common cells as needed for the input parameter commonCells to the function protectLinkedTables in package sdcTable. The function handles two tables based on the same main variables but possibly different aggregating variables.

Usage

```
FindCommonCells(dimList1, dimList2)
```

Arguments

dimList1 As input parameter dimList to the function makeProblem in package sdcTable.

dimList2 Another dimList with the same names and using the same level names.

Value

Output is a list according to the specifications in sdcTable.

Author(s)

Øyvind Langsrud

Examples

```

x <- rep(c('A', 'B', 'C'),3)
y <- rep(c(11,22,11),3)
z <- c(1,1,1,2,2,2,3,3,3)
zy <- paste(z,y,sep='')
m <- cbind(x,y,z,zy)
fg <- FindTableGroup(m,findLinked=TRUE)
dimLists <- FindDimLists(m,fg$groupVarInd)
# Using table1 and table2 in this example cause error,
# but in other cases this may work well
try(FindCommonCells(dimLists[fg$table$table1],dimLists[fg$table$table2]))
FindCommonCells(dimLists[c(1,2)],dimLists[c(1,3)])

```

FindDimLists

*Finding dimList***Description**

Finding lists of level-hierarchy as needed for the input parameter `dimList` to the function `makeProblem` in package `sdcTable`

Usage

```

FindDimLists(
  x,
  groupVarInd = HierarchicalGroups(x = x),
  addName = FALSE,
  sep = ".",
  xReturn = FALSE,
  total = "Total"
)

```

Arguments

<code>x</code>	Matrix or data frame containing the variables (micro data or cell counts data).
<code>groupVarInd</code>	List of vectors of indices defining the hierarchical variable groups.
<code>addName</code>	When TRUE the variable name is added to the level names, except for variables with most levels.
<code>sep</code>	A character string to separate when <code>addName</code> apply.
<code>xReturn</code>	When TRUE <code>x</code> is also in output, possibly changed according to <code>addName</code> .
<code>total</code>	String used to name totals.

Value

Output is a list according to the specifications in `sdcTable`. When `xReturn` is `TRUE` output has an extra list level and `x` is the first element.

Author(s)

Øyvind Langsrud

Examples

```
x <- rep(c('A', 'B', 'C'), 3)
y <- rep(c(11, 22, 11), 3)
z <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
zy <- paste(z, y, sep='')
m <- cbind(x, y, z, zy)
FindDimLists(m)
```

FindTableGroup

Finding table(s) of hierarchical variable groups

Description

A single table or two linked tables are found

Usage

```
FindTableGroup(
  x = NULL,
  findLinked = FALSE,
  mainName = TRUE,
  fCorr = FactorLevCorr(x),
  CheckHandling = warning
)
```

Arguments

<code>x</code>	Matrix or data frame containing the variables
<code>findLinked</code>	When <code>TRUE</code> , two linked tables can be in output
<code>mainName</code>	When <code>TRUE</code> the <code>groupVarInd</code> output is named according to first variable in group.
<code>fCorr</code>	When non-null <code>x</code> is not needed as input.
<code>CheckHandling</code>	Function (warning or stop) to be used in problematic situations.

Value

Output is a list with items

groupVarInd List defining the hierarchical variable groups. First variable has most levels.
 table List containing one or two tables. These tables are coded as indices referring to elements of groupVarInd.

Author(s)

Øyvind Langsrud

Examples

```
x <- rep(c('A', 'B', 'C'), 3)
y <- rep(c(11, 22, 11), 3)
z <- c(1, 1, 1, 2, 2, 2, 3, 3, 3)
zy <- paste(z, y, sep='')
m <- cbind(x, y, z, zy)
FindTableGroup(m)
FindTableGroup(m, findLinked=TRUE)
```

FormulaSums	<i>Sums (aggregates) and/or sparse model matrix with possible cross table</i>
-------------	---

Description

By default this function return sums if the formula contains a response part and a model matrix otherwise

Usage

```
FormulaSums(
  data,
  formula,
  makeNames = TRUE,
  crossTable = FALSE,
  total = "Total",
  printInc = FALSE,
  dropResponse = FALSE,
  makeModelMatrix = NULL,
  sep = "-",
  sepCross = ":",
  avoidHierarchical = FALSE,
  ...
)

Formula2ModelMatrix(data, formula, dropResponse = TRUE, ...)
```

Arguments

<code>data</code>	data frame
<code>formula</code>	A model formula
<code>makeNames</code>	Column/row names made when TRUE
<code>crossTable</code>	Cross table in output when TRUE
<code>total</code>	String used to name totals
<code>printInc</code>	Printing "..." to console when TRUE
<code>dropResponse</code>	When TRUE response part of formula ignored.
<code>makeModelMatrix</code>	Make model matrix when TRUE. NULL means automatic.
<code>sep</code>	String to separate when creating column names
<code>sepCross</code>	String to separate when creating column names involving crossing
<code>avoidHierarchical</code>	Whether to avoid treating of hierarchical variables. Instead of logical, variables can be specified.
<code>...</code>	Further arguments to be passed to FormulaSums

Details

The model matrix is constructed by calling `fac2sparse()` repeatedly. The sums are computed by calling `aggregate()` repeatedly. Hierarchical variables handled when constructing cross table. Column names constructed from the cross table. The returned model matrix includes the attribute `startCol` (see last example line).

Value

A matrix of sums, a sparse model matrix or a list of two or three elements (model matrix and cross table and sums when relevant).

Author(s)

Øyvind Langsrud

See Also

[ModelMatrix](#)

Examples

```
x <- SSBtoolsData("sprt_emp_withEU")

FormulaSums(x, ths_per ~ year*geo + year*eu)
FormulaSums(x, ~ year*age*eu)
FormulaSums(x, ths_per ~ year*age*geo + year*age*eu, crossTable = TRUE, makeModelMatrix = TRUE)
FormulaSums(x, ths_per ~ year:age:geo -1)
m <- Formula2ModelMatrix(x, ~ year*geo + year*eu)
print(m[1:3, ], col.names = TRUE)
attr(m, "startCol")
```

GaussSuppression *Secondary suppression by Gaussian elimination*

Description

Sequentially the secondary suppression candidates (columns in x) are used to reduce the x -matrix by Gaussian elimination. Candidates who completely eliminate one or more primary suppressed cells (columns in x) are omitted and made secondary suppressed. This ensures that the primary suppressed cells do not depend linearly on the non-suppressed cells. How to order the input candidates is an important choice. The singleton problem and the related problem of zeros are also handled.

Usage

```
GaussSuppression(
  x,
  candidates = 1:ncol(x),
  primary = NULL,
  forced = NULL,
  hidden = NULL,
  singleton = rep(FALSE, NROW(x)),
  singletonMethod = "anySum",
  printInc = TRUE,
  ...
)
```

Arguments

x	Matrix that relates cells to be published or suppressed to inner cells. $y_{Publish} = \text{crossprod}(x, y_{Inner})$
candidates	Indices of candidates for secondary suppression
primary	Indices of primary suppressed cells
forced	Indices forced to be not suppressed
hidden	Indices to be removed from the above candidates input (see details)
singleton	Logical vector specifying inner cells for singleton handling. Normally, this means cells with 1s when 0s are non-suppressed and cells with 0s when 0s are suppressed.
singletonMethod	Method for handling the problem of singletons and zeros: "anySum" (default), "subSum", "subSpace" or "none" (see details).
printInc	Printing "..." to console when TRUE
...	Extra unused parameters

Details

It is possible to specify too many (all) indices as candidates. Indices specified as primary or hidded will be removed. Hidden indices (not candidates or primary) refer to cells that will not be published, but do not need protection. The singleton method "subSum" makes new imaginary primary suppressed cells, which are the sum of the singletons within each group. The "subSpace" method is conservative and ignores the singleton dimensions when looking for linear dependency. The default method, "anySum", is between the other two. Instead of making imaginary cells of sums within groups, the aim is to handle all possible sums, also across groups. In addition, "subSumSpace" and "subSumAny" are possible methods, primarily for testing. These methods are similar to "subSpace" and "anySum", and additional cells are created as in "subSum". It is believed that the extra cells are redundant.

Value

Secondary suppression indices

Examples

```
# Input data
df <- data.frame(values = c(1, 1, 1, 5, 5, 9, 9, 9, 9, 9, 0, 0, 0, 7, 7),
                 var1 = rep(1:3, each = 5),
                 var2 = c("A", "B", "C", "D", "E"), stringsAsFactors = FALSE)

# Make output data frame and x
fs <- FormulaSums(df, values ~ var1 * var2, crossTable = TRUE, makeModelMatrix = TRUE)
x <- fs$modelMatrix
datF <- data.frame(fs$crossTable, values = as.vector(fs$allSums))

# Add primary suppression
datF$primary <- datF$values
datF$primary[datF$values < 5 & datF$values > 0] <- NA
datF$suppressedA <- datF$primary
datF$suppressedB <- datF$primary
datF$suppressedC <- datF$primary

# zero secondary suppressed
datF$suppressedA[GaussSuppression(x, primary = is.na(datF$primary))] <- NA

# zero not secondary suppressed by first in ordering
datF$suppressedB[GaussSuppression(x, c(which(datF$values == 0), which(datF$values > 0)),
                                   primary = is.na(datF$primary))] <- NA

# with singleton
datF$suppressedC[GaussSuppression(x, c(which(datF$values == 0), which(datF$values > 0)),
                                   primary = is.na(datF$primary), singleton = df$values == 1)] <- NA

datF
```

HierarchicalGroups *Finding hierarchical variable groups*

Description

According to the (factor) levels of the variables

Usage

```
HierarchicalGroups(  
  x = NULL,  
  mainName = TRUE,  
  eachName = FALSE,  
  fCorr = FactorLevCorr(x)  
)
```

Arguments

x	Matrix or data frame containing the variables
mainName	When TRUE output list is named according to first variable in group.
eachName	When TRUE variable names in output instead of indices.
fCorr	When non-null x is not needed as input.

Value

Output is a list containing the groups. First variable has most levels.

Author(s)

Øyvind Langsrud

Examples

```
x <- rep(c("A","B","C"),3)  
y <- rep(c(11,22,11),3)  
z <- c(1,1,1,2,2,2,3,3,3)  
zy <- paste(z,y,sep="")  
m <- cbind(x,y,z,zy)  
HierarchicalGroups(m)
```

HierarchicalWildcardGlobbing

Find variable combinations by advanced wildcard/globbing specifications.

Description

Find combinations present in an input data frame or, when input is a list, find all possible combinations that meet the requirements.

Usage

```
HierarchicalWildcardGlobbing(
  z,
  wg,
  useUnique = NULL,
  useFactor = FALSE,
  makeWarning = TRUE,
  printInfo = FALSE,
  useMatrixToDataFrame = TRUE
)
```

Arguments

<code>z</code>	list or data.frame
<code>wg</code>	data.frame with data globbing and wildcards
<code>useUnique</code>	Logical variable about recoding within the algorithm. By default (NULL) an automatic decision is made.
<code>useFactor</code>	When TRUE, internal factor recoding is used.
<code>makeWarning</code>	When TRUE, warning is made in cases of unused variables. Only variables common to <code>z</code> and <code>wg</code> are used.
<code>printInfo</code>	When TRUE, information is printed during the process.
<code>useMatrixToDataFrame</code>	When TRUE, special functions (DataFrameToMatrix/MatrixToDataFrame) for improving speed and memory is utilized.

Details

The final variable combinations must meet the requirements in each positive sign group and must not match the requirements in the negative sign groups. The function is implemented by calling [WildcardGlobbing](#) several times within an algorithm that uses hierarchical clustering ([hclust](#)).

Value

data.frame

Author(s)

Øyvind Langsrud

Examples

```

# useUnique=NULL betyr valg ut fra antall rader i kombinasjonsfil
data(precip)
data(mtcars)
codes <- as.character(c(100, 200, 300, 600, 700, 101, 102, 103, 104, 134, 647, 783,
                        13401, 13402, 64701, 64702))

# Create list input
zList <- list(car = rownames(mtcars), wt = as.character(1000 * mtcars$wt),
             city = names(precip), code = codes)

# Create data.frame input
m <- cbind(car = rownames(mtcars), wt = as.character(1000 * mtcars$wt))
zFrame <- data.frame(m[rep(1:NROW(m), each = 35), ],
                    city = names(precip), code = codes, stringsAsFactors = FALSE)

# Create globbing/wildcards input
wg <- data.frame(rbind(c("Merc*", "" , "" , "?00" ),
                      c("F*" , "" , "" , "?????"),
                      c("" , "??0", "C*" , "" ),
                      c("" , "" , "!Co*" , "" ),
                      c("" , "" , "?i*" , "??2"),
                      c("" , "" , "?h*" , "??1")),
                sign = c("+", "+", "+", "+", "-", "-"), stringsAsFactors = FALSE)
names(wg)[1:4] <- names(zList)

# =====
# Finding unique combinations present in the input data frame
# =====

# Using first row of wg. Combinations of car starting with Merc
# and three-digit code ending with 00
HierarchicalWildcardGlobbing(zFrame[, c(1, 4)], wg[1, c(1, 4, 5)])

# Using first row of wg. Combinations of all four variables
HierarchicalWildcardGlobbing(zFrame, wg[1, ])

# More combinations when using second row also
HierarchicalWildcardGlobbing(zFrame, wg[1:2, ])

# Less combinations when using third row also
# since last digit of wt must be 0 and only cities starting with C
HierarchicalWildcardGlobbing(zFrame, wg[1:3, ])

```

```

# Less combinations when using fourth row also since city cannot start with Co
HierarchicalWildcardGlobbing(zFrame, wg[1:4, ])

# Less combinations when using fourth row also
# since specific combinations of city and code are removed
HierarchicalWildcardGlobbing(zFrame, wg)

# =====
# Using list input to create all possible combinations
# =====

dim(HierarchicalWildcardGlobbing(zList, wg))

# same result with as.list since same unique values of each variable
dim(HierarchicalWildcardGlobbing(as.list(zFrame), wg))

```

Hierarchies2ModelMatrix

Model matrix representing crossed hierarchies

Description

Make a model matrix, x , that corresponds to data and represents all hierarchies crossed. This means that aggregates corresponding to numerical variables can be computed as $t(x) \%*\% y$, where y is a matrix with one column for each numerical variable.

Usage

```

Hierarchies2ModelMatrix(
  data,
  hierarchies,
  inputInOutput = TRUE,
  crossTable = FALSE,
  total = "Total",
  hierarchyVarNames = c(mapsFrom = "mapsFrom", mapsTo = "mapsTo", sign = "sign", level
    = "level"),
  unionComplement = FALSE,
  reOrder = TRUE,
  select = NULL,
  removeEmpty = FALSE,
  selectionByMultiplicationLimit = 10^7,
  makeColnames = TRUE,
  verbose = FALSE,
  ...
)

```

Arguments

<code>data</code>	Matrix or data frame with data containing codes of relevant variables
<code>hierarchies</code>	List of hierarchies, which can be converted by AutoHierarchies . Thus, the variables can also be coded by "rowFactor" or "", which correspond to using the categories in the data.
<code>inputInOutput</code>	Logical vector (possibly recycled) for each element of hierarchies. TRUE means that codes from input are included in output. Values corresponding to "rowFactor" or "" are ignored.
<code>crossTable</code>	Cross table in output when TRUE
<code>total</code>	Vector of total codes (possibly recycled) used when running Hrc2DimList
<code>hierarchyVarNames</code>	Variable names in the hierarchy tables as in HierarchyFix
<code>unionComplement</code>	Logical vector (possibly recycled) for each element of hierarchies. When TRUE, sign means union and complement instead of addition or subtraction. Values corresponding to "rowFactor" and "colFactor" are ignored.
<code>reOrder</code>	When TRUE (default) output codes are ordered in a way similar to a usual model matrix ordering.
<code>select</code>	Data frame specifying variable combinations for output.
<code>removeEmpty</code>	When TRUE and when <code>select=NULL</code> , empty columns (only zeros) are not included in output.
<code>selectionByMultiplicationLimit</code>	With non-NULL <code>select</code> and when the number of elements in the model matrix exceeds this limit, the computation is performed by a slower but more memory efficient algorithm.
<code>makeColnames</code>	Colnames included when TRUE (default).
<code>verbose</code>	Whether to print information during calculations. FALSE is default.
<code>...</code>	Extra unused parameters

Details

This function makes use of [AutoHierarchies](#) and [HierarchyCompute](#) via [HierarchyComputeDummy](#). Since the dummy matrix is transposed in comparison to [HierarchyCompute](#), the parameter `rowSelect` is renamed to `select` and `makeRownames` is renamed to `makeColnames`.

Value

A sparse model matrix or a list of two elements (model matrix and cross table)

Author(s)

Øyvind Langsrud

See Also

[ModelMatrix](#), [HierarchiesAndFormula2ModelMatrix](#)

Examples

```

# Create some input
z <- SSBtoolsData("sprt_emp_withEU")
ageHier <- SSBtoolsData("sprt_emp_ageHier")
geoDimList <- FindDimLists(z[, c("geo", "eu")], total = "Europe")[[1]]

# First example has list output
Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList), inputInOut = FALSE,
                        crossTable = TRUE)

m1 <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList), inputInOut = FALSE)
m2 <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList))
m3 <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList, year = ""),
                              inputInOut = FALSE)
m4 <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList, year = "allYears"),
                              inputInOut = c(FALSE, FALSE, TRUE))

# Illustrate the effect of unionComplement, geoHier2 as in the examples of HierarchyCompute
geoHier2 <- rbind(data.frame(mapsFrom = c("EU", "Spain"), mapsTo = "EUandSpain", sign = 1),
                 SSBtoolsData("sprt_emp_geoHier")[, -4])
m5 <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoHier2, year = "allYears"),
                              inputInOut = FALSE) # Spain is counted twice
m6 <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoHier2, year = "allYears"),
                              inputInOut = FALSE, unionComplement = TRUE)

# Compute aggregates
ths_per <- as.matrix(z[, "ths_per", drop = FALSE]) # matrix with the values to be aggregated
t(m1) %*% ths_per # crossprod(m1, ths_per) is equivalent and faster
t(m2) %*% ths_per
t(m3) %*% ths_per
t(m4) %*% ths_per
t(m5) %*% ths_per
t(m6) %*% ths_per

# Example using the select parameter
select <- data.frame(age = c("Y15-64", "Y15-29", "Y30-64"), geo = c("EU", "nonEU", "Spain"))
m2a <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList), select = select)

# Same result by slower alternative
m2B <- Hierarchies2ModelMatrix(z, list(age = ageHier, geo = geoDimList), crossTable = TRUE)
m2b <- m2B$modelMatrix[, Match(select, m2B$crossTable), drop = FALSE]
t(m2b) %*% ths_per

```

HierarchiesAndFormula2ModelMatrix

Model matrix representing crossed hierarchies according to a formula

Description

How to cross the hierarchies are defined by a formula. The formula is automatically simplified when totals are involved.

Usage

```
HierarchiesAndFormula2ModelMatrix(
  data,
  hierarchies,
  formula,
  inputInOutput = TRUE,
  makeColNames = TRUE,
  crossTable = FALSE,
  total = "Total",
  simplify = TRUE,
  hierarchyVarNames = c(mapsFrom = "mapsFrom", mapsTo = "mapsTo", sign = "sign", level
    = "level"),
  unionComplement = FALSE,
  removeEmpty = FALSE,
  reOrder = TRUE,
  sep = "-",
  ...
)
```

Arguments

data	Matrix or data frame with data containing codes of relevant variables
hierarchies	List of hierarchies, which can be converted by AutoHierarchies . Thus, the variables can also be coded by "rowFactor" or "", which correspond to using the categories in the data.
formula	A model formula
inputInOutput	Logical vector (possibly recycled) for each element of hierarchies. TRUE means that codes from input are included in output. Values corresponding to "rowFactor" or "" are ignored.
makeColNames	Colnames included when TRUE (default).
crossTable	Cross table in output when TRUE
total	Vector of total codes (possibly recycled) used when running Hrc2DimList
simplify	When TRUE (default) the model can be simplified when total codes are found in the hierarchies (see examples).
hierarchyVarNames	Variable names in the hierarchy tables as in HierarchyFix
unionComplement	Logical vector (possibly recycled) for each element of hierarchies. When TRUE, sign means union and complement instead of addition or subtraction. Values corresponding to "rowFactor" and "colFactor" are ignored.
removeEmpty	When TRUE, empty columns (only zeros) are not included in output.

reOrder	When TRUE (default) output codes are ordered in a way similar to a usual model matrix ordering.
sep	String to separate when creating column names
...	Extra unused parameters

Value

A sparse model matrix or a list of two elements (model matrix and cross table)

Author(s)

Øyvind Langsrud

See Also

[ModelMatrix](#), [Hierarchies2ModelMatrix](#), [Formula2ModelMatrix](#).

Examples

```
# Create some input
z <- SSBtoolsData("sprt_emp_withEU")
ageHier <- SSBtoolsData("sprt_emp_ageHier")
geoDimList <- FindDimLists(z[, c("geo", "eu")], total = "Europe")[[1]]

# Shorter function name
H <- HierarchiesAndFormula2ModelMatrix

# Small dataset example. Two dimensions.
s <- z[z$geo == "Spain", ]
geoYear <- list(geo = geoDimList, year = "")
m <- H(s, geoYear, ~geo * year, inputInOut = c(FALSE, TRUE))
print(m, col.names = TRUE)
attr(m, "total") # Total code 'Europe' is found
attr(m, "startCol") # Two model terms needed

# Another model and with crossTable in output
H(s, geoYear, ~geo + year, crossTable = TRUE)

# Without empty columns
H(s, geoYear, ~geo + year, crossTable = TRUE, removeEmpty = TRUE)

# Three dimensions
ageGeoYear <- list(age = ageHier, geo = geoDimList, year = "allYears")
m <- H(z, ageGeoYear, ~age * geo + geo * year)
head(colnames(m))
attr(m, "total")
attr(m, "startCol")

# With simplify = FALSE
m <- H(z, ageGeoYear, ~age * geo + geo * year, simplify = FALSE)
head(colnames(m))
```

```

attr(m, "total")
attr(m, "startCol")

# Compute aggregates
m <- H(z, ageGeoYear, ~geo * age, inputInOut = c(TRUE, FALSE, TRUE))
t(m) %*% z$ths_per

# Without hierarchies. Only factors.
ageGeoYearFactor <- list(age = "", geo = "", year = "")
t(H(z, ageGeoYearFactor, ~geo * age + year:geo))

```

Hierarchy2Formula *Hierarchy2Formula*

Description

Conversion between to-from coded hierarchy and formulas written with =, - and +.

Usage

```

Hierarchy2Formula(
  x,
  hierarchyVarNames = c(mapsFrom = "mapsFrom", mapsTo = "mapsTo", sign = "sign", level
    = "level")
)

```

Formula2Hierarchy(s)

Arguments

x Data frame with to-from coded hierarchy
hierarchyVarNames Variable names in the hierarchy tables as in [HierarchyFix](#).
s Character vector of formulas written with =, - and +.

Value

See Arguments

Author(s)

Øyvind Langsrud

Examples

```

x <- SSBtoolsData("sprt_emp_geoHier")
s <- Hierarchy2Formula(x)
Formula2Hierarchy(s)

```

HierarchyCompute *Hierarchical Computations*

Description

This function computes aggregates by crossing several hierarchical specifications and factorial variables.

Usage

```
HierarchyCompute(
  data,
  hierarchies,
  valueVar,
  colVar = NULL,
  rowSelect = NULL,
  colSelect = NULL,
  select = NULL,
  inputInOut = FALSE,
  output = "data.frame",
  autoLevel = TRUE,
  unionComplement = FALSE,
  constantsInOut = NULL,
  hierarchyVarNames = c(mapsFrom = "mapsFrom", mapsTo = "mapsTo", sign = "sign", level
    = "level"),
  selectionByMultiplicationLimit = 10^7,
  colNotInDataWarning = TRUE,
  useMatrixToDataFrame = TRUE,
  handleDuplicated = "sum",
  asInput = FALSE,
  verbose = FALSE,
  reOrder = FALSE,
  reduceData = TRUE,
  makeRownames = NULL
)
```

Arguments

data	The input data frame
hierarchies	A named (names in data) list with hierarchies. Variables can also be coded by "rowFactor" and "colFactor".
valueVar	Name of the variable(s) to be aggregated.
colVar	When non-NULL, the function HierarchyCompute2 is called. See its documentation for more information.

rowSelect	Data frame specifying variable combinations for output. The colFactor variable is not included. In addition rowSelect="removeEmpty" removes combinations corresponding to empty rows (only zeros) of dataDummyHierarchy.
colSelect	Vector specifying categories of the colFactor variable for output.
select	Data frame specifying variable combinations for output. The colFactor variable is included.
inputInOutput	Logical vector (possibly recycled) for each element of hierarchies. TRUE means that codes from input are included in output. Values corresponding to "rowFactor" and "colFactor" are ignored.
output	One of "data.frame" (default), "dummyHierarchies", "outputMatrix", "dataDummyHierarchy", "valueMatrix", "fromCrossCode", "toCrossCode", "crossCode" (as toCrossCode), "outputMatrixWithCrossCode", "matrixComponents", "dataDummyHierarchyWithCodeFrame", "dataDummyHierarchyQuick". The latter two do not require valueVar (reduceData set to FALSE).
autoLevel	Logical vector (possibly recycled) for each element of hierarchies. When TRUE, level is computed by automatic method as in HierarchyFix . Values corresponding to "rowFactor" and "colFactor" are ignored.
unionComplement	Logical vector (possibly recycled) for each element of hierarchies. When TRUE, sign means union and complement instead of addition or subtraction as in DummyHierarchy . Values corresponding to "rowFactor" and "colFactor" are ignored.
constantsInOutput	A single row data frame to be combine by the other output.
hierarchyVarNames	Variable names in the hierarchy tables as in HierarchyFix .
selectionByMultiplicationLimit	With non-NULL rowSelect and when the number of elements in dataDummyHierarchy exceeds this limit, the computation is performed by a slower but more memory efficient algorithm.
colNotInDataWarning	When TRUE, warning produced when elements of colSelect are not in data.
useMatrixToDataFrame	When TRUE (default) special functionality for saving time and memory is used.
handleDuplicated	Handling of duplicated code rows in data. One of: "sum" (default), "sumByAggregate", "sumWithWarning", "stop" (error), "single" or "singleWithWarning". With no colFactor sum and sumByAggregate/sumWithWarning are different (original values or aggregates in "valueMatrix"). When single, only one of the values is used (by matrix subsetting).
asInput	When TRUE (FALSE is default) output matrices match input data. Thus valueMatrix = Matrix(data[, valueVar], ncol=1). Only possible when no colFactor.
verbose	Whether to print information during calculations. FALSE is default.
reOrder	When TRUE (FALSE is default) output codes are ordered differently, more similar to a usual model matrix ordering.

reduceData	When TRUE (default) unnecessary (for the aggregated result) rows of valueMatrix are allowed to be removed.
makeRownames	When TRUE dataDummyHierarchy contains rownames. By default, this is decided based on the parameter output.

Details

A key element of this function is the matrix multiplication: `outputMatrix = dataDummyHierarchy %*% valueMatrix`. The matrix, `valueMatrix` is a re-organized version of the `valueVar` vector from input. In particular, if a variable is selected as `colFactor`, there is one column for each level of that variable. The matrix, `dataDummyHierarchy` is constructed by crossing dummy coding of hierarchies ([DummyHierarchy](#)) and factorial variables in a way that matches `valueMatrix`. The code combinations corresponding to rows and columns of `dataDummyHierarchy` can be obtained as `toCrossCode` and `fromCrossCode`. In the default data frame output, the `outputMatrix` is stacked to one column and combined with the code combinations of all variables.

Value

As specified by the parameter `output`

Author(s)

Øyvind Langsrud

See Also

[Hierarchies2ModelMatrix](#), [AutoHierarchies](#).

Examples

```
# Data and hierarchies used in the examples
x <- SSBtoolsData("sprt_emp") # Employment in sport in thousand persons from Eurostat database
geoHier <- SSBtoolsData("sprt_emp_geoHier")
ageHier <- SSBtoolsData("sprt_emp_ageHier")

# Two hierarchies and year as rowFactor
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "rowFactor"), "ths_per")

# Same result with year as colFactor (but columns ordered differently)
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per")

# Internally the computations are different as seen when output='matrixComponents'
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "rowFactor"), "ths_per",
  output = "matrixComponents")
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per",
  output = "matrixComponents")

# Include input age groups by setting inputInOut = TRUE for this variable
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per",
  inputInOut = c(TRUE, FALSE))
```

```

# Only input age groups by switching to rowFactor
HierarchyCompute(x, list(age = "rowFactor", geo = geoHier, year = "colFactor"), "ths_per")

# Select some years (colFactor) including a year not in input data (zeros produced)
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per",
  colSelect = c("2014", "2016", "2018"))

# Select combinations of geo and age including a code not in data or hierarchy (zeros produced)
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per",
  rowSelect = data.frame(geo = "EU", age = c("Y0-100", "Y15-64", "Y15-29")))

# Select combinations of geo, age and year
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per",
  select = data.frame(geo = c("EU", "Spain"), age = c("Y15-64", "Y15-29"), year = 2015))

# Extend the hierarchy table to illustrate the effect of unionComplement
# Omit level since this is handled by autoLevel
geoHier2 <- rbind(data.frame(mapsFrom = c("EU", "Spain"), mapsTo = "EUandSpain", sign = 1),
  geoHier[, -4])

# Spain is counted twice
HierarchyCompute(x, list(age = ageHier, geo = geoHier2, year = "colFactor"), "ths_per")

# Can be seen in the dataDummyHierarchy matrix
HierarchyCompute(x, list(age = ageHier, geo = geoHier2, year = "colFactor"), "ths_per",
  output = "matrixComponents")

# With unionComplement=TRUE Spain is not counted twice
HierarchyCompute(x, list(age = ageHier, geo = geoHier2, year = "colFactor"), "ths_per",
  unionComplement = TRUE)

# With constantsInOutput
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "colFactor"), "ths_per",
  constantsInOutput = data.frame(c1 = "AB", c2 = "CD"))

# More than one valueVar
x$y <- 10*x$ths_per
HierarchyCompute(x, list(age = ageHier, geo = geoHier), c("y", "ths_per"))

```

Description

Extended variant of [HierarchyCompute](#) with several column variables (not just "colFactor"). Parameter colVar splits the hierarchy variables in two groups and this variable overrides the difference between "rowFactor" and "colFactor".

Usage

```
HierarchyCompute2(
  data,
  hierarchies,
  valueVar,
  colVar,
  rowSelect = NULL,
  colSelect = NULL,
  select = NULL,
  output = "data.frame",
  ...
)
```

Arguments

data	The input data frame
hierarchies	A named list with hierarchies
valueVar	Name of the variable(s) to be aggregated
colVar	Name of the column variable(s)
rowSelect	Data frame specifying variable combinations for output
colSelect	Data frame specifying variable combinations for output
select	Data frame specifying variable combinations for output
output	One of "data.frame" (default), "outputMatrix", "matrixComponents".
...	Further parameters sent to HierarchyCompute

Details

Within this function, `HierarchyCompute` is called two times. By specifying `output` as `"matrixComponents"`, output from the two runs are returned as a list with elements `hcRow` and `hcCol`. The matrix multiplication in `HierarchyCompute` is extended to `outputMatrix = hcRow$dataDummyHierarchy %*% hcRow$valueMatrix %*% t(hcCol$dataDummyHierarchy)`. This is modified in cases with more than a single `valueVar`.

Value

As specified by the parameter `output`

Note

There is no need to call `HierarchyCompute2` directly. The main function [HierarchyCompute](#) can be used instead.

Author(s)

Øyvind Langsrud

See Also

[Hierarchies2ModelMatrix](#), [AutoHierarchies](#).

Examples

```
x <- SSBtoolsData("sprt_emp")
geoHier <- SSBtoolsData("sprt_emp_geoHier")
ageHier <- SSBtoolsData("sprt_emp_ageHier")

HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "rowFactor"), "ths_per",
  colVar = c("age", "year"))
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "rowFactor"), "ths_per",
  colVar = c("age", "geo"))
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "rowFactor"), "ths_per",
  colVar = c("age", "year"), output = "matrixComponents")
HierarchyCompute(x, list(age = ageHier, geo = geoHier, year = "rowFactor"), "ths_per",
  colVar = c("age", "geo"), output = "matrixComponents")
```

HierarchyFix

Change the hierarchy table to follow the standard

Description

Make sure that variable names and sign coding follow an internal standard. Level may be computed automatically

Usage

```
HierarchyFix(
  hierarchy,
  hierarchyVarNames = c(mapsFrom = "mapsFrom", mapsTo = "mapsTo", sign = "sign", level
    = "level"),
  autoLevel = TRUE
)
```

Arguments

`hierarchy` data frame with hierarchy table

`hierarchyVarNames` variable names

`autoLevel` When TRUE, level is computed by automatic method

Value

data frame with hierarchy table

Author(s)

Øyvind Langsrud

Examples

```
# Make input data by changing variable names and sign coding.
h <- SSBtoolsData("FIFA2018ABCD")[, 1:3]
names(h)[1:2] <- c("from", "to")
minus <- h$sign < 0
h$sign <- "+"
h$sign[minus] <- "-"

# Run HierarchyFix - Two levels created
HierarchyFix(h, c(mapsFrom = "from", mapsTo = "to", sign = "sign"))

# Extend the hierarchy table
h2 <- rbind(data.frame(from = c("Oceania", "Asia", "Africa", "America", "Europe"),
                      to = "World", sign = "+"),
            data.frame(from = c("World", "Europe"),
                      to = "nonEurope", sign = c("+", "-")), h)

# Run HierarchyFix - Three levels created
HierarchyFix(h2, c(mapsFrom = "from", mapsTo = "to", sign = "sign"))
```

MakeHierFormula	<i>Make model formula from data taking into account hierarchical variables</i>
-----------------	--

Description

Make model formula from data taking into account hierarchical variables

Usage

```
MakeHierFormula(
  data = NULL,
  hGroups = HierarchicalGroups2(data),
  n = length(hGroups),
  sim = TRUE
)
```

Arguments

data	data frame
hGroups	Output from HierarchicalGroups2()
n	Interaction level or 0 (all levels)
sim	Include "~" when TRUE

Value

Formula as character string

Author(s)

Øyvind Langsrud

Examples

```
x <- SSBtoolsData("sprt_emp_withEU")[, -4]
MakeHierFormula(x)
MakeHierFormula(x, n = 2)
MakeHierFormula(x, n = 0)
```

Match	<i>Matching rows in data frames</i>
-------	-------------------------------------

Description

The algorithm is based on converting variable combinations to whole numbers. The final matching is performed using [match](#).

Usage

```
Match(x, y)
```

Arguments

x	data frame
y	data frame

Details

When the result of multiplying together the number of unique values in each column of x exceeds 9E15 (largest value stored exactly by the numeric data type), the algorithm is recursive.

Value

An integer vector giving the position in y of the first match if there is a match, otherwise NA.

Author(s)

Øyvind Langsrud

Examples

```

a <- data.frame(x = c("a", "b", "c"), y = c("A", "B"), z = 1:6)
b <- data.frame(x = c("b", "c"), y = c("B", "K", "A", "B"), z = c(2, 3, 5, 6))

Match(a, b)
Match(b, a)

# Slower alternative
match(data.frame(t(a), stringsAsFactors = FALSE), data.frame(t(b), stringsAsFactors = FALSE))
match(data.frame(t(b), stringsAsFactors = FALSE), data.frame(t(a), stringsAsFactors = FALSE))

# More comprehensive example (n, m and k may be changed)
n <- 10^4
m <- 10^3
k <- 10^2
data(precip)
data(mtcars)
y <- data.frame(car = sample(rownames(mtcars), n, replace = TRUE),
                 city = sample(names(precip), n, replace = TRUE),
                 n = rep_len(1:k, n), a = rep_len(c("A", "B", "C", "D"), n),
                 b = rep_len(as.character(rnorm(1000)), n),
                 d = sample.int(k + 10, n, replace = TRUE),
                 e = paste(sample.int(k * 2, n, replace = TRUE),
                           rep_len(c("Green", "Red", "Blue"), n), sep = "_"),
                 r = rnorm(k)^99)
x <- y[sample.int(n, m), ]
row.names(x) <- NULL
ix <- Match(x, y)

```

matlabColon

Simulate Matlab's ':'

Description

Functions to generate increasing sequences

Usage

```
matlabColon(from, to)
```

```
SeqInc(from, to)
```

Arguments

from	numeric. The start value
to	numeric. The end value.

Details

matlabColon(a,b) returns a:b (R's version) unless a > b, in which case it returns integer(0). SeqInc(a,b) is similar, but results in error when the calculated length of the sequence (1+to-from) is negative.

Value

A numeric vector, possibly empty.

Author(s)

Bjørn-Helge Mevik (matlabColon) and Øyvind Langsrud (SeqInc)

See Also

[seq](#)

Examples

```
identical(3:5, matlabColon(3, 5)) ## => TRUE
3:1 ## => 3 2 1
matlabColon(3, 1) ## => integer(0)
try(SeqInc(3, 1)) ## => Error
SeqInc(3, 2) ## => integer(0)
```

Matrix2list

Convert matrix to sparse list

Description

Convert matrix to sparse list

Usage

Matrix2list(x)

Matrix2listInt(x)

Arguments

x Input matrix

Details

Within the function, the input matrix is first converted to a dgTMatrix matrix (Matrix package).

Value

A two-element list: List of row numbers (r) and a list of numeric or integer values (x)

Note

Matrix2listInt converts the values to integers by `as.integer` and no checking is performed. Thus, zeros are possible.

Author(s)

Øyvind Langsrud

Examples

```
m = matrix(c(0.5, 1.1, 3.14, 0, 0, 0, 0, 4, 5), 3, 3)
Matrix2list(m)
Matrix2listInt(m)
```

ModelMatrix

Model matrix from hierarchies and/or a formula

Description

A common interface to [Hierarchies2ModelMatrix](#), [Formula2ModelMatrix](#) and [HierarchiesAndFormula2ModelMatrix](#)

Usage

```
ModelMatrix(
  data,
  hierarchies = NULL,
  formula = NULL,
  inputInOut = TRUE,
  crossTable = FALSE,
  sparse = TRUE,
  viaOrdinary = FALSE,
  total = "Total",
  removeEmpty = FALSE,
  modelMatrix = NULL,
  dimVar = NULL,
  ...
)
```

Arguments

<code>data</code>	Matrix or data frame with data containing codes of relevant variables
<code>hierarchies</code>	List of hierarchies, which can be converted by AutoHierarchies . Thus, the variables can also be coded by "rowFactor" or "", which correspond to using the categories in the data.
<code>formula</code>	A model formula

inputInOutput	Logical vector (possibly recycled) for each element of hierarchies. TRUE means that codes from input are included in output. Values corresponding to "rowFactor" or "" are ignored.
crossTable	Cross table in output when TRUE
sparse	Sparse matrix in output when TRUE (default)
viaOrdinary	When TRUE, output is generated by <code>model.matrix</code> or <code>sparse.model.matrix</code> . Since these functions omit a factor level, an empty factor level is first added.
total	String used to name totals
removeEmpty	When TRUE, empty columns (only zeros) are not included in output (relevant when hierarchies)
modelMatrix	The model matrix as input (same as output)
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
...	Further arguments to Hierarchies2ModelMatrix , Formula2ModelMatrix or HierarchiesAndFormula2ModelMatrix

Value

A (sparse) model matrix or a list of two elements (model matrix and cross table)

Author(s)

Øyvind Langsrud

Examples

```
# Create some input
z <- SSBtoolsData("sprt_emp_withEU")
z$age[z$age == "Y15-29"] <- "young"
z$age[z$age == "Y30-64"] <- "old"
ageHier <- data.frame(mapsFrom = c("young", "old"), mapsTo = "Total", sign = 1)
geoDimList <- FindDimLists(z[, c("geo", "eu")], total = "Europe")[[1]]

# Small dataset example. Two dimensions.
s <- z[z$geo == "Spain" & z$year != 2016, ]

# via Hierarchies2ModelMatrix() and converted to ordinary matrix (not sparse)
ModelMatrix(s, list(age = ageHier, year = ""), sparse = FALSE)

# Hierarchies generated automatically. Then via Hierarchies2ModelMatrix()
ModelMatrix(s[, c(1, 3)])

# via Formula2ModelMatrix()
ModelMatrix(s, formula = ~age + year)

# via model.matrix() after adding empty factor levels
ModelMatrix(s, formula = ~age + year, sparse = FALSE, viaOrdinary = TRUE)

# via sparse.model.matrix() after adding empty factor levels
```

```
ModelMatrix(s, formula = ~age + year, viaOrdinary = TRUE)

# via HierarchiesAndFormula2ModelMatrix() and using different data and parameter settings
ModelMatrix(s, list(age = ageHier, geo = geoDimList, year = ""), formula = ~age * geo + year,
  inputInOutput = FALSE, removeEmpty = TRUE, crossTable = TRUE)
ModelMatrix(s, list(age = ageHier, geo = geoDimList, year = ""), formula = ~age * geo + year,
  inputInOutput = c(TRUE, FALSE), removeEmpty = FALSE, crossTable = TRUE)
ModelMatrix(z, list(age = ageHier, geo = geoDimList, year = ""), formula = ~age * year + geo,
  inputInOutput = c(FALSE, TRUE), crossTable = TRUE)
```

Number

Adding leading zeros

Description

Adding leading zeros

Usage

```
Number(n, width = 3)
```

Arguments

n	numeric vector of whole numbers
width	width

Value

Character vector

Author(s)

Øyvind Langsrud

Examples

```
Number(1:3)
```

RbindAll*Combining several data frames when the columns don't match*

Description

Combining several data frames when the columns don't match

Usage

```
RbindAll(...)
```

Arguments

... Several data frames as several input parameters or a list of data frames

Value

A single data frame

Note

The function is an extended version of `rbind.all.columns` at <https://amywhiteheadresearch.wordpress.com/2013/05/13/combining-dataframes-when-the-columns-dont-match/>

Author(s)

Øyvind Langsrud

See Also

[CbindIdMatch](#) (same example data)

Examples

```
zA <- data.frame(idA = 1:10, idB = rep(10 * (1:5), 2), idC = rep(c(100, 200), 5),
                idC2 = c(100, rep(200, 9)), idC3 = rep(100, 10),
                idD = 99, x = round(rnorm(10), 3), xA = round(runif(10), 2))
zB <- data.frame(idB = 10 * (1:5), x = round(rnorm(5), 3), xB = round(runif(5), 2))
zC <- data.frame(idC = c(100, 200), x = round(rnorm(2), 3), xC = round(runif(2), 2))
zD <- data.frame(idD = 99, x = round(rnorm(1), 3), xD = round(runif(1), 2))
RbindAll(zA, zB, zC, zD)
RbindAll(list(zA, zB, zC, zD))
```

Reduce0exact

Reducing a non-negative regression problem

Description

The linear equation problem, $z = t(x) \%*\% y$ with y non-negative and x as a design (dummy) matrix, is reduced to a smaller problem by identifying elements of y that can be found exactly from x and z .

Usage

```
Reduce0exact(
  x,
  z = NULL,
  reduceByColSums = FALSE,
  reduceByLeverage = FALSE,
  leverageLimit = 0.999999,
  digitsRoundWhole = 9,
  y = NULL,
  yStart = NULL,
  printInc = FALSE
)
```

Arguments

<code>x</code>	A matrix
<code>z</code>	A single column matrix
<code>reduceByColSums</code>	See Details
<code>reduceByLeverage</code>	See Details
<code>leverageLimit</code>	Limit to determine perfect fit
<code>digitsRoundWhole</code>	RoundWhole parameter for fitted values (when <code>leverageLimit</code> and <code>y</code> not in input)
<code>y</code>	A single column matrix. With <code>y</code> in input, <code>z</code> in input can be omitted and estimating <code>y</code> (when <code>leverageLimit</code>) is avoided.
<code>yStart</code>	A starting estimate when this function is combined with iterative proportional fitting. Zeros in <code>yStart</code> will be used to reduce the problem.
<code>printInc</code>	Printing iteration information to console when TRUE

Details

Exact elements can be identified in three ways in an iterative manner:

1. By zeros in z . This is always done.
2. By columns in x with a single nonzero value. Done when `reduceByColSums` or `reduceByLeverage` is `TRUE`.
3. By exact linear regression fit (when leverage is one). Done when `reduceByLeverage` is `TRUE`. The leverages are computed by `hat(as.matrix(x), intercept = FALSE)`, which can be very time and memory consuming. Furthermore, without y in input, known values will be computed by `ginv`.

Value

A list of five elements:

- `x`: A reduced version of input x
- `z`: Corresponding reduced z
- `yKnown`: Logical, specifying known values of y
- `y`: A version of y with known values correct and others zero
- `zSkipped`: Logical, specifying omitted columns of x

Author(s)

Øyvind Langsrud

Examples

```
# Make a special data set
d <- SSBtoolsData("sprt_emp")
d$ths_per <- round(d$ths_per)
d <- rbind(d, d)
d$year <- as.character(rep(2014:2019, each = 6))
to0 <- rep(TRUE, 36)
to0[c(6, 14, 17, 18, 25, 27, 30, 34, 36)] <- FALSE
d$ths_per[to0] <- 0

# Values as a single column matrix
y <- Matrix(d$ths_per, ncol = 1)

# A model matrix using a special year hierarchy
x <- Hierarchies2ModelMatrix(d, hierarchies = list(geo = "", age = "", year =
  c("y1418 = 2014+2015+2016+2017+2018", "y1519 = 2015+2016+2017+2018+2019",
    "y151719 = 2015+2017+2019", "yTotal = 2014+2015+2016+2017+2018+2019")),
  inputInOutput = FALSE)

# Aggregates
z <- t(x) %*% y
sum(z == 0) # 5 zeros
```

```

# From zeros in z
a <- Reduce0exact(x, z)
sum(a$yKnown) # 17 zeros in y is known
dim(a$x)      # Reduced x, without known y and z with zeros
dim(a$z)      # Corresponding reduced z
sum(a$zSkipped) # 5 elements skipped
t(a$y)        # Just zeros (known are 0 and unknown set to 0)

# It seems that three additional y-values can be found directly from z
sum(colSums(a$x) == 1)

# But it is the same element of y (row 18)
a$x[18, colSums(a$x) == 1]

# Make use of ones in colSums
a2 <- Reduce0exact(x, z, reduceByColSums = TRUE)
sum(a2$yKnown) # 18 values in y is known
dim(a2$x)      # Reduced x
dim(a2$z)      # Corresponding reduced z
a2$y[which(a2$yKnown)] # The known values of y (unknown set to 0)

# Six ones in leverage values
# Thus six extra elements in y can be found by linear estimation
hat(as.matrix(a2$x), intercept = FALSE)

# Make use of ones in leverages (hat-values)
a3 <- Reduce0exact(x, z, reduceByLeverage = TRUE)
sum(a3$yKnown) # 26 values in y is known (more than 6 extra)
dim(a3$x)      # Reduced x
dim(a3$z)      # Corresponding reduced z
a3$y[which(a3$yKnown)] # The known values of y (unknown set to 0)

# More than 6 extra is caused by iteration
# Extra checking of zeros in z after reduction by leverages
# Similar checking performed also after reduction by colSums

```

RoundWhole

Round values that are close two whole numbers

Description

Round values that are close two whole numbers

Usage

```
RoundWhole(x, digits = 9, onlyZeros = FALSE)
```

Arguments

x vector or matrix
digits parameter to `round`
onlyZeros Only round values close to zero

Details

When `digits` is `NA`, `Inf` or `NULL`, input is returned unmodified. When there is more than one element in `digits` or `onlyZeros`, rounding is performed column-wise.

Value

Modified x

Author(s)

Øyvind Langsrud

Examples

```
x <- c(0.0002, 1.00003, 3.00014)
RoundWhole(x)       # No values rounded
RoundWhole(x, 4)    # One value rounded
RoundWhole(x, 3)    # All values rounded
RoundWhole(x, NA)   # No values rounded (always)
RoundWhole(x, 3, TRUE) # One value rounded
RoundWhole(cbind(x, x, x), digits = c(3, 4, NA))
RoundWhole(cbind(x, x), digits = 3, onlyZeros = c(FALSE, TRUE))
```

RowGroups

Create numbering according to unique rows

Description

Create numbering according to unique rows

Usage

```
RowGroups(x, returnGroups = FALSE, returnGroupsId = FALSE)
```

Arguments

x Data frame or matrix
returnGroups When TRUE unique rows are returned
returnGroupsId When TRUE Index of unique rows are returned

Value

A vector with the numbering or, according to the arguments, a list with more output.

Author(s)

Øyvind Langsrud

Examples

```
a <- data.frame(x = c("a", "b"), y = c("A", "B", "A"), z = rep(1:4, 3))
RowGroups(a)
RowGroups(a, TRUE)
RowGroups(a[, 1:2], TRUE, TRUE)
RowGroups(a[, 1, drop = FALSE], TRUE)
```

SSBtoolsData

Function that returns a dataset

Description

Function that returns a dataset

Usage

```
SSBtoolsData(dataset)
```

Arguments

dataset Name of data set within the SSBtools package

Details

FIFA2018ABCD: A hierarchy table based on countries within groups A-D in the football championship, 2018 FIFA World Cup.

sprt_emp: Employment in sport in thousand persons. Data from Eurostat database.

sprt_emp_geoHier: Country hierarchy for the employment in sport data.

sprt_emp_ageHier: Age hierarchy for the employment in sport data.

sprt_emp_withEU: The data set sprt_emp extended with a EU variable.

sosialFiktiv, z1, z1w, z2, z2w, z3, z3w, z3wb: See [sosialFiktiv](#).

Value

data frame

Author(s)

Øyvind Langsrud

Examples

```
SSBtoolsData("FIFA2018ABCD")
SSBtoolsData("sprt_emp")
SSBtoolsData("sprt_emp_geoHier")
SSBtoolsData("sprt_emp_ageHier")
SSBtoolsData("sprt_emp_withEU")
SSBtoolsData("z1w")
```

Stack

*Stack columns from a data frame and include variables.***Description**

Stack columns from a data frame and include variables.

Usage

```
Stack(
  data,
  stackVar = 1:NCOL(data),
  blockVar = integer(0),
  rowData = data.frame(stackVar)[, integer(0), drop = FALSE],
  valueName = "values",
  indName = "ind"
)
```

Arguments

data	A data frame
stackVar	Indices of variables to be stacked
blockVar	Indices of variables to be replicated
rowData	A separate data frame where NROW(rowData)=length(stackVar) such that each row may contain multiple information of each stackVar variable. The output data frame will contain an extended variant of rowData.
valueName	Name of the stacked/concatenated output variable
indName	Name of the output variable with information of which vector in x the observation originated. When indName is NULL this variable is not included in output.

Value

A data frame where the variable ordering corresponds to: blockVar, rowData, valueName, indName

Author(s)

Øyvind Langsrud

See Also[Unstack](#)**Examples**

```

z <- data.frame(n=c(10,20,30), ssb=c('S','S','B'),
  Ayes=1:3,Ano=4:6,Byes=7:9,Bno=10:12)
zRow <- data.frame(letter=c('A','A','B','B'),answer=c('yes','no','yes','no') )

x <- Stack(z,3:6,1:2,zRow)

Unstack(x,6,3:4,numeric(0),1:2)
Unstack(x,6,5,numeric(0),1:2)
Unstack(x,6,3:4,5,1:2)

```

UniqueSeq*Sequence within unique values*

Description

Sequence within unique values

Usage

```
UniqueSeq(x, sortdata = matrix(1L, length(x), 0))
```

Arguments

x	vector
sortdata	matrix or vector to determine sequence order

Value

integer vector

Author(s)

Øyvind Langsrud

Examples

```

# 1:4 within A and 1:2 within B
UniqueSeq(c("A", "A", "B", "B", "A", "A"))

# Ordered differently
UniqueSeq(c("A", "A", "B", "B", "A", "A"), c(4, 5, 20, 10, 3, 0))

```

Unstack	<i>Unstack a column from a data frame and include additional variables.</i>
---------	---

Description

Unstack a column from a data frame and include additional variables.

Usage

```
Unstack(
  data,
  mainVar = 1,
  stackVar = (1:NCOL(data))[-mainVar],
  extraVar = integer(0),
  blockVar = integer(0),
  sep = "_",
  returnRowData = TRUE,
  sorted = FALSE
)
```

Arguments

data	A data frame
mainVar	Index of the variable to be unstacked
stackVar	Index of variables defining the unstack grouping
extraVar	Indices of within-replicated variables to be added to the rowData output
blockVar	Indices of between-replicated variables to be added to the data output
sep	A character string to separate when creating variable names
returnRowData	When FALSE output is no list, but only data
sorted	When TRUE the created variables is in sorted order. Otherwise input order is used.

Value

When returnRowData=TRUE output is list of two elements.

data	Unstacked data
rowData	A separate data frame with one row for each unstack grouping composed of the stackVar variables

Author(s)

Øyvind Langsrud

See Also

[Stack](#) (examples)

WildcardGlobbing	<i>Row selection by wildcard/globbering</i>
------------------	---

Description

The selected rows match combined requirements for all variables.

Usage

```
WildcardGlobbing(x, wg, sign = TRUE, invert = "!")
```

Arguments

x	data.frame with character data
wg	data.frame with wildcard/globbering
sign	When FALSE, the result is inverted.
invert	Character to invert each single selection.

Details

This function is used by [HierarchicalWildcardGlobbing](#) and [WildcardGlobbingVector](#) and make use of [grepl](#) and [glob2rx](#).

Value

Logical vector defining subset of rows.

Author(s)

Øyvind Langsrud

Examples

```
# Create data input
data(precip)
data(mtcars)
x <- data.frame(car = rownames(mtcars)[rep(1:NROW(mtcars), each = 35)], city = names(precip),
                stringsAsFactors = FALSE)

# Create globbing/wildcards input
wg <- data.frame(rbind(c("Merc*", "C*"), c("F*", "??????"), c("!????????*?", "!????????*?")),
                stringsAsFactors = FALSE)
names(wg) <- names(x)

# Select the following combinations:
# - Cars starting with Merc and cities starting with C
# - Cars starting with F and six-letter cities
# - Cars with less than nine letters and cities with less than seven letters
x[WildcardGlobbing(x, wg), ]
```

`WildcardGlobbingVector`*Selection of elements by wildcard/globbing*

Description

Selection of elements by wildcard/globbing

Usage

```
WildcardGlobbingVector(x, wg, negSign = "-", invert = "!")
```

Arguments

<code>x</code>	Character vector
<code>wg</code>	Character vector with wildcard/globbing
<code>negSign</code>	Character representing selection to be removed
<code>invert</code>	Character to invert each single selection.

Value

vector with selected elements of `x`

Author(s)

Øyvind Langsrud

Examples

```
data(precip)
x <- names(precip)

# Select the cities starting with B, C and Sa.
WildcardGlobbingVector(x, c("B*", "C*", "Sa*"))

# Remove from the selection cities with o and t in position 2 and 4, respectively.
WildcardGlobbingVector(x, c("B*", "C*", "Sa*", "-?o*", "-???t*"))

# Add to the selection cities not having six or more letters.
WildcardGlobbingVector(x, c("B*", "C*", "Sa*", "-?o*", "-???t*", "!?????*))
```

Index

AddLeadingZeros, 2
AutoHierarchies, 4, 23, 25, 30, 33, 38
AutoSplit, 5

CbindIdMatch, 6, 41

DimList2Hierarchy, 5, 8
DimList2Hrc, 9
DummyHierarchy, 9, 29, 30

FactorLevCorr, 11
FindCommonCells, 12
FindDimLists, 4, 13
FindHierarchies (AutoHierarchies), 4
FindTableGroup, 14
Formula2Hierarchy (Hierarchy2Formula), 27
Formula2ModelMatrix, 26, 38, 39
Formula2ModelMatrix (FormulaSums), 15
FormulaSums, 15

GaussSuppression, 17
ginv, 43
glob2rx, 50
grepl, 50

hclust, 20
HierarchicalGroups, 19
HierarchicalWildcardGlobbing, 20, 50
Hierarchies2ModelMatrix, 4, 22, 26, 30, 33, 38, 39
HierarchiesAndFormula2ModelMatrix, 23, 24, 38, 39
Hierarchy2Formula, 5, 27
HierarchyCompute, 4, 23, 28, 31, 32
HierarchyCompute2, 28, 31
HierarchyComputeDummy, 23
HierarchyFix, 4, 23, 25, 27, 29, 33
Hrc2DimList, 4, 23, 25
Hrc2DimList (DimList2Hrc), 9

MakeHierFormula, 34
Match, 35
match, 35
matlabColon, 36
Matrix2list, 37
Matrix2listInt (Matrix2list), 37
model.matrix, 39
ModelMatrix, 16, 23, 26, 38

Number, 40

RbindAll, 7, 41
Reduce0exact, 42
round, 45
RoundWhole, 42, 44
RowGroups, 45

seq, 37
SeqInc (matlabColon), 36
socialFiktiv, 46
sparse.model.matrix, 39
SSBtoolsData, 46
Stack, 47, 49

UniqueSeq, 48
Unstack, 48, 49

WildcardGlobbing, 20, 50
WildcardGlobbingVector, 50, 51