

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](https://doi.org/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

NeedsCompilation no

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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 or FindDimLists .
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.
...	Extra unused parameters

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".

A special possibility is to include character vector(s) as unnamed list element(s) of hierarchies. Then the elements of the character vector(s) must be variable names within data. This will cause hierarchies to be created from selected data columns by running `FindDimLists`. Total coded can be specified by parameter `total` or by naming the character vector. See examples.

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")])

### Examples with character vector(s) as unnamed list elements.

# Same output as FindHierarchies above
AutoHierarchies(list(c("geo", "eu", "age")), data = z)

# Now combined with a named list element
AutoHierarchies(list(year = yearHier, c("geo", "eu", "age")), data = z)
```

```
# Total codes by unnamed list element as named character vector
AutoHierarchies(list(year = yearHier, c(Europe = "geo", "eu", All = "age")), data = z)

# Two types of year input. Total codes by using the parameter `total`.
AutoHierarchies(list("year", year = yearHier, c("geo", "eu", "age")), data = z,
  total = c("allYears", "unused", "Tot"))

# Avoid combineHierarchies to see effect of each year input separately
# (even earlier return possible with `combineHierarchies = NA`)
AutoHierarchies(list("year", year = yearHier, c("geo", "eu", "age")), data = z,
  total = c("allYears", "unused", "Tot"), combineHierarchies = FALSE)
```

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
```

DataDummyHierarchy	<i>Create a (signed) dummy matrix for hierarcical mapping of codes in data</i>
--------------------	--

Description

Create a (signed) dummy matrix for hierarcical mapping of codes in data

Usage

```
DataDummyHierarchy(dataVector, dummyHierarchy)
```

```
DataDummyHierarchies(data, dummyHierarchies, colNamesFromData = FALSE)
```


Arguments

dataVector A vector of codes in data
 dummyHierarchy Output from [DummyHierarchy](#)
 data data
 dummyHierarchies Output from [DummyHierarchies](#)
 colNamesFromData Column names from data when TRUE

Details

DataDummyHierarchies is a user-friendly wrapper for the original function DataDummyHierarchy. When colNamesFromData is FALSE (default), this function returns `mapply(DataDummyHierarchy, data[names(dummyHierarchies)], dummyHierarchies)`.

Value

A sparse matrix. Column names are taken from dataVector (if non-NULL) and row names are taken from the row names of dummyHierarchy.

Author(s)

Øyvind Langsrud

Examples

```

z <- SSBtoolsData("sprt_emp_withEU")[1:9, ]
hi <- FindHierarchies(z[, c("geo", "eu", "age", "year")])
dhi <- DummyHierarchies(hi, inputInOutput = TRUE)
DataDummyHierarchies(z, dhi, colNamesFromData = TRUE)

```

DimList2Hierarchy *DimList2Hierarchy*

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)
```

DummyDuplicated	<i>Duplicated columns in dummy matrix</i>
-----------------	---

Description

The algorithm is based on `crossprod(x)` or `crossprod(x, u)` where `u` is a vector of random numbers

Usage

```
DummyDuplicated(x, idx = FALSE, rows = FALSE, rnd = FALSE)
```

```
XprodRnd(x, duplic = TRUE, idx = FALSE, rows = FALSE, seed = NULL)
```

Arguments

<code>x</code>	A matrix
<code>idx</code>	Indices returned when TRUE
<code>rows</code>	Duplicated rows instead when TRUE
<code>rnd</code>	Algorithm based on cross product with random numbers when TRUE (dummy matrix not required)
<code>duplic</code>	XprodRnd parameter: When <code>duplic</code> and <code>idx</code> are FALSE, this function returns <code>crossprod(x, u)</code> or <code>x%*%u</code> instead of indices or duplicated.
<code>seed</code>	XprodRnd parameter: Seed to be used. When NULL the ordinary random value stream in R continues.

Details

The efficiency of the default algorithm depends on the sparsity of `crossprod(x)`. The random values are generated locally within the function without affecting the random value stream in R.

Value

Logical vectors specifying duplicated columns or vector of indices (first match)

Note

`DummyDuplicated` calls `XprodRnd` with 123 as seed when `rnd` is TRUE. `XprodRnd` performs three runs with different random numbers. A warning is produced if one deviates. Error occurs if all three are different.

Author(s)

Øyvind Langsrud

Examples

```
x <- cbind(1, rbind(diag(2), diag(2)), diag(4)[, 1:2])
z <- Matrix(x[c(1:4, 2:3), c(1, 2, 1:5, 5, 2)])

DummyDuplicated(z)
which(DummyDuplicated(z, rows = TRUE))

# Four ways to obtain the same result
DummyDuplicated(z, idx = TRUE)
DummyDuplicated(z, idx = TRUE, rnd = TRUE)
DummyDuplicated(t(z), idx = TRUE, rows = TRUE)
DummyDuplicated(t(z), idx = TRUE, rows = TRUE, rnd = TRUE)

# The unique values in four ways
which(!DummyDuplicated(z), )
which(!DummyDuplicated(z, rnd = TRUE))
which(!DummyDuplicated(t(z), rows = TRUE))
which(!DummyDuplicated(t(z), rows = TRUE, rnd = TRUE))
```

 DummyHierarchy

Converting hierarchy specifications to a (signed) dummy matrix

Description

A matrix for mapping input codes (columns) to output codes (rows) are created. The elements of the matrix specify how columns contribute to rows.

Usage

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

DummyHierarchies(
  hierarchies,
  data = NULL,
  inputInOut = FALSE,
  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.
hierarchies	List of hierarchies
data	data

Details

DummyHierarchies is a user-friendly wrapper for the original function DummyHierarchy. Then, the logical input parameters are vectors (possibly recycled). mapsInput and keepCodes can be supplied as attributes. mapsInput will be generated when data is non-NULL.

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, inputInOutput = 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"))

# DummyHierarchies
DummyHierarchies(FindHierarchies(SSBtoolsData("sprt_emp_withEU")[, c("geo", "eu", "age")]),
                inputInOut = c(FALSE, TRUE))
```

Extend0

Add zero frequency rows

Description

Microdata or tabular frequency data is extended to contain all combinations of unique rows of (hierarchical) groups of dimensional variables. Extra variables are extended by NA's or 0's.

Usage

```
Extend0(
  data,
  freqName = "freq",
  hierarchical = TRUE,
  varGroups = NULL,
  dimVar = NULL,
  extraVar = TRUE
)
```

Arguments

data	data frame
freqName	Name of (existing) frequency variable
hierarchical	Hierarchical variables treated automatically when TRUE
varGroups	List of variable groups, possibly with data (see details and examples).
dimVar	The dimensional variables
extraVar	Extra variables as variable names, TRUE (all remaining) or FALSE (none).

Details

With no frequency variable in input (microdata), the frequency variable in output consists of ones and zeros. By default, all variables, except the frequencies, are considered as dimensional variables. By default, the grouping of dimensional variables is based on hierarchical relationships (`hierarchical = TRUE`). With `varGroups = NULL` and `hierarchical = FALSE`, each dimensional variable forms a separate group (as `as.list(dimVar)`). Parameter `extraVar` can be specified as variable names. `TRUE` means all remaining variables and `FALSE` no variables.

When the contents of `varGroups[[i]]` is variable names, the data frame `unique(data[varGroups[[i]])` will be made as a building block within the function. A possibility is to supply such a data frame instead of variable names. Then, the building block will be `unique(varGroups[[i]])`. Names and data frames can be mixed.

Value

Extended data frame

Examples

```
z <- SSBtoolsData("sprt_emp_withEU")[c(1, 4:6, 8, 11:15), ]
z$age[z$age == "Y15-29"] <- "young"
z$age[z$age == "Y30-64"] <- "old"

Extend0(z[, -4])
Extend0(z, hierarchical = FALSE, dimVar = c("age", "geo", "eu"))
Extend0(z, hierarchical = FALSE, dimVar = c("age", "geo", "eu"), extraVar = "year")
Extend0(z, hierarchical = FALSE, dimVar = c("age", "geo", "eu"), extraVar = FALSE)
Extend0(z, varGroups = list(c("age", "geo", "year"), "eu"))
Extend0(MakeFreq(z[c(1, 1, 1, 2, 2, 3:10), -4]))
Extend0(z, "ths_per")

# varGroups with data frames (same result as with names above)
Extend0(z, varGroups = list(z[c("age", "geo", "year")], z["eu"]))

# varGroups with both names and data frame
Extend0(z, varGroups = list(c("year", "geo", "eu"), data.frame(age = c("middle", "old"))))
```

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	<i>Finding commonCells</i>
-----------------	----------------------------

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

<code>dimList1</code>	As input parameter <code>dimList</code> to the function <code>makeProblem</code> in package <code>sdcTable</code> .
<code>dimList2</code>	Another <code>dimList</code> 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

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

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)
FindDimLists(m, total = paste0("A", 1:4))
```

FindDisclosiveCells *Find directly disclosive cells*

Description

Function for determining which cells in a frequency table can lead to direct disclosure of an identifiable individual, assuming an attacker has the background knowledge to place themselves (or a coalition) in the table.

Usage

```
FindDisclosiveCells(
  data,
  freq,
  crossTable,
  primaryDims = names(crossTable),
  unknowns = rep(NA, length(primaryDims)),
  total = rep("Total", length(primaryDims)),
  unknown.threshold = 0,
  coalition = 1,
  suppressSmallCells = FALSE,
  ...
)
```

Arguments

data	the data set
freq	vector containing frequencies
crossTable	cross table of key variables produced by ModelMatrix in parent function
primaryDims	dimensions to be considered for direct disclosure.
unknowns	vector of unknown values for each of the primary dimensions. If a primary dimension does not contain unknown values, NA should be passed.
total	string name for marginal values
unknown.threshold	numeric for specifying a percentage for calculating safety of cells. A cell is "safe" in a row if the number of unknowns exceeds unknown.threshold percent of the row total.
coalition	maximum number of units in a possible coalition, default 1
suppressSmallCells	logical variable which determines whether small cells (<= coalition) or large cells should be suppressed. Default FALSE.
...	parameters from main suppression method

Details

This function does not work on data containing hierarchical variables.

Value

list with two named elements, the first (`$primary`) being a logical vector marking directly disclosive cells, the second (`$numExtra`) a data.frame containing information regarding the dimensions in which the cells are directly disclosive.

Examples

```
extable <- data.frame(v1 = rep(c('a', 'b', 'c'), times = 4),
  v2 = c('i','i', 'i','h','h','h','i','i','i','h','h','h'),
  v3 = c('y', 'y', 'y', 'y', 'y', 'y','z','z', 'z', 'z', 'z', 'z'),
  freq = c(0,0,5,0,2,3,1,0,3,1,1,2))
ex_freq <- c(18,10,8,9,5,4,9,5,4,2,0,2,1,0,1,1,0,1,3,2,1,3,2,1,0,0,0,13,8,5,
  5,3,2,8,5,3)
cross <- ModelMatrix(extable,
  dimVar = 1:3,
  crossTable = TRUE)$crossTable

FindDisclosiveCells(extable, ex_freq, cross)
```

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 TRUE, two linked tables can be in output
<code>mainName</code>	When TRUE 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

Sums (aggregates) and/or sparse model matrix with possible cross table

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,
  includeEmpty = 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>includeEmpty</code>	When TRUE, empty columns of the model matrix (only zeros) are included. This is not implemented when a response term is included in the formula and <code>dropResponse = FALSE</code> (error will be produced).
<code>...</code>	Further arguments to be passed to <code>FormulaSums</code>

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")
```

GaussIndependent

Linearly independent rows and columns by Gaussian elimination

Description

The function is written primarily for large sparse matrices

Usage

```
GaussIndependent(
  x,
  printInc = FALSE,
  tolGauss = (.Machine$double.eps)^(1/2),
  testMaxInt = 0,
  allNumeric = FALSE
)

GaussRank(x, printInc = FALSE)
```

Arguments

x	A (sparse) matrix
printInc	Printing "..." to console when TRUE
tolGauss	A tolerance parameter for sparse Gaussian elimination and linear dependency. This parameter is used only in cases where integer calculation cannot be used.
testMaxInt	Parameter for testing: The Integer overflow situation will be forced when testMaxInt is exceeded
allNumeric	Parameter for testing: All calculations use numeric algorithm (as integer overflow) when TRUE

Details

GaussRank returns the rank

Value

List of logical vectors specifying independent rows and columns

Examples

```
x <- ModelMatrix(SSBtoolsData("z2"), formula = ~fylke + kostragr * hovedint - 1)

GaussIndependent(x)
GaussRank(x)
GaussRank(t(x))

## Not run:
# For comparison, qr-based rank may not work
rankMatrix(x, method = "qr")

# Dense qr works
qr(as.matrix(x))$rank

## End(Not run)
```

GaussIterationFunction

An iFunction argument to [GaussSuppression](#)

Description

Use this function as iFunction or write your own using the same seven first parameters and also using

Usage

```
GaussIterationFunction(i, I, j, J, true, false, na, filename = NULL, ...)
```

Arguments

i	Number of candidates processed (columns of x)
I	Total number of candidates to be processed (columns of x)
j	Number of eliminated dimensions (rows of x)
J	Total number of dimensions (rows of x)
true	Candidates decided to be suppressed
false	Candidates decided to be not suppressed
na	Candidates not decided
filename	When non-NULL, the above arguments will be saved to this file. Note that GaussSuppression passes this parameter via
...	Extra parameters

Details

The number of candidates decided (true and false) may differ from the number of candidates processed (i) due to parameter `removeDuplicated` and because the decision for some unprocessed candidates can be found due to empty columns.

Value

NULL

GaussSuppression	<i>Secondary suppression by Gaussian elimination</i>
------------------	--

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,
  tolGauss = (.Machine$double.eps)^(1/2),
  whenEmptySuppressed = warning,
  whenEmptyUnsuppressed = message,
  removeDuplicated = TRUE,
  iFunction = GaussIterationFunction,
  iWait = Inf,
  ...
)
```

Arguments

<code>x</code>	Matrix that relates cells to be published or suppressed to inner cells. <code>yPublish = crossprod(x,yInner)</code>
<code>candidates</code>	Indices of candidates for secondary suppression
<code>primary</code>	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), "anySumNOTprimary", "subSum", "subSpace", "sub2Sum" or "none" (see details).
printInc	Printing "." to console when TRUE
tolGauss	A tolerance parameter for sparse Gaussian elimination and linear dependency. This parameter is used only in cases where integer calculation cannot be used.
whenEmptySuppressed	Function to be called when empty input to primary suppressed cells is problematic. Supply NULL to do nothing.
whenEmptyUnsuppressed	Function to be called when empty input to candidate cells may be problematic. Supply NULL to do nothing.
removeDuplicated	Whether to remove duplicated columns in x before running the main algorithm.
iFunction	A function to be called during the iterations. See the default function, GaussIterationFunction , for description of parameters.
iWait	The minimum number of seconds between each call to iFunction. Whenever iWait<Inf, iFunction will also be called after last iteration.
...	Extra unused parameters

Details

It is possible to specify too many (all) indices as candidates. Indices specified as primary or hidden will be removed. Hidden indices (not candidates or primary) refer to cells that will not be published, but do not need protection. All singleton methods, except "sub2Sum", have been implemented with frequency tables in mind. 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. All the above methods assume that any published singletons are primary suppressed. When this is not the case, "anySumNOTprimary" must be used. The singleton method "sub2Sum" makes new imaginary primary suppressed cells, which are the sum of two inner cells. This is done when a group contains exactly two primary suppressed inner cells provided that at least one of them is singleton.

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 (<code>DataFrameToMatrix/MatrixToDataFrame</code>) 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>	See AutoHierarchies
<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), inputInOutput = FALSE,
  crossTable = TRUE)

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

<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
<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>makeColNames</code>	Colnames included when TRUE (default).
<code>crossTable</code>	Cross table in output when TRUE
<code>total</code>	Vector of total codes (possibly recycled) used when running Hrc2DimList
<code>simplify</code>	When TRUE (default) the model can be simplified when total codes are found in the hierarchies (see examples).
<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>removeEmpty</code>	When TRUE, empty columns (only zeros) are not included in output.
<code>reOrder</code>	When TRUE (default) output codes are ordered in a way similar to a usual model matrix ordering.
<code>sep</code>	String to separate when creating column names
<code>...</code>	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, inputInOutput = 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, inputInOutput = 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.
inputInOut	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.

<code>unionComplement</code>	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.
<code>constantsInOutput</code>	A single row data frame to be combine by the other output.
<code>hierarchyVarNames</code>	Variable names in the hierarchy tables as in HierarchyFix .
<code>selectionByMultiplicationLimit</code>	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.
<code>colNotInDataWarning</code>	When TRUE, warning produced when elements of colSelect are not in data.
<code>useMatrixToDataFrame</code>	When TRUE (default) special functionality for saving time and memory is used.
<code>handleDuplicated</code>	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).
<code>asInput</code>	When TRUE (FALSE is default) output matrices match input data. Thus <code>valueMatrix = Matrix(data[,valueVar],ncol=1)</code> . Only possible when no colFactor.
<code>verbose</code>	Whether to print information during calculations. FALSE is default.
<code>reOrder</code>	When TRUE (FALSE is default) output codes are ordered differently, more similar to a usual model matrix ordering.
<code>reduceData</code>	When TRUE (default) unnecessary (for the aggregated result) rows of valueMatrix are allowed to be removed.
<code>makeRownames</code>	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"))

```

HierarchyCompute2 *Extended Hierarchical Computations*

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

<code>hierarchy</code>	data frame with hierarchy table
<code>hierarchyVarNames</code>	variable names
<code>autoLevel</code>	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"))

```

LSfitNonNeg	<i>Non-negative regression fits with a sparse overparameterized model matrix</i>
-------------	--

Description

Assuming $z = t(x) \%*\% y + \text{noise}$, a non-negatively modified least squares estimate of $t(x) \%*\% y$ is made.

Usage

```
LSfitNonNeg(x, z, limit = 1e-10, viaQR = FALSE, printInc = TRUE)
```

Arguments

x	A matrix
z	A single column matrix
limit	Lower limit for non-zero fits. Set to NULL or -Inf to avoid the non-zero restriction.
viaQR	Least squares fits obtained using qr when TRUE.
printInc	Printing "..." to console when TRUE.

Details

The problem is first reduced by elimination some rows of x (elements of y) using [GaussIndependent](#). Thereafter least squares fits are obtained using [solve](#) or [qr](#). Possible negative fits will be forced to zero in the next estimation iteration(s).

Value

A fitted version of z

Author(s)

Øyvind Langsrud

Examples

```

set.seed(123)
data2 <- SSBtoolsData("z2")
x <- ModelMatrix(data2, formula = ~fylke + kostragr * hovedint - 1)
z <- t(x) %% data2$ant + rnorm(ncol(x), sd = 3)
LSfitNonNeg(x, z)
LSfitNonNeg(x, z, limit = NULL)

## Not run:
mf <- ~region*mnd + hovedint*mnd + fylke*hovedint*mnd + kostragr*hovedint*mnd
data4 <- SSBtoolsData("sosialFiktiv")
x <- ModelMatrix(data4, formula = mf)
z <- t(x) %% data4$ant + rnorm(ncol(x), sd = 3)
zFit <- LSfitNonNeg(x, z)

## End(Not run)

```

MakeHierFormula

Make model formula from data taking into account hierarchical variables

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

Matching rows in data frames

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)
```

Mipf

*Iterative proportional fitting from matrix input***Description**

The linear equation, $z = t(x) \%*\% y$, is (hopefully) solved for y by iterative proportional fitting

Usage

```
Mipf(
  x,
  z = NULL,
  iter = 100,
  yStart = matrix(1, nrow(x), 1),
  eps = 0.01,
  tol = 1e-10,
  reduceBy0 = FALSE,
  reduceByColSums = FALSE,
  reduceByLeverage = FALSE,
  returnDetails = FALSE,
  y = NULL
)
```

Arguments

<code>x</code>	a matrix
<code>z</code>	a single column matrix
<code>iter</code>	maximum number of iterations
<code>yStart</code>	a starting estimate of y
<code>eps</code>	stopping criterion. Maximum allowed value of $\max(\text{abs}(z - t(x) \%*\% y\text{Hat}))$
<code>tol</code>	Another stopping criterion. Maximum absolute difference between two iterations.
<code>reduceBy0</code>	When TRUE, Reduce0exact used within the function
<code>reduceByColSums</code>	Parameter to Reduce0exact (when TRUE)
<code>reduceByLeverage</code>	Parameter to Reduce0exact (when TRUE)
<code>returnDetails</code>	More output when TRUE.
<code>y</code>	It is possible to set z to NULL and supply original y instead ($z = t(x) \%*\% y$)

Details

The algorithm will work similar to [loglin](#) when the input x -matrix is a overparameterized model matrix – as can be created by [ModelMatrix](#) and [FormulaSums](#). See Examples.

Value

yHat, the estimate of y

Author(s)

Øyvind Langsrud

Examples

```
## Not run:
data2 <- SSBtoolsData("z2")
x <- ModelMatrix(data2, formula = ~fylke + kostragr * hovedint - 1)
z <- t(x) %*% data2$ant # same as FormulaSums(data2, ant~fylke + kostragr * hovedint -1)
yHat <- Mipf(x, z)

#####
# loglm comparison
#####

if (require(MASS)){

# Increase accuracy
yHat <- Mipf(x, z, eps = 1e-04)

# Run loglm and store fitted values in a data frame
outLoglm <- loglm(ant ~ fylke + kostragr * hovedint, data2, eps = 1e-04, iter = 100)
dfLoglm <- as.data.frame.table(fitted(outLoglm))

# Problem 1: Variable region not in output, but instead the variable .Within.
# Problem 2: Extra zeros since hierarchy not treated. Impossible combinations in output.

# By sorting data, it becomes clear that the fitted values are the same.
max(abs(sort(dfLoglm$Freq, decreasing = TRUE)[1:nrow(data2)] - sort(yHat, decreasing = TRUE)))

# Modify so that region is in output. Problem 1 avoided.
x <- ModelMatrix(data2, formula = ~region + kostragr * hovedint - 1)
z <- t(x) %*% data2$ant # same as FormulaSums(data2, ant~fylke + kostragr * hovedint -1)
yHat <- Mipf(x, z, eps = 1e-04)
outLoglm <- loglm(ant ~ region + kostragr * hovedint, data2, eps = 1e-04, iter = 100)
dfLoglm <- as.data.frame.table(fitted(outLoglm))

# Now it is possible to merge data
merg <- merge(cbind(data2, yHat), dfLoglm)

# Identical output
max(abs(merg$yHat - merg$Freq))

}

## End(Not run)
```

```
#####
# loglin comparison
#####

# Generate input data for loglin
n <- 5:9
tab <- array(sample(1:prod(n)), n)

# Input parameters
iter <- 20
eps <- 1e-05

# Estimate yHat by loglin
out <- loglin(tab, list(c(1, 2), c(1, 3), c(1, 4), c(1, 5), c(2, 3, 4), c(3, 4, 5)),
              fit = TRUE, iter = iter, eps = eps)
yHatLoglin <- matrix((out$fit), ncol = 1)

# Transform the data for input to Mipf
df <- as.data.frame.table(tab)
names(df)[1:5] <- c("A", "B", "C", "D", "E")
x <- ModelMatrix(df, formula = ~A:B + A:C + A:D + A:E + B:C:D + C:D:E - 1)
z <- t(x) %*% df$Freq

# Estimate yHat by Mipf
yHatPMipf <- Mipf(x, z, iter = iter, eps = eps)

# Maximal absolute difference
max(abs(yHatPMipf - yHatLoglin))

# Note: loglin reports one iteration extra

# Another example. Only one iteration needed.
max(abs(Mipf(x = FormulaSums(df, ~A:B + C - 1),
                        z = FormulaSums(df, Freq ~ A:B + C - 1))
      - matrix(loglin(tab, list(1:2, 3), fit = TRUE)$fit, ncol = 1)))

#####
# Examples utilizing Reduce0exact
#####

z3 <- SSBtoolsData("z3")
x <- ModelMatrix(z3, formula = ~region + kostragr * hovedint + region * mnd2 + fylke * mnd +
                mnd * hovedint + mnd2 * fylke * hovedint - 1)

# reduceBy0, but no iteration improvement. Identical results.
t <- 360
y <- z3$ant
y[round((1:t) * 432/t)] <- 0
z <- t(x) %*% y
a1 <- Mipf(x, z, eps = 0.1)
a2 <- Mipf(x, z, reduceBy0 = TRUE, eps = 0.1)
```

```

a3 <- Mipf(x, z, reduceByColSums = TRUE, eps = 0.1)
max(abs(a1 - a2))
max(abs(a1 - a3))

## Not run:
# Improvement by reduceByColSums. Changing eps and iter give more similar results.
t <- 402
y <- z3$ant
y[round((1:t) * 432/t)] <- 0
z <- t(x) %*% y
a1 <- Mipf(x, z, eps = 1)
a2 <- Mipf(x, z, reduceBy0 = TRUE, eps = 1)
a3 <- Mipf(x, z, reduceByColSums = TRUE, eps = 1)
max(abs(a1 - a2))
max(abs(a1 - a3))

# Improvement by ReduceByLeverage. Changing eps and iter give more similar results.
t <- 378
y <- z3$ant
y[round((1:t) * 432/t)] <- 0
z <- t(x) %*% y
a1 <- Mipf(x, z, eps = 1)
a2 <- Mipf(x, z, reduceBy0 = TRUE, eps = 1)
a3 <- Mipf(x, z, reduceByColSums = TRUE, eps = 1)
a4 <- Mipf(x, z, reduceByLeverage = TRUE, eps = 1)
max(abs(a1 - a2))
max(abs(a1 - a3))
max(abs(a1 - a4))

# Example with small eps and "Iteration stopped since tol reached"
t <- 384
y <- z3$ant
y[round((1:t) * 432/t)] <- 0
z <- t(x) %*% y
a1 <- Mipf(x, z, eps = 1e-14)
a2 <- Mipf(x, z, reduceBy0 = TRUE, eps = 1e-14)
a3 <- Mipf(x, z, reduceByColSums = TRUE, eps = 1e-14)
max(abs(a1 - a2))
max(abs(a1 - a3))

## End(Not run)

# All y-data found by reduceByColSums (0 iterations).
t <- 411
y <- z3$ant
y[round((1:t) * 432/t)] <- 0
z <- t(x) %*% y
a1 <- Mipf(x, z)
a2 <- Mipf(x, z, reduceBy0 = TRUE)
a3 <- Mipf(x, z, reduceByColSums = TRUE)

```

```

max(abs(a1 - y))
max(abs(a2 - y))
max(abs(a3 - y))

```

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,
  inputInOutput = TRUE,
  crossTable = FALSE,
  sparse = TRUE,
  viaOrdinary = FALSE,
  total = "Total",
  removeEmpty = !is.null(formula) & is.null(hierarchies),
  modelMatrix = NULL,
  dimVar = NULL,
  ...
)

NamesFromModelMatrixInput(
  data = NULL,
  hierarchies = NULL,
  formula = NULL,
  dimVar = NULL,
  ...
)

```

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.

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(s) used to name totals
removeEmpty	When TRUE, empty columns (only zeros) are not included in output. Default is TRUE with formula input without hierarchy and otherwise FALSE (see details).
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 <code>Hierarchies2ModelMatrix</code> , <code>Formula2ModelMatrix</code> or <code>HierarchiesAndFormula2ModelMatrix</code>

Details

The default value of `removeEmpty` corresponds to the default settings of the underlying functions. The functions `Hierarchies2ModelMatrix` and `HierarchiesAndFormula2ModelMatrix` have `removeEmpty` as an explicit parameter with FALSE as default. The function `Formula2ModelMatrix` is a wrapper for `FormulaSums`, which has a parameter `includeEmpty` with FALSE as default. Thus, `ModelMatrix` makes a call to `Formula2ModelMatrix` with `includeEmpty = !removeEmpty`.

`NamesFromModelMatrixInput` returns the names of the data columns involved in creating the model matrix. Note that data must be non-NULL to convert `dimVar` as indices to names.

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,
  inputInOut = FALSE, removeEmpty = TRUE, crossTable = TRUE)
ModelMatrix(s, list(age = ageHier, geo = geoDimList, year = ""), formula = ~age * geo + year,
  inputInOut = c(TRUE, FALSE), removeEmpty = FALSE, crossTable = TRUE)
ModelMatrix(z, list(age = ageHier, geo = geoDimList, year = ""), formula = ~age * year + geo,
  inputInOut = c(FALSE, TRUE), crossTable = TRUE)

# via Hierarchies2ModelMatrix() using unnamed list element. See AutoHierarchies.
colnames(ModelMatrix(z, list(age = ageHier, c(Europe = "geo", Allyears = "year", "eu"))))
colnames(ModelMatrix(z, list(age = ageHier, c("geo", "year", "eu"), total = c("t1", "t2"))))

```

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.

my_km2: Fictitious grid data.

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

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

ValueA 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

*Unstack a column from a data frame and include additional variables.***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`*Row selection by wildcard/globbing*

Description

The selected rows match combined requirements for all variables.

Usage

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

Arguments

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

Details

This function is used by [HierarchicalWildcardGlobbing](#) and [WildcardGlobbingVector](#) and make use of [grep1](#) 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

x	Character vector
wg	Character vector with wildcard/globbing
negSign	Character representing selection to be removed
invert	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*", "!?????*))

```

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