Package 'GaussSuppression'

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Description A statistical disclosure control tool to protect tables by suppression using the Gaussian elimination secondary suppression algorithm (Langsrud, 2024) <doi:10.1007/978-3-031-69651-0_6>. A suggestion is to start by working with functions SuppressSmallCounts() and SuppressDominantCells(). These functions use primary suppression functions for the minimum frequency rule and the dominance rule, respectively. Novel functionality for targeted attribute disclosure protection is also included. See Langsrud (2026) <doi:10.1007/978-3-032-37883-5_8> and references therein. General primary suppression functions can be supplied as input to the general working horse function, GaussSuppressionFromData(). Suppressed frequencies can be replaced by synthetic decimal numbers as described in Langsrud (2019) <doi:10.1007/s11222-018-9848-9>. This approach can also be used as a flexible tool for suppression of post-published tabular data (Langsrud and Bøvelstad, 2022) <doi:10.1007/978-3-031-13945-1_8>.

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`AdditionalSuppression` *GaussSuppression from data and suppressed data*

Description

Extended version of `GaussSuppressionFromData` that takes into account suppression pattern in suppressed data sent as input

Usage

```
AdditionalSuppression(
  data,
  ...,
  fun = GaussSuppressionFromData,
  primary = GetDefault(fun, "primary"),
  suppressedData = NULL,
  makePrimary = TRUE,
  makeForced = TRUE,
  forceNotPrimary = TRUE
)
```

Arguments

`data`	Input data as a data frame
`...`	Further parameters to `GaussSuppressionFromData`
`fun`	A function: `GaussSuppressionFromData` or one of its wrappers such as `SuppressSmallCounts` and `SuppressDominantCells`.
`primary`	As input to `GaussSuppressionFromData` before possible extension caused by `suppressedData`. Supply `NULL` if all primary suppressions are retrieved form `suppressedData`.
`suppressedData`	A data frame or a list of data frames as output from `GaussSuppressionFromData`.
`makePrimary`	When `TRUE`, suppression in `suppressedData` is preserved.
`makeForced`	When TRUE, non-suppression in `suppressedData` is preserved. An exception is possible primary suppression which has priority over `forced`. Use forceNotPrimary to avoid this exception.
`forceNotPrimary`	When TRUE, non-suppression in `suppressedData` is forced to be not primary suppressed.

Details

This function is an easy alternative to using PrimaryFromSuppressedData and the relating functions manually. See the examples of PrimaryFromSuppressedData. By default, the suppression pattern in suppressedData is preserved. The behavior can be tuned by the parameters.

Note that the variables used in suppressedData in addition to "suppressed" are those with matching names in crossTable. Others are ignored. See examples (d3, d4, d5). NOW A FIX IS INCLUDED by attribute totCode. EXAMPLES NOT YET CHANGED.

Value

Aggregated data with suppression information

Examples

```
z1 <- SSBtoolsData("z1")
z2 <- SSBtoolsData("z2")
z3 <- SSBtoolsData("z3")

# Ordinary suppressions
a <- GaussSuppressionFromData(z1, 1:2, 3, maxN = 5)
b <- GaussSuppressionFromData(z2, 1:4, 5, maxN = 1)

# As b and also suppression pattern in a preserved
b1 <- AdditionalSuppression(z2, 1:4, 5, maxN = 1, suppressedData = a)

# Rows with differences
cbind(b, b1)[b1$suppressed != b$suppressed, ]

# All primary from a
b2 <- AdditionalSuppression(z2, 1:4, 5, suppressedData = a, primary = NULL, singleton = NULL)

# Rows with suppression
b2[b2$suppressed, ]

# All primary from b2
d1 <- AdditionalSuppression(data = z3, 1:6, 7, suppressedData = b2, primary = NULL,
                            singleton = NULL)

# No suppression since no common codes
d1[d1$suppressed, ]

# Use another coding of fylke
z3$fylke_ <- z3$fylke - 4
d2 <- AdditionalSuppression(data = z3, c(1, 3:6, 8), 7, suppressedData = b2, primary = NULL,
                            singleton = NULL)

# Two primary found in b2 -> several secondary
d2[d2$suppressed,]


# Examples demonstrating limitations of AdditionalSuppression
```

```
# Variable mnd in suppressedData is not used

# No suppression since unsuppressed rows used by makeForced and forceNotPrimary
d3 <- AdditionalSuppression(data = z3, c(1, 3:4, 8), 7, suppressedData = d2, primary = NULL,
                            singleton = NULL)
d3[d3$suppressed, ]

# Now suppression, but not too much
d4 <- AdditionalSuppression(data = z3, c(1, 3:4, 8), 7, suppressedData = d2,
                            forceNotPrimary = FALSE, primary = NULL, singleton = NULL)
d4[d4$suppressed, ]

# The correct way is to limit the input
d5 <- AdditionalSuppression(data = z3, c(1, 3:4, 8), 7, suppressedData = d2[d2$mnd == "Total", ],
                            primary = NULL, singleton = NULL)
d5[d5$suppressed, ]
```

CandidatesDefault *Candidates functions*

Description

Function for GaussSuppressionFromData

Usage

```
CandidatesDefault(freq, x, secondaryZeros = FALSE, weight, ...)

CandidatesNum(
  secondaryZeros = FALSE,
  freq = NULL,
  num,
  weight,
  x,
  candidatesVar = NULL,
  removeCodes = character(0),
  removeCodesForCandidates = TRUE,
  data,
  charVar,
  ...
)
```

Arguments

freq	Vector of output frequencies
x	The model matrix

secondaryZeros	When TRUE, cells with zero frequency or value are prioritized to be published so that they are not secondary suppressed. This is achieved by this function by having the zero frequency indices first in the retuned order.
weight	Vector of output weights
...	Unused parameters
num	Data frame of output aggregates calculated from numVar. When several variables, and without specifying candidatesVar, only first is used.
candidatesVar	One of the variable names from numVar to be used in the calculations. Specifying candidatesVar helps avoid warnings when multiple numVar variables are present.
removeCodes	Same parameter as used in suppression rules, e.g. NContributorsRule. It is often assumed that cells where all contributors (charVar) are present in removeCodes should be published. Here, such cells will be prioritized to achieve this. Note that this functionality is redundant if the same cells are specified by forced.
removeCodesForCandidates	removeCodes ignored when set to FALSE.
data	Input data as a data frame (needed for removeCodes calculations)
charVar	Variable(s) with contributor codes (needed for removeCodes calculations)

Details

CandidatesDefault orders the indices decreasingly according to freq or, when weight is non-NULL, (freq+1)*weight. Ties are handled by prioritizing output cells that are calculated from many input cells. In addition, zeros are handled according to parameter secondaryZeros. When freq is negative (special hierarchy), abs(freq)*weight is used.

CandidatesNum orders the indices decreasingly according to absolute values of the numeric variable (according to abs(num[[1]])). In practice this is done by running CandidatesDefault with manipulated weights.

Value

candidates, GaussSuppression input

ChainedSuppression *Repeated GaussSuppression with forwarding of previous results*

Description

AdditionalSuppression is called several times. Each time with all previous results as suppressedData.

Usage

```
ChainedSuppression(..., withinArg = NULL)

ChainedSuppressionHi(..., hierarchies)

ChainedSuppressionHi1(..., hierarchies)
```

Arguments

...	Arguments to AdditionalSuppression/GaussSuppressionFromData that are kept constant.
withinArg	A list of named lists. Arguments to AdditionalSuppression/GaussSuppressionFromData that are not kept constant. List elements with suppressed data are also allowed.
hierarchies	In the wrapper ChainedSuppressionHi, this argument will be used to generate the withinArg to ChainedSuppression with the same length (see examples). Then, element number i of withinArg is list(hierarchies = hierarchies[1:i]). In the similar wrapper, ChainedSuppressionHi1, withinArg has always two elements: list(hierarchies = hierarchies[1]) and list(hierarchies = hierarchies).

Value

List of data frames. The wrappers, ChainedSuppressionHi and ChainedSuppressionHi1, return a single data frame, which is the last list item.

Examples

```
z1 <- SSBtoolsData("z1")
z2 <- SSBtoolsData("z2")
z2b <- z2[3:5]
names(z2b)[1] <- "region"

# As GaussSuppressionFromData when a single element within withinArg
a1 <- ChainedSuppression(z1, 1:2, 3, maxN = 5)
a2 <- ChainedSuppression(z1, withinArg = list(list(dimVar = 1:2, freqVar = 3, maxN = 5)))
identical(a1, a2[[1]])

# b[[3]] include results from b[[1]] and b[[2]]
b <- ChainedSuppression(z1, freqVar = 3, withinArg = list(
       list(dimVar = 1,   maxN = 55),
       list(dimVar = 2,   maxN = 55),
       list(dimVar = 1:2, maxN = 5)))

# d[[2]] is same as b1 in AdditionalSuppression examples
d <- ChainedSuppression(withinArg = list(
       list(data = z1,  dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2,  dimVar = 1:4, freqVar = 5, maxN = 1)))

# Common variable names important.
# Therefore kostragr renamed to region in z2b.
f <- ChainedSuppression(withinArg = list(
       list(data = z1,  dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2b, dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2,  dimVar = 1:4, freqVar = 5, maxN = 1)))

# Parameters so that only suppressions are forwarded.
# This is first iteration in linked tables by iterations.
e <- ChainedSuppression(withinArg = list(
```

```
       list(data = z1,  dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2b, dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2,  dimVar = 1:4, freqVar = 5, maxN = 1)),
       makeForced = FALSE, forceNotPrimary = FALSE)

# "A" "annet"/"arbeid" could be suppressed here, but not in f since f[[1]]
e[[3]][which(e[[3]]$suppressed != f[[3]]$suppressed), ]


#### Demonstrate SuppressionByChainedHierarchies

dimLists <- SSBtools::FindDimLists(z2[, 4:1])


# Two ways of doing the same calculations
g1 <- ChainedSuppressionHi(z2, c(1, 3), 5, maxN = 1, hierarchies = dimLists)
g1b <-  ChainedSuppression(z2, c(1, 3), 5, maxN = 1, withinArg = list(
         list(hierarchies = dimLists[1]),
         list(hierarchies = dimLists[1:2]),
         list(hierarchies = dimLists[1:3])))[[3]]

# Results different after combining hierarchies
g2 <- ChainedSuppressionHi(z2, c(1, 3), 5, maxN = 1,
         hierarchies = SSBtools::AutoHierarchies(dimLists))

# In this case, the same results can be obtained by:
g3 <- ChainedSuppressionHi1(z2, c(1, 3), 5, maxN = 1, hierarchies = dimLists)
```

`ComputeIntervals` *Function for calculating intervals for suppressed tables.*

Description

This function solves linear programs to determine interval boundaries for suppressed cells.

Usage

```
ComputeIntervals(
  x,
  z,
  primary,
  suppressed,
  minVal = NULL,
  lpPackage = "lpSolve",
  gaussI = TRUE,
  allInt = FALSE,
  sparseConstraints = TRUE,
  cell_grouping = rep(0, length(z))
)
```

Arguments

x	ModelMatrix, as output from SSBtools::ModelMatrix
z	numerical vector with length ncol(x). Corresponds to table cell values
primary	Vector indicating primary suppressed cells. Can be logical or integer. If integer vector, indicates the columns of x which are considered primary suppressed.
suppressed	Vector indicating all suppressed cells. Can be logical or integer. If integer vector, indicates the columns of x which are considered suppressed.
minVal	a known minimum value for table cells. Default NULL. Note that 'minVal' is interpreted as the limiting value for all suppressed cells. Specifying 'minVal=0' would be redundant, as a minimum value of 0 is anyway assumed for inner cells (see details).
lpPackage	The name of the package used to solve linear programs. Currently, 'lpSolve' (default), 'Rsymphony', 'Rglpk' and 'highs' are supported.
gaussI	Boolean vector. If TRUE (default), GaussIndependent is used to reduce size of linear program.
allInt	Integer variables when TRUE. See `all.int` parameter in `lpSolve` and `types` parameter in `Rsymphony` and `Rglpk`.
sparseConstraints	When TRUE, a sparse constraint matrix will be input to the solver. In the case of `lpSolve`, the sparse matrix is represented in triplet form as a dense matrix with three columns, and the `dense.const` parameter is utilized.
cell_grouping	Numeric vector indicating group membership. Cells with the same value that is not 0 belong to the same group. A value of 0 indicates that the cell is not a member of any group. Members of the same group are assumed to have the same z-value and this is included as a condition when calculating intervals.

Details

Default in for `bounds` parameter in `Rsymphony_solve_LP` and `Rglpk_solve_LP`: *The default for each variable is a bound between 0 and* `Inf`. Details in `lpSolve`: *Note that every variable is assumed to be* `>= 0`*!*

Author(s)

Øyvind Langsrud and Daniel Lupp

`default_targeting` *Default* `targeting` *function for SuppressKDisclosure()*

Description

Generates a `targeting` specification for use with `SuppressKDisclosure()`. The function is actually used internally by `KDisclosurePrimary()`.

Usage

```
default_targeting(
  crossTable,
  x,
  identifying = NULL,
  sensitive = NULL,
  targeting_include = NULL,
  targeting_exclude = NULL,
  ...
)
```

Arguments

crossTable	A crossTable, possibly extended after applying mc_hierarchies.
x	The model matrix, x, possibly extended after applying mc_hierarchies.
identifying	Specification of information that an intruder may already know. The specification is subject to the same requirements as sensitive below. If not all variables are included, total codes for the missing variables are derived automatically. This requires that the overall total is included as an output row.
sensitive	Specification of information considered unacceptable to disclose. It may be given as a character vector of variable names, a named list with variable names as names and specified codes as values, or a data frame specifying variable combinations. The wildcard characters * and ?, as well as the exclusion operator !, may be used, since SSBtools::WildcardGlobbing() is applied.
targeting_include	A list of two-element lists with components identifying and sensitive. Each element defines identifying–sensitive relations using the same specification rules as the parameters identifying and sensitive. All specifications together, including the main identifying and sensitive parameters, define the relations that are examined for suppression.
targeting_exclude	A list specified in the same way as targeting_include. The relations defined here are ignored when examining suppression.
...	Unused parameters.

Details

The parameters identifying and sensitive are used to select table cells (including hidden cells constructed via mc_hierarchies). All such cells are represented by rows in crossTable, which may be extended due to mc_hierarchies. Thus, rows in crossTable are selected as identifying or sensitive.

In addition, sensitive specifies which codes within the selected rows are regarded as sensitive.

The logic differs slightly for unspecified variables: For identifying, unspecified variables are set to total codes. For sensitive, all rows in crossTable matching the specified variables are selected.

The parameters `identifying` and `sensitive` are used to construct the `targeting` specification for `KDisclosurePrimary()`, resulting in the elements `identifying`, `sensitive`, and `is_sensitive`.

When `targeting_include` and/or `targeting_exclude` are specified, additional elements `include_relations` and `exclude_relations` are created.

Value

A named `targeting` list. See `SuppressKDisclosure()`.

Examples

```
mm <- SSBtools::ModelMatrix(SSBtoolsData("example1"),
     formula = ~age * eu + geo, crossTable = TRUE)
crossTable <- mm$crossTable
x <- mm$modelMatrix

default_targeting(crossTable, x)  # just NULL

# geo identifying and age sensitive (age sensitive variable)
a2 <- default_targeting(crossTable, x,
                        identifying = "geo",
                        sensitive = "age")
a1 <- default_targeting(crossTable, x,
                        identifying = list(age = "Total", geo = "*"),
                        sensitive = list(age = "*"))
identical(a1, a2)
a1


# Not ok to disclose 'EU' and 'Portugal'
# But ok to disclose 'Spain' with 'EU' known
# and also ok to disclose 'Spain' in other table cells without 'EU' as marginal
default_targeting(crossTable, x,
                  sensitive = list(geo = c("Portugal", "EU")))

# As above but now also ok to disclose 'Portugal' from 'EU' known,
# since protection only considers 'age' identifying.
default_targeting(crossTable, x,
                  identifying = "age",
                  sensitive = list(geo = c("Portugal", "EU")))
```

`FindDominantCells` *Method for finding dominant cells according to (possibly multiple) n,k dominance rules.*

Description

Supports functionality for grouping contributions according to holding variables, as well as calculating dominance in surveys with a given sampling weight. Two methods are implemented, depending on whether the sampling weights sum to total population. The parameter `tauArgusDominance` determines this. If `FALSE`, unweighted contributions are compared to weighted cell values. If `TRUE`, the method described in in the book "Statistical Disclosure Control" (Hundepool et al 2012, p. 151) is used.

Usage

```
FindDominantCells(
  x,
  inputnum,
  num,
  n,
  k,
  charVar_groups,
  samplingWeight,
  tauArgusDominance = FALSE,
  returnContrib = FALSE,
  maxContribution = NULL
)
```

Arguments

`x`	model matrix describing relationship between input and published cells
`inputnum`	vector of numeric contributions for each of the input records
`num`	vector of numeric values for each of the published cells
`n`	vector of integers describing n parameters in n,k rules. Must be same length as `k` parameter.
`k`	vector of numeric values describing k parameters in n,k rules, where percentages are described as numbers less than 100. Must be same length as `n` parameter.
`charVar_groups`	vector describing which input records should be grouped
`samplingWeight`	vector of sampling weights associated to input records
`tauArgusDominance`	logical value, default `FALSE`. determines how to handle sampling weights in the dominance rule (see details).
`returnContrib`	logical value, default `FALSE`. If `TRUE` return value is the percentage of the first n contributors
`maxContribution`	Possible precalculated output from `MaxContribution` as input. To speed up.

Value

logical vector describing which publish-cells need to be suppressed.

`FixRiskyIntervals` *New primary cells to fix risky intervals*

Description

Indices to new primary cells are returned

Usage

```
FixRiskyIntervals(
  x,
  z,
  primary,
  suppressed,
  candidates = NULL,
  minVal = NULL,
  lpPackage = "lpSolve",
  gaussI = FALSE,
  allInt = FALSE,
  sparseConstraints = TRUE,
  intervalLimits,
  cell_grouping = rep(0, length(z))
)
```

Arguments

`x`	ModelMatrix, as output from SSBtools::ModelMatrix
`z`	numerical vector with length ncol(x). Corresponds to table cell values
`primary`	Vector indicating primary suppressed cells. Can be logical or integer. If integer vector, indicates the columns of x which are considered primary suppressed.
`suppressed`	Vector indicating all suppressed cells. Can be logical or integer. If integer vector, indicates the columns of x which are considered suppressed.
`candidates`	`candidates` as indices
`minVal`	a known minimum value for table cells. Default NULL. Note that 'minVal' is interpreted as the limiting value for all suppressed cells. Specifying 'minVal=0' would be redundant, as a minimum value of 0 is anyway assumed for inner cells (see details).
`lpPackage`	The name of the package used to solve linear programs. Currently, 'lpSolve' (default), 'Rsymphony', 'Rglpk' and 'highs' are supported.
`gaussI`	Boolean vector. If TRUE (default), GaussIndependent is used to reduce size of linear program.
`allInt`	Integer variables when TRUE. See `all.int` parameter in `lpSolve` and `types` parameter in `Rsymphony` and `Rglpk`.

`sparseConstraints`
: When TRUE, a sparse constraint matrix will be input to the solver. In the case of `lpSolve`, the sparse matrix is represented in triplet form as a dense matrix with three columns, and the `dense.const` parameter is utilized.

`intervalLimits`
: As computed by `IntervalLimits`

`cell_grouping`
: Numeric vector indicating group membership. Cells with the same value that is not 0 belong to the same group. A value of 0 indicates that the cell is not a member of any group. Members of the same group are assumed to have the same z-value and this is included as a condition when calculating intervals.

Details

Code in this function started from a copy of `ComputeIntervals`

`GaussSuppressDec` *Cell suppression with synthetic decimal numbers*

Description

`GaussSuppressionFromData`, or one of its wrappers, is run and decimal numbers are added to output by executing `SuppressDec`.

Usage

```
GaussSuppressDec(
  data,
  ...,
  fun = GaussSuppressionFromData,
  output = NULL,
  use_freqVar = NA,
  digits = 9,
  nRep = NULL,
  rmse = pi/3,
  sparseLimit = 500,
  rndSeed = 123,
  runIpf = FALSE,
  eps = 0.01,
  iter = 100,
  mismatchWarning = TRUE,
  whenDuplicatedInner = NULL,
  whenMixedDuplicatedInner = warning,
  formula = NULL,
  linkedTables = NULL,
  linked_rep = FALSE
)
```

Arguments

data	Input daata as a data frame
...	Further parameters to GaussSuppressionFromData
fun	A function: GaussSuppressionFromData or one of its wrappers such as SuppressSmallCounts and SuppressDominantCells.
output	NULL (default), "publish", "inner", "publish_inner", or "publish_inner_x" (x also).
use_freqVar	Logical (TRUE/FALSE) with a default value of NA. Determines whether the variable freqVar is used as the basis for generating decimal numbers. If NA, the parameter is set to TRUE, except in the following cases, where it is set to FALSE: • If freqVar is not available. • If runIpf is FALSE and fun is one of the functions SuppressFewContributors or SuppressDominantCells. When use_freqVar is FALSE, only zeros are used instead. This approach is more robust in practice, as decimal numbers can then be stored more accurately. The default value is chosen to ensure compatibility with existing code and to allow for the use of freqVar when dealing with frequency tables, which may be useful.
digits	Parameter to RoundWhole. Values close to whole numbers will be rounded.
nRep	NULL or an integer. When >1, several decimal numbers will be generated.
rmse	Desired root mean square error of decimal numbers. Variability around the expected, according to the linear model, inner frequencies. The expected frequencies are calculated from the non-suppressed publishable frequencies.
sparseLimit	Limit for the number of rows of a reduced x-matrix within the algorithm. When exceeded, a new sparse algorithm is used.
rndSeed	If non-NULL, a random generator seed to be used locally within the function without affecting the random value stream in R.
runIpf	When TRUE, additional frequencies are generated by iterative proportional fitting using Mipf.
eps	Parameter to Mipf.
iter	Parameter to Mipf.
mismatchWarning	Whether to produce the warning "Mismatch between whole numbers and suppression", when relevant. When nRep>1, all replicates must satisfy the whole number requirement for non-suppressed cells. When mismatchWarning is integer (>0), this will be used as parameter digits to RoundWhole when doing mismatch checking (can be quite low when nRep>1).
whenDuplicatedInner	Function to be called when default output and when cells marked as inner correspond to several input cells (aggregated) since they correspond to published cells.
whenMixedDuplicatedInner	Function to be called in the case above when some inner cells correspond to published cells (aggregated) and some not (not aggregated).

formula	formula passed to GaussSuppressionFromData(). Included as a formal argument in this function.
linkedTables	linkedTables passed to GaussSuppressionFromData(). Included as a formal argument in this function.
linked_rep	Logical (default FALSE). Used together with the linkedGauss parameter of GaussSuppressionFromData() to generate separate sets of nRep decimal numbers for each linked table. The decimal number variables are named using the table names as prefixes.

Value

A data frame where inner cells and cells to be published are combined or output according to parameter output.

Author(s)

Øyvind Langrsud

References

Langsrud (2019). doi:10.1007/s1122201898489.

Langsrud and Bøvelstad (2022). doi:10.1007/9783031139451_8.

See Also

SuppressionFromDecimals()

Examples

```
a <- GaussSuppressDec(data = SSBtoolsData("example1"),
                      fun = SuppressSmallCounts,
                      dimVar = c("age", "geo"),
                      preAggregate = TRUE,
                      freqVar = "freq", maxN = 3)
a


b <- GaussSuppressDec(data = SSBtoolsData("magnitude1"),
                      fun = SuppressDominantCells,
                      numVar = "value",
                      formula = ~sector2 * geo + sector4 * eu,
                      contributorVar = "company", k = c(80, 99))
b

# FormulaSelection() works on this output as well
FormulaSelection(b, ~sector2 * geo)
```

GaussSuppressionFromData *Cell suppression from input data containing inner cells*

Description

Aggregates are generated followed by primary suppression followed by secondary suppression by Gaussian elimination by GaussSuppression

Usage

```
GaussSuppressionFromData(
  data,
  dimVar = NULL,
  freqVar = NULL,
  ...,
  numVar = NULL,
  weightVar = NULL,
  charVar = NULL,
  hierarchies = NULL,
  formula = NULL,
  maxN = suppressWarnings(formals(c(primary)[[1]])$maxN),
  protectZeros = suppressWarnings(formals(c(primary)[[1]])$protectZeros),
  secondaryZeros = suppressWarnings(formals(candidates)$secondaryZeros),
  candidates = CandidatesDefault,
  primary = PrimaryDefault,
  forced = NULL,
  hidden = NULL,
  singleton = SingletonDefault,
  singletonMethod = ifelse(secondaryZeros, "anySumNOTprimary", "anySum"),
  printInc = TRUE,
  output = "publish",
  x = NULL,
  crossTable = NULL,
  preAggregate = is.null(freqVar),
  extraAggregate = preAggregate & !is.null(charVar),
  structuralEmpty = FALSE,
  extend0 = FALSE,
  spec = NULL,
  specLock = FALSE,
  freqVarNew = rev(make.unique(c(names(data), "freq")))[1],
  nUniqueVar = rev(make.unique(c(names(data), "nUnique")))[1],
  origIdxVar = rev(make.unique(c(names(data), "origIdx")))[1],
  forcedInOutput = "ifNonNULL",
  unsafeInOutput = "ifForcedInOutput",
  lpPackage = NULL,
  intervalSuppression = TRUE,
```

```
  aggregatePackage = "base",
  aggregateNA = TRUE,
  aggregateBaseOrder = FALSE,
  rowGroupsPackage = aggregatePackage,
  linkedGauss = NULL,
  linkedIntervals = ifelse(linkedGauss == "local-bdiag", "local-bdiag",
    "super-consistent"),
  recordAware = TRUE,
  collapseAware = FALSE,
  linkedTables = NULL,
  da_vars = NULL,
  da_fun = NULL,
  da_args = NULL,
  action_unused_dots = getOption("GaussSuppression.action_unused_dots", "warn"),
  allowed_unused_dots = getOption("GaussSuppression.allowed_unused_dots", character(0))
)
```

Arguments

data	Input data, typically a data frame, tibble, or data.table. If data is not a classic data frame, it will be coerced to one internally unless preAggregate is TRUE and aggregatePackage is "data.table".
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
freqVar	A single variable holding counts (name or number).
...	Further arguments to be passed to the supplied functions and to ModelMatrix (such as inputInOutput and removeEmpty).
numVar	Other numerical variables to be aggregated
weightVar	weightVar Weights (costs) to be used to order candidates for secondary suppression
charVar	Other variables possibly to be used within the supplied functions
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
maxN	Suppression parameter forwarded to the supplied functions. With the default primary function, PrimaryDefault(), cells with frequency <= maxN are marked as primary suppressed, and the default value of maxN is 3. See details below. The parameter is also used by NContributorsRule(). For advanced use cases, including setups with multiple primary functions, maxN can be specified as a named list or vector. See each primary function's documentation for details.
protectZeros	Suppression parameter. When TRUE, cells with zero frequency or value are set as primary suppressed. Using the default primary function, protectZeros is by default set to TRUE. See details.

`secondaryZeros` Suppression parameter. When `TRUE`, cells with zero frequency or value are prioritized to be published so that they are not secondary suppressed. Using the default `candidates` function, `secondaryZeros` is by default set to `FALSE`. See details.

`candidates` GaussSuppression input or a function generating it (see details) Default: `CandidatesDefault`

`primary` GaussSuppression input or a function generating it (see details) Default: `PrimaryDefault`

`forced` GaussSuppression input or a function generating it (see details)

`hidden` GaussSuppression input or a function generating it (see details)

`singleton` GaussSuppression input or a function generating it (see details) Default: `SingletonDefault`

`singletonMethod`
`GaussSuppression` input. The default value depends on parameter `secondaryZeros` which depends on `candidates` (see details).

`printInc` `GaussSuppression` input

`output` One of `"publish"` (default), `"inner"`, `"publish_inner"`, `"publish_inner_x"`, `"publish_x"`, `"inner_x"`, `"input2functions"` (input to supplied functions), `"inputGaussSuppression"`, `"inputGaussSuppression_x"`, `"outputGaussSuppression"` `"outputGaussSuppression_x"`, `"primary"`, `"secondary"` and `"all"`. Here "inner" means input data (possibly pre-aggregated) and "x" means dummy matrix (as input parameter x). All input to and output from `GaussSuppression`, except `...`, are returned when `"outputGaussSuppression_x"`. Excluding x and only input are also possible. The code `"all"` means all relevant output after all the calculations. Currently, this means the same as `"publish_inner_x"` extended with the matrices (or NULL) `xExtraPrimary` and `unsafe`. The former matrix is usually made by `KDisclosurePrimary`. This latter matrix contains the columns representing unsafe primary suppressions. In addition to `x` columns corresponding to unsafe in ordinary output (see parameter `unsafeInOutput` below), possible columns from `xExtraPrimary` may also be included in the unsafe matrix (see details).

`x` `x` (`modelMatrix`) and `crossTable` can be supplied as input instead of generating it from `ModelMatrix`

`crossTable` See above.

`preAggregate` When `TRUE`, the data will be aggregated within the function to an appropriate level. This is defined by the dimensional variables according to `dimVar`, `hierarchies` or `formula` and in addition `charVar`. When `FALSE`, no aggregation is performed. When `NA`, the function will automatically decide whether to aggregate: aggregation is applied unless `freqVar` is present and the data contain no duplicated rows with respect to the dimensional variables and `charVar`. Exception: if a non-`NULL` `x` (the model matrix) is supplied, `NA` is treated as `FALSE`.

`extraAggregate` When `TRUE`, the data will be aggregated by the dimensional variables according to `dimVar`, `hierarchies` or `formula`. The aggregated data and the corresponding x-matrix will only be used as input to the singleton function and `GaussSuppression`. This extra aggregation is useful when parameter `charVar` is used. Supply `"publish_inner"`, `"publish_inner_x"`, `"publish_x"` or `"inner_x"` as `output` to obtain extra aggregated results. Supply `"inner"` or `"input2functions"` to obtain other results.

`structuralEmpty`
: When `TRUE`, output cells with no contributing inner cells (only zeros in column of `x`) are forced to be not primary suppressed. Thus, these cells are considered as structural zeros. When `structuralEmpty` is `TRUE`, the following error message is avoided: `Suppressed cells with empty input will not be protected. Extend input data with zeros?`. When `removeEmpty` is `TRUE` (see `"..."` below), `structuralEmpty` is superfluous

`extend0`
: Data is automatically extended by `Extend0` when `TRUE`. Can also be set to `"all"` which means that input codes in hierarchies are considered in addition to those in data. Parameter `extend0` can also be specified as a list meaning parameter `varGroups` to `Extend0`.

`spec`
: `NULL` or a named list of arguments that will act as default values.

`specLock`
: When `TRUE`, arguments in `spec` cannot be changed.

`freqVarNew`
: Name of new frequency variable generated when input `freqVar` is NULL and `preAggregate` is TRUE. Default is `"freq"` provided this is not found in `names(data)`.

`nUniqueVar`
: Name of variable holding the number of unique contributors. This variable will be generated in the `extraAggregate` step. Default is `"nUnique"` provided this is not found in `names(data)`. If an existing variable is passed as input, this variable will apply only when `preAggregate`/`extraAggregate` is not done.

`origIdxVar`
: Name of the variable generated in the `extraAggregate` step when `preAggregate` is FALSE. The variable contains the original row index in cases where `nUniqueVar` equals 1. Default is `"origIdx"` provided this name is not already present in `names(data)`.

`forcedInOutput`
: Whether to include `forced` as an output column. One of `"ifNonNULL"` (default), `"always"`, `"ifany"` and `"no"`. In addition, `TRUE` and `FALSE` are allowed as alternatives to `"always"` and `"no"`.

`unsafeInOutput`
: Whether to include `usafe` as an output column. One of `"ifForcedInOutput"` (default), `"always"`, `"ifany"` and `"no"`. In addition, `TRUE` and `FALSE` are allowed as alternatives to `"always"` and `"no"`. see details.

`lpPackage`
: - When non-NULL, intervals computed by `ComputeIntervals()` will be included in the output. Valid values are the names of supported R packages for linear programming backends: `"highs"`, `"Rsymphony"`, `"Rglpk"`, or `"lpSolve"`.
  - If interval requirements are specified, additional suppression will be performed to satisfy those requirements. Interval requirements can be set either through arguments of `IntervalLimits()` or by enabling `protectionIntervals = TRUE` in the primary suppression functions. See `IntervalLimits()` for a full description of the parameters (`protectionPercent`, `protectionLimit`, `loProtectionPercent`, `loProtectionLimit`, `rangePercent`, `rangeMin`) and how interval requirements are calculated.
    - In the output variable `suppressed_integer`, suppression status is coded as: 0 = no suppression, 1 = primary suppression, 2 = secondary suppression, 3 = additional suppression applied by an interval algorithm limited to linearly independent cells, 4 = further suppression according to the final gauss algorithm.
    - Intervals `[lo_1, up_1]` are calculated prior to additional suppression.

- To disable additional suppression, set `intervalSuppression = FALSE`.

  Please note that additional suppression based on parameters other than `rangePercent` and `rangeMin` is currently considered experimental. In particular, the names of the newer parameters may still change.

`intervalSuppression`
: Logical. If `FALSE`, additional suppression to satisfy interval requirements is disabled (default is `TRUE`). See description of `lpPackage` above.

`aggregatePackage`
: Package used to preAggregate/extraAggregate. Parameter `pkg` to `aggregate_by_pkg`.

`aggregateNA`
: Whether to include NAs in the grouping variables while preAggregate/extraAggregate. Parameter `include_na` to `aggregate_by_pkg`. Note that NAs will not be present in the output table's dimensions regardless of the value of `aggregateNA`. When using the formula interface, this is controlled by the `NAomit` parameter (default `TRUE`), which is passed to the function `SSBtools::Formula2ModelMatrix()`. It is through this use of the formula interface that NAs in the input data make sense. Note that under normal circumstances, grouping variables should not use NA to represent a category. As such, if NAs are present in the grouping variables, using the `dimVar` or `hierarchies` interfaces will result in errors.

`aggregateBaseOrder`
: Parameter `base_order` to `aggregate_by_pkg`, used when preAggregate/extraAggregate. The parameter does not affect the ordering of ordinary output. Therefore, the default is set to `FALSE` to avoid unnecessary sorting operations. The parameter will have impact when, e.g `output = "inner"`.

`rowGroupsPackage`
: Parameter `pkg` to `RowGroups`. The parameter is input to `Formula2ModelMatrix` via `ModelMatrix`.

`linkedGauss`
: Controls linked table suppression. Accepted values are described in the documentation for `SuppressLinkedTables()`. See also the note and the corresponding examples, which demonstrate usage with alternative function interfaces. In addition, `linkedGauss = "global"` is allowed and corresponds to standard execution (i.e., when `linkedGauss` is not specified). When `linkedGauss` is used, the `formula` parameter should be provided as a list of formulas. Alternatively, `formula` may have an attribute `"table_formulas"` containing such a list. See also the `linkedTables` parameter below.

`linkedIntervals`
: Determines how interval calculations, triggered by the `lpPackage` parameter, are performed when `linkedGauss` is not `"global"`. When `linkedGauss = "global"`, interval settings in `linkedIntervals` are ignored. For allowed values and detailed behaviour, see the documentation of `SuppressLinkedTables()`.

  - Note: With `linkedIntervals = "local-bdiag"`, common cells may have different table-specific intervals. Since the output shows one interval per cell, it is constructed using the maximum lower bound and minimum upper bound across the tables.

`recordAware`
: Parameter associated with `linkedGauss`. See `SuppressLinkedTables()`.

`collapseAware`
: Parameter associated with `linkedGauss`. In the linked-tables algorithm, the model matrix is first *collapsed* by removing duplicate rows. When `collapseAware`

= TRUE, every cell that remains numerically derivable after a pre-aggregation corresponding to this row reduction will be treated as a common cell. This maximizes coordination across tables, given the duplicate-row removal, while adding limited additional computational overhead. In particular, the suppression algorithm automatically accounts for cells in one table that are sums of cells in another table. Note that any cell that recordAware = TRUE would introduce is already included automatically when collapseAware = TRUE.

linkedTables
: A list specifying how the tables referenced in the formula parameter should be combined for use in the linked-tables algorithm. Each element in the list contains one or more names of the tables in formula. The corresponding tables will be combined and treated as a single table by the algorithm. For example: linkedTables = list(c("table_1", "table_3"), "table_2"). If NULL (default), each table in formula is used individually.

da_vars
: The vars argument passed to SSBtools::dummy_aggregate(). Together with the two parameters below, this enables computing results via SSBtools::aggregate_multiple_fun() in the same way as when using SSBtools::model_aggregate(). The calculations are performed by calling SSBtools::dummy_aggregate() with the model matrix (x) before any potential use of extraAggregate. Internally, the result is stored in a data frame named da_out, which is available to the supplied functions in the same manner as num. The columns of da_out are added to the final output. See SuppressDominantCells() examples.

da_fun
: The fun argument passed to SSBtools::dummy_aggregate().

da_args
: A list of additional arguments passed to SSBtools::dummy_aggregate().

action_unused_dots
: Character string controlling how unused arguments in ... are handled. Internally uses ellipsis::check_dots_used() with a custom action. One of "warn", "abort", "inform", or "none". The value "none" disables the check entirely. The default is taken from getOption("GaussSuppression.action_unused_dots"), falling back to "warn" if the option is not set. Users can change the default globally with e.g. options(GaussSuppression.action_unused_dots = "abort").

allowed_unused_dots
: Character vector of argument names ignored by the unused-argument check. May be useful when this function is wrapped by another function, or in other cases where a correctly spelled argument is nevertheless not registered as used. The default is taken from getOption("GaussSuppression.allowed_unused_dots"), falling back to character(0) if the option is not set. Users can change the default globally with e.g. options(GaussSuppression.allowed_unused_dots = c("plotColor", "lineType")).

Details

The supplied functions for generating GaussSuppression input takes the following arguments: crossTable, x, freq, num, weight, maxN, protectZeros, secondaryZeros, data, freqVar, numVar, weightVar, charVar, dimVar aggregatePackage, aggregateNA, aggregateBaseOrder, rowGroupsPackage, structuralEmpty, da_out, and .... where the two first are ModelMatrix outputs (modelMatrix renamed to x). The vector, freq, is aggregated counts (t(x) %*% data[[freqVar]]). In addition, the supplied singleton function also takes nUniqueVar and (output from) primary as input.

Similarly, num, is a data frame of aggregated numerical variables. It is possible to supply several primary functions joined by c, e.g. (c(FunPrim1, FunPrim2)). All NAs returned from any of the functions force the corresponding cells not to be primary suppressed.

The effect of maxN, protectZeros and secondaryZeros depends on the supplied functions where these parameters are used. Their default values are inherited from the default values of the first primary function (several possible) or, in the case of secondaryZeros, the candidates function. When defaults cannot be inherited, they are set to NULL. In practice the function formals are still used to generate the defaults when primary and/or candidates are not functions. Then NULL is correctly returned, but suppressWarnings are needed.

Singleton handling can be turned off by singleton = NULL or singletonMethod = "none". Both of these choices are identical in the sense that singletonMethod is set to "none" whenever singleton is NULL and vice versa.

Information about uncertain primary suppressions due to forced cells can be found as described by parameters unsafeInOutput and output (= "all"). When forced cells affect singleton problems, this is not implemented. Some information can be seen from warnings. This can also be seen by choosing output = "secondary" together with unsafeInOutput = "ifany" or unsafeInOutput = "always". Then, negative indices from GaussSuppression using unsafeAsNegative = TRUE will be included in the output. Singleton problems may, however, be present even if it cannot be seen as warning/output. In some cases, the problems can be detected by GaussSuppressDec.

In some cases, cells that are forced, hidden, or primary suppressed can overlap. For these situations, forced has precedence over hidden and primary. That is, if a cell is both forced and hidden, it will be treated as a forced cell and thus published. Similarly, any primary suppression of a forced cell will be ignored (see parameter whenPrimaryForced to GaussSuppression). It is, however, meaningful to combine primary and hidden. Such cells will be protected while also being assigned the NA value in the suppressed output variable.

Value

Aggregated data with suppression information

Author(s)

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Examples

```
z1 <- SSBtoolsData("z1")
GaussSuppressionFromData(z1, 1:2, 3)

z2 <- SSBtoolsData("z2")
GaussSuppressionFromData(z2, 1:4, 5, protectZeros = FALSE)


# Data as in GaussSuppression examples
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"))

GaussSuppressionFromData(df, c("var1", "var2"), "values")
GaussSuppressionFromData(df, c("var1", "var2"), "values", formula = ~var1 + var2, maxN = 10)
```

```
GaussSuppressionFromData(df, c("var1", "var2"), "values", formula = ~var1 + var2, maxN = 10,
     protectZeros = TRUE, # Parameter needed by SingletonDefault and default not in primary
      primary = function(freq, crossTable, maxN, ...)
                  which(freq <= maxN & crossTable[[2]] != "A" & crossTable[, 2] != "C"))

# Combining several primary functions
# Note that NA & c(TRUE, FALSE) equals c(NA, FALSE)
GaussSuppressionFromData(df, c("var1", "var2"), "values", formula = ~var1 + var2, maxN = 10,
       primary = c(function(freq, maxN, protectZeros = TRUE, ...) freq >= 45,
                   function(freq, maxN, ...) freq <= maxN,
                   function(crossTable, ...) NA & crossTable[[2]] == "C",
                   function(crossTable, ...) NA & crossTable[[1]]== "Total"
                                                & crossTable[[2]]== "Total"))

# Similar to GaussSuppression examples
GaussSuppressionFromData(df, c("var1", "var2"), "values", formula = ~var1 * var2,
       candidates = NULL, singleton = NULL, protectZeros = FALSE, secondaryZeros = TRUE)
GaussSuppressionFromData(df, c("var1", "var2"), "values", formula = ~var1 * var2,
       singleton = NULL, protectZeros = FALSE, secondaryZeros = FALSE)
GaussSuppressionFromData(df, c("var1", "var2"), "values", formula = ~var1 * var2,
       protectZeros = FALSE, secondaryZeros = FALSE)


# Examples with zeros as singletons
z <- data.frame(row = rep(1:3, each = 3), col = 1:3, freq = c(0, 2, 5, 0, 0, 6:9))
GaussSuppressionFromData(z, 1:2, 3, singleton = NULL)
GaussSuppressionFromData(z, 1:2, 3, singletonMethod = "none") # as above
GaussSuppressionFromData(z, 1:2, 3)
GaussSuppressionFromData(z, 1:2, 3, protectZeros = FALSE, secondaryZeros = TRUE, singleton = NULL)
GaussSuppressionFromData(z, 1:2, 3, protectZeros = FALSE, secondaryZeros = TRUE)
```

GaussSuppressionTwoWay

Two-way iteration variant of GaussSuppressionFromData

Description

Internally, data is organized in a two-way table.

Use parameter `colVar` to choose hierarchies for columns (others will be rows). Iterations start by column by column suppression. The algorithm utilizes `HierarchyCompute2`.

With two-way iterations, larger data can be handled, but there is a residual risk. The method is a special form of linked-table iteration. Separately, the rows and columns are protected by `GaussSuppression` and they have common suppressed cells.

Usage

```
GaussSuppressionTwoWay(
  data,
  dimVar = NULL,
```

```
  freqVar = NULL,
  numVar = NULL,
  weightVar = NULL,
  charVar = NULL,
  hierarchies,
  formula = NULL,
  maxN = suppressWarnings(formals(c(primary)[[1]])$maxN),
  protectZeros = suppressWarnings(formals(c(primary)[[1]])$protectZeros),
  secondaryZeros = suppressWarnings(formals(candidates)$secondaryZeros),
  candidates = CandidatesDefault,
  primary = PrimaryDefault,
  forced = NULL,
  hidden = NULL,
  singleton = SingletonDefault,
  singletonMethod = ifelse(secondaryZeros, "anySumNOTprimary", "anySum"),
  printInc = TRUE,
  output = "publish",
  preAggregate = is.null(freqVar),
  colVar = names(hierarchies)[1],
  removeEmpty = TRUE,
  inputInOutput = TRUE,
  candidatesFromTotal = TRUE,
  structuralEmpty = FALSE,
  freqVarNew = rev(make.unique(c(names(data), "freq")))[1],
  ...
)
```

Arguments

data	Input data as a data frame
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
freqVar	A single variable holding counts (name or number).
numVar	Other numerical variables to be aggregated
weightVar	weightVar Weights (costs) to be used to order candidates for secondary suppression
charVar	Other variables possibly to be used within the supplied functions
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
maxN	Suppression parameter. See GaussSuppressionFromData.
protectZeros	Suppression parameter. See GaussSuppressionFromData.
secondaryZeros	Suppression parameter. See GaussSuppressionFromData.
candidates	GaussSuppression input or a function generating it (see details) Default: CandidatesDefault

primary	GaussSuppression input or a function generating it (see details) Default: PrimaryDefault
forced	GaussSuppression input or a function generating it (see details)
hidden	GaussSuppression input or a function generating it (see details)
singleton	NULL or a function generating GaussSuppression input (logical vector not possible) Default: SingletonDefault
singletonMethod	GaussSuppression input
printInc	GaussSuppression input
output	One of "publish" (default), "inner". Here "inner" means input data (possibly pre-aggregated).
preAggregate	When TRUE, the data will be aggregated within the function to an appropriate level. This is defined by the dimensional variables according to dimVar, hierarchies or formula and in addition charVar.
colVar	Hierarchy variables for the column groups (others in row group).
removeEmpty	When TRUE (default) empty output corresponding to empty input is removed. When NULL, removal only within the algorithm (x matrices) so that such empty outputs are never secondary suppressed.
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.
candidatesFromTotal	When TRUE (default), same candidates for all rows and for all columns, computed from row/column totals.
structuralEmpty	See GaussSuppressionFromData.
freqVarNew	Name of new frequency variable generated when input freqVar is NULL and preAggregate is TRUE. Default is "freq" provided this is not found in names(data).
...	Further arguments to be passed to the supplied functions.

Details

The supplied functions for generating GaussSuppression input behave as in GaussSuppressionFromData with some exceptions. When candidatesFromTotal is TRUE (default) the candidate function will be run locally once for rows and once for columns. Each time based on column or row totals. The global x-matrix will only be generated if one of the functions supplied needs it. Non-NULL singleton can only be supplied as a function. This function will be run locally within the algorithm before each call to GaussSuppression.

Note that a difference from GaussSuppressionFromData is that parameter removeEmpty is set to TRUE by default.

Another difference is that duplicated combinations is not allowed. Normally duplicates are avoided by setting preAggregate to TRUE. When the charVar parameter is used, this can still be a problem. See the examples for a possible workaround.

Value

Aggregated data with suppression information

Examples

```
z3 <- SSBtoolsData("z3")

dimListsA <- SSBtools::FindDimLists(z3[, 1:6])
dimListsB <- SSBtools::FindDimLists(z3[, c(1, 4, 5)])

set.seed(123)
z <- z3[sample(nrow(z3),250),]

## Not run:
out1 <- GaussSuppressionTwoWay(z, freqVar = "ant", hierarchies = dimListsA,
                               colVar = c("hovedint"))

## End(Not run)
out2 <- GaussSuppressionTwoWay(z, freqVar = "ant", hierarchies = dimListsA,
                               colVar = c("hovedint", "mnd"))
out3 <- GaussSuppressionTwoWay(z, freqVar = "ant", hierarchies = dimListsB,
                               colVar = c("region"))
out4 <- GaussSuppressionTwoWay(z, freqVar = "ant", hierarchies = dimListsB,
                               colVar = c("hovedint", "region"))

# "mnd" not in  hierarchies -> duplicated combinations in input
# Error when  preAggregate is FALSE: Index method failed. Duplicated combinations?
out5 <- GaussSuppressionTwoWay(z, freqVar = "ant", hierarchies = dimListsA[1:3],
                       protectZeros = FALSE, colVar = c("hovedint"), preAggregate = TRUE)


# charVar needed -> Still problem when preAggregate is TRUE
# Possible workaround by extra hierarchy
out6 <- GaussSuppressionTwoWay(z, freqVar = "ant", charVar = "mnd2",
                       hierarchies = c(dimListsA[1:3], mnd2 = "Total"), # include charVar
                            inputInOutput = c(TRUE, TRUE, FALSE),  # FALSE -> only Total
                               protectZeros = FALSE, colVar = c("hovedint"),
                               preAggregate = TRUE,
                               hidden = function(x, data, charVar, ...)
           as.vector((Matrix::t(x) %*% as.numeric(data[[charVar]] == "M06M12")) == 0))
```

`IntervalLimits` *Construct feasibility interval requirements*

Description

Creates one or more sets of requirements for feasibility intervals of cell values in protected tables. These can include lower bound requirements ("lomax_*"), upper bound requirements ("upmin_*"), and/or minimum width requirements ("rlim_*"). The requirements may be specified as relative percentages or as absolute distances, and can be set symmetrically around the true cell value or separately for lower and upper bounds.

Usage

```
IntervalLimits(
  ...,
  protectionPercent = 0,
  protectionLimit = 0,
  loProtectionPercent = protectionPercent,
  loProtectionLimit = protectionLimit,
  rangePercent = 0,
  rangeMin = 0,
  primary,
  num,
  freq,
  freqVar,
  dominanceVar = NULL,
  intervalVar = NULL
)
```

Arguments

`...`	Unused parameters
`protectionPercent`	Required distance in percent between the true cell value and the upper bound of the feasibility interval. If `loProtectionPercent` is not set, the same percentage distance is also required to the lower bound.
`protectionLimit`	Required absolute distance between the true cell value and the upper bound of the feasibility interval. If `loProtectionLimit` is not set, the same absolute distance is also required to the lower bound.
`loProtectionPercent`	Required distance in percent between the true cell value and the lower bound of the feasibility interval. Is by default set to `protectionPercent`, i.e. symmetrical requirements.
`loProtectionLimit`	Required absolute distance between the true cell value and the lower bound of the feasibility interval. Is by default set to `protectionLimit`, i.e. symmetrical requirements.
`rangePercent`	Minimum required width of the feasibility interval expressed as a percentage of the true cell value.
`rangeMin`	Minimum required width of the feasibility interval expressed as an absolute value.
`primary`	The `primary` vector generated by parent function
`num`	The `num` data frame generated by parent function
`freq`	The `freq` vector generated by parent function
`freqVar`	As input to e.g. `SuppressSmallCounts()`
`dominanceVar`	As input to e.g. `SuppressDominantCells()`

`intervalVar` Numerical variable(s) used for interval calculations. If `NULL`, the variable names may be inferred from the `num` data frame as a consequence of interval requirements created by the primary function(s). If no variables can be inferred this way, `dominanceVar`, first `numVar` or `freqVar` will be used.

Value

A matrix with column names constructed from the type of requirement and the associated variable name.

Note

Interval requirements can also be generated by the primary suppression functions when `protectionIntervals = TRUE` is specified (see examples below). More details are given in the description of `protectionIntervals` in the `MagnitudeRule()` and `PrimaryDefault()` functions.

Examples

```
dat <- SSBtoolsData("magnitude1")
dat["num2"] <- 1:nrow(dat)

SuppressDominantCells(data = dat,
    numVar = "value",
    formula = ~sector2 * geo + sector4 * eu,
    contributorVar = "company",
    k = c(80, 99),
    rangePercent = 10, rangeMin = 1,
    protectionPercent = 3,
    protectionLimit = 5, loProtectionLimit = 4)

SuppressDominantCells(data = dat,
    dominanceVar = "value",
    numVar = "num2",
    formula = ~sector2 * geo + sector4 * eu,
    contributorVar = "company",
    pPercent = 10,
    intervalVar = c("value","freq", "num2"),
    rangePercent = c(10, 10, 30), rangeMin = c(1, 0.2222, 2.222))



## Below are two alternative ways of calculating interval requirements.
## In these cases, the requirements are generated by the primary suppression
## functions when the parameter `protectionIntervals = TRUE` is specified.


# See ?MagnitudeRule
SuppressDominantCells(data = dat,
                      dominanceVar = "value",
                      formula = ~sector2 * geo + sector4 * eu,
                      contributorVar = "company",
                      pPercent = 10,
```

```
                      protectionIntervals = TRUE)

# See ?PrimaryDefault
SuppressSmallCounts(data = dat,
                    formula = ~sector2 * geo + sector4 * eu,
                    maxN = 3,
                    protectionIntervals = TRUE)



## Combining IntervalLimits arguments
## with protectionIntervals = TRUE also works

SuppressSmallCounts(data = dat,
                    formula = ~sector2 * geo + sector4 * eu,
                    maxN = 3,
                    protectionIntervals = TRUE,
                    protectionPercent = 50)
```

KDisclosurePrimary *Construct primary suppressed difference matrix*

Description

Function for constructing model matrix columns representing primary suppressed difference cells

Usage

```
KDisclosurePrimary(
  data,
  x,
  crossTable,
  freqVar,
  mc_hierarchies = NULL,
  coalition = 1,
  upper_bound = Inf,
  targeting = default_targeting,
  print_frames = FALSE,
  ...
)
```

Arguments

data	a data.frame representing the data set
x	ModelMatrix generated by parent function
crossTable	crossTable generated by parent function
freqVar	name of the frequency variable in data

`mc_hierarchies` a hierarchy representing meaningful combinations to be protected. Default value is `NULL`.

`coalition` numeric vector of length one, representing possible size of an attacking coalition. This parameter corresponds to the parameter k in the definition of k-disclosure.

`upper_bound` Numeric value specifying the maximum cell frequency for which disclosure of belonging to the cell may be regarded as unacceptable. When freq > upper_bound, disclosure of belonging to the cell is regarded as acceptable regardless of the specification of the `sensitive` parameter. Default is Inf. Note that this parameter may also be useful for reducing computational burden.

`targeting` NULL, a list, or a function that returns a list specifying attribute disclosure scenarios. See Details. Default is default_targeting.

`print_frames` Logical or character. If TRUE, additional data frames are printed to the console. When `mc_hierarchies` is used, this includes a data frame with hidden results. In addition, a data frame containing the primary suppressed difference cells is printed. If set to `"primary_cells"`, only the primary suppressed difference cells are printed. The default is FALSE.

`...` parameters passed to children functions

Details

The `targeting` specification is a named list that may contain the following optional elements. References to `crossTable` below refer to a data frame that may be extended after applying `mc_hierarchies`.

`identifying` A data frame containing selected rows from `crossTable`. Membership in the cells represented by these rows is regarded as information that an intruder may already know. If omitted, it defaults to `crossTable`.

`sensitive` A data frame containing selected rows from `crossTable`. If an intruder can infer membership in the cells represented by these rows, this is considered an unacceptable disclosure, subject to any further specification provided by `is_sensitive`. If omitted, it defaults to `crossTable`.

`is_sensitive` A data frame with the same structure as `sensitive`, but with logical variables. It indicates which codes in `sensitive` are regarded as sensitive. When specified, disclosure is assessed by which codes within a revealed cell are disclosed. If omitted, it is equivalent to a data frame where all elements are `TRUE`.

`exclude_relations` A specification defining identifying–sensitive relations that are ignored. This may be given either as a sparse logical matrix (or a dummy matrix with values 0/1), or as a list of lists. In the matrix form, rows correspond to rows in `sensitive` (or `crossTable` if `sensitive` is not specified), and columns correspond to rows in `identifying` (or `crossTable` if `identifying` is not specified). In the list form, each list element specifies a set of relations by selecting rows from `identifying` and/or `sensitive` defined above. Each element may contain the components `identifying` and `sensitive`; omitted components default to all rows of the corresponding element. The full list jointly defines the relations to be excluded.

`include_relations` As for `exclude_relations`, but defining the identifying–sensitive relations that are considered. Only the relations specified are included; all others are ignored.

Value

dgCMatrix corresponding to primary suppressed cells

Author(s)

Daniel P. Lupp and Øyvind Langsrud

`LazyLinkedTables` *Linked tables by full* `GaussSuppressionFromData` *iterations*

Description

`AdditionalSuppression` is called several times as in `ChainedSuppression`

Usage

```
LazyLinkedTables(..., withinArg = NULL, maxIterLinked = 1000)
```

Arguments

`...`	Arguments to `GaussSuppressionFromData` that are kept constant.
`withinArg`	A list of named lists. Arguments to `GaussSuppressionFromData` that are not kept constant.
`maxIterLinked`	Maximum number of `GaussSuppressionFromData` calls for each table.

Details

This function is created as a spin-off from `AdditionalSuppression` and `ChainedSuppression`. The calculations run `GaussSuppressionFromData` from the input each time. There is no doubt that this can be done more efficiently.

A consequence of this lazy implementation is that, in output, `primary` and `suppressed` are identical.

Note that there is a residual risk when suppression linked tables by iterations.

Value

List of data frames

Note

In this function, the parameters `makeForced` and `forceNotPrimary` to `AdditionalSuppression` are forced to be `FALSE`.

Examples

```
z1 <- SSBtoolsData("z1")
z2 <- SSBtoolsData("z2")
z2b <- z2[3:5]  # As in ChainedSuppression example
names(z2b)[1] <- "region"

# The two region hierarchies as two linked tables
a <- LazyLinkedTables(z2, freqVar = 5, withinArg = list(
       list(dimVar = c(1, 2, 4)),
       list(dimVar = c(1, 3, 4))))

# As 'f' and 'e' in ChainedSuppression example.
# 'A' 'annet'/'arbeid' suppressed in b[[1]], since suppressed in b[[3]].
b <- LazyLinkedTables(withinArg = list(
       list(data = z1, dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2b, dimVar = 1:2, freqVar = 3, maxN = 5),
       list(data = z2, dimVar = 1:4, freqVar = 5, maxN = 1)))
```

`MagnitudeRule` *Dominance* (`n`,`k`) *or p% rule for magnitude tables*

Description

Supports application of multiple values for `n` and `k`. The function works on magnitude tables containing negative cell values by calculating contribution based on absolute values.

Usage

```
MagnitudeRule(
  data,
  x,
  numVar,
  n = NULL,
  k = NULL,
  pPercent = NULL,
  protectZeros = FALSE,
  min_n_contr = 1,
  min_n_non0_contr = 1,
  min_n_contr_all = 1,
  min_n_non0_contr_all = 1,
  charVar = NULL,
  removeCodes = character(0),
  removeCodesFraction = 1,
  sWeightVar = NULL,
  domWeightMethod = "default",
  allDominance = FALSE,
  outputWeightedNum = !is.null(sWeightVar),
```

```
  dominanceVar = NULL,
  structuralEmpty = FALSE,
  apply_abs_directly = FALSE,
  max_contribution_output = NULL,
  num,
  protectionIntervals = FALSE,
  intervalVar = dominanceVar,
  ...
)

DominanceRule(data, n, k, protectZeros = FALSE, ...)

PPercentRule(data, pPercent, protectZeros = FALSE, ...)
```

Arguments

data	the dataset
x	ModelMatrix generated by parent function
numVar	vector containing numeric values in the data set
n	Parameter n in dominance rule.
k	Parameter k in dominance rule.
pPercent	Parameter in the p% rule, when non-NULL. Parameters n and k will then be ignored. Technically, calculations are performed internally as if n = 1:2. The results of these intermediate calculations can be viewed by setting allDominance = TRUE.
protectZeros	Parameter determining whether cells with value 0 should be suppressed. Unless structuralEmpty is TRUE (see below), cells that result in a value of 0 due to removed removeCode contributions are also suppressed.
min_n_contr	When the value is greater than 1 (default is 1), primary suppression is applied when n_contr > 0 and n_contr < min_n_contr. Here, n_contr is the number of contributors as defined in SSBtools::max_contribution(), after excluding any codes specified by the removeCodes parameter. The three parameters below use corresponding variables from the same function.
min_n_non0_contr	Same logic as min_n_contr, but based on n_non0_contr, which counts contributors contributing a non-zero value.
min_n_contr_all	Same as min_n_contr, but using n_contr_all, which counts all contributors without considering removeCodes.
min_n_non0_contr_all	Same as min_n_non0_contr, but using n_non0_contr_all, which counts all contributors contributing a non-zero value, without considering removeCodes.
charVar	Variable in data holding grouping information. Dominance will be calculated after aggregation within these groups.

removeCodes A vector of charVar codes that are to be excluded when calculating dominance percentages. Essentially, the corresponding numeric values from dominanceVar or numVar are set to zero before proceeding with the dominance calculations. With empty charVar row indices are assumed and conversion to integer is performed. See also removeCodesFraction below.

removeCodesFraction
Numeric value(s) in the range [0, 1]. This can be either a single value or a vector with the same length as removeCodes. A value of 1 represents the default behavior, as described above. A value of 0 indicates that dominance percentages are calculated as if removeCodes were not removed, but percentages associated with removeCodes are still excluded when identifying major contributions. Values between 0 and 1 modify the contributions of removeCodes proportionally in the calculation of percentages.

sWeightVar variable with sampling weights to be used in dominance rule

domWeightMethod
character representing how weights should be treated in the dominance rule. See Details.

allDominance Logical. If TRUE, additional information is included in the output. When n = 2, the following variables are added:

- "dominant2": The fraction associated with the dominance rule.
- "max2contributor": IDs associated with the second largest contribution. These IDs are taken from charVar if provided, or the row indices if charVar is not supplied.
- "n_contr" and "n_non0_contr": Outputs from max_contribution. If removeCodes is used as input, "n_contr_all" and "n_non0_contr_all" are also included. The parameter max_contribution_output can be used to specify custom outputs from max_contribution. Note that if max_contribution_output is provided, only the specified outputs will be included, and the default outputs ("n_contr" and "n_non0_contr") will not be added unless explicitly listed.

outputWeightedNum
logical value to determine whether weighted numerical value should be included in output. Default is TRUE if sWeightVar is provided.

dominanceVar When specified, dominanceVar is used in place of numVar. Specifying dominanceVar is beneficial for avoiding warnings when there are multiple numVar variables. Typically, dominanceVar will be one of the variables already included in numVar.

structuralEmpty
Parameter as input to GaussSuppressionFromData. It is needed also here to handle structural zeros caused by removeCodes.

apply_abs_directly
Logical. Determines how negative values are treated in the rules. When apply_abs_directly = FALSE (default), absolute values are taken after summing contributions, as performed by max_contribution. When apply_abs_directly = TRUE, absolute values are computed directly on the input values, prior to any summation. This corresponds to the old behavior of the function.

max_contribution_output
See the description of the allDominance parameter.

num	Output numeric data generated by parent function. This parameter is needed when protectZeros is TRUE.
protectionIntervals	Logical. When TRUE, symmetric interval requirements from dominance rules or the p% rule are included in the output. Calculated according to formulas for upper protection levels in *Handbook on Statistical Disclosure Control* (2nd ed., Ch. 4.2.2, 2025). The corresponding variables are added with names starting with lomax_ and upmin_.
intervalVar	Numerical variable for interval calculations.
...	unused parameters

Details

This method only supports suppressing a single numeric variable. There are multiple ways of handling sampling weights in the dominance rule. the default method implemented here compares unweighted sample values with the corresponding weighted cell totals. if domWeightMethod is set to "tauargus", the method implemented in tauArgus is used. For more information on this method, see "Statistical Disclosure Control" by Hundepool et al (2012, p. 151).

Value

logical vector that is TRUE in positions corresponding to cells breaching the dominance rules.

Note

Explicit protectZeros in wrappers since default needed by GaussSuppressionFromData

Author(s)

Daniel Lupp and Øyvind Langsrud

Examples

```
  set.seed(123)
z <- SSBtools::MakeMicro(SSBtoolsData("z2"), "ant")
z$value <- sample(1:1000, nrow(z), replace = TRUE)

GaussSuppressionFromData(z, dimVar = c("region", "fylke", "kostragr", "hovedint"),
numVar = "value", candidates = CandidatesNum, primary = DominanceRule, preAggregate = FALSE,
singletonMethod = "sub2Sum", n = c(1, 2), k = c(65, 85), allDominance = TRUE)


num <- c(100,
         90, 10,
         80, 20,
         70, 30,
         50, 25, 25,
         40, 20, 20, 20,
         25, 25, 25, 25)
v1 <- c("v1",
```

```
        rep(c("v2", "v3", "v4"), each = 2),
        rep("v5", 3),
        rep(c("v6", "v7"), each = 4))
sw <- c(1, 2, 1, 2, 1, 2, 1, 2, 1, 1, 2, 1, 1, 1, 2, 1, 1, 1)
d <- data.frame(v1 = v1, num = num, sw = sw)

# without weights
GaussSuppressionFromData(d, formula = ~v1 - 1,
 numVar = "num",  n = c(1,2), k = c(80,70),
  preAggregate = FALSE, allDominance = TRUE, candidates = CandidatesNum,
  primary = DominanceRule)

# with weights, standard method
GaussSuppressionFromData(d, formula = ~v1 - 1,
 numVar = "num",  n = c(1,2), k = c(80,70), sWeightVar = "sw",
 preAggregate = FALSE, allDominance = TRUE, candidates = CandidatesNum,
 primary = DominanceRule)

# with weights, tauargus method
GaussSuppressionFromData(d, formula = ~v1 - 1,
 numVar = "num",  n = c(1,2), k = c(80,70), sWeightVar = "sw",
 preAggregate = FALSE, allDominance = TRUE, candidates = CandidatesNum,
 primary = DominanceRule, domWeightMethod = "tauargus")
```

`MaxContribution` *Find major contributions to aggregates*

Description

Assuming aggregates are calculated via a dummy matrix by `z = t(x) %*% y`, the `n` largest contributions are found (value or index) for each aggregate.

Usage

```
MaxContribution(
  x,
  y,
  n = 1,
  decreasing = TRUE,
  index = FALSE,
  groups = NULL,
  return2 = FALSE
)
```

Arguments

`x`	A (sparse) dummy matrix
`y`	Vector of input values (contributors)

n	Number of contributors to be found
decreasing	Ordering parameter. Smallest contributors found when FALSE.
index	Indices to y returned when TRUE
groups	When non-NULL, major contributions after aggregation within groups. Cannot be combined with index = TRUE. The missing group category is excluded.
return2	When TRUE, two matrices are returned, value and id. The latter contains indices when group is NULL and otherwise a character matrix of groups.

Value

Matrix with lagest contributions in first column, second largest in second column and so on. Alternative output when using parameters index or return2.

Author(s)

Øyvind Langsrud

See Also

ModelMatrix

Examples

```
library(SSBtools)

z <- SSBtoolsData("sprt_emp_withEU")
z$age[z$age == "Y15-29"] <- "young"
z$age[z$age == "Y30-64"] <- "old"

a <- ModelMatrix(z, formula = ~age + geo, crossTable = TRUE)

cbind(as.data.frame(a$crossTable), MaxContribution(a$modelMatrix, z$ths_per, 1))
cbind(a$crossTable, MaxContribution(a$modelMatrix, z$ths_per, 10))
cbind(a$crossTable, MaxContribution(a$modelMatrix, z$ths_per, 10, index = TRUE))

# Both types of output can be achieved with return2 = TRUE)
identical(MaxContribution(a$modelMatrix, z$ths_per, 10, return2 = TRUE),
          list(value =  MaxContribution(a$modelMatrix, z$ths_per, 10),
               id =  MaxContribution(a$modelMatrix, z$ths_per, 10, index = TRUE)))

b <- ModelMatrix(z[, -4], crossTable = TRUE, inputInOutput = c(TRUE, FALSE, TRUE))

k <- cbind(b$crossTable, MaxContribution(b$modelMatrix, z$ths_per, 10))

gr18 <- paste0("g", 1:18)                          # Each row is a group
k18 <- cbind(b$crossTable, MaxContribution(b$modelMatrix, z$ths_per, 10, groups = gr18))
identical(k, k18) # TRUE

gr9 <- paste0("g", as.integer(10 * z$ths_per)%%10) # 9 groups from decimal
k9 <- cbind(b$crossTable, MaxContribution(b$modelMatrix, z$ths_per, 10, groups = gr9))
```

```
k18[c(4, 13, 17, 33), ]
k9[c(4, 13, 17, 33), ]

# Group info obtained with return2 = TRUE
k9_id <- cbind(b$crossTable, MaxContribution(b$modelMatrix, z$ths_per, 10, groups = gr9,
                                             return2 = TRUE)$id)
k9_id[c(4, 13, 17, 33), ]


# Verify similarity
z$y <- z$ths_per + (1:nrow(z))/100  # to avoid equal values
id1 <- MaxContribution(b$modelMatrix, z$y, 10, index = TRUE)
id1[!is.na(id1)] <- paste0("g", id1[!is.na(id1)])
mc2 <- MaxContribution(b$modelMatrix, z$y, 10, groups = gr18, return2 = TRUE)
id2 <- mc2$id
identical(id1, id2)
```

`Ncontributors` *Find the number of unique groups contributing to aggregates*

Description

Assuming aggregates are calculated via a dummy matrix by `z = t(x) %*% y`, the the number of unique contributing groups, according to a grouping variable, are found for each aggregate. The missing group category is not counted.

Usage

```
Ncontributors(x, groups)
```

Arguments

`x`	A (sparse) dummy matrix
`groups`	Vector of group categories

Value

Vector of numbers of unique groups

Author(s)

Øyvind Langsrud

See Also

`ModelMatrix`

Examples

```
library(SSBtools)

z <- SSBtoolsData("sprt_emp_withEU")
z$age[z$age == "Y15-29"] <- "young"
z$age[z$age == "Y30-64"] <- "old"
z$groups <- c("A", "A", "B", "A", "B", "C")

a <- ModelMatrix(z, formula = ~age*eu + geo + year, crossTable = TRUE)

cbind(as.data.frame(a$crossTable), nGroups = Ncontributors(a$modelMatrix, z$groups))
cbind(as.data.frame(a$crossTable), nYears = Ncontributors(a$modelMatrix, z$year))
cbind(as.data.frame(a$crossTable), nUnique_ths_per = Ncontributors(a$modelMatrix, z$ths_per))
```

NcontributorsHolding *Ncontributors with holding-indicator*

Description

The aggregates (columns of x) are grouped by a holding indicator. Within each holding group, the number of unique groups (output) is set to be equal.

Usage

```
NcontributorsHolding(x, groups, holdingInd = NULL)
```

Arguments

x	A (sparse) dummy matrix
groups	Vector of group categories
holdingInd	Vector of holding group categories

Details

A representative within the holding group is used to calculate output by Ncontributors. The one with maximal column sum of x is chosen as the representative. Normally this will be an aggregate representing the holding group total. When holdingInd is NULL (default), the function is equivalent to Ncontributors.

Value

Vector of numbers of unique groups

Author(s)

Øyvind Langsrud

`NContributorsRule` *Number of contributors suppression rule*

Description

The number of contributors is the number unique contributing 'charVar' codes.

Usage

```
NContributorsRule(
  data,
  freq,
  numVar,
  x,
  maxN = 3,
  protectZeros = FALSE,
  charVar = NULL,
  removeCodes = character(0),
  remove0 = TRUE,
  ...
)
```

Arguments

`data`	Input data as a data frame
`freq`	Vector of aggregate frequencies
`numVar`	Numerical variables. When several variables, only first is used.
`x`	Model matrix generated by parent function
`maxN`	Suppression threshold. Cells where the number of unique contributors (based on `charVar`) is less than or equal to `maxN` are marked as primary suppressed. Can be specified as a single numeric value, or as a named list or named vector. When named, the value matching the `charVar` name will be used. If `charVar` contains multiple variables and you want different thresholds for each, `maxN` must be a named list or vector with one value per variable. For example: `maxN = list(char1 = 3, char2 = 2)`.
`protectZeros`	Suppression parameter. Only TRUE (default) is used implemented.
`charVar`	Variable(s) with contributor codes. When empty, unique contributor in each row is assumed. When several variables, see details.
`removeCodes`	Codes to exclude when counting contributors. Can be specified as a character vector (applied to all `charVar` variables), or as a named list of vectors to use different codes per variable. When using a list, its names must match the variables in `charVar`. If `charVar` is empty, codes are interpreted as row indices and converted to integers.

remove0	When set to TRUE (default), data rows in which the first numVar (if any) is zero are excluded from the count of contributors. Alternatively, remove0 can be specified as one or more variable names. In this case, all data rows with a zero in any of the specified variables are omitted from the contributor count. Specifying remove0 as variable name(s) is useful for avoiding warning when there are multiple numVar variables.
...	unused parameters

Details

When several charVar variables, the rule is applied independently to each variable. Primary suppression in at least one case results in primary suppression in the output. As described in the documentation for the maxN and removeCodes parameters, it is possible to specify them independently for each charVar.

Value

List where first element is logical vector defining primary suppressions. The second element is data frame where nRule is number contributors used in rule and where nAll is similar, but without omitting codes in removeCodes.

PackageSpecs *Function for viewing built-in GaussSuppression specs*

Description

Functions to retrieve the built-in specs. These can be retrieved using either numerical indices or by specifying the spec name, see Details.

Usage

```
PackageSpecs(x = NULL, printTable = FALSE)
```

Arguments

x	the character name or index of the spec to be returned. If NULL (default), returns list of all specs
printTable	Logical value (default FALSE). If TRUE, prints a table description of all specs. Primarily used for documentation purposes.

Details

The following table summarizes the built-in specs. Columns represent different specs, and rows represent the parameter settings.

	smallCountSpec	**dominanceSpec**	**fewContributorsSpec**	**kDisclosureSpec**
primary	PrimaryDefault	MagnitudeRule	NContributorsRule	KDisclosurePrima

protectZeros	TRUE	FALSE	FALSE	FALSE
candidates	CandidatesDefault	CandidatesNum	CandidatesNum	DirectDisclosureC
singleton	SingletonDefault	SingletonUniqueContributor	SingletonUniqueContributor	SingletonDefault
extend0	TRUE	FALSE	FALSE	TRUE
preAggregate	NA	!is.null(charVar)	!is.null(charVar)	NA
extraAggregate	FALSE	TRUE	TRUE	FALSE
secondaryZeros	FALSE	FALSE	FALSE	1
domWeightMethod		"default"		
singletonMethod		"numttHTT"	"numttHTT"	"anySum0"

Value

returns a spec (if `!is.null(x)`), list of all specs (if `is.null(x)` and `printTable = FALSE`), or markdown table describing all specs (if `printTable = TRUE`).

Examples

```
PackageSpecs()
PackageSpecs(1)
PackageSpecs("smallCountSpec")
PackageSpecs(printTable = TRUE)
```

`PrimaryDefault` *Default primary function*

Description

Function for `GaussSuppressionFromData`

Usage

```
PrimaryDefault(
  freq,
  maxN = 3,
  protectZeros = TRUE,
  protectionIntervals = FALSE,
  freqVar,
  ...
)
```

Arguments

`freq`	Vector of output frequencies
`maxN`	Cells with frequency `<= maxN` are set as primary suppressed. Can also be a named list or vector, where the value corresponding to `freqVar` will be used if available. If not found, the name `"freq"` is tried as an alternative.

protectZeros	When TRUE, cells with zero frequency are set as primary suppressed.
protectionIntervals	Logical. When TRUE, some interval requirements are included in the output as a safeguard against obvious weaknesses with respect to attribute disclosure. The rule is that the upper bound must be at least 1 above the observed frequency, and the total interval width must be at least 2. The corresponding variables are added with names starting with upmin_ and rlim_. See IntervalLimits() for setting interval limits in general.
freqVar	Character string used to select the appropriate value from maxN if it is a named object. see maxN above.
...	Unused parameters

Value

primary, GaussSuppression input

`PrimaryFromSuppressedData` `primary` *and* `forced` *from suppressed data*

Description

Function for GaussSuppressionFromData

Usage

```
PrimaryFromSuppressedData(
  x,
  crossTable,
  suppressedData,
  forcedData = FALSE,
  totCode = FindTotCode2(x, crossTable),
  ...
)

ForcedFromSuppressedData(..., forcedData = TRUE)

NotPrimaryFromSuppressedData(..., forcedData = TRUE)
```

Arguments

x	A (sparse) dummy matrix
crossTable	crossTable generated by parent function
suppressedData	A data frame or a list of data frames as output from GaussSuppressionFromData. If the variable suppressed is not included, all rows are considered suppressed.
forcedData	When TRUE, the suppressed coding is swapped.

totCode	A named list of totals codes
...	Unused parameters

Details

ForcedFromSuppressedData uses forcedData = TRUE and hence a vector to be use as forced is generated. NotPrimaryFromSuppressedData is similar, but TRUE elements are replaced by NA's. Hence the result can be used as an extra primary vector to ensure that code combinations not suppressed according to suppressedData are forced not to be primary suppressed.

The variables used in suppressedData in addition to "suppressed" are those with matching names in crossTable. Others are ignored. For variables in crossTable not in suppressedData, only totals are considered. Others rows are ignored when mathing with suppressedData.

When suppressedData is a list, the final result is the union of individual results of each data frame.

Value

Logical vector to be used as GaussSuppression input

Examples

```
z2 <- SSBtoolsData("z2")

# Data to be used as suppressedData
a <- GaussSuppressionFromData(z2, c(1, 3, 4), 5, protectZeros = FALSE)

# For alternative ways to suppress the same table
b1 <- GaussSuppressionFromData(z2, 1:4, 5)
b2 <- GaussSuppressionFromData(z2, 1:4, 5, primary = c(PrimaryDefault, PrimaryFromSuppressedData),
                               suppressedData = a)
b3 <- GaussSuppressionFromData(z2, 1:4, 5, primary = c(PrimaryDefault, PrimaryFromSuppressedData),
                               suppressedData = a, forced = ForcedFromSuppressedData)
b4 <- GaussSuppressionFromData(z2, 1:4, 5,
        primary = c(PrimaryDefault, PrimaryFromSuppressedData, NotPrimaryFromSuppressedData),
                               suppressedData = a, forced = ForcedFromSuppressedData)

# Reducing data to rows mathing a
b1r <- b1[SSBtools::Match(a[1:2], b1[1:2]), ]
b2r <- b2[SSBtools::Match(a[1:2], b2[1:2]), ]
b3r <- b3[SSBtools::Match(a[1:2], b3[1:2]), ]
b4r <- b4[SSBtools::Match(a[1:2], b4[1:2]), ]


# Look at rows where new suppression is different from that in a

# Both TRUE and FALSE changed
cbind(a, b1r)[b1r$suppressed != a$suppressed, c(1:5, 9:10)]

# Only  FALSE changed to TRUE (suppression is preserved)
cbind(a, b2r)[b2r$suppressed != a$suppressed, c(1:5, 9:10)]

# Only change is due to new primary suppression rule (protectZeros = TRUE)
```

```
cbind(a, b3r)[b3r$suppressed != a$suppressed, c(1:5, 9:10)]

# No changes
cbind(a, b4r)[b4r$suppressed != a$suppressed, c(1:5, 9:10)]
```

PrimaryRemoveWg *Special functions for the avoidance of suppression*

Description

The SSBtools function WildcardGlobbing is utilized

Usage

```
PrimaryRemoveWg(wg = NULL, ..., crossTable)

CandidatesNumWg(wg = NULL, ..., crossTable)

ForcedWg(crossTable, wg = NULL, ...)
```

Arguments

wg	data.frame with wildcard/globbing. A parameter to WildcardGlobbing
...	unused parameters
crossTable	crossTable generated by parent function

Details

CandidatesNumWg is a generalization of CandidatesNumWg

Value

logical vector or row indices

Examples

```
dataset <- SSBtoolsData("magnitude1")

a1 <- SuppressDominantCells(data = dataset, numVar = "value",
       dimVar = c("sector4", "geo"), n = 1:2, k = c(77, 99))

a1

wg <- data.frame(sector4 = "Ind*", geo = c("Ice????", "Portugal"))
wg
```

```
# Industry:Portugal not primary, but suppressed
a2 <- SuppressDominantCells(data = dataset, numVar = "value",
       dimVar = c("sector4", "geo"), n = 1:2, k = c(77, 99),
       wg = wg, primary = c(DominanceRule, PrimaryRemoveWg))

a2

# Industry:Portugal not primary and not suppressed
a3 <- SuppressDominantCells(data = dataset, numVar = "value",
       dimVar = c("sector4", "geo"), n = 1:2, k = c(77, 99),
       wg = wg, primary = c(DominanceRule, PrimaryRemoveWg),
       candidates = CandidatesNumWg)
a3

# Industry:Portugal primary, but not suppressed
a4 <- SuppressDominantCells(data = dataset, numVar = "value",
       dimVar = c("sector4", "geo"), n = 1:2, k = c(77, 99),
       wg = wg, forced = ForcedWg, whenPrimaryForced = message)
a4
```

`SingletonDefault` *Default singleton function*

Description

Function for `GaussSuppressionFromData`

Usage

```
SingletonDefault(data, freqVar, protectZeros, secondaryZeros, ...)
```

Arguments

`data`	Input data, possibly pre-aggregated within `GaussSuppressionFromData`
`freqVar`	A single variable holding counts (input to `GaussSuppressionFromData`)
`protectZeros`	Suppression parameter (see `GaussSuppressionFromData`)
`secondaryZeros`	Suppression parameter (see `GaussSuppressionFromData`)
`...`	Unused parameters

Details

This function marks input cells as singletons according to the input frequencies (`freqVar`). Zero frequencies are set to singletons when `protectZeros` or `secondaryZeros` is `TRUE`. Otherwise, ones are set to singletons. Empty `freqVar` is treated as all frequencies being ones.

Value

singleton, `GaussSuppression` input

SingletonUniqueContributor

Unique contributor singleton function

Description

Function for GaussSuppressionFromData

Usage

```
SingletonUniqueContributor(
  data,
  freqVar = NULL,
  nUniqueVar = NULL,
  origIdxVar = NULL,
  charVar = NULL,
  removeCodes = character(0),
  integerSingleton = length(charVar) > 0,
  x,
  primary = integer(0),
  whenPrimaryMatters = warning,
  whenNoVar = TRUE,
  specialMultiple = TRUE,
  rowGroupsPackage = "base",
  ...
)

SingletonUniqueContributor0(data, numVar, dominanceVar = NULL, ...)
```

Arguments

data	Input data, possibly pre-aggregated within GaussSuppressionFromData
freqVar	A single variable holding counts (input to GaussSuppressionFromData)
nUniqueVar	A single variable holding the number of unique contributors.
origIdxVar	A possible variable holding the original row index in cases where nUniqueVar equals 1.
charVar	Variable with contributor codes.
removeCodes	Vector, list or data frame of codes considered non-singletons. Single element lists and single column data frames behave just like vectors. In other cases, charVar-names must be used. With empty charVar a vector of row indices is assumed and conversion to integer is performed. See examples.
integerSingleton	Integer output when TRUE. See details.
x	ModelMatrix generated by parent function

primary — Vector (integer or logical) specifying primary suppressed cells. It will be ensured that any non-suppressed inner cell is not considered a singleton.

whenPrimaryMatters — Function to be called when primary caused non-singleton. Supply NULL to do nothing.

whenNoVar — When TRUE, and without nUniqueVar and freqVar in input, all cells will be marked as singletons.

specialMultiple — When TRUE, and when integerSingleton & length(charVar) > 1 & length(nUniqueVar), a special method is used. By re-coding to single charVar and by re-calculating nUnique. To be unique (nUnique=1), uniqueness is only required for a single charvar. Otherwise, the charvar combination must be unique.

rowGroupsPackage — Parameter pkg to RowGroups.

... — Unused parameters

numVar — vector containing numeric values in the data set

dominanceVar — When specified, dominanceVar is used in place of numVar. Specifying dominanceVar is beneficial for avoiding warnings when there are multiple numVar variables. Typically, dominanceVar will be one of the variables already included in numVar.

Details

This function marks input cells as singletons according to ones in data[[nUniqueVar]], if available, and otherwise according to data[[freqVar]]. The output vector can be logical or integer. When, integer, singletons are given as positive values. Their unique values represent the unique values/combinations of data[[charVar]].

Value

logical or integer vector

Note

SingletonUniqueContributor0 is a special version that produces singleton as a two-element list. See GaussSuppression and SuppressDominantCells.

Examples

```
S <- function(data, ...) {
  cbind(data, singleton = SingletonUniqueContributor(data, ...))
}
d2 <- SSBtoolsData("d2")
d <- d2[d2$freq < 5, ]
d$nUnique <- round((5 - d$freq)/3)
d$freq <- round(d$freq/2)
d[7:8, 2:4] <- NA
rownames(d) <- NULL
```

```
S(d, freqVar = "freq", integerSingleton = FALSE)
S(d, freqVar = "freq", nUniqueVar = "nUnique", integerSingleton = TRUE, charVar = "main_income")
S(d, nUniqueVar = "nUnique", integerSingleton = TRUE, charVar = c("main_income", "k_group"))
S(d, freqVar = "freq", nUniqueVar = "nUnique", integerSingleton = FALSE,
  charVar = "main_income", removeCodes = "other")
S(d, nUniqueVar = "nUnique", integerSingleton = FALSE, charVar = c("main_income", "k_group"),
  removeCodes = c("other", "400"))
S(d, nUniqueVar = "nUnique", integerSingleton = FALSE, charVar = c("main_income", "k_group"),
  removeCodes = data.frame(anyname = c("other", "400")))
S(d, nUniqueVar = "nUnique", integerSingleton = FALSE, charVar = c("main_income", "k_group"),
  removeCodes = list(main_income = c("other", "pensions"), k_group = "300"))
S(d, nUniqueVar = "nUnique", integerSingleton = FALSE, charVar = c("main_income", "k_group"),
  removeCodes = data.frame(main_income = "other", k_group = "400"))
S(d, nUniqueVar = "nUnique", integerSingleton = FALSE, removeCodes = 1:5)

x <- SSBtools::ModelMatrix(d, hierarchies = list(region = "Total"))
which(Matrix::colSums(x) == 1)
which(Matrix::rowSums(x[, Matrix::colSums(x) == 1]) > 0)
# columns 2, 3, 4, 5, 7 correspond to inner cells: rows 3, 4, 5, 6, 8
# with 2:4 not primary rows 3:5 are forced non-singleton
S(d, freqVar = "freq", nUniqueVar = "nUnique", integerSingleton = FALSE, x = x, primary = 5:8)
```

`SuppressDirectDisclosure` *Suppression of directly-disclosive cells*

Description

Function for suppressing directly-disclosive cells in frequency tables. The method detects and primary suppresses directly-disclosive cells with the FindDisclosiveCells function, and applies a secondary suppression using Gauss suppression (see GaussSuppressionFromData).

Usage

```
SuppressDirectDisclosure(
  data,
  dimVar,
  freqVar,
  coalition = 1,
  secondaryZeros = coalition,
  candidates = DirectDisclosureCandidates,
  ...
)
```

Arguments

`data`	the input data
`dimVar`	main dimensional variables for the output table

freqVar	variable containing frequency counts
coalition	numeric variable, parameter for primary suppression. Default value is 1.
secondaryZeros	logical or numeric value for secondary suppression. If logical, it is converted to resp numeric value (0 or 1). If numeric, it describes the largest number that is prioritized over zeroes in secondary suppression. Default value is equal to coalition.
candidates	function parameter for gauss suppression.
...	optional parameters that can be passed to the primary suppression method. See FindDisclosiveCells for details. In the case of SuppressDirectDisclosure2, ... are parameters to GaussSuppressionFromData.

Details

SuppressDirectDisclosure has no support for hierarchical data. SuppressDirectDisclosure2 has, but is less general in other ways.

Value

data.frame containing the result of the suppression

Author(s)

Daniel Lupp

Examples

```
tex <- 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))
SuppressDirectDisclosure(tex, c("v1", "v2", "v3"), "freq")
SuppressDirectDisclosure(tex, c("v1", "v2", "v3"), "freq", coalition = 2, unknown.threshold = 10)

z3 <- SSBtools::SSBtoolsData("z3")
a1 <- SuppressDirectDisclosure(z3, c(1, 4, 5), 7)
b1 <- try(SuppressDirectDisclosure(z3, 1:6, 7))
```

SuppressDominantCells *Suppress magnitude tables using dominance* (n,k) *or p% rule for primary suppression.*

Description

This function utilizes MagnitudeRule.

Usage

```
SuppressDominantCells(
  data,
  n = 1:length(k),
  k = NULL,
  pPercent = NULL,
  allDominance = FALSE,
  dominanceVar = NULL,
  numVar = NULL,
  dimVar = NULL,
  hierarchies = NULL,
  formula = NULL,
  contributorVar = NULL,
  sWeightVar = NULL,
  ...,
  candidatesVar = NULL,
  singletonZeros = FALSE,
  preAggregate = !is.null(contributorVar) & is.null(sWeightVar),
  spec = PackageSpecs("dominanceSpec")
)
```

Arguments

data	Input data, typically a data frame, tibble, or data.table. If data is not a classic data frame, it will be coerced to one internally unless preAggregate is TRUE and aggregatePackage is "data.table".
n	Parameter n in dominance rule. Default is 1:length(k).
k	Parameter k in dominance rule.
pPercent	Parameter in the p% rule, when non-NULL. Parameters n and k will then be ignored. Technically, calculations are performed internally as if n = 1:2. The results of these intermediate calculations can be viewed by setting allDominance = TRUE.
allDominance	Logical. If TRUE, additional information is included in the output, as described in MagnitudeRule.
dominanceVar	Numerical variable to be used in dominance rule. The first numVar variable will be used if it is not specified.
numVar	Numerical variable to be aggregated. Any dominanceVar and candidatesVar that are specified and not included in numVar will be aggregated accordingly.
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
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
contributorVar	Extra variables to be used as grouping elements in the dominance rule. Typically, the variable contains the contributor IDs.

sWeightVar	Name of variable which represents sampling weights to be used in dominance rule
...	Further arguments to be passed to the supplied functions and to ModelMatrix (such as inputInOutput and removeEmpty).
candidatesVar	Variable to be used in the candidate function to prioritize cells for publication and thus not suppression. If not specified, the same variable that is used for the dominance rule will be applied (see dominanceVar and numVar).
singletonZeros	When negative values cannot occur, one can determine from a non-suppressed marginal cell with the value 0 that all underlying cells also have the value 0. The use of singletonZeros = TRUE is intended to prevent this phenomenon from causing suppressed cells to be revealable. It is the zeros in the dominanceVar variable that are examined. Specifically, the ordinary singleton method is combined with a method that is actually designed for frequency tables. This approach also works for magnitude tables when SingletonUniqueContributor0 is utilized.
preAggregate	Parameter to GaussSuppressionFromData. Necessary to include here since the specification in spec cannot take sWeightVar into account.
spec	NULL or a named list of arguments that will act as default values.

Value

data frame containing aggregated data and suppression information.

See Also

SSBtools::tables_by_formulas()

Examples

```
num <- c(100,
         90, 10,
         80, 20,
         70, 30,
         50, 25, 25,
         40, 20, 20, 20,
         25, 25, 25, 25)
v1 <- c("v1",
        rep(c("v2", "v3", "v4"), each = 2),
        rep("v5", 3),
        rep(c("v6", "v7"), each = 4))
sweight <- c(1, 2, 1, 2, 1, 2, 1, 2, 1, 1, 2, 1, 1, 1, 2, 1, 1, 1)
d <- data.frame(v1 = v1, num = num, sweight = sweight)

# basic use
SuppressDominantCells(d, n = c(1,2), k = c(80,70), numVar = "num", formula = ~v1 -1)
SuppressDominantCells(d, k = c(80,70), numVar = "num", formula = ~v1 -1) # same as above
SuppressDominantCells(d, pPercent = 7, numVar = "num", formula = ~v1 -1)

# with weights
```

```
SuppressDominantCells(d, n = c(1,2), k = c(80,70), numVar = "num",
dimVar = "v1", sWeightVar = "sweight")

# overwriting some parameters in default spec
SuppressDominantCells(d, n = c(1,2), k = c(80,70), numVar = "num",
dimVar = "v1", sWeightVar = "sweight", domWeightMethod = "tauargus")

# using dominance and few contributors rule together, see second example compared to first
SuppressDominantCells(d, n = c(1,2), k = c(80,70), numVar = "num", formula = ~v1 -1,
primary = c(DominanceRule, NContributorsRule), maxN = 3, allDominance = TRUE)

SuppressDominantCells(d, n = c(1,2), k = c(80,70), numVar = "num", formula = ~v1 -1,
primary = c(DominanceRule, NContributorsRule), maxN = 4, allDominance = TRUE)


d2 <- SSBtoolsData("d2")[1:4]   # Data considered as microdata
set.seed(123)
d2$v <- rnorm(nrow(d2))^2

# Hierarchical region variables are detected automatically -> same output column
SuppressDominantCells(data = d2, n = c(1, 2), k = c(70, 95), numVar = "v",
                      dimVar = c("region", "county", "k_group"), allDominance = TRUE)

# Formula. Hierarchical variables still detected automatically.
SuppressDominantCells(data = d2, n = c(1, 2), k = c(70, 95), numVar = "v",
                      formula = ~main_income * k_group + region + county - k_group)

# With hierarchies created manually
ml <- data.frame(levels = c("@", "@@", "@@@", "@@@", "@@@", "@@"),
       codes = c("Total", "not_assistance", "other", "pensions", "wages", "assistance"))
SuppressDominantCells(data = d2, n = c(1, 2), k = c(70, 95), numVar = "v",
                      hierarchies = list(main_income = ml, k_group = "Total_Norway"))

# With contributorVar and p% rule
SuppressDominantCells(data= SSBtoolsData("magnitude1"),
                      numVar = "value",
                      dimVar= c("sector4", "geo"),
                      contributorVar = "company",
                      pPercent = 10,
                      allDominance = TRUE)


# Using formula followed by FormulaSelection
output <- SuppressDominantCells(data = SSBtoolsData("magnitude1"),
                                numVar = "value",
                                formula = ~sector2 * geo + sector4 * eu,
                                contributorVar = "company",
                                k = c(80, 99))
FormulaSelection(output, ~sector2 * geo)


# This example is similar to the one in the documentation of tables_by_formulas,
# but it uses SuppressDominantCells with the pPercent and contributorVar parameters.
```

```
tables_by_formulas(SSBtoolsData("magnitude1"),
                   table_fun = SuppressDominantCells,
                   table_formulas = list(table_1 = ~region * sector2,
                                         table_2 = ~region1:sector4 - 1,
                                         table_3 = ~region + sector4 - 1),
                   substitute_vars = list(region = c("geo", "eu"), region1 = "eu"),
                   collapse_vars = list(sector = c("sector2", "sector4")),
                   dominanceVar  = "value", pPercent = 10, contributorVar = "company")


 # Example using the dummy_aggregate parameters together with an extra
 # primary rule. A cell becomes primary if the maximum input value
 # exceeds 60% of the cell value.
 SuppressDominantCells(data = SSBtoolsData("magnitude1"),
           dominanceVar = "value",
           formula = ~sector2 * geo + sector4 * eu,
           contributorVar = "company",
           pPercent = 3,
           primary = c(MagnitudeRule,
                       function(..., da_out, num){da_out[[1]]/num[[1]]>0.6}),
           da_fun = c(mAx = function(x) suppressWarnings(max(x))),
           da_vars = c(mAx = "value"),
           da_args = list(name_sep = "__"))


 # More advanced example using dummy_aggregate parameters.
 # The default primary function (MagnitudeRule) is removed.
 # A cell becomes primary if the maximum input value exceeds 70% of
 # the cell value, or if the number of contributions from a single
 # company exceeds 55% of the total number of contributions.
 # Change default preAggregate to speed up.
 SuppressDominantCells(data = SSBtoolsData("magnitude1")[c(1:3, 1:20),],
   dominanceVar = "value",
   formula = ~sector2 * geo + sector4 * eu,
   primary = function(..., da_out, num, freq){
        da_out$value_max/num$value>0.7 |  da_out$company_freq_max/freq>0.55},
   da_fun = c(max = max, freq_max = function(x){max(table(x))}),
   da_vars = c(max = "value", freq_max = "company"),
   preAggregate = TRUE,    # Since default FALSE without contributorVar
   extraAggregate = FALSE, # Not needed since preAggregate and no contributorVar
   singletonMethod = "none")
```

SuppressFewContributors

Few contributors suppression

Description

This function provides functionality for suppressing magnitude tables based on the few contributors rule (NContributorsRule).

Usage

```
SuppressFewContributors(
  data,
  maxN,
  numVar = NULL,
  dimVar = NULL,
  hierarchies = NULL,
  formula = NULL,
  contributorVar = NULL,
  removeCodes = character(0),
  remove0 = TRUE,
  candidatesVar = NULL,
  ...,
  spec = PackageSpecs("fewContributorsSpec")
)
```

Arguments

data	Input data, typically a data frame, tibble, or data.table. If data is not a classic data frame, it will be coerced to one internally unless preAggregate is TRUE and aggregatePackage is "data.table".
maxN	Suppression threshold. Cells where the number of unique contributors is less than or equal to maxN are marked as primary suppressed. This parameter is passed to NContributorsRule() via GaussSuppressionFromData(). Note that within those functions, the parameter name charVar is used instead of contributorVar.
numVar	Numerical variable to be aggregated. Any candidatesVar that is specified and not included in numVar will be aggregated accordingly. Additionally, if remove0 is specified as a variable name and it is not included in numVar, it will also be aggregated accordingly. See parameters candidatesVar and remove0 below.
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
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
contributorVar	Extra variables to be used as grouping elements when counting contributors. Typically, the variable contains the contributor IDs.
removeCodes	Vector of codes to be omitted when counting contributors. With empty contributorVar row indices are assumed and conversion to integer is performed.
remove0	When set to TRUE (default), data rows in which the first numVar (if any) is zero are excluded from the count of contributors. Alternatively, remove0 can be specified as one or more variable names. In this case, all data rows with a zero in any of the specified variables are omitted from the contributor count. Specifying remove0 as variable name(s) is useful for avoiding warning when there are multiple numVar variables.

candidatesVar	Variable to be used in the candidate function to prioritize cells for publication and thus not suppression. The first numVar variable will be used if it is not specified.
...	Further arguments to be passed to the supplied functions and to ModelMatrix (such as inputInOutput and removeEmpty).
spec	NULL or a named list of arguments that will act as default values.

Value

data.frame containing aggregated data and supppression information. Columns nRule and nAll contain the number of contributors. In the former, removeCodes is taken into account.

Examples

```
num <- c(100,
         90, 10,
         80, 20,
         70, 30,
         50, 25, 25,
         40, 20, 20, 20,
         25, 25, 25, 25)
v1 <- c("v1",
        rep(c("v2", "v3", "v4"), each = 2),
        rep("v5", 3),
        rep(c("v6", "v7"), each = 4))
sweight <- c(1, 2, 1, 2, 1, 2, 1, 2, 1, 1, 2, 1, 1, 1, 2, 1, 1, 1)
d <- data.frame(v1 = v1, num = num, sweight = sweight)

SuppressFewContributors(d, formula = ~v1, maxN = 1, numVar = "num")
SuppressFewContributors(d, formula = ~v1, maxN = 2, numVar = "num")
SuppressFewContributors(d, formula = ~v1, maxN = 3, numVar = "num")


d2 <- SSBtoolsData("d2")[-5]
set.seed(123)
d2$v <- round(rnorm(nrow(d2))^2, 1)
d2$family_id <- round(2*as.integer(factor(d2$region)) + runif(nrow(d2)))

# Hierarchical region variables are detected automatically -> same output column
SuppressFewContributors(data = d2, maxN = 2, numVar = "v", contributorVar = "family_id",
                        dimVar = c("region", "county", "k_group"))

# Formula. Hierarchical variables still detected automatically.
# And codes 1:9 not counted
SuppressFewContributors(data = d2, maxN = 1, numVar = "v", contributorVar = "family_id",
                        formula = ~main_income * k_group + region + county - k_group,
                        removeCodes = 1:9)

# With hierarchies created manually
ml <- data.frame(levels = c("@", "@@", "@@@", "@@@", "@@@", "@@"),
       codes = c("Total", "not_assistance", "other", "pensions", "wages", "assistance"))
SuppressFewContributors(data = d2, maxN = 2, numVar = "v", contributorVar = "family_id",
```

```
                    hierarchies = list(main_income = ml, k_group = "Total_Norway"))
```

SuppressionFromDecimals

Cell suppression from synthetic decimal numbers

Description

Decimal numbers, as calculated by GaussSuppressDec, are used to decide suppression (whole numbers or not). Technically, the calculations are done via GaussSuppressionFromData, but without running GaussSuppression. All suppressed cells are primary suppressed.

Usage

```
SuppressionFromDecimals(
  data,
  decVar,
  freqVar = NULL,
  numVar = NULL,
  preAggregate = FALSE,
  digits = 9,
  ...
)
```

Arguments

data	Input data as a data frame
decVar	One ore several (nRep>1) decimal number variables.
freqVar	A single variable holding counts (not needed)
numVar	Other numerical variables to be aggregated
preAggregate	Parameter to GaussSuppressionFromData
digits	Parameter to RoundWhole. Values close to whole numbers will be rounded.
...	Other parameters to GaussSuppressionFromData

Details

Several decimal number variables reduce the probability of obtaining whole numbers by chance.

Value

Aggregated data with suppression information

Author(s)

Øyvind Langsrud

References

Langsrud (2019). doi:10.1007/s1122201898489.

Langsrud and Bøvelstad (2022). doi:10.1007/9783031139451_8.

Examples

```
z2 <- SSBtoolsData("z2")

# Find suppression and decimal numbers with "fylke" in model
a1 <- GaussSuppressDec(z2,
                       fun = SuppressSmallCounts,
                       dimVar = c("region", "fylke", "hovedint"),
                       freqVar = "ant", protectZeros = FALSE, maxN = 2,
                       output = "inner")

# Add decimal numbers to data
z2$freqDec <- a1$freqDec

# Find suppression with "kostragr" in model
a2 <- SuppressionFromDecimals(z2, dimVar = c("region", "kostragr", "hovedint"),
                              freqVar = "ant", decVar = "freqDec")
tail(a2)

b1 <- GaussSuppressDec(data = SSBtoolsData("magnitude1"),
                       fun = SuppressDominantCells,
                       numVar = "value",
                       formula = ~sector2 * geo + sector4 * eu,
                       contributorVar = "company", k = c(80, 99))

b2 <- SuppressionFromDecimals(b1[b1$isInner, ],
                              formula = ~(sector2 + sector4) * eu,
                              numVar = "value",
                              decVar = "freqDec")
FormulaSelection(b2, ~sector2 * eu)
```

SuppressKDisclosure *K-disclosure suppression*

Description

Frequency table suppression for targeted attribute disclosure protection.

Usage

```
SuppressKDisclosure(
  data,
  coalition = 0,
  mc_hierarchies = NULL,
```

```
  upper_bound = Inf,
  dimVar = NULL,
  formula = NULL,
  hierarchies = NULL,
  freqVar = NULL,
  targeting = default_targeting,
  identifying = NULL,
  sensitive = NULL,
  print_frames = FALSE,
  ...,
  spec = PackageSpecs("kDisclosureSpec")
)
```

Arguments

data	a data.frame representing the data set
coalition	numeric vector of length one, representing possible size of an attacking coalition. This parameter corresponds to the parameter k in the definition of k-disclosure.
mc_hierarchies	a hierarchy representing meaningful combinations to be protected. Default value is NULL.
upper_bound	Numeric value specifying the maximum cell frequency for which disclosure of belonging to the cell may be regarded as unacceptable. When freq > upper_bound, disclosure of belonging to the cell is regarded as acceptable regardless of the specification of the sensitive parameter. Default is Inf. Note that this parameter may also be useful for reducing computational burden.
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
formula	A model formula
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.
freqVar	name of the frequency variable in data
targeting	The mechanism underlying the interpretation of identifying and sensitive. See Details in KDisclosurePrimary().
identifying	Specification of information that an intruder may already know. The specification is subject to the same requirements as sensitive below. If not all variables are included, total codes for the missing variables are derived automatically. This requires that the overall total is included as an output row.
sensitive	Specification of information considered unacceptable to disclose. It may be given as a character vector of variable names, a named list with variable names as names and specified codes as values, or a data frame specifying variable combinations. The wildcard characters * and ?, as well as the exclusion operator !, may be used, since SSBtools::WildcardGlobbing() is applied.

print_frames	Logical or character. If TRUE, additional data frames are printed to the console. When mc_hierarchies is used, this includes a data frame with hidden results. In addition, a data frame containing the primary suppressed difference cells is printed. If set to "primary_cells", only the primary suppressed difference cells are printed. The default is FALSE.
...	parameters passed to children functions
spec	NULL or a named list of arguments that will act as default values.

Details

The argument targeting may also be a function that returns such a list. This works similarly to supplied functions in GaussSuppressionFromData(). Note, however, that the function operates on possibly extended versions of freq, x, and crossTable that reflect the use of mc_hierarchies, when applicable.

The parameters identifying and sensitive are included here as explicit arguments, but they are in fact parameters of default_targeting(). In addition, the default_targeting() parameters targeting_include and targeting_exclude may also be used (see examples).

Value

A data.frame containing the publishable data set, with a boolean variable $suppressed representing cell suppressions.

Author(s)

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References

Langsrud (2026). doi:10.1007/9783032378835_8.

Lupp and Langsrud (2023). Disclosure-Driven Suppression in Frequency Tables. Archived unpublished manuscript. https://research.lupp.no/K_disclosure.pdf.

Lupp and Langsrud (2021). Suppression of directly-disclosive cells in frequency tables. Joint UNECE/Eurostat Expert Meeting on Statistical Data Confidentiality, Poznań, Poland. https://unece.org/sites/default/files/2021-12/SDC2021_Day2_Lupp_AD.pdf.

Examples

```
# data
mun_a <- SSBtools::SSBtoolsData("mun_accidents")

# Function to print output in wide format, marking suppressed values with `*`
show_out <- function(out) {
  out$freq = sprintf("%s%s", out$freq, c(" ","*")[1+out$suppressed])
  a <- reshape(out[1:3], idvar = "mun", timevar = "inj", direction = "wide", )
  names(a) <- sub("^freq\\.", "", names(a))
  print(a)}

# hierarchies as DimLists
```

```
mun <- data.frame(levels = c("@", rep("@@", 6)),
codes = c("Total", paste("k", 1:6, sep = "")))
inj <- data.frame(levels = c("@", "@@" ,"@@", "@@", "@@"),
codes = c("Total", "serious", "light", "none", "unknown"))
dimlists <- list(mun = mun, inj = inj)

inj2 <- data.frame(levels = c("@", "@@", "@@@" ,"@@@", "@@", "@@"),
codes = c("Total", "injured", "serious", "light", "none", "unknown"))
inj3 <- data.frame(levels = c("@", "@@", "@@" ,"@@", "@@"),
codes = c( "shadowtotal", "serious", "light", "none", "unknown"))
mc_dimlist <- list(inj = inj2)
mc_nomargs <- list(inj = inj3)

#' # Example with formula, no meaningful combination
out <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                           formula = ~mun*inj, print_frames = TRUE)
show_out(out)

# Example with hierarchy and meaningful combination
out2 <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                      hierarchies = dimlists, mc_hierarchies = mc_dimlist,
                      print_frames = TRUE)
show_out(out2)

#' # Example of table without mariginals, and mc_hierarchies to protect
out3 <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                      formula = ~mun:inj, mc_hierarchies = mc_nomargs,
                      print_frames = TRUE)
show_out(out3)


### Examples with identifying and sensitive ###

out_d <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                             formula = ~mun*inj, sensitive= "inj",
                             print_frames = TRUE)
show_out(out_d)


out_d1 <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                              formula = ~mun*inj, mc_hierarchies = mc_dimlist,
                              sensitive = list(mun =  "k3", inj = "injured"),
                              print_frames = TRUE)
show_out(out_d1)

out_d2 <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                              formula = ~mun*inj,
                              sensitive = list(inj = "serious", mun = "k3"),
                              print_frames = TRUE)
show_out(out_d2)

out_i1 <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                              formula = ~mun*inj, identifying = "mun",
```

```
                              print_frames = TRUE)
show_out(out_i1)

out_i2 <- SuppressKDisclosure(mun_a, coalition = 1, freqVar = "freq",
                              formula = ~mun*inj, identifying = "inj",
                              print_frames = TRUE)
show_out(out_i2)


mun_b <- SSBtools::SSBtoolsData("mun_accidents")
mun_b$freq <- c(0,5,3,4,1,0,
                0,0,2,0,0,6,
                4,1,0,4,0,0,
                0,0,0,0,0,0)

# With cells forced to be published, yielding unsafe table
out_unsafe <- SuppressKDisclosure(mun_b, coalition = 1, freqVar = "freq",
                                  formula = ~mun*inj, sensitive = "inj",
                                  forced = c(12,14,15), output = "all",
                                  print_frames = TRUE)
show_out(out_unsafe$publish)

# colnames in $unsafe give an indication as to which cells/differences are unsafe
colnames(out_unsafe$unsafe)



 ### Advanced examples using `targeting_exclude` and `targeting_include`

# Create a wrapper function to avoid repeating common arguments
fun <- function(..., coalition = 7) {
   SuppressKDisclosure(SSBtoolsData("d3"),
     formula = ~(region + county)*main_income + region*months + county*main_income*months,
       freqVar = "freq", coalition = coalition , print_frames = "primary_cells",
       mc_hierarchies = list(main_income = c("special = assistance + other",
                                             "ordinary = pensions + wages")),
       ...)}

# Without any sensitive or identifying specifications
a1 <- fun()

# Treat the `main_income` variable as sensitive
a2 <- fun(sensitive = "main_income")

# In addition, treat `region` as identifying
a3 <- fun(sensitive = "main_income", identifying = "region")

# Only the categories "assistance" and "wages" are considered sensitive
# Also use "special" and "ordinary" as identifying categories (instead of "Total")
a4 <- fun(sensitive = list(main_income = c("assistance", "wages")),
          identifying = list(region = "*", main_income = c("special", "ordinary")))

# As above, but additionally exclude regions i and j via the sensitive specification
```

```
a5 <- fun(sensitive = list(main_income = c("assistance", "wages")),
          identifying = list(region = "*", main_income = c("special", "ordinary")),
          targeting_exclude = list(list(sensitive = list(region = c("i", "j")))))

# Same exclusion as above, but specified via identifying instead of sensitive
# Here `main_income` must also be specified, since the default for identifying is "Total"
a6 <- fun(sensitive = list(main_income = c("assistance", "wages")),
          identifying = list(region = "*", main_income = c("special", "ordinary")),
          targeting_exclude = list(list(identifying = list(region = c("i", "j"),
                                       main_income = "*"))))

# The results are identical
identical(a5,a6)


# Add relations so that additional difference cells may be suppressed
a7 <- fun(sensitive = list(main_income = c("assistance", "wages")),
          identifying = list(region = "*", main_income = c("special", "ordinary")),
          targeting_exclude = list(list(identifying = list(region = c("i", "j"),
                                       main_income = "*"))),
          targeting_include = list(
            list(identifying = list(region = c("14", "U", "V", "X"),
                                    main_income = c("special", "ordinary"),
                                    months = c("m10m12", "Total")),
                 sensitive = list(region = c("m01m05"),
                                  main_income = c("pensions", "assistance")))))

# As above, but use a data.frame for precise specification of relations
# Therefore, "V ordinary-pensions" is no longer included
a8 <- fun(sensitive = list(main_income = c("assistance", "wages")),
          identifying = list(region = "*", main_income = c("special", "ordinary")),
          targeting_exclude = list(list(identifying = list(region = c("i", "j"),
                                       main_income = "*"))),
          targeting_include = list(
            list(identifying = data.frame(region = c("14", "U", "V", "X"),
                                          main_income = c("special", "ordinary"),
                                          months = c("m10m12", "Total")),
                 sensitive = list(region = c("m01m05"),
                                  main_income = c("pensions", "assistance")))))

# Specify the same relations as above, but in a different way
# Using multiple list elements
a9 <- fun(sensitive = list(main_income = c("assistance", "wages")),
          identifying = list(region = "*", main_income = c("special", "ordinary")),
          targeting_exclude = list(list(identifying = list(region = c("i", "j"),
                                       main_income = "*"))),
          targeting_include = list(
            list(identifying = list(region = "14",
                                    main_income = "special",
                                    months = "m10m12"),
                 sensitive = list(region = "14",
                                  main_income = "assistance",
                                  months = "m10m12")),
```

```
              list(identifying = list(region = c("U", "X"),
                                      main_income = "ordinary",
                                      months = "Total"),
                   sensitive = list(region = c("U", "X"),
                                    main_income = "pensions",
                                    months = "Total"))))

# The results are identical
identical(a8,a9)
```

SuppressLinkedTables *Consistent Suppression of Linked Tables*

Description

Provides alternatives to global protection for linked tables through methods that may reduce the computational burden.

Usage

```
SuppressLinkedTables(
  data = NULL,
  fun,
  ...,
  withinArg = NULL,
  linkedGauss = "super-consistent",
  linkedIntervals = ifelse(linkedGauss == "local-bdiag", "local-bdiag",
    "super-consistent"),
  lpPackage = NULL,
  recordAware = TRUE,
  iterBackTracking = Inf,
  whenEmptyUnsuppressed = NULL
)
```

Arguments

data	The data argument to fun. When NULL data must be included in withinArg.
fun	A function: GaussSuppressionFromData or one of its wrappers such as SuppressSmallCounts and SuppressDominantCells.
...	Arguments to fun that are kept constant.
withinArg	A list of named lists. Arguments to fun that are not kept constant. If withinArg is named, the names will be used as names in the output list.
linkedGauss	Specifies the strategy for protecting linked tables. The "super-consistent", "consistent", and "local-bdiag" methods protect all linked tables together in a single call to GaussSuppression() using an internally constructed block-diagonal model matrix.

- "super-consistent" (default): Shares the key property of "consistent" that common cells are suppressed equally across tables, but also exploits the fact that these cells have identical values in all tables. The coordination is therefore stronger. If intervals are calculated using such coordination, common cells will have identical interval bounds in each table.
- "consistent": Common cells are suppressed equally across tables.
- "local": Each table is protected independently by a separate call to GaussSuppression().
- "back-tracking": Iterative approach where each table is protected via GaussSuppression(), and primary suppressions are adjusted based on secondary suppressions from other tables across iterations.
- "local-bdiag": Produces the same result as "local", but uses a single call to GaussSuppression(). It does not apply the linked-table methodology.

linkedIntervals

This parameter controls how interval calculations, triggered by the lpPackage parameter, are performed.

- **Default:** "local-bdiag" if linkedGauss is set to "local-bdiag", and "super-consistent" in all other cases.
- Possible values of linkedIntervals are "local-bdiag" and "super-consistent".
- Interval calculations can be performed when linkedGauss is "super-consistent", "consistent", or "local-bdiag".
- When linkedGauss is "local-bdiag", "local-bdiag" is the only allowed value in linkedIntervals (except that, with the alternative approaches, "global" may appear as a later element; "super-consistent" is never allowed).
- It is possible to request multiple types of intervals by supplying linkedIntervals as a vector. Only the first value affects the additional suppression defined by rangePercent and/or rangeMin.
- With the alternative approaches (see the note below), "global" may also appear in linkedIntervals, provided it is not the first element.

lpPackage — See GaussSuppressionFromData().

recordAware — If TRUE (default), the suppression procedure will ensure consistency across cells that aggregate the same underlying records, even when their variable combinations differ. When TRUE, data cannot be included in withinArg.

iterBackTracking

Maximum number of back-tracking iterations.

whenEmptyUnsuppressed

Parameter to GaussSuppression. This is about a helpful message *"Cells with empty input will never be secondary suppressed. Extend input data with zeros?"* Here, the default is set to NULL (no message), since preprocessing of the model matrix may invalidate the assumptions behind this message.

Details

The reason for introducing the new method "consistent", which has not yet been extensively tested in practice, is to provide something that works better than "back-tracking", while still offering equally strong protection.

Note that for singleton methods of the *elimination* type (see SSBtools::NumSingleton()), "back-tracking" may lead to the creation of a large number of redundant secondary cells. This is because, during the method's iterations, all secondary cells are eventually treated as primary. As a result, protection is applied to prevent a singleton contributor from inferring a secondary cell that was only included to protect that same contributor.

Note that the frequency singleton methods "subSpace", "anySum0", and "anySumNOTprimary" are currently not implemented and will result in an error. As a result, the singletonZeros parameter in the SuppressDominantCells() function cannot be set to TRUE, and the SuppressKDisclosure() function is not available for use. Also note that automatic forcing of "anySumNOTprimary" is disabled. That is, SSBtools::GaussSuppression() is called with auto_anySumNOTprimary = FALSE. See the parameter documentation for an explanation of why FALSE is required.

Value

A list of data frames, or, if withinArg is NULL, the ordinary output from fun.

Note

Note on differences between SuppressLinkedTables() and alternative approaches. By *alternatives*, we refer to using the linkedGauss parameter via GaussSuppressionFromData(), its wrappers, or through tables_by_formulas(), as shown in the examples below.

- Alternatives can be used when only the formula parameter varies between the linked tables.
- SuppressLinkedTables() creates several smaller model matrices, which may be combined into a single block-diagonal matrix. A large overall matrix is never created.
- With the alternatives, a large overall matrix is created first. Smaller matrices are then derived from it. If the size of the full matrix is a bottleneck, SuppressLinkedTables() is the better choice.
- The "global" method is available with the alternatives, but not with SuppressLinkedTables().
- The collapseAware parameter is supported by the alternatives, but not by SuppressLinkedTables(). This option may improve coordination across tables. See GaussSuppressionFromData().
- Due to differences in candidate ordering, the two methods may not always produce identical results. With the alternatives, candidate order is constructed globally across all cells (as with the global method). In contrast, SuppressLinkedTables() uses a locally determined candidate order within each table. The ordering across tables is coordinated to ensure the method works, but it is not based on a strictly defined global order. This may lead to some differences.
- With the alternatives, linkedIntervals may also contain "global". See the documentaion of the linkedIntervals parameter above and in GaussSuppressionFromData().

Examples

```
### The first example can be performed in three ways
### Alternatives are possible since only the formula parameter varies between the linked tables

a <- SuppressLinkedTables(data = SSBtoolsData("magnitude1"), # With trick "sector4 - sector4" and
             fun = SuppressDominantCells,      # "geo - geo" to ensure same names in output
               withinArg = list(list(formula = ~(geo + eu) * sector2 + sector4 - sector4),
                                list(formula = ~eu:sector4 - 1 + geo - geo),
```

```
                                  list(formula = ~geo + eu + sector4 - 1)),
                  dominanceVar  = "value",
                  pPercent = 10,
                  contributorVar = "company",
                  linkedGauss = "consistent")
print(a)

# Alternatively, SuppressDominantCells() can be run directly using the linkedGauss parameter
a1 <- SuppressDominantCells(SSBtoolsData("magnitude1"),
                formula = list(table_1 = ~(geo + eu) * sector2,
                               table_2 = ~eu:sector4 - 1,
                               table_3 = ~(geo + eu) + sector4 - 1),
                dominanceVar = "value",
                pPercent = 10,
                contributorVar = "company",
                linkedGauss = "consistent")
print(a1)

# In fact, tables_by_formulas() is also a possibility
a2 <- tables_by_formulas(SSBtoolsData("magnitude1"),
                table_fun = SuppressDominantCells,
                table_formulas = list(table_1 = ~region * sector2,
                                      table_2 = ~region1:sector4 - 1,
                                      table_3 = ~region + sector4 - 1),
                substitute_vars = list(region = c("geo", "eu"), region1 = "eu"),
                collapse_vars = list(sector = c("sector2", "sector4")),
                dominanceVar  = "value",
                pPercent = 10,
                contributorVar = "company",
                linkedGauss = "consistent")
print(a2)




####  The second example cannot be handled using the alternative methods.
####  This is similar to the (old) LazyLinkedTables() example.

z1 <- SSBtoolsData("z1")
z2 <- SSBtoolsData("z2")
z2b <- z2[3:5]  # As in ChainedSuppression example
names(z2b)[1] <- "region"
# As 'f' and 'e' in ChainedSuppression example.
# 'A' 'annet'/'arbeid' suppressed in b[[1]], since suppressed in b[[3]].
b <- SuppressLinkedTables(fun = SuppressSmallCounts,
              linkedGauss = "consistent",
              recordAware = FALSE,
              withinArg = list(
                list(data = z1, dimVar = 1:2, freqVar = 3, maxN = 5),
                list(data = z2b, dimVar = 1:2, freqVar = 3, maxN = 5),
                list(data = z2, dimVar = 1:4, freqVar = 5, maxN = 1)))
print(b)
```

```
#################################
####  Examples with intervals
#################################

lpPackage <- "highs"
if (requireNamespace(lpPackage, quietly = TRUE)) {

  # Common cells occur because the default for recordAware is TRUE
  out1 <- SuppressLinkedTables(data = SSBtoolsData("magnitude1"),
              fun = SuppressDominantCells,
              withinArg = list(table_1 = list(dimVar = c("geo", "sector2")),
                               table_2 = list(dimVar = c("eu", "sector4")))),
              dominanceVar = "value", k = 90, contributorVar = "company",
              lpPackage = lpPackage, rangeMin = 50)
  print(out1)


 # In the algorithm, common cells occur because recordAware is TRUE,
 # although this is not reflected in the output variables table_1 and table_2
 out2 <- tables_by_formulas(data = SSBtoolsData("magnitude1"),
              table_fun = SuppressDominantCells,
              table_formulas = list(table_1 = ~geo * sector2,
                                    table_2 = ~eu * sector4),
              substitute_vars = list(region = c("geo", "eu"),
                                     sector = c("sector2", "sector4")),
              dominanceVar = "value", k = 90, contributorVar = "company",
              linkedGauss = "super-consistent",
              lpPackage = lpPackage, rangeMin = 50,
              linkedIntervals = c("super-consistent", "local-bdiag", "global"))
 print(out2)

} else {
 message(paste0("Examples skipped because the '", lpPackage, "' package is not installed."))
}
```

SuppressSmallCounts *Small count frequency table suppression.*

Description

This is a wrapper function of GaussSuppressionFromData for small count frequency suppression. For common applications, the spec parameter can be adjusted, see PackageSpecs for more information. See Details for more information on function call customization.

Usage

```
SuppressSmallCounts(
  data,
```

```
  maxN,
  freqVar = NULL,
  dimVar = NULL,
  hierarchies = NULL,
  formula = NULL,
  ...,
  spec = PackageSpecs("smallCountSpec")
)
```

Arguments

data	Input data, typically a data frame, tibble, or data.table. If data is not a classic data frame, it will be coerced to one internally unless preAggregate is TRUE and aggregatePackage is "data.table".
maxN	Suppression threshold. Cells with frequency <= maxN are marked as primary suppressed. This parameter is passed to PrimaryDefault() via GaussSuppressionFromData().
freqVar	A single variable holding counts (name or number).
dimVar	The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.
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
...	Further arguments to be passed to the supplied functions and to ModelMatrix (such as inputInOutput and removeEmpty).
spec	NULL or a named list of arguments that will act as default values.

Details

The specs provided in the package (see PackageSpecs) provide common parameter setups for small count suppression. However, it might be necessary to customize the parameters further. In this case, certain parameters from GaussSuppressionFromData might need adjusting from the values provided by the package specs. In particular, the parameters protectZeros (should zeros be primary suppressed), extend0 (should empty cells be added before primary suppression), and secondaryZeros (should zero frequency cells be candidates for secondary suppression) might be of interest. The examples below illustrate how to override parameters specified by a spec. Note that this is only possible if specLock = FALSE.

Value

data frame containing aggregated data and suppression information.

See Also

SSBtools::tables_by_formulas()

Examples

```
mun_accidents <- SSBtoolsData("mun_accidents")

SuppressSmallCounts(data = mun_accidents, maxN = 3, dimVar = 1:2, freqVar = 3)
# override default spec
SuppressSmallCounts(data = mun_accidents, maxN = 3, dimVar = 1:2, freqVar = 3,
                    protectZeros = FALSE)


d2 <- SSBtoolsData("d2")
d2$f <- round(d2$freq/10)  # tenth as frequency in examples

# Hierarchical region variables are detected automatically -> same output column
SuppressSmallCounts(data = d2, maxN = 2, freqVar = "f",
                    dimVar = c("region", "county", "k_group"))

# Formula. Hierarchical variables still detected automatically.
SuppressSmallCounts(data = d2, maxN = 3, freqVar = "f",
                    formula = ~main_income * k_group + region + county - k_group)

# With hierarchies created manually
ml <- data.frame(levels = c("@", "@@", "@@@", "@@@", "@@@", "@@"),
       codes = c("Total", "not_assistance", "other", "pensions", "wages", "assistance"))
SuppressSmallCounts(data = d2, maxN = 2, freqVar = "f",
                    hierarchies = list(main_income = ml, k_group = "Total_Norway"))


# Data without pensions in k_group 400
# And assume these are structural zeros (will not be suppressed)
SuppressSmallCounts(data = d2[1:41, ], maxN = 3, freqVar = "f",
                    hierarchies = list(main_income = ml, k_group = "Total_Norway"),
                    extend0 = FALSE, structuralEmpty = TRUE)
# -- Note for the example above --
# With protectZeros = FALSE
#   - No zeros suppressed
# With extend0 = FALSE and structuralEmpty = FALSE
#   - Primary suppression without protection (with warning)
# With extend0 = TRUE and structuralEmpty = TRUE
#   - As default behavior. Suppression/protection of all zeros (since nothing empty)
# With formula instead of hierarchies: Extra parameter needed when extend0 = FALSE.
#   - removeEmpty = FALSE,  to include empty zeros in output.


# Using formula followed by FormulaSelection
output <- SuppressSmallCounts(data = SSBtoolsData("example1"),
                              formula = ~age * geo * year + eu * year,
                              freqVar = "freq",
                              maxN = 1)
FormulaSelection(output, ~(age + eu) * year)


# To illustrate hierarchical_extend0
```

```
# (parameter to underlying function, SSBtools::Extend0fromModelMatrixInput)
SuppressSmallCounts(data = SSBtoolsData("example1"),
                    formula = ~age * geo * eu, freqVar = "freq",
                    maxN = 0,  avoidHierarchical = TRUE)
SuppressSmallCounts(data = SSBtoolsData("example1"),
                    formula = ~age * geo * eu, freqVar = "freq",
                    maxN = 0,  avoidHierarchical = TRUE,
                    hierarchical_extend0 = TRUE)


# This example is similar to the one in the documentation of tables_by_formulas,
# but it uses SuppressSmallCounts, and the input data (SSBtoolsData("magnitude1"))
# is used to generate a frequency table by excluding the "value" variable.
tables_by_formulas(SSBtoolsData("magnitude1"),
                   table_fun = SuppressSmallCounts,
                   table_formulas = list(table_1 = ~region * sector2,
                                         table_2 = ~region1:sector4 - 1,
                                         table_3 = ~region + sector4 - 1),
                   substitute_vars = list(region = c("geo", "eu"), region1 = "eu"),
                   collapse_vars = list(sector = c("sector2", "sector4")),
                   maxN = 2)
```

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