

# Package ‘GaussSuppression’

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**Type** Package

**Title** Tabular Data Suppression using Gaussian Elimination

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**Imports** SSBtools (>= 1.8.2), RegSDC (>= 0.7.0), stats, methods, utils,  
Matrix, ellipsis, rlang

**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](https://doi.org/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 suppression of disclosive cells is also included. 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](https://doi.org/10.1007/s11222-018-9848-9)>.

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**URL** <https://github.com/statisticsnorway/ssb-gausssuppression>,  
<https://statisticsnorway.github.io/ssb-gausssuppression/>

**BugReports** <https://github.com/statisticsnorway/ssb-gausssuppression/issues>

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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 <a href="#">GaussSuppressionFromData</a>                                                                                                                       |
| fun             | A function: <a href="#">GaussSuppressionFromData</a> or one of its wrappers such as <a href="#">SuppressSmallCounts</a> and <a href="#">SuppressDominantCells</a> .                  |
| primary         | As input to <a href="#">GaussSuppressionFromData</a> before possible extension caused by suppressedData. Supply NULL if all primary suppressions are retrieved from suppressedData.  |
| suppressedData  | A data frame or a list of data frames as output from <a href="#">GaussSuppressionFromData</a> .                                                                                      |
| 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 | <i>Candidates functions</i> |
|-------------------|-----------------------------|

---

## 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 returned 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. <a href="#">NContributorsRule</a> . 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 | <i>Repeated GaussSuppression with forwarding of previous results</i> |
|--------------------|----------------------------------------------------------------------|

---

### 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" "anet"/"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  $\geq 0$ !*

**Author(s)**

Øyvind Langsrud and Daniel Lupp

---

|                   |                                                                                                              |
|-------------------|--------------------------------------------------------------------------------------------------------------|
| FindDominantCells | <i>Method for finding dominant cells according to (possibly multiple) <math>n, k</math> dominance rules.</i> |
|-------------------|--------------------------------------------------------------------------------------------------------------|

---

## 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 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

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

## Value

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

---

|                   |                                                 |
|-------------------|-------------------------------------------------|
| FixRiskyIntervals | <i>New primary cells to fix risky intervals</i> |
|-------------------|-------------------------------------------------|

---

**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.
- `intervalsLimits` As computed by [IntervalsLimits](#)
- `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 | <i>Cell suppression with synthetic decimal numbers</i> |
|------------------|--------------------------------------------------------|

---

## 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
)
```

**Arguments**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| data                     | Input daata as a data frame                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| ...                      | Further parameters to <a href="#">GaussSuppressionFromData</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| fun                      | A function: <a href="#">GaussSuppressionFromData</a> or one of its wrappers such as <a href="#">SuppressSmallCounts</a> and <a href="#">SuppressDominantCells</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| output                   | NULL (default), "publish", "inner", "publish_inner", or "publish_inner_x" (x also).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| use_freqVar              | <p>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:</p> <ul style="list-style-type: none"> <li>• If freqVar is not available.</li> <li>• If runIpf is FALSE and fun is one of the functions <a href="#">SuppressFewContributors</a> or <a href="#">SuppressDominantCells</a>.</li> </ul> <p>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.</p> |
| digits                   | Parameter to <a href="#">RoundWhole</a> . 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 <a href="#">Mipf</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| eps                      | Parameter to <a href="#">Mipf</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| iter                     | Parameter to <a href="#">Mipf</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 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 <a href="#">RoundWhole</a> 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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**Value**

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

**Author(s)**

Øyvind Langrød

**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],
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,
action_unused_dots = getOption("GaussSuppression.action_unused_dots", "inform"),
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 <a href="#">ModelMatrix</a> (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 <a href="#">AutoHierarchies</a> . 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, <a href="#">PrimaryDefault()</a> , 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 <a href="#">NContributorsRule()</a> . 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: <a href="#">CandidatesDefault</a>                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| primary         | GaussSuppression input or a function generating it (see details) Default: <a href="#">PrimaryDefault</a>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 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: <a href="#">SingletonDefault</a>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| singletonMethod | <a href="#">GaussSuppression</a> input. The default value depends on parameter secondaryZeros which depends on candidates (see details).                                                                                                                                                                                                                                                                                                                                                                                                       |
| printInc        | <a href="#">GaussSuppression</a> 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 <a href="#">GaussSuppression</a> , 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 unsafeInOut 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 <a href="#">ModelMatrix</a>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 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 <a href="#">GaussSuppression</a> . 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.                                                                                                                                                                                                                                         |
| forcedInOut     | 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 unsafe 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           | <ul style="list-style-type: none"> <li>When non-NULL, intervals computed by <code>ComputeIntervals()</code> will be included in the output. Valid values are the names of supported R packages for linear programming backends: " highs", "Rsymphony", "Rglpk", or "lpSolve".</li> <li>If interval requirements are specified, additional suppression will be performed to satisfy those requirements. Interval requirements can be set either through arguments of <code>Intervallimits()</code> or by enabling <code>protectionIntervals = TRUE</code> in the primary suppression functions. See <code>Intervallimits()</code> for a full description of the parameters (<code>protectionPercent</code>, <code>protectionLimit</code>, <code>loProtectionPercent</code>, <code>loProtectionLimit</code>, <code>rangePercent</code>, <code>rangeMin</code>) and how interval requirements are calculated. <ul style="list-style-type: none"> <li>In the output variable <code>suppressed_integer</code>, 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.</li> <li>Intervals [<code>lo_1</code>, <code>up_1</code>] are calculated prior to additional suppression.</li> <li>To disable additional suppression, set <code>intervalSuppression = FALSE</code>.</li> </ul> </li> </ul> <p>Please note that additional suppression based on parameters other than <code>rangePercent</code> and <code>rangeMin</code> is currently considered experimental. In particular, the names of the newer parameters may still change.</p> |
| intervalSuppression | Logical. If FALSE, additional suppression to satisfy interval requirements is disabled (default is TRUE). See description of <code>lpPackage</code> above.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| aggregatePackage    | Package used to <code>preAggregate/extraAggregate</code> . Parameter <code>pkg</code> to <code>aggregate_by_pkg</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| aggregateNA         | Whether to include NAs in the grouping variables while <code>preAggregate/extraAggregate</code> . Parameter <code>include_na</code> to <code>aggregate_by_pkg</code> . Note that NAs will not be present in the output table's dimensions regardless of the value of <code>aggregateNA</code> . When using the formula interface, this is controlled by the <code>NAomit</code> parameter (default TRUE), which is passed to the function <code>SSBtools::Formula2ModelMatrix()</code> . 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 <code>dimVar</code> or <code>hierarchies</code> interfaces will result in errors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| aggregateBaseOrder  | Parameter <code>base_order</code> to <code>aggregate_by_pkg</code> , used when <code>preAggregate/extraAggregate</code> . 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 <code>output = "inner"</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| rowGroupsPackage    | Parameter <code>pkg</code> to <code>RowGroups</code> . The parameter is input to <code>Formula2ModelMatrix</code> via <code>ModelMatrix</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| linkedGauss         | Controls linked table suppression. Accepted values are described in the documentation for <a href="#">SuppressLinkedTables()</a> . 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     | <p>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 <a href="#">SuppressLinkedTables()</a>.</p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>                                                                                 |
| recordAware         | Parameter associated with linkedGauss. See <a href="#">SuppressLinkedTables()</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| collapseAware       | Parameter associated with linkedGauss. In the linked-tables algorithm, the model matrix is first <i>collapsed</i> 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.                                                                                                                                                                                                                                                                     |
| action_unused_dots  | Character string controlling how unused arguments in ... are handled. Internally uses <a href="#">ellipsis::check_dots_used()</a> with a custom action. One of "warn", "abort", "inform", or "none". The value "none" disables the check entirely. The default is taken from <code>getOption("GaussSuppression.action_unused_dots")</code> , falling back to "inform" if the option is not set. Users can change the default globally with e.g. <code>options(GaussSuppression.action_unused_dots = "abort")</code> .                                                                                                                                                                                            |
| 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 <code>getOption("GaussSuppression.allowed_unused_dots")</code> ,                                                                                                                                                                                                                                                                                                                                                                                |

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`, 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)

Øyvind Langsrud and Daniel Lupp

**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)

```

## 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,
  inputInOut = TRUE,
  candidatesFromTotal = TRUE,
  structuralEmpty = FALSE,
  freqVarNew = rev(make.unique(c(names(data), "freq")))[1],
  ...
)
```

## Arguments

|                      |                                                                                                                                                 |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>    | Input data as a data frame                                                                                                                      |
| <code>dimVar</code>  | The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified. |
| <code>freqVar</code> | A single variable holding counts (name or number).                                                                                              |
| <code>numVar</code>  | 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 <a href="#">AutoHierarchies</a> . 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: <a href="#">CandidatesDefault</a>                                                                                           |
| primary             | GaussSuppression input or a function generating it (see details) Default: <a href="#">PrimaryDefault</a>                                                                                              |
| 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: <a href="#">SingletonDefault</a>                                                                          |
| singletonMethod     | <a href="#">GaussSuppression</a> input                                                                                                                                                                |
| printInc            | <a href="#">GaussSuppression</a> 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 ("lomap\_"), 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. <a href="#">SuppressSmallCounts()</a>                                                                                                                                                                                                                                                |
| dominanceVar        | As input to e.g. <a href="#">SuppressDominantCells()</a>                                                                                                                                                                                                                                              |
| 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 | <i>Construct primary suppressed difference matrix</i> |
|--------------------|-------------------------------------------------------|

---

## 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,
  ...
)
```

**Arguments**

|                             |                                                                                                                                                                                                 |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>           | a data.frame representing the data set                                                                                                                                                          |
| <code>x</code>              | ModelMatrix generated by parent function                                                                                                                                                        |
| <code>crossTable</code>     | crossTable generated by parent function                                                                                                                                                         |
| <code>freqVar</code>        | name of the frequency variable in data                                                                                                                                                          |
| <code>mc_hierarchies</code> | a hierarchy representing meaningful combinations to be protected. Default value is NULL.                                                                                                        |
| <code>coalition</code>      | numeric vector of length one, representing possible size of an attacking coalition. This parameter corresponds to the parameter <code>k</code> in the definition of <code>k</code> -disclosure. |
| <code>upper_bound</code>    | numeric value representing minimum count considered safe. Default set to <code>Inf</code>                                                                                                       |
| <code>...</code>            | parameters passed to children functions                                                                                                                                                         |

**Value**

dgCMatrix corresponding to primary suppressed cells

**Author(s)**

Daniel P. Lupp

---

LazyLinkedTables

*Linked tables by full [GaussSuppressionFromData](#) iterations*

---

**Description**

[AdditionalSuppression](#) is called several times as in [ChainedSuppression](#)

**Usage**

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

**Arguments**

|                            |                                                                                                       |
|----------------------------|-------------------------------------------------------------------------------------------------------|
| <code>...</code>           | Arguments to <code>GaussSuppressionFromData</code> that are kept constant.                            |
| <code>withinArg</code>     | A list of named lists. Arguments to <code>GaussSuppressionFromData</code> that are not kept constant. |
| <code>maxIterLinked</code> | Maximum number of <code>GaussSuppressionFromData</code> 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 | <i>Dominance (n,k) or p% rule for magnitude tables</i> |
|---------------|--------------------------------------------------------|

---

### 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,
  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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 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: <ul style="list-style-type: none"> <li>"dominant2": The fraction associated with the dominance rule.</li> <li>"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.</li> <li>"n_contr" and "n_non0_contr": Outputs from <a href="#">max_contribution</a>. 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 <a href="#">max_contribution</a>. 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.</li> </ul> |
| 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 <a href="#">GaussSuppressionFromData</a> . 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 <a href="#">max_contribution</a> . 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 <i>Handbook on Statistical Disclosure Control</i> (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**

|                         |                                    |
|-------------------------|------------------------------------|
| <code>x</code>          | A (sparse) dummy matrix            |
| <code>groups</code>     | Vector of group categories         |
| <code>holdingInd</code> | 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 | <i>Number of contributors suppression rule</i> |
|-------------------|------------------------------------------------|

---

**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**

|                     |                                                                  |
|---------------------|------------------------------------------------------------------|
| <code>data</code>   | Input data as a data frame                                       |
| <code>freq</code>   | Vector of aggregate frequencies                                  |
| <code>numVar</code> | Numerical variables. When several variables, only first is used. |
| <code>x</code>      | 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.

|                        | <b>smallCountSpec</b> | <b>dominanceSpec</b>       | <b>fewContributorsSpec</b> | <b>kDisclosureSpec</b> |
|------------------------|-----------------------|----------------------------|----------------------------|------------------------|
| <b>primary</b>         | PrimaryDefault        | MagnitudeRule              | NContributorsRule          | KDisclosurePrima       |
| <b>protectZeros</b>    | TRUE                  | FALSE                      | FALSE                      | FALSE                  |
| <b>candidates</b>      | CandidatesDefault     | CandidatesNum              | CandidatesNum              | DirectDisclosureC      |
| <b>singleton</b>       | SingletonDefault      | SingletonUniqueContributor | SingletonUniqueContributor | SingletonDefault       |
| <b>extend0</b>         | TRUE                  | FALSE                      | FALSE                      | TRUE                   |
| <b>preAggregate</b>    | NA                    | !is.null(charVar)          | !is.null(charVar)          | NA                     |
| <b>extraAggregate</b>  | FALSE                 | TRUE                       | TRUE                       | FALSE                  |
| <b>secondaryZeros</b>  | FALSE                 | FALSE                      | FALSE                      | 1                      |
| <b>domWeightMethod</b> |                       | "default"                  |                            |                        |
| <b>singletonMethod</b> |                       | "numttHTT"                 | "numttHTT"                 | "anySumNOTprin         |

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 | <i>Default primary function</i> |
|----------------|---------------------------------|

---

Description

Function for [GaussSuppressionFromData](#)

**Usage**

```

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

```

**Arguments**

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| freq                | Vector of output frequencies                                                                                                                                                                                                                                                                                                                                                                                                                               |
| maxN                | Cells with frequency $\leq$ 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 <a href="#">IntervalLimits()</a> 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**

|                             |                                                                                                                                                                                    |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>x</code>              | A (sparse) dummy matrix                                                                                                                                                            |
| <code>crossTable</code>     | <code>crossTable</code> generated by parent function                                                                                                                               |
| <code>suppressedData</code> | A data frame or a list of data frames as output from <a href="#">GaussSuppressionFromData</a> .<br>If the variable suppressed is not included, all rows are considered suppressed. |
| <code>forcedData</code>     | When TRUE, the suppressed coding is swapped.                                                                                                                                       |
| <code>totCode</code>        | A named list of totals codes                                                                                                                                                       |
| <code>...</code>            | 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/globbering. A parameter to <a href="#">WildcardGlobbering</a> |
| ...        | 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 | <i>Default singleton function</i> |
|------------------|-----------------------------------|

---

**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 | <i>Unique contributor singleton function</i> |
|----------------------------|----------------------------------------------|

---

**Description**

Function for [GaussSuppressionFromData](#)

**Usage**

```

SingletonUniqueContributor(
  data,
  freqVar = NULL,
  nUniqueVar = 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**

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>               | Input data, possibly pre-aggregated within <code>GaussSuppressionFromData</code>                                                                                                                                                                                                                                                                                                                      |
| <code>freqVar</code>            | A single variable holding counts (input to <code>GaussSuppressionFromData</code> )                                                                                                                                                                                                                                                                                                                    |
| <code>nUniqueVar</code>         | A single variable holding the number of unique contributors.                                                                                                                                                                                                                                                                                                                                          |
| <code>charVar</code>            | Variable with contributor codes.                                                                                                                                                                                                                                                                                                                                                                      |
| <code>removeCodes</code>        | 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, <code>charVar</code> -names must be used. With empty <code>charVar</code> a vector of row indices is assumed and conversion to integer is performed. See examples.                                                                        |
| <code>integerSingleton</code>   | Integer output when TRUE. See details.                                                                                                                                                                                                                                                                                                                                                                |
| <code>x</code>                  | <code>ModelMatrix</code> generated by parent function                                                                                                                                                                                                                                                                                                                                                 |
| <code>primary</code>            | Vector (integer or logical) specifying primary suppressed cells. It will be ensured that any non-suppressed inner cell is not considered a singleton.                                                                                                                                                                                                                                                 |
| <code>whenPrimaryMatters</code> | Function to be called when primary caused non-singleton. Supply NULL to do nothing.                                                                                                                                                                                                                                                                                                                   |
| <code>whenNoVar</code>          | When TRUE, and without <code>nUniqueVar</code> and <code>freqVar</code> in input, all cells will be marked as singletons.                                                                                                                                                                                                                                                                             |
| <code>specialMultiple</code>    | When TRUE, and when <code>integerSingleton &amp; length(charVar) &gt; 1 &amp; length(nUniqueVar)</code> , a special method is used. By re-coding to single <code>charVar</code> and by re-calculating <code>nUnique</code> . To be unique ( <code>nUnique=1</code> ), uniqueness is only required for a single <code>charvar</code> . Otherwise, the <code>charvar</code> combination must be unique. |
| <code>rowGroupsPackage</code>   | Parameter pkg to <a href="#">RowGroups</a> .                                                                                                                                                                                                                                                                                                                                                          |

|              |                                                                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ...          | 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

|                             |                                                                                                                                                                                                                                                            |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>           | the input data                                                                                                                                                                                                                                             |
| <code>dimVar</code>         | main dimensional variables for the output table                                                                                                                                                                                                            |
| <code>freqVar</code>        | variable containing frequency counts                                                                                                                                                                                                                       |
| <code>coalition</code>      | numeric variable, parameter for primary suppression. Default value is 1.                                                                                                                                                                                   |
| <code>secondaryZeros</code> | 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. |
| <code>candidates</code>     | function parameter for gauss suppression.                                                                                                                                                                                                                  |
| <code>...</code>            | optional parameters that can be passed to the primary suppression method. See <a href="#">FindDisclosiveCells</a> for details. In the case of <code>SuppressDirectDisclosure2</code> , ... are parameters to <code>GaussSuppressionFromData</code> .       |

### 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 <a href="#">MagnitudeRule</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 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 <a href="#">AutoHierarchies</a> . 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 <a href="#">ModelMatrix</a> (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 <a href="#">SingletonUniqueContributor0</a> is utilized. |
| preAggregate   | Parameter to <a href="#">GaussSuppressionFromData</a> . 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
m1 <- 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 = m1, 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")

```

---

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 <a href="#">NContributorsRule()</a> via <a href="#">GaussSuppressionFromData()</a> . 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 <a href="#">AutoHierarchies</a> . 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 <a href="#">ModelMatrix</a> (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 suppression 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, swweight = swweight)

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
m1 <- 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 = m1, 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

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

### Details

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

### Value

Aggregated data with suppression information

### Author(s)

Øyvind Langsrud

**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 | <i>K-disclosure suppression</i> |
|---------------------|---------------------------------|

---

**Description**

A function for suppressing frequency tables using the k-disclosure method.

**Usage**

```

SuppressKDisclosure(
  data,
  coalition = 0,
  mc_hierarchies = NULL,
  upper_bound = Inf,
  dimVar = NULL,
  formula = NULL,
  hierarchies = NULL,
  freqVar = NULL,

```

```
...,
spec = PackageSpecs("kDisclosureSpec")
)
```

### Arguments

|                             |                                                                                                                                                                                                                                |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>           | a data.frame representing the data set                                                                                                                                                                                         |
| <code>coalition</code>      | numeric vector of length one, representing possible size of an attacking coalition. This parameter corresponds to the parameter <code>k</code> in the definition of <code>k-disclosure</code> .                                |
| <code>mc_hierarchies</code> | a hierarchy representing meaningful combinations to be protected. Default value is <code>NULL</code> .                                                                                                                         |
| <code>upper_bound</code>    | numeric value representing minimum count considered safe. Default set to <code>Inf</code>                                                                                                                                      |
| <code>dimVar</code>         | The main dimensional variables and additional aggregating variables. This parameter can be useful when hierarchies and formula are unspecified.                                                                                |
| <code>formula</code>        | A model formula                                                                                                                                                                                                                |
| <code>hierarchies</code>    | List of hierarchies, which can be converted by <a href="#">AutoHierarchies</a> . Thus, the variables can also be coded by <code>"rowFactor"</code> or <code>" "</code> , which correspond to using the categories in the data. |
| <code>freqVar</code>        | name of the frequency variable in data                                                                                                                                                                                         |
| <code>...</code>            | parameters passed to children functions                                                                                                                                                                                        |
| <code>spec</code>           | <code>NULL</code> or a named list of arguments that will act as default values.                                                                                                                                                |

### Value

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

### Author(s)

Daniel P. Lupp

### Examples

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

# 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(data, coalition = 1, freqVar = "freq", formula = ~mun*inj)

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

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

```

---

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

|                        |                                                                                                                                                                          |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>data</code>      | The data argument to <code>fun</code> . When <code>NULL</code> data must be included in <code>withinArg</code> .                                                         |
| <code>fun</code>       | A function: <a href="#">GaussSuppressionFromData</a> or one of its wrappers such as <a href="#">SuppressSmallCounts</a> and <a href="#">SuppressDominantCells</a> .      |
| <code>...</code>       | Arguments to <code>fun</code> that are kept constant.                                                                                                                    |
| <code>withinArg</code> | A list of named lists. Arguments to <code>fun</code> that are not kept constant. If <code>withinArg</code> is named, the names will be used as names in the output list. |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| linkedGauss           | <p>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 <code>GaussSuppression()</code> using an internally constructed block-diagonal model matrix.</p> <ul style="list-style-type: none"> <li>• "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.</li> <li>• "consistent": Common cells are suppressed equally across tables.</li> <li>• "local": Each table is protected independently by a separate call to <code>GaussSuppression()</code>.</li> <li>• "back-tracking": Iterative approach where each table is protected via <code>GaussSuppression()</code>, and primary suppressions are adjusted based on secondary suppressions from other tables across iterations.</li> <li>• "local-bdiag": Produces the same result as "local", but uses a single call to <code>GaussSuppression()</code>. It does not apply the linked-table methodology.</li> </ul> |
| linkedIntervals       | <p>This parameter controls how interval calculations, triggered by the <code>lpPackage</code> parameter, are performed.</p> <ul style="list-style-type: none"> <li>• <b>Default:</b> "local-bdiag" if <code>linkedGauss</code> is set to "local-bdiag", and "super-consistent" in all other cases.</li> <li>• Possible values of <code>linkedIntervals</code> are "local-bdiag" and "super-consistent".</li> <li>• Interval calculations can be performed when <code>linkedGauss</code> is "super-consistent", "consistent", or "local-bdiag".</li> <li>• When <code>linkedGauss</code> is "local-bdiag", "local-bdiag" is the only allowed value in <code>linkedIntervals</code> (except that, with the alternative approaches, "global" may appear as a later element; "super-consistent" is never allowed).</li> <li>• It is possible to request multiple types of intervals by supplying <code>linkedIntervals</code> as a vector. Only the first value affects the additional suppression defined by <code>rangePercent</code> and/or <code>rangeMin</code>.</li> <li>• With the alternative approaches (see the note below), "global" may also appear in <code>linkedIntervals</code>, provided it is not the first element.</li> </ul>                                                                       |
| lpPackage             | See <a href="#">GaussSuppressionFromData()</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 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 <code>withinArg</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| iterBackTracking      | Maximum number of back-tracking iterations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| whenEmptyUnsuppressed | <p>Parameter to <a href="#">GaussSuppression</a>. This is about a helpful message <i>"Cells with empty input will never be secondary suppressed. Extend input data with zeros?"</i> Here, the default is set to NULL (no message), since preprocessing of the model matrix may invalidate the assumptions behind this message.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## 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 documentation 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."))
}

```

## 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 $\leq$ maxN are marked as primary suppressed. This parameter is passed to <a href="#">PrimaryDefault()</a> via <a href="#">GaussSuppressionFromData()</a> . |
| 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 <a href="#">AutoHierarchies</a> . 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 <a href="#">ModelMatrix</a> (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
m1 <- data.frame(levels = c("@", "@@", "@@@", "@@@", "@@@", "@@"),
                 codes = c("Total", "not_assistance", "other", "pensions", "wages", "assistance"))
SuppressSmallCounts(data = d2, maxN = 2, freqVar = "f",
                    hierarchies = list(main_income = m1, 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 = m1, 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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