Package ‘matrixStats’

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Title Functions that Apply to Rows and Columns of Matrices (and to Vectors)

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Description High-performing functions operating on rows and columns of matrices, e.g. col / rowMedians(), col / rowRanks(), and col / rowSds(). Functions optimized per data type and for subsetted calculations such that both memory usage and processing time is minimized. There are also optimized vector-based methods, e.g. binMeans(), madDiff() and weightedMedian().

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Description

High-performing functions operating on rows and columns of matrices, e.g. col / rowMedians(), col / rowRanks(), and col / rowSds(). Functions optimized per data type and for subsetted calculations such that both memory usage and processing time is minimized. There are also optimized vector-based methods, e.g. binMeans(), madDiff() and weightedMedian().

How to cite this package


Author(s)

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anyMissing  Checks if there are any missing values in an object or not

Description

Checks if there are any missing values in an object or not. Please use base::anyNA() instead of anyMissing(), colAnyNAs() instead of colAnyMissings(), and rowAnyNAs() instead of rowAnyMissings().

Usage

anyMissing(x, idxs = NULL, ...)
colAnyMissings(x, rows = NULL, cols = NULL, ..., useNames = NA)
rowAnyMissings(x, rows = NULL, cols = NULL, ..., useNames = NA)
colAnyNAs(x, rows = NULL, cols = NULL, ..., useNames = NA)
rowAnyNAs(x, rows = NULL, cols = NULL, ..., useNames = NA)
Arguments

x A vector, a list, a matrix, a data frame, or NULL.

idxs A vector indicating subset of elements to operate over. If NULL, no subsetting is done.

... Not used.

rows A vector indicating subset of rows to operate over. If NULL, no subsetting is done.

cols A vector indicating subset of columns to operate over. If NULL, no subsetting is done.

useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Details

The implementation of this method is optimized for both speed and memory. The method will return TRUE as soon as a missing value is detected.

Value

Returns TRUE if a missing value was detected, otherwise FALSE.

Author(s)

Henrik Bengtsson

See Also

Starting with R v3.1.0, there is anyNA() in the base, which provides the same functionality as anyMissing().

Examples

x <- rnorm(n = 1000)
x[seq(300, length(x), by = 100)] <- NA
stopifnot(anyMissing(x) == any(is.na(x)))
**binCounts**

*Fast element counting in non-overlapping bins*

**Description**
Counts the number of elements in non-overlapping bins

**Usage**

```r
binCounts(x, idxs = NULL, bx, right = FALSE, ...)
```

**Arguments**

- `x`: A numeric vector of K positions for to be binned and counted.
- `idxs`: A vector indicating subset of elements to operate over. If NULL, no subsetting is done.
- `bx`: A numeric vector of B + 1 ordered positions specifying the B > 0 bins `[bx[1], bx[2])`, `[bx[2], bx[3])`, ..., `[bx[B], bx[B + 1])`.
- `right`: If TRUE, the bins are right-closed (left open), otherwise left-closed (right open).
- `...`: Not used.

**Details**

`binCounts(x, bx, right = TRUE)` gives equivalent results as `rev(binCounts(-x, bx = rev(-bx), right = FALSE))`, but is faster and more memory efficient.

**Value**

Returns an integer vector of length B with non-negative integers.

**Missing and non-finite values**

Missing values in x are ignored/dropped. Missing values in bx are not allowed and gives an error.

**Author(s)**

Henrik Bengtsson

**See Also**

An alternative for counting occurrences within bins is `hist`, e.g. `hist(x, breaks = bx, plot = FALSE)$counts`. That approach is ~30-60% slower than `binCounts(..., right = TRUE)`.

To count occurrences of indices x (positive integers) in `[1, B]`, use `tabulate(x, nbins = B)`, where x does not have to be sorted first. For details, see `tabulate()`.

To average values within bins, see `binMeans()`. 
binMeans

Fast mean calculations in non-overlapping bins

Description

Computes the sample means in non-overlapping bins

Usage

binMeans(y, x, idxs = NULL, bx, na.rm = TRUE, count = TRUE, right = FALSE, ...)

Arguments

y
A numeric or logical vector of K values to calculate means on.

x
A numeric vector of K positions for to be binned.

idxs
A vector indicating subset of elements to operate over. If NULL, no subsetting is done.

bx
A numeric vector of B + 1 ordered positions specifying the B > 0 bins [bx[1], bx[2]], [bx[2], bx[3]], ..., [bx[B], bx[B + 1]].

na.rm
If TRUE, missing values in y are dropped before calculating the mean, otherwise not.

count
If TRUE, the number of data points in each bins is returned as attribute count, which is an integer vector of length B.

right
If TRUE, the bins are right-closed (left open), otherwise left-closed (right open).

...
Not used.

Details

binMeans(x, bx, right = TRUE) gives equivalent results as rev(binMeans(-x, bx = sort(-bx), right = FALSE)), but is faster.

Value

Returns a numeric vector of length B.

Missing and non-finite values

Data points where either of y and x is missing are dropped (and therefore are also not counted). Non-finite values in y are not allowed and gives an error. Missing values in bx are not allowed and gives an error.

Author(s)

Henrik Bengtsson with initial code contributions by Martin Morgan [1].
indexByRow

References


See Also

binCounts(). aggregate and mean().

Examples

```r
x <- 1:200
mu <- double(length(x))
mu[1:50] <- 5
mu[101:150] <- -5
y <- mu + rnorm(length(x))

# Binning
bx <- c(0, 50, 100, 150, 200) + 0.5
y_s <- binMeans(y, x = x, bx = bx)

plot(x, y)
for (kk in seq_along(y_s)) {
  lines(bx[c(kk, kk + 1)], y_s[c(kk, kk)], col = "blue", lwd = 2)
}
```

Validation

Translates matrix indices by rows into indices by columns.

Description

Translates matrix indices by rows into indices by columns.

Usage

```r
indexByRow(dim, idxs = NULL, ...)
```

Arguments

```r
dim A numeric vector of length two specifying the length of the "template" matrix.
idxs A vector indicating subset of elements to operate over. If NULL, no subsetting is done.
... Not used.
```

Value

Returns an integer vector of indices.
Known limitations

The current implementation does not support long-vector indices, because both input and output indices are of type integers. This means that the indices in argument idxs can only be in range \([1,2^{31}-1]\). Using a greater value will be coerced to \texttt{NA}._integer_. Moreover, returned indices can only be in the same range \([1,2^{31}-1]\).

Author(s)

Henrik Bengtsson

Examples

dim <- c(5, 4)
X <- matrix(\texttt{NA}._integer_, nrow = dim[1], ncol = dim[2])
Y <- t(X)
idxs <- seq_along(X)

# Assign by columns
X[idxs] <- idxs
print(X)

# Assign by rows
Y[indexByRow(dim(Y), idxs)] <- idxs
print(Y)
stopifnot(X == t(Y))

\begin{verbatim}

logSumExp

\textit{Accurately computes the logarithm of the sum of exponentials}

\end{verbatim}

Description

Accurately computes the logarithm of the sum of exponentials, that is, \(\text{log}(\text{sum}(\exp(lx)))\). If \(lx = \text{log}(x)\), then this is equivalently to calculating \(\text{log}(\text{sum}(x))\).

Usage

\texttt{logSumExp(lx, idxs = NULL, na.rm = FALSE, \ldots)}

Arguments

\begin{itemize}
  \item \texttt{lx} \hspace{1cm} A \textit{numeric vector}. Typically \texttt{lx} are \text{log}(x) values.
  \item \texttt{idxs} \hspace{1cm} A \textit{vector} indicating subset of elements to operate over. If \texttt{NULL}, no subsetting is done.
  \item \texttt{na.rm} \hspace{1cm} If \texttt{TRUE}, missing values are excluded.
  \item \ldots \hspace{1cm} \texttt{Not used.}
\end{itemize}
logSumExp

Details

This function, which avoid numerical underflow, is often used when computing the logarithm of the sum of small numbers (|x| << 1) such as probabilities.

This is function is more accurate than \( \log(\text{sum}(\exp(lx))) \) when the values of \( x = \exp(lx) \) are |x| << 1. The implementation of this function is based on the observation that

\[
\log(a + b) = [la = \log(a), lb = \log(b)] = \log(\exp(la) + \exp(lb)) = la + \log(1 + \exp(lb - la))
\]

Assuming \( la > lb \), then |lb – la| < |lb|, and it is less likely that the computation of 1 + \( \exp(lb - la) \) will not underflow/overflow numerically. Because of this, the overall result from this function should be more accurate. Analogously to this, the implementation of this function finds the maximum value of \( lx \) and subtracts it from the remaining values in \( lx \).

Value

Returns a numeric scalar.

Benchmarking

This method is optimized for correctness, that avoiding underflowing. It is implemented in native code that is optimized for speed and memory.

Author(s)

Henrik Bengtsson

References


See Also

To compute this function on rows or columns of a matrix, see `rowLogSumExps()`.

For adding two double values in native code, R provides the C function `logspace_add()` [1]. For properties of the log-sum-exponential function, see [2].

Examples

```r
## EXAMPLE #1
lx <- c(1000.01, 1000.02)
y0 <- log(sum(exp(lx)))
print(y0) # Inf

y1 <- logSumExp(lx)
print(y1) # 1000.708
```
## EXAMPLE #2

```r
lx <- c(-1000.01, -1000.02)
y0 <- log(sum(exp(lx)))
print(y0) # -Inf

y1 <- logSumExp(lx)
print(y1) # -999.3218
```

## EXAMPLE #3

```
## R-help thread 'Beyond double-precision?' on May 9, 2009.

set.seed(1)
x <- runif(50)

## The logarithm of the harmonic mean
y0 <- log(1 / mean(1 / x))
print(y0) # -1.600885

lx <- log(x)
y1 <- log(length(x)) - logSumExp(-lx)
print(y1) # [1] -1.600885

# Sanity check
stopifnot(all.equal(y1, y0))
```

---

### product

`product(x, idxs = NULL, na.rm = FALSE, ...)`

#### Usage

```
product(x, idxs = NULL, na.rm = FALSE, ...)

rowProds(x, rows = NULL, cols = NULL, na.rm = FALSE,
        method = c("direct", "expSumLog"), ..., useNames = NA)

colProds(x, rows = NULL, cols = NULL, na.rm = FALSE,
        method = c("direct", "expSumLog"), ..., useNames = NA)
```

#### Arguments

- **x**: An NxK matrix or, if dim. is specified, an N * K vector.

---

### Description

Calculates the product for each row (column) in a matrix.
idxs      A vector indicating subset of elements to operate over. If NULL, no subsetting is done.
na.rm    If TRUE, missing values are excluded.
...      Not used.
rows     A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
cols     A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
method   A character string specifying how each product is calculated.
useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Details
If method = "expSumLog", then the product() function is used, which calculates the product via the logarithmic transform (treating negative values specially). This improves the precision and lowers the risk for numeric overflow. If method = "direct", the direct product is calculated via the prod() function.

Value
Returns a numeric vector of length N (K).

Missing values
Note, if method = "expSumLog", na.rm = FALSE, and x contains missing values (NA or NaN), then the calculated value is also missing value. Note that it depends on platform whether NaN or NA is returned when an NaN exists, cf. is.nan().

Author(s)
Henrik Bengtsson

---

rowAlls      Checks if a value exists / does not exist in each row (column) of a matrix

Description
Checks if a value exists / does not exist in each row (column) of a matrix.
**Usage**

```r
rowAlls(x, rows = NULL, cols = NULL, value = TRUE, na.rm = FALSE,
        dim. = dim(x), ..., useNames = NA)
```

```r
colAlls(x, rows = NULL, cols = NULL, value = TRUE, na.rm = FALSE,
        dim. = dim(x), ..., useNames = NA)
```

```r
allValue(x, idxs = NULL, value = TRUE, na.rm = FALSE, ...)
```

```r
rowAnys(x, rows = NULL, cols = NULL, value = TRUE, na.rm = FALSE,
        dim. = dim(x), ..., useNames = NA)
```

```r
colAnys(x, rows = NULL, cols = NULL, value = TRUE, na.rm = FALSE,
        dim. = dim(x), ..., useNames = NA)
```

```r
anyValue(x, idxs = NULL, value = TRUE, na.rm = FALSE, ...)
```

**Arguments**

- `x` An NxK **matrix** or, if `dim.` is specified, an N * K **vector**.
- `rows` A **vector** indicating subset of rows to operate over. If `NULL`, no subsetting is done.
- `cols` A **vector** indicating subset of columns to operate over. If `NULL`, no subsetting is done.
- `value` A value to search for.
- `na.rm` If `TRUE`, missing values are excluded.
- `dim.` An integer vector of length two specifying the dimension of `x`, also when not a **matrix**. *Comment:* The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it `dim`).
- `...` Not used.
- `useNames` If `NA`, the default behavior of the function about naming support is remained. If `FALSE`, no naming support is done. Else if `TRUE`, names attributes of result are set.
- `idxs` A **vector** indicating subset of elements to operate over. If `NULL`, no subsetting is done.

**Details**

These functions takes either a matrix or a vector as input. If a vector, then argument `dim.` must be specified and fulfill `prod(dim.) == length(x)`. The result will be identical to the results obtained when passing `matrix(x, nrow = dim.[1L], ncol = dim.[2L])`, but avoids having to temporarily create/allocate a matrix, if only such is needed only for these calculations.

**Value**

`rowAlls()` (colAlls()) returns a **logical vector** of length N (K). Analogously for `rowAnys()` (rowAlls()).
Logical value

When value is logical, the result is as if the function is applied on `as.logical(x)`. More specifically, if `x` is numeric, then all zeros are treated as FALSE, non-zero values as TRUE, and all missing values as NA.

Author(s)

Henrik Bengtsson

See Also

rowCounts

Examples

```r
x <- matrix(FALSE, nrow = 10, ncol = 5)
x[3:7, c(2, 4)] <- TRUE
x[2:4, 1] <- TRUE
x[, 1] <- TRUE
x[, 5] <- FALSE
print(x)
print(rowCounts(x))  # 1 4 4 0 3 3 1 1 1
print(colCounts(x))  # 9 5 3 5 0
print(rowAnys(x))
print(which(rowAnys(x)))  # 1 2 3 4 6 7 8 9 10
print(colAnys(x))
print(which(colAnys(x)))  # 1 2 3 4
```

rowCollapse

Extracts one cell per row (column) from a matrix

Description

Extracts one cell per row (column) from a matrix. The implementation is optimized for memory and speed.

Usage

```r
rowCollapse(x, idxs, rows = NULL, dim. = dim(x), ..., useNames = NA)
colCollapse(x, idxs, cols = NULL, dim. = dim(x), ..., useNames = NA)
```
Arguments

- **x**: An NxK matrix or, if dim. is specified, an N * K vector.
- **idxs**: An index vector of (maximum) length N (K) specifying the columns (rows) to be extracted.
- **rows**: A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
- **dim.**: An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it dim).
- **...**: Not used.
- **useNames**: If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.
- **cols**: A vector indicating subset of columns to operate over. If NULL, no subsetting is done.

Value

Returns a vector of length N (K).

Author(s)

Henrik Bengtsson

See Also

*Matrix indexing* to index elements in matrices and arrays, cf. `[]`.

Examples

```r
x <- matrix(1:27, ncol = 3)

y <- rowCollapse(x, 1)
stopifnot(identical(y, x[, 1]))

y <- rowCollapse(x, 2)
stopifnot(identical(y, x[, 2]))

y <- rowCollapse(x, c(1, 1, 1, 1, 1, 3, 3, 3))
stopifnot(identical(y, c(x[1:5, 1], x[6:9, 3])))

y <- rowCollapse(x, 1:3)
print(y)
y_truth <- c(x[1, 1], x[2, 2], x[3, 3], x[4, 1], x[5, 2],
            x[6, 3], x[7, 1], x[8, 2], x[9, 3])
stopifnot(identical(y, y_truth))
```
**rowCounts**

Counts the number of occurrences of a specific value

**Description**

The row- and column-wise functions take either a matrix or a vector as input. If a vector, then argument `dim.` must be specified and fulfill `prod(dim.) == length(x)`. The result will be identical to the results obtained when passing `matrix(x, nrow = dim.[1L], ncol = dim.[2L])`, but avoids having to temporarily create/allocate a matrix, if only such is needed only for these calculations.

**Usage**

```r
rowCounts(x, rows = NULL, cols = NULL, value = TRUE, na.rm = FALSE, 
         dim. = dim(x), ..., useNames = NA)
```

```r
colCounts(x, rows = NULL, cols = NULL, value = TRUE, na.rm = FALSE, 
          dim. = dim(x), ..., useNames = NA)
```

```r
count(x, idxs = NULL, value = TRUE, na.rm = FALSE, ...)
```

**Arguments**

- **x** An N x K matrix or, if `dim.` is specified, an N * K vector.
- **rows** A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
- **cols** A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
- **value** A value to search for.
- **na.rm** If TRUE, missing values are excluded.
- **dim.** An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it `dim`).
- **...** Not used.
- **useNames** If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.
- **idxs** A vector indicating subset of elements to operate over. If NULL, no subsetting is done.

**Value**

`rowCounts()` (colCounts()) returns an integer vector of length N (K). `count()` returns a scalar of type integer if the count is less than $2^{31}-1 (= .Machine$integer.max) otherwise a scalar of type double.
Description

Cumulative sums, products, minima and maxima for each row (column) in a matrix.
Usage

rowCumsums(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

colCumsums(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

rowCumprods(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

colCumprods(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

rowCummins(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

colCummins(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

rowCummaxs(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

colCummaxs(x, rows = NULL, cols = NULL, dim. = dim(x), ..., useNames = NA)

Arguments

x     An NxK matrix or, if dim. is specified, an N * K vector.
rows  A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
cols  A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
dim.  An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it dim).
...   Not used.
useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Value

Returns a numeric NxK matrix of the same mode as x, except when x is of mode logical, then the return type is integer.

Author(s)

Henrik Bengtsson

See Also

See cumsum(), cumprod(), cummin(), and cummax().
Examples

\[
x <- \text{matrix}(1:12, \text{nrow} = 4, \text{ncol} = 3) \\
\text{print}(x) \\

yr <- \text{rowCumsums}(x) \\
\text{print}(yr) \\

yc <- \text{colCumsums}(x) \\
\text{print}(yc) \\

yr <- \text{rowCumprods}(x) \\
\text{print}(yr) \\

yc <- \text{colCumprods}(x) \\
\text{print}(yc) \\

yr <- \text{rowCummaxs}(x) \\
\text{print}(yr) \\

yc <- \text{colCummaxs}(x) \\
\text{print}(yc) \\

yr <- \text{rowCummins}(x) \\
\text{print}(yr) \\

yc <- \text{colCummins}(x) \\
\text{print}(yc)
\]

rowDiffs

Calculates difference for each row (column) in a matrix

Description

Calculates difference for each row (column) in a matrix.

Usage

\[
\text{rowDiffs}(x, \text{rows} = \text{NULL}, \text{cols} = \text{NULL}, \text{lag} = 1, \text{differences} = 1, \\
\text{dim.} = \text{dim}(x), \ldots, \text{useNames} = \text{NA})
\]

\[
\text{colDiffs}(x, \text{rows} = \text{NULL}, \text{cols} = \text{NULL}, \text{lag} = 1, \text{differences} = 1, \\
\text{dim.} = \text{dim}(x), \ldots, \text{useNames} = \text{NA})
\]

Arguments

- **x**: An NxK matrix or, if dim. is specified, an N*K vector.
- **rows**: A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
rowIQRs

cols A vector indicating subset of columns to operate over. If NULL, no subsetting is done.

lag An integer specifying the lag.

differences An integer specifying the order of difference.

dim. An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it dim).

useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Value

Returns a numeric Nx(K-1) or (N-1)xK matrix.

Author(s)

Henrik Bengtsson

See Also

See also diff2().

Examples

x <- matrix(1:27, ncol = 3)
d1 <- rowDiffs(x)
print(d1)
d2 <- t(colDiffs(t(x)))
stopifnot(all.equal(d2, d1))

rowIQRs Estimates of the interquartile range for each row (column) in a matrix

Description

Estimates of the interquartile range for each row (column) in a matrix.

Usage

rowIQRs(x, rows = NULL, cols = NULL, na.rm = FALSE, ..., useNames = NA)
colIQRs(x, rows = NULL, cols = NULL, na.rm = FALSE, ..., useNames = NA)
iqr(x, idxs = NULL, na.rm = FALSE, ...)

Arguments

\begin{itemize}
\item \textbf{x} \hspace{1cm} An NxK matrix or, if \texttt{dim.} is specified, an N \times K vector.
\item \textbf{rows} \hspace{1cm} A vector indicating subset of rows to operate over. If \texttt{NULL}, no subsetting is done.
\item \textbf{cols} \hspace{1cm} A vector indicating subset of columns to operate over. If \texttt{NULL}, no subsetting is done.
\item \textbf{na.rm} \hspace{1cm} If \texttt{TRUE}, missing values are excluded.
\item ... \hspace{1cm} Additional arguments passed to \texttt{rowQuantiles()} (\texttt{colQuantiles()}).
\item \textbf{useNames} \hspace{1cm} If \texttt{NA}, the default behavior of the function about naming support is remained. If \texttt{FALSE}, no naming support is done. Else if \texttt{TRUE}, names attributes of result are set.
\item \textbf{idxs} \hspace{1cm} A vector indicating subset of elements to operate over. If \texttt{NULL}, no subsetting is done.
\end{itemize}

Value

Returns a numeric vector of length N (K).

Missing values

Contrary to \texttt{IQR}, which gives an error if there are missing values and \texttt{na.rm = FALSE}, \texttt{iqr()} and its corresponding row and column-specific functions return \texttt{NA\_real\_}.

Author(s)

Henrik Bengtsson

See Also

See \texttt{IQR}. See \texttt{rowSds()}.

Examples

\begin{verbatim}
set.seed(1)

x <- matrix(rnorm(50 * 40), nrow = 50, ncol = 40)
str(x)

# Row IQRs
q <- rowIQRs(x)
print(q)
q0 <- apply(x, MARGIN = 1, FUN = IQR)
stopifnot(all.equal(q0, q))

# Column IQRs
q <- colIQRs(x)
print(q)
q0 <- apply(x, MARGIN = 2, FUN = IQR)
stopifnot(all.equal(q0, q))
\end{verbatim}
**Description**

Accurately computes the logarithm of the sum of exponentials across rows or columns.

**Usage**

```r
rowLogSumExps(lx, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(lx), ..., useNames = NA)
colLogSumExps(lx, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(lx), ..., useNames = NA)
```

**Arguments**

- `lx`: A numeric NxK matrix. Typically `lx` are $\log(x)$ values.
- `rows, cols`: A vector indicating subset of rows (and/or columns) to operate over. If `NULL`, no subsetting is done.
- `na.rm`: If `TRUE`, any missing values are ignored, otherwise not.
- `dim.`: An integer vector of length two specifying the dimension of `x`, also when not a matrix.
- `...`: Not used.
- `useNames`: If `NA`, the default behavior of the function about naming support is remained. If `FALSE`, no naming support is done. Else if `TRUE`, names attributes of result are set.

**Value**

A numeric vector of length N (K).

**Benchmarking**

These methods are implemented in native code and have been optimized for speed and memory.

**Author(s)**

Native implementation by Henrik Bengtsson. Original R code by Nakayama ??? (Japan).

**See Also**

To calculate the same on vectors, `logSumExp()`.
rowMads

Standard deviation estimates for each row (column) in a matrix

Description

Standard deviation estimates for each row (column) in a matrix.

Usage

rowMads(x, rows = NULL, cols = NULL, center = NULL, constant = 1.4826, na.rm = FALSE, dim. = dim(x), ..., useNames = NA)

colMads(x, rows = NULL, cols = NULL, center = NULL, constant = 1.4826, na.rm = FALSE, dim. = dim(x), ..., useNames = NA)

rowSds(x, rows = NULL, cols = NULL, na.rm = FALSE, center = NULL, dim. = dim(x), ..., useNames = NA)

colSds(x, rows = NULL, cols = NULL, na.rm = FALSE, center = NULL, dim. = dim(x), ..., useNames = NA)

Arguments

x An NxK matrix or, if dim. is specified, an N * K vector.
rows A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
cols A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
center (optional) The center, defaults to the row means for the SD estimators and row medians for the MAD estimators.
constant A scale factor. See mad for details.
na.rm If TRUE, missing values are excluded.
dim. An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it dim).
... Additional arguments passed to rowMeans() and rowSums().
useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Value

Returns a numeric vector of length N (K).
Author(s)
Henrik Bengtsson

See Also
sd, mad and var, rowIQRs().

---

**rowMeans2**

Calculates the mean for each row (column) in a matrix

---

**Description**

Calculates the mean for each row (column) in a matrix.

**Usage**

rowMeans2(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x),
... , useNames = NA)

colMeans2(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x),
... , useNames = NA)

**Arguments**

- **x**
  An NxK **matrix** or, if dim. is specified, an N * K **vector**.
- **rows**
  A **vector** indicating subset of rows to operate over. If NULL, no subsetting is done.
- **cols**
  A **vector** indicating subset of columns to operate over. If NULL, no subsetting is done.
- **na.rm**
  If TRUE, missing values are excluded.
- **dim.**
  An **integer vector** of length two specifying the dimension of x, also when not a **matrix**. **Comment:** The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it dim).
- **...**
  Not used.
- **useNames**
  If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

**Details**

The implementation of rowMeans2() and colMeans2() is optimized for both speed and memory.

**Value**

Returns a **numeric vector** of length N (K).
Author(s)
Henrik Bengtsson

rowMedians
Calculates the median for each row (column) in a matrix

Description
Calculates the median for each row (column) in a matrix.

Usage
rowMedians(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x),
... , useNames = NA)
colMedians(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x),
... , useNames = NA)

Arguments
x An NxK matrix or, if dim. is specified, an N * K vector.
rows, cols A vector indicating subset of rows (and/or columns) to operate over. If NULL, no subsetting is done.
na.rm If TRUE, NAs are excluded first, otherwise not.
dim. An integer vector of length two specifying the dimension of x, also when not a matrix.
... Not used.
useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Details
The implementation of rowMedians() and colMedians() is optimized for both speed and memory. To avoid coercing to doubles (and hence memory allocation), there is a special implementation for integer matrices. That is, if x is an integer matrix, then rowMedians(as.double(x)) (rowMedians(as.double(x))) would require three times the memory of rowMedians(x) (colMedians(x)), but all this is avoided.

Value
Returns a numeric vector of length N (K).

Author(s)
Henrik Bengtsson, Harris Jaffee
rowOrderStats

See Also

See \texttt{rowWeightedMedians()} and \texttt{colWeightedMedians()} for weighted medians. For mean estimates, see \texttt{rowMeans2()} and \texttt{rowMeans()}.

\begin{verbatim}
rowOrderStats  Gets an order statistic for each row (column) in a matrix

Description

Gets an order statistic for each row (column) in a matrix.

Usage

\texttt{rowOrderStats(x, rows = \texttt{NULL}, cols = \texttt{NULL}, which, dim. = \texttt{dim}(x), ...,
useNames = \texttt{NA})}

\texttt{colOrderStats(x, rows = \texttt{NULL}, cols = \texttt{NULL}, which, dim. = \texttt{dim}(x), ...,
useNames = \texttt{NA})}

Arguments

\texttt{x} \hspace{1cm} An \texttt{NxK matrix} or, if \texttt{dim.} is specified, an \texttt{N * K vector}.
\texttt{rows} \hspace{1cm} A \texttt{vector} indicating subset of rows to operate over. If \texttt{NULL}, no subsetting is done.
\texttt{cols} \hspace{1cm} A \texttt{vector} indicating subset of columns to operate over. If \texttt{NULL}, no subsetting is done.
\texttt{which} \hspace{1cm} An \texttt{integer} index in \texttt{[1,K]} ([1,N]) indicating which order statistic to be returned.
\texttt{dim.} \hspace{1cm} An \texttt{integer vector} of length two specifying the dimension of \texttt{x}, also when not a \texttt{matrix}. \textit{Comment:} The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it \texttt{dim}).
\texttt{...} \hspace{1cm} Not used.
\texttt{useNames} \hspace{1cm} If \texttt{NA}, the default behavior of the function about naming support is remained. If \texttt{FALSE}, no naming support is done. Else if \texttt{TRUE}, names attributes of result are set.

Details

The implementation of \texttt{rowOrderStats()} is optimized for both speed and memory. To avoid coercing to \texttt{doubles} (and hence memory allocation), there is a unique implementation for \texttt{integer} matrices.

Value

Returns a \texttt{numeric vector} of length \texttt{N} (\texttt{K}).
\end{verbatim}
Missing values

This method does not handle missing values, that is, the result corresponds to having `na.rm = FALSE` (if such an argument would be available).

Author(s)

The native implementation of `rowOrderStats()` was adopted by Henrik Bengtsson from Robert Gentleman’s `rowQ()` in the `Biobase` package.

See Also

See `rowMeans()` in `colSums()`.

---

**rowQuantiles**

Estimates quantiles for each row (column) in a matrix

---

**Description**

Estimates quantiles for each row (column) in a matrix.

**Usage**

```r
rowQuantiles(x, rows = NULL, cols = NULL, probs = seq(from = 0, to = 1, by = 0.25), na.rm = FALSE, type = 7L, ..., useNames = NA, drop = TRUE)
colQuantiles(x, rows = NULL, cols = NULL, probs = seq(from = 0, to = 1, by = 0.25), na.rm = FALSE, type = 7L, ..., useNames = NA, drop = TRUE)
```

**Arguments**

- `x` An integer, numeric or logical NxK matrix with `N >= 0`.
- `rows` A vector indicating subset of rows to operate over. If `NULL`, no subsetting is done.
- `cols` A vector indicating subset of columns to operate over. If `NULL`, no subsetting is done.
- `probs` A numeric vector of J probabilities in [0, 1].
- `na.rm` If `TRUE`, missing values are excluded.
- `type` An integer specify the type of estimator. See `quantile` for more details.
- `...` Additional arguments passed to `quantile`.
- `useNames` If `NA`, the default behavior of the function about naming support is remained. If `FALSE`, no naming support is done. Else if `TRUE`, names attributes of result are set.
- `drop` If `TRUE`, singleton dimensions in the result are dropped, otherwise not.
**rowRanges**

**Value**

Returns a \( N \times J \) (or \( K \times J \)) **matrix**, where \( N \) (\( K \)) is the number of rows (columns) for which the \( J \) quantiles are calculated. The return type is either integer or numeric depending on type.

**Author(s)**

Henrik Bengtsson

**See Also**

`quantile`.

**Examples**

```r
set.seed(1)
x <- matrix(rnorm(50 * 40), nrow = 50, ncol = 40)
str(x)
probs <- c(0.25, 0.5, 0.75)

# Row quantiles
q <- rowQuantiles(x, probs = probs)
print(q)
q_0 <- apply(x, MARGIN = 1, FUN = quantile, probs = probs)
stopifnot(all.equal(q_0, t(q)))

# Column IQRs
q <- colQuantiles(x, probs = probs)
print(q)
q_0 <- apply(x, MARGIN = 2, FUN = quantile, probs = probs)
stopifnot(all.equal(q_0, t(q)))
```

---

**rowRanges**

*Gets the range of values in each row (column) of a matrix*

**Description**

Gets the range of values in each row (column) of a matrix.

**Usage**

```r
rowRanges(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x),
  ..., useNames = NA)
```

```r
rowMins(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x), ...
  useNames = NA)
```
rowRanges(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x), ...,
useNames = NA)

colRanges(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x), ...
useNames = NA)

colMins(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x), ...
useNames = NA)

colMaxs(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x), ...
useNames = NA)

Arguments

x   An NxK matrix or, if dim. is specified, an N*K vector.
rows A vector indicating subset of rows to operate over. If NULL, no subsetting is
done.
cols A vector indicating subset of columns to operate over. If NULL, no subsetting
is done.
na.rm  If TRUE, missing values are excluded.
dim. An integer vector of length two specifying the dimension of x, also when not
a matrix. Comment: The reason for this argument being named with a period
at the end is purely technical (we get a run-time error if we try to name it dim).
... Not used.
useNames If NA, the default behavior of the function about naming support is remained. If
FALSE, no naming support is done. Else if TRUE, names attributes of result are
set.

Value

rowRanges() (colRanges()) returns a numeric Nx2 (Kx2) matrix, where N (K) is the number of
rows (columns) for which the ranges are calculated.

rowMins()/rowMaxs() (colMins()/colMaxs()) returns a numeric vector of length N (K).

Author(s)

Henrik Bengtsson

See Also

rowOrderStats() and pmin.int().
rowRanks

Gets the rank of the elements in each row (column) of a matrix

Description

Gets the rank of the elements in each row (column) of a matrix.

Usage

rowRanks(x, rows = NULL, cols = NULL, ties.method = c("max", "average", "first", "last", "random", "max", "min", "dense"), dim. = dim(x), ..., useNames = NA)

colRanks(x, rows = NULL, cols = NULL, ties.method = c("max", "average", "first", "last", "random", "max", "min", "dense"), dim. = dim(x), preserveShape = FALSE, ..., useNames = NA)

Arguments

x An N x K matrix or, if dim. is specified, an N * K vector.
rows A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
cols A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
ties.method A character string specifying how ties are treated. For details, see below.
dim. An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it dim).
... Not used.
useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.
preserveShape A logical specifying whether the matrix returned should preserve the input shape of x, or not.

Details

These functions rank values and treats missing values the same way as rank(). For equal values ("ties"), argument ties.method determines how these are ranked among each other. More precisely, for the following values of ties.method, each index set of ties consists of:

- "first" - increasing values that are all unique
- "last" - decreasing values that are all unique
- "min" - identical values equaling the minimum of their original ranks
• "max" - identical values equaling the maximum of their original ranks
• "average" - identical values that equal the sample mean of their original ranks. Because the average is calculated, the returned ranks may be non-integer values
• "random" - randomly shuffled values of their original ranks.
• "dense" - increasing values that are all unique and, contrary to "first", never contain any gaps

For more information on ties.method = "dense", see frank() of the data.table package. For more information on the other alternatives, see rank().

Note that, due to different randomization strategies, the shuffling order produced by these functions when using ties.method = "random" does not reproduce that of rank().

WARNING: For backward-compatibility reasons, the default is ties.method = "max", which differs from rank() which uses ties.method = "average" by default. Since we plan to change the default behavior in a future version, we recommend to explicitly specify the intended value of argument ties.method.

Value

A matrix of type integer is returned, unless ties.method = "average" when it is of type numeric.

The rowRanks() function always returns an NxK matrix, where N (K) is the number of rows (columns) whose ranks are calculated.

The colRanks() function returns an NxK matrix, if preserveShape = TRUE, otherwise a KxN matrix.

Any names of x are ignored and absent in the result.

Missing values

Missing values are ranked as NA_integer_, as with na.last = "keep" in the rank() function.

Performance

The implementation is optimized for both speed and memory. To avoid coercing to doubles (and hence memory allocation), there is a unique implementation for integer matrices. Furthermore, it is more memory efficient to do colRanks(x, preserveShape = TRUE) than t(colRanks(x, preserveShape = FALSE)).

Author(s)

Hector Corrada Bravo and Harris Jaffee. Peter Langfelder for adding 'ties.method' support. Brian Montgomery for adding more 'ties.method's. Henrik Bengtsson adapted the original native implementation of rowRanks() from Robert Gentleman’s rowQ() in the Biobase package.

See Also

For developers, see also Section Utility functions' in 'Writing R Extensions manual', particularly the native functions R_qsort_I() and R_qsort_int_I().
Description

Calculates the sum for each row (column) in a matrix.

Usage

rowSums2(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x), ...
          useNames = NA)

    colSums2(x, rows = NULL, cols = NULL, na.rm = FALSE, dim. = dim(x),
             ..., useNames = NA)

Arguments

x         An NxK matrix or, if dim. is specified, an N * K vector.
rows      A vector indicating subset of rows to operate over. If NULL, no
           subsetting is done.
cols      A vector indicating subset of columns to operate over. If NULL, no
           subsetting is done.
na.rm     If TRUE, missing values are excluded.
dim.      An integer vector of length two specifying the dimension of x, also
           when not a matrix. Comment: The reason for this argument being
           named with a period at the end is purely technical (we get a run-time error
           if we try to name it dim).
...       Not used.
useNames  If NA, the default behavior of the function about naming support is
           remained. If FALSE, no naming support is done. Else if TRUE, names
           attributes of result are set.

Details

The implementation of rowSums2() and colSums2() is optimized for both speed and memory.

Value

Returns a numeric vector of length N (K).

Author(s)

Henrik Bengtsson
Tabulates the values in a matrix by row (column).

**Description**
Tabulates the values in a matrix by row (column).

**Usage**

```r
colTabulates(x, rows = NULL, cols = NULL, values = NULL, ..., useNames = NA)
rowTabulates(x, rows = NULL, cols = NULL, values = NULL, ..., useNames = NA)
```

**Arguments**

- `x`: An integer, a logical, or a raw NxK matrix.
- `rows`: A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
- `cols`: A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
- `values`: An vector of J values of count. If NULL, all (unique) values are counted.
- `...`: Not used.
- `useNames`: If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

**Details**

An alternative to these functions, is to use `table(x, row(x))` and `table(x, col(x))`, with the exception that the latter do not support the raw data type. When there are no missing values in `x`, we have that all(rowTabulates(x) == t(table(x, row(x)))) and all(colTabulates(x) == t(table(x, col(x))))). When there are missing values, we have that all(rowTabulates(x) == t(table(x, row(x), useNA = "always")[, seq_len(nrow(x))]) and all(colTabulates(x) == t(table(x, col(x), useNA = "always")[, seq_len(ncol(x))])).

**Value**

Returns a NxJ (KxJ) matrix where N (K) is the number of row (column) vectors tabulated and J is the number of values counted.

**Author(s)**

Henrik Bengtsson
Examples

```r
x <- matrix(1:5, nrow = 10, ncol = 5)
print(x)
print(rowTabulates(x))
print(colTabulates(x))
# Count only certain values
print(rowTabulates(x, values = 1:3))
```

```r
y <- as.raw(x)
dim(y) <- dim(x)
print(y)
print(rowTabulates(y))
print(colTabulates(y))
```

---

**rowVars**  
Variance estimates for each row (column) in a matrix

### Description

Variance estimates for each row (column) in a matrix.

### Usage

```r
rowVars(x, rows = NULL, cols = NULL, na.rm = FALSE, center = NULL,
dim. = dim(x), ..., useNames = NA)
```

```r
colVars(x, rows = NULL, cols = NULL, na.rm = FALSE, center = NULL,
dim. = dim(x), ..., useNames = NA)
```

### Arguments

- **x**: An NxK matrix or, if `dim.` is specified, an N * K vector.
- **rows**: A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
- **cols**: A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
- **na.rm**: If TRUE, missing values are excluded.
- **center**: (optional; a vector or length N (K)) If the row (column) means are already estimated, they can be pre-specified using this argument. This avoid re-estimating them again. (*Warning: If biased estimated are given, the estimate of the spread will also be biased.*) If NULL (default), the row/column means are estimated internally.
- **dim.**: An integer vector of length two specifying the dimension of x, also when not a matrix. Comment: The reason for this argument being named with a period at the end is purely technical (we get a run-time error if we try to name it `dim`).
... Additional arguments passed to rowMeans() and rowSums().

useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Value

Returns a numeric vector of length N (K).

Author(s)

Henrik Bengtsson

See Also

See rowMeans() and rowSums() in colSums().

Examples

set.seed(1)

x <- matrix(rnorm(20), nrow = 5, ncol = 4)
print(x)

# Row averages
print(rowMeans(x))
print(rowMedians(x))

# Column averages
print(colMeans(x))
print(colMedians(x))

# Row variabilities
print(rowVars(x))
print(rowSds(x))
print(rowMads(x))
print(rowIQRs(x))

# Column variabilities
print(rowVars(x))
print(colSds(x))
print(colMads(x))
print(colIQRs(x))

# Row ranges
print(rowRanges(x))
print(cbind(rowMins(x), rowMaxs(x)))
print(cbind(rowOrderStats(x, which = 1), rowOrderStats(x, which = ncol(x))))

# Column ranges
print(colRanges(x))
rowWeightedMeans

Calculates the weighted means for each row (column) in a matrix

Description
Calculates the weighted means for each row (column) in a matrix.

Usage
rowWeightedMeans(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, 
... , useNames = NA)

colWeightedMeans(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, 
... , useNames = NA)

Arguments
x  An NxK matrix or, if dim. is specified, an N * K vector.
w  A numeric vector of length K (N).
rows  A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
cols  A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
na.rm  If TRUE, missing values are excluded.
...  Not used.
useNames  If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.
Details

The implementations of these methods are optimized for both speed and memory. If no weights are given, the corresponding rowMeans() / colMeans() is used.

Value

Returns a numeric vector of length N (K).

Author(s)

Henrik Bengtsson

See Also

See rowMeans() and colMeans() in colSums() for non-weighted means. See also weighted.mean.

Examples

```r
x <- matrix(rnorm(20), nrow = 5, ncol = 4)
print(x)

# Non-weighted row averages
mu_0 <- rowMeans(x)
u <- rowWeightedMeans(x)
stopifnot(all.equal(mu, mu_0))

# Weighted row averages (uniform weights)
w <- rep(2.5, times = ncol(x))
u <- rowWeightedMeans(x, w = w)
stopifnot(all.equal(mu, mu_0))

# Weighted row averages (excluding some columns)
w <- c(1, 1, 0, 1)
u <- rowMeans(x[, (w == 1), drop = FALSE])
u <- rowWeightedMeans(x, w = w)
stopifnot(all.equal(mu, mu_0))

# Weighted row averages (excluding some columns)
w <- c(0, 1, 0, 0)
u <- rowMeans(x[, (w == 1), drop = FALSE])
u <- rowWeightedMeans(x, w = w)
stopifnot(all.equal(mu, mu_0))

# Weighted averages by rows and columns
w <- 1:4
mu_1 <- rowWeightedMeans(x, w = w)
u <- colWeightedMeans(t(x), w = w)
stopifnot(all.equal(mu_2, mu_1))
```
rowWeightedMedians

Calculates the weighted medians for each row (column) in a matrix.

Description
Calculates the weighted medians for each row (column) in a matrix.

Usage
rowWeightedMedians(x, w = NULL, rows = NULL, cols = NULL,
na.rm = FALSE, ..., useNames = NA)

colWeightedMedians(x, w = NULL, rows = NULL, cols = NULL,
na.rm = FALSE, ..., useNames = NA)

Arguments
- **x**: An NxK matrix or, if dim. is specified, an N * K vector.
- **w**: A numeric vector of length K (N).
- **rows**: A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
- **cols**: A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
- **na.rm**: If TRUE, missing values are excluded.
- **...**: Additional arguments passed to weightedMedian().
- **useNames**: If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Details
The implementations of these methods are optimized for both speed and memory. If no weights are given, the corresponding rowMedians() / colMedians() is used.

Value
Returns a numeric vector of length N (K).

Author(s)
Henrik Bengtsson

See Also
Internally, weightedMedian() is used. See rowMedians() and colMedians() for non-weighted medians.
Examples

```r
x <- matrix(rnorm(20), nrow = 5, ncol = 4)
print(x)

# Non-weighted row averages
mu_0 <- rowMedians(x)
mu <- rowWeightedMedians(x)
stopifnot(all.equal(mu, mu_0))

# Weighted row averages (uniform weights)
w <- rep(2.5, times = ncol(x))
mu <- rowWeightedMedians(x, w = w)
stopifnot(all.equal(mu, mu_0))

# Weighted row averages (excluding some columns)
w <- c(1, 1, 0, 1)
mu_0 <- rowMedians(x[, (w == 1), drop = FALSE])
mu <- rowWeightedMedians(x, w = w)
stopifnot(all.equal(mu, mu_0))

# Weighted row averages (excluding some columns)
w <- c(0, 1, 0, 0)
mu_0 <- rowMedians(x[, (w == 1), drop = FALSE])
mu <- rowWeightedMedians(x, w = w)
stopifnot(all.equal(mu, mu_0))

# Weighted averages by rows and columns
w <- 1:4
mu_1 <- rowWeightedMedians(x, w = w)
mu_2 <- colWeightedMedians(t(x), w = w)
stopifnot(all.equal(mu_2, mu_1))
```

---

`varDiff`  
*Estimation of scale based on sequential-order differences*

### Description

Estimation of scale based on sequential-order differences, corresponding to the scale estimates provided by `var`, `sd`, `mad` and `IQR`.

### Usage

```r
varDiff(x, idxs = NULL, na.rm = FALSE, diff = 1L, trim = 0, ...)
sdDiff(x, idxs = NULL, na.rm = FALSE, diff = 1L, trim = 0, ...)
madDiff(x, idxs = NULL, na.rm = FALSE, diff = 1L, trim = 0,
        constant = 1.4826, ...)
```
Arguments

x A numeric vector of length N or a numeric NxK matrix.
idxs A vector indicating subset of elements to operate over. If NULL, no subsetting is done.
na.rm If TRUE, missing values are excluded.
diff The positional distance of elements for which the difference should be calculated.
trim A double in [0,1/2] specifying the fraction of observations to be trimmed from each end of (sorted) x before estimation.
... Not used.
constant A scale factor adjusting for asymptotically normal consistency.
rows A vector indicating subset of rows to operate over. If NULL, no subsetting is done.
cols A vector indicating subset of columns to operate over. If NULL, no subsetting is done.
useNames If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.
Details

Note that n-order difference MAD estimates, just like the ordinary MAD estimate by `mad`, apply a correction factor such that the estimates are consistent with the standard deviation under Gaussian distributions.

The interquartile range (IQR) estimates does not apply such a correction factor. If asymptotically normal consistency is wanted, the correction factor for IQR estimate is \(1 / \left(2q_{\text{norm}}(3/4)\right)\), which is half of that used for MAD estimates, which is \(1 / q_{\text{norm}}(3/4)\). This correction factor needs to be applied manually, i.e. there is no constant argument for the IQR functions.

Value

Returns a numeric vector of length 1, length N, or length K.

Author(s)

Henrik Bengtsson

References


See Also

For the corresponding non-differentiated estimates, see `var`, `sd`, `mad` and `IQR`. Internally, `diff2()` is used which is a faster version of `diff()`.

---

**weightedMad**

Weighted Median Absolute Deviation (MAD)

Description

Computes a weighted MAD of a numeric vector.

Usage

```r
weightedMad(x, w = NULL, idxs = NULL, na.rm = FALSE, constant = 1.4826, center = NULL, ...)
rowWeightedMads(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, constant = 1.4826, center = NULL, ..., useNames = NA)
colWeightedMads(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, constant = 1.4826, center = NULL, ..., useNames = NA)
```
Arguments

- **x**: vector of type integer, numeric, or logical.
- **w**: a vector of weights the same length as x giving the weights to use for each element of x. Negative weights are treated as zero weights. Default value is equal weight to all values.
- **idxs**: A vector indicating subset of elements to operate over. If NULL, no subetting is done.
- **na.rm**: If TRUE, missing values are excluded.
- **constant**: A numeric scale factor, cf. mad.
- **center**: Optional numeric scalar specifying the center location of the data. If NULL, it is estimated from data.
- **...**: Not used.
- **rows**: A vector indicating subset of rows to operate over. If NULL, no subetting is done.
- **cols**: A vector indicating subset of columns to operate over. If NULL, no subetting is done.
- **useNames**: If NA, the default behavior of the function about naming support is remained. If FALSE, no naming support is done. Else if TRUE, names attributes of result are set.

Value

Returns a numeric scalar.

Missing values

Missing values are dropped at the very beginning, if argument na.rm is TRUE, otherwise not.

Author(s)

Henrik Bengtsson

See Also

For the non-weighted MAD, see mad. Internally weightedMedian() is used to calculate the weighted median.

Examples

```r
x <- 1:10
n <- length(x)

m1 <- mad(x)
m2 <- weightedMad(x)
stopifnot(identical(m1, m2))

w <- rep(1, times = n)
```
```r
m1 <- weightedMad(x, w)
stopifnot(identical(m1, m2))

# All weight on the first value
w[1] <- Inf
m <- weightedMad(x, w)
stopifnot(m == 0)

# All weight on the first two values
w[1:2] <- Inf
m1 <- mad(x[1:2])
m2 <- weightedMad(x, w)
stopifnot(identical(m1, m2))

# All weights set to zero
w <- rep(0, times = n)
m <- weightedMad(x, w)
stopifnot(is.na(m))
```

---

**weightedMean**

Weighted Arithmetic Mean

**Description**

Computes the weighted sample mean of a numeric vector.

**Usage**

```r
weightedMean(x, w = NULL, idxs = NULL, na.rm = FALSE, refine = FALSE, ...)
```

**Arguments**

- `x` An NxK matrix or, if dim. is specified, an N * K vector.
- `w` a vector of weights the same length as x giving the weights to use for each element of x. Negative weights are treated as zero weights. Default value is equal weight to all values. If a missing-value weight exists, the result is always a missing value.
- `idxs` A vector indicating subset of elements to operate over. If NULL, no subsetting is done.
- `na.rm` If TRUE, missing values are excluded.
- `refine` If TRUE and x is numeric, then extra effort is used to calculate the average with greater numerical precision, otherwise not.
- `...` Not used.

**Value**

Returns a numeric scalar. If x is of zero length, then NaN is returned, which is consistent with mean().
**weightedMean**

**Missing values**

This function handles missing values consistently with `weighted.mean`. More precisely, if `na.rm = FALSE`, then any missing values in either `x` or `w` will give result `NA_real_`. If `na.rm = TRUE`, then all `(x, w)` data points for which `x` is missing are skipped. Note that if both `x` and `w` are missing for a data points, then it is also skipped (by the same rule). However, if only `w` is missing, then the final results will always be `NA_real_` regardless of `na.rm`.

**Author(s)**

Henrik Bengtsson

**See Also**

`mean()` and `weighted.mean`.

**Examples**

```r
x <- 1:10
n <- length(x)

w <- rep(1, times = n)
m0 <- weighted.mean(x, w)
m1 <- weightedMean(x, w)
stopifnot(identical(m1, m0))

# Pull the mean towards zero
w[1] <- 5
m0 <- weighted.mean(x, w)
m1 <- weightedMean(x, w)
stopifnot(identical(m1, m0))

# Put even more weight on the zero
w[1] <- 8.5
m0 <- weighted.mean(x, w)
m1 <- weightedMean(x, w)
stopifnot(identical(m1, m0))

# All weight on the first value
w[1] <- Inf
m0 <- weighted.mean(x, w)
m1 <- weightedMean(x, w)
stopifnot(identical(m1, m0))

# All weight on the last value
w[1] <- 1
w[n] <- Inf
m0 <- weighted.mean(x, w)
m1 <- weightedMean(x, w)
stopifnot(identical(m1, m0))

# All weights set to zero
```
weightedMedian

weightedMedian(x, w = NULL, idxs = NULL, na.rm = FALSE, interpolate = is.null(ties), ties = NULL, ...)

Arguments

x vector of type integer, numeric, or logical.
w a vector of weights the same length as x giving the weights to use for each element of x. Negative weights are treated as zero weights. Default value is equal weight to all values.
idxs A vector indicating subset of elements to operate over. If NULL, no subsetting is done.
na.rm a logical value indicating whether NA values in x should be stripped before the computation proceeds, or not. If NA, no check at all for NAs is done.
interpolate If TRUE, linear interpolation is used to get a consistent estimate of the weighted median.
ties If interpolate == FALSE, a character string specifying how to solve ties between two x’s that are satisfying the weighted median criteria. Note that at most two values can satisfy the criteria. When ties is "min" ("lower weighted median"), the smaller value of the two is returned and when it is "max" ("upper weighted median"), the larger value is returned. If ties is "mean", the mean of the two values is returned. Finally, if ties is "weighted" (or NULL) a weighted average of the two are returned, where the weights are weights of all values x[i] <= x[k] and x[i] >= x[k], respectively.
...
Value

Returns a numeric scalar.

For the n elements x = c(x[1], x[2], ..., x[n]) with positive weights w = c(w[1], w[2], ..., w[n]) such that sum(w) = S, the weighted median is defined as the element x[k] for which the total weight of all elements x[i] < x[k] is less or equal to S/2 and for which the total weight of all elements x[i] > x[k] is less or equal to S/2 (c.f. [1]).
When using linear interpolation, the weighted mean of \(x[k-1]\) and \(x[k]\) with weights \(S[k-1]\) and \(S[k]\) corresponding to the cumulative weights of those two elements is used as an estimate. If \(w\) is missing then all elements of \(x\) are given the same positive weight. If all weights are zero, \texttt{NA\_real\_} is returned.

If one or more weights are \texttt{Inf}, it is the same as these weights have the same weight and the others have zero. This makes things easier for cases where the weights are result of a division with zero.

If there are missing values in \(w\) that are part of the calculation (after subsetting and dropping missing values in \(x\)), then the final result is always \texttt{NA} of the same type as \(x\).

The weighted median solves the following optimization problem:

\[
\hat{\alpha} = \arg\min_{\alpha} \sum_{i=1}^{n} w_i |x_i - \alpha|
\]

where \(x = (x_1, x_2, \ldots, x_n)\) are scalars and \(w = (w_1, w_2, \ldots, w_n)\) are the corresponding "weights" for each individual \(x\) value.

**Author(s)**

Henrik Bengtsson and Ola Hossjer, Centre for Mathematical Sciences, Lund University. Thanks to Roger Koenker, Econometrics, University of Illinois, for the initial ideas.

**References**


**See Also**

\texttt{median}, \texttt{mean()} and \texttt{weightedMean()}.

**Examples**

```r
x <- 1:10
n <- length(x)

m1 <- median(x)  # 5.5
m2 <- weightedMedian(x)  # 5.5
stopifnot(identical(m1, m2))

w <- rep(1, times = n)
ml <- weightedMedian(x, w)  # 5.5 (default)
m2 <- weightedMedian(x, ties = "weighted")  # 5.5 (default)
m3 <- weightedMedian(x, ties = "min")  # 5
m4 <- weightedMedian(x, ties = "max")  # 6
stopifnot(identical(ml, m2))

# Pull the median towards zero
w[1] <- 5
m1 <- weightedMedian(x, w)  # 3.5
```
weightedVar

Weighted variance and weighted standard deviation

Description

Computes a weighted variance / standard deviation of a numeric vector or across rows or columns of a matrix.
weightedVar

Usage

weightedVar(x, w = NULL, idxs = NULL, na.rm = FALSE, center = NULL, ...)

weightedSd(...)

rowWeightedVars(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, ...
... useNames = NA)

colWeightedVars(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, ...
... useNames = NA)

rowWeightedSds(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, ...
... useNames = NA)

colWeightedSds(x, w = NULL, rows = NULL, cols = NULL, na.rm = FALSE, ...
... useNames = NA)

Arguments

x vector of type integer, numeric, or logical.

w a vector of weights the same length as x giving the weights to use for each
element of x. Negative weights are treated as zero weights. Default value is
equal weight to all values.

idxs A vector indicating subset of elements to operate over. If NULL, no subsetting
is done.

na.rm If TRUE, missing values are excluded.

center Optional numeric scalar specifying the center location of the data. If NULL, it is
estimated from data.

... Not used.

rows A vector indicating subset of rows to operate over. If NULL, no subsetting is
done.

cols A vector indicating subset of columns to operate over. If NULL, no subsetting
is done.

useNames If NA, the default behavior of the function about naming support is remained. If
FALSE, no naming support is done. Else if TRUE, names attributes of result are
set.

Details

The estimator used here is the same as the one used by the "unbiased" estimator of the Hmisc
package. More specifically, weightedVar(x, w = w) == Hmisc::wtd.var(x, weights = w).

Value

Returns a numeric scalar.
Missing values

This function handles missing values consistently with `weightedMean()`. More precisely, if `na.rm = FALSE`, then any missing values in either `x` or `w` will give result `NA_real_`. If `na.rm = TRUE`, then all `(x, w)` data points for which `x` is missing are skipped. Note that if both `x` and `w` are missing for a data points, then it is also skipped (by the same rule). However, if only `w` is missing, then the final results will always be `NA_real_` regardless of `na.rm`.

Author(s)

Henrik Bengtsson

See Also

For the non-weighted variance, see `var`. 
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