

Package ‘classInt’

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Title Choose univariate class intervals

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Description A package for choosing univariate class intervals for mapping or other graphics purposes

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classIntervals	<i>Choose univariate class intervals</i>
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Description

The function provides a uniform interface to finding class intervals for continuous numerical variables, for example for choosing colours or symbols for plotting. Class intervals are non-overlapping, and the classes are left-closed — see `findInterval`. Argument values to the style chosen are passed through the dot arguments. `classIntervals2shingle` converts a `classIntervals` object into a shingle.

Usage

```
classIntervals(var, n, style = "quantile", rtimes = 3, ...,
               intervalClosure = "left", dataPrecision = NULL)
## S3 method for class 'classIntervals'
plot(x, pal, ...)
## S3 method for class 'classIntervals'
print(x, digits = getOption("digits"), ..., under="under", over="over", between="-", cutlabels=TRUE)
nPartitions(x)
classIntervals2shingle(x)
```

Arguments

<code>var</code>	a continuous numerical variable
<code>n</code>	number of classes required, if missing, <code>nclass.Sturges</code> is used
<code>style</code>	chosen style: one of "fixed", "sd", "equal", "pretty", "quantile", "kmeans", "hclust", "bclust", "fisher", or "jenks"
<code>rtimes</code>	number of replications of <code>var</code> to catenate and jitter; may be used with styles "kmeans" or "bclust" in case they have difficulties reaching a classification
<code>intervalClosure</code>	default "left", allows specification of whether partition intervals are closed on the left or the right (added by Richard Dunlap)
<code>dataPrecision</code>	default NULL, permits rounding of the interval endpoints (added by Richard Dunlap)
<code>...</code>	arguments to be passed to the functions called in each style
<code>x</code>	"classIntervals" object for printing, conversion to shingle, or plotting
<code>under</code>	character string value for "under" in printed table labels
<code>over</code>	character string value for "over" in printed table labels
<code>between</code>	character string value for "between" in printed table labels
<code>digits</code>	minimal number of significant digits in printed table labels
<code>cutlabels</code>	default TRUE, use cut-style labels in printed table labels
<code>pal</code>	a character vector of at least two colour names for colour coding the class intervals in an ECDF plot; <code>colorRampPalette</code> is used internally to create the correct number of colours

Details

The "fixed" style permits a "classIntervals" object to be specified with given breaks, set in the `fixedBreaks` argument; the length of `fixedBreaks` should be $n+1$; this style can be used to insert rounded break values.

The "sd" style chooses breaks based on pretty of the centred and scaled variables, and may have a number of classes different from n ; the returned `par=` includes the centre and scale values.

The "equal" style divides the range of the variable into n parts.

The "pretty" style chooses a number of breaks not necessarily equal to n using `pretty`, but likely to be legible; arguments to `pretty` may be passed through

The "quantile" style provides quantile breaks; arguments to `quantile` may be passed through

The "kmeans" style uses `kmeans` to generate the breaks; it may be anchored using `set.seed`; the `pars` attribute returns the `kmeans` object generated; if `kmeans` fails, a jittered input vector containing `r` times replications of `var` is tried — with few unique values in `var`, this can prove necessary; arguments to `kmeans` may be passed through

The "hclust" style uses `hclust` to generate the breaks using hierarchical clustering; the `pars` attribute returns the `hclust` object generated, and can be used to find other breaks using `getHclustClassIntervals`; arguments to `hclust` may be passed through

The "bclust" style uses `bclust` to generate the breaks using bagged clustering; it may be anchored using `set.seed`; the `pars` attribute returns the `bclust` object generated, and can be used to find other breaks using `getBclustClassIntervals`; if `bclust` fails, a jittered input vector containing `r` times replications of `var` is tried — with few unique values in `var`, this can prove necessary; arguments to `bclust` may be passed through

The "fisher" style uses the algorithm proposed by W. D. Fisher (1958) and discussed by Slocum et al. (2005) as the Fisher-Jenks algorithm; added here thanks to Hisaji Ono.

The "jenks" style has been ported from Jenks' Basic code, and has been checked for consistency with ArcView, ArcGIS, and MapInfo (with some remaining differences); added here thanks to Hisaji Ono; note that the sense of interval closure is reversed from the other styles, and in this implementation has to be right-closed - use `cutlabels=TRUE` downstream for clarity.

Value

an object of class "classIntervals":

`var` the input variable

`brks` a vector of breaks

and attributes:

`style` the style used

`parameters` parameter values used in finding breaks

`nobs` number of different finite values in the input variable

`call` this function's call

Note

From version 0.1-11, the default representation has been changed to use `cutlabels=TRUE`, and representation within intervals has been corrected, thanks to Richard Dunlap. From version 0.1-15, the print method drops the calculation of the possible number of combinations of observations into classes, which generated warnings for $n > 170$.

Author(s)

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References

Armstrong, M. P., Xiao, N., Bennett, D. A., 2003. "Using genetic algorithms to create multicriteria class intervals for choropleth maps". *Annals, Association of American Geographers*, 93 (3), 595–623; Jenks, G. F., Caspall, F. C., 1971. "Error on choropleth maps: definition, measurement, reduction". *Annals, Association of American Geographers*, 61 (2), 217–244; Dent, B. D., 1999, *Cartography: thematic map design*. McGraw-Hill, Boston, 417 pp.; Slocum TA, McMaster RB, Kessler FC, Howard HH 2005 *Thematic Cartography and Geographic Visualization*, Prentice Hall, Upper Saddle River NJ.; Fisher, W. D. 1958 "On grouping for maximum homogeneity", *Journal of the American Statistical Association*, 53, pp. 789–798 (<http://lib.stat.cmu.edu/cmlib/src/cluster/fish.f>)

See Also

[pretty](#), [quantile](#), [kmeans](#), [hclust](#), [bclust](#), [findInterval](#), [colorRamp](#), [nclass](#), [shingle](#)

Examples

```
data(jenks71)
pal1 <- c("wheat1", "red3")
opar <- par(mfrow=c(2,3))
plot(classIntervals(jenks71$jenks71, n=5, style="fixed", fixedBreaks=c(15.57, 25, 50, 75, 100, 155.30)), pal=pal1)
plot(classIntervals(jenks71$jenks71, n=5, style="sd"), pal=pal1, main="Pretty standard deviations")
plot(classIntervals(jenks71$jenks71, n=5, style="equal"), pal=pal1, main="Equal intervals")
plot(classIntervals(jenks71$jenks71, n=5, style="quantile"), pal=pal1, main="Quantile")
set.seed(1)
plot(classIntervals(jenks71$jenks71, n=5, style="kmeans"), pal=pal1, main="K-means")
plot(classIntervals(jenks71$jenks71, n=5, style="hclust", method="complete"), pal=pal1, main="Complete cluster")
plot(classIntervals(jenks71$jenks71, n=5, style="hclust", method="single"), pal=pal1, main="Single cluster")
set.seed(1)
plot(classIntervals(jenks71$jenks71, n=5, style="bclust", verbose=FALSE), pal=pal1, main="Bagged cluster")
plot(classIntervals(jenks71$jenks71, n=5, style="fisher"), pal=pal1, main="Fisher's method")
plot(classIntervals(jenks71$jenks71, n=5, style="jenks"), pal=pal1, main="Jenks' method")
par(opar)
classIntervals(jenks71$jenks71, n=5, style="fixed", fixedBreaks=c(15.57, 25, 50, 75, 100, 155.30))
classIntervals(jenks71$jenks71, n=5, style="sd")
classIntervals(jenks71$jenks71, n=5, style="equal")
classIntervals(jenks71$jenks71, n=5, style="quantile")
set.seed(1)
classIntervals(jenks71$jenks71, n=5, style="kmeans")
set.seed(1)
```

```

classIntervals(jenks71$jenks71, n=5, style="kmeans", intervalClosure="right")
set.seed(1)
classIntervals(jenks71$jenks71, n=5, style="kmeans", dataPrecision=0)
set.seed(1)
print(classIntervals(jenks71$jenks71, n=5, style="kmeans"), cutlabels=FALSE)
classIntervals(jenks71$jenks71, n=5, style="hclust", method="complete")
classIntervals(jenks71$jenks71, n=5, style="hclust", method="single")
set.seed(1)
classIntervals(jenks71$jenks71, n=5, style="bclust", verbose=FALSE)
classIntervals(jenks71$jenks71, n=5, style="bclust", hclust.method="complete", verbose=FALSE)
classIntervals(jenks71$jenks71, n=5, style="fisher")
classIntervals(jenks71$jenks71, n=5, style="jenks")
x <- c(0, 0, 0, 1, 2, 50)
classIntervals(x, n=3, style="fisher")
classIntervals(x, n=3, style="jenks")

```

findColours

assign colours to classes from classInterval object

Description

This helper function is a wrapper for `findCols` to extract classes from a "classInterval" object and assign colours from a palette created by `colorRampPalette` from the two or more colours given in the `pal` argument. It also returns two attributes for use in constructing a legend.

Usage

```
findColours(cII, pal, under="under", over="over", between="-", digits = getOption("digits"), cutlabels)
```

Arguments

<code>cII</code>	a "classIntervals" object
<code>pal</code>	a character vector of at least two colour names; <code>colorRampPalette</code> is used internally to create the required number of colours
<code>under</code>	character string value for "under" in legend
<code>over</code>	character string value for "over" in legend
<code>between</code>	character string value for "between" in legend
<code>digits</code>	minimal number of significant digits in legend
<code>cutlabels</code>	use cut-style labels in legend

Value

a character vector of colours with attributes: "table", a named frequency table; "palette", a character vector of colours corresponding to the specified breaks.

Author(s)

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See Also

[classIntervals](#), [findInterval](#), [findCols](#), [colorRamp](#)

Examples

```
data(jenks71)
mypal <- c("wheat1", "red3")
h5 <- classIntervals(jenks71$jenks71, n=5, style="hclust", method="complete")
findColours(h5, mypal)
findColours(getHclustClassIntervals(h5, k=7), mypal)
h5Colours <- findColours(h5, mypal)
plot(h5, mypal, main="Complete hierarchical clustering")
legend(c(95, 155), c(0.12, 0.4), fill=attr(h5Colours, "palette"), legend=names(attr(h5Colours, "table")), bg="white")
h5tab <- attr(h5Colours, "table")
legtext <- paste(names(h5tab), " (", h5tab, ")", sep="")
plot(h5, mypal, main="Complete hierarchical clustering (with counts)")
legend(c(95, 165), c(0.12, 0.4), fill=attr(h5Colours, "palette"), legend=legtext, bg="white")
```

findCols

extract classes from classInterval object

Description

This helper function is a wrapper for `findInterval` to extract classes from a "classInterval" object

Usage

```
findCols(cII)
```

Arguments

cII a "classIntervals" object

Value

an integer vector of class indices

Author(s)

Roger Bivand <Roger.Bivand@nhh.no>

See Also

[classIntervals](#), [findInterval](#)

Examples

```
data(jenks71)
fix5 <- classIntervals(jenks71$jenks71, n=5, style="fixed", fixedBreaks=c(15.57, 25, 50, 75, 100, 155.30))
fix5
findCols(fix5)
```

getBclustClassIntervals

Change breaks in a "classIntervals" object

Description

Because "classIntervals" objects of style "hclust" or "bclust" contain hierarchical classification trees in their "par" attribute, different numbers of classes can be chosen without repeating the initial classification. This function accesses the "par" attribute and modifies the "brks" member of the returned "classIntervals" object.

Usage

```
getBclustClassIntervals(cII, k)
getHclustClassIntervals(cII, k)
```

Arguments

cII	a "classIntervals" object
k	number of classes required

Value

a "classIntervals" object with a "modified" attribute set

Author(s)

Roger Bivand <Roger.Bivand@nhh.no>

See Also

[classIntervals](#)

Examples

```
data(jenks71)
pal1 <- c("wheat1", "red3")
opar <- par(mfrow=c(2,2))
hCI5 <- classIntervals(jenks71$jenks71, n=5, style="hclust", method="complete")
plot(attr(hCI5, "par"))
plot(hCI5, pal=pal1, main="hclust k=5")
plot(getHclustClassIntervals(hCI5, k=7), pal=pal1, main="hclust k=7")
```

```

plot(getHclustClassIntervals(hCI5, k=9), pal=pal1, main="hclust k=9")
par(opar)
set.seed(1)
bCI5 <- classIntervals(jenks71$jenks71, n=5, style="bclust")
plot(attr(bCI5, "par"))
opar <- par(mfrow=c(2,2))
plot(getBclustClassIntervals(bCI5, k=3), pal=pal1, main="bclust k=3")
plot(bCI5, pal=pal1, main="bclust k=5")
plot(getBclustClassIntervals(bCI5, k=7), pal=pal1, main="bclust k=7")
plot(getBclustClassIntervals(bCI5, k=9), pal=pal1, main="bclust k=9")
par(opar)

```

jenks.tests

Indices for assessing class intervals

Description

The function returns values of two indices for assessing class intervals: the goodness of variance fit measure, and the tabular accuracy index; optionally the overview accuracy index is also returned if the area argument is not missing.

Usage

```
jenks.tests(cII, area)
```

Arguments

`cII` a "classIntervals" object
`area` an optional vector of object areas if the overview accuracy index is also required

Details

The goodness of variance fit measure is given by Armstrong et al. (2003, p. 600) as:

$$GVF = 1 - \frac{\sum_{j=1}^k \sum_{i=1}^{N_j} (z_{ij} - \bar{z}_j)^2}{\sum_{i=1}^N (z_i - \bar{z})^2}$$

where the $z_i, i = 1, \dots, N$ are the observed values, k is the number of classes, \bar{z}_j the class mean for class j , and N_j the number of counties in class j .

The tabular accuracy index is given by Armstrong et al. (2003, p. 600) as:

$$TAI = 1 - \frac{\sum_{j=1}^k \sum_{i=1}^{N_j} |z_{ij} - \bar{z}_j|}{\sum_{i=1}^N |z_i - \bar{z}|}$$

The overview accuracy index for polygon observations with known areas is given by Armstrong et al. (2003, p. 600) as:

$$OAI = 1 - \frac{\sum_{j=1}^k \sum_{i=1}^{N_j} |z_{ij} - \bar{z}_j| a_{ij}}{\sum_{i=1}^N |z_i - \bar{z}| a_i}$$

where $a_i, i = 1, \dots, N$ are the polygon areas, and as above the a_{ij} term is indexed over $j = 1, \dots, k$ classes, and $i = 1, \dots, N_j$ polygons in class j .

Value

a named vector of index values

Author(s)

Roger Bivand <Roger.Bivand@nhh.no>

References

Armstrong, M. P., Xiao, N., Bennett, D. A., 2003. "Using genetic algorithms to create multicriteria class intervals for choropleth maps". *Annals, Association of American Geographers*, 93 (3), 595–623; Jenks, G. F., Caspall, F. C., 1971. "Error on choroplethic maps: definition, measurement, reduction". *Annals, Association of American Geographers*, 61 (2), 217–244

See Also

[classIntervals](#)

Examples

```
data(jenks71)
fix5 <- classIntervals(jenks71$jenks71, n=5, style="fixed", fixedBreaks=c(15.57, 25, 50, 75, 100, 155.30))
jenks.tests(fix5, jenks71$area)
q5 <- classIntervals(jenks71$jenks71, n=5, style="quantile")
jenks.tests(q5, jenks71$area)
set.seed(1)
k5 <- classIntervals(jenks71$jenks71, n=5, style="kmeans")
jenks.tests(k5, jenks71$area)
h5 <- classIntervals(jenks71$jenks71, n=5, style="hclust", method="complete")
jenks.tests(h5, jenks71$area)
jenks.tests(getHclustClassIntervals(h5, k=7), jenks71$area)
jenks.tests(getHclustClassIntervals(h5, k=9), jenks71$area)
set.seed(1)
b5 <- classIntervals(jenks71$jenks71, n=5, style="bclust")
jenks.tests(b5, jenks71$area)
jenks.tests(getBclustClassIntervals(b5, k=7), jenks71$area)
jenks.tests(getBclustClassIntervals(b5, k=9), jenks71$area)
```

`jenks71`*Illinois 1959 county gross farm product value per acre*

Description

Classic data set for the choice of class intervals for choropleth maps.

Usage

```
data(jenks71)
```

Format

A data frame with 102 observations on the following 2 variables.

`jenks71` a numeric vector: Per acre value of gross farm products in dollars by county for Illinois in 1959

`area` a numeric vector: county area in square miles

Source

Jenks, G. F., Caspall, F. C., 1971. "Error on choroplethic maps: definition, measurement, reduction". *Annals, Association of American Geographers*, 61 (2), 217–244

Examples

```
data(jenks71)
(jenks71)
```

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