Package 'diffeR'

October 7, 2018

Type Package

Title Metrics of Difference for Comparing Pairs of Maps or Pairs of Variables

Version 0.0-6

Date 2018-12-07

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Depends R (>= 2.14.0), rgdal, raster, methods, ggplot2, reshape2

Imports graphics, grDevices

Description Metrics of difference for comparing pairs of variables or pairs of maps representing real or categorical variables at original and multiple resolutions.

License GPL (>= 2)

URL http://amsantac.co/software.html

Encoding latin1

NeedsCompilation no

R topics documented:

`diffeR-package` *Metrics of Difference for Comparing Pairs of Maps or Pairs of Variables*

Description

Metrics of difference for comparing pairs of variables or pairs of maps representing real or categorical variables at original and multiple resolutions.

Details

Package:	diffeR
Type:	Package
Version:	0.0-6
Date:	2018-12-07
License:	GPL (>= 2)
LazyLoad:	yes

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See Also

`differenceMetrics`

`categoryComponentsPlot` *Category Components plot*

Description

If comparison and reference (raster) maps are provided, this function creates the Category Components plot from the comparison between the comparison map (or map at time *t*) and the reference map (or map at time *t*+1). If a square contingency table (matrix) is provided instead of raster maps, then this function creates the Category Components plot from the comparison between the comparison variable (or variable at time *t*) and the reference variable (or variable at time *t*+1).

Usage

```
categoryComponentsPlot(comp = NULL, ref = NULL, ctmatrix = NULL, units = NULL,
                       population = NULL)
```

Arguments

comp	object of class RasterLayer corresponding to a comparison map (or map at time *t*). See Details below
ref	object of class RasterLayer corresponding to a reference map (or map at time *t*+1). See Details below
ctmatrix	matrix representing a square contingency table between a comparison variable or variable at time *t* (rows) and a reference variable or variable at time *t*+1 (columns). See Details below
units	optional; character string indicating units of ctmatrix
population	optional; an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

Users may enter as input either a square contingency table (ctmatrix) or a comparison and a reference raster maps (comp and ref, respectively).

The first column of population must contain integer identifiers of each category, corresponding to the categories in the comparison and reference variables. The second column corresponds to the population totals for each category.

Value

a stacked barplot showing for each category the quantity, exchange and shift components of difference between the comparison map/variable (or map/variable at time *t*) and the reference map/variable (or map/variable at time *t*+1)

References

Pontius Jr., R.G., Millones, M. 2011. *Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment*. International Journal of Remote Sensing 32 (15), 4407-4429.

See Also

diffTablej

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
categoryComponentsPlot(comp, ref)

ctmat <- crosstabm(comp, ref)
categoryComponentsPlot(ctmatrix = ctmat, units = "pixels")
```

`categorySourcesPlot` *Category Sources plot*

Description

If comparison and reference (raster) maps are provided, this function creates the Category Sources plot from the comparison between the comparison map (or map at time *t*) and the reference map (or map at time *t*+1). If a square contingency table (matrix) is provided instead of raster maps, then this function creates the Category Sources plot from the comparison between the comparison variable (or variable at time *t*) and the reference variable (or variable at time *t*+1).

Usage

```
categorySourcesPlot(comp = NULL, ref = NULL, ctmatrix = NULL, analysis = "error",
                    units = NULL, population = NULL)
```

Arguments

`comp`	object of class RasterLayer corresponding to a comparison map (or map at time *t*). See Details below
`ref`	object of class RasterLayer corresponding to a reference map (or map at time *t*+1). See Details below
`ctmatrix`	matrix representing a square contingency table between a comparison variable or variable at time *t* (rows) and a reference variable or variable at time *t*+1 (columns). See Details below
`analysis`	character string indicating type of analysis, either "error" (default) or "change"
`units`	optional; character string indicating units of `ctmatrix`
`population`	optional; an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

Users may enter as input either a square contingency table (`ctmatrix`) or a comparison and a reference raster maps (`comp` and `ref`, respectively).

The first column of `population` must contain integer identifiers of each category, corresponding to the categories in the comparison and reference variables. The second column corresponds to the population totals for each category.

Value

a stacked barplot showing for each category the agreement and the omission and comission components of difference between the comparison map/variable (or map/variable at time *t*) and the reference map/variable (or map/variable at time *t*+1)

References

Pontius Jr., R.G., Millones, M. 2011. *Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment*. International Journal of Remote Sensing 32 (15), 4407-4429.

See Also

differenceMetrics

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
categorySourcesPlot(comp, ref)

ctmat <- crosstabm(comp, ref)
categorySourcesPlot(ctmatrix = ctmat, units = "Pixels")
```

---

composite *create a composite matrix*

Description

provide a method to create a composite matrix from the crosstabulation of a comparison map (or map at time *t*) and a reference map (or map at time *t*+1), both aggregated at a given factor

Usage

```
composite(comp, ref, factor)
```

Arguments

comp	object of class RasterLayer corresponding to a comparison map (or map at time *t*)
ref	object of class RasterLayer corresponding to a reference map (or map at time *t*+1)
factor	integer. Aggregation factor expressed as number of cells in each direction (horizontally and vertically). Or two integers (horizontal and vertical aggregation factor). See raster package for details

Details

the pixel definition in a composite matrix interpretes class membership as the proportion of a pixel that belongs to a class. The pixel contains information about only the quantity of each category (Kuzera and Pontius 2008).

Value

a matrix showing the contingency table derived from the crosstabulation of a comparison map (or map at time *t*) and a reference map (or map at time *t*+1), both aggregated at a given factor. Output values are given as proportion (0 to 1)

References

Kuzera, K., Pontius Jr., R.G. 2008. *Importance of matrix construction for multiple-resolution categorical map comparison*. GIScience & Remote Sensing 45 (3), 249-274.

See Also

memberships

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
composite(comp, ref, factor=2)
```

---

crosstabm *create a contingency table between a comparison raster map (rows) and a reference raster map (columns)*

Description

create a contingency table, also called cross-tabulated matrix, between a comparison raster map (rows), or map at time *t*, and a reference raster map (columns), or map at time *t*+1

Usage

```
crosstabm(comp, ref, percent = FALSE, population = NULL)
```

Arguments

comp	object of class RasterLayer corresponding to the comparison map, or map at time *t*
ref	object of class RasterLayer corresponding to the reference map, or map at time *t*+1
percent	logical. If TRUE, output values are given as percentage. If FALSE, output values are given in pixel counts
population	an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

For correcting the sample count to population count in the square contingency table, assuming a stratified random sampling, an *n* (number of categories) by 2 matrix can be provided in the population argument. The first column of population must contains integer identifiers of each category, corresponding to the categories in the comparison map (or map at time *t*) and reference map (or map at time *t*+1). The second column corresponds to the population totals for each map category

Value

a matrix showing the cross-tabulation between the comparison map (or map at time *t*) and the reference map (or map at time *t*+1)

See Also

memberships

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
crosstabm(comp, ref)

# Population-adjusted square contingency table
(population <- matrix(c(1,2,3,2000,4000,6000), ncol=2))
crosstabm(comp, ref, population = population)

# Population-adjusted square contingency table, output as percentage
crosstabm(comp, ref, percent=TRUE, population = population)
```

`differenceMR` *calculates difference metrics between a reference map and a comparison map both consecutively aggregated at multiple resolutions*

Description

calculates quantity, exchange and shift components of difference, as well as the overall difference, between a comparison raster map (or map at time *t*), and a reference raster map (or map at time *t*+1), both consecutively aggregated at multiple resolutions.

Quantity difference is defined as the amount of difference between the reference map and a comparison map that is due to the less than maximum match in the proportions of the categories. Exchange consists of a transition from category *i* to category *j* in some pixels and a transition from category *j* to category *i* in an identical number of other pixels. Shift refers to the difference remaining after subtracting quantity difference and exchange from the overall difference.

Usage

```
differenceMR(comp, ref, eval = "multiple", percent = TRUE, fact = 2, population = NULL)
```

Arguments

`comp`	object of class RasterLayer corresponding to the comparison map, or map at time *t*
`ref`	object of class RasterLayer corresponding to the reference map, or map at time *t*+1
`eval`	default "original", return difference metrics between the input raster maps at the original resolution; if "multiple", return difference metrics at multiple resolutions aggregated according to a geometric sequence
`percent`	logical. If TRUE, output value is given as percentage. If FALSE, output value is given as proportion (0 to 1)
`fact`	integer. Aggregation factor expressed as number of cells in each direction (horizontally and vertically). Or two integers (horizontal and vertical aggregation factor). See `raster` package for details
`population`	an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

For correcting the sample count to population count in the square contingency table, assuming a stratified random sampling, an *n* (number of categories) by 2 matrix can be provided in the `population` argument. The first column of `population` must contains integer identifiers of each category, corresponding to the categories in the comparison map (or map at time *t*) and reference map (or map at time *t*+1). The second column corresponds to the population totals for each map category

Value

data.frame containing quantity, exchange and shift components of difference, as well as the overall difference, between the comparison map and the reference map at multiple resolutions

References

Pontius Jr., R.G., Millones, M. 2011. *Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment*. International Journal of Remote Sensing 32 (15), 4407-4429.

Pontius Jr., R.G., Santacruz, A. 2014. *Quantity, exchange and shift components of difference in a square contingency table*. International Journal of Remote Sensing 35 (21), 7543-7554.

See Also

`differenceMetrics`

Examples

```
## Not run:
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
differenceMR(comp, ref, eval="original")
differenceMR(comp, ref, eval="multiple", fact=2)

## End(Not run)
```

`diffTablej` *calculates difference metrics at the category level from a square contingency table*

Description

calculates quantity, exchange and shift components of difference, as well as the overall difference, at the category level from a contingency table derived from the crosstabulation between a comparison variable (or variable at time *t*), and a reference variable (or variable at time *t*+1).

Quantity difference is defined as the amount of difference between the reference variable and a comparison variable that is due to the less than maximum match in the proportions of the categories. Exchange consists of a transition from category *i* to category *j* in some observations and a transition from category *j* to category *i* in an identical number of other observations. Shift refers to the difference remaining after subtracting quantity difference and exchange from the overall difference.

Usage

```
diffTablej(ctmatrix, digits = 0)
```

Arguments

ctmatrix	matrix representing a square contingency table between a comparison variable (rows) and a reference variable (columns)
digits	integer indicating the number of decimal places to be used

Value

data.frame containing difference metrics at the category level between a comparison variable (rows) and a reference variable (columns). Output values are given in the same units as ctmatrix

References

Pontius Jr., R.G., Millones, M. 2011. *Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment*. International Journal of Remote Sensing 32 (15), 4407-4429.

Pontius Jr., R.G., Santacruz, A. 2014. *Quantity, exchange and shift components of difference in a square contingency table*. International Journal of Remote Sensing 35 (21), 7543-7554.

See Also

differenceMetrics

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
ctmatCompRef <- crosstabm(comp, ref)
diffTablej(ctmatCompRef)

# Adjustment to population assumming a stratified random sampling
(population <- matrix(c(1,2,3,2000,4000,6000), ncol = 2))
ctmatCompRef <- crosstabm(comp, ref, percent = TRUE, population = population)
diffTablej(ctmatCompRef)
```

MAD *Mean Absolute Deviation (MAD)*

Description

Provides a method to compare the quantity difference and allocation difference between two images of the same real variable at the original resolution or at multiple resolutions. The output provides a stacked graph and an accompanying numerical table for the Mean Absolute Deviation (MAD) for the difference due to quantity, the difference due to stratum-level allocation, and difference due to pixel-level allocation. The output also indicates which image has a smaller average. A scatterplot indicating the distribution of values in relation to the 1:1 line can be produced with MADscatterplot

Usage

```
MAD(grid1, grid2, strata = NULL, eval = "original")
```

Arguments

grid1	object of class RasterLayer corresponding to the first image
grid2	object of class RasterLayer corresponding to the second image
strata	object of class RasterLayer corresponding to the mask or strata image
eval	default "original", return the MAD value for the original resolution; if "multiple", return the MAD values for multiple resolutions following a geometric sequence

Value

a dataframe containing the multiples of the original resolution, the corresponding aggregated resolution, the difference due to quantity, the difference due to stratum-level allocation, and the difference due to pixel-level allocation.

References

Pontius Jr., R.G., Thontteh, O., Chen, H. 2008. *Components of information for multiple resolution comparison between maps that share a real variable*. Environmental and Ecological Statistics 15 (2), 111-142.

See Also

MADscatterplot

Examples

```
old.par <- par(no.readonly = TRUE)
grid1 <- raster(system.file("external/GRID1_INT.rst", package="diffeR"))
grid2 <- raster(system.file("external/GRID2_INT.rst", package="diffeR"))
strata <- raster(system.file("external/strata_int.rst", package="diffeR"))
MAD(grid1, grid2, strata, eval="original")
MAD(grid1, grid2, strata, eval="multiple")

## Not run:
veg_obs1 <- raster(system.file("external/veg_obs1.rst", package="diffeR"))
veg_pre1 <- raster(system.file("external/veg_pre1.rst", package="diffeR"))
veg_mask1 <- raster(system.file("external/veg_mask1.rst", package="diffeR"))
MADscatterplot(veg_obs1, veg_pre1, veg_mask1)
MAD(veg_obs1, veg_pre1, veg_mask1, eval="multiple")

## End(Not run)
par(old.par)
```

MADscatterplot *MAD scatterplot*

Description

Generates a scatterplot indicating the distribution of values from two images in relation to the 1:1 line

Usage

```
MADscatterplot(grid1, grid2, strata = NULL)
```

Arguments

grid1	object of class RasterLayer corresponding to the first image
grid2	object of class RasterLayer corresponding to the second image
strata	object of class RasterLayer corresponding to the mask or strata image

Value

a ggplot object corresponding to the scatterplot

See Also

MAD

Examples

```
old.par <- par(no.readonly = TRUE)
grid1 <- raster(system.file("external/GRID1_INT.rst", package="diffeR"))
grid2 <- raster(system.file("external/GRID2_INT.rst", package="diffeR"))
strata <- raster(system.file("external/strata_int.rst", package="diffeR"))
MADscatterplot(grid1, grid2, strata)

veg_obs1 <- raster(system.file("external/veg_obs1.rst", package="diffeR"))
veg_pre1 <- raster(system.file("external/veg_pre1.rst", package="diffeR"))
veg_mask1 <- raster(system.file("external/veg_mask1.rst", package="diffeR"))
MADscatterplot(veg_obs1, veg_pre1, veg_mask1)
par(old.par)
```

memberships *produces membership values for each category in the input raster at a specified aggregated resolution*

Description

Calculates membership values for each category in the input raster at a specified aggregated resolution

Usage

```
memberships(grid, fact = 2)
```

Arguments

grid	object of class RasterLayer
fact	integer. Aggregation factor expressed as number of cells in each direction (horizontally and vertically). Or two integers (horizontal and vertical aggregation factor). See raster package for details

Value

a RasterBrick object containing membership values for each category in the input raster at a specified aggregated resolution

See Also

composite

Examples

```
ref <- raster(system.file("external/reference.rst", package="diffeR"))
plot(ref)
memb.ref <- memberships(ref, fact=2)
names(memb.ref) <- c("ref.A", "ref.B", "ref.C")
plot(memb.ref)
```

---

overallComponentsPlot *Overall Components plot*

Description

If comparison and reference (raster) maps are provided, this function creates the Overall Components plot from the comparison between the comparison map (or map at time t) and the reference map (or map at time t+1). If a square contingency table (matrix) is provided instead of raster maps, then this function creates the Overall Components plot from the comparison between the comparison variable (or variable at time t) and the reference variable (or variable at time t+1).

Usage

```
overallComponentsPlot(comp = NULL, ref = NULL, ctmatrix = NULL, units = NULL,
                      population = NULL)
```

Arguments

comp	object of class RasterLayer corresponding to a comparison map (or map at time t). See Details below
ref	object of class RasterLayer corresponding to a reference map (or map at time t+1). See Details below
ctmatrix	matrix representing a square contingency table between a comparison variable (rows) and a reference variable (columns).. See Details below

units	character string indicating units of ctmatrix
population	an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

Users may enter as input either a square contingency table (ctmatrix) or a comparison and a reference raster maps (comp and ref, respectively).

The first column of population must contain integer identifiers of each category, corresponding to the categories in the comparison and reference variables. The second column corresponds to the population totals for each category.

Value

a stacked barplot showing the quantity, exchange and shift components of difference between the comparison map/variable (or map/variable at time *t*) and the reference map/variable (or map/variable at time *t*+1)

References

Pontius Jr., R.G., Millones, M. 2011. *Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment*. International Journal of Remote Sensing 32 (15), 4407-4429.

See Also

differenceMetrics

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
overallComponentsPlot(comp, ref)

ctmat <- crosstabm(comp, ref)
overallComponentsPlot(ctmatrix = ctmat, units = "pixels")
```

---

overallSourcesPlot *Overall Sources plot*

Description

If comparison and reference (raster) maps are provided, this function creates the Overall Sources plot from the comparison between the comparison map (or map at time *t*) and the reference map (or map at time *t*+1). If a square contingency table (matrix) is provided instead of raster maps, then this function creates the Overall Sources plot from the comparison between the comparison variable (or variable at time *t*) and the reference variable (or variable at time *t*+1).

Usage

```
overallSourcesPlot(comp = NULL, ref = NULL, ctmatrix = NULL, analysis = "error",
                   units = NULL, population = NULL)
```

Arguments

comp	object of class RasterLayer corresponding to a comparison map (or map at time *t*). See Details below
ref	object of class RasterLayer corresponding to a reference map (or map at time *t*+1). See Details below
ctmatrix	matrix representing a square contingency table between a comparison variable (rows) and a reference variable (columns). See Details below
analysis	character string indicating type of analysis, either "error" (default) or "change"
units	character string indicating units of ctmatrix
population	an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

Users may enter as input either a square contingency table (ctmatrix) or a comparison and a reference raster maps (comp and ref, respectively).

The first column of population must contain integer identifiers of each category, corresponding to the categories in the comparison and reference variables. The second column corresponds to the population totals for each category.

Value

a stacked barplot showing the omission and comission components of difference between the comparison map/variable (or map/variable at time *t*) and the reference map/variable (or map/variable at time *t*+1)

References

Pontius Jr., R.G., Millones, M. 2011. *Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment*. International Journal of Remote Sensing 32 (15), 4407-4429.

See Also

differenceMetrics

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))
overallSourcesPlot(comp, ref)

ctmat <- crosstabm(comp, ref)
overallSourcesPlot(ctmatrix = ctmat, units = "pixels")
```

sample2pop *corrects sample counts to population counts in a square contingency table*

Description

Converts sample count to population count in the square contingency table, assuming a stratified random sampling

Usage

```
sample2pop(ctmatrix, population)
```

Arguments

ctmatrix	matrix representing a sampling-derived square contingency table between a comparison variable (rows) and a reference variable (columns)
population	an *n* x 2 matrix provided to correct the sample count to population count in the square contingency table. See Details below

Details

The first column of population must contain integer identifiers of each category, corresponding to the categories in the comparison and reference variables. The second column corresponds to the population totals for each category.

Value

matrix representing a population-adjusted square contingency table for the crosstabulation between a comparison variable (rows) and a reference variable (columns). Output values are given in the same units as ctmatrix

See Also

crosstabm

Examples

```
comp <- raster(system.file("external/comparison.rst", package="diffeR"))
ref <- raster(system.file("external/reference.rst", package="diffeR"))

# Sample square contingency table
(ctmatCompRef <- crosstabm(comp, ref))

# Population-adjusted square contingency table
(population <- matrix(c(1,2,3,2000,4000,6000), ncol=2))
sample2pop(ctmatCompRef, population = population)

# The square contingency table can also be adjusted directly using the crosstabm function
crosstabm(comp, ref, population = population)
```

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