Package 'mapaccuracy'

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Type Package

Title Unbiased Thematic Map Accuracy and Area

Version 0.1.2

Depends R (>= 3.0.0)

Imports stats

Description
Unbiased estimators of overall and per-class thematic map accuracy and area published in Olofsson et al. (2014) <doi:10.1016/j.rse.2014.02.015> and Stehman (2014) <doi:10.1080/01431161.2014.930207>.

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R topics documented:

`olofsson` *Thematic map accuracy and area.*

Description

Implements the estimators described in Olofsson *et al*. (2013, 2014) for overall accuracy, producer's accuracy, user's accuracy, and area. Includes precision estimates.

Usage

```
olofsson(r, m, Nh, margins = TRUE)
```

Arguments

`r`	character vector. Reference class labels. The object will be coerced to factor.
`m`	character vector. Map class labels. The object will be coerced to factor.
`Nh`	numeric vector. Area, number of pixels, or proportion of the classes in the map. It must be named (see details).
`margins`	logical. If `FALSE`, the error matrix produced includes no margins (sum of the rows and columns).

Details

Argument `Nh` must be named to explicitly and clearly identify the class that each area refers to. The order of `Nh` will be used for displaying the results.

In the error matrix returned, the entries corresponding to no observed cases will present `NA` rather than `0`. This is to emphasize the difference between the absence of cases and the presence of some (few) cases that represent a very small proportion of area (almost zero) and thus possibly rounded to zero. However, `NA` means zero proportion of area.

Value

A list with the estimates and error matrix.

`OA`	overall accuracy
`UA`	user's accuracy
`PA`	producer's accuracy
`area`	area proportion
`SEoa`	standard error of OA
`SEua`	standard error of UA
`SEpa`	standard error of PA
`SEa`	standard error of area proportion
`matrix`	confusion error (area proportion). Rows and columns represent map and reference class labels, respectively

Author(s)

Hugo Costa

References

Olofsson, P.; Foody, G. M.; Stehman, S. V.; Woodcock, C. E. (2013). Making better use of accuracy data in land change studies: Estimating accuracy and area and quantifying uncertainty using stratified estimation. *Remote Sens. Environ.*, 129, 122-131.

Olofsson, P.; Foody, G. M.; Herold, M.; Stehman, S. V.; Woodcock, C. E.; Wulder, M. A. (2014). Good practices for estimating area and assessing accuracy of land change. *Remote Sens. Environ.*, 148, 42-57.

Examples

```
## Example 1 in Olofsson et al. (2013)
r<-c(rep("1",102),rep("2",280),rep("3",118))
m<-c(rep("1",97) ,rep("2",3), rep("3",2),rep("2",279),
             "3",rep("1",3),rep("2",18),rep("3",97))
Nh<-c(22353, 1122543, 610228)
names(Nh)<-c("1", "2", "3")
a<-olofsson(r, m, Nh)

# compare to paper:
a$area[1]                                       # eq. 9
a$area[1]*sum(Nh)                               # eq. 10
a$SEa[1]*sum(Nh)                                # eq. 12
a$area[1]*sum(Nh)-qnorm(0.975)*a$SEa[1]*sum(Nh) # 95% CI lower bound (note typo in the paper)
a$area[1]*sum(Nh)+qnorm(0.975)*a$SEa[1]*sum(Nh) # 95% CI upper bound
a$UA[1]                                         # eq. 14
a$PA[1]                                         # eq. 15
a$OA                                            # eq. 16
a$UA                                            # table 4
qnorm(0.975)*a$SEua                             # table 4
a$PA                                            # table 4
qnorm(0.975)*a$SEpa                             # table 4
a$matrix                                        # table 4


## Example 2 in Olofsson et al. (2013)
r<-c(rep("1", 129), rep("2", 403), rep("3", 611))
m<-c(rep("1", 127), "2", "2", rep("1", 66), rep("2", 322), rep("3", 15), rep("1", 54),
     rep("2", 17), rep("3", 540))
Nh<-c(0.007, 0.295, 0.698)
names(Nh)<-c("1", "2", "3")
b<-olofsson(r, m, Nh)

# compare to paper (table 6):
b$OA
qnorm(0.975)*b$SEoa
b$UA
qnorm(0.975)*b$SEua
```

```
b$PA
qnorm(0.975)*b$SEpa


## Example of table 8 in Olofsson et al. (2014)
r<-c(rep(1,69),rep(2,56),rep(3,175),rep(4,340))
m<-c(rep(1,66), 3, rep(4,2), rep(2,55), 4, rep(1,5), rep(2,8),
             rep(3,153),rep(4,9),rep(1,4),rep(2,12),rep(3,11),rep(4,313))
r[r==1] <- m[m==1] <- "Deforestation"
r[r==2] <- m[m==2] <- "Forest gain"
r[r==3] <- m[m==3] <- "Stable forest"
r[r==4] <- m[m==4] <- "Stable non-forest"
Nh<-c("Deforestation"=200000, "Forest gain"=150000,
    "Stable forest"=3200000, "Stable non-forest"=6450000) * 30^2 # Landsat pixel area = 30^2
e<-olofsson(r, m, Nh)

# compare to paper, left-hand of p. 54:
e$UA                           # User's accuracy
qnorm(0.975)*e$SEua            # 95% CI width
e$PA                           # Producer's accuracy
qnorm(0.975)*e$SEpa            # 95% CI width
e$OA                           # Overall accuracy
qnorm(0.975)*e$SEoa            # 95% CI width

# compare to paper, right-hand of p. 54:
e$area[1]*sum(Nh)/10000                # deforestation in hectares
qnorm(0.975)*e$SEa[1]*sum(Nh)/10000    # 95% CI width in hectares
e$area[2]*sum(Nh)/10000                # forest gain in hectares
qnorm(0.975)*e$SEa[2]*sum(Nh)/10000    # 95% CI width in hectares
e$area[3]*sum(Nh)/10000                # stable forest in hectares
qnorm(0.975)*e$SEa[3]*sum(Nh)/10000    # 95% CI width in hectares
e$area[4]*sum(Nh)/10000                # stable non-forest in hectares
qnorm(0.975)*e$SEa[4]*sum(Nh)/10000    # 95% CI width in hectares


# change class order
olofsson(r, m, Nh[c(4,2,1,3)])


# m (map) may include classes not found in r (reference)
r<-c(rep("1",102),rep("2",280),rep("3",118))
m<-c(rep("1",97) ,rep("2",3), rep("3",2),rep("2",279),
     "3",rep("1",3),rep("2",18),rep("3",95), rep("4",2))
Nh<-c("1"=22353, "2"=1122543, "3"=610228, "4"=10)
olofsson(r, m, Nh)

# r (reference) may include classes not found in m (map)
r<-c(rep("1",102),rep("2",280),rep("3",116),rep("4",2))
m<-c(rep("1",97) ,rep("2",3), rep("3",2),rep("2",279),
     "3",rep("1",3),rep("2",18),rep("3",97))
Nh<-c("1"=22353, "2"=1122543, "3"=610228)
olofsson(r, m, Nh)
```

```
# can add classes not found neither in r nor m
Nh<-c(Nh, "9"=0)
olofsson(r, m, Nh)
```

`stehman2014` *Thematic map accuracy and area under stratified random sampling when the strata differ from the map classes.*

Description

Implements the estimators described in Stehman (2014) for overall accuracy, producer's accuracy, user's accuracy, and area. Includes precision estimates.

Usage

```
stehman2014(s, r, m, Nh_strata, margins = TRUE, order)
```

Arguments

`s`	character vector. Strata class labels. The object will be coerced to factor.
`r`	character vector. Reference class labels. The object will be coerced to factor.
`m`	character vector. Map class labels. The object will be coerced to factor.
`Nh_strata`	numeric vector. Number of pixels forming each stratum. It must be named (see details).
`margins`	logical. If `FALSE`, the error matrix produced includes no margins (sum of the rows and columns).
`order`	(optional) character vector. Classes to be displayed in the results and their sequence. If missing, equal to `sort(unique(c(r,m)))`.

Details

Argument `Nh_strata` must be named to explicitly and clearly identify the stratum that each entry refers to. The names of `Nh_strata` are expected to match the strata class labels of argument `s`.

In the error matrix returned, the entries corresponding to no observed cases will present `NA` rather than 0. This is to emphasize the difference between the absence of cases and the presence of some (few) cases that represent a very small proportion of area (almost zero) and thus possibly rounded to zero. However, `NA` means zero proportion of area.

Value

A list with the estimates and error matrix.

`OA`	overall accuracy
`UA`	user's accuracy
`PA`	producer's accuracy

area	area proportion
SEoa	standard error of OA
SEua	standard error of UA
SEpa	standard error of PA
SEa	standard error of area proportion
matrix	confusion error (area proportion). Rows and columns represent map and reference class labels, respectively

Author(s)

Hugo Costa

References

Stehman, S. V. (2014). Estimating area and map accuracy for stratified random sampling when the strata are different from the map classes. *Int. J. Remote Sens.*, 35, 4923-4939.

Examples

```
# Numerical example in Stheman (2014)
s<-c(rep("A",10), rep("B",10), rep("C",10), rep("D",10))
m<-c(rep("A",7), rep("B",3), "A", rep("B",11), rep("C",6), "B", "B", rep("D",10))
r<-c(rep("A",5), "C", "B", "A", "B", "C", "A", rep("B",5), "A", "A", "B",
     "B", rep("C",5), "D", "D", "B", "B", "A", rep("D",7), "C", "C", "B")
Nh_strata<-c(40000, 30000, 20000, 10000)
names(Nh_strata)<-c("A", "B", "C", "D")
e<-stehman2014(s, r, m, Nh_strata)

e$area[1]                 # Proportion of area of class A (compare with paper in p. 4932)
e$area[3]                   # Proportion of area of class C (p. 4932)
e$OA                        # Overall accuracy (p. 4932)
e$UA[2]                     # User's accuracy of class B (compare with paper in p. 4934)
e$PA[2]                     # Producer's accuracy of class B (p. 4934)
e$matrix[2,3]               # Cell (2, 3) of the error matrix (p. 4935)
e$SEa[1]                  # Standard error (SE) for proportion of area of class A (p. 4935)
e$SEa[3]                  # Standard error (SE) for proportion of area of class C (p. 4935)
e$SEoa                      # SE for overall accuracy (p. 4936)
e$SEua[2]                   # SE for user's accuracy of class B (p. 4936)
e$SEpa[2]                   # SE for producer's accuracy of class B (p. 4936)

# change class order
stehman2014(s, r, m, Nh_strata, order=c("D","C","B","A"))

# the number (and name) of strata and map classes may differ
s<-c(rep("a",5), rep("aa",5), rep("b",10), rep("c",10), rep("d",10))
Nh_strata<-c("a"=20000, "aa"=20000, "b"=30000, "c"=20000, "d"=10000)
stehman2014(s, r, m, Nh_strata)

# m (map) may include classes not found in r (reference)
m<-c(rep("A",7), rep("B",3), "A", rep("B",11), rep("C",6), "B", "B", rep("D",9), "XX")
```

```
stehman2014(s, r, m, Nh_strata)

# r (reference) may include classes not found in m (map)
m<-c(rep("A",7), rep("B",3), "A", rep("B",11), rep("C",6), "B", "B", rep("D",10))
r<-c(rep("A",5), "C", "B", "A", "B", "C", "A", rep("B",5), "A", "A", "B",
     "B", rep("C",5), "D", "D", "B", "B", "A", rep("D",7), "C", "C", "YY")
stehman2014(s, r, m, Nh_strata)

# can add classes not found neither in r nor m
stehman2014(s, r, m, Nh_strata, order=c("A","B","C","D","YY","ZZ"))
```

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