Package 'affluenceIndex'

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Type Package

Title Affluence (Richness) Indices

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Description Enables to compute the statistical indices of affluence (richness) with bootstrap errors, and inequality and polarization indices. Moreover, gives the possibility of calculation of affluence line. Some simple errors are fixed and it works with new version of Spatial Statistics packaged.

Depends R (>= 3.6.2), stats

Imports spatstat.univar

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`affluenceIndex-package`

Affluence (richness) indices

Description

This package allows to compute the affluence indices (average affluence gap, income share of the top p %, richness headcount ratio, concave and convex measures of affluence) and to construct the confidence intervals for the affluence indices. The affluence line is defined by the user as multiple of the income median. This package also allows to compute the Medeiros's affluence line which is set as a multiple (defined by the user) of the income median. Additionally, this package allows also to compute some standard inequality and polarization measures: the Gini coefficient, the Palma index, the Wolfson polarization index. All measures may be calculated with weighted data.

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska
Maintainer: Alicja Wolny-Dominiak

References

1. Alichi A., Kantenga K., Sole J. (2016) Income polarization in the United States. IMF Working Paper, WP/16/121.
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8. Saczewska-Piotrowska A. (2015) Identification of determinants of income richness using logistic regression model. *Zarzadzanie i Finanse. Journal of Management and Finance*, 4, Part 2, pp. 241-259 (in Polish).
9. Wolfson M.C. (1994) When inequalities diverge, *The American Economic Review*, 84, pp. 353-358. https://www.jstor.org/stable/2117858

`affluence` *Equivalised income*

Description

The database contains information about equivalised income of households.

Usage

```
data("affluence")
```

Format

A data frame with 2000 observations on the following 4 variables.

`income` a numeric vector (equivalised income of households; equivalisation using modified OECD scale)

`education` a numeric vector (education of the household's head: 1=tertiary, 2=secondary, 3=basic vocational, 4=low)

`age` a numeric vector (age of the household's head: 1=less than 35, 2=35-44, 3=45-59, 4=60 and more)

`sex` a numeric vector (sex of the household's head: 0=male, 1=female)

`hs_size` vector of weights

Source

Based on Council for Social Monitoring (2016). Integrated database.http://www.diagnoza.com [11.09.2016].

Examples

```
data(affluence)
names(affluence)
```

boot.sd1 *Bootstrap standard error 1*

Description

Calculates the bootstrap standard errors.

Usage

```
boot.sd1(x, weight,  kp, nsim, boot.index = c("r.hc", "r.is"), gamma)
```

Arguments

x	income vector
weight	vector of weights
kp	multiple of the median income (k) or order of quantile (p)
nsim	the number of replications
boot.index	the index for which the error is estimated
gamma	confidence level

Details

The function uses quantile method of calculating bootstrap confidence intervals.

Value

se.r	the bootstrap error
summary	bootstrap summary
boot.ind	bootstraped sample of index

Author(s)

Alicja Wolny-Dominiak

References

Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
boot.sd1(affluence$income, affluence$weight, 0.9, 10, "r.is", 0.95)
boot.sd1(affluence$income, affluence$weight, 2, 10, "r.hc", 0.95)
```

`boot.sd1.sub` *Bootstrap standard error 1*

Description

The estimation of bootstrap standard error of affluence index in subpopulation.

Usage

```
boot.sd1.sub(x.sub, x, weight.sub, weight, kp, nsim, boot.index=c("r.hc", "r.is"), gamma)
```

Arguments

`x`	income vector of subpopulation
`x.sub`	income vector of population
`weight.sub`	weight vector of subpopulation
`weight`	weight vector of population
`kp`	multiple of the median income (k) or order of quantile (p)
`nsim`	the number of replications
`boot.index`	the index for which the error is estimated
`gamma`	confidence level

Details

The function uses quantile method of calculating bootstrap confidence intervals.

Value

`se.r`	the bootstrap error of the affluence index
`summary`	bootstrap summary
`boot.ind`	bootstraped sample of index

Author(s)

Alicja Wolny-Dominiak

References

Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
aff.sub <- subset(affluence, education == 2)

boot.sd1.sub(aff.sub$income, affluence$income, aff.sub$weight, affluence$weight,
             0.9, 10, "r.is", 0.95)

boot.sd1.sub(aff.sub$income, affluence$income, aff.sub$weight, affluence$weight,
             0.9, 10, "r.hc", 0.95)
```

`boot.sd2` *Bootstrap standard error 2*

Description

Calculates the bootstrap standard errors.

Usage

```
boot.sd2(x, weight, k, alpha, nsim, boot.index = c("r.cha", "r.fgt"), gamma)
```

Arguments

`x`	income vector
`weight`	weight vector of population
`k`	multiple of the median income
`alpha`	parameter of the index: `alpha` > 0 for "`r.cha`", `alpha` > 1 for "`r.fgt`"
`nsim`	the number of replications
`boot.index`	the index for which the error is estimated
`gamma`	confidence level

Details

The function uses quantile method of calculating bootstrap confidence intervals.

Value

`se.r`	the bootstrap error
`summary`	bootstrap summary
`boot.ind`	vector of bootstraped index

Author(s)

Alicja Wolny-Dominiak

References

Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.

Examples

```
data(affluence)
boot.sd2(affluence$income, weight = NULL, 2, 2, 10, "r.cha", 0.95)
boot.sd2(affluence$income, weight = NULL, 2, 2, 10, "r.fgt", 0.95)
```

`boot.sd2.sub` *Bootstrap standard error 2*

Description

Calculates the bootstrap standard errors in subpopulation.

Usage

```
boot.sd2.sub(x.sub,x,weight.sub,weight,k,alpha,nsim,boot.index=c("r.cha","r.fgt"),gamma)
```

Arguments

`x`	income vector of subpopulation
`x.sub`	income vector of population
`weight.sub`	weight vector of subpopulation
`weight`	weight vector of population
`k`	multiple of the median income
`alpha`	parameter of the index: `alpha` > 0 for "`r.cha`", `alpha` > 1 for "`r.fgt`"
`nsim`	the number of replications
`boot.index`	the index for which the error is estimated
`gamma`	confidence level

Details

The function uses quantile method of calculating bootstrap confidence intervals.

Value

`se.r`	the bootstrap error
`summary`	bootstrap summary

Author(s)

Alicja Wolny-Dominiak

References

Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
aff.sub <- subset(affluence, education == 2)

x <- aff.sub$income
boot.sd2.sub(x, affluence$income, aff.sub$weight, affluence$weight, 2, 2, 10, "r.cha", 0.95)
boot.sd2.sub(x, affluence$income, aff.sub$weight, affluence$weight, 2, 2, 10, "r.fgt", 0.95)
```

---

gini.w *Gini coefficient*

Description

Computes the Gini coefficient.

Usage

```
gini.w(x, weight)
```

Arguments

x	income vector of population
weight	vector of weights

Details

The Gini coefficient is the most popular measure of income inequality. The formula taking into account the weights of income $w_1, w_2, ..., w_n$ is given by:

$$G_w = \frac{\sum_{i=1}^{n} w_i \sum_{j=1}^{n} w_j |x_i - x_j|}{2(\sum_{i=1}^{n} w_i)^2 \mu_w},$$

where x_i, x_j are incomes of individuals i and j, respectively, n is the number of individuals, μ_w is the mean income. The Gini coefficient ranges between 1 (perfect equality) and 1 (perfect inequality).

Value

GG	the value of coefficient

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Creedy J. (2015). A note on computing the Gini inequality measure with weighted data. Workin Paper No. 3, Victoria University of Wellington.
2. Lerman R.I., Yitzhaki S. (1989) Improving the accuracy of estimates of Gini coefficients. *Journal of Econometrics*, 42(1), pp. 43-47.

Examples

```
data(affluence)
gini.w(affluence$income, affluence$hs_size)
```

`line.med` *Medeiros's affluence line*

Description

Computes the Medeiros's affluence line.

Usage

```
line.med(x, weight, k)
```

Arguments

`x`	the income vector
`weight`	vector of weights
`k`	poverty line as a multiple of the median income

Details

The Medeiros's affluence line is based on the concept of poverty gap related to a given poverty line (in the package this line is set as a defined by the user multiple of the median income). Based on the determined poverty gap, there is calculated the point where the income of the richest should be reduced in order to make possible enough transfers to cover this gap and eliminate poverty. The calculated point of income may be also presented as the multiple of the median income.

Value

`median_inc`	the median income
`Gp`	the poverty gap
`rho_medeiros`	Medeiros's affluence line
`median_multiple`	Medeiros's affluence line as a multiple of the median

Author(s)

Anna Saczewska-Piotrowska, Alicja Wolny-Dominiak

References

Medeiros M. (2006) The rich and the poor: The construction of an affluence line from the poverty line. *Social Indicators Research*, 78(1), pp. 1-18.

Examples

```
data(affluence)
line.med(affluence$income, affluence$hs_size, 0.6)
```

`polar.aff` *Wolfson polarization index*

Description

Computes the Wolfson polarization index.

Usage

```
polar.aff(x, weight)
```

Arguments

`x`	the income vector
`weight`	vector of weights

Details

Standard inequality measures do not give any information about polarization. A more polarized income distribution is one that has relatively fewer middle income class and more low- and/or high-income households (Alichi et al. 2016). Low income class is very often identified with poverty and high-income class with richness. One of the measures of polarization is the Wolfson polarization index (Wolfson 1994). Weighted version of this index is given by:

$$P_w = 2\left(2T - G_w\right)\frac{\mu_w}{\rho_w},$$

where T is the difference between 0.5 and the income share of bottom half of the population, G_w is the Gini coefficient, μ_w is the mean income, ρ_w is the median income.

Value

`Pw`	the value of index
`TT`	the difference between 0.5 and the income share of bottom half of the population

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Alichi A., Kantenga K., Sole J. (2016) Income polarization in the United States. IMF Working Paper, WP/16/121.
2. Wolfson M.C. (1994) When inequalities diverge, *The American Economic Review*, 84, pp. 353-358.

Examples

```
data(affluence)
polar.aff(affluence$income, weight = NULL)
```

`r.cha` *Concave measure of affluence*

Description

Computes the measure of affluence analogous to the poverty index of Chakravarty (1983).

Usage

```
r.cha(x, weight, k, beta)
```

Arguments

`x`	the income vector
`weight`	vector of weights
`k`	multiple of the median income
`beta`	parameter of the index: `beta` > 0

Details

Peichl et. al (2008) defined an affluence index. Weighted index (with weights $w_1, w_2, ..., w_n$) is given by:

$$R_\beta^{CHA}(\boldsymbol{x}, \boldsymbol{w}, \rho_w) = \frac{\sum_{i=1}^{n}(1 - (\frac{\rho_w}{x_i})^\beta)\mathbf{1}_{x_i > \rho_w} w_i}{\sum_{i=1}^{n} w_i}, \beta > 0,$$

where x_i is an income of individual i, n is the number of individuals, ρ_w is the richness line, $\mathbf{1}_{(\cdot)}$ denotes the indicator function, which is equal to 1 when its argument is true and 0 otherwise. Index satisfies transfer axiom $T1$ (concave): a richness index should increase when a rank-preserving progressive transfer between two rich individuals takes place.

Value

`r`	elements of the sum in the index formula
`r.cha`	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Chakravarty S.R. (1983) A new index of poverty. *Mathematical Social Sciences*, 6, pp. 307-313.
2. Peichl A., Schaefer T., Scheicher C. (2008) Measuring richness and poverty - A micro data application to Europe and Germany. IZA Discussion Paper No. 3790, Institute for the Study of Labor (IZA).

Examples

```
data(affluence)
r.cha(affluence$income, weight = NULL, 2, 2)
```

---

r.cha.sub *Concave measure of affluence in subpopulation*

Description

Computes the measure of affluence in subpopulation analogous to the poverty index of Chakravarty(1983).

Usage

```
r.cha.sub(x.sub, x, weight.sub, weight, k, beta)
```

Arguments

x	income vector of subpopulation
x.sub	income vector of population
weight.sub	weight vector of subpopulation
weight	weight vector of population
k	multiple of the median income
beta	parameter of the index: beta > 0

Value

r	elements of the sum in the index formula
r.cha	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Chakravarty S.R. (1983) A new index of poverty. *Mathematical Social Sciences*, 6, pp. 307-313.
2. Peichl A., Schaefer T., Scheicher C. (2008) Measuring richness and poverty - A micro data application to Europe and Germany. IZA Discussion Paper No. 3790, Institute for the Study of Labor (IZA).

See Also

r.cha

Examples

```
data(affluence)
r.cha(affluence$income, weight = NULL, 2, 2)
```

---

r.fgt *Convex measure of affluence*

Description

Computes the measure of affluence analogous to the convex version of Foster, Greer and Thorbecke (1984) family of poverty indices.

Usage

```
r.fgt(x, weight, k, alpha)
```

Arguments

x	the income vector
weight	vector of weights
k	multiple of the median income
alpha	parameter of the index: alpha > 1

Details

Peichl et. al (2008) defined an affluence index. Weighted index (with weights $w_1, w_2, ..., w_n$) is given by:

$$R_\alpha^{FGT,T2}(\mathbf{x}, \mathbf{w}, \rho_w) = \frac{\sum_{i=1}^{n} \left(\frac{x_i - \rho_w}{\rho_w}\right)^\alpha \mathbf{1}_{x_i > \rho_w} w_i}{\sum_{i=1}^{n} w_i}, \alpha > 1,$$

where x_i is an income of individual i, n is the number of individuals, ρ_w is the richness line, $\mathbf{1}_{(\cdot)}$ denotes the indicator function, which is equal to 1 when its argument is true and 0 otherwise. Index satisfies transfer axiom $T2$ (convex): a richness index should decrease when a rank-preserving progressive transfer between two rich individuals takes place.

Value

r	values of the sum in the index formula
r.fgt	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Foster J.E., Greer J., Thorbecke E. (1984) A class of decomposable poverty measures. *Econometrica*, 52, pp. 761-766.
2. Peichl A., Schaefer T., Scheicher C. (2008) Measuring richness and poverty - A micro data application to Europe and Germany. IZA Discussion Paper No. 3790, Institute for the Study of Labor (IZA).

Examples

```
data(affluence)
r.fgt(affluence$income, weight = NULL, 2, 1)
```

---

r.fgt.sub *Convex measure of affluence in subpopulation*

Description

Computes the measure of affluence in subpopulation analogous to the convex version of Foster, Greer and Thorbecke (1984) family of poverty indices.

Usage

```
r.fgt.sub(x.sub, x, weight.sub, weight, k, alpha)
```

Arguments

x	income vector of subpopulation
x.sub	income vector of population
weight.sub	weight vector of subpopulation
weight	weight vector of population
k	multiple of the median income
alpha	parameter of the index: alpha > 1

Value

r	values of the sum in the index formula
r.fgt	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Foster J.E., Greer J., Thorbecke E. (1984) A class of decomposable poverty measures. *Econometrica*, 52, pp. 761-766.
2. Peichl A., Schaefer T., Scheicher C. (2008) Measuring richness and poverty - A micro data application to Europe and Germany. IZA Discussion Paper No. 3790, Institute for the Study of Labor (IZA).

See Also

r.fgt

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
aff.sub <- subset(affluence, education == 2)
r.fgt.sub(aff.sub$income, affluence$income, aff.sub$weight, affluence$weight, 2, 1)
```

---

r.hc *Richness headcount ratio*

Description

Computes the richness headcount ratio.

Usage

```
r.hc(x, weight, k)
```

Arguments

x	the income vector
weight	weight vector of population
k	multiple of the median income

Details

Richness headcount ratio is a proportion of the population with incomes above the affluence line. Weighted version (with weights $w_1, w_2, ..., w_n$) of this ratio is given by:

$$R^{HC}(\boldsymbol{x}, \boldsymbol{w}, \rho_w) = \frac{\sum_{i=1}^{n} \mathbf{1}_{x_i > \rho_w} w_i}{\sum_{i=1}^{n} w_i},$$

where x_i is an income of individual i, n is the number of individuals, ρ_w is the richness line,$\mathbf{1}_{(\cdot)}$ denotes the indicator function, which is equal to 1 when its argument is true and 0 otherwise.

Value

count.rich	the number of the rich
r.hc	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.
2. Saczewska-Piotrowska A. (2015) Identification of determinants of income richness using logistic regression model. *Zarzadzanie i Finanse. Journal of Management and Finance*, 4, Part 2, pp. 241-259 (in Polish).

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
r.hc(affluence$income, affluence$weight, 3)
```

---

r.hc.sub *Richness headcount ratio in subpopulation*

Description

Computes the richness headcount ratio in subpopulation.

Usage

```
r.hc.sub(x.sub, x, weight.sub, weight, k)
```

Arguments

x.sub	income vector of subpopulation
x	income vector of population
weight.sub	weight vector of subpopulation
weight	weight vector of population
k	multiple of the median income

Value

count.rich	the number of the rich
r.hc	the value of the index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

1. Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.
2. Saczewska-Piotrowska A. (2015) Identification of determinants of income richness using logistic regression model. *Zarzadzanie i Finanse. Journal of Management and Finance*, 4, Part 2, pp. 241-259 (in Polish).

See Also

r.hc

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
aff.sub <- subset(affluence, education == 2)
r.hc.sub(aff.sub$income, affluence$income, aff.sub$weight, affluence$weight, 3)
```

---

r.is *Income share of the top p %*

Description

Computes the income share of the top p %.

Usage

```
r.is(x, weight, p)
```

Arguments

x	the vector of income
weight	vector of weights
p	the order of quantile. Must be in [0,1] as probability

Details

The most popular measure of richness which takes a form (with weights $w_1, w_2, ..., w_n$):

$$R^{IS}(\boldsymbol{x}, \boldsymbol{w}, p) = \frac{\sum_{i=1}^{n} x_i w_i \mathbf{1}_{x_i > q_{w(1-p)}}}{\sum_{i=1}^{n} x_i w_i},$$

where $q_{w(1-p)}$ is the $(1-p)$ quantile of the population and $\mathbf{1}_{(\cdot)}$ denotes the indicator function, which is equal to 1 when its argument is true and 0 otherwise. There is always p % of rich individualsa in the population.

Value

r.2	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.

Examples

```
data(affluence)
r.is(affluence$income, weight = NULL, 0.9)
```

---

r.is.sub *Income share of the top p % in subpopulation*

Description

Computes income share of the top p % in subpopulation.

Usage

```
r.is.sub(x.sub, x, weight.sub, weight, p)
```

Arguments

x.sub	income vector of subpopulation
x	income vector of population
weight.sub	weight vector of subpopulation
weight	weight vector of population
p	the order of quantile. Must be in [0,1] as probability

Value

r.2	the value of index

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

Brzezinski M. (2010) Income affluence in Poland. *Social Indicators Research*, 99, pp. 285-299.

See Also

r.is

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
aff.sub <- subset(affluence, education == 2)
r.is.sub(aff.sub$income, affluence$income, aff.sub$weight, affluence$weight, 0.9)
```

---

r.med *Average affluence gap*

Description

Computes the average affluence gap of population.

Usage

```
r.med(x, weight, k)
```

Arguments

x	income vector
weight	vector of weights
k	multiple of the median income

Details

Medeiros (2006) defined an average affluence gap. Weighted gap (with weights $w_1, w_2, ..., w_n$) is given by:

$$R^{Me} = \frac{\sum_{i=1}^{n} \max\{x_i - \rho_w, 0\} w_i}{\sum_{i=1}^{n} w_i},$$

where x_i is an income of individual i, n is the number of individuals, ρ_w is the richness line. Medeiros' index is not standarized and is an absolute measure of richness.

Value

gap	the value of the average affluence gap

Author(s)

Alicja Wolny-Dominiak, Anna Saczewska-Piotrowska

References

Medeiros M. (2006) The rich and the poor: the construction of an affluence line from the poverty line. *Social Indicators Research*, 78, pp. 1-18.

Examples

```
data(affluence)
r.med(affluence$income, weight = NULL, 2)
```

`r.med.sub` *Average affluence gap in subpopulation*

Description

Computes the average affluence gap in subpopulation.

Usage

```
r.med.sub(x.sub, x, weight.sub, weight, k)
```

Arguments

`x`	income vector of subpopulation
`x.sub`	income vector of population
`weight.sub`	weight vector of subpopulation
`weight`	weight vector of population
`k`	multiple of the median income

Value

`gap`	the gap value

Author(s)

Alicja Wolny-Dominiak

References

Medeiros M. (2006) The rich and the poor: the construction of an affluence line from the poverty line. *Social Indicators Research*, 78, pp. 1-18.

See Also

`r.med`

Examples

```
data(affluence)
affluence$weight <- rep(1, nrow(affluence))
aff.sub <- subset(affluence, education == 2)
r.med.sub(aff.sub$income, affluence$income, aff.sub$weight, affluence$weight, 2)
```

`S90S40` *Palma index*

Description

Computes the Palma index (also known as S90/S40 ratio)

Usage

```
S90S40(x, weight)
```

Arguments

`x`	income vector
`weight`	vector of weights

Details

The Palma index is the ratio between the income share of the top 10% and the bottom 40%. The weighted Palma index (with weights $w_1, w_2, ..., w_n$) is given by:

$$S90/S40 = \frac{\sum_{i=1}^{n} x_i w_i \mathbf{1}_{x_i > q_{w(0.9)}}}{\sum_{i=1}^{n} x_i w_i \mathbf{1}_{x_i \leq q_{w(0.4)}}},$$

where x_i is an income of individual i, n is the number of individuals, $q_{w(0.9)}, q_{w(0.4)}$ are the 0.9 and 0.4 quantiles, respectively, $\mathbf{1}_{(\cdot)}$ denotes the indicator function, which is equal to 1 when its argument is true and 0 otherwise.

Value

`S90S40`	the value of index

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