Package ‘seatdist’

August 11, 2019

Type Package

Title Seat Apportionment and Disproportionality Measurement

Version 0.3

Date 2019-08-08

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Description Functions for seat apportionment and
measurement of apportionment disproportionality.

Depends R (>= 3.4.0)

Imports combinat

Encoding UTF-8

BugReports https://github.com/jmedzihorsky/seatdist/issues

R topics documented:

`seatdist-package` *seatdist: Seat Apportionment and Disproportionality Measurement*

Description

Functions for seat apportionment and measurement of apportionment disproportionality.

Details

Currently with 19 apportionment methods and 30 disproportionality measures.

Author(s)

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References

Medzihorsky, J. 2019. Rethinking the D'Hondt Method. PRX 1 (1): 41-55.

`disproportionality` *Apportionment disproportionality*

Description

Function to measure distance from proportionality for allocations of indivisibilities such as parliamentary seats.

Usage

```
disproportionality(s, v, measure = "mixture", ignore_zeros = TRUE, k = 2,
                   eta = 2, alpha = 2, thresh = NULL, powind = "shapley shubik")
```

Arguments

`s`	numeric, vector of seats (allocated indivisiblities)
`v`	numeric, vector of votes (claims)
`measure`	character, name of the disproportionality measure; see Details.
`ignore_zeros`	logical: should parties with zero seats and votes be ignored?
`k`	numeric, k value for the Generalized Gallagher index (k-index)
`eta`	numeric, eta value for the Atkinson index
`alpha`	numeric, alpha value for the Generalized Entropy
`thresh`	numeric, threshold for parliamentary majority for the Fragnelli and the Gambarelli & Biella indexes
`powind`	character, power index for the Fragnelli and the Gambarelli & Biella indexes, defaults to the Shapley-Shubik index,`"shapley shubik"`. no other power indexes implemented yet.

Details

Argument `measure` takes the following values

`"dhondt"` for the D'Hondt index

$$\delta = \max_i \frac{s_i}{v_i}$$

"`monroe`" for the Monroe index

$$I_M = \sqrt{\frac{\sum_i (s_i - v_i)^2}{1 + \sum_i v_i^2}}$$

"`maxdev`" for the Maximum Absolute Deviation

$$I_{MAD} = \max_i \{|s_i - v_i|\}$$

"`rae`" for the Rae index

$$I_{Rae} = \frac{1}{p} \sum_i |s_i - v_i|$$

"`loosemore hanby`" for the Loosemore & Hanby index

$$I_{LH} = \frac{1}{2} \sum_i |s_i - v_i|$$

"`grofman`" for the Grofman index

$$I_{Grof} = \frac{1}{e} \sum_i |s_i - v_i|;\ e = \frac{1}{\sum_i v_i^2}$$

"`lijphart`" for the Lijphart index

$$I_L = \frac{|s_a - v_a| + |s_b - v_b|}{2};\ v_a > v_b > \dots$$

"`gallagher`" for the Gallagher index

$$I_{Gal} = \sqrt{\frac{1}{2} \sum_i (s_i - v_i)^2}$$

"`kindex`" for the Generalized Gallagher index aka k-index

$$I_K = \sqrt[k]{\frac{1}{k} \sum_i (s_i - v_i)^k}$$

"`gatev`" for the Gatev index

$$I_{Gat} = \sqrt{\frac{\sum_i (s_i - v_i)^2}{\sum_i (s_i^2 + v_i^2)}}$$

"`ryabtsev`" for the Ryabtsev index

$$I_{Ryb} = \sqrt{\frac{\sum_i (s_i - v_i)^2}{\sum_i (s_i + v_i)^2}}$$

"`szalai`" for the Szalai index

$$I_{Sz} = \sqrt{\frac{1}{p} \sum_i \left(\frac{s_i - v_i}{s_i + v_i}\right)^2}$$

"`weighted szalai`" for the Weighted Szalai index

$$I_{WSz} = \sqrt{\frac{1}{2}\sum_i \frac{(s_i - v_i)^2}{s_i + v_i}}$$

"`aleskerov`" for the Aleskerov & Platonov index

$$I_{AP} = \frac{\sum_i k_i \frac{s_i}{v_i}}{\sum_i k_i};\ k_i = \mathbf{1}\left(\frac{s_i}{v_i} > 1\right)$$

"`gini`" for the Gini coefficient of inequality

"`atkinson`" for the Atkinson index

$$I_A = 1 - \left[\sum_i v_i \left(\frac{s_i}{v_i}\right)^{(1-\eta)}\right]^{\frac{1}{1-\eta}}$$

"`gen entropy`" for the Generalized Entropy index

$$I_{GE} = \frac{1}{\alpha^2 - \alpha}\left[\sum_i v_i \left(\frac{s_i}{v_i}\right)^{\alpha} - 1\right]$$

"`sainte lague`" for the Sainte-Laguë index

$$I_{SL} = \sum_i \frac{(s_i - v_i)^2}{v_i}$$

"`cox shugart`" for the Cox & Shugart index

$$I_{CS} = \frac{\sum_i (s_i - \bar{s})(v_i - \bar{v})}{\sum_i (v_i - \bar{v})^2}$$

"`farina`" for the Farina index

$$I_{Far} = \arccos\left[\frac{\sum_i s_i v_i}{\sqrt{\sum_i s_i^2 \sum_i v_i^2}}\right]\frac{10}{9}$$

"`ortona`" for the Ortona index

$$I_O = \frac{\sum_i |s_i - v_i|}{\sum_i |u_i - v_i|};\ u_i = \mathbf{1}(s_i = \max_i s_i)$$

"`fragnelli`" for the Fragnelli index

$$I_{Frag} = \frac{1}{2}\sum_i |\varphi_i(s) - \varphi_i(v)|;\ \varphi \text{ is Shapley} - \text{Shubik index}$$

"`gambarelli biella`" for the Gambarelli & Biella index

$$I_{GB} = \max_i\{|s_i - v_i|,\ |\varphi_i(s) - \varphi_i(v)|\}$$

`"cosine"` for the Cosine Dissimilarity index

$$I_{CD} = 1 - \frac{\sum_i s_i v_i}{\sqrt{\sum_i s_i^2}\sqrt{\sum_i v_i^2}}$$

`"mixture"` for the Mixture D'Hondt index

$$\pi^*_{DH} = 1 - \frac{1}{\max_i \frac{s_i}{v_i}}$$

, eqivalent to Lebeda's (2006) Real Residuals index

`"arr"` for Lebeda's (2006) ARR index

$$ARR = \frac{1}{p}\left(1 - \frac{1}{\max_i \frac{s_i}{v_i}}\right)$$

`"srr"` for Lebeda's (2006) SRR index

$$SRR = \sqrt{\sum_i \left(v_i - \frac{s_i}{\max_i \frac{s_i}{v_i}}\right)^2}$$

`"wdrr"` for Lebeda's (2006) WDRR index

$$WDRR = \frac{1}{3}\left(\left(\sum_i |v_i - s_i|\right) + \left(1 - \frac{1}{\max_i \frac{s_i}{v_i}}\right)\right)$$

`"surprise"` for the Kullback-Liebler surprise (how surprising is s given v)

$$KL = \sum_{s_i > 0} s_i \ln \frac{s_i}{v_i}$$

`"lrstat"` for the Likelihood ratio statistic

$$G = 2 \sum_i v_i \ln \frac{v_i}{s_i}$$

`"chisq"` for the Pearson's Chi Squared

$$\chi^2 = \sum_{s_i > 0} \frac{(v_i - s_i)^2}{s_i}$$

`"hellinger"` for the Hellinger Distance

$$HD = \frac{1}{\sqrt{2}}\sqrt{\sum_i \left(\sqrt{s_i} - \sqrt{v_i}\right)^2}$$

Argument `powind` currently only takes a single value `"shapley shubik"` for the Shapley-Shubik index.

Value

A named list of two items:

`measure`	character, the measure used
`value`	numeric, value

Author(s)

Juraj Medzihorsky

References

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Sainte-Laguë, André. 1910. "La représentation proportionnelle et la méthode des moindres carrés". In Annales scientifiques de l'École Normale Supérieure, 27:529–542.

Examples

```
seatdist::disproportionality(v=c(60,28,12)*1e3,
                             s=c(6,3,1),
                             measure="gallagher")
#   $measure
#   [1] "Gallagher"

#   $value
#   [1] 0.02
```

`giveseats` *Allocate indivisibilities*

Description

Function for proportional allocation of indivisibilities such as parliamentary seats

Usage

```
giveseats(v, ns, method, thresh = 0, quota = NA, divs = NULL)
```

Arguments

`v`	numeric, vector of votes (claims)
`ns`	numeric, number of seats (indivisibilities) to allocate
`method`	character, name of the allocation algorithm to use (see Details)
`thresh`	numeric, threshold of exclusion; if in [0,1], treated as a fraction; if in (1, 100), treated as a percent; if larger than 100, treated as a vote coun
`quota`	character, quota for `method="largest remainders"`; see Details
`divs`	numeric, divisors for `method="custom"`, must be non-negative

Details

Argument `method` takes the following values

Divisor methods: `"dh"` for the D'Hondt method, for which the xth divisor value is x

`"je"` for the Jefferson method which is equivalent to the D'Hondt method

`"hb"` for the Hagenbach-Bischoff method which is equivalent to the D'Hondt method

`"ad"` for the Adams method, for which the xth divisor equals $x - 1$

`"sd"` for the Smallest Divisors method, an alias of the Adams method

`"no"` for the Nohlen method, for which the xth divisor is $x + 1$

`"im"` for the Imperiali method, for which the xth divisor is $(x + 1)/2$

`"sl"` for the Sainte-Lague method, for which the xth divsor is $2x - 1$

`"we"` for the Webster method which is equivalent to the Sainte-Lague method

`"sw"` for the (new) Swedish Sainte-Lague method, which is identical to the Sainte-Lague method with the exception of the 1st divisor which equals to 1.2

`"ne"` for the Nepalese Sainte-Lague method, which is identical to the Sainte-Lague method with the exception of the 1st divisor which equals to 1.4

`"nor"` for the Norwegian Sainte-Lague method, which is identical to the Sainte-Lague method with the exception of the 1st divisor which equals to 1.4

`"hu"` for the Hungarian Sainte-Lague method, which is identical to the Sainte-Lague method with the exception of the 1st divisor which equals to 1.5

"msl" for the Modified Sainte-Lague method for which the 1st divisor is 1 and all the subsequent divisors are $(2x-1)5/7$

"da" for the Danish method, for which the xth divisor is $3x-2$

"hh" for the Huntington-Hill method for which the xth divisor is $\sqrt{x(x-1)}$

"ep" for the Equal Proportions method, an alias of the Huntington-Hill method

"pl" for the Plurality (a.k.a. Steady) method (identic divisors) where the xth divisor is a constant (x^0)

"de" for the Dean method; the xth divisor is $x(x-1)/(x-0.5)$

"ts" for the Theil-Schrage method (logarithmic mean divisors); the xth divisor is

$$\frac{1}{\ln\frac{x}{x-1}}$$

"ag" for the Agnew method (identric mean divisors); a.k.a. Theil, Ossipoff, Entropic; the xth divisor is

$$\frac{1}{e}\frac{x^x}{(x-1)^{x-1}}$$

"ich" for the Ichimori 1/3 method; the xth divisor is $\sqrt{x^2+x+1/3}$

"custom" for user-supplied divisors (in argument divs)

Largest remainders method can be called with method="lr" but requires to set the quota argument to one of

"ha" for the Hare quota e/l where e is the size of the number of votes and l the number of seats

"dr" for the Droop quota

$$\left\lfloor 1+\frac{e}{l+1}\right\rfloor$$

"hb" for the Hagenbach-Bischoff quota e/(l+1)

"im" for the Imperiali quota e/(l+2)

"rei" for the Reinforced Imperiali quota e/(l+3)

Under the largest remainder method it is possible that more than the available number of seats will be assigned in the first round (under the Imperiali and Reinforced Imperiali quotas) in which case the funtion terminates with an error message.

Value

A named list of two items:

method character, the name of the apportionment method used

seats numeric vector with seats

Author(s)

Juraj Medzihorsky

References

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Wada, Junichiro. 2016. "Apportionment behind the veil of uncertainty". The Japanese Economic Review 67 (3): 348–360

Examples

```
seatdist::giveseats(v=c(A=60, B=28, C=12)*1e3, ns=1e1,
                    method="lr", quota="hb", thresh=5e-2)

#   thresh treated as a fraction
#   $method
#   "Largest Remainders with Hagenbach-Bischoff quota"

#   $seats
#   A B C
#   6 3 1
```

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