Package 'polarization'

November 17, 2020

Title Measurement Methods for Party Polarization

Version 0.0.0.9000

Authors Yunkyu Sohn <ysohn.r@gmail.com>

Description This package implements several well-known party polarization measures for revealed preference data sets with binary responses (e.g. vote matrices, networks).

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Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.1.1

Imports pscl,
Rvoteview,
wnominate

URL http://ysohn.com

R topics documented:

`net_newman` *Vote profile correlation matrix converter*

Description

Convert an $N \times M$ vote matrix into an $N \times N$ vote profile correlation matrix of N voters following Newman (2001).

Usage

```
net_newman(V)
```

Arguments

V	$N \times M$ vote matrix with yes: 1 and no: 0.

Value

$N \times N$ adjacency matrix of voter-to-voter vote profile correlation for yes votes with normalization following Newman (2001).

References

Newman, Mark EJ. "Scientific collaboration networks. II. Shortest paths, weighted networks, and centrality." *Physical review E* 64.1 (2001): 016132.

Porter, Mason A., et al. "A network analysis of committees in the US House of Representatives." *Proceedings of the National Academy of Sciences* 102.20 (2005): 7057-7062.

Examples

```
## Generate a vote matrix with 1000 votes in a two party legislature consisting of 100 members
party <- rbind(matrix(1,50,1),matrix(2,50,1))
vote_data <- pol_simul(party = party, M = 1000, partyMean = c(-1,1), partySD = c(.5,.5))
V <- vote_data$votes

## Sum up vote profile correlation matrices for yes and no votes respectively
A <- net_newman(V) + net_newman(!V)
```

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pol_measure *Polarization measure*

Description

Polarization measure calculation from an $N \times 1$ vector of voter ideology and an $N \times 1$ vector of voter party affiliation.

Usage

```
pol_measure(ideology, party, method, exclude = NULL)
```

Arguments

ideology	$N \times 1$ vector of voter ideology.
party	$N \times 1$ vector of voter party affiliation.
method	Polarization measure. μ_s is the mean ideology of party s, P is the number of parties, ρ_s is the discrepancy between the maximum value and the minimum value of party s members' ideology, $\bar{\mu}$ is the mean ideology of the entire set of individuals, and N_s is the number of members of party s.

- `dist` Distance measure (McCarty *et al.*, 2016)

$$Distance = \frac{\sum_{s \neq p} |\mu_s - \mu_p|}{P(P-1)}$$

- `range` Range measure (Rehm and Reilly, 2010)

$$Range = \frac{\sum_{s \neq p} \max\left(|\mu_s - \mu_p| - \frac{\rho_s + \rho_p}{4}, 0\right)}{P(P-1)}$$

- `deviation` Deviation measure (Rehm and Reilly, 2010)

$$Deviation = \sqrt{\frac{\sum_s \left\{\max\left(|\mu_s - \bar{\mu}| - \frac{\rho_s}{4}, 0\right)\right\}^2}{P}}$$

- `ER` Esteban and Ray measure (Esteban and Ray, 1994; Rehm and Reilly, 2010)

$$ER = \sum_{p=1}^{P} \sum_{s=1}^{P} N_s^2 N_p \max\left(|\mu_s - \mu_p| - \frac{\rho_s + \rho_p}{4}, 0\right)$$

`exclude` A vector of party labels to be excluded (*e.g.* party label for an independent member).

Value

Polarization measure.

References

Esteban, Joan-Maria, and Debraj Ray. "On the measurement of polarization." *Econometrica: Journal of the Econometric Society* (1994): 819-851.

Rehm, Philipp, and Timothy Reilly. "United we stand: Constituency homogeneity and comparative party polarization." *Electoral Studies* 29.1 (2010): 40-53.

McCarty, Nolan, Keith T. Poole, and Howard Rosenthal. *Polarized America: The dance of ideology and unequal riches*. MIT Press, 2016.

Poole, Keith T., et al. "Scaling roll call votes with wnominate in R." *Journal of Statistical Software* 42.14 (2011): 1-21.

Zeileis, Achim, Christian Kleiber, and Simon Jackman. "Regression models for count data in R." *Journal of statistical software* 27.8 (2008): 1-25.

Examples

```
## Calculate the four versions of party polarization measures after generating
## a vote matrix with 1000 votes in a two party legislature consisting of 100 legislators.
party <- rbind(matrix(1,50,1),matrix(2,50,1))
vote_data <- pol_simul(party = party, M = 1000, partyMean = c(-1,1), partySD = c(.5,.5))
V <- vote_data$votes
rc <- pscl::rollcall(V)
wn_result <- wnominate::wnominate(rc,polarity=c(1),dims=1)
ideology <- wn_result$legislators$coord1D
pol_value <- matrix(0,4,1)
for (i in 1:4){
  pol_value[i,1] <- pol_measure(ideology, party, i)
}


## Measure the party polarization level of the 110th U.S. Senate
```

```
## using the range measure after excluding independent members with party label 328.
res <- Rvoteview::voteview_search(chamber = "Senate", congress = c(110))
rc <- Rvoteview::voteview_download(res$id)
pol_value <- pol_measure(as.numeric(rc$legis.data$dim1), rc$legis.data$party_code, 'range', 328)
```

`pol_net_measure` *Network-based polarization measure*

Description

Polarization measure calculation from an $N \times N$ vote profile correlation matrix.

Usage

```
pol_net_measure(A, party, method)
```

Arguments

`A`	$N \times N$ symmetric weighted adjacency matrix of vote profile correlation.
`party`	$N \times 1$ vector of voter party affiliation.
`method`	Polarization measure.

- `QNewman` Modularity value calculated following Newman (2006).
- `NCut` $-1\times$ Normalized cut calculated following Shi and Malik (2000).

Value

Polarization measure.

References

Newman, Mark EJ. "Modularity and community structure in networks." *Proceedings of the national academy of sciences* 103.23 (2006): 8577-8582.

Shi, Jianbo, and Jitendra Malik. "Normalized cuts and image segmentation." *IEEE Transactions on pattern analysis and machine intelligence* 22.8 (2000): 888-905.

Examples

```
## Generate a vote matrix with 1000 votes in a two party legislature
party <- rbind(matrix(1,50,1),matrix(2,50,1))
vote_data <- pol_simul(party = party, M = 1000, partyMean = c(-1,1), partySD = c(.5,.5))
V <- vote_data$votes

## Sum up vote profile correlation matrices for yes and no votes respectively
A <- net_newman(V)+net_newman(!V)

## Calculate Modularity and - Normalized cut for matrix A
pol_value <- matrix(0,2,1)
for (i in 1:2){
  pol_value[i,1] <- pol_net_measure(A, party, i)
}
```

pol_simul *Simulate data using the quadratic-normal voting model*

Description

Generate simulated data using the quadratic-normal voting model (Poole, 2005) with ideological homogeneity among same party members and ideological distance between different party members.

Usage

```
pol_simul(party, M, partyMean, partySD)
```

Arguments

party	$N \times 1$ vector of voter party affiliation.
M	Number of voting items.
partyMean	$P \times 1$ vector of party mean ideology for P parties.
partySD	$P \times 1$ vector for standard deviation of intra-party ideology.

Value

- votes $N \times M$ binary vote matrix with yes: 1 and no: 0 generated from the quadratic normal voting model (Poole, 2005) with Gaussian noise drawn from $\mathcal{N}(0, 0.2^2)$.
- ideology Ideology of legislators used in the simulation.
- a $M \times 1$ vector of ideological locations of bill proposals drawn from $\mathcal{N}(0, 1)$.
- q $M \times 1$ vector of ideological locations of corresponding status quos drawn from $\mathcal{N}(0, 1)$.

References

Poole, Keith T. *Spatial models of parliamentary voting*. Cambridge University Press, 2005.

Examples

```
## Generate a vote matrix with 1000 votes in a two party legislature consisting of 100 legislators
party <- rbind(matrix(1,50,1),matrix(2,50,1))
vote_data <- pol_simul(party = party, M = 1000, partyMean = c(-1,1), partySD = c(.5,.5))
```

Index