Package 'migraph'

June 24, 2026

Title Inferential Methods for Multimodal and Other Networks

Version 1.6.6

Description A set of tools for testing networks.
It includes functions for univariate and multivariate conditional uniform graph
and quadratic assignment procedure testing, and network regression.
The package is a complement to
'Multimodal Political Networks' (2021, ISBN:9781108985000),
and includes various datasets used in the book.
Built on the 'manynet' package, all functions operate with matrices,
edge lists, and 'igraph', 'network', and 'tidygraph' objects,
and on one-mode and two-mode (bipartite) networks.

URL https://stocnet.github.io/migraph/

BugReports https://github.com/stocnet/migraph/issues

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netrics (>= 0.3.1)

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`make_play` *Simulating multiple diffusion processes*

Description

Simulating multiple diffusion processes

Usage

```
play_diffusions(
  .data,
  ...,
  times = 5,
  strategy = "sequential",
  verbose = FALSE
)
```

Arguments

.data	An object of a manynet-consistent class: • matrix (adjacency or incidence) from {base} R • edgelist, a data frame from {base} R or tibble from {tibble} • igraph, from the {igraph} package • network, from the {network} package • tbl_graph, from the {tidygraph} package
...	Other parameters inherited from manynet::play_diffusion().
times	Integer indicating number of simulations. By default times=5, but 1,000 - 10,000 simulations recommended for publication-ready results.
strategy	If {furrr} is installed, then multiple cores can be used to accelerate the simulations. By default "sequential", but if multiple cores available, then "multisession" or "multicore" may be useful. Generally this is useful only when times > 1000. See {furrr} for more.
verbose	Whether the function should report on its progress. By default FALSE. See {progressr} for more.

Examples

```
play_diffusions(mpn_elite_mex, times = 10)
```

---

measure_over *Helper functions for measuring over splits of networks*

Description

- over_membership() runs a function, e.g. a measure, over different group memberships
- over_waves() runs a function, e.g. a measure, over waves of a panel network
- over_time() runs a function, e.g. a measure, over time slices of a dynamic network

Usage

```
over_membership(
  .data,
  FUN,
  ...,
  membership,
  strategy = "sequential",
  verbose = FALSE
)

over_waves(
  .data,
  FUN,
```

```
  ...,
  attribute = "wave",
  strategy = "sequential",
  verbose = FALSE
)

over_time(
  .data,
  FUN,
  ...,
  attribute = "time",
  slice = NULL,
  strategy = "sequential",
  verbose = FALSE
)
```

Arguments

.data	A manynet-consistent network. See e.g. `manynet::as_tidygraph()` for more details.
FUN	A function to run over all splits.
...	Further arguments to be passed on to FUN.
membership	A categorical membership vector.
strategy	If {furrr} is installed, then multiple cores can be used to accelerate the function. By default "sequential", but if multiple cores available, then "multisession" or "multicore" may be useful. Generally this is useful only when times > 1000. See {furrr} for more.
verbose	Whether the function should report on its progress. By default FALSE. See {progressr} for more.
attribute	A string naming the attribute to be split upon.
slice	Optionally, a vector of specific slices. Otherwise all observed slices will be returned.

---

mpn_bristol *Multimodal (3) Bristol protest events, 1990-2002 (Diani and Bison 2004)*

Description

A multimodal network with three levels representing ties between individuals, civic organisations in Bristol, and major protest and civic events that occurred between 1990 and 2000. The data contains individuals' affiliations to civic organizations in Bristol, the participation of these individuals in major protest and civic events between 1990-2002, and the involvement of the civic organizations in these events.

Usage

```
data(mpn_bristol)
```

Format

```
#> -- # Bristol protest event network ---------------------------------------------
#> # A labelled, two-mode network of 150 individuals and 114 individuals and 1496
#> affiliation and participation ties
#>
#> -- Nodes
#> # A tibble: 264 x 3
#>   name  type    lvl
#>   <chr> <lgl> <dbl>
#> 1 101   FALSE     1
#> 2 102   FALSE     1
#> 3 103   FALSE     1
#> 4 104   FALSE     1
#> 5 105   FALSE     1
#> 6 106   FALSE     1
#> # i 258 more rows
#>
#> -- Ties
#> # A tibble: 1,496 x 2
#>    from    to
#>   <int> <int>
#> 1    36   151
#> 2    40   151
#> 3    73   151
#> 4    94   151
#> 5   138   151
#> 6   145   151
#> # i 1,490 more rows
#>
```

Details

Although represented as a two-mode network, it contains three levels:

1. 150 Individuals, anonymised with numeric ID
2. 97 Bristol civic organizations
3. 17 Major protest and civic events in Bristol, 1990-2002

The network represents ties between level 1 (individuals) and level 2 (organisations), level 1 (individuals) and level 3 (events), as well as level 2 (organisations) and level 3 (events). The network is simple, undirected, and named. For a complete list of civic organisations and protest/civic events included in the data, please see Appendix 6.1 in *Multimodal Political Networks* (Knoke et al., 2021).

Source

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge University Press. Cambridge University Press.

References

Diani, Mario, and Ivano Bison. 2004. "Organizations, Coalitions, and Movements." *Theory and Society* 33(3–4):281–309. doi:10.1023/B:RYSO.0000038610.00045.07.

`mpn_cow` *One-mode interstate trade relations and two-mode state membership in IGOs (COW)*

Description

One-mode interstate trade relations and two-mode state membership in IGOs (COW)

Usage

```
data(mpn_cow_trade)

data(mpn_cow_igo)
```

Format

```
#> # A labelled, weighted, directed network of 116 nodes and 11489 arcs
#>
#> -- Nodes
#> # A tibble: 116 x 1
#>   name
#>   <chr>
#> 1 United States of America
#> 2 Canada
#> 3 Cuba
#> 4 Dominican Republic
#> 5 Jamaica
#> 6 Trinidad and Tobago
#> # i 110 more rows
#>
#> -- Ties
#> # A tibble: 11,489 x 3
#>    from    to  weight
#>   <int> <int>   <dbl>
#> 1     1     2 180387
#> 2     1     3    587.
#> 3     1     4   5511.
#> 4     1     5   1896.
```

```
#> 5     1     6   2188.
#> 6     1     7 123677
#> # i 11,483 more rows
#>
```

```
#> # A labelled, weighted, two-mode network of 112 nodes and 40 nodes and 839 ties
#>
#> -- Nodes
#> # A tibble: 152 x 3
#>   name        type  polity2
#>   <chr>       <lgl>   <dbl>
#> 1 Afghanistan FALSE      -7
#> 2 Albania     FALSE       5
#> 3 Algeria     FALSE      -3
#> 4 Angola      FALSE      -6
#> 5 Argentina   FALSE       8
#> 6 Australia   FALSE      10
#> # i 146 more rows
#>
#> -- Ties
#> # A tibble: 839 x 3
#>    from    to weight
#>   <int> <int>  <dbl>
#> 1     1   113      1
#> 2     1   114      1
#> 3     1   115      0
#> 4     1   116      0
#> 5     1   117      1
#> 6     1   118      0
#> # i 833 more rows
#>
```

Details

`mpn_cow_trade` is a one-mode matrix representing the trade relations between 116 states. The data is derived from the Correlates of War Project (COW) Trade Dataset (v3.0), which contains the annual dyadic and national trade figures for states (listed in COW) between 1870 to 2009. This network is based only on the dyadic trade figures in 2009 for the 116 states listed in Appendix 7.1 in *Multimodal Political Networks* (Knoke et al., 2021). The value in each cell of the matrix represents the value of exports from the 116 row states to the 116 column states.

`mpn_cow_igo` is a two-mode graph representing the membership of 116 states in 40 intergovernmental organizations (IGOs). The data is derived from the Correlates of War Project (COW) Intergovernmental Organizations Dataset (v3.0), which contains information about intergovernmental organizations from 1815-2014, such as founding year and membership. This network contains only a subset of the states and IGOs listed in COW, with 116 states listed in Appendix 7.1 in *Multimodal Political Networks* and 40 IGOs from Table 7.1 in *Multimodal Political Networks* that also overlap with the COW dataset (Knoke et al., 2021).

Source

The Correlates of War Project. 2012. *Trade*.

Barbieri, Katherine and Omar Keshk. 2012. Correlates of War Project Trade Data Set Codebook, Version 3.0.

The Correlates of War Project. 2019. *Intergovernmental Organization v3*.

References

Barbieri, Katherine, Omar M. G. Keshk, and Brian Pollins. 2009. "TRADING DATA: Evaluating our Assumptions and Coding Rules." *Conflict Management and Peace Science* 26(5): 471-491. doi:10.1177/0738894209343887.

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge University Press. Cambridge University Press.

Pevehouse, Jon C.W., Timothy Nordstron, Roseanne W McManus, Anne Spencer Jamison. 2020. "Tracking Organizations in the World: The Correlates of War IGO Version 3.0 datasets". *Journal of Peace Research* 57(3): 492-503. doi:10.1177/0022343319881175.

`mpn_elite_mex` *One-mode Mexican power elite database (Knoke 1990)*

Description

This data contains the full network of 35 members of the Mexican power elite. The undirected lines connecting pairs of men represent any formal, informal, or organizational relation between a dyad; for example, "common belonging (school, sports, business, political participation), or a common interest (political power)" (Mendieta et al. 1997: 37). Additional nodal attributes include their full name, place of birth, state, and region (1=North, 2=Centre, 3=South, original coding added by Frank Heber), as well as their year of entry into politics and whether they are civilian (0) or affiliated with the military (1). An additional variable "in_mpn" can be used to subset this network to a network of 11 core members of the 1990s Mexican power elite (Knoke 2017), three of which were successively elected presidents of Mexico: José López Portillo (1976-82), Miguel de la Madrid (1982-88), and Carlos Salinas de Gortari (1988-94, who was also the son of another core member, Raúl Salinas Lozano).

Usage

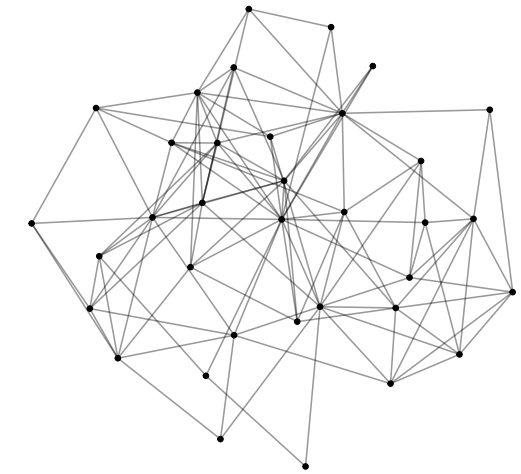
```
data(mpn_elite_mex)
```

Format

```
#>
#> -- # Mexican power elite network ----------------------------------------------
#> # A labelled, undirected network of 35 elites and 117 common belonging or
#> interest ties
#>
```

```
#> -- Nodes
#> # A tibble: 35 x 8
#>   name    full_name       entry_year military in_mpn PlaceOfBirth state region
#>   <chr>   <chr>                <dbl>    <dbl>  <dbl> <chr>       <chr>  <dbl>
#> 1 Trevino  Trevino, Jacint~      1910        1      0 Guerrero    Coah~      1
#> 2 Madero   Madero, Francis~      1911        0      0 Parras de l~ Coah~      1
#> 3 Carranza Carranza, Venus~      1913        1      0 Cuatro Cien~ Coah~      1
#> 4 Aguilar  Aguilar, Candido      1918        1      0 Cordoba     Vera~      3
#> 5 Obregon  Obregon, Alvaro       1920        1      0 Siquisiva, ~ Sono~      1
#> 6 Calles   Calles, Plutarc~      1924        1      0 Guaymas     Sono~      1
#> # i 29 more rows
#>
#> -- Ties
#> # A tibble: 117 x 2
#>    from    to
#>   <int> <int>
#> 1     2     3
#> 2     2     5
#> 3     2     6
#> 4     2     4
#> 5     1     2
#> 6     2     8
#> # i 111 more rows
#>
```

Details



References

Knoke, David. 1990. *Political Networks: The Structural Perspective*. Cambridge: Cambridge University Press.

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge: Cambridge University Press.

`mpn_elite_usa` *Two-mode and three-mode American power elite database (Domhoff 2016)*

Description

`mpn_elite_usa_advice` is a 2-mode network of persons serving as directors or trustees of think tanks. Think tanks are "public-policy research analysis and engagement organizations that generate policy-oriented research, analysis, and advice on domestic and international issues, thereby enabling policymakers and the public to make informed decisions about public policy" (McGann 2016: 6). The Power Elite Database (Domhoff 2016) includes information on the directors of 33 prominent think tanks in 2012. Here we include only 14 directors who held three or more seats among 20 think tanks.

`mpn_elite_usa_money` is based on 26 elites who sat on the boards of directors for at least two of six economic policy making organizations (Domhoff 2016), and also made campaign contributions to one or more of six candidates running in the primary election contests for the 2008 Presidential nominations of the Republican Party (Rudy Giuliani, John McCain, Mitt Romney) or the Democratic Party (Hillary Clinton, Christopher Dodd, Barack Obama).

Usage

```
data(mpn_elite_usa_advice)

data(mpn_elite_usa_money)
```

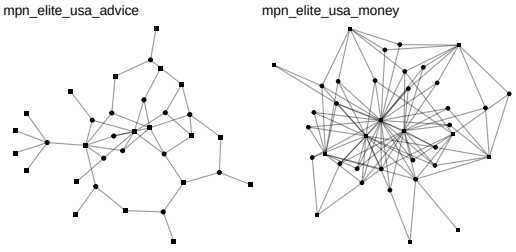
Format

```
#> # A labelled, two-mode network of 14 nodes and 20 nodes and 46 ties
#>
#> -- Nodes
#> # A tibble: 34 x 2
#>   type  name
#>   <lgl> <chr>
#> 1 FALSE Albright
#> 2 FALSE Argyros
#> 3 FALSE Armitage
#> 4 FALSE Curry
#> 5 FALSE Fukuyama
#> 6 FALSE Gray
#> # i 28 more rows
#>
#> -- Ties
#> # A tibble: 46 x 2
#>    from    to
```

```
#>   <int> <int>
#> 1     1    17
#> 2     1    19
#> 3     1    21
#> 4     2    22
#> 5     2    23
#> 6     2    27
#> # i 40 more rows
#>
```

```
#> # A labelled, two-mode network of 26 nodes and 12 nodes and 103 ties
#>
#> -- Nodes
#> # A tibble: 38 x 2
#>   type  name
#>   <lgl> <chr>
#> 1 FALSE Adkerson
#> 2 FALSE Akins
#> 3 FALSE Banga
#> 4 FALSE Boyce
#> 5 FALSE Britt
#> 6 FALSE Cannon
#> # i 32 more rows
#>
#> -- Ties
#> # A tibble: 103 x 2
#>    from    to
#>   <int> <int>
#> 1     1    27
#> 2     1    28
#> 3     1    34
#> 4     1    36
#> 5     2    28
#> 6     2    32
#> # i 97 more rows
#>
```

Details



References

Domhoff, G William. 2016. "Who Rules America? Power Elite Database."

The Center for Responsive Politics. 2019. "OpenSecrets." https://www.opensecrets.org.

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge University Press. Cambridge University Press.

`mpn_evs` *Two-mode European Values Survey, 1990 and 2008 (EVS 2020)*

Description

6 two-mode matrices containing individuals' memberships to 14 different types of associations in three countries (Italy, Germany, and the UK) in 1990 and 2008. The Italy data has 658 respondents in 1990 and 540 in 2008. The Germany data has 1369 respondents in 1990 and 503 in 2008. The UK data has 738 respondents in 1990 and 664 in 2008.

Usage

```
data(mpn_IT_1990)

data(mpn_IT_1990)

data(mpn_IT_2008)

data(mpn_DE_1990)

data(mpn_DE_2008)

data(mpn_UK_1990)

data(mpn_UK_2008)
```

Format

`tbl_graph` object based on an association matrix with 14 columns:

Welfare 1 if individual associated

Religious 1 if individual associated

Education.culture 1 if individual associated

Unions 1 if individual associated

Parties 1 if individual associated

Local.political.groups 1 if individual associated

Human.rights 1 if individual associated

Environmental.animal 1 if individual associated

Professional 1 if individual associated

Youth 1 if individual associated

Sports 1 if individual associated

Women 1 if individual associated

Peace 1 if individual associated

Health 1 if individual associated

An object of class `tbl_graph` (inherits from `igraph`) of length 672.

An object of class `tbl_graph` (inherits from `igraph`) of length 554.

An object of class `tbl_graph` (inherits from `igraph`) of length 1383.

An object of class `tbl_graph` (inherits from `igraph`) of length 517.

An object of class `tbl_graph` (inherits from `igraph`) of length 752.

An object of class `tbl_graph` (inherits from `igraph`) of length 678.

Source

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge University Press. Cambridge University Press.

References

EVS (2020). European Values Study Longitudinal Data File 1981-2008 (EVS 1981-2008). GESIS Data Archive, Cologne. ZA4804 Data file Version 3.1.0, doi:10.4232/1.13486.

`mpn_ryanair` *One-mode EU policy influence network, June 2004 (Christopoulos 2006)*

Description

Network of anonymised actors reacting to the Ryanair/Charleroi decision of the EU Commission in February 2004. The relationships mapped comprise an account of public records of interaction supplemented with the cognitive network of key informants. Examination of relevant communiques, public statements and a number of off-the-record interviews provides confidence that the network mapped closely approximated interactions between 29 January and 12 February 2004. The time point mapped is at the height of influence and interest intermediation played by actors in the AER, a comparatively obscure body representing the interests of a number of European regional bodies at the EU institutions.

Usage

```
data(mpn_ryanair)
```

Format

```
#> -- # EU policy influence network ----------------------------------------------
#> # A labelled, weighted, directed network of 20 policy actors and 177
#> interaction arcs
#>
#> -- Nodes
#> # A tibble: 20 x 1
#>   name
#>   <chr>
#> 1 1 AER
#> 2 2 AER
#> 3 5 AER/COR
#> 4 7 RYANAIR
#> 5 8 DG TRANSPORT
#> 6 9 COR
#> # i 14 more rows
#>
#> -- Ties
#> # A tibble: 177 x 3
#>    from    to weight
#>   <int> <int>  <dbl>
#> 1     1     2      1
#> 2     1     3      1
#> 3     1     4      1
#> 4     1     5      1
#> 5     1     6      1
#> 6     1     7      1
#> # i 171 more rows
#>
```

Source

Christopoulos, Dimitrios C. 2006. "Relational Attributes of Political Entrepreneurs: a Network Perspective." *Journal of European Public Policy* 13(5): 757–78. doi:10.1080/13501760600808964.

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge University Press. Cambridge University Press.

`mpn_senate112` *Two-mode 112th Congress Senate Voting (Knoke et al. 2021)*

Description

These datasets list the U.S. Senators who served in the 112th Congress, which met from January 3, 2011 to January 3, 2013. Although the Senate has 100 seats, 103 persons served during this period due to two resignations and a death. However, the third replacement occurred only two days before

the end and cast no votes on the bills investigated here. Hence, the number of Senators analyzed is 102.

CQ Almanac identified 25 key bills on which the Senate voted during the 112th Congress, and which Democratic and Republican Senators voting "yea" and "nay" on each proposal.

Lastly, we obtained data on campaign contributions made by 92 PACs from the Open Secrets Website. We recorded all contributions made during the 2008, 2010, and 2012 election campaigns to the 102 persons who were Senators in the 112th Congress. The vast majority of PAC contributions to a candidate during a campaign was for $10,000 (the legal maximum is $5,000 each for a primary and the general election). We aggregated the contributions across all three electoral cycles, then dichotomized the sums into no contribution (0) and any contribution (1).

Usage

```
data(mpn_senate_dem)

data(mpn_senate_rep)

data(mpn_senate_over)
```

Format

```
#> # A labelled, weighted, two-mode network of 51 nodes and 63 nodes and 2791 ties
#>
#> -- Nodes
#> # A tibble: 114 x 2
#>   type  name
#>   <lgl> <chr>
#> 1 FALSE Baucus
#> 2 FALSE Begich
#> 3 FALSE Bennet
#> 4 FALSE Blumenthal
#> 5 FALSE Boxer
#> 6 FALSE BrownSh
#> # i 108 more rows
#>
#> -- Ties
#> # A tibble: 2,791 x 3
#>    from    to weight
#>   <int> <int>  <dbl>
#> 1     1    52      1
#> 2     1    53      1
#> 3     1    54      1
#> 4     1    55      1
#> 5     1    56      1
#> 6     1    57      1
#> # i 2,785 more rows
#>

#> # A labelled, weighted, two-mode network of 62 nodes and 72 nodes and 3675 ties
```

```
#>
#> -- Nodes
#> # A tibble: 134 x 2
#>   type  name
#>   <lgl> <chr>
#> 1 FALSE Alexander
#> 2 FALSE Ayotte
#> 3 FALSE Barrasso
#> 4 FALSE Baucus
#> 5 FALSE Blunt
#> 6 FALSE Boozman
#> # i 128 more rows
#>
#> -- Ties
#> # A tibble: 3,675 x 3
#>    from    to weight
#>   <int> <int>  <dbl>
#> 1     1    64      1
#> 2     1    66      1
#> 3     1    67      1
#> 4     1    70      1
#> 5     1    71      1
#> 6     1    72      1
#> # i 3,669 more rows
#>

#> # A labelled, weighted, two-mode network of 20 nodes and 32 nodes and 614 ties
#>
#> -- Nodes
#> # A tibble: 52 x 2
#>   type  name
#>   <lgl> <chr>
#> 1 FALSE Baucus
#> 2 FALSE Cardin
#> 3 FALSE Carper
#> 4 FALSE Casey
#> 5 FALSE Collins
#> 6 FALSE Feinstein
#> # i 46 more rows
#>
#> -- Ties
#> # A tibble: 614 x 3
#>    from    to weight
#>   <int> <int>  <dbl>
#> 1     1    21      1
#> 2     1    22      1
#> 3     1    23      1
#> 4     1    24      1
#> 5     1    25      1
```

```
#> 6     1    26      1
#> # i 608 more rows
#>
```

References

Knoke, David, Mario Diani, James Hollway, and Dimitris C Christopoulos. 2021. *Multimodal Political Networks*. Cambridge University Press. Cambridge University Press.

`predict` *Predict methods for network regression*

Description

Predict methods for network regression

Usage

```
## S3 method for class 'netlm'
predict(object, newdata = NULL, ...)

## S3 method for class 'netlogit'
predict(object, newdata = NULL, type = c("link", "response"), ...)
```

Arguments

`object`	An object of class inheriting "netlm" or "netlogit"
`newdata`	A design matrix with the same columns/variables as the fitted model.
`...`	Additional arguments (not used).
`type`	Character string, one of "response" (default, whether the returned predictions are on the probability scale) or "link" (returned predictions are on the scale of the linear predictor).

Value

A numeric vector of predicted values.

Examples

```
networkers <- ison_networkers %>% to_subgraph(Discipline == "Sociology")
model1 <- net_regression(weight ~ ego(Citations) + alter(Citations) + sim(Citations),
                      networkers, times = 20)
predict(model1, matrix(c(1,10,5,2),1,4))
networkers <- ison_networkers %>% to_subgraph(Discipline == "Sociology") %>%
  to_unweighted()
model1 <- net_regression(. ~ ego(Citations) + alter(Citations) + sim(Citations),
                      networkers, times = 20)
predict(model1, matrix(c(1,10,5,2),1,4))
```

`regression` *Linear and logistic regression for network data*

Description

This function provides an implementation of the multiple regression quadratic assignment procedure (MRQAP) for both one-mode and two-mode network linear models. It offers several advantages:

- it works with combined graph/network objects such as igraph and network objects by constructing the various dependent and independent matrices for the user.
- it uses a more intuitive formula-based system for specifying the model, with several ways to specify how nodal attributes should be handled.
- it can handle categorical variables (factors/characters) and interactions intuitively, naming the reference variable where appropriate.
- it relies on {furrr} for parallelising and {progressr} for reporting progress to the user, which can be useful when many simulations are required.
- results are {broom}-compatible, with `tidy()` and `glance()` reports to facilitate comparison with results from different models. Note that a *t*- or *z*-value is always used as the test statistic, and properties of the dependent network – modes, directedness, loops, etc – will always be respected in permutations and analysis.

Usage

```
net_regression(
  formula,
  .data,
  method = c("qap", "qapy"),
  times = 1000,
  strategy = "sequential",
  verbose = FALSE
)
```

Arguments

`formula` A formula describing the relationship being tested. Several additional terms are available to assist users investigate the effects they are interested in. These include:

- `ego()` constructs a matrix where the cells reflect the value of a named nodal attribute for an edge's sending node
- `alter()` constructs a matrix where the cells reflect the value of a named nodal attribute for an edge's receiving node
- `same()` constructs a matrix where a 1 reflects if two nodes' attribute values are the same
- `dist()` constructs a matrix where the cells reflect the absolute difference between the attribute's values for the sending and receiving nodes

- `sim()` constructs a matrix where the cells reflect the proportional similarity between the attribute's values for the sending and receiving nodes
- `tertius()` constructs a matrix where the cells reflect some aggregate of an attribute associated with a node's other ties. Currently "mean" and "sum" are available aggregating functions. 'ego' is excluded from these calculations. See Haunss and Hollway (2023) for more on this effect.
- dyadic covariates (other networks) can just be named

`.data` A manynet-consistent network. See e.g. `manynet::as_tidygraph()` for more details.

`method` A method for establishing the null hypothesis. Note that "qap" uses Dekker et al's (2007) double semi-partialling technique, whereas "qapy" permutes only the y variable. "qap" is the default.

`times` Integer indicating number of simulations used for quantile estimation. (Relevant to the null hypothesis test only - the analysis itself is unaffected by this parameter.) Note that, as for all Monte Carlo procedures, convergence is slower for more extreme quantiles. By default, `times=1000`. 1,000 - 10,000 repetitions recommended for publication-ready results.

`strategy` If {furrr} is installed, then multiple cores can be used to accelerate the function. By default `"sequential"`, but if multiple cores available, then `"multisession"` or `"multicore"` may be useful. Generally this is useful only when `times` > 1000. See {furrr} for more.

`verbose` Whether the function should report on its progress. By default FALSE. See {progressr} for more.

References

Krackhardt, David. 1988. "Predicting with Networks: Nonparametric Multiple Regression Analysis of Dyadic Data." *Social Networks* 10(4):359–81. doi:10.1016/03788733(88)900044.

Dekker, David, David Krackhard, and Tom A. B. Snijders. 2007. "Sensitivity of MRQAP tests to collinearity and autocorrelation conditions." *Psychometrika* 72(4): 563-581. doi:10.1007/s11336-00790161.

See Also

Other models: `test_distributions`, `tests`

Examples

```
networkers <- ison_networkers %>% to_subgraph(Discipline == "Sociology")
model1 <- net_regression(weight ~ ego(Citations) + alter(Citations) + sim(Citations),
                      networkers, times = 20)
# Should be run many more `times` for publication-ready results
tidy(model1)
glance(model1)
plot(model1)
```

tests *Tests of network measures*

Description

These functions conduct tests of any network-level statistic:

- `test_random()` performs a conditional uniform graph (CUG) test of a measure against a distribution of measures on random networks of the same dimensions.
- `test_permutation()` performs a quadratic assignment procedure (QAP) test of a measure against a distribution of measures on permutations of the original network.

Usage

```
test_random(
  .data,
  FUN,
  ...,
  times = 1000,
  strategy = "sequential",
  verbose = FALSE
)

test_configuration(
  .data,
  FUN,
  ...,
  times = 1000,
  strategy = "sequential",
  verbose = FALSE
)

test_permutation(
  .data,
  FUN,
  ...,
  times = 1000,
  strategy = "sequential",
  verbose = FALSE
)
```

Arguments

`.data`	A manynet-consistent network. See e.g. `manynet::as_tidygraph()` for more details.
`FUN`	A graph-level statistic function to test.

...	Additional arguments to be passed on to FUN, e.g. the name of the attribute.
times	Integer indicating number of simulations used for quantile estimation. (Relevant to the null hypothesis test only - the analysis itself is unaffected by this parameter.) Note that, as for all Monte Carlo procedures, convergence is slower for more extreme quantiles. By default, `times=1000`. 1,000 - 10,000 repetitions recommended for publication-ready results.
strategy	If {furrr} is installed, then multiple cores can be used to accelerate the function. By default "sequential", but if multiple cores available, then "multisession" or "multicore" may be useful. Generally this is useful only when times > 1000. See {furrr} for more.
verbose	Whether the function should report on its progress. By default FALSE. See {progressr} for more.

See Also

Other models: regression, test_distributions

Examples

```
marvel_friends <- fict_marvel %>% to_uniplex("relationship") %>%
  to_unsigned() %>% to_giant() %>%
  to_subgraph(PowerOrigin == "Human")
(cugtest <- test_random(marvel_friends, net_by_heterophily, attribute = "Attractive",
   times = 200))
# plot(cugtest)
# (qaptest <- test_permutation(marvel_friends,
#                 net_by_heterophily, attribute = "Attractive",
#                 times = 200))
# plot(qaptest)
```

---

test_distributions *Tests of network distributions*

Description

These functions conduct tests of distributions:

- `test_distribution()` performs a two-sample Kolmogorov-Smirnov test on whether two "diff_model" objects are drawn from the same distribution.
- `test_fit()` performs a chi-squared test on the squared Mahalanobis distance between a diff_model and diff_models objects.

Usage

```
test_distribution(diff_model1, diff_model2)

test_fit(diff_model, diff_models)
```

Arguments

`diff_model1`, `diff_model2`
: diff_model objects

`diff_model`
: A diff_model object is returned by `play_diffusion()` or `as_diffusion()` and contains a single empirical or simulated diffusion.

`diff_models`
: A diff_models object is returned by `play_diffusions()` and contains a series of diffusion simulations.

Mahalanobis distance

`test_gof()` takes a single diff_model object, which may be a single empirical or simulated diffusion, and a diff_models object containing many simulations. Note that currently only the goodness of fit of the

It returns a tibble (compatible with `broom::glance()`) that includes the Mahalanobis distance statistic between the observed and simulated distributions. It also includes a p-value summarising a chi-squared test on this statistic, listing also the degrees of freedom and number of observations. If the p-value is less than the convention 0.05, then one can argue that the first diffusion is not well captured by

See Also

Other models: `regression`, `tests`

Examples

```
test_distribution(as_diffusion(play_diffusion(ison_networkers)),
            as_diffusion(play_diffusion(ison_networkers, thresholds = 75)))
 # Playing a reasonably quick diffusion
 # x <- play_diffusion(generate_random(15), transmissibility = 0.7)
 # Playing a slower diffusion
 # y <- play_diffusions(generate_random(15), transmissibility = 0.1, times = 40)
 # plot(x)
 # plot(y)
 # test_fit(x, y)
```

`tutorials` *Open and extract code from tutorials*

Description

These functions make it easy to use the tutorials in the {manynet} and {migraph} packages:

- `run_tute()` runs a {learnr} tutorial from either the {manynet} or {migraph} packages, wraps `learnr::run_tutorial()` with some convenience.
- `extract_tute()` extracts and opens just the solution code from a {manynet} or {migraph} tutorial, saving the .R script to the current working directory.

Usage

```
run_tute(tute)

extract_tute(tute)
```

Arguments

tute	String, name of the tutorial (e.g. "tutorial2").

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