

Package ‘socialmixr’

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Title Social Mixing Matrices for Infectious Disease Modelling

Version 0.4.0

Description Provides methods for sampling contact matrices from diary data for use in infectious disease modelling, as discussed in Mossong et al. (2008) <[doi:10.1371/journal.pmed.0050074](https://doi.org/10.1371/journal.pmed.0050074)>.

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Author Sebastian Funk [aut, cre],
Lander Willem [aut],
Hugo Gruson [aut],
Maria Bekker-Nielsen Dunbar [ctb],
Carl A. B. Pearson [ctb],
Sam Clifford [ctb],
Christopher Jarvis [ctb],
Alexis Robert [ctb],
Niel Hens [ctb],
Pietro Coletti [col, dtm]

Maintainer Sebastian Funk <sebastian.funk@lshtm.ac.uk>

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check	<i>Check contact survey data</i>
-------	----------------------------------

Description

Checks that a survey fulfills all the requirements to work with the 'contact_matrix' function

Usage

```
## S3 method for class 'survey'
check(
  x,
  id.column = "part_id",
  participant.age.column = "part_age",
  country.column = "country",
  year.column = "year",
  contact.age.column = "cnt_age",
  ...
)
```

Arguments

<code>x</code>	A survey() object
<code>id.column</code>	the column in both the participants and contacts data frames that links contacts to participants
<code>participant.age.column</code>	the column in the participants data frame containing participants' age; if this does not exist, at least columns "..._exact", "..._est_min" and "..._est_max" must (see the <code>estimated.participant.age</code> option in contact_matrix())
<code>country.column</code>	the column in the participants data frame containing the country in which the participant was queried
<code>year.column</code>	the column in the participants data frame containing the year in which the participant was queried
<code>contact.age.column</code>	the column in the contacts data frame containing the age of contacts; if this does not exist, at least columns "..._exact", "..._est_min" and "..._est_max" must (see the <code>estimated.contact.age</code> option in contact_matrix())
<code>...</code>	ignored

Value

invisibly returns a character vector of the relevant columns

Examples

```
data(polymod)
check(polymod)
```

clean	<i>Clean contact survey data</i>
-------	----------------------------------

Description

Cleans survey data to work with the 'contact_matrix' function

Usage

```
## S3 method for class 'survey'
clean(x, country.column = "country", participant.age.column = "part_age", ...)
```

Arguments

<code>x</code>	A survey() object
<code>country.column</code>	the name of the country in which the survey participant was interviewed
<code>participant.age.column</code>	the column in <code>x\$participants</code> containing participants' age
<code>...</code>	ignored

Value

a cleaned survey in the correct format

Examples

```
data(polymod)
cleaned <- clean(polymod) # not really necessary as the 'polymod' data set has already been cleaned
```

contact_matrix	<i>Generate a contact matrix from diary survey data</i>
----------------	---

Description

Samples a contact survey

Usage

```
contact_matrix(
  survey,
  countries = NULL,
  survey.pop,
  age.limits,
  filter,
  counts = FALSE,
  symmetric = FALSE,
  split = FALSE,
  sample.participants = FALSE,
  estimated.participant.age = c("mean", "sample", "missing"),
  estimated.contact.age = c("mean", "sample", "missing"),
  missing.participant.age = c("remove", "keep"),
  missing.contact.age = c("remove", "sample", "keep", "ignore"),
  weights = NULL,
  weigh.dayofweek = FALSE,
  weigh.age = FALSE,
  weight.threshold = NA,
  sample.all.age.groups = FALSE,
  return.part.weights = FALSE,
  return.demography = NA,
  per.capita = FALSE,
  ...
)
```

Arguments

survey	a survey() object
countries	limit to one or more countries; if not given, will use all countries in the survey; these can be given as country names or 2-letter (ISO Alpha-2) country codes

survey.pop	survey population – either a data frame with columns 'lower.age.limit' and 'population', or a character vector giving the name(s) of a country or countries from the list that can be obtained via <code>wpp_countries</code> ; if not given, will use the country populations from the chosen countries, or all countries in the survey if <code>countries</code> is not given
age.limits	lower limits of the age groups over which to construct the matrix
filter	any filters to apply to the data, given as list of the form (column=filter_value) - only contacts that have 'filter_value' in 'column' will be considered. If multiple filters are given, they are all applied independently and in the sequence given.
counts	whether to return counts (instead of means)
symmetric	whether to make matrix symmetric, such that $c_{ij}N_i = c_{ji}N_j$.
split	whether to split the contact matrix into the mean number of contacts, in each age group (split further into the product of the mean number of contacts across the whole population (<code>mean.contacts</code>), a normalisation constant (<code>normalisation</code>) and age-specific variation in contacts (<code>contacts</code>)), multiplied with an assortativity matrix (<code>assortativity</code>) and a population multiplier (<code>demography</code>). For more detail on this, see the "Getting Started" vignette.
sample.participants	whether to sample participants randomly (with replacement); done multiple times this can be used to assess uncertainty in the generated contact matrices. See the "Bootstrapping" section in the vignette for how to do this..
estimated.participant.age	if set to "mean" (default), people whose ages are given as a range (in columns named "..._est_min" and "..._est_max") but not exactly (in a column named "..._exact") will have their age set to the mid-point of the range; if set to "sample", the age will be sampled from the range; if set to "missing", age ranges will be treated as missing
estimated.contact.age	if set to "mean" (default), contacts whose ages are given as a range (in columns named "..._est_min" and "..._est_max") but not exactly (in a column named "..._exact") will have their age set to the mid-point of the range; if set to "sample", the age will be sampled from the range; if set to "missing", age ranges will be treated as missing
missing.participant.age	if set to "remove" (default), participants without age information are removed; if set to "keep", participants with missing age are kept and treated as a separate age group
missing.contact.age	if set to "remove" (default), participants that have contacts without age information are removed; if set to "sample", contacts without age information are sampled from all the contacts of participants of the same age group; if set to "keep", contacts with missing age are kept and treated as a separate age group; if set to "ignore", contact with missing age are ignored in the contact analysis
weights	column names(s) of the participant data of the <code>survey()</code> object with user-specified weights (default = empty vector)

`weigh.dayofweek` whether to weigh social contacts data by the day of the week (weight $(5/7 / N_week / N)$ for weekdays and $(2/7 / N_weekend / N)$ for weekends)

`weigh.age` whether to weigh social contacts data by the age of the participants (vs. the populations' age distribution)

`weight.threshold` threshold value for the standardized weights before running an additional standardisation (default 'NA' = no cutoff)

`sample.all.age.groups` what to do if sampling participants (with `sample.participants = TRUE`) fails to sample participants from one or more age groups; if FALSE (default), corresponding rows will be set to NA, if TRUE the sample will be discarded and a new one taken instead

`return.part.weights` boolean to return the participant weights

`return.demography` boolean to explicitly return demography data that corresponds to the survey data (default 'NA' = if demography data is requested by other function parameters)

`per.capita` whether to return a matrix with contact rates per capita (default is FALSE and not possible if 'counts=TRUE' or 'split=TRUE')

`...` further arguments to pass to `get_survey()`, `check()` and `pop_age()` (especially column names)

Value

a contact matrix, and the underlying demography of the surveyed population

Author(s)

Sebastian Funk

Examples

```
data(polymod)
contact_matrix(polymod, countries = "United Kingdom", age.limits = c(0, 1, 5, 15))
```

download_survey

Download a survey from its Zenodo repository

Description

Downloads survey data

Usage

```
download_survey(survey, dir = NULL, sleep = 1)
```

Arguments

survey a URL (see [list_surveys\(\)](#))
dir a directory to save the files to; if not given, will save to a temporary directory
sleep time to sleep between requests to avoid overloading the server (passed on to [Sys.sleep](#))

Value

a vector of filenames that can be used with [load_survey](#)

Examples

```
## Not run:  
list_surveys()  
peru_survey <- download_survey("https://doi.org/10.5281/zenodo.1095664")  
  
## End(Not run)
```

get_citation	<i>Citation for a survey</i>
--------------	------------------------------

Description

Gets a full citation for a [survey\(\)](#).

Usage

```
get_citation(x)
```

Arguments

x a character vector of surveys to cite

Value

citation as bibentry

Examples

```
data(polymod)  
citation <- get_citation(polymod)  
print(citation)  
print(citation, style = "bibtex")
```

get_survey	<i>Get a survey, either from its Zenodo repository, a set of files, or a survey variable</i>
------------	--

Description

Downloads survey data, or extracts them from files, and returns a clean data set. If a survey URL is accessed multiple times, the data will be cached (unless `clear_cache` is set to TRUE) to avoid repeated downloads.

Usage

```
get_survey(survey, clear_cache = FALSE, ...)
```

Arguments

survey	a DOI or url to get the survey from, or a survey() object (in which case only cleaning is done).
clear_cache	logical, whether to clear the cache before downloading the survey; by default, the cache is not cleared and so multiple calls of this function to access the same survey will not result in repeated downloads
...	options for clean() , which is called at the end of this

Details

If survey objects are used repeatedly the downloaded files can be saved and reloaded between sessions then survey objects can be saved/loaded using [base::saveRDS\(\)](#) and [base::readRDS\(\)](#), or via the individual survey files that can be downloaded using [download_survey\(\)](#) and subsequently loaded using [load_survey\(\)](#).

Value

a survey in the correct format

Examples

```
## Not run:
list_surveys()
peru_survey <- get_survey("https://doi.org/10.5281/zenodo.1095664")

## End(Not run)
```

is_doi	<i>Checks if a character string is a DOI</i>
--------	--

Description

Checks if a character string is a DOI

Usage

```
is_doi(x)
```

Arguments

x	Character vector; the string or strings to check
---	--

Value

Logical; TRUE if x is a DOI, FALSE otherwise

Author(s)

Sebastian Funk

limits_to_agegroups	<i>Convert lower age limits to age groups.</i>
---------------------	--

Description

Mostly used for plot labelling

Usage

```
limits_to_agegroups(  
  x,  
  limits = sort(unique(x)),  
  notation = c("dashes", "brackets")  
)
```

Arguments

x	age limits to transform
limits	lower age limits; if not given, will use all limits in x
notation	whether to use bracket notation, e.g. [0,4) or dash notation, e.g. 0-4)

Value

Age groups as specified in notation

Examples

```
limits_to_agegroups(c(0, 5, 10))
```

list_surveys

List all surveys available for download

Description

List all surveys available for download

Usage

```
list_surveys(clear_cache = FALSE)
```

Arguments

clear_cache	logical, whether to clear the cache before downloading the survey; by default, the cache is not cleared and so multiple calls of this function to access the same survey will not result in repeated downloads
-------------	--

Value

character vector of surveys

Examples

```
## Not run:  
list_surveys()  
  
## End(Not run)
```

load_survey	<i>Load a survey from local files</i>
-------------	---------------------------------------

Description

Loads a survey from a local file system. Tables are expected as csv files, and a reference (if present) as JSON.

Usage

```
load_survey(files, ...)
```

Arguments

files	a vector of file names as returned by <code>download_survey()</code>
...	options for <code>clean()</code> , which is called at the end of this

Value

a survey in the correct format

Examples

```
## Not run:
list_surveys()
peru_files <- download_survey("https://doi.org/10.5281/zenodo.1095664")
peru_survey <- load_survey(peru_files)

## End(Not run)
```

matrix_plot	<i>Draws an image plot of a contact matrix with a legend strip and the numeric values in the cells.</i>
-------------	---

Description

This function combines the R `image.plot` function with numeric contact rates in the matrix cells.

Usage

```
matrix_plot(
  mij,
  min.legend = 0,
  max.legend = NA,
  num.digits = 2,
  num.colors = 50,
```

```

    main,
    xlab,
    ylab,
    legend.width,
    legend.mar,
    legend.shrink,
    cex.lab,
    cex.axis,
    cex.text,
    color.palette = heat.colors
  )

```

Arguments

<code>mij</code>	a contact matrix containing contact rates between participants of age <i>i</i> (rows) with contacts of age <i>j</i> (columns). This is the default matrix format of contact_matrix() .
<code>min.legend</code>	the color scale minimum (default = 0). Set to NA to use the minimum value of <code>mij</code> .
<code>max.legend</code>	the color scale maximum (default = NA). Set to NA to use the maximum value of <code>mij</code> .
<code>num.digits</code>	the number of digits when rounding the contact rates (default = 2). Use NA to disable this.
<code>num.colors</code>	the number of color breaks (default = 50)
<code>main</code>	the figure title
<code>xlab</code>	a title for the x axis (default: "Age group (years)")
<code>ylab</code>	a title for the y axis (default: "Contact age group (years)")
<code>legend.width</code>	width of the legend strip in characters. Default is 1.
<code>legend.mar</code>	width in characters of legend margin. Default is 5.1.
<code>legend.shrink</code>	amount to shrink the size of legend relative to the full height or width of the plot. Default is 0.9.
<code>cex.lab</code>	size of the x and y labels (default: 1.2)
<code>cex.axis</code>	size of the axis labels (default: 0.8)
<code>cex.text</code>	size of the numeric values in the matrix (default: 1)
<code>color.palette</code>	the color palette to use (default: heat.colors()). Other examples are topo.colors() , terrain.colors() and hcl.colors() . User-defined functions are also possible if they take the number of colors to be in the palette as function argument.

Details

This is a function using basic R graphics to visualise a social contact matrix.

Author(s)

Lander Willem

Examples

```
## Not run:
data(polymod)
mij <- contact_matrix(polymod, countries = "United Kingdom", age.limits = c(0, 18, 65))$matrix
matrix_plot(mij)

## End(Not run)
```

polymod

Social contact data from 8 European countries

Description

A dataset containing social mixing diary data from 8 European countries: Belgium, Germany, Finland, Great Britain, Italy, Luxembourg, The Netherlands and Poland. The Data are fully described in Mossong J, Hens N, Jit M, Beutels P, Auranen K, Mikolajczyk R, et al. (2008) Social Contacts and Mixing Patterns Relevant to the Spread of Infectious Diseases. PLoS Med 5(3): e74.

Usage

polymod

Format

A list of two data frames:

participants the study participant, with age, country, year and day of the week (starting with 1 = Monday)

contacts reported contacts of the study participants. The variable `phys_contact` has two levels (1 denotes physical contact while 2 denotes non-physical contact), `duration_multi` has five levels (1 is less than 5 minutes while 5 is more than 4 hours, increasing in the order found in Figure 1 in Mossong et al.), and `frequency_multi` has five levels (1 is daily, 2 is weekly, 3 is monthly, 4 is less often, and 5 is first time) All other variables are described on the Zenodo repository of the data, available at [doi:10.5281/zenodo.1043437](https://doi.org/10.5281/zenodo.1043437)

Source

[doi:10.1371/journal.pmed.0050074](https://doi.org/10.1371/journal.pmed.0050074)

pop_age

*Change age groups in population data***Description**

This changes population data to have age groups with the given age.limits, extrapolating linearly between age groups (if more are requested than available) and summing populations (if fewer are requested than available)

Usage

```
pop_age(
  pop,
  age.limits,
  pop.age.column = "lower.age.limit",
  pop.column = "population",
  ...
)
```

Arguments

pop	a data frame with columns indicating lower age limits and population sizes (see 'age.column' and 'pop.column')
age.limits	lower age limits of age groups to extract
pop.age.column	column in the 'pop' data frame indicating the lower age group limit
pop.column	column in the 'pop' data frame indicating the population size
...	ignored

Value

data frame of age-specific population data

Examples

```
ages_it_2015 <- wpp_age("Italy", 2015)

# Modify the age data.frame to get age groups of 10 years instead of 5
pop_age(ages_it_2015, age.limit = seq(0, 100, by = 10))

# The function will also automatically interpolate if necessary
pop_age(ages_it_2015, age.limit = c(0, 18, 40, 65))
```

reduce_agegroups	<i>Reduce the number of age groups given a broader set of limits</i>
------------------	--

Description

Operates on lower limits

Usage

```
reduce_agegroups(x, limits)
```

Arguments

x	vector of limits
limits	new limits

Value

vector with the new age groups

Examples

```
reduce_agegroups(seq_len(20), c(0, 5, 10))
```

survey	<i>Contact survey</i>
--------	-----------------------

Description

A survey object contains the results of a contact survey. In particular, it contains two data frames called participants and contacts that are linked by a column specified as `id.column`

Usage

```
survey(participants, contacts, reference = NULL)
```

Arguments

participants	a <code>data.frame</code> containing information on participants
contacts	a <code>data.frame</code> containing information on contacts
reference	a list containing information needed to reference the survey, in particular it can contain a "title", "bibtype", "author", "doi", "publisher", "note", "year"

Value

a new survey object

Author(s)

Sebastian Funk

Examples

```
data(polymod)
new_survey <- survey(polymod$participants, polymod$contacts)
```

survey_countries	<i>List all countries contained in a survey</i>
------------------	---

Description

List all countries contained in a survey

Usage

```
survey_countries(survey, country.column = "country", ...)
```

Arguments

survey	a DOI or url to get the survey from, or a survey() object (in which case only cleaning is done).
country.column	column in the survey indicating the country
...	further arguments for get_survey()

Value

list of countries

Examples

```
data(polymod)
survey_countries(polymod)
```

wpp_age	<i>Get age-specific population data according to the World Population Prospects 2017 edition</i>
---------	--

Description

This uses data from the wpp2017 package but combines male and female, and converts age groups to lower age limits. If the requested year is not present in the historical data, wpp projections are used.

Usage

```
wpp_age(countries, years)
```

Arguments

<code>countries</code>	countries, will return all if not given
<code>years</code>	years, will return all if not given

Value

data frame of age-specific population data

Examples

```
wpp_age("Italy", c(1990, 2000))
```

wpp_countries	<i>List all countries and regions for which socialmixr has population data</i>
---------------	--

Description

Uses the World Population Prospects data from the wpp2017 package

Usage

```
wpp_countries()
```

Value

list of countries

Examples

```
wpp_countries()
```

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