Package ‘synthACS’

January 26, 2020

Title Synthetic Microdata and Spatial MicroSimulation Modeling for ACS Data

Version 1.5.3

Description Provides access to curated American Community Survey (ACS) base tables via a wrapper to library(acs). Builds synthetic micro-datasets at any user-specified geographic level with ten default attributes; and, conducts spatial microsimulation modeling (SMSM) via simulated annealing. SMSM is conducted in parallel by default. Lastly, we provide functionality for data-extensibility of micro-datasets.

Depends R (>= 3.2.3)

Imports data.table (>= 1.9.6), Rcpp, acs (>= 2.1)

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add_constraint

Description

Add a new constraint to the mapping between a given macro dataset (class "macroACS") and a matching micro dataset (class "micro_synthetic"). May be called repeatedly to create a set of constraints.

Usage

add_constraint(attr_name = "variable", attr_totals, micro_data, constraint_list = NULL)

Arguments

attr_name
The name of the attribute, or variable, that you wish to constrain.

attr_totals
A named integer vector of counts per level of the new constraining attribute.

micro_data
The micro dataset, of class "micro_synthetic", for which you wish to add a constraint.

constraint_list
A list of prior constraints on the same dataset which you wish to add to. Defaults to NULL (i.e. the default is that this is the first constraint.)

Value

A list of constraints.

Examples

## Not run:
## assumes that you have a micro_synthetic dataset named test_micro and attribute counts
## named a,e,g respectively

c_list <- add_constraint(attr_name = "age", attr_totals = a, micro_data = test_micro)
c_list <- add_constraint(attr_name = "edu_attain", attr_totals = e, micro_data = test_micro, constraint_list = c_list)
c_list <- add_constraint(attr_name = "gender", attr_totals = g, micro_data = test_micro, constraint_list = c_list)

## End(Not run)
Description

A dataset containing age-adjusted death rate data by race and gender of the deceased. Data is provided for 1980-2013.

Usage

adjDR

Format

A data.frame with 612 observations and 4 variables.

year  The year for which data was recorded.

race The racial group of the deceased One of all races; white whites; black_aa black / African-American; nat_amer American Indian or Native Alaskan; asian_isl Asian or Pacific Islander; hisp_lat Hispanic.

gender The gender of the deceased. One of c(both, male, female)

adj_death_rate The age-adjusted death rate. See details.

Details

- The age-adjusted death rates are used to compare relative mortality risks among groups and over time. They were computed by the direct method, which is defined

\[
R' = \sum_i \frac{P_{si}}{P_s} R_i
\]

where \(P_{si}\) is the standard population for age group \(i\), \(P_s\) is the total US standard population and \(R_i\) is the raw death rate for age group \(i\).

- Populations are based on census counts enumerated as of April 1 of the census year and estimated as of July 1 for non-census years.

Source

http://www.cdc.gov/nchs/nvss/deaths.htm

References

Description

A dataset containing death rates for individuals by age group and race for the United States, 2013.

Usage

AgeRaceDR

Format

A `data.frame` with 360 observations and 4 variables.

- **age** The exact age, in years, at which life expectancy is calculated.
- **race** The racial group of the deceased. One of all races; white whites; black black / African-American; hispanic Hispanic; asian.isl Asian and Pacific Islander; nat.amer Native American or Alaska Native.
- **gender** The gender of the deceased. One of c(both, male, female)
- **death_rate** The raw death rate. See details.

Details

- The death rate is defined as deaths per 100,000 population.

Source

http://www.cdc.gov/nchs/nvss/deaths.htm

References


Description

Add a new constraint to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class ‘macro_micro’). May be called repeatedly to create a set of constraints across the sub-geographies.
**Usage**

```r
all_geogs_add_constraint(attr_name = "variable", attr_total_list,
                         macro_micro, constraint_list_list = NULL)
```

**Arguments**

- `attr_name` The name of the attribute, or variable, that you wish to constrain.
- `attr_total_list` A list of named integer vectors containing counts per level of the new constraining attribute for each geography.
- `macro_micro` The geographical dataset of macro and micro data. Should be of class "macro_micro".
- `constraint_list_list` A list of lists containing prior constraints on the same dataset for which you wish to add to. Defaults to `NULL` (ie. the default is that this is the first constraint.)

**Value**

A list of constraint lists.

**See Also**

- `add_constraint`

**Examples**

```r
## Not run:
# assumes that micro_synthetic already exists in your environment

# 1. build constraints for gender and age
g <- all_geog_constraint_gender(micro_synthetic, method = "macro.table")
a <- all_geog_constraint_age(micro_synthetic, method = "macro.table")

# 2. bind constraints to geographies and macro-data
c1l <- all_geogs_add_constraint(attr_name = "age", attr_total_list = a,
                                macro_micro = micro_synthetic)
c1l <- all_geogs_add_constraint(attr_name = "gender", attr_total_list = g,
                                macro_micro = micro_synthetic, constraint_list_list = c1l)

## End(Not run)
```
**all_geog_constraint_age**

Create age constraint list to a set of geographies

**Description**

Create a new age constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

**Usage**

```r
all_geog_constraint_age(obj, method = c("synthetic", "macro.table"))
```

**Arguments**

- **obj**: An object of class "synthACS".
- **method**: One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are built from the data in the base ACS tables.

**See Also**

`all_geogs_add_constraint`

**Examples**

```r
## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
da1 <- all_geog_constraint_age(obj, "synthetic")
da2 <- all_geog_constraint_age(obj, "macro.table")
## End(Not run)
```

---

**all_geog_constraint_edu**

Create educational attainment constraint list to a set of geographies

**Description**

Create a new educational attainment constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

**Usage**

```r
all_geog_constraint_edu(obj, method = c("synthetic", "macro.table"))
```
Arguments

obj  An object of class "synthACS".

method One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint

Examples

## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
e1 <- all_geog_constraint_edu(obj, "synthetic")
e2 <- all_geog_constraint_edu(obj, "macro_table")
## End(Not run)

all_geog_constraint_employment

Create employment status constraint list to a set of geographies

Description

Create a new employment status constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

Usage

all_geog_constraint_employment(obj, method = c("synthetic", "macro.table"))

Arguments

obj  An object of class "synthACS".

method One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint
all_geog_constraint_gender

Create gender constraint list to a set of geographies

Description

Create a new gender constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

Usage

all_geog_constraint_gender(obj, method = c("synthetic", "macro.table"))

Arguments

obj An object of class "synthACS".
method One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint

Examples

## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
e1 <- all_geog_constraint_employment(obj, "synthetic")
e2 <- all_geog_constraint_employment(obj, "macro_table")

## End(Not run)
**all_geog_constraint_geog_mob**

Create geographic mobility constraint list to a set of geographies

**Description**
Create a new geographic mobility constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

**Usage**

```r
all_geog_constraint_geog_mob(obj, method = c("synthetic", "macro.table"))
```

**Arguments**
- `obj` An object of class "synthACS".
- `method` One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are built from the data in the base ACS tables.

**See Also**
- `all_geogs_add_constraint`

**Examples**

```r
## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
gm1 <- all_geog_constraint_geog_mob(obj, "synthetic")
gm2 <- all_geog_constraint_geog_mob(obj, "macro_table")
## End(Not run)
```

**all_geog_constraint_income**

Create individual income constraint list to a set of geographies

**Description**
Create a new individual income constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

**Usage**

```r
all_geog_constraint_income(obj, method = c("synthetic", "macro.table"))
```
all_geog_constraint_marital_status

Arguments

obj  An object of class "synthACS".
method One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint

Examples

## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
i1 <- all_geog_constraint_income(obj, "synthetic")
i2 <- all_geog_constraint_income(obj, "macro_table")

## End(Not run)

all_geog_constraint_marital_status

Create marital status constraint list to a set of geographies

Description

Create a new marital status constraint list to the mapping between a a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

Usage

all_geog_constraint_marital_status(obj, method = c("synthetic", "macro.table"))

Arguments

obj  An object of class "synthACS".
method One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint
all_geog_constraint_nativity

Create nativity status constraint list to a set of geographies

Description

Create a new nativity status constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

Usage

all_geog_constraint_nativity(obj, method = c("synthetic", "macro.table"))

Arguments

obj An object of class "synthACS".
method One of c("synthetic", "macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are built from the data in the base ACS tables.

See Also

all_geogs_add_constraint

Examples

## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
n1 <- all_geog_constraint_nativity(obj, "synthetic")
n2 <- all_geog_constraint_nativity(obj, "macro_table")

## End(Not run)
all_geog_constraint_poverty

Create poverty status constraint list to a set of geographies

Description

Create a new poverty status constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

Usage

all_geog_constraint_poverty(obj, method = c("synthetic", "macro.table"))

Arguments

obj  An object of class "synthACS".
method  One of c("synthetic", "macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint

Examples

## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
p1 <- all_geog_constraint_poverty(obj, "synthetic")
p2 <- all_geog_constraint_poverty(obj, "macro_table")

## End(Not run)

all_geog_constraint_race

Create race constraint list to a set of geographies

Description

Create a new race constraint list to the mapping between a set of macro datasets and a matching set of micro dataset (supplied as class 'synthACS').

Usage

all_geog_constraint_race(obj, method = c("synthetic", "macro.table"))
Arguments

obj
An object of class "synthACS".

method
One of c("synthetic","macro.table"). Specifying "synthetic" indicates that constraints are built by marginalizing the synthetic micro datasets. Specifying "macro.table" indicates that the constraints are build from the data in the base ACS tables.

See Also

all_geogs_add_constraint

Examples

## Not run:
# assumes that obj of class 'synthACS' already exists in your environment
r1 <- all_geog_constraint_race(obj, "synthetic")
r2 <- all_geog_constraint_race(obj, "macro_table")
## End(Not run)

---

all_geog_optimize_microdata

Optimize the selection of a micro data population for a set of geographies.

Description

Optimize the candidate micro datasets such that the lowest loss against the macro dataset constraints are obtained. Loss is defined here as total absolute error (TAE) and constraints are defined by the constraint_list_list. Optimization is done by simulated annealing and geographies are run in parallel.

Usage

all_geog_optimize_microdata(macro_micro, prob_name = "p",
constraint_list_list, p_accept = 0.4, max_iter = 10000L,
seed = sample.int(10000L, size = 1, replace = FALSE), verbose = TRUE)

Arguments

macro_micro
The geographical dataset of macro and micro data. Should be of class "macro_micro".

prob_name
It is assumed that observations are weighted and do not have an equal probability of occurance. This string specifies the variable within each dataset that contains the probability of selection.

constraint_list_list
A list of constraint lists. See add_constraint, all_geogs_add_constraint
all_geog_synthetic_new_attribute

Add a new attribute to a set (ie list) of synthetic_micro datasets

Description
Add a new attribute to a set (ie list) of synthetic_micro datasets using conditional relationships between the new attribute and existing attributes (eg. wage rate conditioned on age and education level). The same attribute is added to *each* synthetic_micro dataset, where each dataset is supplied a distinct relationship for attribute creation.

Usage
all_geog_synthetic_new_attribute(df_list, prob_name = "p",
attr_name = "variable", conditional_vars = NULL, st_list = NULL)

Arguments
df_list A list of R objects each of class "synthetic_micro".
prob_name A string specifying the column name of each data.frame in df_list containing the probabilities for each synthetic observation.
attr_name A string specifying the desired name of the new attribute to be added to the data.
conditional_vars An character vector specifying the existing variables, if any, on which the new attribute (variable) is to be conditioned on for each dataset. Variables must be specified in order. Defaults to NULL ie- an unconditional new attribute.
all_geog_synthetic_new_attribute

st_list  A list of equal length to df_list. Each element of st_list is a data.frame symbol table with N + 2 columns. The last two columns must be: 1. A vector containing the new attribute counts or percentages; 2. a vector of the new attribute levels. The first N columns must match the conditioning scheme imposed by the variables in conditional_vars. See synthetic_new_attribute and examples.

Value

A list of new synthetic_micro datasets each with class "synthetic_micro".

See Also

synthetic_new_attribute

Examples

## Not run:
set.seed(567L)
df <- data.frame(gender= factor(sample(c("male", "female"), size= 100, replace= TRUE)),
                 age= factor(sample(1:5, size= 100, replace= TRUE)),
                 pov= factor(sample(c("lt_pov", "gt_eq_pov"),
                                    size= 100, replace= TRUE, prob= c(.15,.85)) ),
                 p= runif(100))
df$p <- df$p / sum(df$p)
class(df) <- c("data.frame", "micro_synthetic")

# and example test elements
cond_v <- c("gender", "pov")
levels <- c("employed", "unemp", "not_in_LF")
sym_tbl <- data.frame(gender= rep(rep(c("male", "female"), each= 3), 2),
                      pov= rep(c("lt_pov", "gt_eq_pov"), each= 6),
                      cnts= c(52, 8, 268, 72, 12, 228, 1338, 93, 297, 921, 105, 554),
                      lvls= rep(levels, 4))

df_list <- replicate(10, df, simplify= FALSE)
st_list <- replicate(10, sym_tbl, simplify= FALSE)

# run
library(parallel)
syn <- all_geog_synthetic_new_attribute(df_list, prob_name= "p", attr_name= "variable",
                                        conditional_vars= cond_v, st_list= st_list)

## End(Not run)
Description

A dataset containing birth rate data in the United States by age and race of the mother. Data for all races is provided for 1970-2014 and for individual races from 1989-2014.

Usage

BR2014

Format

A data.frame with 1,750 observations and 4 variables.

- **year** The year for which data was recorded.
- **race** The racial group of the mothers. One of all races; white non-hispanic whites; black_aa black / African-American; nat_amer American Indian or Native Alaskan; asian_isl Asian or Pacific Islander; hisp_lat Hispanic or Latin American.
- **age_group** The age group of the mother.
- **birth_rate** The birth rate. See Details.

Details

- The birth rate is defined as births per 1,000 women in the specified group (age and race).
- Populations are based on census counts enumerated as of April 1 of the census year and estimated as of July 1 for non-census years.
- Beginning in 1997, birth rates for age group 45up by relating births to all women age 45 or older to this group. Prior to 1997, only births to women age 45-49 were included.

Source

http://www.cdc.gov/nchs/nvss/births.htm

References

calculate_TAE  
Calculate the total absolute error (TAE) between sample data and constraints.

Description

Calculates the total absolute error (TAE) between sample micro data and constraining totals from the matching macro data. Allows for updating of prior TAE instead of re-calculating to improve speed in iterating. The updating feature is particularly helpful for optimizing micro data fitting via simulated annealing (see optimize_microdata).

Usage

calculate_TAE(sample_data, constraint_list, prior_sample_totals = NULL, dropped_obs_totals = NULL, new_obs = NULL)

Arguments

- **sample_data**: A data.frame with attributes matching constraint_list.
- **constraint_list**: A list of constraints. See add_constraint.
- **prior_sample_totals**: An optional list containing attribute counts of a prior sample corresponding to the constraint list. Defaults to NULL.
- **dropped_obs_totals**: An optional list containing attribute counts from the dropped observations in a prior sample. Defaults to NULL.
- **new_obs**: An optional data.frame containing new observations with attributes matching those in sample_data, constraint_list, and prior_sample_totals. Defaults to NULL.

Examples

```r
## Not run:
## assumes that you have a micro_synthetic dataset named test_micro and attribute count named g respectively
c_list <- add_constraint(attr_name= "gender", attr_totals= g, micro_data= test_micro, constraint_list= c_list)
calculate_TAE(test_micro, c_list)
## End(Not run)
```
combine_smsm  

Combine separate SMSM optimizations

Description

Combine objects of class "smsm_set" into a single object of class "smsm_set"

Usage

combine_smsm(...)

Arguments

...  A list of objects of class 'smsm_set'.

See Also

split, all_geog_optimize_microdata

Examples

## Not run:
combined <- combine_smsm(smsm1, smsm2, smsm3)

## End(Not run)

derive_synth_datasets  Derive synthetic micro datasets for a given geography.

Description

Derive synthetic micro datasets for each sub-geography of a given set of geographic macro data constraining tabulations. See Details... By default, micro dataset generation is run in parallel with load balancing. Macro data is assumed to have been pulled from the US Census API via the acs package.

Usage

derive_synth_datasets(macro_data, parallel = TRUE, leave_cores = 2)

Arguments

macro_data  A macro dataset list: the result of pull_synth_data.
parallel  Logical, defaults to TRUE. Do you wish to run the operation in parallel?
leave_cores  How many cores do you wish to leave open to other processing?
Value

A list of the input macro datasets produced by `pull_synth_data` and a list of synthetic micro datasets for each geographical subset within the specified macro geography.

Details

In the absence of true micro level datasets for a given geographic area, synthetic datasets can be used. This function uses conditional and marginal probability distributions (at the aggregate level) to generate synthetic micro population datasets, which are built one constraint at a time. Taking as input the macro level data (class "macroACS"), this function builds synthetic micro datasets for each lower level geographical area within the area of study.

In simplest terms, the goal is to generate a joint probability distribution for an attribute vector; and, to create synthetic individuals from this distribution. However, note that information for the full joint distribution is typically not available, so we construct it as a product of conditional and marginal probabilities. This is done one attribute at a time; where it is assumed that there is some sort of continuum of attribute dependence. That is, some attributes are more important (eg. gender, age) in ‘determining’ others (eg. educational attainment, marital status, etc). These more important attributes need to be assigned first, whereas less important attributes may be assigned later. Most of these distinctions are largely intuitive, but care must be taken in choosing the order of constructed attributes.

This function provides a synthetic population with the following characteristics as well as each synthetic individual’s probability of inclusion. The included characteristics are: age, gender, marital status, educational attainment, employment status, nativity, poverty status, geographic mobility in the prior year, individual income, and race. **Note** that these are INDIVIDUAL attributes; they are not at the HOUSEHOLD level. Additional attributes which interest the user may be added in a similar manner via `synthetic_new_attribute`.

References


See Also

`pull_synth_data, acs.fetch, geo.make`

Examples

```r
## Not run:
# make geography
la_geo <- acs::geo.make(state = "CA", county = "Los Angeles", tract = "x")
# pull data elements for creating synthetic data
la_dat <- pull_synth_data(2014, 5, la_geo)
# derive synthetic data
la_synthetic <- derive_synth_datasets(la_dat, leave_cores= 0)
## End(Not run)
```
**fetch_data**

*Get Aggregate Data Specified Geography*

**Description**

Gets aggregate, macro, data, either estimate or standard error, for a specified geography and specified dataset.

**Usage**

```r
fetch_data(acs, geography, dataset = c("estimate", "st.err"), choice = NULL)
```

**Arguments**

- `acs` An object of class "macroACS".
- `geography` A character vector allowing string matching via `grep` to a set of specified geographies. All values may be specified by "*".
- `dataset` Either "estimate" or "st.err". Do you want data on estimated population counts or estimated standard errors?
- `choice` A character vector specifying the name of one of the datasets in `acs`

---

**gen_attr_vectors**

*Generate attribute vectors*

**Description**

Generate a list of attribute vectors for new synthetic attribute creation from a "macroACS" object.

**Usage**

```r
gen_attr_vectors(acs, choice)
```

**Arguments**

- `acs` An object of class "macroACS".
- `choice` A character vector specifying the name of one of the datasets in `acs`

**See Also**

`all_geog_synthetic_new_attribute`, `synthetic_new_attribute`
get_best_fit

 Extract best fit for a specified geography from an 'smsm_set' object

Description

Extract the best fit micro population (resulting from the simulated annealing algorithm) for a given geography.

Usage

get_best_fit(obj, geography)

Arguments

obj          An object of class 'smsm_set', typically a result of call to all_geog_optimize_microdata
geography    A string allowing string matching via grep to a specified geography.

get_dataset_names

Get dataset names from a "macroACS" object.

Description

Get the names of the datasets in a given "macroACS" object.

Usage

get_dataset_names(acs)

Arguments

acs          An object of class "macroACS".

See Also

fetch_data
get_endyear

Get the endyear from a "macroACS" object.

Description
Get the data collection endyear from a "macroACS" object.

Usage
get_endyear(acs)

Arguments
acs An object of class "macroACS".

get_final_tae
Extract the final TAE for a specified geography from an 'smsm_set' object.

Description
Extract the final TAE (resulting from the simulated annealing algorithm) for a given geography.

Usage
get_final_tae(obj, geography)

Arguments
obj An object of class 'smsm_set', typically a result of call to all_geog_optimize_microdata.
geography A string allowing string matching via grep to a specified geography.

get_geography
Get the geography title from a "macroACS" object.

Description
Get the summary information of the geography selected from a "macroACS" object.

Usage
get_geography(acs)

Arguments
acs An object of class "macroACS".
get_span

Get the span from a "macroACS" object.

Description

Get the data collection span from a "macroACS" object

Usage

get_span(acs)

Arguments

acs An object of class "macroACS".

is.macroACS

Check macroACS class

Description

Function that checks if the target object is a macroACS object.

Usage

is.macroACS(x)

Arguments

x any R object.

Value

Returns TRUE if its argument has class "macroACS" among its classes and FALSE otherwise.
**is.macro_micro**  
*Check macro_micro class*

**Description**  
Function that checks if the target object is a macro_micro object.

**Usage**  
`is.macro_micro(x)`

**Arguments**  
`x`  
any R object.

**Value**  
Returns TRUE if its argument has class "macro_micro" among its classes and FALSE otherwise.

---

**is.micro_synthetic**  
*Check micro_synthetic class*

**Description**  
Function that checks if the target object is a micro_synthetic object.

**Usage**  
`is.micro_synthetic(x)`

**Arguments**  
`x`  
any R object.

**Value**  
Returns TRUE if its argument has class "micro_synthetic" among its classes and FALSE otherwise.
is.synthACS

Check synthACS class

Description
Function that checks if the target object is a synthACS object.

Usage
is.synthACS(x)

Arguments
x any R object.

Value
Returns TRUE if its argument has class "synthACS" among its classes and FALSE otherwise.

is.smsm_set
Check smsm_set class

Description
Function that checks if the target object is a smsm_set object.

Usage
is.smsm_set(x)

Arguments
x any R object.

Value
Returns TRUE if its argument has class "macroACS" among its classes and FALSE otherwise.
**la_hospitals**

*Hospitals in Los Angeles County, CA USA*

**Description**

An anonymized dataset containing the geographic information of hospitals in Los Angeles County California, USA.

**Usage**

`la_hospitals`

**Format**

A `data.frame` with 631 observations and 7 variables

- `geo_long` The hospital’s longitude.
- `geo_lat` The hospital’s latitude.
- `city` The hospital’s postal city.
- `state_fips` The hospital’s alpha FIPS code.
- `zip` The hospital’s five digit postal ZIP code.
- `census_tract` The census tract in which the hospital is located.
- `county_name` The hospital’s county – "LOS ANGELES".

**LifeExp**

*Life expectancy at certain ages; United States, 2013*

**Description**

A dataset containing life expectancy at certain ages by race, hispanic origin and sex for the United States, 2013.

**Usage**

`LifeExp`

**Format**

A `data.frame` with 396 observations and 4 variables.

- `age` The exact age, in years, at which life expectancy is calculated.
- `race` The racial group of the deceased One of all all races; white whites; black black / African-American; hispanic Hispanic; non.hisp.white non Hispanic whites; non.hispanic.black non Hispanic blacks.
- `gender` The gender of the deceased. One of c(both,male,female)
- `life_expectancy` The life expectancy for an individual at the exact age with the given race and gender.
marginalize_attr

Source

http://www.cdc.gov/nchs/nvss/deaths.htm

References


marginalize_attr Marginalize synthetic attributes

Description

Marginalize, (ie- reduce in number), attributes of a synthetic dataset of class 'micro_synthetic' or a list of synthetic datasets of class 'synthACS'. This is done by marginalizing the joint distribution based on a set of specified attributes (see Arguments below).

Usage

marginalize_attr(obj, varlist, marginalize_out = FALSE)

Arguments

obj An object of class "micro_synthetic".
varlist A character vector of variable, or attribute, names in obj.
marginalize_out Logical. Do you wish to remove the variables in varlist instead of keeping them? Defaults to FALSE

Examples

{
  # dummy data setup
  set.seed(567L)
  df <- data.frame(gender= factor(sample(c("male", "female"), size= 100, replace= TRUE)),
                   age= factor(sample(1:5, size= 100, replace= TRUE)),
                   pov= factor(sample(c("below poverty", "at above poverty"),
                                      size= 100, replace= TRUE, prob= c(.15,.85))),
                   p= runif(100))
  df$p <- df$p / sum(df$p)
  class(df) <- c("data.frame", "micro_synthetic")

  df2 <- marginalize_attr(df, varlist= "gender")
  df3 <- marginalize_attr(df, varlist= c("gender", "age"))
  df4 <- marginalize_attr(df, varlist= c("gender", "age"), marginalize_out= TRUE)

  df_list <- replicate(10, df, simplify= FALSE)
  dummy_list <- replicate(10, list(NULL), simplify= FALSE)
}
df_list <- mapply(function(a, b) {return(list(a, b))}, a = dummy_list, b = df_list, SIMPLIFY = FALSE)
class(df_list) <- c("list", "synthACS")

# run the function
df_list2 <- marginalize_attr(df_list, varlist = c("gender", "age"))

---

**MBR**

*Multiple Birth Rate data by year and race of mother*

**Description**

A dataset containing multiple birth rate data by race of the mother. Data for all races is provided for 1980-2014 and for individual races from 1990-2014.

**Usage**

MBR

**Format**

A data.frame with 110 observations and 8 variables.

- **year** The year for which data was recorded.
- **race** The racial group of the mothers. One of all all races; white non-hispanic whites; black_aa non Hispanic black / African-American; hisp_lat Hispanic.
- **births** Total births for the year and racial group in the United States.
- **twin_births** Total twin births for the year and racial group in the United States.
- **triplet_more_births** Total triplet or higher order births for the year and racial group in the United States.
- **MBRate** The number of live births in all multiple deliveries per 1,000 live births.
- **twinBR** The number of live births in all twin deliveries per 1,000 live births.
- **twinBR** The number of live births in all triplet or higher order deliveries per 100,000 live births.

**Details**

- Data for race category "all" includes races other than white and black and origin not stated.
- Race and Hispanic origin are reported separately on birth certificates. Persons of Hispanic origin may be of any race.

**Source**


**References**

Optimize the selection of a micro data population.

**Description**

Optimize the candidate micro dataset such that the lowest loss against the macro dataset constraints is obtained. Loss is defined here as total absolute error (TAE) and constraints are defined by the `constraint_list`. Optimization is done by simulated annealing—see details.

**Usage**

```r
optimize_microdata(micro_data, prob_name = "p", constraint_list,
                   tolerance = round(sum(constraint_list[[1]])/2000 *
                                 length(constraint_list), 0),
                   resample_size = min(sum(constraint_list[[1]]), max(500,
                                 round(sum(constraint_list[[1]]) * 0.005, 0))),
                   p_accept = 0.4,
                   max_iter = 1000L, seed = sample.int(10000L, size = 1, replace =
                   FALSE), verbose = TRUE)
```

**Arguments**

- `micro_data`: A `data.frame` of micro data observations.
- `prob_name`: It is assumed that observations are weighted and do not have an equal probability of occurrence. This string specifies the variable within `micro_data` that contains the probability of selection.
- `constraint_list`: A list of constraining macro data attributes. See `add_constraint`.
- `tolerance`: An integer giving the maximum acceptable loss (TAE), enabling early stopping. Defaults to a misclassification rate of 1 individual per 1,000 per constraint.
- `resample_size`: An integer controlling the rate of movement about the candidate space. Specifically, it specifies the number of observations to change between iterations. Defaults to 0.5% the number of observations.
- `p_accept`: The acceptance probability for the Metropolis acceptance criteria.
- `max_iter`: The maximum number of allowable iterations. Defaults to 10000L.
- `seed`: A seed for reproducibility. See `set.seed`.
- `verbose`: Logical. Do you wish to see verbose output? Defaults to TRUE.

**Details**

Spatial microsimulation involves the study of individual-level phenomena within a specified set of geographies in which these individuals act. It involves the creation of synthetic data to model, via simulation, these phenomena. As a first step to simulation, an appropriate micro-level (ie. individual) dataset must be generated. This function creates such appropriate micro-level datasets given a set of candidate observations and macro-level constraints.
Optimization is done via simulated annealing, where we wish to minimize the total absolute error (TAE) between the micro-data and the macro-constraints. The annealing procedure is controlled by the parameters tolerance, resample_size, p_accept, and max_iter. Specifically, tolerance indicates the maximum allowable TAE between the output micro-data and the macro-constraints within a given max_iter allowable iterations to converge. resample_size and p_accept control movement about the candidate space. Specifically, resample_size controls the jump size between neighboring candidates and p_accept controls the hill-climbing rate for exiting local minima.

Please see the references for a more detailed discussion of the simulated annealing procedure.

References


Examples

```r
## Not run:
## assumes you have micro_synthetic object named test_micro and constraint_list named c_list
opt_data <- optimize_microdata(test_micro, "p", c_list, max_iter= 10, resample_size= 500, p_accept= 0.01, verbose= FALSE)
## End(Not run)
```

### plot_TAEpath

Plot simulated annealing path

#### Description

Plot the path TAE in the simulated annealing algorithm for a given geography

#### Usage

`plot_TAEpath(object, geography, ...)`

#### Arguments

- `object` An object of class 'smsm_set', typically a result of call to `all_geog_optimize_microdata`
- `geography` A string allowing string matching via `grep` to a specified geography.
- `...` additional arguments passed to other methods
pull_acs_basetables

Pull ACS base tables

Description

A wrapper function to pull multiple base tables from ACS API via `acs.fetch`.

Usage

```r
pull_acs_basetables(endyear, span, geography, table_vec)
```

Arguments

- `endyear`: An integer, indicating the latest year of the data in the survey.
- `span`: An integer in `c(1,3,5)` indicating the span of the desired data.
- `geography`: A valid `geo.set` object specifying the census geography or geographies to be fetched.
- `table_vec`: A character vector specifying ACS base tables.

Value

A 'macroACS' class object

References

https://www.census.gov/programs-surveys/acs/technical-documentation/summary-file-documentation.html

Examples

```r
## Not run:
# make geography
la_geo <- acs::geo.make(state= "CA", county= "Los Angeles City")
# pull data
la_dat <- pull_acs_basetables(endyear= 2015, span= 1, geography= la_geo, table_vec= c("B00001", "B00002", "B01003"))
## End(Not run)
```
pull_bachelors

Description

Pull ACS data for a specified geography from base tables B15011 and B15012. Note: only 2014 data is supplied by ACS

Usage

pull_bachelors(endyear, span, geography)

Arguments

endyear An integer, indicating the latest year of the data in the survey.
span An integer in c(1, 3, 5) indicating the span of the desired data.
geography a valid geo.set object specifying the census geography or geographies to be fetched.

Value

A list containing the endyear, span, a data.frame of estimates, a data.frame of standard errors, and a data.frame of the geography metadata from acs.fetch.

See Also

acs.fetch, geo.make

pull_edu

Description

Pull ACS data for a specified geography from base tables B14001, B14003, B15001, B15002. Not currently implemented: B15010, B28006 Additional fields, mainly percentages and aggregations, are calculated.

Usage

pull_edu(endyear, span, geography)

Arguments

endyear An integer, indicating the latest year of the data in the survey.
span An integer in c(1, 3, 5) indicating the span of the desired data.
geography a valid geo.set object specifying the census geography or geographies to be fetched.
Value
A list containing the endyear, span, a data frame of estimates, a data frame of standard errors, a character vector of the original column names, and a data frame of the geography metadata from acs.fetch.

See Also
acs.fetch, geo.make

Description
Pull ACS data for a specified geography from base tables B07001, B07003, B07008, B07009, B07010, and B07012. These tables provide data on geographic mobility in the past year by a number of slices. Additional fields, mainly percentages and aggregations, are calculated.

Usage
pull_geo_mobility(endyear, span, geography)

Arguments
endyear An integer, indicating the latest year of the data in the survey.
span An integer in c(1, 3, 5) indicating the span of the desired data.
geography a valid geo.set object specifying the census geography or geographies to be fetched.

Value
A list containing the endyear, span, a data frame of estimates, a data frame of standard errors, a character vector of the original column names, and a data frame of the geography metadata from acs.fetch.

See Also
acs.fetch, geo.make
pull_household

Pull ACS data on households and housing units

Description
Pull ACS data for a specified geography from base tables B09019, B11011, B19081, B25002, B25003, B25004, B25010, B25024, B25056, B25058, B25071, and B27001. Additional fields, mainly percentages and aggregations, are calculated.

Usage

pull_household(endyear, span, geography)

Arguments

endyear  An integer, indicating the latest year of the data in the survey.
span  An integer in c(1, 3, 5) indicating the span of the desired data.
geography  a valid geo.set object specifying the census geography or geographies to be fetched.

Value
A list containing the endyear, span, a data.frame of estimates, a data.frame of standard errors, a character vector of the original column names, and a data.frame of the geography metadata from acs.fetch.

See Also
acs.fetch, geo.make B28001 - TYPES OF COMPUTERS IN HOUSEHOLD B28002 - PRESENCE AND TYPES OF INTERNET SUBSCRIPTIONS IN HOUSEHOLD

pull_inc_earnings

Pull ACS income and earnings data

Description
Pull ACS data for a specified geography from base tables B19083, B19301, B19326, B21001, B22001, B23020, B24011. Not yet implemented: B28004 Additional fields, mainly percentages and aggregations, are calculated.

Usage

pull_inc_earnings(endyear, span, geography)
pull_mar_status

Arguments

  endyear     An integer, indicating the latest year of the data in the survey.
  span        An integer in \texttt{c(1, 3, 5)} indicating the span of the desired data.
  geography   a valid \texttt{geo.set} object specifying the census geography or geographies to be fetched.

Value

  A list containing the endyear, span, \texttt{data.frame} of estimates, \texttt{data.frame} of standard errors, a character vector of the original column names, and a \texttt{data.frame} of the geography metadata from \texttt{acs.fetch}.

See Also

  \texttt{acs.fetch}, \texttt{geo.make}

---

pull_mar_status       \textit{Pull ACS marital status data}

Description

  Pull ACS data for a specified geography from base tables B12001, B12006, B12007, 12501 Additional fields, mainly percentages and aggregations, are calculated.

Usage

  pull_mar_status(endyear, span, geography)

Arguments

  endyear     An integer, indicating the latest year of the data in the survey.
  span        An integer in \texttt{c(1, 3, 5)} indicating the span of the desired data.
  geography   a valid \texttt{geo.set} object specifying the census geography or geographies to be fetched.

Value

  A list containing the endyear, span, \texttt{data.frame} of estimates, \texttt{data.frame} of standard errors, a character vector of the original column names, and a \texttt{data.frame} of the geography metadata from \texttt{acs.fetch}.

See Also

  \texttt{acs.fetch}, \texttt{geo.make}
pull_population

**Description**

Pull ACS data for a specified geography from base tables B01001, B01002, B02001, B06007, B06008, B06009, B06010, B06011, AND B06012. These tables reference population counts by a number of slices. Multiple additional fields, mainly percentages and aggregations, are calculated.

**Usage**

```r
pull_population(endyear, span, geography)
```

**Arguments**

- `endyear`: An integer, indicating the latest year of the data in the survey.
- `span`: An integer in c(1, 3, 5) indicating the span of the desired data.
- `geography`: a valid `geo.set` object specifying the census geography or geographies to be fetched.

**Value**

A list containing the endyear, span, a `data.frame` of estimates, a `data.frame` of standard errors, a character vector of the original column names, and a `data.frame` of the geography metadata from `acs.fetch`.

**See Also**

`acs.fetch`, `geo.make`
pull_race_data

Arguments

- **endyear**: An integer, indicating the latest year of the data in the survey.
- **span**: An integer in \( c(1, 3, 5) \) indicating the span of the desired data.
- **geography**: A valid `geo.set` object specifying the census geography or geographies to be fetched.

Value

A list containing the endyear, span, a `data.frame` of estimates, a `data.frame` of standard errors, a character vector of the original column names, and a `data.frame` of the geography metadata from `acs.fetch`.

See Also

`acs.fetch`, `geo.make`
pull_synth_data

---

**pull_synth_data**  
Pull ACS data for synthetic data creation.

---

**Description**

Pull ACS data for a specified geography from base tables B01001, B02001, B12002, B15001, B06001, B06010, B23001, B17005, and B17005. These tables reference population counts by a number of slices. Multiple additional fields, mainly percentages and aggregations, are calculated.

**Usage**

```
pull_synth_data(endyear, span, geography)
```

**Arguments**

- `endyear`: An integer, indicating the latest year of the data in the survey.
- `span`: An integer in c(1, 3, 5) indicating the span of the desired data.
- `geography`: a valid geo.set object specifying the census geography or geographies to be fetched.

**Value**

A list containing the endyear, span, a list of data.frames of estimates, a list of data.frames of standard errors, and the geography metadata from `acs.fetch`.

**See Also**

`acs.fetch`, `geo.make`

**Examples**

```r
## Not run:
# make geography
la_geo <- acs::geo.make(state = "CA", county = "Los Angeles", tract = "]")
# pull data elements for creating synthetic data
la_dat <- pull_synth_data(2014, 5, la_geo)

## End(Not run)
```
pull_transit_work  
*Pull ACS transit and work data*

**Description**

Pull ACS data for a specified geography from base tables B08012, B08101, B08121, B08103, B08124, B08016, B08017. Additional fields, mainly percentages and aggregations, are calculated.

**Usage**

```
pull_transit_work(endyear, span, geography)
```

**Arguments**

- `endyear`: An integer, indicating the latest year of the data in the survey.
- `span`: An integer in \(c(1,3,5)\) indicating the span of the desired data.
- `geography`: a valid geo.set object specifying the census geography or geographies to be fetched.

**Value**

A list containing the endyear, span, a data.frame of estimates, a data.frame of standard errors, a character vector of the original column names, and a data.frame of the geography metadata from `acs.fetch`.

**See Also**

`acs.fetch`, `geo.make`

---

**rawDR**  
*Raw Death Rate by race and gender*

**Description**

A dataset containing raw death rate data by race and gender of the deceased. Data is provided for 1980-2013.

**Usage**

```
rawDR
```
Format

A data.frame with 612 observations and 4 variables.

- **year** The year for which data was recorded.
- **race** The racial group of the deceased. One of all races; white; whites; black_aa black / African-American; nat_amer American Indian or Native Alaskan; asian_isl Asian or Pacific Islander; hisp_lat Hispanic.
- **gender** The gender of the deceased. One of c(both, male, female)
- **death_rate** The raw death rate. See details.

Details

- The death rate is defined as deaths per 100,000 population.
- Populations are based on census counts enumerated as of April 1 of the census year and estimated as of July 1 for non-census years.

Source

[http://www.cdc.gov/nchs/nvss/deaths.htm](http://www.cdc.gov/nchs/nvss/deaths.htm)

References


---

**split**

Split a "macroACS" object

**Description**

Split a "macroACS" object into subsets. This may be helpful for users who have limited memory available on their machines before proceeding to derive sample synthetic micro data.

**Usage**

```
split(acs, n_splits)
```

**Arguments**

- **acs** An object of class "macroACS".
- **n_splits** An integer for the number of splits you wish to create.

**See Also**

[derive_synth_datasets](#)
Birth rates, by age of mother: United States, each state and territory, 2014

Description
A dataset containing birth rate data by US state and age for all US states and territories in 2014.

Usage
stateFR

Format
A data.frame with 612 observations and 3 variables.

state  The state or territory for which data was was recorded.
age_group  The age group of the mother.
birth_rate  The birth rate. See Details.

Details
- The birth rate is defined as births per 1,000 women in the specified group.
- Birth rates for age_group 45_49 are computed by relating births to women aged 45 and over to women aged 45-49
- Data for the "United States" as a whole excludes data for the territories.
- Data is missing (eg. NA) when data does not meet standards of reliability or precision; birth rates based on fewer than 20 births.

Source
http://www.cdc.gov/nchs/nvss/births.htm

References
**summary.smsm_set**

*Summarizing SMSM fits*

**Description**

Summary method for class `smsm_set`.

**Usage**

```r
## S3 method for class 'smsm_set'
summary(object, ...)
```

**Arguments**

- **object**: An object of class `smsm_set`, typically a result of call to `all_geog_optimize_microdata`.
- **...**: Additional arguments affecting the summary produced.

---

**synthetic_new_attribute**

*Add a new attribute to a synthetic_micro dataset*

**Description**

Add a new attribute to a synthetic_micro dataset using conditional relationships between the new attribute and existing attributes (e.g. wage rate conditioned on age and education level).

**Usage**

```r
synthetic_new_attribute(df, prob_name = "p", attr_name = "variable",
conditional_vars = NULL, sym_tbl = NULL)
```

**Arguments**

- **df**: An R object of class "synthetic_micro".
- **prob_name**: A string specifying the column name of the df containing the probabilities for each synthetic observation.
- **attr_name**: A string specifying the desired name of the new attribute to be added to the data.
- **conditional_vars**: An character vector specifying the existing variables, if any, on which the new attribute (variable) is to be conditioned on. Variables must be specified in order. Defaults to NULL i.e. an unconditional new attribute.
- **sym_tbl**: A data.frame symbol table with N + 2 columns. The last two columns must be: 1. A vector containing the new attribute counts or percentages; 2. is a vector of the new attribute levels. The first N columns must match the conditioning scheme imposed by the variables in conditional_vars. See details and examples.
**Value**

A new synthetic dataset with class "synthetic_micro".

**Details**

New synthetic variables are introduced to the existing data via conditional probability. Similar to `derive_synth_datasets`, the goal with this function is to generate a joint probability distribution for an attribute vector; and, to create synthetic individuals from this distribution. Although no limit is placed on the number of variables on which to condition, in practice, data rarely exists which allows more than two or three conditioning variables. Other variables are assumed to be independent from the new attribute.

** There are four different types of conditional/marginal probability models which may be considered for a given new attribute: (1) Independence: it is assumed that each of the variables is independent of the others (2) Pairwise conditional independence: it is assumed that attributes are related to only one other attribute and independent of all others. (3) Conditional independence: Attributes can be dependent on some subset of other attributes and independent of the rest. (4) In the most general case, all attributes are jointly interrelated.

Conditioning is implemented via symbol-tables (`sym_tbl`) to ensure accurate matching between conditioning variables, new attribute levels, and new attribute probabilities. The symbol table is constructed such that the key in the symbol-table’s key-value pair is the specific values for the set of conditioning variables. This key is the first N columns of `sym_tbl`. A recursive approach is employed to conditionally partition `sym_tbl`. In this sense, the *order* in which the conditional variables are supplied matters.

The value is final 2 columns of `sym_tbl` which are a pair of (A) either counts or percentages used to specify the probability for the new attribute and (B) the level that the new attribute takes on.

**Examples**

```r
{  
  set.seed(567L)
  df <- data.frame(gender= factor(sample(c("male", "female"), size= 100, replace= TRUE)),
                 edu= factor(sample(c("LT_college", "BA_degree"), size= 100, replace= TRUE)),
                 p= runif(100))
  df$p <- df$p / sum(df$p)
  class(df) <- c("data.frame", "micro_synthetic")
  ST <- data.frame(gender= c(rep("male", 3), rep("female", 3)),
                   attr_pct= c(0.1, 0.8, 0.1, 0.05, 0.7, 0.25),
                   levels= rep(c("low", "middle", "high"), 2))
  df2 <- synthetic_new_attribute(df, prob_name= "p", attr_name= "SES", conditional_vars= "gender",
                                 sym_tbl= ST)

  ST2 <- data.frame(gender= c(rep("male", 3), rep("female", 6)),
                   edu= c(rep(NA, 3), rep(c("LT_college", "BA_degree"), each= 3)),
                   attr_pct= c(0.1, 0.8, 0.1, 0.1, 0.1, 0.1),
                   levels= rep(c("low", "middle", "high"), 3))
  df2 <- synthetic_new_attribute(df, prob_name= "p", attr_name= "SES",
                                 conditional_vars= c("gender", "edu"),
                                 sym_tbl= ST2)
}
Total Fertility Rate by race of mother

Description

A dataset containing total fertility rate data by race of the mother. Data for all races is provided for 1970-2014 and for individual races from 1989-2014.

Usage

TFR

Format

A data.frame with 175 observations and 3 variables.

- **year**: The year for which data was recorded.
- **race**: The racial group of the mothers. One of all races; white non-hispanic whites; black_aa black / African-American; nat_amer American Indian or Native Alaskan; asian_isl Asian or Pacific Islander; hisp_lat Hispanic or Latin American.
- **tfr**: The Total Fertility Rate. See Details

Details

The Total Fertility Rate is defined as the sums of the birth rates for the 5-year age groups found in BR2014 multiplied by 5.

Source

http://www.cdc.gov/nchs/nvss/births.htm

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