Package 'malan'

October 13, 2022

Type Package

Title MAle Lineage ANalysis

Version 1.0.2

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Description MAle Lineage ANalysis by simulating
genealogies backwards and imposing short tandem repeats (STR) mutations forwards.
Intended for forensic Y chromosomal STR (Y-STR) haplotype analyses.
Numerous analyses are possible, e.g. number of matches and meiotic distance to matches.
Refer to papers mentioned in citation(``malan") (DOI's:
<doi:10.1371/journal.pgen.1007028>,
<doi:10.21105/joss.00684> and
<doi:10.1016/j.fsigen.2018.10.004>).

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Imports Rcpp (>= 0.12.7), RcppProgress (>= 0.2.1), RcppArmadillo (>=
0.9.880.1.0), igraph (>= 1.0.1), tibble (>= 1.1), magrittr (>=
1.5), methods

Depends R (>= 2.10), dplyr (>= 0.7.3), tidygraph (>= 1.0.0.9999)

LinkingTo Rcpp, RcppArmadillo, RcppProgress

Suggests knitr, rmarkdown, testthat, ggraph, dirmult, Rmpfr

BugReports https://github.com/mikldk/malan/issues

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SystemRequirements C++11

LazyData true

RoxygenNote 7.1.0

NeedsCompilation yes

Repository CRAN

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R topics documented:

`malan-package` *MAle Lineage ANalysis*

Description

Simulating genealogies backwards and imposing STR mutations forwards.

Details

See vignettes and manual for documentation.

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Author(s)

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References

Andersen MM, Balding DJ (2017) How convincing is a matching Y-chromosome profile? PLoS Genet 13(11): e1007028. https://doi.org/10.1371/journal.pgen.1007028.

See Also

Useful links:

- Report bugs at https://github.com/mikldk/malan/issues

analyse_mixture_result

Analyse mixture results

Description

Calculate LR-like quantities by haplotype counts.

Usage

```
analyse_mixture_result(
  mix_res,
  unique_haps_in_mixture,
  unique_haps_in_mixture_counts
)
```

Arguments

mix_res	Mixture result from mixture_info_by_individuals_2pers(), mixture_info_by_individuals_3per mixture_info_by_individuals_4pers(), mixture_info_by_individuals_5pers()
unique_haps_in_mixture	Included unique haplotypes to use as elements in contributor sets.
unique_haps_in_mixture_counts	Population counts of the included haplotypes

Details

NOTE: Only takes up to 9 contributors!

Value

A list with numeric quantities

analyse_mixture_results

Analyse mixture results in a vectorised fashion

Description

Refer to analyse_mixture_result() for details. Essentially, analyse_mixture_result() is run on each element of mixture_results.

Usage

```
analyse_mixture_results(
  mixture_results,
  unique_haps_in_mixture_list,
  unique_haps_in_mixture_counts_list
)
```

Arguments

mixture_results	List of n mixture results from mixture_info_by_individuals_2pers(), mixture_info_by_individua mixture_info_by_individuals_4pers(), mixture_info_by_individuals_5pers()
unique_haps_in_mixture_list	List of n included unique haplotypes, one for each element in mix_res
unique_haps_in_mixture_counts_list	List of n population counts of the included unique haplotypes

Details

NOTE: Only takes up to 9 contributors!

Value

A list with lists of numeric quantities

---

as_tbl_graph.malan_pedigreelist *Get tidy graph object*

Description

Get tidy graph object tbl_graph(), e.g. to plot with ggraph().

Usage

```
## S3 method for class 'malan_pedigreelist'
as_tbl_graph(x, ...)
```

Arguments

x	malan_pedigreelist
...	Ignored

Value

tbl_graph() object

brothers_matching *Number of brothers with matching haplotype*

Description

Get individual's number of brothers that matches `individual`'s haplotype

Usage

```
brothers_matching(individual)
```

Arguments

`individual`	individual

Value

Number of brothers that matches `individual`'s haplotype

build_haplotype_hashmap *Build hashmap of haplotype to individuals*

Description

Makes it possible to find all individuals' pid with a certain haplotype. Must be used with e.g. `get_matching_pids_from_hashmap()`.

Usage

```
build_haplotype_hashmap(individuals, progress = TRUE)
```

Arguments

`individuals`	List of individuals to build hashmap of
`progress`	Show progress?

Value

External pointer to hashmap with haplotype as keys and vector of individuals' pid as value

See Also

`get_matching_pids_from_hashmap()`.

`build_pedigrees` *Build pedigrees from (individuals in) a population.*

Description

In a newly simulated population, each individual only knows its father and children. Using this information, this function builds pedigrees. This makes it easier to e.g. population haplotypes, find path between two individuals (if they are not in the same pedigree, they are not connected).

Usage

```
build_pedigrees(population, progress = TRUE)
```

Arguments

`population`	Population generated by `sample_geneology()` or `sample_geneology_varying_size()`.
`progress`	Show progress.

Value

An object with class `malan_pedigreelist` (an internal list of external pointers to pedigrees).

See Also

`sample_geneology()` and `sample_geneology_varying_size()` for simulating populations.

Examples

```
sim <- sample_geneology(100, 10)
str(sim, 1)
sim$population
peds <- build_pedigrees(sim$population)
peds
```

`calc_autosomal_genotype_conditional_cumdist`
Calculate conditional genotype cumulative probabilities with theta

Description

Calculate conditional genotype cumulative probabilities with theta

Usage

```
calc_autosomal_genotype_conditional_cumdist(allele_dist, theta)
```

Arguments

allele_dist	Allele distribution (probabilities) – gets normalised
theta	Theta correction between 0 and 1 (both included)

Value

Matrix: row i: conditional cumulative distribution of alleles given allele i

---

calc_autosomal_genotype_probs *Calculate genotype probabilities with theta*

Description

Calculate genotype probabilities with theta

Usage

```
calc_autosomal_genotype_probs(allele_dist, theta)
```

Arguments

allele_dist	Allele distribution (probabilities) – gets normalised
theta	Theta correction between 0 and 1 (both included)

---

construct_M *Construct M matrix*

Description

Construct M matrix

Usage

```
construct_M(meioses, mu_dw, mu_up)
```

Arguments

meioses	number of meioses separating the two individuals
mu_dw	mutation rate for 1-step down-mutation
mu_up	mutation rate for 1-step up-mutation

count_brothers *Number of brothers*

Description

Get individual's number of brothers

Usage

```
count_brothers(individual)
```

Arguments

individual	individual

Value

Number of brothers

See Also

get_brothers()

count_haplotype_near_matches_individuals *Count near haplotype matches in list of individuals*

Description

Counts the number of types close to haplotype in individuals.

Usage

```
count_haplotype_near_matches_individuals(individuals, haplotype, max_dist)
```

Arguments

individuals	List of individuals to count occurrences in.
haplotype	Haplotype to count near-matches occurrences of.
max_dist	Maximum distance (0 = match, 1 = 1 STR allele difference, ...)

Value

Number of times that a haplotype within a radius of max_dist of haplotype occurred amongst individuals.

See Also

count_haplotype_occurrences_individuals(), pedigree_haplotype_matches_in_pedigree_meiosis_L1_dists()

---

count_haplotype_occurrences_individuals
Count haplotypes occurrences in list of individuals

Description

Counts the number of types haplotype appears in individuals.

Usage

```
count_haplotype_occurrences_individuals(individuals, haplotype)
```

Arguments

individuals	List of individuals to count occurrences in.
haplotype	Haplotype to count occurrences of.

Value

Number of times that haplotype occurred amongst individuals.

See Also

pedigree_haplotype_matches_in_pedigree_meiosis_L1_dists(), count_haplotype_near_matches_individuals(

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes(peds, 2, c(0, 0))
count_haplotype_occurrences_individuals(sim$end_generation_individuals, c(0, 0))
```

count_haplotype_occurrences_pedigree *Count haplotypes occurrences in pedigree*

Description

Counts the number of types `haplotype` appears in `pedigree`.

Usage

```
count_haplotype_occurrences_pedigree(
  pedigree,
  haplotype,
  generation_upper_bound_in_result = -1L
)
```

Arguments

`pedigree`	Pedigree to count occurrences in.
`haplotype`	Haplotype to count occurrences of.
`generation_upper_bound_in_result`	Only consider matches in generation 0, 1, ... generation_upper_bound_in_result. -1 means disabled, consider all generations. End generation is generation 0. Second last generation is 1. And so on.

Value

Number of times that `haplotype` occurred in `pedigree`.

See Also

`pedigree_haplotype_matches_in_pedigree_meiosis_L1_dists()`.

count_uncles *Number of uncles*

Description

Get individual's number of uncles

Usage

```
count_uncles(individual)
```

Arguments

individual	individual

Value

Number of uncles

See Also

get_uncles()

---

delete_haplotypeids_hashmap *Delete haplotype hashmap*

Description

Delete hashmap made by build_haplotype_hashmap().

Usage

```
delete_haplotypeids_hashmap(hashmap)
```

Arguments

hashmap	Hashmap made by build_haplotype_hashmap()

See Also

get_matching_pids_from_hashmap() and build_haplotype_hashmap().

---

estimate_autotheta_1subpop_genotypes *Estimate autosomal theta from genotypes*

Description

Estimate autosomal theta for one subpopulation given a sample of genotypes.

Usage

```
estimate_autotheta_1subpop_genotypes(genotypes, return_estimation_info = FALSE)
```

Arguments

`genotypes`	Matrix of genotypes: two columns (allele1 and allele2) and a row per individual
`return_estimation_info`	Whether to return the quantities used to estimate `theta`

Details

Assumes that `pedigrees_all_populate_autosomal()` was used first to populate autosomal genotypes.

Value

List:

- `theta`
  - `estimate`: Vector of length 1 containing estimate of theta or NA if it could not be estimated
  - `error`: true if an error happened, false otherwise
  - `details`: contains description if an error happened
  - `estimation_info`: If `return_estimation_info = true`: a list with information used to estimate `theta`. Else `NULL`.

`estimate_autotheta_1subpop_individuals` *Estimate autosomal theta from individuals*

Description

Estimate autosomal theta for one subpopulation given a list of individuals.

Usage

```
estimate_autotheta_1subpop_individuals(
  individuals,
  return_estimation_info = FALSE
)
```

Arguments

`individuals`	Individuals to get haplotypes for.
`return_estimation_info`	Whether to return the quantities used to estimate `theta`

Details

Assumes that `pedigrees_all_populate_autosomal()` was used first to populate autosomal genotypes.

Value

List:

- `theta`
  - `estimate`: Vector of length 1 containing estimate of theta or NA if it could not be estimated
  - `error`: true if an error happened, false otherwise
  - `details`: contains description if an error happened
  - `estimation_info`: If `return_estimation_info = true`: a list with information used to estimate `theta`. Else `NULL`.

`estimate_autotheta_subpops_genotypes`

Estimate autosomal F, theta, and f from subpopulations of genotypes

---

Description

Estimates autosomal F, theta, and f for a number of subpopulations given a list of genotypes.

Usage

```
estimate_autotheta_subpops_genotypes(subpops, subpops_sizes)
```

Arguments

`subpops`	List of subpopulations, each a list of individuals
`subpops_sizes`	Size of each subpopulation

Details

Assumes that `pedigrees_all_populate_autosomal()` was used first to populate autosomal genotypes.

Based on Bruce S Weir, Genetic Data Analysis 2, 1996. (GDA2).

Value

Estimates of autosomal F, theta, and f as well as additional information

estimate_autotheta_subpops_individuals

Estimate autosomal F, theta, and f from subpopulations of individuals

Description

Estimates autosomal F, theta, and f for a number of subpopulations given a list of individuals.

Usage

```
estimate_autotheta_subpops_individuals(subpops, subpops_sizes)
```

Arguments

subpops	List of subpopulations, each a list of individuals
subpops_sizes	Size of each subpopulation

Details

Assumes that pedigrees_all_populate_autosomal() was used first to populate autosomal genotypes.

Based on Bruce S Weir, Genetic Data Analysis 2, 1996. (GDA2).

Value

Estimates of autosomal F, theta, and f as well as additional information

estimate_autotheta_subpops_pids

Estimate autosomal F, theta, and f from subpopulations of individual ids

Description

Estimates autosomal F, theta, and f for a number of subpopulations given a list of pids (individual ids).

Usage

```
estimate_autotheta_subpops_pids(population, subpops, subpops_sizes)
```

Arguments

population	Population obtain from simulation
subpops	List of individual pids
subpops_sizes	Size of each subpopulation

Details

Assumes that pedigrees_all_populate_autosomal() was used first to populate autosomal genotypes.

Based on Bruce S Weir, Genetic Data Analysis 2, 1996. (GDA2).

Value

Estimates of autosomal F, theta, and f as well as additional information

---

`estimate_autotheta_subpops_unweighted_genotypes`
Unweighted estimate of autosomal theta from subpopulations of genotypes

---

Description

Estimates unweighted autosomal theta for a number of subpopulations given a list of subpopulations of genotypes.

Usage

```
estimate_autotheta_subpops_unweighted_genotypes(subpops, assume_HWE)
```

Arguments

subpops	List of individual genotypes
assume_HWE	if the alleles themselves are used instead of genotypes

Details

Assumes that pedigrees_all_populate_autosomal() was used first to populate autosomal genotypes.

Based on Weir and Goudet, Genetics 2017: http://www.genetics.org/content/early/2017/05/26/genetics.116.198424

Value

Estimate of autosomal theta

estimate_autotheta_subpops_unweighted_pids

Unweighted estimate of autosomal theta from subpopulations of individual ids

Description

Estimates unweighted autosomal theta for a number of subpopulations given a list of pids (individual ids).

Usage

```
estimate_autotheta_subpops_unweighted_pids(population, subpops, assume_HWE)
```

Arguments

population	Population obtain from simulation
subpops	List of individual pids
assume_HWE	if the alleles themselves are used instead of genotypes

Details

Assumes that pedigrees_all_populate_autosomal() was used first to populate autosomal genotypes.

Based on Weir and Goudet, Genetics 2017: http://www.genetics.org/content/early/2017/05/26/genetics.116.198424

Value

Estimate of autosomal theta

father_matches

Father matches

Description

Does the father have the same profile as individual?

Usage

```
father_matches(individual)
```

Arguments

individual	individual

Value

Whether father has the same profile as individual or not

from_igraph *Convert igraph to population*

Description

Convert igraph to population

Usage

```
from_igraph(x, ...)
```

Arguments

x	igraph, must be a forest of directed trees with unique positive integer names (as they will be pid's)
...	Ignored

Value

A population

Examples

```
g <- igraph::graph_from_literal( 2 +- 1 -+ 3, 4 -+ 5 )
plot(g)
pop <- from_igraph(g)
peds <- build_pedigrees(pop, progress = FALSE)
plot(peds)
infer_generations(peds)
get_generation(get_individual(pop, 1))
get_generation(get_individual(pop, 2))
get_generation(get_individual(pop, 3))
get_generation(get_individual(pop, 4))
get_generation(get_individual(pop, 5))
```

from_igraph_rcpp *Generate paternal brothers population*

Description

Generate paternal brothers population

Usage

```
from_igraph_rcpp(vertices, edges)
```

Arguments

vertices	vector of vertices
edges	matrix with edges

Value

An external pointer to the population.

---

generate_get_founder_haplotype_db

Generate a function to simulate pedigree founder haplotype based on a haplotype databasep

---

Description

Generate a function to simulate pedigree founder haplotype based on a haplotype databasep

Usage

```
generate_get_founder_haplotype_db(db)
```

Arguments

db	data frame or matrix with haplotypes from which the founder is randomly simulated

---

generate_get_founder_haplotype_ladder

Generate a function to simulate pedigree founder haplotype based on ladder information

---

Description

Generate a function to simulate pedigree founder haplotype based on ladder information

Usage

```
generate_get_founder_haplotype_ladder(ladder_min, ladder_max)
```

Arguments

ladder_min	vector of minimum alleles; `ladder_min[i]` is the minimum allele at locus i
ladder_max	vector of minimum alleles; `ladder_max[i]` is the maximum allele at locus i

get_allele_counts_genotypes

Get autosomal allele counts from subpopulations of genotypes

Description

Assumes that pedigrees_all_populate_autosomal() was used first to populate autosomal genotypes.

Usage

```
get_allele_counts_genotypes(subpops)
```

Arguments

subpops	List of individual genotypes

Value

Matrix with allele counts

get_allele_counts_pids

Get autosomal allele counts from subpopulations given by pids

Description

Assumes that pedigrees_all_populate_autosomal() was used first to populate autosomal genotypes.

Usage

```
get_allele_counts_pids(population, subpops)
```

Arguments

population	Population obtain from simulation
subpops	List of individual pids

Value

Matrix with allele counts

get_brothers *Get brothers*

Description

Get individual's brothers

Usage

```
get_brothers(individual)
```

Arguments

individual	individual

Value

List with brothers

See Also

get_father(), get_uncles(), get_children(), get_cousins()

get_children *Get children*

Description

Get individual's children

Usage

```
get_children(individual)
```

Arguments

individual	individual

Value

List with children

See Also

get_father(), get_brothers(), get_uncles(), get_cousins()

get_cousins *Get cousins*

Description

Get individual's cousins

Usage

```
get_cousins(individual)
```

Arguments

individual	individual

Value

List with cousins

See Also

get_brothers(), get_uncles(), get_children()

get_family_info *Get individual's family information*

Description

Get individual's family information

Usage

```
get_family_info(individual)
```

Arguments

individual	individual

Value

List with family information

get_father *Get father*

Description

Get individual's father

Usage

```
get_father(individual)
```

Arguments

individual	individual

Value

Father

See Also

get_brothers(), get_uncles(), get_children(), get_cousins()

get_generation *Get individual's generation number*

Description

Note that generation 0 is final, end generation. 1 is second last generation etc.

Usage

```
get_generation(individual)
```

Arguments

individual	Individual

Value

generation

Examples

```
sim <- sample_geneology(100, 10)
indv <- get_individual(sim$population, 1)
get_generation(indv)
```

get_haplotype *Get haplotype from an individual*

Description

Requires that haplotypes are first populated, e.g. with pedigrees_all_populate_haplotypes(), pedigrees_all_populate_haplotypes_custom_founders(), or pedigrees_all_populate_haplotypes_ladder_boun

Usage

```
get_haplotype(individual)
```

Arguments

individual	Individual to get haplotypes for.

Value

Haplotype for individual.

See Also

get_haplotypes_individuals() and get_haplotypes_pids().

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes(peds, 2, c(1, 1))
get_haplotype(sim$end_generation_individuals[[1]])
```

get_haplotypes_individuals *Get haplotype matrix from list of individuals*

Description

Requires that haplotypes are first populated, e.g. with pedigrees_all_populate_haplotypes(), pedigrees_all_populate_haplotypes_custom_founders(), or pedigrees_all_populate_haplotypes_ladder_boun

Usage

```
get_haplotypes_individuals(individuals)
```

Arguments

individuals	Individuals to get haplotypes for.

Value

Matrix of haplotypes where row i is the haplotype of individuals[[i]].

See Also

get_haplotypes_pids().

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes(peds, 2, c(1, 1))
get_haplotypes_individuals(sim$end_generation_individuals)
```

---

get_haplotypes_in_pedigree

Get haplotypes in pedigree

Description

Get haplotypes in pedigree

Usage

```
get_haplotypes_in_pedigree(ped)
```

Arguments

ped	Pedigree

Value

List with haplotypes

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes(peds, 2, c(1, 1))
get_haplotypes_in_pedigree(peds[[1]])
```

get_haplotypes_pids *Get haplotypes from a vector of pids.*

Description

Requires that haplotypes are first populated, e.g. with `pedigrees_all_populate_haplotypes()`, `pedigrees_all_populate_haplotypes_custom_founders()`, or `pedigrees_all_populate_haplotypes_ladder_boun`

Usage

```
get_haplotypes_pids(population, pids)
```

Arguments

`population`	Population
`pids`	Vector of pids to get haplotypes for.

Value

Matrix of haplotypes where row `i` is the haplotype of `individuals[[i]]`.

See Also

`get_haplotypes_individuals()`.

get_individual *Get individual by pid*

Description

Get individual by pid

Usage

```
get_individual(population, pid)
```

Arguments

`population`	Population
`pid`	pid

Value

Individual

Examples

```
sim <- sample_geneology(100, 10)
indv <- get_individual(sim$population, 1)
get_pid(indv)
```

`get_individuals` *Get all individuals in population*

Description

Get all individuals in population

Usage

```
get_individuals(population)
```

Arguments

`population`	Population

`get_matching_pids_from_hashmap`
Get individuals with a certain haplotype id by hashmap lookup

---

Description

By using hashmap made by `build_haplotype_hashmap()`, it is easy to get all individuals with a certain haplotype id.

Usage

```
get_matching_pids_from_hashmap(hashmap, haplotype)
```

Arguments

`hashmap`	Hashmap to make lookup in, made by `build_haplotype_hashmap()`
`haplotype`	to get individuals that has this haplotype id

Value

List of individuals with a given haplotype id

See Also

`build_haplotype_hashmap()`.

get_nodes_edges *Get nodes and edges*

Description

Get nodes and edges in `malan_pedigreelist`. For example to plot via `as_tbl_graph()`.

Usage

```
get_nodes_edges(x, ...)
```

Arguments

`x`	`malan_pedigreelist`
`...`	Ignored

Value

List with entries `nodes` and `edges`

get_pedigrees_tidy *Get pedigrees information in tidy format*

Description

Get pedigrees information in tidy format

Usage

```
get_pedigrees_tidy(pedigrees)
```

Arguments

`pedigrees`	Pedigrees

get_pedigree_as_graph *Get pedigree information as graph (mainly intended for plotting)*

Description

Get pedigree information as graph (mainly intended for plotting)

Usage

```
get_pedigree_as_graph(ped)
```

Arguments

ped	Pedigree

get_pedigree_from_individual *Get pedigree from individual*

Description

Get pedigree from individual

Usage

```
get_pedigree_from_individual(individual)
```

Arguments

individual	Individual

Value

pedigree

get_pedigree_id *Get pedigree id*

Description

Get pedigree id

Usage

```
get_pedigree_id(ped)
```

Arguments

ped	Pedigree

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
get_pedigree_id(peds[[1]])
```

get_pedigree_id_from_pid *Get pedigree ids from pids*

Description

Get pedigree ids from pids

Usage

```
get_pedigree_id_from_pid(population, pids)
```

Arguments

population	Population
pids	Pids

Value

Vector with pedigree ids

get_pid *Get pid from individual*

Description

Get pid from individual

Usage

```
get_pid(individual)
```

Arguments

individual	Individual to get pid of

Value

pid

Examples

```
sim <- sample_geneology(100, 10)
indv <- get_individual(sim$population, 1)
get_pid(indv)
```

get_pids_in_pedigree *Get pids in pedigree*

Description

Get pids in pedigree

Usage

```
get_pids_in_pedigree(ped)
```

Arguments

ped	Pedigree

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
get_pids_in_pedigree(peds[[1]])
```

`get_uncles` *Get uncles*

Description

Get individual's uncles

Usage

```
get_uncles(individual)
```

Arguments

`individual`	individual

Value

List with uncles

See Also

`get_brothers()`, `get_children()`, `get_cousins()`

`get_zero_haplotype_generator` *Generate a function to generate the zero haplotype*

Description

Generate a function to generate the zero haplotype

Usage

```
get_zero_haplotype_generator(loci)
```

Arguments

`loci`	Number of loci

grandfather_matches *Grandfather matches*

Description

Does the frandfather have the same profile as `individual`?

Usage

```
grandfather_matches(individual)
```

Arguments

`individual`	individual

Value

Whether grandfather has the same profile as `individual` or not

haplotypes_to_hashes *Convert haplotypes to hashes (integers)*

Description

Individuals with the same haplotype will have the same hash (integer) and individuals with different haplotypes will have different hashes (integers).

Usage

```
haplotypes_to_hashes(population, pids)
```

Arguments

`population`	Population obtained from simulation
`pids`	Vector of individual pids

Details

This can be useful if for example using haplotypes to define groups and the haplotype itself is not of interest.

Value

Integer vector with haplotype hashes

haplotype_matches_individuals

Get individuals matching from list of individuals

Description

Get the indvididuals that matches `haplotype` in `individuals`.

Usage

```
haplotype_matches_individuals(individuals, haplotype)
```

Arguments

`individuals`	List of individuals to count occurrences in.
`haplotype`	Haplotype to count occurrences of.

Value

List of individuals that matches `haplotype` amongst `individuals`.

See Also

`pedigree_haplotype_matches_in_pedigree_meiosis_L1_dists()`.

haplotype_partially_matches_individuals

Get individuals partially matching from list of individuals

Description

Get the indvididuals that partially matches `haplotype` in `individuals`.

Usage

```
haplotype_partially_matches_individuals(
  individuals,
  haplotype,
  ignore_loci = as.integer(c())
)
```

Arguments

`individuals`	List of individuals to count occurrences in.
`haplotype`	Haplotype to count occurrences of.
`ignore_loci`	Vector of loci to ignore (1 = ignore first locus etc.)

Value

List of individuals that partially matches `haplotype` amongst `individuals`.

`infer_generations` *Infer generation numbers from pedigrees*

Description

Infer generation numbers from pedigrees

Usage

```
infer_generations(peds)
```

Arguments

`peds`	Pedigrees infered by `build_pedigrees()`

Value

Nothing

`load_individuals` *Construct a population from data*

Description

Note that individuals loaded this way does not have information about generation.

Usage

```
load_individuals(pid, pid_dad, progress = TRUE, error_on_pid_not_found = TRUE)
```

Arguments

`pid`	ID of male
`pid_dad`	ID of male's father, 0 if not known
`progress`	Show progress.
`error_on_pid_not_found`	Error if pid not found

meioses_generation_distribution *Meiotic distribution*

Description

Get the distribution of number of meioses from `individual` to all individuals in `individual`'s pedigree. Note the `generation_upper_bound_in_result` parameter.

Usage

```
meioses_generation_distribution(
  individual,
  generation_upper_bound_in_result = -1L
)
```

Arguments

`individual`	Individual to calculate all meiotic distances from
`generation_upper_bound_in_result`	Limit on distribution; -1 means no limit. 0 is the final generation. 1 second last generation etc.

meiotic_dist *Meiotic distance between two individuals*

Description

Get the number of meioses between two individuals. Note, that pedigrees must first have been inferred by `build_pedigrees()`.

Usage

```
meiotic_dist(ind1, ind2)
```

Arguments

`ind1`	Individual 1
`ind2`	Individual 2

Value

Number of meioses between `ind1` and `ind2` if they are in the same pedigree, else -1.

mixture_info_by_individuals_2pers

Mixture information about 2 persons' mixture of donor1 and donor2.

Description

Mixture information about 2 persons' mixture of donor1 and donor2.

Usage

```
mixture_info_by_individuals_2pers(individuals, donor1, donor2)
```

Arguments

individuals	Individuals to consider as possible contributors and thereby get information from.
donor1	Contributor1/donor 1
donor2	Contributor2/donor 2

Value

A list with mixture information about the mixture donor1+donor2+donor3 from individuals

See Also

mixture_info_by_individuals_3pers, mixture_info_by_individuals_4pers, mixture_info_by_individuals_5per

mixture_info_by_individuals_3pers

Mixture information about 3 persons' mixture of donor1, donor2 and donor3.

Description

Mixture information about 3 persons' mixture of donor1, donor2 and donor3.

Usage

```
mixture_info_by_individuals_3pers(individuals, donor1, donor2, donor3)
```

Arguments

individuals	Individuals to consider as possible contributors and thereby get information from.
donor1	Contributor1/donor 1
donor2	Contributor2/donor 2
donor3	Contributor3/donor 3

Value

A list with mixture information about the mixture donor1+donor2+donor3 from individuals

See Also

mixture_info_by_individuals_2pers, mixture_info_by_individuals_4pers, mixture_info_by_individuals_5per

---

mixture_info_by_individuals_4pers *Mixture information about 4 persons' mixture of donor1, donor2, donor3 and donor4.*

Description

Mixture information about 4 persons' mixture of donor1, donor2, donor3 and donor4.

Usage

```
mixture_info_by_individuals_4pers(individuals, donor1, donor2, donor3, donor4)
```

Arguments

individuals	Individuals to consider as possible contributors and thereby get information from.
donor1	Contributor1/donor 1
donor2	Contributor2/donor 2
donor3	Contributor3/donor 3
donor4	Contributor4/donor 4

Value

A list with mixture information about the mixture donor1+donor2+donor3 from individuals

See Also

mixture_info_by_individuals_2pers, mixture_info_by_individuals_3pers, mixture_info_by_individuals_5per

`mixture_info_by_individuals_5pers` *Mixture information about 5 persons' mixture of donor1, donor2, donor3, donor4 and donor5.*

Description

Mixture information about 5 persons' mixture of donor1, donor2, donor3, donor4 and donor5.

Usage

```
mixture_info_by_individuals_5pers(
  individuals,
  donor1,
  donor2,
  donor3,
  donor4,
  donor5
)
```

Arguments

`individuals`	Individuals to consider as possible contributors and thereby get information from.
`donor1`	Contributor1/donor 1
`donor2`	Contributor2/donor 2
`donor3`	Contributor3/donor 3
`donor4`	Contributor4/donor 4
`donor5`	Contributor5/donor 5

Value

A list with mixture information about the mixture `donor1+donor2+donor3` from `individuals`

See Also

`mixture_info_by_individuals_2pers`, `mixture_info_by_individuals_3pers`, `mixture_info_by_individuals_4pe`

`pedigrees_all_populate_autosomal` *Populate 1-locus autosomal DNA profile in pedigrees with single-step mutation model.*

Description

Populate 1-locus autosomal DNA profile from founder and down in all pedigrees. Note, that only alleles from ladder is assigned and that all founders draw type randomly.

Usage

```
pedigrees_all_populate_autosomal(
  pedigrees,
  allele_dist,
  theta,
  mutation_rate,
  progress = TRUE
)
```

Arguments

`pedigrees`	Pedigree list in which to populate genotypes
`allele_dist`	Allele distribution (probabilities) – gets normalised
`theta`	Theta correction between 0 and 1 (both included)
`mutation_rate`	Mutation rate between 0 and 1 (both included)
`progress`	Show progress

Details

Note, that pedigrees must first have been inferred by `build_pedigrees()`.

See Also

`pedigrees_all_populate_haplotypes_custom_founders()` and `pedigrees_all_populate_haplotypes_ladder_bour`

`pedigrees_all_populate_haplotypes` *Populate haplotypes in pedigrees (0-founder/unbounded).*

Description

Populate haplotypes from founder and down in all pedigrees. Note, that haplotypes are unbounded and that all founders get haplotype `rep(0L, loci)`.

Usage

```
pedigrees_all_populate_haplotypes(
  pedigrees,
  loci,
  mutation_rates,
  prob_two_step = 0,
  prob_genealogical_error = 0,
  progress = TRUE
)
```

Arguments

`pedigrees`	Pedigree list in which to populate haplotypes
`loci`	Number of loci
`mutation_rates`	Vector with mutation rates, length `loci`
`prob_two_step`	Given a mutation happens, this is the probability that the mutation is a two-step mutation
`prob_genealogical_error`	Probability that a genealogical error happens: if so, give individual haplotype `rep(0L, loci)` instead of father's
`progress`	Show progress

Details

Note, that pedigrees must first have been inferred by `build_pedigrees()`.

See Also

`pedigrees_all_populate_haplotypes_custom_founders()` and `pedigrees_all_populate_haplotypes_ladder_bour`

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes(peds, 2, c(1, 1))
get_haplotype(sim$end_generation_individuals[[1]])
```

`pedigrees_all_populate_haplotypes_custom_founders` *Populate haplotypes in pedigrees (custom founder/unbounded).*

Description

Populate haplotypes from founder and down in all pedigrees. Note, that haplotypes are unbounded. All founders get a haplotype from calling the user provided function `get_founder_haplotype()`.

Usage

```
pedigrees_all_populate_haplotypes_custom_founders(
  pedigrees,
  mutation_rates,
  get_founder_haplotype = NULL,
  prob_two_step = 0,
  prob_genealogical_error = 0,
  progress = TRUE
)
```

Arguments

`pedigrees`	Pedigree list in which to populate haplotypes
`mutation_rates`	Vector with mutation rates
`get_founder_haplotype`	Function taking no arguments returning a haplotype of `length(mutation_rates)`
`prob_two_step`	Given a mutation happens, this is the probability that the mutation is a two-step mutation
`prob_genealogical_error`	Probability that a genealogical error happens: if so, give individual haplotype `get_founder_haplotype()` instead of father's
`progress`	Show progress

Details

Note, that pedigrees must first have been inferred by `build_pedigrees()`.

See Also

`pedigrees_all_populate_haplotypes()` and `pedigrees_all_populate_haplotypes_ladder_bounded()`.

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes_custom_founders(
  peds, c(1, 1), function(x) c(10, 10))
get_haplotype(sim$end_generation_individuals[[1]])
```

`pedigrees_all_populate_haplotypes_ladder_bounded`
Populate haplotypes in pedigrees (custom founder/bounded).

Description

Populate haplotypes from founder and down in all pedigrees. Note, that haplotypes are bounded by `ladder_min` and `ladder_max`. All founders get a haplotype from calling the user provided function `get_founder_haplotype()`.

Usage

```
pedigrees_all_populate_haplotypes_ladder_bounded(
  pedigrees,
  mutation_rates,
  ladder_min,
  ladder_max,
  get_founder_haplotype = NULL,
  prob_two_step = 0,
  prob_genealogical_error = 0,
  progress = TRUE
)
```

Arguments

`pedigrees`	Pedigree list in which to populate haplotypes
`mutation_rates`	Vector with mutation rates
`ladder_min`	Lower bounds for haplotypes, same length as `mutation_rates`
`ladder_max`	Upper bounds for haplotypes, same length as `mutation_rates`; all entries must be strictly greater than `ladder_min`
`get_founder_haplotype`	Function taking no arguments returning a haplotype of `length(mutation_rates)`
`prob_two_step`	Given a mutation happens, this is the probability that the mutation is a two-step mutation; refer to details for information about behaviour around ladder boundaries
`prob_genealogical_error`	Probability that a genealogical error happens: if so, give individual haplotype `get_founder_haplotype()` instead of father's
`progress`	Show progress

Details

Given that a two step mutation should happen (probability specified by `prob_two_step`): With distances >= 2 to ladder bounds, mutations happen as usual. At distance = 0 or 1 to a ladder bound, the mutation is forced to move away from the boundary.

Note, that pedigrees must first have been inferred by `build_pedigrees()`.

See Also

`pedigrees_all_populate_haplotypes()` and `pedigrees_all_populate_haplotypes_custom_founders()`.

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_all_populate_haplotypes_ladder_bounded(
  peds, c(1, 1), c(0L, 0L), c(10L, 10L),
  function(x) c(10, 10))
get_haplotype(sim$end_generation_individuals[[1]])
```

---

pedigrees_count *Get number of pedigrees*

Description

Get number of pedigrees

Usage

```
pedigrees_count(pedigrees)
```

Arguments

`pedigrees`	Pedigrees

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_count(peds)
```

pedigrees_table *Get distribution of pedigree sizes*

Description

Get distribution of pedigree sizes

Usage

```
pedigrees_table(pedigrees)
```

Arguments

pedigrees	Pedigrees

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigrees_table(peds)
```

pedigree_as_igraph *Convert pedigree to igraph*

Description

Convert pedigree to igraph

Usage

```
pedigree_as_igraph(x, ...)
```

Arguments

x	Pedigree
...	ignored

Value

igraph object

pedigree_haplotype_matches_in_pedigree_meiosis_L1_dists
Information about matching individuals

Description

Gives information about all individuals in pedigree that matches an individual. Just as count_haplotype_occurrences_indi counts the number of occurrences amongst a list of individuals, this gives detailed information about matching individuals in the pedigree, e.g. meiotic distances and maximum L1 distance on the path as some of these matches may have (back)mutations between in between them (but often this will be 0).

Usage

```
pedigree_haplotype_matches_in_pedigree_meiosis_L1_dists(
  suspect,
  generation_upper_bound_in_result = -1L
)
```

Arguments

suspect	Individual that others must match the profile of.
generation_upper_bound_in_result	Only consider matches in generation 0, 1, ... generation_upper_bound_in_result. -1 means disabled, consider all generations. End generation is generation 0. Second last generation is 1. And so on.

Value

Matrix with information about matching individuals. Columns in order: meioses (meiotic distance to suspect), max_L1 (on the path between the matching individual and suspect, what is the maximum L1 distance between the suspect's profile and the profiles of the individuals on the path), pid (pid of matching individual)

See Also

count_haplotype_occurrences_individuals().

pedigree_haplotype_near_matches_meiosis *Information about almost matching individuals*

Description

Gives information about all individuals in pedigree that almost matches an individual. Just as `count_haplotype_near_matches_individuals()` counts the number of occurrences amongst a list of individuals, this gives detailed information about almost matching individuals in the pedigree: for now, the meiotic distances.

Usage

```
pedigree_haplotype_near_matches_meiosis(
  suspect,
  max_dist,
  generation_upper_bound_in_result = -1L
)
```

Arguments

`suspect`	Individual that others must match the profile of.
`max_dist`	Maximum distance (0 = match, 1 = 1 STR allele difference, ...)
`generation_upper_bound_in_result`	Only consider matches in generation 0, 1, ... generation_upper_bound_in_result. -1 means disabled, consider all generations. End generation is generation 0. Second last generation is 1. And so on.

Value

Matrix with information about matching individuals. Columns in order: 1) meioses (meiotic distance to `suspect`), 2) haplotype distance, 3) pid (pid of matching individual)

See Also

`count_haplotype_near_matches_individuals()`.

pedigree_size *Get pedigree size*

Description

Get pedigree size

Usage

```
pedigree_size(ped)
```

Arguments

ped	Pedigree

Examples

```
sim <- sample_geneology(100, 10)
peds <- build_pedigrees(sim$population)
pedigree_size(peds[[1]])
```

---

pedigree_size_generation *Size of pedigree*

Description

Get the size of the pedigree. Note the `generation_upper_bound_in_result` parameter.

Usage

```
pedigree_size_generation(pedigree, generation_upper_bound_in_result = -1L)
```

Arguments

pedigree	Pedigree to get size of
generation_upper_bound_in_result	Limit on generation to include in count; -1 means no limit. 0 only include the final generation. 1 only second last generation etc.

---

plot.malan_pedigree *Plot pedigree*

Description

Plot `malan_pedigree`.

Usage

```
## S3 method for class 'malan_pedigree'
plot(
  x,
  ids = TRUE,
  haplotypes = FALSE,
  locus_sep = " ",
  mark_pids = NULL,
  label_color = "black",
  node_color = "lightgray",
  mark_color = "orange",
  ...
)
```

Arguments

x	Pedigree
ids	Show pids
haplotypes	Show haplotypes
locus_sep	Locus separator in haplotypes
mark_pids	Vector of pids to highlight
label_color	Label color
node_color	Node color
mark_color	Highlight color
...	Passed to igraph::plot.igraph

---

plot.malan_pedigreelist

Plot pedigree list

Description

Plot malan_pedigreelist generated by build_pedigrees().

Usage

```
## S3 method for class 'malan_pedigreelist'
plot(x, ...)
```

Arguments

x	Pedigree list
...	ignored

population_populate_autosomal_infinite_alleles

Populate 1-locus autosomal DNA profile in pedigrees with infinite alleles mutation model.

Description

Populate 1-locus autosomal DNA profile from founder and down in all pedigrees. Note, that all founders have type 0 to begin with.

Usage

```
population_populate_autosomal_infinite_alleles(
  population,
  mutation_rate,
  progress = TRUE
)
```

Arguments

`population`	Population in which to populate genotypes
`mutation_rate`	Mutation rate between 0 and 1 (both included)
`progress`	Show progress

Details

The maternal allele is taken by random from the `2*N[g]` alleles in the previous generation consisting of `N[g]` males with descendants in the live population.

This is also why this is not using pedigrees but instead the population.

Note, that pedigrees need not be inferred.

See Also

`pedigrees_all_populate_haplotypes_custom_founders()` and `pedigrees_all_populate_haplotypes_ladder_bour`

population_size_generation

Size of population

Description

Get the size of the population. Note the `generation_upper_bound_in_result` parameter.

Usage

```
population_size_generation(population, generation_upper_bound_in_result = -1L)
```

Arguments

population	Population to get size of
generation_upper_bound_in_result	Limit on generation to include in count; -1 means no limit. 0 only include the final generation. 1 only second last generation etc.

---

print.malan_pedigree *Print pedigree*

Description

Print pedigree

Usage

```
## S3 method for class 'malan_pedigree'
print(x, ...)
```

Arguments

x	Pedigree
...	ignored

---

print.malan_pedigreelist *Print pedigree list*

Description

Print `malan_pedigreelist` generated by `build_pedigrees()`.

Usage

```
## S3 method for class 'malan_pedigreelist'
print(x, ...)
```

Arguments

x	Pedigrees (`malan_pedigreelist`)
...	ignored

print.malan_population *Print population*

Description

Print malan_population generated by sample_geneology() or sample_geneology_varying_size().

Usage

```
## S3 method for class 'malan_population'
print(x, ...)
```

Arguments

x	Population (malan_population)
...	ignored

print.malan_population_abort *Print* malan_population_abort

Description

Print malan_population_abort

Usage

```
## S3 method for class 'malan_population_abort'
print(x, ...)
```

Arguments

x	malan_population_abort
...	ignored

print_individual *Print individual*

Description

Print individual

Usage

```
print_individual(individual)
```

Arguments

individual	Individual

Examples

```
sim <- sample_geneology(100, 10)
indv <- get_individual(sim$population, 1)
print_individual(indv)
```

relationship_allele_diff_dist *Calculate distribution of allele difference*

Description

Calculate distribution of allele difference after m meioses.

Usage

```
relationship_allele_diff_dist(meioses, mu_dw, mu_up, method = "explicit")
```

Arguments

meioses	number of meioses separating the two individuals
mu_dw	mutation rate for 1-step down-mutation
mu_up	mutation rate for 1-step up-mutation
method	"explicit" (default): use known formulas for eigenvalues and eigenvectors. Can cause numerical problems. "matmult": do matrix multiplication instead of diagonalisation. "matmult_mpfr": as "matmult" but with the Rmpfr library (note that this returns list instead of data.frame). "r_eigen": use R's eigen() function to find eigen values. Mostly for debugging.

Value

data.frame with columns d (allele difference) and p (prob)

---

relationship_allele_diff_dist_sym

Calculate distribution of allele difference for symmetric mutation rates

---

Description

Calculate distribution of allele difference after m meioses.

Usage

```
relationship_allele_diff_dist_sym(meioses, mu_updw, method = "explicit")
```

Arguments

meioses	number of meioses separating the two individuals
mu_updw	mutation rate for 1-step down- and up-mutations, i.e. total mutation rate is 2*mu_updw
method	"explicit" (default): use known formulas for eigenvalues and eigenvectors. Can cause numerical problems. "matmult": do matrix multiplication instead of diagonalisation. "matmult_mpfr": as "matmult" but with the Rmpfr library (note that this returns list instead of data.frame). "r_eigen": use R's eigen() function to find eigen values. Mostly for debugging.

Value

data.frame with columns d (allele difference) and p (prob)

---

sample_autosomal_genotype

Sample genotype with theta

Description

Sample genotype with theta

Usage

```
sample_autosomal_genotype(allele_dist, theta)
```

Arguments

allele_dist	Allele distribution (probabilities) – gets normalised
theta	Theta correction between 0 and 1 (both included)

`sample_geneology` *Simulate a geneology with constant population size.*

Description

This function simulates a geneology where the last generation has `population_size` individuals.

Usage

```
sample_geneology(
  population_size,
  generations,
  generations_full = 1L,
  generations_return = 3L,
  enable_gamma_variance_extension = FALSE,
  gamma_parameter_shape = 5,
  gamma_parameter_scale = 1/5,
  progress = TRUE,
  verbose_result = FALSE
)
```

Arguments

`population_size`
: The size of the population.

`generations`
: The number of generations to simulate:

- -1 for simulate to 1 founder
- else simulate this number of generations.

`generations_full`
: Number of full generations to be simulated.

`generations_return`
: How many generations to return (pointers to) individuals for.

`enable_gamma_variance_extension`
: Enable symmetric Dirichlet (and disable standard Wright-Fisher).

`gamma_parameter_shape`
: Parameter related to symmetric Dirichlet distribution for each man's probability to be father. Refer to details.

`gamma_parameter_scale`
: Parameter realted to symmetric Dirichlet distribution for each man's probability to be father. Refer to details.

`progress`
: Show progress.

`verbose_result`
: Verbose result.

Details

By the backwards simulating process of the Wright-Fisher model, individuals with no descendants in the end population are not simulated. If for some reason additional full generations should be simulated, the number can be specified via the `generations_full` parameter. This can for example be useful if one wants to simulate the final 3 generations although some of these may not get (male) children.

Let α be the parameter of a symmetric Dirichlet distribution specifying each man's probability to be the father of an arbitrary male in the next generation. When $\alpha = 5$, a man's relative probability to be the father has 95\ constant 1 under the standard Wright-Fisher model and the standard deviation in the number of male offspring per man is 1.10 (standard Wright-Fisher = 1).

This symmetric Dirichlet distribution is implemented by drawing father (unscaled) probabilities from a Gamma distribution with parameters `gamma_parameter_shape` and `gamma_parameter_scale` that are then normalised to sum to 1. To obtain a symmetric Dirichlet distribution with parameter α, the following must be used: $`gamma_parameter_shape` = \alpha$ and $`gamma_parameter_scale` = 1/\alpha$.

Value

A malan_simulation / list with the following entries:

- `population`. An external pointer to the population.
- `generations`. Generations actually simulated, mostly useful when parameter `generations = -1`.
- `founders`. Number of founders after the simulated `generations`.
- `growth_type`. Growth type model.
- `sdo_type`. Standard deviation in a man's number of male offspring. StandardWF or GammaVariation depending on `enable_gamma_variance_extension`.
- `end_generation_individuals`. Pointers to individuals in end generation.
- `individuals_generations`. Pointers to individuals in last `generations_return` generation (if `generations_return = 3`, then individuals in the last three generations are returned).

If `verbose_result` is true, then these additional components are also returned:

- `individual_pids`. A matrix with pid (person id) for each individual.
- `father_pids`. A matrix with pid (person id) for each individual's father.
- `father_indices`. A matrix with indices for fathers.

See Also

`sample_geneology_varying_size()`.

Examples

```
sim <- sample_geneology(100, 10)
str(sim, 1)
sim$population
peds <- build_pedigrees(sim$population)
```

peds

---

sample_geneology_varying_size
Simulate a geneology with varying population size.

Description

This function simulates a geneology with varying population size specified by a vector of population sizes, one for each generation.

Usage

```
sample_geneology_varying_size(
  population_sizes,
  generations_full = 1L,
  generations_return = 3L,
  enable_gamma_variance_extension = FALSE,
  gamma_parameter_shape = 5,
  gamma_parameter_scale = 1/5,
  progress = TRUE
)
```

Arguments

population_sizes	The size of the population at each generation, g. population_sizes[g] is the population size at generation g. The length of population_sizes is the number of generations being simulated.
generations_full	Number of full generations to be simulated.
generations_return	How many generations to return (pointers to) individuals for.
enable_gamma_variance_extension	Enable symmetric Dirichlet (and disable standard Wright-Fisher).
gamma_parameter_shape	Parameter related to symmetric Dirichlet distribution for each man's probability to be father. Refer to details.
gamma_parameter_scale	Parameter realted to symmetric Dirichlet distribution for each man's probability to be father. Refer to details.
progress	Show progress.

Details

By the backwards simulating process of the Wright-Fisher model, individuals with no descendants in the end population are not simulated If for some reason additional full generations should be simulated, the number can be specified via the `generations_full` parameter. This can for example be useful if one wants to simulate the final 3 generations although some of these may not get (male) children.

Let α be the parameter of a symmetric Dirichlet distribution specifying each man's probability to be the father of an arbitrary male in the next generation. When $\alpha = 5$, a man's relative probability to be the father has 95\ constant 1 under the standard Wright-Fisher model and the standard deviation in the number of male offspring per man is 1.10 (standard Wright-Fisher = 1).

This symmetric Dirichlet distribution is implemented by drawing father (unscaled) probabilities from a Gamma distribution with parameters `gamma_parameter_shape` and `gamma_parameter_scale` that are then normalised to sum to 1. To obtain a symmetric Dirichlet distribution with parameter α, the following must be used: '$gamma_parameter_shape$' $= \alpha$ and '$gamma_parameter_scale$' $= 1/\alpha$.

Value

A malan_simulation / list with the following entries:

- `population`. An external pointer to the population.
- `generations`. Generations actually simulated, mostly useful when parameter `generations = -1`.
- `founders`. Number of founders after the simulated `generations`.
- `growth_type`. Growth type model.
- `sdo_type`. Standard deviation in a man's number of male offspring. StandardWF or GammaVariation depending on `enable_gamma_variance_extension`.
- `end_generation_individuals`. Pointers to individuals in end generation.
- `individuals_generations`. Pointers to individuals in last `generations_return` generation (if `generations_return = 3`, then individuals in the last three generations are returned).

See Also

`sample_geneology()`.

Examples

```
sim <- sample_geneology_varying_size(10*(1:10))
str(sim, 1)
sim$population
peds <- build_pedigrees(sim$population)
peds
```

split_by_haplotypes *Split pids by haplotype*

Description

Individuals with the same haplotype will be in the same group and individuals with different haplotypes will be in different groups.

Usage

```
split_by_haplotypes(population, pids)
```

Arguments

population	Population obtained from simulation
pids	Vector of individual pids

Value

List of integer vector, element i is an IntegerVector with all pids from pids with the same haplotype

test_create_population *Generate test population*

Description

Generate test population

Usage

```
test_create_population()
```

Value

An external pointer to the population.

ystr_kits *Kit information about Y-STR markers*

Description

A dataset containing information about the Y chromosomal short tandem repeat (Y-STR) markers that are present in the kit.

Usage

```
ystr_kits
```

Format

A data frame with 88 rows and 2 variables:

Marker name of Y-STR marker

Kit name of Y-STR kit

Source

http://www.yhrd.org

ystr_markers *Mutational information about Y-STR markers*

Description

A dataset from yhrd.org (and their sources) containing mutational information about Y chromosomal short tandem repeat (Y-STR) markers used in forensic genetics.

Usage

```
ystr_markers
```

Format

A data frame with 29 rows and 5 variables:

Marker name of Y-STR marker

Meioses number of meioses observed

Mutations number of mutations observed in the corresponding number of Meioses

MutProb point estimate of mutation probability, MutProb = Mutations/Meioses

Alleles observed alleles

Details

Note, that loci with duplications (DYS385a/b as well as DYF387S1a/b have been split into two loci).

Source

http://www.yhrd.org

[[.malan_pedigreelist *Get pedigree from pedigree list*

Description

Get pedigree from `malan_pedigreelist` generated by `build_pedigrees()`.

Usage

```
## S3 method for class 'malan_pedigreelist'
x[[...]]
```

Arguments

x	Element id
...	ignored

Value

Pedigree

[[.malan_population *Get individual from population by pid*

Description

Get individual from population by pid

Usage

```
## S3 method for class 'malan_population'
x[[...]]
```

Arguments

x	pid
...	ignored

Value

Individual

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