

Package ‘shapleyHALE’

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Title Shapley Value Decomposition of Health-Adjusted Life Expectancy

Version 0.1.0

Description Implements a Shapley-value framework to decompose changes in health-adjusted life expectancy (HALE) into additive contributions of individual diseases or causes, fully accounting for higher-order interactions. Separates mortality and disability effects and provides second-order Shapley interaction indices. Uncertainty is propagated via parametric bootstrap.

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Encoding UTF-8

LazyData true

Imports data.table, foreach, doParallel, stats

Suggests testthat (>= 3.0.0), ggplot2, knitr, rmarkdown

VignetteBuilder knitr

Depends R (>= 3.5)

Config/testthat/edition 3

Config/roxygen2/version 8.0.0

NeedsCompilation no

Author Jun-Yan Xi [aut, cre] (ORCID: <<https://orcid.org/0000-0001-7473-7783>>, affiliation: Sun Yat-sen University)

Maintainer Jun-Yan Xi <xijy3@mail2.sysu.edu.cn>

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age_info_demo	Example age group information
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Description

Matches the age groups in [demo_gbd](#).

Usage

age_info_demo

Format

A data.table with columns:

age_id numeric age group ID

age_start start of interval

width interval width (years)

bootstrap_shapley	Parametric bootstrap Shapley decomposition
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Description

Performs bootstrap uncertainty analysis by sampling rates from triangular distributions defined by point estimates and 95

Usage

```
bootstrap_shapley(  
  deaths_data,  
  ylds_data,  
  base_year,  
  target_year,  
  cause_ids,  
  age_ids,  
  ages_info,  
  n_boot = 1000,  
  n_perm_inner = 5000,  
  parallel = FALSE,  
  n_cores = NULL  
)
```

Arguments

deaths_data	data.table with mortality rates (cols: year, cause_id, age_id, val, lower, upper)
ylds_data	data.table with YLD rates (same structure)
base_year	baseline year
target_year	target year
cause_ids	character vector of cause IDs
age_ids	numeric vector of age IDs in correct order
ages_info	data.frame with age_start and width, matching age_ids
n_boot	number of bootstrap iterations (default 1000)
n_perm_inner	number of Shapley permutations per bootstrap (default 5000)
parallel	logical, use parallel processing?
n_cores	number of cores (NULL = detectCores()-1)

Value

list containing point estimates and bootstrap summaries

compute_hale	<i>Compute health-adjusted life expectancy</i>
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Description

Sullivan method combining mortality and YLD rates.

Usage

```
compute_hale(mx, yld_rate, ages)
```

Arguments

mx	numeric vector of age-specific mortality rates (per person-year)
yld_rate	numeric vector of YLD rates (per person-year)
ages	data.frame with columns 'age_start' and 'width'

Value

list containing HALE0 and LE0

Examples

```
ages <- data.frame(age_start = c(0,1,5), width = c(1,4,5))
compute_hale(c(0.01,0.02,0.05), c(0.1,0.1,0.1), ages)
```

 compute_shapley_interactions

Second-order Shapley interaction indices

Description

Quantifies pairwise synergies/antagonisms among the leading causes.

Usage

```
compute_shapley_interactions(
  base_mx,
  base_yld,
  target_mx,
  target_yld,
  causes,
  ages,
  top_n = 20,
  n_perm = 1000,
  point_est = NULL
)
```

Arguments

base_mx	matrix, baseline mortality rates
base_yld	matrix, baseline YLD rates
target_mx	matrix, target mortality rates
target_yld	matrix, target YLD rates
causes	character vector of all cause IDs
ages	data.frame with age_start and width
top_n	number of leading causes to consider (default 20)
n_perm	number of permutations (default 1000)
point_est	optional named vector of total Shapley values (for ranking)

Value

data.table with columns cause_A, cause_B, interaction

create_rate_matrix	Create cause-rate matrix from GBD-style data.table
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Description

Create cause-rate matrix from GBD-style data.table

Usage

```
create_rate_matrix(data, year_val, cause_ids, age_ids)
```

Arguments

data	data.table with columns year, cause_id, age_id, val
year_val	numeric year
cause_ids	character vector of cause IDs
age_ids	numeric vector of age IDs in correct order

Value

matrix (ages x causes)

demo_gbd	Demo GBD rates (simulated)
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Description

A small simulated dataset mimicking GBD cause-specific mortality and YLD rates.

Usage

```
demo_gbd
```

Format

A data.table with columns:

- measure_id** 1 = mortality, 3 = YLD
- sex_id** 3 = both sexes
- year** 1990 or 2023
- cause_id** character cause identifier
- cause_name** cause name
- age_id** numeric age group ID
- val** point estimate (rate)
- upper** upper 95% UI
- lower** lower 95% UI

Source

Simulated for package examples.

run_shapley_decomp	<i>Shapley decomposition of HALE change</i>
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Description

Decomposes the HALE change between baseline and target into additive contributions of individual causes, separating mortality and disability effects.

Usage

```
run_shapley_decomp(  
  base_mx,  
  base_yld,  
  target_mx,  
  target_yld,  
  causes = NULL,  
  ages,  
  n_perm = 5000  
)
```

Arguments

base_mx	matrix of baseline mortality rates (age x cause)
base_yld	matrix of baseline YLD rates (age x cause)
target_mx	matrix of target mortality rates
target_yld	matrix of target YLD rates
causes	character vector of cause IDs (column names)
ages	data.frame with 'age_start' and 'width'
n_perm	number of random permutations (default 5000)

Value

list with total_change, total_effect, death_effect, disability_effect

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