Package: HOME (via r-universe)

October 9, 2026

Title Harmonized Orphanhood Mortality Estimation

Version 0.1.2

Description Implements indirect methods for estimating adult mortality from orphanhood data: the Brass and Hill (1973) method, the regression-based method of Timaeus (1992) <https://pubmed.ncbi.nlm.nih.gov/12317481/>, and the extended orphanhood method of Luy (2012) <doi:10.1007/s13524-012-0101-4> for low-mortality populations. Besides the coefficients published by Luy for Italy, the package derives context-specific coefficients (weighting factors, reference-period parameters and the conversion of the mean age at childbearing of surviving parents to that of all parents) for any population and survey date from user-supplied period fertility, population, cohort mortality and period life table data, following the procedure of Luy (2009) <https://www.oeaw.ac.at/fileadmin/subsites/Institute/VID/PDF/Publications/EDRP/edrp_2009_03.pdf>. Estimates are harmonized into comparable adult mortality indicators (30q30, 45q15 and e30) with a relational logit model, and diagnostic tools assess the sensitivity of results to the mean age at childbearing and to the choice of model life table family.

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Depends R (>= 3.5.0)

Imports ggplot2, gridExtra

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VignetteBuilder knitr

URL https://github.com/tamaravaz/HOME

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`app_HOME` *Launch the HOME Shiny Application*

Description

Opens the interactive dashboard for indirect adult mortality estimation using the orphanhood-based methods implemented in the **HOME** package. The application provides a graphical interface to `om_estimate_index`, `om_plot_linearity`, `om_sensitivity_Mn`, and `om_sensitivity_modelLT`.

Usage

```
app_HOME()
```

Details

The Shiny application is located in `inst/shiny/home_app/` and is launched via `shiny::runApp()`. An active R session with the **shiny**, **bslib**, **ggplot2**, **plotly**, **DT**, **readxl**, and **writexl** packages is required; these are listed under `Suggests` in the package `DESCRIPTION` file.

Value

This function is called for its side effect of launching a Shiny application. It does not return a meaningful value; the return value of `shiny::runApp()` is returned invisibly.

See Also

`om_estimate_index` for the underlying estimation function.

Examples

```
if (interactive()) {
  app_HOME()
}
```

---

om_calibrate_luy *Derive Context-Specific Luy Calibration Coefficients*

Description

Derives population-specific weighting factors $W(n)$, reference-date parameters $a(n)$, $b(n)$ and the surviving-parent to all-parent mean-age conversion for the Luy orphanhood method, reproducing the calculation workbooks behind Luy (2009, 2010 supplement) and Luy (2012).

Usage

```
om_calibrate_luy(
  sex_parent,
  asfr,
  cohort_qx,
  pop_age = NULL,
  survey_date,
  age_respondent = seq(20, 60, by = 5),
  mean_age_grid = NULL,
  period_lx = NULL,
  weighting = c("Nf", "f"),
  mixing = c("luy", "exact"),
  smoothing = c("graphical", "lsq"),
  cohort_lag = 4,
  male_shift = 4,
  age_range = NULL,
  s_factors = seq(0.5, 1.5, by = 0.05)
)
```

Arguments

sex_parent	Character. "Female" or "Male".
asfr	Data frame of **period** age-specific fertility rates of **women**. Required columns: age (completed age, integer), year (calendar year, integer), rate (births per woman per year, numeric, *not* per 1000). Needed for ages 15–49 in the respondents' birth years (see om_luy_data_needs). Period rates are required because the weights describe the mothers giving birth in a given calendar year. For fathers the female rates are shifted by male_shift (pass male rates with male_shift = 0).
cohort_qx	Data frame of **cohort** probabilities of dying of the parent's sex. Required columns: age (completed age, integer), cohort (birth year, integer), qx (probability 0-1, numeric). Must cover the parental cohorts up to calendar year $\lfloor T \rfloor - 2$, including cohorts still alive (see om_luy_data_needs); published cohort life tables usually exist only for extinct cohorts, so younger cohorts are typically built from cohort death rates. Ages not supplied are treated as unobserved (see Details). Used for q[x,k]; also for period tables when period_lx is not given.
pop_age	Data frame of **population size** (not exposure) of the parent's sex. Optional; if provided, requires columns age (completed age, integer), year (calendar year, integer), n (population count, numeric). Averaged over the respondents' birth years; enters the mean age at childbearing and, with weighting = "Nf", the weights. If NULL, $N_x = 1$ (with a message).
survey_date	Numeric. Interview date as a decimal year (T), e.g. 1998.5.
age_respondent	Numeric vector of respondent age group lower bounds.
mean_age_grid	Numeric vector of (integer) mean ages at childbearing. Defaults to 22:35 (mothers) and 24:37 (fathers), as in Luy.
period_lx	Optional data frame of **period** life tables of the parent's sex, columns year, age, and lx (or qx). Recommended (e.g. HMD fltper_1x1). If NULL, period tables are assembled from the diagonals of cohort_qx.
weighting	"Nf" (2010 supplement, default) or "f" (Luy 2009).
mixing	"luy" (default, reproduces Luy) or "exact".
smoothing	"graphical" (default; Schmertmann parameters read off the empirical schedule, as Luy did) or "lsq" (least-squares fit of the QS point densities, more robust for noisy rates).
cohort_lag	Integer, default 4 (Luy 2009). Years subtracted, in addition to n and x, from the survey year to obtain the birth cohort of a parent aged x at the respondent's birth: cohort = floor(survey_date) - n - cohort_lag - x. The value 4 combines the 3 years between $\lfloor T \rfloor - n$ and the middle of the respondents' five birth years ($\lfloor T \rfloor - n - 3$, Luy 2009, pp. 10, 16) and 1 year for the parent's completed age x, as in Luy's calculation workbooks. It also fixes the first calendar year of exposure, $\lfloor T \rfloor - n - 4$. See Details.
male_shift	Numeric. Years by which female ASFR are shifted to obtain paternal schedules (Luy: 4).
age_range	Numeric length-2 vector, youngest and oldest parental age. Defaults to c(15, 49) (mothers) and c(15, 49) + male_shift (fathers).

`s_factors` Numeric vector of multipliers applied to the model $S(n)$ to build the mortality scenarios used for $a(n)$, $b(n)$.

Details

For each respondent age group n (exposure $K = n + 3$ years) and each target mean age at childbearing M:

1. The empirical ASFR of the respondents' five birth years is averaged and summarised by Schmertmann's graphical parameters (P, $f(P)$, H, $\alpha = 14$; fathers: rates shifted by `male_shift` years, $\alpha = 18$). The quadratic-spline schedule is moved to M – measured as $\sum(x + 0.5)N_x f_x / \sum N_x f_x$ – by stepping P, H and fine-tuning with the Brass relational Gompertz model.
2. The parental cohorts' probabilities of dying are averaged with fixed weights w_x and chained into a survival curve L_k; $S = L_K$.
3. $t(n)$ is the mean time before the survey of the reconstructed deaths; the reference period is $T - t(n)$.
4. $W(n) = [l(33 + n)/l(30)]_{T-t(n)}/S$.
5. $a(n)$, $b(n)$ come from regressing $t(n)$ on $\ln S$ across logit-relevelled mortality scenarios.

Weights. `weighting = "Nf"` (default) uses $w_x \propto N_x f_x$ as in the 2010 supplement and in the package's built-in coefficients; `"f"` uses $w_x \propto f_x$ as in Luy (2009).

Mixing. `mixing = "luy"` (default) averages the probabilities of dying with weights fixed at the respondents' birth, as Luy's workbooks do. `"exact"` mixes the cohort survival curves, $\sum_x w_x l_x(k)$, which is the demographically exact proportion of parents alive; the two diverge strongly at older respondent ages, so only `"luy"` reproduces the published tables.

Parental cohorts (`cohort_lag`). Respondents aged n to $n + 4$ at the survey were born in the five calendar years $\lfloor T \rfloor - n - 5$ to $\lfloor T \rfloor - n - 1$. Luy (2009, pp. 10 and 16) approximates their parents by the parents who gave birth in the middle of these five years, $\lfloor T \rfloor - n - 3$; in his calculation workbooks a parent aged x (completed years) at that birth belongs to the cohort born in $\lfloor T \rfloor - n - 3 - x - 1$. Hence the parental cohort is

$$c(x, n) = \lfloor T \rfloor - n - \text{cohort_lag} - x, \qquad \text{cohort_lag} = 4,$$

and $q[x, k]$ is the probability of dying of cohort $c(x, n)$ at age $x + k - 1$, i.e. in calendar year $\lfloor T \rfloor - n - 4 + k - 1$, for $k = 1, \ldots, K$ with $K = n + 3$ (Luy 2009, p. 10: exposure of $n + 2.5$ years plus the time of the interview within the survey year).

Unobserved ages. No closure rule is applied to the cohort series. A probability of dying that is not in `cohort_qx` (e.g. ages beyond the last age of a cohort's table, such as the open interval 110+) is kept as `NA` and gets no weight: in each year k the weighted average of the probabilities of dying is taken over the cohorts observed in that year,

$$\bar{q}_k = \sum_{x \in O_k} v_{x,k} q[x, k] / \sum_{x \in O_k} v_{x,k},$$

with $v_{x,k} = w_x$ (`mixing = "luy"`) or $v_{x,k} = w_x l_x(k - 1)$ (`mixing = "exact"`). This distinguishes the absence of observations from a probability of dying of 0 and prevents unobserved ages from contributing to the calculation. Luy's workbooks filled these cells with $q = 0$ (1998 survey) or

$q = 1$ (2003 survey). If no parental cohort is observed in some year k (data that end before the calendar year $\lfloor T \rfloor - 2$), S, $W(n)$, $a(n)$ and $b(n)$ are `NA`. The share of the weights observed in each year is returned in the intermediates (`om_luy_intermediates(cal, "w_observed")`). In a complete cohort life table the last, open age interval (e.g. 110+) has $q = 1$: the cohort is extinct and no older age is needed.

How closely Luy is reproduced. Fed with Luy's own schedules and cohort probabilities, the calculation reproduces his published $W(n)$ (Luy 2009) to within about 1% and his reference periods exactly. Run on independent data (e.g. HMD/HFD for Italy), the differences from the built-in tables are below about 1% up to $n = 40$, a few per cent at $n = 45$–55 and larger at $n = 60$, where Luy's values depend on how he filled the ages after the end of the cohort series (see above) and on his source tables ending around age 100. Treat the $n \geq 55$ coefficients with caution.

Mean age of all vs. surviving parents. The tables are indexed by the mean age at childbearing of *all* parents. If your survey only records the parent's age for living parents, convert it first with the returned `mac` table (survivors' mean in the column header, all parents' mean in the cells), as Luy does with his Tables A.5-A.8.

Value

A named list with elements `"Female"` and `"Male"`; the one matching `sex_parent` holds a list of four data frames (the other is `NULL`). Each data frame has one row per respondent age group (column `Age_Group` = n) and one column per mean age at childbearing in `mean_age_grid` (named `"22"`, `"23"`, ...), the layout of the built-in coefficients, so that the result can be passed to `custom_coef_luy` in `om_estimate_index`:

`wn` weighting factors $W(n)$, with $l(33 + n)/l(30) = S(n)W(n)$ (Luy 2009, eq. 1; Tables A.9–A.12).

`an`, `bn` reference-period parameters, with $t(n) = a(n) \ln S(n) + b(n)$ years before the survey (Luy 2009, Tables A.13–A.20).

`mac` mean age at childbirth of all parents (cells) given the mean age of surviving parents (column names) (Luy 2009, Tables A.5–A.8).

`NA` marks cells that could not be computed (see the warnings). Attributes:

`diagnostics` data frame, one row per age group and mean age: `Age_Group`, `mean_age`, model survival `S_model`, reference year `ref_year`, `t_n`, `W`, Brass-Gompertz `gompertz_alpha`, Schmertmann `P` and `H`, and `weight_dropped` (share of the weights of parental cohorts absent from `cohort_qx`).

`intermediates` list by age group with every intermediate quantity of the calculation, laid out like Luy's workbooks; extract with `om_luy_intermediates`.

`settings` list of the arguments used.

References

Luy, M. (2009). Estimating mortality differentials in developed populations from survey information on maternal and paternal orphanhood. *European Demographic Research Papers* 2009-3; supplement, August 2010.

Luy, M. (2012). Estimating mortality differences in developed countries from survey information on maternal and paternal orphanhood. *Demography*, 49(2), 607-627.

Schmertmann, C. P. (2003). A system of model fertility schedules with graphically intuitive parameters. *Demographic Research*, 9(5), 81-110.

See Also

om_estimate_index, om_luy_intermediates, om_luy_data_needs

Examples

```
# synthetic inputs in the standard long format
asfr <- expand.grid(age = 15:49, year = 1950:2000)
asfr$rate <- 0.1 * exp(-0.5 * ((asfr$age - 28) / 5.5)^2)
cohort_qx <- expand.grid(age = 0:110, cohort = 1900:1990)
cohort_qx$qx <- pmin(1, 0.00005 * exp(0.095 * cohort_qx$age))
cohort_qx <- cohort_qx[cohort_qx$cohort + cohort_qx$age <= 2003, ]
pop_age <- expand.grid(age = 0:110, year = 1950:2000)
pop_age$n <- 1e5 * exp(-0.01 * pop_age$age)
period_lx <- expand.grid(age = 0:110, year = 1980:2003)
period_lx$lx <- 1e5 * exp(-0.00005 / 0.095 * (exp(0.095 * period_lx$age) - 1))

cal <- om_calibrate_luy("Female", asfr = asfr, cohort_qx = cohort_qx,
                        pop_age = pop_age, period_lx = period_lx,
                        survey_date = 2003.9, age_respondent = c(20, 40))
cal$Female$wn    # W(n)
cal$Female$mac   # mean age of all parents given that of surviving parents

# use the coefficients in the estimation
est <- om_estimate_index(method = "luy", sex_parent = "Female",
                         age_respondent = c(20, 40), p_surv = c(0.95, 0.75),
                         mean_age_parent = 27, surv_date = 2003.9,
                         custom_coef_luy = cal)
est$estimates
```

---

om_dashboard *Combined Diagnostic Dashboard*

Description

Produces a three-panel diagnostic display combining the internal consistency check with sensitivity analyses for mean age of childbearing and model life table family.

Usage

```
om_dashboard(
  object,
  index = "30q30",
  family_type = "UN",
  range_m = seq(-1.5, 1.5, 0.5)
)
```

Arguments

object	An object of class OrphanhoodEstimate.
index	Character. Mortality index to display in sensitivity panels. One of "30q30", "45q15", or "e30". Default: "30q30".
family_type	Character. Life table family system for the family sensitivity panel. One of "UN", "CD", or "All". Default: "UN".
range_m	Numeric vector. Offsets applied to the mean age of childbearing. Default: seq(-1.5, 1.5, 0.5).

Value

Invisibly returns the gtable object produced by gridExtra::grid.arrange().

See Also

om_plot_linearity, om_sensitivity_Mn, om_sensitivity_modelLT

Examples

```
result <- om_estimate_index(
  method          = "luy",
  sex_parent      = "Female",
  age_respondent  = seq(20, 60, by = 5),
  p_surv          = c(0.987, 0.967, 0.934, 0.908, 0.882,
                      0.835, 0.769, 0.669, 0.565),
  mean_age_parent = rep(27, 9),
  surv_date       = 1998.5
)

om_dashboard(result, index = "30q30", family_type = "UN")
```

---

om_estimate_index *Estimate Adult Mortality Indices from Orphanhood Data*

Description

Estimates conditional survivorship probabilities using orphanhood methods and harmonizes them into common adult mortality indices using a one-parameter relational logit model.

Usage

```
om_estimate_index(
  method = c("luy", "timaeus", "brass"),
  sex_parent = c("Female", "Male"),
  age_respondent,
  p_surv,
```

```
  mean_age_parent,
  surv_date,
  num_respondents = NULL,
  model_family = "General",
  e0 = 60,
  custom_coef_luy = NULL
)
```

Arguments

`method`	Character. Estimation method. One of `"luy"`, `"timaeus"`, or `"brass"`.
`sex_parent`	Character. Sex of the parent. One of `"Female"` or `"Male"`.
`age_respondent`	Numeric vector. Lower bound of respondent age groups (e.g., `c(15, 20, 25, 30)`).
`p_surv`	Numeric vector. Proportion of respondents reporting the parent alive, one value per age group.
`mean_age_parent`	Numeric scalar or vector. Mean age of parents at respondent's birth (M). A scalar is recycled across all age groups.
`surv_date`	Numeric. Survey reference date as a decimal year (e.g., `2015.5`).
`num_respondents`	Numeric vector. Optional. Number of respondents per age group. Reserved for future use; currently has no effect on estimates.
`model_family`	Character. Model life table family used as the relational logit standard. UN families: `"General"`, `"Latin"`, `"Chilean"`, `"South_Asian"`, `"Far_East_Asian"`. Coale-Demeny families: `"West"`, `"North"`, `"East"`, `"South"`. Default is `"General"`.
`e0`	Numeric. Life expectancy at birth (e_0) level identifying which mortality level of the chosen `model_family` to use as the relational logit standard. Must match one of the levels bundled in the package's internal model life table database (currently `60`, `70`, `80`, `90`, or `100`). Default is `60`, matching the package's previous fixed behaviour. Lower levels represent higher-mortality standards; choose a level close to the expected mortality of the population under analysis.
`custom_coef_luy`	Optional. A named list containing at least the element matching `sex_parent` (`"Female"` or `"Male"`), itself a list with data frames `wn`, `an`, and `bn` in the same format as the package's built-in Luy (2012) coefficients (see `sysdata`). When supplied and `method = "luy"`, these coefficients replace the package's default Italy-calibrated tables for the sex being estimated. Use `om_calibrate_luy` to derive such a set from historical fertility and cohort mortality data for a population other than Italy.

Details

Three orphanhood-based estimation methods are supported. Regardless of the method selected, estimates are harmonized into three comparable mortality indices:

- **30q30**: Probability of dying between ages 30 and 60.

- **45q15**: Probability of dying between ages 15 and 60.
- **e30**: Life expectancy at age 30.

For the Brass method, adjacent orphanhood proportions are paired across successive age groups. The first observation yields `NA` by construction because no preceding adjacent proportion exists.

Value

An object of class `OrphanhoodEstimate`, a named list with:

`estimates` Data frame of estimated adult mortality indices by respondent age group. Columns:

- `Method` Citation label of the estimation method used.
- `RefYear` Estimated reference year of the mortality estimate, expressed as a decimal year.
- `Age` Lower bound of the respondent age group (n) used to derive the orphanhood estimate.
- `b` Initial exact age of the conditional survivorship interval. Equals 30 for Luy (2012); 25 for Timaeus (1992) females, 35 for males; 25 for Brass and Hill (1973) females, 32.5 or 37.5 for males depending on $\bar{M}$.
- `n_b` Terminal exact age of the survivorship interval ($b +$ duration). For Luy (2012) this equals $33 + n$.
- `l(b)` Estimated survivorship at exact age b, derived from the relational logit model.
- `l(n_b)` Estimated survivorship at exact age n_b, derived from the relational logit model.
- `lx_ratio` Conditional survivorship probability $l(n_b)/l(b)$, i.e.\ the probability of surviving from exact age b to exact age n_b. This is the key observable quantity derived from the orphanhood method and used to estimate `Alpha`.
- `Alpha` Relational logit level parameter α estimated by solving $l(n_b)/l(b) =$ lx_ratio against the standard life table. Higher values indicate lower mortality.
- `30q30` Probability of dying between exact ages 30 and 60.
- `45q15` Probability of dying between exact ages 15 and 60.
- `e30` Life expectancy at exact age 30.

`meta` Named list of metadata: sex of the parent, model life table family, family system type (`"UN"` or `"CD"`), method identifier, and primary index name.

`inputs` Named list of the original input arguments, retained for reproducibility and use by `om_sensitivity_Mn` and `om_sensitivity_modelLT`.

References

Brass, W. and Hill, K. H. (1973). Estimating adult mortality from orphanhood. In *Proceedings of the International Population Conference, Liege 1973*, Vol. 3, pp. 111–123. IUSSP.

Luy, M. (2009). Estimating mortality differentials in developed populations from survey information on maternal and paternal orphanhood. *European Demographic Research Papers* 2009-3. Vienna Institute of Demography.

Luy, M. (2012). Estimating mortality differences in developed countries from survey information on maternal and paternal orphanhood. *Demography*, 49(2), 607–627. doi:10.1007/s1352401201014

Timaeus, I. M. (1992). Estimation of adult mortality from paternal orphanhood: a reassessment and a new approach. *Population Bulletin of the United Nations*, 33, 47–63.

United Nations (1983). *Manual X: Indirect Techniques for Demographic Estimation*. New York: United Nations.

See Also

om_sensitivity_Mn, om_sensitivity_modelLT, om_plot_linearity, om_calibrate_luy

Examples

```
result <- om_estimate_index(
  method          = "brass",
  sex_parent      = "Female",
  age_respondent  = c(20, 25, 30, 35, 40, 45),
  p_surv          = c(0.906, 0.840, 0.747, 0.631, 0.518, 0.400),
  mean_age_parent = 28.8,
  surv_date       = 1975.64,
  model_family    = "General"
)
print(result)
```

---

om_luy_data_needs *Data Requirements for om_calibrate_luy()*

Description

Lists, for a given survey date, the calendar years, ages and cohorts that each input of om_calibrate_luy must cover, following the timing conventions of Luy (2009) and his calculation workbooks.

Usage

```
om_luy_data_needs(
  survey_date,
  sex_parent = c("Female", "Male"),
  age_respondent = seq(20, 60, by = 5),
  cohort_lag = 4,
  male_shift = 4,
  age_range = NULL,
  max_age = 110
)

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

Arguments

survey_date	Numeric. Interview date as a decimal year (T), e.g. 1998.5.
sex_parent	Character. "Female" or "Male".
age_respondent	Numeric vector of respondent age group lower bounds.

`cohort_lag`	Integer, default 4 (Luy 2009). Years subtracted, in addition to n and x, from the survey year to obtain the birth cohort of a parent aged x at the respondent's birth: `cohort = floor(survey_date) - n - cohort_lag - x`. The value 4 combines the 3 years between $\lfloor T \rfloor - n$ and the middle of the respondents' five birth years ($\lfloor T \rfloor - n - 3$, Luy 2009, pp. 10, 16) and 1 year for the parent's completed age x, as in Luy's calculation workbooks. It also fixes the first calendar year of exposure, $\lfloor T \rfloor - n - 4$. See Details.
`male_shift`	Numeric. Years by which female ASFR are shifted to obtain paternal schedules (Luy: 4).
`age_range`	Numeric length-2 vector, youngest and oldest parental age. Defaults to `c(15, 49)` (mothers) and `c(15, 49) + male_shift` (fathers).
`max_age`	Last age of the cohort life tables, an open interval (default 110, as in the Human Mortality Database).
`x`	An object of class `"LuyDataNeeds"`.
`...`	Ignored.

Details

For respondent age group n (respondents aged n to $n+4$), survey date T, exposure $K = n+3$ years and parental age x at the respondent's birth (Luy 2009, pp. 10–18):

- `asfr` and `pop_age`: the respondents' five birth years $\lfloor T \rfloor - n - 5$ to $\lfloor T \rfloor - n - 1$; ASFR at ages 15–49 (female rates, also for fathers), population at the parental ages (15–49 mothers, 19–53 fathers).
- `cohort_qx`: parental cohort $\lfloor T \rfloor - n - cohort_lag - x$ (see `cohort_lag` in `om_calibrate_luy`), from age x to $x + K - 1 = x + n + 2$, i.e. from calendar year $\lfloor T \rfloor - n - 4$ to $\lfloor T \rfloor - 2$.
- `period_lx`: ages 30 and $33+n$ (the ratio $l(33+n)/l(30)$, Luy 2009, eq. 1) in the years around the reference period. The reference period depends on mortality; it always lies between $T-K$ and T, and in practice within the "typical" range shown ($T - K + 0.55K$ to $T - K + 0.9K$, plus one year for the linear interpolation between calendar years).

Oldest age. The age reached by the oldest parents at the end of the exposure, $x+n+2$, can exceed the last age of a life table (for $n = 60$: 111 for mothers, 115 for fathers). It is capped at `max_age`: the last age of a life table is an open interval (e.g. 110+, ages 0 to 110+ are 111 age classes) in which $q = 1$, so no older age exists in the data or is needed. Ages without data are not filled in by `om_calibrate_luy()`; they get no weight (see Details there).

Value

A data frame of class `"LuyDataNeeds"` with one row per respondent age group and the columns

`n` respondent age group (lower bound).

`birth_years` respondents' birth years: years needed in `asfr` and `pop_age`.

`asfr_ages` ages needed in `asfr` (female ages).

`pop_ages` ages needed in `pop_age` (parent's sex).

`cohorts` parental birth cohorts needed in `cohort_qx`.

`cohort_ages` ages of those cohorts needed in `cohort_qx` (capped at `max_age`).

`cohort_last_year` last calendar year the cohort series must reach, $\lfloor T \rfloor - 2$.

`period_ages` ages read from `period_lx`: 30 and $33 + n$.

`period_years_bounds` years within which the reference period always lies.

`period_years_typical` years within which it usually lies.

The attribute `"overall"` holds the ranges over all age groups, which the print method shows first.

References

Luy, M. (2009). Estimating mortality differentials in developed populations from survey information on maternal and paternal orphanhood. *European Demographic Research Papers* 2009-3. Vienna Institute of Demography.

See Also

`om_calibrate_luy`, `om_luy_validate_inputs`

Examples

```
om_luy_data_needs(2003.9, "Female")
om_luy_data_needs(1998.5, "Male")
```

---

om_luy_intermediates *Extract the Intermediate Quantities of a Luy Calibration*

Description

Returns the intermediate quantities computed by `om_calibrate_luy` for each respondent age group, arranged like the sheets of Luy's workbooks (Multipliers_*_NEW_REF_YEARS.xls), so that they can be compared cell by cell with his values.

Usage

```
om_luy_intermediates(
  cal,
  what = c("summary", "f_prime", "weights", "N", "f_empirical", "q", "q_bar", "L",
    "w_observed"),
  n = NULL,
  format = c("wide", "long")
)
```

Arguments

cal	Output of om_calibrate_luy().
what	Which quantity:
	"summary" per mean age: model S(n), reference year, t(n), period l(33+n)/l(30), W(n), mean age of all parents, Schmertmann P, H and Gompertz alpha (sheet rows 4-9, 769-774).
	"f_prime" modelled schedules f(x)/sum f, parental age x by mean age (Luy's "MODELED f(x)/TFR", sheet rows 14-48).
	"weights" weights actually used, f' or N f' normalised (equal to f_prime when weighting = "f").
	"N" population age structure N(x) (average over the birth years).
	"f_empirical" averaged empirical ASFR.
	"q" cohort probabilities of dying q[x, k], parental age x by year k after the respondent's birth (sheet rows 55-89).
	"q_bar" weighted average q, year k by mean age (sheet row 129 of each mean-age block).
	"L" reconstructed survival L_k, k = 0..K, by mean age (sheet row 130 / 10000).
	"w_observed" share of the weights whose q[x, k] is observed, year k by mean age (1 = all parental cohorts observed; unobserved ages get no weight, see om_calibrate_luy).
n	Respondent age group(s). Default: all.
format	"wide" (a matrix per age group; a list when several groups are requested) or "long" (one data frame with columns n, row and column identifiers, and value).

Value

With format = "wide": for one age group, the matrix (or named vector for "N" and "f_empirical", data frame for "summary"); for several, a list of them named by age group. With format = "long": a data frame with column n, the row and column identifiers (age, k, mean_age; for "q" also the parental cohort) and value. The "summary" columns are mean_age, S_model, ref_year, t_n, lx_ratio, W, mac, P, H and gompertz_alpha.

References

Luy, M. (2009). Estimating mortality differentials in developed populations from survey information on maternal and paternal orphanhood. *European Demographic Research Papers* 2009-3. Vienna Institute of Demography.

See Also

om_calibrate_luy

Examples

```
# synthetic inputs in the standard long format
asfr <- expand.grid(age = 15:49, year = 1950:2000)
asfr$rate <- 0.1 * exp(-0.5 * ((asfr$age - 28) / 5.5)^2)
```

```
cohort_qx <- expand.grid(age = 0:110, cohort = 1900:1990)
cohort_qx$qx <- pmin(1, 0.00005 * exp(0.095 * cohort_qx$age))
cohort_qx <- cohort_qx[cohort_qx$cohort + cohort_qx$age <= 2003, ]
pop_age <- expand.grid(age = 0:110, year = 1950:2000)
pop_age$n <- 1e5 * exp(-0.01 * pop_age$age)
period_lx <- expand.grid(age = 0:110, year = 1980:2003)
period_lx$lx <- 1e5 * exp(-0.00005 / 0.095 * (exp(0.095 * period_lx$age) - 1))
cal <- om_calibrate_luy("Female", asfr = asfr, cohort_qx = cohort_qx,
                        pop_age = pop_age, period_lx = period_lx,
                        survey_date = 2003.9, age_respondent = c(20, 40))
om_luy_intermediates(cal, "f_prime", n = 40)   # Luy's "MODELED f(x)/TFR"
om_luy_intermediates(cal, "summary", n = 40)
head(om_luy_intermediates(cal, "q", format = "long"))
```

`om_luy_validate_inputs` *Validate the Inputs of om_calibrate_luy()*

Description

Checks that the data frames you prepared are in the standard long format expected by `om_calibrate_luy` and, if `survey_date` is given, that they cover the years, ages and cohorts the calibration needs (see `om_luy_data_needs`). Run it after reading your data and before calibrating.

Usage

```
om_luy_validate_inputs(
  asfr = NULL,
  cohort_qx = NULL,
  pop_age = NULL,
  period_lx = NULL,
  survey_date = NULL,
  sex_parent = c("Female", "Male"),
  age_respondent = seq(20, 60, by = 5),
  cohort_lag = 4,
  male_shift = 4,
  verbose = TRUE
)
```

Arguments

`asfr`, `cohort_qx`, `pop_age`, `period_lx`	Data frames to check (each optional; `NULL` is skipped).
`survey_date`	Optional survey date (decimal year). If given, the coverage of the inputs is compared with `om_luy_data_needs()`.
`sex_parent`	`"Female"` or `"Male"`; used with `survey_date`.
`age_respondent`, `cohort_lag`, `male_shift`	As in `om_calibrate_luy`; used with `survey_date`.
`verbose`	Print a summary (default `TRUE`).

Value

Invisibly, a data frame with one row per input: number of complete rows and the age and year (or cohort) ranges. Stops with an informative error if an input is malformed.

Standard format

argument	columns	content
`asfr`	`age`, `year`, `rate`	period ASFR of women, births per woman (not per 1000)
`cohort_qx`	`age`, `cohort`, `qx`	cohort probability of dying, 0–1
`pop_age`	`age`, `year`, `n`	population size (not exposure)
`period_lx`	`year`, `age`, `lx` (or `qx`)	period life table

`age`, `year` and `cohort` are whole numbers (completed age, calendar year, birth year). Each key combination appears once.

Checks

Errors: not a data frame; missing columns; non-numeric columns; non-integer ages/years/cohorts; duplicated keys; `rate` > 1 (per 1000) or negative; `qx` outside 0–1; negative `n` or `lx`. **Warnings:** rows with `NA` (they are ignored by the calibration); with `survey_date`, years, ages or cohorts the calibration needs but that are missing.

See Also

`om_calibrate_luy`, `om_luy_data_needs`

Examples

```
# synthetic inputs in the standard long format
asfr <- expand.grid(age = 15:49, year = 1950:2000)
asfr$rate <- 0.1 * exp(-0.5 * ((asfr$age - 28) / 5.5)^2)
cohort_qx <- expand.grid(age = 0:110, cohort = 1900:1990)
cohort_qx$qx <- pmin(1, 0.00005 * exp(0.095 * cohort_qx$age))
cohort_qx <- cohort_qx[cohort_qx$cohort + cohort_qx$age <= 2003, ]
pop_age <- expand.grid(age = 0:110, year = 1950:2000)
pop_age$n <- 1e5 * exp(-0.01 * pop_age$age)
period_lx <- expand.grid(age = 0:110, year = 1980:2003)
period_lx$lx <- 1e5 * exp(-0.00005 / 0.095 * (exp(0.095 * period_lx$age) - 1))
om_luy_validate_inputs(asfr, cohort_qx, pop_age, period_lx,
                       survey_date = 2003.9, sex_parent = "Female",
                       age_respondent = c(20, 40))

# a typical preparation error: rates per 1000 women
try(om_luy_validate_inputs(asfr = transform(asfr, rate = rate * 1000)))
```

om_plot_linearity *Diagnostic Plot: Internal Consistency Check*

Description

Displays the estimated Brass logit α parameter across respondent age groups. A roughly constant α indicates internal consistency of the orphanhood-based estimates; a systematic trend suggests age-reporting errors, adoption effects, or structural changes in mortality.

Usage

```
om_plot_linearity(object)
```

Arguments

`object`	An object of class `OrphanhoodEstimate`.

Value

A `ggplot` object with respondent age group (`Age`) on the x-axis and the relational logit level parameter α (`Alpha`) on the y-axis. A dashed horizontal line marks the median α across age groups.

See Also

`om_estimate_index`, `om_dashboard`

Examples

```
result <- om_estimate_index(
  method          = "luy",
  sex_parent      = "Female",
  age_respondent  = seq(20, 60, by = 5),
  p_surv          = c(0.987, 0.967, 0.934, 0.908, 0.882,
                      0.835, 0.769, 0.669, 0.565),
  mean_age_parent = rep(27, 9),
  surv_date       = 1998.5
)
om_plot_linearity(result)
```

`om_sensitivity_Mn` *Sensitivity Analysis: Mean Age of Childbearing*

Description

Evaluates the sensitivity of orphanhood-based mortality estimates to assumptions about the mean age of childbearing (M_n) by re-estimating indices across a grid of additive offsets.

Usage

```
om_sensitivity_Mn(object = NULL, range_m = seq(-1.5, 1.5, 0.5), ...)
```

Arguments

`object`	Optional. An object of class `OrphanhoodEstimate`. When supplied, all estimation arguments are taken from `object$inputs` and may be overridden via `....`
`range_m`	Numeric vector of offsets (in years) applied to the baseline mean age of childbearing. Default: `seq(-1.5, 1.5, 0.5)`.
`...`	Additional arguments passed to `om_estimate_index`, overriding values stored in `object`.

Value

An object of class `OrphanhoodSensitivity`, a named list with:

`data` A data frame of estimates for each offset value, with columns matching `om_estimate_index()$estimates` plus an additional column `Offset_M` identifying the applied offset in years.

`meta` A named list of metadata: variable name, offset range, standard level, and estimation method.

See Also

`plot.OrphanhoodSensitivity`, `om_sensitivity_modelLT`, `om_estimate_index`

Examples

```
result <- om_estimate_index(
  method          = "luy",
  sex_parent      = "Female",
  age_respondent  = seq(20, 60, by = 5),
  p_surv          = c(0.987, 0.967, 0.934, 0.908, 0.882,
                      0.835, 0.769, 0.669, 0.565),
  mean_age_parent = rep(27, 9),
  surv_date       = 1998.5
)
sens <- om_sensitivity_Mn(result, range_m = seq(-2, 2, by = 0.5))
plot(sens, index = "30q30")
```

om_sensitivity_modelLT *Sensitivity Analysis: Model Life Table Family*

Description

Evaluates the sensitivity of orphanhood-based mortality estimates to the assumed age pattern of mortality by re-estimating indices across multiple model life table families.

Usage

```
om_sensitivity_modelLT(
  object = NULL,
  type = c("UN", "CD", "All"),
  families = NULL,
  ...
)
```

Arguments

`object`	Optional. An object of class `OrphanhoodEstimate`.
`type`	Character. Family system to evaluate. One of `"UN"`, `"CD"`, or `"All"` (default). Ignored when `families` is supplied.
`families`	Optional character vector of specific family names to test, overriding `type`.
`...`	Additional arguments passed to `om_estimate_index`.

Value

An object of class `OrphanhoodSensitivityFamily`, a named list with:

`data` A data frame of estimates for each family, with columns matching `om_estimate_index()$estimates` plus an additional column `Family` identifying the model life table family.

`meta` A named list of metadata: variable name, families tested, standard level, family system name, and estimation method.

See Also

`plot.OrphanhoodSensitivityFamily`, `om_sensitivity_Mn`, `om_estimate_index`

Examples

```
result <- om_estimate_index(
  method          = "luy",
  sex_parent      = "Female",
  age_respondent  = seq(20, 60, by = 5),
  p_surv          = c(0.987, 0.967, 0.934, 0.908, 0.882,
                      0.835, 0.769, 0.669, 0.565),
```

```
  mean_age_parent = rep(27, 9),
  surv_date       = 1998.5
)
sens_fam <- om_sensitivity_modelLT(result, type = "UN")
plot(sens_fam, index = "30q30")
```

`plot.OrphanhoodSensitivity` *Plot Method for* `OrphanhoodSensitivity` *Objects*

Description

Displays estimated mortality indices across reference years for each mean-age-of-childbearing offset, coloured from light (low offset) to dark (high offset).

Usage

```
## S3 method for class 'OrphanhoodSensitivity'
plot(x, index = "30q30", ...)
```

Arguments

`x`	An object of class `OrphanhoodSensitivity`.
`index`	Character. Mortality index to plot. One of `"30q30"`, `"45q15"`, or `"e30"`. Default: `"30q30"`.
`...`	Further arguments (currently unused).

Value

A `ggplot` object.

See Also

`om_sensitivity_Mn`

plot.OrphanhoodSensitivityFamily *Plot Method for* OrphanhoodSensitivityFamily *Objects*

Description

Displays estimated mortality indices across reference years for each model life table family, distinguished by line type.

Usage

```
## S3 method for class 'OrphanhoodSensitivityFamily'
plot(x, index = "30q30", ...)
```

Arguments

x	An object of class OrphanhoodSensitivityFamily.
index	Character. Mortality index to plot. One of "30q30", "45q15", or "e30". Default: "30q30".
...	Further arguments (currently unused).

Value

A ggplot object.

See Also

om_sensitivity_modelLT

print.OrphanhoodEstimate *Print method for* OrphanhoodEstimate *objects*

Description

Print method for OrphanhoodEstimate objects

Usage

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

Arguments

x	An object of class OrphanhoodEstimate.
...	Further arguments passed to print.data.frame.

Value

Invisibly returns `x`.

`print.OrphanhoodSensitivity` *Print Method for* `OrphanhoodSensitivity` *Objects*

Description

Prints a concise summary of a mean-age-of-childbearing sensitivity analysis.

Usage

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

Arguments

`x`	An object of class `OrphanhoodSensitivity`.
`...`	Further arguments (currently unused).

Value

Invisibly returns `x`.

`print.OrphanhoodSensitivityFamily` *Print Method for* `OrphanhoodSensitivityFamily` *Objects*

Description

Prints a concise summary of a model life table family sensitivity analysis.

Usage

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

Arguments

`x`	An object of class `OrphanhoodSensitivityFamily`.
`...`	Further arguments (currently unused).

Value

Invisibly returns `x`.

summary.OrphanhoodEstimate *Summary method for* OrphanhoodEstimate *objects*

Description

Summary method for OrphanhoodEstimate objects

Usage

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

Arguments

object	An object of class OrphanhoodEstimate.
...	Further arguments (currently unused).

Value

Invisibly returns object.

summary.OrphanhoodSensitivity *Summary Method for* OrphanhoodSensitivity *Objects*

Description

Summarises the range of estimated mortality indices across all mean-age-of-childbearing offsets.

Usage

```
## S3 method for class 'OrphanhoodSensitivity'
summary(object, index = "30q30", ...)
```

Arguments

object	An object of class OrphanhoodSensitivity.
index	Character. Mortality index to summarise. One of "30q30", "45q15", or "e30". Default: "30q30".
...	Further arguments (currently unused).

Value

Invisibly returns object.

`summary.OrphanhoodSensitivityFamily` *Summary Method for* `OrphanhoodSensitivityFamily` *Objects*

Description

Summarises the range of estimated mortality indices across all model life table families tested.

Usage

```
## S3 method for class 'OrphanhoodSensitivityFamily'
summary(object, index = "30q30", ...)
```

Arguments

`object`	An object of class `OrphanhoodSensitivityFamily`.
`index`	Character. Mortality index to summarise. One of `"30q30"`, `"45q15"`, or `"e30"`. Default: `"30q30"`.
`...`	Further arguments (currently unused).

Value

Invisibly returns `object`.

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