

Package: threemc (via r-universe)

September 3, 2024

Title (Matt's) Multi-Level Model of Male Circumcision in Sub-Saharan Africa

Version 0.1.45

Description Functions and datasets to support, and extend to other Sub-Saharan African countries, Thomas, M. et. al., 2021, A multi-level model for estimating region-age-time-type specific male circumcision coverage from household survey and health system data in South Africa, <[arXiv:2108.09142](https://arxiv.org/abs/2108.09142)>.

Depends R (>= 3.5.0)

LazyData true

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URL <https://github.com/mrc-ide/threemc>

BugReports <https://github.com/mrc-ide/threemc/issues>

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Contents

compute_quantiles	2
create_dirs_r	3
create_shell_dataset	4
datapack_psnu_area_level	5
demo_areas	6
demo_populations	6
demo_survey_circumcision	7
esa_wca_regions	8
minimise_fit_obj	8
prepare_survey_data	9
read_circ_data	10
survey_points_dmppt2_convert_convention	11
threemc_aggregate	11
threemc_empirical_rates	12
threemc_fit_model	13
threemc_initial_pars	14
threemc_ppc	16
threemc_ppc2	17
threemc_prepare_model_data	18
Index	20

compute_quantiles	<i>Calculate Quantiles for Rates and Cumulative Hazard</i>
-------------------	--

Description

Calculate quantiles for samples of rates and cumulative hazard outputted from [threemc_fit_model](#), and add them as columns to the shell `data.frame` out with estimated empirical circumcision rates.

Usage

```
compute_quantiles(
  out,
  fit,
  area_lev = NULL,
  probs = c(0.025, 0.5, 0.975),
  names = FALSE,
  ...
)
```

Arguments

out	Shell dataset with a row for every unique record in circumcision survey data for a given area. Also includes empirical estimates for circumcision estimates for each unique record.
fit	Optional "small" fit object with no sample. Specifying fit means you do not need to specify dat_tmb or parameters, as argument specifications will be overridden by those stored in fit.
area_lev	PSNU area level for specific country.
probs	Specific quantiles to be calculated, Default: c(0.025, 0.5, 0.975)
names	Parameter with <code>quantile</code> : logical; if true, the result has a names attribute. Set to FALSE for speedup with many probs, Default: FALSE
...	Further arguments passed to <code>quantile</code> .

Value

Input out data.frame, including columns with quantiles for hazard rates etc for different circumcision types, and for overall circumcision.

See Also

`threemc_fit_model` `quantile` @importFrom dplyr %>% @importFrom rlang .data

create_dirs_r *Recursively Create Missing Directories*

Description

Function to recursively create directories if any of the directories in a provided path are missing. Similar to `mkdir -p` from Bash.

Usage

```
create_dirs_r(dir_path)
```

Arguments

dir_path	Path to a file or directory which you want to generate.
----------	---

create_shell_dataset *Create Shell Dataset for Estimating Empirical Circumcision Rate*

Description

Create a shell dataset with a row for every unique area ID, area name, year and circumcision age in survey data. Also, computes the empirical number of person years until circumcision and number of people circumcised for several "types" of circumcision; known medical circumcisions, known traditional circumcisions, censored survey entries (i.e. where surveyed individuals had not been circumcised) and left-censored survey entries (i.e. where circumcision occurred at an unknown age).

Usage

```
create_shell_dataset(
  survey_circumcision,
  populations,
  areas,
  area_lev = NULL,
  start_year,
  end_year = 2021,
  time1 = "time1",
  time2 = "time2",
  strat = "space",
  age = "age",
  circ = "indweight_st",
  ...
)
```

Arguments

survey_circumcision	<ul style="list-style-type: none"> Information on male circumcision status from surveys. If this is a list or contains more than one country, the function is performed for each country present, returning a list.
populations	data.frame containing populations for each region in tmb fits.
areas	sf shapefiles for specific country/region.
area_lev	<ul style="list-style-type: none"> Desired admin boundary level to perform the analysis on.
start_year	First year in shell dataset.
end_year	Last year in shell dataset, which is also the year to forecast/model until, Default: 2021
time1	Variable name for time of birth, Default: "time1"
time2	Variable name for time circumcised or censored, Default: "time2"
strat	Variable to stratify by in using a 3D hazard function, Default: NULL

- age • Variable with age circumcised or censored. Default: "age"
- circ Variables with circumcision matrix, Default: "indweight_st"
- ... Further arguments passed to or from other methods.

Value

data.frame with a row for every unique record in survey_circumcision for a given area. Also includes empirical estimates for circumcision estimates for each unique record.

See Also

[datapack_psnu_area_level](#) [crossing](#) [create_integration_matrix_agematrix](#) [create_hazard_matrix_agematrix](#)

datapack_psnu_area_level

PSNU Area Levels for SSA

Description

PSNU area levels for Sub-Saharan African countries. These are the recommended levels at which to perform modelling etc., for each respective country. Inferences on larger regions (i.e. lower PSNU area levels) can be made by aggregating results for higher area levels. The dataset contains the following fields:

- iso3character ISO3 codes for Sub-Saharan African countries.
- psnu_area_levelinteger The sub national level considered to be the organizational level in which a country has prioritised their program. Increasing values refer to more granular regional distinctions.

Usage

```
data(datapack_psnu_area_level)
```

Format

A data.frame with 29 rows and 2 variables:

demo_areas	<i>Malawi shapefiles</i>
------------	--------------------------

Description

sf shapefile representation of Malawi, as a multipolygon.

- iso3character ISO3 codes for Sub-Saharan African countries.
- area_id Unique ID for each region in MWI. Formatted as "County_area_level_ID" (e.g. MWI_3_05 for Mzimba)
- area_name Name of region in question
- parent_area_id Unique ID for region's parent region.
- area_level Numeric value denoting area level of area, in decreasing granularity.
- area_level_label Translates numeric area level to meaning in country in question. For example, in Malawi a region of area level 3 is a "District".
- area_sort_order Order to sort areas in when plotting, roughly equivalent to a geofacet grid.
- center_x X coordinate for centre of region's multipolygon
- center_y Y coordinate for centre of region's multipolygon
- geometry sfc_MULTIPOLYGON representation of region's spatial geometry

Usage

```
data(demo_areas)
```

Format

A sf collection of 6 features and 9 fields, including a data.frame with 387 rows, 10 variables, and a sf

demo_populations	<i>Malawi populations</i>
------------------	---------------------------

Description

Single age, aggregated male populations for each area in Malawi.

- iso3character ISO3 codes for Sub-Saharan African countries.
- area_id Unique ID for each region in MWI. Formatted as "County_area_level_ID" (e.g. MWI_3_05 for Mzimba)
- area_level Numeric value denoting area level of area, in decreasing granularity.
- area_name Name of region in question
- year Year for population in question
- age Age for population in question
- population (Male) Population for each unique area-year-age combination.

Usage

```
data(demo_populations)
```

Format

A data.frame with 58806 rows and 7 variables.

```
demo_survey_circumcision  
      Malawi surveys
```

Description

Circumcision surveys for Malawi.

- iso3character ISO3 codes for Sub-Saharan African countries.
- survey_idSurvey id for each record.
- area_idUnique ID for each region in MWI. Formatted as "County_area_level_ID" (e.g. MWI_3_05 for Mzimba)
- area_level Numeric value denoting area level of area, in decreasing granularity.
- ageAge at interview.
- dob_cmcCMC (Century Month Code) date of birth of individual.)
- interview_cmcCMC date of interview.
- indweightWeighting for survey record in question
- circ_statusCircumcision status of individual, 1 indicating circumcision and 0 indicating right-censoring.
- circ_ageAge at circumcision, if applicable.
- circ_whoCircumcision provider, either medical or traditional.
- circ_whereCircumcision location, either medical or traditional.

Usage

```
data(demo_survey_circumcision)
```

Format

A data.frame with 29313 rows and 12 variables.

esa_wca_regions	<i>WCA - ESA key for Sub-Saharan African countries</i>
-----------------	--

Description

Western and Central Africa (WCA) - Eastern and Southern Africa (ESA) categorisation for Sub-Saharan African countries. Also includes North-South-East-West categorisation.

- iso3character ISO3 codes for Sub-Saharan African countries.
- regioncharacter ESA-WCA categorisation for each iso3
- four_regioncharacter North-South-East-West categorisation for each iso3

Usage

```
data(esa_wca_regions)
```

Format

A data.frame with 38 rows and 3 variables.

minimise_fit_obj	<i>Minimise Fit Object Size</i>
------------------	---------------------------------

Description

Return minimised fit object. Often useful when saving the fit object for later aggregation.

Usage

```
minimise_fit_obj(fit, dat_tmb, parameters)
```

Arguments

- | | |
|---------|---|
| fit | Optional "small" fit object with no sample. Specifying fit means you do not need to specify dat_tmb or parameters, as argument specifications will be overridden by those stored in fit. |
| dat_tmb | list of data required for model fitting, outputted by threemc_prepare_model_data , which includes: <ul style="list-style-type: none"> • design_matricesIncludes X_fixed_mmc, X_fixed_tmc, X_time_mmc, X_age_mmc, X_age_tmc, X_space_mmc, X_space_tmc, X_agemtime_mmc, X_agespace_mmc, X_agespace_tmc, X_spacetime_mmc. Design Create design matrices for fixed effects and temporal, age, space and interaction random effects • integration_matricesIncludes IntMat1, IntMat2. Integration matrices for selecting the instantaneous hazard rate. |

- survival matrices Includes A_mmc, A_tmc, A_mc, B, C. Survival matrices for MMC, TMC, censored and left censored
 - Q_space Precision/Adjacency matrix for the spatial random effects.
- parameters list of fixed and random model parameters.

Value

Object of class "naomi_fit".

prepare_survey_data *Prepare Survey Data*

Description

Prepare survey data required to run the circumcision model. Can also optionally apply [normalise_weights_kish](#), to normalise survey weights and apply Kish coefficients.

Usage

```
prepare_survey_data(
  areas,
  survey_circumcision,
  survey_individuals = NULL,
  survey_clusters = NULL,
  area_lev,
  start_year = 2006,
  cens_year = NULL,
  cens_age = 59,
  rm_missing_type = FALSE,
  norm_kish_weights = TRUE,
  strata.norm = c("survey_id", "area_id"),
  strata.kish = c("survey_id")
)
```

Arguments

- areas sf shapefiles for specific country/region.
- survey_circumcision
- Information on male circumcision status from surveys. If this is a list or contains more than one country, the function is performed for each country present, returning a list.
- survey_individuals
- Information on the individuals surveyed.
- survey_clusters
- Information on the survey clusters.
- area_lev
- Desired admin boundary level to perform the analysis on.

start_year	• Year to begin the analysis on, Default: 2006
cens_year	• Year to censor the circumcision data by (Sometimes some weirdness at the final survey year, e.g. v small number of MCs), Default: NULL
cens_age	• Age to censor the circumcision data at, Default: 59
rm_missing_type	• Indicator to decide whether you would like to keep surveys where there is no MMC/TMC distinction. These surveys may still be useful for determining MC levels, Default: FALSE
norm_kish_weights	• Indicator to decide whether to normalise survey weights and apply Kish coefficients, Default: TRUE
strata.norm	Stratification variables for normalising survey weights, Default: c("survey_id", "area_id")
strata.kish	Stratification variables for estimating and applying the Kish coefficients, Default: "survey_id"

Value

Survey data with required variables to run circumcision model.

See Also

[normalise_weights_kish](#)

read_circ_data	<i>Function to read in Circumcision Data</i>
----------------	--

Description

Function to read in circumcision data to fit model. Handles csv with [fread](#) (but outputs data as a `data.frame`), and geographical data with `coderead_sf` (for which it also adds unique identifiers for each `area_level`).

Usage

```
read_circ_data(path, filters = NULL, selected = NULL, ...)
```

Arguments

path	Path to data.
filters	Optional named vector, whose values dictate the values filtered for in the corresponding column names. Only supports filtering for one value for each column. default: NULL
selected	Optional columns to select, removing others, default = NULL
...	Further arguments passed to or from other methods.

Value

relevant data set, filtered as desired.

See Also

[fread read_sf](#)

survey_points_dmppt2_convert_convention

Create data frame of all ages within provided age group. Convert survey coverage points & dmppt2 data to match convention of aggregated results.

Description

Create data frame of all ages within provided age group. Convert survey coverage points & dmppt2 data to match convention of aggregated results.

Usage

```
survey_points_dmppt2_convert_convention(.data)
```

Arguments

.data	Data frame with either survey calculated coverage, with associated error bounds, or DMPPT2 coverage estimates calculated from VMMC programme data.
-------	--

threemc_aggregate

Produce Population Weighted Aggregated Samples for All Area Levels

Description

Aggregate by area, year, age and type (weighted by population), and convert to a percentage/probability.

Usage

```
threemc_aggregate(
  .data,
  fit,
  areas,
  populations,
  age_var = c("age", "age_group"),
  type = c("probability", "incidence", "prevalence"),
  area_lev,
  N = 100,
```

```

    prev_year = 2008,
    probs = c(0.025, 0.5, 0.975),
    ...
  )

```

Arguments

<code>.data</code>	data.frame of unaggregated modelling results.
<code>fit</code>	TMB list containing model parameters, nested list of samples for the (cumulative) incidence and hazard rate of circumcision for the region(s) in question.
<code>areas</code>	sf shapefiles for specific country/region.
<code>populations</code>	data.frame containing populations for each region in tmb fits.
<code>age_var</code>	Determines whether you wish to aggregate by discrete ages or age groups (0-4, 5-9, 10-14, and so on).
<code>type</code>	Determines which aspect of MC in the regions in question you wish to aggregate for. Can be one of "probability", "incidence" or "prevalence".
<code>area_lev</code>	PSNU area level for specific country.
<code>N</code>	Number of samples to be generated, Default: 100
<code>prev_year</code>	If type == "prevalence", choose year to compare prevalence with.
<code>probs</code>	Percentiles to provide quantiles at. Set to NULL to skip computing quantiles.
<code>...</code>	Further arguments to internal functions.

Value

data.frame with samples aggregated by `aggr_cols` and weighted by population.

threemc_empirical_rates

Use model shell dataset to estimate empirical circumcision rates

Description

Takes the shell dataset with a row for every unique area ID, area name, year and circumcision age in survey data outputted by [create_shell_dataset](#) and returns the empirical circumcision rates for each row, aggregated to age groups from single ages. Also converts from wide format to long format.

Usage

```

threemc_empirical_rates(
  out,
  areas,
  area_lev,
  populations,
  age_groups = c("0-4", "5-9", "10-14", "15-19", "20-24", "25-29", "30-34", "35-39",
    "40-44", "45-49", "50-54", "54-59", "0+", "10+", "15+", "15-24", "10-24", "15-29",
    "10-29", "15-39", "10-39", "15-49", "10-49")
)

```

Arguments

out	Shell dataset outputted by create_shell_dataset
areas	sf shapefiles for specific country/region.
area_lev	<ul style="list-style-type: none"> Desired admin boundary level to perform the analysis on.
populations	data.frame containing populations for each region in tmb fits.
age_groups	Age groups to aggregate by, Default: c("0-4", "5-9", "10-14", "15-19", "20-24", "25-29", "30-34", "35-39", "40-44", "45-49", "50-54", "54-59", "15-24", "10-24", "15-29", "10-29", "15-39", "10-39", "15-49", "10-49")

See Also

[create_shell_dataset](#)

threemc_fit_model	<i>Produce TMB model fit with sample, or re-sample from existing optimised model fit.</i>
-------------------	---

Description

Optimises threemc objective function and produces samples from model fit (if so desired). If provided with an existing optimised model fit, can also perform re-sampling.

Usage

```
threemc_fit_model(
  fit = NULL,
  dat_tmb = NULL,
  mod = NULL,
  parameters = NULL,
  maps = NULL,
  randoms = c("u_time_mmc", "u_age_mmc", "u_space_mmc", "u_agemtime_mmc",
    "u_agespace_mmc", "u_spacetime_mmc", "u_age_tmc", "u_space_tmc", "u_agespace_tmc"),
  sample = TRUE,
  smaller_fit_obj = FALSE,
  sdreport = FALSE,
  N = 1000,
  verbose = TRUE,
  ...
)
```

Arguments

fit	Optional "small" fit object with no sample. Specifying fit means you do not need to specify dat_tmb or parameters, as argument specifications will be overridden by those stored in fit.
-----	--

dat_tmb	list of data required for model fitting, outputted by threemc_prepare_model_data , which includes: <ul style="list-style-type: none"> • design_matricesIncludes X_fixed_mmc, X_fixed_tmc, X_time_mmc, X_age_mmc, X_age_tmc, X_space_mmc, X_space_tmc, X_agemtime_mmc, X_agespace_mmc, X_agespace_tmc, X_spacetime_mmc. Design Create design matrices for fixed effects and temporal, age, space and interaction random effects • integration_matricesIncludes IntMat1, IntMat2. Integration matrices for selecting the instantaneous hazard rate. • survival_matricesIncludes A_mmc, A_tmc, A_mc, B, C. Survival matrices for MMC, TMC, censored and left censored • Q_spacePrecision/Adjacency matrix for the spatial random effects.
mod	TMB model, one of either "Surv_SpaceAgeTime_ByType_withUnknownType" or "Surv_SpaceAgeTime" if the surveys for the country in question make no distinction between circumcision type (i.e whether they were performed in a medical or traditional setting).
parameters	list of fixed and random model parameters.
maps	list of factors with value NA, the names of which indicate parameters to be kept fixed at their initial value throughout the optimisation process.
randoms	vector of random effects.
sample	If set to TRUE, has function also return N samples for medical, traditional and total circumcisions, Default: TRUE
smaller_fit_obj	Returns a smaller fit object. Useful for saving the fit object for later aggregations.
sdreport	If set to TRUE, produces the standard deviation report for the model, Default: FALSE
N	Number of samples to be generated, Default: 1000
verbose	Boolean specifying whether you want detailed updates on function operations and progress, default = TRUE
...	Further arguments passed to internal functions.

Value

TMB model fit, including optimised parameters, hessian matrix, samples and standard deviation report (if desired).

threemc_initial_pars *Initialise thremec (hyper)parameters.*

Description

Return minimised fit object. Often useful when saving the fit object for later aggregation.

Usage

```

threemc_initial_pars(
  dat_tmb,
  custom_init = NULL,
  rw_order = NULL,
  rw_order_tmc_ar = FALSE,
  paed_age_cutoff = NULL,
  inc_time_tmc = FALSE
)

```

Arguments

dat_tmb	list of data required for model fitting, outputted by threemc_prepare_model_data , which includes: <ul style="list-style-type: none"> • design_matricesIncludes X_fixed_mmc, X_fixed_tmc, X_time_mmc, X_age_mmc, X_age_tmc, X_space_mmc, X_space_tmc, X_agemtime_mmc, X_agespace_mmc, X_agespace_tmc, X_spacetime_mmc. Design Create design matrices for fixed effects and temporal, age, space and interaction random effects • integration_matricesIncludes IntMat1, IntMat2. Integration matrices for selecting the instantaneous hazard rate. • survival_matricesIncludes A_mmc, A_tmc, A_mc, B, C. Survival matrices for MMC, TMC, censored and left censored • Q_spacePrecision/Adjacency matrix for the spatial random effects.
custom_init	named list of custom fixed and random model parameters you want to supersede "hardcoded" defaults, default = NULL.
rw_order	Order of the random walk used for temporal precision matrix. Setting to NULL assumes you wish to specify an AR 1 temporal prior. Default: NULL
rw_order_tmc_ar	Whether to use an AR 1 temporal prior for TMC, regardless of whether you are using a RW temporal prior for TMC or not, Default: FALSE
paed_age_cutoff	Age at which to split MMC design matrices between paediatric and non-paediatric populations, the former of which are constant over time. Set to NULL if not desired, Default: NULL
inc_time_tmc	Indicator variable which decides whether to include temporal random effects for TMC as well as MMC, Default: FALSE

Value

Named list of initial (hyper)parameters for `threemc_fit_model`

threemc_ppc

*Posterior Predictive Distribution and checks on OOS survey***Description**

Aggregate specified numeric columns by population-weighted age groups (rather than single year ages), split by specified categories.

Usage

```
threemc_ppc(
  fit,
  out,
  survey_circumcision_test,
  areas = NULL,
  area_lev = 1,
  type = "MMC",
  age_groups = c("0-4", "5-9", "10-14", "15-19", "20-24", "25-29", "30-34", "35-39",
    "40-44", "45-49", "50-54", "54-59"),
  CI_range = c(0.5, 0.8, 0.95),
  N = 1000,
  seed = 123
)
```

Arguments

fit	Fit object returned by <code>naomi::sample_tmb</code> , which includes, among other things, the optimised parameters and subsequent sample for our TMB model.
out	Results of model fitting (at specified model <code>area_lev</code>) outputted by compute_quantiles .
survey_circumcision_test	survey_circumcision dataset loaded with read_circ_data . <i>Do not preprocess with prepare_survey_data</i> If performing an OOS validation of model performance, you should filter this dataset for the years "held back" from your model fit.
areas	sf shapefile for specific country/region. Only required if <code>survey_circumcision_test</code> has records for area levels higher (i.e. more granular) than <code>area_lev</code> , in which case they must be reassigned to their <code>parent_area_id</code> at <code>area_lev</code> , Default = NULL.
area_lev	Area level you wish to aggregate to when performing posterior predictive comparisons with survey estimates.
type	Decides type of circumcision coverage to perform PPC on, must be one of "MC", "MMC", or "TMC", Default = "MMC"
age_groups	Age groups to aggregate by, Default: <code>c("0-4", "5-9", "10-14", "15-19", "20-24", "25-29", "30-34", "35-39", "40-44", "45-49", "50-54", "54-59")</code>

CI_range	CI interval about which you want to compare empirical and posterior predictive estimates for left out surveys, Default = c(0.5, 0.8, 0.95)
N	Number of samples to generate, Default: 1000
seed	Random seed used for taking binomial sample from posterior predictive distribution.

Value

data.frame with samples aggregated by aggr_cols and weighted by population.

threemc_ppc2	<i>Posterior Predictive Distribution and checks on OOS survey</i>
--------------	---

Description

Aggregate specified numeric columns by population-weighted age groups (rather than single year ages), split by specified categories. Using an alternative method to previously.

Usage

```
threemc_ppc2(
  fit,
  out,
  survey_circumcision_test,
  areas = NULL,
  area_lev = 1,
  age_groups = c("0-4", "5-9", "10-14", "15-19", "20-24", "25-29", "30-34", "35-39",
    "40-44", "45-49", "50-54", "54-59"),
  N = 1000,
  seed = 123
)
```

Arguments

fit	Fit object returned by <code>naomi::sample_tmb</code> , which includes, among other things, the optimised parameters and subsequent sample for our TMB model.
out	Results of model fitting (at specified model <code>area_lev</code>) outputted by <code>compute_quantiles</code> .
survey_circumcision_test	<code>survey_circumcision</code> dataset loaded with <code>read_circ_data</code> . <i>Do not preprocess with <code>prepare_survey_data</code></i> If performing an OOS validation of model performance, you should filter this dataset for the years "held back" from your model fit.
areas	sf shapefile for specific country/region. Only required if <code>survey_circumcision_test</code> has records for area levels higher (i.e. more granular) than <code>area_lev</code> , in which case they must be reassigned to their <code>parent_area_id</code> at <code>area_lev</code> , Default = NULL.

area_lev	Area level you wish to aggregate to when performing posterior predictive comparisons with survey estimates.
age_groups	Age groups to aggregate by, Default: c("0-4", "5-9", "10-14", "15-19", "20-24", "25-29", "30-34", "35-39", "40-44", "45-49", "50-54", "54-59")
N	Number of samples to generate, Default: 1000
seed	Random seed used for taking binomial sample from posterior predictive distribution.
type	Decides type of circumcision coverage to perform PPC on, must be one of "MC", "MMC", or "TMC", Default = "MMC"
CI_range	CI interval about which you want to compare empirical and posterior predictive estimates for left out surveys, Default = c(0.5, 0.8, 0.95)

Value

data.frame with samples aggregated by aggr_cols and weighted by population.

threemc_prepare_model_data

Produce Data Matrices for Modelling

Description

Create data for modelling. Output detailed below.

Usage

```
threemc_prepare_model_data(
  out,
  areas,
  area_lev = NULL,
  aggregated = TRUE,
  weight = "population",
  k_dt_age = 5,
  k_dt_time = NULL,
  paed_age_cutoff = NULL,
  rw_order = NULL,
  inc_time_tmc = FALSE,
  type_info = NULL,
  ...
)
```

Arguments

out	Shell dataset (outputted by create_shell_dataset with a row for every unique record in circumcision survey data for a given area. Also includes empirical estimates for circumcision estimates for each unique record.
areas	sf shapefiles for specific country/region.
area_lev	PSNU area level for specific country.
aggregated	aggregated = FALSE treats every area_id as its own object, allowing for the use of surveys for lower area hierarchies. aggregated = TRUE means we only look at area level of interest.
weight	variable to weigh circumcisions by when aggregating for lower area hierarchies (only applicable for aggregated = TRUE)
k_dt_age	Age knot spacing in spline definitions, Default: 5
k_dt_time	Time knot spacing in spline definitions, set to NULL to disable temporal splines, Default: NULL
paed_age_cutoff	Age at which to split MMC design matrices between paediatric and non-paediatric populations, the former of which are constant over time. Set to NULL if not desired, Default: NULL
rw_order	Order of the random walk used for temporal precision matrix. Setting to NULL assumes you wish to specify an AR 1 temporal prior. Default: NULL
inc_time_tmc	Indicator variable which decides whether to include temporal random effects for TMC as well as MMC, Default: FALSE
...	Additional arguments to be passed to functions which create matrices.

Value

list of data required for model fitting, including:

- `design_matrices` Includes `X_fixed_mmc`, `X_fixed_tmc`, `X_time_mmc`, `X_age_mmc`, `X_age_tmc`, `X_space_mmc`, `X_space_tmc`, `X_agemtime_mmc`, `X_agespace_mmc`, `X_agespace_tmc`, `X_spacetime_mmc`. Design Create design matrices for fixed effects and temporal, age, space and interaction random effects
- `integration_matrices` Includes `IntMat1`, `IntMat2`. Integration matrices for selecting the instantaneous hazard rate.
- `survival_matrices` Includes `A_mmc`, `A_tmc`, `A_mc`, `B`, `C`. Survival matrices for MMC, TMC, censored and left censored
- `Q_space` Precision/Adjacency matrix for the spatial random effects.

Index

* datasets

- [datapack_psnu_area_level](#), [5](#)
- [demo_areas](#), [6](#)
- [demo_populations](#), [6](#)
- [demo_survey_circumcision](#), [7](#)
- [esa_wca_regions](#), [8](#)

- [compute_quantiles](#), [2](#), [16](#), [17](#)
- [create_dirs_r](#), [3](#)
- [create_hazard_matrix_agemtime](#), [5](#)
- [create_integration_matrix_agemtime](#), [5](#)
- [create_shell_dataset](#), [4](#), [12](#), [13](#), [19](#)
- [crossing](#), [5](#)

- [datapack_psnu_area_level](#), [5](#), [5](#)
- [demo_areas](#), [6](#)
- [demo_populations](#), [6](#)
- [demo_survey_circumcision](#), [7](#)

- [esa_wca_regions](#), [8](#)

- [fread](#), [10](#), [11](#)

- [minimise_fit_obj](#), [8](#)

- [normalise_weights_kish](#), [9](#), [10](#)

- [prepare_survey_data](#), [9](#), [16](#), [17](#)

- [quantile](#), [3](#)

- [read_circ_data](#), [10](#), [16](#), [17](#)

- [read_sf](#), [10](#), [11](#)

- [survey_points_dmppt2_convert_convention](#),
[11](#)

- [threemc_aggregate](#), [11](#)

- [threemc_empirical_rates](#), [12](#)

- [threemc_fit_model](#), [2](#), [3](#), [13](#)

- [threemc_initial_pars](#), [14](#)

- [threemc_ppc](#), [16](#)

- [threemc_ppc2](#), [17](#)

- [threemc_prepare_model_data](#), [8](#), [14](#), [15](#), [18](#)