Package ‘mcmsupply’

March 18, 2024

Type Package

Title Estimating Public and Private Sector Contraceptive Market Supply Shares

Version 1.1.1

Description
Family Planning programs and initiatives typically use nationally representative surveys to estimate key indicators of a country’s family planning progress. However, in recent years, routinely collected family planning services data (Service Statistics) have been used as a supplementary data source to bridge gaps in the surveys. The use of service statistics comes with the caveat that adjustments need to be made for missing private sector contributions to the contraceptive method supply chain. Evaluating the supply source of modern contraceptives often relies on Demographic Health Surveys (DHS), where many countries do not have recent data beyond 2015/16. Fortunately, in the absence of recent surveys we can rely on statistical model-based estimates and projections to fill the knowledge gap. We present a Bayesian, hierarchical, penalized-spline model with multivariate-normal spline coefficients, to account for across method correlations, to produce country-specific, annual estimates for the proportion of modern contraceptive methods coming from the public and private sectors. This package provides a quick and convenient way for users to access the DHS modern contraceptive supply share data at national and subnational administration levels, estimate, evaluate and plot annual estimates with uncertainty for a sample of low- and middle-income countries. Methods for the estimation of method supply shares at the national level are described in Comiskey, Alkema, Cahill (2022) <arXiv:2212.03844>.

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Encoding UTF-8

LazyData true

Depends R (>= 3.5.0)

RoxygenNote 7.2.3

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

VignetteBuilder knitr

Config/testthat/edition 3

Imports R2jags, magrittr, foreach, tidyverse, tidybayes, runjags, stats, rlang, abind, dplyr, ggplot2, plyr, readxl, stringr, tibble, tidyr
URL: https://hannahcomiskey.github.io/mcmsupply/,
https://hannahcomiskey.github.io/mcmsupply/

NeedsCompilation: no

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Repository: CRAN

Date/Publication: 2024-03-18 15:50:02 UTC

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Country_and_area_classification

The Country and area classification according to the United Nations Statistical Division, Standard country or area codes for statistical use (M49). Adapted for use in FP2030 by the Track20 project. A subset of data from the United Nations country classifications

Description

The Country and area classification according to the United Nations Statistical Division, Standard country or area codes for statistical use (M49). Adapted for use in FP2030 by the Track20 project. A subset of data from the United Nations country classifications

Usage

Country_and_area_classification

Format

A data frame with 231 rows and 8 columns:

- **Country or area**: Country name
- **ISO Code**: 1, 2 & 3 number ISO country codes
- **Major area**: Continent
- **Region**: Sub-continent
- **Developed region**: Binary indicator for development status
- **Least developed country**: Binary indicator for least developed status
- **Sub-Saharan Africa**: Binary indicator for whether country is in Sub-Saharan Africa
- **FP2020**: Binary indicator for FP2020 participation status

Source

https://unstats.un.org/unsd/methodology/m49/

country_names

The names of the countries with national and subnational administration level data stored

Description

The names of the countries with national and subnational administration level data stored

Usage

country_names
DEFT_DHS_database

Format

A data frame with 30 rows and 3 columns:

Country names  Country name

National level data available  Indicator for whether data at the national administration level is available in the package

Subnational level data available  Indicator for whether data at the subnational administration level is available in the package

DEFT_DHS_database  A database of the design effects for some of the DHS surveys in the national and subnational datasets. Due to due to multistage and clustering of the DHS sample, the average standard error is increased by a design effect (DEFT) factor over that in an equivalent simple random sample.

Description

DEFT_DHS_database  A database of the design effects for some of the DHS surveys in the national and subnational datasets. Due to due to multistage and clustering of the DHS sample, the average standard error is increased by a design effect (DEFT) factor over that in an equivalent simple random sample.

Usage

DEFT_DHS_database

Format

A dataframe of Country names, survey year and design effects for DHS surveys

Source

DHS final reports Appendix B, 'ESTIMATES OF SAMPLING ERRORS'.
get_data

Wrapper function that retrieves the DHS data used for modelling the proportion of modern contraceptives supplied by the public and private sectors at the national and subnational administration levels.

Description

Wrapper function that retrieves the DHS data used for modelling the proportion of modern contraceptives supplied by the public and private sectors at the national and subnational administration levels.

Usage

get_data(
    national = TRUE,
    local = FALSE,
    mycountry = NULL,
    fp2030 = TRUE,
    surveydata_filepath = NULL
)

Arguments

national TRUE/FALSE. Default is TRUE for national administration level data. FALSE retrieves subnational level data.

local TRUE/FALSE. Default is FALSE for global runs. Decides if this is a single-country or global run.

mycountry The name of country of interest. Default is NULL. For the names of potential countries, review vigentte.

fp2030 Default is TRUE. Filter raw data to only include the Family Planning 2030 focus countries discussed in the Comiskey et al. paper.

surveydata_filepath Path to survey data. Default is NULL. Survey data should be a .xlsx with the following format national_FPsource_data.

Value

returns a list containing the DHS data set used for inputs into the model and the arguments that specify the data set up.

Examples

raw_data <- get_data(national=FALSE, local=TRUE, mycountry="Nepal")
get_posterior_P_samps  Function to pull the complete posterior sample for the national method-supply share estimates. Functionality for the subnational models is still under development.

Description

Function to pull the complete posterior sample for the national method-supply share estimates. Functionality for the subnational models is still under development.

Usage

get_posterior_P_samps(jagsdata, model_output, nposterior)

Arguments

jagsdata  The inputs for the JAGS model
model_output  The output of the mcmsupply::run_jags_model() function.
nposterior  The number of posterior samples you wish to pull.

Value

A dataframe containing the posterior samples of national method-supply share estimates.

Examples

## Not run:
raw_data <- get_data(national=TRUE, local=TRUE, mycountry="Nepal")
jagsdata <- get_modelinputs(startyear=1990, endyear=2025.5, nsegments=12, raw_data)
mod <- run_jags_model(jagsdata = jagsdata, jagsparams = NULL, n_iter = 5, n_burnin = 1, n_thin = 1)
post_samps <- get_posterior_P_samps(jagsdata = jagsdata, model_output = mod, nposterior=4)
## End(Not run)

get_subnational_modelinputs

Get JAGS model inputs

Description

Get JAGS model inputs
get_subnational_modelinputs

Usage

get_modelinputs(
  startyear = 1990,
  endyear = 2030.5,
  nsegments = 12,
  raw_data,
  varcov_array_filepath = NULL
)

Arguments

startyear      The year you wish to begin your predictions from. Default is 1990.
endyear        The year you wish to finish your predictions. Default is 2030.5.
nsegments      The number of knots you wish to use in your basis functions. Default is 12.
raw_data       The list of arguments and family planning source data from the 'get_data' function.
varcov_array_filepath
                Path to calculated variance-covariance array associated with the custom supplied FP source data. Default is NULL. Covariance data should be a .RDS file.

Value

A list of modelling inputs for the JAGS model.

1. Tstar is the year index for the most recent survey in each province.
2. Kstar is the knot index that aligns with Tstar.
3. B.ik are the basis functions.
4. n_years are total number of years
5. n_obs are the total number of observations
6. K are the number of knots.
7. H is K-1. Used in the calculation of first order differences of spline coefficients.
8. P_count is the number of subnational provinces/regions.
9. M_count is the number of modern contraceptive methods.
10. matchsubnat is the subnational province indexing to match the observed data to the predictions.
11. matchcountry is the country indexing to match the observed data to the predictions.
12. matchmethod is the method indexing to match the observed data to the predictions.
13. matchyears is the year indexing to match the observed data to the predictions.

Examples

raw_data <- get_data(national=FALSE, local=TRUE, mycountry="Nepal")
jagsdata <- get_modelinputs(startyear=1990, endyear=2030.5, nsegments=12, raw_data)
national_estimated_correlations_bivarlogitnormal

The estimated national-level correlations between the rates of change in methods

Description

The estimated national-level correlations between the rates of change in methods

Usage

national_estimated_correlations_bivarlogitnormal

Format

A array of 2 matrices with 5 rows and 5 columns:

- **row**: Contraceptive method the correlation estimate refers to
- **column**: Contraceptive method the correlation estimate refers to
- **public_cor**: The estimated correlation between the rates of change in methods supplied by the public sector
- **private_cor**: The estimated correlation between the rates of change in methods supplied by the private sector

national_FPsource_data

DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the national level

Description

DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the national level

Usage

national_FPsource_data
Format

national_FPsource_data:
A data frame with 562 rows and 15 columns:

Country  Country names
Method   Contraceptive method name
average_year  Average year of the survey
year     Year of the survey
country_code  ISO country codes
Public   Proportion supplied by the Public sector
se.Public  Standard error of proportion supplied by the Public sector
Public_n  Sample size used to calculate proportion supplied by the Public sector
Commercial_medical   Proportion supplied by the private Commercial medical sector
se.Commercial_medical  Standard error of proportion supplied by the private Commercial medical sector
Commercial_medical_n  Sample size used to calculate proportion supplied by the private Commercial medical sector
Other    Proportion supplied by the private Other sector
se.Other  Standard error of proportion supplied by the private Other sector
Other_n  Sample size used to calculate proportion supplied by the private Other sector
check_sum  Check to see if proportions sum to 1

Source

On request from DHS microdata - using the womens individuals recode file. Contact details found at https://dhsprogram.com/data/dataset_admin/login_main.cfm

Description

A checklist for ensuring national-level custom data is appropriate to be used for estimation

Usage

national_FPsource_format
Format

A list of requirements for custom data to meet before being accepted into the model

Country  Country name variable classification
Method   Method name variable classification
average_year  average_year variable classification
sector_category  sector_category name variable classification
proportion  proportion variable classification
SE.proportion  SE.proportion variable classification
n  n variable classification

national_FPsource_VARCOV_bivarlogitnormal

An array of variance-covariance matrices corresponding to the DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the national level

Description

An array of variance-covariance matrices corresponding to the DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the national level

Usage

national_FPsource_VARCOV_bivarlogitnormal

Format

national_FPsource_VARCOV_bivarlogitnormal:
An array of 2x2 matrices for each of the 558 observations in the national_FPsource_data. Each 2x2 array corresponds to the variance of the public and private sectors on the diagonal and their corresponding covariances on the off-diagonal.

Source

The variance-covariance matrices are calculated using the survey R package: prop_mat < svyby(~I(sector_categories), ~I(modern_method_source), design=d.s, svymean, covmat=TRUE) vcov_matrix < vcov(prop_mat) function.
The median estimate for the national-level variance-covariance matrix of the delta.k terms in the multi-country national model.

Description

The median estimate for the national-level variance-covariance matrix of the delta.k terms in the multi-country national model.

Usage

national_inv_sigma_delta_hat_bivarlogitnorm

Format

A array of 2 matrices with 5 rows and 5 columns:

Array 1 Estimated public sector variance-covariance matrix
Array 2 Estimated private sector variance-covariance matrix

The median estimates of the precision for the national-level country, sector-, method-specific intercepts in the multi-country national model. This vector is used to inform the precision in the Normal prior of the national-level intercept in single-country national models.

Description

The median estimates of the precision for the national-level country, sector-, method-specific intercepts in the multi-country national model. This vector is used to inform the precision in the Normal prior of the national-level intercept in single-country national models.

Usage

national_tau_alpha_cms_hat_bivarlogitnorm

Format

A vector of two precision estimates
The median estimates of the national-level sub-continental, sector-, method-specific intercepts in the multi-country national model. This array is used to inform the Normal prior of the country-level intercept in the single-country national model.

**Description**

The median estimates of the national-level sub-continental, sector-, method-specific intercepts in the multi-country national model. This array is used to inform the Normal prior of the country-level intercept in the single-country national model.

**Usage**

national_theta_rms_hat_bivarlogitnorm

**Format**

A array of 6 matrices with 2 rows and 5 columns

The order of observations to join the variance-covariance array data and the DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the national level

**Description**

The order of observations to join the variance-covariance array data and the DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the national level

**Usage**

national_varcov_order_bivarlogitnormal

**Format**

national_varcov_order_bivarlogitnormal:

A data frame with 558 rows and 3 columns:

- **Country**: Country names
- **average_year**: Average year of the survey
- **Method**: Contraceptive method name
plot_estimates

Usage

plot_estimates(jagsdata, model_output)

Arguments

jagsdata Output of the mcmsupply::get_modelinputs() function.
model_output The output of the mcmsupply::run_jags_model() function.

Value

A list of ggplot objects.

Examples

## Not run:
raw_data <- get_data(national=TRUE, local=TRUE, mycountry="Nepal")
jagsdata <- get_modelinputs(startyear=1990, endyear=2030.5, nsegments=12, raw_data)
mod <- run_jags_model(jagsdata, n_iter=5, n_burnin=1, n_thin=1)
plots <- plot_estimates(jagsdata = jagsdata, model_output = mod)
## End(Not run)

pull_estimates

Usage

pull_estimates(model_output, year, country)
Arguments

- **model_output**: The output of the mcmsupply::run_jags_model() function.
- **year**: Numeric. The year of model estimated you wish to pull.
- **country**: String. The name of the country you wish to inspect.

Value

A dataframe of model estimates for each method, with the median (50%), 80% and 95% credible intervals.

Examples

```r
## Not run:
raw_data <- get_data(national=TRUE, local=TRUE, mycountry="Nepal")
jagsdata <- get_modelinputs(startyear=1990, endyear=2025.5, nsegments=12, raw_data)
mod <- run_jags_model(jagsdata = jagsdata, jagsparams = NULL, n_iter = 5, n_burnin = 1, n_thin = 1)
estimates <- pull_estimates(model_output = mod, year=2018, country="Nepal")
## End(Not run)
```

---

**run_jags_model**

Wrapper function to run the jags model for estimating the proportion of modern contraceptive methods supplied by the public & private Sectors using a Bayesian hierarchical penalized spline model for the national and subnational administration levels.

**Description**

Wrapper function to run the jags model for estimating the proportion of modern contraceptive methods supplied by the public & private Sectors using a Bayesian hierarchical penalized spline model for the national and subnational administration levels.

**Usage**

```r
run_jags_model(
  jagsdata,
  jagsparams = NULL,
  n_iter = 80000,
  n_burnin = 10000,
  n_thin = 35,
  n_chain = 2,
  n_cores = NULL,
...)
```
subnational_alpha_cms_hat

Arguments

jagsdata: The object from the mcmsupply::get_modelinputs() function.

jagsparams: The parameters of the JAGS model you wish to review.

n_iter: Default is 80000. Number of iterations to do in JAGS model.

n_burnin: Default is 10000. Number of samples to burn-in in JAGS model.

n_thin: Default is 35. Number of samples to thin by in JAGS model.

n_chain: Default is 2. Number of chains to run in your MCMC sample.

n_cores: The number of cores to use for parallel execution in subnational estimation. If not specified, the number of cores is set to the value of options("cores"), if specified, or to approximately half the number of cores detected by the parallel package.

Value

returns the jags model object

Examples

raw_data <- get_data(national=TRUE, local=TRUE, mycountry="Nepal")
jagsdata <- get_modelinputs(startyear=1990, endyear=2025.5, nsegments=12, raw_data)
run_jags_model(jagsdata, n_iter=5, n_burnin=1, n_thin=1)

subnational_alpha_cms_hat

The median estimates of the subnational-level country, sector-, method-specific intercepts in the multi-country subnational model. This array is used to inform the Normal prior of the subnational-level intercept in the single-country subnational model.

Description

The median estimates of the subnational-level country, sector-, method-specific intercepts in the multi-country subnational model. This array is used to inform the Normal prior of the subnational-level intercept in the single-country subnational model.

Usage

subnational_alpha_cms_hat

Format

A array of 23 matrices with 2 rows and 5 columns
### subnational_estimated_correlations

*The estimated subnational-level correlations between the rates of change in methods*

<table>
<thead>
<tr>
<th>Description</th>
<th>Usage</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>The estimated subnational-level correlations between the rates of change in methods</td>
<td>subnational_estimated_correlations</td>
<td>A array of 2 matrices with 5 rows and 5 columns:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>row</strong> Contraceptive method the correlation estimate refers to</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>column</strong> Contraceptive method the correlation estimate refers to</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>public_cor</strong> The estimated correlation between the rates of change in methods supplied by the public sector</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>private_cor</strong> The estimated correlation between the rates of change in methods supplied by the private sector</td>
</tr>
</tbody>
</table>

### subnational_inv.sigma_delta_hat

*The median estimate for the subnational-level precision matrix of the delta.k terms in the multi-country subnational model. This array is used to inform the multi-variate normal prior in the single-country subnational model.*

<table>
<thead>
<tr>
<th>Description</th>
<th>Usage</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>The median estimate for the subnational-level precision matrix of the delta.k terms in the multi-country subnational model. This array is used to inform the multi-variate normal prior in the single-country subnational model.</td>
<td>subnational_inv.sigma_delta_hat</td>
<td>A array of 2 matrices with 5 rows and 5 columns:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Array 1</strong> Estimated public sector precision matrix</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Array 2</strong> Estimated private sector precision matrix</td>
</tr>
</tbody>
</table>
subnational_tau_alpha_pms_hat

The median estimates of the precision for the subnational-level country, sector-, method-specific intercepts in the multi-country subnational model. This vector is used to inform the precision in the Normal prior of the subnational-level intercept in single-country subnational models.

Description

subnational_tau_alpha_pms_hat The median estimates of the precision for the subnational-level country, sector-, method-specific intercepts in the multi-country subnational model. This vector is used to inform the precision in the Normal prior of the subnational-level intercept in single-country subnational models.

Usage

subnational_tau_alpha_pms_hat

Format

A vector of two precision estimates

subnat_FPsource_data

DHS survey observations for the proportion of modern contraceptives supplied by the public and private sectors at the subnational administration level.

Description


Usage

subnat_FPsource_data

Format

subnat_FPsource_data:
A data frame with 6940 rows and 8 columns:

Country  Country names
Region   Subnational region names
Method   Contraceptive method name
average_year  Average year of the survey
sector_categories  Name of sector
proportion  Proportion supplied by the sector
SE.proportion  Standard error associated with the proportion
n  Sample size associated with the observation

Source

On request from IPUMS - https://www.idhsdata.org/idhs/index.shtml

subnat_FPsource_format
A checklist for ensuring subnational-level custom data is appropriate to be used for estimation

Description

A checklist for ensuring subnational-level custom data is appropriate to be used for estimation

Usage

subnat_FPsource_format

Format

A list of requirements for custom data to meet before being accepted into the model

Country  Country name variable classification
Region  Subnational region name variable classification
Method  Method name variable classification
average_year  average_year variable classification
sector_categories  sector_categories name variable classification
proportion  proportion variable classification
SE.proportion  SE.proportion variable classification
n  n variable classification
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