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Title Vaccine Impact Calculation

Version 0.1.6

Description VIMC IMPACT CALCULATION PACKAGE. This package is mainly for the VIMC Science Team to investigate vaccination impact.

Depends R (>= 3.5.0)

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calculate_impact	<i>Calculate impact - requires a DB connection to montagu.</i>
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Description

This depends on the DB format of VIMC and so is for internal use only.

Usage

```
calculate_impact(  
  con,  
  method,  
  touchstone,  
  modelling_group,  
  disease,  
  focal_scenario_type,  
  baseline_scenario_type,  
  focal_vaccine_delivery = NULL,  
  baseline_vaccine_delivery = NULL,  
  burden_outcomes = c("deaths", "cases", "dalys"),  
  countries = NULL,  
  is_under5 = FALSE,  
  vaccination_years = 2000:2030  
)
```

Arguments

con	Connection to database.
method	Impact method to use one of calendar_year, birth_year, yov_activity_type, yov_birth_cohort.
touchstone	The montagu touchstone to calculate impact for. Either touchstone ID or touchstone name.
modelling_group	The modelling group to calculate impact for.
disease	The disease to calculate impact for.

focal_scenario_type	The focal scenario scenario type e.g. "default"
baseline_scenario_type	The baseline scenario scenario type e.g. "novac"
focal_vaccine_delivery	The focal vaccine delivery methods. This should be a list of lists or NULL if scenario type is novac. Each element of first list needs to specify the vaccination and activity type. e.g. list(list(vaccine = "HepB", activity_type = "routine"), list(vaccine = "HepB_BD", activity_type = "routine"))
baseline_vaccine_delivery	Like 'focal_vaccine_delivery' this should be a list of lists, each element containing vaccination and activity type. If 'baseline_vaccine_delivery' is 'novac' then this should be NULL.
burden_outcomes	List of burden outcomes, defaults to "deaths", "cases" and "dalys".
countries	Vector of countries to get impact for. If NULL then impact calculated for all countries.
is_under5	If TRUE then only include data for age under 5, otherwise calculate impact for all ages
vaccination_years	Years of vaccination of interest, only used for year of vaccination (yov) methods

Value

Impact for this set of parameters.

calculate_impact_from_recipe

Calculate impact from a recipe - requires a DB connection to montagu.

Description

This depends on the DB format of VIMC and so is for internal use only.

Usage

```
calculate_impact_from_recipe(
  con,
  recipe_path,
  method,
  countries = NULL,
  is_under5 = FALSE,
  vaccination_years = 2000:2030
)
```

Arguments

con	Connection to database
recipe_path	Path to file containing recipe for burden outcome calculation. For more details see vignette("vignette").
method	Impact method to use one of calendar_year, birth_year, yov_activity_type, yov_birth_cohort.
countries	Vector of countries to get impact for. If NULL then impact calculated for all countries.
is_under5	If TRUE then only include data for age under 5, otherwise calculate impact for all ages
vaccination_years	Years of vaccination of interest, only used for year of vaccination (yov) methods

Value

The impact for each row in the recipe

cohort_deaths_all_cause

Extract demographic data - all cause mortality, live birth and under5 mortality rate

Description

Extract demographic data - all cause mortality, live birth and under5 mortality rate

Usage

```
cohort_deaths_all_cause(con, touchstone_pop, cohorts, under_5 = TRUE)
```

Arguments

con	Database connection
touchstone_pop	Demography touchstone
cohorts	birth cohorts for which to extract data
under_5	whether constrain to under5 mortality

extract_vaccination_history

Generate target, fvps, coverage for a touchstone This function pulls vaccination and population data from Montagu database, and transform them into target, coverage and fvps. There are two modes of pulling population data: 1.) through touchstone_pop parameter 2.) through demographic_source parameter touchstone_pop is one of touchstone_demographic_dataset.touchstone; this parameter is nullable, when it is null, touchstone_cov is used demographic_source is one of demographic_source.code; by default it is null, when it is not null, it rulls out touchstone_pop parameter

Description

Replace jenner:::fix_covreage_fvps() function

Usage

```
extract_vaccination_history(
  con,
  touchstone_cov = "201710gavi",
  touchstone_pop = NULL,
  year_min = 2000,
  year_max = 2100,
  vaccine_to_ignore = c("DTP3", "HepB_BD_home", "none"),
  disease_to_extract = NULL,
  countries_to_extract = NULL,
  gavi_support_levels = c("with", "bestminus"),
  scenario_type = "default",
  external_population_estimates = NULL,
  full_description = FALSE,
  demographic_source = NULL,
  coverage_scenario_type = NULL,
  db_memory = NULL
)
```

Arguments

con	Database connection
touchstone_cov	Coverage touchstone
touchstone_pop	touchstone_demographic_dataset.touchstone
year_min	extract data from year_min
year_max	extract data to year_max
vaccine_to_ignore	Ignore defined vaccines

disease_to_extract	extract data for specific diseases
countries_to_extract	extract data for specific countries
gavi_support_levels	gavi support levels
scenario_type	scenario type
external_population_estimates	The rationales are 1. we can use external population estimates if any and if necessary; 2. demographic uncertainty not only affects models, but also FVPs. If we are to conduct sensitivity analysis on impact_by_year_of_vaccination, we need to vary population input for adjusting FVPs.
full_description	TRUE if including scenario_descriptions (coverage estimates will be duplicated for scenarios); and FALSE if only providing coverage estimates
demographic_source	Demographic_source.code
coverage_scenario_type	Coverage scenario type. This is particularly useful for a coverage touchstone. Montagu coverage.name follows <disease>:<vaccine>,<activity_type>,<gavi_support_level>:<coverage>. It is NULL by default. When it is not null, only pulls coverage.name that contains specified pattern.
db_memory	if not null, coverage is pulled from in-memory db; this is used from 202507july onwards, as we are moving away from db imports

fetch_stochastic_data *Get data from stochastic tables with specified grouping and filters*

Description

Can query from cross_all, cross_under5, cohort_all and cohort_under5

Usage

```
fetch_stochastic_data(
  annex,
  table,
  groups = c("disease", "country", "year"),
  filters = NULL
)
```

Arguments

annex	Connection to annex db
table	One of cross_all, cross_under5, cohort_all or cohort_under5
groups	Categories to group by for aggregating in query
filters	Filters to apply before aggregation

Value

Mean, 0.025 and 0.975 quantiles for deaths_default, deaths_novac. deaths_impact, dalys_default, dalys_novac, dalys_impact with specified groupings.

fetch_stochastic_data_year_groups

Get data from stochastic tables with specified grouping and filters

Description

This will retrieve mean, 0.025 and 0.975 quantiles from cross_all_2019, cross_under5_2019, cohort_all_2019 and cohort_under5_2019. You can pass a set of year groups to initially aggregate over a range of years. Pass individual years to get mean and quantiles for a year alone.

Usage

```
fetch_stochastic_data_year_groups(
  annex,
  table,
  groups = c("disease", "country"),
  filters = NULL,
  year_groups = list(c(2000:2019)),
  include_proportion_averted = FALSE
)
```

Arguments

annex	Connection to annex db
table	One of cross_all, cross_under5, cohort_all or cohort_under5
groups	Categories to group by for aggregating in query, can be any combination of disease and/or country
filters	Filters to apply before aggregation
year_groups	List of year groups to sum over before calculating mean and quantiles. This will sum over all years within range from min & max of each year group. Note that passing a range of years wider than the data itself will only aggregate over the years for which there is data available
include_proportion_averted	If TRUE then calculates mean and quantiles for proportion_deaths_averted = deaths_impact / deaths_novac and for proportion_dalys_averted = dalys_impact / dalys_novac

Value

Mean, 0.025 and 0.975 quantiles for deaths_default, deaths_novac. deaths_impact, dalys_default, dalys_novac, dalys_impact with specified groupings.

get_population	<i>Extract demographic data</i>
----------------	---------------------------------

Description

Extract demographic data

Usage

```
get_population(
  con,
  touchstone_pop = "201710gavi-5",
  demographic_statistic = "int_pop",
  gender = "Both",
  country_ = NULL,
  year_ = NULL,
  age_ = NULL,
  demographic_source = NULL
)
```

Arguments

con	Database connection
touchstone_pop	Demography touchstone
demographic_statistic	Demographic statistic to extract
gender	Gender codes - "Male", "Female", "Both"
country_	All countries if NULL. Or specify a vector of countries
year_	All years if NULL. Or specify a vector of years
age_	All age groups if NULL. Or specify a vector of age groups
demographic_source	one of demographic_source.code, this works for IU where demography is not a model run version

get_touchstone	<i>Determine touchstone</i>
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Description

Find latest touchstone given touchstone_name

Usage

```
get_touchstone(con, touchstone_name)
```

Arguments

con	Database connection.
touchstone_name	touchstone_name

get_touchstone_id	<i>Determine touchstone id</i>
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Description

Find latest touchstone if touchstone name is provided

Usage

```
get_touchstone_id(con, touchstone)
```

Arguments

con	Database connection.
touchstone	touchstone name or id

impact_by_birth_year	<i>Calculate impact by birth year (lifetime impact)</i>
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Description

The birth year method accounts for the long-term impact accrued over the lifetime of a particular birth cohort. The duration of modelling needs to be appropriate to the pathogen of interest as in some cases, such as HepB, disease occurs later in life. For example if we model vaccination for birth cohorts born from 2000 to 2030 and model disease burden until 2100 we do not account for the vaccine impact for those born in 2030 once they are over 70 years old. The method also does not specifically account for the impact of vaccinating a cohort outside the cohort vaccinated (e.g. because of herd protection).

Usage

```
impact_by_birth_year(baseline_burden, focal_burden)
```

Arguments

baseline_burden	Data frame of baseline burden data this needs to have columns country, burden_outcome, year, age, value
focal_burden	Data frame of focal burden data this needs to have columns country, burden_outcome, year, age, value

Value

Vaccine impact by country and birth year for burden outcomes as a data frame with columns country, year, burden_outcome and impact

impact_by_calendar_year

Calculate impact by calendar year

Description

Calculate impact accrued over all ages for a specific year. This calculates the difference in disease burden between baseline and focal scenarios for a given year. The baseline scenario can have no vaccination or different coverage to the focal scenario. This aggregates the impact over all ages modelled. This does not account for the future disease burden averted through current vaccine activities.

Usage

```
impact_by_calendar_year(baseline_burden, focal_burden)
```

Arguments

baseline_burden

Data frame of baseline burden data this needs to have columns country, burden_outcome, year, age, value

focal_burden

Data frame of focal burden data this needs to have columns country, burden_outcome, year, age, value

Value

Vaccine impact by country and year for burden outcomes as a data frame with columns country, year, burden_outcome and impact

impact_by_year_of_vaccination_activity_type

Calculate impact by year of vaccination: activity type

Description

Impact by year of vaccination with impact ratio stratified by activity type. Stratifying impact ratio by activity type captures the differing effects of routine and campaign vaccination.

Usage

```
impact_by_year_of_vaccination_activity_type(
  baseline_burden,
  focal_burden,
  fvps,
  vaccination_years
)
```

Arguments

baseline_burden	Data frame of baseline burden data this needs to have columns country, burden_outcome, vaccine_delivery, year, age, value
focal_burden	Data frame of focal burden data this needs to have columns country, burden_outcome, vaccine_delivery, year, age, value
fvps	Data frame of additional FVPs (fully vaccinated persons) of focal compared to baseline scenarios. This needs to have columns country, year, activity_type and fvps. Other columns can be included and will be aggregated over.
vaccination_years	Years of vaccination of interest.

Details

To calculate impact by year of vaccination using impact ratios stratified by activity type, we assume that routine vaccination and campaign vaccination, which target multiple age groups, have different effects; for example due to dosage clustering. Hence, this method produces multiple, activity-specific impact ratios which we then multiply by the number of FVPs (fully vaccinated persons) to calculate impact.

Value

Vaccine impact by country, activity type (routine or campaign), year and burden outcome

```
impact_by_year_of_vaccination_birth_cohort
```

Calculate impact by year of vaccination: birth cohort

Description

Impact by year of vaccination with impact ratio stratified by birth cohort. Stratifying impact ratio by birth cohort aims to catch temporal changes in transmission or healthcare.

Usage

```

impact_by_year_of_vaccination_birth_cohort(
  baseline_burden,
  focal_burden,
  fvps,
  vaccination_years
)

```

Arguments

baseline_burden	Data frame of baseline burden data this needs to have columns country, burden_outcome, vaccine_delivery, year, age, value
focal_burden	Data frame of focal burden data this needs to have columns country, burden_outcome, vaccine_delivery, year, age, value
fvps	Data frame of FVPs (fully vaccinated persons) needs to have columns country, year, activity_type, fvps other columns can be included and will be aggregated over.
vaccination_years	Years of vaccination of interest.

Details

This method is invariant to activity type. Vaccine effect is assumed to vary over time through birth cohorts. This means that rather than averaging the effect of vaccination over time, we account for the variation in transmission and health of the population. This influences how one year's vaccination may work compared to another. For example, if therapeutic treatments for a disease improve over time, we may expect the impact of vaccination in 2050 to be less than that now as the population is generally healthier.

Value

Vaccine impact by country, activity type (routine or campaign), year and burden outcome

```

impact_by_year_of_vaccination_cohort_perspective

```

Calculate impact by year of vaccination cohort perspective

Description

This will calculate the impact by year of vaccination by country, birth cohort and burden outcome for a single disease and vaccine.

Usage

```

impact_by_year_of_vaccination_cohort_perspective(
  raw_impact,
  fvps,
  vaccination_years
)

```

Arguments

raw_impact	Data frame of raw impact data this needs to have columns country, value, burden_outcome and either year & age or birth_cohort
fvps	Data frame of fully vaccination person data with columns country, fvps and either year & age or birth_cohort
vaccination_years	Years of vaccination of interest

Details

This can take data either by vaccination year and age at vaccination or by birth cohort year.

Value

Impact ratio by country, birth cohort and burden outcome

```

impact_by_year_of_vaccination_country_perspective
  Calculate impact by year of vaccination country perspective

```

Description

This will calculate the impact by year of vaccination by country and burden outcome for a single disease and vaccine.

Usage

```

impact_by_year_of_vaccination_country_perspective(
  raw_impact,
  fvps,
  activity_type,
  vaccination_years
)

```

Arguments

- raw_impact Data frame of raw impact data this needs to have columns country, value, burden_outcome and either year & age or birth_cohort
- fvps Data frame of fully vaccination person data with columns country, fvps and either year & age or birth_cohort
- activity_type 'routine' or 'campaign' activity type
- vaccination_years Years of vaccination of interest

Details

This can take data either by vaccination year and age at vaccination or by birth cohort year.

Value

Impact ratio by country and burden outcome

recipe_template	<i>Impact recipe template</i>
-----------------	-------------------------------

Description

Generate impact recipe template

Usage

```
recipe_template(template_version = "201710", method)
```

Arguments

- template_version version can be any VIMC model run - e.g. 201710, 201910
- method method can be any VIMC impact methods - method0, method1, method2a, method2b

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