Proportional multi-state life table model

PMSLT is a simulation model that estimates the effect of changes in the population distribution of risk factor/s in terms of health benefits/disbenefits.

Proportional multi-state life table model

Health simulation modelling tool

What for?

- Quantify the health impact of changes in exposure to health risk factors
- Comparative risk assessment tool: what if?
- Comparison of a policy scenario/intervention with baseline scenario

Applications

- Chronic disease modelling studies
- Assessing Cost Effectiveness in Prevention (Australia)
- Burden of Disease Epidemiology, Equity & Cost-Effectiveness Programme (BODE^3) (New Zealand)

Proportional multi-state life table model

Outputs

By age-cohort and sex

- Health-adjusted life years: like QALYs
- Life years
- Disease mortality and incidence
- Life expectancy
- Health adjusted life expectancy

- Per simulation year
- Accumulated over the life course

Proportional multi-state life table model

Scientific development

Mathematical Population Studies
1998, Vol 7(I), pp 29–49
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COPING WITH MULTIPLE MORBIDITY IN A LIFE TABLE

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Population Health Metrics

BioMed Central

Research

Open Access

A generic model for the assessment of disease epidemiology: the computational basis of DisMod II

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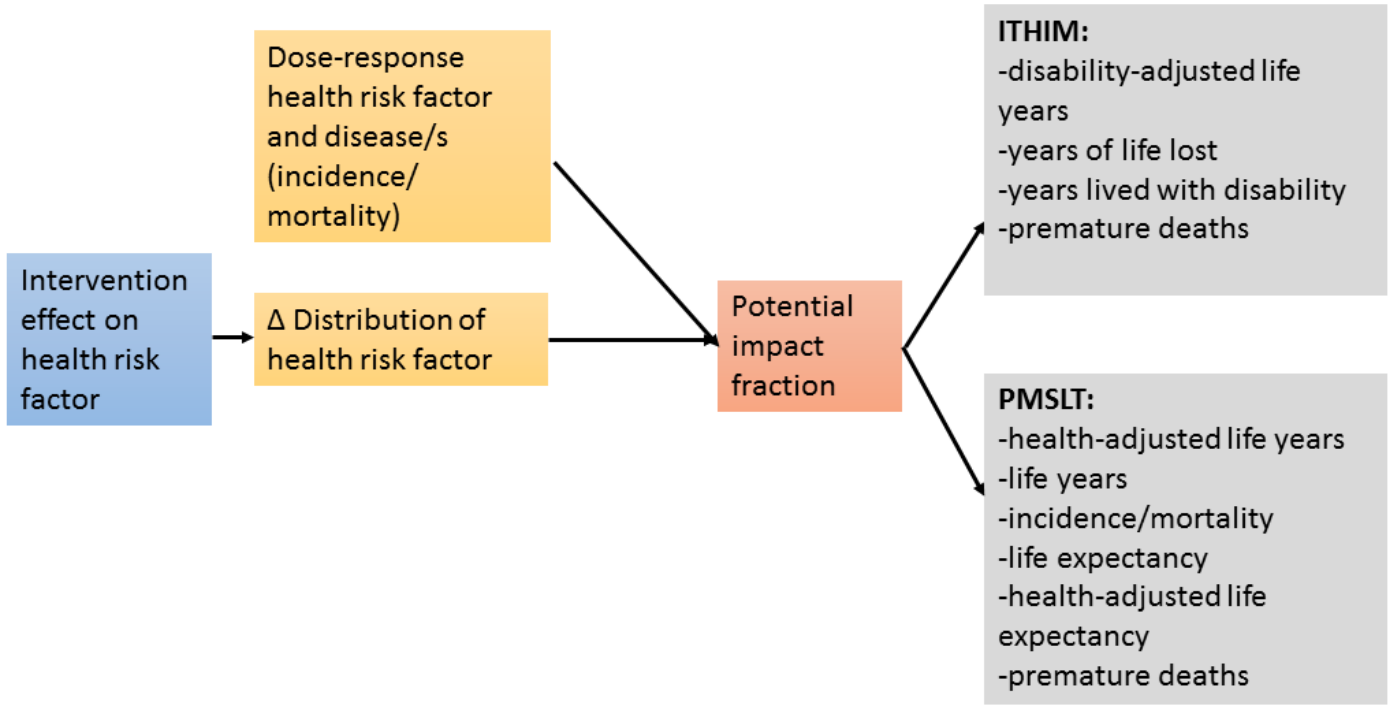
Proportional multi-state life table model

Contribution to ITHIMR



Proportional multi-state life table model

Main differences with ITHIM

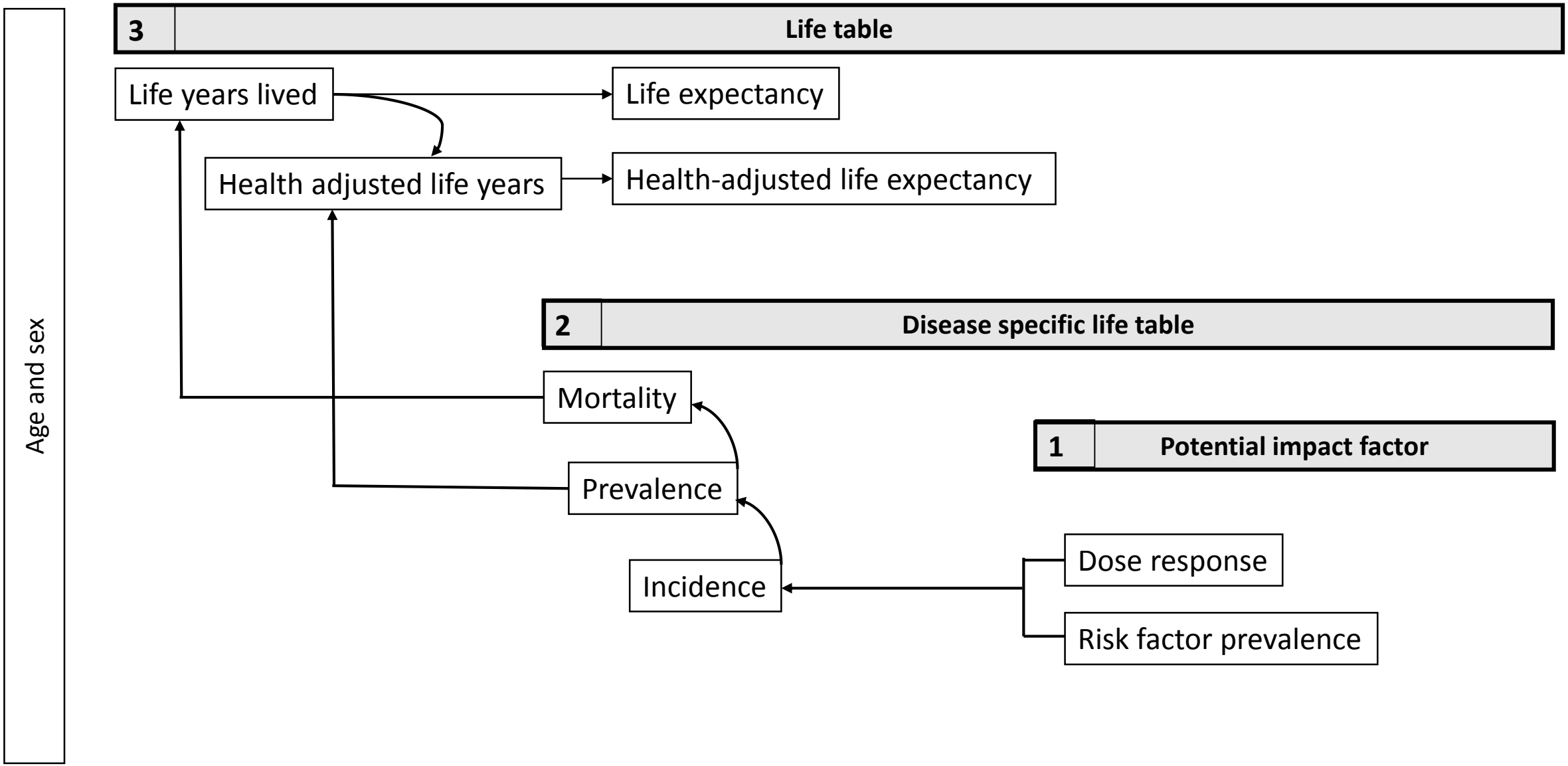
Time component → **Cohorts modelled over time**

- Include diseases' trends (incidence/case fatality)
- Time lags exposure to incidence/case fatality (via the PIF)
- Population growth

Year of life/YLLs → **Based on observed mortality rates**

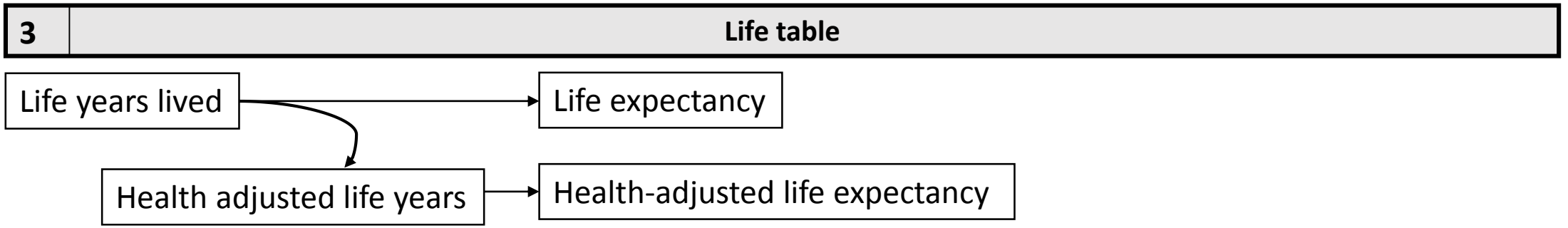
Impact of disability on increased life expectancy → **Burden of disease shift to later years**

Proportional multi-state life table model



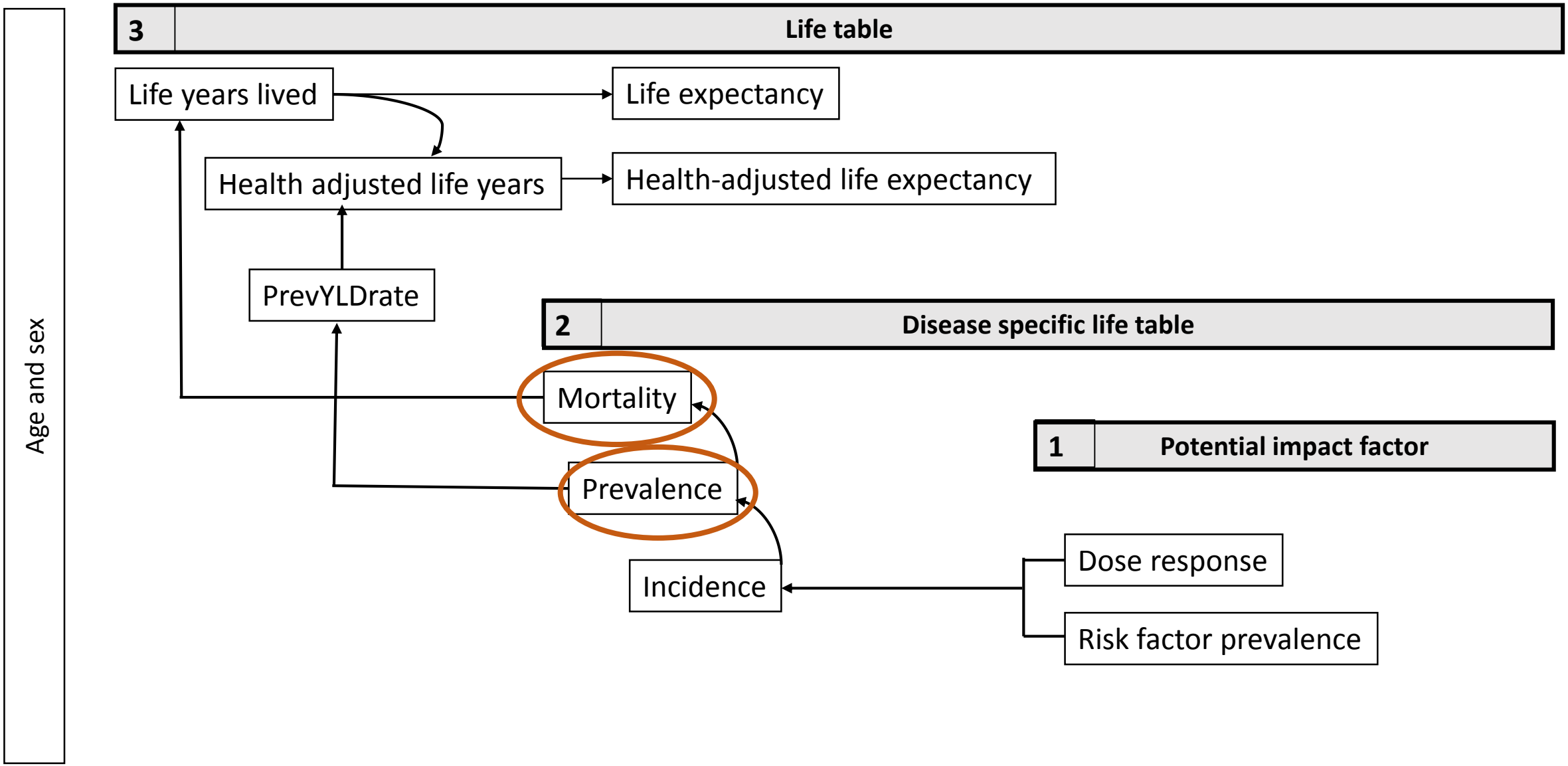
Proportional multi-state life table model

Age and sex



- Adds disability adjustment to life years lived ⟶ prevalent years lived with disability rate (pYLDs)
- Health adjusted life years ⟶ Life years lived*pYLDsrate
- Mechanism of change for scenario analysis: mortality rate and pYLDrate

Proportional multi-state life table model



Proportional multi-state life table model

R development

- Long script (documented in R Markdown)
- Functions
- Inputs

Proportional multi-state life table model

Long script (documented in R Markdown)

Proportional multi-state multiple-cohort life table model

Belen Zapata-Diomedi and Ali Abbas

26 March 2018

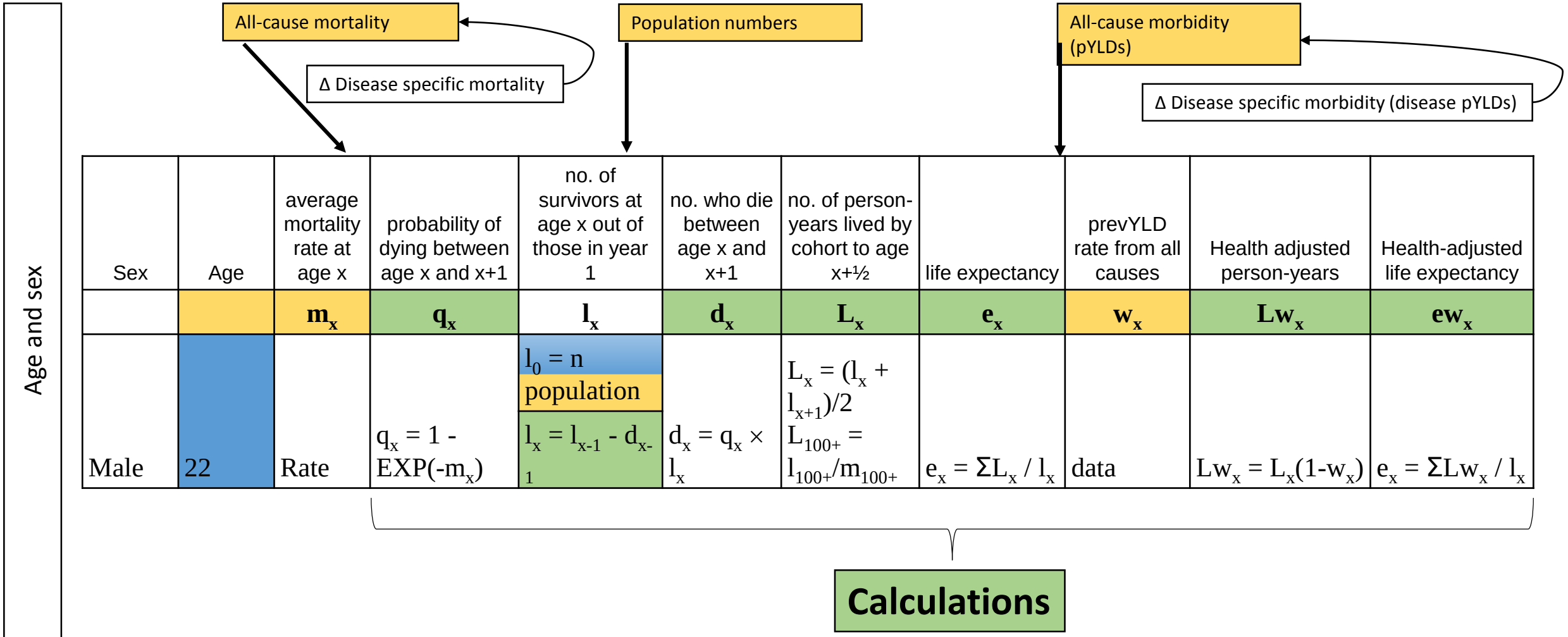
Contents

Proportional multi-state life table model

Functions

1. Life table (baseline and scenario)
2. Disease life table (baseline and scenario)
3. Potential impact fraction
4. Output: (1) plots (Age and sex) and (2) Aggregate outcomes (total population over the years)

Function: life table



Function: disease life table

Age and sex

sex	age	incidence	remission	case fatality	mortality(other)	Intermediate variables				Healthy	Diseased	Dead	Check, should be 1000	(No. alive)	Person-years lived at risk (between x and x+1)	prevalence rate	mortality rate
	x	**i_x**	**r_x**	**f_x**	**m_x**	**l_x**	**q_x**	**w_x**	**v_x**	**S_x**	**C_x**	**D_x**			**PY_x**	**c_x**	**b_x**
		Data	0	Data	0								$=S_x+C_x+D_x$	$=S_x+C_x$	$=0.5(S_x+C_{x+}S_{x+1}+C_{x+1)}$	$c_x=0.5$ $(C_x+C_{x+1})/PY_x$	$b_x=(D_x-D_{x+1})/PY_x$

Calculations **Inputs**

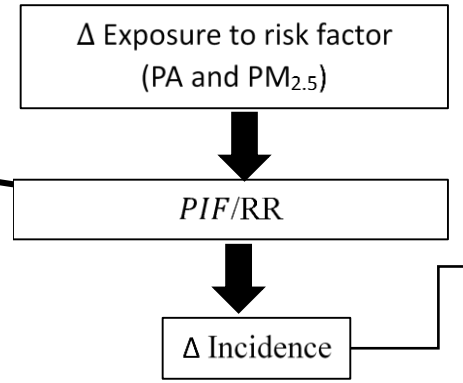
Barendregt et al 2003

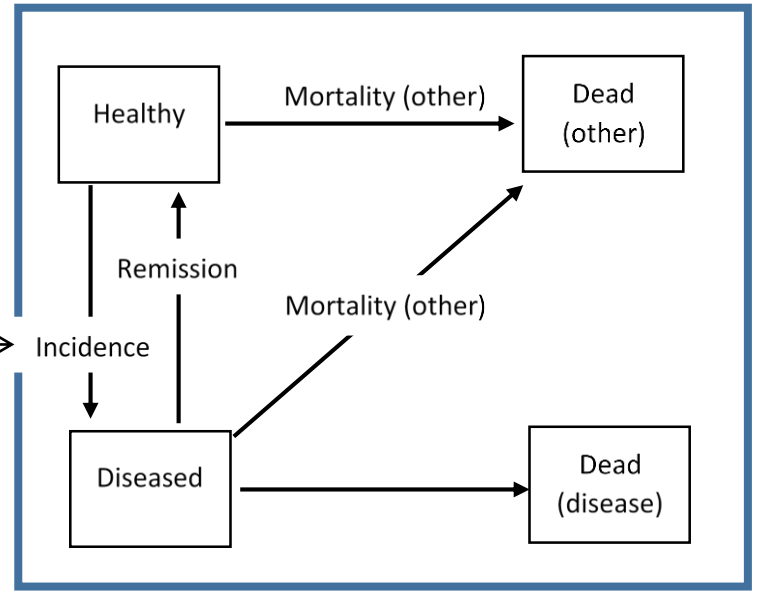
Function: disease life table

Age and sex

- PIF calculations will be the same as those used in the general ITHIM model
- The PIF is used to calculate a parallel population for which incidence of disease changes, therefore, prevalence (pYLDs) and case fatality (mortality).

	new incidence	remission	case fatality	Mortality (other)
1-PIF	**i'_x**	**r'_x**	**f'_x**	**m'_x**
0.9443225	0.053070	0	0.4875	0
0.9423417	0.055334	0	0.5008	0

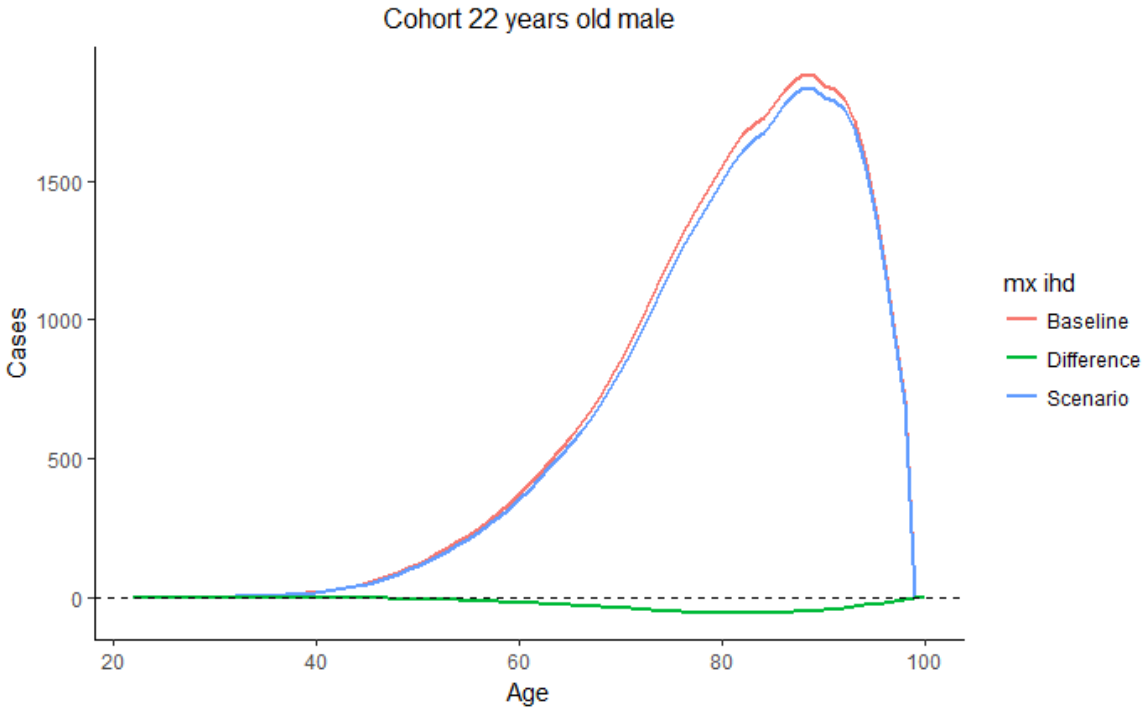


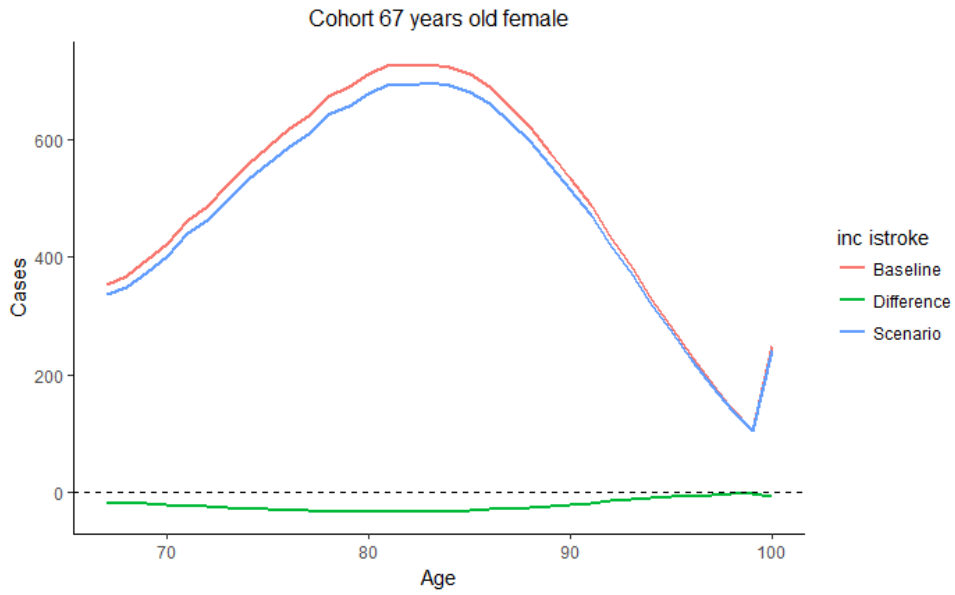


Δincid	Δprev	Δmort	ΔpYLD
			Δprev*DWdisease
-0.003129074	-0.00118042	-0.00063541	-0.00016169
-0.003385678	-0.00315244	-0.00162243	-0.00043182

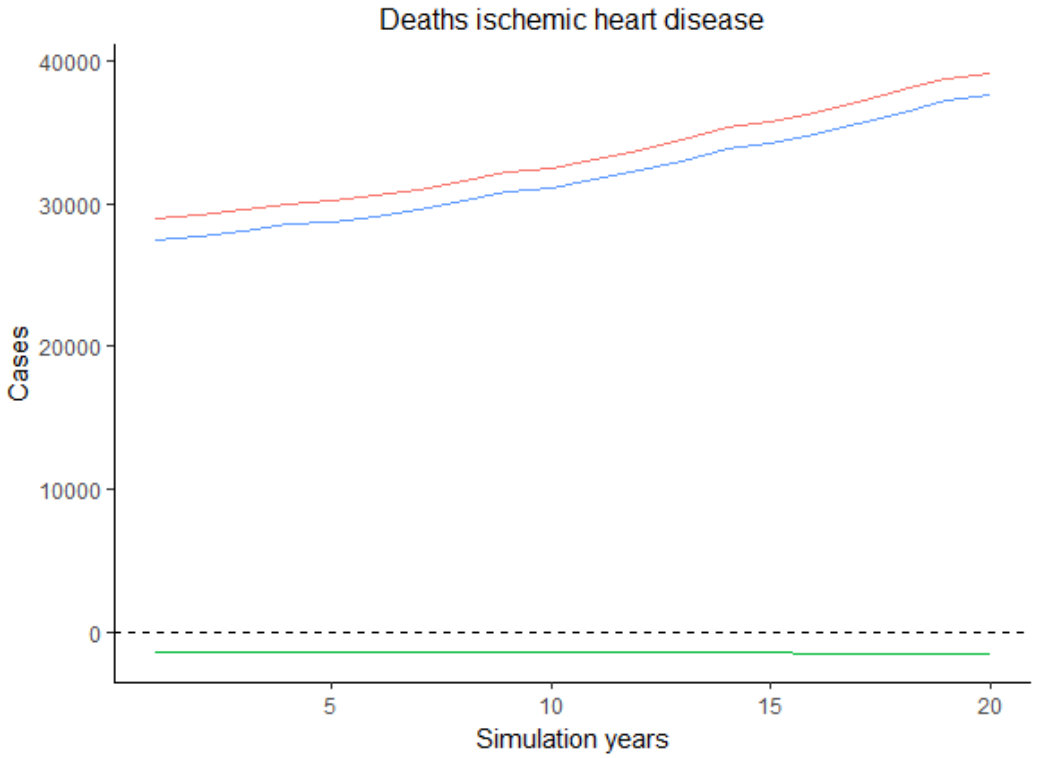
Calculations

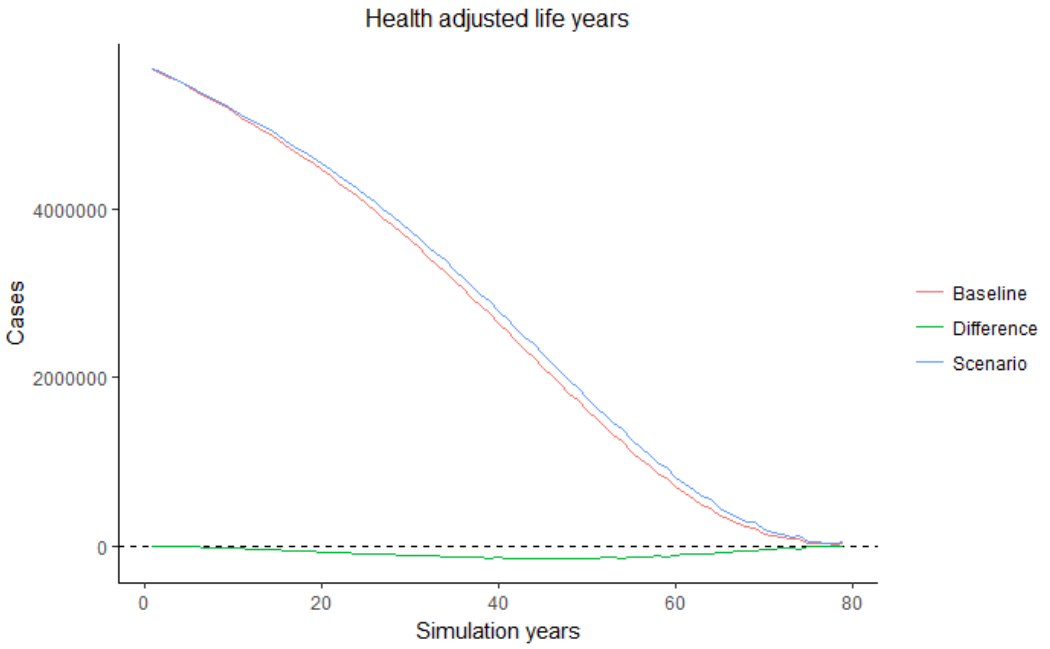
Function: output (plots)



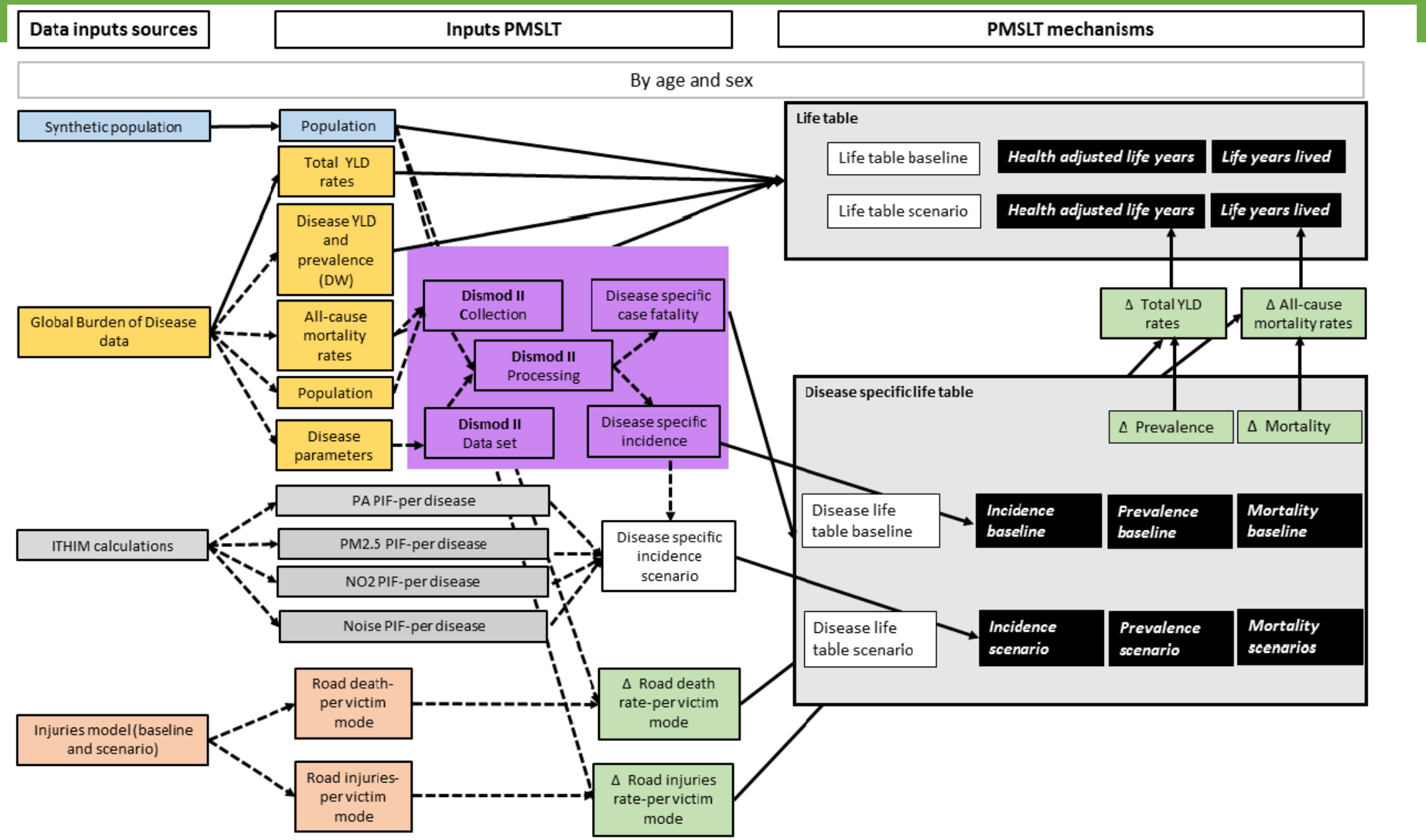


Function + script: output (aggregate outcomes)





PMSLT: Summary



PMSLT: Summary inputs

Table 1: PMSLT inputs

Input	Source	Comments
Life table	Synthetic population per sex and age group	Age grouping in life table to match synthetic population
Life table	Synthetic population per sex and one-year age group	If one year age group is not avabilable it can be derive using interpolation from age groups data
Life table	Global Burden of Disease (GBD) study per one-year age group and sex	GBD data is in five-year age groups, interpolation to derive one-year age groups
Disease life table	GBD data for prevalence, incidence and mortality and DISMOD II	Two step process. First obtain disease and population data from GBD. Second, use Dismod II to derive internally consistent estimates for incidence and case fatality (PMSLT disease life table iputs)
Disease life table	Derive from disease prevalence and years lived with disability from GBD	Adjustments for comorbidities in later years of life to be applied

Proportional multi-state life table model

Model assumptions:

- The incidence of a disease should be independent from all causes of death, except its own disease specific mortality
- Disease incidences are independent
- All causes of death are independent
- Markov type model: markovian assumption, current state occupancy is not related to occupancy in an earlier state.

Proportional multi-state life table model

Challenges

- Data inputs for disease life table: requires processing with Dismod II (or think of alternatives)
- Data intensity?
- More realistic more data needs (e.g. trends)

Discussion

- GBD data at the national level for most case studies. Use rates adjustments based on mortality rates.
- Dismod II, what can we do about it?