Modelling 2020 overall mortality by sex and age

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TAG Working Group I

July 23th, 2021

Data

- Sources for overall deaths:

Source	# of populations	Total # deaths	2020 Mean # of age-groups
WHO	13	6.6	19
STMF	27	4.6	18
Statistical bureaus	7	4.0	78
Eurostat	9	1.3	19
UN PD	11	0.5	20
Totals	67	6.6	25

- Criteria for selecting sources/year:
  - 2020 must be available
  - 2015-2019 when coming from the same source
  - prioritize source coherence with respect to longer periods
  - preference for more detailed age-groups
- Sources for the exposures: UN WPP (single year of age)
- Age-range: 0-100
- Sexes combined

Data

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- ~~Sexes combined~~ Including sex in the analysis

Model: general presentation

- For each population over age x, log-mortality patterns:

	< 2020	2020
Females	$\eta^{F1}(x)$	$\eta^{F2}(x)$
Males	$\eta^{M1}(x)$	$\eta^{M2}(x)$

- In general log-mortality in 2020 is modelled as follows

$$\eta^2(x) = \eta^1(x) + c + \delta(x)$$

  - c scaling factor
  - $\delta(x)$ age-dependent adjustment component ($\sum \delta(x) = 0$)

- Both $\eta^1(x)$ and $\delta(x)$ are assumed to be smooth

- We might assume males log-mortality as additive function of females log-mortality:

$$\eta^M(x) = \eta^F(x) + s(x)$$

- Also $s(x)$ is assumed to be smooth

Model: including sex

- We can include sex using different options:
  - Sex-independent estimation [*Stratified*]

$$\begin{cases} \eta^{F2}(x) &= \eta^{F1}(x) + c^F + \delta^F(x) \\ \eta^{M2}(x) &= \eta^{M1}(x) + c^M + \delta^M(x) \end{cases}$$

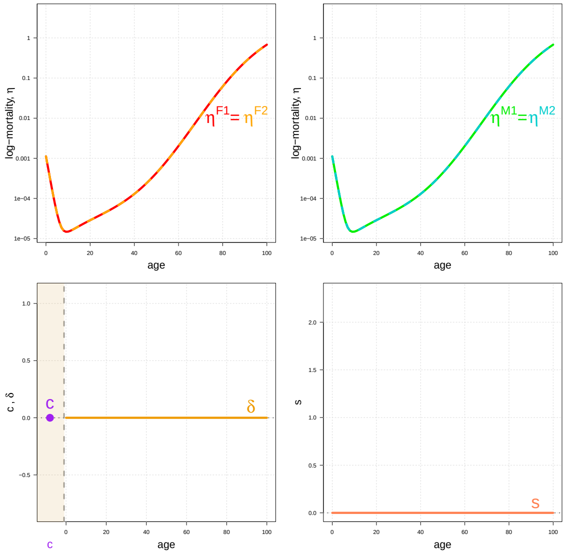
  - Common 2020-factors + sex age-factor [*Common*]

$$\begin{cases} \eta^{F2}(x) &= \eta^{F1}(x) + c + \delta(x) \\ \eta^{M2}(x) &= \eta^{M1}(x) + c + \delta(x) \\ \eta^{M1}(x) &= \eta^{F1}(x) + s(x) \end{cases}$$

  - Sex-specific 2020-factors + sex age-factor [*Saturated*]

$$\begin{cases} \eta^{F2}(x) &= \eta^{F1}(x) + c^F + \delta^F(x) \\ \eta^{M2}(x) &= \eta^{M1}(x) + c^M + \delta^M(x) \\ \eta^{M1}(x) &= \eta^{F1}(x) + s(x) \end{cases}$$

A schematic illustration: model *Common*



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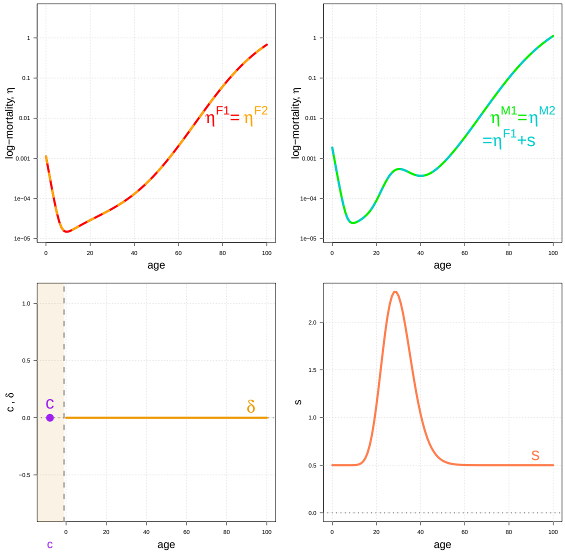

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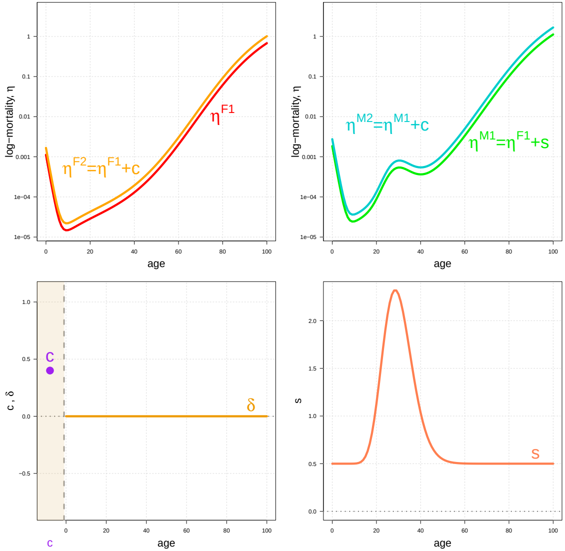

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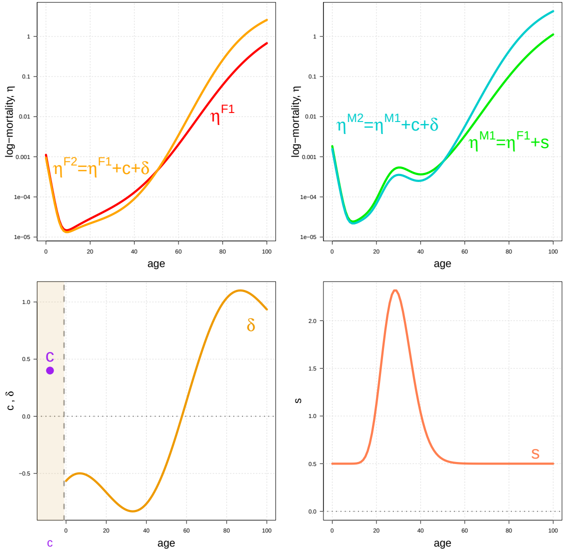
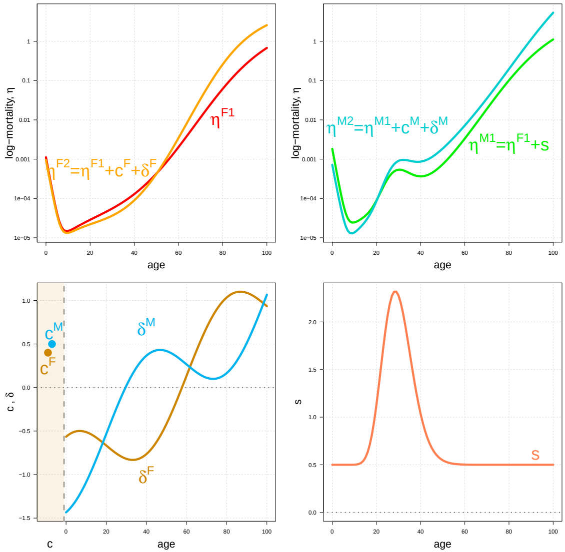
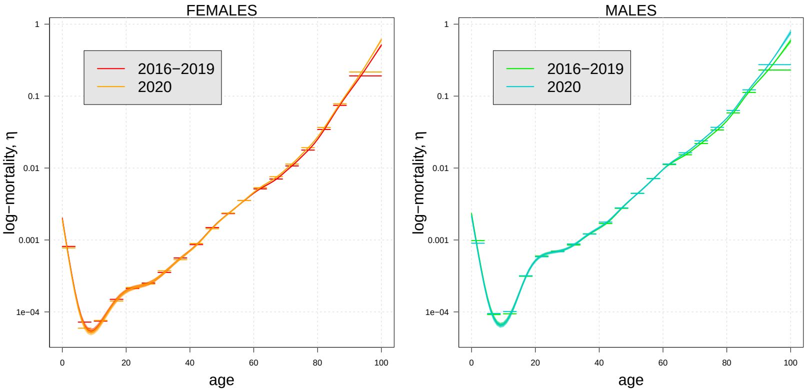


A schematic illustration: model *Saturated*



Actual data illustration 1: France (different scaling factor)



Fitted log-mortality from *Stratified* model

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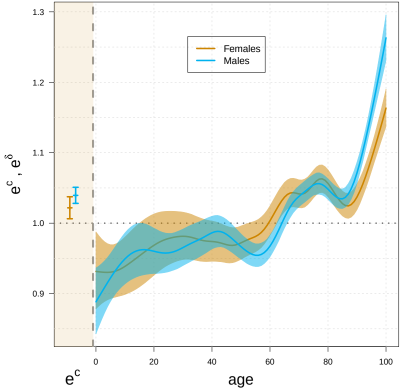

Parameters from *Stratified* model

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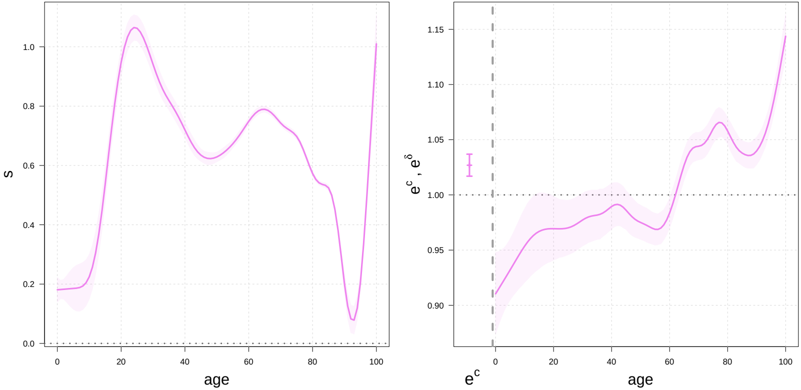

Parameters from *Common* model

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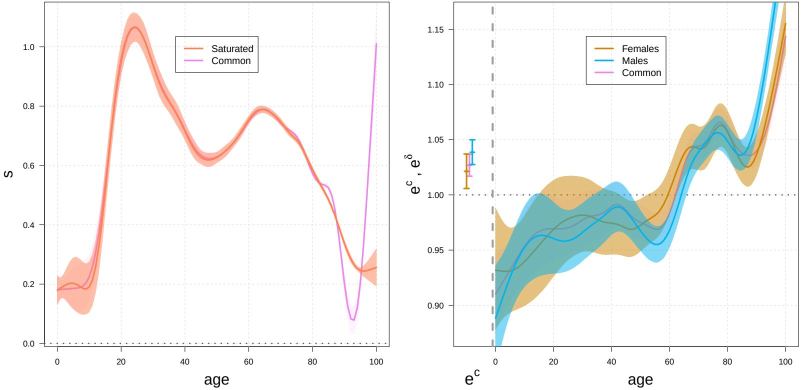
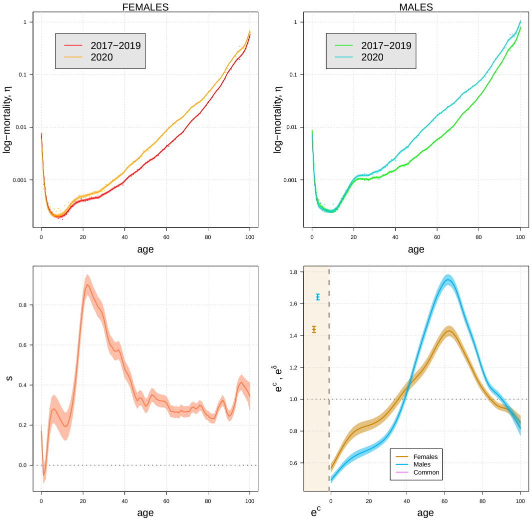


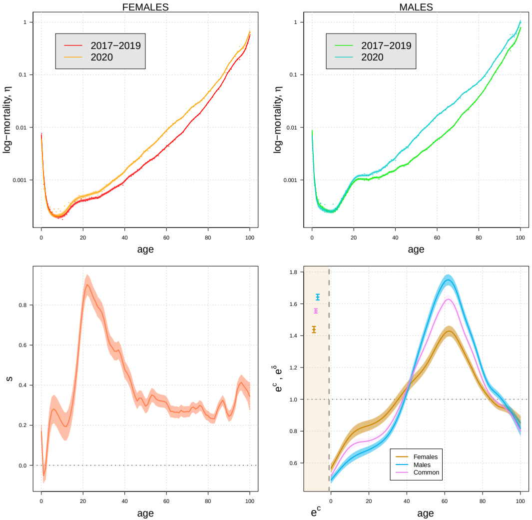
Parameters from *Common* and *Saturated* model

Actual data illustration 2: Peru (middle-age hump)



Fitted log-mortality and parameters from *Saturated* model

Actual data illustration 2: Peru (middle-age hump)



Fitted log-mortality and parameters from *Saturated* model. $\delta(x)$ and c parameters from the *Common* are plotted along

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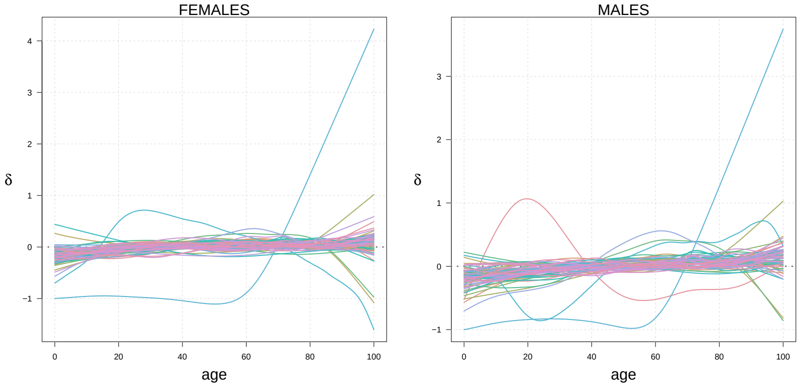
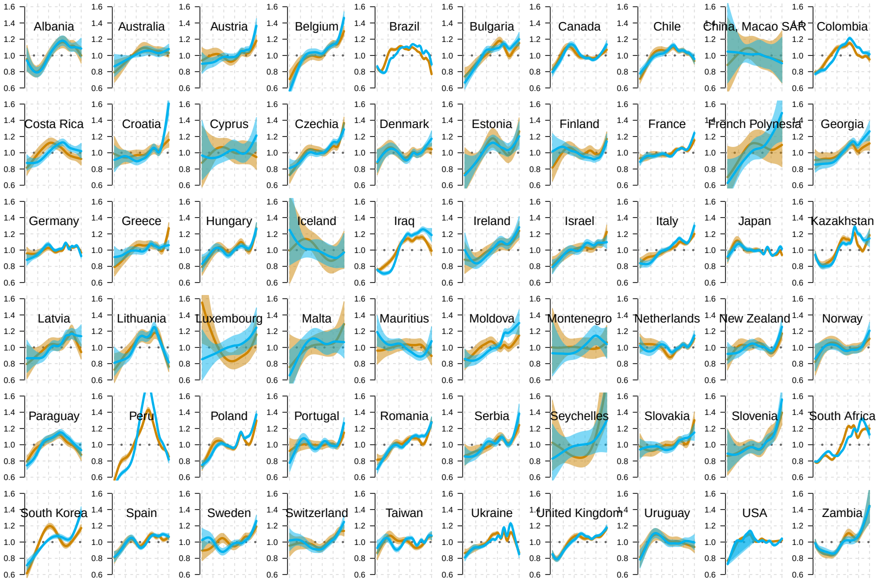


$\delta(x)$ from *Saturated* model by sex

Sex-specific age-dependent component $e^{\delta(x)}$



Sex age-factor $s(x)$