Comparing approaches in modelling 2020 overall mortality by sex and age

Carlo Giovanni Camarda
Tim Riffe
Enrique Acosta

TAG Working Group I

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Data and aim

- Death and exposures by
  - five years age-group: 0-4, 5-9, ..., 85+
  - females and males separately
- 2019 data source (baseline):
  - Mortality and Global Health Estimates (GHE)
  - Data available for all 194 populations
- 2020 data sources:
  - ???
  - Data available for only 60 populations
- Information provided by William et al.
  - Overall excess deaths in 2020 for all populations
  - 8 clusters for all populations, based on external information

AIM

Estimate 2020 mortality by age and sex for pop. with no data

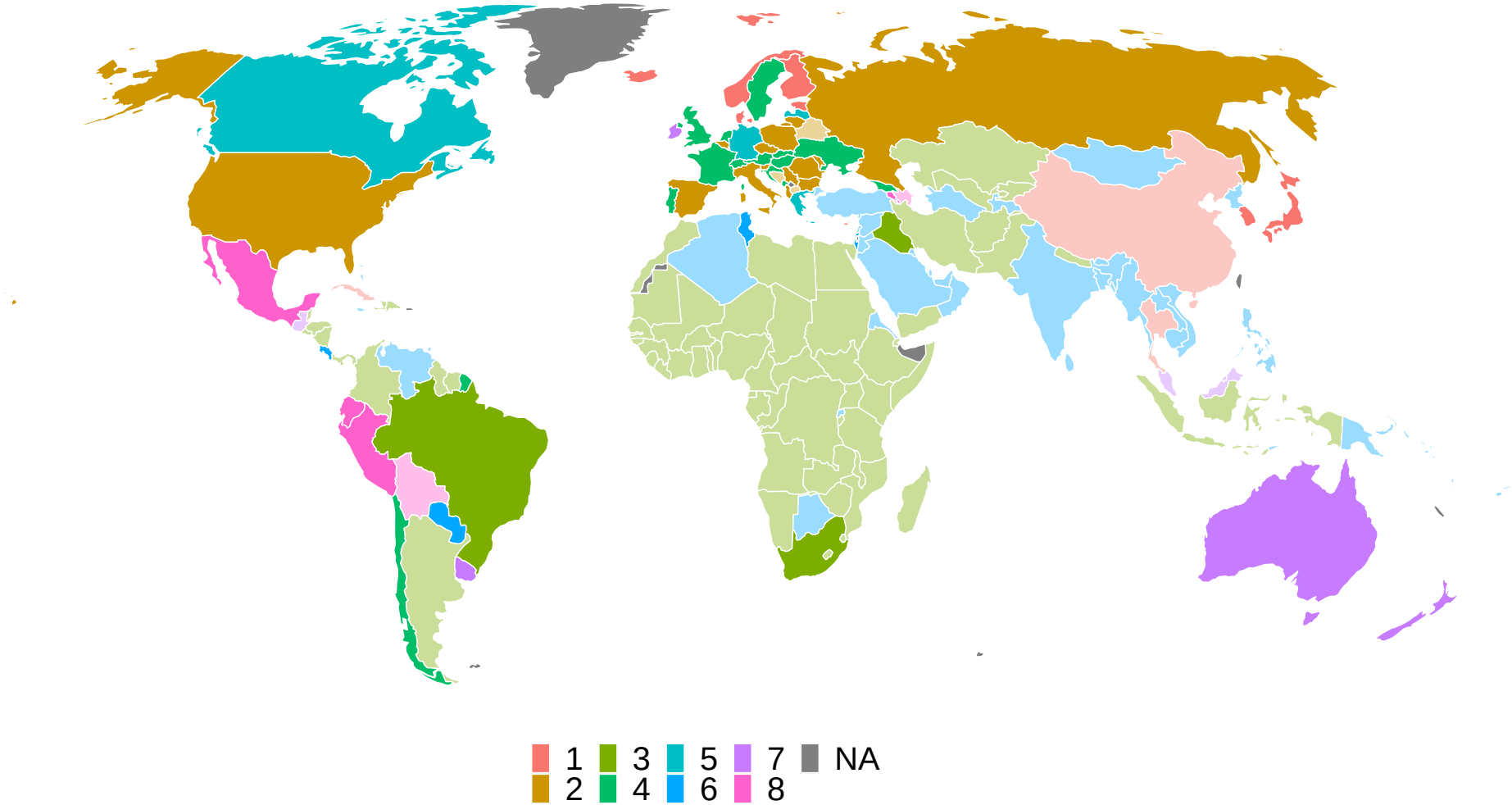
The two approaches

- William's approach:
  1. empirical ratio between mortality in 2019 and 2020 for population with both information
  2. group of these ratios based on mentioned clusters
  3. creation of a smooth cluster-specific distribution of ratios
  4. extract random ratio and apply it to 2019 mortality for population with no information in 2020
- Spin-off (our) approach:
  1. for a given population with both information within a cluster k:

$$\eta^{2020}(x) = \eta^{2019}(x) + c + \delta^k(x)$$

     with $\eta(x)$ and $\delta^k(x)$ assumed to be smooth and $\sum \delta^k(x) = 0$
  2. apply cluster-specific age-factor $\delta^k(x)$ to population with no information in 2020
  3. (uncertainty still to be included)
- Final common step: redistribution of estimated 2020 deaths to match "known" overall excess mortality deaths

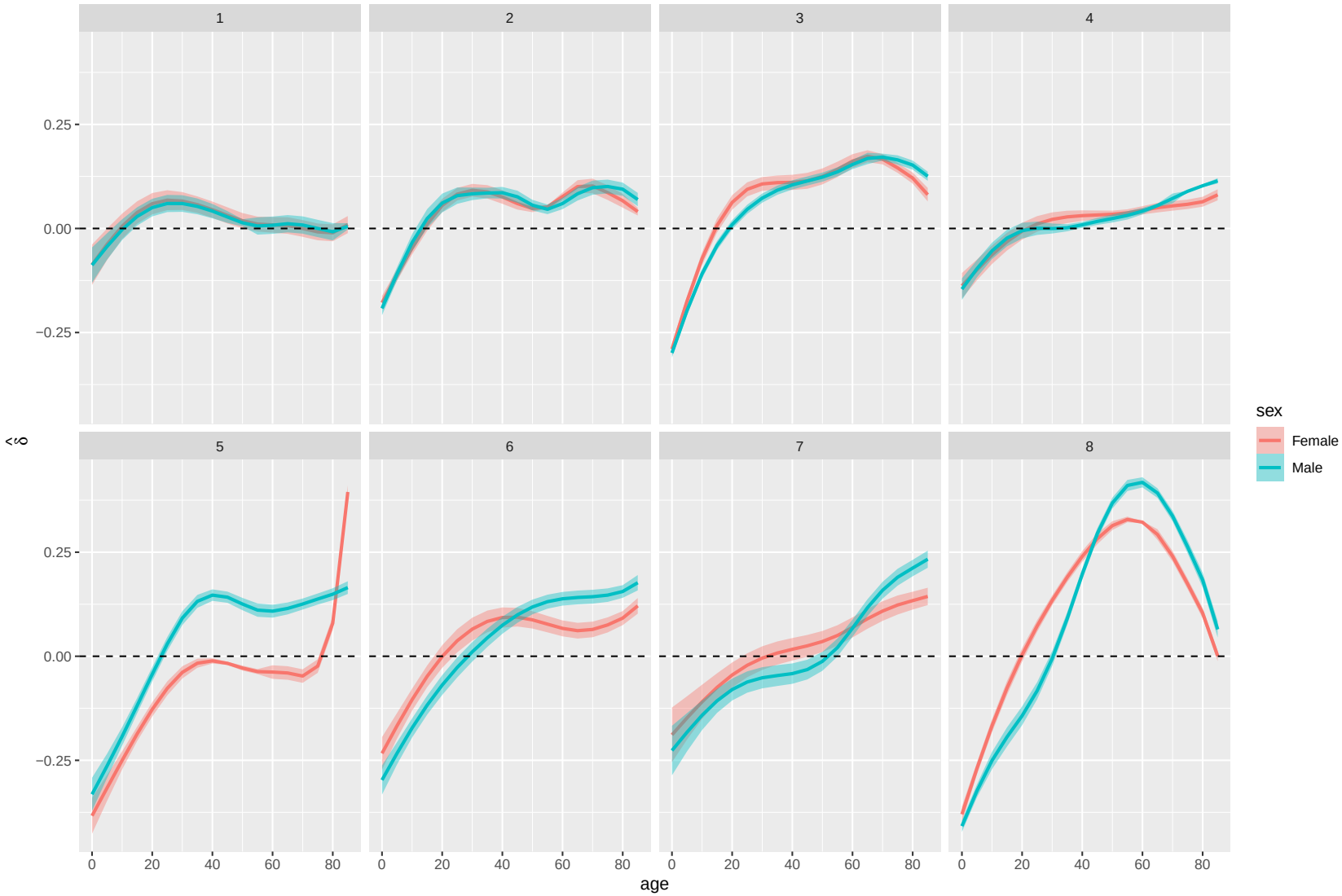
Clusters



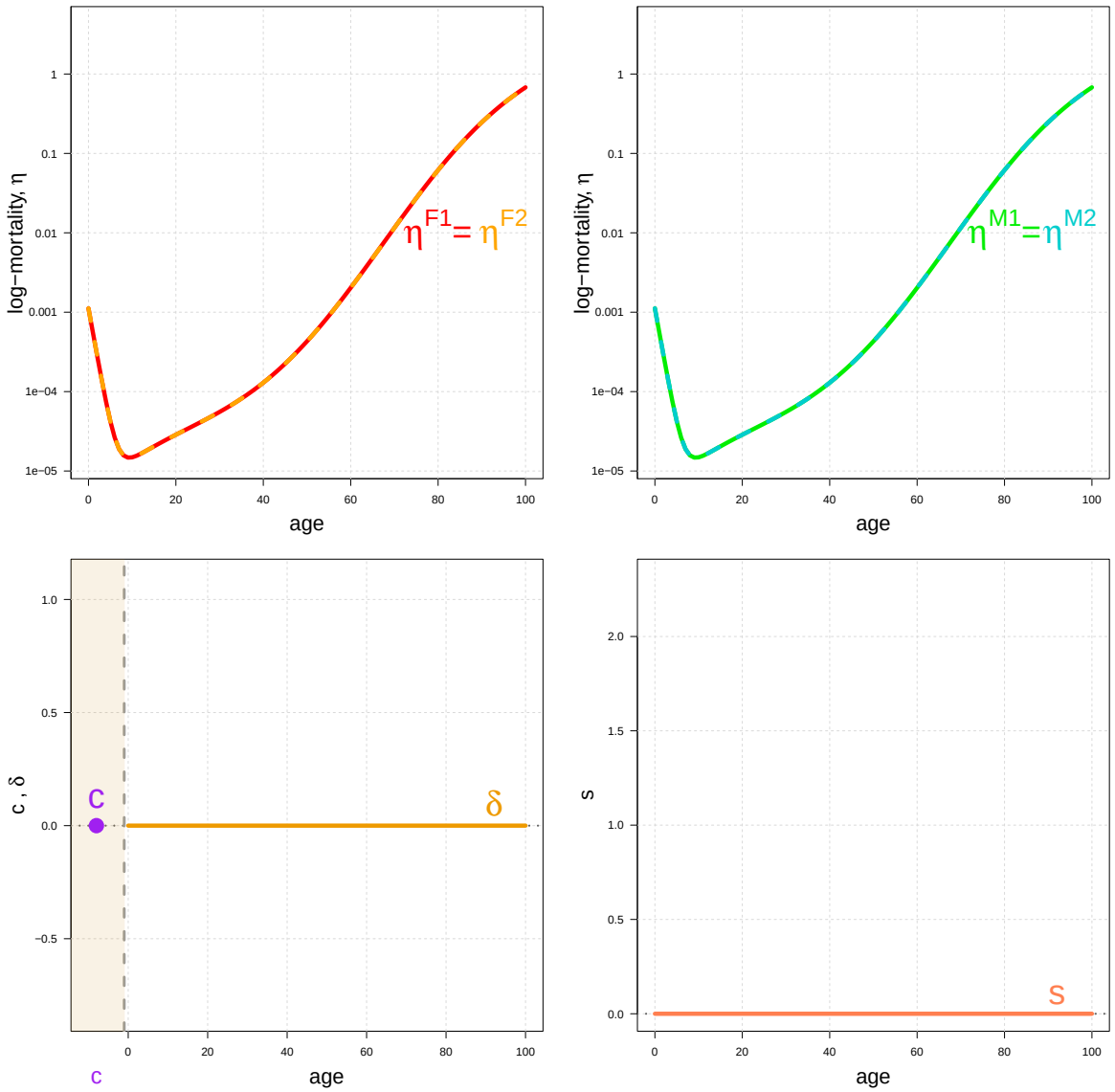
Clusters

Cluster	pop w/ data	# pop w/ data	# pop w/o data	# w/o data / # w/data
1	CYP,DNK,EST,FIN,ISL, JPN,KOR,LUX,NOR	9	4	0.44
2	ALB,AND,BEL,BGR,CZE, ESP,ITA,LTU,MDA,POL,ROU, RUS,SRB,SVN,USA	15	4	0.27
3	BRA,IRQ,ZAF,COL	4	65	16.25
4	AUT,CHE,CHL,FRA,GBR, GEO,HRV,HUN,MNE,NLD, PRT,SVK,SWE,UKR	14	0	0.00
5	CAN,DEU,GRC,LVA,MLT	5	1	0.20
6	CRI,ISR,PRY,TUN	4	51	12.75
7	AUS,IRL,MUS,NZL,URY	5	7	1.40
8	ARM,ECU,MEX,PER	4	2	0.50
Totals		60	134	2.23

Cluster-specific $\delta(x)$



A schematic illustration: model *Common*



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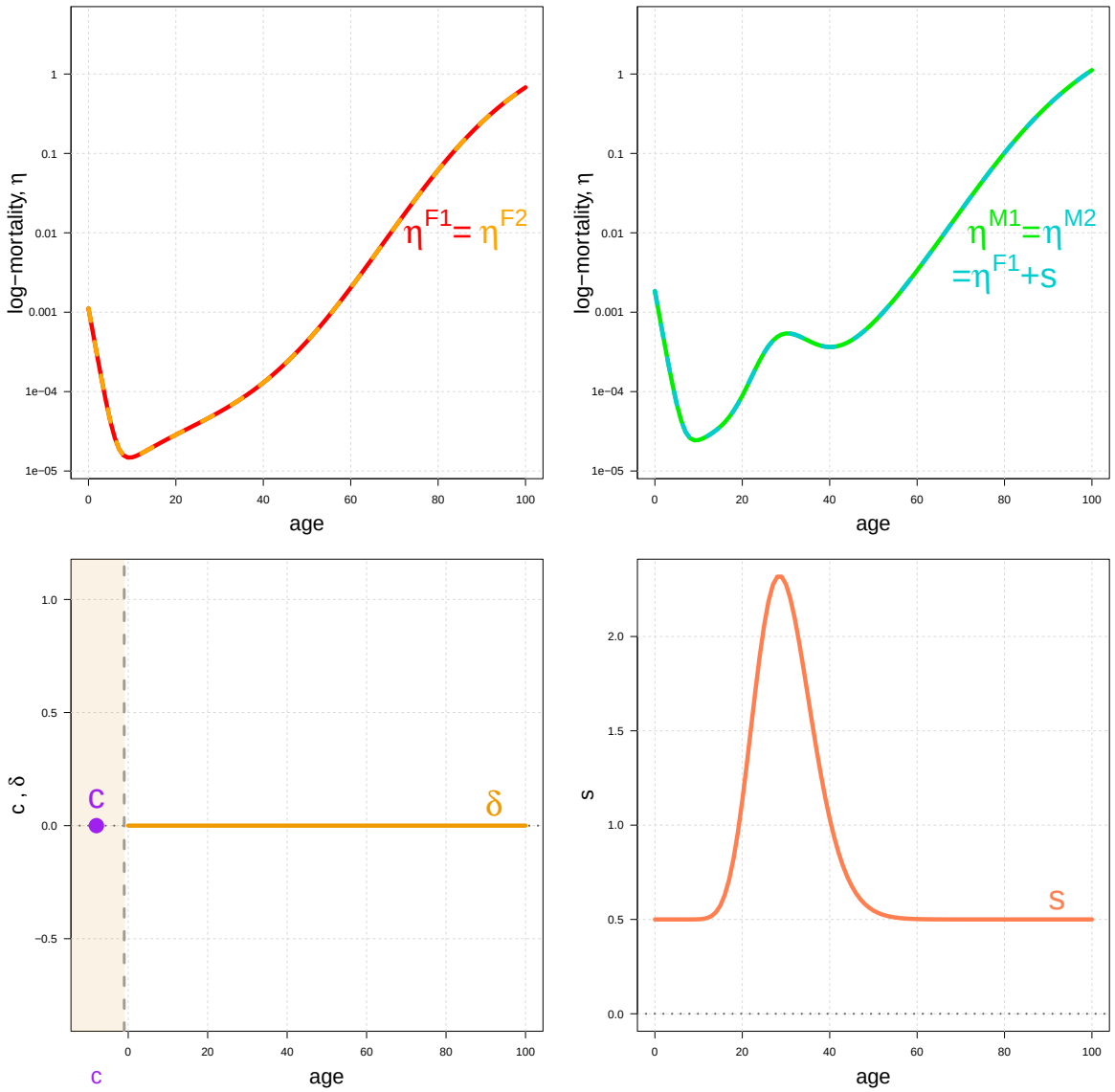

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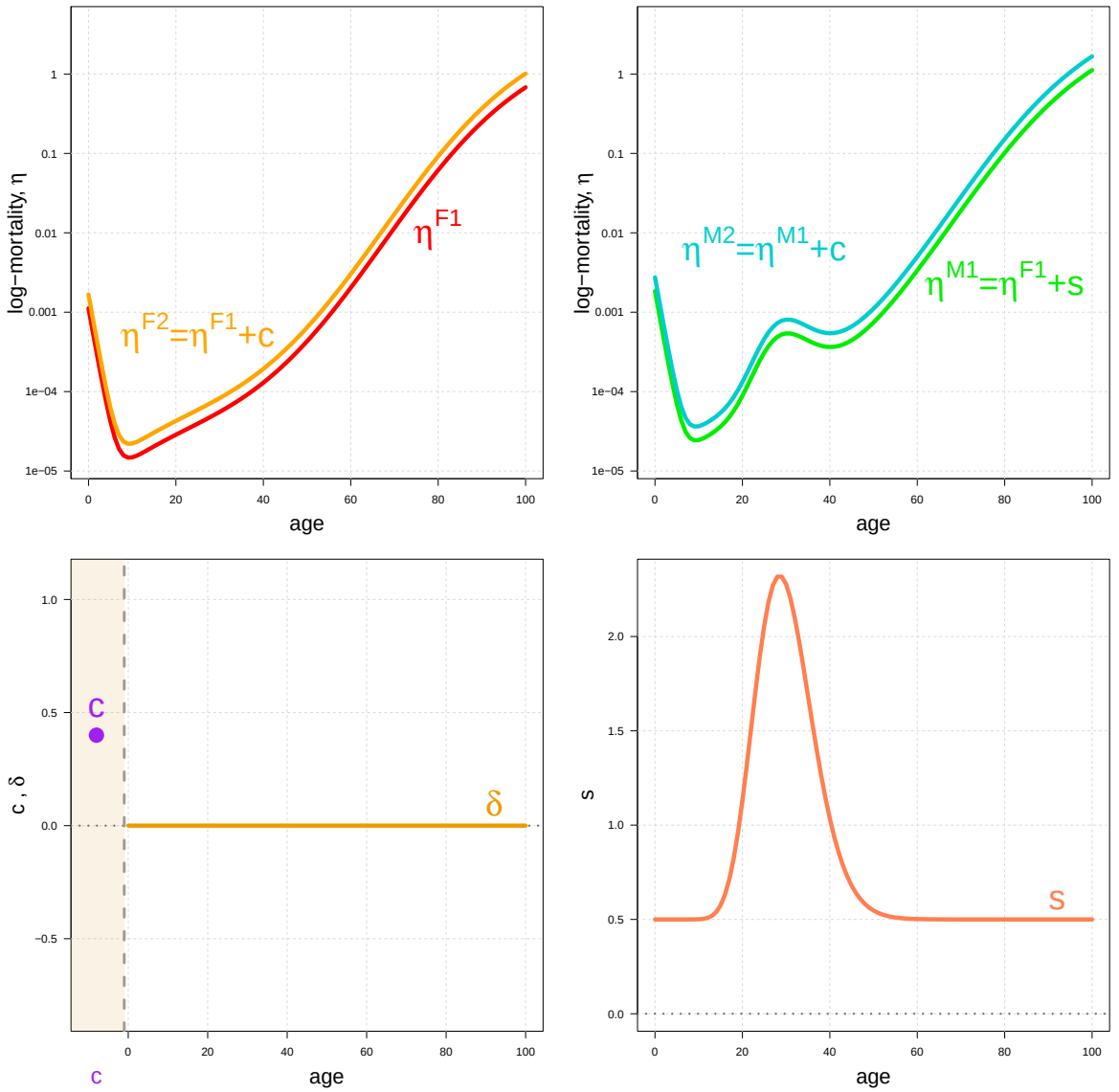
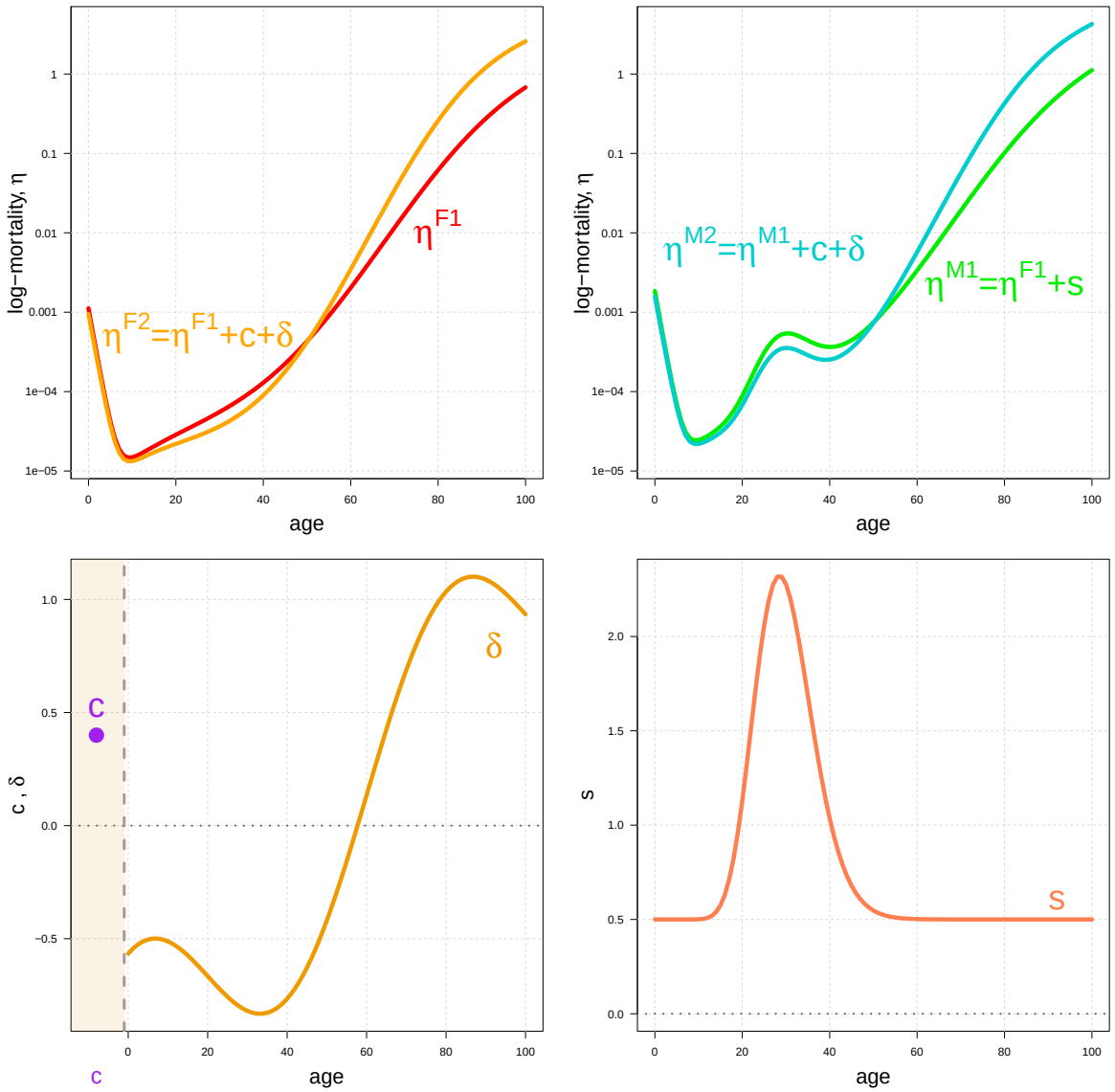
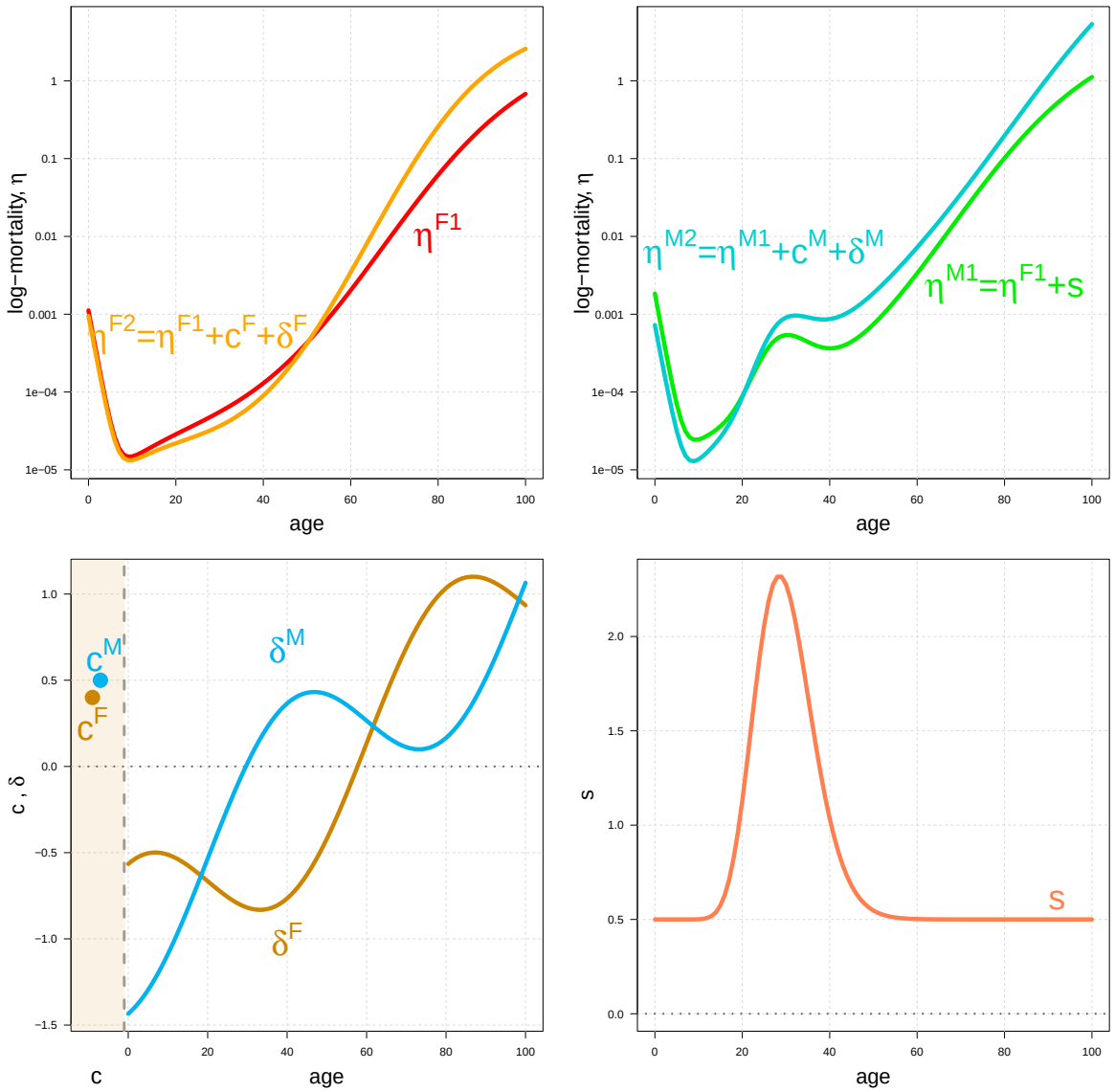


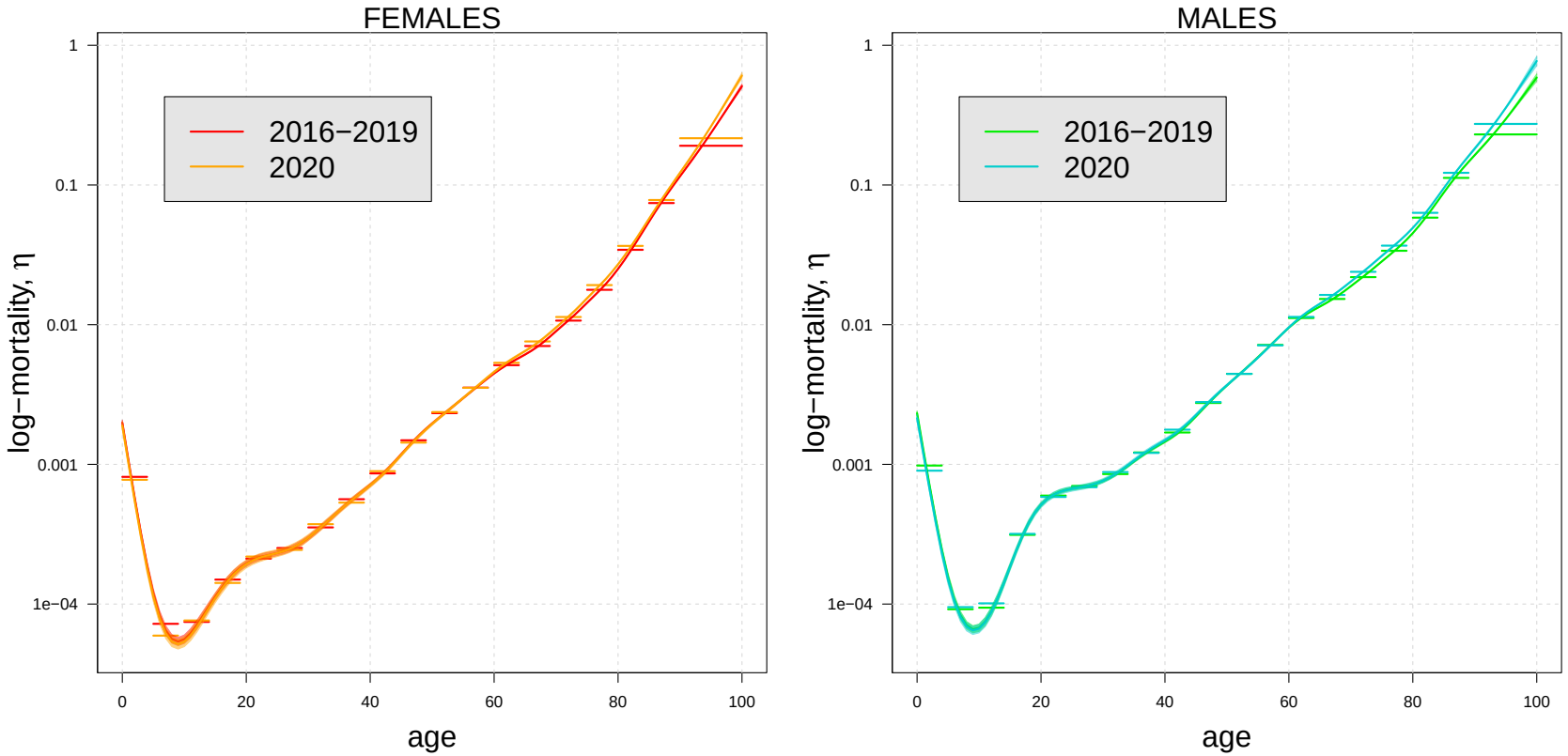
A schematic illustration: model *Common*



A schematic illustration: model *Saturated*

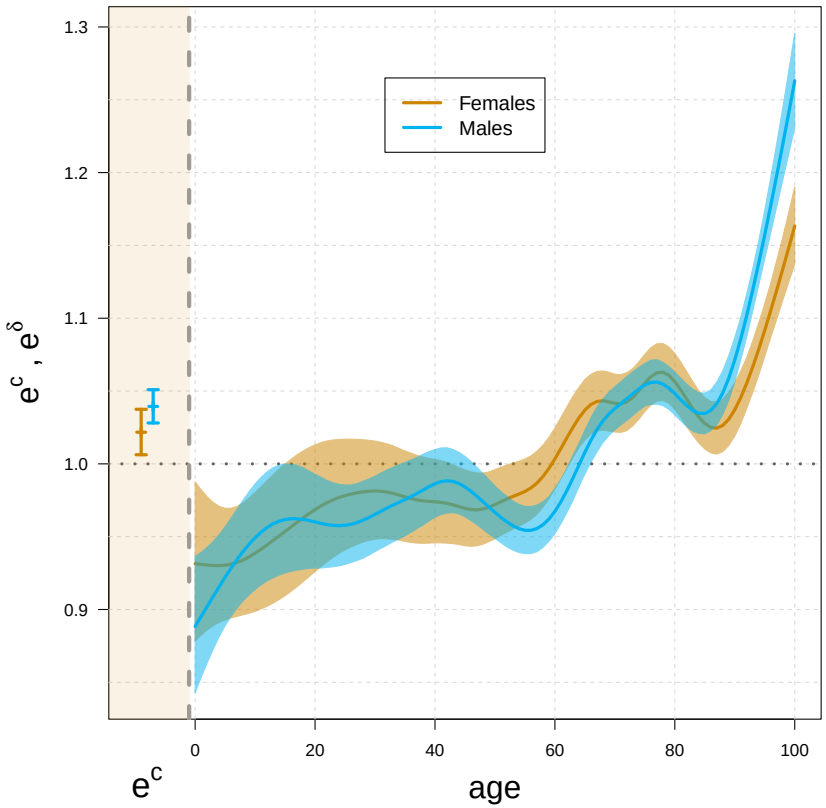


Actual data illustration 1: France (different scaling factor)



Fitted log-mortality from *Stratified* model

Actual data illustration 1: France (different scaling factor)



Parameters from *Stratified* model

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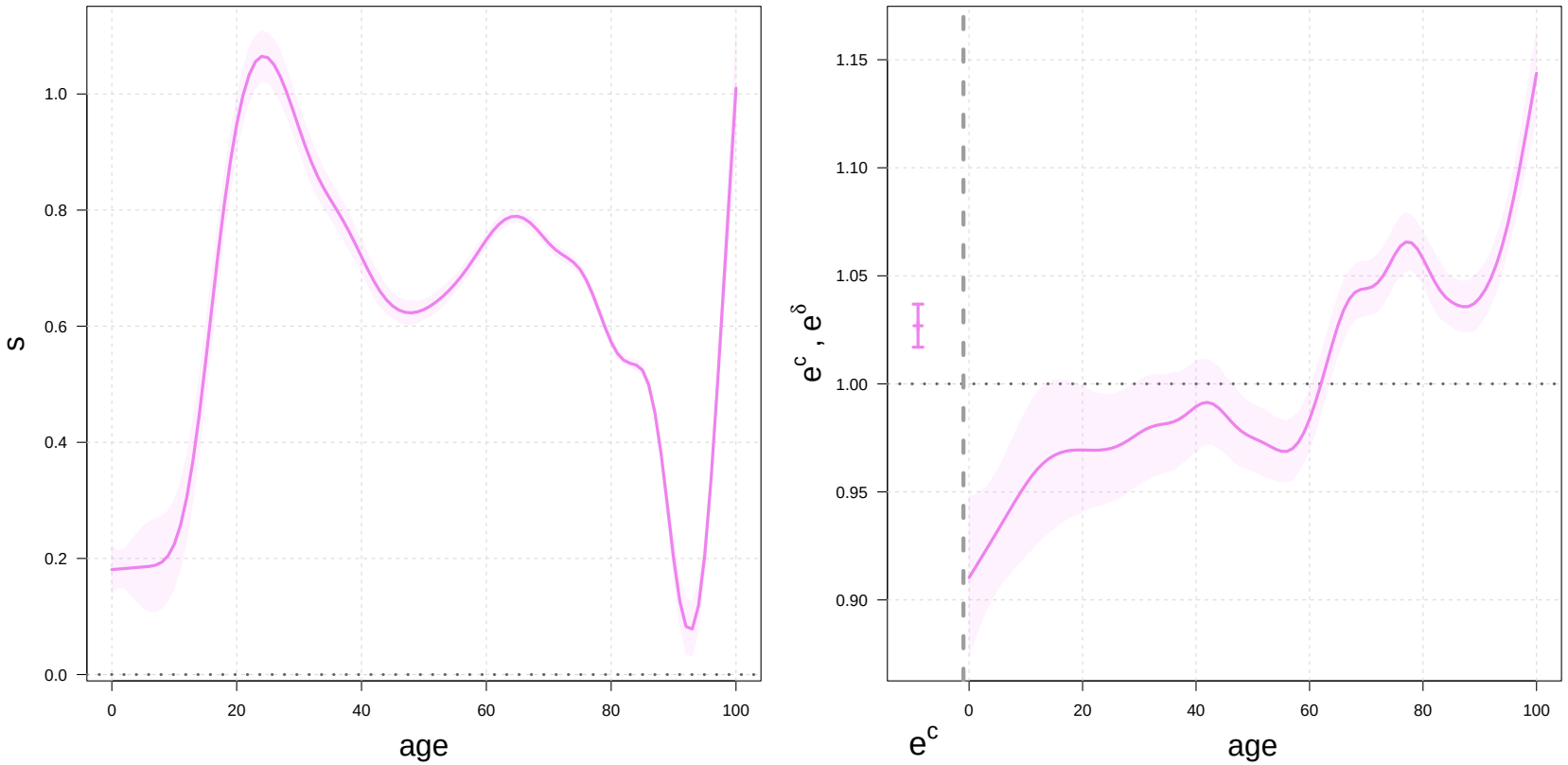

Parameters from *Common* model

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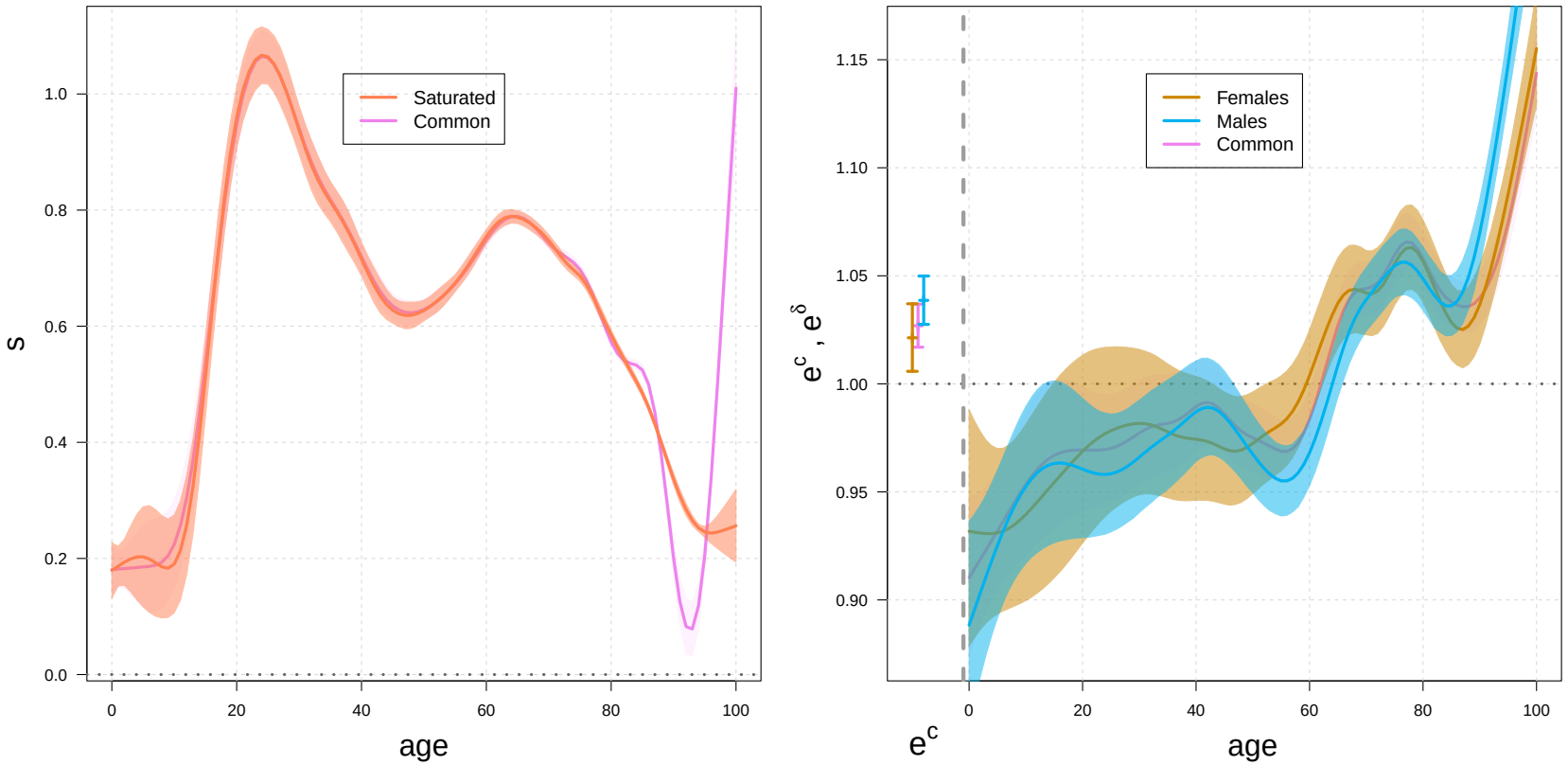
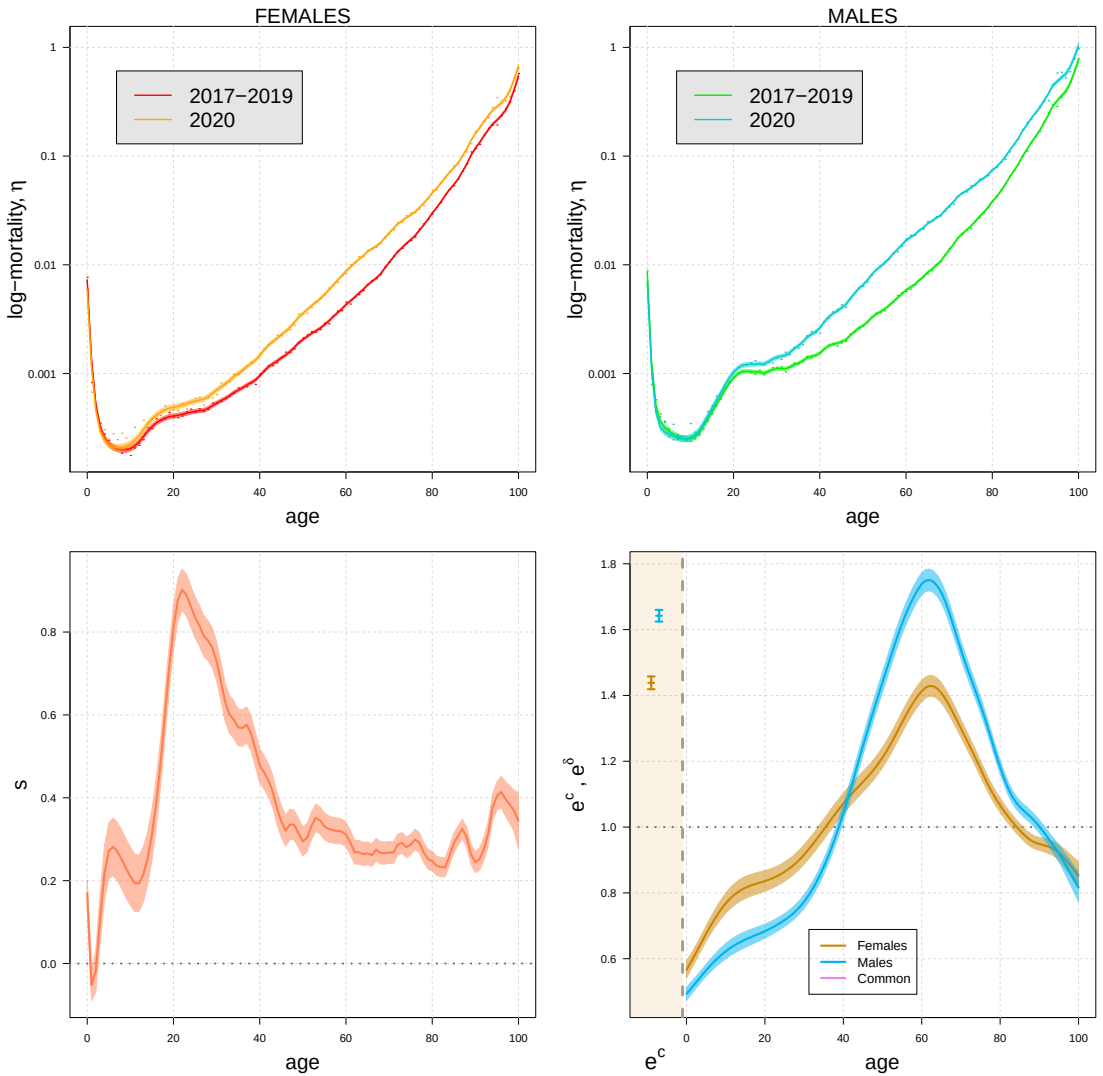


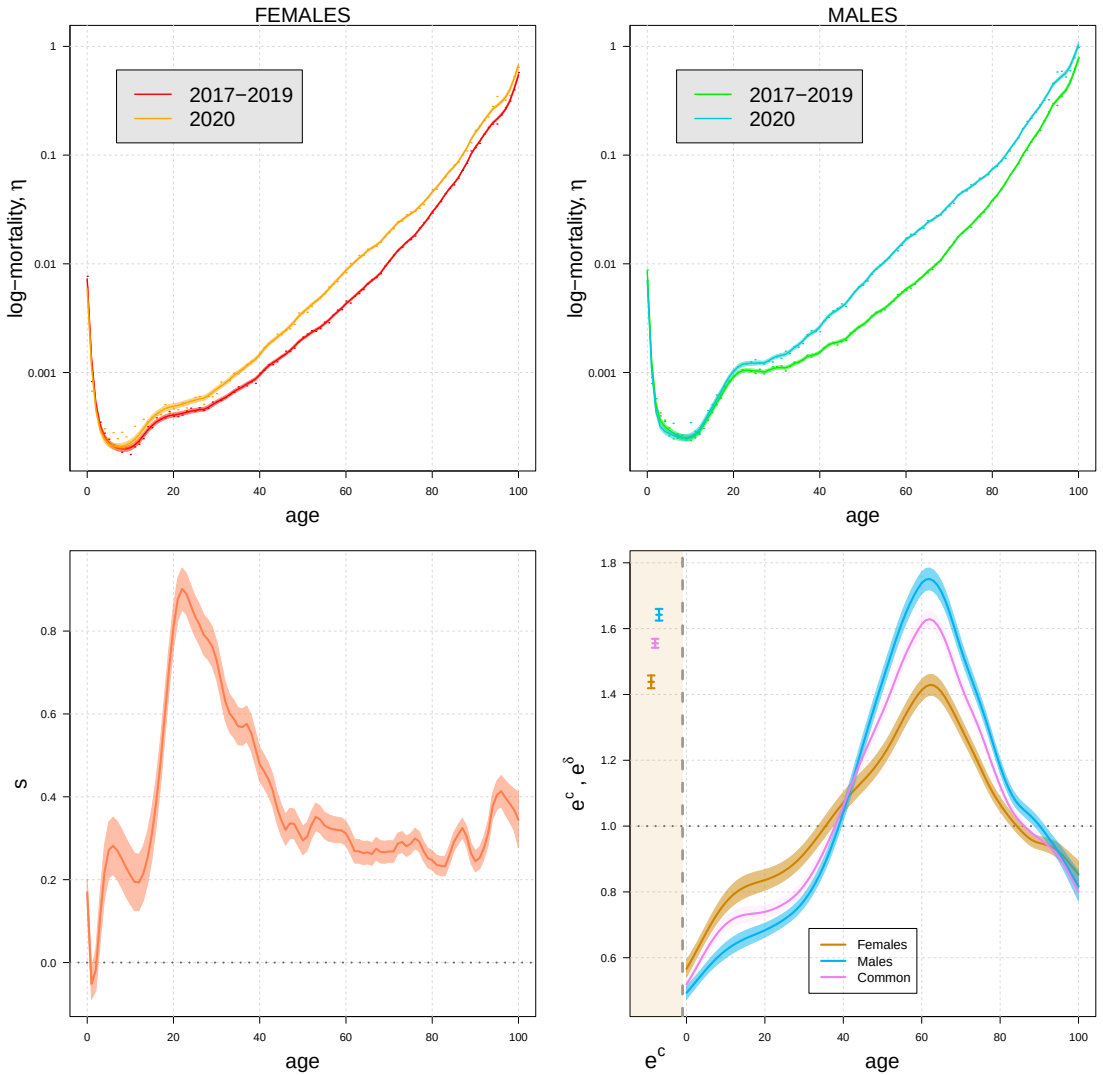
Parameters from *Common* and *Saturated* model

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



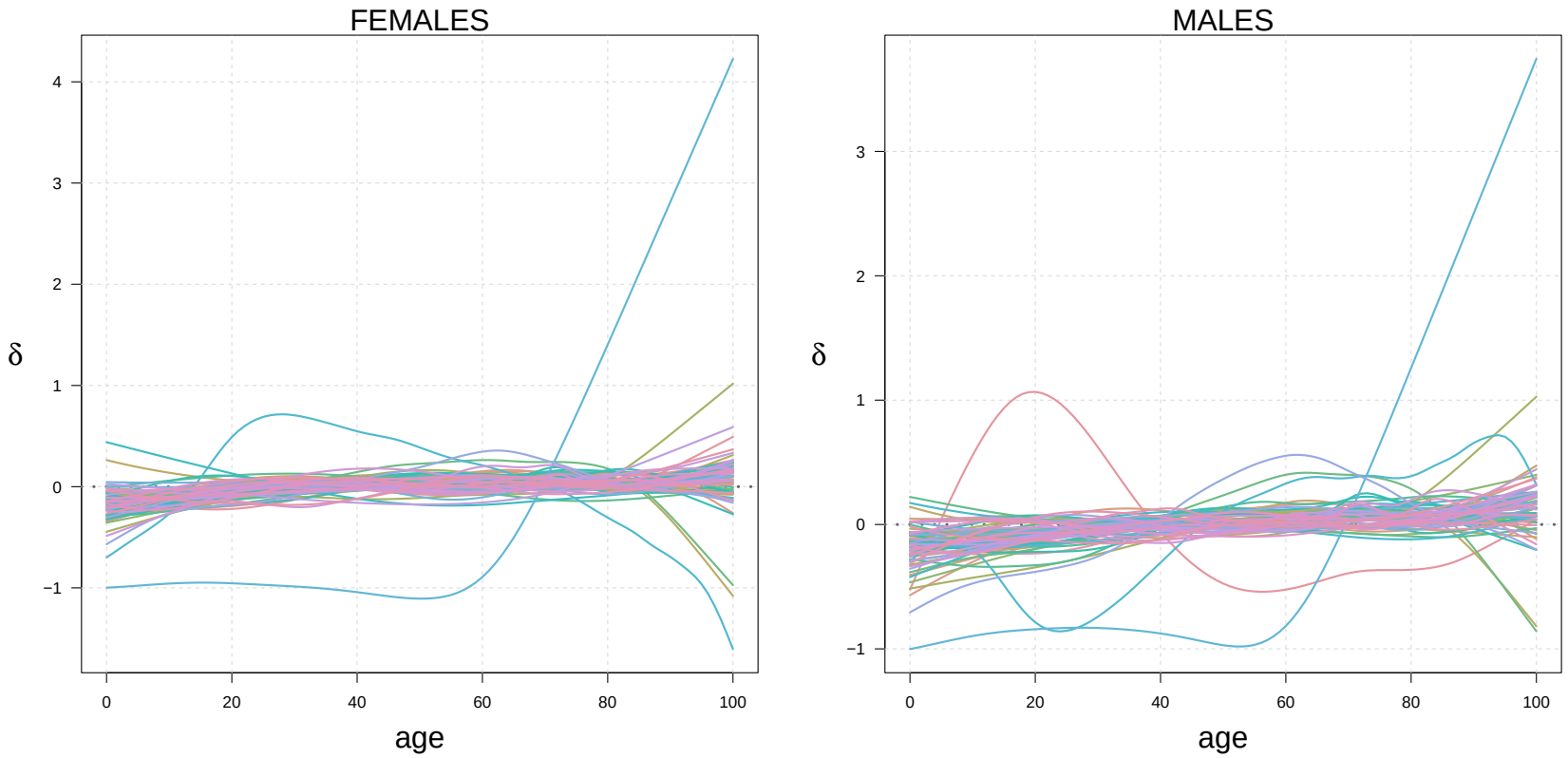
Fitted log-mortality and parameters from *Saturated* model

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



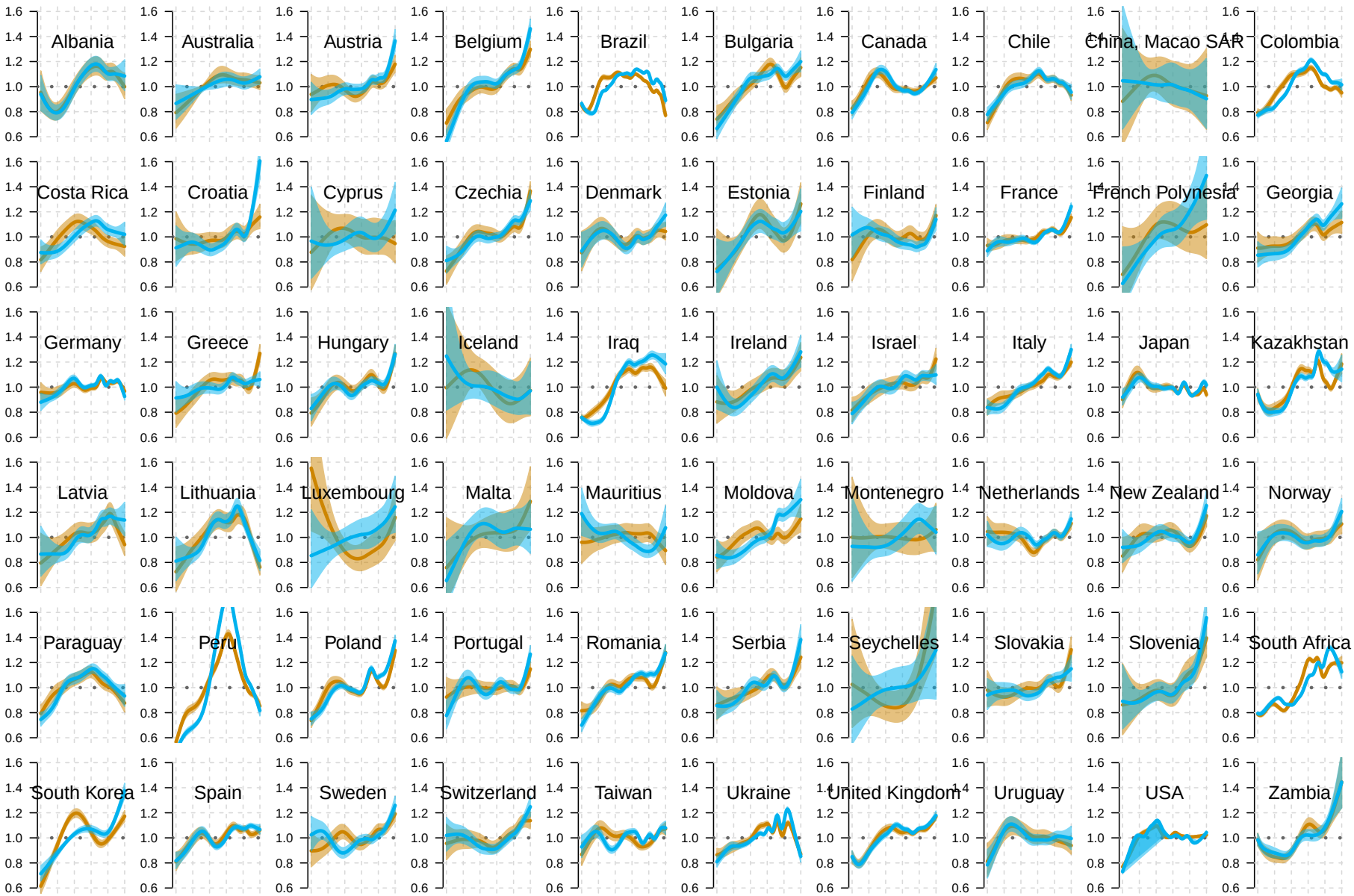
Fitted log-mortality and parameters from *Saturated* model. $\delta(x)$ and c parameters from the *Common* are plotted along

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



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

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



Sex age-factor $s(x)$