MONASH University

MONASH BUSINESS SCHOOL

Forecasting the age structure of the scientific workforce in Australia

Rob J Hyndman & Kelly Nguyen

2 December 2025

Australian Academy of Science

Labour force model

$$P_{i,x+1,t+1} = P_{i,x,t} - D_{i,x,t} - R_{i,x,t} + G_{i,x,t} + E_{i,x,t}$$

i = Discipline x = Age t = Year

$P_{i,x,t}$ = number of equivalent full-time workers

$D_{i,x,t}$ = number of deaths $\sim$ Binomial$(P_{i,x,t}, q_{x,t})$

$R_{i,x,t}$ = number of retirements $\sim$ Binomial$(P_{i,x,t} - D_{i,x,t}, r_x)$

$G_{i,x,t} = g_x G_{i,t}$ = number of graduates who work in discipline i

$E_{i,x,t}$ = other changes (career changes, migration, etc.)

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Simulate future sample paths of $P_{i,x,t}$ by simulating future $q_{x,t}$, $D_{i,x,t}$, $R_{i,x,t}$, $G_{i,t}$ and $E_{i,x,t}$

Working population: $P_{i,x,t}$

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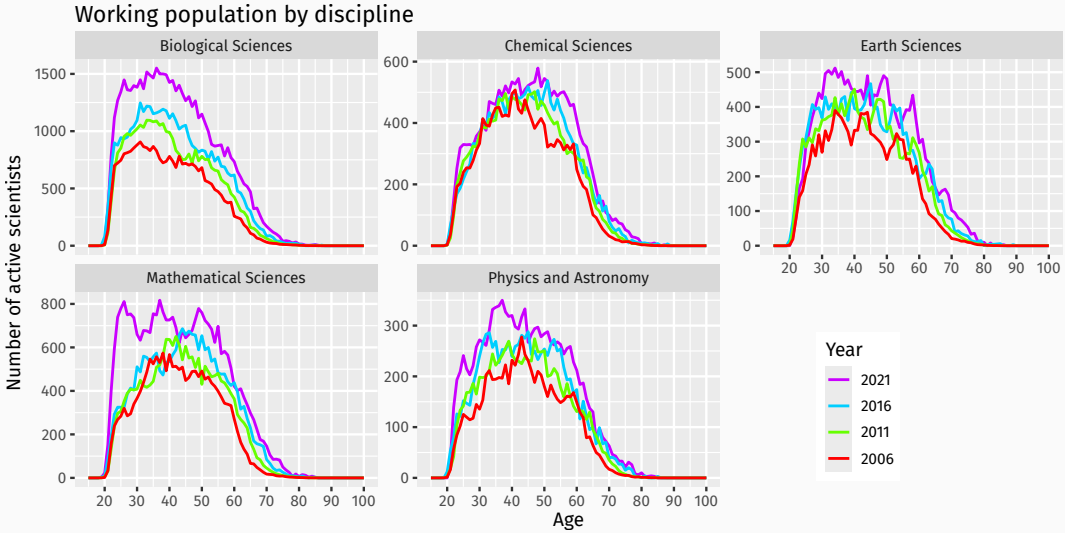

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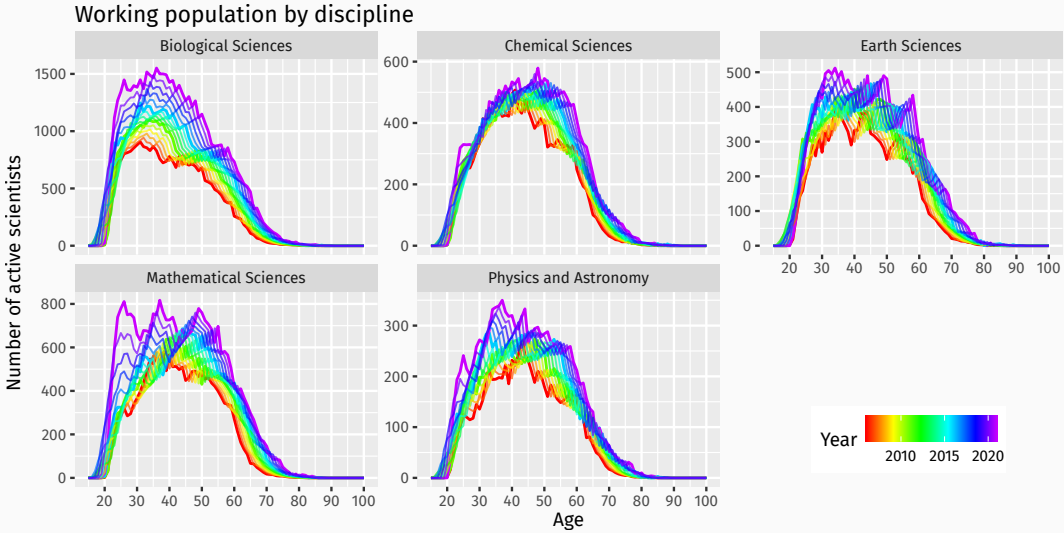

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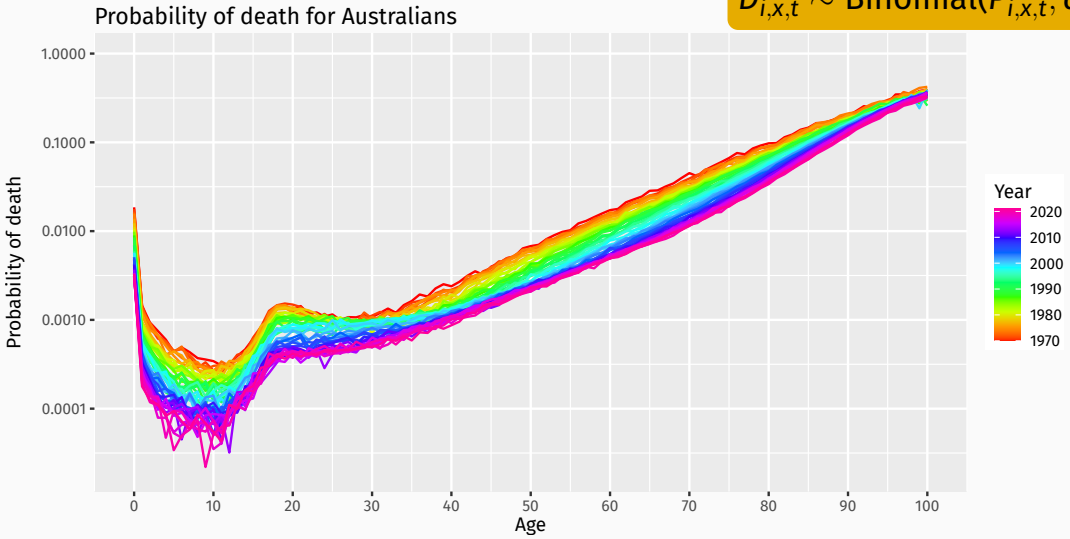

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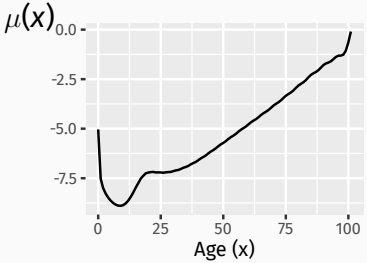
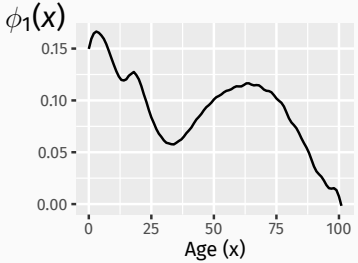
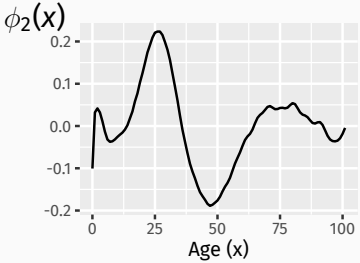
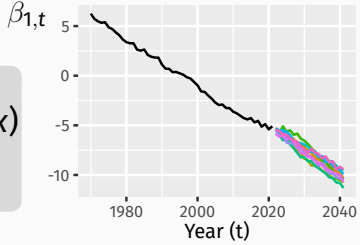


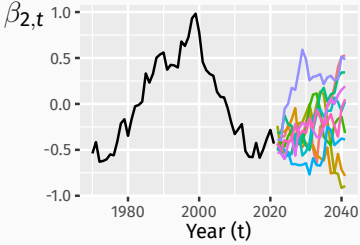




$$q_{x,t} = \mu(x) + \sum_{k=1}^{6} \beta_{k,t}\phi_k(x) + \varepsilon_t(x)$$

$$\beta_{k,t} \sim \text{ARIMA}$$





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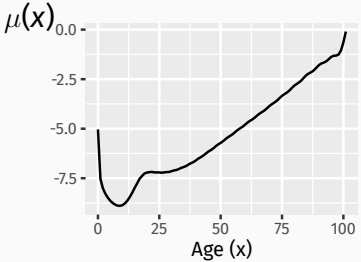

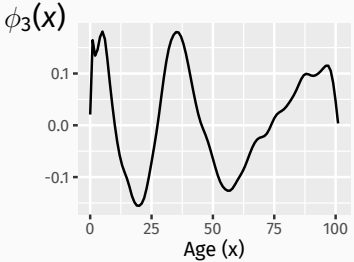

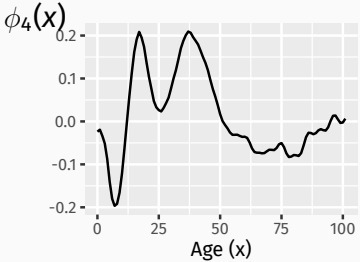

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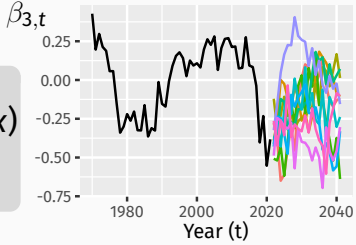

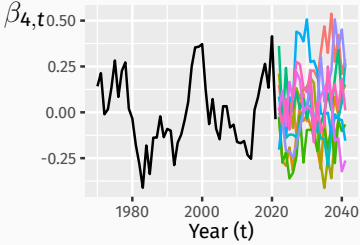

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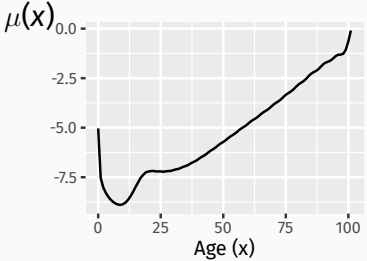

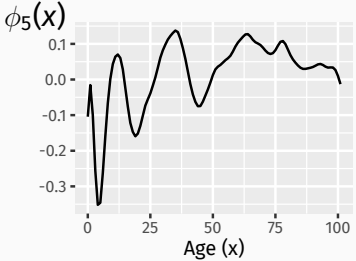

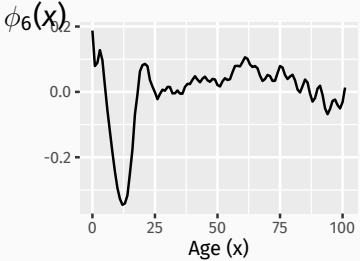

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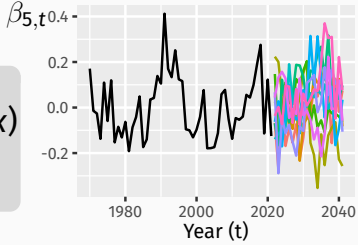

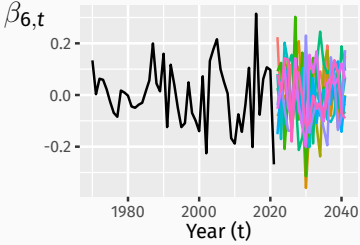

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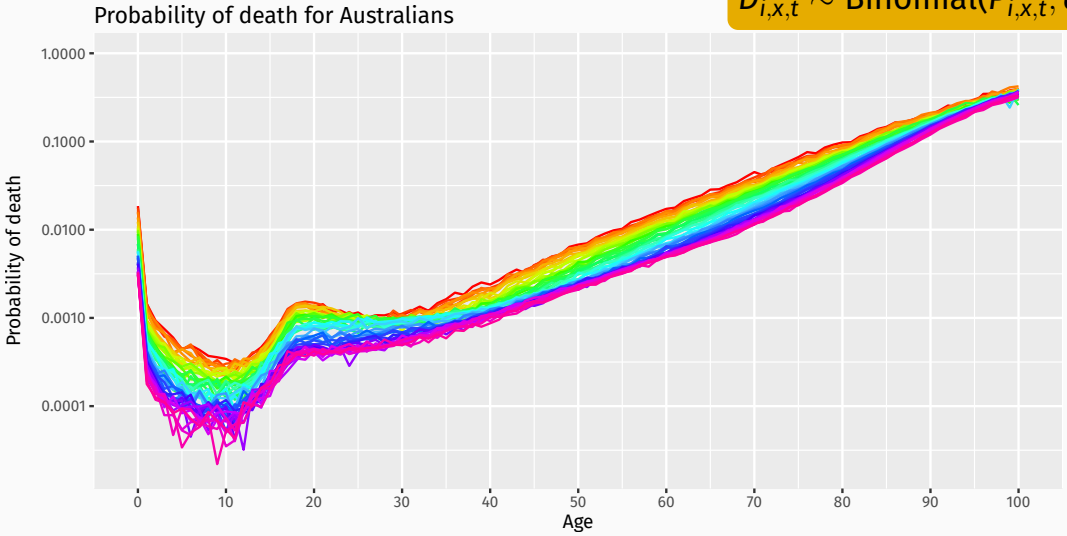

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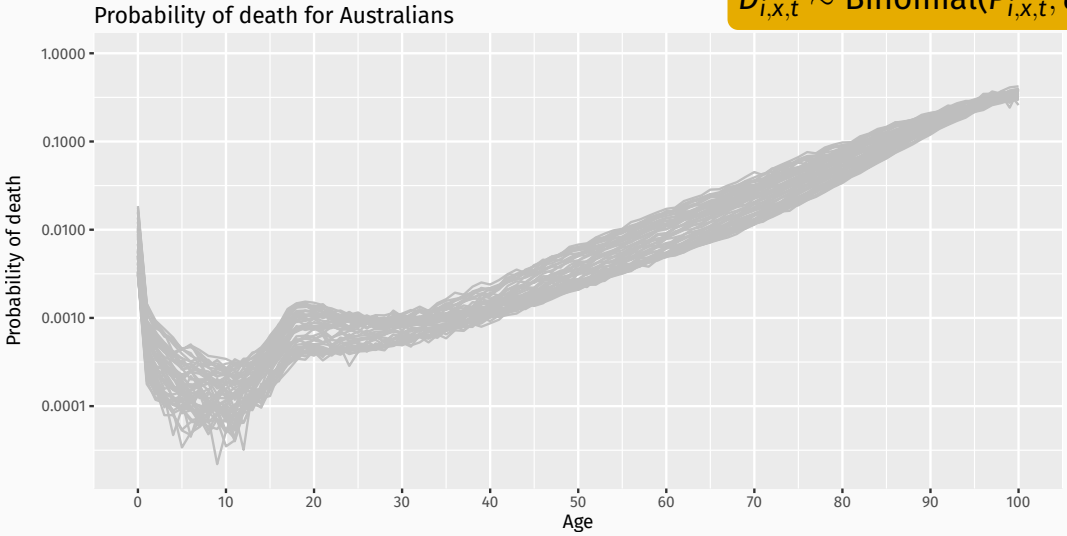

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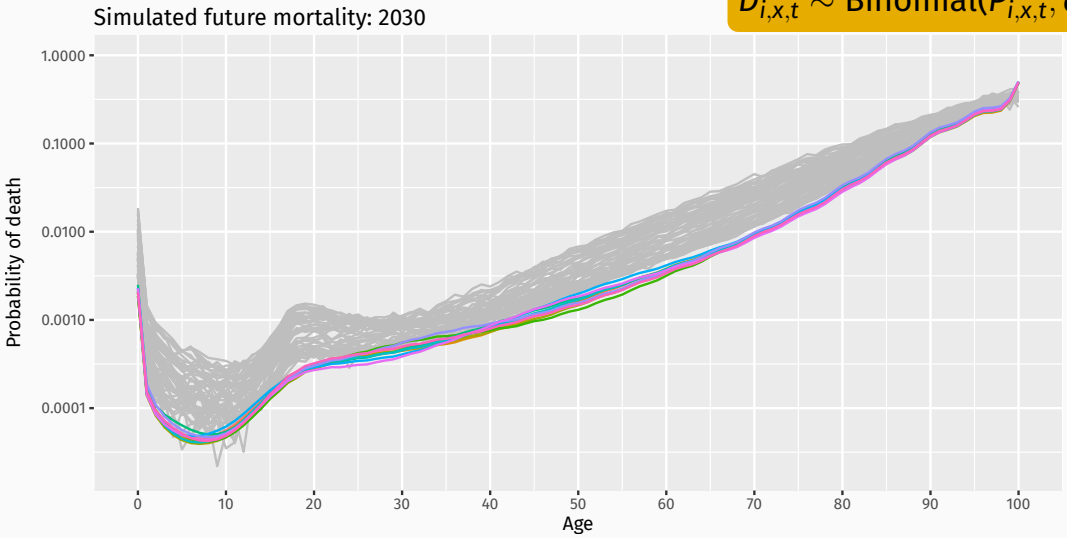

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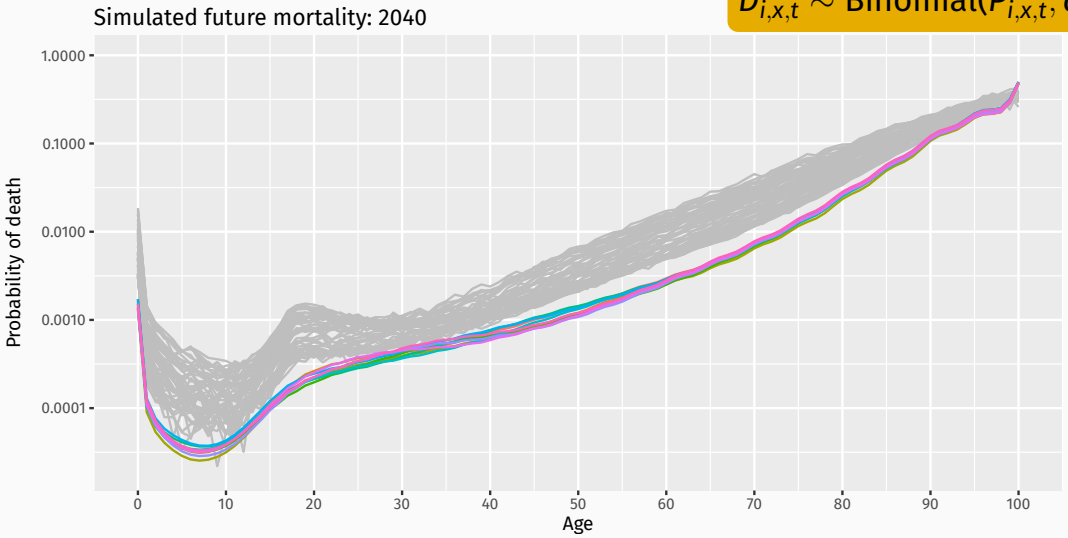

Retirement rates: r_x

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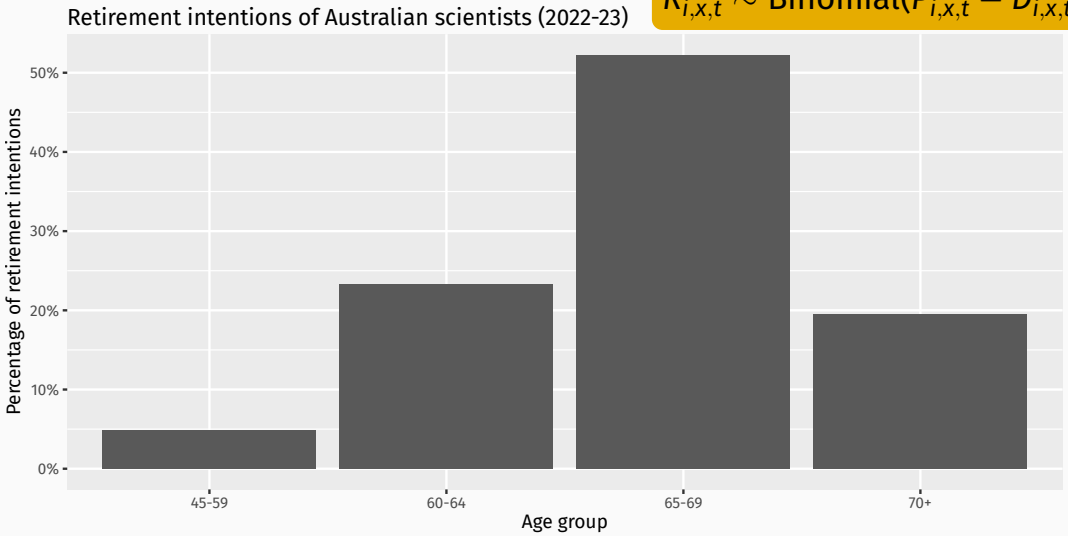

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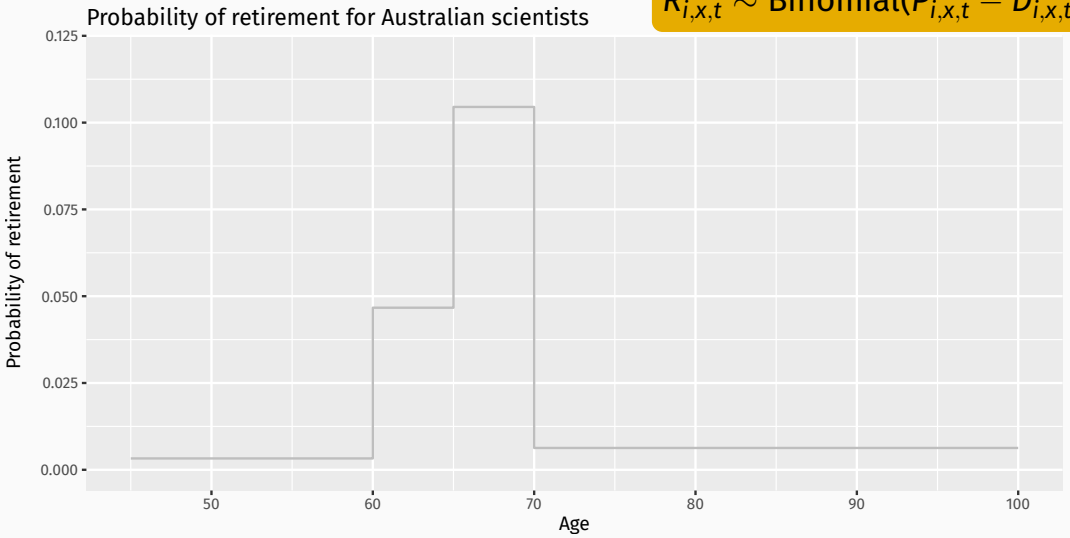

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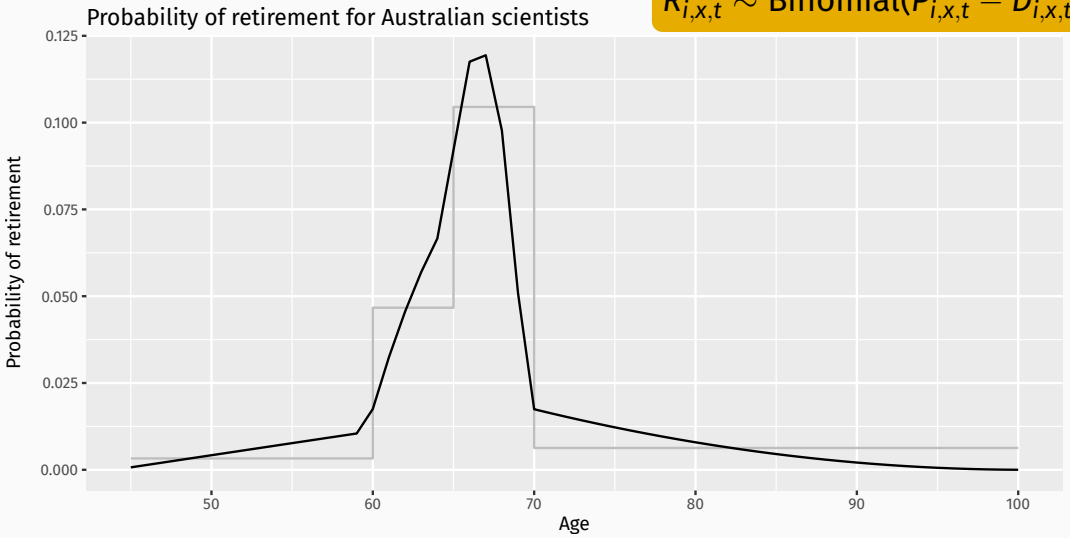

Graduate completions: g_x

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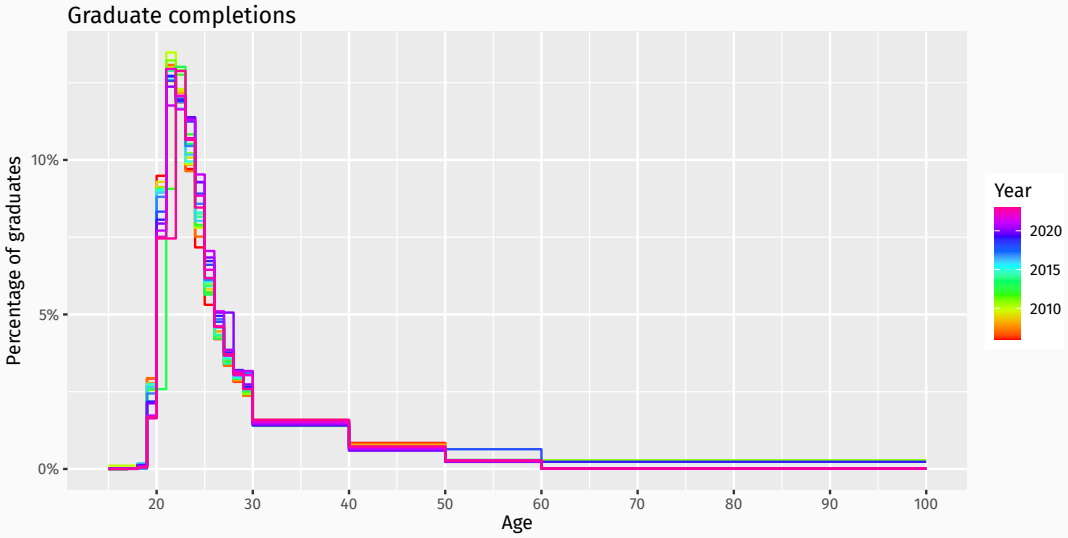

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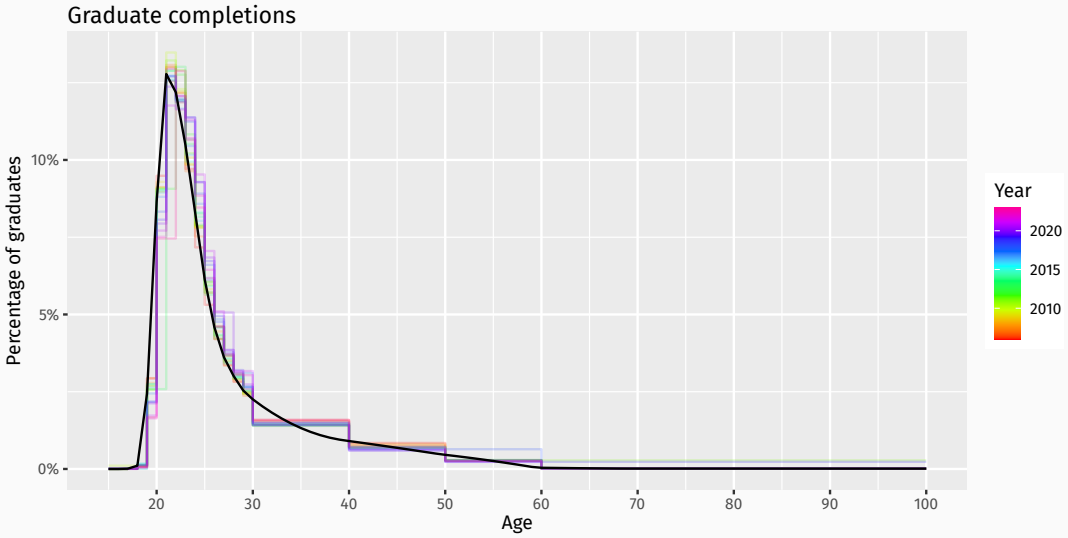

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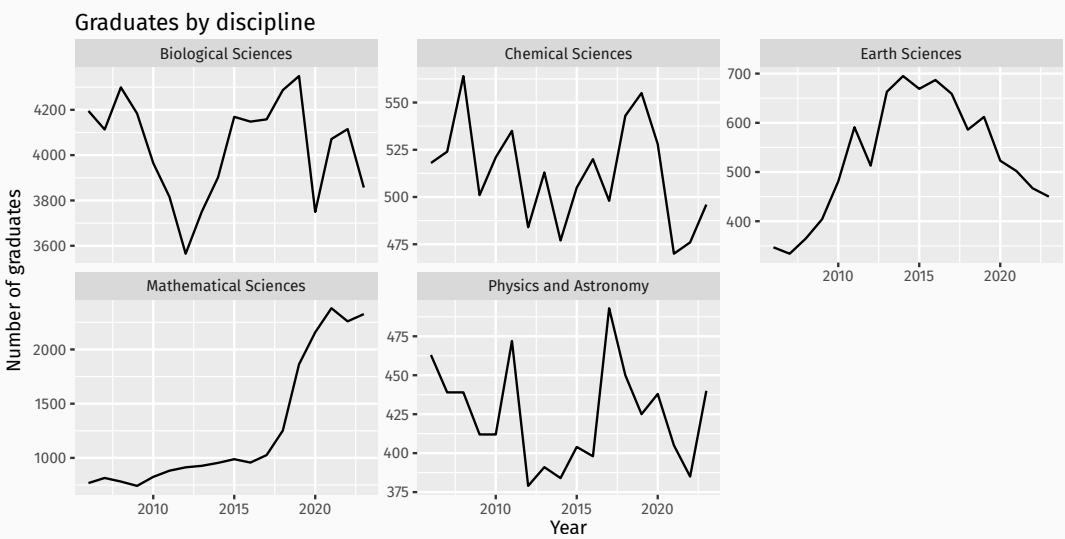

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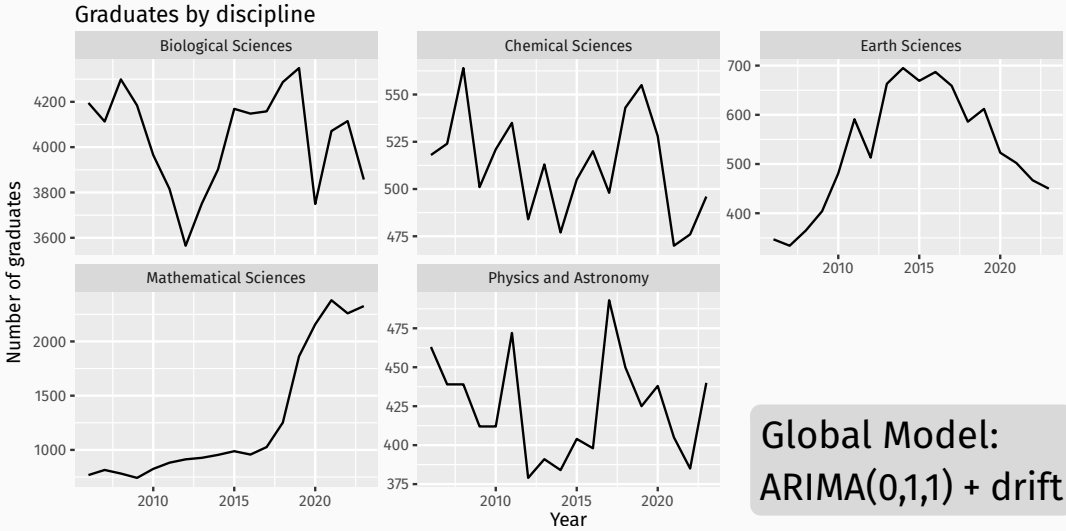

Global Model:
ARIMA(0,1,1) + drift

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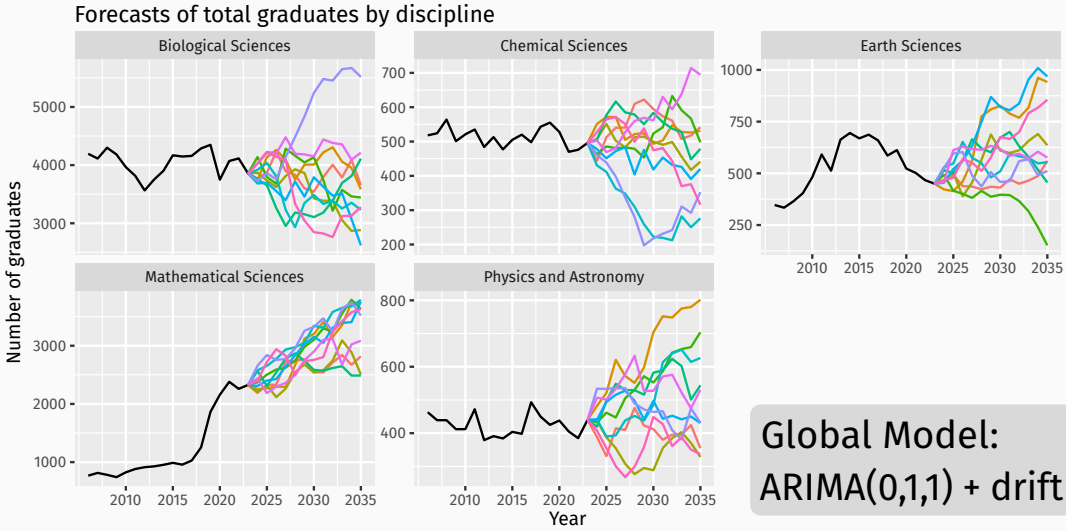

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Remainder: $E_{x,t}$

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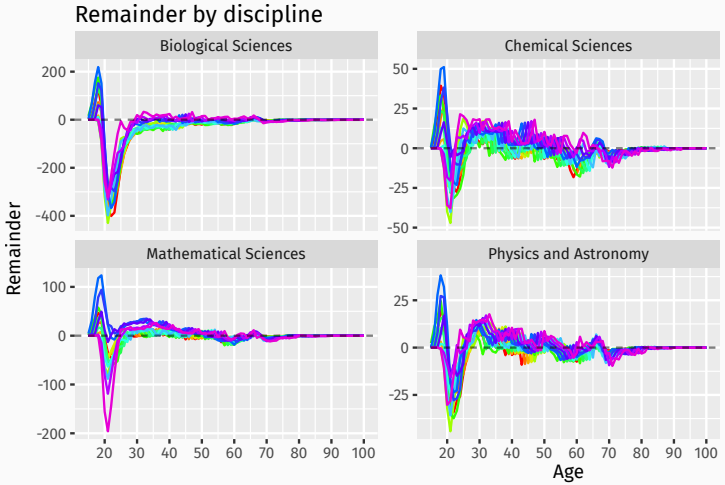

Simulate using functional time series models, as for $q_{x,t}$.

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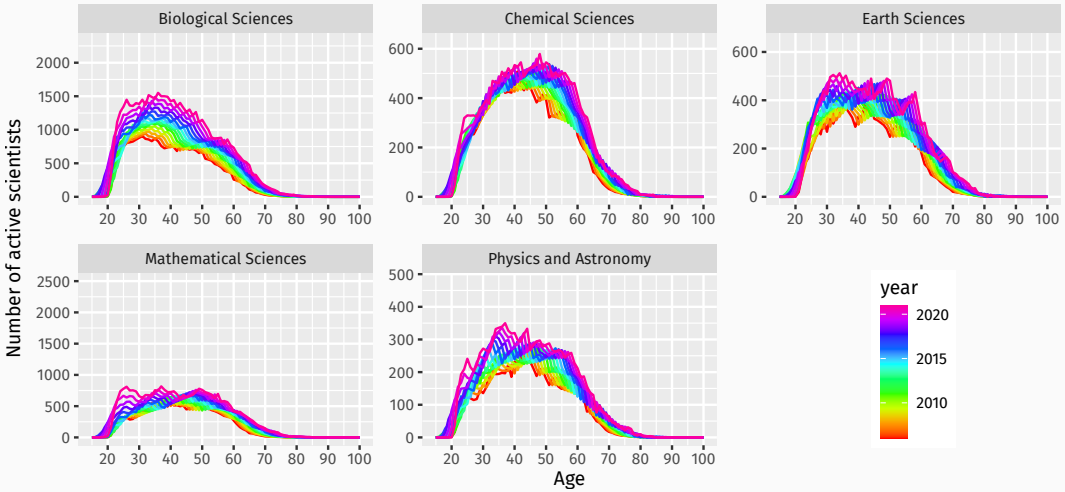
Working population by discipline



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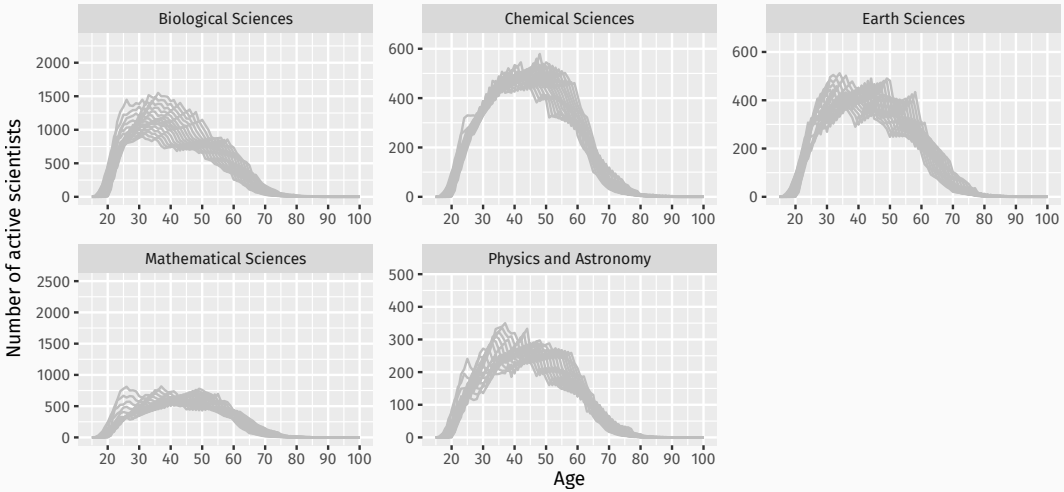

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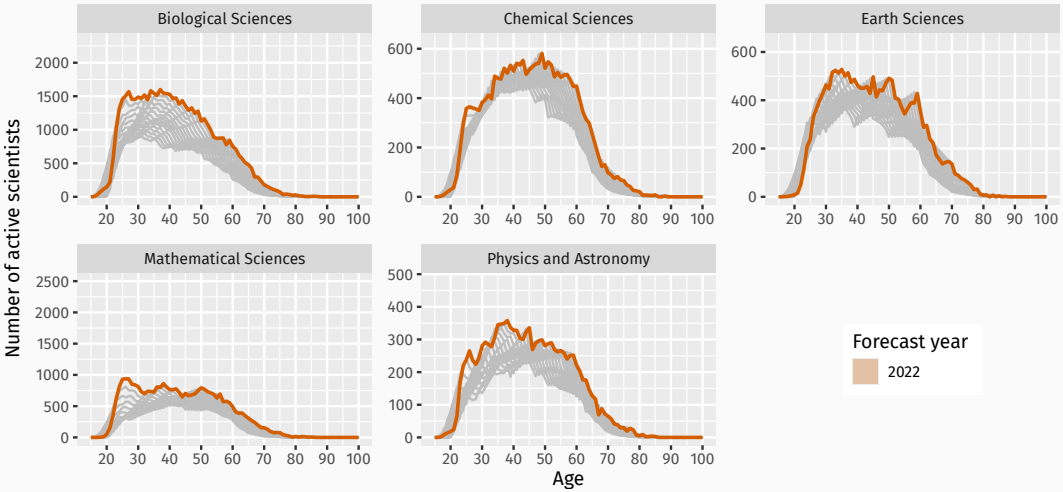

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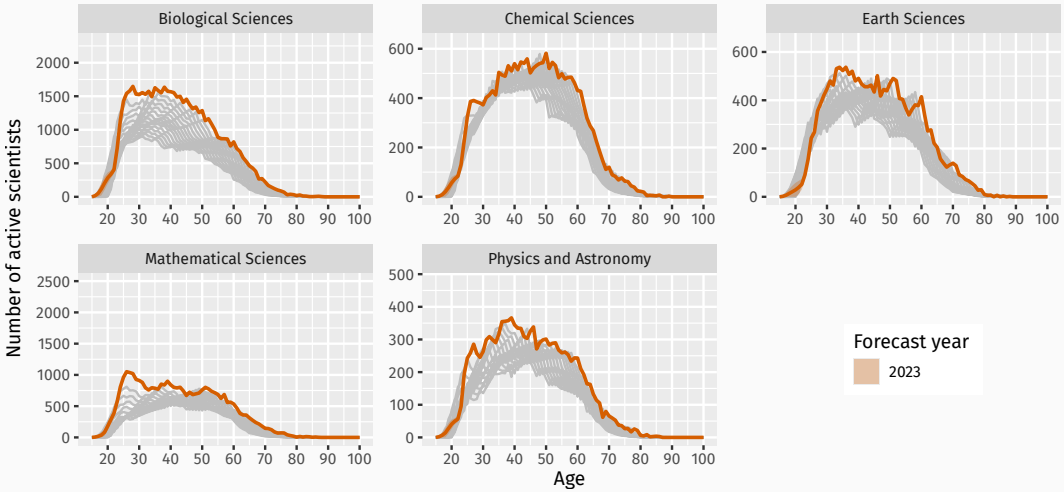

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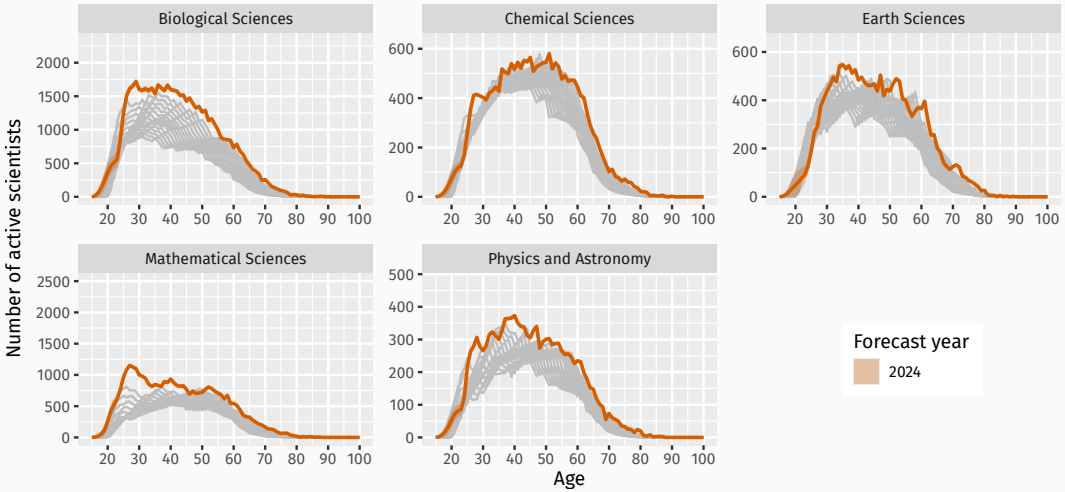

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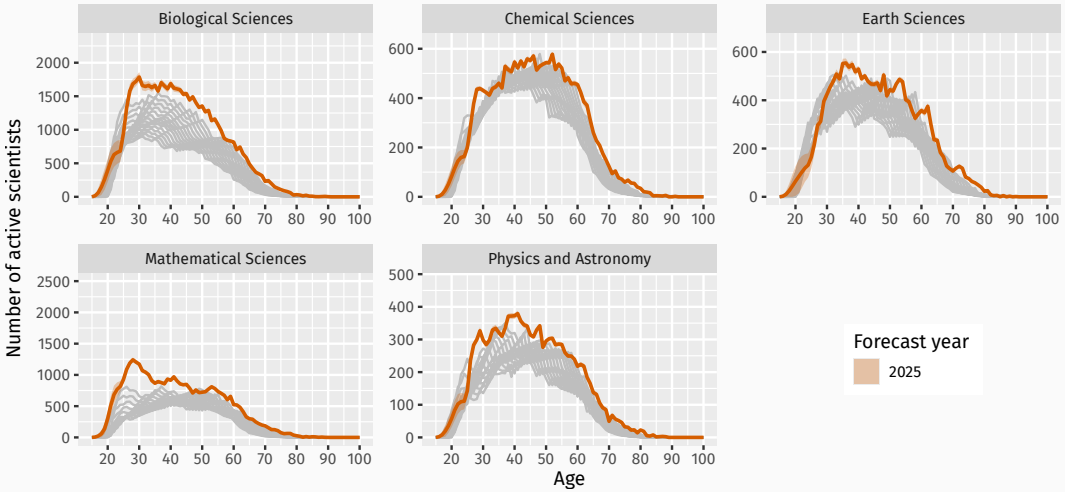

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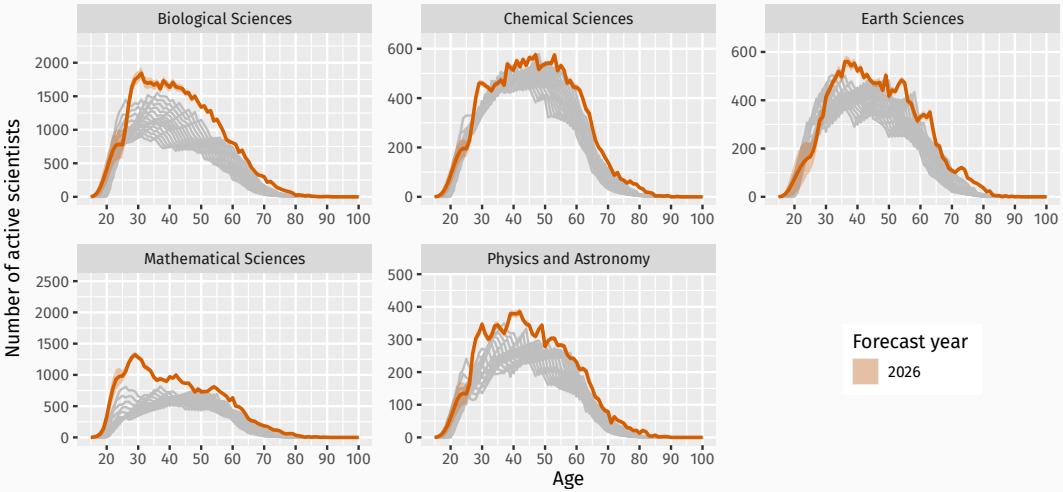

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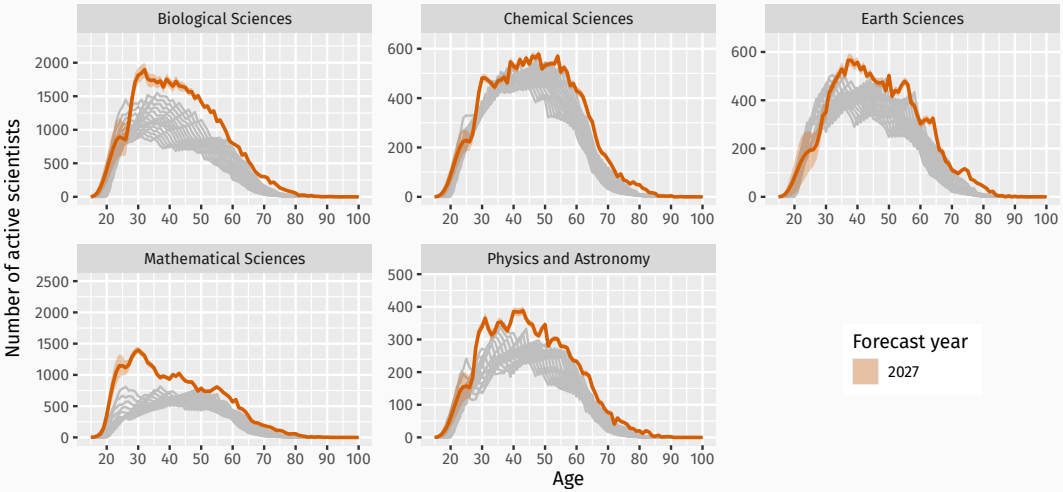

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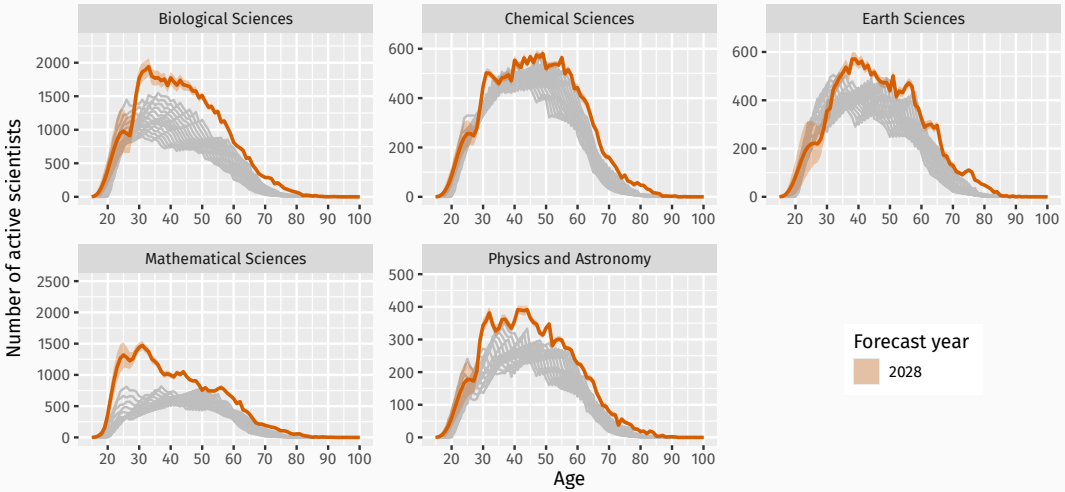

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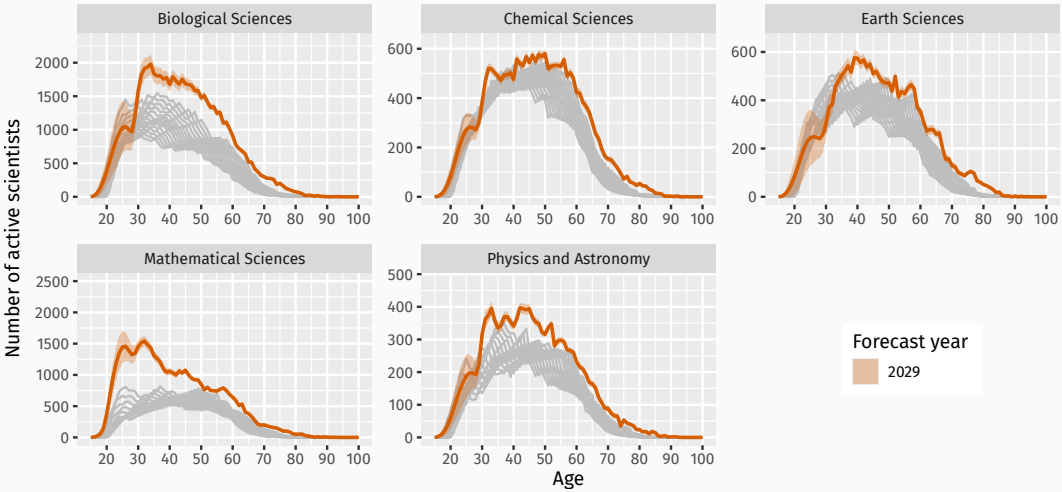

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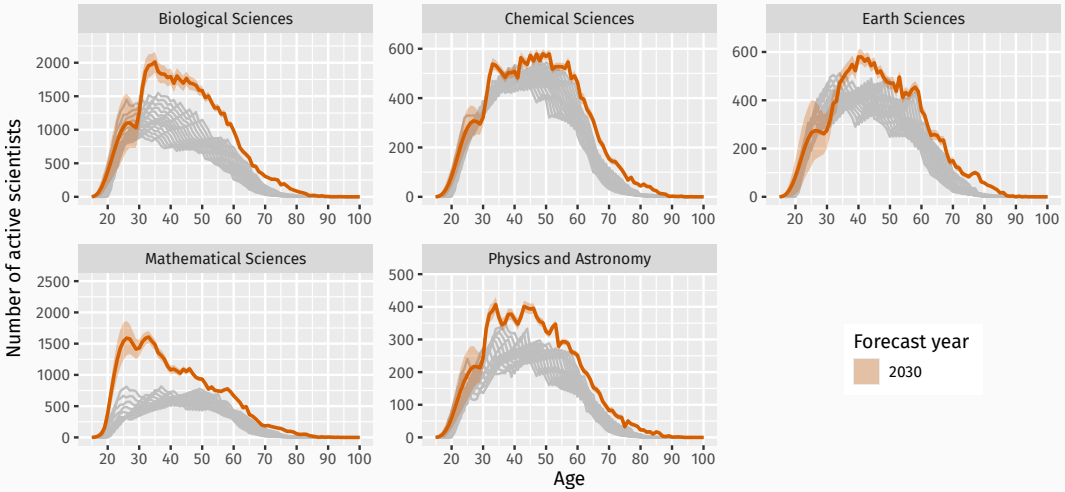

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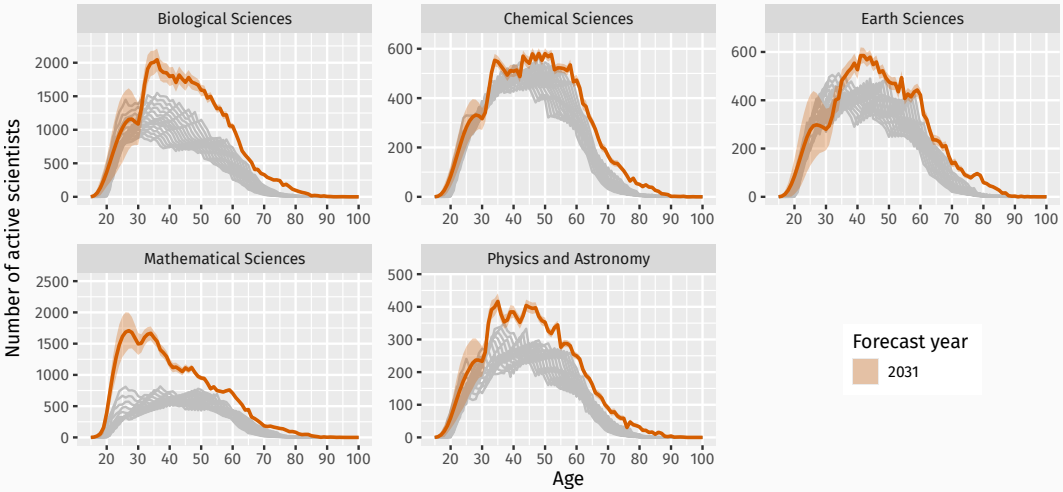

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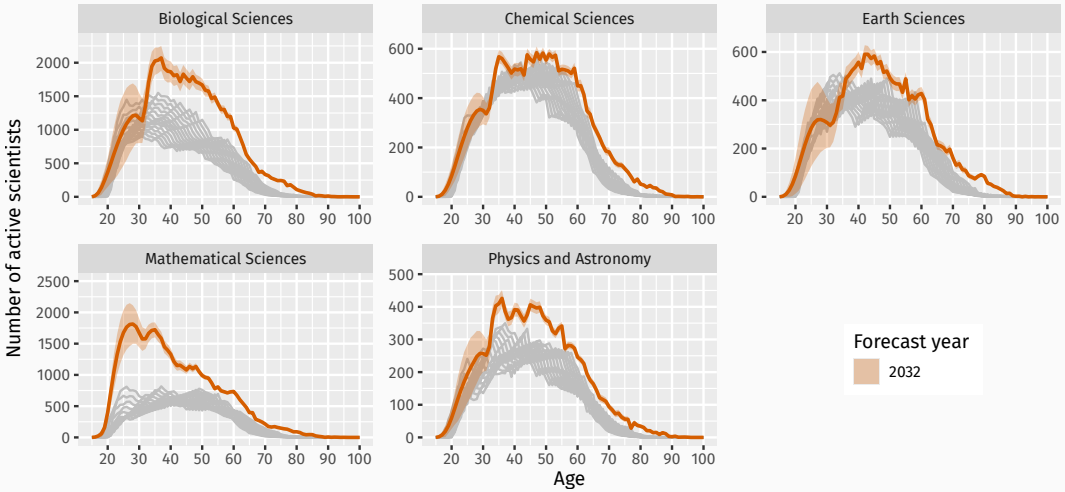

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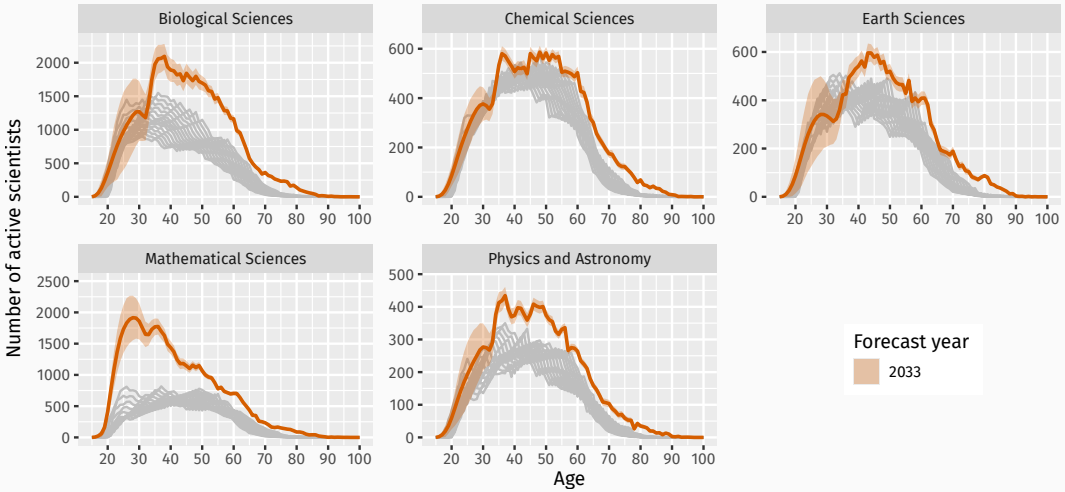

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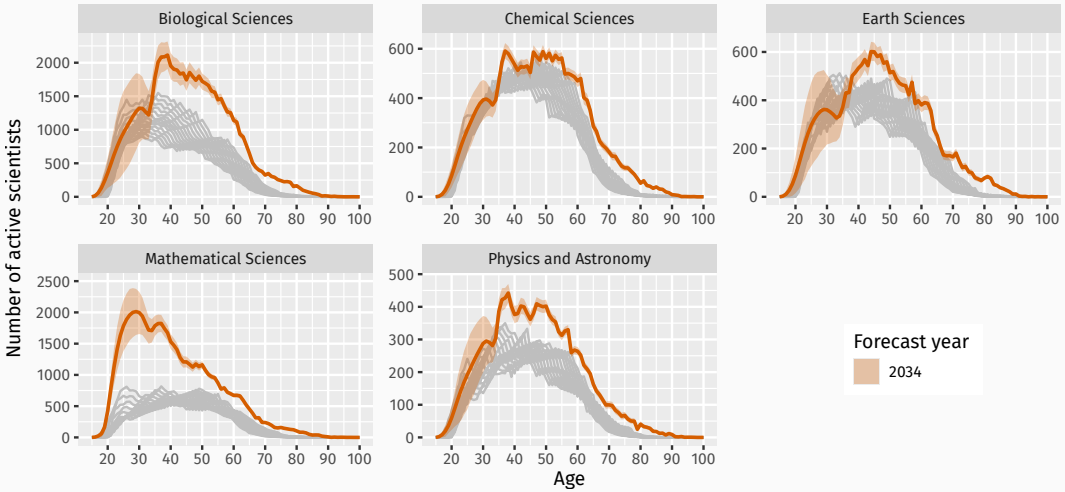

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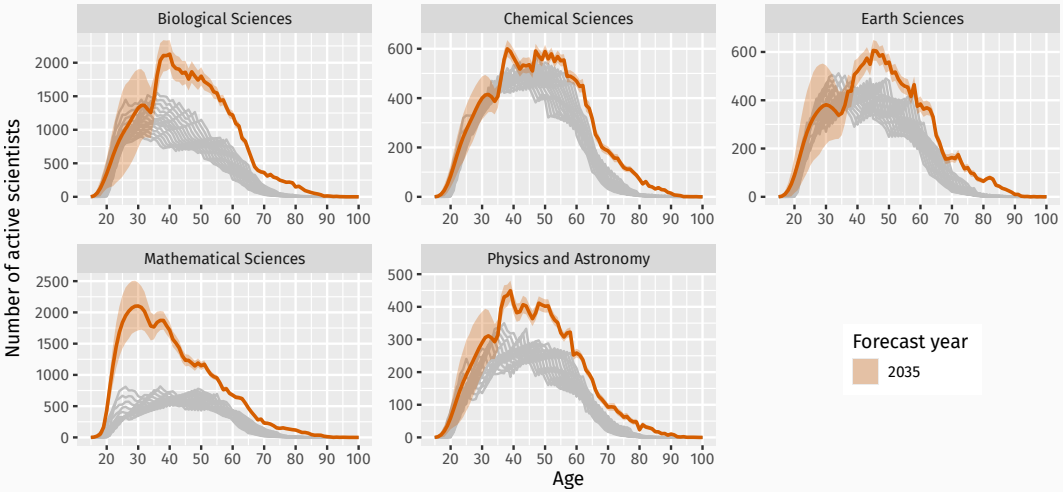

More information

robjhyndman.com/asc2025