Thank you for joining us –
the webinar will start shortly

Canadian mortality improvements

Thoughts on the recent Canadian Institute of Actuaries Mortality Improvement Model

Tuesday October 8th, 2024

9am (PT) / 11am (ET)

linkedin.com/company/club-vita

www.clubvita.net

Our expert panel

Michael Reid
Head of Pensions – North America,
Club Vita

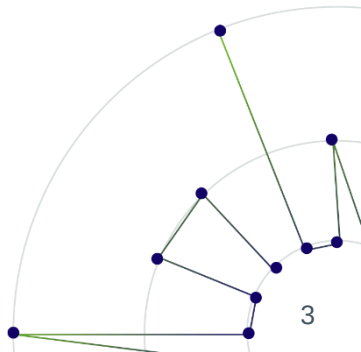
Kai Kaufhold
Managing Director
Ad Res Advanced Reinsurance Services

Matthew Smith
SVP, R&D, Divisional
Pacific Life Re

Shantel Aris
Head of Experience Studies
Club Vita

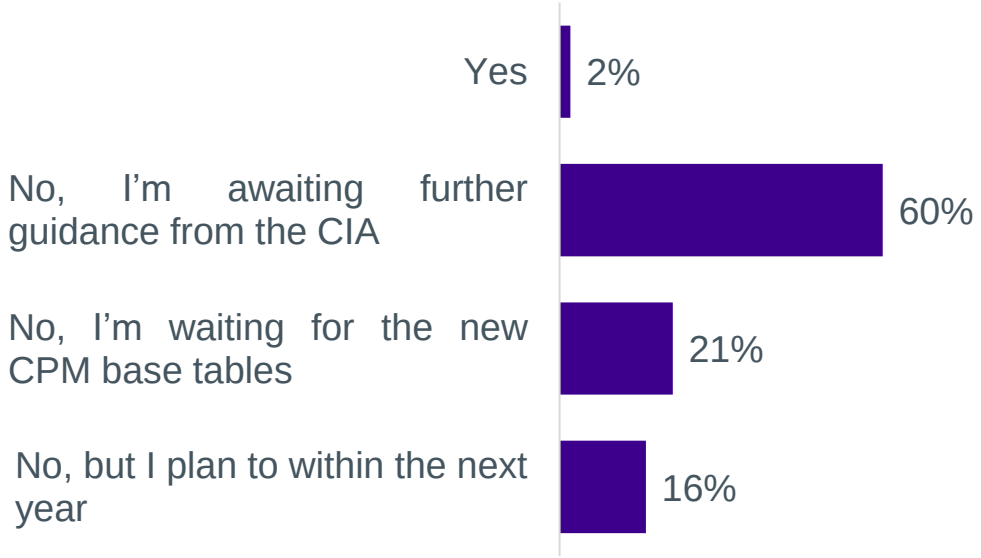
Agenda

1. Background
2. Jump off rates
3. Long term rates
4. Allowances for COVID-19
5. Further Q&A



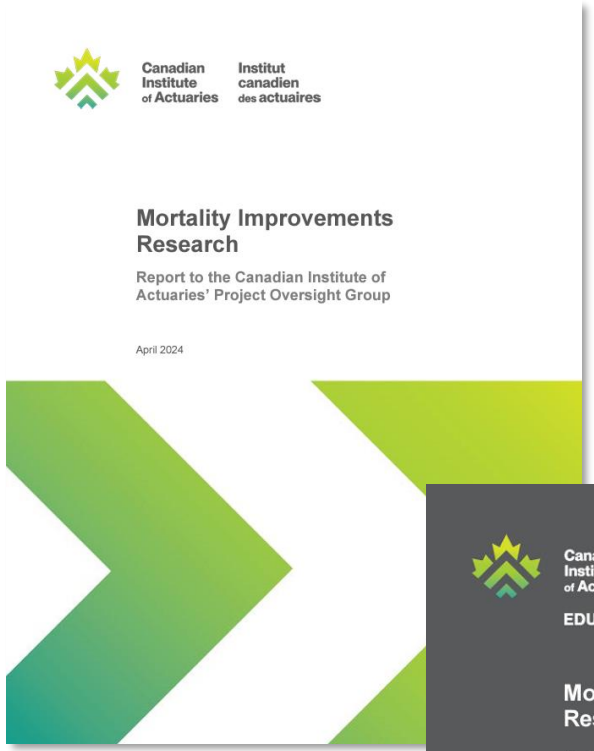
Poll

Have you adopted the CanMI-2024 scale?

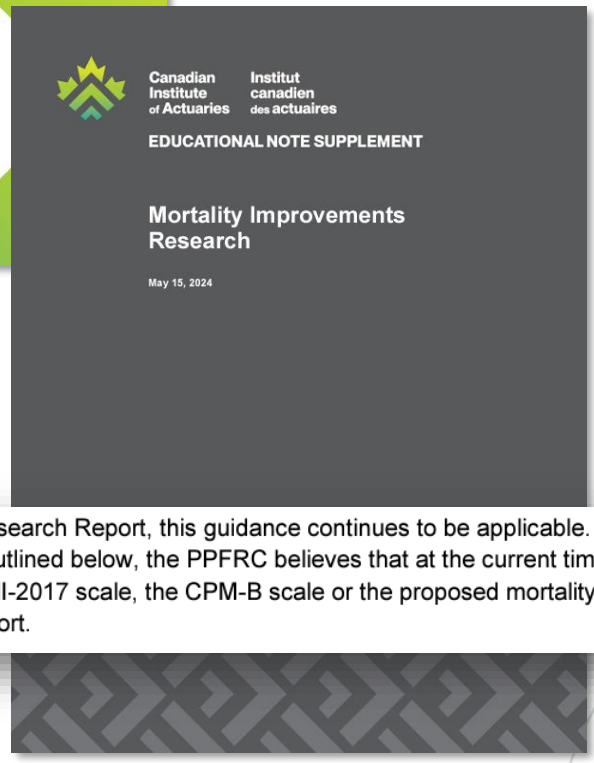


Background

Mortality Improvements Research Report to the Canadian Institute of Actuaries' Project Oversight Group



Link to report here.



Following publication of the Research Report, this guidance continues to be applicable. In particular, subject to the considerations outlined below, the PPFRC believes that at the current time it may be appropriate to use any of the MI-2017 scale, the CPM-B scale or the proposed mortality projection scale published in the Research Report.

Link to educational note supplement here.

CIA MI Research – Project Outline

Data Review

- Human Mortality Database
- CPP / QPP
- Old Age Security

Literature Review

- Stochastic models
- Single population only
- Mortality rates and MI

Select Model

- Stochastic mortality models
- Goodness of fit, Robustness

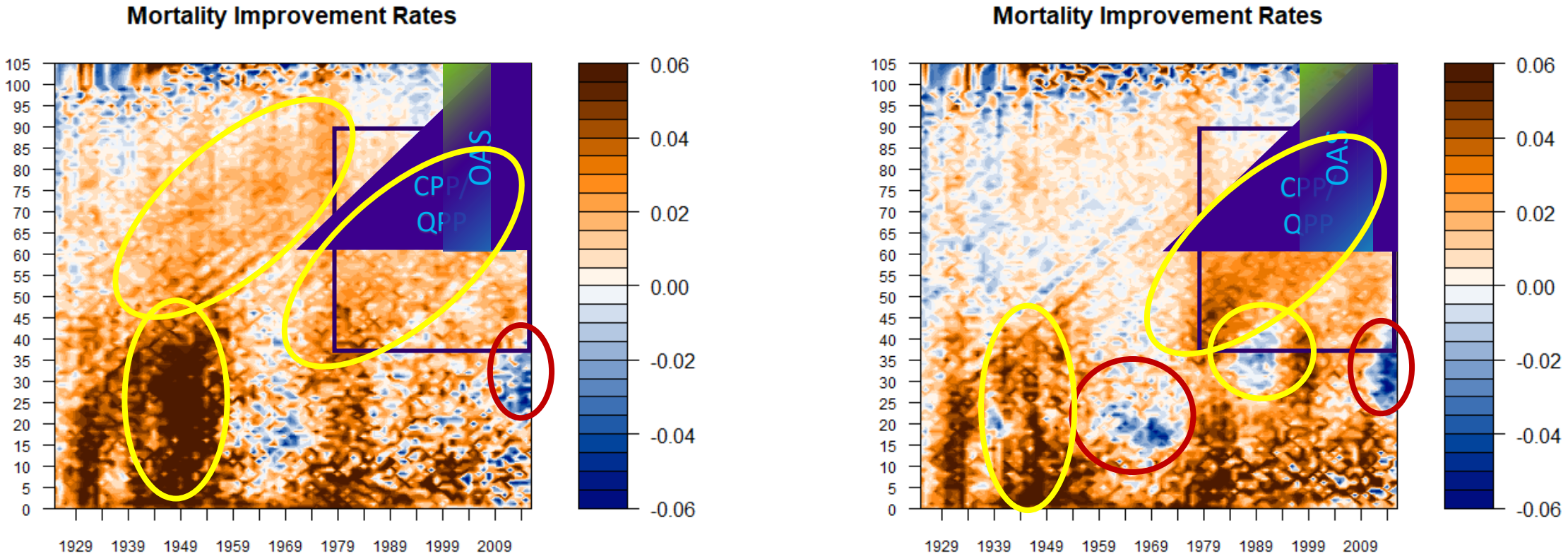
Deterministic Projection

- Adapt CMI method
- Measure impact and refine model

Out of scope

- Multi-population models
- Cause-of-death modelling
- Impact of COVID-19

Canadian Population Mortality



Source: HMD data for Canada, females (left) & males (right), 1921 – 2019, ages 0 – 105, 7-year moving average MI rates

Candidate Stochastic Mortality Models

Mortality Rate Models	Mortality Improvement Rate Models
M1: Lee-Carter for $\log(m_{x,y})$	M1: Lee-Carter for $MI_{x,y}$
M2: Renshaw-Haberman for $\log(m_{x,y})$	
M3: Age-Period-Cohort for $\mathbf{log}(\boldsymbol{m}_{x,y})$	M3: Age-Period-Cohort for $MI_{x,y}$
M5: Cairns-Blake-Dowd for $\log(m_{x,y})$	M5: Cairns-Blake-Dowd for $MI_{x,y}$
M6: CBD with cohort for $\log(m_{x,y})$	
M7: CBD with cohort and quadratic age for $\log(m_{x,y})$	
M8: CBD with age-dependent cohort for $\log(m_{x,y})$	
Simplified Plat for $\log(m_{x,y})$	Simplified Plat for $MI_{x,y}$
Heat-wave model for $\log(m_{x,y})$	
Integrated APC model for $\mathbf{log}(\boldsymbol{m}_{x,y})$ ("APCI")	

Sources: Cairns et al. (2009), Villegas et al. (2018), Li et al. (2020)

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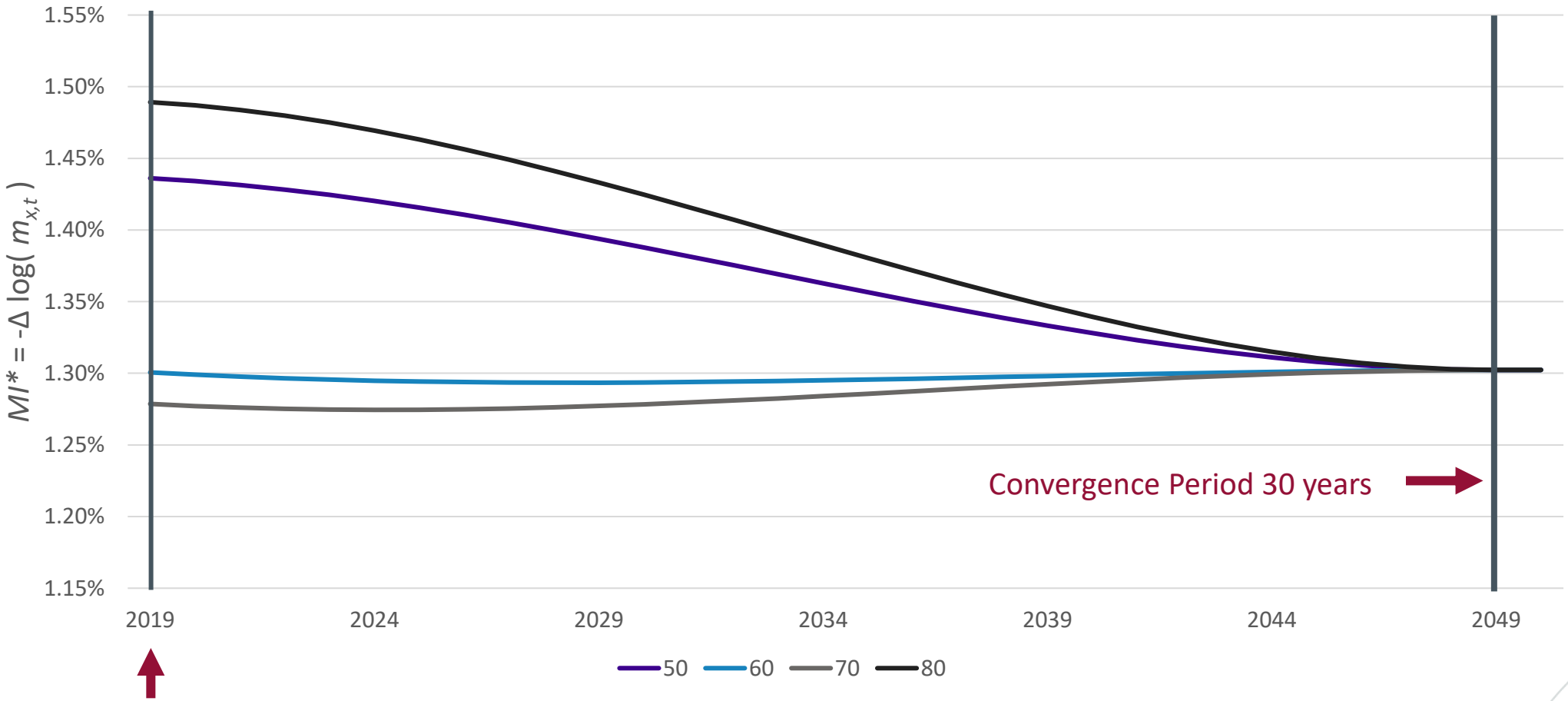
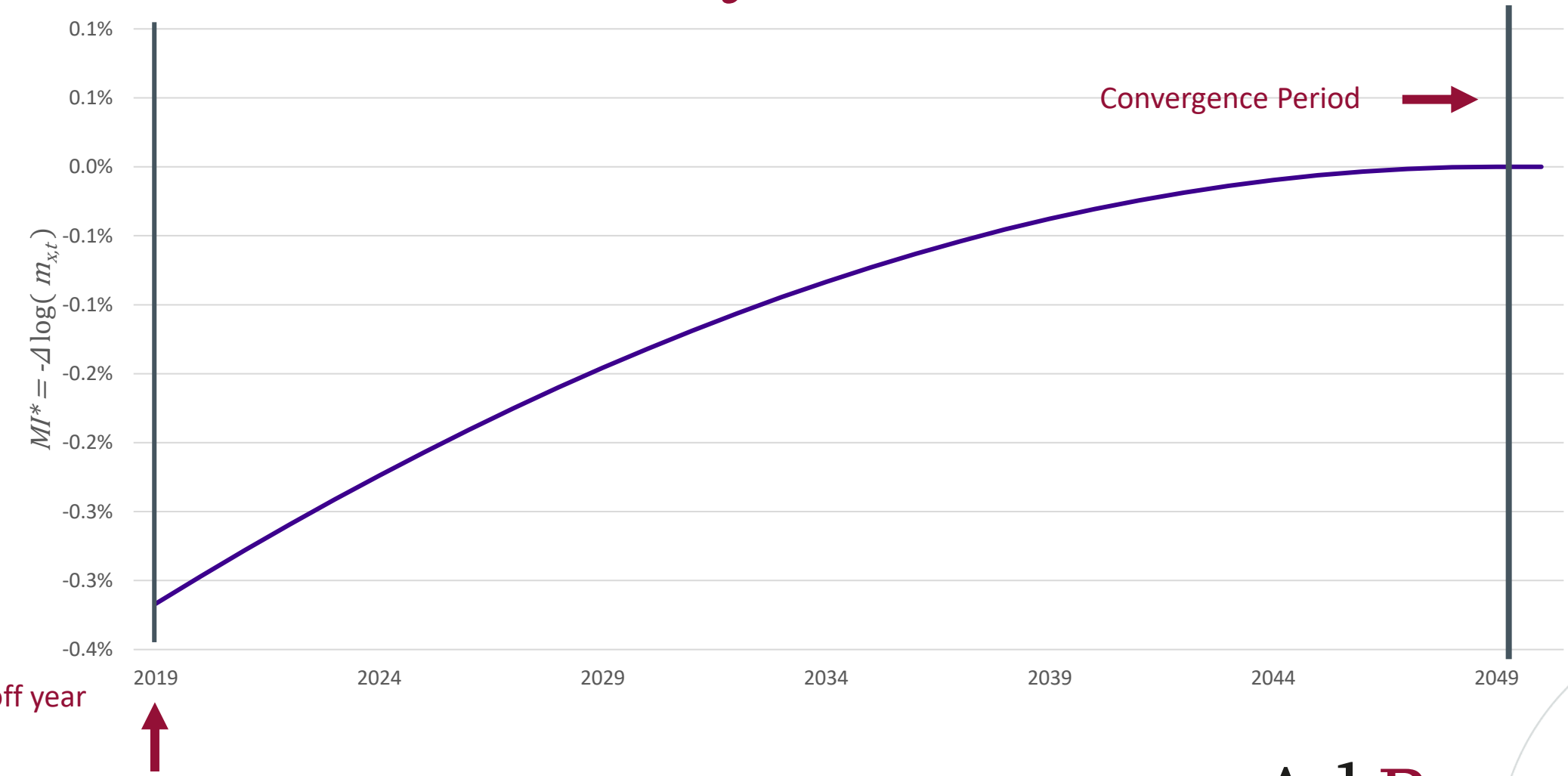
Jump off rates

Jump off for age component $-\beta_x$



Jump-off year 2019

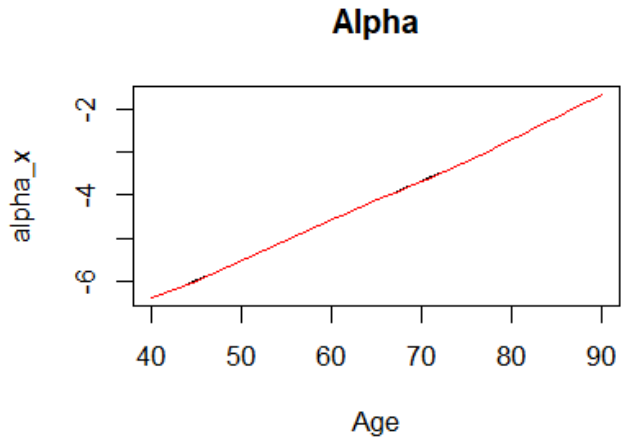
Period component $-\Delta\kappa_t$

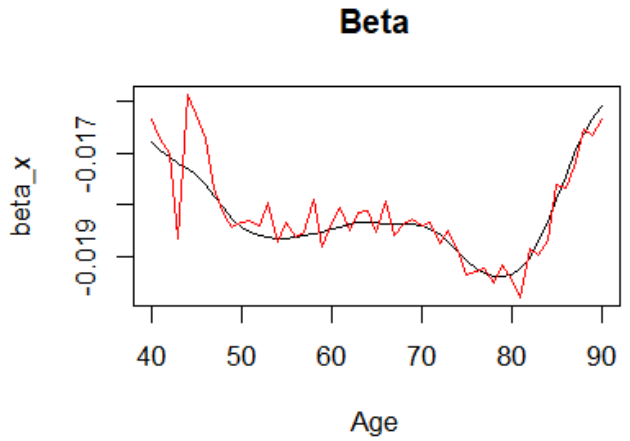


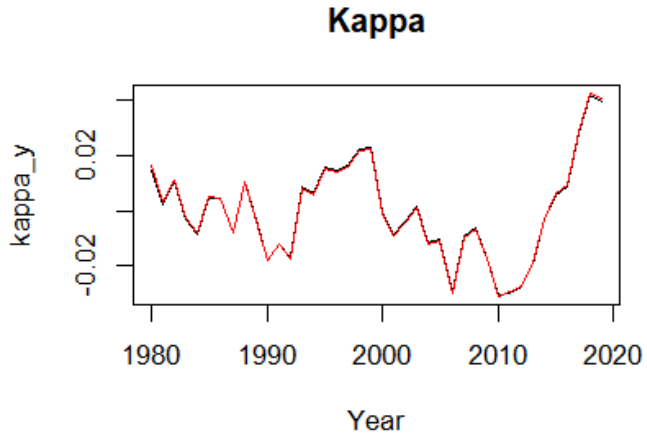
APCI Model

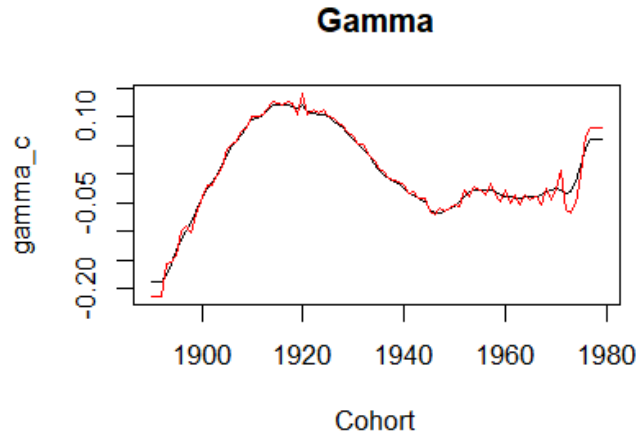
$$\log(m_{x,t}) = \alpha_x + \boldsymbol{\beta_x}(\boldsymbol{t} - \bar{\boldsymbol{t}}) + \boldsymbol{\kappa_t} + \gamma_c$$

Parameter	Count
Ages	2×51
Years	40
Cohorts	89
Total	231









APCI Model – Age

$$\log(m_{x,t}) = \alpha_x + \boldsymbol{\beta_x}(\boldsymbol{t} - \boldsymbol{t_{mid}}) + \kappa_t + \gamma_c$$

Improvement Rate

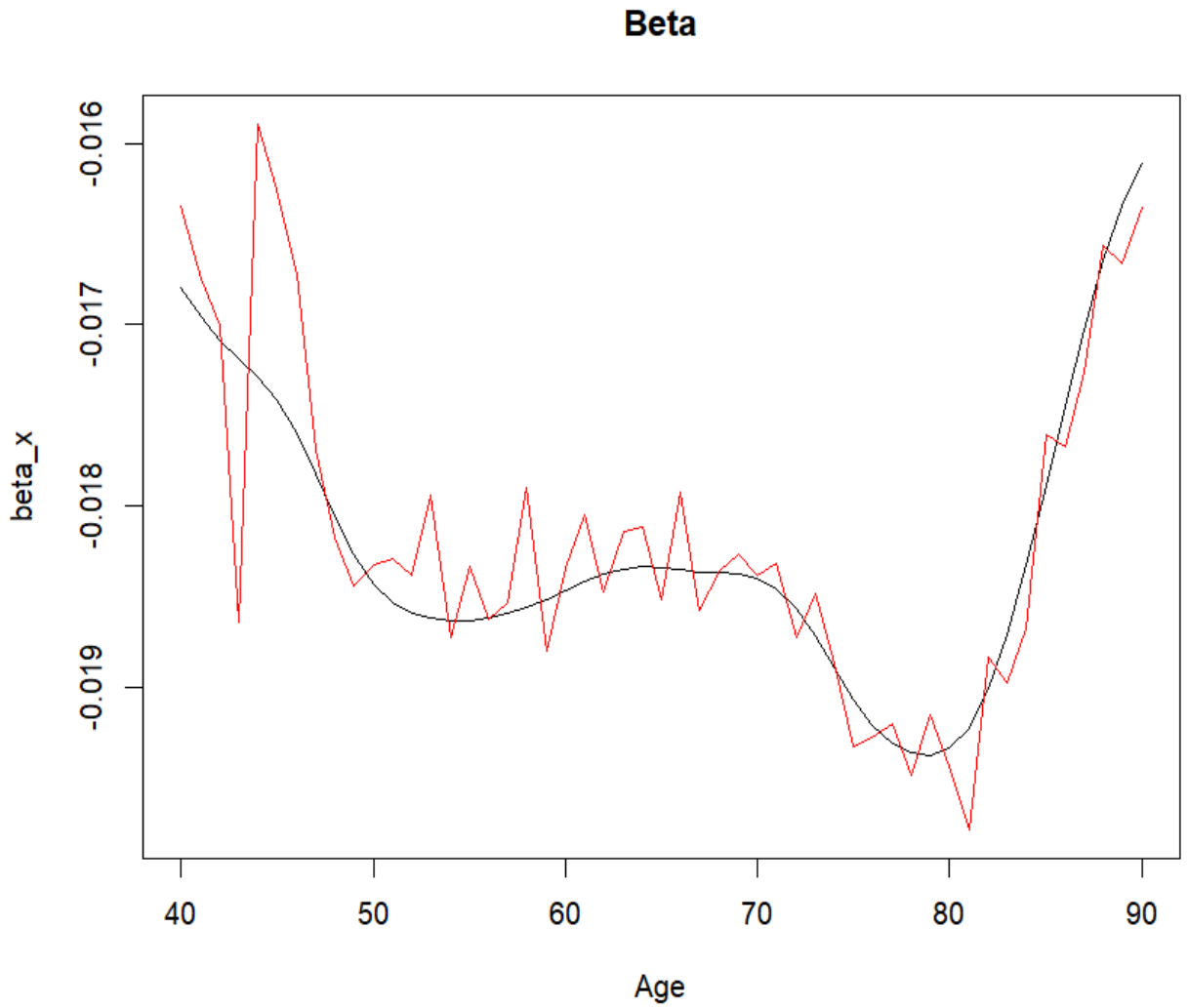
$MI^*_{x,t} := \Delta \log(m_{x,t})$

$= \log(m_{x,t-1}) - \log(m_{x,t})$

$= \boldsymbol{-\beta_x - \Delta\kappa_t - \Delta\gamma_c}$

$\boldsymbol{-\beta_x}$ age-dependent linear MI rate

Smoothing is important.



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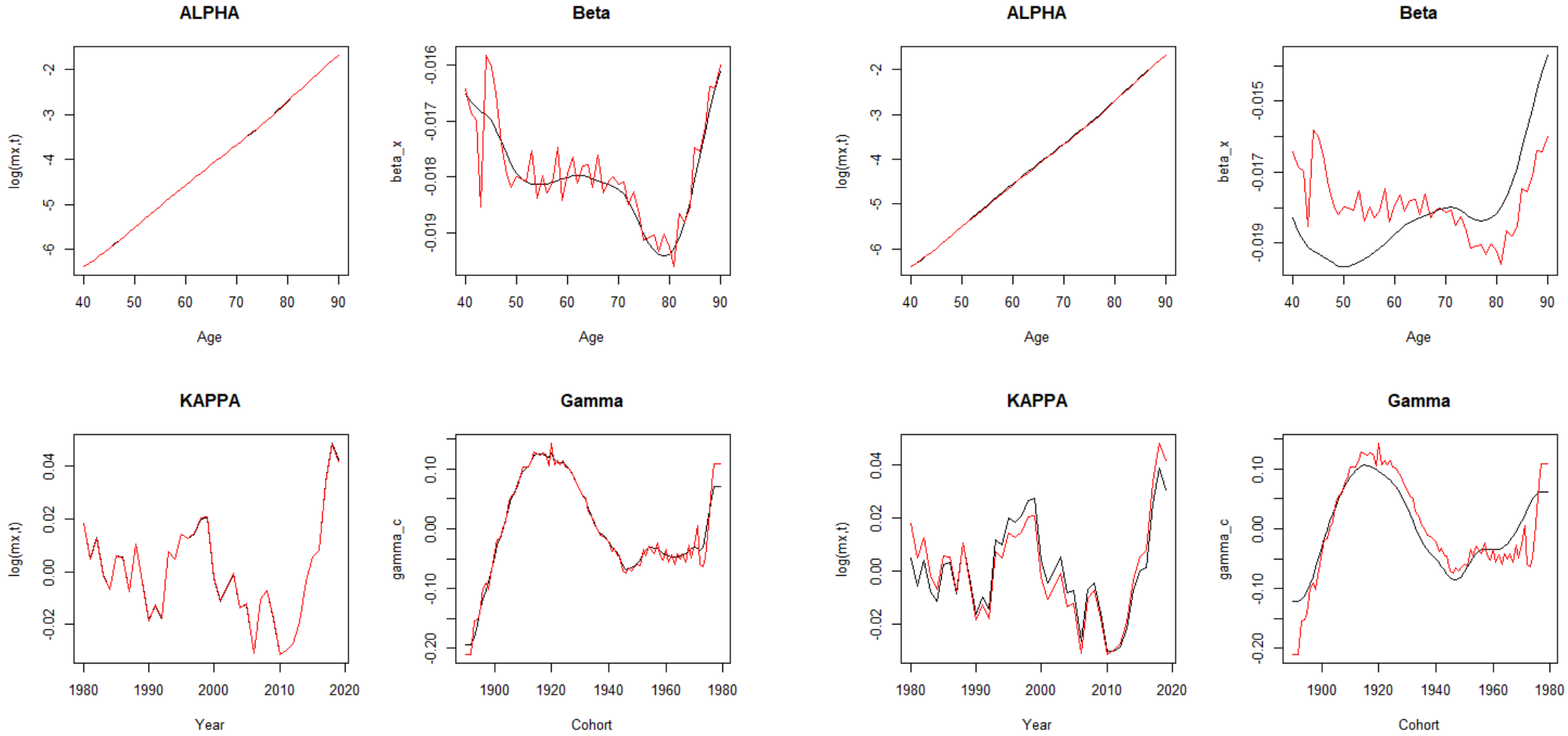
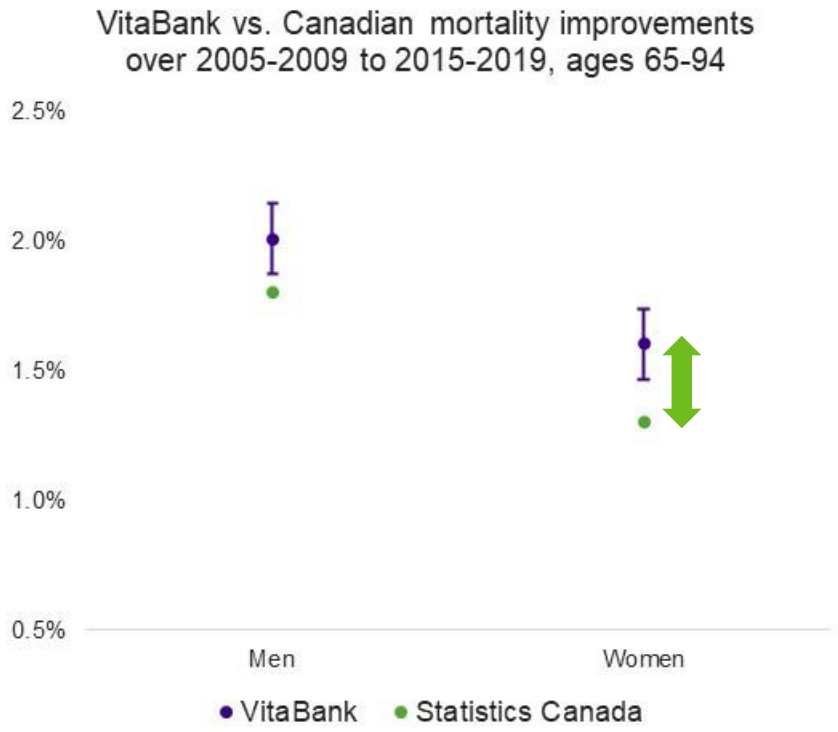
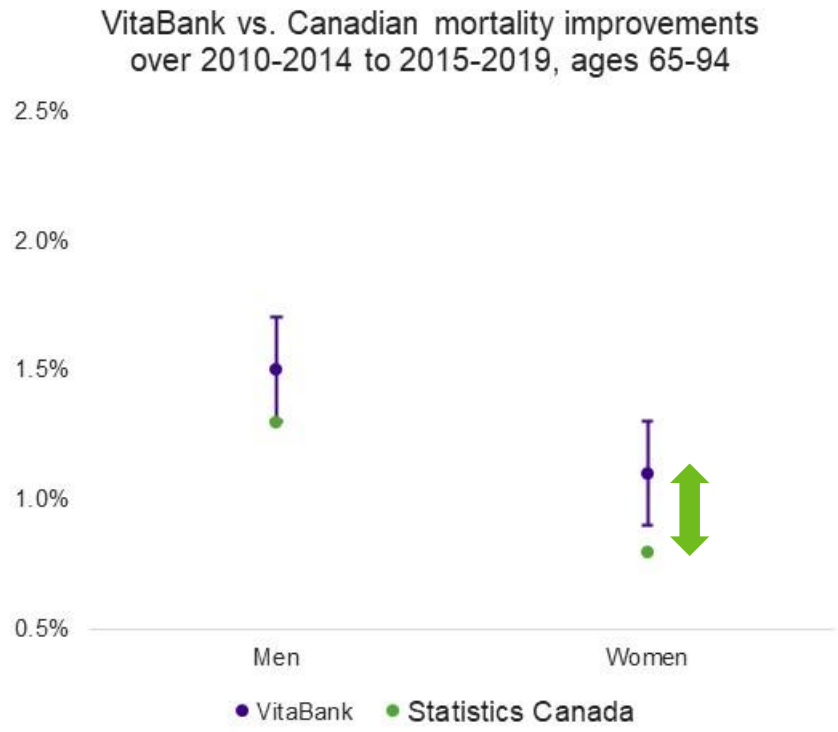
Perils of Smoothing



Club Vita research:

Improvement rates for DB pensioners

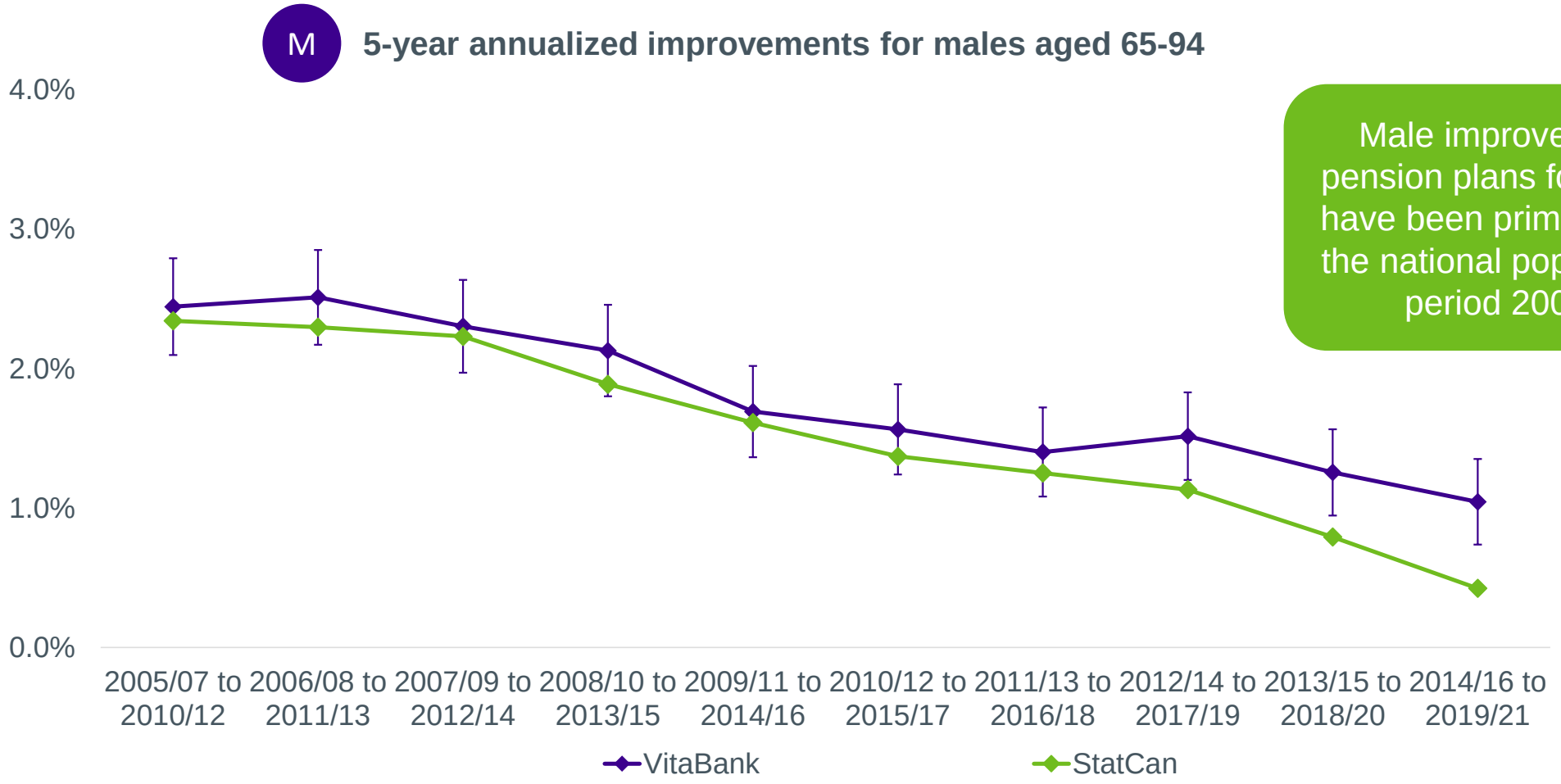




In aggregate, improvement rates in pension plans for ages 65 to 94 have been about 20 to 30 bps higher than national population over the period 2005 to 2019.

Club Vita research:

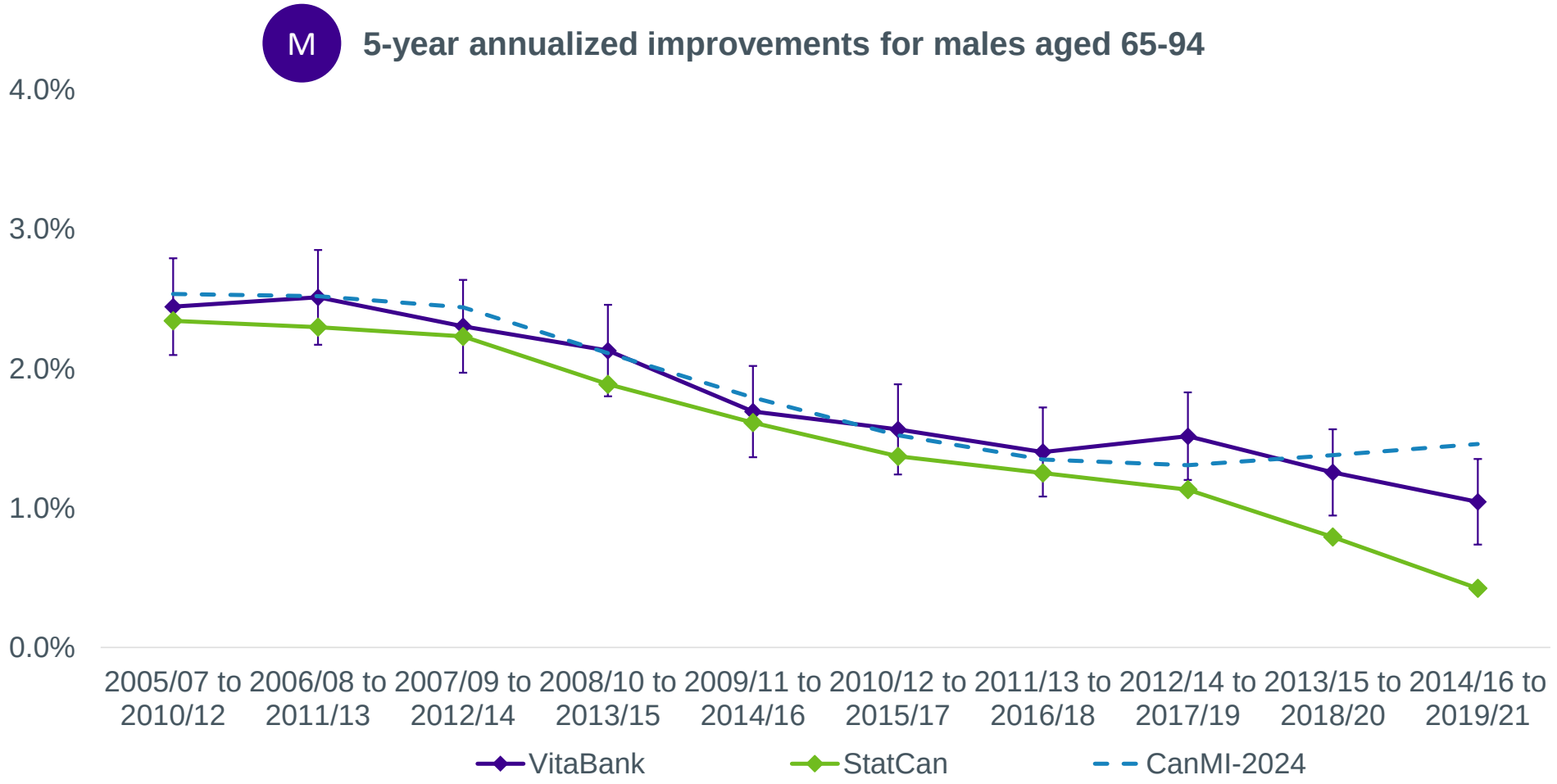
Improvement rates for DB male pensioners



Male improvement rates in pension plans for ages 65 to 94 have been primarily higher than the national population over the period 2005 to 2021.

Club Vita research:

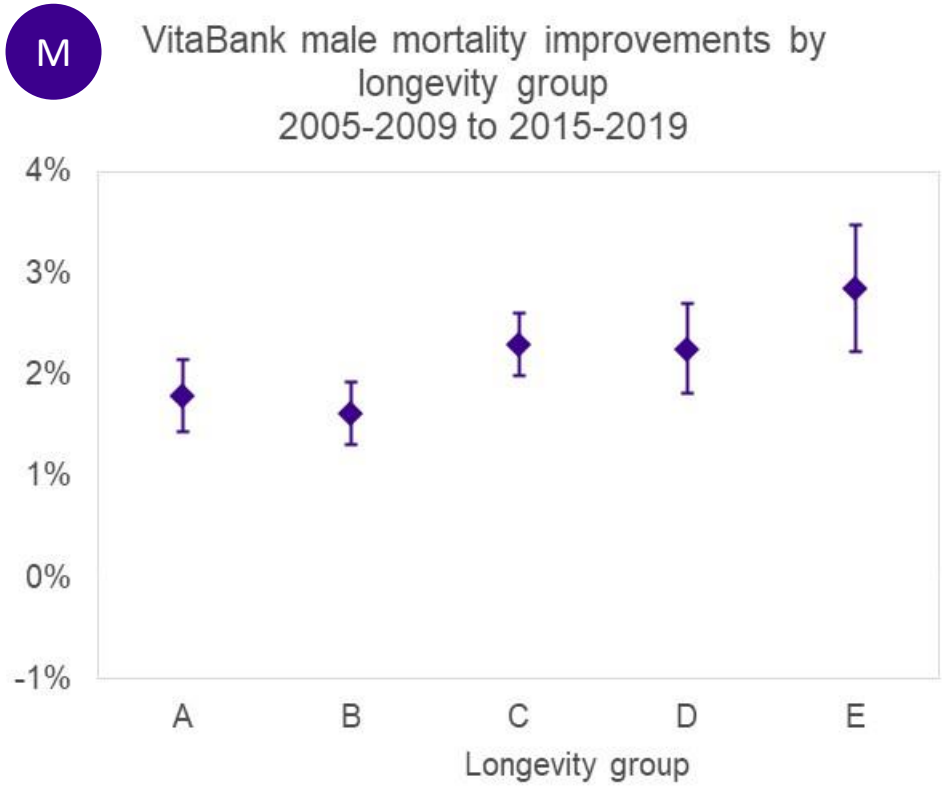
Improvement rates for DB male pensioners



Club Vita research:

Improvement rates for DB pensioners by socio-economic status

M



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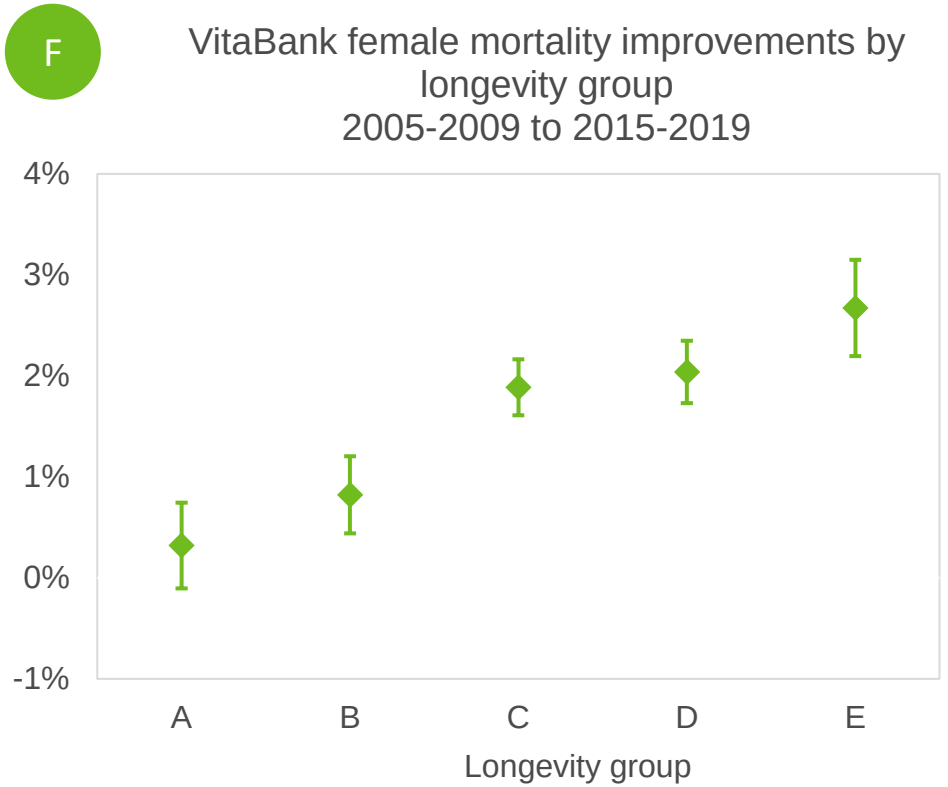

Improvements for defined benefit have differed by socio-economic status, particularly for women.

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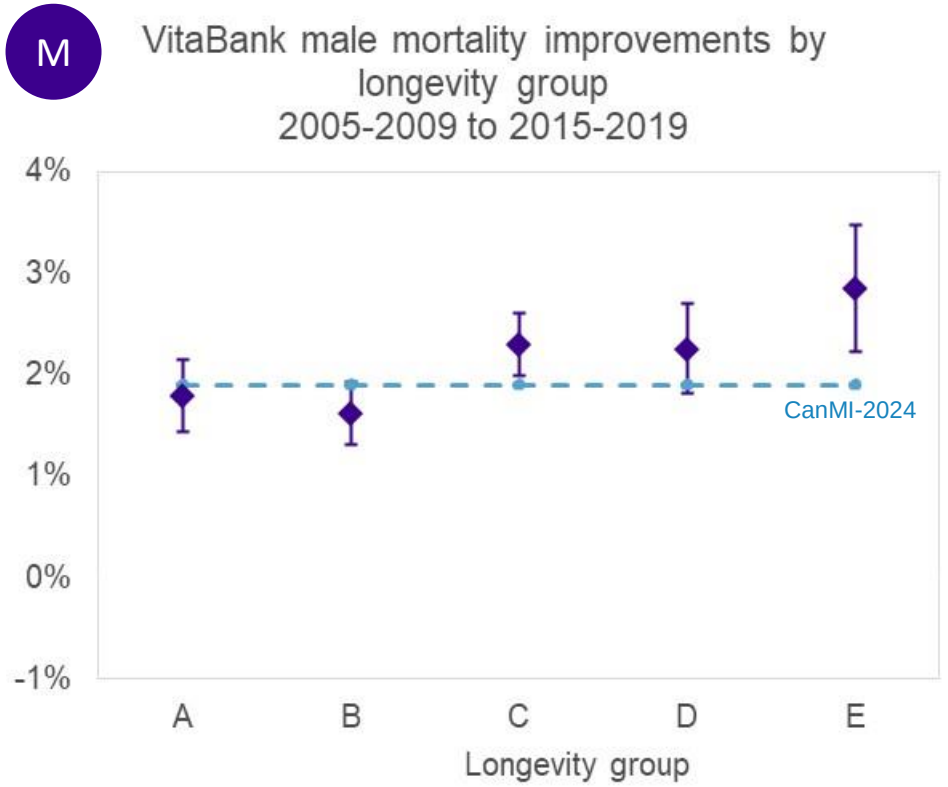
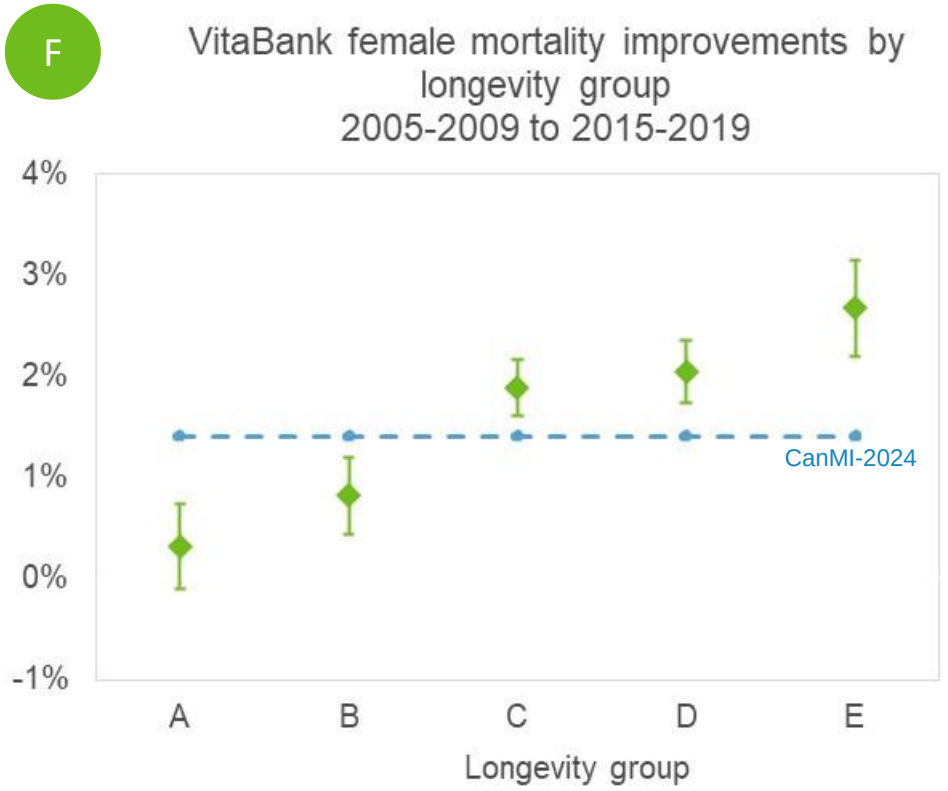
Club Vita research:

Improvement rates for DB pensioners by socio-economic status





Improvements for defined benefit pensioners have differed by socio-economic status, particularly for women.

Long term rates

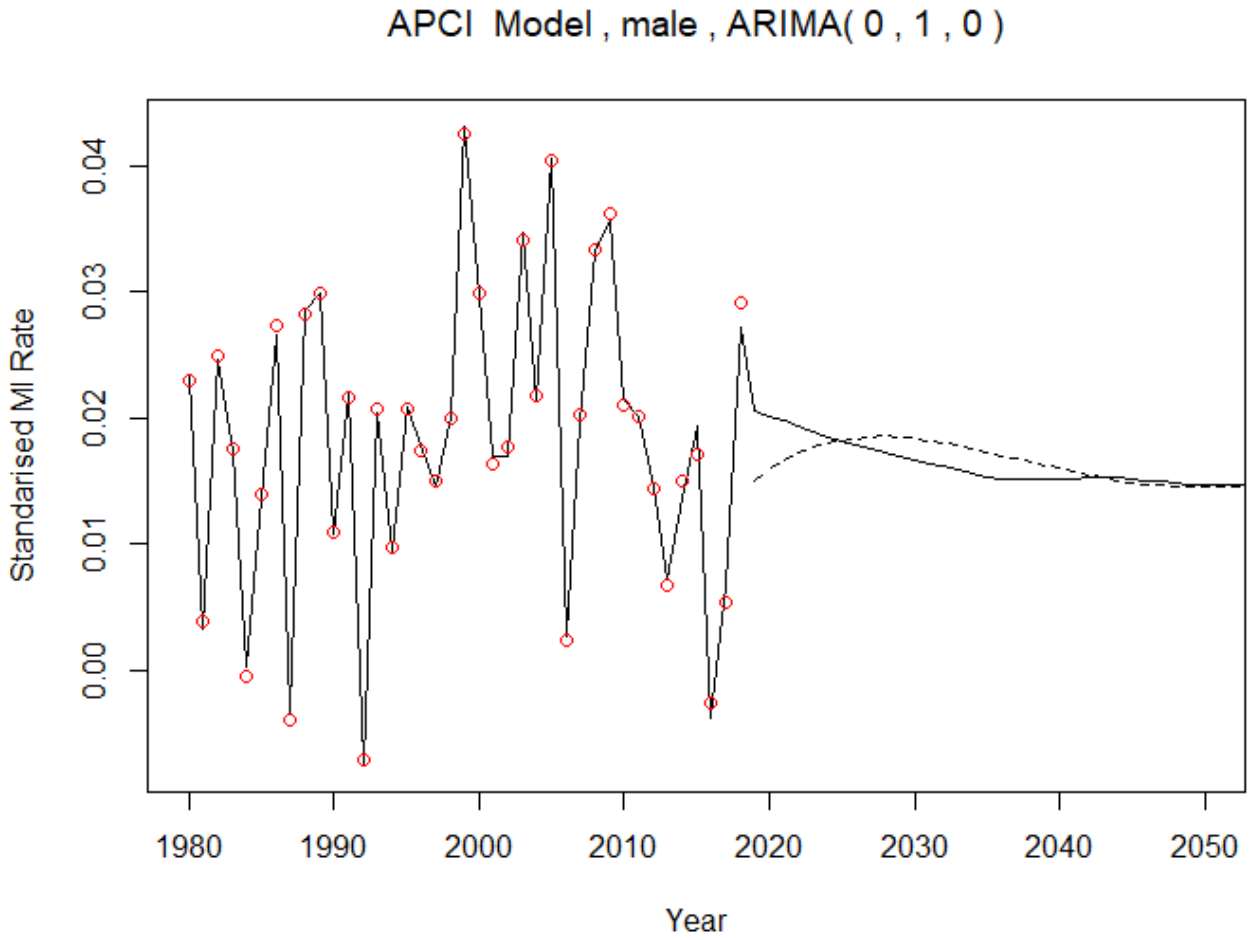
CMI Method Illustrated

Historical MI

- Crude rates (red circles)
- APCI Model (solid line)

Future MI

- APCI Model (solid line)
- CMI Projection (dashed line)



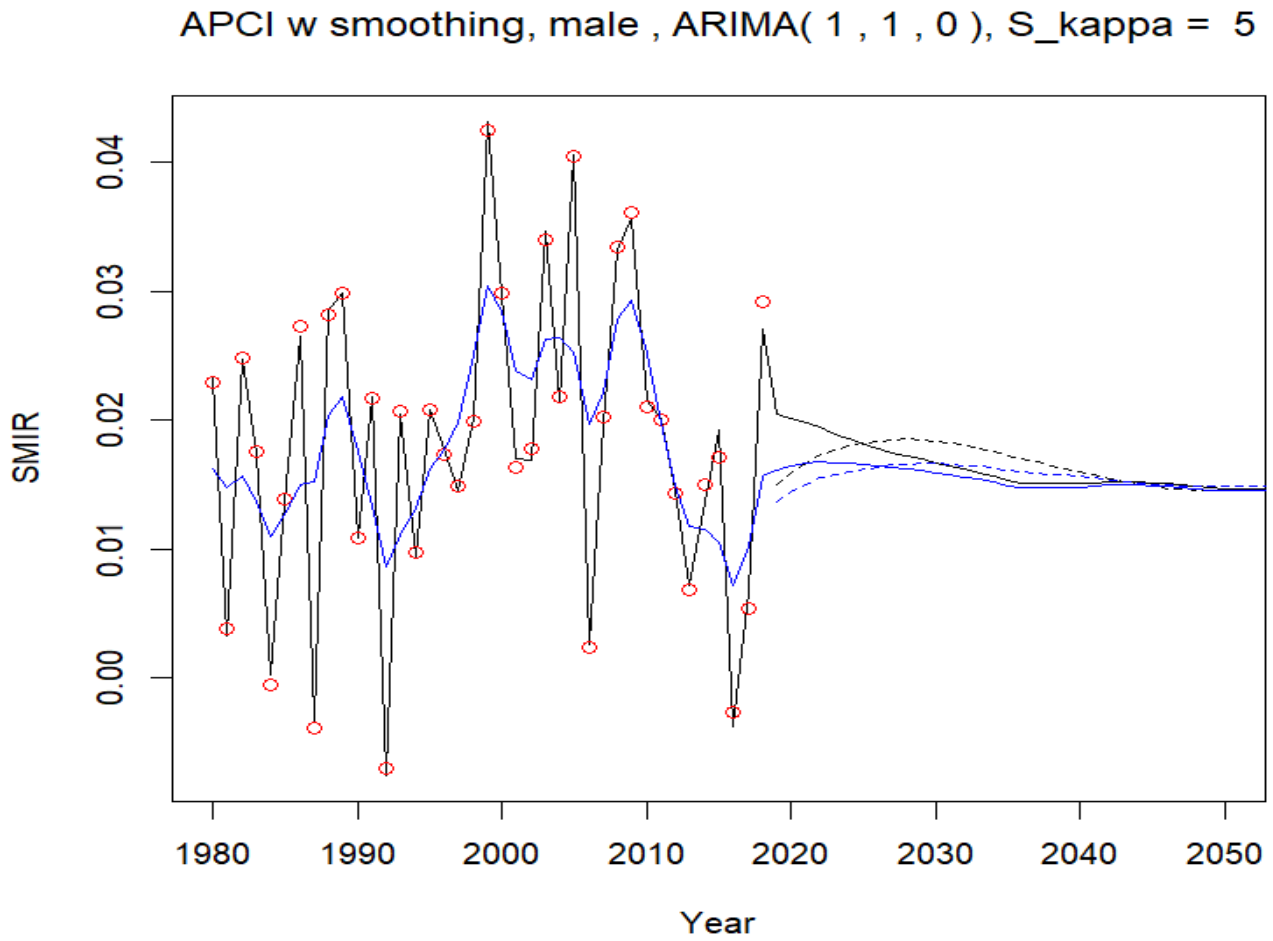
CMI Method Illustrated

Historical MI

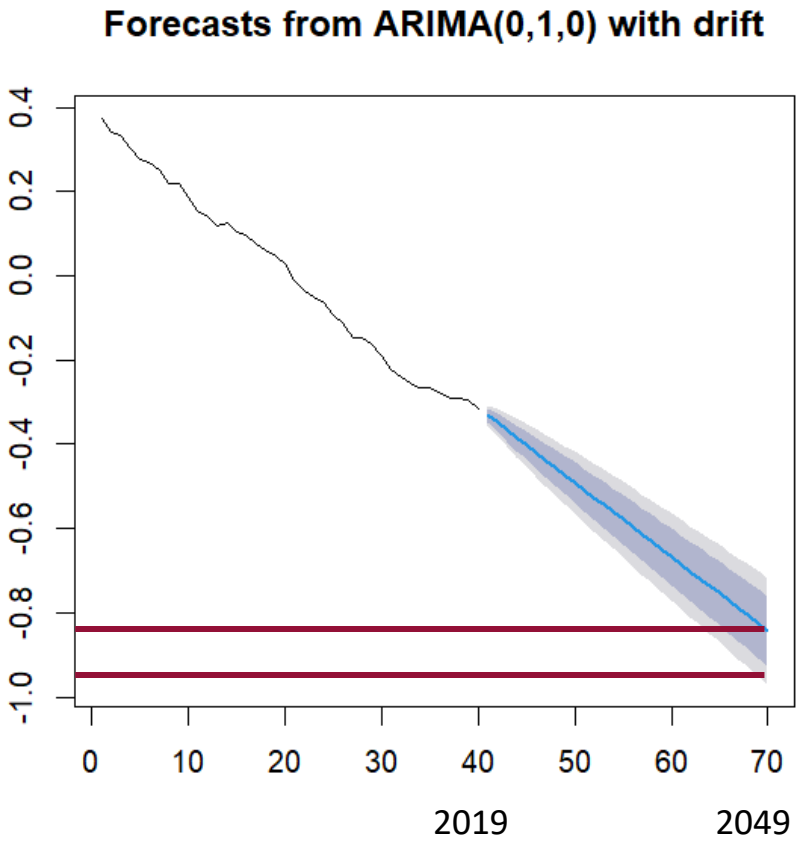
- Crude rates (red circles)
- APCI Model (solid line)

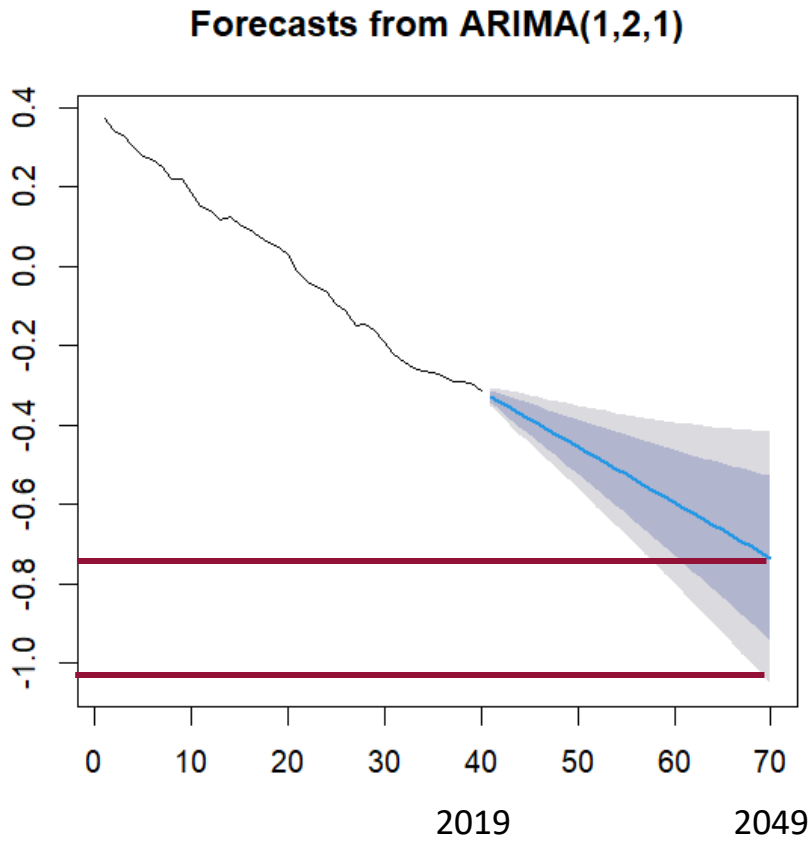
Future MI

- APCI Model (solid line)
- CMI Projection (dashed line)
- Smoothed kappa (blue lines)



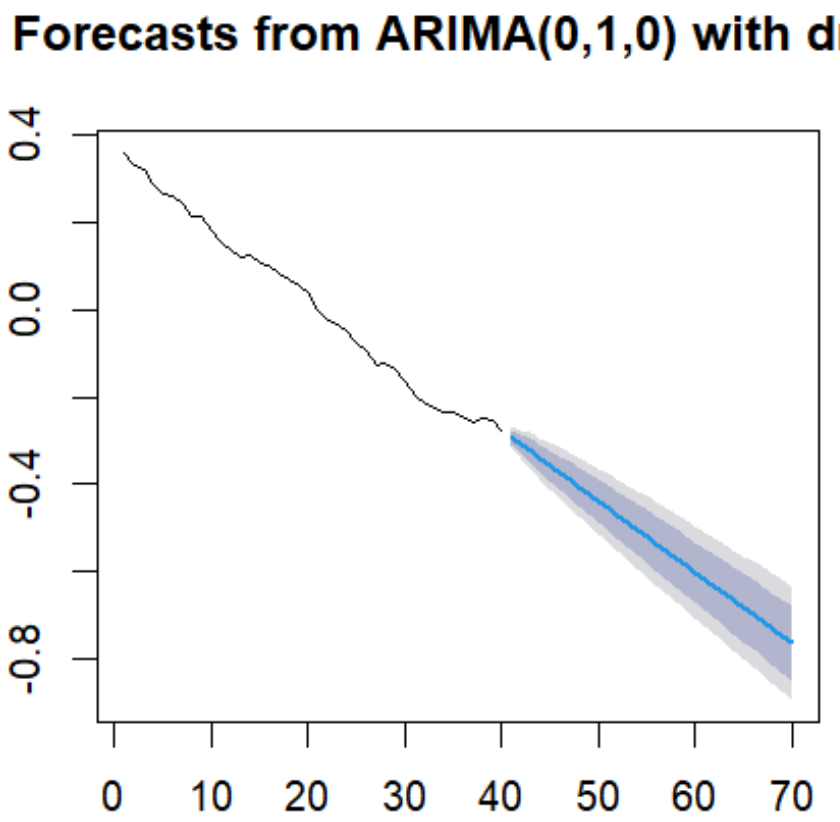
ARIMA model forecasts for APC model

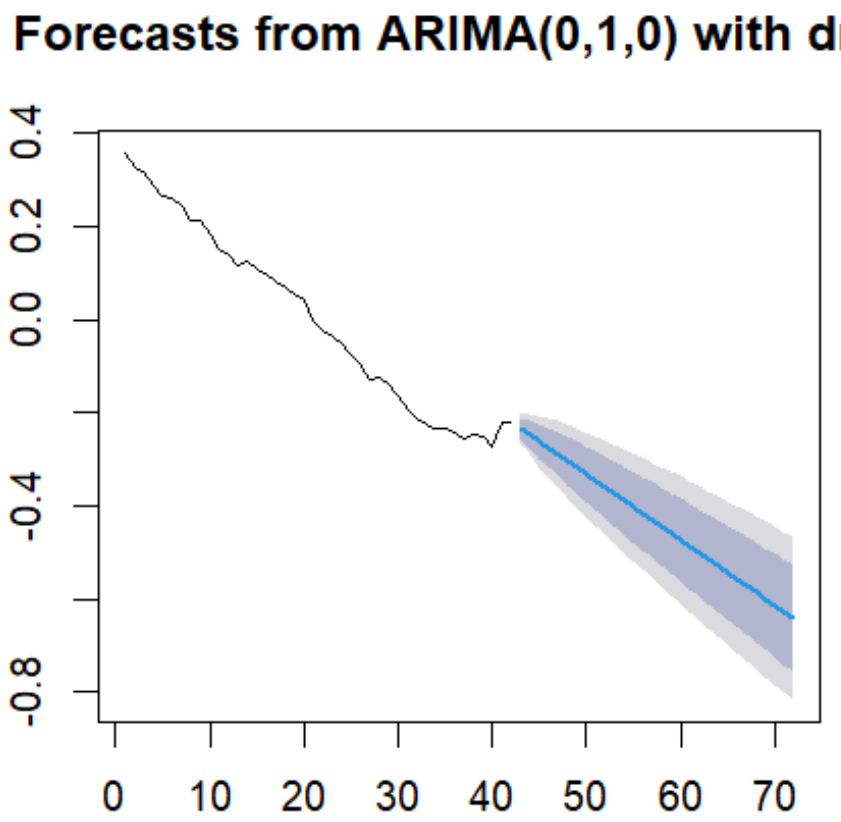




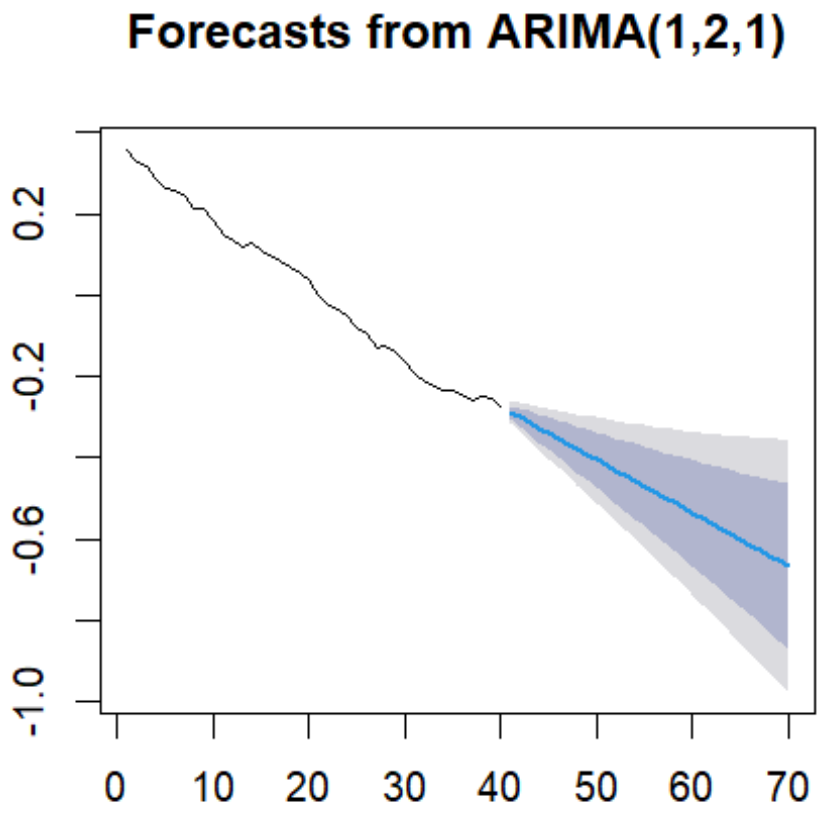
Allowance for COVID-19

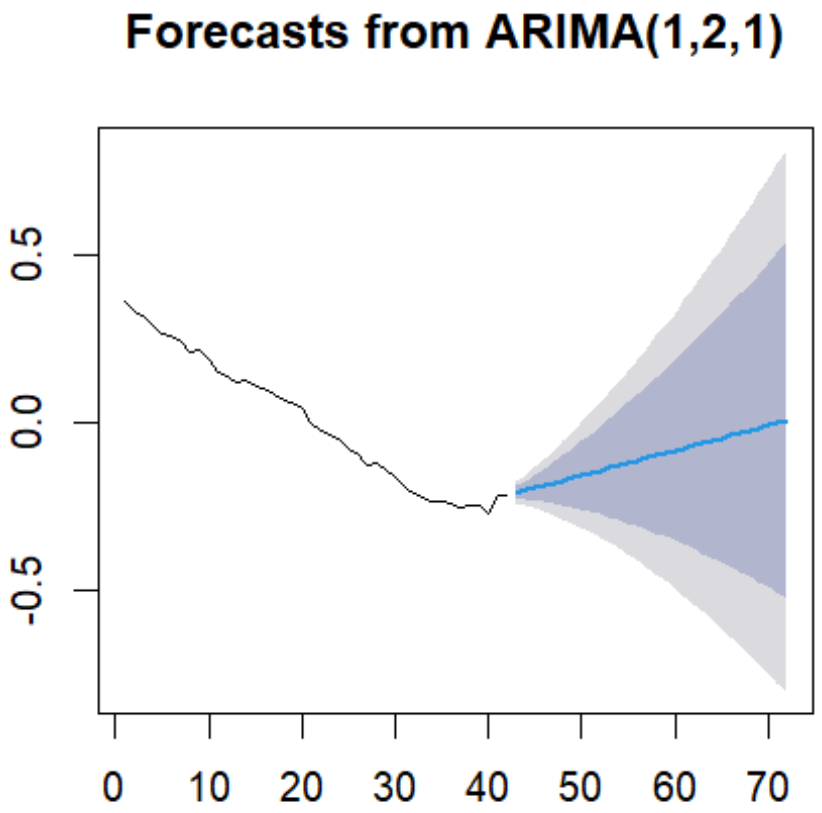
Adding COVID-19 experience naively





Naïve modelling can go really wrong!

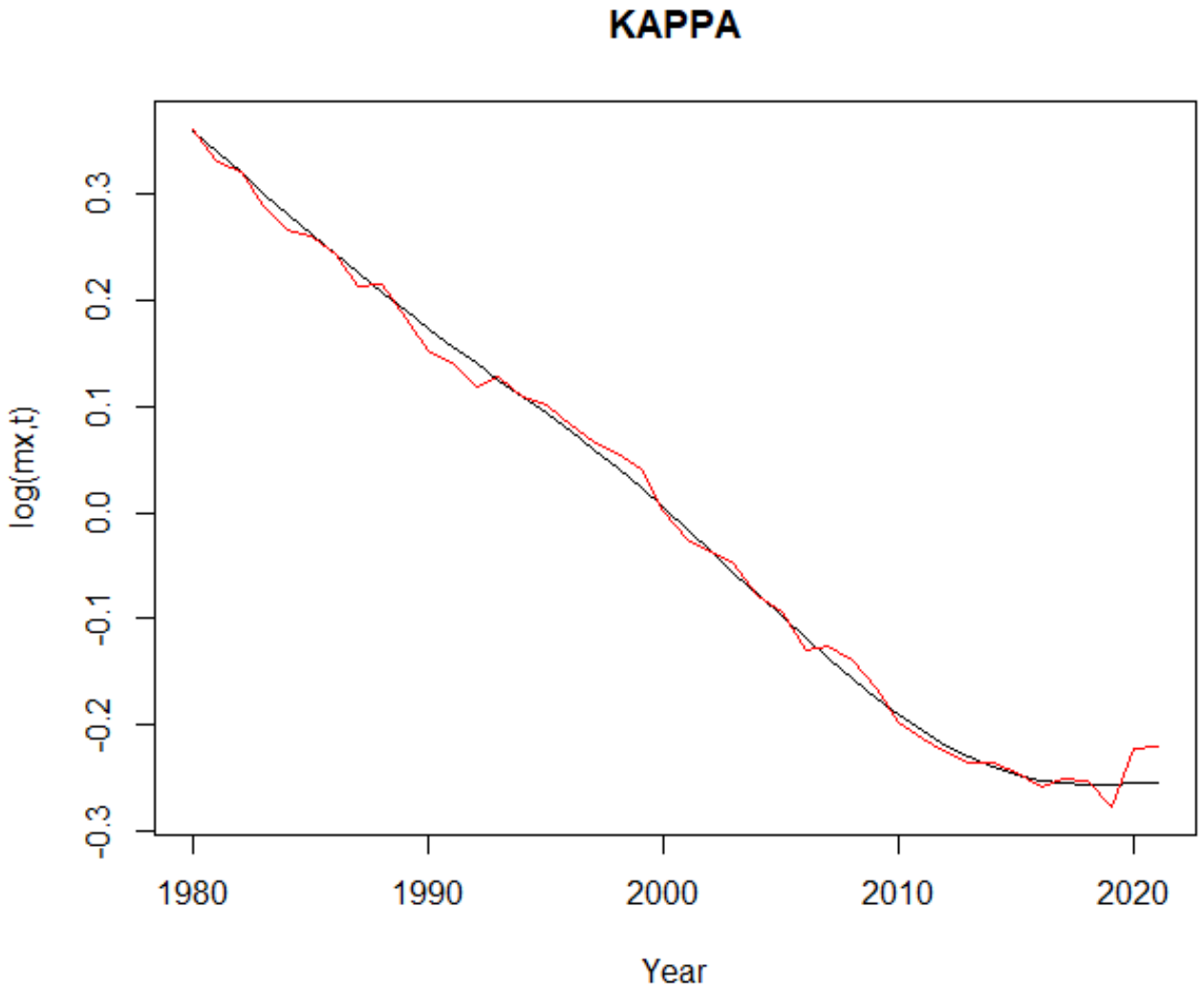




PQL Approach

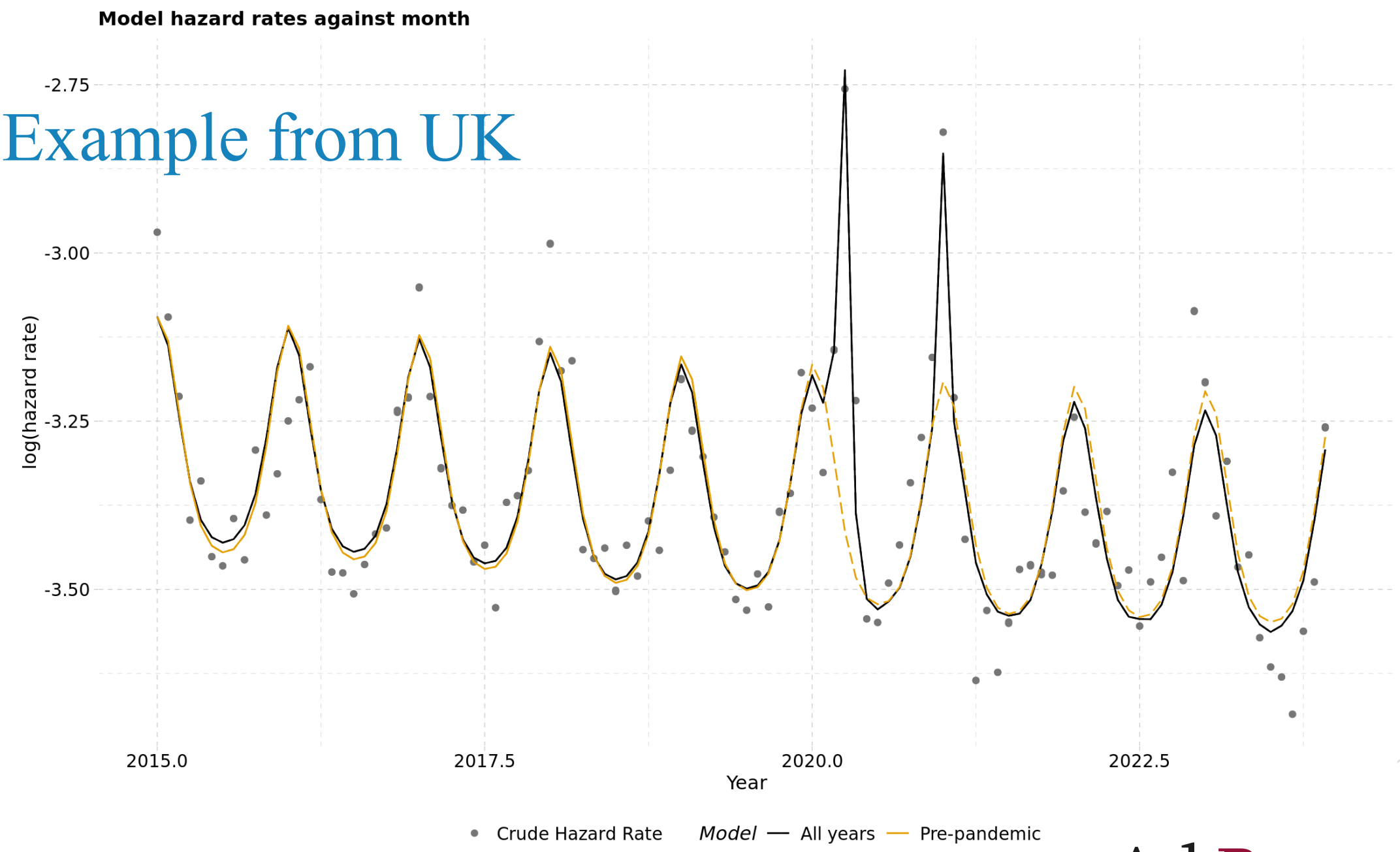
Penalised Quasi Likelihood

- Simultaneously fit stochastic parameters and ARIMA forecast
- Automatic smoothing eliminates COVID-19 spike
- Expert opinion to add spike explicitly

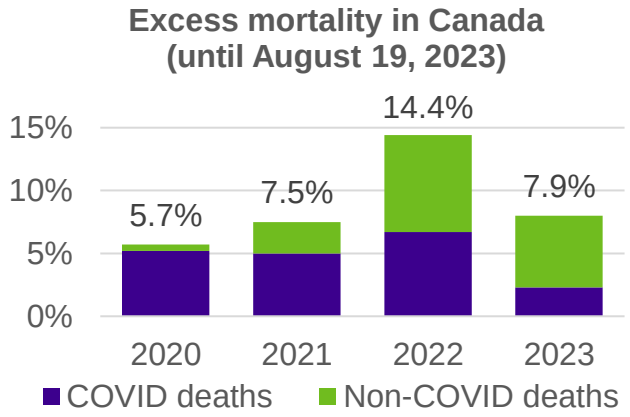


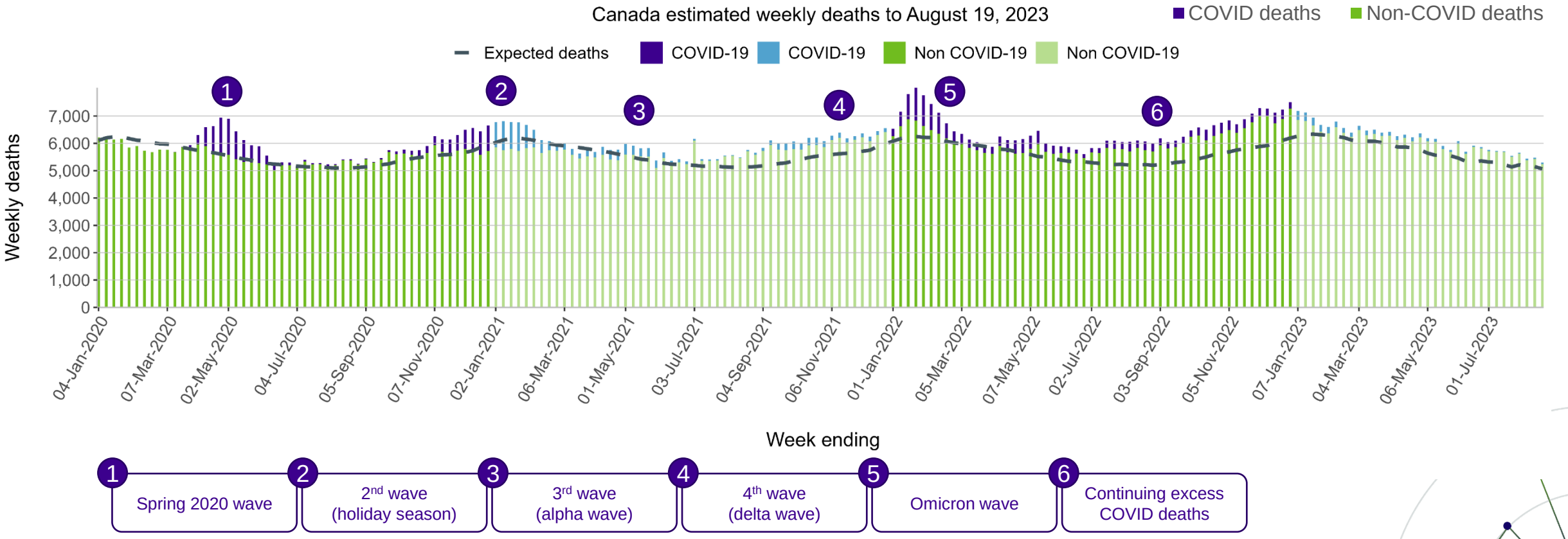
Zhou, Rui & Li, Johnny (2022): A multi-parameter-level model for simulating future mortality scenarios with COVID-alike effects, *Annals of Actuarial Science*. 16. 1-25.

Example from UK



Canadian population excess deaths





1. Spring 2020 wave
2. 2nd wave (holiday season)
3. 3rd wave (alpha wave)
4. 4th wave (delta wave)
5. Omicron wave
6. Continuing excess COVID deaths

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Source: Statistics Canada (Table 13-10-0792-01).
Data is limited for the following provinces: MB data until December 3, 2022, NB data until July 22, 2023, NS data until May 6, 2023 and ON until July 15, 2023.

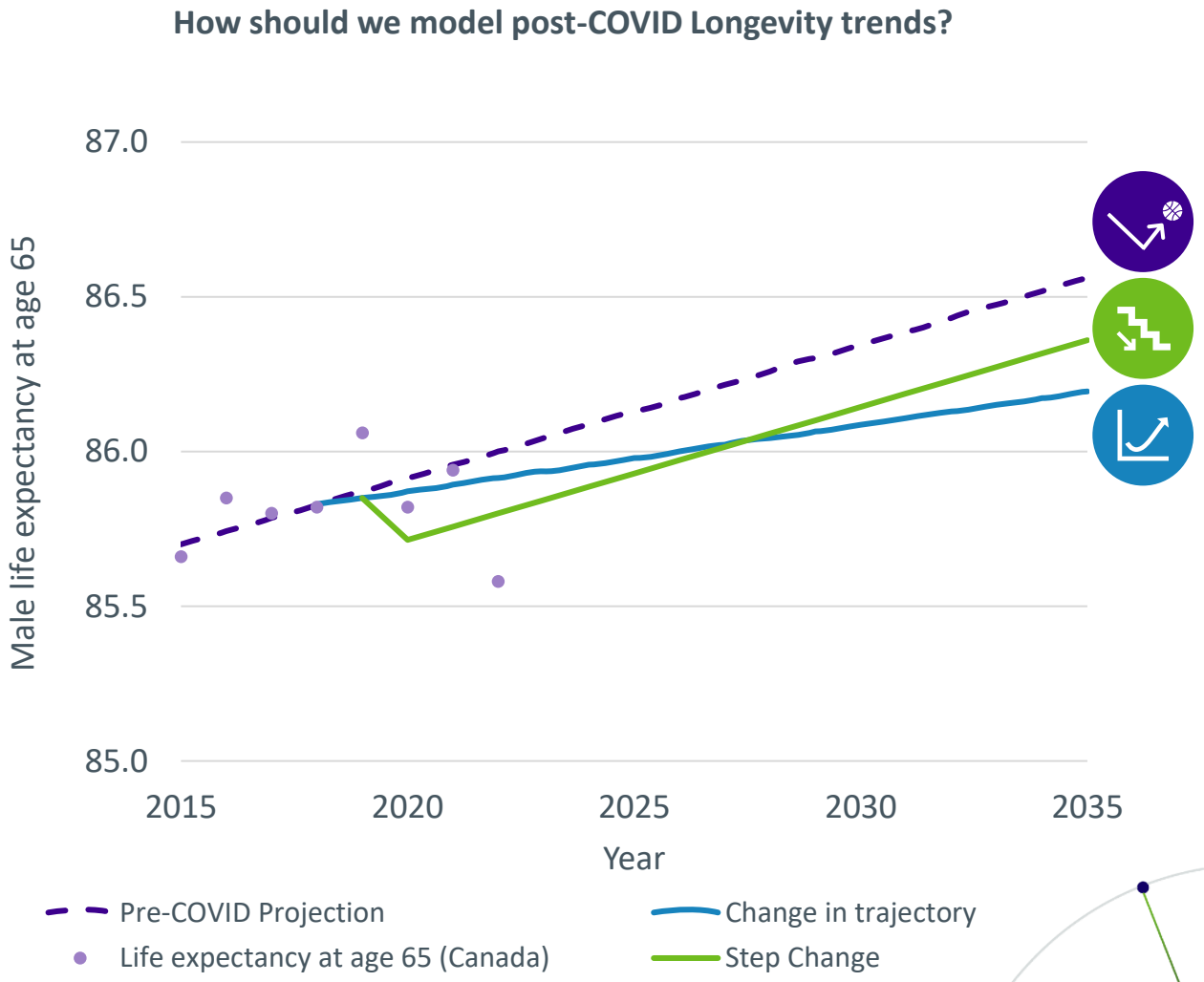
Representative of what?

Continuation of trend / bounce back?
No significant change to mortality rates as a result of the COVID-19 pandemic

Change in Trajectory?
A long-term impact on mortality improvements with longer lasting effects

Step Change?
A short-term adjustment to base rates, with faster improvements shortly picking up

In practice, some combination probably appropriate



Source for purple dots: Table 13-10-0837-01 Life expectancy and other elements of the complete life table, single-year estimates, Canada, all provinces except Prince Edward Island

Many stakeholders are now looking to reflect impact of COVID on future mortality…

Extent to which will depend on a variety of factors:

- Geographical concentration
- Socio-economic groups
- Select populations (eg insured population)

Various modelling approaches available. Most appropriate will depend on judgement of post pandemic outlook.

Bounce Back

Change in Trajectory

Step Change

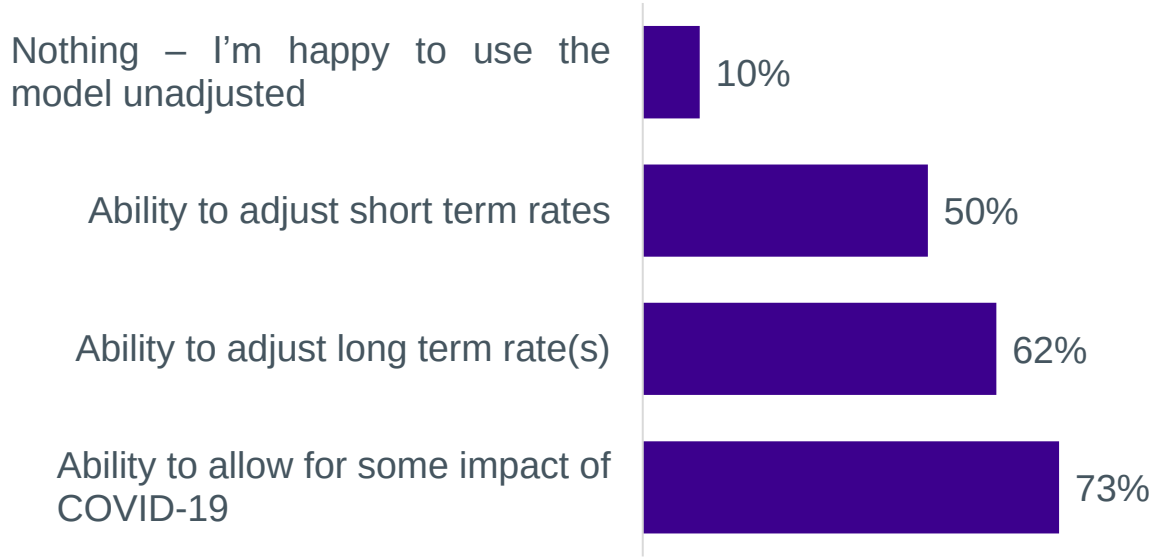
OR

Combination

Poll

Which of the following adjustments would you find useful for implementation?

Select all that apply:



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Q&A

Thank you