

Royal College of Physicians, Edinburgh.

# Challenges in projecting longevity

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# 1. About the speaker

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# 1. About the speaker

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- Consultant on longevity risk since 2005
- Founded longevity-related software businesses in 2006:



- Joint venture with Heriot-Watt in 2009:



# 2. Background

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## 2. Background

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*“The actuary’s interest in the trend of mortality has taken on a more pressing character in recent years, for the trend at the older ages has become one of the great actuarial problems of the immediate future.”*

**A. Pedoe**

Source: Gwilt (1956), page 167

# 3. Model risk

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# 3. Model risk

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- How do you know your model is correct?
- What are the consequences if it is not?
- What independent scrutiny has the model had?



### 3. Model risk — peer review

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- Claims of “transparency” are not enough!
- Model must be openly published...
- ...and open to academic scrutiny

# 4. Targeting models

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# 4. Targeting models

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- Some models have targets:
  - for long-term improvement rate (CMI 1999, 2009–2011)
  - for maximum reduction factor
  - for maximum life expectancy
- Models with targets or limits have a spotty record...

## 4. Targeting models

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*“experts have repeatedly asserted that life expectancy is approaching a ceiling: these experts have repeatedly been proven wrong.”*

**Oeppen and Vaupel (2002)**

*“The disadvantage [of expert opinion] is its subjectivity and potential for bias. The conservativeness of expert opinion with respect to mortality decline is widespread, in that experts have generally been unwilling to envisage the long-term continuation of trends, often based on beliefs about limits to life expectancy.”*

**Booth and Tickle (2008)**

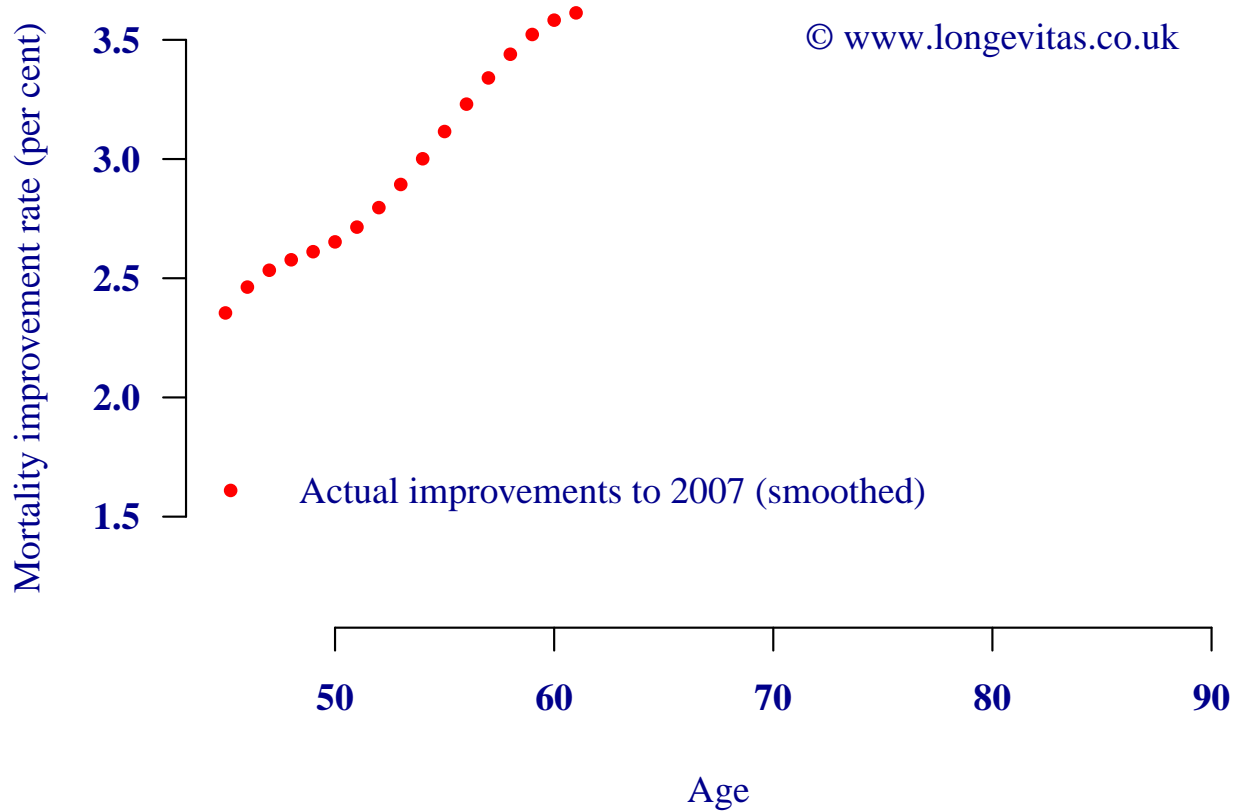
## 4. Targeting models — CMI 2010

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- Deterministic
- Defaults to projecting *decelerating* mortality improvements...

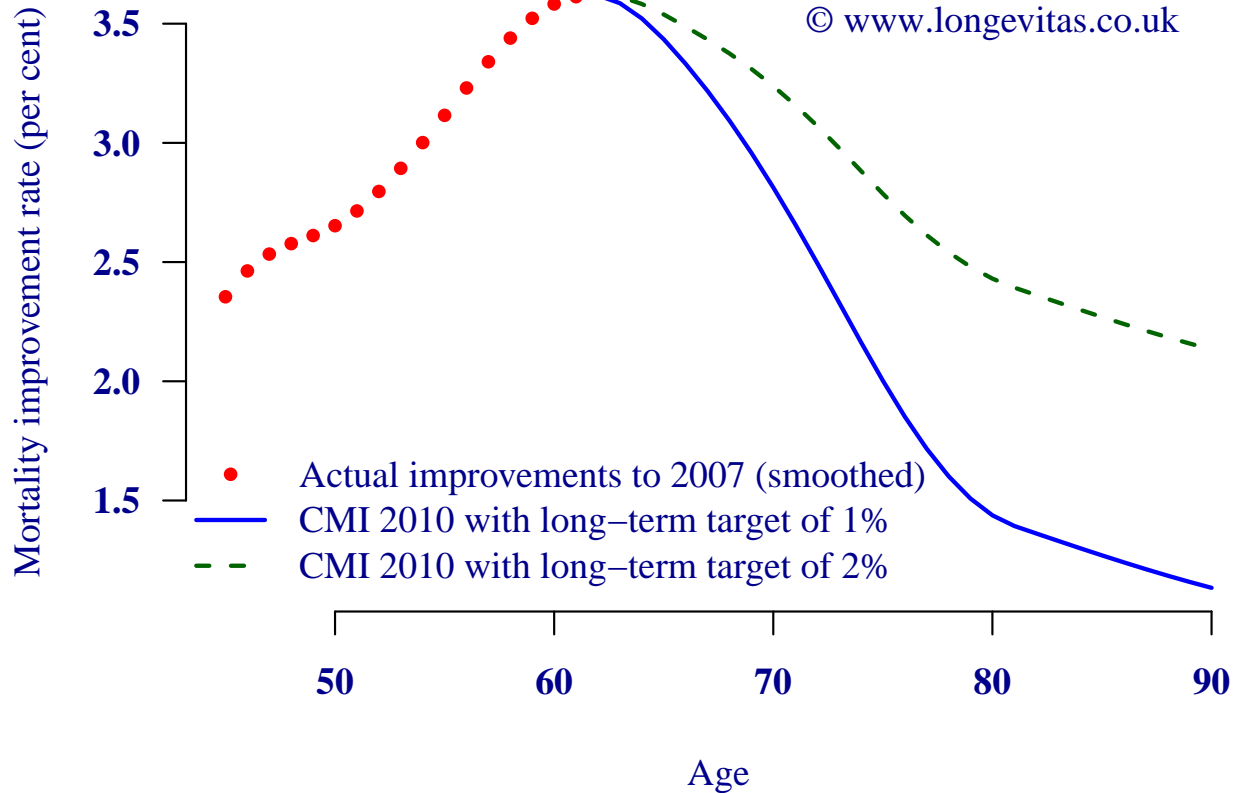
# 4. Targeting models — CMI 2010

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Source: Improvement rates labelled “actual” in [CMI 2010](#).

# 4. Targeting models — CMI 2010



Source: Smoothed actual mortality-improvement rates for males born in 1946, together with projected rates according to CMI 2010 model using default parameters and a long-term target of 1% or 2% improvement per annum.

## 4. Targeting models

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- CMI 2010 is at least published and open to scrutiny — Richards (2011)
- Beware unpublished models with built-in limits or targets



# 5. Cause-of-death data

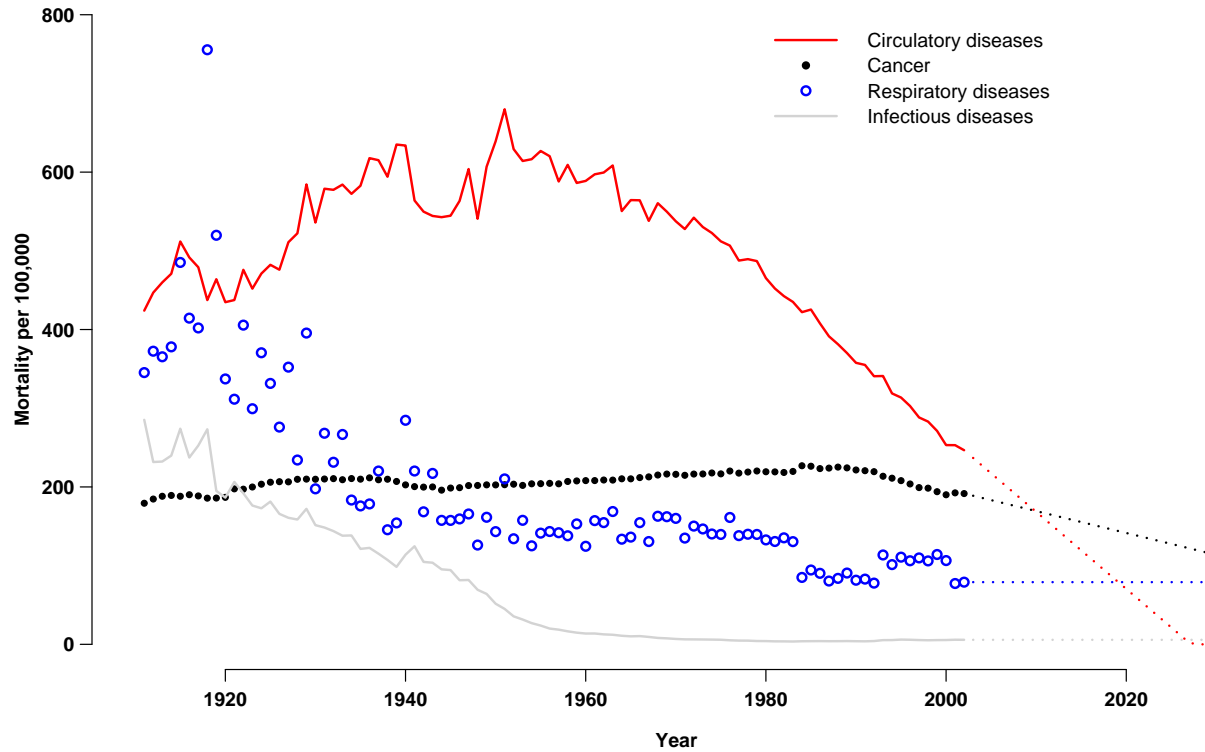
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# 5. Cause-of-death data

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- Useful for understanding the past...

# 5. Cause-of-death data



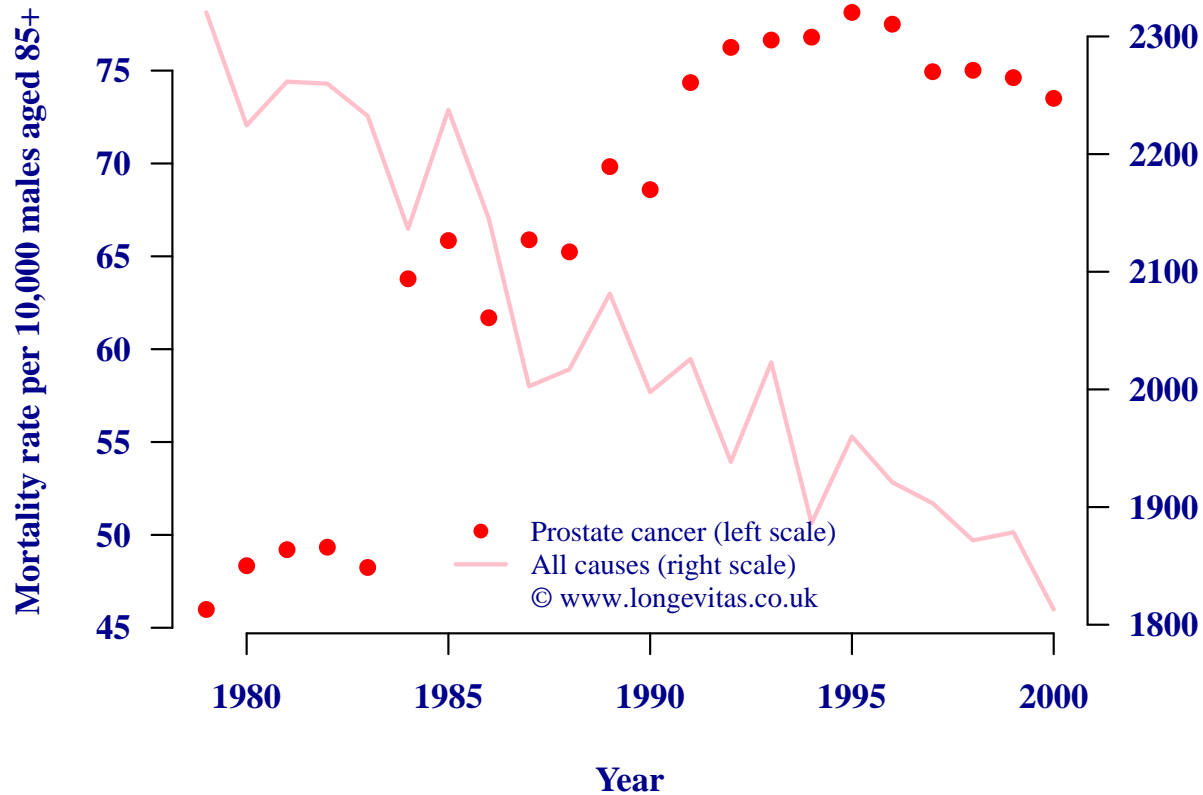
Source: ONS data with own extrapolations.

## 5. Cause-of-death data

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- ...but less useful for projecting the future
- Tends to under-state improvements — CMI (2004), Wilmoth (1995)
- Many difficult hurdles for CoD projections listed in Richards (2010)
- Problems begin with the data...

# 5. Cause-of-death data



Source: ONS data.

## 5. Cause-of-death data

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- Examined and rejected as basis for projection:

*“Projections of mortality should not be carried out by cause of death.”*  
**GAD (2001)**

*“historic cause-specific mortality rates are not as reliable for older ages, reducing the credibility of projections based on them.”*  
**CMI (2004)**

# 6. Extrapolative models

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# 6. Extrapolative models

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- Continuation of existing trends
- No pre-conceived targets
- Stochastic models deal explicitly with uncertainty



# 6. Extrapolative models

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- Paradox:

- a model which fits the data poorly may yield useful projections
- a model which fits the data well may be unsuitable for projections

# 7. Uncertainty

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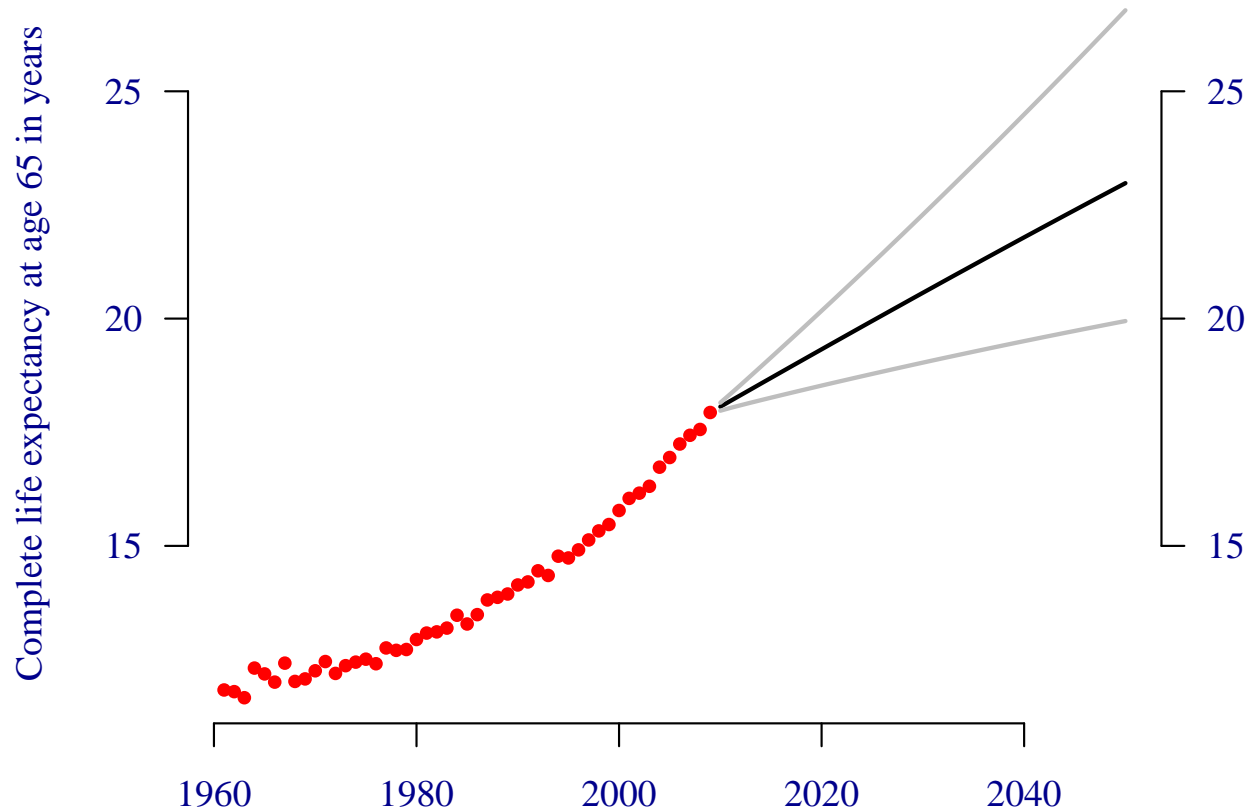
# 7. Uncertainty

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- Motto of Institute of Actuaries was “certum ex incertis”
- “certainty out of uncertainty” is not a good mindset for longevity risk!

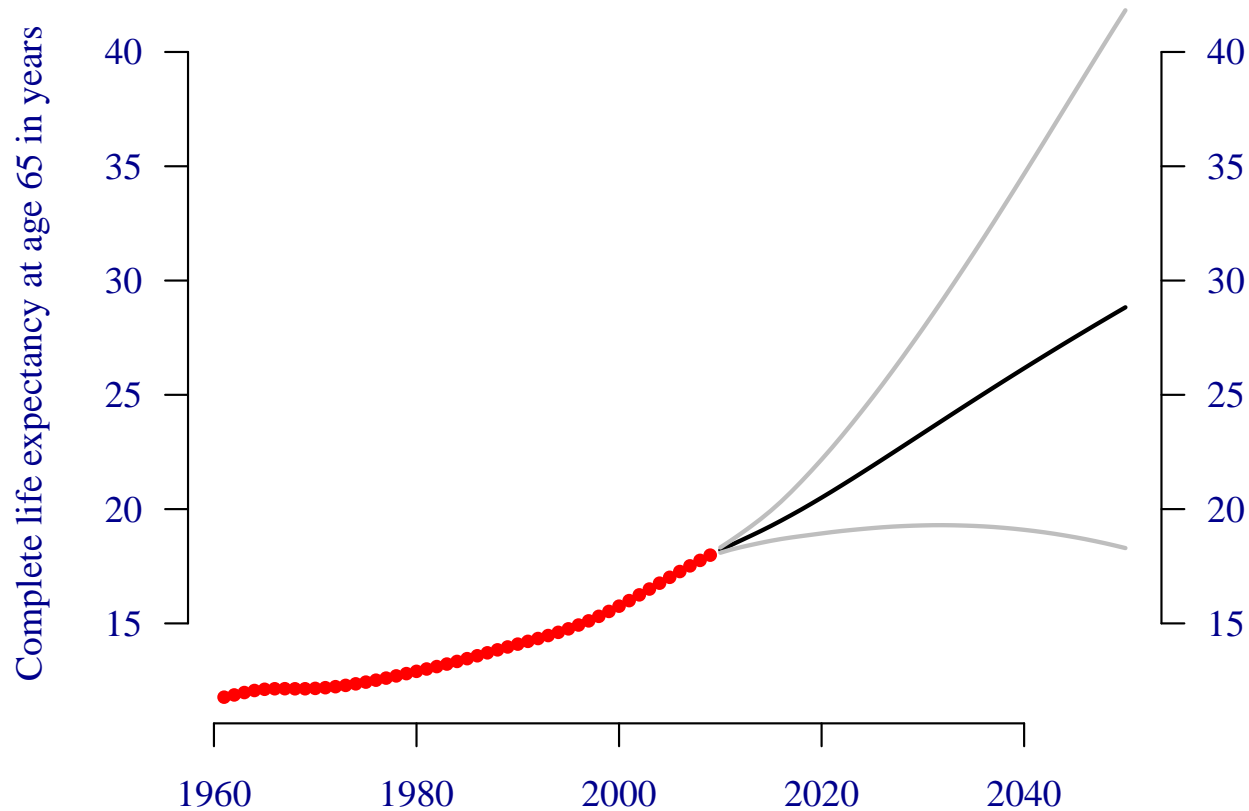
# 7. Uncertainty — period $e_{65}$ using CBD model

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Source: Longevity Ltd. Data for males in England and Wales aged 60–104 between 1961 and 2009 fitted to model proposed by Currie (2011), based on model of Cairns, Blake and Dowd (2006).

# 7. Uncertainty — period $e_{65}$ using 2DAP model



Source: Longevity Ltd. Data for males in England and Wales aged 60–104 between 1961 and 2009 fitted to 2D P-spline model proposed by Richards, Kirkby and Currie (2006).

## 8. Conclusions

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- Stochastic projection models essential to manage uncertainty
- Beware trend reversal in CMI core projection model...
- ...or any other model with maximum improvements
- All-cause projections more robust than cause-of-death methods
- Never rely on a single projection model



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