Finnish reference mortality K2004 and mortality trends

IAA Life 2007 in Stockholm

June 2007

Mika Mäkinen

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LIFE ASSURANCE COMPANY LTD.

Finnish reference mortality K2004

- Cohort model
- No safety margin
- For Finnish life insured
  - Risk selection is based on Retro Life Assurance company's *Guidelines for risk assesments in life and sickness insurance*

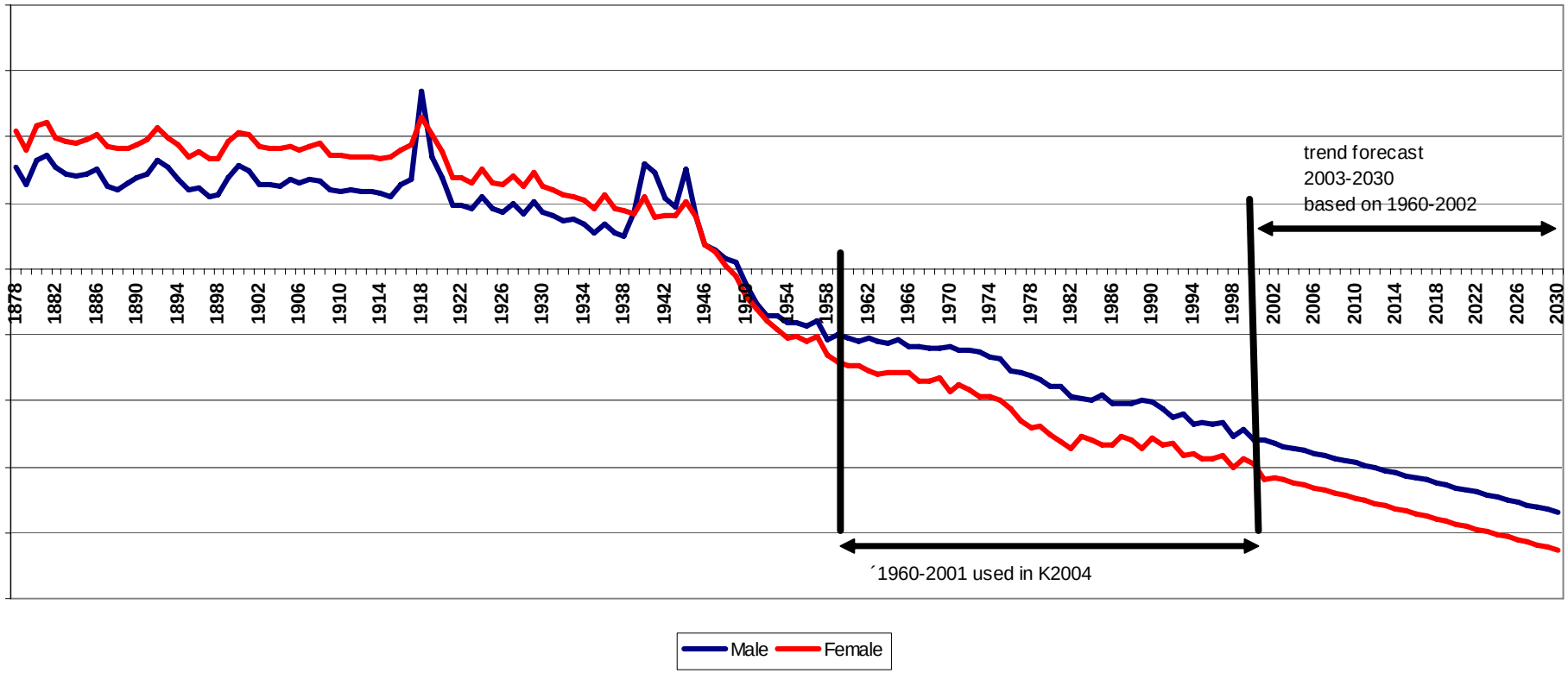
Finnish reference mortality K2004

- Based on
  - Finnish population mortality 1960-2001
  - Finnish life insured mortality 1991-2001
- Has been done with Lee-Carter method with Singular Value Decomposition (SVD)
  - Least-squares fit by using SVD has been made to population data and the result was converted to mortality of life insured

Singular Value Decomposition (SVD)

- Doing SVD to population mortality results two different matrices, Delta represents yearly change of mortality and Beta describes strength of change in different age groups

Finnish mortality trends 1878-2002 [Delta]



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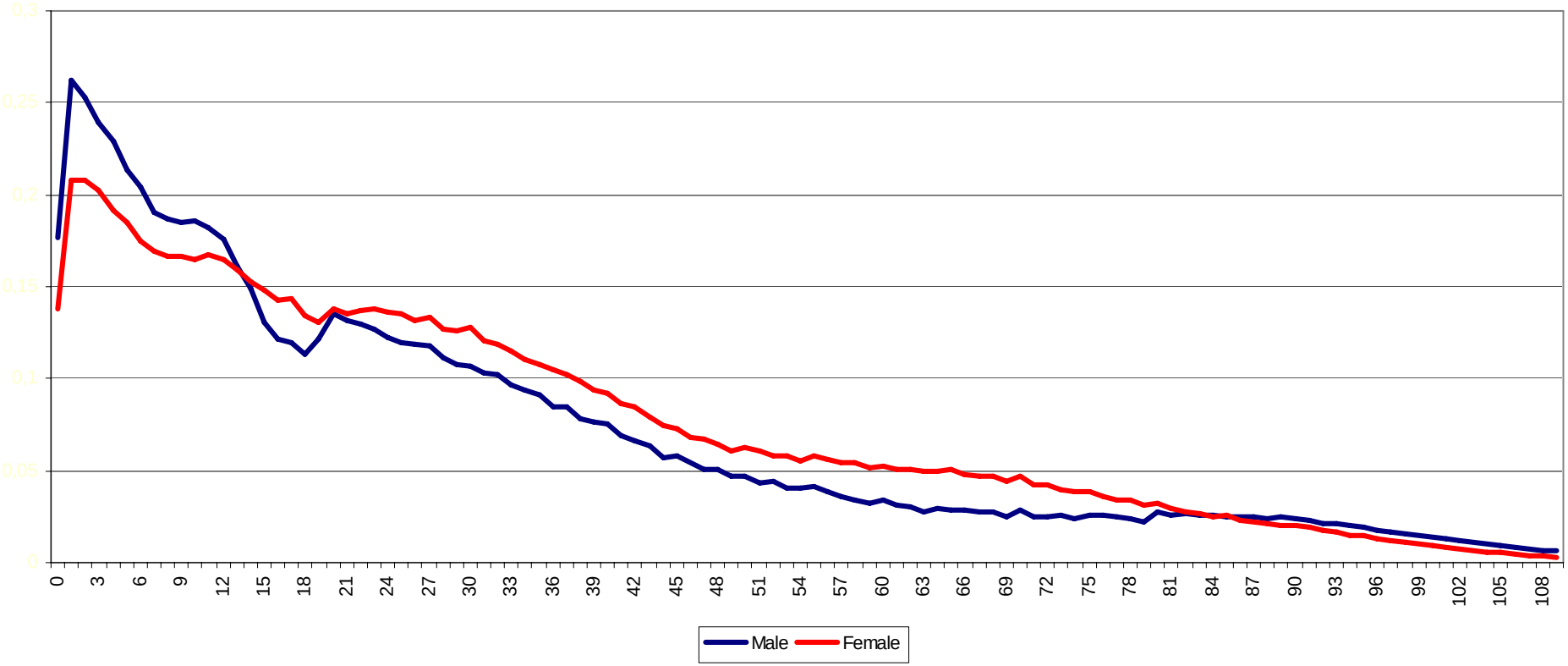
Changes in mortality per age (1878-2002) [Beta]



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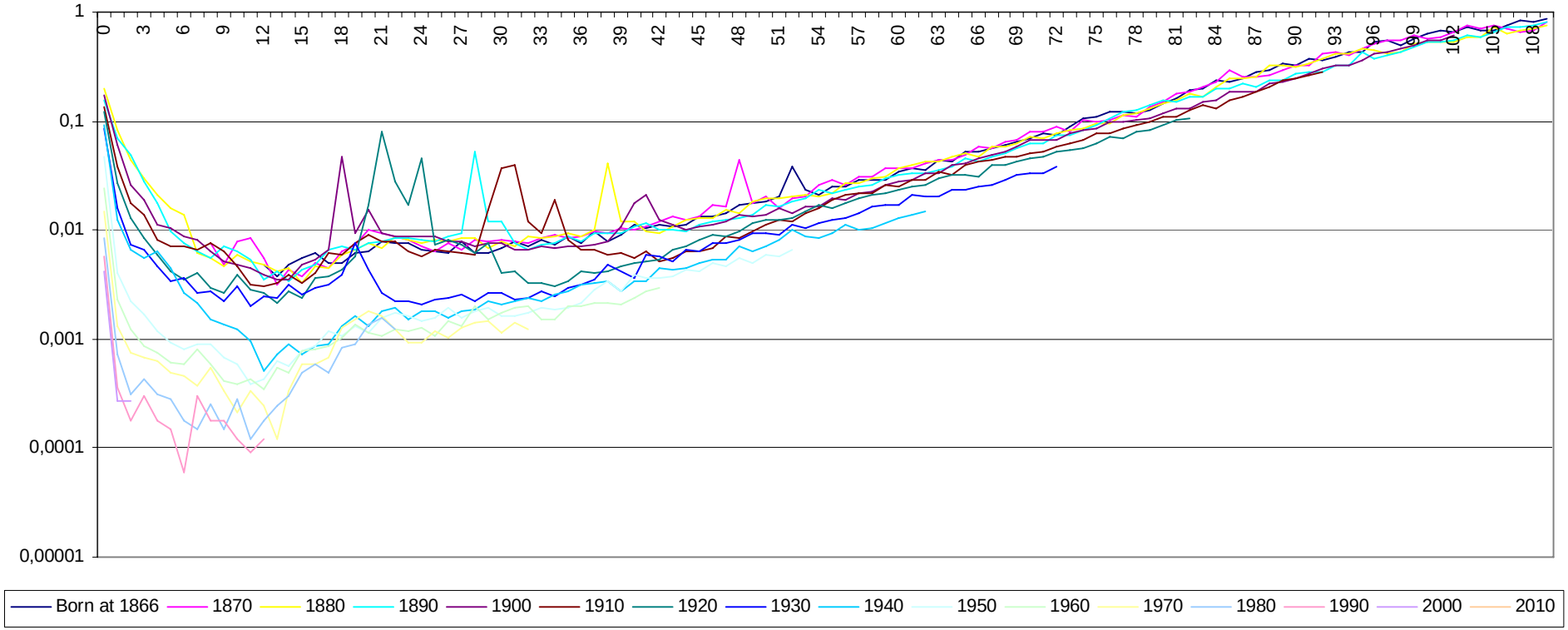
Observed mortality cohorts (log scale)
Males



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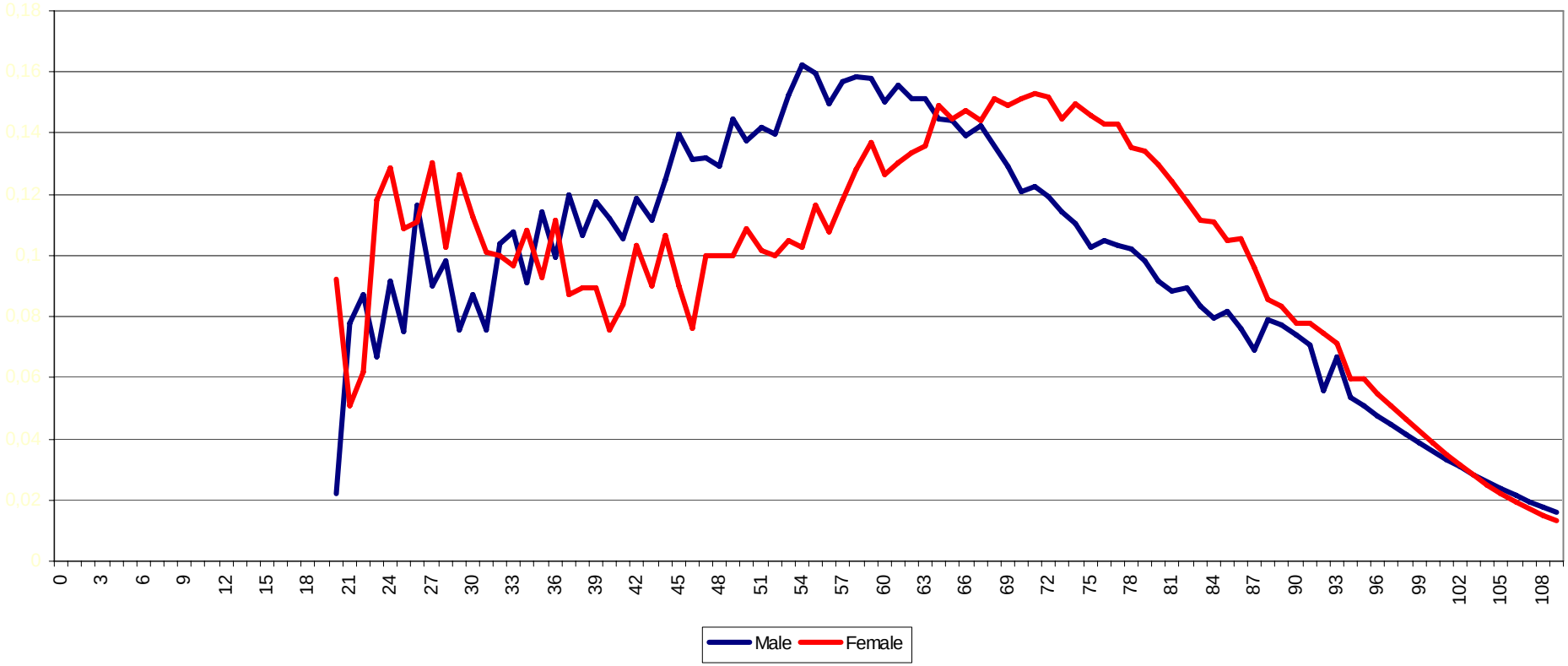
Changes in mortality per ages 19-110 (data 1960-2002) [Delta]



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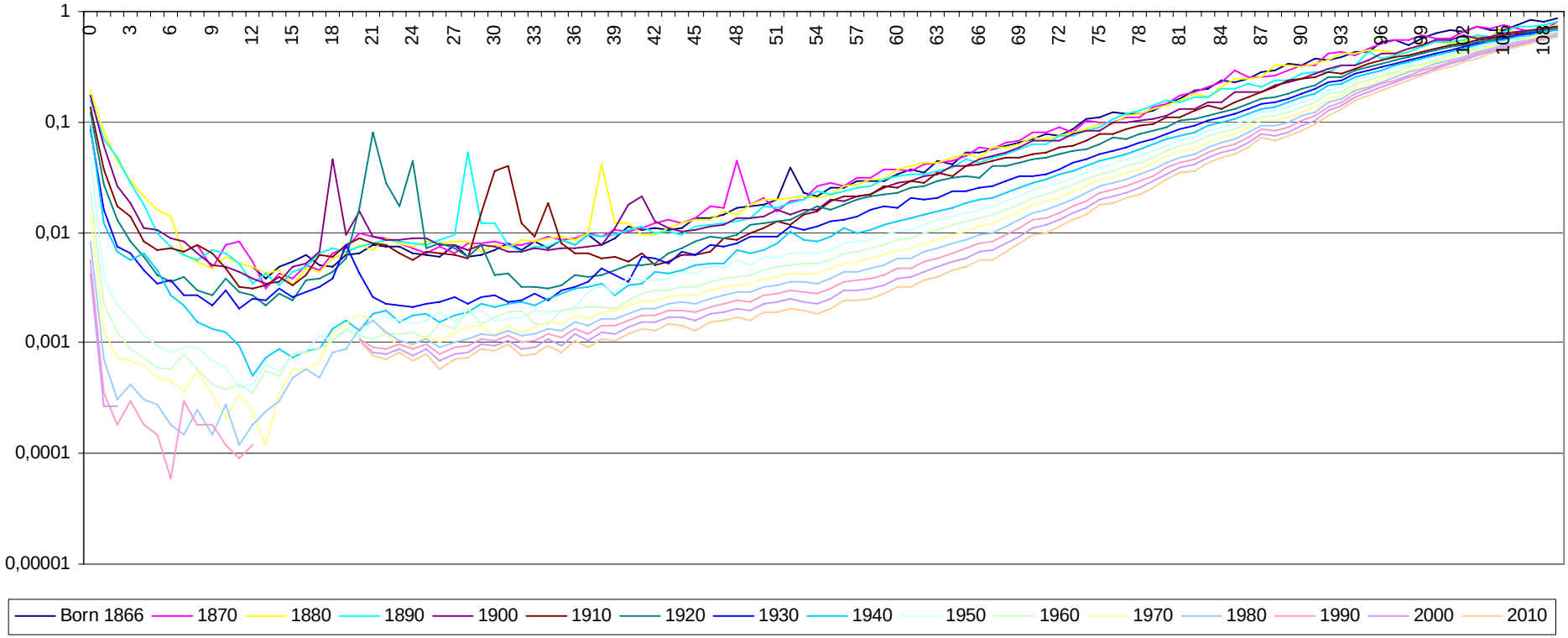
Observed mortality cohorts and forecast (log scale)
Males



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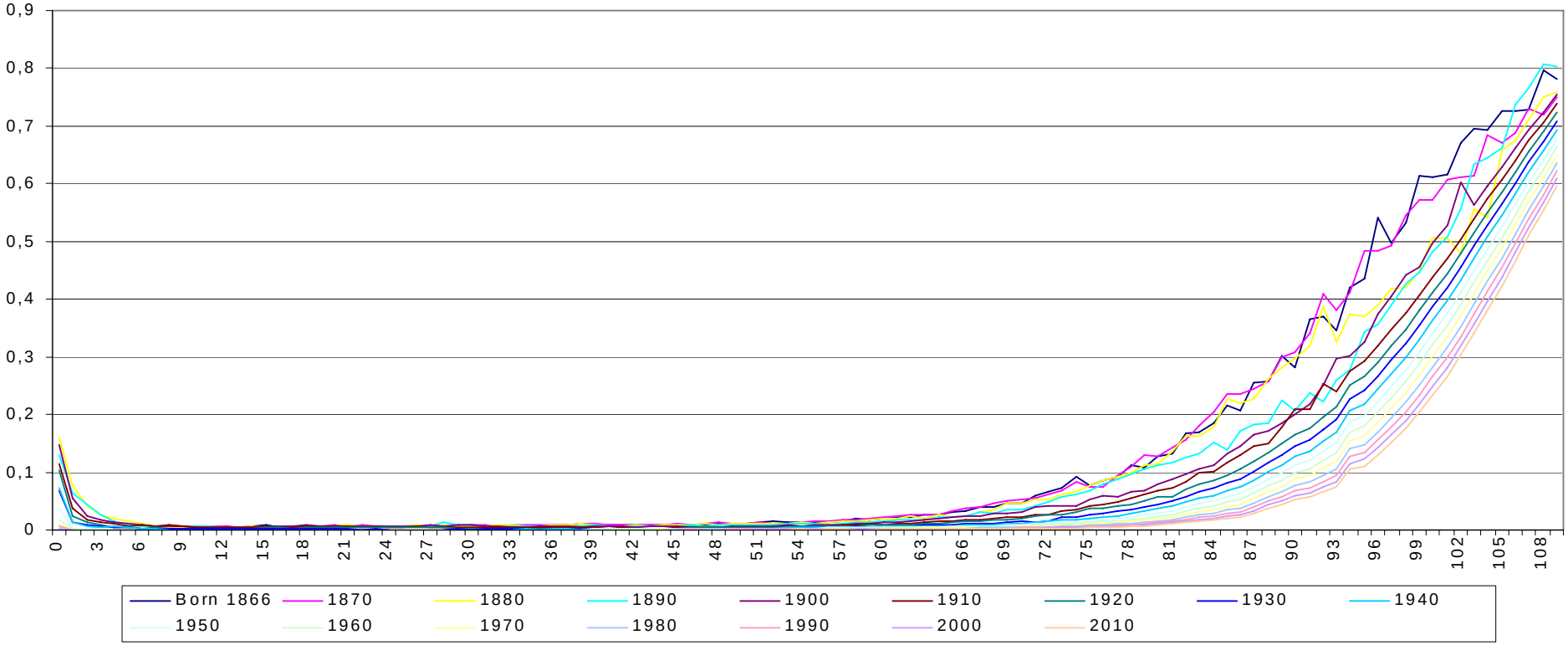
Observed mortality cohorts and forecast
Females



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Finnish reference mortality K2004

K2004 mortality for an insured born in year *sv* and aged now x year is:

$$\mu_{sp}(x, sv) = \max\{0.0001, a_{sp}(sv)\} + e^{c_{sp}(x,sv)}$$

where gender-depedent (male sp=0, female sp=1) functions are

$$a_0(sv) = 10^{-5} \cdot 0.744 \cdot (2070 - sv)$$
$$a_1(sv) = 10^{-5} \cdot 0.206 \cdot (2019 - sv)$$

$$c_0(x, sv) = 0.05438 \cdot (1716 - sv) + 0.000533 \cdot (sv - 1719) \cdot x - 0.000217 \cdot (sv - 1843) \cdot \max\{0; x - 81\}$$
$$c_1(x, sv) = -11.51 + 0.000316 \cdot (2253 - sv) \cdot x - 0.000783 \cdot (sv - 1916) \cdot \max\{0; x - 71\}$$

Future development and possible problems

- How will the trend continue?
- Follow-up of mortality development
- Small Finnish market -> small portfolio of life insured