What methods do you suggest for the projection of longevity risk for a pension fund?

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Prüfungskolloquium Aktuar SAV
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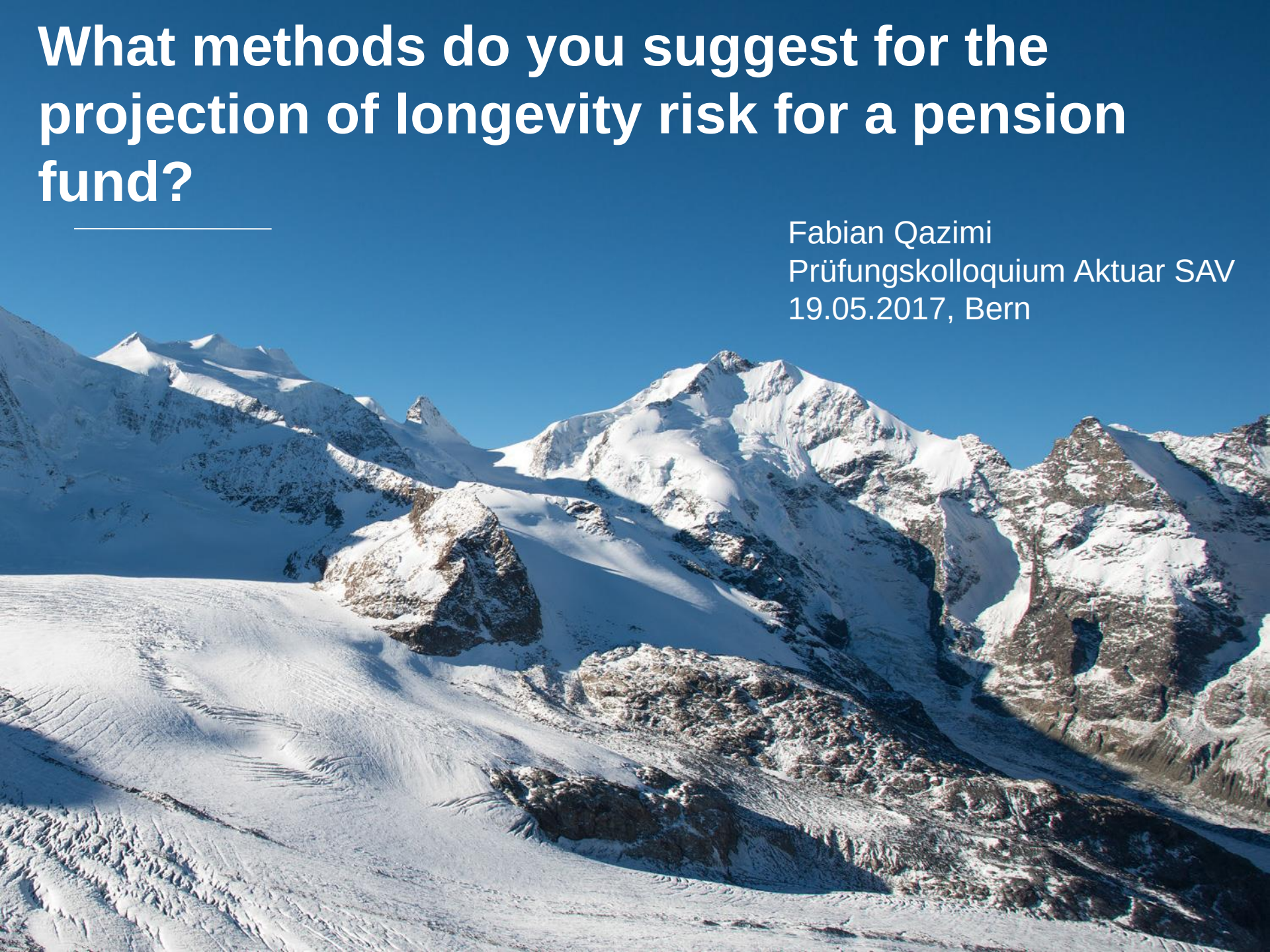
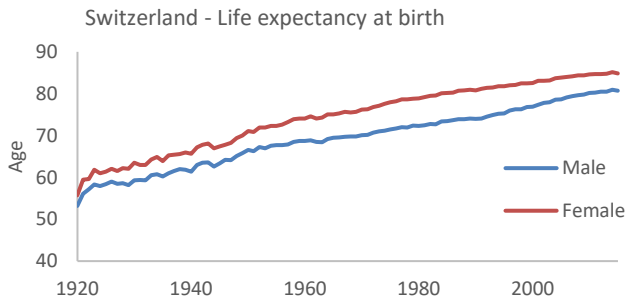


Agenda

1. **Introduction**
   - Demographic trends
   - Longevity risk
2. **Methods for forecasting longevity risk**
   - Approaches to longevity modeling
   - Swiss Market Practice
   - An application to the Swiss population
3. **Conclusions**

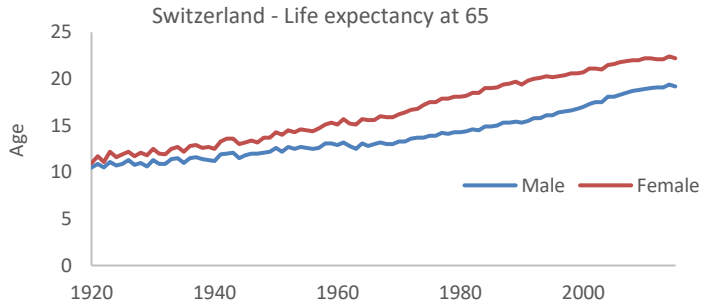
Demographic trends

Longevity is moving



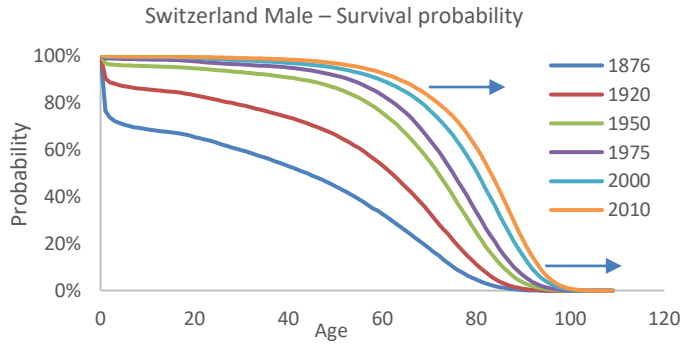
FSO 2016

Average increase of 2.5 months per year in the last 50 years for swiss male population.



FSO 2016

Longevity in Switzerland is moving.
There is a trend.



Rectangularization and expansion of survival probability functions.

We live longer and healthier ☺

Why does longevity matter?

Some facts

21-Milliarden-Loch der Pensionskassen

Die Lage ist extrem schlecht: Gemeinden und Kantone müssen ihren Pensionskassen noch lange eine Staatsgarantie bieten.

«Altersvorsorge 2020» in der Schwebe

Unterschätzte neue Umverteilung im BVG

Experten-Kolumne 27.04.2017 09:23:26

Ist die Schweizer Vorsorge sicher?

MEDIENMITTEILUNG 08.05.2017 - Der Vorstandsausschuss von economiesuisse hat an seiner heutigen Sitzung die Nein-Parole zur Reform der Altersvorsorge 2020 beschlossen.

Konservativen Anlegern bleiben nur wenige Optionen

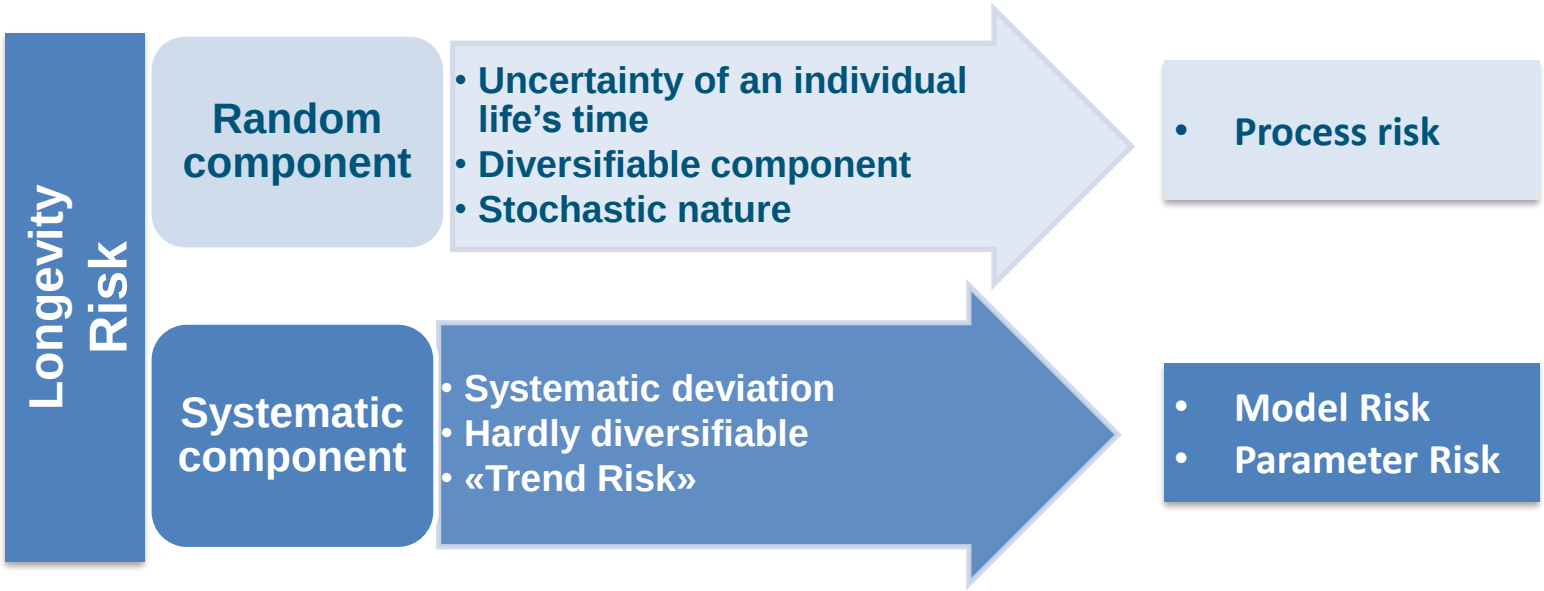
Urabstimmung der SP-Basis

Deutliches Ja zur Altersvorsorge 2020 von der SP

Longevity Risk

“Risk that people live longer than expected or provisioned for, leading to adverse financial impacts”

Why models matter?



The systematic component is dominant. Only this aspect will be discussed in the next slides

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Approaches to longevity forecasting

Approaches

	Expectation	Extrapolative	Explanatory
Overview	➢ Expert opinion ➢ **Deterministic**	➢ Future trends are a continuation of the past ➢ **Deterministic** and **stochastic** methods	➢ Structural or causal models for causes of death ➢ Based on expected future trends in deseases and determinants
Pros (+) & Cons (-)	**(+)** incorporation of future trends knowledge **(-)** bias potential **(-)** no intervals estimates	**(-)** ignore factors that might influence future mortality **(-)** relevance of past data series? **(+)** stochastic models available	**(+)** incorporation of valuable medical information **(-)** relation between risk factors and mortality not well understood

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Widely applied by actuaries!

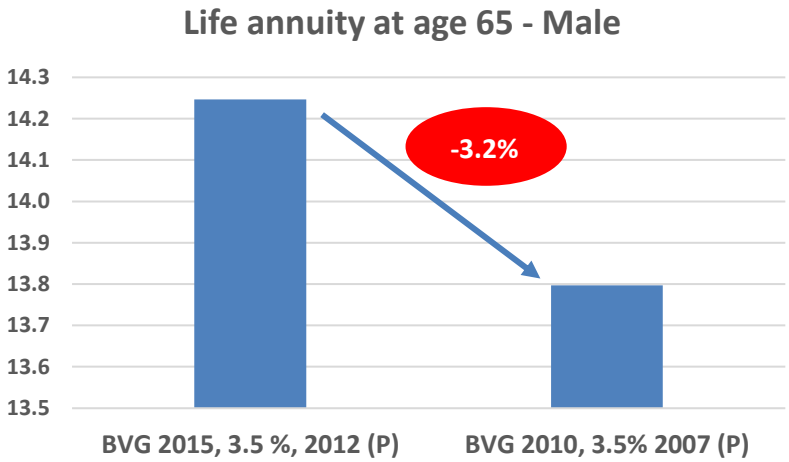
Longevity modeling
Swiss pension funds - market practice

- Swiss pension funds rely mainly on 3 types of standard life tables regularly updated:
  - EVK (Federal Pension Fund experience)
  - VZ (mainly City of Zurich pension funds)
  - BVG (private pension funds experience)

- VZ (2010, 2015) and BVG (2010, 2015) are provided:
  - with period life tables
  - generational life tables with embedded mortality projections (Menthonnex model)

Period life tables alone are not adequate !!

- Clearly, in a situation where longevity is increasing, **period life tables alone underestimate liabilities** relating to insurance contracts with benefits in case of survival



Longevity modeling
Possible alternatives for Swiss Pension funds

- **SKPE Guidelines, FRP 2 - Cap 5.1**
  - When using period tables, account for longevity risk with an additional provision
  - Minimum of 0.3% yearly since the publishing of the applied period table
  - Market practice is generally 0.5%
  - Example: if BVG period table 2012 basis is applied in 2016 → 2% additional provision

- **Use of generational tables → Menthonnex Model**
  - Fast, transparent, more accurate, more elegant, pure Excel solution
  - Allows for longevity forecasting on a cohort basis
  - Mixture between extrapolative and expert judgment model
  - Circa only 20% of the Swiss pension funds do apply generational tables (OAK BV 2015)

- **Use longevity model developed in academia → Lee Carter Model**
  - There exist simple models which can be easily implemented
  - Lee Carter model is an example of a popular uncomplicated model
  - Allows for a different view on longevity trending

Longevity modeling
BVG Generational tables

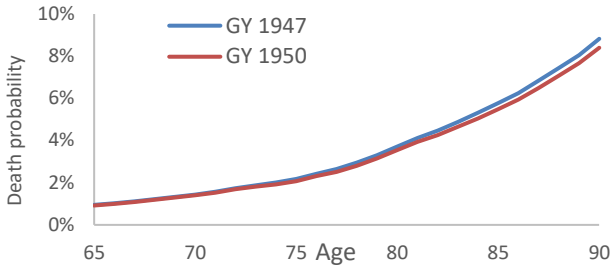
Menthonnex generational model: $q_x^J = q_x^{2012-x} * R_x(J)$

- $R_x(J)$: reduction factor < 1 for generation born in year J and age x

(- +) Not developed in academia → strong expert component

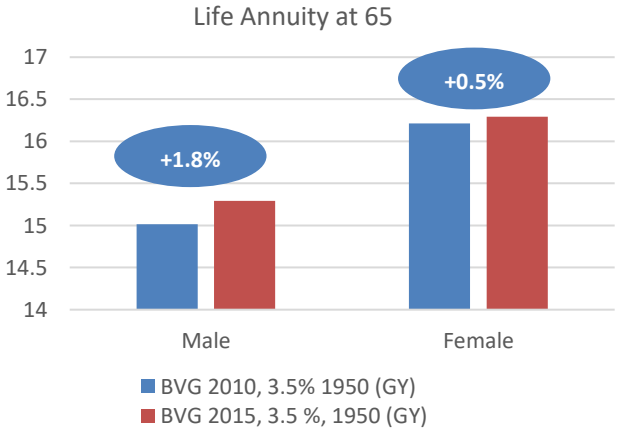
Example:
- GY 1947 → qx aged 65 in 2012, qx aged 66 in 2013 and so on..
- GY 1950 → qx aged 65 in 2015, qx aged 66 in 2016 and so on..

Example of mortality by generation year



Caution is required with mortality projections

- Sensible to the underlying assumptions
- Limits should be considered
- Model release in 2010 different view than release in 2015
- Allows for forecasting until 2150. How reliable is it?



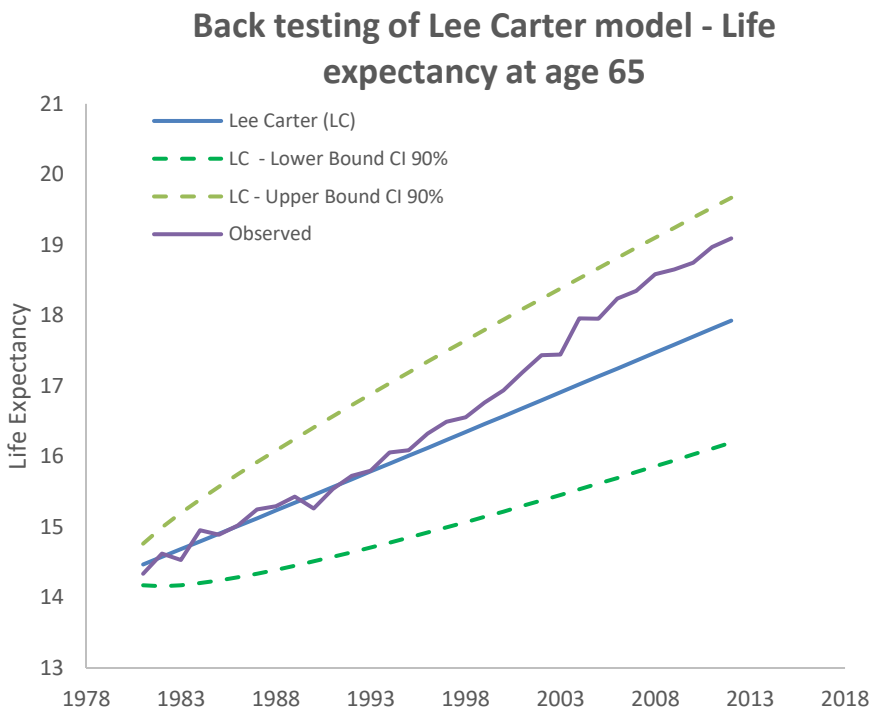
Longevity modeling
Lee Carter application to the Swiss Population

Lee Carter Model: $ln(u_{x,t}) = a_x + B_x k_t$

(+) simple to parametrize
(+) stochastic model → prediction intervals
(-) B_x fixed over time → constant pattern in the rate of change of mortality rates over time
(-) highly dependent on selected fitted period

Back testing

- Crude model parametrized with data series 1950 -1980 of Swiss population
- Projection 1980 - 2012 backtested with actual observations
- Test shows an overall good fit on the short term
- Model performance impacted by:
  - strong assumption of fixed decline of mortality over time at different ages (fixed B_x over time)
  - volatility of very old ages due to scarcity of data
  - selected period and data quality

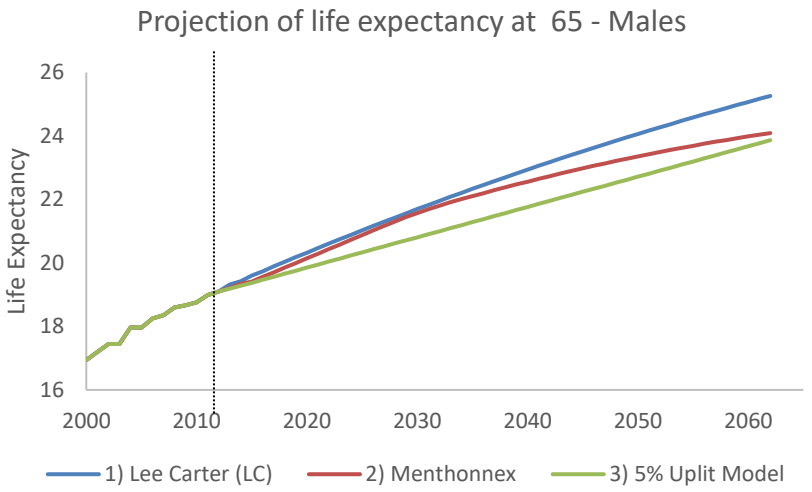


Longevity modeling
Comparison of alternatives

Steps to allow for comparison

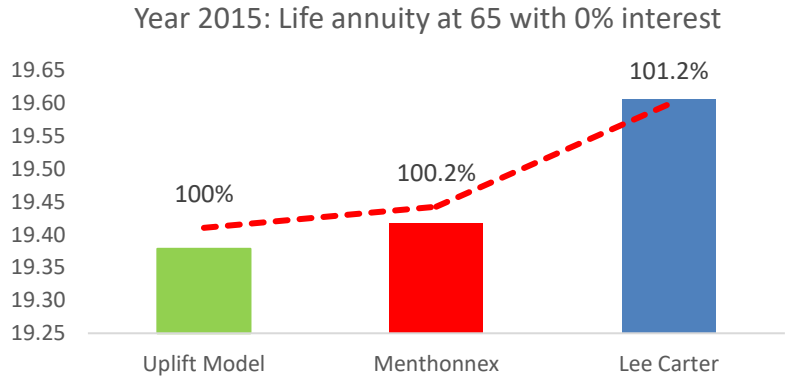
Mortality projected starting from 2013 - 2060:

1. Lee Carter fitted to data series 1950 - 2012 of Swiss population
2. Menthonnex reduction factors applied to Swiss population mortality starting from 2012
3. Yearly improvement of 0.5% in the longevity of Swiss population starting from 2012



Results

- Different views on longevity improvement shapes
- The Menthonex forecasts a slow down of mortality improvements on the long run
- Pension liabilities would be lower under the Menthonnex assumptions than Lee Carter
- Both Menthonnex and Lee Carter more conservative than the 0.5% approach



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Conclusions

- Mortality is moving: long-term calculations based on historical life tables are likely to be erroneous. The valuation of long-term life insurance liabilities requires life tables incorporating the expected changes in life duration

- Longevity risk arises mainly from **parameter** or **model** risk, it is therefore sensible to:
  - consider at the same time various alternatives (assess model risk)
  - use stochastic models to allow for estimation of parameter risk

- Depending on the chosen forecasting approach, pension funds might have to pay higher pensions than what they can afford. Therefore, it is important to consider and compare several alternatives:

  - Period life tables adjusted for longevity risk
  - Generational tables with embedded view of future mortality trends (BVG 2010, BVG 2015)
  - Academicals models easily implementable and understood (e.g., Lee Carter model)

- What ever approach is chosen, pension funds should be aware of limitations and advantages

Thank you