Longevity Beliefs Elicitation: Full Distribution and Visual Support

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Context and Motivation

- Survival probabilities important for valuation any financial product whose payoff is contingent on the holder being alive
    - Life insurance
    - Old-age pensions
    - Annuities
    - Tontines

- Actuarial life tables give very good estimations of survival probabilities for large populations

Context and Motivation

- **Subjective longebity beliefs**
  - one's expectations about survival of him/herself or others
  - may deviate from life tables (for rational or non-rational reasons)
  - aggregation should match life tables for representative samples

- Beliefs key for mapping life-cycle financial decision-making
  - Biased (e.g. Myserth 2019)
  - Subject to age-dependent patterns (Thorp et. al, 2016)
  - Difficult to measure (Bisonette, 2015)
  - Often investigated on people close to or past retirement age only (Lot, 2023 WP)

This project

- **How can we elicit subjective longevity curves more efficiently?**
  - extend and expand the risk elicitation interface of Crosseto and De Haan (2018)

Treatment conditions (between subjects)

- **Probability distribution** of risk to elicit: PDF or CDF
- **Visual support**: none, 1 or 2 visual anchors

Distribution – between-subject condition

Cumulative Distribution Function (CDF)

- Likelihood of remaining alive from now until many target ages *a+t* into the future
- Produces the inverse cumulative hazard curve
- Enforced monotonicity

Probability Distribution Function (PDF)

- Probability that death happens across all future feasible future target ages *a+t*
- Identifying when an (eventually) certain event happens
- Normalization such that probabilities sum up to 1

Anchors – between-subject condition

No anchor

- Blank canvas without visual support

One anchor

- Central parameter curve from actuarial tables

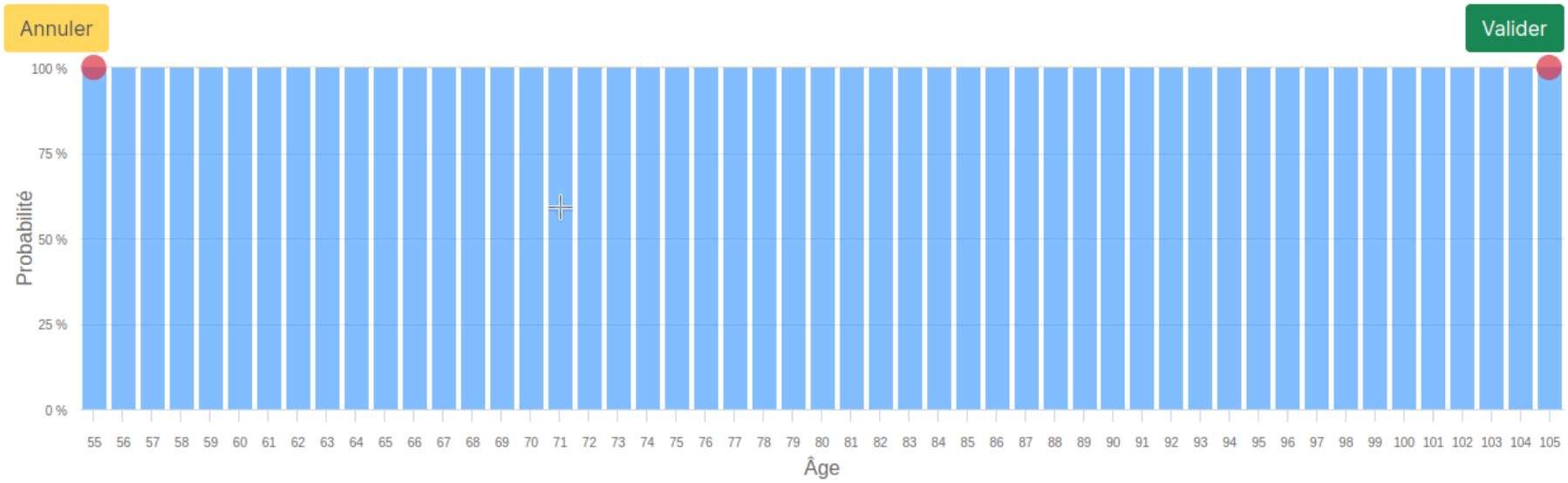
Two anchors

- Upper and lower curves on health status
- 20% most/least healthy at current age

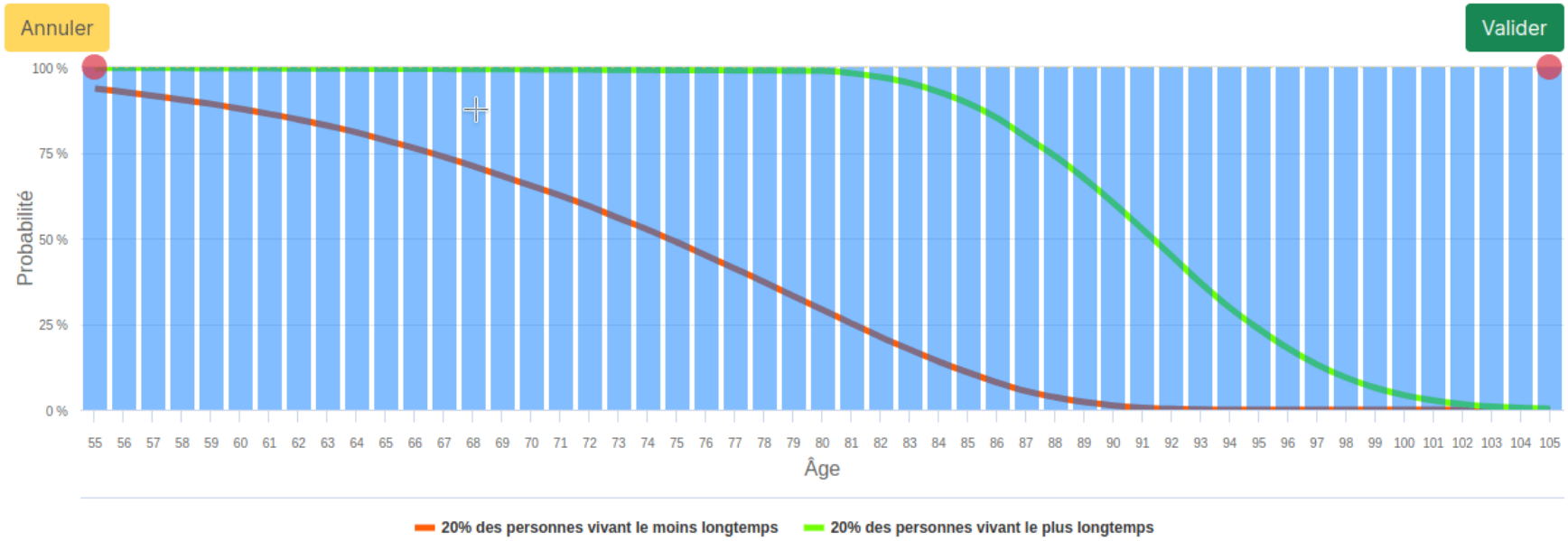
Target (whose survival is measured) – within-subject condition

- Own subject's longevity
- Archetype of same sex and current age as subject
- Archetype of 65 yrs. old person of same sex as subject with different health diagnoses (health scenarios) – **incentivized** responses.

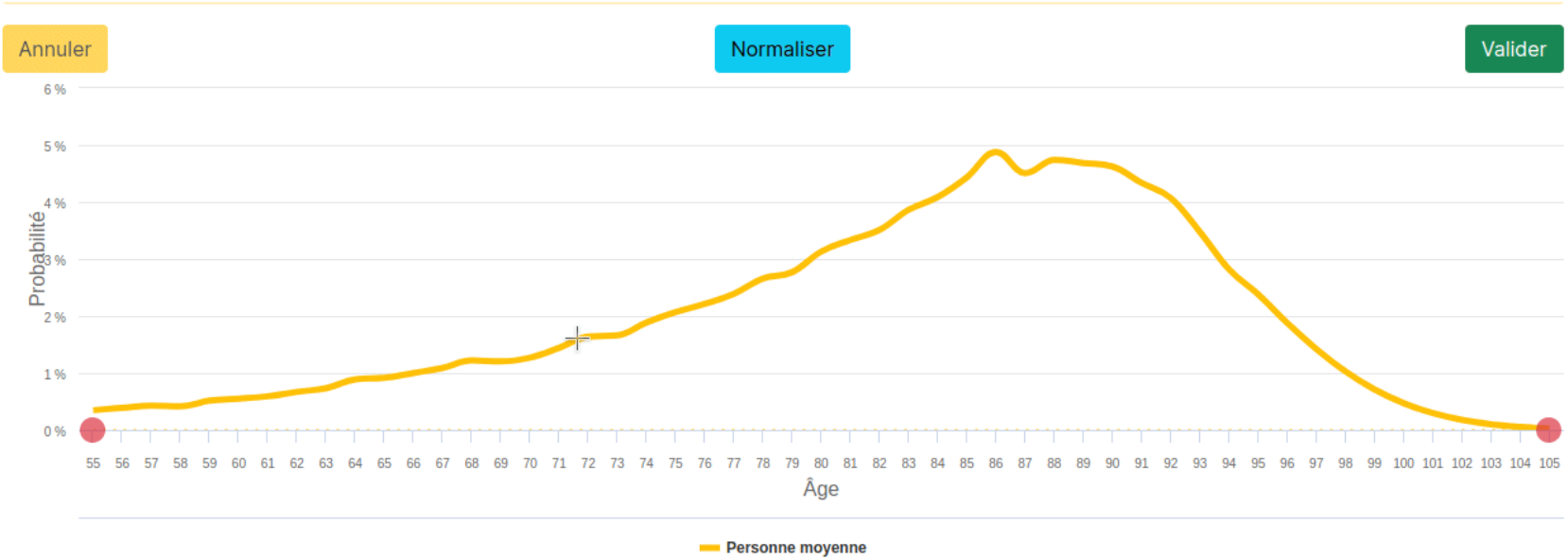
The Click-and-Drag elicitation interface (current age 54) no support line



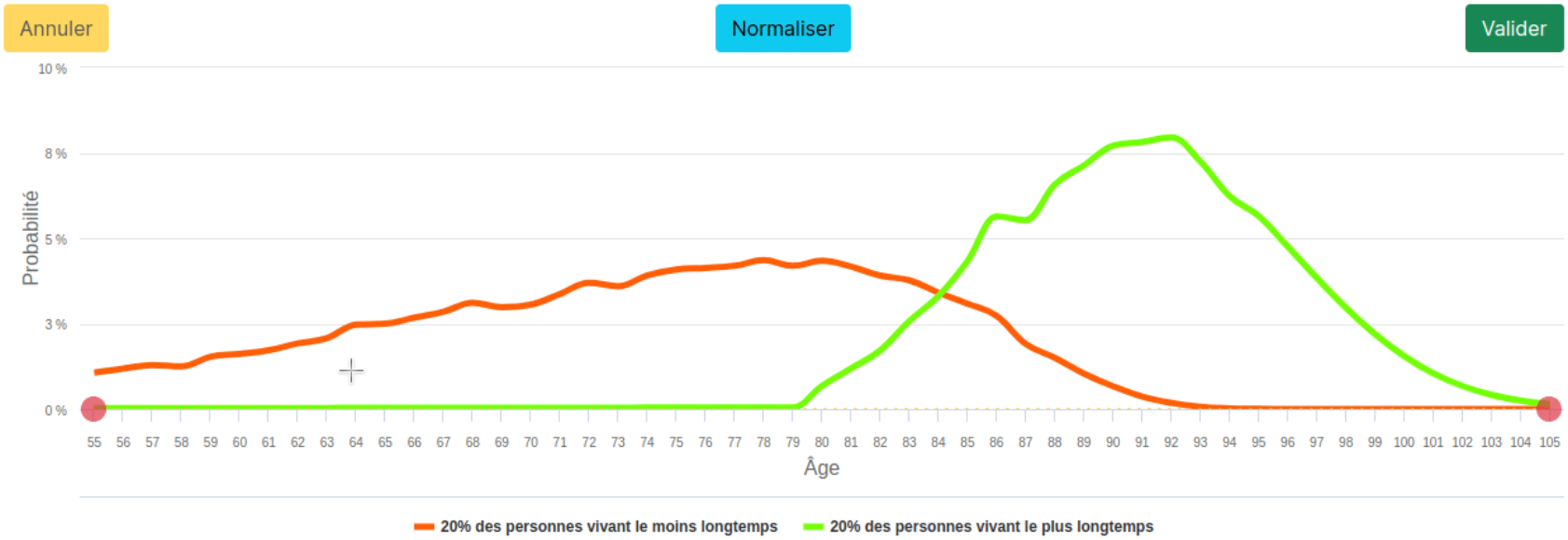
The Click-and-Drag elicitation interface (current age 54)
CDF, 20% most/least healthy cumulative survival prob. support lines



The Click-and-Drag elicitation interface (current age 54)
PDF, average death distribution probability support line



The Click-and-Drag elicitation interface (current age 54)
CDF, death distribution prob. support lines 20% most/least healthy



Health Scenario archetypes

- Scenarios based on Yes/No diagnoses for common diseases and conditions
- actuarial impacts from SHARE Panel - as in Apicella and De Giorgio (JRU, 2024)
- health conditions' effects on longevity simulated in new synthetic cohort as "true parameter"
- **support lines based on total population**!

Health Scenario – 65 y.o. archetypes and effect on survival prob.

Disease	group
High blood pressure	A
Diabetes	S
Cancer	S
Alzheimer or dementia	S
Parkinson	S
Stroke	S
Heart attack	S
Lung disease	S
Other long-term chronic condition	Q

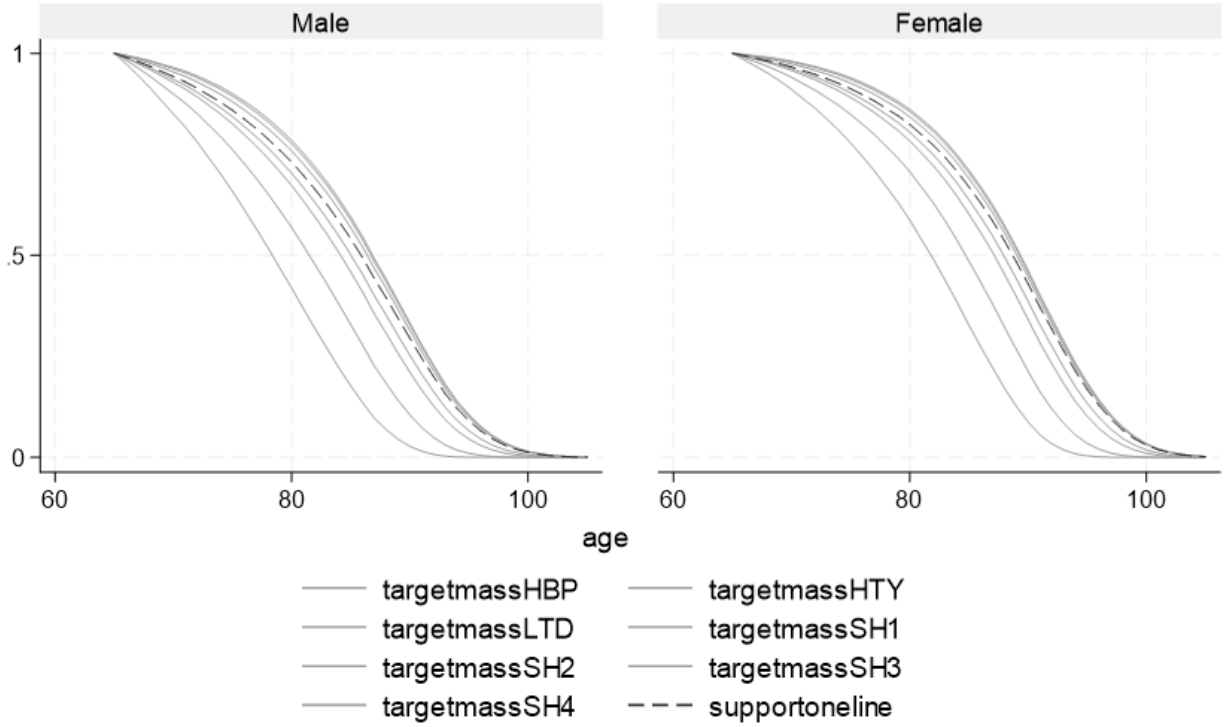
Scenario	diagnoses	effect
HTY	none	-0.48
HBP	only (A)	-0.41
LTD	only (Q)	-0.25
SH1	1 of (A)	0.12
SH2	2 of (A, S)	0.26
SH3	3 of (A, S)	0.78
SH4	4 of (A, S)	1.71

Synthetic cohort (health scenario) longevity curves

Health scenarios of 65 y.o. same sex as subject

y-axis: survival probability until age (x)

x-axis: target ages



Experimental session timeline and treatments

		Elicitation				
Distribution	**Support Lines**	**1**	**2**	**3**	**4**	**5**
CDF	none	archetype same sex and age	health scenario (i)	health scenario (ii)	health scenario (iii)	subject's own longevity
	one					
	two					
PDF	none	archetype same sex and age	health scenario (i)	health scenario (ii)	health scenario (iii)	
	one					
	two					

Sample and data

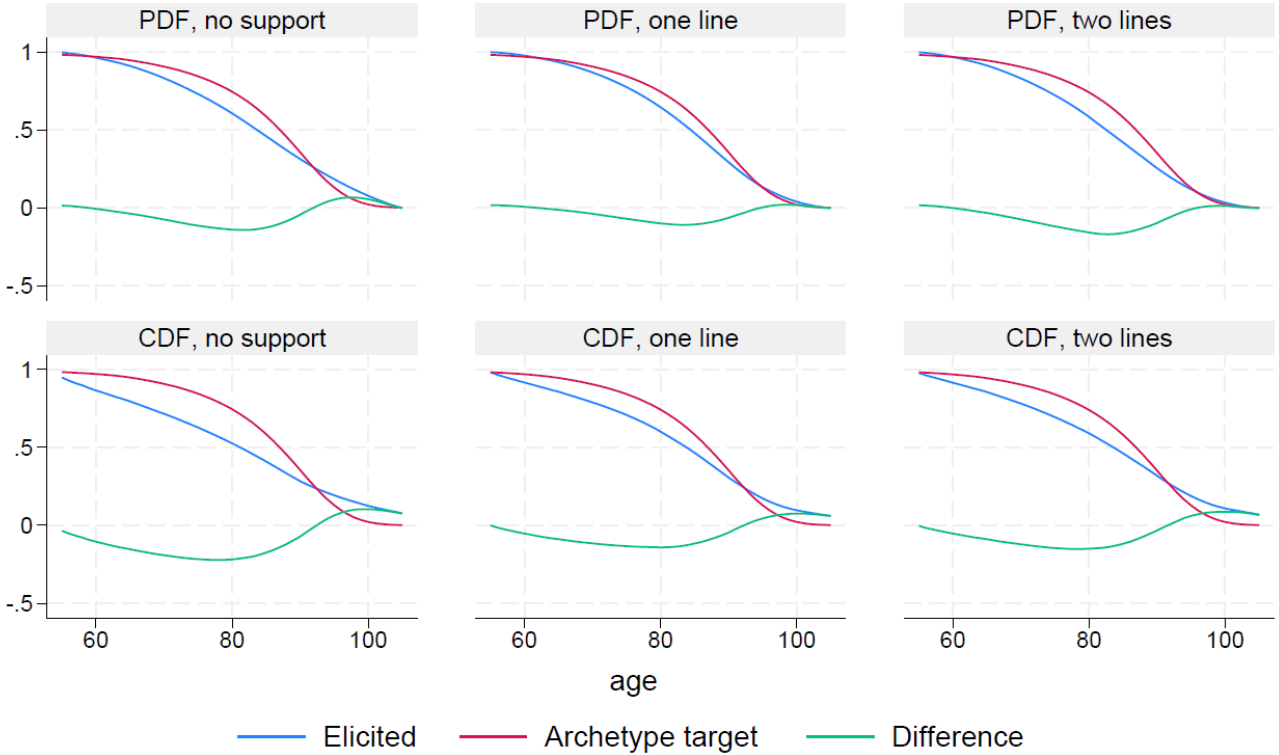
- Bilendi market research panel of Swiss subjects (French and German speakers)
- 2576 valid responses
- Data collected in Nov-Dec/2023

Key result 1: PDF has lower longevity belief bias than CDF

Archetype of same current age and sex of subject

y-axis: prob. being alive at age (x)

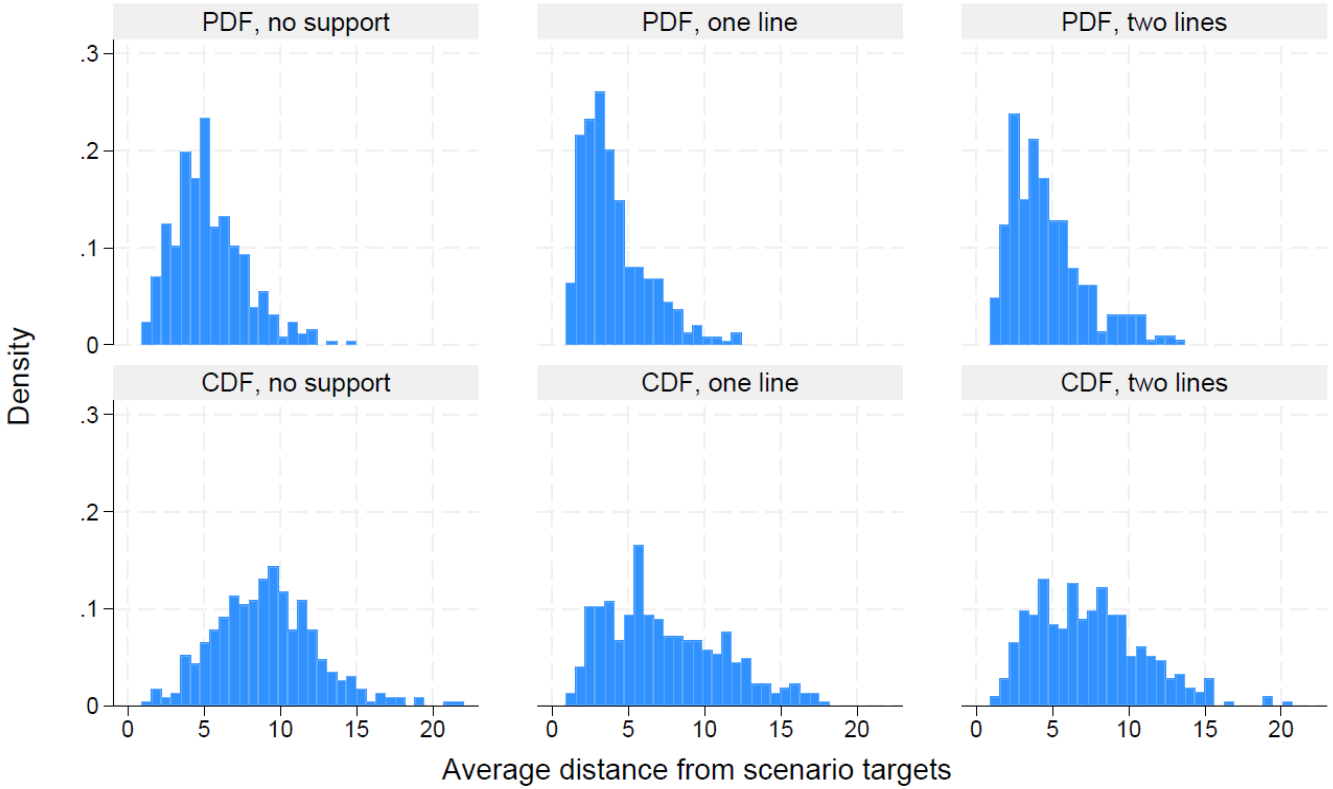
x-axis: target ages



Key result 2a: PDF has lower longevity belief variance than CDF

Health scenarios of 65 y.o. same sex as subject

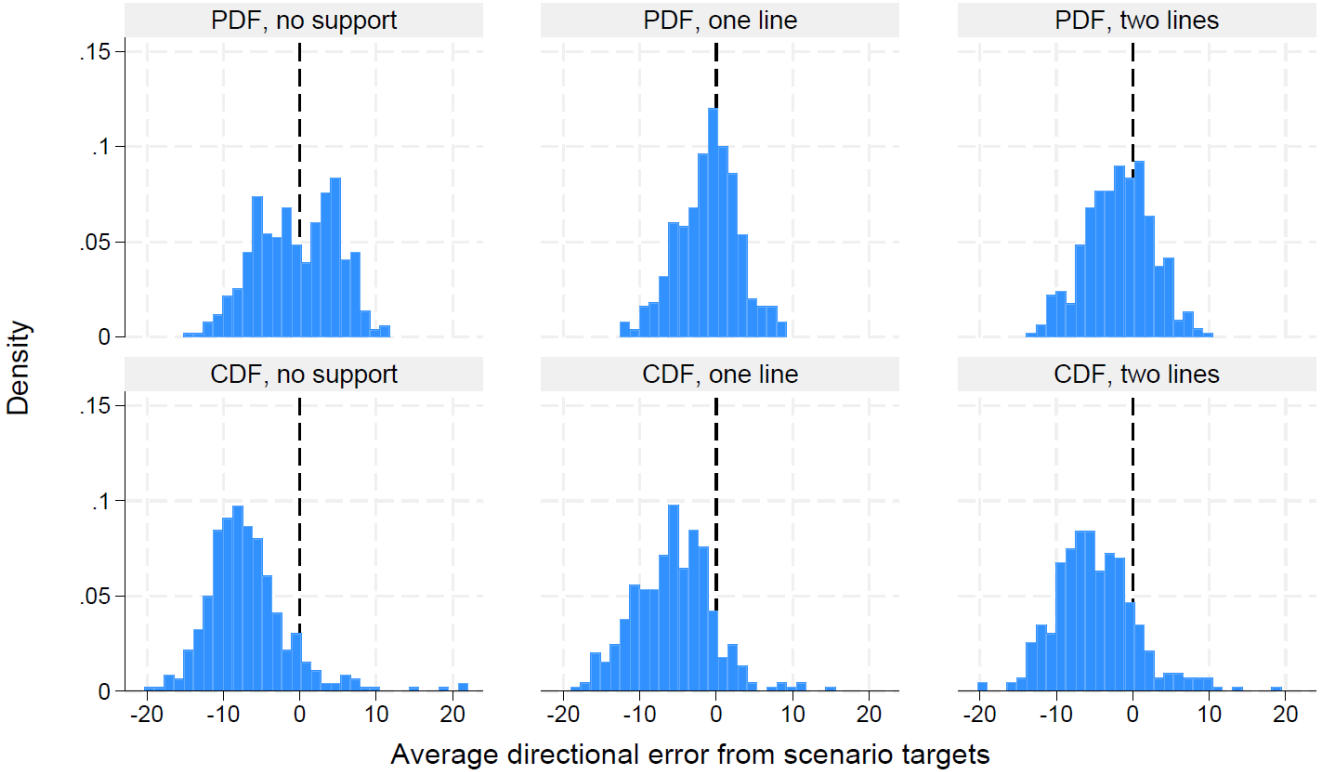
x-axis: distance (X100) from actuarial-derived estimated probabilities



Key result 2b: PDF has higher longevity belief skew than CDF

Health scenarios of 65 y.o. same sex as subject

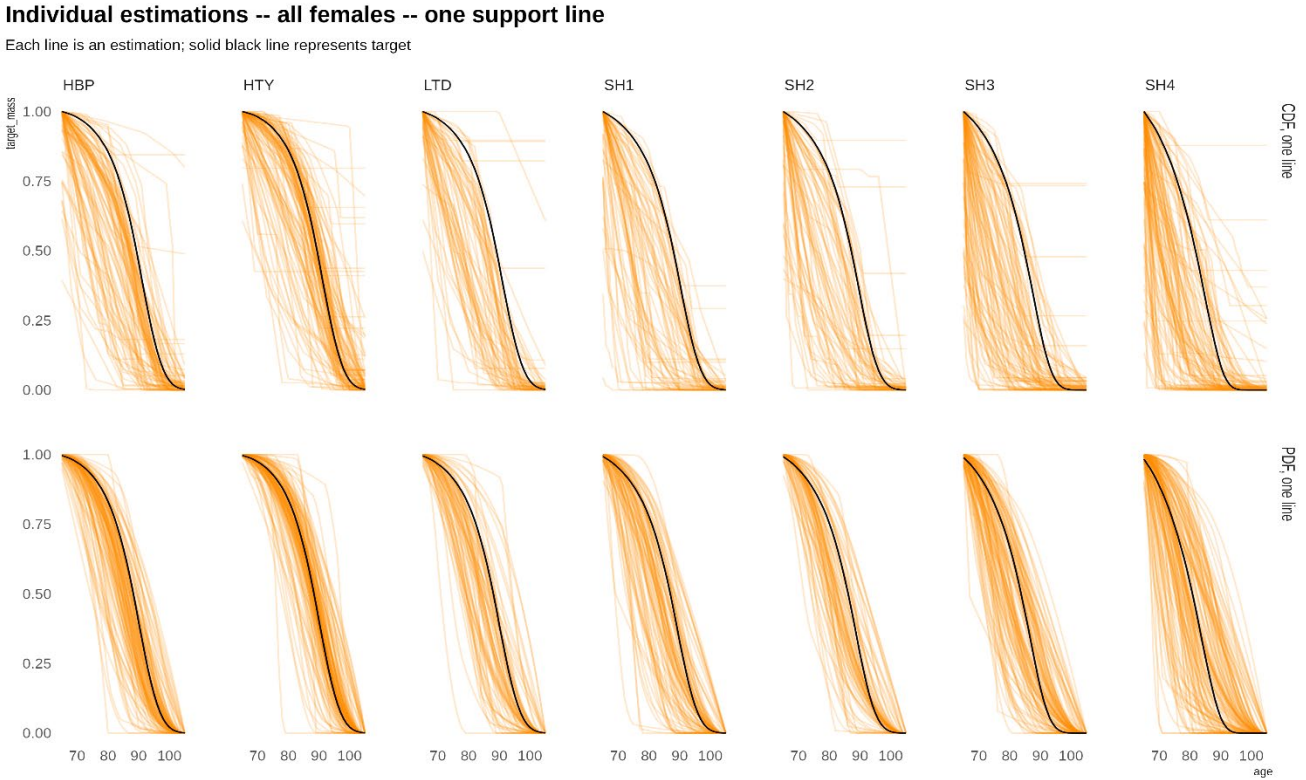
x-axis: error (X100) from actuarial-derived estimated probabilities



Key result 3: PDF captures senescence better than CDF

Archetype of same current age and gender of subject

x-axis: target ages



Longevity bias remain among youth as in previous literature

Average parameters within age range

Subsample: younger than 55

Table 3 – Ages 55 till 89 - Average survival likelihood

	All no-support	No-support PDF	No-support CDF
Participant estimation	0.7117 (0.1527)	0.7544 (0.1225)	0.6640 (0.1684)
Actuarial estimation	0.8295 (0.0337)	0.8300 (0.0339)	0.8290 (0.0336)
t-test p	< 0.0001	< 0.0001	< 0.0001
Wilcoxon sign-rank p	< 0.0001	< 0.0001	< 0.0001
n	761	401	360

Table 4 – Ages 90 till 105 - Average survival likelihood

	All no-support	No-support PDF	No-support CDF
Participant estimation	0.1511 (0.1508)	0.1385 (0.1058)	0.1652 (0.1879)
Actuarial estimation	0.1081 (0.0267)	0.1086 (0.0266)	0.1076 (0.0269)
t-test p	< 0.0001	< 0.0001	< 0.0001
Wilcoxon sign-rank p	< 0.0001	< 0.0001	0.0044
n	761	401	360

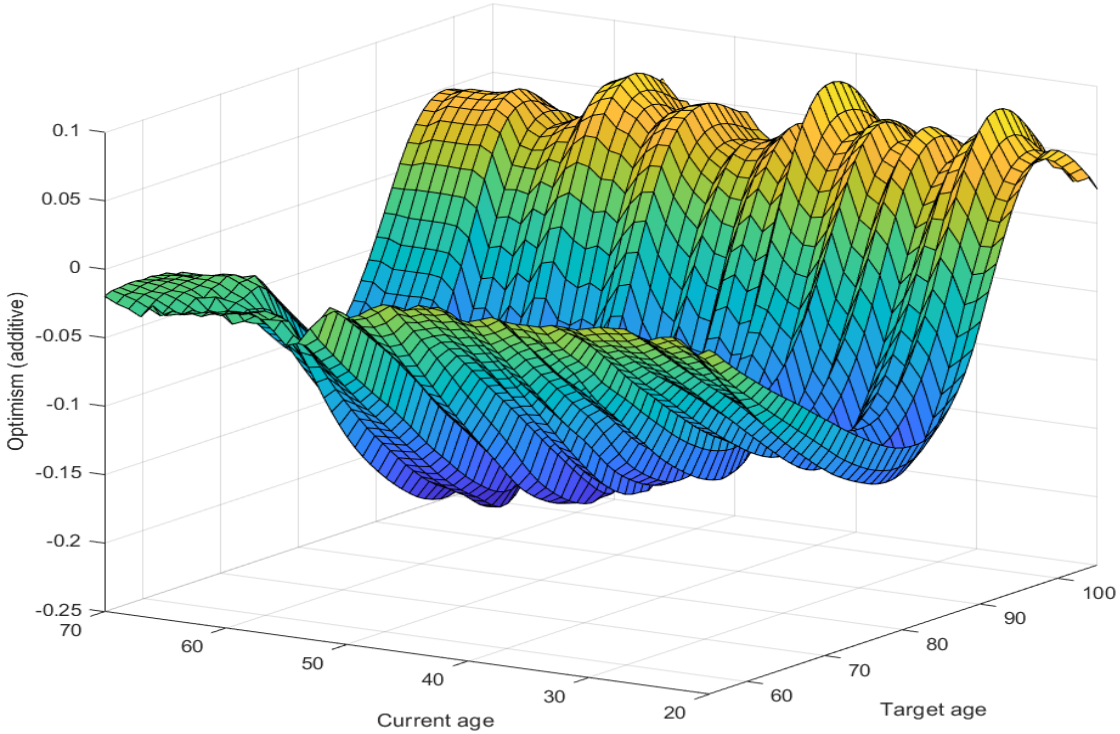
Longevity bias is still age- and target-age dependent

Archetype of same current age and gender

y-axis: longevity optimism index

x-axis: current age

z-axis: target ages



Conclusions and final comments

- While subjective longevity bias exists, elicitation mechanisms might amplify or reduce then
- Drawing full subjective curves is important to understand subjective longevity expectations
- Subjects understand the basic processes of longevity (senescence, health impairment) and their relative impacts surprisingly well

Questions?

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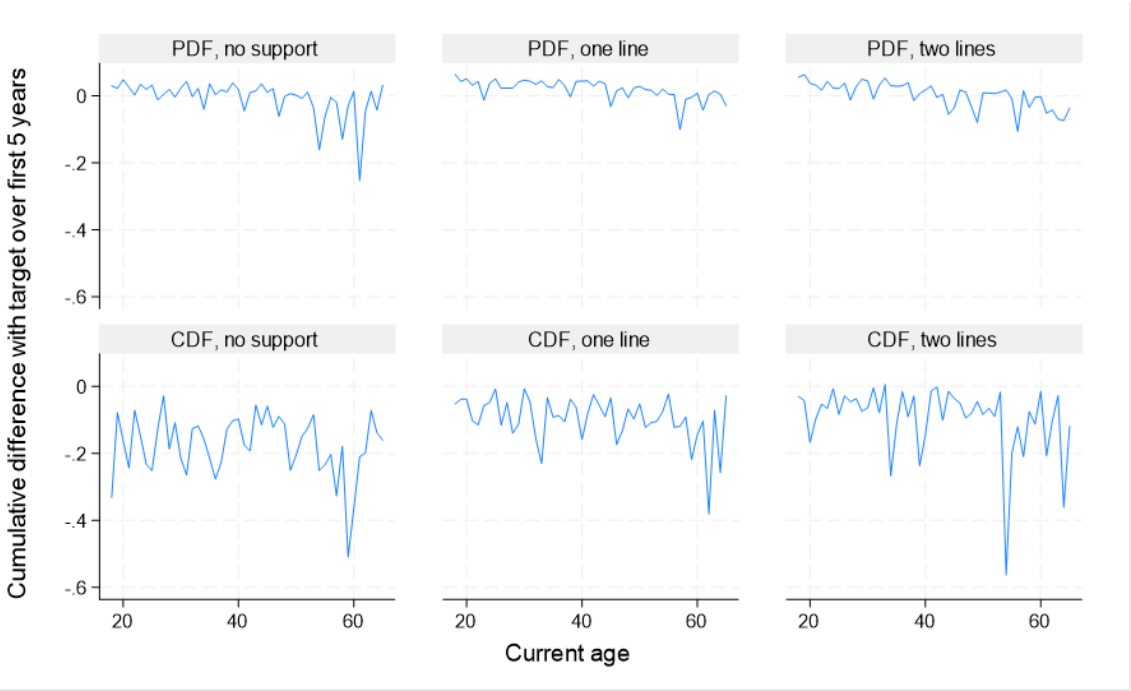
Young are not worse than older estimating short-term (5yr) longevity

Health scenarios of 65 y.o. same sex as subject

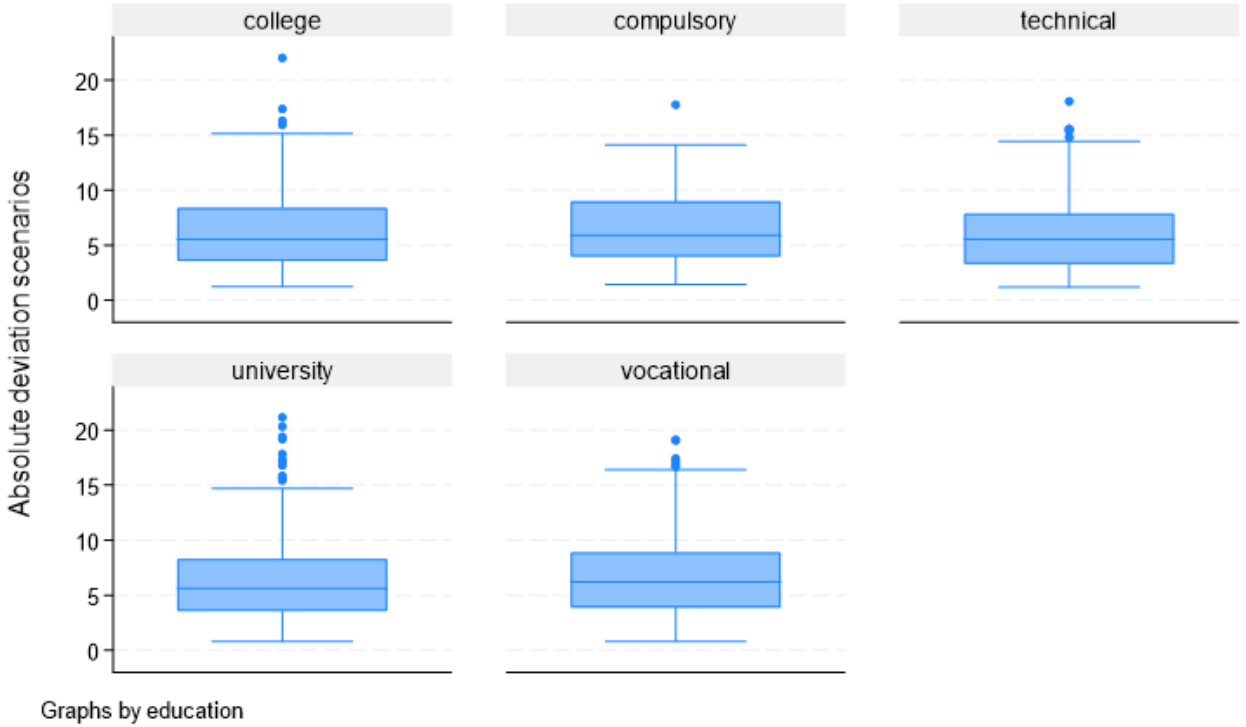
y-axis: cumulative error first 5 years from current age

x-axis: current age



Educational differences and longevity bias on all scenarios

Average deviation (p.p.) from c.d.f. parameter on health scenarios



Income differences and longevity bias on all scenarios

Average deviation (p.p.) from c.d.f. parameter on health scenarios