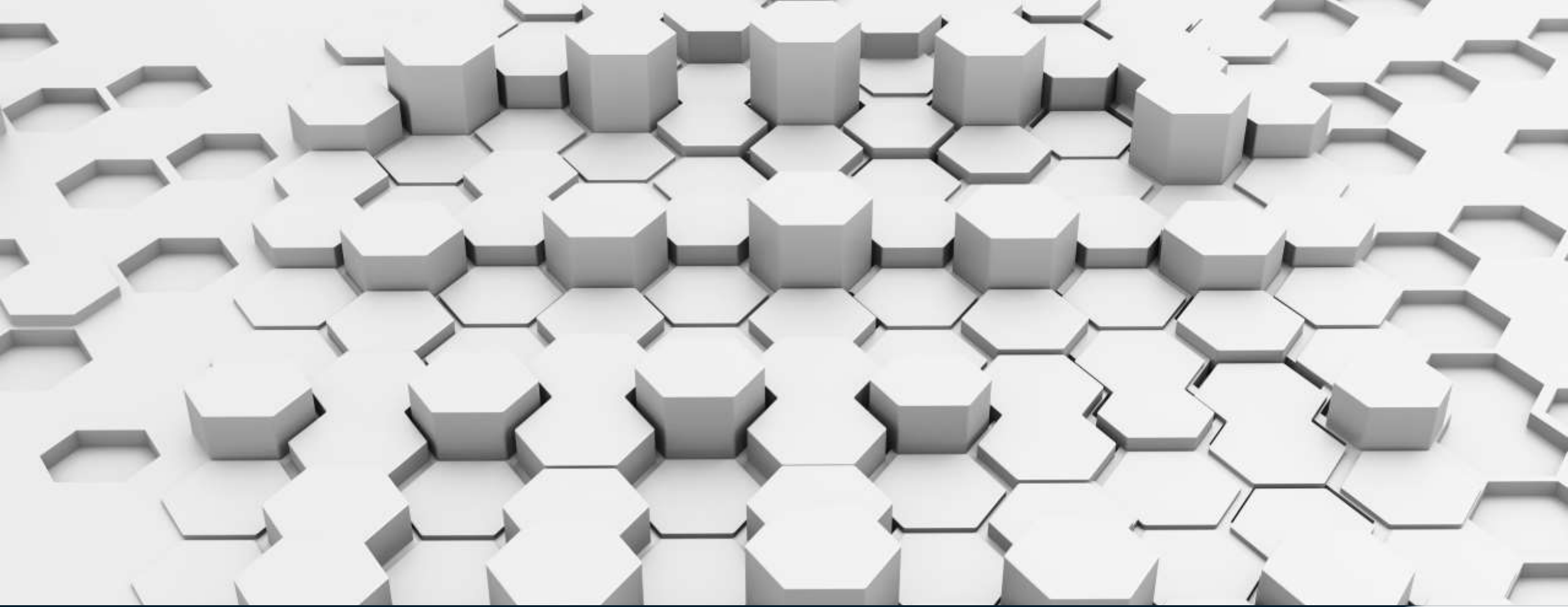




Retirement Products in the Context of Utility Theory

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Risk vs Reward: Analysing post-retirement products in the context of utility theory.

- ❖ Wits University, 2022 Honours research paper
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and Ms. Wisani Ndlovu
- ❖ Supervisor: Mrs. Lucia Viegas





Yaari (1965)

"One need hardly be reminded that a consumer who makes plans for the future must, in one way or another, take account of the fact that he does not know how long he will live."

The Annuity Puzzle

Why do people not purchase guaranteed income annuities to the extent predicted by economic theory?



Trying to solve the puzzle for South Africa

- Applying utility theory.
- Accounting for human behaviour
- Considering alternative options.



RESEARCH QUESTIONS

- ? Which tools or methods, in the presence of behavioural finance, are the most effective in determining the utility a consumer derives from a post-retirement product?
- ? Which post-retirement products and features provide consumers with the most utility, given wide ranging risk-reward trade-offs.

NOVELTY

- ✓ Utility modelling applied to a drawdown product (Living Annuity)
- ✓ Incorporation of South African mortality and wealth data into utility model
- ✓ Application of South African specific retirement age, bond yields and government benefits in utility model.



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ATTEMPTING TO EXPLAIN THE ANNUITY PUZZLE

Rational Factors

- Actual and perceived notion that annuities are “expensive”
- Loss of access and flexibility with respect to savings after annuitisation
- Illiquidity of housing wealth
- Means tested state benefits

Behavioural Factors

- Mortality Salience
- Subjective mortality beliefs

Framing

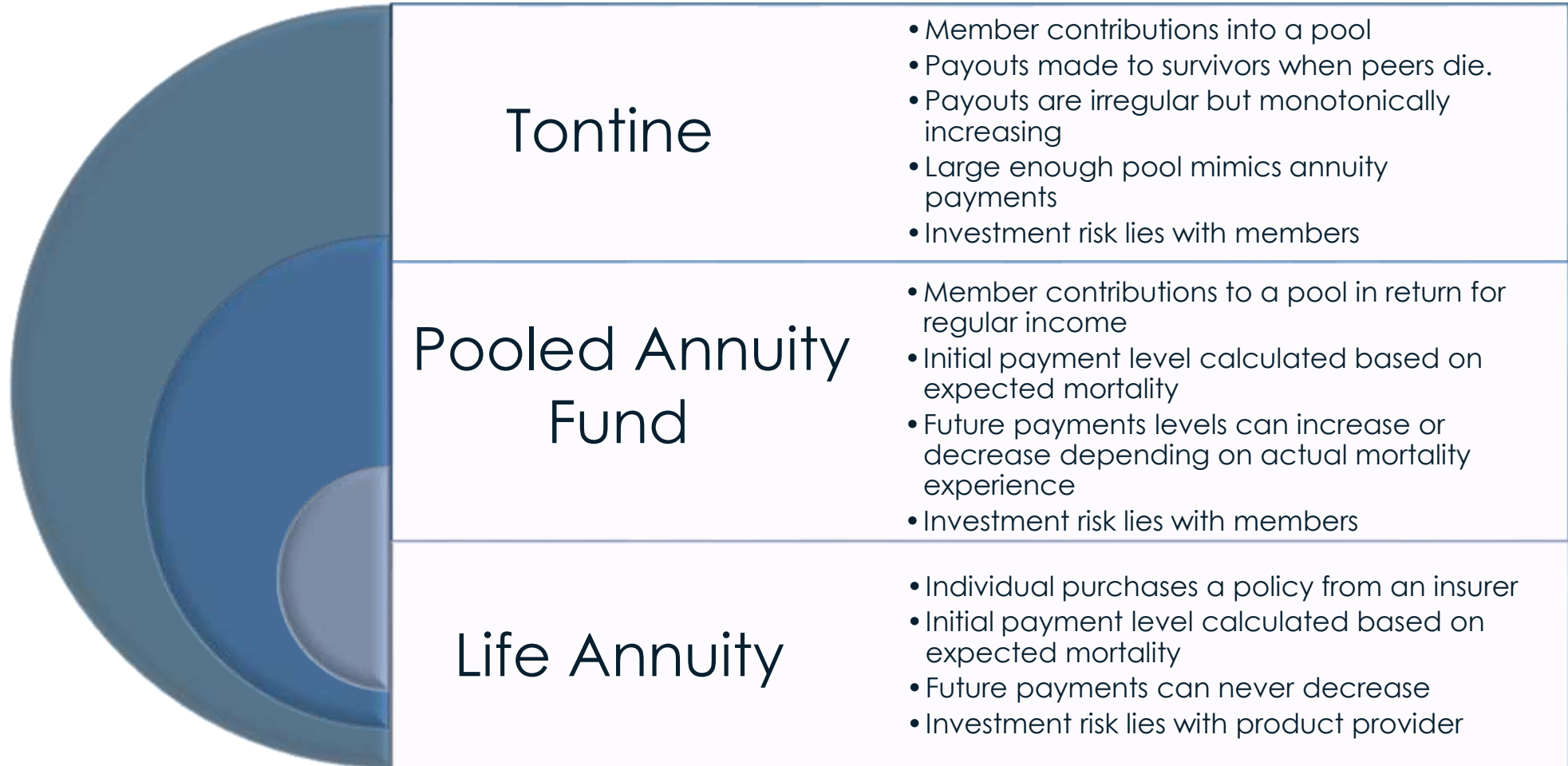
- Positive or negative framing
- Intentional or unintentional framing
- Consumption vs Investment

Defined Contribution Arrangements

- Retirement savings are perceived as an investment (endowment property)
- Income liability is not well understood



PRODUCTS CONSIDERED





EARLIER UTILITY STUDIES

Donnelly, Guillén & Nielsen (2013)

- Consumers may derive more benefit from a pooled annuity fund than a guaranteed life annuity.
- Additional costs within a life annuity could have more of an impact on expected utility than retaining mortality risk in a pooled fund.

Milevsky & Salisbury (2015)

- Assuming negligible annuity charges and loadings.
- Ignoring subjective mortality beliefs.
- Annuities provide greater utility than tontines.

Chen, Hieber & Rach (2021)

- Assuming negligible annuity charges and loadings.
- Considering subjective mortality beliefs.
- Tontines may be preferable to guaranteed life annuities, given a large enough pool size.



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Lifetime Data

- Homogenous lives simulated
- Lives are independent and identical copies of each other.
- Same age, sex, risk preferences and initial wealth level.
- Base case: 60-year-old male
R1.1 million initial wealth

Mortality

- Shocked Gompertz model utilised
- Allows for a longevity shock to be applied
- Can be adjusted for subjective mortality beliefs
- Full Life Tables for South Africa from Vital Registration Data (2006-2008)
- Model parameterised from the data using Root Mean Squared Error (RMSE) calculations.

Utility Function

- Constant Relative Risk Aversion (CRRA) utility function.
- Allows for flexibility in age, income, wealth and payoff structures.
- Can be adapted for subjective mortality beliefs, government old age grant and bequest motive.



EXPECTED DISCOUNTED LIFETIME UTILITY: BASE CASE

Discounted lifetime utility at time t ← $D(t) = D(t-1) + {}_t p_x \times u(t) \times (1+i)^{-t}$ $t > 0$

Discounted lifetime utility at time $t-1$

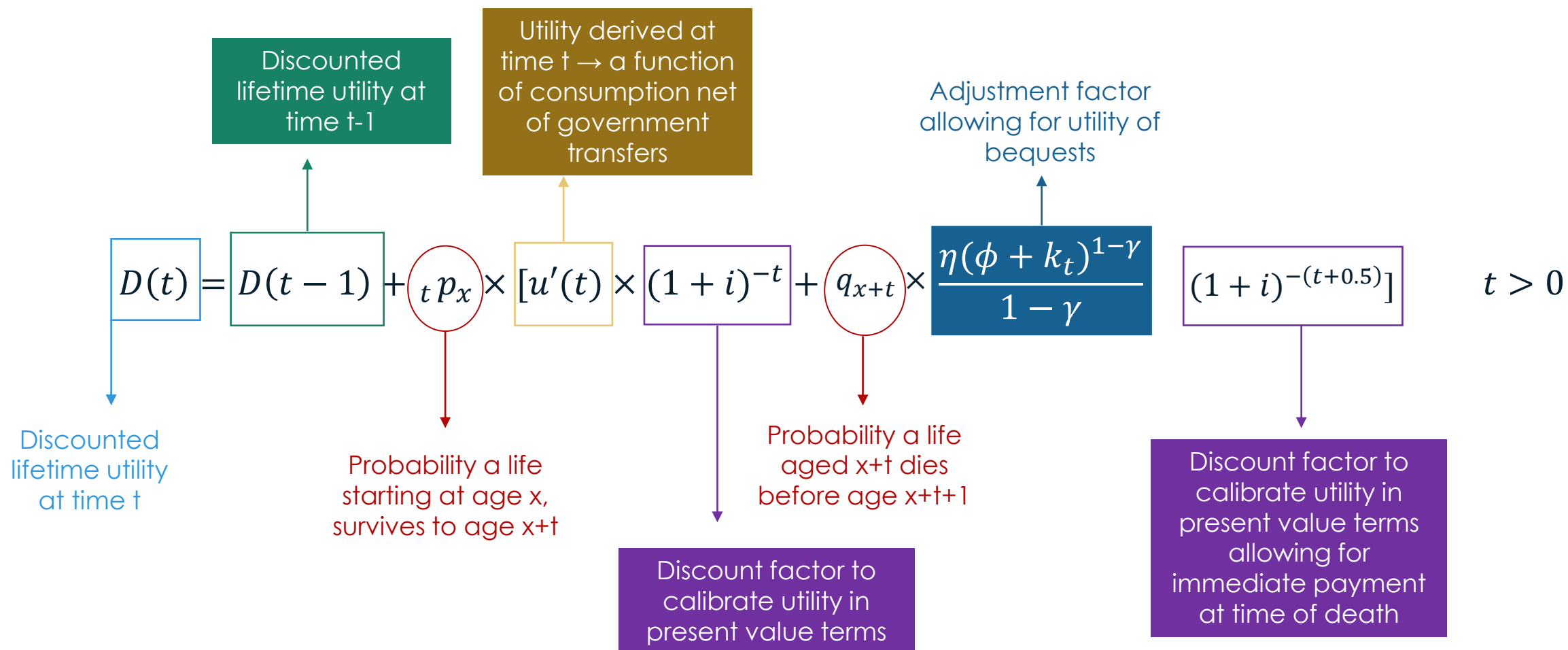
Probability a life starting at age x , survives to age $x+t$

Utility derived at time $t \rightarrow$ a function of consumption

Discount factor to calibrate utility in present value terms



EXPECTED DISCOUNTED LIFETIME UTILITY: ADAPTATIONS





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Life Annuity

Level payments, c , annually in advance.

$$\text{Payout @ } t = c$$

Tontine

$$\text{Payout @ } t = \frac{N_{t-1} q_x C(t)}{N_t p_x}$$

Where:

N = initial number of members in the pool

${}_t q_x$ = probability (x), dies between age $x+t-1$ and $x+t$.

$C(t)$ = capital per member at time t

${}_t p_x$ = probability (x) survives to age $x+t$

Payoffs for surviving members

Pooled Annuity Fund

$$\text{Payout @ } t = \text{Payout @ } (t-1) \times \frac{p_{x+t-1}}{\tilde{p}_{x+t-1}}$$

Where:

p_{x+t-1} = expected survival rate from age $t-1$ to t

$\tilde{p}_{x+t-1}$ = actual survival rate from age $t-1$ to t

Living Annuity

$$\text{Payout @ } t = dC(t)$$

Where:

d = constant drawdown percentage

$C(t)$ = capital per member at time t

On death between $t-1$ and t , $C(t)$ is paid to estate



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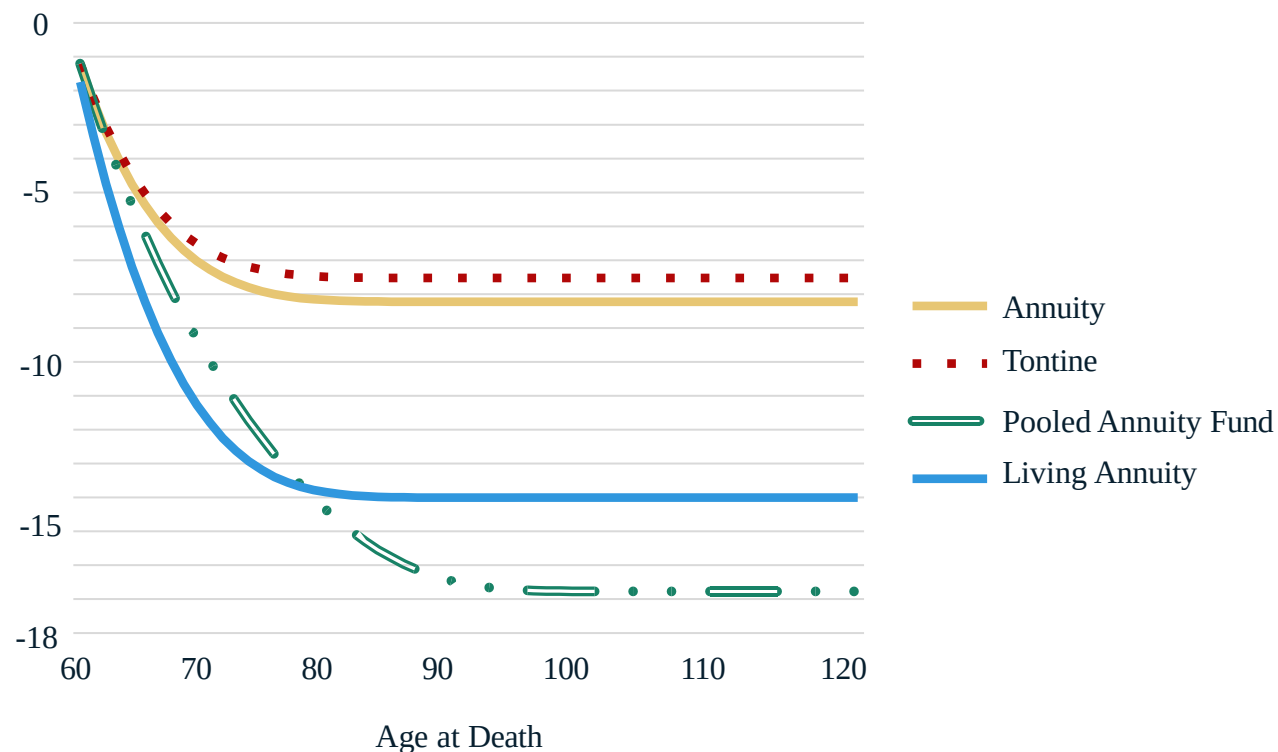
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EXPECTED DISCOUNTED LIFETIME UTILITY

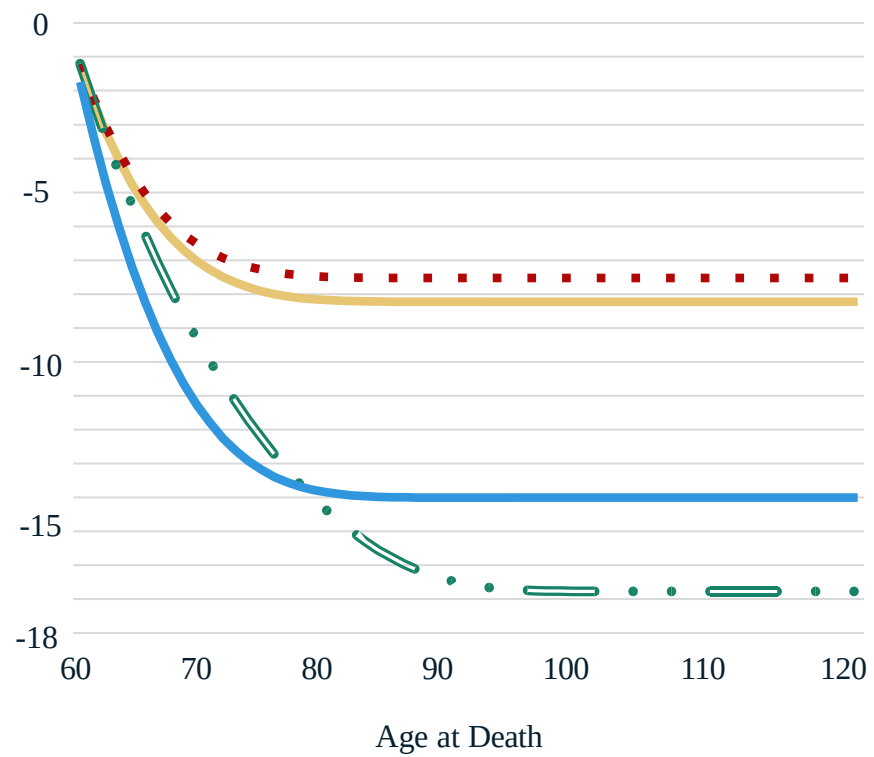
Base Case

- † Subjective mortality beliefs, bequest motives and government transfers ignored.
- † Younger decedents have similar experiences across product types.
- † Utility stabilises for decedents aged 80+.
- † Tontine offers highest utility levels and Pooled Annuity Fund offers lowest.
- † Living annuity vs Pooled Annuity Fund





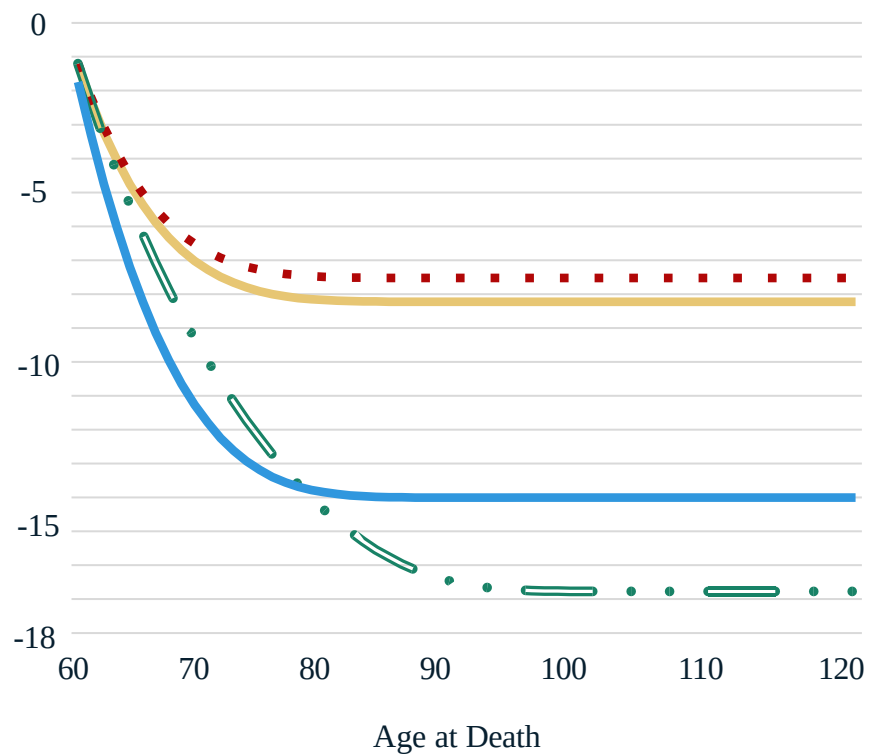
EXPECTED DISCOUNTED LIFETIME UTILITY



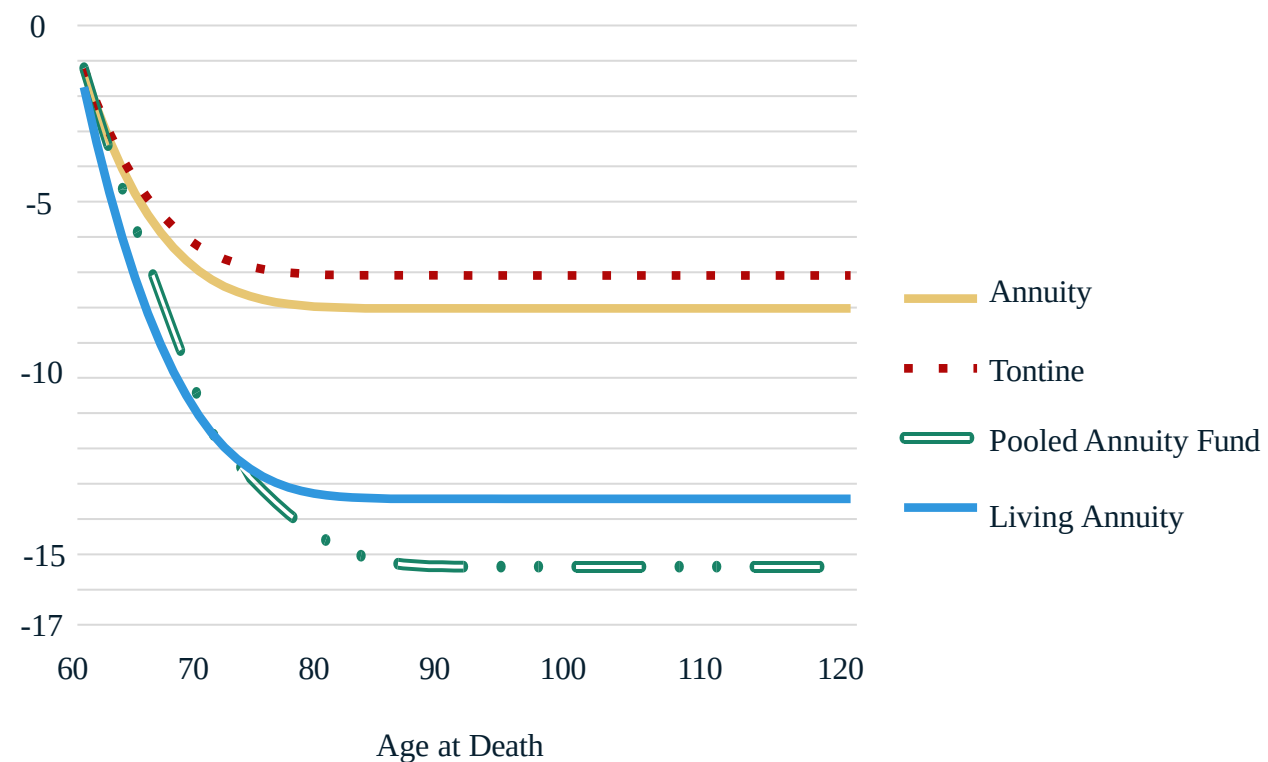


EXPECTED DISCOUNTED LIFETIME UTILITY

BASE CASE



ALL ADAPTATIONS

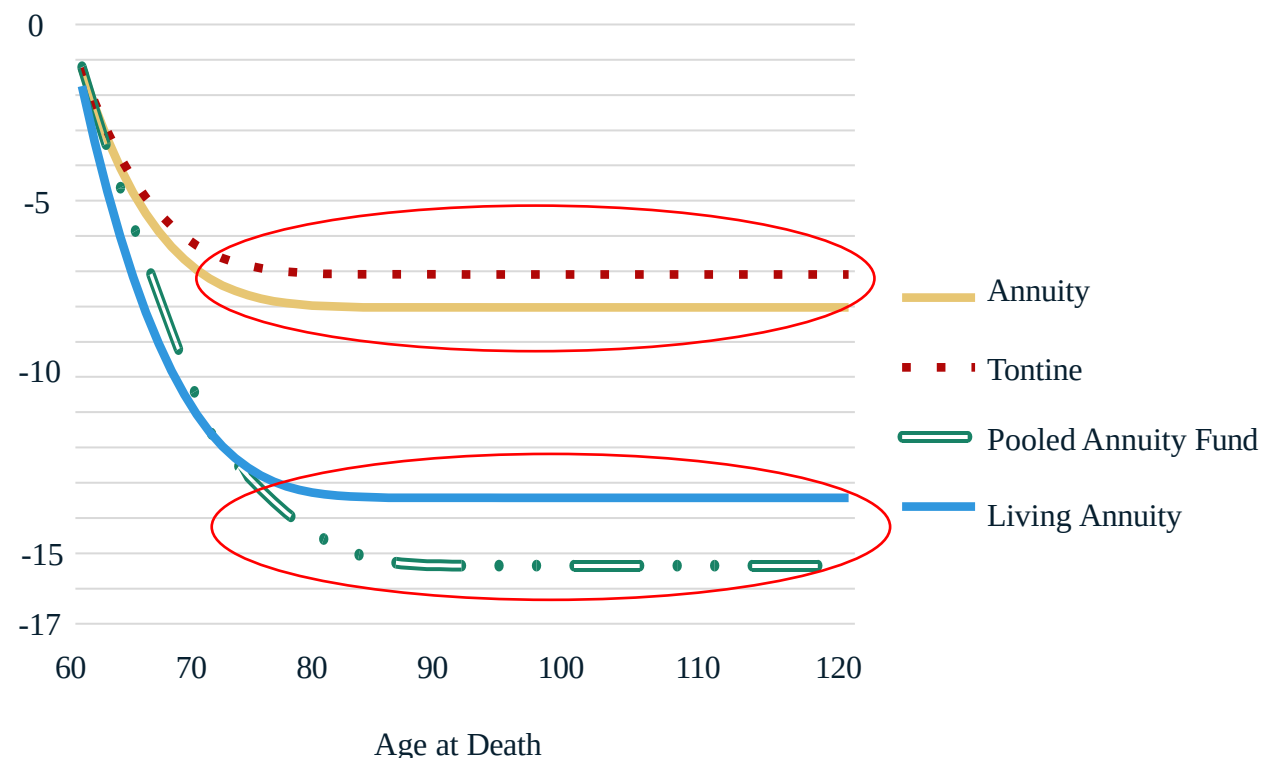




EXPECTED DISCOUNTED LIFETIME UTILITY

All adaptations applied to Base Case

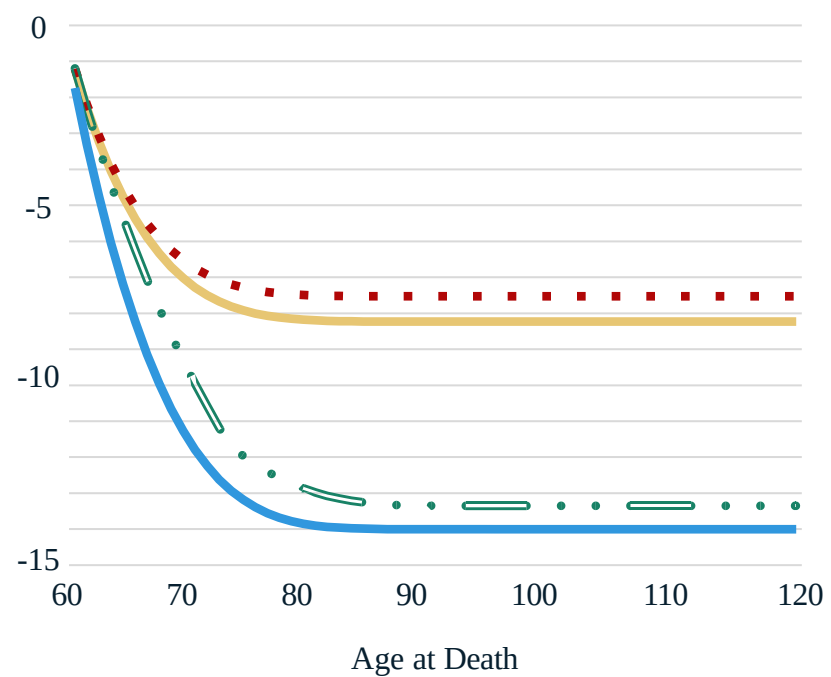
- † Subjective mortality beliefs, bequest motives and government transfers allowed for.
- † Pattern between different products is unchanged from base case.
- † Absolute utility improved for all product types.
- † Gap between the Annuity and the Tontine widens.
- † Gap between Pooled Annuity Fund and Living Annuity is reduced.





EXPECTED DISCOUNTED LIFETIME UTILITY

Adapted for Government Transfers

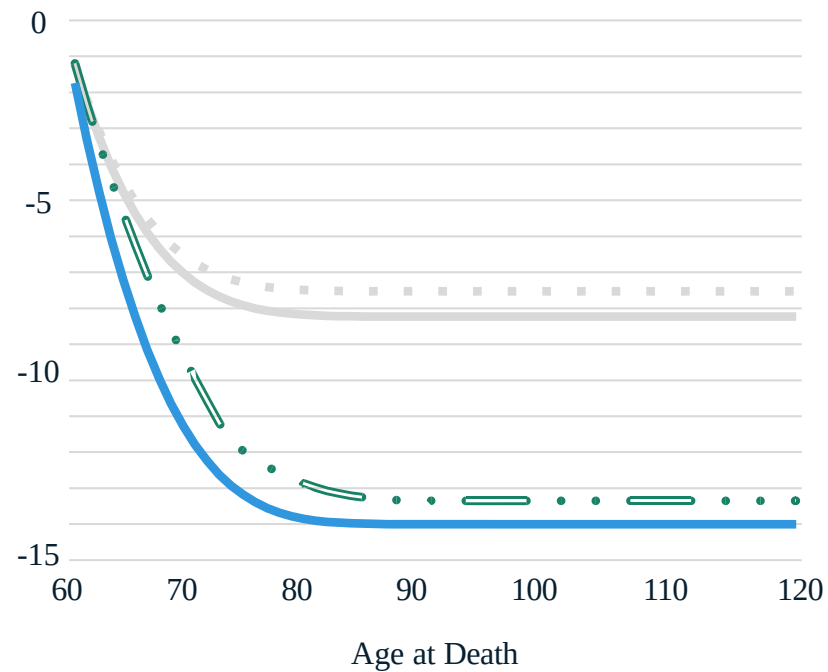


Annuity Tontine Pooled Annuity Fund Living Annuity

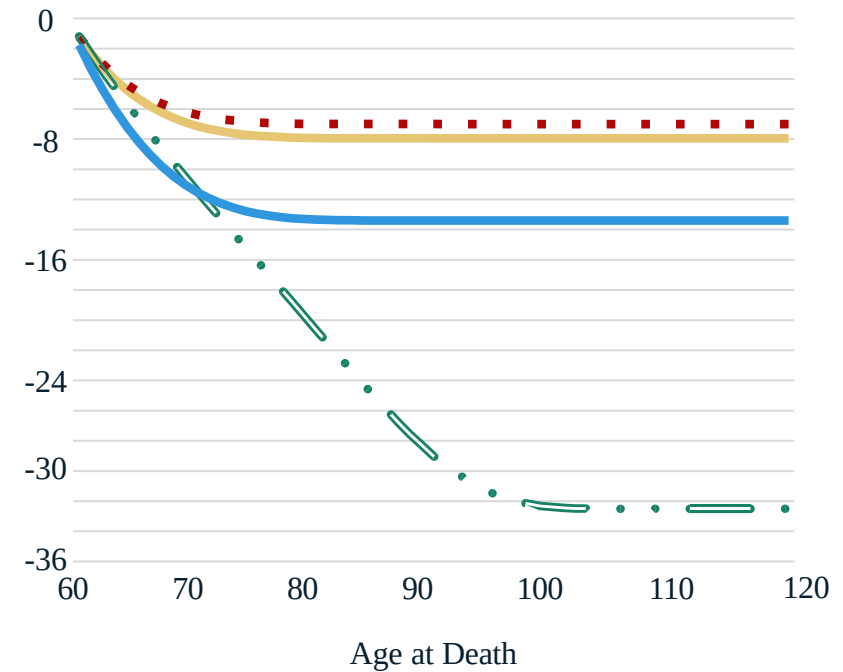


EXPECTED DISCOUNTED LIFETIME UTILITY

Adapted for Government Transfers



Adapted for Subjective Mortality Beliefs

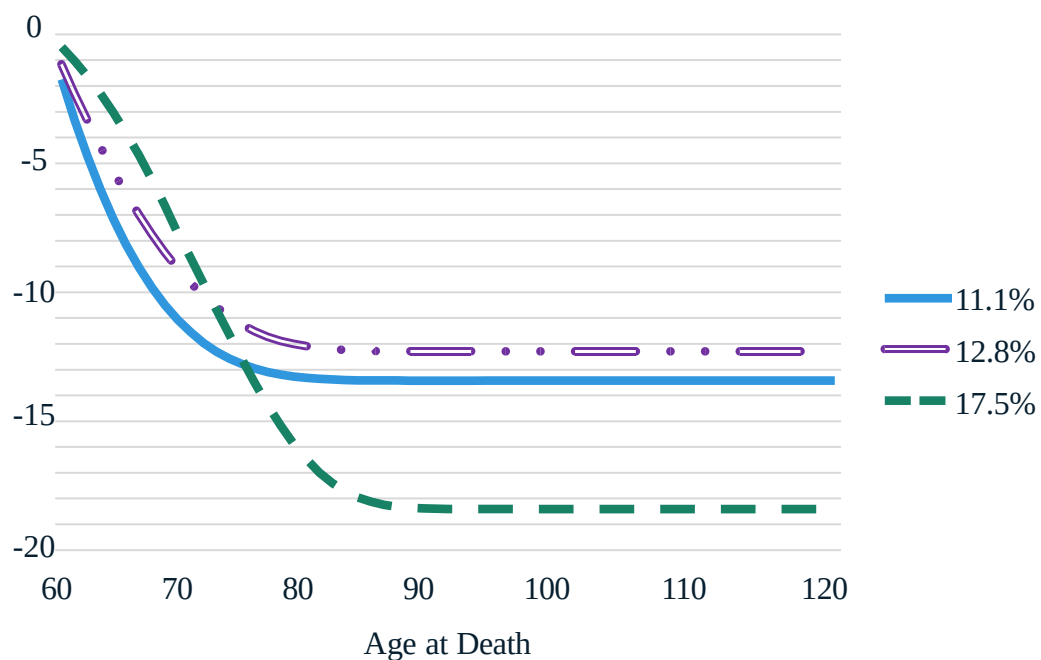


Annuity Tontine Pooled Annuity Fund Living Annuity



EXPECTED DISCOUNTED LIFETIME UTILITY

Living Annuity: Varying drawdown rates



- † Base case including all adaptations.
- † Drawdown slightly more than return favoured even when
 - Subjective mortality beliefs
 - Bequest motive
- † Maximum drawdown rate crosses utility maximising threshold.



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Key Takeaways

- In all cases, neither Living Annuities nor Guaranteed Annuities maximise utility.
- Consumers may be open to greater sharing of mortality risk.
- Possible reductions in income should be excluded.
- Behavioural factors have a significant effect on perceived value.
- Government transfers are important, even at low levels.



Limitations

- Simplifying assumptions generally unrealistic and inflexible.
- Theoretical utility models can be ineffective.
- Utility model is parameterised using non-South African data.



Opportunities for further research

- South African based parameterisation of the utility model.
- Updating of South African mortality and wealth data.
- Stochastic return modelling.
- Testing of risk-sharing options in less homogenous pools.
- Consolidation of wealth for Living Annuitants



THANK YOU

QUESTIONS

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