Are Stochastic Models Useful to Personal Injury Claimants?

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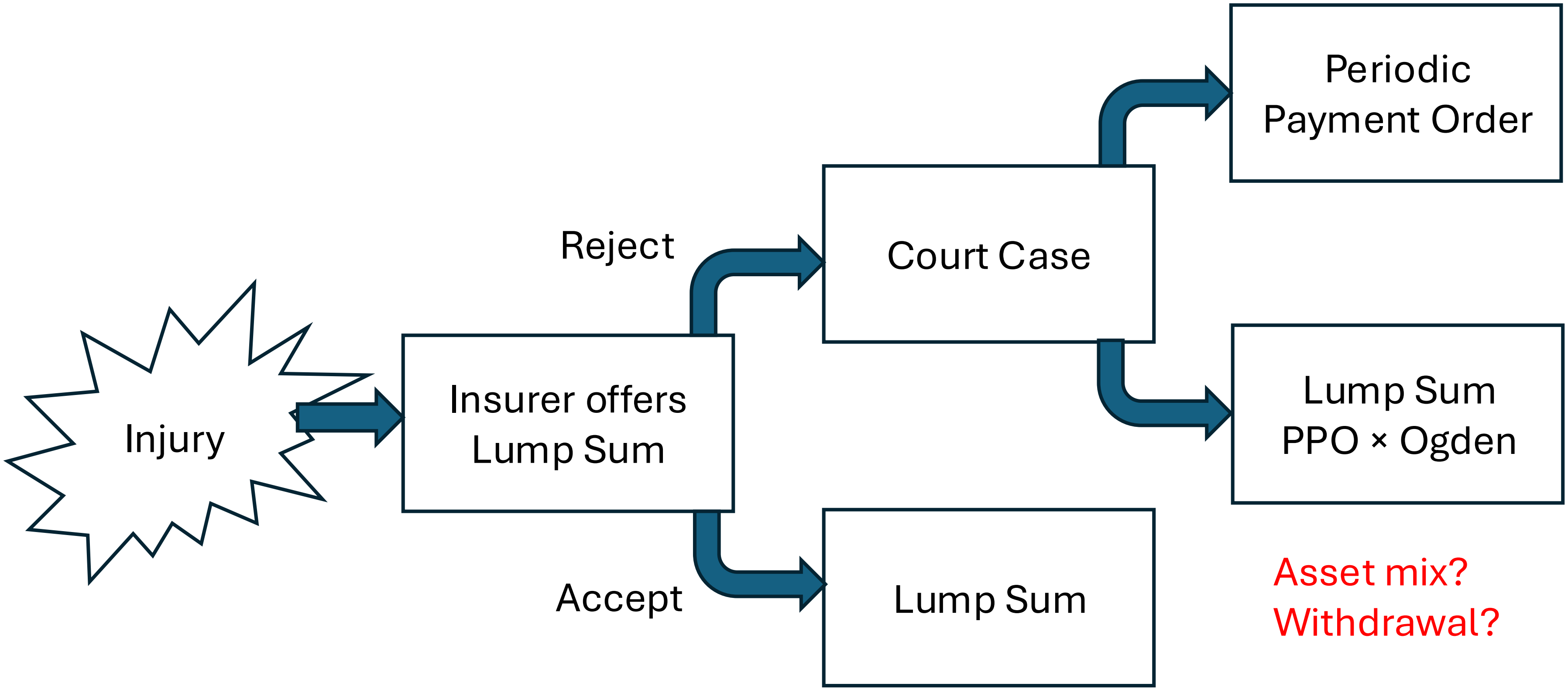
Presentation Overview

- Decisions facing a personal injury claimant.
- Financial advisor rules of thumb.
- Mary’s Yorkshire puddings.
- Scenario Generators and Illustration.
- Mathematical optimisation.
- Conclusions.

Personal Injury Decisions



Claimant Balancing Risks

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BUT a lump sum • allows flexibility over withdrawal timing (eg home adaptation up-front) • avoids the trauma of a court appearance.	

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BUT a lump sum • allows flexibility over timing (eg on home adaptation up-front) • avoids the trauma of a court appearance.	BUT access to a PPO • is mostly via the courts, • entails other legal risks such as contributory negligence.
For a claimant, evaluating a lump sum offer using Ogden's tables is largely meaningless, because (according to GAD reports) the basis of the Ogden multiplier: • relies on opaque economic scenario generator assumptions, • omits aspects of fundamental importance to claimants (eg their own longevity risk) • applies to a quantum unknown prior to the court case that the lump sum seeks to avoid.	

Investment Rules-of-Thumb

For the recipient of a lump sum

Client	Relative Risk Aversion γ	Equity risk premium vs risk-free $\sigma\lambda$	Equity volatility σ	Market price of risk $\lambda = (\sigma\lambda) / \sigma$	Equity Proportion $\beta = \lambda / [\gamma\sigma]$
High risk aversion					10%
Medium risk aversion					50%
Low risk aversion					100%

Safe Withdrawal Rate: 4% Rule

- Spend 4% of your fund every year
- This is the SWR (safe withdrawal rate)
- Assuming a 4% real return in the long run
- Implies the fund preserved in real terms
- Variations include:
  - Keep withdrawal amounts constant in real terms, ie do not cut withdrawn amounts even if market falls
  - Other real return assumptions.
  - Allow fund to deplete over eg 30 years (life expectancy).

More Rules of Thumb: 50/30/20

- The 50/30/20 rule ("All Your Worth: The Ultimate Lifetime Money Plan", Elizabeth Warren, 2005)
  - 50% for needs (food, shelter, utilities, minimum debt repayments)
  - 30% for wants (hobbies, fashion, holidays, eating out, Yorkshire puddings)
  - 20% for savings and financial goals
  - Personal injury claimants may have more % needs and lower % savings.
- Advisors also take account of tax / benefit effects
  - Defer capital gains
  - Avoid straying into higher rate income tax bracket
  - Avoid having just enough income to disqualify for state benefits

Is there a more scientific way to formulate withdrawal and investment decisions, with explicit objectives and optimisation rather than ad-hoc rules?

Mary’s Yorkshire Puddings!

First Scenario

- Mary loves Yorkshire puddings.
- Her supplier allows Mary two puddings per day, for the next year. Mary can allocate these as she wishes between the days of the year.
- The law of diminishing marginal utility suggests that Mary rationally consumes two puddings per day.

Meteorite Risk

- Now suppose that a meteorite is forecast to strike half-way through the year. With a probability of 2/3, this strike kills Mary.
- Otherwise, with a probability of 1/3, Mary (and her pudding supplier) continue as before.
- Nobody knows the outcome until the meteorite strikes.
- Should Mary re-distribute her pudding consumption towards the first half of the year?

Mary’s Possible Strategies

Mary’s preferences	Puddings / day Jan-June	Puddings / day Jul – Dec	Hindsight: early death	Hindsight: survival	Relative risk aversion
Risk averse	2	2	✗	✓	$\gamma > 2$
Risk tolerant	3	1	✗	✗	$0.43 < \gamma < 2$
Risk neutral	4	0	✓	✗	$0 \le \gamma < 0.43$

Risk-averse focuses on the worst case, that is surviving and being hungry.
Risk-neutral maximises expected total withdrawals.
Assume Mary seeks to maximise U(pud1) + U(pud2)/3 with pud1 + pud2 = 4.
The derivative U’(w) of her utility function U(w) satisfies $U'(w) = w^{-\gamma}$.
The critical value of $1 - \gamma = 0.57$ is because $3^{0.57} + 1/3 = 4^{0.57}$.

Life Expectancy Withdrawal Rate

(assume 360 days/ year)

Day Count (a)	Puddings brought forward (b)	Life expectancy (days) (c)	Puddings consumed (d) = (b)/(c)	Puddings carried forward (b) – (d)
0	720	240	3	717
1	717	239	3	714
2	714	238	3	711
…	…	…	…	…
179	183	61	3	180
180	180	180	1	179
181	179	179	1	178
…	…	…	…	…
359	1	1	1	0
360	0	0		

Mary's Pudding: Conclusions

- Mathematics can produce a 'least bad' solution to Mary's pudding problem.
- But no amount of mathematics can escape the regrets of
  - Not having consumed more if you die early
  - Wishing you'd been more frugal in the early years if you live a long time.
  - Reasons for an annuity market to develop.
- Optimal strategy depends on Mary's risk aversion, which is difficult to measure.

What is a Scenario Generator?

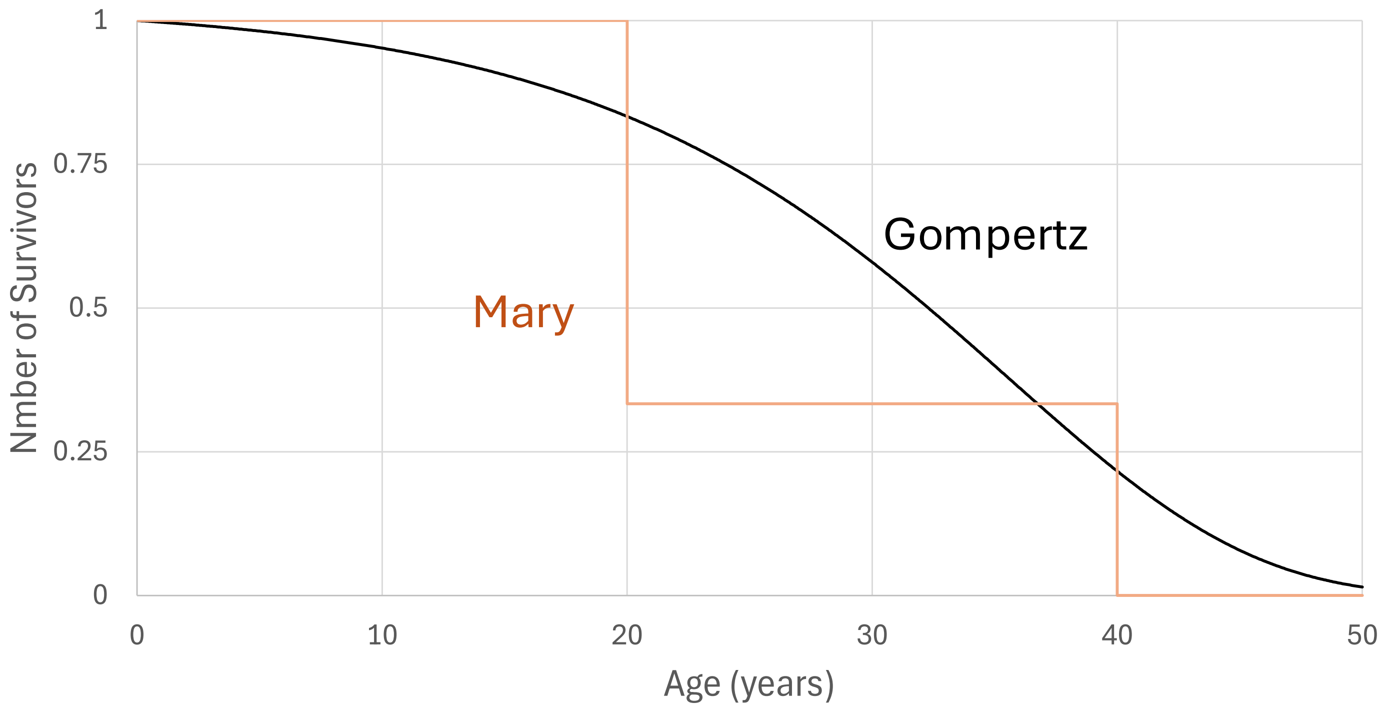
- Given a stochastic (probability) model …
- A scenario generator is a piece of software producing 10,000 scenarios for:
  - Investment returns on several asset classes (cash, government and corporate bonds, equity, property, alternatives …), annual intervals for 50 years
  - Date of death.

Generated Illustrations

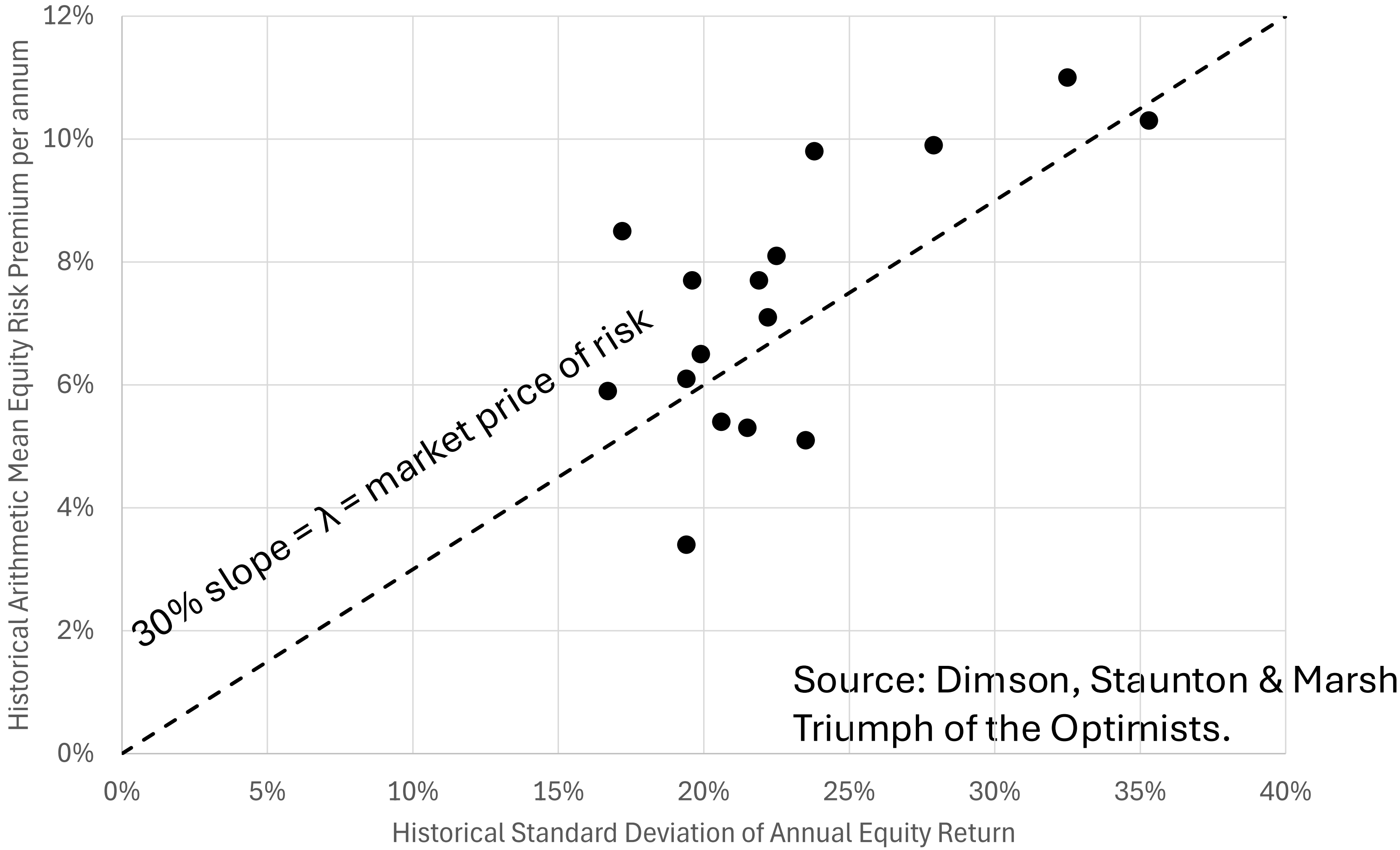
- Investor specifies:
  - Asset mix
  - Withdrawal strategy
    - Fixed component for needs
    - % of Fund for wants.
- Using a scenario generator, deduce expected amount spent each year.
- And calculate risks, eg probability of fund exhaustion, of wants being partially met, worst-case scenarios etc.
- Generated illustrations may support decision-making but do not tell a claimant what to do. Or may blind claimants with science.

Example Mortality Assumption

- Expected future lifetime 30 years
- Standard deviation 10 years



Historical Market Stdevs / Means



The Value of Market Expertise

- Consultant: For €200,000 I will tell you what our leading experts think about the outlook for interest rates, inflation and equity returns in major world economies,
  - Include time-varying / state-dependent risk premiums
  - On which no two experts agree!
  - And embed these in a set of scenarios.
- ChatGPT: For €20/month I can scan and analyse historical data on interest rates, inflation and equity returns.

Theoretical Optimisation

$$\beta = \frac{\lambda}{\gamma\sigma}$$

Where

- β is the proportion of the fund in risky assets
- σ is the volatility of risky assets (equities)
- λ is the market price of risk
  - expected equity return = risk-free + $\lambda\sigma$
- γ is the investor's relative risk aversion

Risk Aversion and Investment

Client	Relative Risk Aversion γ	Equity risk premium vs risk-free $\sigma\lambda$	Equity volatility (international) σ	Market price of risk $\lambda = (\sigma\lambda) / \sigma$	Equity Proportion $\beta = \lambda / (\sigma\gamma)$
High risk aversion	20	4.5%	15%	30%	10%
Medium risk aversion	4	4.5%	15%	30%	50%
Low risk aversion	2	4.5%	15%	30%	100%

Note that volatility and market price of risk do not depend on client preferences. Without an objective way to assess risk aversion, γ, this table is no better than an arbitrary map of high / medium / low risk aversion to low /medium / high equity proportion.

Investment Return and Withdrawal

Discounting argument

- If investment returns are high, then more should be withdrawn in early years because later withdrawals can be funded out of investment returns.
- So high expected return implies high initial withdrawal rate.

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Accumulation argument

- If investment returns are high then there is a strong incentive to save (rather than withdraw) and exploit the magic of compound interest.
- So high expected return implies low initial withdrawal rate.

Theoretical Withdrawal Rate

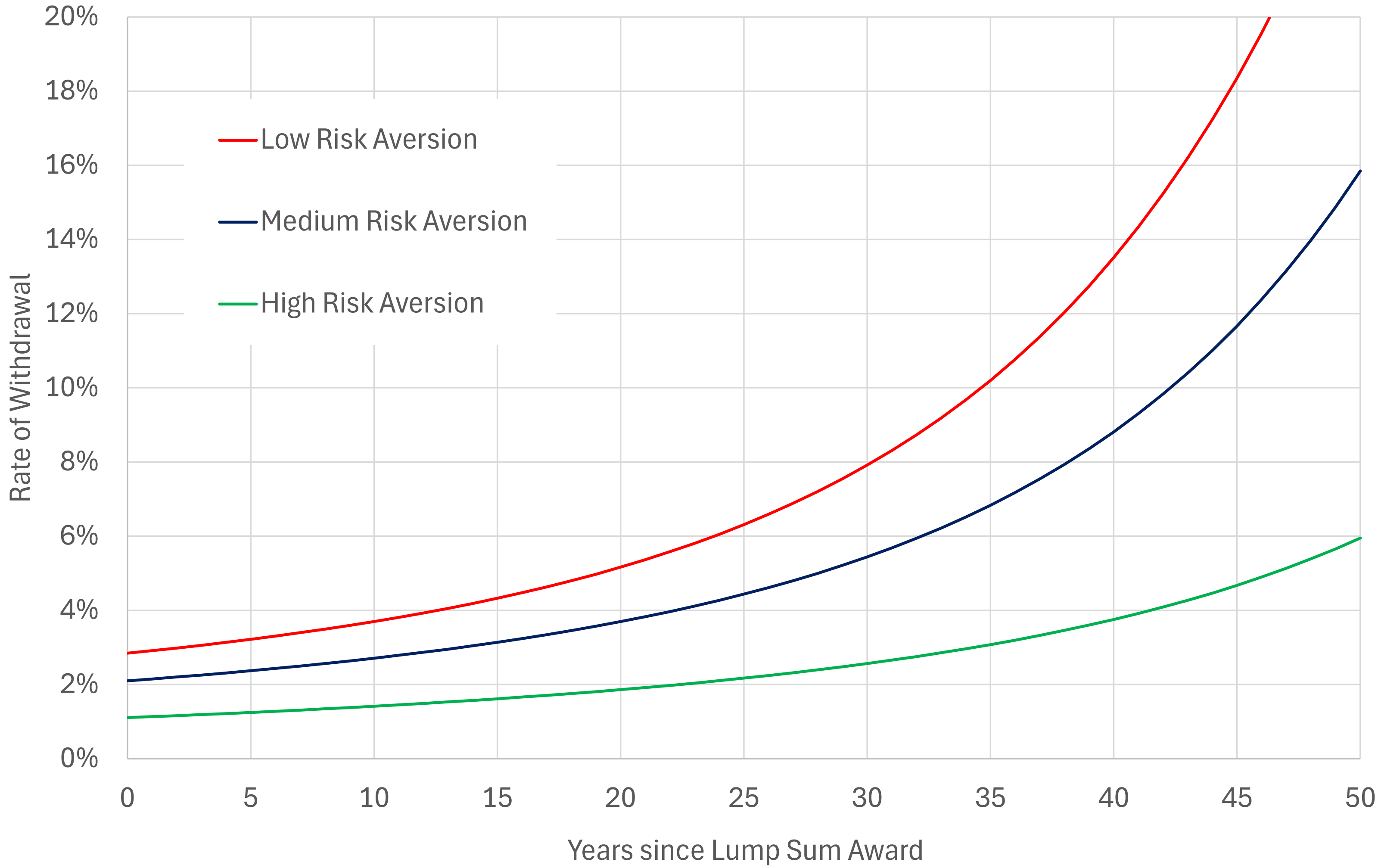
$$\frac{1}{SWR} = \sum_{t=0}^{\infty} \left\{ \exp\left((\gamma - 1) \left[r - \frac{\lambda^2}{2\gamma} \right] t \right) \frac{\ell_{x+t}}{\ell_x} \right\}^{1/\gamma}$$

Reduces to life expectancy rule if $\gamma = 1$.

Solution found by Scott F Richard (1975). Optimal consumption, portfolio and life insurance rules for an uncertain lived individual in a continuous time model.

Can make the solution harder (and ? more realistic) by including bequest motives, habit-formation effects.

Theoretical Withdrawal Rates



Lump Sum vs PPO Decisions

- Not a simple decision because both lump sum investment and going to court are risky.
- We can ask at what level of lump sum a claimant is indifferent between that lump sum and a PPO.
- The answer depends on the claimant's risk aversion (and mortality, investment return distribution etc)
- Longevity risk is the strongest reason for preferring a PPO because a claimant can otherwise do little to manage that risk.

Conclusions

- A scenario generator can illustrate possible outcomes to help a lump sum recipient to set their own investment strategy and withdrawal rates.
- Scenarios should include time of death as well as economic paths; otherwise we model only secondary risks.
- The mathematical optimum strategy is sensitive to individual risk aversion, which is difficult to estimate. This limits the benefits of technical scenario generator sophistication.
- No number of PhD’s in finance can make up for the fact we cannot predict (much) market cycles or our day of death.

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