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Institute and Faculty of Actuaries

LONGITUDE SOLUTIONS

HERIOT WATT UNIVERSITY

A10: Index based longevity hedging as a practical risk mitigation tool for deferred pension liabilities

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Life Conference, Dublin

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Contents

- Defining the Problem (Alan)
- Modelling the longevity risk (Andrew)
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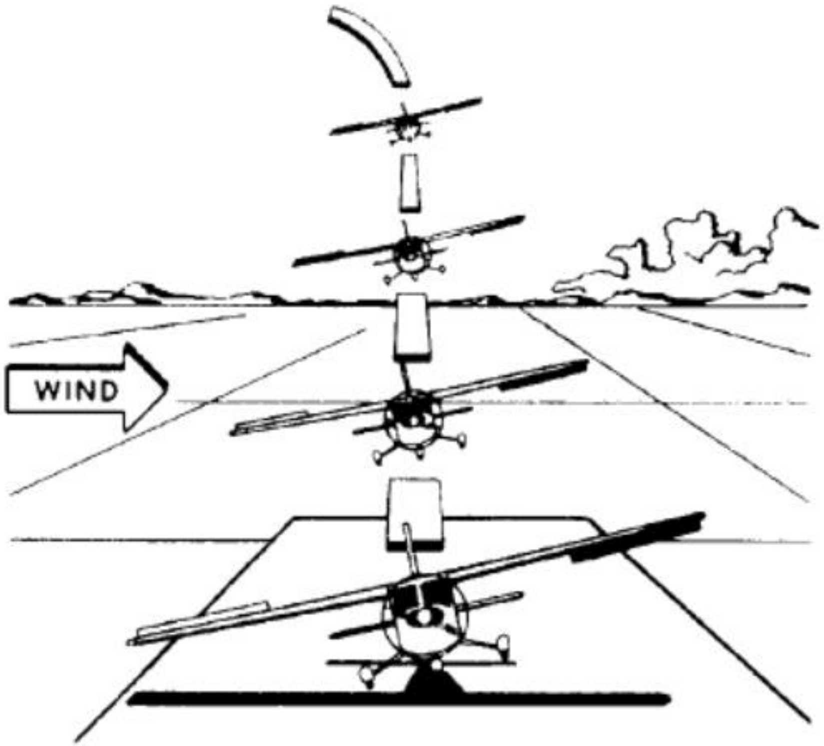
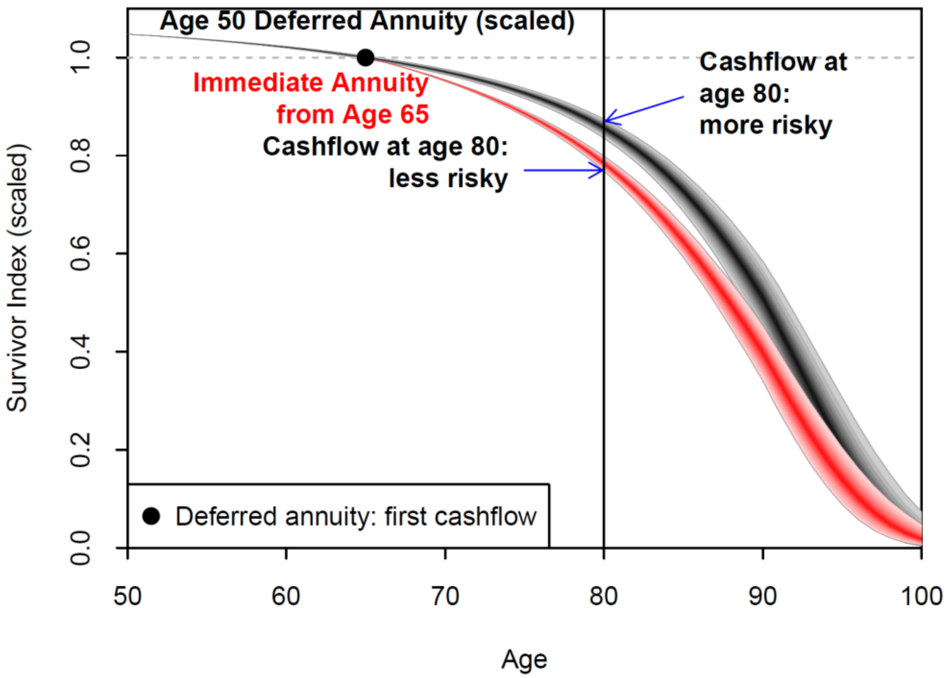
Definition of the Problem, or "The glidepath and the cross wind"

- Most DB schemes are in run-off
- Many have or will "buy-in" or "buy-out" pensioners in payment
- Some can afford a total buyout and wind-up now
  - Some can not!
- Of these most have reduced or are progressively reducing investment risk to "glide" towards an eventual buy-out and wind up once all Pension are in payment
- This leaves longevity risk as the last unhedged risk
- How much could the longevity cost of a future buyout move if longevity improves faster than expected over the next 10-20 years?
- Could this "cross-wind" blow them off the "glidepath"?



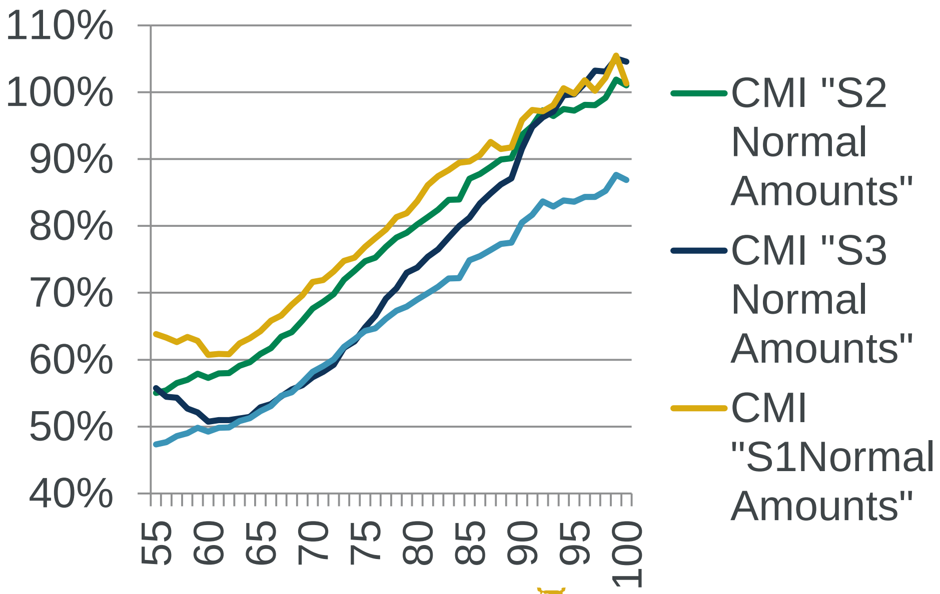
Deferred pensions are “more risky”



- Longevity trend has more time to diverge
- Interest risk more difficult to hedge
- Optionality due to Pensions Freedom
- Duration of contract limits counterparties able to accept

Pension Longevity Risk Model

- Most deterministic longevity models for Pension Schemes combine
  - Pension Mortality Table
  - Scheme Experience Ratio (constant % of Pension Table)
  - General Population Mortality Projection
- Most stochastic longevity models for Pension Schemes apply the stochastic risk explicitly only to the General Population Projection
- Flaws with this approach
  - Scheme and/or Pension mortality may vary over time relative to General Population Mortality
  - Scheme experience ratio may not be well represented by a constant %age for all ages
  - Sampling error based on small scheme size ignored



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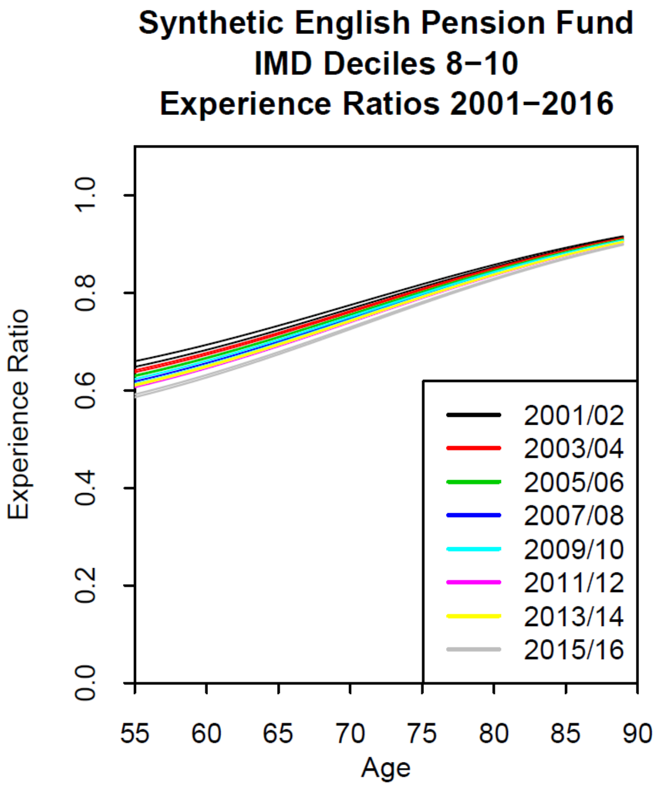
UK Pensions "Experience Ratios"



- Experience ratios:

  ratio of scheme q(x) to national q(x)
- Synthetic scheme = IMD8-10
- CMI-SAPS-S1/S2/S3 versus IMD8-10:
- Both: widening gap
- Both: taper to 100% at high ages, with less variation at high ages
- Different shape below 60 reflects different mix of lives in SAPS below 60

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New model M7XL-M5XL
(Cairns-Rae, 2019)

Cairns-Rae (Cairns et Al.) variant of M7-M5 in Villegas et al. (2017)

Population 1:

$$\log m_1(t,x) = \alpha_1(x) + \kappa_{11}(t) + \kappa_{12}(t)\beta_{12}(x) + \kappa_{13}(t)\beta_{13}(x) + \gamma_1(t-x)$$

Population 2:

$$\log m_2(t,x) = \log m_1(t,x) + \alpha_2(x) + \kappa_{22}(t)\beta_{22}(x)$$

Model features:

- Logistic β(x)'s replace the linear and quadratic age effects in M7-M5.
- $\alpha_2(x)$ and β(x)'s taper to zero as x reaches the high ages – mimicking what we observed in the SAPS experience ratios.

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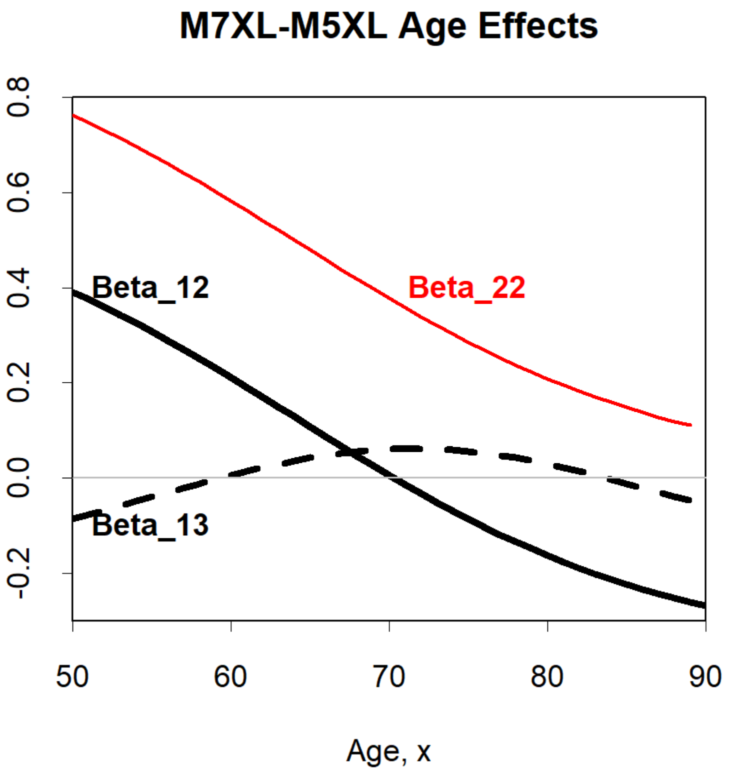
Beta parameters explained



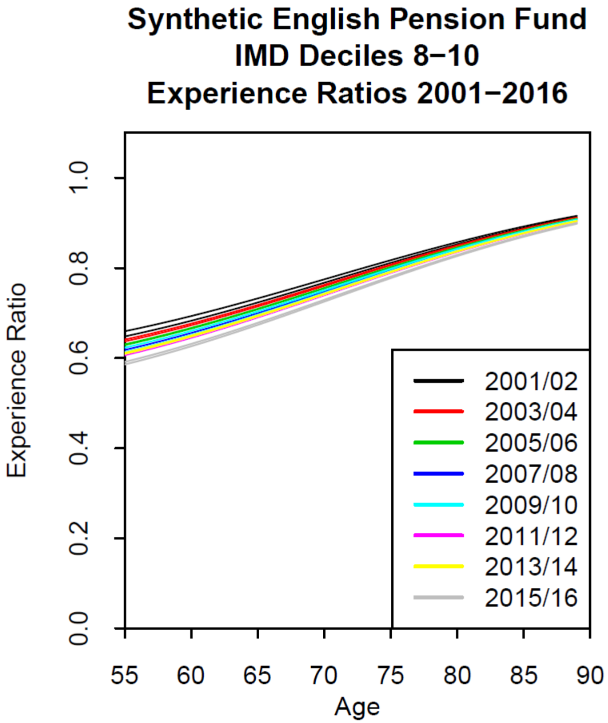
Population 1:

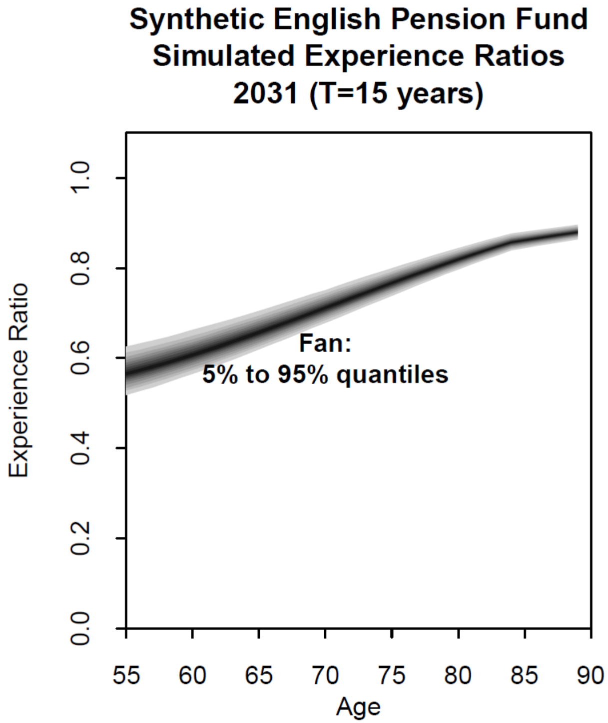
$$\begin{aligned}\log m_1(t,x) &= \alpha_1(x) \\ &\quad + \kappa_{11}(t) + \kappa_{12}(t)\beta_{12}(x) + \kappa_{13}(t)\beta_{13}(x) \\ &\quad + \gamma_1(t-x)\end{aligned}$$

Population 2:

$$\log m_2(t,x) = \log m_1(t,x) + \alpha_2(x) + \kappa_{22}(t)\beta_{22}(x)$$

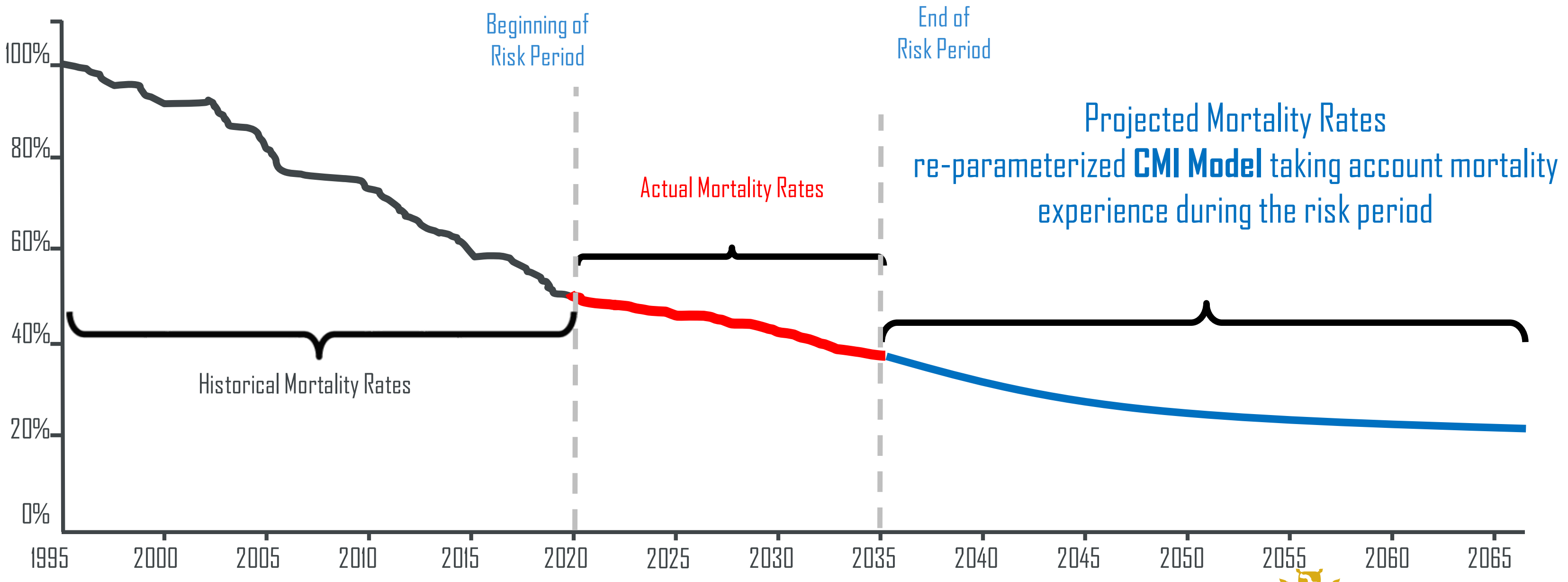
Cairns-Rae model captures the variability experienced over the last 15 years





- Best estimate continues slow downwards trend
- But significant uncertainty around this consistent with the past

Forecasting the buyout pricing



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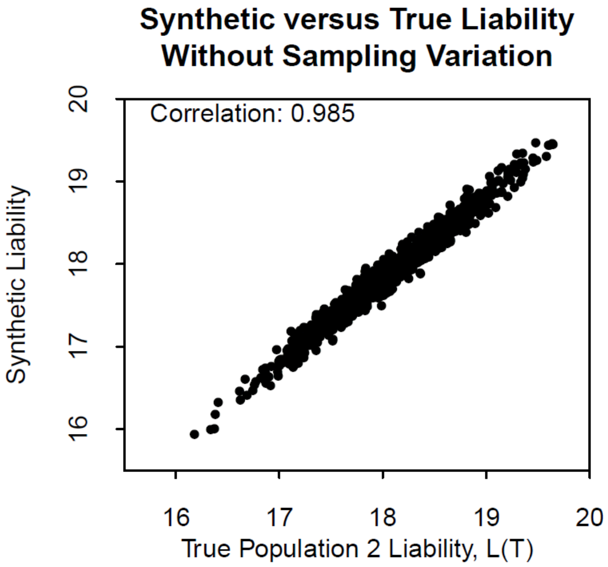
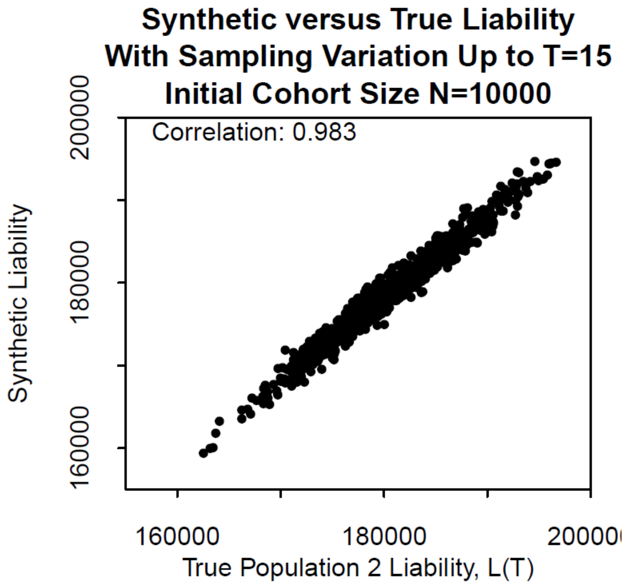
High Correlation Between the Population Index and Pension Scheme experience





- *Preliminary results*
- High correlation due to:
  - Tapering of experience ratios at high ages
  - Recalibrated improvement rate beyond T=15 that affects both populations
- N=10,000 population size:
  - Not much difference with and without sampling variation

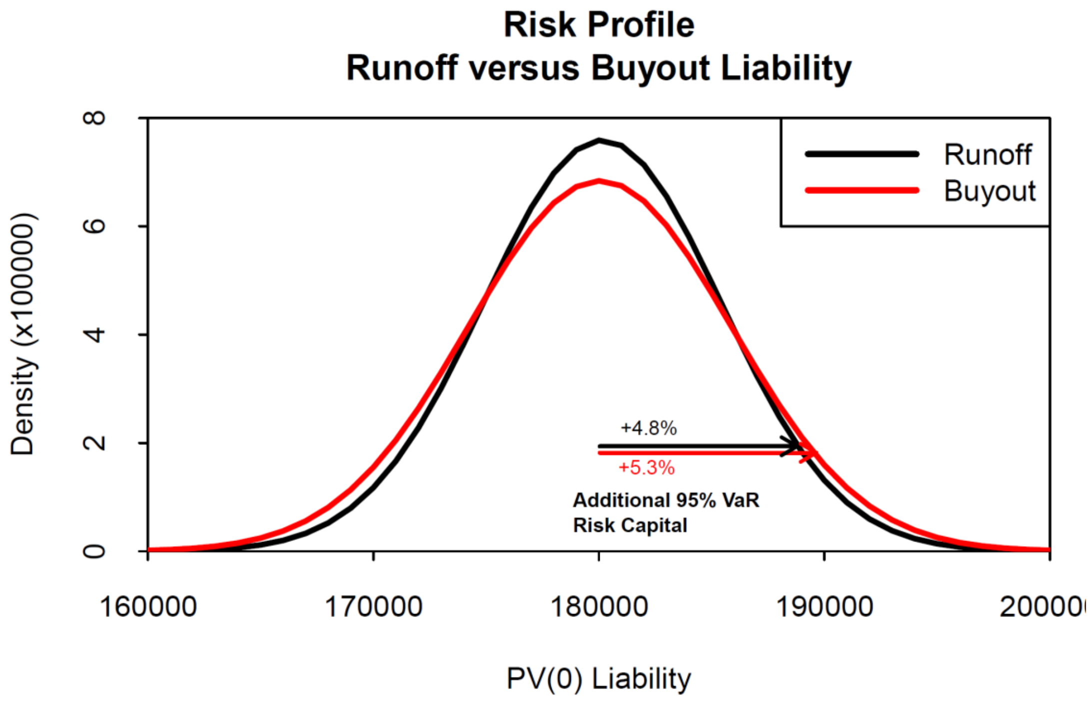
Level of risk in deferred pensioners

Distribution of PV of Deferred Pensions liability

1. Full Runoff
2. Buyout after 15 years

Buyout risk is higher:

- Additional recalibration risk at time 15



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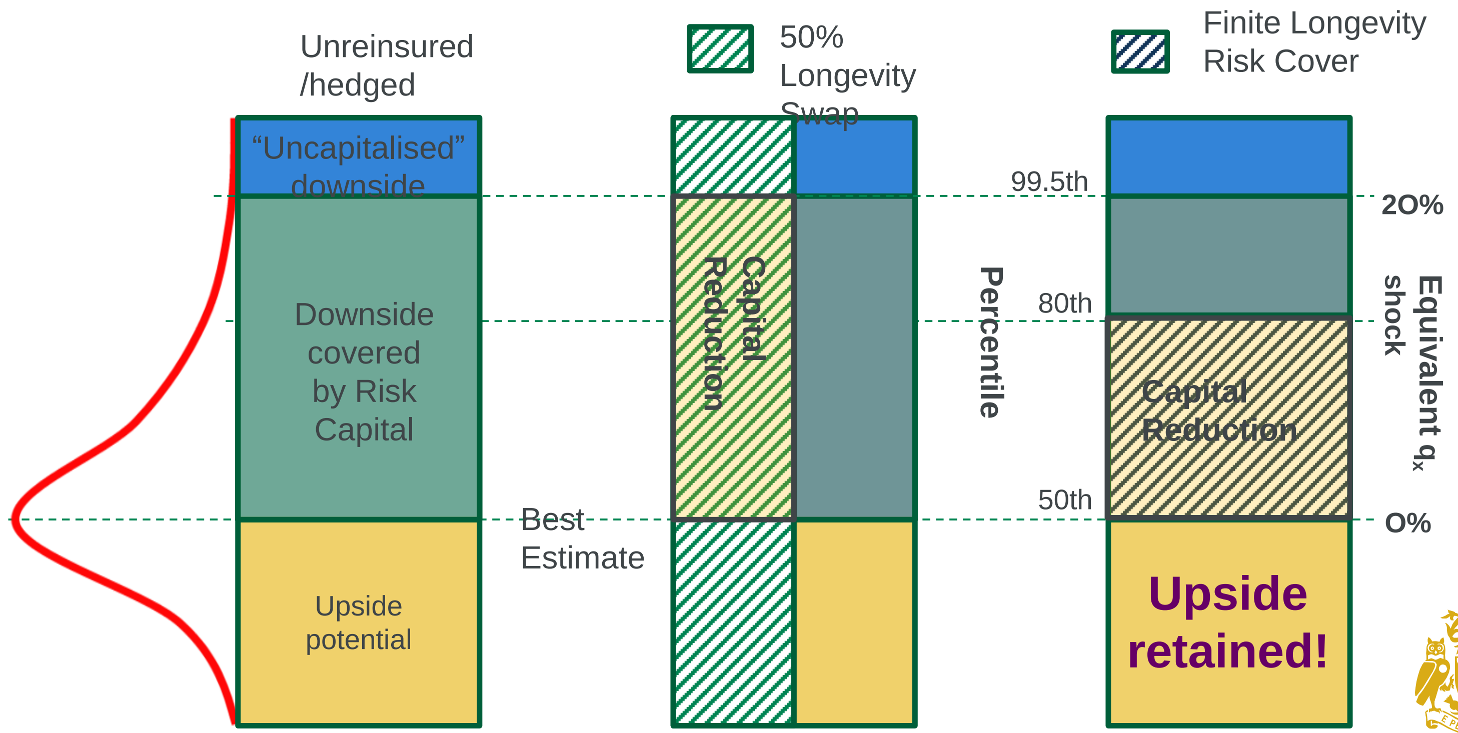
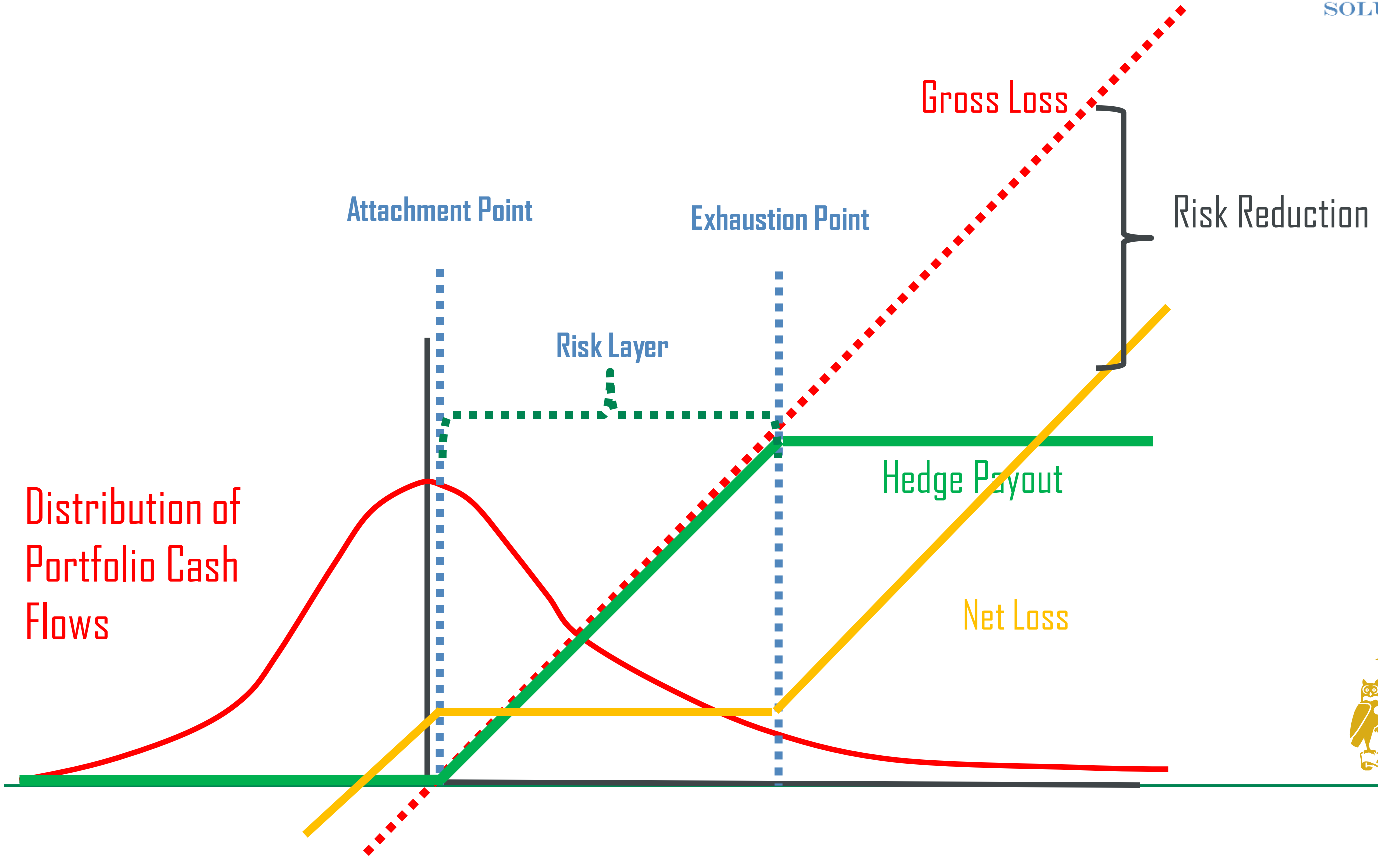
Options to reduce longevity risk for deferred pensioners

- Buy-out
  - Allows scheme to close
  - Expensive, but nice if you can afford it
  - Can offer members Pensions Freedom but with anti-selection for annuity provider
- Buy-in
  - Still expensive
  - Complex administration to allow for Transfers out
- Longevity Swap
  - Retain asset risk / reward (for ever)
  - Expensive, if available
- Longevity downside hedge
  - Indemnity or Index
  - Finite or infinite cover
    - Amount and Duration
  - Upside retained

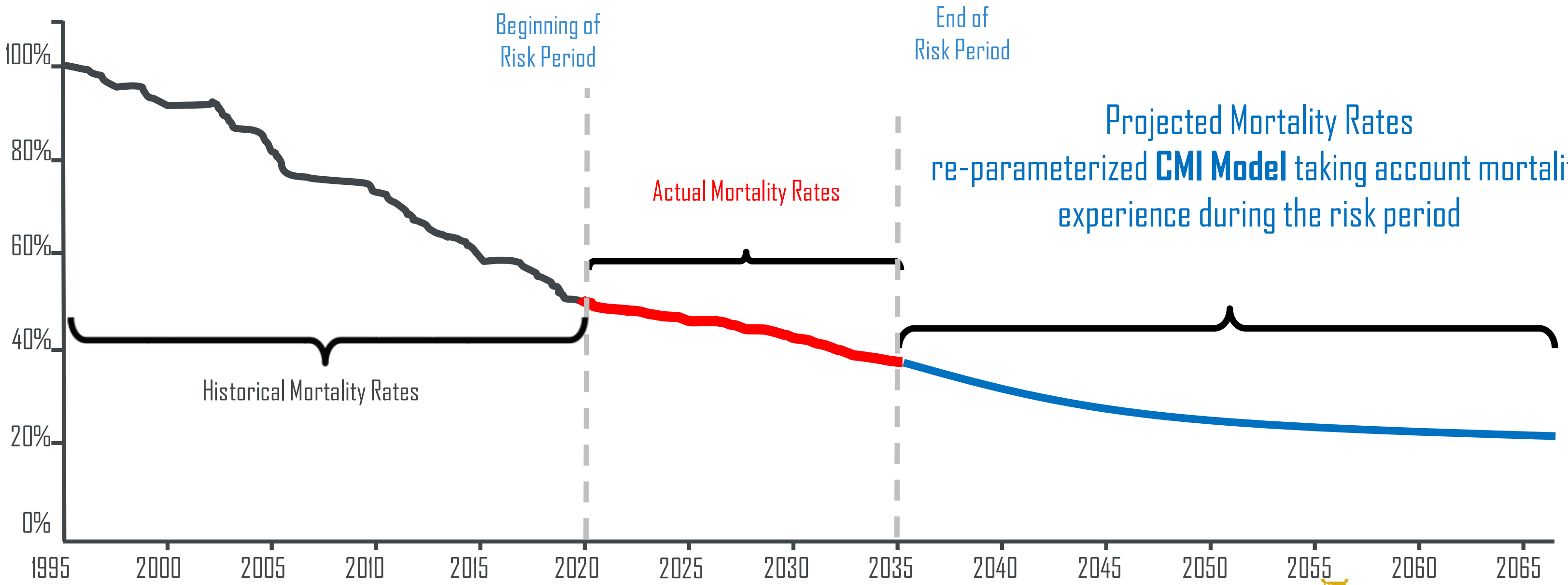
Swap versus Stop Loss



Payout Profile linear between AP & EP



Commutation after 15 years mimics buyout pricing



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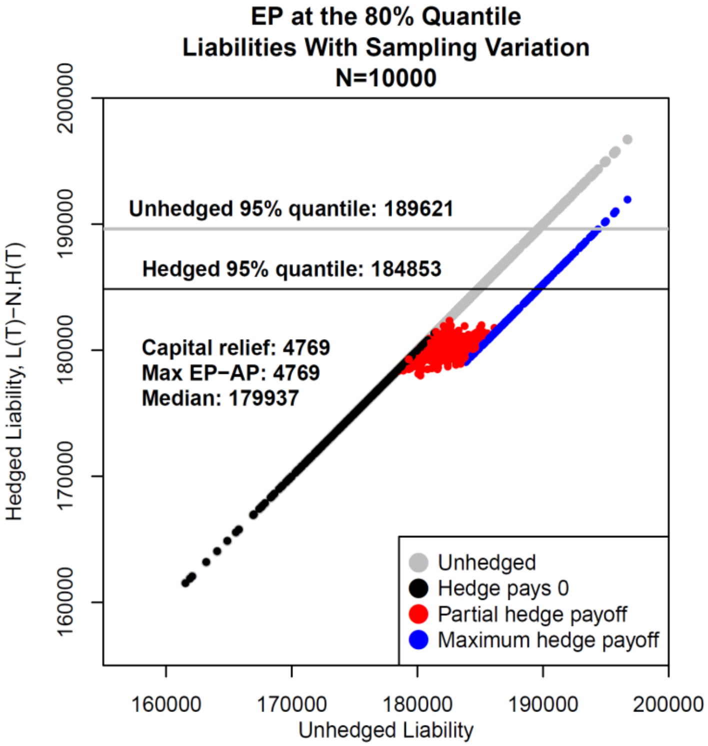
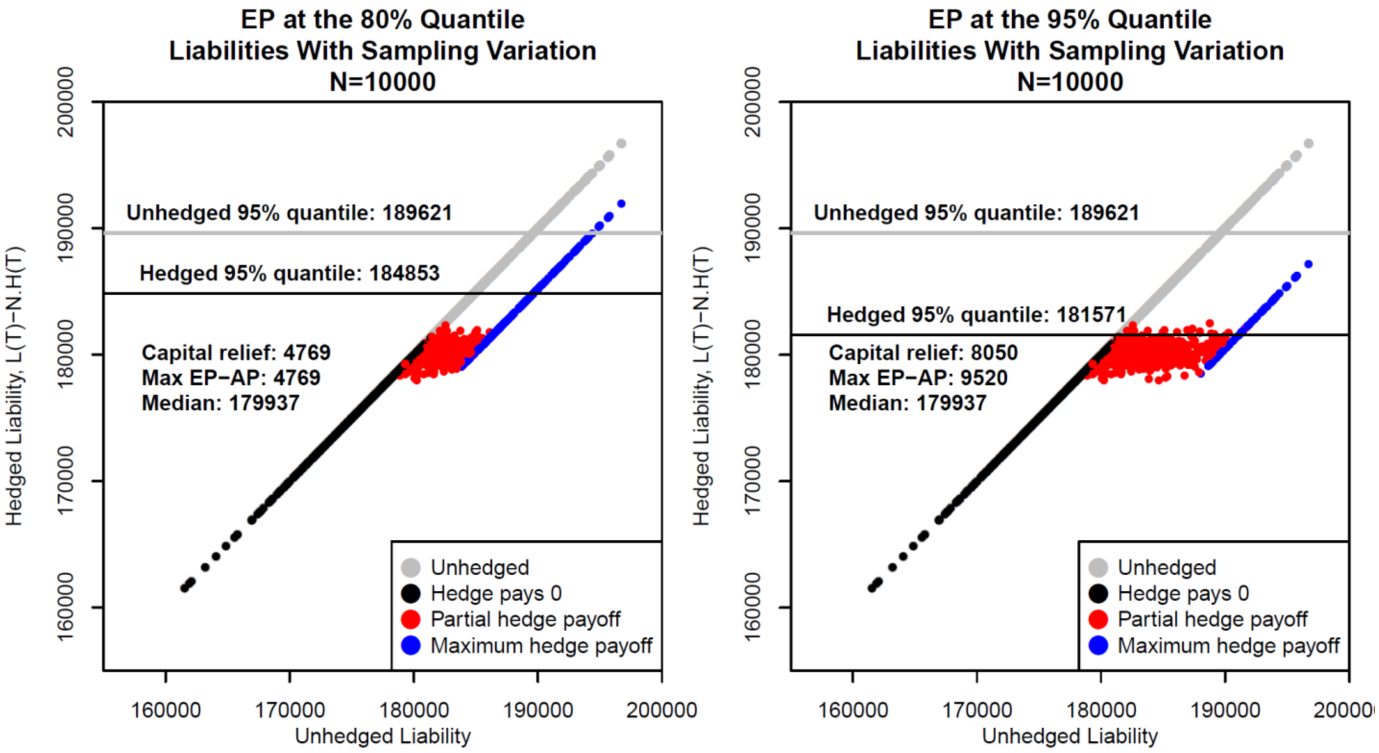
Basis Risk present but may not need extra capital



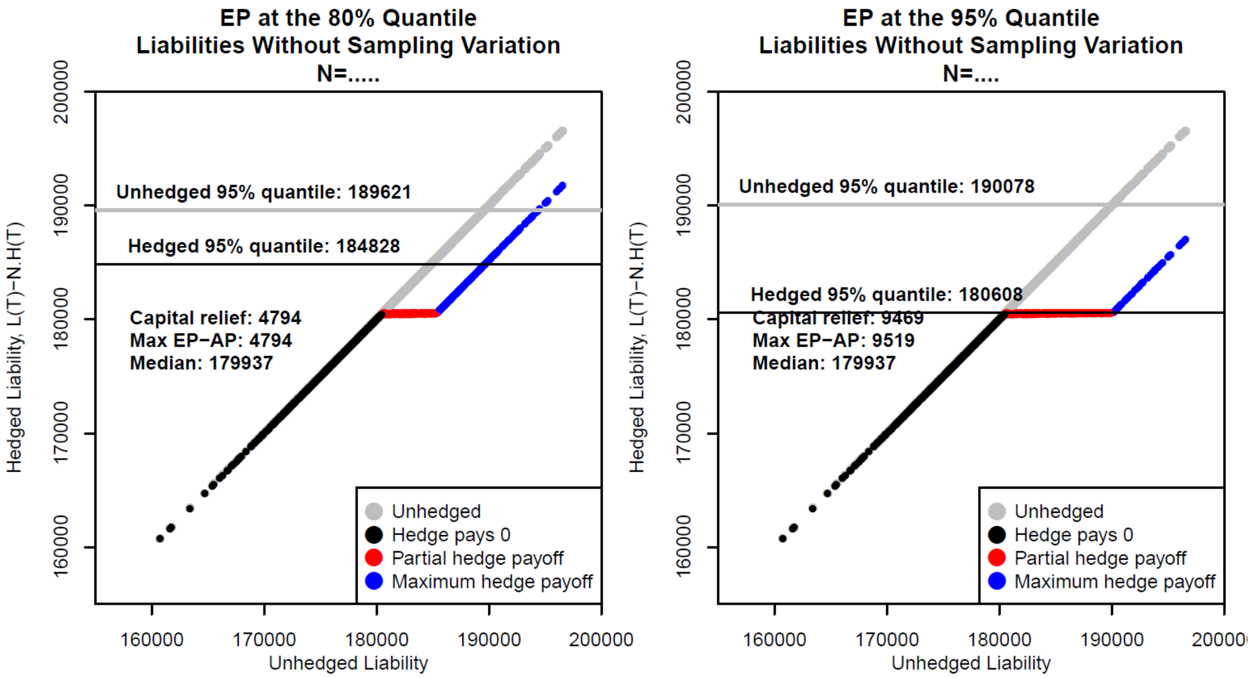
- *Preliminary results*
- Exhaustion point, EP, at the 80% quantile
- At the 95% VaR level the hedge always pays off in full
- Population basis risk has no impact

Exhaustion Point key to capital relief



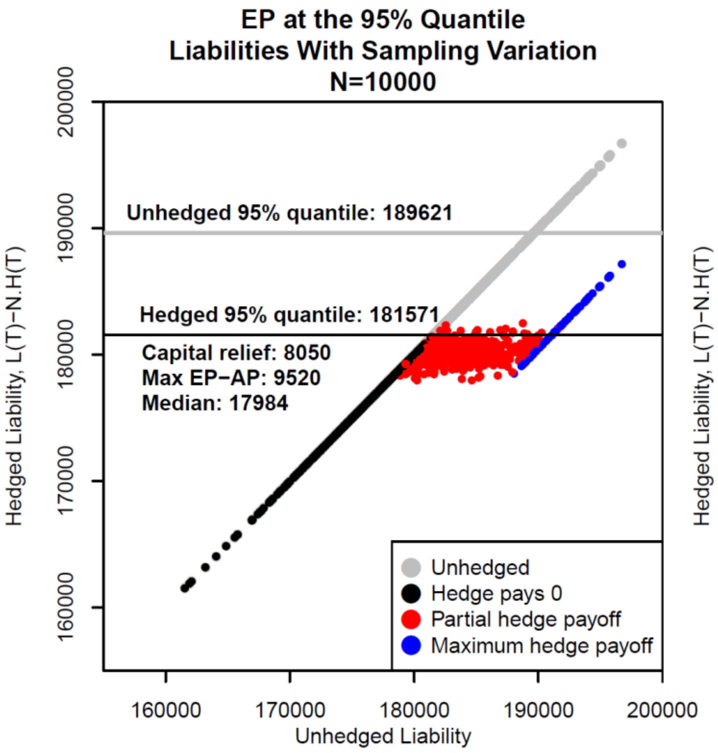
- Increase EP from 80% to 95% quantile
- Population basis risk now kicks in
- EP-AP widens by 4751 (9520 – 4769)
- But capital relief increases by only 3281

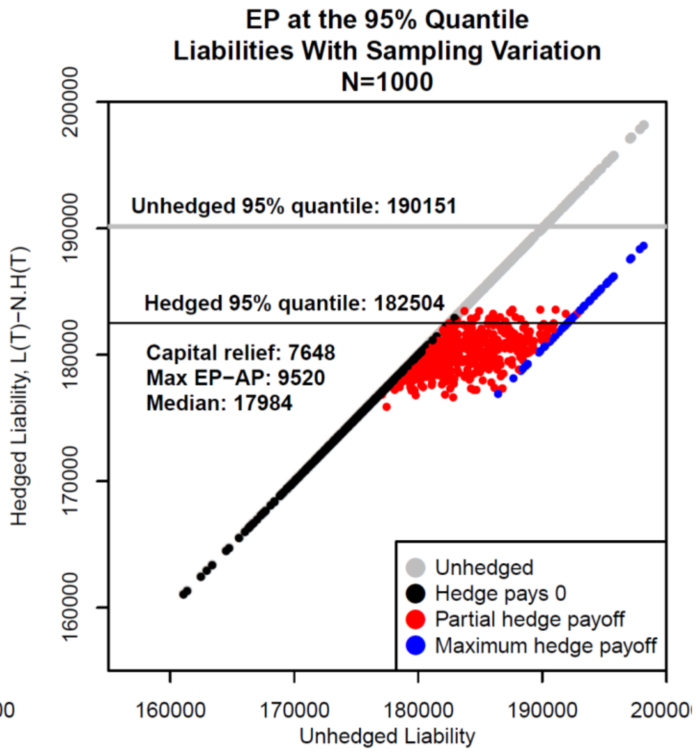
What happens if we “ignore” Basis Risk



- We amend Population 2 model
  - turning off uncertainty in the kappa_22(t) process
  - turning off parameter uncertainty in the mean reversion level of kappa_22
  - Turn off sampling variation (size N=… has no impact)
- We replicated the “yellow line” hedged payoff from earlier slide

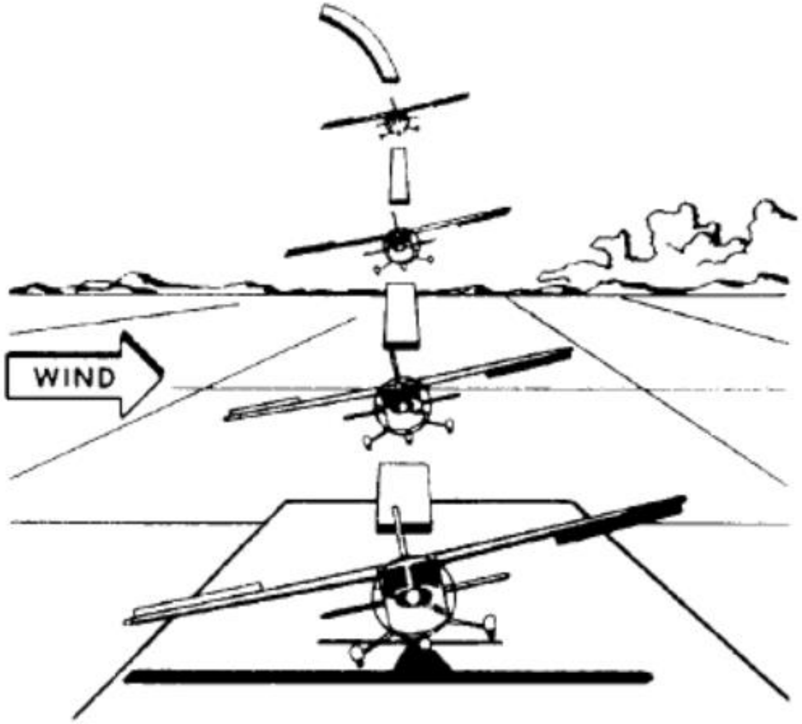
Smaller deferred population increases Basis Risk





- EP at 95% quantile
- N=10000 vs
- N=1000
- Red cloud more dispersed
- Capital relief falls from 8050 to 7648 due to higher sampling variation (=> higher population basis risk

With the Proper Correction disaster can be averted!



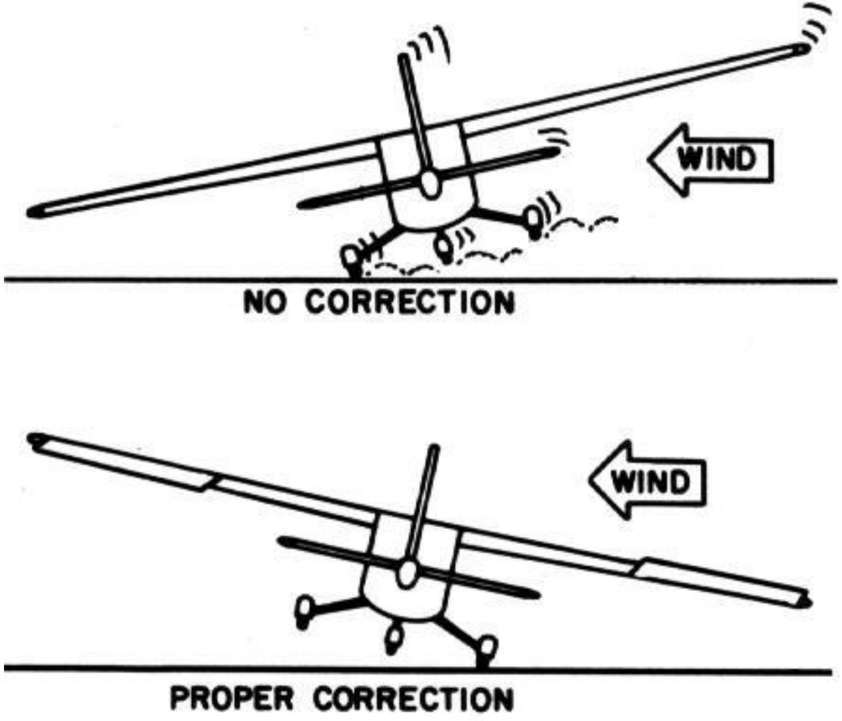


Figure 8–3 Skipping Results with no Correction

Questions

Comments

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