Institute of Actuaries of Australia

BIENNIAL CONVENTION 2011

BEYOND THE MANDATE

10 – 13 APRIL 2011 • HILTON SYDNEY

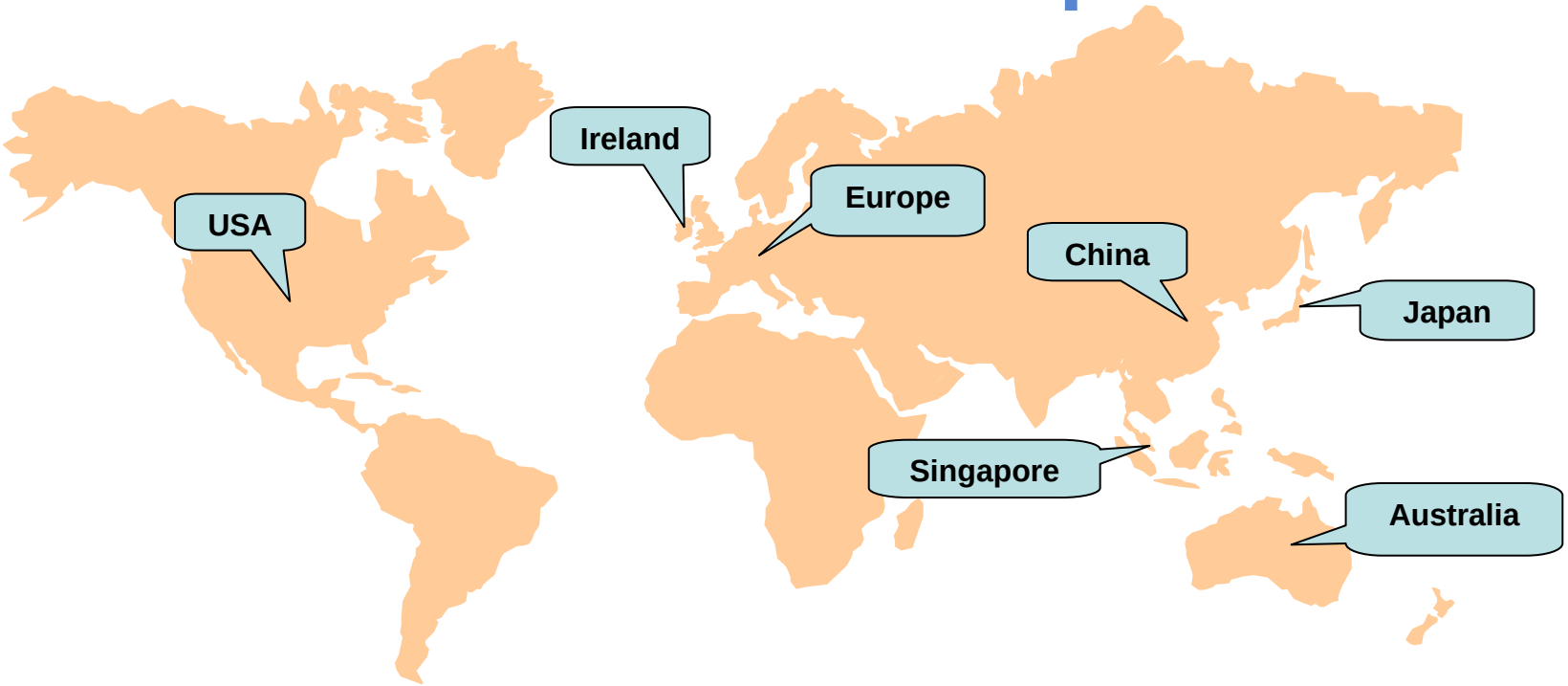
Approaches to Setting Capital for Investment Guarantees

John Nicholls and Ismar Tuzovic

Topics

- Approaches to setting capital margins
- A “theoretically correct” approach
- “Short-cut” approaches

International developments



USA – C3 Phase II capital

- C3 Phase II (risk based capital)
  - Total Asset Requirement (reported) = TAR(best efforts) + E x Max [0, TAR(adjusted) – TAR (best efforts)]
  - TAR based on Conditional Tail Expectation (90)
  - E not less than 0.05
  - Prudent Estimate assumptions
  - Working Reserve equal to the cash surrender value
- TAR (best efforts) reflect Clearly Defined Hedging Strategy
- TAR (adjusted) reflect risks that are not completely reduced, eliminated or considered
- Standard scenario minimum

USA – Actuarial Guideline XLIII reserves

- CTE Amount (reported) =
  E x CTE Amount (best efforts) + (1-E) CTE Amount (adjusted)
  - CTE Amount based on CTE (70)
  - E not more than 0.7 (not more than 0.3 if less than 12 months experience)
  - Prudent Estimate assumptions
  - Working Reserve equal to the cash surrender value
- CTE Amount (best efforts) reflect Clearly Defined Hedging Strategy
- CTE Amount (adjusted) reflects only hedge positions at the valuation date
- Standard scenario minimum

Ireland – Requirements for Reserving and Risk Governance for Variable Annuities

- Capital and Reserves the greater of:
  - Conditional Tail Expectation (95% for business issued from 1 Jan 2011, 90% for earlier business)
  - CTE 65 plus solvency and instantaneous change resilience margins
- An equivalent Value at Risk measure may be used
- No policy may be treated as an asset
- Lapse/surrender reflected only if this increases the CAR

Europe – Draft Report on Variable Annuities

- Committee of European Insurance and Occupational Pensions Supervisors Consultation Paper no. 83 – Draft Report on Variable Annuities
  - Considers supervision under both Solvency I and Solvency II frameworks
  - In relation to the Solvency II framework, findings include
    - adequate for technical provisions
    - standard formula approach not sufficient for capital requirements
    - principles for internal models suitable for VAs

Europe – Solvency II

- Solvency Capital Requirement
  - 99.5% Value at Risk measure over one year, considering change in “own funds”
  - Different timeframe can be considered provided level of protection for the policyholder is the same
  - Reflect dynamic hedge (subject to qualitative and quantitative limitations)

Japan – Insurance Solvency Regulations

- New solvency rules come into effect from March 2012
- For VA guarantees either Normative or Alternative approach can be applied
- In either case credit for hedging program available
- Normative approach
  - Minimum guarantee reserve under a stress
  - Calculation method to be specified by company, subject to regulatory approval
  - Standard or non-standard parameters may be used
    - risk coverage must be equivalent to that using standard parameters
  - Stresses as specified for Asset Value Volatility Risk
- Simplified normative approach may be used for business issued before March 2005

Japan – Insurance Solvency Regulations

- Alternative approach
  - Insurers may develop their own approach
  - Calculation method to be filed in advance with the regulator
  - Once applied, not allowed to switch back to Normative approach unless
    - Back-testing failed
    - Significant change in risk measurement models
  - Insurer must meet 13 specified criteria regarding risk management and risk measurement

China - Interim Rules for Variable Annuity Insurance Management

- Pricing
  - Based on parameters derived in prudent manner
  - Follow generally accepted actuarial standards, option pricing model or stochastic model
- Risk management
  - Dynamic hedging
  - Constant proportional portfolio insurance
- Arbitrage-free option pricing model or stochastic model for pricing and hedging
- Reserve for guarantee maximum of
  - CTE 70 based on stochastic model
    - Over life of the guarantees
    - Scenario independent assumptions to be best estimate plus a risk margin
  - Deterministic result from standard (stressed) scenario
- No credit for hedging in reserve calculations

Singapore

- Guidelines on Use of Internal Models for Liability and Capital Requirements for Life Insurance Products Containing Investment Guarantees with Non-Linear Payouts
- Greater of CTE 95 results with and without margins for adverse deviation applied to best estimate assumptions
- Swaps used to mitigate risk recognised as an asset on the balance sheet
- No credit for the swap when calculating liability or capital for duration mismatch risk

APRA capital review basis

- 99.5% probability that insurer will be able to absorb unexpected shocks or losses that may arise over a one-year period and continue to be able to meet its obligations to policyholders at the end of that period
- Capital Charge = Prudent Liability - Adjusted Liability
- Adjusted Liability = Max (RFBEL, BETV)
- Prudent Liability = Max (Stressed Liability, Stressed TV)

APRA's Review of Capital Standards

- "The proposed standard asset risk capital charge will not adequately cater for the special features of variable annuities."
- "It is likely that stochastic modelling would be required instead of the scenario-based calculations used for other types of products."
  - May consider both asset risks and insurance risks simultaneously

APRA's review of capital standards

- Proposal for variable annuities
  - Capital = E x Capital (Best Efforts) + (1-E) x Capital (Adjusted)
  - E can not be greater than 0.7 (0.3 if company has less than 12 months of experience)

Economic capital model

Risk Measure definition	Time Horizon	Risk Measure	Risk Appetite
Risks Covered	Risk Factors and Choice of Model		
Impact Measure	Risk Bearing Value		
Aggregation	Dependence Structure		

APRA capital review basis - general

Risk Measure definition	Time Horizon 1 year	Risk Measure VaR	Risk Appetite 99.5%
Risks Covered	**Risk Factors –** Various **Choice of Model –** Stress		
Impact Measure	**Risk Bearing Value** Adjusted liability		
Aggregation	**Dependence Structure** Correlation matrices		

APRA capital review basis - VA

Risk Measure definition	**Time Horizon** Portfolio run-off	**Risk Measure** VaR/CTE?	**Risk Appetite** ???
Risks Covered	**Risk Factors –** Various **Choice of Model –** Stochastic & stress		
Impact Measure	**Risk Bearing Value** Risk-free best estimate liability		
Aggregation	**Dependence Structure** Market-based calibration / factors		

Why at least partially stochastic over portfolio run-off?

- Market risk
- Basis risk
- Path dependence
- Counterparty risk
- Turbulence risk
- Policyholder behaviour
- Legal risk
- Longevity risk
- Delay risk
- Hedging program error
- Parameter estimation
- Gap risk

Risk will be present throughout the portfolio run-off

"Short-cut" approaches play an important role

- "Short-cut" approaches
  - Stress/scenario methods
  - Scenario selection techniques
  - Replicating portfolios
  - Projection period less than full run-off
- Potential roles
  - Floor for regulatory capital
  - Interim valuations
  - Fast close
  - Sensitivity analysis

Investment Guarantee Products

	AXA Protected Retirement Guarantee	Macquarie Lifetime Income Guarantee	OnePath MoneyForLife
Lifetime income guarantee	Yes	Yes	Yes
Guarantee rate	From 4.0% (age 60) to 5.0% (age 65)	3.5% (up to age 64) 4.0% (age 65 to 69) 4.5% (from age 70) Lifestyle Bonus	4.0% (up to age 64) 5.0% (from age 65)
Investment strategies (growth allocation range)	Four (35% to 85%)	One (70%)	Three (35% to 60%)
Guarantee fee range	1.20% to 2.15% p.a. of account value	1.10% p.a. of Guarantee Base	1.15% to 1.45% p.a. of Protected Income Base
Ratchet	Annual	Annual	Annual

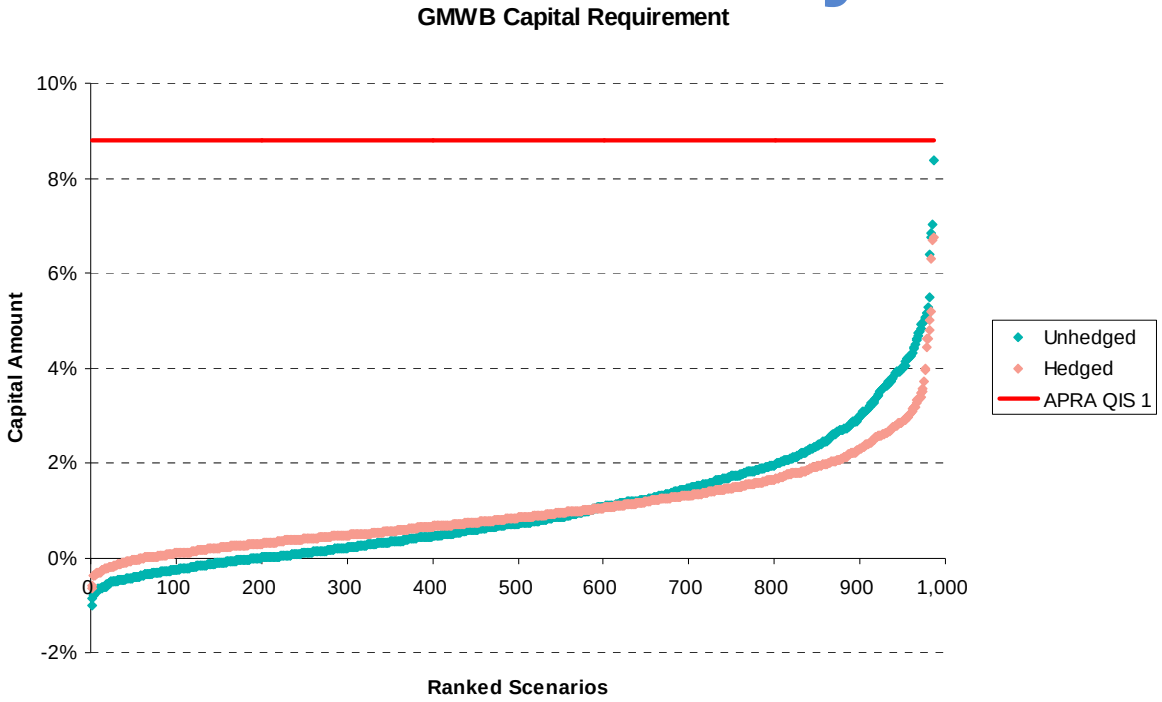
Sample GMWB product

- Guarantee income payment of 5% for life
- Annual ratchet
- 50% Australian Equity, 50% Fixed Interest
- Guarantee charge 1.3%, account fee 1.5%
- Male age 65, in force 6 months
- Expense $200 per annum increasing with inflation
- Dynamic lapse

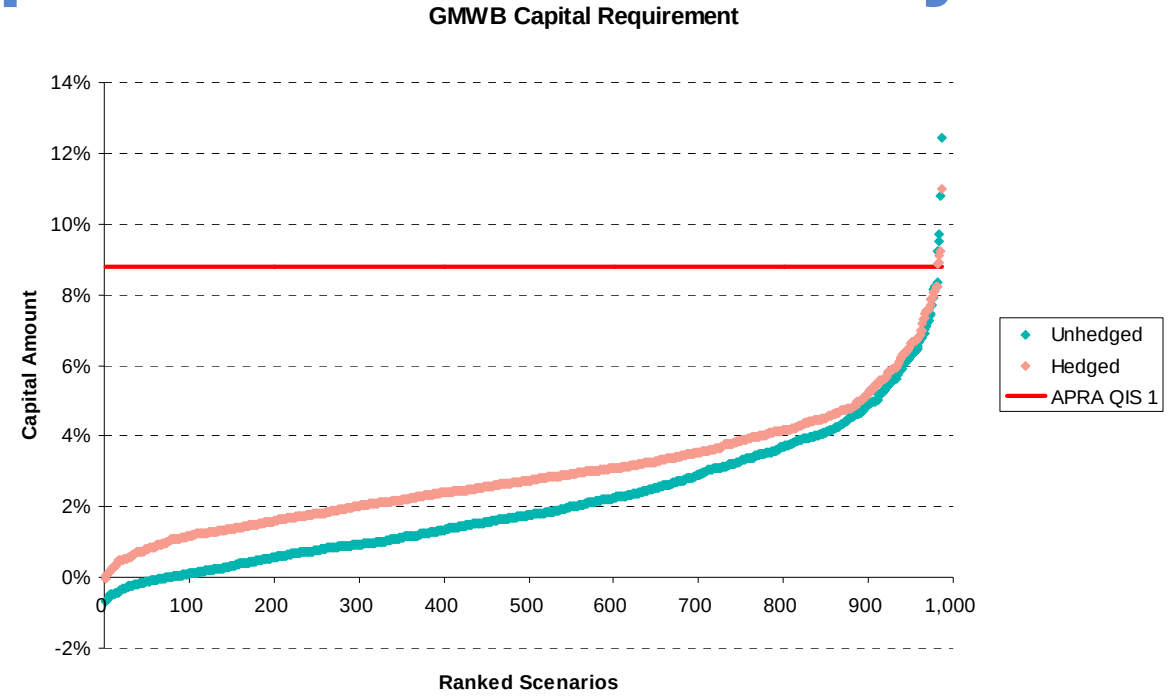
Modelling GMWB capital

- Nested stochastic model:
  - 1,000 real world scenarios
  - 1,000 risk-neutral scenarios coupled to real world scenarios via risk free rate and implied volatility at each point in time
- Real world projection uses stressed future experience assumptions based on APRA's 2010 proposals
- Delta and parallel rho hedge
- Capital set as the negative of the minimum of the present value of future profits (shortfall)

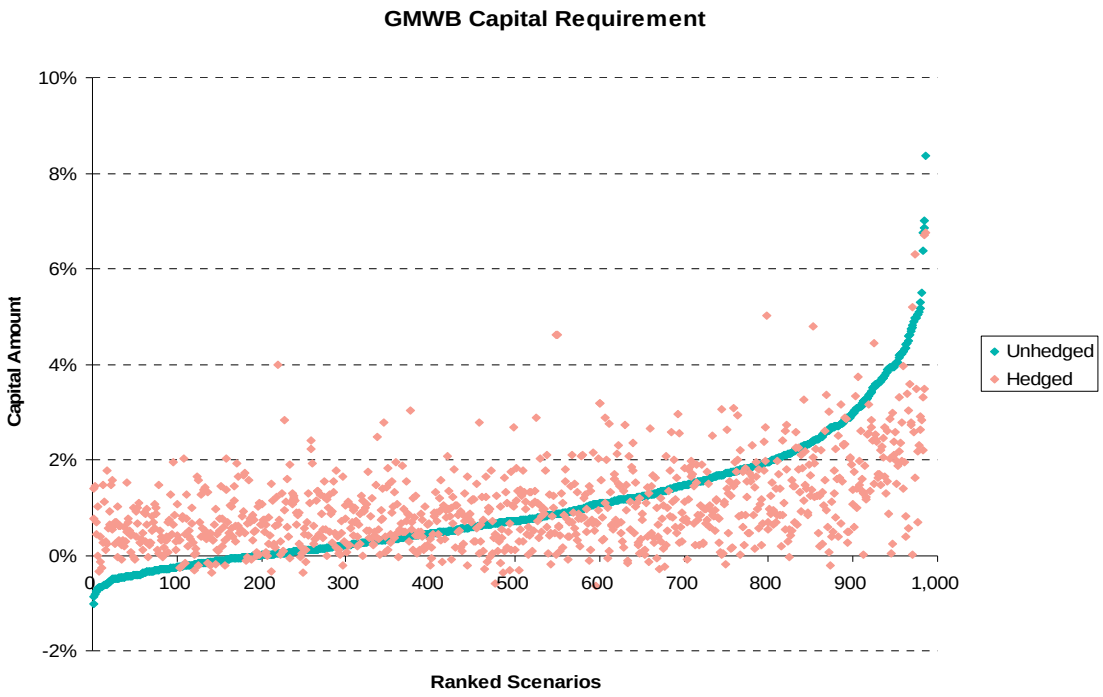
Capital distribution: 1-yr horizon



Capital distribution: 35-yr horizon



Scenario distribution: 1-yr horizon



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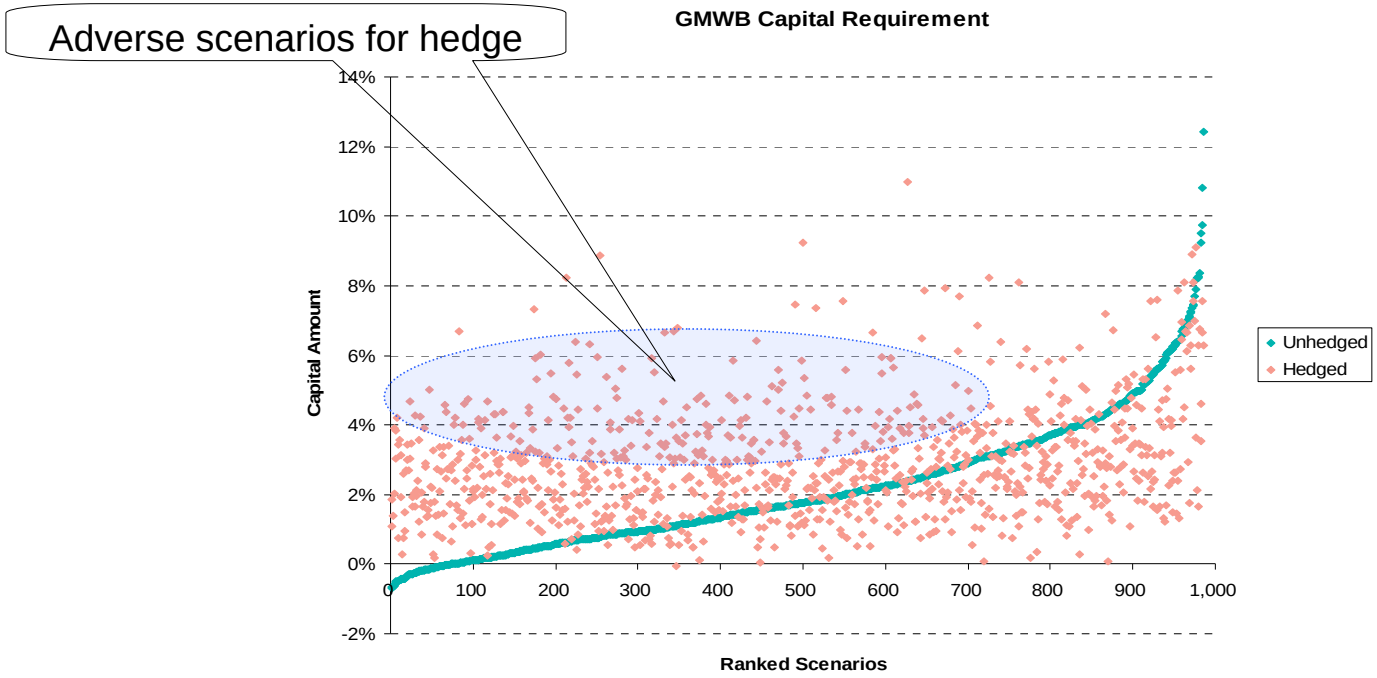
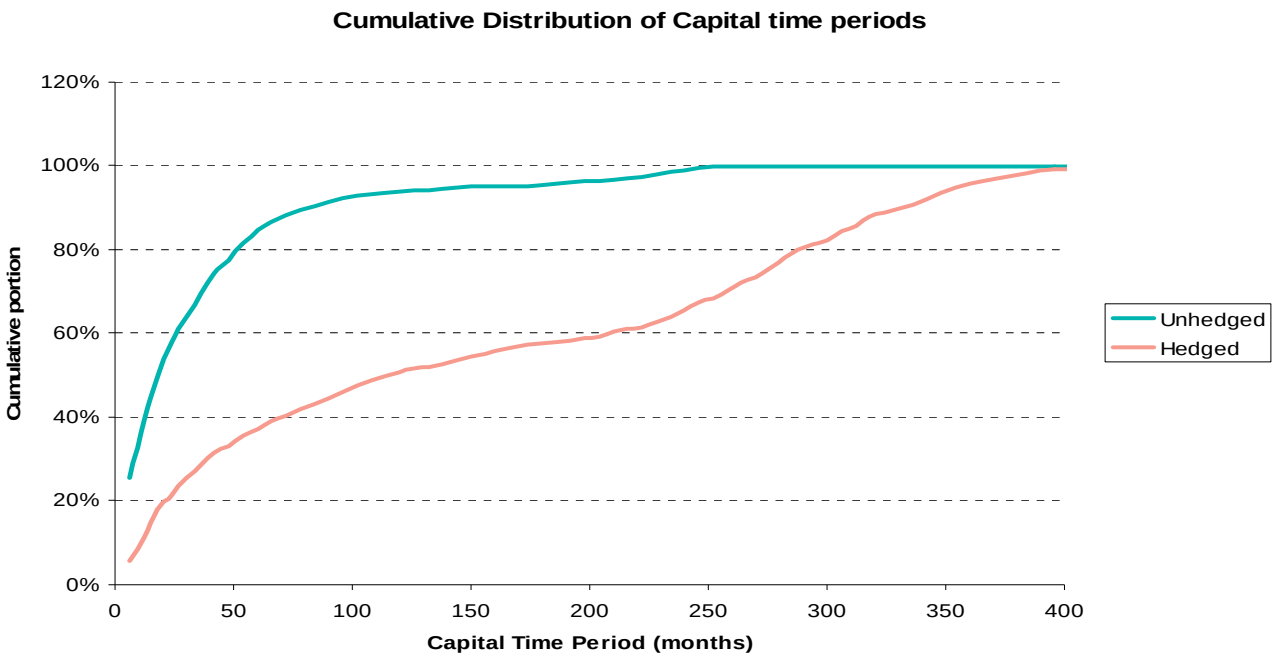


Time to capital event



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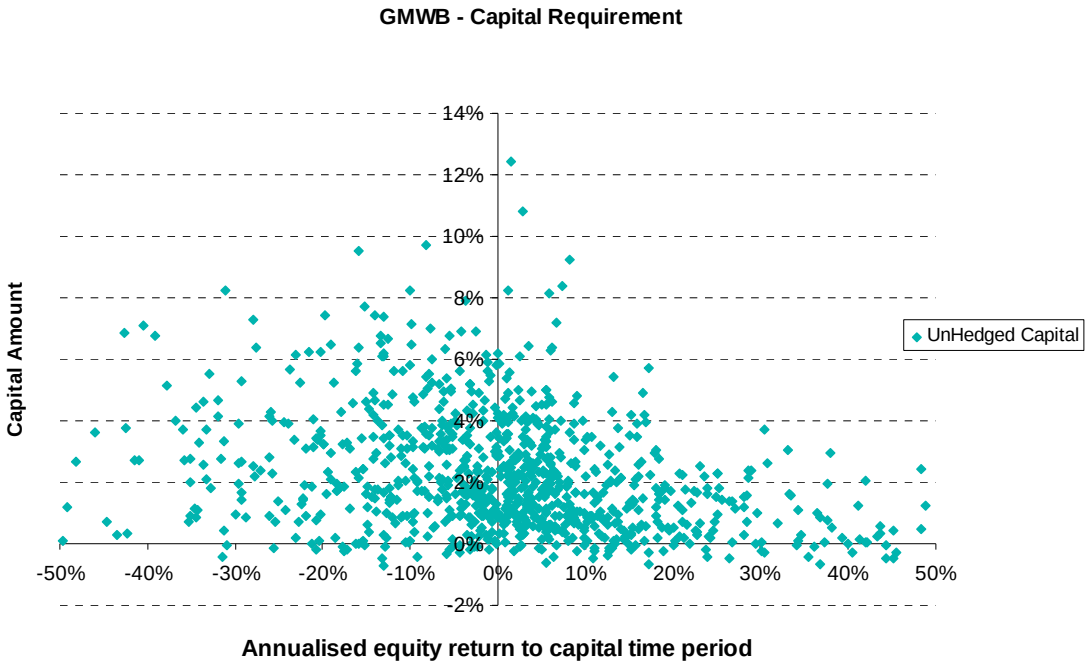

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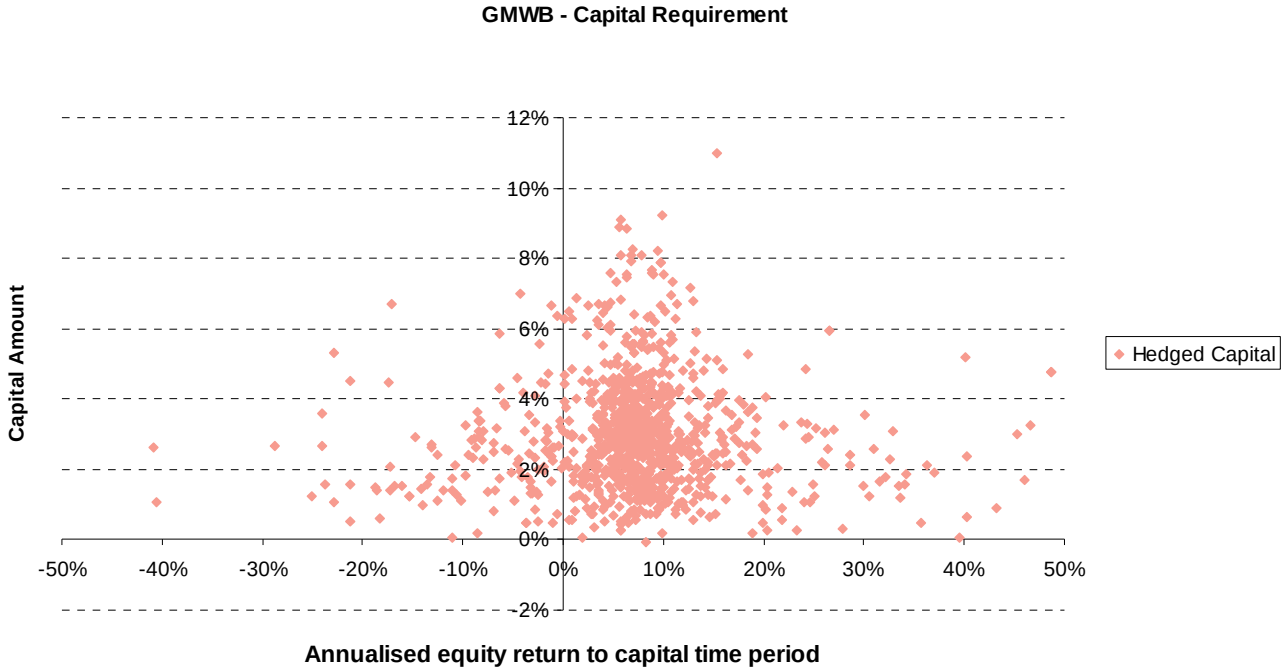
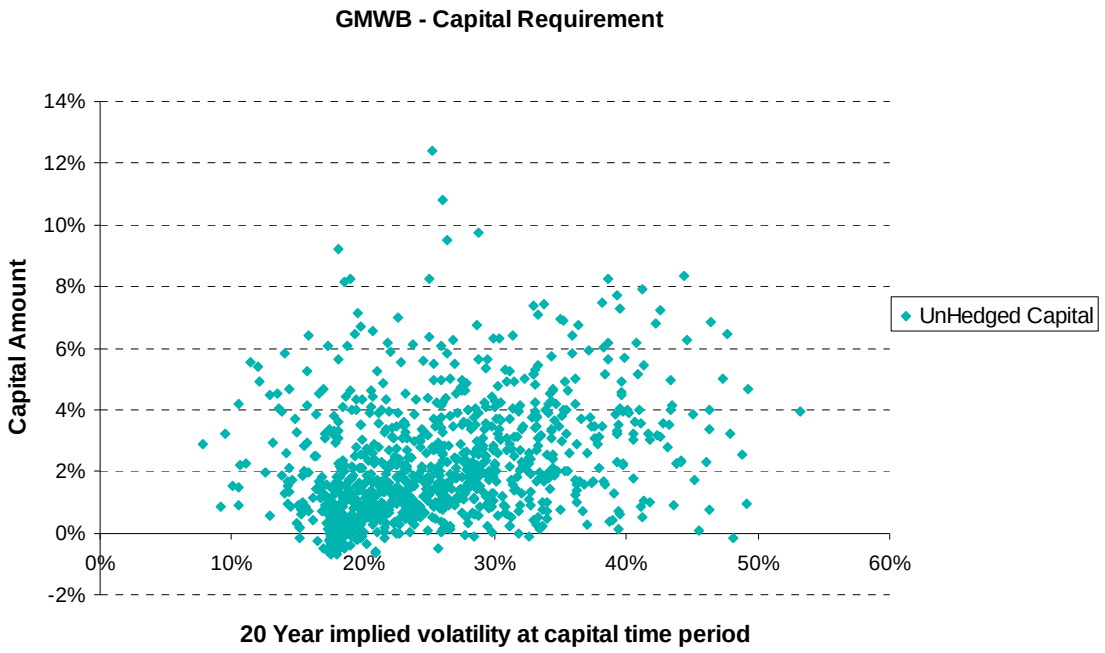
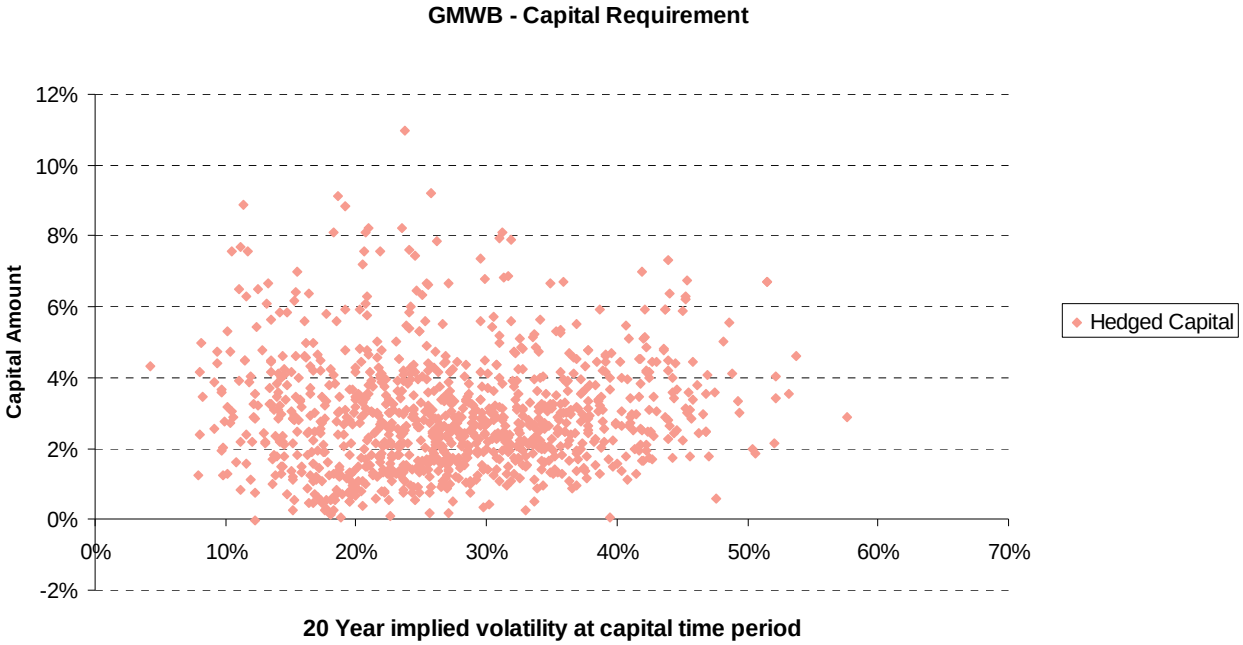


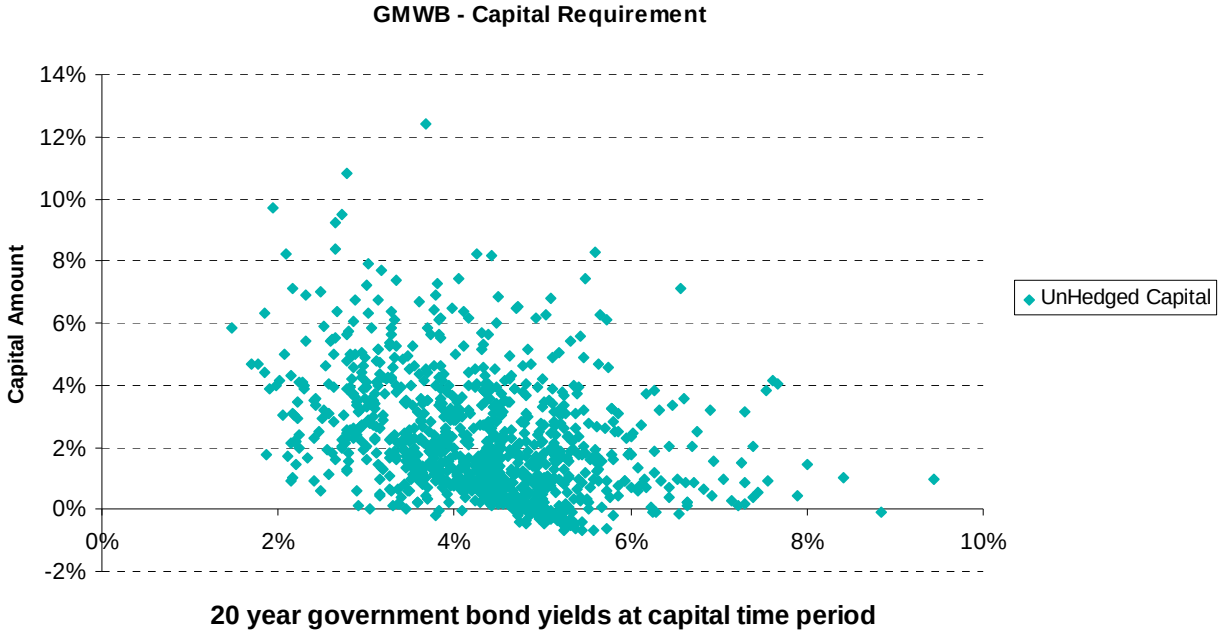
Capital distribution: 35-yr horizon



Capital distribution: 35-yr horizon



Capital distribution: 35-yr horizon



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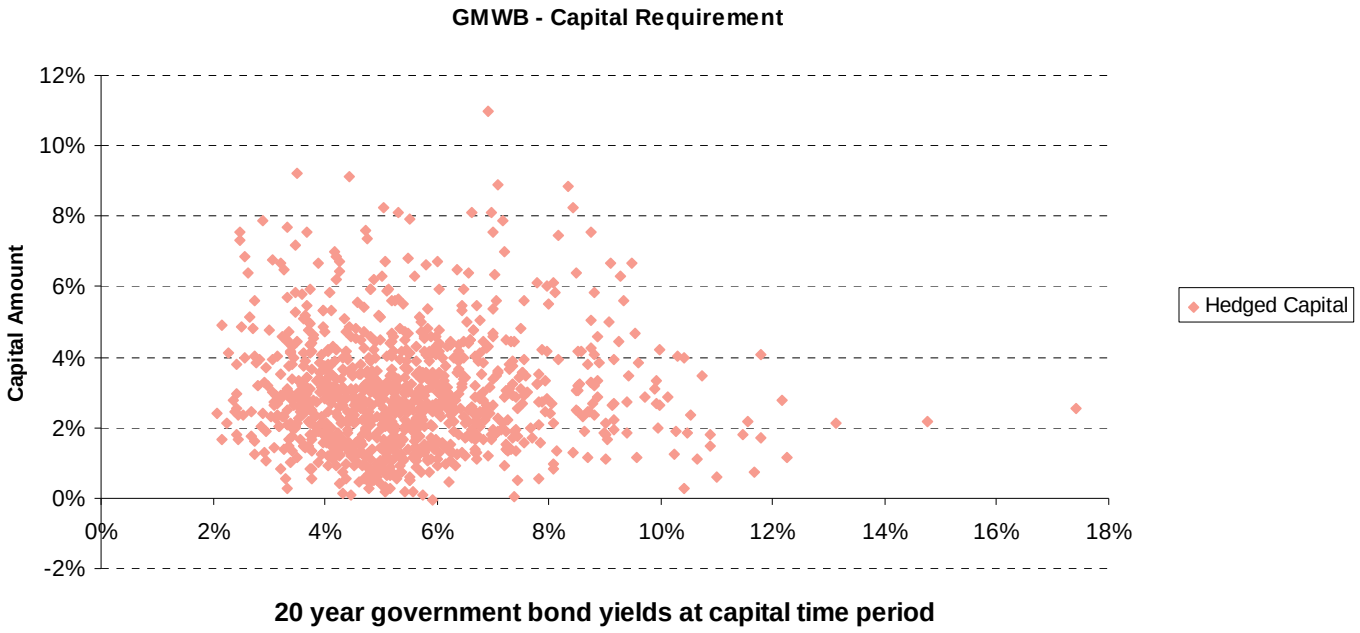
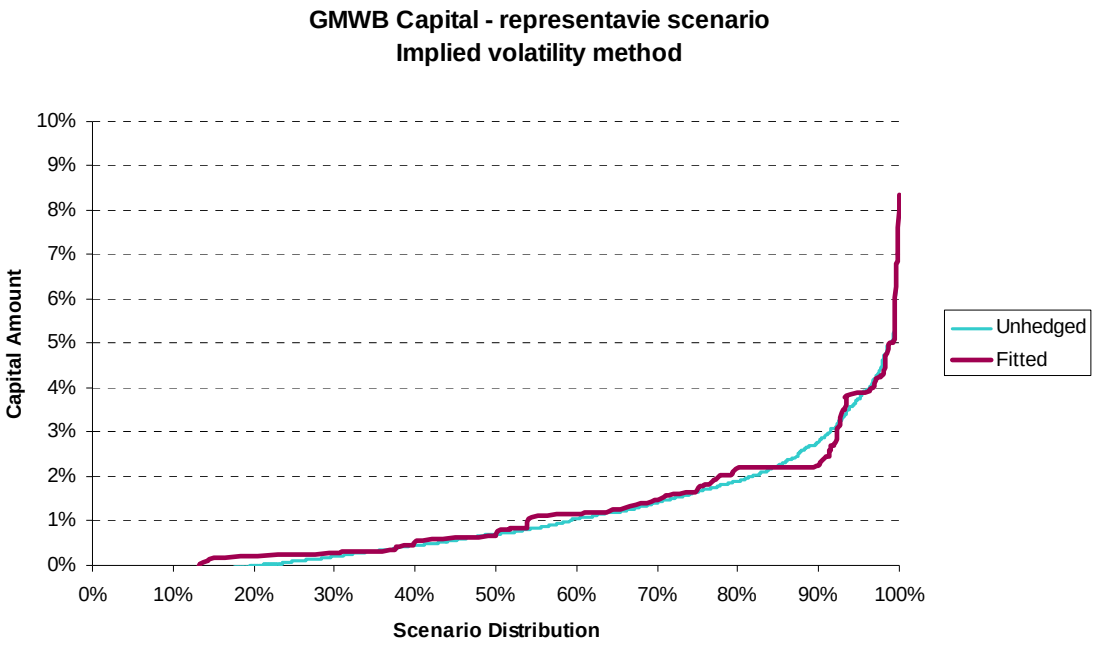


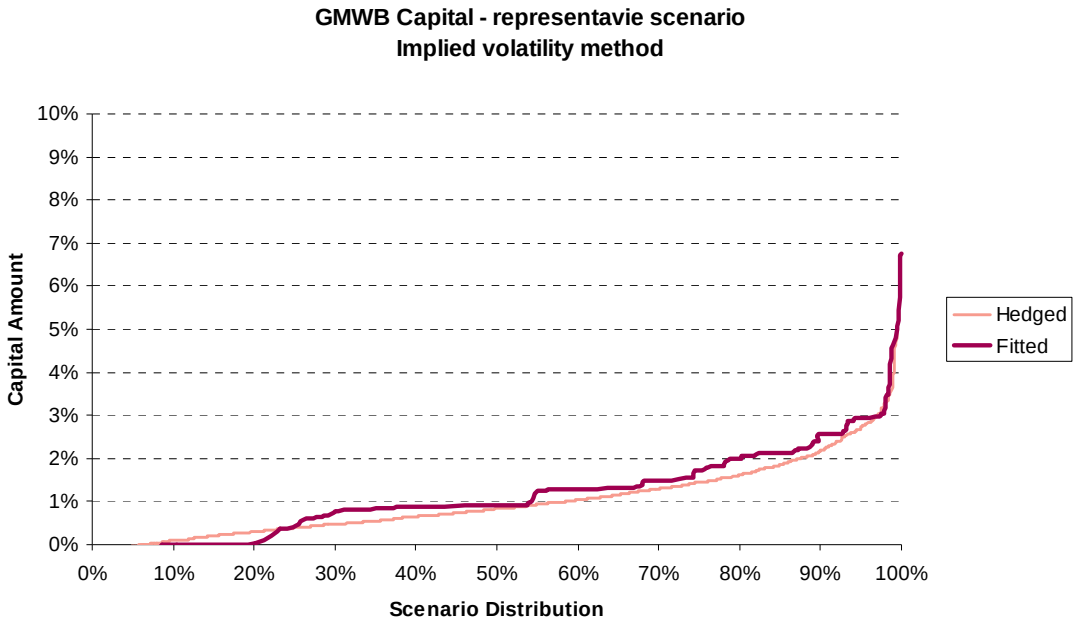
Scenario selection techniques

- Reduce run time by selecting a scenario subset which approximates the full distribution
- The methodology used to select scenarios is known as the “Relative Present Value Distance Method” (Cheuh, 2001)
- Method based on calculating a relative distance measure between each pair of scenarios
- Method 1: distance measure on the implied volatility in each scenario
- Method 2: distance measure on accumulated surplus (loss) holding a 20 year put option.

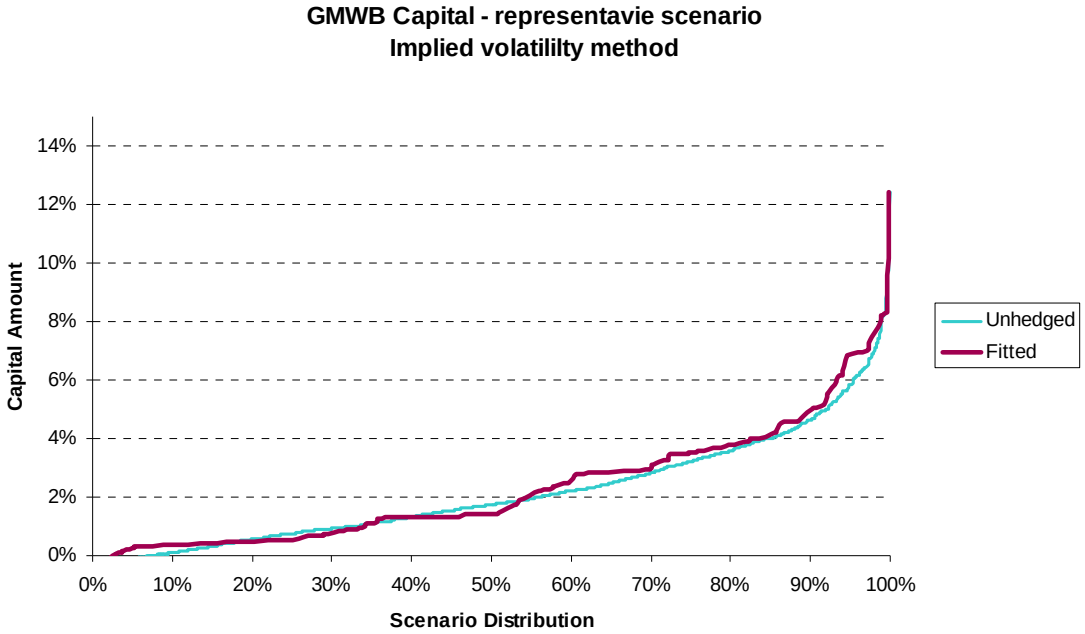
Capital distribution: 1-yr horizon



Capital distribution: 1-yr horizon



Capital distribution: 35-yr horizon



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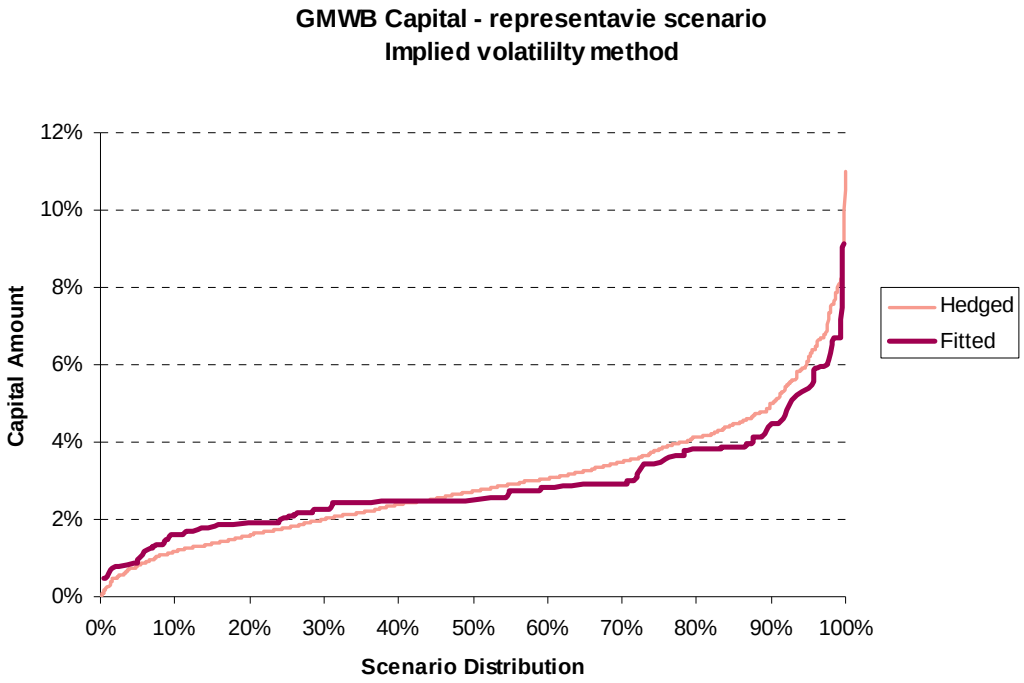
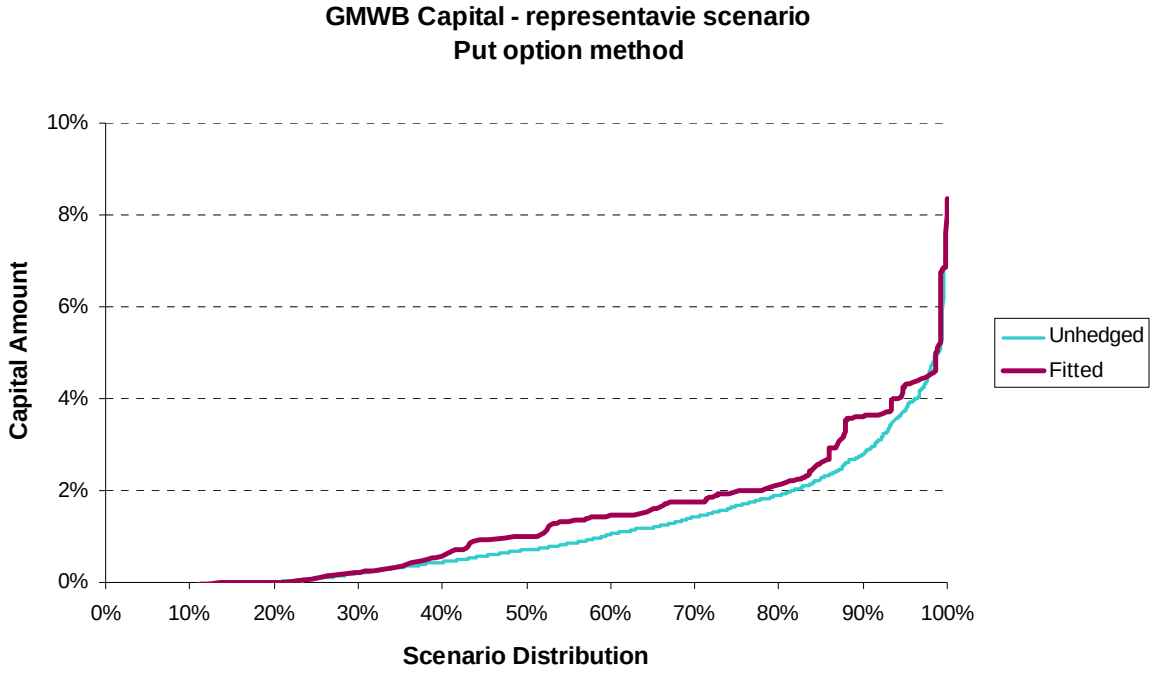


Capital distribution: 1-yr horizon



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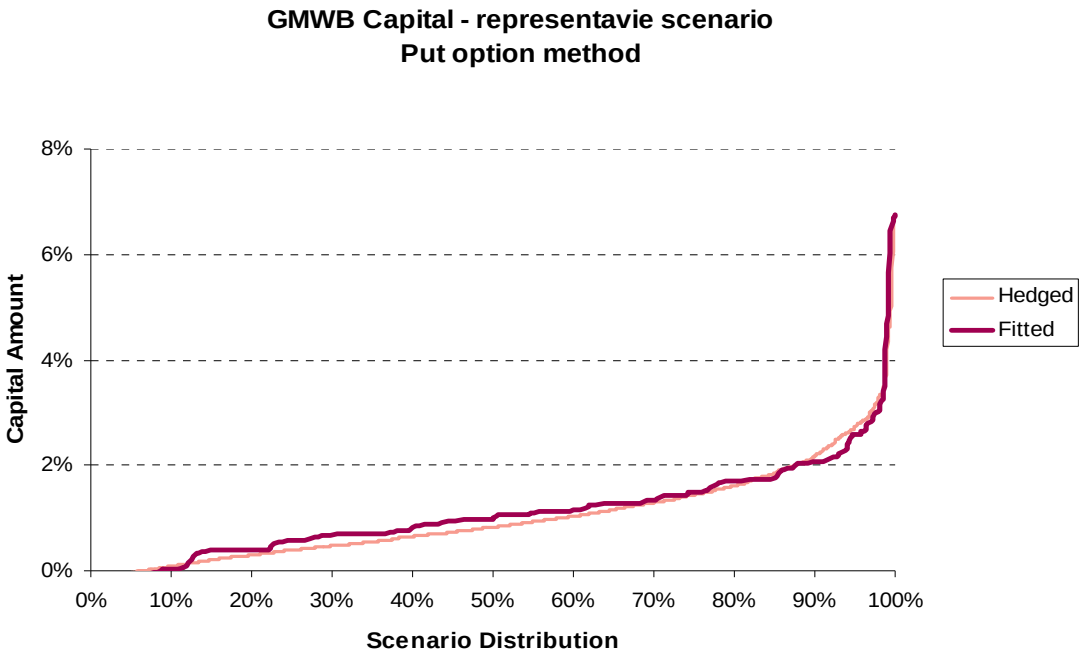

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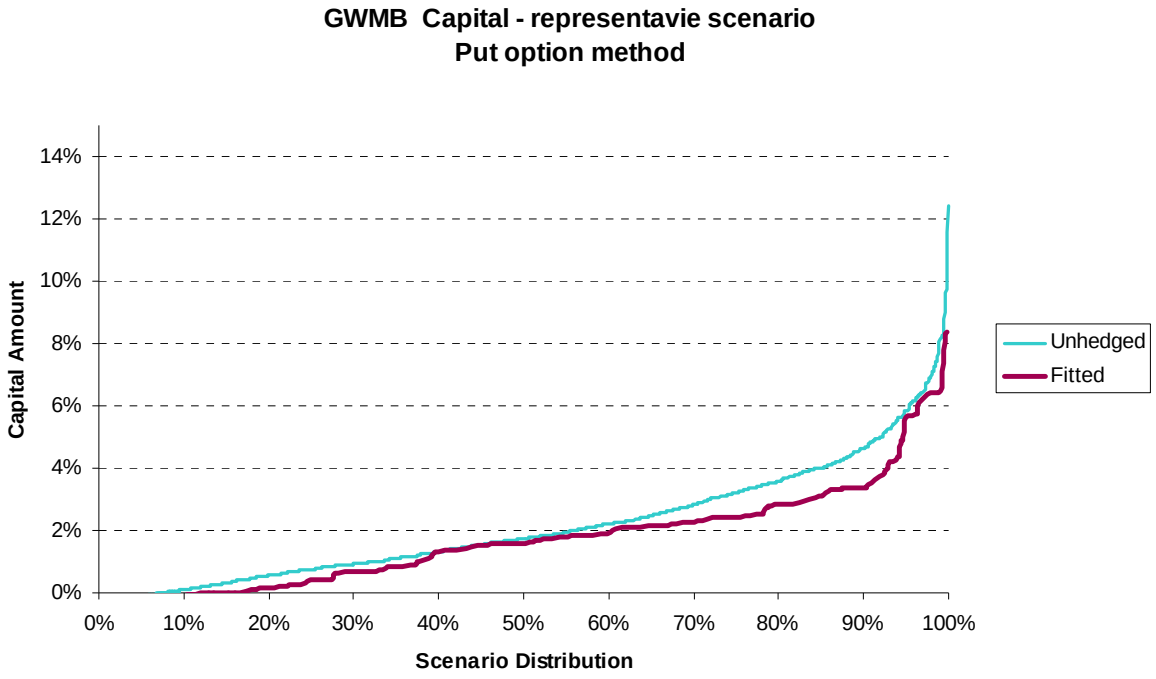

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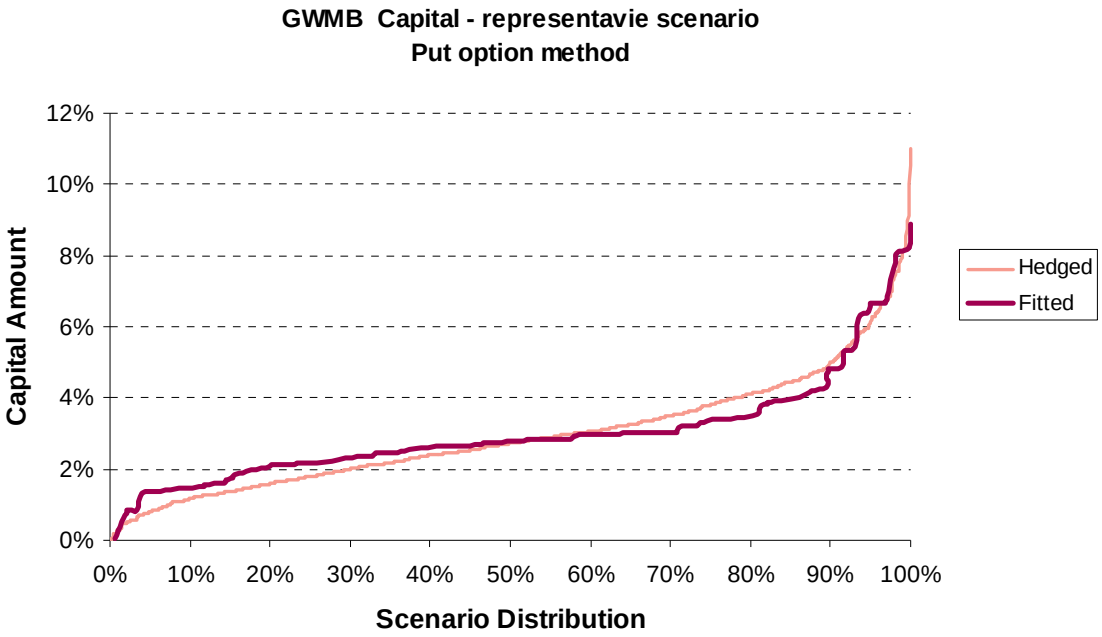

Questions ?

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References

- Yvonne Chueh, “Efficient Stochastic Modeling for Large and Consolidated Insurance Business: Interest Rate Sampling Algorithms,” North American Actuarial Journal, Volume 6, Number 3, July 2002

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