Session 3B, Stochastic Investment Planning

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Stochastic Investment Planning

Paul Manson

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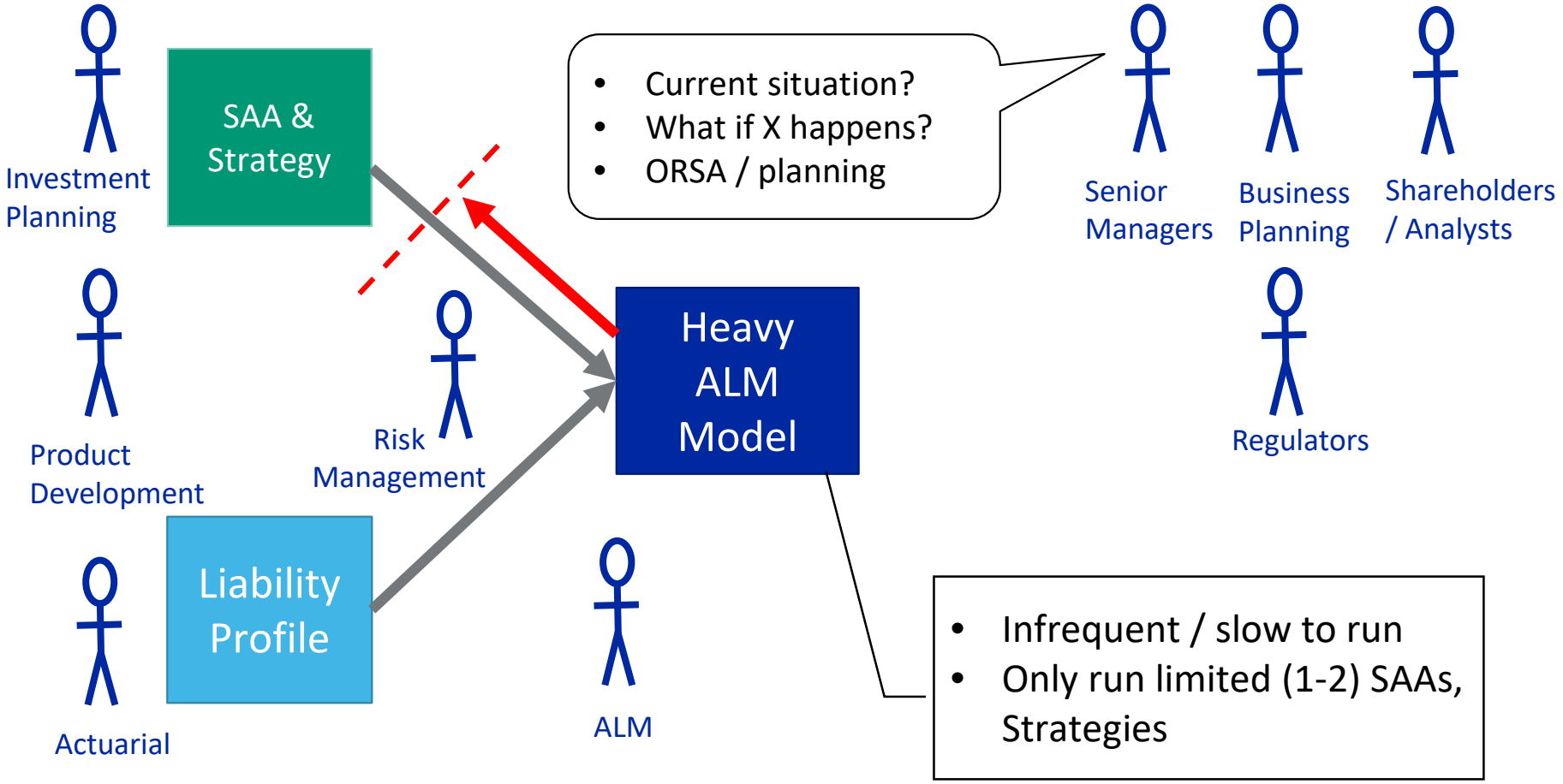
Agenda

1. Background
2. A lighter model
3. Case study
4. Extensions

Background

- ALM / SAA (Strategic Asset Allocation) a growing concern
- Low yield on Gov bonds -> investment in alternative asset classes
- Need to consider increased risk (credit, FX, illiquidity)
- Economic basis valuation / solvency -> K-ICS, C-ROSS, RBC, SII, IFRS17
- Need to optimise SAA & investment strategy

But we already have ALM and SAA!



Heavy ALM - computational scale

- ✓ Liabilities - policy level modelling
- ✓ Assets - instrument level modelling
- x Operate within single team
- x Runtime?
- ? Stochastic scenarios

- x Use heavy ALM to support SAA & test:
  - x Full rage of candidate asset allocations
  - x Range of investment strategies
  - x Base and alternative (stress) economic assumptions

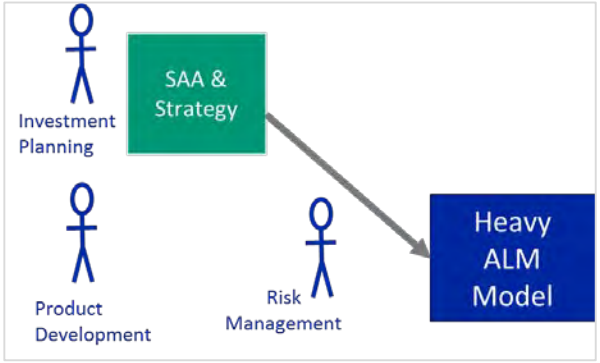
Lighter model

- Liabilities – aggregate level cashflows
- Assets – modelled at grouped level per portfolio

✓Operate within single team

✓Stochastic scenarios

✓Runtime?



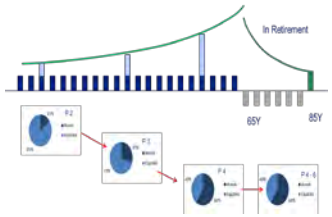
✓Use heavy ALM to support SAA & test:

- ✓Full rage of candidate asset allocations
- ✓Range of investment strategies
- ✓Base and alternative (stress) economic assumptions

Lighter model - applications

Liability-Aware SAA & Portfolio Construction

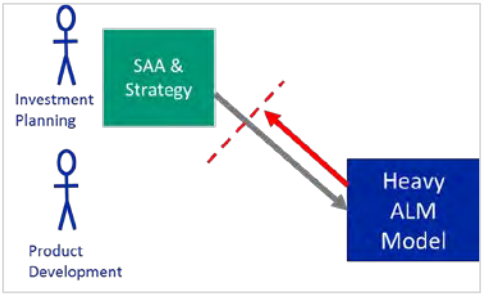
Investment Solution & Product Design



Investment Risk Management

- **Explore –** SAAs, investment strategies, product design economic assumptions, risk measures
- **Monitor** – Efficiently, considering changes to economic situation
- **React** - to significant events or Management 'what-if' questions

Traditional approach to SAA / portfolio construction



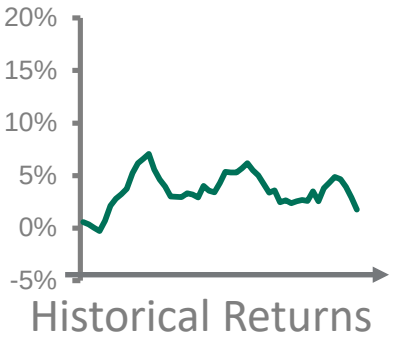
Average Return

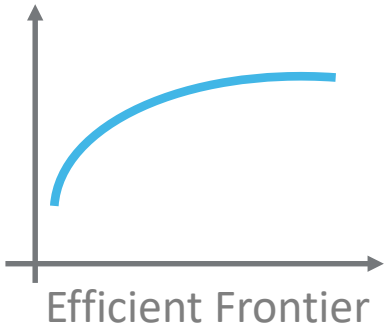
Average Risk

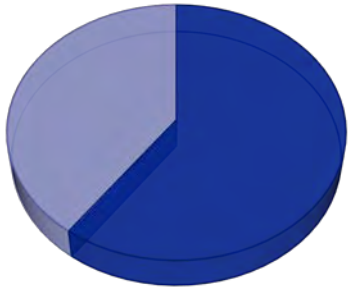
Correlation

Mean Variance (or other) Optimizer

Asset Allocations







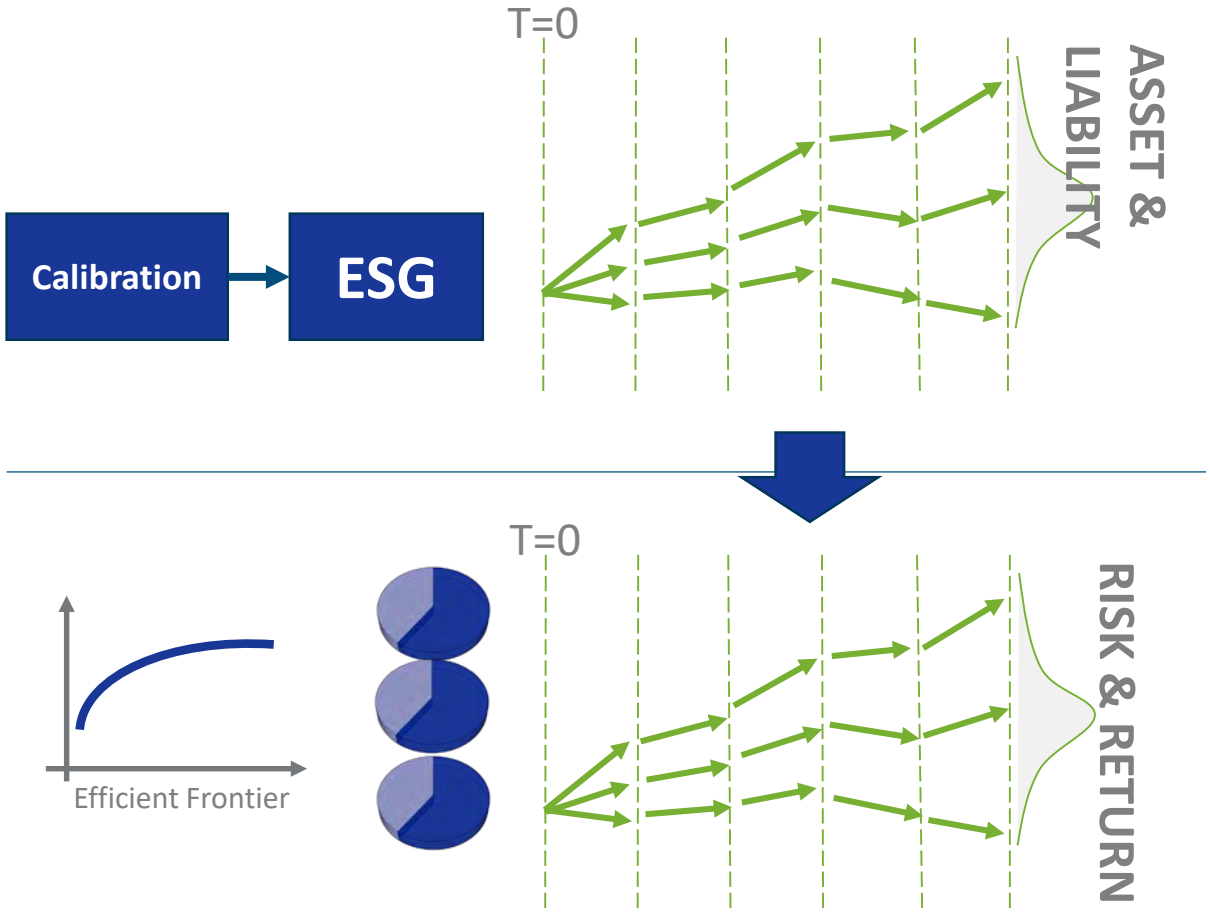
While simple, is it very limited:

- × Single time-step
- × Simple risk measure
- × Does not allow for liabilities
- × Investment strategy not modelled

Real world stochastic scenarios

- **Real World** scenarios are modelled under the "real world" probably measure
- The probably of an outcome in the scenario set would correspond to the real world probability of the same outcome – i.e. the scenarios are realistic
- This makes the scenarios useful where we are interested in the probability of outcomes
  - Capital Calculations (VaR, CTE)
  - SAA / ALM (e.g. probability of hitting investment goal)
- Calibration approach uses a combination of historical data, current prices and forward looking expectations

Stochastic approach to portfolio construction



Use Real World Economic Scenario Generator to project

Calculate Risk / Return for a selection of SAAs or full efficient frontier

Scenario-based portfolio construction

Advantages vs. Traditional Approach

Multi Time-step

Time dependent cashflows in/out. Event or objective driven (dynamic) portfolio rebalancing.

Liability Aware

Can incorporate liability cashflows, proxies or benchmarks.

Risk Metrics

Stochastic models generate a range of outcomes and can produce sophisticated risk metrics.

Realistic Dynamics

Can incorporate features such as fat-tails and increased tail dependency.

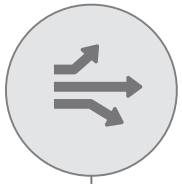
Consistency

Assets and liabilities consistent with joint behavior of core economic variables.

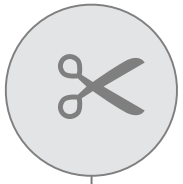
Forward Looking

Can incorporate market or house views on equity volatility, yield curves, etc.

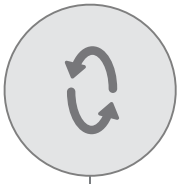
Example portfolio construction process



Calibrate ESG to Market and own views



Identify candidate strategies (MVO)



Verify performance of chosen strategy (Heavy ALM), Loop back if required

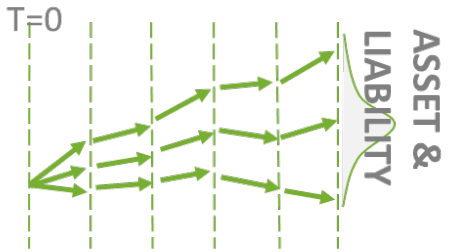
Calibrate | **Configure** | **Identify** | **Assess** | **Verify** | **Monitor**

Configure asset positions and liability proxy

Stochastic projection assess key ALM metrics for candidate strategies

Monitor portfolio risk levels, adjust if strategy is under performing

Investment strategy



- Can implement rules at each timestep, based on:
- Asset / portfolio fair value proportions
- Tracking liability cashflows / duration
- Enforcing minimum credit quality (sell if fall bellow BB)
- Specify when rules apply based on time or economic conditions (e.g. yield > x% etc)
- Rules are converted to equations which are solved simultaneously

Investment strategy

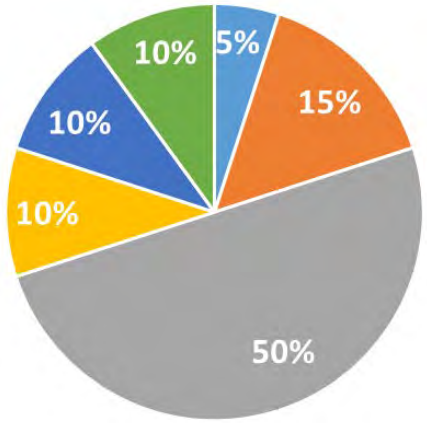
- Assess performance on fair and book value basis
- Alternative individual asset accounting classification
- Define impairment events:
  - Relative value fall
  - Credit rating downgrade to a specific level
  - Credit rating downgrade relative to initial credit state
- Accounting outputs:
  - Carrying amount
  - Realized/unrealized gain/loss
  - Ordinary income
  - Impairment loss

Simple case study

- Asses some alternative SAAs designed to generate increased yield
- Use RW ESG with investment strategy modelling capability
- March 2018 best views (multi year real world calibration)
- 1,000 stochastic scenarios
- 30 year projection – annual timesteps
- Fixed liability cashflows (stochastic discounting)
- Risk measure 99.5th %ile net assets
- Initial asset allocation - mostly domestic asset (JPY)

Initial asset allocation

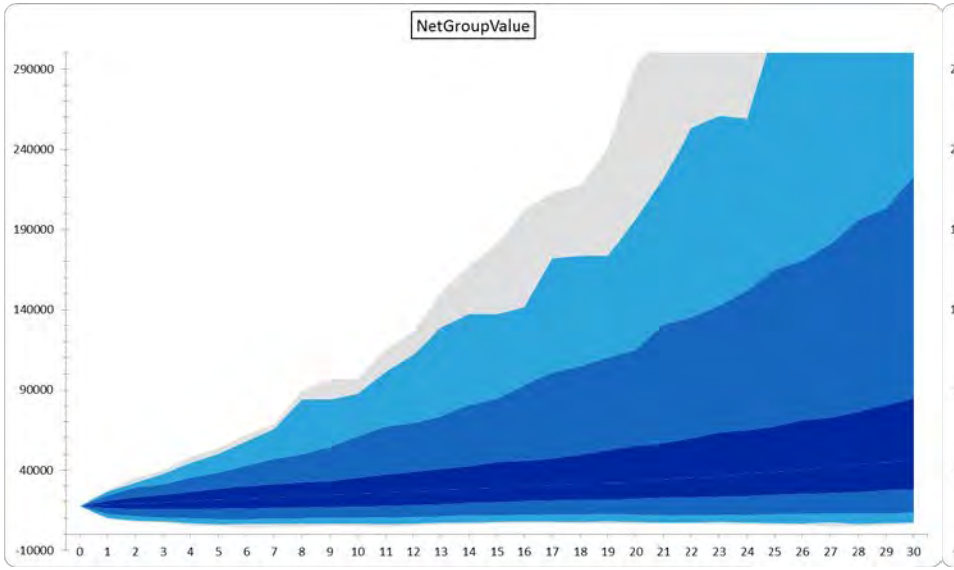
- Based on typical Japanese life insurer allocation (Japan Life Insurance Association data)
- Configure liability cashflows (30 * 3,000)

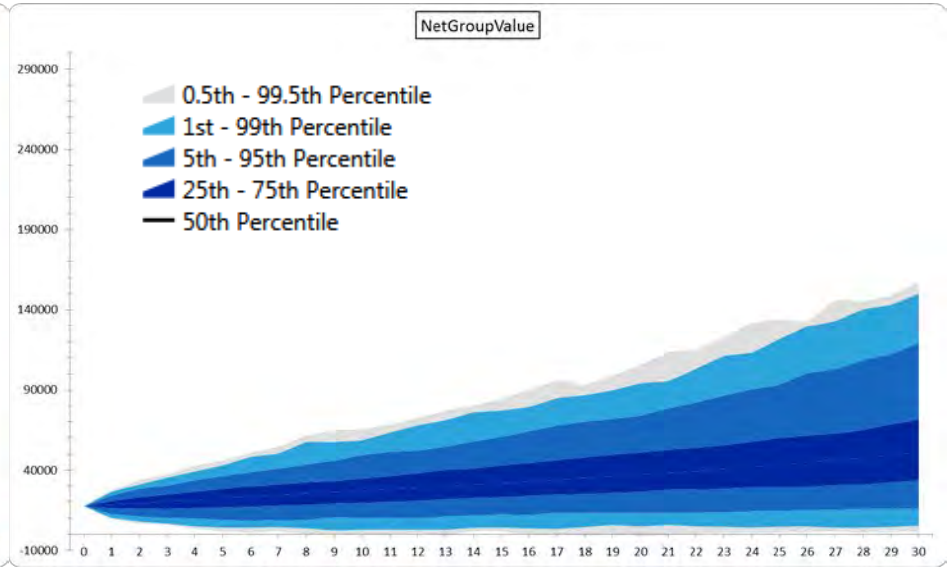


Base	Target Value	Yield	PV	Duration	Weighted Duration
JPY cash	5%	0%	5,000	0	0.00
JPY Gov 5y	15%	0.033%	15,100	5.00	0.75
JPY Gov 20y	50%	0.576%	49,994	18.91	9.42
JPY A 10y	10%	1.000%	10,321	9.57	0.98
JPY Equity	10%	3.700%	10,000	0	0.00
USD Equity	10%	4.040%	10,000	0	0.00
Assets			**100,415**		**11.15**
Liability			**82,972**		**14.77**
A-L			**17,442**		**-1.06**

Buy & hold vs rebalance

Mar 2018 v2



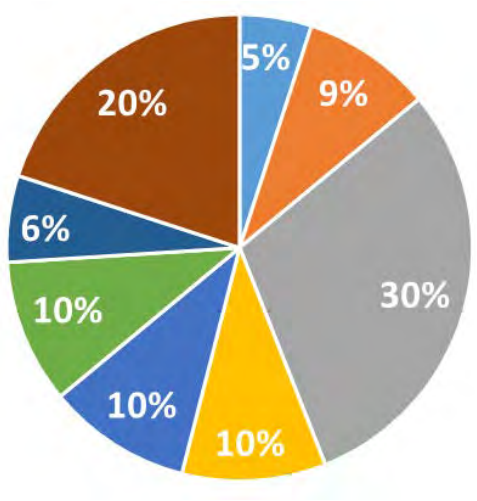


Buy & Hold - Net Assets					
Statistic	**T=0**	**T=5**	**T=10**	**T=20**	**T=30**
99.5th Percentile	17,367	5,024	4,931	6,369	6,513
99th Percentile	17,367	6,089	6,556	7,563	7,117
95th Percentile	17,367	9,312	10,176	12,201	13,181
Mean	17,367	21,445	25,087	32,397	46,307
0.5th Percentile	17,367	53,555	96,842	292,401	612,023

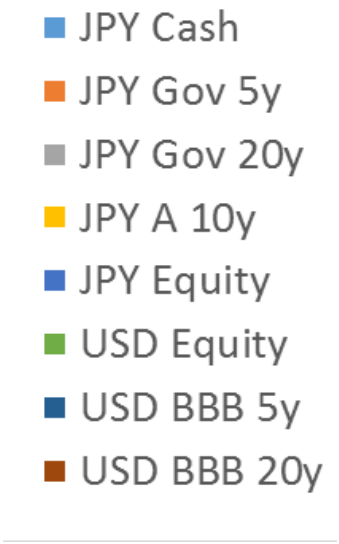
Rebalance - Net Assets					
Statistic	**T=0**	**T=5**	**T=10**	**T=20**	**T=30**
99.5th Percentile	17,367	1,849	105	(825)	1,641
99th Percentile	17,367	4,177	2,786	4,752	5,323
95th Percentile	17,367	8,873	10,007	13,244	16,070
Mean	17,367	22,543	26,779	37,435	51,137
0.5th Percentile	17,367	46,034	65,352	105,602	157,320

Overseas credit +

- JPY Gov -> USD BBB
- Retain same ratio 5y / 20y



Overseas Credit	Target Value	Yield	PV	Duration	Weighted Duration
JPY cash	5%	0%	5,000	0.00	0.00
JPY Gov 5y	9%	0.033%	9,060	5.00	0.45
JPY Gov 20y	30%	0.576%	29,996	18.91	5.60
JPY A 10y	10%	1%	10,321	9.57	0.97
USD BBB 5y	6%	4.2%	6,248	4.62	0.28
USD BBB 20y	20%	4.5%	20,669	13.51	2.76
JPY Equity	10%	3.7%	10,000	0.00	0.00
USD Equity	10%	4.0%	10,000	0.00	0.00
Assets			**101,295**		**10.06**
Liability			**82,972**		**14.77**
A-L			**18,322**		**-2.04**



Initial rebalance vs overseas credit +

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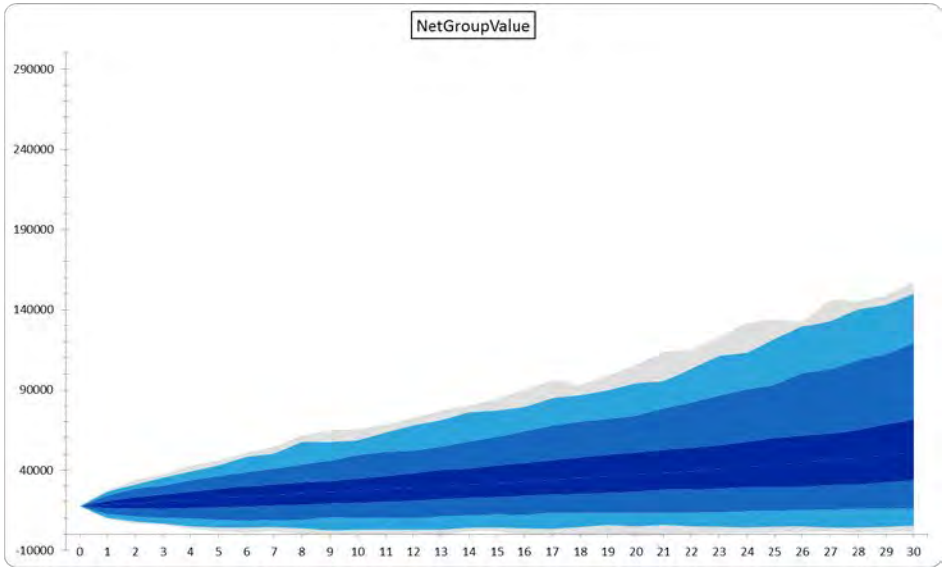

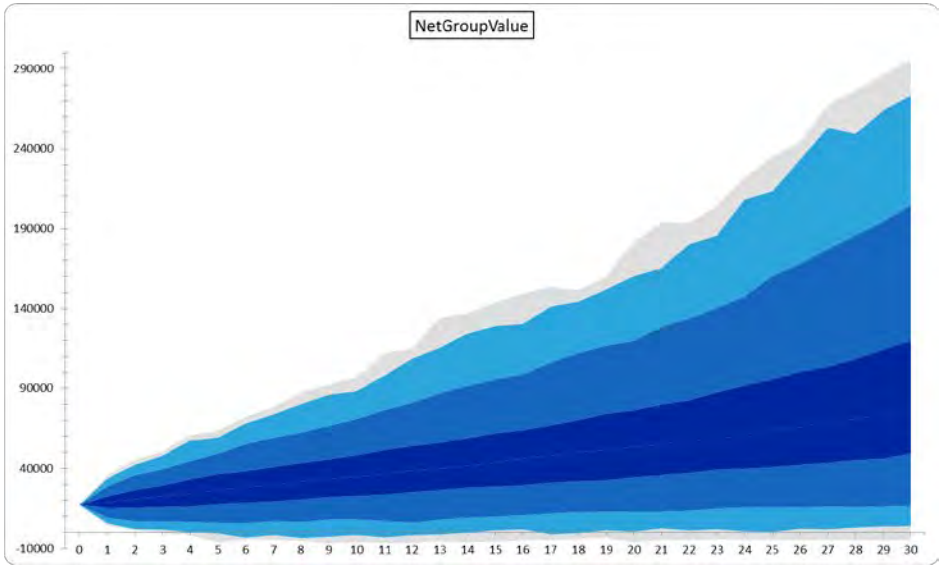

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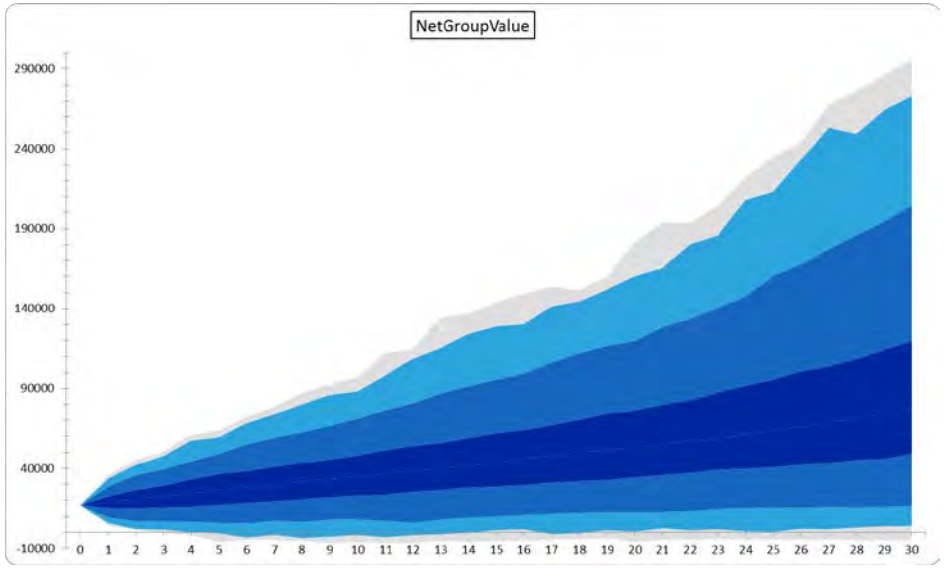
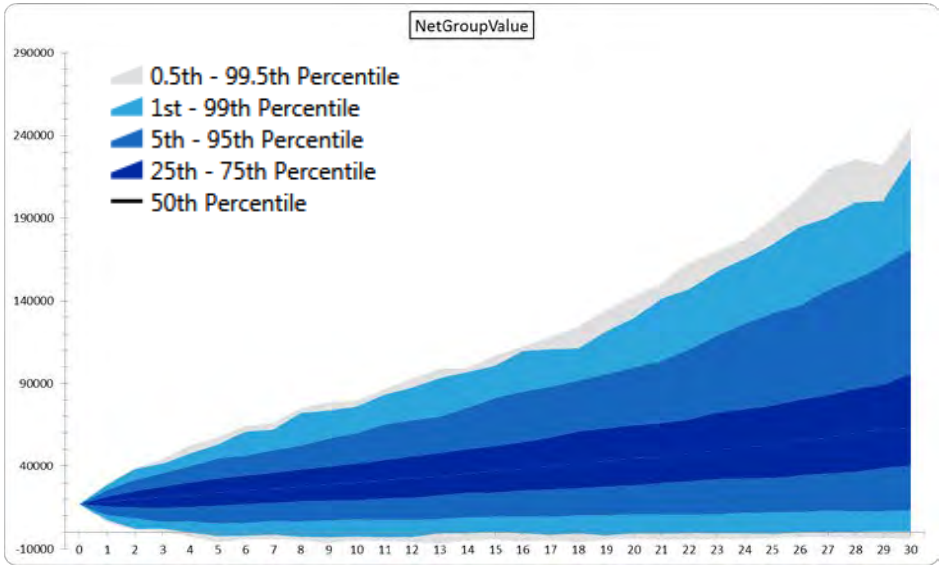
Overseas Credit - Net Assets					
Statistic	**T=0**	**T=5**	**T=10**	**T=20**	**T=30**
99.5th Percentile	17,158	(6,295)	(6,177)	(6,104)	(5,019)
99th Percentile	17,158	(614)	(1,660)	403	3,812
95th Percentile	17,158	5,780	7,924	12,888	16,419
Mean	17,158	26,490	34,800	53,239	77,130
0.5th Percentile	17,158	63,758	96,740	181,160	295,874

Unhedged vs hedged

Mar 2018 v2





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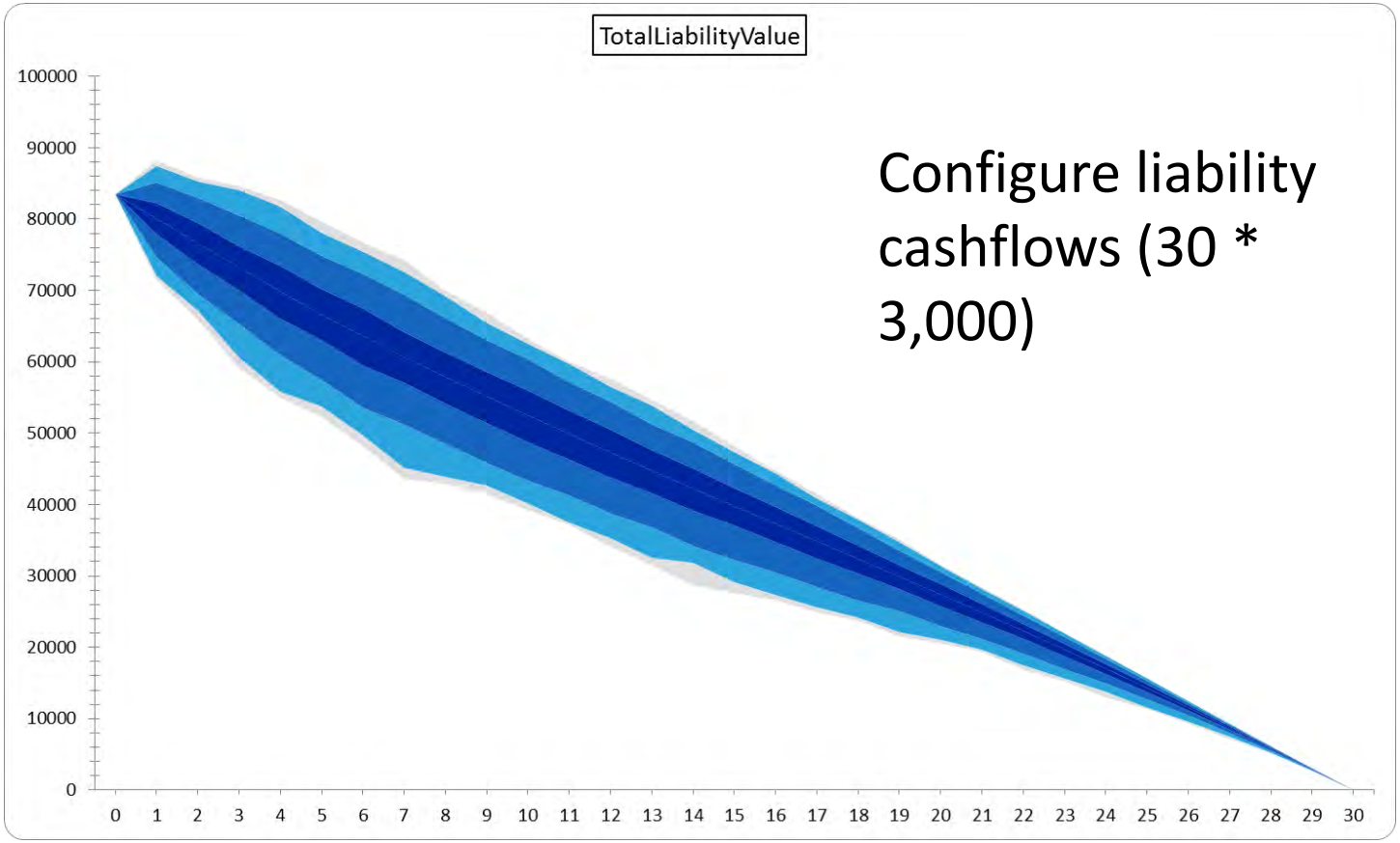
Overseas Credit Hedged - Net Assets					
Statistic	**T=0**	**T=5**	**T=10**	**T=20**	**T=30**
99.5th Percentile	17,158	(5,954)	(4,979)	(3,900)	(3,838)
99th Percentile	17,158	(2,379)	(2,604)	(656)	453
95th Percentile	17,158	5,238	7,675	10,780	13,482
Mean	17,158	24,010	30,119	45,075	63,077
0.5th Percentile	17,158	57,531	79,625	143,329	244,665

Liability – fixed cashflow / stochastic discounting



Configure liability cashflows (30 * 3,000)

Include dynamic liabilities

Why is it important?

- Some features of liabilities are important for investment decisions
  - Bonuses
  - Profit sharing
  - Dynamic policyholder behaviour (lapses)
- Ignoring dynamic liabilities can lead to
  - Sub-optimal portfolios
  - Taking on unrewarded risk
  - Poor balance between policyholder and shareholder returns

Dynamic liabilities

Formula method

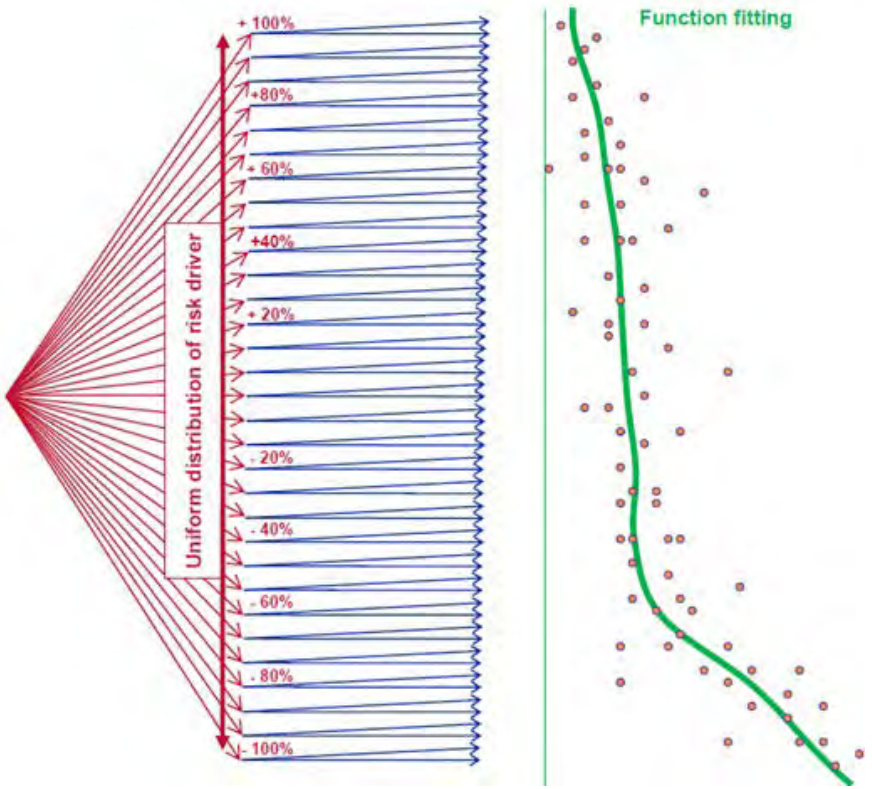
- Receive base cashflow assumptions from actuarial teams
- Code simplified formulae into light model:
  - Policyholder dividend =

  max((investment return - assumed return)*asset value + assumed dividend ,0) * 70%
- Formulae designed to create link between assets and liabilities

Dynamic liabilities

Liability cashflow proxy function method

- Complex, path-dependent liabilities
- Fit a proxy function representing liability cashflow
- Cashflow is a function of investment returns and economic indicators



- Proxy calibration using LSMC method
- Scenarios used for fitting are designed to capture a wide range of investment return behaviors

Conclusions

- Many factors highlighting increased need for meaningful SAA / ALM
- Investment and risk teams need efficient process to meet needs of business
- RW ESG and calibration content important
- Need to asses range of SAAs
- Model realistic investment strategies
- Ability to look at range of risk and return metrics
- Inclusion of liabilities in projection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