Enterprise
Risk Management
Symposium

ERM

April 19–20, 2018

Miami, FL

Session 30: ERM for Health Insurers

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Presenters:
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SOA Antitrust Disclaimer
SOA Presentation Disclaimer

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Standard ERM reporting metrics at Tokio Marine HCC

Mario DiCaro

April 2018

Presented at the 2018 Enterprise Risk Management Symposium.

Figures in this document are fictional. Opinions expressed are those of the author and not necessarily the company.
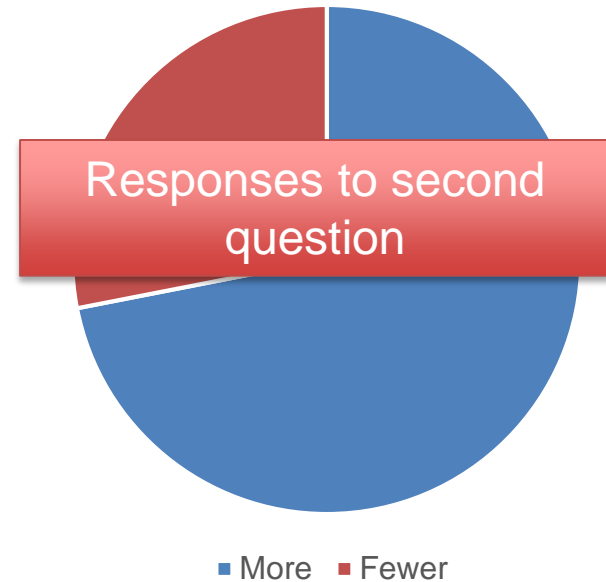
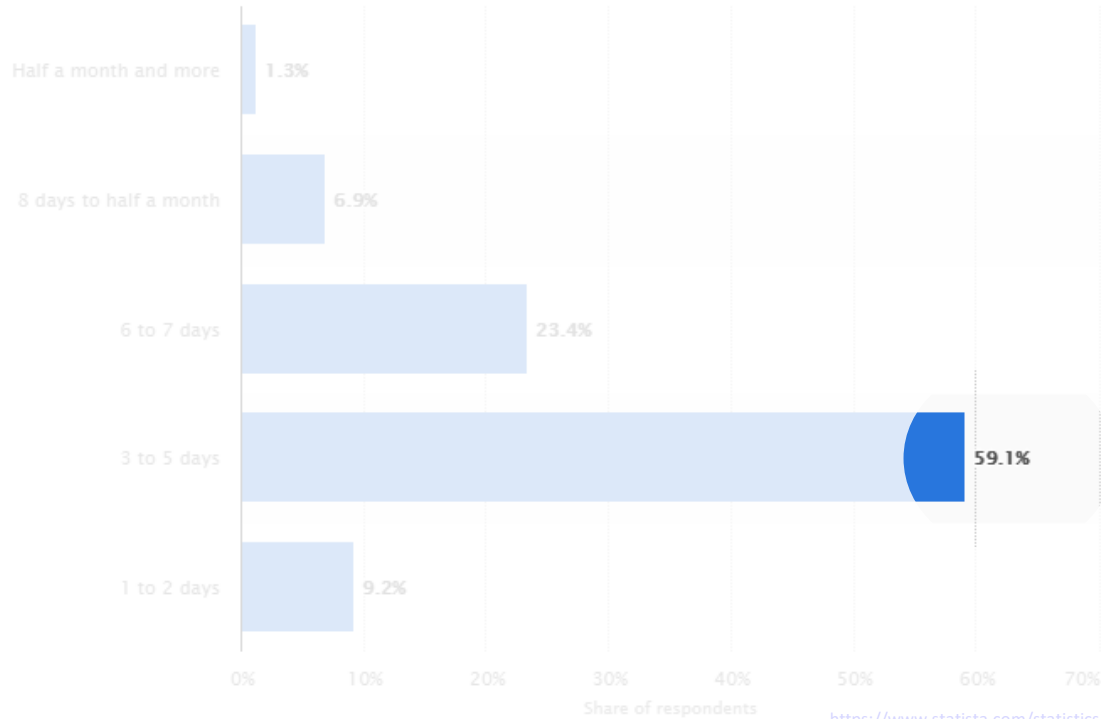# Live polling link

www.ermlinks.com

- How many days long is this business trip for you?
  - [enter a number]

- *More* days or *fewer* than the average business trip?
  - More
  - Fewer

Business trip duration

Duration of this business trip

Responses to first question
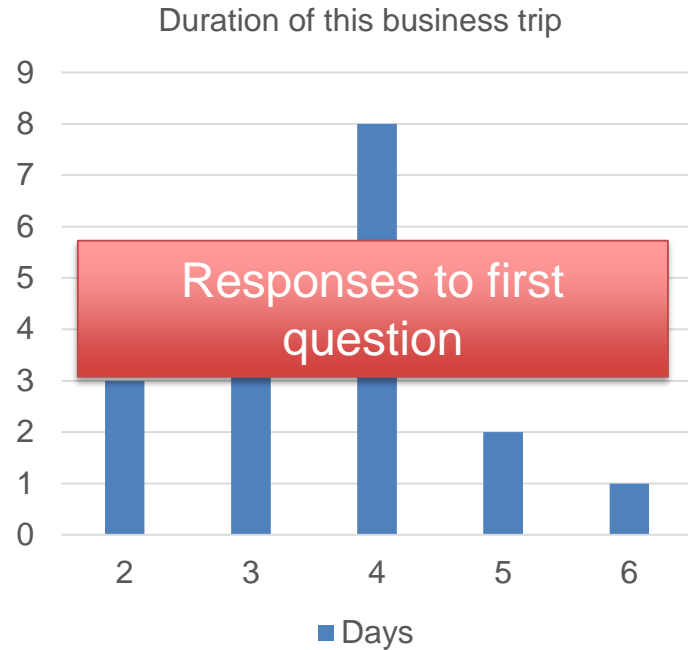
More or fewer than average?

Responses to second question

More Fewer

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Now I know how many people are using the polling system!

What gets measured gets managed…

Assassin bug

Chagas disease

#1: Routine

January	February	March
7-8 Weeks → 21		
April	May	June
	23	
July	August	September
	27	
October	November	December
	20	

Off Qtr work

Qtly work

Scheduled update of detailed models

Annual Update of Patterns

Updated Budget Data

Qtly Cat update

Qtly Res'v balances

Updated Investment

Input data files

Models

Reports for Lines

Reports for Sr Mgt

Reports for Doc'n

#2: Relevant

Economic Capital Model Results								
	Mean	1%	10%	50%	75%	90%	99%	99.60%
Return Period	na	100	10	2	4	10	100	250
Reserve Risk (1yr)	-5.4	-41.9	-25.2	-5.4	5.1	14.6	30.9	36.1
Reserve Risk (ult)	-6.7	-52.3	-31.5	-6.7	6.4	18.3	38.6	45.0
Underwriting Risk	-3.7	-12.6	-9.1	-4.0	-1.0	2.0	7.9	10.1
Loss Ratio	69%	49%	57%	69%	76%	83%	97%	102%
Combined Ratio	91%	71%	79%	91%	98%	105%	119%	124%

Always come armed with a comparison!

Required Capital Comparison

Risk Source	ECM Risk
Reserve	500
Catastrophe	400
Underwriting Non Catastrophe	450
Investment	600
Reinsurer Default	22
Operational	60
Undiversified Required Capital	2,032
Diversified Required Capital	1,900

Key Risk Tolerances

Probability of combined ratio exceeding 100% is 2.5%	2.5%

Net Income

95th Percentile
50th Percentile
Actuals & Forecast

15Q3 15Q4 16Q1 16Q2 16Q3 16Q4 17Q1 17Q2 17Q3 17Q4 18Q1 18Q2 18Q3 18Q4
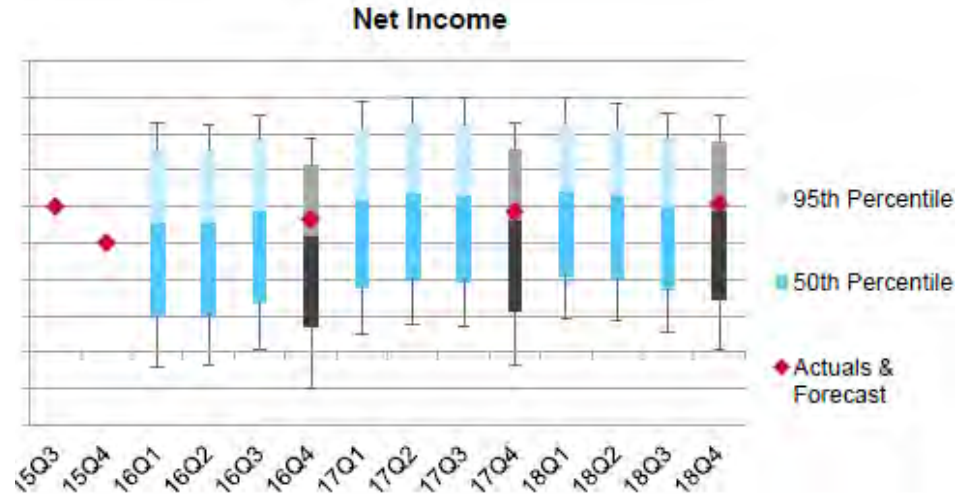
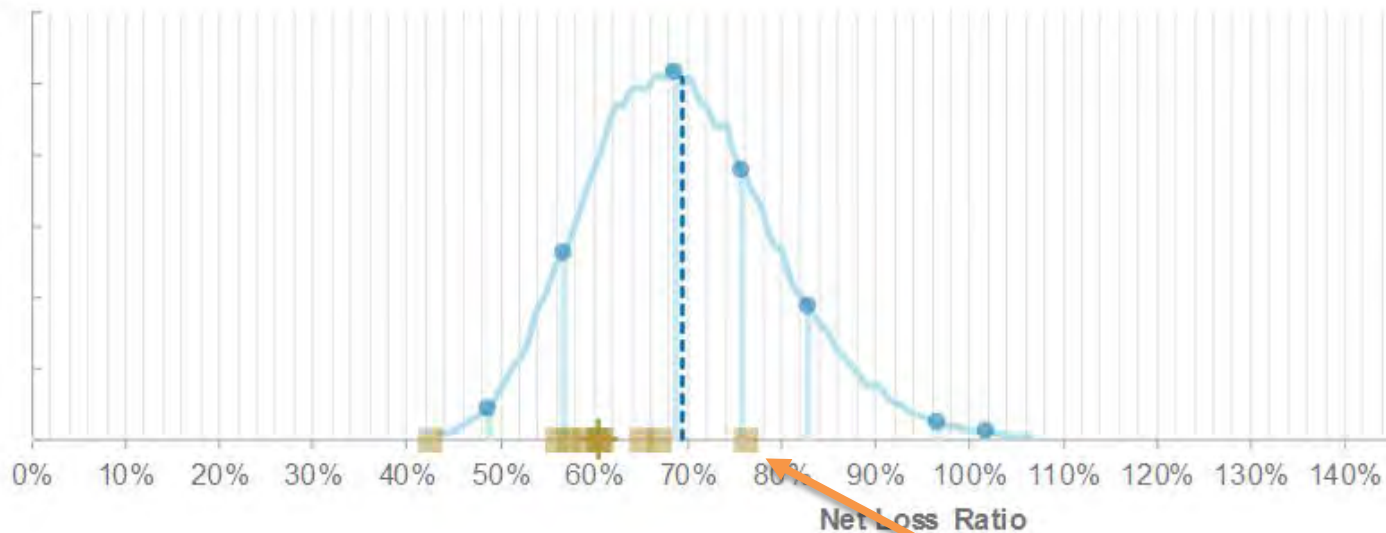# #3: Repetition

- What is this?

- What disease it carry?

Can you make this a livepoll and insert next slide with results?

History		
Year	Net LR AY	ΔReserve CY
1980		
1981		
1982		
1983		
1984		
1985		
1986		
1987		
1988	42%	
1989	60%	
1990	65%	1%
1991	61%	1%
1992	57%	-1%
1993	67%	-1%
1994	59%	-7%
1995	56%	-5%
1996	61%	-4%
1997	76%	

Net Loss Ratio

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ERM Symposium 2018
Session 30

ERM For Health Insurers –
Modeling Approaches

April 20, 2018

ERM AND ECONOMIC CAPITAL MODELING (ECM)

ERM and Economic Capital (EC) Model Growth Paths

Maturity Level

Two Parallel Tracks

Qualitative ERM

- Risk governance
- Risk identification
- Risk impact assessment
  - Often on broad scale (1 to 10)
  - Heat maps, directional information

Quantitative ERM

- Risk appetite and tolerance limits
- Measuring risk impacts — dollar quantification
- Dashboards — cost/benefit relative to other financial measures

Foundational ECM

- Initial models
- Focus on financial risks – assets and underwriting
- Use of ESG
- Reflects correlation and diversification

Robust ECM

- Robust enterprise models
- Quantifying mitigation effects
- All risks included
- Fully integrated with planning and management processes

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Best Practices for Economic Capital Models

Robust risk models on both sides of the balance sheet

- Economic Scenarios – Calibrated to all the volatility of the 20th and 21st centuries

- Assets – Market risk
- Assets – Credit risk

> *Depends on investment strategy – less important for health insurers*

- Insurance – Reserving risk
- Insurance – Underwriting risk

> *Less important for health insurers due to relatively quick benefit payouts*

- Strategic and Operational risk
- Non-insurance Operations

> *Much more important to health insurers due to systemic changes*

Stochastic and stress testing capability

- Must be able to stochastically stress whole enterprise at once
- Must also be able to run deterministic stress tests

Unified, integrated model of all assets and liabilities

- Modeling distinct business entities and at the consolidated enterprise level in the same ECM framework
- Modeling management actions, integrated within the model
- "Capital Fungibility" – Flows of capital and funds between entities must reflect reality
- Liquidity risk evaluated in a consistent ECM framework

The "Use Test" – Model must be transparent and granular enough to be used by management

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Stochastic ECMs – Pros and Cons

Pros

- Provides probability statements for capital adequacy ➔ Provides basis for allocating the cost of capital, to support better financial performance metrics ➔ Critical to creating greater value for management beyond compliance

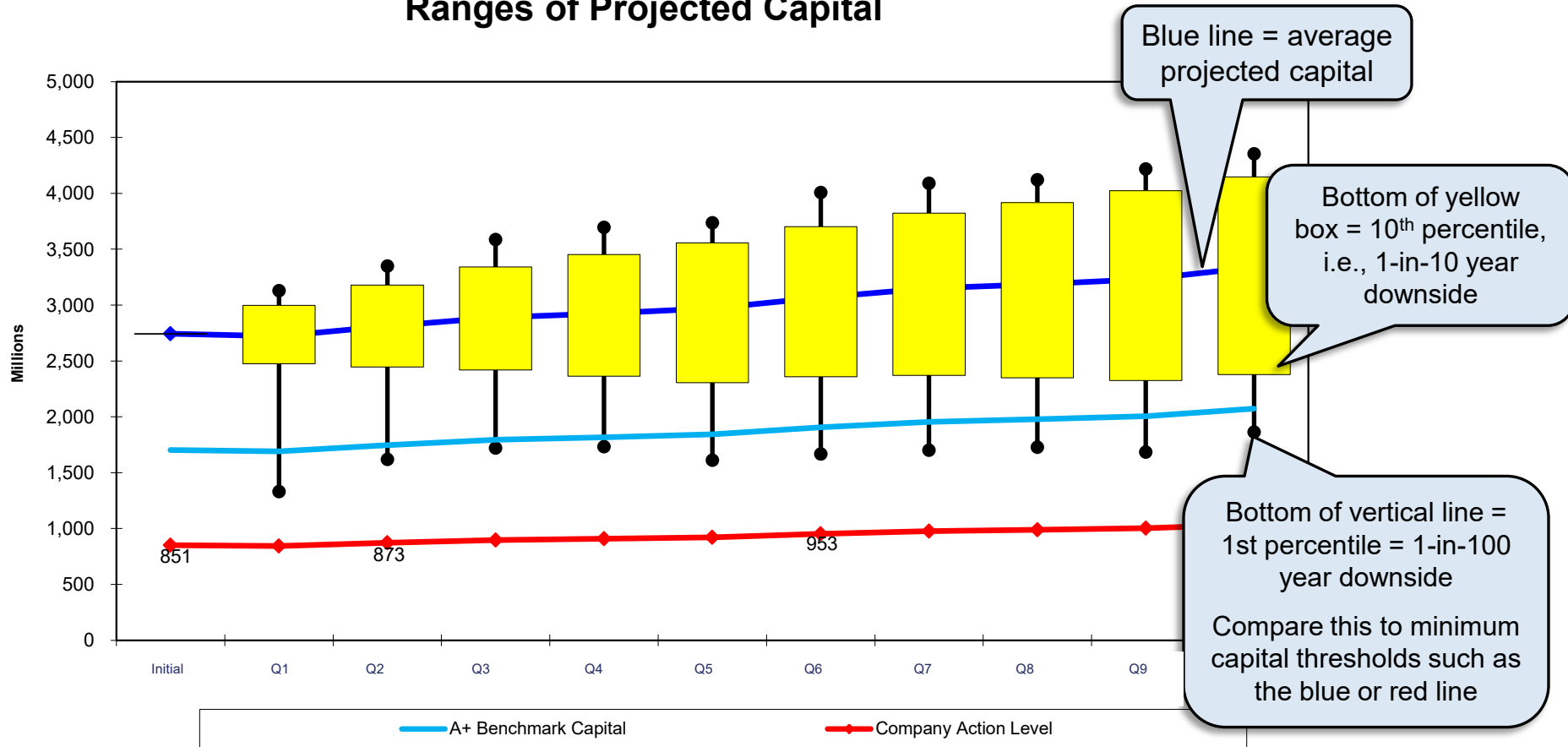- Provides better framework for addressing interactions between risk factors

Cons

- Additional work beyond what is require for a pure scenario testing approach (but the good news is all work done on a scenario testing basis can be leveraged)

- Additional management "education" required

BUSINESS APPLICATIONS OF A STOCHASTIC ECM

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Capital Adequacy Assessment

- To assess capital adequacy, use the ECM to project ranges of balance sheet capital

- The downside ends of the ranges are compared to key regulatory or rating agency thresholds — need to demonstrate a "small" probability of capital shortfall (how small depends on audience)

Ranges of Projected Capital

Blue line = average projected capital

Bottom of yellow box = 10th percentile, i.e., 1-in-10 year downside

Bottom of vertical line = 1st percentile = 1-in-100 year downside

Compare this to minimum capital thresholds such as the blue or red line

Legend: A+ Benchmark Capital — Company Action Level

Capital Adequacy & Risk Tolerance — Key Choices

Capital Adequacy Metric

- Policyholder Surplus
- Shareholders' Equity
- Free Cash Flow
- Earnings

Capital Adequacy Standard

- Regulatory or Rating Agency Threshold
- Debt Rating or Bond Default Threshold

Time Horizon

- 1 Year, 3 Years, 5 Years (can produce very different answers)

Capital Adequacy – Measure, Threshold & Time Horizon

Many companies will use bond rating probability of default as a proxy/threshold for evaluating their solvency

XYZ Company

Capital ($ in millions)

	2017	2018	2019	2020	2021
Average	651	708	739	781	815
Std Dev	27	38	67	101	146
0.07%	599	459	203	10	(389)
0.10%	600	491	224	28	(346)
0.20%	600	526	280	99	(207)
0.35%	600	539	355	148	(73)
0.50%	600	566	392	209	11
1.00%	601	595	468	320	184
2.00%	601	624	541	446	321
2.50%	601	629	561	482	381
5.00%	606	647	623	598	542
10.00%	616	663	674	690	687
25.00%	632	687	719	767	800
50.00%	650	711	751	804	850
75.00%	669	734	778	833	889
90.00%	688	753	799	857	919
95.00%	699	764	811	871	937
97.50%	708	773	821	883	953
98.00%	710	775	824	885	957
99.00%	717	783	831	894	971
99.50%	722	791	839	902	983
99.60%	724	792	842	905	986
99.80%	728	802	850	910	993

- S&P Corp Bond Default Rate: Single A, 1-Year = 0.07% (i.e., 99.93% chance of not defaulting)
- **At the 0.07% probability level, at the end of Year 1 the Capital level falls to about $600M**

- S&P Corp Bond Default Rate: Single A, 5-Year = 0.35% (i.e., 99.65% chance of not defaulting)
- **At the 0.35% probability level, at the end of Year 5 the Capital level falls to negative $73M**

Determine Required Capital

- Calculate/find the 0.35 percentile for Capital held at Year 5 (2021) from the simulation run

- Take the Capital held at the beginning of the simulation (Time=0) and subtract the present value of the 0.35 percentile for Capital held at Year 5 (using 5 year treasury yield as of 12/31/2017)

- The result is the "Required Capital", i.e. the minimum capital level as of 12/31/2017 that will satisfy the chosen risk tolerance.

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XYZ Company

Capital ($ in millions)

	($ in millions)
Held	$ 715
Less: 0.35 percentile @ end of Year 5 (discounted)	$ (70)
Required Capital	$ 785

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Capital Allocation Approach

- Capital itself is not actually sub-divided and allocated to individual segments of the business. All of the capital in a business entity is, in principle, available to support each business segment.

- It is meaningful, however, to allocate the cost of capital to individual business segments. Each segment must bear a share of the total cost of capital for the enterprise (the cost of capital may be a certain return expected by investors, or a certain internal growth rate target).

- How do you fairly allocate the cost of capital in an economically rational manner? It is generally accepted that, qualitatively, the allocation should be proportional to each business segment's contribution to the enterprise's total risk.

- Industry practice is converging on an approach known as "Co-Measures" (also sometimes referred to as the "RMK approach" after a paper by Ruhm, Mango and Kreps) because this approach is analytically powerful, transparent and useful to a broad management audience.

Capturing Profit Measures by Risk Segment

Capital Allocation Using Ruhm-Mango-Kreps Algorithm
Through Year-End 2018 ($ in millions)

Risk Segments	(1) Total Mean Profit/(Loss) (Tax-Adjusted)	(2) Tail Mean Profit/(Loss) (Tax-Adjusted)	(3) = (1) - (2) Allocation Basis (Total Mean - Tail Mean)	(4) Capital Allocation	(5) Allocated Required Capital	(6) = [(1)/(5)+1] ^0.2 - 1 Annualized Risk Adjusted ROE
Profit from Investments	119	111	8	2.5%	20	48%
Government	80	(147)	226	72.0%	565	3%
Large Group	358	325	33	10.4%	82	40%
Individual/Sm Group	93	46	47	15.1%	118	12%
Totals	650	335	315	100.0%	785	13%

(1) Total Mean Profit/(Loss)

▪ Invested Assets – average <u>cumulative</u> profit from investments (income & gains) for ALL paths at the end of Year 5

▪ Business Segments – average <u>cumulative</u> underwriting profit or operating income for ALL paths at the end of Year 5

(2) Tail Mean Profit/(Loss)

▪ Invested Assets — average <u>cumulative</u> profit from investments (income & gains) for **the paths at the risk tolerance threshold** at the end of Year 5

▪ Business Segments — average <u>cumulative</u> underwriting profit or operating income for **the paths at the risk tolerance threshold** at the end of Year 5

(3) Allocation Basis

▪ **Total** Mean Profit/(Loss) minus **Tail** Mean Profit/(Loss) ⟹ measures each segment's shortfall at the enterprise risk tolerance level

Illustrative Capital Allocation Example

Capital Allocation Using Ruhm-Mango-Kreps Algorithm
Through Year-End 2018 ($ in millions)

Risk Segments	(1) Total Mean Profit/(Loss) (Tax-Adjusted)	(2) Tail Mean Profit/(Loss) (Tax-Adjusted)	(3) = (1) - (2) Allocation Basis (Total Mean - Tail Mean)	(4) Capital Allocation	(5) Allocated Required Capital	(6) = [(1)/(5)+1] ^0.2 - 1 Annualized Risk Adjusted ROE
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(4) Capital Allocation

- Using the "Allocation Basis" column (3), this column calculates the proportion of each risk segment's needs to the total

(5) Allocated Required Capital

- Total "Required Capital" of $785M is allocated to the risk segments based upon the "Capital Allocation" percentages in column (4)

(6) Annualized Risk Adjusted ROE

- Measures the cost of capital for each of the risk segments

"Required Capital" = the minimum capital level as of the beginning of the simulation (Time=0) that will satisfy the chosen risk tolerance

ECONOMIC CAPITAL MODELING APPROACH

The Economic Capital Model Is Based on P&L Forecasts

- The main moving parts of the ECM correspond directly to the lines of a P&L

- The best estimate for each line item is tied directly to the financial planning process

- The variability of each item is based on (1) analysis of data, (2) substantial input from business leaders and (3) economic factors

- The result is a model that produces realistic scenarios of possible P&L and balance sheet outcomes

- This will support the key metrics required for ORSA reporting and other risk-based analyses

Potential for Loss Translates to Capital Need
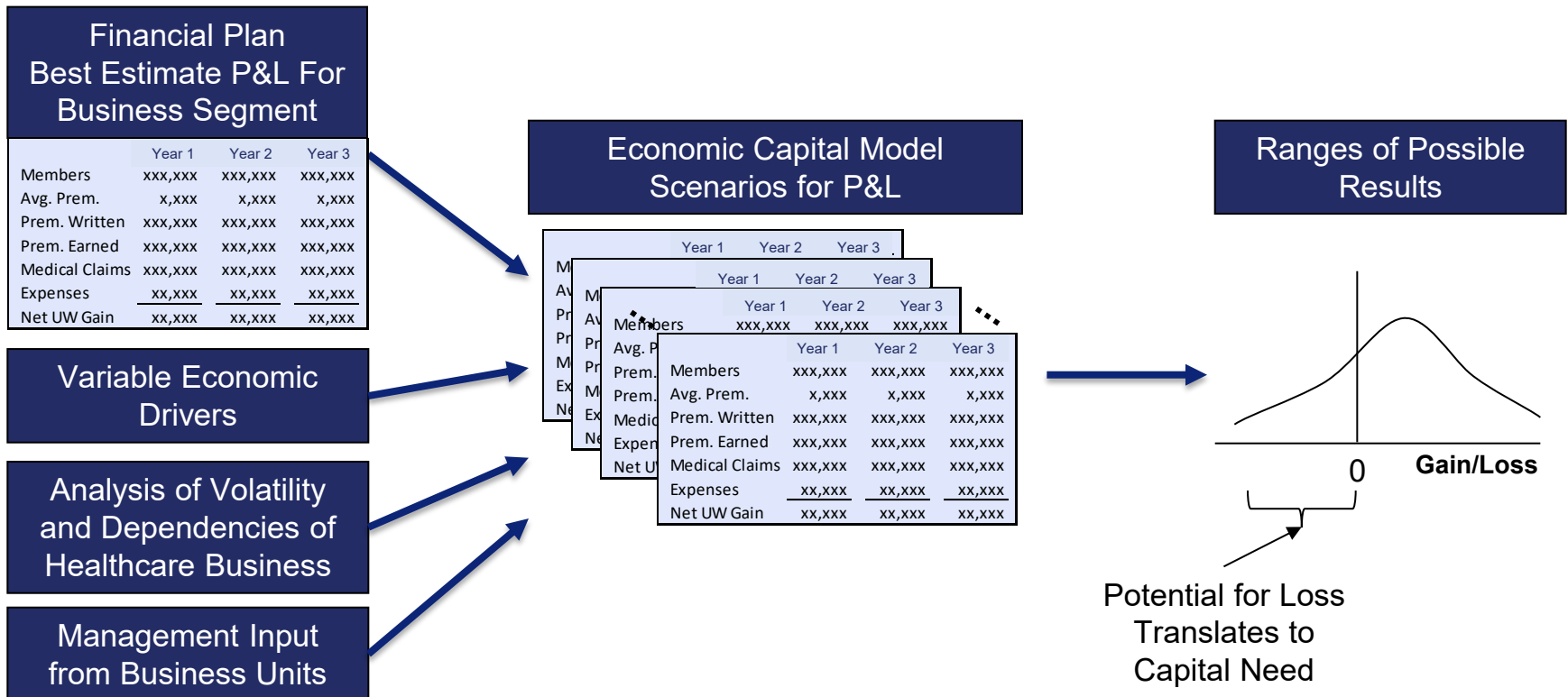
The Results of ECM Feed Back into the Planning Process

- The range of potential results from the stochastic P&L is used to allocate the firm's capital based on each unit's potential to create losses for the firm

- The cost of that capital is then deducted from the expected profits of the unit

- The result is a measure of "risk adjusted profit" or "economic profit"

- This then feeds back into the planning process as a key input to target-setting for prices and profitability

Ranges of Possible Results

0   **UW Gain**

Potential for UW Loss Translates to Capital Need

Risk-Adjusted P&L

	Year 1	Year 2	Year 3
Members	xxx,xxx	xxx,xxx	xxx,xxx
Avg. Prem.	x,xxx	x,xxx	x,xxx
Prem. Written	xxx,xxx	xxx,xxx	xxx,xxx
Prem. Earned	xxx,xxx	xxx,xxx	xxx,xxx
Medical Claims	xxx,xxx	xxx,xxx	xxx,xxx
Expenses	xx,xxx	xx,xxx	xx,xxx
Net UW Gain	xx,xxx	xx,xxx	xx,xxx
Allocated Capital	xxx,xxx	xxx,xxx	xxx,xxx
Cost of Alloc. Cap.	xx,xxx	xx,xxx	xx,xxx
Economic Profit	xx,xxx	xx,xxx	xx,xxx

Profit Targets for Planning Process

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Economic Capital Model — Implementation Stages

- Inventory risk factors

  - Prioritize by impact

  - Identify basis for risk assumptions (actuarial data, risk assessments, etc.)

  - Determine suitable approach for each risk

- Develop scenarios for each risk factor

  - How bad can it get?

  - One year vs. multi-year impacts

  - Management/market responses

- Run scenarios through P&L and balance sheet

- Aggregate distributions of scenario results to generate capital risk metrics

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Potential Risks & ECM Treatment

Potential Risk Factors	Detailed Approach Based On Actuarial/Statistical Internal Models	Simplified Approach Based On Management Input/Judgment	Risk Distribution Derived from an ERM Risk Assessment
Medical Trend	✓		
Quality Ratings	✓		
Cyber Security Risk			✓
Competitor Behavior		✓	
Regulatory Rate Approvals		✓	

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Risk Driver Variability – Government Segment

GOVT: Medical Trend Rate
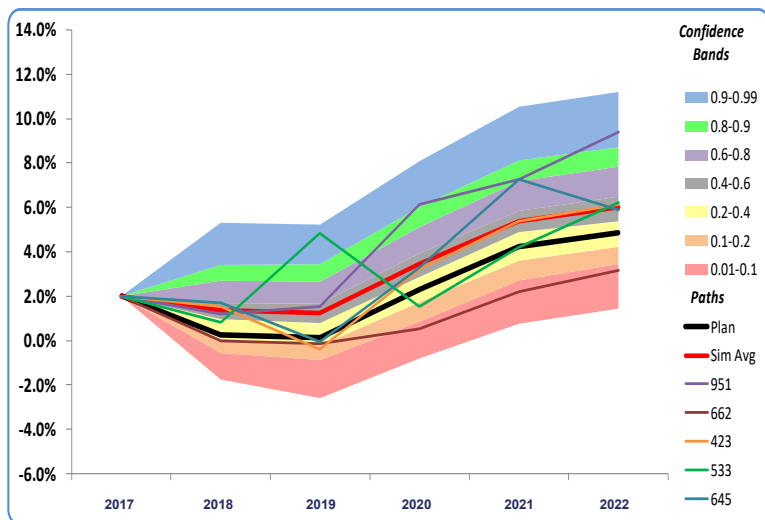
GOVT: Simulated CMS Star Rating (Internal)
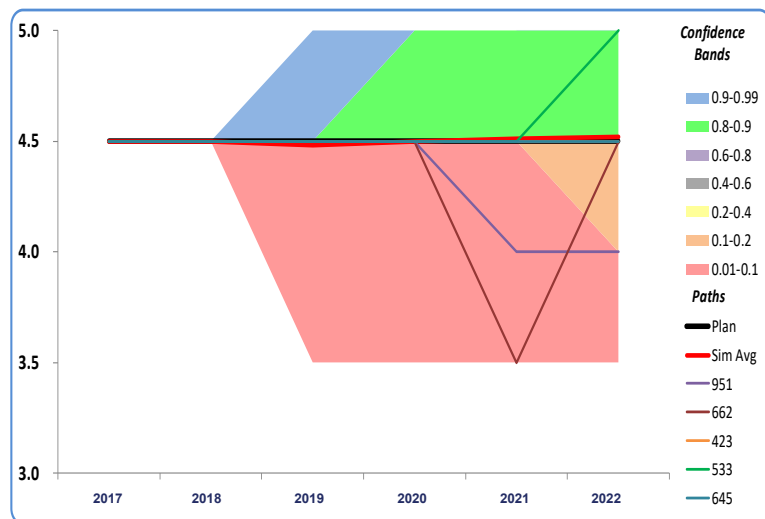
GOVT: Cyber Security Risk Dollar Impacts ($ in 000's)
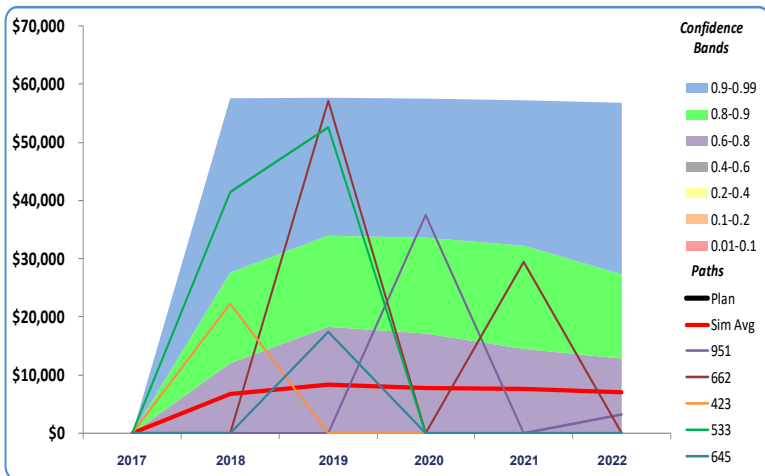
Prepared by Conning, Inc. Source: ADVISE® Enterprise Risk Modeler model using hypothetical data. Simulation = 1,000 paths.

P&L Results Variability – Government Segment

GOVT Membership
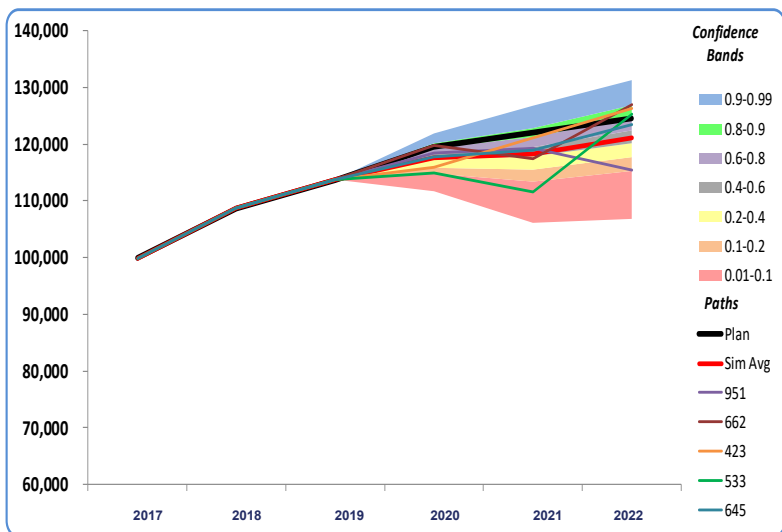
GOVT PremiumRevenue ($000s)
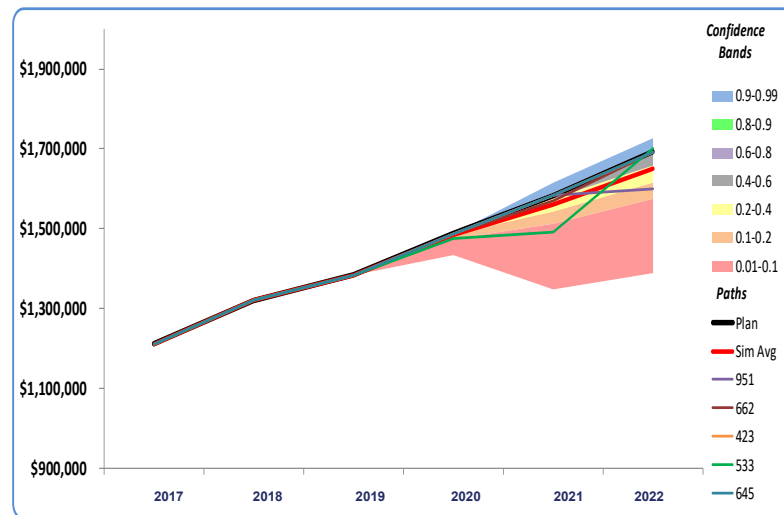
GOVT MedicalClaimsExpense ($000s)
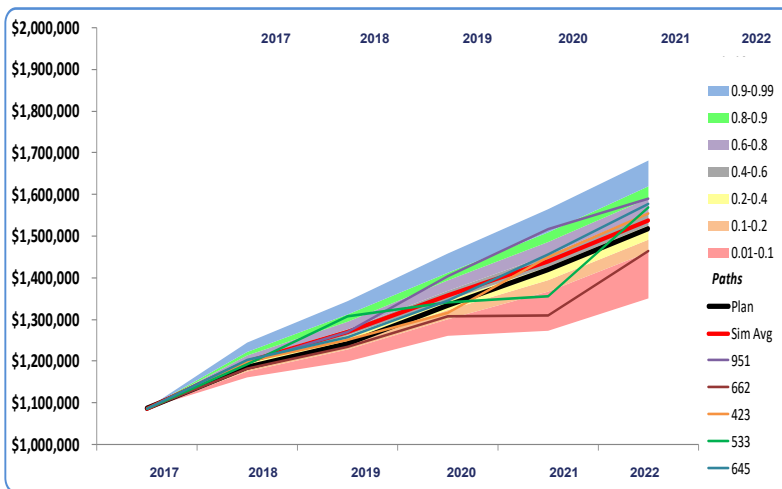
GOVT OperatingMargin ($000s)

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One Adverse Path vs Plan Expectation – Government

Cause-and-effect modeling "tells the story", leading to greater transparency & understanding ...

Operating Margin:

	2017	2018	2019	2020	2021	2022
Expected (Plan)	$ 31,708,046	$ 41,313,837	$ 46,943,544	$ 56,710,310	$ 65,987,192	$ 76,644,742
Total Revenue (Higher / (Lower))	$ (0)	$ (0)	$ -	$ 0	$ (0)	$ (77,690,829)
Total Cost of Benefits ((Higher) / Lower)	$ (0)	$ (11,230,794)	$ (29,375,587)	$(107,197,984)	$ (96,990,810)	$ (88,929,023)
Net Admin Expense ((Higher) / Lower)	$ -	$ -	$ -	$ -	$ -	$ -
Actual (Path = 951)	$ 31,708,046	$ 30,083,042	$ 17,567,956	$ (50,487,673)	$ (31,003,619)	$ (89,975,109)

At a very basic level, Operating Margin is much lower than expected due to higher Cost of Benefits and lower Revenue

Total Cost of Benefits:

	2017	2018	2019	2020	2021	2022
Expected (Plan)	$1,104,868,979	$1,204,289,981	$1,261,176,105	$1,354,775,921	$1,441,210,812	$1,539,520,398
Medical Trend Impact	$ -	$ 11,230,794	$ 29,375,587	$ 82,898,231	$ 132,601,170	$ 213,596,868
IT Operational Risk Impact	$ -	$ -	$ -	$ -	$ -	$ -
Cyber Security Risk	$ -	$ -	$ -	$ 37,496,749	$ -	$ 3,192,448
Membership Impact	$ 0	$ 0	$ (0)	$ (13,196,996)	$ (35,610,359)	$ (127,860,292)
Actual (Path = 951)	$1,104,868,979	$1,215,520,775	$1,290,551,691	$1,461,973,905	$1,538,201,622	$1,628,449,421

Higher Cost of Benefits heavily driven by unfavorable Medical Trend with some impact from Cyber Security Risk

Total Revenue:

	2017	2018	2019	2020	2021	2022
Expected (Plan)	$1,210,883,595	$1,320,802,066	$1,383,693,888	$1,487,438,343	$1,583,529,875	$1,692,878,672
Membership Impact (Internal CMS Star)	$ -	$ -	$ -	$ -	$ -	$ -
Membership Impact (Competitor CMS Star)	$ -	$ -	$ -	$ -	$ -	$ -
Prem Rev PMPM Impact (CMS Star)	$ -	$ -	$ -	$ -	$ -	$ -
Mgt Reactions (Mbrshp & Prem Rev PMPM)	$ (0)	$ (0)	$ -	$ 0	$ (0)	$ (77,690,829)
Actual (Path = 951)	$1,210,883,595	$1,320,802,066	$1,383,693,888	$1,487,438,343	$1,583,529,875	$1,615,187,844

Management response is to increase prices (limited) & shed membership – lower membership lowers the Cost of Benefits, but also Revenue

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Stochastic ECMs – Pros and Cons

Pros

- Provides probability statements for capital adequacy ➔ Provides basis for allocating the cost of capital, to support better financial performance metrics ➔ Critical to creating greater value for management beyond compliance

- Provides better framework for addressing interactions between risk factors

Cons

- Additional work beyond what is require for a pure scenario testing approach (but the good news is all work done on a scenario testing basis can be leveraged)

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Disclosures

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