

Biennial Convention 2009

Go for Gold

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Institute of Actuaries of Australia



A Modern Approach to Group Risk Pricing and Credibility

Hakop Pashayan



A Modern Approach to Group Risk Pricing and Credibility

- Pricing Accuracy
- The Credibility Framework
- Existing Credibility Models
- Proposed Credibility Model
- The Credibility Model Comparison



A Modern Approach to Group Risk Pricing and Credibility

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Pricing Accuracy

- Inter–Plan Cross Subsidisation
 - Anti-selection
 - Implicit anti-selection margin
 - Group risk market traits are a driver
 - Great rewards for reduced cross subsidisation



Pricing Accuracy

- Greater Plan Level Pricing Accuracy
 - Increased market share
 - Increased profit margin
 - Losses by competitors



A Modern Approach to Group Risk Pricing and Credibility

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- **The Credibility Framework**
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Framework for Credibility

- Key Definitions
 - Expected claims cost
 - Underlying claims cost
 - Actual claims cost

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Plan XYZ

Member Number	Member Name	Sex	ANB	Occupation Class	Death Sum Insured	Applicable Rate	Applicable Loadings	Expected Member Prem
1	Ronald Maotai	M	23	White Collar	\$ 100,000.00	1.04	0%	\$ 104.00
2	Richard Nixon	M	56	White Collar	\$ 100,000.00	3.76	0%	\$ 376.00
3	Master Splinter	M	63	White Collar	\$ 100,000.00	7.1	0%	\$ 710.00
4	Max Power	M	18	White Collar	\$ 100,000.00	1.04	0%	\$ 104.00
5	Mark Webber	M	45	White Collar	\$ 100,000.00	1.52	0%	\$ 152.00
6	Nick London	M	29	White Collar	\$ 100,000.00	0.88	0%	\$ 88.00
7	Colin Greenleaves	M	40	White Collar	\$ 100,000.00	0.99	0%	\$ 99.00
8	Cosmo Kramer	M	47	White Collar	\$ 100,000.00	1.88	0%	\$ 188.00
9	Jason Pymble	M	53	White Collar	\$ 100,000.00	3.03	0%	\$ 303.00
10	Dennis Davidson	M	52	White Collar	\$ 100,000.00	2.81	0%	\$ 281.00
11	Boutros Boutros Ghali	M	37	White Collar	\$ 100,000.00	0.85	0%	\$ 85.00
12	Young Gogetter	M	18	White Collar	\$ 100,000.00	1.04	0%	\$ 104.00
13	David Haiku	M	48	White Collar	\$ 100,000.00	2.11	0%	\$ 211.00
14	Sub Zero	M	39	White Collar	\$ 100,000.00	0.92	0%	\$ 92.00
15	David Hasselhoff	M	44	White Collar	\$ 100,000.00	1.37	0%	\$ 137.00
16	Schappelle Corby	F	60	White Collar	\$ 100,000.00	2.95	0%	\$ 295.00
17	Robert Jones	M	62	White Collar	\$ 100,000.00	6.42	0%	\$ 642.00
18	Steven Morris	M	29	White Collar	\$ 100,000.00	0.88	0%	\$ 88.00
19	Isabelle Dawn	F	28	White Collar	\$ 100,000.00	0.38	0%	\$ 38.00
20	Vanessa Spatiri	F	22	White Collar	\$ 100,000.00	0.35	0%	\$ 35.00
21	Dolly Parton	F	55	White Collar	\$ 100,000.00	2.11	0%	\$ 211.00
22	Tim Shore	M	51	White Collar	\$ 100,000.00	2.6	0%	\$ 260.00
23	Iggy Pop	M	66	White Collar	\$ 100,000.00	8.44	0%	\$ 844.00
24	Mustang Sally	F	37	White Collar	\$ 100,000.00	0.58	0%	\$ 58.00
25	Burt Newton	M	112	White Collar	\$ 100,000.00	8.44	0%	\$ 844.00
26	Marcus Einfeld	M	64	White Collar	\$ 100,000.00	7.76	0%	\$ 776.00
27	Puff Daddy	M	40	White Collar	\$ 100,000.00	0.99	0%	\$ 99.00
28	Robert Weekly	M	35	White Collar	\$ 100,000.00	0.87	0%	\$ 87.00
29	Karma Sutra	F	60	White Collar	\$ 100,000.00	2.95	0%	\$ 295.00
30	Boris Yeltsin	M	33	White Collar	\$ 100,000.00	0.84	0%	\$ 84.00

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Robert Jones

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Group XYZ



Framework for Credibility

- Key Definitions
 - Expected claims cost
 - Underlying claims cost
 - Actual claims cost



Framework for Credibility

- The Credibility Model's Aim

To accurately estimate the Underlying claims cost using the Expected and Actual claims cost



Framework for Credibility

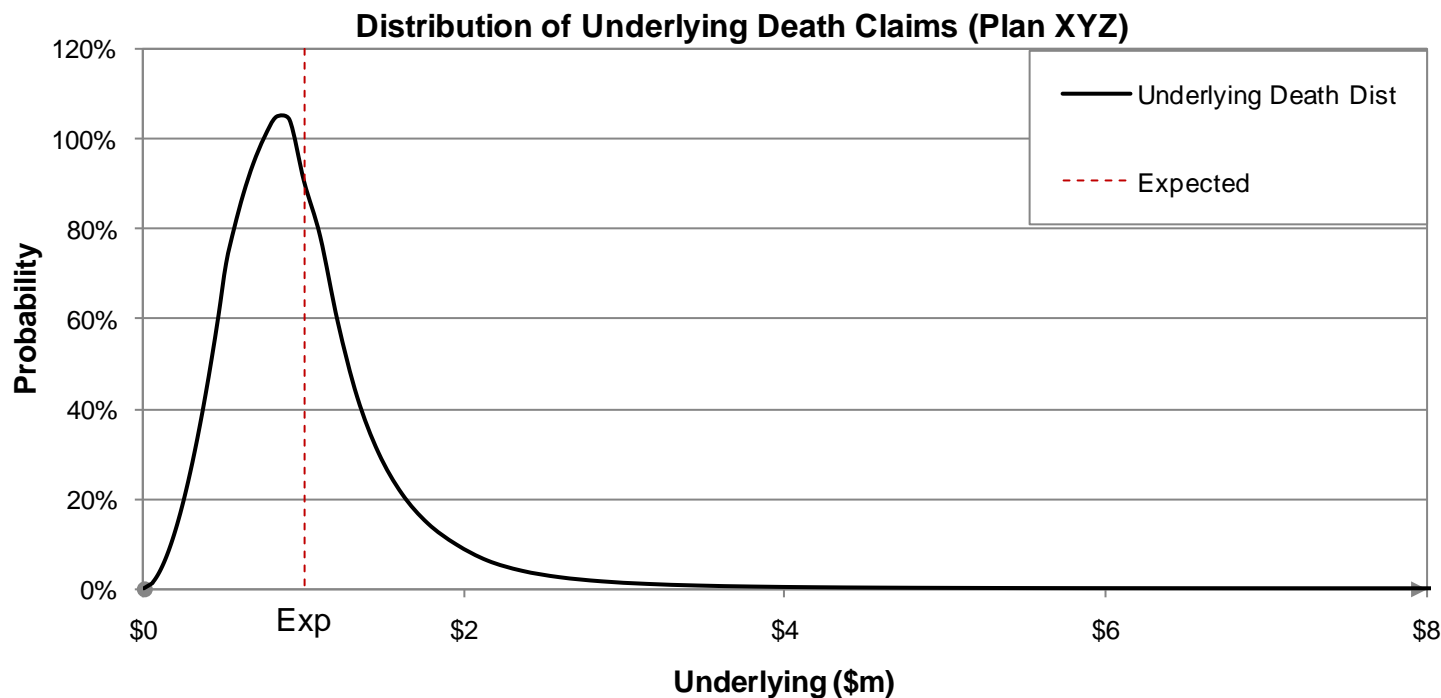
What is the relationship between:

- Expected claims cost and Underlying claims cost
- Underlying claims cost and Actual claims cost



Framework for Credibility

Relationship between Expected and Underlying





Framework for Credibility

The Underlying Distribution is affected by:

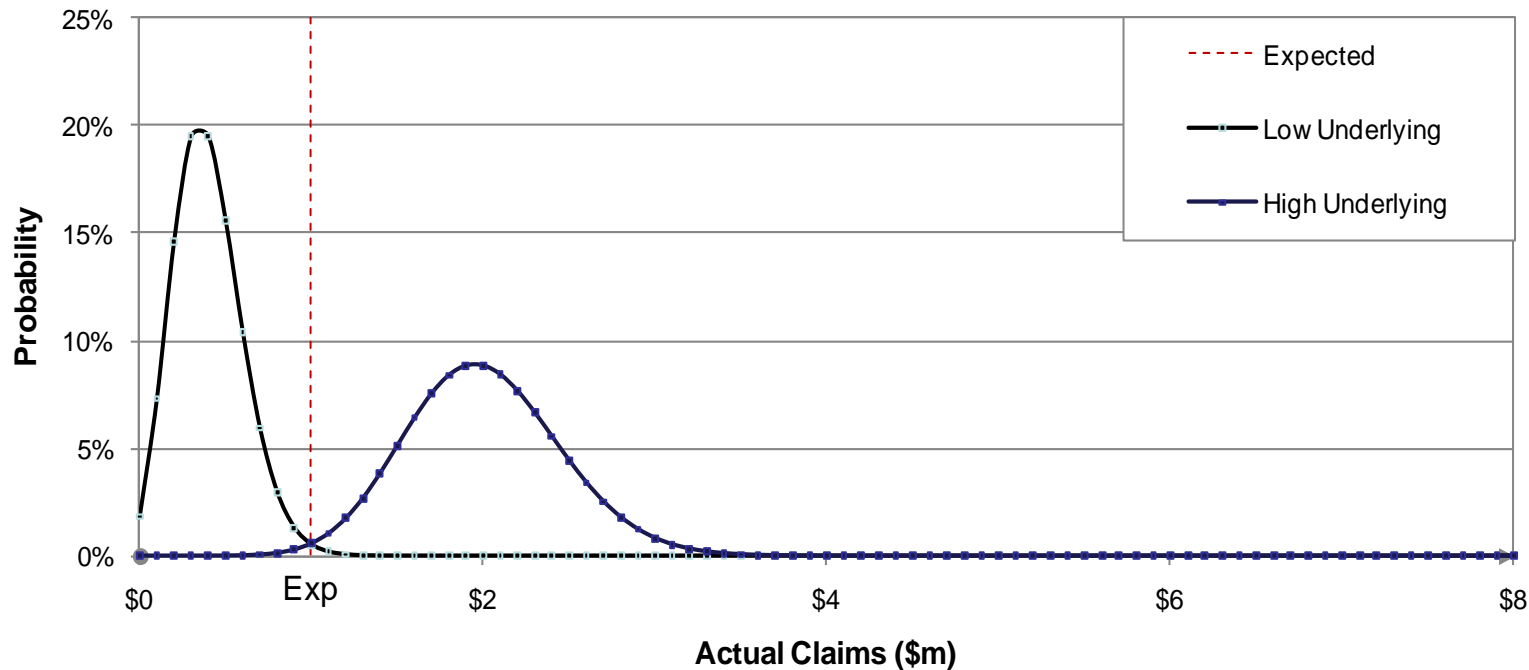
- Product
- Availability of data
- Value of Expected
- Plan type (corporate, master trust, industry fund)



Framework for Credibility

Relationship between Underlying and Actual

Conditional Distribution of Actual Death Claims (Plan XYZ)





Framework for Credibility

The Conditional Actual Distribution is affected by:

- Member's probabilities of claim
- Member's distribution of sum insured
- Life years of exposure



Framework for Credibility

How do we use this information to estimate
Underlying claims?



Framework for Credibility

How do we use this information to estimate
Underlying claims?

Bayesian Conditional Probability!



Framework for Credibility

A Credibility Model is Required to do Three Things:

- Accurately measure the initial distribution of Underlying claims
- Accurately measure the set of conditional Actual claims distributions
- Use an accurate credibility formula



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Existing Credibility Models

- Bayesian Models
- Buhlmann-Straub Model (BSM)
- Limited Fluctuation Model (LFM)



Existing Credibility Models

- Buhlmann-Straub Model (BSM)
- Limited Fluctuation Model (LFM)

$$\textit{Premium} = (1 - b) \times \textit{Expected} + b \times \textit{Actual}$$



Existing Credibility Models

Results of Analysis of BSM:

$$b = \frac{\textit{exposure}}{\textit{exposure} + \textit{constant}}$$

- Linear approximation to Bayesian
- Var(Underlying) is constant
- Var(Actual) is constant except for exposure effect



Existing Credibility Models

Results of Analysis of LFM:

$$b = \sqrt{\frac{\text{number of claims}}{\text{number of claims for full cred}}}$$

- Ignores impact of distribution of Underlying
- Estimates distribution of Actual claims well most of the time
- Credibility formula is not accurate



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Proposed Credibility Model

- Assumptions and Derivation
- Implementation in Practice
- ‘Fringe Benefits’ of Model



Proposed Credibility Model

‘Fringe Benefits’ of Model:

- Identification of new rating factors
- Measurement of effectiveness of rating factors
- Pricing profit share and rate guarantees
- Plan level allocation of risk based capital
- Measuring the impact of reinsurance arrangements
- Reporting



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Credibility Model Comparison

The Hypothetical Portfolio:

- 28,000 plans
- Identical membership info & Expected claims
- Very different Underlying claims
- Claims simulated for each plan





Credibility Model Comparison

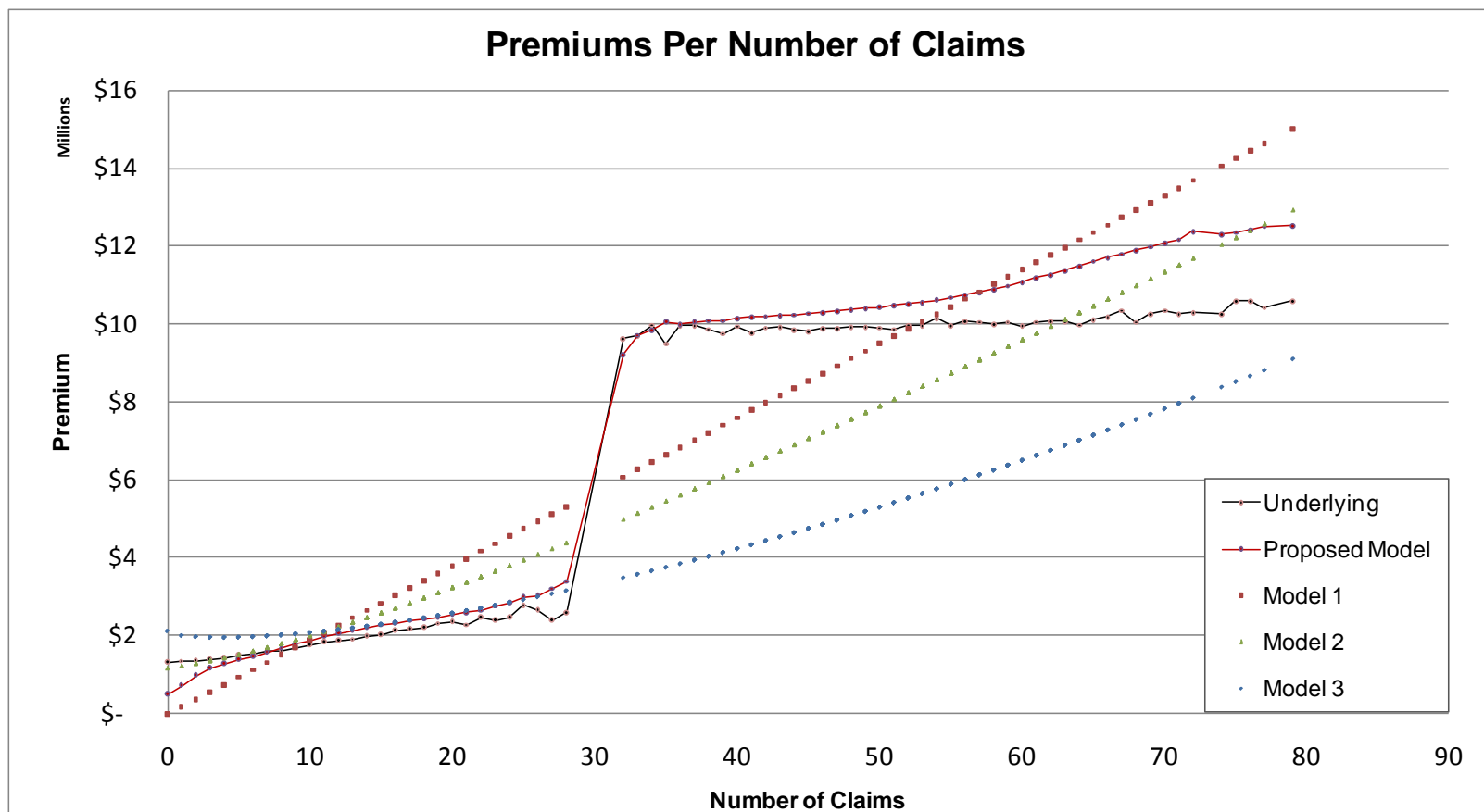


The Existing & Proposed Credibility Models:

- 28,000 plans priced by each model
- Measured pricing accuracy
- Measured premium differentials
- Measured performance in competition



Credibility Model Comparison





Credibility Model Comparison

No Competition

Model	Proposed Model	Model 1	Model 2	Model 3
Prem Won/28,000	\$ 2,206,604	\$ 2,168,336	\$ 2,276,031	\$ 2,235,983
Underlying Claims/28,000	\$ 2,158,999	\$ 2,158,999	\$ 2,158,999	\$ 2,158,999
Premium/Underlying	102%	100%	105%	104%
Proportion of Business Won	100%	100%	100%	100%

In Competition

Model	Proposed Model	Model 1	Model 2	Model 3
Prem Won/28,000	\$ 948,063	\$ 295,025	\$ 0	\$ 308,917
Underlying Claims/28,000	\$ 922,489	\$ 632,815	\$ 0	\$ 603,694
Premium/Underlying	103%	47%	NA	51%
Proportion of Business Won	61%	19%	0%	20%



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QUESTIONS?



Credibility Model Comparison

