Game Theory and Australia's CTP Markets

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Introduction

- Actuarial pricing
- Characteristics of this market
- Game theory
- Some scenarios
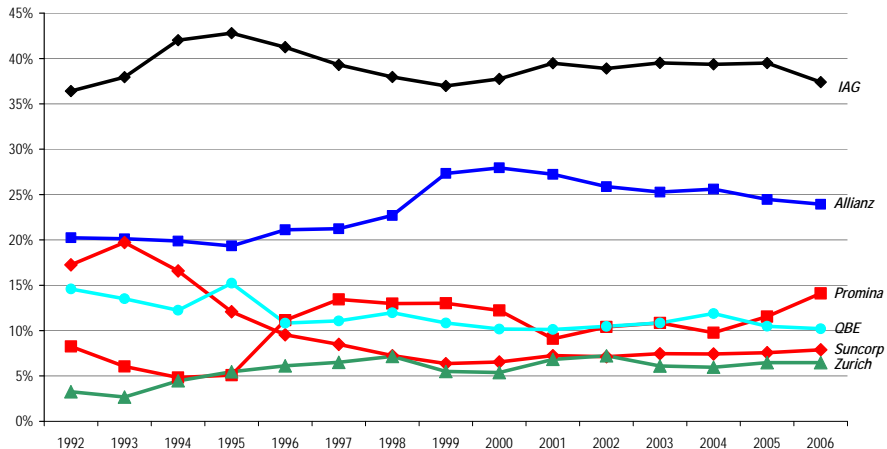- Conclusions

Actuarial Pricing

- ## Considers:

Frequency	Claim Size
Expenses	Capital
Profit Margin	Investment Income
Cash Flows	Systemic Change

- ## Considers less, or does not consider:

Competitor Pricing	Competitors' Reactions
Competitor Strategy	Our strategy
Market cycles	Short vs Long Term tactics

CTP Markets - Concentration

NSW CTP Market Share

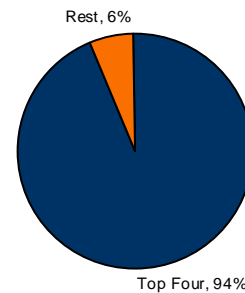Queensland CTP Market Share
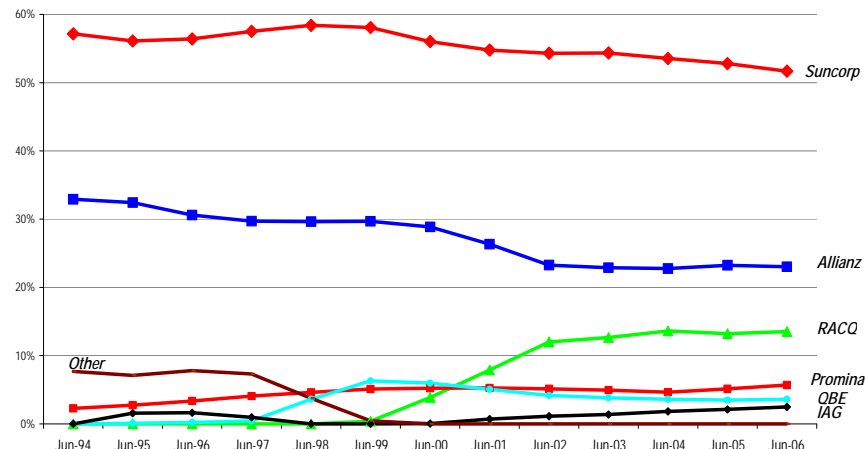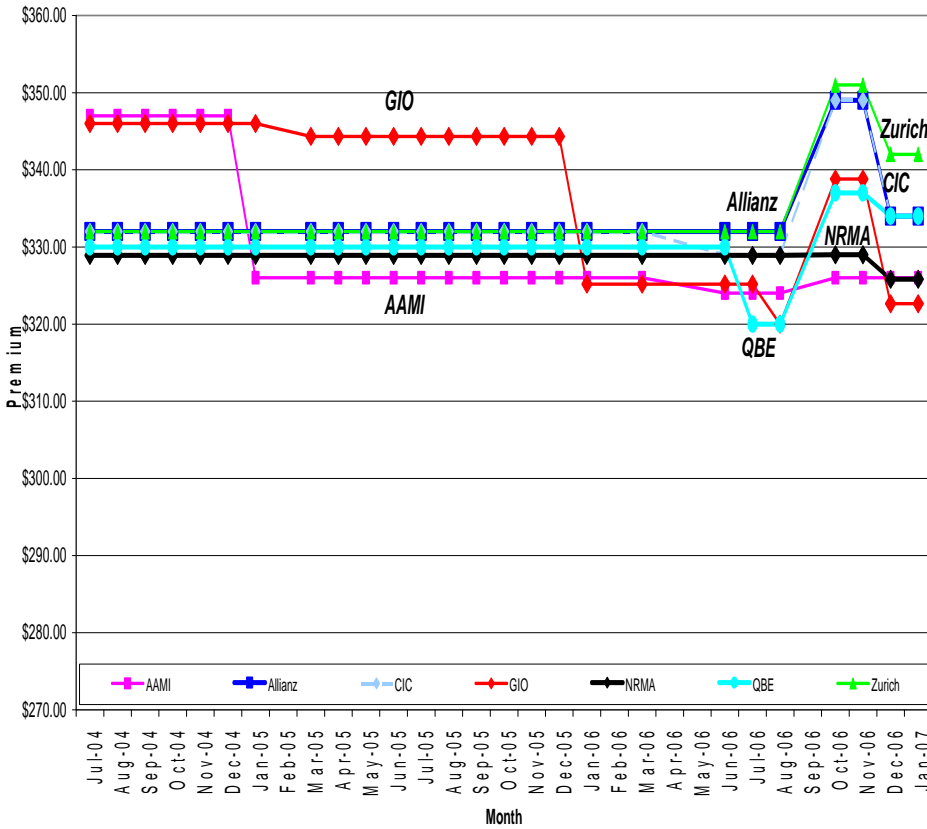
NSW Concentration in top 4

Rest, 14%
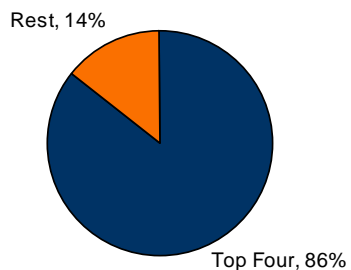
Top Four, 86%

QLD Top Four Player Concentration

Rest, 6%

Top Four, 94%

CTP Markets - Premiums

NSW Headline Rate

Queensland Class 1 Rate

Game Theory: Dominance

Biggy

Newby

Benedict

Unsure

Game Theory: Dominance

Strategy chosen by Newby

	to target Benedict	to target Unsure
Strategy chosen by Biggy — to target Benedict	70	
to target Unsure		

Game Theory: Dominance

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Game Theory: Dominance

	Strategy chosen by Newby	
	to target Benedict	to target Unsure
Strategy chosen by Biggy to target Benedict		
to target Unsure	100	

Game Theory: Dominance

		Strategy chosen by Newby	
		to target Benedict	to target Unsure
Strategy chosen by Biggy	to target Benedict		
	to target Unsure		35

Game Theory: Dominance

Strategy chosen by Newby

	to target Benedict	to target Unsure
to target Benedict	70 ⟵ 70	
to target Unsure	100 ⟵ 35	

Strategy chosen by Biggy

Game Theory: Dominance

Strategy chosen by Newby

	to target Benedict	to target Unsure
to target Benedict	100	100
to target Unsure	70	135

Strategy chosen by Biggy

Game Theory: Dominance

Strategy chosen by Newby

	to target Benedict ✔	to target Unsure
to target Benedict	100	100
to target Unsure	70	135

Strategy chosen by Biggy

Game Theory: Choice of Strategy

- You cannot ignore interactions between you and your competitor

- Your optimal strategy is determined by your bargaining power

- Your bargaining power is determined by how you can affect your competitor's payoffs

Game Theory: Sharing the Benefits

- Consider a situation in which three distribution channels are considering merging in order to save on fixed expenses

- How should the lower, shared fixed expenses be shared between them?

- Many actuaries allocate fixed expenses in proportion to premiums

Game Theory: Sharing the Benefits

Distribution Channel	Premium	Old Fixed Expenses	New Fixed Expenses	
			Allocated by Premium	Allocated by Shapely Value
A	100	12.0	3.4	5.3
B	300	10.0	10.3	3.7
C	50	13.5	1.7	6.5
Total	450	35.5	15.5	15.5

Game Theory: Sharing the Benefits

- We need an allocation that:
  - Totals to the correct amount
  - Gives everyone a benefit from the expense savings (i.e. everyone is better off)
  - Rewards those who contribute the most savings to the coalition

Scenarios

Starting Position

Two insurers

		A			B	
2 categories of policyholders						
	Policy Count	Price	E(Claims)	Policy Count	Price	E(Claims)
Best	800	$320	$224	600	$320	$224
Worst	200	$500	$350	400	$500	$350
Total GWP / GIC	1,000	$356,000	$249,200	1,000	$392,000	$274,400
Loss Ratio			70.0%			70.0%
Expenses Fixed		15%	$53,400		15%	$58,800
Variable		10%	$35,600		10%	$39,200
Profit			$17,800			$19,600
Capital		50%	$178,000		50%	$196,000
ROE			10%			10%

Scenario 1: Aggressive Competitor

- Starting from equilibrium, what happens if one insurer changes its rates?

- Tests different changes and different reactions

Scenario 1: Aggressive Competitor

After 1 quarter

Two insurers

<table>
<tr><td colspan="2">2 categories of policyholders</td><td></td><td></td><td>A</td><td></td><td></td><td>B</td><td></td></tr>
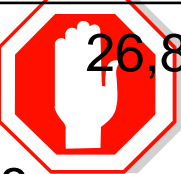</table>

		Policy Count	Price	E(Claims)	Policy Count	Price	E(Claims)
Best	Not yet reached renewal	600	$320	$224	450	$320	$224
	Renewed	140	$320	$224	150	$310	$224
	New business	-	$320	$224	60	$310	$224
Worst	Not yet reached renewal	150	$500	$350	300	$500	$350
	Renewed	15	$500	$350	100	$484	$350
	New business	-	$500	$350	35	$484	$350
	Total GWP / GIC		$319,506	$223,654		$424,291	$299,946
	Loss Ratio			70.0%			70.7%
Expenses	Fixed			$53,400			$58,800
	Variable		10%	$31,951		10%	$42,429
Profit				$10,501			$23,116
Capital				$159,753			$212,145
ROE				7%			11%

Scenario 1: Aggressive Competitor

	Insurer B		
	Drop Premium by $10	No Change	Increase Premium by $10
Insurer A — Drop Premium by $10	16,844 15,297	9,803 23,717	6,552 27,204
No Change	⬆ 23,116 10,501	⬆ 19,600 17,800	⬇ 11,181 27,597
Increase Premium by $10	⬆ 25,714 8,530	⬆ 26,899 11,978	⬆ 22,356 20,303

Scenario 1: Aggressive Competitor

Insurer B

	Drop Premium by $10	No Change	Increase Premium by $10
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Scenario 1: Aggressive Competitor

	Insurer B	
	Drop Premium by $10	No Change
Insurer A — Drop Premium by $10	✔ 16,844 / 15,297	← 9,803 / 23,717
No Change	↑ 23,116 / 10,501	↑ ← 19,600 / 17,800

Scenario 2: Soft Market

- Starting from an unprofitable equilibrium ie market is at bottom of cycle.

- Test different changes and different reactions
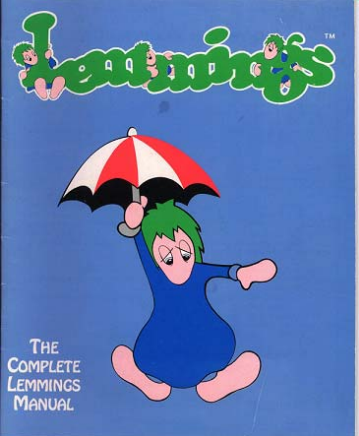
Scenario 2: Soft Market

Starting Position

Two insurers

		A			B		
2 categories of policyholders		Policy Count	Price	E(Claims)	Policy Count	Price	E(Claims)
Best		800	$280	$224	600	$280	$224
Worst		200	$450	$350	400	$450	$350
Total GWP / GIC			$314,000	$249,200		$348,000	$274,400
Loss Ratio				79.4%			78.9%
Expenses	Fixed		15%	$53,400		15%	$58,800
	Variable		10%	$31,400		10%	$34,800
Profit				-$20,000			-$20,000
Capital			50%	$157,000		50%	$174,000
ROE				-13%			-11%

Scenario 2: Soft Market

		Insurer B		
		Drop Premium by $10	No Change	Increase Premium by $40
Insurer A	Drop Premium by $10	-22,796 -22,523	-25,119 -18,824	-26,540 -16,558
	No Change	↑ -20,235 -23,609	↑ -20,000 -20,000	↓ -25,860 -11,980
	Increase Premium by $40	↑ -18,221 -24,137	↓ -16,395 -17,697	↓ -8,814 -9,907

Scenario 2: Soft Market

Insurer B

	Drop Premium by $10	No Change	Increase Premium by $40
Insurer A — Drop Premium by $10	-22,796 -22,523	← -25,119 -18,824	← -26,540 -16,558
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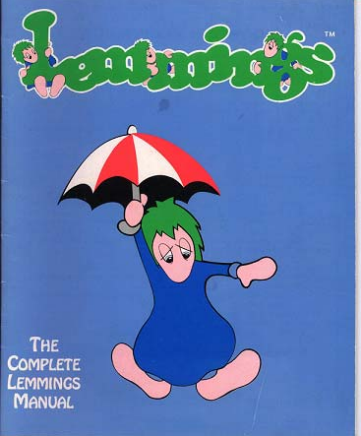
Scenario 2: Soft Market

- Moving up to a technically sound premium can damage your profitability!

- The only way out is to co-operate, but many forms of co-operation are illegal under the Trade Practices Act

- Otherwise you are stuck playing "chicken" with your competitors

Conclusions

- There is more to actuarial pricing than working out the risk

- Actions of competitors can be more important that the technical price as competitor action can affect risk mix and expected volumes and thus coverage of fixed costs

- Following the market down is not necessarily a bad thing

- In a market with increasing competition consideration of your competitors' strategies is paramount. The winner is the one who out thinks his competitor.