WINNER'S CURSE

August 2009

The Unmodelled Impact of Competition

Report of the Winner's Curse GIRO Working Party

APPENDICES

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Appendix 1: Bibliography

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Appendix 2: Output of Models

Appendix 2.1: Basic Model: Demonstrating Winner's Curse

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-5.6%	70.0%
2	94.39	-3.1%	74.2%
3	91.51	-2.0%	76.5%
4	89.67	-1.5%	78.1%
5	88.33	-1.2%	79.2%
6	87.27	-1.0%	80.2%
7	86.39	-0.8%	81.0%
8	85.69	-0.7%	81.7%
9	85.07	-0.6%	82.3%
10	84.57		82.8%

* from 10000 iterations

Appendix 2.2: Comparison of Error Structures

Log-Normal Distribution:

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by LogNormal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.97	-5.6%	70.0%
2	94.40	-2.9%	74.1%
3	91.67	-1.8%	76.4%
4	89.98	-1.3%	77.8%
5	88.76	-1.1%	78.9%
6	87.81	-0.9%	79.7%
7	87.04	-0.7%	80.4%
8	86.42	-0.6%	81.0%
9	85.88	-0.5%	81.5%
10	85.45		81.9%

* from 10000 iterations

Appendix 2.3: Impact of Feedback Loops: Source data subject to Winner's Curse

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	113%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	113.20	-5.6%	61.8%
2	106.87	-3.1%	65.5%
3	103.60	-2.0%	67.6%
4	101.51	-1.5%	69.0%
5	100.00	-1.2%	70.0%
6	98.80	-1.0%	70.9%
7	97.80	-0.8%	71.6%
8	97.01	-0.7%	72.2%
9	96.31	-0.6%	72.7%
10	95.74		73.1%

* from 10000 iterations

Appendix 2.4: Impact of Greater/Less Market-Wide Certainty over Price

Co-Efficient of Variation: 1%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1%	1%	1%	1%	1%	1%	1%	1%	1%	1%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	100.00	-0.6%	70.0%
2	99.44	-0.3%	70.4%
3	99.15	-0.2%	70.6%
4	98.97	-0.1%	70.7%
5	98.83	-0.1%	70.8%
6	98.73	-0.1%	70.9%
7	98.64	-0.1%	71.0%
8	98.57	-0.1%	71.0%
9	98.51	-0.1%	71.1%
10	98.46		71.1%

* from 10000 iterations

Co-Efficient of Variation: 2%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	100.00	-1.1%	70.0%
2	98.88	-0.6%	70.8%
3	98.30	-0.4%	71.2%
4	97.93	-0.3%	71.5%
5	97.67	-0.2%	71.7%
6	97.45	-0.2%	71.8%
7	97.28	-0.1%	72.0%
8	97.14	-0.1%	72.1%
9	97.01	-0.1%	72.2%
10	96.91		72.2%

* from 10000 iterations

Co-Efficient of Variation: 5%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-2.8%	70.0%
2	97.20	-1.5%	72.0%
3	95.75	-1.0%	73.1%
4	94.83	-0.7%	73.8%
5	94.16	-0.6%	74.3%
6	93.63	-0.5%	74.8%
7	93.19	-0.4%	75.1%
8	92.84	-0.3%	75.4%
9	92.53	-0.3%	75.6%
10	92.28		75.9%

* from 10000 iterations

Co-Efficient of Variation: 10%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-5.6%	70.0%
2	94.39	-3.1%	74.2%
3	91.51	-2.0%	76.5%
4	89.67	-1.5%	78.1%
5	88.33	-1.2%	79.2%
6	87.27	-1.0%	80.2%
7	86.39	-0.8%	81.0%
8	85.69	-0.7%	81.7%
9	85.07	-0.6%	82.3%
10	84.57		82.8%

* from 10000 iterations

Co-Efficient of Variation: 15%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
15%	15%	15%	15%	15%	15%	15%	15%	15%	15%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.98	-8.4%	70.0%
2	91.59	-4.7%	76.4%
3	87.26	-3.2%	80.2%
4	84.50	-2.4%	82.8%
5	82.49	-1.9%	84.9%
6	80.90	-1.6%	86.5%
7	79.58	-1.3%	88.0%
8	78.53	-1.2%	89.1%
9	77.60	-1.0%	90.2%
10	76.85		91.1%

* from 10000 iterations

Co-Efficient of Variation: 20%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.97	-11.2%	70.0%
2	88.79	-6.5%	78.8%
3	83.01	-4.4%	84.3%
4	79.33	-3.4%	88.2%
5	76.66	-2.8%	91.3%
6	74.53	-2.4%	93.9%
7	72.77	-1.9%	96.2%
8	71.37	-1.7%	98.1%
9	70.13	-1.4%	99.8%
10	69.14		101.3%

* from 10000 iterations

Co-Efficient of Variation: 25%

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost 70

	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100	100	100	100	100	100	100	100	100	100
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
25%	25%	25%	25%	25%	25%	25%	25%	25%	25%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.96	-14.0%	70.0%
2	85.99	-8.4%	81.4%
3	78.77	-5.8%	88.9%
4	74.17	-4.5%	94.4%
5	70.82	-3.8%	98.8%
6	68.17	-3.2%	102.7%
7	65.97	-2.7%	106.1%
8	64.22	-2.4%	109.0%
9	62.67	-2.0%	111.7%
10	61.42		114.0%

* from 10000 iterations

Appendix 2.5: Subscription Market

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1			
2			
3	108.38	-5.0%	64.6%
4	102.91	-2.9%	68.0%
5	99.91	-2.0%	70.1%
6	97.90	-1.5%	71.5%
7	96.45	-1.3%	72.6%
8	95.24	-1.0%	73.5%
9	94.29	-0.9%	74.2%
10	93.43		74.9%

* from 10000 iterations

Appendix 2.6: Impact of One Insurer having superior pricing models

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	5%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-4.4%	70.0%
2	95.54	-3.0%	73.3%
3	92.65	-2.1%	75.6%
4	90.67	-1.6%	77.2%
5	89.19	-1.3%	78.5%
6	88.00	-1.1%	79.5%
7	87.03	-0.9%	80.4%
8	86.25	-0.8%	81.2%
9	85.57	-0.6%	81.8%
10	85.03		82.3%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
1	999,925										999,925
2	493,671	461,771									955,441
3	272,152	327,009	327,318								926,479
4	167,921	243,506	249,265	246,022							906,714
5	105,156	192,611	199,519	199,239	195,405						891,931
6	69,802	159,434	163,847	161,743	161,975	163,210					880,011
7	49,107	134,056	138,319	138,301	136,721	137,577	136,202				870,283
8	34,267	116,347	118,254	119,399	119,004	120,088	117,340	117,844			862,543
9	26,628	103,723	104,977	105,103	104,293	105,962	102,427	103,898	98,735		855,747
10	20,378	94,474	93,959	94,303	91,208	94,821	92,299	93,015	86,918	88,890	850,265

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	5,024	4,976								
3	2,808	3,590	3,602							
4	1,751	2,716	2,784	2,749						
5	1,107	2,178	2,253	2,253	2,209					
6	741	1,822	1,870	1,852	1,851	1,864				
7	525	1,546	1,594	1,599	1,578	1,586	1,572			
8	370	1,351	1,375	1,391	1,384	1,395	1,366	1,368		
9	289	1,212	1,229	1,234	1,222	1,239	1,202	1,215	1,158	
10	222	1,109	1,107	1,113	1,077	1,116	1,090	1,095	1,027	1,044

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	99.99									
2	98.26	92.80								
3	96.92	91.09	90.87							
4	95.90	89.66	89.53	89.50						
5	94.99	88.43	88.56	88.43	88.46					
6	94.20	87.50	87.62	87.33	87.51	87.56				
7	93.54	86.71	86.77	86.49	86.64	86.74	86.64			
8	92.61	86.12	86.00	85.84	85.99	86.08	85.90	86.14		
9	92.14	85.58	85.42	85.17	85.35	85.52	85.21	85.51	85.26	
10	91.79	85.19	84.88	84.73	84.69	84.96	84.68	84.95	84.63	85.14

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-1.7%									
2	-1.4%	-1.8%								
3	-1.1%	-1.6%	-1.5%							
4	-0.9%	-1.4%	-1.1%	-1.2%						
5	-0.8%	-1.1%	-1.1%	-1.2%	-1.1%					
6	-0.7%	-0.9%	-1.0%	-1.0%	-1.0%	-0.9%				
7	-1.0%	-0.7%	-0.9%	-0.8%	-0.8%	-0.8%	-0.9%			
8	-0.5%	-0.6%	-0.7%	-0.8%	-0.7%	-0.7%	-0.8%	-0.7%		
9	-0.4%	-0.5%	-0.6%	-0.5%	-0.8%	-0.7%	-0.6%	-0.7%	-0.7%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	70.0%										
2	71.2%	75.4%									75.4%
3	72.2%	76.8%	77.0%								76.9%
4	73.0%	78.1%	78.2%	78.2%							78.2%
5	73.7%	79.2%	79.0%	79.2%	79.1%						79.1%
6	74.3%	80.0%	79.9%	80.2%	80.0%	79.9%					80.0%
7	74.8%	80.7%	80.7%	80.9%	80.8%	80.7%	80.8%				80.8%
8	75.6%	81.3%	81.4%	81.5%	81.4%	81.3%	81.5%	81.3%			81.4%
9	76.0%	81.8%	82.0%	82.2%	82.0%	81.9%	82.1%	81.9%	82.1%		82.0%
10	76.3%	82.2%	82.5%	82.6%	82.7%	82.4%	82.7%	82.4%	82.7%	82.2%	82.5%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	50%	50%									50%
3	28%	36%	36%								36%
4	18%	27%	28%	27%							27%
5	11%	22%	23%	23%	22%						22%
6	7%	18%	19%	19%	19%	19%					19%
7	5%	15%	16%	16%	16%	16%	16%				16%
8	4%	14%	14%	14%	14%	14%	14%	14%			14%
9	3%	12%	12%	12%	12%	12%	12%	12%	12%		12%
10	2%	11%	11%	11%	11%	11%	11%	11%	10%	10%	11%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	52%	48%									48%
3	29%	35%	35%								35%
4	19%	27%	27%	27%							27%
5	12%	22%	22%	22%	22%						22%
6	8%	18%	19%	18%	18%	19%					18%
7	6%	15%	16%	16%	16%	16%	16%				16%
8	4%	13%	14%	14%	14%	14%	14%	14%			14%
9	3%	12%	12%	12%	12%	12%	12%	12%	12%		12%
10	2%	11%	11%	11%	11%	11%	11%	11%	10%	10%	11%

Appendix 2.7: Impact of One Insurer having inferior pricing models

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	20%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.97	-8.8%	70.0%
2	91.17	-3.1%	76.8%
3	88.30	-1.9%	79.3%
4	86.62	-1.3%	80.8%
5	85.46	-1.1%	81.9%
6	84.56	-0.9%	82.8%
7	83.81	-0.7%	83.5%
8	83.21	-0.6%	84.1%
9	82.69	-0.5%	84.6%
10	82.27		85.1%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
1	999,700										999,700
2	435,055	476,601									911,656
3	329,078	279,681	274,229								882,989
4	277,743	193,897	196,096	198,511							866,246
5	247,841	147,444	151,665	156,816	150,813						854,578
6	225,993	122,182	123,913	126,689	123,648	123,130					845,556
7	210,281	102,783	104,036	107,707	104,331	104,376	104,536				838,051
8	197,615	89,928	88,584	92,591	91,496	90,340	90,357	91,224			832,136
9	187,038	80,037	79,680	82,725	80,966	80,646	79,362	80,299	76,186		826,939
10	179,326	73,431	71,091	74,009	70,884	73,329	71,497	72,982	67,376	68,770	822,696

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	5,055	4,945								
3	3,994	3,027	2,979							
4	3,458	2,151	2,181	2,210						
5	3,137	1,669	1,714	1,774	1,706					
6	2,898	1,400	1,418	1,454	1,418	1,412				
7	2,724	1,189	1,204	1,250	1,210	1,209	1,214			
8	2,582	1,048	1,036	1,084	1,070	1,056	1,059	1,065		
9	2,462	939	938	976	954	949	938	945	899	
10	2,375	865	843	878	842	868	851	864	801	813

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	99.97									
2	86.06	96.38								
3	82.39	92.40	92.05							
4	80.32	90.14	89.91	89.82						
5	79.01	88.34	88.49	88.40	88.40					
6	77.98	87.27	87.39	87.13	87.20	87.20				
7	77.20	86.45	86.41	86.17	86.22	86.33	86.11			
8	76.54	85.81	85.51	85.42	85.51	85.55	85.32	85.66		
9	75.97	85.24	84.95	84.76	84.87	84.98	84.61	84.97	84.74	
10	75.51	84.89	84.33	84.29	84.19	84.48	84.02	84.47	84.12	84.59

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-13.9%									
2	-4.3%	-4.1%								
3	-2.5%	-2.4%	-2.3%							
4	-1.6%	-2.0%	-1.6%	-1.6%						
5	-1.3%	-1.2%	-1.2%	-1.4%	-1.4%					
6	-1.0%	-0.9%	-1.1%	-1.1%	-1.1%	-1.0%				
7	-0.9%	-0.7%	-1.0%	-0.9%	-0.8%	-0.9%	-0.9%			
8	-0.7%	-0.7%	-0.7%	-0.8%	-0.7%	-0.7%	-0.8%	-0.8%		
9	-0.6%	-0.4%	-0.7%	-0.6%	-0.8%	-0.6%	-0.7%	-0.6%	-0.7%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	70.0%										
2	81.3%	72.6%									72.6%
3	85.0%	75.8%	76.0%								75.9%
4	87.2%	77.7%	77.9%	77.9%							77.8%
5	88.6%	79.2%	79.1%	79.2%	79.2%						79.2%
6	89.8%	80.2%	80.1%	80.3%	80.3%	80.3%					80.2%
7	90.7%	81.0%	81.0%	81.2%	81.2%	81.1%	81.3%				81.1%
8	91.5%	81.6%	81.9%	82.0%	81.9%	81.8%	82.0%	81.7%			81.8%
9	92.1%	82.1%	82.4%	82.6%	82.5%	82.4%	82.7%	82.4%	82.6%		82.5%
10	92.7%	82.5%	83.0%	83.0%	83.1%	82.9%	83.3%	82.9%	83.2%	82.8%	83.0%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	51%	49%									49%
3	40%	30%	30%								30%
4	35%	22%	22%	22%							22%
5	31%	17%	17%	18%	17%						17%
6	29%	14%	14%	15%	14%	14%					14%
7	27%	12%	12%	13%	12%	12%	12%				12%
8	26%	10%	10%	11%	11%	11%	11%	11%			11%
9	25%	9%	9%	10%	10%	9%	9%	9%	9%		9%
10	24%	9%	8%	9%	8%	9%	9%	9%	8%	8%	8%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	48%	52%									52%
3	37%	32%	31%								31%
4	32%	22%	23%	23%							23%
5	29%	17%	18%	18%	18%						18%
6	27%	14%	15%	15%	15%	15%					15%
7	25%	12%	12%	13%	12%	12%	12%				12%
8	24%	11%	11%	11%	11%	11%	11%	11%			11%
9	23%	10%	10%	10%	10%	10%	10%	10%	9%		10%
10	22%	9%	9%	9%	9%	9%	9%	9%	8%	8%	9%

Appendix 2.8: Bid Shading

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	64%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	110.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	109.98	-11.0%	63.6%
2	97.84	-4.5%	71.5%
3	93.46	-2.6%	74.9%
4	91.00	-1.8%	76.9%
5	89.32	-1.4%	78.4%
6	88.04	-1.2%	79.5%
7	87.03	-0.9%	80.4%
8	86.23	-0.8%	81.2%
9	85.54	-0.6%	81.8%
10	84.99		82.4%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
1	1,099,835										1,099,835
2	250,834	727,546									978,380
3	120,370	408,103	406,125								934,598
4	73,196	275,936	280,805	280,042							909,979
5	50,956	205,349	213,090	213,846	209,959						893,200
6	37,277	166,701	169,360	168,163	169,951	168,961					880,413
7	29,642	137,430	140,711	141,523	140,631	140,718	139,623				870,277
8	25,532	117,926	118,749	120,311	120,551	121,534	118,476	119,221			862,301
9	22,195	104,513	105,362	105,309	105,154	106,239	102,864	104,494	99,303		855,433
10	19,146	94,674	94,146	94,496	91,290	94,606	92,624	93,011	87,002	88,930	849,926

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	2,510	7,490								
3	1,256	4,378	4,366							
4	787	3,035	3,094	3,084						
5	558	2,304	2,387	2,397	2,354					
6	415	1,894	1,924	1,915	1,931	1,921				
7	334	1,579	1,617	1,630	1,617	1,617	1,606			
8	290	1,366	1,379	1,399	1,399	1,409	1,377	1,381		
9	254	1,219	1,232	1,235	1,230	1,241	1,206	1,220	1,163	
10	220	1,110	1,108	1,114	1,077	1,113	1,093	1,094	1,027	1,044

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	109.98									
2	99.93	97.14								
3	95.84	93.22	93.02							
4	93.01	90.92	90.76	90.80						
5	91.32	89.13	89.27	89.21	89.19					
6	89.82	88.02	88.02	87.81	88.01	87.95				
7	88.75	87.04	87.02	86.82	86.97	87.02	86.94			
8	88.04	86.33	86.11	86.00	86.17	86.26	86.04	86.33		
9	87.38	85.74	85.52	85.27	85.49	85.61	85.29	85.65	85.39	
10	87.03	85.29	84.97	84.83	84.76	85.00	84.74	85.02	84.72	85.18

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-9.1%									
2	-4.1%	-4.0%								
3	-3.0%	-2.5%	-2.4%							
4	-1.8%	-2.0%	-1.6%	-1.8%						
5	-1.6%	-1.2%	-1.4%	-1.6%	-1.3%					
6	-1.2%	-1.1%	-1.1%	-1.1%	-1.2%	-1.1%				
7	-0.8%	-0.8%	-1.0%	-1.0%	-0.9%	-0.9%	-1.0%			
8	-0.7%	-0.7%	-0.7%	-0.8%	-0.8%	-0.8%	-0.9%	-0.8%		
9	-0.4%	-0.5%	-0.6%	-0.5%	-0.9%	-0.7%	-0.6%	-0.7%	-0.8%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	63.6%										
2	70.0%	72.1%									72.1%
3	73.0%	75.1%	75.3%								75.2%
4	75.3%	77.0%	77.1%	77.1%							77.1%
5	76.7%	78.5%	78.4%	78.5%	78.5%						78.5%
6	77.9%	79.5%	79.5%	79.7%	79.5%	79.6%					79.6%
7	78.9%	80.4%	80.4%	80.6%	80.5%	80.4%	80.5%				80.5%
8	79.5%	81.1%	81.3%	81.4%	81.2%	81.2%	81.4%	81.1%			81.2%
9	80.1%	81.6%	81.9%	82.1%	81.9%	81.8%	82.1%	81.7%	82.0%		81.9%
10	80.4%	82.1%	82.4%	82.5%	82.6%	82.4%	82.6%	82.3%	82.6%	82.2%	82.4%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	25%	75%									75%
3	13%	44%	44%								44%
4	8%	30%	31%	31%							31%
5	6%	23%	24%	24%	24%						24%
6	4%	19%	19%	19%	19%	19%					19%
7	3%	16%	16%	16%	16%	16%	16%				16%
8	3%	14%	14%	14%	14%	14%	14%	14%			14%
9	3%	12%	12%	12%	12%	12%	12%	12%	12%		12%
10	2%	11%	11%	11%	11%	11%	11%	11%	10%	10%	11%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	26%	74%									74%
3	13%	44%	43%								44%
4	8%	30%	31%	31%							31%
5	6%	23%	24%	24%	24%						24%
6	4%	19%	19%	19%	19%	19%					19%
7	3%	16%	16%	16%	16%	16%	16%				16%
8	3%	14%	14%	14%	14%	14%	14%	14%			14%
9	3%	12%	12%	12%	12%	12%	12%	12%	12%		12%
10	2%	11%	11%	11%	11%	11%	11%	11%	10%	10%	11%

Appendix 2.9: Impact of Brand Value

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-5.2%	70.0%
2	94.75	-3.0%	73.9%
3	91.88	-2.0%	76.2%
4	90.01	-1.5%	77.8%
5	88.64	-1.2%	79.0%
6	87.56	-1.0%	79.9%
7	86.65	-0.8%	80.8%
8	85.93	-0.7%	81.5%
9	85.30	-0.6%	82.1%
10	84.78		82.6%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	999,850									
2	620,238	327,278								
3	453,619	232,964	232,265							
4	358,580	177,674	180,713	183,146						
5	297,548	144,867	146,593	150,864	146,555					
6	253,727	123,503	124,372	126,336	123,823	123,803				
7	221,628	106,877	107,596	109,815	106,749	107,563	106,310			
8	197,254	94,255	93,379	96,474	95,408	94,817	93,684	94,017		
9	178,388	85,056	84,376	87,371	84,837	85,033	82,921	84,259	80,714	
10	163,328	78,299	76,114	78,875	75,447	78,247	75,757	77,729	72,222	71,811

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	6,454	3,546								
3	4,829	2,586	2,585							
4	3,880	2,006	2,044	2,070						
5	3,259	1,658	1,678	1,727	1,678					
6	2,807	1,428	1,437	1,463	1,433	1,432				
7	2,473	1,245	1,254	1,284	1,247	1,254	1,243			
8	2,217	1,105	1,098	1,136	1,122	1,114	1,104	1,104		
9	2,017	1,003	998	1,035	1,005	1,005	985	996	956	
10	1,857	927	906	939	900	929	905	923	861	853

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	99.99									
2	96.10	92.30								
3	93.94	90.09	89.85							
4	92.42	88.57	88.41	88.48						
5	91.30	87.37	87.36	87.36	87.34					
6	90.39	86.49	86.55	86.35	86.41	86.45				
7	89.62	85.84	85.80	85.53	85.60	85.78	85.53			
8	88.97	85.30	85.04	84.92	85.03	85.11	84.86	85.16		
9	88.44	84.80	84.54	84.42	84.41	84.61	84.18	84.60	84.43	
10	87.95	84.46	84.01	84.00	83.83	84.23	83.71	84.21	83.88	84.19

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-3.9%									
2	-2.3%	-2.4%								
3	-1.6%	-1.7%	-1.6%							
4	-1.2%	-1.4%	-1.2%	-1.3%						
5	-1.0%	-1.0%	-0.9%	-1.1%	-1.1%					
6	-0.9%	-0.7%	-0.9%	-1.0%	-0.9%	-0.8%				
7	-0.7%	-0.6%	-0.9%	-0.7%	-0.7%	-0.8%	-0.8%			
8	-0.6%	-0.6%	-0.6%	-0.6%	-0.7%	-0.6%	-0.8%	-0.7%		
9	-0.6%	-0.4%	-0.6%	-0.5%	-0.7%	-0.5%	-0.6%	-0.5%	-0.6%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	70.0%										
2	72.8%	75.8%									75.8%
3	74.5%	77.7%	77.9%								77.8%
4	75.7%	79.0%	79.2%	79.1%							79.1%
5	76.7%	80.1%	80.1%	80.1%	80.1%						80.1%
6	77.4%	80.9%	80.9%	81.1%	81.0%	81.0%					81.0%
7	78.1%	81.5%	81.6%	81.8%	81.8%	81.6%	81.8%				81.7%
8	78.7%	82.1%	82.3%	82.4%	82.3%	82.2%	82.5%	82.2%			82.3%
9	79.1%	82.5%	82.8%	82.9%	82.9%	82.7%	83.2%	82.7%	82.9%		82.8%
10	79.6%	82.9%	83.3%	83.3%	83.5%	83.1%	83.6%	83.1%	83.5%	83.1%	83.3%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	65%	35%									35%
3	48%	26%	26%								26%
4	39%	20%	20%	21%							20%
5	33%	17%	17%	17%	17%						17%
6	28%	14%	14%	15%	14%	14%					14%
7	25%	12%	13%	13%	12%	13%	12%				13%
8	22%	11%	11%	11%	11%	11%	11%	11%			11%
9	20%	10%	10%	10%	10%	10%	10%	10%	10%		10%
10	19%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	65%	35%									35%
3	49%	25%	25%								25%
4	40%	20%	20%	20%							20%
5	34%	16%	17%	17%	17%						17%
6	29%	14%	14%	14%	14%	14%					14%
7	26%	12%	12%	13%	12%	12%	12%				12%
8	23%	11%	11%	11%	11%	11%	11%	11%			11%
9	21%	10%	10%	10%	10%	10%	10%	10%	9%		10%
10	19%	9%	9%	9%	9%	9%	9%	9%	9%	8%	9%

Appendix 2.10: Impact of Poor Reputation

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	-5%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-5.3%	70.0%
2	94.72	-3.1%	73.9%
3	91.78	-2.1%	76.3%
4	89.89	-1.5%	77.9%
5	88.53	-1.2%	79.1%
6	87.43	-1.0%	80.1%
7	86.53	-0.8%	80.9%
8	85.81	-0.7%	81.6%
9	85.18	-0.6%	82.2%
10	84.67		82.7%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
1	999,850										999,850
2	341,847	605,329									947,175
3	190,533	364,396	362,849								917,778
4	128,081	254,172	259,252	257,412							898,916
5	92,894	192,942	200,927	201,993	196,504						885,261
6	72,745	157,795	161,929	161,762	160,282	159,743					874,257
7	59,086	131,572	135,594	136,774	133,827	134,282	134,136				865,272
8	49,143	113,807	114,953	116,832	115,954	117,013	114,875	115,539			858,115
9	42,874	100,855	102,127	102,932	101,683	103,236	100,120	101,463	96,479		851,767
10	38,071	91,603	91,278	92,209	88,569	92,449	90,261	91,218	84,732	86,299	846,690

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	3,684	6,316								
3	2,128	3,940	3,932							
4	1,464	2,811	2,872	2,853						
5	1,081	2,174	2,259	2,274	2,212					
6	858	1,800	1,844	1,847	1,828	1,823				
7	705	1,516	1,561	1,579	1,544	1,548	1,547			
8	593	1,321	1,337	1,361	1,349	1,360	1,338	1,341		
9	521	1,179	1,196	1,209	1,192	1,208	1,176	1,187	1,132	
10	466	1,076	1,076	1,089	1,047	1,089	1,067	1,074	1,002	1,014

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	99.99									
2	92.79	95.84								
3	89.54	92.49	92.28							
4	87.49	90.42	90.27	90.22						
5	85.93	88.75	88.95	88.83	88.84					
6	84.78	87.66	87.81	87.58	87.68	87.63				
7	83.81	86.79	86.86	86.62	86.68	86.75	86.71			
8	82.87	86.15	85.98	85.84	85.96	86.04	85.86	86.16		
9	82.29	85.54	85.39	85.14	85.30	85.46	85.14	85.48	85.23	
10	81.70	85.13	84.83	84.67	84.59	84.89	84.59	84.93	84.56	85.11

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-7.2%									
2	-3.5%	-3.5%								
3	-2.3%	-2.2%	-2.2%							
4	-1.8%	-1.8%	-1.5%	-1.5%						
5	-1.3%	-1.2%	-1.3%	-1.4%	-1.3%					
6	-1.1%	-1.0%	-1.1%	-1.1%	-1.1%	-1.0%				
7	-1.1%	-0.7%	-1.0%	-0.9%	-0.8%	-0.8%	-1.0%			
8	-0.7%	-0.7%	-0.7%	-0.8%	-0.8%	-0.7%	-0.8%	-0.8%		
9	-0.7%	-0.5%	-0.7%	-0.5%	-0.8%	-0.7%	-0.6%	-0.6%	-0.8%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	70.0%										
2	75.4%	73.0%									73.0%
3	78.2%	75.7%	75.9%								75.8%
4	80.0%	77.4%	77.5%	77.6%							77.5%
5	81.5%	78.9%	78.7%	78.8%	78.8%						78.8%
6	82.6%	79.9%	79.7%	79.9%	79.8%	79.9%					79.8%
7	83.5%	80.7%	80.6%	80.8%	80.8%	80.7%	80.7%				80.7%
8	84.5%	81.3%	81.4%	81.5%	81.4%	81.4%	81.5%	81.2%			81.4%
9	85.1%	81.8%	82.0%	82.2%	82.1%	81.9%	82.2%	81.9%	82.1%		82.0%
10	85.7%	82.2%	82.5%	82.7%	82.7%	82.5%	82.7%	82.4%	82.8%	82.2%	82.5%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	37%	63%									63%
3	21%	39%	39%								39%
4	15%	28%	29%	29%							28%
5	11%	22%	23%	23%	22%						22%
6	9%	18%	18%	18%	18%	18%					18%
7	7%	15%	16%	16%	15%	15%	15%				15%
8	6%	13%	13%	14%	13%	14%	13%	13%			13%
9	5%	12%	12%	12%	12%	12%	12%	12%	11%		12%
10	5%	11%	11%	11%	10%	11%	11%	11%	10%	10%	11%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	36%	64%									64%
3	21%	40%	40%								40%
4	14%	28%	29%	29%							29%
5	10%	22%	23%	23%	22%						22%
6	8%	18%	19%	19%	18%	18%					18%
7	7%	15%	16%	16%	15%	16%	16%				16%
8	6%	13%	13%	14%	14%	14%	13%	13%			13%
9	5%	12%	12%	12%	12%	12%	12%	12%	11%		12%
10	4%	11%	11%	11%	10%	11%	11%	11%	10%	10%	11%

Appendix 2.11: Discounting Prices from a Superior Model: Single Insurer

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	73%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	95.89	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...	%age of mean								
5%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	95.88	-2.8%	73.0%
2	93.22	-2.1%	75.1%
3	91.22	-1.6%	76.7%
4	89.72	-1.3%	78.0%
5	88.53	-1.1%	79.1%
6	87.53	-1.0%	80.0%
7	86.68	-0.8%	80.8%
8	85.98	-0.7%	81.4%
9	85.36	-0.6%	82.0%
10	84.86		82.5%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
1	958,832										958,832
2	611,568	320,607									932,174
3	415,890	248,633	247,640								912,163
4	294,872	198,303	201,031	202,969							897,174
5	217,725	165,200	166,385	170,162	165,793						885,266
6	164,165	141,955	141,538	143,904	141,667	142,050					875,280
7	126,601	122,152	123,018	124,979	123,252	123,416	123,361				866,778
8	101,421	107,663	107,085	109,330	108,846	109,272	108,292	107,928			859,836
9	83,654	97,036	96,649	98,353	96,593	97,802	95,462	96,181	91,888		853,616
10	68,817	89,119	86,961	88,958	85,682	89,214	87,131	87,657	81,941	83,081	848,561

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	6,458	3,542								
3	4,435	2,784	2,781							
4	3,172	2,246	2,281	2,301						
5	2,359	1,890	1,905	1,948	1,898					
6	1,790	1,637	1,634	1,663	1,636	1,640				
7	1,389	1,419	1,431	1,457	1,434	1,435	1,435			
8	1,119	1,258	1,255	1,283	1,275	1,279	1,269	1,262		
9	927	1,140	1,139	1,161	1,139	1,151	1,127	1,132	1,084	
10	766	1,051	1,031	1,055	1,017	1,055	1,034	1,037	973	981

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	95.88									
2	94.70	90.52								
3	93.77	89.31	89.05							
4	92.96	88.29	88.13	88.21						
5	92.30	87.41	87.34	87.35	87.35					
6	91.71	86.72	86.62	86.53	86.59	86.62				
7	91.15	86.08	85.97	85.78	85.95	86.00	85.97			
8	90.64	85.58	85.33	85.21	85.37	85.44	85.34	85.52		
9	90.24	85.12	84.85	84.71	84.80	84.97	84.70	84.97	84.77	
10	89.84	84.79	84.35	84.32	84.25	84.56	84.27	84.53	84.21	84.69

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-1.2%									
2	-1.0%	-1.3%								
3	-0.9%	-1.1%	-1.0%							
4	-0.7%	-1.0%	-0.9%	-1.0%						
5	-0.6%	-0.8%	-0.8%	-0.9%	-0.9%					
6	-0.6%	-0.7%	-0.8%	-0.9%	-0.7%	-0.7%				
7	-0.6%	-0.6%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%			
8	-0.4%	-0.5%	-0.6%	-0.6%	-0.7%	-0.5%	-0.7%	-0.6%		
9	-0.4%	-0.4%	-0.6%	-0.5%	-0.7%	-0.5%	-0.5%	-0.5%	-0.7%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	73.0%										
2	73.9%	77.3%									77.3%
3	74.6%	78.4%	78.6%								78.5%
4	75.3%	79.3%	79.4%	79.4%							79.4%
5	75.8%	80.1%	80.1%	80.1%	80.1%						80.1%
6	76.3%	80.7%	80.8%	80.9%	80.8%	80.8%					80.8%
7	76.8%	81.3%	81.4%	81.6%	81.4%	81.4%	81.4%				81.4%
8	77.2%	81.8%	82.0%	82.1%	82.0%	81.9%	82.0%	81.9%			82.0%
9	77.6%	82.2%	82.5%	82.6%	82.5%	82.4%	82.6%	82.4%	82.6%		82.5%
10	77.9%	82.6%	83.0%	83.0%	83.1%	82.8%	83.1%	82.8%	83.1%	82.7%	82.9%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	65%	35%									35%
3	44%	28%	28%								28%
4	32%	22%	23%	23%							23%
5	24%	19%	19%	19%	19%						19%
6	18%	16%	16%	17%	16%	16%					16%
7	14%	14%	14%	15%	14%	14%	14%				14%
8	11%	13%	13%	13%	13%	13%	13%	13%			13%
9	9%	11%	11%	12%	11%	12%	11%	11%	11%		11%
10	8%	11%	10%	11%	10%	11%	10%	10%	10%	10%	10%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
1	100%										
2	66%	34%									34%
3	46%	27%	27%								27%
4	33%	22%	22%	23%							22%
5	25%	19%	19%	19%	19%						19%
6	19%	16%	16%	16%	16%	16%					16%
7	15%	14%	14%	14%	14%	14%	14%				14%
8	12%	13%	12%	13%	13%	13%	13%	13%			13%
9	10%	11%	11%	12%	11%	11%	11%	11%	11%		11%
10	8%	11%	10%	10%	10%	11%	10%	10%	10%	10%	10%

Appendix 2.12: Discounting Prices from a Superior Model: Multiple Insurers

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	73%	73%	73%	70%	70%	70%	70%	70%	70%	70%
Required Premium	95.89	95.89	95.89	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc... %age of mean

5%	5%	5%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	95.88	-2.8%	73.0%
2	93.20	-1.5%	75.1%
3	91.82	-1.5%	76.2%
4	90.44	-1.3%	77.4%
5	89.29	-1.1%	78.4%
6	88.31	-1.0%	79.3%
7	87.44	-0.8%	80.1%
8	86.71	-0.7%	80.7%
9	86.07	-0.6%	81.3%
10	85.53		81.8%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	958,832									
2	470,500	461,528								
3	307,089	306,354	304,740							
4	238,690	236,029	234,481	195,218						
5	188,936	184,779	183,610	169,753	165,865					
6	148,408	148,095	146,245	148,365	146,833	145,131				
7	119,576	117,976	118,280	132,453	129,926	127,919	128,226			
8	99,919	97,696	96,322	116,810	116,666	114,381	113,654	111,697		
9	84,510	82,199	81,199	105,618	104,682	103,267	101,060	101,148	96,968	
10	70,885	71,117	67,428	95,923	93,478	94,399	92,887	92,680	87,028	89,464

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	10,000									
2	5,045	4,955								
3	3,340	3,336	3,324							
4	2,609	2,582	2,570	2,239						
5	2,074	2,031	2,020	1,960	1,915					
6	1,636	1,635	1,617	1,724	1,705	1,683				
7	1,324	1,308	1,313	1,548	1,517	1,492	1,498			
8	1,110	1,087	1,074	1,373	1,369	1,341	1,336	1,310		
9	942	918	908	1,248	1,235	1,216	1,195	1,192	1,146	
10	793	796	757	1,138	1,109	1,116	1,103	1,097	1,034	1,057

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	95.88									
2	93.26	93.14								
3	91.94	91.83	91.68							
4	91.49	91.41	91.24	87.19						
5	91.10	90.98	90.90	86.61	86.61					
6	90.71	90.58	90.44	86.06	86.12	86.23				
7	90.31	90.20	90.08	85.56	85.65	85.74	85.60			
8	90.02	89.88	89.69	85.08	85.22	85.30	85.07	85.26		
9	89.71	89.54	89.43	84.63	84.76	84.92	84.57	84.86	84.61	
10	89.39	89.34	89.07	84.29	84.29	84.59	84.21	84.48	84.17	84.64

Impact on Average Price of Adding One More Competitor

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
1	-2.7%									
2	-1.4%	-1.4%								
3	-0.5%	-0.5%	-0.5%							
4	-0.4%	-0.5%	-0.4%	-0.7%						
5	-0.4%	-0.4%	-0.5%	-0.6%	-0.6%					
6	-0.4%	-0.4%	-0.4%	-0.6%	-0.5%	-0.6%				
7	-0.3%	-0.4%	-0.4%	-0.6%	-0.5%	-0.5%	-0.6%			
8	-0.3%	-0.4%	-0.3%	-0.5%	-0.5%	-0.4%	-0.6%	-0.5%		
9	-0.4%	-0.2%	-0.4%	-0.4%	-0.6%	-0.4%	-0.4%	-0.4%	-0.5%	
10										

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg Insurers 1-3	Avg ex Insurers 1-3
1	73.0%										73.0%	
2	75.1%	75.2%									75.1%	
3	76.1%	76.2%	76.4%								76.2%	
4	76.5%	76.6%	76.7%	80.3%							76.6%	80.3%
5	76.8%	76.9%	77.0%	80.8%	80.8%						76.9%	80.8%
6	77.2%	77.3%	77.4%	81.3%	81.3%	81.2%					77.3%	81.3%
7	77.5%	77.6%	77.7%	81.8%	81.7%	81.6%	81.8%				77.6%	81.7%
8	77.8%	77.9%	78.1%	82.3%	82.1%	82.1%	82.3%	82.1%			77.9%	82.2%
9	78.0%	78.2%	78.3%	82.7%	82.6%	82.4%	82.8%	82.5%	82.7%		78.2%	82.6%
10	78.3%	78.4%	78.6%	83.0%	83.0%	82.8%	83.1%	82.9%	83.2%	82.7%	78.4%	83.0%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg Insurers 1-3	Avg ex Insurers 1-3
1	100%										100.0%	
2	50%	50%									50.0%	
3	33%	33%	33%								33.3%	
4	26%	26%	26%	22%							25.9%	22.4%
5	21%	20%	20%	20%	19%						20.4%	19.4%
6	16%	16%	16%	17%	17%	17%					16.3%	17.0%
7	13%	13%	13%	15%	15%	15%	15%				13.2%	15.1%
8	11%	11%	11%	14%	14%	13%	13%	13%			10.9%	13.5%
9	9%	9%	9%	12%	12%	12%	12%	12%	11%		9.2%	12.1%
10	8%	8%	8%	11%	11%	11%	11%	11%	10%	11%	7.8%	10.9%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg Insurers 1-3	Avg ex Insurers 1-3
1	100%										100.0%	
2	50%	50%									50.0%	
3	33%	33%	33%								33.3%	
4	26%	26%	26%	22%							26.1%	21.6%
5	21%	21%	21%	19%	19%						20.8%	18.8%
6	17%	17%	17%	17%	17%	16%					16.7%	16.6%
7	14%	13%	14%	15%	15%	15%	15%				13.6%	14.8%
8	12%	11%	11%	13%	13%	13%	13%	13%			11.3%	13.2%
9	10%	10%	9%	12%	12%	12%	12%	12%	11%		9.6%	11.9%
10	8%	8%	8%	11%	11%	11%	11%	11%	10%	10%	8.2%	10.8%

Appendix 2.13: Discounting Prices to Maintain Market Share: Single Insurer

Models were built to represent situations where the numbers of competitors increases from any number between 2 and 9 and increase to any number up to 10. Of the 36 models that result, we've included only a selection in this appendix.

INCREASING FROM 2 TO 3 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70		
Feedback Adjustment	100%		
	Insurer 1	Insurer 2	Insurer 3
Target Loss Ratio	74%	70%	70%
Required Premium	94.26	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...		%age of mean
	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
3	89.27	-1.5%	78.4%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Total
3	446,373	222,997	223,370	892,740

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3
3	5,028	2,481	2,491

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3
3	88.78	89.88	89.67

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Avg ex Insurer 1
3	78.8%	77.9%	78.1%	78.0%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Avg ex Insurer 1
3	50%	25%	25%	25%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Avg ex Insurer 1
3	50%	25%	25%	25%

INCREASING FROM 3 TO 4 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70			
Feedback Adjustment	100%			
	Insurer 1	Insurer 2	Insurer 3	Insurer 4
Target Loss Ratio	72%	70%	70%	70%
Required Premium	96.88	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean	
	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
4	88.84	-1.3%	78.8%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Total
4	296,134	195,083	198,309	198,859	888,386

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4
4	3,339	2,192	2,232	2,237

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4
4	88.69	89.00	88.85	88.90

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Avg ex Insurer 1
4	78.9%	78.7%	78.8%	78.7%	78.7%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Avg ex Insurer 1
4	33%	22%	22%	22%	22%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Avg ex Insurer 1
4	33%	22%	22%	22%	22%

INCREASING FROM 4 TO 5 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70				
Feedback Adjustment	100%				
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5
Target Loss Ratio	71%	70%	70%	70%	70%
Required Premium	97.97	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean		
	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
5	87.92	-1.1%	79.6%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Total
5	219,803	161,934	165,163	168,364	163,968	879,231

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5
5	2,498	1,843	1,879	1,915	1,865

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5
5	87.99	87.86	87.90	87.92	87.92

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Avg ex Insurer 1
5	79.6%	79.7%	79.6%	79.6%	79.6%	79.6%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Avg ex Insurer 1
5	25%	18%	19%	19%	19%	19%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Avg ex Insurer 1
5	25%	18%	19%	19%	19%	19%

INCREASING FROM 9 TO 10 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	71%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	99.18	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
10	84.49		82.8%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
10	93,908	85,147	83,540	85,689	82,771	85,906	83,798	84,196	80,176	79,813	844,944

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10	1,108	1,004	990	1,016	982	1,016	995	996	951	942

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10	84.75	84.81	84.38	84.34	84.29	84.55	84.22	84.53	84.31	84.73

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
10	82.6%	82.5%	83.0%	83.0%	83.0%	82.8%	83.1%	82.8%	83.0%	82.6%	82.9%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
10	11%	10%	10%	10%	10%	10%	10%	10%	10%	9%	10%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
10	11%	10%	10%	10%	10%	10%	10%	10%	9%	9%	10%

INCREASING FROM 2 TO 6 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70					
Feedback Adjustment	100%					
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6
Target Loss Ratio	79%	70%	70%	70%	70%	70%
Required Premium	88.24	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean			
	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
6	83.85	-0.6%	83.5%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Total
6	419,221	83,614	85,529	84,568	81,445	84,150	838,526

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6
6	5,064	983	1,005	998	961	989

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6
6	82.78	85.06	85.10	84.74	84.75	85.09

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Avg ex Insurer 1
6	84.6%	82.3%	82.3%	82.6%	82.6%	82.3%	82.4%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Avg ex Insurer 1
6	51%	10%	10%	10%	10%	10%	10%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Avg ex Insurer 1
6	50%	10%	10%	10%	10%	10%	10%

INCREASING FROM 4 TO 8 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70							
Feedback Adjustment	100%							
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8
Target Loss Ratio	75%	70%	70%	70%	70%	70%	70%	70%
Required Premium	93.93	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean					
	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
8	84.72	-0.6%	82.6%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Total
8	211,807	89,949	89,871	92,665	91,527	90,830	89,634	90,877	847,160

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8
8	2,516	1,057	1,058	1,093	1,078	1,070	1,059	1,069

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8
8	84.18	85.10	84.94	84.78	84.90	84.89	84.64	85.01

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Avg ex Insurer 1
8	83.2%	82.3%	82.4%	82.6%	82.4%	82.5%	82.7%	82.3%	82.5%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Avg ex Insurer 1
8	25%	11%	11%	11%	11%	11%	11%	11%	11%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Avg ex Insurer 1
8	25%	11%	11%	11%	11%	11%	11%	11%	11%

INCREASING FROM 2 TO 10 INSURERS

Key Assumptions:

Assume all competitors pricing to same target loss ratio and have similar errors in pricing calculations:
Assume competitive tender with business going to lowest bidder

Mean Expected Claims Cost	70									
Feedback Adjustment	100%									
	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
Target Loss Ratio	82%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Required Premium	85.06	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Impact of Brand Value (e.g. cust accept price above lowest)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Standard Deviation in Pricing due to Data Errors, Pricing Assumptions, etc...			%age of mean							
	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Actual Prices Offered by Competitors modelled by Normal Distribution

Winning Quote Statistics

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
10	80.94		86.5%

* from 10000 iterations

Premium Income by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Total
10	404,671	45,760	46,196	45,951	44,064	45,602	45,413	44,947	44,531	42,228	809,364

Policy Count by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10	5,080	553	560	559	537	554	556	547	541	513

Average "Winning" Quote by Insurer

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10
10	79.66	82.75	82.49	82.20	82.06	82.31	81.68	82.17	82.31	82.32

Forecast Expected Loss Ratio

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
10	87.9%	84.6%	84.9%	85.2%	85.3%	85.0%	85.7%	85.2%	85.0%	85.0%	85.1%

Market Share by Policy

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
10	51%	6%	6%	6%	5%	6%	6%	5%	5%	5%	5%

Market Share by Premium

Number of Competitors	Insurer 1	Insurer 2	Insurer 3	Insurer 4	Insurer 5	Insurer 6	Insurer 7	Insurer 8	Insurer 9	Insurer 10	Avg ex Insurer 1
10	50%	6%	6%	6%	5%	6%	6%	6%	6%	5%	6%

Appendix 3: Broker Survey

The Survey

1. Which classes of business do you work with?

- ☐ Motor
- ☐ Property (incl fire and other damage)
- ☐ Accident & Health
- ☐ Aviation
- ☐ Marine and transport
- ☐ Credit and suretyship
- ☐ Liability
- ☐ Energy
- ☐ Financial and professional lines
- ☐ Other

If other, please specify:

2. Which markets do you deal with?

- ☐ Lloyds & London Market
- ☐ Large commercial
- ☐ SME commercial
- ☐ Personal Lines
- ☐ Specific Underwriting
- ☐ Other

If other, please specify:

3. What is your main area?

- ☐ Direct
- ☐ Reinsurance
- ☐ Retro

4. Are you an international, national or regional broker?

- ○ International
- ○ National
- ○ Regional

5. Were you previously aware of the "winner's curse"?

- ☐ Yes
- ☐ No

6. Are you aware of the winner's curse in your market?

- ☐ Yes
- ☐ No

7. How often does business get placed with the cheapest provider?

- ☐ Every time
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

8. On average, how many companies do you collect quotes from for a given risk?

9. How many times can an insurer improve their quote?

- ☐ 1
- ☐ 2
- ☐ 3 or more

10. Typically the most expensive quote is how much more than the cheapest quote in the first round?

- ☐ More than 3 times as much
- ☐ Between 2 and 3 times as much
- ☐ Between 1.5 and 2 times as much
- ☐ Less than 1.5 times as much

11. Please rank the importance of the following factors when placing business:

Price

Relationships with providers

Coverage

Client preference

Providers' services

Brand strength

Please suggest any other factors you think are important

12. Do you regularly use any of the following strategies to obtain the best possible price?

- ☐ Vertical pricing (splitting the risk into several layers of cover, each with different prices)
- ☐ Multiple stage pricing (insurers can improve their quotes each round)
- ☐ Long-term deals
- ☐ Adding more coverage exclusions
- ☐ Increasing deductibles and excesses
- ☐ Applying limits
- ☐ Other (please specify)

If other, please specify:

13. What arguments are insurers using to increase prices?

- ☐ Best Terms (Insurers will only accept risks on the same terms as the highest quote taken from another provider)
- ☐ Differentiation
- ☐ Brand strength
- ☐ Package deals
- ☐ Long-term deals
- ☐ Changing limits
- ☐ Other (please specify)

If other, please specify:

14. Do the strategies used vary according to the insurance market cycle?

- ☐ Yes
- ☐ No

If yes, how?

15. How often do you rebroke for new cover?

- ☐ Every year
- ☐ 2 to 3 years
- ☐ 3 to 5 years

16. Do you rebroke more often in a soft or in a hard market?

- ☐ Soft
- ☐ Hard
- ☐ No difference

Summary of Results

Awareness of Winners Curse		
	Actual Number	**%**
Aware of Winners Curse	6	18.18%
Not Aware of Winners Curse	27	81.82%
Total	33	100.00%

Awareness of Winners Curse in Insurance Market		
	Actual Number	**%**
Aware of Winners Curse in Insurance Market	11	33.33%
Not Aware of Winners Curse in Insurance Market	22	66.67%
Total	33	100.00%

How often choose cheaper quote		
	Actual Number	**%**
Every time	11	33.33%
Sometimes	20	60.61%
Never	1	3.03%
Have not answered	1	3.03%
Total	33	100.00%

How many companies do you collect quotes from		
	Actual Number	**%**
0<..<=5	21	63.64%
5<...<=10	6	18.18%
10<...<=15	1	3.03%
15<...<=20	1	3.03%
>20	4	12.12%
Total	33	100.00%

How many times can the insurer improve the quote		
	Actual Number	**%**
1	18	54.55%
2	9	27.27%
>=3	4	12.12%
Have not answered	2	6.06%
Total	33	100.00%

Typically the most expensive quote is how much more than the cheapest quote in the first round		
	Actual Number	**%**
Less than 1.5 times as much	8	24.24%
Between 1.5 and 2 times as much	18	54.55%
Between 2 and 3 times as much	3	9.09%
More than 3 times as much	3	9.09%
Have not answered	1	3.03%
Total	33	100.00%

Strategies used	
	Actual Number
Vertical pricing (splitting the risk into several layers of cover, each with different prices)	19
Multiple stage pricing (insurers can improve their quotes each round)	6
Long-term deals	19
Adding more coverage exclusions	9
Increasing deductibles and excesses	24
Applying limits	15
Other (please specify)	2

* More than one strategy used by more than one broker

Arguments used to increase rates	
Best Terms (Insurers will only accept risks on the same terms as the highest quote taken from another provider)	5
Differentiation	14
Brand strength	13
Package deals	4
Long-term deals	6
Changing limits	4
Other (please specify)	8

* More than one arguments used by more than one broker

How often do you rebroke for new cover?		
	Actual Number	**%**
Every year	14	42.42%
2 to 3 years	16	48.48%
3 to 5 years	1	3.03%
Have not answered	2	6.06%
Total	33	100.00%

Do you rebroke more often in a soft or in a hard market?		
	Actual Number	**%**
Hard	9	27.27%
Soft	3	9.09%
No difference	20	60.61%
Have not answered	1	3.03%
Total	33	100.00%

Appendix 4: Pricing: The Impact of Uncertainty

The following pages contain a reproduction of Andrew Smith's and Keith Chandler's 1994 paper entitled "Pricing: The Impact of Uncertainty". They are reproduced by kind permission of Andrew Smith as it is believed the paper is not readily available to the general public. Andrew's latest update on this work is included in the main report under Chapter 7.

Pricing: The Impact of Uncertainty

Competitive Pressure and Winner's Curse

Competitive pressure has an unfortunate effect on insurance pricing. Consider a market with two kinds of risk, as follows:

Risk type	Number of Customers	Cost of Risk
A	800	£300
B	200	£250

The cost of the risk includes an allowance for expenses.

Two insurers then publish rate tables as follows:

	Insurer 1 Premium	Insurer 2 Premium
Risk type A	£295	£330
Risk type B	£295	£280

Insurer 1 has priced n the basis of past experience, but has failed to differentiate between the two risk types. He has added a modest profit loading of £5 per policy, and expecting his rates to be competitive, anticipates cornering 85% of he market.

Meanwhile, insurer 2 has distinguished between the risk types but has added a £30 profit margin to his rates. He knows these rates are uncompetitive, but expects to retain 15% of the market. The insurers' projections are:

	number of customers	profit per customer	total profit
Insurer 1	850	£5	£4250
Insurer 2	150	£30	£4500

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However, at renewal, 50% of customers shop around for the cheapest quote. The actual outcome is then

	number of customers	profit per customer	total profit
Insurer 1	740 type A	£0.15	£125
	85 type B		
Insurer 2	60 type A	£30	£2250
	15 type B		

The net effect is hat both insurers get lower profits than they had hoped. Insurer 1 gets a larger than expected market share, but loses money on type A risks; a phenomenon known as *winner's curse*. Insurer 2 has obtained the desired profit per customer, but failed to take account of the suicidal pricing of Insurer 1 for type A risks, and consequently overestimated is own market share.

Measuring the Price Elasticity of Demand

The profit achieved is the profit per customer multiplied by the number of customers. Pricing is a trade-off between profit per policy and volume. The *price elasticity of demand* is defined as the percentage decrease in volume of a 1% increase in price. Generally, as price increases, the price elasticity of demand also increases.

From an economic perspective, one wishes to increase premiums when

$$\text{Price elasticity of demand} < 1 + \frac{1}{m}$$

where m is the profit margin per policy. This equation says that it is worth increasing the price, since the loss of volume is more than compensated by a gain in profit per policy. As the price increases, the left hand side increases and the right hand side decreases. The cross over point is the optimal price.

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The price elasticity is measured in practical terms by quoting different prices to similar risks, and observing the take-up rate. For example, consider a risk type or which the cost is £10 and the current premium is £110. An insurer decides that for the next 1000 quotes, he will quote £110 to 900 customers and £120 to 100 customers. He finds the following

quote	number of customers	conversions	rate
£110	900	180	20%
£120	100	15	15%

The price elasticity of demand is 2.5, while $1+\frac{1}{m}=11$, so it is worth increasing the premium. Effectively, the choice is between getting £10 per policy at a 20% conversion rate o £20 per policy at a 15% conversion rate. Naturally, one chooses the most profitable option, which is o set premiums at £120.

Of course, the insurer will no stop at 120. He will actually quote £120 nine times out of ten, and £130 the rest of the time.

This type of fine tuning is available for direct writers and broker business provided the broker uses EDI. Some care must be exercised. If a customer is fine tuning the price, you might get a conversation like this:

What if I take a £100 excess?

That brings your premium down to £85

Sorry, what was the premium again without the excess?

That comes to £120

Funny! I'm sure you said £110 a minute ago

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Forecasting Errors and Error Forecasting

The economics of maximising profit is complicated by two aspects of uncertainty.

Uncertainty regarding he true cost of cover
Uncertainty regarding competitor pricing

In order to maximise profitability, a model is required which captures these effects. One such model is appended to these notes. The inputs re s follows:

- Planned profit loading
- Planned profit loading in the market
- Insurer's uncertainty of claims cost
- Market's uncertainty of claims cost
- Customer tolerance of price differentials

The output is the expected conversion rate and the expected profit per policy. The main use of the model is to find the planned profit loading which maximises he expected profit. We observe the following:

- As the planned profit loading increases from zero, the expected profit increases from a negative amount to a positive maximum, and then decreases to zero
- As the profit loading planned by the rest of the market increases, the optimal planned loading and the expected profit both increase
- If the insurer manages to decrease the uncertainty of claims cost, he can potentially widen his profit margins in underpriced niches. However, the optimal behaviour turns out to be to cut margins still further, and achieve a dramtic improvement in conversion rates. The reverse is true if the rest of the market increases its accuracy in estimating claims cost.

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- If customers become more tolerant of price differentials, the insurer has room to increase profit by widening margins

Planned and Achieved Profit Margins

The profit margin achieved is always less than the planned profit margin because of winner's curse. If premiums are priced at a zero privet margin, a loss will be achieved. Our model can be used to determine the planned margin at which break even occurs. The problem if winner's curse is greater if cost estimates are more uncertain, particularly if the market as a whole is pricing accurately. It is important that in business projections, the achieved profitability is modelled, rather than just the planned profitability.

Measuring the Value of Data

The greater the uncertainty in cost estimation, the stronger the effect of winner's curse. Additional data reduces the uncertainty in estimation, and thus improved he achieved profit margin. This enables an insurer to quantify the value of data.

From a management perspective, this is crucial. Obtaining data costs money, either by writing at a loss, or paying staff to punch in manual records. Keeping and analysing the data also costs money. Additional data should only be collected and analysed to the extent that the costs outweigh the benefits. The competitive insurance pricing model allows this calculation to be performed.

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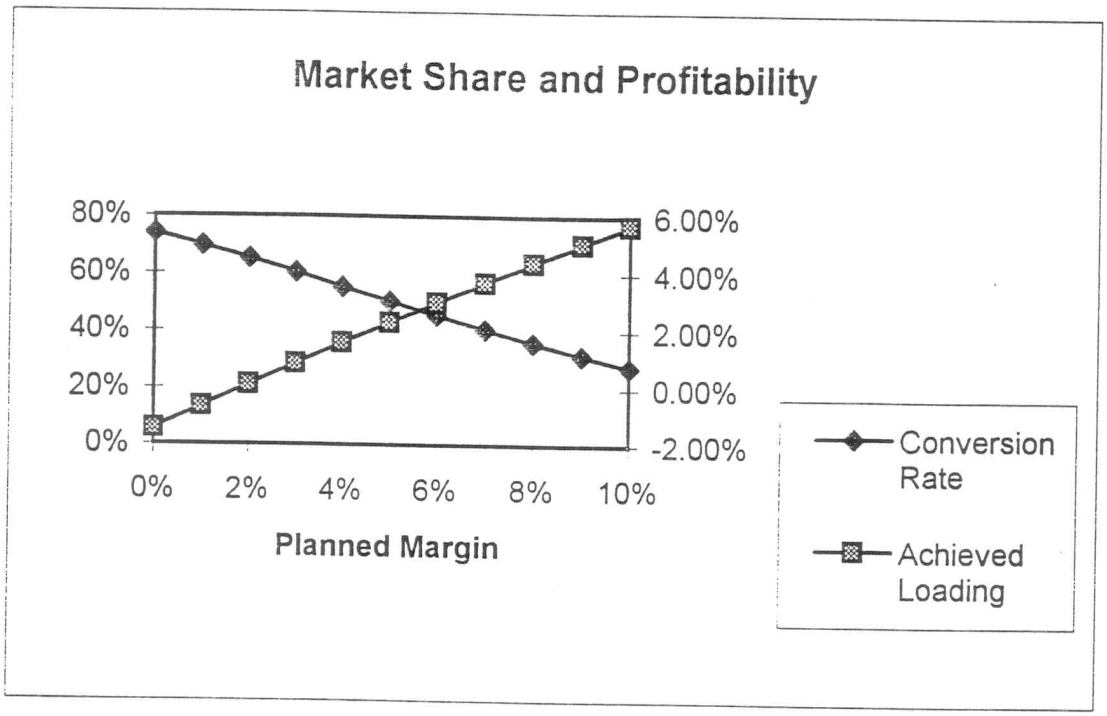

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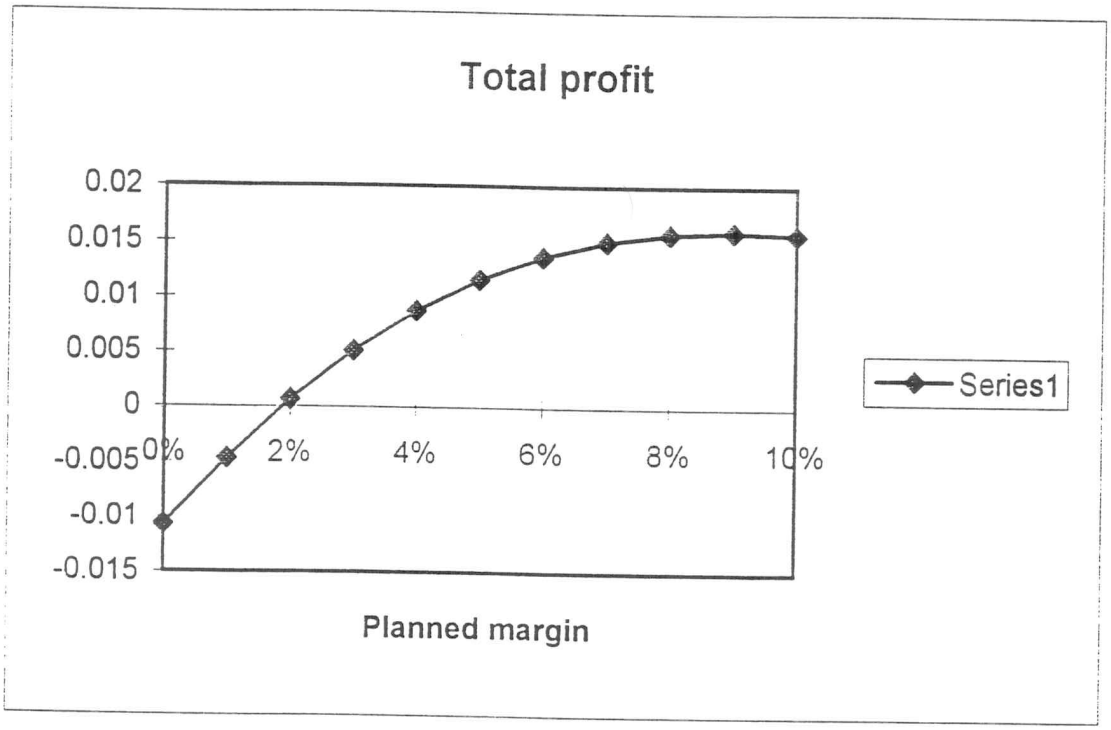

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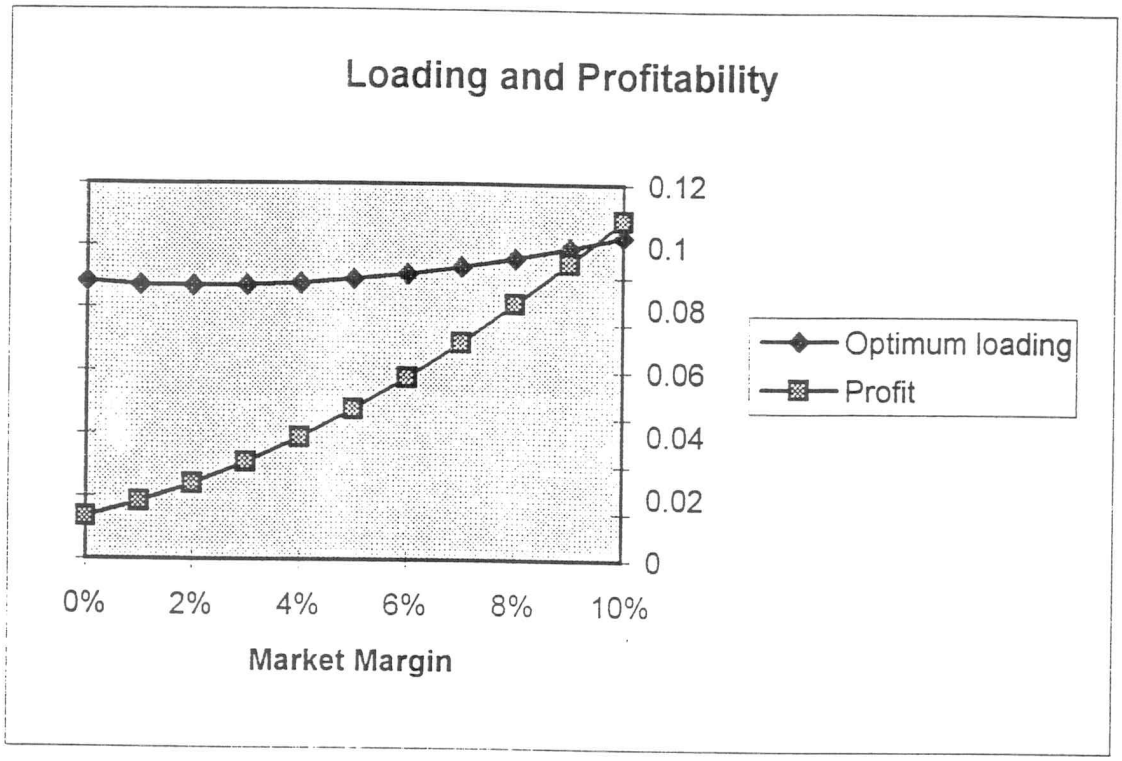

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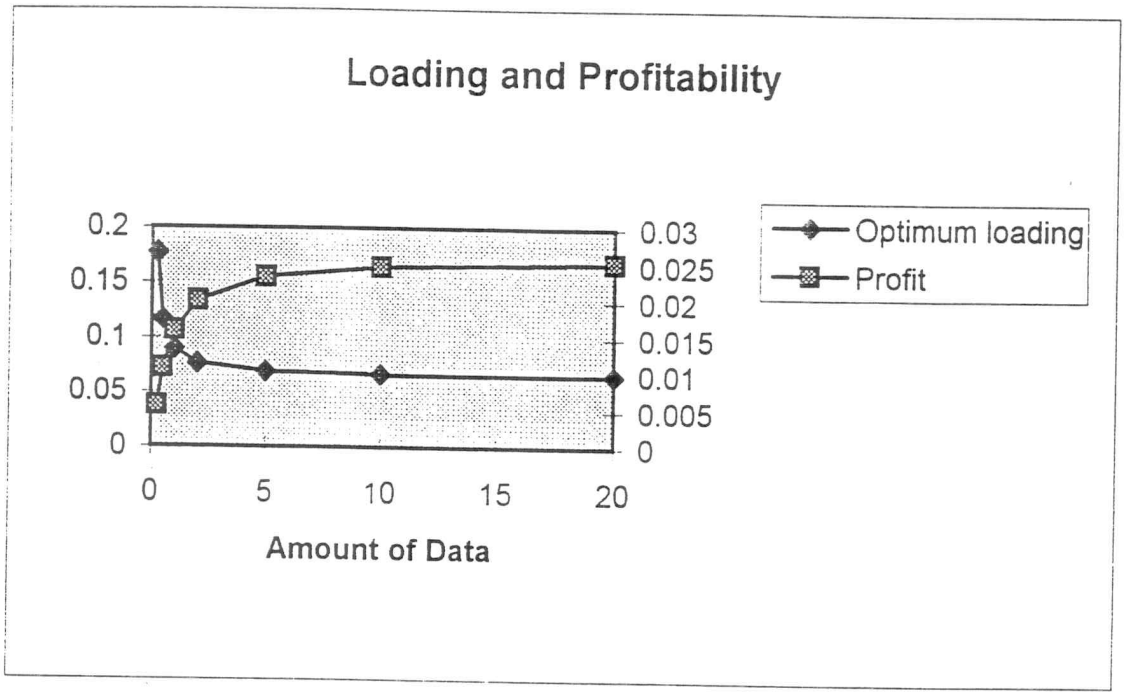

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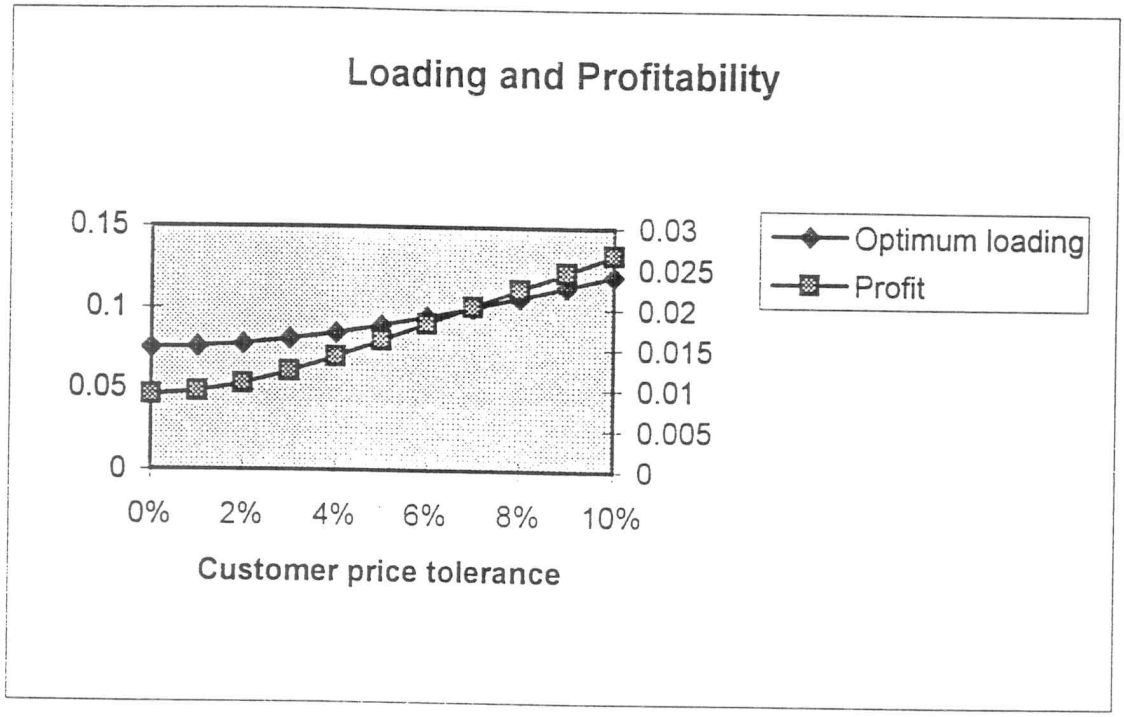

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```
Const TOL = 0.00001

Function bestprofit(sigma1, sigma2, tau, L2) As Variant
'returns best loading, convrsion rate and optimal amount of profit
'First find interval enclosing maximum
L1 = 1
thisprof = outcome(sigma1, sigma2, tau, L1, L2)(2)
Do
    lastprof = thisprof
    L1 = L1 + 0.1
    thisprof = outcome(sigma1, sigma2, tau, L1, L2)(2)
Loop Until thisprof < lastprof
'Now optimise by golden section search
goldensec = (Sqr(5) - 1) / 2
Dim optL(0 To 3)
optL(0) = 1
optL(3) = L1
optL(1) = goldensec * optL(0) + (1 - goldensec) * optL(3)
optL(2) = (1 - goldensec) * optL(0) + goldensec * optL(3)
Dim optprof(1 To 3)
optprof(1) = outcome(sigma1, sigma2, tau, optL(1), L2)(2)
optprof(2) = outcome(sigma1, sigma2, tau, optL(2), L2)(2)
iters = 0
Do
    iters = iters + 1
    If optprof(1) > optprof(2) Then
        'maximum in left hand side
        optL(3) = optL(2)
        optL(2) = optL(1)
        optprof(2) = optprof(1)
        optL(1) = goldensec * optL(0) + (1 - goldensec) * optL(3)
        optprof(1) = outcome(sigma1, sigma2, tau, optL(1), L2)(2)
    Else
        'maximum in right hand side
        optL(0) = optL(1)
        optL(1) = optL(2)
        optprof(1) = optprof(2)
        optL(2) = (1 - goldensec) * optL(0) + goldensec * optL(3)
        optprof(2) = outcome(sigma1, sigma2, tau, optL(2), L2)(2)
    End If
Loop Until optL(3) - optL(0) < TOL Or iters > 100

Dim outvec(1 To 3)
outvec(1) = optL(2) - 1
outvec(2) = outcome(sigma1, sigma2, tau, optL(2), L2)(1)
outvec(3) = optprof(2)
bestprofit = outvec
End Function

Function outcome(sigma1, sigma2, tau, L1, L2) As Variant
'calculates expected profit
d1 = (Log(L2 / L1) - (sigma1 ^ 2 + sigma2 ^ 2) / 2) / Sqr(sigma1 ^ 2 + sigma2 ^ 2
 + tau ^ 2)
d2 = (Log(L2 / L1) + (sigma1 ^ 2 - sigma2 ^ 2) / 2) / Sqr(sigma1 ^ 2 + sigma2 ^ 2
 + tau ^ 2)
Dim temp(1 To 2)
'proportion of conversions
temp(1) = cumnorm(d2)
temp(2) = L1 * cumnorm(d1) - cumnorm(d2)
```

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```
outcome = temp
End Function

Function cumnorm(x)
'Cumulative normal distribution function
'Form Abramowitz and Stegun (1970)
y = 1 / (1 + 0.2316419 * Abs(x))
R = normdens(x) * (0.31938153 * y - 0.356563782 * y ^ 2 + 1.781477937 * y ^ 3 - 1
.821255978 * y ^ 4 + 1.330274429 * y ^ 5)
If x <= 0 Then
    cumnorm = R
Else
    cumnorm = 1 - R
End If
End Function

Function normdens(x)
normdens = Exp(-x ^ 2 / 2) * 0.39894228
End Function
```

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A Two-Player Model of Insurance Pricing

Motivation

This note describes an economic model of two insurance providers competing for a single customer. Each insurer is uncertain of the true cost of the cover, but must quote a price, not knowing the competitor's price. The business usually, but not always, goes to the lowest offeror.

Modelling Uncertainty

We denote by X the expected claims cost, if all the parameters deriving the experience were known perfectly. However, neither insurer has perfect knowledge, and they thus form estimates E_1 and E_2 of X. Since these estimates are formed from disjoint data sets, we assume that they are independent. If the model has been fitted using GLIM with a log link, the error will approximately be normal on a log scale with mean zero. However, we assume that the estimates have been corrected for the bias involved in taking logs, so that so that

$$\log E_1 \sim N\left(\log X - \frac{\sigma_1^2}{2}, \sigma_1^2\right)$$

$$\log E_2 \sim N\left(\log X - \frac{\sigma_2^2}{2}, \sigma_2^2\right)$$

Thus, the estimates are unbiased, and we have

$$\mathrm{E}(E_1) = \mathrm{E}(E_2) = X$$

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Pricing Structure

We assume that both insurers price the business with a proportional profit loading, so that

Insurer 1 premium = L_1E_1
Insurer 2 premium = L_2E_2

where L_1 and L_2 are constants. We refer to these as *planned profit loadings*. We regard insurer 1 as the client and insurer 2 as the competition.

Expected Quoted Premium

The expected value of the premium quoted is readily obtained by linearity, and gives

expected quoted premium = L_1X

Customer Behaviour

We assume that the customer's tendency to go for one insurer or another depends on the relative pricing of the two insurers. However, the customer has a price tolerance τ, and if the price difference is a small multiple of τ, then the decision is not based purely on price. We model the proportion of customers choosing insurer 1 by the formula:

$$\text{conversion rate} = \Phi\left(\frac{\log(\text{price ratio})}{\text{price tolerance}}\right) = \Phi\left(\frac{\log(L_2E_2) - \log(L_1E_1)}{\tau}\right)$$

where Φ is the cumulative normal distribution function. We can see that the more competitive the premium, the higher the conversion rate.

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Probability of Getting the Business

We can calculate the probability of getting the business using the standard laws of conditional probability. Intergrating the conversion rate with respect to the density of E_1 and E_2 we have

$$\text{Prob(purchase from insurer 1)} = \mathrm{E}\Phi\left(\frac{\log(L_2E_2) - \log(L_1E_1)}{\tau}\right)$$

$$= \Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) + \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}}\right)$$

Expected Claims Cost

The ability to attract business is influenced by randomness in premium estimation, not randomness in future claims. Thus, the expected claims cost is simply the expected claims X multiplied by the probability of getting the business. We then have

$$\text{expected claims cost} = X\Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) + \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}}\right)$$

Expected Premium Income

The expected value of the premium income is not simply the product of the expected premium and the probability of getting the business, because of the correlation between these items. In fact, this correlation is always negative, so that the naive calculation always gives an answer which is too high. This effect is sometimes called *winner's curse*: the fact that you are most likely to get business when underpriced. Instead, the correct way to determine the expected premium is by integrating the product of the conversion rate and the premium with respect to the density of E_1 and E_2, which gives:

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$$\text{expected premium income} = \mathbf{E}\left[L_1 E_1 \Phi\left(\frac{\log(L_2 E_2) - \log(L_1 E_1)}{\tau} \right) \right]$$

$$= L_1 X \Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) - \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}} \right)$$

Achieved Profit Loading

The planned profit loading is a factor L_1. However, this profit loading is not achieved because business is more likely to come on the books where it is underpriced. We can calculate the achieved profit loading as the expected premium income divided by the expected claims cost, which gives

$$\text{Achieved profit loading} = \frac{\Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) - \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}} \right)}{\Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) + \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}} \right)} \times L_1$$

We notice that since the numerator is less than the denominator, the achieved profit loading is always less than the planned profit loading, which is again a reflection of winner's curse.

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Profit Payoff

The profit to insurer 1 is

$$\text{profit} = \begin{cases} L_1 E_1 - X & \text{conversion achieved} \\ 0 & \text{conversion not achieved} \end{cases}$$

Expected Profit

The expected profit is the expected premium income minus the expected claims cost, giving the formula:

$$\text{expected profit} = L_1 X\Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) - \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}}\right) - X\Phi\left(\frac{\log\left(\frac{L_2}{L_1}\right) + \frac{\sigma_1^2}{2} - \frac{\sigma_2^2}{2}}{\sqrt{\sigma_1^2 + \sigma_2^2 + \tau^2}}\right)$$

Behaviour for Low Profit Loadings

It the loading L_1 is set very low, then effectively, we are looking at loss-making business. Examining the expected profits for L_1 tending down to zero, we obtain the limiting expression $(L_1 - 1)X$, which indicates that the business is very likely to be written, and to make a loss.

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Behaviour of $\Phi(-z)$ for large z

We wish to consider the expected profit for large loadings L_1. This requires approximations to the cumulative normal distribution function. We can approximate this as

$$\begin{aligned}
\Phi(-z) &= \frac{1}{\sqrt{2\pi}}\int_z^\infty \exp\left(-\frac{t^2}{2}\right)dt \\
&= \frac{-1}{\sqrt{2\pi}}\int_z^\infty \frac{1}{t}d\exp\left(-\frac{t^2}{2}\right) \\
&= \frac{-1}{\sqrt{2\pi}}\left[\frac{1}{t}d\exp\left(-\frac{t^2}{2}\right)\right]_o^\infty - \frac{1}{\sqrt{2\pi}}\int_z^\infty \frac{1}{t^2}\exp\left(-\frac{t^2}{2}\right)dt \\
&= \frac{1}{\sqrt{2\pi}}\exp\left(-\frac{t^2}{2}\right)\left(\frac{1}{t}+O(t^{-3})\right)
\end{aligned}$$

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Achieved Profit Loading for Large Planned Loading

We can now substitute the above expression into the expected profit, to obtain an asymptotic expression for large L_1. To first order, this gives

$$\text{Achieved profit loading} \sim \frac{\exp\left(\dfrac{-\left[\log\left(\dfrac{L_2}{L_1}\right)-\dfrac{\sigma_1^2}{2}-\dfrac{\sigma_2^2}{2}\right]^2}{2(\sigma_1^2+\sigma_2^2+\tau^2)}\right)}{\exp\left(\dfrac{-\left[\log\left(\dfrac{L_2}{L_1}\right)+\dfrac{\sigma_1^2}{2}-\dfrac{\sigma_2^2}{2}\right]^2}{2(\sigma_1^2+\sigma_2^2+\tau^2)}\right)} \times L_1$$

$$\sim \exp\left(\frac{\left[\log\left(\dfrac{L_2}{L_1}\right)+\dfrac{\sigma_1^2}{2}-\dfrac{\sigma_2^2}{2}\right]^2-\left[\log\left(\dfrac{L_2}{L_1}\right)-\dfrac{\sigma_1^2}{2}-\dfrac{\sigma_2^2}{2}\right]^2}{2(\sigma_1^2+\sigma_2^2+\tau^2)}\right) L_1$$

$$\sim \exp\left(\frac{\sigma_1^2\left[2\log\left(\dfrac{L_2}{L_1}\right)-\sigma_2^2\right]}{2(\sigma_1^2+\sigma_2^2+\tau^2)}\right) L_1$$

Where is this?

Collecting together like terms, we have

$$\text{achieved profit loading} \sim \exp\left(\frac{-\sigma_1^2\sigma_2^2}{2(\sigma_1^2+\sigma_2^2+\tau^2)}\right) L_1^{\frac{\sigma_2^2+\tau^2}{\sigma_1^2+\sigma_2^2+\tau^2}} L_2^{\frac{\sigma_1^2}{\sigma_1^2+\sigma_2^2+\tau^2}}$$

Thus, asymptotically, the achieved profit loading behaves like a power (between 0 and 1) of the planned profit loading. The greater the precision of E_1 (that is, the lower the value of σ_1) the higher this power becomes.

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Profit Objective

If the business objective were to maximise the achieved profit loading, then the planned profit loading should be set very high. This gives rise to a large proportional profit on a very small quantity of business.

It is far better to set the premium to maximise the expected profit. We know that for small planned loadings, the expected profit is negative, while for large planned loadings the expected profit tends down to zero from above. Thus, at some finite point in-between, the expected profit attains a maximum. The business objective is to price at this optimum.

The Value of Data

We can use this model to derive the value of data. Keeping and analysing data serves to reduce the uncertainty in cost estimation. Better information reduces the impact of winners curse. The extent of information is captured by the forecast standard error σ_1. We can plot the optimised profit as a decreasing function of σ_1 . Obtaining additional data will decrease σ_1 and thus increases expected profit in a way which can be quantified. We notice that in general, σ_1 behaves like a multiple of $\frac{1}{\sqrt{N}}$, where N is the quantity of data.

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