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Optimized pricing
C23

CAS 2007 Annual Meeting

Claudine Modlin, FCAS, MAAA
November 13, 2007

Watson Wyatt Worldwide

Agenda

- What is price optimization?
- Spectrum of implementation techniques

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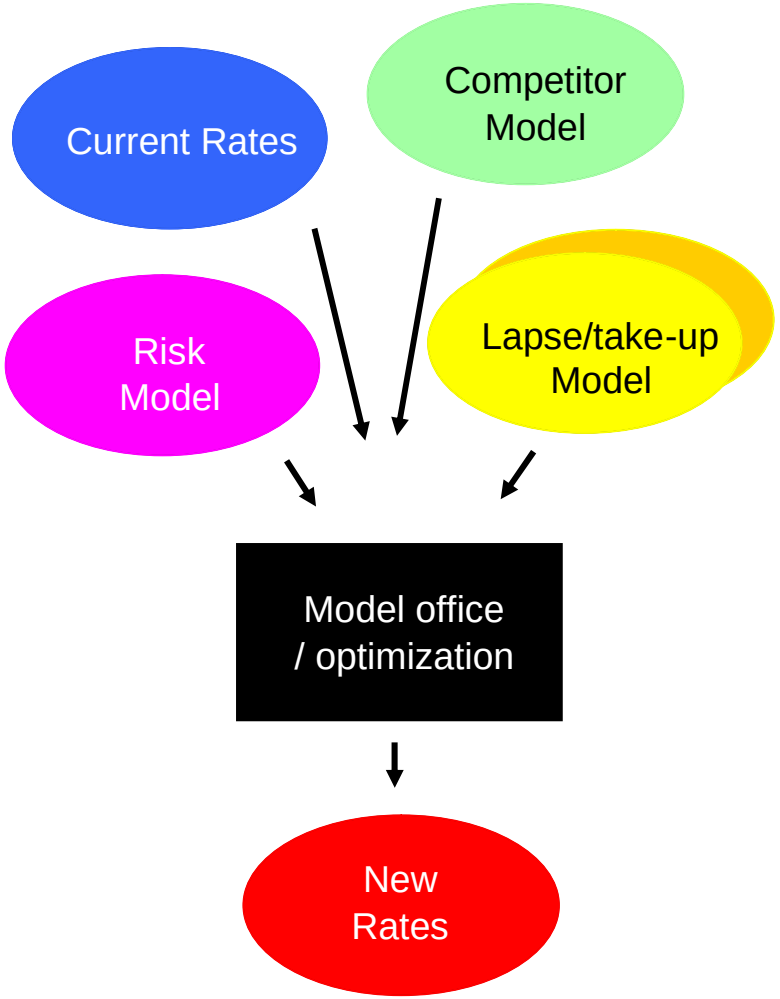
What is price optimization?

- Spectrum of techniques that combine information on loss costs, expenses and customer behavior to produce a premium tailored to meet a particular business target



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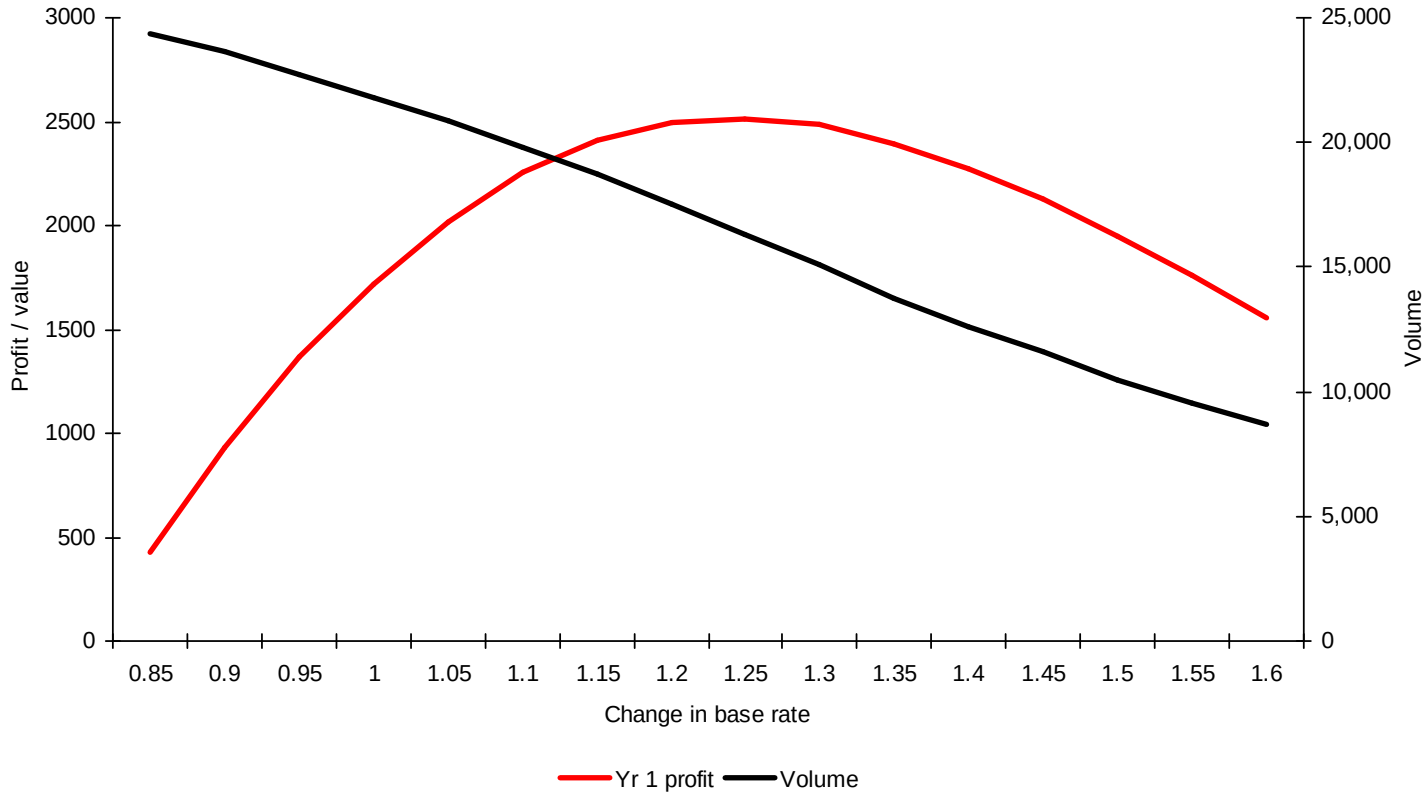
Traditional view of profit

- Profit is typically a flat loading of premium
- You only make profit on policies you actually sell!



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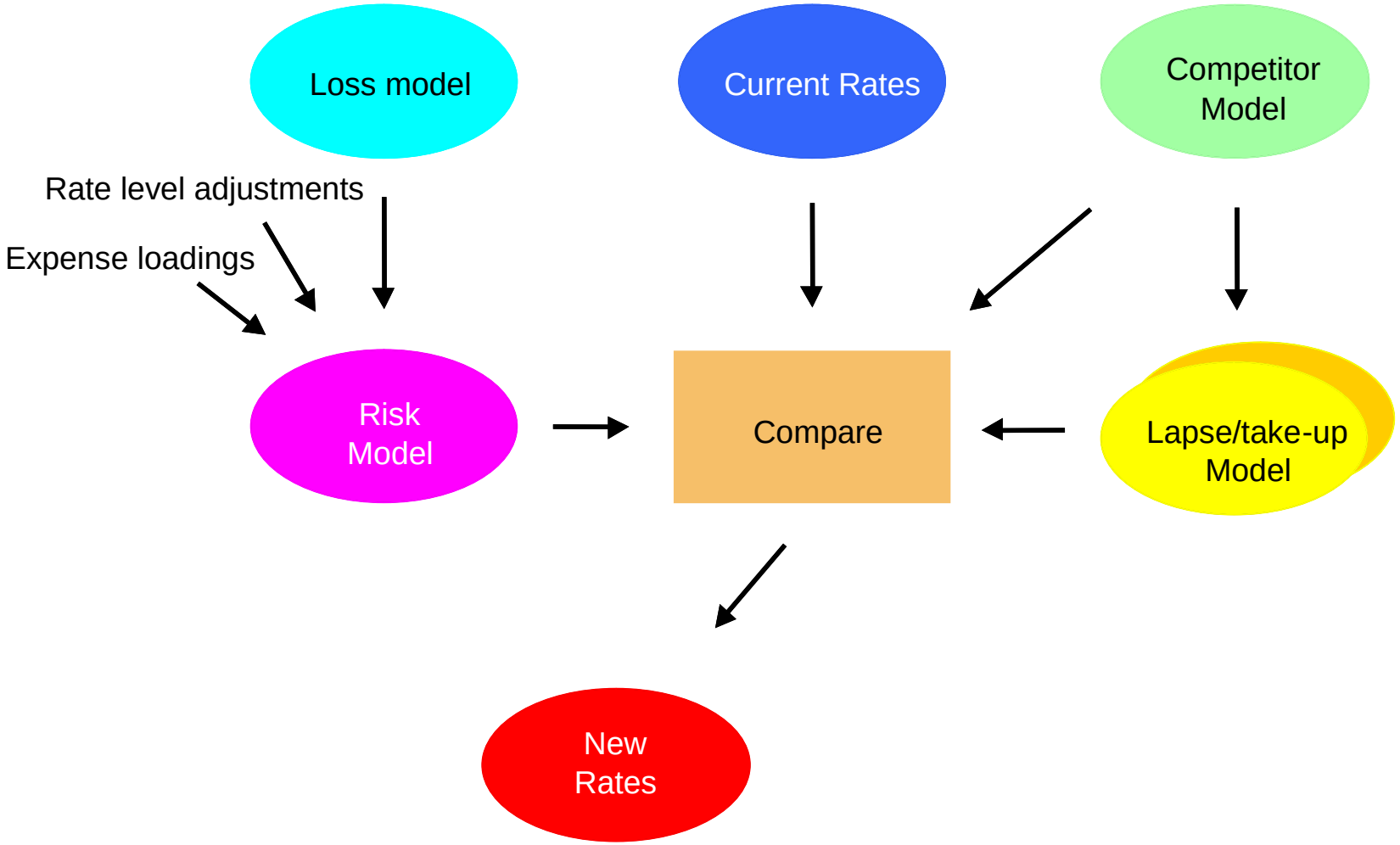
The pricing process



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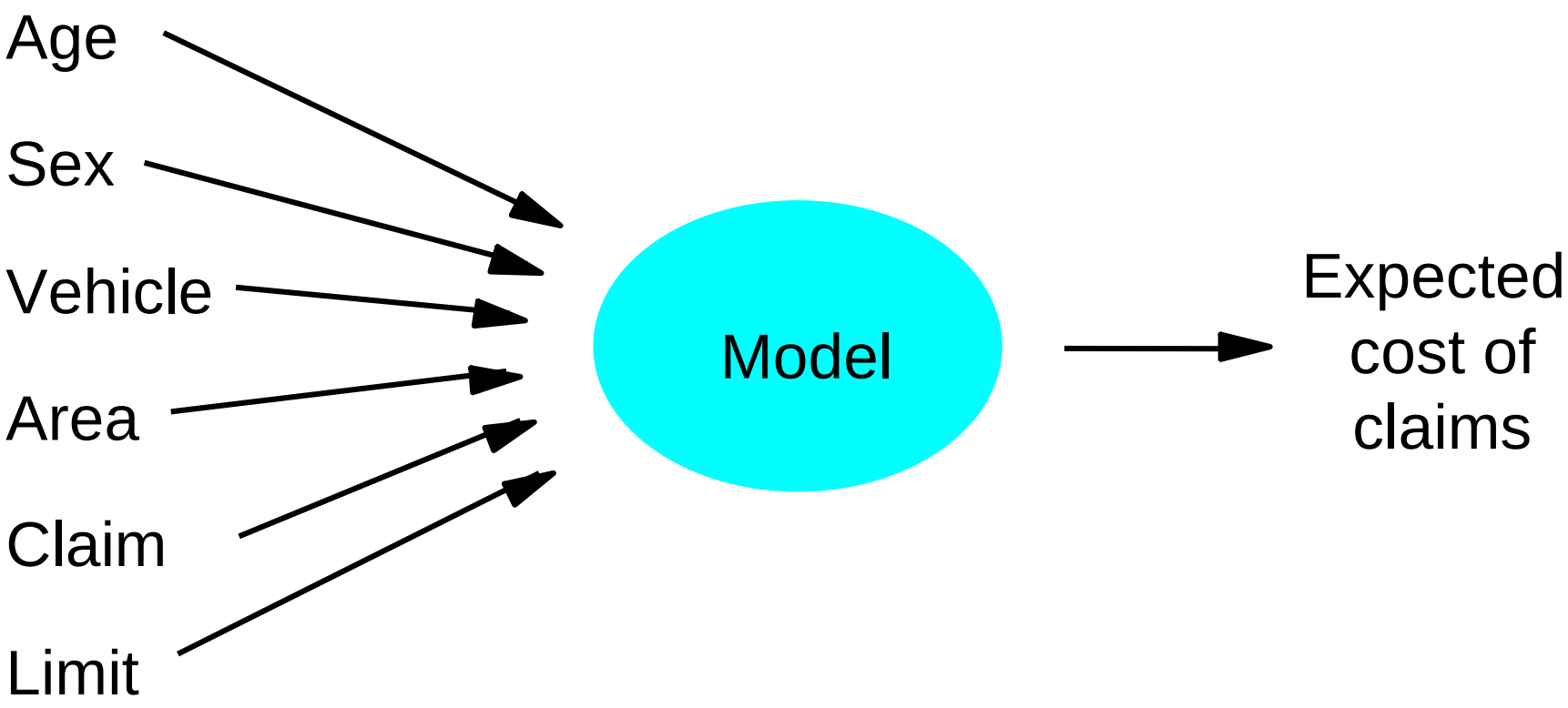
Modeling the cost of claims

Claims model



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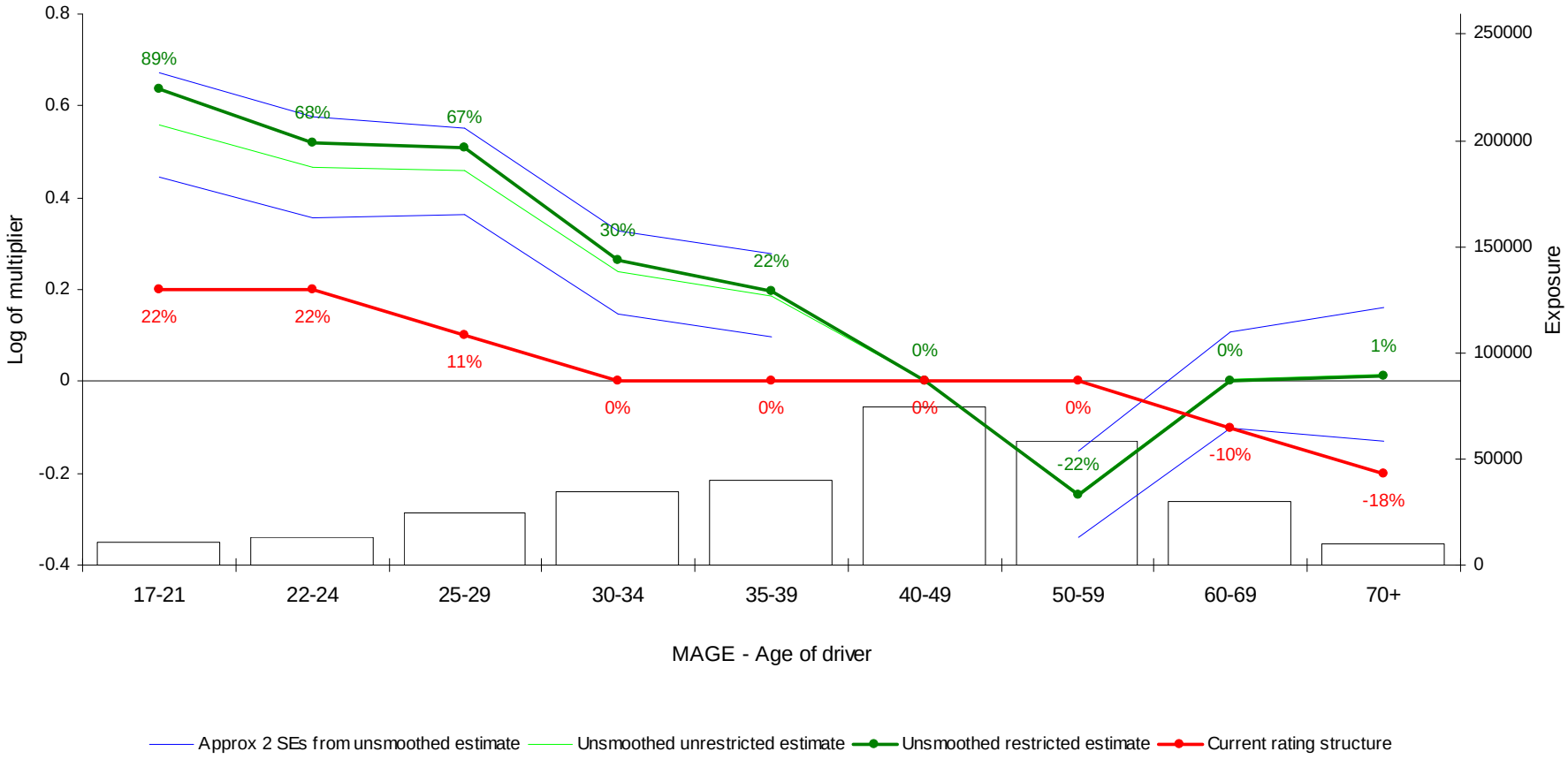
Factor effect analysis

Compare

Demonstration job

Run 10 Model 2 - Third party material, standard risk premium run - Unsmoothed standard risk premium model



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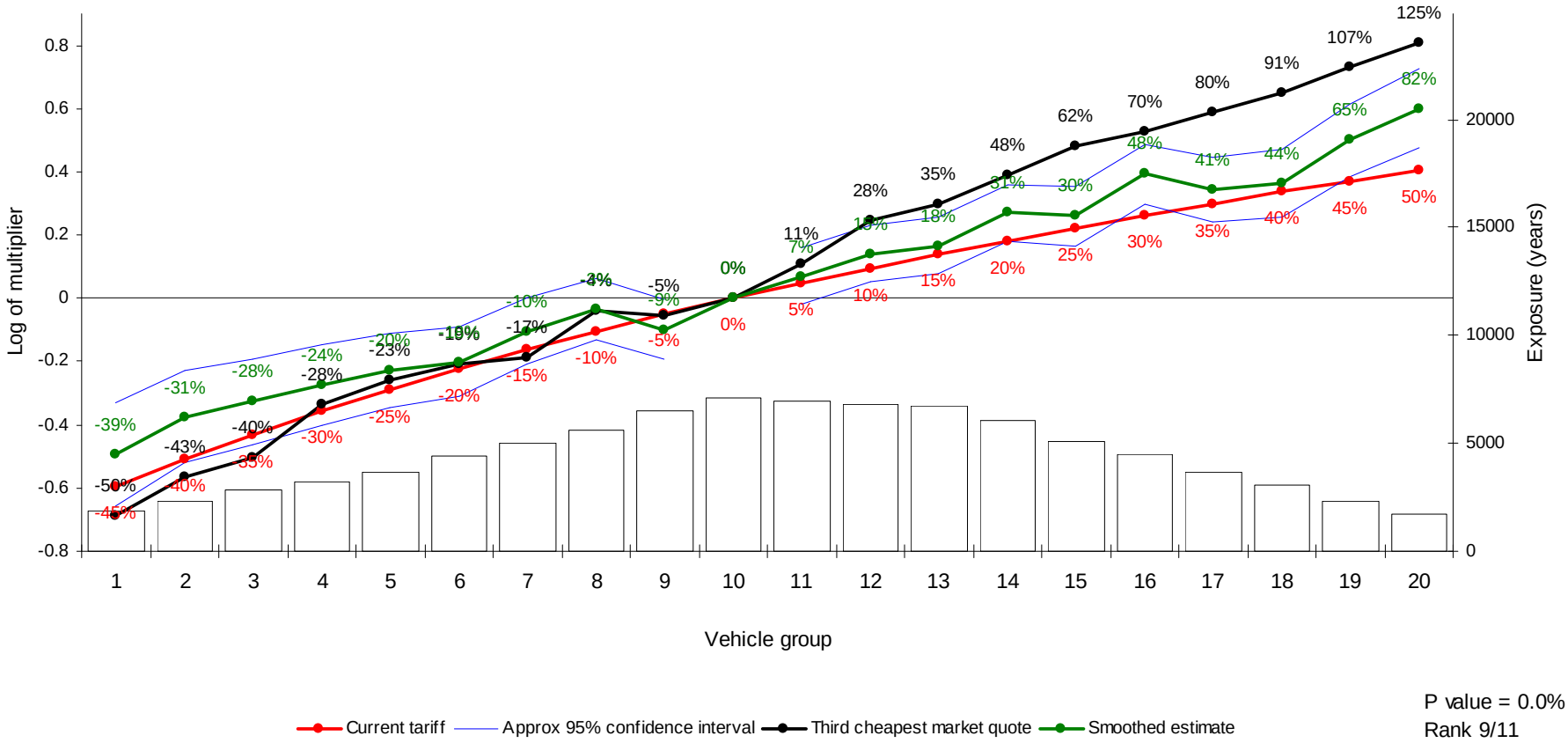
Modeling market rates

Competitor Model

Example of competitor analysis

Third party cover



P value = 0.0%
Rank 9/11

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Expenses

- Analysis behind expense loadings often rather cruder than that behind claims
- Could be based on simple expense analysis or can be modeled in a range of ways
  - simple % loading
  - mix of %, per policy, per claim loads
  - multivariate loadings via GLM

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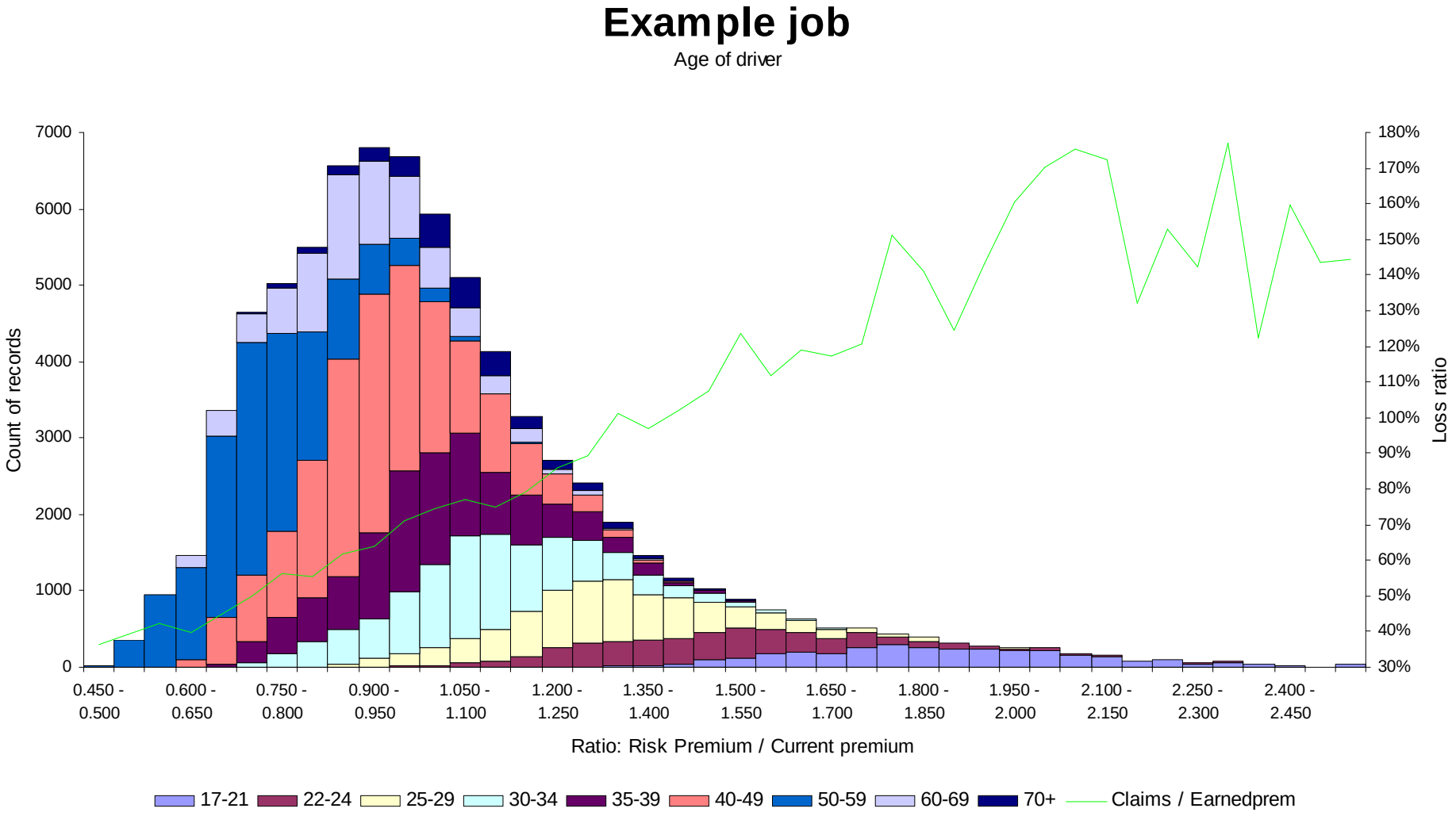
Impact analysis

Compare



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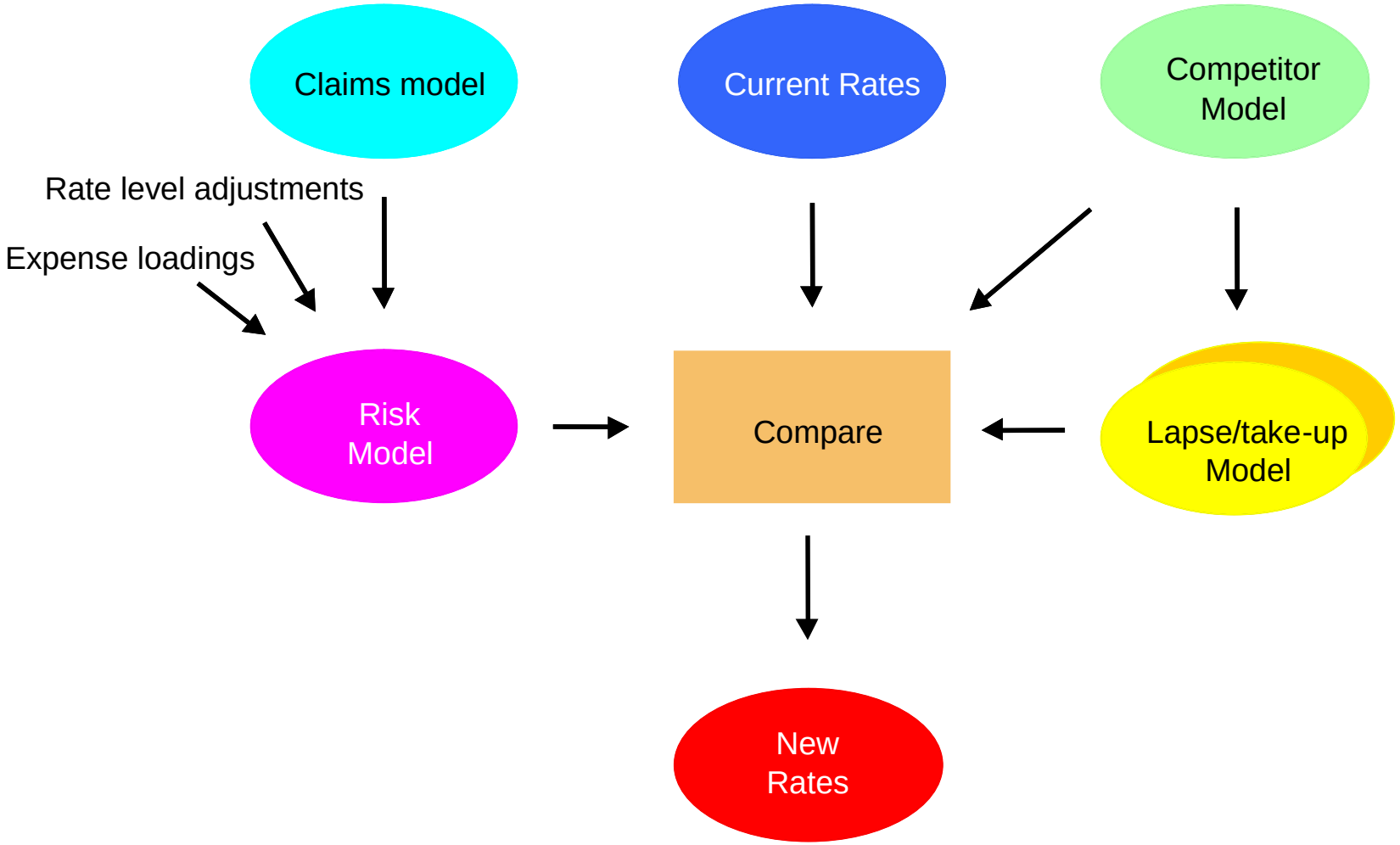
The ratemaking process



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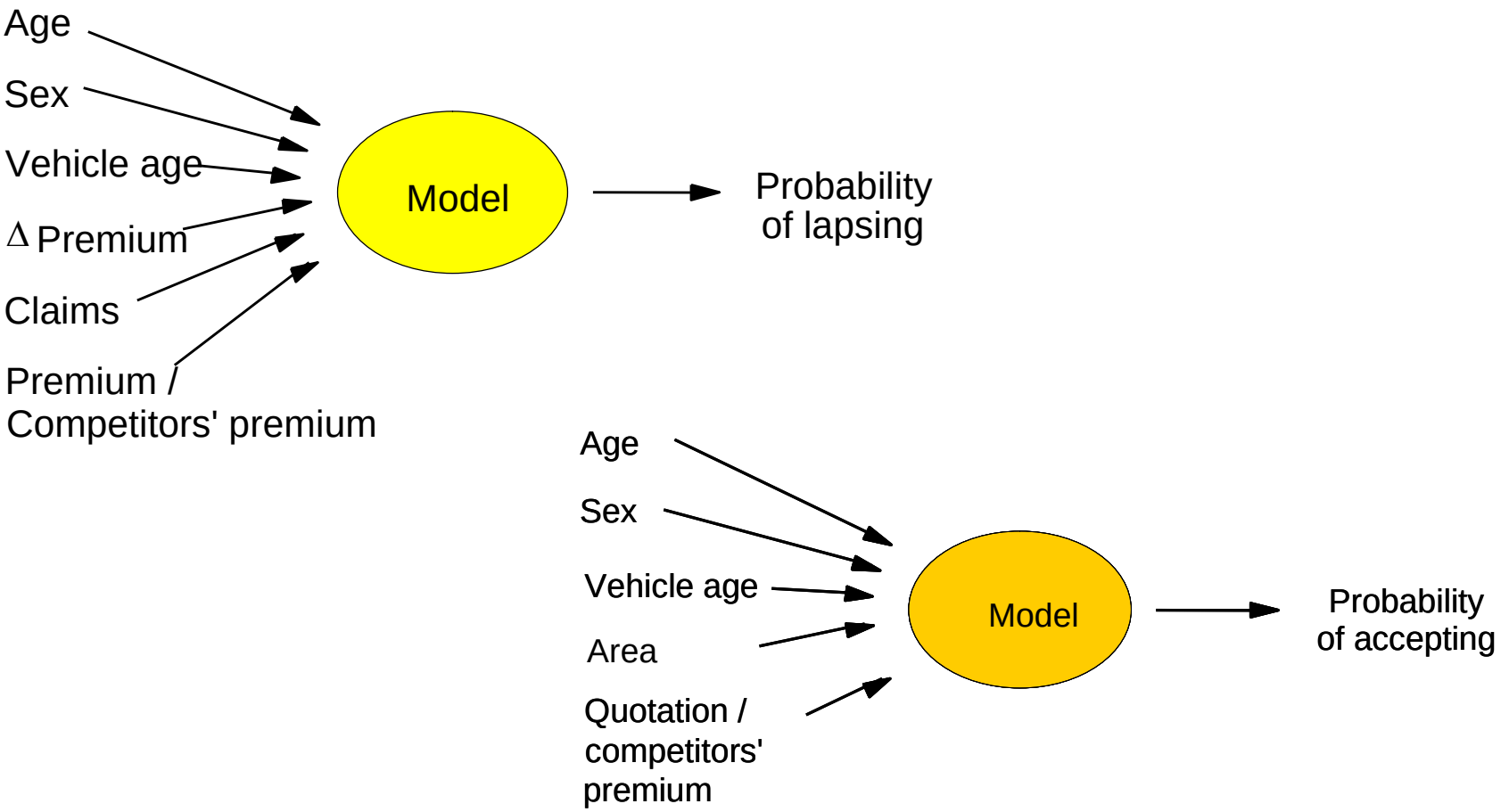
Modeling retention / new business

Lapse model

New business model



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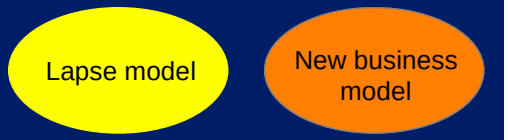
Retention modeling - measurable factors



- Who are your customers?
  - age of policyholder
  - claims history
  - product features
  - other rating factors
  - endorsement activity
  - lifestyle factors
- How do you connect?
  - tenure
  - distribution channel
  - payment method
  - affinity membership
  - other products held
- What have you done to them?
  - proposed rate change
  - last year's rate change
  - cumulative rate changes
  - communications
  - claims service
- What have others done to them?
  - competitors' premium
  - competitors' marketing
  - product differentiation

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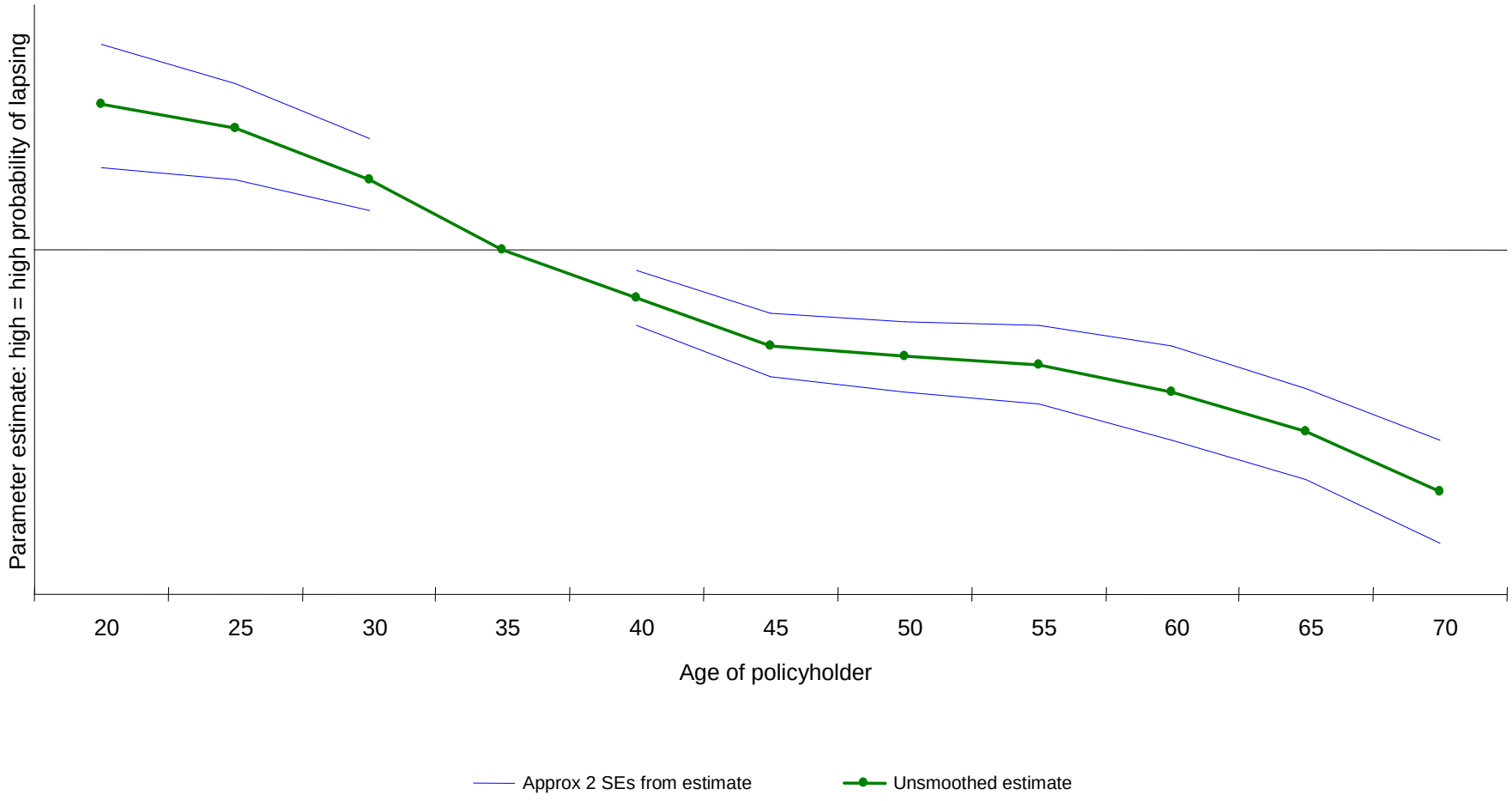
Example - effect of policyholder age on lapses

Lapse model

New business model



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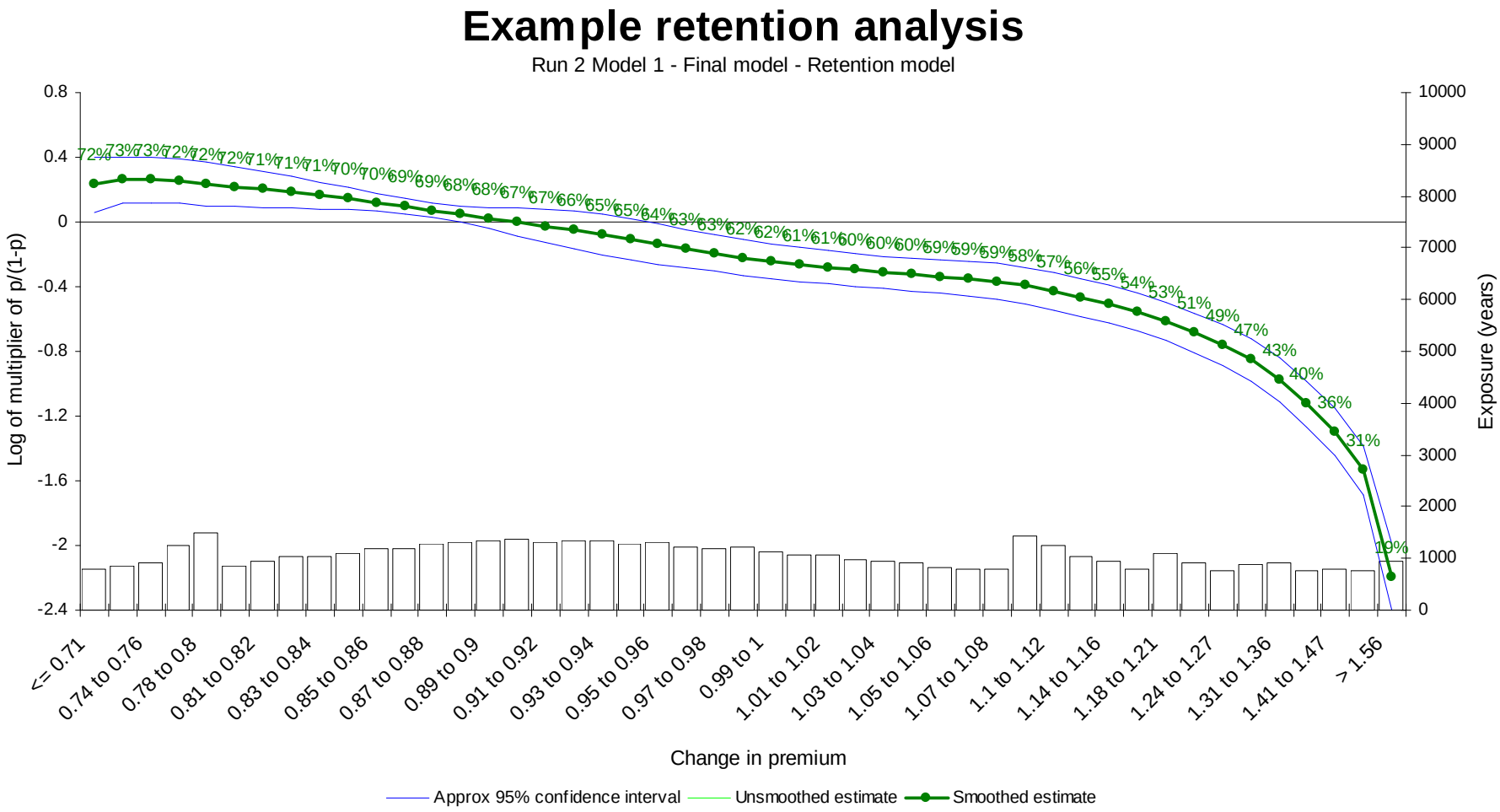
Example retention elasticity curve

Lapse model

New business model



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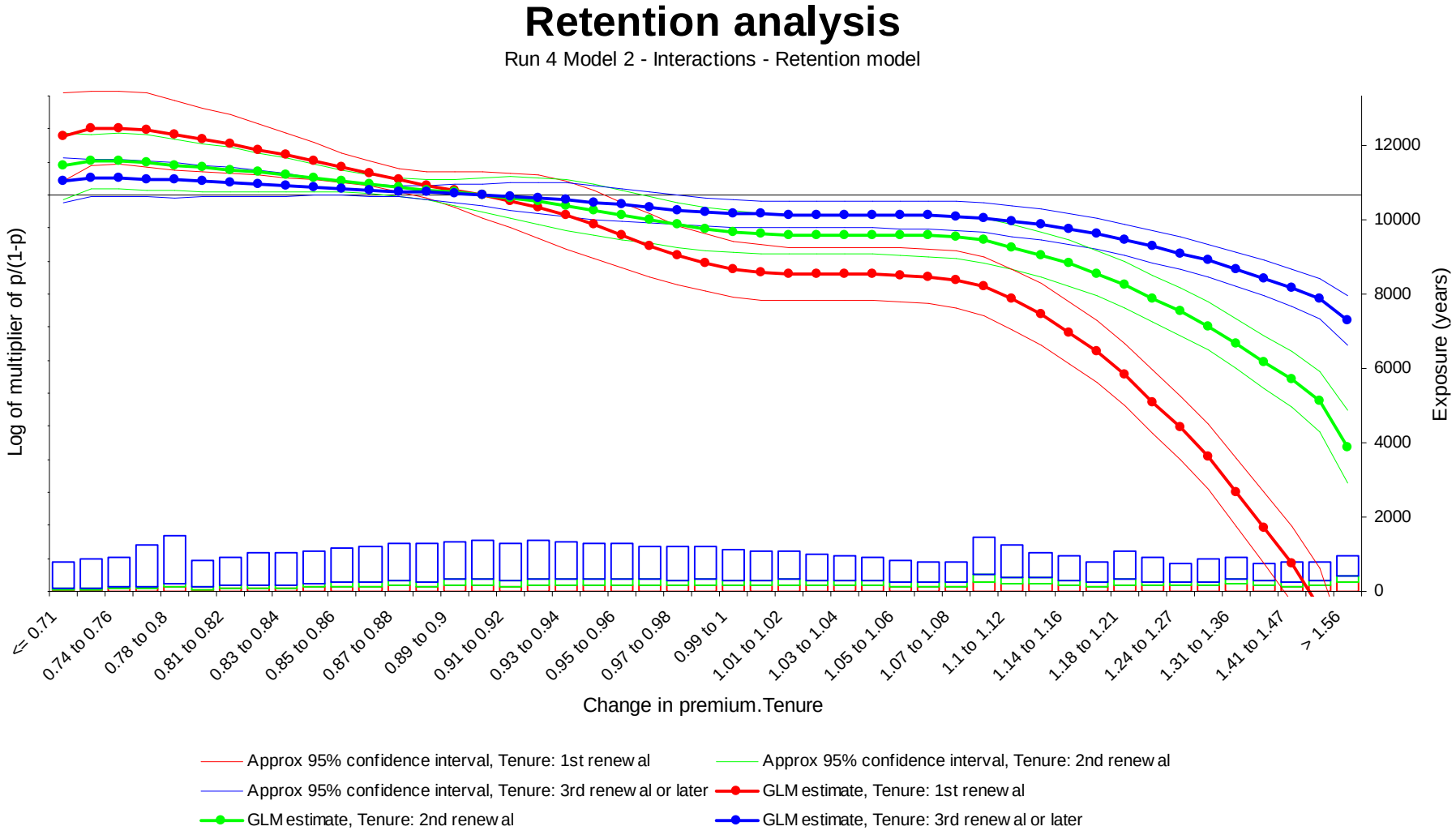
Example retention elasticity curve

Lapse model

New business model



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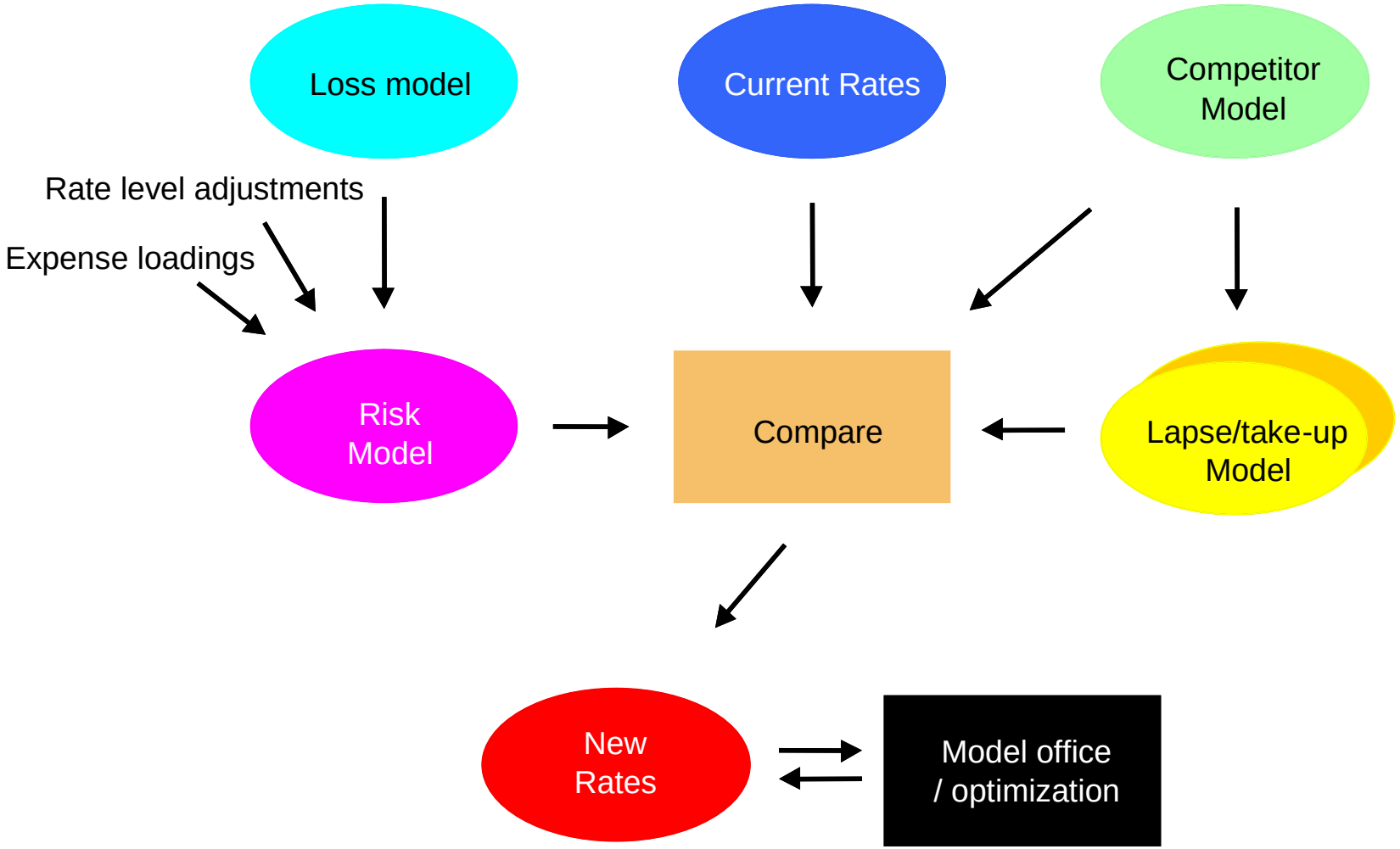
The pricing process



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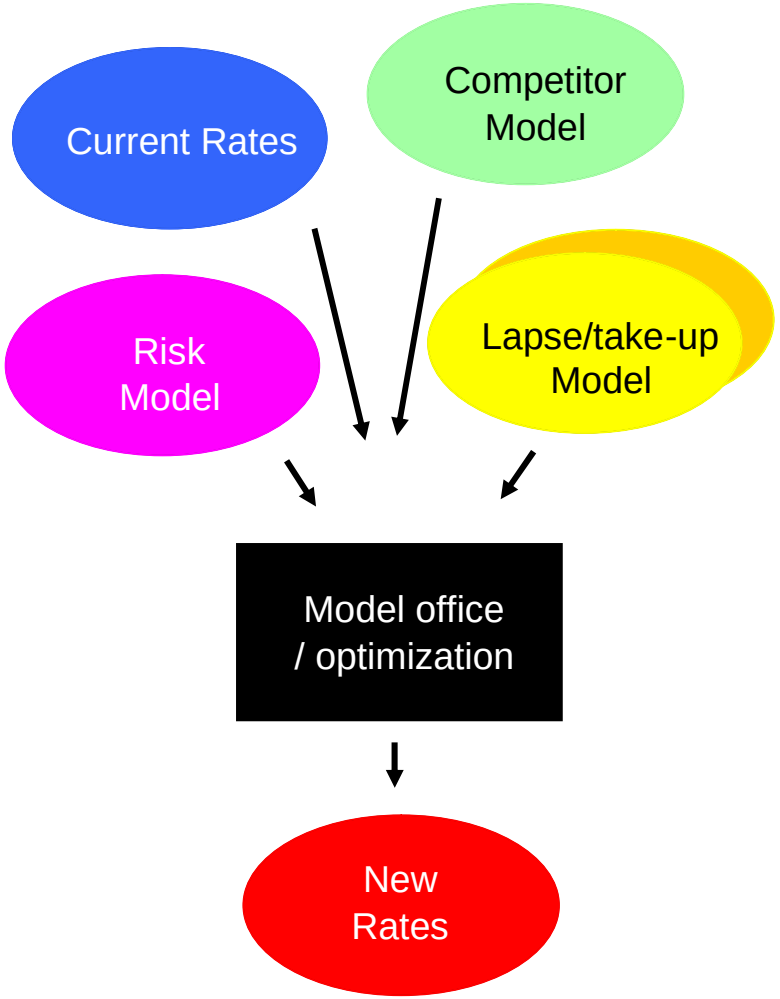
What is price optimization?

- Range of techniques that combine information on loss costs, expenses and customer behavior to produce a premium tailored to meet a particular business target



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Value or profit?

- One year profit is not necessarily the right measure of customer value
- Renewing customers:
  - have lower expenses
  - may be more tolerant of higher premiums
  - represent a cross selling opportunity
- Can take a wider view

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Price optimization

- Replace flat profit load with variable profit load
- Variable load reflects:
  - retention behavior
  - likelihood of cross selling
  - global volume targets
  - etc.
- Results depend on business targets as much as on the data

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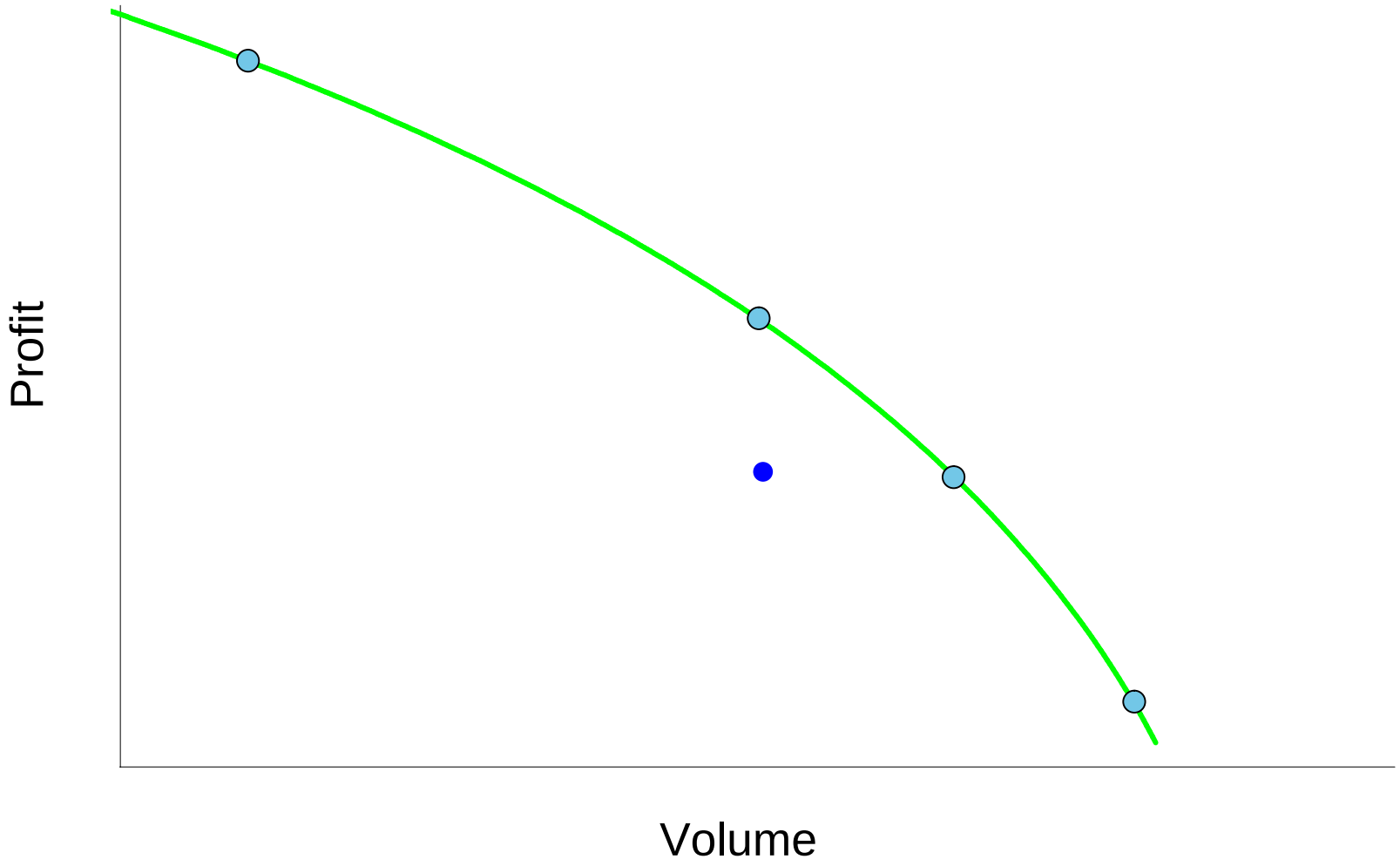
Alternate targets



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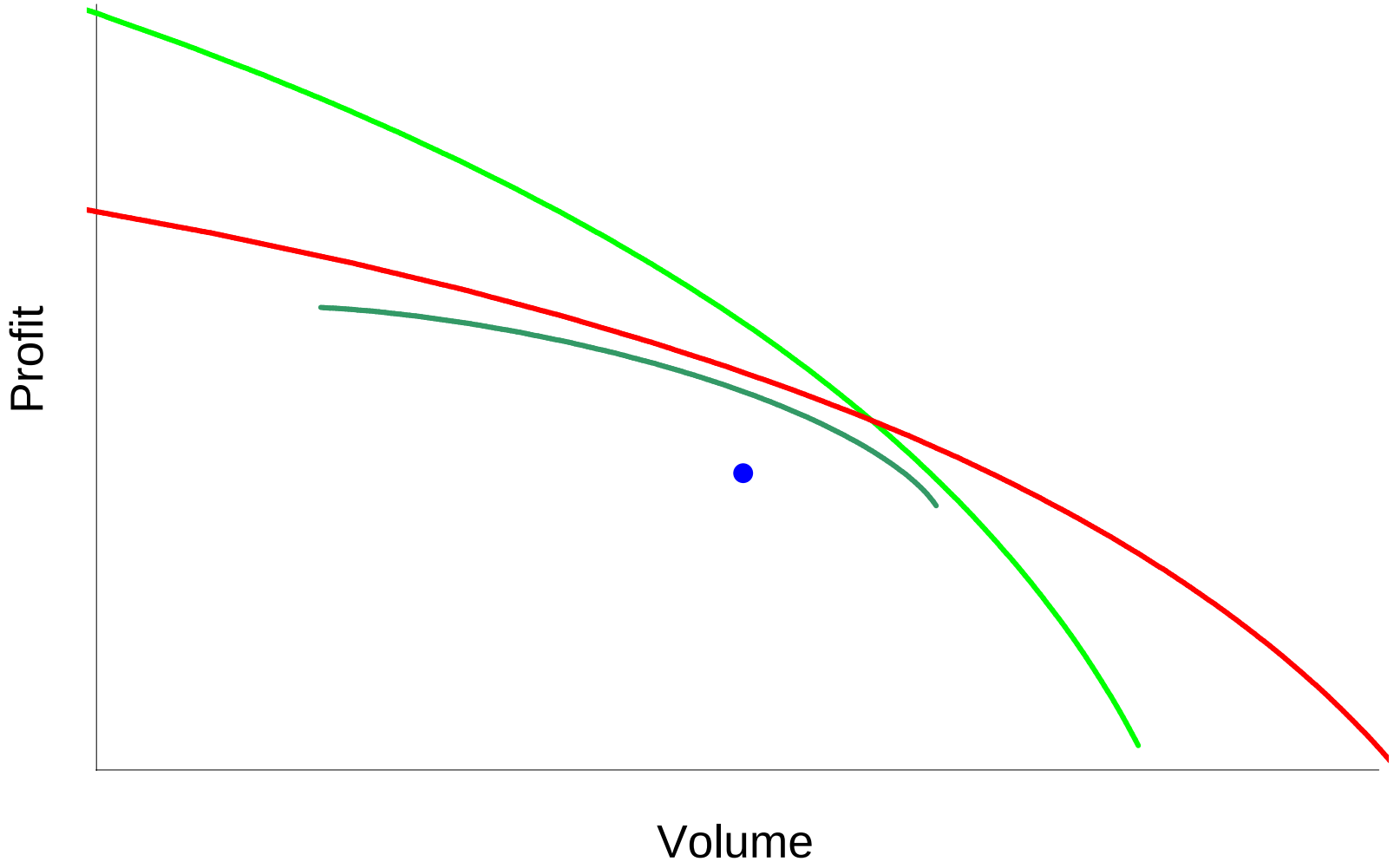
Alternate assumptions



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Price optimization model

- Construct a "model office" taking all known effects into consideration
- Decide on:
  - global targets (e.g. minimum volume)
  - per policy constraints (e.g. minimum per policy profit)
- Perform optimization to determine key parameters

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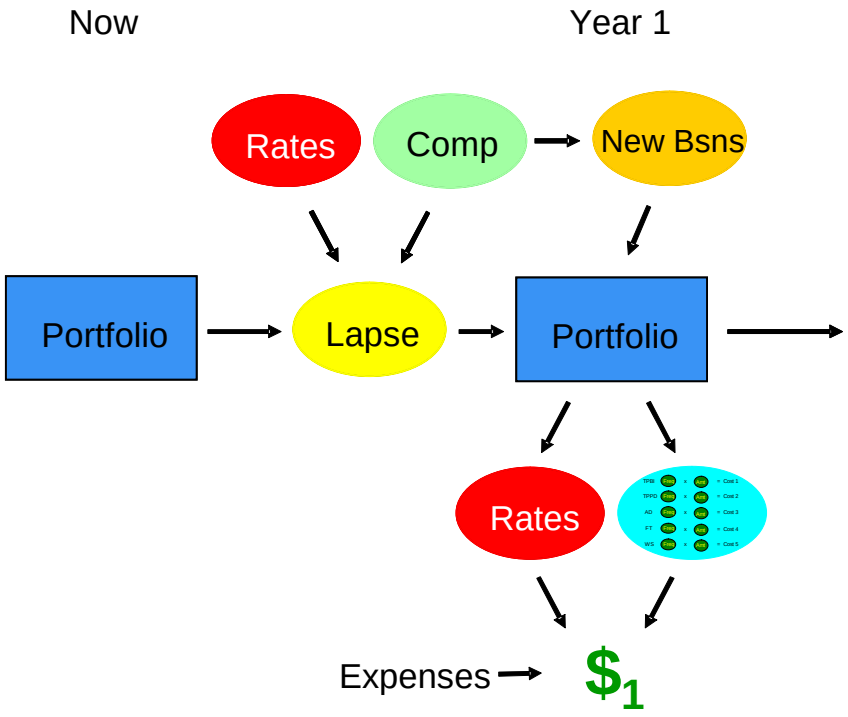
Practical application



+ $X per policy in force

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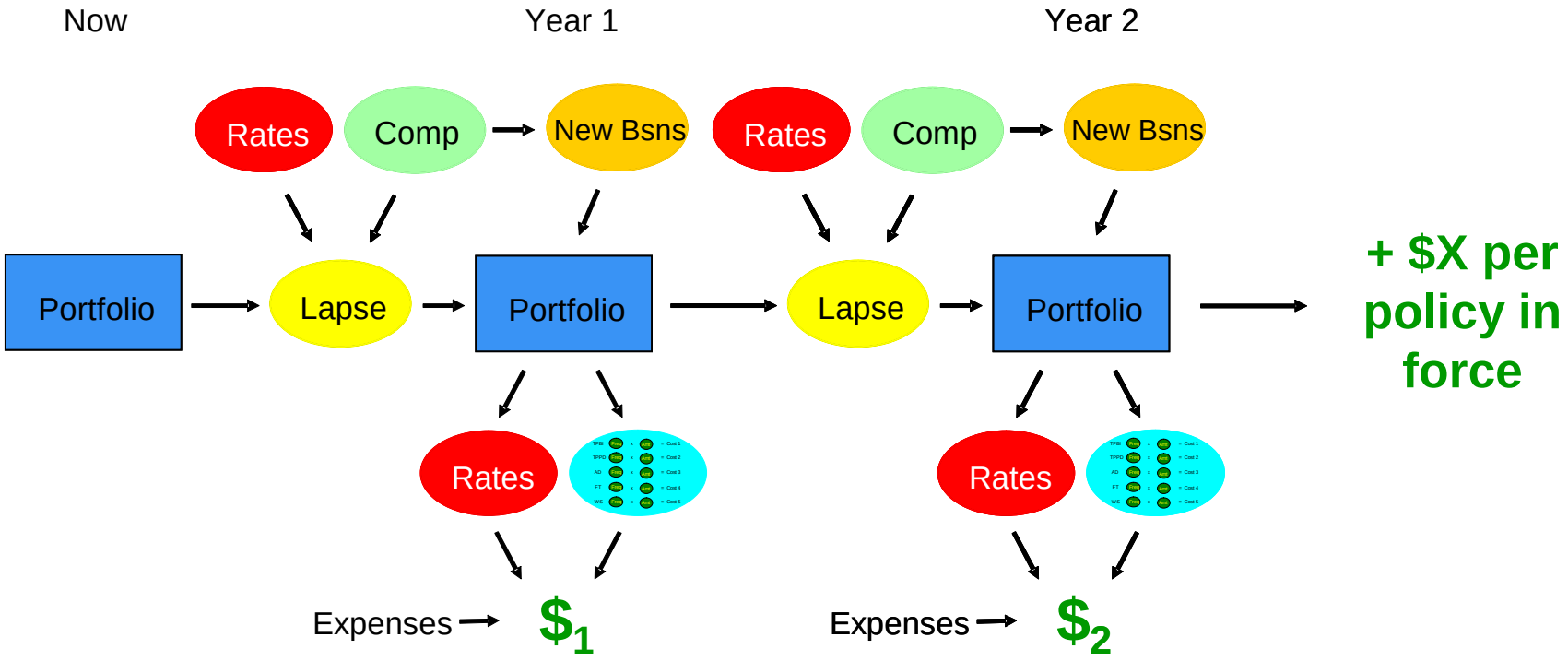
Practical application



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Targets and constraints

- Targets are global, for example:
  - Maximize profit subject to minimum volume
  - Maximize volume subject to minimum profit
- Constraints are at policy level, for example:
  - Minimum decrease in premium
  - Maximum increase in premium (function of number of claims?)
  - Minimum profit (>0?)
  - Minimum $ premium

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Profit definition

- Basic measure: Premium – Claims – Expenses
- Can also include:
  - multiple products
  - cross selling

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Agenda

- What is price optimization?
- Spectrum of implementation techniques

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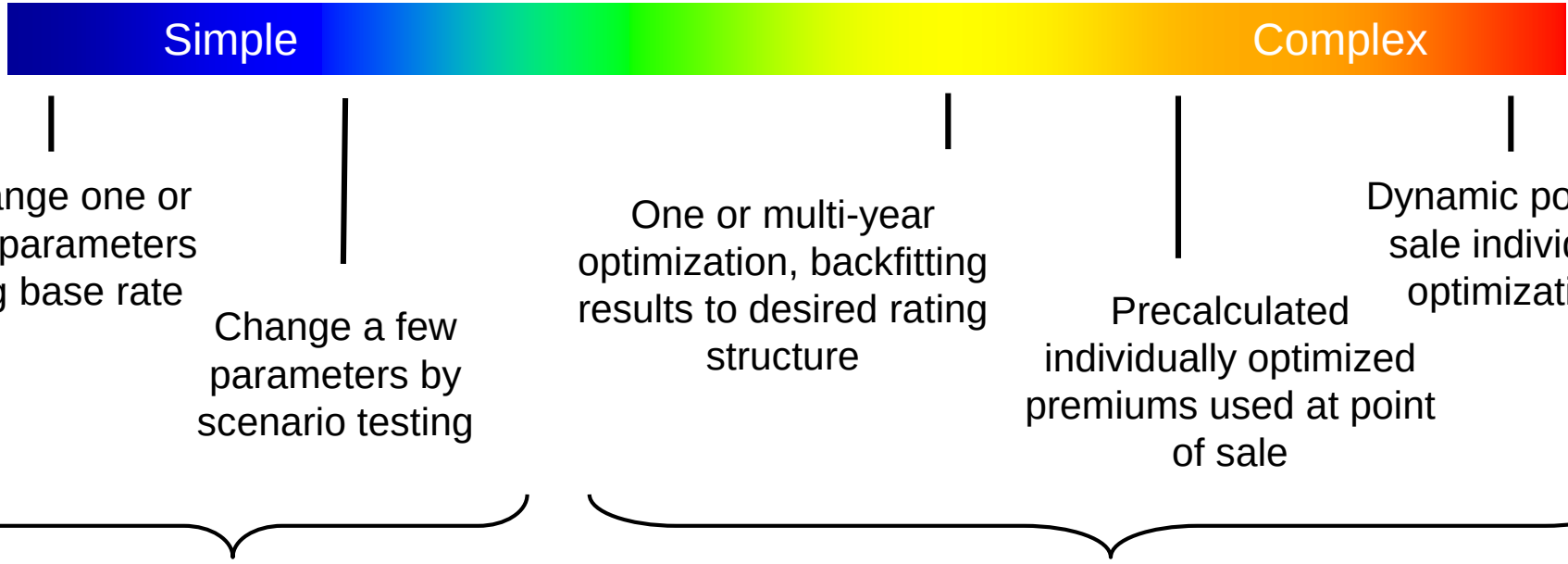
Price optimization
Spectrum of possibilities



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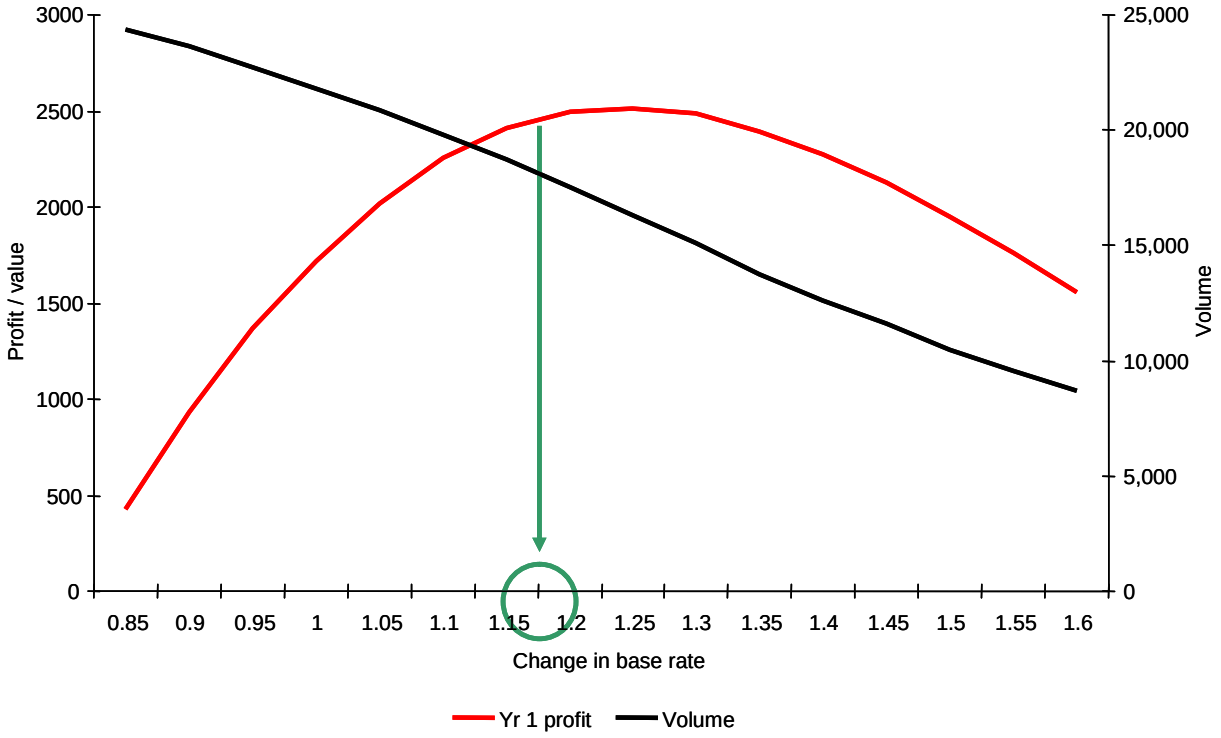
Price optimization
Spectrum of possibilities

Simple — Complex

Change one parameter - eg base rate



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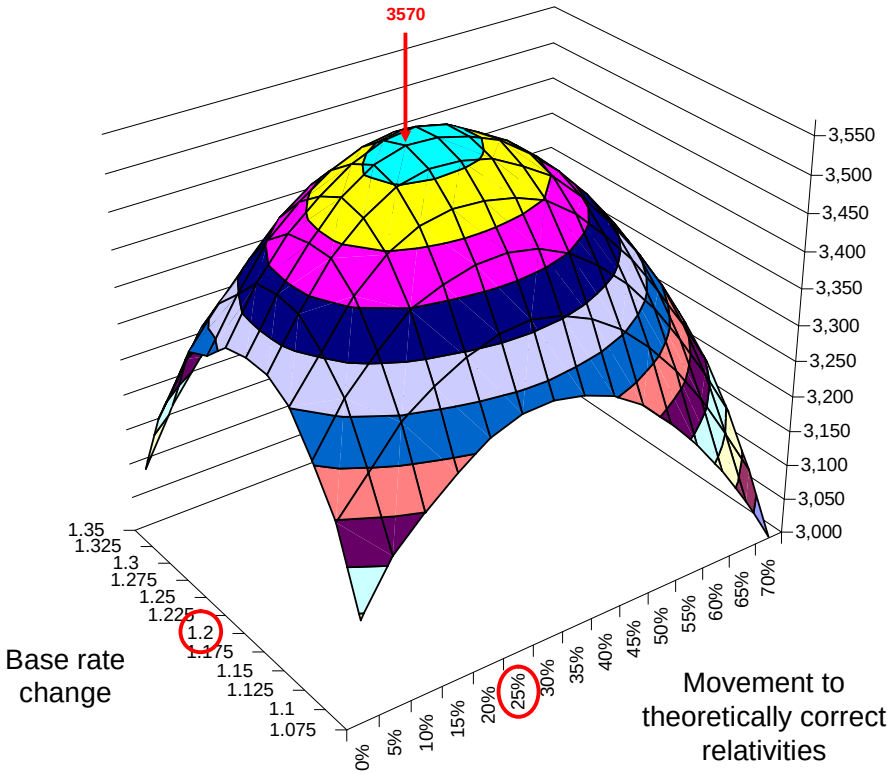
Price optimization
Spectrum of possibilities

Simple — Complex

Change a few parameters by scenario testing



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Price optimization
Spectrum of possibilities

Simple — Complex

One year or multi-year optimization, backfitting results to desired rating structure

Exposure	Age of driver	Gender	Marital status	Territory	Credit score	Earned Premium	# claims BI	Incurred losses BI	# claims PD	Incurred losses PD	Optimal premium
1	1.00	22	M	S	12	178	2,331	0	-	0	-	**2,651**
2	0.65	39	F	D	2	569	512	0	-	1	650	**561**
3	0.35	39	F	D	4	569	440	0	-	0	-	**412**
4	1.00	58	F	M	6	715	968	0	-	0	-	**745**
5	0.66	47	M	M	19	202	760	1	16,138	0	-	**699**
6	1.00	35	M	M	32	550	815	0	-	0	-	**894**
7	1.00	46	M	S	17	420	1,012	0	-	0	-	**1,242**

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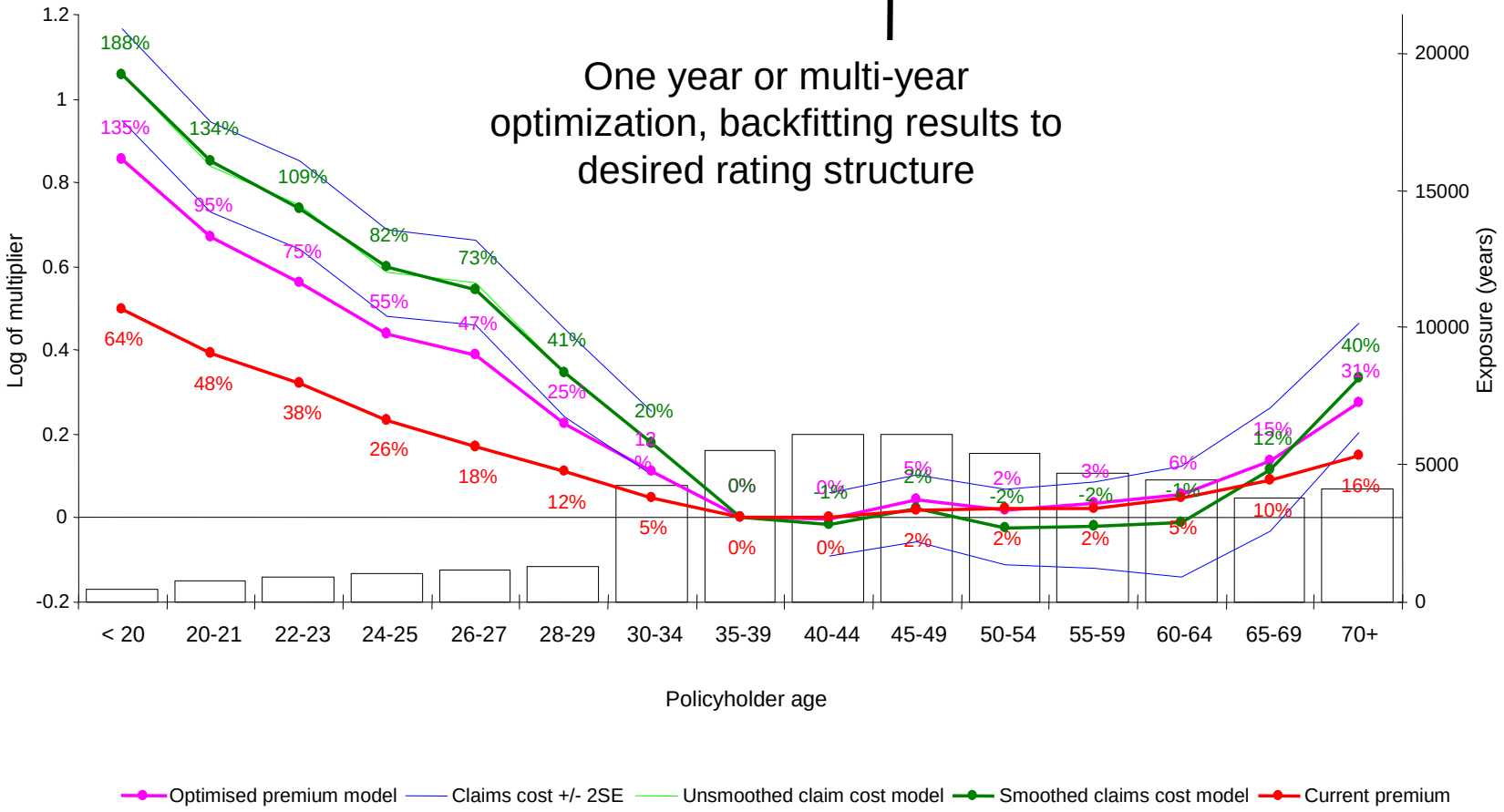
Price optimization
Spectrum of possibilities

Simple — Complex

One year or multi-year optimization, backfitting results to desired rating structure



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Price optimization
Spectrum of possibilities

Simple — Complex

SAS System Viewer - [results1.sas7bdat]

File Edit View Window Help

	OptChng	Newtp	Newad	New	Newcomp	Probret	Probcon	Prob	Var	Enew	Eclaim	Efixed	Evar
1	0.8979677	463.65746	306.81078	463.65746	1.1448955	0.6889263	0.1917394	0.6889263	69.548620	319.42584	209.91922	34.446317	47.913876
2	1.0743081	697.86225	221.71099	697.86225	0.9510912	0.3528515	0.1227717	0.3528515	104.67933	246.24180	170.33705	17.642579	36.936270
3	1.2960345	151.04925	37.083175	188.13243	1.0557637	0.8504961	0.3466301	0.8504961	26.365706	160.00590	62.046427	68.039691	22.423931
4	0.9420930	644.38230	102.55792	644.38230	1.1365385	0.7469566	0.2175450	0.7469566	96.657345	481.32565	239.42779	37.347832	72.198848
5	1.3467581	233.99880	74.009235	308.00804	1.1233670	0.8212476	0.3286662	0.8212476	42.500744	252.95088	121.56000	65.699813	34.903637
6	1.1899904	411.71653	229.33543	641.05196	1.2687083	0.7457213	0.2040981	0.7457213	84.691023	478.04611	224.51250	59.657705	63.155900
7	1.0715898	429.10919	601.98596	1031.0951	1.1000702	0.5886236	0.1409945	0.5886236	124.56497	606.92704	267.07627	47.089895	73.321896
8	0.9268575	643.83263	181.04276	824.87540	1.1176933	0.6985266	0.2184445	0.6985266	114.67917	576.19742	249.42110	55.882129	80.106454
9	1.0255244	463.07664	251.35867	714.43532	1.2973396	0.4784678	0.1262053	0.4784678	94.597364	341.83431	247.23819	38.277426	45.261795
10	0.9117823	446.67295	256.55401	446.67295	1.1631392	0.6015171	0.1123776	0.6015171	67.000943	268.68145	220.88058	30.075859	40.302218
11	0.8328487	390.18113	314.57280	704.75394	1.1513871	0.7223533	0.1872224	0.7223533	89.984451	509.08138	227.74715	57.788269	65.000571
12	0.9616659	324.34409	256.60709	324.34409	0.9245369	0.6157031	0.1490998	0.6157031	48.651614	199.69966	146.33363	30.785155	29.954950
13	0.9636057	252.32308	118.79421	252.32308	0.9396515	0.7359111	0.1975632	0.7359111	37.848463	185.68738	124.64106	36.795559	27.853107
14	1.2631656	990.04292	653.12655	1643.1694	1.2496576	0.2376113	0.0786249	0.2376113	213.81909	390.43567	296.17630	19.008905	50.805838
15	1.0714290	936.61518	648.95093	1585.5661	1.1665047	0.6591689	0.2243380	0.6591689	205.38737	1045.1559	538.69140	52.733516	135.38497
16	1.6248051	2611.2965	1195.8374	2611.2965	1.2752657	0.0737068	0.0579826	0.0737068	391.69447	192.47045	154.69459	3.6853427	28.870568
17	1.1447651	337.10383	429.57107	337.10383	1.3110306	0.4550478	0.0992959	0.4550478	50.565575	153.39837	159.16120	22.752392	23.009756
18	1.2247985	1032.3531	388.60865	1032.3531	0.9195400	0.2623731	0.1373177	0.2623731	154.85297	270.86179	192.87863	13.118659	40.629269
19	1.0367813	464.32740	172.91637	637.24377	1.1668194	0.7029471	0.2139309	0.7029471	86.940747	447.94867	237.31185	56.235769	61.114748
20	1.2968747	334.58229	42.136768	376.71906	1.2740412	0.7965887	0.2486720	0.7965887	54.401020	300.09016	157.18102	63.727099	43.335240
21	1.0744689	282.87163	265.35562	548.22725	1.1884776	0.7875233	0.2209511	0.7875233	68.966307	431.74175	186.83101	63.001866	54.312576
22	1.0924657	186.49415	48.211029	234.70518	1.1201700	0.7347766	0.2077893	0.7347766	32.795226	172.45589	109.93019	58.782133	24.097167
23	1.0904828	560.76265	133.90379	560.76265	1.0792794	0.3946018	0.1033948	0.3946018	84.114398	221.27795	161.13754	19.730090	33.191693
24	1.3616726	252.38466	26.941135	279.32580	1.1172946	0.8489816	0.3247415	0.8489816	40.551813	237.14248	88.565687	67.918534	34.427746
25	1.0687107	508.21108	416.81466	508.21108	0.9718752	0.5622396	0.1407820	0.5622396	76.231662	285.73643	184.37246	28.111983	42.860465
26	1.1731357	959.33901	1334.9962	2294.3352	1.1054887	0.6341882	0.2530914	0.6341882	277.40047	1455.0403	655.15551	50.735056	175.92410
27	1.1343488	169.57437	185.18481	169.57437	0.9128017	0.8050548	0.3440631	0.8050548	25.436156	136.51667	52.714382	40.252743	20.477501
28	1.2707035	218.46932	117.79119	336.26051	1.1325983	0.8205884	0.3032680	0.8205884	44.549517	275.93150	117.88565	65.647079	36.556821
29	1.2217590	402.32836	177.01997	402.32836	1.3396946	0.6813364	0.1454257	0.6813364	60.349254	274.12098	248.17901	34.066823	41.118147
30	1.2676639	709.24940	734.49948	1443.7488	1.1012655	0.7762868	0.3094945	0.7762868	179.83736	1120.7632	281.75285	62.102945	139.60537
31	1.0707497	920.83145	305.98342	920.83145	1.1552277	0.7271997	0.2272657	0.7271997	138.12471	669.62844	293.29745	36.359989	100.44426

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Precalculated individually optimized premiums used at point of sale

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Price optimization
Spectrum of possibilities

Dynamic point of sale individual optimization

- Premiums determined at point of sale via real time optimization algorithm
- Inputs can include current market conditions and frequently updated elasticity assumptions
- Identical customers can get different premiums

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Garbage in, garbage out

- Assumptions, targets and constraints drive the answer
- Optimization process will ruthlessly exploit every error
- Important to:
  - sensitivity test assumptions
  - monitor actual and expected experience

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Claudine Modlin, FCAS, MAAA
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