Customer Retention and New Business Conversion Analysis – Discrete Modeling Issues



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2005 CAS Seminar on Predictive Modeling

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Watson Wyatt Worldwide

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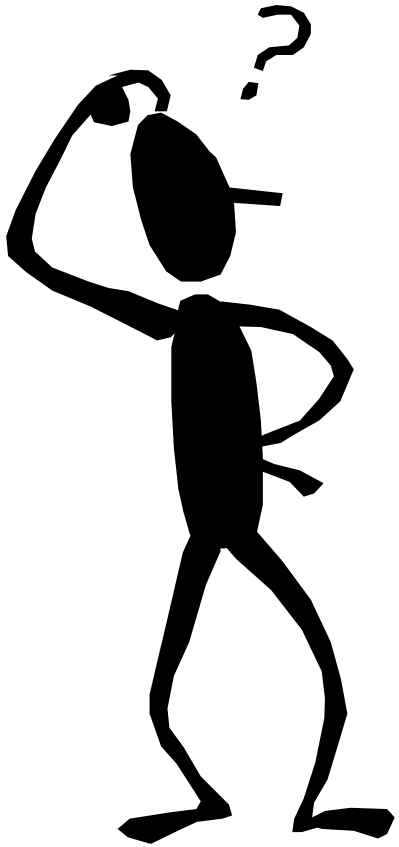
Retention analysis

- What to measure
- What to consider
- Practical tips
- Why do it



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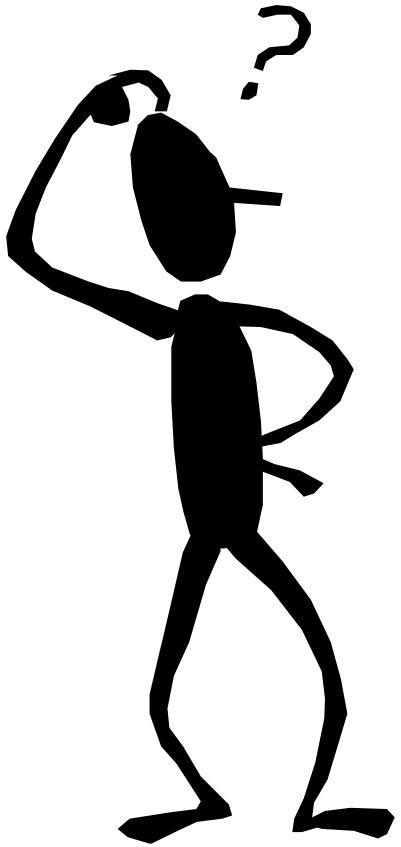
Retention analysis

- **What to measure**
- What to consider
- Practical tips
- Why do it



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Data required

- Individual policy (or quote) level
- Offer & resulting accept/lapse
- Policy characteristics
- Rate change information
- Period during which rates changed

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Generalized linear models

$$E[\underline{Y}] = \underline{\mu} = g^{-1}(\mathbf{X}.\underline{\beta} + \underline{\xi})$$

$$Var[\underline{Y}] = \phi.V(\underline{\mu}) / \underline{\omega}$$

- Consider all factors simultaneously
- Allow for nature of random process
- Provides diagnostics
- Robust and transparent

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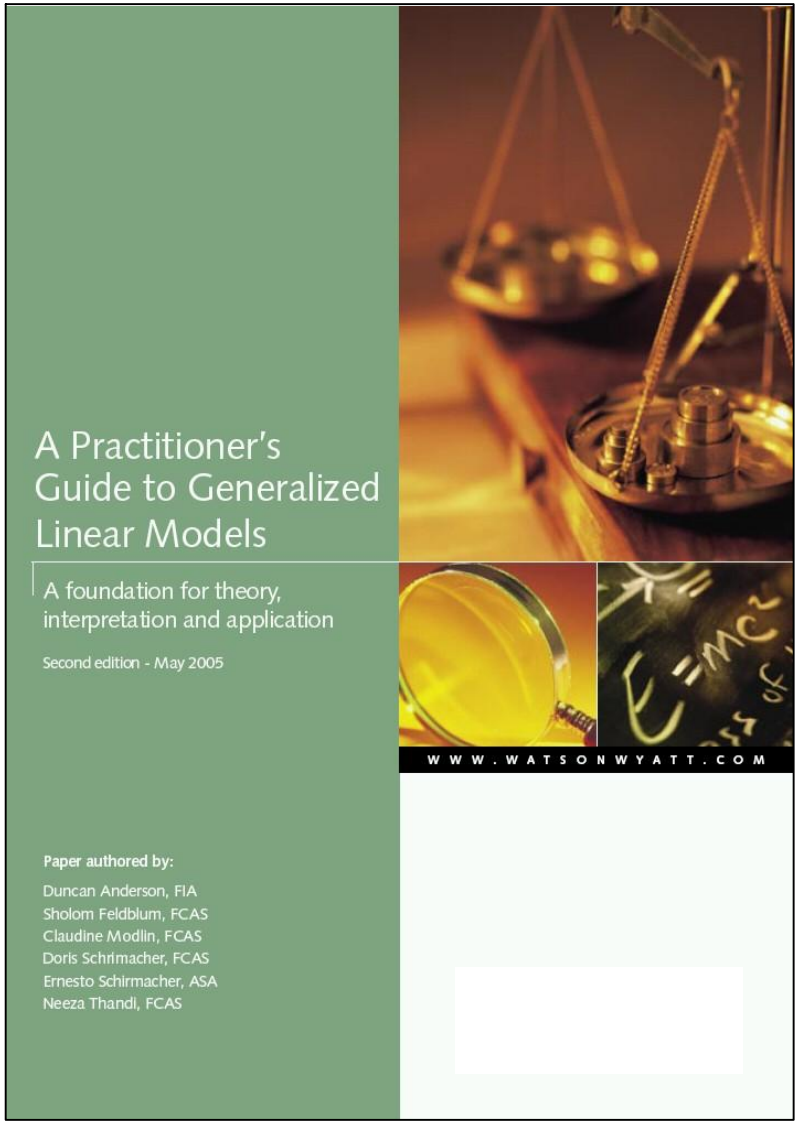
"A Practitioner's Guide to Generalized Linear Models"



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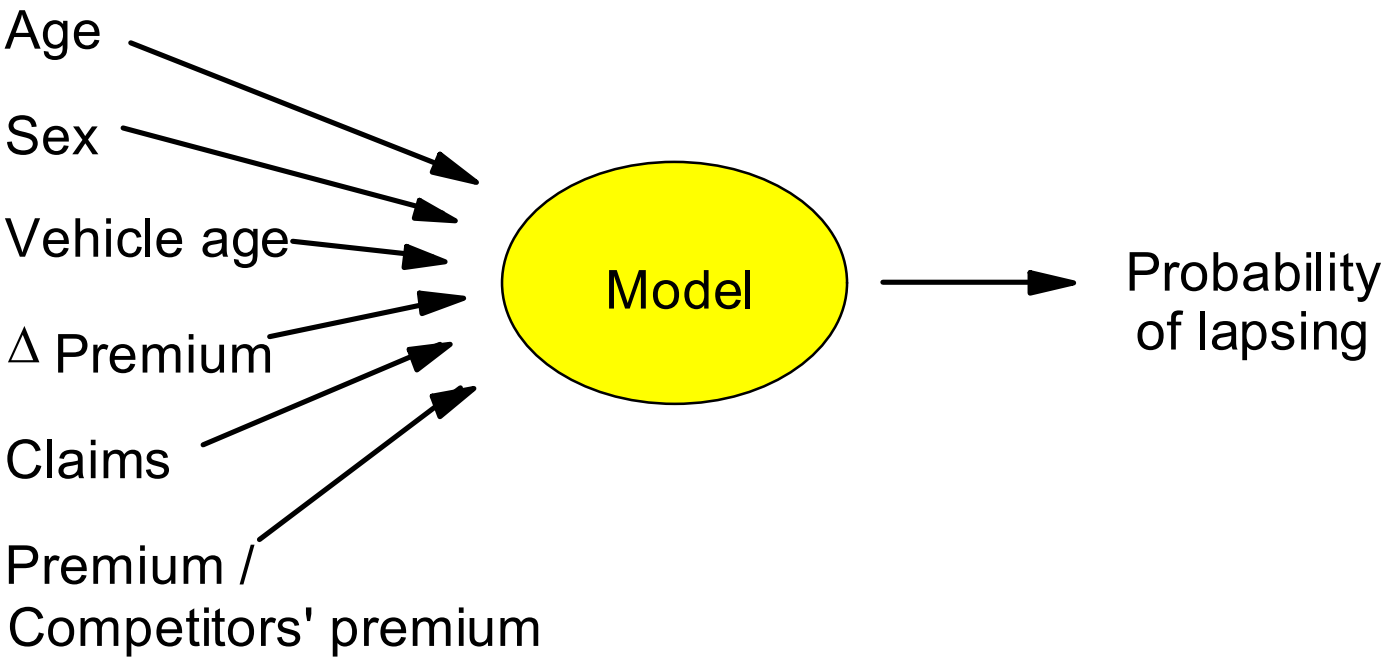
Modeling retention

- Most companies have data on renewal offers



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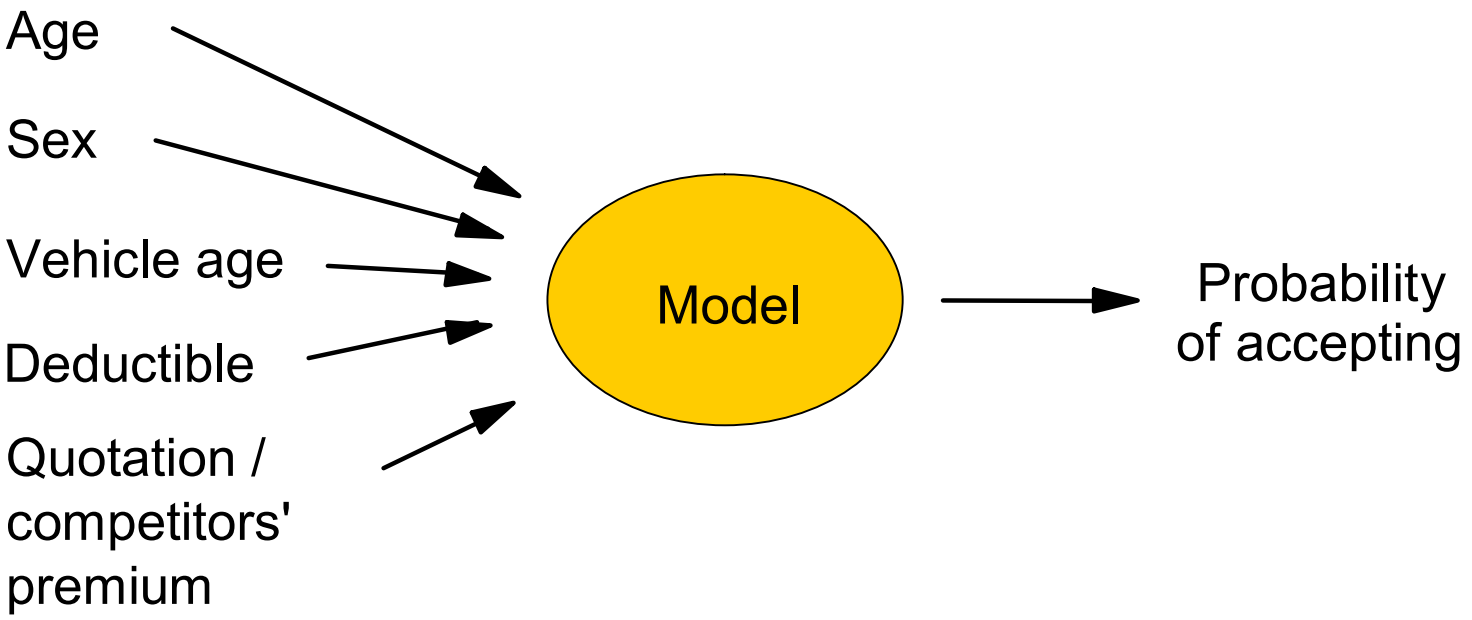
Modeling new business rates

- If details of individual quotes known, can be modeled in similar way
- Otherwise much simpler analysis is all that can be undertaken



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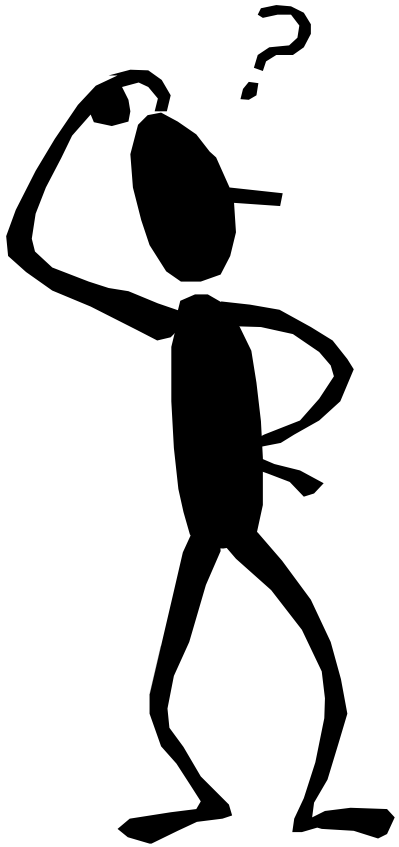
Retention analysis

- What to measure
- **What to consider**
- Practical tips
- Why do it



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What to consider

- Who are your customers
- How do you connect
- What have you done to them
- What have others done to them

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Who are your customers?

- Age of policyholder
- Age of car
- Claims history
- Other rating factors
- Endorsement activity

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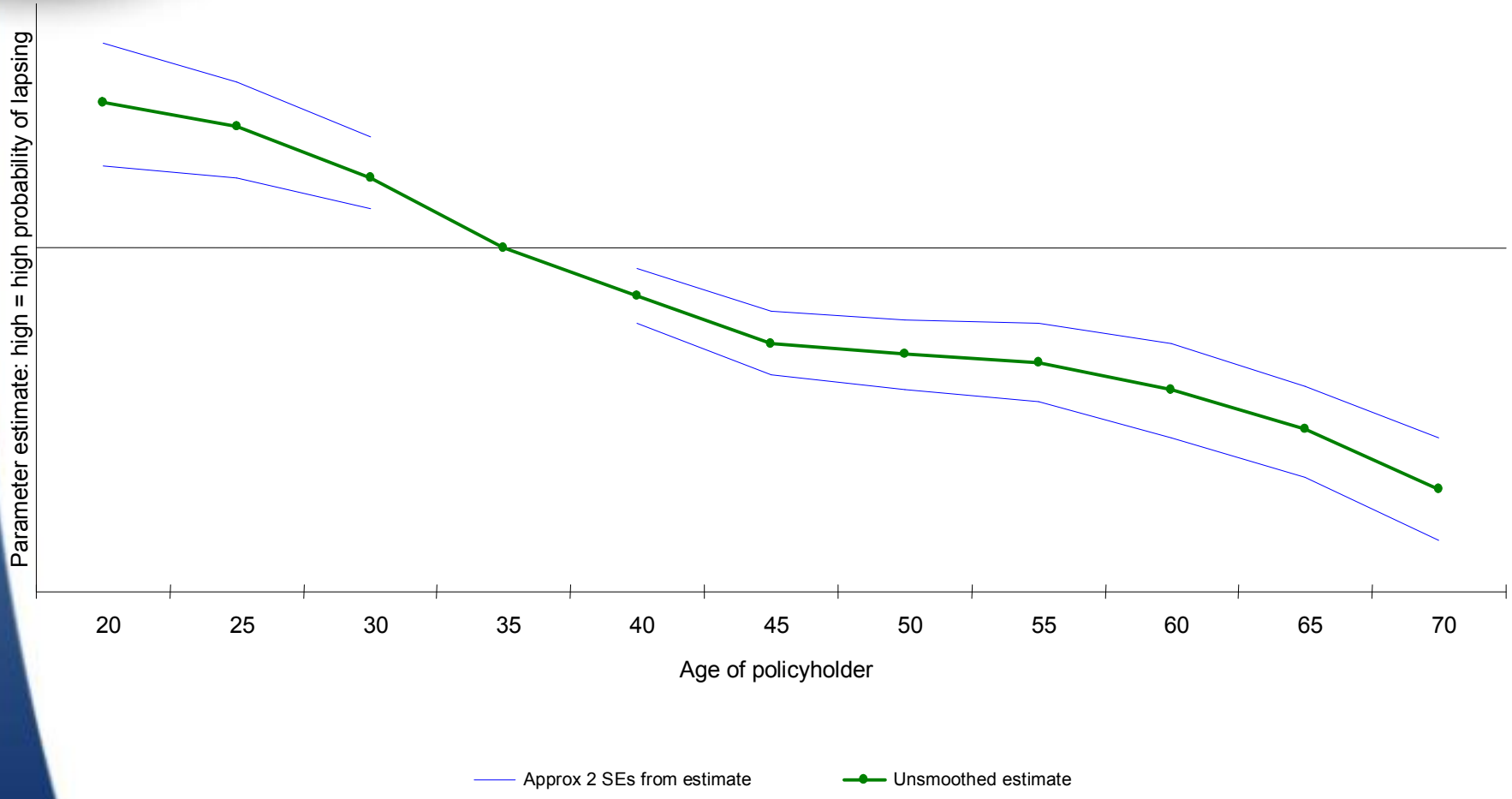
Effect of age of policyholder on lapses



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How do you connect with them?

- Distribution channel
- Payment plan
- Other products held
- Endorsement activity
- # years with company

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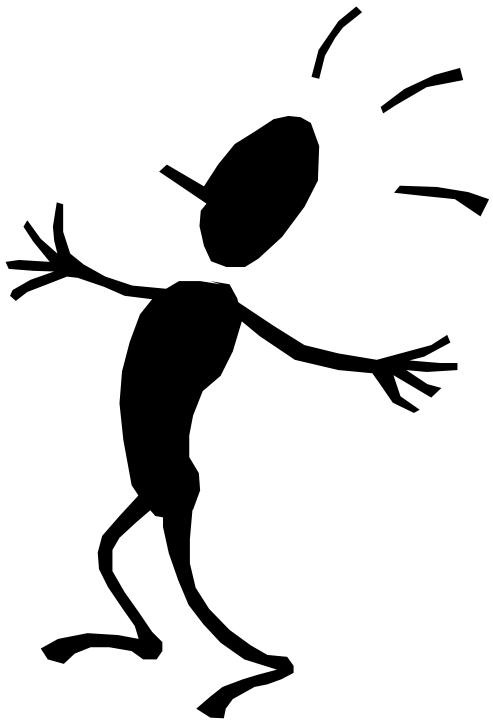
What have you done to them?

- Rate change
- Claims service
- Agent service



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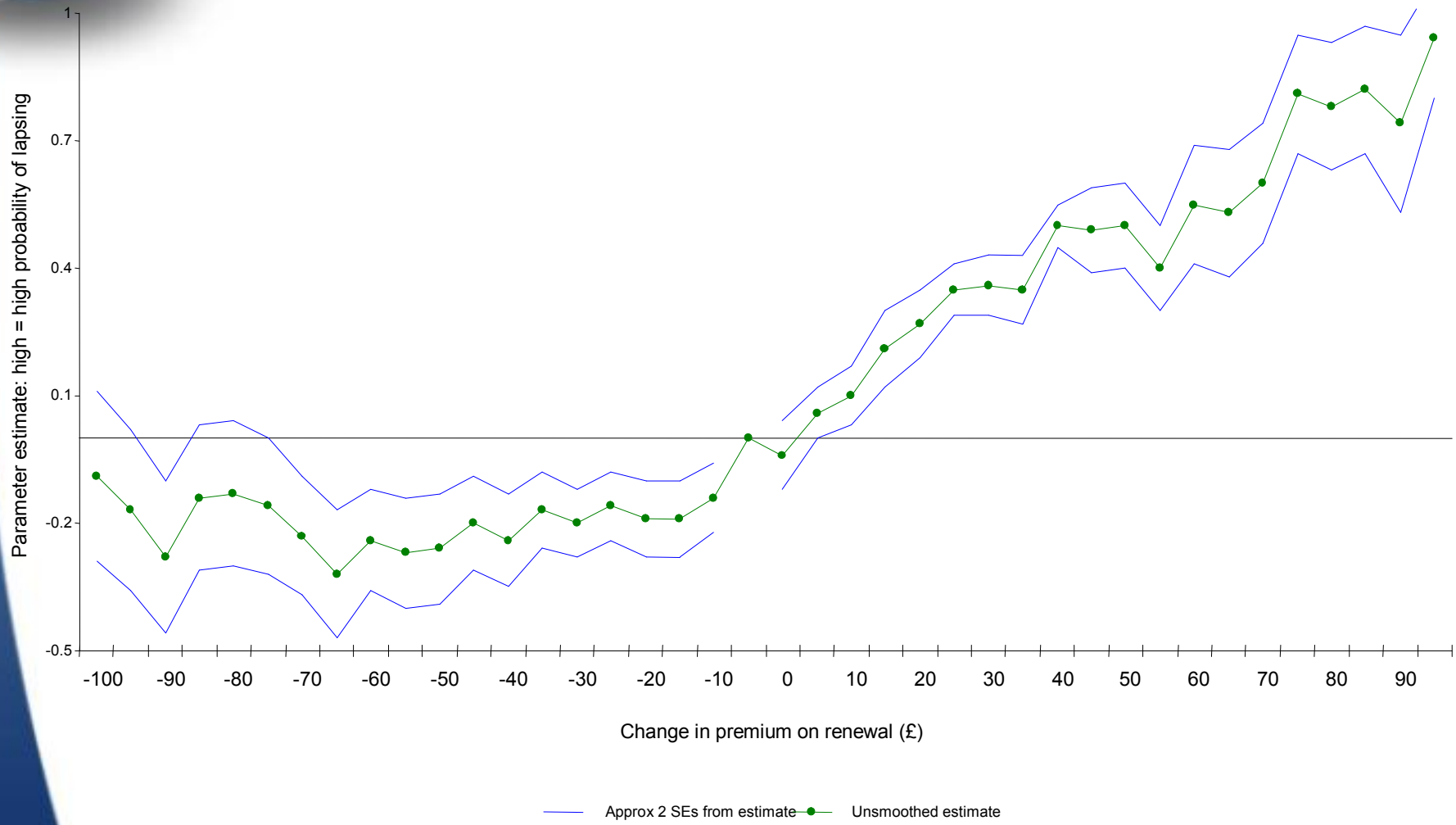
Effect of premium change on lapses



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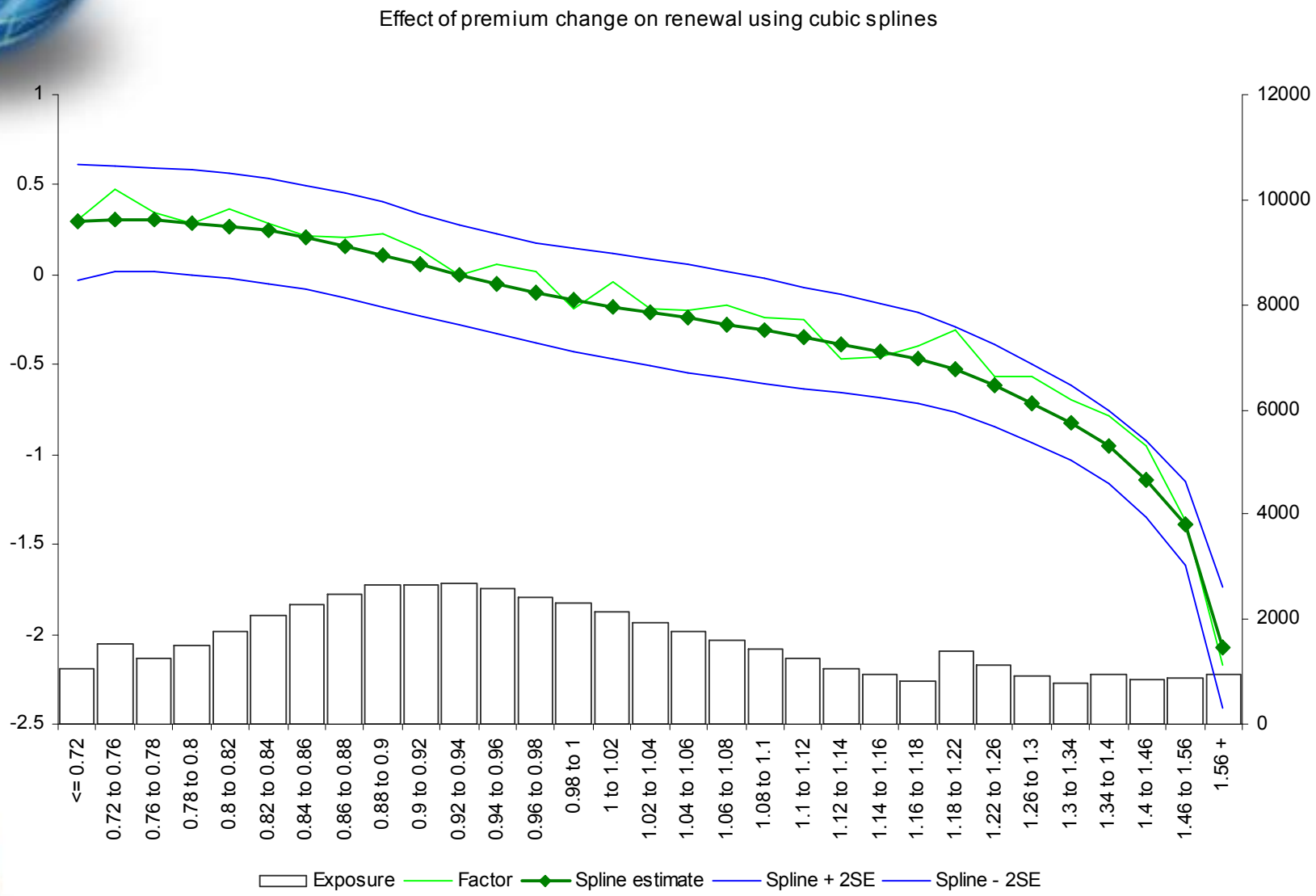
Splines



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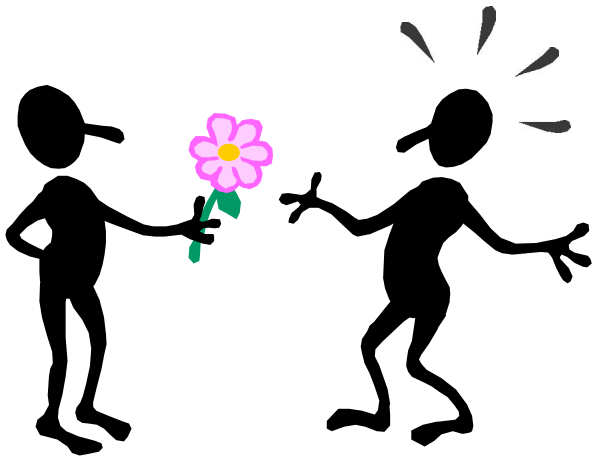
What have others done to them?

- Competitors' premium
- Product differentiation
  (may not be applicable to some products)



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Competitive indices

- For modeling, required at individual policy level
- Sources of competitor info
  - rate manuals
  - comparative rating software
- Measures
  - index (comparing to one competitor or averaged across several)
  - rank of quote relative to competitors
- Challenges
  - tier criteria
  - point in time
  - cost

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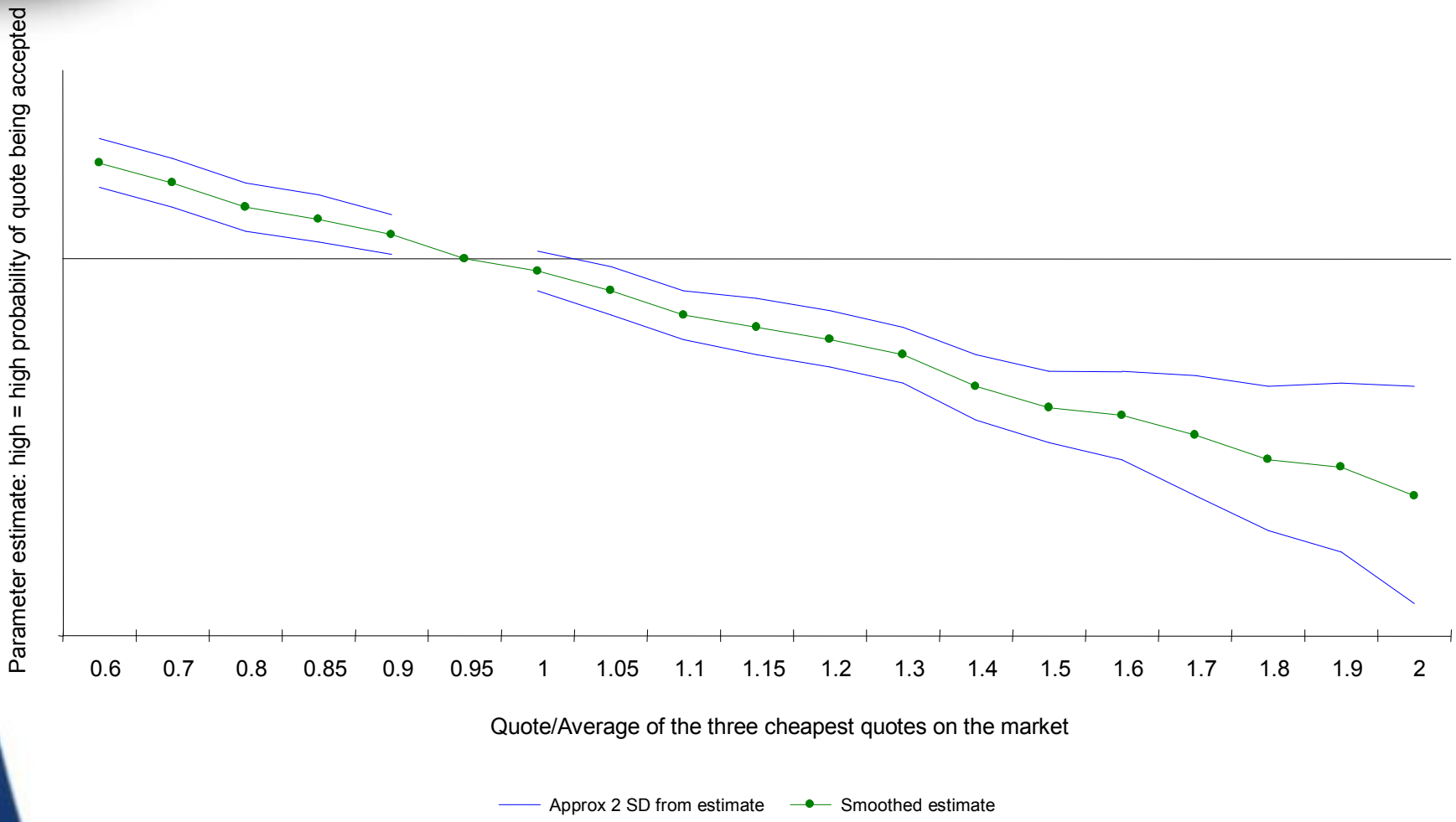
Effect of competitiveness on new business



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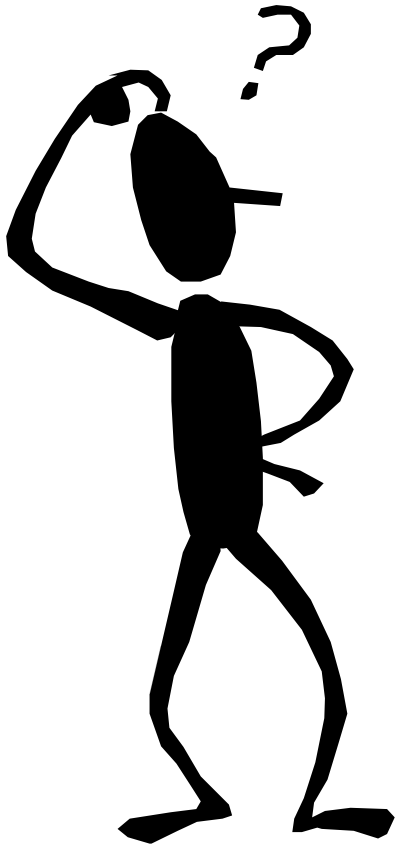
Retention analysis

- What to measure
- What to consider
- **Practical tips**
- Why do it



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Statistical assumptions

- A logistic model is most appropriate
  - considers log(p / [1-p]) and binomial error
  - maps [0,1] to [-∞,∞]
  - invariant to whether you measure lapse/renew
- If lapses are low and results not to be used directly, a Poisson multiplicative model can help
  - theoretically wrong (can predict multiple lapses), but:
  - easier to understand
  - can superimpose one-way results more easily

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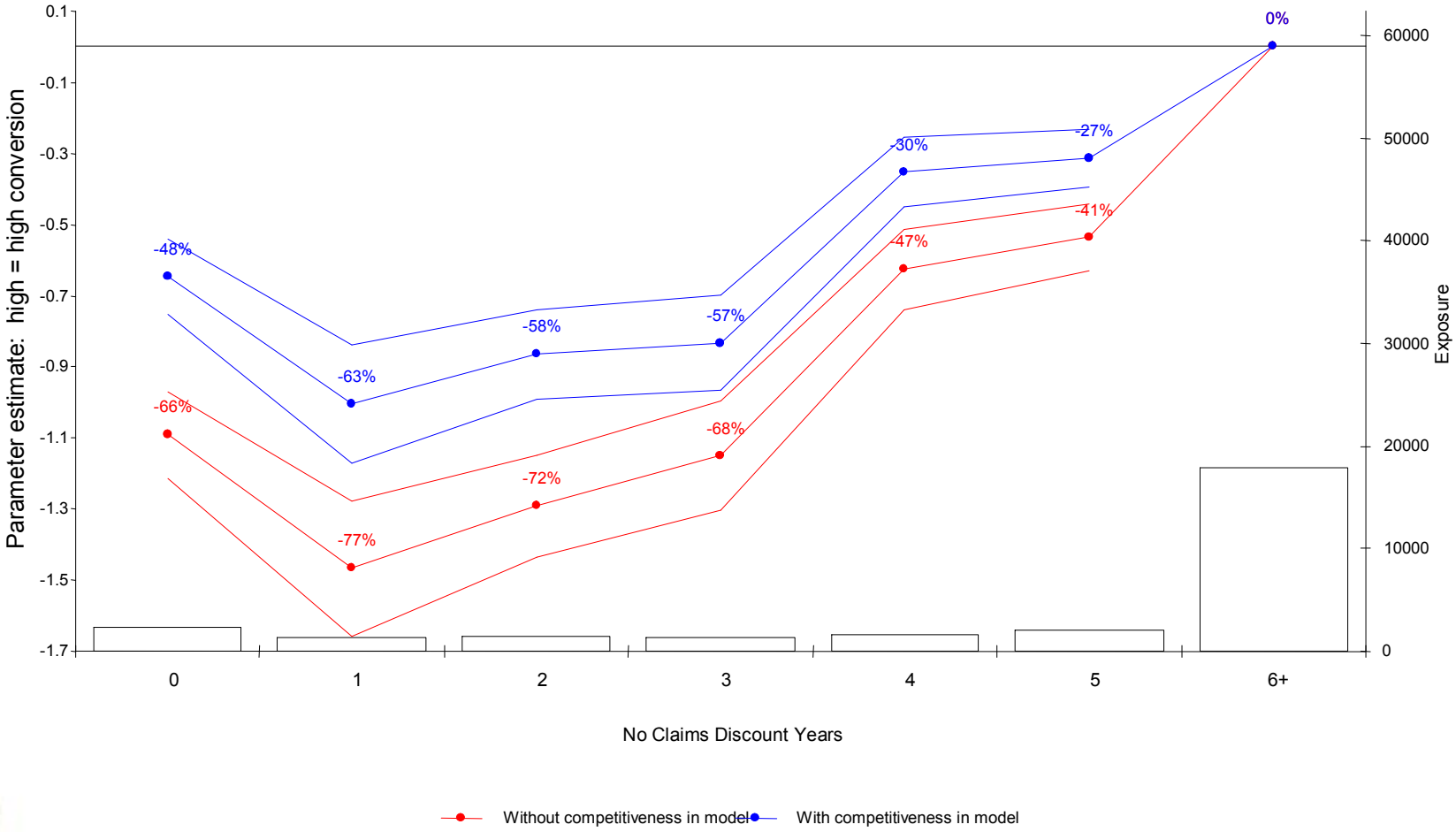
Practical tip on competitiveness

- Superimposing models with and without competitiveness will show extent to which effects are simply price related



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Beware absolute premium

- GLM shows effect *all other factors being equal*
- For varying premium all other factors are never equal
- Results, while statistically correct, can be hard to interpret, for example adding premium size can reverse the multivariate result for age of driver
- Consider fitting separate models for different premiums bands

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Measuring rate change

- Best to have more than one rate change in data
- Investigate % change and $ change
- Suggest fit rate change as a categorical factor and then model with splines if appropriate
  - some results are straight lines in logistic space, some are clearly not

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Beware expectations

- Customer expectations of premium change
  - try to isolate rate change from risk criteria change which affects premium
  - consider premium change adjusted for change in risk criteria (ie new rates for new risk / old rates for new risk)

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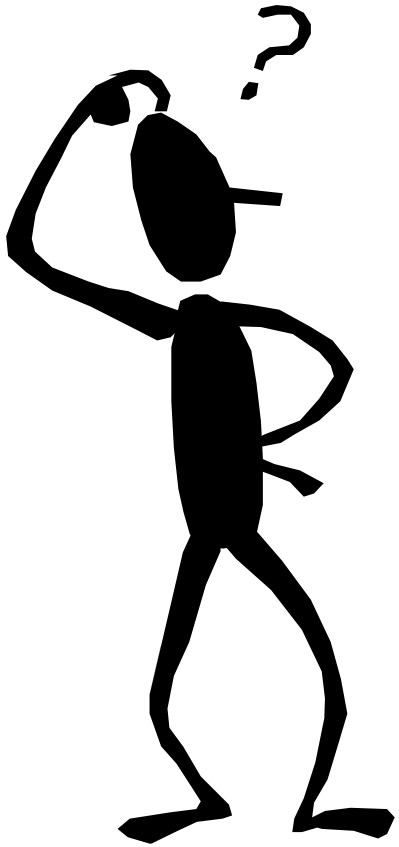
Retention analysis

- What to measure
- What to consider
- Practical tips
- **Why do it**



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Why model lapses / new business?

- Qualitative management decisions
  - marketing strategies
  - renewal campaigns
- Simple expense loadings
- Modeling
  - simple lifetime modeling
  - detailed impact modeling
  - detailed lifetime modeling
  - price optimization

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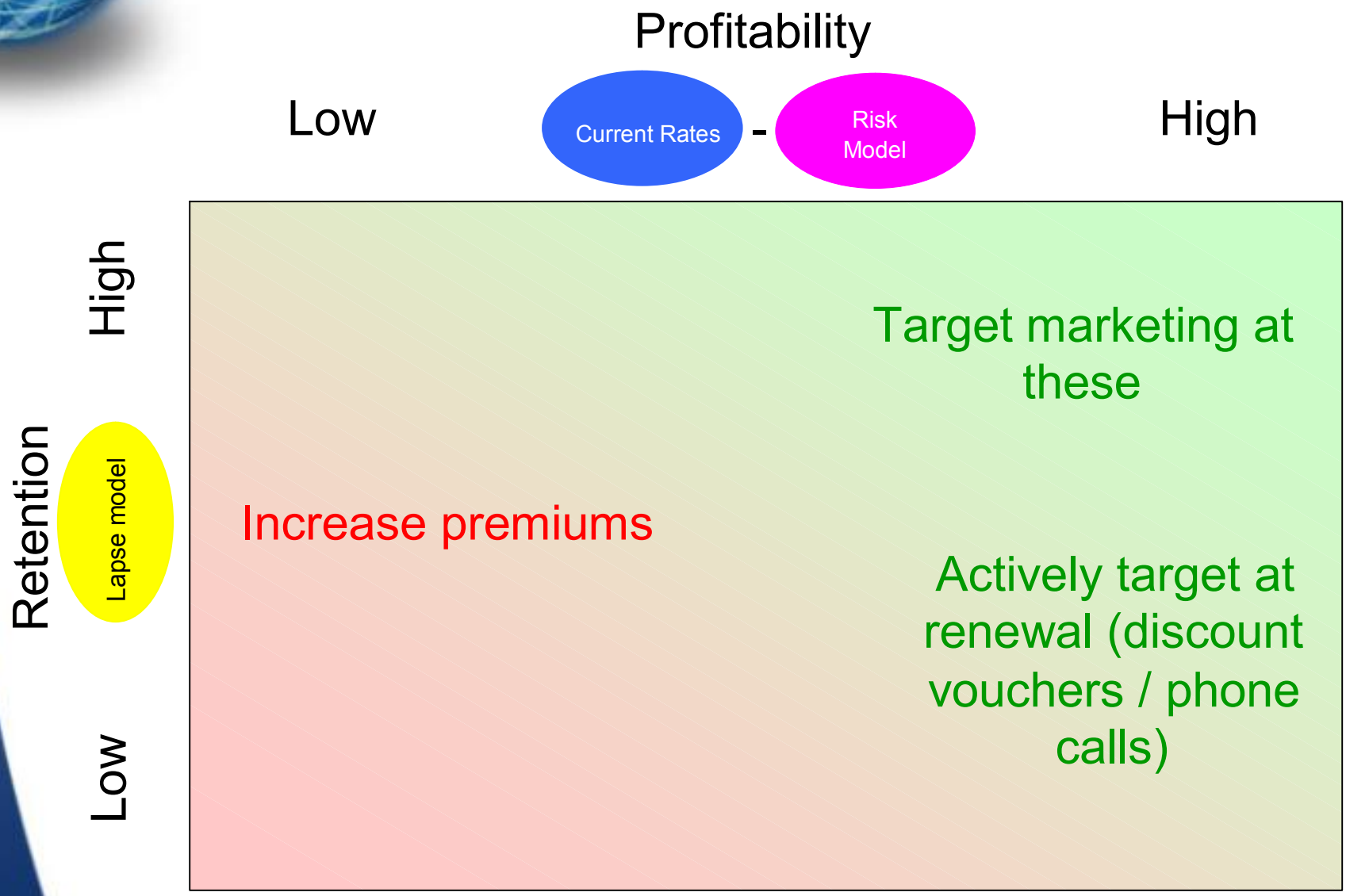
Customer value



Lifetime expense loads

- Expenses per policy
  - acquisition 100
  - renewal 30
- Expected lifetime
  - young 2 years
  - old 5 years
- Lifetime expense loadings
  - young (100 + 1 * 30) / 2 = 65
  - old (100 + 4 * 30) / 5 = 44

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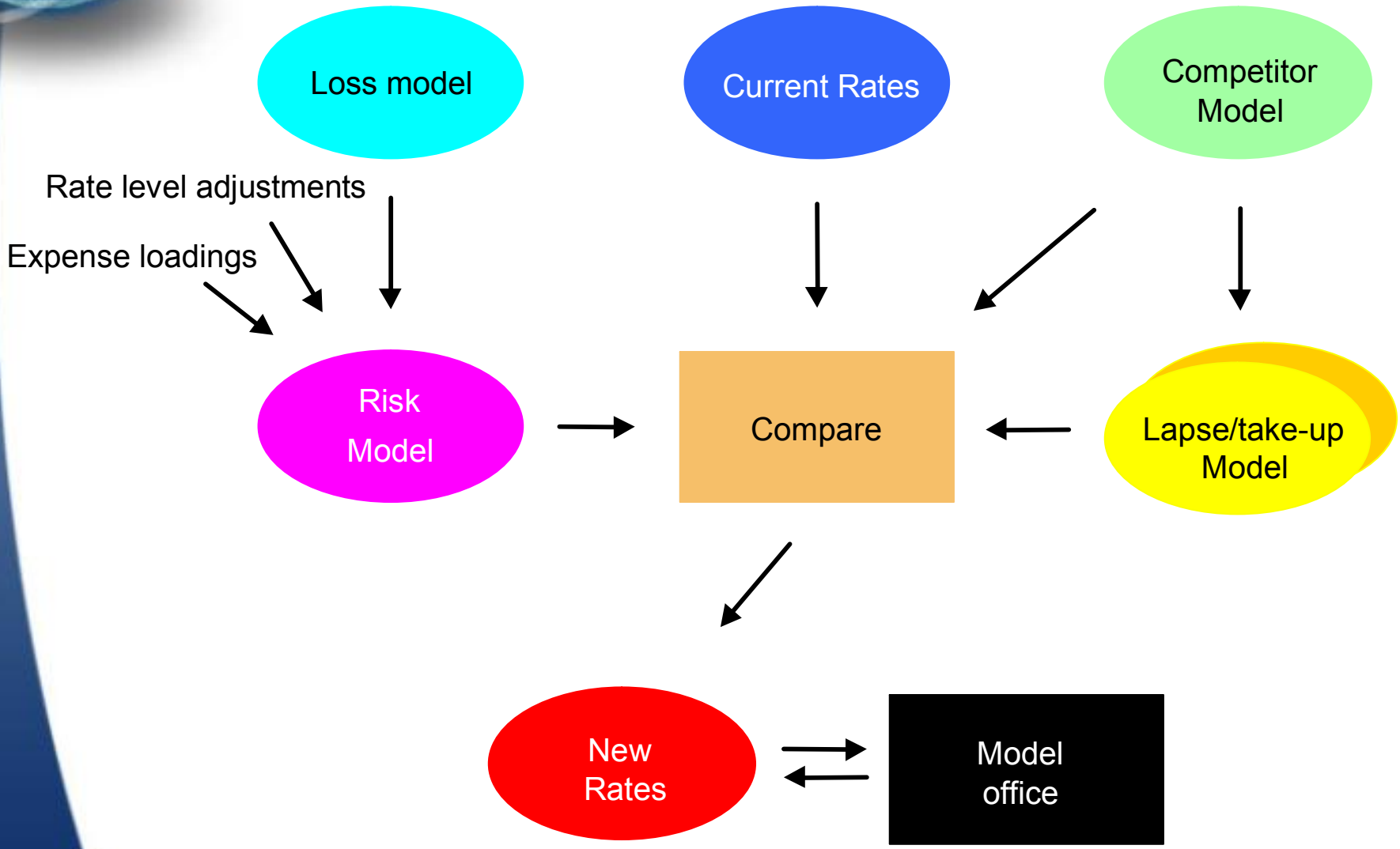
Price optimization



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Scenario testing techniques

- How do we use information from retention models and claims models to change rates optimally?
- Which is more important - overall rate changes or relativity changes?
- How quickly and for what types of policyholder should we move the rates to the theoretical position?
- What might happen if I do X?

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Price optimization

- Given all this information, what is the "best" rating action?
- Given a form of rating structure, seek the parameters which maximize a company's strategic objectives, perhaps with defined constraints

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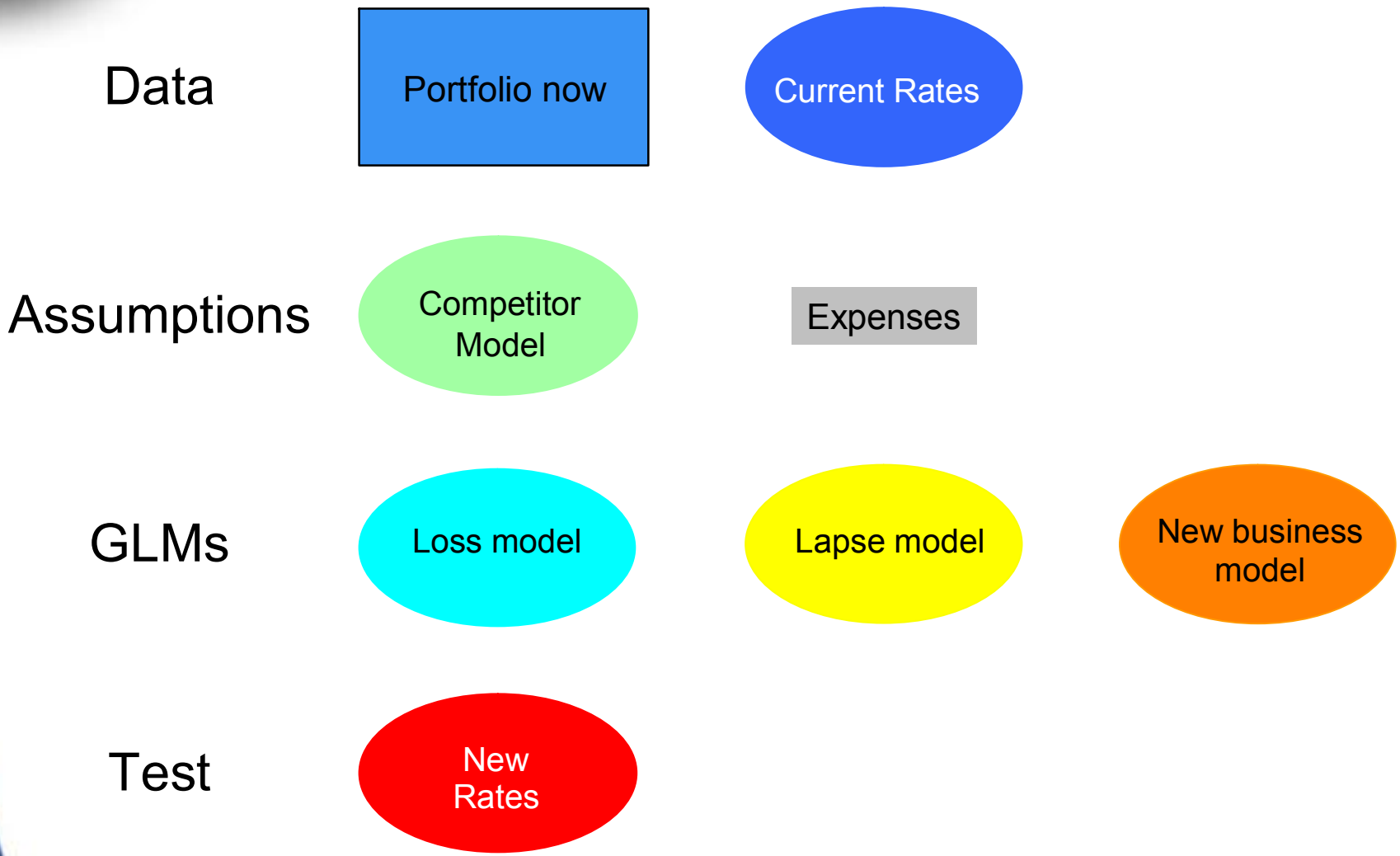
Ingredients



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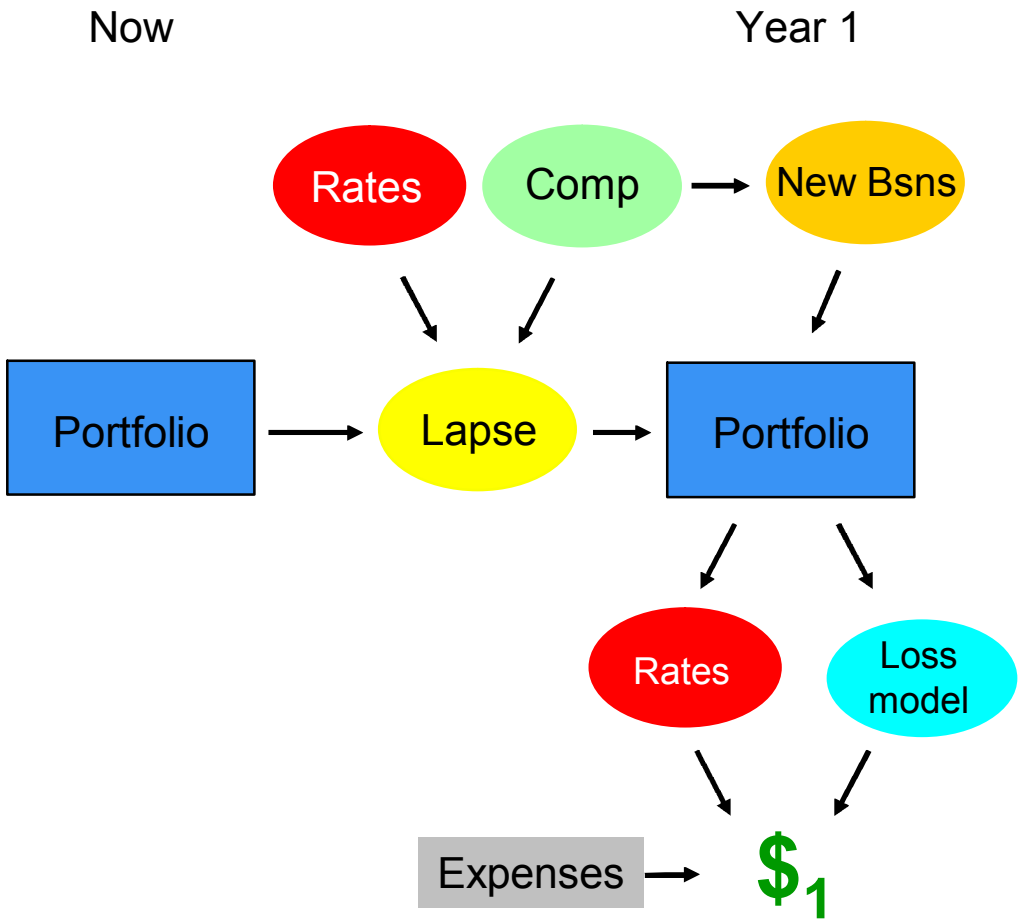
Scenario testing



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Problems (1)

- What will the competition do?
- Things change
  - age of insured
  - age of vehicle (home)
  - vehicle (home)
  - address
  - claim surcharges
- What is the measure of success?
- Over what period is the projection done?

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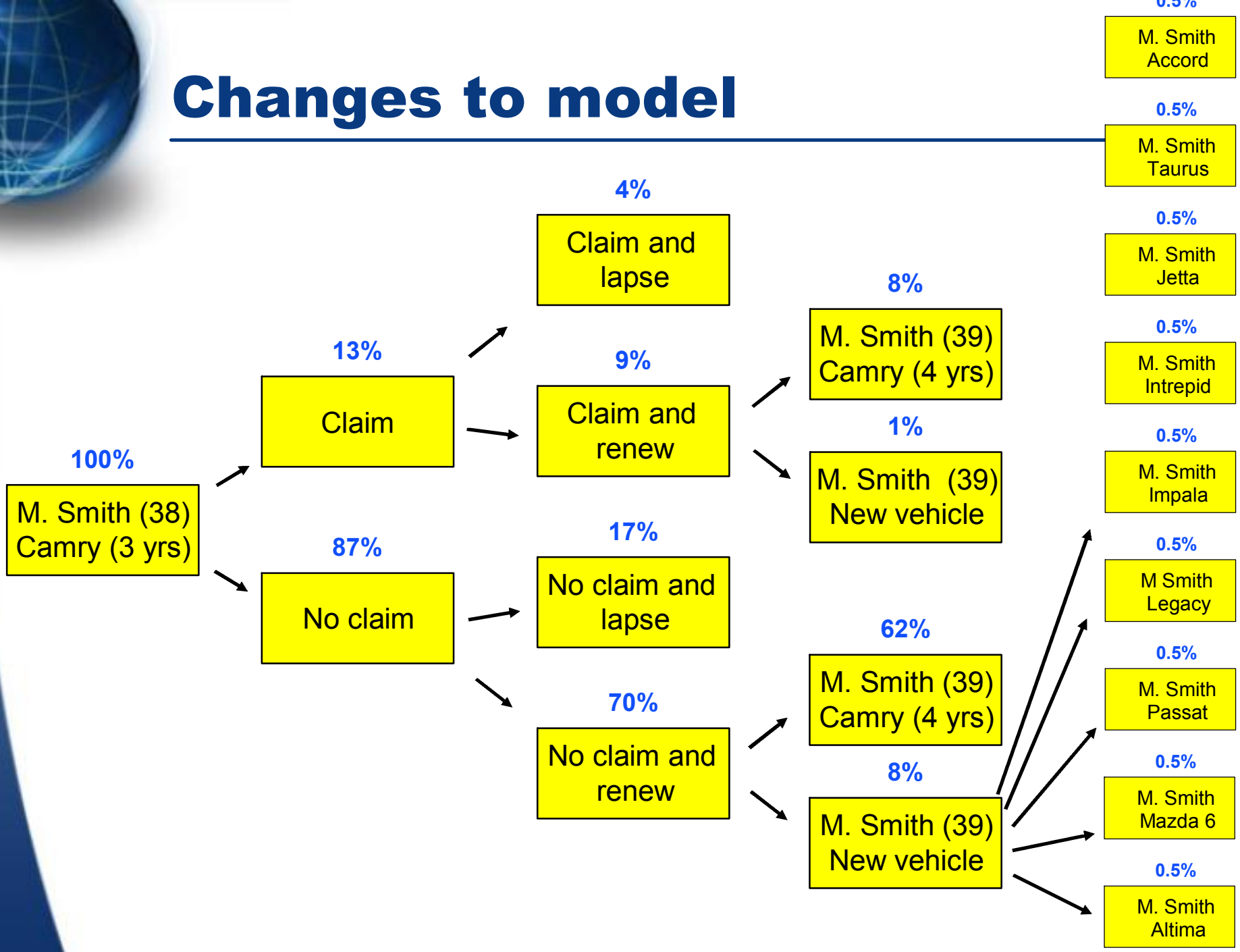
Changes to model



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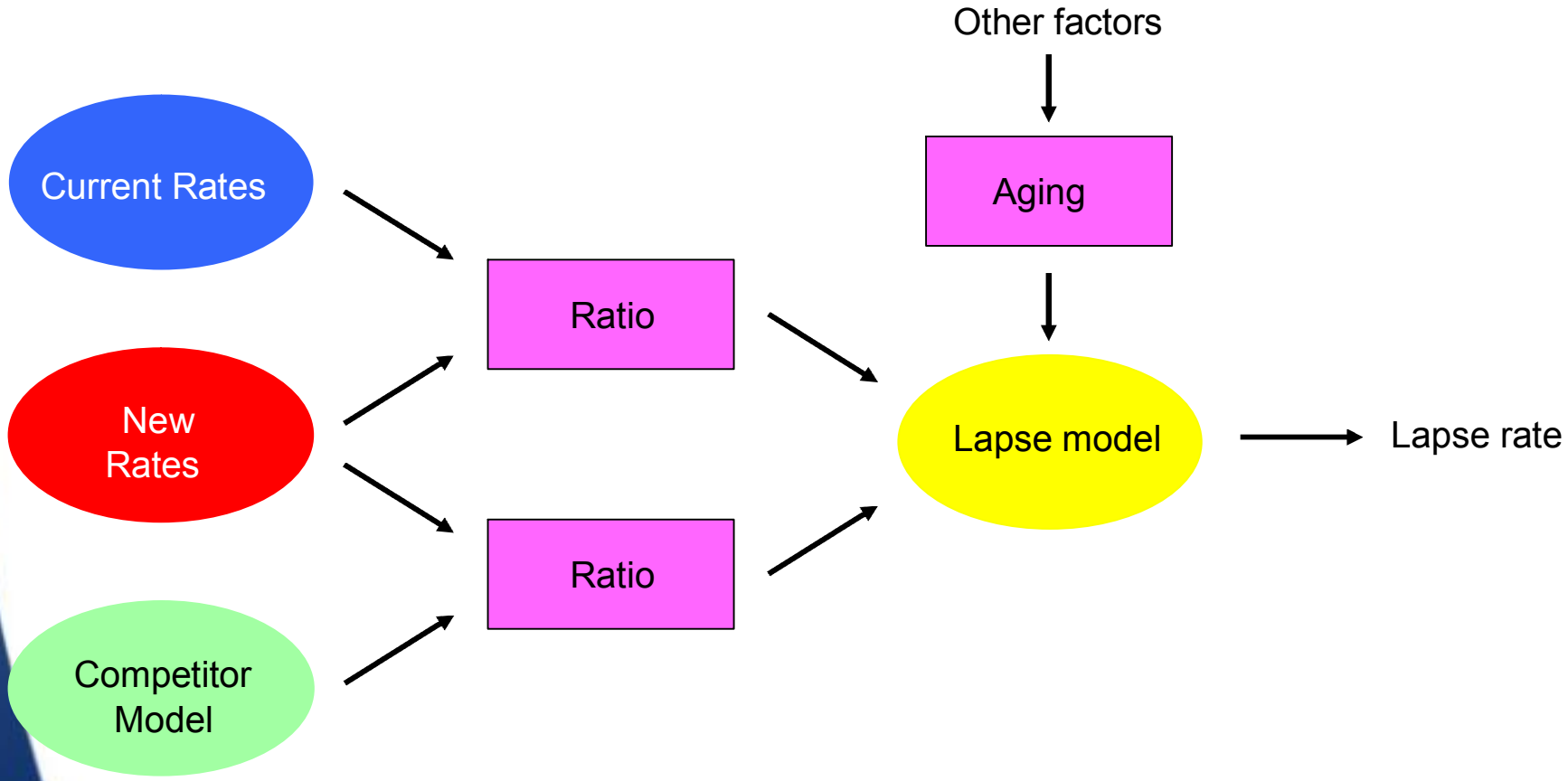
Inputs to some models are outputs from others

- Sometimes model output needs to be processed and/or recategorized before being input to another model



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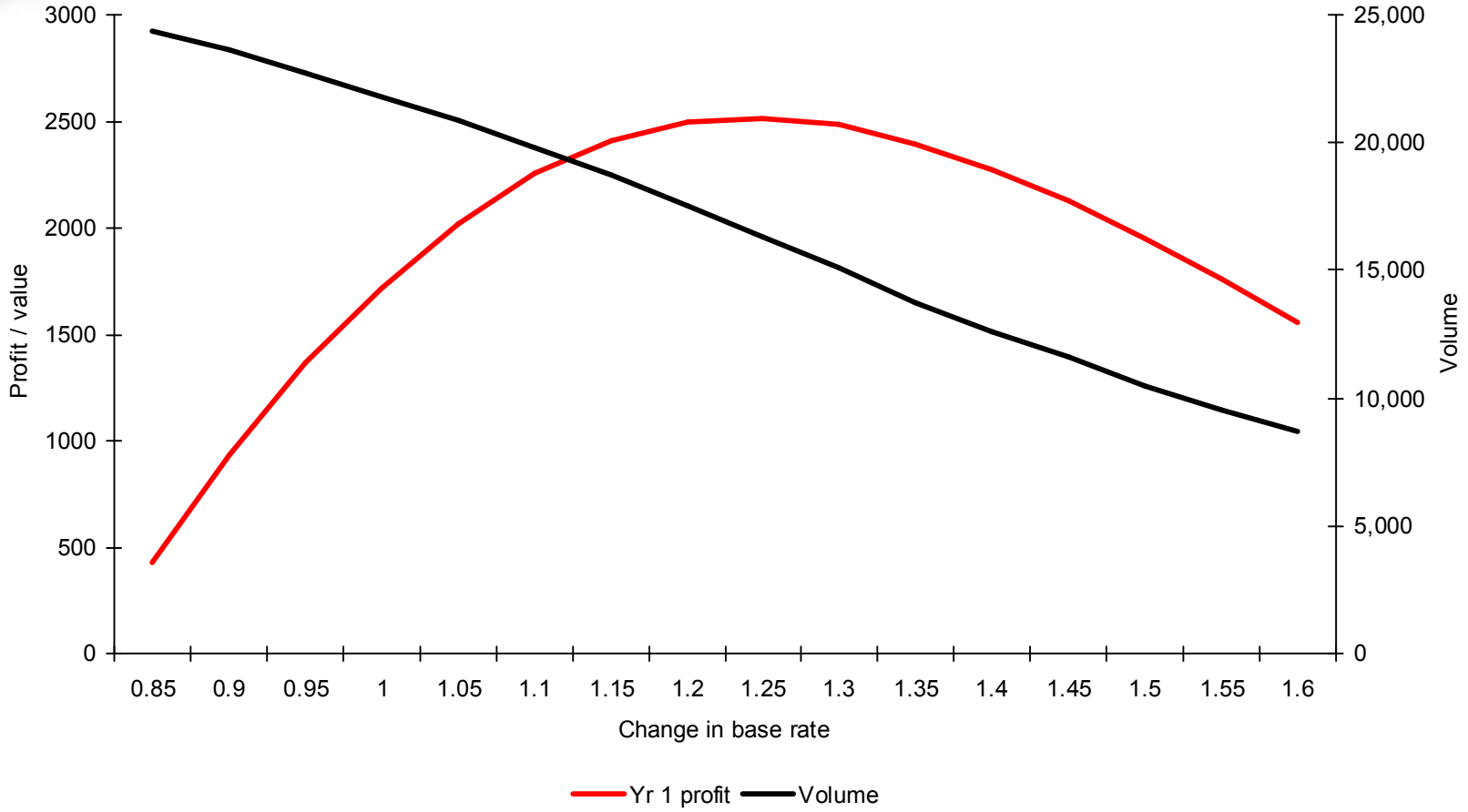
Example - effect of different base rate changes



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Problems (2)

- What are we optimizing?
  - Year 1 profit will not consider value business in the future
  - Putting on a life actuary's hat …
- Seek "a_x"
  - two big drivers of retention are age and tenure => people get stickier
  - expected life higher than 1/(1-r)
  - but multiply by what profit measure?
  - and account for future rating actions how?

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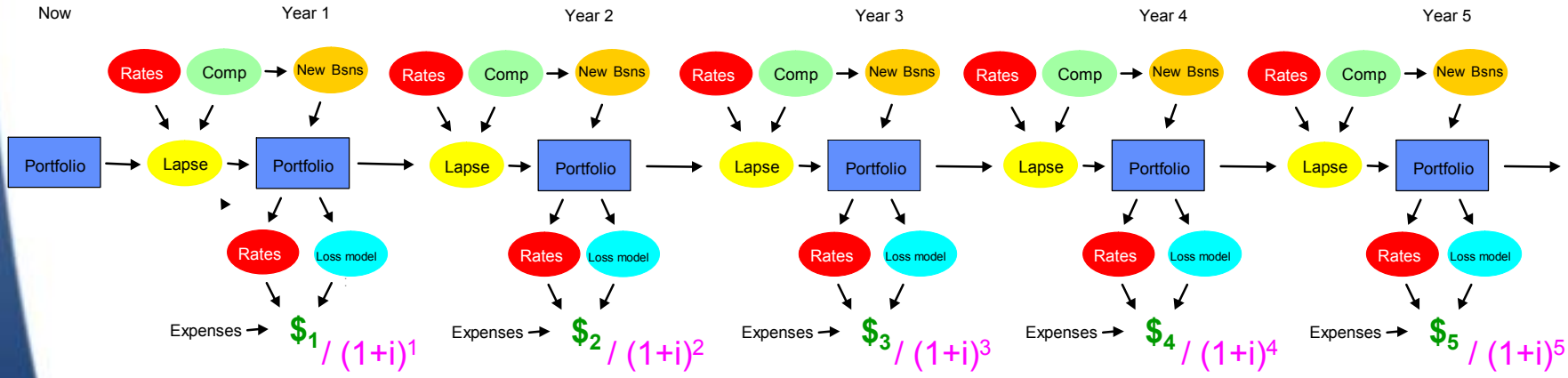
Problems (2)

- What are we optimizing?
  - Year 1 profit will not consider value business in the future
  - Putting on a *modern* life actuary's hat…



- Too many assumptions - (things change)^5

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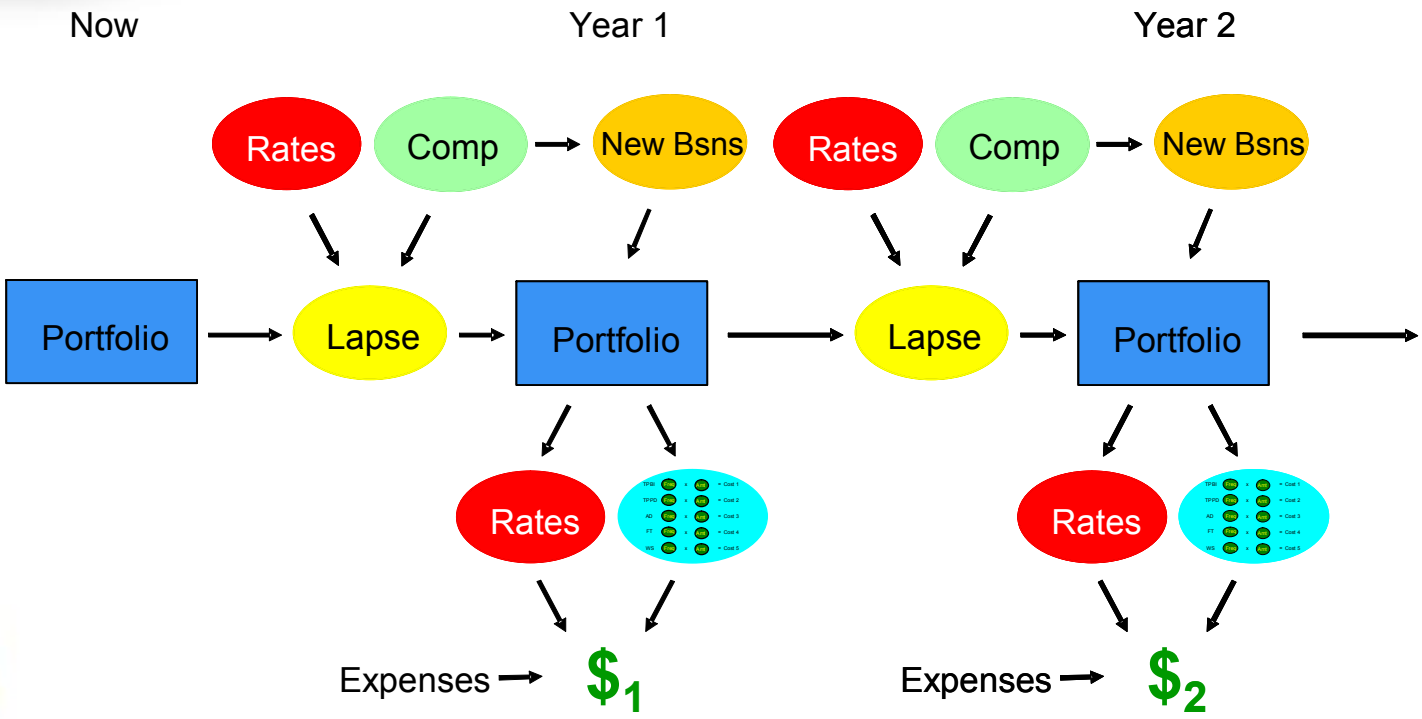
A pragmatic compromise?



+ $X per policy in force, perhaps as a function of factors to make allowance for lifetime value

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Or…

- Constrained optimization
- Seek to maximize profit over short period, subject to constraints such as minimum required business volumes

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Examples

- Base rate change
- Base rate change with relativity change
- Premium moderators
- Full optimization

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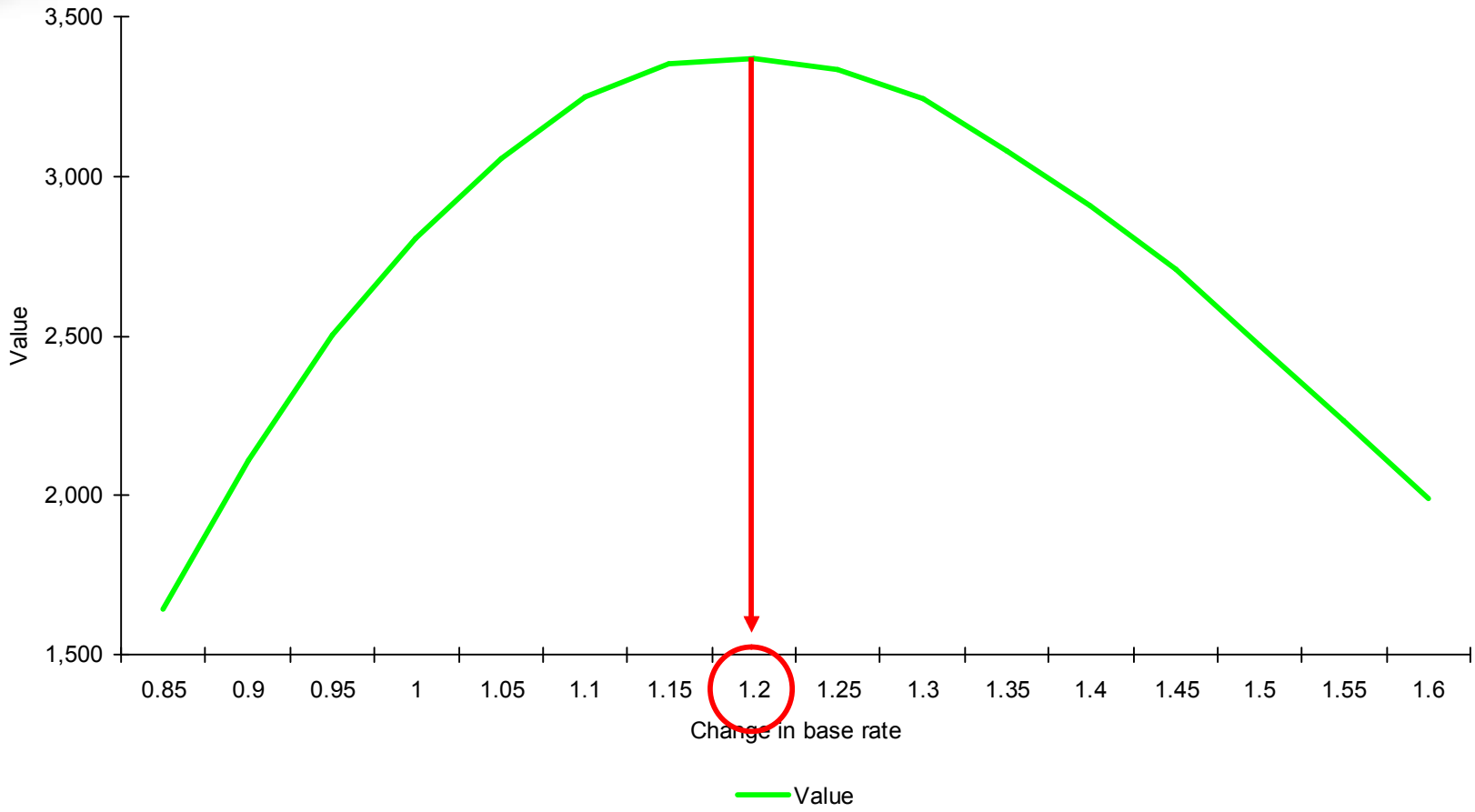
Base rate change



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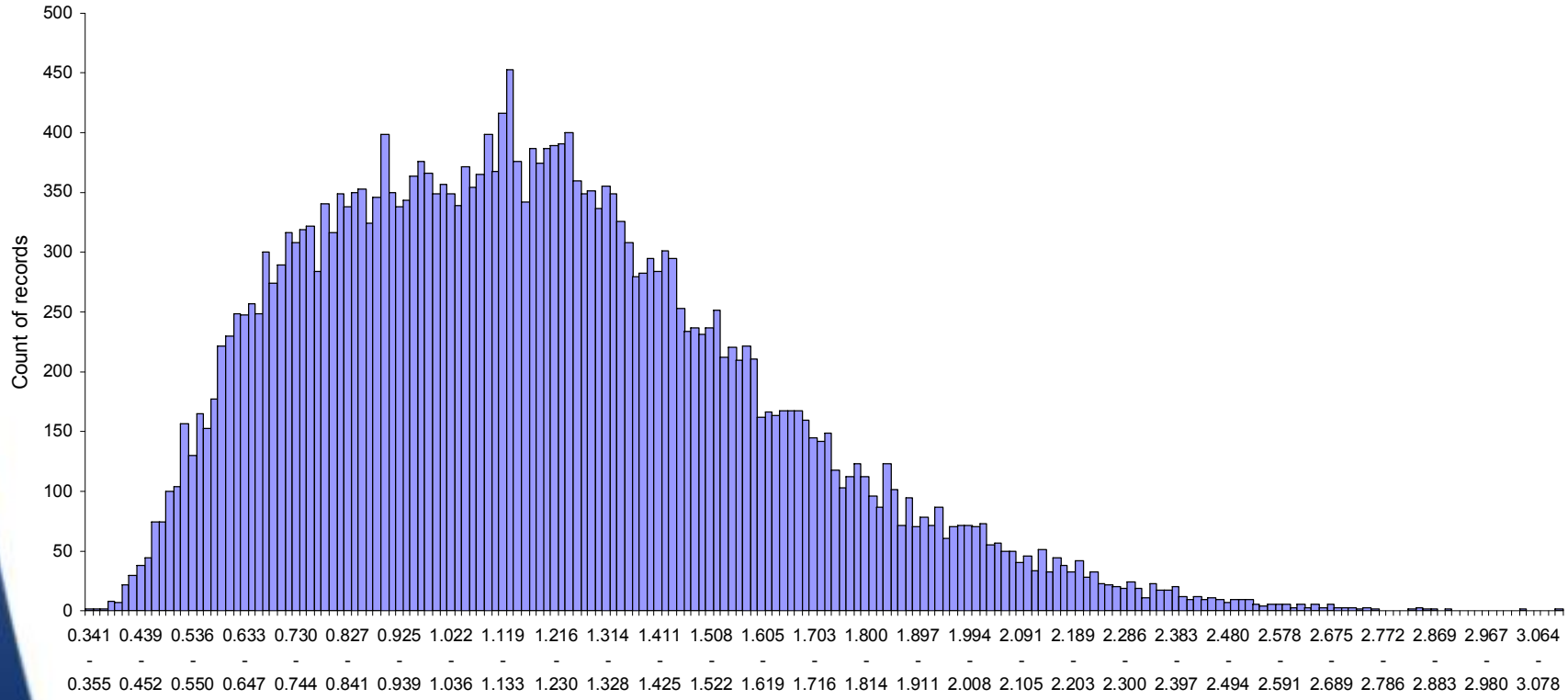
Base rate change with relativity change

Impact from current relativities to correct relativities



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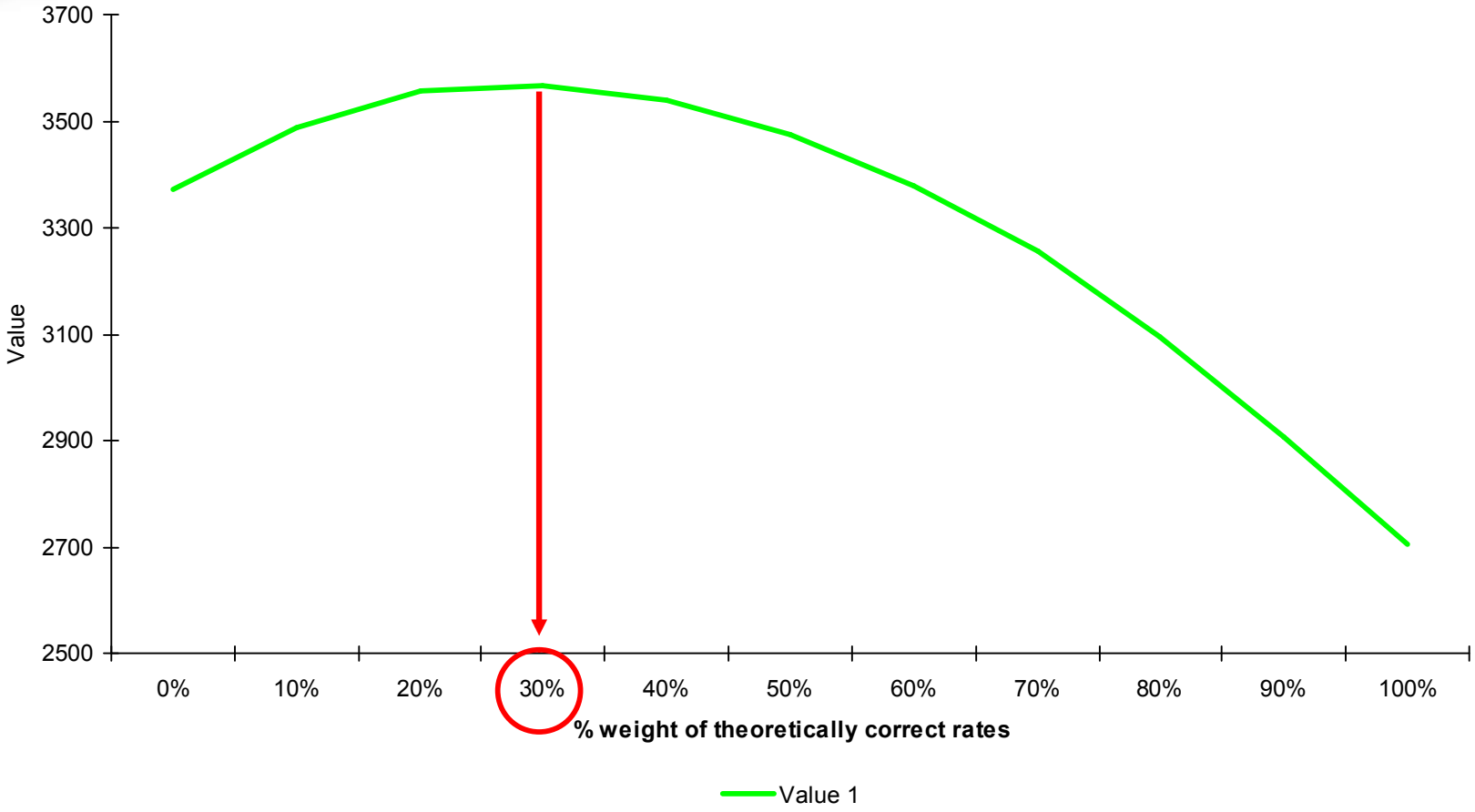
Base rate change with relativity change



Blend of current and theoretically correct relativities

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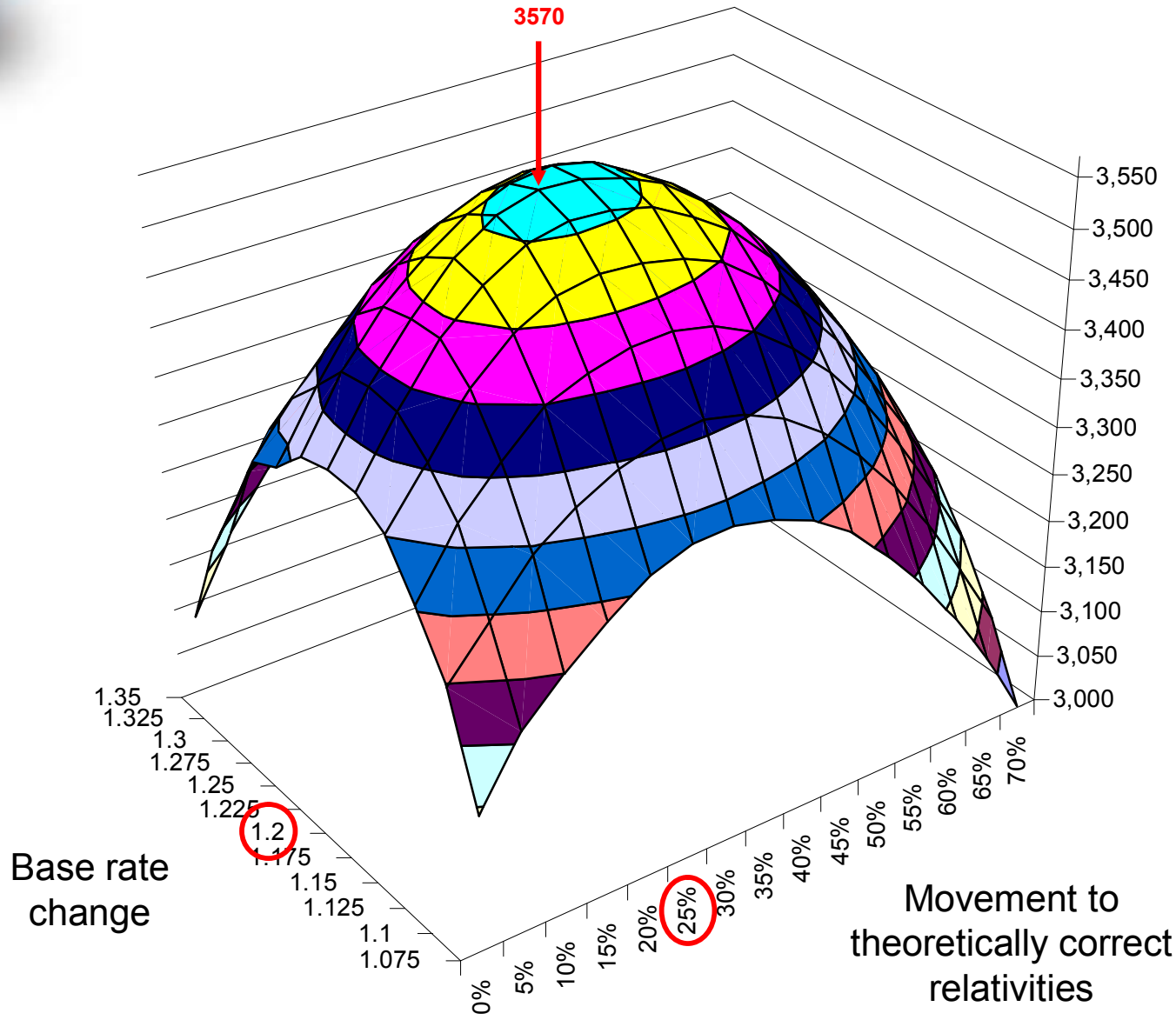
Base rate change with relativity change



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Moderators

Types of rating structures - simple multiplicative

$621.50 x

Age	Factor
17	2.52
18	2.05
19	1.97
20	1.85
21-23	1.75
24-26	1.54
27-30	1.42
31-35	1.20
36-40	1.00
41-45	0.93
46-50	0.84
50-60	0.76
60+	0.78

Group	Factor
1	0.54
2	0.65
3	0.73
4	0.85
5	0.92
6	0.96
7	1.00
8	1.08
9	1.19
10	1.26
11	1.36
12	1.43
13	1.56

Sex	Factor
Male	1.00
Female	1.25

Area	Factor
A	0.95
B	1.00
C	1.09
D	1.15
E	1.18
F	1.27
G	1.36
H	1.44

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Moderators

Types of rating structures - multiplicative with moderator

$621.50 x

Age	Factor
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50-60	0.76
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12	1.43
13	1.56

Sex	Factor
Male	1.00
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Area	Factor
A	0.95
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C	1.09
D	1.15
E	1.18
F	1.27
G	1.36
H	1.44

Subject to
max +20%
min -10%

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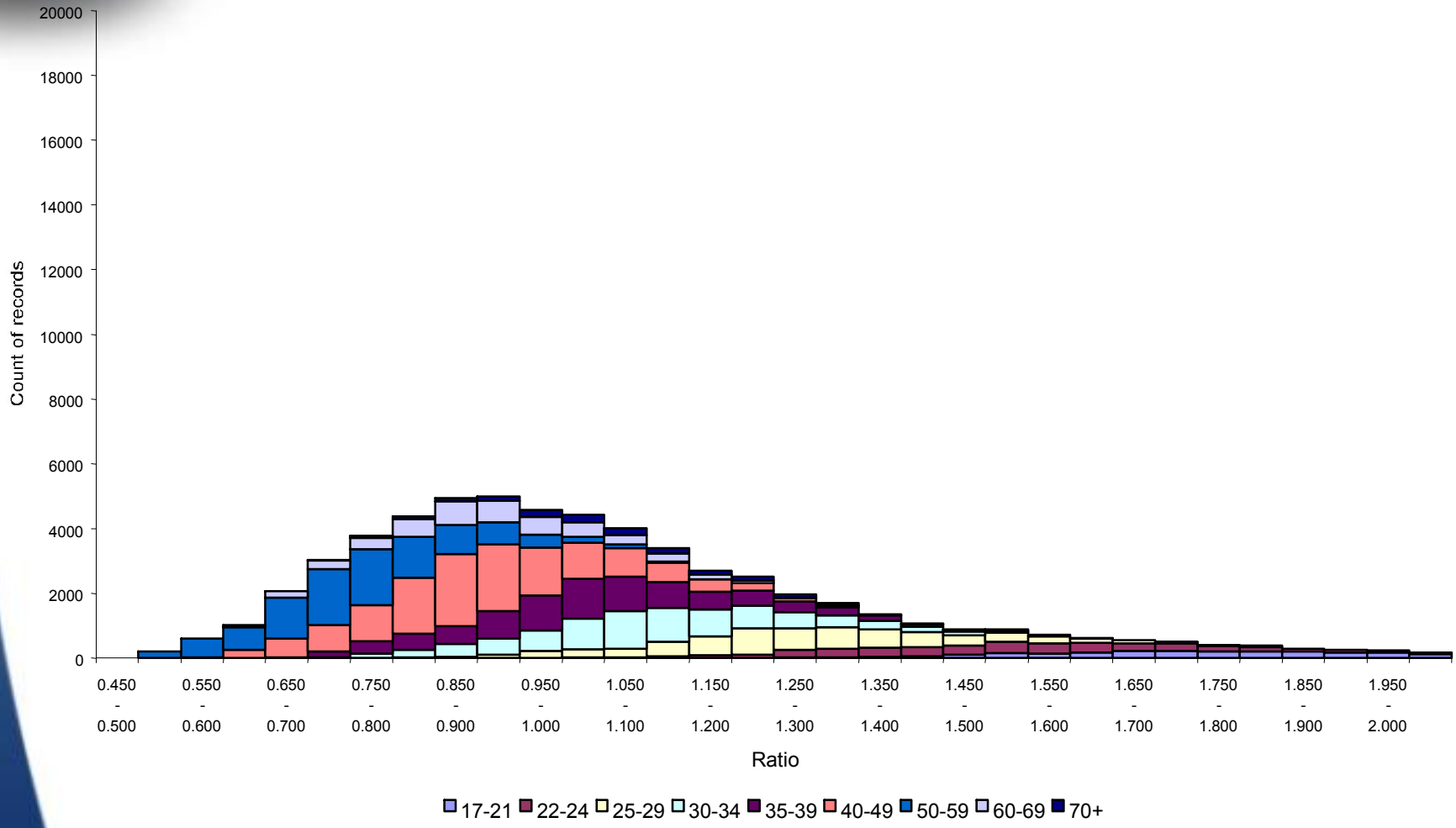
Example of use of moderator



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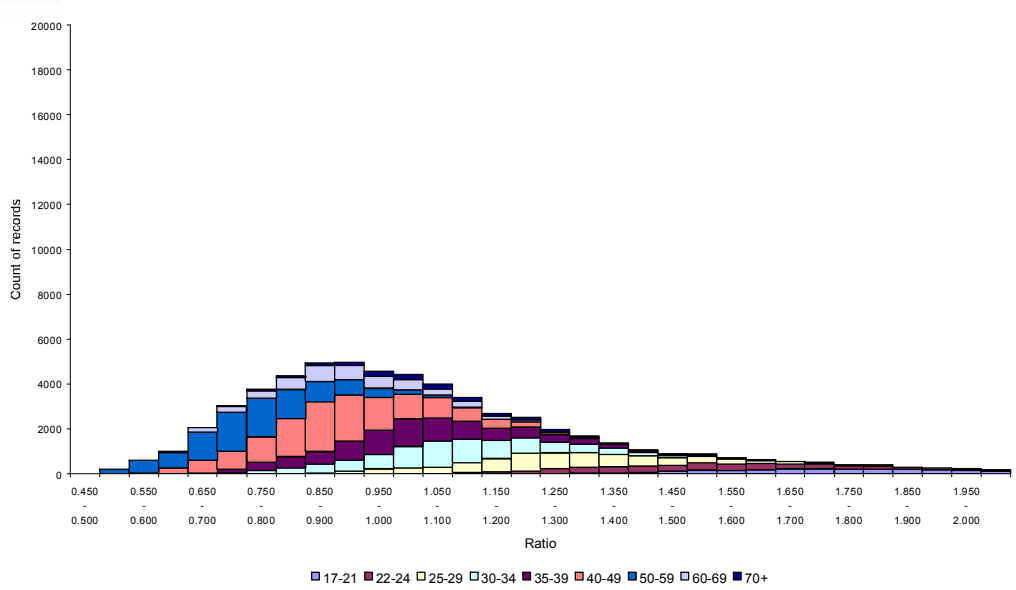
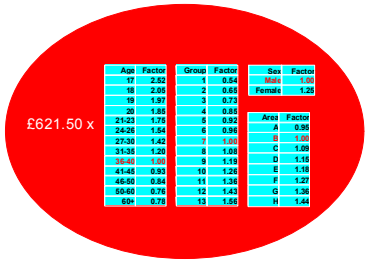
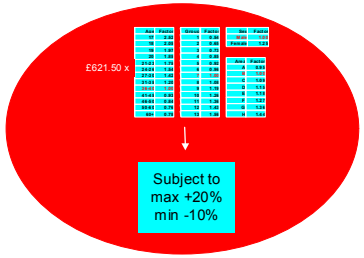
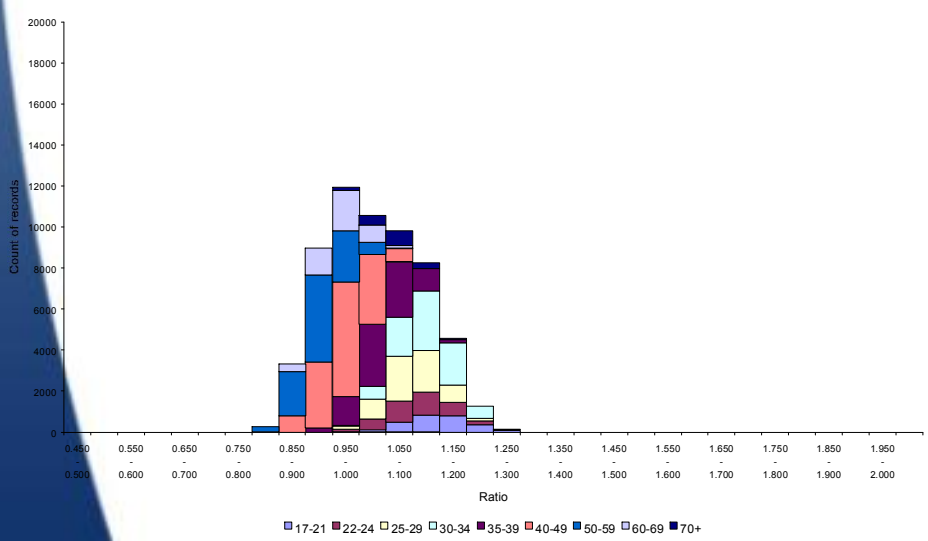

Count of records
Ratio
17-21 22-24 25-29 30-34 35-39 40-49 50-59 60-69 70+


£621.50 x


£621.50 x
Subject to
max +20%
min -10%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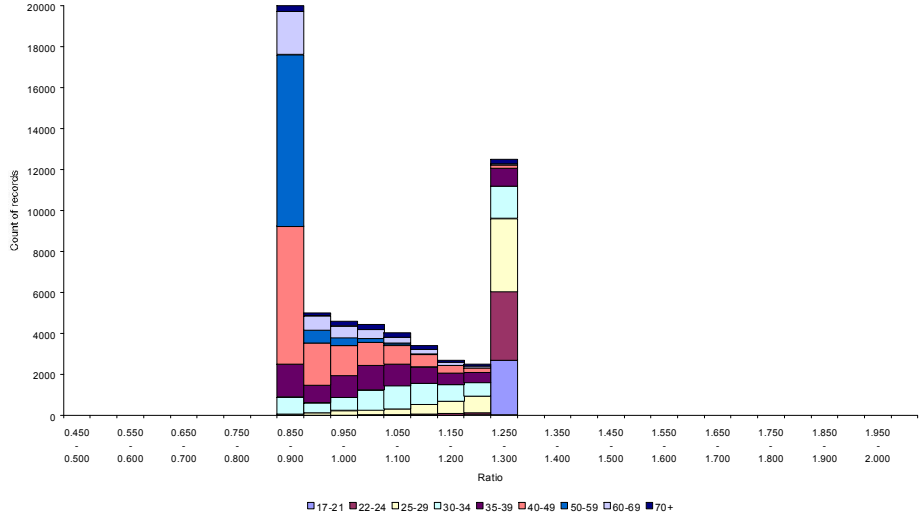
Count of records
Ratio
17-21 22-24 25-29 30-34 35-39 40-49 50-59 60-69 70+

Moderators: pros/cons

- Advantages of moderators include:
  - moves everyone to optimal position (subject to acceptable premium increases) more quickly
  - can take into account elasticity for the type of person in question
  - can be less detailed work required regarding underlying parameterization
  - less work required to parameterize in future
- Disadvantages
  - more onerous system requirements
  - harder to understand rating structure
  - likely to result in different quotes for renewals and new business for an identical risk
  - may not be too popular with some regulators?

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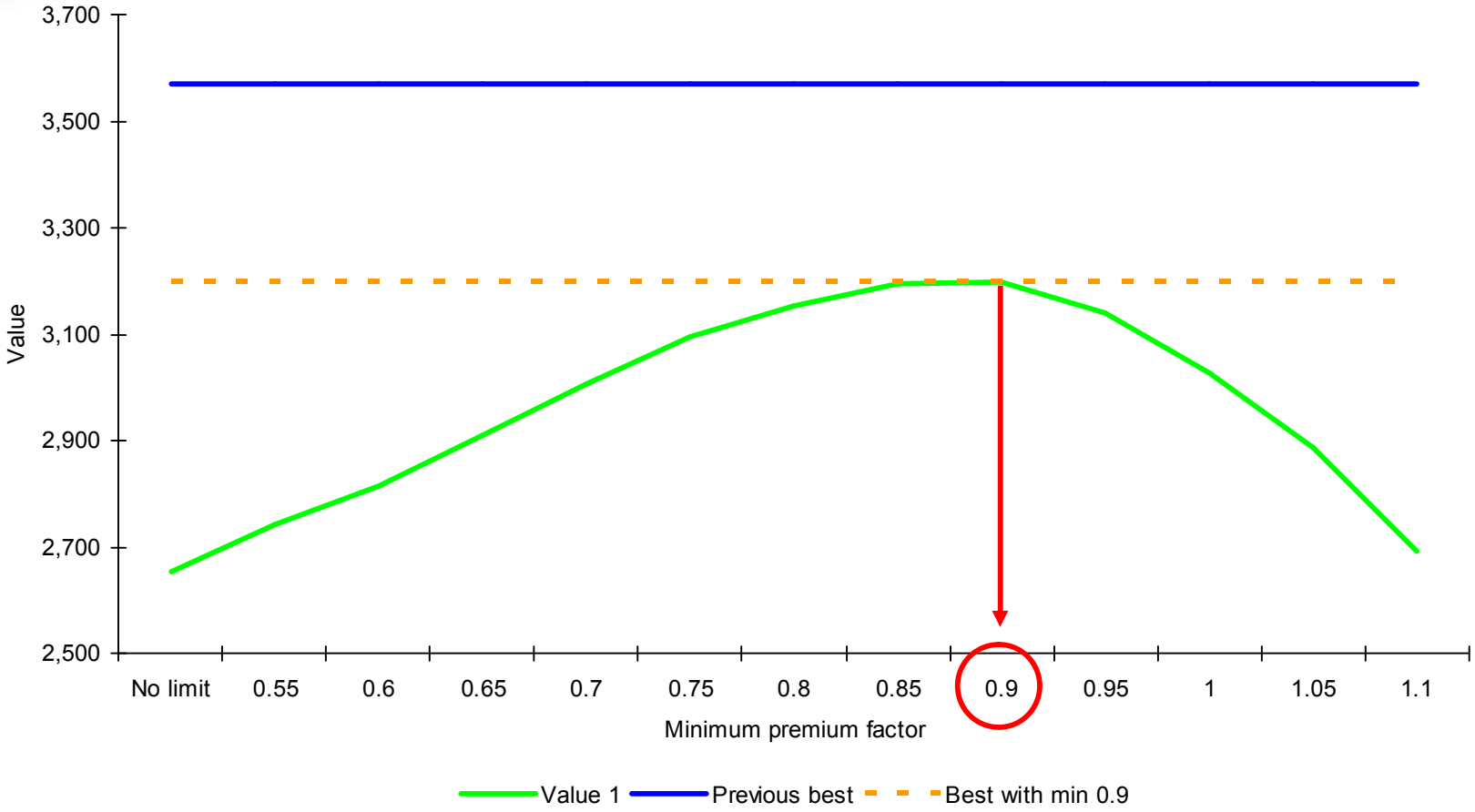
Parameterizing the moderator
Investigation of limiting premium decreases



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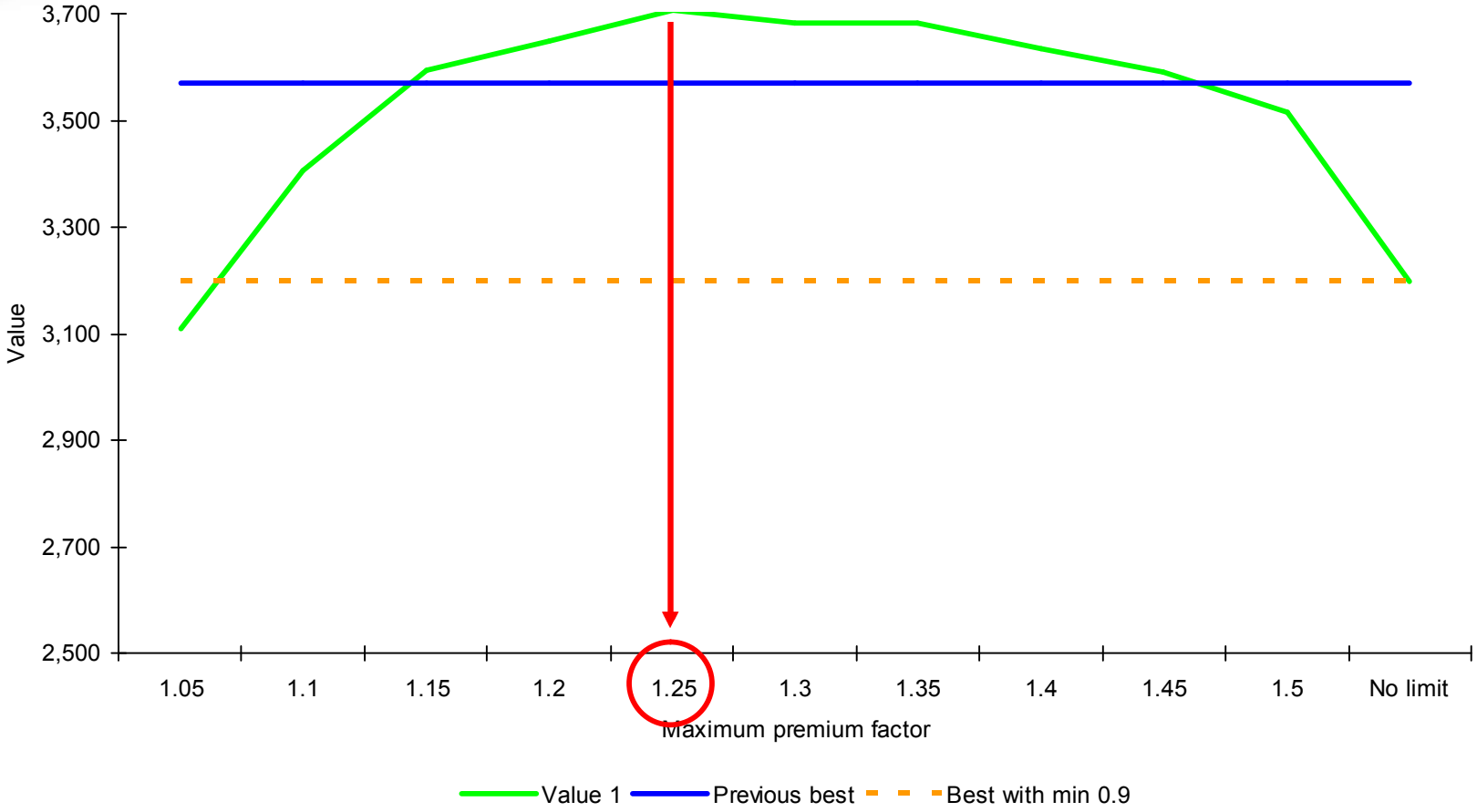
Parameterizing the moderator

Investigation of limiting premium increases given 10% limit on decreases



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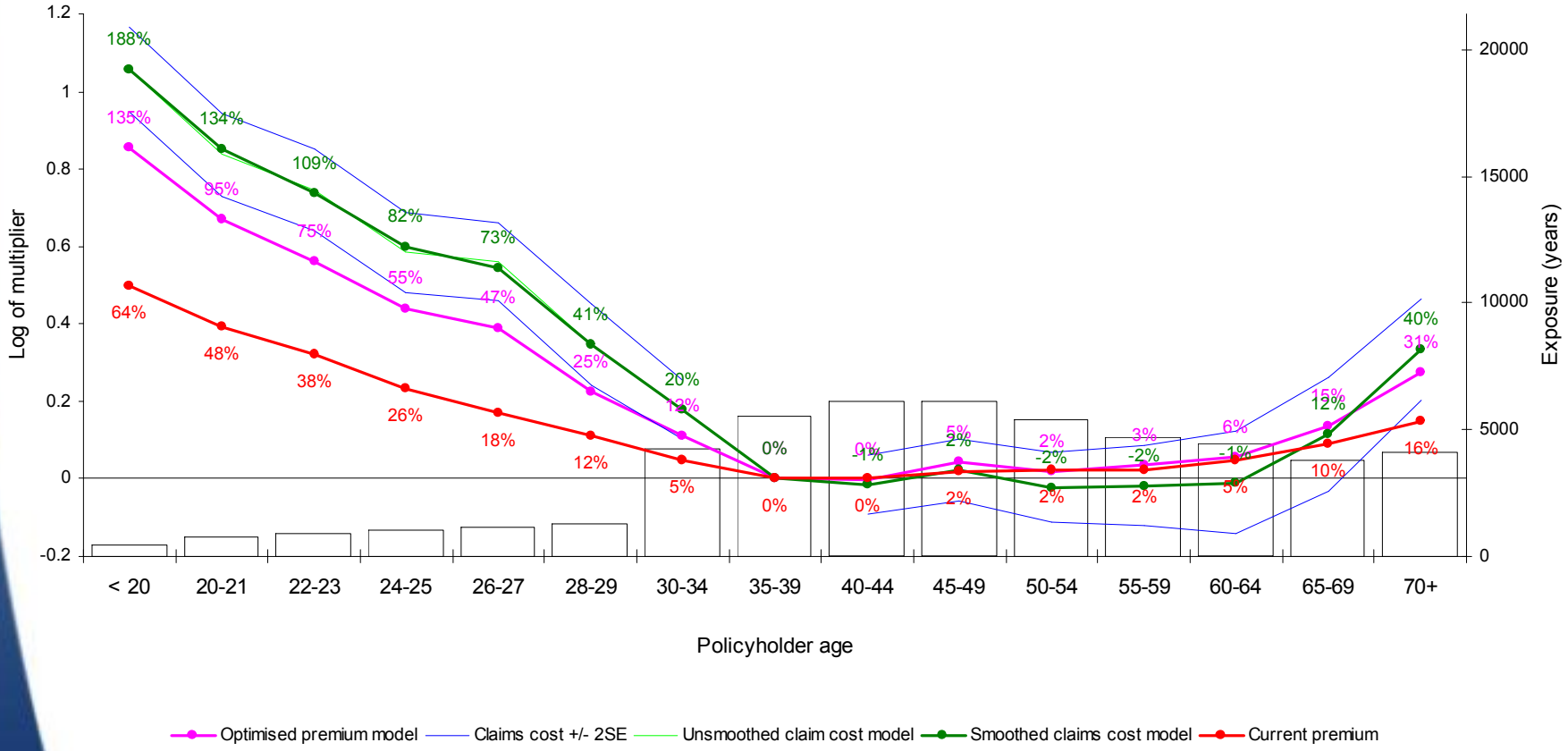
Full optimization

Optimized premium

Comparison with claims model and current premium



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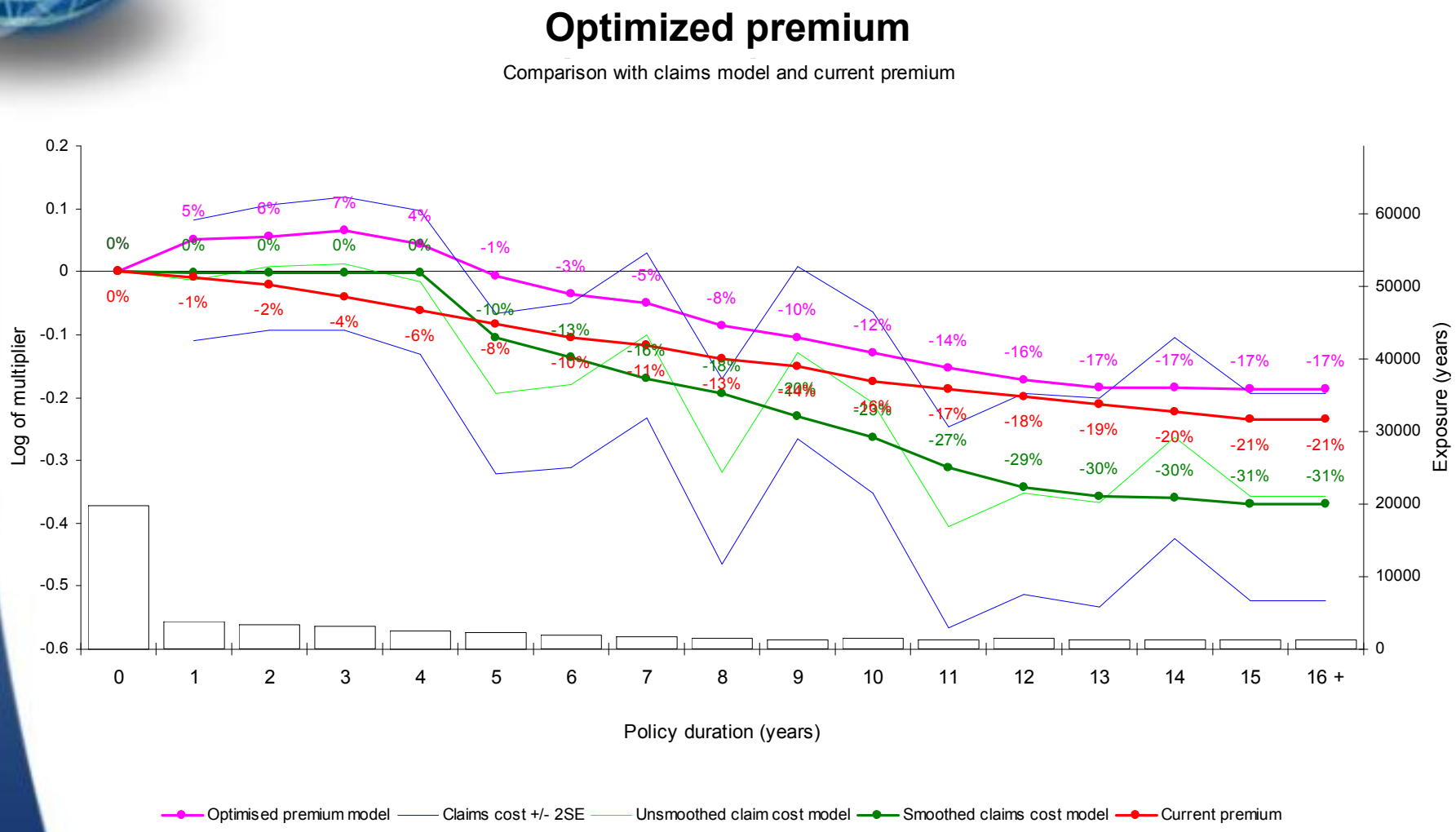
Full optimization



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