# SPE-1
# Policyholder Retention and its Impact on Pricing

WWW.WATSONWYATT.COM

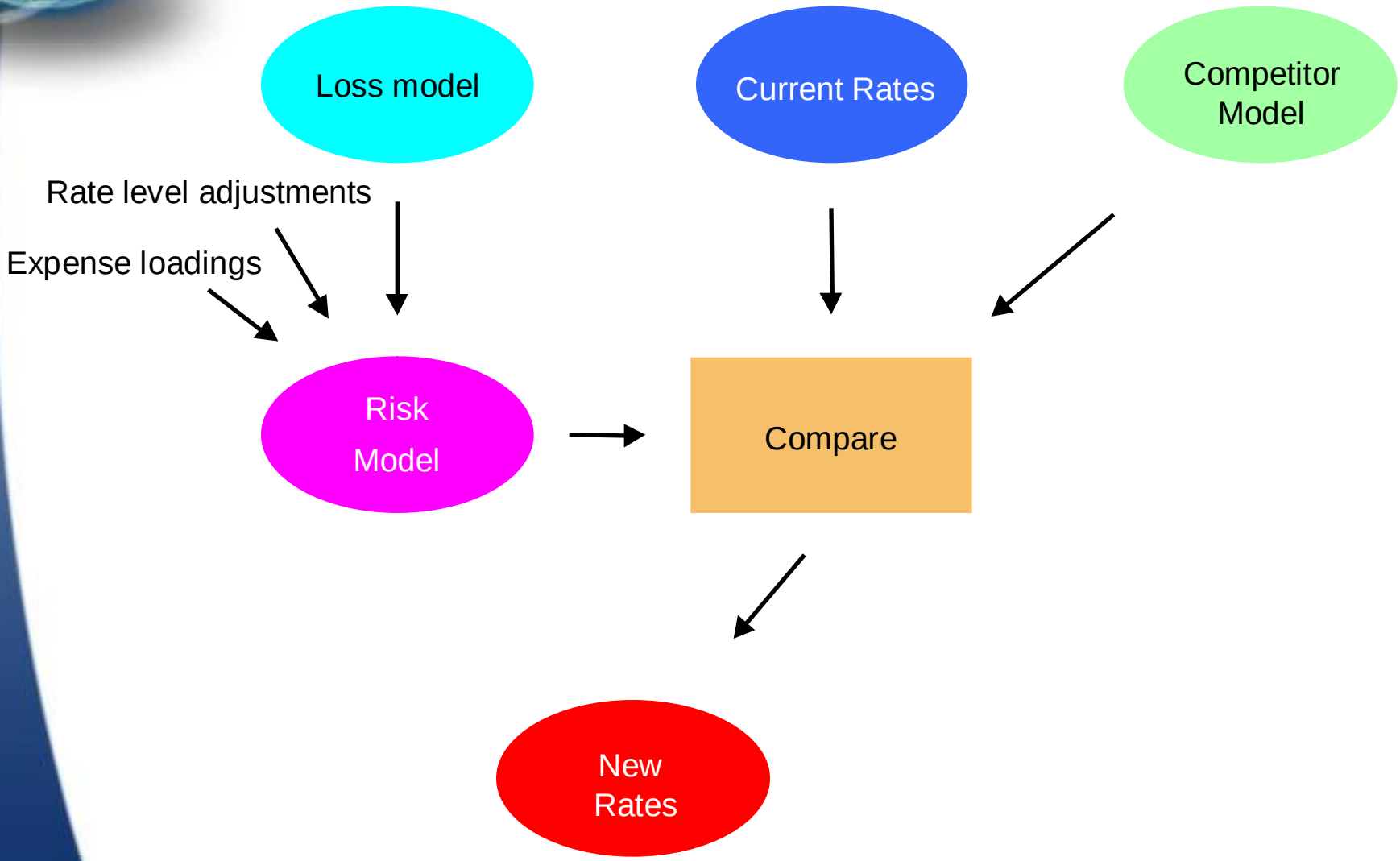
## 2006 CAS Seminar on Ratemaking


Claudine Modlin, FCAS

Watson Wyatt Worldwide

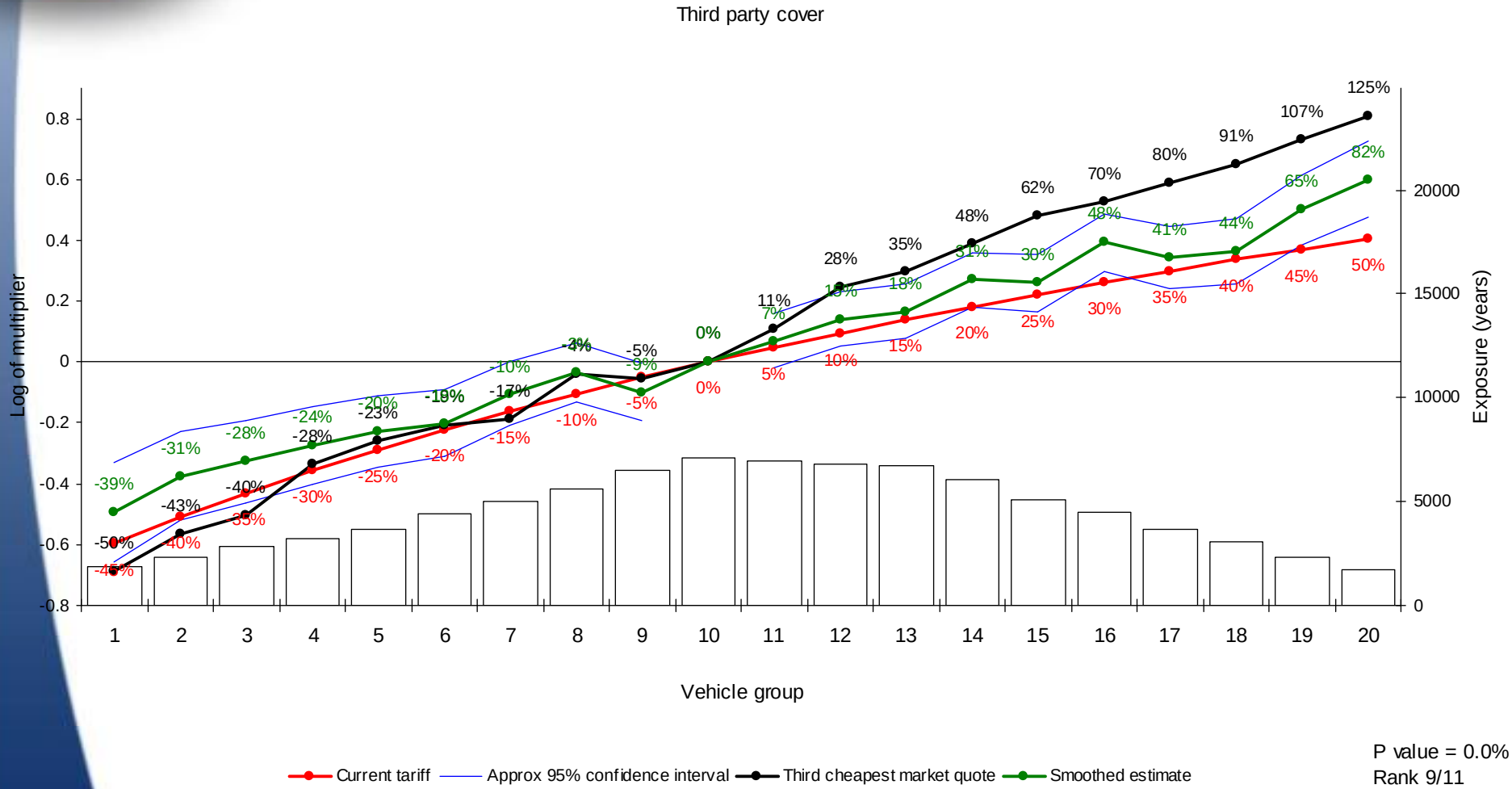

Watson Wyatt Worldwide

# Traditional ratemaking process



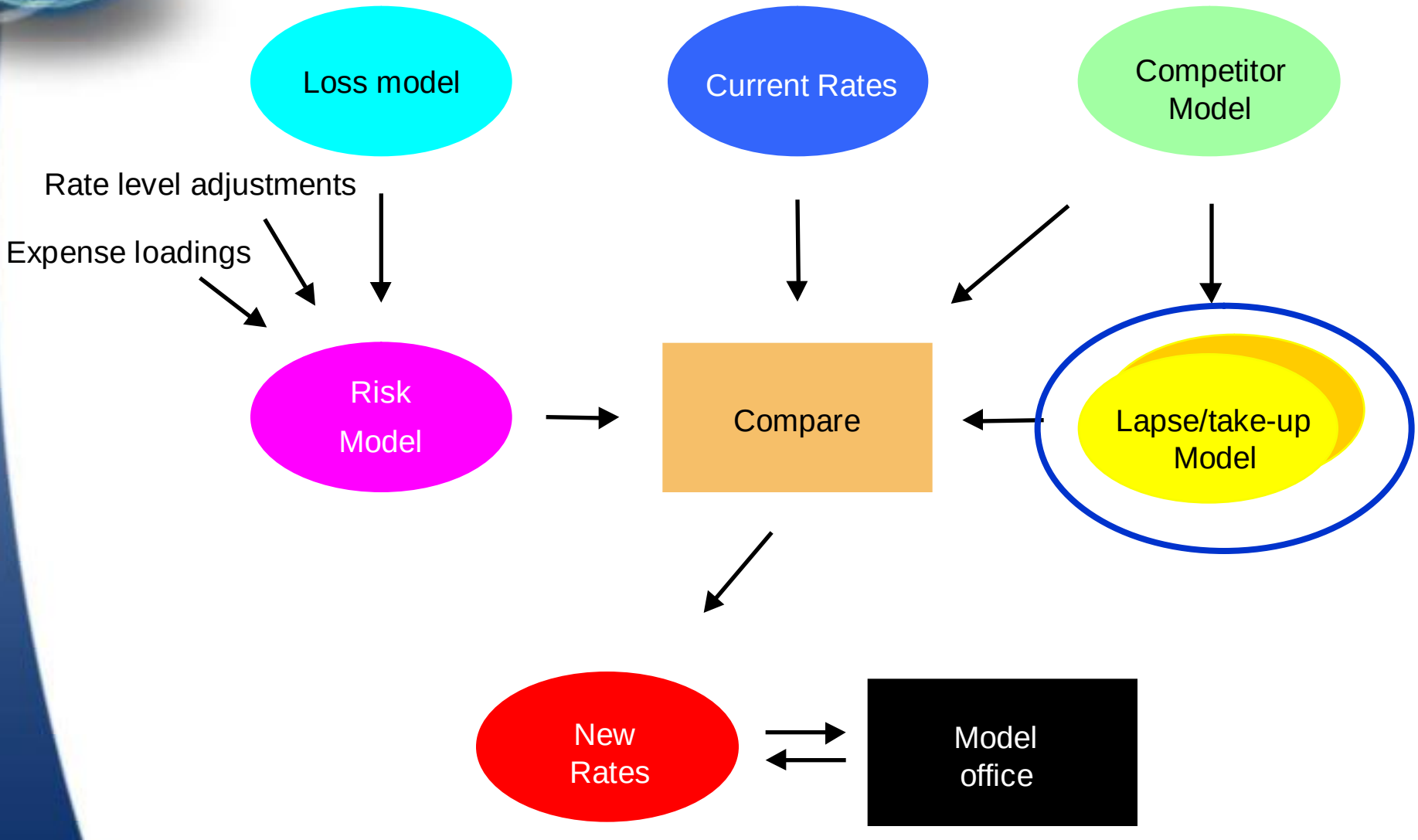
# Rate relativity indication

## Example of competitor analysis



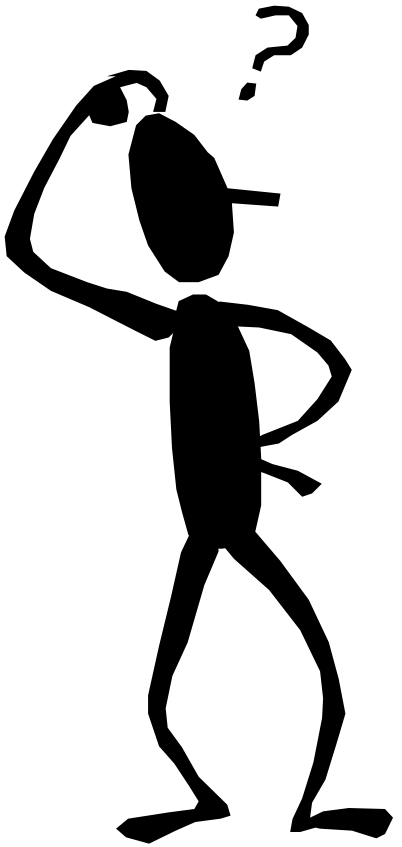

P value = 0.0%
Rank 9/11

# Full ratemaking process



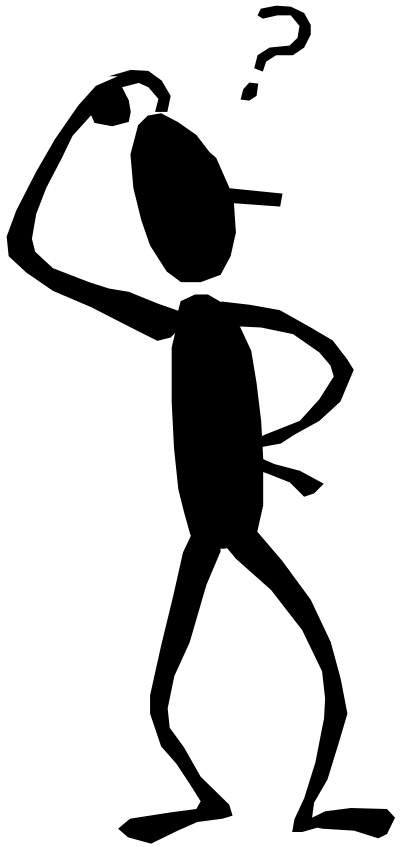
# Retention / conversion analysis

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



# Retention analysis

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



# Data required

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

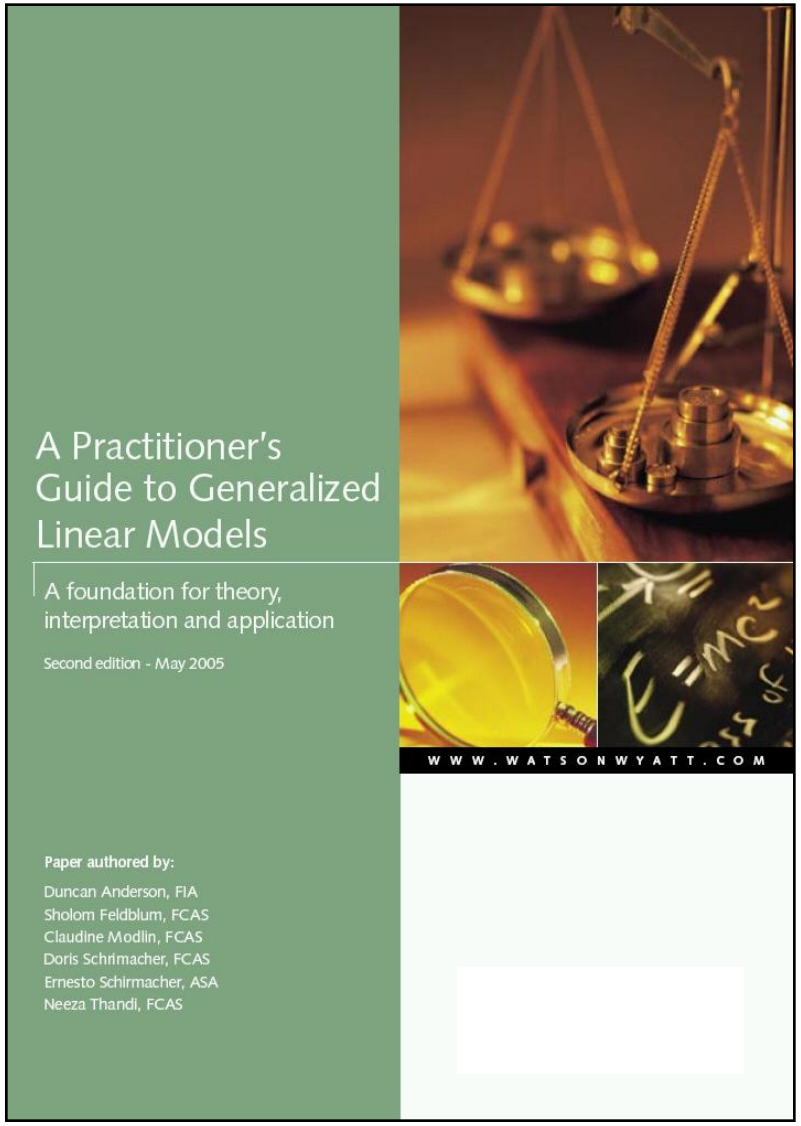
# Generalized linear models

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

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

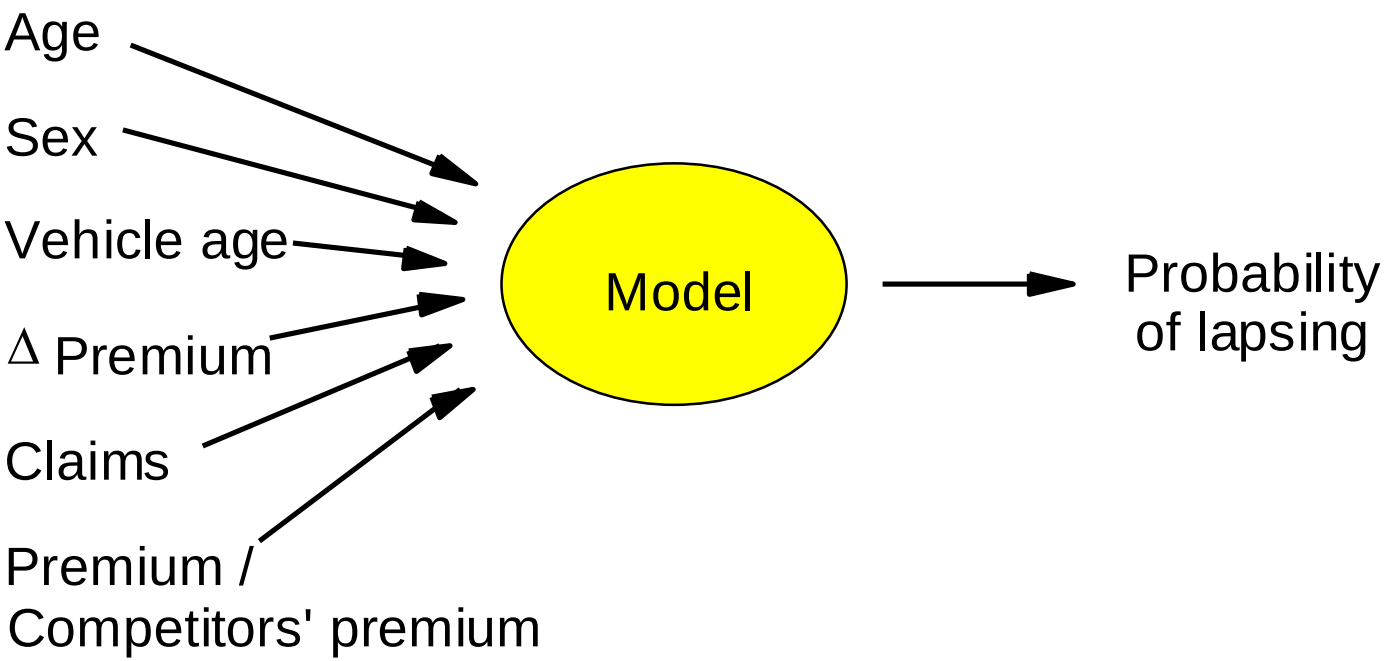
- Consider all factors simultaneously
- Allow for nature of random process
- Provides diagnostics
- Robust and transparent

# "A Practitioner's Guide to Generalized Linear Models"



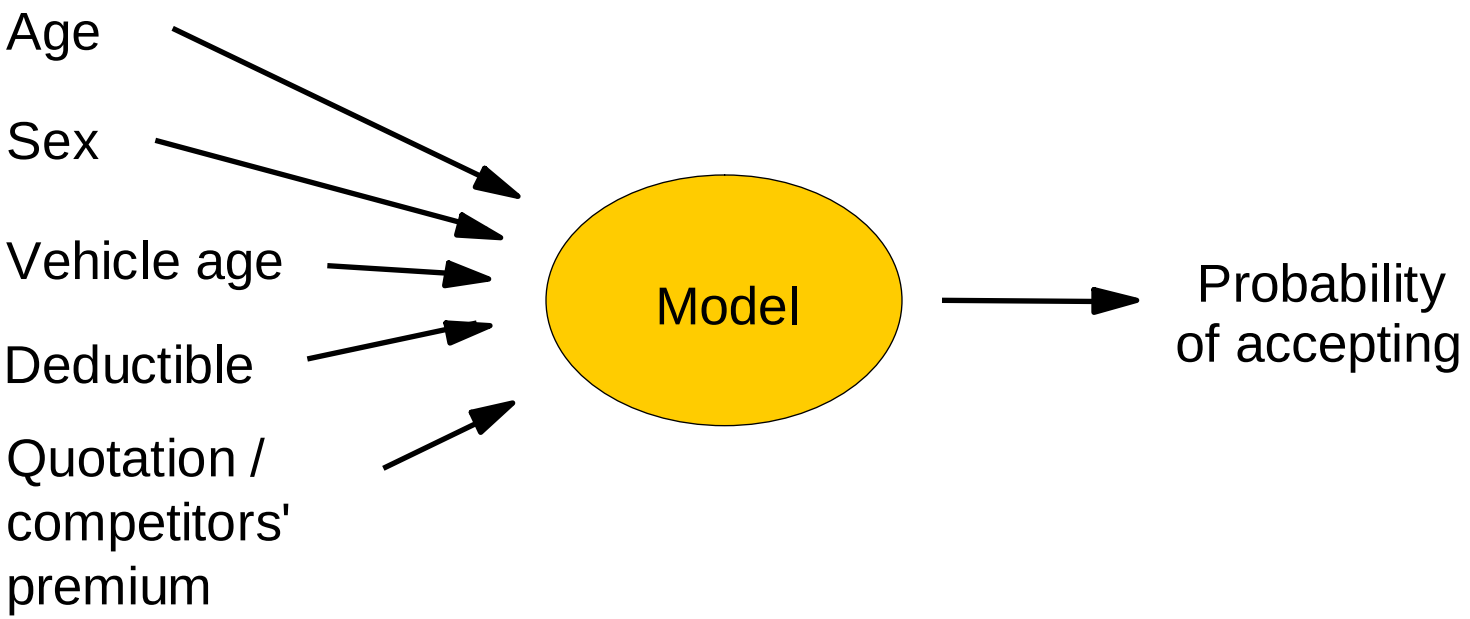
# Modeling retention

- Most companies have data on renewal offers



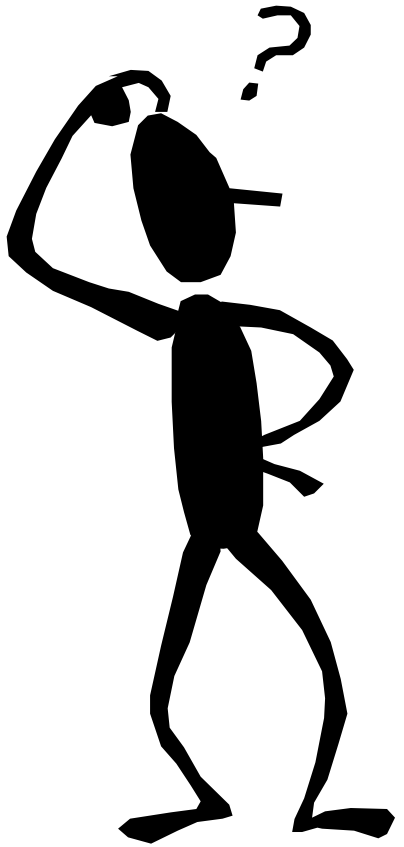
# Modeling new business rates

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



# Retention analysis

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



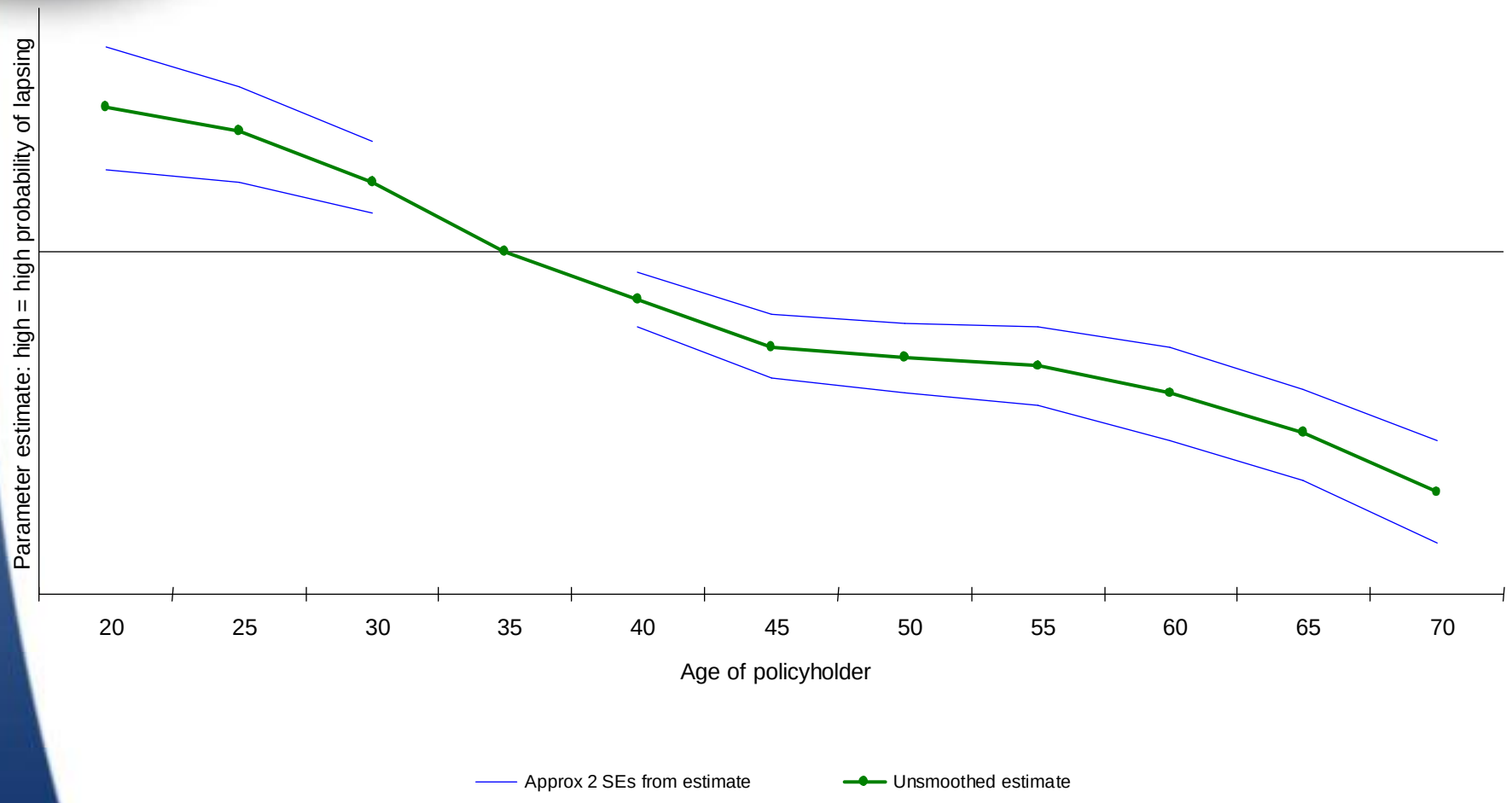
# What to consider

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

# Who are your customers?

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

# Effect of age of policyholder on lapses

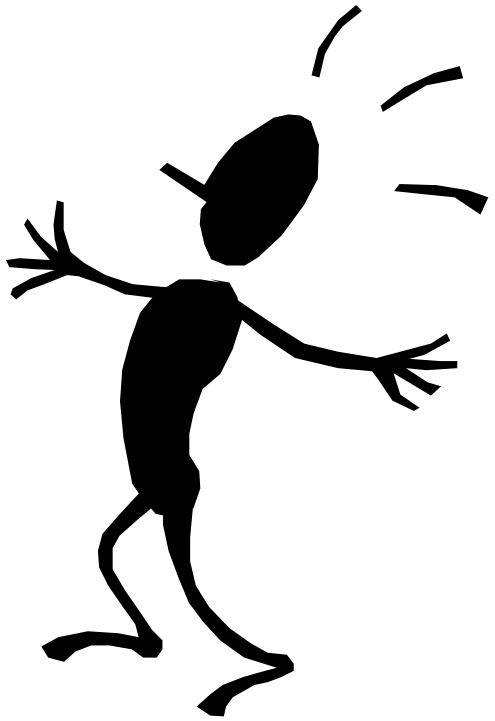


# How do you connect with them?

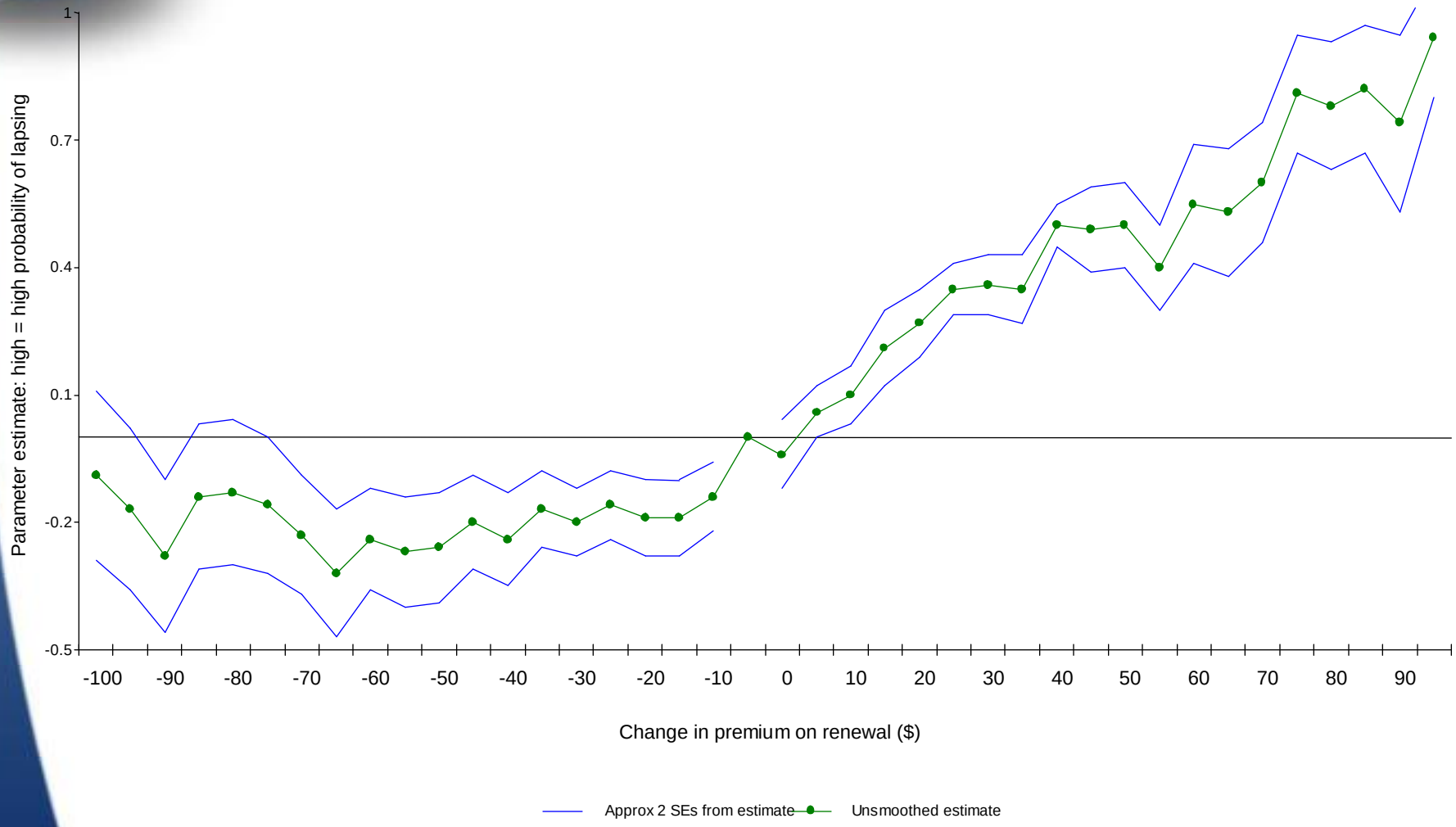
- Distribution channel
- Payment plan
- Affinity membership
- Other products held
- # years with company

# What have you done to them?

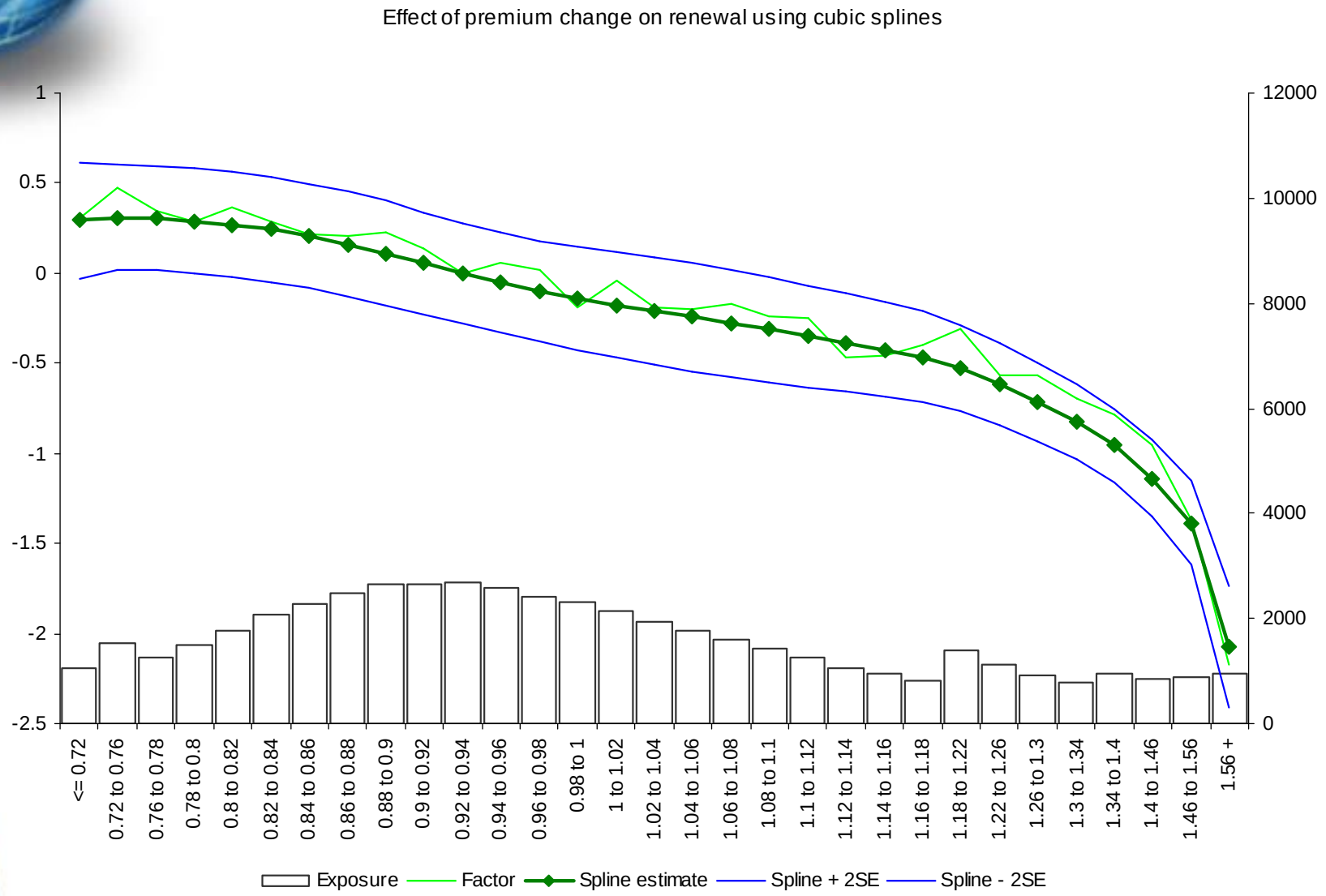
- Rate change
- Claims service
- Agent service



# Effect of premium change on lapses

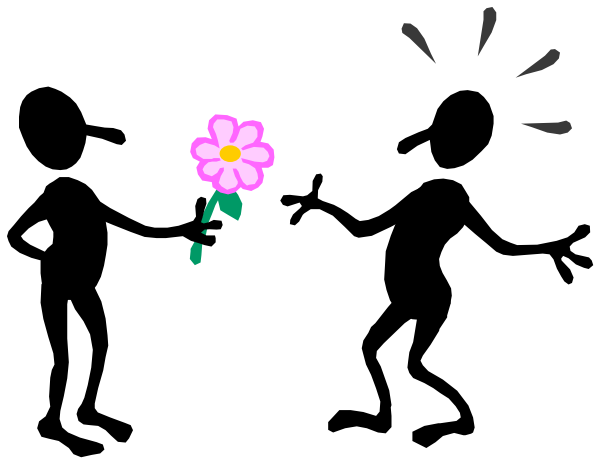


# Splines



# What have others done to them?

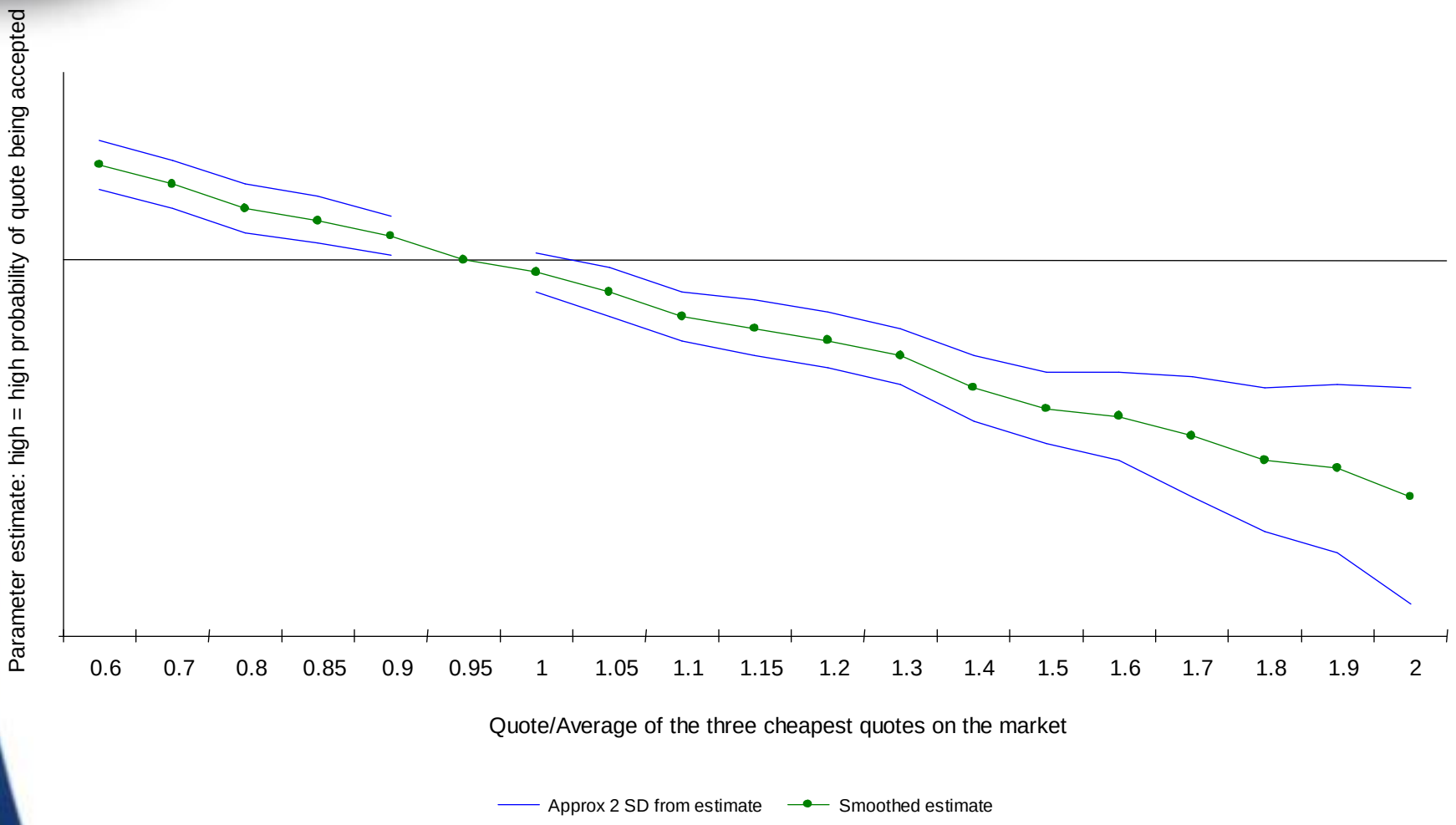
- Competitors' premium
- Product differentiation
  (may not be applicable to some products)



# Competitive indices

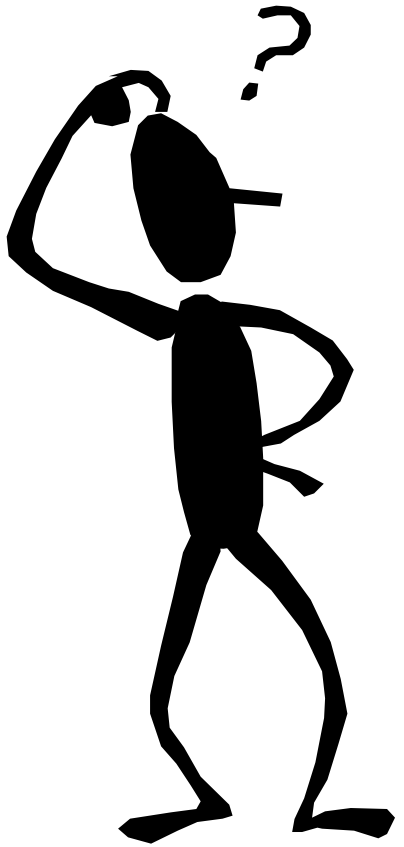
- For modeling, required at individual policy level
- Sources of competitor info
  - rate manuals
  - comparative rating software
- Measures
  - index (comparing to one competitor or averaged across several)
  - rank of quote relative to competitors
- Challenges
  - tier criteria
  - point in time
 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

# Effect of competitiveness on new business



# Retention analysis

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

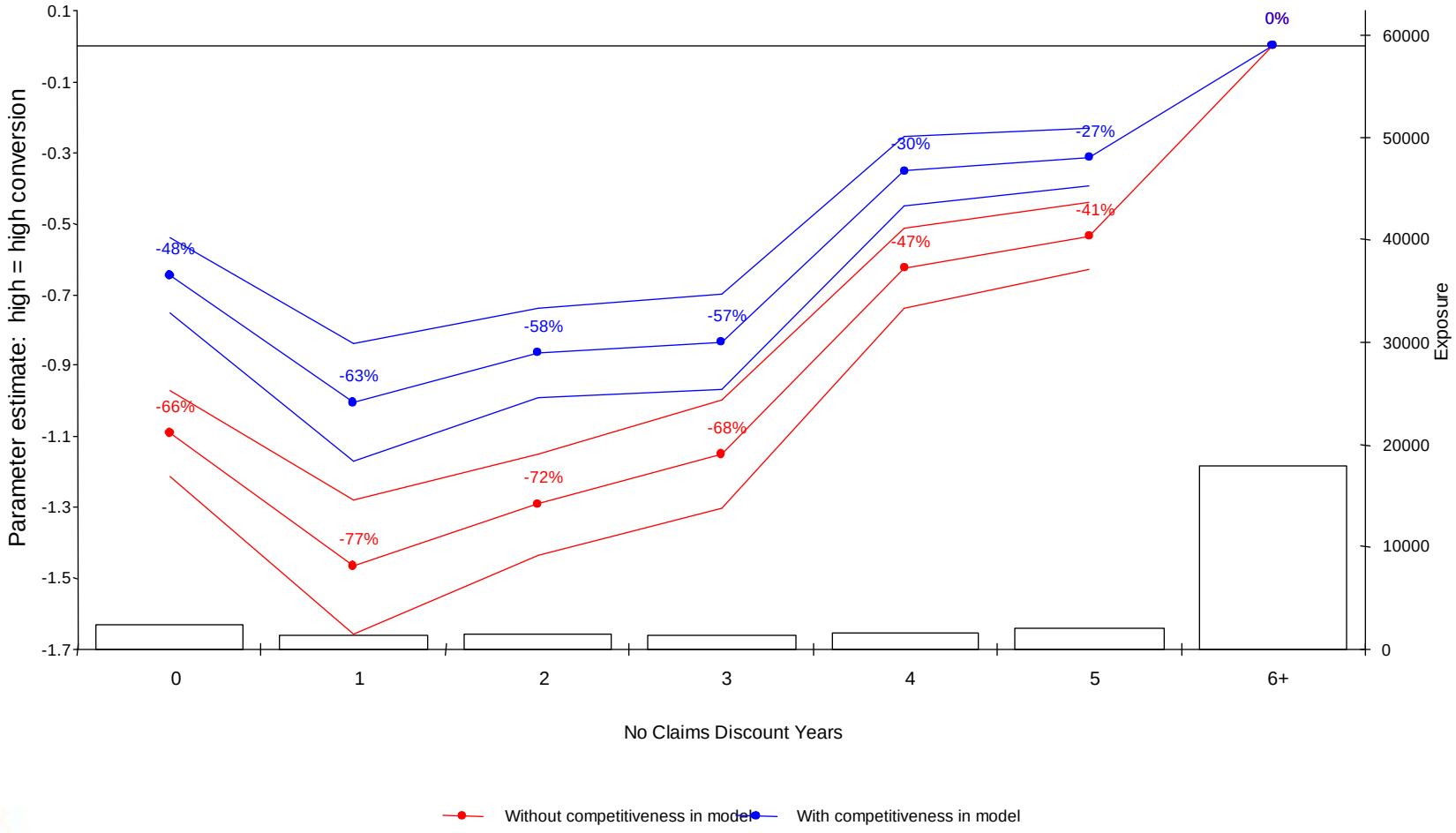


# Statistical assumptions

- 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

# Practical tip on competitiveness

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



# 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

# Measuring rate change

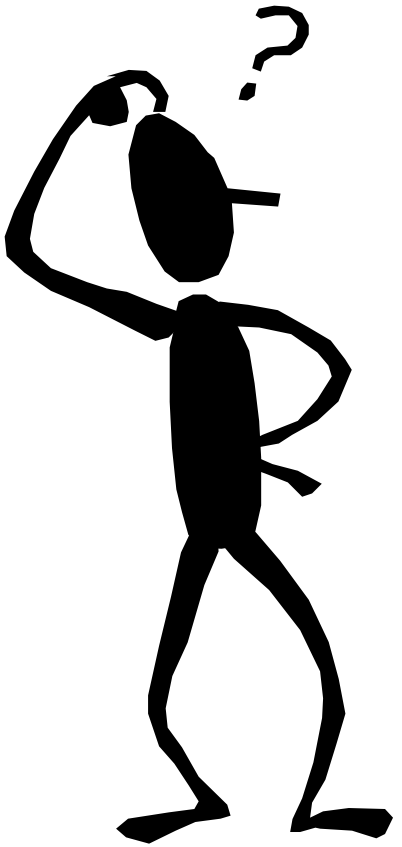
- Best to have more than one rate change in data
- Investigate % change and $ change
- Suggest fit rate change as a categorical factor and then model with splines if appropriate
  - some results are straight lines in logistic space, some are clearly not

# 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)

# Retention analysis

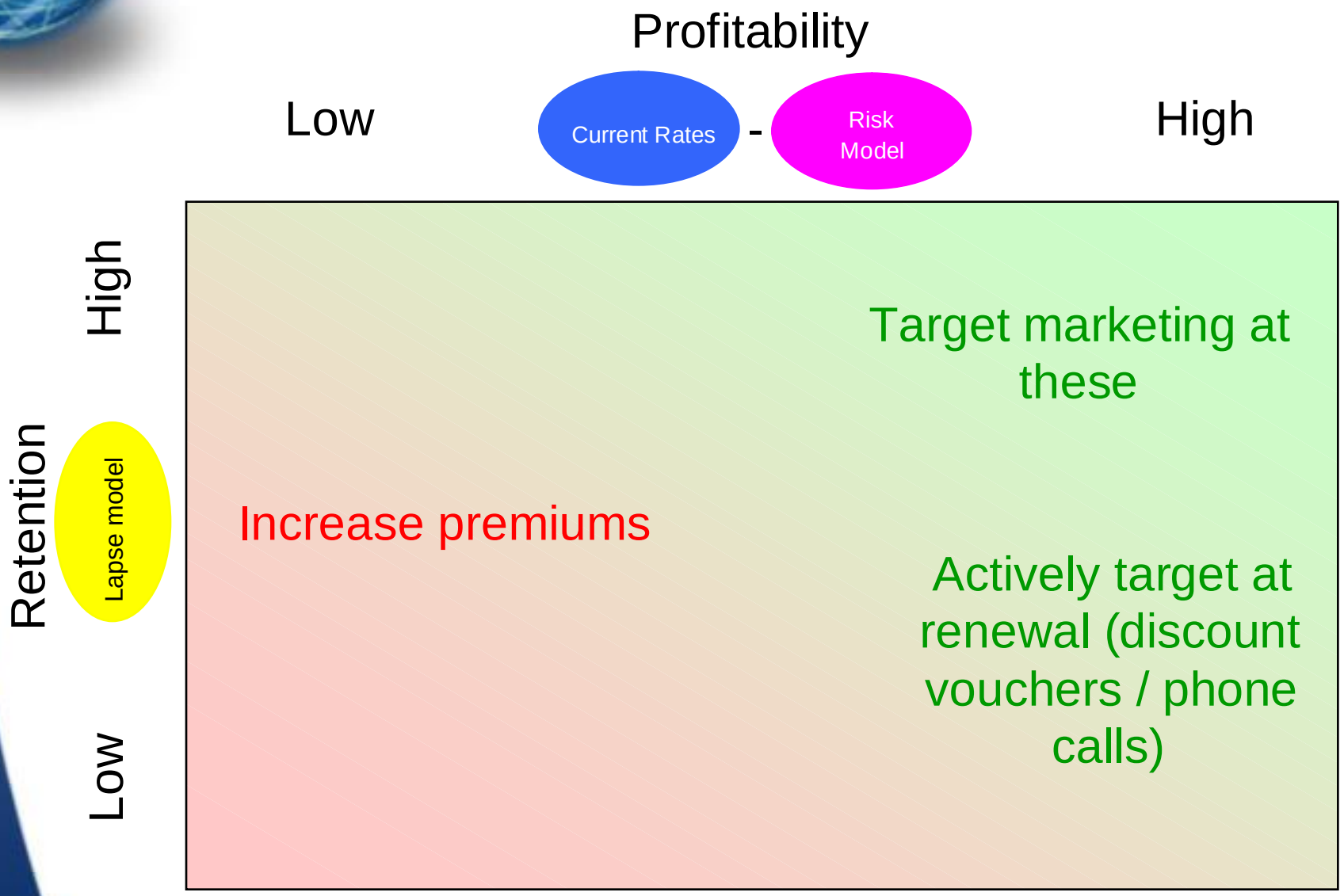
- What to measure
- What to consider
- Practical tips
- **Why do it**



# 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

# Customer value

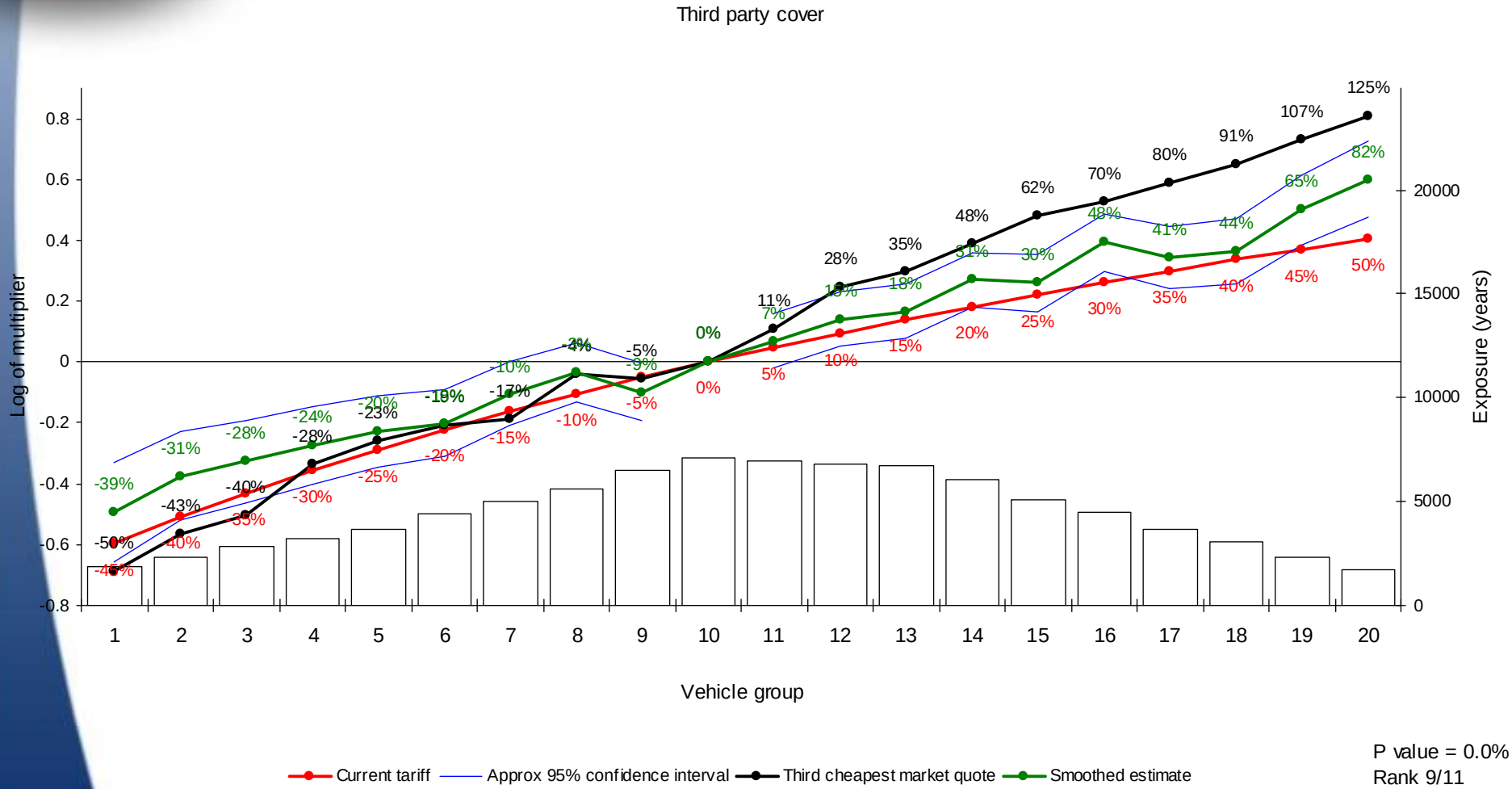


# Lifetime expense loads

- 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

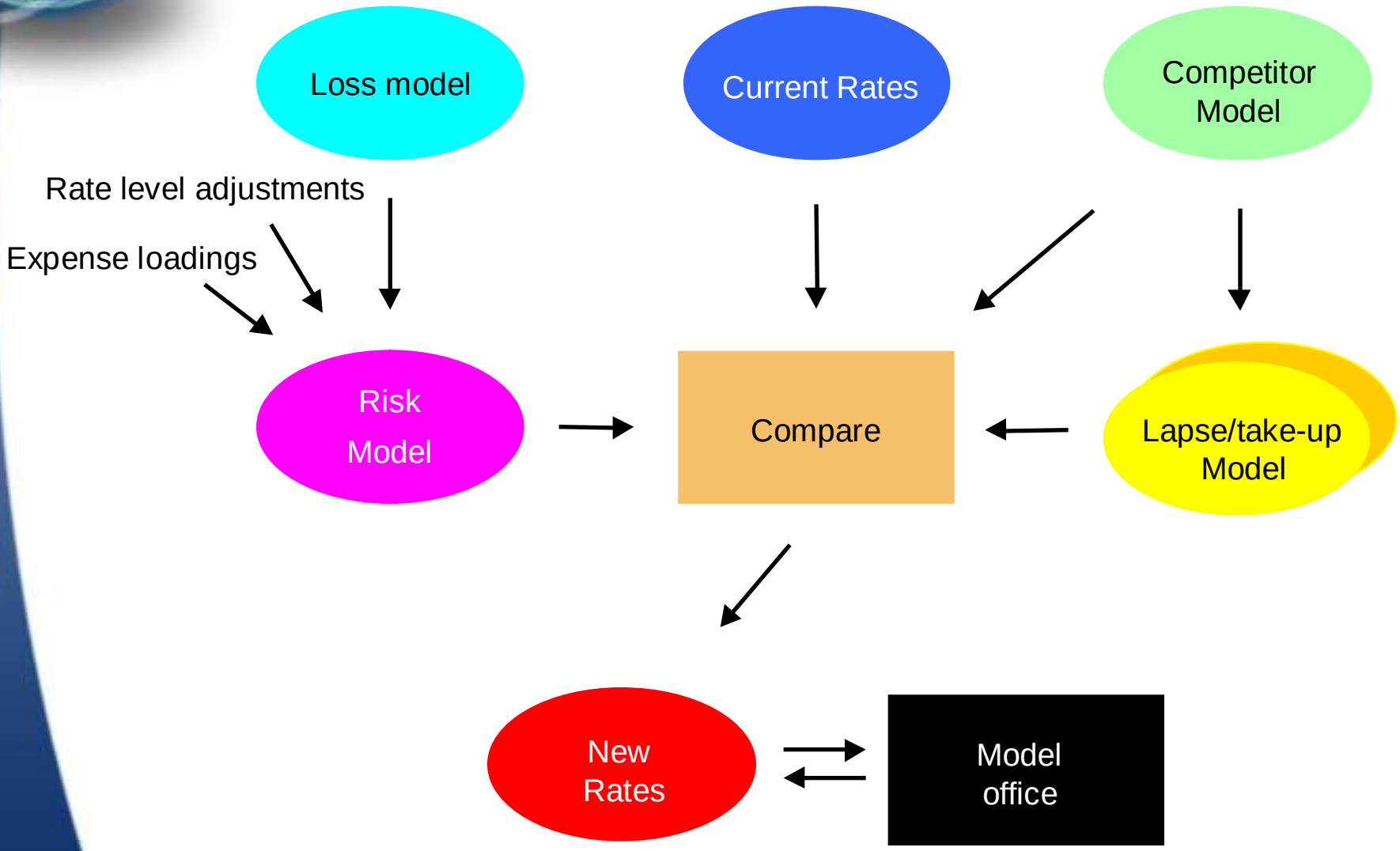
# Rate relativity indication

## Example of competitor analysis




P value = 0.0%
Rank 9/11

# Price optimization



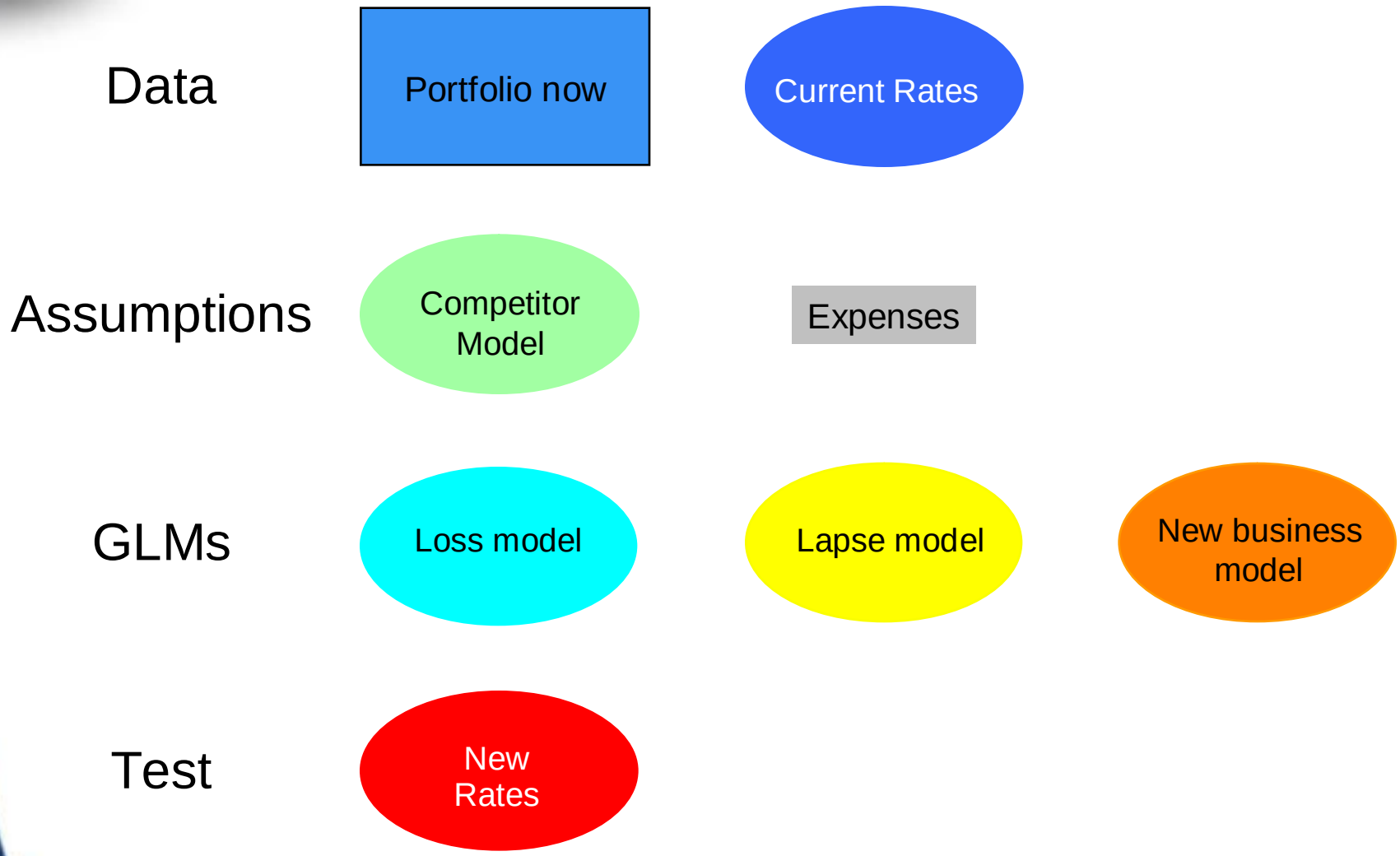
# Scenario testing and price optimization

- What will happen if I do rating action X?
- 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

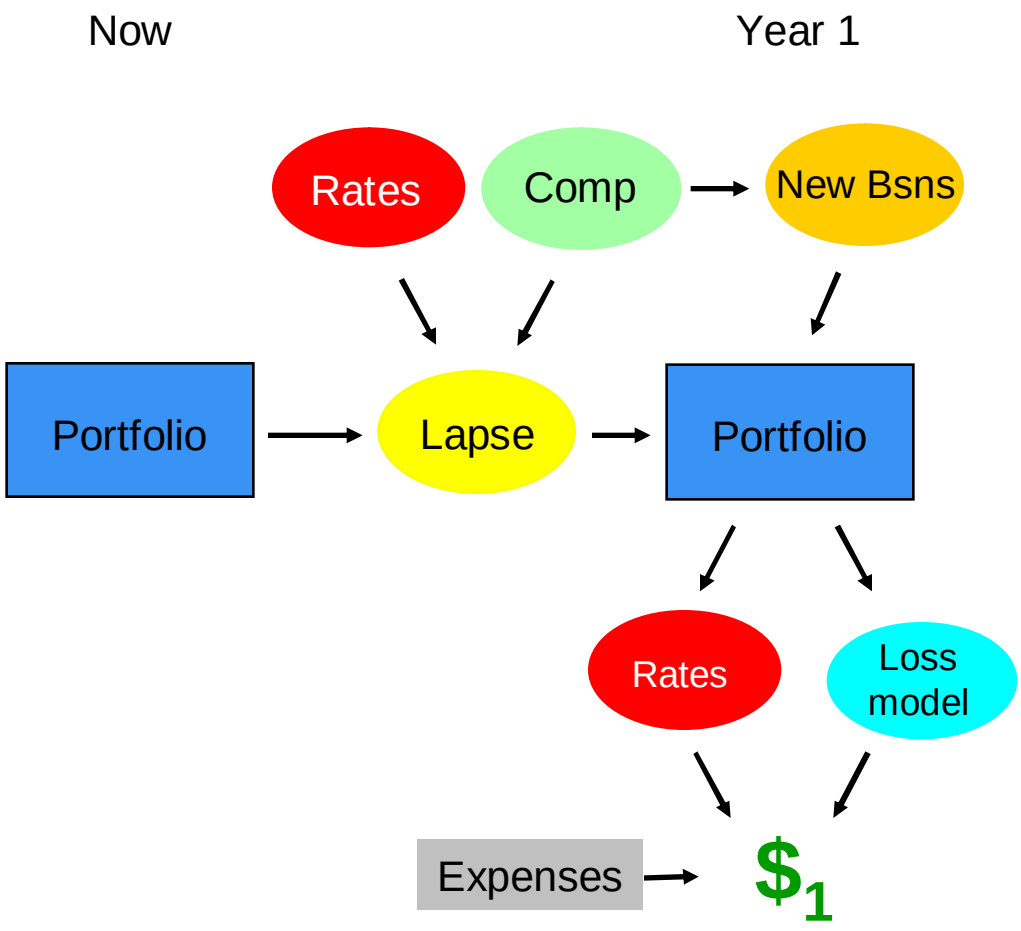
# Price optimization in four easy steps

1. Assemble ingredients
2. Build a "model office" scenario test
3. Define problem and success criteria
4. Optimize

# Ingredients



# Scenario testing

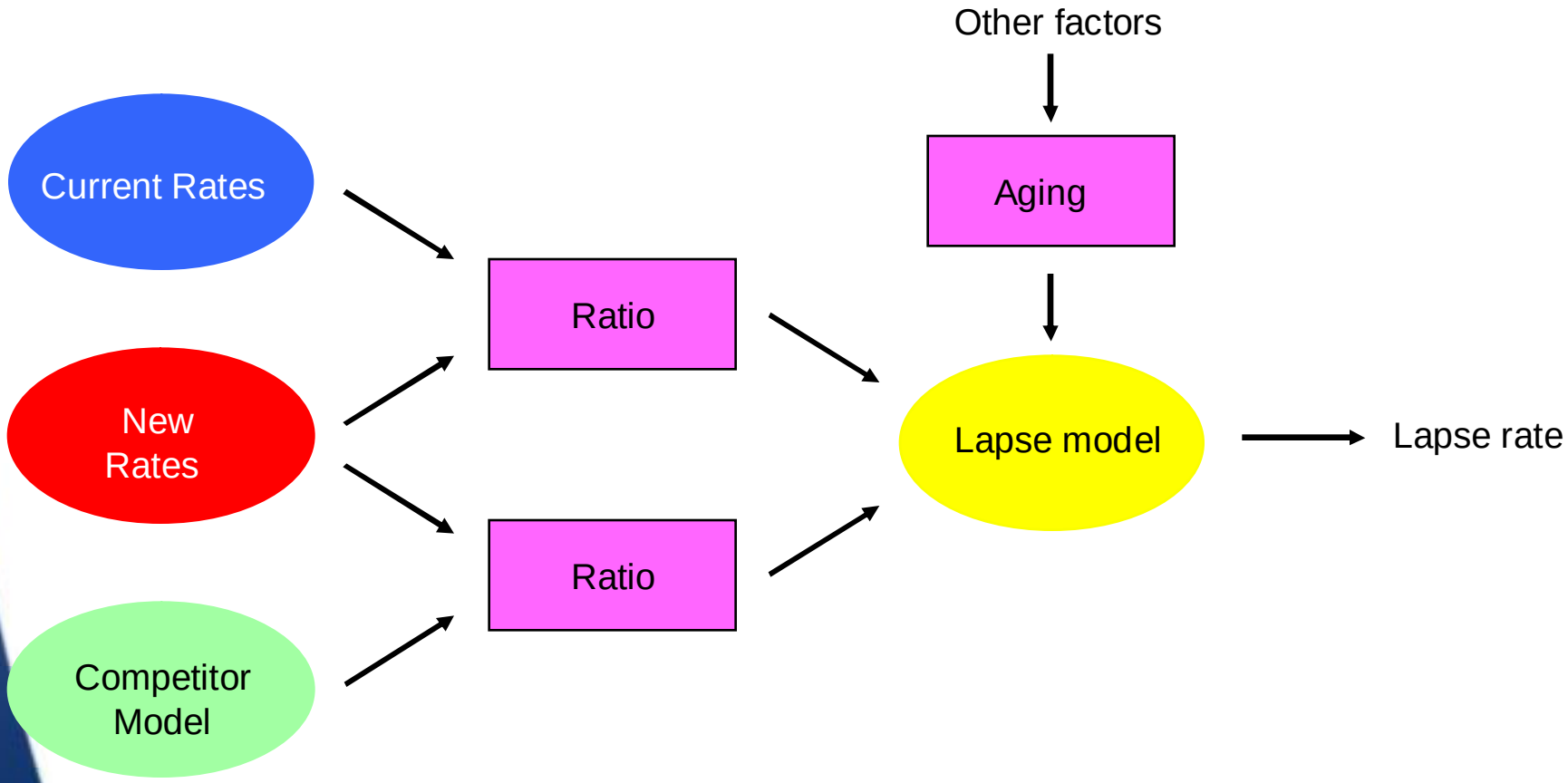


# Issues

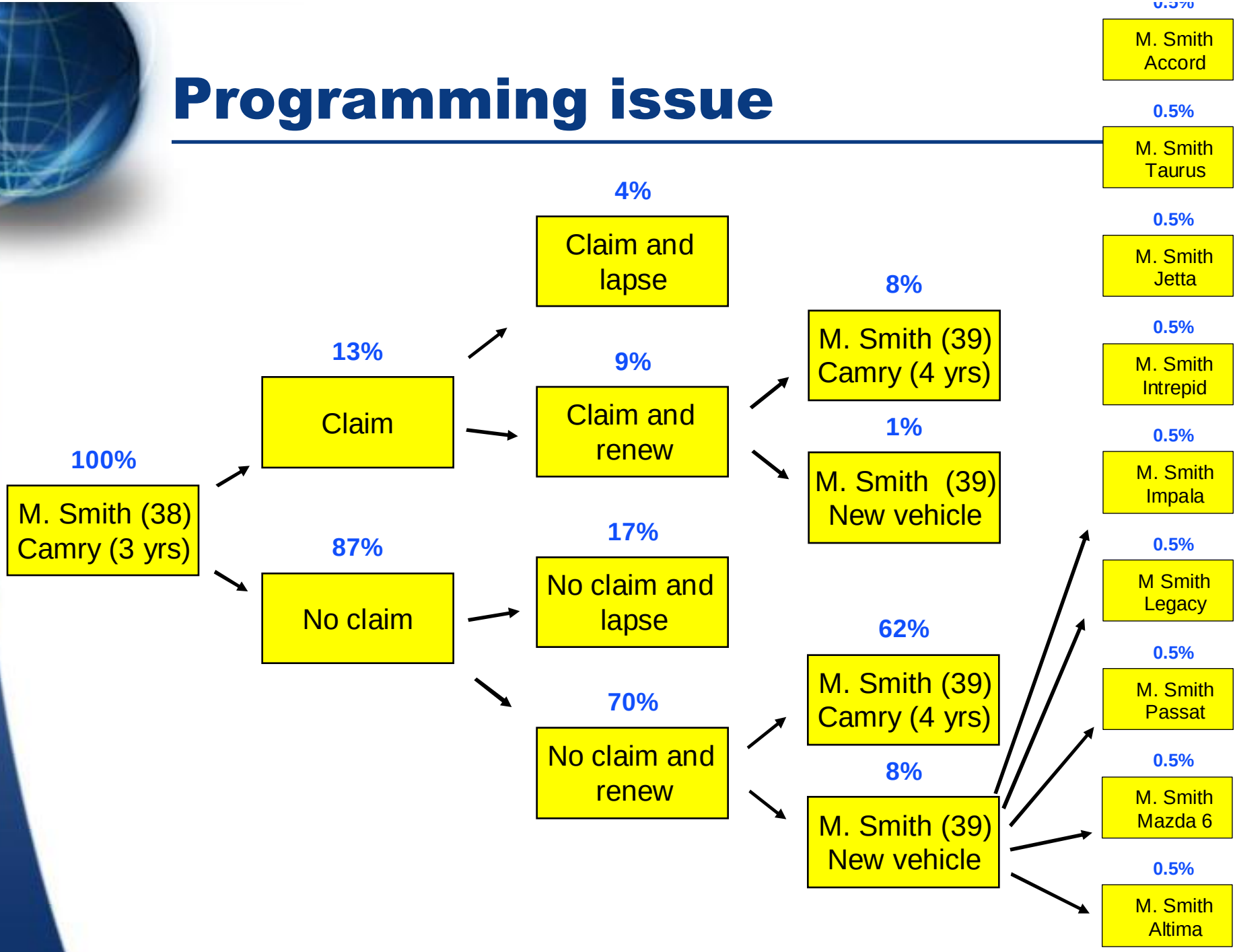
- Competition
- Changes to model
  - age of insured
  - age of vehicle (home)
  - claim surcharges
  - vehicle (home)
  - address
- Programming issues
- Period of projection
- Success criteria

# Programming issue

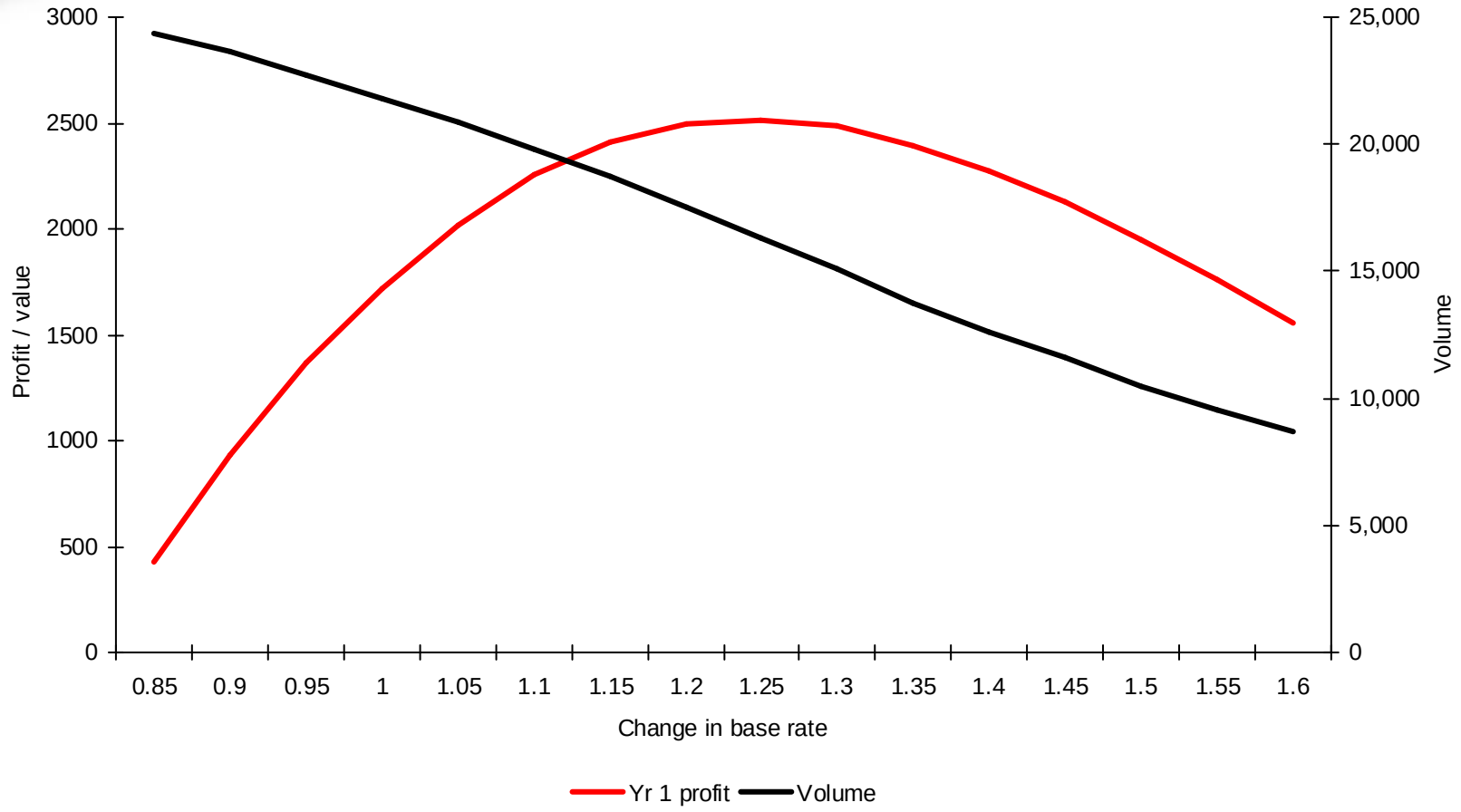
- Sometimes model output needs to be processed and/or recategorized before being input to another model



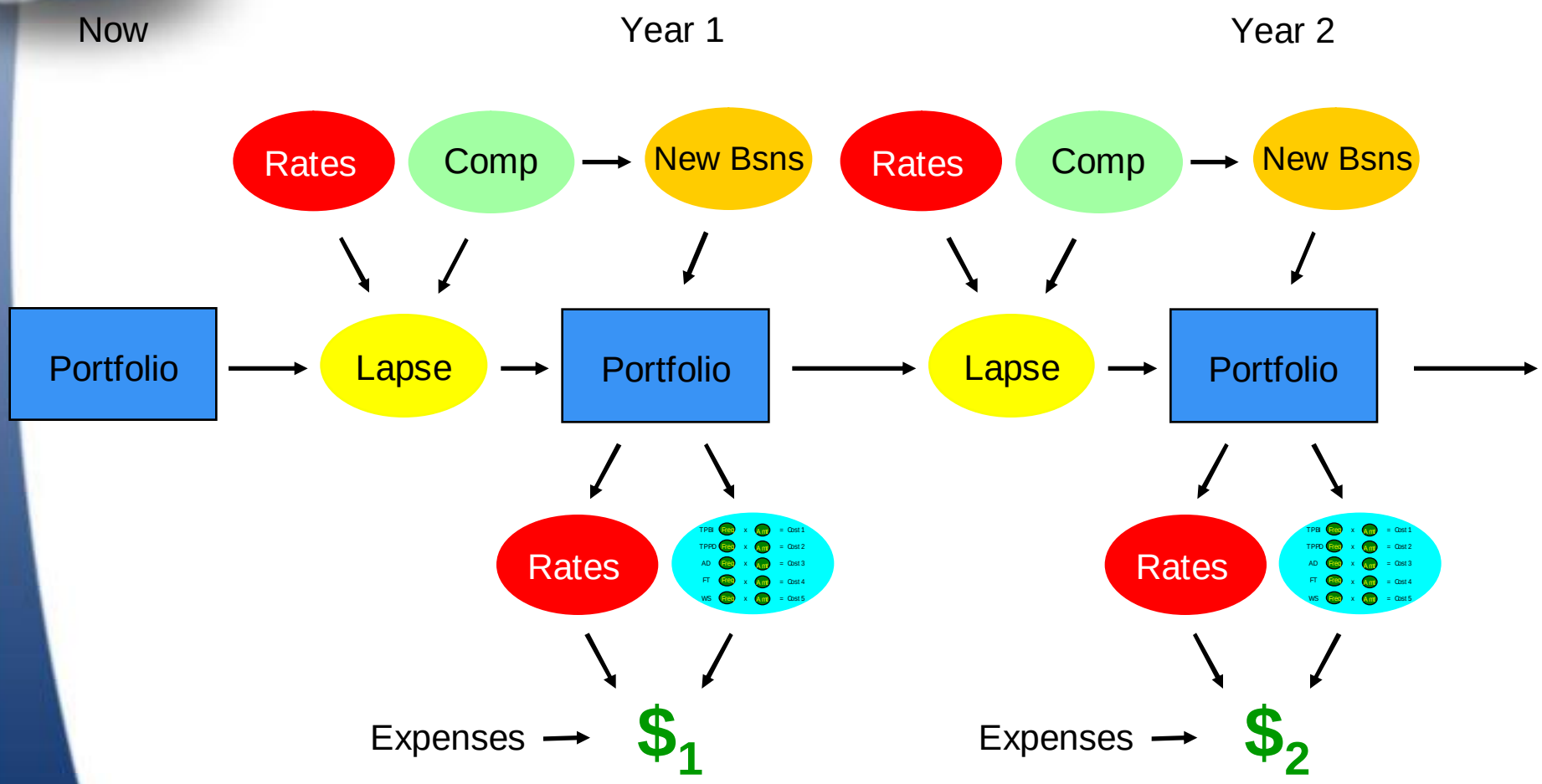
# Programming issue



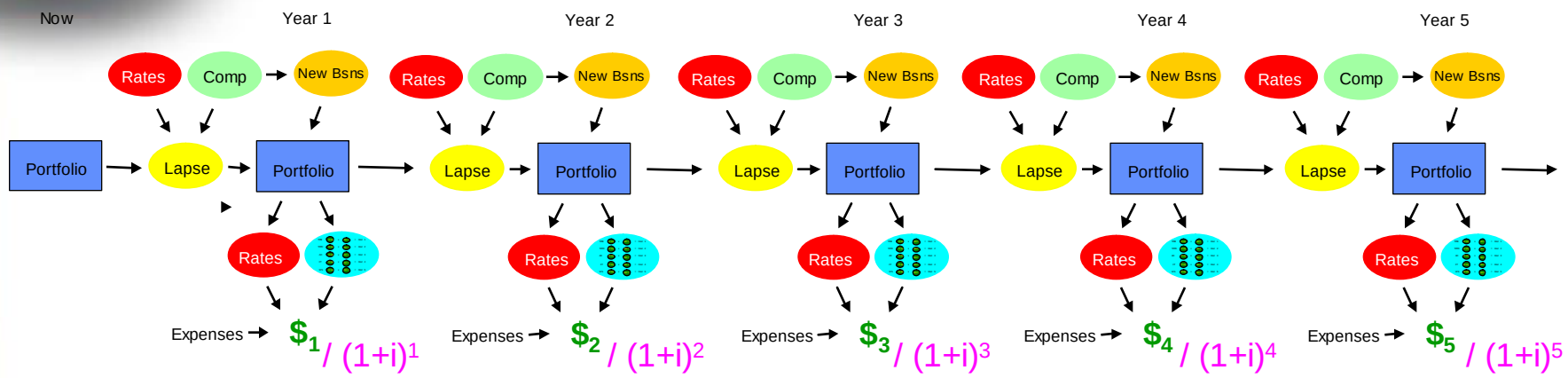
# Period of projection



# Multiple year projections

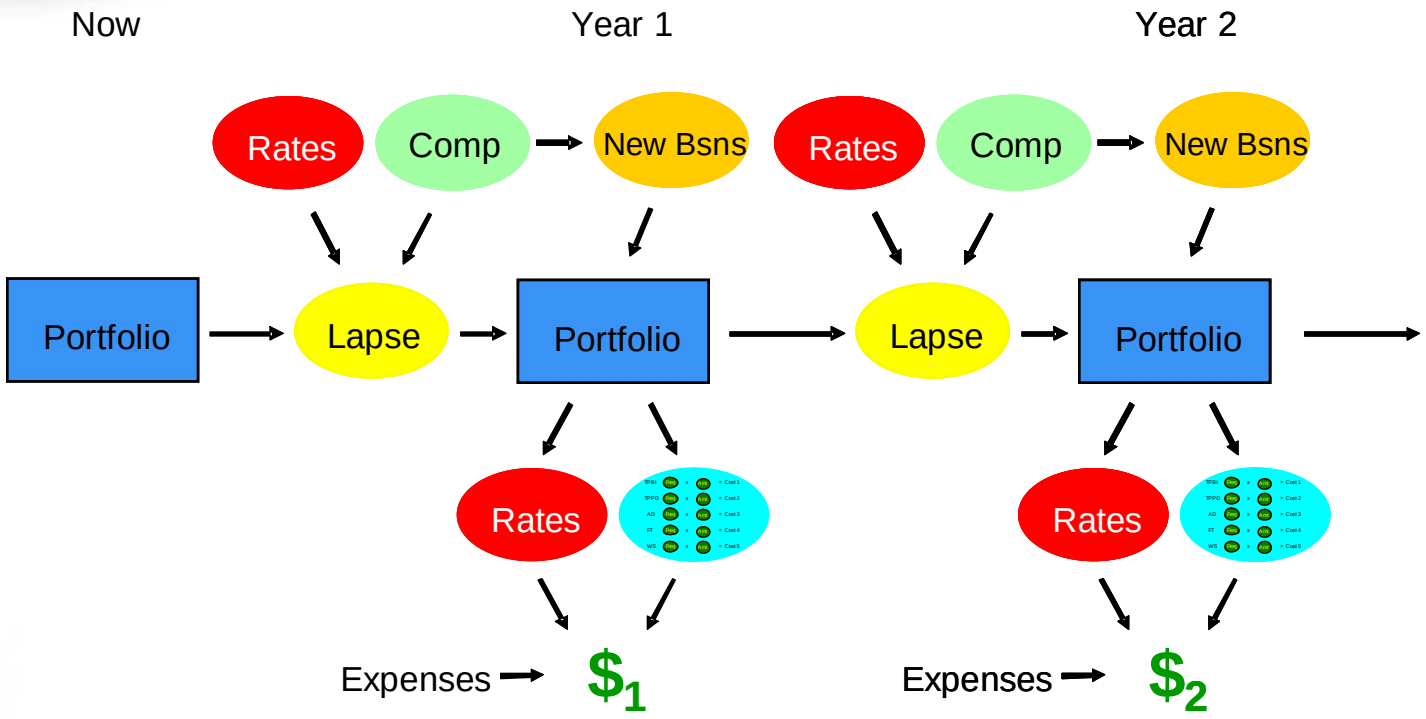


# Multiple year projections




- In theory project many years
- In practice assumptions become too uncertain and model becomes too complex

# A pragmatic compromise?




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

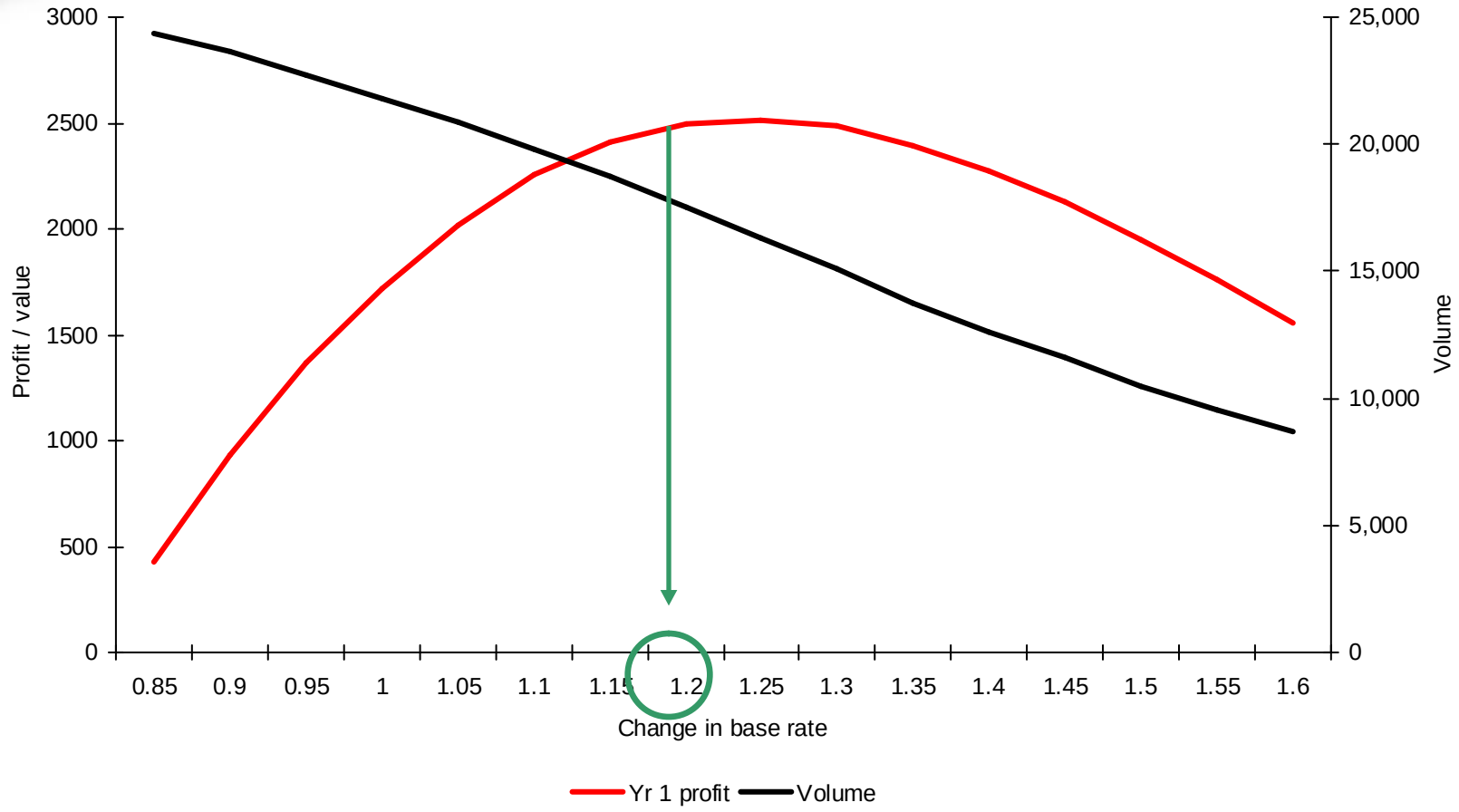
# Model office scenario tests

- Can be very simplistic or highly detailed
- GIGO - level of sophistication dependent upon quality of assumptions and models
- Once constructed can be used to optimize anything from a minor change, eg base rate adjustment, to a wholesale review of entire rating structure

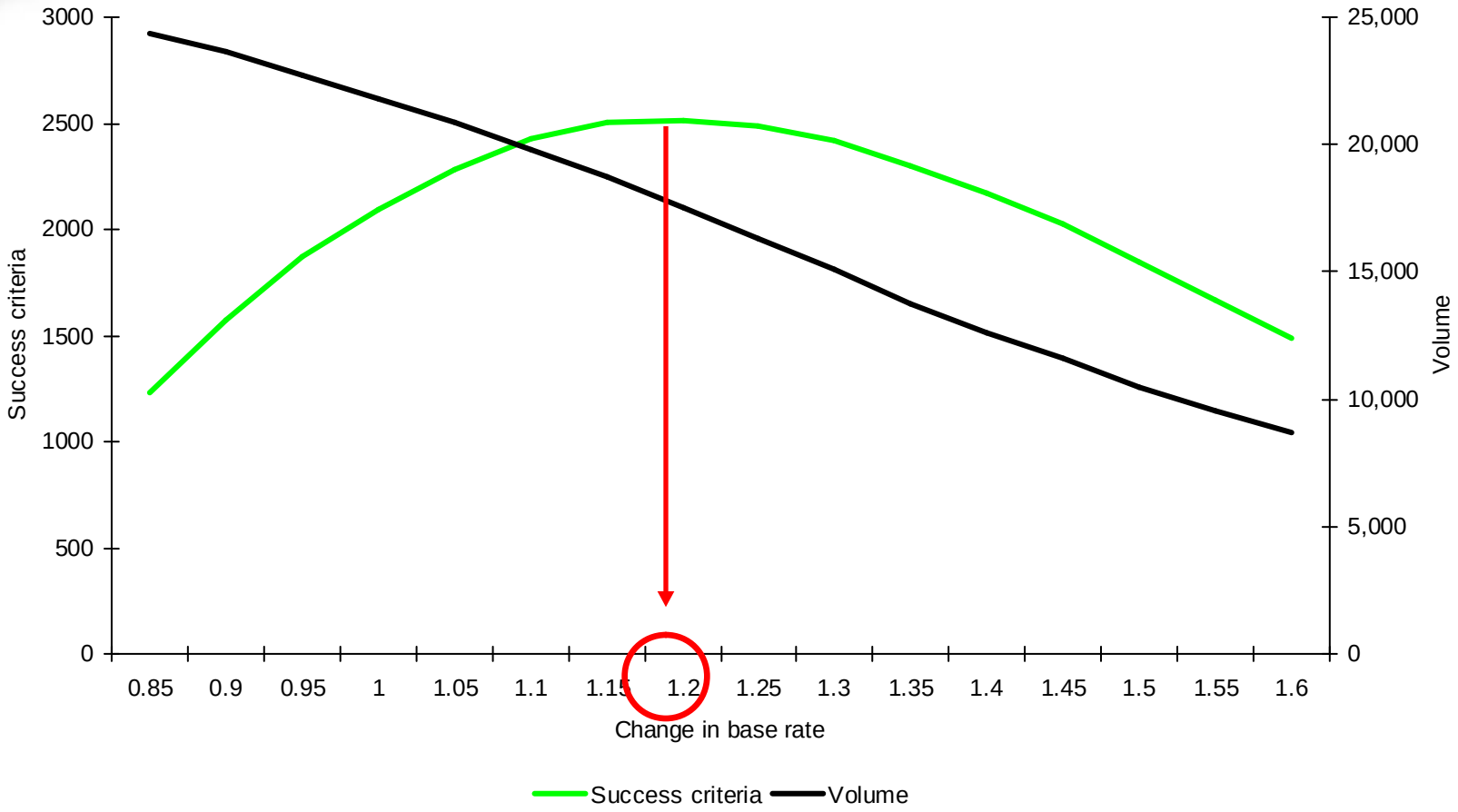
# Types of optimization

- Optimization via scenario tests, for example:
  - base rate change
  - base rate change with simple relativity change
  - moderator algorithms
- Full optimization for each individual policy at point of sale

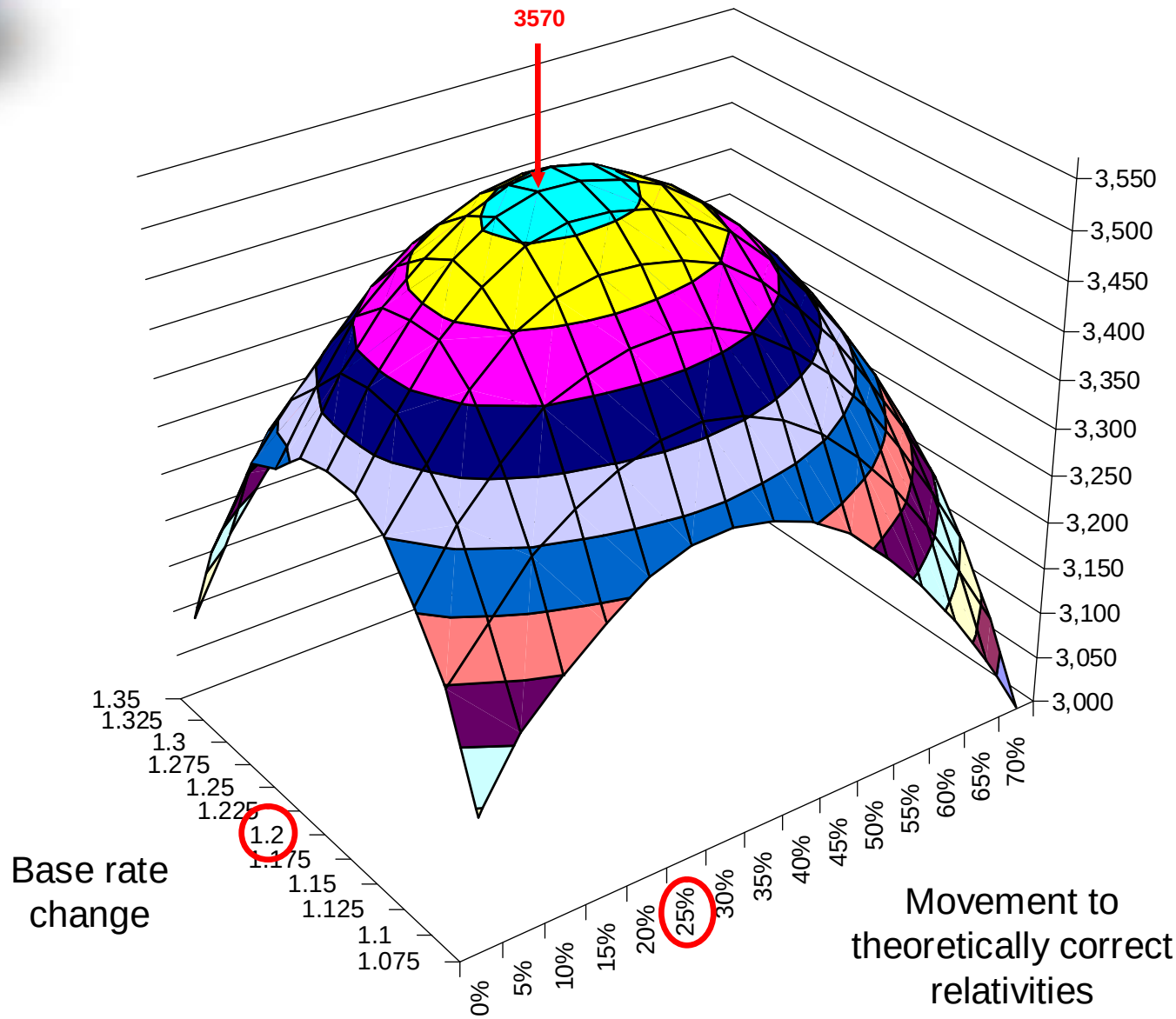
# Base rate change
# - consider profit vs volume



# Base rate change
# - single success criteria



# Base rate change with relativity change



# 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 |

# Moderators

## Types of rating structures - multiplicative with moderator

$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 |

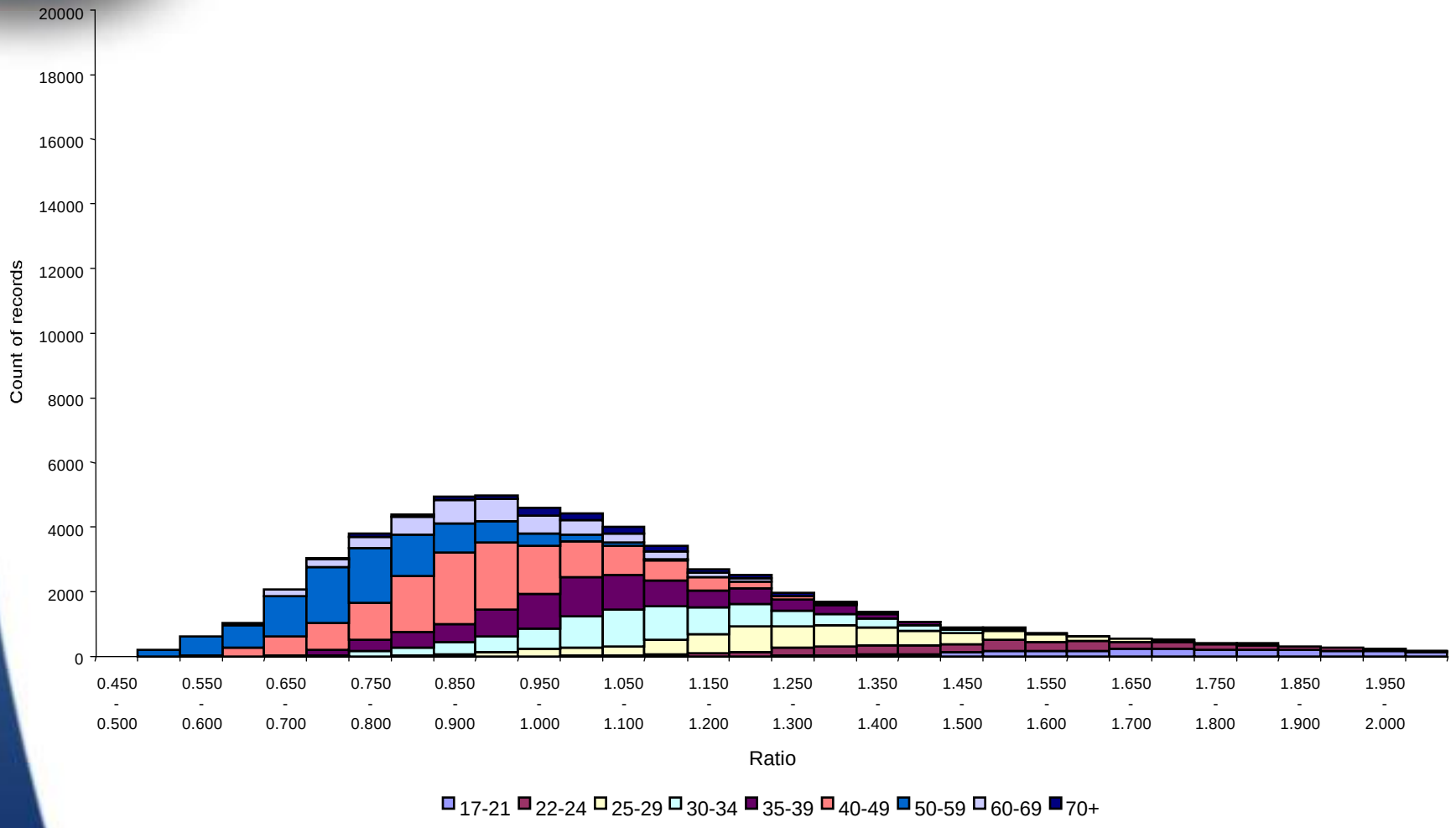
| Group | Factor |
|---|---|
| 1 | 0.54 |
| 2 | 0.65 |
| 3 | 0.73 |
| 4 | 0.85 |
| 5 | 0.92 |
| 6 | 0.96 |
| 7 | 1.00 |
| 8 | 1.08 |
| 9 | 1.19 |
| 10 | 1.26 |
| 11 | 1.36 |
| 12 | 1.43 |
| 13 | 1.56 |

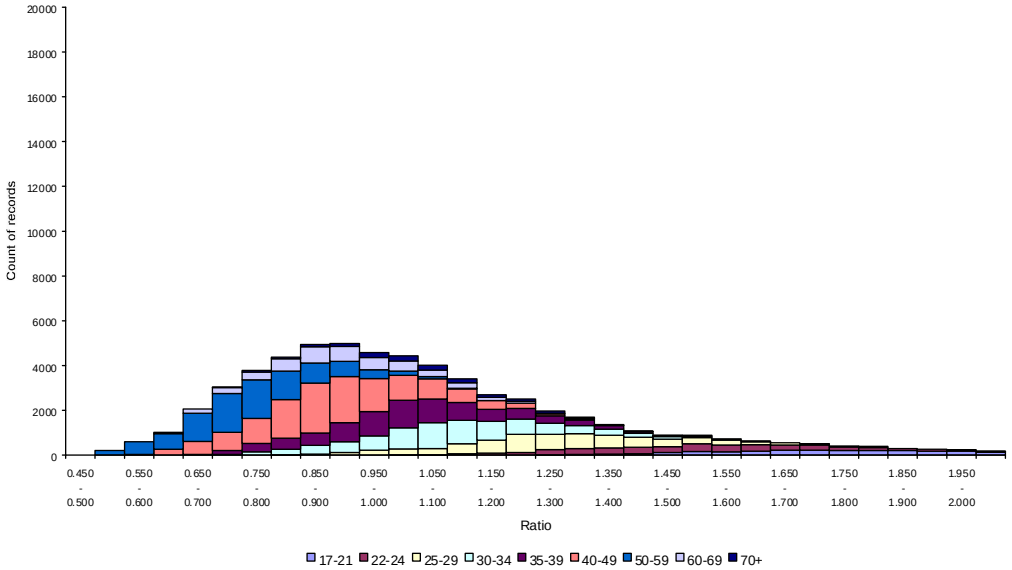
| Sex | Factor |
|---|---|
| Male | 1.00 |
| Female | 1.25 |

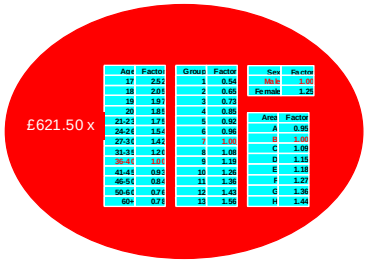
| Area | Factor |
|---|---|
| A | 0.95 |
| B | 1.00 |
| C | 1.09 |
| D | 1.15 |
| E | 1.18 |
| F | 1.27 |
| G | 1.36 |
| H | 1.44 |

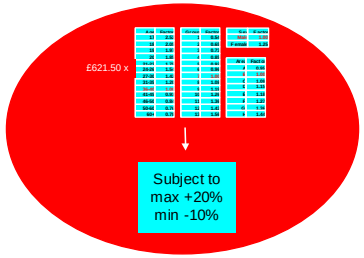
Subject to max +20% min -10%

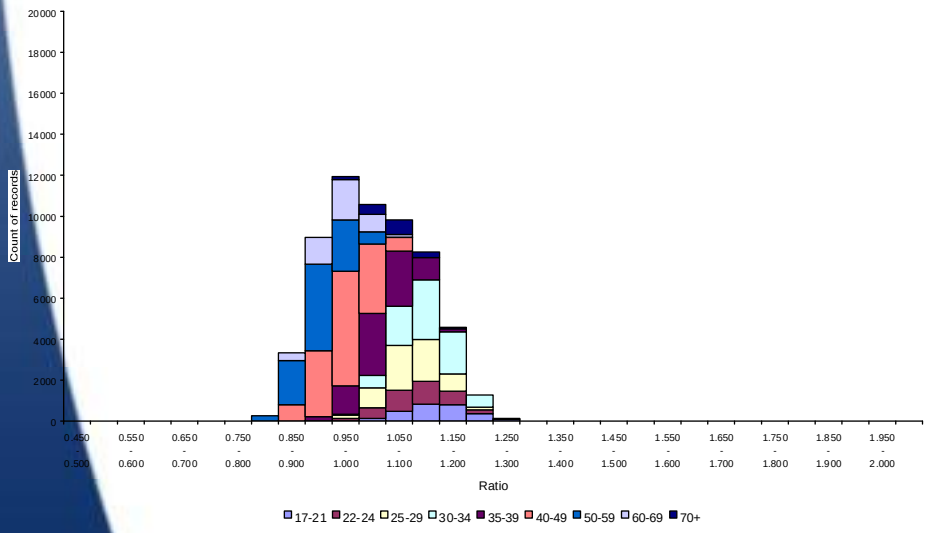
# Example of use of moderator

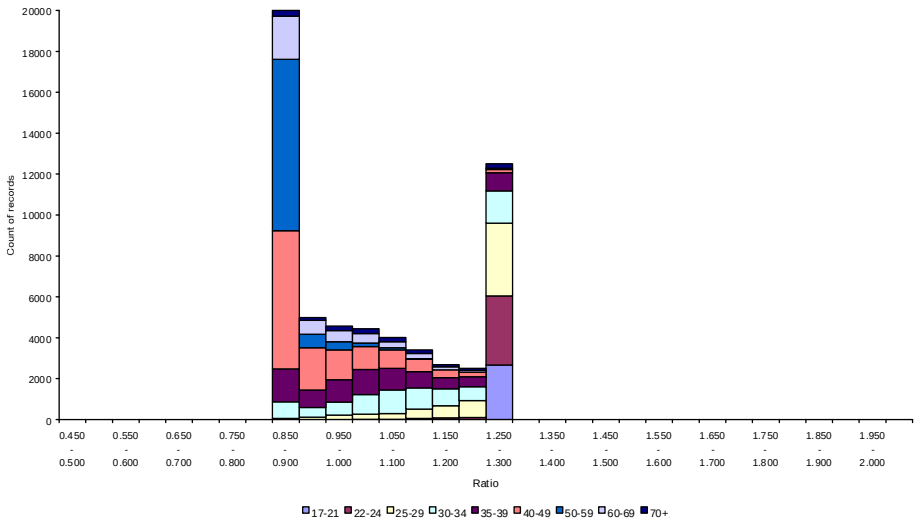



Count of records
Ratio
17-21 22-24 25-29 30-34 35-39 40-49 50-59 60-69 70+


£621.50 x


£621.50 x
Subject to
max +20%
min -10%

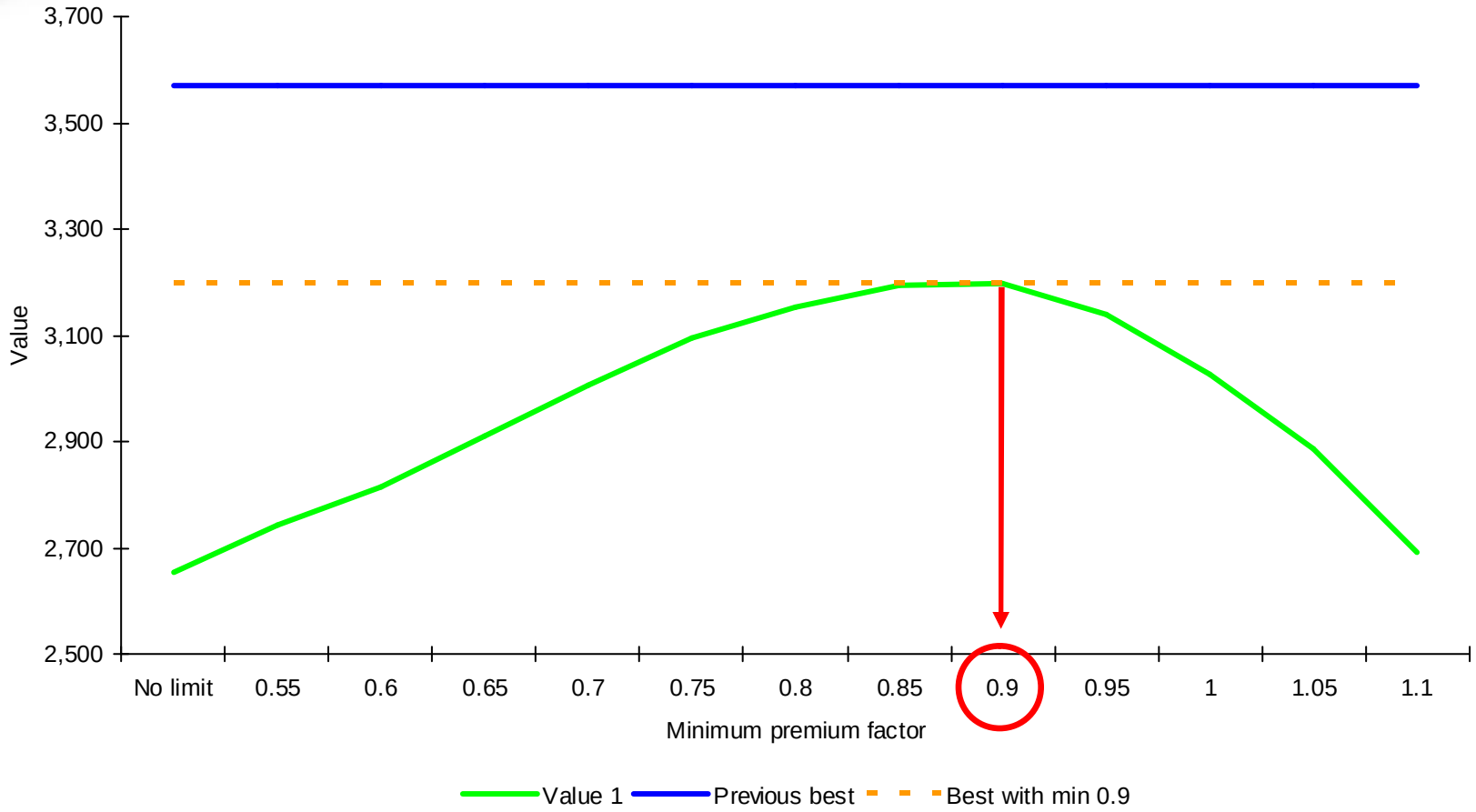

Count of records
Ratio
17-21 22-24 25-29 30-34 35-39 40-49 50-59 60-69 70+


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

# Moderators: pros/cons

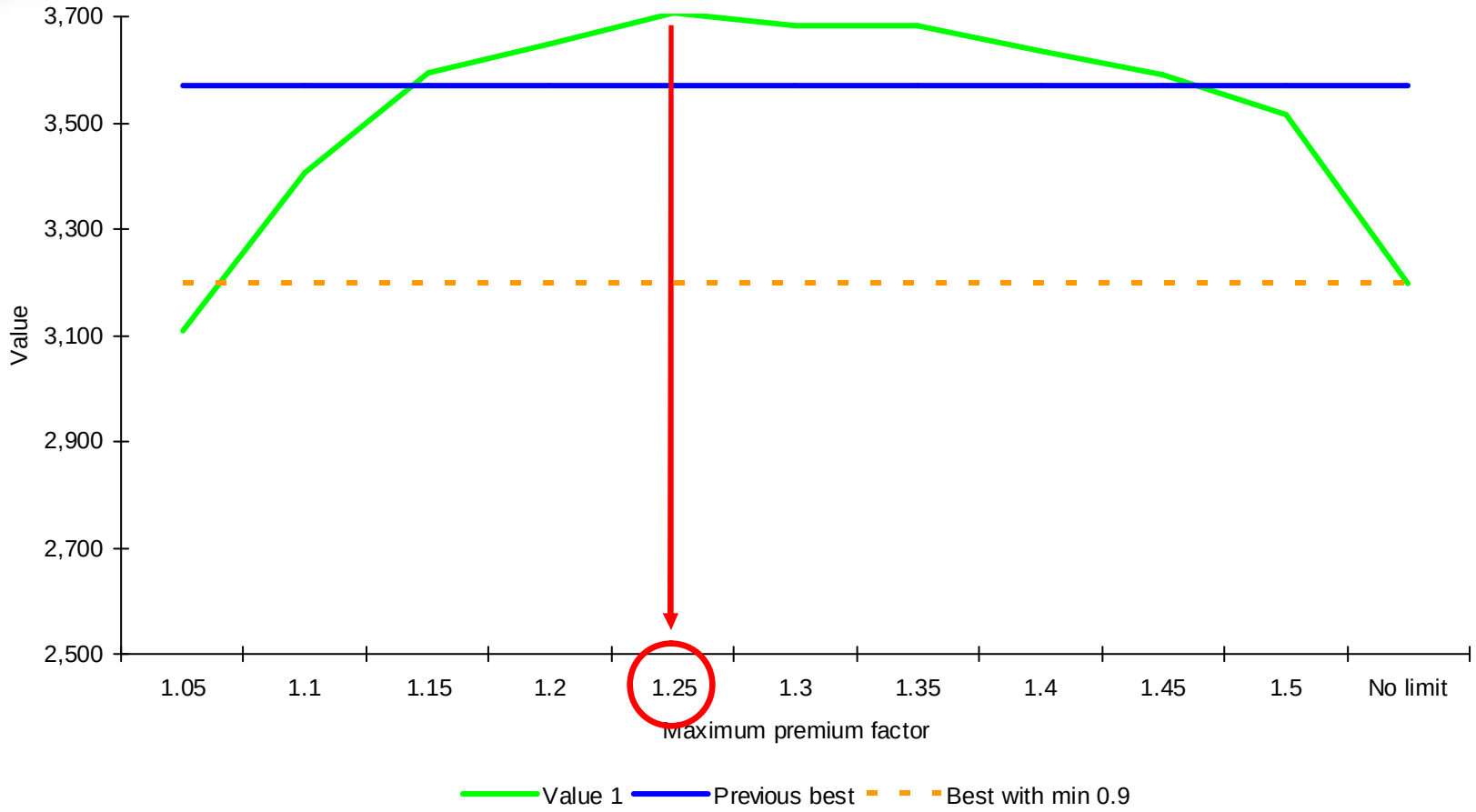
- Advantages of moderators include:
  - moves everyone to optimal position (subject to acceptable premium increases) more quickly
  - can take into account elasticity for the type of person in question
  - can be less detailed work required regarding underlying parameterization
  - less work required 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

# Parameterizing the moderator
## Investigation of limiting premium decreases



# Parameterizing the moderator

## Investigation of limiting premium increases given 10% limit on decreases



# Types of optimization

- Optimization via scenario tests, for example:
  - base rate change
  - base rate change with simple relativity change
  - moderator algorithms
- Full optimization for each individual policy at point of sale

# Full optimization

| 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 |

- For each policy optimize desired success criteria
- Result is individual premium for each renewal
- For new business and mid-term changes, and if required for renewals, can approximate results with a single structure by fitting GLM to optimized individual rates

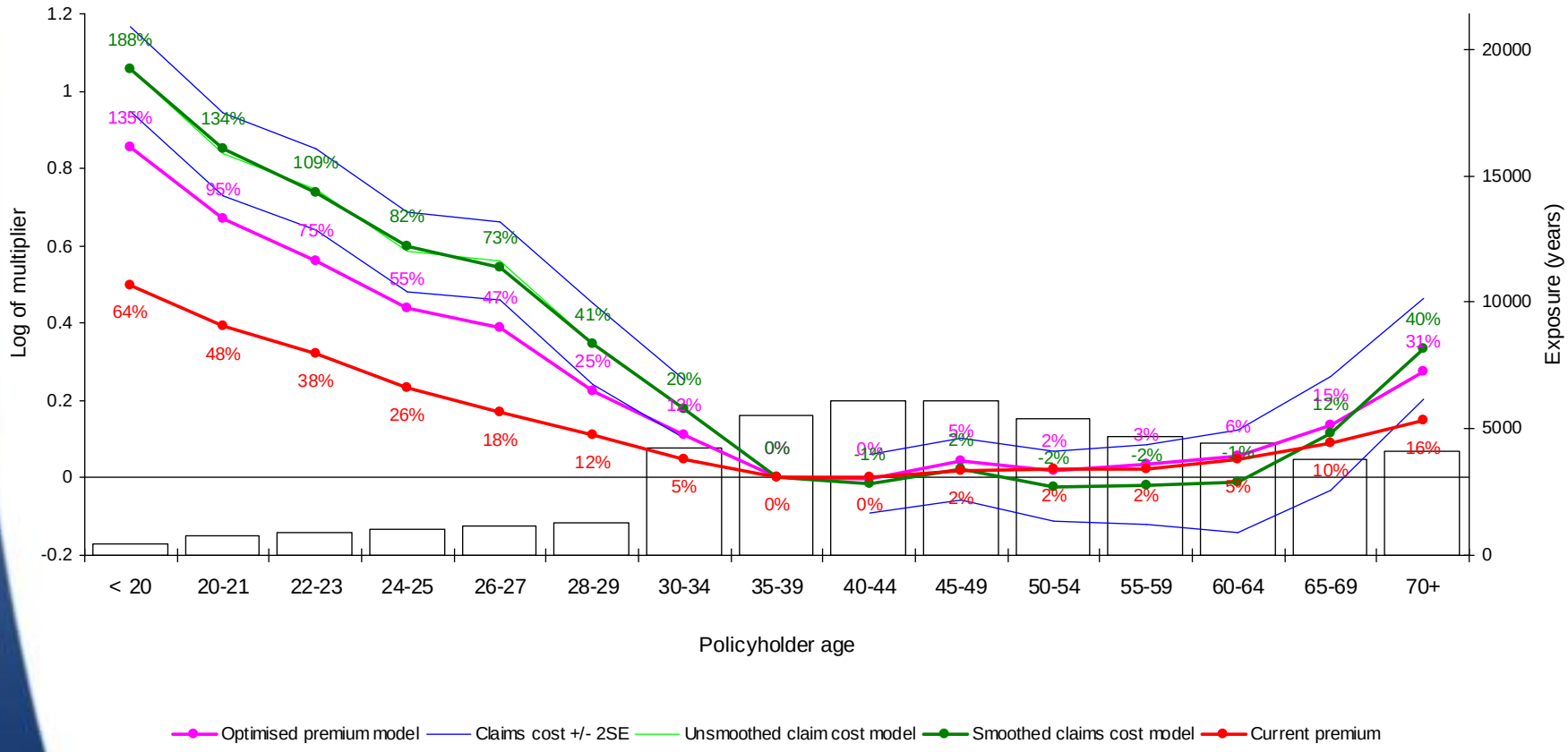
# Constrained and multiple year optimization

- Specified constraints, eg minimum business volume, can be incorporated in optimization algorithm
- For a given policy, the best action next year is interdependent with the action the following year(s) - embedded/looped optimizations allow consideration of multiple year strategies

# Full optimization

## Optimized premium

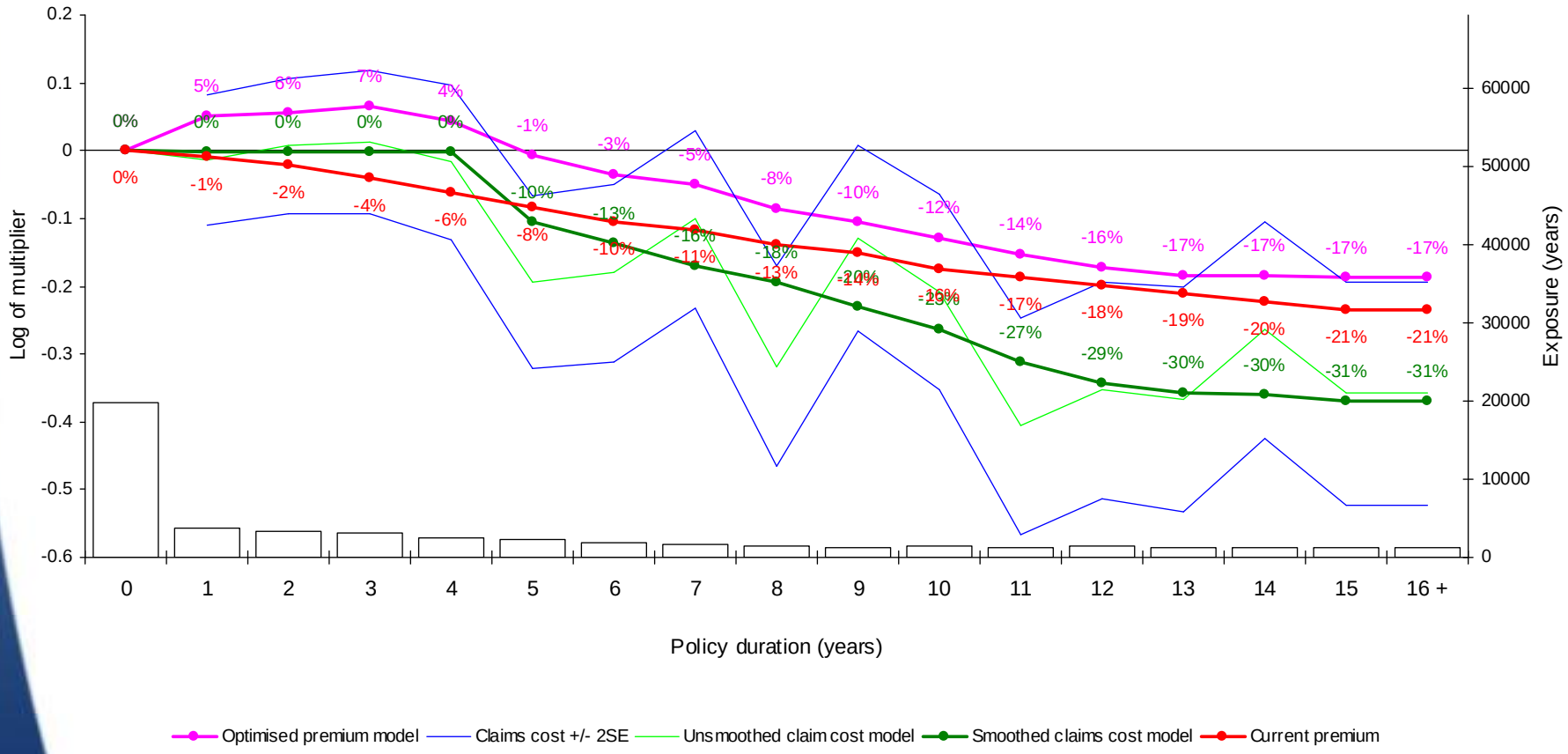
Comparison with claims model and current premium



# Full optimization

## Optimized premium

Comparison with claims model and current premium



# SPE-1
# Policyholder Retention and its Impact on Pricing

WWW.WATSONWYATT.COM

## 2006 CAS Seminar on Ratemaking


Claudine Modlin, FCAS

Watson Wyatt Worldwide


Watson Wyatt Worldwide