Price Optimization and Insurance Regulation With Examples and Calculations

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Presenter

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Disclaimer

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In addition, I do not have authority to speak for the NCDOI on this issue. So I cannot answer any questions about what the Department is doing or may do on this issue.

Today's Presentation

- Part One, consisting of definitions and mathematical examples
- Part Two, consisting of regulatory actions, legal issues and cases, and professionalism considerations
- Quotes like "ABC" refer to a "Recommended Reading" or other citation at the end of this presentation

Part One

- Definitions
- Math examples

Price optimization: what is it?

This is a new and evolving area of actuarial practice. There may be several distinct objectives, so there's no single definition nor a single widely accepted actuarial method.

The birth of Price Optimization

The birth of price optimization for insurers lies in recognizing that a price charged to an insured is a point estimate of a distribution of possible prices. Some of these prices would be excessive or inadequate, yet there would be a range of prices which could be charged, that would be considered reasonable.

Definitions of price optimization (1 of 2)

Can we adjust our current prices within a range of reasonable prices, to increase our profits or revenue, or to increase our customer base (by retaining more current customers and by obtaining a greater share of new business, while recognizing the price elasticity of demand and the prices charged by competitors?

Definitions of price optimization (2 of 2)

Traditional actuarial pricing is cost driven: the price for a specific class of insured is related to the historical claim costs and historical expenses, projected into the future, plus risk load and profit. Price optimization starts from those traditionally calculated prices but mathematically considers “price elasticity of demand” also.

How does “price elasticity of demand” affect insurance pricing?

Instead of merely calculating a rate for a given class of insured based on the insurer’s internal data, largely driven by the losses, which we may term “traditional actuarial pricing”, we will also mathematically consider the expected gain or loss of the number of policies in response to our rate level changes.

Push and pull of prices versus demand in a competitive market

- As company XYZ increases its rate level, policies will generally decrease. They will non-renew or will cut back on coverage through reduced limits or higher deductibles (and conversely if XYZ decreases its rate level, policies will generally increase)
- But competitor prices play an important role! If my current rate is below a competitor, an increase in rate level may not see a decrease in policies. Is a dis-satisfied policyholder going to jump ship in order to pay more? Therefore, we may increase profits simply by increasing rates, in certain classes of business (and conversely)

Modelling demand

- Traditional actuarial pricing is supply driven, with even the most sophisticated models
- Cutting edge actuarial pricing considers modelling demand also
- The results of a combined supply and demand model may lead to very different results than considering supply alone

Factors affecting demand for insurance company XYZ's policy

Demand for insurance from insurance company XYZ is partly affected by law for certain coverages (liability insurance on autos is legally required in all states), by lenders (requiring physical damage on autos or homeowners insurance, private mortgage insurance, title, or flood), by landlords (requiring renters insurance), by a customer's willingness and ability to pay, and by the price offers of competing insurers.

How do other industries use price optimization?

Internet retailers tailor their products or services to consumers, by showing similar items, and by offering discounts or rewards based on their shopping history. Airlines make "last minute" seats available at discounted prices. Hotels offer differing prices on weekdays versus weekends. Note that "offering different prices to different people is legal with …exceptions for race….and other sensitive information." ("WSJ")

Potential Benefits of Price Optimization

--- increased profit margins

--- increased volume of business (premiums)

--- increased customer loyalty (higher retention rates on current business)

--- higher conversion ratios for desired classes (number of new policy offers accepted, divided by number of applicants on new business)

--- maximizing customer lifetime value & loyalty

The true long term benefit to the insurer

The true long term benefit of price optimization to the insurer is to increase enterprise value and to enhance the company as a “good corporate citizen”

Types of models using price optimization

- Increasing profit margins by analyzing competitors prices
- Obtaining and retaining business (strategies to boost new and renewal policy counts)
- Managing claims (maximizing customer loyalty by adjusting premiums or the affect of accidents on premiums)

Price elasticity of demand (PED)

- Economists define PED= Change in quantity / change in price= $((Q_1-Q_0)/Q_0)/((P_1-P_0)/P_0)$
- It is a downward sloping curve
- Example: if price increases 10%, will demand stay the same or increase --- or drop by ten percent --- or drop by twenty percent?
- By convention, economists invert (make positive) the negative sign from the formula above

First hypothetical example (1 of 5)

- Three classes: ages 25 or less; 26 to 64; 65 or over
- Suppose a traditional actuarial rate level change would be applied uniformly over all classes at **plus +8.2%**
- Now let's consider PED.
- Elasticity of demand by class: 2.11; 1.00; 1.61
- Why? Base class is 26 to 64 so we select 1.00 (unity); 25 or less is very price sensitive (starting out in the job market, so relatively low incomes); and 65 and over are price sensitive too, but less so (they are often on fixed incomes)
- Exposures by class: 346; 723; 129
- Current rates by class: $1,027; $934; $980
- Rate level change considering PED**:** **minus 4.3%** (!!!)

First hypothetical (2 of 5)

- Our current aggregate premiums: (346*1027+723*934+129*980)= $1,157,044
- Traditional actuarial calculation of projected aggregate premiums: (346*1111+723*1011+129*1060)=$1,251,922 (8.2% higher than current)
- State of the art actuarial calculation of projected aggregate premiums reflecting demand: (286*1111+664*1011+112*1060)= $1,107,598 (minus 4.3%)

First hypothetical (3 of 5)

- Whoa! What happened to our rate level **increase** of 8.2%?
- The consumers in price sensitive classes dropped their policies at a rate greater than the percent rate level increase of 8.2%.
- So, aggregate revenue **decreased**!

First Hypothetical (4 of 5)

- Projected exposures = Current exposures +(PED)*(Rate Level Change)*Current exposures where PED is expressed as a negative
- Example for first class:
- 286 = 346 + (-2.11)*(.082)*346

First hypothetical (5 of 5)

- We can make this analysis more sophisticated:
- By considering a PED curve rather than a "point estimate" of PED
- By considering the effect on new business versus renewal business (in force)
- By considering competitor's prices for these classes
- By estimating a distribution around the rate for each class, rather than using a point estimate of that rate

Let's consider elasticity in personal auto insurance

- The product consists of liability (required in almost all states at minimum limits) and physical damage (required by lenders on newer vehicles)
- Liability is more inelastic than physical damage
- Drivers using their car for business or commuting are more price inelastic than pleasure use
- We can craft a more sophisticated PED which considers liability changes separately from physical damage changes, and links both to use of car

Second hypothetical optimization example

- We have two classification variables; these could be age, territory, use of car, or number of points on driver history
- Our objective: maximize profit, but only by considering the difference between our rates and a competitor's rates
- Constraint one: if our rate is above competitor, we will decrease our rate to 15% below their rate. We'll market to these consumers. We believe the consumer will switch only if our rate is 15% or more below their rate. Also we believe the PED for this class will result in more than 15% increased exposures, thus more than offsetting the rate drop.
- Constraint two: if our rate is below competitor, we won't change our rate
- Constraint three: we'll assume the competitor won't change their rates in response to our actions

Second hypothetical (rationale)

- There may be other competitors, but we'll assume consumers want a large, nationally known insurer instead of a less expensive locally known insurer

Rates for our second optimization example

Our current rates		
	Class 2, AA	Class 2, BB
Class 1, A	789	891
Class 1, B	412	673
Class 1, C	505	712

Competitors current rates		
	Class 2, AA	Class 2, BB
Class 1, A	1019	911
Class 1, B	389	523
Class 1, C	612	892

Exposures for second optimization example

Exposures		
	Class 2, AA	Class 2, BB
Class 1, A	351	567
Class 1, B	1289	1542
Class 1, C	238	451

How do we solve this?

- Unlike the earlier example, in which PED was a single “point estimate” by class, in this example we need to consider the tradeoffs of increasing our price versus losing business, in certain cells; and decreasing our price but gaining business, in other cells
- This would be a problem to which we could apply the “simplex method”

Two sources to perform optimization

- In Excel and other spreadsheets, Solver (created by Frontline Systems, which makes a more powerful version available on its website, www.solver.com)
- Open Solver (freeware, www.opensolver.com)
- These sources allow the user to apply more complex decisions in the form of various constraints

Monte Carlo simulation

- To make the optimization more realistic, we could replace each rate with a normal distribution, with mean equal to the current rate, and standard deviation determined based on judgment
- Then we could simulate a set of current rates and run the optimization
- We could propose a final set of rates to the regulator which moved our current rates in the direction of the optimal rates, and state the difference from actuarially determined rates was based on judgment and competitive considerations

How to calculate PED (1 of 3)

- A quick and dirty method
- Simply invert the calculations from the “first hypothetical example” to solve for PED
- We know the prices; the number of exposures before the rate change; the size of the rate change by class; the number of exposures after the rate change; so we can solve for the PED by “reverse engineering”
- Caution: we must separate renewal business from new business, as each type of business may have very distinct PED characteristics

How to calculate PED (2 of 3)

- There are four types of more sophisticated methods
- The first method is a top down method, and applying the calculations from the “first hypothetical example” to solve for PED, but also segmenting the business more carefully; for example by considering variables such as geographical location, gender, marital status, or accident history. A problem with this method is that some segments may have too few exposures so their experience is not credible

How to calculate PED (3 of 3)

- The second method is to use a Generalized linear model of the logistic type. This is a bottom up method.
- The third method is a combination of the first two methods. We will use decision trees to determine which variables to model on, then we'll apply a logistic model to those variables.
- The fourth method is the most complex and applies a generalized non-linear model.

Observations on PED for Private Passenger Auto

More Elastic

- Physical damage
- Garaged in city
- High liability limits
- Pleasure use
- Policies with liability and physical damage
- Households with two or more income earners

More Inelastic

- Liability
- Garaged in suburban or rural
- Low liability limits
- Commute, business, farm use
- Liability only policies
- Households with one income earner

Actions consumers can take to reduce their use of insurance

- Reduce liability limits
- Increase deductibles
- Drop the policy entirely (if auto insurance, use public transportation or car pool)

Measuring customer's lifetime value

Insurance Customer Lifetime Value											
Five Policy Renewals Time Horizon											
Time	Premium	Commission	Other Acquisition	General expenses	Claims	Net Cash flow	PV Factor @ 5%	PV of cash flow	New Business or Current Business Conversion or Retention Ratio	Net expected gain or loss	Cumulative gain or loss
0	1	0.2				0.8	1	0.8	0.2	0.16	0.0349295
0.5			0.15	0.1	0.9	-1.15	0.9759	-1.12229	0.2	-0.22446	
1	1	0.2				0.8	0.952381	0.761905	0.9	0.685714	
1.5			0.1	0.1	0.8	-1	0.929429	-0.92943	0.9	-0.83649	
2	1	0.2				0.8	0.907029	0.725624	0.92	0.667574	
2.5			0.05	0.1	0.7	-0.85	0.88517	-0.75239	0.92	-0.6922	
3	1	0.2				0.8	0.863838	0.69107	0.94	0.649606	
3.5			0.05	0.1	0.6	-0.75	0.843019	-0.63226	0.94	-0.59433	
4	1	0.2				0.8	0.822702	0.658162	0.96	0.631836	
4.5			0.05	0.1	0.55	-0.7	0.802875	-0.56201	0.96	-0.53953	
5	1	0.2				0.8	0.783526	0.626821	0.98	0.614285	
5.5			0.05	0.1	0.5	-0.65	0.764643	-0.49702	0.98	-0.48708	

Part Two

- Regulatory actions
- Legal considerations
- Professionalism issues

What is the true rate level change, considering PED (hypothetical example)? (1 of 2)

- Traditional actuarial method: +8.2%
- Traditional actuarial method considering PED on in-force business: -4.3%
- Traditional actuarial change considering PED on in-force business plus the projected effect on new business: -5.6%
- If given the extra calculations considering PED how may management respond?

What is the true rate level change, considering PED (hypothetical example)? (2 of 2)

- Traditional actuarial method: +8.2%
- Traditional actuarial method considering PED on in-force business: +12.6%
- Traditional actuarial change considering PED on in-force business plus the projected effect on new business: +14.7%
- If given the extra calculations considering PED how may a government regulator respond?

First professionalism issue

If we have done the extra calculations considering PED, should we present this additional information to management or to a regulator? Precept 4 states in part that an "actuarial communication is appropriate to its intended audience and satisfies applicable standards of practice". On the other hand, if we have not done the calculations including PED, have we done our job?

Two divergent views on price optimization

- One: Price optimization is the future of actuarial pricing. All future price analyses will have to be accompanied by analysis of the PED to show not only the true "traditional" rate level change but also the "state of the art" calculation, when considering the PED on current business retention, and new business conversion.
- Two: Price optimization is a fad which has come and hopefully will soon be gone. It's another in a long line of attempts to depart from traditional actuarial pricing methods and the use of objective, non-discriminatory pricing variables which are honest and fair and have stood the test of time.

Other than insurance, how many industries can you name

which can legally charge different applicants: different prices, offer different terms, or completely refuse to do business with a consumer?

What is a “Protected Class”?

Definitions vary by state or federal agency but can include: race, gender, religion, national origin, age, sexual orientation, or disability, among others

Two theories of discrimination

- “Disparate treatment” means that a business treats a “protected class” differently
- “Disparate impact” means that a business’ policy, though neutral on the surface, has a demonstrably adverse effect on a “protected class”

Proving Disparate Impact isn't easy but can be done

Plaintiff must identify the policy; show the disparate impact; and show causation. Defendant may show that the policy serves a "business necessity". Plaintiff may show that there is an alternative which can meet the "business necessity" but which would have a less discriminatory effect

What would the results of “disparate impact” be on insurance rates?

- According to “Miller”, “accurate risk assessment will be destroyed, adverse selection will be widespread…..and coverage availability will suffer”
- What is your opinion?

DeHoyos Case

- This case alleged that Allstate's credit scoring model had a racially adverse affect. Allstate settled; refunded certain policyholders; and revised their credit scoring model.

Statistical parameters considered by courts in Disparate Impact cases

- Time frame of data sample
- Geographical area of data sample
- Size of the data sample

Tests of statistical significance which courts have considered (1 of 2)

- The “four fifths” rule is not used much today because it’s not grounded in statistics. The rule says there’s discrimination if the ratio of acceptance for a protected class is less than 80% of the ratio for the non-protected class (see example coming up soon)
- Today, courts look at more sophisticated statistical analyses and tests
- For example, for a regression model, courts today look at R squared and F values for the overall model, along with T tests and p values for individual variables. P values of less than 0.05 are common to consider whether a variable is significant.

Tests (2 of 2)

- Courts are considering Lift curves along with graphs illustrating the goodness of fit. A lift curve divides the data into groups, say deciles, and ranks the performance of the model for each decile.

Example of the four fifths rule (1 of 2)

Non-protected class

- 82 apply, 31 selected
- Ratio 37.8%

Protected class

- 68 apply, 16 selected
- Ratio 23.5%

Example of the four fifths rule (2 of 2)

- The ratio of ratios: 0.235/0.378=62.2%
- This is less than 80.0%
- Therefore the protected class appears to be discriminated against

The ”McDonnell Douglas” test

Requires the Plaintiff to have membership in a protected class; application (for insurance) rejected even though qualified; while the Defendant approved the application for other similarly qualified applicants

The “Reverse redlining” test

Requires the Plaintiff to have membership in a protected class; application for insurance accepted but on grossly unfavorable terms compared to other similarly qualified applicants (example plaintiff has to pay a higher price or receive reduced coverage)

Possible Unfairly Discriminatory Results of Price Optimization

One: Policyholders with similar risk exposure, pay differing prices, or are offered differing terms of coverage, when those differences are not based on the expected cost, but are based on differences in their willingness and ability to pay, or on their history of complaints to the insurer, or on their perceived interest in "shopping around" for better prices.

Two: New business and renewal business could be priced differently with new business getting a discount to "get them in the door"

Is either scenario unfairly discriminatory?

Current events: regulatory action & legal cases (1 of 3)

1) On October 31, 2014, Maryland became the first state to ban the use of price optimization in all lines of P&C insurance, because it creates unfair discrimination among applicants with similar risk exposure. Insurers using price optimization had to file a "corrective action plan" by January 15, 2015.
2) On January 20, 2015, Ohio also banned price optimization, requiring insurers to file adjusted rates by March 31, 2015

Current events (2 of 3)

- On February 18, 2015 the California Department of Insurance banned the use of Price Optimization from future filings and required insurers to adjust their next filing if they had used price optimization previously.
- On March 18, 2015, the New York Insurance Department issued a data call in regard to insurers use of Price Optimization practices

Current events (3 of 3)

- There is a disparate impact case from Texas in front of the US Supreme Court (“Texas”)
- According to Paul Hancock, a lawyer filing on behalf of Texas: “The threat of disparate-impact liability means lenders must pay close attention to racial outcomes of even nondiscriminatory policies….It really pushes more toward advancement of [the use of] racial quotas as the only way to avoid legal claims”

Second professionalism issue

- If you are an actuary reviewing rates in any of the three states which have banned price optimization in rate filings made to that state, which are usually publicly available, is it OK to use price optimization in an **internal** company review of your company's business in that state?
- This would be done with the objective of gradually moving prices toward the indicated rates with price optimization.
- What's your opinion, and why?

Apologists for price optimization

- They state that just as insurers always departed from strict actuarial pricing, by allowing some degree of judgment in choosing rating factors or final rates which differed from the mathematically exact rating factors or rates, and often for competitive reasons, they say that all that Price Optimization does is to formalize that process, to quantify that decision making process; to allow the insurer to express its “informed judgment” quantitatively
- They like to cite how price optimization can be used to minimize price increases to youthful drivers, to elderly drivers, or to coastal properties. However this type of “subsidy calculation” has long been part of traditional pricing without considering PED

Opponents of price optimization

- Ultimately they point out that two insured's with similar risk characteristics cannot be charged differing prices – which is hard to argue with
- It appears to be unfair, as a rating variable, to use: consumer shopping behavior; consumer complaints; consumer's choice of limits, deductibles, or the presence or absence of certain coverages or other policies

Is price optimization unfair? (1 of 2)

Many regulators believe that price optimization is unfairly discriminatory. Should a policyholders' premium be based, in part on how often they complain to the insurer about their premiums or whether they shop their policy around? Should their premium consider their willingness or ability to pay?

It is also a professionalism issue. According to the Code of Professional Conduct, Precept 1, Professional Integrity, states in part: "An actuary shall act **honestly**….to fulfill the profession's responsibility to the public and to uphold the reputation of the actuarial profession" (emphasis added)

Is price optimization unfair? (2 of 2)

Price optimization can extend to handling claims where insured A and B, with comparable claims, receive distinctly different payouts or differing terms for a payment. The difference could be based on whether the insurer wants to retain A as an insured but not B. Is this ethical? Is this honest?

Third professionalism issue

The Code of Conduct, Precept 8 Control of Work Product states in part: "An actuary['s] services are not used to mislead other parties". If an actuary has used price optimization methods to derive final prices, then it would seem that such methods need to be disclosed, at minimum, to a regulator of the state where such rates would be used, and possibly to policyholders to whom such rates would be charged.

Key takeaways

- Price optimization creates legal and ethical issues for the insurer
- Price optimization creates professionalism issues for the actuary
- Will regulators adapt by defining “best practices” or “safe harbors”?
- Most regulators are looking to the NAIC for guidance, perhaps a model law

Key issues involving price optimization which often are not articulated clearly

- Most discussions of price optimization currently are only in the context of private passenger auto. However price optimization is widely applicable to all property and casualty lines as well as to life insurance, health insurance, and even pensions
- A key issue for the insurance industry is whether the potential increases in profit or in customer retention are likely to be so great from that use of this actuarial method cannot be ignored.
- Two key issues for consumers and regulators are first, whether increases in customer retention would be accompanied by improved customer satisfaction too, potentially a "win win" for insurer and customer and second, whether there may be greater availability or affordability of insurance to classes of insureds who currently may have difficulty obtaining insurance. Regulators would probably be persuaded favorably if increased availability or affordability can be demonstrated.

Wrapping Things Up (1 of 2)

Therefore, in May of 2015, we are at an critical decision point for the insurance industry. With three state insurance departments banning Price Optimization in any form, and a fourth highly influential state leaning that way, two starkly distinct scenarios are likely to unfold in the coming months. Either regulators will ban price optimization entirely, or the industry will figure out ways to satisfy regulators concerns and to cooperate with them to craft "safe harbors" within which a constrained form of price optimization can meet regulators concerns **and** meet standards of high integrity, honesty, and professionalism. Note that if regulators would ban the use of price optimization, then actuaries working for insurance companies, could not use the method, not even internally within the insurance company, because they would violate professional standards.

Wrapping Things Up (2 of 2)

Much depends on the potential increase in profit and retention levels for insurers, and whether this actuarial method can be demonstrated to regulators to improve consumer satisfaction, to make coverage more widely available, and to reduce premiums --- for at least some consumers. If the method would only result in increased insurer profits, and increased consumer prices, then it is unlikely to gain acceptance in any state. If the method does gain acceptance among regulators then its usage is likely to increase exponentially (not linearly). In that scenario, regulators would likely respond by defining when "price optimization" may be used and how, and by requiring an insurer to accompany every rate filing with an actuary's certification of methods used and variables considered, along with an actuary's certification that prohibited methods and prohibited variables were not used. It is likely that this certification would become as important as the prescribed "Statements of Actuarial Opinion" are today for loss and LAE reserves.

Legal Cases Cited (1 of 2)

- DeHoyos v. Allstate Corp, 345 F.3d 290 (5th Cir.) 2003
- McDonnell Douglas Corp v. Green, 411 US 792 (1973)
- American Insurance Association v. HUD, 13- cv-966, U.S. District Court, District of Columbia, (Washington)
- Texas Department of Housing and Community Affairs v. The Inclusive Communities Project, 13-1371 (“Texas”

Legal Cases Cited (2 of 2)

Slocombe et al. v. Allstate Corp. et al., No. 15-2-03508-8 SEA, complaint filed (Wash. Super. Ct., King County Feb. 11, 2015). This lawsuit alleges that Allstate calculates insurance prices using a model which includes non-risk-based variables (example, a policyholder's "ability or willingness" to pay more), rather than risk-based variables (example, their accident history).

Regulatory actions cited

- Maryland Insurance Administration, Bulletin 14-23; issued October 31, 2014
- Ohio Department of Insurance, Bulletin 2015-01; January 29, 2015
- State of California, Notice Regarding Unfair discrimination in Rating; February 18, 2015
- New York State Department of Financial Services; Request for Special Report Pursuant to New York Insurance Law 308; issued March 18, 2015

Recommended readings (1 of 2)

- Credit Scoring and Insurance, National Consumer Law Center, June 2007 (“NCLC”)
- Beyond The Cost Model, Serhat Guven and Michael McPhail, (Casualty Actuarial Society’s Forum, 2013, Spring Vol. 1) (“SGMM”)
- Employment Discrimination, 1994 and later, Lex Larson, Chapter 22, “Statistics in proof of Disparate Impact” (“Larson”)

Recommended readings (2 of 2)

- Miller, Michael J., Disparate Impact and Unfairly Discriminatory Insurance Rates; CAS Forum; 2009: Winter; pages 276-288 (“Miller”)
- Wall Street Journal; December 24 2012; “Websites Vary Prices, Deals Based on Users Information” by Jennifer Valentino-Devries, Jeremy Singer-Vine, and Ashkan Soltani (“WSJ”)


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Thanks!

Thank you!

- Please feel free to contact me if you would like additional data or information to support anything in this presentation.
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