Dislocation Analysis:

Segment Detection of Disrupted Rates

November 2022

Rob Zolla, FCAS, MAAA

Thomas Holmes, FCAS

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Dislocation Analysis: Segment Detection of Disrupted Rates

Rob Zolla, FCAS, MAAA

November 2022

Milliman

Rob Zolla, FCAS, MAAA

Rob is an Actuary at Milliman's Orange County office specializing in InsurTech solutions and advanced ratemaking techniques for personal and commercial lines.

He has over 10 years of experience in the insurance industry, much of which came at a top five U.S. personal lines carrier where he held executive roles leading teams focused on competitive intelligence, property pricing, and product and revenue forecasting.

Poll 1

What is your current position?

A. I am an individual contributor with respect to the rate change process.

B. I am in a leadership position making decisions regarding rate changes.

C. I work for a regulatory body reviewing rate change submissions.

D. None of the above.

Poll 2

What line of business do you primarily focus on?

A. Personal Lines Ratemaking

B. Commercial Lines Ratemaking

C. Combination of Personal/Commercial Lines Ratemaking

D. Non-Ratemaking

Poll 3

How would you rate the analytical capabilities available to you to perform or review dislocation analyses?

A. 1 – Best in Class

B. 2 – Above Average

C. 3 – Below Average

D. 4 – Poor

E. Not Applicable

Initial Considerations

Adhering to Actuarial Standards of Practice, Laws, and Regulations

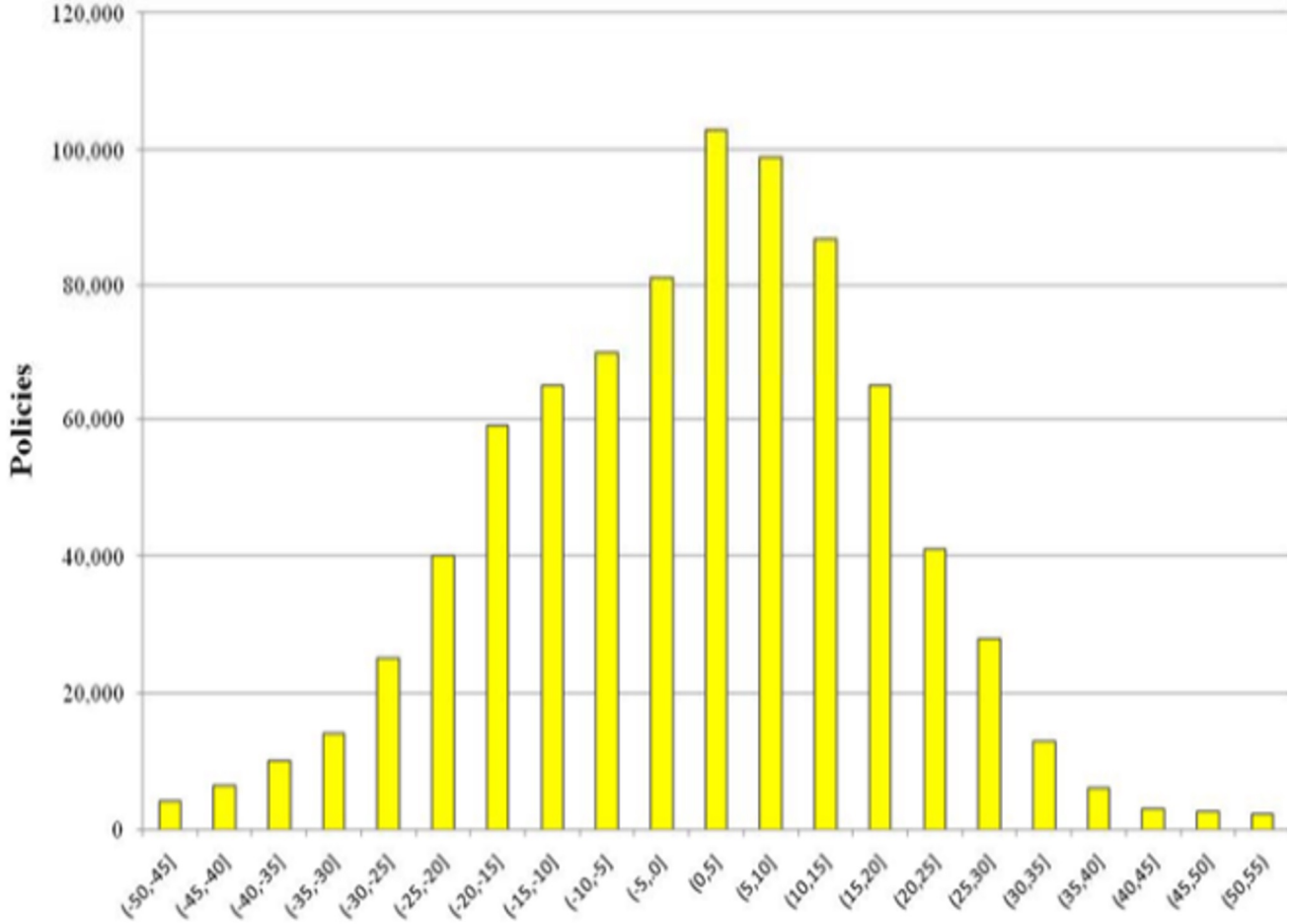
- ASOP 53 – Estimating Future Costs for Prospective Property/Casualty Risk Transfer and Risk Retention
  - Section 3.1 Future Cost Estimate – “The actuary should determine the elements that are appropriate to include in the future cost estimate. Such elements should relate to the applicable coverage and include loss and loss adjustment expenses, operational and administrative expenses, the cost of reinsurance, and the cost of capital.”
- ASOP 56 – Modeling
  - Section 3.1.2 Selecting, Reviewing, or Evaluating the Model – “When selecting, reviewing, or evaluating the model, the actuary should confirm that, in the actuary’s professional judgment, the model reasonably meets the intended purpose.”
  - Section 3.6.d Evaluation of Mitigation of Model Risk – “The type and degree of model risk mitigation that is reasonable and appropriate may depend on the following…..whether there have been changes to the model or its operating environment.”
- ASOP 30 – Treatment of Profit and Contingency Provisions and the Cost of Capital in Property/Casualty Insurance Ratemaking
  - Section 4.1 Conflict with Law or Regulation – “If a law or regulation conflicts with the provisions of this standard, the actuary should develop a rate in accordance with the law or regulation, and disclose any material differences between the rate so developed and the actuarially determined rate to the client or employer.”

Dislocation Impacts

Dislocation Impacts on CAS Exams

- "Typically, companies look at the distribution of rate changes across the entire book of business, summarized by key segments, and by each level of rating variables being specifically adjusted."

- "Once the traditional actuarial indications and marketing considerations are known, the decision-maker needs to weigh all information and select the rates that best meet the goals of the company. Typically, this is done judgmentally."



Source: Werner, G, and Modlin, C., Basic Ratemaking, Casualty Actuarial Society, Fifth Edition, May 2016.

Casualty Actuarial Society

2021-23 Strategic Plan

- The inspiration for the Strategic Plan is illustrated through a new Envisioned Future that foresees:
  - *CAS members are sought after globally for their insights and ability to apply analytics to solve insurance and risk management problems.*

- The Strategic Plan is designed to prepare CAS members with skills in three primary areas:
  1. Analytics, to tackle the important insurance and risk management problems in our data-rich world.
  2. Problem solving, built upon strong strategic thinking and communication skills.
  3. Domain knowledge, specifically property and casualty insurance and risk management.

Source: CAS Strategic Plan | Casualty Actuarial Society (casact.org)

Casualty Actuarial Society

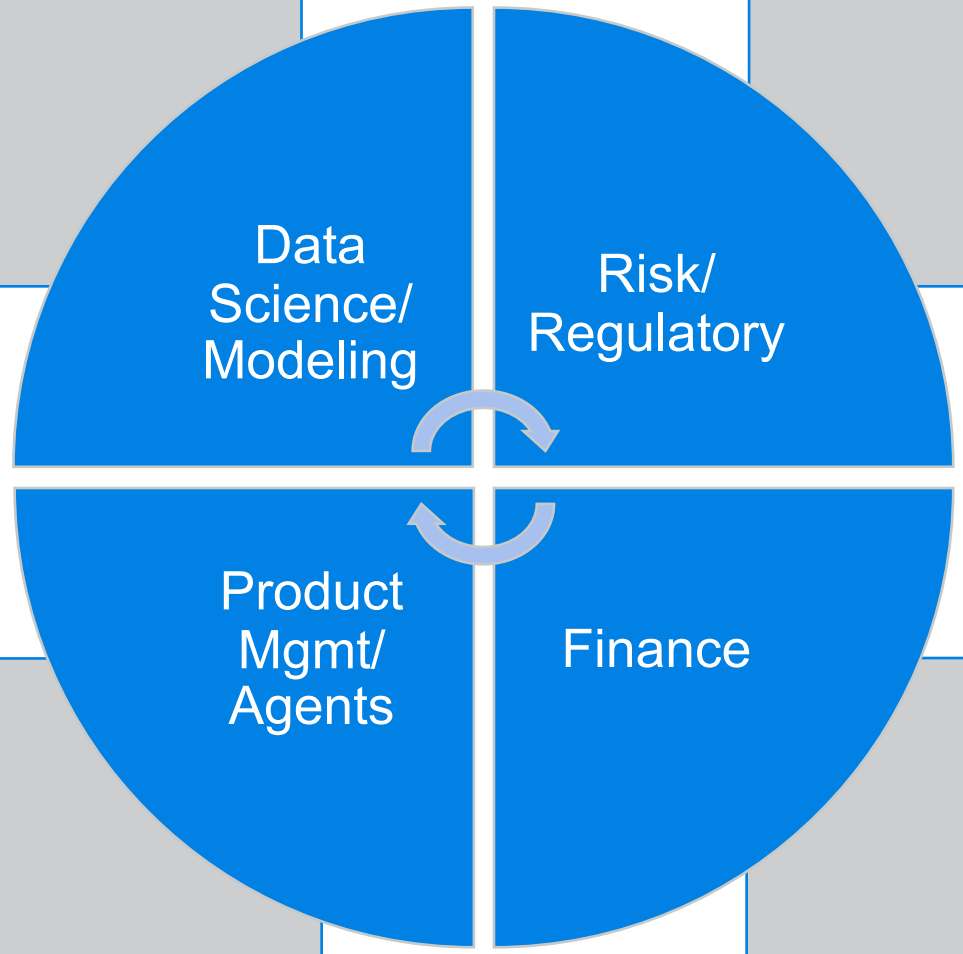
2021-23 Strategic Plan

- “It is becoming increasingly important to have technical and soft skills to translate analysis into business terms. While technical skills are needed to get a foot in the door, those best positioned for success will also possess.”
  - The intellectual curiosity to proactively identify business problems.
  - The ability to apply logic to a problem.
  - The business and industry knowledge need to provide effective recommendations from the analysis.
  - Strong communication skills to tell a clear story.
  - The ability to conquer the “last mile” problem in analytics to successfully get end-users to use the analytics for impact.

The Pricing Actuary and Function Integration

Applying Analytics to Solve Insurance and Risk Management Problems

- Prioritization of analyses
- Regulatory/data/financial constraints
- Analytical constraints



- Impacts to risk metrics
- Regulatory approval

- Growth goals
- Policyholder impacts
- Impacts from prior rate changes

- Translate ratemaking impacts to financial impacts

Pre-Work for an Analysis

What Does the Analysis Set Out to Achieve?

Current State	• Profitability, Growth, Subsidy • Marketplace Trends
Residual Impacts	• Recent Rate Changes • Product/Agent Feedback
Resources	• Time available • Budget considerations
Stakeholders	• Shareholders or policyholders • Internal stakeholders

Dislocation Considerations

How Companies May Approach Different Scenarios?

Scenario 1

- Mature program
- Program with sustained profitability
- Sustainable growth

Scenario 2

- Newer program
- Program with profitability challenges
- Lack of growth in key segments

Additional Considerations:

- Where is the insurance market at in the underwriting cycle?
- What are the pricing actions of competitors?
- Are there market segments with a history of rate increases?
- Should policies in force be expanded to better reflect the target market?
- What are potential non-pricing actions?

Regulatory Constraints

Understanding Regulatory Requirements Prior to Submitting a Filing

- General Restrictions:
  - California – Proposition 103
    - "The application shall be deemed approved sixty days after public notice unless the proposed rate adjustment exceeds 7% of the then applicable rate for personal lines or 15% for commercial lines, in which case the commissioner must hold a hearing…"
  - New York – 30% maximum policy-level rate change
  - Alabama – Filing frequency restricted to coincide with the typical term of coverage
- Restrictions on Rating Variables:
  - Washington – Credit Scoring
    - "Commissioner Kreidler adopted his rule temporarily banning credit scoring."
  - California – Gender (Personal Auto)
  - Tennessee – Fictitious Grouping
    - "Preferences or distinctions in certain insurance transactions prohibited."
    - "Fictitious grouping" means any grouping by way of membership, nonmembership, license, franchise, employment, contract, agreement or any other method or means;

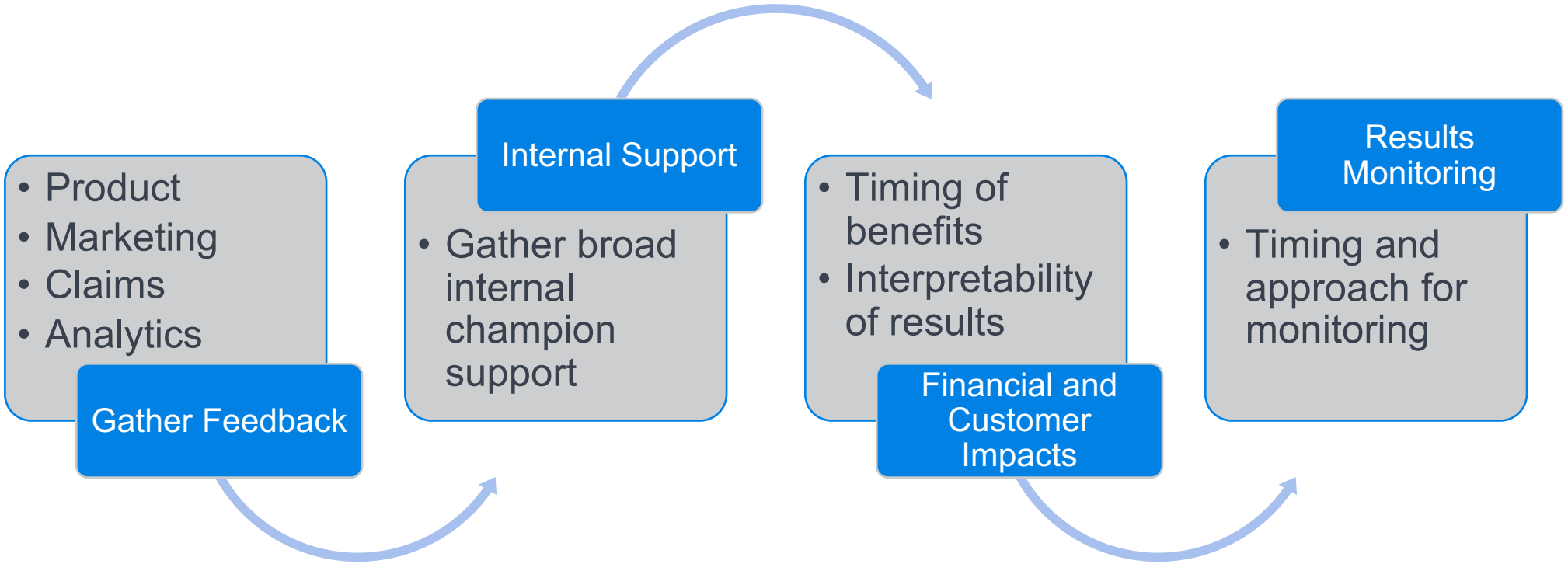
Implementation Considerations

- Methods for Limiting Disruption:
  - Individual Rating Factors – Review selections between current factors and indicated factors.
  - Rate Capping/Rate Stability – Review state regulatory requirements.
  - Advancement Rate Capping/Rate Stability – Asymmetrical capping or capping by renewal period.
- Non-Pricing Actions:
  - Underwriting
  - Marketing
  - Fraud detection
  - Premium leakage

6-Month Policy Term	Months Adjusted for Stability (Consecutively in Same Direction)					
Ratio*	0-11 Months	12-23 Months	24-35 Months	36-47 Months	48-59 Months	60+ Months
>1.300	5.0%	5.0%	7.5%	5.0%	5.0%	D
1.251 to 1.300	5.0%	5.0%	7.5%	5.0%	5.0%	D
1.201 to 1.250	5.0%	5.0%	5.0%	5.0%	5.0%	D
1.151 to 1.200	5.0%	5.0%	5.0%	5.0%	5.0%	D
1.141 to 1.150	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.131 to 1.140	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.121 to 1.130	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.111 to 1.120	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.101 to 1.110	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.091 to 1.100	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.081 to 1.090	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.071 to 1.080	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.061 to 1.070	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.051 to 1.060	2.5%	2.5%	5.0%	2.5%	2.5%	D
1.041 to 1.050	M	M	D	M	M	D
1.031 to 1.040	M	M	D	M	M	D
1.021 to 1.030	M	M	D	M	M	D
1.011 to 1.020	M	M	D	M	M	D
0.990 to 1.010	M	M	D	M	M	D
0.989 to 0.980	M	M	D	M	M	D
0.979 to 0.970	M	M	D	M	M	D
0.969 to 0.960	M	M	D	M	M	D
0.959 to 0.950	M	M	D	M	M	D
0.949 to 0.940	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.939 to 0.930	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.929 to 0.920	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.919 to 0.910	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.909 to 0.900	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.899 to 0.890	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.889 to 0.880	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.879 to 0.870	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.869 to 0.860	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.859 to 0.850	-2.5%	-2.5%	-5.0%	-2.5%	-2.5%	D
0.849 to 0.800	-5.0%	-5.0%	-5.0%	-5.0%	-5.0%	D
0.799 to 0.750	-5.0%	-5.0%	-5.0%	-5.0%	-5.0%	D
0.749 to 0.700	-5.0%	-5.0%	-7.5%	-5.0%	-5.0%	D
<0.700	-5.0%	-5.0%	-7.5%	-5.0%	-5.0%	D

*Ratio = (Continuation or renewal Term's Unstabilized Rate) / (Expiring Term's Stabilized Rate)
D = Do not adjust for stability
M = Maintain "stabilized rate"

Communicating to Internal Stakeholders



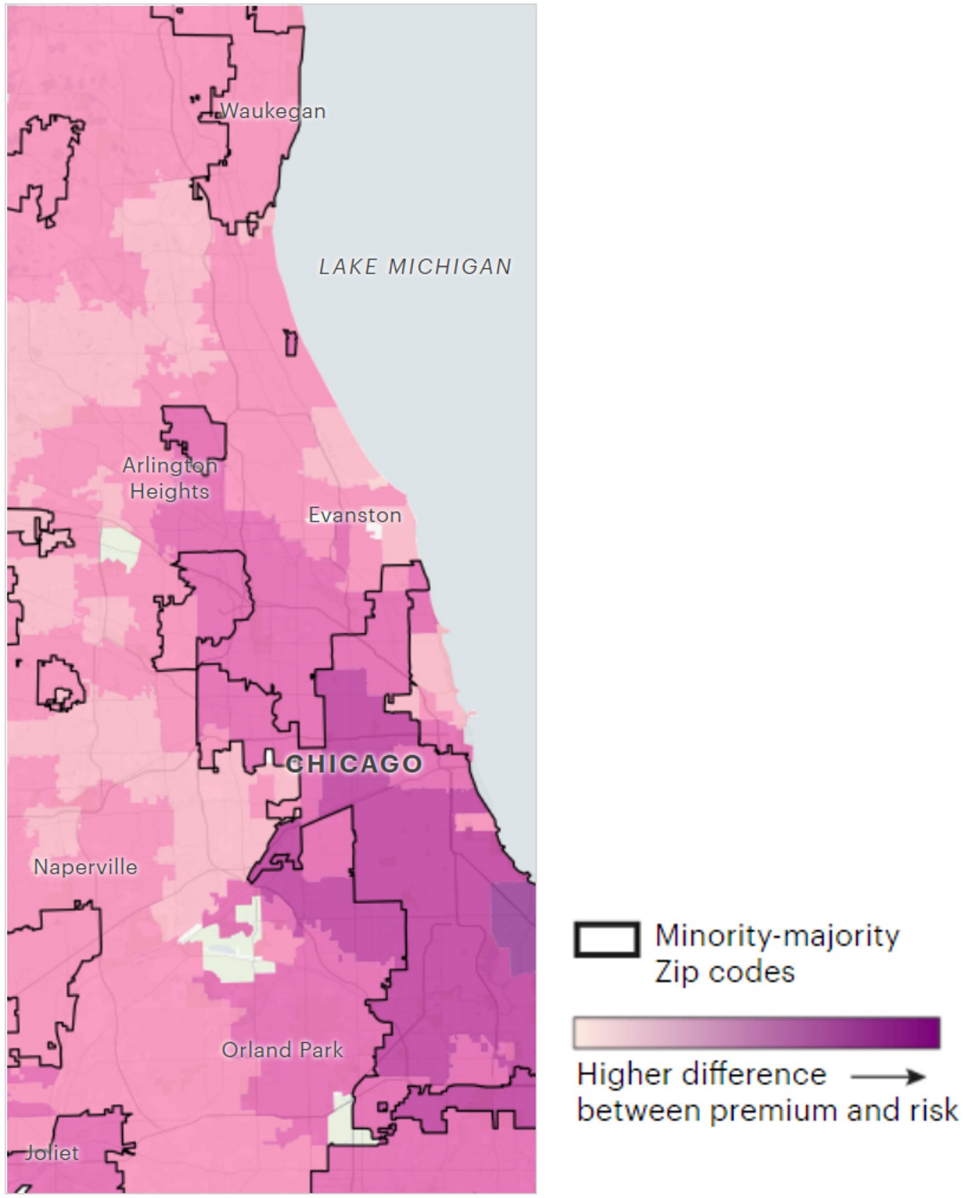
Dislocation and Disparate Impacts

Additional Considerations

- "Minority Neighborhoods Pay Higher Car Insurance Premiums than White Areas With the Same Risk" – ProPublica 2017

- "Confronting the Issues of Race and Pricing" – Actuarial Review
  - Possible ways to examine price discrimination.
    - Do nothing.
    - Exclude certain risk classifications from rating plans.
    - Introduce a variable that controls for a protected risk characteristic.
    - Evaluate the final price's impact on protected classes.

- "We're dropping credit score from car insurance pricing by 2025" – Root Insurance Blog, 2021



Thank you.

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November 2022

Milliman

AKUR8

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2022

Thomas Holmes
Head of US Actuarial Data Science at Akur8

Biography

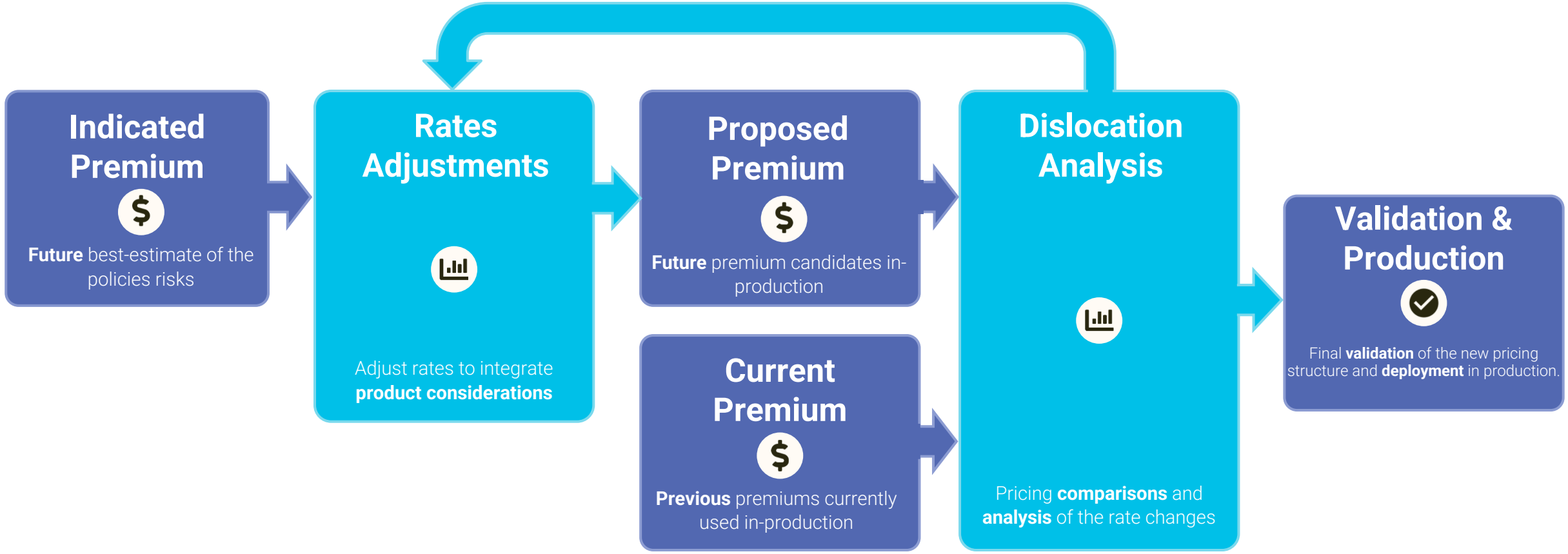
Thomas Holmes is the Head of US Actuarial Data Science at Akur8.

In this role, he works directly with clients providing best practice and modeling insights as well as with Akur8's product development team to improve the software. Prior to Akur8, Thomas has worked in both in traditional ratemaking and modeling roles.

Thomas is a Fellow of the CAS.

AKUR8

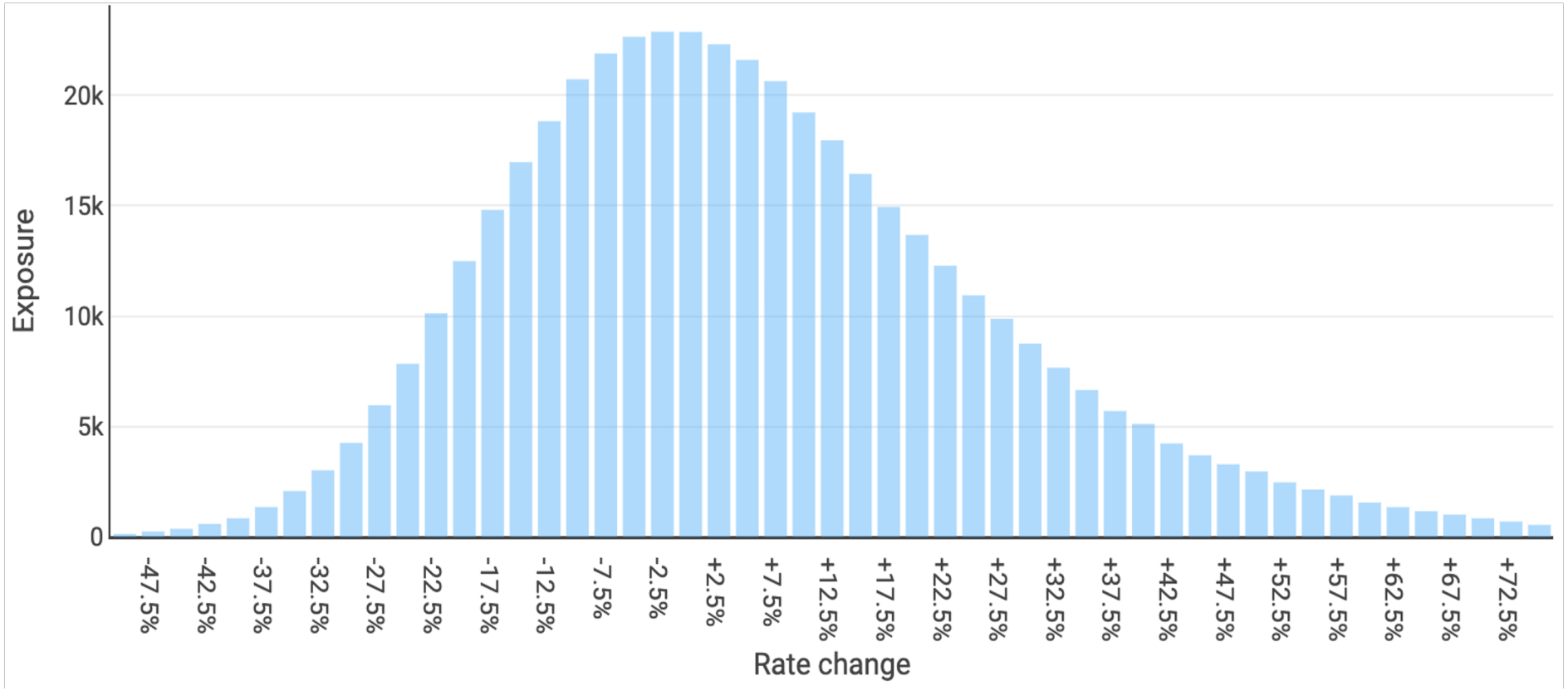
Pricing update process



Premium Comparison

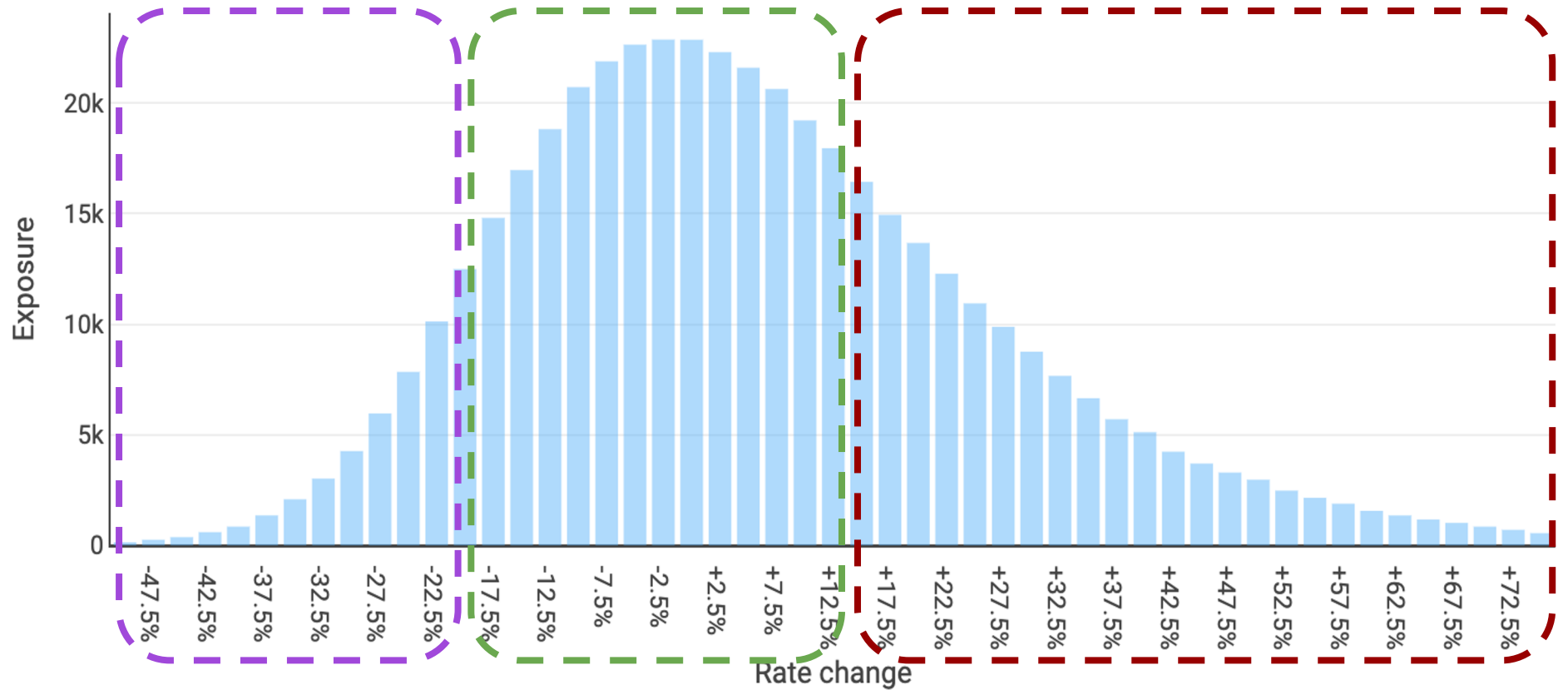
AKUR8

The Basic: Price-Change distribution



The simplest approach only provides a view of the price changes.
This graph also provides a view of the importance of the proposed price change.

The Basic: Price-Change distribution



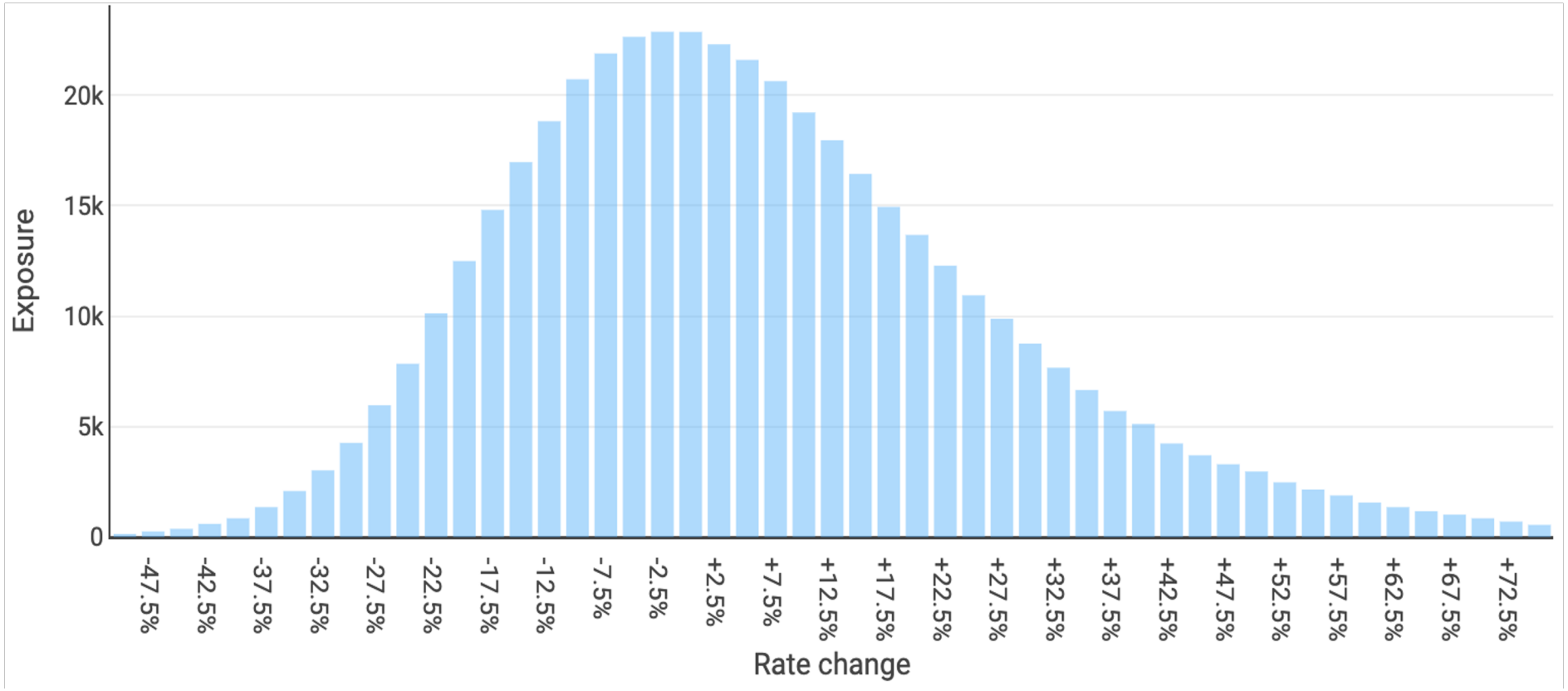
Significant Decrease: loss of opportunity

Stable Rates

Significant increase: High risk of lapse (and potential regulatory limits)

For instance: 3 strategies (1/3)

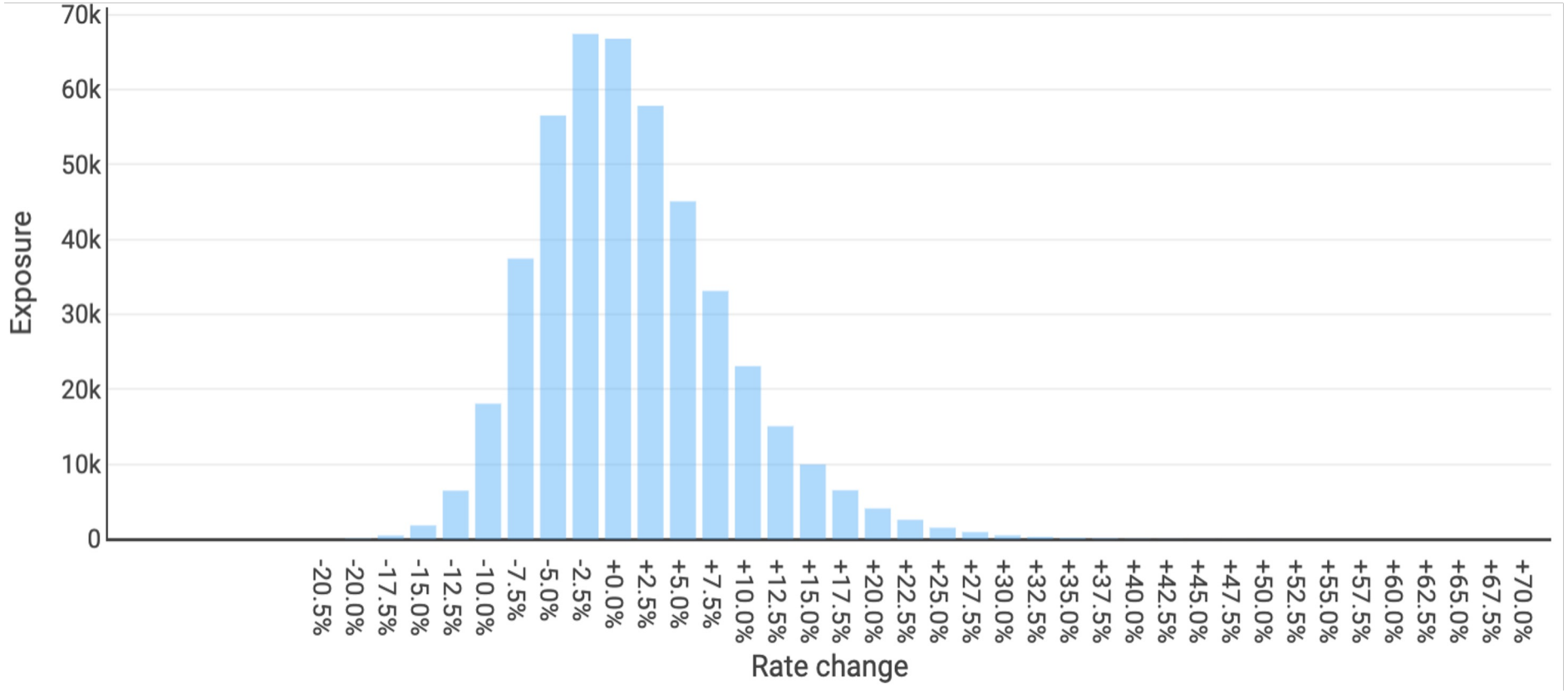
No Constraints



There is no specific constraints in terms of dislocation; e.g., the current portfolio is either very small or extremely unprofitable, and the new indicated premiums can be considered as the only relevant information.

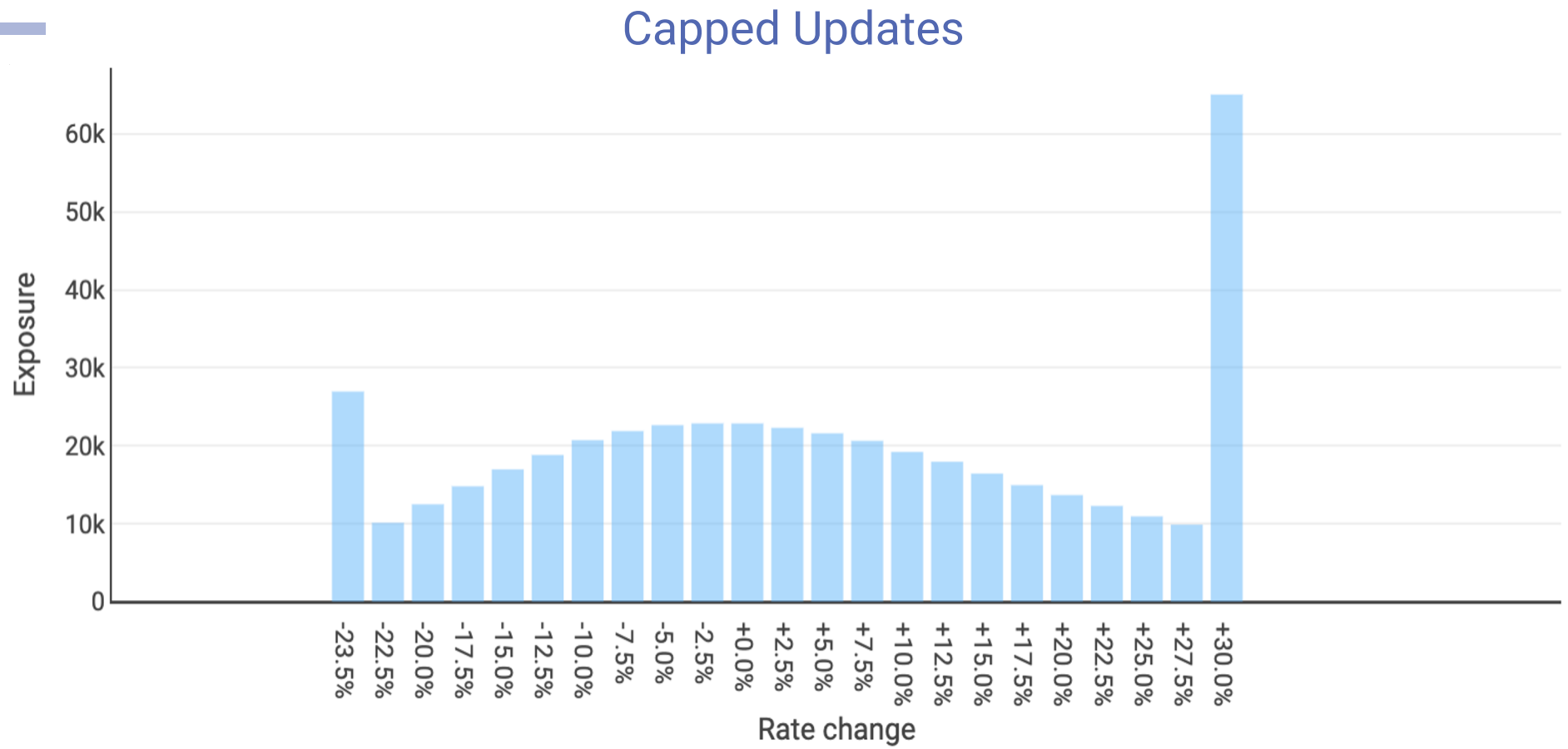
For instance: 3 strategies (2/3)

Soft Update



Keep dislocation small to limit the disruption; e.g., for large and/or profitable portfolios, the new indicated premiums aim to control arising loss patterns, however keeping rates stable is the priority. As a result, a desired strategy is to adopt a soft update with small price changes.

For instance: 3 strategies (3/3)

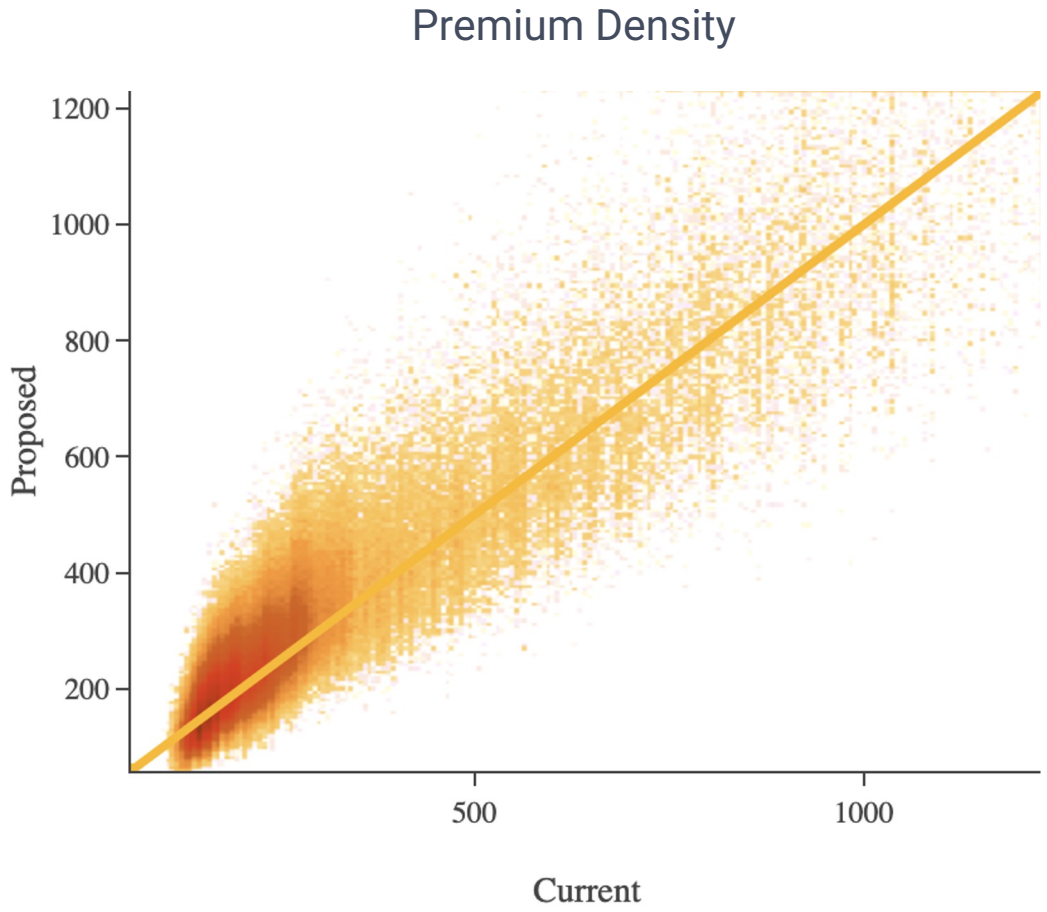


For either regulatory or operational reasons, the updates are limited to a certain range (upper limit of 30% in the example) to avoid extreme impacts.

Who has been updated?

Density of Current vs Proposed price

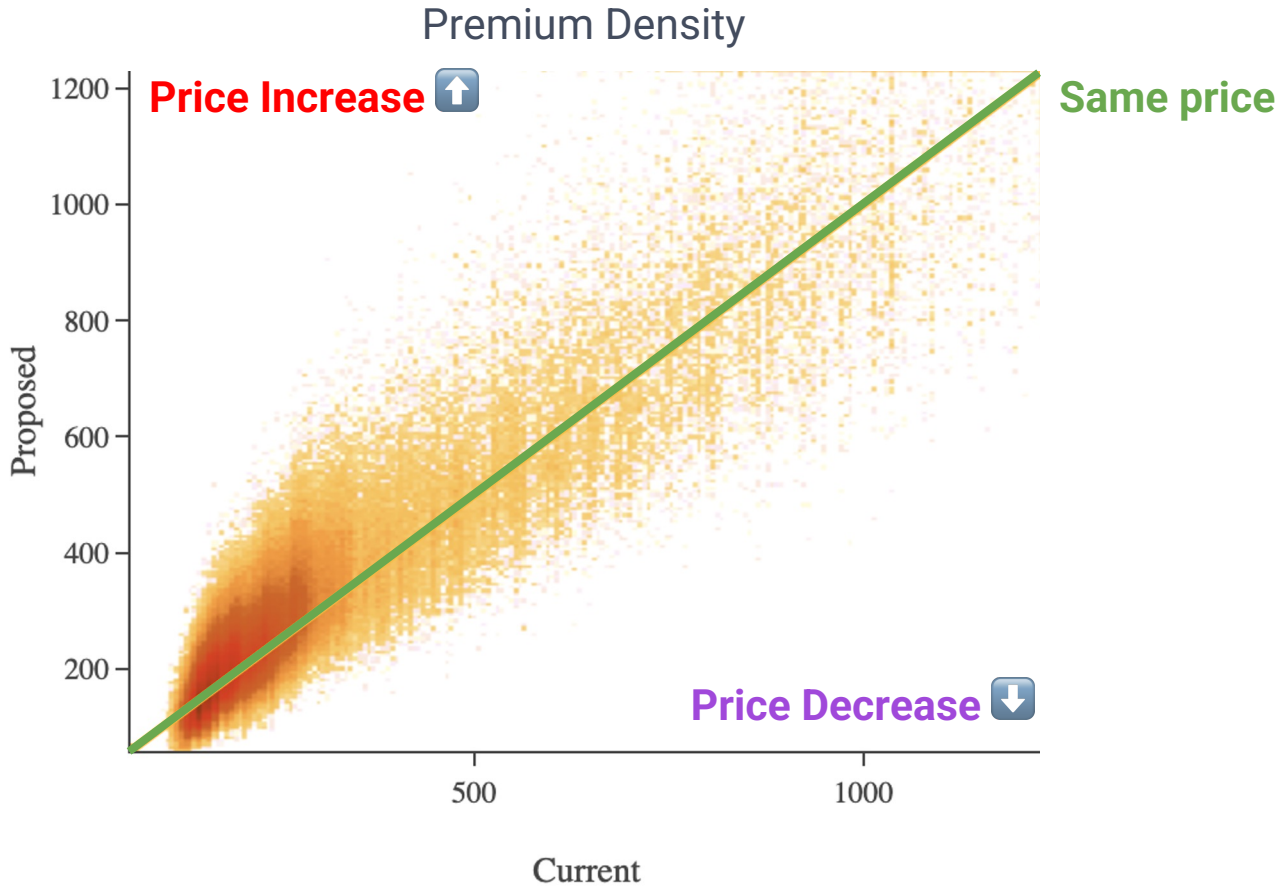
Dark-red areas indicate a high density of policies; lighter yellow areas represent lower density.



Who has been updated?

Density of Current vs Proposed price

Price **increases** and **decreases** are clearly identified on the graph. Policies along the diagonal are not impacted by the rate change.



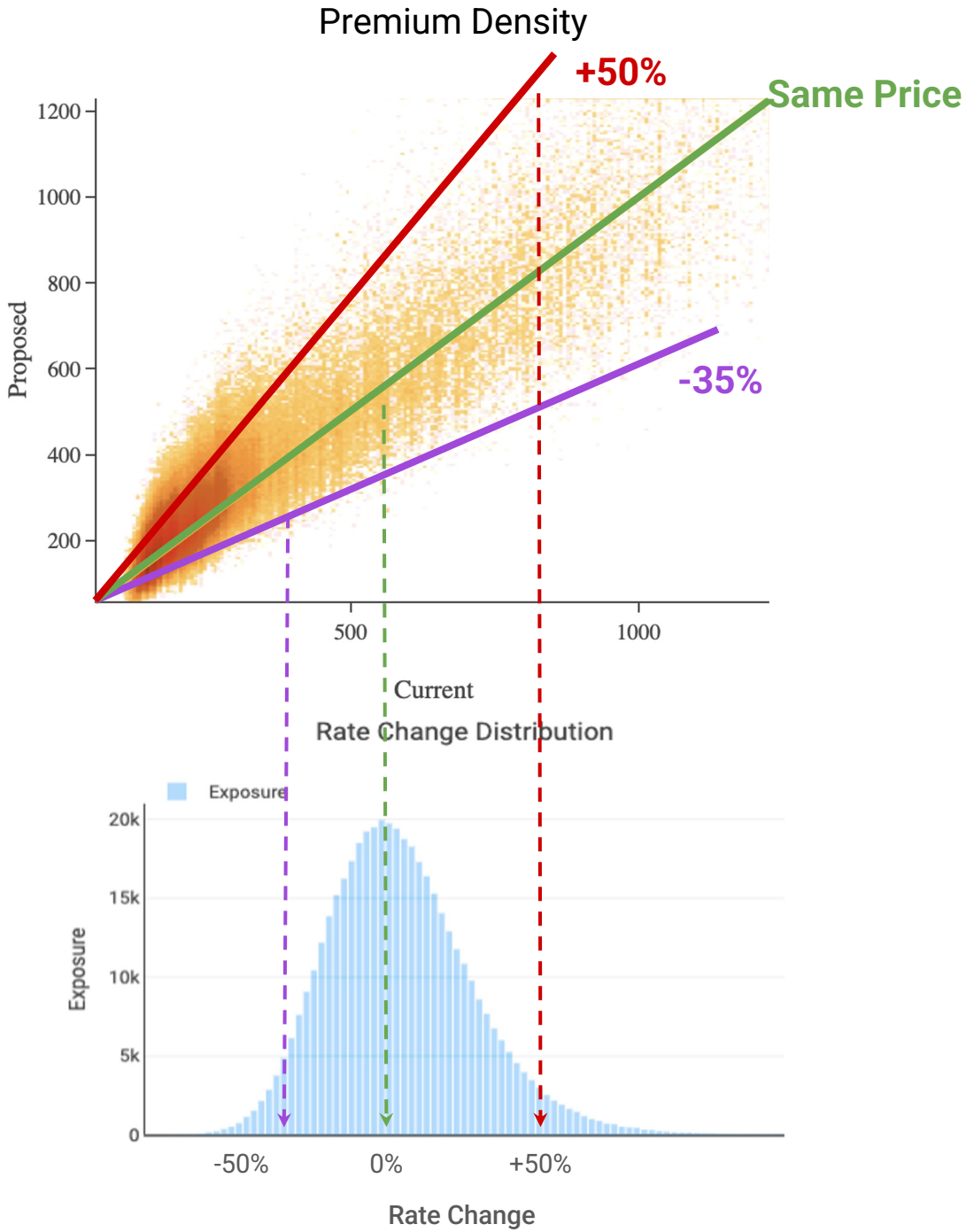
CONFIDENTIAL

Who has been updated?

Density of Current vs Proposed price

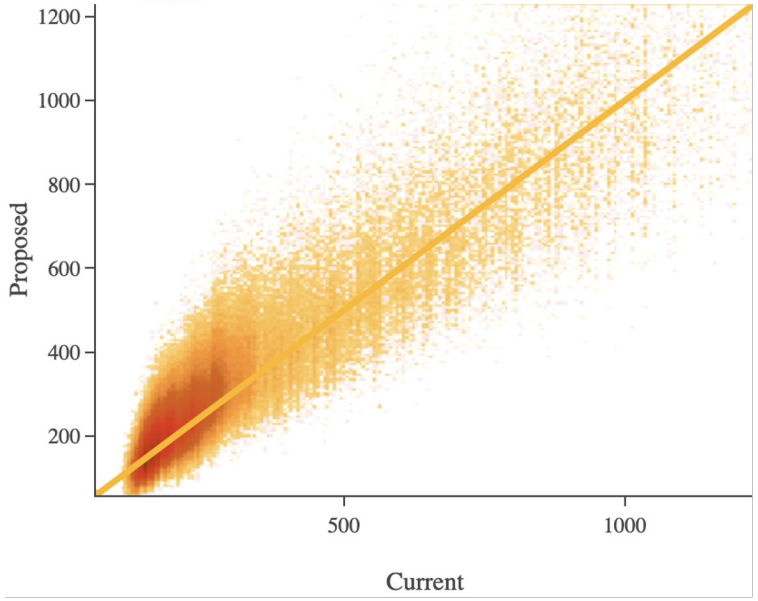
The Premium Density graph provides a richer view of the price changes distribution.

E.g., people with a given price increase (one point of the Rate Change graph) will be on the same line in the Premium Density graph.

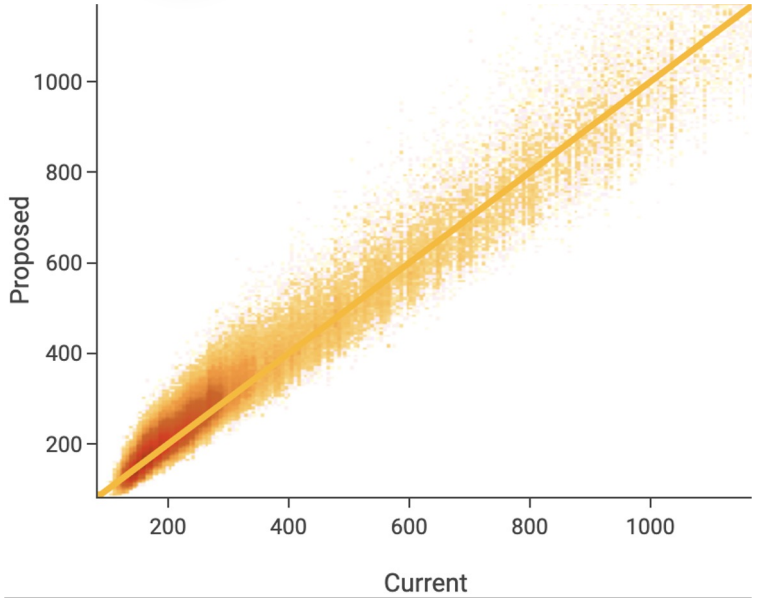


Small or large price update?

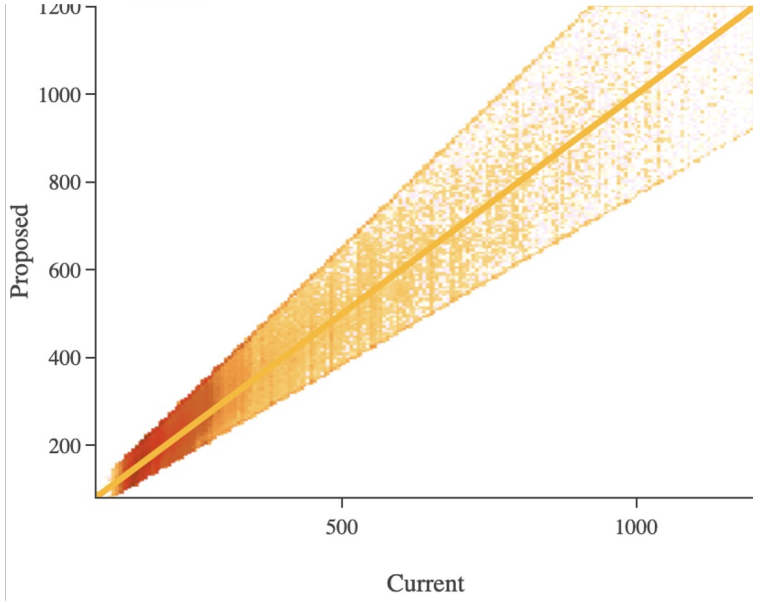
1 No Constraints



2 Soft Updates



3 Capped Updates



In the Capped Updates scenario (right), all the points are grouped around the diagonal where the new proposed price equals the current one. On the No Constraints scenario (left), the price changes are wider: some points are far away from the diagonal indicating the new proposed prices are very different from the current prices.

Who was impacted, and how?

Variable-by-variable review of the price change

The Vehicle_Value_at_Purchase variable has the most significant impact on the price change: any review of the new price should involve an in-depth study of the relationship between this variable and the observed risk.

Who was impacted, and how?

Variable-by-variable review of the price change

Relative impact of each variable on the Rate Change

Segmentation of the Rate Change

Who was impacted, and how?

Variable-by-variable review of the price change

The Vehicle_Value_at_Purchase variable is segmenting less with the new proposed premium; customers were likely overly segmented by this characteristic in the current premium structure.

Who is right?

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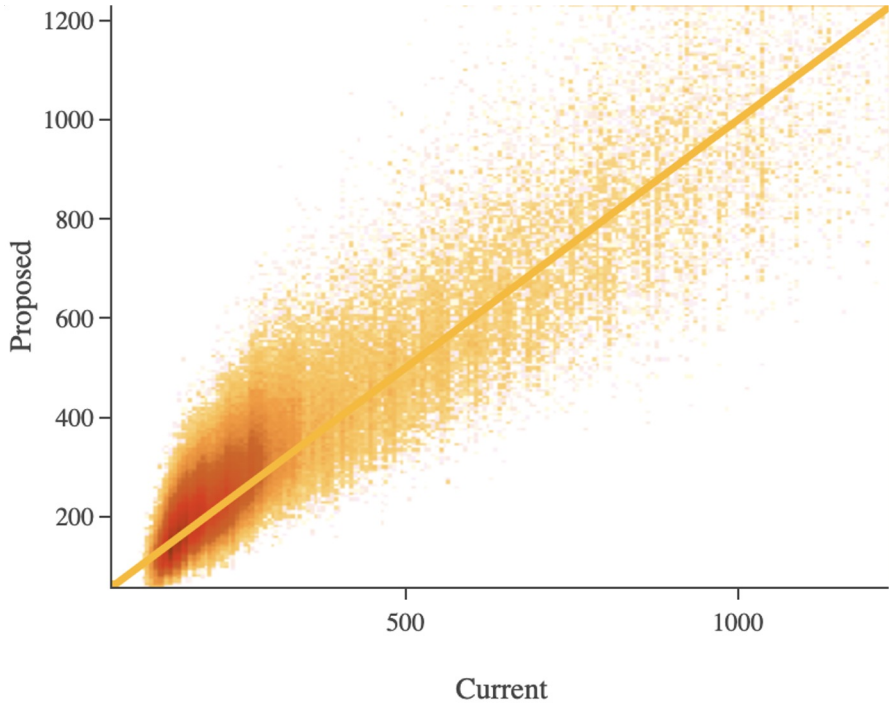
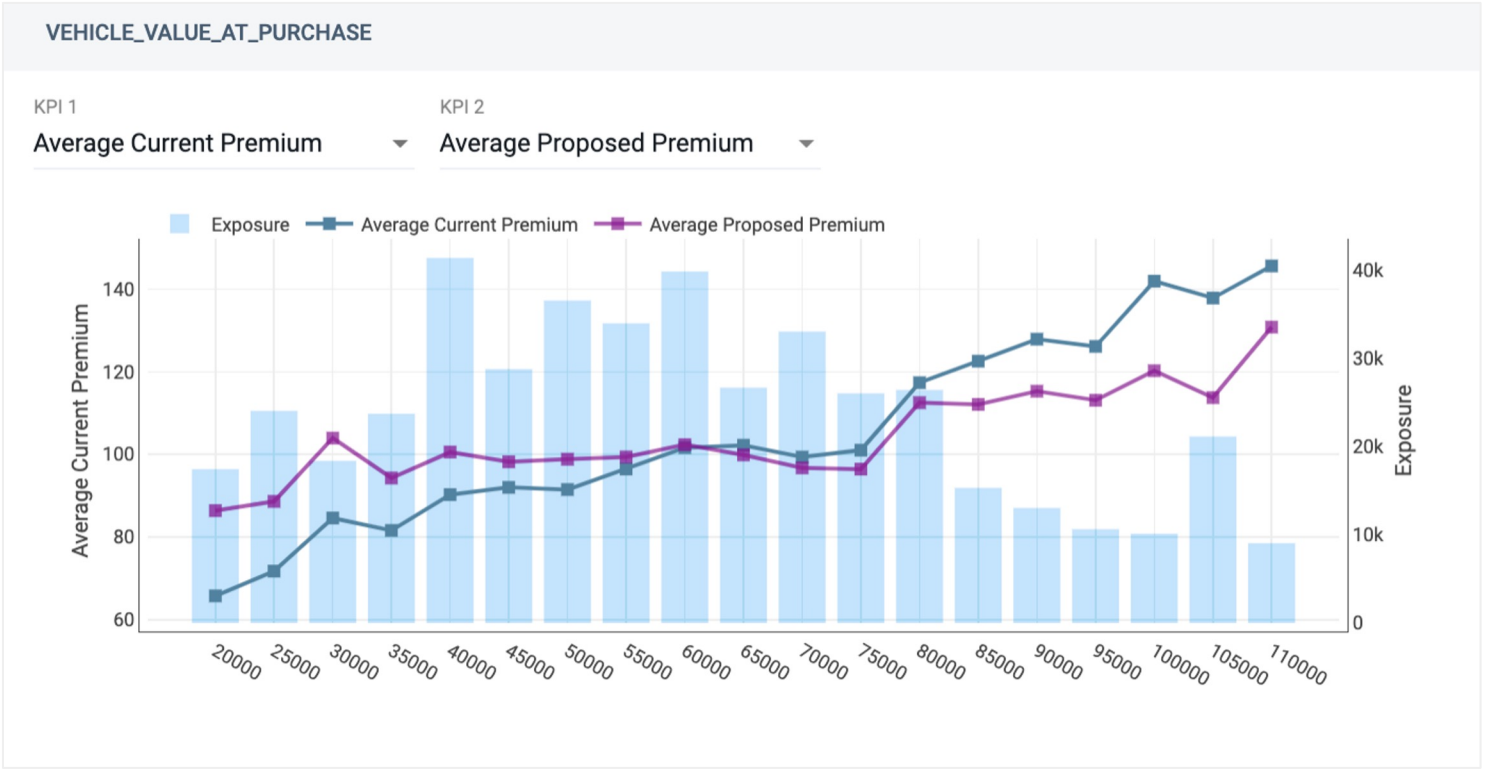
Price Update Analysis

The proposed vs current price





These graphs provide a full view of **which profiles are impacted by the price change**.
They don't give information on **how well justified** these changes are.

Models Performances

Simply compare the underlying models performances?

Models underlying the Current Premium

SEGMENTATION | RESIDUALS | STATISTICS

METRIC	TRAIN FULL	TRAIN K-FOLD	TEST K-FOLD
GINI	27.96 %	28.31 %	26.97 %
NORM. GINI	28.18 %	28.53 %	27.18 %
PSEUDO-R²	3.9 %	3.99 %	3.67 %
RMSE	2070	2070	2070
DEVIANCE	28700000	21500000	7191000
AVG. DEVIANCE	87.47	87.39	87.68
MAE	320.8	320.7	320.8

Model underlying the Proposed Premium

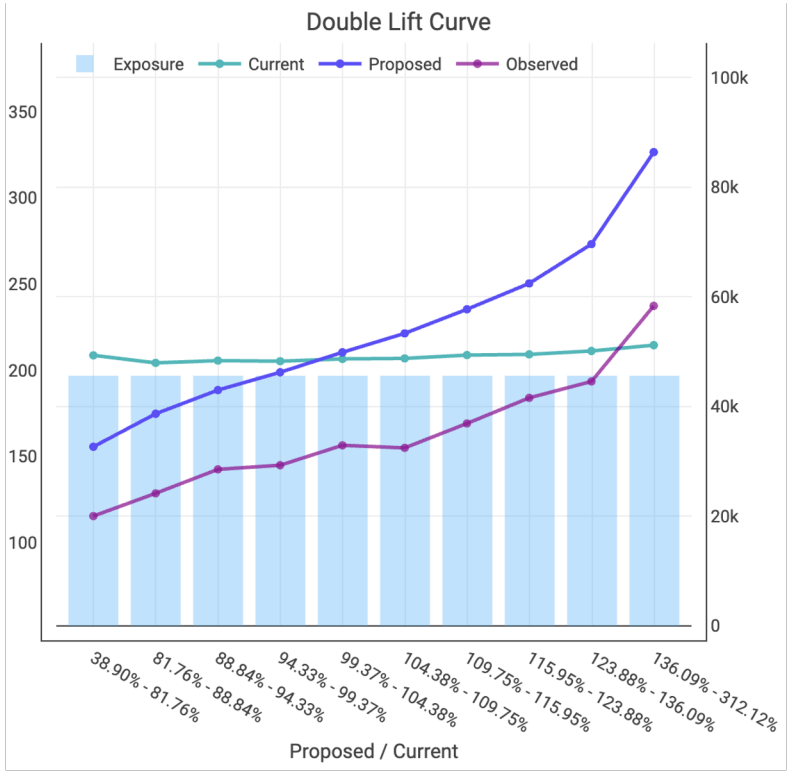
SEGMENTATION | RESIDUALS | STATISTICS

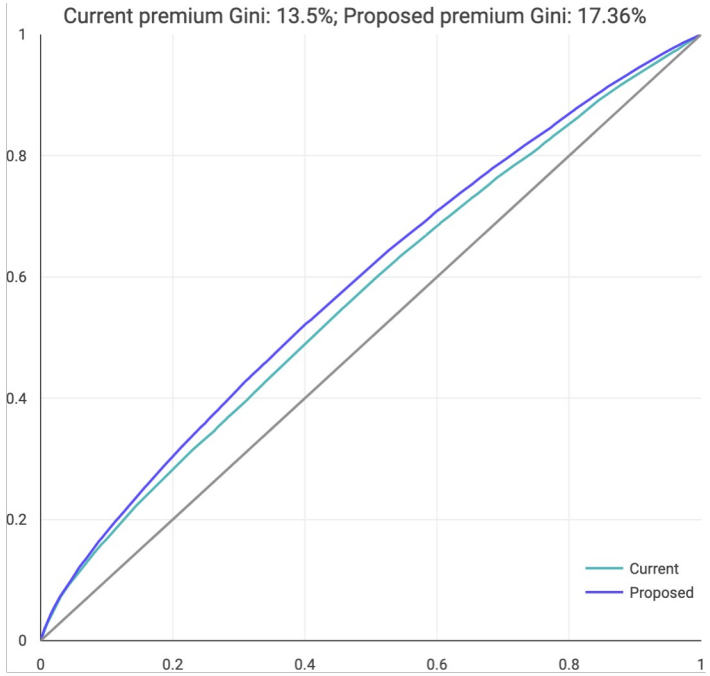
METRIC	TRAIN FULL	TRAIN K-FOLD	TEST K-FOLD
GINI	28.66 %	28.78 %	25.61 %
NORM. GINI	28.87 %	29 %	25.8 %
PSEUDO-R²	4.03 %	4.12 %	3.41 %
RMSE	2106	2106	2106
DEVIANCE	3176000	2380000	799000
AVG. DEVIANCE	87.41	87.32	87.97
MAE	317.5	317.3	317.6

Compare the appropriateness of these two premiums with the insurer's experience.
This approach is purely "performance-based", according to the data available.

Models Performances

Compare the “premium performances”?



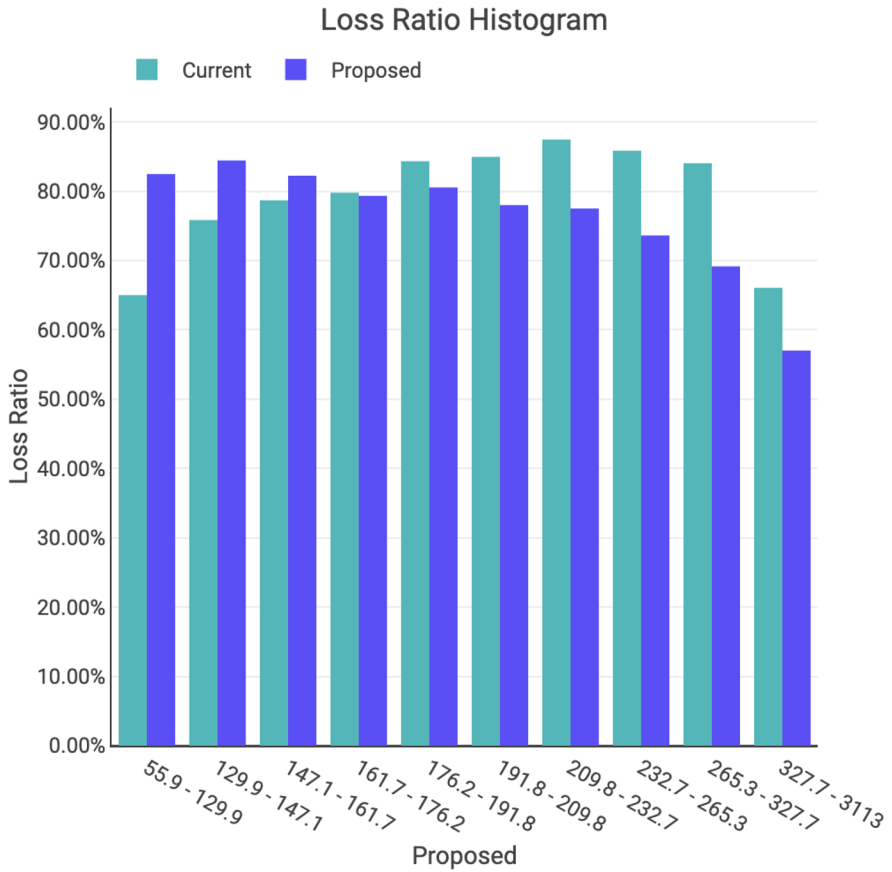


Compare the appropriateness of these two premiums with the insurer’s experience.
This approach is purely “performance-based”, according to the data available.

Loss-Ratio and Premium

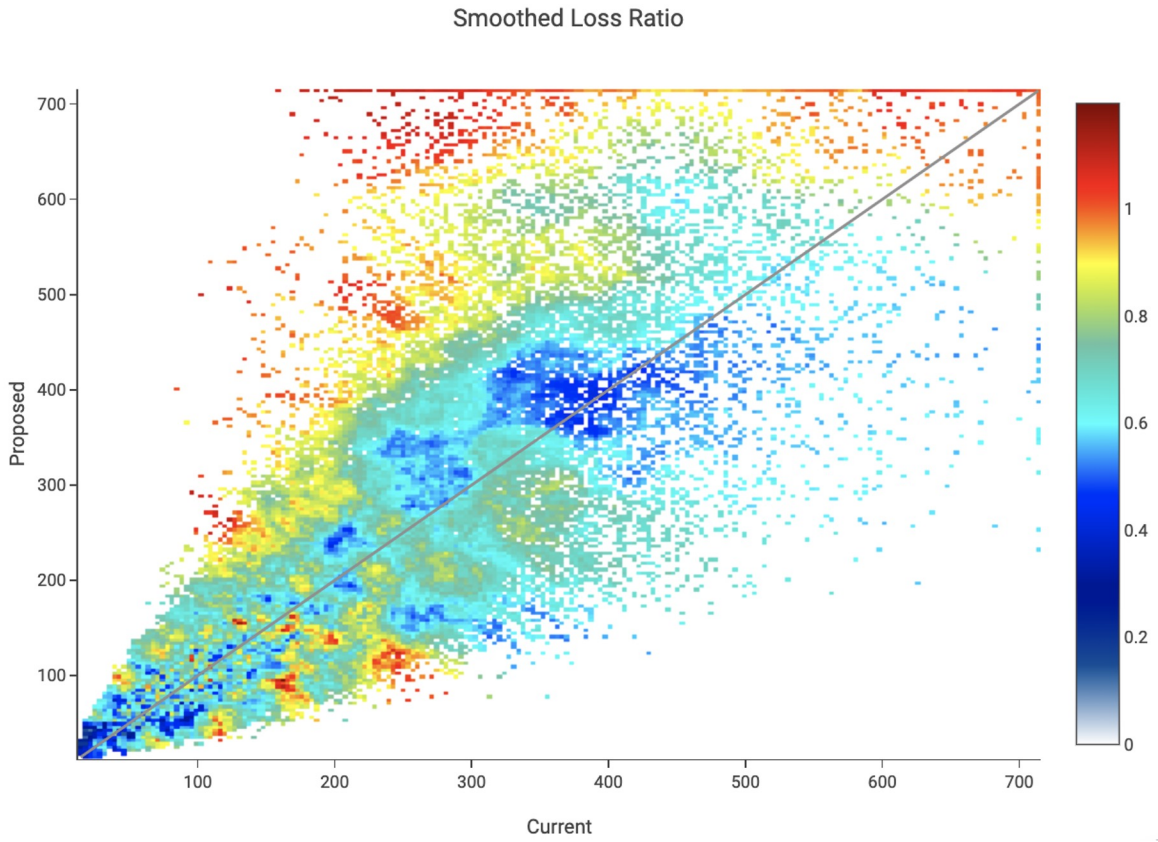
Are there premium segments with “wrong” loss ratios?

A loss ratio comparison by premium segments allows insurers to spot trends and anomalies, for example: the proposed premium under-prices the low risks (first deciles).



Mixing the change and performance analysis

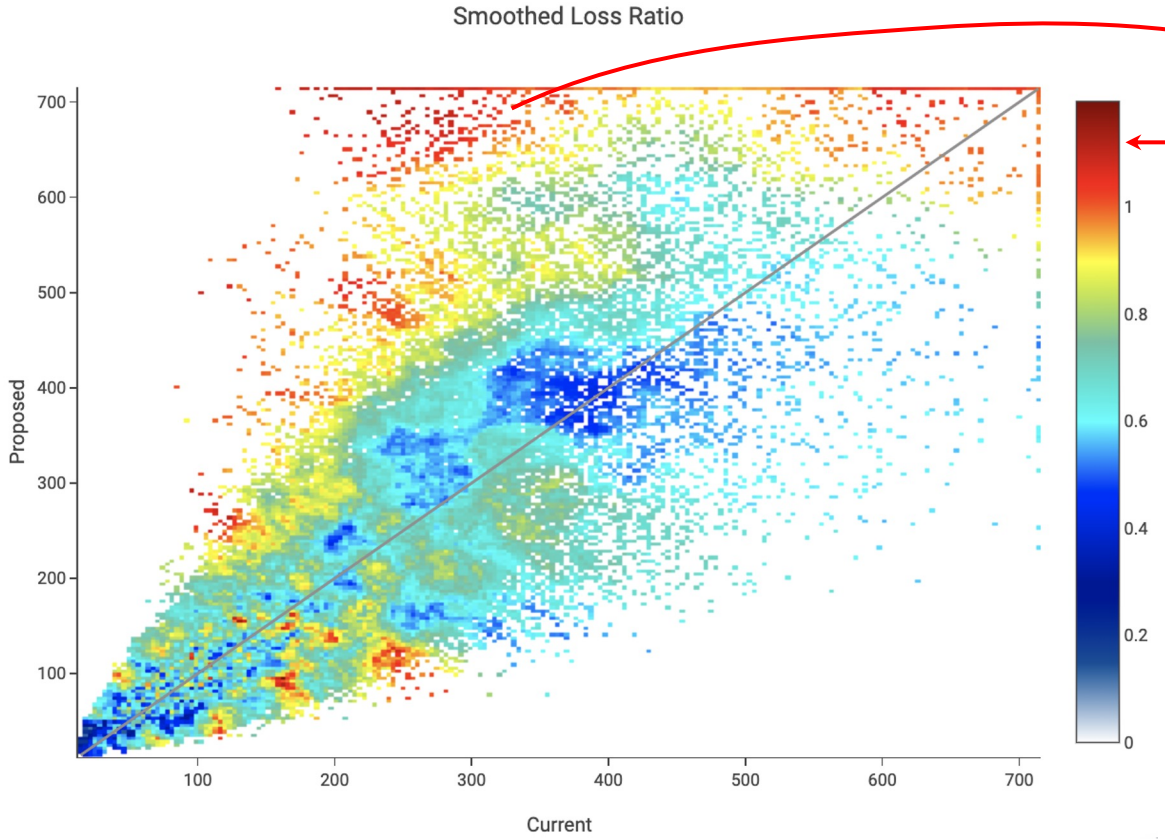
Compare performance?



Enriching the 2D premium distribution graph with the loss ratio provides a full vision of the premium changes and the “quality” of the policies impacted.

Mixing the change and performance analysis

Compare performances?

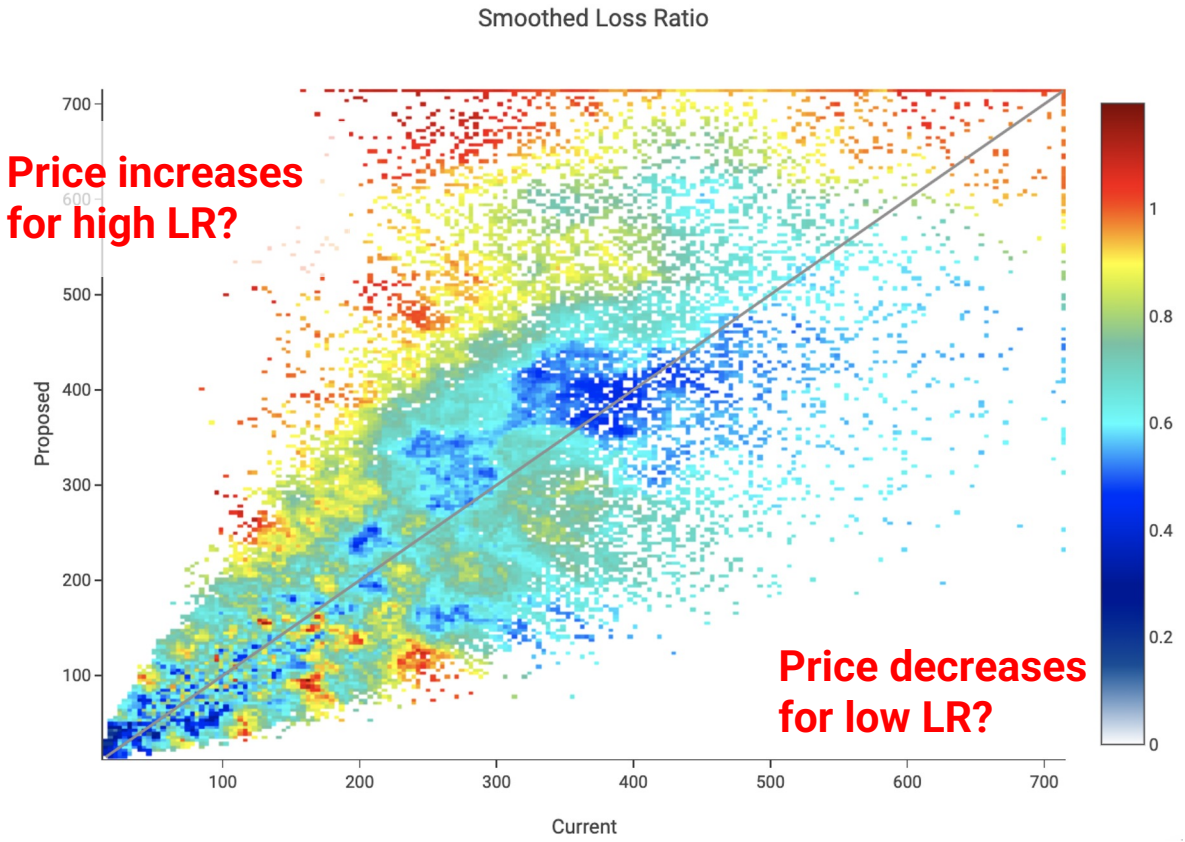


High Price Increases & High Loss Ratios

Is the price increase justified?

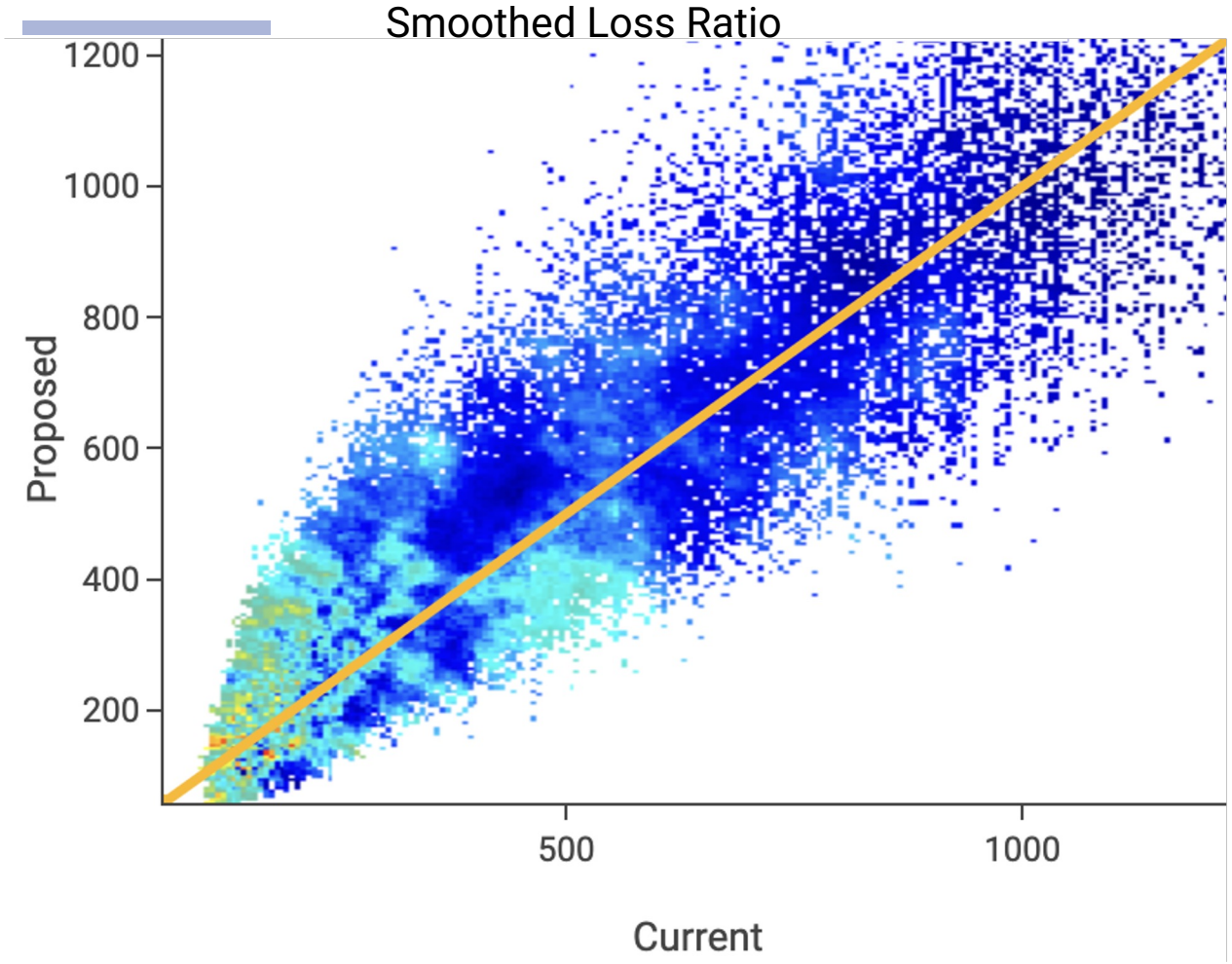
Mixing the change and performance analysis

Loss Ratios, Price Changes and Constraints?



If contracts with price increases also have high LRs, maybe we should increase the prices even more?

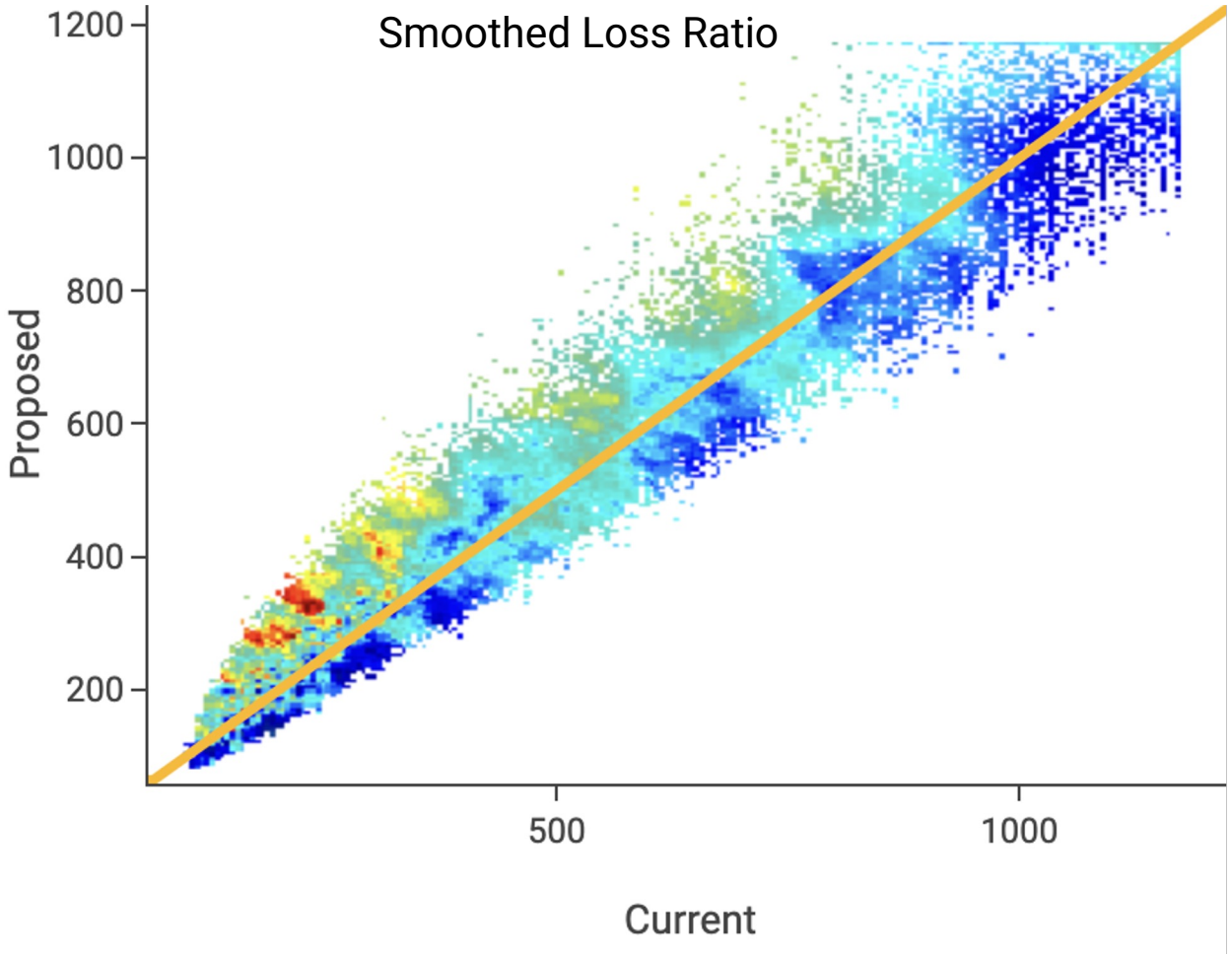
Scenario 1: No constraints



The update aims for an homogeneous loss-ratio.

The LR distribution is expected to be narrow, but at the expense of the premium consistency.

Scenario 2: Soft Update

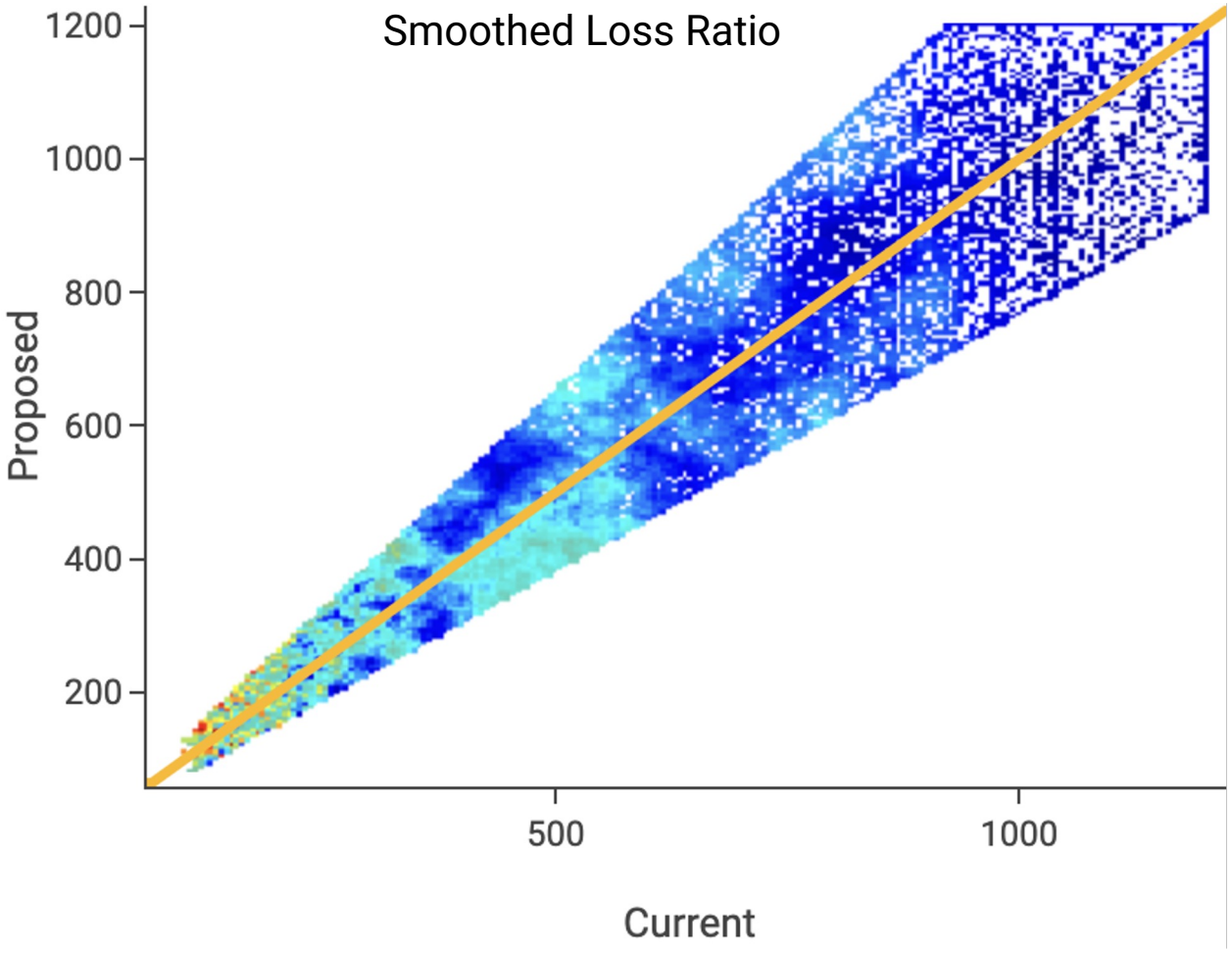


The price-update is limited:

- Identified high risks are “under-increased”: they are **red** on the graph
- Identified low risks are “under-decreased”: they are **blue** on the graph

This graph has a rainbow appearance.

Scenario 3: Capped Updates

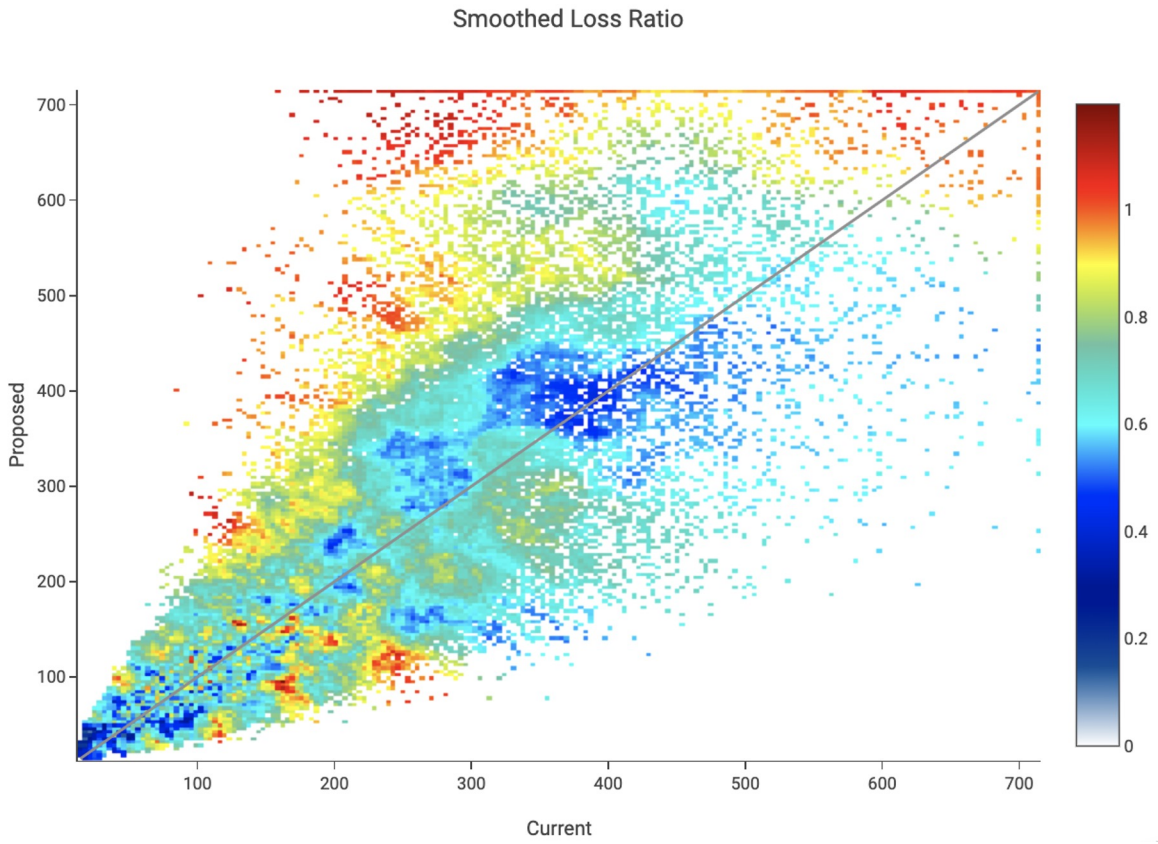


The points within the +/-30% range are not impacted by imposing the limits: these loss ratios are the same as the loss ratios in the No Constraints scenario.

Performance: Are changes motivated?

High loss ratios are expected to be on contracts whose prices have been increased (partially increased)

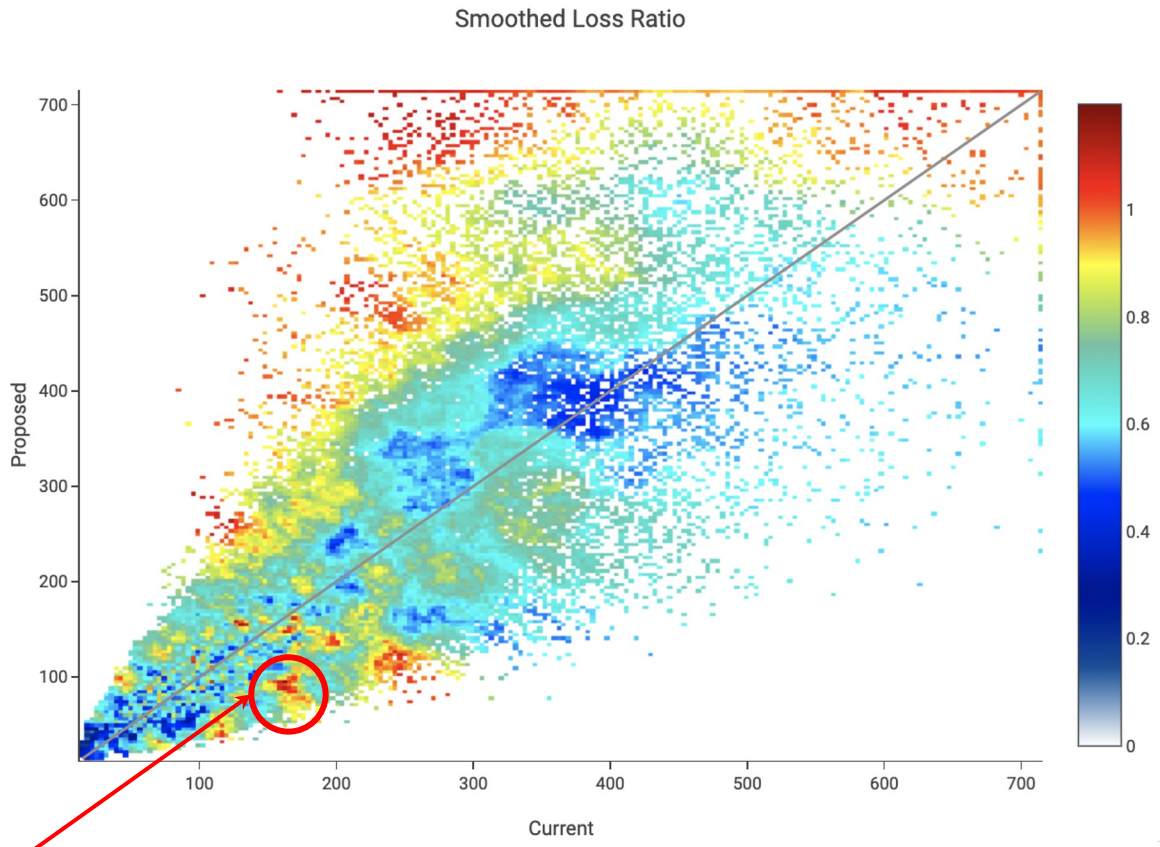
All loss ratios that do not follow the rainbow pattern (premiums of high risks are increased, premiums of low risks are decreased) are caused by noise, errors, or non-technical price adjustments (for example involving external constraints or other product decisions).



Performance: Are changes motivated?

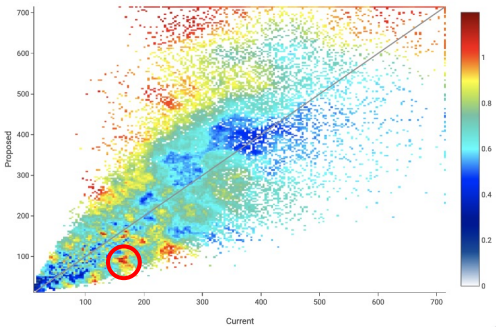
We want to quickly identify who is in the investigated segment:

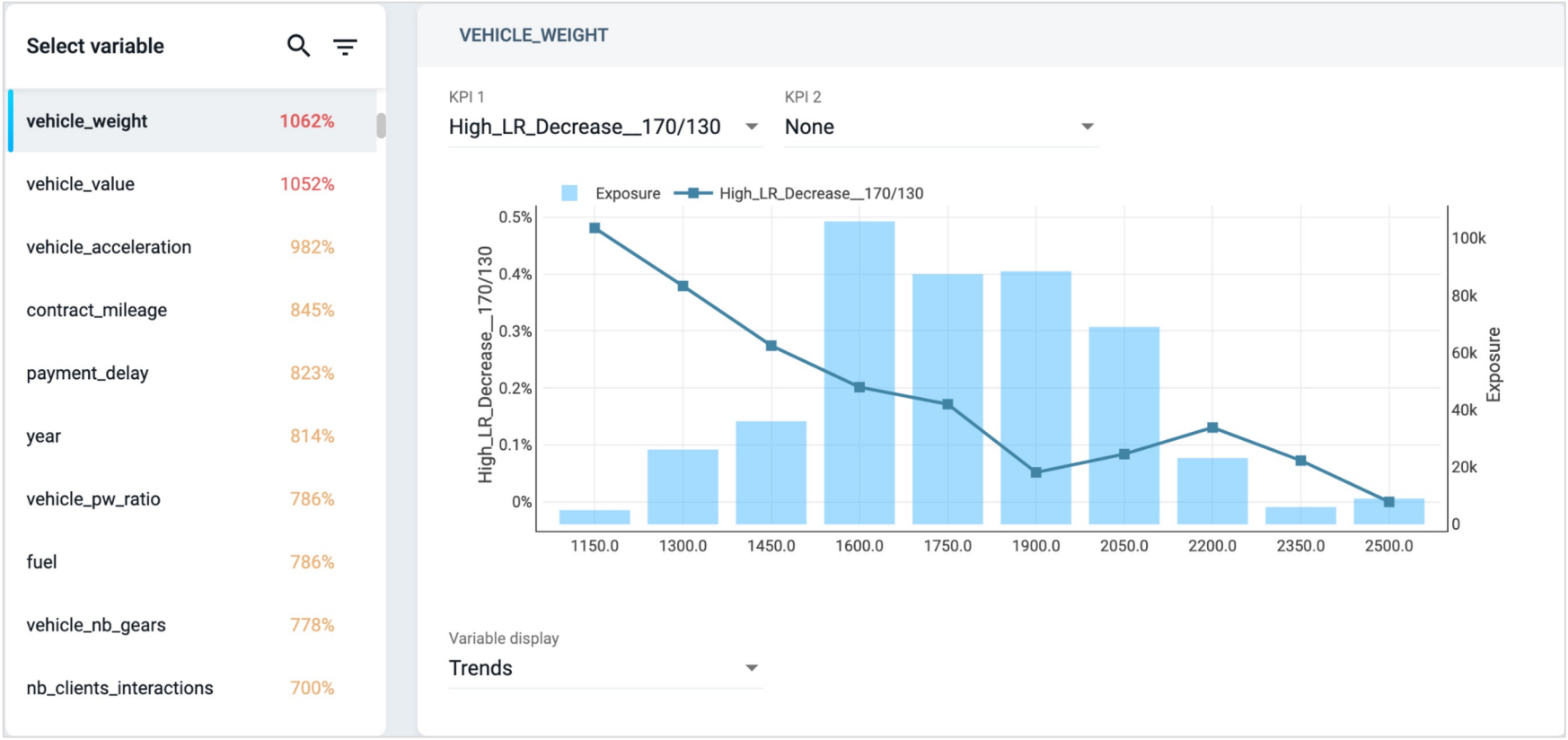
- Review which variables discriminate between contracts that are / aren't within the segment
- For each impacted variable, review which levels are in/out of the segment (in the example, the identified segment mainly includes light vehicles)



High LR & price decrease??

Who is this?

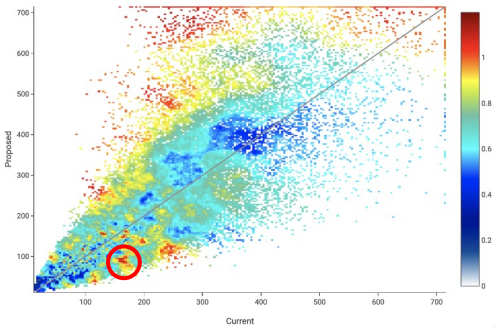




We want to quickly identify who is in the investigated segment:

- Review which variables discriminate between contracts that are / aren't within the segment
- For each impacted variable, review which levels are in/out of the segment (in the example, the identified segment mainly includes light vehicles)

Who is this?



We want to quickly identify who is in the investigated segment:

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- For each impacted variable, review which levels are in/out of the segment (in the example, the identified segment mainly includes light vehicles)

DEFAULT

Aggregation > Dislocation > Dislocation analysis > Proposed_update

BACK TO AGGREGATION

Dislocation Analysis

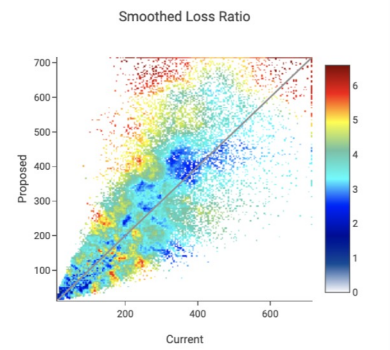
- 90/10_Update
- Proposed_update
  - Suspicious_high_risk
  - Rate change
  - High Price Increase
- No_Divide_Year
- Proposed_update_goodLR
- Divide_Year
- Intermediate_Update

Proposed_update

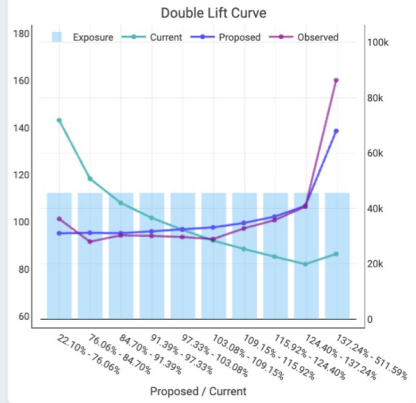
DEFINE SEGMENT

OVERVIEW | LOSS RATIO

SMOOTHED LOSS RATIO



DOUBLE LIFT | LORENZ | LOSS RATIO



DOCUMENTATION NOTE

DEFAULT

Aggregation > Dislocation > Dislocation analysis > Proposed_update > Suspicious_high_risk

BACK TO AGGREGATION

Dislocation Analysis

- 90/10_Update
- Proposed_update
  - Suspicious_high_risk
  - Rate change
  - High Price Increase
- No_Divide_Year
- Proposed_update_goodLR
- Divide_Year
- Intermediate_Update

1 Set goals — 2 Select variables

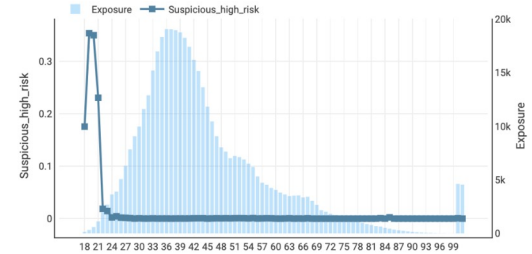
Select variable

driver_age	5153%
vehicle_value_at_purchase	2269%
vehicle_power	1873%
contract_mileage	1593%
vehicle_max_speed	1523%
year	1217%
vehicle_acceleration	1200%
vehicle_age	1178%
vehicle_anti_polution_norm	994%

DRIVER_AGE

KPI 1: Suspicious_high_risk

KPI 2: None



DOCUMENTATION NOTE

Write a Note

DEFAULT

Aggregation > Dislocation > Dislocation analysis > Proposed_update

BACK TO AGGREGATION

Dislocation Analysis

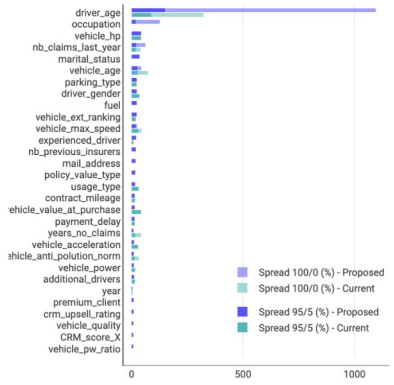
- 90/10_Update
- Proposed_update
  - Suspicious_high_risk
  - Rate change
  - High Price Increase
- No_Divide_Year
- Proposed_update_goodLR
- Divide_Year
- Intermediate_Update

Proposed_update

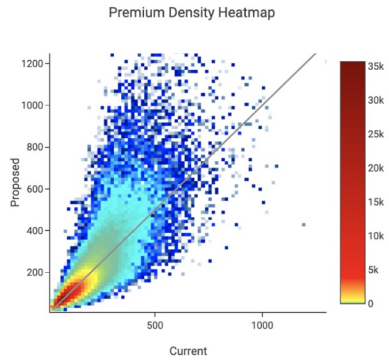
DEFINE SEGMENT

OVERVIEW | LOSS RATIO

SPREAD



RATIO | HEATMAP | PREDICTIONS



DOCUMENTATION NOTE

DEFAULT

Aggregation > Dislocation > Dislocation analysis > Proposed_update > Rate change

BACK TO AGGREGATION

Dislocation Analysis

- 90/10_Update
- Proposed_update
  - Suspicious_high_risk
  - Rate change
  - High Price Increase
- No_Divide_Year
- Proposed_update_goodLR
- Divide_Year
- Intermediate_Update

Set goals — 2 Select variables

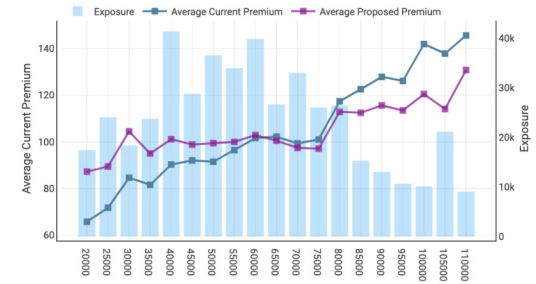
Select variable

vehicle_value_at_purchase	18650%
vehicle_power	18464%
vehicle_max_speed	15418%
vehicle_acceleration	15003%
vehicle_pw_ratio	14252%
vehicle_hp	7345%
experienced_driver	6951%
usage_type	6413%
policy_value_type	6199%

VEHICLE_VALUE_AT_PURCHASE

KPI 1: Average Current Premium

KPI 2: Average Proposed Premium



DOCUMENTATION NOTE

Write a Note

Questions?

AKUR8

Thanks!

Thomas Holmes
Head of US Actuarial Data Science
Thomas.holmes@akur8.com

AKUR8