



Perspectives on Rate Filing Support for Predictive Models: A Filer's Perspective

CAS RPM Seminar

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Background

The project. From 2014 to 2016, we worked with a client to develop new pricing models for their Private Passenger Auto and Homeowners products

§ **Built using Generalized Linear Models (GLMs)**

§ **Included significant changes to both the Auto and Homeowners rating structure and rating factors:**

- ü By-peril pricing for Homeowners
- ü Third party data
- ü Territory definitions based on Location Scores
- ü Introduction of several new rating variables for each product

Model implementation. Assisted client with the implementation of the new pricing models in nearly all 50 states

§ **Milliman led the filing effort in more than half of the states for Auto:**

- ü Included filings in many of the challenging states (e.g. FL, NJ, NY, TX, WA)

§ **Milliman provided filing support for Homeowners and for all remaining Auto states**

Assembling the filings

Limited guidance available. Most states do not have specific instructions or guidelines (yet) when it comes to filing support for the use of predictive models

Even with guidance, still not in the clear. When instructions are available, the required support may not be limited to the requested information in filing instructions

§ **Generally found that filing instructions identify the minimum amount of information needed by an insurance department**

Our (initial) motto. Let them ask for more

§ **Identified structure and factors being proposed for each coverage/peril**

§ **Didn't want to give unnecessary or extraneous information**

§ **Didn't want to disclose too much information that might be useful to competitors**

Variety of support needed by states

Regulators' primary goal. Assess compliance with CAS Principles of Ratemaking

§ Rates should be reasonable and not excessive, not inadequate, and not unfairly discriminatory

§ Interpretation of CAS Principles of Ratemaking vary by regulator

Regulators' secondary goal. Verify modeling analysis was completed in an adequate manner by a qualified actuary, statistician, or data scientist.

§ Predictive models are black box in nature

§ Difficult to demonstrate reasonability of modeling process if only the final product of the model (i.e. relativities) is provided in filing documents

DOI expertise influences requirements. The level of support requested varies with regulators' level of familiarity with the modeling process and modeling concepts

§ Significant range from minimal support to extensive support

Types of Filing Support

Standard modeling support

Written memo. Many states request similar basic information that can be contained in a written memo

- § Describe the data used as well as adjustments to the data
- § Include description of the modeling process

Model specifications.

- § Modeled response variable (e.g. Pure premium, frequency, severity, etc.)
- § Error distribution used
- § Link function
- § Explanatory variables included in final models (i.e. the formula for the final model)

Goodness of fit measures. Exhibits should be readily available, as they are frequently requested by regulators

- § P-values of model estimates
- § Type III tests
- § AIC/BIC tests
- § Holdout graphs
- § Double lift charts

Dealing with volatility in the results

Interpolation.

- § **Consider modeling the proposed rating structure to avoid having to interpolate**
 - ü If the proposed structure is known before final model built
 - ü If the proposed structure provides sufficient stability in the model
- § **If interpolation is needed, it's helpful to show interpolated indicated factors**
 - ü Regulators can more easily compare indicated and proposed factors
- § **Document interpolation methods used in case more detailed information is requested by regulators**

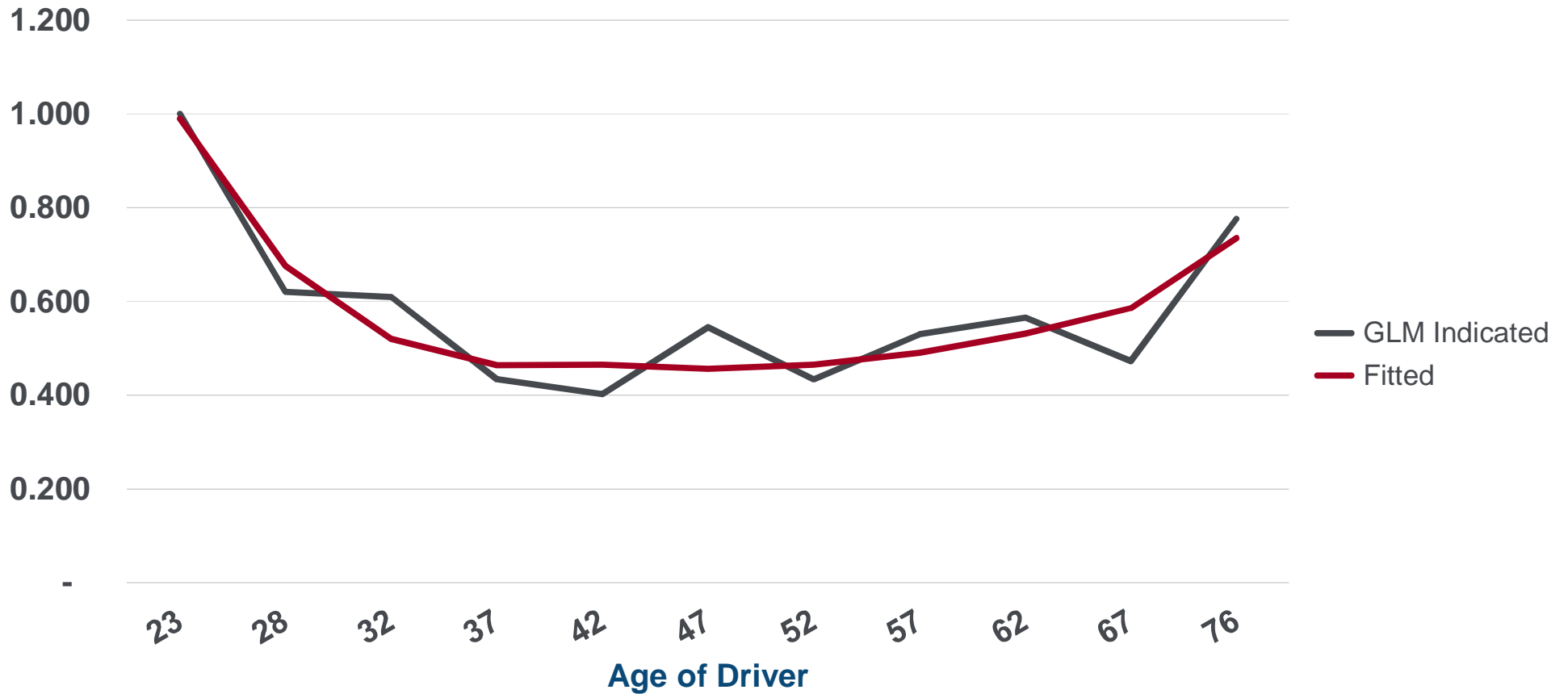
Extrapolation.

- § **Show why extrapolation is necessary (e.g. less data at end points)**
- § **Graphs of indicated vs. fitted factors and graphs of fitted vs. proposed factors can help regulators connect the dots**

Smoothing. Judgmental smoothing also acceptable to regulators

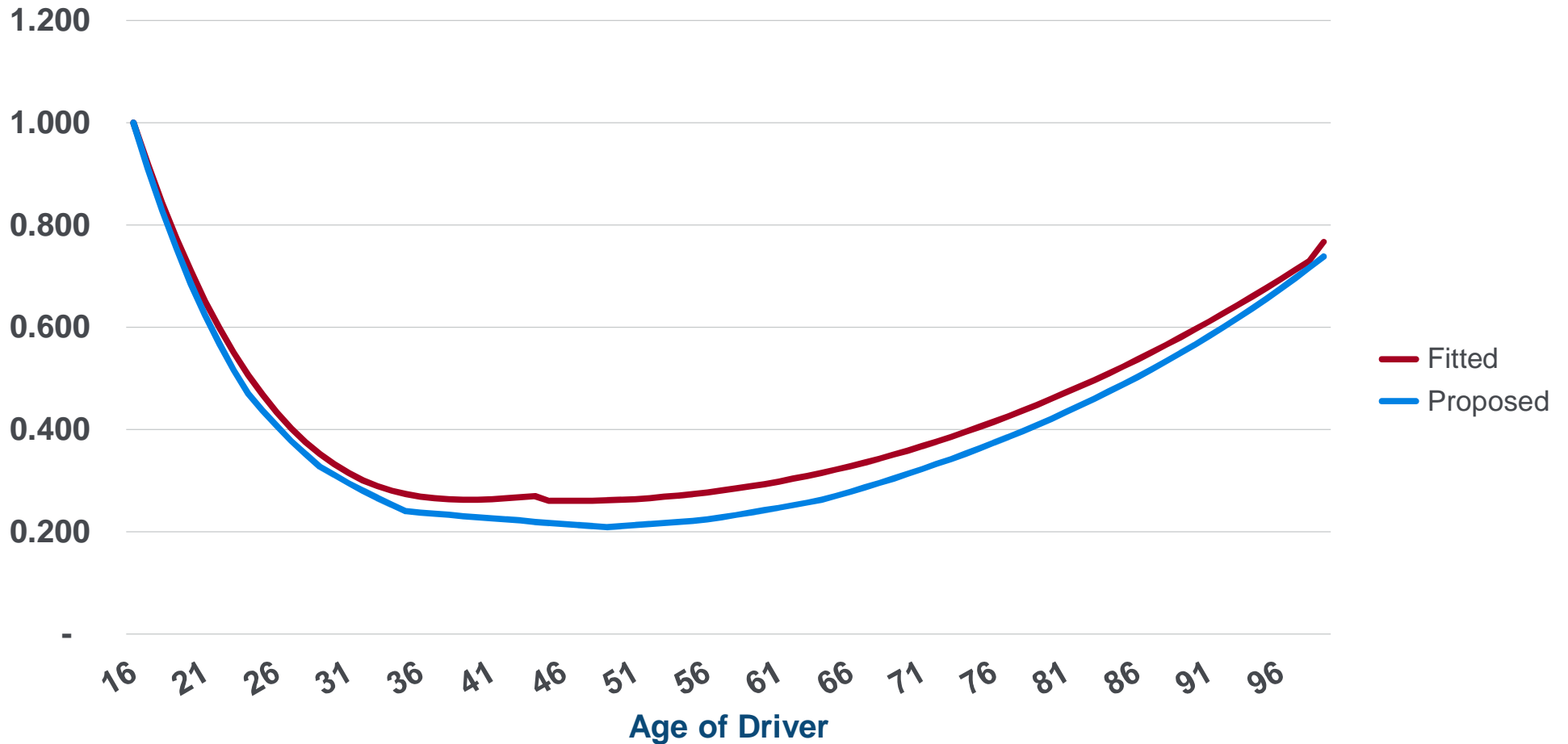
Comparison of Indicated vs. Fitted factors

Bodily Injury - Married Male Rating Factors



Comparison of Fitted vs. Proposed factors

Bodily Injury - Married Male Rating Factors



Selecting factors within a range

Current factors. Nearly all regulators consider it reasonable to select factors within range of current and indicated relativities

- § Acts as an informal credibility-weighted approach
- § Reduces impacts on current policyholders

Confidence intervals.

- § Help justify selections that are slightly above or below the estimate
- § Be prepared to justify further, especially if ranges are wide

Additional support – One-way analyses

Not ideal. One way analyses undo the benefit of multivariate analyses, as they don't account for correlation between rating variables

- § However, one-way analyses are easy to perform if additional support is needed, and are easy for regulators to understand
- § If possible, do a one-way residual analysis, or adjust data for known (obvious) correlations or interactions

May be what the doctor ordered. Regulators with less experience reviewing predictive modeling or less familiarity with complex actuarial concepts may favor more traditional support exhibits

Sample support exhibit

Pretty Predictive Insurance Company Private Passenger Automobile

Florida Model Year - Collision

Model Year	Current Relativities ¹	Earned Car Years ²	Indicated Relativities			Proposed Relativities
			Confidence Interval ³		Confidence Interval ³	
			Lower Bound	Estimate		
1996 & Prior	0.425	16,234	0.214	0.329	0.504	0.300
1997	0.450	17,652	0.236	0.349	0.517	0.375
1998	0.475	22,465	0.307	0.418	0.570	0.415
1999	0.500	24,565	0.476	0.632	0.838	0.460
2000	0.525	24,651	0.350	0.464	0.615	0.500
2001	0.550	26,453	0.380	0.494	0.642	0.550
2002	0.575	28,546	0.527	0.671	0.856	0.580
2003	0.600	29,851	0.291	0.367	0.463	0.625
2004	0.625	32,465	0.343	0.425	0.526	0.675
2005	0.650	34,652	0.357	0.436	0.533	0.700
2006	0.700	38,652	0.668	0.800	0.957	0.750
2007	0.750	42,315	0.687	0.809	0.953	0.800
2008	0.800	50,342	0.510	0.586	0.672	0.825
2009	0.850	52,462	0.804	0.918	1.047	0.875
2010	0.900	60,243	0.771	0.865	0.970	0.915
2011	0.950	62,345	0.666	0.744	0.832	0.960
2012	1.000	53,215	1.000	1.000	1.000	1.000
2013	1.000	43,251	0.874	1.026	1.204	1.040
2014	1.000	12,135	0.510	1.026	2.067	1.080
2015	1.000	512	0.368	0.904	2.224	1.125
2016						1.170
2017						1.215
2018						1.260

¹ Re-indexed to 2012 model year for comparison purposes.

² From underlying modeling dataset

³ Using 2 standard errors away from estimate

Lessons learned

Plan. Can avoid headaches by anticipating required support and planning accordingly

- § **Set up support exhibits that include current, indicated, and proposed factors as well as exposure distribution and confidence intervals, if possible**
- § **Exhaustive set of exhibits not needed for each rating variable, but support should be adequate for each rating variable**
- § **Anticipate rating variables that may cause questions from regulators**

Document. Proper documentation of every selected factor can help you down the road

- § **Filing process is lengthy and may take well over a year before approval is gained in every state**
- § **Discuss selections that were derived using actuarial judgment or business considerations**
- § **Know ahead of time what proposed changes you can and cannot live without**

Discuss. Weekly status update meetings can be beneficial for discussing filing strategy

- § **How to approach filing**
- § **How to address objections**
- § **How to communicate with regulators**

Lessons learned (continued)

Our (initial) motto. Let them ask for more

- § Provide proposed structure and factors for each coverage/peril
- § No “extraneous” information
- § Nothing that might be useful to competitors

Our (revised) motto. Provide the full amount of support necessary for a reviewer to assess the reasonability of the proposed rating factors

- § Reviewer should be able to compare current and indicated relativities and, based on support provided, determine how proposed relativities were selected



Thank you!

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