OLIVER WYMAN

PRIVATE PASSENGER AUTOMOBILE: GRID ANALYSIS

ALBERTA AUTOMOBILE INSURANCE RATE BOARD

July 1, 2021

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1. EXECUTIVE SUMMARY

1.1. Purpose and Scope

The Alberta Automobile Insurance Rate Board (AIRB) requested that Oliver, Wyman Limited (Oliver Wyman) provide an actuarial analysis of the Alberta Grid rating program. The specific objectives of our analysis included the following:

- Estimate the Direct Compensation and Property Damage (DCPD) component of the current Grid base rates; and the amended current Grid base rates excluding DCPD.
- Estimate the required average Grid rates (without DCPD) effective January 1, 2022.
- Following the current Grid rating program structure, recommend updated rates for individual Grid steps, liability limits and territories to more appropriately reflect the different degree of risk, and
- Evaluate the surcharge levels and recommend changes as supported.

The scope of our analysis only includes the effect of changes to the current Grid rating design: steps, liability limit, territories and surcharges. More specifically, our review does not include development of a complete classification plan. As such, our testing of the statistical models that we fit to the data will be more limited than the testing that would be performed to fully specify a class plan.

This report includes several technical insurance and actuarial terms that may not be familiar to readers who are not accustomed to reviewing actuarial reports. A description of our standard terminology is in Appendix A. Those readers may find it useful to review Appendix A of this report before proceeding.

1.2. Board Decision

On May 28, 2021 Oliver Wyman presented to the Board the recommended changes to the Grid rating program based on our analysis. In this report we present our recommended changes and the Board's selected changes to the Grid rating program.

1.3. Actuarial Findings

We developed our estimates using the industry data provided to us and external information and assumptions that we believe are appropriate for use in evaluating this exposure. This report presents the analysis underlying our estimates, our assumptions, and recommendations.

Grid Premium (Excluding DCPD)

In Section 3, we present our calculation of the total Grid rate level indication to reflect the removal of DCPD.

We measure the adequacy of the current Grid rates by comparing our estimate of the required average premium for the policy year spanning January 1, 2022 – December 31, 2022 (referred to as PY2022) with our estimate of the current average premium (referred to as the "street premium") for Grid capped risks.

Our calculations are presented in Appendix C and are summarized in Table 1 below. The estimated rate level indication considers (1) the removal of DCPD from the Grid premium, (2) recent reforms, and (3) the historical rate deficiency for risks capped by the Grid.

Table 1: Grid Premiums

(1)	Estimated Required Average Premium (Excluding DCPD)	$1,930
(2)	Estimated Street Premium (Including DCPD)	$2,427
(3)	Estimated Rate Level Indication (3) = (1)/(2)-1	-20.5%

Based on the Board's review of the Oliver Wyman estimated rate level indication, the Board decided to:

- Reflect the cost impact of removing DCPD,
- Reflect the cost impact of the 2020 reforms, and
- Make no change for the indicated rate deficiency for risks capped by the Grid.

In Table 2, we summarize the incremental impact of each of these components on the estimated rate level indication.

Table 2: Board Rate Level Change

Component	Board Rate Level Change
2020 Reforms	-11.4%
Excluding DCPD from Grid Premium	-20.5%
Total	-31.9%

Excluding DCPD from the rate results in an indicated reduction of 20.5%. Our overall rate indication in Table 1 is also a 20.5% rate reduction. This is a coincidence that results from all other changes offsetting. That is, the 2020 reforms (-11.4%), residual rate indication (+13.9%) and trend and changes in assumptions (+2.6%) offset. See Table 10 for the details of the calculation.

Based on these estimates, the Board's decision is to adopt an overall average rate level change of -31.9%.

Proposed Differentials

In Section 4, we present our discussion and analysis of the Grid rating variables: steps, territories, liability limits, conviction surcharges, and at-fault surcharges. As discussed in Section 4.4, data on the number of at-fault claims within the last 3 years is not available.

Based on the Board's review of the Oliver Wyman indicated changes to the differentials, the Board made the decisions to:

- temper the Edmonton and Calgary differential change, from 1.25 (current) to 1.40,
- temper the Northern District differential change from 1.00 (current) to 0.95,
- not change the conviction surcharges, and

- adopt the step differential changes recommended, subject to modification by considering the Board's noted differential changes.

We summarize our indicated differentials and the Board's selections in the following tables.

In Table 3 we present our indicated Grid step differentials, the Board's selected differentials[1] and compare them to the differentials currently in use. As shown in Table 3, the most pronounced change in the proposed differentials are lower factors at higher grid steps. As a larger Grid step differential will result in a lower percentage of risks being capped by the Grid, we would expect a larger percentage of risks to be capped by the Grid at higher Grid steps if the proposed differentials were adopted.

Table 3: Grid Step Differentials

Grid Step	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
-15	0.50	0.42	0.40
-14	0.50	0.45	0.43
-13	0.50	0.48	0.46
-12	0.50	0.51	0.49
-11	0.50	0.54	0.52
-10	0.50	0.57	0.55
-9	0.55	0.61	0.59
-8	0.60	0.64	0.63
-7	0.65	0.68	0.67
-6	0.70	0.72	0.71
-5	0.75	0.77	0.75
-4	0.80	0.81	0.80
-3	0.85	0.85	0.85
-2	0.90	0.90	0.90
-1	0.95	0.95	0.95
0	1.00	1.00	1.00
1	1.10	1.05	1.05
2	1.20	1.10	1.11
3	1.30	1.16	1.17
4	1.40	1.22	1.23
5	1.50	1.27	1.29
6	1.65	1.34	1.36
7	1.80	1.40	1.42

[1] The Board's selected differentials are based on a model analogous to Oliver Wyman's final model. However, the model considers the Board's decisions on territory differential changes (tempered) and conviction surcharges (no changes) as fixed off-set variables.

Grid Step	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
8	1.95	1.46	1.49
9	2.10	1.53	1.57
10	2.25	1.60	1.64
11	2.48	1.68	1.72
12	2.70	1.75	1.80
13	2.93	1.83	1.89
14	3.15	1.92	1.99
15	3.38	2.01	2.08
16+	Add 0.23 for each additional Grid step	Add 0.10 for each additional Grid step	Add 0.10 for each additional Grid step

In Table 4 we present our indicated territory differentials and the Board's selected differentials; and compare them to the differentials currently in use. We note there is statistical evidence the historical Calgary and Edmonton differentials are significantly understated, and the Northern District territory is materially different than the Rest of Alberta.

Table 4: Territory Differentials

Territory	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
Calgary	1.25	1.70	1.40
Edmonton	1.25	1.70	1.40
Northern District	1.00	0.80	0.95
Rest of Alberta (Base)	1.00	1.00	1.00

In Table 5 we present our indicated limit differentials. We observe the differentials currently in use appear to be supported by the limited data available and therefore we recommend no change.

Table 5: Limit Differentials

Limit	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
200,000	0.85	0.85	0.85
250,000	0.88	0.88	0.88
300,000	0.90	0.90	0.90
400,000	0.93	0.93	0.93
500,000	0.95	0.95	0.95
750,000	0.97	0.97	0.97
1,000,000 (Base)	1.00	1.00	1.00
2,000,000	1.09	1.09	1.09

In the following tables we present our indicated conviction differentials and compare them to the differentials currently in use. The indicated differentials are generally larger, indicating the current differentials are understated. The Board decided not to make changes to the surcharge differentials.

Table 6: Serious Traffic Conviction Differentials

Number of Convictions	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
0	1.00	1.00	1.00
1	1.25	1.50	1.25
2	1.50	1.75	1.50
3	2.00	2.25	2.00
4	3.00	3.00	3.00
5	5.00	5.00	5.00
6	9.00	9.00	9.00

Table 7: Minor Traffic Conviction Differentials

Number of Convictions	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
0	1.00	1.00	1.00
1	1.00	1.25	1.00
2	1.25	1.50	1.25
3	1.35	1.75	1.35
4	1.50	2.00	1.50
5	1.75	2.25	1.75
6	2.00	2.50	2.00

Table 8: Criminal Code Conviction Differentials

Number of Convictions	Current Differential	Oliver Wyman Indicated Differential	Board Selected Differential
0	1.00	1.00	1.00
1	4.00	4.00	4.00
	5.50	5.50	5.50

1.4. Change in Differentials Effect on Rate Indication (Off-Balance Factor)

Changes to the differentials that are currently in use will also affect the total average premium. An off-balance factor offsets the effect of the changes in differentials. Based on the Board's selected

differentials presented in Table 3 to Table 8, we calculate an off-balance factor of 0.966 applied to the proposed base rate selected by the Board. In Table 9 we present the indicated rate change and base rate, considering our selected differentials.

Table 9: Proposed Base Rate

Current Base Rate[2]	$2,658
Board Selected Rate Change	-31.9%
Rate Change including Off-Balance Factor	-34.2%
Proposed Base Rate	$1,748

1.5. Relevant Comments

- Our analysis is limited by the data constraints and the dynamic nature of the Grid. For example, given a new set of differentials, and updated average rate level, we are not able to assess which risks would stay limited/capped by the Grid. Hence, changes by Grid step that we calculate may or may not be realized and as a result, the overall rate level change that we calculate may or may not be realized.
- Although the Grid premiums have been adjusted annually by a uniform percentage change across all steps and territories, the Grid premium rating structure has not changed since 2004. As a separate concurrent project, the AIRB will review the objectives of the Grid and the structure of the Grid rating system to determine if any changes are needed to ensure it functions as intended.
- With the removal of DCPD from the Grid rates, the DCPD premium will be based on the insurer's own rate. As a result, Grid risks may see a wide variance in their 2022 premiums due to (i) removal of the Grid capping effect on the DCPD portion of TPL and (ii) application of vehicle rate group factors. This variance may be further exacerbated if the selected Grid differentials are adopted.
- The General Insurance Statistical Agency (GISA) carries out the activities of a statistical agent on behalf of participating Canadian jurisdictions. Specifically, GISA provides governance, accountability and oversight of the mandated statistical plans including the Automobile Statistical Plan (ASP). GISA contracts with the Insurance Bureau of Canada (IBC) to provide statistical plan services. Oliver Wyman requested that IBC compile the data that we use in the analysis and present in this report.

* * * * *

[2] Base level: Grid step = 0; Territory = Rest of Alberta; Limit = $1,000,000; Number of Type A/B/C Convictions = 0.

We developed the estimates in this report in accordance with the Principles promulgated by the Casualty Actuarial Society and the applicable Actuarial Standards of Practice issued by the Actuarial Standards Board.

Please direct all questions related to this report to the undersigned.

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2. BACKGROUND

2.1. Grid Rating Program

The Grid rating program was established so as to set a maximum premium that insured driver would have to pay for basic coverage (third party liability and accident benefits). The Grid rate is based on the insured's Grid step which considers their historical driving experience. More specifically, the operator's Grid step is determined based on the following set of rules:

- Inexperienced drivers with driver training start at Grid step -2; and steps range from -15 to +15, with -15 the lowest premium and +15 the highest premium.
- The insured's Grid step decreases by one for each year without a third-party liability at-fault claim.
- The insured's Grid step increases by five for each third-party liability at-fault claim within the last six years.
- Convictions and at-fault claims result in surcharges on premium.

2.2. Purpose of the Grid

The AIRB states:

- The Grid should apply to a small percentage of the market: new drivers, and drivers with poor driving behavior.
- The Grid should reward good drivers; penalize drivers demonstrating poor driving behavior and provide a fair opportunity for new drivers to demonstrate their driving behavior.
- The Grid is based on the following principles:
  - Ensures a reasonable entry level premium;
  - Grid annual premium adjustments should be stable and transparent;
  - Grid should protect good drivers from large increases in premiums; and
  - Insurance directly tied to responsibility behind the wheel.

We make the following observations regarding AIRB's intended purpose of the Grid:

- Each year of claim-free experience results in a "step-down" in the Grid and a concentration of risks with longer claim-free driving histories in lower (negative) Grid steps. As the target demographic is primarily inexperienced new drivers, there should be a smaller percentage of risks capped by the Grid at the lowest Grid steps. Similarly, there should be a higher percentage of drivers capped by the Grid at entry level Grid steps.

  Consistent with any capping procedure, the Grid does not necessarily promote rate equity and it is expected that these new drivers will be partially subsidized. This concept is closely related to the dynamic nature of the Grid discussed in Section 3. As Grid rates increase, premiums become more equitable and fewer risks may potentially be capped by the Grid.
- The Grid penalizes poor driving behavior. This is achieved through surcharges dependent on the frequency and type of traffic violations and at-fault claims.

As both grid step and surcharges are dependent upon the number of at-fault accidents, higher grid steps are also more likely to be subject to surcharges. Therefore, poor driving experience results in risks with higher Grid premiums. As a result, there is a lower portion of risks that are capped by the Grid at higher Grid steps. We see the application of surcharges as a benefit, as it decreases the probability that high-risk claimants will be subsidized.

2.3. Removal of DCPD

The Province of Alberta has decided effective January 1, 2022, with the introduction of DCPD, the AIRB should set Grid rates exclusive of DCPD. Therefore, the AIRB will provide Grid premiums that include bodily injury, property damage-tort and accident benefits coverages only.

The insurer will calculate the premium for DCPD based on their own rating program, similar to other coverages such as collision and comprehensive. Grid risks may see a wide variance in their 2022 premiums due to (i) removal of the Grip capping effect on to the DCPD portion of TPL and (ii) application of vehicle rate group factors.

Effective January 1, 2022, the AIRB Grid rate (which will exclude DCPD) will become the basis of determining if a policyholder's premium is capped by the Grid. As is the case for coverages such as collision and comprehensive, the DCPD premium will not be used to determine if a risk's premium is capped by the Grid.

In Section 3, we present our calculation of the total Grid rate level indication to reflect the removal of DCPD.

2.4. Grid Steps, Territories and Liability Limits

Since the introduction of the Grid in 2004, the Grid overall rate level change need has been reviewed annually. Based on the annual analysis, the AIRB approved an overall Grid rate change that has been applied equally across all Grid steps, territories and liability limits. Effective January 1, 2022, the rates for individual Grid steps, territories and liability limits will be updated to more appropriately reflect the different degree of risk at each step, territory and liability limit. In addition, the conviction surcharges will be updated.

In Section 4, we present our discussion and analysis of the Grid rating variables: steps, territories, liability limits, conviction surcharges, and at-fault surcharges.

3. GRID PREMIUM (EXCLUDING DCPD)

3.1. Description of Data: Grid Premium (Excluding DCPD)

The data utilized in this section of the report is based on information published by the General Insurance Statistical Agency (GISA) that has been compiled by the Insurance Bureau of Canada (IBC). More specifically, the source of the data is the GISA AUTO 7001 and AUTO 1201 reports. We use the GISA AUTO 7001 exhibit to estimate loss development factors and the loss cost underlying the required average premium calculation described in Appendix A. We use the GISA AUTO 1201 exhibit to calculate adjustment factors as described below. We have not audited, verified, or reviewed this data for reasonableness, accuracy, or consistency, as it is outside the scope of our study. In the event material errors are found in this data, our findings may need to be revised.

3.2. Limitations

The assumptions and judgments we have made in selecting the factors, provisions, and methodology that we use to derive the rate level indications are based on data and information made available to us at the time of this analysis. Our assumptions, judgments, and findings are subject to uncertainty as is inherent in any loss forecast. However, even if one were to accept our estimates as accurate, and the Board approved the indicated rate change, due to the dynamic nature of the Grid, the rate change we present in this report may not be realized. We discuss this in more detail later in this report.

3.3. COVID-19

The impact of Covid-19 “stay-at-home” orders and various lockdown measures applied intermittently beginning March 2020 have resulted in a dramatic decline in accidents, as well as claimants missing treatments under accident benefits. **Therefore, this study is based on pre-Covid-19 industry data through to December 31, 2019. The rate level indication that we present in this report is intended to be applicable to a traffic level environment similar to that before Covid-19 (i.e., post vaccines).**

3.4. Methodology

Our general methodology to estimate the required average premium remains unchanged from our prior studies to estimate the rate adequacy of the Grid. A description and summary of our general methodology is attached as Appendix A.

Further discussion of specific assumptions follows.

- The experience period that we consider is the five accident years: 2015 - 2019, as of June 30, 2020. We exclude the 2020-1 observation from the experience period to avoid the impact of COVID-19 on the overall rate level indication.

- We estimate ultimate loss and allocated loss adjustment expense amounts per vehicle separately for bodily injury, property damage[3], and accident benefits for each of the five accident years, 2015 - 2019. We do so by applying loss development factors that we select based on an analysis of the reported Grid claim experience.

  Consistent with the Board's "Guidelines for DCPD Filings" effective April 1, 2021 we assume 91%[4] of current property damage loss will be related to the DCDP sub-coverage for future policy periods.
- We apply the unallocated loss adjustment expenses (ULAE) factors determined by GISA for each of these accident years to include a provision for these costs. These factors are based on data for all risks. We assume these factors are also appropriate for risks capped by the Grid.
- We project our estimate of ultimate loss and loss adjustment expense[5] (L&LAE) amounts per vehicle for each accident year to the average accident date of PY2022 claims (January 1, 2023) based on the loss trend rates we present in our 2021 Semi-Annual Review Report.
- We adjust the historical bodily injury and accident benefit loss amounts for the recent reforms. Consistent with the Board's November 24, 2020 guideline bulletin we select reform factors of 0.81 and 1.07 for bodily injury and accident benefits, respectively.
- We calculate a weighted projected ultimate L&LAE per vehicle by assigning weights of 20% to each of the accident years 2015 - 2019 projected ultimate loss cost per vehicle. These weights are intended to reflect a balanced approach to the dynamic nature of the population of risks capped by the Grid that may change from year to year.
- We consider the time value of money at an investment rate of 3.55% based on the average investment rate for automobile insurers over 2018 to 2020.[6] We estimate the average duration of claims payment over time using industry-wide claim payment patterns by coverage. We also consider the delay in receiving premiums by assuming a three-month delay in receipt of policy premiums.
- We include a provision for operating expenses of 26.0% of premium as presented in our 2021 Semi-Annual Review Report which is based on the 2019 GISA AUTO 9502 Expense Exhibit. We assume that 50% of the provision for general expenses and other acquisition expenses to be fixed (i.e., 50% of 9.8%). The fixed expense provision we have selected is based on the industry-wide average written premium and distribution by coverage. We further assume the fixed expenses from 2019 will increase at an annual rate of 2.0% for inflation.
- We include a 7% provision for profit, the Board's guideline.
- The Government's 2021 assessment resulted in a Health Cost Recovery (HCR) equal to 2.94% of the estimated bodily injury and property damage-tort premium. We assume companies will allocate the HCR to bodily injury, property damage-tort, and DCPD in proportion to the written premium. That is, for those exposures that are capped by the Grid, companies should include the health cost recovery

[3] In this report we refer to property damage to mean the combination of both property damage-tort and DCPD. We use the terms property damage and property damage-total interchangeably.

[4] 91% = 26.5% / (26.5% + 2.5%)

[5] The term "loss adjustment expense" (or LAE) includes both allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE).

[6] A 3-year average over 2018-2020 of actual ROI for automobile insurers in the Province of Alberta; each year is based on the weighted average using the automobile written premium of insurers in Alberta as weights.

associated with the DCPD coverage within that coverage; and the Grid premiums for bodily injury and property damage-tort will include the remaining proportionate share of the HCR.

Based on these assumptions we estimate the PY2022 Required Average Premium (excluding DCPD) to be $1,930.

Our estimate of the Grid current street premium is $2,427 for the TPL and AB coverages combined – which includes DCPD. This estimate is based on a weighted average of the estimated on-level average written premium for each of years spanning 2015 through 2019; with each year assigned 20% weight. We do not consider the 2020-1 average written premium in deriving the estimated street premium to avoid any potential seasonality bias or potential COVID-19 bias.[7] The on-level adjustments are based on the Board prior approved Grid rate level changes:

- +5% effective January 1, 2021.
- +15% effective January 1, 2020.
- +5% effective January 1, 2019.
- +10% effective January 1, 2018.
- +8% effective January 1, 2017.
- +7% effective January 1, 2016.
- +7% effective January 1, 2015.

Based on these assumptions, we estimate a total rate level indication of -20.5%. We note this estimate considers both the removal of DCPD and the recent reforms.

3.5. Discussion

Using a similar analysis as in this review but with industry data through to December 31, 2019, and before the removal of DCPD and reforms, we estimate the Grid rate level indication was +18.9% and the Board approved a +5% Grid increase. The gap between that indication of +18.9% and the approved rate change of +5%[8] is greater than our updated rate indication of -20.5%. This is primarily caused by:

- The removal of DCPD from the Grid premium since our prior review. The removal of DCPD reduces our estimated required average written premium by approximately 20.5%.
- The introduction of bodily injury and accident benefit reforms. We estimate the reforms reduced our estimated required average written premium by approximately 11.4%.

As a result, the indicated rate change in this review is significantly lower[9] (-20.5% vs. +18.9%). In Table 10, we present a reconciliation to the rate level indication provided in our prior report.

[7] Individuals with very high Grid premiums may have more incentive to pause coverage during the pandemic.

[8] The +18.9% rate indication offset by the 5% approved rate change resulting in a residual of +13.9%.

[9] We estimate the indicated rate change without consideration for the removal of DCPD or recent reforms would be +15.8%.

Table 10: Reconciliation of Rate Indication

A.1	Prior Rate Level Indication	+18.9%
A.2	Approved Rate Indication	+5.0%
A[10]	Residual Rate Indication	+13.9%
B.1	Impact of 2020 Reforms	-11.4%
B.2	Impact of Excluding DCPD from Grid Premium	-20.5%
B[11]	Total Impact of Regulatory Changes	-31.9%
C	Trend & Change in Assumptions	2.6%
D[12]	Current Rate Level Indication	-20.5%

In considering the -20.5% "rate indication" that we present in this report, we believe it is important for the Board to consider the following additional points.

1. The -20.5% rate indication is based on a calculation assumption that risks capped by the Grid should be self-supporting (including a full 7% profit provision); we do not include a provision for subsidization by risks not capped by the Grid. Whether the risks capped by the Grid *should be* self-supporting is a policy decision.[13]
2. The -20.5% rate level indication represents an average rate level indication[14] for Grid risks and represents a mix of such risks over the five years 2015-2019. This finding is not appropriate for each of the various Grid steps or territories; for some steps it may be too high, and other steps to low. This is supported by our discussion in the next section of indicated differentials for Grid steps.
3. While we believe the -20.5% rate indication is a reasonable measure of the rate level change for the experience period data upon which it is based, the dynamic[15] nature of the Grid may result in a realized rate change that differs from this indication. We note the dynamic nature of the Grid makes the concept of a "self-supporting" Grid problematic.
4. Following an approved rate change, the mix of risks that remain capped by the Grid will change as some risks will no longer be capped by the Grid thereby changing the risk composition of the Grid – perhaps significantly. The larger the approved rate change, the larger the resulting change in the mix

[10] A = A.1 – A.3

[11] B = B.1 + B.3

[12] D = (1+A) * (1+B) * (1+C) – 1

[13] With no profit provision, the rate level indication is approximately -27%.

[14] To sensitivity test our calculation using an average premium basis, we separately estimated a rate level indication of -20.3% when adjusting the historical data to a common base level (Grid step = 0, $1 million limits, territory = Rural, and no convictions).

[15] If Grid rates are increased, some risks may no longer be capped by the Grid (because the regular market premium for that risk may be less than the new higher Grid rate). Hence, risks no longer capped by the Grid would shift into the "Off the Grid" category. This is the dynamic nature of the Grid; and, therefore, changing the Grid rates by the calculated indicated rate change will not likely bring the Grid rates to an adequate level.

of risks that remains. Those risks that remain capped by the Grid (after the rate change approved by the Board) may have different loss experience than those no longer capped by the Grid.

5. Changes to rates and rating plans by insurers contributes to the number of risks capped by the Grid and the mix of the Grid. Most notably, there was an increase of 32% to risks capped by the Grid between 2018 and 2019. Contributing to changes in the risk composition of the Grid will be rate changes implemented by insurers in 2020 and 2021.

Due to the dynamic nature of the Grid, any rate change that is approved will still result in uncertain effects of that rate change on the Grid population and the average rate level that is realized.

4. UPDATED GRID DIFFERENTIALS

4.1. Description of Data

A database file that provide the Grid step, territory, conviction data required to complete this study is not part of the standard exhibits compiled by GISA. Therefore, the AIRB requested through GISA that IBC provide the required database file.[16]

IBC provided a data file containing the requested elements, and two pdfs containing the file layout and a summary of the data provided.

In addition, we reviewed conviction data for the 2013 to 2017 period provided by IBC to supplement this study.

In Appendix D, we describe the steps that we performed to derive our final model data set.

4.2. Summary of Model Data

In Table 11, we summarize the variables in the final model data set.

Table 11: Database Variables (18 available, 11 used in model)

Response Variables (6, 0)	Transformed Responses Variables (3, 1)	Explanatory Variables (2, 2)
Claim count (4, 0)	*Frequency*	Operator Grid Step
Loss amount	*Severity*	Statistical Territory
Expense amount	Pure Premium	
Other Potential Rating Variables (6, 6)	**Grouping Variable (3, 1)**	**Weight/Exposure Variables (4, 1)**
Coverage Type	Grid Indicator	*Written vehicles*
Type A Convictions		Earned vehicles
Type B Convictions		*Written premium*
Limit Amount*		*Earned premium*
Accident Half Year		
Gender		

The goal of our analysis is to quantify the relationship between the **response variable(s)** and the **explanatory variable(s)**.

Grouping variables may be used to segment the data for analysis or capture effects that are highly unlikely to be correlated to the **explanatory variables**. As IBC provided aggregated data, **weight/exposure variables** provide an indication of the volume of underlying data.

[16] We took datafile size limitations into consideration in our request.

In our analysis, we also need to consider the potential for collinearity between the **explanatory variables** and **other potential rating variables**.

4.3. Methodology

The purpose of our analysis is to determine Grid-step and territory differentials based on the loss experience provided in the database file compiled by IBC. Our calculations of the indicated differentials do not consider any policy purpose of the Grid.

We fit various generalized linear models (GLMs or models) to the data compiled in Appendix D. We fit separate GLMs to risks that are capped by the Grid and for all risks combined.[17] In Appendix E we present summaries of our initial and final GLMs fit to both sets of data. We take an iterative approach in arriving at our final models. Our initial models consider all available rating variables, while our final model considers the application of various offset parameters (i.e., holding fixed the liability limit and surcharge factors) and transforming[18] of variables where appropriate. We also include support for the offset parameters included in the final models.

We include the following parameters in our GLMs:

- Operator Grid Step – code to identify the operators current Grid step value, corresponding to the applicable cap on premium.
- Territory – statistical territory corresponding to the location in which the vehicle is usually garaged or primarily used.
- Type A (serious) Conviction Indicator (Offset) – code to identify the number of Type A (serious) convictions.
- Type B (minor) Conviction Indicator (Offset) – code to identify the number of Type B (minor) convictions.
- Grid Indicator - code to identify whether the Basic Coverage Premium charged for the private passenger vehicle has been capped at the Grid step.[19]
- Limit (offset) – third party liability limit amount used in rating the premium.
- Coverage – coverage indicator (TPL vs AB)[20]
- Accident Half Year - refers to either the period January 1 through June 30, or July 1 through December 31 of the indicated year.[21]

[17] We modelled pure premium using a Tweedie distribution with a log link. We selected the Tweedie distribution parameter to minimize the deviance of our models.

[18] In our process, we consider a smoothing process that considers the downward bias of incremental changes at higher steps.

[19] We consider models fit to risks that are capped by the Grid as well as models based on all risks in the province, as they are both impacted by the selected Grid differentials. Our final selected model considers the model based on all risks in the province and uses the Grid indicator field as a rating variable as we require one set of Grid step relativities for all risks.

[20] We consider models fit by coverage and on a combined coverage basis. Our final selected model is on a combined coverage basis as the Grid premium and desired differentials are on a combined coverage basis.

[21] We use the terms “accident half-year” and “semester” (i.e., first semester or second semester; or the June semester or December semester) interchangeably in this report. We also refer to accident half-years or semesters as XXXX-1 or XXXX-2, or XXXX.1 or XXXX.2 where “XXXX” refers to the indicated year.

- Gender - gender of the rated operator. We include this variable to remove the potential impact on the indicated Grid step differentials due to gender imbalances.

4.4. Offset Parameters

At-Fault Claim Offset

In Table 12 we present the surcharges that apply to the Grid premium for at-fault accidents within the last 3-years. GISA does not currently capture the number of at-fault claims within the last three years in their standard statistical plan. Therefore, we are unable to consider these surcharges directly in our model.

We note the number of at-fault claims within the last 3-years is highly correlated with Grid step and is implicitly included in the indicated Grid step differentials. On page 8 of Appendix E, we present an adjustment to the indicated model differentials to remove the impact of the at-fault claim surcharge[22]. Consistent with the Grid step definition, we assume the surcharge applies to an increasing percentage of risks as Grid step increases.

Table 12: At-Fault Claims Surcharge

Number of At-Fault Claims in Last 3-Years	Current Surcharge
0-1	0%
2	30%
3+	15% (each additional)

Conviction Parameters

Alberta categorizes convictions into three types: A for serious convictions, B for minor convictions and C for criminal convictions. As there are a very limited number[23] of type C convictions, our analysis includes only type A and B convictions. In Figure 1 we present the average exposure weighted Grid step by number of type A (serious) and type B (minor) convictions. We observe drivers with convictions are more likely to have a higher Grid step. That is, the conviction variables are correlated with the operator Grid step variable. The inclusion of two correlated variables in a GLM may result in unstable model coefficients. Typically, we would exclude one of the correlated variables to avoid this issue.

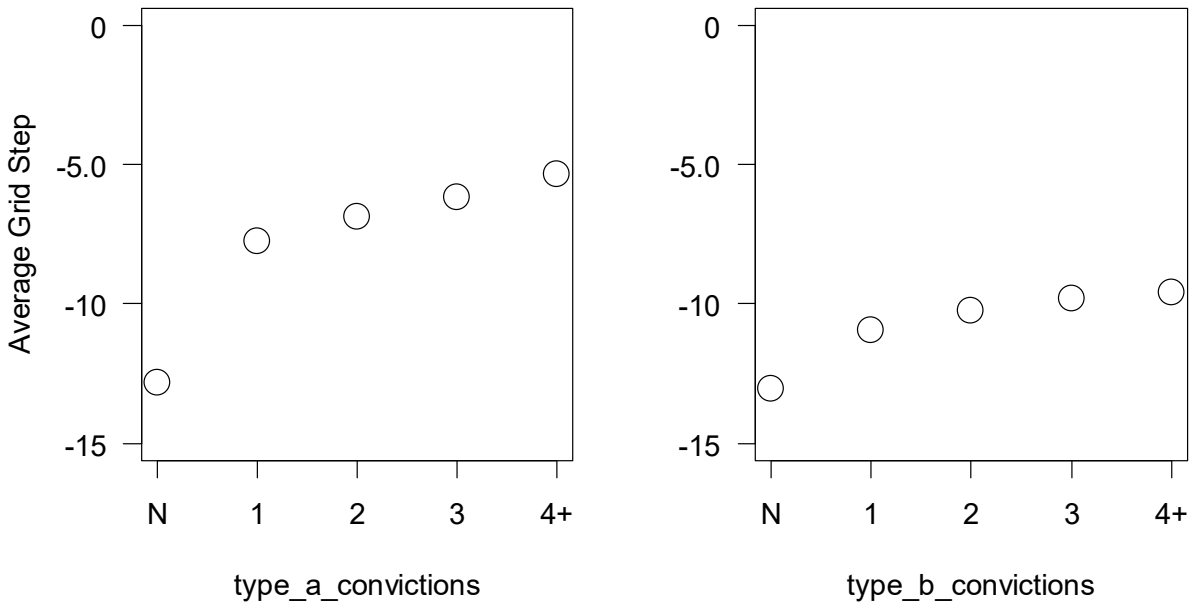
However, as discussed above, one of the primary objectives of the Grid is to penalize drivers demonstrating poor driving behavior. This is achieved through surcharges dependent on the frequency and severity of traffic violations. We note this is effectively a policy decision and needs to be included in our model to avoid double counting the effect a conviction has on the indicated Grid differentials.[24]

[22] We attempted to back-in to the average at-fault premium surcharge by applying the appropriate grid-step, territory, limit, and conviction differentials to the data base provided and comparing the actual and expected average grid premium for each grid step. However, this approach yielded unintuitive results, which we assume is primarily caused by data reporting errors.

[23] Based on industry data over 2013 to 2017, approximately 0.06% of risks have at least one type C conviction.

[24] If the assumed conviction surcharges are not considered in the model, the effect of convictions would influence the Grid rate differentials. That is, the Grid differentials at higher Grid steps would be overstated, resulting in a double punishment for convictions.

Figure 1: Exposure Correlation - Average Grid Step by Number of Convictions



In Appendix E, we present a comparison between the indicated conviction differentials from our initial models and the differentials currently in use. As shown in the exhibit, the type A conviction data is relatively thin and results in unintuitive differentials that lack credibility. We observe the type B conviction differentials follow an intuitive pattern and are generally higher than the differentials currently in use.

We include an offset parameter for the type A (serious) and B (minor) conviction variables in our final GLM model. We select the differentials considering the current differentials, indications from our initial model, and differentials we derive from our review of conviction data from the 2013 to 2017 period.[25] We then perform our GLM analysis with the coefficients equal to those pre-selected differentials in the model. We present the pre-selected relativities used in our models as the "selected offset parameter" column in the exhibit on page 7 of Appendix E.

Policy Liability Limit Parameter

We expect loss costs to monotonically increase with higher policy liability limits. Although this is intuitive, it is common for this expectation not to be met due to data constraints and/or exposure correlation. For example, more prudent drivers may buy higher limits of insurance.

In Appendix E, we present a comparison between the indicated policy limit differentials from our initial models and the differentials currently in use. As shown in the exhibit, the indicated model differentials generally lack credibility and are not monotonically increasing. We note the "All Risk" modelled differentials have significantly higher credibility and are somewhat consistent with the current differential in use.

[25] We reviewed conviction data from the 2013 to 2017 period.

We include an offset parameter for the policy limit in our final GLM model. We set the liability limit differentials equal to the current differentials and then perform our GLM analysis with the coefficients equal to those pre-selected differentials in the model. We present the pre-selected relativities used in our models as the "selected offset parameter" column in the exhibit on page 7 of Appendix E.

4.5. Smoothing of Grid Step and Grouping Territory Factors

Our model incorporates the following adjustments:

- Consistent with the current Grid premium structure, the initial modelled Calgary and Edmonton differentials are approximately the same. We have grouped these territories together in our final GLM.
- Our initial models resulted in insignificant parameters for the higher Grid steps which are sparsely populated. To increase credibility of these Grid steps, we have grouped together steps 11 to 15 for our final "All Risks" model and steps 6 to 15 in our final "Grid Only" model.

We have smoothed the indicated grid step differentials from the GLMs using an exponential regression model[26]. This was done to remove the data noise in the intermediate Grid steps and results in differentials that are monotonically increasing.

Regarding the "All Risks" model, we observe the smoothed differentials do not recognize the large increase in the indicated GLM differential between Grid steps -15 and -14. As approximately 61% percent of risks are located at grid step -15, this introduces downward bias in the smoothed differentials which we have recognized in our final selections.[27]

4.6. Indicated Model Results and Board Selections

In Table 13 we present the fitted Grid step differentials that are based on the model fit to all risks. All risk data is used, as we require one set of differentials for all risks and all *p*-values are significant for this model.[28] Similarly, in Table 14 we present our indicated territory differentials.

In addition, treating the Board's decisions on territory differential changes (tempered) and conviction surcharges (no changes) as off-set variables, we fit an additional GLM in order to provide Grid step differentials that are consistent with the Board's decisions. We present summary exhibits of this model in Appendix F and include the modelled Grid step differentials in Table 13. (We refer to these as the "Board Selected Differentials.").

[26] We recognize that regression assumes that the independent variable is numeric. Grid steps are categorical variables. We evaluated the result with consideration to this issue.

[27] We phase this bias in over all of the Grid steps to avoid a large increase in the differentials between Grid steps -15 and -14.

[28] The GLM fit to Grid risks only has many differentials that are not significant. This appears to be a credibility issue as many of the Grid steps are sparsely populated.

Table 13: Grid Rate Differentials

Grid Step	Current Differentials	Indicated Differentials	Board Selected Differentials
-15	0.50	0.42	0.40
-14	0.50	0.45	0.43
-13	0.50	0.48	0.46
-12	0.50	0.51	0.49
-11	0.50	0.54	0.52
-10	0.50	0.57	0.55
-9	0.55	0.61	0.59
-8	0.60	0.64	0.63
-7	0.65	0.68	0.67
-6	0.70	0.72	0.71
-5	0.75	0.77	0.75
-4	0.80	0.81	0.80
-3	0.85	0.85	0.85
-2	0.90	0.90	0.90
-1	0.95	0.95	0.95
0	1.00	1.00	1.00
1	1.10	1.05	1.05
2	1.20	1.10	1.11
3	1.30	1.16	1.17
4	1.40	1.22	1.23
5	1.50	1.27	1.29
6	1.65	1.34	1.36
7	1.80	1.40	1.42
8	1.95	1.46	1.49
9	2.10	1.53	1.57
10	2.25	1.60	1.64
11	2.48	1.68	1.72
12	2.70	1.75	1.80
13	2.93	1.83	1.89
14	3.15	1.92	1.99
15	3.38	2.01	2.08
16+	Add 0.23 for each additional Grid step	Add 0.10 for each additional Grid step	Add 0.10 for each additional Grid step

Table 14: Territory Differentials

Territory	Current Differentials	Indicated Differentials	Board Selected Differential
Calgary	1.25	1.70	1.40
Edmonton	1.25	1.70	1.40
Northern District	1.00	0.80	0.95
Rest of Alberta	1.00	1.00	1.00

4.7. Conclusions

In considering the Board selected differentials and the indicated differentials that we present in this report, we believe it is important to consider the following additional points.

1. Following any change to the Grid step or territory differentials, the mix of risks that remain capped by the Grid will change as some risks will no longer be capped by the Grid thereby changing the risk composition of the Grid – perhaps significantly. The larger the change in differentials, the larger the resulting change in the mix of risks that remains. Those risks that remain capped by the Grid (after the rate change approved by the Board) may have different loss experience than those no longer capped by the Grid.
2. Due to the dynamic nature of the Grid, any changes to the Grid step or territory differentials may result in significant changes to risk makeup of the Grid. Accurate modelling of these changes is not possible with the data available and would require policy level data including the market price of Grid rated risks. In general, a larger Grid step differential will result in a lower percentage of risks being capped by the Grid at a particular Grid step. As shown in Table 12, the most pronounced change in the proposed differentials are lower factors at higher grid steps. Therefore, if the proposed differentials were adopted, we would expect a larger percentage of risks to be capped by the Grid at higher Grid steps.
3. GISA's AUTO 1201 exhibit may be used to show that Grid rated risks at higher Grid steps have been more profitable (lower loss ratios) than those at lower Grid steps. We note this is consistent with the proposed Grid step differentials which consider and correct the historical rate inequity among the Grid steps.
4. We note any changes to the differentials currently in use will also affect the total rate indication presenting in Section 3. We use an extension of exposures methodology to calculate the change in the exposure weighted average rate differential and off-balance factor of 0.966 applied to the proposed base rate. We note this calculation assumes there are no changes to risk composition of the Grid if these differential changes were implemented. For the reasons described above, future risk composition may not conform to this assumption.

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6. CONSIDERATIONS AND LIMITATIONS

Data Verification – For our analysis, we relied on data and information provided by the AIRB without independent audit. Though we have reviewed the data for reasonableness and consistency, we have not audited or otherwise verified this data. Our review of data may not always reveal imperfections. We have assumed that the data provided is both accurate and complete. The results of our analysis are dependent on this assumption. If this data or information is inaccurate or incomplete, our findings and conclusions might therefore be unreliable.

Rounding and Accuracy – Our models may retain more digits than those displayed. Also, the results of certain calculations may be presented in the exhibits with more or fewer digits than would be considered significant. As a result, there may be rounding differences between the results of calculations presented in the exhibits and replications of those calculations based on displayed underlying amounts. Also, calculation results may not have been adjusted to reflect the precision of the calculation.

Unanticipated Changes – We developed our conclusions based on an analysis of the data of the data provided by AIRB and GISA and on the estimation of the outcome of many contingent events. We developed our estimates from the historical claim experience and covered exposure, with adjustments for anticipated changes. Our estimates make no provision for extraordinary future emergence of new types of losses not sufficiently represented in historical databases or which are not yet quantifiable. Also, we assumed that AIRB will remain a going concern, and we have not anticipated any impacts of potential insolvency, bankruptcy, or any similar event.

Internal / External Changes – The sources of uncertainty affecting our estimates are numerous and include factors internal and external to AIRB. Internal factors include items such as changes in claim reserving or settlement practices. The most significant external influences include, but are not limited to, changes in the legal, social, or regulatory environment surrounding the claims process. Uncontrollable factors such as general economic conditions also contribute to the variability.

Uncertainty Inherent in Projections – Users of this analysis should recognize that our projections involve estimates of future events and are subject to economic and statistical variations from expected values. We have not anticipated any extraordinary changes to the legal, social, or economic environment that might affect the frequency or severity of claims. For these reasons, we do not guarantee that the emergence of actual losses will correspond to the projections in this analysis.

APPENDIX A. DEFINITION OF KEY TERMS

To assist the reader in understanding our report, in this section we define and explain several insurance terms.

Insurance Coverages

We begin with a general description of the insurance coverages. We note that throughout this discussion of the insurance coverages, the term "insured" is generally used to mean the owner, and family of the owner of the policy, as well as any passengers or other drivers using the car with the owner's permission.

Basic Coverages

Third Party Liability (TPL)

There are three parts to this Basic Coverage:

- Bodily Injury (BI) coverage protects the insured against liability arising from an accident that causes bodily injury to another person. Coverage amounts available in Alberta range from the legal minimum of $200,000 per claim to well over $2,000,000 per claim.
- Property Damage-tort (PD-tort) coverage protects the insured against liability arising from an accident that causes damage to the property of another person.
- Direct Compensation Property Damage (DCPD) coverage from own insurer for damage to own vehicle caused by a third party due to a collision.

All drivers must purchase at least the legally required minimum amount of TPL coverage available in Alberta.

Accident Benefits (AB)

This Basic Coverage provides for such items as reimbursement of lost income, medical care costs, and funeral costs; it also provides benefits to the dependents of a deceased insured.

Additional Coverages

Underinsured Motorist (UIM)

This Additional Coverage protects the insured if he or she is caused bodily injury by an at-fault driver who is insured, but who does not have sufficient insurance to cover the liability. In this case the insured collects, from his or her own insurer, the amount of the damage that is in excess of the at-fault driver's liability coverage and up to the limit of UIM coverage purchased.

Collision

This Additional Coverage generally provides coverage (subject to a deductible) for damage to the insured's vehicle arising out of a collision.

Comprehensive

This Additional Coverage generally provides coverage (subject to a deductible) for damage to the insured's vehicle arising out of a peril other than collision (e.g., theft, vandalism, flood, hail, fire, etc.).

All Perils
This Additional Coverage combines the coverages for both collision and comprehensive into one coverage, subject to a common deductible level.

Specified Perils
This Additional Coverage, like collision and comprehensive, provides coverage (subject to a deductible) for specific perils to the insured's vehicle.

Other Terms

Accident Year
Accident year is the year in which an incident that gives rise to a claim occurred, regardless of when the claim is actually reported to an insurance company. For example, a claim reported on January 15, 2016 for injuries suffered in an automobile accident that occurred on December 15, 2015, is considered to be an accident year 2015 claim.

Allocated Loss Adjustment Expense (ALAE)
ALAE is the claim and settlement expense that can be associated directly with individual claims (e.g., legal expenses) typically included with the reported incurred loss amounts. (See ULAE).

Base Rate and Rate Differentials
Insurers generally determine the premium for a particular insured by multiplying a base rate by a series of rate differentials (or rate factors, or rate relativities) that reflect the particular characteristics of the insured. The terms rate differentials, rate factors and rate relativities are used interchangeably. Typically, there is one base rate for each combination of coverage and rating territory. For example, assume a base rate for the TPL coverage of $200 in Territory #1 and a base rate for the TPL coverage of $300 in Territory #2. Also assume the rate differential for a married male driver, age 40, is 1.25. The TPL premium for this driver would be $250 in Territory #1 ($200 times 1.25) and $375 in Territory #2 ($300 times 1.25).

Case Reserve
The Case Reserve is the provision established by claim adjusters for the payment of future losses and claim related expenses associated with a particular claim.

Claim Frequency
Claim Frequency is the average number of claims that occur in a year, per insured vehicle. Claim frequency is a measure of the incidence of automobile claims. For example, if an insurance company provided insurance on 100 vehicles in year 2015 and 5 TPL claims occurred during 2015, the company's TPL claim frequency for 2015 would be 5 percent.

Claim Severity
Claim Severity is the average reported incurred loss and ALAE per claim. Claim severity is a measure of the average cost of automobile claims. For example, if the 5 claims in the previous example resulted in a total incurred loss and ALAE of $100,000, the claim severity would be $20,000.

Claim Count Development
Claim Count Development refers to the change in the number of reported claims for a particular accident year over time. (See Loss Development).

CLEAR
CLEAR refers to Canadian Loss Experience Automobile Rating, a system of categorizing private passenger vehicles, by make and model-year, for physical damage coverage rating purposes. CLEAR was developed by the Vehicle Information Centre of Canada (VICC), a part of the Insurance Bureau of Canada. CLEAR considers such elements as the reparability and damageability of the make and model-year. (See MSRP).

Combined Ratio
Combined ratio is a common measure of premium adequacy. This is the sum of the loss ratio and the expense ratio (operating expenses divided by premium). A combined ratio in excess of 100 percent is an indication of premium inadequacy, before consideration of profit and investment income.

Earned Premium
Earned premium is the amount of written premium that is associated with the portion of the policy term that has expired. For example, assume an automobile policy with a 12-month term is sold on January 1 for $1,000. The amount of earned premium would be $500 on June 30.

Exposure Unit
Exposure unit is a measure of loss potential. In private passenger vehicle insurance, the exposure unit that is commonly used is the number of insured vehicles. For example, all else being equal, it would be expected that the cost to an insurance company to insure 50 cars would be twice the cost to insure 25 cars.

Health Cost Recovery Assessment
As per Provincial legislation, each insurer is assessed to achieve a target amount set by Government. The Minister of Finance publishes the assessment percentage applied to third party liability written premiums every year. GISA calculates and provides the assessment as a percentage of earned third party liability premiums. Under the legislation, the Government has no subrogation rights against the at-fault parties who are insured by policies of TPL insurance; but instead, collects the assessment.

Loss Cost (Pure Premium)
Loss Cost is the average incurred loss and ALAE per insured vehicle. The loss cost is the product of claim frequency and claim severity. Using the above example, a claim frequency of 5 percent, multiplied by a claim severity of $20,000, produces a TPL loss cost of $1,000. But the Loss Cost may also include provisions for ULAE and the Health Cost Recovery assessment.

Loss Development
Loss Development is the amount by which reported incurred losses and ALAE for a particular accident year change over time. The two main reasons why reported incurred losses and ALAE amounts change (or develop) over time are:

- Reported incurred losses and ALAE only include case reserve estimates on claims for which the claim adjuster has knowledge, i.e., case reserves are only established on the claims that have been reported to the insurance company. Since typically some period of time elapses between the time of the incident and when it is reported as a claim, the number of reported claims for an accident year would be expected to increase over time. Claims that are reported after the close of an accident year are referred to as “late-reported” claims; and
- Reported incurred losses and ALAE also develop because, for a number of reasons, the initial case reserves established by claims adjusters, cannot always fully and accurately reflect the ultimate

settlement amount. We further note that, over time, the percentage by which reported incurred losses and ALAE develop for a given accident year should decline. This is because as accident years become more mature (i.e., become older), fewer reserve estimates are adjusted to reflect newly reported late claims, actual payments, and additional information that becomes available to the claims adjuster.

Loss Ratio

Loss ratio is the common measure of premium adequacy. Loss ratio is usually defined as estimated ultimate incurred losses and ALAE, divided by earned premium. But the ultimate incurred losses and ALAE may also include provisions for ULAE and the Health Cost Recovery assessment. A loss ratio that exceeds a company's break-even loss ratio (100 percent less budgeted expenses) would suggest premium inadequacy.

Loss Reserving Methods: Incurred Loss Method and Paid Loss Method

Loss reserving methods are often based on historical data organized into a triangle format. A common approach is to have the rows represent the accident years, and the columns representing the value of the loss at specific maturities, such as 12 months, 24 months, 36 months etc., from the beginning of the accident year. The historical changes in the loss data from period to period is reviewed to estimate a pattern to predict how current accident years losses will change over time as claims are settled and closed. The incurred loss method refers to the triangle method of analysis, based on reported incurred losses. The paid loss method refers to the triangle method of analysis, based on paid losses.

MSRP

MSRP refers to the Manufacturer's Suggested Retail Price, and is a system of categorizing Private Passenger vehicles, by make and model-year, for rating purposes for physical damage coverages, according to the original price of the vehicle. (See CLEAR).

Operating Expenses

Insurance company expenses, other than ALAE and ULAE, are typically categorized as Commissions, Other Acquisition, General, Taxes, Licenses, and Fees.

Paid Losses

The total aggregate dollar amount of losses paid on all reported claims as of a certain date.

Premium Drift

Premium Drift is a more general term, and refers to the changes in the amount of premium collected by insurance companies that are attributed to the purchase of newer and more expensive cars (i.e., rate group drift) as well as to changes in the amount of insurance coverage that is purchased (e.g., the purchase of higher limits of liability coverage would increase the amount of premium collected by insurance companies, while the purchase of higher physical damage deductibles would reduce the amount of premium collected by insurance companies). (See Rate Group Drift).

Rate Group Drift

Rate Group Drift refers to the amount of additional premium collected by insurance companies that is attributed to the purchase of newer and more expensive cars by insureds. The premiums charged by insurance companies are higher for newer and more expensive cars. Therefore, as insureds purchase newer and more expensive cars, the amount of premium collected by insurance companies increases. (See Premium Drift).

Ratemaking Methods: Pure Premium Method and Loss Ratio Method
The pure premium method of ratemaking develops indicated rates that are expected to provide for the expected losses and expenses, and provide for the expected profit. The loss ratio method of ratemaking develops indicated rate changes rather than indicated rates.

Rating Territory
Automobile premiums vary by the principal garaging location of the vehicle. Based on Insurance Bureau of Canada's automobile statistical plan, Alberta is currently divided into three areas, or rating territories, of principal garaging location; and, therefore, has three separate sets of rates depending upon which of the three territories the vehicle is principally garaged. (See Statistical Territory)

Reported Incurred Loss
The sum of:

- the total aggregate dollar amount of losses paid on all reported claims as of a certain date (referred to as the valuation date), and
- the total aggregate dollar amount of losses set in reserve by the claim adjusters on each open claim (referred to as "case reserves") as of a certain date (the same evaluation date as for the paid claim amounts).

For example, if two claims were filed against an insurance company, one that settled for $50,000 and the other that was open with a paid amount of $25,000 and a "case reserve" (i.e., the claim adjuster's estimate of the dollars still to be paid on the claim) of $30,000, then the total reported incurred loss on the two claims would be $105,000 (the sum of $50,000, $25,000, and $30,000).

Reserve
A Reserve is the aggregate provision identified by an insurance company for the payment of future losses and claim related expenses associated with claims that have been incurred.

Surplus
Surplus is the amount of assets of an insurance company in excess of its liabilities.

Statistical Territory
Automobile premiums vary by the principal garaging location of the vehicle. Alberta is divided into four statistical territories, of principal garaging location. Specific statistical territories are grouped together to represent a specific rating territory. In some cases there is one statistical territory in a rating territory, in other cases the rating territory comprises two or more statistical territories. (See Rating Territory).

Total Return on Equity
Total Return on Equity (ROE) refers to an insurer's profit as a percentage of its surplus, where profit is the sum of (i) underwriting profit, and (ii) investment income earned on both the underwriting operations of the company and on the surplus carried by the company.

Unallocated Loss Adjustment Expense (ULAE)
ULAE is the claim and settlement related expense that cannot be associated directly with individual claims (e.g., claim adjuster salaries). (See ALAE).

Underwriting Profit
Underwriting profit is defined as earned premium, less reported incurred losses and ALAE, less ULAE, less operational expenses.

Underwriting Profit Margin
Underwriting profit margin is the provision that is included in the insurance premium for underwriting profit to be earned by the company.

Ultimate Incurred Loss
Ultimate incurred loss is an estimate of the total amount of loss dollars that will ultimately be paid to settle all claims that occur during a particular accident year.

Written Premium
Written premium represents the total amount of premium charged by an insurance company for the insurance policies it has sold. It is generally compiled over a one-year period.

APPENDIX B. REQUIRED AVERAGE PREMIUM

The required average premium is derived by combining the resulting weighted average trended ultimate loss (and loss expense) cost per earned vehicle, adjusted to reflect investment income arising from the insurance operations, with the selected provisions for Health Cost Recovery, expenses, and profit.

More specifically,

- the ultimate loss (claim amount) per car is estimated for each of the most recent five accident years through the application of loss development factors
- the ultimate loss per car estimates by accident year are each trended to reflect the cost conditions anticipated to be in effect for the policy period spanning January 1, 2022 through December 31, 2022
- the resulting estimates by accident year are weighted to arrive at a projected average loss per car
- the projected average loss per car is adjusted to reflect investment income expected to be earned on insurance company operations
- an average expense provision (as a percent of premium and fixed dollar amount) is selected
- an average health cost recovery provision is selected
- an average profit provision (as a percent of premium) is selected
- the projected average loss per vehicle (adjusted to reflect investment income on cash flow), the selected average expense provision, the selected average health cost recovery provision, and the selected average profit provision are combined[29] to determine the estimated required average premium per vehicle.

The exhibits we have attached reflect the assumptions we have made and the factors and provisions we have selected. This methodology can be used by the Board to estimate the required average premium (and hence the Industry-wide rate level adjustment). Should the Board select different assumptions, factors, or provisions, it can apply the same methodology.

[29] The method for combining the selected provisions is to calculate the product of: the projected average loss cost, the present value factor, and the premium delay factor. This product is then divided by 100% less the sum of: the variable expense provision and the profit provision; and then the provisions for the health cost recovery and fixed expenses are added.

APPENDIX C. AVERAGE RATE INDICATION SUPPORTING EXHIBITS

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Indicated Rate Change (Excluding DCPD)
Policy Year: 01/01/22-12/31/22

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Coverage	Sub-Coverage	Projected Ultimate Losses & LAE per Car	Loss Discount Factor	Projected Discounted Loss Cost per Car incl LAE	Premium Delay Factor	Est. Variable Expense Margin	Profit Margin Provision	Required Premium Excl Fixed Expense	Estimated Fixed Expense	Required Premium INCL Fixed Expense	2020.1 Avg Written Premium (including DCPD)	Est. Street Premium (including DCPD)
Third Party Liability	Bodily Injury	1,205.61	0.864	1,041.10	1.009	21.10%	7.0%	1,460.48				
Third Party Liability	Property Damage	38.67	0.967	37.40	1.009	21.10%	7.0%	52.47				
Third Party Liability	Health Levy	49.81	0.983	48.95	1.009	21.10%	7.0%	68.67				
Third Party Liability	Total	1,294.09	0.871	1,127.45	1.009	21.10%	7.0%	1,581.62	55.89	1,637.51	2,083.54	2,305.03
Accident Benefits	Total	215.49	0.933	201.09	1.009	21.10%	7.0%	282.10	9.97	292.07	125.38	121.54
Basic		**1,509.58**	**0.880**	**1,328.54**	**1.009**	**21.10%**	**7.0%**	**1,863.72**	**65.86**	**1,929.58**	**2,208.92**	**2,426.57**
										Indicated Rate Change:		**-20.5%**

Notes

(3) From pages 4-5; HL provision based on 2.94% of estimated TPL street premium
(4) Based on investment rate of 3.55% and selected payment pattern
(5) (3) * (4)
(6) Based on investment rate of 3.55% and assumed three month delay
(7) Based on total expense provision of 21.10% and assumption that 50% of general and other acquisition expenses are fixed
(8) AIRB benchmark
(9) (5) * (6) / (1 - (7) - (8))
(10) Based on assumption that 50% of general and other acquisition expenses (4.90%) are fixed
(11) (9) + (10)
(12) From GISA
(13) Weighted average of 2015-2020 average written premiums adjusted to current rate level

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Indicated Rate Change (Including DCPD)
Policy Year: 01/01/22-12/31/22

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Coverage	Sub-Coverage	Projected Ultimate Losses & LAE per Car	Loss Discount Factor	Projected Discounted Loss Cost per Car incl LAE	Premium Delay Factor	Est. Variable Expense Margin	Profit Margin Provision	Required Premium Excl Fixed Expense	Estimated Fixed Expense	Required Premium INCL Fixed Expense	2020.1 Avg Written Premium	Est. Street Premium
Third Party Liability	Bodily Injury	1,205.61	0.864	1,041.10	1.009	21.10%	7.0%	1,460.48				
Third Party Liability	Property Damage	448.54	0.967	433.89	1.009	21.10%	7.0%	608.67				
Third Party Liability	Health Levy	67.77	0.983	66.60	1.009	21.10%	7.0%	93.42				
Third Party Liability	Total	1,721.92	0.895	1,541.58	1.009	21.10%	7.0%	2,162.57	55.89	2,218.46	2,083.54	2,305.03
Accident Benefits	Total	215.49	0.933	201.09	1.009	21.10%	7.0%	282.10	9.97	292.07	125.38	121.54
Basic		**1,937.41**	**0.899**	**1,742.67**	**1.009**	**21.10%**	**7.0%**	**2,444.67**	**65.86**	**2,510.53**	**2,208.92**	**2,426.57**

Indicated Rate Change: **3.5%**

Notes

(3) From pages 4-5; HL provision based on 2.94% of estimated TPL street premium
(4) Based on investment rate of 3.55% and selected payment pattern
(5) (3) * (4)
(6) Based on investment rate of 3.55% and assumed three month delay
(7) Based on total expense provision of 21.10% and assumption that 50% of general and other acquisition expenses are fixed
(8) AIRB benchmark
(9) (5) * (6) / (1 - (7) - (8))
(10) Based on assumption that 50% of general and other acquisition expenses (4.90%) are fixed
(11) (9) + (10)
(12) From GISA
(13) Weighted average of 2015-2020 average written premiums adjusted to current rate level

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Indicated Rate Change (Excluding Reforms; Excluding DCPD)
Policy Year: 01/01/22-12/31/22

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Coverage	Sub-Coverage	Projected Ultimate Losses & LAE per Car	Loss Discount Factor	Projected Discounted Loss Cost per Car incl LAE	Premium Delay Factor	Est. Variable Expense Margin	Profit Margin Provision	Required Premium Excl Fixed Expense	Estimated Fixed Expense	Required Premium INCL Fixed Expense	2020.1 Avg Written Premium (including DCPD)	Est. Street Premium (including DCPD)
Third Party Liability	Bodily Injury	1,488.41	0.864	1,285.30	1.009	21.10%	7.0%	1,803.06				
Third Party Liability	Property Damage	38.67	0.967	37.40	1.009	21.10%	7.0%	52.47				
Third Party Liability	Health Levy	49.81	0.983	48.95	1.009	21.10%	7.0%	68.67				
Third Party Liability	Total	1,576.89	0.870	1,371.66	1.009	21.10%	7.0%	1,924.20	55.89	1,980.09	2,083.54	2,305.03
Accident Benefits	Total	201.39	0.933	187.94	1.009	21.10%	7.0%	263.64	9.97	273.61	125.38	121.54
Basic		**1,778.28**	**0.877**	**1,559.59**	**1.009**	**21.10%**	**7.0%**	**2,187.84**	**65.86**	**2,253.71**	**2,208.92**	**2,426.57**

Indicated Rate Change: **-7.1%**

Notes

(3) From pages 4-5; HL provision based on 2.94% of estimated TPL street premium
(4) Based on investment rate of 3.55% and selected payment pattern
(5) (3) * (4)
(6) Based on investment rate of 3.55% and assumed three month delay
(7) Based on total expense provision of 21.10% and assumption that 50% of general and other acquisition expenses are fixed
(8) AIRB benchmark
(9) (5) * (6) / (1 - (7) - (8))
(10) Based on assumption that 50% of general and other acquisition expenses (4.90%) are fixed
(11) (9) + (10)
(12) From GISA
(13) Weighted average of 2015-2020 average written premiums adjusted to current rate level

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Indicated Rate Change (Excluding Reforms; Including DCPD)
Policy Year: 01/01/22-12/31/22

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Coverage	Sub-Coverage	Projected Ultimate Losses & LAE per Car	Loss Discount Factor	Projected Discounted Loss Cost per Car incl LAE	Premium Delay Factor	Est. Variable Expense Margin	Profit Margin Provision	Required Premium Excl Fixed Expense	Estimated Fixed Expense	Required Premium INCL Fixed Expense	2020.1 Avg Written Premium (including DCPD)	Est. Street Premium (including DCPD)
Third Party Liability	Bodily Injury	1,488.41	0.864	1,285.30	1.009	21.10%	7.0%	1,803.06				
Third Party Liability	Property Damage	448.54	0.967	433.89	1.009	21.10%	7.0%	608.67				
Third Party Liability	Health Levy	67.77	0.983	66.60	1.009	21.10%	7.0%	93.42				
Third Party Liability	Total	2,004.72	0.891	1,785.79	1.009	21.10%	7.0%	2,505.15	55.89	2,561.05	2,083.54	2,305.03
Accident Benefits	Total	201.39	0.933	187.94	1.009	21.10%	7.0%	263.64	9.97	273.61	125.38	121.54
Basic		**2,206.11**	**0.895**	**1,973.72**	**1.009**	**21.10%**	**7.0%**	**2,768.80**	**65.86**	**2,834.66**	**2,208.92**	**2,426.57**

Indicated Rate Change: **16.8%**

Notes

(3) From pages 4-5; HL provision based on 2.94% of estimated TPL street premium
(4) Based on investment rate of 3.55% and selected payment pattern
(5) (3) * (4)
(6) Based on investment rate of 3.55% and assumed three month delay
(7) Based on total expense provision of 21.10% and assumption that 50% of general and other acquisition expenses are fixed
(8) AIRB benchmark
(9) (5) * (6) / (1 - (7) - (8))
(10) Based on assumption that 50% of general and other acquisition expenses (4.90%) are fixed
(11) (9) + (10)
(12) From GISA
(13) Weighted average of 2015-2020 average written premiums adjusted to current rate level

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Third Party Liability: Projected Average Loss Cost

BI

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Accident Year	Earned Cars	Reported Losses & ALAE (000)	Reported Losses & ALAE Cost per Car	LDF	ULAE	Level Adjustment	Adjusted Ultimate Losses & LAE per Car	Past Trend to 04/01/20	Future Trend to 01/01/23	2020 Net Reform Factor	Projected Ultimate Losses & LAE per Car	Weights
2015	160,717	139,349	867.04	1.061	1.103	1.000	1,014.65	1.379	1.144	0.810	1,296.40	20%
2016	146,828	129,800	884.03	1.091	1.085	1.000	1,046.01	1.289	1.144	0.810	1,249.04	20%
2017	146,558	116,769	796.74	1.192	1.092	1.000	1,036.35	1.205	1.144	0.810	1,156.54	20%
2018	157,596	117,376	744.79	1.420	1.101	1.000	1,163.76	1.126	1.144	0.810	1,213.76	20%
2019	177,080	97,664	551.52	1.867	1.108	1.000	1,141.15	1.052	1.144	0.810	1,112.32	20%
										Weighted Average:	**1,205.61**	

PD

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Accident Year	Earned Cars	Reported Losses & ALAE (000)	Reported Losses & ALAE Cost per Car	LDF	ULAE	Level Adjustment	Adjusted Ultimate Losses & LAE per Car	Past Trend to 04/01/20	Future Trend to 01/01/23	2020 Net Reform Factor	Projected Ultimate Losses & LAE per Car	Weights
2015	160,717	63,745	396.63	1.001	1.103	1.000	437.76	1.073	1.042	1.000	489.51	20%
2016	146,828	51,839	353.06	0.998	1.085	1.000	382.33	1.057	1.042	1.000	421.20	20%
2017	146,558	59,379	405.16	0.998	1.092	1.000	441.46	1.042	1.042	1.000	479.16	20%
2018	157,596	59,637	378.42	1.000	1.101	1.000	416.35	1.026	1.042	1.000	445.23	20%
2019	177,080	59,280	334.77	1.043	1.108	1.000	386.90	1.011	1.042	1.000	407.63	20%
										Weighted Average:	**448.54**	
										% DCPD	91.4%	
										Weighted Average excluding DCPD:	**38.67**	

Notes

(1)	Selected experience period
(2)	From GISA
(3)	From GISA
(4)	(3) / (2) * 1000
(5)	Based on review of Grid loss development patterns
(6)	From GISA ULAE report
(7)	Based on review of Grid loss trend patterns
(8)	(4) * (5) * (6) * (7)
(9)	Based on review of Grid loss trend patterns
(10)	Based on review of Grid loss trend patterns
(11)	November 24, 2020 Board Guidelines
(12)	(8) * (9) * (10) * (11)
(13)	Selected

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Accident Benefits: Projected Average Loss Cost

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

AB Total

Accident Year	Earned Cars	Reported Losses & ALAE (000)	Reported Losses & ALAE Cost per Car	LDF	ULAE	Level Adjustment	Adjusted Ultimate Losses & LAE per Car	Past Trend to 04/01/20	Future Trend to 01/01/23	2020 Net Reform Factor	Projected Ultimate Losses & LAE per Car	Weights
2015	160,459	17,079	106.44	1.016	1.103	1.000	119.24	1.677	1.349	1.070	288.77	20%
2016	146,740	12,635	86.11	1.028	1.085	1.000	96.04	1.504	1.349	1.070	208.60	20%
2017	146,547	13,726	93.66	1.022	1.092	1.000	104.49	1.349	1.349	1.070	203.55	20%
2018	156,895	14,991	95.55	1.015	1.101	1.000	106.73	1.210	1.349	1.070	186.47	20%
2019	176,036	17,851	101.41	1.079	1.108	1.000	121.29	1.085	1.349	1.070	190.04	20%
										Weighted Average:	**215.49**	

Notes

(1) Selected experience period
(2) From GISA
(3) From GISA
(4) (3) / (2) * 1000
(5) Based on review of Grid loss development patterns
(6) From GISA ULAE report
(7) Based on review of Grid loss trend patterns
(8) (4) * (5) * (6) * (7)
(9) Based on review of Grid loss trend patterns
(10) Based on review of Grid loss trend patterns
(11) November 24, 2020 Board Guidelines
(12) (8) * (9) * (10) * (11)
(13) Selected

APPENDIX D. MODELLING DATA

D.1. Raw Data Summary

We present a summary of the fields provided for our review below:

Field	Summary
number_of_written_vehicles	numeric: min = -199; max = 186481; NAs: 0
number_of_earned_vehicles	numeric: min = -207; max = 181561; NAs: 0
written_premium	numeric: min = -194164; max = 51669335; NAs: 0
earned_premium	numeric: min = -57027; max = 51406526; NAs: 0
claim_count	numeric: min = -1; max = 2162; NAs: 0
claim_count_original	numeric: min = -1; max = 2162; NAs: 0
claim_count_ompp	numeric: min = -1; max = 2128; NAs: 0
claim_count_generated	numeric: min = 0; max = 0; NAs: 0
loss_amount	numeric: min = -13000; max = 22223406; NAs: 0
expense_amount	numeric: min = -19675; max = 1462643; NAs: 0
loss_and_expense_amount	numeric: min = -10415; max = 23539801; NAs: 0
factor_flag	numeric: min = 0; max = 0; NAs: 0
section_number	numeric: min = 1; max = 1; NAs: 0
valuation_year	numeric: min = 201912; max = 201912; NAs: 0
company_identification	character: 000
exhibit_type	numeric: min = 0; max = 0; NAs: 0
major_vehicle_class	character: PPV

Field	Summary
minor_vehicle_class	character: PPV-IR excluding Farmers
type_of_business	-
type_of_use	-
driving_record	-
excluded_driver_code_on_only	-
trailer_indicator	character: N; Y
fleet_flag	numeric: min = 0; max = 2; NAs: 0
grid_indicator_ab_only	character: NA; N; Y
first_chance_indicator_nb_only	-
retiree_discount_on_only	-
type_a_convictions	character: NA; 1 Conviction; 2 Convictions; 3 Convictions; 4 or more convictions; No Convictions
type_b_convictions	character: NA; 1 Conviction; 2 Convictions; 3 Convictions; 4 or more convictions; No Convictions
type_c_convictions	-
vehicle_use	-
first_party_vehicle_total_loss_indicator	-
operator_grid_level_ab_only	numeric: min = -15; max = 14; NAs: 4904
driver_type	-
group_marketing_indicator	-
number_other_operators	-
other_operator_years_licensed	-
number_claims	-
number_years_claims_free	-
number_years_licensed	-
Gender	character: NA; Female; Male
age_group	-
driver_training_indicator	-
Region	character: 1 - Alberta
urban_rural_indicator	-

Field	Summary
Province	character: AB
statistical_territory	numeric: min = 100; max = 105; NAs: 0
vehicle_location_postal_code	-
major_coverage_type	character: AB; TPL
minor_coverage_type	character: AB; TPL
deductible_amount	-
limit_amount	character: NA; $2000,000, $1000,000, $2,000,001 - $5,000,000; $200,000, $300,000, $500,000, All Other Limits ; Over $5000,000
size_of_loss_range	-
kind_of_loss_code	character: NA; 31; 02; 09; 34; 39; 01; 32; 30; 37
loss_transfer_flag_on_only	numeric: min = 0; max = 0; NAs: 157481
paid_outstanding_indicator	-
entry_half_year	-
accident_half_year	numeric: min = 201501; max = 201902; NAs: 0

D.2. Missing Variables

Removal of Non-Informative Variables

GISA does not currently capture the number of at-fault claims within the last three years in their standard statistical plan. In Section 4.4, we discuss the derivation of an offset parameter for the at-fault surcharge by Grid step.

Type C Conviction Variable

Every insurer that writes automobile insurance in Alberta is required to report its data in accordance with the Automobile Statistical Plan (ASP). With respect to convictions, the following types of convictions are reported with each premium record for an operator as part of its ASP.

- Type A: Serious
- Type B: Minor, and
- Type C: Criminal.

GISA premium records include the number (up to nine) of each conviction type. We did not request the Type C convictions from IBC to reduce the file size of the database requested. This is likely immaterial to our analysis as the number of Type C convictions within the province is extremely small and likely

correlated to other rating variables included in our model (Type A/B convictions, Grid step). In Table 15 we present the surcharges that apply to the Grid premium for criminal convictions.

Table 15: Criminal Convictions Surcharge

Number of Convictions	Current Surcharge
1	300%
2	450%
3+	150% (each additional)

D.3. Reconciliation

IBC also provided a "High Level Preliminary Observations" document based on data provided to us. We fully reconciled the raw data that we used in our analysis to the summary tables included in that document. We present that reconciliation in Table 16.

Table 16: Reconciliation to Alberta Ad Hoc Convictions Extract

	Earned Vehicles		Claim Count		Loss and Expense	
Accident Year	IBC	Oliver Wyman	IBC	Oliver Wyman	IBC	Oliver Wyman
2015	2,657,465	2,657,465	130,543	130,543	1,336,106,162	1,336,106,162
2016	2,678,797	2,678,797	125,589	125,589	1,356,556,587	1,356,556,587
2017	2,692,885	2,692,885	131,842	131,842	1,369,572,089	1,369,572,089
2018	2,748,083	2,748,083	130,940	130,940	1,242,506,525	1,242,506,525
2019	2,784,904	2,784,904	122,241	122,241	1,007,341,115	1,007,341,115
Total	13,562,134	13,562,134	641,155	641,155	6,312,082,478	6,312,082,478

D.4. Derivation of Model Data

Removal of Non-Populated Variables

We excluded the following variables which contained only NA values.

```
type_of_business
type_of_use
driving_record
excluded_driver_code_on_only
first_chance_indicator_nb_only
retiree_discount_on_only
type_c_convictions
```

```
vehicle_use
first_party_vehicle_total_loss_indicator
driver_type
group_marketing_indicator
number_other_operators
other_operator_years_licensed
number_claims
number_years_claims_free
number_years_licensed
age_group
driver_training_indicator
urban_rural_indicator
vehicle_location_postal_code
deductible_amount
size_of_loss_range
paid_outstanding_indicator
entry_half_year
```

Removal of Non-Informative Variables

Next, we eliminated the following variables that contained all (or almost all) identical entries.

```
fleet_flag: 0 = 215474  1 = 664  2 = 80
company_identification: 000 = 216218
exhibit_type: 0 = 216218
section_number: 1 = 216218
valuation_year: 201912 = 216218
major_vehicle_class: PPV = 216218
minor_vehicle_class: PPV-IR excluding Farmers = 216218
region: 1 - Alberta = 216218
province: AB = 216218
factor_flag: 0 = 216218
```

We also removed `"loss_transfer_flag_on_only"`. This variable indicated whether the record was a loss or premium record[30].

Filters

We filtered the data to exclude records with `trailer_indicator == 'N'` as this coding indicates that the record relates to a trailer rather than a vehicle.

We filtered the data to exclude records with `kind_of_loss_code == '09'` as this coding indicates the record relates to the property damage sub-coverage. The Grid premium will no longer include DCPD beginning January 1, 2022. As it is not possible to separate historical loss experience into separate PD-tort and DCPD sub-coverages, we exclude all PD loss experience from the historical data. We do not expect this to introduce material bias into our models. The PD-tort sub-coverage will be a small portion of the total Grid premium as the majority of future property damage claims will be covered under DCPD.

Redundant Variables

We eliminated redundant variables (`major_coverage_type` and `minor_coverage_type`) and renamed the remaining variable as `"coverage_type"`.

Aggregation

We aggregated all potential response variables over all explanatory variables and calculated the following transformed response variables. From this aggregated data frame, we only retained records with `number_of_earned_vehicles > 0` and `pure_premium >= 0`.

Transformed Response Variables

We then calculated the following transformed response variables.

```
dplyr::mutate(freq = claim_count / number_of_earned_vehicles,
  sev = loss_and_expense_amount / claim_count,
  pp = loss_and_expense_amount / number_of_earned_vehicles)
```

[30] Alternatively, we could have retained this variable at this step. It would ultimately have been discarded in the aggregation step.

APPENDIX E. SELECTED DIFFERENTIALS SUPPORTING EXHIBITS

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Change in Grid Step Differentials - Calculation of Off-Balance Factor

(1)	(2)	(3)	(4)	(5)	(6)
			(3) / (3) Total	App E pg 2	App E pg 2
		Currently Capped by the Grid			
Variable	Level	Earned Vehicles	Exposure Distribution	Current Differential	Selected Differential
Operator Grid Level	-15	273,763	17.3%	0.500	0.421
Operator Grid Level	-14	37,168	2.4%	0.500	0.453
Operator Grid Level	-13	46,556	2.9%	0.500	0.479
Operator Grid Level	-12	59,585	3.8%	0.500	0.507
Operator Grid Level	-11	74,113	4.7%	0.500	0.538
Operator Grid Level	-10	91,730	5.8%	0.500	0.571
Operator Grid Level	-9	51,670	3.3%	0.550	0.606
Operator Grid Level	-8	49,035	3.1%	0.600	0.643
Operator Grid Level	-7	47,649	3.0%	0.650	0.682
Operator Grid Level	-6	47,751	3.0%	0.700	0.723
Operator Grid Level	-5	57,887	3.7%	0.750	0.766
Operator Grid Level	-4	82,403	5.2%	0.800	0.809
Operator Grid Level	-3	111,506	7.1%	0.850	0.855
Operator Grid Level	-2	263,212	16.7%	0.900	0.902
Operator Grid Level	-1	90,482	5.7%	0.950	0.950
Operator Grid Level	0 (Base)	128,113	8.1%	1.000	1.000
Operator Grid Level	1	12,925	0.8%	1.100	1.051
Operator Grid Level	2	14,493	0.9%	1.200	1.105
Operator Grid Level	3	17,559	1.1%	1.300	1.159
Operator Grid Level	4	7,449	0.5%	1.400	1.216
Operator Grid Level	5	6,171	0.4%	1.500	1.275
Operator Grid Level	6	1,422	0.1%	1.650	1.335
Operator Grid Level	7	1,135	0.1%	1.800	1.398
Operator Grid Level	8	1,156	0.1%	1.950	1.464
Operator Grid Level	9	844	0.1%	2.100	1.531
Operator Grid Level	10	795	0.1%	2.250	1.602
Operator Grid Level	11	607	0.0%	2.480	1.675
Operator Grid Level	12	544	0.0%	2.700	1.751
Operator Grid Level	13	443	0.0%	2.930	1.830
Operator Grid Level	14	268	0.0%	3.150	1.924
Operator Grid Level	15	0	0.0%	3.380	2.008
			Average Factor	0.734	0.724
Statistical Territory	Rest of Alberta (Base)	10,593,763	52.5%	1.000	1.000
Statistical Territory	Calgary & Edmonton	7,898,540	39.2%	1.250	1.700
Statistical Territory	Northern District	1,668,890	8.3%	1.000	0.800
			Average Factor	1.098	1.258
Limit Amount	200,000	1,992	0.3%	0.851	0.851
Limit Amount	300,000	3,819	0.5%	0.896	0.896
Limit Amount	500,000	2,537	0.3%	0.950	0.950
Limit Amount	1,000,000 (Base)	609,394	77.1%	1.000	1.000
Limit Amount	2,000,000	172,738	21.8%	1.090	1.090
Limit Amount	2,000,000+	95	0.0%	*1.100*	1.100
Limit Amount	Other	33	0.0%	*0.925*	0.925
			Average Factor	1.019	1.019
Type A Convictions	0 (Base)	1,557,953	98.7%	1.000	1.000
Type A Convictions	1	18,110	1.1%	1.250	1.500
Type A Convictions	2	2,072	0.1%	1.500	1.750
Type A Convictions	3	227	0.0%	2.000	2.250
Type A Convictions	4+	73	0.0%	*3.500*	3.500
			Average Factor	1.004	1.007
Type B Convictions	0 (Base)	1,139,838	72.2%	1.000	1.000
Type B Convictions	1	288,719	18.3%	1.000	1.250
Type B Convictions	2	80,002	5.1%	1.250	1.500
Type B Convictions	3	34,137	2.2%	1.350	1.750
Type B Convictions	4+	35,738	2.3%	*2.000*	2.000
			Average Factor	1.043	1.110
			A. Extension of Exposure Average Factor	1.018	1.113
					A. Selected / A.
			B.1 Average Rate Differential Change	9%	Current - 1
			B.2 Off-Balance Factor	0.915	1 / B.1
			C.1 Current Base Rate	2,658	Current Rates
			C.2 Indicated Rate Change	-20.5%	App C pg 1
			C.3 Indicated Rate Change including Off-Balance Factor	-27.3%	(1 + C.2) * B.2 - 1
			C.4 Indicated Base Rate	1,933	C.1 * (1 + C.3)

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Selected Grid Step Differentials

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
		App E pg 3	LN((3))	Selected	Per Regression	EXP((6))	(7) / (7) at BL		App E pg 5	LN((10))	Selected	Per Regression	EXP((13))	(7) / (7) at BL	Selected	Group -15 to -10 per exposure dist	App E pg 4	per (16)	per (18)
		All Risks							Grid Risks Only									Re-Leveled (Base Level = 0)	
Variable	Level	Modelled Differential	LN[Modelled Differential]	Include in Fit (1=TRUE, 0=FALSE)	Fitted Value	Implied Differential	Smoothed Differential	Smoothed Differentials - Removal Of Flattening Bias	Modelled Differential	LN[Modelled Differential]	Include in Fit (1=TRUE, 0=FALSE)	Fitted Value	Implied Differential	Smoothed Differential	Selected Differential	Current Grouping	Current Differential	Selected Differential	Current Differential
Operator Grid Level	-15 (Base)	1.000	0.000	0	0.270	1.310	1.000	1.000	1.000	0.000	1	-0.037	0.963	1.000	1.00	1.000	1.000	0.421	0.500
Operator Grid Level	-14	1.356 ***	0.304	1	0.313	1.367	1.044	1.076	1.011	0.011	1	0.015	1.016	1.054	1.08	1.000	1.000	0.453	0.500
Operator Grid Level	-13	1.375 ***	0.319	1	0.356	1.427	1.090	1.138	1.095	0.090	1	0.068	1.071	1.112	1.14	1.000	1.000	0.479	0.500
Operator Grid Level	-12	1.512 ***	0.414	1	0.399	1.490	1.138	1.205	1.246	0.220	1	0.121	1.129	1.172	1.20	1.000	1.000	0.507	0.500
Operator Grid Level	-11	1.513 ***	0.414	1	0.442	1.556	1.188	1.277	1.230	0.207	1	0.174	1.190	1.236	1.28	1.000	1.000	0.538	0.500
Operator Grid Level	-10	1.611 ***	0.477	1	0.485	1.624	1.240	1.356	1.268	0.237	1	0.227	1.255	1.303	1.36	1.000	1.000	0.571	0.500
Operator Grid Level	-9	1.495 ***	0.402	1	0.528	1.696	1.295	1.439	1.225	0.203	1	0.280	1.323	1.373	1.44	1.381	1.100	0.606	0.550
Operator Grid Level	-8	1.757 ***	0.563	1	0.571	1.770	1.352	1.528	1.377	0.320	1	0.333	1.395	1.448	1.53	1.466	1.200	0.643	0.600
Operator Grid Level	-7	1.852 ***	0.616	1	0.614	1.848	1.412	1.620	1.347	0.298	1	0.386	1.471	1.527	1.62	1.555	1.300	0.682	0.650
Operator Grid Level	-6	1.801 ***	0.588	1	0.657	1.930	1.474	1.717	1.345	0.296	1	0.439	1.550	1.610	1.72	1.648	1.400	0.723	0.700
Operator Grid Level	-5	1.911 ***	0.648	1	0.701	2.015	1.539	1.818	1.521 ***	0.420	1	0.491	1.635	1.697	1.82	1.745	1.500	0.766	0.750
Operator Grid Level	-4	2.014 ***	0.700	1	0.744	2.103	1.606	1.922	1.251	0.224	0	0.544	1.723	1.789	1.92	1.845	1.600	0.809	0.800
Operator Grid Level	-3	1.979 ***	0.683	1	0.787	2.196	1.677	2.030	1.157	0.146	0	0.597	1.817	1.886	2.03	1.948	1.700	0.855	0.850
Operator Grid Level	-2	2.633 ***	0.968	1	0.830	2.293	1.751	2.141	1.889 ***	0.636	1	0.650	1.916	1.989	2.14	2.055	1.800	0.902	0.900
Operator Grid Level	-1	2.487 ***	0.911	1	0.873	2.394	1.828	2.256	2.071 ***	0.728	1	0.703	2.020	2.097	2.26	2.165	1.900	0.950	0.950
Operator Grid Level	0	4.903 ***	1.590	1	0.916	2.499	1.908	2.375	2.666 ***	0.981	1	0.756	2.129	2.211	2.37	2.279	2.000	1.000	1.000
Operator Grid Level	1	2.647 ***	0.973	1	0.959	2.609	1.992	2.497	1.825	0.602	0	0.809	2.245	2.331	2.50	2.396	2.200	1.051	1.100
Operator Grid Level	2	2.412 ***	0.881	1	1.002	2.724	2.080	2.623	1.400	0.337	0	0.862	2.367	2.457	2.62	2.517	2.400	1.105	1.200
Operator Grid Level	3	2.896 ***	1.063	1	1.045	2.844	2.172	2.753	1.769	0.571	0	0.914	2.496	2.591	2.75	2.642	2.600	1.159	1.300
Operator Grid Level	4	2.770 ***	1.019	1	1.088	2.969	2.267	2.888	1.676	0.516	0	0.967	2.631	2.731	2.89	2.771	2.800	1.216	1.400
Operator Grid Level	5	3.376 ***	1.217	1	1.131	3.100	2.367	3.027	2.665 ***	0.980	1	1.020	2.774	2.880	3.03	2.905	3.000	1.275	1.500
Operator Grid Level	6	3.080 ***	1.125	1	1.174	3.236	2.471	3.171	1.835	0.607	0	1.073	2.925	3.036	3.17	3.043	3.300	1.335	1.650
Operator Grid Level	7	2.525 ***	0.926	0	1.218	3.379	2.580	3.321	1.835	0.607	0	1.126	3.083	3.201	3.32	3.186	3.600	1.398	1.800
Operator Grid Level	8	3.236 ***	1.174	1	1.261	3.528	2.694	3.476	1.835	0.607	0	1.179	3.251	3.375	3.48	3.335	3.900	1.464	1.950
Operator Grid Level	9	3.540 ***	1.264	1	1.304	3.683	2.812	3.637	1.835	0.607	0	1.232	3.427	3.558	3.64	3.490	4.200	1.531	2.100
Operator Grid Level	10	2.806 ***	1.032	0	1.347	3.845	2.936	3.804	1.835	0.607	0	1.285	3.614	3.751	3.80	3.650	4.500	1.602	2.250
Operator Grid Level	11	3.512 ***	1.256	1	1.390	4.014	3.066	3.978	1.835	0.607	0	1.338	3.810	3.955	3.98	3.817	4.960	1.675	2.480
Operator Grid Level	12	3.512	1.256	0	1.433	4.191	3.201	4.158	1.835	0.607	0	1.390	4.017	4.170	4.16	3.990	5.400	1.751	2.700
Operator Grid Level	13	3.512	1.256	0	1.476	4.376	3.341	4.347	1.835	0.607	0	1.443	4.235	4.396	4.35	4.171	5.860	1.830	2.930
Operator Grid Level	14	3.512	1.256	0	1.519	4.568	3.489	4.568	1.835	0.607	0	1.496	4.465	4.635	4.57	4.384	6.300	1.924	3.150
Operator Grid Level	15	3.512	1.256	0	1.562	4.769	3.642	4.769	1.835	0.607	0	1.549	4.707	4.887	4.77	4.577	6.760	2.008	3.380

Regression on (4) and (5)	
Intercept	0.916
Slope	0.043

Regression on (10) and (11)	
Intercept	0.756
Slope	0.053

Notes

*** = Significant

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

GLM Model Results
All Risks - Final Model

(1)	(2)	(3)	(4) (3) / (3) Total	(5)	(6)	(7)	(8)	(9)	(10) EXP((5))	(11)	(12)
				GLM Results							
Variable	Level	Earned Vehicles	Exposure Distribution	estimate	std.error	statistic	p.value	Significant (***)	Modelled Differential	Grouped Model Differential	Current Differential
Explanatory Variables											
Operator Grid Step	-15 (Base)	16,156,015	60.5%	0.000					1.000		1.000
Operator Grid Step	-14	723,874	2.7%	0.304	0.053	5.712	0.000	***	1.356		1.000
Operator Grid Step	-13	743,839	2.8%	0.319	0.052	6.071	0.000	***	1.375	1.000	1.000
Operator Grid Step	-12	772,938	2.9%	0.414	0.051	8.145	0.000	***	1.512		1.000
Operator Grid Step	-11	811,761	3.0%	0.414	0.050	8.347	0.000	***	1.513		1.000
Operator Grid Step	-10	852,158	3.2%	0.477	0.048	9.906	0.000	***	1.611		1.000
Operator Grid Step	-9	608,026	2.3%	0.402	0.057	7.056	0.000	***	1.495	1.368	1.100
Operator Grid Step	-8	618,955	2.3%	0.563	0.055	10.196	0.000	***	1.757	1.607	1.200
Operator Grid Step	-7	619,269	2.3%	0.616	0.055	11.234	0.000	***	1.852	1.694	1.300
Operator Grid Step	-6	620,963	2.3%	0.588	0.055	10.697	0.000	***	1.801	1.648	1.400
Operator Grid Step	-5	618,232	2.3%	0.648	0.055	11.941	0.000	***	1.911	1.748	1.500
Operator Grid Step	-4	608,986	2.3%	0.700	0.055	13.020	0.000	***	2.014	1.843	1.600
Operator Grid Step	-3	620,402	2.3%	0.683	0.054	12.884	0.000	***	1.979	1.811	1.700
Operator Grid Step	-2	966,663	3.6%	0.968	0.043	23.169	0.000	***	2.633	2.408	1.800
Operator Grid Step	-1	435,325	1.6%	0.911	0.062	15.075	0.000	***	2.487	2.275	1.900
Operator Grid Step	0	459,368	1.7%	1.590	0.055	29.374	0.000	***	4.903	4.485	2.000
Operator Grid Step	1	111,468	0.4%	0.973	0.120	8.423	0.000	***	2.647	2.421	2.200
Operator Grid Step	2	101,555	0.4%	0.881	0.127	7.252	0.000	***	2.412	2.207	2.400
Operator Grid Step	3	98,343	0.4%	1.063	0.125	8.918	0.000	***	2.896	2.649	2.600
Operator Grid Step	4	54,476	0.2%	1.019	0.169	6.440	0.000	***	2.770	2.534	2.800
Operator Grid Step	5	43,240	0.2%	1.217	0.183	7.127	0.000	***	3.376	3.088	3.000
Operator Grid Step	6	21,152	0.1%	1.125	0.266	4.706	0.000	***	3.080	2.817	3.300
Operator Grid Step	7	17,839	0.1%	0.926	0.298	3.618	0.000	***	2.525	2.310	3.600
Operator Grid Step	8	14,705	0.1%	1.174	0.317	4.257	0.000	***	3.236	2.960	3.900
Operator Grid Step	9	9,239	0.0%	1.264	0.395	3.640	0.000	***	3.540	3.238	4.200
Operator Grid Step	10	6,520	0.0%	1.032	0.480	2.520	0.012	***	2.806	2.567	4.500
Operator Grid Step	11 to 15+	8,899	0.0%	1.256	0.401	3.586	0.000	***	3.512	3.212	5.495
Statistical Territory	Rest of Alberta (Base)	10,593,763	39.6%	0.000					1.000		1.000
Statistical Territory	Calgary & Edmonton	14,461,555	54.1%	0.537	0.018	29.276	0.000	***	1.710		1.250
Statistical Territory	Northern District	1,668,890	6.2%	-0.204	0.040	-5.128	0.000	***	0.815		1.000
Other Potential Rating Variables											
Coverage	TPL	13,361,448	50.0%	0.000					1.000		
Coverage	Accident Benefits	13,362,761	50.0%	1.511	0.018	85.480	0.000	***	4.530		
Gender	Female (Base)	12,237,760	45.8%	0.000					1.000		
Gender	Male	14,486,448	54.2%	-0.130	0.017	-7.479	0.000	***	0.878		
Accident Semester	201501 (Base)	2,567,806	9.6%	0.000					1.000		
Accident Semester	201502	2,657,132	9.9%	0.189	0.039	4.872	0.000	***	1.208		
Accident Semester	201601	2,605,931	9.8%	0.028	0.039	0.717	0.473		1.029		
Accident Semester	201602	2,667,739	10.0%	0.231	0.039	5.973	0.000	***	1.260		
Accident Semester	201701	2,607,406	9.8%	0.117	0.039	2.992	0.003	***	1.124		
Accident Semester	201702	2,701,116	10.1%	0.183	0.039	4.724	0.000	***	1.200		
Accident Semester	201801	2,660,371	10.0%	0.105	0.039	2.680	0.007	***	1.110		
Accident Semester	201802	2,759,700	10.3%	0.020	0.039	0.505	0.614		1.020		
Accident Semester	201901	2,707,143	10.1%	-0.085	0.039	-2.145	0.032	***	0.919		
Accident Semester	201902	2,789,865	10.4%	-0.118	0.039	-3.000	0.003	***	0.889		
Intercept				3.259	0.034	95.437	0.000	***	26.019		
Offset Parameters											
Limit Amount	200000								0.851		0.851
Limit Amount	300,000								0.896		0.896
Limit Amount	500,000								0.950		0.950
Limit Amount	1,000,000 (Base)								1.000		1.000
Limit Amount	2,000,000								1.090		1.090
Limit Amount	2,000,000+								1.100		N/A
Limit Amount	Other								0.925		N/A
Type A Convictions	0 (Base)								1.000		1.000
Type A Convictions	1								1.500		1.250
Type A Convictions	2								1.750		1.500
Type A Convictions	3								2.250		2.000
Type A Convictions	4+								3.500		>=3.00
Type B Convictions	0 (Base)								1.000		1.000
Type B Convictions	1								1.500		1.250
Type B Convictions	2								1.500		1.250
Type B Convictions	3								1.750		1.350
Type B Convictions	4+								2.000		>=2.00

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

GLM Model Results
All Risks - Initial Model

(1)	(2)	(3)	(4) (3) / (3) Total	(5)	(6)	(7)	(8)	(9)	(10) EXP((5))	(11) AIRB	(12)
				GLM Results							
Variable	Level	Earned Vehicles	Exposure Distribution	estimate	std.error	statistic	p.value	Significant (***)	Modelled Differential	Current Differential	Notes
Explanatory Variables											
Operator Grid Step	-15 (Base)	16,156,015	60.5%	0.000					1.000	1.000	
Operator Grid Step	-14	723,874	2.7%	0.322	0.042	7.674	0.000	***	1.379	1.000	
Operator Grid Step	-13	743,839	2.8%	0.334	0.041	8.101	0.000	***	1.397	1.000	
Operator Grid Step	-12	772,938	2.9%	0.439	0.040	11.083	0.000	***	1.552	1.000	
Operator Grid Step	-11	811,761	3.0%	0.443	0.039	11.455	0.000	***	1.558	1.000	
Operator Grid Step	-10	852,158	3.2%	0.508	0.037	13.610	0.000	***	1.663	1.000	
Operator Grid Step	-9	608,026	2.3%	0.431	0.044	9.694	0.000	***	1.538	1.100	
Operator Grid Step	-8	618,955	2.3%	0.581	0.043	13.583	0.000	***	1.788	1.200	
Operator Grid Step	-7	619,269	2.3%	0.638	0.042	15.092	0.000	***	1.894	1.300	
Operator Grid Step	-6	620,963	2.3%	0.602	0.043	14.146	0.000	***	1.825	1.400	
Operator Grid Step	-5	618,232	2.3%	0.671	0.042	16.070	0.000	***	1.955	1.500	
Operator Grid Step	-4	608,986	2.3%	0.750	0.042	18.229	0.000	***	2.117	1.600	
Operator Grid Step	-3	620,402	2.3%	0.738	0.041	18.203	0.000	***	2.092	1.700	
Operator Grid Step	-2	966,663	3.6%	1.099	0.032	35.504	0.000	***	3.001	1.800	
Operator Grid Step	-1	435,325	1.6%	1.010	0.047	22.241	0.000	***	2.747	1.900	
Operator Grid Step	0	459,368	1.7%	1.683	0.040	42.724	0.000	***	5.381	2.000	
Operator Grid Step	1	111,468	0.4%	0.999	0.089	11.667	0.000	***	2.716	2.200	
Operator Grid Step	2	101,555	0.4%	0.884	0.095	9.764	0.000	***	2.421	2.400	
Operator Grid Step	3	98,343	0.4%	1.094	0.092	12.427	0.000	***	2.987	2.600	
Operator Grid Step	4	54,476	0.2%	1.020	0.124	8.753	0.000	***	2.773	2.800	
Operator Grid Step	5	43,240	0.2%	1.239	0.133	9.960	0.000	***	3.451	3.000	
Operator Grid Step	6	21,152	0.1%	1.118	0.191	6.524	0.000	***	3.058	3.300	
Operator Grid Step	7	17,839	0.1%	0.860	0.217	4.658	0.000	***	2.363	3.600	
Operator Grid Step	8	14,705	0.1%	1.187	0.222	6.128	0.000	***	3.278	3.900	
Operator Grid Step	9	9,239	0.0%	1.182	0.279	4.855	0.000	***	3.260	4.200	
Operator Grid Step	10	6,520	0.0%	1.407	0.320	4.960	0.000	***	4.083	4.500	
Operator Grid Step	11	3,088	0.0%	1.742	0.432	4.440	0.000	***	5.710	4.960	
Operator Grid Step	12	2,431	0.0%	0.678	0.599	1.437	0.151		1.970	5.400	Data is thin,
Operator Grid Step	13	1,908	0.0%	0.771	0.661	1.442	0.149		2.163	5.860	combine into one
Operator Grid Step	14	1,472	0.0%	0.883	0.742	1.436	0.151		2.419	6.300	level
Operator Grid Step	15	0	0.0%	NA	NA	NA	NA		NA	6.760	
Statistical Territory	Rest of Alberta (Base)	10,593,763	39.6%	0.000					1.000	1.000	
Statistical Territory	Calgary	7,898,540	29.6%	0.532	0.017	32.023	0.000	***	1.703	1.250	Combine
Statistical Territory	Edmonton	6,563,016	24.6%	0.507	0.017	28.984	0.000	***	1.660	1.250	Calgary/Edmonton
Statistical Territory	Northern District	1,668,890	6.2%	-0.205	0.032	-6.436	0.000	***	0.814	1.000	
Other Potential Rating Variables											
Limit Amount	200,000 (Base)	12,943	0.0%	0.000					1.000	1.000	
Limit Amount	300,000	87,165	0.3%	-0.138	0.279	-0.496	0.620		0.871	1.053	
Limit Amount	500,000	40,620	0.2%	0.139	0.297	0.469	0.639		1.150	1.116	Unintuitive -
Limit Amount	1,000,000	9,545,266	35.7%	0.172	0.256	0.672	0.501		1.188	1.175	Consider Offset
Limit Amount	2,000,000	3,651,415	13.7%	0.175	0.256	0.685	0.493		1.192	1.281	Parameters
Limit Amount	2,000,000+	23,759	0.1%	-0.250	0.340	-0.734	0.463		0.779	N/A	
Limit Amount	Other	280	0.0%	0.192	1.737	0.111	0.912		1.212	N/A	
Coverage	TPL	13,361,448	50.0%	0.000					1.000		
Coverage	Accident Benefits	13,362,761	50.0%	-1.372	0.256	-5.359	0.000		0.254		
Type A Convictions	0 (Base)	26,667,045	99.8%	0.000					1.000	1.000	
Type A Convictions	1	53,921	0.2%	0.844	0.115	7.354	0.000	***	2.325	1.500	Data is thin -
Type A Convictions	2	2,768	0.0%	1.220	0.457	2.669	0.008	***	3.386	1.750	Consider Offset
Type A Convictions	3	334	0.0%	0.442	1.517	0.291	0.771		1.556	2.250	Parameters
Type A Convictions	4+	141	0.0%	-2.594	3.978	-0.652	0.514		0.075	3.500	
Type B Convictions	0 (Base)	23,846,579	89.2%	0.000					1.000	1.000	
Type B Convictions	1	2,035,684	7.6%	0.329	0.024	13.635	0.000	***	1.389	1.250	Data is thin -
Type B Convictions	2	564,909	2.1%	0.495	0.042	11.673	0.000	***	1.640	1.500	Consider Offset
Type B Convictions	3	182,218	0.7%	0.658	0.071	9.252	0.000	***	1.930	1.750	Parameters
Type B Convictions	4+	94,819	0.4%	1.024	0.091	11.201	0.000	***	2.785	2.000	
Gender	Female (Base)	12,237,760	45.8%	0.000					1.000		Remove impact of
Gender	Male	14,486,448	54.2%	-0.097	0.014	-7.079	0.000	***	0.908		gender imbalance
Accident Semester	201501 (Base)	2,567,806	9.6%	0.000					1.000		
Accident Semester	201502	2,657,132	9.9%	0.190	0.030	6.274	0.000	***	1.210		
Accident Semester	201601	2,605,931	9.8%	0.030	0.031	0.974	0.330		1.031		
Accident Semester	201602	2,667,739	10.0%	0.223	0.030	7.387	0.000	***	1.250		
Accident Semester	201701	2,607,406	9.8%	0.109	0.031	3.557	0.000	***	1.116		Remove impact of
Accident Semester	201702	2,701,116	10.1%	0.177	0.030	5.825	0.000	***	1.193		Development and
Accident Semester	201801	2,660,371	10.0%	0.082	0.031	2.676	0.007	***	1.086		Trend
Accident Semester	201802	2,759,700	10.3%	0.008	0.031	0.245	0.807		1.008		
Accident Semester	201901	2,707,143	10.1%	-0.107	0.031	-3.427	0.001	***	0.899		
Accident Semester	201902	2,789,865	10.4%	-0.151	0.031	-4.837	0.000	***	0.860		
Intercept				4.629	0.257	18.008	0.000	***	102.431		

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

GLM Model Results
Grid Risks Only - Final Model

(1)	(2)	(3)	(4) (3) / (3) Total	(5)	(6)	(7)	(8)	(9)	(10) EXP((5))	(11) AIRB	(12)
				GLM Results							
Variable	Level	Earned Vehicles	Exposure Distribution	estimate	std.error	statistic	p.value	Significant (***)	Modelled Differential	Grouped Model Differential	Current Differential
Explanatory Variables											
Operator Grid Step	-15 (Base)	582,915	36.9%	0.000					1.000		1.000
Operator Grid Step	-14	37,168	2.4%	0.011	0.257	0.041	0.967		1.011		1.000
Operator Grid Step	-13	46,556	2.9%	0.090	0.231	0.392	0.695		1.095	1.000	1.000
Operator Grid Step	-12	59,585	3.8%	0.220	0.205	1.073	0.283		1.246		1.000
Operator Grid Step	-11	74,113	4.7%	0.207	0.188	1.100	0.271		1.230		1.000
Operator Grid Step	-10	91,730	5.8%	0.237	0.173	1.370	0.171		1.268		1.000
Operator Grid Step	-9	51,670	3.3%	0.203	0.217	0.933	0.351		1.225	1.146	1.100
Operator Grid Step	-8	49,035	3.1%	0.320	0.219	1.458	0.145		1.377	1.289	1.200
Operator Grid Step	-7	47,649	3.0%	0.298	0.223	1.333	0.182		1.347	1.260	1.300
Operator Grid Step	-6	47,751	3.0%	0.296	0.223	1.327	0.185		1.345	1.259	1.400
Operator Grid Step	-5	57,887	3.7%	0.420	0.204	2.086	0.037	***	1.521	1.424	1.500
Operator Grid Step	-4	82,403	5.2%	0.224	0.182	1.285	0.199		1.251	1.171	1.600
Operator Grid Step	-3	111,506	7.1%	0.146	0.165	0.976	0.329		1.157	1.083	1.700
Operator Grid Step	-2	263,212	16.7%	0.636	0.123	5.350	0.000	***	1.889	1.768	1.800
Operator Grid Step	-1	90,482	5.7%	0.728	0.167	4.521	0.000	***	2.071	1.939	1.900
Operator Grid Step	0	128,113	8.1%	0.981	0.144	7.003	0.000	***	2.666	2.496	2.000
Operator Grid Step	1	12,925	0.8%	0.602	0.388	1.642	0.101		1.825	1.708	2.200
Operator Grid Step	2	14,493	0.9%	0.337	0.381	0.987	0.323		1.400	1.311	2.400
Operator Grid Step	3	17,559	1.1%	0.571	0.336	1.848	0.065		1.769	1.656	2.600
Operator Grid Step	4	7,449	0.5%	0.516	0.514	1.139	0.255		1.676	1.569	2.800
Operator Grid Step	5	6,171	0.4%	0.980	0.522	2.050	0.040	***	2.665	2.494	3.000
Operator Grid Step	6 to 15+	5,793	0.4%	0.607	0.519	1.487	0.137		1.835	1.718	4.248
Statistical Territory	Rest of Alberta (Base)	499,315	31.6%	0.000					1.000		1.000
Statistical Territory	Calgary & Edmonton	976,950	27.0%	0.514	0.080	6.456	0.000	***	1.672		1.250
Statistical Territory	Northern District	102,169	6.5%	-0.410	0.168	-2.444	0.015	***	0.664		1.000
Other Potential Rating Variables											
Coverage	TPL	790,608	50.1%	0.000					1.000		
Coverage	Accident Benefits	787,826	49.9%	1.900	0.073	25.986	0.000	***	6.686		
Gender	Female (Base)	472,646	29.9%	0.000					1.000		
Gender	Male	1,105,788	70.1%	-0.018	0.077	-0.230	0.818		0.982		
Accident Semester	201501 (Base)	161,998	10.3%	0.000					1.000		
Accident Semester	201502	158,078	10.0%	0.458	0.151	3.027	0.002	***	1.581		
Accident Semester	201601	146,614	9.3%	-0.010	0.160	-0.060	0.952		0.990		
Accident Semester	201602	146,136	9.3%	0.269	0.156	1.718	0.086		1.308		
Accident Semester	201701	140,904	8.9%	0.006	0.161	0.039	0.969		1.006		
Accident Semester	201702	151,774	9.6%	0.138	0.157	0.879	0.379		1.148		
Accident Semester	201801	154,335	9.8%	0.060	0.157	0.381	0.703		1.062		
Accident Semester	201802	159,761	10.1%	-0.016	0.157	-0.101	0.920		0.984		
Accident Semester	201901	163,560	10.4%	-0.229	0.158	-1.444	0.149		0.796		
Accident Semester	201902	195,275	12.4%	-0.312	0.153	-2.042	0.041	***	0.732		
Intercept				3.702	0.167	22.147	0.000	***	40.539		
Offset Parameters											
Limit Amount	200000								0.851		0.851
Limit Amount	300,000								0.896		0.896
Limit Amount	500,000								0.950		0.950
Limit Amount	1,000,000 (Base)								1.000		1.000
Limit Amount	2,000,000								1.090		1.090
Limit Amount	2,000,000+								1.100		N/A
Limit Amount	Other								0.925		N/A
Type A Convictions	0 (Base)								1.000		1.000
Type A Convictions	1								1.500		1.250
Type A Convictions	2								1.750		1.500
Type A Convictions	3								2.250		2.000
Type A Convictions	4+								3.500		>=3.00
Type B Convictions	0 (Base)								1.000		1.000
Type B Convictions	1								1.250		1.000
Type B Convictions	2								1.500		1.250
Type B Convictions	3								1.750		1.350
Type B Convictions	4+								2.000		>=2.00

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

GLM Model Results
Grid Risks Only - Initial Model - No Offset Parameters

(1)	(2)	(3)	(4) (3) / (3) Total	(5)	(6)	(7)	(8)	(9)	(10) EXP((5))	(11) AIRB	(12)
				GLM Results							
Variable	Level	Earned Vehicles	Exposure Distribution	estimate	std.error	statistic	p.value	Significant (***)	Modelled Differential	Current Differential	Notes
Explanatory Variables											
Operator Grid Step	-15 (Base)	273,763	17.3%	0.000					1.000	1.000	
Operator Grid Step	-14	37,168	2.4%	-0.007	0.191	-0.039	0.969		0.993	1.000	
Operator Grid Step	-13	46,556	2.9%	0.073	0.170	0.432	0.666		1.076	1.000	
Operator Grid Step	-12	59,585	3.8%	0.150	0.150	1.003	0.316		1.162	1.000	
Operator Grid Step	-11	74,113	4.7%	0.205	0.136	1.505	0.132		1.227	1.000	
Operator Grid Step	-10	91,730	5.8%	0.192	0.126	1.517	0.129		1.212	1.000	
Operator Grid Step	-9	51,670	3.3%	0.136	0.160	0.854	0.393		1.146	1.100	
Operator Grid Step	-8	49,035	3.1%	0.260	0.158	1.648	0.099		1.297	1.200	
Operator Grid Step	-7	47,649	3.0%	0.309	0.158	1.952	0.051		1.361	1.300	
Operator Grid Step	-6	47,751	3.0%	0.336	0.157	2.141	0.032	***	1.400	1.400	
Operator Grid Step	-5	57,887	3.7%	0.441	0.142	3.136	0.002	***	1.554	1.500	
Operator Grid Step	-4	82,403	5.2%	0.277	0.131	2.193	0.028	***	1.319	1.600	
Operator Grid Step	-3	111,506	7.1%	0.203	0.120	1.818	0.069		1.225	1.700	
Operator Grid Step	-2	263,212	16.7%	0.701	0.088	8.183	0.000	***	2.017	1.800	
Operator Grid Step	-1	90,482	5.7%	0.756	0.116	6.725	0.000	***	2.129	1.900	
Operator Grid Step	0	128,113	8.1%	1.047	0.100	10.750	0.000	***	2.849	2.000	
Operator Grid Step	1	12,925	0.8%	0.711	0.246	3.030	0.002	***	2.035	2.200	
Operator Grid Step	2	14,493	0.9%	0.379	0.257	1.631	0.103		1.461	2.400	
Operator Grid Step	3	17,559	1.1%	0.631	0.222	3.065	0.002	***	1.879	2.600	
Operator Grid Step	4	7,449	0.5%	0.578	0.333	1.943	0.052		1.782	2.800	
Operator Grid Step	5	6,171	0.4%	1.003	0.324	3.377	0.001	***	2.727	3.000	
Operator Grid Step	6	1,422	0.1%	1.285	0.579	2.442	0.015	***	3.615	3.300	
Operator Grid Step	7	1,135	0.1%	0.134	0.899	0.317	0.751		1.143	3.600	
Operator Grid Step	8	1,156	0.1%	0.565	0.777	0.952	0.341		1.759	3.900	
Operator Grid Step	9	844	0.1%	-0.220	1.152	-0.040	0.968		0.803	4.200	Data is thin, combine into one level
Operator Grid Step	10	795	0.1%	0.057	1.092	0.215	0.829		1.059	4.500	
Operator Grid Step	11	607	0.0%	0.677	1.032	0.828	0.407		1.967	4.960	
Operator Grid Step	12	544	0.0%	-0.099	1.382	0.060	0.952		0.906	5.400	
Operator Grid Step	13	443	0.0%	-0.723	1.814	-0.298	0.766		0.486	5.860	
Operator Grid Step	14	268	0.0%	0.724	1.525	0.595	0.552		2.063	6.300	
Operator Grid Step	15	0	0.0%	NA	NA	NA	NA		NA	6.760	
Statistical Territory	Rest of Alberta (Base)	499,315	31.6%	0.000					1.000	1.000	
Statistical Territory	Calgary	426,835	27.0%	0.461	0.066	6.989	0.000	***	1.586	1.250	Combine
Statistical Territory	Edmonton	550,115	34.9%	0.435	0.062	6.981	0.000	***	1.546	1.250	Calgary/Edmonton
Statistical Territory	Northern District	102,169	6.5%	-0.440	0.126	-3.490	0.000	***	0.644	1.000	
Other Potential Rating Variables											
Limit Amount	200,000 (Base)	1,992	0.1%	0.000					1.000	1.000	
Limit Amount	300,000	3,819	0.2%	0.752	0.837	0.899	0.369		2.121	1.053	
Limit Amount	500,000	2,537	0.2%	0.821	0.878	0.935	0.350		2.272	1.116	Data is thin -
Limit Amount	1,000,000	609,394	38.6%	1.033	0.712	1.450	0.147		2.809	1.175	Consider Offset
Limit Amount	2,000,000	172,738	10.9%	1.071	0.714	1.500	0.134		2.920	1.281	Parameter
Limit Amount	2,000,000+	95	0.0%	-17.015	486.993	-0.035	0.972		0.000	N/A	
Limit Amount	Other	33	0.0%	-17.835	837.207	-0.021	0.983		0.000	N/A	
Coverage	TPL	790,608	50.1%	0.000					1.000		
Coverage	Accident Benefits	787,826	49.9%	-0.897	0.713	-1.257	0.209		0.408		
Type A Convictions	0 (Base)	1,557,953	98.7%	0.000					1.000	1.000	
Type A Convictions	1	18,110	1.1%	0.531	0.196	2.701	0.007	***	1.700	1.500	Data is thin &
Type A Convictions	2	2,072	0.1%	1.169	0.470	2.490	0.013	***	3.219	1.750	correlated with grid
Type A Convictions	3	227	0.0%	-2.855	4.629	-0.617	0.537		0.058	2.250	step - Offset
Type A Convictions	4+	73	0.0%	-17.490	491.035	-0.036	0.972		0.000	3.500	Parameter
Type B Convictions	0 (Base)	1,139,838	72.2%	0.000					1.000	1.000	
Type B Convictions	1	288,719	18.3%	0.250	0.065	3.850	0.000	***	1.283	1.250	Data is thin &
Type B Convictions	2	80,002	5.1%	0.404	0.108	3.739	0.000	***	1.497	1.500	correlated with grid
Type B Convictions	3	34,137	2.2%	0.589	0.154	3.824	0.000	***	1.803	1.750	step - Offset
Type B Convictions	4+	35,738	2.3%	0.642	0.152	4.223	0.000	***	1.901	2.000	Parameter
Gender	Female (Base)	472,646	29.9%	0.000					1.000		Remove impact of
Gender	Male	1,105,788	70.1%	0.035	0.055	0.624	0.532		1.035		gender imbalance
Accident Semester	201501 (Base)	161,998	10.3%	0.000					1.000		
Accident Semester	201502	158,078	10.0%	0.404	0.103	3.904	0.000	***	1.498		
Accident Semester	201601	146,614	9.3%	0.040	0.111	0.361	0.718		1.041		
Accident Semester	201602	146,136	9.3%	0.269	0.107	2.505	0.012	***	1.308		
Accident Semester	201701	140,904	8.9%	0.014	0.113	0.120	0.904		1.014		Remove impact of
Accident Semester	201702	151,774	9.6%	0.106	0.109	0.975	0.329		1.112		development and
Accident Semester	201801	154,335	9.8%	0.027	0.110	0.250	0.803		1.028		trend
Accident Semester	201802	159,761	10.1%	-0.039	0.110	-0.353	0.724		0.962		
Accident Semester	201901	163,560	10.4%	-0.288	0.114	-2.526	0.012	***	0.750		
Accident Semester	201902	195,275	12.4%	-0.401	0.111	-3.601	0.000	***	0.670		
Intercept				4.592	0.722	6.362	0.000	***	98.689		

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Offset Parameter Selection

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
			(3) / total(3)	App E pg 6	(5) / (5) BL		(7) / total(7)	App E pg 4	(9) / (9) BL	OW Conviction Study		AIRB	See Report	
		Grid Risks Only				All Risks				Conviction Study Differential				
Variable	Level	Earned Exposure	Exposure Distribution	Initial Model Differential	Re-Level	Earned Exposure	Exposure Distribution	Initial Model Differential	Re-Level	Third Party Liability	Accident Benefits	Current Differential	Selected Offset Parameter	Comments
Limit Amount	200,000	1,992	0.3%	1.000	0.356	12,943	0.1%	1.000	0.842			0.851	0.851	
Limit Amount	300,000	3,819	0.5%	2.121	0.755	87,165	0.7%	0.871	0.733			0.896	0.896	All Risk model: higher credibility and somewhat consistent with current differentials.
Limit Amount	500,000	2,537	0.3%	2.272	0.809	40,620	0.3%	1.150	0.968			0.950	0.950	
Limit Amount	1,000,000 (Base)	609,394	77.1%	2.809	1.000	9,545,266	71.4%	1.188	1.000			1.000	1.000	
Limit Amount	2,000,000	172,738	21.8%	2.920	1.039	3,651,415	27.3%	1.192	1.003			1.090	1.090	
Limit Amount	2,000,000+	95	0.0%	0.000	0.000	23,759	0.2%	0.779	0.656			N/A	1.100	
Limit Amount	Other	33	0.0%	0.000	0.000	280	0.0%	1.212	1.020			N/A	0.925	
Type A Convictions	0 (Base)	1,557,953	98.7%	1.000	1.000	26,667,045	99.8%	1.000	1.000	1.000	1.000	1.000	1.000	Current differentials appear to undercharge for convictions
Type A Convictions	1	18,110	1.1%	1.700	1.700	53,921	0.2%	3.386	3.386			1.250	1.500	
Type A Convictions	2	2,072	0.1%	3.219	3.219	2,768	0.0%	3.386	3.386	3.267	1.687	1.500	1.750	
Type A Convictions	3	227	0.0%	0.058	0.058	334	0.0%	1.556	1.556			2.000	2.250	
Type A Convictions	4+	73	0.0%	0.000	0.000	141	0.0%	0.075	0.075			>=3.00	3.500	
Type B Convictions	0 (Base)	1,139,838	72.2%	1.000	1.000	23,846,579	89.2%	1.000	1.000	1.000	1.000	1.000	1.000	Current differentials appear to undercharge for convictions
Type B Convictions	1	288,719	18.3%	1.283	1.283	2,035,684	7.6%	1.640	1.640	1.364	1.495	1.000	1.250	
Type B Convictions	2	80,002	5.1%	1.497	1.497	564,909	2.1%	1.640	1.640	1.779	1.535	1.250	1.500	
Type B Convictions	3	34,137	2.2%	1.803	1.803	182,218	0.7%	1.930	1.930	2.079	2.064	1.350	1.750	
Type B Convictions	4+	35,738	2.3%	1.901	1.901	94,819	0.4%	2.785	2.785	2.731	1.932	>=2.00	2.000	

Province of Alberta

ıobile Insurance Board - Private Passengers Vehicles (Excluc

At-Fault Surcharge Offset
Accident Year 2019

(1)	(2)	(3)	(4)
	Selected	((2) - 1) / (1.3 - 1)	LN((2))
Grid Step	Selected Average At-Fault Offset	Implied Percent of Drivers with 2 At-Fault Accidents in last 3 Years	Adjustment to Grid Step Estimate
-15	1.000	0.0%	0.000
-14	1.000	0.0%	0.000
-13	1.000	0.0%	0.000
-12	1.000	0.0%	0.000
-11	1.000	0.0%	0.000
-10	1.000	0.0%	0.000
-9	1.000	0.0%	0.000
-8	1.000	0.0%	0.000
-7	1.000	0.0%	0.000
-6	1.000	0.0%	0.000
-5	1.005	1.7%	0.005
-4	1.010	3.3%	0.010
-3	1.015	5.0%	0.015
-2	1.020	6.7%	0.020
-1	1.025	8.4%	0.025
0	1.030	10.1%	0.030
1	1.036	11.8%	0.035
2	1.041	13.6%	0.040
3	1.051	17.0%	0.050
4	1.072	24.0%	0.070
5	1.094	31.2%	0.089
6	1.137	45.8%	0.129
7	1.164	54.6%	0.152
8	1.190	63.3%	0.174
9	1.190	63.3%	0.174
10	1.195	65.0%	0.178
11	1.195	65.0%	0.178
12	1.200	66.7%	0.182
13	1.200	66.7%	0.182
14	1.200	66.7%	0.182
15	1.200	66.7%	0.182

	Exposure Weighted
6 to 15+	0.164
11 to 15+	0.181

APPENDIX F. BOARD APPROVED MODEL SUPPORTING EXHIBITS

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Change in Grid Step Differentials - Calculation of Off-Balance Factor (Board Approved)

(1)	(2)	(3)	(4)	(5)	(6)
			(3) / (3) Total	App F pg 2	App F pg 2
		Currently Capped by the Grid			
Variable	Level	Earned Vehicles	Exposure Distribution	Current Differential	Selected Differential
Operator Grid Level	-15	273,763	17.3%	0.500	0.40
Operator Grid Level	-14	37,168	2.4%	0.500	0.43
Operator Grid Level	-13	46,556	2.9%	0.500	0.46
Operator Grid Level	-12	59,585	3.8%	0.500	0.49
Operator Grid Level	-11	74,113	4.7%	0.500	0.52
Operator Grid Level	-10	91,730	5.8%	0.500	0.55
Operator Grid Level	-9	51,670	3.3%	0.550	0.59
Operator Grid Level	-8	49,035	3.1%	0.600	0.63
Operator Grid Level	-7	47,649	3.0%	0.650	0.67
Operator Grid Level	-6	47,751	3.0%	0.700	0.71
Operator Grid Level	-5	57,887	3.7%	0.750	0.75
Operator Grid Level	-4	82,403	5.2%	0.800	0.80
Operator Grid Level	-3	111,506	7.1%	0.850	0.85
Operator Grid Level	-2	263,212	16.7%	0.900	0.90
Operator Grid Level	-1	90,482	5.7%	0.950	0.95
Operator Grid Level	0 (Base)	128,113	8.1%	1.000	1.00
Operator Grid Level	1	12,925	0.8%	1.100	1.05
Operator Grid Level	2	14,493	0.9%	1.200	1.11
Operator Grid Level	3	17,559	1.1%	1.300	1.17
Operator Grid Level	4	7,449	0.5%	1.400	1.23
Operator Grid Level	5	6,171	0.4%	1.500	1.29
Operator Grid Level	6	1,422	0.1%	1.650	1.36
Operator Grid Level	7	1,135	0.1%	1.800	1.42
Operator Grid Level	8	1,156	0.1%	1.950	1.49
Operator Grid Level	9	844	0.1%	2.100	1.57
Operator Grid Level	10	795	0.1%	2.250	1.64
Operator Grid Level	11	607	0.0%	2.480	1.72
Operator Grid Level	12	544	0.0%	2.700	1.80
Operator Grid Level	13	443	0.0%	2.930	1.89
Operator Grid Level	14	268	0.0%	3.150	1.99
Operator Grid Level	15	0	0.0%	3.380	2.08
			Average Factor	0.734	0.713
Statistical Territory	Rest of Alberta (Base)	10,593,763	52.5%	1.000	1.000
Statistical Territory	Calgary & Edmonton	7,898,540	39.2%	1.250	1.400
Statistical Territory	Northern District	1,668,890	8.3%	1.000	0.950
			Average Factor	1.098	1.153
Limit Amount	200,000	1,992	0.3%	0.851	0.851
Limit Amount	300,000	3,819	0.5%	0.896	0.896
Limit Amount	500,000	2,537	0.3%	0.950	0.950
Limit Amount	1,000,000 (Base)	609,394	77.1%	1.000	1.000
Limit Amount	2,000,000	172,738	21.8%	1.090	1.090
Limit Amount	2,000,000+	95	0.0%	*1.100*	1.100
Limit Amount	Other	33	0.0%	*0.925*	0.925
			Average Factor	1.019	1.019
Type A Convictions	0 (Base)	1,557,953	98.7%	1.000	1.000
Type A Convictions	1	18,110	1.1%	1.250	1.250
Type A Convictions	2	2,072	0.1%	1.500	1.500
Type A Convictions	3	227	0.0%	2.000	2.000
Type A Convictions	4+	73	0.0%	*3.500*	3.500
			Average Factor	1.004	1.004
Type B Convictions	0 (Base)	1,139,838	72.2%	1.000	1.000
Type B Convictions	1	288,719	18.3%	1.000	1.000
Type B Convictions	2	80,002	5.1%	1.250	1.250
Type B Convictions	3	34,137	2.2%	1.350	1.350
Type B Convictions	4+	35,738	2.3%	*2.000*	2.000
			Average Factor	1.043	1.043
			A. Extension of Exposure Average Factor	1.018	1.054
					A. Selected / A.
			B.1 Average Rate Differential Change	4%	Current - 1
			B.2 Off-Balance Factor	0.966	1 / B.1
			C.1 Current Base Rate	2,658	Current Rates
			C.2 Indicated Rate Change	-31.9%	App C pg 1
			C.3 Indicated Rate Change including Off-Balance Factor	-34.2%	(1 + C.2) * B.2 - 1
			C.4 Indicated Base Rate	1,748	C.1 * (1 + C.3)

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Selected Grid Step Differentials (Board Approved)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
		App F pg 3	LN((3))	Selected	Per Regression	EXP((6))	(7) / (7) at BL		Selected	Group -15 to -10 per exposure dist	App E pg 4	per (16)	per (18)
		All Risks										Re-Leveled (Base Level = 0)	
Variable	Level	Modelled Differential	LN[Modelled Differential]	Include in Fit (1=TRUE, 0=FALSE)	Fitted Value	Implied Differential	Smoothed Differential	Smoothed Differentials - Removal Of Flattening Bias	Selected Differential	Current Grouping	Current Differential	Selected Differential	Current Differential
Operator Grid Level	-15 (Base)	1.000	0.000	0	0.287	1.333	1.000	1.000	1.00	1.000	1.000	0.401	0.500
Operator Grid Level	-14	1.410 ***	0.344	1	0.333	1.394	1.046	1.081	1.08	1.000	1.000	0.434	0.500
Operator Grid Level	-13	1.418 ***	0.349	1	0.378	1.459	1.095	1.146	1.15	1.000	1.000	0.460	0.500
Operator Grid Level	-12	1.550 ***	0.438	1	0.423	1.527	1.146	1.218	1.22	1.000	1.000	0.489	0.500
Operator Grid Level	-11	1.558 ***	0.444	1	0.468	1.598	1.199	1.296	1.30	1.000	1.000	0.520	0.500
Operator Grid Level	-10	1.645 ***	0.498	1	0.514	1.672	1.254	1.380	1.38	1.000	1.000	0.554	0.500
Operator Grid Level	-9	1.556 ***	0.442	1	0.559	1.749	1.312	1.470	1.47	1.407	1.100	0.590	0.550
Operator Grid Level	-8	1.813 ***	0.595	1	0.604	1.830	1.373	1.565	1.56	1.498	1.200	0.628	0.600
Operator Grid Level	-7	1.943 ***	0.664	1	0.650	1.915	1.437	1.665	1.67	1.594	1.300	0.668	0.650
Operator Grid Level	-6	1.871 ***	0.626	1	0.695	2.004	1.503	1.771	1.77	1.695	1.400	0.711	0.700
Operator Grid Level	-5	1.982 ***	0.684	1	0.740	2.097	1.573	1.880	1.88	1.800	1.500	0.755	0.750
Operator Grid Level	-4	2.120 ***	0.751	1	0.786	2.194	1.646	1.994	1.99	1.909	1.600	0.800	0.800
Operator Grid Level	-3	2.033 ***	0.709	1	0.831	2.295	1.722	2.112	2.11	2.022	1.700	0.848	0.850
Operator Grid Level	-2	2.678 ***	0.985	1	0.876	2.402	1.802	2.234	2.23	2.138	1.800	0.897	0.900
Operator Grid Level	-1	2.536 ***	0.931	1	0.922	2.513	1.886	2.361	2.36	2.259	1.900	0.948	0.950
Operator Grid Level	0	4.821 ***	1.573	1	0.967	2.630	1.973	2.491	2.49	2.384	2.000	1.000	1.000
Operator Grid Level	1	2.838 ***	1.043	1	1.012	2.752	2.065	2.626	2.63	2.514	2.200	1.054	1.100
Operator Grid Level	2	2.562 ***	0.941	1	1.057	2.879	2.160	2.766	2.77	2.647	2.400	1.110	1.200
Operator Grid Level	3	3.031 ***	1.109	1	1.103	3.013	2.260	2.911	2.91	2.786	2.600	1.168	1.300
Operator Grid Level	4	3.042 ***	1.112	1	1.148	3.152	2.365	3.061	3.06	2.929	2.800	1.229	1.400
Operator Grid Level	5	3.531 ***	1.261	1	1.193	3.298	2.475	3.216	3.22	3.078	3.000	1.291	1.500
Operator Grid Level	6	3.358 ***	1.211	1	1.239	3.451	2.590	3.378	3.38	3.233	3.300	1.356	1.650
Operator Grid Level	7	2.773 ***	1.020	0	1.284	3.611	2.710	3.545	3.55	3.393	3.600	1.423	1.800
Operator Grid Level	8	3.812 ***	1.338	1	1.329	3.779	2.835	3.720	3.72	3.560	3.900	1.493	1.950
Operator Grid Level	9	3.777 ***	1.329	1	1.375	3.954	2.967	3.901	3.90	3.734	4.200	1.566	2.100
Operator Grid Level	10	4.778 ***	1.564	0	1.420	4.137	3.104	4.090	4.09	3.914	4.500	1.642	2.250
Operator Grid Level	11	3.621 ***	1.287	1	1.465	4.329	3.248	4.287	4.29	4.103	4.960	1.721	2.480
Operator Grid Level	12	3.621	1.287	0	1.511	4.529	3.399	4.492	4.49	4.299	5.400	1.803	2.700
Operator Grid Level	13	3.621	1.287	0	1.556	4.739	3.556	4.706	4.71	4.504	5.860	1.889	2.930
Operator Grid Level	14	3.621	1.287	0	1.601	4.959	3.721	4.959	4.96	4.746	6.300	1.990	3.150
Operator Grid Level	15	3.621	1.287	0	1.647	5.189	3.893	5.189	5.19	4.966	6.760	2.083	3.380

Regression on (4) and (5)	
Intercept	0.967
Slope	0.045

Notes
*** = Significant

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

GLM Model Results
All Risks - Final Model (Board Approved)

(1)	(2)	(3)	(4) (3) / (3) Total	(5)	(6)	(7)	(8)	(9)	(10) EXP((5))	(11)	(12)
				GLM Results							
Variable	Level	Earned Vehicles	Exposure Distribution	estimate	std.error	statistic	p.value	Significant (***)	Modelled Differential	Grouped Model Differential	Current Differential
Explanatory Variables											
Operator Grid Step	-15 (Base)	16,156,015	60.5%	0.000					1.000		1.000
Operator Grid Step	-14	723,874	2.7%	0.344	0.056	6.193	0.000	***	1.410		1.000
Operator Grid Step	-13	743,839	2.8%	0.349	0.055	6.384	0.000	***	1.418	1.000	1.000
Operator Grid Step	-12	772,938	2.9%	0.438	0.053	8.267	0.000	***	1.550		1.000
Operator Grid Step	-11	811,761	3.0%	0.444	0.052	8.573	0.000	***	1.558		1.000
Operator Grid Step	-10	852,158	3.2%	0.498	0.050	9.926	0.000	***	1.645		1.000
Operator Grid Step	-9	608,026	2.3%	0.442	0.059	7.454	0.000	***	1.556	1.413	1.100
Operator Grid Step	-8	618,955	2.3%	0.595	0.058	10.342	0.000	***	1.813	1.646	1.200
Operator Grid Step	-7	619,269	2.3%	0.664	0.057	11.656	0.000	***	1.943	1.764	1.300
Operator Grid Step	-6	620,963	2.3%	0.626	0.057	10.945	0.000	***	1.871	1.699	1.400
Operator Grid Step	-5	618,232	2.3%	0.684	0.057	12.127	0.000	***	1.982	1.799	1.500
Operator Grid Step	-4	608,986	2.3%	0.751	0.057	13.452	0.000	***	2.120	1.924	1.600
Operator Grid Step	-3	620,402	2.3%	0.709	0.056	12.852	0.000	***	2.033	1.846	1.700
Operator Grid Step	-2	966,663	3.6%	0.985	0.045	22.563	0.000	***	2.678	2.431	1.800
Operator Grid Step	-1	435,325	1.6%	0.931	0.065	14.787	0.000	***	2.536	2.302	1.900
Operator Grid Step	0	459,368	1.7%	1.573	0.058	27.794	0.000	***	4.821	4.377	2.000
Operator Grid Step	1	111,468	0.4%	1.043	0.123	8.769	0.000	***	2.838	2.577	2.200
Operator Grid Step	2	101,555	0.4%	0.941	0.130	7.525	0.000	***	2.562	2.326	2.400
Operator Grid Step	3	98,343	0.4%	1.109	0.129	9.010	0.000	***	3.031	2.752	2.600
Operator Grid Step	4	54,476	0.2%	1.112	0.172	6.861	0.000	***	3.042	2.762	2.800
Operator Grid Step	5	43,240	0.2%	1.261	0.188	7.168	0.000	***	3.531	3.205	3.000
Operator Grid Step	6	21,152	0.1%	1.211	0.270	4.964	0.000	***	3.358	3.049	3.300
Operator Grid Step	7	17,839	0.1%	1.020	0.301	3.890	0.000	***	2.773	2.518	3.600
Operator Grid Step	8	14,705	0.1%	1.338	0.314	4.809	0.000	***	3.812	3.461	3.900
Operator Grid Step	9	9,239	0.0%	1.329	0.396	3.792	0.000	***	3.777	3.429	4.200
Operator Grid Step	10	6,520	0.0%	1.564	0.455	3.829	0.000	***	4.778	4.338	4.500
Operator Grid Step	11 to 15+	8,899	0.0%	1.287	0.402	3.651	0.000	***	3.621	3.288	5.495
Other Potential Rating Variables											
Coverage	TPL	13,361,448	50.0%	0.000					1.000		
Coverage	Accident Benefits	13,362,761	50.0%	1.507	0.018	81.587	0.000	***	4.511		
Gender	Female (Base)	12,237,760	45.8%	0.000					1.000		
Gender	Male	14,486,448	54.2%	-0.111	0.018	-6.111	0.000	***	0.895		
Accident Semester	201501 (Base)	2,567,806	9.6%	0.000					1.000		
Accident Semester	201502	2,657,132	9.9%	0.185	0.041	4.579	0.000	***	1.204		
Accident Semester	201601	2,605,931	9.8%	0.037	0.041	0.897	0.370		1.038		
Accident Semester	201602	2,667,739	10.0%	0.233	0.040	5.770	0.000	***	1.262		
Accident Semester	201701	2,607,406	9.8%	0.122	0.041	2.983	0.003	***	1.130		
Accident Semester	201702	2,701,116	10.1%	0.186	0.040	4.597	0.000	***	1.204		
Accident Semester	201801	2,660,371	10.0%	0.099	0.041	2.423	0.015	***	1.104		
Accident Semester	201802	2,759,700	10.3%	0.017	0.041	0.423	0.672		1.017		
Accident Semester	201901	2,707,143	10.1%	-0.084	0.041	-2.040	0.041	***	0.919		
Accident Semester	201902	2,789,865	10.4%	-0.126	0.041	-3.085	0.002	***	0.881		
Intercept				3.375	0.034	99.648	0.000	***	29.237		
Offset Parameters											
Limit Amount	200,000								0.851		0.851
Limit Amount	300,000								0.896		0.896
Limit Amount	500,000								0.950		0.950
Limit Amount	1,000,000 (Base)								1.000		1.000
Limit Amount	2,000,000								1.090		1.090
Limit Amount	2,000,000+								1.100		1.100
Limit Amount	Other								0.925		0.925
Type A Convictions	0 (Base)								1.000		1.000
Type A Convictions	1								1.250		1.250
Type A Convictions	2								1.500		1.500
Type A Convictions	3								2.000		2.000
Type A Convictions	4+								3.000		3.000
Type B Convictions	0 (Base)								1.000		1.000
Type B Convictions	1								1.000		1.000
Type B Convictions	2								1.250		1.250
Type B Convictions	3								1.350		1.350
Type B Convictions	4+								2.000		2.000

Province of Alberta

Alberta Automobile Insurance Board - Private Passengers Vehicles (Excluding Farmers)

Offset Parameters (Board Approved)

(1)	(2)	(3)	(4)	(5)
		AIRB	App E	See Report
Variable	Level	Current Differential	Oliver Wyman Indicated Differential	Board Selected Offset Parameter
Limit Amount	200,000	0.851	0.851	0.851
Limit Amount	300,000	0.896	0.896	0.896
Limit Amount	500,000	0.950	0.950	0.950
Limit Amount	1,000,000 (Base)	1.000	1.000	1.000
Limit Amount	2,000,000	1.090	1.090	1.090
Limit Amount	2,000,000+	N/A	1.100	1.100
Limit Amount	Other	N/A	0.925	0.925
Type A Convictions	0 (Base)	1.000	1.000	1.000
Type A Convictions	1	1.250	1.500	1.250
Type A Convictions	2	1.500	1.750	1.500
Type A Convictions	3	2.000	2.250	2.000
Type A Convictions	4+	>=3.00	3.500	3.000
Type B Convictions	0 (Base)	1.000	1.000	1.000
Type B Convictions	1	1.000	1.250	1.000
Type B Convictions	2	1.250	1.500	1.250
Type B Convictions	3	1.350	1.750	1.350
Type B Convictions	4+	>=2.00	2.000	2.000
Statistical Territory	Rest of Alberta (Base)	1.000	1.000	1.000
Statistical Territory	Calgary & Edmonton	1.250	1.700	1.400
Statistical Territory	Northern District	1.000	0.800	0.950

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