



In the Matter of
Manitoba Public Insurance
2022 General Rate Application

Pre-Filed Testimony of
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Submitted to Manitoba Public Utilities Board on behalf of Duffy's Taxi Ltd. And Unicity Taxi Ltd. (the "Taxi Coalition")

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1. Introduction

This testimony has been prepared for Unicity Taxi Ltd. and Duffy's Taxi Ltd. (the "Taxi Coalition") by or under the direction of Antoine F. Hacault, Partner at Thompson Dorfman Sweatman LLP and Jeff Crozier of InterGroup Consultants Ltd. This report reviews the Manitoba Public Insurance ("MPI") 2022 General Rate Application ("GRA") submitted to the Manitoba Public Utilities Board ("PUB").

In preparing this testimony, Dion Strategic Consulting Group Inc. ("Dion Strategic") asked Mandy M. Y. Seto, FCAS, FCIA, and Consulting Actuary for Palm Insurance Canada Inc. to perform a Peer Review of this report. This report contains facts and actuarial opinion. It is important for the PUB to consider more than one viewpoint to formulate a decision.

The following are noted:

- Sylvain Dion and Jason Wong are independent consultants and CVs are provided in **Appendix 5.3**
- Dion Strategic was retained by the Taxi Coalition for the 2022 GRA and asked to focus on Serious Losses, Credibility Weighting, the Minimum Bias Procedure, and Territories.
- This is Dion Strategic's first undertaking with the Taxi Coalition.
- This is Dion Strategic's second involvement with the GRA proceedings. The Coalition of Manitoba Motorcycle Groups (CMMG) retained Dion Strategic for the 2021 and 2022 GRAs.
- Dion Strategic acknowledges that our role is to provide evidence to the PUB that is fair, objective, and non-partisan.
- Dion Strategic is treating this directive as being Strategic Advisors to PUB in possible improvements to MPI ratemaking methodologies.
- Mandy Seto is an independent consultant and CV is provided in **Appendix 5.4**

1.1 Sources of Information

Information within this evidence has been sourced from current and past GRAs of MPI, the April 20th 2021 Vehicle-for-hire (VFH) Technical Conference, and various commonly accepted Actuarial Texts. Commentary includes Dion Strategic's observations and experience in the Canadian Personal and Commercial Lines markets, with a focus in Ontario.

2. Passenger VFH Pricing

2.1 Serious Loss Loading

Serious Losses are large losses that are volatile in nature. These occurrences are random, infrequent, and high severity. Depending on the class of business, one large loss could significantly impact the results of a particular class.

While some classes of business are more prone to serious losses (Public Class) than others (Private Passenger), all risks are subject to the possibility of a serious loss. The absence of serious losses is not a good indicator of a class being free of that risk.

The following are excerpts from the *VFH Technical Conference (April 20, 2021)*:

- *“MPI’s position is that an adjustment should not be made for rating combinations which do not have any Serious Losses”*
- *“In the 2021 GRA almost 50% of insurance uses (excluding trailers and ORVs) did not have any claims costs from Serious Losses.”*
- *“Selecting an appropriate measure that would be applicable to all of these insurance uses would be difficult and involves a lot of judgment.”*

Implied in these responses is: 1) MPI’s assumption of not having a Serious Loss loading for all uses and 2) No Serious Loss loading in particular for Passenger VFH.

Taxi VFH results show the volatility of Serious Losses. Five (5) of the last ten (10) years of Taxi VFH experience show no serious losses.

From *TC1_018_c_Appendix_02_VFH_Taxi_Major_Class_Loss_Experience_Aug20*:

Line No.	Classification	Incident Insurance Year	Non-Serious Loss		Serious Loss			Collision	Comprehensive	PD	Total Incurred	Earned Unit	Earned Premium	Average Premium	Loss Ratio
			ABO	IRI	ABO	IRI	BI								
45	Taxicab Vehicle-for-Hire	2011	398,265.74	92,485.48	0.00	0.00	0.00	2,584,757.60	70,276.70	256,206.81	3,401,992.33	719.50	3,983,263.33	5,536.15	85.41%
46	Taxicab Vehicle-for-Hire	2012	366,568.45	215,872.73	439,365.50	363,587.49	0.00	3,066,002.56	79,966.97	274,410.72	4,805,774.42	722.41	3,919,163.73	5,425.12	122.62%
47	Taxicab Vehicle-for-Hire	2013	233,179.94	218,063.61	0.00	0.00	815.06	3,346,262.40	130,795.11	288,269.31	4,217,385.43	723.75	4,136,113.09	5,714.82	101.96%
48	Taxicab Vehicle-for-Hire	2014	396,058.37	136,529.79	708,158.17	191,124.09	2,480.00	2,712,308.80	197,228.82	196,080.86	4,539,966.90	735.78	4,615,704.98	6,273.19	98.36%
49	Taxicab Vehicle-for-Hire	2015	190,668.78	75,967.32	0.00	0.00	0.00	2,511,665.31	122,178.03	241,347.33	3,141,816.77	732.18	5,087,909.04	6,948.96	61.75%
50	Taxicab Vehicle-for-Hire	2016	368,267.44	209,831.51	18,748.31	278,029.18	0.00	2,733,425.57	80,292.67	259,319.11	3,947,913.79	728.14	5,544,258.45	7,614.27	71.21%
51	Taxicab Vehicle-for-Hire	2017	303,813.45	191,863.77	244,929.73	223,240.53	0.00	2,667,244.36	118,265.88	202,627.49	3,951,985.21	719.25	5,958,954.60	8,285.01	66.32%
52	Taxicab Vehicle-for-Hire	2018	265,650.01	89,124.18	219,146.31	299,692.40	0.00	2,588,419.27	192,825.90	237,388.98	3,892,247.05	637.52	4,621,007.72	7,248.44	84.23%
53	Taxicab Vehicle-for-Hire	2019	347,614.30	181,517.73	0.00	0.00	0.00	2,676,782.90	205,013.44	211,265.79	3,622,194.16	624.51	4,600,555.72	7,366.67	78.73%
54	Taxicab Vehicle-for-Hire	2020	298,357.09	56,108.98	0.00	0.00	0.00	1,513,468.18	238,505.22	92,361.94	2,198,801.41	635.10	4,934,226.05	7,769.25	44.56%
55		Total	3,168,443.57	1,467,355.10	1,630,348.02	1,355,673.69	3,295.06	26,400,336.95	1,435,346.74	2,259,278.34	37,720,077.47	6,978.14	47,401,156.71	6,792.81	79.58%

Years with Serious Losses, such as 2012 and 2014 for Taxi VFH, negatively impact loss ratios in a significant manner. It is not a matter of if a Serious Loss will happen, but when it will happen. A Passenger VFH will have a Serious Loss eventually which will exacerbate its underpricing.

MPI acknowledges this volatility in its methodology.

From **Part VI – Ratemaking RM 4.3.7:**

- *For Serious Losses, MPI used data for the 10 most recent years for Accident Benefits – Other (Indexed) and IRI to better smooth out the larger volatility in the data.*

Given that Passenger VFH has only 3 years of data (one of which is a pandemic year), the assumption cannot be made that its history (of no Serious Losses) is indicative of the future. One cannot both assume that Passenger VFH historical experience is representative of its serious loss risk and claim their credibility is low at the same time.

2.2 Serious Loss Loading – Recommendation

Passenger VFH should have a Serious Loss Loading applied to its historical experience when calculating the relativities. In our opinion, Passenger VFH and Public Vehicles are most similar in its driving risk. Without limiting the items of comparison, both carry (unknown) passengers for compensation with varying routes at different times during the day. Private Passenger drivers usually carry friends and family, mostly driving known routes at consistent times of the day. Contrary to MPI’s comments, in our opinion selecting a Serious Loss measure applicable to Passenger VFH is not difficult and two options are presented below.

Option 1 – Per TC (MPI) 2-9 part a), MPI confirms that the average Serious Loss per Taxi VFH unit is \$428 over the last 10 years. Given that Passenger VFH are most similar to Taxi VFH (both carry passengers for a fee) – while Taxis may transport more passengers daily, it may be offset by Passenger VFH drivers being less familiar with the routes – a Serious Loss loading of \$428 per Passenger VFH unit could be appropriate.

Option 2 – Per TC (MPI) 2-9 part c), MPI calculates that the average Serious Loss per VFH unit is \$258 over the last 10 years. Given that Passenger VFH are similar to other VFH in its use, a Serious Loss loading of \$258 per Passenger VFH unit is fair, appropriate, and the minimum that should be considered.

At the time of writing, MPI has not provided the impact on Passenger VFH by applying the loadings suggested in Options 1 and 2 [TC (MPI) 2-9 part b) and TC (MPI) 2-9 part d)].

Dion Strategic disagrees with MPI in TC (MPI) 2-9 part d). Applying a Serious Loss Loading to Passenger VFH does not mean subsidizing Taxicab VFH. As further discussed in 2.3, it is other Classes that are currently subsidizing Passenger VFH – when observing Loss Ratios, Passenger VFH have higher loss ratios than other VFH/Classes. One Serious Loss will significantly impact Passenger VFH in the future – by applying an appropriate loading now, this will provide a more accurate picture of the rate adjustment required so that Passenger VFH pay just and reasonable rates.



2.3 Passenger VFH Rate Increases and Capping

The following are excerpts from **PUB Order 1/21** regarding VFH:

- *Based upon a jurisdictional scan, MPI determined that the average VFH rate in other jurisdictions was approximately 8% to 25% higher than the All Purpose rate. The Corporation **judgmentally set that difference** at 20% above the current Passenger vehicle all-purpose rates for corresponding vehicle type and rate group.*
- *In the 2019 GRA, **the Corporation acknowledged a significant difference in rates between the Passenger VFH and Taxicab VFH classifications.** It advised that as experience data became available, it would ensure that the rates assigned to each VFH category would be reflective of the risk and actuarially supported.*
- *The Corporation acknowledged that, based on actual claims experience as of February 29, 2020, the rates for Passenger Vehicle VFH do not fully reflect the loss costs and that the Loss Ratio is a clear indication that the Corporation is not collecting enough premium for the Public Vehicle VFH Major Class. **A Loss Ratio in the range of 70-80% would be necessary to break even,** net of all costs.*
- *The Corporation further acknowledged that, based on the actual claims experience as of February 29, 2020, **Passenger Vehicle VFH did not have an appropriate starting rate.***
- *Accordingly, in determining the VFH rates, **the Corporation assigned a minimum credibility weighting of 10% to the current experience** and 90% to the current rate. This is similar to the ratemaking methodology applied to other insurance uses.*
- *In Order 146/20, the Board's Summary Order on rates, the Board ordered a rate increase of 20% from current rates for the Passenger Vehicle For Hire (VFH) category, along with consecutive rate increases of 20% for the Passenger VFH Major class in the 2022/2023 and 2023/2024 GRAs, subject to the Board's ability to vary such increases based upon the experience filed within those GRAs and as the Passenger VFH rates approach actuarially indicated break-even rates.*
- *The Board accepts the Taxi Coalition's position, supported to some extent by the CAC, that the undercharging of rates for the Passenger VFH class is sending the wrong message to persons who may wish to enter the business of providing Passenger VFH services. The probability is that they will make the necessary investment to enter the business at the current low rates only to see considerable increases in future years.*
- *The Board is satisfied that **MPI's starting point for setting Passenger VFH rates was not correct.***
- *Although the Board has determined that a significant increase in Passenger VFH rates is warranted, it is not persuaded that it should exceed the overall rate increase cap of plus or minus 20% established in Board Order 148/04.*

Part VI – Ratemaking RM 5.3 confirms MPI's approach:

- *In response to PUB Order 148/04, all 2022/23 rates are subject to a $\pm 20\%$ cap from 2021/22 rates. Special adjustments are applied after applying the $\pm 20\%$ cap.*

PUB Order 148/04, which set the $\pm 20\%$ cap, did allow for an exception:

- *The rate increase applicable to dealer plates be limited to the greater of 50% of the range of the actuarially indicated rate changes, or 20%, any shortfall to be recovered from all Major Classes.*

To summarize above, Dion Strategic’s observations are as follows:

- **Observation 1** – Initial Passenger VFH rates were judgmentally selected. MPI and the Board acknowledge that the starting point for setting rates was too low.
- **Observation 2** – Generally, a minimum credibility of 10% is applied to the current experience and 90% to the current rate.
- **Observation 3** – A loss ratio of 70 to 80% is needed to break even.
- **Observation 4** – The following Loss Ratios are compiled from *TC1_018_c_Appendix_02_VFH_Taxi_Major_Class_Loss_Experience_Aug20*. *Note that Passenger VFH data begins from 2018.

	<u>2011 - 2019</u>	<u>2015 – 2019</u>	<u>2020</u>
Passenger VFH		128.9%*	67.4%
Taxi VFH	83.6%	71.9%	44.6%
Public Major Class	78.0%	75.9%	50.3%
Private Passenger	69.5%	67.7%	40.4%

- **Observation 5** – PUB Order 148/04 established a $\pm 20\%$ cap on vehicle premiums but allowed for an exception for severely deficient rates.

Based on the observations, Dion Strategic’s views are as follows:

- **Opinion 1** – The 20% cap on yearly rate increases is reasonable under normal circumstances. It is not ideal to have rates fluctuating greatly from year to year based on an additional year of experience and assumption changes.
- **Opinion 2** – Passenger VFH rates have special circumstances that justify an exception to the cap. Both MPI and the Board acknowledge that the initial rate was set too low. The loss ratios were well above 100% pre-pandemic and broke even in 2020. By spreading out the rate increase over 3 years, it is only extending the timeframe for Passenger VFH rates to be increased so that they are just, reasonable, and actuarially sound.
- **Opinion 3** – Other Classes like Taxi VFH are currently subsidizing the Passenger VFH market. In a perfect system, all vehicle types would have a similar loss ratio of 70 to 80% which would be break-even. Given that 5-year pre-pandemic loss ratios are 128.9%, 71.9%, and 75.9% for Passenger VFH, Taxi VFH, and Public Major Class respectively, other Classes are currently subsidizing the Passenger VFH.



- **Opinion 4** – The Passenger VFH market is growing rapidly. The Board understands the low current rates and probability of considerable increases. By capping at 20% and without adjusting the rates further to account for risks of Serious Losses, the PUB will only extend the underpricing of Passenger VFH rates.
- **Opinion 5** – In a competitive private market, insurers would not cap Passenger VFH increases at 20%. Pricing a relatively new line of business is common in insurance – in many cases there is little to no data so the initial rate uses proxies and judgment. One such example is Cyber Insurance. The product was initially priced aggressively for insurers to get into the market and because there were few, if any, claims. This began to shift in 2020 and 2021 as claims started coming in, loss ratios became unprofitable, and losses from extortion and business interruption were severe. Rate increases in excess of 100% are common in 2021, in addition to coverage restrictions.
- **Opinion 6** – The low current rates for Passenger VFH could result in adverse selection and market distortion. Taxi drivers who face high insurance rates with poor loss experience, could make the shift towards driving Passenger VFH.

2.4 Passenger VFH Rate Increase and Capping – Recommendation

The rate increases applicable to Passenger VFH should not be capped at 20%. The rate increases should either be capped at a higher percentage or not capped at all. While the cap prevents rates from excessive fluctuation, when applied to Passenger VFH the drawbacks include:

- Extending the underpricing of the class to more years down the road.
- The low current rates could attract Taxi drivers with poor loss experience resulting in adverse selection and market distortion. This could already be happening with the growth of the Passenger VFH class.
- Taxi VFH and other Classes subsidizing the Passenger VFH.

3. Taxi VFH Pricing

3.1 Credibility

Part VI – Ratemaking RM 4.4 details MPI’s approach to credibility weighting on relativities:

- *MPI determined the new relativities based on a credibility weighted average of the raw relativities and current relativities. In doing so, the methodology mitigates against large fluctuations that can occur in the raw relativities, a result of the individual groupings not being large enough to be statistically reliable. For each raw relativity, a credibility of $N/(N+K)$ was assigned. Here, N is the 5-year earned units used to determine the raw relativity and K is a constant. **The constant, K , is equal to 60,000, and was judgmentally chosen in order that the largest insurance use – All Purpose Passenger Vehicle – was at least 95% credible.** The complement of credibility, $1 - N/(N+K)$, was assigned to the corresponding current relativity.*
- *The credibility assigned to each raw relativity was subjected to a minimum of 10% (i.e. if $N/(N+K) < 10\%$, the raw relativity was assigned a credibility of 10%) and the remaining 90% was assigned to the current relativity. Assigning a minimum credibility ensures that the new relativities for smaller groups partially reflect their historical claims costs.*

In Part VI – Ratemaking RM 4.4, MPI references a text “*The Minimum Bias Procedure – A Practitioner’s Guide*”¹ by Sholom Feldblum and J. Eric Brosius. One section of this text discusses combining the minimum bias procedure with credibility weighting. In particular,

- *“Various credibility parameters are used: the **classical credibility formulas** are most common. Classes with a certain volume of claims or of exposures are given full credibility. **The square root rule** is used for classes with lower volume of claims or exposures.”*

*“The **classical credibility approach**, commonly called limited fluctuation credibility, is the most frequently used method in insurance ratemaking.” Chapter 12: Credibility in “Basic Ratemaking” by Werner and Modlin² provides additional detail (see **Appendix 5.1**).*

The classical approach assumes a Normal distribution with a Poisson claims frequency. A commonly used number of claims needed for full credibility is 1,082. In simpler terms, this means that for a particular class of business, the theory states that a line is fully credible when there are 1,082 or more historical claims. Partial credibility follows the square root rule:

- $Z = \sqrt{N / N_k}$, where Z is the credibility, N is the number of claims, N_k is the number of claims for full credibility

¹ Refer to <https://www.casact.org/pubs/forum/02fforum/02ff591.pdf>

² Refer to https://www.casact.org/sites/default/files/2021-03/5_Werner_Modlin.pdf

Applying this approach to Taxis, using claim counts provided by MPI, gives the following results:

From ***TC1_018_a_b_Appendix_01_VFH_Taxi_Loss_Experience_Aug20***

- Taxi VFH from 2016 to 2020
 - Territory 1 = 3,594 claims for Collision and PD, giving full credibility
 - Territories 2 to 5 = 533 claims for Collision and PD
 - $Z = \sqrt{533 / 1,082} = 70\%$

From ***TC1_018_c_Appendix_02_VFH_Taxi_Major_Class_Loss_Experience_Aug20***

- Taxi VFH from 2011 to 2020
 - 76% of incurred losses come from Collision and PD

In summarizing the overall situation, Dion Strategic's observations are as follows:

- **Observation 1** – MPI's formula $N/(N+K)$ is a form of Bühlmann Credibility and is a valid approach.
- **Observation 2** – The selection of $K = 60,000$ is judgmental. Using MPI's rationale for its selection means K can be any number under 60,000 as well.
 - **Opinion 1** – Selecting a high number for K , gives little credibility to smaller classes of business that would have more credibility under other approaches.
- **Observation 3** – The MPI methodology results in a very low credibility for smaller classes of business. Taxis would be given the minimum credibility of 10% for the current relativity.
 - **Opinion 2** – The minimum credibility is too low and does not allow the rates to be reactive for smaller classes of vehicles like Taxis.
- **Observation 4** – The Classical Credibility Approach gives Taxis 100% Credibility for Collision and Property Damage, which represents 76% of their incurred losses over the last 10 years.
 - **Opinion 3** – In our opinion, Taxi current experience needs to have more than the minimum 10% credibility applied to the current relativity.
- **Observation 5** – As noted in the *VFH Technical Conference (April 20, 2021)*, the “current application of credibility works well for mature insurance uses”. However, given that the current relativity is often the minimum 10% for smaller classes of business, the rating methodology can be slow to react.
 - **Opinion 4** – Rate changes are slow under the current methodology. In the example of Passenger VFH, low credibility means rates will take a long time to catch up (absent Orders such as 146/20). In a reverse example where a class of business improves rapidly, the rate will take a long time to decrease to the correct level.
 - **Appendix 5.2** illustrates how slow the current methodology reacts for classes with low credibility. In the illustration where the raw required relativity is 50% higher than the current relativity, it would take 43 years to fully recognize the true relativity required.

3.2 Credibility – Recommendation

The current approach to credibility weighting on relativities requires fine tuning. Too little credibility is applied to smaller classes like Taxis, that would be much more credible under alternative approaches. This also means rates for smaller classes are extremely slow to react to deteriorating/improving loss experience. Our suggestions to make rates more reactive include:

- **Option 1** – Switch to a Classical Credibility Approach using claim counts as the measure. This is industry standard, simple to calculate, and widely used for automobile insurance. This is our preference.
- **Option 2** – Changing $K = 60,000$ to a lower number.

Choosing K is a difficult and judgmental exercise.

*Werner and Modlin*² provides a formula for K as the expected value of the process variance (EVPV) divided by the variance of the hypothetical means (VHM).

*Dean in An Introduction to Credibility*³ describes the same formula but acknowledges “The selection of P and K is probably more art than science”.

In the *Credibility Practice Note July 2008*⁴, *Whitney [1918]* stated that the credibility factor, Z , needed to be of the form $Z = n / (n+k)$, where n represents “earned premiums” and k is a constant to be determined. The problem was how to determine k . Whitney noted that, “In practice k must be **determined by judgment.**”

- *Mahler and Dean in Chapter 8: Credibility from Foundations of Casualty Actuarial Science*⁵, compares the standard of credibility for claims (1,082) with exposures. “Standards for Full Credibility are calculated in terms of the expected number of claims. It is common to translate these into a number of exposures by dividing by the (approximate) expected claim frequency.”
- Using the statistics provided for the Private Passenger (PP) Major Class in TC1_018_c_Appendix_02_VFH_Taxi_Major_Class_Loss_Experience_Aug20, the average frequency for Collision coverage per unit of PP is about 12.5%. Using the formula from Mahler and Dean, this implies $K = 1,082 / 12.5\% = 8,656$.
- **Option 3** – Changing the minimum credibility of 10% to a higher number. 10% appears to be a judgmental selection. As illustrated in **Appendix 5.2**, it could take 43 years for a relativity to catch up to an indicated relativity that is 50% higher. Raising the minimum credibility to 20%, 30%, or 40% are all valid options.

³ *An Introduction to Credibility by Curtis Gary Dean, FCAS*

⁴ *Credibility Practice Note, July 2008, American Academy of Actuaries’ Life Valuation Subcommittee*

⁵ *Chapter 8: Credibility, by Howard C. Mahler and Curtis Gary Dean, from Foundations of Casualty Actuarial Science, Fourth Edition*

3.3 Territory Differentials

The following relativities come from *VFH Technical Conference (April 20, 2021)*:

Territory	Raw Relativity	
	Public	Taxicab VFH*
1	1.1497	1.2735
2	0.6832	0.3814
3	0.6266	0.4264
4	0.3977	0.1796

*Based on the pure premium for the respective territory compared to the pure premium for all Taxicab VFH

The following are the Loss Ratios for Taxi VFH, provided by MPI.

From *TC1_018_a_b_Appendix_01_VFH_Taxi_Loss_Experience_Aug20*

5-year (2016 to 2020) Loss Ratios

Territory	Loss Ratio
1	72.8%
2	54.1%
3	50.5%
4	21.7%

TC (MPI) 1-18 part d) describes a sample rating example. Figure 1 from MPI illustrates that Taxi rating includes a Required Rate, a Taxicab VFH relativity, a Territory relativity, and other adjustments.

To summarize, Dion Strategic’s observations are as follows:

- **Observation 1** – The current methodology does not properly segment between smaller subsets of risks. Urban taxis in Manitoba are underpriced while rural taxis are overpriced. The relativities and loss ratios indicate this.
- **Observation 2** – The rating methodology is simplistic in nature – there are few rating variables.
- **Opinion** – There is a trade-off between simplicity and complexity in a rating algorithm. A simple rating, while easier to implement, does result in a greater mismatch between charged rates and actuarially sound rates, especially for subsets of risks. Consideration should be given to a Territory and Type of Use rating interaction.

3.4 Territory Differentials – Recommendations

MPI should investigate improvements to the rating algorithm, increase the complexity, and minimize the cross subsidization amongst risks. The relativities and loss ratios indicate that rural taxis are overcharged while urban taxis are undercharged. This is not limited to taxis as other classes of business could be seeing similar subsidization across territories. The contributing factors could include: methodology, credibility, simplicity of rating, volume of business, or the minimum bias procedure. In Dion Strategic's opinion, it is less important to figure out the cause of the mismatch between territory rates versus indications. What is most important is that MPI, the PUB, and the interveners recognize the need to improve the rating and work together to minimize the mismatch between charged and indicated rates for subsets of risks.

4. Ratemaking

4.1 Minimum Bias Procedure

A Practitioner's Guide to Generalized linear Models⁶, written by Anderson, Feldblum, et al., is written for the practicing actuary who would like to understand generalized linear models (GLMs).

In discussing different ratemaking methods:

- *Traditional ratemaking methods in the United States <were originally> not statistically sophisticated. Claims experience for many lines of business <were> often analyzed using simple one-way and two-way analyses. Iterative methods known as **minimum bias procedures, developed by actuaries in the 1960s**, provide a significant improvement, but are still only part way toward a full statistical framework.*
- *The classical linear model and **many of the most common minimum bias procedures are, in fact, special cases of generalized linear models (GLMs)**. The statistical framework of GLMs allows explicit assumptions to be made about the nature of the insurance data and its relationship with predictive variables. The method of solving GLMs is more technically efficient than iteratively standardized methods, which is not only elegant in theory but valuable in practice. In addition, **GLMs provide statistical diagnostics which aid in selecting only significant variables** and in validating model assumptions.*
- *Today GLMs are widely recognized as the **industry standard method** for pricing private passenger auto and other personal lines and small commercial lines insurance in the European Union and many other markets.*

The paper also discusses "**failings of minimum bias procedures**":

- *In the 1960s, actuaries developed a ratemaking technique known as minimum bias procedures. These procedures impose a set of equations relating the observed data, the rating variables, and a set of parameters to be determined. An iterative procedure solves the system of equations by attempting to converge to the optimal solution. The reader seeking more information may reference "The Minimum Bias Procedure: A Practitioner's Guide" by Sholom Feldblum and Dr J. Eric Brosius.*
- *Once an optimal solution is calculated, however, the minimum bias procedures give **no systematic way of testing whether a particular variable influences the result with statistical significance**. There is also **no credible range provided for the parameter estimates**. The minimum bias procedures **lack a statistical framework which would allow actuaries to assess better the quality of their modeling work**.*

⁶ Refer to https://www.casact.org/sites/default/files/database/dpp_dpp04_04dpp1.pdf

In summarizing the overall situation, Dion Strategic's observations are as follows:

- **Observation 1** – The minimum bias procedure (MBP), while being an Accepted Actuarial Practice, was developed in the 1960s, where computational powers were much lower than today. While it was an improvement to methodologies then, its lags behind current and more sophisticated analyses today.
 - **Opinion 1** – There is no reason in 2021, not to be using GLMs for ratemaking. From our personal experience, companies in Ontario have been developing GLMs since the mid-2000s. Nowadays, major insurance players are fitting GLM models in R, which is a free open-source software.
- **Observation 2** – The MBP does not provide a “systematic way of testing whether a particular variable influences the result with statistical significance. There is also no credible range provided for the parameter estimates.” In simpler terms, while the method “minimizes bias”, it does not speak to the accuracy of the estimates for each particular variable used. It does not have a confidence measure to declare how likely the “true” value is to fall within a certain range.
 - **Opinion 2** – There is no systematic way of knowing that the current MPI rating variables are statistically significant and credible.
 - **Opinion 3** – The Minimum Bias Procedure is simply inferior to the Generalized Linear Model. MPI has a robust data set for modeling purposes – excellent GLMs can be built.

4.2 Minimum Bias Procedure – Recommendations

Dion Strategic recommends an immediate plan to be put in place for MPI to switch to Generalized Linear Models. GLMs are superior to the MBP and would provide a systematic method to determine rating variables, significance, and confidence measures. If modelled properly, it would reduce the cross subsidization amongst subsets of risk. It could potentially reduce the involvement of all interveners – if risks are priced more accurately, there would be less time spent debating the segmentation of risks.

APPENDICES

5. Appendices

5.1 Classical Credibility Approach

Chapter 12: Credibility in “Basic Ratemaking” by Werner and Modlin

https://www.casact.org/sites/default/files/2021-03/5_Werner_Modlin.pdf

Classical Credibility Approach

The classical credibility approach, commonly called limited fluctuation credibility, is the most frequently used method in insurance ratemaking. The goal of classical credibility is to limit the effect that random fluctuations in the observations have on the risk estimate.

In this approach, a value of credibility (Z) is calculated and used to assign weights to the observed experience (also known as subject experience or base statistic) and to some related experience in the following linear expression:

$$\text{Estimate} = Z \times \text{Observed Experience} + (1.0 - Z) \times \text{Related Experience}$$

Let Y represent the total number of claims, and S represent the total amount of losses. The actuary first determines the expected number of claims, ($E(Y)$), required for the observed experience to be considered fully credible ($Z=1.00$).

The observed experience is considered fully credible when the probability (p) is high that the observed experience will not differ significantly from the expected experience by more than some arbitrary amount (k). Stated in probabilistic terms:

$$\text{Pr}[(1 - k)E(S) \leq S \leq (1 + k)E(S)] = p.$$

According to the Central Limit Theorem,

$$\frac{S - E(S)}{\sqrt{\text{Var}(S)}} \sim N(0,1).$$

Therefore, the probabilistic expression above can be transformed as follows:

$$\text{Pr} \left[\frac{(1 - k)E(S) - E(S)}{\sqrt{\text{Var}(S)}} \leq \frac{S - E(S)}{\sqrt{\text{Var}(S)}} \leq \frac{(1 + k)E(S) - E(S)}{\sqrt{\text{Var}(S)}} \right] = p.$$



Chapter 12: Credibility

Since the normal distribution is symmetric about its mean, this is equivalent to:

$$\left[\frac{(1+k)E(S) - E(S)}{\sqrt{\text{Var}(S)}} \right] = z_{(p+1)/2},$$

where $z_{(p+1)/2}$ is the value in the Standard Normal table for specified values $(p+1)/2$.

Consider the following simplifying assumptions about the observed experience:

- Exposures are homogeneous (i.e., each exposure has the same expected number of claims).
- Claim occurrence is assumed to follow a Poisson distribution; therefore, it follows that the expected number of claims, $E(Y)$, equals the variance, $\text{Var}(Y)$.
- There is no variation in the size of loss (i.e., constant severity).

Given those assumptions, the expression above can be simplified to:

$$\left[\frac{kE(Y)}{\sqrt{E(Y)}} \right] = z_{(p+1)/2}.$$

By squaring both sides of the equation and rearranging the terms, the expected number of claims needed for full credibility can be expressed as:

$$E(Y) = \left(\frac{z_{(p+1)/2}}{k} \right)^2.$$

For example, an actuary may regard the loss experience as fully credible if there is a 90% probability that the observed experience is within 5% of its expected value. This is equivalent to saying there is a 95% probability that the observed losses are no more than 5% above the mean. In the Standard Normal table, the 95th percentile is 1.645 standard deviations above the mean; therefore, the expected number of claims needed for full credibility is:

$$E(Y) = \left(\frac{1.645}{0.05} \right)^2 = 1,082.$$

If the number of observed claims is equal to or greater than the standard for full credibility (1,082 in the example above), the measure of credibility (Z) is 1.00:

$$Z = 1.00 \text{ where } Y \geq E(Y).$$

If the number of observed claims is less than the standard for full credibility, the square root rule is applied to calculate Z :

$$Z = \sqrt{\frac{Y}{E(Y)}} \text{ where } Y < E(Y).$$

5.2 Illustration of MPI Methodology for Classes with Low Credibility

Assumptions

- The current relativity is 1.00.
- The required relativity is 1.50 which goes unchanged each year.
- Each year the credibility is the minimum 10%.

Example

10% Credibility Illustration				
Year	Raw Required Relativity	Credibility	Current Relativity	Credibility Balanced Relativity
[1]	[2]	[3]	4 = [5] prior	[5] = [2] x [3] + (1 - [3]) x [4]
0	1.50	10%	1.00	1.05
1	1.50	10%	1.05	1.10
2	1.50	10%	1.10	1.14
3	1.50	10%	1.14	1.17
4	1.50	10%	1.17	1.20
5	1.50	10%	1.20	1.23
6	1.50	10%	1.23	1.26
7	1.50	10%	1.26	1.28
8	1.50	10%	1.28	1.31
9	1.50	10%	1.31	1.33
10	1.50	10%	1.33	1.34
11	1.50	10%	1.34	1.36
12	1.50	10%	1.36	1.37
13	1.50	10%	1.37	1.39
14	1.50	10%	1.39	1.40
15	1.50	10%	1.40	1.41
...				
41	1.50	10%	1.49	1.49
42	1.50	10%	1.49	1.49
43	1.50	10%	1.49	1.50

5.3 Team CVs



Sylvain Dion, FCIA, MAAA

PROFESSIONAL EXPERIENCE

Dion Strategic Consulting Group Inc.
December 2011 – present
President and CEO

Dion, Durrell + Associates Inc.
1995 – 2011
Chairman of the Board and President

The Wyatt Company
1976 – 1995
Chair, Risk Management Practice
Committee

EDUCATION

*Bachelor of Actuarial Science 1976 – Laval
University*

PROFESSIONAL DESIGNATIONS

Fellow: Canadian Institute of Actuaries

Fellow: Society of Actuaries

Member: American Academy of Actuaries

Sylvain is the founder of the Dion Strategic Consulting Group Inc. and a principal consultant on a number of major clients for the firm. Sylvain provides strategic advice in addition to consulting and actuarial services relating to optimal risk financing strategies and the evaluation of outstanding and future liabilities with respect to self-insurance and insurance programs.

Sylvain has more than 40 years of experience as a strategic advisor and consulting actuary to his clients. He has been instrumental in the development of computerized risk models to assist organizations in the evaluation and selection of risk retention strategies for their various insurance programs and exposures to risk.

Prior to the creation of the Dion Strategic Consulting Group Inc., Sylvain spent more than 16 years with Dion Durrell, an actuarial consulting firm which he cofounded in 1995. He worked with the Wyatt Company in various leadership capacities from 1976 to 1995.



PROFESSIONAL EXPERIENCE

Dion Strategic Consulting Group Inc.
Senior Actuarial Consultant
April 2017 – present

Desjardins General Insurance Group
Expert Actuarial Advisor and Team Lead
2010 – 2017

Lombard Canada Ltd.
(now Northbridge Insurance)
Actuarial Analyst
2004, 2007 – 2010

Dominion of Canada General Insurance
Company (now Travelers Canada)
Actuarial Co-op
2005 – 2006

EDUCATION

University of Waterloo 2007
Bachelor of Mathematics
Honours Actuarial Science
Co-op Program

SKILLS

Strategic and Business Analysis
Actuarial Consulting
Rate Filing
Pricing/Ratemaking/Segmentation
Loss Modelling/Simulation
Reserving/Valuation
Alternative Risk Financing
Excel, SAS, Emblem, R, VBA, Office,
@Risk, Arius, Power BI



Jason Wong

Jason Wong is a Senior Actuarial Consultant and leads the Property & Casualty (P&C) Actuarial Practice at Dion Strategic Consulting Group. With over 15 years of experience in the P&C industry, Jason has developed expertise in a number of traditional actuarial areas including Pricing, Reserving (Valuation), and Loss Modelling.

Prior to joining the Dion Strategic Team, Jason held progressively senior roles at various insurance companies including Desjardins General Insurance Group. Jason has extensive experience with rate filings for the Ontario, Alberta, and Atlantic Canada markets.

Jason graduated from the University of Waterloo with a Bachelor of Mathematics, Honours Actuarial Science degree.

About Dion Strategic Consulting Group

Dion Strategic Consulting Group is a strategic and actuarial consulting firm with offices in Toronto and Chicago. Founded by Sylvain Dion who has more than 40 years of experience as a Consulting Actuary, Dion Strategic provides actuarial and consulting services for a full range of insurance products, including Property and Casualty (Personal and Commercial), Life Insurance, and Pensions.



24 September 2021

**In the Matter of:
Manitoba Public Insurance
2022 General Rate Application**

Peer Review of the Pre-Filed Testimony of
Sylvain Dion, FCIA, MAAA and Jason Wong

Prepared by: Mandy M. Y. Seto, FCAS, FCIA



Suite 1410, 585 8 Avenue S.W., Calgary Alberta T2P 1G1

September 24, 2021

Mr. Sylvain Dion, FCIA, MAAA
President and Consulting Actuary
Dion Strategic Consulting Group Inc.
55 York Street, Suite 801
Toronto, Ontario
M5J 1R7

Dear Sylvain,

It is with pleasure I present to you a copy of my Peer Review Report for the testimony you have prepared for the 2022 General Rate Application submitted by the Manitoba Public Insurance (“MPI”) to the Public Utilities Board of Manitoba (“PUB”).

Should you have any questions regarding this peer review, please do not hesitate to contact me. Thank you.

Yours sincerely,

Mandy M. Y. Seto, FCAS, FCIA
Consulting Actuary
Palm Insurance Canada Inc.
1410, 585 – 8th Avenue S.W.
Calgary, Alberta
T2P 1G1

Cc: Valerie Cusano, President

Peer Review Report

In the Matter of Manitoba Public Insurance - 2022 General Rate Application

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1. Purpose of the Report

Manitoba Public Insurance (“MPI”) is a non-profit Crown corporation which administers public automobile insurance, motor vehicle registration and driver licensing in Manitoba.

As part of the 2022 General Rate Application (“GRA”) process, Dion Strategic Consulting Group Inc. (“Dion Strategic”) has prepared testimony on behalf of Unicity Taxi Ltd. and Duffy’s Taxi Ltd. (the “Taxi Coalition”). Dion Strategic has engaged Palm Insurance Canada Inc. (“Palm”) to conduct an external actuarial review of its testimony.

Ms. Mandy M. Y. Seto is a Fellow of the Casualty Actuarial Society (FCAS) and a Fellow of the Canadian Institute of Actuaries (FCIA). She has over twenty years of experience in the property/casualty insurance industry, including over ten years experience in the automobile insurance industry, mostly in Alberta and Ontario. Please refer to Appendix A of this Report for her CV.

2. Relationship with Dion Strategic

Ms. Mandy M. Y. Seto, FCAS, FCIA, has no relationship with Dion Strategic that would in any way impair her objectivity. There is no particular guidance on peer reviews for actuaries in Canada except for OSFI Guideline E-15, which is guidance for peer reviewers of Appointed Actuaries for insurers in Canada. We will use this guideline as a general outline for this Report in areas that are relevant.

3. Timing of the Report

The draft of the testimony was released to the reviewer on September 22, 2021 and a finalized copy of the testimony will be provided to the reviewer on September 24, 2021 before it is filed.

This document constitutes the Peer Review Report. Any questions regarding this report should be directed to:

Ms. Mandy M. Y. Seto, FCAS, FCIA
Consulting Actuary
Palm Insurance Canada Inc.
1410, 585 – 8th Avenue S.W.
Calgary, Alberta
T2P 1G1
Phone: (403) 389-2238
E-mail: mandy.seto@palm.global

4. Scope of the Report

The scope of this Peer Review Report includes:

1. Review of the reasonableness of the observations made by Dion Strategic, and
2. Determine the appropriateness of the recommendations presented by Dion Strategic.

5. Findings

The testimony prepared by Dion Strategic focuses on three main areas: Passenger Vehicle-for-Hire (VFH) pricing, Taxi VFH pricing, and Ratemaking methodology.

- For Passenger VFH, the issue of serious loss loading and rate increases and capping are discussed;
- For Taxi VFH, the issue of credibility and territorial differentials are discussed; and
- For Ratemaking, the minimum bias procedure and generalized linear models (GLMs) are discussed.

5.1 Passenger VFH Pricing

Serious Loss Loading

Serious Loss is defined in the *VFH Technical Conference (April 20, 2021)* as “an incident whereby the total PIPP claims costs exceed \$500,000”. Dion Strategic highlighted a few excerpts coming from this same document that imply: (1) MPI assumes not all uses have a Serious Loss loading and (2) there is no Serious Loss loading for Passenger VFH. Palm reviewed these observations and their implications. We find them to be reasonable.

In other provinces where automobile insurance is administered by private insurers, such as Alberta and Ontario, they use a similar term known as Large Loss that is defined by each private insurer based on their own claims data. It is a generally accepted actuarial practice for pricing actuaries in competitive markets, such as Alberta and Ontario, to include a loading for these Large Losses in their pricing analyses for regulatory filing purposes.¹ By allowing such loadings, these provincial regulators are encouraging actuaries to reflect the true pricing adequacy in their filings. These regulators do not permit private insurers to cherry pick some groups to have this loading while other groups do not. By the same logic, Palm finds the recommendation by Dion Strategic, that Passenger VFH should apply a Serious Loss loading to its historical experience when calculating the relativities, to be appropriate. Furthermore, Dion Strategic recommends two options: (1) a minimum Serious Loss loading of \$258 per unit for Passenger VFH, or (2) a Serious Loss loading as high as \$428 per unit (based on Taxi VFH) for Passenger VFH. Palm believes a reasonable Serious Loss loading for Passenger VFH may likely be somewhere between these two extreme values. Only with more time and more data will one be able to derive an appropriate Serious Loss loading specifically for Passenger VFH. In the meantime, the two options recommended by Dion Strategic are a reasonable starting point.

Rate Increases and Capping

The $\pm 20\%$ cap on any rate changes in the province was approved for the year ending February 28, 2006 in *PUB Order 148/04*, which means this capping policy has been in place for approximately fifteen years. All

¹ In Alberta, refer to the filing guidelines: <https://airb.alberta.ca/industry-information/filing-guidelines/AIRB-Filing-Guidelines-Full-and-Simplified-Filing.pdf>. In Ontario, refer to the filing guidelines: <http://www.fsco.gov.on.ca/en/auto/filing-guidelines/Documents/PPA-major.pdf>.

observations made by Dion Strategic on Passenger VFH rate increases and capping were extracted from *PUB Order 1/21*. Palm reviewed these observations and we find them to be reasonable.

Dion Strategic recommends rate increases for Passenger VFH not be capped at 20%. Instead, they suggest a higher capping percentage or no capping at all. In theory, it may seem like an insurer should be happy with charging rates that recoup overall costs, but that doesn't mean it is charging the "right" rates to different groups. When it does not charge the "right" rate for one group, other groups in the same book of business may be unintentionally subsidizing it.²

In "*TC1_018_c_Appendix_02_VFH_Taxi_Major_Class_Loss_Experience_Aug20.xlsx*" provided by MPI, it shows that the two-year average loss ratio for Passenger VFH is greater than 120% (pre-pandemic) compared to the ten-year average loss ratio for Taxi VFH of approximately 80% (pre-pandemic). These loss ratios indicate that the Taxi VFH is subsidizing the Passenger VFH, and that adverse selection is likely to occur if it hasn't already. Therefore, we find the recommendation made by Dion Strategic on Passenger VFH rate increases and capping to be appropriate.

5.2 Taxi VFH Pricing

Credibility

Based on the *VFH Technical Conference (April 20, 2021)*, the minimum credibility for all VFH classes is 10%. This percentage appears to be selected judgmentally and has existed for a good number of years. MPI may want to revisit it.

Dion Strategic provided a significant amount of detail concerning the concept of credibility and the two commonly used credibility methods: (1) Bühlmann credibility and (2) Classical credibility. MPI uses the Bühlmann credibility method where credibility is $[N/(N+K)]$, while Dion Strategic recommends switching to the Classical credibility method where credibility is the square root of the ratio of $[N/N_k]$. The Bühlmann credibility is considered a valid approach but deriving the K constant is a major challenge. MPI may want to consider re-evaluating this selection by updating any data that was used to justify the 60,000 in the past. Dion Strategic prefers the Classical credibility approach since it is: (1) the more commonly used method by actuaries today, (2) the data required is readily available, and (3) the computations are very straight forward. We believe the suggestion by Dion Strategic to use claim counts as a measure is a tangible and simple way to determine credibility. In their testimony, Dion Strategic has provided a reasonable argument that Taxi VFH are fully credible based on Collision and Property Damage claim counts.

Palm has reviewed the observations made by Dion Strategic based on *Part VI – RM 4.4* and we find them to be reasonable. Furthermore, we have reviewed the recommendation by Dion Strategic for MPI to fine tune the credibility weighting methodology and we find their suggestions to be appropriate.

² Actuarial considerations on the subject of pricing for fair and equitable rates will discuss the drawbacks of not doing so, which includes adverse selection and cross-subsidization. The latest reference to discuss this concept can be found in Chapter 10 of Werner, G, and Modlin, C., *Basic Ratemaking*, Casualty Actuarial Society, Fifth Edition, May 2016.

Territorial differentials

It is our understanding that Territory 1 represents Winnipeg and Territories 2-4 are smaller cities and/or rural areas of Manitoba. We have verified the 5-year loss ratio table derived by Dion Strategic based on “*TCI_018_a_b_Appendix_01_VFH_Taxi_Loss_Experience_Aug20.xlsx*”. The 5-year loss ratio in Territory 1 is significantly higher than the 5-year loss ratios in Territories 2-4. The relativity table that Dion Strategic references from the *VFH Technical Conference (April 20, 2021)* may also imply the possibility of an issue with segmentation.

However, Territories 2-4 do not have as much volume (earned units) as Territory 1. The mismatch between differentials and loss ratios could simply be due to the randomness of claims. If possible, MPI may want to subdivide Territory 1 to determine what is causing the high loss ratio and high relativity. Perhaps a few areas in Winnipeg may be causing this result, but we cannot verify this without a deeper dive into the claims details of Territory 1. Exploring this issue may also help us determine what areas of the rating algorithm need improvement. Through this line of thinking, we have arrived at a similar conclusion as Dion Strategic, which is to investigate ways to improve the rating algorithm. While the data suggests that Territory 1 may be underpriced and Territories 2-4 may be overpriced, in my opinion, this could simply be random noise due to the lower volume of data.

5.3 Ratemaking Methodology

The minimum bias procedure has been around for a very long time. Unfortunately, in most actuarial textbooks it is now included as an *introduction* to GLMs. It is often the ratemaking model actuaries learn about, in theory, before progressing to the new and more powerful GLMs. In the testimony by Dion Strategic, they summarize the different ratemaking methods and discuss the failings of the minimum bias procedures. It is difficult to dispute their observations on this subject as the source of their information is the same source any actuary would go to if they need to learn or refresh their memory on this topic.

We are currently enjoying a new wave of technology in the market where there are new tools and software that has the potential to increase computing power significantly. With the increased granularity and accessibility of data, more robust and predictive models *can* be built. Therefore, we agree with the recommendation by Dion Strategic that MPI should consider switching to GLMs, but it may not be as ‘immediate’ as they would want. We suggest a plan to introduce a few new rating variables at a time, so that their impact can be monitored over time, evaluated periodically and revised as needed.

6. Conclusion

Palm has reviewed the testimony prepared by Dion Strategic. We find the observations, implications, and opinions they have made to be reasonable and the recommendations they have presented to be appropriate.

7. Data and Reliance

In the preparation of this Peer Review Report, I have reviewed the relevant sections of the 2022 GRA document. All exhibits included in the testimony by Dion Strategic were based on information from current and prior GRAs of MPI, the April 20th, 2021 Vehicle-for-hire (VFH) Technical Conference and various commonly accepted Actuarial Texts.

8. Distribution and Use

This report is intended for the 2022 General Rate Application. Its sole purpose is to provide a peer review of the testimony prepared by Dion Strategic.

This report is neither intended nor necessarily suitable for any other use. Distribution beyond the parties involved in the 2022 General Rate Application is permitted provided that prior written consent is given by MPI and the third party agrees to keep this Report confidential.

Any use which a third party makes of this Report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Palm Insurance Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Report.

Appendix A: Curriculum Vitae of Mandy M. Y. Seto, FCAS, FCIA

Overview

Mandy is an Actuary with over 20 years of experience in property and casualty insurance. She is a strong leader and works well in a fast-paced, demanding environment. She knows how to build strong relationships with internal and external stakeholders. She is a trusted advisor who is well organized and can prioritize tasks to meet critical deadlines. She is resourceful in perceiving and resolving problems. She is a clear articulate communicator who is a quick learner with a wide range of practical/technical skills. She is competent user of Microsoft Office products, statistical software, and database application/programming.

Mandy has a Bachelor of Science, Major in Actuarial Science and a Bachelor of Commerce, Concentration in Insurance and Risk Management, both from the University of Calgary.

She is a Fellow of the Casualty Actuarial Society (FCAS) and a Fellow of the Canadian Institute of Actuaries (FCIA).

Education

- Bachelor of Science, Major in Actuarial Science
- Bachelor of Commerce, Concentration in Insurance and Risk Management

Professional Designations

- FCIA, Fellow of the Canadian Institute of Actuaries
- FCAS, Fellow of the Casualty Actuarial Society

Work Experience

2018-Present Consulting Actuary; Palm Insurance Canada Inc. (Calgary)
2014-2018 Expert Actuarial Advisor, Auto Ratemaking; Desjardins General Insurance Group (Calgary/Mississauga)
2011-2012 Manager, West - Personal Lines Pricing (Auto & Property); Aviva Canada Inc. (Scarborough)
2010-2011 Manager, Corporate Reserving; Aviva Canada Inc. (Scarborough)
2008-2010 Manager, Economic Capital; Aviva Canada Inc. (Scarborough)
2007-2008 Actuarial Manager; Deloitte & Touche LLP, Assurance & Advisory (Toronto)
2006-2007 Actuarial Manager; Deloitte Consulting LLP, Actuarial & Insurance Solutions (Philadelphia)
2000-2006 Senior Consultant; Deloitte Consulting LLP, Actuarial & Insurance Solutions (Philadelphia)
1998-2000 Actuarial Consultant; Arthur Andersen LLP, Actuarial & Insurance Consulting Group (Philadelphia)

Technical Skills

- Expert user of Microsoft Excel with working knowledge of VBA programming
- Working knowledge of Microsoft products such as Outlook, Word and PowerPoint
- Working knowledge of statistical software such as @Risk
- Working knowledge of database application / programming such as SAS and R
- Working knowledge of accounting and financial database applications such as Hyperion