A Pricing Model for Underinsured Motorist Coverage

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ABSTRACT

Underinsured Motorist (UIM) coverage, also known as Family Protection coverage, is a component of most Canadian personal automobile policies, with similar coverage existing in many American states. Traditional ratemaking methods are not appropriate for UIM due to poor credibility of available data as well as the unique characteristics of the UIM coverage. A substitute pricing model is presented that takes advantage of the association between UIM coverage and increased-limits liability coverage. The Ontario auto insurance industry is analyzed to determine the level of adequacy of UIM rates in light of current industry trends.

KEYWORDS

Pricing models, automobile insurance pricing, Underinsured Motorist, UIM, Ontario

1. Introduction

Underinsured Motorist (UIM) coverage, also known as Family Protection coverage, is a component of most Canadian personal automobile policies, with similar coverage existing in many American states. It is a first-party coverage that responds in the event of a liability claim by the insured or an immediate family member that exceeds the third party's liability limit. Insureds typically purchase UIM at a level that matches their own liability coverage.

For example, Person A, who holds a policy with a liability limit of $1 million and UIM coverage of $1 million, is involved in a collision with Person B, who holds a policy with a liability limit of $300,000. B is liable to A for damages in the amount of $700,000. A's UIM coverage pays the amount of the claim between B's liability limit and A's UIM limit, in this case $400,000. If the damage amount had exceeded $1 million, the UIM coverage would have paid $700,000.

UIM appeals to customers because many drivers carry liability limits that meet statutory requirements but may not be adequate in all claim scenarios. Since insureds do not have control over the limits carried by the other drivers on the road, they are exposed to the possibility of being owed a large sum that is difficult or impossible to collect from an underinsured third party.

Grant (1987) discusses four different pricing models whose applicability depends on the coverage laws of the jurisdiction in question. The situation referred to by the author as the "Standard Difference in Limits Model," whereby UIM provides coverage for the layer between the third party's liability limit and the first party's UIM limit, is the focus of this paper. A comparison with the Grant method is presented in Section 5.

2. Problems with traditional ratemaking procedures

Traditional ratemaking approaches dictate that UIM should be priced using historical loss experience on UIM claims. There are two major problems with this approach:

1) UIM coverage has extremely low frequency and extremely high severity. In 2007, the entire Ontario Private Passenger Automobile industry combined (6.2 million earned exposures) had just 290 incurred UIM claims averaging $280,748 each.[1] Using traditional credibility formulas, a minimum of 1,082 claims are required to achieve full credibility for the frequency alone. When the high level of variance in UIM's severity distribution is factored in, that number becomes much greater.
2) The correct price for UIM is highly dependent on the coverage limit. Insurers generally offer a variety of UIM coverage options, mirroring the different liability limits that are available. Traditional methods of increased limits ratemaking do not work very well for UIM, due to the credibility issues mentioned above and the fact that the severity distribution is conditional on an external factor—the third party's liability limit.

Fortunately, there is an alternative ratemaking method that allows us to sidestep the credibility issues while providing an accurate breakdown of UIM loss costs by limit.

3. An alternative pricing model

This model takes advantage of the fact that UIM acts as a temporary upgrade to the third party's liability coverage, where the third party is a randomly selected member of the driving population. UIM losses are related to liability losses in a specific, measurable way. Therefore, we can impute UIM loss distributions from liability loss data, for which a credible data set will be easier to obtain.

Please note that the following methods and discussions were designed for the standard UIM

[1]General Insurance Statistical Agency, Automobile Insurance Experience Report AU10-N, 2007. Used with permission.

coverage form that is in use in the province of Ontario. Adjustments may be required where coverage specifics vary by jurisdiction. Also, the model presumes that a full rate indication, including increased limits analysis, has already been completed for liability coverage, and that a breakdown of liability claims data by claim type is available.

The first step is to calculate the net liability loss cost for each limit, given by

$$\mathrm{NLLC}_n = \mathrm{LiaLC} \times (\mathrm{LCRel}_n / \mathrm{LCRel}_{\mathrm{avg}}) \tag{3.1}$$

where

NLLC_n is the net liability loss cost for limit n;
LiaLC is the indicated average loss cost for liability;
LCRel_n is the indicated relativity for liability limit n;
$\mathrm{LCRel}_{\mathrm{avg}}$ is the average indicated relativity for all liability limits;

The next step is to determine, for each possible combination of the first party's UIM limit and the third party's liability limit, the average annual cost of increasing the third party's liability coverage to match the first party's UIM limit:

$$\mathrm{Inc}_{mN} = \max\{\mathrm{NLLC}_m - \mathrm{NLLC}_N, 0\} \tag{3.2}$$

where m is the first party's UIM limit and N is the third party's liability limit. Note that while m is a known value for any given purchaser of UIM, N is a random variable—it is the liability limit of an unknown third party.

In order to proceed, the distribution of N is required. A good starting point is the liability limit distribution for the industry. From that, two adjustments are necessary:

1) In Ontario, insurers have the right to reduce claimants' liability limits to the statutory minimum of $200,000 on claims where the policyholder was in violation of the policy conditions during the incident. Policy violations include unlicensed drivers operating the vehicle, impaired drivers operating the vehicle, misrepresentation of material information to the insurer, etc. In these situations, damages in excess of $200,000 will be paid by UIM regardless of the third party's limit.
2) When the third party is uninsured, damages are paid by a separate Uninsured Automobile coverage up to the statutory minimum limit of $200,000. Damages in excess of $200,000 will be paid by UIM when the third party has no insurance.

The adjusted distribution is given by

$$P_n = P(N = n) = \begin{cases} D_n \times (1 - V - U) + V + U & \text{if} \quad n = 200{,}000 \\ D_n \times (1 - V - U) & \text{if} \quad n \neq 200{,}000 \end{cases} \tag{3.3}$$

where

D_n is the proportion of industry insured vehicles that have liability limit n;
V is the proportion of liability claims that are associated with policy violations; and
U is the proportion of industry vehicles that are uninsured.

There are a number of different methods for estimating V and U. V can be estimated from internal claims department data or industry surveys. U can be estimated by the ratio of claim frequency on the Uninsured Automobile coverage to claim frequency on all third-party coverages.

The final step is to calculate the expected UIM loss cost. For UIM limit m, the expected UIM loss cost is defined by the expected value of Inc_{mN} from Equation (3.2), calculated over the distribution of N given by Equation (3.3):

$$\mathrm{UIMLC}_m = \sum_n \mathrm{Inc}_{mn} \times P. \tag{3.4}$$

The result can then be loaded for expenses, risk and profit in order to generate the final indicated UIM premium for each limit.

Table 1. Example liability limit relativities

Limit	Industry Exposure Distribution	Indicated Relativity
$200,000	2%	1.000
$300,000	5%	1.150
$500,000	10%	1.300
$1,000,000	65%	1.600
$2,000,000	18%	1.900
Average		1.5895

Table 2. Calculated net liability loss costs for each limit

Limit	Net Liability Loss Cost
$200,000	188.74
$300,000	217.05
$500,000	245.36
$1,000,000	301.98
$2,000,000	358.60

4. Example

This example uses the following fictitious data and assumptions:

- Indicated loss cost for liability is $300.
- Liability limit relativities are given by Table 1.
- The proportion of all liability claims that are associated with policy violations is 5%.
- The proportion of all drivers who are uninsured is 2%.
- The loading for expenses, risk, and profit is 15% of the final premium.

From Equation (3.1), net liability loss cost for $200,000 limit is:

$$\begin{aligned} &\mathrm{NLLC}_{200,000} \\ &\quad = \mathrm{LiaLC} \times (\mathrm{LCRel}_{200,000}/\mathrm{LCRel}_{\mathrm{avg}}) \\ &\quad = 300 \times (1.000/1.5895) \\ &\quad = 188.74. \end{aligned}$$

Similarly, net liability loss costs for the other limits are shown in Table 2.

From Equation (3.2), the average annual cost of increasing the third party's liability coverage to match the first party's UIM limit is shown in Table 3.

The adjusted third-party limit distribution is calculated as follows, from Equation (3.3):

$$\$200{,}000: \quad 0.02 \times (1 - 0.05 - 0.02) + 0.05 + 0.02 = 0.0886.$$

$$\$300{,}000: \quad 0.05 \times (1 - 0.05 - 0.02) = 0.0465.$$

$$\$500{,}000: \quad 0.10 \times (1 - 0.05 - 0.02) = 0.0930.$$

$$\$1{,}000{,}000: \quad 0.65 \times (1 - 0.05 - 0.02) = 0.6045.$$

$$\$2{,}000{,}000: \quad 0.18 \times (1 - 0.05 - 0.02) = 0.1674.$$

The distribution can be added to Table 3, as shown in Table 4. As per Equation (3.4), the indicated UIM loss cost for each limit is calculated by taking the weighted average of each row in Table 4, using the adjusted distribution as weights. For $2,000,000 limit:

$$\begin{aligned} &(169.86 \times 0.0886) + (141.55 \times 0.0465) \\ &\quad + (113.24 \times 0.0930) + (56.62 \times 0.6045) \\ &\quad + (0 \times 0.1674) = 66.39. \end{aligned}$$

The final indicated premium for $2,000,000 limit is calculated by adding the loading for expenses, risk and profit:

$$66.39/(1 - 0.15) = 78.11.$$

Similarly, for other limits, see Table 5.

Note that the UIM loss cost for the $200,000 limit is zero. This will always be the case for the minimum limit, as it is virtually impossible to encounter a third party whose limit is below the minimum (recall that uninsured third parties are treated under a separate coverage).

5. Comparison with other models

Grant (1987) proposes a model that is conceptually similar to this one. Both models use the liability increased limits factors as inputs to the UIM ratemaking process. Both models assume that the third party's liability limit is a random variable with the industry limit distribution.

Table 3. Cost of increasing third party's liability limit

	Third Party's Liability Limit				
First Party's UIM Limit	$200,000	$300,000	$500,000	$1,000,000	$2,000,000
$200,000	0.00	0.00	0.00	0.00	0.00
$300,000	28.31	0.00	0.00	0.00	0.00
$500,000	56.62	28.31	0.00	0.00	0.00
$1,000,000	113.24	84.93	56.62	0.00	0.00
$2,000,000	169.86	141.55	113.24	56.62	0.00

Table 4. Cost of increasing third party's liability limit, with limit distribution

	Third Party's Liability Limit [Adjusted Distribution]				
First Party's UIM Limit	$200,000 [0.0886]	$300,000 [0.0465]	$500,000 [0.0930]	$1,000,000 [0.6045]	$2,000,000 [0.1674]
$200,000	0.00	0.00	0.00	0.00	0.00
$300,000	28.31	0.00	0.00	0.00	0.00
$500,000	56.62	28.31	0.00	0.00	0.00
$1,000,000	113.24	84.93	56.62	0.00	0.00
$2,000,000	169.86	141.55	113.24	56.62	0.00

Table 5. Indicated loss cost and indicated premium for each limit

Limit	Indicated Loss Cost	Indicated Premium
$200,000	0.00	0.00
$300,000	2.51	2.95
$500,000	6.33	7.45
$1,000,000	19.25	22.65
$2,000,000	66.39	78.11

There are several important differences:

1) In Ontario, Uninsured Automobile only covers damages up to the statutory minimum of $200,000, with any excess covered by UIM. Therefore, the UIM exposure on an uninsured third party is equal to the UIM exposure on a third party with a $200,000 liability limit, necessitating the distributional adjustments given by Equation (3.3).
2) Similarly, this method contains a provision for third parties who have their liability limits temporarily reduced due to policy violations.
3) The Grant method expresses the indicated UIM premium as a multiple of the liability base rate. Thus, the UIM rate will implicitly include provisions for fixed expenses, variable expenses, risk and profit in the same proportion as the liability rate. Since UIM is an optional coverage, insurers who allocate their fixed expenses only to mandatory coverages may choose to use different expense loadings for liability and UIM. ALAE loadings may differ between liability and UIM claims. As well, differences in risk profiles and payout patterns between liability and UIM may suggest different risk and profit loadings between the coverages.

Note that items 1 and 2 above are additional provisions for the Ontario market (and possibly others) that are not accommodated by the Grant method. An exploration of UIM laws in each jurisdiction worldwide is outside the scope of this paper. The actuary should consult the coverage laws of the jurisdiction in question, in order to determine the appropriate treatment of the issues listed above.

6. Additional considerations

6.1. Loss adjustment expenses

One limitation of this model is that it does not distinguish between indemnity and loss adjust-

ment expenses in its treatment of liability loss costs. Since loss adjustment expenses are not subject to liability coverage limits, they are never covered under UIM and should ideally be removed from liability loss data before using the data for UIM pricing. In practice, this is difficult to achieve because the output of the liability pricing analysis is used as an input to the UIM pricing analysis. In order to maximize accuracy, the liability pricing analysis should be done twice—once including loss adjustment expenses (with the result used to calculate liability rates) and once excluding loss adjustment expenses (with the result used to calculate UIM rates).

As liability limits increase, loss adjustment expenses make up a lower proportion of total costs (since a $1,000,000 claim would generally not have five times as much expense as a $200,000 claim). Therefore, the impact of removing loss adjustment expenses would be to steepen the indicated liability limit relativities. Since UIM prices are driven by differences in liability exposure by limit [see Equation (3.2)], it can be concluded that this model slightly underestimates UIM loss costs—especially at the higher limits.

6.2. Frequency distribution

The model implicitly assumes that the same claim frequency applies to all liability limits. In practice, an insured who purchases the statutory minimum limit may have a different underlying frequency distribution than an insured who purchases a higher limit. Bayes' Theorem could be used to calculate the liability limit distribution, conditional on the occurrence of a liability claim. The conditional distribution would then be used as D in Equation (3.3).

6.3. Data accuracy

Historically, there have been practical challenges to pricing UIM, as some insurers are not able to link UIM claims to the corresponding UIM premium transactions. The result is that UIM claims are coded as liability claims. In these situations, the modeled UIM claim cost should be subtracted from the liability claim cost (which is actually combined liability and UIM claim cost) when determining the indicated liability rates. Since the indicated liability rates are used as an input to the model, an iterative approach may be required.

7. Analysis of the current Ontario UIM market

Over the last several years, the industry has shifted towards an increased proportion of insureds opting to purchase higher liability limits. Possible reasons include:

- An increasingly litigious society
- Heightened level of fear of financial devastation due to an auto accident
- Increased efforts by insurers to "up-sell" to higher levels of coverage
- Focus by insurers on selling "customized" policies that meet the specific needs of individual clients

Table 6 shows the trend in both the liability limit distribution and UIM experience for the Ontario Private Passenger automobile market, 2003–2007.[2]

The last five years have seen a sharp increase in the number of purchasers of $2,000,000 liability, coincident with deterioration in UIM claims experience and only a small rise in UIM premiums. As drivers move from uniform limits to different limits, the UIM exposure increases greatly.

Many insurers may not be aware of or adequately priced for the difference in UIM exposure between the $1,000,000 and $2,000,000 levels. Sixteen major Ontario auto insurance carriers were examined to determine the ratio of

[2]General Insurance Statistical Agency, Automobile Insurance Experience Report AU10-N, 2007 (Electronic Version). Used with permission.

Table 6. Ontario trends in liability limits and UIM costs, 2003–2007

Limit Distribution	2003	2004	2005	2006	2007
$200,000	0.5%	0.4%	0.3%	0.3%	0.2%
$300,000	5.9%	5.7%	5.3%	5.1%	4.8%
$500,000	3.9%	3.1%	2.5%	2.1%	1.8%
$1,000,000	81.3%	81.7%	81.2%	80.1%	78.2%
$2,000,000	8.4%	9.1%	10.5%	12.4%	15.0%
UIM Loss Cost	$5.31	$6.16	$10.73	$9.56	$13.13
UIM Avg. Premium	$14.31	$14.56	$14.44	$14.70	$15.10
UIM Loss Ratio	37%	42%	74%	65%	87%

their UIM premium rate for a $2,000,000 limit to their UIM premium rate for a $1,000,000 limit. The ratios ranged from 1.40 to 2.31, with a median of 2.00. The model presented in the preceding sections suggests that, depending on the data and assumptions used, an appropriate ratio is in the 4.00 to 6.00 range, possibly even higher due to the LAE bias described in Section 6.1. Part of this could be due to the effect of fixed expenses, although arguably (see Section 5) UIM rates should not include loadings for fixed expenses.

8. Conclusions

Due to its low average premium, UIM has a tendency to be ignored or overlooked in the course of a full pricing analysis. However, as the marketplace moves more and more towards increased liability limits (and by association, increased UIM limits), loss costs for UIM will continue to escalate at a steep rate.

If insurers continue to use traditional ratemaking approaches (i.e., using UIM claims to price UIM coverage), their pricing responses will be less than adequate to respond to these trends—leading to ever-increasing UIM loss ratios. As well, their price differences between levels of coverage will fail to distinguish accurately and fairly between the different levels of exposure. The method presented in this paper provides a relatively simple way for pricing actuaries to account for this claim potential, thus keeping loss ratios under control for all coverage types.

While this method was designed specifically for UIM, more investigation into alternative methods may benefit other lines of business where similar pricing challenges exist.

Acknowledgments

The author wishes to thank Christopher Cooney and Laurissa Chow for their assistance.

References

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