Motor OD Pure Premium Modeling using Deductibles in India

Biresh Giri, FIAI, M.Stat.
Consulting Actuary, Milliman India

Abstract

Indian vehicle owners have so far been buying auto insurance policies with fixed deductibles. They had no choice if they were accident-prone and wanted from-ground-up cover. Or if they were low risk or risk-loving individuals and wanted to buy a cover with a high deductible. Many policy holders might not even know if there was any deductible on their auto insurance policy. IRDA, through its file & use circular on November 6, 2008, has relaxed the norm of mandatory fixed deductible on auto insurance policies. This opens up a door of opportunities for the insurance companies and they will be able to design and sell motor own damage covers with different deductible levels. Once a few such products come in the market, the marketing pressure will force all other companies to come up with policies which offer this choice to the customers.

This paper looks at the various methods of premium calculation for policies where deductibles can vary. It then discusses the problem from the Indian market context where the deductibles were fixed so far in the claims data. It then goes on to discuss the problem which the companies will face a few years down the line when they will have claim experience which will have varying level of deductibles and it will need to be analyzed.

Introduction

Motor insurance line of business at 45.5% of the total premium income of Rs 28,126.4 Cr of the Indian general insurance (GI) market in the year Apr'07-Mar'08, stands at Rs 12,801.7 Cr (*Source: IRDA Journal Jun-Jul'08*). It is also growing at an attractive rate. As per IRDA statistics, the motor premium for April-September 2008 is 10.5% more than the corresponding period in the last year. It thus becomes one of the major Lines for any GI company – new or old.

Innovation in product designing was so far limited in this LOB due to the tariffed rates which got relaxed effective from January 1, 2007 for motor own damage. Even after detariffing, the policy terms and conditions were not allowed to change. But IRDA, through its circular on November 6, 2008 relaxed this norm and GI companies will be free to sell policies with different deductible levels.

With high competition in the motor LOB, innovation will be a key factor to attract customers. Offering different levels of deductibles as per customers' needs is just one such innovation. Companies, who become aware of this fact soon, will get the first mover advantage. The others will feel the marketing pressure to price products with different levels of deductibles and will follow suit.

Let us look at how the motor insurance regulatory restrictions on deductibles got relaxed over time, what are the various methods for pricing policies with varying deductible options and how we can use them in India over time.

Existing deductible levels

So far the deductibles had been fixed for each of the LOBs within motor – Commercial, Private Car and Two-wheeler. The deductibles were as per the table below:

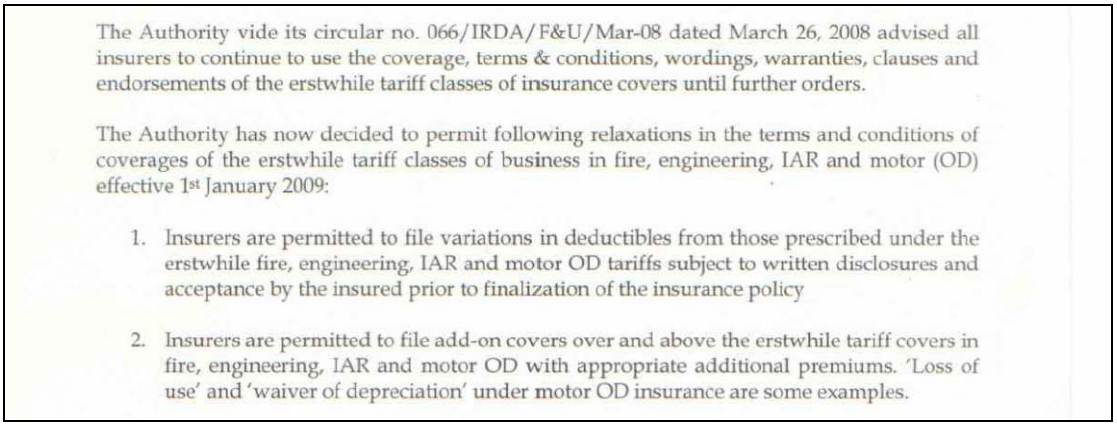
TYPE OF VEHICLES			**COMPULSORY DEDUCTIBLE (Rs)**
Commercial Vehicles (other than vehicles rateable under Class-D,E,F and G of CVT)	**Goods carrying Vehicles**	**Passenger carrying Vehicles**	
	GVW < 7500 Kg. GVW	# Passengers < 17	500/-
	7500 Kg.<= GVW < 16500 Kg.	17 <= # Passengers < 36	1000/-
	GVW >= 16500 Kg.	# Passengers >= 36	1500/-
Vehicles rateable under Class D of the Commercial Vehicles Tariff (CVT)			Max (0.5% of IDV of the vehicle, 2000/-)
Vehicles rateable under Class E, F and G of the Commercial Vehicles Tariff (CVT)			Rs.50/- for two-wheelers and Rs. 500/- for others
Taxis and Three Wheelers rated as Commercial Vehicles (Not exceeding 1500cc)			500/-
Taxis and Three Wheelers rated as Commercial Vehicles (Exceeding 1500 cc)			1000/-
Private Cars including three wheelers rated as Private Cars(Not exceeding1500cc)			500/-
Private Cars including three wheelers rated as Private Cars (Exceeding 1500 cc)			1000/-
Motorized Two Wheelers.			50/-

Source: Tariff Advisory Committee (Indian Motor Tariff 2002)

Economics divides individual into three categories as per their nature towards risk – risk-averse, risk-neutral and risk-loving. Risk-averse customers will tend to like policies with lower or no deductible even if they have to pay proportionately higher premium. On the other hand, a risk-loving customer will tend to like a cover with high deductible if the reduction in premium is attractive. This means given the choice, customers will tend to buy different levels of deductible.

The IRDA circular

IRDA circular number 019/IRDA/NL/F&U/Oct-08 dated November 6, 2008 states the following:



The Authority vide its circular no. 066/IRDA/F&U/Mar-08 dated March 26, 2008 advised all insurers to continue to use the coverage, terms & conditions, wordings, warranties, clauses and endorsements of the erstwhile tariff classes of insurance covers until further orders.

The Authority has now decided to permit following relaxations in the terms and conditions of coverages of the erstwhile tariff classes of business in fire, engineering, IAR and motor (OD) effective 1st January 2009:

1. Insurers are permitted to file variations in deductibles from those prescribed under the erstwhile fire, engineering, IAR and motor OD tariffs subject to written disclosures and acceptance by the insured prior to finalization of the insurance policy

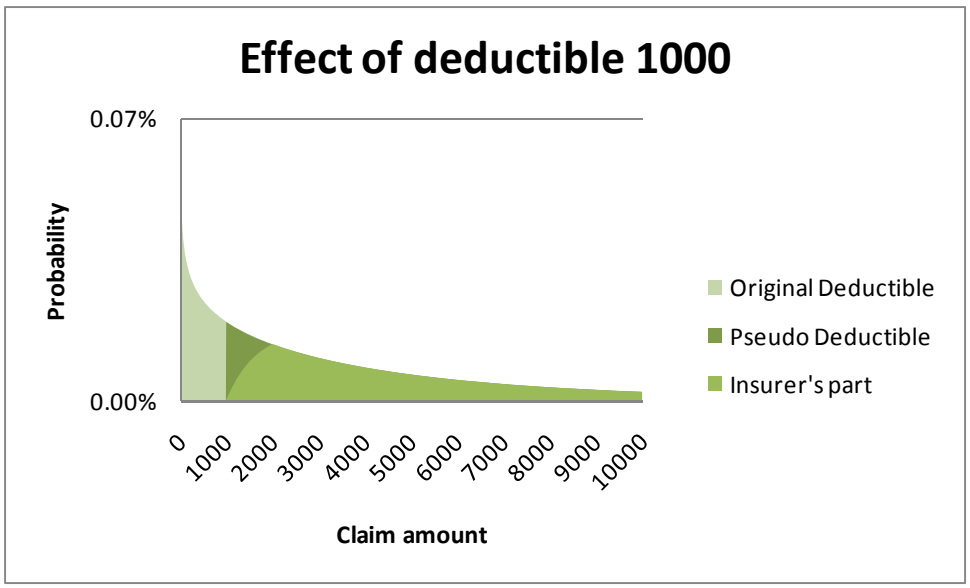
2. Insurers are permitted to file add-on covers over and above the erstwhile tariff covers in fire, engineering, IAR and motor OD with appropriate additional premiums. 'Loss of use' and 'waiver of depreciation' under motor OD insurance are some examples.

This means that all of you would have start on with the analysis of motor (and other lines stated above) premium rates so that a rating table with different deductibles could be made. If not, you should start it soon.

Effects of changing deductible

Introducing deductible reduces the average claim cost per vehicle. This is due to reduction in both the number of claims and the average amount per claim.

The frequency reduces as the claims which are below deductible will not qualify for the insurance claim. In fact, a claim which is marginally above the deductible amount is also at times not claimed to get the benefit of no-claim-bonus next year. This is called the Pseudo-deductible effect. See graph 1 below.



Graph 1: Effect of introducing deductible on the claim distribution

The original deductible and pseudo-deductible parts show the claims which are paid by the insured. The triangular shape of the pseudo-deductible part has vertex towards the right. This is due to the fact that higher proportion of claimants will choose not be claim for a claim amount just above deductible. This proportion goes on decreasing as the claim amount becomes higher than the deductible.

The average claim amount per policy reduces as the deductible amount is paid by the policy holder. So, the claim amount net of deductible is lesser.

Methods of premium rating with deductibles

Generalized Linear Modeling (GLM) method is now widely accepted method for motor OD premium rating. This method helps in identifying the rating variables which affect the premium. It also helps in deciding the levels of rating variables which should be used.

Deductible analysis helps in finding out the change in pure premium by changing the deductible level. There are two broad ways of deductible analysis – traditional and GLM methods. The traditional methods use the impact of deductible on the loss distribution (either empirical or statistically fitted) to estimate the impact on pure premium. The GLM method identifies the rating variables for pure premium calculation. In these methods, deductible can either be used as a rating variable or pure premium relativities can be adjusted for different deductible levels afterwards.

Following are some methods which could be used for deductible analysis:

Traditional Methods

1. Loss elimination ratio (LER)
2. Loss distribution adjustment method

GLM Methods

3. Fit severity distributions using other rating variables and then adjust the estimates for deductibles

4. Use deductible as a rating variable in the frequency-severity modeling

5. Use deductible as a rating variable in the pure premium modeling

   Source: David Cummings, Practical GLM Modeling of Deductibles, CAS Predictive modeling seminar, 2004

Loss Elimination Ratio (LER) Method

Method: This method empirically calculates the impact of deductible on loss amounts. The adjusted losses per policy thus give the pure premium at that deductible level. The method can be applied at a segment level or for the entire portfolio. The algorithm to calculate the pure premium for a higher deductible will be as follows:

- Assume deductible was fixed at X (for example, for private cars with capacity <1500cc, it was Rs 500). Let the sum of total claims at deductible X be S_x.
- For a deductible Y (> 500, say 1000), calculate the sum of net of deductible claims, say S_y.
- $(S_x-S_y)/S_x$ is called the loss elimination ratio. This gives the percentage reduction in the pure premium while going up to deductible Y from X.

Frequency and severity estimates: The adjustment to pure premium can be calculated in this method without calculating frequency or severity of losses. However, if needed the adjusted frequency and severity estimates can also be calculated empirically.

Pros and Cons: This method has the benefit that it is very simple to use. The LER method can be used to adjust the pure premium for a deductible which is higher than the existing deductibles. But the effects of pseudo-deductible cannot be modeled in this method. In other words, no actual data at deductible Y is used to calculate the deductible effect.

Due to the pseudo-deductible effect as mentioned above, it is very difficult to model the impact of deductible. Some assumption regarding behavioral pattern of the claimants will need to be built in. To be able to exactly model the deductible effect at a certain deductible level, we need credible number of claims at those deductibles. We can use the GLM methods in that case.

Loss Distribution Adjustment Method

Method: The Loss Distribution Adjustment method fits a statistical distribution to the claims data. Once a distribution fit is found for the un-truncated claims, distribution and parameter estimates for truncated claims can be found. The estimates for un-truncated can be found by using the MLE method for censored data. Claim with deductible is a left-censored data.

Frequency and severity estimates: The expected claim amount per claim is limited expected value of the claim distribution at the deductible. The frequency of claims above the deductible can be found by claim exceedance probability at the deductible.

Pros and Cons: All the benefits and disadvantages of LER method apply to this method as well. This method has the benefit of smoothing the deductible effect. The deductible discounts may not be smooth for LER method.

Fit Severity Distribution using other Rating Variables

Guiahi in his 2001 paper (see references) explained a method to fit a GLM on a data where deductible is captured apart from other rating variables.

Method: In this method loss data for each loss has the deductible amount and other rating variables. GLM is fitted on number and amount of claims to get the frequency and severity estimates. Deductible is not used as a rating variable.

Frequency and severity estimates: Frequency at each deductible level can be modeled by fitting GLM on number of claims. Un-truncated loss amounts are calculated and used to fit GLM to get severity estimates. Using these estimates, limited expected values at various deductible levels can be found out. The frequency estimates at a new deductible level can be adjusted using the severity distribution.

Pros and Cons: This method models the effect of rating variables which is not captured in the traditional methods. The results can be adjusted to get estimates at different deductible levels. But it is computationally intensive. There is no existing statistical package which can model losses in this way. A customized code will need to be written to carry out the analysis.

Using deductible as a Rating Variable in Frequency-Severity GLM Modeling

Method: This method uses deductible as a covariate rating variable in the GLM. Deductibles can be bucketized in categories and can be used as a categorical rating variable. In both the methods, frequency and severity relativities at existing deductibles can be found out accurately.

Frequency and severity estimates: Frequency and severity relativities at existing deductible levels can be found. Using the two, pure premium can be derived.

Pros and Cons: The estimates using this method are more accurate than the above methods. It takes account of the actual deductible effect on frequency and severity of claims to derive the relativities. But adjusting the pure premium for a new deductible level is very difficult in this case. The results for deductibles which are less common will not be very reliable and may need some smoothing adjustments.

Using deductible as a Rating Variable in Pure Premium GLM Modeling

Method: This is similar to the frequency-severity GLM modeling above. But instead of modeling frequency and severity separately, this method models pure premium using Tweedie distribution. So

Frequency and severity estimates: No separate estimates for frequency and severity are obtained in this method. Instead, a pure premium estimate is directly obtained.

Pros and Cons: The pros and cons of the method are also similar to the method above.

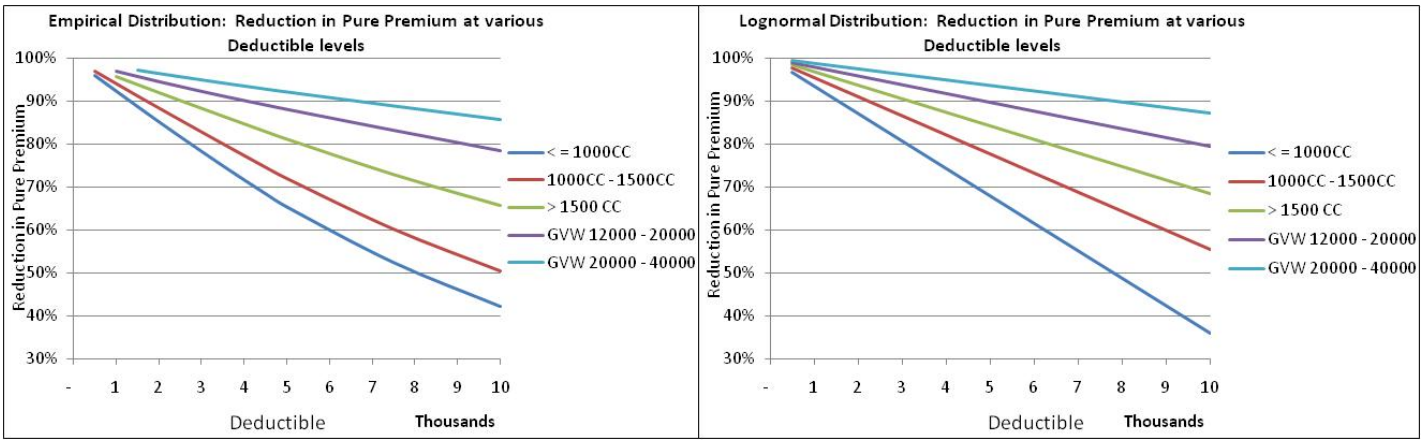
The Indian context

As mentioned above, deductibles were compulsory and fixed in India till 31st December 2008. For example for private cars with capacity less than 1500cc, the deductible was fixed at Rs 500. As the companies will start analyses to derive pure premium at various levels, some of the methods above will be applied.

Not all the methods mentioned above can be applied in India now. As the deductible was fixed so far for each category of vehicles, it cannot be used as a rating variable now. So the traditional methods will need to be applied for the first year. Method 3 can also be used where a deductible adjustment is done after GLM analysis. Once policies with different deductibles are rolled out and claims start coming in, GLM modeling using deductibles can be done.

It is relatively easy to model the effect of a new deductible which is higher than existing fixed deductible. But to estimate the impact on frequency of lowering the deductible below the existing level will be difficult. Using left-censored data, we can only estimate the characteristics of the censored part of the data. The actual data, when collected and studies may be totally different from that estimate. Also, with a lower deductible, the number of vey small or zero claims will increase and it will increase the claim handling cost. Assumptions about ground-up severity distribution and policyholder behavior for various levels of claim amounts will be needed. For example, even when deductible is zero, some claimants still not claim for a small amount to get benefit of the no-claim-bonus.

I tried to find out the reduction in pure premium using a sample data from one of the general insurance companies in India. Please note that the results below are only indicative and should not be used for any rating purposes. The tables below show the reduction in pure premium for 5 categories of vehicles – 3 categories are of private cars and two are of commercial vehicles.



Graph2: Reduction in pure premium at various deductibles using Empirical and Lognormal distributions

Reduction in average claim cost using Empirical distribution

Vehicle Type	Capacity Description	Gross Average Claim Cost	Existing Deductible Level	Average claim at new deductible levels											
				500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	7,500	10,000
Private Car	< = 1000CC	12,679	500	96%	92%	89%	85%	82%	78%	75%	72%	68%	65%	52%	42%
Private Car	1000CC - 1500CC	16,428	500	97%	94%	91%	88%	86%	83%	80%	77%	75%	72%	60%	50%
Private Car	> 1500 CC	24,088	1,000		96%	94%	92%	90%	88%	87%	85%	83%	81%	73%	66%
Commercial	GVW 12000 - 20000	33,197	1,000		97%	96%	95%	93%	92%	91%	90%	89%	88%	83%	79%
Commercial	GVW 20000 - 40000	55,176	1,500			97%	97%	96%	95%	94%	94%	93%	92%	89%	86%

Reduction in average claim cost using Lognormal distribution

Vehicle Type	Capacity Description	Gross Claim Cost		Lognormal Parameters		Average claim at new deductible levels											
		Average	Std Dev	Mean	Sigma	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	7,500	10,000
Private Car	< = 1000CC	12,679	14,356	8.82	1.12	97%	94%	90%	87%	84%	81%	78%	74%	71%	68%	52%	36%
Private Car	1000CC - 1500CC	16,428	26,638	8.72	1.40	98%	96%	93%	91%	89%	87%	84%	82%	80%	78%	67%	55%
Private Car	> 1500 CC	24,088	33,924	9.25	1.30	98%	97%	95%	94%	92%	91%	89%	87%	86%	84%	76%	68%
Commercial	GVW 12000 - 20000	33,197	69,717	9.17	1.58	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	85%	79%
Commercial	GVW 20000 - 40000	55,176	104,158	9.78	1.51	99%	99%	98%	97%	97%	96%	96%	95%	94%	94%	90%	87%

Table 1: The tables corresponding to Graph 2

The reduction using Lognormal distribution is not very far from the reductions using Empirical distribution. But at the same time, there may be other distribution which fit better than Lognormal to the claims data. Empirical reduction is steep in the beginning but it slows down as the deductible becomes high. Lognormal reduction, on the other hand, is slow in the beginning and faster at higher deductibles. Also the difference in reductions between private and commercial vehicles is very evident from the graph.

A correct severity fit to the data is very necessary in the current circumstances. The extent of discount given for various deductible levels will depend mostly on the distribution of losses. The increase in discount for increasing deductible by Rs 500 will not be same for a positively and a negatively skewed distribution. The data should be sub-segmented into categories so that the heterogeneity of the risks can be modeled appropriately. But the number of sub-segments should be restricted so that credible data is available in each sub-segment. A reasonable adjustment for pseudo-deductible effect should also be applied.

The Way Ahead

Claim analysis for motor own damage has been so far simple. This is for various reasons:

- No reason to do complex analysis for pricing as the rates were tariffed
- No reason to do complex analysis for innovative terms and conditions as they could not be changed
- Very few rating variable captured in the data
- Some captured rating variables could not be used as the data captured was not reliable.

This situation is going to change very soon. Almost all the restrictions on the policies will be relaxed sooner or later and the market will become free for innovation. Designing of innovative products will bring premium to the company and accolade to the actuarial department. So there is a very clear case of investment. But, innovation will need:

- Capturing new and reliable data which enables such analyses and

- Being able to carry out complex analysis using captured data

Different-levels-of-deductible is just a beginning. It will be interesting to see how the GI companies and the customers react to this. For the GI companies it will mean developing new products, making changes to the IT systems, proposal forms and more. As for the customers, as always the rational ones will buy the best!

References

- *Guiahi, "Fitting Loss Distributions with Emphasis on Rating Variables", CAS Winter Forum, 2001*
- *David Cummings, Practical GLM Modeling of Deductibles, CAS Predictive modeling seminar, 2004*
- McCullagh, P. and Nelder, J.A. (1989). *Generalized Models*, Second Edition. Chapman and Hall, New York.