AUTOMOBILE WARRANTY UNEARNED PREMIUMS AND DEFERRED POLICY ACQUISITION EXPENSES

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Abstract

This paper describes one approach to calculate the unearned premium reserves of an automobile extended warranty insurance program, test the adequacy of the calculated reserves, and determine the allowable deferred policy acquisition expenses.

A prorata formula is commonly used to calculate unearned premium reserves in property-casualty insurance, but we believe that an exposure adjusted formula is more appropriate in automobile extended warranties.

We organize data by the effective month of the manufacturer warranty and employ an expected pure premium methodology to calculate the unearned premium reserves for an automobile extended warranty contract.

Unearned premium reserves plus future investment income derived thereof are compared against future claims and expenses to determine if premium deficiency exists. Investment income is estimated from interest bearing assets, taking into account credit risk, interest rate risk and payment pattern risk.

Automobile warranties have terms ranging from 1 year to 7 years and acquisition expenses are large relative to the first year earned premiums. In (US and Canadian)

GAAP financial statements, insurance companies are allowed to defer policy acquisition expenses to the extent they meet the test of recoverability.

Finally, we discuss the impact of reinsurance on a mono line warranty insurance company's balance sheet.

1. INTRODUCTION

A new automobile extended warranty (hereinafter called an extended warranty) is usually defined by two limits, time and mileage. An extended warranty is expired when either one of the two limits is reached. For example, a 5 years/60,000 miles extended warranty means the warranty will expire either in 5 years, or when the odometer reading reaches 60,000 miles, whichever comes first. The extended warranty for new vehicles usually does not come into effect until the coverage under the manufacturer warranty has expired. Recently, most manufacturers have been offering 3 years/36,000 miles of full (bumper to bumper) coverage.

As the exposure of an extended warranty is measured from the registration date of the new vehicle, the age of any extended warranty is the time elapsed between the registration date and the valuation date. In this paper, an extended warranty is assumed to be effective on the first day of the effective month.

2. UNEARNED PREMIUM RESERVES

The unearned premium reserves of an extended warranty can be calculated on an exposure adjusted basis or a prorata basis. In our opinion, the exposure adjusted basis is

a better approach. Under this approach premiums are earned in proportion to the emergence of the expected losses; when 5% of the ultimate losses are expected to be the cumulative incurred at the end of year two, the formula should have 95% of the written premiums as unearned premiums. As an illustration, a typical 6 years/72,000 miles (6/72) extended warranty with an underlying three year manufacturer warranty might have the following cumulative expected loss, earned and unearned pattern.

Time	0	12 mos	24 mos	36 mos	48 mos	60 mos	72 mos
Expected losses	0	2	5	15	45	75	100
Earned	0%	2%	5%	15%	45%	75%	100%
Unearned	100%	98%	95%	85%	55%	25%	0%

The above earned pattern, together with a proper amortization of acquisition expenses would theoretically match the income and outgo of the 6/72 contract throughout the life of the contract.

For a contract type *l* we denote the expected monthly pure premiums for month 1,2,……n, as $P_{1,l}$, $P_{2,l}$, $P_{3,l,}$ ….., $P_{n,l}$, where n is the contract term in months +1; and the expected pure premium for contract type *l* as P_l.

Then,

$$P_l = \sum_{i=1}^{n} P_{i,l}\,.$$

The unearned premium ratio for a contract type *l* at *k* months is:

$$R_{k,l} = 1 - \frac{\sum_{i=1}^{k} P_{i,l}}{P_l} = \frac{\sum_{i=k+1}^{n} P_{i,l}}{P_l} \qquad (2.1)$$

For the above contract type *l*, we have inforce extended warranties that are 1,2…..,n-1 months old.

Let $G_{i,l}$ represent the written premiums of a group of extended warranties, all with contract type *l* and *i* months old, and $R_{i,l}$ represent the unearned premium ratio for age *i*. Then, the unearned premiums of these extended warranties are:

$$U_l = \sum_{i=1}^{n-1} R_{i,l} G_{i,l} \qquad (2.2)$$

If there are m different contract types in a program, the unearned premiums of the entire program are:

$$\sum_{l=1}^{m} U_l = \sum_{l=1}^{m} \sum_{i=1}^{n-1} R_{i,l} G_{i,l} \qquad (2.3)$$

The formulae (2.1), (2.2) and (2.3) hold true for either the prorata method or the exposure adjusted method. In the case of the prorata method $P_{1,l} = P_{2,l} = P_{3,l} = \ldots = P_{n,l}$ for contract type *l*.

Under the prorata method, premiums are earned in proportion to the time expired on the contract. Notwithstanding its simplicity, this method produces a severe overstatement of

premiums earned in the early part of the contract and a corresponding understatement of earned premiums near the end of the contract.

At this moment, there is no consensus as to which method is proper. The accounting profession has limited guidance on warranty unearned premium reserves. Under FASB60, extended warranties are classified as short-duration contracts: "Premiums from short-duration contracts ordinarily are recognized as revenue over the period of the contract in proportion to the amount of insurance protection provided."[1]

A straight interpretation of FASB60 would suggest the following 2 approaches.

(1) Time	0 mos	12 mos	24 mos	36 mos	48 mos	60 mos	72 mos
Cumulative Earned	0	0	0	0	1/3	2/3	3/3
(2) Mileage (in miles)	0	12,000	24,000	36,000	48,000	60,000	72,000
Cumulative Earned	0	0	0	0	1/3	2/3	3/3

The first approach presumes that no policyholder drives more than 12,000 miles per year. We know that assumption is highly implausible. The second approach is more accurate than the first, but it is impractical to determine the odometer readings of all policyholders on a valuation date. The exposure adjusted method is really a blending of approach 1 and 2. When it is supported by loss experience, the exposure adjusted method is the only one which follows the intent of FASB60.

3. DATA ORGANIZATION

As an extended warranty comes into effect when the manufacturer warranty expires, it is convenient to track the exposure and claim payments of such an extended warranty by the

[1] Summary of FASB Statement No. 60, paragraph 3 (Appendix A).

registration date of the vehicle (i.e., the effective date of its manufacturer warranty). The sale date of an extended warranty offers less accurate information about the exposure to the insurer because a large percentage of extended warranties are not sold on the same date as the vehicle. Most extended warranty programs give the original owner up to 12 months to purchase an extended warranty as long as the 3 years/36,000 miles portion of the manufacturer warranty has not expired. Claim payments are used here in lieu of incurred claim amount because incurred claim amount might change slightly after the valuation date (e.g. December 31, 1998). The historical data for contract type *l* should look as follows:

	Effective Month						
Age of Contract	1/91	2/91	------	------	10/98	11/98	12/98
1	$A_{1,1,l}$	$A_{1,2,l}$			$A_{1,94,l}$	$A_{1,95,l}$	$A_{1,96,l}$
2	$A_{2,1,l}$	$A_{2,2,l}$			$A_{2,94,l}$	$A_{2,95,l}$	
3	$A_{3,1,l}$	$A_{3,2,l}$			$A_{3,94,l}$		
• • •							
J	$A_{j,1,l}$	$A_{j,2,l}$					
•							
73	$A_{73,1,l}$	$A_{73,2,l}$					

Where, age of contract = valuation month/year – effective month/year of manufacturer warranty +1

$A_{i,j,l}$ = Claim amount from contract type *l* with effective month *j* and paid during the month *i* of the contract.

A set of data for a 2 years/24,000 miles plan with a 1 year/12,000 miles manufacturer warranty is shown in Appendix B.

4. METHODOLOGY AND ASSUMPTIONS

First, the exposures (in contract months) have to be determined. Let $E_{i,j,l}$ be the number of exposures for a specific contract type *l*, age (month) *i* and effective month *j*. For a given effective month (based on manufacturer warranty effective date) and contract type, we can project the number of exposures $E_{i,j,l}$ for each month subsequent to its effective month. We assume no lapse in our projection. For example, assume there are 1,000 contracts in a 6 years/72,000 miles program (contract type *l*) with effective month in July 1991, then, we would project the following exposures:

Calendar month	Age in month *i*	Exposure $E_{i,j,l}$
⋮	⋮	⋮
November 1993	29	1,000
December 1993	30	1,000
⋮	⋮	⋮
June 1997	72	1,000
July 1997	73	1,000
August 1997	74	0

The above projection assumes that after a cooling off period (usually 60 days for consumers to reverse their impulsive decisions to purchase extended warranties), the extended warranty count will remain the same until expiration. A small percentage of warranties are cancelled mid-term because their underlying vehicles have been written off in accidents. This simplification will not have a material effect on the future claim projection because

future claim payments = pure premium x exposure in months.

The exposure term is overstated by the inclusion of cancelled extended warranties, but the pure premium term is understated by roughly the same percentage. (The no-lapse assumption can be removed if we keep track of exposures, not only by effective month and contract type, but also by age of each contract.) For the balance of this paper, we will use the no lapse assumption and drop the first subscript from $E_{i,j,l}$ and use $E_{j,l}$ instead.

The above projection also assumes that all contracts are effective on the first day of each month. The extra month (73rd month) is used to capture all late payments or repairs done in the last month of the contract.

From the data, we can estimate the monthly pure premiums by age for each contract as follows:

LET $N_{i,j,l}$ be the claim count in month *i* of the contract term for contract type *l* with effective dates in month *j*.

$E_{j,l}$ be the warranty count for contract type *l* with effective dates in month *j*.

$A_{i,j,l}$ be the actual claim payment in month *i* of the contract term for contract type *l* with effective dates in month *j*.

$P_{i,l}$ be the average pure premium in month *i* for the contract type *l*,

$P_{i,l}$ = claim frequency x average claim size.

$$P_{i,l} = \frac{\sum_j N_{i,j,l}}{\sum_j E_{j,l}} \times \frac{\sum_j A_{i,j,l}}{\sum_j N_{i,j,l}}$$

$$P_{i,l} = \frac{\sum_j A_{i,j,l}}{\sum_j E_{j,l}} \qquad (4.1)$$

This is usually calculated using the last 12 calendar months of data available for each age (month *i*). (If it is necessary to use more than 12 months of data, some inflation adjustment to formula (4.1) is needed.) For contracts sold recently, the data has not reached the part of the contract term when claims are more likely to be made. Therefore, the pure premiums have to be estimated from the more mature contracts with similar features. In all cases, the $P_{i,l}$s should be smoothed and adjusted to the valuation date cost level. The resultant $P_{i,l}$s become the expected monthly pure premiums for contract type *l*.

Using a 6 years/72,000 miles contract as an illustration, we have monthly expected pure premiums P_1 to P_{73}. (In this illustration, only one contract type is involved. The subscript *l* is dropped for simplicity.) The expected pure premium of a 6 years/72,000 miles contract with four years to expiry would be:

$$\sum_{i=25}^{73} P_i$$

Assuming there are E_{25} contracts that are 24 months old, the expected payments of these contracts would be:

$$E_{25} \times \sum_{i=25}^{73} P_i \qquad \text{OR} \qquad \sum_{i=25}^{73} P_i \times E_{25} \qquad (4.2)$$

Let's assume the valuation date is December 31, 1998 and there are E_{73} (contracts effective in Jan. 93), …, E_{25} (contracts effective in Jan. 97) ….....E_2 (contracts effective in Dec. 98) in the inforce book.

There is usually some inflation in warranty repairs as very few people shop around for a bargain when they are covered by a warranty. As P_i's from formula (4.2) are at December 1998 cost level, they have to be adjusted for inflation after the valuation date. If *r* is the monthly inflation rate, the same repair in January 1999 should cost *r*% more than that in December 1998.

Therefore (4.2), the total expected payment for contracts with 4 years to expiry, becomes:

$$\sum_{i=25}^{73} P_i \times (1+r)^{i-24} \times E_{25} \qquad (4.3)$$

Formula (4.3) can be expanded as follows:

Age of Claim	Payment Month	Expected Pure Premium	Inflation factor	Exposure	Expected Payments
25	Jan. 1999	P_{25}	$(1+r)$	E_{25}	$P_{25} \times (1+r) \times E_{25}$
26	Feb. 1999	P_{26}	$(1+r)^2$	E_{25}	$P_{26} \times (1+r)^2 \times E_{25}$
27	Mar. 1999	P_{27}	$(1+r)^3$	E_{25}	$P_{27} \times (1+r)^3 \times E_{25}$
28	Apr. 1999	P_{28}	$(1+r)^4$	E_{25}	$P_{28} \times (1+r)^4 \times E_{25}$
⋮					
72	Dec. 2002	P_{72}	$(1+r)^{48}$	E_{25}	$P_{72} \times (1+r)^{48} \times E_{25}$
73	Jan. 2003	P_{73}	$(1+r)^{49}$	E_{25}	$P_{73} \times (1+r)^{49} \times E_{25}$

There are E_2 to E_{73} contracts with age ranging from 1 month to 72 months respectively.

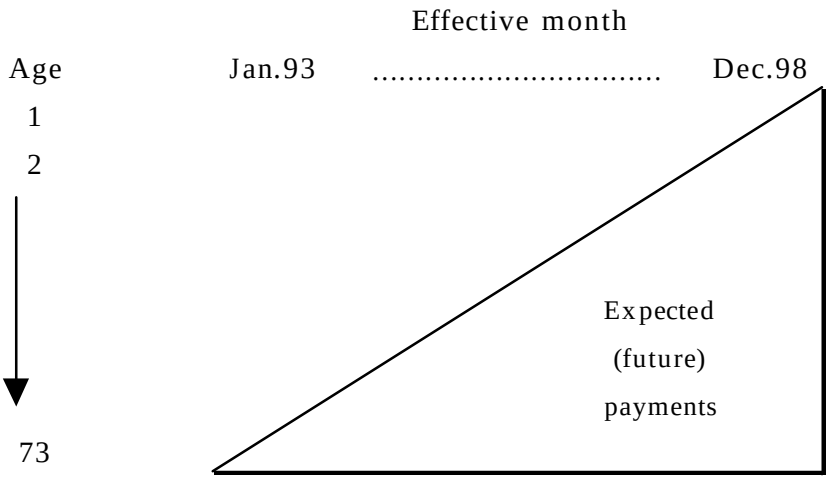
The expected losses (C) of all 6/72 contracts (after the valuation date) can be estimated as follows:

$$C = \sum_{m=2}^{73} \sum_{i=m}^{73} P_i \times (1+r)^{i-m+1} \times E_m \qquad (4.4)$$

Where m = effective month of the contract

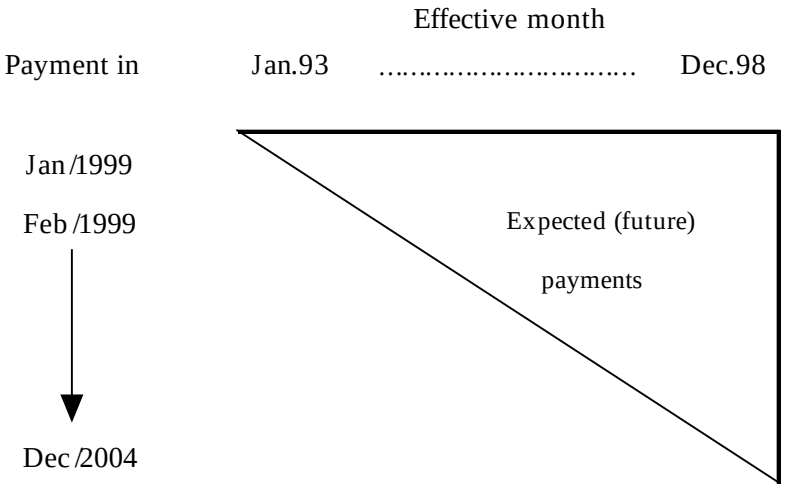
i = age of the contract

The expected loss calculation for all 6/72 contracts can be illustrated by the following diagram:



In the above triangle the rows represent the age of the contracts and the columns represent the effective month of the contracts. Each diagonal, however, represents a calendar month of payments starting with January 1999.

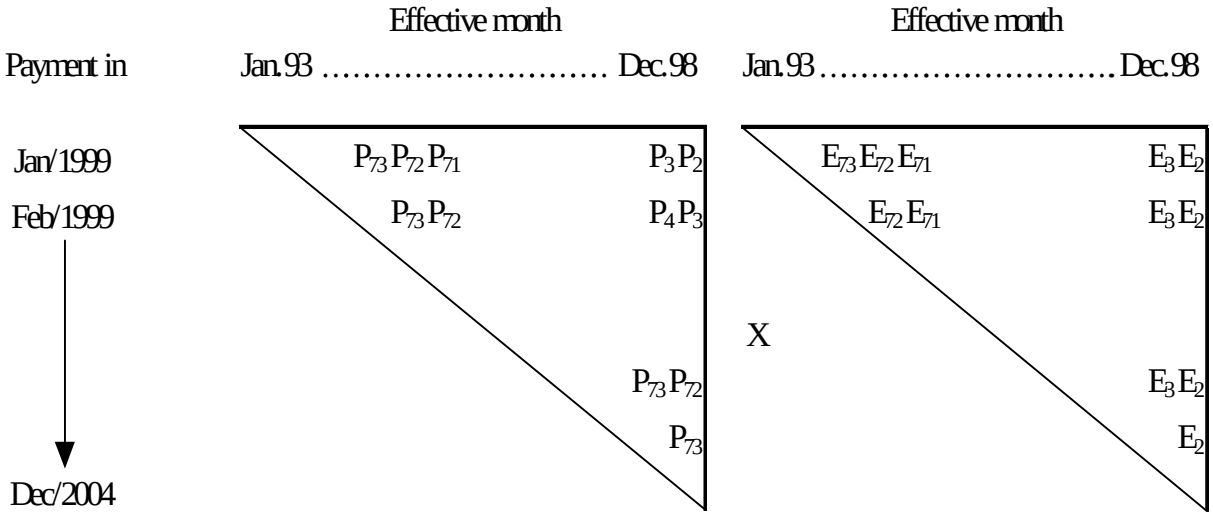
The above triangle can be re-oriented so that each diagonal becomes a row corresponding to the calendar month in which payments are expected. The new triangle would look as follows:



Each diagonal in the top diagram is now a row in the reoriented triangle.

Expected payments = expected monthly pure premiums times exposures. For January 1999, the expected payments = $P_2E_2 + P_3E_3 + \ldots + P_{73}E_{73}$, because E_2, E_3, …, E_{73} are 2 months, 3 months, …, 72 months old respectively. For February 1999, the expected payments = $P_3E_2 + P_4E_3 + \ldots + P_{73}E_{72}$.

The expected payment triangle is a product of the expected pure premium triangle and the exposure triangle.



Where,

P_2…..P_{73} represent the expected pure premiums from age 2 to 73

E_{73}….E_2 represent the contracts with effective month in Jan. 1993, Feb. 1993, …, Dec. 1998.

Before the application of inflation factors, equation (4.4) essentially sums the product of each column of the above diagram from right to left. As inflation applies on a calendar month basis, it is more convenient to sum the product of each row first and apply an appropriate inflation factor.

Now equation (4.4) can be re-written as:

$$C = \sum_{m=2}^{73} \sum_{i=m}^{73} P_i E_{i+2-m} (1+r)^{m-1} \qquad (4.5)$$

The above expected losses are only for contract type *l,* 6 years/72,000 miles. If we repeat this process for each contract type we will obtain the expected losses for the entire extended warranty program.

5. ADEQUACY OF UNEARNED PREMIUMS

The general approach to test the adequacy of unearned premiums is to compare the sum of unearned premiums and investment income from the funds backing the liabilities against the sum of expected losses, claim adjustment expenses and policy maintenance expenses. A positive result of this comparison indicates that the unearned premium reserves are adequate and some acquisition expenses may be deferrable for GAAP financial reporting[2]. A negative result indicates a premium deficiency. When there is premium deficiency, both US and Canadian GAAP require a premium deficiency provision. A premium deficiency should first be recognized by writing off any unamortized deferred policy acquisition expenses to the extent required. If the premium deficiency is greater than the unamortized deferred policy acquisition expenses, a separate liability should be provided for the excess deficiency. This has the same effect as increasing the unearned premium reserves to meet the future claims and expense obligations.

If we use equation (4.5) for each warranty type, we can generate the expected monthly claim payments of the entire program. As extended warranties usually have terms shorter

[2] Relevant sections of FASB60 are reproduced in Appendix A.

than 7 years, it would be reasonable to use a subset of the company's bond portfolio to support the unearned premium reserves. In order to determine the future investment income attributable to the assets supporting the unearned premium reserves, we have to estimate an expected investment yield of this portfolio. Besides the portfolio market yield, there are several considerations: credit risk, interest rate risk, claim payment pattern risk, liquidity risk, and foreign exchange risk. Since most insurance companies invest in high grade bonds and extended warranty claims tend to be in one currency, we decide to ignore the last two risk categories in this paper. We start with the market yield of our bond portfolio and apply a margin for credit risk, interest rate risk, and payment pattern risk to estimate the expected yield of this portfolio. (The margin calculation for each risk category is discussed in Appendix C.)

The following example illustrates how the expected yield is estimated.

(1)	Market yield of portfolio	5.75%
(2)	Credit risk of portfolio	(.10%)
(3)	Interest rate risk	(.30%)
(4)	Payment pattern risk	(.35%)
(5)	Expected yield (annual), sum (1) to (4)	5.00%
(6)	Expected yield (monthly)	0.4074%

Once we know the expected investment yield and the expected losses, we can forecast the run-off experience of the warranty program. Starting with the market value of the bonds backing the unearned premium reserves, we deduct monthly claim payments, claim adjustment expenses, policy maintenance expenses and add back monthly investment income to the account as follows:

Month	Opening Asset	Paid Claims	Claim Adjustment Expenses	Policy Maintenance Expenses	Investment Income	Ending Asset
1/1999	A_1	C_1	CAE_1	AD_1	I_1	A_2 #
2/1999	A_2	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
12/2004	A_{72}	C_{72}	CAE_{72}	AD_{72}	I_{72}	A_{73}

All of the above calculations assume that the payments are made in the middle of the month and investment income is the product of average monthly assets and the selected interest rate.

Specifically,

A_i = opening asset value of each month and A_1 = asset value on 12/31/98

C_i = monthly claim payments from equation (4.5)

CAE_i = claim adjustment expenses, usually a percentage of C_i

AD_i = policy maintenance expenses to keep policy in force, usually a flat amount or a percentage of unearned premiums

$I_i = 0.4074\% \times \frac{1}{2} [2A_i - (C_i + CAE_i + AD_i)]$

$A_{i+1} = A_i - C_i - CAE_i - AD_i + I_i$

[e.g. $A_2 = A_1 - C_1 - CAE_1 - AD_1 + I_1$]

When A_{73} (the surplus in the run-off) is negative, there is a premium deficiency. Otherwise, the unearned premiums are adequate.

6. DEFERRED POLICY ACQUISITION EXPENSES (DPAE)

Extended warranty is a single premium policy. Acquisition costs are paid up front. If they are expensed in the year when the policy is written, there will be a large operating loss in that year. US and Canadian GAAP allow the deferral of acquisition expenses provided they meet the test of recoverability. There are two parts to the test. The first part tests whether there is a reasonable expectation that the insurer will recover some of the acquisition expenses (e.g., brokerage/commission/premium tax, etc.), if a policy is cancelled. The second part tests whether the insurer can expect a reasonable profit, when all the extended warranties expire. If both questions are answered affirmatively, then some policy acquisition expenses are deferrable. However, we still do not know the amount, which is deferrable. A reasonable inference from the guidance on premium deficiency (FASB60, para 32, CICA-ACG3 para 5, 8 & 10) suggests that unearned premiums less DPAE ought to be sufficient to discharge future claims and expenses related to the inforce business. That is, DPAE should not exceed the surplus in the run-off. Also, expenses which have not been incurred, cannot be deferred. Therefore, in our opinion, the allowable deferred policy acquisition expenses should be limited to the lesser of:

(a) the surplus (A_{73}) in the run-off; or

(b) acquisition expense ratio times unearned premium reserves.

The following illustrates the above concept for a 6/72 contract at the end of year two. In practice, the DPAE calculation is done only for the entire extended warranty program.

(1)	Written Premium	105.26
(2)	Acquisition Expenses Paid	42.11

(3)	Acquisition Expense Ratio, (2)/(1)	40.00%
(4)	Unearned Premiums [see table in section 2, 95% x (1)]	100.00
(5)	Expected Losses[3]	50.00
(6)	Claim Adjustment Expenses	5.00
(7)	Policy Maintenance Expenses	2.00
(8)	Investment Income	16.00
(9)	Expected Surplus in Run-off, (4)-(5)-(6)-(7)+(8)	59.00
(10)	Allowable DPAE, Minimum [(3) x (4), (9)]	40.00

The deferral of acquisition expenses does not affect the liabilities of the insurer. It creates an asset[4] on the insurer's balance sheet. As a result, the expenses charged to the income statement for an extended warranty in year one would be substantially reduced.

As deferrable expenses are expressed as a percentage of unearned premiums, the choice of prorata or exposure adjusted method would affect the amount of deferred policy acquisition expenses. The use of prorata method, however, could lead to a premium deficiency situation in the latter part of the extended warranty program because the insurer has declared too much profit in the early part of the program.

7. DEFERRED POLICY ACQUISITION EXPENSES AFTER REINSURANCE

Thus far, we assume no reinsurance in our calculation. As warranty is a high frequency and low severity class, reinsurance, if applicable, will tend to be quota share or aggregate stop loss in nature.

The effect of reinsurance on DPAE is best illustrated with an example:

[3] In most property-casualty insurance, expected losses are derived as expected loss ratio times unearned premiums.

	Direct	Ceded	Net
(1) Unearned Premiums	100.00	75.00	25.00
(2) Expected Losses	50.00	37.50	12.50
(3) Claim Adjustment Expenses	5.00	3.75	1.25
(4) Policy Maintenance	2.00	0.00	2.00
(5) Deferrable Expenses	40.00	26.25	13.75
(6) Investment Income	16.00	N/A	4.00
(7) Expected Surplus in Run-off	59.00	N/A	13.25
(8) Allowable DPAE, Min. [(5), (7)]	40.00		13.25
(9) Unearned Commissions		26.25	

In the above example, the program, before 75% quote share reinsurance, will generate enough surplus (59) to allow the insurer to defer 40% of the unearned premiums. In this quota share reinsurance transaction, the insurer receives 35% ceding commissions and an agreement to share claim adjustment expenses on a prorata basis. The net acquisition expense ratio after reinsurance is 55% (13.75/25), higher than 40% on a direct basis. Furthermore, the cashflow (as a percentage of the unearned premiums) is reduced due to the 100% retained policy maintenance expenses; investment income is reduced to 4. Consequently, the surplus in the run-off is reduced to 13.25 units as opposed to 25% of 59 on a direct basis (i.e., 14.75 units).

The net allowable DPAE is 13.25, being the lesser of deferrable expenses (13.75) and the surplus in the run-off (13.25).

8. BALANCE SHEET

[4] Deferred policy acquisition expenses are classified as an asset (FASB60 para 29, CICA, ACG3 para10).

It is worthwhile to look at the insurer's balance sheet before and after reinsurance. Before reinsurance, we have unearned premiums of 100 and DPAE of 40. The balance sheet looks as follows:

Assets		Liabilities & Shareholders Equity	
Bonds	140.00	Unearned premiums	100.00
Ceded unearned premiums	0.00	Unpaid claims	Small
Ceded unpaid claims	0.00	Unearned commissions	0.00
DPAE	40.00	Shareholders equity	80.00
	180.00		180.00

After reinsurance, the balance sheet (GAAP gross up basis) looks as follows:

Assets		Liabilities & Shareholders Equity	
Bonds	65.00	Unearned premiums	100.00
Ceded unearned premiums	75.00	Unpaid claims	Small
Ceded unpaid claims	Small	Unearned commissions	26.25
DPAE	39.50	Shareholders equity	53.25
	179.50		179.50

The net unearned premiums are 25, being 100 on the liability ledger less 75 on the asset ledger. On the valuation date, the reinsurer's ceding commissions are classified as unearned commissions to the insurer (i.e., a liability) because they have to be returned if the ceded premiums are returned. The gross DPAE on the asset ledger is no longer 40 because in a run-off the insurer will earn 26.25 commissions from the reinsurer and realize an expected surplus of 13.25 from the net retained premiums. Therefore, the gross up DPAE should not exceed (26.25 + 13.25) or 39.50. Furthermore, the gross up DPAE should not exceed 40 (the deferrable expenses before reinsurance) because the

insurer cannot defer more than its actual deferrable policy acquisition expenses. In our example the first limitation is lower. Therefore, the balance sheet should show 39.50 as the gross allowable DPAE. By entering into a quota share reinsurance, some DPAE (40 – 39.5) is lost in the form of frictional cost or profit to the reinsurer.

9. CONCLUSION

This paper describes an exposure adjusted methodology to calculate the unearned premium reserves of an automobile extended warranty insurance program, test the adequacy of the calculated reserves. It also presents a general formula to estimate the allowable deferred policy acquisition expenses on a before and after reinsurance basis for all property-casualty insurance companies.

Appendix A

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SUMMARY OF FASB STATEMENT NO. 60

Accounting and Reporting by Insurance Enterprises (Issued: June/82)

This Statement extracts the specialized principles and practices from the AICPA insurance industry related Guides and Statements of Position and establishes financial accounting and reporting standards for insurance enterprises other than mutual life insurance enterprises, assessment enterprises, and fraternal benefit societies.

Insurance contracts, for purposes of this Statement, need to be classified as short-duration or long-duration contracts. Long-duration contracts include contracts, such as whole-life, guaranteed renewable term life, endowment, annuity, and title insurance contracts, that are expected to remain in force for an extended period. All other insurance contracts are considered short-duration contracts and include most property and liability insurance contracts.

Premiums from short-duration contracts ordinarily are recognized as revenue over the period of the contract in proportion to the amount of insurance protection provided. Claim costs, including estimates of costs for claims relating to insured events that have occurred but have not been reported to the insurer, are recognized when insured events occur.

Premiums from long-duration contracts are recognized as revenue when due from policyholders. The present value of estimated future policy benefits to be paid to or on behalf of policyholders less the present value of estimated future net premiums to be collected from policyholders are accrued when premium revenue is recognized. Those estimates are based on assumptions, such as estimates of expected investment yields, mortality, morbidity, terminations, and expenses, applicable at the time the insurance contracts are made. Claim costs are recognized when insured events occur.

Costs that vary with and are primarily related to the acquisition of insurance contracts (acquisition costs) are capitalized and charged to expense in proportion to premium revenue recognized.

Investments are reported as follows: common and non redeemable preferred stocks at market, bonds and redeemable preferred stocks at amortized cost, mortgage loans at

outstanding principal or amortized cost, and real estate at depreciated cost. Realized investment gains and losses are reported in the income statement below operating income and net of applicable income taxes. Unrealized investment gains and losses, net of applicable income taxes, are included in stockholders' (policyholders') equity.

FASB – Statement No. 60
Accounting and Reporting by Insurance Enterprises (Issued: June 1982)

Acquisition Costs

FAS60, Par. 28

28. Acquisition costs are those costs that vary with and are primarily related to the acquisition of new and renewal insurance contracts. Commissions and other costs (for example, salaries of certain employees involved in the underwriting and policy issue functions, and medical and inspection fees) that are primarily related to insurance contracts issued or renewed during the period in which the costs are incurred shall be considered acquisition costs.

FAS60, Par. 29

29. Acquisition costs shall be capitalized and charged to expense in proportion to premium revenue recognized. To associate acquisition costs with related premium revenue, acquisition costs shall be allocated by groupings of insurance contracts consistent with the enterprise's manner of acquiring, servicing, and measuring the profitability of its insurance contracts. Unamortized acquisition costs shall be classified as an asset.

FAS60, Par. 30

30. If acquisition costs for short-duration contracts are determined based on a percentage relationship of costs incurred to premiums from contracts issued or renewed for a specified period, the percentage relationship and the period used, once determined, shall be applied to applicable unearned premiums throughout the period of the contracts.

FAS60, Par. 31

31. Actual acquisition costs for long-duration contracts shall be used in determining acquisition costs to be capitalized as long as gross premiums are sufficient to cover actual costs. However, estimated acquisition costs may be used if the difference is not significant. Capitalized acquisition costs shall be charged to expense using methods that include the same assumptions used in estimating the liability for future policy benefits.

Premium Deficiency

FAS60, Par. 32

32. A probable loss on insurance contracts exists if there is a premium deficiency relating to short-duration or long-duration contracts. Insurance contracts shall be grouped consistent with the enterprise's manner of acquiring, servicing, and measuring the profitability of its insurance contracts to determine if a premium deficiency exists.

Appendix B

Historical claim amount by manufacturer effective month and by age of warranty

age of contracts	Dec 1996	Jan 1997	Feb 1997	Mar 1997	Apr 1997	May 1997	Jun 1997	Jul 1997	Aug 1997	Sep 1997	Oct 1997	Nov 1997	Dec 1997	Jan 1998	Feb 1998	Mar 1998	Apr 1998	May 1998	Jun 1998	Jul 1998	Aug 1998	Sep 1998	Oct 1998	Nov 1998	Dec 1998
1	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120	115	147	65	110	96	83
2	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120	115	147	65	110	96	
3	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120	115	147	65	110		
4	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120	115	147	65			
5	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120	115	147				
6	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120	115					
7	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64	120						
8	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95	64							
9	100	105	94	95	89	92	131	140	68	114	103	102	135	115	85	87	95								
10	500	525	470	475	445	460	655	700	340	570	515	510	675	575	425	435									
11	500	525	470	475	445	460	655	700	340	570	515	510	675	575	425										
12	500	525	470	475	445	460	655	700	340	570	515	510	675	575											
13	12000	12600	11280	11400	10680	11040	15720	16800	8160	13680	12360	12240	16200												
14	12000	12600	11280	11400	10680	11040	15720	16800	8160	13680	12360	12240													
15	12000	12600	11280	11400	10680	11040	15720	16800	8160	13680	12360														
16	18000	18900	16920	17100	16020	16560	23580	25200	12240	20520															
17	18000	18900	16920	17100	16020	16560	23580	25200	12240																
18	18000	18900	16920	17100	16020	16560	23580	25200																	
19	23000	24150	21620	21850	20470	21160	30130																		
20	23000	24150	21620	21850	20470	21160																			
21	23000	24150	21620	21850	20470																				
22	32500	34125	30550	30875																					
23	32500	34125	30550																						
24	32500	34125																							
25	95000																								
# of insured contracts by manufacturer effective month	10000	10500	9400	9500	8900	9200	13100	14000	6800	11400	10300	10200	13500	11500	8500	8700	9500	6400	12000	11500	14700	6500	11000	9600	8300

Note: Data prior to Dec 1996 are not displayed ,but they should be used in the expected pure premium estimation.

RISK MARGINS IN DISCOUNT RATE

The three major risks associated with the discount rate in an actuarial valuation are credit risk, interest rate risk and payment pattern risk.

(a) Credit Risk

Not all investments are of the same quality. Bond and preferred share issuers are rated by independent firms. Investors, rightly or wrongly, use this type of information and together with their seasoned judgement, trade these securities in the secondary market. In US and Canada, the bonds issued or guaranteed by the federal government are the most credit worthy securities. Over a period of time, the yields of other securities will develop their spreads when compared against the treasury or federal bonds. The extra yield over a comparable treasury (i.e., the same maturity and currency) is the implied credit risk determined by the market place.

(b) Interest Rate Risk (also known as mismatching of asset/liability risk)

For this section, only bonds and T-bills are used as investments. It is a well-known concept in the financial markets that a bond portfolio's market value will change inversely proportional to the product of its duration and the change in interest rate. For example, if a bond portfolio has a duration of 3 years, its value would go up about 3% for a 100 basis point decrease in interest rate. If the expected claims payments should have an identical duration, its present value will also go up 3% when the discount rate decreases 100 basis points. When the asset and liability duration are about the same and the yield curve is

normal (i.e. long term bonds yield more than short term ones), the assets are said to be immunised against the interest rate risk. In the real world, the yield curve does become inverted (i.e. short term bonds yield more than long term ones) occasionally. Fortunately, the yield curve seldom remains inverted for a long period. For the remainder of this section, the yield curve is assumed to be normal. Risk to the insurer's surplus arises when there is a mismatch of asset and liability cashflow. Let us assume market value of assets is equal to present value of claims at the current market yield and both are equal to 1.0. When liability duration D_L exceeds asset duration D_A, any decrease in interest rate will diminish the surplus of the insurer. Conversely, when asset duration D_A exceeds liability duration D_L, any increase in interest rate will diminish the surplus of the insurer. For every 100 basis points (bp) change in interest rate, the impact on the insurer's surplus is approximately as follows:

	$D_L > D_A$	$D_A > D_L$
-100 bp in interest rate	$-(D_L - D_A)$	Favourable effect
+100 bp in interest rate	Favourable effect	$-(D_A - D_L)$

The risk (adverse effect) in both cases is approximately the absolute value of $D_A - D_L$. Since the liability duration is D_L, we can increase the discounted liability value approximately by $|D_A - D_L|$ if we reduce the discount rate by $|D_A - D_L| / D_L$. In so doing, we have absorbed 100 bp interest rate risk in our discounted liability estimate. If the anticipated change in interest rate is *t* bp, the discount rate should be reduced by $|D_A - D_L| / D_L \times t/100$.

Finally, if asset value is higher than liability value, we need to cover only a portion of the assets for the interest rate risk (i.e., P.V. of liability / market value of assets).

Therefore, interest rate risk can be quantified approximately as the absolute value of:

$$\text{coverage \%} \times \left(\frac{\text{asset duration} - \text{liability duration}}{\text{liability duration}} \right) \times \text{anticipated change in interest rate}$$

where,

coverage% = P.V. (claims liabilities + unearned premiums – premium receivables)
market value of selected investments for this calculation

The following tables show the results of our formula in two situations:

$D_A = 1.000$							
$D_L = 1.941$							
Change in interest rate (%)	Interest rate (%)	Market value of assets	Present Value of liability	Actual risk	Approximation by formula	Absolute Error of formula	Relative Error of formula
				(1)	(2)	(3) = (2) – (1)	(4) = (3) / (1)
0	10	83.115	83.115				
-1	9	83.877	84.559	0.682	0.694	0.012	0.018
-2	8	84.654	86.052	1.398	1.400	0.002	0.001
-3	7	85.445	87.594	2.149	2.116	- 0.033	- 0.015
-4	6	86.251	89.189	2.938	2.844	- 0.094	- 0.032

$D_A = 1.000$							
$D_L = 0.500$							
Change in interest rate (%)	Interest rate (%)	Market value of assets	Present Value of liability	Actual risk	Approximation by formula	Absolute Error of formula	Relative Error of formula
				(1)	(2)	(3) = (2) – (1)	(4) = (3) / (1)
0	10	95.345	95.346				
+1	11	94.486	94.916	0.429	0.436	0.007	0.016
+2	12	93.643	94.491	0.847	0.879	0.032	0.038
+3	13	92.814	94.072	1.257	1.327	0.070	0.056
+4	14	92.000	93.659	1.658	1.782	0.124	0.075

(c) Payment Pattern Risk

As faster payment means a shorter liability duration and a smaller discount, the same effect can be achieved by decreasing the (liability) discount rate. In practice, it is more convenient to lower the discount rate.

Suppose:	market yield of portfolio	= 5.75%
	liability duration	= 4 years
	average discount factor	= 0.80
	amount of discount	= $1 - (1/1.0575)^4$ =20%

If payment pattern is assumed to be ¼ year faster, then,

amount of discount	= $1 - (1/1.0575)^{3.75}$ = 19%
average discount factor	= 0.81
implied discount rate	= 5.4% because $(1/1.054)^4 = 0.81$

In this case, the risk margin for the payment pattern risk is 5.75% less 5.4% or 35 basis points.

Appendix C

The following table shows the relationship between shorter duration and implied discount rate:

Average discount	Duration	Implied discount rate
0.800	4.00 years	5.75%
0.811	3.75 years	5.38%*
0.822	3.50 years	5.01%
0.834	3.25 years	4.65%
0.846	3.00 years	4.28%
0.857	2.75 years	3.92%
0.870	2.50 years	3.56%

* Rounded as 5.40% in our example