

**SOURCE OF EARNINGS ANALYSIS FOR FLEXIBLE PREMIUM
AND INTEREST-SENSITIVE LIFE AND ANNUITY PRODUCTS**

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ABSTRACT

Although source of earnings analysis procedures are well defined for traditional life insurance products, it is difficult to apply such procedures to the nontraditional flexible premium and interest-sensitive life and annuity products, because of the dynamic nature of the nontraditional products. This paper provides a solution to this problem by presenting formulas that define a comparable source of earnings analysis for examining the contributions to the income of these nontraditional products. A simple example illustrates the application of the described methodology.

INTRODUCTION

This paper describes the application of source of earnings (SOE) analysis methodology to the reported pretax GAAP income of universal life and other interest-sensitive life and annuity products. SOE analysis procedures have been defined for traditional products, primarily in Richard G. Horn's paper, "Life Insurance Earnings and the Release from Risk Policy Reserve System" (*TSA XXIII* (1971):391). However, the dynamic aspects of flexible premium and interest-sensitive products have made it difficult to readily apply existing analytical procedures to these new products. This paper presents formulas that define a comparable SOE analysis for examining the contributions to income of flexible premium and interest-sensitive products. The described methodology is illustrated through the use of a simple example.

The methodology presented can be used to better understand the earnings reported under GAAP accounting methods that are premium-based. However, the specific methodology can be generalized to apply to situations in which the accounting approach is account value-based. Premium-based methods are prospective; these include the methods commonly referred to as full percent of premium, traditional GAAP, composite, and prospective deposit, all of which vary only by the magnitude of the provisions for adverse deviation included in reserve assumptions. Account value-based methods are retrospective and rely on the policy's account value as a measure of the reserve liability. Approaches included here are the actuarial retrospective

deposit and the FASB retrospective deposit methods. We believe that the described methodology can be useful under present and expected future accounting requirements.

TRADITIONAL PRODUCT ANALYSES

The ability to analyze GAAP earnings by source was demonstrated in Richard G. Horn's landmark paper, which first presented the "release from risk" concept. Although the paper was primarily intended to support the development of a rational approach to GAAP for traditional fixed premium/fixed benefit life products, it also provided a means by which the actual income of a block of business could be examined and attributed to its underlying source. In this context, gain or loss can be associated with:

- The expected GAAP profit margin (that is, the difference between the gross premium and the net GAAP premium)
- The release of provisions for adverse deviation included in reserve assumptions (that is, the difference between "most likely experience" and GAAP reserve assumptions)
- The variation of experience from "most likely" assumptions.

These "sources" of gain and loss can be computed for each experience element used in the calculation of benefit and expense reserves. Thus, the reconciliation of expected and actual income identifies amounts attributable to experience with respect to policy lapse or surrender, death, interest earnings, and expense levels. Variations in results caused by policy parameters (for example, premiums, death benefits, cash values, etc.) were nonexistent, as traditional products' experience could not vary from reserve assumptions. Mr. Horn's paper defines the reported GAAP income of a traditional product by this formula:

$$\begin{aligned}
 \text{Actual Income:} & \\
 &= (GP - NP) (1 + i^a) && \text{[loading gain]} \\
 &+ (q^e - q^a) (1 - V) && \text{[gain from mortality]} \\
 &+ (w^e - w^a) (CV - V) && \text{[gain from withdrawal]} \\
 &+ (\text{Expected Cost} - \text{Actual Cost}) (1 + i^a) && \text{[gain from expense]} \\
 &+ (i^a - i^e) (V + NP - \text{Expected Cost}) && \text{[gain from interest]}
 \end{aligned}$$

OF

Actual Income:

$$\begin{aligned}
 &= (GP - NP) (1 + i^e) \\
 &+ (q^e - q^a) (1 - V) \\
 &+ (w^e - w^a) (CV - V) \\
 &+ (\text{Expected Cost} - \text{Actual Cost}) (1 + i^e) \\
 &+ (i^a - i^e) (V + GP - \text{Actual Cost})
 \end{aligned}$$

A later section of this paper extends this approach to both the experience elements and the policy parameters of flexible premium/interest-sensitive life and annuity products.

Broadening the applicability of this methodology is considered an important step in developing a better means of evaluating and understanding the financial performance of new-generation products. Thus, a means of reconciling actual and expected results that focuses on the variation of experience and policy parameters inherent in the accounting system will provide critical information with respect to the financial consequences of not achieving anticipated experience. This will not only "explain" results, but also allow management to concentrate on areas of performance that most affect financial results. Also, it is believed that this information can support better, more informed product management and pricing decisions. From this perspective, the data can be used to evaluate the reasonableness of key pricing assumptions, leading to improved initial and subsequent pricing of the major variables under such contracts. Thus, implementation of the methodology described can enhance the company's ability to manage the future performance of existing business and future production.

UNIVERSAL LIFE AND FLEXIBLE PREMIUM ANNUITY ANALYSES

Application to New Products

Because of the fixed nature of the traditional life product, the SOE analysis for this product is relatively simple. However, such is not the case with universal life (UL). Death benefits, future premiums, cash values, interest spreads, mortality and expense charges, and reserve factors are all subject to change. Clearly, all such changes affect current and future earnings and their sources. Moreover, an SOE analysis for such products is complicated by the interdependency of the various sources of earnings. To a lesser extent, such complications also exist in the flexible premium annuity (FPA) SOE analysis.

For example, let us take the case of a deviation in the current year's earned rate from the original expectation. Ideally, the company will modify

its credited rate to obtain the same interest spread. However, depending on the GAAP methodology used (both benefit reserve and DAC), maintaining the same interest spread can result in GAAP profits for the current year that vary from originally expected income levels. Also, a change in the current year's credited rate will affect the account balance, which will have a domino effect on the various sources of earnings; it will affect current and future years' cash values, reserves, death benefits, expense and mortality charges, and interest gains. How can we analyze the effects of such earned and credited rate changes on the current and the future years' sources of earnings? Can we develop a procedure for calculating the credited rate so as to maintain the original expected GAAP profit?

A similar situation exists whenever a company revises its expense charges because of variation of actual expenses from assumed expenses. Any changes in current year's expense or mortality charges affect the account balance, which in turn affects current and future years' sources of earnings.

Perhaps the most significant variation, and the most common, is the deviation of actual premium received from assumed premium income. Clearly, such premium variations affect the loading gain (the percent of premium profit). Also, premium variations affect the account balance and charges and expenses, which vary with premium. Because of such changes, the original profit expectations and the sources of such profits will be completely different. How can we measure the effects of such premium variations on current and future years' GAAP profits and on the sources of such profits?

Impact of Reserve Methods

The relative magnitude of the various sources of earnings depends on the GAAP methodology used. That is, GAAP reserve assumptions and experience variations from them will differ for each of the traditional, retrospective, prospective, or composite GAAP methods. Also, an analysis of the sources of actual GAAP profits depends on how the net GAAP reserve is made "dynamic" with respect to actual experience, that is, how the GAAP reserve is adjusted based on the emergence of actual experience. Approaches for making UL and FPA GAAP reserves dynamic currently include the following:

1. Perhaps the most common technique for making GAAP reserves dynamic with respect to actual experience is by adjusting the reserve based on the amount of insurance in force. This is the approach used for traditional life business and is best illustrated when the expense reserve factors are

expressed as amounts per thousand in force, or when dynamic DAC amortization schedules are used. For level premium/level face amount plans (which account for most traditional life business), adjustments based on face amount are the same as adjustments based on premium. Perhaps because of the simplicity and the prevalence of the method in traditional life business, some companies also are making their UL GAAP reserves (mainly DAC) dynamic through the use of in-force amount.

However, adjustments based on the amount of insurance or premium in force make the valuation sensitive only to surrender and mortality experience. This is sufficient for fixed premium/fixed benefit products, but does not recognize the flexible premium/flexible benefits of the new, interest-sensitive products. In general, then, additional or different procedures are necessary to ensure that both the benefit and expense (DAC) reserve valuations appropriately reflect the emerging characteristics of these flexible products.

2. The most popular approach for adjusting benefit and/or expense reserves for interest-sensitive products is to relate reserves to account balances. That is, the GAAP reserve is made dynamic by adjusting the expected reserve by the ratio of actual to expected account balances. Such an approach is widely used because:

- It is simple and easy to apply.
- It is a disciplined approach for adjusting reserves based on actual experience (that is, no subjective judgment is involved in the adjustment).
- It generally gives accurate results when actual policy parameters are reasonably close to expected. Even if actual policy parameters deviate from expected, this approach will still yield reserve close to the “true” reserve (that is, the reserve based on repricing/revaluation using revised assumptions) if the same profit margin is maintained when the mortality and expense charges are revised and when interest crediting rates are determined.
- It has advantages compared to an adjustment based on premiums received to date because:
 - (i) Account balance data are more readily available than premium history.
 - (ii) Unlike the premium history, the account balance takes into account other policy parameters that may affect profit, such as interest credits and actual mortality and expense charges.

However, making the reserves dynamic to account balances also has drawbacks:

- It may not produce sufficiently accurate results if the mortality gain is the main or only source of profit. In such cases, it may be more appropriate to adjust the reserve (or DAC) based on the in-force amount.

- The existence of large dump-in (or nonrecurring) premiums makes the pure application of the actual to expected account balance ratio inappropriate. For this reason, most companies have introduced either one or both of the following refinements:
 - (i) Different GAAP reserve per-account-balance factors are separately used for account balances resulting from dump-in versus non-dump-in premiums.
 - (ii) Each UL plan is modeled by using several premium classes with different premium assumptions and different GAAP reserve to account balance factors. Policies grouped in the same premium class should be homogeneous and should possess the same expected premium pattern.
3. The most cumbersome method is that proposed by the recent FASB Statement on Universal Life Accounting. In this approach, the DAC reflects actual cumulative experience by regularly evaluating the original amortization schedule and revising the schedule if evidence suggests that the earlier estimate of gross profit needs revision. Although such a dynamic DAC approach has its strengths, it also has the following limitations:
- It is tedious and cumbersome to implement.
 - Such an approach can lead to manipulation of earnings, because the determination of when the schedule should be revised is subjective.

With regard to benefit reserves, the FASB statement has made it completely reactive to the account balance by equating it to the account balance. Although the account balance is often sufficient to provide for future benefits, it could be inadequate for some UL plans. For example:

- (i) Some UL policies may guarantee that mortality charges will stay level or decline over the life of the policy, while the actual mortality cost should increase over time.
- (ii) Some UL policies may offer persistency bonuses in the form of extra interest credits or lower expense and mortality charges for policies persisting beyond a given year.

In each of the above UL policies, the account balance for the early durations may not be sufficient to mature all future obligations.

UNIVERSAL LIFE SOURCE OF EARNINGS ANALYSIS FOR RESERVE METHODS BASED ON ACCOUNT BALANCES

The remainder of this paper provides a UL SOE analysis useful when the reserve methodology adjusts GAAP reserves according to the actual to expected account balance ratio. As stated earlier, the reserve adjustment based on account balances has appeal and is perhaps the most popular dynamic approach used for UL reserve computations. The SOE analysis shown below

can be applied to all premium-based UL reserve methods, including traditional, prospective, and composite GAAP methods. With some modifications, the approach also can be applied to account value-based approaches such as the retrospective method.

Assumptions

To aid in understanding the procedure and to simplify the results, the following assumptions have been made:

1. An annual case is assumed, with premiums, expenses, and policy charges occurring at the beginning of the policy year (BOY) and deaths and withdrawals occurring at the end of the policy year (EOY).
2. Expenses and policy charges are expressed in two forms only: per-in-force amount and percentage of premium. Per-policy expenses and expense charges can be easily translated to per-in-force amount or percentage of premium forms through the use of an average size assumption. Mortality charges also can be converted into a charge per in-force amount, which varies by duration.
3. Taxes and interest on surplus are ignored.

The SOE formulas shown below could be easily extended to the situation where some or all of the simplifying assumptions are not used.

Definition of Symbols

For the numerical examples in this paper, primed notation symbolizes expected values, and unprimed notation symbolizes actual values.

Where applicable, all the following values are per amount in force at time t :

- t = Time t
- GP = Gross premium
- V = Net GAAP reserve
- E^o = Non % premium expense (including commission)
- $E^{\%}$ = % premium expense (including commission)
- DB = Death benefit
- CV = Cash surrender value
- AB = Account balance
- q^d = Mortality rate
- q^w = Withdrawal rate
- i^E = Interest earned rate

- i^c = Interest credited rate
 NP = GAAP net premium
 C^o = Non % premium charge (including mortality charge)
 $C^%$ = % premium charge
 BP = Book profit
 $\%Pf$ = % premium profit

To aid in the presentation of results, the following symbols are also used:

- An asterisk is used to denote "adjusted" expected value, defined as the expected value (primed notation) multiplied by the ratio of actual to expected account balances at the beginning of year t (that is, at time $t - 1$). For instance,
 - "Adjusted" expected GP,

$$GP_t^* = GP_t' (A_{t-1})$$

where $A_{t-1} = AB_{t-1}/AB'_{t-1}$

- "Adjusted" expected reserve V ,

$$V_t^* = V_t' (A_{t-1})$$

Because the reserve is made dynamic by using the ratio of actual to expected account balances, the ratio at the beginning of the year will have an impact on the current year's sources of earning. For instance, if the ratio (A_{t-1}) is 95%, then it might be anticipated that the end of the year GAAP reserve also would be 95% of the originally expected reserve. That is, we would have "adjusted" the original expectation by 95%. Hence, the "adjusted" expected reserve

$$V_t^* = V_t' (A_{t-1}) = 95\% V_t'$$

Note that if actual experience is close to expected, the ratio is approximately one, and hence

$$V_t^* = V_t'$$

That is, there is no need to "adjust" our expectation.

- We will use G to denote the ratio of the GAAP reserve to the account balance. In other words, G is the GAAP reserve factor, expressed per dollar of account balance, not per amount in force. We see that

$$G_t = \frac{V_t'}{AB_t'} = \frac{V_t}{AB_t}$$

Derivation of Formulas

Starting with the familiar book profit equation,

$$\begin{aligned}
 BP_t &= GP_t \\
 &+ i_t^E [V_{t-1} + GP_t - E_t^o - E_t^{\%} GP_t] \\
 &- DB_t q_{t-1}^d \\
 &- AB_t q_{t-1}^w \\
 &- [V_t' A_t (1 - q_{t-1}^d - q_{t-1}^w) - V_{t-1}' A_{t-1}] \\
 &- [E_t^o + E_t^{\%} GP_t]
 \end{aligned}$$

where $A_t = \frac{AB_t}{AB_t'}$ and $V_t = V_t' A_t$, we substitute three expressions,

$$\begin{aligned}
 V_{t-1}' &= V_t' (1 - q_{t-1}^d - q_{t-1}^w) - V_{t-1}' i_t^E - NP_t' (1 + i_t^E) \\
 &+ DB_t' q_{t-1}^d + CV_t' q_{t-1}^w + (E_t^o + E_t^{\%} GP_t) (1 + i_t^E)
 \end{aligned}$$

$$\begin{aligned}
 AB_t' &= AB_{t-1}' + i_t^c AB_{t-1}' + GP_t' - GP_t' C_t^{\%} \\
 &+ i_t^c GP_t' - i_t^c GP_t' C_t^{\%} - C_t^o - C_t^o i_t^c
 \end{aligned}$$

and

$$\begin{aligned}
 AB_t &= AB_{t-1} + i_t^c AB_{t-1} + GP_t - GP_t C_t^{\%} \\
 &+ i_t^c GP_t - i_t^c GP_t C_t^{\%} - C_t^o - C_t^o i_t^c
 \end{aligned}$$

After simplifying and collecting related terms, we have the SOE formulas shown below. Those interested in the complete derivation should contact Joe Tan at his *Yearbook* address.

UL SOE Formulas and Interpretations

To aid in understanding the UL SOE formulas, we have classified all the terms of the formula into two groups: terms similar to the traditional life SOE analysis and terms peculiar to UL policies. The latter, as one might expect, are due to the flexible nature of the UL contracts (for example, premium, death benefit, cash value, interest credit) and the effect of the actual to expected account balance ratio on the various sources of earnings.

1. *Terms Similar to Traditional Life SOE Formula**Gain from loading (% of premium profit):*

$$GP_t (\%Pf) (1 + i_t^{E'}) \quad (1.1)$$

Gain from interest earning:

$$(i_t^E - i_t^{E'}) [V_{t-1} + GP_t - (E_t^o + E_t^{\%} GP_t)] \quad (1.2)$$

Gain from mortality:

$$(q_{t-1}^d - q_t^d) (DB_t - V_t) \quad (1.3)$$

Gain from withdrawal:

$$(q_{t-1}^w - q_t^w) (CV_t - V_t) \quad (1.4)$$

Gain from non % premium expense:

$$(E_t^{o'} - E_t^o) (1 + i_t^{E'}) \quad (1.5)$$

Gain from % premium expense:

$$(E_t^{\%'} - E_t^{\%}) GP_t (1 + i_t^{E'}) \quad (1.6)$$

The derivation and interpretation of these terms can easily be found in the actuarial literature (for example, Mr. Larry Warnock's Study Note on GAAP Reserves, 1972) and are not repeated here. The interest-earning item found in terms (1.1), (1.5), and (1.6) stems from the assumption of the BOY occurrence for premium and expenses.

2. *Terms Peculiar to UL**Gain from interest crediting:*

$$(i_t^c - i_t^e) G_t [AB_{t-1} + GP_t - (C_t^o + C_t^{\%} GP_t)] \quad (2.1)$$

For UL, the interest gain depends on the interest spread. In addition to the difference in actual and expected earned rates, term (1.2), the difference in actual and expected credited rates is a source of earnings. However, the difference in credited rates does not flow through current year's income at 100%, but only at $G_t\%$.

Recall that:

- (i) G is the ratio of the expected GAAP reserve to the expected account balance (AB), and
- (ii) The product of G and the actual AB equals the actual (or reported) GAAP reserve.

When a company declares a lower credited rate than originally expected, the only impact on the current year's GAAP profit is through a lesser increase in the GAAP reserve, which results from the lesser increase in account balance. For the gain from interest *earnings*, term (1.2), the difference in the actual and expected rate results in an interest *earnings* differential based on BOY assets (which equals BOY reserve in our formulation) and cash flow occurring at BOY (that is, premium and expenses). In comparison, the difference in actual and expected *credited* rates results in an interest crediting differential based on BOY *AB* and the net flow of money into the *AB* occurring at BOY (that is, premiums less charges).

Additional mortality loss:

$$-q_{t-1}^d [(DB_t - V_t) - (DB_t^* - V_t^*)] \quad (2.2)$$

This additional mortality element results from the difference between the actual and the adjusted expected net amount at risk (that is, $DB - V$). Recall that the adjusted expected value (designated by an asterisk) stands for the expected value at time t "adjusted" by the actual to expected *AB* at BOY t . We can rewrite the above expression as the sum of two pieces, (2.2.1) and (2.2.2):

$$-q_{t-1}^d (NAR_t') (1 - A_{t-1}) \quad (2.2.1)$$

$$-q_{t-1}^d (NAR_t - NAR_t') \quad (2.2.2)$$

where $NAR = \text{net amount at risk} = DB - V$.

Note that (2.2.1) is negative (that is, giving rise to additional mortality loss) whenever the actual *AB* at BOY t is less than originally expected. Such an *AB* could come about, for example, when:

- The actual premiums received in the first $t - 1$ years are less than expected.
- The actual interest credited in the first $t - 1$ years is less than expected.
- The actual mortality and expense charges deducted in the first $t - 1$ years are higher than expected.

This is an example of how the actual experience of the first $t - 1$ years affects the t th year profit.

Similarly, term (2.2.1) is positive (that is, it gives rise to additional mortality gain) whenever the actual *AB* at BOY is higher than originally expected. And term (2.2.1) is zero whenever actual *AB* at BOY t is equal to expected.

Observing term (2.2.2), we see that additional mortality loss will result whenever the actual *NAR* at time *t* is higher than expected. Such an *NAR* occurs, for example, when:

- The actual *DB* is higher than expected due to elective or automatic death benefit increases.
- For those *UL* policyholders who elected the face plus account balance death benefit option, actual *DB* could be higher due to higher than expected *AB* increases.
- The actual reserve released at death for time *t* could be lower than expected.

Additional withdrawal loss:

$$-q_{i-1}^w [(CV_t - V_t) - (CV_t^* - V_t^*)] \quad (2.3)$$

Similar to the net amount at risk (that is, $DB - V$), we can define the net amount at surrender (*NAS*) as $CV - V$. Following (2.2), we can rewrite (2.3) as the sum of:

$$-q_{i-1}^w (NAS_t) (1 - A_{i-1}) \quad (2.3.1)$$

and

$$-q_{i-1}^w (NAS_t - NAS_t^*) \quad (2.3.2)$$

The analysis shown in (2.2) could easily be extended here by substituting cash surrender value for death benefit and withdrawal rate for mortality rate.

Gain from non % premium charge:

$$G_i (C_i^o - C_i^e) (1 + i_i^e) \quad (2.4)$$

This term parallels term (1.5), gain from non % premium expense. However, unlike term (1.5), this gain results from the excess of actual charges over expected, not expected expenses over actual. This term results from the difference between actual and expected non % premium mortality and expense charges deducted from the *AB*, which affect current year's GAAP profit by increasing or reducing the GAAP reserve. As explained in (2.1), this increase or reduction in reserves is not at 100%, but at *G*%, where *G* is the ratio of the expected reserve to the expected *AB*.

In other words, when the actual mortality or the expense charges deducted are higher than expected, the actual *AB* would be lower, which would reduce the actual reserve by *G*% of such excess of actual over expected mortality/expense charges. The *BOY* assumption of the charges also leads to an interest credit for a year.

While some ability to change policy expense charges may be present, in general it is unlikely that such gains or losses would develop. That is, actual and expected expense charges will normally be identical. However, to the extent this item reflects mortality charges, there frequently will be an impact.

Gain from % premium charge:

$$G_t (C_t^{\%} - C_t^{\%e}) GP_t (1 + i_t^c) \quad (2.5)$$

This term parallels term (1.6), gain from % premium expense. Just as in term (2.4), the excess of actual over expected charges, with interest thereon, gives rise to a $G\%$ current year's bottom-line effect.

Additional loss from non % premium expense:

$$-E_t^o (1 - A_{t-1}) (1 + i_t^c) \quad (2.6)$$

This additional expense loss will result whenever actual AB at BOY t is less than expected. The loss disappears whenever the account balance at BOY t matches the expected amount. Because of the BOY expense assumption, there is a one-year interest effect.

Additional gain from non % premium charge:

$$G_t (C_t^o) (1 - A_{t-1}) (1 + i_t^c) \quad (2.7)$$

Just as an additional non % premium expense loss, term (2.6), results whenever actual AB at BOY t is lower than expected, an additional non % premium charge gain, term (2.7), also results whenever actual AB is lower than expected. Because the impact of mortality and expense charges on income is indirectly through AB (which affects the reserve), such impact carries with it a year interest credit effect and only a $G\%$ (unlike expense, which is at 100%) magnitude.

In addition to terms (2.6) and (2.7) (which are non % premium), there also is an additional loss from % premium expense and an additional gain from % premium charge. However, we have included the latter two with the next term, premium persistency gain, as the gain/loss arising from actual versus expected premium persistency is partially offset by such % premium expenses/charges.

Premium persistency gain:

$$(GP_t - GP_t^*) [(1 - E_t^{\%} - \%Pf) (1 + i_t^E) - G_t (1 - C_t^{\%})(1 + i_t^E)] \quad (2.8)$$

Because of the variable premium nature of UL, a policy could stay in force for years even if the actual premiums paid are less than assumed. This discrepancy is often referred to as actual versus assumed premium persistency, whose bottom-line effect is measured by term (2.8).

Looking at the formula, we see that the base from which we are measuring the premium deviation is the adjusted expected GP . Note that

$$GP_t - GP_t^* = (GP_t - GP_t') + GP_t' (1 - A_{t-1});$$

that is, the premium discrepancy is caused by (i) the difference between actual and expected premiums and (ii) the ratio of the actual AB at BOY t to the expected AB .

The bottom-line effect of such a premium discrepancy is equal to the magnitude of the discrepancy multiplied by (A) - (B), where (A) and (B) represent the expressions within the brackets, respectively. Because of the BOY premium assumption, (A) shows that the premium discrepancy earns one year of interest. (A) also shows that the premium discrepancy is partially offset by the % premium expense and % premium profit. The effect of % premium expense is obvious. Regarding the % premium profit term, its appearance here is due to the manner we chose to write term (1.1), gain from loading. Term (1.1) says that for every dollar of premium the company collects, it will increase its bottom line by % Pf times one dollar, which is clearly not true. Because of the reserve methodology used, the % premium profit is earned only on the portion of premium up to the adjusted expected premium. Hence, we see that if we remove the % Pf item from term (2.8) and combine it with term (1.1), term (1.1) will become

$$GP_t^* (\%Pf) (1 + i_t^E).$$

Nevertheless, we chose to show term (1.1) the way it is because we prefer to show term (1.1) as a familiar term of the traditional life SOE formula.

(B) shows that the amount of premium persistency discrepancy flows directly into the account balance, after reduction by the % premium charge. Then, with a year's interest credit, such premium discrepancy affects AB , which increases or reduces the reserve by $G\%$ of the AB .

Combining (A) and (B), we see that the bottom line effect of $GP - GP^*$ is:

- (i) Offset by the % premium expense and the % premium profit included in term (1.1)
- (ii) Increased by a year of interest earnings (because of the BOY premium and expense assumptions)
- (iii) Offset by the amount of increase in reserves caused by such premium discrepancy, which comes about from the effect of such premium discrepancy on AB .

Some Questions Answered by Our SOE Formulas

The different terms of the SOE formulas given in the preceding section are organized in a manner that is easy to understand and interpret and that shows how the total profit comprises the various sources of profit. By rearranging the various terms of the formulas, we also can answer some of the intriguing UL and FPA questions that are often asked of actuaries. Some examples follow.

1. How is the current year's GAAP profit affected when actual BOY AB deviates from expected?

From the formulas presented above, it is clear that the ratio of actual to expected BOY AB has a tremendous impact on GAAP profits. Specifically, each of the following gain or loss items emerges when A_{t-1} is not equal to 1:

- Term (2.2.1), which is part of the additional mortality loss, term (2.2).
- Term (2.3.1), which is part of the additional withdrawal loss, term (2.3).
- Term (2.6), additional loss from non % premium expense.
- Term (2.7), additional gain from non % premium charge.
- A portion of term (2.8), the premium persistency gain. This portion is equal to

$$GP'_t (1 - A_{t-1}) [(1 - E_i^{e'} - \%Pf) (1 + i_i^{e'}) - G_t (1 - C_i^{e'}) (1 + i_i^{e'})].$$

In addition to the above effects, there are some other less obvious gains and losses whenever actual BOY AB deviates from expected. These less obvious gains and losses are likely to be smaller than those mentioned above, and they result from those terms that are functions of BOY AB . For example:

- Term (2.1) and term (1.2) (because V depends on AB). These terms will have no effect if actual rates equal expected.
- Terms (1.3) and (2.2.2), because the amount of BOY AB can affect the EOY DB and V . If the actual mortality rate equals expected, term (1.3) will have no effect.

- Terms (1.4) and (2.3.2), due to the effect of the actual BOY AB on EOY CV and V . No effect will result from term (1.4) if the actual withdrawal rate equals expected.

2. *Knowing that policyholders pay lower premiums than assumed, can we estimate the bottom-line impact?*

This question is answered by term (1.1) (% premium profit) and term (2.8) (premium persistency gain). The effect on term (1.1) is obvious; for term (2.8), please refer to that section for an explanation of the effect.

Also, lower premium paid will result in lower EOY AB , which will affect

- Current year's terms (2.2) and (2.3), due to the EOY assumption of deaths and withdrawals, and
- Future years' earnings. An analysis similar to that for question 1 can be made to determine the earnings impact and sources.

3. *If the actual earned rate turns out to be 2% lower than expected, can we maintain the same current and future years' GAAP profits by declaring a credited rate 2% lower than the expected credited rate?*

We can answer this question by comparing terms (1.2) and (2.1). Note that term (2.1) can be rewritten as the sum of:

- Term (2.1.1) = $(i_t^w - i_t^e) \left[\frac{G_t}{G_{t-1}} (V_{t-1}) \right]$.

and

- Term (2.1.2) = $(i_t^w - i_t^e) G_t [GP_t - (C_t^w + C_t^e GP_t)]$.

Similarly, term (1.2) can be rewritten as the sum of:

- Term (1.2.1) = $(i_t^e - i_t^f) V_{t-1}$

and

- Term (1.2.2) = $(i_t^e - i_t^f) [GP_t - (E_t^w + E_t^e GP_t)]$.

Comparing terms (2.1.1) and (1.2.1), we see that the current year's interest gain or loss due to BOY reserve V is minimal because the two terms more or less offset each other. The only difference in the two terms is that the gain due to a 2% reduction in credited rate is grossed by the ratio of G at EOY to G at BOY. Recalling that G is the ratio of V to AB , we expect G to increase from BOY to EOY. Hence, the gain due to a 2% reduction

in credited rate will more than offset the loss due to a 2% reduction in earned rate. That is, a minimal current year's gain will result from interest effect on BOY reserve V .

Comparing terms (2.1.2) and (1.2.2), we note that current year's profit will be different when both earned and credited rates are reduced 2%. This is caused by the following differences in terms (2.1.2) and (1.2.2):

- % and non % charges versus expenses. For early durations, expenses are likely to be higher than charges, primarily due to high acquisition cost. For later durations, unless substantial expense escalation occurs (for example, high inflation rate), the opposite is generally true, since mortality charge increases with duration.
- $G\%$ in term (2.1.2) versus 100% in term (1.2.2). G is smaller than 100%; hence the loss due to lower earned rate on *premium and expenses*, term (1.2.2), will more than offset the gain due to lower credited rate on *premium and charges*, term (2.1.1).

Because lower credited rate will result in lower EOY AB , terms that depend on AB also will be affected. The analysis similar to the last part of question 2 can be repeated here.

4. *Knowing that the company's actual expenses are higher than expected, how can we adjust expense charges to maintain essentially the same bottom line?*

The income effect of an expense variance (that is, actual versus expected) is represented by term (1.5) (gain from non % premium expense) and term (1.6) (gain from % premium expense). To offset this income variance, expense charges can be increased. Looking at terms (2.4) and (2.5), we note that to maintain the same bottom line, the increase in expense charge has to be larger than the increase in expense. This amount is roughly equal to the expense variance divided by G . Also, if we consider the interest effect, the above quantity has to be grossed up by the following factor (which is greater than 1):

$$(1 + i_t^E)/(1 + i_t^C).$$

Also, any increase in current year's expense charge will decrease the EOY AB , which will affect future earnings (and their sources). The analysis used in the last part of question 2 can be repeated here.

Examples

In this section, we illustrate the above methodology with a typical UL policy issued at age 45 to a nonsmoker male. The values shown are for the first 20 policy years. The following assumptions are made:

Mortality rate (q^d): as shown in Appendix 1.A.

Withdrawal rate (q^w): 20%, 15%, 10%, 5% thereafter.

Gross premium (GP): \$1,000 per year.

% Premium charge ($C^%$): 5%.

Non % premium charge (C^o): \$50 per year.

% Premium expense ($E^%$): 80%, 5% thereafter.

Non % premium expense (E^o): \$75, \$25 thereafter.

Death benefit (DB): \$50,000 all years.

Earned rate (i^E): 10% all years.

Credited rate (i^c): 8% all years.

Surrender charges (SC): Used in the computation of CV and expressed as a % of total premium paid since issue:

Year	SC
1	90%
2	80
3	70
4	60
5	50
6	40
7	30
8	20
9	10
10+	0

Expected net GAAP reserve (V): Based on traditional GAAP method with no provision for adverse deviation. This gives rise to a net GAAP premium of \$965.38 per year.

We illustrate with five examples. The first example is the case in which actual experience equals expected, and the last four correspond to the four questions raised above. These five examples are shown in Appendices 1 to 5. For each example, three tables are shown:

1. The assumptions and policy values used (for example, Appendix 1.A).
2. The regular income statement (for example, Appendix 1.B).
3. The SOE statement (for example, Appendix 1.C).

Example 1: Actual Experience Equals Expected

Using the assumptions and policy values shown in Appendix 1.A and assuming that actual experience emerges as expected, Appendices 1.B and 1.C were derived. We see that the only profit is the % premium profit. That is, with the exception of term (1.1), all the terms of our SOE formula are zero. The % premium profit can be computed as:

$$\$1,000 \left(1 - \frac{965.38}{1,000}\right) (1 + .10)$$

where the middle quantity is the % profit.

Example 2: Lower Than Expected AB

In this example, we consider a lower than expected increase in *AB* by assuming that the interest credited rate decreased by 50 basis points in year 2 and 100 basis points in years 3 to 20. Appendix 2.A shows the resulting policy values.

Comparing Appendix 2.B with Appendix 1.B, we see that as the credited rate decreased, GAAP profit increased. As expected, the increase in profit compounds year after year, resulting in a large profit in year 20. What are the sources of such profits? Appendix 2.C provides the answer.

First, we would expect a gain due to the lower interest credited rate starting in year 2 (the first year when the credited rate is reduced). As shown in Appendix 2.C, this gain amounts to \$4.92, term (2.1). Because of the decrease in *EOY AB* for year 2, additional gain and loss items also emerge due to terms (2.3.2) and (2.2.2), respectively. For instance, term (2.3.2) shows that the additional withdrawal loss in year 2 is

$$- q_1^w [(CV_2 - V_2) - (CV'_2 - V'_2)] \\ = -.15 [(412.40 - 1057.75) - (421.76 - 1062.67)] = 0.67$$

Because of our *EOY* assumption for deaths and withdrawals, additional mortality and withdrawal losses due to terms (2.2.2) and (2.3.2) always appear in the year when the *EOY AB* is changed. In reality, however, the effects of terms (2.2.2) and (2.3.2) are less, because deaths and withdrawals can occur any time during the year.

Starting in year 3, because the *BOY AB* is lower than expected, more sources of profit emerge. From the analysis given for question 1 above, we

realize that aside from the % premium profit, other sources of profit are present in year 3:

Source	Term	Amount
Gain from interest crediting	2.1	\$20.11
Additional mortality loss	2.2	- 0.42
Additional withdrawal loss	2.3	1.73
Additional loss from non % premium expense	2.6	- 0.13
Additional gain from non % premium charge	2.7	0.17
Premium persistency gain	2.8	1.38
Gain from interest earning	1.2	0*
Gain from mortality	1.3	0*
Gain from withdrawal	1.4	0*

*This is zero because actual rate (e.g., mortality rate) equals expected.

Example 3: Actual Premiums Less Than Expected

This example assumes that actual premium is lower than expected starting year 2:

- \$950 for year 2
- \$900 for year 3
- \$850 for year 4
- \$800 thereafter

Appendix 3.A shows the corresponding policy values.

For the first year when actual premium differs from expected (for example, year 2), the sources of profit affected are:

1. % of premium profit term (1.1). This is decreased by the amount of premium reduction multiplied by the % profit, compounded with a year's interest earnings. That is,

$$\$50 (3.46\%) (1 + .1) = \$1.90.$$

2. Premium persistency gain, term (2.8). This amounts to

$$(\$950 - 1 * \$1,000) \left[(1 - .05 - .0346) (1 + .1) - \frac{1062.67}{2021.76} (1 - .05) (1 + .08) \right] = - \$23.38.$$

3. Terms that depend on EOY AB for year 2 [\$ - 0.04 for term (2.2.2) and \$ - 2.35 for term (2.3.2)]. The analysis here is the same as for example 2 above.

For years 3 and beyond, because the BOY AB is lower than expected, other sources of profit also emerge. Analysis similar to example 2 can be made. Again, if actual rates (for example, mortality rate) equal expected, some terms will have no effect. Hence, terms (1.2), (1.3), (1.4), and (2.1) turned out to be zero.

Example 4: 2% Reduction in Both Earned and Credited Rates

Appendix 4.A shows the resulting policy values when we reduce both earned and credited rates by 2% starting year 3. The analysis for this example is as shown in question 3.

For year 3, we have

$$\text{BOY } G = 0.5256.$$

$$\text{EOY } G = 0.6906.$$

$$E^{\%} = C^{\%} = 5\%.$$

$$E^{\circ} = \$25.$$

$$C^{\circ} = \$50.$$

Hence:

$$\text{Term (2.1.1)} = 2\% * \left[\frac{0.6906}{0.5256} \right] * 1062.67 = 27.93.$$

$$\text{Term (2.1.2)} = 2\% * 0.6906 * [1,000 - (50 + .05 * 1,000)] = 12.43.$$

$$\text{Term (1.2.1)} = -2\% * 1062.67 = -21.25.$$

$$\text{Term (1.2.2)} = -2\% * [1,000 - (25 + .05 * 1,000)] = -18.50.$$

Regarding the interest spread on BOY reserve V , term (1.2.1) versus term (2.1.1), we see that because the ratio of G 's is 1.314, a gain amounting to \$6.68 arises. Regarding the effect of the interest spread on premium, expenses, and charges, term (1.2.2) versus term (2.1.2), we see that there is a loss of \$6.07. This is due to the G value of 0.6906 (less than 1) and to the non % premium expense being lower than the non % premium charge. The net gain of \$0.61 (\$6.68 - \$6.07) equals the sum of terms (1.2) and (2.1) of Appendix 4.C.

Because the credited rate affects EOY AB , terms (2.2.2) and (2.3.2) also are affected in year 3. They amount to \$-0.07 and \$1.81. The analysis

here is the same as for example 2. It should be emphasized that in reality, the effects of terms (2.2.2) and (2.3.2) are less, because deaths and withdrawals can occur any time during the year.

For years 4 and beyond, because BOY *AB*'s are changed, terms that depend on BOY *AB* also contribute additional gains or losses. Analysis similar to example 2 can be applied here.

Example 5: Increasing the Expense Charge Due to the Increase in Actual Expenses

In this example, we assume that the non % premium expense increases by \$10 starting in year 5. To overcome this expense problem, the insurance company decides to increase the mortality charge (which is treated as a type of non % premium charge in our formulation). The question is, how much should the increase be?

According to question 4 above, if we wish to completely offset the loss due to the increased expense by the gain due to the increased charge in year 5, the charge has to be increased by

$$\frac{E_t^o - E_t^{o'}}{G_t} * \frac{(1 + i_t^e)}{(1 + i_t^i)}$$

Appendix 5.A shows the resulting policy values when such a change is introduced.

Appendix 5.B shows that, contrary to our expectation, the resulting fifth year GAAP profit is higher than the original expected profit of \$38.09. Why? Turning to Appendix 5.C, we find the answer. Even though term (2.4) offsets term (1.5) dollar for dollar, additional gains and losses emerge due to terms (2.2.2) and (2.3.2). These gains and losses emerge because the fifth year EOY *AB* decreased due to increased mortality charges. This phenomenon should have been expected, because it occurs in all previous examples. In reality, however, the magnitude of terms (2.2.2) and (2.3.2) in year 5 will likely be reduced by half. This is because in reality, mortality charges are levied monthly, and on the average, deaths and withdrawals occur at the middle of the year. (Note that the midyear assumption is more realistic than our simplified EOY assumption.)

For years 6 and beyond, because BOY *AB*'s are changed, more terms are affected and analysis similar to that for example 2 should be used.

Consider another question. Knowing that terms (2.2.2) and (2.3.2) also contribute additional gains and losses in the fifth year, how much should

the mortality charges be increased to yield the original \$38.09 expected profit?

It can be shown algebraically that under our EOY assumption, the increase in mortality charge is equal to the above formula, but with G_t replaced by

$$G_t + q_{t-1}^w (1 - G_t) - q_{t-1}^d G_t.$$

If such an increase in mortality charges is implemented instead, the resulting policy values and income statement will be as shown in Appendix 5.D and 5.E, respectively. As Appendix 5.F shows (the resulting SOE statement), the sum of terms (2.2), (2.3) and (2.4) exactly offsets the loss due to term (1.5) in year 5.

CONCLUSION

In this paper we have stressed the importance of SOE analysis. We also have presented the difficulties involved in performing such an analysis on UL and other interest-sensitive products. The primary difficulty lies in the variability of the account balance and its effects on policy values and reserves.

The main contribution of this paper is in the extension of the traditional source of earnings analysis to Universal Life and other interest-sensitive products. The sources of earnings (and their magnitudes) depend on the reserve methodology and the manner in which the reserve is made dynamic with respect to actual experience. The procedure illustrated in the paper is for a reserve methodology that is premium-based (that is, full percent of premium, traditional GAAP, composite, and prospective deposit), and made dynamic with the use of the account balance. We believe that the procedure can be generalized to apply to account value-based reserve methods and other reserve methodologies. The difficulty of the generalization will depend on the methodology used. Nonetheless, the illustrated procedure will be useful because it promotes an understanding of how the different parameters and policy values of an interest-sensitive product are interrelated and how they contribute to income. Also, the results of a premium-based method can approximate the results of an account value-based method. (This is because the two methods are inherently interrelated. For example, by choosing the assumptions appropriately, we can easily derive the profit pattern of the retrospective deposit method by using the composite method.) Thus, this analysis technique should prove to be an important step toward understanding how profits emerge from UL and other interest-sensitive products.

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APPENDIX 1.A

ACTUAL EXPERIENCE ASSUMPTIONS

i	C°	C*	E°	E*	GP	i ^c	i ^e	q ^d	q ^w	DB	AB	CV	A	V	NP
1	50.00	.0500000	75.00	.8000000	1,000	.0800000	.1000000	.0009533	.2000000	50,000	972.00	72.00	1.00000	46.74	965.38
2	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0013138	.1500000	50,000	2,021.76	421.76	1.00000	1,062.67	965.38
3	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0017038	.1000000	50,000	3,155.50	1,055.50	1.00000	2,179.25	965.38
4	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0020238	.0500000	50,000	4,379.94	1,979.94	1.00000	3,350.72	965.38
5	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0023441	.0500000	50,000	5,702.34	3,202.34	1.00000	4,630.24	965.38
6	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0027494	.0500000	50,000	7,130.52	4,730.52	1.00000	6,016.03	965.38
7	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0031915	.0500000	50,000	8,672.96	6,572.96	1.00000	7,508.19	965.38
8	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0035453	.0500000	50,000	10,338.80	8,738.80	1.00000	9,112.14	965.38
9	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0038401	.0500000	50,000	12,137.91	11,237.91	1.00000	10,832.06	965.38
10	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0042098	.0500000	50,000	14,080.94	14,080.94	1.00000	12,666.81	965.38
11	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0047339	.0500000	50,000	16,179.41	16,179.41	1.00000	14,670.19	965.38
12	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0053938	.0500000	50,000	18,445.77	18,445.77	1.00000	16,858.50	965.38
13	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0062972	.0500000	50,000	20,893.43	20,893.43	1.00000	19,247.83	965.38
14	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0072644	.0500000	50,000	23,536.90	23,536.90	1.00000	21,863.99	965.38
15	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0082652	.0500000	50,000	26,391.85	26,391.85	1.00000	24,738.33	965.38
16	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0099000	.0500000	50,000	29,475.20	29,475.20	1.00000	27,893.65	965.38
17	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0108060	.0500000	50,000	32,805.22	32,805.22	1.00000	31,390.60	965.38
18	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0118140	.0500000	50,000	36,401.64	36,401.64	1.00000	35,279.04	965.38
19	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0129780	.0500000	50,000	40,285.77	40,285.77	1.00000	39,618.24	965.38
20	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0142860	.0500000	50,000	44,480.63	44,480.63	1.00000	44,480.63	965.38

APPENDIX 1.B

INCOME STATEMENT

Year	Premium	Inv Inc	Exps	Dth Ben	Sur Ben	Chg-Res	Total Income
1	1,000.00	12.50	875.00	47.67	14.40	37.35	38.09
2	1,000.00	97.17	75.00	65.69	63.26	855.14	38.09
3	1,000.00	198.77	75.00	85.19	105.55	894.94	38.09
4	1,000.00	310.42	75.00	101.19	99.00	997.15	38.09
5	1,000.00	427.57	75.00	117.21	160.12	1,037.16	38.09
6	1,000.00	555.52	75.00	137.47	236.53	1,068.44	38.09
7	1,000.00	694.10	75.00	159.57	328.65	1,092.79	38.09
8	1,000.00	843.32	75.00	177.26	436.94	1,116.03	38.09
9	1,000.00	1,003.71	75.00	192.01	561.90	1,136.73	38.09
10	1,000.00	1,175.71	75.00	210.49	704.05	1,148.08	38.09
11	1,000.00	1,359.18	75.00	236.70	808.97	1,200.43	38.09
12	1,000.00	1,559.52	75.00	269.69	922.29	1,254.45	38.09
13	1,000.00	1,778.35	75.00	314.86	1,044.67	1,305.73	38.09
14	1,000.00	2,017.28	75.00	363.22	1,176.85	1,364.13	38.09
15	1,000.00	2,278.90	75.00	413.26	1,319.59	1,432.96	38.09
16	1,000.00	2,566.33	75.00	495.00	1,473.76	1,484.49	38.09
17	1,000.00	2,881.87	75.00	540.30	1,640.26	1,588.22	38.09
18	1,000.00	3,231.56	75.00	590.70	1,820.08	1,707.69	38.09
19	1,000.00	3,620.40	75.00	648.90	2,014.29	1,844.13	38.09
20	1,000.00	4,054.32	75.00	714.30	2,224.03	2,002.91	38.09

APPENDIX 1.C

SOE INCOME

Year	Gain 1.1	Gain 1.2	Gain 1.3	Gain 1.4	Gain 1.5	Gain 1.6	Gain 2.1	Gain 2.2	Gain 2.3	Gain 2.4	Gain 2.5	Gain 2.6	Gain 2.7	Gain 2.8	Total Income
1	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
2	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
3	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
4	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
5	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
6	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
7	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
8	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
9	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
10	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
11	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
12	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
13	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
14	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
15	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
16	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
17	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
18	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
19	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
20	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09

Gain 1.1 = gain from loading (% of premium profit)

Gain 1.2 = gain from earned interest

Gain 1.3 = gain from mortality

Gain 1.4 = gain from withdrawal

Gain 1.5 = gain from non % premium expenses

Gain 1.6 = gain from % premium expenses

Gain 2.1 = gain from credited interest

Gain 2.2 = additional mortality loss

Gain 2.3 = additional withdrawal loss

Gain 2.4 = gain from non % premium charge

Gain 2.5 = gain from % premium charge

Gain 2.6 = additional loss from non % premium expense

Gain 2.7 = additional gain from non % of premium charge

Gain 2.8 = premium persistency gain

APPENDIX 2.A

ACTUAL EXPERIENCE ASSUMPTIONS

t	C ^e	C ^w	E ^e	E ^w	GP	i ^e	i ^w	q ^d	q ^w	DB	AB	CV	A	V	NP
1	50.00	.0500000	75.00	.8000000	1,000	.0800000	.1000000	.0009533	.2000000	50,000	972.00	72.00	1.00000	46.74	965.38
2	50.00	.0500000	25.00	.0500000	1,000	.0750000	.1000000	.0013138	.1500000	50,000	2,012.40	412.40	.99537	1,057.75	965.38
3	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0017038	.1000000	50,000	3,116.27	1,016.27	.98757	2,152.15	965.38
4	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0020238	.0500000	50,000	4,297.41	1,897.41	.98116	3,287.58	965.38
5	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0023441	.0500000	50,000	5,561.23	3,061.23	.97525	4,515.66	965.38
6	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0027494	.0500000	50,000	6,913.51	4,513.51	.96957	5,832.93	965.38
7	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0031915	.0500000	50,000	8,360.46	6,260.46	.96397	7,237.66	965.38
8	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0035453	.0500000	50,000	9,908.69	8,308.69	.95840	8,733.05	965.38
9	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0038401	.0500000	50,000	11,565.30	10,665.30	.95282	10,321.05	965.38
10	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0042098	.0500000	50,000	13,337.87	13,337.87	.94723	11,998.36	965.38
11	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0047339	.0500000	50,000	15,234.52	15,234.52	.94160	13,813.43	965.38
12	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0053938	.0500000	50,000	17,263.93	17,263.93	.93593	15,778.36	965.38
13	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0062972	.0500000	50,000	19,435.41	19,435.41	.93022	17,904.65	965.38
14	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0072644	.0500000	50,000	21,758.89	21,758.89	.92446	20,212.35	965.38
15	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0082652	.0500000	50,000	24,245.01	24,245.01	.91866	22,726.00	965.38
16	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0099000	.0500000	50,000	26,905.16	26,905.16	.91281	25,461.51	965.38
17	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0108060	.0500000	50,000	29,751.52	29,751.52	.90691	28,468.59	965.38
18	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0118140	.0500000	50,000	32,797.13	32,797.13	.90098	31,785.69	965.38
19	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0129780	.0500000	50,000	36,055.93	36,055.93	.89500	35,458.49	965.38
20	50.00	.0500000	25.00	.0500000	1,000	.0700000	.1000000	.0142860	.0500000	50,000	39,542.84	39,542.84	.88899	39,542.84	965.38

APPENDIX 2.B

INCOME STATEMENT

Year	Premium	Inv Inc	Exps	Dth Ben	Sur Ben	Chg-Res	Total Income
1	1,000	12.50	875.00	47.67	14.40	37.35	38.09
2	1,000	97.17	75.00	65.69	61.86	850.96	43.67
3	1,000	198.28	75.00	85.19	101.63	875.52	60.94
4	1,000	307.72	75.00	101.19	94.87	964.39	72.26
5	1,000	421.26	75.00	117.21	153.06	991.72	84.27
6	1,000	544.07	75.00	137.47	225.68	1,009.59	96.33
7	1,000	675.79	75.00	159.57	313.02	1,019.74	108.46
8	1,000	816.27	75.00	177.26	415.43	1,027.78	120.78
9	1,000	965.81	75.00	192.01	533.26	1,032.31	133.22
10	1,000	1,124.61	75.00	210.49	666.89	1,026.88	145.34
11	1,000	1,292.34	75.00	236.70	761.73	1,059.01	159.90
12	1,000	1,473.84	75.00	269.69	863.20	1,090.91	175.05
13	1,000	1,670.34	75.00	314.86	971.77	1,118.30	190.40
14	1,000	1,882.96	75.00	363.22	1,087.94	1,150.25	206.55
15	1,000	2,113.74	75.00	413.26	1,212.25	1,189.51	223.71
16	1,000	2,365.10	75.00	495.00	1,345.26	1,210.37	239.47
17	1,000	2,638.65	75.00	540.30	1,487.58	1,276.02	259.76
18	1,000	2,939.36	75.00	590.70	1,639.86	1,352.30	281.50
19	1,000	3,271.07	75.00	648.90	1,802.80	1,439.70	304.68
20	1,000	3,638.35	75.00	714.30	1,977.14	1,542.30	329.60

APPENDIX 2.C

SOE INCOME

Year	Gain 1.1	Gain 1.2	Gain 1.3	Gain 1.4	Gain 1.5	Gain 1.6	Gain 2.1	Gain 2.2	Gain 2.3	Gain 2.4	Gain 2.5	Gain 2.6	Gain 2.7	Gain 2.8	Total Income
1	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
2	38.09	.00	.00	.00	.00	.00	4.92	-0.01	0.67	.00	.00	.00	.00	.00	43.67
3	38.09	.00	.00	.00	.00	.00	20.11	-0.42	1.73	.00	.00	-0.13	0.17	1.38	60.94
4	38.09	.00	.00	.00	.00	.00	30.73	-1.30	1.82	.00	.00	-0.34	0.51	2.76	72.26
5	38.09	.00	.00	.00	.00	.00	42.20	-2.27	2.67	.00	.00	-0.52	0.83	3.28	84.27
6	38.09	.00	.00	.00	.00	.00	54.51	-3.50	3.29	.00	.00	-0.68	1.13	3.50	96.33
7	38.09	.00	.00	.00	.00	.00	67.64	-4.99	3.52	.00	.00	-0.84	1.42	3.61	108.46
8	38.09	.00	.00	.00	.00	.00	81.62	-6.57	3.22	.00	.00	-0.99	1.71	3.70	120.78
9	38.09	.00	.00	.00	.00	.00	96.46	-8.22	2.24	.00	.00	-1.14	2.00	3.80	133.22
10	38.09	.00	.00	.00	.00	.00	112.13	-10.23	0.40	.00	.00	-1.30	2.29	3.96	145.34
11	38.09	.00	.00	.00	.00	.00	129.10	-12.88	0.42	.00	.00	-1.45	2.58	4.04	159.90
12	38.09	.00	.00	.00	.00	.00	147.46	-16.27	0.45	.00	.00	-1.61	2.88	4.04	175.05
13	38.09	.00	.00	.00	.00	.00	167.33	-20.87	0.47	.00	.00	-1.76	3.19	3.95	190.40
14	38.09	.00	.00	.00	.00	.00	188.90	-26.26	0.48	.00	.00	-1.92	3.50	3.76	206.55
15	38.09	.00	.00	.00	.00	.00	212.39	-32.40	0.48	.00	.00	-2.08	3.82	3.41	223.71
16	38.09	.00	.00	.00	.00	.00	237.96	-41.88	0.46	.00	.00	-2.24	4.16	2.93	239.47
17	38.09	.00	.00	.00	.00	.00	266.06	-49.11	0.42	.00	.00	-2.40	4.51	2.19	259.76
18	38.09	.00	.00	.00	.00	.00	297.06	-57.46	0.33	.00	.00	-2.56	4.87	1.17	281.50
19	38.09	.00	.00	.00	.00	.00	331.39	-67.33	0.20	.00	.00	-2.72	5.26	-0.21	304.68
20	38.09	.00	.00	.00	.00	.00	369.56	-78.82	0.00	.00	.00	-2.89	5.67	-2.00	329.60

Gain 1.1 = gain from loading (% of premium profit)

Gain 1.2 = gain from earned interest

Gain 1.3 = gain from mortality

Gain 1.4 = gain from withdrawal

Gain 1.5 = gain from non % premium expenses

Gain 1.6 = gain from % premium expenses

Gain 2.1 = gain from credited interest

Gain 2.2 = additional mortality loss

Gain 2.3 = additional withdrawal loss

Gain 2.4 = gain from non % premium charge

Gain 2.5 = gain from % premium charge

Gain 2.6 = additional loss from non % premium expense

Gain 2.7 = additional gain from non % of premium charge

Gain 2.8 = premium persistency gain

APPENDIX 3.A

ACTUAL EXPERIENCE ASSUMPTIONS

t	C ^c	C ^{*c}	E ^o	E ^{*c}	GP	i ^c	i ^{*c}	q ^d	q ^w	DB	AB	CV	A	V	NP
1	50.00	.0500000	75.00	.8000000	1,000	.0800000	.1000000	.0009533	.2000000	50,000	972.00	72.00	1.00000	46.74	965.38
2	50.00	.0500000	25.00	.0500000	950	.0800000	.1000000	.0013138	.1500000	50,000	1,970.46	410.46	.97463	1,035.71	965.38
3	50.00	.0500000	25.00	.0500000	900	.0800000	.1000000	.0017038	.1000000	50,000	2,997.50	1,002.50	.94993	2,070.13	965.38
4	50.00	.0500000	25.00	.0500000	850	.0800000	.1000000	.0020238	.0500000	50,000	4,055.40	1,835.40	.92590	3,102.44	965.38
5	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0023441	.0500000	50,000	5,146.63	2,896.63	.90255	4,179.01	965.38
6	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0027494	.0500000	50,000	6,325.16	4,205.16	.88705	5,336.54	965.38
7	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0031915	.0500000	50,000	7,597.97	5,767.97	.87605	6,577.57	965.38
8	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0035453	.0500000	50,000	8,972.61	7,592.61	.86786	7,908.04	965.38
9	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0038401	.0500000	50,000	10,457.22	9,687.22	.86153	9,332.19	965.38
10	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0042098	.0500000	50,000	12,060.60	12,060.60	.85652	10,849.36	965.38
11	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0047339	.0500000	50,000	13,792.24	13,792.24	.85246	12,505.70	965.38
12	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0053938	.0500000	50,000	15,662.42	15,662.42	.84911	14,314.66	965.38
13	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0062972	.0500000	50,000	17,682.22	17,682.22	.84631	16,289.54	965.38
14	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0072644	.0500000	50,000	19,863.59	19,863.59	.84393	18,451.77	965.38
15	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0082652	.0500000	50,000	22,219.48	22,219.48	.84191	20,827.37	965.38
16	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0099000	.0500000	50,000	24,763.84	24,763.84	.84016	23,435.08	965.38
17	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0108060	.0500000	50,000	27,511.75	27,511.75	.83864	26,325.39	965.38
18	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0118140	.0500000	50,000	30,479.49	30,479.49	.83731	29,539.52	965.38
19	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0129780	.0500000	50,000	33,684.64	33,684.64	.83614	33,126.50	965.38
20	50.00	.0500000	25.00	.0500000	800	.0800000	.1000000	.0142860	.0500000	50,000	37,146.22	37,146.22	.83511	37,146.22	965.38

APPENDIX 3.B

INCOME STATEMENT

Year	Premium	Inv Inc	Exps	Dth Ben	Sur Ben	Chg-Res	Total Income
1	1,000.00	12.50	875.00	47.67	14.40	37.35	38.09
2	950.00	92.42	72.50	65.69	61.57	832.25	10.42
3	900.00	186.57	70.00	85.19	100.25	823.88	7.25
4	850.00	285.26	67.50	101.19	91.77	870.91	3.90
5	800.00	383.74	65.00	117.21	144.83	857.83	-1.13
6	800.00	491.40	65.00	137.47	210.26	876.03	2.65
7	800.00	607.15	65.00	159.57	288.40	891.16	3.02
8	800.00	731.26	65.00	177.26	379.63	907.03	2.34
9	800.00	864.30	65.00	192.01	484.36	921.70	1.23
10	800.00	1,006.72	65.00	210.49	603.03	929.03	-0.84
11	800.00	1,158.44	65.00	236.70	689.61	971.85	-4.72
12	800.00	1,324.07	65.00	269.69	783.12	1,016.02	-9.77
13	800.00	1,504.97	65.00	314.86	884.11	1,057.82	-16.82
14	800.00	1,702.45	65.00	363.22	993.18	1,105.60	-24.54
15	800.00	1,918.68	65.00	413.26	1,110.97	1,162.09	-32.65
16	800.00	2,156.24	65.00	495.00	1,238.19	1,203.95	-45.91
17	800.00	2,417.01	65.00	540.30	1,375.59	1,289.57	-53.45
18	800.00	2,706.04	65.00	590.70	1,523.97	1,388.17	-61.80
19	800.00	3,027.45	65.00	648.90	1,684.23	1,500.74	-71.42
20	800.00	3,386.15	65.00	714.30	1,857.31	1,631.74	-82.20

APPENDIX 3.C

SOE INCOME

Year	Gain 1.1	Gain 1.2	Gain 1.3	Gain 1.4	Gain 1.5	Gain 1.6	Gain 2.1	Gain 2.2	Gain 2.3	Gain 2.4	Gain 2.5	Gain 2.6	Gain 2.7	Gain 2.8	Total Income
1	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
2	36.18	.00	.00	.00	.00	.00	.00	-0.04	-2.35	.00	.00	.00	.00	-23.38	10.42
3	34.28	.00	.00	.00	.00	.00	.00	-2.25	-2.76	.00	.00	-0.70	0.95	-22.26	7.25
4	32.37	.00	.00	.00	.00	.00	.00	-5.23	-1.75	.00	.00	-1.38	2.07	-22.18	3.90
5	30.47	.00	.00	.00	.00	.00	.00	-8.94	-1.99	.00	.00	-2.04	3.25	-21.88	-1.13
6	30.47	.00	.00	.00	.00	.00	.00	-13.65	-1.44	.00	.00	-2.68	4.44	-14.49	2.65
7	30.47	.00	.00	.00	.00	.00	.00	-18.29	-1.00	.00	.00	-3.11	5.28	-10.33	3.02
8	30.47	.00	.00	.00	.00	.00	.00	-22.24	-0.58	.00	.00	-3.41	5.90	-7.81	2.34
9	30.47	.00	.00	.00	.00	.00	.00	-25.64	-0.14	.00	.00	-3.63	6.37	-6.20	1.23
10	30.47	.00	.00	.00	.00	.00	.00	-29.41	0.35	.00	.00	-3.81	6.73	-5.17	-0.84
11	30.47	.00	.00	.00	.00	.00	.00	-34.24	0.31	.00	.00	-3.95	7.03	-4.33	-4.72
12	30.47	.00	.00	.00	.00	.00	.00	-40.10	0.27	.00	.00	-4.06	7.28	-3.63	-9.77
13	30.47	.00	.00	.00	.00	.00	.00	-47.85	0.23	.00	.00	-4.15	7.51	-3.03	-16.82
14	30.47	.00	.00	.00	.00	.00	.00	-56.20	0.20	.00	.00	-4.23	7.71	-2.49	-24.54
15	30.47	.00	.00	.00	.00	.00	.00	-64.91	0.17	.00	.00	-4.29	7.90	-1.99	-32.65
16	30.47	.00	.00	.00	.00	.00	.00	-78.74	0.14	.00	.00	-4.35	8.08	-1.51	-45.91
17	30.47	.00	.00	.00	.00	.00	.00	-86.88	0.11	.00	.00	-4.40	8.26	-1.01	-53.45
18	30.47	.00	.00	.00	.00	.00	.00	-95.87	0.07	.00	.00	-4.44	8.44	-0.49	-61.80
19	30.47	.00	.00	.00	.00	.00	.00	-106.17	0.04	.00	.00	-4.47	8.64	0.08	-71.42
20	30.47	.00	.00	.00	.00	.00	.00	-117.70	0.00	.00	.00	-4.51	8.85	0.69	-82.20

Gain 1.1 = gain from loading (% of premium profit)

Gain 1.2 = gain from earned interest

Gain 1.3 = gain from mortality

Gain 1.4 = gain from withdrawal

Gain 1.5 = gain from non % premium expenses

Gain 1.6 = gain from % premium expenses

Gain 2.1 = gain from credited interest

Gain 2.2 = additional mortality loss

Gain 2.3 = additional withdrawal loss

Gain 2.4 = gain from non % premium charge

Gain 2.5 = gain from % premium charge

Gain 2.6 = additional loss from non % premium expense

Gain 2.7 = additional gain from non % of premium charge

Gain 2.8 = premium persistency gain

APPENDIX 4.A

ACTUAL EXPERIENCE ASSUMPTIONS

t	C ^c	C*	E ^c	E*	GP	i ^c	i*	q ^c	q*	DB	AB	CV	A	V	NP
1	50.00	.0500000	75.00	.8000000	1,000	.0800000	.1000000	.0009533	.2000000	50,000	972.00	72.00	1.00000	46.74	965.38
2	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0013138	.1500000	50,000	2,021.76	421.76	1.00000	1,062.67	965.38
3	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0017038	.1000000	50,000	3,097.07	997.07	.98148	2,138.89	965.38
4	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0020238	.0500000	50,000	4,236.89	1,836.89	.96734	3,241.28	965.38
5	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0023441	.0500000	50,000	5,445.10	2,945.10	.95489	4,421.37	965.38
6	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0027494	.0500000	50,000	6,725.81	4,325.81	.94324	5,674.57	965.38
7	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0031915	.0500000	50,000	8,083.36	5,983.36	.93202	6,997.77	965.38
8	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0035453	.0500000	50,000	9,522.36	7,922.36	.92103	8,392.56	965.38
9	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0038401	.0500000	50,000	11,047.70	10,147.70	.91018	9,859.14	965.38
10	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0042098	.0500000	50,000	12,664.56	12,664.56	.89941	11,392.68	965.38
11	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0047339	.0500000	50,000	14,378.44	14,378.44	.88869	13,037.21	965.38
12	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0053938	.0500000	50,000	16,195.14	16,195.14	.87799	14,801.54	965.38
13	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0062972	.0500000	50,000	18,120.85	18,120.85	.86730	16,693.63	965.38
14	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0072644	.0500000	50,000	20,162.10	20,162.10	.85662	18,729.06	965.38
15	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0082652	.0500000	50,000	22,325.83	22,325.83	.84594	20,927.06	965.38
16	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0099000	.0500000	50,000	24,619.38	24,619.38	.83526	23,298.37	965.38
17	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0108060	.0500000	50,000	27,050.54	27,050.54	.82458	25,884.08	965.38
18	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0118140	.0500000	50,000	29,627.57	29,627.57	.81391	28,713.88	965.38
19	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0129780	.0500000	50,000	32,359.23	32,359.23	.80324	31,823.04	965.38
20	50.00	.0500000	25.00	.0500000	1,000	.0600000	.0800000	.0142860	.0500000	50,000	35,254.78	35,254.78	.79259	35,254.78	965.38

APPENDIX 4.B

INCOME STATEMENT

Year	Premium	Inv Inc	Exps	Dth Ben	Sur Ben	Chg-Res	Total Income
1	1,000.00	12.50	875.00	47.67	14.40	37.35	38.09
2	1,000.00	97.17	75.00	65.69	63.26	855.14	38.09
3	1,000.00	159.01	75.00	85.19	99.71	858.69	40.43
4	1,000.00	245.11	75.00	101.19	91.84	933.76	43.31
5	1,000.00	333.30	75.00	117.21	147.26	948.66	45.18
6	1,000.00	427.71	75.00	137.47	216.29	953.87	45.08
7	1,000.00	527.97	75.00	159.57	299.17	950.98	43.25
8	1,000.00	633.82	75.00	177.26	396.12	945.41	40.03
9	1,000.00	745.40	75.00	192.01	507.39	935.77	35.25
10	1,000.00	862.73	75.00	210.49	633.23	915.94	28.07
11	1,000.00	985.41	75.00	236.70	718.92	930.96	23.84
12	1,000.00	1,116.98	75.00	269.69	809.76	944.42	18.11
13	1,000.00	1,258.12	75.00	314.86	906.04	952.28	9.94
14	1,000.00	1,409.49	75.00	363.22	1,008.11	962.92	0.24
15	1,000.00	1,572.32	75.00	413.26	1,116.29	978.68	-10.90
16	1,000.00	1,748.16	75.00	495.00	1,230.97	975.75	-28.55
17	1,000.00	1,937.87	75.00	540.30	1,352.53	1,011.80	-41.75
18	1,000.00	2,144.73	75.00	590.70	1,481.38	1,054.88	-57.23
19	1,000.00	2,371.11	75.00	648.90	1,617.96	1,105.01	-75.76
20	1,000.00	2,619.84	75.00	714.30	1,762.74	1,165.35	-97.55

APPENDIX 4.C

SOE INCOME

Year	Gain 1.1	Gain 1.2	Gain 1.3	Gain 1.4	Gain 1.5	Gain 1.6	Gain 2.1	Gain 2.2	Gain 2.3	Gain 2.4	Gain 2.5	Gain 2.6	Gain 2.7	Gain 2.8	Total Income
1	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
2	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
3	38.09	-39.75	.00	.00	.00	.00	40.36	-0.07	1.81	.00	.00	.00	.00	.00	40.43
4	38.09	-61.28	.00	.00	.00	.00	61.16	-1.97	2.95	.00	.00	-0.51	0.77	4.11	43.31
5	38.09	-83.33	.00	.00	.00	.00	83.42	-3.96	4.75	.00	.00	-0.90	1.43	5.68	45.18
6	38.09	-106.93	.00	.00	.00	.00	107.07	-6.39	6.06	.00	.00	-1.24	2.06	6.37	45.08
7	38.09	-131.99	.00	.00	.00	.00	132.03	-9.33	6.61	.00	.00	-1.56	2.65	6.74	43.25
8	38.09	-158.46	.00	.00	.00	.00	158.35	-12.41	6.11	.00	.00	-1.87	3.24	6.98	40.03
9	38.09	-186.35	.00	.00	.00	.00	186.02	-15.61	4.26	.00	.00	-2.17	3.81	7.21	35.25
10	38.09	-215.68	.00	.00	.00	.00	214.96	-19.48	0.76	.00	.00	-2.47	4.36	7.54	28.07
11	38.09	-246.35	.00	.00	.00	.00	245.99	-24.55	0.81	.00	.00	-2.77	4.93	7.71	23.84
12	38.09	-279.24	.00	.00	.00	.00	279.27	-30.99	0.85	.00	.00	-3.06	5.49	7.70	18.11
13	38.09	-314.53	.00	.00	.00	.00	314.97	-39.71	0.88	.00	.00	-3.36	6.07	7.53	9.94
14	38.09	-352.37	.00	.00	.00	.00	353.38	-49.90	0.89	.00	.00	-3.65	6.66	7.14	0.24
15	38.09	-393.08	.00	.00	.00	.00	394.85	-61.44	0.88	.00	.00	-3.94	7.26	6.48	-10.90
16	38.09	-437.04	.00	.00	.00	.00	439.59	-79.21	0.84	.00	.00	-4.24	7.87	5.54	-28.55
17	38.09	-484.47	.00	.00	.00	.00	488.38	-92.63	0.76	.00	.00	-4.53	8.51	4.14	-41.75
18	38.09	-536.18	.00	.00	.00	.00	541.77	-108.07	0.60	.00	.00	-4.82	9.18	2.20	-57.23
19	38.09	-592.78	.00	.00	.00	.00	600.43	-126.24	0.36	.00	.00	-5.12	9.88	-0.39	-75.76
20	38.09	-654.96	.00	.00	.00	.00	665.18	-147.31	.00	.00	.00	-5.41	10.62	-3.76	-97.55

Gain 1.1 = gain from loading (% of premium profit)

Gain 1.2 = gain from earned interest

Gain 1.3 = gain from mortality

Gain 1.4 = gain from withdrawal

Gain 1.5 = gain from non % premium expenses

Gain 1.6 = gain from % premium expenses

Gain 2.1 = gain from credited interest

Gain 2.2 = additional mortality loss

Gain 2.3 = additional withdrawal loss

Gain 2.4 = gain from non % premium charge

Gain 2.5 = gain from % premium charge

Gain 2.6 = additional loss from non % premium expense

Gain 2.7 = additional gain from non % of premium charge

Gain 2.8 = premium persistency gain

APPENDIX 5.A

ACTUAL EXPERIENCE ASSUMPTIONS

t	C ^c	C ^e	E ^o	E ^e	GP	i ^f	i ^r	q ^d	q ^w	DB	AB	CV	A	V	NP
1	50.00	.0500000	75.00	.8000000	1,000.00	.0800000	.1000000	.0009533	.2000000	50,000.00	972.00	72.00	1.00000	46.74	965.38
2	50.00	.0500000	25.00	.0500000	1,000.00	.0800000	.1000000	.0013138	.1500000	50,000.00	2,021.76	421.76	1.00000	1,062.67	965.38
3	50.00	.0500000	25.00	.0500000	1,000.00	.0800000	.1000000	.0017038	.1000000	50,000.00	3,155.50	1,055.50	1.00000	2,179.25	965.38
4	50.00	.0500000	25.00	.0500000	1,000.00	.0800000	.1000000	.0020238	.0500000	50,000.00	4,379.94	1,979.94	1.00000	3,350.72	965.38
5	62.54	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0023441	.0500000	50,000.00	5,688.79	3,188.79	.99762	4,619.24	965.38
6	62.07	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0027494	.0500000	50,000.00	7,102.85	4,702.85	.99612	5,992.68	965.38
7	61.77	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0031915	.0500000	50,000.00	8,630.38	6,530.38	.99509	7,471.33	965.38
8	61.56	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0035453	.0500000	50,000.00	10,280.33	8,680.33	.99434	9,060.60	965.38
9	61.41	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0038401	.0500000	50,000.00	12,062.43	11,162.43	.99378	10,764.70	965.38
10	61.32	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0042098	.0500000	50,000.00	13,987.19	13,987.19	.99334	12,582.47	965.38
11	61.23	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0047339	.0500000	50,000.00	16,066.04	16,066.04	.99299	14,567.39	965.38
12	61.14	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0053938	.0500000	50,000.00	18,311.28	18,311.28	.99271	16,735.59	965.38
13	61.06	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0062972	.0500000	50,000.00	20,736.24	20,736.24	.99248	19,103.03	965.38
14	60.96	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0072644	.0500000	50,000.00	23,355.30	23,355.30	.99228	21,695.30	965.38
15	60.87	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0082652	.0500000	50,000.00	26,183.99	26,183.99	.99212	24,543.49	965.38
16	60.76	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0099000	.0500000	50,000.00	29,239.09	29,239.09	.99199	27,670.20	965.38
17	60.64	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0108060	.0500000	50,000.00	32,538.72	32,538.72	.99188	31,135.60	965.38
18	60.51	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0118140	.0500000	50,000.00	36,102.47	36,102.47	.99178	34,989.09	965.38
19	60.36	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0129780	.0500000	50,000.00	39,951.48	39,951.48	.99170	39,289.49	965.38
20	60.19	.0500000	35.00	.0500000	1,000.00	.0800000	.1000000	.0142860	.0500000	50,000.00	44,108.60	44,108.60	.99164	44,108.60	965.38

APPENDIX 5.B

INCOME STATEMENT

Year	Premium	Inv Inc	Exps	Dth Ben	Sur Ben	Chg-Res	Total Income
1	1,000.00	12.50	875.00	47.67	14.40	37.35	38.09
2	1,000.00	97.17	75.00	65.69	63.26	855.14	38.09
3	1,000.00	198.77	75.00	85.19	105.55	894.94	38.09
4	1,000.00	310.42	75.00	101.19	99.00	997.15	38.09
5	1,000.00	426.57	85.00	117.21	159.44	1,026.74	38.19
6	1,000.00	553.42	85.00	137.47	235.14	1,057.33	38.48
7	1,000.00	690.77	85.00	159.57	326.52	1,081.23	38.45
8	1,000.00	938.63	85.00	177.26	434.02	1,104.12	38.23
9	1,000.00	997.56	85.00	192.01	558.12	1,124.53	37.90
10	1,000.00	1,167.97	85.00	210.49	699.36	1,135.68	37.44
11	1,000.00	1,349.75	85.00	236.70	803.30	1,187.58	37.17
12	1,000.00	1,548.24	85.00	269.69	915.56	1,241.15	36.83
13	1,000.00	1,765.06	85.00	314.86	1,036.81	1,291.99	36.39
14	1,000.00	2,001.80	85.00	363.22	1,167.77	1,349.90	35.92
15	1,000.00	2,261.03	85.00	413.26	1,309.20	1,418.17	35.41
16	1,000.00	2,545.85	85.00	495.00	1,461.95	1,469.26	34.63
17	1,000.00	2,658.52	85.00	540.30	1,626.94	1,572.16	34.12
18	1,000.00	3,205.06	85.00	590.70	1,805.12	1,690.68	33.56
19	1,000.00	3,590.41	85.00	648.90	1,997.57	1,826.03	32.91
20	1,000.00	4,020.45	85.00	714.30	2,205.43	1,983.54	32.18

APPENDIX 5.C

SOE INCOME

Year	Gain 1.1	Gain 1.2	Gain 1.3	Gain 1.4	Gain 1.5	Gain 1.6	Gain 2.1	Gain 2.2	Gain 2.3	Gain 2.4	Gain 2.5	Gain 2.6	Gain 2.7	Gain 2.8	Total Income
1	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
2	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
3	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
4	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
5	38.09	.00	.00	.00	-11.00	.00	.00	-0.03	0.13	11.00	.00	.00	.00	.00	38.19
6	38.09	.00	.00	.00	-11.00	.00	.00	-0.35	0.37	11.00	.00	-0.07	0.11	0.34	38.48
7	38.09	.00	.00	.00	-11.00	.00	.00	-0.64	0.47	11.00	.00	-0.11	0.18	0.46	38.45
8	38.09	.00	.00	.00	-11.00	.00	.00	-0.89	0.44	11.00	.00	-0.14	0.23	0.50	38.23
9	38.09	.00	.00	.00	-11.00	.00	.00	-1.11	0.29	11.00	.00	-0.16	0.27	0.52	37.90
10	38.09	.00	.00	.00	-11.00	.00	.00	-1.33	0.03	11.00	.00	-0.17	0.30	0.52	37.44
11	38.09	.00	.00	.00	-11.00	.00	.00	-1.60	0.03	11.00	.00	-0.18	0.33	0.51	37.17
12	38.09	.00	.00	.00	-11.00	.00	.00	-1.92	0.02	11.00	.00	-0.19	0.35	0.48	36.83
13	38.09	.00	.00	.00	-11.00	.00	.00	-2.32	0.02	11.00	.00	-0.20	0.36	0.45	36.39
14	38.09	.00	.00	.00	-11.00	.00	.00	-2.76	0.02	11.00	.00	-0.21	0.38	0.41	35.92
15	38.09	.00	.00	.00	-11.00	.00	.00	-3.22	0.01	11.00	.00	-0.21	0.39	0.35	35.41
16	38.09	.00	.00	.00	-11.00	.00	.00	-3.94	0.01	11.00	.00	-0.22	0.40	0.28	34.63
17	38.09	.00	.00	.00	-11.00	.00	.00	-4.37	0.01	11.00	.00	-0.22	0.41	0.20	34.12
18	38.09	.00	.00	.00	-11.00	.00	.00	-4.84	0.01	11.00	.00	-0.22	0.43	0.10	33.56
19	38.09	.00	.00	.00	-11.00	.00	.00	-5.37	.00	11.00	.00	-0.23	0.44	-0.02	32.91
20	38.09	.00	.00	.00	-11.00	.00	.00	-5.97	.00	11.00	.00	-0.23	0.45	-0.16	32.18

Gain 1.1 = gain from loading (% of premium profit)
 Gain 1.2 = gain from earned interest
 Gain 1.3 = gain from mortality
 Gain 1.4 = gain from withdrawal
 Gain 1.5 = gain from non % premium expenses
 Gain 1.6 = gain from % premium expenses
 Gain 2.1 = gain from credited interest

Gain 2.2 = additional mortality loss
 Gain 2.3 = additional withdrawal loss
 Gain 2.4 = gain from non % premium charge
 Gain 2.5 = gain from % premium charge
 Gain 2.6 = additional loss from non % premium expense
 Gain 2.7 = additional gain from non % of premium charge
 Gain 2.8 = premium persistency gain

APPENDIX 5.D

ACTUAL EXPERIENCE ASSUMPTIONS

t	C ^c	C [%]	E ^o	E [%]	GP	i ^c	i ^r	q ^d	q ^w	DB	AB	CV	A	V	NP
1	50.00	.0500000	75.00	.8000000	1,000	.0800000	.1000000	.0009533	.2000000	50,000	972.00	72.00	1.00000	46.74	965.38
2	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0013138	.1500000	50,000	2,021.76	421.76	1.00000	1,062.67	965.38
3	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0017038	.1000000	50,000	3,155.50	1,055.50	1.00000	2,179.25	965.38
4	50.00	.0500000	25.00	.0500000	1,000	.0800000	.1000000	.0020238	.0500000	50,000	4,379.94	1,979.94	1.00000	3,350.72	965.38
5	62.43	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0023441	.0500000	50,000	5,688.91	3,188.91	.99765	4,619.34	965.38
6	61.99	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0027494	.0500000	50,000	7,103.07	4,703.07	.99615	5,992.87	965.38
7	61.71	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0031915	.0500000	50,000	8,630.67	6,530.67	.99512	7,471.58	965.38
8	61.52	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0035453	.0500000	50,000	10,280.68	8,680.68	.99438	9,060.91	965.38
9	61.39	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0038401	.0500000	50,000	12,062.84	11,162.84	.99382	10,765.07	965.38
10	61.31	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0042098	.0500000	50,000	13,987.65	13,987.65	.99338	12,582.89	965.38
11	61.23	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0047339	.0500000	50,000	16,066.54	16,066.54	.99302	14,567.84	965.38
12	61.15	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0053938	.0500000	50,000	18,311.82	18,311.82	.99274	16,736.08	965.38
13	61.08	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0062972	.0500000	50,000	20,736.80	20,736.80	.99250	19,103.54	965.38
14	61.00	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0072644	.0500000	50,000	23,355.86	23,355.86	.99231	21,695.82	965.38
15	60.92	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0082652	.0500000	50,000	26,184.54	26,184.54	.99214	24,544.00	965.38
16	60.84	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0099900	.0500000	50,000	29,239.59	29,239.59	.99201	27,670.68	965.38
17	60.74	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0108060	.0500000	50,000	32,539.16	32,539.16	.99189	31,136.02	965.38
18	60.62	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0118140	.0500000	50,000	36,102.83	36,102.83	.99179	34,989.44	965.38
19	60.48	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0129780	.0500000	50,000	39,951.73	39,951.73	.99171	39,289.74	965.38
20	60.33	.0500000	35.00	.0500000	1,000	.0800000	.1000000	.0142860	.0500000	50,000	44,108.71	44,108.71	.99164	44,108.71	965.38

APPENDIX 5.E

INCOME STATEMENT

Year	Premium	Inv Inc	Exps	Dth Ben	Sur Ben	Chg-Res	Total Income
1	1,000.00	12.50	875.00	47.67	14.40	37.35	38.09
2	1,000.00	97.17	75.00	65.69	63.26	855.14	38.09
3	1,000.00	198.77	75.00	85.19	105.55	894.94	38.09
4	1,000.00	310.42	75.00	101.19	99.00	997.15	38.09
5	1,000.00	426.57	85.00	117.21	159.45	1,026.83	38.09
6	1,000.00	553.43	85.00	137.47	235.15	1,057.40	38.41
7	1,000.00	690.79	85.00	159.57	326.53	1,081.29	38.39
8	1,000.00	838.66	85.00	177.26	434.03	1,104.16	38.20
9	1,000.00	997.59	85.00	192.01	558.14	1,124.56	37.88
10	1,000.00	1,168.01	85.00	210.49	699.38	1,135.71	37.43
11	1,000.00	1,349.79	85.00	236.70	803.33	1,187.60	37.17
12	1,000.00	1,548.28	85.00	269.69	915.59	1,241.16	36.84
13	1,000.00	1,765.11	85.00	314.86	1,036.84	1,291.99	36.42
14	1,000.00	2,001.85	85.00	363.22	1,167.79	1,349.88	35.96
15	1,000.00	2,261.08	85.00	413.26	1,309.23	1,418.13	35.47
16	1,000.00	2,545.90	85.00	495.00	1,461.98	1,469.20	34.72
17	1,000.00	2,858.57	85.00	540.30	1,626.96	1,572.08	34.23
18	1,000.00	3,205.10	85.00	590.70	1,805.14	1,690.58	33.68
19	1,000.00	3,590.44	85.00	648.90	1,997.59	1,825.91	33.05
20	1,000.00	4,020.47	85.00	714.30	2,205.44	1,983.40	32.34

APPENDIX 5.F

SOE INCOME

Year	Gain 1.1	Gain 1.2	Gain 1.3	Gain 1.4	Gain 1.5	Gain 1.6	Gain 2.1	Gain 2.2	Gain 2.3	Gain 2.4	Gain 2.5	Gain 2.6	Gain 2.7	Gain 2.8	Total Income
1	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
2	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
3	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
4	38.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	38.09
5	38.09	.00	.00	.00	-11.00	.00	.00	-0.03	0.13	10.90	.00	.00	.00	.00	38.09
6	38.09	.00	.00	.00	-11.00	.00	.00	-0.35	0.37	10.93	.00	-0.06	0.11	0.33	38.41
7	38.09	.00	.00	.00	-11.00	.00	.00	-0.64	0.46	10.95	.00	-0.11	0.18	0.46	38.39
8	38.09	.00	.00	.00	-11.00	.00	.00	-0.89	0.44	10.97	.00	-0.13	0.23	0.50	38.20
9	38.09	.00	.00	.00	-11.00	.00	.00	-1.10	0.29	10.98	.00	-0.15	0.27	0.51	37.88
10	38.09	.00	.00	.00	-11.00	.00	.00	-1.33	0.03	10.98	.00	-0.17	0.30	0.52	37.43
11	38.09	.00	.00	.00	-11.00	.00	.00	-1.59	0.03	11.00	.00	-0.18	0.32	0.51	37.17
12	38.09	.00	.00	.00	-11.00	.00	.00	-1.91	0.02	11.01	.00	-0.19	0.34	0.48	36.84
13	38.09	.00	.00	.00	-11.00	.00	.00	-2.31	0.02	11.02	.00	-0.20	0.36	0.45	36.42
14	38.09	.00	.00	.00	-11.00	.00	.00	-2.75	0.02	11.04	.00	-0.21	0.38	0.40	35.96
15	38.09	.00	.00	.00	-11.00	.00	.00	-3.21	0.01	11.05	.00	-0.21	0.39	0.35	35.47
16	38.09	.00	.00	.00	-11.00	.00	.00	-3.93	0.01	11.08	.00	-0.22	0.40	0.28	34.72
17	38.09	.00	.00	.00	-11.00	.00	.00	-4.36	0.01	11.09	.00	-0.22	0.41	0.20	34.23
18	38.09	.00	.00	.00	-11.00	.00	.00	-4.83	0.01	11.11	.00	-0.22	0.42	0.10	33.68
19	38.09	.00	.00	.00	-11.00	.00	.00	-5.37	.00	11.14	.00	-0.23	0.44	-0.02	33.05
20	38.09	.00	.00	.00	-11.00	.00	.00	-5.97	.00	11.16	.00	-0.23	0.45	-0.16	32.34

Gain 1.1 = gain from loading (% of premium profit)

Gain 1.2 = gain from earned interest

Gain 1.3 = gain from mortality

Gain 1.4 = gain from withdrawal

Gain 1.5 = gain from non % premium expenses

Gain 1.6 = gain from % premium expenses

Gain 2.1 = gain from credited interest

Gain 2.2 = additional mortality loss

Gain 2.3 = additional withdrawal loss

Gain 2.4 = gain from non % premium charge

Gain 2.5 = gain from % premium charge

Gain 2.6 = additional loss from non % premium expense

Gain 2.7 = additional gain from non % of premium charge

Gain 2.8 = premium persistency gain

