SOURCE-OF-EARNINGS ANALYSIS UNDER *FAS 97* UNIVERSAL LIFE ACCOUNTING

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ABSTRACT

The *Statement of Financial Accounting Standards No. 97 (FAS 97)* [4], which prescribes the GAAP accounting methodology for universal life-type contracts, will have far-reaching effects on income-reporting and pricing of such contracts. To fully evaluate the implications of *FAS 97*, an understanding of how profits will emerge is needed. This paper provides such an understanding and also illustrates a procedure for analyzing the various sources of profits. In addition, the paper suggests an analytical procedure for reflecting actual experience and revised future assumptions in the recalculation of the estimated gross profit defined by *FAS 97*. The suggested procedure is a direct extension of source-of-earnings analysis. To help illustrate the suggested procedures, a simple example is included.

INTRODUCTION

Source-of-earnings (SOE) analyses for traditional products have been discussed in Richard Horn's landmark paper [5]. The application of this procedure to universal life and other interest-sensitive products requires modifications to capture the flexible and interest-sensitive nature of these products. The paper by Robert Stein and Joseph Tan [7] represents an attempt to identify the required modifications. That paper presents a procedure for analyzing the earnings for such products reported under GAAP accounting methods, which are "premium-based." "Premium-based" methods are prospective, net level premium approaches and include the "full percent of premium," "traditional GAAP," "composite," and "prospective deposit" methods.

The *Statement of Financial Accounting Standards No. 97 (FAS 97)* [4] mandates the use of the retrospective deposit method to account for universal life-type contracts. It establishes a liability for policy benefits at an amount determined by the account balance and requires that capitalized acquisition costs be amortized based on a constant percentage of the present value of estimated gross profits. It also requires that estimates of expected gross profits used as the basis for amortization be evaluated regularly and be revised if warranted by actual experience or other evidence.

This paper analyzes the emergence of pretax GAAP profits and examines the fundamental income statement structure under *FAS 97*. The suggested SOE analysis applicable to the *FAS 97* universal life (UL) accounting methodology is demonstrated both with and without a revision in the amortization schedule. This paper also proposes an analytical procedure for changing the estimated gross profit stream used to create the revised amortization schedule. To aid in the understanding of the suggested procedure, a simple example is included.

OVERVIEW OF *FAS 97* UNIVERSAL LIFE ACCOUNTING

In December 1987, the Financial Accounting Standards Board (FASB) issued *Statement of Financial Accounting Standards No. 97 (FAS 97)* [4]. This statement applies to investment contracts, substantially all limited-payment contracts, univeral life-type contracts, and realized investment gains and losses. However, this statement does not apply to contracts with terms that are fixed and guaranteed and for which premium-paying periods are the same as benefit periods, nor does it apply to accident and health products.

Universal life-type contracts provide either death or annuity benefits and are characterized by any of the following:

- One or more of the amounts assessed by the insurer (for example, mortality charge) are not fixed and guaranteed by contract terms.
- Amounts that accrue to policyholder's benefit (for example, interest accrued to policyholder balances) are not fixed and guaranteed by contract terms.
- Premiums may be varied by the policyholder within contract limits and without insurer's consent.

FAS 97 does not apply to a participating or a nonguaranteed premium contract unless the terms of the contract suggest that it is, in substance, a universal life-type contract. Paragraphs 12 and 13 of *FAS 97* describe some situations in which a participating or a nonguaranteed premium contract is accounted for as a universal life-type contract.

FAS 97 provides that the liability for policy benefits for universal life-type contracts be equal to the sum of:

- The balance that accrues to the benefit of the policyholders
- Amounts assessed to compensate the insurer for services to be performed over future periods
- Amounts previously assessed against policyholders that are refundable on contract termination
- Any probable loss (premium deficiency) as described in *FAS 60*.

Amounts assessed for services in the future should be reported as unearned revenue and recognized in income by using the same assumptions and factors used to amortize capitalized acquisition costs. The initiation or front-end fee is an example of unearned revenue.

For universal life-type contracts, *FAS 97* provides that revenue include amounts assessed against policyholders except for amounts assessed for future services. Expenses include benefit claims in excess of policyholder balances, expenses of contract administration, interest accrued to policyholders, and amortization of capitalized acquisition costs.

FAS 97 provides that capitalized acquisition costs be amortized by applying a constant amortization rate to each year's gross profit. The amortization rate is determined by dividing the present value of capitalized acquisition costs at issue by the present value of the estimated gross profits at issue. The discount rate used is the rate of interest that accrues to policyholder balances. As actual experience develops, the estimated gross profits and the amortization rate may have to be revised and the total amortization recorded to date adjusted. The interest rate used to compute the present value of the revised estimated gross profits is either the rate in effect at inception or the latest revised rate.

FAS 97 requires that the estimated gross profit include the following amounts based on best estimate and without provision for adverse deviation:

- Amounts expected to be assessed for mortality less benefit claims in excess of related policyholder balances
- Amounts expected to be assessed for contract administration cost (including acquisition costs not included in capitalized acquisition costs)
- Amounts expected to be earned from the investment of policyholder balances less interest credited to policyholder balances
- Surrender charges
- Other expected assessments and credits.

If significant negative gross profits are expected in any period, the present value of estimated gross revenues, gross costs, or the balance of insurance in force is used as the base for computing amortization.

APPLICABLE PRODUCTS AND ASSUMPTIONS USED

The SOE analysis introduced in this paper applies to those products that can be accounted for under the *FAS 97* universal life-type accounting. Examples of such products are:

- Universal life
- Interest-sensitive whole life

- Single-premium whole life with excess interest credits
- Single- and flexible-premium deferred annuities
- Variable life and annuity
- Variable universal life.

Even though deferred annuity and variable annuity are classified as investment contracts during the accumulation stage, universal life-type accounting (that is, retrospective deposit method) can also be used. Regarding variable products, some assumptions may need to be made regarding the computation of some of the terms used in our SOE formulas. For instance, the interest earned rate, credited rate, and account balance should include the effects of market value fluctuation.

To simplify the presentation, the following assumptions are made:

1. A policy-year orientation is used.
2. Premium, expenses (which include commissions), and expense charges occur at the beginning of the policy year (*BOY*).
3. Death and withdrawal occur at the end of the policy year (*EOY*).
4. Invested assets equal the net GAAP reserve (that is, account balance less deferred acquisition cost). The extension to those cases in which assets are defined differently (for example, statutory reserve plus required surplus) are trivial. Essentially, an additional term representing interest on GAAP surplus will emerge.
5. Mortality charge occurs at *BOY* and is based on the net amount at risk at *BOY*. In reality, mortality charges may be deducted monthly and may be based on the amount at risk at the beginning of the month. The extension of our SOE formulas to the monthly case is more complicated but follows the same procedure.
6. The death benefit does not increase with the increase in account balance.
7. No rider is attached to the base policy.
8. No other complications occur, for example, no policy loan, no partial withdrawal, no change in face amount other than at *BOY*.
9. No significant negative gross profits are expected in any period. Hence, the amortization of deferred acquisition cost is based on estimated gross profit.
10. Nonextra first-year expense consists of administrative expenses only.
11. The only unearned revenue item is the front-end fee, which is called first-year charge in the paper.
12. No extra reserve is needed for premium deficiency because the latter is not anticipated.

NOTATION

A. *Symbols*

q = Mortality rate
w = Withdrawal rate

m	= Mortality charge rate
DB	= Death benefit
AB	= Account balance
CSV	= Cash surrender value
MC	= Mortality charge
FYC	= Extra first-year expense charge, also called front-end fee
C	= Nonextra first-year expense charge, including all administrative charges except front-end fee
P	= Gross premium
FYE	= Extra first-year expense
E	= Nonextra first-year expense (administrative expense)
i	= Earned interest rate
l	= Survivorship function at time t, that is, units in force at time t
l_t	$= l_{t-1} \, (l - q_t - w_t)$
r	= Credited interest rate
DE	= Deferrable expense, as defined in *FAS 60*
DAC	= Outstanding deferred acquisition cost
V	= Net GAAP reserve $= AB - DAC$
Δ	= Change
Pf	= Profit
G	= Estimated gross profit used to derive the amortization schedule, as defined in *FAS 97* Paragraph 23. (To avoid confusion with GAAP profit *Pf*, we refer to G as gain.)

Except for q, m, w, r, and i, values are per unit in force at time t.

B. *Subscript*

t denotes policy year t.

For some terms, the subscript is omitted if there is no ambiguity.

C. *Superscripts*

A	= Actual experience
G	= GAAP assumption, which is based on the best estimate of future experience, that is, expected.

For some terms, the superscript is omitted if there is no ambiguity.

Refer to Appendix I for a complete list of notation used in this paper.

EXPECTED GAAP PROFITS

We will derive the expected GAAP profit for year t when actual experience conforms to the GAAP assumption (which is also the best estimate of expected experience, without adverse deviation provision). Let us first consider how the universal life (UL) income statement looks under *FAS 97*.

	Income Statement Items	Symbols
Expected GAAP Profit =	+ Mortality charge	$+ MC$
	+ Surrender charge	$+ w(AB_t - CSV_t)$
	+ Administrative charge	$+ C$
	+ Earned interest	$+ i (V_{t-1} + P - E - FYE)$
	− (Death benefit-account balance released due to death)	$- q(DB_t - AB_t)$
	− Administrative expense	$- E$
	− First-year expense	$- FYE$
	− Credited interest	$-r(AB_{t-1} + P - MC - C - FYC)$
	+ Deferrable expense	$+ DE$
	+ Amortization of unamortized deferred expense	$+ \Delta DE$
	− Amortization of unamortized first-year charge	$- \Delta FYC$

Note that:

1. For ease of presentation, the values shown under the Symbols column (except for q, m, w, r, and i) are expressed as per unit in force at *BOY t*. To obtain the aggregate values for the company, we simply multiply the terms by the outstanding in force at *BOY t* (that is, l_{t-1}). The l_t's notation has been omitted in this section to minimize the amount of symbols.
2. *FYC*, *FYE*, and *DE* are zero except for the first year. The extension to the case in which some of these items are nonzero beyond the first year is trivial.
3. $AB_t = AB_{t-1} + P +$ credited interest $- MC - FYC - C$.
4. $MC = m (DB_{t-1} - AB_{t-1})$.
5. The superscript is not used in the above symbols because all the values in this section are expected and have superscript G.

Rearranging and setting

$$\Delta DAC = \Delta DE - \Delta FYC,$$

we have

Expected GAAP profit $= Pf_t = MC - q(DB_t - AB_t)$
$$+ w(AB_t - CSV_t)$$
$$+ [C - E - (FYE - DE)]$$
$$+ i(V_{t-1} + P - E - FYE)$$
$$- r(AB_{t-1} + P - MC - C - FYC)$$
$$+ \Delta DAC_t. \tag{1}$$

Note:

(i) If $DE = FYE$, then the third term reduces to $(C - E)$. Otherwise, $(FYE - DE)$ is an extra first-year loss.

(ii) FYE, DE, and FYC are zero for $t > 1$.

(iii) $\Delta DAC_t = (1 - q_t - w_t) DAC_t - DAC_{t-1}$
$$= r DAC_{t-1} - (A\%) G_t \tag{2}$$

where $G_t =$ the t-th year estimated gross profit used to amortize DAC, per *FAS 97* (to avoid confusion with GAAP profit, we refer to G_t as gain), and

$$(A\%) = \frac{DE - FYC}{\sum_s v^s {}_sp\, G_s}$$

$$v^s = \left(\frac{1}{1 + r}\right)^s$$

$${}_sp = (1 - q_s - w_s) {}_{s-1}p$$

According to *FAS 97*, the t-th year gain (estimated gross profit) is to be computed as:

$G_t =$	Symbols	Description
	$MC_t - q_t (DB_t - AB_t)$	Gain from mortality (GM)
	$+ w_t (AB_t - CSV_t)$	Gain from withdrawal (GW)
	$+ [C_t - E_t - (FYE - DE)]$	Gain from expense (GE)
	$+ i_t (AB_{t-1} + P_t - E_t - FYE)$	
	$- r_t (AB_{t-1} + P_t - MC_t - C_t - FYC)$	Gain from interest (GI) (3)

Substituting Equations (2) and (3) into (1), we see that the expected GAAP profit for year t is

$$Pf_t = G_t + \Delta DAC_t - i_t DAC_{t-1}$$

$$Pf_t = (1 - A\%) G_t - (i_t - r_t) DAC_{t-1}. \qquad (4)$$

Whereas expected profit under a traditional GAAP approach emerges as a fixed percentage of gross premium (plus the release of margins for adverse deviation), expected profit under *FAS 97* UL accounting [see Equation (4)] emerges as the sum of:

1. A percentage of gain (that is, estimated gross profit), such percentage is equal to the complement of the *DAC* amortization rate, or $(1 - A\%)$.
2. The loss due to interest spread on the *BOY DAC*. This term emerges because *DAC* is discounted by using the credited rate r, but the net GAAP reserve $(AB - DAC)$ earns interest at the earned rate i.

Of course, this expected profit will emerge only if all GAAP assumptions are realized. If some or all of the GAAP assumptions are not realized, variations from this expected profit level will emerge. As shown in the next section, these variations can be traced to various specific sources of profit.

It should be pointed out that the above derivation of expected profit assumed two interpretations of the calculation of t-th year gain (that is, the estimated gross profit as described in *FAS 97* Paragraph 23).

Interpretation 1:   The gain from expense, GE, of Equation (3) is net of (FYE − DE) in the first year.

In other words, the nondeferrable expense (including first-year nonpolicy-related overhead expense) is netted out in the computation of first-year *GE*. Although this is in line with the *literal* provision of *FAS 97* Paragraph 23b, some practitioners argue that this is not the *intention* of *FAS 97*. Their reasons are as follows:

a) The phrase used in *FAS 97* Paragraph 23b that reads "acquisition costs not included in capitalized acquisition costs" should be interpreted to mean "recurring" acquisition cost, not first-year nondeferrable acquisition cost.
b) Interpretation 1 varies from the usual procedure used under the traditional GAAP approach. *FAS 60* Paragraph 27 states that "Costs incurred . . . that do not vary with and are not primarily related to the acquisition . . . shall be charged to expense as incurred" [3]. It can be argued that to *fully* charge the nondeferrable expenses as they are incurred, the nondeferrable expenses should not be part of the gain (estimated gross profit). This is the case with the traditional GAAP reserve, whose formula excludes any assumption regarding nondeferrable expense and which allows the nondeferrable expense to flow into first-year GAAP profit dollar-for-dollar. Although the *FAS 97* amortization base of gross profits differs from *FAS 60*'s base of premiums, there is no indication that FASB intended that nondeferrable expense be considered in amortizing DAC.

c)   The use of Interpretation 1 is likely to lead to negative first-year gain (estimated gross profit). This is particularly true for annuities, because annuities have minimal first-year gain from mortality (*GM*). Even if negative first-year gain does not occur, the inclusion of nondeferrable expense will reduce first-year amortization and increase subsequent amortization and increase the likelihood of a loss recognition situation.

If the reasoning of these practitioners is correct and if (*FYE* − *DE*) is not to be netted out in the first-year *GE*, then our expected GAAP profit formula would become, for $t > 1$,

$$Pf_t = (1 - A\%)G_t - (i_t - r_t)DAC_{t-1}$$

and for $t = 1$,

$$Pf_1 = (1 - A\%)G_1 - (i_1 - r_1)DAC_0 - (FYE - DE)$$

where the last item is the loss due to nondeferrable expense in the first year, which flows into profit 100 percent. Note that $A\%$ and G_1 in the last equation are different from those of Equation (4).

Interpretation 2: The interest earned portion of the gain from interest, GI, *of Equation (3) is the interest earning on* BOY AB *plus the change in cash flow during the year.*

The interest earning on the change in cash flow has been included because it can be argued that an insurance company earns interest on the asset it holds at *BOY* (which is assumed to be equal to *BOY AB* in the computation of estimated gross profit) plus the change in cash flow during the year. That is, because an insurance company invests any net cash flow during the year, the projection of the estimated gross profit should include the interest earning from such investment. This thinking is also more in line with other actuarial formulas, for example, asset share, book profit, and so on. Hence, it can be argued that Interpretation 2 is a refinement of the wording of Paragraph 23c.

For those readers who disagree with Interpretation 2 and who prefer to apply the wording of Paragraph 23c literally, the interest earned portion of the gain from interest, *GI*, of Equation (3) should be changed to

$$i_t (AB_{t-1} + P_t - MC_t - C_t - FYC).$$

In this case, it can be shown that the expected GAAP profit for year t will be equal to Equation (4) less

$$i_t[(E_t - C_t - MC_t) + (FYE - FYC)].$$

Note that in reality, the magnitude of this term will generally be reduced by half, because most expenses and charges often occur evenly throughout the year.

In the remaining discussion, we assume that Interpretations 1 and 2 hold; hence expected GAAP profit is as shown in Equation (4). If either Interpretation 1 or 2 or both are violated, adjustments to the SOE formulas shown in the next section should be made. The development of such adjustments is not difficult.

SOURCE-OF-EARNINGS ANALYSIS

A. *Calculation of Total Expected Profit*

Because the SOE analysis is a procedure for analyzing the deviation of actual versus expected profit, we first need to define how expected profit is calculated. Taking expected to mean expected based on GAAP (best estimate) assumptions, there are two methods for calculating total expected profit for the company:

Method 1
Expected in force times the expected profit per in force,

$$I_{t-1}^G \, Pf_t^G;$$

that is, the t-th year expected profit for the company is computed as the expected in force at *BOY t* times the t-th year expected profit per unit in force at *BOY t*.

Method 2
Actual in force times the expected profit per in force,

$$I_{t-1}^A \, Pf_t^G.$$

Due to the difference in actual versus expected mortality and lapse rates, the actual in force at *BOY t* will be different from expected. The Method 2 calculation of total expected profit is dynamic; that is, it adjusts for the difference in actual versus expected in force.

In actual practice, the difference in the two methods will be temporary and perhaps minimal. This is due to the "unlocking" provision of *FAS 97* Paragraph 25, which requires that the GAAP assumption be evaluated and

revised regularly. For instance, if the GAAP assumption is revised every year-end, there is no difference in the two methods.

The author prefers Method 1 because:

- It is the total expected profit based entirely on GAAP (best estimate) assumptions, that is, not adjusted.
- The resulting SOE formulas of Method 1 are easier to understand.
- Unless the estimated gross profit and *DAC* schedule are revised, the application of *FAS 97* will normally be based on the static *DAC* calculation procedure (that is, using the original *DAC* schedule regardless of the actual versus expected in force). Because of this requirement, the author believes that adjusting the total expected profit based solely on the deviation between actual versus expected in force (that is, without revising the estimated gross profit) is inappropriate.

Note that the last point is generally not a problem under the traditional GAAP approach, because the latter often uses either the dynamic worksheet method or the factor method to amortize *DAC*. Hence, under the traditional GAAP approach, the expected GAAP profit per unit in force generally does not change regardless of the difference between actual versus expected in force (unless the static *DAC* worksheet procedure is used).

Nevertheless, the author realizes that there are benefits associated with the Method 2 calculation of total expected profit (for example, ease of calculation) and that some readers may prefer the Method 2 calculation. For these reasons, the SOE procedure using the Method 2 calculation of total expected profit is included in Appendix II. Note that because of the static nature of *DAC* amortization under *FAS 97* (unless a revision in *DAC* amortization is made), there is an extra item in the SOE formula shown in Appendix II. This extra item effectively adjusts *DAC* for the deviation of the actual versus expected in force.

The remainder of the paper is based on the Method 1 calculation of total expected profit. Hence, the t-th year total expected profit is

$$l^G_{t-1} \, Pf^G_t.$$

B. *Source-of-Earnings Analysis*

The total actual profit for year t, excluding the effects of changes in *DAC* balances due to revisions of estimated gross profits, can be expressed as

$$l^A_{t-1} \, Pf^A_t = l^A_{t-1} \, MC^A - l^A_{t-1} \, q^A \, (DB^A_t - AB^A_t)$$
$$+ \, l^A_{t-1} \, w^A \, (AB^A_t - CSV^A_t)$$

$$+ l_{t-1}^A [C^A - E^A - (FYE^A - DE^A)]$$
$$+ l_{t-1}^A i^A (AB_{t-1}^A + P^A - E^A - FYE^A)$$
$$- l_{t-1}^A r^A (AB_{t-1}^A + P^A - MC^A - C^A - FYC^A)$$
$$- l_{t-1}^G (i^A DAC_{t-1}^G)$$
$$+ l_{t-1}^G \Delta DAC_t^G \tag{5}$$

We see that most of the terms of Equation (5) are multiplied by the actual in-force of the company. The only exceptions are $i^A DAC^G$ and ΔDAC^G, which are multiplied by the expected in-force. Without a revision in the estimated gross profits, *DAC* amortization would be static; that is, the total amortized amount for the company would not be adjusted according to actual versus expected in force. For the same reason, we note that the total actual net GAAP reserve, V, is equal to total actual *AB* less total expected *DAC*. That is,

$$l^A V^A = l^A AB^A - l^G DAC^G.$$

By rearranging terms, we can write the total actual profit for year t as follows, where the l's represent the in-force at *BOY t* and have subscript $t - 1$:

	Symbols	Description
$l^A Pf_t^A =$	$l^G (1 - A^G\%) G_t^G$	Expected % gain profit
	$- l^G (i_t^G - r_t^G) DAC_{t-1}^G$	Expected interest spread loss on *BOY DAC*
	$+ (l^A GM_t^A - l^G GM_t^G)$	Variation due to gain from mortality (*VGM*)
	$+ (l^A GW_t^A - l^G GW_t^G)$	Variation due to gain from withdrawal (*VGW*)
	$+ (l^A GE_t^A - l^G GE_t^G)$	Variation due to gain from expense (*VGE*)
	$+ (l^A GI_t^A - l^G GI_t^G)$	Variation due to gain from interest (*VGI*)
	$- l^G (i_t^A - i_t^G) DAC_{t-1}^G$	Variation due to interest earnings on *BOY DAC*

Let us look at each of these items.

1. Expected Profit

As discussed earlier, the first two terms (that is, expected % gain profit and expected interest spread loss on *DAC*) comprise the expected GAAP profit under the *FAS 97* UL accounting. This corresponds to the percentage of premium profit expected under traditional GAAP accounting.

2. *Variations Due to Gain from Mortality* (VGM)

This is simply the excess of actual over expected gain from mortality:

$$l^A [MC^A - q^A (DB_t^A - AB_t^A)] - l^G [MC^G - q^G (DB_t^G - AB_t^G)].$$

In actual practice, unless the mortality charge rate, m, is revised, the difference between actual and expected mortality charges will normally be immaterial. Thus, the main contributor to *VGM* will be the variance between expected and actual mortality rates ($q^G - q^A$). Clearly, *VGM* is also affected by the actual versus expected relationship between *DB* and *AB*, although such effect is not as great because m and q work in opposite directions. Also, the difference between l^A and l^G contributes additional profit, although this is not material if GAAP assumptions are updated frequently.

3. *Variations Due to Gain from Withdrawal* (VGW)

This is equal to the excess of actual over expected gain from withdrawal:

$$l^A w^A (AB_t^A - CSV_t^A) - l^G w^G (AB_t^G - CSV_t^G).$$

Except for some peculiar contracts (for example, those with bailout provisions or other features that waive or decrease the surrender charge collected), the surrender charge scale cannot be revised once the policy is issued. Hence, *VGW* variation can only result from three causes:

(a) The difference between actual and expected account balances gives rise to a deviation between actual and expected surrender charges collected at surrender.
(b) The difference between actual and expected in force at *BOY*.
(c) The variance between actual and expected withdrawal rates.

Of these three causes, the last one is often the major cause for *VGW*.

4. *Variations Due to Gain from Expense* (VGE)

This is equal to the difference between the actual and expected excesses of expense charges over expenses and nondeferrable first-year expense:

$$l^A [C^A - E^A - (FYE^A - DE^A)] - l^G [C^G - E^G - (FYE^G - DE^G)].$$

Because expense charges can be changed only according to contract specifications, the deviation between actual and expected charges likely will be small, and the deviation between actual and expected expenses will be the major cause of *VGE*. For the first year, the difference between actual versus expected nondeferrable expenses has a material effect on *VGE*. Again, we

see that the difference in *BOY* actual versus expected in force has some impact on *VGE*.

Note that the earned and credited interest on expenses and expense charges are not included in *VGE*, but are included in *VGI*. This is done to preserve the symmetry with Equation (3), the computation of the components of estimated gross profits, *GM, GW, GI,* and *GE*.

5. *Variations Due to Gain from Interest* (VGI)

This is the excess of actual over expected interest spreads:

$$
\begin{aligned}
I^A \, [i^A \, (AB_{t-1}^A &+ P^A - E^A - FYE^A) \\
&- r^A \, (AB_{t-1}^A + P^A - MC^A - C^A - FYC^A)] \\
- I^G \, [i^G \, (AB_{t-1}^G &+ P^G - E^G - FYE^G) \\
&- r^G \, (AB_{t-1}^G + P^G - MC^G - C^G - FYC^G)].
\end{aligned}
$$

Except for the earlier durations, the major cause of *VGI* will be the excess of the actual over the expected spread earned on *BOY AB*,

$$
I^A \, (i^A - r^A) \, AB_{t-1}^A - I^G \, (i^G - r^G) \, AB_{t-1}^G.
$$

In practice, the interest credited rate is often declared on a monthly or quarterly basis. Knowing that the actual earned rate has deviated from expected, the actuary can use the *VGI* formula to determine the credited rate that will give rise to zero *VGI*.

6. *Variation Due to Interest Earnings on* BOY DAC

Because our model assumes that invested assets are equal to the net GAAP reserve (that is, *AB* minus *DAC*), the deviation between actual and expected earning rates also will give rise to a deviation in actual and expected interest loss on the *DAC* balance.

It may be helpful to combine this item (that is, *DAC* interest earning deviation) with the previous item (that is, *VGI*). The sum of these two items can be rewritten as:

$$
\begin{aligned}
I^A \, [i^A \, (V_{t-1}^A &+ P^A - E^A - FYE^A) \\
&- r^A \, (AB_{t-1}^A + P^A - MC^A - C^A - FYC^A)] \\
- I^G \, [i^G \, (V_{t-1}^G &+ P^G - E^G - FYE^G) \\
&- r^G \, (AB_{t-1}^G + P^G - MC^G - C^G - FYC^G)]. \quad (6)
\end{aligned}
$$

We see that while the deviation in credited rates is applied to *AB*, the deviation in earned rates is applied to *AB* less *DAC* (that is, net GAAP

reserve). Knowing that the actual earned rate deviates from expected, the actuary can apply the above formula to determine the credited rate that will yield the expected GAAP profit. For instance, if the objective is to have no additional interest gain or loss, the above formula should be set to zero and solved for the appropriate r^A.

To summarize, we note that the total actual GAAP profit for year t is

$$
\begin{aligned}
l^A \, Pf_t^A = \ & \text{total expected profit for year } t \\
& + (l^A G_t^A - l^G \, G_t^G) \\
& - l^G (i_t^A - i_t^G) \, DAC_{t-1}^G
\end{aligned}
\tag{7}
$$

where $G = GM + GW + GE + GI$
   $=$ the t-th year gain (consisting of four components: mortality, withdrawal, expense, and interest)
   $l =$ in force at *BOY t*.

The second term of Equation (7) represents the variation due to the gains (that is, estimated gross profits) from four components: mortality, withdrawal, expense, and interest. The last term of Equation (7) represents the variation in profit caused by the actual versus expected interest earnings on *BOY DAC*. Over time, as existing GAAP assumptions become more outdated, these two terms, which represent the variations between actual and expected profits, may increase. This may signal the need to revise the existing GAAP assumptions.

REVISING *FAS 97* ESTIMATED GROSS PROFITS AND DAC SCHEDULES

The previous development ignores the "unlocking" aspect of *FAS 97*, which states that

"Estimates of estimated gross profit . . . .and the total amortization recorded to date . . . . shall be adjusted . . . if evidence suggests that earlier estimates should be revised."

If such a revision is made at *EOY n*, the following term, representing the variation due to revised *DAC* amortization, should be added to Equations (5) and (7):

$$
l^{G'} \, DAC_n^{G'} - l^G \, DAC_n^G
$$

where primed notation represents the revised values. Sometimes, the revision of the *DAC* amortization schedule can be traced to a single cause. For instance, *DAC* schedule revision may be caused by an unusually high withdrawal rate. If this is the case, it may be appropriate to classify the above

quantity (variation due to revised *DAC* amortization) as a variation in GAAP profit caused by current-year withdrawal experience and to combine it with *VGW*.

Clearly, *if* the new, revised *DAC* schedule is used to compute *DAC* for *BOY* and *EOY n*, the resulting actual profit of year *n* would be the same as the revised expected GAAP profit of year *n*. This is because the revised *DAC* schedule would be based on the *actual experience up to EOY n* and the revised expectation for the future. Hence,

$$I^A \; Pf_n^A \;=\; I^{G'} \; Pf_n^{G'}$$

where $Pf_n^{G'} =$ the revised expected GAAP profit per in force for year *n*. Also, we know that

$$Pf_n^{G'} \;=\; (1 \,-\, A'\%) \; G_n^{G'} \,-\, (i_n^{G'} \,-\, r_n^{G'}) \; DAC_{t-1}^{G'}$$

where $G_n^{G'} =$ the *n*-th year gain per in force based on the revised values and $A'\% =$ the revised amortization rate based on the revised values.

Note that the author is not implying that the new revised *DAC* schedule is used to restate the *BOY DAC* for year *n*; this is not done in practice. Instead, this discussion is intended to help explain the concept of *DAC* schedule revision and to illustrate its possible effect. Such an effect could occur, for instance, if the benefit of hindsight is used at the *FAS 97* adoption date to restate prior years' profits.

Starting in year *n* + 1, the revised GAAP assumptions and *DAC* schedule should be used in reporting income and in performing the source of earnings analysis discussed above. As a result, if actual emerging experience is consistent with the revised expected assumptions, then actual profit will be equal to the sum of

- The revised expected percentage of gain (that is, estimated gross profit), and
- The revised expected interest spread loss on *BOY DAC*.

Revising the *FAS 97* estimated gross profit (and hence the *DAC* schedule) is not easy, but a convenient method for revising current and future estimated gross profits is proposed below. The proposed method resembles, and is based on, the SOE analysis discussed above.

PROCEDURE FOR REVISING ESTIMATED GROSS PROFITS

To be strictly consistent with *FAS 97*, whenever changes occur in (i) those items affecting the account balance (for example, mortality and expense charges, interest crediting rate), or (ii) expectations of current and future

experience (for example, mortality and withdrawal rates, expenses, earned interest rates), the estimated gross profit (which we called gain) stream should be revised.

Clearly, a straightforward procedure for revising the estimated gross profit stream is to input all the new assumptions and values into the computer and generate the revised yearly gains. However, such a procedure does not explain why or how the estimated gross profit changes; that is, all that is known is that the results are different. There is no conceptual framework for analyzing the underlying process. In contrast, the following proposed procedure is based on the effects of each change on the various sources of gain (estimated gross profit).

The following additional notation is used:

(i)   Primed symbols denote revised assumptions or values.
(ii) Unprimed symbols denote original assumptions or values.
(iii) n is the time when the assumptions or values are revised.

A.   *Effect of a Change in Mortality or Withdrawal Rate in Year* n

If the n-th year's actual withdrawal (or mortality) rate turns out to be different from the original expectation, we can determine the effect on n-th year's gain by examining Equation (3). Specifically, the revised n-th year gain per in force can be derived by simply substituting the revised withdrawal/mortality rate into the gain from withdrawal/mortality term of Equation (3).

The effect on future years' (that is, beyond year n) gain of such a withdrawal/mortality deviation also is easily determined. If future withdrawal/mortality rates remain unchanged, the revised future gain per unit issue is equal to the original future gain per unit issue multiplied by the ratio,

$$\frac{(1 - q_n^{G'} - w_n^{G'})}{(1 - q_n^{G} - w_n^{G})},\tag{8}$$

that is, future gain per issue is proportionately reduced by the ratio of the revised in-force to the originally expected in-force at the end of year n.

This procedure will give the same result as the illustrated example shown in Appendix B of *FAS 97*.

B.   *Effect of a Change in Interest Earned Rate or Expense in Year* n

The effect of a deviation (between actual results and original expectations) in the n-th year's interest earned rate or expense on n-th year's gain per in

force is apparent by examining Equation (3). Also, the effect on future years' (that is, beyond year n) gain per in force should be zero. To obtain the gain per unit issue, we multiply the gain per in force by the survivorship function.

C. *Effect of a Change in Those Items Affecting the Account Balance*

Whenever a deviation (between the actual and original expectation) occurs in the n-th year's mortality charge, expense charge, credited rate, or premium, the $EOY\, n$ account balance will be different. The revised EOY account balance affects both the n-th year's (that is, current) and $n+t$-th year's (that is, future) gains.

For the remainder of the discussion in this section, we express the formulas as per unit in-force in order to make them appear less complicated. To obtain the formulas in terms of per unit issue, the corresponding terms need to be multiplied by the survivorship function.

1. *Effects on the* n-*th Year's (Current Year's) Gain*

The effects on the n-th year's gain of a deviation in one of the above four items (that is, mortality charge, expense charge, credited rate, and premium) are not difficult to determine. For instance, if the mortality charge is MC' instead of MC, then according to Equation (3), the n-th year's gain will be increased by the following three items:

  (i) $(MC' - MC)(1 + r)$
  (ii) $q\,(AB_n' - AB_n)$, and
  (iii) $w\,(AB_n' - AB_n)$
where $AB_n' = AB_n - (MC_n' - MC_n)(1 + r)$ and $(CSV_n' - CSV_n)$ is assumed to be zero or negligible.

Simplifying, we see that the total effect on the n-th year gain due to the difference between MC' and MC is

$$(MC_n' - MC_n)(1 + r)(1 - q - w). \tag{9}$$

2. *Effects on Future Years' (beyond Year* n) *Gain*

A revised $EOY\, n$ account balance (AB_n') will give rise to a different account balance at $EOY\, n+t$ $(AB_{n+t}'$, where $t \geq 0)$ when compared to the original account balance, AB_{n+t}. The revised AB at BOY and $EOY\, n+t$ will, in turn, result in revised gain, G_{n+t}'. To determine the revised gain (G_{n+t}'), we first need to determine the difference between AB_{n+t}' and AB_{n+t}.

Appendix III shows that if $AB'_n = AB_n + k$, then

$$AB'_{n+t} = AB_{n+t} + k_t^*$$ (10)

where $k_t^* = k \dfrac{t}{\underset{s=1}{\prod}} (1 + r_{n+s})(1 + m_{n+s})$

$\dfrac{t}{\underset{s=1}{\prod}}$ stands for the product from 1 to t.

That is, if the revised AB at EOY n is \$$k$ higher, then the revised AB at EOY $n+t$ is higher by \$$k$ compounded for the next t years for:

(i)   The interest credited rate, and
(ii) The mortality rate used for determining mortality charges.

Clearly, if k is negative, AB'_{n+t} becomes zero and the policy terminates whenever the compounded value of k becomes larger than AB_{n+t}.

The above expression can be seen intuitively. If at EOY n, AB' is higher than AB by \$$k$, then at EOY $n+1$, AB' should be higher than AB by the sum of the following three items:

(i)   \$$k$
(ii)   One year credited interest on \$$k$, or $k\, r_{n+1}$
(iii) The amount of mortality charge "saved." That is, due to \$$k$ higher account balance, the net amount at risk at BOY $n+1$ is \$$k$ lower. This reduces the mortality charge by $k\, m_{n+1}$, which increases AB by the same amount. Because of the BOY assumption of mortality charges, this amount is compounded with a year's interest, $k\, m_{n+1}(1 + r_{n+1})$.

Now, the sum of (i), (ii), and (iii) equals

$$k\,(1 + r_{n+1})(1 + m_{n+1}),$$

which we denote as k_1^*. Following the same analysis, we see that k_1^* will become

$$k_1^*\,(1 + r_{n+2})(1 + m_{n+2})$$

at EOY $n+2$, which we denote as k_2^*. And so on.

For our remaining discussion, we assume that k is *positive*. However, the analysis for negative k is similar.

Because of their effects on the account balance, deviations between actual experience and original expectations in the n-th year's expense charge, mortality charge, credited rate, and premium will have lasting effects on future years' (that is, beyond year n) gain stream. Looking at Equation (3), we know that the revised gain $G^{G'}$ for year $n+t$ (where $t>0$) is equal to G^G *plus* the following additional gains:

(A)   Gain from interest due to *AB* revision
(B)   Gain form mortality due to *AB* revision
(C)   Gain from withdrawal due to *AB* revision.

Let us examine each of these separately. (Note that if the expenses or expense charges also depend on *AB*, an additional term, gain from expense due to *AB* revision, would be added. The formula for this additional term can be easily derived.)

(A) Gain from Interest Due to AB *Revision*
Appendix IV shows that this additional gain is equal to

$$(k^{*}_{t-1}) \left[i_{n+t} - r_{n+t} (1 + m_{n+t}) \right]. \tag{11}$$

This quantity represents the value of $\$k$ compounded for $t-1$ years (that is, to *BOY t*), multiplied by the interest spread for year $n+t$. Note that the credited rate for year $n+t$ is grossed up by $(1+m)$ because mortality charge is assumed payable at *BOY*. The earned rate i is not multiplied by $(1+m)$ because mortality charge does not affect earned interest for year $n+t$.

(B) Gain from Mortality Due to AB *Revision*
From Equation (3), it is apparent that this additional gain is equal to

$$-m_{n+t} (AB'_{n+t-1} - AB_{n+t-1}) + q_{n+t} (AB'_{n+t} - AB_{n+t}).$$

For instance, if k is positive (that is, $AB' > AB$), gain can be higher or lower due to these two offsetting terms:

(i)   Lower, due to lower mortality charges caused by the lower net amount at risk at *BOY*, and
(ii)   Higher, due to the higher *AB* released when death occurs (assumed *EOY*).

Substituting Equation (10) into the above expression and simplifying, we can show that the above expression reduces to

$$-k^{*}_{t-1} \left[m_{n+t} - q_{n+t} (1 + r_{n+t}) (1 + m_{n+t}) \right]. \tag{12}$$

That is, the additional gain from mortality due to AB revision for year $n + t$ resulting from \$$k$ higher AB at EOY n is equal to:

- \$$k$ compounded with credited interest and mortality rate for $t - 1$ years, multiplied by
- The mortality loading for year $n + t$, that is, the differences between the mortality used in the mortality charge calculation and the expected (or GAAP) mortality rate. Also, because of the timing difference of mortality charges (BOY) and deaths (EOY), the expected mortality rate has to be augmented by both the credited interest rate and the mortality rate used in the AB calculation for year $n + t$.

(C) Gain from Withdrawal Due to AB Revision

From Equation (3), we know that the gain from withdrawal equals the product of withdrawal rate (w) and surrender gain (SG). SG is defined as the difference between the AB and the CSV. Depending on how the surrender charge (SC) is expressed, the effects of a revised AB on year $n + t$ SG are different:

Case 1: SC *expressed as a percentage of the* AB
If $SC_{n+t} = (S_{n+t}\%) (AB_{n+t})$, where $0 \leq S_{n+t}\% \leq 100\%$, then

$$SG'_{n+t} = SG_{n+t} + (S_{n+t}\%) (k^*_t); \tag{13}$$

that is, the surrender gain is increased by the product of the SC% and \$$k$ compounded for t years. And the gain from withdrawal due to AB revision is equal to the withdrawal rate, w, multiplied by the above product.

Case 2: SC *expressed as a function of face amount or policy values other than* AB
Let us assume that $AB' > AB$. That is,

$$AB'_n = AB_n + k \text{ and } k > 0$$

$$AB'_{n+t} = AB_{n+t} + k^*_t$$

For year $n + t$, the gain from withdrawal due to AB revision will generally be *zero* because SC is not dependent on AB. The exception occurs when $AB < SC$. The latter will yield a gain from withdrawal due to AB revision equal to:

(i) $w_{n+t}(k^*_t)$ if $AB_{n+t} < AB'_{n+t} < SC_{n+t}$

or

(ii) $w_{n+t} (SC_{n+t} - AB_{n+t})$ if $AB_{n+t} < SC_{n+t} < AB'_{n+t}$

where $AB'_{n+t} = AB_{n+t} + k_t^*$. That is, because the amount of surrender charge collectible at withdrawal cannot exceed the AB at withdrawal, the gain from withdrawal due to AB revision is equal to

$$\text{Min } (AB'_{n+t}, SC_{n+t}) - \text{Min } (AB_{n+t}, SC_{n+t})$$

where Min stands for the minimum of. Except for early durations, AB will generally be greater than SC and the gain from withdrawal due to AB revision will often be zero for year $n+t$.

ILLUSTRATIVE EXAMPLE

This section contains an example that illustrates how the various formulas and procedures are used. The example is based on UL policies issued at age 45 to nonsmoking males having the following features, policy values, and assumptions (based on best estimate):

Mortality rate (q): as shown in Table 1
Mortality charge rate (m): as shown in Table 1
Withdrawal rate (w): 10 percent for the first three years, 5 percent thereafter
Gross premium (P): $20 per year
Extra first-year expense charge (FYC): $10 in the first year
Nonextra first-year expense charge (C): $4 per year
Extra first-year expense (FYE): $16.50 in the first year
Nonextra first-year expense (E): $2.50 per year
Death benefit (DB): $1000 all years
Earned interest rate (i): 10 percent all years
Credited interest rate (r): 8 percent all years
Surrender charge % $(SC\%)$: Used in the computation of cash surrender value and expressed as a percentage of account balance. It starts with 100 percent in the first year and decreases by 10 percent per year until it reaches 0 percent.
Deferrable Expense (DE): $16 in the first year.

Table 1 summarizes these values and assumptions. Also shown are the computed mortality charge (MC), account balance (AB), cash surrender value (CSV), and the survivorship function, $l(t)$, for 20 policy years. For simplicity, we perform the calculation only for the first 20 policy years. Note that the values and assumptions used are for illustrative purposes only and may or may not resemble those of any actual existing UL policy.

TABLE 1

POLICY VALUES AND ASSUMPTIONS BASED ON BEST ESTIMATE

Policy Year	FYC + C	FYE + E	P	r	i	q	w	m	DB	MC	AB	SC/AB%	CV	l(t)
1.....	14.00	19.00	20.00	0.08	0.10	0.0009533	0.10	0.0050825	1,000	5.08	0.99	100.00%	0.00	0.899047
2.....	4.00	2.50	20.00	0.08	0.10	0.0013138	0.10	0.0052470	1,000	5.24	12.69	90.00	1.27	0.807961
3.....	4.00	2.50	20.00	0.08	0.10	0.0017038	0.10	0.0054060	1,000	5.34	25.22	80.00	5.04	0.725788
4.....	4.00	2.50	20.00	0.08	0.10	0.0020238	0.05	0.0055600	1,000	5.42	38.66	70.00	11.60	0.688030
5.....	4.00	2.50	20.00	0.08	0.10	0.0023441	0.05	0.0060800	1,000	5.84	52.72	60.00	21.09	0.652016
6.....	4.00	2.50	20.00	0.08	0.10	0.0027494	0.05	0.0066560	1,000	6.31	67.41	50.00	33.71	0.617622
7.....	4.00	2.50	20.00	0.08	0.10	0.0031915	0.05	0.0072880	1,000	6.80	82.75	40.00	49.65	0.584770
8.....	4.00	2.50	20.00	0.08	0.10	0.0035453	0.05	0.0079680	1,000	7.31	98.75	30.00	69.13	0.553458
9.....	4.00	2.50	20.00	0.08	0.10	0.0038401	0.05	0.0087120	1,000	7.85	115.45	20.00	92.36	0.523660
10.....	4.00	2.50	20.00	0.08	0.10	0.0042098	0.05	0.0095200	1,000	8.42	132.87	10.00	119.59	0.495272
11.....	4.00	2.50	20.00	0.08	0.10	0.0047339	0.05	0.0104000	1,000	9.02	151.04	0.00	151.04	0.468164
12.....	4.00	2.50	20.00	0.08	0.10	0.0053938	0.05	0.0113680	1,000	9.65	169.98	0.00	169.98	0.442231
13.....	4.00	2.50	20.00	0.08	0.10	0.0062972	0.05	0.0124320	1,000	10.32	189.72	0.00	189.72	0.417335
14.....	4.00	2.50	20.00	0.08	0.10	0.0072644	0.05	0.0136000	1,000	11.02	210.28	0.00	210.28	0.393436
15.....	4.00	2.50	20.00	0.08	0.10	0.0082652	0.05	0.0148720	1,000	11.74	231.69	0.00	231.69	0.370512
16.....	4.00	2.50	20.00	0.08	0.10	0.0099000	0.05	0.0162720	1,000	12.50	254.01	0.00	254.01	0.348319
17.....	4.00	2.50	20.00	0.08	0.10	0.0108060	0.05	0.0177920	1,000	13.27	277.27	0.00	277.27	0.327139
18.....	4.00	2.50	20.00	0.08	0.10	0.0118140	0.05	0.0194480	1,000	14.06	301.55	0.00	301.55	0.306917
19.....	4.00	2.50	20.00	0.08	0.10	0.0129780	0.05	0.0212560	1,000	14.85	326.92	0.00	326.92	0.287588
20.....	4.00	2.50	20.00	0.08	0.10	0.0142860	0.05	0.0232320	1,000	15.64	353.47	0.00	353.47	0.269100

Two sets of computations are shown: Tables 1–10, which illustrate expected GAAP pretax profit and SOE analysis procedure, and Tables 11–15, which illustrate the procedure for revising estimated gross profits.

We see in Table 2 that the present value of the estimated gross profits is $54.82. Because the excess of deferrable expense over first-year charge is $6, the *DAC* amortization rate *(A%)* is 10.9454 percent. The last column shows the percentage of *DAC* that is still unamortized at *EOY*.

TABLE 2

COMPUTATION OF ESTIMATED GROSS PROFITS (GAINS) AND DAC AMORTIZATION SCHEDULE
BASED ON BEST ESTIMATE

Policy Year	Gain from					Total Gain per Issued $G \cdot l(t)$	Present Value Using r	Discounted Gain	% DAC Unamortized
	Mortality (GM)	Withdrawal (GW)	Expense (GE)	Interest (GI)	Total (G)				
1....	4.13	0.10	1.00	0.03	5.26	5.26	0.925926	4.87	98.41%
2....	3.94	1.14	1.50	0.91	7.50	6.74	0.857339	5.78	93.99
3....	3.68	2.02	1.50	1.15	8.34	6.74	0.793832	5.35	89.21
4....	3.47	1.35	1.50	1.41	7.74	5.61	0.735030	4.13	86.11
5....	3.62	1.58	1.50	1.71	8.42	5.79	0.680583	3.94	82.43
6....	3.74	1.69	1.50	2.03	8.96	5.84	0.630170	3.68	78.37
7....	3.87	1.65	1.50	2.36	9.39	5.80	0.583490	3.38	74.07
8....	4.11	1.48	1.50	2.71	9.80	5.73	0.540269	3.10	69.53
9....	4.45	1.15	1.50	3.07	10.18	5.64	0.500249	2.82	64.82
10....	4.77	0.66	1.50	3.45	10.39	5.44	0.463193	2.52	60.08
11....	5.00	0.00	1.50	3.85	10.35	5.13	0.428883	2.20	55.54
12....	5.17	0.00	1.50	4.26	10.94	5.12	0.397114	2.03	50.64
13....	5.22	0.00	1.50	4.70	11.41	5.05	0.367698	1.86	45.48
14....	5.28	0.00	1.50	5.15	11.93	4.98	0.340461	1.69	40.04
15....	5.39	0.00	1.50	5.62	12.51	4.92	0.315242	1.55	34.27
16....	5.12	0.00	1.50	6.10	12.72	4.71	0.291890	1.38	28.41
17....	5.46	0.00	1.50	6.61	13.57	4.73	0.270269	1.28	22.06
18....	5.80	0.00	1.50	7.14	14.44	4.73	0.250249	1.18	15.20
19....	6.11	0.00	1.50	7.69	15.30	4.70	0.231712	1.09	7.85
20....	6.40	0.00	1.50	8.26	16.16	4.65	0.214548	1.00	0.00

$$PV \text{ Gain} = 54.82$$
$$DE - FYC = 6.00$$
$$A\% = 10.9454\%$$

We see in Table 3 that the various income statement items net out to a GAAP pretax profit that equals the expected GAAP profit, computed by using Equation (4) multiplied by $l(t)$ at *BOY*.

With the actual mortality rate being 110 percent of expected in years 3 and 4, we see in Table 4 that years 3 and 4 contain material negative *VGM* (-0.134 and -0.142, respectively). The formulas shown in the section

TABLE 3

INCOME STATEMENT, SHOWING THAT PROFIT EQUALS EXPECTED GAAP PROFIT AS SHOWN IN EQUATION (4) WHEN ASSUMPTIONS ARE REALIZED

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Release	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	Expected GAAP Profit $(1-A\%)G$	$-(i-r)^*$ BOY DAC	Total
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892
4	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893
5	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.054	5.157	−0.103	5.054
6	4.11	1.10	2.61	4.08	1.67	1.63	0.00	3.26	0.00	(0.65)	(0.41)	5.101	5.200	−0.099	5.101
7	4.20	1.02	2.47	4.77	1.81	1.54	0.00	3.79	0.00	(0.69)	(0.43)	5.069	5.163	−0.094	5.069
8	4.27	0.87	2.34	5.42	1.87	1.46	0.00	4.28	0.00	(0.73)	(0.45)	5.017	5.106	−0.089	5.017
9	4.35	0.64	2.21	6.02	1.88	1.38	0.00	4.73	0.00	(0.75)	(0.47)	4.935	5.019	−0.083	4.935
10	4.41	0.35	2.09	6.57	1.91	1.31	0.00	5.15	0.00	(0.76)	(0.47)	4.766	4.844	−0.078	4.766
11	4.47	0.00	1.98	7.09	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	4.492	4.564	−0.072	4.492
12	4.52	0.00	1.87	7.56	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	4.493	4.560	−0.067	4.493
13	4.56	0.00	1.77	7.99	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	4.433	4.494	−0.061	4.433
14	4.60	0.00	1.67	8.38	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	4.379	4.433	−0.055	4.379
15	4.62	0.00	1.57	8.72	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	4.335	4.383	−0.048	4.335
16	4.63	0.00	1.48	9.03	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	4.156	4.197	−0.041	4.156
17	4.62	0.00	1.39	9.29	2.72	0.87	0.00	7.15	0.026	(1.02)	(0.64)	4.177	4.211	−0.034	4.177
18	4.60	0.00	1.31	9.51	2.70	0.82	0.00	7.31	0.026	(1.10)	(0.69)	4.182	4.208	−0.026	4.182
19	4.56	0.00	1.23	9.70	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	4.164	4.182	−0.018	4.164
20	4.50	0.00	1.15	9.86	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	4.129	4.139	−0.009	4.129

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original *DAC* amortization schedule is used throughout.

SOE Analysis can be verified easily. For instance, -0.134 is equal to $l(t)$ at *BOY* 3 of 0.807961 multiplied by

$$[-110\%(0.0017038) + 0.0017038] (1000 - 25.22).$$

Because the outstanding actual in force is lower than expected starting in year 5, the increase in mortality in years 3 and 4 also affects future profits. Looking at the sources of such future profits, we see that the effect of the lower actual in-force is noticeable on *VGM* and *VGI* for years 5 to 20 (with a value of -0.001) and not noticeable on *VGW* and *VGE*.

In Table 5, with the actual withdrawal rate 10 percent higher in year 4, we collect additional surrender charge, resulting in a fourth year *VGW* of

$$0.15 (38.66 - 11.60) - 0.05 (38.66 - 11.60) = 2.71$$

per in force at *BOY* 4. Multiplying 2.71 with the $l(t)$ at *BOY* 4 of 0.725788, we get a *VGW* of \$1.964 per issue, which is the number shown under the column *VGW* for year 4.

Similar to Table 4, the lower actual in force at *BOY* 5 lowers the profits for years 5 to 20. But unlike Table 4, the effect on future profits is substantially greater. This is because the effect of a 10 percent additional withdrawal rate on persistency is substantially greater. Looking at the sources of earning, we see that the effects on *VGM, VGW, VGE,* and *VGI* are all significant for years 5 to 20. *VGW* is zero for years 11 to 20 because *SC%* is zero for those years. Variation from interest on *BOY DAC* is zero because *DAC* is based on a static schedule, that is, independent of actual in force.

In Table 6, with the doubling of expense for years 5 to 10, GAAP profit is depressed for those years. Looking at the sources of earning, we see that *VGE* is the main cause. For instance, *VGE* for year 9 is equal to

$$l_8 (\$2.50 - \$5) = 0.553458 (-\$2.50) = -\$1.384.$$

VGI is also affected because we assume expense is paid at *BOY*. In reality, the magnitude of *VGI* is smaller (perhaps half) because most expenses occur evenly throughout the year. Note that unlike Tables 4 and 5, there is no effect on future years (that is, beyond year 10).

In Table 7, with the increase in the credited rate starting the sixth year, profit is reduced due to negative *VGI*. The reduction in profit is partly offset by positive *VGW* due to higher *AB*. *VGM* is also affected and could be either positive or negative depending on the relative magnitude of: (1) the decrease in mortality charge due to higher *AB*, and (2) the increase in profit due to higher *AB* released at death. In reality, only a fraction of the magnitude of

TABLE 4

SOURCE OF EARNINGS ANALYSIS WHEN ACTUAL MORTALITY RATE (q) IS 110% OF EXPECTED IN YEARS 3 AND 4

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (PJ)	Expected GAAP Profit $(1-A\%)G$	$-(i-r)^*$ BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Total Actual Profit
1 ..	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2 ..	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3 ..	4.31	1.63	3.23	1.88	1.48	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.757	6.004	−0.113	5.892	−0.134	0.000	0.000	0.000	0.000	5.757
4 ..	3.93	0.98	2.90	2.56	1.55	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.750	5.000	−0.107	4.893	−0.142	0.000	0.000	0.000	0.000	4.750
5 ..	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.052	5.157	−0.103	5.054	−0.001	0.000	0.000	0.000	0.000	5.052
6 ..	4.11	1.10	2.61	4.08	1.67	1.63	0.00	3.25	0.00	(0.65)	(0.41)	5.099	5.200	−0.099	5.101	−0.001	0.000	0.000	−0.001	0.000	5.099
7 ..	4.20	1.02	2.47	4.77	1.81	1.54	0.00	3.78	0.00	(0.69)	(0.43)	5.066	5.163	−0.094	5.069	−0.001	0.000	0.000	−0.001	0.000	5.066
8 ..	4.27	0.87	2.34	5.42	1.87	1.46	0.00	4.28	0.00	(0.73)	(0.45)	5.015	5.106	−0.089	5.017	−0.001	0.000	0.000	−0.001	0.000	5.015
9 ..	4.34	0.64	2.21	6.01	1.88	1.38	0.00	4.73	0.00	(0.75)	(0.47)	4.933	5.019	−0.083	4.935	−0.001	0.000	0.000	−0.001	0.000	4.933
10 ..	4.41	0.35	2.09	6.57	1.91	1.31	0.00	5.15	0.00	(0.76)	(0.47)	4.764	4.844	−0.078	4.766	−0.001	0.000	0.000	−0.001	0.000	4.764
11 ..	4.46	0.00	1.98	7.08	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	4.490	4.564	−0.072	4.492	−0.001	0.000	0.000	−0.001	0.000	4.490
12 ..	4.52	0.00	1.87	7.55	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	4.491	4.560	−0.067	4.493	−0.001	0.000	0.000	−0.001	0.000	4.491
13 ..	4.56	0.00	1.77	7.98	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	4.431	4.494	−0.061	4.433	−0.001	0.000	0.000	−0.001	0.000	4.431
14 ..	4.60	0.00	1.67	8.37	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	4.377	4.433	−0.055	4.379	−0.001	0.000	0.000	−0.001	0.000	4.377
15 ..	4.62	0.00	1.57	8.72	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	4.333	4.383	−0.048	4.335	−0.001	0.000	0.000	−0.001	0.000	4.333
16 ..	4.63	0.00	1.48	9.02	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	4.154	4.197	−0.041	4.156	−0.001	0.000	0.000	−0.001	0.000	4.154
17 ..	4.62	0.00	1.39	9.28	2.72	0.87	0.00	7.15	0.00	(1.02)	(0.64)	4.175	4.211	−0.034	4.177	−0.001	0.000	0.000	−0.001	0.000	4.175
18 ..	4.60	0.00	1.31	9.51	2.70	0.82	0.00	7.30	0.00	(1.10)	(0.69)	4.180	4.208	−0.026	4.182	−0.001	0.000	0.000	−0.001	0.000	4.180
19 ..	4.55	0.00	1.23	9.70	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	4.162	4.182	−0.018	4.164	−0.001	0.000	0.000	−0.001	0.000	4.162
20 ..	4.50	0.00	1.15	9.85	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	4.127	4.139	−0.009	4.129	−0.001	0.000	0.000	−0.001	0.000	4.127

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original *DAC* amortization schedule is used throughout.

TABLE 5

Source of Earnings Analysis When Actual Withdrawal Rate (w) Is 15% (Versus 5% Expected) in Year 4

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	Expected GAAP Profit (1−A%)G	−(i−r)* BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Total Actual Profit
1 ..	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2 ..	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3 ..	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	5.892
4 ..	3.93	2.95	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	6.857	5.000	−0.107	4.893	0.000	1.964	0.000	0.000	0.000	6.857
5 ..	3.60	0.97	2.46	2.94	1.37	1.54	0.00	2.40	0.00	(0.59)	(0.37)	4.443	5.157	−0.103	5.054	−0.263	−0.115	−0.109	−0.124	0.000	4.443
6 ..	3.68	0.98	2.33	3.60	1.50	1.46	0.00	2.91	0.00	(0.65)	(0.41)	4.485	5.200	−0.099	5.101	−0.257	−0.116	−0.103	−0.140	0.000	4.485
7 ..	3.75	0.91	2.21	4.22	1.62	1.38	0.00	3.39	0.00	(0.69)	(0.43)	4.457	5.163	−0.094	5.069	−0.252	−0.108	−0.098	−0.154	0.000	4.457
8 ..	3.82	0.77	2.09	4.80	1.67	1.31	0.00	3.83	0.00	(0.73)	(0.45)	4.412	5.106	−0.089	5.017	−0.254	−0.091	−0.093	−0.167	0.000	4.412
9 ..	3.89	0.57	1.98	5.34	1.68	1.24	0.00	4.23	0.00	(0.75)	(0.47)	4.341	5.019	−0.083	4.935	−0.260	−0.067	−0.088	−0.179	0.000	4.341
10 ..	3.94	0.31	1.87	5.84	1.71	1.17	0.00	4.61	0.00	(0.76)	(0.47)	4.193	4.844	−0.078	4.766	−0.264	−0.037	−0.083	−0.191	0.000	4.193
11 ..	4.00	0.00	1.77	6.30	1.78	1.11	0.00	4.96	0.00	(0.73)	(0.45)	3.951	4.564	−0.072	4.492	−0.261	0.000	−0.078	−0.201	0.000	3.951
12 ..	4.04	0.00	1.68	6.73	1.87	1.05	0.00	5.27	0.00	(0.78)	(0.49)	3.953	4.560	−0.067	4.493	−0.256	0.000	−0.074	−0.211	0.000	3.953
13 ..	4.08	0.00	1.58	7.11	2.02	0.99	0.00	5.56	0.00	(0.82)	(0.52)	3.901	4.494	−0.061	4.433	−0.243	0.000	−0.070	−0.219	0.000	3.901
14 ..	4.11	0.00	1.49	7.46	2.14	0.93	0.00	5.81	0.00	(0.87)	(0.54)	3.854	4.433	−0.055	4.379	−0.233	0.000	−0.066	−0.227	0.000	3.854
15 ..	4.13	0.00	1.41	7.78	2.23	0.88	0.00	6.04	0.00	(0.92)	(0.58)	3.816	4.383	−0.048	4.335	−0.224	0.000	−0.062	−0.233	0.000	3.816
16 ..	4.14	0.00	1.33	8.05	2.45	0.83	0.00	6.24	0.00	(0.94)	(0.59)	3.659	4.197	−0.041	4.156	−0.200	0.000	−0.059	−0.239	0.000	3.659
17 ..	4.14	0.00	1.25	8.29	2.43	0.78	0.00	6.40	0.00	(1.02)	(0.64)	3.678	4.211	−0.034	4.177	−0.201	0.000	−0.055	−0.243	0.000	3.678
18 ..	4.11	0.00	1.17	8.49	2.41	0.73	0.00	6.54	0.00	(1.10)	(0.69)	3.683	4.208	−0.026	4.182	−0.200	0.000	−0.052	−0.246	0.000	3.683
19 ..	4.08	0.00	1.10	8.67	2.40	0.69	0.00	6.65	0.00	(1.18)	(0.74)	3.668	4.182	−0.018	4.164	−0.198	0.000	−0.049	−0.249	0.000	3.668
20 ..	4.02	0.00	1.03	8.81	2.38	0.64	0.00	6.74	0.00	(1.26)	(0.78)	3.639	4.139	−0.009	4.129	−0.194	0.000	−0.046	−0.251	0.000	3.639

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original DAC amortization schedule is used throughout.

TABLE 6

SOURCE OF EARNINGS ANALYSIS WHEN ACTUAL EXPENSE IS $5 (VERSUS $2.50 EXPECTED) FOR YEARS 5 TO 10

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (P)	Expected GAAP Profit (1−A%)G	−(i−r)* BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Total Actual Profit
1 ..	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2 ..	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3 ..	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	5.892
4 ..	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893	0.000	0.000	0.000	0.000	0.000	4.893
5 ..	4.02	1.09	2.75	3.18	1.53	3.44	0.00	2.69	0.00	(0.59)	(0.37)	3.162	5.157	−0.103	5.054	0.000	0.000	−1.720	−0.172	0.000	3.162
6 ..	4.11	1.10	2.61	3.92	1.67	3.26	0.00	3.26	0.00	(0.65)	(0.41)	3.308	5.200	−0.099	5.101	0.000	0.000	−1.630	−0.163	0.000	3.308
7 ..	4.20	1.02	2.47	4.62	1.81	3.09	0.00	3.79	0.00	(0.69)	(0.43)	3.370	5.163	−0.094	5.069	0.000	0.000	−1.544	−0.154	0.000	3.370
8 ..	4.27	0.87	2.34	5.27	1.87	2.92	0.00	4.28	0.00	(0.73)	(0.45)	3.409	5.106	−0.089	5.017	0.000	0.000	−1.462	−0.146	0.000	3.409
9 ..	4.35	0.64	2.21	5.88	1.88	2.77	0.00	4.73	0.00	(0.75)	(0.47)	3.413	5.019	−0.083	4.935	0.000	0.000	~1.384	−0.138	0.000	3.413
10 ..	4.41	0.35	2.09	6.44	1.91	2.62	0.00	5.15	0.00	(0.76)	(0.47)	3.326	4.844	−0.078	4.766	0.000	0.000	−1.309	−0.131	0.000	3.326
11 ..	4.47	0.00	1.98	7.09	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	4.492	4.564	−0.072	4.492	0.000	0.000	0.000	−0.000	0.000	4.492
12 ..	4.52	0.00	1.87	7.56	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	4.493	4.560	−0.067	4.493	0.000	0.000	0.000	−0.000	0.000	4.493
13 ..	4.56	0.00	1.77	7.99	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	4.433	4.494	−0.061	4.433	0.000	0.000	0.000	−0.000	0.000	4.433
14 ..	4.60	0.00	1.67	8.38	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	4.379	4.433	−0.055	4.379	0.000	0.000	0.000	−0.000	0.000	4.379
15 ..	4.62	0.00	1.57	8.72	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	4.335	4.383	−0.048	4.335	0.000	0.000	0.000	−0.000	0.000	4.335
16 ..	4.63	0.00	1.48	9.03	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	4.156	4.197	−0.041	4.156	0.000	0.000	0.000	−0.000	0.000	4.156
17 ..	4.62	0.00	1.39	9.29	2.72	0.87	0.00	7.15	0.00	(1.02)	(0.64)	4.177	4.211	−0.034	4.177	0.000	0.000	0.000	−0.000	0.000	4.177
18 ..	4.60	0.00	1.31	9.51	2.70	0.82	0.00	7.31	0.00	(1.10)	(0.69)	4.182	4.208	−0.026	4.182	0.000	0.000	0.000	−0.000	0.000	4.182
19 ..	4.56	0.00	1.23	9.70	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	4.164	4.182	−0.018	4.164	0.000	0.000	0.000	−0.000	0.000	4.164
20 ..	4.50	0.00	1.15	9.86	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	4.129	4.139	−0.009	4.129	0.000	0.000	0.000	−0.000	0.000	4.129

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original *DAC* amortization schedule is used throughout.

TABLE 7

SOURCE OF EARNINGS ANALYSIS WHEN ACTUAL CREDITED RATE (r) IS 9% (VERSUS 8% EXPECTED) FOR YEARS 6 TO 20

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (PJ)	Expected GAAP Profit (1-A%)G	Expected GAAP Profit -(i-r)*/BOY DAC	Expected GAAP Profit Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Total Actual Profit
1	5.08	0.10	4.00	− 0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	− 0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	− 0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	− 0.113	5.892	0.000	0.000	0.000	0.000	0.000	5.892
4	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	− 0.107	4.893	0.000	0.000	0.000	0.000	0.000	4.893
5	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.054	5.157	− 0.103	5.054	0.000	0.000	0.000	0.000	0.000	5.054
6	4.11	1.11	2.61	4.08	1.67	1.63	0.00	3.66	0.00	(0.65)	(0.41)	4.705	5.200	− 0.099	5.101	0.001	0.010	0.000	− 0.407	0.000	4.705
7	4.19	1.04	2.47	4.81	1.81	1.54	0.00	4.29	0.00	(0.69)	(0.43)	4.617	5.163	− 0.094	5.069	0.000	0.018	0.000	− 0.470	0.000	4.617
8	4.27	0.89	2.34	5.50	1.86	1.46	0.00	4.89	0.00	(0.73)	(0.45)	4.511	5.106	− 0.089	5.017	− 0.002	0.022	0.000	− 0.527	0.000	4.511
9	4.33	0.66	2.21	6.16	1.87	1.38	0.00	5.45	0.00	(0.75)	(0.47)	4.374	5.019	− 0.083	4.935	− 0.004	0.021	0.000	− 0.579	0.000	4.374
10	4.39	0.36	2.09	6.77	1.90	1.31	0.00	5.98	0.00	(0.76)	(0.47)	4.148	4.844	− 0.078	4.766	− 0.007	0.014	0.000	− 0.626	0.000	4.148
11	4.44	0.00	1.98	7.36	1.97	1.24	0.00	6.48	0.00	(0.73)	(0.45)	3.813	4.564	− 0.072	4.492	− 0.011	0.000	0.000	− 0.668	0.000	3.813
12	4.48	0.00	1.87	7.90	2.07	1.17	0.00	6.95	0.00	(0.78)	(0.49)	3.773	4.560	− 0.067	4.493	− 0.015	0.000	0.000	− 0.706	0.000	3.773
13	4.51	0.00	1.77	8.42	2.22	1.11	0.00	7.38	0.00	(0.82)	(0.52)	3.676	4.494	− 0.061	4.433	− 0.019	0.000	0.000	− 0.739	0.000	3.676
14	4.53	0.00	1.67	8.90	2.35	1.04	0.00	7.79	0.00	(0.87)	(0.54)	3.589	4.433	− 0.055	4.379	− 0.023	0.000	0.000	− 0.767	0.000	3.589
15	4.53	0.00	1.57	9.34	2.43	0.98	0.00	8.16	0.00	(0.92)	(0.58)	3.516	4.383	− 0.048	4.335	− 0.029	0.000	0.000	− 0.790	0.000	3.516
16	4.51	0.00	1.48	9.75	2.65	0.93	0.00	8.51	0.00	(0.94)	(0.59)	3.317	4.197	− 0.041	4.156	− 0.030	0.000	0.000	− 0.810	0.000	3.317
17	4.47	0.00	1.39	10.12	2.61	0.87	0.00	8.81	0.00	(1.02)	(0.64)	3.314	4.211	− 0.034	4.177	− 0.039	0.000	0.000	− 0.824	0.000	3.314
18	4.41	0.00	1.31	10.47	2.56	0.82	0.00	9.10	0.00	(1.10)	(0.69)	3.297	4.208	− 0.026	4.182	− 0.050	0.000	0.000	− 0.835	0.00	3.297
19	4.33	0.00	1.23	10.78	2.51	0.77	0.00	9.36	0.00	(1.18)	(0.74)	3.260	4.182	− 0.018	4.164	− 0.062	0.000	0.000	− 0.842	0.000	3.260
20	4.21	0.00	1.15	11.07	2.45	0.72	0.00	9.59	0.00	(1.26)	(0.78)	3.209	4.139	− 0.009	4.129	− 0.075	0.000	0.000	− 0.845	0.000	3.209

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original DAC amortization schedule is used throughout.

VGW and *VGM* will emerge, because a mid-year assumption of death, withdrawal, and mortality charge collection is more reasonable.

In Table 8, with the decrease in earned rate starting in year 6, profit is reduced due to negative *VGI*. Unlike Table 7, the decrease in earned rate does not affect *AB*, and hence *VGM* and *VGW* are not affected. However, the variation from interest on *BOY DAC* is affected, contributing some positive profit due to a lower actual earned rate. For instance, the variation from interest on *BOY DAC* for year 7 is equal to

$$-(0.09 - 0.10) [78.37\% (\$6)] = \$0.047.$$

Although Table 8 contains the same interest spread (that is, 1 percent) as Table 7, the *VGI* of Table 8 is lower (that is, more negative). This is because, in our example, expense (for example, $2.50 in year 6) is lower than the sum of expense charge and mortality charge (for example, $10.31 in year 6). In fact, if we multiply the difference of $10.31 and $2.50 with -1 percent and the survivorship function $l(t)$ at *BOY* 6, we get the difference in the two *VGI*'s of year 6.

In Table 9, when we lump together the experiences of Tables 4–9, all the sources of earning are affected. For our example, we are fortunate to find that profit is still positive for all years.

In Table 10, knowing that the earned rate decreases from 10 percent to 9 percent in year 6, we can set Formula (6) to zero and solve for the actual credited rate that will result in no additional interest gain or loss. Crediting the solve-for rate, 6.9971 percent, we see that the sum of *VGI* and variation from interest on *BOY DAC* is zero for year 6. However, this does not mean that we obtain the original sixth-year expected GAAP profit, because crediting the lower rate results in lower *AB*, which affects *VGM* and *VGW*.

Starting in year 7, crediting the same 6.9971 percent rate does not result in zero interest loss. This is due to the difference in actual versus expected *AB*. If zero interest loss is desired for years 7 and beyond, the credited rate has to be recomputed every year by setting Formula (6) to zero.

Table 11 is self-explanatory.

The remaining discussion deals with the procedure for revising estimated gross profits and *DAC* amortization schedule.

In Table 12, with the actual withdrawal rate being 15 percent (versus 5 percent originally expected) in year 4, the estimated gross profits and amortization schedule are recomputed. It is assumed that no other changes in past experience and future expectation occur. We see that only *GW* changes

TABLE 8

Source of Earnings Analysis When Actual Earned Rate (i) Is 9% (Versus 10% Expected) for Years 6 to 20

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	Expected GAAP Profit (1−A%)G	Expected GAAP Profit −(i−r)* BOY DAC	Expected GAAP Profit Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	5.892
4	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893	0.000	0.000	0.000	0.000	0.000	4.893
5	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.054	5.157	−0.103	5.054	0.000	0.000	0.000	0.000	0.000	5.054
6	4.11	1.10	2.61	3.68	1.67	1.63	0.00	3.26	0.00	(0.65)	(0.41)	4.693	5.200	−0.099	5.101	0.000	0.000	0.000	−0.458	0.049	4.693
7	4.20	1.02	2.47	4.30	1.81	1.54	0.00	3.79	0.00	(0.69)	(0.43)	4.591	5.163	−0.094	5.069	0.000	0.000	0.000	−0.524	0.047	4.591
8	4.27	0.87	2.34	4.88	1.87	1.46	0.00	4.28	0.00	(0.73)	(0.45)	4.475	5.106	−0.089	5.017	0.000	0.000	0.000	−0.586	0.044	4.475
9	4.35	0.64	2.21	5.42	1.88	1.38	0.00	4.73	0.00	(0.75)	(0.47)	4.334	5.019	−0.083	4.935	0.000	0.000	0.000	−0.643	0.042	4.334
10	4.41	0.35	2.09	5.92	1.91	1.31	0.00	5.15	0.00	(0.76)	(0.47)	4.109	4.844	−0.078	4.766	0.000	0.000	0.000	−0.696	0.039	4.109
11	4.47	0.00	1.98	6.38	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	3.783	4.564	−0.072	4.492	0.000	0.000	0.000	−0.745	0.036	3.783
12	4.52	0.00	1.87	6.80	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	3.737	4.560	−0.067	4.493	0.000	0.000	0.000	−0.789	0.033	3.737
13	4.56	0.00	1.77	7.19	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	3.635	4.494	−0.061	4.433	0.000	0.000	0.000	−0.829	0.030	3.635
14	4.60	0.00	1.67	7.54	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	3.541	4.433	−0.055	4.379	0.000	0.000	0.000	−0.865	0.027	3.541
15	4.62	0.00	1.57	7.85	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	3.463	4.383	−0.048	4.335	0.000	0.000	0.000	−0.896	0.024	3.463
16	4.63	0.00	1.48	8.12	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	3.253	4.197	−0.041	4.156	0.000	0.000	0.000	−0.923	0.021	3.253
17	4.62	0.00	1.39	8.36	2.72	0.87	0.00	7.15	0.00	(1.02)	(0.64)	3.248	4.211	−0.034	4.177	0.000	0.000	0.000	−0.946	0.017	3.248
18	4.60	0.00	1.31	8.56	2.70	0.82	0.00	7.31	0.00	(1.10)	(0.69)	3.230	4.208	−0.026	4.182	0.000	0.000	0.000	−0.964	0.013	3.230
19	4.56	0.00	1.23	8.73	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	3.193	4.182	−0.018	4.164	0.000	0.000	0.000	−0.979	0.009	3.193
20	4.50	0.00	1.15	8.87	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	3.144	4.139	−0.009	4.129	0.000	0.000	0.000	−0.991	0.005	3.144

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original *DAC* amortization schedule is used throughout.

TABLE 9

SOURCE OF EARNINGS ANALYSIS WHEN THE CONDITIONS UNDER TABLES 4–8 ARE ALL USED

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pt)	Expected GAAP Profit (1−A%)G	Expected GAAP Profit −(i−r)* BOY DAC	Expected GAAP Profit Total	Variations in EGP Due to Mort.	Variations in EGP Due to With.	Variations in EGP Due to Expense	Variations in EGP Due to Interest	Variation Fr. Int. on BOYDAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3	4.31	1.63	3.23	1.88	1.48	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.757	6.004	−0.113	5.892	−0.134	0.000	0.000	0.000	0.000	5.757
4	3.93	2.95	2.90	2.56	1.55	1.81	0.00	2.08	0.00	(0.50)	(0.31)	6.714	5.000	−0.107	4.893	−0.142	1.964	0.000	0.000	0.000	6.714
5	3.60	0.97	2.46	2.78	1.37	3.08	0.00	2.40	0.00	(0.59)	(0.37)	2.749	5.157	−0.103	5.054	−0.264	−0.115	−1.647	−0.278	0.000	2.749
6	3.68	0.99	2.33	3.11	1.49	2.91	0.00	3.28	0.00	(0.65)	(0.41)	2.180	5.200	−0.099	5.101	−0.257	−0.107	−1.561	−1.045	0.049	2.180
7	3.75	0.93	2.21	3.70	1.61	2.76	0.00	3.84	0.00	(0.69)	(0.43)	2.121	5.163	−0.094	5.069	−0.253	−0.092	−1.479	−1.171	0.047	2.121
8	3.82	0.79	2.09	4.27	1.67	2.61	0.00	4.37	0.00	(0.73)	(0.45)	2.045	5.106	−0.089	5.017	−0.256	−0.072	−1.400	−1.288	0.044	2.045
9	3.87	0.59	1.98	4.80	1.67	2.47	0.00	4.87	0.00	(0.75)	(0.47)	1.942	5.019	−0.083	4.935	−0.265	−0.049	−1.325	−1.397	0.042	1.942
10	3.93	0.32	1.87	5.31	1.70	2.34	0.00	5.35	0.00	(0.76)	(0.47)	1.760	4.844	−0.078	4.766	−0.271	−0.024	−1.254	−1.497	0.039	1.760
11	3.97	0.00	1.77	5.89	1.76	1.11	0.00	5.79	0.00	(0.73)	(0.45)	2.688	4.564	−0.072	4.492	−0.272	0.000	−0.079	−1.489	0.036	2.688
12	4.00	0.00	1.67	6.33	1.85	1.05	0.00	6.21	0.00	(0.78)	(0.49)	2.604	4.560	−0.067	4.493	−0.270	0.000	−0.074	−1.579	0.033	2.604
13	4.03	0.00	1.58	6.74	1.99	0.99	0.00	6.60	0.00	(0.82)	(0.52)	2.473	4.494	−0.061	4.433	−0.261	0.000	−0.070	−1.660	0.030	2.473
14	4.05	0.00	1.49	7.13	2.10	0.93	0.00	6.96	0.00	(0.87)	(0.54)	2.353	4.433	−0.055	4.379	−0.254	0.000	−0.066	−1.733	0.027	2.353
15	4.05	0.00	1.41	7.49	2.18	0.88	0.00	7.30	0.00	(0.92)	(0.58)	2.249	4.383	−0.048	4.335	−0.250	0.000	−0.062	−1.797	0.024	2.249
16	4.04	0.00	1.33	7.83	2.37	0.83	0.00	7.61	0.00	(0.94)	(0.59)	2.037	4.197	−0.041	4.156	−0.227	0.000	−0.059	−1.854	0.021	2.037
17	4.00	0.00	1.25	8.13	2.33	0.78	0.00	7.88	0.00	(1.02)	(0.64)	2.001	4.211	−0.034	4.177	−0.236	0.000	−0.055	−1.901	0.017	2.001
18	3.95	0.00	1.17	8.41	2.29	0.73	0.00	8.13	0.00	(1.10)	(0.69)	1.956	4.208	−0.026	4.182	−0.245	0.000	−0.052	−1.941	0.013	1.956
19	3.87	0.00	1.10	8.67	2.25	0.69	0.00	8.37	0.00	(1.18)	(0.74)	1.896	4.182	−0.018	4.164	−0.254	0.000	−0.049	−1.975	0.009	1.896
20	3.77	0.00	1.03	8.91	2.19	0.64	0.00	8.58	0.00	(1.26)	(0.78)	1.825	4.139	−0.009	4.129	−0.262	0.000	−0.046	−2.001	0.005	1.825

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for understanding of the application of the illustrated procedures, the original *DAC* amortization schedule is used throughout.

TABLE 10

Source of Earnings Analysis When Actual Earned Rate (i) Is 9% (Versus 10% Expected) and Actual Credited Rate (r) Is 6.9971% (Versus 8% Expected) for Years 6 to 20 (The 6.9971% Rate is Solved for Using Formula (6))

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (PI)	Expected GAAP Profit			VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Total Actual Profit
													(1−A%)G	~(i−r)* BOY DAC	Total						
1 ..	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2 ..	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3 ..	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	5.892
4 ..	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893	0.000	0.000	0.000	0.000	0.000	4.893
5 ..	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.054	5.157	−0.103	5.054	0.000	0.000	0.000	0.000	0.000	5.054
6 ..	4.11	1.09	2.61	3.68	1.67	1.63	0.00	2.85	0.00	(0.65)	(0.41)	5.089	5.200	−0.099	5.101	−0.001	−0.010	0.000	−0.050	0.049	5.089
7 ..	4.20	1.00	2.47	4.26	1.81	1.54	0.00	3.28	0.00	(0.69)	(0.43)	5.040	5.163	−0.094	5.069	0.000	−0.018	0.000	−0.057	0.047	5.040
8 ..	4.28	0.84	2.34	4.80	1.87	1.46	0.00	3.68	0.00	(0.73)	(0.45)	4.975	5.106	−0.089	5.017	0.002	−0.022	0.000	−0.066	0.044	4.975
9 ..	4.36	0.62	2.21	5.29	1.89	1.38	0.00	4.04	0.00	(0.75)	(0.47)	4.884	5.019	−0.083	4.935	0.004	−0.021	0.000	−0.077	0.042	4.884
10 ..	4.43	0.33	2.09	5.74	1.92	1.31	0.00	4.37	0.00	(0.76)	(0.47)	4.710	4.844	−0.078	4.766	0.007	−0.014	0.000	−0.088	0.039	4.710
11 ..	4.49	0.00	1.98	6.14	2.01	1.24	0.00	4.66	0.00	(0.73)	(0.45)	4.438	4.564	−0.072	4.492	0.011	0.000	0.000	−0.101	0.036	4.438
12 ..	4.56	0.00	1.87	6.50	2.12	1.17	0.00	4.92	0.00	(0.78)	(0.49)	4.427	4.560	−0.067	4.493	0.014	0.000	0.000	−0.114	0.033	4.427
13 ..	4.61	0.00	1.77	6.82	2.29	1.11	0.00	5.15	0.00	(0.82)	(0.52)	4.353	4.494	−0.061	4.433	0.018	0.000	0.000	−0.129	0.030	4.353
14 ..	4.67	0.00	1.67	7.09	2.44	1.04	0.00	5.34	0.00	(0.87)	(0.54)	4.285	4.433	−0.055	4.379	0.022	0.000	0.000	−0.144	0.027	4.285
15 ..	4.71	0.00	1.57	7.33	2.56	0.98	0.00	5.49	0.00	(0.92)	(0.58)	4.226	4.383	−0.048	4.335	0.027	0.000	0.000	−0.160	0.024	4.226
16 ..	4.74	0.00	1.48	7.52	2.82	0.93	0.00	5.62	0.00	(0.94)	(0.59)	4.029	4.197	−0.041	4.156	0.028	0.000	0.000	−0.177	0.021	4.029
17 ..	4.76	0.00	1.39	7.66	2.82	0.87	0.00	5.71	0.00	(1.02)	(0.64)	4.037	4.211	−0.034	4.177	0.037	0.000	0.000	−0.194	0.017	4.037
18 ..	4.77	0.00	1.31	7.77	2.82	0.82	0.00	5.77	0.00	(1.10)	(0.69)	4.030	4.208	−0.026	4.182	0.046	0.000	0.000	−0.211	0.013	4.030
19 ..	4.76	0.00	1.23	7.85	2.83	0.77	0.00	5.80	0.00	(1.18)	(0.74)	4.001	4.182	−0.018	4.164	0.057	0.000	0.000	−0.229	0.009	4.001
20 ..	4.75	0.00	1.15	7.89	2.84	0.72	0.00	5.81	0.00	(1.26)	(0.78)	3.956	4.139	−0.009	4.129	0.069	0.000	0.000	−0.247	0.005	3.956

Note: Values shown are per unit issue; that is, the values contain the effect of the survivorship function $l(t)$. Also, for easier understanding of the application of the illustrated procedures, the original *DAC* amortization schedule is used throughout.

TABLE 11

COMPUTATION OF ESTIMATED GROSS PROFITS (GAINS) AND *DAC* AMORTIZATION SCHEDULE
BASED ON BEST ESTIMATE (SAME AS TABLE 2 BUT WITH $l(t)$ COLUMN ADDED)

Policy Year	Gain from					$l(t)$	Total Gain per Issued $G * l(t)$	Present Value Using r	Discounted Gain	% *DAC* Unamortized
	Mortality (GM)	Withdrawal (GW)	Expense (GE)	Interest (GI)	Total (G)					
1 ...	4.13	0.10	1.00	0.03	5.26	0.899047	5.26	0.925926	4.87	98.41%
2 ...	3.94	1.14	1.50	0.91	7.50	0.807961	6.74	0.857339	5.78	93.99
3 ...	3.68	2.02	1.50	1.15	8.34	0.725788	6.74	0.793832	5.35	89.21
4 ...	3.47	1.35	1.50	1.41	7.74	0.688030	5.61	0.735030	4.13	86.11
5 ...	3.62	1.58	1.50	1.71	8.42	0.652016	5.79	0.680583	3.94	82.43
6 ...	3.74	1.69	1.50	2.03	8.96	0.617622	5.84	0.630170	3.68	78.37
7 ...	3.87	1.65	1.50	2.36	9.39	0.584770	5.80	0.583490	3.38	74.07
8 ...	4.11	1.48	1.50	2.71	9.80	0.553458	5.73	0.540269	3.10	69.53
9 ...	4.45	1.15	1.50	3.07	10.18	0.523660	5.64	0.500249	2.82	64.82
10 ...	4.77	0.66	1.50	3.45	10.39	0.495272	5.44	0.463193	2.52	60.08
11 ...	5.00	0.00	1.50	3.85	10.35	0.468164	5.13	0.428883	2.20	55.54
12 ...	5.17	0.00	1.50	4.26	10.94	0.442231	5.12	0.397114	2.03	50.64
13 ...	5.22	0.00	1.50	4.70	11.41	0.417335	5.05	0.367698	1.86	45.48
14 ...	5.28	0.00	1.50	5.15	11.93	0.393436	4.98	0.340461	1.69	40.04
15 ...	5.39	0.00	1.50	5.62	12.51	0.370512	4.92	0.315242	1.55	34.27
16 ...	5.12	0.00	1.50	6.10	12.72	0.348319	4.71	0.291890	1.38	28.41
17 ...	5.46	0.00	1.50	6.61	13.57	0.327139	4.73	0.270269	1.28	22.06
18 ...	5.80	0.00	1.50	7.14	14.44	0.306917	4.73	0.250249	1.18	15.20
19 ...	6.11	0.00	1.50	7.69	15.30	0.287588	4.70	0.231712	1.09	7.85
20 ...	6.40	0.00	1.50	8.26	16.16	0.269100	4.65	0.214548	1.00	0.00

$$PV\text{ Gain} = 54.82$$
$$DE - FYC = 6.00$$
$$A\% = 10.9454\%$$

in year 4. Looking at Equation (3), we know that the new *GW* is simply equal to

$$0.15 (38.66 - 11.60) = 4.06.$$

For years 5 to 20, we know that the new gain per issue is simply equal to the original gain per issue (as shown in Table 11) times Formula (8). For instance, for year 20

$$4.65 \frac{(1 - 0.15 - 0.0020238)}{(1 - 0.05 - 0.0020238)} = 4.16.$$

In Table 13, with expense doubled in year 5 (from $2.50 to $5), it is clear from our analysis (see Subsection B under the section Procedure for Revising Estimated Gross Profits) that the only effect is on the fifth-year *GE* and *GI*. The new *GE'* for year 5 is ($4 – $5) = – $1. *GI* is also affected because we assume expense is paid at *BOY*.

TABLE 12

REVISED GROSS PROFITS AND AMORTIZATION SCHEDULE
WHEN THE REVISED WITHDRAWL RATE (w) IS 0.15 (VERSUS 0.05 EXPECTED) IN YEAR 4
(EVERYTHING ELSE IS THE SAME AS EXPECTED)

Policy Year	Gain from					l(t)	Total Gain per Issued G * l(t)	Present Value Using r	Discounted Gain	% DAC Unamortized
	Mortality (GM)	Withdrawal (GW)	Expense (GE)	Interest (GI)	Total (G)					
1 ...	4.13	0.10	1.00	0.03	5.26	0.899047	5.26	0.925926	4.87	98.01%
2 ...	3.94	1.14	1.50	0.91	7.50	0.807961	6.74	0.857339	5.78	93.04
3 ...	3.68	2.02	1.50	1.15	8.34	0.725788	6.74	0.793832	5.35	87.66
4 ...	3.47	4.06	1.50	1.41	10.44	0.615451	7.58	0.735030	5.57	80.27
5 ...	3.62	1.58	1.50	1.71	8.42	0.583236	5.18	0.680583	3.53	76.84
6 ...	3.74	1.69	1.50	2.03	8.96	0.552471	5.22	0.630170	3.29	73.06
7 ...	3.87	1.65	1.50	2.36	9.39	0.523084	5.19	0.583490	3.03	69.05
8 ...	4.11	1.48	1.50	2.71	9.80	0.495075	5.13	0.540269	2.77	64.82
9 ...	4.45	1.15	1.50	3.07	10.18	0.468420	5.04	0.500249	2.52	60.42
10 ...	4.77	0.66	1.50	3.45	10.39	0.443027	4.87	0.463193	2.25	56.01
11 ...	5.00	0.00	1.50	3.85	10.35	0.418779	4.58	0.428883	1.97	51.77
12 ...	5.17	0.00	1.50	4.26	10.94	0.395581	4.58	0.397114	1.82	47.20
13 ...	5.22	0.00	1.50	4.70	11.41	0.373311	4.51	0.367698	1.66	42.40
14 ...	5.28	0.00	1.50	5.15	11.93	0.351933	4.45	0.340461	1.52	37.33
15 ...	5.39	0.00	1.50	5.62	12.51	0.331428	4.40	0.315242	1.39	31.94
16 ...	5.12	0.00	1.50	6.10	12.72	0.311575	4.22	0.291890	1.23	26.48
17 ...	5.46	0.00	1.50	6.61	13.57	0.292630	4.23	0.270269	1.14	20.56
18 ...	5.80	0.00	1.50	7.14	14.44	0.274541	4.23	0.250249	1.06	14.17
19 ...	6.11	0.00	1.50	7.69	15.30	0.257251	4.20	0.231712	0.97	7.32
20 ...	6.40	0.00	1.50	8.26	16.16	0.240713	4.16	0.214548	0.89	0.00

PV Gain = 52.60
$DE - FYC \approx$ 6.00
$A\% =$ 11.4065%

Table 14 shows the same policy values and assumptions as Table 1, except that the actual gross premium for year 6 turns out to be \$50 (versus \$20 originally expected). Hence, we see that the sixth-year AB increases from \$67.41 to \$99.81. Note that

$$99.81 = 67.41 + (50 - 20)(1 + 0.08).$$

Let us verify Equation (10) for years 7 and 8. In this case,

$$n = 6$$

$$AB'_6 = 99.81$$

$$AB_6 = 67.41$$

$$k = 32.40.$$

TABLE 13

Revised Gross Profits and Amortization Schedule When the Revised Expense Is $5
(Versus $2.50 Expected) in Year 5 (Everything Else Is the Same As Expected)

Policy Year	Mortality (GM)	Withdrawal (GW)	Expense (GE)	Interest (GI)	Total (G)	I(t)	Total Gain per Issued G * I(t)	Present Value Using r	Discounted Gain	% DAC Unamortized
1 ...	4.13	0.10	1.00	0.03	5.26	0.899047	5.26	0.925926	4.87	98.18%
2 ...	3.94	1.14	1.50	0.91	7.50	0.807961	6.74	0.857339	5.78	93.45
3 ...	3.68	2.02	1.50	1.15	8.34	0.725788	6.74	0.793832	5.35	88.33
4 ...	3.47	1.35	1.50	1.41	7 74	0.688030	5.61	0.735030	4.13	84.90
5 ...	3.62	1.58	1.00	1.46	5.67	0.652016	3.90	0.680583	2.65	84.41
6 ...	3.74	1.69	1.50	2.03	8.96	0.617622	5.84	0.630170	3.68	80.26
7 ...	3.87	1.65	1.50	2.36	9.39	0.584770	5.80	0.583490	3.38	75.85
8 ...	4.11	1.48	1.50	2.71	9.80	0.553458	5.73	0.540269	3.10	71.21
9 ...	4.45	1.15	1.50	3.07	10.18	0.523660	5.64	0.500249	2.82	66.38
10 ...	4.77	0.66	1.50	3.45	10.39	0.495272	5.44	0.463193	2.52	61.52
11 ...	5.00	0.00	1.50	3.85	10.35	0.468164	5.13	0.428883	2.20	56.87
12 ...	5.17	0.00	1.50	4.26	10.94	0.442231	5.12	0.397114	2.03	51.86
13 ...	5.22	0.00	1.50	4.70	11.41	0.417335	5.05	0.367698	1.86	46.58
14 ...	5.28	0.00	1.50	5.15	11.93	0.393436	4.98	0.340461	1.69	41.00
15 ...	5.39	0.00	1.50	5.62	12.51	0.370512	4.92	0.315242	1.55	35.09
16 ...	5.12	0.00	1.50	6.10	12.72	0.348319	4.71	0.291890	1.38	29.09
17 ...	5.46	0.00	1.50	6.61	13.57	0.327139	4.73	0.270269	1.28	22.59
18 ...	5.80	0.00	1.50	7.14	14.44	0.306917	4.73	0.250249	1.18	15.57
19 ...	6.11	0.00	1.50	7.69	15.30	0.287588	4.70	0.231712	1.09	8.04
20 ...	6.40	0.00	1.50	8.26	16.16	0.269100	4.65	0.214548	1.00	0.00

PV Gain = 53.53
$DE - FYC$ = 6.00
$A\%$ = 11.2087%

According to Equation (10), the revised AB's are:

$$AB_7' = 82.75 + 32.40\,(1 + 0.08)\,(1 + 0.007288) = 117.99$$
$$AB_8' = 98.75 + 32.40\,(1 + 0.08)\,(1 + 0.007288)$$
$$* (1 + 0.08)\,(1 + 0.007968)$$
$$= 137.12.$$

Hence the numbers check out.

In Table 15, we examine the revised estimated gross profits resulting from Table 14. The effect on the sixth-year gross profit (gain) can be analyzed by using Equation (3). For instance, the sixth-year revised GW' is equal to

$$w_6\,(AB_6' - CSV_6')$$
$$= 0.05\,[99.81 - 50\%\,(99.81)]$$
$$= 2.50.$$

TABLE 14

POLICY VALUES AND ASSUMPTIONS WHEN THE REVISED GROSS PREMIUM IS $50 (VERSUS $20 EXPECTED) IN YEAR 6
(EVERYTHING ELSE IS THE SAME AS EXPECTED)

Policy Year	$FYC + C$	$FYE + E$	P	r	i	q	w	m	DB	MC	AB	$SC/AB\%$	CV	$I(t)$
1.....	14.00	19.00	20.00	0.08	0.10	0.0009533	0.10	0.0050825	1,000	5.08	0.99	100.00%	0.00	0.899047
2.....	4.00	2.50	20.00	0.08	0.10	0.0013138	0.10	0.0052470	1,000	5.24	12.69	90.00	1.27	0.807961
3.....	4.00	2.50	20.00	0.08	0.10	0.0017038	0.10	0.0054060	1,000	5.34	25.22	80.00	5.04	0.725788
4.....	4.00	2.50	20.00	0.08	0.10	0.0020238	0.05	0.0055600	1,000	5.42	38.66	70.00	11.60	0.688030
5.....	4.00	2.50	20.00	0.08	0.10	0.0023441	0.05	0.0060800	1,000	5.84	52.72	60.00	21.09	0.652016
6.....	4.00	2.50	50.00	0.08	0.10	0.0027494	0.05	0.0066560	1,000	6.31	99.81	50.00	49.91	0.617622
7.....	4.00	2.50	20.00	0.08	0.10	0.0031915	0.05	0.0072880	1,000	6.56	117.99	40.00	70.80	0.584770
8.....	4.00	2.50	20.00	0.08	0.10	0.0035453	0.05	0.0079680	1,000	7.03	137.12	30.00	95.99	0.553458
9.....	4.00	2.50	20.00	0.08	0.10	0.0038401	0.05	0.0087120	1,000	7.52	157.25	20.00	125.80	0.523660
10.....	4.00	2.50	20.00	0.08	0.10	0.0042098	0.05	0.0095200	1,000	8.02	178.45	10.00	160.60	0.495272
11.....	4.00	2.50	20.00	0.08	0.10	0.0047339	0.05	0.0104000	1,000	8.54	200.78	0.00	200.78	0.468164
12.....	4.00	2.50	20.00	0.08	0.10	0.0053938	0.05	0.0113680	1,000	9.09	224.31	0.00	224.31	0.442231
13.....	4.00	2.50	20.00	0.08	0.10	0.0062972	0.05	0.0124320	1,000	9.64	249.12	0.00	249.12	0.417335
14.....	4.00	2.50	20.00	0.08	0.10	0.0072644	0.05	0.0136000	1,000	10.21	275.30	0.00	275.30	0.393436
15.....	4.00	2.50	20.00	0.08	0.10	0.0082652	0.05	0.0148720	1,000	10.78	302.96	0.00	302.96	0.370512
16.....	4.00	2.50	20.00	0.08	0.10	0.0099000	0.05	0.0162720	1,000	11.34	332.23	0.00	332.23	0.348319
17.....	4.00	2.50	20.00	0.08	0.10	0.0108060	0.05	0.0177920	1,000	11.88	363.25	0.00	363.25	0.327139
18.....	4.00	2.50	20.00	0.08	0.10	0.0118140	0.05	0.0194480	1,000	12.38	396.22	0.00	396.22	0.306917
19.....	4.00	2.50	20.00	0.08	0.10	0.0129780	0.05	0.0212560	1,000	12.83	431.34	0.00	431.34	0.287588
20.....	4.00	2.50	20.00	0.08	0.10	0.0142860	0.05	0.0232320	1,000	13.21	468.86	0.00	468.86	0.269100

TABLE 15

REVISED GROSS PROFITS AND AMORTIZATION SCHEDULE UNDER THE CONDITION OF TABLE 14

Policy Year	Gain from					$l(t)$	Total Gain per Issued $G * l(t)$	Present Value Using r	Discounted Gain	% DAC Unamortized
	Mortality (GM)	Withdrawal (GW)	Expense (GE)	Interest (GI)	Total (G)					
1 ...	4.13	0.10	1.00	0.03	5.26	0.899047	5.26	0.925926	4.87	98.89%
2 ...	3.94	1.14	1.50	0.91	7.50	0.807961	6.74	0.857339	5.78	95.13
3 ...	3.68	2.02	1.50	1.15	8.34	0.725788	6.74	0.793832	5.35	91.06
4 ...	3.47	1.35	1.50	1.41	7.74	0.688030	5.61	0.735030	4.13	88.61
5 ...	3.62	1.58	1.50	1.71	8.42	0.652016	5.79	0.680583	3.94	85.67
6 ...	3.83	2.50	1.50	2.63	10.45	0.617622	6.82	0.630170	4.30	80.71
7 ...	3.75	2.36	1.50	2.99	10.60	0.584770	6.54	0.583490	3.82	75.83
8 ...	3.97	2.06	1.50	3.39	10.92	0.553458	6.38	0.540269	3.45	70.84
9 ...	4.28	1.57	1.50	3.81	11.17	0.523660	6.18	0.500249	3.09	65.79
10 ...	4.56	0.89	1.50	4.26	11.21	0.495272	5.87	0.463193	2.72	60.88
11 ...	4.76	0.00	1.50	4.72	10.98	0.468164	5.44	0.428883	2.33	56.33
12 ...	4.90	0.00	1.50	5.21	11.61	0.442231	5.44	0.397114	2.16	51.42
13 ...	4.91	0.00	1.50	5.73	12.14	0.417335	5.37	0.367698	1.97	46.23
14 ...	4.95	0.00	1.50	6.27	12.72	0.393436	5.31	0.340461	1.81	40.73
15 ...	5.02	0.00	1.50	6.84	13.35	0.370512	5.25	0.315242	1.66	34.88
16 ...	4.73	0.00	1.50	7.44	13.67	0.348319	5.06	0.291890	1.48	28.90
17 ...	5.00	0.00	1.50	8.07	14.57	0.327139	5.07	0.270269	1.37	22.42
18 ...	5.25	0.00	1.50	8.73	15.48	0.306917	5.06	0.250249	1.27	15.44
19 ...	5.45	0.00	1.50	9.42	16.37	0.287588	5.03	0.231712	1.16	7.97
20 ...	5.62	0.00	1.50	10.15	17.28	0.269100	4.97	0.214548	1.07	0.00

PV Gain = 57.72
$DE - FYC$ = 6.00
$A\%$ = 10.3956%

Regarding future years (that is, years 7 to 20), there are three effects on gains, as follows.

A. *Gain from Interest Due to* AB *Revision*

We can use Formula (11) to determine the additional gain resulting from this factor. For instance, the revised GI' for year 9 is

$$GI'_9 = GI_9 + k^*_{3\cdot1} [i_9 - r_9 (1 + m_9)]$$

$$= 3.07 + 38.37 [0.10 - 0.08 (1 + 0.008712)]$$

$$= 3.81$$

where $k^*_{3\cdot1} = AB'_8 - AB_8 = 137.12 - 98.75$.

B.   *Gain from Mortality Due to* AB *Revision*

Formula (12) provides the additional gain resulting from this factor. For instance, the revised GM' for year 9 is

$GM_9' = GM_9 - k_{3\text{-}1}^* [m_9 - q_9 (1 + r_9)(1 + m_9)]$

$\quad\ = 4.45 - 38.37 [0.008712 - 0.0038401 (1 + 0.08)(1 + 0.008712)]$

$\quad\ = 4.28.$

C.   *Gain from Withdrawal Due to* AB *Revision*

Because in our example surrender charge is expressed as a percentage of the *AB*, Formula (13) can be used to determine the effect resulting from this factor. For instance, the revised GW' for year 8 is

$$GW_8' = GW_8 + w_8 (S_8\%)(k_2^*)$$

$$= 1.48 + 0.05 (30\%)(38.37)$$

$$= 2.06.$$

SUMMARY

This paper illustrates both the form of the income statement and the forces driving the emergence of the pretax GAAP income under the *FAS 97* UL accounting. We have shown that if expected experience is realized, profits will emerge as a fixed proportion of the estimated gross profit used to derive the *DAC* amortization schedule less the interest spread on *DAC*. The fixed proportion is equal to the complement of the amortization rate.

Further, variations from the expected profit level can be related to the deviations in mortality, withdrawal, expense, or interest experience. An additional item, variation due to revised *DAC* amortization, also emerges if the amortization schedule has been revised.

Lastly, the paper discusses the effects on the estimated gross profit stream due to revisions in expectations with respect to mortality, withdrawal, earned interest, expenses, and account balance. Of these, the effects due to account balance revision are the most difficult to understand and the most far-reaching. However, knowing how the current difference between the original and the revised account balance compounds over time, the effects of such account balance difference on current and future estimated gross profits can be determined. As shown in the paper, the effects on gross profits consist of the

effects on various gross profit sources, that is, mortality, withdrawal, interest, and expense. Depending on the product's design and pricing, the effects of some of these gross profit sources could be zero or negligible.

ACKNOWLEDGMENT

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APPENDIX I

NOTATION

Δ	= Change
$A\%$	= Amortization rate
AB	= Account balance
CSV	= Cash surrender value
DAC	= Outstanding deferred acquisition cost
DB	= Death benefit
C	= Nonextra first-year expense charge, including all administrative charges
DE	= Deferrable expense, as defined in *FAS 60*
E	= Nonextra first-year expense (administrative expense)

FYC	= Extra first-year expense charge, also called front-end fee
FYE	= Extra first-year expense
G	= Estimated gross profit used to derive the amortization schedule (To avoid confusion with GAAP profit *Pf*, we refer to *G* as gain.)
GE	= Gain from expense
GI	= Gain from interest
GM	= Gain from mortality
GW	= Gain from withdrawal
i	= Earned interest rate
$l(t)$	= Survivorship function at time *t*, that is, units in force at time *t*
m	= Mortality charge rate
MC	= Mortality charge
P	= Gross premium
Pf	= Profit
q	= Mortality rate
r	= Credited interest rate
Subscript *t*	= Time *t*
Superscript *A*	= Actual
Superscript *G*	= GAAP (best estimate) assumption
V	= Net GAAP reserve = $AB - DAC$
VGE	= Variation due to gain from expense
VGI	= Variation due to gain from interest
VGM	= Variation due to gain from mortality
VGW	= Variation due to gain from withdrawal
w	= Withdrawal rate

APPENDIX II
ALTERNATIVE SOE FORMULAS

If total expected profit is defined as the actual in-force times the expected profit per unit in-force, the resulting total actual profit for year *t* is equal to the sum of seven terms. This is a different version of the *SOE* formula. The symbol l^A represents the actual in-force at *BOY t*.

1. Expected Total Profit

$$l^A \left[(1 - A^G\%) \, G_t^G - (i^G - r^G) \, DAC_{t-1}^G \right]$$

This is equal to the product of the actual in-force and the expected profit per unit in-force.

2. *"Variation Due to Gain from Mortality"* ("VGM")

$$l^A (GM^A - GM^G)$$

To contrast this with the *VGM* shown in the body of the paper, we have enclosed *VGM* within quotation marks. We see that the difference between *"VGM"* (the formula shown in this appendix) and *VGM* (the formula shown in the paper) is in the calculation of the second quantity. The GM^G is multiplied by

(i)   Actual in-force, l^A, for *"VGM,"* and
(ii) Expected in-force, l^G, for *VGM.*

The explanations for the next three terms (*"VGW," "VGE,"* and *"VGI"*) are the same as that for *"VGM."*

3. *"Variation Due to Gain from Withdrawal"* ("VGW")

$$l^A (GW^A - GW^G)$$

4. *"Variation Due to Gain from Expense"* ("VGE")

$$l^A (GE^A - GE^G)$$

5. *"Variation Due to Gain from Interest"* ("VGI")

$$l^A (GI^A - GI^G)$$

6. *"Variation Due to Interest Earnings on* BOY DAC"

$$-l^A (i^A - i^G) DAC^G_{t-1}$$

In contrast to the variation due to interest earnings on *BOY DAC* shown in the paper

$$-l^G (i^A - i^G) DAC^G_{t-1},$$

which is based on the expected in-force, this term (in quotation marks) is based on the actual in-force.

7. *Adjustment Needed Due to Static* DAC *Balances*

$$(l^A - l^G) (i^A DAC^G_{t-1} - \Delta DAC^G_t)$$

Since the calculation of *DAC* balance is static under *FAS 97* (unless the estimated gross profit is revised), defining the total expected profit as a function of the actual in-force requires the above adjustment, which converts the static *DAC* balance to a somewhat dynamic *DAC* balance.

<div align="center">

APPENDIX III

PROOF FOR EQUATION (10)

</div>

To show that:

If $AB'_n = AB_n + k$

Then $AB'_{n+t} = AB_{n+t} + k^*_t$ $\qquad$ for $t, n > 0$

where $k^*_t = \dfrac{t}{\displaystyle\prod_{s=1}} (1 + r_{n+s}) (1 + m_{n+s})$

Proof: By mathematical induction

(A) For $t = 1$, a recursive formula for AB is

$$AB_{n+1} = AB_n (1 + r_{n+1}) + P_{n+1} (1 + r_{n+1})$$

$$- m_{n+1}(DB_n - AB_n) (1 + r_{n+1})$$

$$- C_{n+1} (1 + r_{n+1})$$

$$AB_{n+1} = AB_n (1 + r_{n+1}) (1 + m_{n+1})$$

$$+ \text{(terms not involving } AB_n)$$

and

$$AB'_{n+1} = AB'_n (1 + r_{n+1}) (1 + m_{n+1})$$

$$+ \text{(terms not involving } AB'_n)$$

Substituting $AB'_n = AB_n + k$ and simplifying, we have

$$AB'_{n+1} = AB_{n+1} + k^*_1$$

where $k^*_1 = k (1 + r_{n+1}) (1 + m_{n+1})$.

Hence we have shown that the conclusion is true for $t = 1$.

(B)   Assuming that the conclusion is true for t, we need to show that it is true for $t + 1$. Since,

$$AB_{n+t+1} = AB_{n+t} (1 + r_{n+t+1}) (1 + m_{n+t+1})$$

$$+ \text{(terms not involving } AB_{n+t})$$

and

$$AB'_{n+t+1} = AB'_{+t} (1 + r_{n+t+1}) (1 + m_{n+t+1})$$

$$+ \text{(terms not involving } AB'_{n+t})$$

Substituting $AB'_{n+t} = AB_{n+t} + k^*_t$ and simplifying, we have

$$AB'_{n+t+1} = AB_{n+t+1} + k^*_{t+1}$$

Hence the conclusion is true for all $t > 0$.

APPENDIX IV
PROOF FOR FORMULA (I)

To show that:

$GI'_{n+t} = GI_{n+t} + k^*_{t-1} [i_{n+t} - r_{n+t} (1 + m_{n+t})]$ for $t, n > 0$
GI = original gain from interest,
GI' = revised gain from interest due to AB revision, and
$AB' = AB + k$.

Proof

$$GI_{n+t} = i_{n+t} (AB_{n+t-1} + P - E)$$
$$- r_{n+t} [AB_{n+t-1} + P - C$$
$$- m_{n+t} (DB_{n+t-1} - AB_{n+t-1})]$$
$$GI_{n+t} = AB_{n+t-1} [i_{n+t} - r_{n+t} (1 + m_{n+t})]$$
$$+ \text{(terms not involving } AB_{n+t-1})$$

and

$$GI'_{n+t} = AB'_{n+t-1} [i_{n+t} - r_{n+t} (1 + m_{n+t})]$$
$$+ \text{(terms not involving } AB'_{n+t-1})$$

Substituting $AB'_{n+t-1} = AB_{n+t-1} + k^*_{t-1}$ and simplifying, we have

$$GI'_{n+t} = GI_{n+t} + k^*_{t-1} [i_{n+t} - r_{n+t} (1 + m_{n+t})]$$

DISCUSSION OF PRECEDING PAPER

BRADLEY E. BARKS:

I thank Mr. Tan for a thorough discussion of the formulas involved in source-of-earnings (SOE) analyses for *FAS 97* products. These formulas are particularly valuable because the biggest stumbling block to performing SOE analysis on traditional products, namely, availability of information, should no longer be an issue with *FAS 97* products.

First, I would like to comment on Interpretation 2 and offer an adjustment to the formula for the literal interpretation of Paragraph 23c. The difference between the literal and modified interpretations of Paragraph 23c arises because of different assumptions regarding when profit is earned during the reporting period. The accounting profession has not promulgated any rules about the incidence of profit within an accounting period, but rather addresses the allocation of profit between accounting periods. The modified interpretation assumes that profits arise when cash is collected, so if there is cash in excess of AB, that is, surplus or earned profit, the investment income on the excess cash should be attributed to the expected gross profit in the product cell. This method essentially recognizes profit when cash is collected. The literal interpretation assumes that assets are equal to AB at any time during the policy year, which implies that the profits are distributed out of the particular product cell during the policy year. However, when calculating $A\%$ (the amortization factor), the paper assumes that profits are earned at the end of the policy year. This results in an inconsistency between the incidence of the profit and the discount factor.

To make the literal interpretation more consistent with accrual accounting, simply assume that estimated gross profit is earned evenly throughout the year (or effectively at mid-year) by modifying the discount factor for expected gross profit when calculating $A\%$ and adjusting the rest of the formulas accordingly.

For companies that track assets on a sophisticated investment-year method, the author's interpretation should pose no problems because they will be able to identify the earned rates applicable to cash flows separately by product type and date of occurrence. For companies that use a portfolio method, the alternative interpretation should be much easier to employ. This results in a much simplified version of Formula (6) for the Variation Due to Gain

from Investment and Interest Earnings on *BOY DAC*, which would be as follows:

$$I^A \left[(i^A - r^A)(AB_{t-1}^A + P^A - MC^A - C^A - FYC^A) - i^A DAC_{t-1}^G \right]$$
$$- I^G \left[(i^G - r^G)(AB_{t-1}^G + P^G - MC^G - C^G - FYC^G) - i^G DAC_{t-1}^G \right]$$

This could be implemented as follows:

1. Determine the total interest credited on all contracts supported by the asset pool. This information is virtually required for *FAS 97* implementation. This amount represents the following part of Formula (6):

$$I^A r^A (AB_{t-1}^A + P^A - MC^A - C^A - FYC^A)$$

2. Determine the total investment income on the assets in the pool. The size of the pool should equal the net GAAP liability for the book of contracts. This may require some arbitrary asset allocations on a line-of-business level. This amount represents the following part of Forumla (6):

$$I^A \left[i^A (AB_{t-1}^A + P^A - MC^A - C^A - FYC^A) - i^A DAC_{t-1} \right]$$

3. Item 2 less item 1 represents the first term of Formula (6) for the line of business, so all that is needed for an aggregate gain/loss analysis is to sum the expected interest spread from the company's *FAS 97* models.

4. Items 1 and 2 can be allocated to a product level. First, gross up item 1 by the ratio of (a) the crediting rate plus the spread to (b) the crediting rate for each different product type. At the same time, reduce item for each product type to reflect interest on the net GAAP liability instead of the full *AB*. This will produce an amount for each product type that represents the interest that would actually be earned if all assumed pricing spreads were met. The ratio of (a) the difference between this amount and item 1 to (b) the difference between item 2 and item 1 for all product types combined is then used to adjust all assumed spreads to reflect the actual interest earned.

Thus, for each product type, interest credited should be available for *FAS 97* purposes, and actual interest spreads are calculated through the above procedure. Note that the quantitative difference between the literal and the modified Interpretation 2 should be quite small. The purpose of using the literal interpretation formulas is to simplify gathering the data.

Second, I offer some observations about some alternative assumptions that frequently occur. These changes in assumptions lead to changes in the formulas involved in determining the effect on future profit of current-year deviations from expected profit.

Average policy characteristics such as average death benefit, *AB*, and renewal premiums are assumed to be static. In many cases, the policies that

lapse tend to be the policies with smaller AB and premiums. When this occurs, the effect of withdrawal rates on future years' profit will be much more complex than described in Formula (8). This circumstance, if material, will probably warrant a revision of the FAS 97 DAC amortization schedule.

Mr. Tan has also assumed that death benefits do not increase because of AB. For plans that have a constant net amount at risk (death benefit option B), the adjustments to the formulas are fairly straightforward because AB does not affect the mortality charge. However, level death benefit plans also have death benefits that increase in later years because of the IRC Section 7702 corridor test. This should not have an impact on profits in the early years, but in later years, K^* in Formula (10) should be modified to reflect the change in mortality charge due to the change in Section 7702 minimum death benefit when AB changes to AB'.

Finally, I would like to comment on the usefulness of SOE analysis. It has been said many times that a company will not know the true profit of a product until the last contract terminates. But this truism has been used as an excuse to ignore how a company's products perform after the original pricing, instead of an opportunity to modify the nonguaranteed elements of its contracts to meet company objectives. Unexpected events in the future will change overall product profitability, but with SOE analysis, an appropriate action plan can be formulated to respond to these events.

JAMES E. FELDMAN:

Joseph Tan has made an excellent demonstration of how various patterns of emerging experience affect the sources of earnings for blocks of business reported using FAS 97. He compares those that will ultimately evolve to those that were originally anticipated. I believe, however, that the focus of an SOE analysis should be to measure the variances from current expectations as opposed to original expectations.

As life insurance products have become "unbundled," and presumably more easily understood by policyholders, they have become harder for actuaries to analyze. Operating under a shroud of mystery surrounding a traditional life insurance contract, an actuary could assign appropriate percentages to the gross premium, determine appropriate reserves for benefits and maintenance expenses, and write off the acquisition expenses according to a predetermined percentage of face amount inforce. Mr. Tan's references on source of earnings under FAS 60 are all based on the premise that the portion of premium allocated for expenses, for example, was proper to cover those expenses with a risk-related provision for adverse deviation.

Under Universal Life, the policyholder is led to believe that he is paying a mortality charge for mortality, an expense charge for company expenses, and so on. In reality, the policyholder is providing the insurance company with various sources of revenue that together cover the expenses, profits, and benefits provided under the policy. As noted in the last sentence of his summary, the various margins depend on the product design.

Under *FAS 97*, it is very tempting to look at the margins used in determining the amortization schedule as being inherently meaningful. The margins are readily available, and they tie directly to reported GAAP earnings. Because they are a function of product design, they do not provide a quick understanding of the relative value of the margins, or even a point of comparison of the relative performance of one product versus another. Furthermore, because the relative contribution of the margins changes over time — even for a single block of business — measurement and analysis of margins and associated amortization does not in itself provide a good look at the financial impact of emerging experience.

What is important is the change in the margins relative to some expected standard. For traditional products, with fixed premiums and "locked in" GAAP assumptions, pricing or original GAAP provided a convenient standard. Under a typical Universal Life product, the basic price charged to the customer can be varied year to year through changes in interest spreads, mortality charges, and even expense charges. An appropriate standard for comparison would be based on current expectations such as the *FAS 97* GAAP assumptions, the previous year, the financial plan, and the like.

Note that the focus of these comparisons is short term, that is, against a current view of expected experience. In the absence of significant long-term guarantees, this is consistent with the pricing philosophy. A comparison of the source of current earnings to this type of standard will answer the question "Why are earnings different than my current expectations?" but will not directly answer "Why are ROE's different than assumed when the product was introduced?" Answers to those basic questions must still be derived by studies examining mortality, interest spread, terminations, and expenses.

Because the focus of earnings by source is assumed to be short term, the effects shown for all future years of a current change are not needed in the analysis. In Table 5 of Mr. Tan's paper there are negative variances in each margin in years 5 and later due to the excess withdrawals in year 4. Assuming that the experience develops exactly as shown, this could mislead management into believing that there is an ongoing mortality problem, for example, when in fact there was a one-time high withdrawal rate.

The analysis can be reduced to a direct comparison of actual versus expected margins (assuming Mr. Tan's simplifying assumptions regarding the amount of invested assets and the timing of cash flows, etc.) plus an adjustment for amortization.

The determination of the amortization component is not trivial. He mentions as an aside that an additional item, variation due to revised *DAC* amortization, also emerges if the amortization schedule has been revised. Because *FAS 97* requires such a revision if either actual experience is different from expected or if anticipated future margins change, this item should be included in the basic analysis. Depending on the magnitude of the variances, this item can be quite significant. This is particularly true as the block of business ages or if it has a high ratio of deferrable expenses to gross margins on a present-value basis.

I suggest a relatively simple method for determining the amortization component that, while it does not necessarily capture the mathematical elegance often associated with articles printed in this journal, does produce a reasonable result that can be computed under the tight deadlines normally found in financial reporting.

Four types of amortization under *FAS 97* are identified:

1. Expected amortization
2. Amortization due to a variance from expected in prior periods' margins
3. Amortization due to a variance from expected in the current period's margins
4. Amortization due to a variance from expected in future periods' margins.

The first type measures current amortization that is associated with the expected margins. This amount is based on an assumed standard rate of amortization (the ratio of the present value deferrable expense to the present value of gross margins, referred to as the *A*% factor) such as that determined at the inception of a block, and represents expected amortization.

The second type measures changes in current amortization due to a variance from expected in past experience. A change in past experience will result in a change in the *A*% factor from what existed at the inception of the block. There may be some sentiment for separating this item by the historical sources of earnings variance that caused the change, but that exercise adds little value to an analysis of current earnings.

In practice, these two components of amortization can be determined together by multiplying the expected margins by the *A*% factor in place at the end of the prior reporting period.

The third type measures current and past amortization associated with a current variance from the expected margins. This measurement requires that a new term, $A'\%$, be defined. $A'\%$ is equal to the amount that the ending DAC balance changes for a given change in any margin divided by the amount of the change. For example, suppose that a DAC calculation using the current period's expected gross profit elements produces an ending DAC balance of 25,000, and that increasing the mortality margin by 1,000 and recalculating produces an ending DAC balance of 24,450. This lower DAC, which is not as low as $25,000 - (A\%$ times 1000), results from the fact that a lower $A\%$ factor is used for amortization against past margins. In this example, $A'\%$ would be 0.55. $A'\%$ will have a value near $A\%$ for a newly opened block of business, and near 0 for a very old block of business.

The last type of amortization is due to the changes in future margins from those assumed at the previous valuation date. This does not include changes in future margins due to prospective unlocking, but solely those that arise from a different amount and mix of inforce on the valuation date than had originally been assumed. For simplicity, this is all allocated to lapse and surrender because this would be the major factor changing future margins. This can be calculated directly, or more simply solved for as the difference between the total amortization and the pieces above.

Changes arising from prospective unlocking or loss recognition are not part of the normal amortization calculation, but can readily be identified by source of the change in future expected margins.

Define AM as the sum of the four pieces of amortization described above that are associated with the mortality margin. The SOE variance for mortality is

$$(GMa - AM) - (GMe)(1 - A\%)$$

where GMa is the gain from mortality actually experienced and GMe is the expected gain from mortality using an appropriate standard for comparison. The $A\%$ factor is that which was in place at the end of the previous financial reporting period.

The other sources of earnings variance are similarly defined.

This method expands on Mr. Tan's solid fundamental groundwork by allocating the full amount of DAC amortization, including that associated with a change in amortization schedules, to its proper source. The comparisons from one period to another, or from some standard of expected to actual, ties directly to reported GAAP results, and can be produced from

basic information that is readily available during the normal financial close process.

MARK FREEDMAN:

Mr. Tan's paper presents valuable insights for anyone attempting to explain the flow of GAAP earnings. This discussion is an attempt to tie in some concepts of Mr. Tan's paper with some concepts discussed in Bradley M. Smith's paper, "Pricing in a Return-on-Equity Environment" [*TSA* XXXIX (1987): 257–272].

As Mr. Smith noted, GAAP return on equity (ROE) is a common profitability measure. He showed that, under *FAS 60*, if the GAAP discount rate is equal to the return on invested statutory surplus (ROI), the ROE will be level and equal to the ROI. (This assumes no adverse deviation, no non-deferrable expenses, and no federal income taxes, and that actual experience equals GAAP assumptions.)

Under *FAS 97*, this does not hold. Using Mr. Tan's notation,

$$PF_t = (1 - A\%) \, G_t - (i_t - r_t) \, DAC_{t-1},$$

where, in the general case, r_t is the GAAP discount rate and not necessarily the credited rate. Then,

$$ROE_t = [PF_t + i_t \, (GAAP \; Equity_{t-1})]/GAAP \; Equity_{t-1}$$

Note that

$$GAAP \; Equity_{t-1} = DAC_{t-1} + {}_{t-1}V - {}_{t-1}AV,$$

where V refers to statutory reserves and AV refers to account values.

Then, substituting Mr. Tan's formula for Pf_t in the formula for ROE and rearranging terms, the formula becomes

$$ROE_t = (1 - A\%) \, G_t/GAAP \; Equity_{t-1}$$
$$+ \; i_t \, ({}_{t-1}V - {}_{t-1}AV)/GAAP \; Equity_{t-1}$$
$$+ \; r_t \, DAC_{t-1}/GAAP \; Equity_{t-1}$$

Assume that statutory reserves equal account value, which admittedly is usually not the case if CRVM is followed. Then,

$$ROE_t = (1 - A\%) \, G_t/GAAP \; Equity_{t-1} + r_t.$$

$ROE_t = r_t$ under two conditions. The first is where $G_t = 0$ for all years; there would be no deferred acquisition expenses (or loads) and therefore no amortization.

The second (and more interesting) case is where $A\% = 1$; that is, r_t equals the interest rate such that the present value of gross margins equals the present value of acquisition expenses minus acquisition loads. This is approximately equal to the *ROI*.

The proof is as follows:

G_t = *Statutory Book Profit*$_t$ + *Deferrable Expenses* (*less loads*)$_t$ $(1 + i_t)$
    = *Statutory Book Profit*$_t$ + *Deferrable Expenses* (*less loads*)$_t$ $(1 + r_t)$
    + *Deferrable Expenses* (*less loads*)$_t$ $(i_t - r_t)$

If $r_t = ROI$, the present value of the gross profits then equals zero plus the present value of deferrable expenses (less loads) plus the present value of "excess interest" on the deferrable expenses (less loads). Assuming the last term is immaterial on a present-value basis, the definition that $A\% = 1$ is satisfied.

<div align="center">(AUTHOR'S REVIEW OF DISCUSSION)</div>

<div align="center">JOSEPH H. TAN:</div>

I thank Bradley Barks, James Feldman, and Mark Freedman for contributing discussions to this paper. Their discussions expand on the concepts presented in the paper and provide valuable additions/improvements to some of the methods. I also express my appreciation to those who pointed out the typographical errors in the preprint.

Mr. Barks points out the difference between the literal and modified interpretations of Paragraph 23c with regard to the computation of estimated gross profit arising from the interest component. To make the literal interpretation more consistent with accrual accounting, he suggests adjusting the discount factor by half a year. He also points out that the quantitative difference between the literal and the modified Intepretation 2 would be minimal.

Mr. Barks' observations on some alternative assumptions and their impact on the formulas presented in the paper are valuable. To the extent they are material, they should be reflected in the formulas. To his list, I add the following:

1. Calendar-year versus the policy-year orientation assumed in the paper
2. More accurate reflection of cash-flow timing during the year
3. The existence of some amount of fixed expense (that is, reflect that not all expenses are variable)
4. Reflection of reinsurance and policy riders.

Mr. Barks' last point is most interesting. A company needs to continually monitor the performance of the products it has sold. Given the company's ability to modify the nonguaranteed elements of its contracts and the requirements of accumulating experience data to fully implement *FAS 97*, management should monitor the emergence of profit and take appropriate action to correct any undesirable result.

Mr. Feldman notes that in Table 5 the excess withdrawals in year 4 have given rise to negative variances in years 5 and later. He then suggests an alternative SOE variance formula to rectify this problem. My apology to Mr. Feldman and others who have been misled by the illustrative example (as in Table 5). As indicated by the footnote in the tables, the values shown are purposely based on the original *DAC* schedule throughout; this was done so the reader could follow the calculation more easily.

In actual practice, I believe that the phenomenon Mr. Feldman observed seldom occurs. This is due to the "unlocking" provision of *FAS 97*, which requires that estimated gross profits (and hence expected GAAP profit) be adjusted regularly as warranted by experience or other evidence. For our example, with the actual withdrawal rate being 15 percent as opposed to 5 percent in year 4, the estimated gross profits and expected GAAP profit will be revised at the end of year 4. The resulting revised estimated gross profits are shown on Table 12 of the paper. When such a revision is implemented, the resulting SOE analysis will be as shown in Table 5A. Note that the revised SOE analysis has zero variations in *EGP* for years 5 and later. This is because the only deviation between the actual and the expected assumption at issue is the year 4 withdrawal rate. In reality though, there will likely be deviation every year and hence revised estimated gross profits and amortization schedules every year.

An alternative method could also rectify the problem that Mr. Feldman observed. Similar to the procedure suggested by Mr. Feldman, this alternative method assumes that the estimated gross profit and amortization schedule are not revised even though the actual withdrawal rate for year 4 deviated from the expected assumption at issue. Two possible reasons for not revising the schedule are:

1. The actuary thinks that the deviation is so small that a revision is unnecessary.
2. The deviation between actual and expected occurs during the year, but the actuary considers that it is better to revise the amortization schedule

TABLE 5A

SOURCE OF EARNINGS ANALYSIS WHEN THE REVISED AMORTIZATION SCHEDULE OF TABLE 12 (WITH 0.15 WITHDRAWAL RATE IN YEAR 4) IS USED FOR YEARS 5 TO 20

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amon. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	Expected GAAP Profit $(1-4\%)$ EGP	$-(i-r)^*$ DAC	Total	Variations in EGP due to Mort.	With.	Expense	Interest	Variation Due to i on DAC	Total Actual Profit
1 ..	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	4.561
2 ..	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	5.883
3 ..	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	5.892
4 ..	3.93	2.95	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	6.857†	5.000	−0.107	4.893	0.000	1.964	0.000	0.000	0.000	6.857†
5 ..	3.60	0.97	2.46	2.98	1.37	1.54	0.00	2.40	0.00	(0.55)	(0.34)	4.493	4.589	−0.096	4.493	0.000	0.000	0.000	0.000	0.000	4.493
6 ..	3.68	0.98	2.33	3.63	1.50	1.46	0.00	2.91	0.00	(0.61)	(0.38)	4.535	4.627	−0.092	4.535	0.000	0.000	0.000	0.000	0.000	4.535
7 ..	3.75	0.91	2.21	4.25	1.62	1.38	0.00	3.39	0.00	(0.64)	(0.40)	4.506	4.594	−0.088	4.506	0.000	0.000	0.000	0.000	0.000	4.506
8 ..	3.82	0.77	2.09	4.83	1.67	1.31	0.00	3.83	0.00	(0.68)	(0.42)	4.461	4.544	−0.083	4.461	0.000	0.000	0.000	0.000	0.000	4.461
9 ..	3.89	0.57	1.98	5.37	1.68	1.24	0.00	4.23	0.00	(0.70)	(0.44)	4.388	4.466	−0.078	4.388	0.000	0.000	0.000	0.000	0.000	4.388
10 ..	3.94	0.31	1.87	5.87	1.71	1.17	0.00	4.61	0.00	(0.71)	(0.44)	4.238	4.311	−0.073	4.238	0.000	0.000	0.000	0.000	0.000	4.238
11 ..	4.00	0.00	1.77	6.33	1.78	1.11	0.00	4.96	0.00	(0.68)	(0.42)	3.994	4.062	−0.067	3.994	0.000	0.000	0.000	0.000	0.000	3.994
12 ..	4.04	0.00	1.68	6.75	1.87	1.05	0.00	5.27	0.00	(0.73)	(0.46)	3.996	4.058	−0.062	3.996	0.000	0.000	0.000	0.000	0.000	3.996
13 ..	4.08	0.00	1.58	7.13	2.02	0.99	0.00	5.56	0.00	(0.77)	(0.48)	3.943	3.999	−0.057	3.943	0.000	0.000	0.000	0.000	0.000	3.943
14 ..	4.11	0.00	1.49	7.48	2.14	0.93	0.00	5.81	0.00	(0.81)	(0.51)	3.894	3.945	−0.051	3.894	0.000	0.000	0.000	0.000	0.000	3.894
15 ..	4.13	0.00	1.41	7.79	2.23	0.88	0.00	6.04	0.00	(0.86)	(0.54)	3.856	3.900	−0.045	3.856	0.000	0.000	0.000	0.000	0.000	3.856
16 ..	4.14	0.00	1.33	8.07	2.45	0.83	0.00	6.24	0.00	(0.87)	(0.55)	3.697	3.735	−0.038	3.697	0.000	0.000	0.000	0.000	0.000	3.697
17 ..	4.14	0.00	1.25	8.30	2.43	0.78	0.00	6.40	0.00	(0.95)	(0.59)	3.715	3.747	−0.032	3.715	0.000	0.000	0.000	0.000	0.000	3.715
18 ..	4.11	0.00	1.17	8.50	2.41	0.73	0.00	6.54	0.00	(1.02)	(0.64)	3.720	3.745	−0.025	3.720	0.000	0.000	0.000	0.000	0.000	3.720
19 ..	4.08	0.00	1.10	8.67	2.40	0.69	0.00	6.65	0.00	(1.10)	(0.69)	3.704	3.721	−0.017	3.704	0.000	0.000	0.000	0.000	0.000	3.704
20 ..	4.02	0.00	1.03	8.82	2.38	0.64	0.00	6.74	0.00	(1.17)	(0.73)	3.674	3.683	−0.009	3.674	0.000	0.000	0.000	0.000	0.000	3.674

†Excludes the profit impact due to the change in amortization schedule.

only at the end of the year (that is, not at the end of every month or every quarter).

The alternative method that I am suggesting is based on the use of the alternative SOE formulas shown in Appendix II of the paper. The Appendix II formulas are based on computing the total expected profit as the actual inforce times the expected profit per unit inforce. Revised Tables 4 to 9 show the values resulting when the alternative SOE formulas of Appendix II are used.

Mr. Freedman relates some concepts in my paper to the "Pricing in a Return-on-Equity Environment" paper of Bradley Smith [3]. Mr. Freedman points out that level ROE will result under *FAS 60* methodology (as shown in Mr. Smith's paper) but not under *FAS 97* methodology.

Level ROE methodology was first introduced by Donald Sondergeld in his paper "Earnings and the Internal Rate of Return Measurement of Profit" [4]. Mr. Sondergeld calls it the internal rate of return method of accounting (IRRMA). With some minor variation, this same methodology was also discussed in two other papers [1] and [2].

Even though Mr. Smith started with a different premise (that is, using *FAS 60* methodology but assuming no adverse deviation, nondeferrable expense, etc.), it can be shown that Mr. Smith's structure is a special case of the IRRMA's structure. I believe that this is why Mr. Smith was able to arrive at a level ROE.

Under *FAS 97* methodology, the GAAP accounting structure is quite different from that of IRRMA. Consequently, as also shown by Mr. Freedman, level ROE does not occur.

I conclude by reiterating an important point: SOE analysis is a tool for management to better understand the cause and contribution of profit and to help identify areas in which improvements should be made. The result is the identification of an action plan appropriate to the situation. Any SOE analysis exercise should be predicated on this point. Without it, the SOE analysis exercise would become another theoretical but perhaps meaningless mathematical computation.

REFERENCES

1. LIFE INSURANCE COMPANY FINANCIAL REPORTING SECTION COUNCIL. *Report of the Committee on Accounting Principles for Management Financial Statements of Mutual Life Insurance Companies.* Itasca, Ill.: Society of Actuaries, January 14, 1987.

2. RAMSEY, H.B., JR. Discussion of Sondergeld, D.R., "Profitability As a Return on Total Capital," *TSA* XXXIV (1982): 431–32.
3. SMITH, B.M. "Pricing in a Return-on-Equity Environment," *TSA* XXXIX (1987): 257–72.
4. SONDERGELD, D.R. "Earnings and the Internal Rate of Return Measurement of Profit," *TSA* XXVI (1974): 617–36.

REVISED TABLE 4 BASED ON APPENDIX II SOE FORMULAS

SOURCE OF EARNINGS ANALYSIS WHEN ACTUAL MORTALITY RATE (g) IS 110% OF EXPECTED IN YEARS 3 AND 4

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	(1−A%) G	−(1−r)* BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOY- DAC	Adj on DAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	0.000000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	0.000000	5.883
3	4.31	1.63	3.23	1.88	1.48	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.757	6.004	−0.113	5.892	−0.134	0.000	0.000	0.000	0.000	0.000000	5.757
4	3.93	0.98	2.90	2.56	1.55	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.750	4.999	−0.107	4.892	−0.141	0.000	0.000	0.000	0.000	−0.000137	4.750
5	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.052	5.155	−0.103	5.052	0.000	0.000	0.000	0.000	0.000	−0.000297	5.052
6	4.11	1.10	2.61	4.08	1.67	1.63	0.00	3.25	0.00	(0.65)	(0.41)	5.099	5.198	−0.099	5.099	0.000	0.000	0.000	0.000	0.000	−0.000298	5.099
7	4.20	1.02	2.47	4.77	1.81	1.54	0.00	3.78	0.00	(0.69)	(0.43)	5.066	5.161	−0.094	5.067	0.000	0.000	0.000	0.000	0.000	−0.000294	5.066
8	4.27	0.87	2.34	5.42	1.87	1.46	0.00	4.28	0.00	(0.73)	(0.45)	5.015	5.104	−0.089	5.015	0.000	0.000	0.000	0.000	0.000	−0.000289	5.015
9	4.34	0.64	2.21	6.01	1.88	1.38	0.00	4.73	0.00	(0.75)	(0.47)	4.933	5.017	−0.083	4.933	0.000	0.000	0.000	0.000	0.000	−0.000282	4.933
10	4.41	0.35	2.09	6.57	1.91	1.31	0.00	5.15	0.00	(0.76)	(0.47)	4.764	4.842	−0.078	4.764	0.000	0.000	0.000	0.000	0.000	−0.000271	4.764
11	4.46	0.00	1.98	7.08	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	4.490	4.562	−0.072	4.490	0.000	0.000	0.000	0.000	0.000	−0.000255	4.490
12	4.52	0.00	1.87	7.55	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	4.491	4.558	−0.067	4.491	0.000	0.000	0.000	0.000	0.000	−0.000253	4.491
13	4.56	0.00	1.77	7.98	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	4.431	4.492	−0.061	4.432	0.000	0.000	0.000	0.000	0.000	−0.000247	4.431
14	4.60	0.00	1.67	8.37	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	4.377	4.432	−0.055	4.377	0.000	0.000	0.000	0.000	0.000	−0.000242	4.377
15	4.62	0.00	1.57	8.72	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	4.333	4.381	−0.048	4.333	0.000	0.000	0.000	0.000	0.000	−0.000237	4.333
16	4.63	0.00	1.48	9.02	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	4.154	4.196	−0.041	4.154	0.000	0.000	0.000	0.000	0.000	−0.000225	4.154
17	4.62	0.00	1.39	9.28	2.72	0.87	0.00	7.15	0.00	(1.02)	(0.64)	4.175	4.209	−0.034	4.175	0.000	0.000	0.000	0.000	0.000	−0.000222	4.175
18	4.60	0.00	1.31	9.51	2.70	0.82	0.00	7.30	0.00	(1.10)	(0.69)	4.180	4.206	−0.026	4.180	0.000	0.000	0.000	0.000	0.000	−0.000219	4.180
19	4.55	0.00	1.23	9.70	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	4.162	4.180	−0.018	4.162	0.000	0.000	0.000	0.000	0.000	−0.000215	4.162
20	4.50	0.00	1.15	9.85	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	4.127	4.137	−0.009	4.128	0.000	0.000	0.000	0.000	0.000	−0.000209	4.127

REVISED TABLE 5 BASED ON APPENDIX II SOE FORMULAS

Source of Earnings Analysis When Actual Withdrawal Rate (w) Is 15% (Versus 5% Expected) in Year 4

| Policy Year | Mortality Charge (MC) | Surrender Charge | Admin. Charge (C) | Earned Interest | Death Ben. Less AB Rel. | Admin. Expense (E) | First-Year Expense (FYE) | Credited Interest | Deferrable Expense | Amort. of Def. Exp. | Amort. of Unamort. FY Charge | GAAP Profit (Pf) | Expected GAAP Profit | | | VGM | VGW | VGE | VGI | Variation Fr. Int. on BOYDAC | Adj on DAC | Total Actual Profit |
													(1-A%) G	-(i-r)* BOY DAC	Total							
1	5.08	0.10	4.00	-0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	-0.120	4.561	0.000	0.000	0.000	0.000	0.000	0.000000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	-0.118	5.883	0.000	0.000	0.000	0.000	0.000	0.000000	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	-0.113	5.892	0.000	0.000	0.000	0.000	0.000	0.000000	5.892
4	3.93	2.95	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	6.857	5.000	-0.107	4.893	0.000	1.964	0.000	0.000	0.000	0.000000	6.857
5	3.60	0.97	2.46	2.94	1.37	1.54	0.00	2.40	0.00	(0.59)	(0.37)	4.443	4.613	-0.092	4.521	0.000	0.000	0.000	0.000	0.000	-0.077765	4.443
6	3.68	0.98	2.33	3.60	1.50	1.46	0.00	2.91	0.00	(0.65)	(0.41)	4.485	4.651	-0.088	4.563	0.000	0.000	0.000	0.000	0.000	-0.077851	4.485
7	3.75	0.91	2.21	4.22	1.62	1.38	0.00	3.39	0.00	(0.69)	(0.43)	4.457	4.618	-0.084	4.534	0.000	0.000	0.000	0.000	0.000	-0.076855	4.457
8	3.82	0.77	2.09	4.80	1.67	1.31	0.00	3.83	0.00	(0.73)	(0.45)	4.412	4.567	-0.080	4.488	0.000	0.000	0.000	0.000	0.000	-0.075573	4.412
9	3.89	0.57	1.98	5.34	1.68	1.24	0.00	4.23	0.00	(0.75)	(0.47)	4.341	4.489	-0.075	4.415	0.000	0.000	0.000	0.000	0.000	-0.073871	4.341
10	3.94	0.31	1.87	5.84	1.71	1.17	0.00	4.61	0.00	(0.76)	(0.47)	4.193	4.333	-0.070	4.264	0.000	0.000	0.000	0.000	0.000	-0.071010	4.193
11	4.00	0.00	1.77	6.30	1.78	1.11	0.00	4.96	0.00	(0.73)	(0.45)	3.951	4.083	-0.064	4.018	0.000	0.000	0.000	0.000	0.000	-0.066780	3.951
12	4.04	0.00	1.68	6.73	1.87	1.05	0.00	5.27	0.00	(0.78)	(0.49)	3.953	4.079	-0.060	4.019	0.000	0.000	0.000	0.000	0.000	-0.066149	3.953
13	4.08	0.00	1.58	7.11	2.02	0.99	0.00	5.56	0.00	(0.82)	(0.52)	3.901	4.020	-0.054	3.966	0.000	0.000	0.000	0.000	0.000	-0.064677	3.901
14	4.11	0.00	1.49	7.46	2.14	0.93	0.00	5.81	0.00	(0.87)	(0.54)	3.854	3.966	-0.049	3.917	0.000	0.000	0.000	0.000	0.000	-0.063238	3.854
15	4.13	0.00	1.41	7.78	2.23	0.88	0.00	6.04	0.00	(0.92)	(0.58)	3.816	3.921	-0.043	3.878	0.000	0.000	0.000	0.000	0.000	-0.061895	3.816
16	4.14	0.00	1.33	8.05	2.45	0.83	0.00	6.24	0.00	(0.94)	(0.59)	3.659	3.755	-0.037	3.718	0.000	0.000	0.000	0.000	0.000	-0.058755	3.659
17	4.14	0.00	1.25	8.29	2.43	0.78	0.00	6.40	0.00	(1.02)	(0.64)	3.678	3.767	-0.030	3.736	0.000	0.000	0.000	0.000	0.000	-0.058190	3.678
18	4.11	0.00	1.17	8.49	2.41	0.73	0.00	6.54	0.00	(1.10)	(0.69)	3.683	3.764	-0.024	3.740	0.000	0.000	0.000	0.000	0.000	-0.057349	3.683
19	4.08	0.00	1.10	8.67	2.40	0.69	0.00	6.65	0.00	(1.18)	(0.74)	3.668	3.741	-0.016	3.724	0.000	0.000	0.000	0.000	0.000	-0.056141	3.668
20	4.02	0.00	1.03	8.81	2.38	0.64	0.00	6.74	0.00	(1.26)	(0.78)	3.639	3.702	-0.008	3.694	0.000	0.000	0.000	0.000	0.000	-0.054653	3.639

REVISED TABLE 6 BASED ON APPENDIX II SOE FORMULAS

Source of Earnings Analysis When Actual Expense Is $5 (Versus $2.50 Expected) for Years 5 To 10

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Defer-rable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	Expected GAAP Profit $(1-A\%)$ G	$-(i-r)*$ BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Adj on DAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	0.000000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	0.000000	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	0.000000	5.892
4	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893	0.000	0.000	0.000	0.000	0.000	0.000000	4.893
5	4.02	1.09	2.75	3.18	1.53	3.44	0.00	2.69	0.00	(0.59)	(0.37)	3.162	5.157	−0.103	5.054	0.000	0.000	−1.720	−0.172	0.000	0.000000	3.162
6	4.11	1.10	2.61	3.92	1.67	3.26	0.00	3.26	0.00	(0.65)	(0.41)	3.308	5.200	−0.099	5.101	0.000	0.000	−1.630	−0.163	0.000	0.000000	3.308
7	4.20	1.02	2.47	4.62	1.81	3.09	0.00	3.79	0.00	(0.69)	(0.43)	3.370	5.163	−0.094	5.069	0.000	0.000	−1.544	−0.154	0.000	0.000000	3.370
8	4.27	0.87	2.34	5.27	1.87	2.92	0.00	4.28	0.00	(0.73)	(0.45)	3.409	5.106	−0.089	5.017	0.000	0.000	−1.462	−0.146	0.000	0.000000	3.409
9	4.35	0.64	2.21	5.88	1.88	2.77	0.00	4.73	0.00	(0.75)	(0.47)	3.413	5.019	−0.083	4.935	0.000	0.000	−1.384	−0.138	0.000	0.000000	3.413
10	4.41	0.35	2.09	6.44	1.91	2.62	0.00	5.15	0.00	(0.76)	(0.47)	3.326	4.844	−0.078	4.766	0.000	0.000	−1.309	−0.131	0.000	0.000000	3.326
11	4.47	0.00	1.98	7.09	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	4.492	4.564	−0.072	4.492	0.000	0.000	0.000	0.000	0.000	0.000000	4.492
12	4.52	0.00	1.87	7.56	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	4.493	4.560	−0.067	4.493	0.000	0.000	0.000	0.000	0.000	0.000000	4.493
13	4.56	0.00	1.77	7.99	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	4.433	4.494	−0.061	4.433	0.000	0.000	0.000	0.000	0.000	0.000000	4.433
14	4.60	0.00	1.67	8.38	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	4.379	4.433	−0.055	4.379	0.000	0.000	0.000	0.000	0.000	0.000000	4.379
15	4.62	0.00	1.57	8.72	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	4.335	4.383	−0.048	4.335	0.000	0.000	0.000	0.000	0.000	0.000000	4.335
16	4.63	0.00	1.48	9.03	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	4.156	4.197	−0.041	4.156	0.000	0.000	0.000	0.000	0.000	0.000000	4.156
17	4.62	0.00	1.39	9.29	2.72	0.87	0.00	7.15	0.00	(1.02)	(0.64)	4.177	4.211	−0.034	4.177	0.000	0.000	0.000	0.000	0.000	0.000000	4.177
18	4.60	0.00	1.31	9.51	2.70	0.82	0.00	7.31	0.00	(1.10)	(0.69)	4.182	4.208	−0.026	4.182	0.000	0.000	0.000	0.000	0.000	0.000000	4.182
19	4.56	0.00	1.23	9.70	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	4.164	4.182	−0.018	4.164	0.000	0.000	0.000	0.000	0.000	0.000000	4.164
20	4.50	0.00	1.15	9.86	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	4.129	4.139	−0.009	4.129	0.000	0.000	0.000	0.000	0.000	0.000000	4.129

REVISED TABLE 7 BASED ON APPENDIX II SOE FORMULAS

SOURCE OF EARNINGS ANALYSIS WHEN ACTUAL CREDITED RATE (*r*) IS 9% (VERSUS 8% EXPECTED) FOR YEARS 6 TO 20

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Defer-rable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (P)	(1−A%) G	−(i−r)* BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Adj on DAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	0.000000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	0.000000	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	0.000000	5.892
4	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893	0.000	0.000	0.000	0.000	0.000	0.000000	4.893
5	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.054	5.157	−0.103	5.054	0.000	0.000	0.000	0.000	0.000	0.000000	5.054
6	4.11	1.11	2.61	4.08	1.67	1.63	0.00	3.66	0.00	(0.65)	(0.41)	4.705	5.200	−0.099	5.101	0.001	0.010	0.000	−0.407	0.000	0.000000	4.705
7	4.19	1.04	2.47	4.81	1.81	1.54	0.00	4.29	0.00	(0.69)	(0.43)	4.617	5.163	−0.094	5.069	0.000	0.018	0.000	−0.470	0.000	0.000000	4.617
8	4.27	0.89	2.34	5.50	1.86	1.46	0.00	4.89	0.00	(0.73)	(0.45)	4.511	5.106	−0.089	5.017	−0.002	0.022	0.000	−0.527	0.000	0.000000	4.511
9	4.33	0.66	2.21	6.16	1.87	1.38	0.00	5.45	0.00	(0.75)	(0.47)	4.374	5.019	−0.083	4.935	−0.004	0.021	0.000	−0.579	0.000	0.000000	4.374
10	4.39	0.36	2.09	6.77	1.90	1.31	0.00	5.98	0.00	(0.76)	(0.47)	4.148	4.844	−0.078	4.766	−0.007	0.014	0.000	−0.626	0.000	0.000000	4.148
11	4.44	0.00	1.98	7.36	1.97	1.24	0.00	6.48	0.00	(0.73)	(0.45)	3.813	4.564	−0.072	4.492	−0.011	0.000	0.000	−0.668	0.000	0.000000	3.813
12	4.48	0.00	1.87	7.90	2.07	1.17	0.00	6.95	0.00	(0.78)	(0.49)	3.773	4.560	−0.067	4.493	−0.015	0.000	0.000	−0.706	0.000	0.000000	3.773
13	4.51	0.00	1.77	8.42	2.22	1.11	0.00	7.38	0.00	(0.82)	(0.52)	3.676	4.494	−0.061	4.433	−0.019	0.000	0.000	−0.739	0.000	0.000000	3.676
14	4.53	0.00	1.67	8.90	2.35	1.04	0.00	7.79	0.00	(0.87)	(0.54)	3.589	4.433	−0.055	4.379	−0.023	0.000	0.000	−0.767	0.000	0.000000	3.589
15	4.53	0.00	1.57	9.34	2.43	0.98	0.00	8.16	0.00	(0.92)	(0.58)	3.516	4.383	−0.048	4.335	−0.029	0.000	0.000	−0.790	0.000	0.000000	3.516
16	4.51	0.00	1.48	9.75	2.65	0.93	0.00	8.51	0.00	(0.94)	(0.59)	3.317	4.197	−0.041	4.156	−0.030	0.000	0.000	−0.810	0.000	0.000000	3.317
17	4.47	0.00	1.39	10.12	2.61	0.87	0.00	8.81	0.00	(1.02)	(0.64)	3.314	4.211	−0.034	4.177	−0.039	0.000	0.000	−0.824	0.000	0.000000	3.314
18	4.41	0.00	1.31	10.47	2.56	0.82	0.00	9.10	0.00	(1.10)	(0.69)	3.297	4.208	−0.026	4.182	−0.050	0.000	0.000	−0.835	0.000	0.000000	3.297
19	4.33	0.00	1.23	10.78	2.51	0.77	0.00	9.36	0.00	(1.18)	(0.74)	3.260	4.182	−0.018	4.164	−0.062	0.000	0.000	−0.842	0.000	0.000000	3.260
20	4.21	0.00	1.15	11.07	2.45	0.72	0.00	9.59	0.00	(1.26)	(0.78)	3.209	4.139	−0.009	4.129	−0.075	0.000	0.000	−0.845	0.000	0.000000	3.209

REVISED TABLE 8 BASED ON APPENDIX II SOE FORMULAS

SOURCE OF EARNINGS ANALYSIS WHEN ACTUAL EARNED RATE (i) IS 9% (VERSUS 10% EXPECTED) FOR YEARS 6 TO 20

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (PJ)	(1-4%) G	-(i-r)° BOY DAC	Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Adj on DAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	0.000000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	0.000000	5.883
3	4.31	1.63	3.23	1.88	1.34	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.892	6.004	−0.113	5.892	0.000	0.000	0.000	0.000	0.000	0.000000	5.892
4	3.93	0.98	2.90	2.57	1.41	1.81	0.00	2.08	0.00	(0.50)	(0.31)	4.893	5.000	−0.107	4.893	0.000	0.000	0.000	0.000	0.000	0.000000	4.893
5	4.02	1.09	2.75	3.35	1.53	1.72	0.00	2.69	0.00	(0.59)	(0.37)	5.054	5.157	−0.103	5.054	0.000	0.000	0.000	0.000	0.000	0.000000	5.054
6	4.11	1.10	2.61	3.68	1.67	1.63	0.00	3.26	0.00	(0.65)	(0.41)	4.693	5.200	−0.099	5.101	0.000	0.000	0.000	−0.458	0.049	0.000000	4.693
7	4.20	1.02	2.47	4.30	1.81	1.54	0.00	3.79	0.00	(0.69)	(0.43)	4.591	5.163	−0.094	5.069	0.000	0.000	0.000	−0.524	0.047	0.000000	4.591
8	4.27	0.87	2.34	4.88	1.87	1.46	0.00	4.28	0.00	(0.73)	(0.45)	4.475	5.106	−0.089	5.017	0.000	0.000	0.000	−0.586	0.044	0.000000	4.475
9	4.35	0.64	2.21	5.42	1.88	1.38	0.00	4.73	0.00	(0.75)	(0.47)	4.334	5.019	−0.083	4.935	0.000	0.000	0.000	−0.643	0.042	0.000000	4.334
10	4.41	0.35	2.09	5.92	1.91	1.31	0.00	5.15	0.00	(0.76)	(0.47)	4.109	4.844	−0.078	4.766	0.000	0.000	0.000	−0.696	0.039	0.000000	4.109
11	4.47	0.00	1.98	6.38	1.99	1.24	0.00	5.54	0.00	(0.73)	(0.45)	3.783	4.564	−0.072	4.492	0.000	0.000	0.000	−0.745	0.036	0.000000	3.783
12	4.52	0.00	1.87	6.80	2.10	1.17	0.00	5.89	0.00	(0.78)	(0.49)	3.737	4.560	−0.067	4.493	0.000	0.000	0.000	−0.789	0.033	0.000000	3.737
13	4.56	0.00	1.77	7.19	2.26	1.11	0.00	6.21	0.00	(0.82)	(0.52)	3.635	4.494	−0.061	4.433	0.000	0.000	0.000	−0.829	0.030	0.000000	3.635
14	4.60	0.00	1.67	7.54	2.39	1.04	0.00	6.50	0.00	(0.87)	(0.54)	3.541	4.433	−0.055	4.379	0.000	0.000	0.000	−0.865	0.027	0.000000	3.541
15	4.62	0.00	1.57	7.85	2.50	0.98	0.00	6.75	0.00	(0.92)	(0.58)	3.463	4.383	−0.048	4.335	0.000	0.000	0.000	−0.896	0.024	0.000000	3.463
16	4.63	0.00	1.48	8.12	2.74	0.93	0.00	6.97	0.00	(0.94)	(0.59)	3.253	4.197	−0.041	4.156	0.000	0.000	0.000	−0.923	0.021	0.000000	3.253
17	4.62	0.00	1.39	8.36	2.72	0.87	0.00	7.15	0.00	(1.02)	(0.64)	3.248	4.211	−0.034	4.177	0.000	0.000	0.000	−0.946	0.017	0.000000	3.248
18	4.60	0.00	1.31	8.56	2.70	0.82	0.00	7.31	0.00	(1.10)	(0.69)	3.230	4.208	−0.026	4.182	0.000	0.000	0.000	−0.964	0.013	0.000000	3.230
19	4.56	0.00	1.23	8.73	2.68	0.77	0.00	7.43	0.00	(1.18)	(0.74)	3.193	4.182	−0.018	4.164	0.000	0.000	0.000	−0.979	0.009	0.000000	3.193
20	4.50	0.00	1.15	8.87	2.66	0.72	0.00	7.53	0.00	(1.26)	(0.78)	3.144	4.139	−0.009	4.129	0.000	0.000	0.000	−0.991	0.005	0.000000	3.144

REVISED TABLE 9 BASED ON APPENDIX II SOE FORMULAS

SOURCE OF EARNINGS ANALYSIS WHEN THE CONDITIONS UNDER TABLES 4–8 ARE ALL USED

Policy Year	Mortality Charge (MC)	Surrender Charge	Admin. Charge (C)	Earned Interest	Death Ben. Less AB Rel.	Admin. Expense (E)	First-Year Expense (FYE)	Credited Interest	Deferrable Expense	Amort. of Def. Exp.	Amort. of Unamort. FY Charge	GAAP Profit (Pf)	Expected GAAP Profit (1−A%) G	Expected GAAP Profit −(i−r)* BOY DAC	Expected GAAP Profit Total	VGM	VGW	VGE	VGI	Variation Fr. Int. on BOYDAC	Adj on DAC	Total Actual Profit
1	5.08	0.10	4.00	−0.50	0.95	2.50	16.50	0.07	16.00	(0.25)	(0.16)	4.561	4.681	−0.120	4.561	0.000	0.000	0.000	0.000	0.000	0.000000	4.561
2	4.71	1.03	3.60	1.07	1.17	2.25	0.00	0.85	0.00	(0.71)	(0.44)	5.883	6.001	−0.118	5.883	0.000	0.000	0.000	0.000	0.000	0.000000	5.883
3	4.31	1.63	3.23	1.88	1.48	2.02	0.00	1.51	0.00	(0.76)	(0.48)	5.757	6.004	−0.113	5.892	−0.134	0.000	0.000	0.000	0.000	0.000000	5.757
4	3.93	2.95	2.90	2.56	1.55	1.81	0.00	2.08	0.00	(0.50)	(0.31)	6.714	4.999	−0.107	4.892	−0.141	1.964	0.000	0.000	0.000	−0.000137	6.714
5	3.60	0.97	2.46	2.78	1.37	3.08	0.00	2.40	0.00	(0.59)	(0.37)	2.749	4.611	−0.092	4.519	0.000	0.000	−1.538	−0.154	0.000	−0.078047	2.749
6	3.68	0.99	2.33	3.11	1.49	2.91	0.00	3.28	0.00	(0.65)	(0.41)	2.180	4.649	−0.088	4.561	0.001	0.009	−1.457	−0.904	0.044	−0.072898	2.180
7	3.75	0.93	2.21	3.70	1.61	2.76	0.00	3.84	0.00	(0.69)	(0.43)	2.121	4.616	−0.084	4.532	0.000	0.016	−1.381	−1.016	0.042	−0.072155	2.121
8	3.82	0.79	2.09	4.27	1.67	2.61	0.00	4.37	0.00	(0.73)	(0.45)	2.045	4.565	−0.079	4.486	−0.001	0.020	−1.307	−1.120	0.040	−0.071142	2.045
9	3.87	0.59	1.98	4.80	1.67	2.47	0.00	4.87	0.00	(0.75)	(0.47)	1.942	4.487	−0.075	4.413	−0.004	0.019	−1.237	−1.217	0.037	−0.069723	1.942
10	3.93	0.32	1.87	5.31	1.70	2.34	0.00	5.35	0.00	(0.76)	(0.47)	1.760	4.331	−0.070	4.262	−0.006	0.013	−1.171	−1.305	0.035	−0.067151	1.760
11	3.97	0.00	1.77	5.89	1.76	1.11	0.00	5.79	0.00	(0.73)	(0.45)	2.688	4.081	−0.064	4.017	−0.010	0.000	0.000	−1.288	0.032	−0.063207	2.688
12	4.00	0.00	1.67	6.33	1.85	1.05	0.00	6.21	0.00	(0.78)	(0.49)	2.604	4.077	−0.060	4.018	−0.013	0.000	0.000	−1.368	0.030	−0.062861	2.604
13	4.03	0.00	1.58	6.74	1.99	0.99	0.00	6.60	0.00	(0.82)	(0.52)	2.473	4.018	−0.054	3.964	−0.017	0.000	0.000	−1.440	0.027	−0.061695	2.473
14	4.05	0.00	1.49	7.13	2.10	0.93	0.00	6.96	0.00	(0.87)	(0.54)	2.353	3.964	−0.049	3.915	−0.021	0.000	0.000	−1.505	0.024	−0.060578	2.353
15	4.05	0.00	1.41	7.49	2.18	0.88	0.00	7.30	0.00	(0.92)	(0.58)	2.249	3.919	−0.043	3.876	−0.025	0.000	0.000	−1.563	0.021	−0.059577	2.249
16	4.04	0.00	1.33	7.83	2.37	0.83	0.00	7.61	0.00	(0.94)	(0.59)	2.037	3.753	−0.037	3.716	−0.027	0.000	0.000	−1.614	0.018	−0.056792	2.037
17	4.00	0.00	1.25	8.13	2.33	0.78	0.00	7.88	0.00	(1.02)	(0.64)	2.001	3.765	−0.030	3.735	−0.035	0.000	0.000	−1.657	0.015	−0.056597	2.001
18	3.95	0.00	1.17	8.41	2.29	0.73	0.00	8.13	0.00	(1.10)	(0.69)	1.956	3.763	−0.024	3.739	−0.044	0.000	0.000	−1.694	0.012	−0.056157	1.956
19	3.87	0.00	1.10	8.67	2.25	0.69	0.00	8.37	0.00	(1.18)	(0.74)	1.896	3.739	−0.016	3.723	−0.055	0.000	0.000	−1.725	0.008	−0.055380	1.896
20	3.77	0.00	1.03	8.91	2.19	0.64	0.00	8.58	0.00	(1.26)	(0.78)	1.825	3.701	−0.008	3.692	−0.067	0.000	0.000	−1.750	0.004	−0.054353	1.825