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Revisiting FAS 97's Management Potential

by Steve Malerich

In the 1999 *Financial Reporting Section Monograph* article, "Unlocking FAS 97's Management Potential," Bruce R. Darling presented ways to understand and explain the effects of Statement of Financial Accounting Standard (FAS) 97.

Since 1999, we've seen the adoption of AICPA Statement of Position (SOP) 03-1, which altered the way earnings emerge under certain circumstances. We've also seen the enactment of Sarbanes-Oxley (SOX) control requirements and are seeing increased interest in sensitivities to variances in current experience and to possible changes in assumptions.

New Problems

SOP 03-1 complicates the analysis from what was presented in 1999. The formulas given then may be inadequate if a cohort requires accruing and amortizing costs against assessments. If we are to explain current results, we need to know the combined effects.

SOX also challenges the utility of the 1999 article. Darling's focus was on understanding FAS 97 effects after they happen. SOX requires testing of results against various controls to ensure that they are reasonable.

Management and shareholder interest in sensitivities can be satisfied by inserting hypothetical variances and assumption changes into our existing valuation, but at a cost. As we add sensitivities, the cost compounds.

There are also situations when updates to amortization rates are performed less frequently than financial reporting. In these situations, we estimate the effects of variances from expected experience. The better the estimation, the lower the earnings volatility we'll see from the less frequent true-up or unlocking.

A New Solution

It is possible to satisfy many of these needs and wants without running new models or inserting hypothetical variances into our valuation systems. Some situations may still require new models, but the results need not be inserted into the valuation system. To do this, we must capture sufficient information from our existing valuation. In this article, we'll see what's needed, how to measure the effects, what the measures mean and some examples.

We apply, here, the concepts presented by Mike A. Lesar in the 2004 *Financial Reporter* article, "Resolution of Circularity Issues in SOP 03-1." Tentative gross profits and tentative assessments exclude changes in the mortality and unearned revenue reserves, respectively. And, interest on these reserves is excluded from final gross profits and assessments.

In this article, we do not deal with constraints, such as a floor on the mortality reserve or a cap on the DAC asset. When breached, such constraints would alter results.

What's Needed

The following values are already calculated in the valuation of FAS 97 assets and liabilities. For this article, I've treated any deferrable sales inducements as a part of deferred acquisition costs. This does not impair our ability to calculate the net effect of an assumption change or a variance. All of these are measured before any current variance or change in assumption:

${}^{e}k$ = the expense amortization rate

${}^{r}k$ = the revenue amortization rate

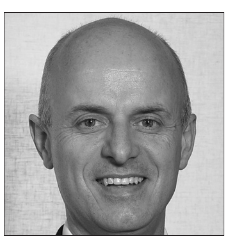
b = the mortality benefit accrual rate
(the benefit ratio)

DAC = deferred acquisition cost asset

URR = unearned revenue reserve

MR = mortality reserve

The following amounts are easily calculated from the existing valuation, again before any current variance or assumption change.



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A( ) = accumulated value, at the valuation date, accrued at the valuation interest rate:

A(GP) = accumulated value of actual *tentative* gross profits

A(TA) = accumulated value of actual *tentative* assessments

A(DE) = accumulated value of actual deferred expenses

A(DR) = accumulated value of actual deferred revenue

A(CM) = accumulated value of actual deferred mortality costs

P( ) = present value, at the valuation date, discounted at the valuation interest rate:

P(GP) = present value of expected *tentative* gross profits

P(TA) = present value of expected *tentative* assessments

P(DE) = present value of expected deferrable expenses

P(DR) = present value of expected deferrable revenue

P(CM) = present value of expected deferrable mortality costs

k = the net amortization rate (the net k-factor) = ${}^{e}k - {}^{r}k$

F( ) = future proportion of gross profits and assessments:

$$F(GP) = \frac{P(GP) + MR}{A(GP) + P(GP)}$$

$$F(TA) = \frac{P(TA) + URR}{A(TA) + P(TA)}$$

H( ) = historic proportion of gross profits and assessments:

$$H(GP) = \frac{A(GP) - MR}{A(GP) + P(GP)} = 1 - F(GP)$$

$$H(TA) = \frac{A(TA) - URR}{A(TA) + P(TA)} = 1 - F(TA)$$

Calculating Marginal Effects

From the above values, we can calculate the marginal effects of a current variance and of a change in present value. We define these as:

m = marginal effect of a current variance on *net amortization*

p = marginal effect of a present value change on the *net intangible asset*

Note the different focus—m on income and p on the balance sheet. Other than the convenience of making both positive, this is consistent with a common focus on income during a regular reporting period and on the balance sheet during unlocking.

If there is a mortality reserve, the marginal effects depend on the type of variance or assumption change. Three possible situations are changes in deferrable mortality costs, in other costs and in tentative assessments. Since current variances can also affect what's left in force, it also helps to look at a proportionate change in all present values.

For a change in deferrable mortality costs:

(1)
$${}^{1}m = \frac{F(GP) \times (k + {}^{r}k \times b) + F(TA) \times (1 - k)}{1 + {}^{r}k \times b}$$

(2)
$${}^{1}p = \frac{H(GP) \times (k + {}^{r}k \times b) + H(TA) \times (1 - k)}{1 + {}^{r}k \times b}$$

For a change in other costs:

(3)
$${}^{2}m = \frac{F(GP) \times (k + {}^{r}k \times b)}{1 + {}^{r}k \times b}$$

(4)
$${}^{2}p = \frac{H(GP) \times (k + {}^{r}k \times b)}{1 + {}^{r}k \times b}$$

continued on page 30 >>

For a change in tentative assessments:

(5)

$$^{3}m = \frac{F(GP)\times\left(k+{}^{r}k\times b\right)+F(TA)\times b\times(1-k)}{1+{}^{r}k\times b}$$

(6)

$$^{3}p = \frac{H(GP)\times\left(k+{}^{r}k\times b\right)+H(TA)\times b\times(1-k)}{1+{}^{r}k\times b}$$

For a change affecting everything proportionately:

(7)

$$^{4}p = \frac{\begin{gathered}H(GP)\times(DAC-URR-k\times MR)\\ +H(GP)\times b\times\left\{{}^{r}k\times\left[P(GP)-P(DE)\right]-P(DR)\times\left(1-{}^{e}k\right)\right\}\\ -H(TA)\times(1-k)\times(MR+b\times URR)\end{gathered}}{P(GP)\times\left(1+{}^{r}k\times b\right)}$$

If there is no deferrable revenue, the same formulas apply, but deferrable revenue and the revenue amortization rate are both zero. Substituting into formula (7), for example, leaves:

$$^{4}p = \frac{H(GP)\times(DAC-k\times MR)-H(TA)\times(1-k)\times MR}{P(GP)}$$

The same formulas also apply if mortality costs are not deferrable. Here, the first situation doesn't exist. Deferrable mortality is zero by definition, so there can be no variance or change in deferrable mortality costs. Putting a benefit ratio of zero into formula (5), for example, leaves:

$$^{3}m = F(GP)\times k$$

Understanding the Results

Even a glance at the marginal rates shows a clear symmetry between m and p. For each type of change, the formulas are identical except that m is a function of future ratios F(GP) and F(TA), and p is a function of historic ratios H(GP) and H(TA). This symmetry is more than just a nice coincidence.

If we add m and p, we get formulas that are independent of time:

$$^{1}m+{}^{1}p = 1$$

$$^{2}m+{}^{2}p = \frac{k+{}^{r}k\times b}{1+{}^{r}k\times b}$$

$$^{3}m+{}^{3}p = \frac{k+{}^{r}k\times b+b\times(1-k)}{1+{}^{r}k\times b}$$

Each is an average net amortization rate, including the mortality reserve and applicable to the three different components of tentative gross profits: 1) deferrable mortality; 2) other costs; and 3) tentative assessments.

In practice, we may want to express amortization in two pieces. The first piece, average amortization against actual gross profits, might already be built into routine reporting processes. The second piece is a true-up associated with any variance from expected gross profits. Even before revised amortization rates are known, the true-up can be estimated as the product of the variances and the difference between average and marginal rates. Given the symmetry, we know that difference is equal to p.

Now let's look at the average amortization rates to see what else they tell us.

In retrospect, $^{1}m + {}^{1}p = 1$ seems obvious. It tells us that deferrable mortality costs have no effect on current earnings as long as they remain as expected.

The average amortization rate for other costs is equal to or a little greater than the net k-factor. How much greater depends on the significance of deferrable revenue. This, too, is intuitive. We know that other costs affect the mortality reserve only as a residual of their effect on unearned revenue.

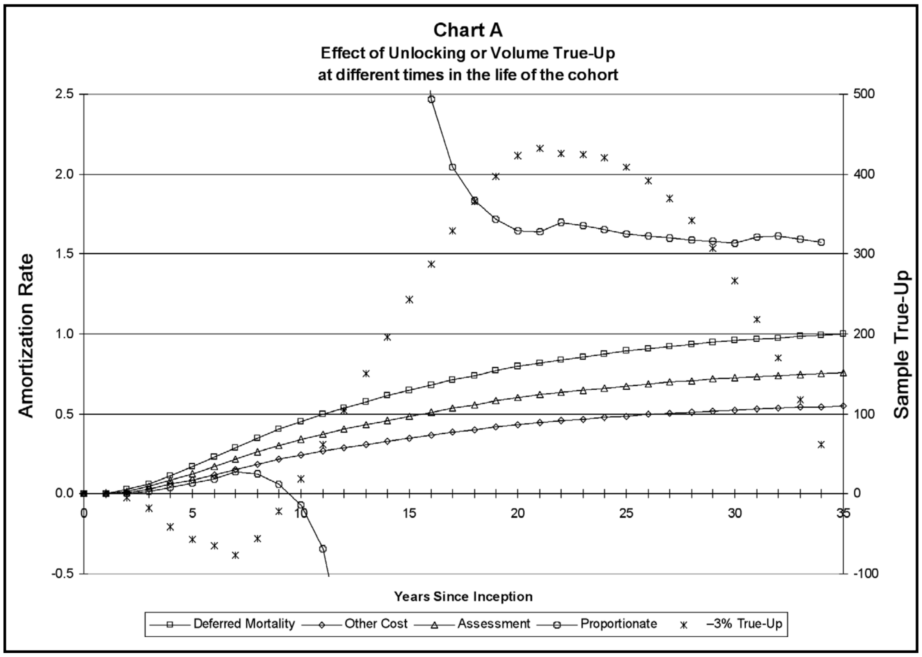
Average amortization for assessments is more complex, but still understandable. Their effect on DAC and unearned revenue is muted by their effect on the mortality reserve, but their total effect is greater because it includes the mortality reserve.

Next, a look at the two pieces, m and p, helps us to understand how time alters the effect of variances and assumption changes. Early in the life of a cohort, a variance in deferrable mortality cost has almost no effect on current earnings. The variance is almost entirely offset by a change in the benefit reserve. Offsets to other cost and assessment variances are also most significant early in the life of a cohort. The effect is lowest for an other cost variance, where most of the effect is in amortization, with a small effect on the mortality reserve. The offset for an assessment variance lies in between—it has a significant effect on the mortality reserve, but not dollar-for-dollar. As time passes, history grows and the offset to a variance declines until, late in the life of the cohort, there is little offset to a current variance.

Similarly, assumption changes have little effect on earnings early in the life of a cohort. As time passes, a growing share of the change in expected gross profits passes through into current earnings. For a change in a deferrable mortality assumption, the earnings effect eventually approaches 100 percent of the present value change. The effect of a change in other costs approaches something a little greater than the net k-factor times the present value change. And, the effect of a change in assessments approaches something a little greater than the present value change times the sum of the net k-factor and the portion of the benefit ratio not offset by amortization.

Finally, a proportionate change in all expected values does not lend to such a simple understanding as the other changes. However, we can observe that this marginal effect, in contrast to the others, is dampened by the mortality reserve, not magnified. For example, a lower than expected volume would mean a write-off of DAC because expected gross profits are now lower. The same condition would also result in a lower present value of future mortality losses. In effect, the reduction in volume creates a redundancy in the reserve, which is released at the same time as the DAC write-off.

Chart A shows the progression of marginal rates 1p to 4p over the life of a sample cohort. For mortality, other costs and assessments, we can see the smooth progression from zero to the average net amortization rates. The proportionate change needs a little more thought.



In this example, the marginal rate for a proportionate change starts positive but smaller than the other rates. It declines after seven years, falling below zero when the marginal effect on MR exceeds the net effect on DAC and URR. For the sample cohort, expected negative margins on mortality eventually lead to negative tentative gross profits. As the present value of tentative gross profits approaches zero, the marginal effect approaches negative infinity. Once the present value turns negative, the marginal effect changes sign, jumping to positive infinity but then rapidly declines as the present value moves further into the negative range.

The net effect of this discontinuity is not as confusing as we might guess from the infinities. Again looking at Chart A, we can see that the dollar value of a hypothetical true-up forms a smooth curve through the life of the cohort.

Improving the Estimate

Although these are all precise marginal effects, they become approximations in any practical application. Four key reasons are: (1) variances do not occur precisely on a valuation date; (2) the effects are not linear; (3) variances and assumption changes have secondary effects; and (4) multiple variances and assumption changes occur simultaneously.

continued on page 32 >>

In contrast, the effect of a lapse variance on expected gross profits may be as significant as its effect on current gross profits.

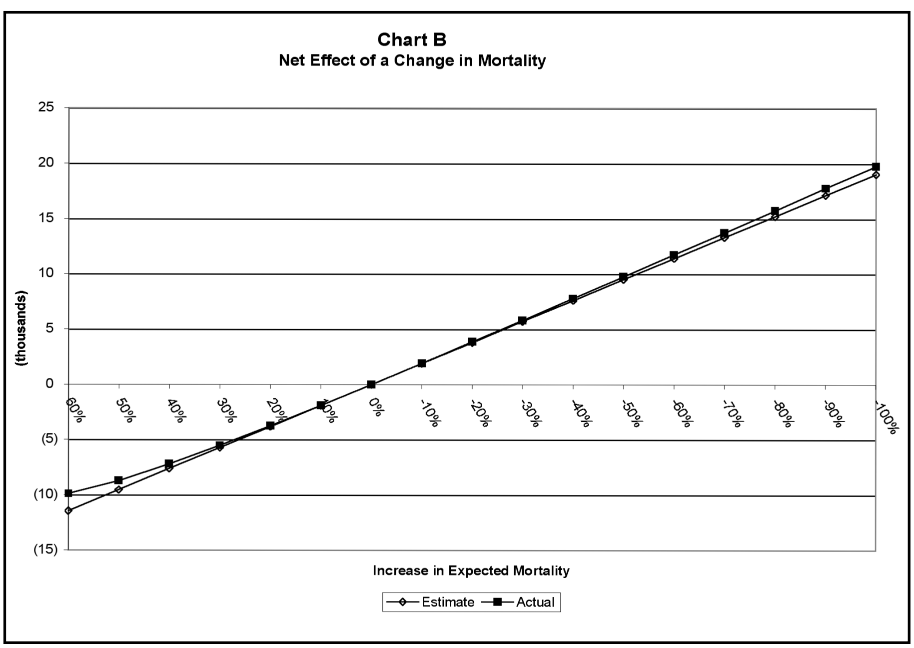
Timing
Addressing the first difference is simple; we already know how to account for time. For example, if my valuation assumes simple interest for fractional periods and that gross profits occur mid-quarter, my adjustment for a current quarter variance is to multiply by:

$1+\frac{1}{8}\times$valuation interest rate

Nonlinearity
If we think of net effects as a function of the change in tentative gross profits, we can envision a curve with the gross profits change on the X-axis and the net effect on the Y-axis. Formulas (1) through (7) all represent the exact slope of the curve at the point where X equals zero.

Using these formulas, the net effect is approximated by the product of the factor and the change in gross profits. The difference between this and the actual effect is the difference between the tangent of the curve and the curve itself. For most effects, this will be a suitable approximation.

Chart B compares the approximate formula with the exact formula over a range of possible changes in the mortality assumption of our sample cohort, at a particular point in time.



The range in this chart is broad—from 60 percent increase in mortality to 100 percent decrease. These are extremes for this cohort. A little past 60 percent increase, the cohort would go into loss recognition. Anything greater than 100 percent decrease would imply negative mortality rates. As you can see here, the gap between the two curves is hardly noticeable until we approach the extremes. Even at the extremes, it remains small.

When greater precision is needed, refer to the appendix for the more complex formulas that account for this effect. For example, if SOX controls are based on marginal rates, a large variance or assumption change might trigger an exception to the control. The exact formulas can be used to determine if the observed effect is appropriate for this extreme event.

Secondary Effects
Secondary effects can usually be identified as significant or insignificant without any mathematical analysis.

For example, a mortality variance will have an effect on expected gross profits. That effect, however, should be very small compared to the variance itself and can normally be ignored without concern.

In contrast, the effect of a lapse variance on expected gross profits may be as significant as its effect on current gross profits.

When a secondary effect cannot be ignored, it may be practical to estimate its effect on gross profits and apply the appropriate marginal rate.

Whether secondary effects are ignored or approximated, they will cause these calculations to result in approximations, even if exact adjustments are made for timing and nonlinearity.

Simultaneous Events
Simultaneous events do not introduce any new error into the calculations. They do present the problem, however, of attributing a total effect to each of the separate events.

The traditional approach to handling simultaneous assumption changes is to make one change at a time and revalue the asset after each change. The same approach can be used here, except that each step changes the most recent valuation. Recalculating marginal rates after each step would add significantly to this effort.

A problem with the traditional approach is that the effect of each change depends on the order the changes are made. With these formulas, that can be avoided at the same time we simplify the effort. To do this, we apply the formulas using the results from the most recent valuation preceding the assumption changes.

When considering multiple variances in actual experience, it is not possible to determine the order in which they occurred. With this technique, that is not necessary. As with multiple assumption changes, these formulas can be applied independently to each variance.

In both situations, there will be an unexplained residual difference, but it will normally be small enough for crude allocation.

Examples

These examples are from a flexible premium universal life contract. It has front end loads and is expected to have positive mortality margins followed by negative mortality margins. In each case, I assume the changes occur exactly on the valuation date.

The following amounts are taken from the most recent valuation:

${}^{e}k = 1.015$

${}^{r}k = 0.587$

$b = 0.461$

DAC = 28,596

URR = 6,013

MR = 12,365

A(GP) = 23,721

A(TA) = 56,657

A(DE) = 40,120

A(DR) = 12,676

A(CM) = 11,004

P(GP) = 19,029

P(TA) = 115,346

P(DE) = 3,265

P(DR) = 12,406

P(CM) = 68,366

From these, we can calculate:

$k = 1.015 – 0.587 = 0.428$

F(GP) = [19,029+12,365]÷[23,721+19,029] = 0.734

F(TA) = [115,346+6,013]÷[56,657+115,346] = 0.706

H(GP) = 1–0.734 = 0.266

H(TA) = 1–0.706 = 0.294

Asset Default Variance

Asset default is an assessment. It has no direct effect on any other component of gross profits or on future gross profits. Any residual effect from replacing the asset with something that yields a different rate of return is assumed to be insignificant.

We'll estimate the offset to an additional $100 of asset default over the expected level.

This is a –100 variance in the current assessment. The marginal effect of a current assessment variance is:

$${}^{3}m = [0.734\times(0.428+0.587\times0.461)+0.706\times 0.461\times(1-0.428)]\div(1+0.587\times0.461) = 0.550$$

Current amortization on a –100 default variance is then –100×0.550 = –55. Subtracting this from the –100 variance, we see a net effect on earnings of –45.

continued on page 34 >>

To estimate the first effect, we start with the expected surrender gain in the next year.

Mortality Assumption Change

We want to test the sensitivity of our valuation to a change in the mortality assumption. This would be a change in the expected deferrable cost of mortality. Such a change would affect the projection of insurance in force and, consequently, expected gross profits in general. That effect, however, is assumed to be insignificant compared to the direct effect on mortality costs.

We'll estimate the current effect of a 10 percent increase in the assumed mortality rates.

We've already captured the present value of the expected cost of mortality, P(CM) = 68,366. A 10 percent increase would be a –6,837 change in the present value of gross profits. The marginal effect of a change in the mortality assumption is:

$$^{1}p = [0.266\times(0.428+0.587\times0.461)+0.294\times(1-0.428)]\div(1+0.587\times0.461) = 0.279$$

The net effect of a 10 percent increase in the mortality assumption is then –6,837×0.279 = –1,905.

Lapse Variance

A current lapse variance has two significant effects: (1) an immediate variance in the surrender gain; and (2) a change in the amount of business remaining in force. For this test, we assume a one-year, 50 percent shock to lapse rates.

Current Variance

To estimate the first effect, we start with the expected surrender gain in the next year. Returning to my most recent valuation, I see an expected surrender gain of 1,370. A 50 percent increase would then be 685 of assessment variance. The marginal effect of a current assessment variance is, again:

$$^{3}m = [0.734\times(0.428+0.587\times0.461)+0.706\times0.461\times(1-0.428)]\div(1+0.587\times0.461) = 0.550$$

The current offset to a 50 percent shock lapse is then 685×0.550 = 377.

Present Value Effect

Returning to my existing valuation, I estimate that this shock would reduce the amount of business remaining in force by 3 percent. I assume that all components of expected gross profits are reduced proportionately. With the present value of expected tentative gross profits at 19,029, this would be a –571 change in expected gross profits.

The marginal effect of such a change is:

$$^{4}p = \{0.266\times(28{,}596-6{,}013-0.428\times12{,}365)+0.266\times0.461\times[0.587\times(19{,}029-3{,}265)-12{,}406\times(1-1.015)]-0.294\times(1-0.428)\times(12{,}365+0.461\times6{,}013)\}\div[19{,}029\times(1+0.587\times0.461)] = 0.132$$

The net secondary effect of the shock lapse is then –571×0.132 = –76.

Altogether, the shock lapse results in an immediate gain of 685, an immediate amortization of 377 and a present value adjustment of –76, for a net gain of 232.

Expense Assumption Change

We also want to test the sensitivity of our valuation to a change in the maintenance expense assumption. This would be a change in expected other costs.

We'll estimate the current effect of a 5 percent increase in the maintenance expense assumption.

We return again to our current valuation, to find the present value of a 5 percent increase in expected maintenance expenses equal to –518. The marginal effect of a change in an other cost assumption is:

$$^{2}p = 0.266\times(0.428+0.587\times0.461)\div(1+0.587\times0.461) = 0.146$$

The net effect of a 5 percent maintenance expense assumption change is then –518×0.146 = –76.

Variance Analysis

Our final example looks at variances in current income and their effect on amortization. The table, to the right, shows only those components that affect gross profits. Other variances would not affect amortization.

	Earnings Variance	Marginal Factor		Amort-ization	Net Variance
Mortality charges	–189	^{3}m	0.550	–104	–85
Surrender charges	–100	^{3}m	0.550	–55	–45
Policy charges	–198	^{3}m	0.550	–109	–89
Gross investment income	168	^{3}m	0.550	93	76
Revenues	**–319**			**–175**	**–143**
Interest credited	12	^{3}m	0.550	7	5
Assessments	**–331**			**–182**	**–149**
Death benefits	27	^{1}m	0.721	20	8
Commissions not deferred	56	^{2}m	0.404	23	34
Expenses not deferred	–6	^{2}m	0.404	–2	–4
Premium taxes	–0	^{2}m	0.404	–0	–0
Gross profit	**–408**			**–222**	**–186**
Volume in force	+0.9%				
ΔGP = 167		^{4}p	0.132	–22	22
Total	**–408**			**–244**	**–164**

Appendix—Adjusting for Nonlinearity

Where greater precision is needed or desired, our formulas can reflect nonlinearity. To precisely measure the effects of simultaneous changes, we would have to apply these formulas step-by-step, adjusting A( ) and P( ) after each step, as is often done in unlocking of multiple assumptions. But even here, such a precise application should not be necessary for most events.

To simplify these formulas, it helps to define a new function, Y( ), which is the ratio of a new total amount to the previous total amount, Y( ) = [A( ) + P( ) + Δ] ÷ [A( ) + P( )] = 1 + Δ ÷ [A( ) + P( )], where Δ is the change in a total amount—either a current variance from expected or a change in the present value. For example:

$$Y(TA) = 1 + \frac{\Delta TA}{A(TA) + P(TA)}$$

Then:

(1E)

$${}^{1}m = \frac{F(GP) \times \left[k + {}^{r}k \times b \times Y(CM)\right] + F(TA) \times \left[Y(GP) - k\right]}{Y(GP) + {}^{r}k \times b \times Y(CM)}$$

(2E)

$${}^{1}p = \frac{H(GP) \times \left[k + {}^{r}k \times b \times Y(CM)\right] + H(TA) \times \left[Y(GP) - k\right]}{Y(GP) + {}^{r}k \times b \times Y(CM)}$$

(3E)

$${}^{2}m = \frac{F(GP) \times \left(k + {}^{r}k \times b\right)}{Y(GP) + {}^{r}k \times b}$$

continued on page 36 >>

(4E)

$$ {}^{2}p = \frac{H(GP) \times \left(k + {}^{r}k \times b\right)}{Y(GP) + {}^{r}k \times b} $$

(5E)

$$ {}^{3}m = \frac{F(GP) \times \left[k \times Y(TA) + {}^{r}k \times b\right] + F(TA) \times b \times \left[Y(GP) - k\right]}{Y(GP) \times Y(TA) + {}^{r}k \times b} $$

(6E)

$$ {}^{3}p = \frac{H(GP) \times \left[k \times Y(TA) + {}^{r}k \times b\right] + H(TA) \times b \times \left[Y(GP) - k\right]}{Y(GP) \times Y(TA) + {}^{r}k \times b} $$

(7E)

$$ {}^{4}p = \frac{\begin{array}{l} H(GP) \times Y(TA) \times \left(DAC - URR - k \times MR\right) \\ + H(GP) \times b \times Y(CM) \times \left\{ {}^{r}k \times \left[P(GP) - P(DE)\right] - P(DR) \times \left(1 - {}^{e}k\right) \right\} \\ - H(TA) \times \left[Y(GP) - {}^{e}k \times Y(DE) + {}^{r}k \times Y(DR)\right] \times \left(MR + b \times URR\right) \end{array}}{P(GP) \times \left[Y(GP) \times Y(TA) + {}^{r}k \times Y(DR) \times b \times Y(CM)\right]} $$