ACTUARIAL RESEARCH CLEARING HOUSE
1988 VOL. 3

Required Surplus with Emphasis on the C-2 Risk

by

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CUNA Mutual, a multi-line life, health and casualty insurance group, made a decision to study surplus with the following goals in mind:

1. Determine surplus available for financing additional business, including new ventures (i.e. Strategic Surplus). This would be the complement of that surplus earmarked to cover plausible losses from existing and currently planned new business (i.e. Required Surplus). Financing of additional business generally involves both actual expenditures and additions to Required Surplus, both diminishing that surplus available for further growth.

2. Facilitate measurement of financial performance by line of business consistent with reasonable corporate goals. Since company surplus consists of that put at risk (Required Surplus) and that not put at risk (Strategic Surplus), a reasonable corporate goal, consistent with the viewpoint of a stockholder, would be a risk-adjusted return on Required Surplus plus a normal investment income on Strategic Surplus. This is easily translated into an equitable financial performance standard for each line of business, this being such risk-adjusted return on the line's Required Surplus (in addition to such risk-adjusted return on any surplus actually expended) with credit given for investment income on such Required Surplus. Thereby, we are left with investment income on Strategic Surplus unassigned to any line. If each line exactly meets the standard, the company will exactly meet its corporate goal.

3. Provide a mechanism for evaluating alternative strategies based on their estimated marginal effect on the company's ability to meet the above corporate goal. Alternatives, including more speculative investment policies, should be analyzed as to effect, both on expected future profit and on Required Surplus. Any additions to Required Surplus should at least be offset by additional expected profit equal to (additional Required Surplus) × (risk adjusted rate of return - normal investment income rate).

An assumption we made at the beginning was that we would not pull out of any line of business regardless of circumstances.

We were able to confine our study largely to the C-2 risk. Our relatively small block of permanent life insurance was evaluated, for all risks other than AIDS, by using the estimated surplus required to maintain a favorable A.M. Best rating. The C-3 risk on our pension business was reduced considerably by market value adjustments applicable to employer lapses, and the small remaining risk was estimated subjectively. It was clear that all but a small percentage of our Required Surplus would relate to term coverages, including credit insurance, property and casualty, group life and health and individual life, and that the central issue would be C-2 risk, including the critical element of the AIDS risk.

We studied the risk of premium inadequacy in two parts, first without considering AIDS, then integrating the AIDS risk into these preliminary results. The disjointed nature of the two parts resulted from working with a model for the first part which had been designed without appreciating the extent of the AIDS risk, and then doing the AIDS adjustments when time constraints weighed against an entire restructuring of the earlier model. The highly subjective nature of the pessimistic AIDS scenario figures was also a justification for dispensing with a more exact integrated model.

Non-AIDS Model

The non-AIDS model, described in detail in the companion paper, "A Risk-Theory Model for Analyzing Surplus," studied the progression of surplus year-by-year as a stochastic process. The process was studied for only 5 years into the future, as indications were that extension beyond that would not significantly alter results. Each of the 13 lines of business subject to C-2 risk was first considered separately. The basic equation used was

$$S_j = S_{j-1} + (1 - F_j)\left[P_j \cdot (1 - Y_j - Z_j) + (S_{j-1} + P_j \cdot Q_j) \cdot X_j\right] ,$$

where

S_j = Surplus at the end of the year j,

F_j = Federal Income Tax Rate for year j,

P_j = Earned Premium for year j,

Y_j = Expense Ratio for year j,

Z_j = Loss Ratio for year j treating Dividends as Incurred Claims,

Q_j = Mean Reserves for year j as percent of Earned Premium, and

X_j = Net Investment Income Rate during year j.

The F_j's and Q_j's were treated as constants, all S_j's were derived from S_0, and all the others were considered random variables. The line of business actuaries gave, as input, the expected values and the variances for all random variables, other than the S_j's, for each of the five years.

It was assumed that (1) for any given year j, P_j, X_j, Y_j and Z_j are mutually independent and (2) the distribution of S_j is normally distributed. The line actuaries also supplied us with correlation coefficients for gain (i.e. change in surplus) among the different years.

As detailed in the companion paper, this led us to the density function for S_j in terms of the above constants and variables, thus allowing us, for any S_0, to estimate the probability of survival in any year.

By iteration the appropriate S_0 was determined so that the probability of ruin ($S_j < 0$ for some $j \le 5$) is that probability desired. Thus was calculated each line's stand-alone surplus for p = .01, p = .1 and p = .5.

Since losses in different lines of business are not perfectly correlated, it is not necessary to earmark, for the company, the total of the stand-alone Required Surplus for the various lines. The Required Surplus for the company as a whole was calculated by running the model on the aggregate, with the expected value of the aggregate gain equal to the sum of the lines of business, and with the variance taking into account the assumed correlations among the lines of business.

Realizing our model had an implicit assumption of unlimited tax loss carry backs, we then estimated the effect of being limited in tax loss carry backs, in case of large losses, as follows:

Let C = estimated profits in the three years before large losses occur. We used our average historical profits for 3 years.

F = average Federal Income Tax Rate assumed.

We adjusted aggregate Required Surplus (S) to $[S \div (1 - F)] - C \cdot F$.

We then allocated the aggregate Required Surplus to lines of business in proportion to each line's stand-alone Required Surplus, the philosophy being that each line should share proportionately in the benefit of the lines being combined by having its stand-alone Required Surplus reduced by a common percentage.

Adjustment For AIDS

We constructed three deterministic AIDS scenarios: a 50 percentile, a 90 percentile and a 99 percentile. For example, the 99 percentile scenario is such that there is an estimated 1% probability that the impact of AIDS will be at least that great. Each of these had to extend well beyond five years, as the biggest impact from AIDS is almost certain to occur farther into the future.

The 50 percentile scenario was based on the Cowell-Hoskins paper adjusted up 20% to account for some spread into the heterosexual population. Dr. Robert Redfield's remarks at the Montreal Society of Actuaries meeting in October, 1987, relating statistics on HIV^+ prevalence among heterosexual partners of infected individuals, came after the Cowell-Hoskins paper and caused this adjustment thereto for our purposes.

Calling people at CDC, the New York City Health Department, Los Alamos Lab and larger insurance companies, as well as various academics and members of the Society Task Force on AIDS, we found ourselves frustrated in our attempt to elicit expert or informed opinion on what characteristics a 90 or 99 percentile scenario might have. Expert sources to which pessimistic scenarios were attributed in trade literature were either impossible to locate or denied having such an opinion. People heavily involved in studying AIDS refused to conjecture about a 90 or 99 percentile scenario often saying it was difficult enough to construct a best estimate. One major consulting firm had constructed a pessimistic scenario of AIDS infections, which we obtained. Conversations with several individuals within the firm and a recognized expert in academia resulted in general agreement that this could reasonably be assigned a 1% probability.

We altered the figures from the consulting firm by (1) grading a multiple of Cowell-Hoskins infections into those indicated, (2) using Cowell-Hoskins mortality after infection with between a one- and two-year setback (studies have indicated possible periods after infection before antibodies show up and possible lengthening of the lag between infection and AIDS) and (3) linking to current mortality equal to CDC figures adjusted up by 30% for underreporting of AIDS deaths. Recent studies indicating a 30-fold increase in suicides for HIV^+ individuals bring to mind questions as to what the total mortality effect of HIV will be. Might not reckless behavior, including taking physical risks, abusing of drugs and ignoring of good health habits be a likely response of some individuals to such a bleak outlook for the future? It may be impossible to truly identify all "AIDS deaths."

The 99 percentile scenario thus obtained was recognized as highly approximate. The 90 percentile scenario was estimated as a year-by-year interpolation between the 50 percentile and 99 percentile scenarios as follows:

Let C_{50} = claims for a given year for the 50 percentile scenario;
C_{99} = claims for a given year for the 99 percentile scenario;
C_{90} = claims for a given year for the 90 percentile scenario.

Then using a variation of geometric interpolation between a 50% and 1% probability, we assumed that

$$C_{90} = C_{99} \cdot \left(\frac{C_{50}}{C_{99}} \right)^{\log_{50} 10} .$$

Figures in the Cowell-Hoskins paper were used to translate population figures into percent of insured population by age-sex cell as follows:

1. The chart on Page 21 of "AIDS and Life Insurance" indicates percent of male insureds by age infected 1/1/87, which we related to the middle scenario on Page 28 HIV infected at year-end 1986.

2. All population death figures in the scenarios were initially assumed to have a similar ratio into percent's of male insureds by age as infecteds had in No. 1.

3. A percent male and percent female was estimated for each scenario and these were multiplied by the percent's in #2 to give percent of male

and percent of female face amounts resulting in AIDS death claims each year by age category[1].

Line of business actuaries were then consulted as to whether underwriting, marketing and/or geographical considerations warranted adjustment for particular lines of business. We also looked at currently identified AIDS claims by line of business as compared to those predicted by the model. This was given limited weight, however, due to (1) underreporting possibilities, (2) possible acceleration in anti-selection effects, (3) current claims representing, figuratively speaking, only the "tip of the iceberg".

For disability coverages we assumed a 12-month period of total disability just prior to death. For medical coverages we adjusted estimates by the Health Care Financing Administration, of percent of health care costs currently spent on AIDS, in proportion to assumed increases in AIDS deaths.

The resulting projections of AIDS claims by year into the future for each of the 50 percentile, 90 percentile and 99 percentile scenarios were then studied with the line actuaries in order to estimate the mitigating effects of pricing responses. Some examples are:

(1) For credit coverages regulatory constraints cause us to price for a given year based on the prior 3 years of experience. Therefore, we assumed, on average, a 2-year lag between those claims we priced for and those claims we experience.

(2) For group medical coverages we examined the projected effect on annual trend and estimated the extent to which our pricing would keep pace.

(3) By examining the scenarios year-by-year the individual life actuary predicted the time progression of his realization of the extent of the epidemic. This was stated in terms of what percent of the excess over the 50-percentile scenario he would be pricing new business for, given what would have already unfolded to date. In addition, our renewal

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[1] It was recognized that in reality the percent female would increase over time but using an assumed average percent for all years was deemed adequate, given the approximate nature of other assumptions relative to the potential effect.

pricing capability on most of this business was assumed to absorb a proportion of the remaining shortfall in pricing[2].

Finally, the integration of the AIDS scenario with the non-AIDS Required Surplus proceeded as follows.

For a given line of business let

F = average Federal Income Tax Rate assumed (as before),

$S'_{.01}$ = Non-AIDS stand-alone Required Surplus for p = .01 ,

$S^{NA}_{.01} = S'_{.01} + (1-F)$,

$S^{A'}_{.01}$ = present value at 6% of AIDS claims from the 99 percentile scenario,

and let $S^{NA}_{.1}$, $S^{NA}_{.5}$, $S^{A'}_{.1}$, $S^{A'}_{.5}$ be similarly defined.

Then Required Surplus (p = .01) was taken to be

$$\text{Max}\{ S^{A}_{.01} + S^{NA}_{.5},\ S^{A}_{.5} + S^{NA}_{.01} \} ,$$

and Required Surplus (p = .1) was taken to be

$$\text{Max}\{ S^{A}_{.1} + S^{NA}_{.5},\ S^{A}_{.5} + S^{NA}_{.1} \} .$$

where $\left.\begin{array}{l} S^{A}_{.01} = S^{A'}_{.01} \\ S^{A}_{.1} = S^{A'}_{.1} \\ S^{A}_{.5} = S^{A'}_{.5} \end{array}\right\}$ adjusted in the following way:

(a) When being added to $S^{NA}_{.5}$ all losses beyond year 5 are offset year-by-year by projected average pre-FIT profits.

(b) When added to $S^{NA}_{.01}$ no profit offset is used.

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[2] On individual business the question of differential lapses is an important one. We assumed no lapses starting two years after infection.

(c) When added to $S^{NA}_{.1}$ profit offset is based on judgement (fortunately, the effect was relatively small on the only line for which it was potentially applicable).

The rationale here was that if we were (1) covering the unlikely AIDS scenario plus expected non-AIDS required surplus, and also (2) covering the unlikely non-AIDS scenario plus expected AIDS claims, our surplus would be adequate.

The same procedure was followed for the business in aggregate after which C•F, as earlier defined, was subtracted from the result to give aggregate Required Surplus, $p = .01$ and $p = .1$. This was then allocated to lines of business in proportion to stand-alone surplus. An interesting result was that Property and Casualty lines, for which no AIDS claims were assumed, came out with significantly more Required Surplus after the AIDS adjustments, because of the lesser proportional benefit from combining lines when a large, perfectly-correlated risk is included. The seeming inequity of this is merely a consequence of the fact that a line's Required Surplus is affected by the other lines with which it is aggregated.

Results and Future Enhancements

The end product was, by necessity, only an approximation due to (1) the highly subjective nature of the assumptions, especially for AIDS, and (2) the limited mathematical rigor in our combination of AIDS and non-AIDS (which was justified by the imprecision of the assumptions). In spite of this, we managed to get the attention of top management by demonstrating that (1) the level of safety we can achieve is materially less now than in the pre-AIDS environment, and (2) such limited level of safety justifies top management participation in exploring the effect on Required Surplus of assuming that lines of business might be abandoned in more drastic AIDS scenarios.

We are planning, in the near future, to model in decisions to pull out of lines of business as follows. Taking the appropriate executive through a year-by-year simulation of financial results, including separate identification of AIDS claims (without revealing any then future results), the executive identifies that point in time at which he/she would decide to pull out of a line of business. We then model (1) the rate at which business can be cancelled and the further losses prior thereto, (2) shutdown expenses for the line, (3) fixed overhead allocated to the line in terms of if and when it could be reduced and (4) effect of conversion privileges.

Other enhancements will become increasingly relevant as the course of the AIDS epidemic becomes more predictable, especially relative to the spread through heterosexual activity. The Non-AIDS model will be extended beyond 5 years and the AIDS scenarios translated into a probability curve of scenarios so that the joint effect of the two can be directly studied. The correlation among years for the AIDS component will be assumed to be 100%, that is, each point on the density function will correspond to a multi-year scenario. Any advantage of year-by-year variations would depend on a level of accuracy unlikely to be achievable until the epidemic and its effects are winding down many years into the future.

Greater attention will be paid to differentiating among issue years for individual life with regard to likely anti-selection and testing effects. In a company with more emphasis on this line, this "enhancement" would have been a first iteration basic step.

The Non-AIDS model will also be changed to reflect the fact that the most likely reason for fluctuations in our expense ratios is fluctuation in premium volume. This will be accomplished by looking at expenses as fixed expense plus a variable percentage multiplied by premium volume. Yet to be decided is whether these will be random variables or constants.

Finally, the cash flow projection work necessitated by New York Regulation 126 will yield, as a side benefit, our ability to measure the C-3 risk component of Required Surplus, in accordance with the joint opinion of the Valuation Actuary and Chief Investment Officer, and consistently among lines of business. While a less critical factor for our company than for others, resolving this will add to our comfort with the results.