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## How Much Life Insurance Do You Need?

***by Glenn S. Daily***

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**Case Study: The Blue Family**

Husband: Gene, age 38. Works full-time. Earns $70,000 a year.
Wife: Jean, age 37. Works part-time. Earns $30,000 a year.
Son: Pat, age 5
Daughter: Pat, age 3

Current assets:

| | |
|---|---|
| Checking account | $1,000 |
| Mutual funds | 99,000 |
| IRAs | 50,000 |

Annual savings:
Within retirement plans: $4,000 ($2,000 each)
Outside retirement plans: Varies

Annual expenses:
Rent: $1,500 per month
Other: Varies

Economic assumptions:

| | |
|---|---|
| Inflation: | 3% |
| Before-tax rate of return within retirement plans: | 7% |
| Before-tax rate of return outside retirement plans: | 7% |

Tax rate: Varies

Financial planning goals:

- Retirement at Gene's age 67 and Jean's age 66
- College education for both children ($20,000 per year)
- Adequate life insurance

What methods are available to determine how much life insurance is needed on Gene's life and for how long it is needed?

***Practitioner approaches***

- *Multiple of income*

There are many variations; e.g., buy total amount on both spouses equal to six times household income, split proportionately. For the Blue family, the coverage needed on Gene would be $420,000 (i.e., $100,000 x 6 x .70), less whatever portion of current assets is available to be consumed.

Criticisms:

This approach is so simple that it should be regarded with great suspicion. How can it possibly take account of the multitude of factors that enter into a successful financial plan? And does it make sense that life insurance needs should increase linearly over time as family income rises?

- *Capital needs analysis*

This is the most common approach, and it is the method that is taught in Chartered Life Underwriter (CLU) and Certified Financial Planner (CFP) courses. The steps are:

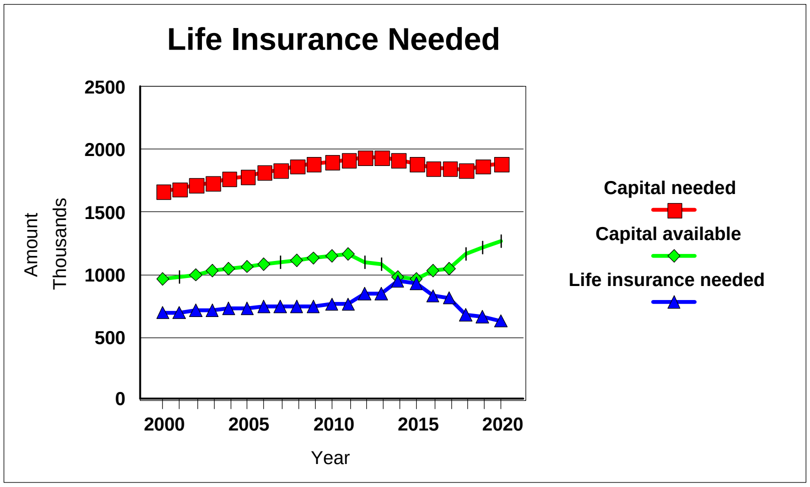
1. Specify the after-death objectives.
2. Compute the present value of the resources needed to accomplish the objectives.
3. Compute the present value of the resources available to accomplish the objectives.
4. Life insurance needed = PV of resources needed – PV of resources available

There are two approaches that you can use: capital liquidation (i.e., assume that all principal is exhausted at the end of the planning period) or capital retention (i.e., assume that principal is not touched). A convenient compromise is to use the capital liquidation approach with an explicit goal of providing a specified inheritance for the heirs. (Brain teaser: Using a capital retention method, how much capital is needed to provide an inflation-adjusted after-tax income of $10,000 per year for 10 years, assuming that the after-tax rate of return equals inflation?)

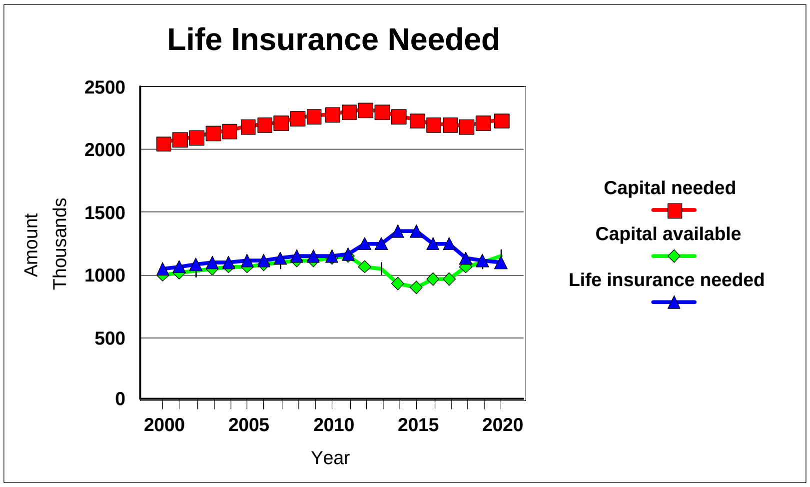
Another choice is whether to calculate only the current life insurance need (often called a static analysis) or estimate future life insurance needs by projecting the gap between future resources needed and resources available (often called a dynamic analysis).

For the Blue family, assume two goals if Gene dies: (1) provide annual living expenses of $54,429 (in 2000 dollars) until the youngest child is age 17, and $38,120 until Jean is 95; and (2) provide $20,000 (in 2000 dollars) a year for a four-year college education for both children.

Scenario #1: 7% before-tax rate of return
3% inflation
25% average tax rate




Scenario #2: 6% before-tax rate of return
3% inflation
30% average tax rate



Life insurance needs calculators on the Internet typically use the capital needs analysis approach.

For more information:

Kenneth Black, Jr. and Harold D. Skipper, Jr., *Life & Health Insurance*, Thirteenth Edition, 2000, pp. 350-370

Criticisms:

1. A capital needs analysis does not explicitly take account of other financial planning goals, such as having an adequate income in retirement. This can lead to a distorted financial plan that provides a better standard of living if one spouse dies than if both spouses live into retirement.

2. The analysis is usually based on deterministic, rather than stochastic, assumptions. This creates an illusion of precision, and it can understate the amount of capital needed to meet the desired objectives with a reasonable chance of success.

   Example: How much money is needed to provide an inflation-adjusted after-tax income of $40,000 at the beginning of each year for 50 years, with nothing left at the end?

| **Deterministic analysis** | **Stochastic analysis** |
|---|---|
| Assume:<br><br>• 3% inflation<br>• 6.09% constant after-tax return (3% real return)<br><br>Answer: $1,060,066 | Assume:<br><br>• 3% inflation<br>• After-tax return is lognormally distributed with 6.09% mean and 5% standard deviation<br>• Monte Carlo simulation has 1,000 trials<br><br>Answer: You need to have about $1,430,000 (35% more than $1,060,066) to have a 95% chance of not running out of money. |

- *Human life value*

This is more often used in wrongful death litigation than in estimating life insurance needs. The idea is to compute the present value of the insured’s future income, minus personal expenses, in order to indemnify the survivors for the lost net earnings.

For more information:

www.humanlifevalue.com

Frank W. Taylor, “An Economic Indemnity Model as the Basis For Life Insurance Programs,” *Journal of Risk and Insurance*, June 1975

***Academic approaches***

- *Life cycle model of consumption and savings*

The predominant economic theory of consumption and savings is the life cycle model, developed by Nobel laureate Franco Modigliani. It argues that rational people devise a lifetime consumption plan based on their expected lifetime earnings. This plan typically requires running into debt in the early years, then accumulating wealth, and then spending that wealth in retirement.

Economic Security Planner (ESPlanner) is software that was developed by three economists — Douglas Bernheim, Jagadeesh Gokhale and Laurence Kotlikoff — to create personal financial plans based on the life cycle model. Whereas other financial planning software tells you what you have to do to afford a desired standard of living, ESPlanner tells you the highest standard of living that you can maintain with specified net worth, earnings, and other assumptions. This living standard takes account of all financial planning goals, including retirement, children’s education, and survivor income. The life insurance need is calculated for each year until the end of the planning period, and this calculation handles circularity; i.e., the living standard determines the amount of life insurance needed, which determines the cost of life insurance, which affects the living standard, and so on.

**ESPlanner, in the developers’ own words**

Consider maximizing an intertemporally separable, isoelastic utility function, which is defined over survival-state-specific levels of consumption and economics in shared living. Let this maximization be subject to resource constraints, liquidity constraints, and nonnegativity constraints on life-insurance purchases. ESPlanner finds the limit of the solutions to this problem as the intertemporal elasticity of substitution approaches zero. In so doing, it smooths the living standards of household members to the extent permitted by the household’s borrowing constraints.

From B. Douglas Bernheim, Lorenzo Forni, Jagadeesh Gokhale, and Laurence J. Kotlikoff, “How Much Should Americans Be Saving for Retirement?”, *American Economic Review*, May 2000

For the Blue family, assume that (1) the desired living standard is constant for life; (2) there are no bequests; (3) a couple can live as cheaply as 1.6 adults and a child's expenses are 70% of an adult's; (4) a four-year college costs $20,000 a year; (5) final expenses are $10,000; (6) rent is $1,500 per month; (7) inflation is 3%; and (8) the pretax return on assets inside and outside of qualified plans is 7%.

ESPlanner generates 28 reports. The five reports on pages 10 through 14 show the key elements of the Blues' financial plan. All amounts are in 2000 dollars. (To determine the amounts in future dollars, multiply by 3% annual inflation for the appropriate number of years).

The first three reports are for the household with both spouses alive. The last two reports are for Jean alone, assuming that Gene dies in the first year. The first report (Annual Recommendations) shows the amount of life insurance needed each year.

Two equations are useful for understanding ESPlanner's reports:

Total Income = Total Spending + Total Taxes + Tax-Favored Contributions (i.e., retirement plan contributions) + Non-Tax-Favored Saving

Total Spending = Consumption + Special Expenditures + Housing Expenditures + Life Insurance Premiums + Funerals and Bequests

ESPlanner takes some expenditures (e.g., life insurance premiums, housing, college) "off the top" and then performs its optimization for the rest, which it labels Consumption. (Brain teaser: Should ESPlanner treat disability income insurance in the same way as life insurance; i.e., should it solve for the affordable level of consumption that can be fully insured against both morbidity and mortality, or should it treat expenditures for disability income insurance as simply one item in Consumption? And what about other types of insurance, such as health and long term care?)

For more information:

www.esplanner.com

Browning, Martin and Thomas F. Crossley, "The Life-Cycle Model of Consumption and Saving," *Journal of Economic Perspectives*, Summer 2001

Jagadeesh Gokhale, Laurence J. Kotlikoff and Mark J. Warshawsky, "Comparing the Economic and Conventional Approaches to Financial Planning," September 1999

B. Douglas Bernheim, Lorenzo Forni, Jagadeesh Gokhale and Laurence J. Kotlikoff, "The Adequacy of Life Insurance: Evidence from the Health and Retirement Survey," September 1999

Peter Coy, "A Smooth Financial Ride," *Business Week*, November 15, 1999

Malcolm R. Fisher, "Life cycle hypothesis," in *The New Palgrave: A Dictionary of Economics*, 1988

Robert C. Merton, *Continuous-Time Finance*, Revised Edition, 1992.

Criticisms:

1. ESPlanner's recommendations are based on the premise that maximization of expected utility is a sensible analytical framework for decision-making. Expected utility theory is the foundation of mainstream economics and decision analysis, but it has been challenged from two directions: positive (descriptive; what people actually do) and normative (prescriptive; what people should do).

   For more information:

   Daniel Kahneman, Ed Diener and Norbert Schwartz (editors), *Well-Being: The Foundations of Hedonic Psychology*, Russell Sage Foundation, 1999

   Daniel Kahneman, Peter P. Wakker and Rakesh Sarin, "Back to Bentham? Explorations of Experienced Utility," *Quarterly Journal of Economics*, May 1997

   Daniel Kahneman, "New Challenges to the Rationality Assumption," *Journal of Institutional and Theoretical Economics*, March 1994

   Hersh M. Shefrin and Richard H. Thaler, "The Behavioral Life-Cycle Hypothesis" in Richard H. Thaler, *Quasi Rational Economics*, Russell Sage Foundation, 1991

   Chris Starmer, "Developments in Non-Expected Utility Theory: The Hunt for a Descriptive Theory of Choice under Risk," *Journal of Economic Literature*, June 2000

   Richard H. Thaler, "Psychology and Savings Policies," *American Economic Review*, May 1994

2. ESPlanner's recommendations are based on deterministic, rather than stochastic, assumptions. As noted above, this creates an illusion of precision, and the recommended amount of life insurance might be inadequate to maintain the targeted standard of living at a reasonable level of certainty. This could be addressed through simulation or sensitivity analysis.

3. ESPlanner must necessarily make some simplifying assumptions. For example, it does not choose an optimal plan for taking qualified plan distributions or for using a life annuity in retirement, and its assumed cost of life insurance may be higher or lower than what is appropriate for a particular buyer.

- *Game theory*

In a 1988 paper, Prof. Marvin D. Troutt looked at life insurance needs using game theory. In his model, the life insurance buyer is playing a game against Nature. The buyer has two possible strategies (Insure and Not Insure), and Nature has two possible strategies (Live and Die). The payoff of the game is the family's wealth at the end of the year. The payoff matrix looks like this:

| | | Nature | |
|---|---|---|---|
| | | Live | Die |
| Buyer | Insure | $a | $b |
| | Not Insure | $c | $d |

In many cases, the solution to the game is a pure strategy: Buyer insures for the full amount needed (determined using other methods). In some cases, however, the solution is a mixed strategy, which can be interpreted as buying only a portion of the needed coverage and adding more coverage each year.

For more information:

Marvin D. Troutt, "A Purchase Timing Model for Life Insurance Decision Support Systems," *Journal of Risk and Insurance*, December 1988, pp. 628-643.

***A personal view: Adaptation, not optimization***

> "In fact, in the increasing-returns environment I've just sketched, standard optimization makes little sense. You cannot optimize in the casino of increasing-returns games. You can be smart. You can be cunning. You can position. You can observe. But when the games themselves are not even fully defined, you cannot optimize. What you *can* do is adapt. Adaptation, in the proactive sense, means watching for the next wave that is coming, figuring out what shape it will take, and positioning the company to take advantage of it. Adaptation is what drives increasing-returns businesses, not optimization."
>
> From W. Brian Arthur, "Increasing Returns and the New World of Business," *Harvard Business Review*, July-August 1996.

If you believe that surviving a loved one's death is a matter of adaptation rather than optimization, here are some guidelines for determining life insurance needs:

- From the survivor's perspective, focus on having enough money so that you will have some good options after your loved one's death. Instead of relying on an "optimal" plan that can never anticipate all of the uncertainties of life, think about what you will need to adapt.

- Use ESPlanner or another tool to go through the valuable exercise of creating a financial plan, and then use that information to help you decide how much money you will need to have some good options. Be conservative in setting assumptions, to offset the impact of future volatility in rates of return and other variables.

- To do a back-of-the-envelope calculation of the present value of inflation-adjusted income and expense streams, start by assuming that the after-tax rate of return is equal to the inflation rate. In that case, the present value of the stream is just the initial payment times the number of payments. Then make adjustments up or down to reflect higher or lower real rates of return, and then make an upward adjustment for volatility.

| Percentage adjustments to present value of inflation-adjusted payments | | | | |
|---|---|---|---|---|
| After-tax real rate of return | Number of years of payments | | | |
| | 10 | 20 | 30 | 40 |
| –2% | +10% | +22% | +36% | +52% |
| 0 | 0 | 0 | 0 | 0 |
| 2 | –8 | –17 | –24 | –30 |
| 4 | –16 | –29 | –40 | –49 |

Example: What is the present value of $40,000 increased for inflation each year for 30 years?

Assuming a 0% after-tax real rate of return, PV = 40,000 x 30 = $1,200,000.

Assuming a 2% after-tax real rate of return, PV = $1,200,000 x (1– 0.24) = $912,000. If you add 25% for volatility, you have $1,140,000.