13 ✧ CASH FLOW TESTING

13.1 INTRODUCTION

The earlier chapters in this book discussed the assumptions, methodologies and procedures that are required as part of a statutory valuation. These discussions covered an important aspect of an actuary's work because the actuary is required to certify that the policy reserves prepared in accordance with statutory accounting principles meet minimum legal requirements. Once these minimum requirements have been satisfied, an important question remains to be answered: Do the reserves make "good and sufficient"[1] provision for the liabilities undertaken by the company?" In other words, are reserves and related liabilities adequate under ***moderately adverse*** conditions?[2]

Minimum valuation standards are generally intended to be conservative but this is not always the case. This can occur for a variety of reasons such as unexpected results from product features, different marketing techniques or underlying experience evolving differently than expected. For example, consider the reserves for a single premium immediate annuity. The Standard Valuation Law specifies a maximum rate of interest that can be used in valuing these liabilities. For a given year's issues this interest rate is level for the term of the contract[3]. For example, the valuation interest rate for a single premium immediate annuity issued in 1982 was as high as 13.25%. Rates available on investments made during that period were well in excess of 13.25%. However, it is difficult to invest for the full benefit period associated with immediate annuities. Even if the company does invest fairly long, issuers of bonds may elect to call them if interest rates change. As a result, money might have to be reinvested at rates well below 13.25%.

In practice any number of events might occur that would make the statutory minimum reserves prescribed by law insufficient. The Standard Valuation Law cannot contemplate all of these items. Therefore, actuarial judgment and testing is required to ensure that reserves not only meet legal requirements but that the assets supporting the reserves are sufficient to cover outstanding liabilities.

Not too many years ago, a discussion of the good and sufficient provision would have emphasized gross premium valuations. A gross premium valuation involves the calculation of reserves, reflecting best estimate assumptions and including all policyholder benefits and expenses. This sort of approach was suggested to cover the following situations:

(1) The statutory valuation methodology was deficient because it did not consider withdrawals or expenses;

(2) The experience mortality was actually higher than mortality contemplated by the statutory valuation standard; or

(3) Reserve strengthening was needed due to investment yields not supporting the valuation interest rate.

---

[1] In the 1970's a valuation task of the Society of Actuaries introduced the phrase "good and sufficient" without giving it a precise definition. This phrase has recently been replaced by "moderately adverse conditions." See Item 3.4.2 of Actuarial Standard of Practice No. 22 (ASOP No. 22) [2].

[2] Generally, "moderately adverse" means that reserves are adequate 85% of the time or cover 65% Conditional Tail Expectation (CTE). This concept is discussed in Chapter 16.

[3] Unless the life insurance company strengthens reserves by lowering the valuation interest rate.

Today this discussion has led to what has been termed the ***valuation actuary concept*** and ***principle-based reserves***. The valuation actuary must consider whether or not reserves make good and sufficient provision for future obligations not only under expected experience but under a number of different scenarios that might be plausible.

The valuation actuary concept has led to the analysis of many different items that might affect the adequacy of reserves, including but not limited to the following:

(1) Cash flow testing that includes the interaction between assets and liabilities under a number of different scenarios;

(2) Determination of the cost of embedded options;

(3) Evaluation of the impact of mortality deterioration due to selective cancellation by the policyholder on certain types of term products; or

(4) Estimation of the impact of epidemics such as AIDS and SARS on the adequacy of the company's reserves.

An area currently receiving considerable attention is asset adequacy analysis. Cash flow testing is one of the primary procedures used in an asset adequacy analysis. This chapter is devoted to this topic.

13.2 CASH FLOW TESTING

Actuarial Standard of Practice No. 7 (ASOP No. 7), *Analysis of Life, Health, or Property/Casualty Insurer Cash Flows,* is an important standard of practice with regards to cash flow testing. Its primary purpose is to provide guidance to actuaries who are performing a cash flow analysis. An actuary who is performing a cash flow analysis should be familiar with this standard.

13.2.1 DEFINITION

The definition section of Actuarial Standard of Practice No. 7 defines ***cash flow analysis*** as "any evaluation of the risks associated with the timing or amount of cash flows."[4] In general terms, a cash flow analysis provides insight to such questions as:

(1) What cash obligations (e.g., expenses, claims, taxes) will the life insurance company have in the future?

(2) When will these obligations occur?

(3) What will be the amount of these obligations?

(4) Is there a sufficient amount of assets set aside to provide for these obligations?

(5) Are they the right types of assets (for example, will the life insurance company be able to sell the assets without incurring a loss when the investment proceeds are needed to pay for an obligation)?

(6) Analysis must also include documentation of findings and recommendations.

Actuarial Standard of Practice No. 7 also defines ***cash flow testing*** as "a form of cash flow analysis involving the projection and comparison of the timing and amount of cash flows resulting from economic and other

[4] See Section 2.5 of Actuarial Standard of Practice No.7, [1].

assumptions."[5] In other words, cash flow testing addresses the above questions under a range of scenarios to develop an understanding of the underlying risks and to assess their impact on the capital and surplus of the life insurance company.

13.2.2 SCOPE

An actuary must have an understanding of the life insurance company's insurance products, its investments, financial reporting and financial modeling to perform this type of analysis. This is because the actuary must consider:

(1) the type of liabilities included in the analysis;

(2) the type of assets supporting these liabilities;

(3) the various risks associated with the liabilities and assets and the severity of these risks;

(4) the options embedded in the assets and liabilities and the likelihood that these options will be exercised at a time that may result in a financial loss;

(5) the interrelationship between assumptions (e.g., between lapse rates and mortality rates, or between lapse rates and the difference between credited interest rates and competitor rates);

(6) financial reporting requirements; and

(7) company policy with regards to:

  (a) non-guaranteed elements or dividends in different economic environments;

  (b) use of financial derivatives; and

  (c) investment policies, guidelines and restrictions.

Cash flow testing is often complex, requiring the skills of several individuals who collectively have extensive training and knowledge in investments, financial reporting and financial modeling. It also requires someone with strong management skills that has the knowledge and authority to identify and plan the tasks, to assign and coordinate the resources, and to motivate and communicate with a wide variety of individuals.

13.3 CASH FLOW TESTING PROCESS

The most common approaches[6] to cash flow testing can be grouped into the following activities:

(1) Identification of the assets and liabilities included in the cash flow analysis;

(2) Selection and validation of models for asset and liabilities cash flows;

(3) Selection of appropriate scenarios;

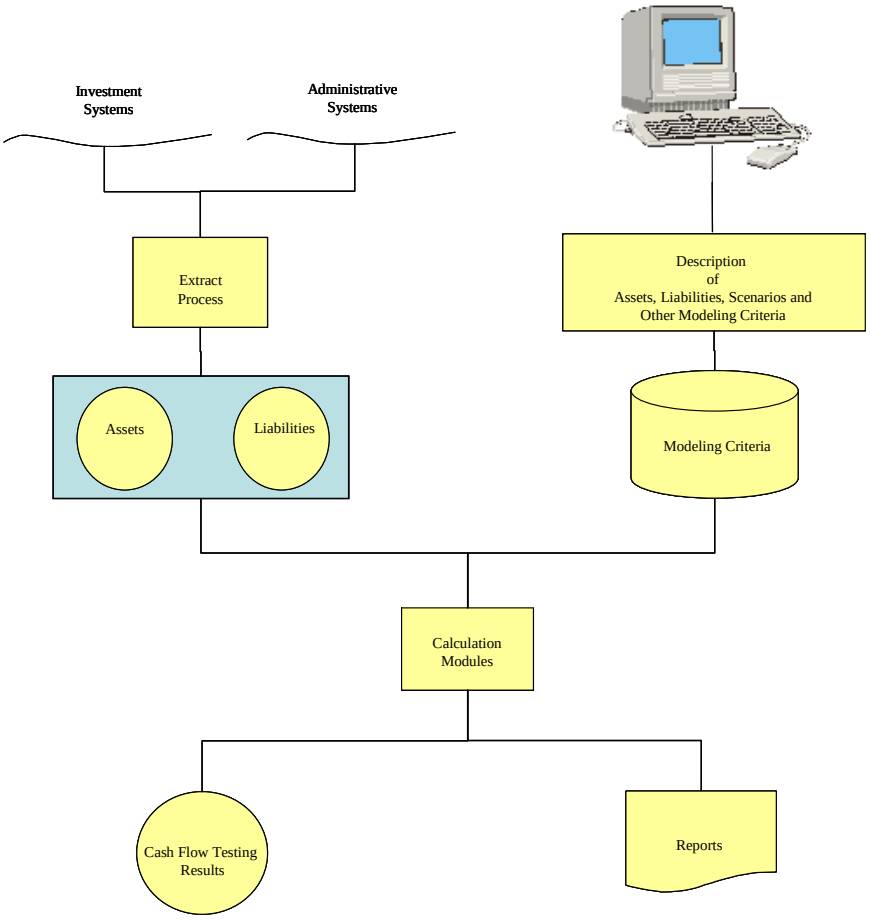
(4) Projection of the selected asset and liabilities cash flows under each scenario; and

(5) Development of conclusions based on analysis of the cash flow projections.

Similar to the valuation process, cash flow testing utilizes a significant amount of data and resources. The following diagram is a flow chart of a typical cash flow testing system.

[5] See Section 2.6 of Actuarial Standard of Practice No. 7, [1].

[6] See Appendix 1, Current Practices of Actuarial Standard of Practice No. 7, [1].



This flow chart divides a cash flow testing system into five major parts:

(1) Extract process;
(2) Description of assets, liabilities, scenarios and other criteria;
(3) Calculation modules;
(4) Cash flow testing results; and
(5) Reports.

The next several sections provide a brief description of these parts.

13.3.1 EXTRACT FILES

The primary purpose of the extract process is to retrieve information from investment systems and the policy administrative systems that is needed during the cash flow testing process. This information is stored in computer files or databases. Typically, there are two types of files created during this process: ***asset files*** and ***liability files***.

Asset files contain information about the assets currently held in support of the existing liabilities. For example, if bonds are held in support of the liabilities, these files would contain the type of bonds, the par value, the coupon rate, the call provisions and the maturity date and other critical information. The following is the type of information that is stored for each bond in an asset file:

Asset File	
Asset Number	B123456789
Cusip	17303MGW3
Asset Type	Bond
Industry	Financial
Moody's Rating	Aa2
S&P Rating	A+
SVO Classification	2
Issue Date	7/1/2000
Maturity Date	7/1/2009
Coupon Type	Fixed
Coupon Rate	7.00%
Frequency of Coupon Payments	Semiannually
Callable	Yes
First Call Date	7/1/2004
Call Premium	1.00%
Par Value	100,000
Market Value	105,000
Book Value	100,000

Liability files contain information about the current liabilities. The most important liability files are the policy extract files. The policy extracts contain information about insureds such as gender, issue age and smoking habit[7]. They also identify the plan of insurance and the amount of insurance coverage.

The following is the type of information that is stored for each policy in a policy extract:

Policy Extract	
Policy Number	P001
Plan Code	UL2000
Policy Status	Active
Underwriting Criteria	Medical
Extract Date	12/31/2005
Issue Date	7/1/2000
Maturity Date	7/1/2040
Issue Age	60
Gender	Male
Smoking Criteria	Nonsmoker
Gross Premium	35,000
Premium Payment Period	40 years
Face Amount	1,000,000
Fund Value	100,000
Cash Value	90,000
Statutory Reserve	95,000

In most circumstances, policy extract files will contain a large amount of data. As was noted earlier, it is not uncommon for a policy extract to have several million records, with each record in the policy extract having

[7] Often the policy extract file is produced from the seriatim files used to determine formula reserves under a statutory valuation, as discussed in Chapter 3.

25 or more fields. To reduce the size of these files, most life insurance companies group similar policies into representative cells. The rules used to group these files must be chosen carefully in order to accurately model the risks. A cash flow analysis using grouped files should lead to the same conclusions and discussions as a cash flow analysis using detailed files. In other words, the differences between a cash flow analysis using grouped files and a cash flow analysis using detailed files should be immaterial[8].

For example, the policy extract file might contain the following policies:

Policy Extract File					
Policy No.	**P001**	**P002**	**P003**	**P004**	**P005**
Plan ID	VUL2000	VUL2000	VUL2000	VUL2000	VUL2000
Underwriting Criteria	Medical	Paramedical	Nonmedical	Medical	Medical
Issue Date	7/1/2000	7/1/2000	10/1/2000	7/1/2000	4/1/2000
Issue Age	60	62	60	64	61
Gender	Male	Male	Male	Male	Male
Smoking Criteria	Nonsmoker	Nonsmoker	Nonsmoker	Nonsmoker	Nonsmoker
Gross Premium	35,000	9,000	3,750	40,000	20,000
Face Amount	1,000,000	250,000	100,000	1,000,000	500,000
Fund Value	100,000	25,000	10,000	100,000	50,000
Cash Value	90,000	22,500	9,000	90,000	45,000
Statutory Reserve	95,000	23,750	9,500	95,000	47,500

The grouping rules might be:

Plan Groups:	One group for each Plan ID
Underwriting Groups:	Guaranteed Issue, Simplified Issue or Fully Underwritten[9]
Issue Date Groups:	One group for each Issue Year
Issue Age Groups:	0-9, 10-19, 20-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79 or 80 & older
Gender:	Male or Female
Smoking Criteria:	Nonsmoker, smoker or unknown

These grouping rules would lead to the following representative model cell[10]:

[8] Materiality addresses the question "Is this item large enough for users of the information to be influenced by it?" It is important that the actuary discuss materiality with those who make accounting decisions which typically is the accounting department. See Section VI in the Preamble of the NAIC *Accounting Practices and Procedures Manual* [18] for a more through discussion of materiality.

[9] Fully underwritten would include nonmedical, paramedical and medical.

[10] A model cell is a representative policy of all the policies in the policy extract that have been "grouped" together.

Model Cell	
Cell Number	VUL2000-F-2000-60:64-M-NS
Plan Code	VUL2000
Underwriting Criteria	Full
Extract Date	12/31/2005
Issue Year	2000
Average number of years to maturity	38
Issue Age	62
Gender	Male
Smoking Criteria	Nonsmoker
Average Gross Premium	21,150
Average Premium Payment Period	38 Years
Average Face Amount	570,000
Average Fund Value	57,000
Average Cash Value	51,200
Average Statutory Reserve	54,150
Number of Policies in Cell	5

13.3.2 DESCRIPTION FILES

In order to project the cash flows for each asset in the asset files and each model cell in the liability files, the information about the assets and liabilities must be specified. In addition, the valuation method, assumptions and scenarios must also be specified. The primary purpose of this part of the cash flow testing process is to gather this information and store it in a database. The following list is the type of information that is needed:

- Valuation basis
- Premium rates
- Cash value scales
- Reserve factors
- Dividend scales
- Expense charges
- Cost of insurance charges
- Surrender charges
- Liability assumptions (e.g., expenses, morality, lapses, etc.)
- Asset assumptions (e.g., yield curves, defaults rates, reinvestment rates, etc.)
- Scenarios

This information will depend on the type of assets and liabilities being tested.

13.3.3 CALCULATION MODULES

The calculation modules perform three major functions. First, these modules project the asset and liability cash flows into the future for each scenario specified. Second, they store the result of these projections and other information in a results file. Third, they produce various reports.

When projecting the asset cash flows for a given scenario, the characteristics of the assets of the life insurance company must be considered. As discussed in Actuarial Standard of Practice No. 7, the “characteristics of an asset affect the timing and amounts of its cash flows. The cash flows of some assets are relatively immune to external factors and can be predicted on the basis of asset structure alone (for example, high-quality

noncallable bonds). The cash flows of other assets (for example, callable bonds, mortgage-backed securities, common stocks, derivative contracts, or premium receivables) are more sensitive to external events, and their analysis should be based on a combination of their structure and external factors. The actuary should consider the following issues in making cash flow projections:

(a) the sensitivity to economic factors, such as interest rates, equity, or other market returns, and inflation rates on the insurer's asset cash flows;

(b) any limitations on the ability to use asset cash flows to support policy or other liability cash flows, such as when a block of assets is specifically held in support of a particular block of business by contract or regulation;

(c) the impact on cash flow associated with asset quality as it relates to the risk of a delay in asset cash flows being collected, asset default, or other financial nonperformance;

(d) the associated costs of maintaining the assets or of converting the assets into cash when necessary;

(e) the historical experience of similar assets, to the extent such experience is credible and relevant to the projection of future asset cash flows; and

(f) other known factors that are likely to have a material effect on asset cash flows, particularly those factors that are likely to have an effect on asset risk or investment rate-of-return risk.[11]"

Equally important is the investment strategy of the life insurance company. Actuarial Standard of Practice No. 7 lists the following items that an actuary should consider[12]:

(a) the insurer's strategy regarding the sale of assets prior to maturity;

(b) asset segmentation in support of the insurer's policy cash flows;

(c) the insurer's strategy regarding the sale of assets with a declining market value;

(d) the insurer's strategy for the investment of future positive or negative cash flows;

(e) to the extent the insurer's investment strategy contemplates borrowing to cover negative cash flows, whether the funds borrowed pursuant to the strategy are reasonable in relation to the insurer's existing indebtedness, borrowing capacity, and cost of borrowing funds;

(f) the insurer's use of derivative contracts, including strategies to mitigate asset, policy, or other liability cash flow risk;

(g) to the extent the insurer's investment strategy contemplates capital contributions from a parent or other source, whether the capital contributions can be sustained and are appropriate for the type of analysis;

(h) the costs or gains due to asset, policy, or other liability cash flows denominated in foreign currencies; and

(i) any other known factors that are likely to have a material effect on investment strategy or the insurer's ability to execute its investment strategy.

Similarly, when projecting the liability cash flows for a given scenario, the characteristics of the liabilities of the life insurance company must be considered. As discussed in Actuarial Standard of Practice No. 7, the "characteristics of a policy affect the timing and amounts of its cash flows. The actuary should consider the following factors in projecting policy cash flows:

[11] See Section 3.4.1, Asset Characteristics of Actuarial Standard of Practice No. 7, [1].

[12] See Section 3.4.2, Asset Characteristics of Actuarial Standard of Practice No. 7, [1].

(a) the risk of insolvency or other nonperformance by providers of services, including reinsurers and other counter-parties;

(b) the associated costs of maintaining, collecting, or paying out the policy cash flows;

(c) the historical experience of similar policy cash flows, to the extent such experience is credible and relevant to the projection of future cash flows;

(d) the effect of external factors such as interest rates, equity or other market returns, unemployment rates, and inflation rates on the insurer's policy cash flows;

(e) the ability of the policyholder or other party to exercise options under the policy that have an effect on policy cash flows (for example, put options subject to a predefined event occurring, or allowing the transfer of funds between contracts or funding vehicles);

(f) the effect of changes in premium (for example, rate increases) or changes in other policy charges (for example, cost of insurance charges in universal life contracts); and

(g) other known factors that are likely to have a material effect on policy cash flows, including off-balance sheet items."[13]

Finally, the "actuary should consider management policy concerning the settlement or payment of liabilities, and the effect that this management policy may be reasonably expected to have on the projection of policy cash flows. Considerations that might affect the projection include claim settlement and benefit payment practices, expense control strategies, company philosophy relative to the determination of policyholder dividends, and charges or benefits that vary at the discretion of the company, as well as significant relationships between management policy and the scenarios analyzed."[14]

13.3.4 MODEL VALIDATION

The model should be tested and validated to determine that:

(1) The liabilities and assets have been properly grouped into represented cells;

(2) The data in the extract files and plan description files is accurate and is being accessed correctly by the calculation routines;

(3) The formulas in the calculation routines have been programmed correctly; and

(4) The model can replicate past performance.

With regards to this last point, a scenario should be run with assumptions that closely match recent past experience. Certain key financial results produced by the model for this scenario should be compared to actual financial results. For example, assume paid death claims in 2000 for a particular product line was $10,000,000. What did the model produce using the most recent mortality study? For certain balance sheet items, the difference between actual results and modeled results should be less than 1%. For income statement items, the difference should be less than 10%. If the model results are outside these ranges, the data, assumptions and formulas should be examined closely to determine the cause of this inaccuracy, and the model should then be corrected accordingly.

Model validation can be a time consuming, tedious and, at times, frustrating activity. However, it is the only way to determine the reliability of the modeling process. If it cannot accurately reproduce recent historical experience, then it is unlikely that it can relied upon to assess future risks.

[13] See Section 3.5.1, Policy Cash Flow Characteristics of Actuarial Standard of Practice No. 7, [1].

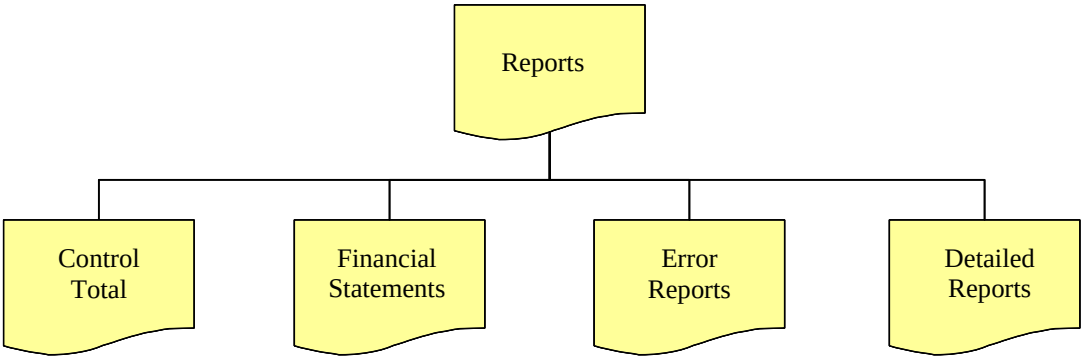
[14] See Section 3.5.2, Management Policy of Actuarial Standard of Practice No. 7, [1].

13.3.5 MODEL REPORTS

A critical part of the cash flow testing process is the generation of reports:

(1) To demonstrate that the data in the extract files and plan description files is accurate and is being accessed correctly;
(2) To demonstrate that the formulas in the calculation routines have been programmed correctly;
(3) To determine that all the liabilities and assets have been processed correctly;
(4) To validate the model; and
(5) To document the results of the cash flow analysis.

The following diagram is a high level flow chart of types of reports a cash flow testing system should produce:



A control report contains critical date, time and other information to help determine if the appropriate assets and liabilities files have been accessed and processed correctly for each scenario. Financial reports would include a projection of the balance sheet, income statement and other financial statements for each scenario. Not only are these reports needed for the cash flow analysis, but they are necessary for model validation. An error report lists the errors encountered during the cash flow testing process. This list would contain a brief description or error code indicating the type of problem encountered. Finally, detailed reports would provide enough information to show exactly how the cash flows for the assets and liabilities for a particular scenario were calculated. This is particularly important in order to determine that the formulas in the calculations modules have been programmed correctly and the files are being accessed correctly.

13.4 SCENARIOS

To perform cash flow testing, the actuary must first choose a set of future economic scenarios under which the asset and liability cash flows will be calculated. There are several methods currently in use for selecting a set of scenarios. These methods fall into two broad categories:

- ***Deterministic***; and
- ***Stochastic***.

13.4.1 Deterministic

Under this approach, scenarios are selected by choosing future scenarios that are of particular interest to the tester. This is the approach followed in both the regulations supporting the 1990 Standard Valuation Law, and in New York Regulation 126. The advantage of this approach is that the cash flow tester generally has more

comfort with looking at results on a scenario-by-scenario basis, since he or she has constructed the scenarios. Scenarios constructed under this method tend to be easy to describe and can be generally categorized as "rapidly increasing," "down and up," "wave," and so forth. Some disadvantages of this approach are:

(a) It is very cumbersome to generate a large number of handpicked scenarios;
(b) Choosing handpicked scenarios can also lead to disagreement over the probability of a given scenario;
(c) In certain instances (reserve testing is probably one) a large set of scenarios may be necessary to generate statistical credibility; and
(d) If the starting yield curve is too low, it may understate the cost of certain embedded options and overstate others (the opposite is true, if the starting yield curve is too high).

Finally, deterministic scenarios tend, in practice, to produce more favorable results than would be expected statistically.

13.4.2 STOCHASTIC

A stochastic approach recognizes that the assumptions are random variables. Accordingly, for certain key assumptions (e.g., interest rates and equity returns), an assumption is made about the underlying probability distribution of these random variables and a range of values is generated in accordance with this distribution for each year in the future. Some advantages of this approach are:

(a) It tests a large number of possibilities;
(b) Outliers can provide significant insight; and
(c) It gives a much better perspective on the range of possible outcomes.

Some disadvantages of this approach are:

(a) It is difficult to test that the formulas are working correctly;
(b) It can become a very complex and timing consuming exercise;
(c) It generates a large amount of data to analyze;
(d) It is sometimes difficult to summarize;
(e) It is difficult to decide which simulations are realistic and which are not; and
(f) It is difficult to establish reliable correlation among all the variables.

13.4.3 INTEREST RATE MODELS

Excluding variable products, most of the invested assets held in the general account of a life insurance company in support of the liabilities are bonds and, to a lesser extent, mortgages. Accordingly, the choice of an interest model is critical. The following are some of the characteristics of a good interest model:

(1) The current spot rate curve can be reproduced;
(2) Projected rates tend to revert to their long-term averages (i.e., mean-reverting);
(3) Projected rates are consistent with historical information and judgments about the future;
(4) Rates at different maturities are positively correlated, with higher correlation for maturities that are closer together than those that are further apart;
(5) Rates are not negative; and
(6) The rates are arbitrage-free[15].

[15] An investor can not enter into two or more financial transactions simultaneously to create a risk-free profit.

It is very difficult to build a model that satisfies all these conditions[16].

13.4.4 INVESTMENT STRATEGY

In performing cash flow testing, the actuary and investment officer must work together to develop an investment strategy. The life insurance company usually establishes an investment strategy for a particular product within the context of investment limitations approved by the Board of Directors. For example, a life insurance company may have the following investment limitations for bonds:

Investment Limitations as a Percentage of Total Assets	
Bond Limitations by Issue:	
AAA	1.00%
AA	0.80%
A	0.60%
BBB	0.40%
BB	0.20%
B	0.10%
Foreign Bond Limitations:	
AAA	5.00%
AA	4.00%
A	3.00%
BBB	2.00%
BB	1.00%
B	0.50%
Overall Bond Rating	A or higher
Bond Limitations by Industry	10% limit in any one industry
Effective duration	Less than 1 year difference between duration of assets and liabilities

Also, it is suggested that increasing the domestic bond percentages since it is more probable that a company will invest more of its assets in domestic bonds than foreign bonds as presented in this example.

These limitations will have a direct impact on the investment strategy. Thus the actuary and the investment officer must work closely together to define how positive cash flows will be invested in the future. This is generally done either by specifying a portion of cash flows to be invested in each type of security or by maintaining a balance of each type of security in the total portfolio. As a simple example, a company might decide to invest 50% of each positive cash flow in ten-year BBB bonds and 50% in ten-year Treasuries. The second approach would be to maintain 50% of the total portfolio in each of these two securities and solve for the percentage of each cash flow that must be invested in each in order to maintain this balance. Obviously, real-life reinvestment strategies are more complicated.

The reinvestment strategy may also define situations under which it is anticipated that this strategy will change. Key examples of points in time that changes in reinvestment strategies might be projected to occur include inversions of yield curves, increases or decreases in interest rates above specified levels, or changes in overall asset durations.

In setting up the parameters for a cash flow study, a decision must also be made with regard to negative cash flows. If negative cash flows occur in the projection, they may be modeled by selling assets, by buying

[16] The paper by Kevin C. Ahlgrim, et al. [3] discusses how well some of the popular models currently satisfy these conditions.

negative assets (this is used to simulate borrowing between lines of business, and has an impact similar to selling assets), or borrowing at a short-term rate.

13.4.5 POLICYHOLDER BEHAVIOR

Although difficult to predict, anticipating how policyholders will behave under various scenarios will affect the results of a cash flow analysis. The following are some other items that the actuary should consider when doing a cash flow analysis:

(1) How should lapses be modeled?

(2) How should mortality be modeled?

(3) How should changes in the tax law be handled?

(4) How should embedded options be valued?

(5) How should additional deposits be modeled?

(6) How should partial deposits be modeled?

(7) How should switches between fixed and variable accounts be modeled?

For example, when performing a cash flow analysis of variable annuity contracts with minimum guaranteed death benefits, the lapse rate should be a function of how much the contract is "in the money." In particular, the lapse rate for a contract that is significantly "in the money" should be lower than an otherwise identical contract that is significantly "out of the money." Similarly, when performing a cash flow analysis for universal life policies, the mortality rates should reflect some antiselection due to excess lapses. Conversely, mortality might be more favorable due to lower lapses. Finally, the utilization of certain embedded options might be very difficult to value. For example, the cost of dollar-for-dollar partial withdrawals under early variable annuity minimum guaranteed death benefit designs can be very large. The only way to handle this cost is to monitor experience very closely and adjust the cash flow analysis accordingly.

Recognition should be given to the notion that policyholders do not always behave in a financially rational manner (i.e., they do not always choose an option that maximizes personal wealth). Consideration should be given to such questions as:

(1) Why was the product purchased?

(2) How was the product marketed?

(3) Who is the financial decision maker?

(4) How sophisticated is the financial decision maker?

(5) How long has the policy been inforce?

Many of the functional relationships in cash flow testing key off of the relationship between credited interest rates, market rates, and lapse rates. The competitor rate or market rate describes what is available to a policyholder who surrenders his policy and buys a comparable new policy. This market rate can be defined in terms of credited interest rates on a universal life policy or single premium deferred annuity policy, or dividend rates on a participating whole life policy.

The market rate is used to make an assessment of how competitive the policy is in a future scenario relative to the other options available to the policyholder. Obviously the company cannot perform a competitive survey of financial products available in the future. As a simplifying assumption, the competitor rate often is defined as a single interest rate. When defining the competitor rate, it is important to consider the life insurance company's

competitive profile and the characteristics of the policy from a sales perspective (for example, how important the interest rate is). If the sales channel requires a credited rate in the top 10% of competitors to meet competitive objectives, this should be reflected in the choice of a definition of competitor rate.
Market rate assumptions will also depend on the type of product being studied. Often market rate assumptions are based on some function of a current interest rate and a moving average of an interest rate. The moving average is generally meant to reflect the impact of competitors who use portfolio rate crediting strategies, as well as a tendency for some companies to lag the market.

Generally, the life insurance company should experience excess lapse rates[17] when its credited rate lags the market. However, other factors that might dampen these excess lapses include surrender penalties, market value adjustments, underwriting, taxes and general inertia of the policyholder.

13.4.6 NONGUARANTEED ELEMENTS PRACTICES

For some contracts this is as simple as determining the interest rate crediting strategy. For others, however, there is not a specific interest rate credited, but rather interest rates influence dividends or other non-guaranteed elements. In any event, the actuary must make some assumption regarding the impact of future economic environments on the benefits passed on to policyholders.

For example, a universal life product that credits a company-declared rate might use one of the following strategies:

(1) Credit the earned rate less an investment margin.

(2) Credit some function of the market rate.

(3) Use a hybrid approach.

Other strategies might include multipliers rather than constant investment margins that would increase or decrease the investment margin as interest rates go up or down or as time passes.

13.4.7 LAPSE RATES

The actuary must come up with a best estimate of future lapse rates and some forecast for how lapses may depart from this best estimate if the economic environment changes. There is little published industry experience with regard to the interaction between lapse rates and credited rates on life insurance and annuities. There is some indication during the mid to late 1970s that as investment returns on alternate investments became very attractive, companies experienced higher than expected withdrawals of their cash values and extensive use of the policy loan provision. The lapse assumption is based upon the common sense argument that as policyholders' other options become more and more attractive they will be more likely to surrender their policies.

Items to consider in developing a lapse function include the following:

(1) The presence and level of any surrender charges. Many lapse rate functions take into account the level of surrender charge relative to policyholder account values.

(2) The marketing techniques and loyalty of the field force.

(3) The prominence of the interest rate in the marketing and maintenance of the policy. Arguments have been put forth that participating business may be less sensitive to excess lapses since the credited interest rate often is not obvious to the policyholder.

[17] "Excess lapse rate" means lapses in excess of the expected or baseline lapse rate.

(4) Duration from issue.

(5) Type of products sold. Products that are primarily investment products such as single premium deferred annuities might be more subject to excess lapsation than more protection-oriented products.

(6) Other guarantees available under the contract (e.g., a variable annuity contract with a minimum guaranteed death benefit that is "in the money" will most likely have a lower propensity to lapse than an otherwise identical contract that is "out of the money.")

In practice, when performing cash flow testing the actuary must develop estimates of the amount of excess lapsation expected at various differentials between crediting rates and market rates, and adjust these for the expected impact of surrender charges. The parameters of the excess lapse formula would then be set to produce excess lapses of approximately this magnitude.

13.5 CASE STUDY

Associated with this chapter is an Excel workbook, Chapter 13.xls. This workbook will be used to provide some insights into the following questions posed at the beginning of this chapter:

(1) What cash obligations (e.g., expenses, claims, taxes) will the life insurance company have in the future?

(2) When will these obligations occur?

(3) What will be the amount of these obligations?

(4) Is there a sufficient amount of assets set aside to provide for these obligations?

(5) Are they the right types of assets (for example, will the life insurance company be able to sell the assets without incurring a loss when the investment proceeds are needed to pay for an obligation)?

The workbook makes the following simplifying assumptions:

- All positive cash flows are reinvested in six-month commercial paper with a rating of Class 2 (i.e., an S&P and Moody's rating of A)
- Negative cash flows are borrowed at a short-term rate;
- Assets are not rebalanced to maintain a certain distribution by rating class and industry;
- Statutory reserves are equal to the cash surrender values; and
- The tax rate is zero

The exercises are an important part of this case study.