



AMERICAN ACADEMY *of* ACTUARIES

Special Issues for Equity Indexed Products

Introduction

This practice note was prepared by a work group organized by the Committee on State Life Insurance Issues of the American Academy of Actuaries. The work group was charged with developing a description of some of the current practices that could be used by illustration actuaries in the United States.

The practice notes represent a description of practices believed by the work group to be commonly employed by actuaries in the United States in 1998. The purpose of the practice notes is to assist actuaries with special issues for equity indexed products. However, no representation of completeness is made; other approaches may also be in common use. It should be recognized that the information contained in the practice notes provides guidance, but is not a definitive statement as to what constitutes generally accepted practice in this area. This practice note has not been promulgated by the Actuarial Standards Board nor is it binding on any actuary.

The members of the work group responsible for the practice note are as follows:

Thomas A. Campbell, FSA, MAAA	Donna R. Claire, FSA, MAAA
Errol Cramer, FSA, MAAA	Bruce J. Crozier, FSA, MAAA
Larry M. Gorski, FSA, MAAA, MCA	Daniel O'Neill Kane, FSA, MAAA
Michael J. O'Connor, FSA, MAAA	Frank W. Podrebarac, FSA, MAAA
Stephen J. Preston, FSA, MAAA	Mark Tenney
Viswanath Tirupattur	

Comments are welcome as to the appropriateness of the practice notes, desirability of annual updating, validity of substantive disagreements, etc.

This practice note has been divided into five sections:

- Section A. Reserve and Actuarial Opinion Requirements.
- Section B. Additional Actuarial Certification Requirements for Equity Indexed Annuities.
- Section C. Analysis of Risk.
- Section D. Asset Adequacy Analysis Considerations.
- Section E. Hedged as Required– Option Replication

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Section A: Reserve and Actuarial Opinion Requirements

Q. Are there any Model Regulations or Actuarial Guidelines which specifically address reserve requirements for equity indexed products?

A. Although the NAIC Interest Indexed Annuity Model Regulation refers to annuity contracts where “the interest credits are linked to an external reference”, many actuaries believe the regulation does not apply to equity indexed annuities. One of the reasons for this opinion is the fact that the language in the Model Regulation did not foresee the current structure of equity indexed annuities; therefore it does not address the unique characteristics of these products. In addition, despite the NAIC having adopted the Interest Indexed Annuity Model Regulation in 1988, no state has officially adopted it.

This means there are currently no Model Regulations or Actuarial Guidelines which specifically address minimum statutory reserve requirements for equity indexed products. Consequently, the sole source of guidance, at this time, is the Standard Valuation Law (SVL).

The American Academy of Actuaries has formed a task force (Academy Task Force) to make specific recommendations to the National Association of Insurance Commissioners (NAIC) concerning the valuation of equity indexed products. In addition, the Life and Health Actuarial Task Force of the NAIC (LHATF) has drafted Actuarial Guideline ZZZ to address minimum formula reserve requirements for equity indexed annuities. Note that some regulators have indicated that they intend to enforce the requirements of Actuarial Guideline ZZZ beginning with year-end 1997.

Q. What minimum reserve requirements for equity indexed products are contained in the recommendations of the Academy Task Force?

A. At this point, the Academy Task Force has made a recommendation only for equity indexed deferred annuities. This recommendation is consistent with the requirements contained in proposed Actuarial Guideline ZZZ (Guideline ZZZ), and is explained below. It is anticipated that the Academy’s recommendation for equity indexed immediate annuities will follow the Commissioner’s Annuity Reserve Method (CARVM) and the recommendation for equity indexed life (proposed Actuarial Guideline ZZZZ), which is expected by the end of 1998, will follow the Commissioner’s Reserve Valuation Method (CRVM). Following CARVM and CRVM will be necessary unless (or until) changes are made to the SVL.

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Q. What minimum reserve requirements are proposed in Guideline ZZZ?

A. The minimum reserve requirements for equity indexed deferred annuities contained in Guideline ZZZ consists of a “dual track” approach. Both tracks identify certain computational methods as reasonable interpretations of CARVM for specific product designs. Guideline ZZZ also provides requirements for optional and required changes in reserve methods.

One track includes what Guideline ZZZ refers to as Type 1 methods. A Type 1 method does not incorporate the actual option market value as of the valuation date. At this time, Guideline ZZZ recognizes only one computational method as a Type 1 method, that being the Enhanced Discounted Intrinsic Method (EDIM). Reserves under this method are the sum of a Fixed Component and an Equity Component. The initial reserve for the Fixed Component is set equal to the initial reserve under any of the other methods accepted in Guideline ZZZ. The reserve for the Equity Component is based on the discounted value of the equity option embedded in the annuity contract.

In order to use a Type 1 method, the company would agree to an investment strategy that meets the “Hedged as Required” criteria. In turn, the appointed actuary would be required to certify that the company is complying with these requirements. Both the “Hedged as Required” criteria and the associated certification are covered in more detail later in this Practice Note.

The second track would not require the company to commit to an investment strategy meeting the “Hedged as Required” criteria. However, the company would calculate formula reserves for its equity indexed annuities using a computational method that incorporates option market values as of the valuation date. In addition, the appointed actuary would be required to certify that the assumptions used to calculate the option market values are reasonable and consistent with assumptions underlying the statutory statement value of any derivative instruments held by the company to hedge the equity obligations embedded in the equity indexed annuities. The reserving methods recognized under this track are known as Type 2 methods. The certification associated with the Type 2 methods is also covered in more detail later in the Practice Note. Note that since Guideline ZZZ is still a proposed Actuarial Guideline, this “dual track” approach has not yet been formally endorsed by either the NAIC or any individual state.

Q. How are companies currently reserving for equity indexed products?

A. Reserve methods vary considerably among the companies that currently write equity indexed products, but include both Type 1 and Type 2 methods. The key characteristic that the majority of reserve methods share is consistency between the valuation of assets and liabilities (i.e., when assets are held at book or amortized cost, the reserves are valued using a Type 1 method; conversely, when fixed-income assets are held at amortized cost and options are held at market value, the reserves are valued using a Type 2 method).

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Q. What sources have valuation actuaries taken into consideration in the absence of a specific Model Regulation or Actuarial Guideline?

A. We know of three sources of information that valuation actuaries have taken into consideration. First, some actuaries look to formal communications from state insurance departments. A few regulators have indicated that they will be sending out letters explaining what they will accept for reserve standards for equity indexed products. Many of these regulators have indicated that they will enforce Actuarial Guideline ZZZ for year-end 1997. Second, many actuaries review the papers and articles that address reserve methods for equity indexed products. From among these methods the actuaries select the methodology which, in their judgment, best fits their product(s) and produces the most appropriate reserves. In particular, many actuaries review reports from the Academy Task Force which includes more detail on the Type 1 and Type 2 reserve methods for equity indexed annuities. Third, in the absence of formal communication, some actuaries have informally discussed the acceptability of potential reserve method with the domiciliary state insurance department.

Q. Does the Actuarial Opinion and Memorandum Model Regulation specifically address equity indexed products?

A. No. However, the requirements of the Actuarial Opinion and Memorandum Model Regulation (AOMR) apply to all products with respect to issues such as when asset adequacy analysis needs to be performed, selection and allocation of assets, and aggregation of reserves and assets. In applying the AOMR, the appointed actuary is required to follow relevant Actuarial Standards of Practice (ASOP) published by the Actuarial Standards Board, especially ASOP No. 7, *Performing Cash Flow Testing for Insurers*, ASOP No. 14, *When to do Cash Flow Testing for Life and Health Insurance Companies* and ASOP No. 22, *Statutory Statements of Opinion Based on Asset Adequacy Analysis by Appointed Actuaries for Life or Health Insurers*. These ASOPs do not address equity indexed products directly, but many actuaries believe the general tenets of the standards apply to these products.

Note that the AOMR allows the Commissioner to request an Actuarial Opinion supported by asset adequacy analysis for a company that is otherwise exempt from the requirement to submit such an opinion. A few regulators have indicated that they intend to formally request such an opinion, beginning in 1997, for exempt companies that write equity indexed products. In addition, both Guideline ZZZ and revisions to the AOMR (recently proposed by LHATF) require that asset adequacy analysis be performed for all companies with material blocks of equity indexed products.

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**Section B: Additional Actuarial Certification Requirements
for Equity Indexed Annuities**

Q. Are any additional actuarial certifications required for equity indexed products?

A. Not currently. However, Guideline ZZZ requires an additional actuarial certification to support the computational methods contained in either of the “dual tracks” for equity indexed deferred annuities, as previously discussed.

Q. Will either of the additional actuarial certifications be an opinion concerning the adequacy of assets supporting the reserves?

A. No. One of the additional actuarial certifications proposed in Guideline ZZZ deals with whether the investment strategy used to support the equity indexed annuities meets the “Hedged as Required” criteria. The other deals with the assumptions used to calculate the option market values which are used in the calculation of reserves. Neither certification in any way opines on whether the assets backing equity indexed annuity reserves are adequate.

Although the additional actuarial certifications do not address reserve adequacy, the detail in the certifications supports the reserve calculation. For this reason, actuaries generally feel it will be important to adequately document the work and the details that go into the certifications.

Q. Describe the nature of the actuarial certification supporting Type 2 reserve methods proposed in Guideline ZZZ.

A. Guideline ZZZ requires an insurer to provide a certification signed by the appointed actuary with each annual and quarterly statutory financial statement filed with the appropriate insurance regulatory official in each state in which the insurer does business. The certification states that the assumptions used to determine the market value of options used in the calculation of statutory reserves are:

1. reasonable in light of current relevant economic conditions, and
2. consistent with the comparable assumptions used to determine the statement value of any derivative instruments used to hedge the equity based obligations embedded in the equity indexed annuities.

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Q. What are some of the assumptions that will likely be discussed in this certification?

A. The models currently used by valuation actuaries to determine the market value of the options range from the Black-Scholes Option Pricing Model to Monte Carlo simulation. The Academy Task Force's recommendation anticipates that the actuary will use the same types of assumptions. The assumptions can be classified into two groups: *option description* and *economic*. The *option description* assumptions include option type (e.g., European, high water mark, annual reset), underlying index or indices (e.g., S&P 500), index averaging method (e.g., last business day of final three months), option term (e.g., 5 years, 7 years) and strike price. The *economic assumptions* include the risk free rate of return, the index dividend rate and the implied volatility of the index.

Q. What does the volatility assumption measure?

A. Volatility measures the uncertainty of future stock prices or index values. If one considers stock price or index value a random variable, the standard deviation of the assumed distribution of the random variable is related to the volatility of the stock price or index value. Volatility can be expressed on a historical basis or as an implied volatility.

Q. Is implied volatility the same as historical volatility?

A. No. Historical volatility is computed from a sequence of actual historical stock prices or index values. For purposes of option valuation, implied volatility is derived by solving an equation that relates the current observed option price to the value computed from an option pricing model. The option pricing model uses several assumptions, including one for volatility. By holding all assumptions but volatility constant, one can typically solve for a volatility assumption that produces equality between the model value and the value observed in the market.

Q. What is the Academy Task Force's recommendation regarding the use of current option market values provided by a derivatives dealer to avoid the need to model the options?

A. For purposes of calculating reserves using a methodology that utilizes dealer-provided current option market values as a surrogate for the present value of benefits, the Academy Task Force recommends that the valuation actuary may rely on option values provided by a derivatives dealer if:

1. the actuary obtains quotes from one or more dealers and uses an option value that is representative of this set of quotes, and

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2. the option values used for reserve calculations are consistent with the option values used for reporting the statement value of options owned by the insurer.

Q. What are some of the sources of information that the valuation actuary may use in providing the certification supporting Type 2 reserve methods proposed in Guideline ZZZ?

A. Under the Academy Task Force recommendations, the option description assumptions follow the description of the equity based benefits provided in the equity indexed annuity contract, and the strike price assumption reflects the contract participation rate, contractual guarantees as to expense assumptions and guaranteed interest rate, and the index value at the inception of the contract.

Information concerning the choice of economic assumptions can come from many sources. Under the recommendation, the risk free rate of interest assumption is based on the interest rates underlying interest rate swap transactions of comparable duration. The index dividend rate is based on an analysis of historical index dividend rates, with particular attention given to recent historical data. The volatility assumption may be developed by analyzing the implied volatility underlying the current prices of similar options.

Q. What are some sources where the valuation actuary may find more information on option pricing and derivative instruments in general?

A. One source is: Darrell Duffie, *Dynamic Asset Pricing Theory*, Princeton University Press. This has a bibliography of over 30 pages that is quite exhaustive and references working papers and papers in obscure journals. In addition, *The Handbook of Fixed Income Securities* by Frank J. Fabozzi (Irwin Press) gives a basic description of derivatives.

Q. What is the purpose of the “Hedged as Required” criteria?

A. Type 1 reserving methods are typically less responsive than Type 2 methods to changes in the economic factors underlying the equity based obligations embedded in equity indexed annuity contracts. To the extent that this is true, differences between the value of the equity indexed obligations arising from the annuity contracts and the value of financial instruments hedging these obligations are not reflected in statutory financial statements when Type 1 reserving methods are used. In order to diminish the likelihood of these mismatches occurring, Guideline ZZZ requires insurers using a Type 1 reserving method to utilize an investment strategy that meets the “Hedged as Required” criteria. The purpose of the criteria is to identify investment strategies and practices which are likely to produce cash flows and values that match

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the emerging obligations associated with the equity indexed obligations associated with equity indexed annuities.

Q. What are the “Hedged as Required” criteria?

A. The “hedged as required” criteria are five items to which the appointed actuary is required to certify under Guideline ZZZ. The items are covered in detail in the December 1997 report of the Academy Task Force.

The first two items in the certification deal exclusively with “end of term” exposure. The first item that the appointed actuary would be asked to certify is that option contracts held by the insurer to hedge the “end of term” equity based obligations are equivalent to “end of term” equity options embedded in the annuity contracts. The second item of the certification deals with the amount of options purchased and held by the insurer. The amount purchased and held must be greater than or equal to the “Specified Percentage” of the product’s account value at contract issuance. The Specified Percentage varies by the length of the option guarantee and allows the company to assume no more than 3 percent per year of elective benefit decrements (e.g., for a five year point-to-point product, the Specified Percentage would be $(1 - .03)^5$, or 86 percent). These decrements would be in addition to mortality (which must be based on annuitant mortality) and other appropriate non-elective utilization rates.

Items three and four deal with the equity indexed benefits provided to the contractholder prior to the end of the term. This includes, but is not limited to, death benefits, annuitization benefits and withdrawal benefits. Item three presumes a company would have a specific plan for hedging risks associated with these interim benefits and item four presumes an insurer would have a system in place to monitor the effectiveness of the plan.

Item five presumes that the insurer would have a stated maximum tolerance for differences between the expected performance of the hedging strategy and the actual results.

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Q. With respect to the first “Hedged as Required” criterion, would the equivalence of characteristics between the option contracts held by the insurer and the options embedded in the annuity contract be held only at issue?

A. No. The equivalence of characteristics would be an ongoing consideration. Under Guideline ZZZ, if the insurer fails to meet the criteria, the required actuarial certification must disclose this fact. If the reason for failing the “Hedged as Required” criteria is not corrected within one quarterly financial reporting of the initial disclosure of the failure in the actuarial certification, the reserve method must be changed to a Type 2 method.

Q. Would an insurer using an option replication strategy satisfy the “equivalence” aspect of the “Hedged as Required” criteria?

A. One type of option replication strategy attempts to replicate the performance of a long dated option with a collection of short dated instruments including long and short option positions and futures contracts. The Academy Task Force is currently considering whether, under its proposal, such strategies would satisfy the “equivalence requirement” of the “Hedged as Required” criteria. At least one of the states that intends to enforce Guideline ZZZ for year-end 1997 has indicated that such strategies will not satisfy the “equivalence requirement” at this time.

Section C: Analysis of Risk

Q. What are some of the risk elements that valuation actuaries typically consider when modeling equity indexed products?

A. The following risks are among those that valuation actuaries often consider:

- a) Disintermediation risk
- b) Hedging risk
- c) Enhanced benefit risk
- d) Guaranteed element risk
- f) Credit/counter-party risk
- g) Reinsurance risk

Although these risks are present in many different insurance products, each of these risks have elements that are unique to equity indexed products. This section will discuss these elements.

Q. What are some of the elements of disintermediation risk which are unique to equity indexed products?

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A. In a typical fixed rate life or annuity contract, the disintermediation risk is a function of the increasing probability of surrender in an environment in which market interest rate increase faster than credited rates. When interest rates increase, the market value of the underlying assets generally decrease, which can result in losses to the company as it sells assets to meet the increasing surrender payments. Similar disintermediation risks exist with equity indexed products, but are potentially more complex. As is true with fixed annuities, the scenarios where it is most advantageous for the contractholder to surrender are typically the scenarios that are most damaging to the company.

Since there is little historical experience available, contractholder behavior is still unknown. However, many actuaries believe that surrender patterns for equity indexed products will vary with both the level of interest rates and the performance of the index used for excess interest credits. For example, in periods of poor index performance, there may be a stronger likelihood of surrender than in periods of strong index performance. Additionally, rising interest rates may result in increased surrender activity, as other fixed annuities become more attractive.

The combined movements of index performance and interest rate levels may have a compounding effect on surrenders at the most disadvantageous time to the company. Poor index performance coupled with rising interest rates could result in significantly increasing levels of surrenders when fixed income and option market values are at a low point. Conversely, strong index performance coupled with declining interest rates could result in low surrender rates, leaving the company with the problem of reinvesting asset cash flows intended for surrenders at the most inopportune time. Also, if surrenders are lower than anticipated, the options purchased to hedge the index credits may be insufficient to provide for the index credits on the persisting contracts. The cost of purchasing additional options or providing the index credits could result in losses.

Many current equity indexed products contain product features that can help reduce disintermediation risk. One such feature provides for a substantial loss of index growth in the event of surrenders prior to the end of the defined term. Therefore, in situations where the index has performed well and then declines, surrender activity may be tempered because of the relatively severe penalty.

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Q. What special considerations are taken into account by valuation actuaries when modeling disintermediation risk?

A. Many actuaries believe that special consideration is needed in modeling the disintermediation risk for equity indexed products, especially in the areas of contractholder behavior and valuation of underlying assets (especially options). Because of the additional factors affecting both contractholder behavior and option values (discussed above) and the extensive modeling that may be required to evaluate all of the risks, sensitivity testing may take on increased importance in evaluating some risks, such as the value of the options in periods of changing volatility.

The contractholder lapse algorithm is often given special attention to reflect features such as the sensitivity to the movement of the underlying index, the contract term, the vesting pattern of the interest credits, the underlying interest rate guarantees and the economic impact of surrender on the contractholder. The lapse algorithm often reflects the relative advantage to the contractholder of surrendering now versus waiting to the end of the term. Lapse assumptions typically reflect differences in contract provisions. For example, the contractual penalties for early surrender vary significantly by contract and may depend on index performance from the beginning of the term. In this case, past performance and current values of the index typically are both considered.

Many valuation actuaries have taken into consideration the fact that, since the inception of most equity indexed products, the equity market has performed very well, so there is little relevant data on customer behavior in a market downturn.

The value of assets supporting these products can cause additional modeling issues. Typically, fixed investments are used to back the guarantees, with options being used to hedge the excess interest credits tied to index growth. The asset backing the fixed investments generally are modeled similarly to those used to back fixed rate annuities. The value of options used to back the index credits are typically based on factors that include interest rates, index levels, implied volatility and dividend rates. These factors are usually incorporated into the model used to evaluate the disintermediation risk.

Q. What are some of the elements of hedging risk which are unique to equity indexed products?

A. Because these products typically involve investment in a unique combination of options and fixed income assets, equity indexed products generally subject insurers to a level of hedging risk much different than that experienced with other fixed products. To assess hedging risk, valuation actuaries often consider the interaction of the existing options, the company's reinvestment and disinvestment strategies and the projected capital market with both the "end of term" equity based obligations and the equity indexed benefits provided prior to the end of the term (e.g., death benefits, annuitization benefits and withdrawal benefits). This interaction is usually considered critical whether or not the company is using an option replication method.

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Q. What techniques are currently used to model hedging risk?

A. Many techniques currently used to model hedging risk involve analysis performed over a broad range of economic conditions in order to observe different combinations of equity index and fixed interest rate performance. Such techniques usually involve both liability and asset considerations.

Liability modeling considerations are covered throughout this Practice Note and include lapse assumptions, enhanced benefits and product features, including guaranteed and non-guaranteed elements. Many actuaries use liability assumptions that are dependent upon economic variables and that specify management strategies applicable to non-guaranteed elements.

Asset modeling considerations typically include several factors. First, the company's reinvestment and disinvestment strategies are often modeled, especially if an option replication strategy is being used. Many actuaries believe it is preferable for the model to reflect the tolerances set for adhering to these strategies, including the company's propensity to vary from the strategies. Second, many actuaries believe that it is preferable for the model to reflect the future market volatility within each reasonably foreseeable scenario and its impact on the cost and risk of assets that may need to be purchased or sold in the future. Third, many actuaries consider both the liquidity of the options (e.g., the extent to which options could be sold to fund excessive interim surrender benefits) and the depth of the marketplace for purchasing options, which could substantially impact the future cost of hedging the liabilities. Fourth, many actuaries would consider the option strategy (e.g., "buy and hold" strategies versus dynamic option replication strategies, the latter tending to be more complex to implement and manage, but often tending to offer a greater degree of flexibility when rebalancing hedges). Finally, many actuaries reflect the availability of management information needed to allow the company to properly assess the effectiveness of the hedge program and to quickly adjust any mismatches. This would usually include the availability on a regular basis of timely and accurate information on actual experience rate (such as lapse rates) and if an option replication strategy is being used, market values of assets backing inforce business.

Q. How do actuaries currently analyze the strategy of guaranteeing both the index-related and minimum nonforfeiture benefits at maturity by purchasing 100 percent of the notional option coverage and putting the rest in bonds?

A. When analyzing this issue, many actuaries consider the impact on product features of possible interest rates and market conditions for option prices, and check to see if there are scenarios in which the assets are insufficient to cover maturities, surrenders and other benefits. Such shortfall may be due to the presence, regardless of the combination of hedges purchased, of "hedge hugging" scenarios in which most or all of the asset options do not pay off. In these cases, the quantity of bonds that can be purchased is usually reduced by the added cost of the options, and funds available to pay the minimum guarantee benefit may be insufficient.

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Q. What are some typical enhanced benefits, and what special considerations can there be in modeling them?

A. Some equity indexed products provide access to vested, and in some situations non-vested, index values either as a result of some insured event (e.g., death, nursing home confinement or diagnosis of a terminal illness) or for a specific purposes (e.g., annuitization). These benefits can result in liability cash flow patterns that vary significantly with index performance, interest rate movement and even contractholder action. Many actuaries model these benefits under varying economic conditions, with emphasis on situations where there is potential for disintermediation and hedging risk.

For example, death benefits provided by various equity indexed products range from payment of the guaranteed cash value to benefits that include vested, and even non-vested, index credits as of the date of death. Since a portion of the assets are held in the form of index options, the company runs the risk that the fixed portion of the portfolio will be insufficient to fund death benefits if the index is down at the time of death. If the death benefit provides for some or all of the index growth, one modeling consideration usually is the projection of interim index values to derive the death benefit exposure. Another typically is the potential for a relatively small amount of options that may be needed to be sold as the result of death benefits, but may be economically unattractive to sell. To the extent that the death benefits are not hedged, many actuaries consider potential differences between the value of the hedges and the actual value of index credits available as part of the death benefit. Depending on the level of interest rates, the index value and the value of the options held, there could be gains or losses in the event of death even if mortality does not vary from expected.

Another enhanced benefit that many equity indexed products have is a “window” at the end of the term period where the contractholder has the option to surrender without penalties. This window may extend beyond the renewal date, the time at which a company would need to purchase new fixed rate instruments and options to hedge the renewal index risk. Many actuaries model the risk that the contractholder may surrender the contract after options have been purchased. In some scenarios, the resulting mix of assets may be insufficient to fund the surrender value (this is similar to a free look benefit risk at issue; however, expected utilization of this option can be significantly higher). In addition, the surrender amount may be so small that it is not economically practical to sell comparable hedges.

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Finally, some equity indexed products have multiple index and term options that allow for transfers among the various alternatives at various times. For the most part, there are limits to the timing and amount of these options. However, if the transfer options result in disintermediation opportunities for the contractholder, then some actuaries include such risks in their models.

Q. What are some of the elements of guaranteed element risk which are unique to equity indexed products?

A. Some companies guarantee various factors impacting index credits in equity indexed products. These guarantees are generally for either one year or for the length of the term of the contract. In some contracts, there are guarantees with respect to renewal terms (such as participation rates, caps or floors), but to date, they generally have not been very significant.

The guarantee of factors impacting index credits in equity indexed products are generally similar to the guarantee of current interest rates in a fixed annuity. When a company guarantees these factors for the length of the term, the risk is analogous to guaranteeing a fixed interest rate for the same length of time. The company is taking the risk that it can manage the investment portfolio to provide for the interest and index credits resulting from the guarantees to the contractholder.

Q. What techniques are currently used to assess the impact of guaranteed elements contained in equity indexed product?

A. To assess the impact of guaranteed elements under varying economic conditions, with emphasis on situations where there is potential disintermediation and hedging risk, actuaries frequently focus on the length of the modeling period, the availability of options and the impact of renewal guarantees.

Many actuaries believe it is advisable to extend the length of the modeling period over a period that covers all material guaranteed elements. This period could extend over one or several index terms. These actuaries also typically consider the period of the assets utilized to hedge the index credits and the length and significance of the index credit guarantees. If assets are purchased to hedge several terms of index credit, or if there are significant index credit guarantees that extend over multiple terms, then they would usually extend the modeling period over at least that period of time. As a practical consideration, having the modeling period coincide with the end of an index term often has at least two advantages. First, both option and policy values (including statutory reserves) tend to be more easily determined at the end of an index term. Second, issues surrounding the handling of mid-term surrender penalties at the end of the modeling period can often be eliminated.

Many actuaries also make assumptions about the availability of options to hedge the index risk. If the contract has an exotic crediting method requiring customized options, and if there is any significant doubt about the availability of such options in the future, many actuaries would model alternative investment strategies that could be used if the custom options are unavailable. When

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modeling the purchase or sale of options at future dates, many actuaries take account of additional cost that may result if the nominal amount of options is small.

If the modeling period extends into index crediting renewal terms, both the contract guarantees and contractholder behavior at renewal are often considered. Factors including performance prior to the modeling period, the economic conditions at renewal and the terms of the renewal factors (e.g., participation rate, floors and caps) may have an impact on persistency at renewal.

Q. What techniques are typically used to model the risk that a contractholder may select against a company that has current rate guarantees for future flexible premiums on an equity indexed product?

A. To the extent contractholders are guaranteed a current interest rate for future premiums on a flexible premium policy, they have an option and can select against the insurer. This risk could vary considerably depending on elements such as economic conditions and contractholder attitudes.

When modeling this risk, actuaries generally consider factors such as the length of time the option is available, qualifiers or criteria to exercising the option, the characteristics of the business (e.g., qualified versus non-qualified or payroll deduction versus other types of flexible premium arrangements) and any relevant arrangements the company may have with option issuers with respect to option price guarantees.

Q. Do fixed income securities usually play a different role when supporting equity indexed products than when supporting other insurance products?

A. The role of fixed income securities supporting equity indexed products typically is to meet a minimum guarantee level, as opposed to supporting a crediting rate as in the case of traditional products, such as SPDAs.

Q. How does the analysis of credit risk used for hedging instruments usually differ from that used for traditional assets?

A. With the exception of exchange traded derivative securities such as the relatively short term futures and options, most hedging instruments typically used to support equity indexed products are over-the-counter (OTC) contracts. The counter-parties are typically investment banks. While credit analysis for traditional asset classes tends to focus on events which might lead to a potential downgrading of the issuer and the resulting spread widening, credit analysis for hedging instruments generally focuses on an actual default of the counter-party or a failure by the counter-party to honor the OTC contract. The existence of any provision giving the counter-party the right to terminate the option contract could also impact the analysis.

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Q. What are the differences in counter-party risks between exchange traded derivatives and OTC derivatives?

A. Exchange traded derivatives fall under the purview of exchange clearinghouses. The clearinghouse is an adjunct of the exchange and acts as an intermediary in all transactions to guarantee the performance of the parties of each transaction. Only members of the clearinghouse can trade directly in an exchange. Brokers who are not members themselves must channel their operations through a member. All members are required to maintain a margin account with the clearinghouse which is adjusted for gains and losses at the end of each business day. The purpose of the clearinghouse mechanism is to minimize the possibility of non-performance of a contractual obligation by the market participants through defaults. This has been an extremely successful system and losses from defaults have been virtually nonexistent.

However, no such mechanism exists for OTC instruments. While attempts to standardize the performance obligations of OTC contracts have been made through International Swap Dealers Association (ISDA) agreements, they have not evolved into systems comparable to a clearinghouse. Therefore, for OTC contracts, many actuaries reflect in their models the ability of the issuer to honor the obligations of the contract as well as the willingness of investment banks to post collateral on long term OTC derivatives.

In addition, unlike exchange traded instruments, OTC derivatives do not have a standardized contract structure. Contract provisions regarding details such as calculation agents, calculation procedures, terms of settlement and dispute resolution are taken into account by some actuaries.

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Q. A common technique for projecting asset defaults is to assume a level basis point reduction in yield. Is there a similar way to deal with credit risk on a hedging instrument?

A. Modeling default risks of derivative instruments is an evolving discipline. One way of incorporating such risks on a hedging instrument is to increase the interest rate that is used for discounting to reflect the potential for default. One interpretation of this adjustment is that a “risky” discount rate replaces the risk-free discount rate in derivative valuation. It is important to point out that in valuation, the discount rate enters the calculations in two ways -- to discount the expected return from the underlying security (here a risk-free rate may be used) and to discount the expected payoff (the discount rate may be adjusted to reflect default). The credit default adjustment is only made to the interest rate used to discount the expected option payoff and not to discount the expected returns of non-derivative securities.

Q. What types of risks need to be transferred under a reinsurance agreement covering equity indexed products in order for a ceding company to take reserve credit?

A. The NAIC *Reinsurance Model Act* specifies requirements for taking a reserve credit for reinsurance. Typically the risks that need to be transferred will vary by type of product. In addition, ASOP No. 7 requires that reinsurance be reflected in asset adequacy analysis.

Q. How does the valuation actuary reflect exposure limits applicable to reinsurance?

A. Because of the volatility of market values, reserves for equity indexed products have the potential to fluctuate. The valuation actuary usually considers the potential for reserves to increase beyond internal exposure limits.

Q. What are some commonly used sources of data for obtaining and monitoring different market parameters used to value options?

A. In order to monitor the market behavior of equity index options, many actuaries track several variables on a regular basis, including implied and historical volatility, dividend yields, risk-free interest rates, the equity index and correlations between movements in equity and interest rate markets. Specialized data providers (e.g., Bloomberg, Data Stream, Telerate and Reuters) routinely provide information on interest rates, equity indices and dividend yields. Using historical experience of equity index levels, one can generally compute a 30 or 60 day historical volatility. However, it is often relatively difficult to obtain data on implied volatility for non-exchange traded long dated OTC options. Most investment banks use a term structure of implied volatility (referred to as a “volatility curve”) rather than one implied volatility number. Some investment banks provide daily market updates including their perception of the mid-market levels of at-the-money (ATM) implied volatilities.

Section D: Asset Adequacy Analysis Considerations

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Q. What methods of asset adequacy analysis are used for equity indexed products?

A. ASOP No. 22 states that "both the type and depth of asset adequacy analysis will vary with the nature and significance of the asset, obligation, and/or investment-rate-of-return risks".

Cash flow testing methodologies are typically more appropriate for products where future cash flows may differ under different economic or interest rate scenarios. Because of the unique combination of equity and fixed interest rate returns that equity indexed products provide, many actuaries prefer cash flow testing as the method of choice for performing asset adequacy analysis for these products.

Q. What special concerns do some actuaries have regarding models used for asset adequacy analysis of equity indexed products?

A. Many actuaries believe that the model used to perform asset adequacy analysis for equity indexed products properly captures and assesses the various risk characteristics that substantially impact the financial results of these products. Because of the unique combination of equity and fixed interest rate returns that these products provide, many actuaries take special care that all relevant product design and market risks are reflected in the model and that the scenarios tested reflect the expected return and volatility of the underlying funds and reasonably cover the distribution of possible outcomes.

Many actuaries also consider how accurately the product design and features are modeled and consider reviewing the model to understand the interaction of various factors and to assess whether the risks are adequately modeled. The decision whether to use cash flow testing and the choice of deterministic or stochastic scenarios are thought by many actuaries to be especially important in this assessment. Scenarios that are moderate in their movements, but in combination produce adverse consequences, are of special concern. Among these are "hedge hugger" scenarios (discussed above) that produce low option payoffs, and in which moderate rises in interest rates and moderate falls in the equity market result in higher lapses than anticipated.

The interaction of lapses with volatility in interest rates and the market index may result in a wider distribution of possible outcomes. Many actuaries prefer to use Monte Carlo simulation to perform cash flow testing since it provides the capability to reflect the interaction of these factors and to capture the distribution of possible outcomes.

Q. Are there any special considerations in determining the assets to be allocated to equity indexed products for asset adequacy analysis?

A. Section 10B of the *AOMR* gives the basic requirements. Typically, statutory reserves for equity indexed products are less than the value of the assets supporting the products. In choosing

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assets, actuaries often verify that the assets allocated to the product for asset adequacy analysis (which are required to equal the reserves) reflect the unique characteristics of the entire portfolio of assets. If assets which have the potential to produce large gains or losses under different economic scenarios are not allocated to the equity indexed product, many actuaries believe this could impact the resulting analysis.

Q. What are some of the ways to correlate fixed interest and equity scenarios when performing asset adequacy analysis?

A. To properly consider the risks inherent in equity indexed products, many actuaries consider a broad range of economic conditions that measure different combinations of equity index and fixed interest rate performance. While asset adequacy analysis for traditional products is usually performed using a set of scenarios reflecting the movement of market interest rates, many actuaries augment the analysis in the case of equity indexed products to reflect a range of different equity market (i.e., index) movements within each of the interest rate scenarios.

Some of the ways to accomplish this include random generation of index movements within each fixed interest rate scenario and using a formula to model index movements in relationship to the fixed interest rate (e.g., expected return on the index equals the ten year yield minus the three month yield times a coefficient plus a constant -- see research by Craighead and Tenney, and by Becker).

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Q. What special considerations apply to modeling the company's investment strategy for equity indexed products?

A. ASOP No. 7, section 5.4.2 states that "the actuary should consider the insurer's strategy concerning asset management and the effect that this strategy will have on the projection of asset cash flow." Many actuaries model the actual investment strategy as closely as possible. If there are deviations between the strategy used and the strategy modeled, those actuaries consider the potential effect the deviation may have on the results of the analysis.

Q. How do actuaries model option replication strategies?

A. One approach used by actuaries if a company uses an option replication strategy is to calculate the price of assets purchased or sold during the course of each modeled scenario. Some actuaries use a pricing model that employs risk neutral scenarios; others use the equivalent closed form formula, if one exists, for determining hedge ratios (i.e., investment proportions in the available assets). In the event such a pricing model is used, the actuary may wish to consider the effect of model specifications and parameters on the actual exposure of the portfolio to changes in the stock index, dividend yield and interest rates.

Q. What value is there in modeling scenarios deterministically?

A. Deterministic scenarios generally can help examine what drives the results of the model, and often can address risks that occur too infrequently to be uncovered by a reasonable number of stochastically generated scenarios. If used without stochastically generated scenarios, deterministic scenarios usually make it more difficult to demonstrate that all combinations of risk and a reasonable distribution of all possible outcomes are being examined. Many actuaries believe it is preferable not to use deterministic scenarios as the sole basis of cash flow testing for equity indexed products.

Q. What are the differences between a risk neutral probability and a realistic probability?

A. Realistic probability is the probability of events in a model that are believed to be an accurate forecast of their future likelihood, usually based on historical estimation. Risk neutral probability is a calculational tool for solving for the price of a contract when the underlying model is arbitrage free in the sense that there exists no strategy under which, by buying and selling at the prices in the realistic probability version of the model, one can invest zero money, have no risk of loss and some positive probability of ruin. Risk neutral probability is not defined for a model which is not arbitrage free in this sense. It is distinct from calibration of a model's parameters or variables to an initial set of market data (e.g., treasury yield curve or set of option prices of different strikes and maturities). The Black Scholes model is a good example of arbitrage free models. The Cox, Ingersoll and Ross interest rate model is an example of an arbitrage free model of interest rates.

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Risk neutral probability is used for calculating price, such as the price of an insurance contract. The proceeds from selling an equity indexed product less costs typically exceeds the price of the equity indexed product calculated by risk neutral probability if the company is earning a profit consistent with the risks modeled in the risk neutral probability calculation. If this condition exists, then there also exists a dynamic strategy that diffuses the liability under all scenarios, assuming that the model assumptions are correct.

For risk control, the assets typically have a market value that exceeds the risk neutral price, even if such a dynamic strategy will not be pursued, since non-dynamic strategies holding the model assumptions constant usually lead to an inferior set of net payoffs to the company. For all other purposes, real probability is generally used, including risk analysis, profitability and investment strategy.

Q. Are “gliding” models, where an option price is assumed to follow a curve from its initial price to its termination price, appropriate for valuing equity indexed products?

A. If stochastic modeling is used, the option prices produced by such a “gliding” model may not have sufficient volatility to accurately track an option pricing model. Many actuaries believe that “gliding” models are generally inappropriate for modeling option values supporting equity indexed products, and that using a model which produces accurate option values at all points in time is usually more appropriate.

Section E. Hedged As Required - Option Replication

Q. What is Option Replication?

A. Option Replication is an investment strategy in which an investor will use one or more financial instruments to attempt to mimic the market value changes of a targeted option. The financial instruments used may be cash, debt instruments, futures, or option contracts. The targeted option may be a single position, or a group of positions.

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Q. Why would a company use an Option Replication Strategy?

A. The motivation in using an Option Replication strategy is an expected reduction in the cost of the option position to the investor. It should be noted that this reduction in cost usually increases the risk to the investor. This increased risk is usually in the form of increased uncertainty about the ultimate cost of the option.

Potential savings to an investor employing an Option Replication strategy come from:

- a) assuming the risk that future option costs will rise, thereby avoiding risk charges;
- b) eliminating packaging costs that an option trader will build into an OTC option price, and
- c) realizing economies of scale by aggregating hedging activity.

If the Option Replication strategy is successful, then changes in the market value of the basket of financial instruments used to replicate the option(s) should track changes in the market value of the targeted option(s). Any divergence in the market values of the positions would indicate that the replication is less than completely successful.

Q. What are some types of Option Replication Strategies?

A. The most typical Option Replication Strategy is to use a combination of futures, short-term calls and puts, and Eurodollar futures to replicate a longer-term option. Buying the right mixture of these instruments will produce a portfolio that will mimic the market value behavior of a longer term option, with respect to movements in the underlying instrument. A different combination, and perhaps different instruments, might be necessary to mimic changes in market values due to swings in interest rates or volatility.

Another type of option replication is to use a combination of European calls, puts, futures, and fixed instruments to replicate a more complicated option such as a High Water Mark or Asian Option. The terms and amounts of the options and futures would be determined so that the combined market value of the replication strategy moved in tandem with the market value of the targeted option as market conditions (price of the underlying, implied volatility, interest and dividend rates) changed. These positions would have to be monitored and changed as market conditions changed. Frequently, just the passage of time may cause the need for positions to be changed to maintain the strategy.

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Q. What are some methods that can be used to monitor an Option Replication Strategy?

A. Three possibilities are:

The Greeks: Quantitative hedging experts who monitor hedge positions typically calculate a series of derivatives (in the calculus sense) to measure expected changes in the market value of the hedge due to a change in one or more components of the market conditions. For example, “delta” measures the change in market value that will occur for a given change in the underlying security. “Vega” measures the change that will occur for a change in the implied volatility of the underlying security. The list goes on, and includes second and third derivatives.

This approach to risk management is similar to managing the duration of assets and liabilities, which will likely be familiar to most actuaries. Sophisticated software is used to measure the risk characteristics (i.e., the "greeks") of the option replication portfolio and compare that to a similar analysis done on the targeted option or on the actual liability portfolio. This type of analysis usually requires sophisticated software, the expertise to use it, and the ability to judge how many greeks to match and how closely.

Market Value Movement: This is a retrospective test and is usually used to monitor a portfolio already established using one of the other methods. What is involved here is the retrospective measurement of the market value movement of the Option Replication Strategy. This is compared to the market value movement of the target or liability. This is used to monitor the Hedged As Required criteria.

Scenario Analysis: This is similar to multiple scenario testing that is used for pricing or Cash Flow Testing. Here, a Replication Strategy is tested over a variety of fixed and stochastic scenarios to test how well it replicates the targeted option, or liability. Actuaries using this technique are generally careful to vary all the parameters that are crucial to option pricing. These actuaries generally use enough scenarios to get a full taste of the goodness of fit. If enough scenarios are used, covering a sufficient variety of parameters, the results generally will give the actuary information that is identical to (a) above. A subset of this category is to look at some worst case scenarios to understand how the option replication strategy might perform under some severe situations.

Q. What certification will the actuary provide?

A. For an insurer using an option replication strategy to satisfy the “Hedged as Required” criteria, the actuary certifies that the insurer is meeting the requirements of the “Hedged as Required” criteria applicable to Option Replication strategies. Particular attention is usually given to Items 1, 2, and 5 in the criteria since these criteria differ from the comparable requirements in the standard “Hedged as Required” criteria.

Q. What reliances, if any, will be permitted?

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A. When preparing the required actuarial certification, the actuary may rely on data supplied by others. The actuary should be mindful of the guidelines provided in Actuarial Standard of Practice No. 23 dealing with Data Quality.

Q. Can one switch from the standard Hedged As Required criteria to these criteria?

A. Yes, a company may switch criteria if their strategy changes. It is possible when starting to issue equity indexed annuities a company may use a buy and hold strategy, but as critical mass is built, it may be desirable to switch to an option replication strategy. If a company's investment strategy changes it may be appropriate to switch which Hedged As Required criteria the company is complying with. If a company does switch criteria, the company is required to notify the commissioner of their state of domicile in a timely manner.

Q. Can a Company have some products covered by the standard Hedged As Required criteria and other products covered by these criteria?

A. Yes, it is possible to have products covered under both sets of criteria at the same time. Different products may lend themselves to different option strategies. In addition, different issue periods of the same product may have different option strategies. When first starting to sell equity indexed products, a buy and hold strategy may be employed. As the sales volume increases, a company may choose to use option replication for newer issues. The actuary usually provides the different certifications required for the standard criteria and for these criteria.