



FINAL

PROVISION FOR ADVERSE DEVIATIONS

FINAL VERSION AS APPROVED BY COUNCIL

IN EFFECT - JANUARY 1, 1990



Canadian Institute of Actuaries

Institut Canadien des Actuaires

MEMORANDUM

PROVISION FOR ADVERSE DEVIATIONS

To: All CIA Members
From: James A. Brierley, Vice-President
Date: March 12, 1990
Subject: Recommendations for Life Insurance Company Financial Reporting
• **Provision for Adverse Deviations for GAAP Life Insurance Company Valuation**

The exposure draft of this standard of practice dated June 1988, was distributed to all members on August 11, 1988. Following the Institute's interim rules for due process, the Committee on Life Insurance Company Financial Reporting and the Committee on Standards of Practice each approved a modification of the exposure draft based on comments from the members during, and subsequent to, the exposure period.

At its November 1989 meeting, Council gave final approval to this standard of practice. The attached standards, which become effective the date of this mailing, are for use in the valuation of life insurance company liabilities in accordance with GAAP.

JAB

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SECTION 0 – INTRODUCTION

0.0 Environment

In August 1984, the Committee on Life Insurance Financial Reporting (CLIFR) of the Institute published its comments on the report of the Joint CIA/CICA Task Force on Life Insurance Company Financial Reporting.

In March 1986, the CIA Council formally adopted, by majority vote, the August 1984 CLIFR report as the CIA's official position on financial reporting for life insurance companies under generally accepted accounting principles. That is, the Council endorsed the policy premium method for GAAP, but with the provision that its use be preceded by the establishment of appropriate standards for the provision for adverse deviation and for the retention of surplus. (It should also be remembered that legislative changes are required before these standards take effect.)

At its meeting of June 4, 1986, the CLIFR gave the following mandate to the Subcommittee on Provision for Adverse Deviation (PAD):

- Give some quantitative standards to Valuation Actuaries for margins (e.g., fixed value for a margin or give a kind of corridor for it) and find areas for which exceptions are appropriate.
- Develop guides that will:
 - be more precise
 - be stricter
 - deal with each assumption
 - be more practical (less technical)
- Standards have to be developed for use with the policy premium method for the income statement under GAAP. The standards in this paper apply to general situations and are subject to the standards in valuation technique papers (VTP) for special situations.
- For each assumption, there must be a margin only for the misestimation of its mean and the possible deterioration of the mean.

Note: There was a general consensus that, for valuation under GAAP, the provision for adverse deviation should not encompass catastrophic risks. Moreover, statistical fluctuation was considered to be more closely related to surplus standards required to ensure solvency.

- At present, work only on individual life insurance.

It should be mentioned that, before the mandate was given in June 1986, the subcommittee had been working for more than a year on three basic approaches to define margins and submitted these to the CLIFR in March 1986. These approaches were risk theory, stochastic models and simulations. The risk theory's approach was not considered very flexible. There were difficulties in integrating the interest rate assumption.

A great deal of energy was spent on the second approach, namely stochastic models. The basic model was considered simple and flexible. More importantly, the margin was to cover statistical fluctuation at that time and the stochastic models were well suited for that purpose. However, it was found that important practical problems resulted from using this approach: in

its pure form, the model requires that all data on all plans in force be known at the same time so that covariances can be valued. To overcome this problem would require so many approximations that the essential nature of the model would be lost.

The simulation approach was also studied. Simulations are sometimes the only possible alternative to evaluate a risk. In our case, the number of simulations is by far too important when we want to take into account the numerous parameters of insurance business. It was concluded that the best way to define the margin, when taking the timetable into account, was to use a more traditional approach.

Given that background, the CLIFR subcommittee on PAD prepared a discussion draft covering non-par individual life policies that was reviewed by the CLIFR and submitted to the Council in June 1987. The paper was then distributed to Valuation Actuaries in August 1987 in order to obtain input on the approach chosen and the different parameters. A survey was also distributed in September 1987 as a formal way of receiving the input.

Following the survey, many changes were made. The principal ones are listed below:

- The approach of arriving at the margin for the interest and the expense assumptions was modified.
- The section on the lapse assumption was modified to put more emphasis on principles to follow instead of showing only a detailed formula to be applied for each and every cell.

Note: We hope that the modification will give an answer to the question of whether the margin must be met on a seriatim basis for every different type of policy, or whether it would be sufficient to show overall compliance for a large block of business. For many years, the profession has had Recommendation 3.02 which says: "The member should not make the same assumption for two policies unless he expects that their experience for that assumption will be similar." The previous draft implied detailed compliance. We have modified it because we have no intention of intervening in the interpretation of 3.02.

0.1 Overview of the Approach

In essence, the subcommittee's approach was to transform the general principles of Recommendation 3.09 into a series of both qualitative and quantitative standards for each of the mortality, interest, expense and lapse assumptions to help the Valuation Actuary in determining the level of each margin.

Although Recommendation 3.06 says that a valuation assumption is a combination of an expected assumption and a margin for adverse deviation, the subcommittee has been confronted with the fact that margins are usually implicitly set. Since the expected assumption should be the Valuation Actuary's best estimate of the future experience of the product of his company, the subcommittee prepared notes to be considered by the actuary in defining each expected assumption. These notes serve as a guide for the factors that should be covered by an expected assumption. Although they are highly recommended by the CLIFR, they are not mandated. In their present forms, these lists are illustrative rather than exhaustive and include without distinction both important and trivial items.

The first type of standards are the qualitative standards (herein called considerations). These considerations are defined for each assumption and serve to describe the extreme situations in terms of the level of the margin. The situation of the product and the company with regard

to considerations mentioned in these two extreme situations will be the basis for the Valuation Actuary's judgment of the level of the margin required. Some considerations, which are defined below as *significant considerations* preclude the selection of a margin near the low end of the range.

The second type of standards are the quantitative standards (herein called parameters). These parameters are also defined for each assumption and serve to define the margin for the two extreme situations (e.g., the low and high margin situations). In choosing the different parameters, the objective pursued was that of determining a *fair risk charge* with an *appropriate release in the income statement* for the risk assumed in every period for each assumption. In this area, the subcommittee has been breaking new ground.

It is very important to understand the process that was followed to arrive at these different parameters. The first step was to review the different methods used to set an explicit margin. For example, the explicit margin for the mortality assumption is often a percentage of the expected assumption or a function of the life expectancy for the different versions of the CSO tables. The level of the margin was then analyzed, bearing in mind the purpose of the current valuations (e.g., a solvency test). The method used to choose the level of **HIGH** margin for each assumption was to compare the first year provision for adverse deviation that each **HIGH** margin produces.

That exercise was done for three different products, namely non-par whole life, low cash value endowment to 100, and a 20-year term. For each product, we made sure that the provision produced by an assumption was logical in relation to those produced by other assumptions (whether an assumption was or was not a critical assumption as defined in Recommendation 3.03). We have included some of our results in Section 6 of the report to help you appreciate the choice of the subcommittee.

Once the **HIGH** margins were set, we verified the first year provision they produced by comparing it with two measures, namely the first year profit in a situation without margin and the gross premium. It was then decided to set **LOW** margins at 25% of **HIGH** margins. We feel that, at this stage, there is no "right answer" to the question of how much margin is necessary in each circumstance. However, what is important is that these parameters are reasonable in the eyes of the profession considering the points mentioned above.

VALUATION ASSUMPTION FOR APPROPRIATE INCOME STATEMENT

SECTION 1 – DEFINITIONS

Margin Part of the valuation assumption covering the uncertainty related to the expected assumption (see Recommendation 3.06).

Provision Additional reserve created by adding a margin in an assumption.

Adverse deviations In this document, adverse deviations take into account the misestimation and the deterioration of the mean of the assumption and do not take into account the statistical fluctuations and catastrophic occurrences.

Parameter Quantitative standards that define the margin for the two extreme situations of the low and high margins. The following parameters are used:

ASSUMPTION	PARAMETER
<i>Mortality</i>	The parameter is a constant, divided by the life expectancy of the expected mortality assumption.
<i>Interest</i>	The parameter decreases the interest rates expected from the current assets over their remaining lifetime.
<i>Expenses</i>	The parameter is a positive percentage of the expected assumption. There are also some constraints on the projection of the current unit expenses into the future.
<i>Lapse</i>	The parameter is a percentage (greater or lesser than 100% depending on the sign of the nonforfeiture value less the reserve) of the expected assumption. The margin is the resulting increase or decrease in the assumption.

High / Low margin situations For each assumption, extreme cases in terms of level of the margin are described by qualitative standards (herein called considerations).

The situation of the product and the company with regard to considerations mentioned in the low and high margin situations will be the basis for the Valuation Actuary to determine the level of the margin.

Significant considerations Some considerations, which are defined below as *significant considerations* preclude the selection of a margin near the low end of the range.

SECTION 2 – ASSUMPTION: MORTALITY

2.0 Introduction

The subcommittee worked on three main approaches:

- A) A valuation table equal to a blend of the expected assumption of the Valuation Actuary and a standard table

Both the CLIFR and our subcommittee agree that this method may produce some unusual results. We must respect, as much as possible, the distribution of mortality experienced and expected in each company because the characteristics of each insured population may vary.

- B) A valuation table equal to x times the expected assumption

This kind of formula cannot be applied across the board. We must use different factors for lower and higher rate of mortality to achieve appropriate margins. By the same token, fairness cannot be achieved if some other factor is not present to take into account the different level of mortality of the table.

- C) A process similar to the one used for the CSO mortality tables

The first two methods were rejected because of problems it generated as previously described. The proposed method is already generally accepted by the profession, does not cause any particular problem and meets the basic requirements. The level of margins proposed is consistent with other assumptions and lower than CSO margins. We are looking for proper income reporting rather than solvency as examined by the CSO.

Also, this approach (contrary to method B) implies that the margin is inversely related to the expected assumption, a desirable characteristic. (Please refer to TSA XXXIII, p.640-655 for more details).

2.1 Definition

The valuation assumption is the sum of an expected assumption plus a margin defined as a constant divided by the expectation of life.

The margin will be determined by the Valuation Actuary considering the situation of the product and his company. The margin should lie between the following parameters:

	Margin per 1000
Situation of high margin	$15/e_x$
Situation of low margin	$3.75/e_x$

where e_x is calculated on the curtate basis using ultimate rates and x is the attained age (e_x does not consider the benefit period because the risk is a function of the attained age only).

When one out of the three significant considerations that leads to a high margin situation is present, the margin must be at least the average of the high and low margins.

Note The standards in this section apply to general situations and are subject to standards in VTP 2 for special situations.

If it is more practical, the Valuation Actuary can use the following approach to approximate the margin expressed as a constant divided by the expectation of life:

Margin: $Aq_x + B$ where B must be positive.

It must be verified that both methods produce the same level of margin in aggregate.

2.2 Expected Assumption

The expected assumption should be the Valuation Actuary's best estimate of the future experience and trend for the product.

When available, the actuary should consider successively the following sources:

1. his own company's experience and studies (only to the extent that it is more credible than (2) below);
2. intercompany studies if (1) is not available.

In defining the expected assumption, the actuary should consider the following list of items:

- Number of distinct rates
 - composite vs. smoker/nonsmoker
 - unisex vs. male/female
- Mortality projection (possible variation by age)
- Plan type
 - short term vs. whole life
 - Valuation Technique Paper No 2 – Valuation of Renewable Term Insurance
- Characteristics of the product (options and benefits)
 - conversion privilege
 - paid-up options
 - guaranteed insurability
 - antiselection option
- Distribution system
 - direct mail
 - brokers
 - career agents
- Underwriting rules regarding constraining laws (unisex rates, blood tests)
- Reinsurance and/or coinsurance treaties (level of the retention)
- Average face amount
- Policy of internal replacement
- Pricing plan: desired markets
- Geographical situation (location of the business)
- External factors: social, economical and medical developments

2.3 Description of the High Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the high margin situation.

I. Misestimation

- It is a new type of benefit or a new way of distributing the products; the limited experience results in published or experience data being either inapplicable or not credible (e.g., new desired market, mortality study without detailed results).
- There is little similarity in the characteristics of the insured (e.g., same premium by sex and/or smoking habit).
- * • The credibility of the company's experience and studies is too low to be the main source of data.

II. Deterioration

A) COMPANY

i) Structural

Products

- * • The persistency rate of the product is low (e.g., five-year renewable term, old product with low return on cash value, etc.).

Distribution system

- Antiselection by the sales force.

Management

- The company is slow to protect itself against changes which adversely affect it.

ii) Discretionary

Products

- New product with composite rates (for both sexes, different smoking habits, different classes of risks, etc.).
- A policy of internal replacement is favorable to rotation of the old business.
- Antiselection on certain options and benefits (paid-up addition, guaranteed insurability options, conversion privilege) affects the mortality of certain specific plans of a company.

Management

- * • Weaker underwriting criteria are implemented.

B) THE INSURED

Antiselection is present from explicit or implicit *reentry* options for healthy lives or from underwriting criteria.

* *significant consideration*

2.4 Description of the Low Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the low margin situation.

I. Misestimation

- The company has credible experience data for this product.
- The characteristics of the insured lives are very similar.

II. Deterioration

A) COMPANY

i) Structural

Products

- The product is well adapted to evolving market conditions and has a good persistency rate.

Distribution system

- The sales force follows good selection procedure.

ii) Discretionary

Products

- A policy of internal replacement is unfavorable to rotation of the old business.

Management

- Stronger underwriting criteria are implemented.

B) ENVIRONMENT

There are favorable medical developments.

SECTION 3 – ASSUMPTION: INTEREST RATE

3.0 Introduction

The margin for adverse deviation for any investment assumption with respect to assets acquired after the valuation date is determined in accordance with Valuation Technique Paper N° 3.

The margin for adverse deviations for an assumption regarding the rate of interest when an existing asset is sold (or alternatively, money is borrowed) in order to meet negative cash flow is at the discretion of the actuary.

The margin for adverse deviations for all other investment assumptions is determined in accordance with this paper. These other situations are:

- The timing of cash flow which requires a reinvestment or a disinvestment, or which results from the exercise of an option by a policyholder or an issuer of a security: the adverse risk is that the positive cash flow is more than expected when interest rates are low, and the negative cash flow is less than expected when interest rates are high.
- The rate of default: the adverse risk is for defaults in excess of those in the expected assumption.
- The rate of investment expense: the adverse risk is for expense in excess of those in the expected assumption.

3.1 Definition

The margin will be determined by the Valuation Actuary considering the situation of the product and his company. The margin should lie between the following parameters:

	Margin
Situation of high margin	2%
Situation of low margin	0.5%

When one out of the three significant considerations that leads to a high margin situation is present, the margin must be at least the average of the high and low margins.

3.2 Expected Assumption

The expected assumption should be the Valuation Actuary's best estimate of the future experience of the product.

When they are available, the actuary should consider the following sources:

1. his own company's experience and studies
2. future investment rates (positive and negative cash flows)
3. asset default studies

In defining the expected assumption, the actuary should consider the following variables:

- Valuation and allocation of assets and investment income:
 - segmentation of assets
 - method of allocating investment income

- types of assets backing the liabilities
- method for valuing assets
- capital gains and losses
- Asset default risk:
 - concentration vs. diversification (geographical, industry, ...)
 - types of investments (bonds, mortgages, shares, ...)
 - types of risks (interest/dividends, capital/value)
 - liquidity
 - quality of asset
 - term of investments
 - economic conditions
- Matching:
 - need for reinvestment or disinvestment
 - current and future investment rates
 - new money or aggregate product
 - possible options against the company
 - flexible term of investments (extendible or callable)
 - investment policy
 - type of assets
 - activity of traders
- Possible options against the company (The member should assume that both the borrowers and the insured who benefit from doing so will tend to exercise contractual options to the company's detriment.):
 - Asset:
 - cash value and reinvestment
 - early repayment and breaking of the contract
 - nonguaranteed income
 - forward commitments and breaking of commitments
 - policy loan borrowing and repayment
 - for the assets with repayment options presently owned, options will be fully exercised when the difference between the guaranteed rate on the asset and the current rate is equal to or greater than 5%
 - Liability:
 - cash value and policy replacements (interest rate credited, cash values, penalties)
 - options to alter or adjust the policies
 - minimum rate guaranteed over a long period
 - rate guarantee
 - to define cash flows, consider the more conservative of the expected assumption and the maximum margin assumption for the expense, lapse and mortality assumptions
- Fiscal considerations:
 - Investment expenses:
 - level of expenses
 - correlation between investment expenses and the inflationary part of the investment rate

3.3 DESCRIPTION OF THE HIGH MARGIN SITUATION

Important note

The more the following conditions exist, the closer the margin should be to the high margin situation.

I. Misestimation

- The cash flow projections are not sophisticated.
- The valuation applies to a new product, a new type of benefit, a new market or a new distribution system with little experience for cash flow projections.
- The investment allocation method is not particularly sophisticated (e.g., average funds).
- * • The interest rate assumption is not directly determined from an explicit allocation of assets and investment return.
- The information for the determination of the asset default risk margin is of low quality.
- Investments include items other than fixed income investments.

II. Deterioration

A) COMPANY

i) Structural

Products

- Antiselection is possible because of loose contractual clauses.
- Guaranteed cash values (other than those with market value adjustment features) are important.

Assets

- Liabilities are covered by assets in cases where options could possibly be exercised against the company:
 - callable assets
 - extendible assets
- * • Matching is inadequate or inadequately verified.
- The quality of assets is lower than average.

Management

- The company is slow to protect itself against changes which adversely affect it.
- * • The investment policy is not clearly defined or understood by the actuary.

ii) Discretionary

Circumstances encourage the rapid turnover of assets (e.g., remuneration policies, internal replacements policies).

Investment policies

Policies producing less easily predictable investment return.

B) ENVIRONMENT (economic, governmental measures such as monetary and fiscal policies ...)

- Products are developed to take advantage of a favorable environment (e.g., products based on high interest rates, products are priced with the assumption of high increases of assets).
- Important interest rate variations
- These variations are currently difficult to predict: economic instability.

* *significant consideration*

3.4 Description of the Low Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the low margin situation.

I. Misestimation

- The cash flow projections are sophisticated.
- The valuation applies to an existing product with a good experience for cash flow projections.
- The investment income allocation is relatively sophisticated.
- The interest rate assumption is directly determined from an explicit allocation of assets and investment return.
- The information for the determination of the asset default risk margin is of high quality.
- The investments allocated are fixed income investments.

II. Deterioration

A) COMPANY

i) Structural

Products

- Little chance of antiselection because of strict contractual clauses.
- Cash values are small or nonguaranteed with market value adjustment.

Assets

- Assets backing liabilities rarely allow the opportunity of exercising options.
- Matching is verified and found adequate.
- The quality of assets is higher than average.

Management

- The company adjusts rapidly to changes.
- The investment policy is clearly defined and understood by the actuary.

ii) Discretionary

Circumstances do not encourage the rapid turnover of assets (e.g., remuneration policies, internal replacements policies).

Investment policies

Policies favor predictable investment return.

B) ENVIRONMENT (economic, governmental measures, such as monetary and fiscal policies, ...)

- The economic situation is stable.
- There is a long-term forecast of economic stability.

SECTION 4 – ASSUMPTION: ISSUE AND ADMINISTRATIVE EXPENSES AND INFLATION RATE

4.0 Introduction

A strict definition regarding issue expenses is not required when the valuation method does not specify a maximum issue expense that may be deferred. However, a more specific definition of administrative expenses is needed, since they have a significant impact on the reserve level.

Except for the extraordinary expenses defined in Section 4.2, the Valuation Actuary must make sure that all the issue and administrative expenses assumed in the calculation of reserves represent the amount of expense taken from the annual statement for all lines of business. These expenses include general expenses (excluding investment expenses which are already deducted from investment revenues), premium taxes, licensing as well as fees, commissions and bonuses paid to agents or brokers.

The Valuation Actuary should avoid an overestimate of issue expenses which leads to an understatement of administrative expenses. To prevent that situation from occurring, the expected assumption for expenses is described in a very detailed form. However, the Valuation Actuary should assure himself that the total administrative expenses assumed in the valuation (through its unit expense value) exceed the expenses incurred by the company.

4.1 Definition

The valuation assumption for the year of valuation is the sum of an expected assumption plus a margin defined as a percentage of the expected assumption, excluding premium taxes, commissions and bonuses.

The margin will be determined by the Valuation Actuary considering the situation of the product and of his company. The margin should lie between the following parameters:

	Margin
Situation of high margin	10.0%
Situation of low margin	2.5%

When one out of the three significant considerations that leads to a high margin situation is present, the margin must be at least the average of the high and low margins.

The unit expenses (excluding the commissions and bonuses) must not decrease when projected into the future. The projection must be related to the current inflation rate and the increasing rate of in-force.

Moreover, beginning no later than twenty years after the valuation date, unit expenses should increase at a rate no less than the difference between 3% and the reinvestment interest rate assumption at that time.

4.2 Expected Assumption

i) Principles

The expected assumption is determined by the Valuation Actuary using an internal expense analysis of his own company and nothing else.

In defining the expected assumption, the actuary should consider the following items:

Pricing Assumptions

- The limitation in the degree of flexibility for adjustments in gross premium due to the nature of the premium guarantees, their duration, and the guaranteed maximum increase for the gross premium
- A certain consistency between pricing and valuation assumptions regarding issue and administrative expenses and the inflation rate

Company Characteristics

- In-force amounts and expected growth rate, particularly in the case where the expected growth rate is used to reduce the assumed inflation rate in the reserve calculation
- Company policy regarding the control of general expenses
- The write-off of some general expenses and their duration (write-off expenses are not subject to inflation)
- Celerity in revising the nonguaranteed premiums and other policy values to reflect the difference between expected and realized experience
- Distribution of the in-force amounts by lines of business and their respective growth rates
 - Any development plan regarding a line of business will affect the distribution of the general expenses (particularly the expenses indirectly imputed to a line of business).
- Distribution of the in-force amounts within a line of business by products and their respective rates of growth
 - There could be different unit expenses by products or by the type of guarantees (e.g., contracts, riders, clauses).

Commission scales and renewal bonuses

- The probability of agent-turnover, particularly if the commissions and/or bonuses are not vested
- Company policy concerning orphan policies
- Company policy concerning replacement of policies
- Differences in compensation

ii) Methodology

The expenses for which an assumption is required are general expenses, premium taxes, licensing, fees, commissions and bonuses, excluding any extraordinary expenses which are nonrecurrent.

Note: To be treated as an issue expense, there must be a cause-and-effect relationship between the expense and the production of new business (i.e., issue expenses generate new business and new business generates issue expenses).

Subject to the above, for a company operating on the branch office systems, issue expense could include all or part of the following, depending on the circumstances of the company:

- first-year commissions and bonuses
- some heaped renewal commissions
- agency convention costs
- agency manager salaries
- regional manager and head office sales supervisory
- executive salaries
- agent support costs (e.g., proposals)
- out-of-pocket underwriting expenses (e.g., inspection report fees)
- head office and field underwriting staff salaries
- policy issue staff salaries
- expense related to the above expenses (e.g., rent and fringe benefits)

For a company selling by mail order, some issue expense is incurred before issue:

- out-of-pocket expense for *rental* of mailing list
- cost of mail order campaign

4.3 Description of the High Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the high margin situation.

I. Misestimation

- *
 - The distribution of general expenses by line of business, by product, by issue and administrative expenses is based on an obsolete internal expense study.
 - A change is likely in the distribution of the in-force among lines of business or products which can alter unit expense rates.
- *
 - There are different compensation contracts for full-time agents, brokers and general agents; the distribution of in-force amounts and volume of new business is unstable among these three groups and alters unit expense rates.

II. Deterioration

- The volume of new business and in-force amounts, as well as their respective growth rate are very unstable.
- The level of administrative expenses assumed in the reserve calculation is based on hypothetical or poorly established cost-control measures.
- The renewal bonus paid is calculated as a function of lapse rates which can fluctuate.
- Different compensation contracts exist for agents and brokers, and the lapse rates for policies sold by one or the other are different.

- *
 - An assumed increasing rate of in-force is used to reduce the assumed inflation rate.
 - The inflation rate used before the ultimate period is less than the average inflation rate experienced in the last few years.
- * *significant consideration*

4.4 Description of the Low Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the low margin situation.

I. Misestimation

- The distribution of general expenses by lines of business, by product and by issue and administrative expenses is based on an internal expense study which is validated each year.
- The distribution of in-force amounts is very stable by line of business and by product over time.
- The same compensation contract applies to all full-time agents, brokers and general agents.

II. Deterioration

- The volume of new business and in-force amounts as well as their respective growth rates are stable.
- The level of administrative expenses assumed in the calculation of reserves is supported by efficient and well established cost control measures.
- The renewal bonus is quite stable and not particularly affected by lapse rates.
- The renewal commissions and bonuses are paid to the agent after his departure but are still accounted for in the valuation.
- The ultimate inflation rate assumed is at least the difference between 3% and the ultimate reinvestment interest rate used in the calculation of reserves.
- The inflation rate assumption is completely independent from the growth rate of in-force.

SECTION 5 – ASSUMPTION: LAPSE RATES

5.0 Introduction

The margin for lapse rate should recognize the following principles:

- The margin must increase reserves at each duration: this situation implies a positive margin when the nonforfeiture value is greater than the reserve, and a negative margin when the opposite is true.

Corollary 1: The margin may differ by issue age and duration.

Corollary 2: The provision will not be affected by any choice of margins when nonforfeiture values and reserves are identical.

This situation can be seen by looking at the release in policy year t from the provision for adverse deviations:

$$R_t = (1 - q_t^d) \cdot W_t \cdot (NF_t - V_t) \quad \text{for } t > 1$$

where:

q_t^d Mortality rate for policy year t

W_t Margin added to the expected lapse rate for policy year t

NF_t Nonforfeiture value at the end of policy year t

V_t Reserve at the end of policy year t

- The margin must be greater when the event is farther in the future: past history shows us that the general principle is justified for lapse rates.
- Recommendation 3.03 (The actuary should give more careful study to those assumptions for which reserves are more sensitive) the subcommittee's approach should put the emphasis on situations in which reserves differ materially from nonforfeiture values.
- Valuation Technique Paper No 1 takes precedence over these recommendations.

These principles lead us to an approach with rigid parameters for the sign and the magnitude of the margin, but which is applicable in a flexible way *for different mixes of products*, age and duration.

5.1 Definition

The valuation assumption is a percentage (hereafter called the *margin percentage*) of the expected lapse rate. The actuary should select a percentage (hereafter called the *selected percentage*) within the range between the high margin situation and the low margin situation from the following table, based on the situation of the product and his company. Where the sign of the nonforfeiture value less the reserve (hereafter called *sign*) changes (the date of change is hereafter called a *crossover*) there should be two selected percentages.

Each policy has a *crossover* at its maturity and the typical policy has a *crossover* during its early policy years. Several *crossovers* are possible although, where they are numerous, reserves may not be sensitive to the lapse assumption.

The actuary should set the *margin percentage*:

at the appropriate *selected percentage* at sale and at each mid-point between *crossovers*

at 100% at each *crossover*, and

at an interpolated amount at other dates.

	<i>SIGN</i>	
	+	-
Situation of high margin	140%	60%
Situation of low margin	110%	90%

Generalized Model

Most of the products may be covered by the following model:

Point A The first duration where the reserve is higher than the nonforfeiture value

Point B Beginning of the period, ending at maturity of the contract, for which the cancellation of the contract would have no clear advantage or disadvantage to the insured

Percentage	Event or Period
% in the table	Duration 0 ⁽⁴⁾
100%	Point A ⁽⁵⁾
% in the table	Mid-point between A and B ⁽¹⁾
100%	Period starting at Point B ⁽³⁾
Interpolation between known points	For durations not defined above ⁽²⁾

- Notes:
- (1) Principal period where the margin is applied
 - (2) Ensure continuity and increasing margin before the basic period
 - (3) Usually the second half of a permanent policy and the majority of a term policy
 - (4) Usually the period to recover the issue expenses and where reserves are negative
 - (5) Point where a material change may have happened in the sign of the nonforfeiture value less the reserve

5.2 Expected Assumption

The expected assumption should be the Valuation Actuary's best estimate regarding the future experience for the product.

When available, the actuary should consider successively the following sources:

1. His own company's experience and studies
2. If (1) is not available:
 - a) intercompany studies, or,
 - b) pricing assumption if (a) is not available

The actuary should consider these sources only as a last resort. In such a situation, it is expected that he will be in a maximum margin situation.

In defining the expected assumption, the actuary should consider the following list of items:

- issue age and duration (or attained age)
- type of product (permanent, temporary, etc.)
- sex
- type of underwriting (medical, paramedical, nonmedical)
- risk class (preferred, standard, etc.)
- amount of insurance
- mode of payment and frequency
- status (premium paying, paid-up, reduced paid-up)
- level of nonforfeiture values and other pertinent features
- pertinent legislation (insurance laws, tax laws, etc.)
- policy of internal replacement
- economic situation (level of interest rate, etc.)
- competitive situation for the product
- quality of remuneration and turnover rate of sales personnel
- quality and type of service to clients (involvement of sales personnel)

5.3 Description of the High Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the high margin situation.

I. Misestimation

- New product or new type of coverage
- * • The company has little information on the experience.
- There is little homogeneity in the characteristics of the insureds.
- The economic environment has been unstable in the recent past.

II. Deterioration

Note: The conditions given below apply to durations for which a decrease in lapse rates increases liabilities. Otherwise, the reverse conditions justify the high margin.

A) COMPANY

i) Structural

Products

- The company sets itself apart through product design rather than competitive premiums.

- The product is an innovative one that meets a new need.
- The company seldom changes product line.

Agents

- The company does not depend entirely on the agent in its contact with the insured.

Management

- The company is quick to protect itself against changes which adversely affect it such as:
 - improvement of existing contracts
 - modified remuneration

- ii) Discretionary (past, present or future)

Products

- The company improves existing products rather than implementing an internal replacement policy.

Agents

- * • The remuneration policy favours persistency.

B) THE INSURED

- * The cancellation of a contract by the insured would be clearly disadvantageous to him or her.

C) ENVIRONMENT (economy, governmental measures such as monetary and fiscal policies, ...)

The product does not depend on an environment likely to be favourable in the short term only.

- * *significant consideration*

5.4 Description of the Low Margin Situation

Important note

The more the following conditions exist, the closer the margin should be to the low margin situation.

I. Misestimation

- The product or type of coverage is one for which the company has a lot of information on the experience, and this data is relevant in the current and expected future market and economic environment.
- There is strong homogeneity in the characteristics of the insured population (and the actuary foresees no major changes in these characteristics).

II. Deterioration

Note: The conditions given below apply to durations for which a decrease in lapse rates increases liabilities. Otherwise, the reverse conditions justify the low margin.

A) COMPANY

i) Structural

Products

- The company competes on the basis of premium and does not set itself apart through product design.
- The innovative product is now subject to competition.
- The company frequently changes its product line.

Agents

- The company depends entirely on the agent in its contacts with the insured, and turnover among agents is high.

Management

- The company is slow to adjust to changes affecting the persistency of its products.

ii) Discretionary (past, present or future)

Products

- Rather than improving the product in question, the company implements an internal replacement policy.

Agents

- The remuneration policy encourages terminations.

B) THE INSURED

The insured stands to gain significantly from cancelling his contract.

C) ENVIRONMENT (economy, governmental measures such as monetary and fiscal policies, ...)

The product depends on an environment which could be favorable in the short term only.

Section 6.1 – Book Profits per Duration (continued)**Male Nonsmoker – \$1000 of Insurance**

Plan: Non-par whole life
 Issue age: 55

Assumption: All

Policy Year	CIA Method						Policy Premium Method					
	No Margin		Low Margin		High Margin		No Margin		Low Margin		High Margin	
	BP	%	BP	%	BP	%	BP	%	BP	%	BP	%
1	-6.63	0	-6.05	0	-6.40	0	5.38	0	0.65	0	-6.40	0
2	1.17	10	0.53	5	0.53	4	0.00	0	0.12	3	0.53	4
3	0.32	12	-0.17	8	0.52	9	0.00	0	0.13	5	0.52	9
4	1.06	21	0.67	9	0.51	13	0.00	0	0.14	8	0.51	13
5	1.10	30	0.81	16	0.55	18	-0.00	0	0.15	11	0.55	18
6	0.95	38	0.73	22	0.58	23	-0.00	0	0.16	15	0.58	23
7	0.82	45	0.65	28	0.60	28	0.00	0	0.17	18	0.60	28
8	0.71	51	0.59	33	0.62	33	0.00	0	0.17	22	0.62	33
9	0.61	56	0.50	38	0.60	38	-0.00	0	0.14	25	0.60	38
10	0.53	61	0.47	42	0.63	44	-0.00	0	0.17	28	0.63	44
15	0.38	82	0.43	65	0.45	67	0.00	0	0.17	47	0.45	67
20	0.18	92	0.25	79	0.23	80	0.00	0	0.13	64	0.23	80
25	0.08	97	0.22	90	0.22	90	0.00	0	0.17	81	0.22	90
30	0.03	99	0.10	97	0.10	97	0.00	0	0.08	93	0.10	97
35	0.01	100	0.04	99	0.04	99	0.00	0	0.03	98	0.04	99
40	0.00	100	0.01	100	0.01	100	0.00	0	0.01	100	0.01	100
45	0.00	100	0.00	100	0.00	100	0.00	0	0.00	100	0.00	100
(1)	17.28		18.07		20.70							
(2)	19.32		19.32		19.32							
(1)/(2)	0.89		0.94		1.07							

Symbols

- (1) : Net premium before testing with gross premium
 (2) : Gross premium
 BP : Present value at duration 1 of the book profit for year t
 % : Cumulative % of the first year provision for margin already passed through earnings
 e.g., policy premium method, high margin:
 $4\% = 0.53 / [5.38 - (-6.40)]$
 $9\% = 4\% + 0.52 / [5.38 - (-6.40)]$

Section 6.1 – Book Profits per Duration (continued)**Male Nonsmoker – \$1000 of Insurance**

Plan: Low cash value endowment to 100 Assumption: All

Issue age: 35

Policy

Year	CIA Method						Policy Premium Method					
	No Margin		Low Margin		High Margin		No Margin		Low Margin		High Margin	
	BP	%	BP	%	BP	%	BP	%	BP	%	BP	%
1	-4.26	0	-3.88	0	-10.45	0	1.38	0	-2.91	0	-10.45	0
2	0.72	13	0.20	4	0.34	3	0.00	0	0.08	2	0.34	3
3	0.39	20	-0.02	4	0.32	6	0.00	0	0.07	3	0.32	6
4	0.51	29	0.16	7	0.30	8	0.00	0	0.07	5	0.30	8
5	0.48	37	0.19	10	0.31	11	0.00	0	0.07	7	0.31	11
6	0.42	45	0.17	14	0.33	14	0.00	0	0.07	8	0.33	14
7	0.36	51	0.16	17	0.35	17	0.00	0	0.08	10	0.35	17
8	0.31	56	0.15	19	0.37	20	0.00	0	0.08	12	0.37	20
9	0.27	61	0.13	22	0.38	23	0.00	0	0.08	14	0.38	23
10	0.23	65	0.13	24	0.42	26	0.00	0	0.09	16	0.42	26
15	0.14	83	0.14	39	0.43	45	0.00	0	0.12	29	0.43	45
20	0.07	91	0.14	52	0.39	63	0.00	0	0.13	44	0.39	63
25	0.04	95	0.18	68	0.39	79	0.00	0	0.18	62	0.39	79
30	0.02	97	0.11	82	0.12	89	0.00	0	0.11	78	0.12	89
35	0.01	99	0.07	91	0.10	95	0.00	0	0.07	89	0.10	95
40	0.01	99	0.04	95	0.05	97	0.00	0	0.04	94	0.05	97
45	0.00	100	0.02	98	0.03	99	0.00	0	0.02	98	0.03	99
50	0.00	100	0.01	99	0.01	100	0.00	0	0.01	99	0.01	100
55	0.00	100	0.00	100	0.00	100	0.00	0	0.00	100	0.00	100
60	0.00	100	0.00	100	0.00	100	0.00	0	0.00	100	0.00	100
65	0.00	100	0.00	100	0.00	100	0.00	0	0.00	100	0.00	100
(1)	3.71		4.17		5.86							
(2)	4.60		4.60		4.60							
(1)/(2)	0.81		0.91		1.27							

Symbols

- (1) : Net premium before testing with gross premium
(2) : Gross premium
BP : Present value at duration 1 of the book profit for year t
% : Cumulative % of the first year provision for margin already passed through earnings
e.g., policy premium method, high margin:
3% = $0.34 / [1.38 - (-10.45)]$
6% = $3\% + 0.32 / [1.38 - (-10.45)]$

Section 6.1 – Book Profits per Duration (continued)**Male Nonsmoker – \$1000 of Insurance**

Plan: 20-year term
 Issue age: 35

Assumption: All

Policy Year	CIA Method						Policy Premium Method					
	No Margin		Low Margin		High Margin		No Margin		Low Margin		High Margin	
	BP	%	BP	%	BP	%	BP	%	BP	%	BP	%
1	-3.97	0	-3.84	0	-3.41	0	0.68	0	-0.07	0	-2.05	0
2	0.69	15	0.62	14	0.49	12	0.00	0	0.07	9	0.30	11
3	0.47	25	0.48	24	0.39	21	0.00	0	0.06	17	0.25	20
4	0.47	35	0.45	34	0.37	30	0.00	0	0.05	23	0.22	28
5	0.43	44	0.41	43	0.32	38	0.00	0	0.04	29	0.20	35
6	0.37	52	0.33	51	0.29	45	0.00	0	0.04	35	0.18	42
7	0.32	59	0.30	57	0.26	52	0.00	0	0.04	40	0.17	48
8	0.28	65	0.27	63	0.24	58	0.00	0	0.04	46	0.16	54
9	0.24	70	0.24	68	0.22	63	0.00	0	0.04	51	0.15	59
10	0.20	75	0.21	73	0.21	68	0.00	0	0.04	57	0.15	65
15	0.12	92	0.12	90	0.13	88	0.00	0	0.03	82	0.10	87
20	0.06	100	0.07	100	0.07	100	0.00	0	0.02	100	0.06	100
(1)	1.69		1.84		2.29							
(2)	2.50		2.50		2.50							
(1)/(2)	0.68		0.74		0.92							

Symbols

- (1) : Net premium before testing with gross premium
 (2) : Gross premium
 BP : Present value at duration 1 of the book profit for year t
 % : Cumulative % of the first year provision for margin already passed through earnings
 e.g., policy premium method, high margin:
 $11\% = 0.30 / [0.68 - (-2.05)]$
 $20\% = 11\% + 0.25 / [0.68 - (-2.05)]$

Section 6.1 – Book Profits per Duration (continued)**Male Nonsmoker – \$1000 of Insurance**

Plan: 20-year term
 Issue age: 55

Assumption: All

Policy Year	CIA Method						Policy Premium Method					
	No Margin		Low Margin		High Margin		No Margin		Low Margin		High Margin	
	BP	%	BP	%	BP	%	BP	%	BP	%	BP	%
1	-5.44	0	-5.12	0	-4.17	0	2.96	0	1.10	0	-3.96	0
2	1.05	12	0.85	11	0.33	5	0.00	0	0.12	6	0.51	7
3	0.45	18	0.29	14	-0.11	8	0.00	0	0.11	12	0.46	14
4	0.82	28	0.71	23	0.40	9	0.00	0	0.10	18	0.43	20
5	0.82	37	0.74	32	0.51	16	0.00	0	0.11	23	0.43	26
6	0.71	46	0.65	40	0.50	23	0.00	0	0.11	29	0.43	32
7	0.61	53	0.58	47	0.49	30	0.00	0	0.11	35	0.44	39
8	0.52	59	0.51	54	0.49	37	0.00	0	0.11	41	0.44	45
9	0.45	65	0.45	59	0.47	43	-0.00	0	0.11	47	0.44	52
10	0.39	69	0.41	64	0.48	50	-0.00	0	0.12	53	0.45	58
15	0.26	90	0.30	88	0.39	84	0.00	0	0.10	83	0.32	87
20	0.12	100	0.12	100	0.12	100	0.00	0	0.03	100	0.09	100
(1)	9.59		10.03		11.43							
(2)	11.10		11.10		11.10							
(1)/(2)	0.86		0.90		1.03							

Symbols

- (1) : Net premium before testing with gross premium
 (2) : Gross premium
 BP : Present value at duration 1 of the book profit for year t
 % : Cumulative % of the first year provision for margin already passed through earnings
 e.g., policy premium method, high margin:
 $7\% = 0.51 / [2.96 - (-3.96)]$
 $14\% = 7\% + 0.46 / [2.96 - (-3.96)]$

6.2 Cumulative impact of Margins – Policy Premium Method

Male Nonsmoker – \$1000 of Insurance

Plan	Issue Age	Assumption	FIRST YEAR PROVISION FOR MARGIN*		First Year Profit No Margin	Gross Premium	(2)/(3)	(2)/(4)
			Low Margin	High Margin				
			(1)	(2)	(3)	(4)		
Non-Par Whole Life	35	Lapses	0.30	1.38	1.94	6.53	0.71	0.21
		Mortality	0.60	2.39	1.94	6.53	1.23	0.37
		Expenses	0.32	0.53	1.94	6.53	0.27	0.08
		Interest	2.19	2.19	1.94	6.53	1.13	0.34
		Total	3.41	6.49	1.94	6.53	3.35	0.99
	All Assumptions	3.69	8.35	1.94	6.53	4.30	1.28	
	55	Lapses	0.79	3.52	5.38	19.32	0.65	0.18
		Mortality	0.97	3.87	5.38	19.32	0.72	0.20
		Expenses	0.25	0.43	5.38	19.32	0.08	0.02
		Interest	2.47	2.47	5.38	19.32	0.46	0.13
Total		4.48	10.29	5.38	19.32	1.91	0.53	
All Assumptions	4.73	11.78	5.38	19.32	2.19	0.61		
Low Cash Value Endowment to 100	35	Lapses	0.98	4.80	1.38	4.60	3.48	1.04
		Mortality	0.61	2.43	1.38	4.60	1.76	0.53
		Expenses	0.33	0.53	1.38	4.60	0.38	0.12
		Interest	2.08	2.08	1.38	4.60	1.51	0.45
		Total	4.00	9.84	1.38	4.60	7.13	2.14
All Assumptions	4.29	11.83	1.38	4.60	8.57	2.57		
20-Year Term	35	Lapses	0.00	0.02	0.68	2.50	0.03	0.01
		Mortality	0.54	2.17	0.68	2.50	3.19	0.87
		Expenses	0.20	0.37	0.68	2.50	0.54	0.15
		Interest	0.00	0.00	0.68	2.50	0.00	0.00
		Total	0.74	2.56	0.68	2.50	3.76	1.02
	All Assumptions	0.75	2.73	0.68	2.50	4.01	1.09	
	55	Lapses	0.46	2.03	2.96	11.10	0.69	0.18
		Mortality	0.98	3.94	2.96	11.10	1.33	0.35
		Expenses	0.19	0.35	2.96	11.10	0.12	0.03
		Interest	0.18	0.18	2.96	11.10	0.06	0.02
Total		1.81	6.50	2.96	11.10	2.20	0.59	
All Assumptions	1.86	6.92	2.96	11.10	2.34	0.62		

* Difference in first year book profit for a situation with margin when compared to one without margin

6.3 ANALYSIS OF THE NUMERICAL EXAMPLES

Comparing the results under the two methods was useful in showing us that the apparent sensitivity to changes in assumptions was not inherent to our system. From the first page in Section 6.1 (non-par whole life – age 35) we see that the first year book profit, when using the CIA method, goes from -4.54 to -4.20 when we add a low margin to the assumptions (this illogicality in the first year is inherent to the 150% limit on acquisition expenses). Under the policy premium method, the first year book profit goes from 1.94 to -1.75 when adding the same low margin. So we see that the variation in first year results depends on the method used.* (It should be noted that results are independent of the valuation method when adding a high margin, the product being on a deficiency basis under the CIA method).

Beside considering the provision implied by a certain level of margin, we also wanted to look at its release in profits as years go by. This was an attempt to better understand the *fair risk charge* and *release from risk* principles. Again from the first page, we see that under the policy premium method (high margin situation) 34% of the first year provision has flown back into earnings after 10 years; and 65% after 20 years. As much as this is interesting, it does not tell us what kind of *release pattern* an appropriate provision should have. It does, however, provide a good tool for searching for it.

Section 6.2 provided us with a tool for evaluating the appropriateness of our parameters. By using an assumption with margin while holding the other assumptions constant, we could evaluate its impact on the provision. We could then reflect the results by plan and age to determine if the relative impacts of the assumptions were logical. As an example, for the low cash value endowment to 100, one would expect the lapse rate to be the critical assumption. Unexpected relationships were researched more thoroughly to see if changes were needed in the parameters.

Those calculations also helped us in studying the cumulative impact of the margins. For the non-par whole life example at age 35, the total of the first year provisions for the assumptions with high margin was 6.49. However, when we run a test using all the assumptions with high margin at the same time, we get a first year provision of 8.35. We are still looking, both theoretically and practically, to find a case where the assumptions did not interact in an additive way.

Finally, the other interesting aspect of Section 6.2 is the comparison of the first year provision with the expected first year profit for the policy and its gross premium. If the ratio of the provision to the profit is less than one, then it means that the policy would show a book profit in the first year.

One should always remember that apart from the choice of the different parameters, those resulting ratios are materially affected by the difference between the expected assumptions for valuation purposes and pricing assumptions.

* Even by removing the 150% limit on the CIA method and amortizing the acquisition expenses from issue instead of renewal only, as long as we are not in a deficiency premium situation, the policy premium method will be more sensitive in the first year than that modified CIA method by a factor of \ddot{a}_x .

APPENDIX A**DESCRIPTION OF THE THREE EXAMPLES WITH VALUATION ASSUMPTIONS****I. Plan**

- Example 1. Non-par whole life
 2. Low cash values endowment to 100
 3. 20-year term

Cash values

- i) EXAMPLE 1 (Non-par whole life)

Cash values are a percentage of tax reserves.

The percentage is 10% at duration 4, increasing by 5% per year (maximum of 90%).

- ii) EXAMPLE 2 (Low cash values endowment to 100)

Same as Example 1 except that no cash values are available before attained age 65.

- iii) EXAMPLE 3 (20-year term)

Nil

II. Expected Assumptions

Note: The assumptions are used for the three examples unless specifically mentioned.

VOLUME \$100,000 of insurance

INSURED Male nonsmoker
Age 35 and 55

MORTALITY 80% CIA 69-75 – Male Select

SMOKING Bill C-139 version

INTEREST 10%, decreasing .2% per year (minimum of 6%)

LAPSE RATE 15% – 10% – 7 1/2% and 5% thereafter

Exception: For example 2, lapse rates differ for some attained ages:

Attained age	Rate	Attained age	Rate
59	5%	65	10%
60	4%	66	9%
61	3%	67	8%
62	2%	68	7%
63	1%	69	6%
64	0%	70+	5%

EXPENSES	Acquisitions	\$250 per policy + 20% of the premium		
	Maintenance	\$30 per policy indexed at 3% per year		
	Commissions	Year	Base (%)	Bonus (%)
		1	65	55
		2	15	2
		3	12	2
		4	5	2
		5-10	3	2
		11+	—	—
	Taxes	2%		

III. Gross Premium per Thousand

The gross premiums are calculated on the basis of the expected assumptions then increase by 4% of gross premium for an explicit profit margin.

Example

Issue Age	1	2	3
35	6.53	4.60	2.50
55	19.32		11.10

IV. Valuation Assumptions

Note: Under the policy premium method, the first year profit for the test without margin is the present value of the explicit annual profit which is 4% of the gross premium.

ASSUMPTIONS	DURATION	LEVEL OF THE MARGIN		
		NO	LOW	HIGH
LAPSES (%)	1	15.00	15.00	15.00
	2	10.00	9.90	9.60
	3	7.50	7.35	6.90
	4	5.00	4.85	4.40
	5	5.00	4.80	4.20
	6	5.00	4.75	4.00
	7	5.00	4.70	3.80
	8	5.00	4.65	3.60
	9	5.00	4.60	3.40
	10	5.00	4.55	3.20
	11+	5.00	4.50	3.00

Note: We assume that for the contracts considered, there is no material difference between the reserve and the nonforfeiture value at duration 1. Thus point A is at the end of the first year and the full margin is applied starting at duration 11.

For example 2, the assumption cannot be higher than the pricing assumption during the "cliff" period. The valuation assumption cannot be higher than the pricing assumption. (At the ultimate duration, the low margin assumption is at 90% of the pricing assumption and the high margin assumption is at 60%.)

MORTALITY		80% CIA	80% CIA	80% CIA
		+0.00375/ e_x +.015/ e_x		
EXPENSES	Maintenance	30.00	30.75	33.00
	Inflation Rate	3% – 5 years, valuation interest rate minus 3% thereafter.		
	Commissions and Taxes	Identical to expected assumptions		
INTEREST (%)	1	10.00	9.95	9.95
	2	9.80	9.70	9.70
	3	9.60	9.44	9.44
	4	9.40	9.19	9.19
	5	9.20	9.00	9.00
	6	9.00	8.83	8.83
	7	8.80	8.66	8.66
	8	8.60	8.49	8.49
	9	8.40	8.39	8.39
	10	8.20	8.13	8.13
	11	8.00	7.87	7.87
	12	7.80	7.63	7.63
	13	7.60	7.41	7.41
	14	7.40	7.23	7.23
	15	7.20	6.97	6.97
	16	7.00	6.70	6.70
	17	6.80	6.46	6.46
	18	6.60	6.24	6.24
	19	6.40	6.04	6.04
	20	6.20	5.78	5.78
	21	6.00	5.50	5.50
	22	6.00	5.28	5.28
	23	6.00	5.12	5.12
	24	6.00	5.02	5.02
	25	6.00	4.92	4.92
	26+	6.00	4.86	4.86

Note: In determining the interest valuation assumption, we considered only new policies. Being in a situation of no current assets, the margin comes only from the reinvestment rate and does not vary with the situation of the product and the company.

Details of the determination of the interest valuation assumption are shown in the following pages.

Determination of the Interest Valuation Assumption (High Margin Situation)

	AVG.		-REINVEST-		CASH - FLOW				-INTEREST-		-CAPITAL-		OP-	AMOUNT		VALUE OF FUND		INT.
	TPX	RATE	TERM	PREM.	EXPE.	MORT.	LAPSE	TOTAL	INVES	LIQUI	INVES	LIQUI	TIONS	INVEST	INVES	LIQUI	TOTAL	RATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	0.8491	9.95	0	8.48	15.2	1.03	0.00	-7.73	0.00	-0.72	0.00	0.00	0.00	-8.45	0.00	-8.45	-8.45	9.95
2	0.7633	9.70	0	7.20	1.92	1.04	0.00	4.24	0.00	-0.36	0.00	-8.5	0.00	-4.57	0.00	-4.57	-4.57	9.70
3	0.7050	9.44	0	6.47	1.54	1.12	0.00	3.82	0.00	-0.02	0.00	-4.6	0.00	-0.76	0.00	-0.76	-0.76	9.44
4	0.6686	9.19	5	5.97	1.01	1.22	0.03	3.72	0.00	0.33	0.00	-0.8	0.00	3.29	3.29	0.00	3.29	9.19
5	0.6339	8.93	5	5.66	0.85	1.36	0.06	3.39	0.30	0.37	0.00	0.00	0.03	4.09	7.34	0.00	7.34	9.00
6	0.6014	8.68	5	5.36	0.81	1.51	0.09	2.95	0.65	0.33	0.00	0.00	0.11	4.04	11.28	0.00	11.28	8.83
7	0.5709	8.42	5	5.08	0.78	1.66	0.13	2.52	0.99	0.29	0.00	0.00	0.22	4.02	15.08	0.00	15.08	8.66
8	0.5424	8.17	5	4.83	0.74	1.84	0.18	2.07	1.29	0.26	0.00	0.00	0.37	3.99	18.70	0.00	18.70	8.49
9	0.5155	7.91	5	4.60	0.71	2.04	0.23	1.62	1.58	0.23	2.96	0.00	0.40	6.79	22.13	0.00	22.13	8.39
10	0.4904	7.66	5	4.39	0.68	2.25	0.29	1.16	1.81	0.20	3.69	0.00	0.42	7.28	25.29	0.00	25.29	8.13
11	0.4608	7.41	5	4.19	0.45	2.46	0.86	0.42	2.00	0.19	3.64	0.00	0.48	6.73	27.90	0.00	27.90	7.87
12	0.4333	7.15	5	3.90	0.43	2.62	0.92	-0.07	2.14	0.15	3.63	0.00	0.57	6.42	30.13	0.00	30.13	7.63
13	0.4077	6.90	5	3.63	0.40	2.79	0.97	-0.53	2.24	0.13	3.60	0.00	0.67	6.11	31.96	0.00	31.96	7.41
14	0.3838	6.64	5	3.39	0.38	2.96	1.01	-0.96	2.32	0.10	6.13	0.00	0.67	8.26	33.42	0.00	33.42	7.23
15	0.3612	6.39	5	3.17	0.36	3.15	1.03	-1.38	2.34	0.08	6.57	0.00	0.65	8.26	34.46	0.00	34.46	6.97
16	0.3395	6.13	5	2.96	0.35	3.75	1.04	-2.17	2.31	0.05	6.06	0.00	0.68	6.93	34.65	0.00	34.65	6.70
17	0.3189	5.88	5	2.77	0.33	3.88	1.11	-2.55	2.24	0.03	5.79	0.00	0.71	6.23	34.37	0.00	34.37	6.46
18	0.2992	5.62	5	2.58	0.31	4.01	1.18	-2.92	2.14	0.01	5.50	0.00	0.77	5.51	33.61	0.00	33.51	6.24
19	0.2803	5.37	5	2.40	0.30	4.12	1.24	-3.26	2.03	0.00	7.45	0.00	0.70	6.93	32.38	0.00	32.38	6.04
20	0.2623	5.11	5	2.23	0.28	4.20	1.29	-3.55	1.87	-0.01	7.44	0.00	0.64	6.39	30.69	0.00	30.69	5.78
21	0.1225	4.86	5	1.34	0.15	2.12	1.26	-2.19	1.69	0.01	6.25	0.00	0.60	6.36	30.20	0.00	30.20	5.50
22	0.1143	4.86	5	1.24	0.14	2.14	1.22	-2.26	1.59	0.00	5.61	0.00	0.36	5.31	29.54	0.00	29.54	5.28
23	0.1066	4.86	5	1.15	0.13	2.15	1.18	-2.32	1.51	0.00	5.02	0.00	0.20	4.41	28.72	0.00	28.72	5.12
24	0.0992	4.86	5	1.06	0.13	2.16	1.14	-2.36	1.44	-0.01	6.45	0.00	0.06	5.58	27.80	0.00	27.80	5.02
25	0.0922	4.86	5	0.97	0.12	2.16	1.09	-2.40	1.37	-0.01	6.14	0.00	0.00	5.09	26.75	0.00	26.75	4.92
26	0.0859	4.86	5	0.89	0.11	2.17	1.04	-2.43	1.30	-0.01	6.36	0.00	0.00	5.22	25.61	0.00	25.61	4.86
27	0.0801	4.86	5	0.81	0.10	2.17	0.98	-2.45	1.24	-0.02	5.31	0.00	0.00	4.08	24.39	0.00	24.39	4.86
28	0.0749	4.86	5	0.74	0.10	2.18	0.93	-2.46	1.19	-0.02	4.41	0.00	0.00	3.11	23.09	0.00	23.09	4.86
29	0.0702	4.86	5	0.68	0.09	2.18	0.87	-2.47	1.12	-0.02	5.58	0.00	0.00	4.21	21.72	0.00	21.72	4.86
30	0.0660	4.86	5	0.62	0.09	2.18	0.81	-2.46	1.06	-0.03	5.09	0.00	0.00	3.66	20.23	0.00	20.28	4.86
31	0.0593	4.86	5	0.56	0.08	2.16	1.64	-3.32	0.99	-0.03	5.22	0.00	0.00	2.85	17.92	0.00	17.92	4.86
32	0.0534	4.86	5	0.50	0.07	2.08	1.44	-3.10	0.87	-0.03	4.08	0.00	0.00	1.82	15.66	0.00	15.66	4.86
33	0.0482	4.86	5	0.44	0.07	1.98	1.26	-2.87	0.76	-0.03	3.11	0.00	0.00	0.98	13.52	0.00	13.52	4.86
34	0.0436	4.86	5	0.39	0.06	1.88	1.10	-2.65	0.66	-0.03	4.21	0.00	0.00	2.19	11.50	0.00	11.50	4.86
35	0.0396	4.86	5	0.34	0.06	1.77	0.96	-2.44	0.56	-0.03	3.66	0.00	0.00	1.75	9.59	0.00	9.59	4.86
36	0.0360	4.86	5	0.30	0.05	1.67	0.83	-2.25	0.47	-0.03	2.85	0.00	0.00	1.04	7.78	0.00	7.78	4.86
37	0.0327	4.86	5	0.27	0.05	1.58	0.77	-2.13	0.38	-0.03	1.82	0.00	0.00	0.04	6.00	0.00	6.00	4.86
38	0.0296	4.86	5	0.23	0.04	1.49	0.72	-2.01	0.29	-0.03	0.98	0.00	0.00	-0.77	4.25	0.00	4.25	4.86
39	0.0268	4.86	5	0.21	0.04	1.40	0.67	-1.90	0.21	-0.03	2.19	0.00	0.00	0.47	2.53	0.00	2.53	4.86
40	0.0242	4.86	5	0.18	0.04	1.32	0.62	-1.79	0.12	-0.02	1.75	0.00	0.00	0.06	0.84	0.00	0.84	4.86
41	0.0218	4.86	5	0.16	0.03	1.24	0.57	-1.69	0.04	-0.02	1.04	0.00	0.00	-0.63	-0.83	0.00	-0.83	4.86
42	0.0197	4.86	5	0.14	0.03	1.17	0.53	-1.59	-0.04	-0.02	0.04	0.00	0.00	-1.61	-2.48	0.00	-2.48	4.86
43	0.0176	4.86	5	0.12	0.03	1.11	0.49	-1.50	-0.12	-0.02	-0.77	0.00	0.00	-2.41	-4.13	0.00	-4.13	4.86
44	0.0158	4.86	5	0.11	0.03	1.05	0.45	-1.42	-0.20	-0.02	0.47	0.00	0.00	-1.17	-5.77	0.00	-5.77	4.86
45	0.0137	4.86	5	0.09	0.02	1.35	0.39	-1.67	-0.28	-0.03	0.06	0.00	0.00	-1.92	-7.75	0.00	-7.75	4.86
46	0.0122	4.86	5	0.08	0.02	0.84	0.36	-1.14	-0.38	-0.02	-0.63	0.00	0.00	-2.16	-9.28	0.00	-9.28	4.86
47	0.0108	4.86	5	0.07	0.02	0.82	0.33	-1.10	-0.45	-0.02	-1.61	0.00	0.00	-3.18	-10.35	0.00	-10.85	4.86
48	0.0095	4.86	5	0.06	0.02	0.80	0.30	-1.06	-0.53	-0.02	-2.41	0.00	0.00	-4.02	-12.46	0.00	-12.46	4.86
49	0.0083	4.86	5	0.05	0.01	0.78	0.27	-1.01	-0.61	-0.02	-1.17	0.00	0.00	-2.81	-14.09	0.00	-14.09	4.86
50	0.0072	4.86	5	0.05	0.01	0.75	0.23	-0.95	-0.68	-0.02	-1.92	0.00	0.00	-3.57	-15.74	0.00	-15.74	4.86
51	0.0061	4.86	5	0.04	0.01	0.71	0.20	-0.89	-0.77	-0.02	-2.16	0.00	0.00	-3.84	-17.41	0.00	-17.41	4.86
52	0.0052	4.86	5	0.03	0.01	0.67	0.18	-0.82	-0.85	-0.02	-3.18	0.00	0.00	-4.86	-19.09	0.00	-19.09	4.86
53	0.0043	4.86	5	0.03	0.01	0.61	0.15	-0.75	-0.93	-0.01	-4.02	0.00	0.00	-5.71	-20.79	0.00	-20.79	4.86
54	0.0036	4.86	5	0.02	0.01	0.56	0.13	-0.67	-1.01	-0.01	-2.81	0.00	0.00	-4.50	-22.48	0.00	-22.48	4.86
55	0.0029	4.86	5	0.02	0.01	0.50	0.11	-0.59	-1.09	-0.01	-3.57	0.00	0.00	-5.27	-24.17	0.00	-24.17	4.86
56	0.0024	4.86	5	0.02	0.01	0.44	0.09	-0.51	-1.17	-0.01	-3.84	0.00	0.00	-5.53	-25.87	0.00	-25.87	4.86
57	0.0019	4.86	5	0.01	0.00	0.38	0.07	-0.44	-1.26	-0.01	-4.86	0.00	0.00	-6.57	-27.57	0.00	-27.57	4.86
58	0.0015	4.86	5	0.01	0.00	0.32	0.06	-0.37	-1.34	-0.01	-5.71	0.00	0.00	-7.43	-29.29	0.00	-29.29	4.86
59	0.0012	4.86	5	0.01	0.00	0.27	0.05	-0.31	-1.42	-0.01	-4.50	0.00	0.00	-6.24	-31.03	0.00	-31.03	4.86
60	0.0009	4.86	5	0.01	0.00	0.22	0.04	-0.26	-1.51	-0.01	-5.27	0.00	0.00	-7.04	-32.80	0.00	-32.80	4.86
61	0.0007	4.86	5	0.01	0.00	0.18	0.03	-0.21	-1.59	0.00	-5.53	0.00	0.00	-7.34	-34.61	0.00	-34.61	4.86
62	0.0005	4.86	5	0.00	0.00	0.15	0.02	-0.17	-1.68	0.00	-6.57	0.00	0.00	-8.42	-36.47	0.00	-36.47	4.86
63	0.0004	4.86	5	0.00	0.00	0.12	0.02	-0.14	-1.77	0.00	-7.43	0.00	0.00	-9.34	-38.38	0.00	-38.38	4.86
64	0.0002	4.86	5	0.00	0.00	0.10	0.01	-0.11	-1.87	0.00	-6.24	0.00	0.00	-8.22	-40.36	0.00	-40.36	4.86
65	0.0000	4.86	5	0.00	0.00	0.24	0.00	-0.24	-1.96	-0.01	-7.04	0.00	0.00	-9.25	-42.57	0.00	-42.57	4.86

Column Definition(1) Average ${}_t p T_x$

For this column and for the determination of the cash flows, we have assumed the following proportions between the different products and the two ages (35 and 55):

T-20:	50%	35 years:	60%
T-100:	25%	55 years:	40%
Whole life:	25%		

(2) **Reinvestment rate**

We consider Valuation Technique Paper No 3 (2nd version) in the determination of these reinvestment rates.

Current reinvestment rate (CRR)

Averaged annualized yield registered over the last year (1987) on the Federal Government medium and long-term bonds

minus

0.25% for investment expenses

CRR: 9.95%

Ultimate reinvestment rate (URR)

According to Valuation Technique Paper No 3 (revised version) considering the civil years 1985 to 1987 as the reference years and subtracting 0.25% for the investment expenses

URR: 4.86%

Transition from CRR to URR

Constant adjustment over 20 years

(3) The term of reinvestments when the amount to invest (14) is positive.

(4) Premiums

For the first year:

$$\begin{aligned}
 & 50\% (60\% \times 2.50 + 40\% \times 11.10) \\
 + & 25\% (60\% \times 4.60 + 40\% \times 19.13) \\
 + & 25\% (60\% \times 6.53 + 40\% \times 19.32) \\
 = & 8.48
 \end{aligned}$$

For the following years, we have to multiply each premium by the corresponding ${}_t p T_x$.

- (5) Expenses
- (6) Face amount payments
- (7) Cash value payments
- (8) (4) – (5) – (6) – (7)
- (9) Interest earned on investments

Example of interest earned in policy year 6

Policy Year (PY)	Initial Capital to invest	Repayment from Options		(1) – (2)	Reinvestment Rate	(3) x (4)
	(1)	PY=5 (2)	PY=6 (3)	(3)	(4)	(9)
4	3.29	0.03	0.065	3.192	0.0919	0.293
5	4.09	—	0.041	4.049	0.0893	0.362
		0.03	0.11			0.65
(COLUMN) _{PY}	(14)	(13) ₅	(13) ₆		(2)	(9) ₆

- (10) Interest on liquidity
- $[(16)_{t-1} + (4) - (5) - 0.5 \times (6)] \times (2)$
- (11) Repayment of capital
- (12) Liquidity to reinvest for one year when the amount to invest (14) is negative
- (13) Repayment of capital from options that have been exercised

For every variation of 1% of the reinvestment rate, 4% of the assets are repaid (maximum of 20% for a variation of 5%)

- (14) = (8) + (9) + (10) + (11) + (12) + (13)
- (15) Amount of investments that have not matured and that have not been repaid
- (16) Amount of liquidity
- (17) (15) + (16)
- (18) $[(9) + (10)] / [(17)_{t-1} + (4) - (5) - 0.5 \times (6)]$

DESCRIPTION OF THE FORMULAS

I. Book Profits From Operation

$$\begin{aligned}
 BP_t \text{ (end of year)} &= (GP - E_t) \times (1 + i_t) \\
 &\quad - 1000 q_{x+t-1} \times (1 + i_t / 2) \\
 &\quad - CV_t (1 - q_{x+t-1}) \times w_t \\
 &\quad - [{}_tV (1 - q_{x+t-1}) (1 - w_t) - {}_{t-1}V(1 + i_t)]
 \end{aligned}$$

where GP : Gross premium

E_t : All expenses (fixed and/or in percentage)

i_x : Interest rate

q : Mortality rate

CV_t : Cash value at t

w_t : Lapse rate at t

${}_tV$: Reserve at t

II. Present Value of Book Profit Occurring in Year t at Time = 1

$$PVBT_t \text{ at time} = 1 = BP_t \times F_t$$

where $F_1 = 1$

$$t \geq 2 \quad F_t = F_{t-1} \times \frac{(1 - q_{x+t-1})(1 - w_t)}{(1 + j_t)}$$

j_t = Interest rate (we used $i_t = j_t$)

III. CIA Reserve (Symbols are similar to Valuation Technique No Paper 1)

$$\begin{aligned}
 {}_tV &= 1000 A_{x+t} \\
 &\quad + \sum_{s=t}^w v^{s+t-1} {}_{s-t}P_{x+t}^T (1 - q_{x+s}) w_{s+1} CV_{s+1} \\
 &\quad + \sum_{s=t}^w v^{s-t} {}_{s-t}P_{x+t}^T E^{ADM} \text{ (administration charges component)} \\
 &\quad - P^{CIA} \ddot{a}_{x+t}
 \end{aligned}$$

where $P^{CIA} = \min (\text{Gross Premium}, M)$

$$M = N + \left[\min(1.5N, \frac{250}{100} + K1 \times G) \right] - \frac{1}{\ddot{a}_x}$$

$$+ \sum_{t=0}^w v^t {}_tP_x^T \left(\frac{30}{100} 1.03^t + K2 \times G \right) - \ddot{a}_x \quad (\text{administration charges component})$$

$$N = \frac{1000 A_x + \sum_{t=1}^w v^t {}_{t-1}P_x^T (1 - q_{x+t-1}) w_t CV_t}{\ddot{a}_x}$$

$$K1 = 65\% + 55\% + 20\% = 140\%$$

$$K2 = 2\% + 0\% + 0\% = 2\%, t = 0$$

$$2\% + 15\% + 2\% = 19\%, t = 1$$

$$2\% + 12\% + 2\% = 16\%, t = 2$$

...

$$2\% + 3\% + 2\% = 7\%, t = 9$$

$$2\%, t = 10 \text{ and so on ...}$$

$$P_x^T = \text{Surviving probability (all decrements)} = (1 - q_x)(1 - w)$$

Note: The additional part in the reserve for the administrative charges cannot decrease the reserve.

IV. Policy Premium Reserve

$${}_tV = 1000 A_{x+t}$$

$$+ \sum_{s=t}^w v^{s+1-t} {}_{s-t}P_{x+t}^T (1 - q_{x+s}) w_s CV_s$$

$$+ \sum_{s=t}^w v^{s-t} {}_{s-t}P_{x+t}^T E^{ADM}$$

$$- GP \ddot{a}_{x+t}$$