DESIGN AND PRICING OF HOME EQUITY LINE OF CREDIT INSURANCE

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ABSTRACT

This paper presents the application of the asset share technique of pricing to a new group credit insurance product - Home Equity Line of Credit insurance (HELOC).

The paper's objective is to provide useful tools when developing a new HELOC product including projections for marketing and underwriting, distinctions between desirable and undesirable product design features and development of premium rate structures. Several HELOC insurance projections are made in the paper to illustrate the effect of differences in underwriting, premium rate changes, etc. on the product's profitability. Compliance with state insurance regulations is also discussed.

First, the HELOC design and underwriting features are described in detail. The extensive description serves two purposes: to familiarize the reader with this fairly new product and to analyze the HELOC insurance provisions that affect the assumptions used in pricing.

The traditional asset share type formulas used in individual insurance are adapted to account for differences between the structure of HELOC insurance and individual insurance. Since only

limited experience of HELOC insurance exists, some pricing assumptions used are based on the available data of a comparable individual insurance product, ART. These data are adjusted as the differences in the products suggest.

Other pricing assumptions are based on the experience of a comparable credit insurance product: an insurance on the life of a borrower to cover the outstanding balance of loans written on credit cards.

The asset share-type calculations are performed to illustrate how the technique works for the HELOC insurance product described.

The results obtained are analyzed to determine the effects on the product's profitability of variation in product design, compensation structure and premium rates. The impact of regulations imposed on this type of insurance by state insurance departments is also analyzed. Suggestions are made as to the product design and the rates.

Next, the calculations are modified to account for the stochastic nature of mortality and lapses. The effects of random fluctuations in these assumptions are analyzed.

The model can be adapted for pricing a variety of credit insurance products.

INTRODUCTION

Credit life insurance is insurance on the life of a debtor in connection with a specific loan or other credit transaction. Credit life insurance varies by the type of the loan covered (e.g. closed end vs. open end) and the manner in which the insurance charges are assessed (e.g. single premium vs. monthly outstanding balance premium). This paper is mainly concerned with the open end credit life insurance, home equity line of credit (HELOC) insurance, and monthly outstanding balance (MOB) premiums, with the other types referred to if necessary.

Open end credit life insurance is an insurance on the life of a borrower to cover the outstanding balance of loans written on checking accounts, credit cards, equity lines of credit, etc. This insurance is usually sold on a group basis, where the creditor becomes the policyholder and the first beneficiary of the proceeds. Here and throughout this paper, the term "insured" in group credit insurance means an individual debtor, while the lending institution is referred to as a policyholder. Typically, the insured amount equals the outstanding balance of the loan on the date of death.

HELOC insurance, a fairly new open end credit life insurance product, has become important because the Tax Reform Act of 1986 eliminated consumer interest deductions other than for interest on real estate secured loans. According to the studies performed

by the Consumer Bankers Association, HELOC grew by 35% during first half of 1988. The need of the lender, and, especially, the individual debtor to insure the account makes HELOC a desirable product.

The limited experience of this type of insurance, however, complicates the product's design and pricing procedures.

A careful analysis of the various insurance elements of HELOC insurance suggests that the asset share-type calculations used in individual insurance can be adapted for this product. To build a set of assumptions for these calculations, the existing data for a comparable credit insurance product (credit card insurance) is used. However, since some insurance provisions of HELOC insurance are similar in many respects to individual insurance, some assumptions are based on existing ART insurance experience.

In this paper the ART insurance is an indeterminate premium, one year term policy, where the insured has an option to renew the contract at each policy anniversary without underwriting. The asset share-type calculations are performed for two designs of the HELOC insurance product. The profit measures chosen are compared in order to determine whether one or another should be promoted.

BENEFITS

The unique characteristic of HELOC insurance is the transfer of control over the insured amount from the insurer to the person insured. The amount of debt and, therefore, the amount insured, can be decreased and increased at the debtor's option. This feature is common for all open end insurance products. However, under credit card insurance, the outstanding balance is usually limited to $2,000 - $10,000. The maximum outstanding balance on HELOC can be as high as $100,000.

The option to increase the amount insured under HELOC insurance at any time and age without an additional risk premium charged to exercise the option opens an insurer to the applicant's anti-selection as no other product does, with the amounts at risk varying from relatively low to $100,000 for some home equity lines of credit insurance.

Various underwriting techniques and their effectiveness in combating anti-selection have an impact on the mortality and persistency assumptions. These are analyzed when the measurements of risks are discussed.

PREMIUMS

HELOC insurance premiums are paid by the policyholder monthly. They are based on the total monthly volume of insured indebtedness multiplied by a rate specified in the contract between the policyholder and the insurer. The premium rates vary for single and joint debtors and may vary according to the debtor's attained age (age-graded rates). These charges are added to the individual account balances. The factors determining the premium rates are discussed when the cost development of the product is analyzed.

ELIGIBILITY

Both the policyholder and the debtor have to satisfy certain eligibility requirements before HELOC insurance is issued. The policyholder's financial and corporate statuses are scrutinized. If the coverage is added to an existing contract between the policyholder and the insurer, the past insurance experience is analyzed. If a change in carrier is planned, reasons for the change and the insurance experience are considered.

Certain participation requirements (such as a minimum of 100 new loans per year) are usually imposed. This requirement stems from the group insurance concept that only groups of certain minimum

size are considered for insurance purpose. The reasons for a minimum size requirement in credit life insurance are similar to that of group insurance - to preclude individual selection and to ensure a reasonable proportion of expenses to mortality rate.

The debtor is insured if his indebtedness is included in an eligible class (as specified in the contract), and if his age (and the age of co-debtor, if joint insurance is applied for) is within the limiting age range, usually specified as the age at which the policy terminates (e.g. 66). Evidence of insurability may or may not be required depending on the underwriting standards of the insurer.

TERMINATIONS AND CONVERSIONS

Termination of the HELOC insurance policy can be initiated by the policyholder or by the insurer (by the insurer only for non-payment of premiums or non-compliance with the contract). An individual debtor may terminate coverage, in which case the group policy remains active. Only the inforce (the amount of insured indebtedness) and the number of insured lives change.

One common cause of a policyholder's termination is the change of insurer due to a merger, acquisition, etc. In that case, if the creditor-successor has an insurance policy with a different insurer, that insurer often assumes the coverage.

Another common cause is replacement. The factors affecting the decision to change an insurer or to replace the policy are not discussed in this paper.

The right of an insurer to terminate the policy is limited to the non-payment of premiums, and less frequently, insufficient participation. The assumed amount of insured indebtedness (or an assumed number of participants) is taken into account when the product is priced. If the participation is insufficient, and it is determined that the penetration efforts cannot correct the situation, an insurer can terminate the contract. Some contracts include provisions for the right to terminate the policy if an insurer is unable to get a sufficient premium rate approved .

An insured debtor can terminate the contract by written request. The insurance automatically terminates at the stipulated age as described in the "ELIGIBILITY" section. No conversion privileges are granted.

RENEWAL

The renewal process for a HELOC insurance policy involves an analysis of the prior year's experience and the determination of new premium rates. Several factors besides the policyholder's experience affect the new rates. The most important are competition, credit insurance regulations and the insurer's

perception of the balance between the premium rate charged and the participation level. Since both the policyholder and the debtor have an option to renew or to terminate the coverage, all factors influencing these decisions must be examined.

COST DEVELOPMENT

REGULATIONS

A fairly extensive set of regulations exists for credit insurance. The vast majority of these regulations refer to closed-end credit insurance. These regulations have eliminated the abuses of non-disclosure to the debtor, lack of refunds, and coercion of debtors to buy insurance. These regulations are as applicable to HELOC as they are to closed-end credit insurance. However, the regulations developed to ensure a reasonable cost of insurance (rate regulations and compensation limits) provide a limited protection to the consumers of HELOC insurance. Some provisions designed to ensure equity and fairness among insureds under closed-end credit insurance have an opposite effect on HELOC insurance.

The key provision of the NAIC Model Act for the regulation of credit life insurance is that benefits have to be reasonable in relation to premiums. From this requirement there evolved a flat

minimum loss ratio requirement and a maximum premium for which the loss ratio requirement would be assumed to have been met. This maximum premium is called the prima facie premium. Prima facie is Latin for true, valid or sufficient at first impression. This definition, however, implies that the prima facie premiums do not guarantee "sufficiency" and could merely serve as a starting point in pricing of a new product. The original 50% loss ratio benchmark was adopted by NAIC resolution in 1959; a 60% loss ratio became the NAIC benchmark in 1979. It was included in the NAIC Model Regulation adopted in 1980. Several states have reduced their prima facie rates since 1959, and some have adopted 60% as the benchmark loss ratio; however, the procedure for properly adjusting prima facie rates in the face of new experience was never implemented.

Many state regulations do not permit a credit insurance product with rates that equitably classify the potential risks insured. Often, a pre-existing condition (PEC) contestability and a suicide exclusion are not permitted. Many states permit the use of age-graded rates only to the extent that none of the rates exceed the prima facie premium in the state. Few states have recognized the fundamental differences in risks between providing credit insurance on decreasing (or, infrequently, level) amounts and insuring monthly varying amounts.

These issues attracted the attention of the NAIC Credit Insurance (E) Task Force. The underwriting issues in connection with large open-end credit life insurance were discussed at the December, 1986 Task Force Meeting [1]. Various effective control measures, such as insuring the full credit limit and an extensive use of PEC exclusion were suggested. It was pointed out that these measures would not imply a premium reduction, but the avoidance of premium increases. Because the regulations were developed for the closed end type products where anti-selection cannot be as easily exercised as it is with HELOC insurance, the insurer often is left with no other choice than to market the HELOC insurance product at the same prima facie premium. The insurer's only hope is that as soon as the inevitable poor experience emerges, it will file and be granted a premium increase. If the new premiums are approved, they must be acceptable to the policyholder and then communicated to the individual debtors.

This action can give rise to individual cancellations by the insureds who are now alerted to the monthly insurance charge and find this rate increase unpalatable. The HELOC insurance charges are incorporated in the monthly statement among all other

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1.NAIC Proceedings - 1987 Vol.I, p.924.

charges. They usually constitute an insignificant portion of the total and are, therefore, less visible to the insured. However, the risk of monthly lapses exists. This can cause both an increase in the group claim cost (because of anti-selection) and a shrinkage in the size of the group. Both are problems to the insurer.

An alternative to increased premium rates is a product with an anti-selection protection. This would seem easier and more equitable, but it is not supported by the current state regulators. The lack of uniformity and controversy in state credit life insurance regulations add to the challenge of designing HELOC insurance products that are marketable and able to operate on a profitable basis.

The actuarial functions central to the product's success are underwriting and pricing.

UNDERWRITING

The objective of underwriting is the efficient selection and classification of potential insurance risks. The underwriting process is based on the ability to discriminate in a fair manner.

There is a concern in individual insurance that this ability is under attack [1]. The same concern is valid for group credit insurance. As much as the actuarial/underwriting function of classifying risks should be defended in individual insurance, it should be defended in group credit insurance. The ability to discriminate between good risks and bad risks is essential when the pricing assumptions are formulated.

The underwriting techniques used to combat anti-selection in HELOC insurance vary with the anti-selection anticipated. Risk selection is used to determine whether the debtor applying for insurance should be issued an insurance contract. This is accomplished by asking the proposed insured questions on his health history. As a simple measure to protect the insurer against the anti-selection connected with AIDS, a question may include reference to AIDS among the various diseases listed. The coverage is usually denied if the answer to any question is unsatisfactory.

Risk classification for HELOC insurance is a challenge for the underwriter. First, it is typical to use only one premium classification. The mortality assumptions must be consistent with the use of one rating class to cover all acccepted applicants.

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1. "Methods of Underwriting And Considerations In Pricing", RSOA, Vol.13, No.2, p.779-781

Second, since the insured has an option to increase the amount insured at any point of time without additional underwriting, the initial underwriting does not prevent an insured from changing the amount of risk when he feels he has entered a new risk classification.

The insurer is in a vulnerable position when an unhealthy insured exercises the option of increasing the loan, and, therefore, the benefit amount in contemplation of death. Moreover, the insured has a strong incentive to increase this benefit just before death to maximize the benefit/cost ratio.

One of the solutions discussed within the industry [1] is to insure the full credit limit, independent of how much of this limit is actually used. This solution, however, may appear excessive to a borrower. It also places on the policyholder an administrative burden : to collect the insurance charge due on the insured accounts even if the actual account balance is zero. The cost of premium collection for zero balances would be ultimately transferred to the insured debtors, thereby increasing the cost of the loan.

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1. Jaffe, Jay M.; Lund, H. Neil. "Credit Insurers, Beware", Best's Review - Life-Health Insurance Edition, March 1987

To overcome anti-selection, an underwriting/contractual limitation, referred to in this paper as a rolling PEC & suicide exclusion, has been suggested. By the terms of the contract, the insurer's liability on debt increased within six months of death is limited to a return of premiums on the increased amount. These terms apply only to cases where death is a result of a pre-existing condition (PEC) or suicide and do not apply to the HELOC insured amount prior to increase. Sample contractual language is shown below.

> **BENEFIT AMOUNT AND LIMITATIONS:** The benefit is equal to your account balance on the date of death, unless it is limited as follows:
>
> 1. If you commit suicide, the benefit will be reduced by the unrepaid portion of any credit you drew against the account during the six months before you died.
>
> 2. If death results from a pre-existing medical condition, the benefit will be reduced by the unrepaid portion of any credit you drew against the account during the six months before you died. A pre-existing medical condition is one for which you consulted a doctor or received treatment during the six months before you drew the credit.

This procedure clearly requires a significant increase in expenses at the time of claim, since the determination of the benefit becomes fairly complex. Such an increase should be tested against the mortality gain expected.

The rolling PEC and suicide exclusion "discriminates" against the increases in insured amount because of the deterioration in one's medical condition. However, it does not discriminate against the insurance amounts prior to the increase. Thus, insurance protection is provided only on the "needed" amounts borrowed, ensuring equity for the group insured. An alternate to this underwriting technique would be to assume higher mortality rates, balanced, partially, by the lower expenses. The net effect, as well as the marketing considerations, should be taken into account when the product is designed and priced.

As was noted in the REGULATIONS section, the rolling PEC and suicide exclusions in HELOC insurance are not supported by the regulatory authorities. A comparison of the experience projections using underwriting with and without a rolling PEC could serve as an argument to combat these reservations. Since the insurance premiums charged are limited to what regulators approve, independent of whether the contract includes a rolling PEC and suicide exclusion, potential profitability estimates are crucial for both underwriting designs when the decision to promote one or another is being made.

MORTALITY

In the absence of credible HELOC insurance experience data, mortality rates assumed in pricing can be derived from the existing data from other insurance products.

In this paper, the Annual Renewable Term insurance product (ART) is chosen as a HELOC insurance prototype to develop the mortality rate pattern.

Mortality assumptions used for HELOC insurance pricing can be based on the mortality rates developed for ART with the following adjustments:

1. the composite smoker and non-smoker rates should be used, because non-smoker products are not offered,

2. the rates for male ages 25-45 are affected by the AIDS risk,

3. the rates for males and females are blended, because the premiums are unisex,

4. extra-risk components are incorporated: an impairment risk component, a guaranteed issue component, and an anti-selection risk component. This last component is included or excluded depending on the underwriting assumed, and

5. the rates are adjusted for a less stringent underwriting.

LAPSES

The persistency risk for HELOC insurance consists of two components: the lapse risk of the individual debtor and the risk of the policyholder's cancellation. If the inflow of new loans is taken into account, the lapse risk of the individual debtor can be partially balanced by the insurance issued to new debtors who become participants of the plan.

However, when profitability is considered over a period of time for the initial group of debtors, the pattern of individual persistency is an important component. A cohort approach may be used. Under this approach, a homogeneous group of insureds is observed for a specified period. Several factors are considered:

1. the fact that the line of credit extended by the policyholder is usually for a stated term,

2. the effect of relocation (i.e., the turnover rate of the equity),

3. the perceived need for insurance, which varies by age and

4. the effect of rate increases, if anticipated.

While a starting point for the lapse assumptions for HELOC insurance in this paper is the ART lapse experience, a very different pattern results when accounting for all the factors above.

The risk of a policyholder's termination is very significant for HELOC insurance, since the loss of the group would mean loss of not only the unrecouped past deficits, but also the unamortized first-year expenses. The risk of group termination represents a specific "group" feature and, therefore, is not included in the asset share calculations. An analysis of this risk is outside the scope of this paper.

INTEREST

Interest rate assumptions based on current investment projections can be used for HELOC insurance. The volatility of this parameter affects the calculations of the present values of future benefits, premiums and profits. The estimates of the results using different interest rates can be combined by assigning a probability to each assumption [1].

EXPENSES

The functional categories of expenses analyzed for HELOC insurance are acquisition, compensation, maintenance, termination and overhead. The assumptions should be based on the company's experience with a similar credit life insurance product, if available. If other experience is used, the difference in underwriting features and their cost should be taken into account.

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1. "Actuarial Pricing Assumptions in a Volatile Environment", RSOA, Vol. 11, #1.

Most credit insurance contracts specify that the policyholder's compensation be a level percentage of premium. The aquisition cost for a new policyholder often includes expenses for direct marketing. These expenses can be amortized over the period tested for the HELOC insurance product.

The expenses can be split by per policy issued (per individual account for the HELOC insurance policyholder), as a percent of premium, per death claim, per termination and per $1,000 issued. These expenses can be estimated for HELOC insurance using a distribution of the average monthly insured amounts.

CONSTRUCTION OF THE ASSET SHARE PRICING MODEL

This section outlines the procedure of building an asset share pricing model for the HELOC insurance product.

The starting point is to analyze the HELOC product design and to choose a model that reflects this design. Then, the mortality, lapses, expenses, and other assumptions for the asset-share pricing model are formulated. The formulas used to calculate the asset shares for this model are listed, and the profit objective is stated. Finally, the initial set of HELOC insurance premiums is tested.

The assumptions and the formulas for the asset share-type calculations, discussed below, are used to illustrate how this technique can be used to develop and test the premiums for the HELOC insurance product analyzed. Obviously, when the product's design differs from the one described, a new set of assumptions and formulas is to be developed and a new set of premiums has to be tested.

PRODUCT DESIGN

The HELOC insurance analyzed is a product with the following features:

1. health questions are used at issue to eliminate critically ill risks,

2. a rolling PEC and suicide exclusion is used,

3. the maximum amount of insurance issued is $100,000,

4. the termination age is 70,

5. age-graded premium rates are suggested, but to enhance the product's flexibility, a flat rate is offered also,

6. the policyholder's compensation is 25% of the premium for all years if age-graded rates are used and 20% for all years if flat rates are used, the difference serving as an incentive to promote the age-graded rates,

7. 2% broker's or agent's compensation is provided, and

8. joint HELOC insurance is offered at a multiple of the single HELOC insurance premiums. However, no testing of joint insurance performance is done in this paper.

To determine whether the rolling PEC and suicide exclusion is desireable for the HELOC insurance product analyzed, additional testing is performed for the same product without this protection. The tests for HELOC insurance with rolling PEC and suicide are referred to as scenario 1; the tests without rolling PEC and suicide are referred to as scenario 2.

As a base for analysis, the following distribution of HELOC insured accounts is used:

THE AGE DISTRIBUTION OF INSURED LOANS BY NUMBER AND AMOUNT

Age Group	# of Loans	% of Total	Insured Amount	% of Total	Average Loan Amt('000s)
< 35	300	8%	5,130,000	7%	17
35-49	2,150	60%	44,720,000	61%	21
50-59	930	26%	19,623,000	27%	21
>=60	220	6%	4,092,000	6%	19
TOTAL	3,600	100%	73,565,000	100%	20

These data are used to estimate expenses allocated per policy and per $1,000 issued. They are also used to develop the aggregate mortality rates when the flat premium rate is tested.

ASSUMPTIONS

Four age groups are analyzed, with the distribution of insured amounts as described above.

1. **MORTALITY**

The aggregate ART experience rates are used for the central ages for each age group range. The rates are adjusted to account for an increasing percentage of substandard risks at the higher ages.

The rates are loaded 30%. This loading is consistent with the experience developed by the New England Life Insurance Company on policies underwritten on some form of guaranteed issue basis [1].

In addition the mortality rates for scenario 2 are loaded 20% for anti-selsection. It has been found that the average

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1. Individual Policies Issued Without Individual Underwriting" by Peter F. Chapman, F.S.A. and Harold G. Ingraham, F.S.A. Cource I-340 Study Note.

death benefit for HELOC insurance is almost always greater than the average amount of insurance. The 20% loading factor was developed by comparing the average amount insured with the average amount of benefits for a large HELOC insurance policyholder. The excess was assumed to be the result of anti-selection.

The loading varies by the terms of the contract in question and should be based on a company's experience. The resulting mortality rates are listed in each illustration for respective age groups and scenarios. They are approximately 15% higher than the 1975-80 Ultimate Basic Tables; however, they are significantly lower (15% to 40%) than the 1960 Basic Group Mortality Table rates. The model's rates are felt to be appropriate since the use of 1960 group rates would not reflect the significant improvement in mortality since 1960 and would be redundant, while the use of 1975-80 tables would not reflect the risks inherent in group insurance.

2. LAPSES

Lapse assumptions are based on ART lapse rate experience for the monthly premium mode. The rates are adjusted to account for the factors discussed in the "LAPSES" section on page 18.

3. **EXPENSES**

Death claim with rolling PEC exclusion - $850 per claim. This expense is designated in the formulas and illustrations as "Edeath". The expense of an investigation of the insured amount history within six months prior to death is included in Edeath.

Edeath without rolling PEC exclusion - $100 per claim. This expense involves a minor investigation for contestability. The contestability period is two years, but the assumption is that individual debtors who terminate will be balanced by new debtors. Thus, this expense continues beyond two years.

Termination expense -$ 7 per lapse.
This expense is designated in the formulas as Elapse.

Annual per policy expense, Exp/pol, varies for each age group. These expenses are lower for the underwriting without rolling PEC.

Premium collection, administration, etc. - 8% of premiums.
Total policyholder/broker compensation - 22% or 27%, depending on whether the flat rate or age-graded rates are tested.

Administration, sales, service, and other expenses per $1,000 of insurance issued are translated into per policy expenses.

4. INTEREST

Interest rate, i, used for the asset-share accumulation and discounting, is 8%.

5. INCOME TAX

Income tax rate, itax, is 37%.
This rate is assumed to be fairly typical for a large mutual company

6. PREMIUM RATES TESTED

For the four age groups analyzed, the central ages and the annual premiums per $1,000 of insured indebtedness tested are summarized below.

Age Group	< 35	35-49	50-59	>=60
Central Age	32	42	55	62
Annual Premium per $1000	$4.80	$8.40	$25.80	$48.00

The period tested is ten years. Since the average period of a HELOC account is seven years, it is felt that in ten years after the line of credit is open and insured, an insurer's risk is minimal.

FORMULAS

1. $p(t) = (1-q^d(t)) * (1-q^w(t))$
2. $D(t) = D(t-1) * p(t) / [1+i*(1-itax)]$ with $D(0)=1$
3. $Prem(t) = Annual\ Premium\ per\ \$1,000$
4. $Ben(t) = \frac{i}{\delta} * \left(1000 * \frac{Edeath}{Aver.\ Size}\right) * q^d(t) + \frac{Elapse}{Aver\ Size} * (1-q^d(t)) * q^w(t)$
5. $Expense(t) = \frac{Exp/Pol}{Aver.\ Size} + (Exp\%\ Prem) * Prem(t)$
6. $Tax(t) = [(Prem(t) - Expense(t)) * (1+i) - Ben(t)] * itax$
7. $AS(0) = 0$, $Tax\ AS(t) = Tax(t) + itax * i * AS(t-1)$
8. $AS(t) = [[AS(t-1) + Premium(t) - Expense(t)) * (1+i) - Ben(t) - Tax\ AS(t)] \div p(t)$
9. $Profit(t) = AS(t) - [AS(t-1) * (1+i*(1-itax))] / p(t)$
10. $P.V.\ Premiums = \sum_{t=1}^{10} [D(t-1) + D(t)] * Prem(t) / 2$
11. $P.V.\ Profit = \sum_{t=1}^{10} D(t) * Profit(t)$

The profit objective chosen is:

P.V. of Profit = .10 * P.V. of Premiums

To test for compliance with existing regulations the loss ratio at issue is calculated also. The present value of benefits is calculated, using the formula:

P.V. BENEFITS = $\sum_{t=1}^{10} D(t) * Ben(t)$

The Loss Ratio at issue = (P.V. BENEFITS/P.V. Premiums)

Pages A1-A4 in Appendix A show the calculations for each age group. Page A5 shows the calculations for the flat premium rate of $1.10 per $1,000 monthly ($13.20 annually). This premium rate is lower than the weighted average of the age-graded premium rates tested, $1.25 per $1,000 monthly; however, even this rate is higher than the prima facie rates prescribed by the majority of state regulations.

Page A6 in Appendix A shows calculations analogous to those on page A5, but with the interest rate changed to 9.5%. The effect of the change in the interest rate assumption is discussed in the "STOCHASTIC APPROACH" section.

ANALYSIS

SUMMARY

As shown on pp. A1-A4, the annual HELOC insurance profits become negative for all age groups but the youngest, after the first few policy years. However, the present values of profits are positive for all age groups for both scenarios and range from 8% to 19%. Thus, the profit objective is met.

However, when the illustration with the flat premium rate (page A5) is examined, the present value of profits is below the objective for scenario 1 and negative for scenario 2.

This occurs for two reasons:

1. in the HELOC insurance product, a level commission scale is used and

2. new business is not taken into consideration.

While the level commission scale is typical for credit insurance, it is obvious that level premiums can only be sustained with the inflow of new lives. It can be shown that a participation requirement of a minimum of 100 new loans per year (see Eligibility section) increases profits significantly. Starting with N_1 loans, for each policy year, k, it is calculated, how many loans, N_k, remain in force by using

$$N_k = N_{k-1} * \left(1 - q^{d}(k-1)\right) * \left(1 - q^{w}(k-1)\right) , \qquad k = 2, \ldots, 10$$

The same process is used to estimate the number of loans, n_k^i, that remain in force for a year i out of n_k issued in the policy year k.

Then, weighing each year's profit by the number of loans, ("old" and "new") remaining in force for that year, the average profit, $Profit_t$, is calculated for each year, t.

$$Profit_t = N_t * Profit(t) + \sum_{i=0}^{t-1} n_{i+1}^{t-i} * Profit(t-i)$$

The present value of these profits is recalculated using the same formula:

$$\text{P.V. Profits} = \sum_{t=1}^{10} D(t) * Profit_t$$

When applied to the flat premium rate case at 8% interest, starting with 3,600 loans (p. 24), an inflow of 100 new loans produces an increase in P.V. of profit of almost 30% for scenario 1 and turnes the P.V. of profit positive for scenario 2.

This discussion is only applicable if the insurer is not at risk after ten years, as was assumed before (p. 28).

Since the study in this paper is limited to the cohort approach, the discussion below does not take into consideration the potential growth of the group. The issue is briefly addressed in the conclusion.

The present value of profits divided by the present value of premiums (i.e., operating margin) is higher than 10% for the first two age groups, with a smaller margin available for scenario 2 (without rolling PEC and suicide). The profit objective is not satisfied for the age groups 50-59 and >=60;

however, the present value of the profit remains positive. It is important to ensure that mortality and lapse deviations from the rates assumed would not cause negative profitability. This problem is addressed in "STOCHASTIC APPROACH" below.

REGULATORY IMPLICATIONS

The two most common objections from the state regulators when HELOC insurance product designed as outlined above is filed for approval are:

1. the age-graded rates for older ages exceed the prima facie rates and
2. the flat rate exceeds the prima facie rate in the state in question.

The first objection can be addressed by analyzing the calculations on pages A2-A4. If the rates for ages 50-59 and >=60 are to be reduced to the prima facie level acceptable in many states ($13.20, the premium used for the flat rate illustrations) the profits are still acceptable for the issue age 42 (p. A7). There are significant losses, however, for the central issue ages 55 and 62. The overall profitability is negative. The premium rates for older ages can be somewhat decreased producing a higher loss ratio and a lower profitability margin. The model permits to achieve an acceptable balance among

these three variables. Several illustrations of the results anticipated can be used when filing the product for approval.

The second objection can also be addressed now. The calculations on page A5 show the use of $1.10 per $1,000 flat monthly rate for the HELOC insurance product. The use of $1.10 per $1,000 achieves a 60% loss ratio for scenario 1 and a 70% loss ratio for Scenario 2. The profits, positive in the first few years, sharply decline as the mortality rates increase, producing negative profitability for scenario 2. Clearly, the prima facie rates below $1.1 per $1,000 are not sufficient to cover the HELOC insurance risk. The insurer will either avoid the risk of offering the product at the prima facie rate or will market it, anticipating bad experience results and filing for an even higher rate deviation after a few years.

CONCLUSIONS

The illustrations show that the HELOC insurance product satisfies the profit objective when the age graded premiums are used for both scenarios. The profit margins for the age groups 50-59 and >=60 are smaller than for the age groups <35 and 35-49. However, for both scenarios the weighted average of the present value of profits is above the 10% of the weighted average of the present value of premiums. The profit objective is not satisfied when the flat premiums are used for scenario 1, and the present value of

profits is negative for scenario 2. Thus, if the product designed with the rolling PEC and suicide exclusion is approved, it can be marketed. Even if the flat premium design is selected by the majority of the policyholders for administrative simplicity, profits can still be expected over the ten year period. If the rolling PEC and suicide exclusion is not approved, more consideration and estimates are needed to decide whether the product can still be profitable.

STOCHASTIC APPROACH

It is often important to determine the probability that the present value of profit is positive if the assumptions used do not deviate from the experience.

This section offers a simple stochastic model to establish the relationship between the probability that the present value of profit is positive and one of the HELOC insurance parameters, number of insured accounts. The model uses the normal distribution to approximate the mean and variance of the present value of profit.

The present value of profit (PVP) is now split into three components: the present value of profits for the surviving account (PVPSA), the present value of profit for the account terminated by death (PVPDA), and the present value for the withdrawn account (PVPWA).

Formulas:

1. $_{t}p = {}_{t-1}p * (1 - q^{d}(t)) * (1 - q^{w}(t))$, $t = 1$
2. ${}_{t}q^{d} = {}_{t-1}p * q^{d}(t)$
3. ${}_{t}q^{w} = {}_{t-1}p \cdot q^{w}(t) * (1 - q^{d}(t))$
4. $D(0) = 1$, $D(t) = D(t-1) / [1 + i * (1 - itax)]$
5. $Profit\ P = (Prem - Exp) * (1+i) * (1 - itax)$
6. $Profit\ D = \left[(Prem - Exp) * (1+i) - \frac{i}{\delta} * \left(1000 * \frac{Edeath}{Aver.\ Size}\right)\right] * (1 - itax)$
7. $Profit\ W = \left[(Prem - Exp) * (1+i) - \frac{E\ lapse}{Aver.\ Size}\right] * (1 - itax)$
8. $PVPSA = (Aver.\ Size) * \sum_{t=1}^{10} D(t) * Profit\ P$
9. $PVPDA(t) = (Aver.\ Size) * [D(t) * Profit\ D + \sum_{r=1}^{t-1} D(r) * Profit\ P]$
10. $PVPWA(t) = (Aver.\ Size) * [D(t) * Profit\ W + \sum_{r=1}^{t-1} D(r) * Profit\ P]$
11. $E(PVP) = {}_{10}p * PVPSA + \sum_{t=1}^{10} {}_{t}q^{d} * PVPDA(t) + \sum_{t=1}^{10} {}_{t}q^{w} * PVPWA(t)$
12. $Var(PVP) = \left[{}_{10}p * (PVPSA)^{2} + \sum_{t=1}^{10} {}_{t}q^{d} * (PVPDA(t))^{2} + \sum_{t=1}^{10} {}_{t}q^{w} * (PVPWA(t))^{2}\right] - [E(PVP)]^{2}$
13. $Std.\ Dev. = \sqrt{Var(PVP)}$

A sample calculation for HELOC insurance with a rolling PEC and suicide exclusion and an annual flat rate is shown on page A8. Similar calculations can be performed for the product without the rolling PEC and suicide exclusion, but since negative profitability was estimated in the deterministic model, the stochastic approach will only emphasize this deficiency.

The values on page A8 can now be used to determine the adequacy of the premiums tested.

Using the normal distribution, the probability that the present value of profit will exceed 0 for the policyholder with a predetermined number of insured HELOC accounts, n, can be determined:

Let $$\frac{\sqrt{n} * E(PVP)}{\text{Std. Dev.}} = t$$

The required probability is $\Phi(t)$ where $\Phi(t) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{t} e^{-\frac{r^2}{2}} dr$

The calculations can also be reversed to determine for a given probability $\Phi(t)$ the number of insured accounts, n, required for the group insured to assure a profit.

$$n > \frac{t^2 * Var(PVP)}{[E(PVP)]^2}$$

The chart below shows the required number of accounts ,n, for given different predetermined probabilities ,p, for a HELOC insurance product with a rolling PEC and suicide exclusion at a flat premium with interest rates of 8% and 9.5% assumed (p. A9).

		Interest 8%	Interest 9.5%
E(PVP)		72.4	81.25
Std. Deviation		2612	2510
P = .85,	n =	1408	1032
P = .90,	n =	2133	1564
P = .95,	n =	3501	2567

It is clear that different marketing results are needed when different interest rates are assumed. The method suggested can help to set up the marketing goals consistent with the product design and profit objectives. One way of taking into account the variation due to interest rates is to study the effect of a "weighted" interest assumption on profitability. As was mentioned in the "INTEREST" section, by assigning probabilities

to the different interest rates assumed, the mean and variance of the present value of profit can be calculated over a combination of interest rates. If, for example, the probability of .5 is assigned to the interest of 8%, .25 to the 7%, and .25 to the 9.5%, the formulae are:

$$E(PVP) = .5 * E(PVP)_{8\%} + .25 * E(PVP)_{7\%} + .25 * E(PVP)_{9.5\%}$$

$$Var(PVP) = .5 * [E(PVP)_{8\%}]^2 + .25 * [E(PVP)_{7\%}]^2 + .25 * [E(PVP)_{9.5\%}]^2 - [E(PVP)]^2 +$$

$$+ .5 * Var(PVP)_{8\%} + .25 * Var(PVP)_{7\%} + .25 Var(PVP)_{9.5\%}$$

Using the values of mean and variance, calculated for 7% and 9.5% respectively (pages A10 and A9) and the values of the mean and variance for 8% (page A8) for Scenario 1 (rolling PEC and suicide), we have

E(PVP)	=	73.00
Std. Deviation	=	2635

These calculations should be used when the interest rate is expected to deviate from the one assumed originally.

The asset share accumulation and discount interest rates of 7%, 8% and 9.5% are chosen for illustrative purposes only. Similar calculations can be performed for different sets of mortality rates or lapse rates assumed. The impact of these parameters on the profitability estimates can be significant.

CONCLUSION

This paper has examined the pricing process of a HELOC insurance product. The product's design and characteristics in conjunction with the existing regulations determined the set of assumptions used for pricing. The asset share pricing model was used then to project the product's profitability over a 10 year period. The results were analyzed and the recommendations made. A simplified stochastic approach was used also to illustrate the sensitivity of profits to the changes in pricing assumptions.

The paper can be used as a starting point in developing an asset share approach to pricing credit insurance products. Some possible extensions, refinements and uses of the technique illustrated are outlined below.

DESIGNING STAGE

The impact of various product design features on profitability can be tested by varying the assumptions that each feature affects. By comparing the present value of profit for each feature tested, the product design can be finalized to satisfy the profit objective chosen.

SOLUTION FOR "UNKNOWN"

There are three major interrelated parameters in estimating future profitability of the product: design, price, and marketability. When the profit objective is defined, the technique presented in this paper allows an easy and flexible solution for the third parameter, given the first two.

Often while the market's demands define the most important design features, the effect of the premium rate on profitability is difficult to predict, due to the interrelationship of design, price, and marketability. Using the model described, a premium rate can be determined for every given set of assumptions. A similar procedure can be used to determine the level of future sales that would ensure a predetermined profit with the preset premium rates.

MONITORING PROFITABILITY

The product's profitability can be tested frequently by substituting the emerging experience for the assumptions used in the asset-share calculations. While a "cohort" approach provides data for "detailed" analysis, a dynamic approach can serve to estimate the overall profitability of each group by taking into account the number of new loans insured during the year.

STATE REGULATORS

As was pointed out before in the "ANALYSIS" section, the model projections can help to alleviate the objections to certain design features of the product filed and serve as a justification that the benefits offered are reasonable in relation to premiums charged.

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APPENDIX A

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) - ISSUE AGE 32

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	13
itax=	0.37	Exp % Prem	35
Avsize	17	Expenses	2.4447 for yrs t<4
Prem. (t<4)	4.80		3.7047 for yrs t>3
Prem. (t>3)	8.40	Edeath	850

t	1000 q(t)	d q(t)	w	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	1.21775	0.100		0.89890	0.8558	1.3702	0.4342	0.8224	0.8224
2	1.36424	0.020		0.97866	0.7973	1.4972	0.3872	1.5564	0.6736
3	1.48058	0.020		0.97855	0.7428	1.6242	0.3402	2.2626	0.5919
4	1.61991	0.020		0.97841	0.6919	1.7763	1.2190	4.5505	2.1214
5	1.73626	0.020		0.97830	0.6444	1.9033	1.1720	6.9258	2.0398
6	1.90575	0.075		0.92324	0.5664	2.1109	1.0952	9.8996	2.0198
7	2.06663	0.090		0.90812	0.4897	2.2926	1.0280	13.3780	1.9274
8	2.25765	0.100		0.89797	0.4186	2.5052	0.9493	17.4490	1.8000
9	2.44723	0.100		0.89780	0.3578	2.7121	0.8728	22.0701	1.6551
10	2.67701	0.100		0.89759	0.3057	2.9629	0.7800	27.3070	1.4795

P.V. OF PREMIUMS	43.138
P.V. OF PROFITS	8.3487
P.V. OF BENEFITS	11.271
LOSS RATIO	26.13

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ISSUE AGE 32

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	11
itax=	0.37	Exp % Prem	35
Avsize	17	Expenses	2.3270 for yrs t<4
Prem. (t<4)	4.80		3.5870 for yrs t>3
PREM. (T>3)	8.40	EDEATH	100

t	1000 q(t)	d q(t)	w	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	1.46129	0.100		0.89868	0.8555643	1.5604	0.41082	0.77837	0.7783
2	1.63709	0.020		0.97840	0.7969159	1.7103	0.35537	1.45411	0.6184
3	1.77670	0.020		0.97826	0.7421839	1.8554	0.30166	2.08641	0.5250
4	1.94389	0.020		0.97809	0.6910952	2.0292	1.17241	4.28162	2.0409
5	2.08352	0.020		0.97796	0.6434331	2.1744	1.11869	6.54653	1.9477
6	2.28690	0.075		0.92288	0.5653223	2.4085	1.03209	9.35527	1.9042
7	2.47995	0.090		0.90774	0.4885448	2.6153	0.95555	12.6178	1.7923
8	2.70918	0.100		0.89756	0.4174592	2.8578	0.86585	16.4090	1.6425
9	2.93668	0.100		0.89736	0.3566355	3.0943	0.77834	20.6844	1.4768
10	3.21241	0.100		0.89711	0.3045895	3.3810	0.67227	25.4948	1.2759

P.V. OF PREMIUMS	43.074
P.V. OF PROFITS	7.7654
P.V. OF BENEFITS	12.842
LOSS RATIO	29.81

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) - ISSUE AGE 42

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	8
itax=	0.37	Exp % Prem	35
Avsize	21	Expenses	3.3209 for yrs t<9
Prem. (t<9)	8.40		9.4109 for yrs t>8
Prem. (t>8)	25.80	Edeath	850

t	1000 q(t)	d q(t)	w p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	2.23168	0.080	0.91795	0.8739	2.4403	1.1267	2.0899	2.0898
2	2.77964	0.020	0.97728	0.8131	3.0130	0.9148	3.8401	1.5938
3	3.32318	0.020	0.97674	0.7561	3.6009	0.6973	5.3451	1.2155
4	3.84310	0.020	0.97623	0.7027	4.1632	0.4892	6.6045	0.8532
5	4.42062	0.020	0.97567	0.6527	4.7878	0.2581	7.5608	0.4504
6	5.01735	0.075	0.92036	0.5719	5.4514	0.0126	8.6523	0.0232
7	5.63327	0.090	0.90487	0.4926	6.1226	-0.2358	9.6002	-0.443
8	6.25362	0.100	0.89437	0.4195	6.7968	-0.4852	10.3512	-0.923
9	6.95667	0.100	0.89374	0.3569	7.5572	3.7529	19.3155	7.1498
10	7.73356	0.100	0.89304	0.3034	8.3974	3.4420	29.2817	6.5626

P.V. OF PREMIUMS	65.343
P.V. OF PROFITS	8.8851
P.V. OF BENEFITS	27.585
LOSS RATIO	42.22

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ISSUE AGE 42

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	6
itax=	0.37	Exp % Prem	35
Avsize	21	Expenses	3.2257 for yrs t<9
Prem. (t<9)	8.40		9.3157 for yrs t>8
Prem. (t>8)	25.80	Edeath	100

t	1000 q(t)	d q(t)	w p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	2.67801	0.080	0.91754	0.8735	2.8236	1.02290	1.89824	1.8982
2	3.33557	0.020	0.97673	0.8122	3.4904	0.77618	3.39451	1.3530
3	3.98782	0.020	0.97609	0.7548	4.1716	0.52412	4.56722	0.9142
4	4.61172	0.020	0.97548	0.7010	4.8232	0.28303	5.41203	0.4940
5	5.30474	0.020	0.97480	0.6505	5.5471	0.01521	5.85833	0.0265
6	6.02081	0.075	0.91943	0.5694	6.3132	-0.2682	6.19606	-0.496
7	6.75992	0.090	0.90385	0.4900	7.0901	-0.5556	6.15386	-1.046
8	7.50434	0.100	0.89325	0.4167	7.8708	-0.8445	5.62659	-1.609
9	8.34800	0.100	0.89249	0.3540	8.7520	3.34887	13.0111	6.3890
10	9.28027	0.100	0.89165	0.3005	9.7256	2.98861	21.0348	5.7071

P.V. OF PREMIUMS	65.086
P.V. OF PROFITS	6.3211
P.V. OF BENEFITS	31.808
LOSS RATIO	48.87

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) - ISSUE AGE 55

i=	0.08	Elapse	7		
delta=	0.0769	Exp/Pol	10		
itax=	0.37	Exp % Prem	35		
Avsize	21	Expenses	9.51	for yrs t < 6	
Prem. (t<6)	25.80		17.28	for yrs t > 5	
Prem. (t>5)	48.00	Edeath	850		

t	1000 d q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	7.49931	0.080	0.91310	0.8693	8.1374	3.5002	6.5269	6.5269
2	8.46888	0.020	0.97170	0.8042	9.1662	3.1195	12.5218	5.4662
3	10.46245	0.020	0.96975	0.7424	11.3224	2.3217	17.6398	4.0765
4	12.33564	0.020	0.96791	0.6841	13.3483	1.5721	21.9087	2.7656
5	14.30612	0.020	0.96598	0.6291	15.4795	0.7836	25.2046	1.3811
6	16.48932	0.075	0.90975	0.5449	17.8588	5.6695	39.7125	10.611
7	18.74012	0.090	0.89295	0.4632	20.2980	4.7670	55.8048	9.0898
8	25.42653	0.150	0.82839	0.3653	27.5491	2.0841	75.0445	4.2836
9	28.28578	0.100	0.87454	0.3041	30.6252	0.9459	91.9765	1.8416
10	31.39236	0.100	0.87175	0.2524	33.9851	-0.2972	110.2453	-0.580

P.V. OF PREMIUMS	202.67
P.V. OF PROFITS	27.827
P.V. OF BENEFITS	88.811
LOSS RATIO	43.82

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ISSUE AGE 55

i=	0.08	Elapse	7		
delta=	0.0769	Exp/Pol	8		
itax=	0.37	Exp % Prem	35		
Avsize	21	Expenses	9.41	for yrs t < 6	
Prem. (t<6)	25.80		17.18	for yrs t > 5	
Prem. (t>5)	48.00	Edeath	100		

t	1000 d q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	8.99917	0.080	0.91172	0.8680	9.42549	3.06163	5.717812	5.7178
2	10.16266	0.020	0.97004	0.8016	10.6208	2.61934	10.78919	4.5977
3	12.55493	0.020	0.96770	0.7385	13.1194	1.69487	14.69350	2.9822
4	14.80277	0.020	0.96549	0.6788	15.4671	0.82622	17.44276	1.4571
5	17.16735	0.020	0.96318	0.6224	17.9367	-0.0875	18.86761	-0.154
6	19.78718	0.075	0.90670	0.5373	20.6909	7.76452	36.43910	14.581
7	22.48814	0.090	0.88954	0.4550	23.5167	6.71897	55.88988	12.861
8	30.51184	0.150	0.82406	0.3569	31.9161	3.61120	78.70197	7.4615
9	33.94294	0.100	0.86945	0.2955	35.4834	2.29130	99.56849	4.4872
10	37.67084	0.100	0.86610	0.2436	39.3768	0.85073	122.4289	1.6724

P.V. OF PREMIUMS	128.39
P.V. OF PROFITS	19.577
P.V. OF BENEFITS	101.32
LOSS RATIO	78.92

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) - ISSUE AGE 62

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	31
itax=	0.37	Exp % Prem	35
Avsize	19	Expenses	18.5222
Prem.	48.00	Edeath	850

t	1000 d q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	11.34952	0.050	0.93922	0.8942	12.3437	7.2122	13.0749	13.074
2	13.42882	0.100	0.88791	0.7558	14.6199	6.3700	27.6829	12.215
3	16.08853	0.100	0.88552	0.6372	17.5082	5.3013	43.0308	10.193
4	20.17126	0.100	0.88185	0.5349	21.9419	3.6608	58.3240	7.0684
5	24.56894	0.100	0.87789	0.4471	26.7176	1.8938	73.4583	3.6731
6	29.31784	0.100	0.87361	0.3718	31.8746	-0.0143	88.2956	-0.027
7	34.50864	0.100	0.86894	0.3076	37.5116	-2.1000	102.6191	-4.114
8	39.65493	0.100	0.86431	0.2531	43.1003	-4.1678	116.5029	-8.210
9	53.01153	0.050	0.89964	0.2168	57.5875	-9.5280	117.9931	-18.03
10	58.37184	0.050	0.89455	0.1846	63.4086	-11.6819	116.3151	-22.23

P.V. OF PREMIUMS	240.52
P.V. OF PROFITS	21.473
P.V. OF BENEFITS	115.41
LOSS RATIO	47.99

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ISSUE AGE 62

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	28
itax=	0.37	Exp % Prem	35
Aver.size	19	Expenses	18.3555
Prem.	48.00	Edeath	100

t	1000 d q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	13.61943	0.050	0.93706	0.8920997	14.2498	6.573459	11.94441	11.944
2	16.11458	0.100	0.88550	0.7520482	16.8753	5.602059	24.94085	10.772
3	19.30623	0.100	0.88262	0.6319270	20.2103	4.368098	38.10845	8.4266
4	24.20551	0.100	0.87822	0.5283395	25.3296	2.473935	50.37660	4.7965
5	29.48273	0.100	0.87347	0.4393434	30.8439	0.433655	61.42654	0.8453
6	35.18140	0.100	0.86834	0.3631931	36.7986	-1.76957	70.83587	-3.469
7	41.41037	0.100	0.86273	0.2983033	43.3074	-4.17782	77.99932	-8.245
8	47.58592	0.100	0.85717	0.2434286	49.7603	-6.56541	82.54059	-13.04
9	63.61384	0.050	0.88957	0.2061558	66.4910	-12.7557	73.04833	-24.41
10	70.04621	0.050	0.88346	0.1733907	73.2124	-15.2426	57.47449	-29.37

P.V. OF PREMIUMS	237.19
P.V. OF PROFITS	9.9655
P.V. OF BENEFITS	129.90
LOSS RATIO	54.77

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) -ALL AGES

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	10
itax=	0.37	Exp % Prem	30
Avsize	20	Expenses	4.46
Prem.	13.2	Edeath	850

t	d 1000 q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)	
1	4.06906	0.080	0.91626	0.8723	4.4374	1.8507	3.4391	3.4391	:
2	4.78734	0.020	0.97531	0.8099	5.1948	1.5704	6.4456	2.7416	:
3	5.80504	0.020	0.97431	0.7513	6.2977	1.1624	8.9803	2.0313	:
4	6.85671	0.020	0.97328	0.6961	7.4373	0.7407	10.9877	1.2958	:
5	7.98546	0.020	0.97217	0.6443	8.6605	0.2881	12.3764	0.5046	:
6	9.20547	0.075	0.91648	0.5621	10.0017	-0.2081	13.7982	-0.386	:
7	10.47912	0.090	0.90046	0.4819	11.3870	-0.7207	14.7329	-1.362	:
8	11.80756	0.100	0.88937	0.4080	12.8300	-1.2546	14.9985	-2.401	:
9	13.13441	0.100	0.88818	0.3450	14.2678	-1.7866	14.3128	-3.425	:
10	14.56090	0.100	0.88690	0.2913	15.8136	-2.3585	12.4235	-4.528	:

P.V. OF PREMIUMS	82.058
P.V. OF PROFITS	3.6189
P.V. OF BENEFITS	49.439
LOSS RATIO	60.25

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ALL AGES

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	8
itax=	0.37	Exp % Prem	30
Aver.size	20	Expenses	4.36
Prem.	13.2	Edeath	100

t	d 1000 q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)	
1	4.88288	0.080	0.91551	0.8715801	5.12892	1.63476	3.04040	3.0404	:
2	5.74481	0.020	0.97437	0.8084935	6.00847	1.30932	5.56568	2.2880	:
3	6.96604	0.020	0.97317	0.7490520	7.28426	0.83728	7.47229	1.4649	:
4	8.22805	0.020	0.97194	0.6930988	8.60265	0.34948	8.68777	0.6122	:
5	9.58256	0.020	0.97061	0.6404494	10.0176	-0.1740	9.09659	-0.305	:
6	11.04656	0.075	0.91478	0.5577604	11.5661	-0.7470	9.05476	-1.390	:
7	12.57494	0.090	0.89856	0.4771319	13.1679	-1.3396	8.04629	-2.538	:
8	14.16907	0.100	0.88725	0.4030220	14.8367	-1.9571	5.77001	-3.755	:
9	15.76130	0.100	0.88581	0.3398732	16.5000	-2.5725	1.89716	-4.944	:
10	17.47308	0.100	0.88427	0.2861206	18.2882	-3.2341	-3.9739	-6.227	:

P.V. OF PREMIUMS	81.622
P.V. OF PROFITS	-1.137
P.V. OF BENEFITS	56.716
LOSS RATIO	69.49

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) -ALL AGES

i=	0.095	Elapse	7
delta=	0.0907	Exp/Pol	10
itax=	0.37	Exp % Prem	30
Avsize	20	Expenses	4.46
Prem.	13.2	Edeath	850

t	1000 d q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)	
1	4.06906	0.080	0.91626	0.8645	4.4683	1.8877	3.5080	3.5080	:
2	4.78734	0.020	0.97531	0.7956	5.2313	1.6054	6.6149	2.8028	:
3	5.80504	0.020	0.97431	0.7313	6.3418	1.1945	9.2832	2.0875	:
4	6.85671	0.020	0.97328	0.6716	7.4895	0.7699	11.4558	1.3469	:
5	7.98546	0.020	0.97217	0.6161	8.7212	0.3142	13.0392	0.5502	:
6	9.20547	0.075	0.91648	0.5327	10.0717	-0.1855	14.7343	-0.344	:
7	10.47912	0.090	0.90046	0.4526	11.4667	-0.7017	16.0155	-1.326	:
8	11.80756	0.100	0.88937	0.3798	12.9198	-1.2393	16.7127	-2.372	:
9	13.13441	0.100	0.88818	0.3183	14.3677	-1.7750	16.5401	-3.402	:
10	14.56090	0.100	0.88690	0.2663	15.9244	-2.3510	15.2521	-4.513	:

P.V. OF PREMIUMS	79.142
P.V. OF PROFITS	4.0622
P.V. OF BENEFITS	47.342
LOSS RATIO	59.82

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ALL AGES

i=	0.095	Elapse	7
delta=	0.0907	Exp/Pol	8
itax=	0.37	Exp % Prem	30
Aver.size	20	Expenses	4.36
Prem.	13.2	Edeath	100

t	1000 d q(t)	w q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)	
1	4.88288	0.080	0.91551	0.8638087	5.16472	1.67057	3.10701	3.1070	:
2	5.74481	0.020	0.97437	0.7941401	6.05059	1.34280	5.72613	2.3465	:
3	6.96604	0.020	0.97317	0.7291937	7.33533	0.86745	7.75386	1.5177	:
4	8.22805	0.020	0.97194	0.6687078	8.66297	0.37622	9.11431	0.6590	:
5	9.58256	0.020	0.97061	0.6124016	10.0879	-0.1510	9.68740	-0.264	:
6	11.04656	0.075	0.91478	0.5285785	11.6471	-0.7279	9.86878	-1.354	:
7	12.57494	0.090	0.89856	0.4481368	13.2601	-1.3247	9.12999	-2.510	:
8	14.16907	0.100	0.88725	0.3751554	14.9405	-1.9464	7.17063	-3.735	:
9	15.76130	0.100	0.88581	0.3135521	16.6155	-2.5662	3.64664	-4.932	:
10	17.47308	0.100	0.88427	0.2616087	18.4163	-3.2325	-1.8536	-6.224	:

P.V. OF PREMIUMS	78.731
P.V. OF PROFITS	-0.484
P.V. OF BENEFITS	54.317
LOSS RATIO	68.99

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE) - ISSUE AGE 42

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	8
itax=	0.37	Exp % Prem	35
Avsize	21	Expenses	3.3209 for yrs t<9
Prem. (t<9)	8.40		5.0009 for yrs t>8
Prem. (t>8)	13.20	Edeath	850

t	1000 q(t)	d q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	2.23168	0.080	0.91795	0.8739	2.4403	1.1267	2.0899	2.0898
2	2.77964	0.020	0.97728	0.8131	3.0130	0.9148	3.8401	1.5938
3	3.32318	0.020	0.97674	0.7561	3.6009	0.6973	5.3451	1.2155
4	3.84310	0.020	0.97623	0.7027	4.1632	0.4892	6.6045	0.8532
5	4.42062	0.020	0.97567	0.6527	4.7878	0.2581	7.5608	0.4504
6	5.01735	0.075	0.92036	0.5719	5.4514	0.0126	8.6523	0.0232
7	5.63327	0.090	0.90487	0.4926	6.1226	-0.2358	9.6002	-0.443
8	6.25362	0.100	0.89437	0.4195	6.7968	-0.4852	10.3512	-0.923
9	6.95667	0.100	0.89374	0.3569	7.5572	0.4802	13.0805	0.9148
10	7.73356	0.100	0.89304	0.3034	8.3974	0.1693	15.7081	0.3228

P.V. OF PREMIUMS	56.292
P.V. OF PROFITS	4.7664
P.V. OF BENEFITS	27.585
LOSS RATIO	49.00

HELOC (UNDERWRITING WITHOUT ROLLING PEC & SUICIDE) - ISSUE AGE 42

i=	0.08	Elapse	7
delta=	0.0769	Exp/Pol	6
itax=	0.37	Exp % Prem	35
Avsize	21	Expenses	3.2257 for yrs t<9
Prem. (t<9)	8.40		4.9057 for yrs t>8
Prem. (t>8)	13.20	Edeath	100

t	1000 q(t)	d q(t)	p(t)	D(t)	BEN(t)	TAX(t)	AS(t)	PROF(t)
1	2.67801	0.080	0.91754	0.8735	2.8236	1.02290	1.89824	1.8982
2	3.33557	0.020	0.97673	0.8122	3.4904	0.77618	3.39451	1.3530
3	3.98782	0.020	0.97609	0.7548	4.1716	0.52412	4.56722	0.9142
4	4.61172	0.020	0.97548	0.7010	4.8232	0.28303	5.41203	0.4940
5	5.30474	0.020	0.97480	0.6505	5.5471	0.01521	5.85833	0.0265
6	6.02081	0.075	0.91943	0.5694	6.3132	-0.2682	6.19606	-0.496
7	6.75992	0.090	0.90385	0.4900	7.0901	-0.5556	6.15386	-1.046
8	7.50434	0.100	0.89325	0.4167	7.8708	-0.8445	5.62659	-1.609
9	8.34800	0.100	0.89249	0.3540	8.7520	0.07614	6.76742	0.1452
10	9.28027	0.100	0.89165	0.3005	9.7256	-0.2841	7.42979	-0.542

P.V. OF PREMIUMS	56.107
P.V. OF PROFITS	2.2327
P.V. OF BENEFITS	31.808
LOSS RATIO	56.69

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE)

Issue age	ALL	Aver.size	20	PROFIT P	5.947	Premium	Expenses
Interest	0.08	Edeath	850	PROFIT D	-676.762	13.20	4.460
d	0.077	Elapse	7	PROFIT W	5.726		
		Taxrate	0.37	p*PVPSA	436.581		

t	1000 q_t^d	q_t^w	$_tp$	1000 $_tq^d$	$_tq^w$	D(t)	SUM(D(t))	q^d*PVPDA(t)	q^w*PVPWA(t)	q^d*(PVPDA(t))^2	q^w*(PVPWA(t))^2
1	4.0691	0.080	0.9163	4.0691	0.0797	0.9520	0.9520	-52.4331	8.6868	675,643.12	947.11
2	4.7873	0.020	0.8936	4.3864	0.0182	0.9063	1.8584	-53.3140	3.9580	647,994.12	858.98
3	5.8050	0.020	0.8707	5.1876	0.0178	0.8629	2.7212	-59.4386	5.6832	681,039.94	1,817.70
4	6.8567	0.020	0.8474	5.9700	0.0173	0.8215	3.5427	-64.4452	7.2241	695,678.15	3,017.65
5	7.9855	0.020	0.8238	6.7670	0.0168	0.7820	4.3247	-68.7775	8.5898	699,034.39	4,388.55
6	9.2055	0.075	0.7550	7.5838	0.0612	0.7445	5.0692	-72.5220	36.7077	693,513.36	22,010.60
7	10.4791	0.090	0.6799	7.9120	0.0672	0.7088	5.7780	-71.1351	45.9975	639,556.96	31,465.71
8	11.8076	0.100	0.6047	8.0277	0.0672	0.6748	6.4528	-67.8028	51.3614	572,670.28	39,264.67
9	13.1344	0.100	0.5371	7.9419	0.0597	0.6424	7.0952	-62.9606	50.1858	499,128.03	42,207.50
10	14.5609	0.100	0.4763	7.8199	0.0529	0.6116	7.7068	-58.1336	48.3662	432,166.23	44,201.81

E(PVP)	72.38
VAR(PVP)	6,821,534
STD. DEV.	2,612

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE)

Issue age	ALL	Aver.size	20	PROFIT P	6.029	Premium	Expenses
Interest	0.095	Edeath	850	PROFIT D	-681.471	13.20	4.460
d	0.091	Elapse	7	PROFIT W	5.809		
		Taxrate	0.37	p*PVPSA	423.034		

t	1000 q_t^d	q_t^w	p	1000 q^d	q^w	D(t)	SUM(D(t))	q^d*PVPDA(t)	q^w*PVPWA(t)	q^d*(PVPDA(t))^2	q^w*(PVPWA(t))^2
1	4.0691	0.080	0.9163	4.0691	0.0797	0.9435	0.9435	-52.3272	8.7335	672,914.63	957.33
2	4.7873	0.020	0.8936	4.3864	0.0182	0.8902	1.8338	-52.7240	3.9612	633,731.50	860.38
3	5.8050	0.020	0.8707	5.1876	0.0178	0.8400	2.6738	-58.2421	5.6632	653,899.19	1,804.92
4	6.8567	0.020	0.8474	5.9700	0.0173	0.7925	3.4663	-62.5621	7.1683	655,617.97	2,971.18
5	7.9855	0.020	0.8238	6.7670	0.0168	0.7478	4.2141	-66.1399	8.4882	646,445.41	4,285.35
6	9.2055	0.075	0.7550	7.5838	0.0612	0.7056	4.9196	-69.0744	36.1268	629,143.78	21,319.41
7	10.4791	0.090	0.6799	7.9120	0.0672	0.6657	5.5854	-67.0948	45.0901	568,969.72	30,236.50
8	11.8076	0.100	0.6047	8.0277	0.0672	0.6281	6.2135	-63.3179	50.1527	499,415.60	37,438.39
9	13.1344	0.100	0.5371	7.9419	0.0597	0.5927	6.8061	-58.2004	48.8184	426,507.00	39,938.83
10	14.5609	0.100	0.4763	7.8199	0.0529	0.5592	7.3653	-53.1806	46.8732	361,662.85	41,515.02

E(PVP)	81.25
VAR(PVP)	6,298,753
STD. DEV.	2,510

HELOC (UNDERWRITING WITH ROLLING PEC & SUICIDE)

Issue age	ALL	Aver.size	20	PROFIT P	5.892	Premium	Expenses
Interest	0.07	Edeath	850	PROFIT p	-673.611	13.20	4.460
d	0.068	Elapse	7	PROFIT W	5.671		
		Taxrate	0.37	p*PVPSA	446.070		

t	1000 $_dq(t)$	$_wq(t)$	$_tp$	1000 $_dq$	$_wq$	D(t)	SUM(D(t))	$_d$q*PVPDA(t)	$_w$q*PVPWA(t)	$_d$q*(PVPDA(t)) ^{2}	$_w$q*(PVPWA(t)) ^{2}
1	4.0691	0.080	0.9163	4.0691	0.0797	0.9578	0.9578	-52.5039	8.6552	677,468.21	940.23
2	4.7873	0.020	0.8936	4.3864	0.0182	0.9173	1.8751	-53.7134	3.9557	657,738.99	857.99
3	5.8050	0.020	0.8707	5.1876	0.0178	0.8786	2.7536	-60.2551	5.6966	699,879.12	1,826.30
4	6.8567	0.020	0.8474	5.9700	0.0173	0.8415	3.5951	-65.7403	7.2620	723,920.20	3,049.36
5	7.9855	0.020	0.8238	6.7670	0.0168	0.8059	4.4010	-70.6057	8.6591	736,689.57	4,459.70
6	9.2055	0.075	0.7550	7.5838	0.0612	0.7719	5.1729	-74.9298	37.1065	740,329.44	22,491.40
7	10.4791	0.090	0.6799	7.9120	0.0672	0.7393	5.9122	-73.9787	46.6236	691,710.04	32,328.14
8	11.8076	0.100	0.6047	8.0277	0.0672	0.7080	6.6202	-70.9836	52.1996	627,661.95	40,556.72
9	13.1344	0.100	0.5371	7.9419	0.0597	0.6781	7.2983	-66.3628	51.1387	554,528.32	43,825.57
10	14.5609	0.100	0.4763	7.8199	0.0529	0.6495	7.9478	-61.7011	49.4117	486,835.13	46,133.35

E(PVP)	66.00
VAR(PVP)	7,206,625
STD. DEV.	2,685