RESERVING LONG TERM MEDICAL CLAIMS

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Abstract

In this paper, the use of life contingencies to establish reserves for claimants requiring lifetime medical care is explored. In evaluating such claims, consideration should be given to the effects of inflation, discounting for interest, life expectancy, the impact of the claimant's medical condition on life expectancy, and the accurate measurement of medical costs. The evaluation is made in three phases: a claim evaluation, a medical evaluation, and an actuarial evaluation.

The claim evaluation consists of gathering accurate information about the claimant's medical condition and the current cost of providing medical care. The medical evaluation consists of using the medical information obtained from the claim evaluation to estimate the effect on the claimant's life span. Information obtained from the claim and medical evaluations is combined with assumptions regarding interest, inflation, and mortality to produce the actuarial evaluation.

1. INTRODUCTION

Among the most difficult claims to adjust are those requiring medical care for the lifetime of the claimant. These claims usually arise from unlimited medical coverage provided under workers' compensation insurance or in connection with unlimited PIP benefits in certain no-fault auto states. In many cases, the claimants are seriously injured with little likelihood of recovery, and the cost of providing the required care is extremely high.

Although such claims occur infrequently, the potential financial impact of a mere handful of them very often can be catastrophic for an insurer. Consider, for example, the case of a permanently disabled person of age 20 requiring continuing medical care and treatment currently costing $50,000 annually. Despite serious injuries, a normal life span of 50 years might safely be assumed for this individual, suggesting a potential total cost of $2.5 million.

This amount is expressed in current dollars. What of the consequences of inflation? Inflation rates applicable to medical care expenditures are much greater than overall monetary inflation rates. Suppose costs are assumed to increase by 10% annually, a rate that reasonably approximates long term inflation rates applicable to medical care. The potential cost then becomes approximately $150 million. Of course, there are other elements to consider. Suppose the claimant dies early or lives to the age of 100. How can these and other contingencies be dealt with? How can an insurer set reasonable reserves on cases of this nature?

In this paper, an approach is suggested that combines claim adjusting expertise with actuarial processes and with principles employed in underwriting life insurance and annuity contracts. By its nature the suggested approach requires centralization in order to bring together these diverse elements. Claim adjusters in the field can hardly be expected to acquire all of the skills needed to deal with long term medical cases. Many will not see even one such claim in a lifetime of adjusting.

In evaluating long term medical claims, consideration must be given to the effects of inflation, discounting for interest, normal life expectancy, the claimant's medical condition (i.e., the probability of living a normal life span) and the accurate measurement of medical costs. The evaluation can then be made in three steps:

- a claim evaluation;
- a medical evaluation; and,
- an actuarial evaluation.

Taken together, these three steps constitute the financial evaluation of the claim.

The claim evaluation consists of gathering accurate and current data concerning (1) the amount and timing of medical expenditures and (2) the medical condition of the claimant based on the most current medical information available. The claim evaluation should be performed annually. The medical evaluation consists of using the medical information obtained from the claim evaluation to estimate the effect on the claimant's life span. Such an evaluation might be performed by a person with life insurance underwriting expertise or by some other person capable of relating medical information to life expectancies. Ideally, the result of the medical evaluation should be expressed as a multiplier applicable to standard mortality rates taken from an appropriate mortality table.

2. ACTUARIAL EVALUATION

Information obtained from the claim and medical evaluations together with appropriate assumptions regarding inflation and interest rates can be used to make the actuarial evaluation. Before getting too deeply involved in the details of the evaluation, a brief review of the applicable principles of life contingencies will be helpful. It will be assumed that the reader is familiar with standard actuarial notation as presented by Jordan [1] or by Bowers, et al [2].

3. REVIEW

An immediate life annuity of 1 payable to a life aged (x) with the first payment commencing at the end of one year is given by

$$a_x = \sum_{t=1}^{\infty} v^t {}_tp_x.$$

Where $v = (1 + i)^{-1}$ for effective interest rate i and ${}_tp_x$ may be considered the probability of making a payment at the end of year (t), or more simply the "probability of payment."

If the first payment is due at the beginning of the year, the series of payments is called an annuity due and is given by

$$\ddot{a}_x = \sum_{t=0}^{\infty} v^t {}_tp_x = 1 + a_x .$$

A temporary annuity payable for n years is given by

$$a_{x:\overline{n}|} = \sum_{t=1}^{n} v^t {}_tp_x.$$

An annuity deferred for a period of n years is given by

$${}_{n|}a_x = \sum_{t=n+1}^{\infty} v^t {}_tp_x.$$

4. GENERALIZED FORMULAE

Before annuity principles can be applied to reserving lifetime medical claims, the formulas must be generalized in order to gain sufficient flexibility to deal with more complicated situations.

Assume initially that only medical payments are being reserved, as might be the case in dealing with a Michigan no-fault claim.

Let $M_{x,t}$ be the medical payment due to (x) at the end of year (t), expressed in terms of current dollars.

Let i be the interest rate assumption expected to prevail over the lifetime of the claim and j be the inflation rate assumption pertaining to medical care costs.

If the reserve for future medical payments for a life aged (x) is denoted by R_x, an expression for the reserve is

$$R_x = \sum_{t=1}^{\infty} M_{x,t}(1 + i)^{-t}(1 + j)^t {}_tp_x.$$

The expression can be simplified somewhat by letting v_m denote the combined interest rate-inflation rate assumption and defining it by

$$v_m = (1 + i)^{-1} (1 + j).$$

The incurred cost of the claim is determined by adding the payments made to date to the reserve, R_x. If C_x is the incurred cost and P is the amount paid to date,

$$C_x = P + R_x.$$

When dealing with workers' compensation insurance, income replacement benefits as well as medical care costs are usually paid over the claimant's lifetime. In most cases, income replacement benefits are made at a fixed rate, but in some instances they are indexed to the CPI and therefore subject to inflation.

The previous formulation is easily extended to cover this situation by the introduction of a few additional terms.

Let $S_{x,t}$ be the indemnity payment due to (x) at the end of year (t).

Let i be the interest rate assumption, and k be the inflation rate assumption.

The combined interest rate-inflation rate assumption is given by $v_s = (1 + i)^{-1} (1 + k)$, the reserve is

$$R_x = \sum_{t=1}^{\infty} (S_{x,t}v_s^t + M_{x,t}v_m^t) {}_tp_x,$$

and the incurred cost is still given by

$$C_x = P + R_x.$$

Since R_x is a discounted reserve, it will have an impact on reserve development observed in Schedule P. Even if mortality assumptions materialize exactly as predicted, adverse development will occur as a result of discount amortization over the lifetime of all claims reserved in this manner. This phenomenon is illustrated in Appendix A.

5. REINSURANCE

Ferguson [3] addressed the problem of calculating retained and ceded reserve components, but did not cover the situation involving lifetime medical care. The generalized formulas can be extended with relative ease to deal with reinsurance.

If Q is the primary insurer's reinsurance retention, the problem is solved by finding an integer, n, such that

$$Q^- = P + \sum_{t=1}^{n} [(1 + k)^t S_{x,t} + (1 + j)^t M_{x,t}] \le Q, \text{ and}$$

$$Q^+ = P + \sum_{t=1}^{n+1} [(1 + k)^t S_{x,t} + (1 + j)^t M_{x,t}] > Q.$$

n can be thought of as the number of years required to exhaust the primary layer of coverage under the assumption that the claimant is still living.

The primary insurer's reserve is denoted by $R^*_{x:\overline{n}|}$, where

$$R_{x:\overline{n}|} \le R^*_{x:\overline{n}|} < R_{x:\overline{n+1}|},$$

$$R_{x:\overline{n}|} = \sum_{t=1}^{n} (S_{x,t} \cdot v_s^t + M_{x,t} \cdot v_m^t)\ {}_tp_x, \text{ and}$$

$$R_{x:\overline{n+1}|} = \sum_{t=1}^{n+1} (S_{x,t} \cdot v_s^t + M_{x,t} \cdot v_m^t)\ {}_tp_x.$$

$R^*_{x:\overline{n}|}$ is approximated by linear interpolation:

$$R^*_{x:\overline{n}|} \doteq (R_{x:\overline{n+1}|} - R_{x:\overline{n}|}) \left(\frac{Q - Q^-}{Q^+ - Q^-}\right) + R_{x:\overline{n}|}.$$

And the reinsurer's reserve is given by

$${}_{n|}R^*_x \doteq R_x - R^*_{x:\overline{n}|}.$$

Some reinsurance agreements provide coverage only for so called catastrophe claims, where more than one worker is injured by a single event. Confusion occasionally results from the situation where the lifetime benefits of two or more claimants of different ages must be considered in establishing reinsurance reserves.

A general approach for resolving this problem can be illustrated by the following example.

- Let $A_{x,t}$ be the amount expected to be paid to (x) at the end of year (t).
- Let $B_{y,t}$ be the amount expected to be paid to (y) at the end of year (t).
- Let $C_{z,t}$ be the amount expected to be paid to (z) at the end of year (t).
- Assume $A_{x,t}$, $B_{y,t}$ and $C_{z,t}$ have already been adjusted to the expected inflation level of year (t).
- Assume $A'_{x,t}$, $B'_{y,t}$, and $C'_{z,t}$ have been discounted to the present day for interest.

$$R = \sum_{t=1}^{\infty} (A'_{x,t} \cdot {}_tp_x + B'_{y,t} \cdot {}_tp_y + C'_{z,t} \cdot {}_tp_z).$$

Now find an integer n such that

$$P + \sum_{t=1}^{n} (A_{x,t} + B_{y,t} + C_{z,t}) \leq Q, \text{ and}$$

$$P + \sum_{t=1}^{n+1} (A_{x,t} + B_{y,t} + C_{z,t}) > Q.$$

It follows that the primary insurer's share can be determined by linear interpolation between

$$\sum_{t=1}^{n} (A'_{x,t} \cdot {}_tp_x + B'_{y,t} \cdot {}_tp_y + C'_{z,t} \cdot {}_tp_z), \text{ and}$$

$$\sum_{t=1}^{n+1} (A'_{x,t} \cdot {}_tp_x + B'_{y,t} \cdot {}_tp_y + C'_{z,t} \cdot {}_tp_z).$$

The reinsurer's share is the total reserve less the primary insurer's share.

This method determines n based on the assumption that all three claimants live long enough for their combined payments to exceed the primary retention. It is possible that one or more of the claimants might die earlier than expected, in which case the time required to reach the retention could be much longer. The proposed method is conservative in that it provides the reinsurer with the earliest possible recognition of liability. A technically more exact method conceivably could be constructed based on the multiple life status $(x\ y\ z)$, but such a method would be quite complicated. The procedure outlined above is reasonable for real life situations.

The foregoing procedures can easily be extended to deal with several layers. It is possible, however, that C_x will exceed all layers of reinsurance, in which case the excess over the limit of the uppermost layer will revert to the primary insurer.

6. REVISED MORTALITY ASSUMPTIONS

Usually the very seriously injured claimants have extremely high annual costs associated with their medical care. Paraplegics, quadriplegics and brain stem injuries are examples of cases requiring expensive care. If these individuals could be expected to live normal life spans, the reserve values for their claims could become astronomical. Many times, however, such individuals are not expected to live as long as an unimpaired life. In such cases, a thorough medical evaluation will provide a basis for altering the mortality assumptions inherent in a standard table. Usually the results of such an evaluation are expressed in terms of the relationship to standard mortality. Normally revised values of q'_x are related to the q_x values of a standard mortality table so that

$$q'_x = f \cdot q_x,$$

subject to the restrictions that $f > 1$ and $f \cdot q_x \leq 1$. Then

$$p'_x = 1 - q'_x = 1 - f \cdot q_x, \text{ and}$$

$$_tp'_x = (1 - f \cdot q_x)(1 - f \cdot q_{x+1}) \ldots (1 - f \cdot q_{x+t-1}).$$

The generalized reserve formulas can now be given as

$$R'_x = \sum_{t=1}^{\infty} (S_{x,t} \cdot v_s^t + M_{x,t} \cdot v_m^t)\, _tp'_x;$$

$$R'_{x:\overline{n}|} = \sum_{t=1}^{n} (S_{x,t} \cdot v_s^t + M_{x,t} \cdot v_m^t)\, _tp'_x; \text{ and,}$$

$$R'_{x:\overline{n+1}|} = \sum_{t=1}^{n+1} (S_{x,t} \cdot v_s^t + M_{x,t} \cdot v_m^t)\, _tp'_x.$$

$R^*_{x:\overline{n}|}$ is found by interpolation and $_{n|}R^*_x$ is found by subtraction.

An alternative might be to relate p'_x to p_x by

$$p'_x = (1 - f)p_x, \; 0 < f < 1.$$

In this case,

$$_tp'_x = (1 - f)^t\, _tp_x.$$

It should be noted that other, possibly more rigorous methods for adjusting mortality can be found in actuarial literature ([1], p. 57). There also are alternatives to adjusting mortality rates from a standard table. For example, one method is to estimate a fixed remaining life, e.g., five years, for the claimant.

Another method would be to construct a separate impaired life table that would reflect the average mortality rates of claimants with certain serious injuries.

7. FURTHER GENERALIZATION

Additional refinements can be made in the reserve formulas. For example, interest rates and inflation rates can be allowed to vary with time. Consider the expression for a medical expense reserve. Suppose i_r is the interest rate expected to be earned in year r, and j_r is the inflation rate expected to be applicable to payments made at the end of year r. Recall that $M_{x,t}$ is expressed in terms of current dollars. Then the present value of $M_{x,t}$ is given by

$$M_{x,t}(1+j_1)(1+j_2)\ldots(1+j_r)\ldots(1+j_t)(1+i_1)^{-1}(1+i_2)^{-1}\ldots$$
$$\ldots(1+i_r)^{-1}\ldots(1+i_t)^{-1},$$

and the present value of expected future payments is

$$\sum_{t=1}^{\infty}\prod_{r=1}^{t}[(1+i_r)^{-1}(1+j_r)]M_{x,t}\cdot {}_tp_x.$$

The formulas can be generalized even further by assuming that payments occur at the mid-point of the time intervals instead of at the end-points. This last refinement is achieved by adjusting exponents applicable to inflation and interest and by adjusting mortality factors. For example:

$$R_x = \sum_{t=1}^{\infty} M_{x,t}{v_m}^{t-1/2}\cdot {}_{t-1/2}f_x,$$

where

$${}_{t-1/2}p_x \doteq \frac{1}{2}\left({}_{t-1}p_x + {}_tp_x\right).$$

8. THE MODEL IN OPERATION

The general approach should now be obvious. Claims must be reviewed annually to obtain current medical data and cost information. This is the responsibility of adjusters in the field who must provide accurate estimates of the amount and timing of payments expected to be made after the reserve evaluation date.

Timing of payments is the essence of the discount calculation. It should not automatically be assumed that payments will be made in equal amounts each year. For example, it might be that very large payments will be required over the first few years of a claimant's injury when hospital care is needed. Afterwards, however, lower payments may be required if the claimant can be cared for in a less expensive facility or at home.

In addition to providing estimated payments, field adjusters must acquire sufficient medical information to determine if the claimant's life is impaired and, if so, the extent of impairment. Since the claimant's medical condition is subject to change, it must be evaluated frequently. A change in medical condition results in a change in life expectancy and usually is accompanied by a change in expected costs.

Once payment data and medical information have been assembled, it is a fairly easy task to develop a reserving model.

- First, display the expected payment stream by year of expected payment.
- Adjust the individual payments to reflect the level of inflation expected to apply to each year of payment.
- Next, discount the individual payments for interest to the present time.
- Multiply each discounted payment by the probability of payment (${}_tp_x$) to obtain the discounted values of expected payments.
- Sum the discounted expected payments to obtain the reserve.

If the claimant is so badly impaired that a shortened life span is anticipated, it will be necessary to estimate the increase in mortality rates resulting from the impairment. Such an estimate can be made only by a person trained in evaluating medical information and translating such information into revised mortality rates.

Life insurance underwriters are often called upon to make such assessments. Their judgments are usually expressed as multipliers applicable to the q_x values in some standard mortality table. Multipliers might range from 1.2 to 10 or even higher. Once the multiplier has been determined, the payment probabilities can be adjusted and the operational steps described above can be taken.

The following examples are given as illustrations of the model in operation.

Example 1

Assume unimpaired individuals aged (x) are expected to experience the following mortality.

t	Number Living Aged $(x + t)$	Expected Deaths
0	1,000	307
1	693	218
2	475	153
3	322	106
4	216	72
5	144	49
6	95	33
7	62	22
8	40	15
9	25	10
10	15	15
		1,000

Assume a claim is being evaluated for which both medical and indemnity payments are made and that the total amount paid to date is \$230,000, consisting of \$30,000 for indemnity and \$200,000 for medical expense. Assume further that indemnity payments have been awarded at an annual rate of \$15,000 and medical expenses are expected to be \$100,000 each year for the claimant's lifetime. Indemnity payments are discounted at 3.5%. Medical payments are not discounted and are not expected to be increased by inflation. Claim payments in excess of \$1 million are reinsured.

The schedule of payments is shown in the following table.

Year (t)	Indemnity Benefits	Medical Payments	Total Annual Payments	Cumulative Payments
Paid to Date	$30,000	$200,000		$ 230,000
1	15,000	100,000	$115,000	345,000
2	15,000	100,000	115,000	460,000
3	15,000	100,000	115,000	575,000
4	15,000	100,000	115,000	690,000
5	15,000	100,000	115,000	805,000
6	15,000	100,000	115,000	920,000
7	10,435	69,565	80,000	1,000,000
7	4,565	30,435	35,000	1,035,000
8	15,000	100,000	115,000	1,150,000
9	15,000	100,000	115,000	1,265,000
10	15,000	100,000	115,000	1,380,000

Inflation Rate, Indemnity = 0.0%
Inflation Rate, Medical = 0.0%
Interest Rate, Indemnity = 3.5%
Interest Rate, Medical = 0.0%

Details of the reserve calculations are shown in the following table.

Year (t)	Indemnity Discount Factor	Medical Discount Factor	Probability of Payment
1	.9662	1.000	.693
2	.9335	1.000	.475
3	.9019	1.000	.322
4	.8714	1.000	.216
5	.8420	1.000	.144
6	.8135	1.000	.095
7	.7860	1.000	.062
7	.7860	1.000	.062
8	.7594	1.000	.040
9	.7337	1.000	.025
10	.7089	1.000	.015

Year (t)	Discounted Indemnity	Discounted Medical	Discounted Total	Discounted Cumulative
Paid to Date	$30,000	$200,000	$230,000	$230,000
1	10,044	69,300	79,344	309,344
2	6,651	47,500	54,151	363,495
3	4,356	32,200	36,556	400,051
4	2,823	21,600	24,423	424,474
5	1,819	14,400	16,219	440,693
6	1,159	9,500	10,659	451,352
7	509	4,313	4,822	456,174
7	222	1,887	2,109	458,283
8	456	4,000	4,456	462,739
9	275	2,500	2,775	465,514
10	160	1,500	1,660	467,174
	$58,474	$408,700	$467,174	

From these tables it can be seen that:

- the incurred cost of the claim, with future payments discounted for both interest and mortality, is $467,174,

- the present value of future payments, which is the reserve for the claim, is \$237,174,
- claim payments will exceed the retention between the sixth and seventh year,
- the primary insurer's share of the reserve is approximated by \$226,174, and
- the reinsurer's share of the reserve is approximated by \$11,000.

Example 2

In this example, it is assumed that medical payments are subject to an annual inflation rate of 10%, and these payments can safely be discounted at 8%. For convenience, indemnity payments are discounted at a statutory rate of 3.5%.

Inflation Rate, Indemnity	=	0.0%
Inflation Rate, Medical	=	10.0%
Interest Rate, Indemnity	=	3.5%
Interest Rate, Medical	=	8.0%

Year (t)	Indemnity Benefits	Medical Payments	Total Annual Payments	Cumulative Payments
Paid to Date	\$30,000	\$200,000		\$230,000
1	15,000	110,000	\$125,000	355,000
2	15,000	121,000	136,000	491,000
3	15,000	133,100	148,100	639,100
4	15,000	146,410	161,410	800,510
5	15,000	161,051	176,051	976,561
6	7,199	21,609	23,439	1,000,000
6	7,801	155,547	168,717	1,168,717
7	15,000	194,872	209,872	1,378,589
8	15,000	214,359	229,359	1,607,948
9	15,000	235,795	250,795	1,858,742
10	15,000	259,374	274,374	2,133,117

Year (t)	Indemnity Discount Factor	Medical Discount Factor	Probability of Payment
1	.9662	.9259	.693
2	.9335	.8573	.475
3	.9019	.7938	.322
4	.8714	.7350	.216
5	.8420	.6806	.144
6	.8135	.6302	.095
6	.8135	.6302	.095
7	.7860	.5835	.062
8	.7594	.5403	.040
9	.7337	.5002	.025
10	.7089	.4632	.015

Year (t)	Discounted Indemnity	Discounted Medical	Discounted Total	Discounted Cumulative
Paid to Date	$30,000	$200,000	$230,000	$230,000
1	10,044	70,583	80,627	310,627
2	6,651	49,276	55,927	366,554
3	4,356	34,022	38,379	404,933
4	2,823	23,245	26,068	431,001
5	1,819	15,784	17,602	448,603
6	556	1,294	1,435	450,038
6	603	9,312	10,330	460,368
7	731	7,050	7,781	468,149
8	456	4,632	5,088	473,237
9	275	2,949	3,224	476,461
10	160	1,802	1,962	478,423
	$58,474	$419,949	$478,423	

Incurred Cost of the Claim	$478,423
Present Value of Future Payments	248,423
Primary Insurer's Share	220,038
Reinsurer's Share	28,385

Making no assumptions regarding inflation or interest and basing all estimates of future expenditures on current costs, as was done in the first example with respect to medical payments, is often thought to be equivalent to assuming interest earnings will be exactly offset by inflation. It might, therefore, be said that payments have been discounted at an implied interest rate equal to the rate of future inflation.

This oversimplification may be sufficient for estimating the gross reserve but does not work very well when reinsurance is involved. If future costs are projected in current dollars, the time required to reach the reinsurance retention will be overestimated and the reserve will not be accurately divided into reinsurance layers. The proper sequence of calculations is to adjust future payments so that they reflect the levels of inflation expected to apply at the time the payments are made, and then to estimate the retention period, n.

Example 3

This example is the same as the first, except that it is assumed the claimant is subject to a mortality rate 50% greater than normal. Using the relationship

$$q'_x = 1.5\, q_x,$$

the following table can be developed.

t	${}_tp_x$	q_{x+t-1}	q'_{x+t-1}	${}_tp'_x$
1	.693	.3070	.4605	.5395
2	.475	.3146	.4719	.2849
3	.322	.3221	.4832	.1472
4	.216	.3292	.4938	.0745
5	.144	.3333	.5000	.0373
6	.095	.3403	.5105	.0182
7	.062	.3474	.5211	.0087
8	.040	.3548	.5322	.0041
9	.025	.3750	.5625	.0018
10	.015	.4000	.6000	.0007

Reserve values are now calculated as follows:

Year (t)	Indemnity Discount Factor	Medical Discount Factor	Probability of Payment
1	.9662	.9259	.5395
2	.9335	.8573	.2849
3	.9019	.7938	.1472
4	.8714	.7350	.0745
5	.8420	.6806	.0373
6	.8135	.6302	.0182
6	.8135	.6302	.0182
7	.7860	.5835	.0087
8	.7594	.5403	.0041
9	.7337	.5002	.0018
10	.7089	.4632	.0007

Year (t)	Discounted Indemnity	Discounted Medical	Discounted Total	Discounted Cumulative
Paid to Date	$30,000	$200,000	$230,000	$230,000
1	7,819	49,952	57,771	287,771
2	3,989	26,867	30,856	318,627
3	1,991	14,139	16,130	334,757
4	974	7,288	8,262	343,019
5	471	3,717	4,188	347,207
6	107	887	994	348,201
6	115	961	1,076	349,277
7	103	899	1,002	350,279
8	47	432	479	350,758
9	20	193	213	350,971
10	7	76	83	351,054
	$45,643	$305,411	$351,054	

Incurred Cost of the Claim	$351,054
Present Value of Future Payments	121,054
Primary Insurer's Share	118,201
Reinsurer's Share	2,853

Example 4

In this example, (x) and (y) are injured in a common occurrence. Expected medical costs are \$50,000 per year to (x) and \$100,000 per year to (y). Reinsurance is excess over \$1 million. Payments are not discounted and are not expected to be increased by inflation. Expected mortality is shown in the following table.

t	Number Living Aged $(x + t)$	Expected Deaths	Number Living Aged $(y + t)$	Expected Deaths
0	1,000	307	1,000	257
1	693	218	743	201
2	475	153	542	147
3	322	106	395	108
4	216	72	287	75
5	144	49	208	58
6	95	33	150	42
7	62	22	108	31
8	40	15	77	23
9	25	10	54	17
10	15	15	37	12
11			25	9
12			16	6
13			10	4
14			6	3
15			3	3

Details of the reserve calculations are shown in the following table.

Year (*t*)	Payments to (*x*)	Payments to (*y*)	Total Payments	Cumulative Payments
1	$50,000	$100,000	$ 150,000	$ 150,000
2	50,000	100,000	150,000	300,000
3	50,000	100,000	150,000	450,000
4	50,000	100,000	150,000	600,000
5	50,000	100,000	150,000	750,000
6	50,000	100,000	150,000	900,000
7	33,333	66,667	100,000	1,000,000
7	16,667	33,333	50,000	1,050,000
8	50,000	100,000	150,000	1,200,000
9	50,000	100,000	150,000	1,350,000
10	50,000	100,000	150,000	1,500,000
11		100,000	100,000	1,600,000
12		100,000	100,000	1,700,000
13		100,000	100,000	1,800,000
14		100,000	100,000	1,900,000
15		100,000	100,000	2,000,000
			$2,000,000	

Year (t)	${}_tP_x$	${}_tP_y$	Expected Payments to (x)	Expected Payments to (y)	Expected Total	Cumulative Total
1	.693	.743	$ 34,650	$ 74,300	$108,950	$108,950
2	.475	.542	23,750	54,200	77,950	186,900
3	.322	.395	16,100	39,500	55,600	242,500
4	.216	.287	10,800	28,700	39,500	282,000
5	.144	.208	7,200	20,800	28,000	310,000
6	.095	.150	4,750	15,000	19,750	329,750
7	.062	.108	2,067	7,200	9,267	339,017
7	.062	.108	1,033	3,600	4,633	343,650
8	.040	.077	2,000	7,700	9,700	353,350
9	.025	.054	1,250	5,400	6,650	360,000
10	.015	.037	750	3,700	4,450	364,450
11		.025		2,500	2,500	366,950
12		.016		1,600	1,600	368,550
13		.010		1,000	1,000	369,550
14		.060		600	600	370,150
15		.030		300	300	370,450
			$104,350	$266,100	$370,450	

Present Value of Future Payments = $370,450
Primary Insurer's Share = 339,017
Reinsurer's Share = 31,433

9. SENSITIVITY

An additional example based on more realistic mortality assumptions is given in Appendix B. The example also employs plausible inflation and interest rate assumptions. It is constructed from the following hypothetical set of circumstances.

- The claimant is 40 years old.
- Annual medical payments, currently estimated at $50,000, are expected to be required for the lifetime of the claimant. Payments are estimated in current dollars.
- Payments are uniformly distributed throughout each year.
- Mortality follows the 1969–71 U.S. Life Table for the Total Population.
- The primary insurer's retention is $1,000,000. The limit for the first layer of reinsurance is $5,000,000 over the $1,000,000 retention. The limit for the second layer is $5,000,000 excess over $6,000,000.

The problem is to find the reserve required for the primary insurer and the reinsurers. Several inflation rate, interest rate, and mortality scenarios have been constructed. Three of these scenarios are displayed in Appendix B. The first exhibit of the appendix portrays the situation where future payments are not inflated and not discounted. The second exhibit shows the situation where inflation and interest are both assumed to be 6%. The third exhibit portrays "realistic" interest and inflation assumptions.

The "realistic" interest rate assumption is similar to an assumption that a life insurer might use in calculating GAAP reserves for annuities. Specifically, the following assumption is employed.

First 10 years	8%
Next 10 years	7%
Next 10 years	6%
Remaining years	5%

In constructing a "realistic" inflation rate assumption, we assume the medical care component of the CPI is a good indicator. Over a relatively long period the medical inflation rate, as measured by the CPI, ranged between 9% and 10%, but more recently has declined to approximately 7.5%. It is reasonable to anticipate a gradual return to the long term level in the near future. In the very long term, it seems reasonable to assume that medical inflation and interest rates will follow each other fairly closely, with medical inflation (as opposed to general economic inflation) exceeding interest rates by a slight margin. From these considerations, the following "realistic" inflation scenario is constructed.

Year 1	7.5%
Year 2	8.0%
Year 3	8.5%
Years 4 to 10	9.0%
Next 10 years	8.0%
Next 10 years	7.0%
Remaining years	6.0%

In the following tables, we examine the effect that variations in the assumptions have on the reserve calculations. Table 1 illustrates the effect of several different interest/inflation combinations. Mortality is assumed to follow the 1969–71 population table and is referred to as "standard mortality." Reserves are in thousands.

TABLE 1—STANDARD MORTALITY

Insurance Layer	Interest/Inflation Assumption				
	0%, 0%	6%, 6%	8%, 8%	10%, 10%	Realistic
1	$ 941	$ 641	$ 588	$ 545	$ 591
2	760	842	738	651	868
3	0	218	375	505	540
Total	$1,701	$1,701	$1,701	$1,701	$1,999

In the first four columns, interest and inflation are separately but equally quantified. The first column illustrates the notion that using no specific inflation or interest assumption is equivalent to discounting at an implied interest rate equal to inflation.

The total reserves shown for the first four columns are equal, as expected. The fifth column shows the results of realistic inflation and interest assumptions. The total reserve is higher in this case because inflation exceeds interest over most of the payout period.

Except for the 0%, 0% assumption, the primary insurer's reserve is relatively insensitive to changes in interest and inflation. This result occurs when the retention is low compared with possible total payments. The inflation and interest rate assumptions selected are more important to reinsurers.

Table 2 shows the effect of variations in interest rates when mortality and inflation rates are held constant.

TABLE 2—STANDARD MORTALITY, REALISTIC INFLATION

Insurance Layer	Interest Assumption 6%	8%	10%	Realistic
1	$ 661	$ 590	$ 530	$ 591
2	1,130	770	534	868
3	662	328	166	540
Total	$2,453	$1,688	$1,230	$1,999

As expected, the total reserve decreases as the interest rate assumption increases. As previously observed, the primary insurer's reserve is low relative to possible total payments.

In Table 3, the effect of changes in inflation rates for constant mortality and interest rates is illustrated.

TABLE 3—STANDARD MORTALITY, REALISTIC INTEREST

Insurance Layer	Inflation Assumption 6%	8%	10%	Realistic
1	$ 571	$ 589	$ 605	$ 591
2	646	837	1,010	868
3	185	634	1,593	540
	$1,402	$2,060	$3,208	$1,999

As expected, the total reserve increases with inflation while the primary reserve is not materially affected. The choice of the inflation assumption is obviously a prime concern for the insurer of the third layer.

The final table illustrates the effect of variations in mortality assumptions. The results require no comment.

TABLE 4—REALISTIC INFLATION, REALISTIC INTEREST

INSURANCE LAYER	MORTALITY ASSUMPTION Standard	2.5 × Standard	5 × Standard	10 × Standard
1	$ 591	$ 566	$528	$460
2	868	649	414	189
3	540	149	27	1
	$1,999	$1,364	$969	$650

REFERENCES

[1] C. W. Jordan, *Life Contingencies,* Chicago, Society of Actuaries, 1967.

[2] N. L. Bowers, Jr., H. U. Gerber, J. C. Hickman, D. A. Jones, C. J. Nesbitt, *Actuarial Mathematics,* Chicago, Society of Actuaries, 1986.

[3] R. E. Ferguson, "Actuarial Note on Workmen's Compensation Loss Reserves," *PCAS* LVIII, 1971.

APPENDIX A

The amortization of discount and its impact on reserve development can be illustrated by assuming a block of claims exists for a large number of annuitants, each one aged (x). Suppose annual payments of one dollar are made to all surviving members of the group with the first payment being made at the end of one year. Payments to survivors are unaffected by inflation.

Denote the number of claimants by l_x, the number of survivors at the end of one year by l_{x+1}, at the end of two years by l_{x+2}, and so on. Denote the undiscounted or "full value" reserve by

$$FV_x = l_{x+1} + l_{x+2} + l_{x+3} + \ldots$$

$$= \sum_{t=1}^{\infty} l_{x+t} .$$

The reserve for any one individual is

$$\frac{1}{l_x} \sum_{t=1}^{\infty} l_{x+t} = \sum_{t=1}^{\infty} {}_tp_x = e_x ,$$

where e_x is known as the *expectation of life*.

The expected value of payments made at the end of the first year is l_{x+1}, and the reserve for the surviving claimants is given by

$$FV_{x+1} = \sum_{t=1}^{\infty} l_{x+t+1} .$$

Development on the initial reserve is

$$l_{x+1} + FV_{x+1} - FV_x$$

$$= l_{x+1} + \sum_{t=1}^{\infty} l_{x+t+1} - \sum_{t=1}^{\infty} l_{x+t}$$

$$= l_{x+1} + (l_{x+2} + l_{x+3} + \ldots) - (l_{x+1} + l_{x+2} + l_{x+3} + \ldots)$$

$$= 0.$$

Denote the discounted or "present value" reserve by

$$PV_x = vl_{x+1} + v^2l_{x+2} + v^3l_{x+3} + \ldots$$

$$= \sum_{t=1}^{\infty} v^tl_{x+t} .$$

For any one individual, the reserve is

$$\frac{1}{l_x} \sum_{t=1}^{\infty} v^t l_{x+t} = \sum_{t=1}^{\infty} v^t {}_tp_x = a_x \; .$$

The expected value of payments made at the end of the first year is still l_{x+1}. The reserve for the survivors is

$$PV_{x+1} = \sum_{t=1}^{\infty} v^t l_{x+t+1} \; .$$

In this case, development on the initial reserve is

$$\begin{aligned} & l_{x+1} + PV_{x+1} - PV_x \\ &= l_{x+1} + \sum_{t=1}^{\infty} v^t l_{x+t+1} - \sum_{t+1}^{\infty} v^t l_{x+t} \\ &= l_{x+1} + (vl_{x+2} + v^2 l_{x+3} + \ldots) - (vl_{x+1} + v^2 l_{x+2} + v^3 l_{x+3} + \ldots) \\ &= (1 - v)(l_{x+1} + vl_{x+2} + v^2 l_{x+3} + \ldots) \\ &= \left(\frac{1 - v}{v}\right) (vl_{x+1} + v^2 l_{x+2} + v^3 l_{x+3} + \ldots) \\ &= i \sum_{t=1}^{\infty} v^t l_{x+t} = i \; PV_x, \text{ since } \frac{1 - v}{v} = i \; . \end{aligned}$$

It has been shown that, for this set of circumstances, observed development equals the interest earned on the original reserve.

This observation can be extended intuitively to any situation where reserves are discounted. If reserves have been estimated with total accuracy and payments precisely follow the assumed payment pattern, observed development for undiscounted reserves will be zero and for discounted reserves will equal the interest earned on the average value of assets required to secure the reserves during the payment period.

APPENDIX B

SCENARIO 1

Age of Claimant = 40
Interest on Medical Payments = 0 %
Inflation Rate for Medical Payments = 0 %
Mortality Rate = 1 Times Standard Mortality
Retention Limits = 1,000,000

Year	Medical Payments Current Dollars	Medical Payments Inflated Dollars	Disc. Factor	Mort. Factor	Reserve Amount	Cumulative Reserve Amount
1	50,000	50,000	1.0000	.9969	49,843	49,843
2	50,000	50,000	1.0000	.9935	49,673	99,516
3	50,000	50,000	1.0000	.9898	49,489	149,005
4	50,000	50,000	1.0000	.9858	49,289	198,295
5	50,000	50,000	1.0000	.9814	49,071	247,366
6	50,000	50,000	1.0000	.9767	48,833	296,199
7	50,000	50,000	1.0000	.9715	48,576	344,775
8	50,000	50,000	1.0000	.9659	48,297	393,071
9	50,000	50,000	1.0000	.9599	47,995	441,067
10	50,000	50,000	1.0000	.9534	47,670	488,737
11	50,000	50,000	1.0000	.9464	47,318	536,055
12	50,000	50,000	1.0000	.9388	46,938	582,993
13	50,000	50,000	1.0000	.9305	46,527	629,519
14	50,000	50,000	1.0000	.9216	46,081	675,601
15	50,000	50,000	1.0000	.9120	45,601	721,201
16	50,000	50,000	1.0000	.9017	45,083	766,284
17	50,000	50,000	1.0000	.8905	44,525	810,810
18	50,000	50,000	1.0000	.8786	43,928	854,738
19	50,000	50,000	1.0000	.8658	43,291	898,028
20	50,000	50,000	1.0000	.8522	42,611	940,639
21	0	0	1.0000	.8378	0	940,639
21	50,000	50,000	1.0000	.8378	41,889	982,528
22	50,000	50,000	1.0000	.8224	41,122	1,023,650
23	50,000	50,000	1.0000	.8062	40,311	1,063,961
24	50,000	50,000	1.0000	.7890	39,451	1,103,412
25	50,000	50,000	1.0000	.7708	38,541	1,141,953
26	50,000	50,000	1.0000	.7516	37,580	1,179,533
27	50,000	50,000	1.0000	.7313	36,565	1,216,098
28	50,000	50,000	1.0000	.7100	35,498	1,251,596
29	50,000	50,000	1.0000	.6876	34,379	1,285,976
30	50,000	50,000	1.0000	.6642	33,210	1,319,186
31	50,000	50,000	1.0000	.6399	31,995	1,351,181

32	50,000	50,000	1.0000	.6147	30,733	1,381,914
33	50,000	50,000	1.0000	.5884	29,422	1,411,336
34	50,000	50,000	1.0000	.5611	28,056	1,439,392
35	50,000	50,000	1.0000	.5326	26,632	1,466,024
36	50,000	50,000	1.0000	.5031	25,153	1,491,177
37	50,000	50,000	1.0000	.4726	23,629	1,514,806
38	50,000	50,000	1.0000	.4414	22,070	1,536,876
39	50,000	50,000	1.0000	.4098	20,492	1,557,368
40	50,000	50,000	1.0000	.3781	18,905	1,576,273
41	50,000	50,000	1.0000	.3464	17,319	1,593,592
42	50,000	50,000	1.0000	.3148	15,739	1,609,330
43	50,000	50,000	1.0000	.2836	14,182	1,623,512
44	50,000	50,000	1.0000	.2533	12,665	1,636,177
45	50,000	50,000	1.0000	.2241	11,203	1,647,380
46	50,000	50,000	1.0000	.1959	9,795	1,657,175
47	50,000	50,000	1.0000	.1690	8,449	1,665,624
48	50,000	50,000	1.0000	.1437	7,183	1,672,807
49	50,000	50,000	1.0000	.1205	6,023	1,678,830
50	50,000	50,000	1.0000	.0996	4,981	1,683,811
51	50,000	50,000	1.0000	.0812	4,060	1,687,870
52	50,000	50,000	1.0000	.0650	3,252	1,691,123
53	50,000	50,000	1.0000	.0511	2,557	1,693,680
54	50,000	50,000	1.0000	.0395	1,973	1,695,652
55	50,000	50,000	1.0000	.0298	1,492	1,697,145
56	50,000	50,000	1.0000	.0222	1,108	1,698,253
57	50,000	50,000	1.0000	.0162	809	1,699,063
58	50,000	50,000	1.0000	.0117	583	1,699,645
59	50,000	50,000	1.0000	.0083	414	1,700,059
60	50,000	50,000	1.0000	.0058	290	1,700,349
61	50,000	50,000	1.0000	.0040	201	1,700,550
62	50,000	50,000	1.0000	.0028	138	1,700,688
63	50,000	50,000	1.0000	.0019	94	1,700,782
64	50,000	50,000	1.0000	.0013	63	1,700,845
65	50,000	50,000	1.0000	.0008	42	1,700,886
66	50,000	50,000	1.0000	.0006	28	1,700,914
67	50,000	50,000	1.0000	.0004	18	1,700,932
68	50,000	50,000	1.0000	.0002	12	1,700,944
69	50,000	50,000	1.0000	.0002	8	1,700,952
70	50,000	50,000	1.0000	.0001	5	1,700,956

Retention Layer	Reserve Share
1	940,639
2	760,317
Total	1,700,956

SCENARIO 2

AGE OF CLAIMANT = 40
INTEREST ON MEDICAL PAYMENTS = 6 %
INFLATION RATE FOR MEDICAL PAYMENTS = 6 %
MORTALITY RATE = 1 TIMES STANDARD MORTALITY
RETENTION LIMITS = 1,000,000 5,000,000

Year	Medical Payments Current Dollars	Medical Payments Inflated Dollars	Disc. Factor	Mort. Factor	Reserve Amount	Cumulative Reserve Amount
1	50,000	51,478	.9713	.9969	49,843	49,843
2	50,000	54,567	.9163	.9935	49,673	99,516
3	50,000	57,841	.8644	.9898	49,489	149,005
4	50,000	61,311	.8155	.9858	49,289	198,295
5	50,000	64,990	.7693	.9814	49,071	247,366
6	50,000	68,889	.7258	.9767	48,833	296,199
7	50,000	73,023	.6847	.9715	48,576	344,775
8	50,000	77,404	.6460	.9659	48,297	393,071
9	50,000	82,048	.6094	.9599	47,995	441,067
10	50,000	86,971	.5749	.9534	47,670	488,737
11	50,000	92,190	.5424	.9464	47,318	536,055
12	50,000	97,721	.5117	.9388	46,938	582,993
13	50,000	103,584	.4827	.9305	46,527	629,519
14	12,743	27,982	.4554	.9216	11,744	641,263
14	37,257	81,817	.4554	.9216	34,337	675,601
15	50,000	116,387	.4296	.9120	45,601	721,201
16	50,000	123,370	.4053	.9017	45,083	766,284
17	50,000	130,773	.3823	.8905	44,525	810,810
18	50,000	138,619	.3607	.8786	43,928	854,738
19	50,000	146,936	.3403	.8658	43,291	898,028
20	50,000	155,752	.3210	.8522	42,611	940,639
21	50,000	165,097	.3029	.8378	41,889	982,528
22	50,000	175,003	.2857	.8224	41,122	1,023,650
23	50,000	185,503	.2695	.8062	40,311	1,063,961
24	50,000	196,634	.2543	.7890	39,451	1,103,412
25	50,000	208,432	.2399	.7708	38,541	1,141,953
26	50,000	220,938	.2263	.7516	37,580	1,179,533
27	50,000	234,194	.2135	.7313	36,565	1,216,098
28	50,000	248,245	.2014	.7100	35,498	1,251,596
29	50,000	263,140	.1900	.6876	34,379	1,285,976
30	50,000	278,929	.1793	.6642	33,210	1,319,186
31	50,000	295,664	.1691	.6399	31,995	1,351,181

32	50,000	313,404	.1595	.6147	30,733	1,381,914
33	50,000	332,208	.1505	.5884	29,422	1,411,336
34	50,000	352,141	.1420	.5611	28,056	1,439,392
35	50,000	373,269	.1340	.5326	26,632	1,466,024
36	33,304	263,544	.1264	.5031	16,754	1,482,777
36	16,696	132,122	.1264	.5031	8,399	1,491,177
37	50,000	419,405	.1192	.4726	23,629	1,514,806
38	50,000	444,570	.1125	.4414	22,070	1,536,876
39	50,000	471,244	.1061	.4098	20,492	1,557,368
40	50,000	499,519	.1001	.3781	18,905	1,576,273
41	50,000	529,490	.0944	.3464	17,319	1,593,592
42	50,000	561,259	.0891	.3148	15,739	1,609,330
43	50,000	594,935	.0840	.2836	14,182	1,623,512
44	50,000	630,631	.0793	.2533	12,665	1,636,177
45	50,000	668,469	.0748	.2241	11,203	1,647,380
46	50,000	708,577	.0706	.1959	9,795	1,657,175
47	50,000	751,091	.0666	.1690	8,449	1,665,624
48	50,000	796,157	.0628	.1437	7,183	1,672,807
49	50,000	843,926	.0592	.1205	6,023	1,678,830
50	50,000	894,562	.0559	.0996	4,981	1,683,811
51	50,000	948,235	.0527	.0812	4,060	1,687,870
52	50,000	1,005,130	.0497	.0650	3,252	1,691,123
53	50,000	1,065,437	.0469	.0511	2,557	1,693,680
54	50,000	1,129,364	.0443	.0395	1,973	1,695,652
55	50,000	1,197,125	.0418	.0298	1,492	1,697,145
56	50,000	1,268,953	.0394	.0222	1,108	1,698,253
57	50,000	1,345,090	.0372	.0162	809	1,699,063
58	50,000	1,425,796	.0351	.0117	583	1,699,645
59	50,000	1,511,343	.0331	.0083	414	1,700,059
60	50,000	1,602,024	.0312	.0058	290	1,700,349
61	50,000	1,698,145	.0294	.0040	201	1,700,550
62	50,000	1,800,034	.0278	.0028	138	1,700,688
63	50,000	1,908,036	.0262	.0019	94	1,700,782
64	50,000	2,022,518	.0247	.0013	63	1,700,845
65	50,000	2,143,869	.0233	.0008	42	1,700,886
66	50,000	2,272,502	.0220	.0006	28	1,700,914
67	50,000	2,408,852	.0208	.0004	18	1,700,932
68	50,000	2,553,383	.0196	.0002	12	1,700,944
69	50,000	2,706,586	.0185	.0002	8	1,700,952
70	50,000	2,868,981	.0174	.0001	5	1,700,956

Retention Layer	Reserve Share
1	641,263
2	841,514
3	218,179
Total	1,700,956

SCENARIO 3

AGE OF CLAIMANT = 40
INTEREST ON MEDICAL PAYMENTS = REALISTIC
INFLATION RATE FOR MEDICAL PAYMENTS = REALISTIC
MORTALITY RATE = 1 TIMES STANDARD MORTALITY
RETENTION LIMITS = 1,000,000 5,000,000

Year	Medical Payments Current Dollars	Medical Payments Inflated Dollars	Disc Factor	Mort. Factor	Reserve Amount	Cumulative Reserve Amount
1	50,000	51,841	.9623	.9969	49,727	49,727
2	50,000	55,729	.8910	.9935	49,328	99,056
3	50,000	60,188	.8250	.9898	49,146	148,202
4	50,000	65,303	.7639	.9858	49,174	197,376
5	50,000	71,181	.7073	.9814	49,409	246,785
6	50,000	77,587	.6549	.9767	49,626	296,411
7	50,000	84,570	.6064	.9715	49,821	346,232
8	50,000	92,181	.5615	.9659	49,993	396,225
9	50,000	100,477	.5199	.9599	50,141	446,367
10	50,000	109,520	.4814	.9534	50,263	496,629
11	50,000	119,377	.4478	.9464	50,588	547,217
12	43,453	112,045	.4185	.9388	44,018	591,235
12	6,547	16,883	.4185	.9388	6,633	597,868
13	50,000	139,242	.3911	.9305	50,676	648,544
14	50,000	150,381	.3655	.9216	50,660	699,204
15	50,000	162,411	.3416	.9120	50,600	749,805
16	50,000	175,404	.3193	.9017	50,493	800,298
17	50,000	189,437	.2984	.8905	50,335	850,633
18	50,000	204,592	.2789	.8786	50,124	900,757
19	50,000	220,959	.2606	.8658	49,858	950,615
20	50,000	238,636	.2436	.8522	49,534	1,000,149
21	50,000	257,727	.2287	.8378	49,381	1,049,530
22	50,000	275,767	.2158	.8224	48,935	1,098,464
23	50,000	295,071	.2035	.8062	48,421	1,146,886
24	50,000	315,726	.1920	.7890	47,836	1,194,721
25	50,000	337,827	.1812	.7708	47,173	1,241,895
26	50,000	361,475	.1709	.7516	46,430	1,288,325
27	50,000	386,778	.1612	.7313	45,603	1,333,929
28	50,000	413,853	.1521	.7100	44,690	1,378,619
29	50,000	442,822	.1435	.6876	43,690	1,422,309
30	43,794	415,009	.1354	.6642	37,315	1,459,624
30	6,206	58,811	.1354	.6642	5,288	1,464,912
31	50,000	506,987	.1283	.6399	41,627	1,506,539

32	50,000	537,406	.1222	.6147	40,367	1,546,905
33	50,000	569,651	.1164	.5884	39,013	1,585,918
34	50,000	603,830	.1108	.5611	37,555	1,623,473
35	50,000	640,060	.1056	.5326	35,989	1,659,462
36	50,000	678,463	.1005	.5031	34,314	1,693,776
37	50,000	719,171	.0957	.4726	32,542	1,726,318
38	50,000	762,321	.0912	.4414	30,685	1,757,003
39	50,000	808,061	.0868	.4098	28,761	1,785,764
40	50,000	856,544	.0827	.3781	26,788	1,812,552
41	50,000	907,937	.0788	.3464	24,773	1,837,325
42	50,000	962,413	.0750	.3148	22,727	1,860,052
43	50,000	1,020,158	.0714	.2836	20,674	1,880,726
44	50,000	1,081,367	.0680	.2533	18,639	1,899,365
45	50,000	1,146,249	.0648	.2241	16,644	1,916,009
46	50,000	1,215,024	.0617	.1959	14,692	1,930,700
47	50,000	1,287,926	.0588	.1690	12,792	1,943,493
48	50,000	1,365,201	.0560	.1437	10,980	1,954,473
49	50,000	1,447,113	.0533	.1205	9,293	1,963,766
50	50,000	1,533,940	.0508	.0996	7,760	1,971,526
51	50,000	1,625,977	.0484	.0812	6,384	1,977,910
52	50,000	1,723,535	.0461	.0650	5,163	1,983,073
53	50,000	1,826,947	.0439	.0511	4,099	1,987,172
54	50,000	1,936,564	.0418	.0395	3,192	1,990,363
55	50,000	2,052,758	.0398	.0298	2,438	1,992,801
56	50,000	2,175,924	.0379	.0222	1,827	1,994,629
57	50,000	2,306,479	.0361	.0162	1,348	1,995,976
58	50,000	2,444,868	.0344	.0117	979	1,996,955
59	50,000	2,591,560	.0327	.0083	702	1,997,657
60	50,000	2,747,053	.0312	.0058	497	1,998,154
61	50,000	2,911,877	.0297	.0040	348	1,998,502
62	50,000	3,086,589	.0283	.0028	241	1,998,743
63	50,000	3,271,785	.0269	.0019	165	1,998,907
64	50,000	3,468,092	.0256	.0013	112	1,999,019
65	50,000	3,676,177	.0244	.0008	75	1,999,094
66	50,000	3,896,748	.0233	.0006	50	1,999,144
67	50,000	4,130,553	.0222	.0004	33	1,999,177
68	50,000	4,378,386	.0211	.0002	22	1,999,199
69	50,000	4,641,089	.0201	.0002	14	1,999,213
70	50,000	4,919,554	.0191	.0001	9	1,999,223

RETENTION LAYER	RESERVE SHARE
1	591,235
2	868,389
3	539,599
TOTAL	1,999,223