AMERICAN ACADEMY of ACTUARIES

Report of the Disability Income Risk-Based Capital Work Group

To the

NAIC Health Risk-Based Capital Working Group

Nashville — March 2001

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This report was prepared by the Academy's DI RBC Working Group of the Joint DI/LTC/SL/LB Task Force on Health Risk-Based Capital (HRBC).

Dennis P. Lauzon, FSA, MAAA, Chairperson

Charles N. Bieter, F.S.A., M.A.A.A.

Burton D. Jay, F.S.A., M.A.A.A .

James F. Reiskytl, F.S.A., M.A.A.A.

Virginia K. Gammill

Robert G. Meilander, F.S.A., M.A.A.A.

Albert A. Riggieri, Jr., F.S.A., M.A.A.A.

March 2, 2001

Table of Contents

PAGE

Executive Summary and Recommendations

1. Charge to Group

The NAIC Health Organization and Life Risk Based Capital Working Groups asked the American Academy of Actuaries (AAA) to recommend the treatment and factors that should be incorporated into the Managed Care Organization Risk Based Capital (MCORBC) formula for Disability Income (DI), Long Term Care (LTC) and Stop Loss (SL) products. Further, the Academy was asked to recommend any changes to the Life RBC formula which would be required to achieve consistency with the MCORBC formula with regard to these products. Subsequently, the request was expanded to include Limited Benefit (LB) products.

The academy formed the Joint DI/LTC/SL/LB Task Force from members of its Life Risk Based Capital Committee (LRBC) and the its Task Force on Health Organization Risk Based Capital (HORBC) to respond to the NAIC. This report contains the analysis and recommendations of the DI Working Group of the Joint DI/LTC/SL/LB Task Force.

2. The need for a new study

The DI Working Group reviewed the disability income analysis and proposals in the November 27, 1991 report of the Industry Advisory Committee to the Life Risk Based Capital Work Group. This report is the source of the current disability income factors. The Working Group also reviewed the analysis and proposals of the work reported on in 1994 by the Academy's HORBC Working Group and reported to the NAIC HORBC Working Group.

The DI analysis in both of these studies was part of much larger efforts that were subject to severe time constraints. The 1991 report was over 100 pages. However, less than two pages of the final documentation were on the development of the disability income factors. While some additional background was located, the total available documentation was not adequate to reach an independent conclusion that the 1991 recommendations would still be appropriate. In addition, the DI Working Group wanted to analyze additional disability income segments such as credit disability and group short-term disability.

The 1994 work focused on all medical products. The risk dynamics of the typical medical product are significantly different than the risk dynamics for disability. The 1994 analysis produced non-intuitive results for certain disability products. Due to time constraints, significant judgment was used in the 1994 analysis to translate model results into reasonable recommendations. After reviewing the 1991 and 1994 work, the DI Working Group concluded a new analysis was needed.

3. General Working Guidelines

The DI/LTC/SL/LB Task Force wanted to be consistent with the analysis underlying the risk based capital requirements of other insurance products. Consistency in approach helps keep the relative requirements of different insurance products reasonable. While no specific guidelines exist, the DI Working Group believes the typical approach to prior analysis was to find the surplus required to reduce the probability of ruin for a stationary population over a 5 year period to 5% while giving full recognition to taxes. As the recent review of tax assumptions underlying all risk based capital requirements has highlighted, the approach taken to risk based capital has not always been uniform. Where possible the sensitivity of results to alternative approaches and assumptions is provided.

The DI Working Group wanted to keep the analysis as straight forward as possible so that the work could be understood and the results judged for reasonableness. At the same time, the Working Group sought to include on a simplified basis all the major aspects of risk and management dynamics for the disability income segments being analyzed. The Working Group wanted the documentation to be of sufficient detail for a third party to provide an independent appraisal of the recommendations. With the exception of identifying the data voluntarily provided by individual companies with those companies, this report and the appendices contains a complete documentation of the analysis, models and recommendations.

4. Summary of Recommendation

The current disability income risk based capital factors are those proposed in the 1991 Report. They are listed in TABLE 1. In 1999 the application of the TABLE 1 factors were modified so that the .25 factor for Other Disability Income on the first $50 million of earned premium only had to be applied to the extent individual Noncancellable (NonCan) earned premium was less than 50 million.

TABLE 1

Item	Annual Statement Source	Factor
Disability Income Premium		
Noncancellable Disability Income – Individual Morbidity	A) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million	35%
	Earned Premium (Schedule H, Part 1, Line 2, in part) over 50 Million	15%
Other Disability Income – Individual Morbidity	B) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million less amount in A	25%
	Earned Premium (Schedule H, Part 1, Line 2, in part) over amount in line B	15%
Disability Income – Group and Credit Morbidity	Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million	25%
	Earned Premium (Schedule H, Part 1, Line 2, in part) over 50 Million	15%
Claim Reserves	Exhibit 9 Claim Reserves	5%

Based on the DI Working Group's analysis, the current factors for NonCan are reasonable and no change is recommended. However, using the same techniques and modeling that supports the current NonCan factors, the DI Working Group found the current premium factor for Individual Guaranteed Renewable Disability (GR) above $50 million to be high. GR is currently categorized as other disability income. Similarly, the DI Working Group found the current factors for Group Long Term Disability (GLTD) to be high relative to NonCan risk.

No analysis was done in 1991 or 1994 on Group Short Term Disability (GSTD); however, the 1994 report did recommend lower factors. GSTD is a high frequency low amount claim coverage relative to GLTD with which it is currently grouped for risk based capital. Not surprisingly, when tested separately the capital required for GSTD is lower than for GLTD.

No prior analysis was done on credit disability products. Credit coverages tend to have lower loss ratios, higher terminations and shorter claim benefit periods than the GLTD products with which they are currently grouped. Offsetting this is the ability to re-price GLTD in-force. When single premium credit (SP) and monthly outstanding balance (MOB) credit were tested separately the capital required for credit disability products were similar to GLTD.

Table 2 summarizes the recommendations of the DI Working Group. The claim reserve factor for all products is left unchanged at 5%. The first $50 million of earned premium for each of the Individual Morbidity Grouping and the Group and Credit Grouping are subject to higher factors than premium over $50 million.

TABLE 2

Item	Annual Statement Source	Factor
Premium Requirements		
	Individual Morbidity Grouping	
Noncancellable Disability Income – Individual Morbidity	A) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million	35%
	Earned Premium (Schedule H, Part 1, Line 2, in part) not included in A	15%
Other Disability Income - Individual Morbidity	B) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million less the premium in A	25%
	Earned Premium (Schedule H, Part 1, Line 2, in part) not included in B	7%
	Group and Credit Morbidity Grouping	
Credit Monthly Balance Disability	C) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million	20%
	Earned Premium(Schedule H, Part 1, Line 2, in part) not included in C	3%
Group Long Term Disability	D) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million less premium in C	15%
	Earned Premium (Schedule H, Part 1, Line 2, in part) not included in D	3%
*Credit Single Premium Disability without unearned premium reserves	(1) Earned Premium (Schedule H, Part 1, Line 2, in part) Amount to be reported on Health Premiums, Line (17.2)	
	(2) Additional Reserves (Exhibit 9, Column 3, Line 2}	
	(3) Prior Year Additional Reserves (Exhibit 9, Column 3, Line 2, Prior Year)	
	(4) Adjusted Premiums equals ((1) -(2) + (3))	
	E) Adjusted Premium (Line (4) above) first 50 Million less the premium in C and D	15%
	Adjusted Premium (Line (d) above) not included in E	3%
Credit Single Premium Disability with unearned premium reserves	E') Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million less the premium in C and D	10%
	Earned Premium (Schedule H, Part 1, Line 2, in part) not included E'	3%
Group Short Term Disability	F) Earned Premium (Schedule H, Part 1, Line 2, in part) first 50 Million less the premium in C, D, E and E'	5%
	Earned Premium (Schedule H, Part 1, Line 2, in part) over 50 Million not included in F	3%
Reserve Requirements	**Individual, Group and Credit**	
Claim Reserves	Exhibit 9 Claim Reserves	5%

* Recommended in anticipation of a change in statutory accounting to active life reserves.

Introduction

1. Background, Charge and Purpose of project

The 1991 report of the Industry Advisory Committee to the Life Risk Based Capital Work Group represented the first effort to develop statutory RBC standards for disability income products. This effort was part of a larger project to develop RBC factors for all the risks of life companies. A small task force of actuaries from a number of major writers of disability insurance provided the DI portion of this effort. The effort consisted of a review of independent work done by the companies represented. The standards that resulted (and are still in use today) are based on this review and thus represent industry wisdom as it existed at that time. It is noteworthy that this effort was not based on specific modeling performed by any independent body.

In 1994, at the request of the NAIC, the Academy again undertook a major effort to create consistent RBC standards for all health insurance. While the primary motivation for this effort was a desire to create standards for medical coverages that were the same for all types of health organizations, disability income was also studied. The term HORBC used to refer to this task stands for Health Organizations Risk Based Capital.

The HORBC task force relied heavily on modeling for its work. A model was developed that calculated probabilities of ruin for target surplus requirements based on variability in loss ratios. The engine of this model was a simulation of loss ratios based on an assumed distribution. This distribution was based on observed variations in loss ratios in the data of a number of companies.

The HORBC group produced a report that was delivered to the NAIC in December of 1994. In this report, recommendations were made for all forms of health coverage, including disability. However, because medical insurance RBC requirements did not exist at that time for some forms of health organizations, the primary focus of the NAIC efforts was on these forms of coverage. As a result, adoption of the standards for disability insurance was postponed until after the medical standards were put in place.

In 1996 an analysis was performed and recommendations were made for accident only disability business. Subsequently, the factors applied to this business were reduced, and the reporting on this segment was moved to an “other category”. This segment is no longer reported with other disability segments. We did not consider review of this segment part of our charge.

The NAIC Health Organization and Life Risk Based Capital Working Groups asked the American Academy of Actuaries to recommend the treatment and factors that should be incorporated into the MCORBC formula for Disability

Income, Long Term Care and Stop Loss coverages sold by the various health organizations to which the MCORBC formula applies. Further, the Academy was asked to recommend any changes to the Life RBC formula which would be required to achieve consistency with MCORBC formula with regard to these products. The P&C RBC formula is already linked to the Life RBC formula with respect to the treatment of health products. It is, therefore, expected that any such changes to the Life formula would be reflected in the P&C formula as soon as practicable.

The charge was given to a Work group of the American Academy of Actuaries assembled for this purpose. To facilitate consistency between the formulas, members were selected from both the AAA HORBC Task Force and the LRBC committee. This group is called the DI/LTC/SI/LB Work Group and is chaired by Burt Jay.

Early in the process the DI/LTC/SL/LB Work Group decided to expand their review to include other "limited benefits" (LB) products which were included in the recommendations made to the NAIC by the AAA's HORBC Task Force in 1994 and 1996. For a number of reasons the 1994 and 1996 recommendations for these products were not acted upon. Recommendations for LB products were made in March of 1999. Recommendations for DI should now be considered as a part of the package to maintain consistency between all of the health products and between the three formulas.

2. Project History

The task force took the following approach to the task it had been given (there is more detail on the work performed in each of these steps in the remainder of the report).

Review Prior Projects – The first part of our task was to review the 1994 HORBC report to determine if we could simply implement their recommendations. In addition, we took a look at the current standards and the 1991 work upon which they were based to see if we could simply continue the current standards. After review of these items, we determined that a new study was necessary.

Determine the Basic Approach – Once we had determined that additional work was necessary, we settled on an approach to our work.

Develop Model – A model was developed that was based on the principles of the 1994 model but that addressed the concerns the task force had with the 1994 model.

Gather Data – A number of input items that the developed model requires were based on data collected from DI writers. In addition to gathering data, the group spent considerable time reviewing the data and addressing apparent anomalies in it.

Model Results – The model was run for a large number of scenarios to determine the surplus requirements that would reduce the probability of ruin to the target level.

Analyze Data – Considerable time was spent reviewing the results of the various models. To some extent, this led to an iterative process cycling back to the Develop Model step. The analysis of the data led to concerns about both the model and the data, which were then addressed.

Construct Recommendations – Once the modeling was completed, recommendations for appropriate RBC requirements were developed.

Write Report – The final step in the process was the development of this report.

Timeline

Our timeline for this project was as follows:

July 1998	Organization of the task force
September 1998 to March. 1999	Review of previous work.
March 1999	Development of the approach
March 1999 to April. 2000	Data Gathering
May 1999 to August 2000	Model development
May 2000 to January 2001	Model Results & Analyze Data
November 2000 to January 2001	Construct Recommendation
December 2000 to March 2001	Write Report

Participants

The key participants in the process were:

Dennis Lauzon (chair)
Nick Bieter
Ginny Gammill
Burton Jay
Bob Meilander
Jim Reiskytl
Al Riggieri
Meredith Watts (AAA staff)

3. Review of Prior Projects

As part of the work of this task force, we reviewed both the 1991 and 1994 work to see if an update was needed. We considered the 1991 study first. While we had no reason to think that the current factors were inappropriate, we did not find sufficient documentation in our review to determine that they were appropriate. As noted earlier, this analysis represented the internal estimates of only four companies and involved little modeling.

Our task force also reviewed the 1994 HORBC effort. For the most part, we were impressed with the work and in many respects it forms the basis for what we have done in this effort. However, there were several items of concern to us.

First, because this effort was focused on medical coverage, it did not adequately address the effect of a trend in morbidity on the calculation of RBC targets for disability. In the calculations of the distributions of future loss ratios, standard deviations were based on variation around the trend line rather than around the mean. This approach was taken because the Academy had been asked to use a uniform model to develop RBC factors for all types of health products. For many types, using variation around the trend line is more appropriate. Removal of trend has little impact on the simulation of products with non-guaranteed premiums but it makes a significant difference for NonCan products. This may explain why the modeled results in the HORBC effort showed a greater need for surplus for guaranteed renewable products than for noncan products. Since most individual DI is NonCan, we deemed the treatment of trends in disability experience a significant concern.

Second, we noted that the method used in the 1994 study limited the maximum loss ratio that could occur in the future to the highest loss ratio that had ever occurred. This was a result of the type of random simulation used and the method used to develop the loss ratio distributions; a direct method based on actual experience. We felt that a random walk would produce a better result and that data should be based more on measures of the variation in the data from expected than directly on the data points themselves.

Finally, we were concerned about the data used in the 1994 study. As it turned out, the entire study was based on the experience on NonCan DI. There was no GR experience and the group data was not used. What's more, the NonCan data was based on experience from four companies for the large company experience and 12 for the small company experience. Finally, the time period studied was limited to ten years. It was hoped that we could get a broader data set for a new study that would encompass more types of coverage, more companies and more current data.

As a result of these concerns with both the 1991 and 1994 efforts, we decided that a new study was warranted.

Basic Approach

The DI Working Group focused the majority of its effort on determining the aggregate risk based capital requirement for active and disabled lives. This was done using an "aggregate model". A much less intense effort was made on the risk based capital requirements for disabled lives, the claim reserve component of risk based capital. A simple claim reserve model was used to determine that the 5% claim reserve factor recommended in 1991 and again in 1994 was reasonable. The premium requirement for risk based capital was then found by subtracting the claim reserve requirement from the aggregate requirement. The remainder of this section discusses the approach taken to determine aggregate requirements.

1. Stationary Population

The DI Working Group spent a significant amount of time discussing whether the analysis should determine capital requirements for a closed block or a stationary population.

The purposes of risk based capital were identified in the 1991 report as:

- An early warning tool to identify possible weakly capitalized companies for purposes of initiating further regulatory action, and
- A new minimum capital standard which would supplement the generally prevailing system of low, fixed minimum capital and surplus requirements. The new minimum would be the greater of a state's current minimum and an amount based on a company's RBC.

The DI Working Group decided to model a stationary population for three reasons:

1. It appears consistent with most of the prior work underlying the current health RBC factors.
2. Modeling a stationary population is significantly easier than a closed block. It is not necessary to determine the release of statutory strain, potential atypical terminations and other unusual conditions for a company running off its business.
3. The historic data from which volatility was being extracted was much closer to a stationary population than a closed block.

2. Historic Volatility

The analysis, modeling and recommendations are based on the premise that historical volatility is a reasonable predictor of future volatility. The model uses

Monte Carlo techniques to translate volatility and a given level of required capital into a ruin probability.

The historic volatility in our approach is measured as the difference between an expected value and an actual value. It should not be confused with the deviation between successive loss ratios. For example, if the actual loss ratios in year A1 and A2 are 70% and 85%, the deviation in actual loss ratios is 15%. However, If the loss ratio in year A2 were expected to be 65%, the deviation of 85% from this expected value would be 20%. The expected value of a loss ratio is described in the "Random Walk" part of this section. The formula for the calculations of expected value is given in Appendix C.

Volatility in our analysis is assumed to come from a normal random variable with an initial mean of zero. Additional parameters needed to model the volatility include:

- The standard deviation,
- The serial correlation of successive deviates,
- The cap on the loss ratio during the seasoning period. This would indirectly limit the deviations. The seasoning period is the number of years loss ratios are varied before testing begins.
- The cap on the resulting loss ratios during the testing period, and
- The floor on the loss ratio during the testing period.

The serial correlation parameter describes how the expected value of a random number relates to the value of the prior random number. In our model, the expected value of a random number was zero plus the serial correlation parameter times the prior random number. If the serial correlation was minus 30% and the prior number was .10, the expected value of the next random number would be –.03 (-30% of .1). That is, if the actual loss ratio were .1 higher than the expected loss ratio in period 1, in period 2 we would expect the random deviation to give back .03 of that deviation. A way to think of this is that any part of the deviation from expected that is purely random should not be expected to persist and thus should be given back on an expected basis in the next period. The historic data for almost every company in every segment had a negative serial correlation.

The historic data by disability segment (NonCan, GR, GLTD, GSTD, SP and MOB) was analyzed. The standard deviation of the historic data clearly decreased with company size. When the data was analyzed to determine an appropriate serial correlation, the serial correlation in each segment was different but within a segment it did not seem to depend on company size.

While the model developed allows caps and floors to be put on the loss ratios, the use of caps and floors would cause the output volatility from the model to have a standard deviation different from that inputted and a distribution less spread out than the normal distribution. Some review of the results and adjustment to the input volatility would be needed to have output volatility at target levels. In the analysis supporting our recommendations, the floors were set very low and the caps very high as a proxy for no caps and floors.

Several limitations are involved in using historic volatility to estimate future requirements for a stationary population:

- The historic data is not from a stationary population. This is more of a simplification for lines growing rapidly, such as GR, or lines in decline. When companies with volatile loss ratios are examined, the source is often volatile earned premium. Thus, the historic data may tend to overstate the volatility of a truly stationary population. In some cases, the historic data was rejected because of very erratic premium.
- The volatility in the historic data is only an approximation of the "true" prospective volatility since the historic data represents a single sample of exogenous factors. Data was collected for the years 1983 to 1998. This was from a particularly stressful time for DI. Companies were experiencing below average profit levels, consolidating and exiting the business. The historic data could represent an unusually volatile period. On the other hand, much of the data was from a relatively favorable economic environment.
- The analysis treats volatility as if it were stable over time. It probably is not. With improvements in the speed and analysis of information, it could be argued that response times to market and experience developments are always improving, producing faster changes in product design, pricing, claims management, underwriting and distribution.
- The historic data for a segment is not homogeneous across companies. The companies will have differences in product design, underwriting, claim management, mix of business and other factors and thus not have the same underlying volatility.
- The historic data is from a select sample of companies that may have lower volatility than the average. The companies are a select subset of companies doing business during this time in that they are still in the DI business at the end of this time frame.
- The historic data does not produce a single estimate of volatility, but varying estimates depending on how the data is treated. The DI Working Group had to use significant judgment to translate historic data into model volatility parameters. In some cases, if the data for a segment was limited, the DI Working Group looked to similar segments with more data to help set assumptions or determine the reasonableness of what the limited data was suggesting.

The historic volatility implicitly has two sources. The first is the random variation subject to the laws of chance. This is called statistical risk. The second is the difference between the statistical (random) risk and the total variation. In the 1994 report this was referred to as historical risk. Volatility can be estimated as a function of business size. We used earned premiums as size factors for a company's data. Size 1 is the company's 1998 annual earned premium. Size 2 is the company's aggregate earned premium over all years for which it provided data.

A decrease in volatility is apparent in the historic data for larger blocks of business. This is not unexpected because of the law of large numbers. However, other factors also drive down volatility as size increases. Size may result in more information sooner allowing quicker response times on pricing. Better information can help set reserves more precisely (e.g., by cause of disability). Economies of scale may allow for a greater use of specialist in claims management and other services. Finally, with more relative size comes closer attention by senior management, industry analysis, regulators and other interested parties.

3. Reasonable Pricing Assumptions

The DI Working Group felt strongly that the level of required capital must be consistent with a viable product. We concurred with the following view expressed in the 1994 report:

> The regulatory environment must also recognize that health plans compete for business and capital in various markets. The various regulations must also consider their impact on price and profitability to ensure a product remains affordable and allows for sufficient profit to provide a return that will allow a plan to attract capital.

To this end, the profit margin as a percent of premium was adjusted in the analysis to maintain a fixed return on equity (ROE) as alternative levels of risk based capital were tested. In our calculations the invested equity was defined as the sum of the statutory strain and the risk-based capital being tested in the model. With profit as a percent of premium changing to maintain a constant ROE, other adjustments are needed to keep revenue balanced with profits, benefits and expenses. While small changes occurred in investment income as statutory capital varied, the main balancing item was the expense margin.

To put some perspective on the reasonableness of our ROE assumptions, we note the following information reported in the "S&P Life Insurance Outlook 2001". The average ROE for the top 15 publicly traded US Life Insurers for the 12 months ending 9/30/00 was 13.36%. The top 12 publicly Traded U.S. Banks had an average ROE for the same time period of 18.51%. It was also noted that, "Insurance companies enjoy on average a much greater stability of earnings, for which the market will pay a premium. However, Standard & Poor's believes insurance companies in general are capable of generating higher ROEs. Until companies attain ROEs of 15% or better, their market capitalization relative to book value will lag other industries." In considering this information, one would expect significant variation in ROE at the product level that is not apparent in a company's aggregate ROE.

The DI Working Group felt that 15% was a reasonable figure for a ROE target. However, for most types of DI we took a more conservative view than that. Since

ROE is directly related to profit requirements which in turn is the first line of defense against poor claims experience, in this case, a lower rate of return is conservative in that it means there is less profit available to absorb unfavorable claim fluctuations. This conservatism shows up in ROEs that are generally lower than 15% for most of our model cells. The DI Working Group also took a conservative view in calculating the equity on which a return is earned. In practice, companies will typically assume that invested equity is equal to the sum of the surplus strain and some multiple of the RBC requirement. In our models, we only assumed that 100% of the RBC requirement is held. Again, this means that fewer dollars of profits are available to pay claims and is the conservative approach.

The DI Working Group had diverse opinions on whether we should communicate profit margins in terms of ROE or in terms of percent of premium, given that model ROE is calculated using the RBC level being tested in the model rather than an RBC level considered typical for product pricing. Looking at profit as a percent of premium is a bridge, a way to compare model assumptions with typical pricing assumptions. For products with low capital requirements, such as GSTD, and or other important criteria for sale, which for GSTD would include service levels and possibly packaging with GLTD, the typical profit as a percent of premium can look high in terms of ROE.

Whether a product remains affordable and viable will depend on whether a company can manage within the parameters explicit in the analysis. Since most companies will target more than 100% of risk based capital in their pricing, they will require a higher profit margin as a percent of premium than those in our analysis to achieve the assumed ROEs in our analysis. This will require better expense, investment income, or loss ratio results than implied in our analysis. All things being equal, pricing for more than 100% of the recommended requirement will imbed a higher profit margin and thus a lower probability of ruin than 5% when capital is held at 100% of our recommendations.

The following pricing assumptions are used in the analysis (input to the model used):

- The pre-tax interest rate on funds (net of expense and default cost).
- Invested capital less RBC. This is an estimate of statutory strain or GAAP equity less statutory equity. As the tested RBC varied, statutory strain was held constant as a percent of premium to simplify the analysis.
- Target return on equity; equity = 100% of modeled RBC + statutory strain.
- Tax rate on profit (i.e., federal income tax rate)
- The loss ratio implicit in pricing.
- Target RBC level as a percent of premium is input if the probability of ruin is being found. If the probability of ruin is given, then the required surplus level is found by iteration and this input is used as an initial guess.

While the model determines profit as a percent of premium based on the target ROE, the tax rate and the capital invested, a significant consideration in determining a reasonable ROE was the profit as a percent of premium that resulted.

As mentioned above, the expense margin is not an assumption but a balancing item to achieve the target ROE.

The statutory strain should pick up, among other things; the average assumed strength in statutory reserves over GAAP reserves. Thus while this approach does not give credit on a company basis to strong reserves, it can reflect it in a general way for a segment (e.g., the SP segment strain due to gross unearned premium reserves).

The approach we have taken and the model used implicitly assume all adjustments to achieve a target loss ratio are through pricing. In practice, other options are available to manage loss ratios, capital and profitability. These include reinsurance, claims administration changes, wellness programs, dividend changes, etc. In short the ability to manage loss ratios and protect against insolvency will be significantly greater than modeled. Prior use of these practices to enhance capital or limit risk could show up in the historical data as increased or decreased volatility (e.g., reinsurance that releases statutory strain). Since we make no distinction between good volatility and bad volatility, prior capital enhancement activities could increase or decrease the current measure of required capital.

4. Dynamic Management Assumptions

The model uses three types of assumptions, volatility assumptions described above, the pricing assumptions also described above and the dynamics by which pricing is managed as experience emerges, which is described in this section.

In this latter group, an assumption is needed on the time delay from a change in the exogenous factors effecting losses to when sales are occurring with premiums re-priced to compensate for the changes. This assumption is called the phase in delay and it has three components, the time it takes to recognize a change has occurred, the time it takes to re-price for the change and the time it takes to get approval for the re-priced product.

The phase in delay may not be stable over time and it may not be symmetric, with different response times for a favorable change than for an unfavorable change. However, only one static phase in delay is modeled. The regulatory approval process and management decisions based on market and financial conditions will influence the actual delay to re-pricing.

The analysis implicitly builds in varying phase in delays that may or may not be symmetric by using three loss ratio assumptions. The first is the loss ratio implicit in the pricing, sometimes referred to as the target loss ratio. This is given as part of the pricing assumptions. The second is a "High Re-price Ratio" which is greater than the target loss ratio. The known loss ratio must equal or exceed the "High Re-price Ratio" for re-pricing to occur. In this case, repricing will lower loss ratios by raising premiums. Similarly there is a "Low Re-price Ratio" less than the target loss ratio. The known loss ratios must be less than or equal to the "Low Re-price Ratio" for re-pricing to occur. In this case, repricing will raise loss ratios by cutting premiums.

Another dynamic management assumption is the phase in factor. It is the annual percentage of in-force earned premium that can be re-priced once new pricing is being implemented at the end of the phase in delay. Clearly, this will be faster for a guaranteed renewable product that allows all in-force policies to be re-priced, than for a NonCan product in which only new policies can be re-priced. In a stationary population, new policies are limited by the lapsing and maturing policies. The analysis allows for two phase in factors. The "High Loss Ratio Phase in Factor" is used when losses exceed the "High Re-price Ratio" and a "Low Loss Ratio Phase in Factor" is used when losses are less than the "Low Re-price Ratio". For our analysis, both of these factors were kept the same in a segment.

In many situations salary inflation could increase the phase in factor as the percentage of new premium dollars would increase relative to the in-force. However, the model did not accommodate an inflation assumption. The analysis also assumes a company can always re-price to achieve the target loss ratio. If a company's experience is worse/better than the industry as a whole, the company's pricing flexibility may be less/more than the industry average. This may be less significant for larger blocks. Both of these effects, inflation and ability to re-price, are accounted for to some extent implicitly in the historical data on loss ratios by size of company.

To recap, the key management dynamic assumptions in the analysis are:

- Phase In Delay,
- Low Loss Ratio Phase in Factor
- High Loss Ratio Phase in Factor
- Low Re-price Ratio
- High Re-price Ratio

5. The Random Walk

In the analysis, the parameters for historic volatility and the dynamic management assumptions are related. There are two keys to understanding this relationship.

First, as already mentioned, the historic volatility is not based on successive loss ratios but on the difference between a loss ratio and its expected value given the management dynamics. It is this deviation from expected given the management dynamics that is modeled as a random walk.

Second, for any year, an expected loss ratio is determined from the historic data by using the dynamic management assumptions, "Phase in Delay", "Low Loss Ratio Phase in Factor", "High Loss Ratio Phase in Factor", "Low Re-price Ratio", "High Re-price Ratio" and "Loss Ratio implicit in pricing". With the same historic data, if the dynamic management assumptions are changed, the deviates, their standard deviation and their serial correlation will change.

Given the same set of historic data and greater smoothing in the management dynamics, the calculated volatility will be higher. This is because the smoothing would assume less deviation from the prior loss ratio while the actual historical deviations are unchanged. The yearly deviates given the historic data and the management assumptions are used to determine the standard deviation and serial correlation of the random walk for the analysis.

6. Other Assumptions

Test Parameters

The approach used in this analysis was designed to be consistent with the analysis underlying the risk based capital requirements of other insurance products. The DI Working Group believed the typical approach to prior analysis was to find the surplus required to reduce the probability of ruin for a stationary population over a 5 year period to 5% while giving full credit for tax losses. The model is capable of examining different testing periods, probabilities of ruin, tax rates and tax recognition factors.

Tax Rates

A change in tax rates would change the profit margin necessary to achieve the target ROE. A change in tax recognition factors determines risk-based capital at less than full tax recognition (e.g., pre-tax). It does not change the ROE since the actual capital allocated to the product is not assumed to change (i.e., will eventually be allocated on an after-tax basis).

Reinsurance

In general, risk based capital is determined net of reinsurance with factors applied to financial items which are net of reinsurance. In addition, by using loss ratios net of reinsurance, the data implicitly adjusts for retention levels by company size (i.e., the greater use of proportional or stop loss reinsurance by small companies is implicitly considered in the data). Thus the analysis and modeling does not have any provision for reinsurance assumptions. As noted below, the data on the credit segments is on a direct basis and not net of reinsurance.

Surplus Cap

We capped surplus accumulations at the required surplus level being tested. When a " Cap Surplus Accumulation" indicator was on, profits from the model were accumulated each year only to the extent that accumulated surplus did not exceed the original surplus level being tested. The DI Working Group believes the bulk of the analysis underlying the current risk based capital factors did not cap the surplus accumulation in this manner. However, limiting the accumulated surplus to the initial tested level is consistent with modeling the minimum capital needed for an ongoing operation. The sensitivity of results to this assumption is in table SA21 of Appendix B.

Seasoning

Seasoning refers to the time prior to the start of the testing period over which the model runs and the loss ratio of the in-force is allowed to vary. If the expected loss ratio of the in-force were 60%, without a seasoning period the in-force would always start at 60%. With a seasoning period the initial loss ratio of the in-force will be randomly distributed around the 60% and dynamic management assumptions will already be in effect. A longer seasoning period results in a greater variance around the mean in starting loss ratios. There was a concern that with a very long seasoning period a company would be ruined in many scenarios even before the testing horizon began. This would be less of a problem if reserves were strengthened after the seasoning period. The 1994 analysis used a two-year seasoning period. The current analysis uses a three-year seasoning period based on a review of loss ratio volatility. The model also allows the loss ratios during the seasoning period to be capped to dampen the effects of seasoning. However, this feature was not used.

Reserve Strengthening

The Academy's 1994 report noted it was trying to measure volatility not deliberately caused by management; thus the impact of basis changes were removed from the reserve changes reflected in loss ratios. As best as we could determine, prior risk based capital analysis, including the 1991 analysis, did not include capital for the possibility that reserves would need strengthening after the testing period. We kept with this approach. However, one could argue that not all changes in basis are "caused by management" but may also reflect real changes in the environment or prospects for the business segment. Some scenarios where ruin did not occur would have insufficient assets to set up adequate (gross premium type) reserves given the loss ratios at the end of testing. This would be mitigated by any margin in the reserves at more typical loss ratios.

The model is capable of estimating the impact of reserve strengthening using an input to specify the degrees of reserve strengthening and an input to specify the loss ratio that must be reached before additional reserves begin to be set up. Estimates are included in the sensitivity analysis, see table SA18 of Appendix B.

To recap, the other assumptions in the analysis which were fixed throughout the analysis, except for sensitivity testing, and did not vary by segment included:

- The probability of ruin, 5%,
- The testing period, 5 years,
- The tax rate, 35%
- The percentage of tax recognition, 100%
- Limiting surplus during the testing period to the required capital level,
- The seasoning period, 3 years
- Reserve strengthening percentage, 0%
- Adjust reserves for loss ratios over, no adjustment

The Models

1. Overview

The 1994 report provided a useful perspective on the practical aspects of modeling. The following is from page 10 of that report and is completely applicable to the modeling done for the current study:

> Standard actuarial practice used in assessing risk is to develop a model that imitates and projects financial results of an economic system (a product, a company, an industry...). These models are developed by gathering and analyzing past financial results and isolating independent and dependent variables. The models are employed by inputting underlying data and assumptions, the independent variables, and applying statistical formulas to produce the results being assessed.
>
> The Academy RBC model, therefore, represents a simplification of a complex economic system. Simplification occurs in nearly every step of this process. For example, the data represents a summary of a limited period's financial results. Another simplification is that the model can only reflect a finite number of variables in both input and output. These are chosen for their materiality but still clearly represent a simplification.

An aggregate model was used to determine the total capital requirement for C-2 risk in terms of earned premium. The aggregate model accounted for both active and disabled life risks since the loss ratios modeled include the deviations from both active and disabled lives. However, the DI Working Group concluded a premium factor alone would not produce a reasonable fit of required capital to risk. To better fit requirements to the inforce, the DI Working Group continued the current practice of developing factors for both active lives, using an earned premium factor, and factors for disabled lives, using a claim reserve factor. A second very simple model was developed to check the 5% capital requirement for claim reserves. The requirement for claim reserves could then be subtracted from the total requirement to determine the factor for earned premium. The DI Working Group did not look at active life requirements separately.

2. Description of Aggregate Model

The aggregate model requires as input the pricing assumptions listed in section 3 of the Basic Approach. These assumptions translate into a specific profit margin that is a significant consideration in the protection of surplus. While modeled as stable, pricing assumptions change overtime. For example, ROE targets would change over time to reflect the changing cost of capital. Expense margins would vary with the complexity of products, distribution cost and the development of efficiencies in information management.

The model also requires as input the standard deviation and serial correlation in the random difference from period to period between the actual loss ratio and expected loss ratio based on management dynamics. The standard deviation and serial correlation are described in section 2 of the Basic Approach and the management dynamics are described in section 3.

The model finds the required surplus for a given probability of ruin through trial and error. As the required surplus is adjusted to achieve the target probability of ruin, the profit margin is also adjusted to achieve, on an expected basis, the target return on equity. The balancing item as changes are made in the profit margin is the expense margin. If the resulting expense margin from the ending required surplus is not adequate, the product is not viable.

The model can put caps and floors on the generated loss ratios during the testing period and during the seasoning period. However, with caps and floors the expected standard deviations of the output will no longer equal the input value.

The loss ratios produced by the model can be higher and lower than any loss ratios in the actual historical data. This is not surprising as the model attempts to produce many histories, not just the one that occurred.

The effects of the seasoning period on the dynamics of the loss ratios were reviewed. It was thought that the mean of the loss ratios at a specific time should not vary significantly from time period to time period. It was also felt that the standard deviation of loss ratios across all scenarios at a specific time should not expand too much for successive time periods. The DI Working Group discussed an appropriate way to view the reasonableness of the standard deviation in loss ratios at a point in time across all scenarios. It was decided to relate this standard deviation to the historic deviations across the companies. While the former is the deviation of one company across many scenarios and the later is the deviation of many companies across one scenario, no better comparison was found.

Without a mean reverting feature, loss ratios can reach absurd levels and the standard deviation in loss ratios will grow without bound overtime. The negative serial correlation coefficient dampens this growth over time; however, it does not cap it. The model allows collection of the loss ratios at the beginning and end of the testing horizon so their average and standard deviation can be examined.

The model can generate random numbers on the fly (by using a positive seed number) or generate adjusted random numbers to reduce the dependence of the results on the particular seed chosen (by using a negative seed number). The DI Working Group used the latter. For a specific set of assumptions, seven seed numbers were tested under the number of scenarios shown in TABLE 3.

TABLE 3

	Standard Deviation of Results from Seven Seed Numbers	
Number of Scenarios	On the Fly Generation	Adjusted
1,000	3.17%	2.79%
5,000	1.66%	0.95%
10,000	0.79%	0.49%
20,000	0.82%	0.50%
30,000	0.89%	0.38%
40,000	0.47%	0.22%
50,000	0.53%	0.13%

The seed -100,000 was close to the average result at all the scenario levels. Our recommendations are based on 50,000 scenarios and a seed of -100,000. A complete description of the aggregate model is in Appendix C. The model is an excel file which is available from the Academy.

3. Description of Claim Reserve Model

The DI Working Group concluded that the analysis done in 1994 on claim reserves seemed reasonable. The 5% factor developed in 1994 agreed with the factor developed in 1991. Nevertheless, a simple claim reserve model was developed (see Appendix C) to calculate required capital on claim reserves using the same underlying assumptions as used in 1994.

Basic assumptions were made for a large claim block, 3100 disabled lives, and a small claim block, 310 disabled lives. The termination rates for all claims were 65% in the first year, 12% in the second year and 5% in the third and subsequent years. Claims were segmented into two sizes. For the large claim block there were 3000 claims of $12,000 a year and 100 claims of $120,000 a year. For the small claim block there were 300 claims of $6,000 a year and 10 claims of $36,000 a year.

The claim reserve model projects forward the assets supporting the initial claim block plus the assumed capital requirement as a percent of the claim reserves using Monte Carlo simulations to determine if the claim persists. The reserve level is then compared annually to the assets to determine if ruin has occurred.

The model can be run as a closed or stationary block. In a stationary run the same number and size of new claims are added each year; however, the total claims will vary with the scenario. No additional surplus is added as the new claims are added. The model tests the deviation in results due to the uncertainty of actual terminations. The model does not reflect any reserve strengthening that may be appropriate if duration of claims is increasing (i.e., lower expected termination assumptions become more appropriate then the initial expected termination assumptions). When the model is run as a closed block, this is less material, as the block is run down to near zero.

When the model is run as a closed block the claim block shrinks over time because while some claims terminate, no new claims are added. Once again, it is assumed that no new surplus is added and reserves are not strengthened in deteriorating situations. In the closed block situation, the lack of reserve strengthening is less material because the block shrinks over time.

Data Collection and Review

1. Description of Intent

After reviewing the development of disability income factors in 1991 and 1994, the DI Working Group decided a new analysis was needed. Next, the DI Working Group determined the basic approach the new analysis would take and the important risk dynamics that needed to be modeled. With a good idea of the assumptions needed for the new model, a data collection effort was undertaken to support making informed choices on those input assumptions.

2. Description of Survey

The DI Working Group decided that the best way to collect data was through a survey of the larger writers of the pertinent forms of disability insurance. The survey is attached as Appendix D. The survey was distributed as an excel file. The file had 7 worksheets. The first worksheet was an overview with instructions. The other six worksheets collected data on six different segments of disability income business. The segments were:

- Group LTD (Group business not captured in Group STD).
- Group STD (Group business with a short-term premium guarantee of three years or less and benefit payment periods of two years or less).
- Individual non-cancelable business (premiums guaranteed for the life of the policy).
- Other individual business (other than non-cancelable, credit, and accident only). This was the Guaranteed Renewable data.
- Credit disability (individual business to support credit payments or balances)
- Accident only disability (individual business paying benefits when the cause is accident). No significant data was submitted for accident only business and this information was not used.

The worksheet for each segment consisted of three parts. The first part asked for historical data on earned premiums, claim reserves, policy reserves, changes in reserves due to basis changes and reserve interest rates. This data was used to develop interest-adjusted loss ratios with any change in reserves due to a basis change being backed out of the loss ratio. The first part also asked for historical unit data on lives covered and outstanding basic monthly indemnity. Annual data was requested from 1983 through 1998.

The second part of the worksheet collected model office data (e.g., how business is distributed by age, sex and occupation). The DI Working Group initially considered using the 1994 model, which required model office assumptions. Using a model office allows a separate analysis of the volatility due to the law of large numbers (statistical variance) and the volatility due to all other causes (historical variance). Since required surplus ultimately depends on total volatility, it is not necessary to split it into its statistical and historical components. Hence, the DI Working Group decided to develop a simpler model not requiring model office data.

The third part of the worksheet collected opinions on the management dynamics of a stationary population and on the typical pricing of the segment. In the former category were opinions on the percentage of premiums that would be re-priced each year and opinions on the time needed to recognize pricing is not producing acceptable results and implement changes. In the latter category were questions on the capital invested in the segment, expenses for the segment, benefit ratios implicit in pricing and profit margins.

3. Source and extent of data

The survey was sent to 61 separate companies including all major disability income writers. Fourteen companies declined to participate, and twenty-four companies did not respond to the initial survey or follow-ups. The remaining twenty-three companies provided data.

Twelve companies provided NonCan data. One company provided data for only 4 years; this data was not used. A second company provided data that reflected significant block purchases generating statutory losses. This data was also not used. Data from the remaining ten companies was used to determine appropriate assumptions. Five companies provided 15 years of data, one company provided 14 years of data, three companies provided 11 years of data and 1 company provided 8 years of data. More useable data was available on non-cancelable business than any other segment.

Ten companies provided GR data. However, four companies provided data for 3 years or less. A fifth company only had a key-man product until 1996, with significant premium increases starting in 1996. A sixth very small company had unusual data that could not be verified, the inclusion or exclusion of this company's data was not significant. We had useable data from four companies.

Twelve companies provided data for GLTD. Five companies provided data for 5 years or less. We had seven companies provide useable data.

Eleven companies provided data for the GSTD. Six companies provided data of 6 years or less; one company said their data was a mixture and included a significant portion of GLTD data; one company could not provide earned premium data. We had useable data from five companies.

For the group credit segments we received more than 5 years of data from only one company. The DI Working Group decided to use statutory data from the "Credit Insurance Experience Exhibit". We gathered seven years of data for 13 companies. We chose the five with the largest earned premium in 1998 for the

SP segment and the five with the largest earned premium in 1998 for the MOB segment. One company was in both groups. The remaining four companies were chosen at random from companies that had seven years of data.

Of the thirteen companies, nine had usable data for the SP segment. Two had no data and the data from companies #6 and #10 were not used because of erratic premium patterns not indicative of a stationary population.

Of the thirteen companies, 7 had usable data for the MOB segment. Four companies had incomplete data. The data for company #6 was not used because of erratic premium. The data for company #3 was dropped as unreliable, because the serial correlation from the data was +80% (i.e., the low loss ratios were expected to move up over time, but they continued to move lower).

The credit data was different from the other data in three ways. First it is not adjusted for reserve changes due to a basis change. Second the data is on direct business and not net of reinsurance. And third the data was not interest adjusted.

4. Data Cleansing

Reserve changes due to a basis change were removed from the historical data, except for credit products where that information was not available. Since loss ratios were looked at net of reinsurance, except for credit, any volatility due to changing percentages of reinsurance on in-force business is in the data. Such changes could produce volatility in current loss ratios even though the long-term objective is reduced volatility. Similarly the purchase (sale) of blocks of business could have a current impact on volatility that is very different from how long term prospects for volatility are changing.

Companies were asked to identify any data not reflective of the underlying volatility of the business. However, given resource constraints on companies, we strongly suspect that data was often supplied with little analysis.

Loss ratios were calculated from income statement items and from balance sheet items. Companies were asked to explain discrepancies. If small differences could not be explained, the loss ratios used in the study were all based on balance sheet items. The loss ratios, other than from the credit data, were interest adjusted.

Significant follow-up of the initial submissions was required. The following were the more typical reasons for follow-up:

- Incomplete data (e.g., reserves given but no premium). Usually the additional data was not available.
- To verify that amounts were given in thousands.

- To ask for completion of the questions on pricing and management dynamics.
- If segments were combined (e.g., GSTD and GLTD), to ask for them to be split.
- Asking for insight on particular loss ratios that looked strange.

Some responses to unusual loss ratio data included the following:
- Premiums were lowered to increase market share.
- There was a typographical error.
- Cause was a large block purchase.
- Reported numbers may have mistakes.
- No one is around from that period that knows what was happening.
- A change in product mix being sold.
- Resubmission of the entire data set because the first submission was not correct.
- Strange ratios are due to small size.
- Change was due to a significant claims review process undertaken in those years.
- I have no time to answer follow up questions.

5. Survey Data

TABLE 4 summarizes the average responses to our survey questions by disability segment. Individuals were asked to give their estimates on the time they take to re-price. For the other questions, respondents were asked to provide what would be typical for the industry in a stationary population (i.e., not their own blocks). We didn't ask for separate responses for different size blocks. Not every response seemed reasonable based on how it would be used in the model. For example, we had three responses on the guaranteed renewable segment and the phase in factor looks very low and the invested equity over statutory surplus looks high. In choosing assumptions for modeling the DI Working Group used its own judgment as well as survey responses. Since only one company responded for credit, credit results are not included.

TABLE 4

	Non Can	Guar. Renew	Group LTD	Group STD
Months to recognize trend	16.5	6.0	15.4	16.2
Months to re-price	4.5	2.0	4.0	2.0
Months for Approval	7.4	4.5	3.6	3.9
Total Phase in delay	28.4	12.5	23.0	22.1
Provide as a % of Earned Premium				
Phase in of new premium in a stationary population	7%	14%	61%	60%
Loss Ratio	62%	55%	75%	72%
Expense Ratio	38%	30%	24%	23%
Profit Ratio	10%	15%	9%	6%
Target Surplus	58%	50%	47%	28%
Statutory Strain	86%	106%	23%	3%

The loss ratio data used and the calculation of the deviates is in Appendix I.

Analysis and Recommendations

1. Overview of DI products and markets

The individual and group disability products that are the subject of this report vary in premium structure, premium guarantees, coverage, provisions to renew, underwriting methodology, length of benefit period, and definition of disability. There are risk elements common to all of these products including claim frequency rates and claim severity (length of disability and size of benefit). For this report, claim frequency and severity are measured by the combined effect on loss ratios. The most fundamental risk in disability products is the chance that actual claim frequency and / or severity become materially worse than predicted in pricing and loss ratios exceed the expected level. Other significant risk elements include interest on assets backing reserves and surplus and policyholder persistency rates.

Companies manage disability risk through experience monitoring, coverage design, underwriting, policy and claim administration, original pricing margins, and pricing revisions. Large blocks of disability coverage create opportunities for more effective risk management compared to small blocks of business through more credible experience data and through economies of scale, particularly in premium revisions and claims administration. Large blocks also have less random fluctuation in experience than small blocks of business.

Group disability insurance has the short-term risk of claim frequency deterioration before trends are recognized and price changes are implemented. Because group coverage can be canceled and premiums are guaranteed for a short time, if at all, adjustments can be made to all of the risk elements that apply to claims incurred after the time period needed to recognize trends and implement changes. Group short-term disability (GSTD) elimination periods are generally short compared to other disability products and there is comparatively small risk of random increases in claim frequency. GSTD has benefit periods that are less than one year and relatively small risk of claim severity deterioration. Group long-term disability (GLTD) has elimination periods that are generally 180 days or longer and has a greater risk of random fluctuations in claim frequency than GSTD. GLTD benefit periods are generally to age 65 or longer, increasing the long-term risk of claim severity. The definition of GSTD used by the DI Working Group was a premium guarantee period of not more than 3 years and benefit periods of not more than 2 years.

Individual disability has greater risk of claim frequency deterioration than group disability because coverage is generally guaranteed to continue, often to the insured's age 65. Adjustments to coverage provisions and underwriting impact only policies sold after changes are made. For guaranteed renewable policies, premiums can be changed after issue within the rules and guidelines set by state insurance departments. Non-cancelable disability policies cannot have premium increases after issue. Elimination periods on individual coverage are generally longer than on GSTD and shorter than on GLTD. Benefit periods are generally to age 65, or in some cases longer. Individual disability has the long-term risk of claim severity becoming greater than expected as well as generally weaker policy provisions addressing claim duration concerns than are commonly found in group disability coverage.

Credit Disability Insurance is issued in conjunction with a consumer credit transaction and typically offers a term of sixty months or less. The premium charged for Credit Insurance may be either a Monthly Premium based on the Outstanding Loan Balance on each billing date (MOB) or, more commonly, a Single Premium, paid at the inception of the policy.

Credit Insurance is heavily regulated and premium rates are subject to state law. Deviations from prescribed rates may be required as determined by each state's insurance department. Though Credit Insurance is sold to individuals, there is little underwriting and the premium charge is the same for each consumer of a financial institution regardless of age. Rate increases in a state do not affect policies in force except in the case of Open End MOB. Benefit periods, which match the respective loan obligation, extend generally to age 65 and elimination periods are short, only up to thirty days. Claim experience resulting in either excessively high or low loss ratios compels the state to require that a company charge a deviated premium rate in order to bring loss ratios to a more reasonable level.

2. Claim Reserves

The claim model was run using the basic assumption from 1994 for a small claim block and a large claim block. The large block had 3,000 claims with annual payments of $12,000 and 100 claims with annual payments of $120,000. The corresponding numbers for the small claim block were 300 claims at $6,000 and 100 claims at $36,000. Expected termination rates were 65% in year 1, 12% in year two and 5% for subsequent years. The reserve rate was 5% and asset rates of 5.5% and 5% were modeled (i.e., with no margin and a margin of 50 basis points). A stationary population (open block) was tested over a 5-year horizon and a closed block was tested over a 50-year horizon. 5000 scenarios were run using 10 as the initial seed for the random number generation. Finally, ruin probabilities were developed for claim reserves beyond the second duration. Results are summarized in TABLE 5.

TABLE 5

SIZE	BLOCK	MARGIN	SURPLUS	RUIN	Ruin 3+
LARGE	CLOSED	50 basis points	1%	5.6%	
LARGE	CLOSED	50 basis points	2%	0.3%	
LARGE	OPEN	50 basis points	1%	7.5%	
LARGE	OPEN	50 basis points	2%	0.6%	
LARGE	CLOSED	None	2%	16.0%	5.3%
LARGE	CLOSED	None	3%	3.8%	1.0%
LARGE	OPEN	None	2%	8.7%	4.3%
LARGE	OPEN	None	3%	2.5%	0.3%
SMALL	CLOSED	50 basis points	4%	5.8%	
SMALL	CLOSED	50 basis points	5%	2.7%	
SMALL	OPEN	50 basis points	3%	10.4%	
SMALL	OPEN	50 basis points	4%	3.9%	
SMALL	CLOSED	None	6%	8.1%	0.9%
SMALL	CLOSED	None	7%	5.1%	0.4%
SMALL	OPEN	None	5%	7.2%	2.2%
SMALL	OPEN	None	6%	3.4%	0.8%

The requirement for a closed block with a 50-year testing period is similar to a stationary block with a 5-year testing period. Because the closed block's claim reserves are run down to near zero, the question of reserve strengthening at the end of the testing period is not material.

The model simulates the statistical variation around the assumed termination rates (65%, 12% and 5% beyond the second duration). It does not simulate that the expected termination rates may change. This would add more volatility and produce higher surplus requirements.

Because the method used to determine the aggregate requirement made use of the assumed profit margin, the no margin results is appropriate to subtract from the aggregate result to produce an earned premium factor.

For the large claim block a requirement between 2% and 3% would reduce the probability of ruin to 5% (for a closed or stationary block). For the small claim block a requirement of between 5% and 6% would reduce the probability of ruin on an open block to 5%. Thus, we are comfortable with the 5% factor developed for claim reserves in both 1991 and in 1994. The somewhat higher than modeled requirement for large blocks is offset by a somewhat lower requirement on earned premium, as the total requirement was determined using the aggregate model.

It is interesting to note that the Canadian Minimum Continuing Capital and Surplus Requirements for Life Insurance Companies (MCCSR) formula applies different factors to claim reserves segmented by both duration of claim and by the length of the benefit period. The Canadian factor for claims with duration of 2 or less is twice the factor for claims of duration of 5 or more. This is consistent with our model's results that indicate the requirement for claim reserves past the second duration is significantly less than the aggregate requirement (i.e., the ruin 3+ column is lower than the ruin column).

A refinement of claim reserve factors by claim duration or benefit period would not change the aggregate requirement. While claim reserve risk may vary by benefit period or duration, as indicated by the MCCSR formula, no adjustment for these factors is recommended at this time.

There are other possible ways to segment claim reserves (e.g., by cause of claim such as AIDS or Maternity). No additional review was considered due to time limitations and expected materiality.

While the aggregate requirement is "best estimate", the dynamics of the allocation is to be more conservative on claim reserves and within claim reserves to be more conservative on the requirements for claim reserves past the second duration. This may produce additional safety in a situation where a company is reducing sales due to financial difficulty, as the aggregate surplus requirement will decline somewhat slower.

The claim reserve factor should be applied to claim expense reserves, although this would not be a significant requirement. Companies that don't hold claim expense reserves in exhibit 9 should still include them in the RBC calculation. This is to ensure consistent application of the RBC formula independent of where a company places its expense reserves in the annual statement.

The duration of the stationary claim reserve block in the model was 8.8 years. This is long relative to the data we collected. While premium is growing the ratio of claim reserves to earned premiums will be much lower than in a stationary population. The DI Working Group examined the historic ratio of earned premium to claim reserves and used its judgement to translate the claim reserve requirement into a reduction in the aggregate requirement as a percent of premium. This translation is needed to net the aggregate requirement as a percent of premium to a net requirement after the provision in claim reserves.

3. Aggregate Model Assumptions fixed for all Segments

Although some of the risk elements in disability coverage are very long-term in nature, the risk based capital calculations cover a five-year test of ruin. The DI Working Group believes this is consistent with the risk based capital calculations for other types of insurance.

Like the five-year test period, many of the input assumptions for the model did not change from segment to segment. These inputs and their setting are in TABLE 6.

TABLE 6

Item	Setting	Rationale
Number of Scenarios	50,000	Low standard deviation of results
Random Seed	-100,000	Low standard deviation of results
Pre-tax earned rate on funds	6%	A reasonable net earning rate after default and expenses.
Cap Surplus Indicator	On	Finding a capital level for ongoing operations
Years of seasoning	3 years	Reasonable starting spread of loss ratios.
Testing time horizon	5 years	Consistency with prior analyses
Tax Rate	35%	Best Estimate of current
Tax Recognition %	100%	Consistency with prior analyses
Reserve Strengthening %	0%	Consistency with prior analyses
Reserve Strengthening	NA	Consistency with prior analyses
Loss Ratio Caps	300%	As a proxy for none
Loss Ratio Floors	1%	As a proxy for none
Probability of Ruin	5%	Consistency with prior analyses

Sections 4 through 9 detail the assumptions for the aggregate model. Section 10 explains the way the aggregate and claims models are combined for RBC purposes.

4. Individual Non-cancelable Products

Assumptions for Large Blocks of Non-cancelable Business

Standard deviation of 11.2% and Serial Correlation of –25%

The standard deviation assumption refers to the modeled variation in random walk loss ratios before adjustment for repricing effects (phase-in). Standard deviation experience was derived from company loss ratio data by calculating the annual deviation in actual loss ratios from the pattern of expected loss ratios. The expected loss ratios take into account each company's experience and the assumed rate at which business is re-priced to reflect experience. The serial correlation assumption is calculated from the same data.

Four of the ten companies submitting useable data have more than $200 million in annualized premium. Those four companies have a random walk loss ratio standard deviation of 10.3% when weighted by the aggregate premium submitted in the loss ratio data, Size 2. The average of the four standard deviations is 11.2%. Since the standard deviation of the largest company is considerably lower than the standard deviation of the other three, we chose to use the average of the company data instead of weighting the results. The average serial correlation of the four companies is –24.9% while –25.5% is the Size 2 weighted value. Because research indicates that serial correlation is relatively flat by size of block, –25% was selected to be consistent with the small block assumption.

Seasoning of 3 years

An appropriate length of seasoning was found by comparing the standard deviation of the loss ratios developed in model runs to the standard deviation of loss ratios in the collected data. For all NonCan data, the average standard deviation of historic loss ratios in a year among the companies was 16.7%. For companies with annual premium greater than $200 million, the average standard deviation of historic loss ratios in a year among the companies is 12.6%. When the model is run with the large block NonCan assumptions, the standard deviation of loss ratios is 16.1% at the end of seasoning and 21.5% at the end of the five-year test. It is logical for the model to produce a reasonable amount of extra loss ratio variation because the model should reflect more economic scenarios than can be found in a fixed number of years for a small group of companies.

Profit Assumption

Pre-tax profit as a percent of premium is 20% including investment income on capital and surplus. Model profit is set through the target ROE field (11% for large non-can DI), while in practice companies price to a target ROE based on internal company formulas. The profit margin seems conservative but reasonable and is consistent with the 20% profit margin used in the initial model runs for the 1994 HORBC study.

Phase in Factor of 8%

For non-can DI, phase in is the percent of premium in a stationary population that is in the first policy year. Termination rates are the primary driver. Pricing assumptions from two of the major companies were used to calculate the appropriate phase in factors. One study using experience termination data indicated a phase in factor of 9% while the other study indicated a 6.7% factor. The 8% assumption is a blending of the two studies.

Re-pricing Loss Ratios (low 60%, high 75%)

These are the high and low loss ratios that trigger a change in premium vs. the loss ratio implicit in pricing. Using symmetric repricing loss ratios causes modeled loss ratios to decline over time because of company re-pricing actions that increase new premiums when loss ratios are high and decrease new premiums when loss ratios are low. Newly re-priced premium becomes a larger percent of total premium in high loss ratio scenarios than in low loss ratio scenarios. The recommended assumptions help to minimize the natural loss ratio decline by modeling premium actions quicker when loss ratios are below target then when loss ratios are above target.

Other Recommended Assumptions

Loss ratio implicit in pricing, 65% (based on the survey and judgement).
Phase-in delay 2.5 years (based on the survey data and judgement).
Statutory Strain at 85% (based on survey data and judgement).

Reserves at 550% of premium (including active life reserves) (based on the ratio of reserves to premiums in historic data and judgment). Other than earning interest income, active life reserves are not explicitly considered in the model.

Model Results

Target RBC set at 32.85% of premium results in a ruin probability of 5% over five years.

Assumptions for Small Blocks of Non-cancelable Business

All assumptions are the same as for large blocks of NonCan business except for the random walk loss ratio standard deviation.

Standard Deviation 15% and Serial Correlation –25%

When the largest four companies are removed from the loss ratio data, the unweighted average random walk loss ratio standard deviation is 15.8% and the unweighted average serial correlation is –25.6%. The Size 2 weighted standard deviation is 17.2% and the Size 2 weighted serial correlation is –31.6%. Standard deviation and serial correlation should be considered together, along with the effects of seasoning. The 15% assumption is lower than the historic data, but results in a variation in modeled loss ratios that is approximately 25% and 65% higher at the start and end respectively of the testing horizon than seen across the small company data in an average year. Use of 15.8 would have made the variation in modeled loss ratios at the start and end of the testing horizon 35% and 75% higher than the historic variation among small companies (see the comments below).

Statistical analysis for the NonCan (and every other segment) indicated the variation of serial correlation by size was purely random. Thus, a single assumption for both large and small blocks is appropriate. The –25% serial correlation assumption is consistent with the choice for large blocks.

When the model is run with the selected assumptions, including three years of seasoning, the model's standard deviation of actual loss ratios, not the deviation from expected, is 21% at the end of seasoning and 28% at the end of the five-year test. These results compare to a yearly average 16.7% standard deviation in historical loss ratios among companies when the four largest companies are excluded. Had we selected the average random walk standard deviation of 15.8%, the model's standard deviation of loss ratios would be 22.5% at the end of seasoning and 29.3% at the end of the five-year test.

Model Results

Target RBC set at 52.7% of premium results in a ruin probability of 5% over five years.

5. Individual Guaranteed Renewable Products

Assumptions for Large Blocks of Guaranteed Renewable Business

Experience loss ratio data on guaranteed renewable blocks is very limited. Only four companies submitted usable data and none of these would be considered a large block relative to the non-cancelable and LTD data. Analysis on the limited guaranteed renewable data produced assumptions of 15% for the random walk standard deviation and –25% for the serial correlation, the same as the assumptions for small block non-can.

The data for GR business is mostly from growing blocks. This may overstate what the volatility would be in a stationary population. On the other hand, because the data is from the growth phase of GR business, it may not adequately reflect the anti-selection cycle that could result from raising premiums on in-force business.

Because the small block data on GR produces assumptions that are consistent with assumptions for small block non-cancelable business, it is reasonable to use the large block non-can assumptions for large blocks of GR business. The method of calculating random walk standard deviation and serial correlation removes the effects of repricing and new premium phase-in, so it is reasonable to see similar NonCan and GR assumptions.

Although GR should utilize the same assumptions for random walk loss ratio standard deviation and serial correlation as non-cancelable products, GR phase-in assumptions should be larger than the non-cancelable phase-in of 8% because inforce business can be repriced. The GR phase in should be lower than the LTD phase-in of 50% because of the necessity to file and get state approval of premium increases. Large block GR phase-in of 40% is reasonable. Profit margins are logically lower on GR than on non-cancelable. Changing the ROE to 9% produces a pre-tax margin of 16% of premium (including investment income on capital and surplus) compared to the non-cancelable profit margin of 20% of premium.

Other assumptions are the same as for large blocks of non-cancelable individual disability.

Model Results

Target RBC set at 24.5% of premium results in a ruin probability of 5% over five years.

Assumptions for Small Blocks of Guaranteed Renewable Business

Analysis of the small block GR loss ratio data produced assumptions for random walk loss ratio standard deviation and serial correlation that are the same as the assumptions for small blocks of non-cancelable business.

Phase-in factors for small block GR business should be lower than the 40% phase-in for large GR blocks, reflecting a lower economic return for the expense of filing and implementing rate changes. Based on the judgement of the DI Working Group a phase-in factor of 30% was chosen for small blocks of GR business.

Model Results

Target RBC set at 40.9% of premium results in a ruin probability of 5% over five years.

6. Group Long Term Disability Products

Assumptions for Large Blocks of GLTD Business

Standard deviation 10% and Serial Correlation –40%

Data was submitted on twelve companies, but five of these do not have enough calendar years to be included. One company has data for 1987 that is obviously flawed. For this company, we used only the loss ratio deviations occurring after the flawed data point. One company that contributed a great deal more data by premium volume than the others significantly influenced random walk loss ratio standard deviations.

The Size 1 weighted random walk standard deviation is 8.6% including the largest company and 11.1% excluding the largest company. Removing the largest company does not materially effect serial correlation. The Size 1 weighted serial correlations with and without the largest company were negative 45.5 and 48.9 respectively. The –40% assumption is a little conservative. The assumed 10% random walk standard deviation exceeds the average of 8.6 and 11.1 and recognizes that the GLTD data is not as representative of the whole industry as we would like.

Seasoning of 3 years

Because the phase-in factors are much larger for GLTD than individual DI, the length of the seasoning period is not a significant driver of model loss ratios. Three years was selected to be consistent with individual DI.

Profit Assumption

Although 13% ROE is higher than the ROE for Noncan DI, it produces only a 9% of premium pre-tax profit margin. The percent of premium is the more relevant measure. The model formulas for ROE and profit margin assume companies will price with the modeled RBC factor, while actual pricing depends on internal company RBC formulas and targets. ROE assumptions were set so that pre-tax profit as a percent of premium is reasonable for the product line being tested.

Phase in Factor of 50%

The phase-in factor should consider both new business (15% to 20% of the total in a stationary population) and a renewal program to update the premium on 30% to 35% of the block each year. Premium guarantees of 1 to 2 years generally apply only to new groups.

Re-pricing Loss Ratios (low 70%, high 80%)

Set 5% above and below the target loss ratio, these assumptions reflect a more constant repricing practice in LTD than in the longer term oriented individual DI business.

Other Recommended Assumptions

Target loss ratio 75% (based on the survey and judgement).
Phase-in delay 2 years (based on the survey and judgement).
Statutory Strain of 25% (based on survey and judgement).
Reserves at 300% of premium (disabled lives reserves only) (based on data submitted and judgement).

Model Results Using Proposed Assumptions

Target RBC set at 18.68% of premium has a 5% five-year probability of ruin.

Assumptions for Small Blocks of GLTD Business

All assumptions are the same as for large block GLTD except for the random walk loss ratio standard deviation.

Standard Deviation 14% and Serial Correlation –40%

Data on small GLTD blocks is very limited. The four companies with annual premium under $100 million have a size 2 weighted standard deviation of 15% and a size 2 weighted serial correlation of –46%. The assumed 14% is similar to the limited data and 4% higher than the large block LTD assumption, consistent with non-can DI where the small block standard deviation is also 4% higher than the large block assumption.

Model Results Using Proposed Assumptions
Target RBC set at 28.76% of premium has a 5% five-year probability of ruin.

7. Group Short Term Disability Products

Assumptions for Large Blocks of GSTD Business

Loss Ratio Standard Deviation 4% and Loss Ratio Serial Correlation –65%

Eleven companies submitted loss ratio data but only five could be used in the analysis and only three had more than six years of useable data. Weighted by Size 2, the standard deviation of random walk loss ratios for the three companies is 4% and the serial correlation is –65%. Three of the companies had consistent standard deviations between 3.2% and 3.9%. The other two companies had standard deviations of 6.2% and 15%. The company with 15% had the least amount of data, five years, and ignoring its first data point (the start up year), its standard deviation would be 7%.

Seasoning of 3 Years

Like GLTD, the length of seasoning is not a significant driver of results. Three years was used for consistency with the other lines of business.

Profit Assumption

The pre-tax profit margin is 5.2% of premium compared to the GLTD assumption of 8.8%, reflecting the more predictable short-term disability results. Profit targets indicated in the company data average 6% and range from 3% to 12%.

Phase-in Factor of 50%

Set to be consistent with the GLTD phase-in assumption.

Re-Pricing Loss Ratios (low 70%, high 80%)

Set to be consistent with GLTD.

Other Recommended Assumptions

Target loss ratio 75% (based on survey and judgement).
Phase-in delay 2 years (based on the survey answers).
Statutory Strain of 5% (based on survey and judgement).
Reserves at 12% of premium (disabled lives reserves only) are based on the data submitted.

Model Results

Target RBC set at 2.85% of premium has a 5% five-year probability of ruin.

Assumptions for Small Blocks of GSTD Business

All assumptions are the same as for large blocks of GSTD except for the random walk loss ratio standard deviation.

Loss Ratio Standard Deviation 5.6% and Loss Ratio Serial Correlation –65%

Because short-term disability data is very limited, it is not practical to develop assumptions for small blocks of GSTD business directly from the experience. Instead, we utilized relationships of large and small block assumptions for group long-term disability. Because the small block GLTD assumption for random walk loss ratio standard deviation is 140% of the assumption for large block GLTD, small block GSTD standard deviation was set to 140% of the assumption for large block GSTD. Similarly, serial correlation assumptions are the same for large and small blocks of GLTD, so the small block GSTD serial correlation assumption is the same as the -65% used for large GSTD blocks.

Model Results

Target RBC set at 4.41% of premium has a 5% five-year probability of ruin.

8. Single Premium Credit Products

Because the data for the credit segment is public information, this section goes into more detail illustrating the analysis.

The management dynamic assumptions were chosen based on the survey data, the opinion of DI Working Group members familiar with the credit segment and general reasoning given the maturity characteristics of the business. The assumptions were as follows:

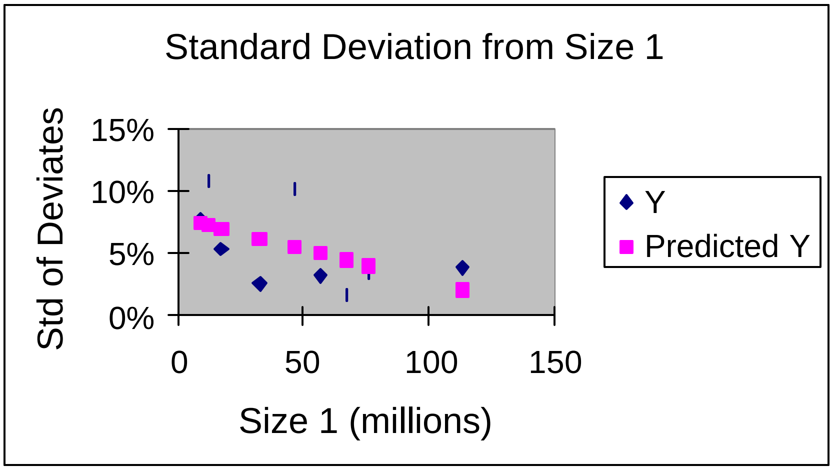
- Phase in delay — 1 year
- Low Loss Ratio Phase in Factor — 20%
- High Loss Ratio Phase in Factor — 20%
- Low Re-price Ratio — 50%
- High Re-price Ratio — 60%
- Implicit Pricing Loss Ratio — 55%

Using the management assumptions and the historical loss ratios, the deviations of actual loss ratios from expected were calculated. See table SP3 in the Credit appendix. The management dynamics look back one year for current pricing, because the phase in delay is one year. Since 1992 is the first historic information, 1993 is the first year for which the management dynamics of re-pricing can be developed based on prior historic data, and 1994 is the first year we can compare the expected result of that repricing to actual. Thus, there are five reliable deviates, 1994, 1995, 1996, 1997 and 1998.

The estimated standard deviation and serial correlation can be calculated from the deviates. These data items can then be regressed against our measures of size.

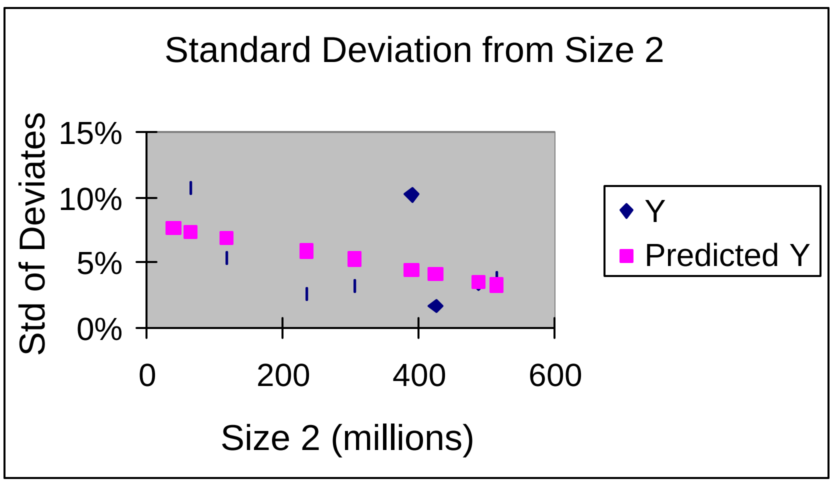
Regressing Size 1 with the standard deviation of deviates is graphed below:

Chart 1



Regressing Size 2 against the standard deviations is graphed below:

Chart 2



While the fit is not perfect, there is an obvious decline in standard deviation related to size. For a $30 million, "small", company the regressed standard deviation of deviates against Size 1 and Size 2 were 6.32% and 6.33% respectively; 7% was used in the modeling. For a $85 million, "large", company the regressed standard deviations of deviates against Size 1 and Size 2 were 3.5% and 3.3% respectively, 4% was used in the analysis.

Similar graphs against serial correlation are shown below:

Chart 3

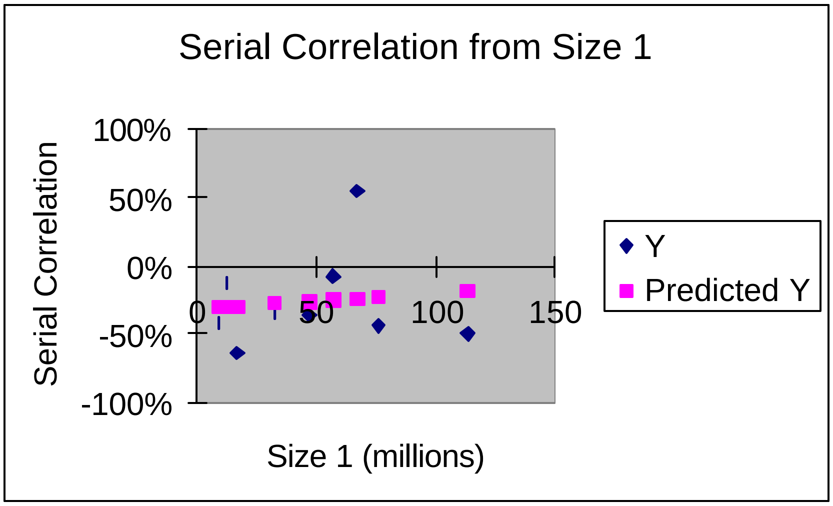
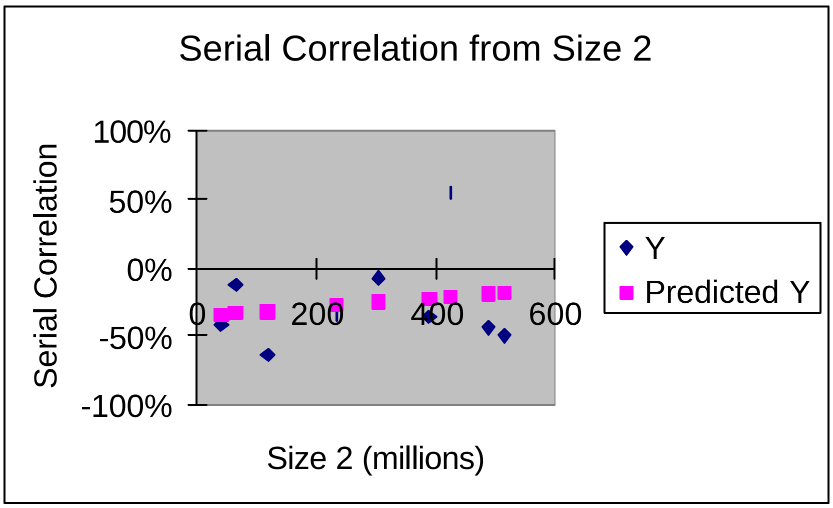


Chart 4



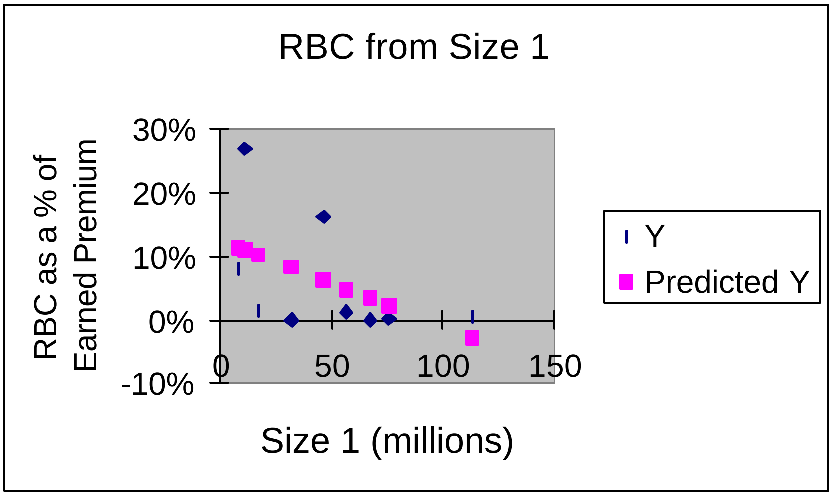
Serial correlation was assumed independent of size and set at –20%. The regressed values for a small and large company were -28 and -22 against Size 1 and –29 and -18 against Size 2. If company 2 were removed from the data, because of its high positive serial correlation of 54%, the small and large company Size 1 standard deviations would be 6.56% and 4.12% respectively and their Size 1 serial correlations would be -35% and -39%. Size 2 would give similar results.

Target ROEs were set at 10% for SP credit business, due to the low risk. This produced a profit margin of about 10% of premium. As in GSTD, because of the low capital requirements and possibly other important sale criteria, ROE may not be a significant criterion in the pricing of SP business.

The result of running these assumptions in the model was a requirement of 2.06% for large companies and 10.47% for small companies.

An alternative to finding a standard deviation and serial correlation for the segment and running the model with these assumptions was to run the model with the calculated standard deviation and serial correlation for each company. The surplus requirements of these runs can then be regressed against size. If standard deviation and serial correlation are not independent (as implied in our separate analysis), this approach would implicitly pick up that relationship. Below is the graph of regressing the results of this approach against Size 1.

Chart 5



The requirement from the above linear regression would be 8.45% for a small company ($30 million in premium) and 1.64% for a large company ($80 million in premium). The corresponding data using Size 2 would be 9.23% for a small company and 3.07% for a large. See table SP4 in the Appendix E for the underlying data.

Company 12, at 27%, and company 5, at 16%, are above the regression line. An examination of table SP1 in Appendix E shows company 5 has some of the lower loss ratios and company 12 has the lowest average loss ratio. Table SP3 shows most of their deviates are negative (i.e., good volatility from a risk perspective). Our approach makes no distinction between good and bad volatility.

The DI Working Group is aware of a potential change in the accounting for the single premium credit segment. The change would substitute a policy reserve for the current unearned premium reserve. This change will change the capital investment and level of reserves for this segment. It is not clear what will happen to other model factors such as standard deviation and serial correlation. While no data is available, the DI Working Group assumed such factors would move in the direction of MOB assumptions and developed recommendation for SP after the accounting change, which we label as SP2. Those assumptions that are different for SP and SP2 are given in TABLE 7.

TABLE 7 Single Premium Credit

ITEM	Large SP2	Large SP	Small SP2	Small SP
Standard Deviation	5%	4%	8%	7%
Serial Correlation	-25%	-20%	-25%	-20%
Target ROE	12.5%	10%	12.5%	10%
Statutory Strain	30%	60%	30%	60%
Reserves	170%	240%	170%	240%

9. Monthly Outstanding Balance Credit Products

The standard deviations from the regression of historical data on size were 12.01% and 12.04% for a small company ($40 million in premium) based on Size 1 and Size 2 respectively. The DI Working Group used 12% in the model. The standard deviations from the regression of historical data on size were 5.74% and 5.73% for a large company ($200 million in premium) for Size 1 and Size 2 respectively. The DI Working Group used 6% in the model.

The serial correlations from the regression of historical data on size were -39.4% and -38.5% for a small company ($40 million in premium) based on Size 1 and Size 2 respectively. The serial correlations from the regression of historical data on size were -38.1 and -39.8 for a large company ($200 million in premium) for Size 1 and Size 2 respectively. The DI Working Group used -40% in the model for both large and small companies.

Because of the higher volatility, the DI Working Group used a ROE of 15% for the MOB credit segment. Also because MOB does not have the capital commitment required by single premiums, the statutory strain was reduced to 25%, the same as for GLTD and less than the 60% used for the SP credit segment. The results of these assumptions on capital and ROE were profit as a percent of premium of 11.18% for small companies and 7.63% for large companies.

All other assumptions were the same as for the SP segment.

This analysis produced an aggregate requirement of 8.08% for large companies and 23.43% for small companies.

10. Formula Recommendations

The steps taken to develop recommendations from modeled data is in the first table of Appendix A. The starting point was the small company results from the aggregate model. For example, for NonCan this was 52.72%.

The DI Working Group used the data collected and some judgement to set a ratio of claim reserves to earned premium for each segment (e.g., 350% for NonCan).

As noted above the DI Working Group is recommending the current requirement of 5% of claim reserves be continued. With this requirement and the ratio of claim reserves to earned premium, the claim reserve requirement as a percent of earned premium was calculated (e.g., 5% x 3.5=17.5% for NonCan).

The aggregate model requirement net of the claim reserve requirement (e.g., 35.22% for NonCan) was the basis for recommending the earned premium factor for a small company (i.e., the first $50 million in premium). The DI Working Group rounded these results to a 5% multiple because of the general uncertainty in small block results.

The first step to determine the factor for earned premium over $50 million was to take the Large Company aggregate results and reduce it by the requirement for claim reserves as a percent of earned premium. For NonCan, the 32.85% was reduced by the 17.5% to produce the 15.35%. This is the preliminary estimate.

Because the surplus requirement for the first $50 million of earned premium for the large block will be the small block factor, the requirement for amounts over $50 million is less than the preliminary factor that applies to all premium. The rate on premium over $50 million times that premium plus the rate on the first $50 million of premium times $50 million should equal the preliminary rate times the total earned premium. For NonCan, the large block is assumed to be $500 million. Thus the rate for amounts over $50 million should be 13.17 because:
$50x.35+$450x.13.17=$500x .1535
This produced a small block credit of 2.18% (15.35% -13.17%).

Since the first tier factor is applied on a combined basis for GR and NonCan business, some of the small block credit for GR is not available (it is used to reduce the large factor on NonCan business over $50 million). We estimated this amount at 50%. Similarly we estimated the actual small block credit available for GSTD, SP, MOB, and SP2 at 50%,

Clearly the need and desire for simplification has limitations. For example fitting the RBC requirements to two premium levels can be very approximate to the true drop off in requirements as size increases (see chart 5 in section 9). Setting all claim reserve to 5% produces anomalies when the result exceeds the aggregate requirement, as in large block SP. The 5% claim reserve also leads to an unusual result in that the premium factor for GSTD and GLTD are the same for premium over $50 million, when GLTD clearly has more risk. However, If one were to substitute 3% for large claim reserves, as modeled above, the factors for premium over $50 million would be approximately 9% for GLTD and still 3% for GSTD (i.e., the 5% conservatism in claim reserves is much more of a factor for GLTD). Given these limitations, the DI Working Group thought it appropriate to set a minimum premium factor of 3% for premiums over $50 million. In addition, the DI Working Group added margins in choosing the recommendations for individual large block factors.

11. Comparison to Current Requirements

The following table compares the recommendations in this report to the current standards:

Table 8 Comparison of Proposed and Current RBC Factors

Item	Base	Proposed Factor	Current Factor
Premium Factors			
NonCan DI	First $50 million	35%	35%
	Remainder	15%	15%
Other DI	First $50 million	25%	25%
	Remainder	7%	15%
Credit DI – MOB	First $50 million	20%	25%
	Remainder	3%	15%
Credit DI – SP	First $50 million	15%	N/A
(with additional reserves)	Remainder	3%	N/A
Credit DI – SP	First $50 million	10%	25%
(without additional reserves)	Remainder	3%	15%
Group LTD	First $50 million	15%	25%
	Remainder	3%	15%
Group STD	First $50 million	5%	25%
	Remainder	3%	15%
Claim Reserves	All	5%	5%

It is immediately obvious that the proposal provides more texture in the premium based RBC factors than does the current system. The current RBC standard provides but two levels that are applied to premium, that for noncan and that for all other business. The recommendations provide different standards for two types of individual coverage, two types of group coverage and three types of credit coverage.

The improved texture reflects the Committee's intent to capture the differences in volatility of the product lines that were considered as part of this study. To the Committee, it was clearly obvious that the risk presented by the various products varies between products, for example, between group STD and Group LTD. Due to limitations in information available to those who set the current standards, these differences are not reflected in those standards. Our committee had available information on these differences and they are reflected in the proposal.

The level of the factors also differs between the current standards and the proposed standards. Except for NonCan and the percentage of claim reserves, all of the factors are lower than their current counterparts. Again, this reflects the additional information that was available to the Committee that was not available to those who did the earlier work. As noted earlier the current standards were largely based on the internal standards of several large writers of DI. Limitations on that information meant that the current recommendations were based largely on the holdings for only a few products. While the data available to the Committee this time around was also limited we did have substantial information on all the products with which we worked. The lower proposed standards reflect logical differences in risk that were evident in our modeling rather than a perception that the risk is lower today than it was in 1991.

The Committee also calculated the change in RBC amounts required by these two sets of standards for sample blocks of business. In constructing this analysis claim reserves were assumed to bear the relationship to premium that was used in setting the factors. The results of that analysis are shown below:

Table 9
Comparison of Proposed and Current Surplus Requirements
For Various Product Blocks of Various Sizes

Product	**Block Size (millions)**	**Proposed RBC Amount (millions)**	**Current RBC Amount (millions)**	**Difference (millions)**	**Difference (percent)**
Noncan	$25	$13.1	$13.1	0.0	0%
	$100	$42.5	$42.5	0.0	0%
	$500	$172.5	$172.5	0.0	0%
Other Individual	$25	$10.6	$10.6	0.0	0%
	$100	$33.5	$37.5	-4.0	-11%
	$500	$131.5	$167.5	-36.0	-21%
Credit MOB	$25	$5.8	$7.1	-1.3	-18%
	$100	$14.8	$23.3	-8.5	-37%
	$500	$39.8	$96.3	-56.5	-59%
Credit SP	$25	$3.3	$7.0	-3.8	-54%
(w/o addn'l res.)	$100	$9.5	$23.0	-13.5	-59%
	$500	$33.5	$95.0	-61.5	-65%
Group LTD	$25	$7.5	$10.0	-2.5	-25%
	$100	$24.0	$35.0	-11.0	-31%
	$500	$96.0	$155.0	-59.0	-38%
Group STD	$25	$1.4	$6.4	-5.0	-78%
	$100	$4.6	$20.6	-16.0	-78%
	$500	$19.0	$83.0	-64.0	-77%

This table shows the magnitude of the proposed changes for various sizes of blocks of business of various types.

- Noncan does not change at all and changes to the Other Individual section, which is mostly Guaranteed Renewable, range from no change for small blocks to a 20% or more reduction for the largest blocks.
- Reductions in the credit requirements are quite large but it must be remembered that this is the first study of this type to actively consider credit requirements. In previous studies, credit business was simply included with other forms of business. Group LTD shows intermediate reductions in overall requirements, ranging from 25% for small blocks to about a 38% reduction for the largest blocks.
- Group STD shows significant reductions of about 80%. Again, previous studies did not consider STD separately from other requirements. This

reduction reflects the fact that STD is a product with relatively little volatility of results.

To summarize, the proposed RBC requirements are quite different from those in place currently. There is more texture in that more products were considered, and, for the most part, the proposed requirements are lower than the current requirements. The reduced requirements result from improved data availability and study methods focused on disability products. They do not reflect a belief that DI is less risky today than it was 10 years ago.

12. Sensitivity Analysis & Other Considerations

In several cases, the DI Working Group was DI Working with limited data. The DI Working Group had to make judgments to exclude some data that did not seem reasonable. In other cases data was excluded for known reasons (e.g., the purchase of large blocks). For some assumptions, no data was available and the DI Working Group relied on the general expertise of its members and those surveyed. Except as noted in the report, the DI Working Group did not try to pick conservative assumptions. Best estimate assumptions should be used with the conservatism explicitly set by the 95% survival requirement over the five-year testing horizon. For most assumptions we have made, higher or lower values would be reasonable.

The sensitivity analysis provides an indication of what results would have been under other assumptions. If asked to do so, results for other assumptions within the context of the available model can be produced quickly. Tables with the results of the sensitivity analysis are in an Appendix B. The following summarizes the sensitivity testing.

Standard Deviation

Tables SA1 and SA2 look at the effect of increasing and decreasing the standard deviations by 10% of their assumed values. A 10% increase in the standard deviation of the random walk increases risk based capital about 15%. The SP credit segment is more sensitive to this change than the other lines. The changes for a 10% decrease are very similar, but in the opposite direction of the 10% increase.

Serial Correlation

Tables SA3 and SA4 look at the effect of increasing and decreasing the serial correlation by 10% of their assumed values. A change of 10% of the serial correlation produces about a 5% change in required capital. GSTD seemed more sensitive to this assumption; it had the largest negative serial correlation. Again, a decrease of 10% of the serial correlation produces about an equivalent change in required capital but in the opposite direction of the 10% increase.

Probability of Ruin

Tables SA5 and SA6 look at the effect of finding required surplus for a probability of ruin of 4% and 6% respectively. Changing the probability by 1%, to 4% or 6%, changes required surplus about 10%. The change is slightly larger in going to 4% than in going to 6%. Again the SP segment shows the greatest sensitivity. Its low absolute level of required capital could cause this. The large company result increased more than the small company result for all segments except for the Guaranteed Renewable segment.

Other Profit & Surplus Levels

Table SA7 illustrates the change in ruin probability for holding and pricing for 50% of the recommended RBC level without changing ROE. The profit margin as a percent of premium decreases and the probability of ruin increases from a low of 9% for the large SP credit segment to 26% for the small GLTD segment. This table is just illustrative for comparison with table SA8. No company should be pricing its products based on holding capital at 50% of the statutory requirement.

Table SA8 shows the probability of ruin at 50% of the recommended RBC level, the authorized control level, if profit margins were based on 100% of the recommended requirement and the same ROE. That is, the profit as a percent of premium is the same as that determined using the baseline ROE and 100% of the recommended requirement (e.g., 19.94% for the Large Non-can segment). The actual ROE is higher because the capital investment is less. Comparing table SA7 and SA8 indicates the importance of profit margin in lowering the probability of ruin (since both tables are based on holding the same level of capital). For example, the difference in the profit margins of the alternate cases for the large NonCan segment from table SA8 to SA7 is 2.78%, 19.94% less 17.16%. The extra profit margin reduces the chance of ruin 3.22% from 13.57% to 10.35%.

Table SA9 illustrates the reduction in ruin from holding 200% of the recommended requirement and pricing for this level of capital. The probability of ruin falls to less than 1% for all segments but SP, where the increase in capital is small and did not add significantly to the profit as a percent of premium.

Seasoning Period

SA10 illustrates the change in required capital when using a 2-year seasoning period. SA11 illustrates the change when using a four-year seasoning period. It is interesting to note, and somewhat counter intuitive, that the decrease in seasoning period did not always result in a decrease in the capital needed to reduce ruin to 5%. Similarly, an increase in the seasoning period did not always result in an increase in the capital required to reduce ruin to 5%. Those segments with the largest phase in factors seemed to be less sensitive to the change.

Testing Horizon

SA12 illustrates the change in required capital if a 6-year testing horizon is used. Table SA13 illustrates a 4-year testing horizon. Again, the segments with the faster phase in factors seem to be less impacted by the change.

Phase in Delay

Table SA14 and SA15 show the effect of increasing and decreasing the phase in delay by 1/2 a year. The importance of speed to re-price is illustrated in these tables. It is relatively more important to those lines with high phase in factors. This seems reasonable as the information can be put to more use in these lines. The model requires at least a one-year phase in factor, so data for the credit lines at half a year was not generated. Although the standard deviation and serial correlation assumptions would change with a change in management dynamics, these factors were kept at the baseline amounts.

Invested Capital over Statutory Surplus

Tables SA16 and SA17 show the effect of a decrease and increase of capital invested in the form of statutory strain of 10% of the baseline assumptions. The change in statutory strain changes the profit margin and hence the impact on ruin. Clearly this has a major percentage impact on SP credit as the strain is significant and the baseline capital is low.

Reserve Strengthening

Table SA18 shows the effect of strengthening reserves. Because of negative serial correlation and possible margins in the basic reserves, the additional reserves needed would be less than implied by taking 100% of a current high loss ratio as the future expectation. Reserves are strengthened at the start and end of the test horizon to reflect 75% of the excess, if any, of the known in-force loss ratio over the sum of the loss ratio implicit in pricing plus the profit margin for the base case. The known loss ratio is the loss ratio “Phase in delay” years ago. The model assumes the higher surplus levels in the alternate run require a higher profit margin to maintain the ROE, which is unchanged from the base. This helps to dampen the significant increases in required capital.

As reserve strengthening was not part of the basic modeling approach, the DI Working Group spent very little time reviewing the strengthening methodology or considering alternatives. Test results should be considered only a very rough indication of the sensitivity to reserve strengthening. The choice of the 75% factor in the strengthening formula is for demonstration purposes only. Appropriate factors would likely vary by product line, taking into consideration more dynamics than can be modeled with a simple loss ratio. Any consideration of reserve strengthening in RBC analysis would have to address the related subjects of valuation standards and imbedded reserve margins. The committee feels that this is an area for future consideration as new types of models and approaches are developed for combining tests of reserve adequacy and capital requirements.

Because surplus is provided for “new business” in a stationary population, it is not clear how the surplus requirements without reserve increases would compare to the surplus requirement for running off a closed block, where reserve strengthening is much less of an issue. The very simple analysis on claim reserves showed the requirement for a stationary population without reserve strengthening was close to the requirement for running off the closed block.

Loss Ratios

Gross loss ratios in a stationary population will be about 10% higher (with correspondingly higher interest earnings from the absence of discounting) than normally seen in pricing work. Pricing loss ratios are often based on discounted benefits to discounted premiums. Table SA19 shows the effect of raising all the loss ratios 10%. The effect is not significant, as it is the volatility of loss ratios from their expected values and not their absolute value that determines results.

Tax Recognition

SA20 has two different results. It shows the effect of zero tax recognition and the effect of a zero tax rate. The required capital for the zero tax recognition assumes there are no tax offsets to losses, it doesn’t assume a change in profit margin needed to meet the baseline ROE. It assumes the “after tax” surplus requirement will be allocated to the segment. The alternate case just turns out to be the base case divided by one minus the tax rate.

No Tax is different, it assumes there are no taxes so a much lower profit as a percent of premium is needed to achieve the ROE. Lower profit means more risk. A segment that depends relatively more on profit margins than capital to avoid ruin has a much larger increase for no taxes because the profit margins decline more.

Capping the Accumulation of Surplus

Table 21 shows the impact of not capping the accumulation of surplus at the required capital level being tested. Again this has a greater impact on segments relying more on profit for protection as they accumulate more surplus.

Disability C-2 Requirements in Context

The combined capital requirement of disability products can be less than the sum of the requirements for each product because the additional requirement on the first tier of premium, $50 million, is determined for a combination of products. Individual disability products, such as NonCan and GR, have similar exogenous variables. Thus the additional requirements needed to reduce ruin to 5% on small blocks should be applied only once. Without a combination feature, a company with $50 million in NonCan premium and $50 million in GR premium would have a higher requirement than a company with $100 million in NonCan premium. It doesn't make sense to have a higher capital requirement for a company with more flexibility to change premiums.

The combining of products on the first tier of premium is not a correlation reduction similar to the correlation reduction in the general formula. It is driven by the reduced volatility from more risk of the same type, while correlation among the various C risks is driven by the independence of the different types of risk. The combination of tiers is more like the reduction in bond factors based on the number of bonds.

A similar combination of the first tier of premium occurs for the group and credit segments. Again, these risks are assumed to be subject to the same exogenous factors.

Disability income is not subject to a C-3 requirement. While disability income products are not considered interest sensitive liabilities, the active life liability for some products can have a very high duration. Failure to recognize the duration of such liabilities would eventually result in the need for reserve strengthening in a declining rate environment. As the analysis we performed backed out the volatility of reserve strengthening, no implicit provision is made for C-3 risk.

Disability income products are subject to C-1 requirements based on the risk of the supporting assets. The C-1 requirements in part were based on an analysis that assumed some portion of investment earnings is available to fund an AVR type reserve and hence reduce C-1 requirements. While we made no explicit provision in our analysis to fund an AVR type reserve, the somewhat conservative 6% earned rate and ROEs are an offset to the double counting of available margins. In addition, expense margins may be available for this purpose.

The recommended formula consists of two parts. The first part is applied to earned premium and can be thought of as providing for the incidence and claim continuance risk on active lives. The second part is applied to claim reserves and can be thought of as providing for the claim continuance and claim duration risk on disabled lives.

An alternative to applying a factor to earned premiums would have been to develop a factor for earned premium plus active life reserves (including unearned premium reserves for single premium credit). The combined earned premium plus active life reserves may be a better measure of the incidence and claim continuance risk on active lives (i.e., a better measure of the current size of the in-force). This was not done for two reasons. First, the analysis was on loss ratios with earned premium in the denominator, not on exposure ratios with

earned premium plus active life reserves in the denominator. Second, using active life reserves would have resulted in a more complicated formula.
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Considerations for the Future

1. Global Issues

Guidelines

In would be worthwhile to develop written guidelines on the basic approach to be taken in developing factors. This may save future task forces much effort on determining the appropriate approach. They will not need to spend time considering what is appropriate in terms of taxes, reserve strengthening, testing horizon, capping of surplus, use of stationary population, etc. The sensitivity analysis included with this report indicates the relative importance of many of these factors for disability products. This should help in the consideration of these global issues.

Documentation

It was fairly difficult to recover and evaluate the analysis done in 1991 and 1994. In the end, we either could not find enough documentation, 1991, or we couldn’t completely follow what was done, 1994. Documentation, to the extent possible, should be saved electronically. The documentation should be adequate so that 10 years down the road, the next task force could nearly “reproduce” the results and have a clear understand on the perceived limitations. We hope that our documentation meets these criteria.

Limitations of data

The collection and cleansing of data is a very difficult process. The DI Working Group had virtually no control over the resources needed to gather and explain data. Once the data is collected, due to its proprietary nature, very few people can be involved in the review. The solution to this problem is not obvious; however, more and better statutory experience exhibits would make future analysis easier.

Capital is not sufficient for Solvency Analysis

It is not impossible that one company’s true chance of ruin could be 20 times that of another company with the same earned premium, claim reserves and capital. Individual company volatility and profit levels can be very different. Within the same general risk segment, companies can have significant differences in product design, pricing and management practices. Clearly, risk based capital by itself is not a sufficient measure of solvency.

Even the same set of data from one company can reflect an evolution of business risk over time. As interest rates change, target loss ratios could change either to reflect changing profit targets or a different mix of required revenue from premium and income. Changing loss ratios could be based on changes in the mix of business in the segment, changes in product design or changes in practices. None of this is due to the inherent volatility in the segment. Expense savings in a competitive market would drive up loss ratios without any change in the fundamental underlying volatility of claims.

2. Internal Issues

Ranges of Reasonable assumptions

The DI Working Group had to make choices all along the way on how risk was going to be modeled, what assumptions were going to go into the modeling and how results were going to be used to develop factors. Additional work on developing more appropriate assumptions or the same assumptions with better arguments of support is always possible.

Seasoning vs. more stable model

The standard deviation in loss ratios increases from period to period. This is not dissimilar to interest models were rates can climb to levels never seen historically. This is a consequence of the underlying mathematics (e.g., the standard deviation of the sum of independent random variables increases with the square root of the number of variables in the sum). The negative serial correlation and other model features constrain this growth but do not eliminate it. Some analysis on what growth and limits should be anticipated in the outcomes would be useful.

Others

A drawback to using premiums and reserves as a basis to apply factors is that more conservative reserves and premiums result in less risk but produce higher capital requirements. Some consideration was given to applying factors to other in-force items (e.g., lives or basic monthly income exposure). However, these other in-force items have more serious drawbacks. They are less reflective of the economic value of the variety of benefits in a segment as they do not adjust for age, occupation, or the underlying claim exposures. Earned premium and reserves at least implicitly reflect these characteristics.

There are many ways to segment disability income risk to determine risk based capital requirements. Some ways of segmenting are either not used or used sparingly. These include benefit features (elimination periods, cost of living increases, benefit periods), markets (blue collar versus white collar, physician versus non-physician, geographic concentrations), underwriting, distribution channel (broker, agent and block acquisition), use of reinsurance, claim practices, claim reserve duration and alternative reserve practices. The result is a possible significant variation in the volatility of loss ratios among the same class of risk in the data collected (e.g., NonCan blocks of similar size). The DI Working Group believes it looked at the most important considerations given the limited ability to collect data, analyze results and provide workable recommendations.

3. Future Analysis

Several areas of research were left unexplored due to time and resource limitations. The following may be worth reviewing in the future.

Continuous Formula

Instead of using a two-tier formula, a formula could have a continuous recognition of the advantage of size. For example, the following type of formula may fit the change in risk by size better than a two step function:

RBC = Factor x Co. In-force x (Fixed In-force Level/Co. In-force Level)^{A}
where A and the Fixed in-force Level would be chosen to fit the data.

More detailed Review

A more detailed review of claim reserves could result in multiple factors based on the remaining benefit period or the duration of the claim. In addition, a separate analysis of active life risk could result in a better split of the aggregate requirement determined in this analysis between active lives and disabled lives.

Other Approaches

We note two other broad approaches to determining risk based capital for disability income factors. We are not recommending these approaches be taken in the future, but only that they could be considered.

The 1991 report noted risk could be segmented into six sources.

a. Statistical (variation from expected due to chance)
b. Basis (on new designs since pricing must be inferred from similar but not identical designs)
c. Secular shifts (in (a) because expected is not stable over time)
d. Cyclical fluctuations in profit
e. Catastrophe
f. Contagion

The 1991 analysis opined that risk based capital should focus on a, d, e and f while b and c emerge slowly over time and are not a significant source of risk over a short time horizon. In the current context, to the extent the risk is implicitly in the historic data and manifest itself over five years, we are picking up the sources a, b, d, e and f. However, while c distorts our volatility measure, which we assume is stable over time, it is not fully implicit in how volatility is extracted from the historical data.

Another possible approach, more appropriate for a company specific analysis, would be to segment risk into pieces that can be managed. For example:

a. Incidence Risk: How good is underwriting, pricing, recognition of trend by segment and block size to reduce random fluctuations?
b. Mortality: How large is the database to recognize trend and mitigate volatility, How large is the claim base to reduce fluctuations?
c. Recovery: How good is claims management, and size to reduce fluctuations?
d. Profitability: How high and stable are profits.
e. Re-pricing. How fast is the response time; how good is the information; and what are the market constraints?

This approach is more appropriate for a company trying to determine its own surplus needs, but is too complex for developing a general formula for the industry. In addition, data is not generally available in this format.

Use of Semi Variance

Some of the volatility in loss ratios, for example changes in reinsurance, could increase capital but show up in the data as increased risk. The problem with volatility is that it doesn't distinguish between good volatility that increases capital and bad volatility that decreases capital. A possible avenue of future research is to focus more on downside risk measures such as semi-variance. This may require better data, as a clearer picture is needed on the distribution of results.

Overall Summary

1. Commentary

These recommendations required decisions on many issues and many actuarial judgments. The recommendations are those of the Task Force and not of any one member. If done independently, each task force member would have made different decisions and different judgments that would have resulted in different recommendations and different interpretations of the results. However, given the basic guidelines the DI Working Group was working within, no member of the Task Force believes any recommendation is unreasonable.

2. Acknowledgments

The DI Working Group would like to thank the Companies and their staff that took the time to respond to our data survey and follow-up questions. We would also like to express our appreciation to the actuaries behind the work done in 1991 and 1994 which gave us a good foundation on which to build. Finally we would like to thank Darrell Knapp, Steven Ostlund, William Thompson and William Weller for reviewing our work.

Appendices

A - Recommendation Development & Model Runs
B - Sensitivity Analysis

C - Description of Models
D - Data Survey
E – Data

Appendices

Appendix A- Recommendation Development and Model Runs

	Recommendation Development	NonCan	GR	GLTD	GSTD	SP	MOB	SP2
A)	Small Block Model Results	52.72%	40.93%	28.76%	4.41%	10.47%	23.43%	17.76%
B)	Claim Reserves as a percent premium	350%	350%	300%	12%	60%	65%	60%
C)	**Recommended RBC factor**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**
D)	Reserve RBC as percent premium (BxC)	17.50%	17.50%	15.00%	0.60%	3.00%	3.25%	3.00%
	A-D Small Block Model net of Reserve RBC	35.22%	23.43%	13.76%	3.81%	7.47%	20.18%	14.76%
E)	**Recommended RBC on Earned Premium (first $50 million in tier)**	**35%**	**25%**	**15%**	**5%**	**10%**	**20%**	**15%**
	Large Block Model Results	32.85%	24.46%	18.68%	2.85%	2.06%	8.08%	8.15%
F)	Large Block Model net of DLR RBC	15.35%	6.96%	3.68%	2.25%	-0.94%	4.83%	5.15%
G)	Small block premium size (millions)	$50	$50	$50	$50	$50	$50	$50
H)	Large block premium size (millions)	$500	$500	$500	$500	$85	$200	$85
I)	(E-F) x G/(H-G) Small block full Credit	2.18%	2.00%	1.26%	0.31%	15.63%	5.06%	14.07%
J)	Small Block Credit Used by Higher Tier in Blending (NonCan or GLTD)	0%	50%	0%	50%	50%	50%	50%
K)	Small Credit I x (1-J)	2.18%	1.00%	1.26%	0.15%	7.81%	2.53%	7.04%
	F-K Net large block RBC	13.17%	5.96%	2.42%	2.10%	-8.75%	2.30%	-1.89%
	Recommended RBC above $50 million	**15%**	**7%**	**3%**	**3%**	**3%**	**3%**	**3%**

APPENDIX A - LARGE COMPANY ASSUMPTIONS and RESULTS

Description	NonCan	GR	GLTD	GSTD	SP	MOB	SP2
Standard Deviation	11.20%	11.20%	10.00%	4.00%	4.00%	6.00%	5.00%
Serial Correlation	-25.00%	-25.00%	-40.00%	-65.00%	-20.00%	-40.00%	-25.00%
Phase In Delay	2.5	2.5	2.0	2.0	1.0	1.0	1.0
Target ROE	11.00%	9.00%	13.00%	43.00%	10.00%	15.00%	12.50%
Input % of Premium Amounts							
Phase in Factor	8.00%	40.00%	50.00%	50.00%	20.00%	20.00%	20.00%
Low Re-price Ratio	60.00%	60.00%	70.00%	70.00%	50.00%	50.00%	50.00%
High Re-price Ratio	75.00%	75.00%	80.00%	80.00%	60.00%	60.00%	60.00%
Statutory Stain	85.00%	85.00%	25.00%	5.00%	60.00%	25.00%	30.00%
Required Surplus	32.85%	24.46%	18.68%	2.85%	2.06%	8.08%	8.15%
Reserves	550.00%	550.00%	300.00%	12.00%	240.00%	65.00%	170.00%
Target Pricing Loss Ratio	65.00%	65.00%	75.00%	75.00%	55.00%	55.00%	55.00%
Implied Values as a % Premium							
Probability of Ruin	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Interest Income	34.97%	34.47%	19.12%	0.89%	14.52%	4.38%	10.69%
Pricing Pre-tax Profit	19.94%	15.16%	8.74%	5.19%	9.55%	7.63%	7.34%
Non FIT Expense Margin	50.03%	54.31%	35.39%	20.70%	49.98%	41.75%	48.35%
Mean After Tax ROE	10.86%	8.57%	12.80%	42.86%	10.13%	15.43%	12.77%
STD of After Tax ROE	10.04%	6.65%	10.17%	21.49%	4.96%	11.16%	9.56%
Mean Minimum Surplus	27.61%	19.47%	14.10%	2.34%	1.75%	6.59%	6.71%
STD of Minimum Surplus	13.12%	8.80%	6.56%	1.13%	1.17%	3.29%	3.30%
Mean Loss Ratio (start of test)	65.00%	65.24%	74.93%	74.99%	54.91%	54.83%	54.86%
STD of Loss Ratio (start of test)	16.06%	15.63%	11.04%	3.72%	5.27%	6.65%	6.24%
Mean Ending Loss ratio	64.18%	64.92%	74.92%	75.01%	54.70%	54.48%	54.55%
STD of Ending Loss ratios	21.53%	16.39%	11.39%	3.84%	6.00%	7.39%	7.05%

APPENDIX A – SMALL COMPANY ASSUMPTIONS and RESULTS

Description	NonCan	GR	GLTD	GSTD	SP	MOB	SP2
Standard Deviation	15.00%	15.00%	14.00%	5.60%	7.00%	12.00%	8.00%
Serial Correlation	-25.00%	-25.00%	-40.00%	-65.00%	-20.00%	-40.00%	-25.00%
Phase In Delay	2.5	2.5	2.0	2.0	1.0	1.0	1.0
Target ROE	11.00%	9.00%	13.00%	43.00%	10.00%	15.00%	12.50%
Input % of Premium Amounts							
Phase in Factor	8.00%	30.00%	50.00%	50.00%	20.00%	20.00%	20.00%
Low Re-price Ratio	60.00%	60.00%	70.00%	70.00%	50.00%	50.00%	50.00%
High Re-price Ratio	75.00%	75.00%	80.00%	80.00%	60.00%	60.00%	60.00%
Statutory Stain	85.00%	85.00%	25.00%	5.00%	60.00%	25.00%	30.00%
Required Surplus	52.72%	40.93%	28.76%	4.41%	10.47%	23.43%	17.76%
Reserves	550.00%	550.00%	300.00%	12.00%	240.00%	65.00%	170.00%
Target Pricing Loss Ratio	65.00%	65.00%	75.00%	75.00%	55.00%	55.00%	55.00%
Implied Values as a % Premium							
Probability of Ruin	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Interest Income	36.16%	35.46%	19.73%	0.98%	15.03%	5.31%	11.27%
Pricing Pre-tax Profit	23.31%	17.44%	10.75%	6.22%	10.84%	11.18%	9.19%
Non FIT Expense Margin	47.86%	53.02%	33.97%	19.76%	49.19%	39.13%	47.08%
Mean After Tax ROE	10.81%	9.00%	12.69%	42.73%	10.38%	14.89%	13.05%
STD of After Tax ROE	11.50%	8.72%	11.74%	28.22%	7.24%	282.23%	12.13%
Mean Minimum Surplus	43.89%	32.44%	21.21%	3.54%	8.67%	18.72%	14.39%
STD of Minimum Surplus	19.87%	14.47%	9.99%	1.70%	4.33%	8.61%	6.65%
Mean Loss Ratio (start of test)	64.96%	65.06%	74.86%	75.00%	54.69%	54.28%	54.62%
STD of Loss Ratio (start of test)	21.42%	20.89%	15.43%	4.95%	8.89%	13.11%	9.79%
Mean Ending Loss ratio	63.52%	62.67%	74.81%	75.04%	54.00%	52.77%	53.77%
STD of Ending Loss ratios	28.05%	22.70%	16.03%	5.06%	10.17%	14.88%	11.16%

Appendix B - Sensitivity Analysis

TABLE SA1 (Higher Standard Deviation)

	Standard Deviation			Required Capital		
	Base	Alternate	Alt / BASE	Base	Alternate	Alt / BASE
Large Co.						
NonCan	11.20%	12.32%	110.0%	32.85%	38.65%	117.6%
GR	11.20%	12.32%	110.0%	24.46%	28.31%	115.7%
GLTD	10.00%	11.00%	110.0%	18.68%	21.15%	113.2%
GSTD	4.00%	4.40%	110.0%	2.85%	3.23%	113.4%
SP-Credit	4.00%	4.40%	110.0%	2.06%	2.93%	142.5%
MOB-Credit	6.00%	6.60%	110.0%	8.08%	9.56%	118.3%
Small Co.						
NonCan	15.00%	16.50%	110.0%	52.72%	60.66%	115.1%
GR.	15.00%	16.50%	110.0%	40.93%	46.96%	114.7%
GLTD	14.00%	15.40%	110.0%	28.76%	32.33%	112.4%
GSTD	5.60%	6.16%	110.0%	4.41%	4.99%	113.2%
SP-Credit	7.00%	7.70%	110.0%	10.47%	12.81%	122.4%
MOB-Credit	12.00%	13.20%	110.0%	23.43%	26.56%	113.4%

TABLE SA2 (Lower Standard Deviation)

	Standard Deviation			Required Capital		
	Base	Alternate	Alt / BASE	Base	Alternate	Alt / BASE
Large Co.						
NonCan	11.20%	10.08%	90.0%	32.85%	27.17%	82.7%
GR.	11.20%	10.08%	90.0%	24.46%	20.76%	84.9%
GLTD	10.00%	9.00%	90.0%	18.68%	16.16%	86.5%
GSTD	4.00%	3.60%	90.0%	2.85%	2.48%	87.3%
SP-Credit	4.00%	3.60%	90.0%	2.06%	1.28%	62.1%
MOB-Credit	6.00%	5.40%	90.0%	8.08%	6.66%	82.4%
Small Co.						
NonCan	15.00%	13.50%	90.0%	52.72%	44.82%	85.0%
GR.	15.00%	13.50%	90.0%	40.93%	35.18%	86.0%
GLTD	14.00%	12.60%	90.0%	28.76%	25.18%	87.6%
GSTD	5.60%	5.04%	90.0%	4.41%	3.84%	87.2%
SP-Credit	7.00%	6.30%	90.0%	10.47%	8.23%	78.6%
MOB-Credit	12.00%	10.80%	90.0%	23.43%	20.29%	86.6%

TABLE SA3 (Larger Negative Serial Correlation)

	Serial Correlation			Required Capital		
	Base	Alternate	Alt / BASE	Base	Alternate	Alt / BASE
Large Co.						
NonCan	-25.0%	-27.5%	110.0%	32.85%	31.37%	95.5%
GR.	-25.0%	-27.5%	110.0%	24.46%	23.55%	96.3%
GLTD	-40.0%	-44.0%	110.0%	18.68%	17.65%	94.5%
GSTD	-65.0%	-71.5%	110.0%	2.85%	2.48%	87.2%
SP-Credit	-20.0%	-22.0%	110.0%	2.06%	1.93%	93.9%
MOB-Credit	-40.0%	-44.0%	110.0%	8.08%	7.50%	92.8%
Small Co.						
NonCan	-25.0%	-27.5%	110.0%	52.72%	50.78%	96.3%
GR.	-25.0%	-27.5%	110.0%	40.93%	39.51%	96.5%
GLTD	-40.0%	-44.0%	110.0%	28.76%	27.34%	95.1%
GSTD	-65.0%	-71.5%	110.0%	4.41%	3.88%	88.0%
SP-Credit	-20.0%	-22.0%	110.0%	10.47%	10.03%	95.8%
MOB-Credit	-40.0%	-44.0%	110.0%	23.43%	22.02%	94.0%

TABLE SA4 (Smaller Negative Serial Correlation)

	Serial Correlation			Required Capital		
	Base	Alternate	Alt / BASE	Base	Alternate	Alt / BASE
Large Co.						
NonCan	-25.0%	-22.5%	90.0%	32.85%	34.28%	104.3%
GR.	-25.0%	-22.5%	90.0%	24.46%	25.34%	103.6%
GLTD	-40.0%	-36.0%	90.0%	18.68%	19.65%	105.2%
GSTD	-65.0%	-58.5%	90.0%	2.85%	3.20%	112.3%
SP-Credit	-20.0%	-18.0%	90.0%	2.06%	2.18%	105.8%
MOB-Credit	-40.0%	-36.0%	90.0%	8.08%	8.73%	108.0%
Small Co.						
NonCan	-25.0%	-22.5%	90.0%	52.72%	54.67%	103.7%
GR.	-25.0%	-22.5%	90.0%	40.93%	42.39%	103.6%
GLTD	-40.0%	-36.0%	90.0%	28.76%	30.13%	104.8%
GSTD	-65.0%	-58.5%	90.0%	4.41%	4.93%	111.9%
SP-Credit	-20.0%	-18.0%	90.0%	10.47%	10.89%	104.0%
MOB-Credit	-40.0%	-36.0%	90.0%	23.43%	24.91%	106.3%

TABLE SA5 (Lower Probability of Ruin)

	Probability of Ruin			Required Capital		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	5.0%	4.0%	80.0%	32.85%	36.54%	111.2%
GR.	5.0%	4.0%	80.0%	24.46%	26.42%	108.0%
GLTD	5.0%	4.0%	80.0%	18.68%	19.80%	106.0%
GSTD	5.0%	4.0%	80.0%	2.85%	3.05%	107.0%
SP-Credit	5.0%	4.0%	80.0%	2.06%	2.46%	119.7%
MOB-Credit	5.0%	4.0%	80.0%	8.08%	8.91%	110.3%
Small Co.						
NonCan	5.0%	4.0%	80.0%	52.72%	57.68%	109.4%
GR.	5.0%	4.0%	80.0%	40.93%	44.25%	108.1%
GLTD	5.0%	4.0%	80.0%	28.76%	30.40%	105.7%
GSTD	5.0%	4.0%	80.0%	4.41%	4.66%	105.7%
SP-Credit	5.0%	4.0%	80.0%	10.47%	11.79%	112.6%
MOB-Credit	5.0%	4.0%	80.0%	23.43%	25.36%	108.2%

TABLE SA6 (Higher Probability of Ruin)

	Probability of Ruin			Required Capital		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	5.0%	6.00%	120.0%	32.85%	29.93%	91.1%
GR.	5.0%	6.00%	120.0%	24.46%	22.79%	93.2%
GLTD	5.0%	6.00%	120.0%	18.68%	17.69%	94.7%
GSTD	5.0%	6.00%	120.0%	2.85%	2.69%	94.5%
SP-Credit	5.0%	6.00%	120.0%	2.06%	1.73%	84.3%
MOB-Credit	5.0%	6.00%	120.0%	8.08%	7.43%	92.0%
Small Co.						
NonCan	5.0%	6.00%	120.0%	52.72%	48.95%	92.8%
GR.	5.0%	6.00%	120.0%	40.93%	38.23%	93.4%
GLTD	5.0%	6.00%	120.0%	28.76%	27.40%	95.3%
GSTD	5.0%	6.00%	120.0%	4.41%	4.19%	95.0%
SP-Credit	5.0%	6.00%	120.0%	10.47%	9.47%	90.4%
MOB-Credit	5.0%	6.00%	120.0%	23.43%	21.82%	93.1%

TABLE SA7 (50% of Recommended)

	Profit Margin as a % Premium			Probability of Ruin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	19.94%	17.16%	86.06%	5.00%	13.57%	271.40%
GR.	15.16%	13.46%	88.83%	5.00%	17.64%	352.80%
GLTD	8.74%	6.87%	78.62%	5.00%	24.02%	480.40%
GSTD	5.19%	4.25%	81.86%	5.00%	21.16%	423.16%
SP-Credit	9.55%	9.39%	98.34%	5.00%	8.98%	179.52%
MOB-Credit	7.63%	6.70%	87.79%	5.00%	15.83%	316.68%
Small Co.						
NonCan	23.31%	18.85%	80.86%	5.00%	15.25%	305.08%
GR.	17.44%	14.60%	83.75%	5.00%	17.94%	358.76%
GLTD	10.75%	7.88%	73.25%	5.00%	26.21%	524.28%
GSTD	6.22%	4.77%	76.58%	5.00%	25.28%	505.60%
SP-Credit	10.84%	10.04%	92.57%	5.00%	13.09%	261.76%
MOB-Credit	11.18%	8.47%	75.81%	5.00%	18.68%	373.60%

TABLE SA8 (50% of Recommended, Profit at 100%)

	Return on Initial Capital			Probability of Ruin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	11.00%	12.78%	116.20%	5.0%	10.35%	207.04%
GR.	9.00%	10.13%	112.58%	5.0%	14.24%	284.88%
GLTD	13.00%	16.54%	127.19%	5.0%	17.63%	352.52%
GSTD	43.00%	52.53%	122.16%	5.0%	12.98%	259.68%
SP-Credit	10.00%	10.17%	101.68%	5.0%	8.47%	169.44%
MOB-Credit	15.00%	17.09%	113.91%	5.0%	12.15%	243.04%
Small Co.						
NonCan	11.00%	13.60%	123.67%	5.0%	11.12%	222.40%
GR.	9.00%	10.75%	119.40%	5.0%	13.89%	277.80%
GLTD	13.00%	17.75%	136.51%	5.0%	18.70%	374.04%
GSTD	43.00%	56.15%	130.59%	5.0%	14.68%	293.56%
SP-Credit	10.00%	10.80%	108.02%	5.0%	11.03%	220.52%
MOB-Credit	15.00%	19.79%	131.90%	5.0%	12.70%	254.00%

TABLE SA9 (200% of Recommended, Held and Used for Pricing)

	Profit as a % of Premium			Required Capital		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	19.94%	25.50%	127.88%	5.00%	0.50%	10.08%
GR.	15.16%	18.54%	122.35%	5.00%	0.21%	4.20%
GLTD	8.74%	12.47%	142.76%	5.00%	0.07%	1.40%
GSTD	5.19%	7.07%	136.28%	5.00%	0.10%	2.00%
SP-Credit	9.55%	9.86%	103.31%	5.00%	1.76%	35.20%
MOB-Credit	7.63%	9.50%	124.43%	5.00%	0.45%	8.92%
Small Co.						
NonCan	23.31%	32.23%	138.28%	5.00%	0.28%	5.52%
GR.	17.44%	23.10%	132.50%	5.00%	0.19%	3.72%
GLTD	10.75%	16.50%	153.49%	5.00%	0.04%	0.84%
GSTD	6.22%	9.14%	146.84%	5.00%	0.06%	1.12%
SP-Credit	10.84%	12.45%	114.86%	5.00%	0.80%	16.08%
MOB-Credit	11.18%	16.58%	148.37%	5.00%	0.18%	3.60%

TABLE SA10 (2 Year Seasoning Period)

	Seasoning Period in Years			Required Capital		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	3	2	66.67%	32.85%	29.91%	91.03%
GR.	3	2	66.67%	24.46%	24.47%	100.02%
GLTD	3	2	66.67%	18.68%	18.75%	100.37%
GSTD	3	2	66.67%	2.85%	2.82%	99.09%
SP-Credit	3	2	66.67%	2.06%	1.87%	90.84%
MOB-Credit	3	2	66.67%	8.08%	7.76%	96.08%
Small Co.						
NonCan	3	2	66.67%	52.72%	48.61%	92.19%
GR.	3	2	66.67%	40.93%	41.03%	100.25%
GLTD	3	2	66.67%	28.76%	28.94%	100.62%
GSTD	3	2	66.67%	4.41%	4.41%	100.14%
SP-Credit	3	2	66.67%	10.47%	10.02%	95.69%
MOB-Credit	3	2	66.67%	23.43%	22.93%	97.86%

TABLE SA11 (4 Year Seasoning Period)

	Seasoning Period in Years			Required Capital		
	Base	Alt. %	LR above	Base	Alternate	Alt / Base
Large Co.						
NonCan	3	4	133.33%	32.85%	35.40%	107.74%
GR.	3	4	133.33%	24.46%	24.61%	100.59%
GLTD	3	4	133.33%	18.68%	18.89%	101.16%
GSTD	3	4	133.33%	2.85%	2.85%	100.26%
SP-Credit	3	4	133.33%	2.06%	2.13%	103.78%
MOB-Credit	3	4	133.33%	8.08%	8.23%	101.81%
Small Co.						
NonCan	3	4	133.33%	52.72%	56.12%	106.45%
GR.	3	4	133.33%	40.93%	40.64%	99.29%
GLTD	3	4	133.33%	28.76%	29.14%	101.33%
GSTD	3	4	133.33%	4.41%	4.40%	99.95%
SP-Credit	3	4	133.33%	10.47%	10.70%	102.19%
MOB-Credit	3	4	133.33%	23.43%	23.73%	101.29%

TABLE SA12 (6 Year Testing Horizon)

	Testing Horizon			Required Capital/Profit Margin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	5	6	120.00%	32.85%	38.07%	115.88%
GR.	5	6	120.00%	24.46%	26.74%	109.33%
GLTD	5	6	120.00%	18.68%	20.06%	107.40%
GSTD	5	6	120.00%	2.85%	3.01%	105.77%
SP-Credit	5	6	120.00%	2.06%	2.35%	114.54%
MOB-Credit	5	6	120.00%	8.08%	8.85%	109.59%
Small Co.						
NonCan	5	6	120.00%	52.72%	60.26%	114.30%
GR.	5	6	120.00%	40.93%	44.67%	109.15%
GLTD	5	6	120.00%	28.76%	30.89%	107.42%
GSTD	5	6	120.00%	4.41%	4.62%	104.87%
SP-Credit	5	6	120.00%	10.47%	11.78%	112.51%
MOB-Credit	5	6	120.00%	23.43%	25.69%	109.65%

TABLE SA13 (4 Year Testing Horizon)

	Testing Horizon			Required Capital/Profit Margin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	5	4	80.00%	32.85%	27.59%	83.98%
GR.	5	4	80.00%	24.46%	21.81%	89.15%
GLTD	5	4	80.00%	18.68%	17.19%	92.05%
GSTD	5	4	80.00%	2.85%	2.63%	92.36%
SP-Credit	5	4	80.00%	2.06%	1.65%	80.37%
MOB-Credit	5	4	80.00%	8.08%	7.10%	87.86%
Small Co.						
NonCan	5	4	80.00%	52.72%	44.85%	85.08%
GR.	5	4	80.00%	40.93%	36.49%	89.15%
GLTD	5	4	80.00%	28.76%	26.69%	92.83%
GSTD	5	4	80.00%	4.41%	4.15%	94.19%
SP-Credit	5	4	80.00%	10.47%	8.97%	85.71%
MOB-Credit	5	4	80.00%	23.43%	20.73%	88.51%

TABLE SA14 (Increase in Phase in Delay 1/2 Year)

	Phase in Delay			Required Capital/Profit Margin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	2.5	3	120.00%	32.85%	34.57%	105.23%
GR.	2.5	3	120.00%	24.46%	29.81%	121.88%
GLTD	2.0	2.5	125.00%	18.68%	21.65%	115.90%
GSTD	2.0	2.5	125.00%	2.85%	3.41%	119.72%
SP-Credit	1.0	1.5	150.00%	2.06%	2.64%	128.57%
MOB-Credit	1.0	1.5	150.00%	8.08%	9.27%	114.70%
Small Co.						
NonCan	2.5	3	120.00%	52.72%	55.22%	104.74%
GR.	2.5	3	120.00%	40.93%	46.92%	114.64%
GLTD	2.0	2.5	125.00%	28.76%	32.79%	114.04%
GSTD	2.0	2.5	125.00%	4.41%	5.10%	115.72%
SP-Credit	1.0	1.5	150.00%	10.47%	12.25%	117.02%
MOB-Credit	1.0	1.5	150.00%	23.43%	25.82%	110.20%

TABLE SA15 (Decrease in Phase in Delay 1/2 Year)

	Phase in Delay			Required Capital/Profit Margin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	2.5	2	80.00%	32.85%	30.80%	93.76%
GR.	2.5	2	80.00%	24.46%	20.55%	84.01%
GLTD	2.0	1.5	75.00%	18.68%	14.59%	78.11%
GSTD	2.0	1.5	75.00%	2.85%	2.78%	97.65%
SP-Credit*	1.0				NA	
MOB-Credit	1.0				NA	
Small Co.						
NonCan	2.5	2	80.00%	52.72%	50.00%	94.83%
GR.	2.5	2	80.00%	40.93%	35.91%	87.74%
GLTD	2.0	1.5	75.00%	28.76%	22.80%	79.27%
GSTD	2.0	1.5	75.00%	4.41%	4.01%	91.12%
SP-Credit	1.0				NA	
MOB-Credit	1.0				NA	

*The model is limited to a phase in delay of at least 1 year and could not run 1/2 year delays for the credit segments.

TABLE SA16 (Decrease in Statutory Strain)

	Strain as a % of Premium			Required Capital/Profit Margin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	85.00%	76.50%	90.00%	32.85%	35.72%	108.72%
GR.	85.00%	76.50%	90.00%	24.46%	26.43%	108.06%
GLTD	25.00%	22.50%	90.00%	18.68%	19.38%	103.76%
GSTD	5.00%	4.50%	90.00%	2.85%	3.07%	107.95%
SP-Credit*	60.00%	54.00%	90.00%	2.06%	2.88%	139.91%
MOB-Credit	25.00%	22.50%	90.00%	8.08%	8.92%	110.42%
Small Co.						
NonCan	85.00%	76.50%	90.00%	52.72%	55.77%	105.77%
GR.	85.00%	76.50%	90.00%	40.93%	43.37%	105.96%
GLTD	25.00%	22.50%	90.00%	28.76%	29.47%	102.46%
GSTD	5.00%	4.50%	90.00%	4.41%	4.64%	105.24%
SP-Credit	60.00%	54.00%	90.00%	10.47%	11.98%	114.41%
MOB-Credit	25.00%	22.50%	90.00%	23.43%	24.46%	104.43%

TABLE SA17 (Increase in Statutory Strain)

	Strain as a % of Premium			Required Capital/Profit Margin		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	85.00%	93.50%	110.00%	32.85%	29.99%	91.28%
GR.	85.00%	93.50%	110.00%	24.46%	22.58%	92.31%
GLTD	25.00%	27.50%	110.00%	18.68%	17.97%	96.21%
GSTD	5.00%	5.50%	110.00%	2.85%	2.64%	92.87%
SP-Credit*	60.00%	66.00%	110.00%	2.06%	1.37%	66.45%
MOB-Credit	25.00%	27.50%	110.00%	8.08%	7.29%	90.26%
Small Co.						
NonCan	85.00%	93.50%	110.00%	52.72%	49.76%	94.38%
GR.	85.00%	93.50%	110.00%	40.93%	38.62%	94.37%
GLTD	25.00%	27.50%	110.00%	28.76%	28.00%	97.37%
GSTD	5.00%	5.50%	110.00%	4.41%	4.19%	95.08%
SP-Credit	60.00%	66.00%	110.00%	10.47%	9.09%	86.78%
MOB-Credit	25.00%	27.50%	110.00%	23.43%	22.45%	95.84%

TABLE SA18 (Impact of 75% Reserve Strengthening)

	Reserve for Loss Ratios over	Profit Margin			Required Capital/Profit Margin		
		Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.							
NonCan	84.94%	19.94%	24.46%	122.62%	32.85%	59.52%	181.16%
GR.	80.16%	15.16%	15.78%	104.15%	24.46%	29.00%	118.56%
GLTD	83.74%	8.74%	9.47%	108.37%	18.68%	22.33%	119.58%
GSTD	80.19%	5.19%	5.32%	102.44%	2.85%	3.04%	106.72%
SP-Credit*	64.55%	9.55%	9.66%	101.15%	2.06%	2.77%	134.85%
MOB-Credit	62.63%	7.63%	8.63%	113.04%	8.08%	12.39%	153.39%
Small Co.							
NonCan	88.31%	23.31%	30.43%	130.54%	52.72%	94.79%	179.78%
GR.	82.44%	17.44%	19.02%	109.07%	40.93%	52.35%	127.91%
GLTD	85.75%	10.75%	11.94%	111.04%	28.76%	34.69%	120.65%
GSTD	81.22%	6.22%	6.44%	103.47%	4.41%	4.73%	107.41%
SP-Credit	65.84%	10.84%	11.68%	107.74%	10.47%	15.92%	152.10%
MOB-Credit	66.18%	11.18%	13.56%	121.35%	23.43%	33.76%	144.13%

TABLE SA19 (10% Increase in Loss Ratios)

	Loss Ratios after Increase			Required Capital/Profit Margin		
	Low Re-price	Implicit in Pricing	High Re-price	Base	Alternate	Alt / Base
Large Co.						
NonCan	70.00%	75.00%	85.00%	32.85%	33.03%	100.55%
GR.	70.00%	75.00%	85.00%	24.46%	24.60%	100.54%
GLTD	80.00%	85.00%	90.00%	18.68%	18.69%	100.08%
GSTD	80.00%	85.00%	90.00%	2.85%	2.85%	100.02%
SP-Credit*	60.00%	65.00%	70.00%	2.06%	2.09%	101.59%
MOB-Credit	60.00%	65.00%	70.00%	8.08%	8.17%	101.14%
Small Co.						
NonCan	70.00%	75.00%	85.00%	52.72%	53.04%	100.60%
GR.	70.00%	75.00%	85.00%	40.93%	41.24%	100.76%
GLTD	80.00%	85.00%	90.00%	28.76%	28.71%	99.85%
GSTD	80.00%	85.00%	90.00%	4.41%	4.40%	99.88%
SP-Credit	60.00%	65.00%	70.00%	10.47%	10.61%	101.30%
MOB-Credit	60.00%	65.00%	70.00%	23.43%	23.74%	101.34%

TABLE SA20 (Impact of 0% Tax Recognition and No Tax)

	0% Tax Recognition RBC			No Tax RBC		
	Base	Alternate	Alt / Base	Base	Alternate	Alt / Base
Large Co.						
NonCan	32.85%	50.55%	153.85%	32.85%	68.25%	207.73%
GR.	24.46%	37.64%	153.85%	24.46%	49.71%	203.20%
GLTD	18.68%	28.73%	153.85%	18.68%	33.02%	176.83%
GSTD	2.85%	4.38%	153.85%	2.85%	5.65%	198.50%
SP-Credit*	2.06%	3.16%	153.83%	2.06%	8.97%	436.47%
MOB-Credit	8.08%	12.43%	153.85%	8.08%	17.56%	217.28%
Small Co.						
NonCan	52.72%	81.11%	153.85%	52.72%	100.50%	190.62%
GR.	40.93%	62.97%	153.85%	40.93%	77.98%	190.52%
GLTD	28.76%	44.24%	153.84%	28.76%	49.14%	170.87%
GSTD	4.41%	6.78%	153.85%	4.41%	8.09%	183.52%
SP-Credit	10.47%	16.11%	153.85%	10.47%	25.80%	246.40%
MOB-Credit	23.43%	36.04%	153.86%	23.43%	42.54%	181.61%

TABLE SA21 (No Cap on Accumulated Surplus)

	Base	Alternate	Alt / Base
Large Co.			
NonCan	32.85%	31.27%	95.16%
GR.	24.46%	21.10%	86.26%
GLTD	18.68%	16.11%	86.28%
GSTD	2.85%	2.19%	77.07%
SP-Credit*	2.06%	0.42%	20.25%
MOB-Credit	8.08%	7.03%	86.99%
Small Co.			
NonCan	52.72%	51.27%	97.24%
GR.	40.93%	38.34%	93.67%
GLTD	28.76%	25.44%	88.47%
GSTD	4.41%	3.50%	79.52%
SP-Credit	10.47%	8.83%	84.30%
MOB-Credit	23.43%	22.19%	94.71%

Appendix C - Description of Models

DI RBC AGGREGATE MODEL DOCUMENTATION

A stochastic model is being used to develop risk based capital factors for disability income products. This memo documents that model. Below are definitions, an explanation of the model's logic (algebra), and descriptions of the Excel worksheets and Visual Basic Modules used to implement the model.

DEFINITIONS OF MODEL INPUT

Adjust Reserves for Loss Ratios over is the level of loss ratio above which reserve adjustments are made during the testing time horizon. If it equals the target loss ratio plus the pre-tax profit it could adjust reserves to a gross premium reserves. This assumes the current loss ratio is not high due to a recent random fluctuation that is not expected to continue (i.e., this adjustment would result in reserves in excess of the gross premium reserve when changes in loss ratios are negatively correlated and the last change was an increase). If the input item "Reserve Strengthening %" is set to zero this input field has no effect.
After Tax ROE is a model output. For each scenario the after tax profits are added over the testing horizon. This sum is divided by the sum of the invested capital each year (the constant strain as a percent of premium plus the varying surplus at the start of each year in the testing horizon). The average of this ratio over all scenarios is the After Tax ROE. When capital gets near zero, very large negatives can develop; thus this output can be greatly influenced by 1 or 2 scenarios.
Cap Surplus Accumulation is an indicator that when set to zero allows the accumulated surplus over the testing time horizon to exceed the inputted required surplus (i.e., no dividends). If it is set to one, any surplus accumulated in excess of the required surplus target is removed as dividends.
Generate Extra Data is an indicator, if set to one the average and standard deviation over all scenarios of "After Tax Roe", "Minimum Surplus as a % of Premium", "Los Ratio at start of testing", and "Final Loss ratio" will be generated. This information is not generated if the level of required surplus is being found.
High Loss Ratio Phase in Factor: is the percent of inforce units re-priced each year when the loss ratio "Phase In Delay" years ago is above the "High Re-price Ratio". It will be much lower in a stationary population were the only source of turn over is lapse, maturity and death (such as non-cancelable products) than for stationary populations where inforce premiums can be re-priced (Group or Guaranteed Renewable products).
High Re-price Ratio is the loss ratio above the target loss ratio which must be reached before management decides to re-price business to the target loss ratio.
Implied Non FIT Expense Margin is the margin for expenses, other than tax on statutory gain, as a percent of premium. This item has no impact on the "Probability of Ruin". It is a balancing item that is calculated from other inputs. However, if the "Required Surplus", "Target ROE", and "Target Loss Ratio" that result in an acceptable level of ruin require an unreasonably low expense margin, the product is not a viable product. The

implied non FIT expense margin is calculated as follows with all items as a percent of premium:

(1 + Interest Income) – (Pre-Tax Profit + Target Loss ratio)

Interest Income is the return on assets as a percent of premium. In the model interest income varies based on surplus and reserve changes. It is the Pre-tax interest Rate on funds times reserves plus the estimated after tax required surplus as a percent of premium.

Loss Ratio Cap: The model replaces loss ratios generated above the cap by the cap.

Loss Ratio Floor: The model replaces loss ratios generated below the floor by the floor. It needs to greater than zero or the model may freeze up.

Low Loss Ratio Phase in Factor is the percent of inforce units re-priced each year when the loss ratio "Phase In Delay" years ago is below the "Low Re-price Ratio". See High Loss Ratio Phase in Factor.

Low Re-price Ratio it the loss ratio below the target loss ratio which must be reached before management decides to re-price business to the target loss ratio.

Number of Scenario is the number of runs the model will test with each run either resulting in exhausting the starting surplus (a ruin) or not. Many scenarios are run to find the ruin probability of one set of input assumptions. Scenarios in excess of 50,000 may run into program limitations (e.g., on calculations in RunData). Between 30,000 and 50,000 scenarios are recommended if required surplus is desired to the nearest ½%.

Phase in Delay is the time from recognition that pricing is not producing an acceptable loss ratio until new business is being sold with corrected pricing. As the model is an annual model, the phase in delay has to be at least 1 year; however, fractional input is okay (e.g., 2.5 years in which case "PLR" (see below) will be linearly interpolated between the loss ratios 2 and 3 years prior).

Pre-tax interest rate on funds is the earnings rate on investments net of defaults and expense.

Pricing Pre-tax Profit is the pre-tax profit margin as a percent of premium. It is implied in the model as follows:

"Target ROE"("Statutory Strain" + After Tax Required Surplus)/(1-"Tax Rate").

If required surplus is not on an after-tax basis (i.e., tax recognition is less than 100%) it is estimated as follows:

After Tax Required Surplus = Required Surplus * (1- Tax Rate (1- Tax Recognition %))

Probability of Ruin is the number of scenarios where surplus was less than zero sometime during the testing time horizon divided by the total number of scenarios. It is an output if the model is being run to find the probability of ruin. It is an input item if the model is being run to find the required surplus.

Random Seed is a seed number to generate random scenarios. If the seed is greater than or equal to zero, the Visual Basic function Rnd is used to generate random numbers. If the seed number is less than zero the random numbers are read from the worksheet RNumbers (see the description of module 1 below). If RNumbers is not set up correctly for the given run, the model will run RNumbers to get the appropriate random numbers. A seed of negative 100,000 (-100,000) in some limited testing produced a result close to the average of 7 different seed numbers.

Required Surplus is the surplus held at the start of the testing time horizon as a percentage of premiums available to absorb losses. It will not equal the assumed allocation of surplus for setting the profit margin and interest income unless tax recognition is at 100%. If the probability of ruin is being found, required surplus is an input item. If the required surplus for the given probability of ruin is being determined, required surplus is the user supplied initial guess on the correct amount of required surplus.

Reserves this is the reserves as a percent of premium. It is used to determine the Interest Income.

Reserve Strengthening % (RSP) is the percent of the reserve strengthening during the testing horizon. For example, if RSP is 100%, the pricing loss ratio (PLR) based on the phase in delay is 80%, the "Adjust Reserves for Loss Ratios over" factor (RALR) is 65%, the high loss ratio phase in factor (HPIF) is 10% and the Pre-tax interest rate on funds (IR) is 6% then the additional reserve per dollar of premium is;

Reserve = MAX (0, RSP* (PLR - RALR) /(HPIF+IR))

= 100%(15%)/(.06+.1)=93.75%

Serial Correlation is the assumed underlying serial correlation of successive deviates from the distribution from which the random numbers are generated for a scenario. To the extent a change in loss ratio is due in part to random factors, some of the change in loss ratio is not expected to persist (i.e., one would expect negative correlation in historic data to the extent changes are completely random. The smaller the block of business the more negative correlation expected).

Standard Deviation is the standard deviation of a normal distribution with mean zero. It is used to generate random deviations in the change in loss ratios. It is not the standard deviation of the loss ratios themselves.

Starting Loss Ratio Cap caps the historic loss ratio during the seasoning period less the phase in delay. IF the cap is set at 80% and the seasoning is 20 years and the phase in delay is 2.5 years, the first 17 loss ratios in the seasoning will be capped at 80%.

Statutory Strain is the capital invested over statutory capital. It is the statutory strain as a percent of premium. It could be approximated by GAAP capital less statutory capital.

Target Pricing Loss Ratio is the expected loss ratio in a stationary population (paid claims/earned premium) on which pricing is based. The reserve change component of the loss ratio is zero in a stationary population.

Target ROE is an after tax return on capital goal. It implicitly sets the profit margin based on the capital invested (after tax required surplus plus statutory strain) and the tax rate.

Tax Rate on Profit is the tax rate paid on statutory gain before tax.

Tax Recognition % determines the effective tax rate applied to profits and losses. If it is 80% and the tax rate is 30% losses/profits will provide a tax credit/payment of 24%.

Testing Time Horizon is the number of years over which the required surplus is modeled to see if it turns negative. At the beginning of the testing time horizon the surplus in the model is set to the "Required Surplus" level and random loss ratios are generated equal to the number of years in the testing time horizon. If at any time during the testing time horizon the surplus is negative, a ruin is recorded.

Years of Seasoning is the number of years the model is run before surplus is set equal to the inputted required surplus and the testing time horizon begins. If the years of seasoning is zero, the assumed prior loss ratios at the start of the testing time horizon will equal the target loss ratio. If the years of seasoning is greater than zero, then the prior loss ratios at the start of the testing time horizon will be random.

MODEL LOGIC

The Model generates a loss ratio at time t, LR(t), which can be viewed as the sum of three terms.

LR(t)=LR(t-1) [the prior loss ratio]
+ CD(t) [a correlated deviate at time t]
+ P(t)LR(t-1)([M/PLR(t)]-1) [a phase in amount]

Here CD(t) is a correlated deviate. If std is given as the standard deviation and sc as the serial correlation the deviates are generated as follows: set s = (std) x $(1\text{-}sc^2)^{1/2}$. Then the first deviate is drawn from a normal distribution with mean 0 and standard deviation s, (i.e., sN(0,1)). Subsequent deviates are given by CD(t+1) = (sc) x CD(t) + s x N(0,1).

Here M is the ***Target Pricing Loss Ratio*** (see the definitions above).

Here PLR(t) is the loss ratios experience in year t that is the basis on which new re-priced business is being put on the books.

PLR (t)=LR (t- ***Phase In Delay***) see the definitions above for ***Phase In Delay***.

If the total time from change in experience to re-pricing is 1 year, than PLR (t) = LR (t-1). If the ***Phase In Delay*** is not a whole number PLR (t) will be an interpolated value of earlier loss ratios.

P(t) is a phase in factor. It is the dollar equivalent of P which is either the "***High Loss Ratio Phase in Factor***" or the ***"Low Loss Ratio Phase in Factor***". See the definitions above. If we started with $1 of premium and 10% of units phase in, P=.1, the new premium dollars, PD, will be

PD= .9 (from old units) +.1 PLR/M from new units =(1-P) + PxPLR/M

That is, to get the target loss ratio to M when the experience is PLR premiums need to be changed by PLR(t)/M. Thus the dollars phased in =PxPLR(t)/M.

The expected dollar loss in the next period (as the experience is unchanged) is still LR(t-1). However the expected loss ratio is now LR(t-1)/PD.

The new units as percentage of total premium, P(t), will be

Px (PLR(t)/M)/[Px(PLR(t)/M)+(1-P)] = (PxPLR (t))/[Px (PLR (t))+(1-P) xM]

The expected loss ratio on re-priced dollars, P(t), would be M if the current loss ratio, LR (t-1), was the basis for re-pricing (i.e., equal to PLR(t)). The loss ratio on an old dollar is LR(t-1), but we have (PLR(t)/M) dollars per old dollar rewritten, thus the expected Loss ratio on new dollars is LR(t-1)/(PLR(t)/M)= Mx(LR (t-1)/PLR (t)).

The new expected loss ratio as a percentage of premium is:

=(1-P (t)) LR (t-1)+P (t) xMxLR(t-1)/PLR (t)

= LR (t-1)+P (t) LR (t-1)([M/PLR (t)]-1) [prior loss ratio plus phase in amount]

= LR (t-1)/PD [prior losses per new dollars]
Thus the phase in adjustment can be thought of as P (t) LR (t-1)([M/PLR (t)]-1))

The profit for the period is the PD dollars times the (TLR + target profit margin - LR (t)) plus an interest adjustment on additional reserves (if any) and actual surplus versus the target required surplus giving rise to the target profit margin. The aggregate is then divided by PD to put it on a per dollar basis.

If reserve strengthening is used, the change in the additional reserve from year to year over the testing time horizon is subtracted from pre-tax profits (i.e., the reserve is assumed fully tax deductible if tax recognition = 100%). The added reserves is made based on PLR being the level of losses in the current block and RALR (reserve adjustment loss ratio) as being the loss ratio above which additional reserves are required (i.e., add reserves for losses over RALR up to PLR). RALR could equal the target loss ratio plus the profit margin. The size of the additional reserve depends on the phase in factor and the pre-tax interest rate on funds. The reserve adjustment is made at year-end based on the PLR determined at the end of the year. It is calculated based on the high phase in factor and the pre-tax interest rate on funds.

The model allows reserve strengthening to be done at other than 100% of the calculated amount. This may be appropriate if there is correlation in the deviates.

Depending on how the loss ratios are calculated and how the dynamics are modeled, reserve changes may be implicit in the loss ratio dynamics. The DI loss ratios included normal reserve changes but not basis changes, so no reserve adjustment is required to implicitly model normal reserve changes. If serial correlation is –30%, then 30% (or more accurately .3/(1-. 3)) of the change in loss ratio is expected to be reversed (e.g., think of this as that part of the change coming from random fluctuation and not expected to persist). In this case, setting up reserves for the current loss ratio after an increase in loss ratios would exceed gross premium reserves.

If the required surplus is being calculated, the model goes through each scenario as outlined above using the inputted required surplus and tracks the scenarios in which a ruin (hit) occurs. If the probability of ruin is 5% and 1000 scenarios are being used the model is looking for a level of surplus that produces at least 50 hits but less than 51. If 1001 scenarios were used the model would be looking for 51 hits but less than 52.

If the initial run produces less than the target number of hits (50 for 5% ruin and 1,000 scenarios), required surplus is too high and the next try will be a lower level of required surplus. Any hit scenarios are not rerun as they are assumed to fail when the lower required surplus is found.

If the initial run produces more than the target number of hits, required surplus is too low. Any scenario that was not a hit would not be rerun, as they are assumed to not fail when the higher required surplus is found. It is usually best to have the initial guess of required surplus be on the low side because more scenarios will drop out of the testing after the first trial. Once the initial set of random numbers are generated with a negative seed number (e.g., -100,000), this process runs very fast.

WORKSHEETS (shown in bold Italics)

1. ***Overview***: This worksheet, if included, has this model documentation.
2. ***Model:*** This worksheet has the basic model. It accepts input for scenarios, runs one or many scenarios and saves results.
3. ***RunData:*** If cell B19 of ***Model*** has a 1, then data is collected for each scenario on the minimum surplus over the testing time horizon, the starting loss ratio after the seasoning process, the ending loss ratio and the aggregate return divided by the aggregate capital invested. Summary data is on these items is also given. [Warning: On the worksheet function PERCENTILE Excel Help says "If array is empty or contains more than 8,191 data points, PERCENTILE returns the #NUM! error value." However, I have run up to 50,000 scenarios and not received an error value.]
4. ***RNumbers***: This worksheet produces random scenarios adjusted to satisfy certain criteria. This sheet is used in the model only if the random seed in cell B6 of ***Model*** is negative.
5. ***CalcSTD:*** This is an auxiliary worksheet not used in running the model. It calculates a standard deviation in the change in loss ratios given loss ratio data (historic results) and a set of model assumptions on management dynamics.

MODULES

1. Module 1 has a subroutine called *Scenario*. For the number of scenarios in the left most set of input, cell B6 in ***Model***, *Scenario* runs scenarios and counts the number of times ruin occurs. While *Scenario* is running the number of scenarios completed and the percentage of ruin scenarios is updated in cells B2 and B3 of ***Model***. The *Scenario* subroutine is not accessed directly but is triggered by using the buttons "Find Probability of Ruin – One" or "Find Probability of Ruin – All" in ***Model***.

   If the seed, cell B6 of ***Model***, is greater than or equal to zero, *Scenario* will use the Visual Basic function Rnd to generate random numbers. If the seed number is less than zero, *Scenario* will read the random numbers from ***RNumbers***. If necessary, *Scenario* will set ***RNumbers*** and run the program RNFIX for the seed number, number of scenarios and years per scenario needed for the run. To get the full benefit of the adjustments in the random numbers in ***RNumbers,*** the years of seasoning and the testing time horizon, Cells B12 and B14 in ***Model,*** should equal the length of scenarios in ***RNumbers***.

2. Module 2 has the program *Prob*. It is much like Scenario only it iterates to find the required surplus needed for a given level of ruin and it ignores the generation of extra data indicator.
3. Module 3 has one subroutine, *Calcdeviates*. It is accessed directly in ***CalcSTD*** by clicking the button "Calculate Deviates". The same management dynamics as found in ***Model***, (***Phase In Delay***, ***Low Loss Ratio Phase in Factor***, ***High Loss Ratio Phase in Factor***, ***Low Re-price Ratio***, ***High Re-price Ratio***, and ***Target Pricing Loss Ratio***) are used as input into *Calcdeviates*. A different set of dynamics can be inputted for each set of data. These are inputted in rows 4 through 9 in consecutive columns starting with column B for up to 99 columns. Given these inputs the deviates required to produce a given set of historic loss ratios are calculated. The historic loss ratios are inputted in rows 18 to 33 under the appropriate management dynamics. The historic loss ratios do not have to be of the same length. The resulting standard deviation of the deviates is a likely candidate for the standard deviation to be used in cell B8 of ***Model*** with the assumed management dynamics. The same historical experience will produce a different standard deviation given different assumptions on management dynamics.
4. Module 4 has one macro, *RUNONE*, which is accessed directly in ***Model*** by clicking the "Find Probability of Ruin – One" button. The macro uses the sub *Scenario* in module 1 to run the next set of input assumptions found in ***Model***. After the run, the input and result is saved in ***Model*** (the prior output having being shifted over one column to the right). The remaining input scenarios are shifted over one column to the left.
5. Module 5 has one macro, *runmany*, which is accessed directly in ***Model*** by clicking the "Find Probability of ruin – All" button. The macro repeatedly runs RUNONE until all the input sets have been run.
6. Module 6 has one subroutine, *RNFIX*, which is accessed directly in the worksheet ***RNumbers*** by clicking the button RNFIX. *RNFIX* uses the seed number in cell E1 of RNumbers, the number of scenarios in cell C1 and the length of each scenario in cell C2. The scenarios are generated then numbered, with 1 being the scenario with the lowest sum of deviates, 2 the next lowest and so on. The scenarios are then ordered (but not re-numbered) based on the lowest sum of squares. Finally, the scenarios are adjusted.

   Each scenario of random numbers, X (i), is adjusted to aX (i)+b. Here a and b are chosen so that the sum of the adjusted X (i) and the sum of the X (i) squared match the expected distribution. For example, each scenario has 10 random numbers and the sum of those 10 random numbers is normally distributed with a mean of zero and a standard deviation of $(10)^{1/2}$. The sum of the square of the 10 random numbers will have a chi-square distribution with 10 degrees of freedom. If there are five scenarios (of ten random numbers each) the sum of the ten random numbers of each scenario are adjusted so that the five sums are at 10%, 30%, 50%, 70%, and 90% respectively of the Normal distribution with mean 0 and standard deviation $10^{1/2}$. The sum of the squares are adjusted so the five values equal 10%, 30%, 50%, 70% and 90% for the Chi Square distribution with ten degrees of freedom. Finding a and b to get the target adjustments requires solving a quadratic equation. If the equation has no real roots, a and b are chosen to produce the target sum and minimize the difference between the sum squared and the target sum squared. In these cases the difference is given in column one of ***RNumbers***.

[The program RNFIX uses the excel function CHIINV which uses 1- probability as input, and the excel function NORMINV which uses on the probability as input]

7. Module 7 has one macro, *PROBALL*, which is accessed directly in ***Model*** by clicking the “Find Required Surplus - All” button. The macro uses the sub *PROB* in module 2 to run all the input assumptions found in ***Model***. After the run, the input and result is saved in ***Model*** (the prior output having being shifted over one column to the right). The remaining input scenarios are shifted over one column to the left.
8. Module 8 has one macro, *PROBONE*, which is accessed directly in ***Model*** by clicking the “Find Required Surplus - One” button. The macro repeatedly runs *PROB* for the next input set in model.

Running the Model

In ***Model*** input the assumptions for the items listed in A5 to A34 in columns B5 to B34. If you want to run multiple scenarios, input the additional scenarios in columns C, D etc. To run only the first scenario, the one in B5 to B34, click one of the buttons that run one scenario. To run all the scenarios, click one of the buttons with the "All". The progress of the run will show in cells B2 and B3. When a scenario is done, the prior output, in rows 55 to 95, will be shifted one column to the right and the most recent scenario will be stored in B55 to B95. If there is another scenario in C5 to C34 all the input scenarios will be shifted over one column to the left.

If the run all button is chosen then the model will either always find the required surplus or probability of ruin for all runs. To have the model stop during a run all request, leave a blank input column between the runs to be separated. When the model sees cell C6 is empty it stops the run all processes.

Model is available from the Academy on request.

DI RBC CLIM RESERVE MODEL DOCUMENTATION

Claim Reserve Model (12/21/00)

INPUT

1. Choose two annual payment sizes in cells A4 and A5 of sheet1
2. Choose the number of claims with the given payment size, cells B4 and B5
3. Choose the first, second and subsequent year termination rates for the two payment sizes in cell block D4:F5
4. Choose the annual earned rate on assets supporting reserves in cell B6.
5. Choose the discount rate for reserves in cell B7

6. Choose the initial surplus as a percent of reserves in cell B11
7. Choose the testing horizon in cell B12
8. Choose the number of scenarios in cell B13
9. Choose the seed for random number generation in B14

EXCEL CALCULATIONS

1. The block H4:J5 determines the number of initial, one-year and subsequent claims in a stationary block in which there is one new claim each year and the termination rates in D4:F5 are applied.
2. The block H8:J9 provides the number of initial, one-year and subsequent claims as a percent of total claims.
3. The block H12:J13 applies the % in H8:J9 to the number of claims in B4 and B5 to give the distribution of the number claims in a stationary population given the termination rates and the starting number of claims. For most combinations this will result in fractional claims which are treated as a complete claim for a lower amount (e.g. if there are 13.4 initial claims of size $120,000 per year it is treated as 13 claims of $120,000 and 1 claim of (.4 x $120,000)).
4. Cells L4:N5 have the reserves per dollar of annual payment for initial, one-year and subsequent years for both payment sizes based on the given reserve rate and termination rates. At the beginning of a year, it is assumed there are no payments or terminationS until mid-year. At mid-year everyone gets a payment then terminations occur. All survivors will get a payment at year-end.
5. Cells L8:N9 have the reserves per claim, given the size of a claim.

Visual Basic Calculations - Stationary Block

1. Assets are accumulated for 1/2 year at interest.
2. Payments are calculated and deducted from assets
3. Lapses are calculated using random numbers and the population reduced accordingly.
4. Assets are accumulated for 1/2 year at interest.
5. Payments are calculated for survivors and deducted from assets.
6. The number of subsequent year claims becomes the remaining subsequent year number of claims plus the remaining one-year number of claims.
7. The number of one-year claims becomes the remaining initial claims.
8. New initial claims are assumed equal to the numbers in cell H12 and H13.
9. Assets are increased for the reserves on new claims (without new surplus).
10. If assets are less than reserves a failure is recorded and the program moves to the next scenario.
11. If assets exceed reserves, begin again at 1 until the number of testing years is completed. When completed, begin a new scenario.

Visual Basic Calculations - Closed Block

Follows the procedures for a stationary block except that new claims are not introduced at the beginning of a year.

Model is available from the Academy on request.

Appendix D - Data Survey

Instructions and Overview Given to Recipients

The NAIC asked the American Academy of Actuaries to recommend risk based capital requirements for disability income, long term care, stop loss and limited benefit insurance products. The requirements are for the Life, Health and Casualty risk based capital formulas. A DI subgroup was formed to respond to this request.

The DI subgroup intends to use models to quantify risk based capital requirements. The model requires assumptions on the volatility of loss ratios, profit levels, the speed of re-pricing, the average interest rate applicable to reserves and typical active and disabled life stationary populations.

This request for information is being made so model assumptions can reflect historical results and the judgment of actuaries familiar with these businesses.

The DI subgroup may also use the data collected to model the surplus requirements of a closed block of business. At this time, a closed block model is not available.

Format and Questions

A worksheet is provided for the major disability income products for which distinct risk based capital requirements are anticipated. If you don't have data for a major product type, just leave that work sheet blank. Columns E to U of each sheet capture data from which historical loss ratio volatility can be determined. Columns AA through AQ capture data to develop typical stationary populations. Columns BA through BH capture data on the speed of re-pricing and profit assumptions. Columns BA through BH also ask for the company contact if there are questions on the data. If you have any questions on filling out this questionnaire please contact any of the following (committee contacts followed).

Confidentiality

This information will be compiled and individual responders will not be identified explicitly with their data. Every effort will be made to avoid displays of data in a group of less than four and where possible to only display aggregate data. The Academy will need to make some data available in the report supporting its conclusions.

Unbiased Data

It is important that the data not be biased as to the underlying risk. If for any reason the data reported does not consist of the entire data for the type of product being reported, please disclose the nature of the data omitted in the comment section.

PART 1 of Survey - Historic Data

	(Provide data in thousands)	1983	1984	…	1996	1997	1998
	1) BOY Policy Reserves						
1	2) BOY Claim, Expense and IBNR Reserves						
	3) BOY Exhibit 11 Liabilities not in item 2						
2	4) Earned Premium						
3	5) Paid Claims						
4	6) Change in Claim Reserves and Liabilities						
5	7) Change in Policy Reserves						
	8) Average Claim Reserve Discount Rate						
	9) Average Policy Reserve Discount Rate						
	10) Claim Reserve Change due to Basis Change						
	11) Policy Reserve Change due to Basis Change						
6	12) BOY Disabled Lives						
	13) BOY Active Lives						
	14) BOY BMI in payment status net of reinsurance						
	15) BOY BMI on active lives net of reinsurance						

1. If expense reserves are not available, provide the reserves available and indicate in the comment section, below, that reserve and reserve changes do not include expenses.

2. Provide data as it would be defined in Schedule H Part 3 lines 1A and 1B in 1998

3. Provide data as it would be defined in Schedule H Part 3 lines 1A and 1B in 1998.

4. Provide data as it would be defined in Schedule H Part 2 line C3. If items 5 and 6 would not tie to incurred claims, please explain. If incurred claims are available, but not the separation into paid and reserve changes, please provide the incurred claims and indicate in the comments that you have done so.

5. Provide data as it would be defined in 1998 Schedule H Part 1 line 4.

6. If only the number of policies as available in items 12 and 13, provide that information and indicate in the comment section that the data is number of policies.

PART 2 of Survey - Model Office Data

For each category please indicate the percentage of a representative stationary population of **active lives** in each sub category.

Elimination Period	%		Sex	%		Attained	
0-7 days			Male			Age	%
8-30 days			Female	____		<=24	
31-60 days			Total	100%		25-29	
61-90 days						30-34	
91-180 days						35-39	
>180 days	____		CIDA			40-44	
Total	100%		Occupations	%		45-49	
			White Collar			50-54	
Benefit			Skilled			55-59	
Period	%		Light Manual			>=60	____
<= Two Years			Hazardous	____		Total	100%
>2 and <=65 or 70			Total	100%			
> 70 or lifetime							
Total	100%						

For each category please indicate the percentage of a representative stationary population of **disabled lives** in each sub category.

Attained				CIDA			
Age	%	EP	%	Occupations	%	Benefit	
<=24		<=90 days		White Collar		Period	%
25-29		>90 days	____	Skilled		<= Two Years	
30-34		Total	100%	Light Manual		>2 and <=65 or 70	
35-39				Hazardous	____	> 70 or lifetime	____
40-44				Total	100%	Total	100%
45-49							
50-54		Sex	%				
55-59		Male				Cola	%
>=60	____	Female	____			Yes	
Total	100%	Total	100%			No	____
						Total	100%

PART 3 of Survey - Pricing and Management Dynamics Data

To help determine the period required to re-price for a trend, please indicate:
1) How many months does it take to recognize a trend?
2) How many months does it take to internally re-price a product?
3) How many months does it take to get state approval?
4) What is the average annual lapse rate for earned premium?

For the typical company in the industry of your company's size and for a stationary population of active lives, what would you estimate the following to be as a percentage of earned premium.
1) Loss Ratio (claims incurred/earned premium)
2) Expense Ratio (all expense, commissions and tax / earned premium)
3) Profit Ratio
4) Target Statutory Surplus as a percentage of Premium
5) Other capital invested as a % earned premium (e.g. Statutory Strain)

In a stationary population of disabled lives, what would you estimate the ratio of statutory claim reserves to best estimate reserves to be for the industry?

Contact if follow up questions are needed on the data provided:
Name:_______________________________________
Phone:_______________________________________
Email:_______________________________________

Appendix E Data
NonCan Loss Ratio Data

Year	Co. 1	Co. 2	Co. 3	Co. 4	Co. 5	Co. 6	Co. 7	Co. 8	Co. 9	Co. 10
1983		51%	68%				79%		100%	53%
1984	53%	55%	64%				71%		47%	50%
1985	52%	53%	62%				76%		16%	60%
1986	55%	59%	76%				64%		38%	57%
1987	58%	63%	63%	80%	56%	57%	56%		43%	68%
1988	70%	51%	92%	74%	48%	87%	79%		56%	57%
1989	65%	62%	80%	73%	60%	67%	51%		46%	69%
1990	68%	75%	66%	69%	69%	73%	22%	68%	55%	75%
1991	65%	92%	61%	81%	76%	74%	27%	80%	67%	75%
1992	61%	92%	84%	70%	78%	63%	64%	64%	68%	78%
1993	62%	104%	76%	53%	79%	63%	67%	77%	49%	78%
1994	74%	100%	82%	75%	84%	110%	59%	78%	47%	89%
1995	75%	115%	87%	83%	86%	106%	83%	64%	73%	77%
1996	82%	89%	92%	82%	43%	114%	66%	65%	71%	65%
1997	78%	81%	97%	90%	76%	109%	54%	68%	77%	53%
1998	77%	105%	72%	110%	90%	100%	56%	66%	63%	59%

GR Loss Ratio Data

Year	Co. 1	Co. 2	Co. 3	Co. 4
1983		53%	36%	199%
1984		61%	31%	53%
1985	162%	41%	60%	60%
1986	58%	26%	61%	58%
1987	55%	56%	28%	53%
1988	66%	40%	18%	43%
1989	75%	74%	30%	**-7*%**
1990	94%	70%	31%	24%
1991	91%	78%	64%	68%
1992	73%	57%	33%	38%
1993	55%	58%	34%	32%
1994	64%	61%	53%	53%
1995	60%	39%	66%	72%
1996	71%	55%	42%	41%
1997	64%	44%	46%	43%
1998	61%	72%	51%	47%

*This point and prior data were ignored for this company.

GLTD Loss Ratio Data

Year	Co. 1	Co. 2	Co. 3	Co. 4	Co. 5	Co. 6	Co. 7
1983	87%	76%	68%				
1984	81%	82%	79%	60%	57%		
1985	71%	69%	70%	71%	55%		
1986	64%	70%	99%	76%	52%		66%
1987	71%	93%	**18*%**	82%	58%		70%
1988	70%	85%	153%	108%	52%		69%
1989	84%	85%	142%	65%	55%	37%	68%
1990	100%	77%	102%	75%	55%	48%	70%
1991	102%	80%	70%	105%	58%	49%	77%
1992	90%	90%	82%	91%	56%	36%	72%
1993	97%	98%	96%	82%	76%	47%	58%
1994	114%	91%	104%	98%	58%	51%	71%
1995	101%	85%	122%	76%	62%	35%	69%
1996	76%	94%	83%	81%	66%	54%	73%
1997	81%	97%	86%	61%	62%	41%	79%
1998	69%	81%	85%	60%	69%	43%	83%

*This point and prior data were ignored for this company.

GSTD Loss Ratio Data

Year	Co. 1	Co. 2	Co. 3	Co. 4	Co. 5
1983			64%		
1984		63%	71%		
1985		61%	68%		
1986		65%	76%		
1987		60%	82%	52%	
1988		64%	79%	58%	
1989		55%	72%	60%	
1990		61%	71%	62%	
1991		60%	71%	66%	
1992		58%	72%	62%	
1993		62%	73%	65%	79%
1994	80%	67%	71%	62%	80%
1995	47%	64%	72%	61%	75%
1996	49%	73%	74%	61%	79%
1997	51%	65%	73%	63%	84%
1998	52%	62%	74%	66%	83%

Table SP1 “Historic SP Credit Loss Ratios”

Co. #	1992	1993	1994	1995	1996	1997	1998
1	46%	46%	48%	49%	42%	46%	46%
2	46%	39%	42%	42%	41%	39%	39%
3	55%	56%	60%	58%	53%	56%	55%
4	58%	51%	51%	56%	54%	52%	51%
5	51%	46%	35%	38%	34%	30%	47%
6	66%	50%	41%	39%	39%	38%	41%
7	76%	75%	77%	72%	70%	73%	73%
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	49%	52%	45%	42%	201%	54%	50%
11	47%	44%	43%	36%	43%	36%	32%
12	40%	20%	21%	35%	50%	37%	38%
13	81%	46%	53%	47%	56%	57%	46%

Table SP2 “Historic SP Credit Premium Growth Rate”

Co. #	1993	1994	1995	1996	1997	1998
1	4%	16%	31%	33%	15%	9%
2	-18%	2%	0%	0%	6%	10%
3	33%	-1%	9%	4%	-2%	1%
4	3%	5%	21%	20%	9%	4%
5	-10%	2%	-12%	0%	-15%	2%
6	-22%	201%	99%	0%	-9%	-27%
7	-5%	-3%	1%	2%	0%	-3%
10	6%	4%	0%	-100%	332173%	-17%
11	7%	9%	10%	4%	-4%	-6%
12	7%	9%	22%	21%	4%	0%
13	153%	7%	11%	26%	17%	13%

Table SP3 "SP Credit Calculated deviates"

Co. #	1993	1994	1995	1996	1997	1998
1	-0.021	0.005	0.002	-0.080	0.017	-0.015
2	-0.084	0.005	-0.025	-0.028	-0.039	-0.030
3	0.016	0.035	-0.021	-0.045	0.029	-0.015
4	-0.068	0.000	0.054	-0.021	-0.023	-0.014
5	-0.046	-0.122	-0.004	-0.058	-0.075	0.142
7	0.045	0.069	0.012	0.021	0.065	0.040
11	-0.046	-0.026	-0.089	0.041	-0.085	-0.065
12	-0.215	-0.028	0.111	0.126	-0.132	-0.016
13	-0.281	0.054	-0.057	0.075	0.004	-0.109

Table SP4 "SP Credit Other Characteristics"

Co. #	Size 1 (Million)	Size 2 (Million)	STD of Deviates	Serial Correlation	5% Ruin RBC on Co. STD and SC
1	113.7	516.4	0.0386	-0.4959	0.38%
2	67.1	425.2	0.0168	0.5453	0.00%[1]
3	76.2	489.9	0.0343	-0.4347	0.08%
4	56.9	304.7	0.0323	-0.0763	1.12%
5	46.9	390.2	0.1016	-0.3617	16.17%
7	32.5	234.6	0.0256	-0.3429	0.00%[2]
11	17.0	117.4	0.0539	-0.6357	1.49%
12	11.8	65.6	0.1073	-0.1217	26.98%
13	9.0	40.3	0.0764	-0.4160	7.89%

1. 3.42% chance of ruin with no surplus.
2. 1.67% chance of ruin with no surplus.

MOB Loss Ratios

Co. #	1992	1993	1994	1995	1996	1997	1998
1	36%	48%	32%	36%	40%	40%	30%
2	-57%	10%	38%	4%	N/A	N/A	N/A
3	47%	37%	43%	44%	40%	32%	27%
4	102%	55%	84%	69%	82%	59%	93%
5	26%	35%	39%	35%	35%	31%	27%
6	121%	87%	161%	110%	82%	31%	52%
7	65%	64%	65%	64%	65%	65%	65%
8	48%	47%	50%	54%	78%	46%	39%
9	46%	33%	43%	42%	43%	41%	41%
10	N/A	N/A	N/A	175%	N/A	67%	81%
11	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	43%	62%	51%	66%	66%	70%	86%

MOB Premium Growth Rate

Co. #	1993	1994	1995	1996	1997	1998
1	8%	14%	12%	14%	7%	11%
2	10%	-66%	-59%	-100%	NA	NA
3	5%	18%	44%	52%	27%	-18%
4	34%	97%	73%	40%	-11%	-6%
5	61%	63%	50%	25%	10%	-7%
6	-22%	-61%	-24%	70%	23%	295%
7	3%	5%	8%	3%	4%	6%
8	29%	33%	-7%	26%	10%	182%
9	15%	12%	14%	9%	5%	-1%
10	NA	NA	NA	-100%	NA	-8%
11	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA
13	453%	19%	7%	-1%	-6%	-16%