# DRAFT: Evaluating Mortgage Insurance

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# Evaluating Mortgage Insurance

## Outline



**The following criteria procedure should be read in conjunction with *Best's Credit Rating Methodology (BCRM)* and all other related BCRM-associated criteria procedures. The BCRM provides a comprehensive explanation of A.M. Best Rating Services' rating process.**

## A. Market Overview

Mortgage insurers are monoline insurance companies that provide insurance against financial loss to mortgage lenders due to nonpayment or default by homeowners. As part of the credit rating analysis of mortgage insurers, Best's Credit Rating Methodology (BCRM) remains the governing document that provides a comprehensive explanation of A.M. Best's rating process.

This criteria procedure highlights rating considerations unique to the evaluation of mortgage insurers. Such considerations include housing market dynamics, the mortgage underwriting and origination process, the calculation of reserve risk, the quality and characteristics of the underlying mortgage portfolio, and the claims-paying resources used to fund reserves. This criteria procedure also provides a framework for evaluating potential losses that may be associated with mortgage pools, such as those considered by the reinsurance industry for excess of loss coverage pursuant to the risk-sharing initiatives of Government Sponsored Enterprises (GSEs) – Freddie Mac and Fannie Mae – and other non-GSE-related mortgage exposures. This potential loss evaluation will then be used as a factor in a reinsurer's Best's Capital Adequacy Ratio (BCAR) analysis. Section B of this criteria procedure covers the rating process for primary monoline mortgage insurers, and Sections C and D describe how capital charges are assigned to GSE and non-GSE mortgage risks assumed by reinsurers.

### Mortgage Guaranty Insurance

Mortgage guaranty insurance or mortgage insurance (MI) protects mortgage lenders by ceding the mortgage risk from lenders to insurers, thus providing an added layer of credit protection should homeowners default on their payment obligations. The National Association of Insurance Commissioners (NAIC) Mortgage Guaranty Insurance Model Act defines MI as insurance against financial loss by reason of nonpayment of principal, interest, or other sums agreed to be paid on any authorized real estate security; this includes nonpayment of rent under the terms of a written lease for the possession, use, or occupancy of real estate.

# Evaluating Mortgage Insurance

In the United States, private mortgage insurance (PMI) is typically provided on residential loans consisting of one to four family residences, including condominiums and townhouses, with most policies written on first-lien mortgages with a loan-to-value ratio (LTV) greater than 80%. PMI makes the loan eligible for acquisition by the GSE, as the PMI reduces the GSE's effective exposures on such mortgages to the 80% threshold.

## Market Characteristics

Demand for MI depends on mortgage originations, housing prices, loan amounts and the percent of loan originations with an LTV in excess of 80%. Despite a limited number of active players, the PMI market is very competitive, given the commoditized nature of this product and the limited opportunity for product differentiation. In addition, private mortgage insurers compete with the Federal Housing Administration (FHA), which provides MI on mortgages originated by the FHA, approved banks and private lending institutions.

Mortgage insurance claims generally are affected by swings in the economy, which impact the unemployment rate and housing prices. This was demonstrated in 2008 during the credit crisis, when housing prices rapidly deteriorated. From 2007 through 2012, the MI industry suffered its worst financial and credit performance in two decades. With the current return to profitability and the Private Mortgage Insurer Eligibility Requirements (PMIERs) established by the Federal Housing Finance Agency (FHFA), private mortgage insurers' participation in the insurance of mortgage loans acquired by the GSEs recently has increased. PMIERs is a risk-based approach that requires approved private mortgage insurers to maintain sufficient assets for claim payments and meet certain requirements to provide MI for loans acquired or enhanced by the GSEs. The GSEs are entering into risk-sharing programs (as discussed later in this criteria procedure) to facilitate the efforts of the FHFA, the conservator of the GSEs, to attract private capital to the housing market and reduce a taxpayer's potential exposure to losses.

## A.M Best's Rating Process

The building blocks of A.M. Best's rating process are outlined in **Exhibit A.1**.

**Exhibit A.1: A.M. Best's Rating Process**

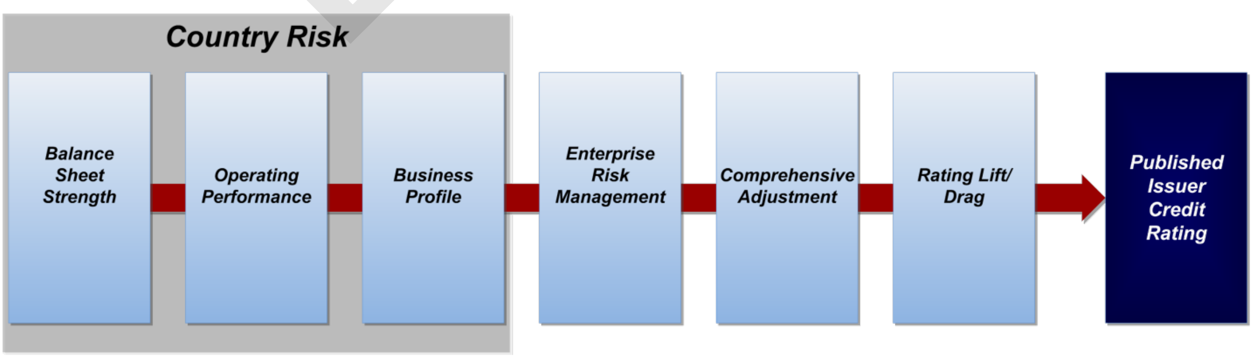



**Exhibit A.2** details the possible assessment descriptors for the evaluations of balance sheet strength, operating performance, business profile, and enterprise risk management.

**Exhibit A.2: BCRM Building Block Assessments**

| Balance Sheet Strength | Operating Performance | Business Profile | Enterprise Risk Management |
|---|---|---|---|
| Strongest | Very Strong | Very Favorable | Very Strong |
| Very Strong | Strong | Favorable | Appropriate |
| Strong | Adequate | Neutral | Marginal |
| Adequate | Marginal | Limited | Weak |
| Weak | Weak | Very Limited | Very Weak |
| Very Weak | Very Weak | | |

A.M. Best's rating process **(Exhibit A.1)** for MI companies provides an opinion on an insurer's ability to meet its ongoing obligations to policyholders. The valuation of a MI company's financial strength is based on in-depth analysis of its balance sheet strength – including its available resources to satisfy potential claims and its capital adequacy following the application of stress scenarios or assumptions – along with a review of the insurer's operating performance, business profile, and enterprise risk management.

## B. Rating Considerations: Mortgage Insurance

### Balance Sheet Strength

A.M. Best's rating analysis begins with an evaluation of the rating unit's balance sheet strength. Balance sheet strength measures the exposure of a company's surplus to its operating and financial practices. MI is characterized by its long exposure period, with an average policy period of approximately seven years, and by occasional catastrophic losses due to widespread defaults resulting from sudden, systematic and severe economic downturns. These unique characteristics may lead to losses that far exceed the mortgage insurer's financial resources, causing financial impairment or insolvency. Thus, A.M. Best believes that the mortgage insurer's balance sheet strength and its ability to meet its current and ongoing obligations to policyholders in various stress scenarios are key drivers in the rating assessment. The balance sheet analysis for the primary MI companies begins with a quantitative estimate of the insurer's capital adequacy at different confidence levels. As a result, an analysis of an MI company's underwriting, financial, and asset leverage is important in assessing the overall strength of its balance sheet.

### Capital Adequacy and BCAR

A key component of the evaluation of balance sheet strength is a company's BCAR score **(Exhibit B.1)**.

**Exhibit B.1: BCAR Formula**

$$BCAR = \left( \frac{\text{Available Capital} - \text{Net Required Capital}}{\text{Available Capital}} \right) X\ 100$$

A.M. Best's BCAR model evaluates and quantifies the adequacy of a company's risk-adjusted capital position. BCAR uses a risk-based capital approach that calculates the net required capital (NRC) needed to support three broad risk categories: investment risk, credit risk, and underwriting risk. The NRC in the BCAR formula also contains an adjustment for covariance, reflecting some statistical independence of the individual components. The covariance adjustment recognizes the low probability that all risk elements would occur simultaneously and serves to reduce the overall net required capital (**Exhibit B.2**).

**Exhibit B.2: Required Capital Components and Modified Net Required Capital Formula**

**(B1) Fixed Income Securities Risk**

**($B1_n$) Non-affiliated Fixed Income Securities Risk**

**(B2) Equity Securities Risk**

**($B2_n$) Non-affiliated Equity Securities Risk**

**(B3) Interest Rate Risk**

**(B4) Credit Risk**

**(B5) Net Loss and LAE Reserves Risk**

**($B5_m$) Mortgage Net Loss and LAE Reserves Risk**

**(B6) Net Premiums Written Risk**

**($B6_m$) Mortgage Net Premiums Written Risk**

**(B7) Business Risk**

**(B8) Potential Catastrophe Losses**

The modified NRC formula to incorporate the correlation between Non-affiliated Fixed Income Securities/Non-affiliated Equity Securities Risk and mortgage Net Loss and LAE Reserves/Net Premiums Written Risk is shown below:

$$\text{NRC} = \sqrt{B1^2 + B2^2 + (B1_n + B2_n) * (B5_m + B6_m) + B3^2 + (0.5B4)^2 + (0.5B4 + B5)^2 + B6^2 + B8^2} + B7$$

This equation is similar to the standard NRC equation except for the covariance term "($B1_n$+$B2_n$)*($B5_m$+$B6_m$)." In this equation, $B1_n$ is the non-affiliated Fixed Income Securities Risk, which represents investment in government bonds, non-affiliated corporate bonds, and other non-affiliated fixed income assets. $B2_n$ is the Non-affiliated Equity Securities Risk, which represents investments in non-affiliated common stocks, non-affiliated preferred stocks, and other non-affiliated equity-like assets. $B5_m$ is the Net Loss and LAE Reserves Risk associated with mortgages and $B6_m$ is the Net Premiums Written Risk associated with mortgages.

This covariance term is calculated as follows:

**Covariance Term = 2 * $\text{Correlation}_1$ * $B1_n$ * ($B5_m$+$B6_m$) + 2 * $\text{Correlation}_2$ * $B2_n$ * ($B5_m$+$B6_m$)**

Where $\text{Correlation}_1$ is the correlation between non-affiliated Fixed Income Securities Risk and mortgage risk, and $\text{Correlation}_2$ is the correlation between non-affiliated Equity Securities Risk and mortgage risk.

If we assume that both $\text{Correlation}_1$ and $\text{Correlation}_2$ are equal to 50%, the equation reduces to the following:

**Covariance Term = 2 * 50% * ($B1_n$+$B2_n$) * ($B5_m$+$B6_m$) = ($B1_n$+$B2_n$) * ($B5_m$+$B6_m$)**

If an entity has no mortgage risks, the covariance term is 0 so the NRC formula reduces back to the standard NRC formula used for rating typical property and casualty insurers shown below:

$$\text{NRC} = \sqrt{B1^2 + B2^2 + B3^2 + (0.5B4)^2 + (0.5B4 + B5)^2 + B6^2 + B8^2} + B7$$

Capital represents a very important part of the financial strength analysis of a mortgage insurer. Policyholders' surplus, loss reserves, unearned premium reserves, contingency reserves, and other claims-paying resources form a buffer to protect policyholders against potential losses.

A mortgage insurer's Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) is estimated by a mortgage credit risk model based on the insurer's existing loan portfolio, changes in interest rate path, changes in home price indices, and other economic drivers. In incorporating mortgage Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) into the BCAR, A.M. Best assumes a correlation between the mortgage Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) and Non-affiliated Fixed Income Securities Risk ($B1_n$) of 50%. A.M. Best also assumes a correlation between the mortgage Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) and Non-affiliated Equity Securities Risk ($B2_n$) of 50%. Non-affiliated Fixed Income Securities Risk ($B1_n$) is from the investment in government bonds, non-affiliated corporate bonds, etc., while the Non-affiliated Equity Securities Risk ($B2_n$) arises from the investment in non-affiliated common stocks, non-affiliated preferred stocks, and the like.

A mortgage insurer's Net Premiums Written Risk ($B6_m$) is estimated using the projected 30-year ground up losses and three years of premiums associated with loans originated during the current vintage year as derived from the model at various confidence levels, times a growth factor based on mortgage insurer's historical risk-in-force. In incorporating mortgage Net Premiums Written Risk ($B6_m$) into the BCAR, A.M. Best assumes a correlation between mortgage Net Premiums Written Risk ($B6_m$) and Non-affiliated Fixed Income Securities Risk ($B1_n$) of 50%. A.M. Best also assumes a correlation between mortgage Net Premiums Written Risk ($B6_m$) and Non-affiliated Equity Securities Risk ($B2_n$) of 50%.

The mortgage insurer's policyholders' surplus is adjusted for its contingency reserves and unearned premium reserves associated with non-refundable policies.

### *Credit Risk Model*

The mortgage Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) and the mortgage Net Premiums Written Risk ($B6_m$) are estimated based on a third-party mortgage credit risk model (see **Appendix 1** on Andrew Davidson and Co.'s "LoanKinetics" application). To capture the necessary data for the credit analysis, A.M. Best will provide the mortgage insurer with a template in which to enter the data (see **Exhibit B.3** for type of data requested). A.M. Best expects that this data is reliable and credible.

**Exhibit B.3: Loan Portfolio Information**

| Attribute | Description |
|---|---|
| Origination Date | Mortgage loan date (Year, Month, and Day) |
| Original Term | Original term in months |
| Loan Age | Age of the loan in months |
| Remaining Term | Remaining term in months |
| Original Rate | Gross mortgage rate at origination in percent |
| Current Loan Size | Current unpaid principal balance in dollars |
| Original Loan Size | Original unpaid principal balance in dollars |
| Original LTV | Original Loan-to-Value (%) |
| Original Credit Score | Credit score at loan origination |
| Product Type | Fixed, ARM, Balloon, Interest Only |
| Product Type Characteristics | Interest Only Period, Balloon Period, ARM Index, ARM Margin, ARM Life Cap, ARM First Reset Age, ARM Reset Period |
| Current Loan Status | The status of the loan as of the report date: Current, Foreclosure, Real Estate Owned, Terminated, Number of months delinquent |
| Documentation | Full, Limited, None |
| MI Cutoff | The LTV after which mortgage insurance is canceled |
| MI Premium | The premium paid by the borrower for mortgage insurance (%) |
| MI Percent | Percentage of balance covered by mortgage insurance |
| Occupancy | Owner Occupied, Second Home, Investment Property |
| Loan Purpose | Purchase, Rate/Term Refinance, Cash Out Refinance |
| Property Type | Single Family, Multi Family, Condo, Coop, Planned Unit Development (PUD), Manufactured Housing |
| State | State location of property |
| Zip | Zip code location of property |
| Credit Sector | GSE, Prime, Alt A, Subprime |

The credit risk model's loan-level inputs typically include but are not limited to the following:

- Risk-in-force
- Original term
- Loan age
- Loan balance
- Original credit score
- Original loan-to-value
- Loan product type
- Property location
- Current and historical delinquency status
- Insurance coverage amount
- Mortgage insurance premium

The amount of MI future premium credit during the projected period associated with non-single premium policies at the time of modeling is limited to only three years in the credit risk model. The reduction in the amount of future premium to be credited reflects the uncertainty regarding the availability of the full premium amount. This uncertainty may be due to the possibility of a capital shortfall or regulatory intervention prior to the recognition of future premium as observed during stress situations. Other risks addressed by this credit risk model include prepayment potential, interest rate volatility, home price indices, and loan performance under various economic conditions.

One of the key systemic factors that drive the mortgage credit risk model is the Home-Price Model. The Home-Price Model incorporates the idea of housing affordability, Home Price Appreciation (HPA) equilibrium, mean reversion to HPA equilibrium and oscillation (overshoot when correcting) characteristics. The resulting capital requirement component determined by this mortgage credit risk model reflects the partial countercyclical nature of required capital in that it increases during the upswing of a housing price bubble, and decreases as home prices fall.

The credit risk model produces a monthly time series forecast of prepayment rates, default rates, delinquencies, loss severities, transition probabilities, cumulative prepayments, defaults, losses, and premium income. It uses these forecasts to project the outstanding balances of the underlying loans and the monthly cash flows of the mortgage portfolio from the mortgage insurer's perspective in different economic scenarios. The credit risk model assumes a run-off situation, that is, projections of monthly cash flows – premiums and losses – reflect current business only. The monthly cash flows generated by the credit risk model are affected, in every month, by changes in risk-in-force (and thus changes in the premium income and potential losses). The mortgage insurance will terminate in the model when the corresponding LTV level falls below a certain threshold which triggers the cancellation of MI coverage or upon the occurrence of a default or after a specified cutoff period of insurance coverage.

A.M. Best uses the Scenario Stress Grid (see **Appendix 1: Exhibit 1** for an example of the grid) from the credit risk model, which reflects various economic scenarios grouped into three different buckets: base case (one scenario), bad cases (six scenarios), and extreme cases (six scenarios). Each scenario is assigned a probability using a cumulative distribution function (CDF), which corresponds to a confidence level derived from LoanKinetics. The assigned CDF reflects stresses in the following parameters underlying the model:

Economic stresses:

1. Interest rate changes based on parallel shifts in the interest curve up or down by basis points (bps)
2. Changes in home prices, as illustrated by the following percentage shifts:
    - One-year Home Price Index forecast
    - Two-year Home Price Index forecast
    - Maximum decline in the Home Price Index forecast

Model stresses:

1. Changes in the mortgage default rate
2. Changes in loss severity associated with loans
3. Changes in prepayment rates as a result of total terminations due to voluntary prepayments

The base case scenario in the Scenario Stress Grid projects the monthly cash flows at the 50th percentile, and the six scenarios of extreme cases show the monthly cash flow amounts at higher confidence intervals.

The monthly cash flows are computed for the mortgage loan portfolio. In the modeling of the loan portfolio, the cash flows reflect three years of projected future premium and losses over a 30-year period. Annual discounted cumulative cash flows of the loan portfolio are derived at different yearly intervals up to 30 years for scenarios that correspond to different confidence levels. The discounted cumulative cash flows of the loan portfolio include the impact of reinsurance.

A.M. Best interpolates these cash flows based on the Scenario Stress Grid results to obtain the discounted cumulative cash flows at the 95%, 99%, 99.5%, and 99.6% confidence levels. The discounted unexpected loss is the difference between the discounted cumulative cash flows at the selected confidence level and the discounted cumulative cash flows at the 50% confidence level. A.M. Best believes the discounted unexpected loss is the appropriate capital charge for the insured mortgage portfolio's Loss and Loss Adjustment Expense Reserves Risk ($B5_m$).

The calculated unexpected loss amount for the mortgage portfolio at the various confidence levels is used to account for the mortgage Net Loss and Loss Adjustment Expense Reserves Risk ($B5_m$). The company's book mortgage Loss and Loss Adjustment Reserves is adjusted for any deficiency as reflected in discounted cash flows obtained at the 50% confidence level.

The calculated ground up loss amount for the mortgage loans originated during the current vintage year at the various confidence levels times the projected growth factor is used to account for the mortgage Net Premiums Written Risk ($B6_m$).

### *Claims-Paying Resources*

A mortgage insurer's ability to make timely payments on losses is reflected in the insurer's claims-paying ability. The components of the mortgage insurer's claims-paying resources are captured from the insurer's filed statutory financial statements and include statutory capital, which is composed of policyholders' surplus and contingency reserves; unearned premium reserves; net loss and loss adjustment expense reserves; and committed third-party support, such as soft capital facilities, liquidity facilities, collateral trust funds, and contingent capital programs. A.M. Best assesses and reviews the quality and viability of any committed third-party support to determine the amount of credit given as part of the mortgage insurer's claims-paying resources.

The components of the mortgage insurer's claims-paying resources are reflected in its adjusted policyholders' surplus calculations as part of the BCAR analysis. Lower leverage ratio measures, as reflected by a mortgage insurer's ratio of risk-in-force to statutory capital and risk-in-force to qualified claims-paying resources, may enable the mortgage insurer to withstand extreme financial and market events, severe economic downturns and better manage risks to surplus.

#### *Contingency Reserves*

Mortgage insurers are required by regulators to establish a contingency reserve to protect policyholders during extremely adverse economic conditions. These reserves are established as 50% of earned premium and maintained for a period of 10 years. Regulatory approval is also required to release these reserves in any year when incurred losses exceed 35% of the corresponding earned premium.

#### *Unearned Premium Reserves*

Mortgage insurers are required by statute to compute and maintain unearned premium reserve liability based on premium revenue recognition. Apart from recognition of revenue over the policy period and compliance with statutory requirements, unearned premium reserves provide a fund from which refunds can be issued for canceled policies and provide monies for the payment of losses as they arise.

#### *Loss and Loss Adjustment Reserves*

Mortgage insurers are required to establish a liability for unpaid loss and loss allocated expenses, including case reserves on claims reported and claims that have been incurred but not reported. The estimates include losses on insured loans that have resulted in the conveyance of unsold property, losses on insured loans in the process of foreclosure and insured losses on leases in default for four months or earlier per the default period as specified in the insurance policy's provisions.

### Operating Performance

When evaluating operating performance of mortgage insurers, A.M. Best's analysis centers on the stability and sustainability of the mortgage insurer's sources of earnings in relation to the liabilities that the company retains over a long time interval given the long duration contracts associated with mortgage insurance business. A.M. Best reviews the components of a company's statutory earnings over a five-year period or more to evaluate the sources of profits and the degree and trend of various profitability measures. Profitability measures are distorted easily by operational changes; therefore, A.M. Best reviews the mix and trends of premium volume, investment income, net income, and surplus. The degree of volatility in an MI company's earnings and the impact this could have on its capitalization and balance sheet are of particular interest to A.M. Best. Areas reviewed include underwriting, investments, capital gains/losses, and total operating earnings, before and after taxes. Traditional insurance profitability measures, which include the loss ratio, expense ratio, combined ratio, operating ratio, pretax return on revenue, yield on invested assets, and change in policyholders' surplus are viewed on a long-term basis.

### Business Profile

As monoline companies, mortgage insurers are faced with an element of inherent systemic risk given the correlation between mortgage risk with the broader economy. This may be compounded if a mortgage insurer has a limited distribution channel and relies on just a few large entities for mortgage loan originations. The distribution (or lack of concentration) of risk-in-force by vintage, mortgage loan characteristics – loan age, original LTV, credit score and delinquency status – and the geographic scope of the underlying insured portfolio impacts the business profile of the mortgage insurer.

### Enterprise Risk Management

Mortgage insurers with strong enterprise risk management practices will exhibit and include the following characteristics:

- Written procedures, controls, and safeguards in place to ensure sound underwriting decisions from staff and delegate underwriters
- Detailed and up-to-date exposure information at the loan level, including but not limited to risk-in-force amount, loan balance, loan age, loan origination year, LTV at origination, credit score, loan type, property location, premium amount, insurance coverage, and delinquency status, such that there is an accurate assessment of the potential claims associated with the insurer's loan portfolio and an avoidance of concentration of its risk-in-force
- Standards in place to evaluate and assess the performance of its loan origination process, including the amount of risk presented and types of insured loans from its originators and lenders
- A quality control program that assesses the effectiveness of the overall insurance business process, including risk selection and monitoring, underwriting discipline, rescission rights and responsibilities practices, claims processing, and loss mitigation practices.

### Surveillance/Monitoring Activities

Once a rating committee has assigned a rating, A.M. Best monitors and updates the rating by regularly analyzing the mortgage insurer's creditworthiness. As part of the surveillance process, A.M. Best will review changes in the mortgage insurer's risk-in-force by loan product type, original LTV, credit score, and delinquent loan portfolios by age, bucketed by number of missed monthly payments. In addition, A.M. Best will review changes to underwriting guidelines and quality control mechanisms that may lead to deterioration in underwriting standards. Any suspension or termination of approved insurer status associated with the PMIERs will be monitored as well. Quarterly and annual financial statements for the mortgage insurer also will be reviewed to compare actual results with the forecast operating performance and to assess changes in claims-paying ability.

## C. Rating Considerations: GSE Reinsurance Programs

A.M. Best's rating process includes determining the amount of capital that will be charged in the BCAR model to account for net unexpected losses associated with GSE-sponsored credit risk-sharing reinsurance programs. These capital charges depend on stressed loss projections associated with the reference pool of mortgages as well as on the premiums earned by the insurers for providing protection on the risk-sharing programs. A.M. Best uses factor-based analysis for calculating capital charges for these programs as opposed to the model-based approach used to rate mortgage insurers as described in earlier sections of this criteria procedure. The factor-based analyses conform to the BCAR criteria in that calculations are made based on the standard set of Value-at-Risk Confidence Levels (VaR Levels) of 95%, 99%, 99.5%, and 99.6%.

Regardless of the type of the insurance-based risk transfer program, the general procedure for determining capital charges should adhere to the same basic steps as follows:

- Calculate the losses associated with a mortgage reference pool
- Determine if/how the losses breach each reinsurance layer covered by a reinsurer
- Calculate the premiums that accrue to each reinsurance layer
- Calculate the net capital charge for the reinsurance coverage of the layers as the loss associated with each layer less the corresponding premiums associated with each layer[1]
- Set a capital charge floor of 5% of the total limit associated with each transaction after considering the layers covered by the reinsurer

In this section of the criteria procedure, the methods for calculating the capital charges are detailed and include 1) a description of the tables and data necessary for the calculations and 2) a demonstration of how the tables and data are used in practice. Later in this section of the criteria procedure, there is further description of the effect of the mortgage-related capital charge on the net required capital for a reinsurer and the BCAR, which is used to determine a reinsurer's balance sheet strength.

## Tables and Data Provided by A.M. Best for the Capital Charge Analysis

The factor-based approach includes the use of several tables provided by A.M. Best that will be necessary for the calculation of losses and premiums. The manner in which the tables are used is detailed in **Appendix 2,** which shows how A.M. Best calculates capital charges associated with two different GSE-sponsored credit risk-sharing reinsurance programs.

### Unpaid Principal Balance Distribution Matrix

The Unpaid Principal Balance (UPB) Distribution Matrix is a grid that demonstrates the percent of the UPB associated with a reference pool segmented by original LTV and original credit score buckets. All of the elements in the matrix add up to 100% to reflect inclusion of the total reference portfolio in the matrix. A.M. Best will provide the UPB Distribution Matrix for each reference pool associated with insurance-based GSE transactions provided that the data is made available by the GSEs. **Exhibit C.1** shows an example of a UPB Distribution Matrix for a reference portfolio.

[1] For transactions with multiple layers and for which a reinsurer covers the most remote layers, which are unlikely to be breached, A.M. Best will give premium credit for no more than three years, because those layers are unlikely to be outstanding for the maximum term of the reinsurance agreement, given mortgage prepayments and regular amortization.

**Exhibit C.1: UPB Distribution Matrix**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| **Original LTV** | **<620** | **[620,660)** | **[660,700)** | **[700,740)** | **[740,780)** | **>=780** |
| **<=60** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(60-65]** | 0.00% | 0.50% | 1.00% | 1.40% | 1.90% | 2.40% |
| **(65,70]** | 0.00% | 1.00% | 2.00% | 2.70% | 3.40% | 3.80% |
| **(70,75]** | 0.00% | 1.10% | 2.90% | 4.50% | 6.70% | 7.20% |
| **(75,80]** | 0.00% | 2.60% | 7.30% | 12.50% | 17.10% | 18.00% |
| **(80,85]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(85,90]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(90,95]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(95,97]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **97+** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

Each time the capital charges associated with a transaction is evaluated, the UPB Distribution Matrix is recalculated based on the original LTVs and original credit scores of the remaining mortgages. The percentages in this matrix may change due to the scheduled amortizations and prepayments associated with the reference pools.

## The Stressed Ultimate Loss Matrix

In order to calculate the losses associated with a reference pool of mortgages, it is first necessary to use the Stressed Ultimate Loss (SUL) Matrix for the specific reference pool being evaluated. The SUL Matrix is derived from GSE loan performance data for the 2007 vintage and adjusted by A.M. Best based on quantitative and qualitative considerations. In developing the grid, A.M. Best considered the following elements: 1) the default frequency associated with the 2007 mortgage vintage, 2) the loss severity associated with the 2007 mortgage vintage, 3) the contractual and effective mortgage insurance coverage associated with original LTVs and credit scores, 4) the fact that losses in the 2007 mortgage vintage are still developing, 5) the differences between the types of mortgage loans originated in the 2007 environment versus the current mix of business in today's mortgage marketplace, 6) the more disciplined loan origination environment that emerged after the 2008 credit crisis, and 7) other considerations.

**Exhibit C.2** shows an example of the SUL Matrix for a pool of 30-year mortgages at the VaR 99 level. **Exhibit C.3 and Exhibit C.4** shows all the SUL Matrices at all VaR levels for mortgages based on two different original maturities.

**Exhibit C.2: SUL Matrix (30-Year Mortgages, VaR 99)**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| **Original LTV** | **<620** | **[620,660)** | **[660,700)** | **[700,740)** | **[740,780)** | **>=780** |
| **<=60** | 4.48% | 2.62% | 1.52% | 0.96% | 0.50% | 0.24% |
| **(60-65]** | 6.44% | 4.94% | 3.25% | 2.21% | 1.12% | 0.48% |
| **(65,70]** | 8.00% | 6.70% | 4.71% | 3.39% | 1.87% | 0.87% |
| **(70,75]** | 9.29% | 8.06% | 5.96% | 4.52% | 2.71% | 1.39% |
| **(75,80]** | 10.44% | 9.18% | 7.06% | 5.59% | 3.63% | 2.06% |
| **(80,85]** | 10.14% | 9.04% | 7.16% | 5.89% | 4.10% | 2.54% |
| **(85,90]** | 8.36% | 7.56% | 6.04% | 5.10% | 3.73% | 2.49% |
| **(90,95]** | 7.77% | 7.07% | 5.49% | 4.67% | 3.53% | 2.51% |
| **(95,97]** | 9.40% | 8.85% | 6.65% | 5.77% | 4.53% | 3.51% |
| **97+** | 12.47% | 11.93% | 8.28% | 6.96% | 5.37% | 4.37% |

## Exhibit C.3: SUL Matrix – All VaR Levels (Maturity > 20 Years)

### SUL Matrix - VaR 95

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 2.24% | 1.31% | 0.76% | 0.48% | 0.25% | 0.12% |
| (60-65] | 3.22% | 2.47% | 1.62% | 1.11% | 0.56% | 0.24% |
| (65,70] | 4.00% | 3.35% | 2.36% | 1.70% | 0.93% | 0.43% |
| (70,75] | 4.65% | 4.03% | 2.98% | 2.26% | 1.35% | 0.70% |
| (75,80] | 5.22% | 4.59% | 3.53% | 2.79% | 1.81% | 1.03% |
| (80,85] | 5.07% | 4.52% | 3.58% | 2.95% | 2.05% | 1.27% |
| (85,90] | 4.18% | 3.78% | 3.02% | 2.55% | 1.87% | 1.25% |
| (90,95] | 3.89% | 3.53% | 2.75% | 2.34% | 1.76% | 1.25% |
| (95,97] | 4.70% | 4.43% | 3.33% | 2.89% | 2.26% | 1.76% |
| 97+ | 6.23% | 5.96% | 4.14% | 3.48% | 2.69% | 2.18% |

### SUL Matrix - VaR 99

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 4.48% | 2.62% | 1.52% | 0.96% | 0.50% | 0.24% |
| (60-65] | 6.44% | 4.94% | 3.25% | 2.21% | 1.12% | 0.48% |
| (65,70] | 8.00% | 6.70% | 4.71% | 3.39% | 1.87% | 0.87% |
| (70,75] | 9.29% | 8.06% | 5.96% | 4.52% | 2.71% | 1.39% |
| (75,80] | 10.44% | 9.18% | 7.06% | 5.59% | 3.63% | 2.06% |
| (80,85] | 10.14% | 9.04% | 7.16% | 5.89% | 4.10% | 2.54% |
| (85,90] | 8.36% | 7.56% | 6.04% | 5.10% | 3.73% | 2.49% |
| (90,95] | 7.77% | 7.07% | 5.49% | 4.67% | 3.53% | 2.51% |
| (95,97] | 9.40% | 8.85% | 6.65% | 5.77% | 4.53% | 3.51% |
| 97+ | 12.47% | 11.93% | 8.28% | 6.96% | 5.37% | 4.37% |

### SUL Matrix - VaR 99.5

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 5.38% | 3.15% | 1.82% | 1.15% | 0.60% | 0.29% |
| (60-65] | 7.73% | 5.93% | 3.90% | 2.65% | 1.35% | 0.58% |
| (65,70] | 9.60% | 8.05% | 5.66% | 4.07% | 2.24% | 1.04% |
| (70,75] | 11.15% | 9.67% | 7.16% | 5.42% | 3.25% | 1.67% |
| (75,80] | 12.53% | 11.02% | 8.47% | 6.70% | 4.35% | 2.47% |
| (80,85] | 12.17% | 10.85% | 8.60% | 7.07% | 4.92% | 3.04% |
| (85,90] | 10.04% | 9.07% | 7.25% | 6.12% | 4.48% | 2.99% |
| (90,95] | 9.33% | 8.48% | 6.59% | 5.61% | 4.24% | 3.01% |
| (95,97] | 11.28% | 10.62% | 7.98% | 6.93% | 5.44% | 4.21% |
| 97+ | 14.96% | 14.31% | 9.94% | 8.36% | 6.45% | 5.24% |

### SUL Matrix - VaR 99.6

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 5.60% | 3.28% | 1.90% | 1.20% | 0.62% | 0.30% |
| (60-65] | 8.05% | 6.18% | 4.06% | 2.76% | 1.41% | 0.60% |
| (65,70] | 10.00% | 8.38% | 5.89% | 4.24% | 2.33% | 1.08% |
| (70,75] | 11.62% | 10.08% | 7.46% | 5.65% | 3.38% | 1.74% |
| (75,80] | 13.05% | 11.48% | 8.82% | 6.98% | 4.53% | 2.57% |
| (80,85] | 12.67% | 11.30% | 8.95% | 7.37% | 5.12% | 3.17% |
| (85,90] | 10.45% | 9.45% | 7.55% | 6.37% | 4.67% | 3.11% |
| (90,95] | 9.71% | 8.84% | 6.86% | 5.84% | 4.41% | 3.14% |
| (95,97] | 11.75% | 11.07% | 8.32% | 7.21% | 5.66% | 4.39% |
| 97+ | 15.59% | 14.91% | 10.35% | 8.71% | 6.71% | 5.46% |

### Exhibit C.4: SUL Matrix – All VaR Levels (Maturities <= 20 Years)

**SUL Matrix - VaR 95**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 1.02% | 0.57% | 0.32% | 0.19% | 0.07% | 0.04% |
| (60-65] | 1.26% | 0.84% | 0.54% | 0.38% | 0.21% | 0.10% |
| (65,70] | 1.49% | 1.12% | 0.75% | 0.55% | 0.35% | 0.16% |
| (70,75] | 1.74% | 1.39% | 0.96% | 0.73% | 0.49% | 0.21% |
| (75,80] | 2.00% | 1.67% | 1.18% | 0.91% | 0.64% | 0.27% |
| (80,85] | 2.27% | 1.94% | 1.41% | 1.10% | 0.80% | 0.33% |
| (85,90] | 2.55% | 2.21% | 1.65% | 1.32% | 0.99% | 0.41% |
| (90,95] | 2.85% | 2.48% | 1.91% | 1.55% | 1.20% | 0.52% |
| (95,97] | 3.16% | 2.74% | 2.20% | 1.82% | 1.44% | 0.65% |
| 97+ | 3.50% | 3.00% | 2.53% | 2.13% | 1.73% | 0.82% |

**SUL Matrix - VaR 99**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 2.04% | 1.14% | 0.63% | 0.39% | 0.15% | 0.08% |
| (60-65] | 2.51% | 1.69% | 1.08% | 0.75% | 0.43% | 0.21% |
| (65,70] | 2.99% | 2.24% | 1.50% | 1.10% | 0.70% | 0.31% |
| (70,75] | 3.49% | 2.79% | 1.93% | 1.45% | 0.98% | 0.42% |
| (75,80] | 4.00% | 3.34% | 2.36% | 1.82% | 1.28% | 0.53% |
| (80,85] | 4.54% | 3.88% | 2.81% | 2.21% | 1.60% | 0.66% |
| (85,90] | 5.11% | 4.42% | 3.30% | 2.63% | 1.97% | 0.83% |
| (90,95] | 5.70% | 4.96% | 3.82% | 3.11% | 2.39% | 1.03% |
| (95,97] | 6.33% | 5.48% | 4.41% | 3.65% | 2.88% | 1.30% |
| 97+ | 6.99% | 6.00% | 5.06% | 4.26% | 3.45% | 1.63% |

**SUL Matrix - VaR 99.5**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 2.45% | 1.37% | 0.76% | 0.47% | 0.18% | 0.10% |
| (60-65] | 3.01% | 2.03% | 1.29% | 0.90% | 0.51% | 0.25% |
| (65,70] | 3.59% | 2.69% | 1.80% | 1.32% | 0.84% | 0.38% |
| (70,75] | 4.18% | 3.35% | 2.31% | 1.74% | 1.17% | 0.50% |
| (75,80] | 4.80% | 4.01% | 2.83% | 2.18% | 1.53% | 0.64% |
| (80,85] | 5.45% | 4.66% | 3.37% | 2.65% | 1.92% | 0.79% |
| (85,90] | 6.13% | 5.31% | 3.96% | 3.16% | 2.37% | 0.99% |
| (90,95] | 6.84% | 5.95% | 4.59% | 3.73% | 2.87% | 1.24% |
| (95,97] | 7.59% | 6.58% | 5.29% | 4.37% | 3.46% | 1.56% |
| 97+ | 8.39% | 7.20% | 6.07% | 5.11% | 4.14% | 1.96% |

**SUL Matrix - VaR 99.6**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 2.56% | 1.43% | 0.79% | 0.49% | 0.18% | 0.10% |
| (60-65] | 3.14% | 2.11% | 1.35% | 0.94% | 0.53% | 0.26% |
| (65,70] | 3.74% | 2.80% | 1.88% | 1.38% | 0.87% | 0.39% |
| (70,75] | 4.36% | 3.49% | 2.41% | 1.82% | 1.22% | 0.52% |
| (75,80] | 5.00% | 4.17% | 2.95% | 2.27% | 1.59% | 0.66% |
| (80,85] | 5.68% | 4.85% | 3.52% | 2.76% | 2.00% | 0.83% |
| (85,90] | 6.38% | 5.53% | 4.12% | 3.29% | 2.46% | 1.03% |
| (90,95] | 7.13% | 6.20% | 4.78% | 3.89% | 2.99% | 1.29% |
| (95,97] | 7.91% | 6.86% | 5.51% | 4.56% | 3.60% | 1.62% |
| 97+ | 8.74% | 7.50% | 6.33% | 5.32% | 4.31% | 2.04% |

## The Stressed Ultimate Loss

Given an SUL Matrix as described in the prior section, the initial SUL can be calculated by performing a cell-by-cell multiplication of the SUL Matrix and the UPB Distribution Matrix and then adding all the elements in this new matrix.

As an example, multiply the UPB Distribution Matrix in **Exhibit C.1** by the SUL Matrix in **Exhibit C.2**. The cell-by-cell product of these two matrices, as well as the sum of all the elements of this product (i.e., the initial SUL), is shown in **Exhibit C.5**. This sum, 3.66%, represents the initial SUL.

**Exhibit C.5: SUL Calculation (30-Year Mortgages, VaR 99)**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| **Original LTV** | **<620** | **[620,660)** | **[660,700)** | **[700,740)** | **[740,780)** | **>=780** |
| **<=60** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(60-65]** | 0.00% | 0.02% | 0.03% | 0.03% | 0.02% | 0.01% |
| **(65,70]** | 0.00% | 0.07% | 0.09% | 0.09% | 0.06% | 0.03% |
| **(70,75]** | 0.00% | 0.09% | 0.17% | 0.20% | 0.18% | 0.10% |
| **(75,80]** | 0.00% | 0.24% | 0.52% | 0.70% | 0.62% | 0.37% |
| **(80,85]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(85,90]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(90,95]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **(95, 97]** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **97+** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

**SUL = Sum of Elements In The Table = 3.66%***
**This is the sum of the Cell-by-Cell Product of The UPB Distribution Matrix (Exhibit C.1) and the SUL Matrix (Exhibit C.2)**

* Value may not be exact due to rounding

It is important to note that the SUL calculated at the inception of a transaction (the initial SUL) will differ from the SULs calculated as the transaction ages for any or all of the following reasons: 1) the UPB Distribution Matrix may change, 2) the transaction "seasons," or 3) there is a decrease in the UPB of the mortgages in the reference pool over time.

Seasoning reflects the phenomenon that as a mortgage pool ages, its aggregate risk of default initially increases and then declines. The rate of increase and decline will vary depending on the time that has passed since the original underwriting of the loans and on the original term of the loans. Therefore, at any given point in time after calculating an initial SUL, the subsequent SULs calculated are multiplied by elements in a Seasoning Vector shown in **Exhibit C.6**. This exhibit shows seasoning factors for mortgages depending on their original terms and how much time has elapsed since their origination. Column A in **Exhibit C.6** is the Seasoning Vector for mortgages with original maturity of greater than 20 years and Column B is the Seasoning Vector for mortgages with original maturity of less than or equal to 20 years.

**Exhibit C.6: Seasoning Vectors**

| Year | A<br>Maturity > 20 Years | B<br>Maturity <= 20 Years |
|---|---|---|
| Initial | 100% | 100% |
| 1 | 105% | 108% |
| 2 | 109% | 115% |
| 3 | 108% | 110% |
| 4 | 102% | 95% |
| 5 | 94% | 78% |
| 6 | 86% | 62% |
| 7 | 78% | 48% |
| 8 | 70% | 36% |
| 9 | 62% | 27% |
| 10 | 55% | 21% |
| 11 | 48% | 15% |

The diminution of the UPB of the mortgages in the reference pool is reflected by expressing the new UPB of the reference pool (at the time of the new evaluation of capital charges) as a fraction of the original UPB of the reference pool. This ratio, the Remaining UPB, is also used as a factor in determining subsequent SULs as the transaction ages. The formula for calculating the Seasoned SUL is as follows:

Seasoned SUL = Remaining UPB * Seasoning Factor * SUL

For example, if the reference pool of 30-year mortgages has aged by one year, the Remaining UPB is 85%, and the SUL calculated as previously described is now 3.67% (as opposed to the initial SUL of 3.66%), the 1-Year-Seasoned SUL would be:

1-Year-Seasoned SUL = 85% * 105% * 3.67% = 3.29%

In some cases, significant amount of time would have elapsed between the formation date of the reference pool on which a reinsurance transaction is based and the average origination date of the mortgages in the pool. In these cases, A.M. Best may choose to advance the seasoning factor in accordance with the actual seasoning period of the mortgage pool.

## Loss Pattern Matrix

After determining the SUL of the initial reference pool associated with a portfolio of mortgages, what remains unknown is how this loss manifests over time. A.M. Best has derived a Loss Pattern Matrix for losses throughout the term of the transactions for which capital charges are to be calculated. **Exhibit C.7** and **Exhibit C.8** show the Loss Pattern Matrix associated with mortgages with original maturities over 20 years and maturities less than or equal to 20 years, respectively. Each column in the Loss Pattern Matrix represents the loss pattern associated with an SUL over time. For example, Column A in the Loss Pattern Matrix in **Exhibit C.7** shows the initial loss pattern at the inception of the transaction. After the transaction has aged by one year, the applicable loss development pattern becomes the 1-Year-Seasoned loss development pattern – Column B. Each column of the Loss Pattern Matrix is referred to as a Loss Pattern Vector. Column A, for example, is known as the initial Loss Pattern Vector.

### Exhibit C.7: Loss Pattern Matrix - Maturity > 20 Years

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Initial | 1-Year-Seasoned | 2-Year-Seasoned | 3-Year-Seasoned | 4-Year-Seasoned | 5-Year-Seasoned | 6-Year-Seasoned | 7-Year-Seasoned | 8-Year-Seasoned | 9-Year-Seasoned | 10-Year-Seasoned | 11-Year-Seasoned |
| 1 | 0.23% | | | | | | | | | | | |
| 2 | 2.44% | 2.22% | | | | | | | | | | |
| 3 | 9.60% | 9.40% | 7.34% | | | | | | | | | |
| 4 | 20.17% | 19.98% | 18.17% | 11.69% | | | | | | | | |
| 5 | 31.14% | 30.98% | 29.42% | 23.83% | 13.75% | | | | | | | |
| 6 | 41.34% | 41.21% | 39.88% | 35.11% | 26.52% | 14.82% | | | | | | |
| 7 | 50.51% | 50.40% | 49.27% | 45.25% | 38.01% | 28.13% | 15.63% | | | | | |
| 8 | 58.63% | 58.53% | 57.60% | 54.23% | 48.18% | 39.92% | 29.47% | 16.41% | | | | |
| 9 | 65.75% | 65.67% | 64.89% | 62.11% | 57.10% | 50.26% | 41.61% | 30.79% | 17.21% | | | |
| 10 | 71.93% | 71.87% | 71.23% | 68.95% | 64.84% | 59.24% | 52.15% | 43.29% | 32.16% | 18.05% | | |
| 11 | 77.24% | 77.19% | 76.67% | 74.82% | 71.49% | 66.94% | 61.19% | 54.01% | 44.98% | 33.54% | 18.90% | |
| 12 | 81.75% | 81.71% | 81.29% | 79.81% | 77.14% | 73.50% | 68.89% | 63.12% | 55.89% | 46.72% | 34.98% | 19.82% |

### Exhibit C.8: Loss Pattern Matrix - Maturity <= 20 Years

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Initial | 1-Year-Seasoned | 2-Year-Seasoned | 3-Year-Seasoned | 4-Year-Seasoned | 5-Year-Seasoned | 6-Year-Seasoned | 7-Year-Seasoned | 8-Year-Seasoned | 9-Year-Seasoned |
| 1 | 0.30% | | | | | | | | | |
| 2 | 3.73% | 3.43% | | | | | | | | |
| 3 | 16.45% | 16.20% | 13.22% | | | | | | | |
| 4 | 35.25% | 35.05% | 32.74% | 22.49% | | | | | | |
| 5 | 52.90% | 52.76% | 51.08% | 43.63% | 27.27% | | | | | |
| 6 | 67.15% | 67.05% | 65.88% | 60.69% | 49.28% | 30.26% | | | | |
| 7 | 77.89% | 77.82% | 77.03% | 73.53% | 65.85% | 53.05% | 32.68% | | | |
| 8 | 85.61% | 85.57% | 85.05% | 82.78% | 77.78% | 69.45% | 56.19% | 34.92% | | |
| 9 | 90.94% | 90.92% | 90.59% | 89.16% | 86.01% | 80.77% | 72.43% | 59.04% | 37.06% | |
| 10 | 94.49% | 94.47% | 94.28% | 93.41% | 91.49% | 88.30% | 83.23% | 75.08% | 61.71% | 39.16% |

## Cumulative Loss Vector

A Cumulative Loss Vector can be calculated given an SUL and a Loss Pattern Vector (from the Loss Pattern Matrix). The Cumulative Loss Vector shows how the ultimate loss associated with a reference pool of mortgages, as represented by the SUL, can be distributed. The calculation of the initial Cumulative Loss Vector is as follows:

Cumulative Loss Vector = SUL * Loss Pattern Vector

For example, **Exhibit C.9** shows the initial Cumulative Loss Vector based on an initial SUL of 3.66% (as determined earlier) for a reference pool of 30-year mortgages. As stated in the prior section, the initial Loss Pattern Vector is Column A in the Loss Pattern Matrix (associated with 30-year mortgages).

**Exhibit C.9: Initial Cumulative Loss Vector (30-Year Mortgages)**

| Year | A[1] Initial Loss Pattern Vector | B Initial SUL | C[2] Initial Cumulative Loss Vector |
|---|---|---|---|
| 1 | 0.23% | 3.66% | 0.01% |
| 2 | 2.44% | 3.66% | 0.09% |
| 3 | 9.60% | 3.66% | 0.35% |
| 4 | 20.17% | 3.66% | 0.74% |
| 5 | 31.14% | 3.66% | 1.14% |
| 6 | 41.34% | 3.66% | 1.51% |
| 7 | 50.51% | 3.66% | 1.85% |
| 8 | 58.63% | 3.66% | 2.15% |
| 9 | 65.75% | 3.66% | 2.41% |
| 10 | 71.93% | 3.66% | 2.63% |
| 11 | 77.24% | 3.66% | 2.83% |
| 12 | 81.75% | 3.66% | 2.99% |

1. From Column A of the Loss Pattern Matrix (Exhibit C.7)
2. C = A * B



## Amortization Pattern Matrix

Over time, the mortgages in the reference portfolio amortize as projected by the Amortization Pattern Matrix. This matrix is used for transactions where premium calculations are based on UPB as opposed to transactions where premiums are calculated based on the limits of the reinsurance layers. An Amortization Pattern Matrix represents the average annual amortization percentage for a mortgage reference pool. **Exhibit C.11** is the Amortization Pattern Matrix for mortgages with original maturities of greater than 20 years and **Exhibit C.12** is the Amortization Pattern Matrix for mortgages with original maturities of less than or equal to 20 years. It is important to note that each Amortization Pattern Matrix generally considers both scheduled and unscheduled amortizations. In general, unscheduled amortizations, also known as prepayments, are typically extremely low in most stress scenarios.

Each column of the Amortization Pattern Matrix is referred to as an Amortization Pattern Vector. Column A in the Amortization Pattern Matrix, for example, is known as the initial Amortization Pattern Vector.

As transactions season, the subsequent columns or other vectors of the Amortization Pattern Matrix are applied to the calculation of capital charges. For example, after the transaction has seasoned by one year, the 1-Year-Seasoned Amortization Pattern Vector is used in the calculation of premiums associated with the transaction. **Exhibit C.10** shows the initial Amortization Pattern Vector for a reference pool of 30-year mortgages.

**Exhibit C.10: Initial Amortization Pattern Vector (30-Year Mortgages)**

| Year | Initial* |
|---|---|
| 0 | 100.00% |
| 1 | 97.73% |
| 2 | 92.77% |
| 3 | 87.43% |
| 4 | 81.88% |
| 5 | 76.39% |
| 6 | 71.11% |
| 7 | 66.10% |
| 8 | 61.36% |
| 9 | 56.87% |
| 10 | 52.63% |
| 11 | 48.61% |
| 12 | 44.80% |

* From Column A of the Amortization Pattern Matrix (Exhibit C.11)

**Exhibit C.11: Amortization Pattern Matrix - Maturity > 20 Years**

| Year | A<br>Initial | B<br>1-Year-Seasoned | C<br>2-Year-Seasoned | D<br>3-Year-Seasoned | E<br>4-Year-Seasoned | F<br>5-Year-Seasoned | G<br>6-Year-Seasoned | H<br>7-Year-Seasoned | I<br>8-Year-Seasoned | J<br>9-Year-Seasoned | K<br>10-Year-Seasoned | L<br>11-Year-Seasoned |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 100.00% | | | | | | | | | | | |
| 1 | 97.73% | 100.00% | | | | | | | | | | |
| 2 | 92.77% | 97.30% | 100.00% | | | | | | | | | |
| 3 | 87.43% | 91.73% | 96.98% | 100.00% | | | | | | | | |
| 4 | 81.88% | 85.98% | 90.89% | 96.74% | 100.00% | | | | | | | |
| 5 | 76.39% | 80.25% | 84.84% | 90.30% | 96.60% | 100.00% | | | | | | |
| 6 | 71.11% | 74.72% | 79.00% | 84.08% | 89.94% | 96.51% | 100.00% | | | | | |
| 7 | 66.10% | 69.46% | 73.44% | 78.16% | 83.61% | 89.72% | 96.45% | 100.00% | | | | |
| 8 | 61.36% | 64.48% | 68.17% | 72.55% | 77.62% | 83.28% | 89.53% | 96.38% | 100.00% | | | |
| 9 | 56.87% | 59.77% | 63.19% | 67.25% | 71.94% | 77.19% | 82.98% | 89.33% | 96.31% | 100.00% | | |
| 10 | 52.63% | 55.31% | 58.47% | 62.23% | 66.57% | 71.44% | 76.79% | 82.67% | 89.12% | 96.23% | 100.00% | |
| 11 | 48.61% | 51.09% | 54.01% | 57.48% | 61.49% | 65.98% | 70.93% | 76.36% | 82.32% | 88.88% | 96.13% | 100.00% |
| 12 | 44.80% | 47.08% | 49.77% | 52.97% | 56.67% | 60.81% | 65.37% | 70.37% | 75.86% | 81.91% | 88.60% | 96.02% |

**Exhibit C.12: Amortization Pattern Matrix - Maturity <= 20 Years**

| Year | A<br>Initial | B<br>1-Year-Seasoned | C<br>2-Year-Seasoned | D<br>3-Year-Seasoned | E<br>4-Year-Seasoned | F<br>5-Year-Seasoned | G<br>6-Year-Seasoned | H<br>7-Year-Seasoned | I<br>8-Year-Seasoned | J<br>9-Year-Seasoned |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 100.00% | | | | | | | | | |
| 1 | 96.24% | 100.00% | | | | | | | | |
| 2 | 88.34% | 95.69% | 100.00% | | | | | | | |
| 3 | 80.32% | 87.03% | 95.24% | 100.00% | | | | | | |
| 4 | 72.29% | 78.40% | 85.80% | 94.82% | 100.00% | | | | | |
| 5 | 64.51% | 69.99% | 76.60% | 84.65% | 94.43% | 100.00% | | | | |
| 6 | 57.06% | 61.92% | 67.76% | 74.89% | 83.54% | 94.01% | 100.00% | | | |
| 7 | 49.94% | 54.19% | 59.31% | 65.55% | 73.12% | 82.28% | 93.49% | 100.00% | | |
| 8 | 43.12% | 46.79% | 51.21% | 56.60% | 63.13% | 71.04% | 80.72% | 92.81% | 100.00% | |
| 9 | 36.56% | 39.68% | 43.42% | 47.99% | 53.53% | 60.24% | 68.44% | 78.69% | 91.91% | 100.00% |
| 10 | 30.23% | 32.81% | 35.91% | 39.69% | 44.27% | 49.82% | 56.60% | 65.08% | 76.01% | 90.68% |

## Discretion to Modify Matrices or Use Model Results

It is important to note that in calculating capital charges, A.M. Best at its discretion may a) use a modified SUL Matrix, Amortization Pattern Matrix, Loss Pattern Matrix, and Seasoning Vector, at each VaR level and maturity or b) use the LoanKinetics application to analyze mortgage risks under certain conditions. Those may include, but are not limited to, the following:

1. The mortgage pool being evaluated has a significantly different risk profile than the mortgage pool from which the factors were originally derived – for example, if the reference pool being evaluated is made up of multifamily adjustable rate mortgages or if new and riskier products are added to the origination mix.
2. Economic conditions warrant such modifications – for example, if the general housing price level is considerably different from the level in existence at the time the mortgage pool used in creating the SUL Matrix was originated leading to an overestimation or underestimation of losses in various stress scenarios.

## Reinsurer Information for Capital Charge Analysis

In order to calculate the capital charges associated with the GSE-sponsored credit risk-sharing reinsurance programs covered by a reinsurer, A.M. Best expects to review the following: 1) the specific transactions covered by the reinsurer, 2) the proportion of the transactions (and layers, if applicable) covered by the reinsurer, 3) any cessions to other reinsurers associated with the transactions, and 4) any booked reserves associated with the transactions.

The first three data requirements are used to determine the risk factors associated with calculating the expected and unexpected losses associated with mortgage reinsurance coverage of the GSE-sponsored credit risk sharing programs. The fourth data requirement, booked reserves, is used as a proxy for expected losses. This amount, after adjusting for any reserve deficiencies, is subtracted from the total capital charges calculated for credit risk sharing programs to determine the net unexpected capital charge attributed to such programs.

## Effect of Reinsurance Capital Charges on BCAR

As discussed in Section B of this criteria procedure, calculating an insurer's BCAR requires calculating its net required capital (NRC) – namely the capital the insurer needs to support the financial risks associated with the exposure of its assets and underwriting to adverse economic and market conditions – and determining its capital available to support these risks. **Exhibit B.1** shows the BCAR formula and its dependence on NRC and available capital; **Exhibit B.2** shows the components of NRC.

To illustrate the effect of mortgage-related reinsurance transactions, A.M. Best assumes that the reinsurer taking on the mortgage risk has a well-diversified book of business and has capital and shareholders' funds of USD 4 billion. Furthermore, the example assumes various factor-based unexpected losses (at the VaR levels) associated with USD 1 billion of limit in a reinsurance transaction as shown in **Exhibit C.13**. For example, the exhibit shows that at the VaR 99 level, the unexpected losses as calculated using the factor-based approach is $400 million of the $1 billion limit or 40% of the limit.

**Exhibit C.13: Assumed Mortgage-Related Losses at VaR Levels ($000)**

| | VaR 95 | VaR 99 | VaR 99.5 | VaR 99.6 |
|---|---|---|---|---|
| Mortgage Exposure Limit* | 1,000,000 | 1,000,000 | 1,000,000 | 1,000,000 |
| Calculated Unexpected Loss** | 200,000 | 400,000 | 480,000 | 500,000 |
| Loss as % of Limit | 20% | 40% | 48% | 50% |

*Adjusted for retrocession and other risk transfer agreements

**Adjusted for company's GSE mortage exposure reserves

In incorporating mortgage-related reserve risk into the BCAR, A.M. Best assumes a correlation between the mortgage Net Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) and Non-affiliated Fixed Income Securities Risk ($B1_n$) of 50%. A.M. Best also assumes a correlation between the mortgage Net Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) and Non-affiliated Equity Securities Risk ($B2_n$) of 50%. Furthermore, A.M. Best assumes a correlation between mortgage Net Loss and Loss Adjustment Expense Reserves Risk ($B5_m$) and non-life reserves risk associated with other lines of business of 10%.

It is important to emphasize the role diversification plays in the calculation of the NRC and, hence, the BCAR. In the BCAR, the correlation of mortgage losses to other reserve lines is generally assumed to be very low – thus the reserve diversification benefit is high when mortgage risk is added to an insurer's business mix. In addition to the reserve-line diversification, the BCAR level is also further affected by the covariance adjustment, which further dampens the effect of the unexpected losses associated with the mortgage-related reinsurance transactions.

**Exhibit C.14** shows the overall impact of diversification and the covariance adjustment on the NRC and ultimately on the BCAR associated with the example. For example, the VaR 99 level shows that the unexpected loss associated with the mortgage risk of $400 million (or 40% of the $1 billion in limit) increases NRC by about $168 million (or about 16.8% of the $1 billion limit). In this example, it is assumed that there is no affiliated Fixed Income Securities Risk or affiliated Equity Securities Risk.

**Exhibit C.14: Impact of Mortgage Capital Charges on NRC and the BCAR ($000)**

| | Item | Var 95 | Var 99 | VaR 99.5 | Var 99.6 |
|---|---|---|---|---|---|
| **Limits and Assumed Losses** | | | | | |
| (1) | GSE Mortgage Exposure Limit | 1,000,000 | 1,000,000 | 1,000,000 | 1,000,000 |
| (2) | Model Unexpected Loss | 200,000 | 400,000 | 480,000 | 500,000 |
| (3) = (2) / (1) | Ratio of Model Unexpected Loss to GSE Mortgage Exposure Limit | **20.0%** | **40.0%** | **48.0%** | **50.0%** |
| **Net Required Capital** | | | | | |
| (4) | Net Required Capital Without Mortgage Risk | 1,398,841 | 2,018,981 | 2,272,769 | 2,347,867 |
| (5) | Net Required Capital With Mortgage Risk | 1,485,661 | 2,187,453 | 2,473,303 | 2,555,207 |
| (6) = (5) - (4) | Incremental Net Required Capital (INRC) | 86,820 | 168,472 | 200,534 | 207,340 |
| (7) = (6) / (1) | Ratio of INRC to GSE Mortgage Exposure Limit | **8.7%** | **16.8%** | **20.1%** | **20.7%** |
| **BCAR** | | | | | |
| (8) | BCAR Score Without Mortgage Risk | 66.7% | 51.9% | 45.8% | 44.1% |
| (9) | BCAR Score With Mortgage Risk | 64.6% | 47.9% | 41.1% | 39.1% |
| (10) = (9) - (8) | BCAR Scores (absolute difference) | **-2.07%** | **-4.01%** | **-4.78%** | **-4.94%** |

Notes:
Row (1) Gross Mortgage Exposure Limit Adjusted for Retrocession and Other Risk Transfer Agreements
Row (2) Modeled Unexpected Loss -- Ground Up Modeled Losses Adjusted for Mortgage Exposure Reserves
Row (3) Ratio of Row 2 to Row 1
Row (4) Net Required Capital Before Adding Mortgage-Related Losses
Row (5) Net Required Capital After Adding Mortgage-Related Losses
Row (6) Net Required Capital After Mortgage Losses Less Net Required Capital Before Mortgage Losses
Row (7) Ratio of Row 6 to Row 1
Row (8) BCAR Score Before Adding Mortgage Risk
Row (9) BCAR Score After Adding Mortgage Risk
Row (10) Row 9 Less Row 8

The exhibit also shows that the BCAR score is reduced by a nominal level of about 4.01% (at the VaR 99 level) compared to the base level when mortgage risk is added to the insurer.

## D. Rating Considerations: Other Reinsurance Programs

### Capital Charges Related to Other Reinsurance Programs

Aside from the GSE-sponsored reinsurance transactions, reinsurers also provide coverage on mortgage pools on both a proportional and non-proportional basis globally. Reinsurers assuming these risks may provide to A.M. Best their views on the capital charges associated with their exposures net of any retrocession agreements. A.M. Best expects a description of the model (if any) used in the analysis and additional information including but not limited to the following:

- Key model inputs and output results
- The underpinnings and rationale regarding the stresses applied to the mortgage portfolio
- Model-derived losses on a gross and net basis at the 95, 99, 99.5 and 99.6 VaR levels – including the assumptions (such as housing price declines, rates, etc.) driving the VaR levels
- Model-derived losses based on a repeat of the 2008 credit crisis
- Treatment afforded to non-U.S. mortgage exposures

## Evaluating Mortgage Insurance

In some cases and where appropriate, A.M. Best may request copies of the reinsurance/retrocession agreements underlying these exposures, UPB distribution (segregated by broad product categories and geographical locations inside and outside the United States), detail loan-level data, and other information from the company so it can use the LoanKinetics application to estimate capital charges.

Given the capital charges associated with non-GSE-sponsored mortgage reinsurance transactions, A.M. Best will apply the same analytical techniques described in the prior sections to incorporate such charges into a reinsurer's BCAR.

## Appendix 1: Credit Risk Model – LoanKinetics

A.M. Best used a third party credit risk model, LoanKinetics, to develop the Net Loss and Loss Adjustment Expense Reserve and the Premium risks used in BCAR. LoanKinetics is an application developed by Andrew Davidson & Co. (AD&Co) for analyzing the credit risk of a portfolio of mortgage loans, either from the mortgage insurer's or investor's perspective. LoanKinetics integrates AD&Co's Interest Rate Model, Home-Price Model, and LoanDynamics Model (LDM, loan level credit, and prepayment model) described below, in conjunction with a proprietary alternative to Monte Carlo analysis that relies on a grid of 20 deterministic scenarios, to quantify credit risk.

### Interest Rate Model

The Interest Rate Model is a term structure model. It is a Hull-White one-factor model calibrated to swaps or Treasury curve and a matrix of at-the-money swaptions.

### Home-Price Model

The Home-Price Model is a stochastic, interest-rate-linked model that provides forecasts up to the Metropolitan Statistical Area (MSA) level. The model forecasts Home-Price Indices (HPI) and Home-Price Appreciation (HPA) over time. The model includes four dynamically simulated factors: (1) financing rate, (2) income inflation, (3) HPA diffusion (systematic trend), and (4) HPA jump (non-systemic shocks). In addition, the model considers the historical cost of down payment and underpriced risk; those cost components are projected to be unchanged from the analysis date. Along with factors (1) and (2), the model determines housing affordability and HPA equilibrium ("soft equilibrium"); it is the long-term HPA that the model projects based on housing affordability.

The Home-Price Model models the HPA by a mean-reverting system of equations in that HPA reverts back to HPA equilibrium. The system incorporates the phenomenon that home prices tend to oscillate and overshoot when correcting.

### LoanDynamics Model

The LoanDynamics Model (LDM) is an integrated prepayment and credit default and loss-forecasting model that produce monthly time series forecasts of Prepayments, Defaults, Delinquencies, and Loss Severities.

The model is unified across credit sector (jumbo prime, subprime, Alt-A, High LTV) and product type (fixed, adjustable, hybrid, IOs, first and second lien). It relies on observed loan characteristics, such as Credit Score, LTV, Original Loan Sizes, data that are available in the typical servicing system file, and two economic drivers, interest rates and home prices, to make its projections.

There are two model subclasses in LDM: Agency LDM and Non-Agency LDM.

Agency LDM was developed using loan data released by The Federal Home Loan Mortgage Corporation (Freddie Mac), covering 2000 to 2015 originations. Non-Agency LDM was estimated from publicly available non-agency securities data collected from the corporate trust department of Wells Fargo Bank, N.A. The database (used to estimate the initial model) contained over eight million loans from 144 different issuers covering the period from 1998 to 2006. It has since been supplemented with loan level data from Intex and covers a robust cross-section of non-agency loan types, including jumbo prime, new prime, Alt-A, subprime, and second liens. All databases are updated monthly to monitor the accuracy of LDM forecasts and for current model development.

LDM is a state transition model. In LDM, loans can transition between Current (C, 0-1 Month Delinquent), Delinquent (D, 2-5 Months Delinquent), seriously Delinquent (S, 6+ Months Delinquent), and Terminated (T, No Current Balance) states. CT, CD, DC, DT, SC, and ST are the transitions used in the model. For example, CT is the transition where a loan transitions from a Current to a Terminated state.

#### *Voluntary Prepayment Transition*

The voluntary prepayment transition (Current to Terminated Prepayment transition) in LDM uses a cumulative distribution function (CDF) to construct the classic refinance S-curve for voluntary prepayments. Variables such as credit score, original loan balance, current LTV (based on local home price indices), and current interest rates all are used in determining the forecasted vector of prepayments directly. Factors in the CT model include:

- Rate incentive
- Credit score, loan-to-value ratio (LTV), and original loan size (OLS)
- Turnover and seasonality
- Burnout Effect

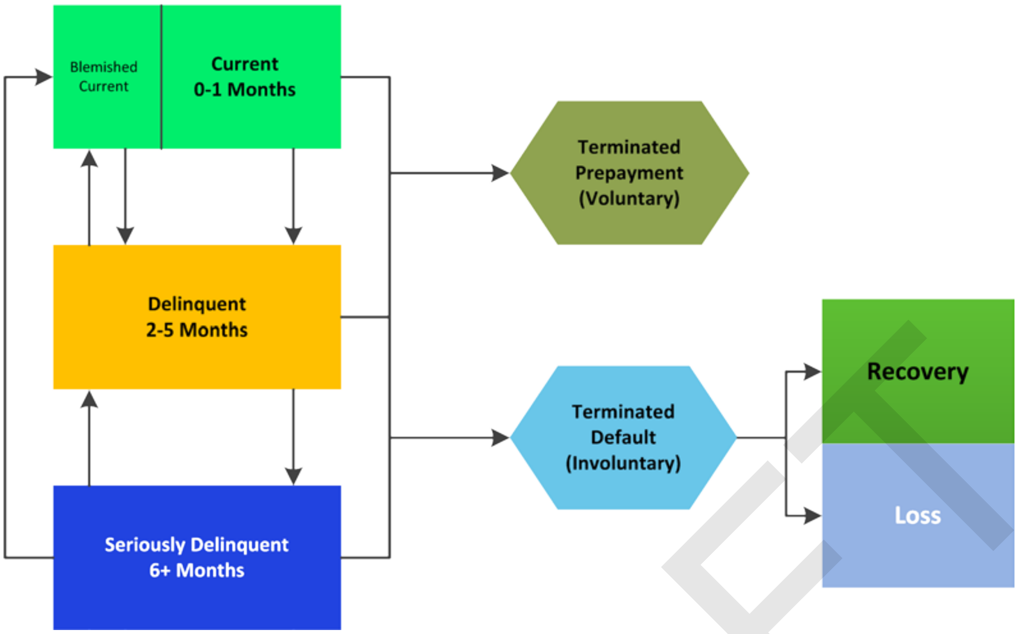
#### *Other Transitions*

The other transitions represent different economic situations, as shown below:

| | |
|---|---|
| CD - Delinquency | (Current to Delinquent) |
| DC - Cure | (Delinquent to Current) |
| DT - Delinquent Prepayment / Short Sale | (Delinquent to Terminated) |
| SC - Cure | (Seriously Delinquent to Current) |
| ST - REO Liquidation | (Seriously Delinquent to Terminated) |

Each transition model uses a specific set of input variables and effects. The major drivers may include (but are not limited to): Age, Credit Score, LTV at Origination, Payment Type (ARM or Fixed), Prepay Penalty, Occupancy, Loan Purpose, Number of Units, Property Type, Amortization Type, Payment Shocks, Previous Delinquencies, Local and National Home Price Appreciation, Seasonality, Current Combined LTV, and Judicial/Non-Judicial.

**Exhibit 1: Transition Model**




*Loss Severity*

As loans terminate, the loss severity component of LDM determines if a loss is likely (loss probability) and for what amount (loss magnitude).

**Scenario Grid and 3-Part Vasicek Probability Model**

The sample Scenario Grid in **Appendix 1: Exhibit 2** contains a set of 20 engineered stress scenarios ranging from best, to base case, to worst. **Appendix 1: Exhibit 2** is only an example and may not reflect the current economic environment. The Scenario Grid settings are updated as needed by AD&Co. Each scenario in the Scenario Grid contains interest rate shifts, settings for the integrated LDM (Default, Severity, and Prepayment), and Home-Price Model. The Scenario Grid settings incorporate adverse modeling error. The extreme scenarios include both economic shocks and model shocks. The following table contains an example of stress scenario variables and their values, which can be categorized as follows:

- Scenario interest rate shifts (IRSHIFT)
- Scenario scales for the LDM (MDR, SEVERITY, and Prepay)
- Stress scenario results from the Home-Price Model (1YrHPA, 2YrHPA, MinHPA)
- The Cumulative Distribution Function (CDF2), which shows the cumulative probability of each level of default rate occurring

The last column in the Scenario Grid shows the cumulative probabilities associated with each scenario.

**Exhibit 2: Sample Scenario Grid**

| SCENARIO GRID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DESCR | SCENARIO # | IRSHIFT | MDR | SEVERITY | Prepay | 1YRHPA | 2YRHPA | MINHPA | CDF2 |
| Good | 0 | -125.00 | 0.88 | 0.88 | 1.25 | 16.29 | 30.43 | 0 | 0.00 |
| | 1 | -100.00 | 0.90 | 0.90 | 1.20 | 14.22 | 26.34 | 0 | 2.95 |
| | 2 | -75.00 | 0.93 | 0.93 | 1.15 | 12.18 | 22.39 | 0 | 8.77 |
| | 3 | -50.00 | 0.95 | 0.95 | 1.10 | 10.73 | 19.55 | 0 | 15.57 |
| | 4 | -37.50 | 0.96 | 0.96 | 1.08 | 8.93 | 16.17 | 0 | 23.32 |
| | 5 | -25.00 | 0.98 | 0.98 | 1.05 | 7.16 | 12.88 | 0 | 32.29 |
| | 6 | -12.50 | 0.99 | 0.99 | 1.03 | 5.93 | 10.59 | 0 | 39.97 |
| Base | 7 | 0.00 | 1.00 | 1.00 | 1.00 | 4.21 | 7.46 | 0 | 50.00 |
| Bad | 8 | 12.50 | 1.03 | 1.01 | 0.98 | 2.52 | 4.42 | 0 | 60.29 |
| | 9 | 25.00 | 1.05 | 1.03 | 0.95 | 1.34 | 2.31 | 0 | 67.92 |
| | 10 | 37.50 | 1.08 | 1.04 | 0.93 | -0.30 | -0.59 | -0.94 | 76.60 |
| | 11 | 50.00 | 1.10 | 1.05 | 0.90 | -1.92 | -3.40 | -5.30 | 84.24 |
| | 12 | 62.50 | 1.13 | 1.06 | 0.88 | -3.05 | -5.36 | -8.73 | 89.03 |
| | 13 | 75.00 | 1.15 | 1.08 | 0.85 | -4.63 | -8.05 | -13.45 | 93.60 |
| Extreme | 14 | 100.00 | 1.20 | 1.10 | 0.80 | -6.33 | -10.93 | -18.47 | 97.12 |
| | 15 | 125.00 | 1.25 | 1.13 | 0.75 | -7.55 | -13.01 | -22.06 | 98.69 |
| | 16 | 150.00 | 1.30 | 1.15 | 0.70 | -9.21 | -15.75 | -26.69 | 99.62 |
| | 17 | 175.00 | 1.35 | 1.18 | 0.65 | -10.85 | -18.41 | -31.07 | 99.94 |
| | 18 | 200.00 | 1.40 | 1.20 | 0.60 | -12.03 | -20.34 | -34.20 | 99.99 |
| | 19 | 225.00 | 1.45 | 1.23 | 0.55 | -13.63 | -22.86 | -38.16 | 100.00 |

These scenarios (which capture both macroeconomic changes as well as shocks to LDM, Home-Price, and Interest Rate models), in combination with a base case scenario, are used to forecast the performance of each loan in terms of its likelihood to prepay, become delinquent, default, or generate a loss of a certain amount. AD&Co has derived the CDF2 for the 20 scenarios by modifying standard Vasicek theory to take into account scenarios in which a loan has neither a 0% likelihood of default nor a 100% likelihood of default. AD&Co research shows that this three-part Vasicek approach captures the tail risk inherent in extremely adverse scenarios, which would otherwise only be simulated using a Monte Carlo approach with a vast number of paths.

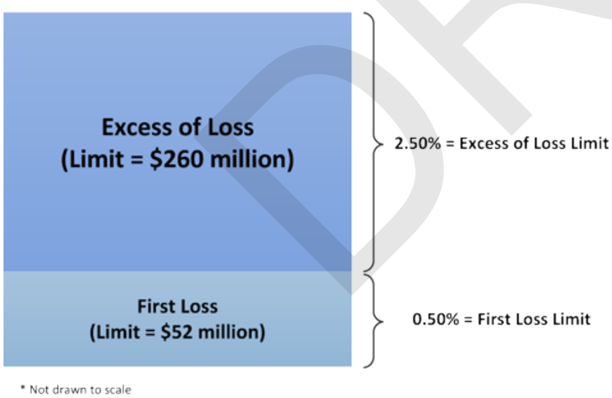
## Appendix 2: Factor-Based Capital Charge Calculations

The following examples of insurance-based risk transfer programs will help illustrate the important elements of the procedures for the capital charge calculations. Example 1 is partially derived from an actual transaction and relates to an insurance-based risk transfer program where a reinsurer has chosen to provide coverage for a program with a single risk layer. Example 2 shows the calculation for another transaction in the insurance-based risk transfer program, where a reinsurer provides coverage for a program with multiple layers of risk.

### Example 1

Example 1 shows the initial capital charge and the capital charge after one year of seasoning of the transaction associated with the VaR 99 level. The example assumes that in a reference pool consisting of $10.3 billion of 30-year fixed rate mortgages with LTVs greater than 60% and less than or equal to 80%, a GSE desires to transfer an exposure of up to 2.50% of the unpaid principal balance, after the first loss of 0.50% of UPB over a 10-year risk period. Any losses realized after that 10-year risk period associated with mortgage defaults that occurred within the 10-year risk period are also covered by the reinsurers. Thus, in this simplified example, A.M. Best assumes that losses continue for 12 years, while premiums earned by reinsurers cease by the tenth year. For the reinsurer providing the excess of loss coverage, this means it can cover a maximum exposure of about $260 million ($260 million = 2.50% * $10.3 billion) associated with the mortgage reference pool on the first day in which it enters the reinsurance contract. The reinsurer's exposure may decline as the UPB decreases due to scheduled amortizations and prepayments. **Appendix 2: Exhibit 1** shows the risk tower associated with this particular example of an insurance-based risk transfer program.

**Exhibit 1: Transaction Risk Tower***




The exposure layers with associated premiums based on the Remaining UPB as shown in **Appendix 2: Exhibit 1** are as follows:

- First Loss: 0.50% of losses associated with the $10.3 billion reference pool
- Single Tranche: 2.50% excess of 0.50% of losses associated with the $10.3 billion reference pool; premiums are 14bps of the Remaining UPB

In this example, the calculation of the initial and 1-Year-Seasoned capital charges for the excess of loss layer is shown.

### *Initial Capital Charge Calculation*

#### Calculating the Initial Stressed Ultimate Loss

The first step is to calculate the initial SUL to help determine the net losses in the reference portfolio. In this example, the assumption is made that the initial UPB Distribution Matrix is the same matrix as shown in **Exhibit C.1** and that the SUL Matrix is the same matrix as shown in **Exhibit C.2**. Thus, the initial SUL (as calculated earlier and shown in Exhibit C.5) is 3.66%.

#### Calculation of Initial Gross Capital Charge

The initial Gross Capital Charge (GCC) is the loss that builds up in the excess of loss layer as a percentage of the limit before taking premiums into consideration. **Appendix 2: Exhibit 2** illustrates the procedures and elements associated with the initial Gross Capital Charge of the reinsurance contract. Explanations of the columns in the exhibit follow:

| | |
|---|---|
| **Column A:** | Initial Loss Pattern Vector |
| Description: | This is Column A in the Loss Pattern Matrix (**Exhibit C.7**). |
| | |
| **Column B:** | Initial Stressed Ultimate Loss |
| Description: | This is the initial SUL as calculated using the SUL Matrix and initial UPB Distribution Matrix. |
| | |
| **Column C:** | Total Realized Loss – the cumulative losses at the time of the analysis. |
| Description: | The Total Realized Loss is 0 at the beginning of the transaction; as the transaction ages, the Total Realized Loss will grow. |
| | |
| **Column D:** | Initial Cumulative Loss Vector |
| Description: | This is the product of the Initial Loss Pattern Vector and the SUL. The Total Realized Loss is also added to this vector but this is 0 at the beginning of the transaction and will increase as the transaction ages. |
| Formula: | (Column A * Column B) + Column C |
| | |
| **Column E:** | Initial Remaining Limit |
| Description: | This is the limit that remains after considering losses. |
| Formula: | Max [0, min (Excess of Loss Limit, Maximum Limit[2] – Column D)] |

[2] Maximum Limit is the detachment point associated with the layer.

| | |
|---|---|
| **Column F:** | Tranche Cumulative Loss |
| Description: | This is the amount of loss suffered by the tranche. Note that the tranche is not breached until the first loss position is exhausted. |
| Formula: | Min [Max (0, Column D – First Loss Limit), Excess of Loss Limit] |

| | |
|---|---|
| **Column G:** | Tranche Incremental Loss |
| Description: | This is the mathematical difference (except for the first year) between Column F at any particular year and Column F in the prior year. |
| Formula: | $(\text{Column F})_t - (\text{Column F})_{t-1}$ |

| | |
|---|---|
| **Column H:** | PV of Tranche Incremental Loss |
| Description: | This is the present value of the Tranche Incremental Loss (Column G) before taking premiums into consideration. A 4% discount rate is used in the calculation to remain consistent with A.M. Best's calculation methodology for asset capital charges.[3] |
| Formula: | PV of Column G |

The initial Gross Capital Charge is the sum of the present value of Tranche Incremental Loss (Column H) divided by the Excess of Loss Limit. This value is 1.90% / 2.50% = 76.10%.



[3] In this criteria procedure, mid-period present values are calculated; thus, the first term in the discount rate is 0.5 years, the second term is 1.5 years, etc.

**Exhibit 2: Initial Gross Capital Charge Calculation**

| Year | A[1] Initial Loss Pattern Vector | B Initial SUL | C Total Realized Loss | D[2] Initial Cumulative Loss Vector | E[3] Initial Remaining Limit | F[4] Tranche Cumulative Loss | G[5] Tranche Incremental Loss | H PV of Tranche Incremental Loss |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.23% | 3.66% | 0.00% | 0.01% | 2.50% | 0.00% | 0.00% | 0.00% |
| 2 | 2.44% | 3.66% | 0.00% | 0.09% | 2.50% | 0.00% | 0.00% | 0.00% |
| 3 | 9.60% | 3.66% | 0.00% | 0.35% | 2.50% | 0.00% | 0.00% | 0.00% |
| 4 | 20.17% | 3.66% | 0.00% | 0.74% | 2.26% | 0.24% | 0.24% | 0.21% |
| 5 | 31.14% | 3.66% | 0.00% | 1.14% | 1.86% | 0.64% | 0.40% | 0.34% |
| 6 | 41.34% | 3.66% | 0.00% | 1.51% | 1.49% | 1.01% | 0.37% | 0.30% |
| 7 | 50.51% | 3.66% | 0.00% | 1.85% | 1.15% | 1.35% | 0.34% | 0.26% |
| 8 | 58.63% | 3.66% | 0.00% | 2.15% | 0.85% | 1.65% | 0.30% | 0.22% |
| 9 | 65.75% | 3.66% | 0.00% | 2.41% | 0.59% | 1.91% | 0.26% | 0.19% |
| 10 | 71.93% | 3.66% | 0.00% | 2.63% | 0.37% | 2.13% | 0.23% | 0.16% |
| 11 | 77.24% | 3.66% | 0.00% | 2.83% | 0.17% | 2.33% | 0.19% | 0.13% |
| 12 | 81.75% | 3.66% | 0.00% | 2.99% | 0.01% | 2.49% | 0.17% | 0.11% |

1. From Column A of the Loss Pattern Matrix (Exhibit C.7)
2. D = (A * B) + C
3. E = Max[0,Min(2.50%, 3.00% - D)]
4. F = Min[Max(0, D - 0.50%), 2.50%]
5. $G = F_t - F_{t-1}$

| | |
|---|---|
| Sum of Column H = Sum of PV of Tranche Incremental Loss = | 1.90% |
| Gross Capital Charge = Sum of Column H / Initial Limit = | 76.10% |



**Calculation of Initial Premium Credit**

The Premium Credit represents premium that is collected based on a fixed premium rate and the average UPB associated with the reference pool. **Appendix 2: Exhibit 3** shows the elements used in calculating the Premium Credit associated with the reinsurance contract. Explanations of the columns in **Appendix 2: Exhibit 3** follow:

**Column A:** Initial Remaining Limit

Description: This is the limit that remains after considering losses. This was already calculated in **Appendix 2: Exhibit 2** (Column E). The premiums are earned as long as the Remaining Limit is greater than 0.

**Column B:** Premium Rate

Description: This is the premium rate that is applied to the Remaining Amortization Pattern Vector (as described later).

**Column C:** Initial Amortization Pattern Vector

Description: This is from Column A in the Amortization Pattern Matrix (**Exhibit C.11**)

**Column D:** Remaining UPB

Description: This is the percentage of the original UPB that remains in the reference portfolio. This is 100% at the inception of the transaction but will be reduced over time due to scheduled amortization and prepayments.

**Column E:** Remaining Amortization Pattern Vector

Description: This is the product of the Initial Amortization Pattern Vector and the Remaining UPB. This product is equal to the Initial Amortization Pattern Vector at the beginning of the transaction but will be reduced as Remaining UPB diminishes.

**Column F:** Incremental Premium Credit

Description: This is the Incremental Premium Credit based on the Premium Rate and the Remaining Amortization Pattern Vector. Note that the premium payments cease by the 10th year although the losses beyond ten years are recognized in the Gross Capital Charge calculation.

Formula: Column B * Column E

**Column G:** PV of Incremental Premium Credit

Description: This is the present value of the Incremental Premium Credit (Column F). A 4% discount rate is used in the calculation to remain consistent with A.M. Best's calculation methodology for asset capital charges.

Formula: PV of Column F

The sum of the present value of the Incremental Premium Credit (Column G) divided by the Excess of Loss Limit is the Premium Credit to the loss layer at the inception of the transaction. This value is 0.88% / 2.50% = 35.24%.

### Exhibit 3: Initial Premium Credit

| Year | A[1] Initial Remaining Limit | B Premium Rate | C[2] Initial Amortization Pattern Vector | D Remaining UPB | E[3] Remaining Amortization Pattern Vector | F[4] Incremental Premium Credit | G PV of Incremental Premium Credit |
|---|---|---|---|---|---|---|---|
| 1 | 2.50% | 0.14% | 97.73% | 100.00% | 97.73% | 0.14% | 0.13% |
| 2 | 2.50% | 0.14% | 92.77% | 100.00% | 92.77% | 0.13% | 0.12% |
| 3 | 2.50% | 0.14% | 87.43% | 100.00% | 87.43% | 0.12% | 0.11% |
| 4 | 2.26% | 0.14% | 81.88% | 100.00% | 81.88% | 0.11% | 0.10% |
| 5 | 1.86% | 0.14% | 76.39% | 100.00% | 76.39% | 0.11% | 0.09% |
| 6 | 1.49% | 0.14% | 71.11% | 100.00% | 71.11% | 0.10% | 0.08% |
| 7 | 1.15% | 0.14% | 66.10% | 100.00% | 66.10% | 0.09% | 0.07% |
| 8 | 0.85% | 0.14% | 61.36% | 100.00% | 61.36% | 0.09% | 0.06% |
| 9 | 0.59% | 0.14% | 56.87% | 100.00% | 56.87% | 0.08% | 0.06% |
| 10 | 0.37% | 0.14% | 52.63% | 100.00% | 52.63% | 0.07% | 0.05% |
| 11 | 0.17% | 0.00% | 48.61% | 100.00% | 48.61% | 0.00% | 0.00% |
| 12 | 0.01% | 0.00% | 44.80% | 100.00% | 44.80% | 0.00% | 0.00% |

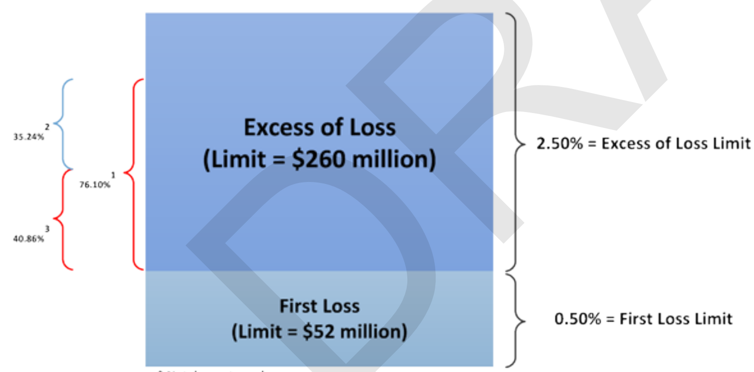
1. From Column E of the Calculation of Initial Gross Capital Charge (Appendix 2: Exhibit 2)
2. From Column A of the Amortization Pattern Matrix (Exhibit C.11)
3. E = C * D
4. F = B * E

| | |
|---|---|
| Sum of Column G = Sum of PV Incremental Credit = | 0.88% |
| Initial Premium Credit = Sum of Column G / Initial Limit = | 35.24% |

### Calculation of Initial Net Capital Charge

The initial Net Capital Charge (NCC), 40.86% (= 76.10% - 35.24%), is the initial Gross Capital Charge minus the initial Premium Credit. **Appendix 2: Exhibit 4** is a diagram of the initial Net Capital Charge associated with the layer in the reinsurance tower.

### Exhibit 4: Diagram of Initial Net Capital Charge*




* Not drawn to scale
¹ Initial Gross Capital Charge
² Initial Premium Credit
³ Initial Net Capital Charge

## *1-Year-Seasoned Capital Charge Calculation*

### Calculating the 1-Year-Seasoned Stressed Ultimate Loss

To calculate the 1-Year-Seasoned SUL, it is necessary to first determine the SUL as described earlier. In summary, the SUL is calculated as the sum of the cell-by-cell product of the 1-Year-Seasoned UPB Distribution Matrix and the SUL Matrix.

The 1-Year-Seasoned UPB Distribution Matrix is shown in **Appendix 2: Exhibit 5**. It is very similar to the initial UPB Distribution Matrix in example (**Exhibit C.1**) because only one year has elapsed since the transaction's inception. One would not expect that the portion of the UPB in each original LTV and original credit score bucket to have changed significantly in that time period.

**Exhibit 5: 1-Year-Seasoned UPB Distribution Matrix**

| | Original Credit Score | | | | | |
|---|---|---|---|---|---|---|
| Original LTV | <620 | [620,660) | [660,700) | [700,740) | [740,780) | >=780 |
| <=60 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| (60-65] | 0.00% | 0.48% | 0.98% | 1.35% | 1.87% | 2.38% |
| (65,70] | 0.00% | 0.96% | 1.93% | 2.65% | 3.42% | 3.76% |
| (70,75] | 0.00% | 1.10% | 2.82% | 4.40% | 6.56% | 7.20% |
| (75,80] | 0.00% | 2.67% | 7.40% | 12.67% | 17.29% | 18.12% |
| (80,85] | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| (85,90] | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| (90,95] | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| (95,97] | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 97+ | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

| | | |
|---|---|---|
| A) New SUL | 3.67% | This is the sum of all cell-by-cell products of the UPB Distribution Matrix Above and the SUL Matrix in Exhibit C.2 |
| B) Seasoning Factor | 105% | From Column A [Year 1] of Exhibit C.6 |
| C) Remaining UPB | 85% | Assumed |
| D) 1-Year-Seasoned SUL | 3.29% | Item A * Item B * Item C |

The newly calculated SUL, 3.67%, is the sum of the cell-by-cell product of the 1-Year-Seasoned UPB Matrix shown in **Appendix 2: Exhibit 5** and the SUL Matrix. The assumption is made that the Remaining UPB is 85% after one year, and the Seasoning Factor (from the one-year row of the Seasoning Vector, **Exhibit C.6**) is 105%. The 1-Year-Seasoned SUL is then calculated as follows:

$$\text{1-Year-Seasoned SUL} = 85\% * 105\% * 3.67\% = 3.29\%$$

**Calculation of 1-Year-Seasoned Gross Capital Charge**

**Appendix 2: Exhibit 6** illustrates the procedures and elements associated with the 1-Year-Seasoned Gross Capital Charge of the reinsurance contract. Explanations of the columns in the exhibit follow:

**Column A:** 1-Year-Seasoned Loss Pattern Vector
Description: This is Column B in the Loss Pattern Matrix (**Exhibit C.7**)

**Column B:** 1-Year-Seasoned Stressed Ultimate Loss
Description: This is the 1-Year-Seasoned SUL as calculated using the SUL Matrix, the 1-Year-Seasoned UPB Distribution Matrix, the Seasoning Factor after one year, and the Remaining UPB.

**Column C:** Total Realized Loss
Description: This is the cumulative losses at the time of the analysis. Total Realized Loss should be small in the early years of the transaction.

| | |
|---|---|
| **Column D:** | 1-Year-Seasoned Cumulative Loss Vector |
| Description: | This is the product of the 1-Year-Seasoned Loss Pattern Vector and the SUL. The Total Realized Loss is also added to this vector but the expectation is that this will be small in the early years of the transaction. |
| Formula: | (Column A * Column B) + Column C |

| | |
|---|---|
| **Column E:** | 1-Year-Seasoned Remaining Limit |
| Description: | This is the limit that remains after considering losses. |
| Formula: | Max[0, min(Excess of Loss Limit, Maximum Limit – Column D)] |

| | |
|---|---|
| **Column F:** | Tranche Cumulative Loss |
| Description: | This is the amount of loss suffered by the tranche. Note that the tranche is not breached until the first loss position is exhausted. |
| Formula: | Min[Max(0, Column D – First Loss Limit), Excess of Loss Limit] |

| | |
|---|---|
| **Column G:** | Tranche Incremental Loss |
| Description: | This is the mathematical difference (except for the first year) between Column F in any particular year and Column F in the prior year. |
| Formula: | $(\text{Column F})_t - (\text{Column F})_{t-1}$ |

| | |
|---|---|
| **Column H:** | PV of Tranche Incremental Loss |
| Description: | This is the present value of the Tranche Incremental Loss (Column G) before taking premiums into consideration. A 4% discount rate is used in the calculation to remain consistent with A.M. Best's calculation methodology for asset capital charges. |
| Formula: | PV of Column G |

The 1-Year-Seasoned Gross Capital Charge, 69.17%, is the sum of the present value of the Tranche Incremental Loss (Column H) divided by the Excess of Loss Limit.

### Exhibit 6: 1-Year-Seasoned Gross Capital Charge

| Year | A[1] 1-Year-Seasoned Loss Pattern Vector | B 1-Year-Seasoned SUL | C Total Realized Loss | D[2] 1-Year-Seasoned Cumulative Loss Vector | E[3] 1-Year-Seasoned Remaining Limit | F[4] Tranche Cumulative Loss | G[5] Tranche Incremental Loss | H PV of Tranche Incremental Loss |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.00% | 0.00% | 0.0003% | 0.0003% | 2.50% | 0.00% | 0.00% | 0.00% |
| 2 | 2.22% | 3.29% | 0.0003% | 0.07% | 2.50% | 0.00% | 0.00% | 0.00% |
| 3 | 9.40% | 3.29% | 0.0003% | 0.31% | 2.50% | 0.00% | 0.00% | 0.00% |
| 4 | 19.98% | 3.29% | 0.0003% | 0.66% | 2.34% | 0.16% | 0.16% | 0.14% |
| 5 | 30.98% | 3.29% | 0.0003% | 1.02% | 1.98% | 0.52% | 0.36% | 0.32% |
| 6 | 41.21% | 3.29% | 0.0003% | 1.35% | 1.65% | 0.85% | 0.34% | 0.28% |
| 7 | 50.40% | 3.29% | 0.0003% | 1.66% | 1.34% | 1.16% | 0.30% | 0.24% |
| 8 | 58.53% | 3.29% | 0.0003% | 1.92% | 1.08% | 1.42% | 0.27% | 0.21% |
| 9 | 65.67% | 3.29% | 0.0003% | 2.16% | 0.84% | 1.66% | 0.23% | 0.17% |
| 10 | 71.87% | 3.29% | 0.0003% | 2.36% | 0.64% | 1.86% | 0.20% | 0.15% |
| 11 | 77.19% | 3.29% | 0.0003% | 2.54% | 0.46% | 2.04% | 0.17% | 0.12% |
| 12 | 81.71% | 3.29% | 0.0003% | 2.69% | 0.31% | 2.19% | 0.15% | 0.10% |

1. From Column B of the Loss Pattern Matrix (Exhibit C.7)
2. D = (A * B) + C
3. E = Max[0,Min(2.50%, 3.00% - D)]
4. F = Min[Max(0, D - 0.50%), 2.50%]
5. $G = F_t - F_{t-1}$

| | |
|---|---|
| Sum of Column H = Sum of PV of Tranche Incremental Loss = | 1.73% |
| Gross Capital Charge = Sum of Column H / Initial Limit = | 69.17% |

### Calculation of 1-Year-Seasoned Premium Credit

The 1-Year-Seasoned Premium Credit is premium that is collected based on a fixed premium rate and the average UPB associated with the reference pool. **Appendix 2: Exhibit 7** shows the elements used in calculating the Premium Credit associated with the reinsurance contract. Explanations of the columns in **Appendix 2: Exhibit 7** follows:

**Column A:** 1-Year-Seasoned Remaining Limit

Description: This is the limit that remains after considering losses as calculated in **Appendix 2: Exhibit 6** (Column E). The premiums are earned as long as the 1-Year-Seasoned Remaining Limit is greater than 0.

**Column B:** Premium Rate

Description: This is the premium rate that is applied to the Remaining Amortization Pattern Vector (described later).

**Column C:** 1-Year-Seasoned Amortization Pattern Vector

Description: This is Column B in the Amortization Pattern Matrix (**Exhibit C.11).**

**Column D:** Remaining UPB

Description: This is the percentage of the original UPB that remains in the reference portfolio.

**Column E:** Remaining Amortization Pattern Vector

Description: This is the product of the 1-Year-Seasoned Amortization Pattern Vector and the Remaining UPB.

**Column F:** Incremental Premium Credit

Description: This is the Incremental Premium Credit based on the Premium Rate and the 1-Year-Seasoned Remaining Amortization Pattern Vector. Note that the premium payments cease by the 10th year although the losses beyond ten years are recognized in the Gross Capital Charge calculation.

Formula: Column B * Column E

**Column G:** PV of Incremental Premium Credit

Description: This is the present value of the 1-Year-Seasoned Incremental Premium Credit (Column F). A 4% discount rate is used in the calculation to remain consistent with A.M. Best's calculation methodology for asset capital charges.

Formula: PV of Column F

The sum of the present value of the 1-Year-Seasoned Incremental Premium Credit (Column G) divided by the Excess of Loss Limit, 27.73%, is the 1-Year-Seasoned Premium Credit to the loss layer.

**Exhibit 7: Example: 1-Year-Seasoned Premium Credit**

| Year | A[1] 1-Year-Seasoned Remaining Limit | B Premium Rate | C[2] 1-Year-Seasoned Amortization Pattern Vector | D Remaining UPB | E[3] Remaining Amortization Pattern Vector | F[4] Incremental Premium Credit | G PV of Incremental Premium Credit |
|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - |
| 2 | 2.50% | 0.14% | 97.30% | 85.00% | 82.70% | 0.12% | 0.11% |
| 3 | 2.50% | 0.14% | 91.73% | 85.00% | 77.97% | 0.11% | 0.10% |
| 4 | 2.50% | 0.14% | 85.98% | 85.00% | 73.08% | 0.10% | 0.09% |
| 5 | 2.50% | 0.14% | 80.25% | 85.00% | 68.21% | 0.10% | 0.08% |
| 6 | 2.49% | 0.14% | 74.72% | 85.00% | 63.52% | 0.09% | 0.07% |
| 7 | 2.38% | 0.14% | 69.46% | 85.00% | 59.04% | 0.08% | 0.07% |
| 8 | 2.28% | 0.14% | 64.48% | 85.00% | 54.81% | 0.08% | 0.06% |
| 9 | 2.19% | 0.14% | 59.77% | 85.00% | 50.80% | 0.07% | 0.05% |
| 10 | 2.12% | 0.14% | 55.31% | 85.00% | 47.01% | 0.07% | 0.05% |
| 11 | 2.05% | 0.00% | 51.09% | 85.00% | 43.42% | 0.00% | 0.00% |
| 12 | 2.00% | 0.00% | 47.08% | 85.00% | 40.02% | 0.00% | 0.00% |

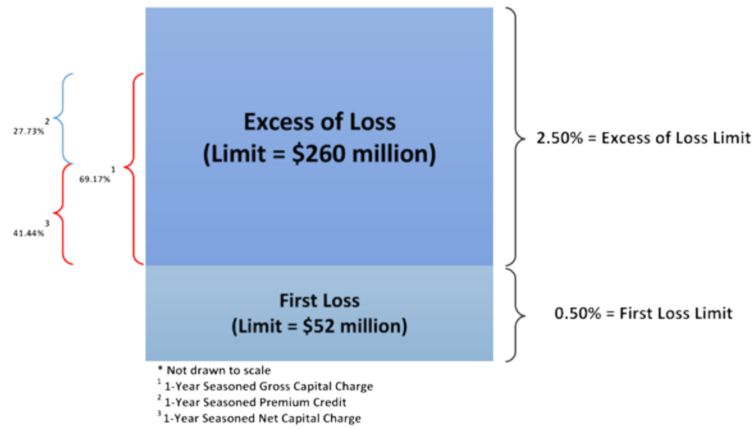
1. From Column E of the Calculation of 1-Year-Seasoned Gross Capital Charge (Appendix 2: Exhibit 6)
2. From Column B of the Amortization Pattern Matrix (Exhibit C.11)
3. E = C * D
4. F = B * E

| | |
|---|---|
| **Sum of Column G = Sum of PV of Incremental Premium Credit =** | **0.69%** |
| **1-Year-Seasoned Premium Credit = Sum of Column G / Initial Limit =** | **27.73%** |

**Calculation of 1-Year-Seasoned Net Capital Charge**

The 1-Year-Seasoned Net Capital Charge, 41.44 % (= 69.17% - 27.73%), is the 1-Year-Seasoned Gross Capital Charge minus the 1-Year-Seasoned Premium Credit. **Appendix 2: Exhibit 8** is a diagram of the 1-Year-Seasoned Net Capital Charge associated with the layers in the reinsurance tower.

#### Exhibit 8: Example: Diagram of 1-Year-Seasoned Net Capital Charge*




#### Capital Charge Results Summary

The results of the capital charge calculation are shown in **Appendix 2: Exhibit 9** below. In addition, the exhibit extends the capital charge calculation to the third, fifth, and seventh year seasoning periods.

To extend to capital charge calculations, A.M. Best assumes the following:

- The UPBs in the third, fifth, and seventh years as a percentage of the original UPB are 55%, 35% and 10%, respectively.
- The cumulative realized losses in the third, fifth, and seventh years are 0.03%, 0.08% and 0.15%, respectively.
- The UPB Distribution Matrix is the same as the 1-Year-Seasoned UPB Distribution Matrix.

Some of these assumptions are based on currently observed reference pool behavior and may not reflect the true behavior of a pool of mortgages under stressed conditions.

#### Exhibit 9: Capital Charges Associated with Example over Various Seasoning Periods

| | Initial | 1-Year-Seasoned | 3-Year-Seasoned | 5-Year-Seasoned | 7-Year-Seasoned* |
|---|---|---|---|---|---|
| Gross Capital Charge | 76.10% | 69.17% | 42.02% | 15.78% | 0.00% |
| Premium Credit | 35.24% | 27.73% | 15.02% | 7.49% | 1.42% |
| Net Capital Charge | 40.86% | 41.44% | 27.00% | 8.30% | -1.42% |

* All risk charges will be floored at 5% of the remaining limit.

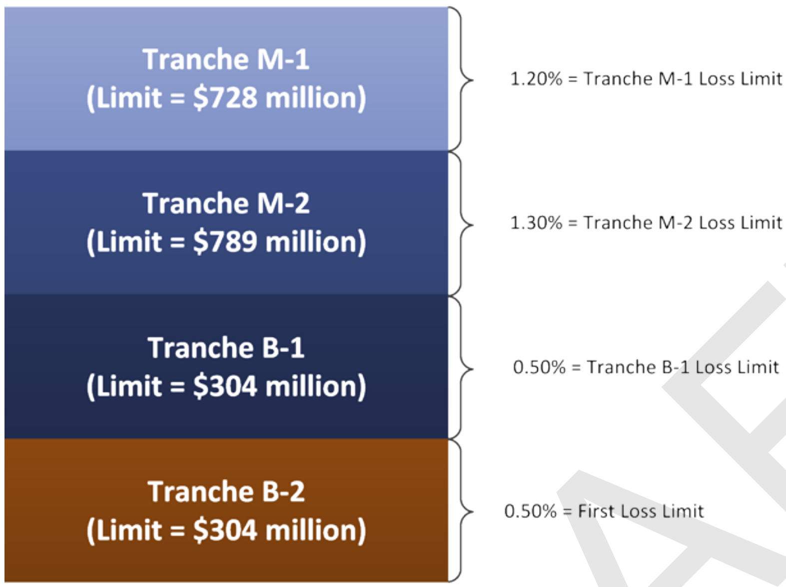
#### Example 2

*Calculating Capital Charges for another Variety of CRT Transactions*

In Example 2, the calculation of the initial capital charge and the capital charge after one year of seasoning of the transaction associated with the VaR 99 level is shown. The example assumes that in a reference pool consisting of $60.7B of 30-year fixed rate mortgages with LTVs greater than 60% and less than or equal to 80%, a GSE desires to transfer an exposure of up to 3.00% of the UPB, after the first loss of 0.50% of UPB over a 12-year period. For the reinsurer providing the excess of loss coverage, this means it can cover a maximum exposure of $1.82 billion ($1.82 billion = 3.00% *

$60.7 billion) associated with the mortgage reference pool on the first day in which it enters the reinsurance contract. Because the risks are broken out into different layers, reinsurers can choose which layer they will cover based on their risk appetite. **Appendix 2: Exhibit 10** shows the risk tower associated with this particular example of an insurance-based risk transfer program.

**Exhibit 10: Example: Transaction Risk Tower***




* Not Drawn to Scale



The exposure layers as shown in **Appendix 2: Exhibit 10**, with associated premiums based on the remaining limits is as follows:

- Tranche B-2 (First Loss): 0.50% of losses associated with the $60.7 billion reference pool
- Tranche B-1: 0.50% excess of 0.50% of losses associated with the $60.7 billion reference pool; premiums are 4.95% of remaining limit
- Tranche M-2: 1.30% excess of 1.00% of losses associated with the $60.7 billion reference pool; premiums are 3.25% of remaining limit
- Tranche M-1: 1.20% excess of 2.30% of losses associated with the $60.7 billion reference pool; premiums are 1.10% of remaining limit

In this example, the assumption is that the reinsurer is covering only the M-2 risk layer. The capital charge calculation is similar to the calculation in Example 1 except that 1) the premiums are calculated based on the remaining limits of each layer covered by a reinsurer, and 2) due to the structure of this particular type of reinsurance program, the risk limits are generally reduced sequentially, such that the highest layer receives all the scheduled amortizations and prepayments before the subordinate layers.

The average life of each tranche varies because the exposure of each tranche is paid down sequentially (from safest tranche to riskiest tranche) generally in proportion to the amortization and prepayment of the reference pool, under most economic conditions. Essentially, the reduction of the exposures is disproportionately advantageous to the top tranche because the higher-level exposures are reduced first, before the lower level exposures. For this reason, the expected life of the top tranche can be much shorter than that of the lower tranches. However, the VaR levels considered in these criteria project losses so severe that the principal allocation tests (which determine whether prepayments can accrue to the reinsurance layers) fail, thereby prohibiting principal prepayments to the reinsurance tranches. In this scenario, the expected life of these tranches is much longer than the expected life in what is considered a "normal" loss environment.

### *Initial Capital Charge*

#### The Initial Gross Capital Charge

Calculation of the initial Gross Capital Charge for the M-2 layer first requires the initial SUL. As discussed earlier, deriving the initial SUL requires a cell-by-cell multiplication of the SUL Matrix (**Exhibit C.2**) and the UPB Matrix, which is assumed to be the same UPB Matrix as in **Exhibit C.1**. The sum of the cell-by-cell product of the SUL Matrix and the UPB Matrix, as described in the main body of this criteria procedure, is the initial SUL.

Given this initial SUL of 3.66%, the initial Gross Capital Charge calculation for the M-2 layer is shown in **Appendix 2: Exhibit 11** as the sum of Column H – the PV of Tranche Incremental Loss – divided by the Tranche M-2 Excess of Loss Limit. Thus, the Gross Capital Charge for the M-1 layer is 77.69%. The elements in **Appendix 2: Exhibit 11** for the Gross Capital Charge calculation are the same elements described in Example 1.



**Exhibit 11: Initial Gross Capital Charge for M-2 Layer**

| | A[1] | B | C | D[2] | E[3] | F[4] | G[5] | H |
|---|---|---|---|---|---|---|---|---|
| Year | Initial Loss Pattern Vector | Initial SUL | Initial Total Realized Loss | Initial Cumulative Loss Vector | Initial Remaining Limit | Tranche Cumulative Loss | Tranche Incremental Loss | PV of Tranche Incremental Loss |
| 1 | 0.23% | 3.66% | 0.00% | 0.01% | 1.30% | 0.00% | 0.00% | 0.00% |
| 2 | 2.44% | 3.66% | 0.00% | 0.09% | 1.30% | 0.00% | 0.00% | 0.00% |
| 3 | 9.60% | 3.66% | 0.00% | 0.35% | 1.30% | 0.00% | 0.00% | 0.00% |
| 4 | 20.17% | 3.66% | 0.00% | 0.74% | 1.30% | 0.00% | 0.00% | 0.00% |
| 5 | 31.14% | 3.66% | 0.00% | 1.14% | 1.16% | 0.14% | 0.14% | 0.12% |
| 6 | 41.34% | 3.66% | 0.00% | 1.51% | 0.79% | 0.51% | 0.37% | 0.30% |
| 7 | 50.51% | 3.66% | 0.00% | 1.85% | 0.45% | 0.85% | 0.34% | 0.26% |
| 8 | 58.63% | 3.66% | 0.00% | 2.15% | 0.15% | 1.15% | 0.30% | 0.22% |
| 9 | 65.75% | 3.66% | 0.00% | 2.41% | 0.00% | 1.30% | 0.15% | 0.11% |
| 10 | 71.93% | 3.66% | 0.00% | 2.63% | 0.00% | 1.30% | 0.00% | 0.00% |
| 11 | 77.24% | 3.66% | 0.00% | 2.83% | 0.00% | 1.30% | 0.00% | 0.00% |
| 12 | 81.75% | 3.66% | 0.00% | 2.99% | 0.00% | 1.30% | 0.00% | 0.00% |

1. From Column A of the Loss Pattern Matrix (Exhibit C.7)
2. D = (A * B) + C
3. E = Max[0,Min(1.30%, 2.30% - D)]
4. F = Min[Max(0, D - 1.0%), 1.30%]
5. G = $F_t$ - $F_{t-1}$

| | |
|---|---|
| **Sum of Column H = Sum of PV of Tranche Incremental Loss =** | **1.01%** |
| **Gross Capital Charge = Sum of Column H / Initial Limit =** | **77.69%** |

#### The Initial Premium Credit

The Initial Premium Credit is premium that is collected based on a fixed premium rate for each risk layer and the limit of each risk layer.

**Appendix 2: Exhibit 12** shows the elements used in calculating the Premium Credit associated with the reinsurance contract. The elements in **Appendix 2: Exhibit 12** for the Premium Credit calculation are the exact same elements that are described in Example 1 with the following exception: the premium credit relies only on the remaining limit of the risk layer, not on the remaining UPB of the mortgages in the reference pool. For this reason, the Incremental Premium Credit shown in Column C of **Appendix 2: Exhibit 12** is simply the product of the Premium Rate and the Initial Remaining Limit. The Initial Premium Credit of 17.21% is the sum of Column D divided by the Tranche M-2 Excess of Loss Limit.

**Exhibit 12: Initial Premium Credit Charge Calculation**

| Year | A<br>Initial Remaining Limit | B<br>Premium Rate | C[1]<br>Incremental Premium Credit | D<br>PV of Incremental Premium Credit |
|---|---|---|---|---|
| 1 | 1.30% | 3.25% | 0.04% | 0.04% |
| 2 | 1.30% | 3.25% | 0.04% | 0.04% |
| 3 | 1.30% | 3.25% | 0.04% | 0.04% |
| 4 | 1.30% | 3.25% | 0.04% | 0.04% |
| 5 | 1.16% | 3.25% | 0.04% | 0.03% |
| 6 | 0.79% | 3.25% | 0.03% | 0.02% |
| 7 | 0.45% | 3.25% | 0.01% | 0.01% |
| 8 | 0.15% | 3.25% | 0.01% | 0.00% |
| 9 | 0.00% | 3.25% | 0.00% | 0.00% |
| 10 | 0.00% | 3.25% | 0.00% | 0.00% |
| 11 | 0.00% | 3.25% | 0.00% | 0.00% |
| 12 | 0.00% | 3.25% | 0.00% | 0.00% |

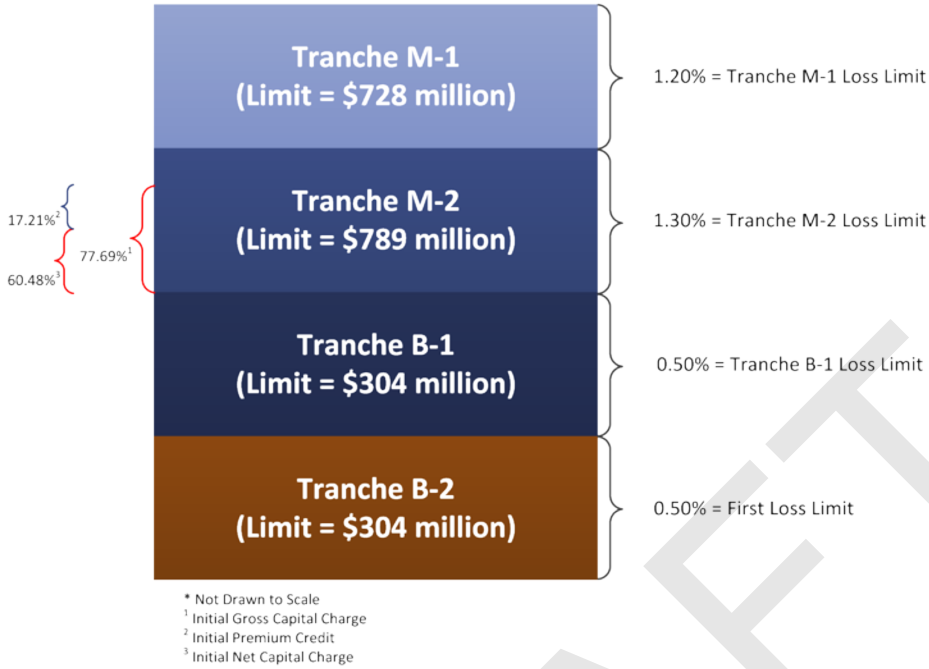
[1] C = A * B

| | |
|---|---|
| **Sum of Column D = Sum of PV of Incremental Premium Credit =** | **0.22%** |
| **Initial Premium Credit = Sum of Column D / Initial Limit =** | **17.21%** |

**Calculation of Initial Net Capital Charge**

The Initial Net Capital Charge, 60.48% (= 77.69% - 17.21%), is the Initial Gross Capital Charge minus the Initial Premium Credit. **Appendix 2: Exhibit 13** is a diagram of the Initial Net Capital Charge associated with the M-2 layer.

**Exhibit 13: Example: Diagram of Initial Net Capital Charge***




### *1-Year-Seasoned Capital Charge*

#### The 1-Year-Seasoned Gross Capital Charge

Calculating the 1-Year-Seasoned Gross Capital Charge for the M-2 layer first requires the 1-Year-Seasoned SUL. The 1-Year-Seasoned SUL, in turn, requires the 1-Year-Seasoned UPB Matrix, the Remaining UPB (assumed to be 85% in this example), the corresponding Seasoning Factor (105% from **Exhibit C.6**), and the standard SUL (the sum of the elements in the cell-by-cell product of the 1-Year-Seasoned UPB Matrix and the SUL Matrix). Assuming that the 1-Year-Seasoned UPB Matrix is the same as shown in Example 1 **(Appendix 2: Exhibit 5)**, the SUL is 3.67%. Therefore, the 1-Year-Seasoned SUL is calculated as follows:

$$\text{1-Year-Seasoned SUL} = 85\% * 105\% * 3.67\% = 3.29\%$$

Given the 1-Year-Seasoned SUL, the calculations for the 1-Year-Seasoned Gross Capital Charge are fairly routine and are shown in **Appendix 2: Exhibit 14** as 78.81%. Once again, the elements in **Appendix 2: Exhibit 14** for the Gross Capital Charge Calculation are the exact same elements that are described in Example 1.

**Exhibit 14: 1-Year Seasoned Gross Capital Charge**

| Year | A[1] 1-Year-Seasoned Loss Pattern Vector | B 1-Year-Seasoned SUL | C Total Realized Loss | D[2] 1-Year-Seasoned Cumulative Loss Vector | E[3] 1-Year-Seasoned Remaining Limit | F[4] Tranche Cumulative Loss | G[5] Tranche Incremental Loss | H PV of Tranche Incremental Loss |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.00% | 0.00% | 0.0000% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% |
| 2 | 2.22% | 3.29% | 0.0003% | 0.07% | 1.30% | 0.00% | 0.00% | 0.00% |
| 3 | 9.40% | 3.29% | 0.0003% | 0.31% | 1.30% | 0.00% | 0.00% | 0.00% |
| 4 | 19.98% | 3.29% | 0.0003% | 0.66% | 1.30% | 0.00% | 0.00% | 0.00% |
| 5 | 30.98% | 3.29% | 0.0003% | 1.02% | 1.28% | 0.02% | 0.02% | 0.02% |
| 6 | 41.21% | 3.29% | 0.0003% | 1.35% | 0.95% | 0.35% | 0.34% | 0.28% |
| 7 | 50.40% | 3.29% | 0.0003% | 1.66% | 0.64% | 0.66% | 0.30% | 0.24% |
| 8 | 58.53% | 3.29% | 0.0003% | 1.92% | 0.38% | 0.92% | 0.27% | 0.21% |
| 9 | 65.67% | 3.29% | 0.0003% | 2.16% | 0.14% | 1.16% | 0.23% | 0.17% |
| 10 | 71.87% | 3.29% | 0.0003% | 2.36% | 0.00% | 1.30% | 0.14% | 0.10% |
| 11 | 77.19% | 3.29% | 0.0003% | 2.54% | 0.00% | 1.30% | 0.00% | 0.00% |
| 12 | 81.71% | 3.29% | 0.0003% | 2.69% | 0.00% | 1.30% | 0.00% | 0.00% |

1. From Column B of the Loss Pattern Matrix (Exhibit C.7)
2. D = (A * B) + C
3. E = Max[0,Min(1.30%, 2.30% - D)]
4. F = Min[Max(0, D - 1.0%), 1.30%]
5. G = $F_t - F_{t-1}$

| | |
|---|---|
| **Sum of Column H = Sum of PV of Tranche Incremental Loss =** | **1.02%** |
| **Gross Capital Charge = Sum of Column H / Initial Limit =** | **78.81%** |

### 1-Year-Seasoned Premium Credit

The 1-Year-Seasoned Premium Credit is based on a fixed premium rate for the M-2 risk layer and the remaining limit of that risk layer. **Appendix 2: Exhibit 15** shows the elements used in calculating the 1-Year-Seasoned Premium Credit Premium Credit associated with the reinsurance contract. Once again, the elements in **Appendix 2: Exhibit 15** for the Premium Credit calculation are the exact same elements that are fully described in Example 1, with the following exception: unlike Example 1, the premium credit relies only on the remaining limit of the risk layer, not the remaining UPB of the mortgages in the reference pool. For this reason, the Incremental Premium Credit shown in Column C of **Appendix 2: Exhibit 15** is simply the product of the Premium Rate times the 1-Year-Seasoned Remaining Limit. The 1-Year Seasoned Premium Credit of 16.26% is the sum of Column D divided by the Tranche M-2 Excess of Loss Limit.

**Exhibit 15: 1-Year-Seasoned Premium Credit**

| Year | A<br>1-Year-Seasoned Remaining Limit | B<br>Premium Rate | C[1]<br>Incremental Premium Credit | D<br>PV of Incremental Premium Credit |
|---|---|---|---|---|
| 1 | - | - | - | - |
| 2 | 1.30% | 3.25% | 0.04% | 0.04% |
| 3 | 1.30% | 3.25% | 0.04% | 0.04% |
| 4 | 1.30% | 3.25% | 0.04% | 0.04% |
| 5 | 1.28% | 3.25% | 0.04% | 0.04% |
| 6 | 0.95% | 3.25% | 0.03% | 0.03% |
| 7 | 0.64% | 3.25% | 0.02% | 0.02% |
| 8 | 0.38% | 3.25% | 0.01% | 0.01% |
| 9 | 0.14% | 3.25% | 0.00% | 0.00% |
| 10 | 0.00% | 3.25% | 0.00% | 0.00% |
| 11 | 0.00% | 3.25% | 0.00% | 0.00% |
| 12 | 0.00% | 3.25% | 0.00% | 0.00% |

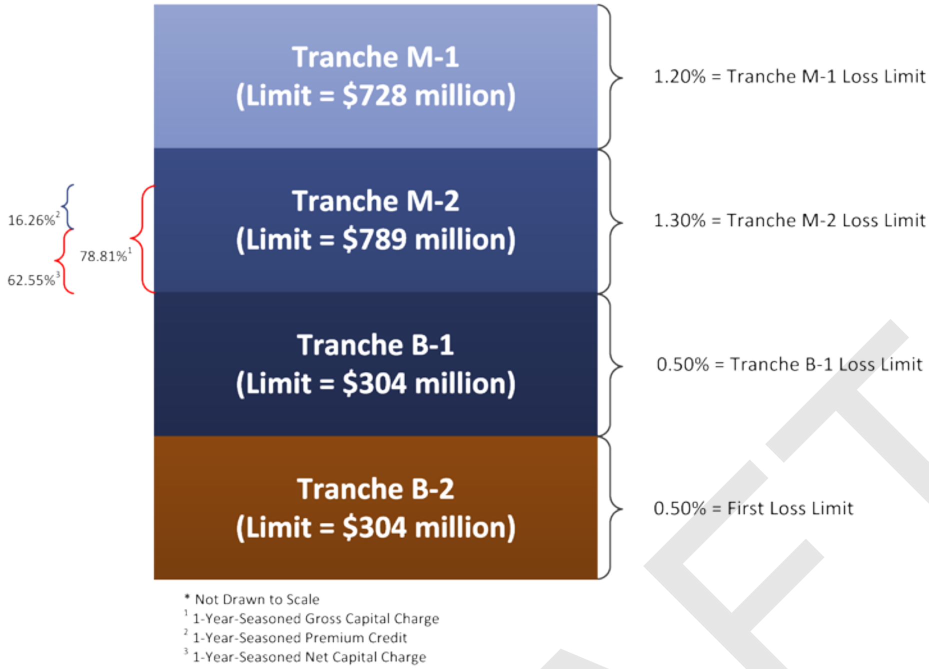
[1] C = A * B

| | |
|---|---|
| Sum of Column D = Sum of PV of Incremental Premium Credit = | 0.21% |
| Initial Premium Credit = Sum of Column D / Initial Limit = | 16.26% |

**Calculation of 1-Year-Seasoned Net Capital Charge**

The 1-Year-Seasoned Net Capital Charge, 62.55% (= 78.81% - 16.26%), is the 1-Year-Seasoned Gross Capital Charge minus the 1-Year-Seasoned Premium Credit. **Appendix 2: Exhibit 16** is a diagram of the 1-Year-Seasoned Net Capital Charge associated with the M-2 layer.

**Exhibit 16: Example: Diagram of 1-Year-Seasoned Net Capital Charge***




### *Capital Charge Results Summary*

The results of the capital charge calculation are shown in **Appendix 2: Exhibit 17** below. In addition, the exhibit extends the capital charge calculation to the third, fifth, and seventh year seasoning periods.

To derive the capital charge calculations, A.M. Best made the following assumptions:

- The UPBs in the third, fifth, and seventh years as a percentage of the original UPB are 55%, 35% and 10%, respectively.
- The cumulative realized losses in the third, fifth, and seventh years are 0.03%, 0.08% and 0.15%, respectively.
- The UPB Distribution Matrix is the same as the 1-Year-Seasoned UPB Distribution Matrix.

Some of these assumptions are based on currently observed reference pool behavior and may not reflect the true behavior of a pool of mortgages under stressed conditions.

**Exhibit 17: Capital Charges Associated With Example over Various Seasoning Periods**

| | Initial | 1-Year-Seasoned | 3-Year-Seasoned | 5-Year-Seasoned* | 7-Year-Seasoned* |
|---|---|---|---|---|---|
| **Gross Capital Charge** | 77.69% | 78.81% | 65.15% | 0.00% | 0.00% |
| **Premium Credit** | 17.21% | 16.26% | 10.03% | 1.59% | 0.00% |
| **Net Capital Charge** | 60.48% | 62.55% | 55.12% | -1.59% | 0.00% |

* All risk charges will be floored at 5% of the total remaining limit associated with each transaction after considering the layers covered by the reinsurer.

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# METHODOLOGY

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