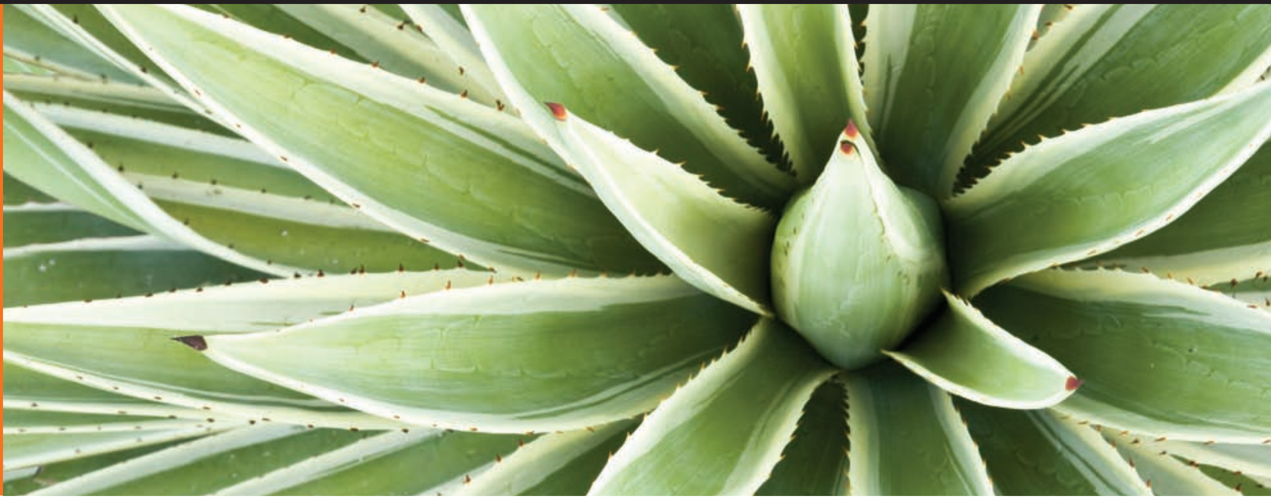

THE SECURITISATION & STRUCTURED FINANCE HANDBOOK

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Credit enhancement optimisation model in securitisation transactions

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Northern Arc Capital (previously known as IFMR Capital) acts as a structurer, arranger and investor of securitisation transactions in different sectors like microfinance, housing finance, vehicle finance, consumer durables and small business loans. It has done over 400 securitisation transactions in the last eight years and helped different originators to raise more than US$3.15bn capital through these transactions. To date, the losses to the investors in the securitisation transactions are well below 0.49%, for senior investors, the losses are below 0.09%.

On November 8, 2016, the Government of India announced the demonetisation of all INR500 and INR1000 banknotes. Because of the sudden nature of the announcement, it caused prolonged cash shortage in the following weeks. It caused significant disruption in the economy and caused stress in the portfolio of financial institutions which has a cash-based model like Microfinance. Due to the stress, many originators in the microfinance sector have faced losses in the range of 4% to 6%. However, due to Northern Arc's pool selection criteria and its credit enhancement optimisation models, the investors in Northern Arc transactions faced a loss of only 0.88%, which is significantly lower than the losses which these originators have faced.

To understand the risk in a securitisation transaction, it is important for an investor to see both the expected losses and the available credit enhancement in the transaction. It is possible that a transaction with high-risk underlying asset is safer due to the availability of higher credit enhancements as compared to a transaction with a low-risk underlying pool due to the availability of lower credit enhancements. For securitisation transaction, credit rating agencies also look at the available credit enhancement with respect to the estimated losses, to provide the credit ratings to different tranches.

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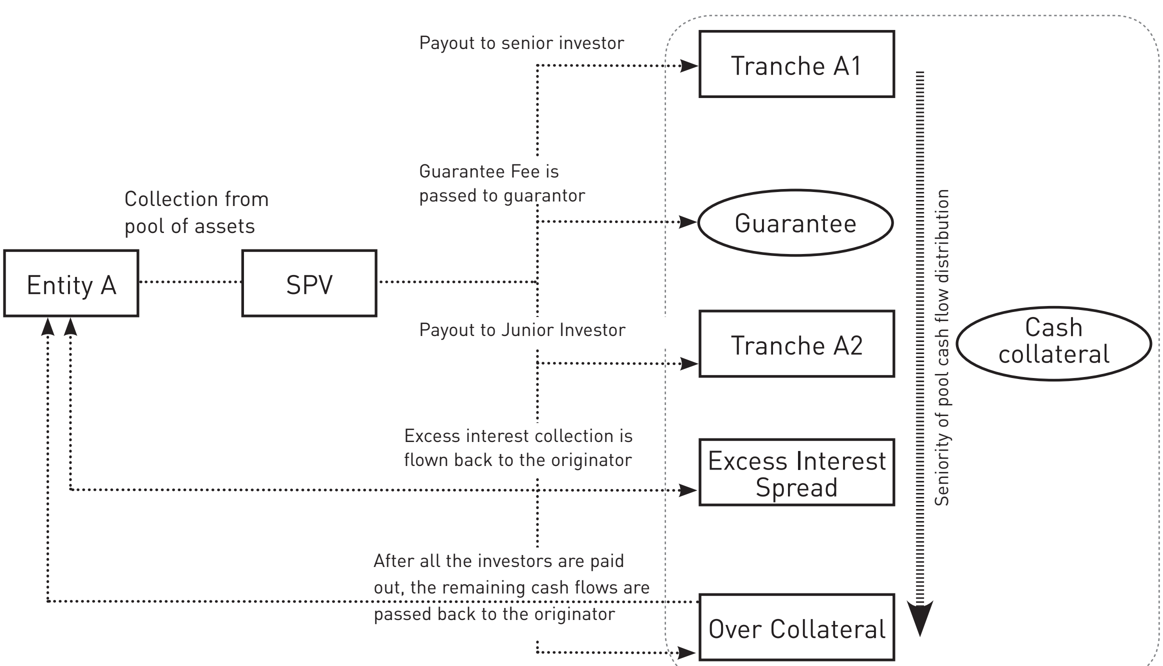
Methodology for the estimation of loss distribution from the underlying pool was discussed in *The Securitisation & Structured Finance Handbook 2018*, *Estimating loss distribution for a securitisation transaction*. This article will discuss the next logical step, which is estimating the optimum credit enhancement to safeguard the investors against the possible losses in the pool of loans.

Impact of underlying pool losses on the different type of credit enhancements

There are different types of credit enhancements built in the waterfall structure of a securitisation transaction like cash collateral, excess interest spread, over collateral, guarantee, etc. A sample two tranche Northern Arc transaction is used to explain the impact of underlying pool loss on these credit enhancements. This sample transaction is depicted in Exhibit 1 and Exhibit 2.

In Exhibit 1, Entity A is the originator of the transaction, which disburses loans to the retail borrowers. A pool of retail loans is selected from the originator's portfolio and sold to an SPV (special purpose vehicle). Along with being an originator, Entity A acts as a 'servicer' as well, which means that it is responsible for the repayment collections from the pool. These repayment collections are passed to the SPV and based on the waterfall structure, the SPV allocates the cashflows to A1 tranche, A2 tranche, guarantee fee, excess interest spread & over collateral. Tranche A1 is senior to Tranche A2 which means that the payments to A2 tranche are made only when the A1 tranche is fully paid off. An external guarantor has given the guarantee to the senior tranche A1. So, if there is a shortfall to A1, then the shortfall will be made good by utilising the guarantee, subjected to a 'guarantee cap'. At every payout, the differential of the interest on an

Flow of cash in Northern Arc's two tranche PAR transaction **Exhibit 1**



underlying pool and the interest on PTC (pass through certificate) is passed as excess interest spread. Over collateral and cash collateral in the transaction provides additional cushion to the investors. Excess interest spread (EIS) is not kept in a bank but it is passed back to the Entity A, and once the EIS is passed back to the entity, it cannot be clawed back to pay for the future defaults.

Excess interest spread (EIS) and over collateral (OC) comes from the underlying pool collections, so if the underlying pool gets into stress due to overdue, then the amount of EIS and OC also get reduced. Also, if the overdue start building up later in the life of the transaction, much of the EIS would have been already passed back to the originator, so the cushion available from EIS would reduce significantly. So, the actual safety provided by the EIS and OC is not only dependent on the underlying pool overdue, but also on the timing of overdue in the transaction. This is explained with the help of Exhibit 2 which shows a simplified version of a two-tranche waterfall structure of a securitisation transaction.

At the settlement date of the transaction, the scheduled underlying pool collection of US$12,000 is distributed across senior tranche A1, junior tranche A2, Guarantee fee, EIS and OC. At the settlement date of the transaction, the total credit enhancement of A1 is 69.2% and A2 is 49.2%, which is calculated as:

Total credit enhancement to A1 = CC + OC + EIS + Guarantee + Total A2 payouts

Total credit enhancement to A2 = CC + OC + EIS

Waterfall of a two-tranche PAR transaction at the settlement date **Exhibit 2**

Payout date	Pool collection	Payout to A1 tranche	Guarantee fee	Payout to A2 tranche	Excess interest spread	Over collateral
Jan-18	1000	700	10	0	290	0
Feb-18	1000	700	10	0	290	0
Mar-18	1000	700	10	0	290	0
Apr-18	1000	700	10	0	290	0
May-18	1000	700	10	0	290	0
Jun-18	1000	700	10	0	290	0
Jul-18	1000	700	10	0	290	0
Aug-18	1000	700	10	0	290	0
Sep-18	1000	0	0	700	300	0
Oct-18	1000	0	0	700	300	0
Nov-18	1000	0	0	0	0	1000
Dec-18	1000	0	0	0	0	1000

Guarantee to A1	1000	Total A1 payout	5600
Guarantee %	8.3%	Total A1 payout %	46.7%
Cash collateral	1000	Total A2 payout	1400
Cash collateral %	8.3%	Total A2 payout %	11.7%
Excess interest spread	2920	Total credit enhancement to A1	8320
Excess interest spread %	24.3%	Total credit enhancement to A1 %	69.3%
Over collateral	2000	Total credit enhancement to A2	5920
Over collateral %	16.7%	Total credit enhancement to A2 %	49.3%

However, in a loan portfolio, the loss generally starts building up after some months are passed. If in this transaction, the loss starts building up from the sixth month onward, the EIS for the first five months (approximately 290 * 5 = 1450) would pass back to the originator. So, as of the sixth month, the EIS cover available to A2 would reduce from 24.2% to 14.5%. There is also a risk of further deterioration in the underlying pool collection, which would further reduce the available cushion from EIS and OC.

Optimisation of credit enhancement in a securitisation transaction

The outputs of the following three models are used in the model to optimise credit enhancements.

1. Model to generate a securitisation waterfall
2. Transaction loss estimation model
3. Model to estimate loss absorption capacity of different tranche investors

These three models will be discussed below, followed by the model to optimise credit enhancement.

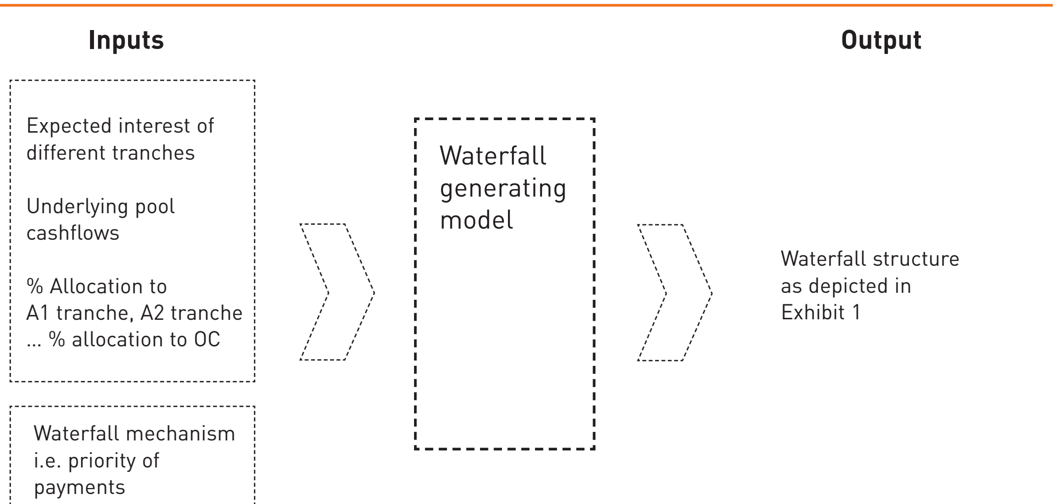
Model 1: Model to generate a securitisation waterfall

This model generates a waterfall structure as mentioned in Exhibit 1, by using some of the transaction-related inputs like expected yield to different tranches, cash collateral amount, percentage allocation of pool cashflows to different tranches and over collateral.

Rules for allocation of underlying pool cashflows are mentioned in the waterfall mechanism. The waterfall mechanism set rules for priority of payments amongst different tranches and rules for utilisation and replenishment of credit enhancements.

At the time of settlement of the securitisation transaction, all the input parameters are fixed except the **"% Allocation to different tranches and OC"**. So, multiple sets of waterfalls can be generated by providing different combinations of "% Allocation input". These multiple sets of waterfalls are passed through Model 3, which will generate multiple sets of 'loss absorption capacities' for different tranches.

Model to generate a securitisation waterfall **Exhibit 3**



Model 2: Transaction loss estimation model

A detailed methodology for estimation of loss distribution from the underlying pool was discussed in *The Securitisation & Structured Finance Handbook 2018, Estimating loss distribution for a securitisation transaction*. To get the loss distribution, the underlying pool of loans are divided into different homogeneous groups and the losses for every group is calculated through Vasicek's ASRF model. Intergroup correlation amongst these homogeneous groups is incorporated by using Cholesky decomposition. Servicer default risk can also be incorporated in the model by stressing the input probability of default estimate by a servicer risk premium.

Investors of securitisation transactions face two sources of credit risk, one is from the underlying pool overdue, and another is from servicer default risk. Servicer risk is higher for a few of the sectors because of their high touch operational model. For example, in the microfinance sector in India, loan repayments generally happen in a group meeting of borrowers, where the loan officer physically collects cash from them. Finding an alternative servicer in such a high touch operation model is difficult. So, for these sectors, a higher servicer risk premium must be considered while estimating the loss distribution of the transaction.

A sample output of the 'transaction loss estimation' model is shown in Exhibit 4.

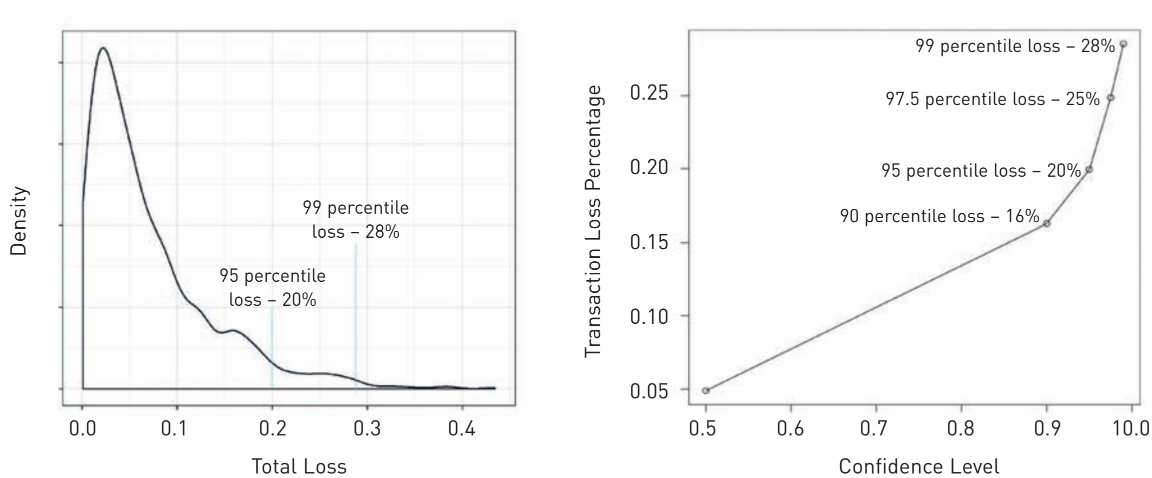
The chart on the left of Exhibit 4 depicts the estimated loss distribution of the underlying pool and the chart on the right concentrates on the tail of the loss distribution. From the chart, it can be seen that the 95th percentile loss is 20%, 99th percentile loss is 28% and so on.

Model 3: Model to estimate the loss absorption capacity of different tranche investors

The total credit enhancement cushion available to investors of different tranches in a securitisation transaction is dependent upon the underlying pool overdue and the timing of the underlying overdue. In other words, the loss faced by the tranche investors is a function of three factors – type of credit enhancement available to the tranche, possible pool overdue and the timing of the underlying pool overdue:

Loss of a tranche = f (available credit enhancements, underlying pool overdue, timing of pool overdue)

Sample output of transaction loss estimation model **Exhibit 4**



Type of credit enhancement available for the tranche is directly given in the waterfall structure of the transaction and it does not change over the life of the transaction. So, if a specific overdue pattern is assumed, the maximum overdue amount for which the tranche investors will not face any loss can be calculated. This is done by using the following optimization equation:

Minimise [{f, available credit enhancement, overdue pattern}, {pool overdues}]

.... (1.1)

i.e. minimise function *f* with respect to pool overdue, subject to constraints of available credit enhancements and an overdue pattern.

There are many optimisation algorithms, which can be used to solve the above equation. Northern Arc uses the 'Gradient descent algorithm' to solve the above optimisation problem. Exhibit 5 is used to explain the algorithm.

The Gradient descent algorithm starts with a guess of overdue, OD_o, for which the function f is minimised. Then a sequence of OD_1, OD_2, OD_3 ..., OD_n is generated such that

$OD_{n+1} = OD_n - \alpha_n \nabla f(OD_n),\ n \geq 0$

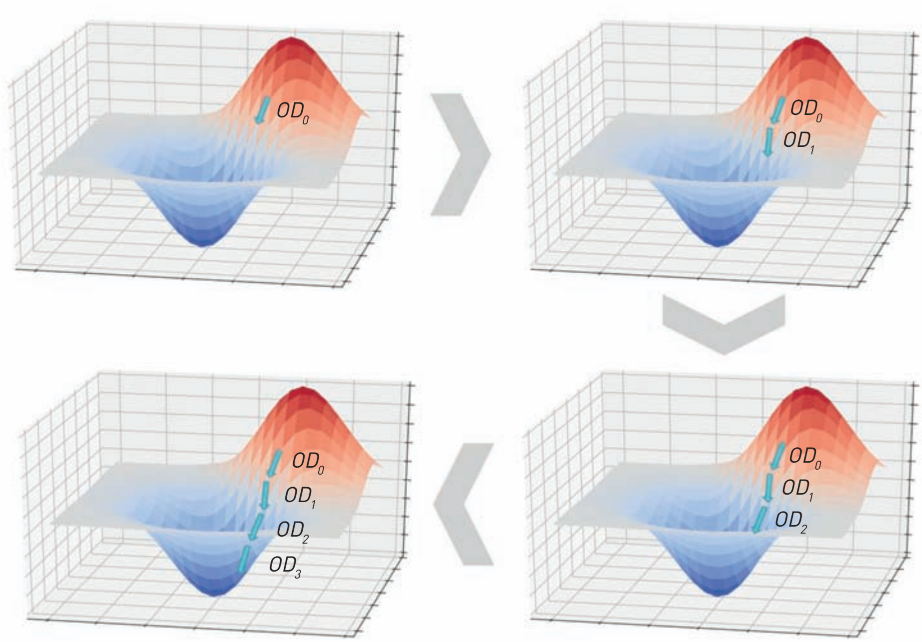
And for different OD values

$f(OD_0) \geq f(OD_1) \geq f(OD_2) \ldots,$

This iteration is done till a sequence OD_n is reached, where the function f is minimized, i.e. $f \rightarrow 0$. This overdue of OD_n is the maximum overdue amount at which the tranche investor will not face a loss, for a given overdue pattern. This can be called as the **"loss absorption capacity of tranche"** for a given OD allocation pattern.

To check the robustness of a securitisation transaction, this model can be run for different scenarios of OD allocation to estimate the loss absorption capacity of different tranches for these different scenarios. A sample output of this model is shown in Exhibit 6.

Use of Gradient descent for optimising (1.1) **Exhibit 5**



The output mentioned in Exhibit 6 provides the loss absorption capacity of senior tranche A1 and junior tranche A2, for different overdue allocation scenarios. For example, circle A in Exhibit 6 can be explained as: "If the timing of overdue follows a back-ended exponential pattern as shown in Exhibit 6, then the credit enhancement of A1 tranche can absorb losses up to 18%. In other words, investors of the A1 tranche will not face losses until the losses are below 18%"

By considering the most conservative output, an investor of a specific tranche can estimate the maximum possible pool loss that the investor can withstand. For example, it is more penal to have back-ended losses for A2 tranche. So, an investor of A2 tranche can look at the loss absorption capacity of A2 tranche for an extreme scenario of back-ended losses i.e. "Back-ended exponential". This value is shown as circle B, from which it can be inferred that A2 investor should not face any loss if the underlying pool losses are below 13%.

Credit enhancement optimisation model for a given loss estimate and pattern of loss

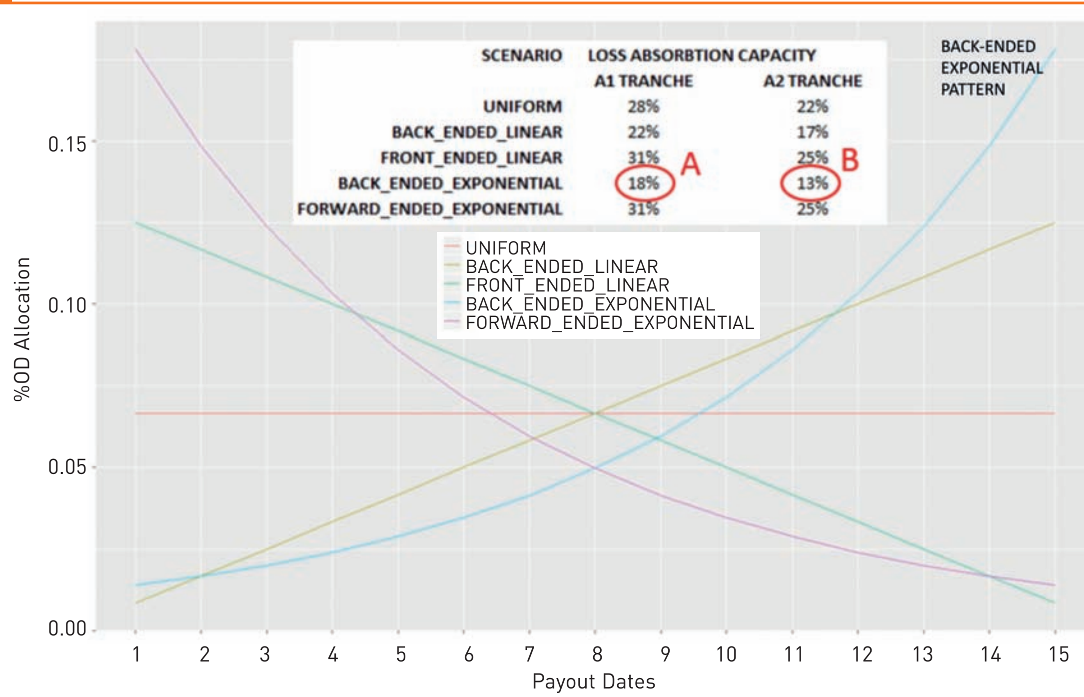
To find out the optimum credit enhancement level, it should be first identified that at what confidence level the transaction needs to be secure. The required confidence level can be determined as:

Required confidence level for tranche

$= (1 - PD_{Target\ rating} \mid Tenure\ of\ the\ transaction)$

Where $PD_{Target\ rating}$ is the associated probability of default of the target rating for a given tenure of the transaction. These PD values can be taken from the default study of different

Sample output of "Tranche loss absorption capacity estimation" model **Exhibit 6**



rating agencies. However, rating agencies publish these PD values for some specific intervals like 1-year, 2-year, 3-year etc. So, a PD value between these intervals is needed to be estimated, then some interpolation technique must be applied to get the PD value. For example, if a transaction is of 2.7 years, then 2.7-year PD is needed to be estimated. This can be achieved through linear interpolation or any other method of curve filling. Northern Arc uses the CDF (cumulative distribution function) of Weibull distribution to fit a curve between the two available PD values and estimate the required PD value using that curve.

After determining the confidence level for which the tranche is needed to be secured, the output of 'transaction loss model' is used to get the amount of loss which is required to be absorbed by the credit enhancement, for making the transaction secure at that confidence level. Then the pattern of the occurrence of this loss amount is estimated using historical data. An example of the overdue pattern is shown in the Exhibit 7 where, for a two-year tenure transaction, the loss amount that needs to be absorbed by the credit enhancement is US$100m. From historical data, it is found that for a similar portfolio, overdue follows a pattern which is mentioned as a line plot in Exhibit 7. This means that the total losses of US$100m are expected to be allocated across the life of the transaction based on this line plot.

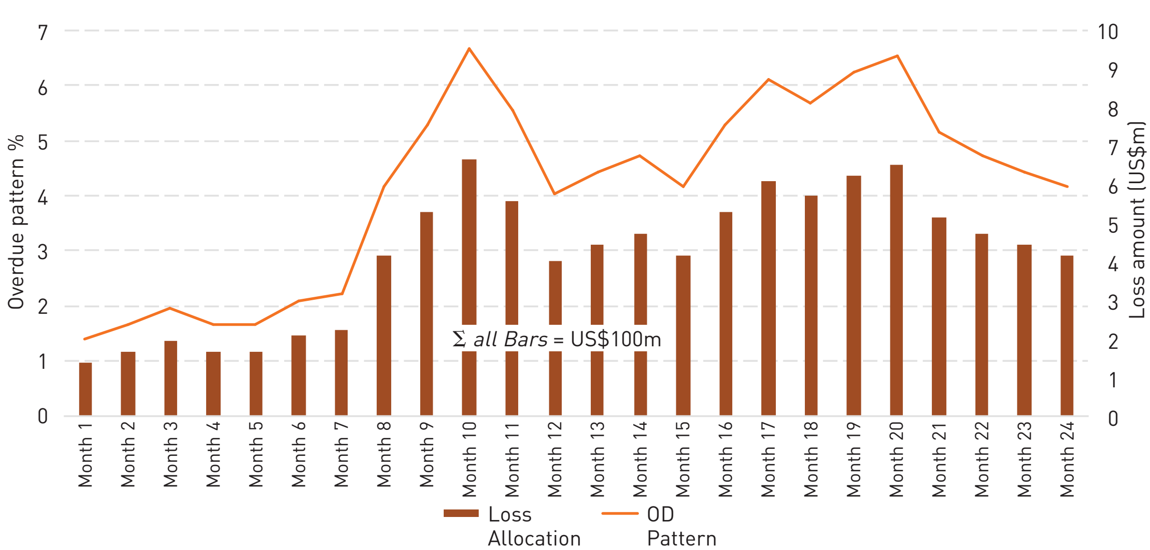
By providing different "% Allocation inputs" in the "Waterfall generating model", multiple waterfalls are generated. These multiple waterfalls and the estimated OD pattern is passed to the "Loss absorption capacity calculation model" to generate multiple values of the loss absorption capacity of a required tranche.

Amongst these multiple waterfalls, the optimum waterfall is the one for which the following equation is met:

(Loss required to be absorbed by the trance – Tranche loss absorption capacity) → 0

The credit enhancement available in the final optimised waterfall is the optimum credit enhancement which will secure the tranche at the required confidence interval.

Pattern of overdue occurrence and allocation of losses over the life of a transaction **Exhibit 7**



Summary

The following steps are required to get the optimum credit enhancement in a securitisation transaction:

Step 1: Determine the target rating of the tranche.

Step 2: Get the corresponding PD value for that target rating from the rating agency. For an intermediate interval, use interpolation.

Step 3: Calculate the required confidence level, for which the tranche needs to be secure. This is calculated as: $1 - PD_{\text{Target rating}}$ | *Tenure of the transaction*

Step 4: Using transaction loss model, get the loss amount for the confidence interval calculated in Step 3.

Step 5: From historical data of similar underlying loans, calculate the overdue pattern.

Step 6: Start the iteration by giving different "% Allocation input" to generate multiple waterfalls.

Step 7: Pass the waterfall form these iterations to the "Loss absorption capacity calculation model" can calculate the loss absorption capacity of the tranche for each iteration.

Step 8: Stop the iteration when the following condition is met: *(Loss from Step 4 – Tranche loss absorption capacity)* $\rightarrow 0$

Step 9: Credit enhancement of the waterfall in the final iteration is the optimum credit enhancement for the transaction.

References:

- Vishal Saxena and Dilip Mohan, 2018, "*Estimating loss distribution for a securitisation transaction*", Securitisation & Structured Finance Handbook 2018
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