



## LEVERAGE ANALYTICS IN LOAN PORTFOLIO MANAGEMENT

### Abstract

This paper focuses on commercial real estate line of business for implementing analytical models in different process areas of portfolio Management. These process areas include:

- Selection of loan and associated properties that are eligible for review and creating clusters for loan
- Prediction of the financials associated with the property
- Prediction of property valuation
- Delinquency Management

As part of this paper, we would discuss about different models and how their application could help the portfolio management team to make informed & accurate decisions.

## Introduction

Credit risk is one of the most important metrics that allow financial institutions to analyze potential customers with high risk. A portfolio management team within a financial institution conducts loan review on a recurring basis for controlling credit risk. This helps a bank to take corrective actions before the loan goes delinquent or default. The commercial banks hold huge portfolio of loans and it is an expensive affair to review each loan every year. The first step is identifying the loans that must be reviewed in the upcoming fiscal cycle. After the loans are identified, the portfolio management team reviews the associated property in different ways:

- Reviewing financials of the property
- Performing the Property Inspection
- Conducting the property appraisal to evaluate the current market value of the property

These evaluation parameters allow the portfolio management team to assess the performance of the loans and in turn assess exposure to the risk.

## Business Use Cases for implementation of Analytical Models

There are multiple challenges that a portfolio manager faces today in order to ensure the credit risk on the loan is minimized. In order to achieve the goal of minimizing the risk, the portfolio management team reviews the loans on recurring basis to get a deep insight about the loans and its issues. The process to identify right loans for review is critical and missing the loans that may default in near future may incur heavy cost to the financial institutions.

While over the years the process to pick up the loans for review has been manual; the analytical models can recommend the loans that must be reviewed. Additionally, once the loans are identified the models can also predict the borrower's financials, its associated property value and loans defaults for the shortlisted loan. This would help the financial institutions to get a better insight of the property and in turn can mitigate the risks of any delinquency that may happen in future

### How to Leverage analytical based models

There are variety of use cases that can leverage the analytical model. As part of this paper following use cases are discussed in detail:

- Analytical model to create sampling group of loans that are eligible for review. The model will create cluster of loans which would be based on the most significant parameters for the loan and its associated property & borrower
- Regression based model to predict the financial elements of the real estate property. For e.g. prediction of Net Operating Income of the property would help the Portfolio Management team to know the risk associated with loans
- Valuation Analytics to predict the value of the property
- Models predicting loan delinquency

With the usage of models in above mentioned areas, the banks can realize multi-fold benefits and can save from loan losses and optimize the cost of operations. Some of these benefits are listed below:

- Special focus and attention could be given to the loans that carry higher risk and should get immediate attention
- Manage the size of portfolio management team effectively based on the number of reviews to be conducted in a given period of time
- The capital reserve required in case of default can also be effectively managed by having better insight about the loans

As a pilot phase for execution, the above use cases can be picked up for one of the segments in the entire portfolio. Based on the results this can be extended to other segments in phased manner.

Let us now discuss about these use cases in details.

### Use Case 1 - Process to identify loans eligible for review

Since it is not pragmatic to review all loans in the portfolio, so the portfolio management team reviews only a subset of the loans and evaluates the quality of the portfolio. A million dollar question is what loans should be selected for the review.

There is no clear definition to select loans eligible for review and each institution has its own way to demarcate such loans. Some of these criteria include:

- Selection of proportional number for different loan products. There percentage may vary depending on loan type, amount etc.
- Each financial institution has a rule about selecting the loans which may range between 15-25% of the total portfolio
- The sample of loans shall depict the entire portfolio
- The process is manual, tedious requiring multiple discussions among different stakeholders

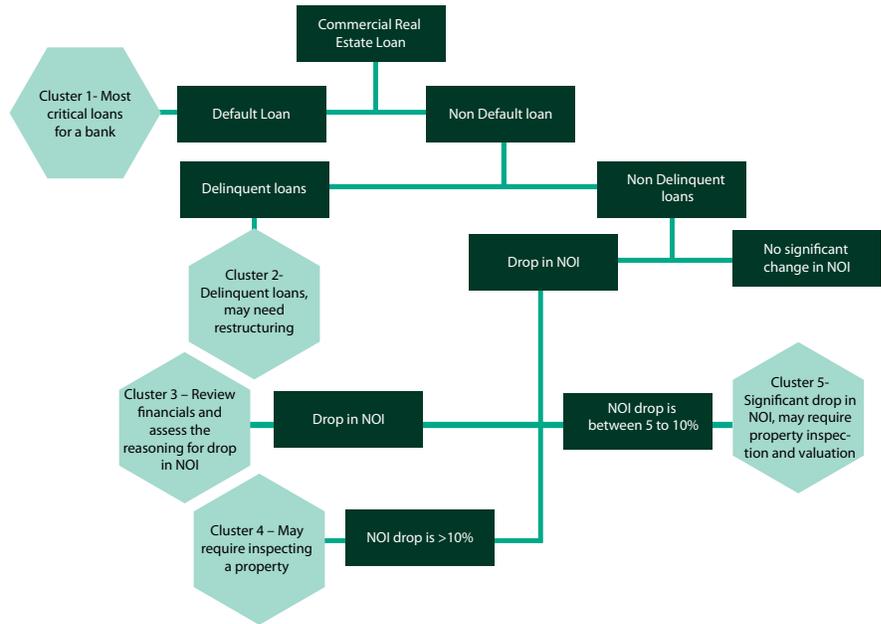
To address the problem selecting right loans for review, we can use the segmentation-based model creating clusters of loans.

### How to create loan clusters using analytical model?

The Portfolio Segmentation is a process to divide the loan portfolio into different groups on certain significant parameters of loan, borrower and associated property.

The classification model can help to categorize the loans that carry higher risk and must be reviewed. This is a supervised learning technique, where the model creates loan clusters based on most significant input parameters.

The model shown here is "Supervised learning technique" through application of decision trees. The figure is just a representation of the approach for creating the sampling groups of the portfolio. There could be multiple attributes that would be considered to build the model, which could be based on loan amount, loan type geography etc.



The terminal nodes depicted in the diagram are the final clusters made by the model which is based on a set of input variables/attributes for loan, borrower, property etc.

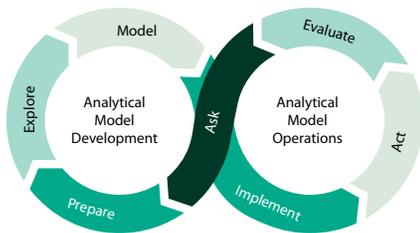
The profiling of these terminal nodes should be done appropriately for business to understand the significance of each loan segment.

### Benefits of the modelling in loan segmentation

- Specific focus on high risk loans
- Target based reviews
- Personalized customer treatment
- Significant improvement in operational cost and strategic decisioning



## Use Case 2 - Analytical model to review Borrower's Financials (Cash Flow)



On identification of loans that are eligible for review, the PM team then reviews the financials of the property associated with loan.

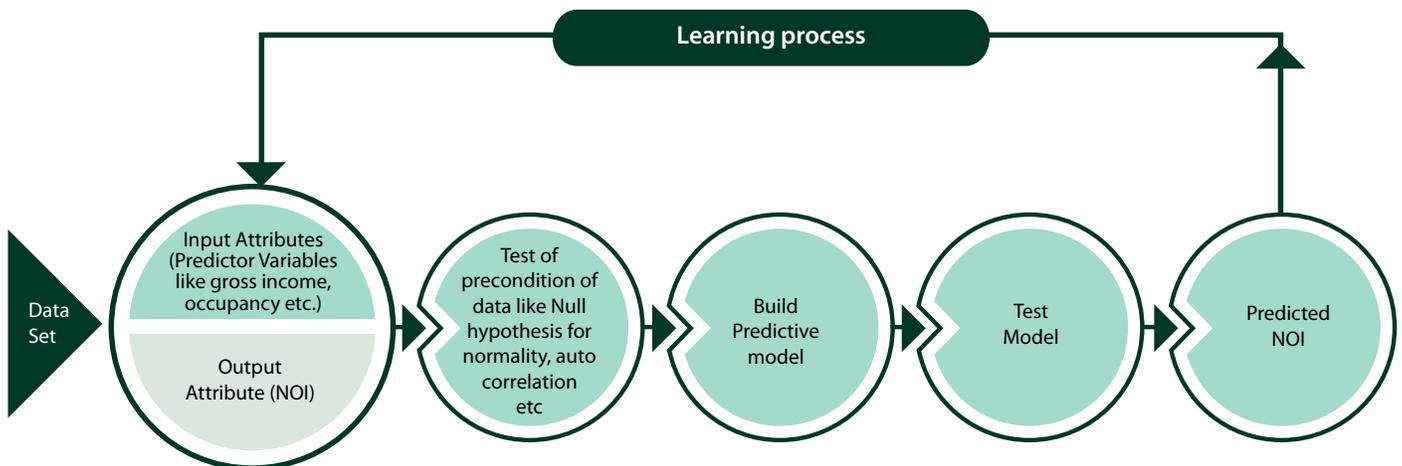
As part of the property review the analytical model can assist in predicting property's financial elements

For the simplicity of this use case we consider here, that the business is interested to know the Net Operating Income of the property as shown in this table.

Y (Response Variable)	X (Predictor Variables)
Annual Operating Income	Annual Gross Income
	Annual Other Income
	Annual Vacancy Loss
	Occupancy Percent
	Property Taxes
	Property Insurance
	Maintenance Cost
	Other Miscellaneous Expenses

Apart from variables listed here, there could be other variables that business may be interested to predict.

Once the preconditions of the dataset are met the Linear regression model gives a mathematical equation that represents the relationship between the predictor and the response variables.



The predicted value of Net Operating income can be compared to the actual value and the model must be improved based on learning. Though we have represented here the linear regression model, there are other supervised learning techniques that could be utilized in this space. Ideally, there should multiple models that should be implemented and the model with better accuracy and minimal errors should be adopted

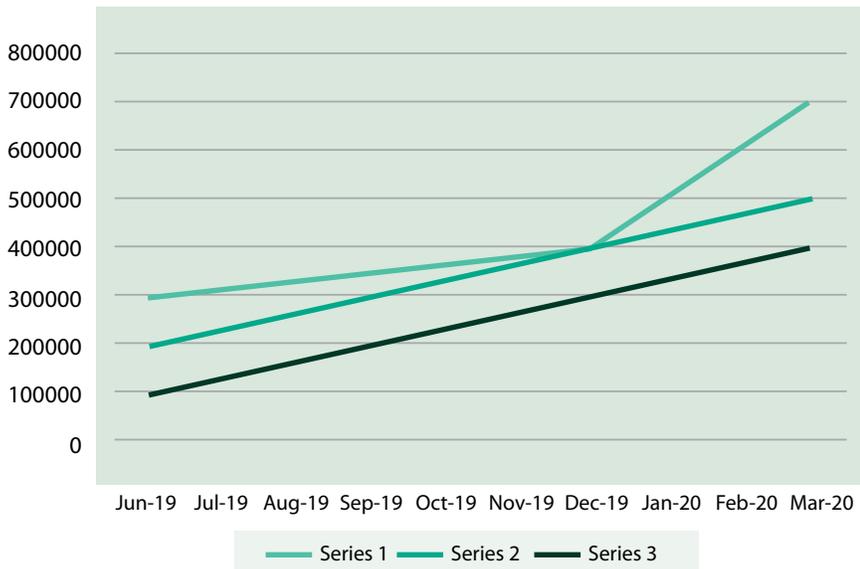
### Benefits of the modelling in reviewing financials

- Better insight at property's financials like net operating income, debt coverage ratio etc.
- If the trend of financials is on the slide, these loans can be handled by specialized team
- Better plan for loan loss reserve



## Use Case 3 – Property Valuation Analytics

Sales Price Trend



Valuation, in layman's term is the determination of the dollar amount for which the property will transact on a particular date. The Portfolio Management team may ask for the property valuation on recurring basis in order to ensure that the bank has sufficiently covered the risk for the loan associated with the property.

The objective of this use case is to provide a brief overview about how an analytical model could be used in real estate valuation. We have discussed here couple of model; though, there could be other models as well that could be developed based on the business needs. Nevertheless the data points captured shall remain similar to implement any model.



Analytical models provide scientific approach towards real estate evaluation

As per the traditional approach the banks appraise the properties using any of these approaches – comparable properties and its sales, income and cost. However, the regression model provides an alternate method to evaluate the properties using huge data associated with real estate and other linked entities in the ecosystem. The banks can utilize the data from their own warehouse and can also enhance the model using third party data and services.

The diagram clearly depicts variety of the datasets that could be utilized for development of the analytical model.

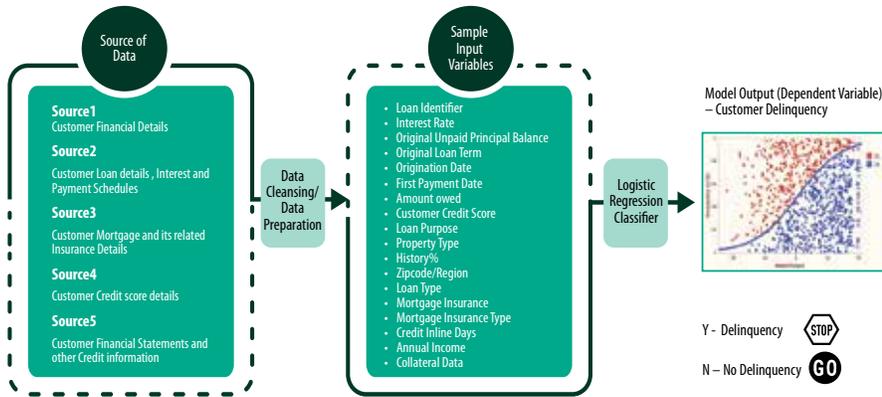
Each of the data segment has a weightage in determination of the property value. Based on the existing dataset, the model would assign weights to different variables for prediction of the property value. The analytical model would consume this data and transform it into detailed information about the property, which would help the PM team to take informed decision

### Benefits of Property Valuation Analytics

- Estimated prediction of property value in the market
- Sentiment Analysis about the area/ zip code
- Insights in financials like LTV at certain point in time

## Use Case 4 – Delinquency Management Model

Any scheduled payment be it Principal, Interest, fees of a financial asset for which the bank stops receiving the payment is referred as Delinquent loan. The controls that is brought in place to manage and monitor the credit risk, outstanding loans and schedule repayments is part of delinquency management. There could be variety of reasons for delinquency. The sample logistic regression model depicts the details for delinquency prediction



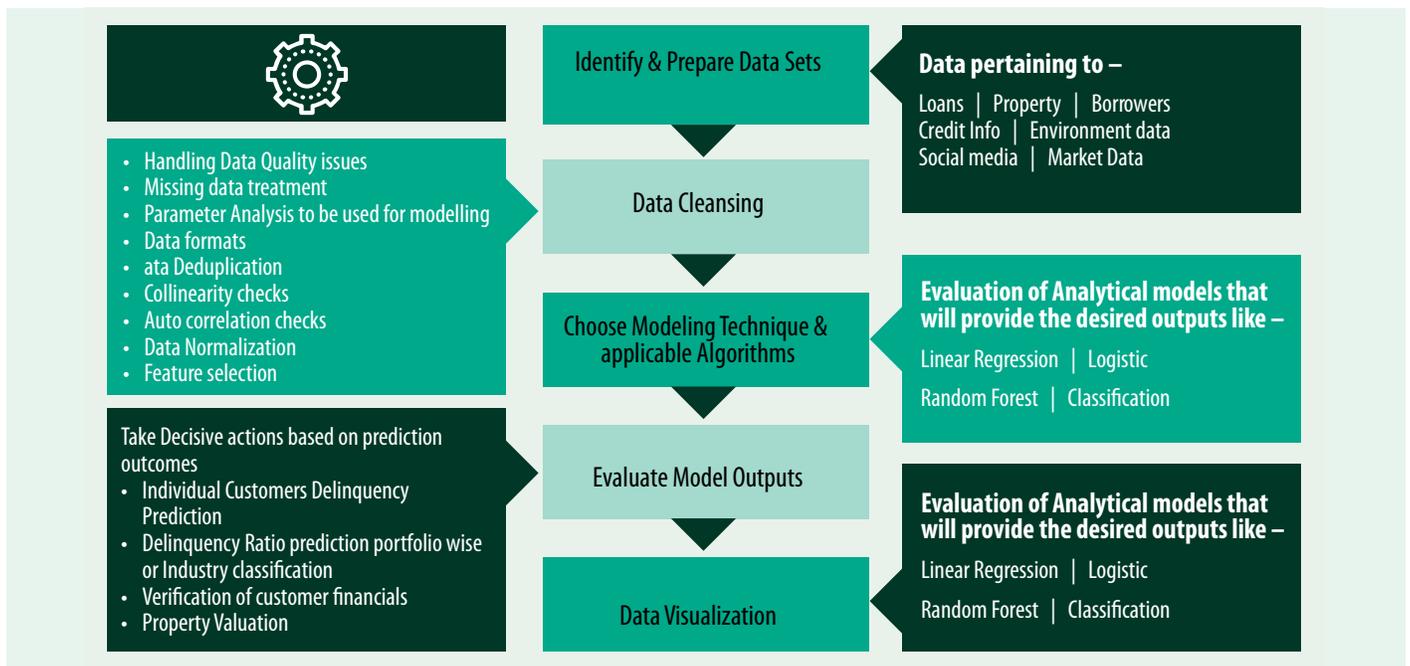
As shown in the diagram above, various sources of data could be considered for building the model and subsequently when we look at these sources, there

could be multiple predictor variables. In the long run, the model can learn from its on calculation and reduce the errors in prediction of delinquent loans.

### Benefits of Property Valuation Analytics

- Predict delinquency before it happens
- Better budgeting for loan loss reserve
- Deeper insight in the portfolio and informed decision making
- Customer centric offers/loan restructuring to regularize the payments

## Typical steps in implementation of Analytical Model



Data plays a key role in building any data model and as a first step it is important to identify and prepare appropriate data. Though preparing the data is important, we do not get data as expected and it is equally important to clean the data which involve steps like missing data treatment,

handling collinearity, data normalization etc. Once these things are taken care, the models could be built using different algorithms. Each of these models are then evaluated and the results should be presented to the business for making informed decisions. These implementation

steps must be followed for any of the models represented in this paper. For e.g. if we consider Delinquency model – the data gathered must be cleaned and normalized, followed by implementation and evaluation of the models.

## Readiness of Commercial Real Estate Banks to adopt Analytics

If we look at the commercial banks and the foundation of the technology that they work on; there are multiple impediments that they must overcome to adopt analytics and digitally transform their business. If these points are not handled appropriately then the models to be developed would not produce accurate results. Some of these areas that commercial banks must work on to remove such hurdles and embrace the future technology are:

	Challenge	Mitigation
Data	Limitation of legacy systems	Getting data from legacy system in a common data warehouse is a challenge, however the banks should look in this area to capture the data which is required for building and testing the models
	No Golden source of data	Sometimes the data is stored in multiple systems but there is no golden source. Identifying it must be considered for having consistent and one source of truth
	Absence of data for significant data attributes	Since the data is maintained in variety of systems, sometimes data is incomplete. While missing data is significant from model perspective it is important that the data should be complete and accurately imputed and must be completed in collaboration with business.
	Common data warehouse holding data from different sources	There is a need to adopt best practices where all necessary data is persisted in one location. This data must be updated in the data warehouse on regular basis as it is captured in different systems. This should be the only source of data to build and evaluate analytical models
Operations	Reluctance in adopting new technology	With data size increasing manifold this decade and rapid changes in technological landscape, there is a good potential for banks to adopt analytical models in different business process. There is a need for top down push to adopt these changes in order to add significant value to the business
	Lack of right skills	This is one of the major problems that financial organizations face to realize the potential of their data. To overcome this problem one of the following actions can be taken up by these organizations: <ul style="list-style-type: none"> <li>• On boarding talent in house with analytical/data science skills</li> <li>• Partnership with IT firms or Fintech companies working in the area of Analytics</li> </ul>



## Conclusion

With proliferation of the data in last decade, there are several opportunities that all banks want to capitalize on to stay ahead of the competition. Portfolio management in commercial banks is no exception to this.

Data and analytics are disrupting the existing business models. Portfolio Management should overcome the challenges that they face today by adopting these models. It should start adopting this technology and harness the power of data that they hold. There would be challenges in the journey, however as described in this paper, these can be mitigated by taking appropriate actions. The use cases and the analytical models described in this paper lay down the foundation for strategic business decision making. Additional models can be built and extended to other areas that can help banks reap benefits multi-fold.

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