

Basel II Advanced IRB in Commercial Banking: Quantify the Borrower and Guarantor by Two-Step Scoring Model

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Introduction

The financial crisis hit banks hard after years of extending loans and concentrating on the commercial real estate (CRE). The regulators not only urge the banks to diversify their commercial loan portfolios, but also push the banks to control CRE portfolio and strengthen both CRE and C&I risk management.

Basel II encourages banks to initiate internal-ratings based approach for measuring the credit risks. Basel II framework set banks to determine their own estimation for three key risk components: the probability of default (PD), loss given default (LGD) and exposure at default (EAD).

To both CRE and C&I, the guarantors could be the secondary source of repayment. It is vital to properly investigate and assess both borrower and guarantor' overall financial strength, management and development expertise before the loans are booked and funded.

Methods

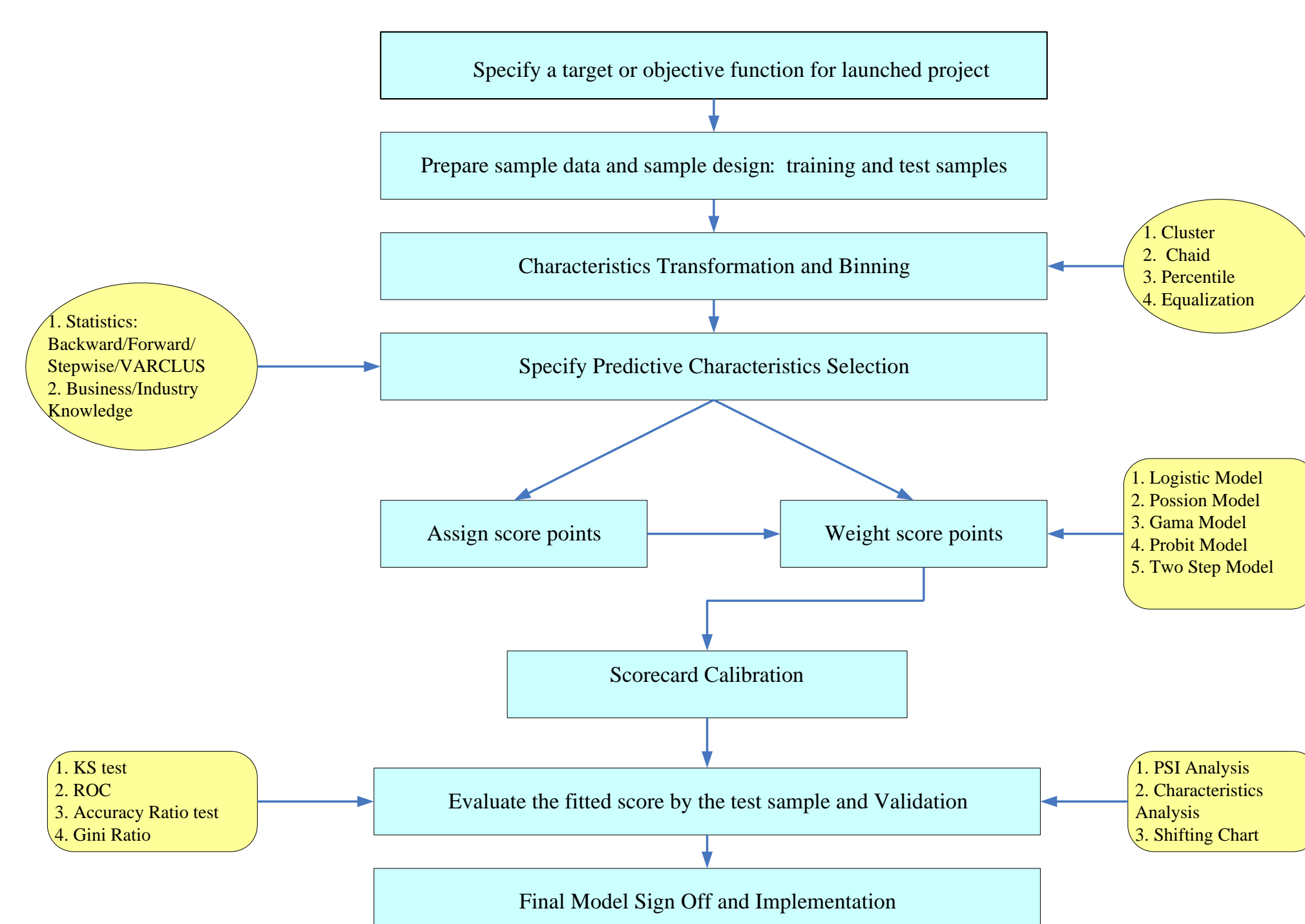
The simultaneous Logit-Tobit model is suggested to quantify both borrower and guarantor's risk in commercial lending. The model is therefore:

$$PD = F(\alpha_0 + \beta_1 GTR + \beta_2 X_0) + \varepsilon_0 \quad (i)$$

$$GTR = \alpha_1 + \gamma_1 X_1 + \varepsilon_1 \quad (ii)$$

$$GTR = \begin{cases} E[GTR|X_1, \gamma_1], & \text{if } E[GTR|X_1, \gamma_1] \geq 0 \\ 0, & \text{if } E[GTR|X_1, \gamma_1] < 0 \end{cases} \quad (iii)$$

Scorecards Development Procedure



Binning, WOE and Score Points

$$\text{Weight of Evidence: } Woe_i = \ln \left(\frac{\frac{\sum Good_i}{\sum Good}}{\frac{\sum Bad_i}{\sum Bad}} \right) = \ln \left(\frac{Good_i}{Bad_i} \right) - \ln \left(\frac{\sum Good}{\sum Bad} \right)$$

Where "Good" means wanted target definition and "Bad" represent unwanted target definition. The WOE could capture the risk of all kinds of characteristics at the comparable measure, no matter what kind of characteristics. It could effectively produce the linear relationship with the project target through the target function.

Liquidity	# Goods	# Bads	# Total	Good_%	Bad_%	Total_%	WOE	IV	scorepoints	Liquidity (WOE)
<0.025	911	48	959	0.11	0.28	0.11	-0.97	0.17	-100	
0.025 - 0.14	2,128	50	2,178	0.25	0.25	0.25	-0.16	0.01	-16	
0.15 - 0.39	1,702	37	1,739	0.20	0.22	0.20	-0.08	0.00	-8	
0.4 - 0.69	952	13	965	0.11	0.08	0.11	0.38	0.01	38	
0.7 - 1.19	753	9	762	0.09	0.05	0.09	0.52	0.02	52	
1.2 - 1.89	565	6	571	0.07	0.03	0.07	0.82	0.03	82	
1.9 +	1,529	9	1,538	0.18	0.05	0.18	1.22	0.15	100	
Total	8,540	171	8,711	1.00	1.00	1.00	0.34			

Model Results

Characteristic	Attribute Break	Scorecard Output 1		Scorecard Output 2	
		Scorepoint	Weight	Weighted Scorepoint	
Liquidity	1.900	100	17.0%		17
	1.200	65			11
	0.700	35			6
	0.400	25			4
	0.150	-20			-3
	0.025	-25			-4
	<0.025	-100			-17
Profitability	0.100	100	25%		25
	0.060	90			23
	0.040	80			20
	0.025	40			10
	0.015	20			5
	0.010	0			0
	<0.01	-100			-25
Guarantor	0.6	100	20%		20
	0.5	70			14
	0.3	65			13
	0.2	30			6
	0.1	10			2
	<0.1	0			0

Score	PD
7.621	0.049%
7.188	0.075%
6.891	0.102%
6.750	0.117%
6.348	0.175%
6.016	0.243%
5.556	0.385%
5.086	0.614%
4.480	1.121%
3.731	2.340%
3.217	3.854%
2.996	4.760%

PD Rating or Grade Mapping

The mapping table could turn PD measurement into common rating often used in the industry, from AAA rating to CCC- rating or PD grade 1 to 16. The final mapping rating or grade provides the convenient tool for pricing strategy, economic capital management, forecasting, reserve and stress test.

PD	Score Index	Grade	Rating
0.049%	880	1	Aa3 / AA-
0.075%	860	2	A1 / A+
0.102%	840	3	A2 / A
0.117%	820	4	A3 / A-
0.175%	740	5	Baa1 / BBB+
0.243%	720	6	Baa2 / BBB
0.385%	710	7	Baa3 / BBB-
0.614%	700	8	Ba1 / BB+
1.121%	690	9	Ba2 / BB
2.340%	680	10	Ba3 / BB-
3.854%	660	11	B1 / B+
4.760%	620	12	B2 / B
25.000%	560	13	B3 / B-
50.000%	550	14	Caa2 / CCC
75.000%	530	15	Caa1 / CCC+
100.000%	500	16	Caa3 / CCC-

Conclusion

The two-step Logit-Tobit model could help increase the model fitting ratio. In the case study, the sample back end tests show the KS increase from 42% to 48%. The ROC increases from 77% to 80%. It fits the hypothesis that the well quantified guarantor could strengthen internal rate base modeling.

The scorecard provides a reliable and scientific tool for business risk solutions. Under the scorecard framework, two-step scoring model provide the Basel II IRB method to quantify the risk of both borrower and guarantor.

Reference

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