J. Basic. Appl. Sci. Res., 2(5)4423-4432, 2012
ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Modeling Credit Rating for Bank of Eghtesade Novin in Iran

Maesomeh Abdolrezaei Madani[1], Yaser Madani[2], Mohammad Ebrahim zadeh[3], Mehram Gholami Shahmorad[4]

[1]Graduate student in MBA, PAYAME NOOR University, branch of GHESHM, IRAN
[2]Ph. D Student of Economics and Management, National Academy of Sciences of Tajikistan, Dushanbe, Tajikistan
[3]Master in economic and social systems, Mazandaran University of Science and Technology
[4]Ph.D Student of Industrial Economic, National University of Tajikistan, Dushanbe, Tajikistan

ABSTRACT

The aim of this paper is Modeling Credit Rating for Bank of Eghtesade Novin in Iran. For do it, we have implied logistic regression for estimation credit model. We have used information about 310 customers for determining the main factors in credit risk. Results indicate that industrial type of loan in which the applicant is one of the most important factors affecting the credit risk of customers. Results indicate that 70 cases (92% of the total 76 cases) classified correctly in observations Y = 0 (lack of timely repayment of the facility) and 227 cases (97% of the total 234) classified correctly in observations Y = 1 (timely repayment of the facility).
Key Words: Credit Rating, Bank of Eghtesade Novin, Logit, Probit, Iran.

1. INTRODUCTION

Eghtesade Novin (EN) Bank is Iran's first private bank; established in 2001 by a consortium of industrial, construction and investment companies, with the aim of providing flexible financial services to the burgeoning Iranian private sector.

Table 1. EN Bank Specifications

	Year Ended March 20, 2010	Year Ended March 20, 2009	Year Ended March 20, 2008	Year Ended March 20, 2007
Employees	2,113	2,126	1,764	1,240
Branches	228	220	180	122
ATMs	670	650	522	200
Customers	3,777,404	3,440,227	3,008,507	2,001,253
Net Income	216,418	191,842	116,299	85,279
Total Assets	11,318,272	10,438,818	8,233,103	4,467,879
Total Deposits	9,821,424	8,983,239	6,912,086	3,764,416
Paid-In Capital	303,859	256,858	221,019	216,146
Shareholders' Equity	744,723	492,952	361,799	311,335
Earnings per Share (EPS) –USD	0.073	0.076	0.059	0.042

* All amounts in USD thousands, except where stated. (http://english.en-bank.com)

Ratings are opinions about the creditworthiness of a rated entity, be it a sovereign, an institution or a financial instrument. They reflect both quantitative assessments of credit risk and the expert judgment of a ratings committee. Thus, no rating can be unequivocally explained by a particular set of data inputs and formal rules.

EN Bank is the first private bank in Iran to be rated by an international credit rating agency. The following table shows our ratings by Capital Intelligence for 2009:

***Corresponding Author:** YASER MADANI, Ph. D Student of Economics and Management, National Academy of Sciences of Tajikistan, Dushanbe, Tajikistan.

Table 2. EN Bank ratings by Capital Intelligence for 2009

Foreign Currency	
Long-Term	BB-
Short-Term	B
Financial Strength	BB-
Support	4
Outlook	
Foreign Currency	Stable
Financial Strength	Stable

Ratings convey information about the relative and absolute creditworthiness of the rated entities. Agencies often emphasize that a rating reflects the creditworthiness of the rated entity relative to that of others. That said, agencies regularly publish studies that convey the historical association of ratings and indicators of absolute creditworthiness, such as default rates and the magnitude of losses at default. Moreover, in the case of structured finance products, ratings are explicitly tied to estimates of default probabilities and credit losses.

Many researchers investigated credit rating. Some of most important research are: Peel and Wilson (1986), Altman (1968), (Altman, 1983), (Lin et al., 2007),Bharath and Shumway (2004), Larry and Timothy (1986), Chandy and Duett (1990), Pinches and Mingo (1973), Kaplan and Urwitz (1979), Belkaoui (1983), Kim (1993), Manzoni (2004), Huang et al. (2004), Laitinen, (1999), Doumpos and Pasiouras (2005), Manickavasagam and Srinivas (2009), Patricia and David (2009) and Manickavasagam and Srinivas (2009)

In this paper, we have used Logit regression for EN Bank's credit rating. In the next section, we introduce the method and we show empirical results in section 3. Section 4 is devoted to conclusion.

2. METHODS

There are four methodological forms of multivariate credit scoring models: (1) the linear probability model, (2) the logit model, (3) the probit model, and (4) the multiple discriminant analysis model. All of these models identify financial variables that have significant statistical explanatory power in differentiating defaulting companies from non-defaulting companies.

Some Basic Facts about Binary Response Models

linear probability model: $Pr(Y=1)=Xb+u$

Suitable for estimating average percentage-point treatment effects in special case of a single dichotomous X. In other applications, can produce out-of-bounds predicted values.

Logistic regression model: $Pr(Y=1)=1/(1+e^{-Xb})= e^{Xb} /(1+e^{Xb})$

Example: let –Xb=1:

$Pr(Y=1)=1/(1+e^{-1})= 1/1.37=.73=e^{1} /(1+e^{1})=.73$

Another way to think about the logistic regression model is that it is like a regression model in which the log odds, i.e., ln(p/(1-p)) are the dependent variable.

$$\Pr(Y=1)=\frac{e^{\alpha}}{1+e^{\alpha}}$$

$$\Pr(Y=1)(1+e^{\alpha})=e^{\alpha}$$

$$\Pr(Y = 1) + \Pr(Y = 1)e^{\alpha}) = e^{\alpha}$$

$$\Pr(Y = 1) = e^{\alpha}(1 - \Pr(Y = 1))$$

$$\frac{\Pr(Y = 1)}{1 - \Pr(Y = 1)} = e^{\alpha}$$

$$\ln\left(\frac{\Pr(Y = 1)}{1 - \Pr(Y = 1)}\right) = \alpha$$

In other words, logistic regression coefficient (here, an intercept) represents the expected log odds.

Note that there is no disturbance term in this model. However, we can derive a logistic regression specification from a latent variable model in which Y*=Xb+u, where u is drawn from a logistic distribution (approximately the same as a t distribution with 7 degrees of freedom). We don't observe Y* directly. Instead, we observe Y=1 when Y* > 0 and Y=0 otherwise.

Probit regression model: Pr(Y=1)=¥(Xb), where ¥(.) is the cumulative distribution function for a standard normal density (mean=0, variance=1)

For example: ¥(0)=.5. Half of the area of a standard normal density lies to the left of 0. ¥(1)=.84 since 68% of the area on a normal curve lies within 1 standard deviation of the mean; 32% of the area lies outside 1 SD, so 84% lies to the left of one standard deviation above the mean.

The probit regression specification has an intuitive basis in a latent variable model. Y*=Xb+u, where u is drawn from a normal distribution. Again, we observe Y=1 when Y* is positive, Y=0 otherwise.

Logistic regression and probit tend to generate very similar predicted values, except at the extremes of the probability scale. Rarely do they generate results that have different substantive or statistical interpretations.

Note also that for bivariate regression models with a binary independent variable, LPM, probit, and logit all give the same predicted values and t-ratios.

We have used the following model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8$$
$$+ \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + \beta_{15} X_{15} + \beta_{16} X_{16}$$

Where:
X1 : The loan amount is paid to the customer.
X2 : Guarantee, the amount of collateral received from customers.
X3 : Term loans
X4 : Interest rate
X5 : Industry of the applicant
X6 : Experience with bank
X7 : Retained earnings to total assets ratio
X8 : Sales to total assets ratio
X9 : Ratio of total debt to total assets
X10 : Current debt to equity ratio
X11 : Current asset turnover ratio
X12 : Current Ratio (Current debts / Current Assets)
X13 : Immediate ratio (the debt / inventory - current assets)
X14 : Return on assets (total assets / net interest))
X15 : Cash flow to debt ratio
X16 : Turnover of total assets (total assets / net sales)

3. EMPIRICAL RESULTS

We have estimated logit model. Estimation results were shown by table 3 as following:

Table 3. Estimation Results

Variables		Coefficient	EXP (β)	Wald test	P-value
Intercept		3.9346	51,11	28.891	**0.0000**
X_1		0.0018	1.0018	4.487	**0.034**
X_2		1.661	5.264	8.410	**0.0062**
X_3		1.207	3.343	7.501	**0/0052**
X_4		0.007	1.007	12.02	**0/0009**
X_5	Industrial and mineral	2.762	15.831	13.011	**0.0008**
	Agricultural	1.903	6.705	11.45	**0.001**
	Oil	2.597	13.435	8.556	**0.007**
	Building	2.291	9.88	4.717	**0.031**
X_6		0.007	1.007	5.512	**0/0168**
X_7		1.56	4.76	3.794	**0.0421**
X_8		1.102	3.010	9.001	**0.0074**
X_9		1.812	6.122	10.954	**0.001**
X_{10}		0.006	1.006	5.096	**0.0144**
X_{11}		0.0017	1.0017	4.499	**0.0361**
X_{12}		1.17	3.22	3.81	**0/040**
X_{13}		1.69	5.419	9.032	**0.0077**
X_{14}		1.247	3.479	10.817	**0.001**
X_{15}		0.018	1.018	5.121	**0.0285**
X_{16}		**1.95**	**7.02**	**8.765**	**0.0041**

Estimated equation is as:

$$Y = \ln (p/p-1) = 3.93 + 0.001\ X1 + 1.661\ X2 + 1.207\ X3 + 0.007\ X4 + (2.762X51 + 1.903\ X52 + 2.597\ X53 + 2.291\ X54) + 0.007\ X6 + 1.56\ X7 + 1.102\ X8 + 1.812\ X9 + 0.006\ X10 + 0.0017\ X11 + 1.17X\ 12 + 1.69\ X13 + 1.247\ X14 + 0.018\ X15 + 1.95\ X16$$

All of the coefficients are significant at 95% confidence level.

Table 4. Goodness of Fit Statistics

Mean dependent var	**0.5**	**S.D. dependent var**	**0.5025**
S.E. of regression	0.2486	Akaike info criterion	0.576601
Sum squared resid	5.756071	Schwarz criterion	0.759321
Log likelihood	-21.09123	Hannan-Quinn criter.	0.67732
Restr. log likelihood	-65.55093	Avg. log likelihood	-0.23592
LR statistic (16 df)	94.43081	McFadden R-squared	0.818832
Probability(LR stat)	0		
Obs with Dep=0	155	Total obs	310
Obs with Dep=1	155		

Table 5. Goodness of Fit Tests

Probability	value	statistic
0.000	94.4308	**LR(16df)**
0.654	15.64	**H-L(8df)**
-	0.818832	**McFadden R- squared**

Table 4 and 5 indicate that the explanatory power of the variables are very good.
Colinearity test shows no colinearity between independent variables. Table 6 indicates this test for logit model.

Table 6. Colinearity Test

Model		Unstandardized Coefficients		Standardized Coefficients	Wald test	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	9.2	5.662		1.628	.150		
	X1	-5.3	2.264	0.0018	0.0000	28.891	.933	1.021
	X2	17.2	2.476	1.661	0.034	4.487	.922	1.133
	X3	-5.8	3.043	1.207	0.0062	8.410	.935	1.211
	X4	6.02	4.435	0.007	0/0052	7.501	.891	1.541
	X5	6.93	3.091	2.762	0/0009	12.02	.903	1.091
	X6	11.2	6.001	1.903	0.0008	13.011	.977	1.723
	X7	8.1	2.912	2.597	0.001	11.45	.761	1.130
	X8	7.7	2.887	2.291	0.007	8.556	.780	1.177
	X9	-4.2	3.091	0.007	0.031	4.717	.801	1.201
	X10	12.2	3.805	1.56	0/0168	5.512	1.001	1.298
	X11	10.8	2.229	1.102	0.0421	3.794	.691	1.441
	X12	5.9	4.498	1.812	0.0074	9.001	.722	1.381
	X13	9.1	5.091	0.006	0.001	10.954	.992	1.009
	X14	-6.9	2.762	0.0017	0.0144	5.096	.921	1.672
	X15	13.8	2.887	1.17	0.0361	4.499	.821	1.044
	X16	11.1	2.702	1.69	0/040	3.81	.787	1065

The value of the collateral, and one of the important variables that affect the quality of facilities in default or not default, the estimated model plays a fundamental role.

Variable period of repayment of the facilities is the main parameters related to credit risk customers legal EN Bank.

Variable "interest rate facilities", in relation to credit risk has little effect.

Industrial type of loan in which the applicant is one of the most important factors affecting the credit risk of customers.

Experience with bank has a significantly positive effect on the probability of a no default facility to default.

Ratio of retained earnings to total assets is the main factor of financial ratios affecting the credit risk.

Sales to total assets ratio of financial ratios has a significantly effect on credit risk.

The ratio of debt is considered very influential financial ratios on credit risk and it is the second effectiveness factor.

Current debt to equity ratios of financial ratios has a minimal impact on credit risk.

Capital ratio of financial ratios has a negligible impact on the credit risk.

Current ratio equals current assets to current liabilities of the financial ratios have a significant impact on credit risk.

Immediate relative of important financial ratios has a significant effect on credit risk.

Return on assets has a significant positive effect on credit risk.

Cash flow to debt ratio has a significant positive effect on credit risk.

Turnover of total assets is one of the most important factors on credit risk.

Reliance on bank and prioritization of the variables influencing the bank's credit risk in relation to legal Customers are:

1. Type of Industry of the applicant
2. Turnover of total assets
3. Ratio of total debt to total assets
4. Immediate ratio (the debt / inventory - current assets)
5. Retained earnings to total assets ratio
6. Guarantee, the amount of collateral received from customers
7. Return on assets (total assets / net interest)
8. Term loans
9. Sales to total assets ratio
10. Current Ratio (Current debts / Current Assets)
11. Interest rate
12. Cash flow to debt ratio
13. Experience with bank
14. Current debt to equity ratio
15. The loan amount is paid to the customer
16. Current asset turnover ratio

Prediction Evaluation of model is considered by following table:

If the facilities granted to a customer's IRR increases the probability of a no default facility to default is 1. Variable "loan" has not an important impact on credit risk

Table 7. Expectant probability threshold

Dependent Variable: Y						
Method: ML - Binary Logit						
Date: 11/16/05 Time: 11:04						
Sample: 1600						
Included observations: 310						
Prediction Evaluation (success cutoff C = 0.5)						
	Estimated Equation			**Constant probability**		
	default Dep=0	No default Dep=1	Total	Dep=0	Dep=1	Total
P(Dep=1)<=C	70	3	73	76	234	310
P(Dep=1)>C	10	227	237	0	0	0
Total	80	230	310	76	234	310
Correct	70	227	297	76	0	76
% Correct	87.50	98.69	95.80	100.00	0.00	24.51
% Incorrect	12.50	1.31	4.2	0.00	100.00	75.49
Total Gain*	-12.00	98.69	45.80			
Percent Gain**	NA	98.69	91.60			

310 cases to assess the predictive power of the model and test data are used to estimate power and performance of the model and type II errors can be determined. The left side of the table, the predicted probability values for the dependent variable Y (the fitted equation) based on the higher or lower than the threshold are observed in the actual amounts are classified. In the table, the observations demonstrate the possibility of using the same sample of observations is Y = 1, are classified. This probability is constant during the observations, numerical model, which estimates that only include the width of the source is C, is calculated.

Results indicate that 70 cases (92% of the total 76 cases) classified correctly in observations Y = 0 (lack of timely repayment of the facility) and 227 cases (97% of the total 234) in observations Y = 1 (timely repayment of the facility).

In general, the model can fit 87.5% of all observations Y = 0 and 98.7% percent of all observations Y = 1, which has accurately predicted. The model is called the degree of sensitivity equal to 87.5% and the detection rate equal to 98.7% percent.

Customer rating system for EN Bank:

Y value for each customer is calculated as follows:

Table 8. Customers rating

$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer
59.776	81	28.228	61	141.12	41	41.505	21	71.3985	**1**
76.3785	82	16.605	62	448.208	42	91.3185	22	178.4675	**2**
49.81	83	26.565	63	83.0185	43	332.01	23	332.01	**3**
69.7385	84	54.79	64	178.46	44	30.715	24	27.979	**4**
41.508	85	69.87	65	178.6	45	62.4	25	174.315	**5**
66.4175	86	124.52	66	56.45	46	26.568	26	43.172	**6**
66.42	87	58.11	67	74.7185	47	141.12	27	41.508	**7**
215.82	88	33.21	68	99.61752	48	74.7185	28	53.27	**8**
83.15	89	39.85	69	59.77	49	39.018	29	71.53	**9**
59.776	90	74.72	70	99.62	50	49.8175	30	31.548	**10**
41.505	91	76.51	71	63.096	51	41.505	31	16.605	**11**
49.81	92	54.93	72	16.605	52	29.055	32	38.188	**12**
38.185	93	16.605	73	74.85	53	38.185	33	49.95	**13**
74.71	94	19.925	74	41.505	54	332.01	34	83.02	**14**
41.508	95	33.208	75	49.81	55	66.4175	35	178.466	**15**
79.6975	96	178.467	76	58.108	56	174.316	36	63.096	**16**
49.95	97	415.008	77	116.2175	57	66.42	37	132.8185	**17**
59.91	98	91.32	78	92.976	58	174.45	38	69.736	**18**
104.5985	99	29.885	79	99.75	59	41.505	39	178.6	**19**
29.885	**100**	**72.36**	**80**	**69.7385**	**60**	**41.505**	**40**	**69.7385**	**20**

$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer
45.658	181	77.206	161	16.605	141	92.9785	121	16.605	**101**
41.51	182	77.206	162	64.7585	142	16.605	122	41.505	**102**
41.505	183	19.925	163	89.6575	143	63.23	123	83.02	**103**
41.505	184	29.888	164	74.72	144	157.72	124	33.21	**104**
16.605	185	39.848	165	48.15	145	29.888	125	56.59	**105**
49.95	186	53.13	166	53.13	146	59.776	126	92.976	**106**
66.4175	187	199.208	167	66.55	147	33.208	127	178.4675	**107**
60.606	188	91.32	168	76.37	148	332.01	128	41.508	**108**
174.316	189	116.22	169	58.1175	149	53.125	129	41.508	**109**
99.608	190	109.5785	170	80.5275	150	132.8185	130	16.605	**110**
107.92	191	174.45	171	33.208	151	21.585	131	16.605	**111**
102.94	192	69.7385	172	41.505	152	70.5685	132	124.5185	**112**
33.21	193	41.508	173	40.68	153	44	133	91.316	**113**
91.32	194	66.416	174	16.605	154	199.22	134	71.53	**114**
39.845	195	332.01	175	107.9185	155	108.05	135	26.568	**115**
174.3175	196	64.7575	176	48.15	156	63.0985	136	49.81	**116**
16.605	197	16.605	177	36.525	157	60.606	137	107.92	**117**
53.27	198	21.585	178	41.505	158	44.83	138	178.4675	**118**
178.466	199	69.736	179	174.45	159	33.208	139	107.9185	**119**
77.198	**200**	**91.3185**	**180**	**59.765**	**160**	**41.508**	**140**	**66.4185**	**120**

$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer	$\hat{Y}_i$	Customer
74.7185	281	174.315	261	41.508	241	39.845	221	71.3985	**201**
39.018	282	43.172	262	174.316	242	49.95	222	33.21	**202**
69.7385	283	41.508	263	99.608	243	83.02	223	59.91	**203**
41.505	284	53.27	264	107.92	244	178.466	224	66.4185	**204**
91.3185	285	71.53	265	102.94	245	63.096	225	58.108	**205**
332.01	286	31.548	266	178.6	246	132.8185	226	19.925	**206**
30.715	287	16.605	267	66.42	247	69.736	227	55.626	**207**
62.4	288	38.188	268	16.605	248	178.6	228	99.62	**208**
26.568	289	49.95	269	39.845	249	69.7385	229	68.0775	**209**
141.12	290	83.02	270	49.95	250	41.505	230	174.45	**210**
74.7185	291	178.466	271	83.02	251	91.3185	231	44	**211**
39.018	292	63.096	272	178.466	252	332.01	232	81.3585	**212**
178.6	293	69.7385	273	63.096	253	99.62	233	38.185	**213**
178.4675	294	41.505	274	132.8185	254	68.0775	234	178.4685	**214**
332.01	295	91.3185	275	69.736	255	174.45	235	76.3775	**215**
27.979	296	332.01	276	178.6	256	44	236	332.01	**216**
174.315	297	30.715	277	178.4675	257	81.3585	237	41.508	**217**
43.172	298	62.4	278	332.01	258	38.185	238	178.6	**218**
41.508	299	26.568	279	27.979	259	178.4685	239	66.42	**219**
53.27	**300**	**141.12**	**280**	**41.508**	**260**	**76.3775**	**240**	**16.605**	**220**

$\hat{Y}_i$	Customer
71.53	**301**
31.548	**302**
16.605	**303**
38.188	**304**
49.95	**305**
83.02	**306**
178.466	**307**
63.096	**308**
132.8185	**309**
69.736	**310**

Source: Researchers Findings

Then, we calculated probability of no default by following formula:

$$\hat{Y}_i = \ln\left(\frac{\hat{p}_i}{1-\hat{p}_i}\right) \Longrightarrow \hat{p}_i = \frac{e^y}{1+e^y}$$

Table 9. Probability of no default for customers

$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer
0.64422	81	0.569638	61	0.80245	41	0.601627	21	0.670217	**1**
0.681056	82	0.541139	62	0.988477	42	0.712391	22	0.854785	**2**
0.621222	83	0.565584	63	0.695208	43	0.96435	23	0.96435	**3**
0.666563	84	0.63279	64	0.854775	44	0.575683	24	0.569032	**4**
0.601634	85	0.666853	65	0.854948	45	0.650171	25	0.84959	**5**
0.659191	86	0.775006	66	0.636612	46	0.565592	26	0.605589	**6**
0.659197	87	0.640418	67	0.677464	47	0.80245	27	0.601634	**7**
0.895073	88	0.581725	68	0.72898	48	0.677464	28	0.629274	**8**
0.695485	89	0.597681	69	0.644206	49	0.595692	29	0.670506	**9**
0.64422	90	0.677468	70	0.728985	50	0.62124	30	0.577703	**10**
0.601627	91	0.68134	71	0.651741	51	0.601627	31	0.541139	**11**
0.621222	92	0.633113	72	0.541139	52	0.571651	32	0.593705	**12**
0.593698	93	0.541139	73	0.67775	53	0.593698	33	0.621549	**13**
0.677446	94	0.549316	74	0.601627	54	0.96435	34	0.695211	**14**

0.601634	95	0.58172	75	0.621222	55	0.659191	35	0.854783	**15**
0.688174	96	0.854785	76	0.640413	56	0.849591	36	0.651741	**16**
0.621549	97	0.984048	77	0.760301	57	0.659197	37	0.789052	**17**
0.644525	98	0.712394	78	0.715752	58	0.849761	38	0.666557	**18**
0.738643	99	0.573668	79	0.72924	59	0.601627	39	0.854948	**19**
0.573668	**100**	**0.672324**	**80**	**0.666563**	**60**	**0.601627**	**40**	**0.666563**	**20**

$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer
0.611471	181	0.682839	161	0.541139	141	0.715757	121	0.541139	**101**
0.601639	182	0.682839	162	0.65548	142	0.541139	122	0.601627	**102**
0.601627	183	0.549316	163	0.708998	143	0.652043	123	0.695211	**103**
0.601627	184	0.573675	164	0.677468	144	0.827292	124	0.581725	**104**
0.541139	185	0.597676	165	0.617335	145	0.573675	125	0.636934	**105**
0.621549	186	0.62895	166	0.62895	146	0.64422	126	0.715752	**106**
0.659191	187	0.878536	167	0.659487	147	0.58172	127	0.854785	**107**
0.646107	188	0.712394	168	0.681038	148	0.96435	128	0.601634	**108**
0.849591	189	0.760306	169	0.640435	149	0.628938	129	0.601634	**109**
0.728961	190	0.748079	170	0.68994	150	0.789052	130	0.541139	**110**
0.744961	191	0.849761	171	0.58172	151	0.553394	131	0.541139	**111**
0.73545	192	0.666563	172	0.601627	152	0.668392	132	0.775003	**112**
0.581725	193	0.601634	173	0.599661	153	0.607551	133	0.712385	**113**
0.712394	194	0.659188	174	0.541139	154	0.878549	134	0.670506	**114**
0.597669	195	0.96435	175	0.744959	155	0.745207	135	0.565592	**115**
0.849593	196	0.655478	176	0.617335	156	0.651747	136	0.621222	**116**
0.541139	197	0.541139	177	0.589714	157	0.646107	137	0.744961	**117**
0.629274	198	0.553394	178	0.601627	158	0.609515	138	0.854785	**118**
0.854783	199	0.666557	179	0.849761	159	0.58172	139	0.744959	**119**
0.682822	**200**	**0.712391**	**180**	**0.644195**	**160**	**0.601634**	**140**	**0.659194**	**120**

$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer	$\hat{p}_i$	customer
0.677464	281	0.84959	261	0.94091	241	0.597669	221	0.670217	**201**
0.595692	282	0.605589	262	0.601634	242	0.621549	222	0.581725	**202**
0.666563	283	0.601634	263	0.849591	243	0.695211	223	0.644525	**203**
0.601627	284	0.629274	264	0.728961	244	0.854783	224	0.659194	**204**
0.712391	285	0.670506	265	0.744961	245	0.651741	225	0.640413	**205**
0.98735	286	0.577703	266	0.73545	246	0.789052	226	0.549316	**206**
0.575683	287	0.541139	267	0.854948	247	0.666557	227	0.634717	**207**
0.650171	288	0.593705	268	0.659197	248	0.854948	228	0.728985	**208**
0.565592	289	0.621549	269	0.541139	249	0.666563	229	0.662886	**209**
0.80245	290	0.695211	270	0.597669	250	0.601627	230	0.849761	**210**
0.677464	291	0.854783	271	0.621549	251	0.712391	231	0.607551	**211**
0.595692	292	0.651741	272	0.695211	252	0.96435	232	0.691703	**212**
0.854948	293	0.666563	273	0.854783	253	0.728985	233	0.593698	**213**
0.854785	294	0.601627	274	0.651741	254	0.662886	234	0.854786	**214**
0.96035	295	0.712391	275	0.789052	255	0.849761	235	0.681054	**215**
0.569032	296	0.96430	276	0.666557	256	0.607551	236	0.97725	**216**
0.84959	297	0.575683	277	0.854948	257	0.691703	237	0.601634	**217**
0.605589	298	0.650171	278	0.854785	258	0.593698	238	0.854948	**218**
0.601634	299	0.565592	279	0.92482	259	0.854786	239	0.659197	**219**
0.629274	**300**	**0.80245**	**280**	**0.569032**	**260**	**0.681054**	**240**	**0.541139**	**220**

$\hat{p}_i$	customer
0.670506	**301**
0.577703	**302**
0.541139	**303**
0.593705	**304**
0.621549	**305**
0.695211	**306**
0.854783	**307**
0.651741	**308**
0.789052	**309**
0.666557	**310**

Source: Research findings

Bank based on the probability of default can take decision on a grant or denial of the facility to customers.

4. Conclusion

In this paper, we have used Logit regression for EN Bank's credit rating. 310 cases to assess the predictive power of the model and test data are used to estimate power and performance of the model and type II errors can be determined.

Reliance on bank and prioritization of the variables influencing the bank's credit risk in relation to legal Customers are:

1. Type of Industry of the applicant
2. Turnover of total assets
3. Ratio of total debt to total assets
4. Immediate ratio (the debt / inventory - current assets)
5. Retained earnings to total assets ratio
6. Guarantee, the amount of collateral received from customers
7. Return on assets (total assets / net interest)
8. Term loans
9. Sales to total assets ratio
10. Current Ratio (Current debts / Current Assets)
11. Interest rate
12. Cash flow to debt ratio
13. Experience with bank
14. Current debt to equity ratio
15. The loan amount is paid to the customer
16. Current asset turnover ratio

Results indicate that 70 cases (92% of the total 76 cases) classified correctly in observations Y = 0 (lack of timely repayment of the facility) and 227 cases (97% of the total 234) in observations Y = 1 (timely repayment of the facility).

In general, the model can fit 87.5% of all observations Y = 0 and 98.7% percent of all observations Y = 1, which has accurately predicted. The model is called the degree of sensitivity equal to 87.5% and the detection rate equal to 98.7% percent.

5. REFERENCES

[1]. Allen NB, Gregory FU (2004). World Bank Conference on Small and Medium Enterprises: Overcoming Growth Constraints World Bank, MC 13-121 October 14-15, 2004.
[2]. Altman EI (1968). Financial Ratio's, Discriminant Analysis and the Prediction of Corporate Bankruptcy. J. Fin., 23: 589-609.
[3]. Altman E, Narayanan P (1997). An International Survey of Business Failure Classification Models in Financial Markets Institutions and Instruments. Malden, MA: Blackwell Publishers.
[4]. Beaver WH (1966). Financial Ratio as predictors of Failure. J. Account. Res., 4: 71-111.
[5]. Bharath ST, Shumway T (2004). Forecasting default with the KMVMerton model. University of Michigan Working Paper.
[6]. Chandy PR, Edwin HD (1990). Commercial Paper Ratings Models," Q. J. Bus. Econs., Vol. 29.
[7]. Charitou A, Neophytou E, Charalambous C (2004). Predicting
[8]. Corporate Failure: Empirical Evidence from UK. Eur. Account. Rev.13: 465-497.
[9]. ECD Small and Medium Enterprise Outlook (2002). Published by OECD Publication Services, France
[10]. Keasey K, Watson R (1986). Current Cost Accounting and the Prediction of Small Company (1991), (9)4: 11-29.
[11]. Larry GP, Timothy PC (1986). A note on rank transformation discriminant analysis: An alternative procedure for classifying bank holding company commercial paper ratings. J. Banking Fin., 10(4): 605-610.
[12]. Lennox C (1999). Identifying Failing Companies: A Re-evaluation of the Logit, Probit and DA Approaches , J. Econs. Bus.
[13]. Lin SM, Ansell J, Andreeva G (2007). Predicting default of a small business using different definitions of financial distress. Proceedings of Credit Scoring and Credit Control X.

[14]. Manickavasagam V, Srinivas G (2009). Property Valuation for Investment Decision (Special Reference to Commercial Mortgage Backed Securities (CMBS)) at 2009 International Conference on Financial Theory and Engineering. Dubai, UAE. Organized by IEEE and IACSIT. Web site:
[15]. Manickavasagam V, Srinivas G (2009). Risk Management Frame Work for ITES Organizations at International Conference on Business and Information, BAI 2009 at Kuala Lumpur, Malaysia, and July 6th to 8th 2009. http://bai2009.org/file/Pages/Accounting.htm.
[16]. Manickavasagam V, Srinivas G (2010). Risk Assessment Model for Assessing NBFCs' (Asset Financing) Customers in Intl. J. Trade, Econs. Fin. (IJTEF) accepted for publishing in June, issue.
[17]. Merton RC (1974). The Pricing of Corporate Debt: The Risk Structure of Interest Rates, J. Fin., 29(2): 449-470.
[18]. Ohlson J (1980). Financial ratios and the probabilistic prediction of bankruptcy, J. Acct. Res., 18(1): 109-131.
[19]. Patricia S, David, (2009). Evaluation of small business failure and the framing problem. Intl. J. Econs. Bus. Res., 1(4): 438-453.
[20]. Peel MJ, Wilson N (1986). Some Evidence on Discriminating between Failing and Distressed Acquired Firms in the UK Corporate Sector. Omega Intl. J. Manag. Sci., 16(4): 309-318.