

Chapter XI

Application of Discriminant Function in the Borrowers Repayment Performance : A Study in Malda District.

INTRODUCTION

The analysis of repayment performance behaviour in the foregoing chapter indicates that a multiplicity of factors simultaneously operate to determine the repayment behaviour. The present chapter is an extension of this analysis and uses discriminant function approach to distinguish the borrowers into two groups - defaulters and non-defaulters on their socio-economic characteristics. It is likely to suggest which categories of people are more prone to default. Further, it will make an attempt to identify the dominant factors responsible for poor repayment performance. Specifically, the objectives of the study are (i) to identify the borrowers into defaulters and non-defaulters on the basis of differences in socio-economic characteristics and (ii) to further distinguish the defaulters into wilful and non-wilful, on the basis of such characteristics.

This would necessitate development of indicators that would enable observers including credit institutions to judge the borrowers and sort them out on the above lines in advance. It is hoped that the credit agencies would be able to broadly identify a good repayer or a likely wilful defaulter on the basis of socio-economic characteristics, that would lend themselves to observation, quantification and analysis.

Methodology adopted for study

For the purpose of our study three stages of random sampling has been adopted. In the first stage 15 blocks of the district have been classified into two categories viz. developed and underdeveloped. Thereafter one block from each category has been selected randomly. Kaliachack-I and Kaliachack-III have been selected from developed and underdeveloped category of blocks respectively

In the second stage, four villages, two from each selected blocks, have been chosen just randomly. The villages were Boro-Sujapur and Chotto-Sujapur from Kaliachack-I block and Chak-Shehardi and Baisnabnagar from Kaliachack-III block respectively.

In the third stage, a borrowing households list has been prepared for each selected village. A total of 200 borrowing households (50 in each village) have been selected randomly.

Finally, relevant information, primary data have been collected from the borrowers through questionnaires and personal interviews. From among 200 borrowers, 110 were classified as defaulters and 90 as non-defaulters. We have taken into consideration a borrower to be a defaulter who was found to have not paid 50 percent of his loan even after the lapse of 2-3 years. The defaulter (110) were again sorted. Out of two groups on the basis of 'family net surplus' available from each respondent and it was found that 70 were wilful and 40 were non-wilful defaulters. Non-wilful default may arise from infructuous investment, erosion of farm income due to natural calamity, failure on the part of lending

agency to give loan when needed by the borrowers, faulty repayment schedule prescribed by the credit institution etc. Wilful default may be defined as a failure to meet the repayment obligation even when the borrower has the ability to repay. Such default can arise mainly from the borrower's attitude towards repayment. Formation of such an attitude may be because a large number of factors such as :influence of social and political groups, vested interests of certain agencies insisting the borrowers not to repay, hardships faced by the borrowers in obtaining loan, the high cost of borrowings etc.

Importance in Selection of Variables

The basic assumption of the study is that except under abnormal conditions like natural calamity, outside pressure not to repay the loan in time etc., the variations in repayment behaviour of the borrowers can be explained in terms of some selected demographic and socio-economic variables. The rationale for selection of the variables in the repayment behaviour and the methods used to measure them are explained hereunder.

1. CASTE :

It is assumed that the caste system has profound effect on the borrower's repayment attitude. Traditionally, higher caste people have been owning land and other economic resources and lower caste people do not own any significant size of these resources. Thus, it is assumed that higher caste people have a

higher repayment capacity and lower caste people have lower repayment capacity. In our study, castes have been classified as high and low. High castes/social groups in this study include Brahmin, Middle Caste, Rich Muslims while low castes include scheduled caste and other backward classed and poor muslims.

2. EDUCATION :

The individual's ability to read and write and the amount of formal education he possesses affect the manner in which the individual gathers information and adjusts himself to his environment. It may be assumed that more of formal education may result in better use of credit. Timely repayment of credit may therefore, depend on the level of education of the borrower. To quantify the level of education, the respondents have been classified into two groups - viz. educated - those who can read and write and uneducated - who can not read and write.

3. OCCUPATION :

The nature of one's occupation determines the stability of earning on which, in turn, depends one's repayment behaviour. Agriculture forms the major occupation in rural India and income from agriculture varies fairly widely. Income from other occupations such as trade, service, small industry, etc. is likely to be more stable. Thus, there appears to be positive correlation between occupation and repayment performance of an individual. For the purpose of our study, occupation is broadly classified as

agricultural and non-agricultural.

4. PER CAPITA INCOME :

Timely repayment of loan of the borrower depends on per capita income. Generally, the higher the per capita income higher will be the capacity to repay the borrowed fund and vice-versa. It is with this intention this variable is included in our study.

5. PER CAPITA BORROWING :

Keeping in view the rural poor's limited capacity to repay, it is logical to assume that probability of default may increase with the increase in debt burden. Lower amount of borrowing leaves more advantage for repayment of loans and vice-versa. The timely repayment of loan may, therefore, be related to the per capita borrowing. In case of institutional borrowings, the agency from which the borrower stated to have borrowed was also visited to confirm the date, amount, purpose of loan as well as indebtedness on the specified date.

6. INCREASE IN INCOME AFTER THE USE OF CREDIT :

Percentage increase in income after the effective use of credit also plays a crucial role in the repayment behaviour pattern. This variable is most important to classify the borrowers into wilful and non-wilful. It is mostly seen that inspite of a venture proving profitable to the borrower, the borrower has not repaid the due instalments. In this case, the borrower is deemed

to be a wilful defaulter.

7. CONTACTS/RELATIONS WITH THE LENDING AGENCY OR THE GOVERNMENT MACHINERY :

Contacts/relations with the lending agency or the government machinery also play an important role in the repayment behaviour. This variable not only acts as an instrument in securing credit but also in affording a delay in repayment. For the purpose of our study, the respondents' response were classified into two groups i.e. good relations and poor relations.

8. ADEQUACY OF LOAN :

The adequacy/inadequacy of loan is an important determinant of repayment behaviour. The effective utilisation of loan depends to a larger extent on its adequacy for a particular purpose. It is quite likely that the inadequacy of funds may lead to diversion of borrowed amount to channels other than productive. Here also, the borrowers' responses have been classified into two groups i.e. adequate and inadequate.

9. RATE OF INTEREST :

Borrower's attitude towards repayment and the rate of interest are closely connected. This correlation either may be positive or negative. High rate of interest may force the borrower to repay his loan to minimise his debt burden. Thus, the higher the rate of interest, the stronger be the tendency to repay on the

otherhand, the debt burden due to high rate of interest, may become so large that the borrower is unable to pay it promptly and consequently, becomes a defaulter. Thus, rate of interest was included in this study to examine its impact on repayment performance of the borrower.

10. CONDITION OF THE HOUSE :

During our field visits, it has been observed that the rural poor have a strong tendency to own a 'pucca' dwelling unit. In a fairly large number of cases, the credit though obtained for an economic activity, was, in fact, used for the construction of a dwelling unit or its extension. This kind of utilisation of loan, though desirable from the social point of view, turns the borrower into a defaulter due to non-productive investment, Keeping this end in view, the information regarding the condition of the borrower's dwelling unit was collected.

Analytical Model

In order to measure the net effect of each variable in this analysis, all other variables are taken constants by using the Discriminant Function Approach⁽¹⁾.

The relative importance of the variables in the study in regard to their power to discriminate between the groups of defaulters and non-defaulters and further in between the groups of wilful and non-wilful defaulters can also be known with the help of this model. The general model used for the present study is as

follows :

$$Z = {}^1_1X_1 + {}^1_2X_2 + {}^1_3X_3 + {}^1_4X_4 + {}^1_5X_5 + {}^1_6X_6 + {}^1_7X_7 + {}^1_8X_8 + {}^1_9X_9 + {}^1_{10}X_{10}$$

Where, Z = total discriminate score for defaulters and non-defaulters or wilful and non-wilful defaulters.

Caste X_1 = '1' if the borrower belongs to high caste and '0' if he belongs to low caste.

Education X_2 = '1' if the borrower is educated and '0' if he is uneducated.

Percapita Income X_3 =
$$\frac{\text{Total Income of the family}}{\text{Total number of members in the family}}$$

Percapita borrowing X_4 =
$$\frac{\text{Total borrowing of the family}}{\text{Total number of members in the family}}$$

Incremental income after the use of credit

X_5 = Percentage increase in income after the use of Credit. This has been calculated as :

$$\frac{\text{Change in income after the use of credit}}{\text{Initial income before the use of credit}} \times 100$$

Occupation X_6 = '1' if the borrower's occupation is agriculture and '0' if his main occupation is other than agriculture.

Adequacy of loan X_7 = '1' if the borrower stated that the amount of loan was adequate for taking up the activity for which he borrowed and '0' if it was stated otherwise.

Rate of Interest $X_8 = '1'$ for rates upto 12 percent of interest and
'0' if it was above 12 percent.

Contacts/relation with lending agency or the government machinery $X_9 = '1'$ if the borrower stated that he had good contacts and '0' if the relations were stated to poor.

Condition of the House $X_{10} = '1'$ in case the house was pucca and '0' if it was not.

$l_p = (P=1,2,...10)$ are the coefficients of the linear discriminant function.

The method seeks to find out the values of co-efficients (l_p 's) such that the squared difference between the mean 'Z' score for the one group and the mean 'Z' score for the other group is as large as possible in relation to the variation of 'Z' scores within the groups.

The determination of the value of co-efficient (l_p 's) necessitates the solution of the following 10 equations shown in matrix notation.

$$\begin{array}{c}
 \text{SL=D} \\
 S = \begin{bmatrix} s_{11} & s_{12} & \dots & s_{1p} \\ s_{21} & s_{22} & \dots & s_{2p} \\ s_{p1} & s_{p2} & \dots & s_{pp} \end{bmatrix}
 \end{array}
 \quad
 \begin{array}{c}
 L = \begin{bmatrix} l_1 \\ l_2 \\ \vdots \\ l_p \end{bmatrix}
 \end{array}
 \quad
 \text{and}$$

$$\begin{array}{c}
 D = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_p \end{bmatrix}
 \end{array}$$

where $p=10$; " $L_{p \times 1}$ " is the vector of the co-efficients of the discriminant function; "SPXP" is the pooled dispersion matrix and " $D_{p \times 1}$ " is the vector of the elements representing differences between the means of the two groups. The discriminant function obtained is subjected to test of significance in order to examine whether the variables considered together are effectively discriminating the borrowers belonging to two groups - defaulters and non-defaulters or wilful defaulters and non-wilful defaulters.

The Mahalanabis D^2 statistic has been used to measure the distance between the two groups. D^2 statistic is transformed into F statistic whether the two groups are different from each other.

$$F = \frac{Na Nb (Na + Nb - P - 1)}{P (Na + Nb) (Na + Nb - 2)} D^2$$

$$\text{where } D^2 = \sum_{i=1}^P \sum_{k=1}^P C_{ik} d_{ik} = \sum_{i=1}^P l_i l_i d_i ;$$

$C_{i,k}$ = (i,k)th elements of the inverted Matrix of S,

P = number of factors = 10

Na = number of defaulters or wilful defaulters.

Nb = number of non-defaulters or non-wilful defaulters.

The value of observed F is compared with that of tabulated F with (P) and (Na + Nb - P - 1) degree of freedom at 1 percent level of significance.

Results and Discussions

(A) Defaulters and non-defaulters :

The discriminating function considering the above mentioned socio-economic characteristics fitted to the data for defaulters and non-defaulters is as follows :

$$Z = 0.4291X_1 - 0.2483X_2 - 0.000768X_3 + 0.001204X_4 + 1.5706X_5 - 0.8492X_6 + 0.02597X_7 - 0.0930X_8 + 1.1383X_9 - 0.3407X_{10}$$

The F value was worked out to be 4.5683. Since the tabulated value of $F_{10,189} = 2.32$ at 1 percent level of significance. The discriminant function is highly significant. This means that the 10 socio-economic characteristics together were useful in classifying the borrowers into the groups of defaulters and non-defaulters.

To ascertain the relative importance of the characteristics (variables) in their power to discriminate between the two groups of borrowers, the percentage to the total distance measured was calculated and is given in Table-11.1.

The Table - 11.1 indicates that caste, per capita borrowing, incremental income after the use of credit, occupation, rate of interest, contacts/relations with the lending agency are the significant factors which classify the borrowers into two groups i.e. defaulters and non-defaulters and their respective discriminating powers are 6.5892 percent, 15.5021 percent, 31.9304 percent, 17.3550 percent, 1.3080 percent and 34.5628 percent respectively.

TABLE - 11.1

**DEFAULTERS AND NON-DEFAULTERS : PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS
TO THE TOTAL DISTANCE MEASURED**

Sl. No. 1	Socio-economic Characteristics of the borrowers 2	Co-efficient (lp) 3	Mean difference (dp) 4	Co-efficient x mean difference (lp x dp) 5	Percentage contribution 6
1.	Caste	0.4291	0.1889 (2.41)**	0.0811	6.5892
2.	Education	-0.2483	0.0989 (1.39)	-0.0246	-1.9987
3.	Per Capital Income	-0.000768	53.8768 (0.97)	-0.0414	-3.3636
4.	Per capita borrowing	0.001204	158.4081 (3.51)**	0.1908	15.5021
5.	Incremental Income after the use of credit	1.5706	0.2502 (5.88)**	0.3930	31.9304
6.	Occupatioin	-0.8492	-0.2515 (3.71)**	0.2136	17.3550
7.	Adequacy of Loan	0.02597	-0.0989 (1.42)	-0.0026	-0.2112
8.	Rate of interest	-0.0930	-0.1727 (2.70)**	0.0161	1.3080
9.	Contacts/relations with the lending agency	1.1383	0.3737 (5.67)**	0.4254	34.5628
10.	Dwelling House	-0.3407	0.0606 (0.87)	-0.0206	-1.6737
	TOTAL			1.2308	100.0000

Calculated 't' values are shown in brackets
**Significant at 1 percent level.

The second iteration or re-run was done taking only those socio-economic characteristics or variables for which the calculated t values were greater than the corresponding table values at 5 percent or 1 percent level of significance.

From the Table 11.1, it is found that only six characteristics (viz. Caste, per capita borrowing, incremental income after the use of credit, occupation, rate of interest, contacts/relations with the lending agency are statistically significant and as such the discriminant function was again re-run taking these six characteristics in the equation to see whether these characters alone can distinguish the defaulters and non-defaulters significantly.

The second set of formed equation for the significant factors in the present analysis is given below :

$$Z = 0.2949X_1 + 0.000393X_4 + 1.8802X_5 - 1.0072X_6 - 0.2117X_8 + 1.0149X_9$$

The value of F was worked out to be 8.2287. Since the tabulated value of $F_{6,193}$ at 1 percent level being 2.80, the discriminant function was highly significant. It means that 6 characteristics out of 10 considered together were very useful in classifying the borrowers into defaulters and non-defaulters groups.

The relative importance of the characteristics in their power to discriminant between the groups of borrowers, the percentage contribution of each character to the total distance

measured were examined and the results are exhibited in Table - 11.2.

The Table 11.2 indicates that incremental income after the use of credit, contacts/relations with the lending agency, occupation, per capita borrowing, caste and rate of interest are the significant characteristics which classify the borrowers into two groups i.e. defaulters and non-defaulters and their respective discriminating powers are 37.4125 percent, 30.1606 percent, 20.1415 percent, 4.9459 percent, 4.4291 percent and 2.9104 percent respectively.

(B) Wilful and non-wilful defaulters :

The same model was used for identifying the defaulters into wilful and non-wilful on the basis of the existing socio-economic characteristics. The equations derived from the model on their socio-economic characteristics are exhibited below :

$$Z = 0.7917X_1 - 0.0309X_2 + 0.000115X_3 - 0.0000018X_4 + 5.1490X_5 + 0.4343X_6 + 0.0366X_7 - 0.1407X_8 + 0.5726X_9 - 0.2402X_{10}$$

The F value was worked out to be 34.4544. Since the tabulated value of $F_{10,99}$ at 1 percent level being 2.47, the discriminant function was still highly significant. This means that the 10 characteristics considered together were useful in classifying into wilful and non-wilful defaulters.

TABLE - 11.2

**DEFAULTERS AND NON-DEFAULTERS : PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS
TO THE TOTAL DISTANCE MEASURED: (SIGNIFICANT VARIABLES ONLY)**

Sl. No.	Socio-economic characteristics of the borrowers	Co-efficient (lp)	Mean difference (dp)	Co-efficient x mean difference (lp x dp)	Percentage contribution
1	2	3	4	5	6
1.	Caste	0.2949	0.1889	0.0557	4.4291
2.	Per capita borrowing	0.000393	158.4081	0.0622	4.9459
3.	Incremental Income after the use of credit	1.8802	0.2502	0.4705	37.4125
4.	Occupation	-1.0072	-0.2515	0.2533	20.1415
5.	Rate of interest	-0.2117	-0.1727	0.0366	2.9104
6.	Contacts/relations with the lending agency	1.0149	0.3737	0.3793	30.1606
	TOTAL			1.2576	100.0000

With a view to find out relative significance of the characteristics in their power to discriminate between the two groups of defaulters, the percentage to the total distance measured was calculated and is shown in Table 11.3.

Table 11.3 shows that incremental income after the use of credit, caste, contacts/relations with the lending agency, occupation, rate of interest and per capita income are major characteristics which classify the defaulters into wilful and non-wilful and their respective discriminating powers are 81.3782 percent, 10.9340 percent, 6.4104 percent, 2.1358 percent, 1.2803 percent and 0.7676 percent respectively.

In the case of wilful and non-wilful defaulters, the second iteration or re-run of the discriminant function was not possible as the calculated t values of all the characteristics were found to be greater than the corresponding table values and from Table 11.3, it can easily be understood.

MERITS :

Frequently, the analysis of conventional problems in terms of sub-groups of the original observations will yield insight into aspects of the problem not previously considered.

LIMITATIONS

1. Even after standardisation, a certain degree of ambiguity remains as long as the predictors are correlated.

TABLE - 11.3
WILFUL DEFAULTERS AND NON-WILFUL DEFAULTERS : PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS TO THE TOTAL DISTANCE MEASURED

Sl. No.	Socio-economic characteristics of the borrowers	Co-efficient (lp)	Mean difference (dp)	Co-efficient x mean difference (lp x dp)	Percentage contribution
1.	Caste	0.7917	0.4714 (5.43)**	0.3732	10.9340
2.	Education	-0.0309	0.4399 (4.88)**	-0.0136	-0.3984
3.	Per capita Income	0.000115	228.0214 (3.49)**	0.0262	0.7676
4.	Per capita borrowing	-0.0000018	232.7893 (4.38)**	-0.004	-0.0120
5.	Incremental Income after the use of credit	5.1490	0.53945 (17.42)**	2.7776	81.3782
6..	Occupation	0.4343	0.1678 (1.70)*	0.0729	2.1358
7.	Adequacy of Loan	0.0366	-0.2428 (2.51)**	-0.0089	-0.2607
8.	Rate of interest	-0.1407	-0.3107 (3.38)**	0.0437	1.2803
9.	Contacts/relations with the lending agency	0.5726	0.3821 (4.65)**	0.2188	6.4104
10.	Dwelling house	-0.2402	0.3178 (3.38)**	-0.0763	-2.2354
	TOTAL			3.4132	100.0000

Calculated 't' values are shown in brackets

** Significant at 1 percent level

* Significant at 5 percent level

2. Selection of predictor variables does not usually follow from any theory and in that sense, a little arbitrary. This selection has to be on the basis of conceptual relevance and that should ideally dictate why certain variables are included.

However, in our present study we have tried to remain fully conscious of these limitations and tried to avoid the pitfalls.

Usefulness of discriminant function analysis

Firstly : the discriminant function approach helps the public policy-makers to manipulate the factors which would affect the "credit-worthiness" (especially more contributing factors to the non-wilful default). Thus, the policy formation can suitably be changed to improved their "credit-worthiness" and further ensure large flow of credit of such individuals which would result in better repayment performance in future.

Secondly, the discriminant function is very helpful to the financial institution to understand the characteristics of the borrowers before advancing loans. Once the financial institutions understand the characteristic features of the 'prompt repayers', the default in repayment can be minimised.

CONCLUSION

The conclusion based on discriminant function analysis indicate that the characteristics like incremental income after the use of credit, caste, per capita borrowing, occupation, rate of interest, contacts/relations with the lending agency and officials of the Governments are very helpful in classifying the borrowers into defaulters and non-defaulters. Among these contact with the lending agency and officials of the government and incremental income after the use of credit have the highest discriminating power.

As regards classification of defaulters into wilful and non-wilful, the relevant factors are found to be incremental income after the use of credit, caste, contact with the lending agency and officials of the government, occupation, rate of interest and per capita income. However, among these the two factors viz. incremental income after the use of credit and caste are the prominent determinants. The characteristics like incremental income after the use of credit, caste and contacts with the lending agency are found to be valid factors in both the analysis.

One outstanding revelation of discriminant function analysis is that the borrowers have become more wilful defaulters who have effectively utilised credit and generated income by it. In spite of the ventures proving profitable and ability to repay, the borrowers have wilfully refused to repay bank loan to the credit institutions. Such default may arise mainly from borrower's attitude towards repayment. Formation of such an attitude may be because of a large

number factors such as : influence of social and political groups, vested interests of certain agencies insisting the borrowers not to repay, hardships faced by borrowers in obtaining loan and the high cost of borrowing. This variable is found to be the most important in classifying the borrowers into two groups - wilful and non-wilful.

The analysis also categorically, brings out the existence of an "entente cordial" between the rural influential people and the functionaries involved in the disbursement of credit and other benefits. This mutual cordial relationship is used not only in getting credit but also in getting protection for their defaulting behaviour towards repayment of borrowed funds.

The discriminant function approach helps the public policy makers to manipulate the factors which would effect the credit worthiness (especially more contributing factors to the non-wilful default). Thus the policy formation can suitably be changed to improve their "credit-worthiness" and further ensures large flow of credit to such individuals as would result in better repayment performance in future.

This analyses is also very helpful to the financial institutions to understand the characteristics of the borrowers before advancing loans. Once the financial institutions understand the characteristic features of the 'prompt-rePAYERS', the default in repayment can be minimised.

REFERENCES

1. The application of Discriminant Function has been done in many studies in Social Sciences, the references, are George, P.T. Namasivayam, D. and Ramchandraiah, G., "Application of Discriminant Function in the Farmers' Repayment Performance : A study in Chingleput District, Tamil Nadu, Journal of Rural Development, Vol.3, May 1984, No.3; Pandey and Muralidharan, "An Application of Discriminant Function in Agricultural Finance, Indian Journal of Agricultural Economics, Vol.XXXII, No.2, April - June, 1977; Brandow, G.E. and Potter, A.K., "An Application of Linear Discriminant Function", Rural Sociology, Vol.18, No.4, December, 1953; Dean D.J. and Fray, T.L., "Discriminant - Analysis of Loans for Cash Grain Farmers", Agricultural Economic Review, Vol.36 (Annual), April 1976; Morrison, D.G., "On the interpretation of Discriminant Analysis", Journal of Marketing Research, Vol.IV, May 1969 Krause, K.R. and Williams, P.L., "Personality characteristics and successful use of credit by Farm Families", American Journal of Agricultural Economics, Vol.53, No.4, November, 1971; Rami Reddi, S, "Factors Discriminating Defaulters from non-defaulters in primary credit co-operatives", Indian Co-operative Review, Vol.XIV, No.1, October, 1976 and Aswini Paul, "Application of Discriminant Function on "Factors Behind Inter-Farm Yield variation of wheat in West Bengal", Wheat Revolution in India, Mital Publications, New Delhi, 1990.