

Exploring the role of microfinance in encouraging entrepreneurship using unsupervised learning

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Abstract

Microfinance institutions in India have a significant role in providing financial services to a large sector of users who would otherwise be unable to access these services. These institutions have an important role in the reduction of poverty by providing small loans to the users. This study examines the impact of microfinance on entrepreneurial activities in Indian context. Two widely used machine learning approaches, Principal Component Analysis (PCA) and clustering have been employed to identify correlation among the microfinance and a set of selected factors. The selected factors have been associated with Gross Loan Portfolio (GLP), since the GLP has been used in the literature as a significant control variable for computing the entrepreneurship level. Initially, PCA technique has been applied to determine main principal components, and then K-Means clustering has been applied to get clusters, in order to get the labelled dataset. The labelled data obtained from K-Means clustering is useful for applying classification techniques, through which we can predict level of entrepreneurship using Supervised Learning. Finally, the results obtained

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from machine learning algorithms indicate that GLP being the main contributing factor for computing the entrepreneurship level.

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1. Introduction

Microfinance plays a significant role in facilitating financial services to a substantial number of individuals, hence exerting a profound influence on the economic progress of a nation [2], [10]. Microfinance initiatives contribute to fostering entrepreneurship among individuals, by offering small loans and financial services to persons who face barriers in accessing conventional banking services [8]. Microfinance institutions facilitate the initiation or expansion of entrepreneurial activities for individuals seeking to establish or grow their businesses.

According to [13], the utilization of microfinance has the potential to play a substantial role in poverty alleviation, gender equality enhancement, and community development. Microfinance institutions provide innovative and cost-effective paths for reducing poverty and putting an impetus for a social change [4]. Providing better paths for low-income households for savings is a significant aim of such institutions. Improved management practices, and focus on female customers are some other aspects that are related to microfinance.

According to [1], the implementation of microfinance initiatives has been found to contribute to poverty reduction. The poor require microfinance for investing as well as for day-to-day requirements, emergency and insurance. The impact of microfinance institutions on entrepreneurship and society needs to be explored in greater depth [6], [9].

Microfinance institutions help in providing the financial services to users. These institutions provide small loans, collecting savings, insurance and other services [15]. According to [5] microfinance has emerged as a means to facilitate financial access for individuals who are marginalized by conventional financial institutions, hence fostering the growth of entrepreneurial endeavors. Microfinance, particularly the use of microcredit instruments, is emphasized by Rohman et al. in [14] as a major choice for small organizations and enterprises. This is particularly relevant due to the inadequacy of bank funding in addressing these challenges.

Bros et al. in [3] assert the significance of comprehending the broader implications of microfinance, with particular attention to organizations that facilitate entrepreneurial endeavors.

Microfinance institutions have created opportunities and these are gaining momentum in India. The focus of this study is to use machine learning techniques like principal component analysis (PCA) and K-means clustering to investigate the role of microfinance in fostering entrepreneurship in India. The research makes use of the Microfinance Information Exchange (MIX) database for the Indian context. There hasn't been a lot of study done in the past using machine learning methods to examine how microfinance may inspire entrepreneurship like this one [16-18].

Rest of the paper is as follows: Section 2 discuss about the relationship of entrepreneurship with the microfinance using GLP variable. Section 3 discusses the proposed methodology used in the paper. Section 4 illustrates the results of applying PCA and clustering techniques on the MIX dataset. Finally, a conclusion of the main findings is given in section 5.

2. Using machine learning technique on GLP based data of microfinance institutions in India

In the literature, Entrepreneurship has been related to microfinance and microfinance variables like Gross Loan Portfolio (GLP) [11]. It has been shown that GLP and control variables affect the amount of entrepreneurship. A regression equation had been used for calculating the entrepreneurship.

$$E = a + b + v + c + cv + error \quad (1)$$

The variable E has been used for the amount of Entrepreneurship in the equation, the variable 'a' represents intercept, variable 'b' represents coefficient for variable v, variable v represents microfinance variable and this has been based on Gross Loan Portfolio (GLP), variable c represents coefficient for the variable cv, the variable cv is used as a control variable and error represents an error term.

Since equation 1 has used GLP as main contributing factor, this paper uses 8 significant factors associated with GLP of microfinance institutions in Indian context. This study uses these eight significant factors to explore a way to apply machine learning algorithms.

The assessment of the impact of microfinance on entrepreneurship involves the utilization of the Gross Loan Portfolio (GLP) statistic, which

measures the aggregate value of loans provided by microfinance institutions. The database utilized in this study is the MIX online datasets. The following variables are chosen for inclusion in the dataset:

(1) Average gross loan portfolio, (2) Gross loan portfolio, (3) Gross loan portfolio, Rural (4) Gross loan portfolio, Urban, (5) Gross loan portfolio, village Banking (SHG), (6) Gross loan portfolio, Individual, (7) Number of active borrowers, Rural, (8) Number of active borrowers, Urban

3. Proposed Methodology

It can be seen from previous section that the effect of microfinance on entrepreneurship is measured using Gross Loan portfolio (GLP) of microfinance institutions. Entrepreneurship has been related to microfinance and microfinance variables like Gross Loan Portfolio (GLP), in the literature [11]. The dataset for Indian context contains of 250 records and each record contains 8 features. The research encompasses the features pertaining to the Gross Loan Portfolio of microfinance institutions within the Indian context for year 2019.

But the dataset being extracted from MIX database is unlabeled dataset, due to which it is not possible to predict the category for the entrepreneurship level by using classification techniques (Supervised learning). Hence, labels for samples are obtained by using PCA and clustering technique. This labeled data will be useful for a data analyst in applying machine learning techniques – supervised methods for classification and regression. Figure 1 discussed about the workflow of the proposed work, in order to obtain labeled dataset.

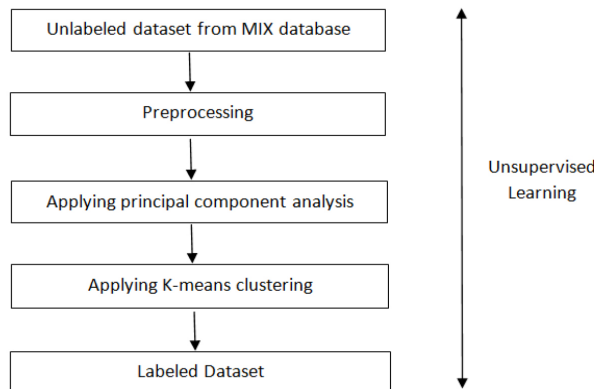


Figure 1
Proposed Work Flow

4. Result and Analysis

This section describes the outputs that are obtained from machine learning algorithms. Machine learning techniques of PCA for identifying two principal components and clustering technique for assigning labels are applied to the samples in the dataset.

4.1 Using PCA Algorithm

Principal component analysis (PCA) has been used for dimensionality reduction [7]. Initially, the standard ‘scalar’ function is applied to the dataset for normalizing the values on a common scale. Then PCA algorithm has been applied on a given dataset for finding the first principal component and the second principal component.

Figure 2 shows the heatmap for each of the PCA components for the dataset of the year 2019. The heatmap has been used for depicting the correlation among the two variables.

In the next subsection, the outputs of clustering using K-Means algorithm are presented.

4.2 Applying Clustering Technique on the Output Obtained from PCA

Clustering algorithms use input data for generating different clusters of data points [12]. Next, when a new data point is given as input, this will identify the suitable cluster for this point. This machine learning algorithm learns the attributes from the given data set and puts a new data point using these attributes. All the data points that have similar attributes are

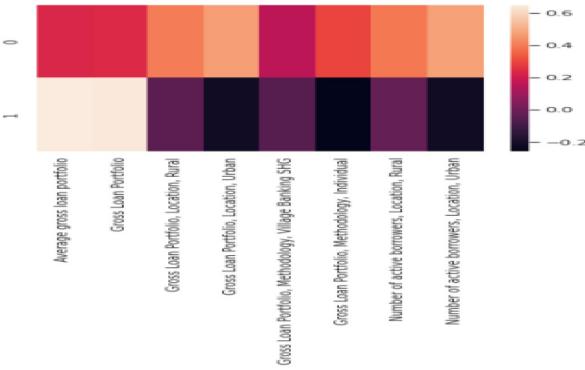


Figure 2
Heatmap for PCA components (Year 2019)

**Figure 3****Output of the clustering using K-Means algorithm for India, 2019**

grouped together in a distinct cluster. The output commonly has multiple clusters.

Figure 3 shows a scatter plot for the clusters obtained after applying K-Means technique for the year 2019, India. The output of the clustering shows a set of labels that are obtained from K-Means technique ($k=3$ is obtained using elbow method).

The labels of category 0, or 1, or 2 have been obtained after applying the clustering algorithm.

The labels signify the following categories:

Label 0 High entrepreneurship category

Label 1 Medium level of entrepreneurship category

Label 2 Low entrepreneurship value

Thus, this section has shown the use of clustering technique based on K-Means algorithm on a sample dataset, through which we are able to label the dataset. These results indicate that GLP being the main contributing factor for the microfinance variable in the regression model. The labeled data obtained from K-Means clustering is useful for applying classification (Supervised Learning). The classification can be now applied to identify high levels of entrepreneurship or low levels of entrepreneurship.

The machine learning techniques used in this study are capable of predicting a correct category for entrepreneurship based on selected features in the data set.

5. Conclusion

Microfinance institutions play a vital role in offering financial services in India. This paper has applied machine learning techniques on a sample dataset which has eight significant factors. These factors are related to GLP of the microfinance institutions in Indian context.

The two main components are identified using the PCA algorithm, a machine learning technique. This paper has also applied clustering using the K-Means algorithm on the output data. The labels are obtained for samples by applying clustering. This labeled data will be useful for a data analyst in applying machine learning techniques – supervised methods for classification and regression.

Future research work must explore the role of control variables in evaluating this impact. The labeled data which has been obtained from the application of clustering will be a very useful tool to predict a category for the entrepreneurship level by using classification techniques.

Conflicts of Interest

The authors declare that they have no competing interests.

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