

# Entrepreneurial Intention Model-Based Quantitative Approach to Estimate Entrepreneurial Success

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**ABSTRACT.** Entrepreneurial development plays a major role in maintaining the healthy economic structure of a country. Though the importance of socio-psychological factors on entrepreneurial success is well recognized in the existing literature, still there is a strong need for developing a quantitative model in order to estimate the future economic success of an individual who is willing to become an entrepreneur. Keeping this in view, this article makes an attempt to build classification and regression tree models for estimating the economic success of an entrepreneur in a homogeneous market condition. To handle the heterogeneous market situation, a generalized idea based on quantiles has been proposed as well. This study has a strong practical implication, especially for the financiers who have a strong need to identify the potential of an entrepreneur in a comprehensive way.

**SOMMAIRE.** Le développement entrepreneurial est important pour maintenir en bonne santé la structure économique d'un pays. Bien que la documentation existante reconnaisse l'importance des facteurs socio-psychologiques pour la réussite entrepreneuriale, il n'en est pas moins nécessaire de mettre en place un modèle quantitatif afin d'évaluer la réussite économique future d'un individu désirant devenir entrepreneur. En conséquence, cet article tente de construire des arbres de classification et de régression visant à évaluer la réussite économique d'un entrepreneur dans des conditions de marché homogènes. On y propose également, en ce qui concerne les conditions hétérogènes, une idée généralisée basée sur les quantiles. Cette étude a de solides applications pratiques—surtout pour les financiers, qui doivent identifier le potentiel d'un entrepreneur d'une manière compréhensive.

## Introduction

Entrepreneurship plays an important role in the economic development of each and every country. Though researchers from different disciplines studied entrepreneurship under their own premises, it is impossible for a particular discipline to explain the whole process of entrepreneurship in a comprehensive way. As interactions among different factors like economical, social, cultural, psychological, etc. make entrepreneurship desirable and possible, a comprehensive study on entrepreneurship must incorporate all these factors. Realizing the importance of this comprehensive study, researchers were inclined to develop interdisciplinary models of entrepreneurship (Gartner, 1985; Bird, 1988; Greenberger & Sexton, 1988; Herron & Sapienza, 1992; Learned, 1992; Boyd & Vozikis, 1994; Krueger & Brazeal, 1994). Though these models are quite efficient in understanding entrepreneurial action and behavior, they are subjective in nature and there is a lack of quantification. To make entrepreneurship research more scientific, there is a strong need for a quantitative model. This problem has great importance in the applied field. In developing countries, people used to take loans from banks or other financiers to run their

business. But if they fail to do this, the authority finds it difficult to get back the money, hindering the entrepreneurial as well as economic development. These types of wrong investments from government or non-government sectors are not at all desirable from the country's economic point of view. Therefore, it is an extremely important task for the investigators to identify the entrepreneur who has real potential to pursue the business in the long run. In this article, we make an attempt to develop a simple quantitative model for measuring the entrepreneurial potential of an individual in terms of numerical figures.

To build up a meaningful quantitative model, first it is necessary to look at the underlying theoretical background. But unfortunately, apart from the Giessen-Amsterdam model of entrepreneurial success (see for e.g. Rauch and Frese, 2000), there is no well-known model that directly deals with entrepreneurial success. However, the Giessen-Amsterdam model of entrepreneurial success does not deal with any quantitative analysis, and according to Rauch and Frese (2000) its practical implication is controversial as well.

Therefore, to investigate the theoretical background of the entrepreneurial success model, it is necessary to look at some other recognized interdisciplinary models that may guide us in developing the theoretical understanding. In this article, we have borrowed the basic idea from the entrepreneurial intention model to build up the primary background. Like the entrepreneurial intention model, here we have considered entrepreneurial success as a function of some exogenous factors like demographic, personal, personality, social, cultural and environmental. There are several variables under each of these factors. However, some of these variables were beyond the scope of our analysis. We have tested the effect of other variables in association with entrepreneurial success and retained those whose effects were found to be statistically significant (a detailed discussion on variable selection will be given in the next section). Here it should be noted that all these selected variables were also considered in the Giessen-Amsterdam model of entrepreneurial success.

This paper begins with the understanding of entrepreneurial intention models. Taking ideas from the theoretical background of some prominent intention models, we have developed the theoretical framework of our quantitative model. From the entrepreneurial intention model, we have selected some variables whose importance has been well investigated in the existing literature. After that, objectives of this study have been presented. The methodology section describes the sampling and data collection, as well as measures of entrepreneurial success and related predictor variables. In the result section, we have presented the quantitative models and also tested their efficiencies. Lastly, we summarized our findings by highlighting the strength and the limitation of our study.

### **Theoretical Background and Review of Literature**

Entrepreneurial intention models are promising approaches for explaining entrepreneurial behavior from multidisciplinary points of view. As noted by Krueger (1993), "intentions models offer a coherent parsimonious and robust framework for pursuing a better understanding of entrepreneurial process." Several models of entrepreneurs' intentions have been presented in entrepreneurship literature (see e.g., Bird, 1988; Boyd and Vozikis, 1994; Krueger and Brazeal, 1994). Each of these models suggests that entrepreneurs' intentions result from some sort of cognitive process (a process that incorporates perceptions), beliefs, expectations and values. These models consider intentions as key determinants of entrepreneurial action, and these cognitions and intentions mediate the influence of other exogenous factors (demographic variables, personal characteristics, personality traits, social, cultural and environment variables) on entrepreneurial behavior

and action. Such models have the potential to understand and explain the findings of earlier research that employed such exogenous factors (these factors were individually studied by different researchers at different times). By analyzing different models of entrepreneurial intentions, in a broad sense, we got the following exogenous factors of entrepreneurial action and behavior under different dimensions:

- Demographic factors: age, gender, education, ethnic background, nationality, etc. (Swayne and Tucker, 1973; Cohen, 1980; Brockhaus, 1982; Sexton and Auken, 1982; Gasse, 1985; Singh and Gupta, 1985; Hisrich, 1986; Deivasenapathy, 1986; Cooper and Dunkenberg, 1987; Chandralekha et al., 1998; Ghosh et al., 1998).
- Personal characteristics: technical expertise, managerial experience, entrepreneurial experience, etc. (Cooper, Dunkenberg and Woo, 1988; Lamont 1972; Ronstadt, 1988).
- Personality trait: need for achievement, locus of control, risk-taking, tolerance of ambiguity, need for independence, etc. (Begley and Boyd, 1986; Hornaday and Aboud, 1971; McClelland, Atkinson, Clark, and Lowell, 1953; Green, David and Dent, 1996; Rauch and Frese, 2000; Brockhaus, 1982; Cormie and Johns, 1983; Venkatapathy 1984; Miller and Toulouese, 1986; Begeley and Boyed, 1987; Duchesneau and Gratner, 1990; Rahim, 1996; Goebel and Frese, 1999; Ganesan et al., 2003; Schere, 1982; Sexton and Bowman, 1985).
- Social factors: parental role model, cultural role models, family support, community support, etc. (Birley, 1985; Aldrich and Zimmer, 1986; Dubini and Aldrich, 1991; Greve and Salaff, 2003).
- Cultural factors: individualism-collectivism, uncertainty avoidance, materialism, Confucian dynamism, etc. (McGrath, MacMilan and Scheninberg, 1992).
- Environmental factors: economic resources, lack of employment opportunities, political climate, etc. (Gartner, 1985; Roure and Maiduie, 1986; Brenner, 1987; Covin and Slevin, 1989; Kolvereid and Oibloj, 1994).

As has been mentioned before, to develop the theoretical background of the entrepreneurial success model, we have adopted the basic idea of entrepreneurial intention models. Here, we have assumed entrepreneurial success as a function of some exogenous factors that have been studied in entrepreneurial intention models. We primarily selected some of the variables from the above stated list, and then retained those which were found to have a statistically significant effect on entrepreneurial success. Detailed discussion of variable selection for the entrepreneurial success model is given below.

#### ***Selection of Variables for the Entrepreneurial Success Model***

**Variables from Demographic and Personal Factors:** Associations between demographic variables and entrepreneurial behavior are well recognized in the entrepreneurship literature. The demographic and personal variables found to be most investigated are age, gender, education, socio-economic status, family background, birth order, role model, marital status, previous work experience, work habit, training, etc. (see e.g., Swayne and Tucker, 1973; Cohen, 1980; Brockhaus, 1982; Sexton and Auken, 1982; Gasse, 1985; Singh and Gupta, 1985; Hisrich, 1986; Deivasenapathy, 1986; Chandralekha et al., 1998; Ghosh et al., 1998; Brockhaus and Horwitz, 1986; Hull, Bosley, and Udell, 1980; Timmons, Smollen, and Dingee, 1985). Intention models also emphasize variables like age, gender, education, ethnic background, nationality, technical expertise, managerial experience, entrepreneurial experience, etc. under demographic and personal factors. In

this study, we have selected age, gender and technical expertise of the entrepreneurs under demographic and personal factors. Variables like education, ethnic background, nationality and managerial experience were treated as control variables in this study. The variable entrepreneurial experience was used to define the success rate (which is the response variable of this study), therefore we did not incorporate it in the set of predictor variables.

**Variables from Personality Trait:** Researchers at different times have recognized the importance of different personality traits in association with entrepreneurial behavior. Several studies on different personality traits investigated the differences between entrepreneurs and non-entrepreneurs. Summarization of these studies leads to the emergence of at least three characteristics (for an overview see Brockhaus, 1982): (1) high need for achievement (Begley and Boyd, 1986; Hornaday and Aboud, 1971; McClelland, Atkinson, Clark, and Lowell, 1953; Green, David and Dent, 1996; Rauch and Frese, 2000); (2) internal locus of control (Brockhaus, 1982; Cormie and Johns, 1983; Venkatapathy, 1984; Miller and Touloese, 1986; Begeley and Boyed, 1987; Duchesneau and Gratner, 1990; Rahim, 1996; Goebel and Frese, 1999; Ganesan et al., 2003); and (3) risk-taking propensity (Brockhaus and Horwitz, 1986; Hull, Bosley, and Udell, 1980; Timmons, Smollen, and Dingee, 1985). In this study we have selected two personality traits: task motivation and locus of control. Instead of selecting achievement motivation, here we have taken task motivation because task motivation theory may be considered as the alternative to achievement motivation theory (Miner, 1986). The original objective of task motivation theory is to recast achievement motivation into role motivation format. Moreover, along with four other role motive patterns (personal innovation, planning for the future, self achievement, feed back of results), this theory incorporates risk taking. Therefore, there is no need to study the variable "risk-taking" separately. Bellu (1988) and Miner, Smith and Bracker (1989) found that task motivation is higher in company founders than managers; even all five sub-scales were able to distinguish managers from company founders.

**Variables from Social Factor:** Effect of social factors on entrepreneurial performance is well investigated in entrepreneurship literature. Fairbain (1988) mentioned that the concept of the innovating entrepreneur is not always applicable in developing countries, where entrepreneurial activities depend mainly on applying, modifying and adapting existing knowledge, rather than making new discoveries. He further added that large, closely integrated families or kinship groups continue to persist in many developing countries which means that the focus should be on the family as the entrepreneurial unit rather than on the individual. Hisrich (1990) identified several factors for becoming an entrepreneur. These factors are: conditions that make entrepreneurship desirable and possible, childhood and family background, education level, personal values, motivation, role-modelling effect and other support systems. Different researchers showed the importance of the social network in entrepreneurial action and behaviour (Birley, 1985; Aldrich and Zimmer, 1986; Dubini and Aldrich, 1991; Greve and Salaff, 2003). Entrepreneurial intention models also consider some of the above stated factors under social categories. In this study, to incorporate the effect of childhood and family background, family support, and parental and cultural role, we define one indicator variable that we call "entrepreneurial status." This variable indicates whether the entrepreneur comes from a traditional entrepreneurial family or he/she is the first-generation entrepreneur. In India, traditional entrepreneurs have early exposure to entrepreneurial activities, as they grown up with a parental or cultural role-model of entrepreneurship. Integrated family relationships and

social networking help traditional entrepreneurs to continue their business. On the other hand, first-generation entrepreneurs do not get these kinds of support. Therefore, they start their business with their own initiatives and personal values.

**Variables from Cultural Factor:** Hofstede (1980) identified four dimensions of national culture: individualism/collectivism, power distance, uncertainty avoidance and materialism/ quality of life. Three of Hofstede's four dimensions (individualism/collectivism, uncertainty avoidance and materialism/ quality of life) have been linked theoretically and empirically to entrepreneurship and economic development. (see e.g., Hofstede, 1980; McGrath et al., 1992a, 1992b). In this study, we have considered individualism-collectivism because of the presence of significantly higher numbers of supportive literature for this concept as compared to the other two concepts (see e.g., Morris et al. 1993, 1994; Bhawuk et al., 1996; Johannisson and Monsted, 1997; Tiessen, 1997; Iyer and Shapiro, 1999; Chattopadhyay and Ghosh, 2002). Moreover, uncertainty avoidance is contaminated with the risk-taking attitude which we have already incorporated in task motivation. Besides these concepts, entrepreneurial intention models suggested the concept of "Confucian dynamism." This concept may have effect in South-east Asia or in China, but in Indian culture it is not applicable.

**Variables from Environmental Factor:** Entrepreneurial intention models pointed out some environmental factors like economic resources, political climate, lack of employment opportunities, etc. Considering Indian economic policies towards entrepreneurship, all entrepreneurs get equal opportunities to avail of government resources. In case of a traditional entrepreneur, as they enter into an already established business they automatically get economic resources. But in the case of first-generation entrepreneurs in the preliminary stage, economic resources are not so strong. Anyway, we have already incorporated this in the traditional/first-generation category in our study. As India is a democratic country, generally changes in the political situation occur every five years, and we have collected our data in a stable government and economic condition. Therefore, we may consider the political climate as a control variable in this study. We have questioned the entrepreneur regarding the reason for starting the entrepreneurial work to find that only a small proportion of entrepreneurs started the business because of less employment opportunities. For that reason, we have excluded the variable "lack of employment opportunities" from our study.

Finally, we have selected three variables from demographic and personal dimensions (age, gender and technical expertise), two variables from the personality trait dimension (task motivation and locus of control), one variable from the social dimension (entrepreneurial status) and one variable from the cultural dimension (individualism-collectivism) as the predictor variables for this study.

### Objectives of the Study

There are three basic objectives of this study:

- Development of a classification model to categorize the entrepreneur in different levels of economic success groups.
- Development of a prediction model to estimate the entrepreneurial economic success rate.
- Development of a generalized model to estimate the entrepreneurial economic success in heterogeneous market conditions.

## Methodology

### *Sample*

This study was conducted on registered small-scale entrepreneurs of West Bengal (one of the major states of India), aged between 21 and 60 years who had formal education at least up to 10+ level. All entrepreneurs had Indian nationality and their ethnic background was Hindu.

We used a two-stage random sampling scheme to choose the entrepreneurs for our study. At the first stage, we divided West Bengal into four zones—North, South, East and West. The northern zone consists of five districts (Maldah, West Dinajpur, Coochbihar, Jalpaiguri and Darjeeling), the southern zone consists of five districts (Howrah, Hughly, 24 Parganas (N), 24 Parganas (S), and Midnapur), the eastern zone consists of two districts (Murshidabad and Nadia) and the western zone consists of four districts (Purulia, Bankura, Bardwan and Birbhum). From each zone we selected one district randomly. In this way, we got Darjeeling from the northern zone, 24-Parganas (N) from the southern zone, Murshidabad from the eastern zone and Birbhum from the western zone.

In the second stage, we collected the total list of registered entrepreneurs from District Industries Center (DIC) of each randomly selected district. From these total lists, we selected 5% to 6% of entrepreneurs randomly from each district. In this way, we got 50 entrepreneurs from Darjeeling, 50 entrepreneurs from 24 Parganas (N), 55 entrepreneurs from Birbhum and 62 entrepreneurs from Murshidabad. Therefore, the total number of entrepreneurs from West Bengal was 217.

To fulfill the above stated objectives, it is very clear that a reasonable amount of data are needed for the development of the model and some independent data are also needed to test the validity of the developed model. For that reason, we divided our collected data into two independent parts consisting of 150 and 67 observations, respectively. The large part was used for the development of different models and the small part of the data was used to test the efficiency of the developed model. In this article, we refer to these two parts as the training set and the test set, respectively.

Additionally, to fulfill the third objective of the study, i.e. to handle the problem of different market conditions, we collected some data from two other geographical regions; one of them is Agartala (capital city of the state of Tripura) and the other one is Bangalore (capital city of the state of Karnataka). These two places were selected because of their totally different market conditions. Agartala is a hilly region on the northeastern side of India. People have to depend on air-route communication since land communication is almost impossible here. So, supply of raw material from other parts of the country is a costly affair. Entrepreneurs from this region have to depend only on the local market, and they hardly get the opportunity to spread their business widely. On the other hand, Bangalore is one of the mega-cities in India, where the entrepreneur gets all possible facilities for raw materials, communication, marketing and spreading business. Industries are well-developed in this place. For collecting the data from these two places, we have collected the name and contact addresses of all registered entrepreneurs from the office of small-scale industrial services of Agartala and Bangalore. From these lists, we have randomly selected 5% of the registered entrepreneurs from each of these two cities who have their business running. After contacting them personally, we found 48 entrepreneurs from Agartala and 36 from Bangalore were willing to participate in this study.

Data were collected personally from each and every entrepreneur through personal

interviews and standard questionnaires. Response rates of selected entrepreneurs were 100% in this study.

**Measures and Data Collection**

**Measures of Entrepreneurial Economic Success**

As has been mentioned before, the main goal of this study is to measure the potential of an individual for being a successful entrepreneur. Therefore, entrepreneurial success rate is our prime concern and that is the response variable for our study. Suppose  $P_0$  is the profit of an entrepreneurial organization at the initial year and after “t” years it becomes  $P_t$ , which is the current profit of the organization. Therefore, the average relative increment in profit (SP) can be expressed as

$$S_p = (P_t - P_0) / P_0 \times t.$$

But this measure is somewhat crude in nature, and it is unable to incorporate the change in the market condition that took place over these “t” years. To find a more realistic measure for the success rate, these changes in the market condition can be taken into consideration by using the wholesale price index number of the initial and the current year (wholesale price index numbers were taken from the statistical abstract published by Government of India). Suppose that  $I_0$  and  $I_t$  are these wholesale price index numbers, respectively. So, a profit of  $P_0$  in the initial year is equivalent to a profit of  $(P_0 \times I_t) / I_0$  in the current year. Therefore, the adjusted increment turns out to be  $P_t - (P_0 \times I_t) / I_0$ , and adjusted average relative increment  $S_p^*$  may be expressed as

$$S_p^* = \frac{P_t - (P_0 \times I_t) / I_0}{t(P_0 \times I_t) / I_0} = \frac{P_t / I_t - P_0 / I_0}{t \times P_0 / I_0} = \frac{P_t^* - P_0^*}{t \times P_0^*}$$

where  $P_0^* = P_0 / I_0$  and  $P_t^* = P_t / I_t$  can be viewed as the adjusted profit function for the initial and the final year, respectively. As a measure of success rate,  $S_p^*$  is more realistic as it incorporates the changes in the market condition. Here it should be noted that in spite of having more profit in the final year (as compared to that in the initial year), an entrepreneur could have a negative success rate if he/she fails to increase the profit at least at the rate with which the wholesale price increases.

To get information about the economic condition of the organization, one *Economic Information Schedule* was prepared. In this schedule, first of all we asked the subject about the year in which he/she started the business. Then we asked him/her about the amount of profit, turn-over and capital of the firm in the initial and the current year. We also asked about the number of employees in the first and the current year. Everybody gave the information by consulting their record books, which they have to produce for the government each and every year.

We calculated the success rate on the basis of profit. But the other information that we collected (amount of turn-over, capital, number of employees in the first and the current year) helped us in cross-checking the direction of success.

**Measures of Predictor Variables**

At first, one *Personal Information Schedule* was given to the entrepreneur. In this schedule, we collected information like age, gender, nationality, ethnic background, educational level, technical expertise, entrepreneurial status (traditional/first-generation), and managerial experiences. We also asked the entrepreneur to choose the reason for

starting the business from a set of given options: own inspiration/ family inspiration/lack of employment opportunities/other.

#### **Measures of Individualism-Collectivism Attitude**

To measure individualism-collectivism, we used a 16-item individualism-collectivism scale developed by Triandis and Gelfand (1998). This 16-item scale of Triandis and Gelfand covers horizontal and vertical individualism and collectivism [4 for each of Horizontal Individualism (HI) (Cronbach's  $\alpha = 0.67$ ), Vertical Individualism (VI) ( $\alpha = 0.74$ ), Horizontal Collectivism (HC) ( $\alpha = 0.74$ ) and Vertical Collectivism (VC) ( $\alpha = 0.68$ )]. Here, in this study, we have presented these 16 items with a 7-point summated rating scale. Therefore, the maximum possible score for individualism was 56 and the maximum possible score in collectivism was also 56. As this scale was never used in Indian culture, before administering it to our entrepreneur group we applied it on 100 undergraduate students. Split-half reliability coefficients were found to be 0.90 and 0.93 for individualism and collectivism respectively.

#### **Measures of Task Motivation**

For measuring task motivation, we used the Entrepreneurial Task Motivation Scale (Ghosh, 2002). This scale was basically developed from the Miner Sentence Completion Scale: Form T (1986). Miner's scale is semi-projective in nature and it has 40 items, whereas, the Entrepreneurial Task Motivation Scale is forced-choice in nature and it consists of 26 triads. The total score of this scale varies from 26 to 26. Odd-even reliability between the two parts of this scale was found to be 0.80. Cronbach's alpha for the total score was also found to be 0.75. The validity of the scale with different measures was found to be quite satisfactory.

#### **Measures of Locus of Control**

For measuring entrepreneurial locus of control, we used Rotter's Internal-External Locus of Control Scale (1966). This scale has 29 items; 23 items are directly related to the concept of locus of control, and 6 are unrelated filler items. Each item consists of a pair of statements: one statement of each pair is related to the external locus of control and the other is related to the internal locus of control. The subject is asked to indicate the statement within the pair that is more strongly believed or felt to be truer by him/herself. If the belief of the entrepreneur is related to the statement which reveals the external locus of control, then score "1" is given for that particular item; otherwise, if it is related to the internal locus of control, score "0" is given for that item. Therefore, the maximum possible score on this scale ranged between +23 and -23. So, it is apparent that high score on this scale indicates external locus of control and low score indicates internal locus of control. Reliability and validity of this scale was widely tested by different researchers. Anyway, before administering this scale to the entrepreneur, we administered it to a sample of 100 undergraduate students and the split-half reliability coefficient was found to be 0.89.

### **Results and Discussion**

#### ***Selection of significant covariates***

To study the effect of selected variables on entrepreneurial success, we have performed a one-way ANOVA, which is equivalent to a t-test in this case. In case of continuous variables (age, individualism, collectivism, task motivation, locus of control), we

**Table 1: ANOVA results for selecting the significant covariate**

	Calculated F value	Critical F value
Age	0.38	3.88 (0.05), 6.75 (0.01)
Gender	1.53	3.88 (0.05), 6.75 (0.01)
Technical Expertise	45.64**	3.88 (0.05), 6.75 (0.01)
Entrepreneurial Status	69.56**	3.88 (0.05), 6.75 (0.01)
Individualism	81.36**	3.88 (0.05), 6.75 (0.01)
Collectivism	48.19**	3.88 (0.05), 6.75 (0.01)
Task Motivation	79.84**	3.88 (0.05), 6.75 (0.01)
Locus of Control	70.40**	3.88 (0.05), 6.75 (0.01)

have split the score into two halves: at and above the median and below the median. Results are given in Table 1.

ANOVA results indicate that the variables entrepreneurial status, technical expertise, individualism, collectivism, task motivation and locus of control have a significant effect on entrepreneurial economic success. Therefore, we have considered these selected variables for the development of classification and prediction models. We did not find any effect of age and gender on entrepreneurial economic success. For that reason, we have excluded these two variables from our study.

**Classification of Entrepreneurs on the Basis of Their Economic Success**

Distribution of the entrepreneurial success rate ( $S_p^*$ ) shows an interesting pattern (see Figure 1). Both the density plot and the histogram suggest that the distribution of  $S_p^*$  is almost tri-modal in nature or, in other words, it can be viewed as a mixture of three different distributions. However, to estimate the exact number of components in this mixture, we ran a “k-means” clustering algorithm for different choices of k and plot the sum of within-cluster variations in Figure 2. In this figure, we observed a sharp fall in variation from k=2 to k=3, but after that it became almost flat. This clearly suggests that there are

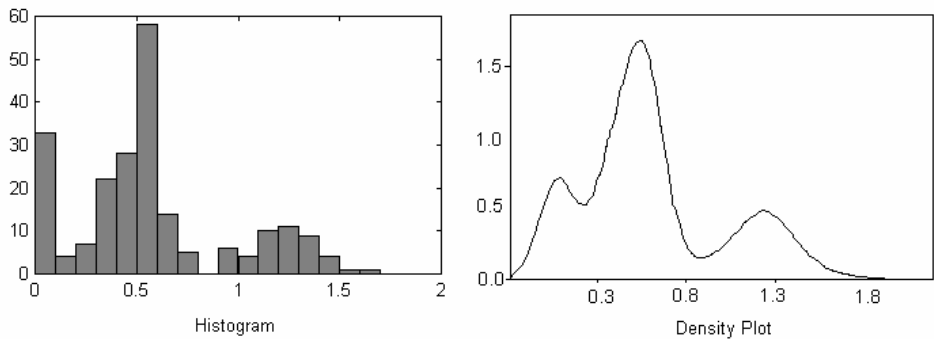


Figure 1. Histogram and density plot for success rate.

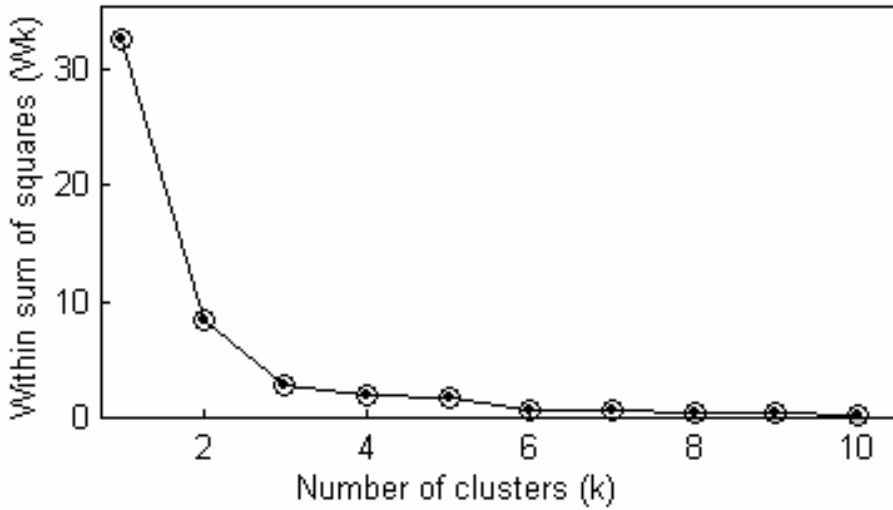


Figure 2. Plot for deviance measure for different k.

three components in the mixture. We also used the gap statistic (see e.g., Tibshirani, Walther and Hastie, 2001) to find the optimum value of k and it turned out to be 3. Therefore, it seems to be reasonable to categorize the entrepreneurs in three groups on the basis of their economic success rate. The entrepreneurs having a success rate of more than 0.84, can be considered as highly successful. On the other hand, entrepreneurs with  $S_p^* \leq 0.32$  can be considered to have low success while the entrepreneurs having the success rate between 0.32 and 0.84 can be termed as moderately successful. These cut-offs were selected on the basis of a 3-means clustering algorithm. For further analysis, we denote these high, moderate and low success groups as A, B and C, respectively.

**Development of Classification Model**

In an earlier section, we observed some socio-cultural and psychological variables to have significant effect on entrepreneurial success rate. Therefore, it might be possible to identify the success level (A, B or C) of an entrepreneur based on these variables.

In order to find it out, one may use some suitable classification algorithm. Since some of these measurement variables (entrepreneurial status and technical expertise) are dichotomous in nature, it is not quite reasonable to use the traditional linear or quadratic discriminant analysis (see e.g., Anderson, 1984), which are mainly motivated by the normality of the underlying distributions. In this case, one can use some non-parametric classification technique, which requires fewer assumptions. Here, we used a classification tree model (Breiman et. al., 1984) (statistical package S-Plus, 2000, was used for implementation), which is nonparametric in nature and at the same time is easy to visualize and interpret. The classification and regression tree (CART) is a recursive partitioning method that splits the sample space into several homogeneous regions for predicting the response variable, which could be categorical (for classification) or quantitative (for regression) in nature.

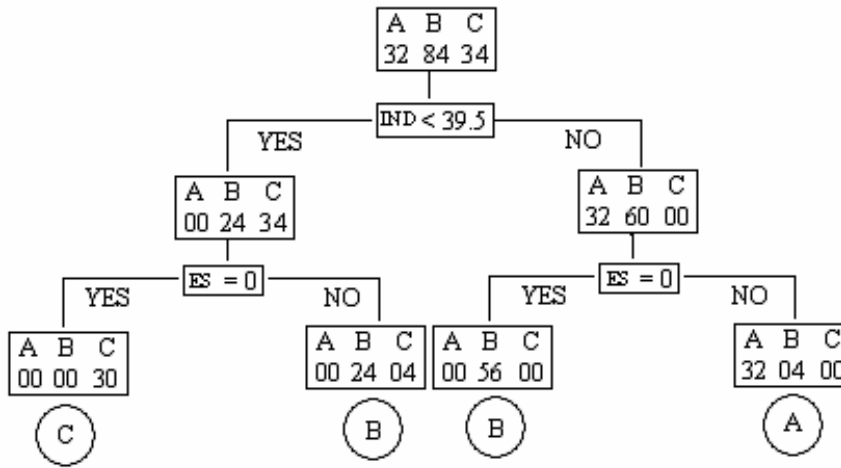


Figure 3. Classification tree for success rate. IND = Individualism Score; ES = Entrepreneurial Status.

**Explanation of Developed Classification Tree Model**

- First of all, 150 entrepreneurs (32 were originally from high-success group A, 84 from moderate-success group B, and the remaining 34 were from low- success group C) are separated according to their individualism score (X3). Entrepreneurs with individualism scores above 39.5 came under one group and the entrepreneurs with individualism scores below 39.5 came under the other group.
- Again, both these groups are subdivided on the basis of the entrepreneurial status (X1) (Traditional/First-generation) category.
- Finally, on the basis of the classification-tree model, entrepreneurs are categorized into three separate groups (A, B, C).
- Group A (high success) consists of traditional entrepreneurs with individualism scores at and above 39.5.
- Group C (low success) consists of first-generation entrepreneurs with individualism scores below 39.5.
- Group B (moderate success) shows a mixed nature. First-generation entrepreneurs with individualism scores above 39.5 and traditional entrepreneurs with individualism scores below 39.5 came under this category.

**Testing the Efficiency of the Developed Model on Test-Set Data (N=67)**

In this dataset, this simple tree model led to a very good classification. Only 8 out of 150 training sample observations (4 from each group B and C) were misclassified. Performance of this classification-tree model was even better on the test set. It correctly classified 65 out of 67 cases, which clearly shows the usefulness of this model in identifying potential of an entrepreneur.

**Development of Entrepreneurial Success Prediction Model**

Apart from classifying the entrepreneurs on the basis of their success rate, one may like to have estimates for their success rates as well. Linear regression is the simplest one

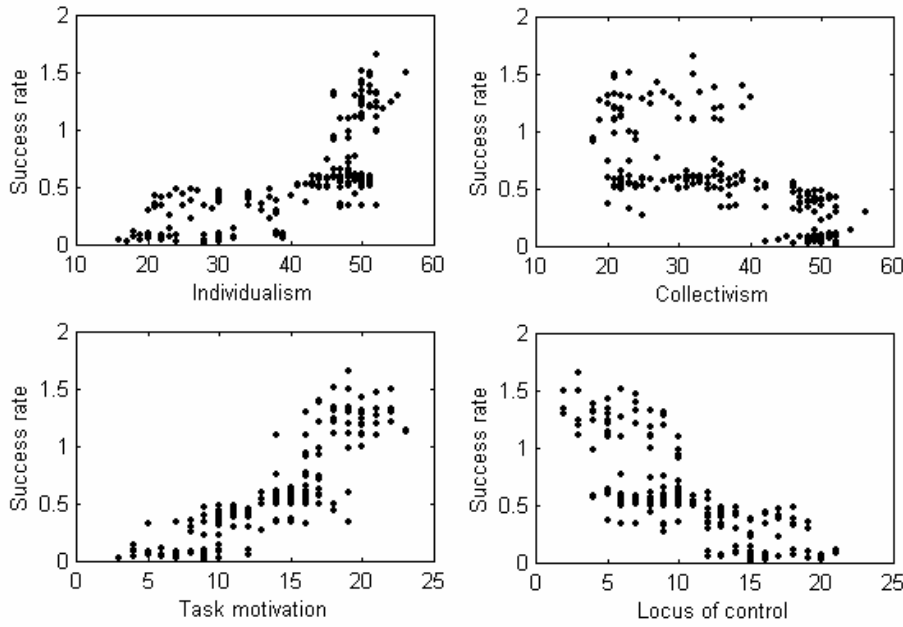


Figure 4. Scatter plot of success rate and other continuous covariates.

for this prediction. But in this dataset, success rate does not seem to be linearly related with the other continuous covariates (see Figure 4). Even after using Box-Cox and Box Tidwell transformations that include logistic regression (see e.g., Rawlings, Pantula and Dickey, 1984), we could not achieve desired linearity.

In this situation, one can use other nonparametric methods like local polynomials (see e.g., Fan and Gijbels, 1996) or splines (see e.g., de Boor, 1978). But these methods usually lead to some complicated regression surface, which are not very easy to interpret. On the other hand, this interpretation becomes much simpler if we adopt a regression-tree model (see e.g., Breiman et al., 1984). We have used the same training set to build up the regression tree and the same test-set observations were used to study its validity. For

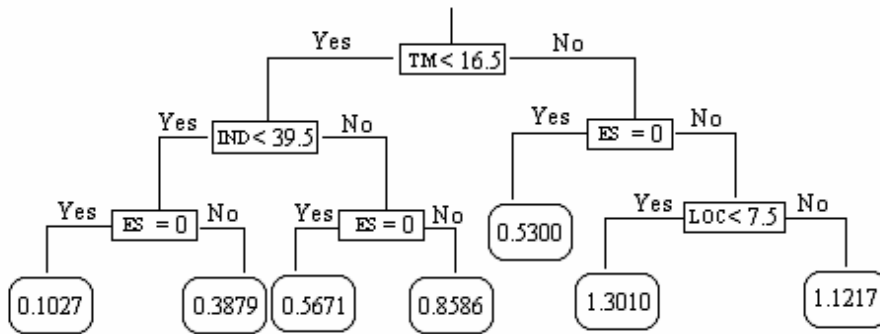


Figure 5. Regression tree for estimating success rate. TM = Task Motivation, IND = Individualism Score, ES = Entrepreneurial Status, LOC = Locus of Control.

regression, we obtained a relatively larger tree as the optimum one, where in addition to individualism score and entrepreneurial status, some other variables also appear in the final model.

#### **Explanation of Developed Regression-Tree Model**

- First of all, entrepreneurs are divided into two groups on the basis of the task motivation score. Entrepreneurs with task motivation scores above 16.5 form one group and the entrepreneurs with task motivation scores below 16.5 form the other group.
- Entrepreneurs who have task motivation scores above 16.5 are further subdivided into two groups, on the basis of their entrepreneurial status (traditional or first-generation). Average economic success rate of entrepreneurs within the first-generation category turns out to be 0.53. Traditional entrepreneurs are again subdivided on the basis of their locus of control score. Entrepreneurs with locus of control scores below 7.5 are found to have an average economic success rate of 1.3 and the entrepreneurs with locus of control scores above 7.5 are found to have an average economic success rate of 1.12.
- Entrepreneurs with task motivation scores below 16.5 are further subdivided into four categories on the basis of individualism scores (39.5) and entrepreneurial status (first-generation/traditional). Average economic success rates of these four groups are found to be 0.85 (for traditional entrepreneurs with individualism scores above 39.5), 0.57 (for first-generation entrepreneurs with individualism scores above 39.5), 0.38 (for traditional entrepreneur with individualism scores below 39.5) and 0.10 (for first-generation entrepreneur individualism scores below 39.5).

This model is easy to interpret as compared to the other nonparametric methods. Given the values of the related covariates, starting from the root node, one can easily proceed downward to predict the success rate without any further calculation. Moreover, this model has some other advantages in the case of missing values. For example, for a first-generation entrepreneur, if it is known that his/her task motivation score is more than 16.5 that is enough to predict his/her success rate (0.53). In this case, we do not need any other information on the other covariates, and that leads to some saving both in terms of time and cost. Similarly, for a traditional entrepreneur, if the task motivation score is known to be greater than 16.5, one can immediately get some idea about the success rate (1.12–1.30). Note that the traditional entrepreneurs are more successful than first-generation entrepreneurs. So, the results are in conformity with the classification results obtained earlier.

#### **Testing the Efficiency of the Developed Model on Test-Set Data (N=67)**

Applying this tree model, we got satisfactory results both in training and test samples which are presented in Figure 6. In both the plots, we observed a high degree of concentration around the 45° line, which indicates the efficiency of the tree model in predicting the entrepreneurial success rate. In the training set, the correlation coefficient between the observed and estimated success rate was found to be 0.964, which was even better (0.967) in the test set. The mean square errors in these two cases were observed as 0.011 and 0.009 respectively. The histogram of the residual values also shows a high degree of concentration around zero, indicating a good performance of the regression-tree model.

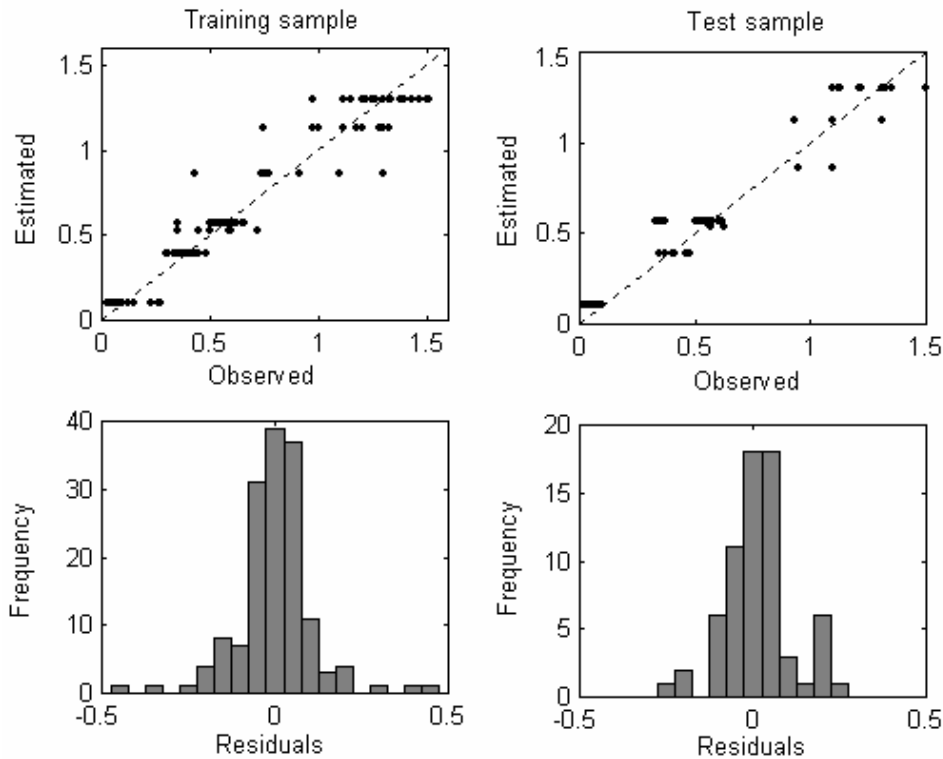


Figure 6. Estimated and observed success rate on the samples from West Bengal.

***Development of a Generalized Model of Entrepreneurial Success in Heterogeneous Market Condition***

The success rate of an entrepreneur also varies with the marketing facilities of different places. To study the effect of the market condition on entrepreneurial economic success, we have collected the data from Bangalore and Agartala.

It is quite clear that due to good marketing facilities in Bangalore, an entrepreneur with the same psychological and socio-cultural set-up as a person in Agartala is expected to achieve a relatively higher success rate. If we use the same regression-tree model that we have developed using the data from West Bengal to predict success rates, for the entrepreneurs from Agartala it leads to an overestimation, whereas for Bangalore in almost all cases estimated figures become much lower than the actual success rates. This is reflected in Figure 7, where most of the residuals are found to be negative for Agartala and positive for Bangalore data. The scatter plots also tell us the same story.

To develop a meaningful quantitative model for predicting entrepreneurial success in different market conditions, we defined another notion of success rate based on population quantiles. Note that instead of the actual value of the success rate  $S_p^*$ , sometimes it becomes more important to know the relative position of an entrepreneur in a market with respect to his success rates. Therefore, instead of predicting  $S_p^*$  one may look at the proportions of entrepreneurs in a certain place having a success rate less than  $S_p^*$ . This proportion (denoted by  $S_Q^*$ ) can be viewed as an alternative measure of success rate and

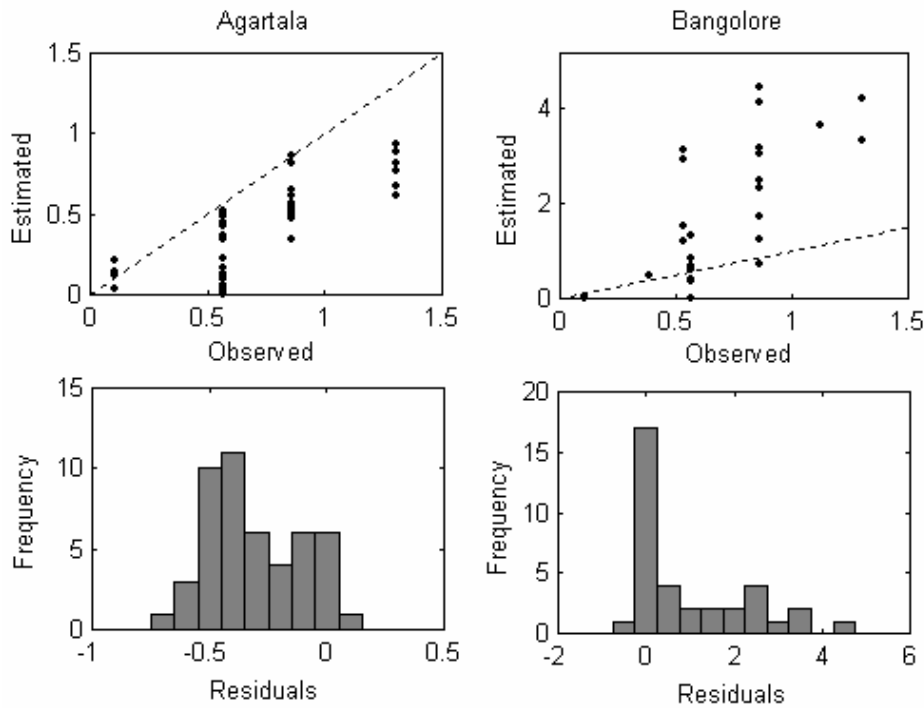


Figure 7. Estimated and observed success rate for Agartala and Bangalore.

we will refer to it as the success index. Notice that  $S_Q^*$  increases with  $S_P^*$ , and as a result both of them lead to the same ordering for the entrepreneurial potential. Moreover, one should note that unlike  $S_P^*$ , given that value of the covariates,  $S_Q^*$  remains more or less unaffected by the change in market conditions and therefore it is more acceptable as a measure of success to compare the positions of two entrepreneurs in two different market conditions.

Since  $S_Q^*$  is a function of  $S_P^*$ , the factors which have a significant effect on  $S_P^*$  may have a significant effect on  $S_Q^*$  as well. To estimate the success index  $S_Q^*$  of an entrepreneur, one may develop a regression-tree model as before. However, a regression tree estimates the response surface by piecewise constant function. As a result, often it becomes difficult to prefer one of two entrepreneurs on the basis of their estimated success. But in many cases, mainly due to limitation in economic resources, it becomes important for a funding agency to order the entrepreneurs on the basis of their entrepreneurial potential. Keeping that in mind, here we adopt a different strategy for estimating  $S_Q^*$ . To make our regression model simpler we choose entrepreneurial status and task motivation score as our predictor variables. From our previous analysis, it is quite transparent that entrepreneurial status plays a major role in entrepreneurial success. The other variable, task motivation, has been selected because of its higher sensitivity in predicting  $S_P^*$  by a regression-tree model as compared to that of the other continuous covariates. Of course, one can use other predictor variables or the full set of predictor variables for regression. However, for model parsimony, here we consider only task motivation and entrepreneurial status to estimate  $S_Q^*$ .

Our theoretical knowledge suggests that both  $SP^*$  and  $SQ^*$  monotonically increase with task motivation. Therefore the estimated function should be monotonic in nature. Now, we adopt a very simple technique to approximate this monotonic function by a piecewise linear curve. We fit two curves for success index, one for traditional entrepreneurs and the other for first-generation entrepreneurs. In order to fit these curves, we start from the data point having the lowest value for task motivation and then find the next value of task motivation, which has a higher value for success index. In this way, we get a sequence of data points and join them by pieces of straight lines. This line can be viewed as an upper bound for success index. Similarly, starting from the highest value of task motivation we can proceed backward to get a lower bound as well. The average of these two functions is considered as the fitted regression line, which is shown in Figure 8 below. Since the upper and lower bounds are sensitive to the presence of outliers, we remove them before finding the final fit. Instead of fitting the curves in this way, one can also adopt the local linear regression method (see e.g., Fan and Gijbels, 1996). Note that for large values of bandwidth, local linear regression gives a global linear fit, which is monotonic in nature. So, one can always ensure the monotonicity of the fitted function by increasing the bandwidth to a desired level. This method will give a smoother fit but at the cost of significantly higher computations.

Our fitted function worked well both for training and test data sets, which is quite evident from the plots in the top panel of Figure 9. Mean square errors were found to be 0.0092 and 0.0170 respectively for the training and the test data sets. Correlation coefficients between the estimated and observed success indices were also very high (0.9472 for

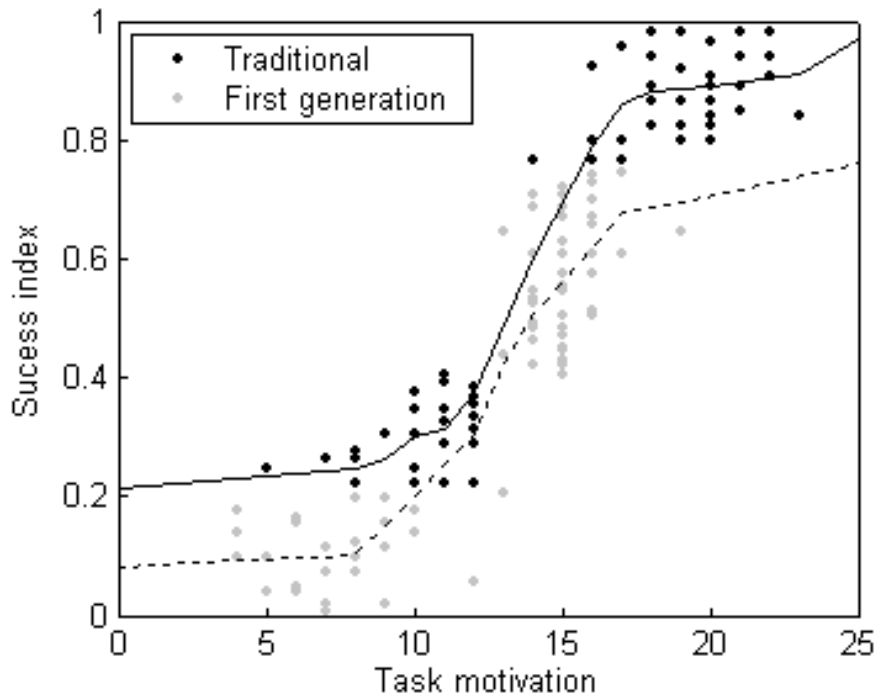


Figure 8. Estimation of success index based on task motivation and entrepreneurial status.

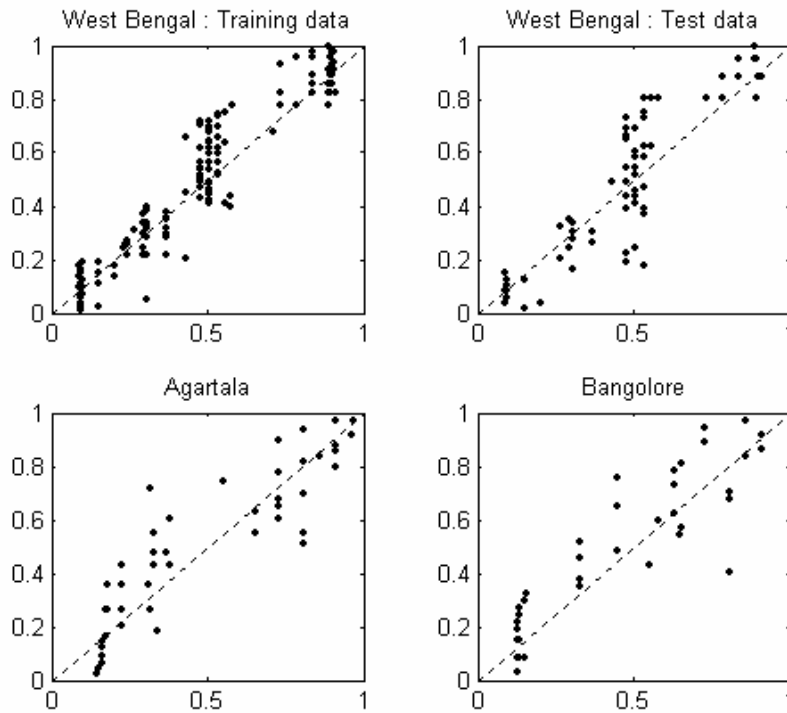


Figure 9. Estimated (X-axis) and observed (Y-axis) success indices for different places.

training and 0.8935 for test set). This new definition of success helped to figure out the successful entrepreneurs in other places. The same model, when used to predict the success indices of entrepreneurs in Agartala and Bangalore, yielded very good performance. The mean squares errors for these two cases were 0.0265 and 0.0297, whereas the correlation coefficients were found to be 0.8912 and 0.8882 respectively. Clearly, the results are more encouraging than that obtained using the tree model based on success rate  $S_p^*$ . The quantile-based definition of success index helped to develop a more general model for ranking the entrepreneurs in different market conditions.

### Concluding Remarks

Entrepreneurship makes a significant contribution to the economic development of a country. To explain entrepreneurial action and behavior, entrepreneurship researchers have already provided the evidence that no single discipline can explore the whole phenomenon of entrepreneurship. Therefore, multidisciplinary approaches have been introduced to study entrepreneurial behavior and action. Entrepreneurial intention models (see e.g., Bird, 1988; Boyd and Vozikis, 1994; Krueger and Brazeal, 1994) are among such multidisciplinary approaches to understanding entrepreneurial intention. Considering the theoretical idea of entrepreneurial intention models, here we have developed some quantitative models for entrepreneurial success. Instead of dealing with “entrepreneurial intention,” this study is directly related to “entrepreneurial success” which is one of the working aspects of entrepreneurial behavior. In that sense, this study is highly application-oriented.

In a developing country like India, where entrepreneurship is highly needed for the country's economic growth, the government introduced different policies to incline the general population towards entrepreneurship. Here, it should be noted that not every individual is capable of performing successfully as an entrepreneur. Therefore, it is extremely important to identify the individuals who have real entrepreneurial potential; otherwise selection of an inappropriate person for entrepreneurship will be detrimental for the economic growth of the country.

The models we have developed in this study may be helpful for the financiers who usually provide different supports to the entrepreneur and are always interested in knowing whether an entrepreneur has the potential to run the business or not. Before giving any financial or other supports, the use of these models may help to prevent wrong selection and wrong investment, which in turn will lead to the healthy economic growth of a country. The use and interpretation of these proposed models is very easy; the investigator does not have to utilize complicated calculations.

No research is without limitations. First of all, this study was conducted completely in an Indian setting; therefore it is necessary to test the efficiency of these models in different cultural settings as well. Secondly, in this study, the sample sizes from two different market conditions (Agartala and Bangalore) were quite small. So, the generalized model that we have developed to deal with heterogeneous market conditions needs to be tested on moderately large samples from different market conditions. Note that we have used only one continuous variable task motivation to develop this model. Inclusion of other predictor variables or some other modifications of this model may be helpful for its application. We encourage entrepreneurship researchers of different cultures to use this model in different market settings, so that possible modifications may be achieved.

Despite these weaknesses, this study is the first comprehensive quantitative approach to identify potential entrepreneurs. Though the interdisciplinary studies (Gartner, 1985; Bird, 1988; Greenberger and Sexton, 1988; Herron and Sapienza, 1992; Learned, 1992; Boyd and Vozikis, 1994; Krueger and Brazeal, 1994) on entrepreneurship provide us the theoretical knowledge of entrepreneurial behavior and action, still these studies were not able to establish any quantitative criteria through which one can differentiate between entrepreneurs and non-entrepreneurs. The models which we have developed in this article can classify the entrepreneurs in different success categories, and they are also able to estimate the actual success of an entrepreneur. In addition, we have provided a technique to deal with different market conditions. This study may give entrepreneurship research a new platform and more scientific precision.

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