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The optimal model of employment and entrepreneurship models in colleges and universities based on probability theory and statistics

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Abstract

The paper relies on the practice process of entrepreneurship education in colleges and universities to carry out research. It summarizes the optimal models suitable for students' employment and entrepreneurship based on statistical analysis using the probability theory. We built a pyramid structured model of college students' entrepreneurial ability based on this model. The thesis uses statistical methods to carry out a factor analysis of various abilities. It provides a basis for the adjustment and implementation of employment-oriented entrepreneurship education models in colleges and universities.

Keywords: college students, probability theory and statistics, entrepreneurial ability, entrepreneurial model, model construction.

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1 Introduction

The entrepreneurial ability of college students is an extension of the entrepreneurial ability among college students. The understanding of the entrepreneurial ability of college students also starts from the understanding of entrepreneurial ability. Entrepreneurship is a very complex concept. Based on different research perspectives, the concept and connotation of entrepreneurial ability are different [1]. Based on the relationship between entrepreneurial ability and management ability, entrepreneurial ability can be divided into the broad and narrow types.

Entrepreneurship ability should be distinguished from management ability. Entrepreneurship ability has its specific meaning. Some scholars believe that entrepreneurial ability is needed to start a company, while

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management ability is needed to develop a company [2]. Although entrepreneurial ability requires the above two aspects of ability, it is still necessary to distinguish between entrepreneurial ability and management ability. The entrepreneurial ability of scholars refers to the ability of people to discover and capture business opportunities under certain conditions, combine various resources and create excellent value. Some scholars believe that entrepreneurial ability is mainly embodied in exploration of opportunities and the ability to integrate and utilize resources. The combined effects of the two constitute entrepreneurial ability.

Entrepreneurship ability is a diversified and comprehensive ability, closely linked with management ability. Even management ability is an aspect of entrepreneurial ability [3]. Some scholars believe that entrepreneurial ability is a comprehensive ability related to social occupations and a comprehensive ability closely related to people's careers and occupations. Entrepreneurship ability is the comprehensive reflection of a person's survival competitiveness in social life. These views do not make a clear distinction between entrepreneurial ability and management ability.

As for the entrepreneurial ability of college students, there is no universally recognized concept. Most of the existing studies consider the connotation of entrepreneurship training education and entrepreneurial ability in universities to be the first entrepreneurial ability of college students after leaving school [4]. We believe that the entrepreneurial ability of college students refers to the comprehensive ability that college students combine with their characteristics and are formed through cultivation by family, school, society, etc., which are necessary for the success of their first entrepreneurship.

2 Construction of the model of college students' entrepreneurial ability based on probability theory and statistics

2.1 Nonprobability interval analysis method

We assume that the uncertain parameter matrix $B = (b_{ij})$ is an interval matrix, and the mean matrix or midpoint matrix of the uncertain parameter matrix is as follows:

$$\begin{aligned} B_c &= (b_{ij,c}) = m(B) = \frac{(B+B)}{2} \\ b_{ij,c} &= \frac{(b_{ij}+b_{ij})}{2} (i, j = 1, 2, \dots, n) \end{aligned} \quad (1)$$

The deviation magnitude matrix or uncertainty matrix of the uncertainty parameter matrix is defined as follows:

$$\begin{aligned} \Delta B &= (\Delta b_{ij}) = \frac{(B+B)}{2}, \\ \Delta b_{ij} &= \frac{(b_{ij}-b_{ij})}{2} (i, j = 1, 2, \dots, m) \end{aligned} \quad (2)$$

According to interval mathematics, the uncertainty parameter matrix B is expressed as follows:

$$B = B_c + \delta B, |\delta B| \leq \Delta B \quad (3)$$

We carry out the first-order Taylor series expansion of the eigenvalue at B_c ,

$$\lambda_j(B) = \lambda_j(B_c + \delta B) = \lambda_j(B_c) + \sum_{j=1}^m \frac{\partial \lambda_j(B_c)}{\partial b_{ij}} \delta b_{ij} \quad (4)$$

$$\delta b_{ij} \in \Delta b_{ij,l} = [-\Delta b_{ij}, \Delta b_{ij}] (i, j = 1, 2, \dots, m) \quad (5)$$

It can be obtained from the natural expansion of the interval that

$$\lambda_j^l(B) = \lambda_j(B_c + \delta B) = \lambda_j(B_c) + \sum_{i=1}^m \frac{\partial \lambda_j(B_c)}{\partial b_{ij}} \delta b_{ij,l} (j = 1, 2, \dots, n) \quad (6)$$

The upper and lower bounds of the eigenvalue interval can be obtained by interval operation:

$$\begin{aligned}\lambda_j(B) &= \lambda_j(B_c) + \sum_{i=1}^m \left| \frac{\partial \lambda_j(B_c)}{\partial b_{ij}} \right| \Delta b_{ij} = \lambda_j(B_c) + \left| \frac{\partial \lambda_j(B_c)}{\partial (csB)^T} \right| \Delta(csB) \quad (j = 1, 2, \dots, n) \\ \lambda_j(B) &= \lambda_j(B_c) - \sum_{i=1}^m \left| \frac{\partial \lambda_j(B_c)}{\partial b_{ij}} \right| \Delta b_{ij} = \lambda_j(B_c) - \left| \frac{\partial \lambda_j(B_c)}{\partial (csB)^T} \right| \Delta(csB) \quad (j = 1, 2, \dots, n)\end{aligned}\quad (7)$$

where $\frac{\partial \lambda_j}{\partial B}$ is the eigenvalue sensitivity matrix.

2.2 Perturbation method based on probability theory

According to the nature of mean value calculation, the mean value λ_{i0} of the eigenvalue is obtained, and the i th eigenvalue and eigenvector can be expressed as follows:

$$\lambda_i = \lambda_{i0} + \Delta \lambda_i \quad (i = 1, 2, \dots, n) \quad (8)$$

We expand the first-order Taylor series of λ_i near csB_c and combine it with the properties of variance calculation to get

$$\text{var}[\lambda_i] = E[(\Delta \lambda_i)^2] = \left[\frac{\partial \lambda_i}{\partial (csB)^T} \right]^2 \text{var}(csB) \quad (9)$$

Here, $\text{var}(csB) = (\xi \mu_B)^2$. We combine the sensitivity matrix of the eigenvalues to obtain the first-order approximation of the variance of the eigenvalues. The mean and variance of the feature vector can also be calculated accordingly. Figure 1 shows the flow of the perturbation method of probability theory [5]. We write the mean and variance of the eigenvalues obtained by the probability method in interval form, and the result is shown in the following formula:

$$\begin{aligned}\bar{\lambda}_j(B) &= E(\lambda_j) + k\sigma_{\lambda_j} = \mu_{\lambda_j} + k\sqrt{\text{var}(\lambda_j)} = \mu_{\lambda_j} + k\xi \sqrt{\sum_{i=1}^m \left(\frac{\partial \lambda_j}{\partial b_{ij}} \right)^2} \quad (j = 1, 2, \dots, n) \\ \lambda_j(B) &= E(\lambda_j) - k\sigma_{\lambda_j} = \mu_{\lambda_j} - k\sqrt{\text{var}(\lambda_j)} = \mu_{\lambda_j} - k\xi \sqrt{\sum_{i=1}^m \left(\frac{\partial \lambda_j}{\partial b_{ij}} \right)^2} \quad (j = 1, 2, \dots, n)\end{aligned}\quad (10)$$

Fig. 1 The flow of the perturbation method of probability theory.

We introduce the coefficient of variance $\xi = \frac{\sqrt{\text{var}(B)}}{E(B)}$ and combine $\bar{B} = B_c + k\sigma_B$, $B = B_c - k\sigma_B$ (where k is a constant coefficient) and interval mathematics to get

$$\Delta b_{ij} = k\sigma_{b_{ij}} = k\xi \mu_{b_{ij}} \quad (11)$$

We substitute the sensitivity matrix and the variance expression into Eq. (7) to obtain the upper and lower bounds of the nonprobability interval analysis eigenvalue interval.

$$\begin{aligned}\lambda_j(B) &= \lambda_j(B_c) + \sum_{i=1}^m \left| \frac{\partial \lambda_j(B_c)}{\partial b_{ij}} \right| k \xi \mu_{bij} (j = 1, 2, \dots, n) \\ \lambda_j(B) &= \lambda_j(B_c) - \sum_{i=1}^m \left| \frac{\partial \lambda_j(B_c)}{\partial b_{ij}} \right| k \xi \mu_{bij} (j = 1, 2, \dots, n)\end{aligned}\quad (12)$$

2.3 Construction of the model for college students' entrepreneurial ability

This article attempts to construct a more comprehensive model of the entrepreneurial ability of college students based on the research of domestic and foreign scholars on the entrepreneurial ability models and the connotation and characteristics of college students' entrepreneurial ability [6]. According to the statistical analysis of the entrepreneurial ability model, we summarize entrepreneurial ability into six dimensions of ability: self-efficacy, knowledge and professional skills, learning and innovation ability, opportunity recognition ability, interpersonal relationship ability, and organization and management ability. The frequency statistics of these capacity dimensions in the above research results are shown in Table 1.

Table 1 Frequency statistics of dimensions of entrepreneurship ability

Entrepreneurship dimension	Frequency of occurrence
6 Organization and management capabilities	16/19
5 Interpersonal skills	13/19
4 Opportunity recognition ability	10/19
3 Learning and innovation ability	12/19
2 Knowledge and professional skills	9/19
1 Self-efficacy	9/19

Based on the above engineering research, we construct a college students' entrepreneurial ability model, as shown in Figure 2. The model is a pyramid-structured capability model. The lower the level of competence, the more basic and extensive it is. This is a necessary condition for college students to succeed in starting a business [7]. On the other hand, the higher-level ability elements are the comprehensive abilities needed by college students to succeed in entrepreneurship. Their ability elements tend to be specialized, unique, and practical. This is the decisive factor that determines the level of entrepreneurial achievement of college students. It is also an important distinction between the levels of entrepreneurial ability of different college students.

3 Explanation of the model of college students' entrepreneurial ability

The entrepreneurial ability model of college students constructed in this article mainly includes six levels of ability: self-efficacy, knowledge and professional skills, learning and innovation ability, opportunity recognition ability, interpersonal relationship ability, and organization and management ability.

3.1 Self-efficacy

Self-efficacy is an essential component in the structural model of college students' entrepreneurial ability. It reflects an individual's ability to work or deal with problems and is an individual's judgment on self-ability and beliefs. Personal effectiveness is mainly composed of five abilities: self-management ability, adaptability, commitment ability, self-motivation, and breakthrough ability.

Self-management ability is also called self-control ability. It refers to the individual's ability to control negative emotions and actions and remain calm in the face of frustration, pressure, and temptation. Some

Fig. 2 Conceptual model of college students' entrepreneurial ability.

scholars put forward the terms self-control and willpower [8]. Emotional control ability and frustration resistance ability belong to the category of self-management ability.

Self-adaptability refers to the adaptability and flexibility that an individual exhibits when working with different people or groups in different environments. It includes specific abilities such as stress resistance and emotional control. Self-adaptability is necessary for college students in the process of entrepreneurship. It helps college students change their ways of doing things according to actual conditions and quickly adapt to changes in the environment.

Entrepreneurship quality refers to a person's ability and willingness to adjust individual behavior to conform to the organization's needs and goals, act according to the organization's needs, and assist the organization in achieving its goals. It includes specific abilities such as commitment ability, self-motivation, and self-breakthrough. Some scholars believe that commitment ability is necessary for entrepreneurial ability, and it is also a manifestation of excellent entrepreneurial quality.

In addition, college students will inevitably encounter many difficulties in the process of starting a business. Therefore, they must have the ability for self-motivation and breakthrough, with firm entrepreneurial beliefs, be positive, dare to take risks, and – through the continuous overcoming of difficulties and self-improvement – successfully start a business.

3.2 Knowledge and professional skills

Entrepreneurship knowledge and professional skills are necessary conditions for entrepreneurs. It includes specific abilities such as knowledgeability and professional technical ability.

Knowledgeability is an important indicator reflecting the efficiency of knowledge absorption and transformation. Its meaning refers to synthesizing various abilities with knowledge as the core possessed by the knowledge holder. Some scholars believe that college students should have a 'T' knowledge structure in entrepreneurship [9]. Some scholars believe that the knowledge element system necessary for college students to start a business should be based on finance, business, law, marketing, marketing management, finance, taxation, business establishment procedures, and macroeconomic policies. This is the social knowledge formed by entrepreneurial ability. Basically, in addition, students must have the necessary knowledge of natural sciences.

Professional technical ability refers to mastering the profession-related knowledge, being proficient in the

industry's business, and having specialized skills, as well as engaging experienced workers. It is the skill that people must possess to engage in a particular social occupation. Entrepreneurs should pay attention to accumulating professional and technical experience and undergoing vocational skills training in the process of starting a business.

3.3 Learning and innovation ability

Learning and innovation ability is a comprehensive ability, including learning ability and innovation ability.

Learning ability refers to the ability to actively learn and change one's behavior from past experiences and critical events of oneself or others. It consists of limited learning ability, conceptual ability, and analytical ability (logical thinking ability), as well as the ability to reflect on and solve problems. Concept and analysis ability is the ability to look at the overall situation, recognize the development of things, and grasp the direction of progress [10]. Entrepreneurs can perceive the interaction between the enterprise and the environment. Concepts and analytical skills help college students to simplify the complex situation in the entrepreneurial process, extract and abstract a lot of trivial information, and make objective decisions by weighing different options, thereby leading the development direction of the enterprise. Introspection and problem-solving ability can check one's errors, sum up experience, and obtain solutions to problems from it. Entrepreneurship is a process of constant exploration. Undergraduate entrepreneurs must constantly conduct self-reflection, learn from failures, and summarize successful experiences. Through comparative research, some scholars have found that entrepreneurs and college teachers place more emphasis on learning ability than college students. It can be seen that college students have not yet realized the importance of learning ability. The importance and cultivation of the learning ability of college students must be strengthened [11]. An enterprise needs to continuously develop and innovate to continue to develop and remain invincible. Entrepreneurship itself is the beginning of innovation, so the ability to innovate is essential for entrepreneurs. Some scholars have proved through empirical evidence that the innovation ability of entrepreneurs has a strong positive correlation with the growth of enterprises. New ventures must grow and develop new products, all of which require entrepreneurs to have the ability to innovate.

3.4 Opportunity recognition ability

Entrepreneurship opportunities refer to the existence and perception of opportunities available in the market. Opportunity is a necessary condition for starting a business, but this alone is not enough. Entrepreneurs must have the necessary abilities (motivation and skills) to create a new business.

Some scholars believe that identifying opportunities refers to the ability to discover potential market opportunities and make objective assessments. However, we believe that the ability to identify opportunities is the ability to discover opportunities and the ability to grasp opportunities [12]. In other words, the ability to identify opportunities refers to the ability to objectively analyze the surrounding environment and various types of information, explore potential market opportunities, and transform potential opportunities into reality.

Some scholars decompose the ability to identify and develop opportunities to identify viable niche markets, develop products and services suitable for selected niche markets, generate ideas, conduct environmental observations, identify and conceive how to use opportunities, and develop relevant strategies. We believe that information analysis is the most important manifestation of the ability to identify and develop opportunities. Some scholars have found through research that there is a significant positive correlation between the entrepreneur's ability to identify opportunities and the growth of enterprises. Recognizing and using opportunities is the central concept of entrepreneurship, which distinguishes entrepreneurship from management.

3.5 Interpersonal relationship ability

Interpersonal relationships can have a rich social network, facilitating communication with people and handling of the interaction between people and between individuals and organizations. Establishing good interpersonal relationships is the essential ability of people to maintain interpersonal relationships and maintain survival

in daily life. Unlike the ability of learning and innovation, interpersonal relationship ability is different from abstract thinking ability [13]. It has a strong practicality and tends to be more concrete.

Some scholars have pointed out – by comparing the entrepreneurial ability reflected by entrepreneurs at home and abroad – that the relationship ability is affected by the entrepreneur's personality, behavior, attitude, and cultural background. Although relationship skills are capabilities that domestic and foreign entrepreneurs possess, domestic entrepreneurs are more inclined to use their interpersonal networks. From the perspective of Chinese social and cultural traditions and college students, interpersonal skills are essential for college entrepreneurs, including interpersonal relationship-processing skills, expression skills (written and oral expression skills), and communication skills.

Entrepreneurs must communicate with investors, government departments, customers, and consumers during the entire process of starting a business. Whether it is oral interviews or providing written documents, such as business plans or other corporate announcements, they need good language skills. Some scholars conducted a questionnaire survey of 100 significant entrepreneurs and the chief executive officers (CEOs) of the fastest-growing startups in the United States and found that written and oral expression skills are more critical to these successful entrepreneurs.

3.6 Organization and management ability

Organization and management ability is a comprehensive entrepreneurial ability. It contains many specific skills, such as organization ability, management ability, team-building ability, marketing ability, operation management ability, resource integration ability, etc. Therefore, we can divide these skills into two categories: broad organizational skills and management skills.

Organizational capabilities include organizational capabilities and resource integration capabilities in a narrow sense. Organizational ability in a narrow sense refers to the internal and external resources (human, financial, material, and technical resources) of the organization and includes team building, leadership of subordinates, training, and monitoring skills. Many scholars believe that organizational ability is an integral part of entrepreneurial ability, which is of great significance to the entrepreneurial activities of college student entrepreneurs. Resource integration ability refers to the ability to acquire and organize various required resources [14]. Entrepreneurs always engage in entrepreneurial activities when resources are scarce at the beginning of their business. They must borrow external forces and use their resources to integrate the resources of others to achieve the effect of $1 + 1 > 2$. Thus, the cultivation of the ability to integrate resources is an important component of entrepreneurial ability. Through empirical research, some scholars have found that college teachers, entrepreneurial entrepreneurs, and college students themselves believe that organizational management capabilities and resource integration capabilities are important components of entrepreneurial capabilities.

Management capabilities include management capabilities, leadership capabilities, decision-making capabilities, marketing capabilities, business and management capabilities, and many other specific skills. Some empirical studies have found that management ability plays an essential role in college students' entrepreneurship: leadership communication ability is the most influential ability on entrepreneurship; Li Fanning found that college students pay more attention to cultivating their leadership inspiring ability. Some scholars have found that most entrepreneurs in the United States believe that leadership is the most critical entrepreneurial ability. Foreign entrepreneurs pay more attention to organizational ability than domestic entrepreneurs and tend to manage organizations. It shows that domestic college student entrepreneurs need to strengthen their organization and management awareness.

4 Conclusion

This research is a statistical model of the probability theory of the structure of the entrepreneurial ability of college students, summarized based on the elements of entrepreneurial ability recognized by most researchers.

Some of these capability elements have received empirical support, while others are theoretical and speculative. A series of external environmental factors restrict the success of entrepreneurship. Different industries have different requirements for entrepreneurial capabilities. In certain circumstances, specific capabilities are more critical than others.

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