
Original Research Article

Analysis of innovation in the path of computer science based on business administration in the era of big data

In the process of enterprise management, there are some problems such as poor accuracy and long selection time of computer science innovation path, which seriously affect the effective selection of computer science path innovation. Based on a big data mining method, this paper analyzes the path innovation of computer science from three dimensions, constructs the path set of path innovation by least dichotomy, and obtains the optimal innovation path by derivation. Then, the maximum likelihood theory is used to calculate the innovation path and compared it with the previous path innovation methods, comparing the accuracy and calculation time of different innovation paths. MATLAB simulation results show that the big data mining method can improve the accuracy and comprehensiveness of innovation path selection, reaching more than 90%, and control the selection time of the innovation path within 25 seconds, and the overall result is better than the previous path innovation methods. Therefore, the big data mining method can improve the accuracy of computer science innovation path selection and meet the needs of computer science path innovation in business administration. However, in the research of big data mining methods, this paper ignores the analysis of multi-path innovation, which leads to insufficient research depth. In the future, it will further analyze multi-path innovation.

Keywords: multi-specialty; big data; Computer science; Business Administration; Innovation path

1. Introduction

With the deepening of the development of business administration, the scope of the application of computers in this field is also expanding[1]. However, the situation of business administration is more complicated, involving many fields, computers cannot effectively integrate with business administration and lack innovation[2]. The key to the analysis of the innovation path of business administration is to find innovative points, reduce non-innovative content, and find the key points of computer applications[3]. Starting from the actual situation of business administration, the big data mining method uses data mining methods to carry out the innovative content of business administration and simplify the innovation process. Literature research shows that the big data mining method conducts a multi-professional analysis of business administration content[4], the depth of analysis is greater than 90%, the analysis results are relatively stable, and the cultural industry management is not affected by uncertainties. Some scholars believe that the big data mining method can continuously analyze business administration[5], quickly innovate the application points of computers, and accurately find the innovation path of business administration. Some scholars believe that big data mining can comprehensively analyze business administration

data, innovate the key innovation scope through feature analysis, and choose a more reasonable innovation path. Some scholars believe that under comprehensive data[6], the big data mining method can reduce the complexity of analyzing data in business administration, combine the advantages of computer science, and find out the innovation path[7]. Based on this, to improve the accuracy of computer science path innovation scheme selection and shorten the selection time, this paper starts from the fields of business administration and computer science, carries out big data mining on scientific path innovation scheme, and calculates it by a least square method. The main contents can be summarized as follows: (1) Explain the advantages of data mining, including business administration professional integration, computer content optimization, etc., to lay the foundation for later analysis.(2) Mining the contents of business administration and computer, forming a collection of optimization schemes of computer science path, and carrying out the calculation of least square method. (3) Compared with previous algorithms, verify the advantages of big data mining algorithm in scheme selection accuracy and selection time, and analyze the internal reasons. However, there are some deficiencies in this study, mainly reflected in the business administration involving more specialties, the rapid development of computer science, the need for a large number of sample data to support, and the sample provided in this paper is relatively small, which affects the accuracy of the research results to a certain extent.

2. Description of the innovation path of business administration

2.1 The selection of innovation paths

The innovation path selection is to innovate business administration indicators under different majors, such as marketing, financial management, human resource management, property management[8], and cultural industry management. To obtain the corresponding combination point from computer science, it is necessary to set the degree of innovation and innovation direction, eliminate the management content that does not meet the requirements, and enlarge the combination point of computer and business administration[9]. Big data processing methods to track arbitrary innovation directions increase the workload of business administration innovation, occupy a lot of system resources, and cannot accurately select innovation paths. At the same time, factors such as discipline development, professional integration, and the international environment will increase the difficulty of choosing an innovation path[10], so more accurate calculation methods are needed. To better study the path innovation of computer science in business administration, we should use the research method of big data to analyze the path innovation and show the content and process of path innovation in the form of mathematical formulas. The following is a mathematical description of the path innovation process, as follows.

The definition of data mining in business administration: Business administration situation is $I^T = (s_1, \dots, s_n | t_i)$, the content involved is I_i , and the constraint of each content is M_i , the innovation path selection function $W(I_i, s_n | \sum M_i \cdot t)$ of business administration.

The definition of the scientific path in computer science: The scale amplification of the innovation path is $\frac{d_i}{\sum d}$, and the innovation amplification function is $L(d_i)$. The degree of magnification represents the importance of the innovation path, as shown in equation (1).

$$L(d_i) = w \cdot \max\{L(I \cup t)\}_i \quad (1)$$

where is the w adjustment factor for scale amplification?

The Constraints of Path Innovation in Computer Science: The field involved in business administration is ξ_i , and the constraint of the direction of innovation is θ . At this point, d_i is calculated as shown in equation (2).

$$\max(d_i) = \sin \theta \cdot \frac{(I_i, s_n | \sum t)}{\lambda \cap \sum \xi_i} \quad (2)$$

Among them, is the multi-speciality where the innovation path is located, and this coefficient is λ , the characteristic of judging the degree of innovation in business administration.

The choice of path innovation in computer science: The number of contents involved in business administration is n , and the processing functions of different majors is $L(d_i)$ [15], x_i, y_i representing the enlargement and reduction of the business administration innovation path, then business administration is the judicial function of the innovation path is shown in equation (3).

$$L(d_i) = rand(0,1) \cdot W \left(\frac{I_i, s_n}{D_i} | \lambda \cdot t \right) \quad (3)$$

where s_n , is the business administration situation [16], the content indicators involved, and I_i the $rand(0,1)$ random selection function of the path.

2.2 Mathematical description of big data mining method

2.2.1 Big data mining method

The big data mining method mainly analyzes the application of computer science and business administration, including innovation direction [11], development degree, integration, etc., to realize a multi-professional analysis of path innovation. Different business administrations have different indicators of innovation options [12]. Firstly, according to the innovation path involved in business administration, the fit degree of computer and business administration is judged, and the corresponding innovation path is calculated [13]. Then, the innovation path is processed by continuous amplification and given the corresponding innovation direction [8]; Finally, the

amplification value that does not conform to the degree of innovation is abandoned, and the innovation direction of other majors is analyzed to achieve a comprehensive analysis of multiple specialities[14]. The application of computer science and business administration are cross-analyzed, and under constraints[17], the degree of innovation in business administration is calculated, the function of which is shown in equation (4).

$$L(d_i) = w \cdot \sum W\left(\frac{I_i \cdot S_n}{\sqrt{D_i}} \mid \lambda \cdot t\right) \quad (4)$$

Among them $I_i \in [0, n]$.

2.2.2 Adjustment of business administration innovation path

In the stage of understanding the situation of business administration innovation, if the relevant data is not standardized, the analysis results may have large errors, which will reduce the accuracy of selecting the business administration innovation path. In the analysis process of different majors in business administration[18], it is necessary to expand the scope of majors as much as possible, make comprehensive judgments on the enlarged innovation direction, and constantly adjust the accuracy of path selection. Among them, a coordination factor V needs to be set between the professional range and the accuracy of judgment, and the calculation of this factor is shown in equation (5).

$$v_i = w \cdot \sum f(k_i) \quad (5)$$

Under the transformation of path direction and innovation depth, the final calculation result can be obtained, as shown in equation (6).

$$\Delta L(d_i) = p_i \cdot W\left(\frac{I_i \cdot S_n}{\sqrt{D_i} \cdot t}\right) \quad (6)$$

In summary, in the early stage of understanding the situation of business administration innovation, the value V is constantly expanding to expand the scope of the judgment. The later stage of understanding the innovation situation of business management V is relatively small to strengthen the in-depth research of innovation, and the specific change process is shown in Figure 1.

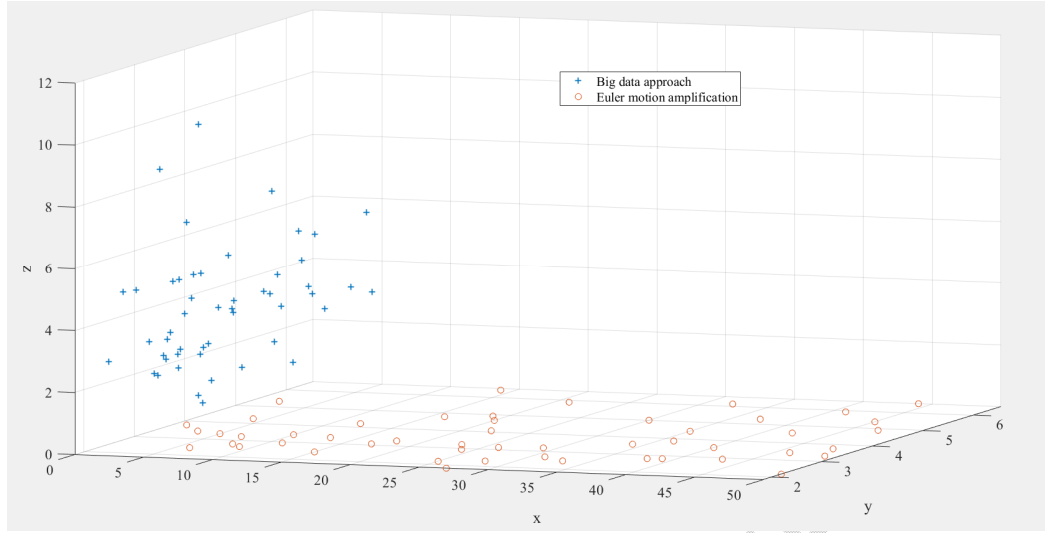


Figure 1 Path adjustment process of business administration

The innovation path of business administration presents stable and continuous characteristics, and switching between different majors is free, which can better choose the innovation path. This shows that the choice of business administration innovation path by big data mining method is in line with the actual analysis requirements.

2.2.3 In-depth analysis of the degree of innovation

After the innovation path is comprehensively analyzed many times after the analysis requirements are not met, it will be eliminated and the approximate path will be switched. Due to the strong randomness of the choice of business administration innovation path, it is necessary to reduce errors in the early stage. To reduce the error of business administration path selection, this paper introduces the Fourier factor to reduce the business administration path selection through the Fourier function error, the formula for which the function is calculated is shown in equation (7).

$$L(d_i) = \sum w_i \cdot \lim_{x \rightarrow n} \frac{f(x_i, y_i, z_i)}{t} \quad (7)$$

Follows a normal distribution, if $f(x_i, y_i, z_i) < 0.1$, the error decreases, otherwise the error increases. In addition, the value t is smaller than the entire path selection process. Based on the above analysis, the business administration path selection problem is shown in equation (8).

$$L(d_i) = \frac{\text{Cauchy}(0,1) \otimes W\left(\frac{I_i, S_n}{|D_i \cdot t|}\right)}{\sqrt{f(x_i, y_i, z_i)}} \quad (8)$$

2.3 Selection of business administration innovation paths

2.3.1 Selection of business administration innovation paths

The selection of innovation path needs to be analyzed according to the actual situation of business administration, and the integration analysis of computer and business administration is carried out. First, it is necessary to judge the problems involved in business administration and realize the transformation of different paths. According to the depth of innovation in business administration, choose different innovation path schemes. Currently, there are mainly the following path search schemes based on big data mining methods.

1) Single-major business administration path innovation plan, as shown in equation (9).

$$L(d_i) = \frac{\sum_i L(d_i)}{(p_i|t)} \quad (9)$$

2) Multi-professional business administration path innovation plan, as shown in equation (10).

$$L(d_i) = \sum_i L(d_i) \cdot \sqrt{\text{Cauchy}(0,1)} \quad (10)$$

3) Preliminary business administration path innovation scheme, as shown in equation (11).

$$L(d_i) = \max \frac{\sum_{i=1,t}^n f(d_i)}{K(x)} \quad (11)$$

4) Comprehensive business administration path innovation plan, as shown in equation (12).

$$L(d_i) = \min \sum_{i=1,t}^n f(d_i) \cdot \sqrt{K(x)} \quad (12)$$

where t is the selection time of the business administration innovation path.

The choice of the path innovation program of business administration mainly has two functions: on the one hand, it conducts differentiated analysis for business administration majors, highlights the direction of innovation, and maps the degree of innovation real constraints. At the same time, different business administration programs can achieve a multi-professional comprehensive analysis. Moreover, in the later stage of business administration innovation judgment, the scope of business administration innovation judgment is rapidly reduced, and the diversity of business administration professional judgment is maintained. On the other hand, implementing the path scheme helps transform different professions.

2.3.2 Synergy between multiple innovation paths

Multi-innovation path collaborative analysis is the key to improving the accuracy of business

administration professional analysis and can be provided through a comprehensive analysis of the path. Different professional subsets adopt different collaborative analyses and cooperate with corresponding professional solutions. Each path subset corresponds to a professional innovation result. Each result is analyzed multiple times to avoid falling into local traps. When the business administration major is comprehensively analyzed, compare the different professional sub-groups of marketing, financial management, human resource management, and Property management and record the best path judgment results.

2.4 Calculation steps for business administration majors

The basic idea of the multi-professional big data mining method is to use the professional judgment scheme to optimize the initial value and innovation degree of multi-professional business administration innovation^[18], obtain the innovation path of business administration innovation and conduct a professional analysis of business administration innovation.

Step 1: Determine the overall situation of business administration, trace the path data, and record the vibration characteristics of business administration to determine the business administration major Data structure, and distribution.

Step 2: Set the business administration innovation selection indicators, innovation degree and direction, and the innovation criteria for computer and business administration. Also, set the number of iterations for the path analysis.

Step 3: Determine the professional judgment function, map the innovation direction to the one-dimensional space, and select the appropriate professional analysis scheme.

Step 4: Determine the best solution for business administration innovation, compare the best sub-results of business administration innovation, and obtain the final judgment result

Step 5: Iteratively update according to the professional plan, adjust the relationship between different models, and output the results that meet the requirements of professional judgment.

Step 6: Whether the path meets the stop requirements, if not, repeat steps 1~5, otherwise, stop the professional judgment.

3. Case study of business administration innovation path

3.1 Basic information about business administration majors

Business administration in vocational colleges and universities is selected as the test object, and its basic information is shown in Table 1.

Table 1 Business administration information

index	Dispersion	Normality	average	standard	error
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			value	deviation	
Professional and innovative	98.49	97.26	96.97	8.76	1.49
Innovative in the field	96.82	99.24	85.32	7.97	1.82
Depth of innovation	99.92	99.74	98.22	8.97	1.92
The route selects the direction	96.10	98.16	97.55	8.06	1.10
Computer convergence	96.97	97.97	99.70	7.22	1.97
Integrated innovation	98.35	97.98	98.84	8.12	1.35

It can be seen from Table 1 that the basic information of business administration majors in vocational colleges and universities can be obtained, and the standard deviation and error of relevant data meet the actual vibration tracking requirements and can be professionally identified and analyzed by the big data mining method. Moreover, the professional scope, average value, and self-binding point of judgment error of the big data mining method conform to the normal distribution, and the legitimacy of the data is better. To more intuitively verify the professional ability of business administration innovation and judge the professional impact of the proposed method on business administration innovation, the following analysis curve is given, as shown in Figure 2.

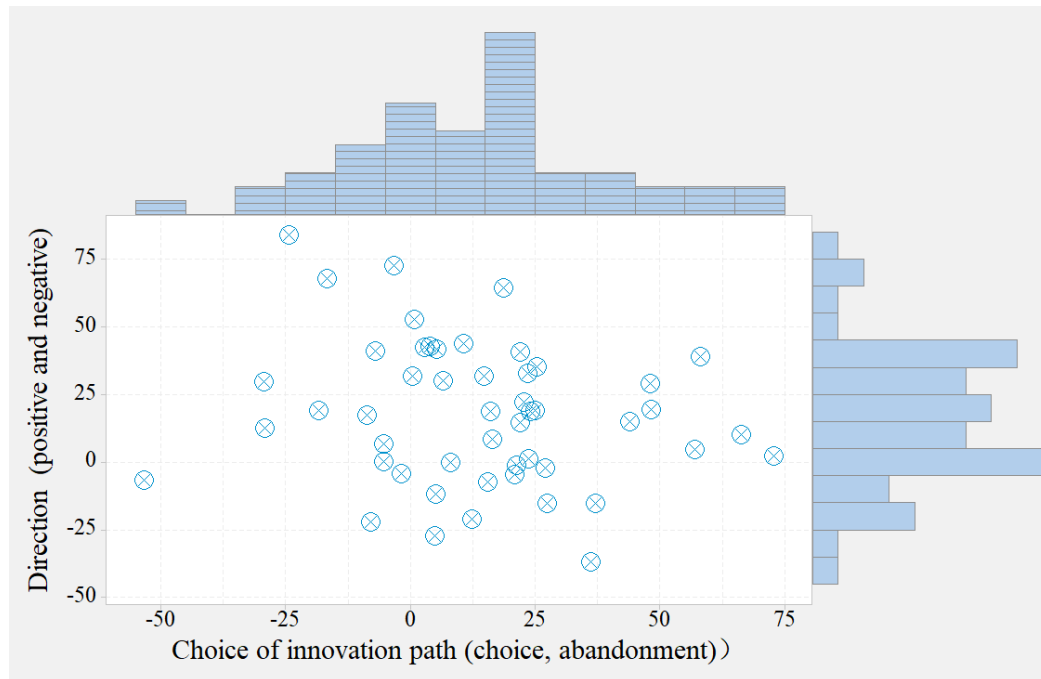


Figure 2 The selection process of business administration innovation path

It can be seen from Figure 2 that the big data mining method has a more complete choice of innovation path for business administration, faster calculation and better stability, which is better than the big data mining method. Therefore, the big data mining method switches between multiple specialities, and the judicial process are more stable.

3.2 Comprehensive selection of business administration majors

According to the binding standards of higher vocational colleges on the innovation path of business administration, the business administration majors are classified into three categories, marketing, financial management and The specific information composition of human resources management is shown in Table 2.

Table 2: Proportion of business administration majors

Major in Business Administration	Data composition	F	Z
Marketing	23	21.1	11.2
financial management	41	12.85	4.25

Human Resource Management	36	23.73	2.13
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Table 2 shows that the result of the understood path data is 2 3-41-36, and the distribution of the data is normal, which can be analyzed later, and the distribution results of different paths can be performed This is shown in Figure 3.

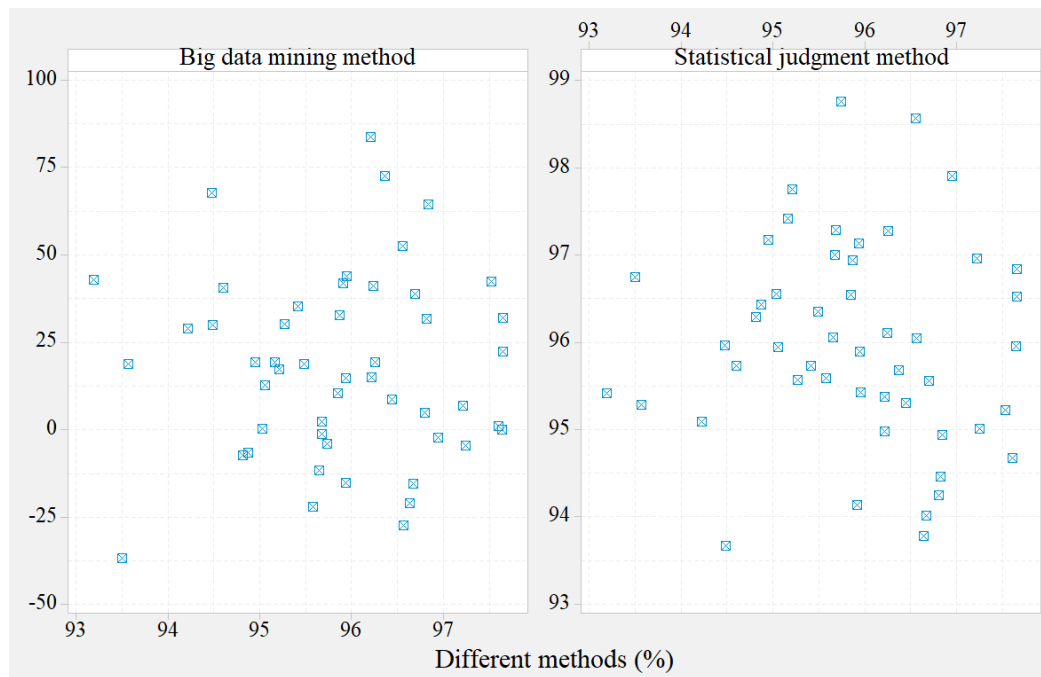


Figure 3 Distribution of innovation pathways

Comparative analysis shows that the innovation path processed by the big data mining method shows normality, which is consistent with the actual test of business administration professional data. Among them, the big data mining method is more concise in processing business administration majors, and the correlation between data is low, which greatly improves the processing results in the later stage. In addition, the innovation path of the data processed by the big data mining method is more stable and continuous, without large fluctuations. The reason is that the big data mining method increases the synergistic factor between the path indicators, and different paths adopt targeted schemes. To further identify the effect of the path, it is necessary to compare with the statistical judgment method, including gray value, displacement signal innovation rate, characteristic signal innovation time, and redundant signal rejection rate, the result is shown in Figure 4.

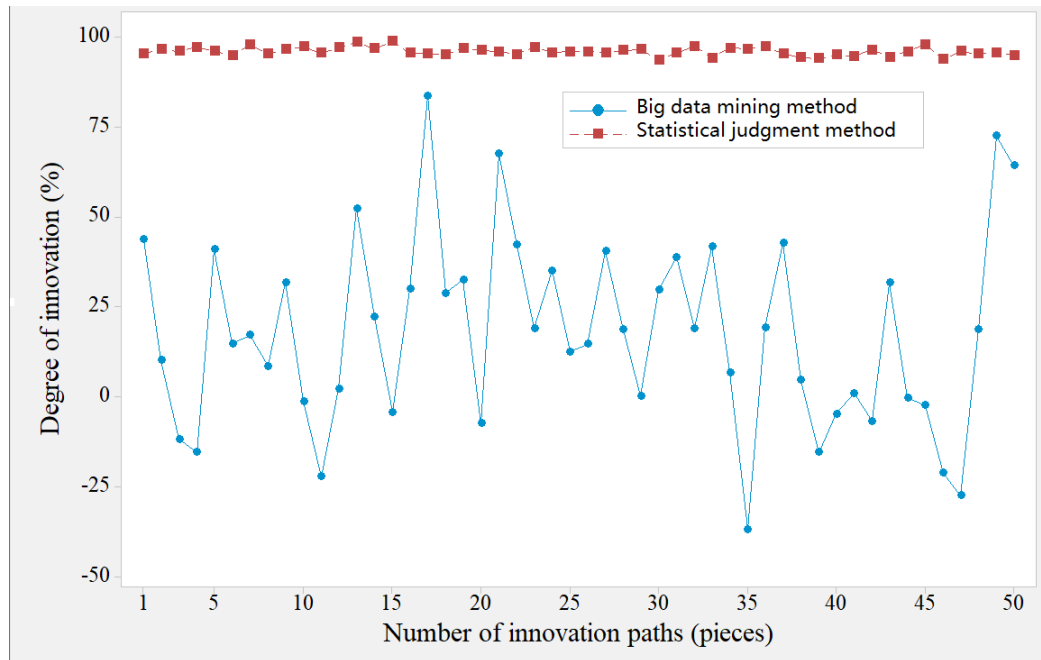


Figure 4 Path innovation results of the two methods

It can be seen from Figure 4 that the displacement signal innovation rate, feature signal innovation time and redundant signal rejection rate of the big data mining method are better than those of the big data algorithm. Under the same constraints, the gray value of the big data mining method is higher, and the multi-discipline innovation rate for vibration is better. The reason is that the big data mining method adopts a targeted path innovation scheme and uses the Fourier function for eigenvalue analysis, which can better innovate the abnormal management content and improve the success rate of signal amplification to ensure the accuracy of the calculation results. The results of the analysis of the innovation path of business administration are shown in Table 3.

Table 3 Comprehensive analysis results of business administration innovation paths by different methods

		Big data mining method		Methods of statistical judgment	
		accuracy	Time	Blend in depth	Time
Major in Business Administration	Marketing	94.21	28.05	84.21	38.74

	financial management	95.86	23.44	85.86	42.50
	Human Resource Management	94.81	15.33	84.81	27.47
Innovation path direction	Positive	94.47	16.77	84.47	67.46
	Negative	97.52	2.80	87.52	42.23
Depth of innovation	high	94.95	18.51	84.95	29.06
	middle	95.41	25.33	85.41	35.05
	low	95.05	29.15	85.05	52.44

Table 3 shows that the big data mining method is superior to the big data algorithm in terms of professional scope, path direction and innovation depth, and the accuracy of innovation path selection does not change with the fusion of computers. The main reason is that the big data mining method sets the threshold of innovation direction and innovation degree, simplifies the data of business administration innovation path in the preliminary processing process volume, reduces the influence of different majors on the path results, and provides a guarantee for the later research of innovation depth. Therefore, the big data mining method can reduce the influence of different majors on the innovation path and improve the accuracy of innovation path selection. The specific process is shown in Figure 5.



Figure 5 Processing process of big data mining method

4 Conclusion

This paper proposes a big data mining method to analyze business administration's innovation path to ensure the analysis results' accuracy. The business administration innovation path is accurately selected by setting the threshold of innovation degree, innovation direction, and increasing synergistic function. The research results show that the standardized processing of innovation paths can be realized through data mapping, which lays the foundation for path selection, improves the accuracy of selection, and ensures the effectiveness of innovation paths. The MATLAB simulation results show that the big data mining method has high judgment accuracy, shortens the selection time of the innovation path, and ensures the selection effect. However, the algorithm in this article also has its shortcomings and cannot switch between different indicators. In future research, the data processing of different majors will be analyzed further to optimize the selection of business administration innovation paths.

References

- [1] U. Bretschneider, P. A. Ebel, and J. M. Leimeister, "Open Business Model Innovation via the Internet: How Wiki Technologies Can Improve the Quality of Business Models," *International Journal of Innovation and Technology Management*, vol. 18, no. 02, 2021.
- [2] J. Kaszowska-Mojša, "innovation strategies of polish manufacturing companies through the business cycle," *Ekonomista*, no. 2, pp. 224-250, 2021.
- [3] J. M. Kneipp, C. M. Gomes, I. Kruglianskas, F. D. Motke, and K. Frizzo,

“Sustainable innovation practices and the degree of innovation of business models in Brazilian industrial companies,” *World Journal of Science Technology and Sustainable Development*, vol. 18, no. 3, pp. 221-238, 2021.

[4] O. Matthias, and I. Fouweather, “The Long Game: Technological Innovation and the Transformation of Business Performance,” *International Journal of Technology and Human Interaction*, vol. 17, no. 2, pp. 60-78, 2021.

[5] L. C. Wu, Y. Q. Wei, and C. G. Wang, “Disentangling the effects of business groups in the innovation-export relationship,” *Research Policy*, vol. 50, no. 1, 2021.

[6] S. Ammirato, R. Linzalone, and A. M. Felicetti, “The value of system dynamics' diagrams for business model innovation,” *Management Decision*, vol. 60, no. 4, pp. 1056-1075, 2022.

[7] T. P. Bottcher, J. Weking, A. Hein, M. Bohm, and H. Krcmar, “Pathways to digital business models: The connection of sensing and seizing in business model innovation,” *Journal of Strategic Information Systems*, vol. 31, no. 4, 2022.

[8] S. Caravella, and F. Crespi, “On the growth impact of different eco-innovation business strategies,” *Economia Politica*, vol. 39, no. 2, pp. 657-683, 2022.

[9] D. S. Finley, and V. Sathe, “Sustaining the Arts by Means of Business Model Innovation,” *International Journal of Arts Management*, vol. 24, no. 3, pp. 36-43, 2022.

[10] K. Ivanov, "values-based business model innovation-the case of Ecosia and its business model," *International Journal of Innovation Management*, vol. 26, no. 05, 2022.

[11] J. K. Nwankpa, Y. Roumani, and P. Datta, “Process innovation in the digital age of business: the role of digital business intensity and knowledge management,” *Journal of Knowledge Management*, vol. 26, no. 5, pp. 1319-1341, 2022.

[12] Yin, D., Xu, C., Jia, H., Yang, Y., Sun, C., Wang, Q., & Liu, S. (2022). “Sponge city practices in China: From pilot exploration to systemic demonstration,” vol. 21, no. 3, pp. 133, 2022.

[13] Yin, D., Xu, C., Jia, H., Yang, Y., Sun, C., Wang, Q., & Liu, S. “Sponge City Practices in China: From Pilot Exploration to Systemic Demonstration. *Water, "Urban Runoff Control and Sponge City Construction*, vol. 7, no. 14, pp. 1531, 2022.

[14] Yu, S., Sial, M. S., Tran, D. K., Badulescu, A., “Thu, P. A., &Sehleanu, M. (2020). Adoption and implementation of sustainable development goals (SDGs) in China—Agenda 2030,” *Sustainability*, vol. 12, no. 15, pp. 6288, 2020.

[15] Zevenbergen, C., Fu, D., & Pathirana, A. (2018). “Transitioning to sponge cities: Challenges and opportunities to address urban water problems in China, ”*Water, 10(9)*,.vol. 10, no. 9, pp. 1230, 2018.

[16] Zhang, W., Zhang, M., Zhang, W., Zhou, Q., & Zhang, X. (2020). "What influences the effectiveness of green logistics policies? A grounded theory analysis," *Science of the Total Environment*, vol. 1, no. 714, pp. 136731, 2020.

[17] Zhao, X., Ma, X., Chen, B., Shang, Y., & Song, M. "Challenges toward carbon neutrality in China: Strategies and countermeasures," *Resources, Conservation and Recycling*, 176, 105959. vol.11, no. 3, pp. 105959, 2022.

[18] Zou, Y., Chen, Z., Zhong, N., & Zhao, W. "Urban planning as a way to pursue quality-oriented urbanization: Anatomy of the urban planning of Xiong'an New Area, China," *Journal of Urban Affairs*, vol. 23, no. 1, pp. 1-16, 2021.

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