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Research on the Design of Curriculum System for Business Administration Students Based on Discrete Optimization Algorithm under Digital Talent Cultivation Mode

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ABSTRACT

The study of student behavior data is a necessary way to enhance the digitalization process of the curriculum system of business administration. This paper collects students' online platform learning behavior and other data, and carries out data cleaning and other pre-processing on them. Using the density function and entropy discretization algorithm to divide the continuous student data into intervals, and study the course learning characteristics of students in different attribute intervals. On this basis, optimize the curriculum system of business administration majors in colleges and universities, and judge its application value through comparative experiments. Obtain students' satisfaction data on the curriculum system of business administration majors in colleges and universities, and analyze the direction of continuous improvement. Through preprocessing and descriptive analysis, it can be judged that the student behavior data conforms to the characteristics of continuous data, and can be classified using the discretization algorithm. The student behavior data are discretized into 3 major categories and 11 subcategories, and the attribute characteristics of each category can represent the behavioral characteristics and curriculum needs of different students. The mean value of the overall satisfaction of the optimized business administration curriculum system is 3.567 points, and the scores of all dimensions are higher than those before optimization, and there is no gender difference in satisfaction (P>0.05). The entropy-based discretization algorithm can effectively support the optimization of business administration professional course system.

Keywords: data cleaning, density function, entropy-based discretization algorithm, business administration curriculum, student satisfaction

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1. Introduction

In the context of economic globalization and the rapid development of digital economy, digital technology is reshaping the development pattern of various industries [1]. Through the integration of information technology, artificial intelligence, big data, cloud computing and other advanced technologies, digital empowerment not only changes the operation mode of traditional industries, but also gives rise to new industrial forms and business models, which puts forward higher requirements on the knowledge structure, skill level and innovation ability of talents [2-5]. Under this macro background, the education field, especially the higher education system, faces new challenges and opportunities [6-7]. Adapting to and leading the development of digital production, cultivating compound talents with interdisciplinary literacy, strong innovation ability, and the ability to solve complex problems has become an important mission of higher education given by the times [8-10].

As an important part of the higher education system, business administration majors mainly cultivate senior management talents who master modern management theories and methods and have strong practical ability and innovative spirit [11]. The high-quality development of China's economy has prompted the requirements for business administration talents to change from having a single management ability to having comprehensive applied talents with professional qualities [12-14]. The limitations of the traditional talent training system for business administration majors have been gradually revealed, and the problems of the curriculum lagging behind the market demand have become more and more prominent [15-16]. Restricted by the previous social environment and educational conditions, the construction of the curriculum system fails to cover all kinds of cutting-edge knowledge that must be understood or mastered to cope with the new business and social development needs in the environment of “Internet Plus”, and it is difficult to help students fully understand and effectively solve the new problems emerging in the business environment [17-20]. In addition, business administration majors pay too much attention to the teaching of theoretical knowledge in the curriculum content setting, neglecting the cultivation of students' innovative thinking and innovation ability, resulting in a single teaching content, lack of relevant cases, and students are unable to apply the theoretical knowledge to practice [21-24]. Based on the optimization algorithm to reconstruct the body of business administration professional courses, it can transform the disciplinary advantages into teaching productivity matching the characteristics of this type of profession, which is ultimately conducive to the cultivation of business administration professionals with comprehensive application ability [25-27].

Under the background of professional digital construction, the traditional business administration professional curriculum system has problems such as the disconnection between theory and practice, which affects the improvement of students' digital literacy. This paper integrates students' online platform learning behavior, learning performance and other multi-source data, and studies the potential association between students' behavioral characteristics and curriculum needs through data cleaning, feature reconstruction, entropy discretization algorithm and other techniques. Student behavior data of two grades of business administration majors in a university are selected to construct the research dataset. Discrete analysis of student behavior data is carried out on a class-by-class basis, and optimization of the curriculum system of business administration majors is carried out based on the results of discrete data analysis. Through comparative experiments and satisfaction analysis, we understand the degree of students' recognition of the curriculum system before and after optimization and the demand for continuous improvement.

2. Data processing and curriculum optimization pathways

This chapter takes business administration students as a sample and systematically collects heterogeneous data from multiple sources covering academic performance and career development. Aiming at problems such as redundancy of raw data, data normalization is achieved through sample screening and feature reconstruction to ensure the reliability of subsequent analysis. The entropy discretization algorithm is further introduced to transform continuous academic features into discrete intervals to improve the accuracy of data classification. Combined with the talent cultivation needs in the era of digital economy, the shortcomings of the traditional curriculum system are analyzed and improvement ideas are proposed.

2.1. Data sources

In order to ensure the authenticity of the experiment, the experimental data used in this study came from the students of the classes of 2020 and 2021 in the College of Information and Business Administration of a university. These data include students' academic performance, personal information, research competitions, school scholarships, and graduation destinations. In this study, the features that can reflect students' performance are collected from different dimensions, and the effective features that can reflect students' performance in the students' data table are filtered by manual features. After that, the selected effective features are integrated to construct a complete student data table.

The acquired student performance data are in the form of EXCEL tables, and the data of students' research competitions and school scholarships are in the form of WORD text. The original student achievement data is understood, and the achievement data structure of business administration students of class 2020 and class 2021 shows the data fields including student name, student semester, student gender, student course code, college where the course is offered, nature of the course, credits, course name, course GPA, grade, total credit hours, assessment method, whether to retake the course, and class level.

2.2. Data cleansing

Data cleansing refers to the original data may exist in some of the errors to distinguish between the deletion and processing, such as deleting the existence of abnormal sample data, supplementing the sample data in the presence of missing eigenvalues, dealing with the data table in the meaningless eigenvalues and so on. The purpose of data cleaning is to remove the possible existence of “dirty data”. The process of data cleansing mainly includes, for the existence of missing data samples, you need to fill in the missing parts, if there are too many missing feature values in the student samples, you need to consider whether to delete the data samples; for the existence of duplicated data samples, you need to delete the operation.

First, for some students who dropped out of school for reasons, or some students who did not graduate on time, the various academic and practical data generated among these students are “dirty data” for the study, and this study deletes this type of student data after screening.

Secondly, for the student achievement data table, after mining found that some students in some courses have two examination results, obviously belong to the abnormal situation. In order to ensure the authenticity of students' course grades, it is necessary to select students' first course grades and exclude students' second course grades.

2.3. Data discretization process

Data discretization is the division of continuous data into a finite number of discrete intervals, and this transformation can improve the reliability, stability, and usability of the data, as well as reduce the computational cost of the algorithm, improve the generalization ability of the model, and have important advantages in the protection of data privacy and other aspects. Through discretization, data storage and computation costs can be reduced, the impact of outliers and noise can be reduced, data analysis and mining can be facilitated, the expressive ability and diversity of features can be improved, data privacy can be protected, as well as the visualization and presentation of data can be facilitated. The choice of discretization needs to consider the characteristics of the data, the target task and the algorithm model according to the specific situation, and select the appropriate discretization method and parameters. Figure 1 shows the data discretization steps.

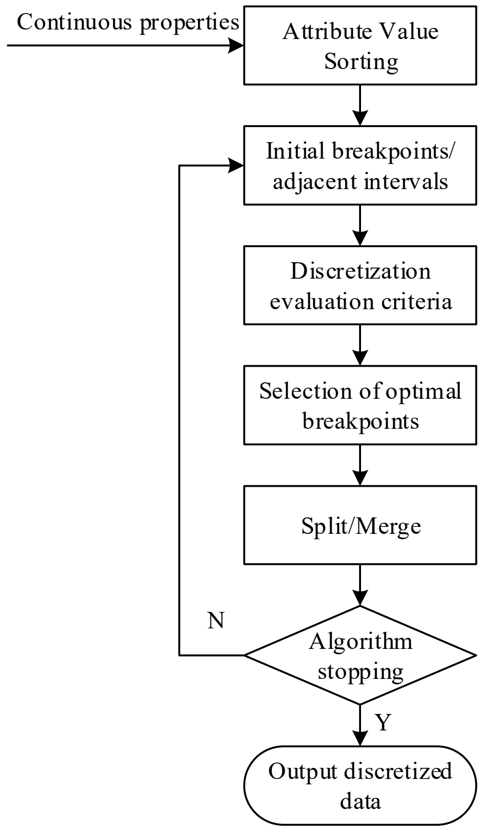


Fig. 1. Discretization steps

2.3.1. Density functions of continuous random variables and their probabilistic properties. Let X be a continuous random variable with density function denoted as $f(x)$. Then $f(x)$ has the following three basic properties.

Property 1 (non-negativity) $f(x) \geq 0$.

Property 2 (normality) $\int_{-\infty}^{+\infty} f(x)dx = 1$.

Property 3 (probability formula) $P(a \leq X \leq b) = \int_a^b f(x)dx$.

From Property 3 and the properties of continuity of functions and integrals, it is easy to justify the following proposition.

Corollary Let the density function $f(x)$ of a random variable X be a continuous function with minimal and maximal value points, then

1) For the point of very small value ξ, there exists an interval I_1 centered at ξ, and for any two adjacent equal-length intervals (a,b), (c,d) within I_1, where ξ is the midpoint of (a,b), $\xi \notin (c,d)$, there is $P(a < X < b) < P(c < X < d)$.

2) For the extreme value point η, there exists an interval I_2 centered at η, and for any two adjacent equal-length intervals (a,b), (c,d) within I_2, where η is the midpoint of (a,b), $\eta \notin (c,d)$, there is $P(a < X < b) > P(c < X < d)$.

The probability that a random variable will be taken in an interval is large, which means that the data points are more "dense" in the interval, so it can be said that the minimum point of the density function is the "local most sparse point" of the data, and the maximum point is the "local most dense point" of the data. Therefore, based on the above inference, the basic idea of selecting the discretized points of data can be obtained.

2.3.2. Entropy-based discretization algorithm. The basic idea of the entropy-based discretization algorithm is to divide the continuous attribute values into a number of discretization intervals, so that the samples within each interval have similar attribute values and the difference in attribute values between different intervals is as large as possible. Given a dataset M, the discretization steps for continuous conditional attribute a are as follows:

Step1 Order the values of a from smallest to largest and denote them by $\{a_0, a_1 \dots, a_n\}$, where each value can be considered as a potential interval boundary T. For example, the attribute value a_i can divide the sample set into two subsets smaller than a_i and not smaller than a_i thus dividing two intervals.

Step2 For the set of data tuples M, the boundary value chosen should minimize the information entropy obtained by its partitioning and the information gain is:

$$IG(S,T) = \frac{|M_1|}{|M|} Ent(M_1) + \frac{|M_2|}{|M|} Ent(M_2) \tag{1}$$

In Equation (1), M_1 and M_2 correspond to the set of samples in M that satisfy the conditions less than T and not less than T, respectively, and the entropy function Ent is calculated based on the distribution of categories in the set of samples, and the entropy of M_1 is:

$$Ent(M_1) = -\sum_{j=1}^{L} p_j \log(p_j) \tag{2}$$

Eq. (2) where p_j is the probability of occurrence of a sample of class j in M_1, i.e., the samples of class j in M_1 divided by the total number of samples in M_1.

Step3 Apply this procedure recursively to all intervals to complete the interval partitioning until the algorithm stopping criterion is satisfied:

$$Ent(M) - IG(M,T) > \delta \tag{3}$$

Information entropy-based discretization is a common method of data discretization that uses decision class information to measure the quality of discretization results. Compared to other discretization methods, information entropy-based methods are more likely to define the interval boundaries at the exact location, which improves the accuracy of the classification algorithm. However, the information entropy-based discretization methods are computationally intensive because they require multiple divisions and calculations of the dataset. In order to solve this problem, some improved methods have been proposed, such as gain-ratio based discretization method and minimum description length based discretization method. These methods are able to reduce the amount of computation to a certain extent and at the same time maintain the accuracy and reliability of the discretization results.

2.4. Problems and Countermeasures of the Curriculum System of Business Administration Programs

Under the background of digital economy, the problems faced by the curriculum system of business administration majors in colleges and universities mainly include the following aspects:

Lack of digital economy literacy. Due to the rapid development of the digital economy, many students and teachers lack the necessary digital economy literacy, resulting in difficulties in meeting the needs of the development of the digital economy in the curriculum and teaching.

The curriculum does not match the actual needs. Many colleges and universities have a traditional curriculum for business administration majors, which lacks attention to the digital economy and is inconsistent with practical application, making it difficult to meet the social demand for business administration talents.

Insufficient application ability of students. Many colleges and universities' business administration courses emphasize the teaching of theoretical knowledge, but neglect the cultivation of practical ability, resulting in insufficient application ability of students in practical work.

In order to solve the above problems, the following countermeasures can be taken:

Strengthen the construction of faculty. Encourage and support teachers to participate in academic research and practical activities in the field of digital economy, improve teachers' digital economy literacy, and then improve the curriculum and teaching quality.

Optimize the curriculum. According to the needs and practical applications of the development of digital economy, optimize the curriculum of business administration, introduce digital-related courses, focus on the combination of theory and practice, and cultivate students' practical ability.

Strengthen the practical teaching link. Strengthen the setting of practical teaching, encourage students to participate in actual projects, and cultivate students' practical ability and application ability.

Establish the mechanism of cooperation between industry, academia and research. Establish a close cooperation mechanism with enterprises and research institutions, strengthen university-enterprise cooperation, closely combine academic research and practical application, and improve the practical ability and application ability of business administration talents.

3. Research on the application of algorithms and optimization of the curriculum system

This part collects the learning behavior data of students majoring in business administration in colleges and universities and carries out preprocessing and descriptive analysis to ensure that the processed data meet the classification requirements of the discretization algorithm. Discrete analysis of the data in the dataset is carried out on a class-by-class basis, and the curriculum system of business administration majors is optimized according to the analysis results. Carry out comparative experiments to study students' satisfaction with the optimized business administration professional curriculum system and the direction of continuous optimization.

3.1. Data pre-processing

In the process of collecting data, due to various reasons, such as technical problems in the process of data collection or human operation improper entry errors, etc. lead to data duplication, missing and other problems, which may lead to bias or even wrong conclusions when we analyze the data, so data preprocessing is a necessary step before applying the data. Processing and transforming the raw data before performing data analysis, it can improve the quality of the data, make the data more standardized and consistent, and at the same time make the data suitable for subsequent analysis and modeling tasks, this process is the data preprocessing process.

The preprocessing process done on the dataset in this paper is summarized as follows:

1) Firstly, the duplicate values and missing values of the two datasets of class 2020 and class 2021 are queried, and it is found that there are no duplicate values and missing values in both the student learning and achievement dataset and the historical behavior dataset, so there is no need to carry out the two steps of deleting the duplicate values and filling the missing values. Since the columns verb-id, object-definition-type and statement-object-id are the basis for obtaining the columns verb-zh-cn and verb-def-zh-cn, in the case where the columns verb-zh-cn and verb-def-zh-cn already exist, the columns verb-id, object-definition-type and statement-object-id will be deleted for the sake of convenience of subsequent processing. In the case of existing verb-zh-cn and verb-def-zh-cn columns, the verb-id, object-definition-type, and statement-object-id columns are deleted for the convenience of subsequent processing;

2) Since the purpose of this research paper is to investigate the relationship between students' online behavior and students' performance, it is necessary to remove the information of teachers and teaching assistants contained in the behavioral dataset. First, the actor-name column in the historical behavioral data set is matched with the name, and after the matching is completed, the historical

behavioral data generated by teachers and teaching assistants are removed according to the name column;

3) Convert the World Standard Time (UTC) timestamps in the historical behavior dataset to time type data in Python, and then convert UTC to Beijing time;

4) Desensitize the sensitive information such as name and username in the two datasets.

Table 1 shows the student learning profiles of the two datasets (parts) after the above preprocessing process. As can be seen from Table 1, there is no case of failing total score (<60 points) in the preprocessed data. All variables are continuous numerical variables except for the number of check-ins, which is a discrete value. The preprocessed data set is suitable for discrete analysis using entropy-based discretization algorithm.

Table 1. Preprocessed student Learning situation Data Set (Part)

Name	Total score (after checking)	Pass or not	Total grade	Number of check-ins	Classroom practice completion rate (%)	Test completion rate (%)	Questionnaire completion rate (%)	Self-viewing completion rate (%)	Discuss task completion rate (%)
Zhou*	99	1	4963	31	96	100	100	60	100
Liu*	97	1	4332	30	97	100	98	89	99
Chen*	96	1	4881	32	99	100	100	90	85
Zhao*	94	1	4380	32	100	100	96	99	90
Li*	93	1	4921	31	100	100	100	85	95
Zhang*	89	1	4281	32	99	100	98	93	0
Wang*	88	1	4555	31	91	100	100	99	99
Deng*	86	1	4060	30	98	100	99	89	95
Zhu*	85	1	4903	32	95	100	100	100	100
Xie*	80	1	4602	31	89	100	100	88	50
Qin*	78	1	4857	30	77	100	95	95	100
Lin*	77	1	3856	32	90	100	97	100	99
Yi*	75	1	5042	32	94	100	100	99	94
Ji*	73	1	4200	31	89	100	99	95	89
Yan*	72	1	4843	31	100	100	100	96	0

3.2. Descriptive analysis

Descriptive statistical analysis of data is an analytical process that reveals the characteristics, distribution, and relationships of data by calculating and presenting a variety of statistical quantities and graphs of the data in the preliminary stages of data analysis. It serves to provide a comprehensive understanding of the data set and establishes a foundation for subsequent data analysis and modeling. The measures of central tendency and dispersion are two commonly used statistics in descriptive statistical analysis of data, in addition to which descriptive statistical analysis of data also visually reveals the distributional characteristics of the data by drawing graphs and charts. Data descriptive statistical analysis helps to objectively describe and analyze the empirical data, through the display of specific statistics and charts, so that the data analysts have a preliminary understanding of the data situation, to provide a certain basis for the subsequent analysis process.

For the specific characteristics of the data of the two datasets used in this time, the total number of different categories of behaviors in the students' historical behavioral dataset and the number of categories of behavioral operation objects under each type of behavior are counted and plotted as a graph.

Figure 2 shows the total number of student behaviors in different categories (top 12 categories). From Figure 2, we can see that the data distribution of the behaviors in each category is unbalanced, with the click, view, open, enter, and complete categories accounting for about 85% of the total data volume, while the number of behaviors in other categories accounts for a relatively low percentage. The reason for this may be that the course is mainly based on knowledge transfer and content digestion, and students need more of these behaviors to access learning resources. Figure 3 shows the distribution of the total number of categories of operant objects under various behaviors (the first 12 categories), and the total number of categories of operant objects under these categories is relatively large, accounting for about 65%, which shows that the platform provides rich and diverse learning resources and content, including different types of documents, tasks, etc., and can also better collect data related to the learning behaviors of business administration students for in-depth research and analysis. When using the discretization algorithm for classification, the different categories of student behaviors and the categories of objects under which the behaviors operate under these categories can be used as a reference for classification.

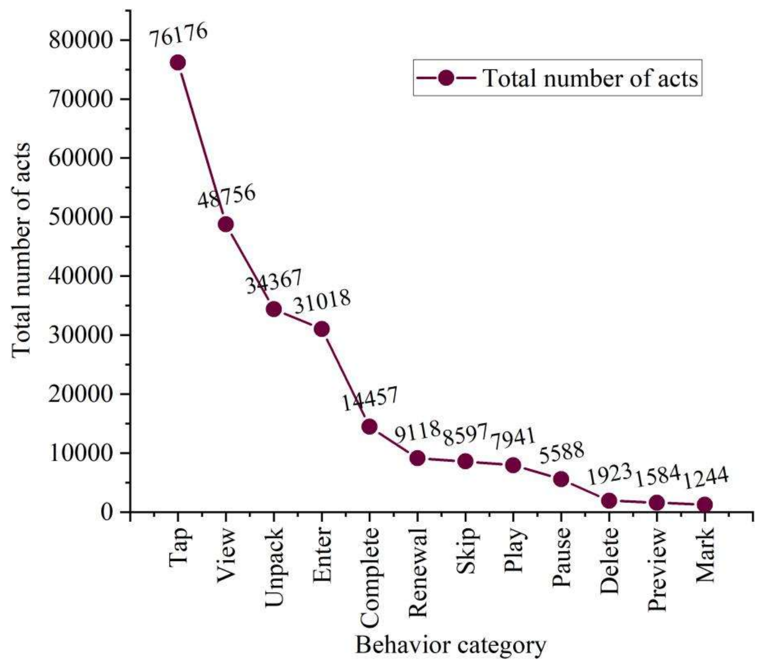


Fig. 2. Total number of behaviors in different categories (Top 12)

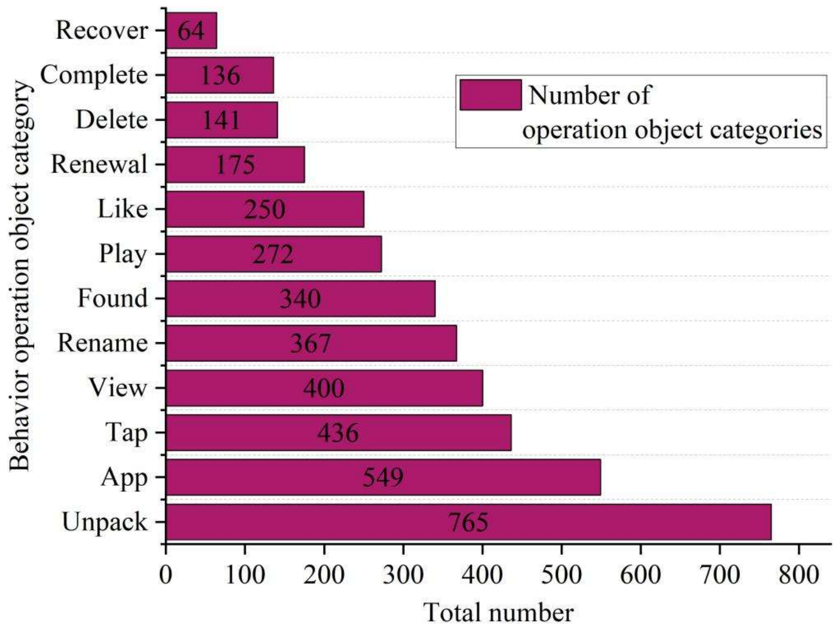


Fig. 3. Total number of categories of behavioral operation objects

The distribution of students' time-of-use data on the online platform can reveal their study habits to some extent, so the distribution of the time of occurrence of students' behaviors over the 24 hours of the day was also plotted. Figure 4 shows the distribution of the time of occurrence of student behaviors over 24 hours in a day. There are three class periods in the business administration course, namely 10:00-12:00 in the morning, 14:00-16:00 in the afternoon, and 16:20-18:00 in the afternoon.It can be seen that these three time periods generate more behaviors, but a large amount of behavioral data is also generated in the time period of 18:00-24:00 in addition to the class periods, which indicates that students also invested More study time, and business administration students tend to study offline in the evening during their free time slots for their major courses.

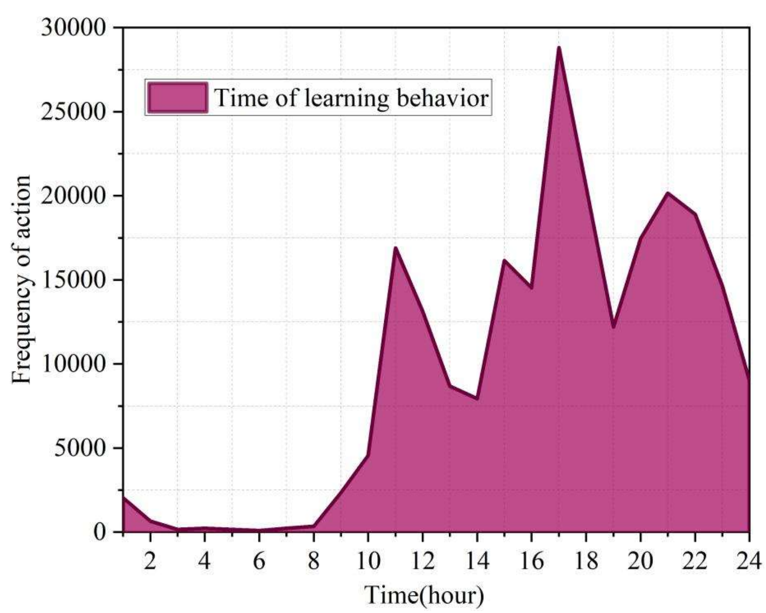
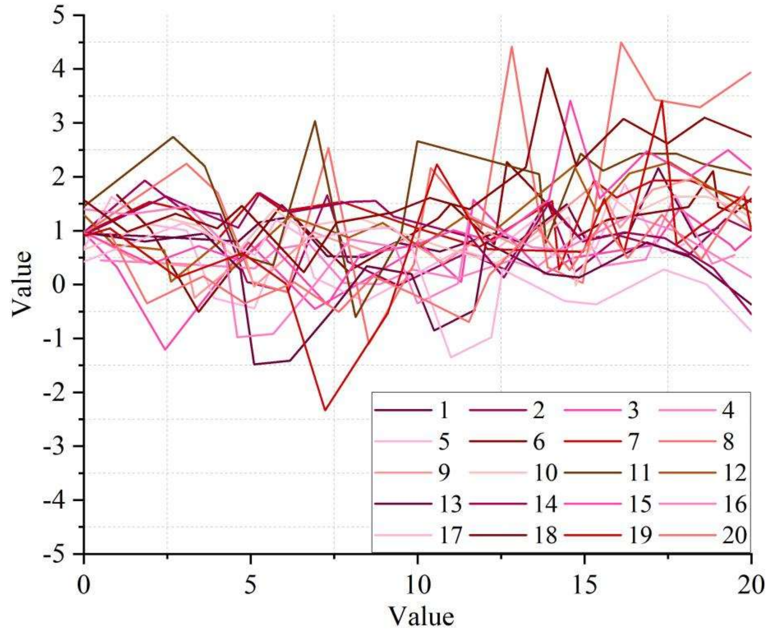


Fig. 4. Distribution of students' behavior occurrence time in a day

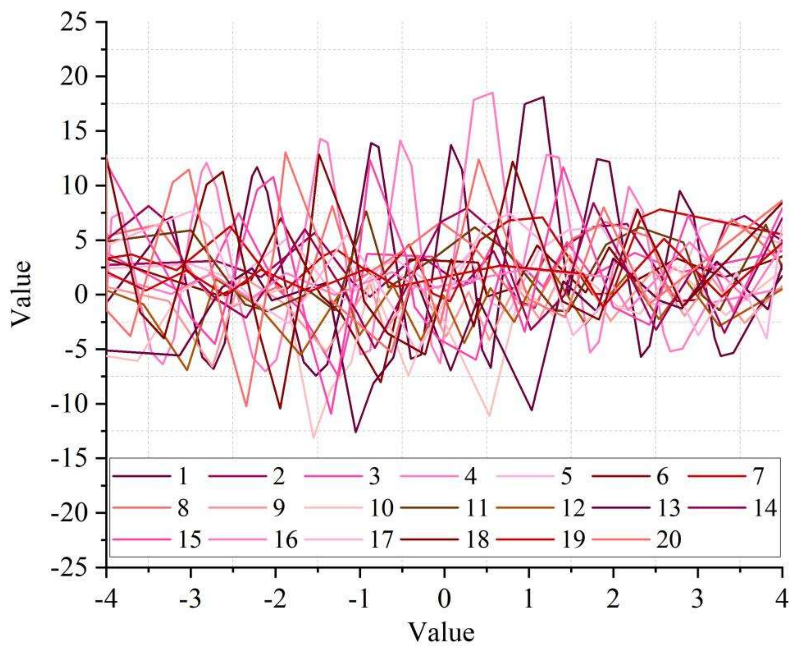
3.3. Discrete analysis of class data

3.3.1. General Characteristic Portrait of Class Data. The above global data analysis can only give the overall characteristics of student data at the level of college and major, etc. Although it has a macroscopic guiding role for administrators to formulate the curriculum system, the class, as a basic unit of college management, should be analyzed in a more detailed and in-depth analysis of student data in the class. The following 20 students from the freshman class 213 of the business administration major in the class of 2021 are extracted for discrete analysis visualization display, resulting in the corresponding data analysis contour plot, trigonometric polynomial plot and other graphics, which can quickly visualize the data, and can discover the relevant data characteristics from the visualization graphics.

Figure 5 shows the overall stability and data portrait analysis of the freshman class 213 in business administration. As can be seen from the contour and trigonometric polynomial plots in Figure 5, with the exception of a few students, the majority of the 20 students in the class maintain good stability and continuity between the various data, which also meets the data requirements for discretization.



(a) Outline drawing



(b) Trigonometric polynomial drawing

Fig. 5. Overall stability and data portrait of class 213

3.3.2. Discrete analysis of attribute variables. Using entropy-based discretization algorithm to discretize and analyze the continuous learning behavior data of each class in the dataset, the discretization results of the data including the classification of attributes such as learning time are obtained. Each attribute interval obtained from the discrete classification is visualized by means of a cluster diagram to determine whether the boundary delineation of each discrete interval is in the exact position.

Figure 6 shows the clustering of each attribute interval after discrete analysis. As can be seen from Figure 6, the discretization algorithm divides the data in the dataset into three categories according to the attribute categories, one is the achievement situation such as the total score of X1 semester, etc.;

the second is the classroom indicators such as classroom practice completion rate, etc.; and the third is the behavioral indicators such as the number of times of signing in. That is, students can be classified into excellent, good, and passing categories according to the achievement situation; students can be classified into active and average categories according to classroom indicators; and students can be classified into active and passive categories according to behavioral indicators. Overall, the classification of students' behavioral attributes by the discretization algorithm can better reflect that students of different attribute categories have different needs for classroom system construction. For example, active students spend more time on independent learning after class, have better self-learning ability, and do not have a strong need for one-on-one guidance and assistance from teachers. For this group of students, policymakers need to integrate more self-learning resources into the business administration curriculum system to reduce the burden of collecting resources for self-learning and assist them in learning better.

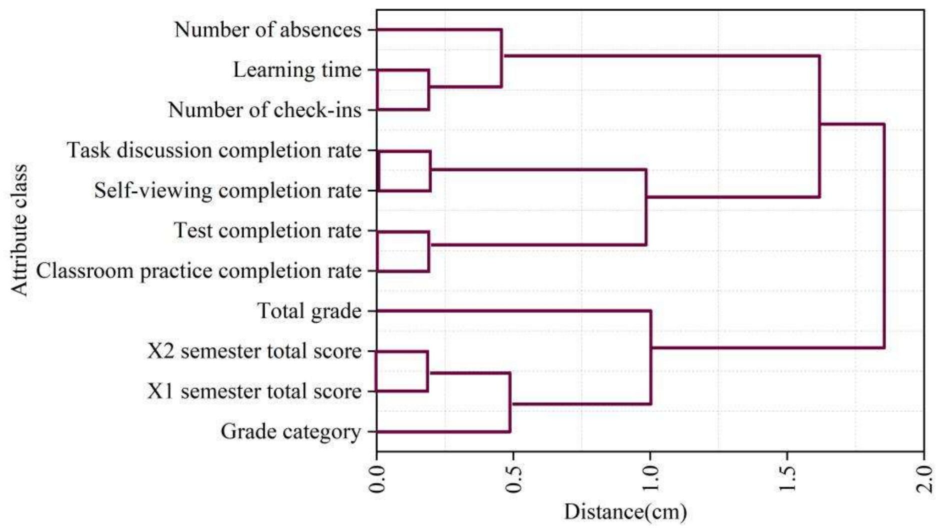


Fig. 6. Clustering of each attribute interval after discrete analysis

3.4. Analysis of Satisfaction with Undergraduate Curriculum System of Business Administration Programs

3.4.1. Descriptive analysis of student satisfaction surveys. According to the discrete analysis of business administration students by the discretization algorithm, the students are divided into 3 major categories and 11 subcategories according to their learning behaviors and learning needs. Combined with the algorithm calculation results and the curriculum system setting analysis of 2.4, targeted to improve the undergraduate curriculum system of business administration majors in this university. Conduct a one-year comparison experiment, and then collect students' satisfaction data on undergraduate business administration majors through questionnaires to analyze whether the undergraduate curriculum system of business administration majors improved according to the discretization algorithm can meet students' needs. At the same time, it is judged whether the entropy-based discretization algorithm is practical in the classification of student behavioral data and other aspects.

Table 2 shows the results of the survey on the overall and each dimension satisfaction of the optimized curriculum system. As seen in Table 2, the mean value of the overall satisfaction of the business administration program in this university is 3.567, which is at the upper-lower level, indicating that the current business administration course system is not far from the students' expectations. It is higher than the overall satisfaction mean value of 3.263 of the pre-optimization course system, and in each dimension, the student satisfaction of the optimized course system is higher than that of the pre-optimization course system in the following order: course resources, course teaching, course evaluation, course objectives, course content, and course arrangement, and the corresponding dimensions are all higher than the pre-optimization course system satisfaction mean. It can be seen that students' satisfaction with the curriculum system construction of business administration majors has been improved after discrete analysis of students' behavioral data using the discretization algorithm and optimization of the curriculum system accordingly.

Further specific analysis of the optimized curriculum system of business administration majors is carried out to determine the satisfaction situation under each dimension of the system, which facilitates the subsequent continuous optimization.

In the dimension of curriculum objectives, the highest student satisfaction is in the aspect of reflecting service to the local area (3.49), while the lowest is in the aspect of reflecting the needs of vocational positions (3.16). At present, the teaching objectives of the business administration major generally meet the expectations, while there is a gap between the requirements of the job positions and the expectations of college students. Students reflect that the course objectives of this major are biased toward the theoretical, while they are not well practiced in practical training, which leads to the fact that students are not well adapted to the highly technical occupation of business administration.

In the dimension of course content, the highest level of satisfaction is relevance (3.48) and the lowest is breadth and depth (3.26). Students were satisfied with all indicators of course content. It is understood that the course content of current majors emphasizes theory over practice, and the connection between courses is vague and conventional, which makes students' satisfaction with course content low.

In the dimension of course arrangement, students' satisfaction with the design of course credits is the highest (3.46), and the lowest is the arrangement of the number of courses (3.17), which suggests that at the current stage, the program's curriculum better meets the expectations of students, but there is a certain gap between the setting of class hours and the expectations of students. Through the survey, it is found that there are some confusing phenomena in the current teaching content of the school, such as more theory than practice, more compulsory courses than elective courses.

In the dimension of course teaching, students' satisfaction with teachers' teaching attitude is the highest (3.86), and the lowest is the classroom teaching atmosphere (3.56). Students felt that in the classroom the teacher generally used the traditional way of lecturing and seldom communicated with students. Due to the lack of student participation, the teaching subject position was not well reflected, resulting in a low level of student satisfaction with the classroom atmosphere.

In the dimension of course resources, the highest student satisfaction was with online resources (3.80), and the lowest was with paper resources (3.59). The university's teaching resources are generally in line with students' expectations, but there is room for improvement. After the survey, the main reason for students' low satisfaction with paper course resources is that although the current business administration program has a wide variety of textbooks, related books and other paper resources, the content lacks characteristics.

In the course evaluation dimension, the satisfaction of course evaluation content is the highest (3.53), and the satisfaction of course evaluation importance (3.46) is low. The teaching resources of the university are generally in line with students' expectations, but there is room for improvement. However, at present, the teaching evaluation of business administration majors in China's colleges and universities favors the assessment of students' academic performance, while the examination of students' affective attitudes and professionalism is rare and rather formalized, with a small proportion of self-assessment.

Table 2. Curriculum system and satisfaction of each dimension

Dimensionality satisfaction	Mean value	Variable satisfaction	Mean value

Course objective	3.380	Promote students' physical and mental development	3.47
		Embody the service place	3.49
		Reflect the needs of professional positions	3.16
		Consistent with undergraduate education level	3.40
Course content	3.331	Practicability of course content	3.28
		The course content is cutting-edge	3.32
		Relevance of course content	3.48
		The course content is broad and deep	3.26
		Applicability of course content	3.37
Course arrangement	3.287	Courses offered	3.35
		Course quantity arrangement	3.17
		The proportion of various courses is set	3.20
		Course sequence	3.32
		Course credit design	3.46
Course teaching	3.665	Teacher's teaching attitude	3.86
		Teachers' theoretical teaching level	3.65
		Teachers practice teaching skills	3.71
		Teacher's teaching method	3.58
		Classroom teaching atmosphere	3.56
Curriculum resources	3.734	Course network resources	3.80
		Curriculum paper resources	3.59
		Course material resources	3.78
Curriculum evaluation	3.486	Importance of curriculum evaluation	3.46
		Curriculum evaluation content	3.53
		Curriculum evaluation method	3.47
Overall satisfaction evaluation	3.567		

3.4.2. Differential Analysis of Student Satisfaction. This study utilizes the independent samples t-test to investigate the differences in satisfaction with the curriculum system among business administration students of different genders.

Table 3 shows the results of independent samples t-test of satisfaction with the curriculum system of male and female students. Overall, male students are slightly more satisfied with the curriculum system than female students. The overall significance of 0.001<0.01 indicates that the variance of this factor is non-homogeneous. The two-tailed probability is 0.576>0.005 under non-variance homogeneity. It can be seen that there is no significant difference between male and female students in terms of their overall satisfaction with the course system.

In addition, girls' satisfaction with course resources is significantly higher than boys'; in other dimensions, boys' satisfaction is significantly higher than girls'; the probability P-value of F-value on the three dimensions of course content, course instruction, and course resources is greater than 0.05, which indicates that there is a variance chi-square among the factors, and it is possible to read out the data with the same hypothesized variance. Whereas, the probability p-value of F-value on all three dimensions of course objectives, course organization and course evaluation is less than 0.05, which implies that the variance of the factors is not homogeneous, so it is necessary to test the data from under the assumption that the variances are not equal. The two-square outlier probability of each factor was examined and the two-square outlier probability p-value for each dimension was above 0.05, indicating that there is no significant difference between male and female students' satisfaction with the dimensions.

Table 3. Independent sample T-test of satisfaction of different genders

		Levin's test for variance equality		Mean equivalence t test	
		F	Significance	T	Sig. (Double tail)
Course objective	Assumed equal variance	9.293	0.002	0.349	0.728
	Equivariance is not assumed			0.304	0.761
Course content	Assumed equal variance	7.655	0.009	0.224	0.820
	Equivariance is not assumed			0.206	0.85
Course arrangement	Assumed equal variance	8.318	0.003	1.518	0.133
	Equivariance is not assumed			1.340	0.186
Course teaching	Assumed equal variance	6.859	0.02	0.957	0.338
	Equivariance is not assumed			0.865	0.391
Curriculum resources	Assumed equal variance	3.686	0.059	-0.294	0.774
	Equivariance is not assumed			-0.256	0.797
Curriculum evaluation	Assumed equal variance	8.874	0.004	0.100	0.920
	Equivariance is not assumed			0.086	0.933
Totality	Assumed equal variance	16.500	0.001	0.651	0.5162
	Equivariance is not assumed			0.556	0.577

4. Conclusion

Based on multi-source data integration and entropy discretization algorithm, this paper explores the digital optimization path of the curriculum system of business administration majors in colleges and universities. Through the discretization analysis of students' behavioral data, it is found that the data can be divided into 3 major categories and 11 subcategories according to the attribute characteristics, including 3 major categories such as achievement situation, classroom indicators, behavioral indicators, and 11 subcategories such as classroom practice completion rate. Different categories correspond to different students' curriculum needs. Based on the discrete classification results, the curriculum system of business administration majors is optimized. Through comparison experiments and questionnaires, it is found that students' overall satisfaction with the optimized curriculum system of business administration majors is 3.567 points, which is higher than the 3.263 points before optimization. The mean satisfaction score of each dimension after optimization is also higher than that before optimization. Among the specific dimensions after optimization, the satisfaction scores of curriculum resources and teaching attitude are higher, both exceeding 3.7, while the scores of practical teaching and career demand matching are lower, which still need to be further optimized. In the future, decision makers of business administration majors can strengthen university-enterprise cooperation to enhance the practicality of the courses, introduce a dynamic data updating mechanism to respond to industry needs in real time, meet the development needs of students, and enhance the digital literacy and employment competitiveness of business administration students.

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