Research on the impact of AI on college students based on the entropy weight integrated scoring model

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Abstract. In recent years, artificial intelligence technology is developing continuously, which has had a wide impact on the study of college students. This paper uses scale, independent heat coding and other methods to quantify the questionnaire data, screen the evaluation index system by establishing gradual regression model, correlation model and comprehensive evaluation model of entropy right, and quantify the influence of artificial intelligence on college students' learning. First of all, the raw data was statistically analyzed and visualized. The analysis showed that 93.2% of college students hoped to actively use artificial intelligence tools to improve their academic performance. Then, the influence of artificial intelligence on the learning of college students was studied, and the evaluation index system was determined through the Pearson correlation model and the stepwise regression model. Finally, the effect of AI on undergraduate learning is studied through the entropy weight integrated scoring model.

Keywords: Independent heat coding; Outlier analysis; Gradual regression; Correlation; Entropy weight comprehensive score.

1. Introduction

In order to seize the major strategic opportunities of the development of artificial intelligence, The State Council of China issued the Development Plan for Artificial Intelligence in 2017, pointing out that the power should give play to the power of artificial intelligence technology, deploy the first-mover advantage of the development of artificial intelligence in China, and accelerate the construction of an innovative country and a world power in science and technology. In 2018, the Ministry of Education issued the Action Plan of Education Informatization 2.0, which put forward the action guide of "intelligent leading education informatization" and emphasized the development of intelligent education. The development of artificial intelligence has different degrees of influence on all levels of society, and also affects the study of college students.

2. Numerization of the questionnaire data

2.1. Preprocessing and analysis of the questionnaire quantification data

Through the quantification of the questionnaire index data, the quantitative data is further used for data analysis. In order to ensure the validity of questionnaire data, use boxchart analysis, data distribution estimation, and compare the questionnaire data reliability results before and after outlier processing to verify the validity of data processing.

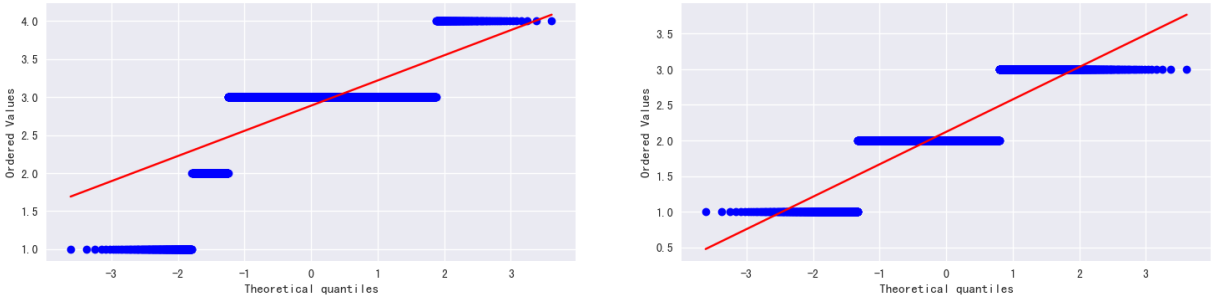

Fig. 1 QQ plot of the normality test for some samples

For the estimation of related parameters, we mainly use maximum likelihood estimation to obtain the results of parameter estimation. For the test of the distribution fitting effect, we mainly used the Kolmogorov-Smirnov (KS) test. Then find out the optimal distribution of single loss fit and the corresponding parameters, expectations, etc.

The probability density function of the Lognormal distribution is defined as:

$$f(x \mid \mu, \sigma) = \frac{1}{x\sigma\sqrt{2\pi}} \exp\left\{\frac{-(ln\ x-\mu)^2}{2\sigma^2}\right\}; x > 0 \quad (1)$$

The expectation and the variance are, respectively:

$$mean = \exp(\mu + \frac{\sigma^2}{2}) \quad (2)$$

$$var = \exp(2\mu + \sigma^2)(\exp(\sigma^2) - 1) \quad (3)$$

Table 1. Lognormal Distribution of fitting parameters and KS test results

Distribution type	Fitted parameters	95% confidence interval	Kolmogorov-Smirnov (KS) test
Lognormal distribution	μ=0.9472 σ=1.24519	[-0.1133,1.2487] [0.9999,1.2577]	h=0.09,p=0.162

From the KS test statistic h=0.09, p=0.162> 0.05, we infer that our data basically fit the Lognormal distribution.

According to the above results of the fitting parameters of the Lognormal distribution, we can finally get the cumulative distribution and the probability density map of the Lognormal distribution as follows:

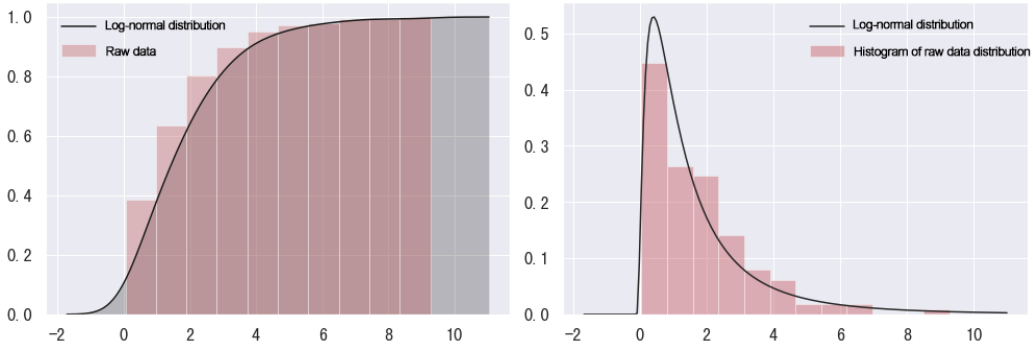

Fig. 2 Cumulative distribution plots and fitted probability density function curves

According to the above figure, we can also find that the log-normal distribution can be basically better fitted to the above original variables. Therefore, this paper uses the Raida criterion to handle the sample outliers, so the outlier processing is considered to use boxchart analysis for further processing.

This paper analyzes the obtained data to prepare for the following modeling analysis.For the processing analysis of outliers, the occurrence of abnormal extreme values in variables will lead to a large gap in the analysis conclusions. So we plan to use boxplot analysis to remove some missing values.

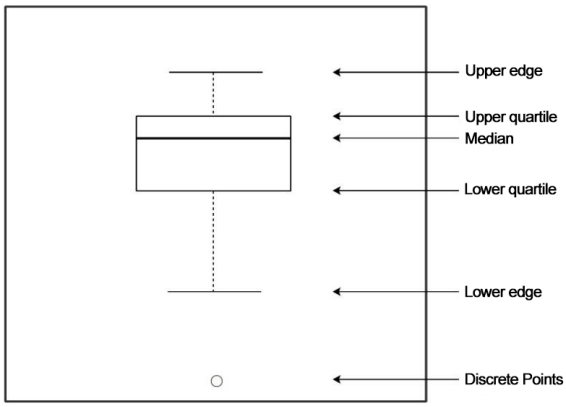

Fig. 3 Case plot analysis of the outlier principle

According to the principle of the above diagram, we plot the boxplot of some variables of the original sample, and eliminate or replace these outlier samples.

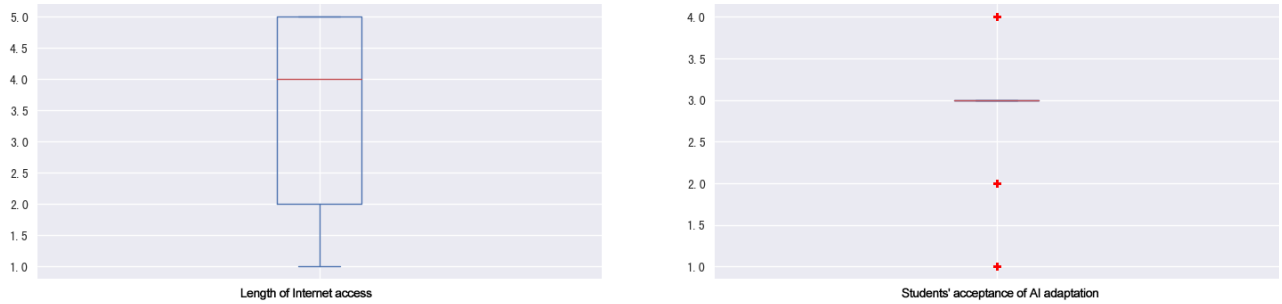

Fig. 4 Boxplots of outlier for questionnaire quantified samples

According to the above method, we can finally preprocess the original data of part of the quantitative indicators, and finally get the complete quantitative sample data after outlier processing. In this paper, the sample data after these outlier processing will be used to establish the evaluation index system and modeling analysis.

2.2. Reliability analysis and description statistics of the questionnaire-quantified data

The scientificity and validity of questionnaire are the basis of sampling survey analysis. Generally speaking, we mainly use reliability analysis and validity analysis to evaluate the reliability and stability of questionnaire. The following is the questionnaire sample data after the above abnormal processing.

Reliability mainly refers to the credibility degree of the questionnaire, which mainly shows the inertia, consistency, reproducibility and stability of the test results. Reliability (Reliability) is reliability, which refers to the consistency of the results obtained from repeated measurements of the same object using the same method. Reliability indicators are mostly expressed by correlation coefficient, which can be roughly divided into three categories: stability coefficient (consistency across time), equivalence coefficient (consistency across forms) and internal consistency coefficient (consistency across items). There are four methods of reliability analysis: retest reliability method, complex reliability method, half reliability method and α reliability coefficient method. In this paper, the α reliability coefficient method is mainly used to test the validity of the questionnaire. Generally speaking, the reliability coefficient is generally between 0 and 1. Generally speaking, the reliability coefficient above 0.6 indicates that the reliability of the questionnaire is acceptable.

In this study, Cronbach's α coefficient was used to measure the consistency within the table. According to the table below, the overall data of the questionnaire are credible. The detailed description is shown in Table 2. The overall reliability of the processed questionnaire data sample reached 0.76, and the reliability of all dimensions exceeded 0.7, indicating that the questionnaire is very credible.

Table 2. Table of reliability analysis before and after outlier processing

Before and after outlier handling	The number of items	Cronbach's Alpha
Before processing	28	0.33
After processing	28	0.76

According to the results of the table analysis, the Cronbach's α coefficient of the questionnaire is high, reaching 0.76, so the data of the survey results are credible.

For further descriptive statistical analysis using the quantitative index data, the final descriptive statistical analysis results of the final scale data can be calculated as shown in the main text Table 3.

According to the results in the above table, the surveyed students generally have a high acceptance of AI, which also shows that most students have a positive attitude towards developing AI tools and the introduction of teaching. They believe that the introduction of artificial intelligence can improve learning efficiency and help to improve academic performance.

Table 3. Results of the descriptive statistical analysis of partially quantified questionnaire indicator data

	The degree of adaptation of students to the acceptance of AI	Artificial intelligence replaces the possibility of teachers	The degree of trust in the AI answer	The degree of approval for AI tools	Time spent online	Grade
count	4605	4605	4605	4605	4605	4605
mean	2.887947883	2.051249	2.120738	2.476004	3.562866	2.000869
std	0.482576776	1.156696	0.538458	0.681867	1.268739	0.944369
min	1	1	1	1	1	1
25%	3	1	2	2	2	1
50%	3	2	2	3	4	2
75%	3	3	2	3	5	3
max	4	4	3	3	5	4

3. Index of refinement based on correlation and stepwise regression models

The pearson correlation analysis of the pearson simple correlation coefficient is calculated as follows:

$$r = \frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2 \sum_{i=1}^{n}(y_i-\bar{y})^2}} \tag{4}$$

Before building the model, this paper first conducts a linear correlation analysis of each variable to roughly analyze the significant relationship between each index variable. Pearson The simple correlation coefficient is used to measure the linear relationship between the fixed-distance variables.

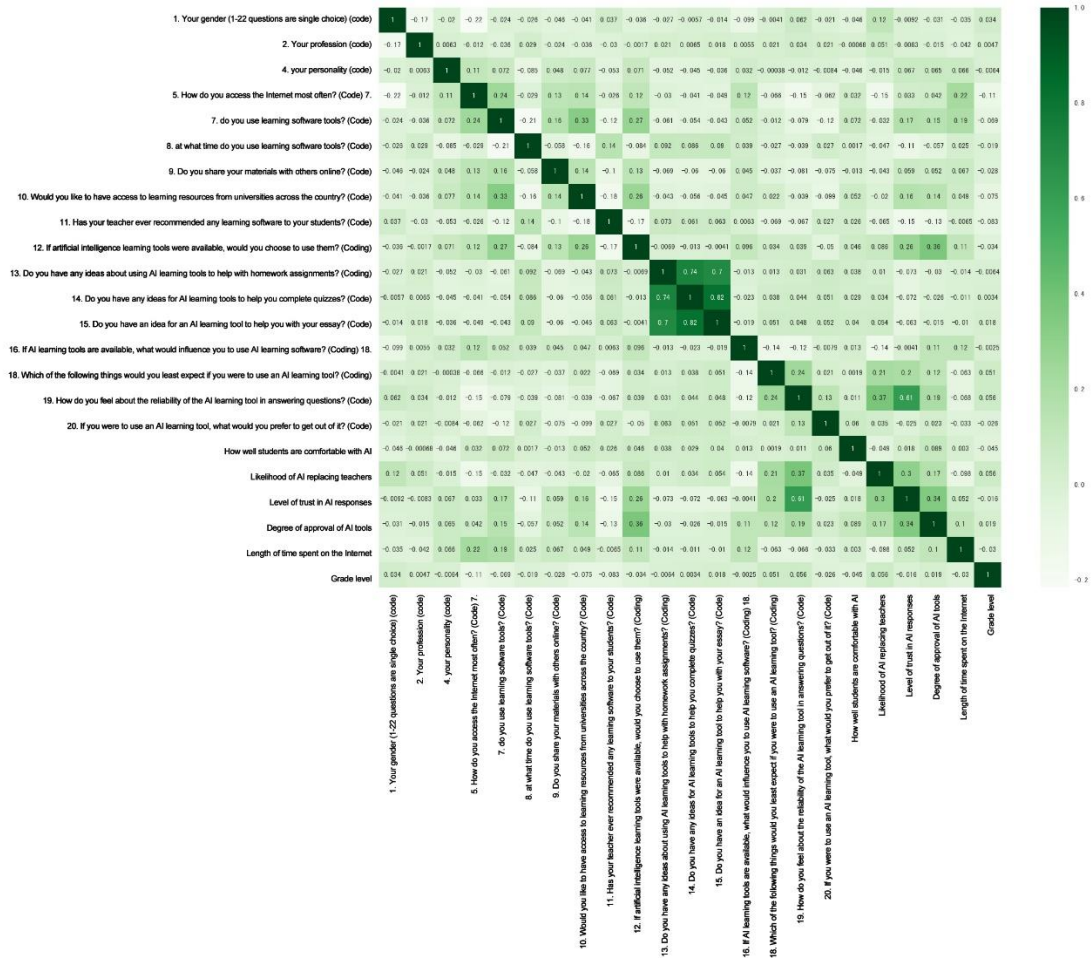

Fig. 5 Heat map of the questionnaire

According to the figure above, it can be found that there is basically no significant linear relationship between the variables, so some variables can be removed, such as gender, Internet access, artificial intelligence tools. Finally, the four index variables can be eliminated through the correlation analysis.

The evaluation index system can be obtained by further using the stepwise regression model to finally refine the index system. The idea of least squares parameter estimation of the regression model is. A set of discrete data $(x_i, y_i), i = 1, \cdots, n$. Choose a relatively simple function $f(x)$, such as a polynomial, under a certain criterion, such as nonlinear least squares, to approximate these data. The value of the highest order in the polynomial fit of order n should follow the sum of deviation squares as small as possible. That is, the core idea of polynomial fitting is to find out the minimum i to satisfy the following formula:

$$Min \sum_{i=1}^{n} |f(x_i) - y_i|^2 \tag{5}$$

Using SPSS software, the gradual regression analysis of the final goodness of fit. The overall test of the regression equation is passed, that is, the overall test of the model is passed, so the model has a certain statistical significance. Then, to verify the index with a small impact score, we only need to find the regression coefficient is not significant, that is, the independent variable excluded by the stepwise regression model. Finally, the evaluation index system can be found in the table below.

Table 4. Complete the evaluation index system

Quantitative indicators of the questionnaire
1.Your Major (Code)
2.When do you use learning software tools? (Code)
3.Will you share your information online with others? (Code)
4.If there were AI learning tools, would you choose to use them? (Code)
5.Do you have an idea to help you with your essay with an AI learning tool? (Code)
6.If there is an AI learning tool, what influences your use of AI learning software? (Code)
7.If you used an AI learning tool, what would be the last thing you wanted? (Code)
8.If you use AI learning tools, what would you rather get? (Code)
9.The degree of adaptation of students to the acceptance of AI
10.Artificial intelligence replaces the possibility of teachers
11.The degree of trust in the AI answer
12.The degree of approval for AI tools
13.Time spent online

4. Entropy weight integrated scoring model was built

Because this paper is a comprehensive evaluation problem with multiple indicators, it is necessary to determine the weight coefficient of each index in the process of comprehensive evaluation, and the subjective empowerment method has strong subjectivity, which often reduces the effectiveness and scientificity of the calculation results. Therefore, we need to choose the indicators required by the model on the basis of expert experience, and use more objective methods to allocate weights, avoid errors caused by human factors, and fully let the data speak. Considering the simplicity and accuracy of objective weight solving, the entropy weight method [8-9] is used to determine the weight.

The data standardization method mainly adopted in this paper is Z-score standardization method. Generally speaking, this method is relatively simple, and the standardization effect is also good. This method standardizes the data based on the mean (mean) and standard deviation (standard deviation) of the raw data. Normalize the original value x of A to x' using Z-score. The Z-score normalization method is applicable where the maximum and minimum values of attribute A are unknown or with outlier data beyond the range of values:

$$New\ data = (Original\ data - Mean)/Standard\ deviation \tag{6}$$

Among them, the default normalization method of SPSS software is Z-score normalization.

Select the n th city share and the m th index, and then x_{ij} is the value of the j th index of the i th country, including: $i = 1,2,\cdots,n, j = 1,2,\cdots,m$.

Calculate the proportion of the i country under the j index:

$$P_{ij} = {X_{ij}}\Big/{\sum_{i=1}^{n} X_{ij}}\ (i = 1,2,\cdots,n, j = 1,2,\cdots,m) \tag{7}$$

The entropy value of the j-th-term index is calculated

$$e_j = -k\sum_{i=1}^{n} P_{ij}\ln(P_{ij}) \tag{8}$$

In the formula, $k > 0, k = 1/\ln(n), e_j > 0$.

The difference coefficient of the j th index was calculated. For the j index, the greater the difference of the index value, the larger the left and right evaluation of the scheme, and the smaller the entropy value. The difference coefficient is defined: $g_j = 1 - e_j/m - E_e$. In formula:

$$E_e = \sum_{j=1}^{m} e_j, 0 \le g_i \le 1, \sum_{j=1}^{m} g_j = 1 \tag{9}$$

The last step is to solve the entropy weight size of the selected index as follows

$$W_j = g_j / \sum_{j=1}^{m} g_j, 1 \le j \le m \quad (10)$$

According to the solution weight of the entropy weight method, the final entropy weight score results of the 13 indicators can be obtained as follows

Table 5. Comprehensive score of the index entropy weight

Index	Metric weight score
If you use AI learning tools, what would you rather get? (Code)	0.076096919
Your Major (Code)	0.075421362
The degree of adaptation of students to the acceptance of AI	0.069623677
The degree of trust in the AI answer	0.064783462
If you used an AI learning tool, what would be the last thing you wanted? (Code)	0.058913811
Time spent online	0.051010896
grade	0.047483923
Will you share your information online with others? (Code)	0.038929258
Do you have an idea to help you with your essay with an AI learning tool? (Code)	0.030503069
Artificial intelligence replaces the possibility of teachers	0.028869682
If there is an AI learning tool, what influences your use of AI learning software? (Code)	0.023400125
When do you use learning software tools? (Code)	0.014412334
If there were AI learning tools, would you choose to use them? (Code)	-0.000496026

According to the above entropy right comprehensive scoring results, the development of ARTIFICIAL intelligence has a significant impact on the improvement of students' learning. The quantified index entropy right score shows that the maximum index entropy right score of artificial intelligence tools is 0.076, which is the index that students care most about in the process of using artificial intelligence. It directly determines whether artificial intelligence can have a significant impact on learning, which is also well understood. It is reflected in the good demand and use way that is the driving force for the vigorous development of artificial intelligence technology. In addition, students' acceptance degree of AI, specialty, trust degree and other indicators also have a significant positive impact on the development of AI.

5. Evaluation and improvement of the model

5.1. Advantages of the model

Using the gray correlation-fuzzy algorithm, the information entropy can be used to evaluate the order of the system information and its utility, that is, the judgment matrix composed of the evaluation index value to determine the weight of the index, so as to eliminate the human interference of the weight of each index, so that the evaluation results are more in line with the reality;

This paper uses the clustering algorithm to test the fuzzy evaluation results and fully explain the accuracy of fuzzy rating;

This paper uses the gray correlation degree to determine the maximum membership operator of fuzzy evaluation, so that the research of this paper is more accurate.

5.2. The shortcomings of the model

Due to ignoring the importance of the index itself, the entropy method sometimes determines the weight of the index far from the expected result, and the entropy method cannot reduce the dimension of the evaluation index.

References

[1] He Yi, Liu Yun. Machine learning-based algorithm for outlier detection of questionnaire data [J]. Electronic Technology and Software Engineering, 2021 (02): 40-41;

[2] Wang Qinghua, selection of standard evaluation indicators of Artificial Intelligence [J], Journal of Luoyang Normal University, 15 (1): 2-3,2004;

[3] Xu Yi, Yuan Jianhua, et al., design of comprehensive evaluation index system for sustainable development and evaluation of three future artificial intelligence standard schemes [J], practice and understanding of mathematics, 12 (4): 5-6,2003;

[4] Zhang Caixia, Liu Guisong, Hebei Evaluation method and empirical Analysis of Artificial Intelligence Standards [J], Journal of Shijiazhuang Railway University, 5 (2): 56-78,2009;

[5] Huang Mei, Yang Shaobing, application of fuzzy clustering in negative charge modeling [J], Power grid technology, 30 (14): 49-52,2006.

[6] Li Cheng, K-means clustering algorithm based on immunization programming [J], Journal of Computer Science, 26 (5): 605-610,2003;

[7] Guo Cunzhi, Ling Kang, Bai Xianchun, et al., an improvement of the comprehensive evaluation of sustainable development [J], Resources Science, 32 (7): 23-25,2010;

[8] Huang Qiusheng, on artificial Intelligence Standards and Sustainable Development in Hengyang City [J], Journal of the University of South China: Social Science Edition, 2008 (6): 120-122,2008;

[9] Wang Daxing, Zhai Mingqing, Application of Data Processing and Modeling Method in Mathematical Modeling Teaching [J], Journal of Beijing Institute of Education, 9 (1): 5-10,2014;

[10] Ma Hongqi, Chen Zhongchang, China's Index System Construction and Comprehensive Evaluation of Artificial Intelligence Standard Evaluation [J], Southern Artificial Intelligence Standard, 27 (3): 3-12,2012;

[11] Qiu Ling, Li Houqiang, Research on the Decision Model of AI Standard Evaluation combining ideal solution and gray correlation [J], School of Architecture and Environment, Sichuan University, 2007,71-75;