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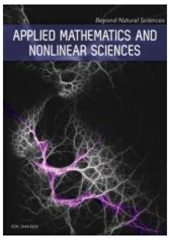

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Construction of a mathematical modeling teaching quality assessment system for universities based on Eviews model

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Abstract

Quality assessment of university education and teaching is an essential and important part of teaching and learning activities. Over the years, a large amount of data has been accumulated in teaching and management, but the potential value of these data has not been fully utilized. How to use a large amount of data scientifically, automatically, and more effectively for rational analysis and guidance of current teachers' teaching work has become a key issue in testing the effectiveness of teaching quality assessment, and an in-depth study is urgently needed. In this paper, we use the Eviews model, regression analysis algorithm, Apriori association rule algorithm, and other techniques. It conducts research on the assessment of teaching quality in Chinese universities. Finally, after completing the construction of the system, the main modules in the system, system management, resource management, quality assessment, and assessment query module, focused on testing. A total of 160 test cases were designed, of which 157 test results met the requirements of the system, and 3 results did not meet the requirements, with a success rate of more than 98%. The results show that the system has no major defects, runs normally, has stable performance, and meets the system requirements for teaching quality assessment in universities.

Keywords: Eviews model; Teaching quality; Assessment system; Regression analysis algorithm; Apriori algorithm
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1 Introduction

In recent years, more and more universities have begun to pay attention to the quality of teaching, and many of them realize quality management through the inspection and control of teaching quality [1]. In the management of teaching quality, the classroom effect of teachers' teaching and students' evaluation of teachers are very important components. The current mainstream teaching assessment is based on students, supplemented by internal or external experts listening to classes []-[3]. Students' assessment, often by the school academic management department at the end of the period, will be sent to students the teacher's teaching quality assessment card, students from their own perspective, according to the actual situation of the rating; experts listening to the class can be divided into internal experts listening to the class and external experts listening to the class, these experts have rich experience in teaching, they are through the random with the classroom to assess the teacher; teaching assessment can also be conducted within the school teachers to evaluate each other, these scores counted, and finally the teachers' teaching quality grade is determined according to the scoring results after the statistics of the academic affairs management department []-[6]. Under this evaluation method, only purely quantitative assessment results can be obtained, and the assessment data cannot be analyzed. The traditional evaluation method can only obtain the ratings of students or experts, or teachers, and these ratings only contain the results, and the characteristics or strengths and weaknesses of the evaluated person cannot be analyzed from these results, and thus no further guidance can be formed for these teachers. With the progress of computer technology, many universities have successively established increasingly perfect teaching quality assessment management systems and accumulated a large amount of teaching assessment data information []-[8]. However, at present, the main use of these data is to provide statistical reports to school management departments at all levels for information inquiries. It is a pity that the valuable information hidden in these data has not been fully exploited []-[11]. Therefore these data cannot fully play the role of guidance for teaching and learning. How to scientifically and effectively use a large amount of data and its hidden valuable information to guide teachers' teaching has become a key issue concerning the effectiveness of teaching quality assessment, which needs to be studied in depth urgently.

In the field of vocational education in China, the first college to evaluate the quality of teaching and learning was in Guangdong Province, and in 2004, the Ministry of Education of China organized national colleges and universities to evaluate the construction of teaching and learning in various professional sciences. Later, in 2005, the Ministry of Education (MOE) launched the "100 Model Higher Vocational Colleges Construction Project" to improve the overall construction of higher vocational colleges. In the literature [12], many scholars have made important discussions on the methods of teaching quality evaluation, but few Chinese universities and research institutions have adopted data mining techniques for teaching management systems. Therefore, combining regression analysis algorithm and Eviews technology to deeply mine the teaching information in the teaching quality evaluation system and obtain objective and fair evaluation results has become the focus of research. Literature [13], represented by Zhejiang University, used data mining methods for the management of talent information of university teachers to explore the favorable factors related to the construction of teachers' teams according to teaching management. The teaching management department of Xiamen University conducted a study on the teaching methods of students, which used linear regression equations and association rules to study the intrinsic link between students' academic performance and teachers' teaching methods. The literature [14] introduced data mining in the teaching evaluation process by obtaining teaching management-related data, such as students' grades, course schedules, and teachers' information, from the college's academic affairs management system to form a data warehouse and then using an algorithm based on association rules to establish a data mining model, through which the model was able to mine the degree of teachers' education and the course grades of teaching students with a certain correlation, so as to guide the college to strengthen the construction of teaching faculty and introduce higher level talents. The literature [15] developed a teaching quality assessment system based on B/S architecture within Zhejiang University, and the frequent item set algorithm Apriori of association rules and the classification decision tree algorithm C4.5 of the machine learning algorithm was also used in the teaching quality assessment part of the system. The literature [16] also used relevant algorithms of data mining to study the model of teaching quality assessment and proposed a data mining model for teaching quality assessment based on rough set theory and genetic algorithm. The literature [17] selected higher education institutions for the study of the teacher assessment systems, and in its, the study mainly used data analysis software SPSS (Statistical Product and Service Solutions) and Weka (Waikato Environment for Knowledge Analysis). The data on teachers' teaching quality assessment was mined and analyzed.

In order to design a system for a faster and more comprehensive assessment of teaching quality. This paper investigates the advantages of regression models over traditional approaches to numerical prediction and the ability of the Apriori algorithm to discover association rules. The regression model is then optimized by combining the statistical, analytical, and predictive capabilities of Eviews software with a series of derivative analysis processes. After analyzing and comparing the optimal regression model, the flawed part of the Apriori algorithm is then improved so that it takes less time to discover association rules compared to the original algorithm.

2 Mathematical modeling of university teaching quality assessment using Eviews

The main content of this chapter is an introduction to Eviews software, which provides us with sophisticated data analysis, regression, and forecasting tools based on the Windows platform. Eviews enable us to quickly obtain statistical relationships from data and make predictions based on these statistical relationships.

2.1 Introduction to Eviews software

The Eviews software system is a sophisticated Windows-based data analysis, regression, and forecasting tool provided by QWS, Inc. in the United States, often referred to as an econometric software package and is one of the most popular econometric software packages in the world today.

Eviews is the abbreviation of ECONOMETRICS VIEWS, which originally meant "observation" of the quantitative laws of socio-economic relations and economic activities using econometric methods and techniques. It has the functions of data processing, graphing, statistical analysis, modeling and analysis, forecasting and simulation, etc.

Eviews provides a convenient way to enter data from the keyboard, from disk files, and to obtain new data from existing data, as well as to display and print data, perform statistical analysis of data series, and correlation analysis. And you can use the results displayed in the window through standard Windows technology. In addition, Eviews' powerful command functions and its extensive programming language can be used to access the command window to modify commands and to generate and store the corresponding computational program files for a series of computational tasks. This allows the work to be completed by running the program directly.

2.2 Eviews Foundation

The core of Eviews is the object, which is a unit of information or arithmetic bundled together with certain relationships for use, and working with Eviews is working with different objects [18]. The objects are placed in a collection of objects, where the working document is the most important collection of objects.

1) Create a new working document

   Selecting Menu Plus brings up the Frequency of Data dialog box. The frequency of the data can be selected from the menu. The optional frequencies include annual, semi-annual, quarterly, monthly, weekly, daily, and non-time series or irregular data. The start date can be entered in the Start date text box and the end date in the End date text box, with the year, separated from the number followed by ":." The date is expressed as follows: Year: two digits are available for the twentieth century, the rest are four digits; Half year: year followed by 1 or 2; Quarterly: year followed by 1-4; Monthly: year followed by 1-12; Week: month/day/year; Day: month/day/year; Non-time series or irregular data: number of samples.

2) Open old work files

   Use the menu File/open/workfile to open an existing workfile.

3) Working document window

   After creating a work file or opening an old work file, you can see the following work file window

4) Save working files

   To save a work file, select File/Save or File/Save from the Windows standard dialog box that appears and choose the directory and file name where the file is to be saved.

5) Reset the working paper scope

   To change the range interval of a work file, select Procs/Change work file Range and enter the new start and end dates. The workfile range can also be changed by double-clicking on Range in the workfile directory [19].

2.3 Object base

The information in Eviews is stored in objects. Each object contains information related to a specific analysis domain. Associated with each type of object is a set of views and procedures that are used together with the information in the object [20]. This association of views and procedures with the data in the objects is referred to as an object-oriented design of Eviews.

1) Data in the object

   Different objects contain many different kinds of information. For example, sequence objects, matrix objects, vector objects, etc., contain mainly numerical information. Equation objects and system objects contain complete information about the equation or system and contain information about the result of the estimation in addition to the data used to make the estimation. Graph and table objects contain numerical, textual, and format information.

2) Object view

There are different views for different objects. Sequence objects have a chart view (to view raw data), linear coordinate view, bar coordinate view, histogram view, correlation view, distribution scatter view, QQ scatters view, and kernel density plot. Simple hypothesis testing and statistical analysis can also be performed using the views of the series.

3) Object process

Many Eviews objects also include procedures. Like views, procedures are usually displayed in the object window as charts or coordinates. Unlike views, procedures change data, whether in the object itself or in other objects. Many procedures also create new objects. For example, a sequence object contains procedures that perform smoothing and seasonal adjustment, and the procedure can create a new sequence containing the smoothed as well as the adjusted data. The equation object process can create new series containing residuals, fitted values, and predictions. Procedures can be selected using Procs on the Eviews main menu or on the Object window toolbar [21].

4) Object type

In addition to sequence objects and equation objects, there are many other types of objects, each of which is represented by a specific icon in the object collection. Although object collections are also objects, object collections do not have icons, so work files and databases cannot be placed in other work files or databases.

5) Create objects

Before you can create an object, you must have a working file collection open, and the working file window must be active. Then select Objects/New Object on the main menu, and the Working File Collection window will appear. Select the type of the new object in Type of Object, and enter the object name in Name for Object.

6) Selection of objects

Objects can be selected by clicking the object icon in the work file window or by using the View menu on the main Eviews window or the work file window, which includes Deselect All, Select all, and Select by Filter.

7) Open object

The selected object can be opened by double-clicking or by using the menu View/Open as One Window. Opening a single object brings up the object window. Opening multiple selected objects create a new object or open each object in its respective window.

8) Display objects

Another way to select and open an object is to use Show in the Quick/Show working file window on the main menu. If you enter the name of a single object in the dialog box, it opens the object window. If multiple objects are entered, Eviews will open a window to display the results and create a new object if necessary [22].

9) Object window toolbar

Each object window has a toolbar, the content of which varies from object to object, but some buttons are the same. The view button is used to change the view form of the object window. The Procs button can be used to perform a procedure on an object. The objects button can store, name, copy, delete, and print objects. Print button prints the view of a single previous object. The name button allows you to name or change the name of the object. The Freeze button allows you to create a new graphical object, table object, or text object with the current view prevailing.

10) Object naming

Name in the Object window toolbar allows you to name an object, whereas Display Name is the name of the object displayed in the graph or table. If you want to rename an object, you can select Objects/Rename Selected. Serial objects cannot use the following names: ABS, ACOS, AR, ASIN, C, CON, CNORM, COEF, COS, D, DLOG, DNORM, ELSE, ENDIF, EXP, SMA, SQR, THEN.

2.4 Basic data processing

The paper mainly consists of discussing the operations of sequences and groups, and the operations of sequences are shown in Table 1. The operations of groups are shown in Table 2.

Table 1. Eviews Sequence Operations

Create sequence objects	(1) Click on Object/New Object in the main menu of Eviews and then select Series. (2) Click on Object/Generate Series in the main menu of Eviews to type an expression that will form a new sequence.
Edit Sequence	Click on the sequence name and then click on the Edit+/- button to switch the editing status. When in the editable state, you can modify the data and press enters to confirm.
Change form display	It is usually displayed in vertical rows. Click the Wide+/- button to switch to a table display.
Changing the sample interval	Click the Smpl+/- button to toggle the sample interval of the sequence to the current sample interval or the working de-sample interval.
Insert Delete Value	Select the cell to be inserted or deleted and click the InsDel button to insert or delete it.

Table 2. Eviews Group Operation

Create group objects	(1) Click on Objects/New Object in the main menu of Eviews and then select Group to type in the sequence list. (2) Select the name and sequence name and click show to form a new group.
Editor	Click on the group name or Show to display the data in the group, and then click on the Edit+/- button to switch the editing status. When in the editable state, you can modify the data and press enters to confirm.
Changing the sample interval	Click the Smpl+/- button to switch the sample interval of the sequence to the current sample interval or the sample interval of the working area.

3 Model design of teaching quality assessment system

3.1 Application of association rule method in teaching quality assessment

The most famous association rule discovery method, is the Apriori algorithm proposed by R. Agrawal []-[24]. The Apriori algorithm uses a circular hierarchical sequential search method to find frequent item sets: frequent k-itemsets are used to find frequent (k+1)-itemsets. This is done by first scanning the entire database to find all frequent 1-item sets with minimum support greater than or equal to L1;

then L1∞L1 to find the set of all candidate 2-item sets and generate the set of frequent 2-item sets through a pruning step; and so on and so forth until the user's mining needs are satisfied or no more frequent k-item sets can be generated.

3.1.1 Steps of the Apriori algorithm

1) Scan the database and find the set of all frequent 1- items with support > min-sup denoted as L1.

2) Connection step: Connect Lk-1 with Lk-1 to obtain the candidate set Ck of Lk; the connection is made by setting l1 and l2 to be the set of items in Lk-1 and the items in li(1≤i≤k-1) are ordered by a dictionary, and setting li[j] to denote the jth item of li. If the first k-2 items of li are equal to the first k-2 items of lj(1≤j≤k-1), then li and lj are connectable. That is, they satisfy the condition

$$(li[1]=lj[1])\wedge(li[2]=lj[2])\wedge\ldots(li[k-2]=lj[k-2])\wedge(li[k-1]<lj[k-1]) \qquad (13)$$

   li and lj produce an itemset from the candidate k- itemset, and so on, until no more itemsets can be found.

3) Pruning step, two properties of the Apriori algorithm:

   All frequent k- itemsets must be in Ck, i.e., all subsets of frequent k-itemsets are frequent itemsets (k-1) itemsets. Based on these two properties and the predefined min-sup, the itemsets that do not satisfy the conditions are removed and finalized. Each determination requires scanning the entire database, which consumes a lot of time and space, so the optimization of this step of determining frequent itemsets has become the focus of many scholars' research. The association rules are generated from the frequent itemsets according to the previously set minimum confidence level.

3.1.2 Defects of Apriori algorithm and improvement methods

According to the analysis of the Apriori algorithm, association rule mining can generate association rules relatively efficiently, but it also has the serious drawback of an inefficient algorithm [25]. The main reason is that the number of database scans is too many. Finding each k a frequent itemset (k=1, 2, ..., k) requires scanning the database once, for a total of k scans. Therefore when the database or k is too large, the algorithm will be to time-consuming or even impossible to complete [26]. In order to improve the performance of the Apriori algorithm, there have been many methods to further improve and extend Apriori. The more productive ones are hash-based techniques, transaction compression, division methods for finding candidate items, dynamic item set counting, etc., which will not be discussed in detail here.

3.1.3 Comparison of the classical Apriori algorithm with the improved algorithm

The improved Apriori algorithm improves the operational efficiency because it reduces the I/O access to the database during pruning and reduces the generation of new duplicate items during the union, and the time comparison between the improved Apriori algorithm and the classical algorithm in this paper is shown in Figure 1.

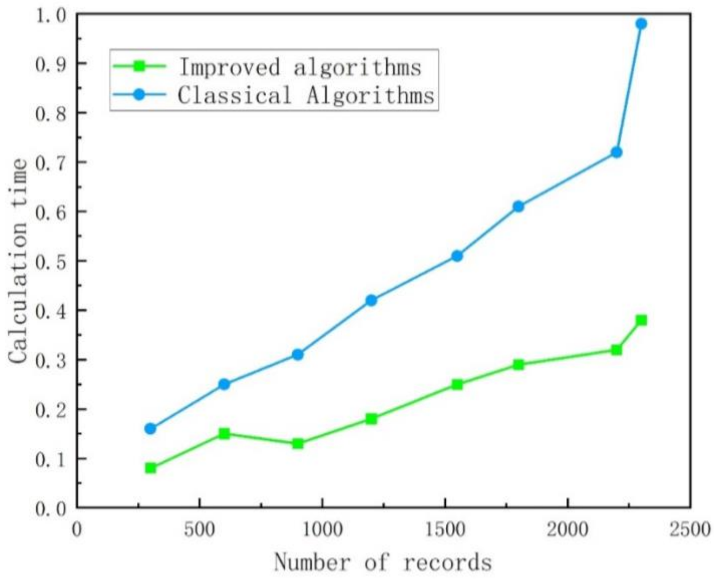

Figure 1. Algorithm time comparison chart

From Figure 1, it can be seen that the running time of the improved algorithm is generally 1/2 of the time of the classical algorithm. With the increase of database records, the time used by the classical algorithm increases very fast, and the improved algorithm reduces the access to database I/O, so the time increases more slowly, and the time advantage of the improved algorithm is even more obvious in the calculation of 10,000 and 100 million records.

3.2 Multiple linear regression model

Numerical prediction is the prediction of continuous or ordered values based on a given input. Currently, the most widely used numerical prediction method is the regression method [27]. Teaching assessment prediction in higher education is the prediction of the marks given by students at the end of the course based on the information available about the teacher. This work belongs to numerical prediction, and in this paper, the multiple linear regression method was chosen for prediction.

Multiple linear regression considers the dependent variable y multiple influenced by n factors $x_1, x_2, \cdots, x_n$ and random factors ε , $n > 1$. y and n factors $x_1, x_2, \cdots, x_n$ satisfying a linear relationship between them:

$$y = c_0 + c_1 x_1 + \cdots + c_n x_n + \varepsilon \tag{1}$$

Where $c_0, c_1, \cdots, c_n$ is the $n+1$ unknown parameters, ε is an unmeasured random error, and is usually assumed to be $\varepsilon \sim N\left(0, \sigma^2\right)$. Where (1) is called the multiple linear regression model. y is called the explained variable (dependent variable) and $x_i (i = 1, 2, \cdots, n)$ is the explanatory variable (independent variable).

If there is k set of sample data $\left(x_{i1}, x_{i2}, \cdots, x_{im}; y_i\right), i = 1, 2, \cdots, k$ from the actual problem, then they all satisfy equation (1), i.e., there is equation (2)

$$\begin{cases} y_1 = c_0 + c_1 x_{11} + c_2 x_{12} + \cdots + c_p x_{np} + \varepsilon_1 \\ y_2 = c_0 + c_1 x_{21} + c_2 x_{22} + \cdots + c_p x_{np} + \varepsilon_2 \\ \cdots\cdots \\ y_k = c_0 + c_1 x_{k1} + c_2 x_{k2} + \cdots + \beta_p x_{np} + \varepsilon_k \end{cases} \tag{2}$$

We usually express equation (2) in matrix form, as in equation (3)

$$Y = XC + \varepsilon \tag{3}$$

Where $Y = \left(y_1, y_2, \cdots, y_k\right)^T$, $C = \left(c_0, c_1, \cdots, c_n\right)^T$, $\varepsilon = \left(\varepsilon_1, \varepsilon_2, \cdots, \varepsilon_k\right)^T$, $\varepsilon \sim N_k\left(0, \sigma^2 I_k\right)$,1, I_k is the k rd order unit matrix and the $k \times (n+1)$ th order matrix X is called the information matrix or design matrix and is assumed to be full column rank, i.e. $rank(X) = n+1$.

$$X = \begin{bmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1n} \\ 1 & x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & & \vdots \\ 1 & x_{k1} & x_{k2} & \cdots & x_{mn} \end{bmatrix} \tag{4}$$

From model (3) and the properties of the multivariate normal distribution, Y still obeys a n-dimensional normal distribution, which has an expectation vector of $X\beta$ and a variance and covariance array of $\sigma^2 I_n$, or $Y \sim N_n\left(X\beta, \sigma^2 I_n\right)$.

3.2.1 Least squares estimation of the parameters of the multiple linear regression model

The first step in establishing the multiple linear regression equation is to estimate the unknown parameters. $c_0, c_1, \cdots, c_n$ For this purpose, we need to obtain k sets of sample data $\left(x_{i1}, x_{i2}, \cdots, x_{in}; y_i\right), i = 1, 2, \cdots, k$ from the actual problem, and then the least squares (OLS) method can be used to estimate the unknown parameters based on these k samples $c_0, c_1, \cdots, c_n$ []-[29].

The principle of least squares is to minimize the sum of squares of the residuals (estimates of the error terms), i.e., the calculated $C = \left(c_0, c_1, \cdots, c_n\right)^T$ minimizes the sum of squares of the residuals, i.e., $S(C)$ minimizes in Equation (5).

$$\begin{aligned} S(C) \triangleq \sum_{i=1}^{k} \varepsilon_i^2 &= \vec{\varepsilon}^T \vec{\varepsilon} = (Y - XC)^T (Y - XC) \\ &= \sum_{i=1}^{k} \left(y_i - c_0 - c_1 x_{i1} - c_2 x_{i2} - \cdots - c_n x_{in}\right)^2 \end{aligned} \tag{5}$$

Since $S(C)$ is a non-negative quadratic function about $c_0, c_1, \cdots, c_n$, there must be a minimum value using the polar solution of calculus. Denoting the least-squares estimate of $c_i (i = 0, 1, \cdots, n)$ by $\hat{c}_i (i = 0, 1, \cdots, n)$, we have the system of equations (6)

$$\begin{cases} \dfrac{\partial S(\hat{C})}{\partial c_0} = -2\sum_{i=1}^{k}\left(y_i - \hat{c}_0 - \hat{c}_1 x_{i1} - \hat{c}_2 x_{i2} - \cdots - \hat{c}_n x_{in}\right) = 0 \\ \dfrac{\partial S(\hat{C})}{\partial c_1} = -2\sum_{i=1}^{k}\left(y_i - \hat{c}_0 - \hat{c}_1 x_{i1} - \hat{c}_2 x_{i2} - \cdots - \hat{c}_n x_{in}\right)x_{i1} = 0 \\ \cdots\cdots\cdots\cdots \\ \dfrac{\partial S(\hat{C})}{\partial c_n} = -2\sum_{i=1}^{k}\left(y_i - \hat{c}_0 - \hat{c}_1 x_{i1} - \hat{c}_2 x_{i2} - \cdots - \hat{c}_n x_{in}\right)x_{in} = 0 \end{cases} \tag{6}$$

The system of equations (6) can be expressed as equation (7).

$$X^T(Y - X\hat{C}) = 0 \tag{7}$$

Shift the term to obtain equation (8).

$$X^T X\hat{C} = X^T Y \tag{8}$$

Based on the assumption $R(X) = n+1$, so $R\left(X^T X\right) = R(X) = n+1$, so $\left(X^T X\right)^{-1}$ exists, solve the regular system of equations (6) to obtain the formula (9)

$$\hat{C} = \left(X^T X\right)^{-1} X^T Y \tag{9}$$

Call $\hat{y} = \hat{c}_0 + \hat{c}_1 x_1 + \hat{c}_2 x_2 + \cdots + \hat{c}_n x_n$ the empirical multiple linear regression equation.

3.2.2 Prediction of teaching assessment scores based on multiple regression analysis

Construction of a predictive model for teaching evaluation using multiple linear regression models

$$y = c_0 + c_1 x_1 + \cdots + c_8 x_8 \tag{10}$$

The least squares estimation of the parameters of the multiple linear regression model was used to calculate the value of $\hat{c}_i (i = 0,1,\cdots,8)$ as shown in Table 3.

Table 3. Predictive model parameter values for teaching evaluation based on multiple regression analysis

Parameters	Corresponding independent variables and their meanings	Value
c_0		54.222
c_1	x_1 Sex	2.1676
c_2	x_2 Title	6.5459
c_3	x_3 Education	3.9322
c_4	x_4 Degrees	6.8523
c_5	x_5 Teaching experience	4.8649
c_6	x_6 Learning Edge	5.3816
c_7	x_7 Whether you have held relevant courses	5.4534
c_8	x_8 Scientific Research Capability	1.4786

Therefore, the prediction model of teaching assessment scores based on multiple regression analysis is shown in Equation (11), and teaching assessment prediction can be made based on this model.

$$\begin{aligned} y = 54.222 + 2.1676x_1 + 6.5459x_2 + 3.9322x_3 + 6.8523x_4 \\ +4.8649x_5 + 5.3816x_6 + 5.4534x_7 + 1.4786x_8 \end{aligned} \tag{11}$$

3.2.3 Independent variable selection in the linear regression model

When building a multiple linear regression analysis models, it is common to always make the model include as many independent variables as possible for fear of losing useful factors. However, as more independent variables are taken into account, problems arise. Some of the independent variables actually have no effect, and some of them overlap with the effects of other independent variables, which not only increases the computational effort but also decreases the estimation of model parameters and the predictive performance of the model. Therefore, it is necessary to select the important independent variables among many factors and build up a regression model that is both reasonable and simple, and practical.

Commonly used independent variable selection methods are []-[31]:

1) Regression of all possible subsets: The subsets of all independent variables are selected to build regression equations separately, and the regression equation built by the optimal combination of independent variables is selected as the final choice.

2) Forward method: The most important variable is first introduced into the regression equation to check whether it passes the significance test, then the second important independent variable is introduced into the regression equation, and the regression continues in this way until the partial F values of all the independent variables not introduced into the equation are less than the critical value of the significance test, i.e., no more independent variables can be introduced into the regression equation. The resulting regression equation is the finalized equation.

3) Backward method: First, the regression equation is built with all independent variables, then the least important independent variable is deleted from this equation, and then the linear

regression equation is built with the remaining N independent variables, and the least important independent variable is deleted again.

The independent variable selection method adopted in this paper is a combined improvement of the forward and backward methods to reduce the amount of arithmetic involved in selecting independent variables in linear regression.

The steps of the independent variable selection method in this paper are specified as follows:

1) Let there be a total of m independent variables affecting the dependent variable y in the regression problem under consideration, and first establish m linear regression equations with y for each of these m independent variables; calculate the partial F-test values of these m linear regression equations and rank the independent variables in ascending order as x1, x2, ...xm.

2) Select the first k=m/2 independent variables to establish a linear regression equation; calculate the F-test value of this regression equation; if the F-test value passes the significance test, turn k=k+1 to (3); if the F-test value does not pass the significance test, turn k=k-1 to (4).

3) Select the first k independent variables to establish a linear regression equation; calculate the F-test value of this regression equation; if the F-test value passes the significance test, then turn k=k+1 and turn to (3). Otherwise end.

4) Select the first k independent variables to establish a linear regression equation; calculate the F-test value of this regression equation; if the F-test value does not pass the significance test, then turn k=k-1, turn to (4), otherwise end.

3.2.4 Testing the optimized teaching evaluation prediction model based on

The independent methodological variables using this paper were selected in order to create an optimized instructional assessment model. The results of the independent variable selection are shown in Table 4.

Table 4. Results of independent variable selection

Independent variable	Correspondence and its meaning
x_1	Degrees
x_2	Title
x_3	Whether you have held relevant courses
x_4	Learning Edge
x_5	Teaching experience
x_6	Education
x_7	Sex

Table 5. Predictive model parameter values for teaching evaluation based on multiple regression analysis

Parameters	Corresponding independent variables and their meanings	Value
c_0		54.222
c_1	x_1 Degrees	6.8523
c_2	x_2 Title	6.5459
c_3	x_3 Whether you have held relevant courses	5.4534
c_4	x_4 Learning Edge	5.3816
c_5	x_5 Teaching experience	4.8649
c_6	x_6 Academic qualifications	3.9322
c_7	x_7 Sex	2.1676

The multiple linear regression equation used for the predictive model of instructional assessment was reconstructed according to the independent variables selected in Table 3, the coefficients are shown in Table 5, and the equation is shown in Equation (12).

$$\begin{aligned} y = 54.222 + 6.8523x_1 + 6.5459x_2 + 5.4534x_3 + 5.3816x_4 \\ +4.8649x_5 + 3.9322x_6 + 2.1676x_7 \end{aligned} \tag{12}$$

The optimized prediction model was tested, and the test results are shown in Table 6. It can be seen that the fit improves a little with the reduction of one independent variable. A check of the F distribution table shows that the F statistic $509.48 > F_{0.01(7,308)}$, so the formula passes the significance test.

Table 6. Optimized prediction model test results

R Value	R^2 Value	$\bar{R}^2$ Value	F Statistics
316	0.9205	0.9187	509.48

The optimized prediction model is evaluated, and the errors are shown in Table 7, which shows that the errors are reduced a little with the reduction of one independent variable.

Table 7. Optimization of predictive model evaluation

Root mean square error *MAE*	Average absolute error *MAE*	The average absolute value of relative error *MAPE*
0.64813	0.95331	0.011099

4 System requirement analysis

4.1 Data Analysis

Using the improved Apriori algorithm in this paper, the input minimum confidence threshold is 0.4. In order to make the data analysis more obvious, the minimum support threshold of 0.1 is selected for the analysis part of this paper, and the candidate 1 item set support statistics plot is obtained according to the constructed scoring information matrix, as shown in Figure 2.

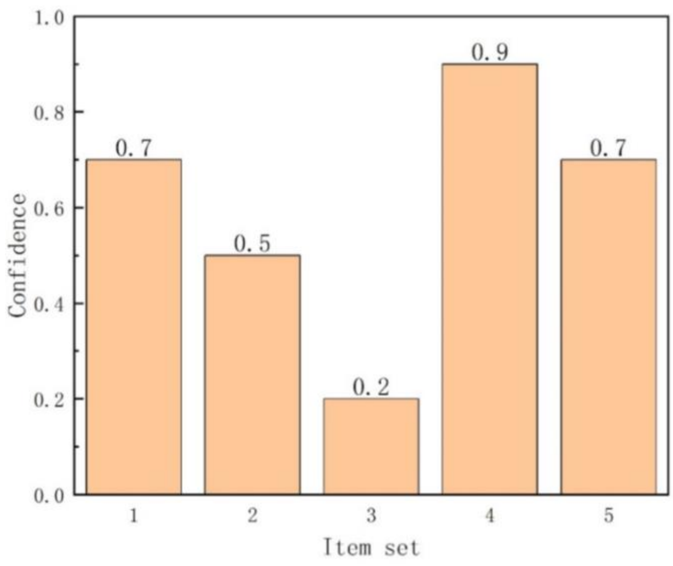

Figure 2. Candidate 1 item set support statistics graph

Analyzing Figure 2, in which:1 represents the 1-item set {T1}, 2 represents the 1-item set {T2}, 3 represents the 1-item set {T3}, 4 represents the 1-item set {T4}, and 5 represents the 1-item set {T5}. The black horizontal line is the lower line of the minimum support, and the support of each candidate 1-item set is above the minimum support, so it is concluded that all five candidate 1-item sets are frequent sets, which can be considered as frequent 1-item set support statistics graph. For the 1-item frequent set for the union, the candidate 2-item set is generated, as shown in Figure 3, which is the candidate 2-item set support degree distribution graph.

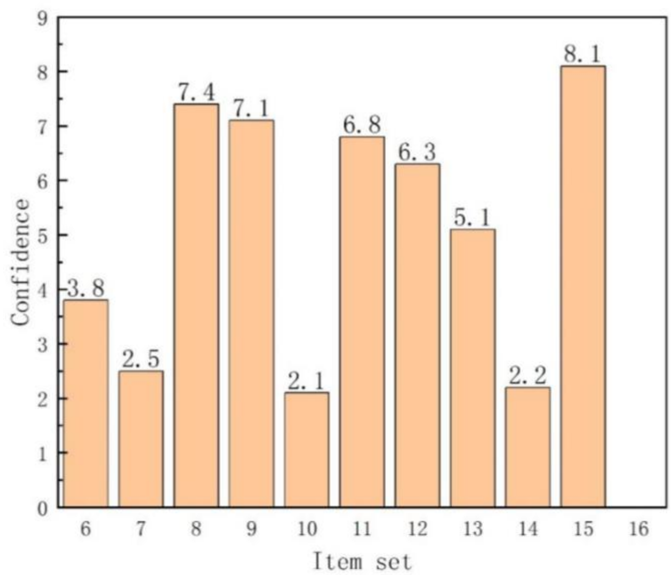

Figure 3. Candidate 2 item set support statistics graph

In Figure 3, 6 represents candidate 2 itemsets {T1, T2}, 7 represents candidate 2 itemsets {T1, T3}, and so on, 15 represents candidate 2 itemsets {T4, T5}. Since all candidate 2 itemsets support is greater than the minimum support threshold, the candidate 2 itemsets support statistics can also be the frequent 2 itemsets support statistics. The candidate 3-item set is continued to be connected to generate the candidate 3-item set, as shown in Figure 4, which shows the candidate 3-item set support distribution.

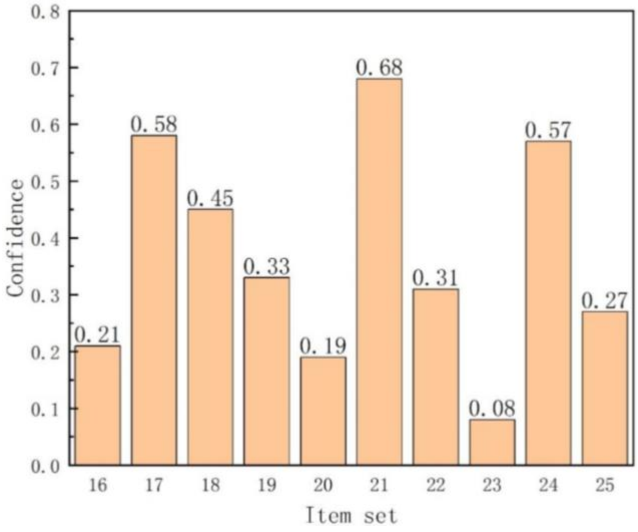

Figure 4. Candidate 3 item set support statistics graph

In Figure 4, 16 represents the candidate 3-item set {T1, T2, T3}, 17 represents the candidate 3-item set {T1, T2, T4}, and so on. From the analysis of the figure, it can be seen that the support of the candidate 3-item set {T2, T3, T5} is less than the minimum support of 0.1, so the 3-item set {T2, T3, T5} should be removed from the selected 3-item set by pruning, thus constituting a frequent 3-item set. As in Figure 5, the support distribution of the frequent 3-item set is shown.

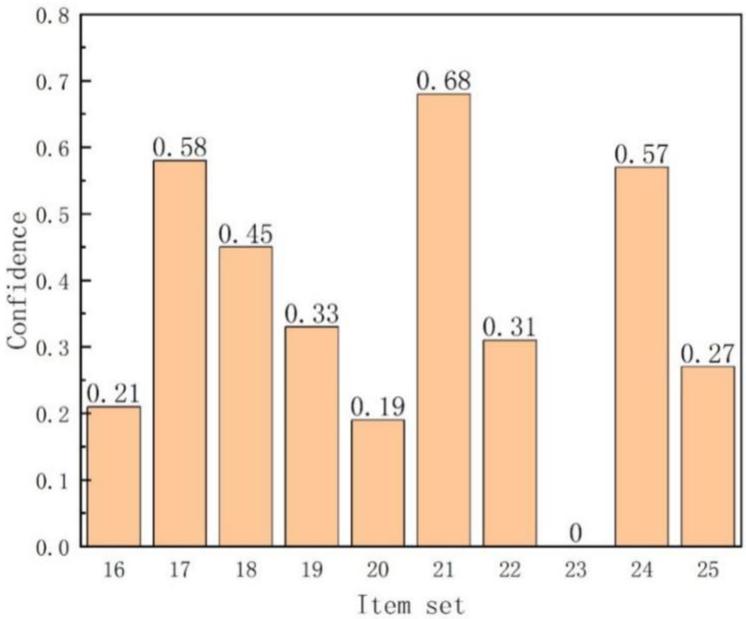

Figure 5. Frequent 3 item set support statistics graph

The new frequent 3-item set is obtained, and the union continued to obtain the candidate 4-item set, as shown in Figure 6, which shows the support statistics of the candidate 4-item set.

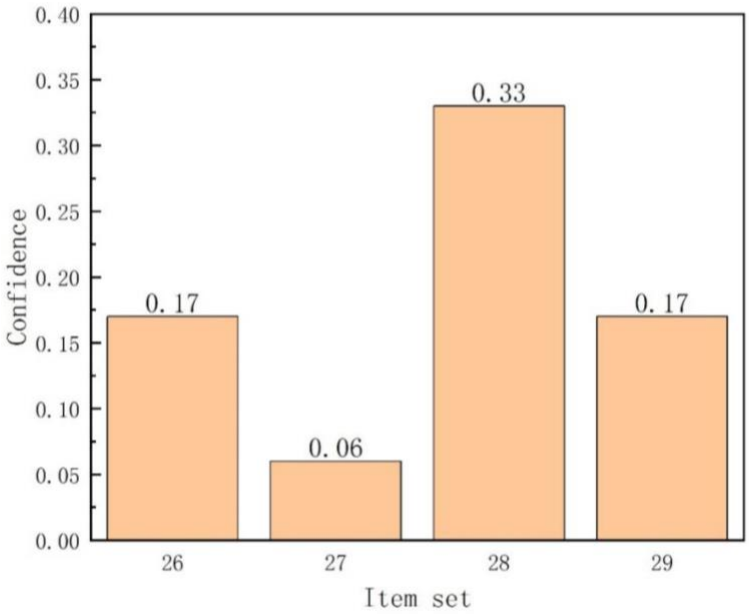

Figure 6. Candidate 4 item set support statistics graph

In the candidate 4-item set, the support of {T1, T2, T3, T5} is less than the minimum support of 0.1, which is similarly removed by pruning to form a frequent 4-item set, as in Figure 7.

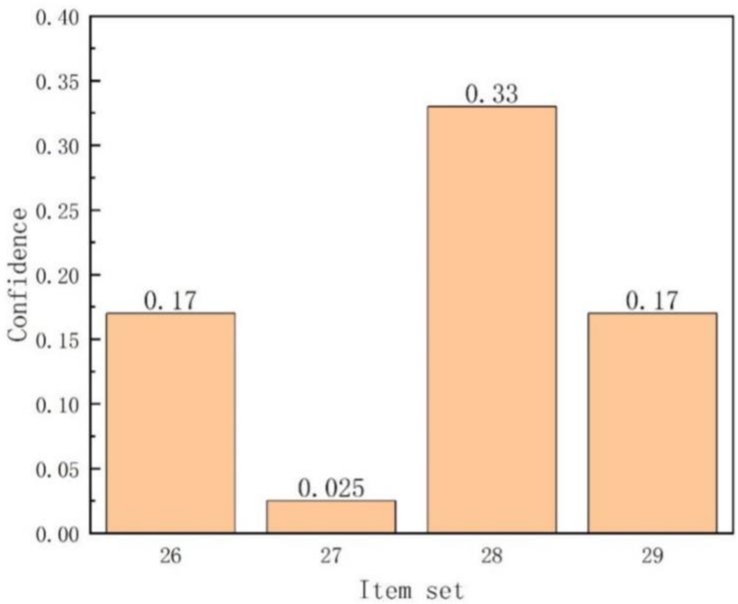

Figure 7. Frequent 4-item set support statistics graph

After obtaining the frequent 4-item set, the unique 5-item set {T1, T2, T3, T4, T5} is obtained after the union, and its support is 0.003, which is much smaller than the minimum support threshold, so it should be removed from the frequent item set, and finally, the total frequent item set is obtained, and the strong association rule results are obtained by confidence calculation for each frequent item set in the total frequent item set.

4.2 System Requirements Description

System analysis is actually the description of the user's requirements after a series of analyses, making it clearer to the user, clearer to the problems to be solved and a preliminary understanding of the software system to be developed. Specifically, the analysis phase usually includes the following two tasks: Establish a conceptual model that reflects the static relationships of the problem domain. Create a dynamic model that reflects the behavior of the system, i.e., a use case model. The purpose of building a conceptual model is to help the development team understand the various concepts, terms, and relationships between them in the problem domain. The purpose of building a use case model, on the other hand, is to help the development team understand the various functional requirements of the customer for the system.

4.2.1 System use case analysis

Analyzing and evaluating the requirements of the system, we should fully consider the practicality of the system and on this basis, establish the Use Case diagram of the system in order to clearly and accurately express the functional requirements of the system and model the future behavior of the system.

1) Identification of participants

   A participant is a role in which the user acts directly on the system. Participants have their own goals and achieve them by interacting with the system. Participants include human participants and external system participants. Among the people who deal with the system, anyone who uses the system directly can be identified as a human participant. Anyone who is connected to the system and interacts with the system as an external system can be identified as a system participant [32]. A participant can run multiple Use Cases, and a Use Case can be run by multiple participants. In this system, students, teachers, expert groups, administrators, leaders, etc., are identified as participants. The Use Case diagram of participants is shown in Figure 8.

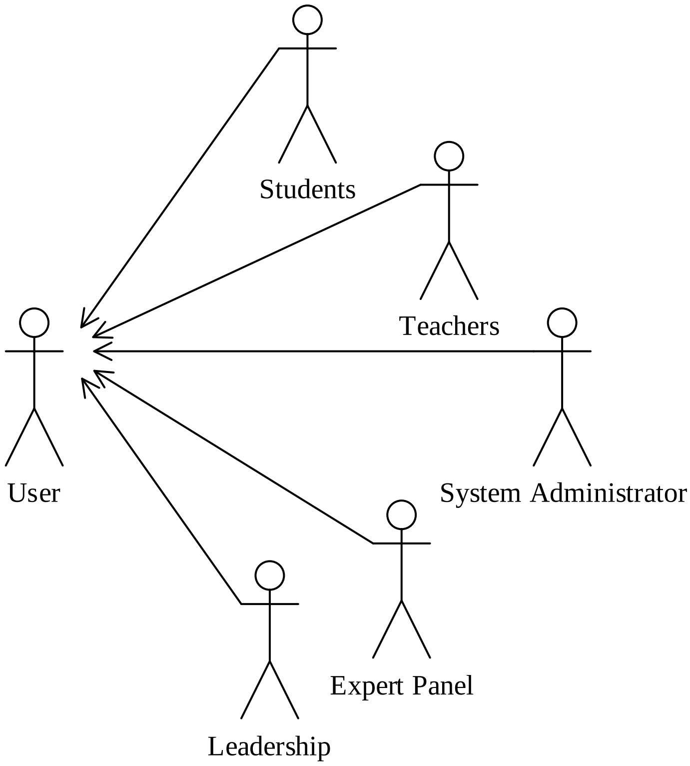

Figure 8. Participant Use Case Relationship Diagram

The participants' descriptions are as follows:

1.1) Student

Description: Students can register and modify their personal registration information, log in to the evaluation system, and evaluate the teachers of the current semester online.

1.2) Teacher

Description: Teachers can register and modify their personal registration information, log in to the evaluation system, evaluate their peer teachers, and check the statistics and analysis of their evaluation results.

1.3) Administrator

Description: The administrator can manage the accounts of teachers, students, leaders, and expert groups, change administrator passwords, modify user rights, enter and modify the evaluation index system, and calculate and query teacher evaluation results.

1.4) Expert

Description: The expert can register and modify personal information, log in into the evaluation system, evaluate any teacher, and check all evaluation results. The expert team members are members of the teaching supervisory team and the leaders who participated in the evaluation.

1.5) Leader

Description: The leader can register and modify personal registration information, log in to the evaluation system, and check the evaluation results data of the faculty members.

2) Use case

A Use case is a sequence of textual descriptions of the interactions that an activist performs using a feature of the system. Each Use case is a sequence of related transactions performed by an activist in interaction with the system. Although a Use case describes the conversation in which an activist interacts with the system, it only describes what to do. However, it only describes what to do, not how to do it. The entire Use case constitutes a description of the behavior that is visible to the outside of the system.

All Use cases should be identified according to the system requirements, and the event flow should be given from the perspective of the activist. By analyzing the system, it can be determined that the following Use cases exist in the system, and the Use case diagram of this system is shown in Figure 9.

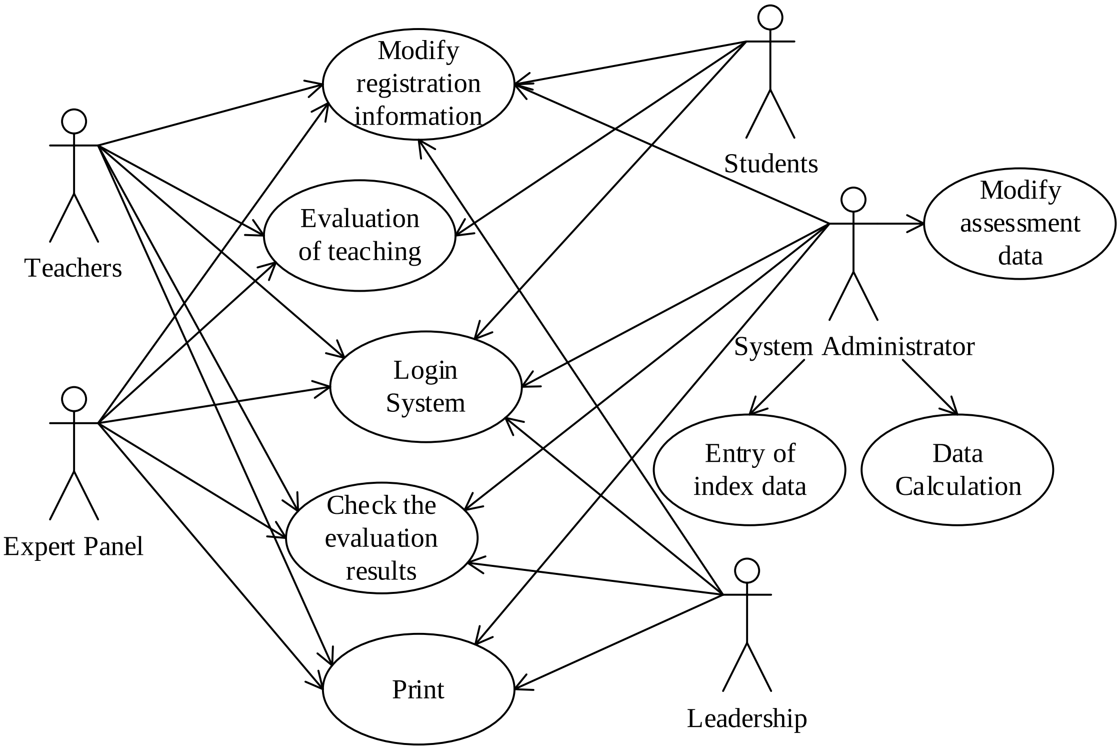

Figure 9. System Use Case Diagram

The use case is described as follows:

2.1) Modify the registration information.

Provides aunction for users to modify their personal registration information.

2.2) Log inn to the system.

Provides the ability to verify the user's identity.

2.3) Evaluation of teaching.

Provides functions for students, participating teachers, and experts to evaluate teaching.

2.4) Entry of index data.

Provides a function for the system administrator to enter the initial data of assessment indicators.

2.5) Modify the evaluation data.

Provides the system administrator with the function to modify the evaluation index data.

2.6) Data calculation.

Provides the ability to calculate the assessment data submitted by the assessment topics into a final score.

2.7) Printing.

Provides the functions of printing evaluation results, printing index system tables, and printing query data.

2.8) Check the evaluation results.

Provides a query function for teachers, experts, and leaders on assessment data.

5 Teaching quality assessment system implementation

5.1 System implementation tools and development platform

The analysis and prediction of data by Eviews tool, regression algorithm, and Apriori algorithm assisted by the combination of system implementation tools to build a university teaching evaluation system

1) The three-tier B/S structure of the system

   The B/S architecture is a new software architecture that makes use of the maturing browser technology and combines a variety of scripting languages with a common browser to achieve powerful functions that require complex dedicated software and saves development costs [33]. Based on the B/S architecture, the system installation, modification and maintenance are all solved on the server side. The B/S architecture also provides the most realistic and open basis for online networking, and unified services of heterogeneous machines, networks, and application services.

2) ASP.NET

ASP.NET is a compiled. NET-based environment that allows the development of applications in any. NET-compatible language (including Visual Basic.NET, C#, and Jscript. NET) [34]. In addition, any ASP.NET application can use the entire.NET Framework. Developers have easy access to the benefits of these technologies, which include a managed public language runtime library environment, type safety, inheritance, etc. ASP.NET works seamlessly with HTML editors and other programming tools, including Microsoft Visual NET). This not only makes Web development easier but also provides all the benefits that these tools offer, including a GUI that developers can use to drag and drop server controls onto Web pages and fully integrated debugging support []]. In order to design a system for a faster and more comprehensive assessment of teaching quality. This paper investigates the advantages of regression models for numerical prediction compared to traditional approaches and the ability of the Apriori algorithm to discover association rules. The regression model is then optimized by combining the statistical, analytical, and predictive capabilities of Eviews software with a series of derivative analysis processes. After the analysis and comparison of the optimal regression model, the flawed part of the Apriori algorithm was improved so that it would take less time to find association rules compared to the original algorithm, which would enable the evaluation system designed later to produce evaluation results more quickly than other systems. The combination of the optimized regression model and the Apriori algorithm design resulted in a system that can evaluate the quality of teaching and learning in a comprehensive way. Finally, the system is built with the help of a system implementation tool and development platform. In this way, the quality of teaching and learning in universities can be improved with the help of the system's excellent quality assessment capability.

5.2 Teaching quality assessment system implementation

1) User management functions

The main functional modules of user management are: user permission setting, user identity verification, changing user password, setting evaluation time, and updating related data. The function of user identity verification is to verify the legitimacy of the user and to control the corresponding authority according to the different identities, and the users of this system have the authority to modify their own passwords. Among them, the initial user name of students is student number, and the password is “123456’’. The user name of leaders, experts, and teachers are work number, and the initial password is “123456’’. The user name of the administrator is manager, and the password is manager, which is defined in the configuration file. It is up to the user to change the password after logging into the system. Regulations on the rights of different users: Students can only evaluate teachers for this semester. Experts can evaluate all teachers and can check and print them. Teachers can evaluate their peer teachers, and they can also check and print their own evaluation results. Leaders are divided into department leaders and school leaders. School leaders can query and print all data, while department leaders can only query and print data of teachers in their departments. Administrators can query and print all the result data, set the evaluation time, and update the system data.

2) Calculation of evaluation data function

The calculation function mainly includes the calculation of evaluation results, the ranking of results, and the generation of comments.

2.1) Calculation of appraisal results

The data of assessment results submitted by the assessment subjects (teachers, students, and expert groups) were collected, and then the fuzzy comprehensive evaluation method was used to calculate the total score of each teacher. The system establishes different assessment indexes for theory classes, laboratory classes, and physical education classes, so the distinction of index categories is considered in the calculation. In addition, different assessment subjects will have different assessment interfaces in the assessment.

2.2) Sorting of results

The system provides sorting of faculty evaluation results by major and by faculty. Major refers to a teacher's professional direction, such as computer science, mathematics, English, Chinese language and literature, etc. Since some departments contain several majors, for example, our Department of Mathematics and Computer Science includes both math and computer science, the evaluation results can be sorted by both majors and departments.

3) Query function implementation

Teachers' final assessment scores and comments can be queried in the system based on user permissions. For example, after logging into the system, teachers can query their own evaluation result data, including final scores and comments, by entering their own numbers.

Except for the teacher number text box, which receives user input, the read-only item of all the text boxes is set to True to prohibit users from modifying the query results. After the number is input, validation is required, that is, to verify whether the input matches the user number when the current user logs in. If not, an error message is output. Otherwise, the query result is output.

4) Assessment index data management function implementation

The assessment index system cannot be static, and we may add, delete, and modify the current assessment index system and weights from time to time as time and school-related regulations change.

Add: including adding new evaluation indicator tables, adding new evaluation indicator items to existing evaluation indicator tables

Delete: Including deleting the existing assessment indicator table and deleting some assessment indicator items in the assessment indicator table.

Modification: Including modification of the existing assessment index table, and modification of some assessment index items to the existing assessment index table. Modify the weighting coefficients of the indicator items.

First, you should select only the indicator data table and then make changes to the indicator data. Click on the Edit link in front of the current row for whichever indicator you are ready to modify, and the edit is replaced with the Update and Cancel links. The data is re-displayed in control for modification. To confirm the changes click Update, and the data is sent back to the data source. Otherwise, click Cancel.

5.3 System Testing

Load Runner is the most frequently used testing tool in the software testing process, which can simulate the behavior of real users and detect the deficiencies and defects of the system during the operation of real users. Therefore, Load Runner is the most used testing tool in the testing of this university's teaching quality assessment system. The system performance test was set up with 160 people online at the same time and continued to increase to test intensity.

1) At the same time, when 30 users simultaneously enter the attribute values of user name and password, log in to the system and perform the corresponding operations at the same time, the average response time to complete the log-in is 0.362 seconds, and the system is successfully logged in.

2) At the same time, when 60 users simultaneously entered the attribute values of user name and password, logged into the system, and performed related operations at the same time, the average response time to complete the log-in was 0.687 seconds, and the system log-in was normal, and no abnormalities occurred.

3) At the same time, when 90 users simultaneously entered the attribute values of user name and password, logged into the system, and performed related operations at the same time, the average response time to complete the log-in was 1.011 seconds, and the system log-in was normal, and no abnormalities occurred.

4) At the same time, when 120 users simultaneously entered the attribute values of user name and password, logged into the system, and performed related operations at the same time, the average response time to complete the log-in was 1.238 seconds, and the system log-in was normal without any abnormalities.

5) At the same time, when 150 users simultaneously entered the attribute values of user name and password, logged into the system, and performed related operations, the average response time to complete the log-in was 1.413 seconds, and the system log-in was normal without any abnormalities. With the increase in the number of users, the response time of system login also increases, and the system can meet the basic requirements of users with 150 users concurrently logging in at the same time without any login abnormalities or errors.

The test results are shown in Table 8.

Table 8. System module test results

Modules	Number of tests	Number of successes	Number of failures	Success rate
System Administration	40	40	0	100%
Quality Assessment	50	49	1	98%
Resource Management	30	30	0	100%
Evaluation Inquiry	40	39	1	97.5%

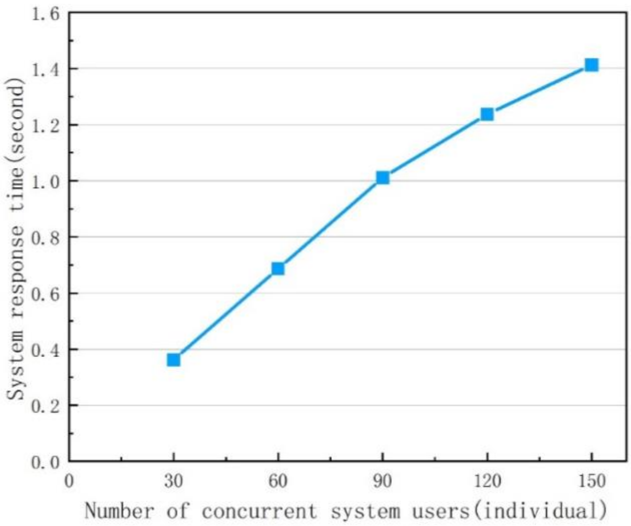

Figure 10. Stress test of teaching quality assessment system in higher education

In Figure 10, the horizontal coordinate is the number of concurrent users of the system, the vertical coordinate is the response time of the system, and the line in the figure indicates the changing trend of the response time of the system with the increase of the number of concurrent users of the system. It can be seen from Figure 10 that the larger the number of concurrent users of the system, the longer the system response time of the college teaching quality assessment systemand the changingng trend is relatively smooth. Therefore, it can be concluded that the performance of this college teaching quality assessment system is stable and can meet the performance operation requirements of college teaching quality assessment.

Through the functional testing of the college teaching quality assessment system, all the functional modules of the college teaching quality assessment system were tested. The test results showed that the functions of the system reached the functional requirements of the college teaching quality assessment system, and the performance was relatively stable and could meet the performance requirements of the college teaching quality assessment, and the defects of the college teaching quality assessment system were also found in the process of testing, and based on the test results, the defects of the college teaching quality assessment system were modified and improved.

6 Conclusion

The college teaching quality assessment system designed in this paper is based on the specific business of college teaching quality assessment, and the core functions of the college teaching quality assessment system are analyzed based on the positioning of the system usage object and the overall architecture and network topology of the college teaching quality assessment system is designed on the basis of the full investigation of the business requirements of the college teaching quality assessment system, and The core functions of the college teaching quality assessment system are designed using B/S architecture and ASP.NET technology, and the E-R diagram and database tables of the database of the college teaching quality assessment system are designed. Finally, the system testing was conducted for the college teaching quality assessment system, and the testing process and test cases were designed.

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