Instructor's Performance Evaluation System using Data Mining Techniques

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Abstract: The development of an improved and intelligent model for the evaluation of instructors' performance in higher institutions uses the efficient data mining techniques considering the drawbacks of the prior traditional techniques. This proposed system analyses the factors related with the evaluation of instructors teaching performance using predictive data mining techniques known as regression statistical model. Regression is a data mining predictive technique that is used to make statistical prediction of the variables, given a set of data. Consequently, the evaluation of instructors' performance is useful for the academic institutions as it helps to make effective managerial decisions, improve the quality, reliability and efficiency of the instructors, provides a basis for the performance improvement that will optimize students' academic outcomes and improve standard of education and contribute to successful accomplishment of the organizational goals.

Keywords*:* Prediction algorithms, Statistical Regression Model, Linear Regression algorithm, Performance Evaluation, Educational Data Mining (EDM).

I. INTRODUCTION

One of the most common problems in higher educational sectors is the efficient evaluation of instructors' performances in a particular course. The most eminent tool used to evaluate the instructors' performance in a particular course is through surveying various students' responses about the course and its instructor through a questionnaire system. When evaluations of instructor performance were introduced to higher education systems, there has been a debate on the reliability, accuracy and validity of these evaluations.

Hidden information and hidden patterns in large datasets can be efficiently analysed with data mining techniques. It is also known as knowledge discovery process, which involves discovering hidden patterns, messages and knowledge within large datasets and the process of analysing outcomes or behaviours. It is a systematic process of extracting relevant knowledge and information which includes associations, changes, structures and trends that are unknown from large structured and unstructured data. It is an eminent tool in the field of academics.

Data mining techniques are used in higher education, because of its various abilities such as efficient allocation of resources, academic planning, predicting student and instructor performance, and promotion of alumni development. Educational data mining (EDM) deals with developing methods for exploring data from educational sectors with the purpose of providing quality education to students and to make effective managerial decisions. With EDM, the useful information can be gained from various entities such as lecturers, students, and alumni. This information can be used to allocate resources and assign staff more effectively, make effective decisions on educational academic activities to improve students' performance, increase students' learning behaviour, increase student's retention rate, and increase students' consistency in various academic activities. EDM can also be used in discovery and improving domain models by modification of the existing models.

II. LITERATURE SURVEY

Two types of performance evaluation methods used in the literature review are formative and summative evaluations. During earlier days, instructors were evaluated based on certain typical characteristics which may or may not have been related to performance, and yet no knowledge confirms that the teaching performance is dependent on several characteristics. Hence, this evaluation technique was eliminated.

Formative performance evaluation method is referred as qualitative evaluation on the instructors' teaching assessment, which mainly deals with identifying strengths, weaknesses and providing appropriate professional development opportunities for particular areas which need significant improvements. Formative performance evaluation technique is based on the criteria such as classroom observations and student assessment report as important tools to measure the staff performance. The overall intention of this method is to provide useful informative feedback about a particular faculty for assisting them in improving the effectiveness and efficiency of their teaching methodologies.

Summative performance evaluation technique is illustrated as a source of documentation and a reliable way for the evaluation of instructors' performance by providing a set of statements regarding instructor's capabilities through regular inspection, examination and various informative interviews, in order to measure aptitude skills, effectiveness and knowledge to ensure that the required pre-defined standards are met, and to promote the level of performance. This method is used to determine the worth and career advancement of an instructor, and ensures that instructors adopt the appropriate actions and best practices which improves student performance. Hence, summative evaluation method is a source of useful documentation. In many institutions, annual performance evaluation report (APER) and informative interviews are used as effective tools to measure their quality, performance and effectiveness.

Although the prior studies support the effectiveness of these eminent tools at various levels of evaluation, yet there are various debatable issues about their reliability and accuracy when they are used separately. Stacy and Gaurini (2012) [1] stated that a single measure of rating will highlight only one entity and ignore the other entities. In this traditional method, it can be observed that this formative method is one sided. Hence this method did not prove to be reliable.

In the research of Nakpodi (2011) [2] the disadvantages of summative method are highlighted and in can be observed that formative method is not suitable for providing all the useful information required for performance evaluation of the faculty. Hence, an additional tool should be used to gather essential information required for professional development. Additional entities include various academic activities, research paper publications, attending academic conferences, participation in important seminars, informative workshops. The author also highlights that if APER will play an important role, the elimination of ambiguous sections is required to simplify the overall evaluation process. Steele (2010) [3] states that staff performance rating system should include a wide variety of measures to analyze the assessment system.

In recent years, teacher evaluation is used to measure the pedagogical effectiveness of teaching and the quality of education. During the earlier days, educational sectors used the evaluation results to assess the performance and helping teachers improve their pedagogical effectiveness. These results are also used to implement other ideas by providing the required information to other entities in educational sectors (Kulikk, 2001) [4]. Thus the admin uses these ratings to make important decisions like, hiring new staff, making promotions, rewarding awards, assigning the appropriate staff, and other managerial decisions. Thus the instructors use these results to improve their pedagogical effectiveness and to monitor their performance Students use these dimensions to select courses and to choose teachers for rewards. Though various studies have been carried out, there is still no guarantee about the reliability, validity, usefulness and dependability of these techniques. It is subjected to debatable issues regarding the accuracy of these methods.

The main issue encountered is the relationship between assessments and learning. Claayson (2009) [5] claims that an average relationship exists between assessments and learning. But this relation is situational and is not applicable to all cases of academic sectors and all the educational levels. It is claimed that, the level of measurement of learning, affects the relation between learning and assessment.

III. SYSTEM DESIGN

Student's feedback evaluations are used to improve the course result and increase the level of teaching quality. It is also used for evaluation process for staff appraisal systems. Several prior research have identified that student evaluation offers a reliable and valid assessment of the instructors. Students' evaluation is collected and stored in the database, and this huge dataset is analysed using various data mining techniques and further used for managerial purposes. Figure 1 depicts the overall dataflow of the performance evaluation system.
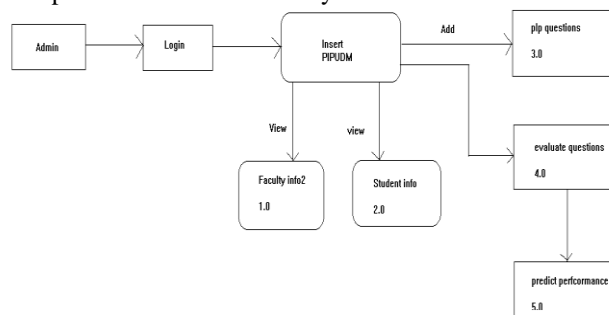

Figure 1: Overall dataflow diagram

A. Data collection and variables:

The performance evaluation system consists of data with 26 variables. The responses are measured on an interval scale. . Response option values of these 26 questions are ''Never'', ''Rarely'', ''Sometimes'', ''Often'', ''Always'' that have different weightage such as 1, 2, 3, 4, 5 respectively for the questions 1 to 4 questions. The responses 1, 2, 3, 4, 5

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represents ``Strongly disagree", ``Disagree", ``Neutral", ``Agree", and ``Strongly agree" respectively for the questions 5 to 25.The last variable is measured on a nominal scale in the form of {1, 2} where 1 stands for ``Not satisfactory" and 2 stands for ``Satisfactory". Details of the variables are as follows:

1) How frequently you attended this course?
2) How frequently did the instructor attend this course?
3) Did the instructor come to class on time?
4) Did the instructor use the class hours fully?
5) The instructor's knowledge of the subject was adequate?
6) The instructor came to class well prepared.
7) Lectures were clear and well structured?
8) The syllabus was followed and fully covered
9) There was a good balance between theory and application.
10) The instructor was effective in presenting the material in lectures and discussions.
11) Subjects were not well organized and did not follow each other.
12) The instructor answered questions satisfactorily.
13) The instructor was enthusiastic about this course.
14) The instructor motivated the students to ask questions and to get involved in the discussions.
15) The instructor was approachable, nice and easy to communicate with?
16) The instructor was available to give help outside the class.
17) The course materials (textbooks, handouts etc) were satisfactory.
18) The assignments (case studies, homework, projects, presentations etc) were relevant and helpful.
19) This was an easy AA course?
20) The assignments/exams increased the ability to think creatively.
21) The assignments/exams adequately tested the knowledge taught.
22) I had to spend a lot of time to get prepared for assignments/exams.
23) This course was helpful in increasing my knowledge and interest in the subject matter.
24) I learned a lot in this course.
25) The instructor's grading (assignments/exams) was fair.
26) The overall performance of the instructor was satisfactory.

B. Data Pre-processing:

Pre-processing of the data is an important phase in the data mining process. The raw data is more prone to inconsistent and inaccurate data. Hence the raw data is pre-processed to increase the quality of data. It includes tasks such as data cleaning, selection, transformation and integration. It is the precise collection of data being used for appropriate reason from different origin. It has been recognized, registered and classified. The scope of collecting the data is to retrieve information, to preserve data, to form decisions regarding crucial problems and transmission of data to the residuals.
The considered dataset consisting of 600 records and students academic details is uploaded to the database by the faculty. It is pre-processed manually by checking the attribute entries in the Microsoft excel format. This data is pre-processed to remove the noisy and inconsistent data which are not required by our analysis. This data is then stored in the WAMP server for further processing. It is often used for development of web interface and testing purposes.

C. Data Mining Model:

After performing the required pre processing on the data, the transformed data is fed into the suitable data mining model which will carry out the analysis. In this case, the prediction technique is used to predict the staff performance by computing the analysis using the regression statistical model. This model identifies the related variables and forms a suitable equation. The evaluation of the data is performed and the final result is represented in the graphical manner.

Predictive analytics technique:

Predictive analysis deals with prediction of future trends and frequently occurring behavior. It comes under statistics. The main idea lies in identifying the relation between the relevant variables previously occurred. This relation is then exploited to predict the final outcome. The assumptions made and the analysis level greatly impacts the accuracy or the result. It is used in credit card fraud, business applications, forecasting.

It deals with generating the probabilities for each entity at a very coarse and detailed level so that all the aspects are covered. It is useful in driving better decisions in the future since it learns from the past patterns. It is useful in optimization and prevents various issues that might occur in the future. The final data can also be used for improvement

of the loop life cycle. It is also known as decision modeling or descriptive modeling or optimization. It is widely used in business applications to make effective decisions.

The models deal with the relation between the capacity of the units and characteristics of the units. The main aim here is to identify that the units exhibit different behavior in every different sample. It is used widely in applications that require live transactions such as customer relation management to make decisions. With latest innovations, predictive analysis is also used to capture the behavior of the human in specific scenarios.

The training example consists of the known information such as attributes and performances. The other samples consisting of unknown performances are known as out of training examples. The predictive technique used in this evaluation system is the regression statistical model.

Regression Statistical model:
Regression is a data mining predictive technique that is used to make statistical prediction of the variables, given a set of data. Used to predict numerical or a continuous value. It is used in multiple areas such as business marketing and planning, applications that need forecasting, environmental modelling and analysis of trends.
Regression analysis is a step-wise statistical process. It deals with identifying the relationship between dependent and independent variables. It provides an outlook of how the values of the variables change, when any one of the variables is varied. It calculates the average mean value of the dependent variable when the independent variables are constant. The variation of values of the dependent variable observed in the regression function is known as probability distribution. It is widely used for applications that use forecasting, prediction and machine learning.
The regression function consists of finite unknown parameters. Nonparametric regression consists of infinite parameters. The data generating process and its relationship with the type of regression approach being used is responsible for the final performance of the regression analysis. Simple linear regression falls under the category of parametric regression.

Linear regression algorithm:
Linear regression is used for predictive analysis. The main things to be observed are:
1. The capability of the set of variables in the prediction of a result variable.
2. Analysing the variables that are dependent variable predictors and observing their influence on that particular dependent variable. These observations are used to find the relationship between the dependent and independent variables.
3. The prediction of the final outcome variable is determined by the regression equation which consists of predictor variables. The simplest equation with a dependent and an independent variable is given by: $y = c + b * x$ where y= dependent variable, c = constant, b = regression coefficient and x = independent variable.

IV. RESULT AND ANALYSIS

The sequences of events under the staff module are:
1. The staff can login and add their branch, course, and subject details.
2. All the informative data about the staff will be stored in the database for further evaluation by the regression analysis.
3. The staff can view their individual performance and percentage in a graphical representation.

The sequences of events under the staff student are:

1. The students can login with their login-id and password.
2. The students can select the particular staff and give the feedback according to the questionnaire.
3. The feedback is fed to the regression analysis and performance evaluation is computed.
4. The students can view the feedback of the staff in a graphical representation.

The admin can login and search through the subjects and view the details such as:

1. The names of the students who have submitted the feedback according to the questionnaire in the feedback form.
2. The names of the staff for whom the feedback has been submitted by the students according to the feedback form.
3. The total points obtained by each staff after performing the regression analysis.

Figure 2 represents the individual performance evaluation graph. Figure 3 represents the performance evaluation graph by questions.
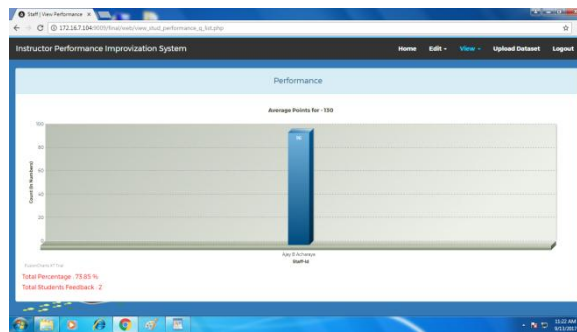

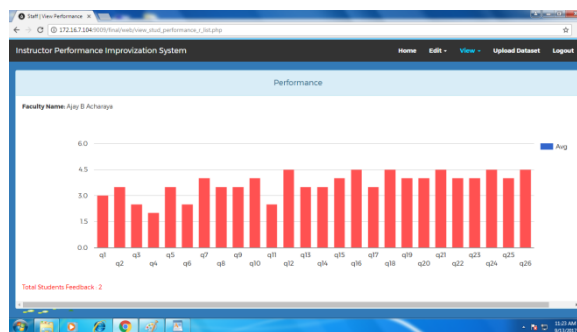Figure 2: Individual Performance Evaluation graph

Figure 3: Performance Evaluation graph by question.

V. CONCLUSION

Data mining techniques are applied in higher education to give appropriate solutions to educational and administrative problems in order to increase capability and consistency. The need for an intelligent statistical model for performance evaluation of instructors' in higher institutions all over the world has become necessary in order to find an efficient solution to the limitations of the old traditional methodologies. Using factors and resources obtained from course evaluation questionnaire, a system framework for the instructors' performance evaluation system is presented. The framework is designed with some basic components which satisfy the reliability and efficiency. This method examines the factors associated with the assessment of teaching performance and promotes them to reach the highest level of performance quality. The proposed system will assist the higher administrators in making appropriate managerial decisions, which will optimize students' academic outcomes and improves the standard of education. Consequently, this will lead to the accomplishment of objectives and goals.

ACKNOLEDGEMENT

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