

# Summative Assessment for Performance Evaluation of a Faculty Using Data Mining Techniques

Renuka Agrawal<sup>1</sup>, Jyoti Singh<sup>2</sup>, A.S. Zadgoankar<sup>3</sup>

Research Scholar<sup>1</sup>

Joint Controller, VYAPM (C.G.)<sup>2</sup>

Ret. V.C., C.V. Raman University<sup>3</sup>

**Abstract:** Assessment as a dynamic process produces data, which acts as a performance indicator for an individual. The evaluation of instructors' performance is especially relevant for the academic institutions as it helps to formulate efficient plans to guarantee quality of instructors and learning process. Effort in this work is directed at modeling an intelligent technique for evaluation of instructors' performance, propose an optimal algorithm and designing a system framework suitable for predicting instructors' performance. The proposed technique will improve reliability and efficiency of instructors' performance evaluation system, provide basis for performance improvement that will optimize students' academic outcomes and improve standard of education. Consequently, it will contribute to successful achievement of the goals and objectives defined in the vision and mission of the new education reform agenda. We propose a model to evaluate the performance through the use of techniques of data mining like association, classification rules (Decision Tree, Rule Induction, K-NN, Naïve Bayesian (Kernel)) to determine ways that can help them to better serve the educational process. The data mining methodology used for extracting useful patterns from the institutional database is able to extract certain unidentified trends in teacher's performance when assessed across several parameters.

**Index Terms:** Educational Institute, Performance Evaluation, Summative Assessment.

## I. INTRODUCTION

Academic institutions regularly generate huge data on students, courses, faculty, staff that includes managerial systems, organizational personnel, lectures details and so on. This useful data serves as a strategic input to any academic institution for improving the quality of education process. Today in the changing global scenario where the knowledge and technology is expanding rapidly giving rise to the talent crunch, it is the need of the hour to find out the competencies that can help to adopt the individuals to remain competitive. Data Mining technique, is the least utilized technique for the human resource data, can be proved worthy if utilized for the knowledge management and dissemination. It can be utilized in every discipline of human resource management and in many such areas which are still untouched. The information retrieved through the data mining technique can be proved worthy in organizing and extending the generated information to the various stake holders of the academic institutions. Institutional management has become a very crucial element in the effective operation of any enterprise or any business organization, due to the increased need of the latter to be agile enough to adapt to quick market changes. In this situation, it is necessary for the institutions to manage and develop the skills of their employees, recruit the most appropriate candidates [2]. Research efforts are also realized in the overall development of faculty members to improve the quality of teaching and learning process.

Data mining techniques have been applied in many application domains such as Banking, Fraud detection, Instruction detection and Communication, marketing, medicine, real estate, customer relationship management, engineering, web mining and recently in education which known as Educational Data Mining [3][4]. Most research focused on improving the performance of students and improves the curriculum and what is reflected in the educational process, there are a few researches that have been proposed for teacher performance.

The main objective of this paper is to improve teacher performance through the study of their specialization and expertise and the time of the period in the service of the educational process, evaluate and determine courses for needy teachers under improving their performance. The paper is an endeavor to explore personality, ability, knowledge and skills of a Faculty that is necessary to perform a particular task independently at a prescribed proficiency level. Rest of the study is organized as follows. Section 2 is about the purpose of the study and expected benefits. In Section 3, the data set is described; preparation and preprocessing steps are explained along with the questionnaire for summative evaluation. Section 4 presents the architecture of the proposed system. Results and discussions constitute Section 5. Finally Section 6 concludes with further research directions.

**II. PURPOSE OF STUDY AND EXPECTED BENEFITS**

Performance evaluation of faculty can be further classified in 2 categories. Two types of assessment method identified and widely used in the literature are: Formative and Summative; **Formative** Assessment refers to a quantitative evaluation of the instructors aimed at identifying its strengths, weakness and providing adequate professional development opportunities. It involves the use of classroom observations, student evaluation report etc., to measure the performance and effectiveness of an instructor. The overall intention of this is to provide informative feedback to assist faculty in improving the effectiveness of their teaching performance.

While Summative Assessment is described as an indispensable source of documentation and recognizable way to evaluate instructors' quality, in order to measure aptitude and knowledge to ensure that required standards are met. It is used to determine the worth and career advancement of an instructor. It deals with the professional development of a faculty, his research advancements, journal contributions and many others which assist him in his overall professional development besides classroom teaching.

A lot of work has been done on the teaching learning assessment ie. Formative assessment [6][7][8][9][10][11], but the area of Summative assessment still need further study. This paper is an endeavor for it. So after both the assessment it will be helpful to analyze the overall skills of a faculty.

Data Mining intersects technology, information, academic practices through efficient models, analyzes the diversified faculty relationship management, assesses the competences of the faculty and their performance management, skill management etc. It is the predictive ability that distinguishes Data Mining from other one-dimensional data management applications. Since the number of colleges have significantly grown over the period of years, it becomes prudent to look at how teaching and learning have changed.

The institutions have been making substantial investments for their computing infrastructure to meet their goals. With the increasing competition in the market, institutions are under pressure to improve their performance. Evaluation results can be used as the basis for making decisions about hiring, disciplining, compensating, awarding tenure to the deserving candidates. The strength of good education in any educational institution depends on the quality of the academic staff in that institution; and there is no satisfactory substitute for competent staff that possesses sound educational philosophy and dynamic leadership. As the most significant resource in schools, teachers are vital to improve student outcomes and raise education standards [12]. From this perspective, teachers' performance evaluation is a vital step to improve the effectiveness of learning system and raise educational standards. Data Mining can enable academic institutions to gain more comprehensive, integrative and reflexive view of the impact information technology by obtaining a better understanding around issues of information use and access, ultimately leading to improved knowledge sharing.

**III. DATA SET AND QUESTIONNAIRE**

Performance appraisal system is basically a formal interaction between an employee by management conducted periodically to identify the areas of strength and weakness of the employee. The objective is to be consistent about the strengths and work on the weak areas to improve performance of the individual and thus achieve optimum process quality [13]. For this research, teacher's Summative performance is evaluated. First a survey of the teachers' requirements is made. Then we interact with the teachers and got some knowledge about their methods. We should meet different teachers that have been given some ideas about the finding of the teacher's performance. For this study data were collected from graduate studies at different department in the college of engineering over three years period of the same set of faculty for the purpose of investigating how their professional improvement has taken place during this tenure.

The data is collected from the faculty in the form of a questionnaire so as to evaluate their performance as:

**Table 1. Questionnaires for Performance Evaluation**

S. No	Attributes	Description	Possible Value
1.	Name	Faculty's Name	Text
2.	Design and Dept.	Prof. P-5, Asso. Prof AP-4, Selection Grade SG-3, Senior Lecturer SL-2, Lecturer L-1	Text
3.	Qualification and Exp.	Doctorate, Master, Bachelor, Diploma and Certificate	Text and Numbers
4.	UE-PS	University Examinations Paper Setting	{yes, No}
5.	UE-PE	University Examinations Paper Evaluation	{yes, No}
6.	UE-SE	University Examination Sessional Evaluation	{yes, No}
7.	UE-ID	University examinations Invigilation Duty	{yes, No}
8.	COE	Conduct of Exams	{yes, No}
9.	EOP	Evaluation of Project/ Dissertation work	{yes, No}
10.	RA-W	Research Activity: Workshop Attended	{yes, No}

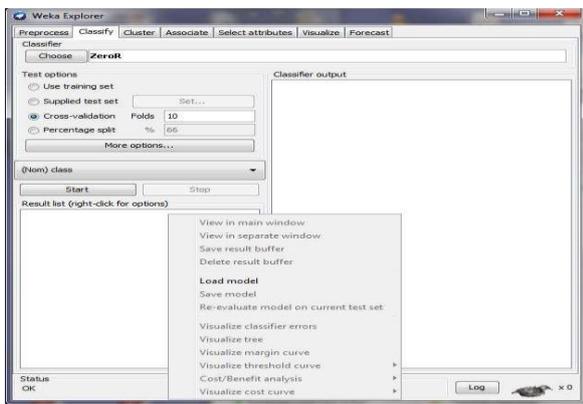


classification attribute). Each line specifies an attribute's name and the values it may take. In this paper the attributes have nominal values so these are listed explicitly. In other cases attributes might take numbers as values and in such cases this would be indicated. The @data represents lists with actual examples, in comma separated format; the attribute values appear in the order in which they are declared above.

By default, a classifier called ZeroR has been selected. A different classifier is desired so click on the Choose button. A hierarchical popup menu appears. Click to expand 'Trees', which appears at the end of this menu, then select J48 which is the decision tree program. The Explorer window now looks like this indicating that J48 has been chosen.

**4.3 Opening a Data Set in WEKA**

We can open file directly from double clicking on it. Also we can open weka, select explorer, we can open file from open file button and then select the specific file



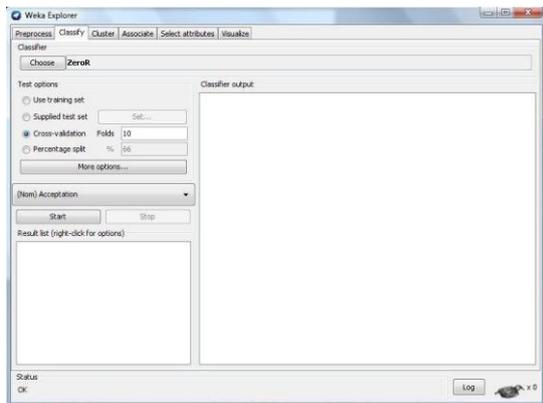
**Fig 3 Using WEKA Explorer**

This is a 'Teacher evaluation' data set, like the ones used in class for demonstration purposes. In this case, the normal usage is to learn to predict the 'Acceptation' attribute from four others providing information about the Teacher evaluation.

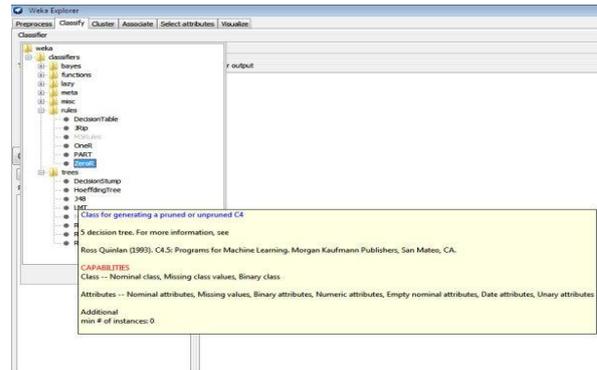
**4.4 Choosing A Classifier**

Next it is necessary to select a machine learning procedure to apply to this data. Six tabs available for the various pattern in weka like preprocess, classify, cluster, associate, select attributes, visualize. We can classify the information from classify tab. The task is classification so click on the 'classify' tab near the top of the Explorer window. The window should now look like this:

The window should now look like this:



**Fig.4. Selecting classify algorithm in WEKA for this study.**

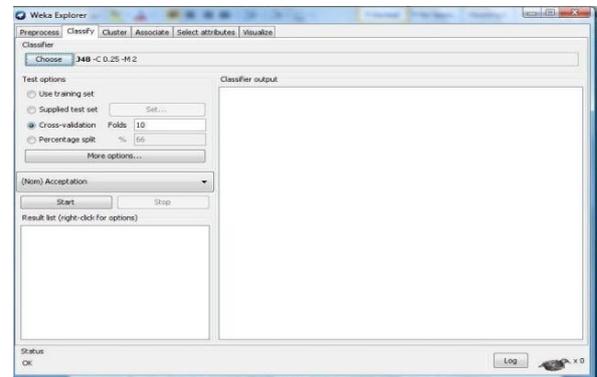


**Fig 5. Selecting J48**

**4.5 Select j48 Option**

Select tree from drop down list and select j48 option from choose button. It is use for decision tree.

The other information alongside J48 indicates the parameters that have been chosen for the program



**Fig.5. Decision tree with J48 tree in WEKA**

**4.6 Choosing the experimental procedures**

The panel headed 'Test options' allows the user to choose the experimental procedure. This paper shall has more to say about this later. For this click on 'Use training set'. (This will simply build a tree using all the examples in the data set).

**4.7 Running the decision tree program**

Right click on result list and select option visualize tree. Despite the implementation method adopted, most decision tree algorithms in literature are constructed in two phases: tree growth and tree pruning phase. Tree pruning is an important part of decision tree construction as it is used improving the classification/prediction accuracy by ensuring that the constructed tree model does not over fit the data set (Mehta et al, 1996).

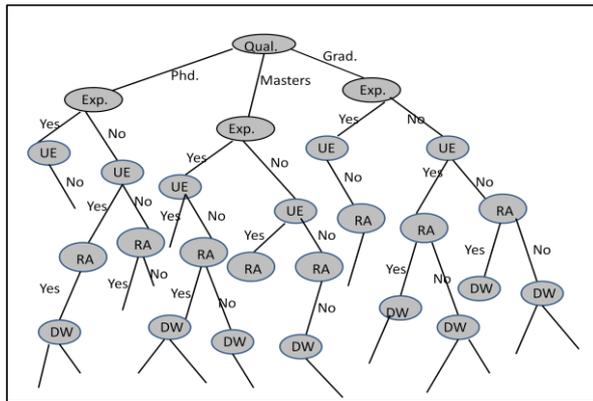


Fig 6. A Portion of Decision Tree Generated

In this study we focused on serial implementation of decision tree algorithms which are memory resident, fast and easy to implement compared to parallel implementation of decision that is complex to implement. The disadvantages of serial decision tree implementation is that it is not scalable (disk resident) and its inability to exploit the underlying parallel architecture of computer system processors. From the Decision tree Association Rules can be generated. The discovery of interesting association relationships among large amounts of business transactions is currently vital for making appropriate business decisions. There are currently a variety of algorithms to discover association rules. Essentially, association mining is about discovering a set of rules that is shared among a large percentage of the data. Association rules mining tend to produce a large number of rules. The goal is to find the rules that are useful to users..

A few rules which are discovered are:

- 1) If [Designation = Prof.] And [Qualification = Doctorate] And [Experience > 10 Yrs.] And [Score = Best] ; Then: Exceptionally Good Prof.
- 2) If [Designation = Prof.] And [Qualification = Doctorate] And [Experience > 6 Yrs.] And [Score = Best] ; Then: Superior Prof.
- 3) If [Designation = Asso.Prof.] And [Qualification = Masters] And [Experience > 8 Yrs.] And [Score = Best] ; Then: Exceptionally Good Asso. Prof.
- 4) If [Designation = Asso.Prof.] And [Qualification = Masters] And [Experience > 4 Yrs.] And [Score = Good] ; Then: Successful Asso.Prof.
- 5) If [Designation = Sen. Lect.] And [Qualification = Grad.] And [Experience > 10 Yrs.] And [Score = Best] ; Then: Exceptionally Good Sen. Lect..
- 6) If [Designation = Sen. Lect.] And [Qualification = Masters] And [Experience > 1 Yrs.] And [Score = Very Good] ; Then: Superior Sen. Lect.
- 7) If [Designation = Lect.] And [Qualification = Grad.] And [Experience > 2 Yrs.] And [Score = Satisfactory] ; Then: Satisfactory Lecturer.
- 8) If [Designation = Lect.] And [Qualification = Grad.] And [Experience = 0 Yrs.] And [Score = Satisfactory] ; Then: Satisfactory Lecturer.

9) If [Designation = Lect.] And [Qualification = Grad.] And [Experience > 2 Yrs.] And [Score = Poor] ; Then: Lecturer Needs Improvement.

Here we have done the following Assumptions:

- The Faculty's performances are categorized in five categories depending on their performance as Exceptionally Good, Superior, Successful, Satisfactory and Needs Improvement.
- The scores of the Questionnaires are categorized in five parts as Best, Very Good, Good, Satisfactory and Poor.
- These scores are categorized depending on the no. of questions answered 'Yes'. If # 'Yes' > 20, then Best, If # 'Yes' > 15, then Very Good and so on.
- Again the No. of Years of Experience of faculty is Categorized in five categories; >10 yrs., >8 yrs., > 6 yrs., >4 yrs., > 2 yrs.

## V. RESULTS AND DISCUSSIONS

Data mining has a large family composed of different algorithms, and the scope of research is rapidly increasing to improve the accuracy of existed algorithms. In this paper, we evaluate some Data Mining algorithms. The performance appraisal is dealing with people, judging them, motivating and cultivating people as is the basis for core competency of the organization. It can help to distinguish top performers from the mediocre and help to achieve the motivational effect by rewarding the former reasonably. As working smarter has become vital, effective performance appraisal helps employees identify areas for improvement in work.

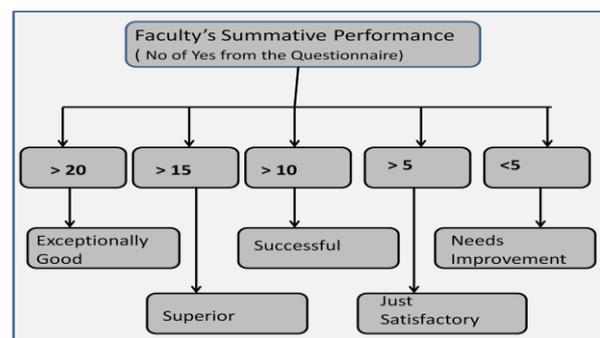


Fig 7. Faculty Performance Assessment

## VI. LIMITATIONS

We have assessed the performance based on no of questions which has been answered positive by the faculty, for better results a suitable weightage needs to be given at each question. Also the no. of times the faculty has consistently tried to improve their research activities, assisted in departmental work, contributed in university examinations need to be addressed. Also if the faculty joining the institute is a fresh one, then there are fewer chances of his contributions in these fields. This does not necessarily categorize him as an unsuccessful one. This needs to be addressed as well.

## VII. SCOPE FOR FURTHER STUDY

The overall assessment of the faculty for their continuous knowledge and skills up gradation requires not only summative assessment but also formative one.

- ❖ We need to take feedback from students' i.e. Formative assessment of Faculty as well.
- ❖ After evaluating the performance of Faculty, in terms of Summative and Formative Assessment, there is a need for overall assessment of Faculty, by integrating the results of both.
- ❖ How to make use of the proposed assessment for the betterment of the faculty, students and institutes as well.

## VIII. CONCLUSION

One of the data mining techniques i.e., classification is an interesting topic to the researchers as it is accurately and efficiently classifies the data for knowledge discovery. Decision trees are so popular because they produce classification rules that are easy to interpret than other classification methods. Frequently used decision tree classifiers are studied and the experiments are conducted to find the best classifier for prediction of student's performance in First Year of engineering exam,. These students can be considered for proper counseling so as to improve their result. Machine learning algorithms such as the C4.5 decision tree algorithm can learn effective predictive models from the student data accumulated from the previous years. The empirical results show that we can produce short but accurate prediction list for the student by applying the predictive models to the records of incoming new students.

## REFERENCES

- [1] Randa Kh. Hemaïd, Alaa M. El-Halees "Improving Teacher Performance using Data Mining" International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 2, February 2015 pages 407-412.
- [2] Pooja Tripathi, "Competence Based Management in Academics through Data Mining Approach" Computer Engineering and Intelligent Systems, ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online) Vol.6, No.2, 2015 pages 50-57
- [3] Naeimeh, D. and Mohammad, B., and Somnuk, P. Application of Enhanced Analysis Model for Data Mining Processes in Higher Educational System, In Proceedings of the ITHET 6th Annual International Conference, IEEE, 2005.
- [4] Yadav, S. and Pal, S. Data Mining: A Prediction for Performance Improvement of Engineering Students using Classification, World of Computer Science and Information Technology Journal (WCSIT) ISSN: 2221-0741 Vol. 2, No. 2, 51-56, 2012.
- [5] Pooja Tripathi, Jayanthi Ranjan, Tarun Pandya, "PAKS: A Competency Based Model for an Academic Institutions", International Journal of Innovation, Management and Technology, Vol.1, No. 2, June 2010 Page 214-219.
- [6] Aranuwa Felix Ola, Prof. Sellapan Pallaniappan, "A data mining model for evaluation of instructors' performance in higher institutions using machine learning algorithms" International Journal of Conceptions on Computing and Information Technology, Vol. 1, Issue 2, Dec' 2013; ISSN: 2345 - 9808, 17-22
- [7] S. Mardikyan, B. Badur, "Analyzing Teaching Performance of Instructors Using Data Mining Techniques". Journal of Informatics in Education, 2011, Vol. 10, No. 2, 245-257.
- [8] Fateh Ahmadi, M.E. Shiri Ahmed Abadi "Data Mining in Teacher Evaluation System using WEKA", International Journal of Computer Applications (0975 – 8887) Volume 63– No.10, February 2013, pp.14-18.
- [9] Ajay kumar Pal, Saurabh Pal, "Evaluation of Teacher's Performance: A Data Mining Approach", A Monthly Journal of Computer Science and Information Technology ISSN 2320-088X ,IJCSMC, Vol. 2, Issue. 12, December 2013, pg.359 – 369
- [10] Chandrini Singh, Arpita Goyal, "Performance Analysis of Faculty using Data Mining Techniques", International Journal of Computer Science and Application Issue 2010, ISSN 0974-0767 page 40-45.
- [11] ] N. Mangesh M.E., P.Thangaraj, S.Sivagobika, S. prabha, R. Mohanpriya, "Employee performance evaluation using Machine learning Algorithm", IJCCN International Journal of Computer Communications and Networks, Vol.4, No.2, April 2014, ISSN 2289-3369.
- [12] J.M. William. Research-Based Options for Education Policymaking- "Teacher Evaluation". National Education Policy Centre (NEPC) 2012.
- [13] Archer-North and Associates, "Performance Appraisal", <http://www.performance-appraisal.com>, 2006, Accessed Dec, 2012
- [14] <http://www.cs.waikato.ac.nz/ml/weka/>
- [15] Anish P. Joshi, Ronak K Panchal, "Data Mining for Staff Recruitment in Education System using WEKA" , International Journal of Research in Computer Science and management, Vol. 2(1), December 2014 (ISSN: 2321-8088) .
- [16] Hamidah Jantan<sup>1</sup>, Mazidah Puteh<sup>1</sup>, Abdul Razak, Hamdan, Zuaila Ali Oathman, "Applying Data Mining Classification Techniques for Employee's Performance Prediction"