Effective Performance Evaluation of Faculty

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The purpose of educational data mining is to uncover hidden knowledge in academic domain data. Learning analytics, artificial intelligence, database administration, psychometrics, and data science are all used in educational data mining to give it more dimensions. Every company recognizes the importance of an evaluation process, but putting one in place is challenging due to a variety of factors. Governments and societies around the world want higher education teaching staff to engage in real-world problem-solving instruction. Any university faces difficulties in measuring faculty performance. The mathematical modeling of evaluation parameters only provides a sliver of teacher effectiveness. Various teaching evaluation methodologies, such as student feedback, peer review, and reference to assessment parameters, will be included in the teaching group. According to the debate offered in the literature review, the following parameters must be studied while evaluating the performance of a faculty. Silhouette index is a set of internal measures used to evaluate the clustering algorithm's performance.

Keywords: Educational Data Mining, Performance Analysis , Silhouette index.

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1 Introduction

Data mining application in the educational domain and data mining application specifically in faculty performance evaluation are discussed in two parts. Employee performance in a production unit is proportional to product quality and quantity. There is no straightforward tool for evaluating the productivity of faculty members in an educational institute. Many businesses have a performance appraisal system in place to assess their employees' effectiveness and efficiency.
Teachers' feedback on their performance helps shape and improve their teaching practice and support effective school leadership, says the Association of School Superintendents (AST) in the UK. AST: Teachers should be held accountable for their performance and progress based on demonstrated effective teaching practice. Raising teaching performance is certainly the most likely policy path to result in significant student learning gains. Avalos and Assael [6] divided the obligations of teachers into four categories: planning and preparation, classroom environment, instruction, and professional responsibility. Each of these components has a number of factors to assess. The study of Sampson J P et al. [8] elucidated the factors that influence faculty performance. They also stated that for good faculty performance, faculty vision must be clear.Figure 1 represent Baker RSJ and Inventado PS conclusion of educational data mining.

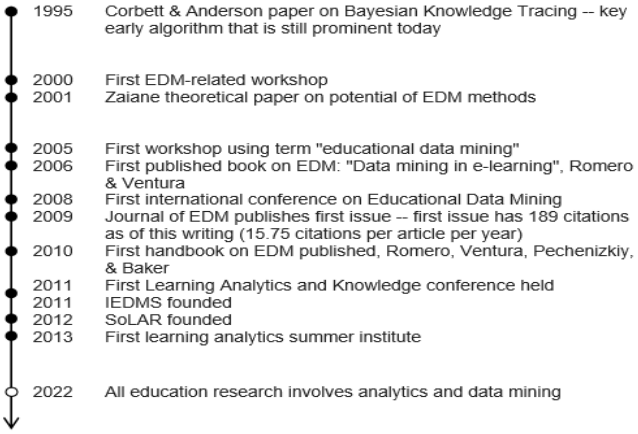

Fig 1: Educational Data Mining development

2 Methodology

Data mining has been widely used in a variety of industries and has proven to be useful. Data analytics is known as big data analytics because of its 5Vs (Volume, velocity, veracity, ,). Such a need to evaluate educational data demanded the use of data mining strength as a result of the rise of data collection, storage, and capabilities.

For partition based clustering, K means clustering is a prominent method. This algorithm is applicable to problems in Euclidean space. Clustering with a K value is sensitive to outliers and simple to implement. The centroid value, which represents the representational value of a certain group, is determined by the mean central tendentcy.

For data collection, Akbar Jesarati et al. [2] employed a descriptive survey and a multistage sampling procedure on four randomly selected faculty members from Tabriz's Islamic Azad University. They figure

how to rank the components used to assess teacher performance. Ajay Kumar Patel et al. [1], also discussed faculty performance evaluation using data mining.

Any university challenges difficulties in measuring faculty performance. The mathematical modeling of evaluation parameters only would provide a sliver of faculty effectiveness. The prominence of any scoring parameter is indicated by the weights applied to it.

The institution administrator must adjust the weight values so that faculties are driven to improve their overall score by boosting certain assessment parameters. The faculty's collected scores are used to categorize them into a pre-determined number of groups in the unsupervised learning method.
Number of internal and external evaluation indices proposed out of which three internal evaluation metrics named in the figure 2 are Davis Bouldin, Dunns Indicator, Silhouette whereas four external evaluation metris are Rand indicator, Jaccard indicator, Fowlkes-Mallows indicator, Mutual Information and confusion matrix.[3]

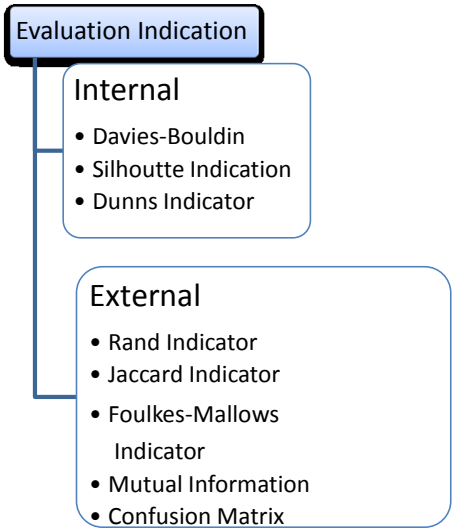

Fig. 2 Evaluation Indicators for Clustering Algorithm

Faculty can be evaluated using a variety of factors. Other faculty metrics would be easier to consider when evaluating them in order to improve the caliber of teaching and, as a result, the institute's results. Faculty results, student assessments, and additional acts such as papers published, lectures, seminars, and conferences attended and held can all be used to evaluate a professor.[4]

Framework Architecture The proposed technique saves the data for all faculty members in a database. [6] The productivity of any faculty member or group of faculty members is mathematically examined, allowing management to make swift decisions on any faculty-related parameter. Figure 3 shows process flow of faculty performance evaluation.

The number of clusters is determined by the distortion level that is closest to the acceptable threshold leve l.The elbow approach is typically used in conjunction with the Kmeans clustering algorithm.A fresh way of

grouping data has been coined using inspiration from the elbow method, agglomerative clustering, and th e closest neighbour notion in data mining.

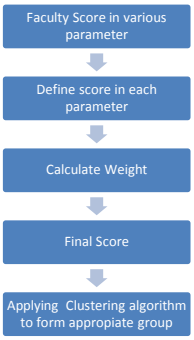

Fig. 3 Process flow diagram of Faculty Performance evaluation

3. Result

Proposed Clustering algorithm : 1st level completed using the aid of nearest neighbour, assign data element to any cluster If the value is close to the preceding data element, the cluster is allocated to it; otherwise, a new cluster is created and assigned to it.

The clustering's Pass2 step is crucial. The agglomerative idea is employed at this step to minimise the number of clusters in order to get a higher cluster validation index.

minD : Minimum value in Dataset D
maxD : Maximum value in Dataset D
r : Difference value of maxD and minD
k : number of elements in dataset D with the equation.
t : Calculate density area value in t as

$$t = \log(\text{standard deviation}(D)) * (0.5 * r/k)$$

minData: Calculate minimum data in each cluster using equation

The result of the proposed method yields four clusters at the end. Initially, it gives 7 clusters with a silhouette value of 0.5501586087520715 in the first pass. The silhouette value after the second pass is 0.6149607243415922. The second silhouette value is higher than the first silhouette value, indicating that the cluster received better after pass 2.

Finally, utilizing sorted data, cluster 4 was generated, resulting in three decision boundaries, as shown in table 5.2:

Table 5.2: Decision levels and respective cluster number

Decision Levels	**Cluster Number**
Less than or equal to 20.68	1
Greater than or equal to 23.87 and less than or equal to 32.64	2
Greater than or equal to 37.62 and less than or equal to 41.39	3
Greater than or equal to 46.3 and less than or equal to 58.7	4

4 Discussion

One of the most difficult tasks for any clustering algorithm is determining the number of clusters. A large number of clusters might mislead the interpretation or pattern. In the clustering algorithm, it is anticipated that two or more faculties have comparable scores, but when clustering, it is assumed that each faculty will be used only once, and that after obtaining the cluster and decision boundary, all faulty members will be mapped into the appropriate group.

- The number of clusters to be chosen is self-calculative.
- The amount of data points in each cluster is kept to a bare minimum.
- The only thing the user has to contribute throughout the procedure is a dataset.

The data distribution is used to calculate the approximate number of clusters. Many feature sets and preliminary levels of the calculation were identified and established by faculty evaluation agencies. However, a gap has been observed in reaching any conclusion using the feature set and data collected. This study aims to close the gap.

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