

# International Journal of Innovative Research in Science, Engineering and Technology

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## Statistical Model for Classification of Teacher's Performance

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**ABSTRACT :** The main goal of the education system or educational institute is to achieve quality objectives related to the students. The success of this mission depends on right teacher with right skills. Teacher plays key role in student's development. Performance of teacher with respect to teaching depends on several key factors like subject knowledge, preparation of lecture, communication skills, interaction with students and many other things related to the lecture. Data mining technique has the ability to discover knowledge from this unexplored data.

In this paper, data mining techniques particularly Bayesian classification method is applied to classify the teacher in groups like outstanding, very good, good, satisfactory and fair according to several factors maintained above. This study will help the college or educational institute to increase the quality of teaching by analyzing teacher's performance according to student's point of view.

After fitting the Naïve Baye's model observed that subject knowledge, regularity and punctuality, behavior with students and preparation of lecture are main factors that affects the teacher's overall performance.

**KEYWORDS:** Data mining technique, Teacher's performance, Naïve Baye's model, Confusion Matrix.

### I. INTRODUCTION

Teachers are dedicated professionals who have a lasting impact on students. Becoming a teacher will allow you to leverage your strengths and passion as a leader in the education field. Each day you will exercise your creativity, patience and communication skills as you present engaging lessons.

Teachers play vital roles in the lives of the students in their classrooms. The most common role a teacher plays in the classroom is to give knowledge to students. Teachers teach in many ways including lectures, small group activities and hands-on learning activities.

The teacher is the main aspect of education system or educational institute to achieve quality objectives related to the students. The success of this task depends on right teacher with right skills. The educational institutes are now paying attention to select the right talent who can perform consistently throughout all generic framework activities and execute the process properly. A proper system to evaluate the teacher's performance still remains unexplored and not much related work has been done to analyze the performance. They are attempting to build a proper evaluating system for the same using various methods.

The evaluation of teacher performance was not always considered as determinant in improving the quality of student learning. A greater focus on teacher evaluation allows more informed decision making to the improvements that are intended to be sustainable and meaningful of learning, which consequently translates to the greater relevance that is attributed to teacher evaluation. [8]

In the context of each College, there is a teacher with a level of performance that is desired to be the standard performance of all teachers in the specific context in which its action is it developed. This is the teacher who combines scientific and professional competence, taking into account the means of provenance of the students and the knowledge they hold, the resources that exist in College and how they are mobilized by the teacher to help develop its professional

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activity in order to improve the knowledge and skills of their students and consequently the improvement of their College results. Therefore, any teachers under evaluation know performance places them at a certain level of performance, taking into account their knowledge of existing descriptors in each of the performance levels. In this paper, we consider six levels and present them in descending order of performance: *Outstanding*, *Very Good*, *Good*, *Satisfactory*, *Fair* and *Average*.

As mentioned the development of performance standards is based on the principle of the definition of Good performance level, as a reference standard. In this context, *Good* is the base standard indicator of what is good professional performance in the different fields and their indicators in a given context.

In the context of each College this is a teacher with a level of performance that is desired to be the standard performance of all teachers in the specific context in which its action is it developed. This is the teacher who combines scientific and professional competence, taking into account the means of provenance of the students and the knowledge they hold, the resources that exist in College and how they are mobilized by the teacher to help develop its professional activity in order to improve the knowledge and skills of their students and consequently the improvement of their College results.

The *Very Good* level of performance is the over-coming of the reference standard. Clearly exceeding the standard, *Outstanding* was established as a great teacher effectiveness reference.

In contrast to teachers with high teaching performance, these teachers show a substandard teaching performance, which needs attention from the existing structures in each College, with responsibilities in the evaluation of teaching performance. These teachers must be supported in order to meet other performance standards.

## II. RELATED WORK

João Casanova de Almeida Universidade Fernando Pessoa [1]-This paper is focused on the standards of teacher evaluation,for this they addressed an essential elements for the absolute necessary transparency in the teacher performance evaluation process.

Sangita Gupta, Suma V. [2] In this paper author works on performance of employee in software industry. According to various factors the employees are classified in the classes like good, average, poor by using Navie Bayes Classifier.

S.Karthika, N.Sairan[7] This paper developed a classification of persons into different classes base on several attributes which represents their educational qualification. This classification is done by Navie Bayes classification.

## III. METHODOLOGY

Every year college conducts feedback of teachers from students. For this purpose, students are given feedback forms in which there are questionnaire such as Preparation of lecture, teaching method/communication skill , Use of teaching aids ,Co-relation of curriculum with day to day life ,Supply of study ,Depth of subject knowledge , Syllabus completion-Exam preparation , Regularity and punctuality , Behavior with students and Class control. Students should give 10 point rating for each question. And they are categorized in classes like Outstanding, Very good, Good, Satisfactory, Fair and Average. From these questions, college analyzes the teacher's overall performance .Here we consider overall performance as a response variable.

For further analysis, college uses weighted mean to analyze the performance of the teachers. And this calculated weighted mean is used to categorized the teacher according to the classes such as Outstanding, Very good, Good, Satisfactory, Fair and Average.

### Naïve Bayesian classification:

Bayesian classifiers are statistical classifiers. They can predict class membership probabilities such as the probability that a given tuple belongs to a particular class. Bayesian classification is based on Baye's theorem. Bayesian classifiers have also exhibited high accuracy and speed when applied to large databases. Naïve Bayes classifiers assume that the effect of an attribute value on a given class is independent of the values of the other attributes.

The Naïve Bayes classifier works as follows:

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Let D be a training set of tuples and their associated class labels. As usual, each tuple is represented by an n-dimensional attribute vector,  $X=(x_1,x_2,\dots,x_n)$ , depicting n measurements made on the tuple from n attributes, respectively,  $A_1,A_2,\dots,A_n$ .

Suppose that there are m classes,  $C_1,C_2,\dots,C_m$ . Given a tuple, X, the classifier will predict that X belongs to the class having the highest posterior probability, conditioned on X. That is, the naïve Bayesian classifier predicts that tuple X belongs to the class  $C_i$  if and only if

$$P(C_i|X) > P(C_j|X) \quad \text{for } 1 \leq j \leq m, \quad j \neq i.$$

Thus we maximize  $P(C_i|X)$ . The class  $C_i$  for which  $P(C_i|X)$  is maximized is called the maximum posteriori hypothesis. By Bayes theorem

$$P(C_i|X) = \frac{P(X|C_i)P(C_i)}{P(X)}$$

As  $P(X)$  is constant for all classes, only  $P(X|C_i)P(C_i)$  needs to be maximized. If the class prior probabilities are not known, then it is commonly assumed that the classes are equally likely, that is,  $P(C_1) = P(C_2) = \dots = P(C_m)$ , and we would therefore maximize  $P(X|C_i)P(C_i)$ . Given data sets with many attributes, it would be extremely computationally expensive to compute  $P(X|C_i)$ . To reduce computation in evaluating  $P(X|C_i)$ , the naïve assumption of class-conditional independence is made.

$$P(X|C_i) = \prod_{k=1}^n p(x_k | C_i) = p(x_1|C_i) * p(x_2|C_i) * \dots * p(x_n|C_i)$$

Here  $x_k$  refers to the value of attribute  $A_k$  for tuple X.

If  $A_k$  is continuous-valued; A continuous-valued attribute is typically assumed to have a Gaussian distribution with mean  $\mu$  and standard deviation  $\sigma$ , defined by

$$g(x, \mu, \sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \quad \dots \dots (1)$$

So that  $P(x_k|C_i) = g(x, \mu_{C_i}, \sigma_{C_i})$

We need to compute  $\mu_{C_i}$  and  $\sigma_{C_i}$ , which are the mean and standard deviation, respectively, of the value of attribute  $A_k$  for training tuples of class  $C_i$ . We then plug these two Eq.(1).

To predict the class label of X,  $P(X|C_i)P(C_i)$  is evaluated for each class  $C_i$ . The classifier predict that the class label of the tuple X is the class  $C_i$  if and only if

$$P(X|C_i)P(C_i) > P(X|C_j)P(C_j) \quad \text{for } 1 \leq j \leq m, \quad j \neq i$$

In other words, predicted class label is the class  $C_i$  for which  $P(X|C_i)P(C_i)$  is maximum.

Bayesian classifier have minimum error rate in comparison to all other classifiers.

## IV. ANALYSIS AND RESULTS

**A-priori probabilities of OP:**

|             |                    |                  |
|-------------|--------------------|------------------|
| <b>good</b> | <b>outstanding</b> | <b>Very good</b> |
| 0.3         | 0.4                | 0.3              |

**Conditional probabilities:**

**Variable PL:**

|                    |                |             |                    |                     |                  |
|--------------------|----------------|-------------|--------------------|---------------------|------------------|
| <b>OP</b>          | <b>average</b> | <b>good</b> | <b>outstanding</b> | <b>satisfactory</b> | <b>Very good</b> |
| <b>Good</b>        | 0.03333333     | 0.46666667  | 0.03333333         | 0.10000000          | 0.36666667       |
| <b>Outstanding</b> | 0.00000000     | 0.02500000  | <b>0.57500000</b>  | 0.00000000          | 0.40000000       |
| <b>Very good</b>   | 0.00000000     | 0.16666667  | 0.53333333         | 0.00000000          | 0.30000000       |

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Here above table shows the conditional probabilities of factor PL i.e. Preparation of Lecture and the maximum probability is 0.5750 corresponding to outstanding overall performance and outstanding Preparation of Lecture.

### Variable TMCS:

| OP          | fair       | good       | outstanding | satisfactory | Very good  |
|-------------|------------|------------|-------------|--------------|------------|
| Good        | 0.03333333 | 0.46666667 | 0.00000000  | 0.03333333   | 0.46666667 |
| Outstanding | 0.00000000 | 0.00000000 | 0.45000000  | 0.00000000   | 0.55000000 |
| Very good   | 0.00000000 | 0.10000000 | 0.53333333  | 0.00000000   | 0.36666667 |

Here above table shows the conditional probabilities of factor TMCS i.e. Teaching Methods/Communication Skill. In this matrix there is no maximum probability.

### Variable ICT:

| OP          | fair       | good       | outstanding | satisfactory | Very good  |
|-------------|------------|------------|-------------|--------------|------------|
| Good        | 0.03333333 | 0.50000000 | 0.00000000  | 0.13333333   | 0.33333333 |
| Outstanding | 0.00000000 | 0.22500000 | 0.30000000  | 0.00000000   | 0.47500000 |
| Very good   | 0.03333333 | 0.30000000 | 0.20000000  | 0.03333333   | 0.43333333 |

Here above table shows the conditional probabilities of factor ICT i.e. Use of Teaching aids.

### Variable CCD:

| OP          | fair       | good       | outstanding | satisfactory | Very good  |
|-------------|------------|------------|-------------|--------------|------------|
| Good        | 0.13333333 | 0.46666667 | 0.00000000  | 0.06666667   | 0.33333333 |
| Outstanding | 0.00000000 | 0.02500000 | 0.55000000  | 0.02500000   | 0.40000000 |
| Very good   | 0.00000000 | 0.06666667 | 0.53333333  | 0.00000000   | 0.40000000 |

The above table shows the conditional probabilities of factor CCD i.e. Correlation of curriculum with day to day life.

### Variable SSM:

| OP          | fair       | Average    | good       | outstanding | satisfactory | Very good  |
|-------------|------------|------------|------------|-------------|--------------|------------|
| Good        | 0.00000000 | 0.03333333 | 0.43333333 | 0.00000000  | 0.13333333   | 0.40000000 |
| Outstanding | 0.02500000 | 0.00000000 | 0.17500000 | 0.45000000  | 0.00000000   | 0.35000000 |
| Very good   | 0.03333333 | 0.00000000 | 0.10000000 | 0.30000000  | 0.00000000   | 0.56666667 |

Here above table shows the conditional probabilities of factor SSM i.e. Supply of Study material.

### Variable DSK:

| OP          | average    | fair       | good       | outstanding       | satisfactory | Very good  |
|-------------|------------|------------|------------|-------------------|--------------|------------|
| Good        | 0.03333333 | 0.03333333 | 0.40000000 | 0.03333333        | 0.10000000   | 0.40000000 |
| Outstanding | 0.00000000 | 0.00000000 | 0.02500000 | <b>0.80000000</b> | 0.00000000   | 0.17500000 |
| Very good   | 0.00000000 | 0.00000000 | 0.10000000 | 0.53333333        | 0.06666667   | 0.30000000 |

Here above table shows the conditional probabilities of factor DSK i.e. Depth of Subject Knowledge and the maximum probability is 0.8 corresponding to outstanding overall performance and outstanding Depth of Subject Knowledge.

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**Variable SC:**

| OP          | average    | good       | outstanding | satisfactory | Very good  |
|-------------|------------|------------|-------------|--------------|------------|
| Good        | 0.03333333 | 0.43333333 | 0.03333333  | 0.16666667   | 0.33333333 |
| Outstanding | 0.00000000 | 0.00000000 | 0.47500000  | 0.05000000   | 0.47500000 |
| Very good   | 0.00000000 | 0.03333333 | 0.46666667  | 0.03333333   | 0.46666667 |

The above table shows the conditional probabilities of factor SC i.e. Syllabus Completion.

**Variable RP:**

| OP          | average    | good       | outstanding       | satisfactory | Very good  |
|-------------|------------|------------|-------------------|--------------|------------|
| Good        | 0.03333333 | 0.33333333 | 0.03333333        | 0.06666667   | 0.53333333 |
| Outstanding | 0.00000000 | 0.00000000 | <b>0.77500000</b> | 0.00000000   | 0.22500000 |
| Very good   | 0.00000000 | 0.06666667 | 0.63333333        | 0.00000000   | 0.30000000 |

The above table shows the conditional probabilities of factor RP i.e. Regularity and Punctuality and the maximum probability is 0.775 corresponding to outstanding overall performance and outstanding Regularity and Punctuality.

**Variable BS:**

| OP          | average    | good       | outstanding       | satisfactory | Very good  |
|-------------|------------|------------|-------------------|--------------|------------|
| Good        | 0.03333333 | 0.30000000 | 0.13333333        | 0.00000000   | 0.53333333 |
| Outstanding | 0.00000000 | 0.05000000 | <b>0.70000000</b> | 0.00000000   | 0.25000000 |
| Very good   | 0.00000000 | 0.13333333 | 0.63333333        | 0.03333333   | 0.20000000 |

The above table shows the conditional probabilities of factor BS i.e. Behavior with Students and the maximum probability is 0.7 corresponding to outstanding overall performance and outstanding Behavior with Students.

**Variable CC:**

| OP          | average    | good       | outstanding       | satisfactory | Very good  |
|-------------|------------|------------|-------------------|--------------|------------|
| Good        | 0.03333333 | 0.50000000 | 0.13333333        | 0.03333333   | 0.30000000 |
| Outstanding | 0.00000000 | 0.00000000 | 0.55000000        | 0.00000000   | 0.45000000 |
| Very good   | 0.00000000 | 0.00000000 | <b>0.56666667</b> | 0.00000000   | 0.43333333 |

The above table shows the conditional probabilities of factor CC i.e. Class Control and the maximum probability is 0.7 corresponding to outstanding overall performance and outstanding Class Control.

**Confusion matrix of Naïve Baye’s model:**

|             |             |           |      |
|-------------|-------------|-----------|------|
|             | outstanding | very good | good |
| outstanding | 35          | 19        | 0    |
| very good   | 4           | 7         | 2    |
| good        | 1           | 4         | 28   |

## V. CONCLUDING REMARKS

From the confusion matrix, the accuracy of the model is 70%.

Here, there are three classes, but confusion matrix has only two classes that is positive class and negative class, therefore to find specificity and sensitivity we merge outstanding and very good class as a positive class .From new confusion matrix the specificity of the model is 93.33% and sensitivity of the model is 92.85%

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From the fitted model, the conditional probabilities of factors like DSK (Depth of subject knowledge), RP (Regularity and punctuality), BS (Behavior with students) and PL (Preparation of lecture) are significantly high. Therefore, we can conclude that these factors mostly affect the overall performance of the teacher.

Therefore we can say that if we are interested to improve the teacher's performance we must have to concentrate on these factors.

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