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Mining Sentiments from Students' Feedback

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Abstrate:-Student's feedback is a very important and crucial tool for any teacher to know his/her performance and to plan the potential improvements. In the present study the student's opinion comprises of the several characteristics about their teacher's teaching performance are collected through closed ended questions on Likert scale as well as through few open ended questions in terms of brief statements. The open ended questions being difficult to infer; mostly are ignored. For such cases the sentiment analysis is a good tool to bring them in main analysis stream for the inference of data. The satisfaction level pertaining to the teacher's overall performance also is enquired during the survey as a datum reference. Multinomial logistic regression is fitted and satisfaction levels are estimated using it. These two values are compared subsequently with the third resultant value that is obtained by using the sentiment analysis to evaluate, whether the same feelings about a teacher are being reflected from students feedback collected in the form of statements or not. Sentiment analysis is a technique used to measure the sentiments in numerical values that are associated with the text or the statements under consideration. The sentiment scores obtained using sentiment analysis is further processed to estimate the satisfaction levels and classification rates. Further artificial neural network is used to find out the important characteristic which characterizes the satisfaction levels.

Key Words: Feedback, sentiment analysis, multinomial logistic regression, artificial neural network, classification, word cloud, classification rates

I. INTRODUCTION

Students' feedback is an essential tool to measure teacher's performance. Based on this constructive critic, teachers can get a clear idea about their strengths, weaknesses, and improvement opportunities of teaching process and plan further performance improvement by overcoming the weaknesses if any. Generally the feedback is taken on Likert Scale and in terms of few open ended descriptive statements. However the data in terms of categorical or quantitative terms is analysed and the descriptive information in terms of statements is generally neglected and it's not considered while analysing because it is not in terms of categorical variable nor in terms of quantitative variable. However it is important to know the students' perspectives in various aspects about performance of teacher that might not be included in the limited questions of feedback.

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Ayfer, Su Bergil, Işil Atli (2012) have studied the two important perspectives namely; impact of feedback on students and impact of feedback on teachers. Juan Antonio Morwno-Murcia et al. (2015), Juan Antonio Morwno-Murcia et al. (2015) have proposed a questionnaire and termed it as measuring instrument to evaluate the teacher's performance, Chhaya Sonar (2020) have studied and analyzed the feedback and proposed a method to find out the quality of teaching using simple and weighted performance indicators. Sentiment analysis is a technique used to measure the sentiments associated with the text, messages, and paragraphs under consideration. Many investigators Lun-Wei Ku, Yu-Ting Liang and Hsin- Hsi Chen (2006), Feimerer I, Hornik K., Meyer D. (2008) has used sentiment analysis for this purpose. Sentiment analysis can be applied to capture the feelings in numerical values. Hence several researchers Quratulain Rajput, Sajjad Haider, and Sayeed Ghani (2016) have described the method of sentiment analysis for measuring performance of teachers. In addition to stop words in lexicon based dictionary he has also removed some words which are not meaningful or have some different meaning with respect to teacher's feedback. Sujata Rani and Parteek Kumar (2017) also used sentiment analysis, Phu X. V. Nguyen, Tham T. T. Hong, Kiet Van Nguyen, NganLuu-Thuy Nguyen (2018) have determined sentiment polarity to study the students opinion about teachers of Vietnamese University students. He has applied the Naive Bayes classifier, long-short term memory, maximum entropy and also bi-directional long-short term memory which are machine learning techniques for correct classification of students' sentiments. Francis F. Balahadia, and Benilda Eleonor V. Comendador (2014) have used sentiment analysis in capturing the emotions of students about their teacher's teaching.

II. METHODOLOGY

1.1 Related Work

The descriptive or text feedbacks are not measurable because of its very nature. Hence if the process performance is made quantifiable in terms of some scores or numeric values, then such performance or the process can easily be measured, analysed and interpreted for improvements apart from establishing the control measures. For the present study more than 600 feedbacks of PG students are collected which consists of 24 important features of teachers pertaining to the teaching effectiveness, class environment, assessment, exam evaluation, motivation, enthusiasm while teaching. Apart from this, student's overall satisfaction score about teaching process in percentage ranging from 0 to 100% for respective teachers also is asked. For further clarity and details on teaching features, the research paper of Chhaya Sonar (2020) can be referred.

In this process, for each question students have to opt one of the 5 responses on 5 point Likert scale: 1-never, 2-rarely, 3-some times, 4-often, 5- always. Moreover, along with these questions students are also asked to write briefly about their teacher's performance.

1.2 Multinomial logistic regression:

Multinomial logistic regression is used to model response or dependent variable if it is a nominal variable with two or more than two levels. Log odds of the outcomes are modelled in it, as a linear combination of the predictor or independent variables. It is an extension of logistic regression, which analyzes dichotomous (binary) dependents. The students have asked to give the satisfaction level ranging from 0 to 100 %. To apply multinomial logistic regression it is considered as dependent variable and hence converted into 5 categories; <60 as '1', 60 to 69 as '2', 70 to 79 as '3', 80 to 89 as '4' and > 90 as '5'. Here 24 independent variables are used which are the categories opted by students for their respective teachers on 5 point Likert scale as elaborated in section 2.1. Further it can be also used to find the classification rates to find group (here 5 categories) membership of every observation.

1.3 2.3 Word Cloud for Visualisation of frequent response and Sentiment analysis

Generally the graded or categorised data is analysed but the statements or views (in text) cannot be analysed easily and interpretation is far off, unless they are converted into some numerical form. The students are also asked to write about their teacher's performance in few sentences. To analyse these statements and draw some logical inference from these trivial many statements, sentiment analysis is a suitable tool which is employed here using R studio and NRC directory. The cores of the statements are obtained for each statement. NRC gives the sentiments as anger, anticipation, disgust, fear, joy, sadness, surprise, trust and also negative and positive words from each statement. Word cloud is a good visualization technique based on frequency of the words. It is very simple tool to identify the repetitive or frequent feelings which occur in any text. In education it can be effectively used to find the opinion of students about particular teacher or subject.

Sentiment analysis is a largely used technique to find or extract the feelings or opinions of people from the text or subjective information. NRC along with frequencies representing emotions also gives the sentiment scores which are positive or negative. These values represent the extent of emotions reflecting from text. For every statement it can be determined and this information can be effectively used further for analysis or interpretation purpose.

1.4 Artificial Neural Network

Artificial Neural network (ANN) are largely used in various fields particularly to model the relation between dependent and independent variables through hidden layers. The advantage of this technique is, it doesn't require a rigid model structure and set of assumptions that are imposed before learning from the data as in linear regression analysis and it is suitable for non linear data also. It closely resembles with linear regression analysis for linear type of data if the data satisfies its assumptions. However, if model interpretability is not important, ANN is a good option. It is based on principle of minimizing the prediction error of target variables (also called outputs or response or dependent variables).

Artificial neural network is used to know which feature characterizes the satisfaction level. The dependent variable is the satisfaction level given by students and the covariates (predictors) are the categories opted by students for 24 questions. In SPSS factors are used for quantitative variables and covariates are used for categorical variables. If the data is quantitative, then the classification rates also can be evaluated using ANN. But since the independent variables are categorical type; only independent variable importance analysis is done using SPSS and importance scores are obtained.

III. RESULT AND DISCUSSION

Multinomial logistic regression is executed in SPSS. The dependent variable is having 5 categories as explained in section 2.1 and 24 predictor variables. The model fit gives p value < 0.001 which indicates that model fits significantly. Then the classification rates are obtained. The correct classification rate is 88.30 % with Nagelkerke's R^2 94.5. This means that 88.30 % of the times the fitted logistic model correctly identifies the satisfaction category given by students. Whereas 11.70% of the times it is misclassified into one of the four categories to which it actually doesn't belong to.

To have preliminary idea about the sentiments of students they are represented in pictorial form. For example a specimen sample of three teachers with more than 50 feedbacks is represented by Fig.1 below in a word cloud form.

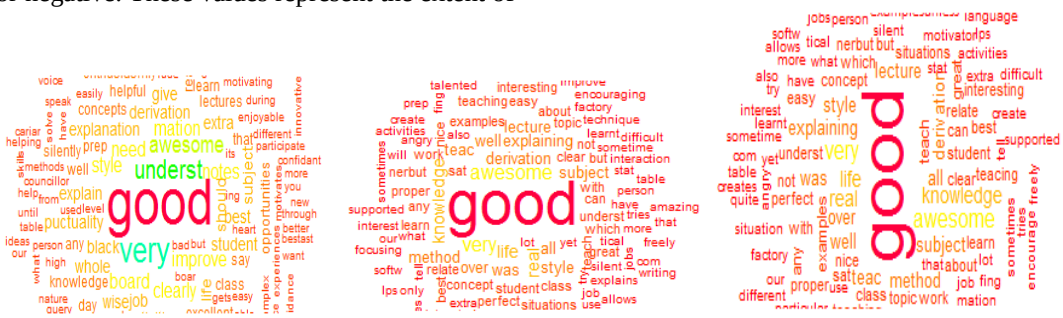

Fig.1: Word cloud of student's statements about teachers

Before applying this tool on the feedback statements, all the common words are removed from vocabulary along with some additional words such as the name of teacher, the word 'teacher', and also entire data is cleaned; removing the blank spaces, punctuation marks and numbers also. Using R studio polarity of the words is obtained as positive or negative. The word cloud is a good technique for visualising the unrestricted feelings of students about their teacher's performance. The word with bigger size represents the higher frequency of the respective word. The most frequent words used for teacher's performance are: good, improvement, best, knowledge, helpful, supportive, and awesome. However the disadvantage of this method is, for some opinions or words the clarity on positivity or negativity of sentiment can't be clear. E.g. the word improvement becomes a misleading sentiment because it may be extracted form: "The teacher needs an improvement" or "Significant improvement is observed in teaching" also. Hence sentiment scores are required for more precision.

The sentiment scores are also obtained using R studio. These scores ranges from -0.75 to 2.55 and for two exceptional cases it is 4.35. To compare the sentiment scores obtained using sentiment analysis for the statements and the satisfaction level given by students about teachers; the scores are divided into 5 categories as -0.75 to -0.04 as '1', -0.05 to 0.64 as '2', 0.65 to 1.34 as '3', 1.35 to 2.04 as '4' and more than 2.05 as '5'. Using these categories as dependent variables and the categories given by students for various questions as independent variables the multinomial logistic regression is fitted and the satisfaction levels are estimated. The correct classification rate is 87.50% with Nagelkerke pseudo R2 as 94.40%. This means the estimated satisfaction level using sentiment scores matches with the actual score given by student 87.50% of the times and it doesn't match 12.50% of the times.

Further to know which feature characterizes the satisfaction level, artificial neural network is used. The dependent variable is a satisfaction level given by students and the covariates are the 24 questions answered by students. Since the independent variables are categorical type only independent variable importance analysis is done using SPSS and importance scores are obtained. The results obtained are graphically shown in fig.2.

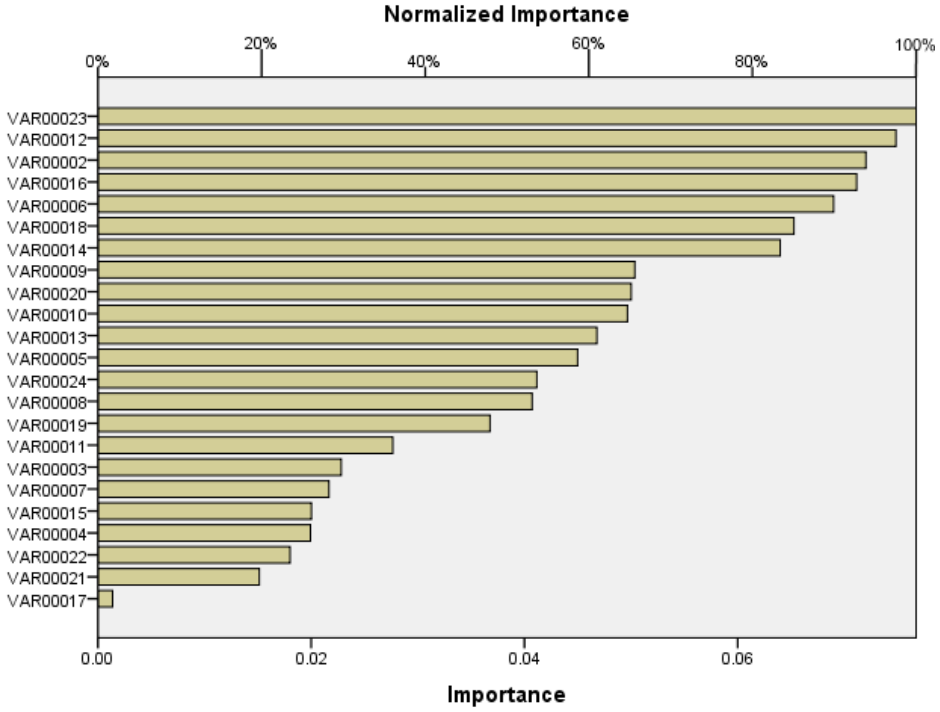

Fig.2: Normalized importance of characteristics using ANN

Fig. 2 represents relative importance of features from students' perspectives. The important features are the teaching methods, adequacy of opportunity allowed to student in participation and discussion? Is the teacher well prepared for each class? Is the teacher more focused on the subject related information? Does the teacher relate the topic with real life situations through different examples? The importance score and normalized importance score are (0.091, 75.1%), (0.121, 100%), (0.105, 86.7%), (0.109, 90.4%) respectively.

IV. CONCLUSIONS

The correct classification rate identifying the group membership using datum levels reported by students and the levels obtained by using sentiment scores are nearly same. The sentiments of students are represented using a word cloud in pictorial form. The word cloud is a visualisation of the students' strong feelings such as good, awesome, improvement and so on. However this does not give a clear idea about the opinion whether it is positive or negative feeling. Hence the sentiment scores also are required to be determined for further precision. Using sentiment analysis, a reliable measure of performance through more precise mapping of students views is obtained which leads to facilitate more detailed insights on the features in addition to features which otherwise were missed from the questionnaire.

From the ANN it can be observed that, there is no evidence of selective vital-few features those have been indicated as of extremely high importance. This implies that almost all the characteristics are important for students in cognitive learning process and this becomes an obvious fact in teaching process as-well.

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