

Mining Better Advertisement Tool for Government Schemes Using Machine Learning

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Abstract--- *Public opinion impacts most government policies and sets the limits within which policymakers must operate. It also sets the pace of reform. Central and state governments allocate massive budget for advertising schemes. Advertisement is necessary for reaching out to maximum people. But more money is invested in the advertisement. This invested amount will be reduced if governments select proper advertisement medium (Printed/Television/Social). India is diverse behavior nation. Citizens of India have different kinds of diverse educational background, culture, etc., Habitation of people in rural, urban and tribal varies considerably. The same advertisement medium is not suitable to reach out to these diverse natured set of peoples. So this paper focuses on public opinion mining to find the best advertising medium for government schemes. Data set is collected through online. Collected citizen data include gender, qualification, government school/private school, the field of work, occupation, year of experience, city/village, age, government job/private job, type of advertising medium people are comfortable. The proposed system introduces two new classification algorithms to predict the best advertisement medium to advertise government schemes. The final results show that the performance of the proposed algorithms outperformed existing algorithms.*

Keywords--- *Government Schemes, Advertisement Tool, Classification, Class Imbalance, Mean Error Based Ensemble.*

I. INTRODUCTION

The number of people using the internet for various purposes is increasing day by day. Comments on Facebook, tweets, reviews in e-commerce sites, comments/feedbacks in online blogs are filled with user opinions. If the analyst analyses this huge amount of data, then more hidden information/knowledge can be extracted. This can be used for better decision making in future. Opinion mining is one of the main branches of data mining. This mining focuses on computational techniques to extract, understand, categorize and analyze the opinions conveyed by users in online news, Facebook, Twitter and other online forums. Sentiment analysis plays a significant role in opinion mining to identify the sentiments based on given comments [9].

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The public opinion helps to understand and categorize the views or the sentiments which are expressed through the source text. Social media have gained huge amount of attraction nowadays. Opinions about various fields are given as comments. This is spread continually to various sources. Public opinion is the citizens' view on politics and government actions and schemes. Citizens' views influence political activities. Government looks for public opinion to determine what citizens want them to do. Opinion mining not only includes feedback analysis, movie review and product review. It also plays a huge role in effective policy-making by governments.

In many countries, all people are not directly participating in framing new policy. Higher-level representatives only involved in framing new policy. Most of the policies formed based on vote bank politics. To make useful policy formulation public opinion need to be involved [1].

These days both the central and state governments allot a massive budget for advertising schemes. It is essential to advertising new schemes to reach a maximum of people. That will help the people to utilize those schemes quickly and successfully. But the critical issue in our country is diversity. Different kinds of educational background, different habitation of people (rural/urban/tribal), etc., so similar type of advertisement medium will not be suitable to reach all sections of society.

Government uses various advertising mediums like Printed media (Newspaper/books/Notice), Television media(TV/Radio), Social media (Facebook/Twitter/Whatsapp), Online Advertisement, Institution/Office, Mobile message, E-mails, Online Advertisement, etc., While government use existing methods, advertisement will reach quickly one sector of society, while the other sector may know latterly.

The number of comments regarding government schemes in social media is reaching a million comments per day. There are not much research is carried out in this area. Also, there is no standard method for mining and analyzing public opinion. In this paper, government schemes like digital India, clean India, make in India, national food security, the association for non-traditional employment for women (ANEW), new bank account opening, land acquisition in India, Pradhan Mantri Jan – Dhan Yojana, Pradhan Mantri Jeevan Jyoti BimaYojana and right to information are considered. Based on what medium (Printed media/ Television media/ Social media) these schemes are reached public? is the main focus of this paper. This will help to avoid unnecessary budget in advertising through all media to all people.

Data is collected through online Google forms. Association rules and traditional classification algorithms are applied to the data set. Association rule is used to identify interesting relationship between various parameters. Classification algorithms are applied to classify the public opinion about the government scheme advertisement correctly. This is helpful for evaluation government advertisement medium performance monitoring based on citizen perspective. This analysis will help the state and central government to save huge money. In addition to this work, a new algorithm based on enhancing sampling to handle class imbalance is also proposed. Because improving the predicting accuracy is the main factor behind successful opinion mining work.

In this paper, section I one is all about introduction to the public opinion mining and sentiment analysis. Section II is about the background and related works of the paper and different existing technologies available for opinion

mining classification. Section III is about novel proposed technology and architecture of proposed technology. Section IV discusses results and section V is about conclusion and future scope of the paper.

II. LITERATURE SURVEY

Bharat R.Naiknaware et al., in [4] proposed new public opinion mining architecture to analyze sentiments of users about Indian Government Schemes Using Twitter Datasets. Authors calculated and counted a number of positive, negative and neutral tweets for given #Hashtag and predicted the public opinion of government schemes. They concluded that this analysis of different #Hashtags tweets for sentiment analysis helps peoples and governments to find the public opinion behind that declared scheme.

D. Suganthi and A. Geetha in [7] discussed the application of sentiment analysis to twitter data of Goods and Services Tax. Their work focused on classifying the tweets as positive or negative or neutral based on the sentiments. Authors used various Machine Learning Algorithms for classification. They concluded that this opinion mining is very useful for the evaluation of government scheme.

Sachira Chinthana Jayasanka, Saminda Premaratne [23] analysed the user comments on products review. The authors included emotion symbols for processing and classification of the sentiment. Their work also focused on user interest and their profile such as age, profession. Authors concluded that these factors play major role in predicting the classifier accuracy.

Ashna Bali et al., [3] introduced a novel mechanism to analyse customer sentiments of popular phone brands and operating system. This type of analysis gives major benefits in preference and recommendation. This review analysis would be helpful for e-Commerce organizations. The authors used Bag of words techniques for better understanding and analysis.

Omar Alqaryouti et al in [15] proposed a new sentiment analysis mechanism based on an aspect-based hybrid approach. It combines the domain rules and domain lexicons to mine and analyses the reviews of the smart app. Their proposed model aims to mine the key characteristics of the reviews. Based on these characteristics sentiments were classified. This mechanism employs new techniques, rules, and lexicons to address the challenges of several sentiment analysis. New integrated classification model outperforms the existing algorithms.

Ravi Arunachalam and Sandipan Sarkar in [22] focused on a novel approach to monitor and analyze the citizen sentiment in social media by Governments. Authors applied this approach to a real-world problem and presented how Government agencies can get benefited out of it. Results provided greater and valuable insights, which can be converted into an actionable roadmap for the Government.

Until 2010 not much research carried out a regards sentiment analysis on government schemes. J. Zabin, and A. Jefferies in [10] introduced a new mechanism to extract new information from the public to get the real value for Governments. In 2010, Open Government Maturity Model is introduced by Gartner [2]. Gartner proposed public opinion mining as a mean to achieve collaboration for Governments. Chip Gliedman in [5] observed that the US Federal government was monitoring the citizen sentiment on Twitter. Gartner given suggestion that the Governments should use the social media for achieving better discussion forum [2].

A lot of government rules and advertisement of government schemes are currently in digital type. But extracting knowledge of data from that is a difficult task. It has complexness and variety, distinguishing those relevant to a selected context may be a non-trivial task. Very few research concentrated on mining public opinion for government scheme advertisement. Many researches focused on data mining techniques like association rules to mine the public opinions. Here Association rule [17], [18] is used to find the interesting relationships in the data set collected from the people. From the analysis, it is clear that age group, education qualifications and other factors highly influence the requirement of different type of advertisement medium. Association rules used for mining important relationships [19], [25].

K. Nithya, P.C.D. Kalaivaani and R. Thangarajan in [12] introduced a new data mining framework for classifying data. Micro-Blog Based Recommendation Systems for recommending news's is discussed in [11].

Imbalanced data sets need to be balanced in order to get better accuracy[21]. An imbalanced data set can be balanced either using data level or algorithm level approach. Sampling approach can be distinguished into the over-sampling approach and under-sampling approach. Under-sampling consists of random undersampling, totem links, condensed nearest neighbour rule, one-sided selection, neighbourhood cleaning rule [8]. Under-sampling can increase the loss of information. But there is no over-fitting and not a time-consuming process. Oversampling consists of random oversampling, SMOTE[14], Borderline SMOTE[8]. Over-sampling can increase the likelihood of occurring over-fitting and it will take more time to over-sample because of adding the samples. But there is no loss of information.

The methods at the algorithm level provide the steps to the classifier to classify the examples. In recent years, some algorithms are studied to combine the data level approaches with the algorithm level approaches to solve the class imbalance problem [13].

This algorithm level approach involves Boosting, Adaboost, SMOTEBoost, RUSBoost[6], modification of ensembles [16].

Many learning algorithms introduced in existing frameworks to integrate other field with data mining [20], [24].

III. PROPOSED METHODOLOGY

A lot of government rules and advertisement of government schemes are currently in digital type. In the Existing System, one of the main problems is the lack of citizen's participation in the decision-making process. Nowadays, topics related to governmental decisions are among the most widely discussed ones within digital societies. But in the Existing system, there are not enough techniques towards capturing the public's opinion communicated online and concerning governmental decisions. Fig.1. shows the steps involved in the proposed system.

Proposed System – Steps:

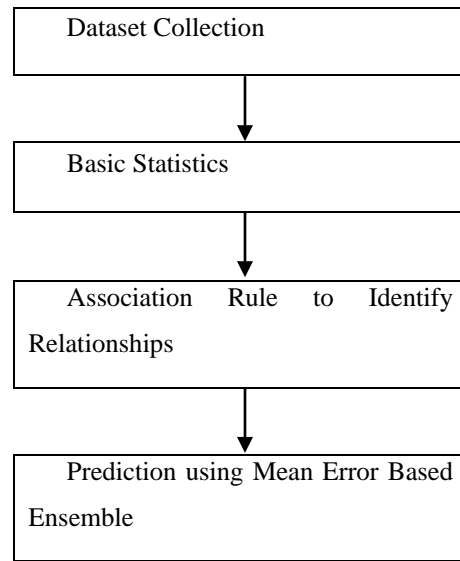


Fig.1: Proposed System Architecture

Dataset collection: Data is collected through Google forms by considering various attributes.

Basic Statistics: Statistics charts are generated using RapidMiner tool to understand characteristics and data behaviours clearly.

Association Rule: Association rule is used to identify the key relationship between various attributes. To identify this, Tableau tool is used.

Prediction using Mean Error Based Ensemble: New algorithm is proposed to predict the people opinion accurately.

Classification algorithms used: Existing ensemble algorithms like boosting, bagging, random forest is used to compare the performance of the new algorithm.

Class Imbalance: Collected data set have a severe class imbalance problem. To solve this issue, the algorithm level approach is used in Mean Error Based Ensemble.

Mean error based ensemble – algorithm

- i) Find the confusion matrix for the given base classifier in the first iteration.
- ii) Calculate the mean error.
- iii) Based on error rate increase the weight for the class.
- iv) Then apply the classifier for successive iterations.

The best base classifier from the set of base classifiers is selected based on its accuracy. Now, let us consider that the output from the best base classifier is given to the next iteration. The “fp error probability (False Positive)” and the “fn error probability (False Negative)” can be computed as follows:

$P_{FP} = E_{FP} / E_{Total}$
$P_{FN} = E_{FN} / E_{Total}$

where E_{Total} is a total error, E_{FP} is the false-positive error, E_{FN} is the false-negative error, P_{FP} is the false-positive error probability, and P_{FN} is the false-negative error probability.

IV. RESULTS AND DISCUSSIONS

A. Dataset Collection

Attribute list 1 - List 1 deals with a profile of the opinion makers. It includes Name, Qualification, Area of Living, Age, etc. List of attributes is given in TABLE I.

Table I: Attribute List 1

Student/ employee/ others
Name (optional)
Gender
Qualification
Government school / Private school
Field of Working
Occupation
Year of experience (optional)
City/village
Age
Job government/ private

Attribute list 2 - List 2 considers various communication mediums Printed media, Television media, Social media, Online Advertisement, E-mails, etc., List of attributes are given in TABLE II.

Table II: Attribute List 2

Printed media (Newspaper/books/Notice)
Television media (TV/Radio)
Social media (Facebook/Twitter/Whatsapp)
Online Advertisement
Institution/Office
Mobile message
E-mails
Online Advertisement
Others(through friends /Relatives)

Table III: Attribute List 3

Digital India
Clean India
Make In India
National Food Security
Association for Non-traditional Employment for Women
Bank account
Land acquisition in India
Pradhan Mantri Jan – DhanYojana
Pradhan Mantri Jeevan Jyoti Bima Yojana
RTI(Right To Information)
Pradhan Mantri Suraksha Bima Yojana

Attribute List 3 - List 3 consists of various government schemes. This list involves schemes like Digital India, Clean India, Make In India, National Food Security, etc., List of attributes are given in TABLE III.

Attribute List 4 - List 4 deals with the 3 parameters used to evaluate the reachability. List of attributes is given in TABLE IV.

Table IV: Attribute List 4

Easily Reachable
Moderately Reachable
Less Reachable

B. Basic Statistics

Gender - The following chart shows the data for gender attribute. From the chart, it is clear that female participants responded more than male participants. Fig.2. shows gender details.

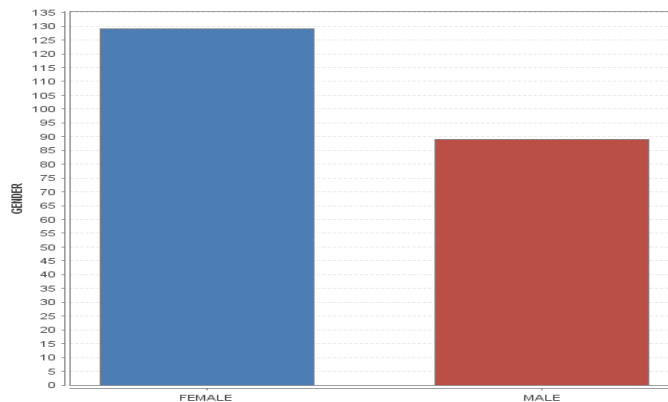


Fig.2: Gender Details

RESIDENCE - The following chart shows the data for residence. Chart shows that city people involved in filling Google forms than rural people. Fig.3. shows residence details of the participants.

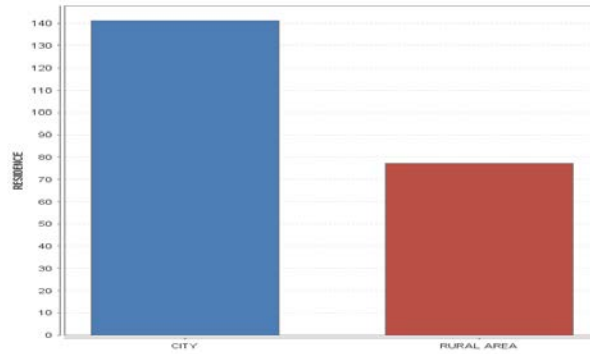


Fig.3: Residence Details

MODE OF EDUCATION - The given chart describes that students from matriculation schools responded more than students from government schools and CBSE schools. Fig.4. shows mode of education.

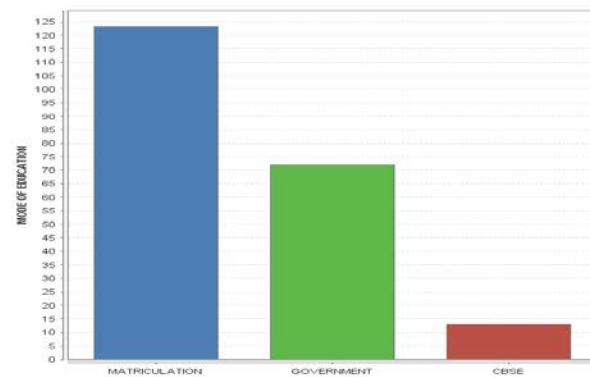


Fig.4: Mode of Education

PRINTED MEDIA - From chart, it is clear that printed mediums like newspaper is one of the easiest medium to reach the public. People are more convenient with the printed medium. Fig.5. shows responses for printed media.

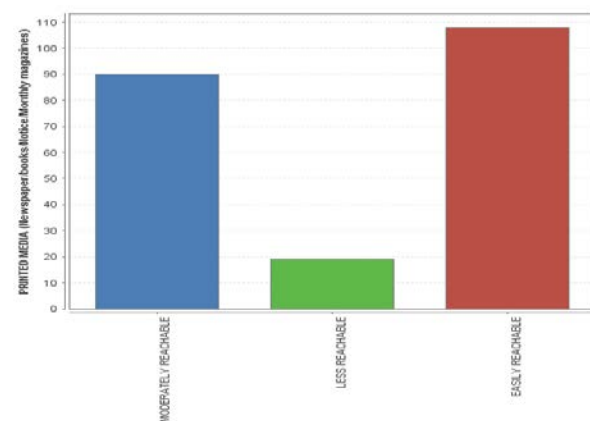


Fig.5: Printed Media

TELEVISION MEDIA - Compared to printed media, television media is the most preferred choice of the people. Fig.6. shows responses for television media.

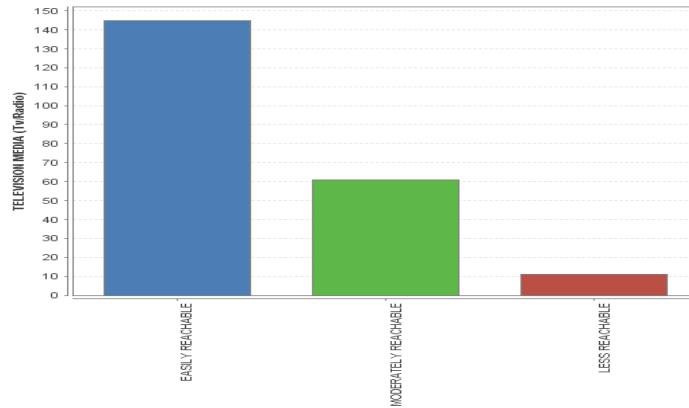


Fig.6: Television Media

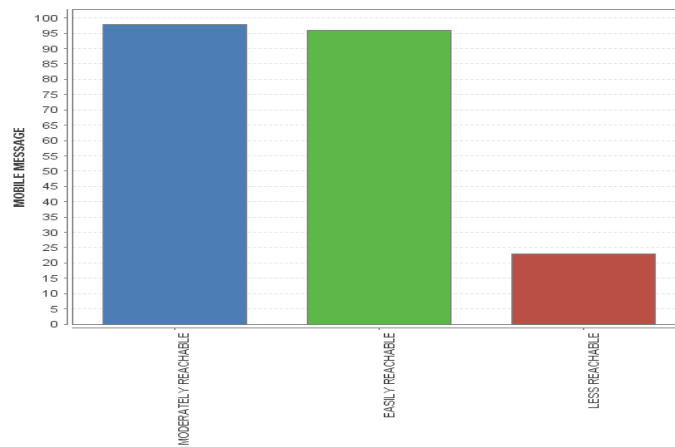


Fig.7: Mobile Message

MOBILE MESSAGE - People are not that much convenient with the mobile message advertisements. Fig.7. shows responses for the mobile message.

ONLINE ADVERTISEMENT - Students are not feeling online advertisement as better communication media for advertising government schemes. Fig.8. shows responses for online advertisement.

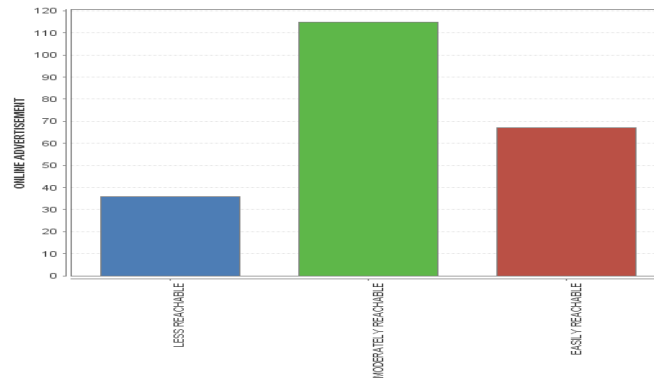


Fig.8: Online Advertisement

C. Association Rule – To Identify Relationships

Both male and female participants are feeling social media is the better medium for communication. Fig.9. shows the relationship between gender and social media.

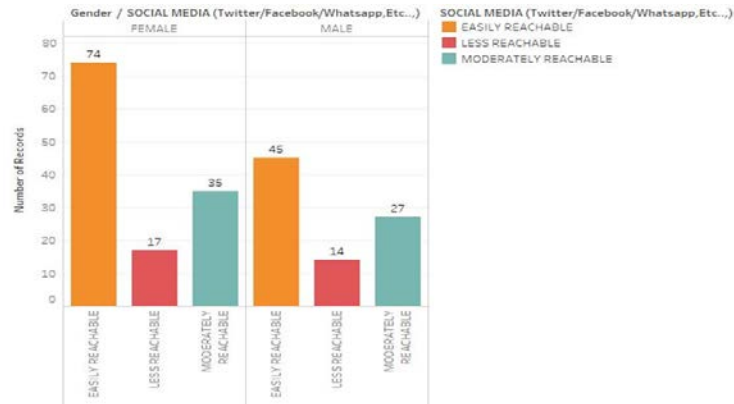


Fig.9: Relationship between Gender and Social Media

Mobile messages are not that much convenient as social media. Fig.10. shows the relationship between gender and mobile message.

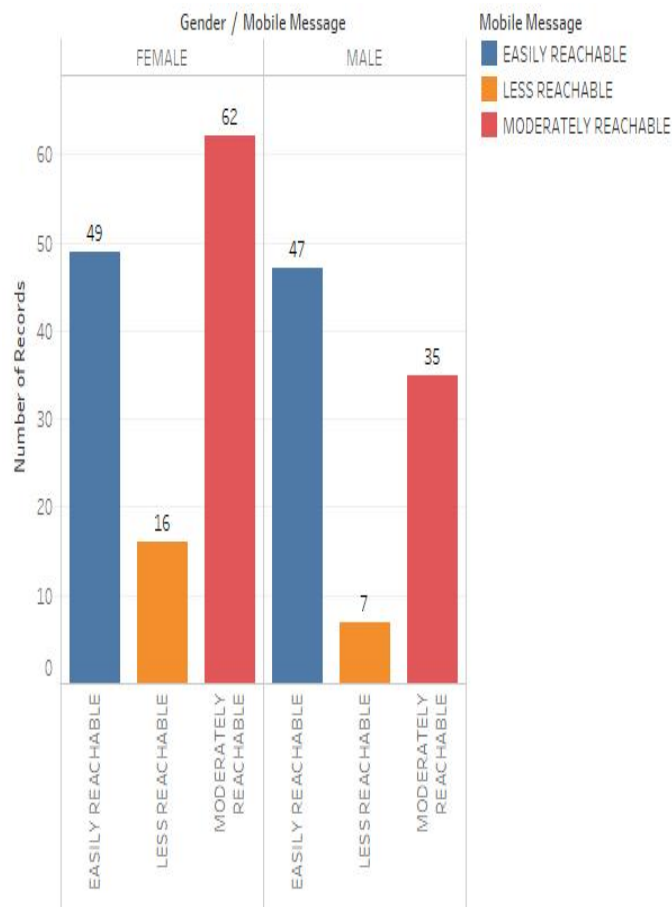


Fig.10: Relationship between Gender and Mobile Message

D. Performance Metrics

Accuracy is used as an evaluation metric to measure the performance of the algorithms. Accuracy is calculated based on the ratio of correctly classified records to the total number of records.

E. Results & Discussions

Four algorithms namely boosting, bagging, random forest and mean error based ensemble are applied to the dataset without preprocessing and dataset with preprocessing. In dataset without preprocessing raw data taken into consideration. In a dataset with preprocessing, SMOTE is applied to balance the classes.

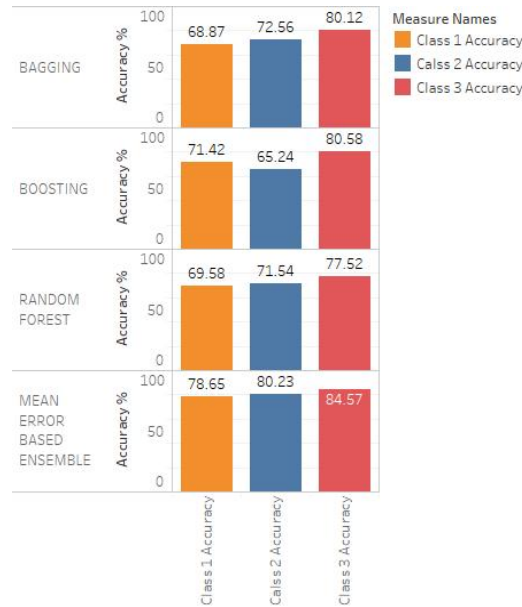


Fig.11: Accuracy – Dataset without Preprocessing

Class 1 represents easily reachable, class 2 represents moderately reachable and class 3 represents less reachable. Bagging gives better accuracy for class 3, but it fails to give standard level of accuracy for other 2 classes. In overall, new proposed mean error based ensemble gives good accuracy in all cases.

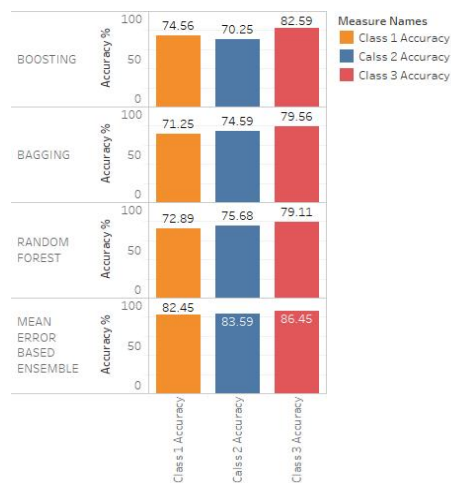


Fig.12: Accuracy – Dataset with Preprocessing

In a dataset with preprocessing also, bagging gives better accuracy for class 3, but it fails to give a standard level of accuracy for other 2 classes. In overall, new proposed mean error based ensemble outperforms all other existing algorithms. Compared to the dataset without preprocessing results, these results are better. It justifies the need for balancing the classes during training.

V. CONCLUSION AND FUTURE WORK

Central and state governments spends large amount of money to advertise the schemes through different mediums. In order to reduce the amount, this paper introduces new mechanism. This paper concentrated on mining public opinion for government scheme advertisement. From the analysis, it is clear that age group, education qualifications and others factors highly influence the requirement of different type of advertisement medium. In addition, this paper proposed the architecture of an interactive eGovernment platform that encapsulates the mined user opinions. Boosting, Bagging and Random Forest techniques are used in this paper to compare the performance of the new algorithm. Results shows that new mean error based ensemble outperforms all other existing algorithms.

Future work will focus on suggesting new framework with automatic opinion mining system for government scheme advertisements.

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