

Decision Tree and Ordinal Logistic Regression Methods for Maintaining University Sustainability

Teoh Siew Chin^{#1}, Mohammed Syazwan Mohd Shokri^{*2}, Rosshairy Abd Rahman^{#3}

[#] Dept. of Decision Science, School of Quantitative Science, Universiti Utara Malaysia, 06010, Sintok, Kedah, Malaysia.

¹celynn33@gmail.com

²syazwanshokri5161@gmail.com

³shairy@uum.edu.my

Abstract— Recently, there are lots of cases regarding the use of fake account and cyberbullying. The irresponsible attitude is badly affecting the motivation of individual who being attacked and ruining the reputation of organization involved. This study is conducted among university students that aims to determine the factors of choosing fake account as a medium to raise an issue and to identify the impact of cyberbullying towards university's reputation. About 380 samples were taken from undergraduate and postgraduate students. The data was analyzed using Decision Tree and Ordinal Logistic Regression (ORD) methods. The results show that there are students who have experienced cyberbullying or cyber victimization, which caused by the lack of parental support. The analysis from ORD method shows that fake account could affect university's reputation. Hence, this research hopefully capable to create awareness among university students and help them to proudly present their university's great name throughout the world. This is important to ensure the sustainability of community and university.

Keywords— Decision Tree, Ordinal Logistic Regression, University sustainability, cyberbullying, fake account.

1. Introduction

Nowadays, the world is keep changing. The changes in technologies have causes millions of impacts towards civilization. Technologies make life easier and better, by providing efficiency and joy at the same time. However, although technologies serve many advantages to human being disadvantages of it remain inevitable [1]-[3]. The drawback could easily be seen when people tend to rely more on technologies and make use of them in irresponsible manner. Nowadays, social media has turned as part of human's need

and they rely 100% on it for communication purposes. The mislead communication practice is also involves during the use of social media and this can be seen through the irresponsible behavior of spreading untruth rumors lead to cyberbullying. The use of Information Technology (IT) has become as an increasing factor of cyberbullying among university students and institutions. Based on previous research, cyberbullying has been a common phenomenon that happened among students from secondary school and university [4]. To be precise, cyberbullying can be divided into several types, which are harassment, flaming, exclusion, outing, and masquerading. [4] mentioned that cyberbullying victimization becomes an issue among college students as many incidents are linked to online bullying. Many online social networks have been created in order to make an ease and convenient life. However, Facebook has turned to be among the first and the largest online social network that ever been created [5]. Initially, many cyberbullying cases happened in this social media through the fake account created, which enable an attack onto individual via the grapevine of irresponsible user. Community are over relying on social media which is undoubtedly surrounded with rumors, fake news, by simply agreed and accepted those "facts" without taking any further research or investigation. Furthermore, those unproven fact that uncontrollably spreading might mislead others and trigger the spreading of chain among innocent community especially through social media platforms like Facebook and Twitter. As time goes by, community will gradually accept the fact that information is reciprocally spreading across social network. The action of creating fake account through online social media in order to spread the untruth rumors to public has becomes the common problem that

happened in many institutions, including universities.

Social media has been misused by some unethical students in university. Recently, there were many students involved with the creation of fake account in university. The use of fake account has become a trend when students tend to use the platform to spread untruth rumors and slander other people. These groups of people simply create issues and make other people to have a bad impression towards the targeted university. By having these groups of people in campus, university is in a great loss.

The use of fake account has led to serious problems towards person whom being attacked and simultaneously lead the university involved to loss its great reputation. The rumors created by irresponsible people is normally being published into social media and the issues gone viral to the whole world in a short period of time. Therefore, this study is conducted to determine the factors on university students to involve in this issue; whether is it because of jealousy, revenge or looking for other attention. The predictive model is developed in order to investigate the important factors that could detect cyberbully.

The next section is discussed on literature review, follows by methodology section. The following section will be regarding the results and discussion, which then being concluded in the final section of the study.

[6] mentioned that “fake accounts refer to humorous social media accounts that satirize a politician or a political organization by impersonating him/her/it.” Fake social media accounts on Facebook and Twitter have proliferated in the last few years in Italy, becoming an established sub-genre of satire, which draws media coverage, public attention, and sometimes, as can be seen above, even unexpected recognition by the satirized [6]. A fake account is an account where someone is pretending to be something or someone that does not exist. Usually, a person fakes their identities by pretending to be someone which impersonating other people or be someone that do not exist at all.

The analysis of the fake Facebook profile experiment showed that creating and maintaining a fake profile is an easy task. The Facebook Immune

System by [7] was unable to identify profiles as fake. Furthermore, when creating the profiles, the researchers did not come across a single CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart [8]). Furthermore, the researchers have found that in general, female fake profiles are more successful in obtaining friends than male ones. However, the gender distribution shows that female profiles are not necessarily attracted solely to male profiles [5].

[1], [9] and [10] discussed the different things for the criteria measurement in fake account, which include cyberbullying. [1] discussed about three effects that will lead to fake account creation, which are break-up, envy, intolerance and ganging up. Moreover, they also discussed about the causes happen and remedies to solve the problem. For the causes, this included anger, powerlessness, fear and sadness, while the remedies is to educate student, educators and parents on the dangers that lurk in cyberspace and identify the specific ways to protect students in this technological era. Then, [9] mentioned that there are 16 impacts of cyberbullying on adolescent health, namely anger, sadness, frustration, fear, embarrassment, higher levels of proactive, reactive aggression, property damage, illegal acts, substance use, delinquency, suicidal behavior, somatic symptoms, loneliness, anxiety, and depression. Meanwhile, [10] used factors as a measurement for the involvement in the cyberbullying, and the factors used to measure include the technologies use, parental involvement and safety regarding to the adults itself.

There are seven factors of using fake account among university students which taken from literature review as listed in Table 1. [11] has identified some major motives for cyberbullying in their studies which are looking for others attention, lack of parental support [12], [9] and also revenge [13], and these act as the major motives for cyberbullying. The most important factor will be found in the result which has been distributed to the rank of cyberbullying. The other factor such as lack of understanding and empathy were discussed by [14], [15], and [9], and those has stated that cyberbullying and cyberbullying victims show less empathy and higher relationship aggression than those who are not involved in. However, jealousy or frustration and low self-esteem has been mentioned by [13] as to be a part of those particular reasons that can be explained in the use of

cyberbullying by those who would not confront their victim face-to-face.

Table 1. Factors Contributing to Fake Account

Factors	Authors
Feel powerless in their own lives	[9]
Looking for others attention	[11]
Lack of understanding and empathy	[14], [15], [9]
Jealousy or frustration	[13]
Low self-esteem	[13]
Lack of parental support	[12], [9], [11]
Revenge	[11], [13]

There are several approaches through the different method of fake account such as multinomial logistic regression, regression, decision tree and ordinal logistic regression. Table 2 shows several methods used by the authors in cyberbullying domain.

Table 2. Research approaches of Cyberbullying

Method	Author
Multinomial Logistic Regression	[10]
Regression	[16], [1]
Decision Tree	[17], [18]
Ordinal Logistic Regression	[19]

According to [10], Multinomial Logistic Regression or also known as "Multinomial Regression" is used to predict a nominal dependent variable with the given of one or more independent variables. This method was used to examine the relationship between the cyber bullying categories with independent variables while simultaneously controlling for how each of these may be influenced by the other variables. According to [16], regression is a good method to determine the relationship between factors, where three factors were considered in their research. First factor is about online harassment, second is intentionally excluding someone from online group and disturbing him, and the third factor is about spreading mean or embarrassing rumors. Meanwhile, [1] used regression to demonstrate the prevalence and causes of cyberbullying, the psychological impact on students, and the response of students and managers to cyberbullying. The goal is to give school leaders a better understanding of the phenomenon and to come up with steps to address this challenging issue. Firstly, the author is

divided into two broad categories: cyberbullying due to relationship problems, and cyberbullying unrelated to relationship issues. In the second level of analysis, these examples were classified according to the four specific relationship tensions that emerged in this study, including: breakup, jealousy, intolerance or solidarity. It is clear from this analysis that highlighted the ability of students to deal with social tensions, especially those who are centered on relationship issues, as that is the root of most cyberbullying among these adolescents.

Decision tree predicts the class variables by depending on the attribute values of the input variables. It divides the input variables into smaller subsets based on the weight or value of the input variables at the attribute level. This means that the classified smaller subset has rich information that predicts the class variables. The decision tree continues to split subsets recursively until the value of the end node is same as the class value. The decision tree classifier uses only those input variables that could obtain the utmost information to predict the class output and discards the rest of the variables [20]. [17] mentioned that decision tree is suitable to predict online cyberbullying. Decision tree classifies the target variables based on the decisions made by the classifier on the input variables. The decision tree classifier is used to develop predictive models to detect cyberbullying on Twitter. Although it is marked as a "black box" when being tested on a test dataset, the feature selection technique for random forests works best compared to other classifiers. Leaves and branches are common terminologies used to describe the decision tree classifier, where leaves are the target or class variable and branches are the conjunctions of input variables that predict the class variable [20].

[19] employed Ordinal Logistic Regression to study the unique relationship between cyberbullying and adolescent mental health, and to explore the potential regulatory role of family ties in this association. According to [19], the advantages of using ordinal logistic regression are the model assumes that the relationship between the ordinal result and the argument is independent of the category. The assumption implies that the corresponding regression coefficients in the link function are equal for each cut-off point. Therefore, it is easy to construct and interpret the ordinal

regression model, which only requires a model hypothesis and produces only one set of regression coefficients.

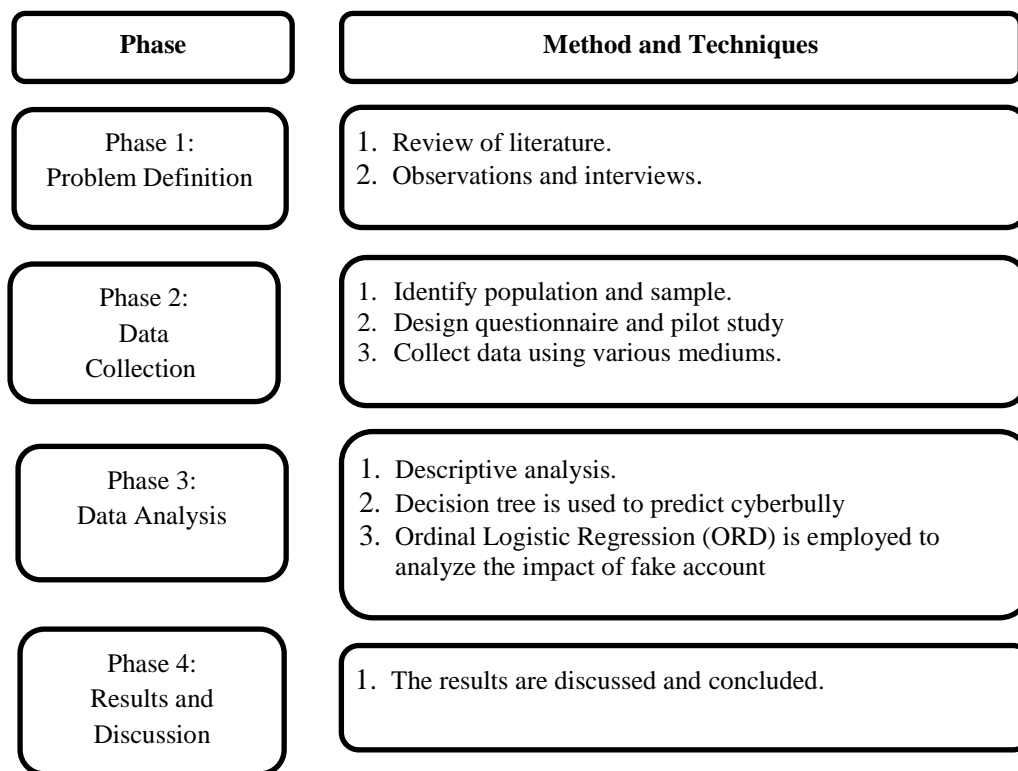
In this research, Decision Tree is employed onto class membership and calculated by repeated division of dataset into a uniform subset. Hierarchical classifiers allow class labels to be accepted and rejected at each intermediate stage. Thus, the advantages of used decision tree in this research are, non-parametric training data can be processed, no need for extensive design and training, provides hierarchical associations between input variables to predict class memberships and provides a set of rules that are easy to interpret, as well as, it is simple and well computational efficiency [18]. Then, Ordinal Logistic Regression is used to examine the contributions of factors in involvement with bad impact towards the

university reputation. The data were weighted to ensure a balanced representation of the sample across university students. Confidence intervals were adjusted according to design of factors involvement and impact towards university.

2. Materials and methods

2.2 Research Framework

This study aims to determine the significant factors of the fake account that occur among students, which are fruitful to reduce and help the cases that happened in university. To achieve the objective, this research adopted four phases of research activities, which are problem definition, data collection, data analysis and results and discussion. Figure 1 shows the steps and methods in each phase of research activities, then the details of each step are discussed.



2.3 Problem Definition

The problem definition for this research is gained from the observation, media social, interviews and review of literature from journals, blogs and website. The main objective of this research is to determine the significant factors of the fake account that occur among university students,

which are also helpful in reducing the cases happened in university.

2.4 Data Collection

The data is collected by using questionnaire, which was developed via google form and distributed through email and social media such as WhatsApp, Telegram and Facebook. The questionnaire was designed in three different sections as discussed below:

2.4.1 Section A: Socio-demographic characteristics

The question listed in the form of multiple-choice questions in which the respondents will choose only one answer for each question. Age, races, and gender are among the questions asked in social demographic's section.

2.4.2 Section B: Technology used

In this section, the behavior of university students related to technology is asked based on five Likert scales (strongly agree, agree, neutral, disagree and strongly disagree). The factors such as technological safety and duration of time spend with social media are among the important elements that contribute to the involvement of students with fake account.

2.4.3 Section C: Factor and Impact

In this section, the main factor why university students prefer to use fake account is investigated. The questions are listed in the Likert scale where the respondents will choose the preferred answer according to the ranking from one to five. Additionally, the experience of cyberbullying from the respondents is also asked in order to study the tendency of creating fake account among an individual. Additionally, the impact towards the university is also explored.

In this research, printed questionnaire is also used and distributed to students around library and academic building. The questionnaires were distributed randomly to university students either undergraduate or postgraduate.

2.5 Sampling

The populations for this study are university students in one of the universities in Malaysia. The undergraduate and postgraduate students consist of 28,025 and 5,601 respectively. The total number of students are 33,626. Convenience sampling, which also known as availability sampling is a specific type of non-probability sampling method that relies on data collection from population members who are conveniently available to participate in study. In other words, this sampling method involves in getting the participants in wherever you can find them, and typically wherever is convenient. In convenience sampling, there is no inclusion criteria

identified prior to the selection of subjects. All subjects are invited to participate. Thus, 370 students have become as respondents for this research, and the random selection is applied by using convenience sampling technique.

2.6 Data Analysis

At first, the factors of involvement in fake account were obtained from literature review especially journals. Then, from those listed factors, the most significant factors of involvement with fake account was determined using decision tree. It divides the input variables into smaller subsets based on the weight or value of the input variables at the attribute level. This means that the classified smaller subset has rich information that predicts the class variables. The decision tree continues to split the subsets recursively until the value of the end node is similar as the class value. Finally, Ordinal Logistic Regression (ORD) was employed to determine the impact of fake account to the university. The reliability analysis and correlation analysis have been applied to test the correlation between each variable and to ensure that all the dependence and independence variables can come out with the significant result. There are three assumptions that need to achieve before using ORD, which are multicollinearity assumption, model fitting information test, and the Pseudo R-square test. ORD method will help the researchers to identify which impact is greatly affected the university.

3. Results and Discussion

Total respondents for this research are 380 students which consists of 64.7% (246) of female and 35.3% (134) of male. From the data collected, 50.8% of university students spend 3 hours and above on social media every day, 22.9% spend 2 to 3 hours every day, 18.2% spend 1 to 2 hours every day and 8.2% the spend the least number of hours on social media which is 30 minutes to 1 hour.

In this study, the seven factors of involvement in fake account as cyberbully purposes have been determined in Table 1 of previous section, which are feel powerless in their own lives, looking for others attention, lack of understanding and empathy, jealousy or frustration, low self-esteem, lack of parental support and revenge. Then, the predictive model in investigating the important

factors of using fake account that can detect cyberbully was achieved by using Decision Tree with Entropy Splitting Rule. Figure 2 shows the decision tree of the predictive model in investigating the important factors of using fake account that can detect cyberbully.

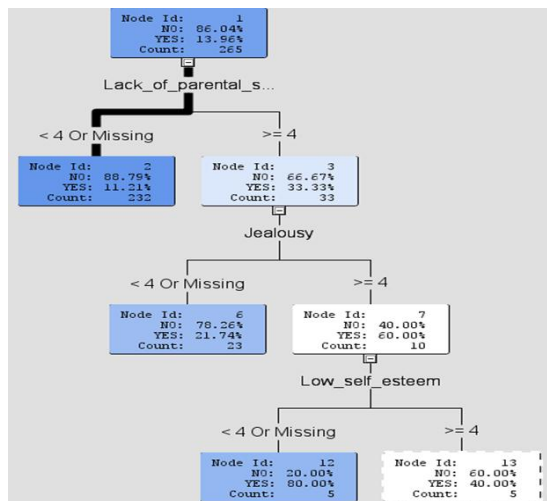


Figure 2. Decision Tree

The significant factors that contribute to fake account creation has been defined by the importance value, as per shown in Table 3. The most significant factor is lack of parental support, followed by jealousy, and low self-esteem. Then, the variables that stated the zero importance or insignificant value are looking for others attention, powerless, lack of understanding and empathy and revenge. Therefore, the researchers of this study can come out with some interesting rules through the result, which if the lack of parental support is less than or equal to 3 (strongly disagree, disagree and neutral) then the respondents are not considered as cyberbullying victims. He/she maybe is the cybercriminal or the person who are not involve with any cyberbullying issues and just

gives their opinion. However, through the other interesting rules from the result have shown that if low self-esteem is less than or equal to 3 (strongly disagree, disagree and neutral) and lack of parental support is greater than or equal to 4 (agree and strongly agree) and jealousy is also greater than or equal to 4, then it shows the result with the respondents are cyberbullying victims.

Table 3. Importance variable

Variables Name	Importance
Lack of parental support	1.0000
Jealousy	0.8493
Low self-esteem	0.5318
Looking for other attention	0.0000
Powerless	0.0000
Lack of understanding and empathy	0.0000
Revenge	0.0000

According to the previous studies [21], [22] and [11], parental support is one of the most important factors that can reduces the cases of student’s involvement in cyberbullying. Parents should take their responsibilities in concerning the life of their children regardless of their busy working day.

Lastly, the impact of fake account towards university reputation is achieved by using ORD. However, the correlation between each variable are required in order to investigate any possible relationship among the variables that need to be proceeded with ORD method. Thus, Pearson Correlation test is conducted as per shown in Figure 3.

		Correlations				
		Sig. (2-tailed)				
		Bad impact	Lost of interest	Feel embarrassed	Outsider preference	Graduate employability
Sig. (2-tailed)	Bad impact	0.000	0.000	0.000	0.000	0.000
	Lost of interest	0.000	0.000	0.000	0.000	0.000
	Feel embarrassed	0.000	0.000	0.000	0.000	0.000
	Outsider preference	0.000	0.000	0.000	0.000	0.000
	Graduate employability	0.000	0.000	0.000	0.000	0.000
		Pearson Correlation				
		Bad impact	Lost of interest	Feel embarrassed	Outsider preference	Graduate employability
Pearson Correlation	Bad impact	1	0.448	0.575	0.560	0.483
	Lost of interest	0.448	1	0.603	0.482	0.495
	Feel embarrassed	0.575	0.603	1	0.670	0.650
	Outsider preference	0.560	0.482	0.670	1	0.735
	Graduate employability	0.483	0.495	0.650	0.735	1

Figure 3. Pearson Correlations Test

The Pearson Correlations test shows that all the variables have positive correlation with each other with the p-value of 0.00. The variable has the highest correlation in between outsider preference and graduate employability, with the $r=0.735$ is close to 1. Since there is correlation amongst all variables, then the ORD method is proceeded. However, in order to use ORD, there are four assumptions that need to be achieved, namely multicollinearity assumption, model fitting assumption, assumption of pseudo R-square and proportional odds assumptions. Figure 4 shows the multicollinearity assumption which is tested based on variation inflation factor (VIF).

		Collinearity Statistics	
		Tolerance	VIF
Model	lost of interest	.616	1.623
	feel embarrassed	.423	2.362
	outsider preference	.394	2.535
	graduate employability	.409	2.448

a. Dependent Variable: bad impact toward university reputation

Figure 4. Multicollinearity assumption

The result shows all the independent variables as having the less than four of VIF, which indicates that there is no correlation among the explanatory variables and hence the independent variables are not inflated at all. In other words, the higher value of VIF, the lesser reliable of the ORD results. Second assumption which is model fitting was also checked as per shown in Figure 5.

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	777.933			
Final	582.354	195.580	4	.000

Link function: Logit.

The model is significant since the significant value is 0.000 or less than 0.05, which means that at least one of the regression coefficients in the model is not equal to zero. Thus, it is meaningful to perform with ORD in order to determine either the fake account of social media has significant relationship towards the impact on university. The third assumption which is assumption of pseudo R-square was then checked as per shown in Figure 6.

Pseudo R-Square	
Cox and Snell	.402
Nagelkerke	.428
McFadden	.184

Link function: Logit.

Figure 6. Assumption of Pseudo R-Square

The value of R2 (Nagelkerke) shows in the model is 42.8% that represents a moderate positive linear relationship between the independent variables. The final test for ORD method's requirements is proportional odds assumptions and tested by using Test of Parallel Lines. The result is shown in Figure 7.

Test of Parallel Lines^a

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	582.354			
General	560.861 ^b	21.492 ^c	12	.044

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Figure 7. Proportional Odds Assumptions

As the significant value is 0.044 which is smaller than 0.05, the null hypothesis is rejected as it indicates that the appeared proportional odds assumption does not held for the model. The significant value should be more than 0.05 in order to ensure the location parameters are the same across response categories. Thus, the model was rerun to eliminate the independent variables loss of interest and graduate employability. After eliminating these two variables, all four assumptions including assumption four were approved with significant value of 0.743 as shown in Figure 8. This time, the null hypothesis was not rejected as it indicates the proportional odds assumption for this model.

Test of Parallel Lines^a

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	237.981			
General	234.471	3.510	6	.743

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Figure 8. Proportional Odds Assumptions

Based on these four assumptions, it shows that all variables have successfully fulfilled all the assumptions. Thus, the parameter estimation is proceeded to determine the significant relationship between the dependent variable and independent variables.

Table 4. Parameter Estimates

		Estimate	Std.Error	Sig.
Threshold	Bad impact =1	1.885	0.395	.000
	Bad impact =2	3.237	0.402	.000
	Bad impact =3	4.529	0.435	.000
	Bad impact =4	6.274	0.488	.000
Location	Feel embarrassed	0.843	0.121	.000
	Outsider preference	0.682	0.118	.000

In this research, two impacts are taken into considerations, which are university student will feel embarrassed towards university’s reputation and the outsider preference in choosing the university to pursue their studies will be affected. Both impacts give the significant relationship towards university reputation with the p-value of 0.000. The results show that when the university is affected by bad public perception, pre-university students will reluctant to choose the university as one of their main preferences to pursue study.

4. Conclusion

Cyberbullying is an intrusive, significant and detrimental to anyone including students and organization. Through the significant result, the researchers found that the lack of parental support is the most important factor that cause the involvement of students in cyberbullying issues. In fact, the fake account created could also affect the university reputation. In order to overcome above matter, it requires not only the role from university but also parents and family supports. This research gives an awareness about the impact of fake account created to maintain the sustainability of the community. However, research in cybercriminal is limited and only appears in a small scope. Thus, for future research, a qualitative method could be applied to focus on the cybercriminal where details reason might be obtained.

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