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ORIGINAL STUDY

Logistic Regression and Multiple Linear Regression Applied on Measures Taken by Facebook Users

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Abstract

The research statistically includes checking the suitability of logistic regression or multiple linear regression for modeling the independent variables and the dependent variable, it turns out that logistic regression is more efficient than multiple linear regression as the first one arranges the dependent variables which allows the researcher to conclude that a variable is considered stronger than the other variable. Where applying that has been done to the measures taken by Facebook users, and technically a way to protect the account and dealing with privacy violation and its relationship with electronic hacks, i.e., mail fraud against others for obtaining some classified information.

The importance of the research stands out through its attempt to identify the most significant incorporeal determinants by using logistic regression and comparing it with the results via using the multiple linear regression technique, and which one of them is more appropriate that leads to limit the penetrations happening on Facebook users' accounts.

The most important conclusion of the research is the weakness of the multiple linear regression model in the possibility of penetration happening to the accounts while the results of logistic regression clarify the efficiency and suitability of this model for modeling the relationship between the independent variables and the dependent variable.

Keywords: Logistic regression, Linear regression, Facebook

1. Introduction

The scientific research approach is considered as the main way to civilization establishment and nation superiority. And as the first tool in developing the challenges of the present and brightens the future. The researchers took refuge to insert the dependent or non-quantitative variables in estimating the logistic regression models and use the multiple linear regression analysis in obtaining any estimation for the parameters which can be better for the two approaches mentioned above because using the suitable regression model requires using a mechanism or technique for obtaining suitable regression models to get reasonable results and by applying to the most common Facebook users in the present time (see Fig. 1).

As online social networks acquired a huge popularity over the past years such as MySpace, Facebook and Orkut because they facilitate communication and interaction among users. These network platforms caused increasing fears concerning security and privacy too, where the harmful, attacking or penetrating users try to violate the users' private information and gain access to other people's accounts illegally.

Social networks, such as Facebook, contains weakness points. So, it is necessary to warn users and protect them from these points without any possibility of violating these networks. Because of these weakness points, there have been many penetrating attempts against the same website, and future attempts are expected. The mean and penetrating users aim to exploit the existence of security vulnerabilities

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in social network services and attracted to it as soon as they feel its existence. In this research paper, we study the weakness points in the prevailing social network services and estimate their vulnerability to attacks via the Internet. And because of the overwhelming popularity of Facebook, we decided to concentrate on the security sides of this particular platform [1].

2. First axis: the methodology of the research

2.1. First: the problem of the research

2.1.1. Statistically

It lies in choosing the correct statistical model because it requires a number of conditions related to the dependent variables concerning their total number, nature and singularity in one type or mixing between two types.

2.1.2. The problem (technically)

The personal accounts as well as the official ones which belong to personages, officials and governmental institutions incur unwanted interference and penetrations by some hackers, and that leads to damage to individuals' social life. Besides, it could lead to financial losses and overwhelming damages if those accounts belonged to officials in governmental institutions in case their accounts were hacked and their data was exposed. The damage might exceed to other people, not only the owner of the account, such as his/her friends and family members if the account was personal, and if it belonged to an important official, that might harm his/her institution and coworkers in case of exposing classified and secret information in the account.

Therefore, the problem of the research lies in answering the following questions:

- Are there penetrations happening to Facebook users?
- What are the measurements taken by Facebook users to protect their accounts?
- Is there any relationship between the technical measurements taken by Facebook users and the penetrations happening to their accounts?
- Is there any relationship between the technical precautions taken by Facebook users and the penetrations happening to their accounts?

2.2. Second: the importance of the research:

- The study highlights using Facebook by individuals and the measurements taken by the users to keep their accounts intact.

- The study is beneficial in showing the role and importance of the measurements and precautions which must be taken to protect the personal accounts on Facebook.
- The study shows the relationship connecting the technical precautions taken by individuals to protect the accounts with the occurrence or non-occurrence of penetration depending on the taken measurements.
- The study adds information about the relationship between the technical measurements taken to protect the accounts and their relationship with the penetration happening.
- Guiding users to the need to take protection procedures for their accounts.

2.3. Third: the goals of the research

Statistically, the research aims to find two models, logistic regression and multiple linear regression, and know the parameters of each model as well as their effects on building the models mentioned above, and performing logical comparison in both models by applying the measurements taken by Facebook users, and not for the purpose of statistical application and statistical goals, but for benefiting from the data under consideration by the measurements and needs taken by the users to keep their accounts intact from being penetrated. So, the goals have been clarified technically by achieving the following:

- Making a theoretical frame for each Facebook concept and the measures taken by individuals to protect their personal accounts on Facebook.
- Identifying the role and importance of the precautions and measurements taken by individuals to protect their personal accounts on Facebook.
- Identifying the relationship connecting the technical precautions taken by individuals to protect their accounts with the occurrence or non-occurrence of a penetration against the account depending on the measures taken.
- Clarifying the technical measurements taken to protect the personal Facebook accounts and their relationship with the penetrations happening.
- Informing the users of the need to take measurements for protecting the personal accounts on Facebook.
- Finding two models, logistic regression and linear regression, and knowing the parameter values of each model and their effects on building the model, and making reasonable

comparison in both models by applying on the data of measurements taken by Facebook users and not for applying only as well as for statistical purposes, but for benefiting from the data under consideration by the measurements and precautions taken by users to protect their accounts from being penetrated.

2.4. Fourth: the research model

The model below (Fig. 1) will show how we could protect users' accounts.

2.5. Fifth: the research hypotheses

2.5.1. Statistically

The researcher assumes a number of hypotheses that must be verified, and they are as follows:

First hypothesis: The importance of regression parameters. In this hypothesis, the parameters of logistic regression are selected if they are equal or different in effect according to hypothesis null (H_0) versus alternative hypothesis (H_1) as follows:

H_0 : parameters are equal in effect.

H_1 : parameters are not equal in effect.

Second hypothesis: The suggested model represents data. In this hypothesis, a choice is made as to whether the proposed model represents data appropriately through making hypothesis null (H_0) versus alternative hypothesis (H_1) as follows:

H_0 : model represents data.

H_1 : model does not represent data.

Third hypothesis: The parameters of logistic regression and multiple linear regression are equal. In this hypothesis, logistic regression is compared with the parameters of multiple linear regression, and it is to be known that if they are equal in effect or not through making hypothesis null (H_0) versus alternative hypothesis (H_1) as follows:

H_0 : the variables in the parameters of logistic regression and parameters of multiple linear regression are equal.

H_1 : the variables in the parameters of logistic regression and parameters of multiple linear regression are not equal.

2.5.2. Technically

Fourth hypothesis: non-commitment in the technical precautions to protect the account leads to penetrating the account.

Fifth hypothesis: non-commitment in the technical measurements to protect the account leads to penetrating the account.

2.6. Sixth: data collection

The theoretical side is covered by depending on the Arabic and foreign resources as well as relevant studies, in addition to the Internet network which is filled with modern relevant resources.

As for the applicable side (practical side), we depended on the electronic questionnaire form distributed on researched individuals by friends and acquaintances who use Facebook after interviewing some of them in person. And the data was analyzed by using statistical research tools, and the results was shown by using SPSS 19.

2.7. Seventh: the research sample

The simple random model was chosen to be away from discrimination due to the harmony existed in the researched community terms [2]. In addition, the model of the research was chosen by corresponding a number of Facebook users' friends and relatives, and sending the electronic questionnaire to them. In return, they forwarded them to their friends and relatives until the number of individuals responded to the electronic questionnaire reached 189.

2.8. Eighth: the research determinants

There are a few parameters and restrictions to do the research

- The research includes a model of users of social network sites where an electronic form related to the research was posted in a number of pages and groups to obtain the data of the research.
- The model of the research was collected in 2020–2021.
- It was limited to study two axes; each one includes a group of terms as considered to be the most important in the study.

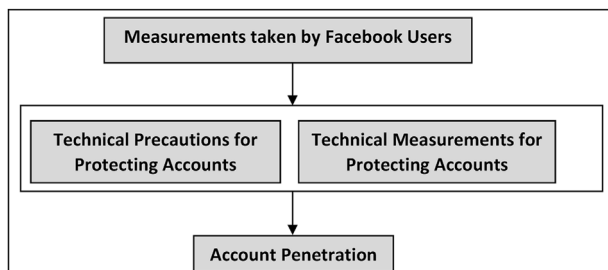


Fig. 1. The research model.

First axis: includes thirteen terms in using Facebook and account penetrating.

Second axis: includes twelve terms in the measurements used in account protection.

3. Second axis: the theoretical frame in making use of logistic regression, multiple linear regression, the concept of Facebook penetration and technical measurements and precautions taken by users to prevent account penetration

3.1. First: logistic regression concept

A model used in predicting the possibility of something happens by fitting data logistically. And logistic regression uses a few expected variables which can be digital or categorical, and logical regression is based on a basic assumption, and that is the dependent variable (Y) which we consider in studying is a binary variable that takes the value (1) with possibility (P) and the value (0) with possibility (1-P), i.e., the occurrence and non-occurrence of response [3]. As we know, in linear regression whose independent variables and dependent variable take continuous values, the model connecting the variables is as equation (1) [4]:

$$Y = b_0 + b_1x + e \quad (1)$$

Where (Y) represents a continuous view variable assuming the actual view value average (Y) at a certain value of variable (x) which is $E(Y)$, and variable e represents error $e = Y - \widehat{Y}$. So, the model can be written as in equation (2) below:

$$E(Y/x) = \hat{b}_0 + b_1x \quad (2)$$

In regression, it is known that the right side of these models takes the values $(-\infty)$ to $(+\infty)$, but when we have two variables and one of them is response (Y), the simple linear regression is not appropriate because:

$$E(Y/x) = P(Y=1) = P' \quad (3)$$

Thus, the value of the right side is (0,1). So, the model is inapplicable though applying regression. One of the methods to solve this problem is performing the proper mathematical transformation on dependent variable (Y). Also, it is known that probability value is between $(0 \leq P \leq 1)$, then the rate of $(P/(1-P))$ is a positive magnitude between $(0, \infty)$, i.e., $(0 \leq P \leq \infty)$, and it takes the normal logarithm of transformation value.

3.2. Second: multiple variables' linear regression

Used in analysis when we have a number of views (or dimensions).

$$y_j = (y_j^{(1)}, \dots, y_j^{(p)})$$

For each independent variable like x_j , the general shape of regression model will be:

$$Y_{n \times p} = X_{n \times p} B_{k \times p} + V_{n \times p} \quad (4)$$

n = number of views

K = number of parameters. Also, represents independent variables +1

P = number of dependable variables, the columns of matrix (B), or dimensions corresponding to each independent variable

The maximum likelihood magnitude of known parameter matrix (B) will be as follows:

$$\hat{B}_{k \times p} = (\chi' \chi)^{-1} \chi' Y' \quad (5)$$

And for testing the hypothesis $H_0: CB = D$, where $C_{m \times k}$ from rank (m), so:

$$H = (CB - D)' [C(\chi' \chi)^{-1} C']^{-1} (CB - 1) \quad (6)$$

With (m) degrees of freedom (H)

$$E = n \hat{\Sigma} = Y'Y - \hat{B}' \chi' Y \quad (7)$$

With (n-k) degrees of freedom (E)

So, the statistics of testing the hypothesis (H_0) mentioned above will be:

$$U_{p,m,n-k} = \frac{|E|}{|E + H|} \quad (8)$$

Where:

m = matrix rank (c), or the number of (B) elements which are really in the test

p = number of columns of parameter vector (B), the number of independent variables, or the number of dimensions (dimensionality) accepting each independent variable.

And the method of testing by statistical testing in (8) mentioned above is performed by depending on what (Rao) proved, which is as follows:

$$\frac{1 - U_s^{\frac{1}{s}}}{U_s^{\frac{1}{s}}} - \frac{gs^{-r}}{P_m} \approx F_{pm, gs^{-r}} \quad (9)$$

So, we will calculate the value of (F) corresponding to the value of (U), and comparing it with tabular (F) to determine if hypothesis (H_0) accepts or not.

3.3. Third: social communication means

They are the ways and tools by which information and knowledge can be exchanged, and upscale human relationships can be found. And it includes the electronic and modern traditional means [5].

But in this research, we will discuss (the network electronic means, Facebook). Online electronic networks allow user to create his/her own website, then link it through an electronic-social system with other users having the same interests and hobbies.

3.4. Fourth: the concept of facebook and penetrating personal accounts

Facebook is considered as an electronic social network that can be accessed freely, and it is run by Facebook Company limited as a private property. By which, a personal account determining the person's identity can be made, and communicating and socializing with all other users in this network to exchange news as well as creating visions and directions without restrictions or limitations. Mark Zuckerberg established Facebook in association with his two flat mates at university when he was a student at Harvard University. In the beginning, the membership of the website was limited to the students of Harvard University, then it expanded to include the other colleges in Boston, Ivy league University and Stanford University. Later on, the circle expanded to include every university student, then high school students, and finally, any person who was thirteen years and over [6].

Facebook is considered as one of the modern social media sites which has helped to connect many people wherever they are and whenever they are, and it is a website owned by Facebook, Inc., there are many people using current Facebook in many purposes, Facebook can be used in educational, political or social purposes, leading social awareness campaigns, social relationships, trade or advertising. Facebook has been a part of everyday affairs for facilitating the building of the required fan base for any of these works as well as posting opinions, ideas and activities to reach all types of people of all walks of life as quickly as possible [3].

Facebook is a social media site that enables users to publish their pictures, sharing their news as well as links and other contents on the site, and users can chat and share in video games. And the content can be shared with everybody or just a group of friends, family or even with one person only [7].

The increase in using social media sites as well as users including Facebook has led to hacking or account penetration, and account penetration or

violating privacy is known as “viewing other people's privacies without their knowledge or permission (even if they are not secrets)” [8]. As [9] says that violating information privacy is using this information in unintended areas.

3.5. Fifth: motives of penetrating accounts on facebook

The penetrator's intention is harming the owner of the penetrated account: either for blackmailing him/her, defaming him/her, or cancelling private data or deleting, ruining, leaking, damaging, changing or reposting them [10].

3.6. Sixth: the reasons leading to penetrating personal accounts

There are weakness points in personal accounts on social media sites that help hackers in sneaking and penetrating these accounts, we can mention the following:

Using predictable passwords, many people use common passwords or a small password, or limited to letters only or numbers only. Or, previously used passwords could be used in other websites and forums, and become less protected and more likely penetrated. Furthermore, mobile apps can be categorized as weakness points leading to penetration. There might be a lot of anonymous apps uploaded everyday on Android Play Store for example through which the developer of those apps exposes the users of the app. Besides, the links on social media sites are considered as traps leading to penetration [11].

3.7. Seventh: the measurements taken to protect facebook accounts

Any person has a slight knowledge in computers and programming can be an intruder, especially if the Facebook user is a beginner and does not know what to do. So, it is easy to fall into the intruders' traps. Thus, we demonstrate some of the things which can be done to protect accounts from being penetrated.

The Methods of Protecting Accounts

Penetrations are forms of electronic scam to get some classified information belong to the victims, such as username and password, or the data related to credit card or getting money in an indirect way.

Facebook penetration is stealing a Facebook password owned by someone else, and there are programs can be downloaded on one's personal

computer by which one can penetrate the Facebook account one wants, and one of these programs, there is one called (it freezes your Facebook account and penetrates it). And this program penetrates Facebook account after sending a friend request, and after accepting, one can get access to the friend's password, then changing it and forbid that friend from signing in his account on Facebook.

And there are many reasons make many people fall victims to those intruders, because anyone who has a simple knowledge in computers and programming can be a hacker these days, especially if you are a beginner and do not know what to do. So, it is very easy to fall in the intruders' traps. Thus, we will demonstrate some of the things that can be done to avoid penetrating Facebook account.

[11] says: to avoid penetrating personal social media accounts, user can follow some procedures to secure his accounts on social media sites, such as: using a strong password consists of letters, numbers and symbols, and it would be better for this password not to represent personal information such as name and birth date, and making sure that there is an updated antivirus software on the user's computer.

In addition, it illustrates the necessity of avoiding downloading programs from unknown sources, and not mentioning personal information on social media sites such as date of birth, and not clicking on unnecessary links which sent by some followers only after examining them by websites of link testing in case it is necessary to open those links, and as example of these websites (URL Void).

4. Third axis: the practical side

4.1. Practical results:

In this axis, data statistical analysis will be made by using logistic regression and multiple linear regression to know the effect of each variable and distinguish the differences between the two techniques as well as the effect of each variable (measurements taken by Facebook users) on the possibility of penetrating users' accounts.

4.2. First: using logistic regression

Questionnaire forms were distributed online on a group of friends and acquaintances, and in their turn, they distributed them on their friends and acquaintances who used Facebook, (189) responses from the individuals were received. The form included three basic axes according to what the

researchers thought of the importance of those three axes and their direct effect on penetrating personal accounts of the site's users which are (the axis of using Facebook, the axis of the ways of dealing with violating privacy, the axis of the ways of protecting account from being penetrated), where each axis contained a group of variables (6, 6, 13) in sequence and according to the previous axes. So, the total of the studied variables in all axes is (25) variables, the results of regression of response were analyzed according to the following terms:

The Cases covered by the Questionnaire: [Table 1](#) shows the number of cases of Facebook users included by the study where the results of the analysis shows that there are (189) individuals included in the research, and there is no missing case, and the acceptance ratio is (100 %).

Dependent Variable Encoding: in [Table 2](#), the dependent variable was encoded where it was given the code (0) for the case of non-penetrating the account, and the code (1) for the case of penetrating the account for the sample of the research under consideration.

[Table 3](#) illustrates the efficiency of the analysis, as the program correctly expected that (103) individuals did not have their accounts penetrated, and (30) individuals will have their accounts penetrated, which is a correct possibility [12].

And [Table 4](#) shows the variables included in the final logistic model equation which written as follows:

$$Y = -0.16 - 1.31 X_4 + 1.861 X_8 - 1.688 X_9$$
 penetration variable

Where for each increase in the independent variables, we expect a change that equals its regression factor in the odds ratio logarithm of the dependent variable with the other independent variables as constant (and this explanation goes for all variables).

And the values of significance here show that the parameter value is different from zero, and the independent variable has effect on the dependent one.

Table 1. Case processing summary.

Unweighted Cases		N	Percentage
Selected cases	Included in analysis	189	100.0
	Missing cases	0	0
	Total	189	100.0
Unselected cases		0	0
Total		189	100.0

Table 2. Dependent variable encoding.

Original Value	Internal Value
Non-penetrating	0
Penetrating	1

Table 3. Classification table.

Observed		Predicted Values		
		Has your account ever been penetrated?		Correct Classification Ratio
		0	1	
Has your account ever been penetrated?	0	103	18	85.1
	1	38	30	44.1
Total statistics				70.4

Table 4. Variables in the equation.

		Constant Value	Standard Deviation	Wald Test Value	Degrees of Freedom	Significance	Odds Ratio
Step 1 ^a	X 2 (1)	−0.016	0.369	0.002	1	0.965	0.984
	X 3 (1)	0.285	0.451	0.399	1	0.528	1.329
	X 4 (1)	−1.310	0.458	8.183	1	0.004	0.270
	X 5 (1)	0.383	0.445	0.738	1	0.390	1.466
	X 6 (1)	0.507	0.575	0.776	1	0.378	1.660
	X 7			0.853	2	0.653	
	X 7 (1)	−20.636-	40192.970	0.000	1	1.000	0.000
	X 7 (2)	0.374	0.405	0.853	1	0.356	1.454
	X8 (1)	1.861	0.581	10.242	1	0.001	6.430
	X9 (1)	−1.688	0.558	9.162	1	0.002	0.185
	X 10 (1)	0.211	0.413	0.260	1	0.610	1.235
	X 11 (1)	−1.260-	0.542	5.392	1	0.020	0.284
	X 12 (1)	−0.214-	0.431	0.245	1	0.620	0.808
	X13 (1)	0.045	0.473	0.009	1	0.924	1.046
	Constant	−0.126-	0.365	0.120	1	0.729	0.881

^a If weight is in effect, see classification table for the total number of cases.

The last column represents the odds ratio of the independent variables. For instance, the number (6.43) means that every time the variable (X_8) increases one unit, the odds of non-penetrating the personal account increase by (6.43) units [13].

4.3. Second: using multiple linear regression

In this axis, the variables existed in all questionnaire axes will be used, and the researchers used 5-point Likert Scale, and each axis was calculated and multiple linear regression was performed as shown in the attached questionnaire form.

- Descriptive Statistics: descriptive statistics of the variables included in the analysis were calculated, and they included finding the arithmetic means and standard deviations for all variables, and the results in Table 5 were as follows:

When noticing the results of Table 5, the arithmetic means value of variable (X_6) recorded the highest value (0.85) and the lowest value of standard deviation for the same variable, then followed by (X_8) and so on for the other variables, which refers to the importance of each variable in the questionnaire. And it is worth noting that the arithmetic means value of the dependent variable (X_1)

Table 5. Descriptive statistics.

Variables	Mean	Standard Deviations
X1	0.37	0.483
X2	0.49	0.501
X3	0.64	0.482
X4	0.57	0.496
X5	0.61	0.490
X6	0.85	0.357
X7	0.67	0.471
X8	0.84	0.372
X9	0.72	0.451
X10	0.75	0.434
X11	0.79	0.410
X12	0.38	0.486
X13	0.27	0.446

(success) reaches (0.37) with a standard deviation equals to (0.483) as it is shown above.

- Correlation Matrix: in Table 6, we notice the correlation matrix between different variables which affecting the penetration against Facebook accounts.

From the results of Table (6), we notice that the variables (X_{12} , X_{13}) recorded the highest correlation parameter which is (0.561), and it is a weak correlation value, and so on for the other variables that recorded less values than the one above, which

Table 6. Correlations.

		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
Pearson correlation	X1	1.000	0.116	0.137	0.231	0.071	0.040	0.065	−0.108	0.256	0.032	0.180	0.044	0.057
	X2	0.116	1.000	0.272	0.369	0.288	0.170	0.166	0.148	0.211	0.025	0.275	0.093	0.073
	X3	0.137	0.272	1.000	0.404	0.368	0.276	0.225	0.143	0.537	0.026	0.204	−0.030	0.061
	X4	0.231	0.369	0.404	1.000	0.496	0.305	0.266	0.226	0.345	0.075	0.262	0.116	0.186
	X5	0.071	0.288	0.368	0.496	1.000	0.427	0.176	0.170	0.318	−0.088	0.220	0.111	0.222
	X6	0.040	0.170	0.276	0.305	0.427	1.000	0.183	0.257	0.336	−0.035	0.294	0.049	0.154
	X7	0.065	0.166	0.225	0.266	0.176	0.183	1.000	0.176	0.340	0.013	0.188	−0.037	0.123
	X8	−0.108	0.148	0.143	0.226	0.170	0.257	0.176	1.000	0.231	−0.025	0.364	0.110	0.207
	X9	0.256	0.211	0.537	0.345	0.318	0.336	0.340	0.231	1.000	0.075	0.281	0.000	0.170
	X10	0.032	0.025	0.026	0.075	−0.088	−0.035	0.013	−0.025	0.075	1.000	0.090	−0.006	0.076
	X11	0.180	0.275	0.204	0.262	0.220	0.294	0.188	0.364	0.281	0.090	1.000	0.083	0.171
	X12	0.044	0.093	−0.030	0.116	0.111	0.049	−0.037	0.110	0.000	−0.006	0.083	1.000	0.561
	X13	0.057	0.073	0.061	0.186	0.222	0.154	0.123	0.207	0.170	0.076	0.171	0.561	1.000

means that the correlation between independent variables with the dependent one is weak.

- The mathematical Model Parameters of Multiple Regression: the mathematical model parameters of multiple regression were calculated, and the model became as follows:

$$Y = 0.324 + 0.012 X_2 - 0.046 X_3 + 0.227 X_4 - 0.089 X_5 - 0.079 X_6 - 0.044 X_7 - 0.033 X_8 + 0.288 X_9 - 0.042 X_{10} + 0.220 X_{11} + 0.033 X_{12} + 0.010 X_{13} \quad (10)$$

We notice from the results of Equation (10) of the model above that the variable (X_9) recorded a value that reached (0.288). So, if the dependent variable (Y) changed by one unit, the parameter of this variable would change by (0.288), then followed by (X_4) which recorded (0.277) and this one was followed by the variable (X_{11}) and recorded (0.220) and so on for the other variables.

Therefore, we notice the weakness of multiple linear regression model in the penetration probability against accounts (dependent variable Y) through the results of the technical measurements for protecting against penetration represented by the independent variables ($X_2 \dots X_{13}$).

While the results of logistic regression proved the efficiency and suitability of this model for modeling the relationship between independent variables and dependent variable.

5. Conclusions

5.1. First: statistical conclusions

- Using logistic regression leads to estimating accurate and logical regression parameters especially after the growing need for adopting qualitative variables as dependent variables. And that requires suitable quantitative analysis tools.

- The importance of analyzing logistic regression lies in comparing it with the other statistical methods (multi-variable linear regression).
- The advantageous thing in logistic regression is that it is less sensitive to other regressions in natural distribution of the study variables.
- It is not possible to use multi-variable linear regression in estimating the regression models of quantitative dependent variables because they lead to estimating non-logical regression parameters.
- The logistic regression parameters do not equal to the multiple regression ones in affecting the model

$$Y = b_0 + b_1 x$$

5.2. Second: technical conclusions

- (35 %) of the research sample had their accounts penetrated. And in rare cases, there were accounts penetrated more than once.
- (50 %) of the researched sample who had their accounts penetrated restored their accounts through their emails. That was proved by the results as it showed that (120) individuals made sure that their emails used in their Facebook accounts were activated from time to time. And about (40 %) of the other individuals of the sample whose accounts were penetrated did not do anything and gave in their accounts to the penetrator. In rare situations, there were communications with Facebook Inc. concerning restoring their penetrated accounts, and that what was obtained by asking the individuals of the sample about what they would do if their accounts were penetrated, but that contradicted the answers obtained from asking the individuals of the sample "In case of losing the account, do you communicate with the company

via its known links to get it restored?”, and (126) of them answered with “Yes”.

- Most of the motives of the individuals of the sample to use Facebook were educational, social and for business.
- Most of the individuals of the sample take proper procedures to protect their accounts from being penetrated. Where (108) individuals make sure of there is any unknown or untrusted app that they subscribed previously, and (161) individuals delete unknown apps from their accounts, (157) individuals use the way of protection by accepting the sign-in process, and (142) individuals link their personal accounts to their phone numbers.
- It is noticed that there is a weakness in protecting personal accounts from being penetrated by asking the individuals of the sample some questions such as “Do you change your Facebook account password?” where there was (97) individuals do not change their passwords which could be detected or guessed by penetrators, while only (92) individuals change their passwords from time to time, and by asking the individuals of the sample “Do you use Internet Security software on your gadget?”, it turned out that (138) individuals do not use these important software, and (117) do not use antivirus software on their devices”.

6. Recommendations

6.1. First: statistical recommendations

- It is recommended to use logistic regression when the dependent variables in the research models are qualitative.
- The possibility of adding other things for studying according to the appearance of additional variables affecting the increase in these rations.

6.2. Second: technical recommendations

- Paying attention to using antivirus software and Internet Security software on computers and

mobiles for the damage happening to the ones who do not use them.

- Bringing the attention of the individuals of society who use Facebook and social media sites to the importance of changing their Facebook account passwords from time to time so as not to be exploited as a weakness point in case of knowing it or guessing it by possible penetrators.

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