International Journal of Instruction *April 2023 ● Vol.16, No.2*
e-ISSN: 1308-1470 ● www.e-iji.net *p-ISSN: 1694-609X*
pp. 927-944

Article submission code: 20220523203231
Received: 23/05/2022 Revision: 16/11/2022
Accepted: 09/12/2022 OnlineFirst: 25/02/2023

The Impact of Guessing on the Accuracy of Estimating Simple Linear Regression Equation Parameters and the Ability to Predict

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The current study aimed at identifying the impact of guessing on the accuracy of estimating simple linear regression equation parameters and the ability to predict. To achieve the objectives of the study, an achievement test was built in its final form of (40) multiple-choice items in a measurement and evaluation course. After verifying the psychometric properties of the test, it was applied to a sample of (134) male and female general diploma students registered at AL-Hussein Bin Talal University in the second semester of the year 2020/2021. The test was divided into two sections: the first section was tested based on the traditional correction method, while the second section was tested based on the correction formula for the impact of guessing. The results of the study concluded that there are statistically significant differences among the predicted values in the scores of the examinees when using the traditional method and the correction formula for the impact of guessing in favor of the traditional method, and that there are statistically significant differences among the means of residual squares for estimating the scores of the study sample attributed to the correction method and in favor of the traditional method. The results of the study also found that the value of the explained variance (R2) increases when using the correction equation for the guessing effect, and that the values of the parameters of the simple linear regression equation increase when using the correction equation for the impact of guessing, and that the values of the standard error in estimating the parameters of the simple linear regression equation decrease when using the correction equation for the impact of guessing.

Keywords: simple linear regression, equation parameters, guessing, prediction, linear

INTRODUCTION

Achievement tests occupy a prominent position in the educational process, and an essential element, as they are not limited to the learner only, but also to the teacher and

Citation: Al-zboon, H. S., & Alharayzeh, M. I. Y. (2023). The impact of guessing on the accuracy of estimating simple linear regression equation parameters and the ability to predict. *International Journal of Instruction*, *16*(2), 927-944. https://doi.org/10.29333/iji.2023.16249a

everyone who is associated with the educational process. Tests are considered one of the most important means of assessing and evaluating students and knowing their achievement levels. Therefore, educators and researchers ensured that these tests have high level of efficiency, which stems from preparing standard tests that are accurate and objective (Al-Tarawneh, 2019).

Achievement tests also gain importance in the educational process because they are an integral part of the evaluation process, and they are one of the components of the educational process, because they provide those in charge of the educational process with indicators that reveal how successful the educational process is, and help in reviewing the education process in order to develop it in the light of what tests results indicate. (Allam, 2010).

Allam (2006) believes that achievement tests are among the most important components of the educational process, which are supervised by the supervisor, the principal, and the teacher alike. Interest in them (tests) reflects its positive impact directly on the student, who is the center of the educational process.

The importance of achievement tests for the teacher is clear in that they reveal students' readiness, diagnose the difficulties that students face in reaching another teaching method, and provide him (the teacher) with feedback that he may benefit from to determine students' needs (Gronlund & Linn 2000).

Achievement tests have many varied forms, including written and non-written tests. Written tests include short-answer tests (restricted), long-answer tests (open-ended), pairing tests, true-false tests, and multiple-choice tests (Odeh,2010; Thorndike, 1982).

Frisbie & Sweeney (1982) note that the multiple-choice items are the most widely used in measuring student achievement in many educational purposes, as they outperform the true and false items in measuring student achievement, and their results are highly valid and reliable.

The multiple-choice items consist of a problem presented in a sentence called the origin of the paragraph (the text), and then several solutions and answers called alternatives are placed, and the student is asked to choose the correct answer from among these alternatives. Multiple-choice items have several advantages, as they achieve a large number of educational goals, starting with simple operations such as memory, and ending with complex operations such as analysis and evaluation. Students' answers can also be estimated with complete objectivity, reduce the impact of Bluffing to the minimum possible, and they are less affected by the random guessing factor compared with other objective tests (oda, 2010).

Despite the advantages of the multiple-choice test items, they lack the possibility to uncover students' ability to create or come up with many, varied and original ideas. Their items cannot, also, measure students' ability to synthesize and evaluate as higher mental processes, and it is also difficult to determine through them students' ability to organize information and relate them to each other. In addition, it prompts the examinees to focus on small scattered and unconnected details of the study content. In

this context, Schneider, Christian, Karla, and Julian (2013) indicate that when the student chooses a wrong alternative in answering a multiple-choice test item, the concept is reinforced to him; thus, students may gain incorrect knowledge, and this is called the impact of the wrong alternative. Also, the structure of the multiple-choice test items questions leads the students to resort to cheating and random guessing. Resorting to random guessing by the student is considered, perhaps, one of the largest problems encountered by this type of tests.

The random guessing that the student resorts to when he does not have the information that would enable him to reach the correct answer is one of the largest problems facing this type of tests where the student randomly chooses one of the alternatives even if he is asked to leave the item unanswered if he does not know the correct answer. Some students tend to take risks in different degrees according to their degree of adherence to the instructions, and their wisdom in answering. Sometimes there may be clues or keys in the item or the alternatives that help the student come up with the correct answer thus, the corrector cannot decide whether the student's correct answer of an item reflects his true ability, especially when the goal of the test is diagnosing learning difficulties or reaching the mastery degree of a particular skill (Annie & Chan, 2012).

Guessing in multiple-choice tests sometimes leads to an unfairness of the results. If two examinees of an average ability level undergo an objective multiple-choice test, it is possible that the examinee who resorts to guessing will pass the test, while the other who answered the test items based on his real knowledge will fail, which leads to violating the most basic characteristics of the test, which is fairness, and the test results become biased (Kubinger & Holocher, Reif, 2010).

Several methods have appeared in controlling the impact of guessing in multiple-choice tests, as these methods use different statistical modes while test correction, which would limit the impact of random guessing and the impact it causes on test characteristics. Among these methods is the correction method for the impact of guessing and the traditional method. (punishment) (Distraction Scoring Formula-DSF) (Annie &Chan, 2012).

This method (Distraction Scoring Formula-DSF) is one of the most common ways to measure the effect of guessing for multiple-choice tests. This method is based on punishing the examinee for guessing while answering multiple-choice items by deleting the scores that he estimated to have obtained through guessing. This method assumes that every wrong response is the result of a wrong guess made by the examinee, as this method does not take into account the partial information that the examinee may have relied on in his answer to the test items, and according to this method, the examinee's mark on the test is estimated through the following equation:

$$F = R - \frac{W}{A - 1} = \ldots\ldots\ldots\ldots \quad (1)$$

Where :

F = corrected or Formula score R= number of items answered right.

W = number of items answered wrong. A = number of choice per item.

An example can be given for this. If an examinee answered (41) items out of (50) multiple-choice items with four alternatives, then the final score obtained by the examinee is as follows:

$$F = 41 - \frac{9}{3} = 38$$

A number of researchers such as Sabbe, Valcke & Lesage (2013) indicate that this method does not encourage the examinee to random guessing that inflates the examinees' scores. It also gives the examinee an unbiased estimation of the real knowledge possessed by the examinee, all based on his performance in the multiple-choice test. This method, also, increases the validity and reliability of the test compared to the correction method based on the number of correct answers. Some other researchers, such as Mehrens & Lehmann, (1991) see that this equation tends to punish the examinees those with partial knowledge of the test material more than the examinees who are with incorrect information. As a result, Fray (1988) suggested, in order to address the tendency of this method to punish the guessing resulting from partial knowledge, that the examinee be given instructions stating that he has partial knowledge of it that would guide him to choose the correct alternative, or enable him to exclude any of the alternatives that he firmly believes to be incorrect, then he guesses from among the remaining alternatives. The test instructions must be clear to inform the examinee and convince him to follow this strategy when taking the test. Fray sees that using the previous correction equation in the light of these instructions enables the examinee in making use of his partial knowledge as he will only delete the item which he thinks that his answers are from random guessing.

Regression analysis:

Regression analysis aims to estimate the mathematical form of the relationship between the dependent variable (y) and the independent variable(s) (x). Regression analysis is used to study the extent of the impact of one or more independent variables on a specific dependent variable so that the values of the dependent variable can be predicted if the values of the independent variable(s) are known (Ismail, 2001).

Regression analysis is classified into:

First: linear regression, which is divided into:

1. Simple linear regression, which consists of one independent variable with a linear relationship with the dependent variable.

2. Multiple linear regression, which consists of several independent variables that have a linear relationship with the dependent variable.

Second: Nonlinear regression, which is divided into:

1. Non-linear simple regression consisting of one independent variable that has a non-linear relationship with the dependent variable

2. Non-linear multiple regression which consists of several independent variables associated with a non-linear relationship with the dependent variable (Abdel Hamid, 2011).

Simple linear regression analysis determines the mathematical relationship between the independent variable and the dependent variable by drawing the best straight line that fits the data and has the smallest sum of the squares of the distance between the observed values and the expected values of the dependent variable. The simple linear regression equation is written as in equation (2) (Kunter, Nachtsheim, Nater &Li, 2005).

$\hat{Y} = a + bx$ ……. (2)

Where:

ŷ : the predicted criterion variable score for a student who obtains score x on the predictor variable.

b : the regression coefficient.

a : the intercept of the regression line.

b can computed using formula …..

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$$

a: can computed using formula …..

$$a = \bar{y} - b\bar{x}$$

Where:

Ȳ: the mean of the y values in the regression sample.

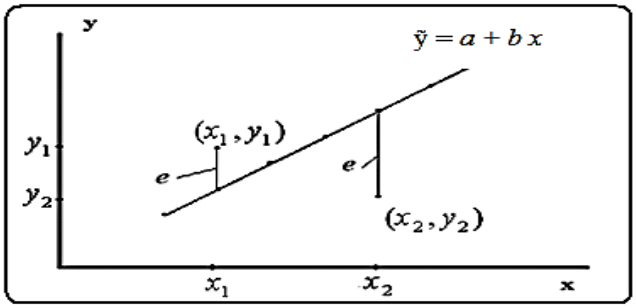
X: the mean of the x values in the regression sample.

The least squares method is considered one of the most widely used methods in estimating the parameters of the model, because it makes the random error as small as possible (Draper & Smith, 1988), and the best linear correction is found in it by reducing the squares of variation among the actual values and the estimated values, which is symbolized by the following:

$\sum_{i=1}^{n} \varepsilon_i^2$

where : $\epsilon_i = y_i - \hat{y}_i$

This error can be illustrated in the diagram below:



The method of least squares is one of the common methods used to estimate the parameters of the simple linear regression model. This method is concerned with estimating the values of the fixed regression coefficients in the regression equation so that the regression line passes through most of the points of the scatter plot and passes in a balanced way among the rest of the points. This method has two characteristics:

1. The sum of the deviations of the values (degrees or observations) from the regression line and they are called residuals = zero. That is, the sum of the positive deviations above the regression line = the sum of the negative deviations (below the regression line).

2. The sum of the squares of the deviations of the values (degrees or observations) from the regression line is as small as possible. That's why, this method is called the least squares method (Abdel Hamid, 2011).

Determination Coefficient

It is a measure for estimating the accuracy of the regression coefficient and is symbolized by R^2, because it is equal to the square of the simple correlation coefficient. This coefficient has values between 0 to 1, meaning that it is $(0 \leq R^2 \leq 1)$. Whenever the value of the coefficient of determination approaches 1, this indicates that the value of the random error is less, and R^2 is calculated as follows:

$$R^2 = \frac{SS_R}{SS_T}$$

$$SS_e = \sum y^2 - a \sum y - b \sum xy$$

$$SS_T = \sum y^2 - n(\bar{y})^2$$

$$SS_R = SS_T - SS_e$$

Where:

SS_T : total sum of square

SS_e : sum of experimental error square

SS_e : sum of regression square

Previous Studies

Many studies related to the methods of correction for the impact of guessing and other studies related to the equation of simple linear regression have been conducted, but the studies that are within the researcher's knowledge did not address the impact of guessing on the accuracy of estimating the parameters of the simple linear regression equation. Among these studies, Youssef (2015) conducted a study aimed at identifying the outliers and their impact on the parameters of the multiple linear regression equation. To achieve the objectives of the study, it was applied to a sample of (30) male and female students who were randomly selected from the Faculty of Education students at the University of Gezira. The results of the study concluded that the method of deleting the outliers rendered better results in the multiple linear regression equation compared to the amputation average method.

The study of Abu Qudeiri(2016) aimed to detect violations simple linear regression and accuracy regression analysis assumption by using residuals and outlier values. A set of tests were carried out in this research such as (Lack of fit, Homoscedasticity, independence of residuals, Normal Distribution) in order to detect violation of assumption. The results of the test showed that the large values for coefficient of determination as well as the significance of (f) test and significance of regression equation coefficients are not sufficient evidence that data is identical to the linear regression model and it can't be relied on alone to judge the accuracy of linear model. Lack of fit test results for data which contains duplicated values of independent variable showed that some data doesn't fit the linear model. Homscedasticity test results indicated that the homoscedasticity assumption hasn't been achieved in some data.

Allasasmah study (2016) aimed at identifying the impact of missing values ratio and the method of handling on accuracy of estimating simple regression equation parameters, comparing between the treatment methods used in the study and identifying the best treatment methods for these missing percentages of the data. To achieve this goal, the researcher used a WINGEN3 program to generate two test responses; each test consisted of (12) items with a constant difficulty coefficient of variation, distributed over (200) normally distributed respondents, with a (0) arithmetic mean and a (1) standard deviation.

The results of the study showed that the percentage of loss (5%) had an effect on the accuracy of the parameters of the simple regression equation when comparing between the original simple regression equation without loss with the simple regression equation after the loss, and comparing the squares of the residuals for each.

The study of Al- Shourafa (2016) aimed at comparing three methods of correction to adjust the effect of guessing on calculated amount of inflation in the value of item correlation coefficient, these methods are: punishment, rewarding as well as rewarding and punishment. In order to achieve the study objective, the researcher designed an attainment for – choice multiple test that consist of 25 items in the subject of mathematics for the fifth grade. The test was applied to a sample of 300 male and female students who were divided randomly into three groups; each of them consists of 100

male and female students to which the test was applied, so that one method of correction was used with each group in order to control the impact of guessing.

The study results showed that the least calculated amount of inflation in the value of item correlation coefficient in the total degree was related to using the method of correction to adjust the effect of guessing regarding (rewarding and punishment), and this method also resulted in the least mean for inflation in the value of item correlation coefficient in the total degree, while the highest mean for inflation in the value of item correlation coefficients in the total degree was related to using the method of correction to adjust the effect of guessing regarding (punishment), the results showed there are statistically significant differences at the level of significance ($\alpha \leq 0.05$) in the calculated average amount of inflation in the value of item correlation coefficient in the total degree attributed to the method of correction to adjust the effect of guessing, which was in favor of the method of (rewarding and punishment) in comparison with the method of (punishment).

The study of al-trawnah(2019) aimed at studying the effect of treatment outliers on the verification of assumption of simple linear regression analysis. The study sample consisted of (15) master's thesis whose data contain outliers. A series of tests were used to verify the assumption of simple linear regression analysis: Tests of lack of fit, Homogeneity of variance, independence of residuals, and normal distribution, Tukey method was used to detect outliers, trimmed mean was used to treat outliers. The results of the study showed that the existence of outliers violates the verification of the assumptions of simple linear regression analysis, the results of the study showed that handling of outliers leads to the verification of the assumption of simple linear regression analysis.

The study of Aqel & alsmadi (2022) aimed at comparing between the complete ordering method and the traditional method to control the effect of guessing in psychometric properties of the multiple – choice test. The study sample consisted from 180 students, the researcher constructed an achievement test consisting from (27) multiple –choice items with four alternatives.

The study results showed that there are statistically significant differences in the average of students performance on the test between the three methods of correction in favor of the complete ordering method followed by the standard method, then the traditional method of correction. Also there are statistically significant differences in criterion validity in favor of complete ordering method versus the standard method and the traditional method of correction.

In the light of the previous studies, it appears that some studies have showed interest in studying abnormal values and their impact on the parameters of the regression equation such as Al- Shourafa (2016) and al-trawnah(2019) study. In addition, some studies have dealt with the impact of missing values on the parameters of the regression equation. Such as Allasasmah (2016) study, Within the researcher's knowledge, there are no studies that dealt with the impact of guessing on the accuracy of estimating the parameters of the simple linear regression equation and the standard residuals.

Therefore, this study came to identify the impact of guessing on estimating the values of the parameters of the regression equation.

Study Problem:

The purpose of this study is to identify the impact of guessing on the accuracy of estimating the parameters of the simple linear regression equation and the ability to predict, where guessing is one of the main sources of measurement errors. The examinee may obtain, by relying on guessing, a score higher than the score that represents his real ability. The guessing problem is considered one of the criticisms that face the multiple-choice test questions for its negative impact on the test characteristics.

Lau & Usop, (2011) as referred to in (Al-Kharsha, 2016) indicated that guessing affects the score which the examinee deserves in the achievement tests, which affects the validity of these tests. Guessing, also, inflates the value of the variance resulting from random error where some kind of partiality or bias occurs (Camilli, 2006) which may affect the estimation of the parameters of the regression equation. From here, many methods emerged to correct the scores of the examinee from the impact of the guessing, which increases confidence in the results and consequently the true score approaches the predicted score, which reduces prediction errors. Thus, this study seek to answer the following questions:

1. Are there statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the predicted values according to the method of correction?

2. Are there statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the arithmetic means of the residual squares for estimating the scores of the study sample attributed to the method of correction (the traditional, correction equation for the impact of guessing)?

3. Does the percentage of the explained variance in the scores of the dependent variable by the independent variable differ according to the method of correction?

4. What is the impact of the correction method for the guessing effect (the correction equation for the impact of the guessing, the traditional method) on the accuracy of the coefficients of the simple linear regression equation?

Significance of the study

The significance of the study lies in the impact of the correction methods for the impact of the guessing in the accuracy of estimating the parameters of the simple linear regression equation and the ability to predict. Through this study, it will be known whether the percentage of the explained variance in the scores of the dependent variable differed by the independent variable according to the method of correction. The study also highlights the importance of the simple linear regression equation and the great dependence on it to identify the impact of an independent variable on a dependent variable so that it is possible to predict the values of the dependent variable if the value of the independent variable is known based on this equation. Therefore, this equation should be accurate in order to rely on it in the prediction.

The importance of this study also lies in that it will provide theoretical frameworks regarding the study variables, the impact of guessing, achievement tests, and psychometric properties, to benefit researchers and those interested in conducting future studies. Also, the results of the study will contribute in finding successful solutions in reducing the impact of guessing.

Objectives of the study

The current study aims to

1. Identify the statistical differences among the predicted values, according to the method of correction.

2. Identify the differences between the arithmetic means of the residual squares for estimating the scores of the study sample attributed to the method of correction (traditional, correction equation for the impact of guessing).

3. Identify the impact of the correction method for the impact of guessing (the correction equation for the impact of guessing, the traditional method) on the accuracy of the regression line equation coefficients.

4. To identify the difference in the percentage of the explained variance in the scores of the dependent variable by the independent variable, according to the method of correction.

Definition of terms

1) The conventional method

It is the method that gives the examinee one mark for each correct answer or zero for any other answer. The student is alerted not to leave unanswered items. It is noted that this method is unfair as it does not take into account partial knowledge wherein the examinee's score is calculated based on this method through the following equation: (Alnabhan, 2002)

$$F = \sum_{i=1}^{n} R$$

F: Corrected final score. R: The number of correct answers.

2) Correction-for impact of guessing method (punishment): defined by Mehrens and Lehmann (1991) as "a method based on deleting the scores that it is estimated that the examinee obtained through guessing". This method assumes that every wrong response is the result of a guess made by the examinee, as this method does not take into account the partial information that the examinee may have relied on in his answer to the test items. The examinee's score is calculated based on this method through the following equation:

$$\mathbf{F = R - \frac{W}{A - 1}}$$

Where :

F = corrected or Formula score R= number of items answered right.

W = number of items answered wrong. A = number of choice per item.

3) Simple linear regression equation

This equation links one quantitative variable, which is the dependent variable, with another quantitative variable, which is the independent variable. It can be used to explain the relationship between the two variables or to estimate the value of the dependent variable when knowing the value of the independent variable. This relationship is referred to by the following equation:

$\hat{Y} = a + bx$

METHOD

Study Approach

The researcher used the descriptive approach, in order to identify the impact of guessing on the accuracy of estimating the parameters of the simple linear regression equation and the ability to predict.

Study population

The study population consisted of all general diploma students registered at Al-Hussein Bin Talal University in the second semester of the year 2020/2021, numbering (186), according to the university's admission and registration statistics for the year 2020/2021.

The study sample:

The study sample consisted of (122) male and female students, who were selected randomly, divided into two sections taught by the researcher himself.

Study tool:

To achieve the objectives of the study, a criterion-referenced achievement test was constructed in the measurement and evaluation subject / course according to the following steps:

1. Determining the purpose of the test: That is to measure students' achievement level and to reveal the extent of their acquisition of basic skills and knowledge in the measurement and evaluation course that was taught in the second semester of 2020-2021.

2. Analyzing the content of the course "Introduction to Measurement and Evaluation", which is taught at Al-Hussein Bin Talal University.

3. Constructing a table of specifications for the test to connect the levels of content objectives with the content of the subject matter of the test, where the relative weights of the study units and levels of objectives were determined through the size of the study material.

4. Drafting of test items: (50) multiple-choice items were formulated for each item, including four alternatives, one of which represents the correct answer. The formulation

of test items was taken into account through the technical bases of writing this type of items.

5. Content validity of the test: To ensure the validity of the test content, the test was presented in its initial form, as well as analyzing the content and the table of specification to a group of referees specialized in the measurement and evaluation field, in order to get their viewpoints regarding the validity of the test items in measuring the specific behavioral goal. They were, also asked to suggest any suitable modifications of the items and the objectives. Based on referees' notes, some unclear words were modified so that they have clear meaning, and 3 items were deleted.

6. Analyzing the test items by applying it (the test) to an exploratory sample from the study population and from outside its sample selected randomly, consisting of (30) male and female teachers, in order to find out the items parameters (items difficulty and discrimination).

7. Applying the test to the assigned study sample, which consisted of two sections: the traditional correction method was applied to the first section, and the correction method that depends on the correction equation for the impact of guessing was applied to the second section. Then papers were collected, corrected and then, test marks were distributed.

8. Finally, data were Collected, analyzed and results were extracted.

Psychometric properties of the test

***Test Validity*:** It was validated in two ways:

1. Content validity: To ensure the content's validity, the test was presented to a group of (10) specialized referees who were asked about their viewpoints regarding the degree to which the test represented the content, the accuracy and integrity of the language and the clarity of the items. In light of the referees' observations, the test items were modified by reformulating some items, modifying the alternatives, and deleting (3) items, to become (47) items.

2. Internal consistency validity

To verify the internal consistency of the test in its initial form, it was applied to an exploratory sample consisting of (30) high diploma students in the College of Education from the study population and from outside its sample, and the correlation coefficients were found between the score of each item and the total score on the test. The correlation coefficients of the items' scores with the total score ranged between (0.22-0.83). All the correlation coefficients had acceptable and statistically significant scores, except for two items that had non-statistically significant correlation coefficients. Therefore, the two items were deleted, so that the test consisted of (45) items.

Psychometric properties of test items

The items discrimination and difficulty coefficients were verified, as the answers of the exploratory sample students were analyzed, and (5) items were excluded because their

discrimination coefficient was less than (0.19) while the rest of the items were kept. Their values of the discrimination coefficients ranged between (0.41 - 0.79) and the difficulty coefficients ranged between (0.24 - 0.76). These coefficients are considered suitable according to Ebel's criteria referred to in (Al-Nabhan, 2004), therefore, the test consists in its final form of (40) items.

***Test Reliability*:** The test's reliability was verified by applying it to an exploratory sample from within the population and outside the study sample consisting of (30) high diploma students in the College of Education. The reliability coefficient was calculated by using the internal consistency method utilizing Couder-Richardson equation (20). The reliability coefficient calculated by this method was (0.84). Using the split-half method, the reliability coefficient calculated by this method, after correcting it from the impact of the half-splitting was (0.81), based on the Spearman-Brown equation - which are acceptable reliability coefficients in this type of studies (Al Nabhan, 2004).

FINDINGS AND DISCUSSION

To answer the first question, which states: "Are there any statistically significant differences at the level of significance (**$\alpha \leq 0.05$**) among the predicted values according to the correction method?

The researcher calculated the predicted values for a set of scores after finding out the simple linear regression equation to predict the scores of the examinees on the final test based on their scores when applying the achievement test prepared in this study, where the simple linear regression, based on the first method (the traditional method), was as follows:

$\hat{Y} = 0.18 + 38\ x$

The simple linear regression equation was also found based on the second method (the correction equation for the impact of guessing), represented in the following equation:

$\hat{Y} = 0.35 + 34\ x$

Then, the significance of the differences among the predicted values was calculated based on the independent sample t-test. Table (1) shows that.

Table 1
Independent samples for t-test comparing the arithmetic means among the predicted values

Method	Number	Mean	Std. Deviation	t	Sig
conventional	52	40.40	1.27	8.08	.000
Correction-for guessing formula	70	38.82	0.72		

The results in table (1) show that there are differences among the predicted values in the scores of the examinees when using the traditional method and the correction equation for the impact of guessing in favor of the traditional method. This may be due to the fact that when using the correction equation for the impact of guessing, the instructions

for this method do not encourage students to guess which reduces students' reliance on guessing and, consequently, the observed score will increase.

This confirms that the mean predicted values when relying on the traditional method will be higher when relying on the correction equation for the impact of guessing, which leads to an increase in the square value of the observed value deviations from the expected values on the regression line (residuals) when relying on the traditional method. This is evident from Figure No. (1) and Figure No. (2):

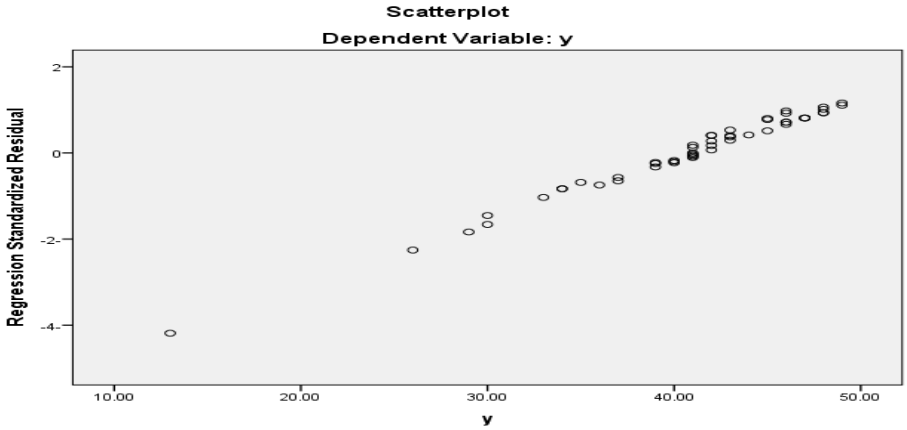


Figure 1
Scatter plot for regression standardized residual for method one

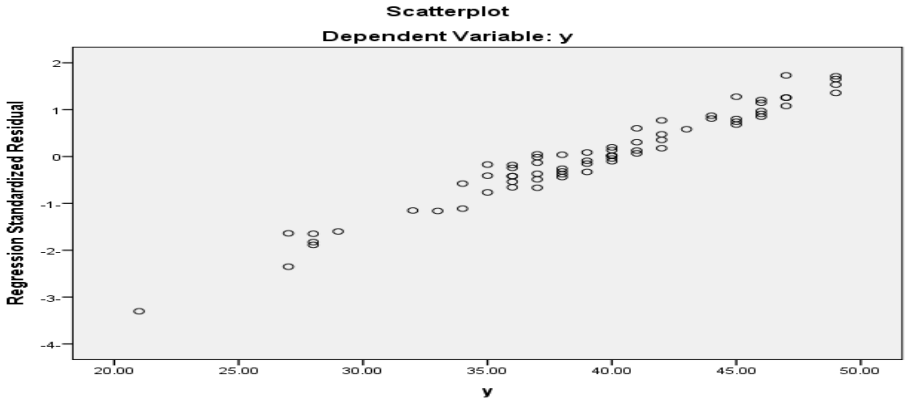


Figure 2
Scatter plot for regression standardized residual for method two

It is clear from Figure (1) and Figure (2) that the squares of the deviations of the observed values from the regression line when relying on the first method (traditional) are less when relying on the second method (correction equation for the impact of guessing).

To answer the second question, which states: Are there statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the arithmetic means of the residual squares to estimate the study sample scores attributed to the method of correction (traditional, correction equation for the impact of guessing)?

To answer this question, the residual squares were found out according to the method of correction, and then the significance of the differences between the residual squares values was calculated based on the independent sample t-test as shown in table (2).

Table 2
Independent samples for t-test comparing arithmetic means, squares of residuals

Method	Number	Mean	Std. Deviation	t	Sig
conventional	52	44.4	111.5	0.55	0.002
Correction-for guessing formula	70	36.1	48.1		

The results in table (2) show that there are differences among the means of squares residuals for estimating the study sample scores attributed to the correction method and in favor of the traditional method, that is, the means of the squares residuals when using the traditional method were higher than the arithmetic means when using the correction equation for the impact of guessing. This indicates that when using the correction equation for the impact of guessing, the value of the random error in estimating the examinees' scores decreases, and the observed score approaches the expected value. So, the lower the value of the residual squares, the closer the observed scores approach the regression line, and the accuracy in prediction increases.

To answer the third question, which states: Does the percentage of the explained variance in the scores of the dependent variable by the independent variable differ according to the method of correction?

To answer this question, the value of the constant simple regression coefficients was calculated, the slope and constant (a and b) and the determination coefficient was calculated, relying on the (Independent sample t-test) to determine the significance of each of the simple regression coefficients as shown in table (3).

Table 3
R square and regression coefficient and standard error

			Simple regression coefficient		Standard error			
method	R^2	Durbin-Waston	A	B	A	B	t	sig
conventional	0.13	1.81	0.18	38	0.21	3.04	12.36	0.00
Correction-for guessing formula	0.45	1.93	0.35	34	0.19	2.67	12.93	0.00

It is clear from table (3) that the value of the explained variance ($\mathbf{R^2}$) increases when using the correction equation for the impact of guessing, and perhaps the reason for this is that when relying on this equation, the rate of guessing decreases, which reduces the error percentage and the scores of the examinees approaches the true score.

To answer the fourth question, which states: What is the impact of the correction method (the correction equation for the impact of guessing, the traditional method) on the accuracy of the regression line equation coefficients?

To answer this question, table No. (3) was used, which shows that the values of the parameters of the simple regression equation increase when the correction equation is used for the impact of guessing, and that the values of the standard error in estimating the regression parameters decrease when using the correction equation for the impact of guessing.

It is also clear that the value of (Durbin-Waston) increases when relying on the correction equation for the impact of guessing, which confirms the independence of the residuals from each other and the absence of correlation among them (independence of residuals), where the calculated values of (Durbin-Waston) ranged between (1.5 -2.5) (Norosis, 2010, Bani Hani, 2014).

This confirms that the method of correction for the impact of guessing is the most accurate method for the impact of guessing, and it is the most accurate in measuring the examinees' scores. As such, relying on this method may leave a positive impact on students' preparation for tests and may increase their motivation to learn, as the instructions accompanying this method focus on punishing the examinee if he guesses, which reduces the guessing and, eventually, reduces random errors in estimating the examinee's true score, which may increase the accuracy in estimating the parameters of the simple linear regression equation.

CONCLUSIONS AND RECOMMENDATIONS

The results of the study showed that there were statistically significant differences among the predicted values in the examinees' scores when using the traditional method and the correction equation for the impact of guessing in favor of the traditional method, and there are statistically significant differences among the residual squares means to estimate the scores of the study sample attributed to the correction method and in favor of the traditional method.

It also showed that the value of the explained variance (R^2) increases when using the correction equation for the impact of guessing, and that the parameters of the simple regression equation values increase when using the correction equation for the impact of the guessing, and that the values of the standard error in estimating the regression parameters decrease when using the correction equation for the impact of the guessing.

Based on the findings of the study, the researcher recommended relying on the correction method to control the impact of guessing in correcting multiple-choice tests, and conducting more studies to identify the impact of guessing on the accuracy of estimating the parameters of the simple linear regression equation and the ability to predict depending on the item response theory.

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