Journal of Global Scientific Research 7 (12) 2022/ 2782-2788

Contents lists available at www.gsjpublications.com

Journal of Global Scientific Research
in Applied Mathematics and Statistics

journal homepage: www.gsjpublications.com/jgsr

Using Matrices to Predict the Future Value of a Simple Linear Regression Model

Huda Ismail Hussain, Maryam Khenyab Kareem

Alzahraa University, College of Education, Department of Mathematics, Karbala, Iraq.

ARTICLE INFO

Received: 13 Nov 2022,
Revised: 15 Nov 2022,
Accepted: 21 Nov 2022,
Online: 11 Dec 2022

Keywords:
Prediction, Future Value, Model, Simple Linear Regression

ABSTRACT

This research aims to study: the use of matrices in predicting the future value of a simple linear regression model, by identifying the processes related to matrices and their concept, as well as touching on the concept of linear regression as a "linear equation" and methods of predicting it and its estimating properties, and the researcher reached a set of results: Method of predicting the use of matrices is one of the methods of predicting the future value, and there are many applications related to matrices in other mathematical sciences, and prediction contributes in many scientific fields, including administrative, economic and mathematical, and access is a simple and easy way to predict the future value using matrices, and that methods and methods of prediction generally assume That the underlying factors present in the past will continue in the future, and this represents the tendency of phenomena to be repeated in the future, and that predictions are rarely complete; Actual results are usually different from estimated or predicted values, and the inability to accurately predict is due to the multiplicity and multiplicity of the variables affecting or the influence of random factors; Therefore, the limits of variation and the extent of deviation are set to take these factors into consideration, and the accuracy of the prediction decreases the longer the time horizon for forecasting, and generally short-term forecasts are more accurate than long-term predictions: because the first is less likely to be uncertain of the second, the historical data that usually forms time series What takes a certain form is called a change pattern, and knowing the latter helps to achieve more accurate predictions. As for historical data characterized by an unstable and stable pattern of change, the pattern is hidden and unclear; it does not help achieve accurate forecasts and its prediction errors are significant.

1. Introduction

Multiple linear regression analysis is interested in studying and analyzing the effect of quantitative independent variables on a quantitative dependent variable, whereby the multiple regression model is used as a means to predict future values from estimating discretionary model parameters for prediction purposes as a result of the evolution (Kazem, 2009), and matrices have been linked to the prediction methods used as a starting method and compute In non-computational methods, where mathematics is a mathematical science that has many applications, including predicting the simple regression line equation, and the researcher in this research will

Corresponding author:
E-mail addresses: huda.ismail@alzahraa.edu.iq (Huda), maryam.henyab@alzahraa.edu.iq (Maryam)
doi: 10.5281/jgsr.2022.7424789

address the concept of predicting the regression line equation through matrices.

The Study Problem:

There are many types and forms of forecasting the future value in scientific, mathematical and statistical studies, as part of it merged under the concepts of time series or linear regression (linear equations), whether it is simple linear regression or multiple linear regression, and the importance of forecasting science as mentioned in the study (Delhome, 2009) where Whether forecasting in general and forecasting sales in particular are considered one of the first and most important functions of the organization, whether it is an enterprise in the production phase that owns data and information about the product and the market in which it is active, or the newly established organization which does not have historical data on the product the size and pattern of demand, and therefore the importance of forecasting appears On different levels, and accordingly, the researcher discussed one of the methods of prediction, which is predicting the use of matrices for the future value:

What is the role of matrices in predicting the future value of a simple linear regression?

From it, the following sub-questions are derived:

1. What are the matrices and the most important operations on them
2. What is a simple linear regression model?
3. How do you predict the use of matrices?
4. What are the most important recommendations and results that the researcher will reach?

Terminology of study:

Prediction: Prediction represents the forecast of future events, such as predicting the amount of industrial production for the coming year, for example (Farkous, 1995: 11).

Matrices: The matrix of m * n rank is a rectangular arrangement of quantities belonging to a field in m of rows and n of columns and is usually written in uppercase (long, 1999).

Regression Equations: used to describe the relationship between the dependent variable y consisting of n observations and the independent variables x1 x2 x3 x4 x5 = xn (Kazim, 2009: 3).

Theoretical Framework:

First: the matrices:

Matrices are a very powerful method for organizing and multiplying data to find unknowns or quick results that cannot be reached in the normal way except with great difficulty, especially when the numbers are large and their numbers are huge and therefore it is difficult for researchers to find the desired results, and the matrix is a Latin word and has been circulated in several languages, but this word is derived from The word mater means the Romanian mother, meaning the place or city that supplies several cities with water or in other words the main source that provides branches or several branches with water. The best example in the Roman state was the city of Augusta supplied eight cities with water, so the matrix is several elements that are enclosed in arranged or coordinated brackets with rows and columns, and each matrix has a rank and is denoted by capital letters. The numbers that represent the elements of a matrix are organized into rows (lines) and columns, which gives it a dimension. A matrix with grade or order m * n and m represents the number of rows and in the number of columns (Juburi and Virgins, 2012)

Matrices play an important role in expressing multivariate mathematical relationships in a simple, easy-to-understand manner and thus setting solutions to these relationships. Moreover, matrices have many applied fields of economics, statistics, process research and other sciences, and then we will address in this paper some concepts, important definitions, types of matrices and then go to algebra matrices (addition, subtraction and multiplication), and a number of other operations.

Matrix concept:

An array of m * n ranks is a rectangular arrangement of quantities belonging to a field Filed in m of rows and (n) of columns. The matrix is usually written in uppercase (long, 1999).

Matrix A is defined as a number system consisting of a set of horizontal rows m and anchored columns n and each A_ number (m * n) (Saleh, 2013).

The matrix also defines "any set of m n elements of a field arranged in a rectangular form of m rows as well as n of columns on the body"

$$\begin{bmatrix} a11 & a12 \ldots.. & a1n \\ a21 & a22 \ldots. & a1n \\ am1 & am2 \ldots.. & amn \end{bmatrix}$$

(The Soldier, 2012: 107).

As another defines it, "it is an arrangement of numbers consisting of rows and columns" (Awad, 1991: 274).

Basics about matrices: (Saleh, 2013):

1. **Unit Matrix:** It is a square matrix. Elements with a unit diameter are always (1 =). As for non-diagonal elements, they are zeros. Therefore:

$$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

2. **The inverse of the matrix:** it is a matrix inferred from A and we denote it A ^ (- 1), and the rectangular matrix has two opposite matrices, one from the right Inverse and check the following:

$$A_{m*n} \ * \ A^{-1}{}_{n*m} \ = \ I_{m*n}$$

In addition, one on the left is called left inverse:

$$A^{-1}{}_{n*m} \ * \ \mathrm{A}_{m*n} \ = \ I_{n*n}$$

If the matrix is square (m = n) then its left inverse equals its right inverse.

3. **Two matrices are equal**: the two matrices A B are equal if all the corresponding elements in the two matrices are equal (Al-Taweel, 1999), and two matrices are equal if they are of the same rank and the corresponding matrices are equal, meaning that the two matrices are equal if they are identical (Awad, 1991: 274).

4. **The degree of the matrix**: this term is used to denote the number of rows and the number of columns, for the degree of matrix A whose number of rows m and the number of their columns n is (m, n) is:

5. $$\mathrm{A}= \begin{bmatrix} a11 & a12 & a13 \\ a21 & a22 & a23 \\ a31 & a32 & a33 \end{bmatrix}$$

Some types of matrices:

1. The square matrix: is the matrix whose number of rows m is equal to the number of columns n of their examples. The fixed matrix A is the number of rows 4 and the number of columns 4.

You can also say that the matrix is square if its dimensions are equal, that is, it has the same number of rows and columns, that is, m = n. For example, both matrices A and B are two matrices:

$$A = \begin{bmatrix} 2 & 0 \\ 5 & 3 \end{bmatrix} \qquad B = \begin{bmatrix} S & 0 \\ C & 3 \end{bmatrix}$$

(Al-Jubouri and Al-Adhari, 2012: 103).

2. **Diagonal matrix**: If matrix A is a square matrix, then it is called a diagonal matrix if all of its elements are the main diameter except that m ≠ n, $a_{\_mn} = 0$

For example

$$A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 41 \end{bmatrix}$$

3. Zero matrix: It is a matrix whose elements are zeros, meaning that each component i and j for each component $a_{\_ij} = 0$ and its most important properties are:

$$O_{m*n} \ * \ A_{n*1} \ = \ O_{m*1}$$

$$A_{m*1} \ * \ O_{1*n} \ = \ O_{m*n}$$

$$, \begin{bmatrix} O & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} = A$$

The square matrix whose components are all under the main diagonal zeros is the upper trigonometric matrix, and the square matrix whose all elements are above the main diagonal is called the nulls of the lower triangular matrix and the matrix is called homeopath, if it is an upper triangular or inferior triangular (Al-Quds Open University, 2009).

Operations on Matrices:

1. Addition: Additions are made between two arrays only in matrices that have the same dimension, i.e. combining a two-square matrix only with a two-square matrix, for example on the following addition:

$$\begin{bmatrix} 3 & 8 \\ 15 & 12 \end{bmatrix} = \begin{bmatrix} 2 & 8 \\ 6 & 7 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 9 & 5 \end{bmatrix}$$

We noticed in the addition process that the first element of the first matrix is combined with the first elements of the second matrix and so the matter is done from the addition if we are as we have said only in the square matrices.

2. Subtraction: The subtraction operations between matrices is a state that is contrary to the addition process and has the same conditions, i.e. the matrices presented must have the same dimensions

$$\begin{bmatrix} 30 & 40 & 10 \\ 20 & 15 & 11 \\ 25 & 32 & 12 \end{bmatrix} - \begin{bmatrix} 40 & 50 & 17 \\ 45 & 25 & 16 \\ 20 & 44 & 35 \end{bmatrix} = \begin{bmatrix} -10 & -10 & -7 \\ -25 & -10 & -5 \\ 5 & -12 & -23 \end{bmatrix}$$

3. Multiplications of a matrix: The multiplication of matrices varies between two matrices or a matrix and a vector or between vectors or between an absolute real number that hits the matrix and so we can understand these as follows:

Multiply an absolute real number by an array: if we had an array like a square with two dimensions i.e. two columns and two rows (2 * 2)

$$A = 4\begin{bmatrix} 2 & 0 \\ 5 & 3 \end{bmatrix} = \begin{bmatrix} 8 & 0 \\ 20 & 12 \end{bmatrix} \; \mathbf{4}$$

$$A = -4\begin{bmatrix} 2 & 0 \\ 5 & 3 \end{bmatrix} = \begin{bmatrix} -8 & 0 \\ -20 & -12 \end{bmatrix} \; -\mathbf{4}$$

4. Multiplication of two matrices: The multiplication rule differs from what is in it in addition and subtraction operations, as the multiplication process is not related to matrices that are equal in dimensions with each other, but the multiplication process between two matrices or between a vector and a matrix or a matrix and a vector or between vectors, the purpose of the multiplication process It is to obtain a specific result, for example, that there are unknowns that we want to get their values to be completed by multiplying between the matrices. For example, if we have the following equations:

$$a_{11}\, x_1 + a_{12}\;\; x_2 = \; b_1$$

$$a_{21}\, x_1 + a_{22}\;\; x_2 = \; b_2$$

If we notice in the above equations that each of the coefficients in a are the coefficients of the variables and are known values, and b are constants as is well known, the unknowns are x.

5. Movable matrix (transposed): that mathematics operations need most of the time in processing them to matrices to facilitate the solution and reduce its difficulty and the amount of large numbers that are generated in the midst of its operations, as well as some of these matrices are useful to use their transposition to find solutions in algebra of matrices, and movable matrix means Transferring rows to columns and columns to its rows or in other words is an organizational process for what we mentioned in the process of turning rows or columns and can be coded for as follows:

6. Small T indicates that the matrix is taken from the original:

$$A=\begin{bmatrix} 40 & 50 & 17 \\ 45 & 25 & 16 \\ 20 & 44 & 35 \end{bmatrix}$$

The transposed matrix is as follows:

The rules governing the transfer process:

$$A^T = \begin{bmatrix} 40 & 45 & 20 \\ 50 & 25 & 44 \\ 14 & 16 & 35 \end{bmatrix}$$

1. **The first rule:**

$$(A+B)^T = (A^T + B^T)\ , (A-B)^T = (A^T - B^T)$$

2. **The second rule:** The second rule states that a transposed matrix is the original matrix:

$(A)^T)T = A$

3. The Third Rule:

$(AB)^T = (B^T A^T)$

$(AB)^T \neq (A^T B^T)$

(Al-Jubouri and Al-Adhari, 2012)

Initial operations on matrices:

The initial operations on the arrays are the following:

1. Switch two rows (two columns).
2. Multiply a row (column) by a non-zero constant.
3. To be added to a row (column) a linear structure from other rows (columns).
4. Initial column operations are called vertical primary operations (El-Gendy, 2012).

Matrix calculation laws:

If we have the matrices A B C and the real numbers, a b then the following laws for calculating the matrices are achieved by assuming that the operations are defined:

- A + B = B + A (the substitution property of the sum)
- A + (C + B) = B + (A + C) (the aggregate property in relation to the sum)
- A (BC) = (AB) C.
- (B + C) A = BA + CA
- A (B + C) = AB + AC
- A (B-C) = AB-AC
- (B-C) A = BA-CA
- a (B + C) = a B + a C
- (a + b) C = a C + B C
- (a-b) C = a C- B C
- a (BC) = (Ab) C (Al-Quds Open University, 2009).

Second: Linear Regression Analysis:

Linear regression analysis is concerned with studying and analyzing the effect of several quantitative independent variables on a quantitative dependent variable, whereby the linear regression model is used as a means of predicting future values by estimating the model parameters that are adopted in the estimative model for predictive purposes (Fikri, 2005).

Simple regression model hypotheses.

The regression model is usually constructed by analyzing the observations of a sample from a randomly drawn community, the community may be real or hypothetical, and the results of the analysis of the sample are relied upon and circulated to the statistical community, and therefore the analysis process must ensure the approximate representation of the community from which the sample is drawn, And it is not expected that the sample will be fully representative of the society, therefore the construction of the regression model must meet the following assumptions:

1. **The first hypothesis:** It relates to the independent variable) (X and it is assumed that the data collected in relation to this variable are able to show its effect in changing the values of the dependent variable (Y) so that it is at least one of the values, then when there are errors in measuring the variables, the matter will lead to a violation The independence of the variables was imposed, leading to biased and inconsistent feature estimates (Minor and Sabri, 2000).
2. **The second hypothesis**: that the random error ei follows the normal distribution, and as a result, Y and the mean distribution of the regression parameters follow the normal distribution, so that the significance of these parameters can be tested.

Therefore, this hypothesis is an extension of the idea of a normal distribution of the arithmetic mean of apparent values , which, as is well known, follows a moderate distribution (Bendib, 1999).

3. **The third hypothesis**: The expected value of a random error (i.e. its mean) equals zero, and because of this hypothesis, the equation Y = a + bX gives the average value of Y as X is constant, whereas Y in the equation: Yi = a + b Xi + ei changes above or below its mean With a decrease or decrease in ei of zero (Kazmier, 1982).

4. **The fourth hypothesis:** that the variance of the random error limit is constant in each period for all X values, and this hypothesis ensures that each view is equally reliable, so that the estimates of the regression coefficients as a category, and their hypothesis tests are unbiased (Baldawi, 2000).

Third: Predicting the future value of the regression line models:

Prediction Concept:

It is the function that adjusts - realizes - the future, based on reliable market data and developments, and the most accurate and reliable forecast based on mathematical models (Gauthy & Vandercammen, 2005).

It is also known as "it is the process of presenting future values using historical observations after studying their behavior in the past" (Hashman, 1998).

Prediction Types:

Predicting different types according to the approved classification criteria, including:

- **Prediction formula:** According to this criterion, we distinguish between point and period forecasts.
- **Point prediction:** is the prediction of a single value for the dependent variable in the forecast year or for each upcoming period, i.e. one expected value given to the dependent variable where (Navigator, 2003),

p (zn + m = zn (m)) = 0, pour que m> 0

- **Predicting a field or period**: represents the prediction of a specific range within which the value of the dependent variable of a certain probability falls, such as if a maximum and a minimum threshold are set within which the estimated value of the request falls (Othman, 2002).

General features of the prediction:

1. Methods and methods of prediction generally assume that the basic factors present in the past will continue in the future, and this represents the tendency of phenomena to be repeated in the future.
2. The predictions are rarely complete; Actual results are usually different from estimated or predicted values، and the inability to accurately predict is due to the multiplicity and multiplicity of the variables affecting or the influence of random factors; Therefore، the limits of variance and extent of deviation are set to consider these factors.
3. Predictions a group of vocabulary or products tends to be more accurate than prediction by a single item or a single product; this is because prediction errors for multiple words or products have the effect of elimination; Whereas، the negative error in prediction for a specific product removes the positive error for a second product.
4. The accuracy of the prediction decreases the longer the time horizon for forecasting، and generally, short-term predictions are more accurate than long-term predictions: because the former is less likely to be unsure of the second.
5. The historical data that makes up the time series usually takes a certain form called a change pattern, and knowing the latter helps to achieve the most accurate predictions. As for historical data characterized by an unstable and stable pattern of change, the pattern is hidden and unclear; It does not help achieve accurate forecasts and its prediction errors are significant. (Delhome, 2009).

List of Sources and References:

[1]. Al-Jubouri, Sadiq and Al-Adhari, Adnan (2012): Mathematics and Economics, Dar Al-Jarir, for publication and distribution.

[2]. Al-Jundi, Mustafa (2012): Principles of Modern Algebra, University Salary House, 1st edition.

[3]. Al-Mallah, Jalal (2003): The Economic Introduction to Market Study: Analytical Tools for Student Study, Presentation and Shares, King Faisal University.

[4]. Al-Quds Open University (2009): Linear Algebra, Amman, the Hashemite Kingdom of Jordan.

[5]. Al-Taweel, Majdi (1999): Theoretical and Application Matrices, Faculty of Engineering, Cairo University, Egypt.

[6]. Awad, Adnan (1991): General Mathematics and its Economic Applications, Al-Furqan Publishing House.

[7]. Delhome, Khalida (2009): Sales Forecasting Methods, published Master Thesis, University of Hajj Lakhdar, Algeria.

[8]. Farkous, Mohamed (1995): Estimated Budgets, University Press Office, Ben Aknoun, Algeria

[9]. Hachman, Born (1998): Models and Techniques for Short-Term Prediction, Doyan University Press, Algeria.

[10]. Léonard J Kazmier , statistiques de gestion , traduit par :Jean-marc picard , Mc GRW Hill Editeurs, Paris , 1982, P2.

[11]. Mansour, Awad and Sabri, Azzam (2000): Principles of Statistics, Dar Safaa for Publishing and Distribution, Amman, 1st edition.

[12]. Martine-Gauthy,Marc-Vandercammen, Etude demarchés**:** méthode et outils**,** 2éme édition, (Deboeck:Bruxelles, 2005), p.424.

[13]. Saleh, Mahmoud (2013): classes in.