MODELING FOR FORECASTING STOCK MARKET USING THE DISCRETE LEAST SQUARE METHOD AND THE LAGRANGE INTERPOLATION METHOD

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1. Introduction

The least-squares method was used as an estimation method developed independently in 1796 by Gauss, Legendre, and Adrain in 1805 and 1808 respectively (Abazid et al., 2018). It is a method that involves statistical means by evaluating in-depth regression analysis to estimate the solution of a more determined system in which there is more unknown in a set of equations. Next, the Lagrange Interpolation method is the technique to estimate the value of a mathematical function for any intermediate value of the independent variables.

The stock market is also well-known as the equity market or share market. The stock market is widely known as a platform to engage in economic transactions of selling and buying stocks or shares that are ownership claims over a business (Asalatha, 2019). The stock market, without a doubt, is an important part of a country's economy. Furthermore, stock market movements are influenced by many macro-economic factors, such as political events, firm policies, general economic conditions, commodity price indices, bank rates, and more (Patel et al., 2015).

We obtained the data from Yahoo Finance and the two mathematical modeling methods used in this study were the discrete least-square method and the Lagrange interpolation method. Microsoft Excel 2019 is used to analyze and evaluate the data to find the stock market forecast value of the discrete least-squares method as well as for the Lagrange interpolation method. Next, the sum of each data is evaluated to find errors.

2. Methodology

The two mathematical modeling methods decided to be used in this study were the discrete least-square method and the Lagrange interpolation method.

The Discrete Least-Square Method involving with three types such as:

Linear: $f(x) = a_0 + a_1 x$ subject to a_0 and a_1 = coefficient of variables and x = exact values. (1)

Quadratic: $f(x) = a_0 + a_1 x + a_2 x^2$ subject to a_0, a_1 and a_2 = coefficient of variables and x and x^2 = exact values. (2)

Cubic: $f(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3$ subject to $a_0, a_1, a_2 and\ a_3$ = coefficient of variables and x, x^2 and x^3 = exact values. (3)

$$f(x) = a_0 + a_1 x \quad (3.1)$$

$$f(x) = a_0 + a_1 x + a_2 x^2 \quad (3.2)$$

$$f(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3 \quad (3.3)$$

The Lagrange interpolation Method involving with three types such as:

Linear: $P_n(x) = f(x_0)L_0 + f(x_1)L_1$ subject to $L_0(x) = \frac{(x-x_1)}{(x_0-x_1)}$ and $L_1(x) = \frac{(x-x_0)}{(x_1-x_0)}$ (4)

Quadratic: $P_n(x) = f(x_0)L_0 + f(x_1)L_1 + f(x_2)L_2$ subject to $L_0(x) = \frac{(x-x_1)(x-x_2)}{(x_0-x_1)(x_0-x_2)}, L_1(x) = \frac{(x-x_0)(x-x_2)}{(x_1-x_0)(x_1-x_2)}$ and $L_2(x) = \frac{(x-x_0)(x-x_1)}{(x_2-x_0)(x_2-x_1)}$ (5)

Cubic: $P_n(x) = f(x_0)L_0 + f(x_1)L_1 + f(x_2)L_2 + f(x_3)L_3$ subject to $L_n(x) = \frac{(x-x_1)(x-x_2)(x-x_3)}{(x_n-x_1)(x_n-x_2)(x_n-x_3)}\ n = 0,1,..,3$ (6)

$$P_n(x) = f(x_0)L_0 + f(x_1)L_1 \quad (6.1)$$

$$P_n(x) = f(x_0)L_0 + f(x_1)L_1 + f(x_2)L_2 \quad (6.2)$$

$$P_n(x) = f(x_0)L_0 + f(x_1)L_1 + f(x_2)L_2 + f(x_3)L_3 \quad (6.3)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (y_p - y)^2}{N}} \quad (7)$$

3. Results and Discussions

The results for both methods show the forecasting data for the stock market. It also shows the error of both methods.

a. The predicted *y* values of the stock price using linear, quadratic, and cubic least-squares equations are shown in Table 1. The results show that the linear least-squares equation gives the stock price value that is closest to the actual data.

Table 1: Results for the linear, quadratic, and cubic least square

Week, x	Close price, y	Linear	Quadratic	Cubic
1	17.1	16.4914	17.1937	17.1287
2	16.92	16.5548	16.874	16.8796
3	16.74	16.6182	16.6309	16.6715
4	16.42	16.6816	16.4644	16.5122
5	16.38	16.745	16.3745	16.4095
6	16.4	16.8084	16.3612	16.3712
7	16.36	16.8718	16.4245	16.4051
8	16.76	16.9352	16.5644	16.519
9	16.46	16.9986	16.7809	16.7207
10	17.24	17.062	17.074	17.018
11	17.3	17.1254	17.4437	17.4187
12	18	17.1888	17.89	17.9306
78	202.08	202.0812	202.0762	201.9848

b. The predicted y values for stock prices using linear, quadratic, and cubic Lagrange interpolation equations are shown in Table 2. The results show that the linear Lagrange interpolation equation gives the stock price value that is closest to the actual data.

Table 2: Results for linear, quadratic, and cubic Lagrange interpolations

Week, x	Close price, y	Linear	Quadratic	Cubic
1	17.1	14.2133	78.76	-75.4334
2	16.92	14.4466	77.26	-47.7405
3	16.74	14.6799	75.76	-26.1616
4	16.42	14.9132	74.26	-9.9437
5	16.38	15.1465	72.76	1.6662
6	16.4	15.3798	71.26	9.4211
7	16.36	15.6131	69.76	14.074

8	16.76	15.8464	68.26	16.3779
9	16.46	16.0797	66.76	17.0858
10	17.24	16.313	65.26	16.9507
11	17.3	16.5463	63.76	16.7256
12	18	16.7796	62.26	17.1635
78	202.08	185.9574	846.12	-49.8144

c. Table 3 shows that the cubic least squares method has the smallest mean square root (RMSE) error compared to other methods.

Table 3: RMSE for Discrete least squares and Lagrange interpolation methods

Methods		**RMSE**
Discrete Least-Square	Linear	0.427199
	Quadratic	0.139047
	Cubic	0.133423
Lagrange Interpolation	Linear	1.527019
	Quadratic	53.94235
	Cubic	35.99894

Based on the observational results from the calculations of the two methods which are the Discrete Least-Square Method and the Lagrange Interpolation Method, this study found that the cubic least square method is the best method to implement stock price forecasting because the cubic least square method gives the smallest RMSE among the others.

4. Conclusion

This study shows the stock price can be forecasted by mathematical modeling. So, for this study, the expected values can be obtained by using the discrete least square method and the interpolation method. In addition, from the result obtained after using both methods, a root means square error (RMSE) can be calculated and it will be compared with the two methods, to find the least error given. Throughout this study, the discrete least square method for cubic least-square has the least square method for cubic least square, which degree three, has the smallest root mean square error (RMSE) compared to others. Therefore, the cubic least square equation is chosen as the best equation to forecast the values. Moreover, it is also that the cubic least square equation has better accuracy performance.

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