

Decision Support System For Determining Inventory And Sales Of Goods Using Economic Order Quantity Methods And Linear Regression

Manaf Khaerul

*Department of Information System,
Sangga Buana University, Department
of Informatics, Faculty of Science and
Technology
University State Islamic Sunan Gunung
Djati,
Bandung, Indonesia
khaerulmanaf@uinsgd.ac.id*

Kaffah M F

*Department of Informatics,
Islam Nusantara University
Bandung, Indonesia
faiz@uninus.ac.id*

Alam Nurul Cecep

*Department of Informatics, Faculty of
Science and Technology State Islamic
University Sunan Gunung Djati
Bandung, Indonesia
cecep@uinsgd.ac.id*

Ira Rupaida

*Department of Information System,
Sangga Buana University,
Bandung, Indonesia
irarupaida@gmail.com*

Subaeki Beki

*Department of Information System,
Sangga Buana University, Department
of Informatics, Faculty of Science and
Technology
University State Islamic Sunan Gunung
Djati,
Bandung, Indonesia
beki807@gmail.com*

Aedah Binti Abd Rahman

*Department of Information
Communication Technology
Asia e University,
Kaulalumpur, Malaysia
aedah.abdrahman@aeu.edu.my*

Abstract— Inventory control and sales are important activities for the company to run. Errors in determining the inventory of goods can cause swelling in operational costs so that the company experiences losses. To overcome this problem, a Decision Support System (DSS) is needed that can help make decisions in determining inventory and sales of goods. In this case, the researcher uses the Economic Order Quantity (EOQ) EOQ provides a reference regarding the number of purchases or orders of goods with minimum cost. Meanwhile, to determine the number of future sales, researchers used the Linear Regression method, which looks at the relationship between sales as a response variable and the sales period as a predictor variable. The results of this study can be used to estimate the amount of quantity each time order of goods and predict the number of sales in the next period.

Keywords : Decision Support System, Economic Order Quantity, Linear Regression, Inventory.

I. INTRODUCTION

Inventory and sales of goods are very important for a company. Determination of the wrong inventory of goods can cause material losses for the company. In the current economic development, which has begun to penetrate e-business, it requires a company to be faster and more precise in making decisions, to survive in today's business competition. Muslimah Millionaire (MM) is a company engaged in selling Muslim clothes, Muslim dolls, and herbal medicines. Keeping up with the times Muslim millionaire women also take advantage of internet technology to develop their business. To overcome the above problems, it is necessary to develop a system that can manage inventory data and sales of goods, and can support the right decision making for distributors. Decision support system (DSS) is a computer-based information system that provides interactive information support for managers and business people during the decision-making process [1][2].

Two methods were used in developing this DSS. The first method is Economic Order Quantity (EOQ) to support

decisions regarding inventory management. EOQ is a mathematical method that determines the number of goods that must be ordered to meet the projected demand with minimized supplies [3]. And the second method is Linear Regression to estimate the sales of goods in the coming period. Linear regression is a regression analysis that involves the relationship between one dependent variable (sales) and one independent variable (sales period)[4] .

II. LITERATURE REVIEW

A. Decision Support System (DSS)

Decisions Support System (DSS) or Decision Support System is a computer-based information system that provides interactive information support for managers and business players during the decision-making process. The decision support system uses (1) an analytical model, (2) a specialized database, (3) a decision maker who has insight and judgment, and (4) a computer-based and interactive model / form making process to support business decisions[5].

B. Economic Order Quantity (EOQ)

One of the most popular inventory models is the EOQ (economic order quantity) or Model Q or the fixed order quantity model. This means that the quantity of one message is fixed, while the period is different. The purpose of this model is to determine the number of messages at the most economical cost[6], [7]. The EOQ model is a mathematical method that determines the number of goods that must be packed to meet the projected demand with a minimized supply[8] The formula for calculating EOQ is as follows:

$$Q = \sqrt{\frac{2 D S}{H}}$$

Information :

Q = EOQ or order quantity

D = demand

S = Order cost (setup cost)

H = holding cost

To find out the optimal total cost based on the findings of the Q value, the formula used is:

$$TC = DC + \frac{D}{Q}S + \frac{Q}{2}H$$

Information :

TC = total cost (total cost)

D = Demand

C = Price of inventory / unit (inventory cost)

Q = Order quantity (quantity)

S = Order cost (setup cost)

H = holding cost

There are basic assumptions in the use of the EOQ model, namely [6]:

- a) The rate of sales can be estimated
- b) Constant use of materials
- c) Orders can be made instantly
- d) Delivery can be made quickly

There are basic assumptions in the use of the EOQ model, Safety stock is the company's ability to create conditions that are always safe or full of security in the hope that the company will never experience shortages of inventory [9].

There are several determining factors in calculating safety stock[10], namely:

- a) Average raw material usage
- b) The time factor
- c) Costs used

After knowing Q, a question will appear when we should place an order. The time of order is made when the inventory reaches a certain point. This particular point is called the reorder point.

Reorder Point is the point at which a company or business institution must order goods or materials, to create controlled inventory conditions [7].

The reorder point formula is as follows:

$$R = \bar{d}L$$

Information :

R = Reorder point

\bar{d} = Average daily demand

L = lead time in days

To find out how many orders are made in a year, as well as the time interval between one order and another, the following formula is used:

$$N = \frac{D}{Q}$$

$$T = \frac{\text{Number of working days in a year}}{N}$$

Where N is the frequency of ordering times in one year and T is the interval of ordering times [4].

C. Linear Regression

Linear regression is a regression analysis that involves the relationship between one dependent variable and one independent.

Linear regression is a statistical method that functions to test the extent of the causal relationship between the variable causal factors and the effect variable. The causative factor is generally denoted by X or also known as predictor while the resultant variable is denoted by Y or also known as a response. The causative factor is generally symbolized by X or also known as a predictor, while the resulting variable is symbolized by Y or also known as a response. Linear regression which has one independent variable is called simple linear regression[11].

Linear Regression Equation

$$\hat{Y} = a + b(x)$$

Information :

\hat{Y} = dependent variable

a = Constant

b = Regression Coefficient

x = Independent variable

To calculate parameters a and b:

$$b = \frac{\sum_{i=1}^n X_i Y_i}{\sum_{i=1}^n X_i^2}$$

$$a = \frac{\sum_{i=1}^n Y_i}{n} - b(\bar{x})$$

D. Inventory Function

Some of the important functions contained by inventory in meeting company needs are as follows[12]:

- 1) Eliminates the risk of delays in the delivery of raw goods or goods required by the company.
- 2) Eliminates the risk if the material ordered is not good so it must be returned.
- 3) Eliminates the risk of price increases or inflation.
- 4) To store raw materials that are produced seasonally, so that the company will have no trouble if the raw materials are not available in the market.
- 5) Profit from purchases based on quantity discounts.
- 6) Providing services to customers with the availability of the goods needed.

Inventory costs consist of all expenses, both direct and indirect, related to the purchase, preparation, and placement of inventory for sale. Inventory costs of raw materials or goods obtained for resale, including the purchase price, delivery,

receipt, storage, and all costs incurred until the goods are ready for sale[13].

III. RESEARCH METHOD

A. Development method

The development method used is the Prototyping method. Software prototyping is a system life cycle method based on the concept of a working model. The stages of developing a prototype model according to Mr. Roger S. Pressman is [14]:

1. Listening to Customers

At this stage, the system needs to be collected by hearing complaints from customers. To create a system that suits your needs, you must first know how the system is running and then find out what problems occur.

2. Designing and Making Prototypes

At this stage, a system prototype is designed and made. Prototypes that are made are tailored to the system requirements that have been previously defined by customer or user complaints.

3. Testing

At this stage, the prototype of the system is tested by customers or users. Then do an evaluation of the deficiencies of customer needs. Development then returned to listening to complaints from customers to improve the existing Prototype.

B. Current System Analysis

At this time, the running system is still manual. When there is an order, the employee will check the inventory, if the goods run out, it will be recorded as out of stock. If the goods are available, sales will be carried out, then the sales turnover will be calculated per day, after which the data will be calculated daily turnover then this turnover will be inputted into Ms. Excel. Daily turnover, will be recapitulated regularly every month by the Distributor.

C. EOQ is a method used to calculate the number of orders

That are effective to be efficient in terms of both storage costs and customer costs. To calculate EOQ, we need data on the number of orders per year, the cost of ordering per unit, and the cost of storage per unit. In carrying out the EOQ calculation function, you can determine what items will be calculated EOQ. Can be based on the name of the item, or by category of goods[15], [16].

D. Linear Regression Method

In this study, the authors estimate the number of sales in the next period. In this study, it is determined that x is the sales period, and y is sales, based on the relationship between these two variables it can be estimated that sales in the next period will be[17], [18].

IV. RESULT AND ANALISYS

A. SYSTEM TESTING

1. Testing The Eoq Method

Data entered into the system:

- Demand (D): 1062 pieces of product
- Order Fee (S): Rp. 145,000, -
- Storage Cost (H): Rp. 3,420, - / product / year

- Average delay: 2 days
 - Number of Working Days: 292 Days
 - Product Name: All products
 - Product price: Rp. 76.090, -
- Manual calculation:

a) EOQ

$$Q = \sqrt{\frac{2 D S}{H}}$$

$$Q = \sqrt{\frac{2 \times 1062 \times 145000}{3420}}$$

$$Q = \sqrt{\frac{307980000}{3420}}$$

$$Q = \sqrt{90052,6136}$$

$$Q = 300,08$$

Rounded up is 3001 products

b) Total Cost

$$TC = DC + \frac{D}{Q}S + \frac{Q}{2}H$$

$$TC = (1062 \times 76090) + \frac{1062}{300,08}145000 + \frac{300,8}{2}3420$$

$$TC = 81833879,95$$

c) Reorder Point

$$R = \bar{d}L$$

$$R = \frac{1062}{292}2$$

$$R = 7,2$$

Round to 8 Items

d) N dan T

$$N = \frac{D}{Q}$$

$$N = \frac{1062}{300,08}$$

$$N = 3,54$$

Round to 4 Items.

$$T = \frac{\text{Number of working days}}{N}$$

$$T = \frac{292}{3,54}$$

$$T = 82,48$$

Round to 83 days.

What the system displays:

TABLE 1: System EOQ Calculation Results

EOQ	301
TC	Rp. 81.833.880,-
Reorder Point	8
N	4
T	83

V. CONCLUSION

Based on the results of the research and development of a decision support system, it can be concluded that this system can calculate the effective amount of inventory with the Economic Order Quantity (EOQ) method, and can estimate the number of sales in the next period using the linear regression method.

ACKNOWLEDGMENT

The author would like to express his appreciation and gratitude to the Research and Publication Centre of UIN Sunan Gunung Djati Bandung that supports and funds this research publication.

REFERENCES

- [1] G. Walsham, "Geoff Walsham: Interpreting Information Systems in Organizations," *Organ. Stud.*, vol. 15, no. 6, pp. 937–937, 1994, doi: 10.1177/017084069401500614.
- [2] S. H. Chan, Q. Song, S. Sarker, and R. D. Plumlee, "Decision support system (DSS) use and decision performance: DSS motivation and its antecedents," *Inf. Manag.*, vol. 54, no. 7, pp. 934–947, 2017, doi: 10.1016/j.im.2017.01.006.
- [3] N. Kazemi, S. H. Abdul-Rashid, R. A. R. Ghazilla, E. Shekarian, and S. Zaroni, "Economic order quantity models for items with imperfect quality and emission considerations," *Int. J. Syst. Sci. Oper. Logist.*, vol. 5, no. 2, pp. 99–115, 2018, doi: 10.1080/23302674.2016.1240254.
- [4] J. Y. C. Liu, H. G. Chen, C. C. Chen, and T. S. Sheu, "Relationships among interpersonal conflict, requirements uncertainty, and software project performance," *Int. J. Proj. Manag.*, vol. 29, no. 5, pp. 547–556, 2011, doi: 10.1016/j.ijproman.2010.04.007.
- [5] F. Jalaei, A. Jade, and M. Nassiri, "Integrating decision support system (DSS) and building information modeling (BIM) to optimize the selection of sustainable building components," *J. Inf. Technol. Constr.*, vol. 20, pp. 399–420, 2015.
- [6] R. Kumar, "Economic Order Quantity (EOQ) Model," *Encycl. Prod. Manuf. Manag.*, vol. 5, no. 1, pp. 176–176, 2006, doi: 10.1007/1-4020-0612-8_275.
- [7] S. Khalilpourazari and S. H. R. Pasandideh, "Modeling and optimization of multi-item multi-constrained EOQ model for growing items," *Knowledge-Based Syst.*, vol. 164, pp. 150–162, 2019, doi: 10.1016/j.knosys.2018.10.032.
- [8] L. E. Cárdenas-Barrón, A. A. Shaikh, S. Tiwari, and G. Treviño-Garza, "An EOQ inventory model with nonlinear stock dependent holding cost, nonlinear stock dependent demand and trade credit," *Comput. Ind. Eng.*, vol. 139, 2020, doi: 10.1016/j.cie.2018.12.004.
- [9] T. Singh, P. J. Mishra, and H. Pattanayak, "An EOQ inventory model for deteriorating items with time-dependent deterioration rate, ramp-type demand rate and shortages," *Int. J. Math. Oper. Res.*, vol. 12, no. 4, pp. 423–437, 2018, doi: 10.1504/IJMR.2018.092103.
- [10] C. K. Jaggi, A. Khanna, and Nidhi, "Effects of inflation and time value of money on an inventory system with deteriorating items and partially backlogged shortages," *Int. J. Ind. Eng. Comput.*, vol. 7, no. 2, pp. 267–282, 2016, doi: 10.5267/j.ijiec.2015.10.003.

2. Testing the Linear Regression Method

In linear regression calculations, we compare manual the counting process with the results issued by the system, here are the results obtained.

TABEL 2 : Comparison of Linear Regression Calculation Results

	Calculate Manual	System
Coefficient a	7690,85	7690,85
Coefficient b	35,3	35,3
The calculation results	8079,5	8080 (Rounding results)

3. Software Implementation

The implementation stage is the result of the previous stages. At this stage, a Decision Support System (DSS) is produced[19][20]. After the user has successfully logged in, the dashboard page that is displayed for employees is as follows:

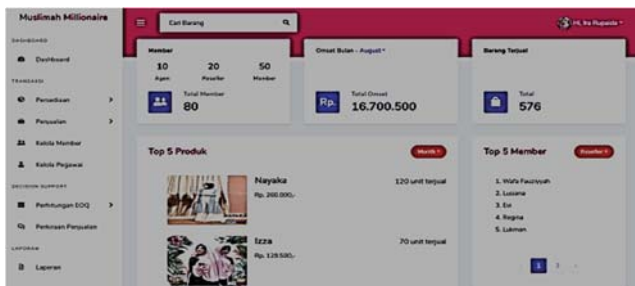


Figure 1: Distributor Dashboard Page

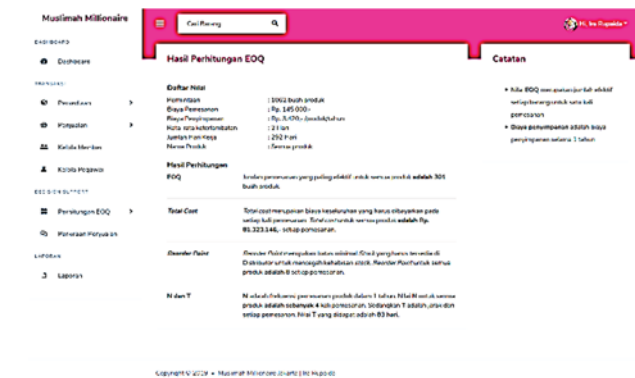


Figure 2: EOQ Results page

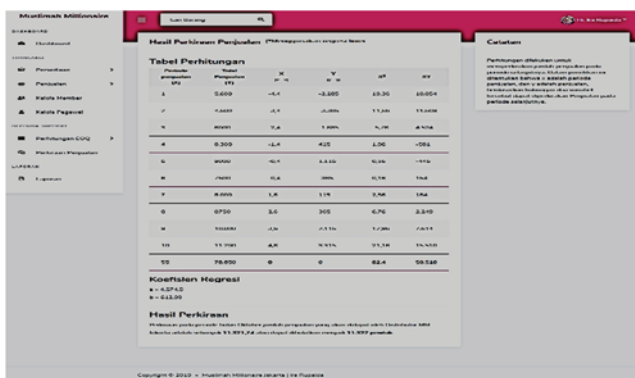


Figure 3: Sales Forecast Results page

- [11] M. del C. Bas, J. Ortiz, L. Ballesteros, and S. Martorell, "Evaluation of a multiple linear regression model and SARIMA model in forecasting ⁷Be air concentrations," *Chemosphere*, vol. 177, pp. 326–333, 2017, doi: 10.1016/j.chemosphere.2017.03.029.
- [12] S. Geertman and J. Stillwell, "Planning support systems: an inventory of current practice," vol. 28, pp. 291–310, 2004, doi: 10.1016/S0198-9715(03)00024-3.
- [13] J. H. Greenslade and K. M. White, "The Journal of Social The Prediction of Above- Average Participation in Volunteerism: A Test of the Theory of Planned Behavior and the Volunteers Functions Inventory in Older Australian Adults," no. December 2013, pp. 37–41, doi: 10.3200/SOCP.145.2.155-172.
- [14] P. R. S, *A PRACTITIONER'S APPROACH*. 2005.
- [15] M. C. Mabini, L. M. Pintelon, and L. F. Gelders, "EOQ type formulations for controlling repairable inventories," *Int. J. Prod. Econ.*, vol. 28, no. 1, pp. 21–33, 1992, doi: 10.1016/0925-5273(92)90110-S.
- [16] F. Fazel, "A comparative analysis of inventory costs of JIT and EOQ purchasing," *Int. J. Phys. Distrib. Logist. Manag.*, vol. 27, no. 8, pp. 496–504, 1997, doi: 10.1108/09600039710182680.
- [17] P. Hall and J. L. Horowitz, "Methodology and convergence rates for functional linear regression," *Ann. Stat.*, vol. 35, no. 1, pp. 70–91, 2007, doi: 10.1214/009053606000000957.
- [18] W. S. DESARBO, "A SIMULATED ANNEALING METHODOLOGY FOR CLUSTERWISE LINEAR REGRESSION," vol. 54, no. 4, pp. 707–736, 1989.
- [19] K. Manaf, "Implementasi Sistem Pakar Diagnosa Kerusakan Pada Canon Np6650Xx Menggunakan Metoda Dempster Shafer," *J. Online Inform.*, vol. 1, no. 2, pp. 92–97, 2017, doi: 10.15575/join.v1i2.36.
- [20] E. Sugiyarti, K. A. Jasmi, B. Basiron, M. Huda, K. Shankar, and A. Maseleno, "Decision support system of scholarship grantee selection using data mining," *Int. J. Pure Appl. Math.*, vol. 119, no. 15, pp. 2239–2249, 2018, doi: 10.5772/47788.