ANALYSIS INVENTORY OF CONSUMABLE GOODS USING MIN-MAX METHOD AT UNIVERSITAS PERTAMINA

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Abstract
Inventory control is one of the problems faced by Universitas Pertamina. In the management of inventory, especially office Stationery Stock, Universitas Pertamina does not determine the limited value of inventory that must be stored. There are 138 type of office stationery items managed by Universitas Pertamina. Thus, this causes asset management difficult to determine the ordering quantity for each item and how many items should be stored in the warehouse. As a result, the overall cost of Office Stationery at Universitas Pertamina and shown to increase almost 50% every year. The Therefore, it is necessary to analyze the inventory policies that used by Universitas Pertamina. The purpose of this study is to recommend policies related to the value of safety stock, minimum stock, and maximum stock for each consumable item. In addition, a comparison of inventory cost between the existing policy and Proposed policy is carried out. The method used is the Min-Max Stock method. In addition, the ABC classification method is also used to classify items based on the level of usage. The results of this study show from 138 items of office stationery, 19% are A class, 30% are B class and 51% are C class. The classification can be used to prioritize the number of ordered and reduce the overall inventory. Based on the calculation results, it is found that ordering cost with existing method is Rp.100,898,604 and with Proposed method is Rp. 71,595,499 and form this result by using the min-max method, Universitas Pertamina can save up to 30% of inventory costs compared to the current policy.

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1. Introduction

Facilities and infrastructure are one of the most influential factors in the quality of education, which has a contribution of 40.38% [1]. Facilities and infrastructure are defined as requirements that are used in the process of teaching and learning activities, both moving and immobile so that educational goals can run smoothly, regularly, effectively, and efficiently [2]. According to Matin and Fuad (2018), facilities and infrastructure are divided into several types of groups including books, tools, furniture, buildings, and land [3].

As an educational institution, Universitas Pertamina has several facilities and infrastructure to support its students. Some of the facilities include a library, classrooms, laboratory, indoor field, swimming pool, auditorium room, etc. In addition, Universitas Pertamina also provides consumable goods used to lecture activities and administration processes such as Office Stationery (ATK). Management control of goods in teaching and learning activities must be carried out optimally, where the amount must be adjusted to the level of user needs but also do not make large purchases because they require storage [4]. Fig. 1 is the overall cost of Office Stationery at Universitas Pertamina and shown to increase every year due to an increase of student, educational activities, and laboratories.

One of the methods that is widely used in the inventory control process is the min-max method. Min-Max is the method of controlling inventory by determining the minimum and maximum amount of inventory that can be stored, and the safety stock. In other studies, this method is able to save inventory costs for each period [5], this method is also able to produce a smaller value than the company's final inventory [6]. Therefore, this paper aims to calculate the value of safety stock, minimum stock, and maximum stock for each stationery item.
2. Methods

In this study, the ABC analysis methods was used to classify the office stationery into 3 groups, Group A, B and C. ABC Analysis is a methods of inventory control based on the pareto principles [7]. ABC analysis method, the small portion of items represent the high value or amount of the total inventory. Technically, Class A is 15-20% of the total goods, but represents 75–80% of the total value. Class B is 20-25% of the total number of items but represents 10-15% of the total value and Class C is 60-65% of the total goods but represents 5–10% of the total value [7-11]. Determination of the class of goods is carried out based on the ordering frequency that occur from 2017 to 2019.

The Min-Max Stock method is a method of controlling inventory by determining the minimum and maximum stock values that must be stored, as well as the value of safety stock. The stages and calculation formulas are as follows [5]:

1. Determine the safety stock (ss)

   Safety Stock is a security stock to prevent the inventory from running out [4, 8]. The following is an equation used to calculate the value of safety stock:

   \[
   ss = (\text{Maximum Usage} - T) \times \frac{C}{\text{period of time}}
   \]  

   Where:
   \( T \) = Average usage of goods per period
   \( C \) = Lead time per period
   \( SS \) = Safety Stock

2. Determine the minimum stock

   The following is an equation used in calculating the value of minimum stock:

   \[
   \text{Minimum stock} = \frac{(T \times C)}{\text{Period of time}} + SS
   \]  

3. Determine the maximum stock

   The following is an equation used in calculating the maximum stock value:

   \[
   \text{Maximum stock} = \frac{2(T \times C)}{\text{period of time}} + SS
   \]  

   Other stages that are also carried out in inventory control are calculation of the quantity or number of orders of goods \( Q \) to replenishment of supplies [11]. Reorder or order quantity is the order quantity for each period, as follows is the calculation formula [12].

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![Figure 1. Cost of Office Stationery](image)
3. Results and Discussions

A. Stock Classification

This process is carried out by classifying the stock of Office Stationery to ABC class based on the number of ordering frequencies from 2017 to 2019. From inventory data, there are 138 type of stock that included in the Office Stationery. The example stock of Office Stationery was showed in Table 1 below.

Table 1. Demand Data During the 2017 - 2019 Period (Sample data)

| No | Items                          | Attribute | 2017 Even | 2017 Odd | 2018 Even | 2018 Odd | 2019 Even | 2019 Odd | Total |
|----|--------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|
| 1  | Amplop Coklat Custom Pack      |           | 0         | 0         | 2200      | 0         | 4,003     | 2,500     | 8703  |
| 2  | Amplop Putih PaperLine/110x230| Box       | 8         | 1         | 23        | 7         | 83        | 10        | 132   |
| 3  | Amplop Universitas pcs         |           | 0         | 2700      | 1350      | 0         | 1,520     | 1,507     | 7077  |
| 4  | Bantex Box File 4011/100mm     | pcs       | 67        | 221       | 530       | 243       | 721       | 351       | 2133  |
| 5  | Bantex ordner                  | pcs       | 111       | 138       | 177       | 123       | 1,006     | 284       | 2872  |
| 6  | Bantex Pocket Transparant/A4   | pcs       | 520       | 148       | 5100      | 1000      | 1,123     | 125       | 28381 |
| 7  | Bantex Pocket Transparant/A4   | pcs       | 640       | 100       | 780       | 1500      | 723       | 149       | 4292  |
| 8  | Binder Clip No.105/15mm Pack   |           | 69        | 52        | 41        | 85        | 5         | 42        | 294   |
| 9  | Binder Clip No.107/19mm Pack   |           | 64        | 98        | 56        | 70        | 534       | 31        | 1053  |
| 10 | Binder Clip No.111/25mm Pack   |           | 83        | 86        | 76        | 22        | 465       | 184       | 916   |
| 11 | Binder Clip No.155/32mm Pack   |           | 41        | 66        | 78        | 131       | 112       | 51        | 479   |
| 12 | Binder Clip No.200/41mm Pack   |           | 15        | 29        | 48        | 18        | 453       | 74        | 637   |
| 13 | Binder Clip No.260/51mm Pack   |           | 9         | 7         | 53        | 75        | 411       | 67        | 622   |
| 14 | Buku Hard Cover                | pcs       | 0         | 2         | 28        | 17        | 17        | 2         | 66    |
| 15 | Tisu Kering                    | Box       | 8         | 5         | 0         | 4         | 30        | -         | 47    |
| 16 | Trigonal Clip No.1             | Pack      | 90        | 94        | 125       | 242       | 724       | 240       | 1515  |
| 17 | Trigonal Clip No.5             | Pack      | 28        | 2         | 9         | 5         | 202       | 85        | 331   |
| 18 | Zipper Bag/ A5                 | Pcs       | 105       | 0         | 9         | 128       | 70        | 48        | 360   |

By using data from Table 1, the percentage of goods usage was calculated to determine the ABC classification based on the ordering frequency as shown in Table 2 below.
Table 2. ABC Classification of Office Stationery Stock

| No | Items                                | Attribute | Total Usage (2017-2019) | % Usage | % Cumulative | ABC Class |
|----|--------------------------------------|-----------|--------------------------|---------|--------------|-----------|
| 1  | Bantex Pocket Transparat              | pcs       | 28381                    | 22.628% | 22.628%      | A         |
| 2  | Amplop Coklat Custom                  | Pack      | 8703                     | 6.939%  | 29.567%      | A         |
| 3  | clear sleeve Map/ A4                  | Pack      | 7735                     | 6.167%  | 35.734%      | A         |
| 4  | Map Coklat perperekat                 | Pcs       | 7179                     | 5.724%  | 41.458%      | A         |
| 5  | Amplop Universitas                    | Pcs       | 7067                     | 5.635%  | 47.093%      | A         |
| 24 | Kertas Sinar Dunia 70gr               | Rim       | 930                      | 0.741%  | 78.410%      | A         |
| 25 | Binder Clip No. 111/25mm              | Pack      | 916                      | 0.730%  | 79.140%      | A         |
| 26 | Pena Standard                         | Pcs       | 900                      | 0.718%  | 79.858%      | A         |
| 27 | Pena Pilot                            | Pcs       | 796                      | 0.635%  | 80.493%      | B         |
| 28 | Panghatus white board                 | Pcs       | 683                      | 0.545%  | 81.038%      | B         |
| 29 | Double Tap 1/2"x72                    | Roll      | 679                      | 0.541%  | 81.579%      | B         |
| 66 | Isi Spidol Snowman Board Marker       | pcs       | 255                      | 0.20%   | 94.55%       | B         |
| 67 | Spidol WB Marker ABG-12               | pcs       | 234                      | 0.19%   | 94.73%       | B         |
| 68 | Clear Sleeve Map/ A4                  | Pack      | 212                      | 0.17%   | 94.90%       | B         |
| 69 | Spidol WB Marker ABG-12               | pcs       | 212                      | 0.17%   | 95.07%       | C         |
| 70 | Lem Stick/ 8gr                        | pcs       | 193                      | 0.15%   | 95.22%       | C         |
| 134| Stapler Heavy Duty                    | Pcs       | 16                       | 0.013%  | 99.95%       | C         |
| 135| Buku Name Card Holder/ A5             | Pcs       | 14                       | 0.011%  | 99.97%       | C         |
| 136| Map Diamond / Biola / Stop Map        | Pack      | 14                       | 0.011%  | 99.98%       | C         |
| 137| Spidol Gambar Snowman PW-12A          | Set       | 14                       | 0.011%  | 99.99%       | C         |
| 138| Map Diamond / Biola / Stop Map        | Pack      | 13                       | 0.010%  | 100%         | C         |

Based on stock data, there are 138 types of items stored as Office Stationery. Fig. 2 below shows the percentage of ABC stock classification.

![Percentage ABC Classification](image)

**Figure 2. ABC Stock Classification**

**B. Safety Stock Calculation**

Using formulation (2), the safety stock was calculated for each item. Therefore, average consumption, maximum usage, and lead time were counted in these steps.
Table 3. Example of Average, Maximum and Lead Time Calculation

| No | Items                                      | Average usage (units) | Maximum Usage (units) | Lead Time (month) |
|----|--------------------------------------------|-----------------------|-----------------------|-------------------|
| 1  | Bantex Pocket Transparan (A4)              | 4,731                 | 21,519                | 0.1667            |
| 2  | Amplop Coklat Custom                       | 1,451                 | 4,003                 | 0.1667            |
| 3  | Clear Sleeve Mal (A4)                      | 1,290                 | 2,848                 | 0.1667            |
| 4  | Map Coklat Berperekat                      | 1,197                 | 3,600                 | 0.1667            |
| 5  | Amplop Universitas                         | 1,178                 | 2,700                 | 0.1667            |
| 6  | Clear Sleeve Mal (F4)                      | 878                   | 2,624                 | 0.1667            |
| 7  | Kertas PaperOne (A4-80gr)                  | 774                   | 1,636                 | 0.1667            |
| 8  | Bantex Pocket Transparan (F4)              | 716                   | 1,900                 | 0.1667            |
| 9  | Bantex Ordner 1465V01 (70mm)               | 479                   | 1,156                 | 0.1667            |
| 10 | Kertas PaperOne (A4-70gr)                  | 397                   | 1,352                 | 0.1667            |

The data from Table 3 was used to find safety stock value for each consumable good.

Table 4. Example of Safety Stock Calculation

| No | Items                                      | Attribute  | Unit Type | Safety Stock |
|----|--------------------------------------------|------------|-----------|--------------|
| 1  | Bantex Pocket Transparan (A4)              | Bening     | Pcs       | 2799         |
| 2  | Amplop Coklat Custom                       | Coklat     | Pack      | 426          |
| 3  | Clear Sleeve Map (A4)                      | Bening     | Pack      | 7            |
| 4  | Map Coklat Berperekat                      | Coklat     | Pcs       | 401          |
| 5  | Amplop Universitas                         | Coklat     | Pcs       | 254          |
| 6  | Clear Sleeve Map (F4)                      | Bening     | Pack      | 292          |
| 7  | Kertas PaperOne (A4-80gr)                  | Putih/A4   | Rim       | 144          |
| 8  | Bantex Pocket Transparan (F4)              | Bening     | Pcs       | 198          |
| 9  | Bantex Ordner 1465V01 (70mm)               | Biru       | Pcs       | 113          |
| 10 | Kertas PaperOne (A4-70gr)                  | Putih/F4   | Rim       | 4            |

C. Min-Max Calculation

The Min-Max calculation stock method showed in Table 5 below. Min. Stock is used as a point where a reorder must be made to maintain stock at the warehouse, while Max. Stock is used to show the maximum amount of inventory that can be stored in the warehouse [5]. In addition, Min. Stock usually called as the Reorder Poin.

Table 5. Example Min-Max Calculation

| No | Items                                      | Safety Stock | Min. Stock | Max. Stock |
|----|--------------------------------------------|--------------|------------|------------|
| 1  | Bantex Pocket Transparan (A4)              | 2799         | 3,588      | 4377       |
| 2  | Amplop Coklat Custom                       | 426          | 668        | 910        |
| 3  | Clear Sleeve Map (A4)                      | 7            | 476        | 691        |
| 4  | Map Coklat Berperekat                      | 401          | 601        | 801        |
| 5  | Amplop Universitas                         | 254          | 451        | 647        |
| 6  | Clear Sleeve Map (F4)                      | 292          | 439        | 585        |
| 7  | Kertas PaperOne (A4-80gr)                  | 144          | 274        | 403        |
| 8  | Bantex Pocket Transparan (F4)              | 198          | 318        | 437        |
| 9  | Bantex Ordner 1465V01 (70mm)               | 113          | 193        | 273        |
| 10 | Kertas PaperOne (A4-70gr)                  | 4            | 227        | 293        |
Based on Table 5, each type of item has a different value, this is because the needs for each item are different. Where at each period the number of requests for ATK goods varies depending on the needs of each user.

D. Inventory Cost Analysis

Inventory control activities will be related to ordering policies. This ordering activity is carried out to replenish stock that are close to the reorder point, this case is between the points of safety stock to minimum stock. But there is also a method of carrying out an ordering policy when the amount of inventory is approaching the minimum inventory limit. Determining the ordering policy using Equation (4) and carried out for each group. This activity will make it easier for Pertamina University in the determination process number of future orders.

Order quantity costs are costs incurred to carry out ordering ATK goods. The calculation of the cost is based on the price of each item of goods. This cost calculation does not consider costs of ordering or costs incurred to place an order for stationery goods. Based on the graph in Fig. 3 for the replenishment of inventory, the costs incurred for Class A are Rp. 71,595,499, while class B and C are Rp. 23,011,786 and Rp. 6,291,319. In addition, with the method of ABC class, order quantity costs can be more efficient. Table 6 showed an ordering cost comparison between the existing condition and Min-Max with the ABC class method.

| Class  | Ordering Cost Using Min-Max Method |
|--------|-----------------------------------|
| Class A| Rp80,000,000.00                   |
| Class B| Rp60,000,000.00                   |
| Class C| Rp40,000,000.00                   |
| Class D| Rp20,000,000.00                   |
| Class E| Rp0                               |

Figure 3. Ordering Cost

From Table 6, can be concluded by Min-Max Method with the ABC classification, the cost of the order quantity is decreasing by 30% compared to the existing policy.

4. Conclusion

The conclusions of this study are as follows:

1. Inventory management carried out by Universitas Pertamina does not apply ABC Classification, so the items being managed will increase in number. From the inventory side, there are no stored stationery items, so it has the potential to delay the fulfillment of consumable items. So, the asset manager has had difficulties in tracking goods, this is due to the large number of items that must be handled.

2. The result of implementing the min-max policy with the ABC classification method, not all items will be stored in the warehouse, so it will streamline the cost of storing consumable items. With this classification process, the focus of managing goods will be more efficient because the number of goods will be less but have a greater value. From calculation results, it is shown that using Min-Max Method, the cost of the order quantity is decreasing by 30% compared to the existing policy.
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