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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 whit 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.

Keywords:
Inventory control; min-max method; ABC classification, consumable goods; office stationery

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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.

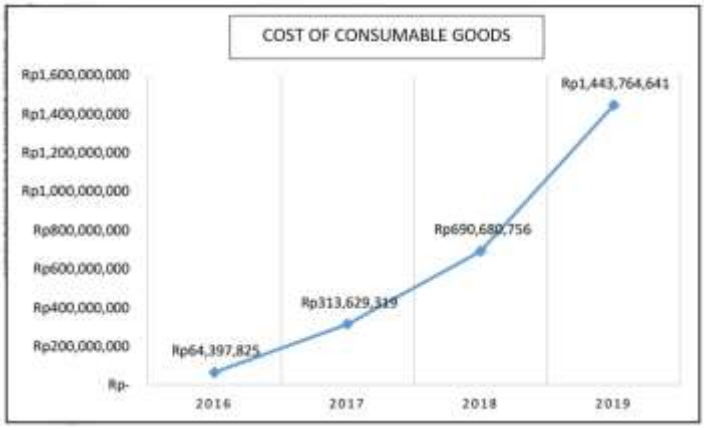

Figure 1. Cost of Office Stationery

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:

$$ss = (Maximum\ Usage - T) \times \frac{C}{period\ of\ time} \quad (1)$$

   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:

$$Minimum\ stock = \frac{(T \times C)}{Period\ of\ time} + SS \quad (2)$$

3. Determine the maximum stock

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

$$Maximum\ stock = \frac{2(T \times C)}{period\ of\ time} + SS \quad (3)$$

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].

$$Ordering\ Quantity\ (Q) = \frac{2\ x\ T\ x\ C}{period\ of\ time} \quad (4)$$

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	Atribute	2017		2018		2019		Total
			Even	Odd	Even	Odd	Even	Odd	
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	1156	1,006	284	2872
6	Bantex Pocket Transparant/ A4	pcs	520	440	5100	21519	677	125	28381
7	Bantex Pocket Transparant/ A4	pcs	640	100	780	1900	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	231	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
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
134	Tipe-X Liquid	pcs	73	24	75	53	287	132	644
135	Tisu Kering	Box	8	5	0	4	30	-	47
136	Trigonal Clip No.1	Pack	90	94	125	242	724	240	1515
137	Trigonal Clip No.5	Pack	28	2	9	5	202	85	331
138	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	Atribute	Total Usage (2017-2019)	% Usage	% Commulative	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	Penghapus 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.

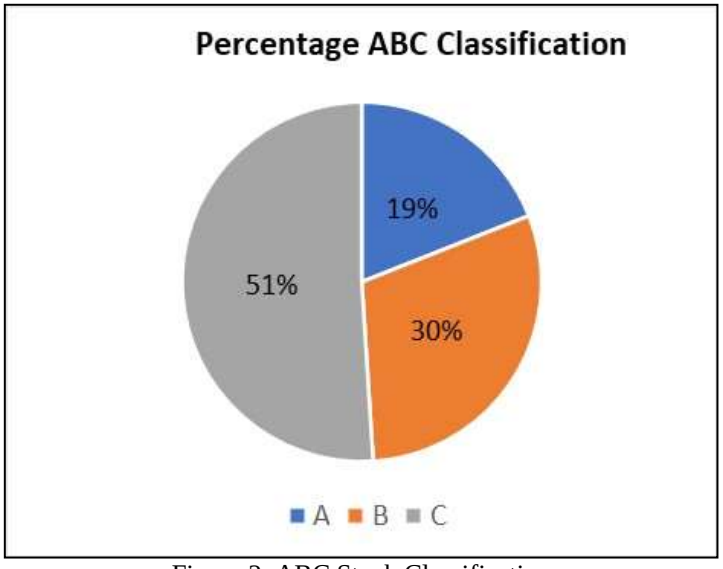

Figure 2. ABC Stock Classification

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	Avarage 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 some 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.

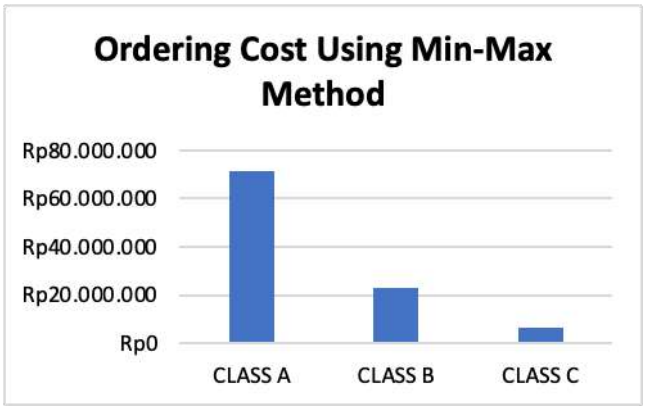

Figure 3. Ordering Cost

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.

Table 6. Ordering Cost Comparison

Ordering Cost Existing Condition	Ordering Cost using Min-Max with ABC Classification
Rp100,898,604	Rp71,595,499

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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Nurma Irfani Romadhon is a student of the Logistics Engineering Department at University of Pertamina. The author was born in Tegal on January 22, 1996. Before becoming a student, the author had completed his studies at SMA Negeri 24 Jakarta. During his time as a student, the author was active in several activities of the committee and campus organization, including being the PSDM Staff at the Logistics Engineering Student Association (HIMALOG UP) and being the coordinator of the Logistics Engineering Student Regeneration activities

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