BALTIC JOURNAL OF LAW & POLITICS
A Journal of Vytautas Magnus University
VOLUME 16, NUMBER 3 (2023)
ISSN 2029-0454

sciendo

Cite: Baltic Journal of Law & Politics 16:3 (2023): 3375-3393
DOI: 10.2478/bjlp-2023-00000255

Analysis of hessian sack inventory system using eoq method at xyz logistics company

M.Syafaruddin Mahaputra
Universitas Islam Nusantara Bandung
Email: msmahaputra@uninus.ac.id

Galih Raka Sri Guritno
Universitas Islam Nusantara Bandung
Email: rakasriguritno@uninus.ac.id

Muhamad Ilham Nasirul Haq,
Universitas Islam Nusantara Bandung
Email: ilhamnasirulhaq@uninus.ac.id

Eri Nugraha
Universitas Islam Nusantara Bandung
Email: erinugraha@uninus.ac.id

Arsyad Arid
Universitas Islam Nusantara Bandung
Email: arsyadarid@uninus.ac.id

Received: December 24, 2022; reviews: 2; accepted: January 14, 2023

Abstract

The business process in XYZ logistics company is divided into four stages of the logistics service provision process. In these four stages, it is not uncommon for some packages to be scattered due to their small size. This, of course, causes losses for the company as it has to bear the cost of compensation for the lost packages. To address this issue, the company has implemented a policy that mandates the use of sacks in stages 1, 2, and 3. The mandatory use of sacks has led to an increase in sack consumption. However, the high consumption of sacks has resulted in irregular ordering, compounded by limited available space. The determination of Hessian sack stock using the Economic Order Quantity method to determine the economically optimal order quantity that meets the company's needs. The data used is based on historical data, specifically the usage data of printed Hessian sacks over a period of 12 months from August 2021 to July 2022. Microsoft Excel 2019 software was used for data analysis. The field research was conducted at the Sorting Center located in North Jakarta.

Keywords

Economic Order Quantity Method, Normality Test, Forecasting.

Introduction

Many companies today focus on production, product development, target markets, and sales outcomes. The transportation of goods from production to market often receives little attention, and many companies prefer to rely on third-party logistics companies to handle the movement of products. This presents a promising business opportunity. By utilizing third-party logistics companies, companies no longer need to worry about logistics costs such as vehicle maintenance, travel expenses, travel risk, and other costs that would become a burden if handled internally. Therefore, there are companies that specialize in delivery and logistics, taking into account the costs that will be incurred during transportation, from receiving the goods to delivering them to their destination. These companies typically offer their services to production-focused companies. The logistics business is also very promising, as regardless of how advanced the production process and customer ordering process may be, the goods still need to be delivered.

Therefore, the author is interested in companies that focus on providing logistic delivery services. XYZ Logistics Companies is one such company that operates in the field of providing logistic delivery services. The business process at XYZ Logistics Companies that I have studied is divided into four stages as follows:

1. The first stage involves the driver collecting several packages that have been wrapped by the sellers and bringing them to a designated pick-up point, where all drivers gather to pick up the packages and transport them to the sorting center.
2. The second stage is when the sorting center receives the packages from the drivers and proceeds to sort them according to the destination area codes.
3. In the third stage, packages with the same destination are loaded onto the same truck and transported to the destination sorting center, where they are sorted based on specific addresses.
4. The fourth stage, the final stage, is when the sorted packages for specific destinations are delivered directly to the recipients' addresses. To facilitate the understanding of the above stages, please refer to Figure 1 below:

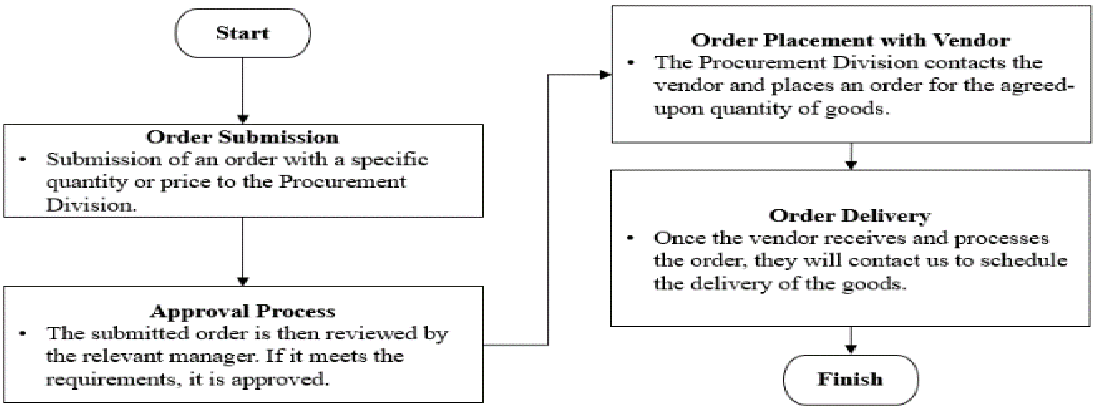

Figure 1. Flow business process

From the four stages mentioned above, it is common for small packages to become scattered and left behind. This situation causes financial loss for the company as it incurs costs for compensating lost packages. To address this issue, the company has implemented a policy where the use of sacks is mandatory in stages 1, 2, and 3. The mandatory use of sacks increases their consumption. Sacks are used daily to support the ongoing process and prevent package scattering and other losses. With the use of printed gunny sacks reaching 40,850 units per week and limited land availability of 90,000 m3, the ordering process becomes irregular. This situation has sparked my interest in conducting research on economic order quantity.

Based on the aforementioned problem and the book by Prof. Ir. I Nyoman Pujawan, M.Eng., Ph.D., CSCP, and Mahendarwathi Er, S.T., M.Sc., Ph.D., titled "Supply Chain Management, 3rd Edition" (2013, Andi Publisher, Yogyakarta), I am interested in conducting research on inventory management using the economic order quantity (EOQ) method. The XYZ Logistics sorting center has fulfilled the requirements for implementing the EOQ method by considering the ordering and holding costs to optimize the order quantity and minimize these two costs.

2.1. Materials and methods

2.2. Research Materials

The research materials used in this study are printed gunny sacks used in one of the sorting centers located in North Jakarta. The historical data collected includes the usage data of printed gunny sacks over a period of 12 months, starting from August 2021 to July 2022.

2.3. Location and Research Period

The field research was conducted at the sorting center located in North Jakarta. The research was carried out from September to December 2023, using historical data from August 2021 to July 2022.

2.4. Research Procedure

The research method used in this study is quantitative research. According to V. Wiratna Sujarweni (2014:39), quantitative research is a type of research that generates findings that can be achieved through statistical procedures or other quantification methods. This research consists of five stages, as presented in the following figure:

ISSN 2029-0454
2023

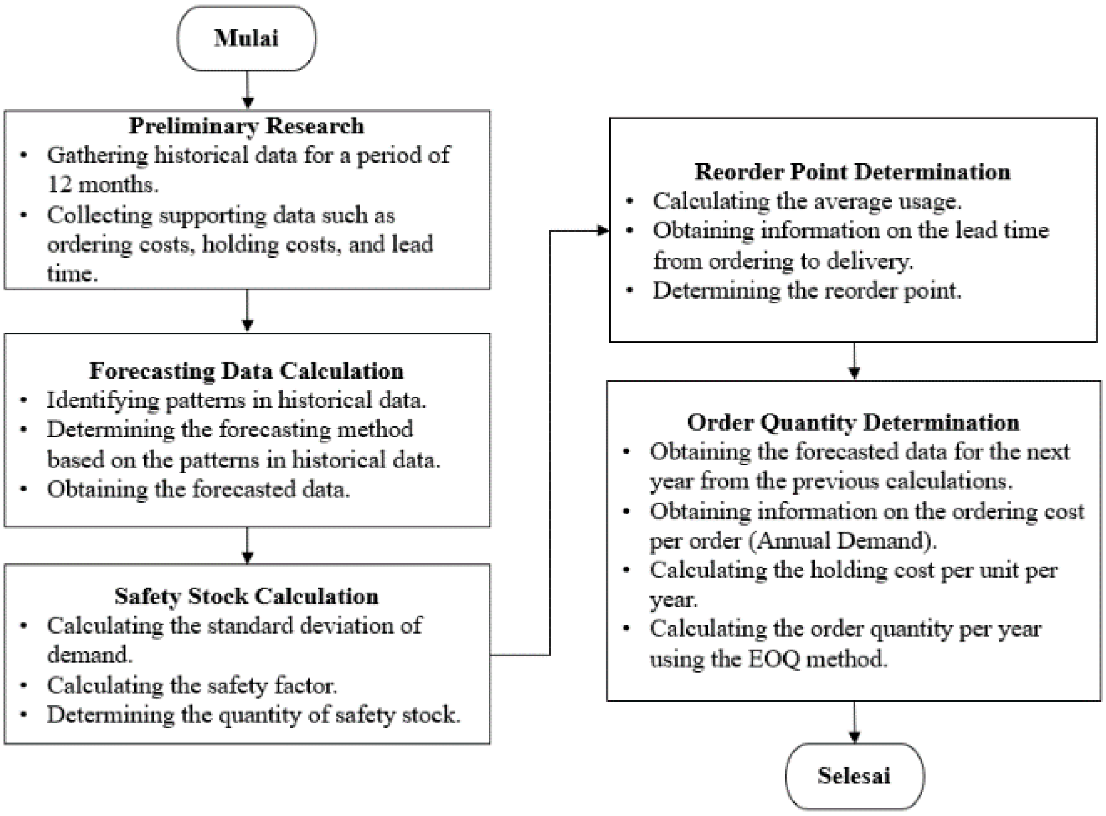

Figure 2. Flow Research Process

1. Preliminary Research
2. Determination of a forecasting method that is suitable for the data pattern and obtaining the most accurate forecasted data.
3. Finding the appropriate amount of Safety Stock.
4. Determining the reorder point that is suitable.
5. Calculating the order quantity using the Economic Order Quantity (EOQ) method.

3. Results

3.1. Basic Literature Study

According to Wiradi (Hadiyanto and Makinuddin, 2006), analysis is an activity that involves sorting, analyzing, distinguishing, classifying, and grouping things based on certain criteria, and then seeking meaning and their respective relationships.

According to the Kamus Besar Bahasa Indonesia (KBBI), "karung" refers to a large coarse sack made of jute or other materials used for storing rice or other goods. "Goni" refers to the fiber derived from plants used for making sacks and similar products. Based on these definitions, it is clear that a "karung" is made from "goni." However, the meaning of "karung" has expanded over time and is no longer limited to coarse jute material but has evolved to include various materials. The changing era has led to innovations in product development, and "karung" is one of the products that has undergone a revolution.

According to Jacobs and Chase (2016), inventory refers to the stock of goods or resources used in a company for production and operational activities. Typically, inventory represents the largest asset on the balance sheet that is difficult to convert into cash, and therefore, companies strive to maintain low inventory levels as much as possible.

Heizer & Render (2015) state that, the objective of inventory management is to strike a balance between inventory investment and customer satisfaction. Inventory can serve various functions that are expected to enhance the operational flexibility of a company. The following are the functions of inventory according to Heizer & Render:

1. Providing more product options: Inventory is intended to anticipate customer demand and help the company avoid demand uncertainty by offering a greater variety of products.
2. Separating various stages of the production process: If the company's inventory is subject to uncertainty, additional inventory may be required to separate production from suppliers.
3. Taking advantage of quantity discounts: Purchasing in large quantities can reduce the cost of shipping goods, allowing the company to benefit from volume discounts.
4. Avoiding high inflation and price increases: By maintaining inventory, the company can mitigate the impact of high inflation and price hikes.

To fulfill the functions of inventory, Heizer and Render (2015) classify inventory into four types:

1. Raw material inventory: This includes materials that have been purchased but not yet processed. Raw material inventory can be used to separate suppliers from the production process, thereby eliminating supplier variations in quality, quantity, and delivery time.
2. Work in process inventory: This consists of components or raw materials that have been processed but are not yet finished. Work in process inventory exists because a product takes time to be completed.
3. Maintenance, Repair, and Operating (MRO) inventory: This type of inventory is necessary for the maintenance, repair, and operation of the production process. MRO inventory requires planning as the timing for maintenance and repairs is uncertain.Finished goods inventory: This inventory comprises products that have been completed in the production process and are stored in the company's warehouse. Finished goods are included in inventory due to fluctuations in consumer demand over an unknown period of time.

Stock cost, according to Heizer and Render (2014), are costs that arise due to the existence of inventory. The following are the cost components associated with inventory:

1. Holding cost: Holding cost refers to the cost associated with storing inventory over a specific period of time. It includes costs such as warehousing costs, inventory insurance, depreciation, obsolescence, and any other costs related to storing inventory.

2. Ordering cost: Ordering cost arises during the ordering process. It includes administrative costs related to placing orders, such as paperwork, order processing, communication, and any other costs associated with the ordering process.
3. Setup cost: Setup cost is the cost incurred to prepare machines or processes for production. It is applicable when a company produces its own components or goods. Setup costs can include costs associated with cleaning, adjusting, or maintaining production equipment before starting a new production run.

These cost components are important considerations in inventory management, as they directly impact the overall cost and profitability of maintaining inventory levels. Efficient management of these costs is essential to optimize inventory levels and minimize associated expenses.

The purpose of companies implementing inventory control is as follows (Faizal Eka Santria, 2010):

1. Striving to make planned objectives a reality.
2. Ensuring that work execution aligns with issued instructions.
3. Identifying weaknesses and difficulties encountered in plan implementation.

Based on the above information, it can be concluded that the purpose of inventory control is to ensure the availability of inventory at an optimal level to facilitate smooth production with minimal inventory costs.

The determination of inventory levels can be done using two systems (Yonasfiko Hendratmiko, 2010):

1. Periodic System: This involves physically counting the inventory at the end of each period to determine the exact quantity of ending inventory.
2. Book Inventory or Perpetual Book Inventory: In this system, inventory administration is maintained through accurate records. Every inventory change resulting from purchases or sales is recorded in the inventory records. With this method, physical inventory counts are typically conducted at least once a year for the purpose of cross-checking the physical inventory with the records in the inventory administration system.

The Economic Order Quantity (EOQ) is a inventory management model used to determine the order quantity that minimizes both inventory holding costs and ordering costs (Mieke Adiyastri, 2013). The EOQ model is a technique that aims to minimize the total cost of ordering and holding inventory. Most inventory literature states that the EOQ model is easy to apply when certain assumptions are met, which include the following (Agus Ristono, 2009):

1. Only one item is considered.
2. The demand rate is known.
3. The lead time for replenishment is known and constant.
4. There are no stockouts or backorders.
5. The warehouse capacity and capital are sufficient to accommodate and purchase the order.

6. There are no quantity discounts.
7. The costs considered are the ordering costs and holding costs.

The objective of the EOQ method is to determine the economic order quantity for each order in order to minimize the total inventory cost. Each order incurs two types of costs: ordering costs and holding costs. The EOQ method calculates the order quantity by considering the ordering cost (TOC) and holding cost (THC). The relationship between the order quantity and these costs is determined by the following formula:

Explanation:

TC = Total Cost (Total inventory cost)
THC = H = Holding cost per unit per year
D = Demand quantity per period
Q = Order quantity per order
TOC = S = Ordering cost per order

To determine the most economical order quantity, which minimizes the total inventory cost, it is required that the total ordering cost is equal to the total holding cost (TOC = THC).

Safety stock refers to additional inventory held by a company to prevent material shortages (Aldiprawiro, 2015). Safety stock is necessary to anticipate unexpected surges in demand. Safety stock is held to protect against the possibility of stockouts. The purpose of maintaining safety stock is to mitigate the risk of stockouts and ensure uninterrupted production. The establishment of safety stock helps to reduce losses incurred due to stockouts, but it also increases carrying costs. The reduction in costs or losses incurred by the company is equal to the product of the quantity of safety stock held to mitigate stockouts and the stockout cost per unit. Therefore, safety stock is implemented to prevent disruptions in the production process caused by uncertainties in the availability and delays of raw materials due to unforeseen circumstances. Safety stock is a permanent inventory, and therefore, minimum raw material inventory is included in the asset group.

According to Iqra Wardani (2014), the factors that influence the size of safety stock for raw materials are as follows:

1. Average material usage: Estimating the average usage of raw materials during a specific period, particularly during the ordering period, based on previous data.
2. Lead time: There is a significant time gap between placing an order for replenishing inventory and receiving the ordered goods. Safety stock ensures that production runs smoothly by preventing delays.

Reorder Point (ROP) is the point at which a company or business institution needs to place an order for goods or materials to maintain controlled inventory levels (Fahmi, 2016). Before the inventory is depleted, the company needs to initiate a reorder. The reorder point is determined by the minimum level of raw material inventory plus the usage during the lead time. The Reorder Point System indicates the level of inventory at which a reorder should be placed. Simple inventory models assume that the company will wait until the inventory level reaches zero before ordering again, and instant delivery is assumed.

Lead Time refers to the duration between placing an order and the arrival of the ordered raw materials (Slamet, 2015).

The advantages of the Economic Order Quantity (EOQ) model are as follows:

1. Optimal purchase quantity: The company can determine the optimal quantity of raw material purchases, allowing for accurate budget planning.
2. Continuous production: The production process can continue without the risk of raw material shortages due to the presence of safety stock.
3. Order timing: The company can determine when to place orders for raw materials, ensuring that production is not hindered by material shortages.
4. Reduced capital investment: Excessive investment in raw material inventory can be reduced.

The disadvantages of EOQ faced by companies are:

1. Insufficient data availability: Obtaining the necessary data often requires additional costs for data collection.
2. Changing material usage and costs: Fluctuations in material usage and costs require recalculating the EOQ.
3. Seasonal demand variations: EOQ is not suitable for scenarios with strong seasonal variations in demand.

The graph of the Economic Order Quantity (EOQ) model is shown in Figure 2.

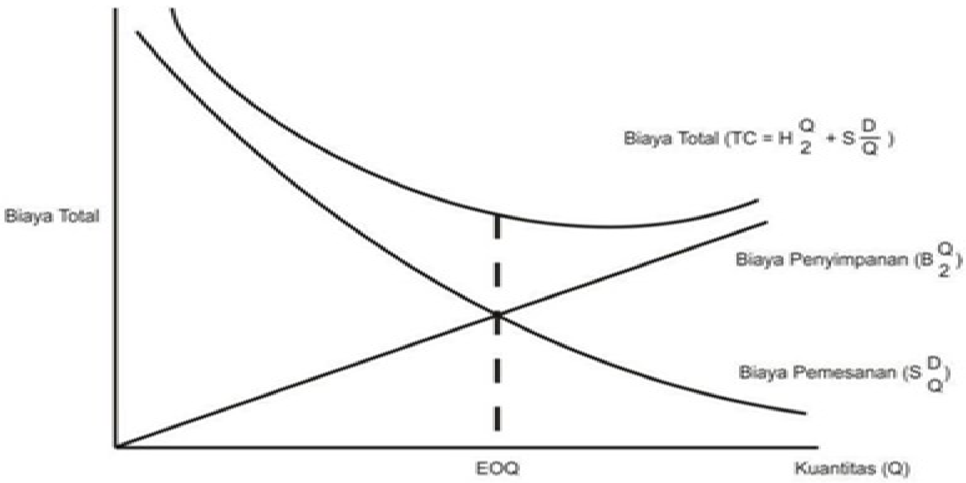

Figure 3 Graphic model stock using method EOQ

Based on the image, it can be concluded that it is visible that the company can place an order when the inventory of raw materials reaches D units, which is when the inventory is just sufficient for usage during the lead time. An order of E units arrives when the inventory is already depleted. The assumption of EOQ is constant, so there is no shortage of inventory due to increased usage of raw materials or delayed arrival of raw materials.

3.2 Collection of Supporting Research Data

A. Historical data on the usage of sacks for 12 months.

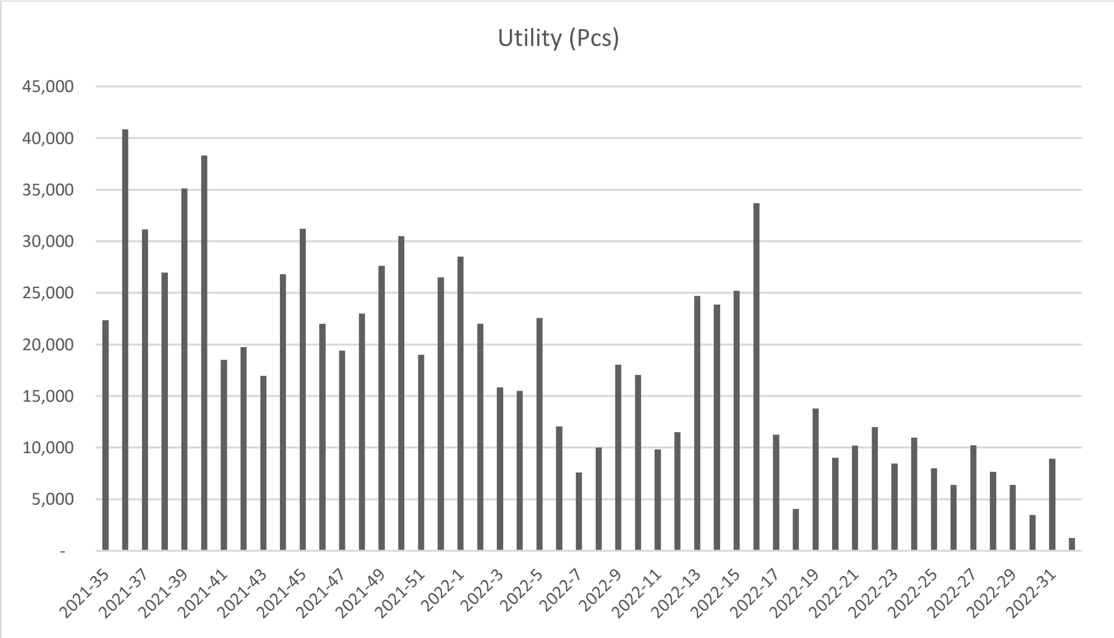

Figure 4 Graphic utility sack.

B. Ordering Cost

The ordering cost for a single order of printed jute sacks is Rp. 500,000. This cost includes administrative ordering fees as well as delivery fees from the supplier to our location as a consumer.

C. Holding Cost

The holding cost for a single order of printed jute sacks is Rp. 500,000. This cost includes administrative ordering fees as well as delivery fees from the supplier to our location as a consumer. The dimensions of one sack are as follows: length 130 cm ≈ 1.3 m, width 90 cm ≈ 0.9 m, and height 2 mm ≈ 0.002 m, making its volume 0.00234 m3. The storage cost per year is Rp. 11,111/m3/year, and since we use only 0.00234 m3 for each sack, the cost per unit per year is Rp. 26.

D. Lead Time

The process of purchasing printed jute sacks follows the following flow: From the Order Submission process to receiving the goods, it takes an average of 3 weeks or 21 days. Therefore, the lead time is 3 weeks or 21 days.

3.3. Calculating Data Forecast

A. Identification Historical Data

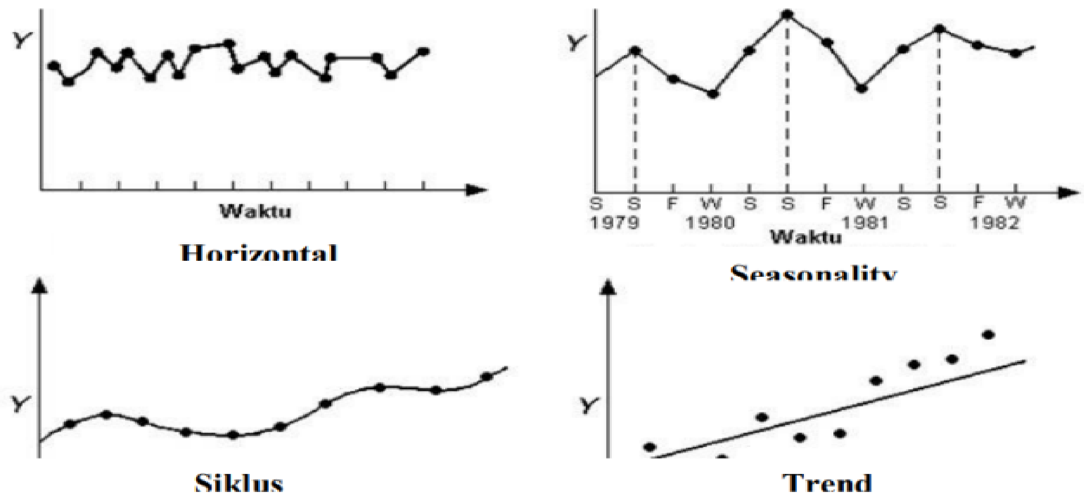

Figure 5 type of historical data.

There are four types of historical data patterns:

1. Horizontal (H) pattern, also known as stationary, occurs when the data values fluctuate around a stable or constant mean value.
2. Seasonal (S) pattern occurs when the data follows a repeating pattern after a certain period, such as daily, weekly, monthly, quarterly, or yearly cycles.
3. Cycles (C) pattern refers to long-term economic fluctuations that occur over several years, often influenced by business cycles.
4. Trend (T) pattern occurs when there is a gradual increase or decrease in the data over an extended period of time.

Based on the historical data of jute sack usage over 12 months or 52 weeks, if depicted in a graph as shown in Figure 5, it can be concluded that the data pattern for printed jute sack usage is a trend without seasonality.

3.4. Determining Forecasting Methods Based on Historical Data

The next step is to choose the forecasting technique that will be most effective once we have established that the printed burlap sack spending data pattern is a trend without seasonality. I use table 3 from the book "Supply Chain Management Strategy, Planning, and Operation" (Chopra, Sunil, & Meindl: 2016) to determine the approach, as follows:

Forecasting Method	Data Pattern to be Applied
Moving Avergae	No trend or seasonal
Simple exponential smoothing	No trend or seasonality
Holts	With trend without seasonality
Winters	With trend and seasonality

Based on the above table, the forecasting method I will use is Holt's method, as it can handle data with a trend but without seasonality.

3.5 Forecasting for next one year

Holt smoothes the trend value with different parameters from the parameters used in smoothing the original data. The formulas used in the double exponential smoothing method of Holt can be seen in the following equations:
The value of Single exponential smoothing can be determined based on equation (1).

$S'_t = \propto X_t + (1-\propto)(S'_{t-1} + b_{t-1})$ (1)

The value of trend smoothing can be determined based on equation (2).

$b_t = \gamma(S'_t - S'_{t-1}) + (1-\gamma)(b_{t-1})$ (2)

Equation can be used to determine the forecast value.(3)

$F_{t-m} = S'_t + b_t m$ (3)

The forecast value can be determined based on equation (3).
Where:

S'_t : Single exponential smoothing value for period t
S'_{t-1} : Single exponential smoothing value for period t-1
$\propto$: Exponential smoothing parameter (0<α<1)
X_t : Actual data for period t
b_t : Trend smoothing value for period t
b_{t-1} : Trend smoothing value for period t-1
γ : Trend smoothing parameter (0<γ<1)
m : Forecasted future period
F_{t+m} : Forecast value for (t+m) periods ahead

The Holt's forecasting method requires an initialization process with two estimates, S_1 and b_1. The initialization process starts with the estimate $S_1 = X_1$ while the estimate $b_1 = X_2 - X_1$.

he forecasting constants α and γ in this method act as weighting factors. The values of α and γ determine how much the latest observation influences the forecast value. If α and γ approach zero, the latest forecast will be very similar to the previous forecast. Conversely, if α and γ have values close to one, the forecast results will have a significant adjustment compared to the previous forecast.

Table 1 Data Forecast

Per	Actual data	S. Exponential	S. Trend	Forecast
0				
1	22950	22950	21650	
2	44600	44600	21650	44600.00
3	22350	35520	12431	66250.00
4	40850	42980.3	10939.79	47951.00
5	31150	37981.027	6158.0711	53920.09
6	26950	32106.72943	2548.360499	44139.10
7	35100	34966.52698	2641.791614	34655.09

Per	Actual data	S. Exponential	S. Trend	Forecast
8	38300	38092.49558	2787.044709	37608.32
9	18500	25213.86209	-1912.658751	40879.54
10	19750	20815.361	-2658.411451	23301.20
11	16950	17312.08486	-2911.870857	18156.95
12	26800	23080.0642	-307.9157983	14400.21
13	31200	28671.64452	1461.933037	22772.15
14	22000	24440.07327	-246.1182504	30133.58
15	19400	20838.18651	-1252.848804	24193.96
16	23000	21975.60131	-535.7697212	19585.34
17	27600	25751.94948	757.8656451	21439.83
18	30500	29302.94454	1595.804469	26509.82
19	19000	22569.6247	-902.9328218	30898.75
20	26500	25050.00756	112.0618834	21666.69
21	28500	27498.62083	813.0272995	25162.07
22	22000	23893.49444	-512.4188086	28311.65
23	15850	18109.32269	-2093.944691	23381.08
24	15500	15654.6134	-2202.174071	16015.38
25	22550	19820.7318	-291.6863299	13452.44
26	12050	14293.71364	-1862.285878	19529.05
27	7600	9049.428329	-2876.885708	12431.43
28	10000	8851.762786	-2073.119659	6172.54
29	18050	14668.59294	293.8652846	6778.64
30	17050	16423.73747	732.2490578	14962.46
31	9837	12032.69596	-804.7381124	17155.99
32	11499	11417.68735	-747.8192598	11227.96
33	24704	20493.76043	2199.34844	10669.87
34	23850	23502.93266	2442.295578	22693.11
35	25207	25428.46847	2287.267648	25945.23
36	33700	31904.72084	3543.963063	27715.74
37	11250	18509.60517	-1537.760556	35448.68
38	4050	7926.553384	-4251.347925	16971.84
39	13800	10762.56164	-2125.141071	3675.21
40	9020	8905.22617	-2044.79939	8637.42
41	10180	9184.128034	-1347.689014	6860.43
42	11993	10746.03171	-474.8112082	7836.44
43	8450	8996.366149	-857.2675127	10271.22
44	10959	10113.02959	-265.0882264	8139.10
45	7989	8546.682409	-655.465913	9847.94
46	6371	6827.064949	-974.7113772	7891.22
47	10213	8904.806072	-58.97562727	5852.35
48	7639	8001.049133	-312.4100206	8845.83
49	6376	6769.791734	-588.0642342	7688.64
50	3482	4291.91825	-1155.007009	6181.73
51	8932	7193.473372	61.9616303	3136.91
52	1247	3049.530501	1286.556003	7255.44
53			1815.448352	4336.09
54			1270.813846	4864.98
55			889.5696925	4320.34
56			622.6987848	3939.10
57			435.8891493	3672.23
58			305.1224045	3485.42

Per	Actual data	S. Exponential	S. Trend	Forecast
59			213.5856832	3354.65
60			149.5099782	3263.12
61			104.6569848	3199.04
62			73.25988933	3154.19
63			51.28192253	3122.79
64			35.89734577	3100.81
65			25.12814204	3085.43
66			17.58969943	3074.66
67			12.3127896	3067.12
68			8.61895272	3061.84
69			6.033266904	3058.15
70			4.223286833	3055.56
71			2.956300783	3053.75
72			2.069410548	3052.49
73			1.448587384	3051.60
74			1.014011169	3050.98
75			0.709807818	3050.54
76			0.496865473	3050.24
77			0.347805831	3050.03
78			0.243464082	3049.88
79			0.170424857	3049.77
80			0.1192974	3049.70
81			0.08350818	3049.65
82			0.058455726	3049.61
83			0.040919008	3049.59
84			0.028643306	3049.57
85			0.020050314	3049.56
86			0.01403522	3049.55
87			0.009824654	3049.54
88			0.006877258	3049.54
89			0.00481408	3049.54
90			0.003369856	3049.54
91			0.002358899	3049.53
92			0.00165123	3049.53
93			0.001155861	3049.53
94			0.000809102	3049.53
95			0.000566372	3049.53
96			0.00039646	3049.53
97			0.000277522	3049.53
98			0.000194266	3049.53
99			0.000135986	3049.53
100			0.000095190	3049.53
101			0.000066633	3049.53
102			0.000046643	3049.53
103			0.000032650	3049.53
104			0.000022855	3049.53
total forecast				165913.64

After performing the calculations, it can be determined that the forecasted value for one year ahead is 165,914 units.

Safety Stock Calculation

a) Lilliefors Normality Test

Before calculating the Safety Stock (SS), the author must first ensure whether the data is normally distributed or not. To do so, the author performs the Lilliefors Normality Test to examine whether the demand data values are normally distributed or not in a single dataset. The Lilliefors Normality Test is similar to the Kolmogorov-Smirnov test, but it uses the Lilliefors table instead.

The steps for conducting the Lilliefors Normality Test are as follows:

1. Sort the data (xi) from the smallest to the largest.
2. Transform the observations x_1, x_2, ..., x_i into standard scores z_1, z_2, ..., z_i using the formula (4) as follows:

$$z_i = \frac{x_i - \hat{x}}{\sigma} \quad (4)$$

Where $\bar{x}$ and σ are the sample mean and standard deviation, respectively.

3. Determine the critical values z (z_{tabel}) by referring to the standard normal distribution table. Calculate the probability F(z) = P(z ≤ z_i) where if zi is negative, then F(z_i) = 0,5 - z_{tabel}, and if zi is positive, then.

$$F(z_i) = 0,5 + z_{tabe} \quad (5)$$

4. Calculate S(z_i) which is the proportion of each zi using the following formula:

$$S(z_i) = \frac{banyaknya\ z_{1,}z_2z_3,\ldots,z_n\ yang \le z_i}{n} \quad (6)$$

5. Calculate the absolute difference between F(z_i)-S(z_i)
6. Take the maximum value among these absolute differences, which is called $L_{\text{calculate}}$. When making a decision, compare $L_{\text{calculate}}$ with the critical value in the Lilliefors test critical value table at a significance level of α = 1%
7. If the data is proven to be normally distributed, show that $Liliefors$ ≤ Lilliefors Table Z.

Table 2 Liliefors test

n \ α	0.01	0.05	0.10	0.15	0.20
4	0.417	0.381	0.352	0.319	0.300
5	0.405	0.337	0.315	0.299	0.285
6	0.364	0.319	0.294	0.277	0.265
7	0.348	0.300	0.276	0.258	0.247
8	0.331	0.285	0.261	0.244	0.233
9	0.311	0.271	0.249	0.233	0.223
10	0.294	0.258	0.239	0.224	0.215
11	0.284	0.249	0.230	0.217	0.206
12	0.275	0.242	0.223	0.212	0.199
13	0.268	0.234	0.214	0.202	0.190
14	0.261	0.227	0.207	0.194	0.183
15	0.257	0.220	0.201	0.187	0.177
16	0.250	0.213	0.195	0.182	0.173
17	0.245	0.206	0.189	0.177	0.169
18	0.239	0.200	0.184	0.173	0.166
19	0.235	0.195	0.179	0.169	0.163
20	0.231	0.190	0.174	0.166	0.160
25	0.203	0.180	0.165	0.153	0.149
30	0.187	0.161	0.144	0.136	0.131
OVER 30	$\frac{1.031}{\sqrt{n}}$	$\frac{0.886}{\sqrt{n}}$	$\frac{0.805}{\sqrt{n}}$	$\frac{0.768}{\sqrt{n}}$	$\frac{0.736}{\sqrt{n}}$

ISSN 2029-0454
2023

b) Calculation the Lilliefors normality test on demand data for Sack

After understanding the steps to perform the Lilliefors Normality Test mentioned above, here is the table of the calculation results for the Lilliefors Normality Test on the demand data for Karung Goni.

Tabel 3. Calculation table for Liliefors Normality Test on Sack demand data.

Periode	Actual data	Zi	F(z)	S(z)	|F(z)-S(z)|
1	1247	-1.7199	0.0427	0.0192	0.0235
2	3482	-1.4999	0.0668	0.0385	0.0284
3	4050	-1.4440	0.0744	0.0577	0.0167
4	6371	-1.2155	0.1121	0.0769	0.0352
5	6376	-1.2150	0.1122	0.0962	0.0160
6	7600	-1.0945	0.1369	0.1154	0.0215
7	7639	-1.0907	0.1377	0.1346	0.0031
8	7989	-1.0562	0.1454	0.1538	0.0084
9	8450	-1.0108	0.1561	0.1731	0.0170
10	8932	-0.9634	0.1677	0.1923	0.0246
11	9020	-0.9547	0.1699	0.2115	0.0417
12	9837	-0.8743	0.1910	0.2308	0.0398
13	10000	-0.8582	0.1954	0.2500	0.0546
14	10180	-0.8405	0.2003	0.2692	0.0689
15	10213	-0.8373	0.2012	0.2885	0.0872
16	10959	-0.7638	0.2225	0.3077	0.0852
17	11250	-0.7352	0.2311	0.3269	0.0958
18	11499	-0.7107	0.2386	0.3462	0.1075
19	11993	-0.6620	0.2540	0.3654	0.1114
20	12050	-0.6564	0.2558	0.3846	**0.1288**
21	13800	-0.4842	0.3141	0.4038	0.0897
22	15500	-0.3168	0.3757	0.4231	0.0474
23	15850	-0.2824	0.3888	0.4423	0.0535
24	16950	-0.1741	0.4309	0.4615	0.0306
25	17050	-0.1642	0.4348	0.4808	0.0460
26	18050	-0.0658	0.4738	0.5000	0.0262
27	18500	-0.0215	0.4914	0.5192	0.0278
28	19000	0.0277	0.5111	0.5385	0.0274
29	19400	0.0671	0.5268	0.5577	0.0309
30	19750	0.1016	0.5405	0.5769	0.0365
31	22000	0.3231	0.6267	0.5962	0.0305
32	22000	0.3231	0.6267	0.6154	0.0113
33	22350	0.3575	0.6396	0.6346	0.0050
34	22550	0.3772	0.6470	0.6538	0.0069
35	22950	0.4166	0.6615	0.6731	0.0116
36	23000	0.4215	0.6633	0.6923	0.0290
37	23850	0.5052	0.6933	0.7115	0.0183
38	24704	0.5892	0.7222	0.7308	0.0086
39	25207	0.6388	0.7385	0.7500	0.0115

Periode	Actual data	Zi	F(z)	S(z)	|F(z)-S(z)|
40	26500	0.7660	0.7782	0.7692	0.0089
41	26800	0.7956	0.7869	0.7885	0.0016
42	26950	0.8103	0.7911	0.8077	0.0166
43	27600	0.8743	0.8090	0.8269	0.0179
44	28500	0.9629	0.8322	0.8462	0.0139
45	30500	1.1598	0.8769	0.8654	0.0116
46	31150	1.2238	0.8895	0.8846	0.0049
47	31200	1.2287	0.8904	0.9038	0.0134
48	33700	1.4748	0.9299	0.9231	0.0068
49	35100	1.6126	0.9466	0.9423	0.0043
50	38300	1.9277	0.9731	0.9615	0.0115
51	40850	2.1787	0.9853	0.9808	0.0046
52	44600	2.5478	0.9946	1.0000	0.0054

After obtaining the calculation results above, the analysis of the calculation is as follows.

Table 10. data of the normalcy test for printed burlap sacks: Analysis of the data.

Notasi	Variabel
Total	973348
Average	18718.23
Standard dev	10158.35
Liliefors Calculation	0.1288
Confidence level	0.01
Liliefors	1.031
Liliefors Tabel	0.142974

It is evident from the preceding table that Lcount = Ltable, or 0.1288 0.142974, demonstrating a regularly distributed demand for printed gunny sacks.

The lead time information is not provided by the author, but according to information from local employees, it always takes exactly 3 weeks from the moment a request is placed until the item is delivered.

c) FormulationStupid Stock

In Indonesian, safety stock is another word for the quantity of inventory required to guard against errors in anticipating demand during lead time (waiting time).

The formula below can be used to determine savety stock:

$$SS = Z \times Sdl \qquad (7)$$

With,

SS : Savety Stock

Z : Correlation value with service level what the company wants

Sdl : Standard deviation of requests duringlead time

$$S_{dl} = \sqrt{d^2 \times S_l^2 + l + S_d^2} \qquad (8)$$

Depending on the kind of the request and lead time, whether it is variable or constant, different formulae may be used on the equation to estimate the Standard deviation of demand during lead time (Sdl). The formula "Savety Stock" is used in the following equation for the variables "Request" and "Lead Time":
This is crucial if demand is erratic and lead time is consistent.Apply the following equation to the Savety Stock determined by the demand uncertainty:

$S_{dl} = S_d \times \sqrt{l}$ (9)

This is significant if lead time is variable and demand is constant.Use the following equation to determine the Savety Stock given the uncertainty lead time:

$S_{dl} = S_l \times d$ *(10)*

With

S_{dl} : Standard deviation of requests during*lead time*

d : Average requests per period

S_l : Standard deviation*lead time*

l : Rat-rat*lead time*

S_d : Standard deviation*Demand* (request)

The writer will utilize equation (9) to calculate the standard deviation of demand during lead time (Sdl) based on the data that the author receives, which shows that requests are variable and lead time is constant.

d) Estimating the Savings Stock

The following is how the writer continues to calculate Savety Stock using a Z value that correlates with 99% after finding the equation that accurately represents the facts.

$$SS = Z \times S_{dl}$$
$$SS = Z \times (S_d \times \sqrt{l})$$
$$SS = 2{,}326 \times (10158{,}35 \times \sqrt{3})$$
$$SS = 40391{,}59 \approx 40.392$$

It can be inferred that 40,392 printed gunny sacks constitute the necessary savety stock.

3.7 Choosing the reorder point

Reorder point (ROP), also known as the number of stocks that will be reordered to prevent emptying a raw material, is determined. The author uses the following equation to compute ROP.

$ROP = d \times l + SS$ (11)

With	

ROP:Reorder Point

SS : Savety Stock

l : Average lead time

d : Average requests our period

Equation (11) above can be used to determine ROP in the manner shown below.

$$ROP = d \times l + SS$$
$$ROP = 3{,}191 \times 3 + 40{,}392$$

$ROP =$ 49,965

It follows that the Company will place orders once more when its inventory reaches 49,965.

3.8 Calculation of the quantity of orders

a) Obtain projections for the upcoming year.Using the Holts forecasting approach, calculations were performed to acquire the forecasting data.

b) Obtain pricing information for each order (Annual Demand).

The writer paid a local employee for the expense of this communication.

c) estimating annual storage costs per unit The cost of leasing land and buildings per cubic meter per year and the volume we will use for storage are then divided to determine the cost of storage per unit per year.

d) Using the EOQ method to determine the annual amount of orders

Based on the third version of the Supply Chain Management book by Mahendarwathi Er, S.T., M.Sc., Ph.D. and Prof. Ir. I Nyoman Pujawan, M.Eng. According to the author, EOQ is a technique for calculating the ideal number of orders while ensuring that both ordering costs and holding costs are kept to a minimum.

You can utilize equation (12) to determine EOQ:(12)

With,

Q is the ideal order size.

Cb = message fee, and

h = annual holding costs for each unit.

D = The quantity of requests

in the case

$$Q = \sqrt{\left(\frac{(2)(500{,}000)(165{,}914)}{(26)}\right)} = \sqrt{6{,}381{,}307{,}692.30}$$

$$= 79{,}883.09$$

Q = 80,000

The optimal amount of orders per message, according to the computation above, is 80,000 units.

4. Conclusion

The basis for data analysis is Analysis:

1. The suitability of forecasting techniques The Holts approach, with 165,914 unit projections for the following year, is the forecasting technique that best matches the data pattern.
2. Determine the quantitySavings in Stock AmountThe computed value of Savety Stock is 40.392 units. It follows that a 40,392 unit inventory is advised in order to account for demand unpredictability.Mendapatkan titik pemesanan kembali (*Reorder Point*)

3. The author determined a reorder point of 96,549 units. This indicates that it is preferable to place a new order or recalculate the number to be ordered in the future if there are 96,549 units still available.Menentukan jumlah pemesanan yang sesuai dengam menggunakan metode *Economic order quantity* (EOQ)
4. The total number of orders, as determined by the EOQ approach, is 80,000 units. Accordingly, 80,000 units are the number of orders with the lowest ordering costs and holding expenses.

Bibliography

Supply Chain Management, Third Edition, Yogyakarta: Publisher Andi, 2017. Pujawan, N., and Er, M.

Analysis of Raw Material Inventory Control for Deflector Axel Counter Products Utilizing the Economic Order Quantity (Eoq) and Economic Order Interval (Eoi) Methods at Pt. Bandung Main Engineering Smart, Fatima N.S. 2022.Bandung. Islamic University of Nusantara

Testing of Analysis Requirements (homogeneity and normality tests) Usmadi.2020. 50–62 in Educational Innovation, Vol. 7, No. 1

Application of the Eoq Method for Inventory Control of Wheat Flour Raw Materials, Wahyuningtyas E. 2017. Kediri. UPN PGRI (UNIVERSITY OF THE NUSANTARA)

Application of Forecasting Methods on Roof Demand at Pt X. Lusiana A, Yuliarty P. 2020. ITN Malang's Innovative Industry: Journal of Industrial Engineering, March 2020, pages 11–20

Inventory System for Dispersant Products in the Chemical Industry, Kushardini D, Almahdy I. 217–234 in Volume X No. 2 of the PASTI Journal

Purnamasari I, Yuniarti D, and Hapsari HDP.(Case Study: CPI Data of East Kalimantan Province) Forecasting Using the Double Exponential Smoothing Method and Verifying Forecasting Results Using a Tracking Signal Control Chart. Journal of Mathematics and Applied Sciences, Volume 14 Number 1, Pages 13–22 2013

Normality Test Based on the Anderson-Darling, Cramer-Von Mises, and Lilliefors Methods Using the Bootstrap Method. Fallo JO, Setiawan A, Susanto B. FMIPA UNY Yogyakarta, National Seminar on Mathematics and Mathematics Education, 9 November 2013, 151–158