Developing the Inventory Policies with the application of ABC Categorization: The case of Footware Industry

Muhammad Touseef [1], Abdullah Shahzad [2] and Ijaz Yusuf [3]

[1] Muhammad Youseef MS Industrial Engineering, IQTM, Punjab University, Lahore

[2] Abdullah Shahzad MS Industrial Engineering, IQTM, Punjab University, Lahore

[3] Assistant Professor, Chairman of the Department Operations and Supply Chain Department, Dr. Hasan Murad School of Management, University of Management and Technology, Lahore/Pakistan (Correspoinding Author)

Abstract

This research article leads to developing the strategy for creating inventory policies that is based on the ABC categorization of inventories. A popular technique for classifying inventory items according to their value is the ABC categorization. Organizations can prioritise the resources they devote to managing each sort of inventory by dividing it into categories A, B, and C. With the application of ABC technique, the amount tied up with the inventory holding cost can be significantly reduced while keeping high-value items accessible. With the aim of reducing holding costs while ensuring the availability of high-value items chosen on the basis of ABC cateagorization, this strategy is frequently used to prioritise the resources that an organisation spends managing its inventory. Researchers in the past suggest that using the ABC categorization can be an effective way to find out which products are high-demanding. The problem unders study is the shoe company in Pakistan. Application of ABC analysis with inventory policies according to the A categorization inventory (Min/Max) policy. B-categorization inventory with Q and R policies and C-categorization inventory with periodic review policies. Implementing inventory policies led to a considerable decrease in holding costs, stock-out costs, and overall expenses based on the ABC categorization of inventories. Particularly, costs associated with keeping inventory were reduced by 30%, costs associated with running out of stock were reduced by 45%, and overall expenditures were reduced by 31%. These improvements show how applying the ABC categorization system and the implementation of realistic inventory policies can minimise costs and maintain availability.

Keywords: Holding cost, stockout, ABC Analysis, Inventory policies.

1. Introduction

Inventory management plays a significant role in the supply chain by ordering, storing and supply the inventory according to the demand. This include the management of raw material being used or being ready for sale as a finished good.

One of a company's most valuable assets is its inventory. A company's inputs and finished products are the heart of its business in retail, manufacturing, food services, and other inventory-intensive industries. A lack of inventory when and where it is needed can be disastrous. At the same time, inventory can be considered a liability (if not in an accounting sense). A large inventory is vulnerable to spoilage, theft, damage, or changes in demand. Inventory must be insured, and if it is not sold in a timely manner, it may be salvaged or simply destroyed. (Lwiki et al., 2013)

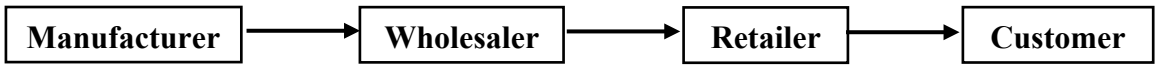
1.1 Aim of Inventory Management

Inventory management aims to

(i) Boost business profitability through better inventory control
(ii) Anticipate how corporate policies can affect stock levels
(iii) Reduce overall logistical costs while still providing for consumer needs.

1.2 Inventory Flow

The passage of goods from manufacturers to warehouses and from distribution centres to retail locations is guided by inventory management as a component. Controlling inventory refers to the efficient administration of supplies, raw materials, semi-finished goods, and final goods.(Ganeshan et al., 2001) To do this there must be a categorization of inventories.



1.3 ABC Analysis

ABC Analysis helps in sectioning inventory into most important to least important sections. A small number of goods account for the majority of yearly material uses. Some of these parts are referred to as "A" parts and play a crucial role in the company. There are many objects with the name "B" and "C," but they are not very important. All materials are divided into three categories for this examination: A, B, and C. based on yearly usage. This enables the Management & Organizations to concentrate on the primary inventory. (D. Annie Rose Nirmala, 2022)

The goal of using ABC-analysis is to rank the positions under consideration and identify those whose contributions to the overall result are the most significant. Positions are classified into three categories: A, B, and C.(Nuzhna et al., 2019) The ABC analysis boils down to the following: The Pareto principle (20/80) is applied, which is commonly stated as "20% of the effort yields 80% of the result" ("vital few and trivial many"). The method allows you to divide the list under study into three groups based on their importance; in other words, the ABC analysis allows you to choose the positions that have the greatest impact on the outcome.(Kvon et al., 2018)

1.4 Inventory Policies

The Inventory Policies define the reorder point of the Inventory. That point may be according to the time or the quantity on hand. It defines when Inventory will be reordered again for fulfilling the demand of the customers. An inventory management system's primary goal is to maintain the stock so that it is neither overstocked nor understocked. Understock will cause operations to cease, and overstock will slow down other manufacturing processes.(Tayur et al., 2012) Inventory management has both operational and economic goals. By using the Inventory Policies, many problems of Inventory can be solved out.

These Policies are used in this Project:

- Continuous Review:
    - Q/R policy based on order quantity and reorder point.
    - Min/Max policy based on minimum and maximum inventory levels
- Periodic Review:
    - T/S policy based on time period and standard order quantity.

1.5 Related Work

Author(s)	Industry	Methodology	Conclusions & Findings
(Kumar, 2017)	Hospitality Sector	ABC Analysis	Liquor, Beverages & Tobacco Inventory was categorized by the ABC Analysis and after that some steps were taken to maintain the Inventory according to the Revenue.
(Jiapeng Liu, 2016)	Universal For All Industries	ABC Analysis; Simulated annealing algorithm	The ABC analysis is frequently used in inventory management and can assist businesses in classifying

			inventory items according to various evaluation criteria.
(S. Nallusamy, 2017)	Automotive Manufacturing Industry	ABC Analysis, Inventory Review Policy	It was discovered that by managing the inventory level for a year, the developed periodic review policy reduced the inventory turnover ratio from 3.15 to 2.13.
(D. Annie Rose Nirmala, 2022)	SRI DEVI SNACKS	ABC Analysis, VED Analysis, EOQ Model	Based on the price and volume of items purchased, an ABC analysis is performed. The Vital, Essential, and Desirable (VED) analysis gives a clear picture of how items are divided into these three categories. The production's Economic Order Quantity was determined by EOQ Model.
(Stanisław Ambroszkiewicz, 2022)	Universal For All Industries	SM-v-Policies	The SM-v policies can outperform policies found as solutions to the severely confined situation, where the maximum vendor's inventory level is equal to the maximum achievable space limit.
(Peter Berling, 2022)	Ecommerce & Mainly Retail Industry	(R, Q) Policies	The computationally effective algorithms that are made to deal with the highly variable customer order sizes, (R, Q) policies at all stock points in real-world one warehouse many retailer inventory systems.
(Abdo Abouelrous, 2022)	Retail Industry	Good–Turing sampling and Linear Programming	In comparison to other Algorithms, the suggested algorithm achieves an average cost reduction of 7.56% in comparison with that are produced at random. Short time horizons and a sizable share of consumers who are in-store benefit greatly from the proposed algorithm.

(Jun-Yeon Lee, 2009)	Universal For All Industries	Periodic Review Inventory System	The challenge of controlling stochastic demand for replenishment in periodic-review inventory systems, where a replenishment order may be fulfilled right away or one period later, based on the likelihood of an extensive endeavour.
(D. Kim, 2022)	Semiconductor Industry	Arena Software Usage & Order-up-to policy	By adopting the order-up-to policy, inventory models may be directly applied to the industrial sector, and they look at how a die bank can be utilized to decrease completed product inventory and boost customer's satisfaction.

1.6 Research Gap

In all Articles, there are inventory Characterization in the past and that is solely based on the Dollar volume which represent the worth of inventory. Moving from single criteria to multiple criteria helps in finding an optimal solution to fulfil multiple objectives. By putting stockout cost and holding cost as an additional cost with the dollar volume helps in maintaining the availability as well reducing the holding cost.

By using this not only the profit will be maximised but also the customer experience will be maximised as it will lower the stockout cost. By using Categorization and policy making side by side helps the inventory manager to track the Stock more effectively.

1.7 Problem Statement

This practical examination of the Pakistani shoe industry is reflected in this paper. The working method in the sector is "make to stock." This industry bases on the storage of materials on the principles of purchasing raw materials and storing them. It ensures the availability but there is overstocking in the storage causing higher inventory cost. There is demand forecasting, but inventory is not being used properly. The more space-consuming inventory is kept in storage. However, it is increasing the industry's holding costs.

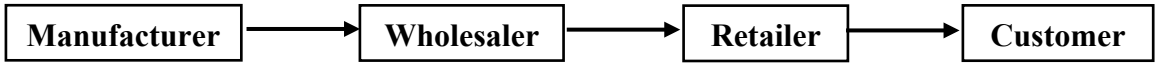
1.8 Our Work

In this article, ABC analysis applied on the forecasted demand and inventory policies are developed. In addition, the most important level of inventory having higher profits is handled with care and stockout is minimised for it while the least important type of inventory referred

to as a C category is reordered periodically. By this work there is a negligible probability of valuable inventory to be overstocked as the holding cost is high for it. Moreover, modelling the inventory consumption throughout for a year clearly depicts the reduction of costs ensuring availability.

1.9 Impact On the Real World

This research is not helpful only for the Manufacturing Industries. This will also play important role in the Whole Supply Chain. Industrialist, Wholesaler & Retailer can stock the Product according to the Demand with Minimizing Holding cost, Stockout Cost and Increased Availability. Ensuring Availability is also ensured in this project. The stockout on any side causes the customer dissatisfaction and customer/ wholesaler might search for some other trustworthy supplier.(Shrouty, 2019) Manufacturer, Wholesaler, Retailer will serve their customers on time by adopting these techniques maintain the inventory bulk up risk on there side.



The importance of this method lies in the fact that it provide an optimal reorder point during inventory consumption after converting policies from periodic review to continuous review. These makes the stockout negligible for the worth items.

2. Methodology

2.1 Available methods

Methods Like HML (consider the unit price of cost as the criteria ignoring the sales value), VED (consider how important an item for an industry), SDE(Bases on the product scarcity in market) is used as an inventory categorization methods but these criteria's belong to certain parameter and not consider all the parameters at once.

2.2 Why ABC analysis

However ABC analysis provide an easiest way to put all the concerned industry cost related criteria's into one variable which is then used in characterization. It is an easiest method of putting all the cost's into a single variable Unlike comparing individually. (Indrasan et al., 2018)Moreover certain biased can be added with the individuals depending upon how important it is. There, ABC Analysis is utilised in order to respond to revenue-related concerns and then create focused future activities based on this circumstance. When using ABC Analysis, it is possible to learn about the necessary raw materials that should be kept in the store to lower the cost of holding inventory.(Kubasakova et al., 2015)

Bases on the final criteria the range of criteria cost is divided by two cut points that divided the cost data to three equal halves where the category A has percentile above 66 percent and Category C have the lowest 33 percent while middle is occupied with the Category B.

Three categories are as follows :

- Category A

  These are the most valuable products of the industry having high dollar volume and the unavailability of it causes a major loss of business. Because of high worth it is handled with care causing high holding cost

- Category B

  These are the middle valued items like it does affect the business but less affective than category A product but more worthy than last category.

- Category C

  These are the least valued products as the demand of these products are less and these product generally don't requires to be reviewed continuously. However these products stockout generally not affect the business greatly.

2.3 Footwear industry Case

This categorization is applied on a subcontract business conducted testing on the suggested inventory management system created for the shoes sector. The business focuses on producing a broad selection of driving or loafer mocks. In terms of the ABC analysis of inventories, the three main material components that make up loafer shoes—cutting the upper, cutting the socks, stitching the upper, stitching the socks, and lasting are categorized as Category A materials because they make up a significant portion of the footwear. The cost of the Category A materials used in the production of loafer shoes for the footwear sector was 17122.63 dollars. As can be seen, however, the total value of inventories as of August 26, 2022, was 22870.82 dollars. This indicates that, excluding additional materials, 74.87% of the total volume of materials purchased went toward the components used to make the shoes. The inventories are barely impacted by the other materials. Their observation is frequently inefficient in terms of both time and money. Only Category A materials are the focus of this research due of this. An overview of the inventories of the input materials for the monitored product was created, taking into account the average monthly purchases and material consumption for August 2022, in order to ascertain the relationship between material purchases and the level of inventories, or to evaluate whether the real inventories correspond to the material consumption. The Given

data of footwear industry is provided and it is characterised based on the criteria cost that is sum of IH(Inventory Holding), SC(stockout cost) and the DV (Dollar volume).

Raw Material Code Number	Unit Price ($)	Yearly Volume	Criteria Cost (IH + SC +DV)	Category
FG-3008	29.32	5395	158181.4	A
FG-3591	23.43	5531	129591.33	A
FG-2003	22.05	5167	113932.35	A
FG-1526	20.52	4839	99296.28	B
FG-1085	15.36	4963	76231.68	B
FG-0797	11.54	5782	66724.28	B
FG-1761	15.27	3763	57461.01	B
FG-1432	28.02	1895	53097.9	B
FG-1438	5.22	4317	22534.74	C
FG-0579	26.09	2154	56197.86	C
FG-3651	28.84	1868	53873.12	C
FG-2009	8.64	3899	33687.36	C
FG-1921	19.39	1918	37190.02	C
FG-7351	10.39	1550	16104.5	C
FG-3925	17.14	1350	23139	C
FG-0873	10.15	1589	16128.35	C
FG-4821	8.12	1404	11400.48	C
FG-3628	7.47	1385	10345.95	C
FG-0271	10.55	1279	13493.45	C
FG-3811	6.19	1404	8690.76	C
FG-0312	5.55	1279	7098.45	C

After the Characterization has been done The policies are designed for the inventories to help the manager in reviewing the products.

2.4 Inventory policies

These policies are described below:

Periodic Review

In this policy Inventory is reviewed after a certain period of time and order is placed to fulfil the maximum inventory level.(Mahadevan et al., 2003)

(T,S) policy

Its T,S policy where T is the period after which you review and S is the order up to level such that Inventory is reviewed after a particular period of time. At that time if the inventory level is less than S it is reordered and it will be delivered after a certain lead time. This type of Inventory policy is used when inventory worth is not too high such that if there is uncertain demand come in the given period which is usually not happened not affect the profit as the stockout cost is less for such product.

The Quantity to be ordered after every period of time is shown below:

Such that if the lead time is L days and daily demand is D

$$Expected\ deman\ in\ lead\ Time = D * L$$

While the order quantity is as below:

$$Order\ Quantity = (Maximum\ inventory\ Level - Inventory\ On\ hand) + D * L$$

In this case S is the maximum inventory level and after the lead time inventory on hand reaches to the level which is around S. This type of review is used where demand is not fluctuating and dollar volume is less.

Continuous Review

In this policy inventory is continuously reviewed and if the inventory falls below a certain point order is placed. This type of inventory policy usually used when the stockout cost is relatively high such that if demand is high for a certain week or a day and supply is not enough to meet the demand then one may loose a large share of business.(Hung, 2016)

This policy is divided into two kinds

- QR policy
- Min/Max Policy

(Q,R) policy

In this policy a certain quantity say Q is ordered when on hand inventory falls below a certain level which is called the Reorder point that are defined in number of units left in the inventory. In this case the Safety stock is the Reorder point minus the demand that may comes during the lead time. After that an order of order quantity Q is placed.

This type of policy is used when stockout price is not low such that it is worthwhile to loose a business and inventory holding cost is comparable to the cost of replenishment. A certain pairs of R and Q is plotted to get the optimal availability maintaining the optimal cost.

Min / Max policy

It is similar to the above policy such that the minimum inventory point here is similar to the reorder point while the order quantity is not Q but random and the point of order it is the difference of on hand inventory like one can do at the ordering time in periodic review policy.

This thing makes the Min/Max policy relatively more dynamic and can handle the worthy products where the stockout is not acceptable at all.

The Quantity to be ordered after the on hand inventory goes below is equal to :

$$Order\ Quantity = (Min_{limit} - On\ hand\ inventory) + (Max_{limit} - Min_{limit})$$

Where the Reorder point can be estimated in both cases as :

$$Reorder\ point = D * L + ss$$

Where SS is the safety stock one can kept and DL is the demand during lead time.

The policy by category is shown below:

	Dollar Volume	Stockout Risk	Holding Cost	Suggested policy	Reviewed
Category A	High	Risk to Business Safety stock must	Percentage of Inventory price	Min/Max Policy	Continuously
Category B	Medium	Low Risk to business	-	Q R policy	Continuously
Category C	Low	No Risk to Business	-	T S policy	periodically

After assigning all the policies its time to check how much these policies helps in reducing the cost therefore stochastic demand that is obtained by demand forecasting is used. The issue here is to model the weekly demand

2.5 Modelling the inventory Consumption

The inventory consumption is being modelled in MATLAB for 52 weeks (A whole year) where the weekly demand is modelled as a normal distribution.

2.5.1 Why Normal Distribution

This issue in inventory control is the statistical description of total demand during the time between placing and receiving an order. Because both demand per unit time and lead time are random variables, the lead time demand distribution is formulated as a mixture. In practise, despite their nonnegativity, one or both components of the mixture are frequently assumed to be normally distributed.(Radasanu, 2016) In practise, this assumption implies that a normal curve truncated at zero is a valid description. Several approximations to the true tail area probabilities are investigated (given truncation). As a result, an improved and simpler expression for the normal-gamma mixture is obtained. There are also some numerical results presented.(J. K. Ord, 2006)

In many Inventory Control system, the demand per unit time is modelled as a normal distribution that can be shown as N(μ , σ) where the μ is the mean demand per unit time while the uncertainties in demand can be shown as σ . Because of its convenient mathematical

properties, the normal distribution is frequently used to model demand. In practise, however, actual customer demand for some products may be better represented by an asymmetric, or skewed, probability distribution. The goal of this paper is to determine the best inventory order quantity and reorder point policies when demand follows a typical PDF. (Cobb, 2013)

The weekly consumption is thus modelled as normal distribution in MATLAB.

$$Weekly\ Demad = N(\mu, \sigma)$$

where

$$\mu = \text{Average Weekly demand} = \frac{\text{Yearly Demand}}{52}$$

$$\sigma = \text{Uncertainty in demand}$$

After modelling the weekly demand a simulation is run for 52 weeks(an year) to check the advantage in the form of cost maintaining the availability.

The pseudo Codes for this policies(Simulation) is shown below:

2.5.2 Pseudo Code of Modelling periodic Vs Continuous Review

Periodic review Algorithm
procedure

YD ← Yearly Demand

PQD ← planned Quarter demand

QOH ← Quantity on hand Initially

LT ← Lead Time to manufacture LOT

WWY ← Working Weeks in year (52)

Initialize YD, PQD, QOH, LT and WWY

FOR weeks in year

QOH ← QOH – N(Average Week Demand , Demand Uncertainty)

Weekday++ % Update the weeks For Quarter

IF Quarter Reached

Order Quantity ← PQD - QOH

QOH(week +LT) ← QOH + Ordered Quantity

Weekday = 1 % Reset the quarter

END

END

Plot QOH Vs Weeks

END PROCEDURE

Continuous Review (QR policy) Algorithm

PROCEDURE

$QOH \leftarrow Quantity\ on\ hand\ initialy$

$SS \leftarrow Safety\ Sotck$

$OQ \leftarrow Order\ Quantity$

$YD \leftarrow Yearly\ Demand$

$LT \leftarrow lead\ time$

$WW \leftarrow Working\ weeks$

$Q \leftarrow Fixed\ Order\ Quantity$

Initialize LT, SS, QOH, YD, OQ, Q

$ROP \leftarrow SS + LT * Expected\ demand\ in\ lead\ time$

While $I <= WW$

QOH ← QOH – N(Average Week Demand , Demand Uncertainty)

$I++$

IF QOH goes below ROP

QOH($I+LT$) ← QOH + Q

END

END

Plot QOH Vs Weeks

END PROCEDURE

Continuous Review MIN/ MAX Algorithm
PROCEDURE

$QOH \leftarrow Quantity\ on\ hand\ initialy$

$SS \leftarrow Safety\ Sotck$

$OQ \leftarrow Order\ Quantity$

$YD \leftarrow Yearly\ Demand$

$LT \leftarrow lead\ time$

$WW \leftarrow Working\ weeks$

$Q \leftarrow Variable\ Order\ Quantity$

$MIN \leftarrow SS + LT * Expected\ demand\ in\ lead\ time$

$MAX \leftarrow Maximum\ Order\ Quantity$

Initialize LT, SS, QOH, YD, OQ, Q,MIN,MAX

While $I <= WW$

QOH ← QOH – N(Average Week Demand , Demand Uncertainty)

$I++$

IF QOH goes below MIN

Q = MAX - QOH

QOH($I+LT$) ← QOH + Q

END

END

Plot QOH Vs Weeks

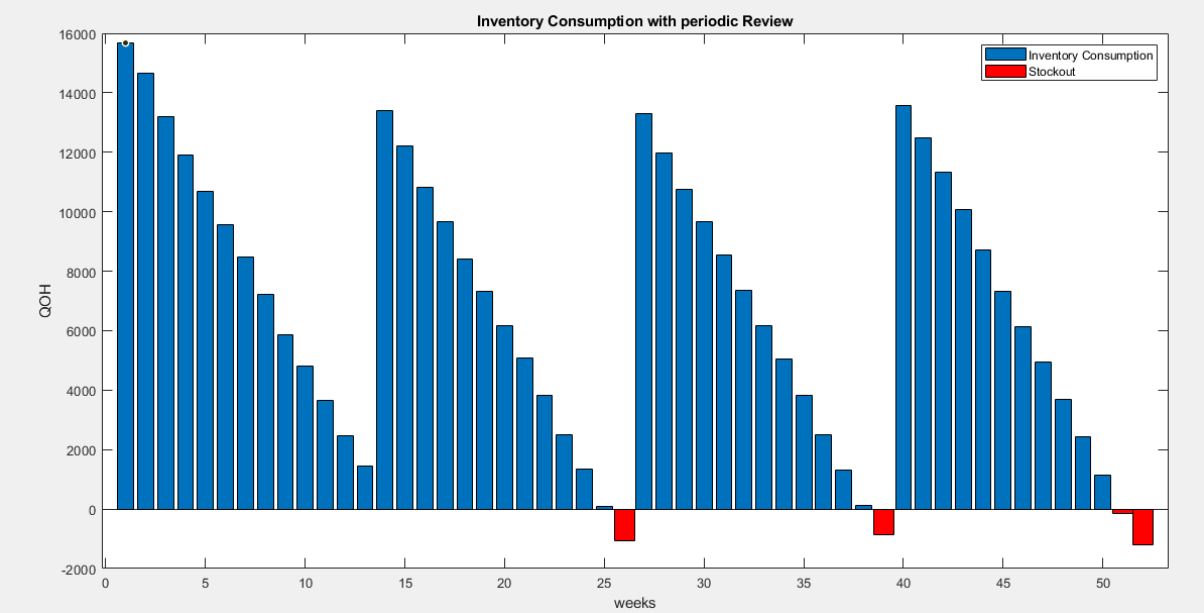
END PROCEDURE

Applying the inventory policies without the above ABC characterization and using the manager perspective leads abnormalities in the system causing the overstocking, losing business, pay less attention to the most valued inventories and vice versa and customer unsatisfaction. These problems will arrive if policies are not applied on categories.

3.Results

3.1 Current Scenario

The Current scenario is all about taking inventory as a single Category and handling it as a periodic review. This thing might make the stockout minimum but may impose a high holding cost to the firm making the profit of the firm less.



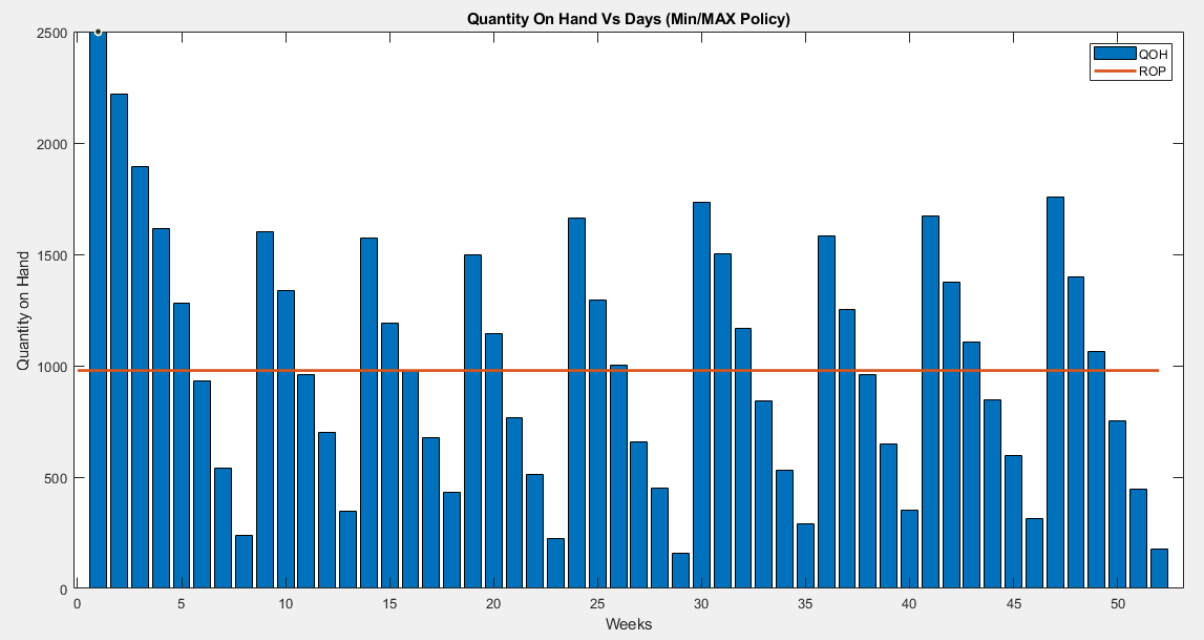
The Goal is to minimize the holding cost keeping the availability as high as possible and restrict the periodic review policy to the less important inventory that is characterized as Category C while the other two categories (A & B) is handled with continuous review policy with an optimal value of QR or Min Max parameter that makes the stockout zero.

3.2 Devised Scenario

The suggested scenario based on categorization and related policies according to the table and there corresponding consumption.

3.2.1 Category A Inventory consumption

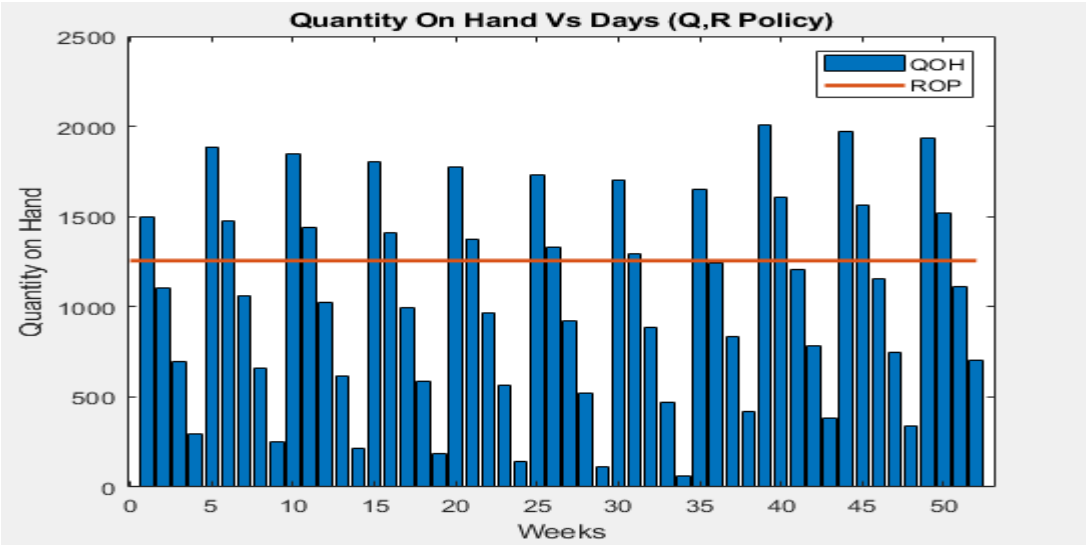
To Determine the inventory Holding cost It is required to estimate the presence of inventories in warehouse for year where weekly demand is estimated with a normal distribution such that mean demand is known for a week but variance shows how uncertain the demand will be and it is shown by MATLAB below:



The graph shows the Quantity on hand vs weeks. Because the cycle time for making new inventory is 3 weeks, whenever inventory falls below the ROP, it will be ordered and restocked after 3 weeks. The graph shows no stockouts, but they could occur if there is an unexpectedly high demand. This is encountered, however, by taking a sufficient variance in weekly demand.

3.2.2 Category B Inventory Consumption

For Category B inventories the process is similar to the Min/Max except the order quantity is not random but fixed. The Weekly demand is normally distributed with mean equal to the estimated yearly demand divided by the number of working years. The Consumption of inventories is shown with the help of MATLAB below:

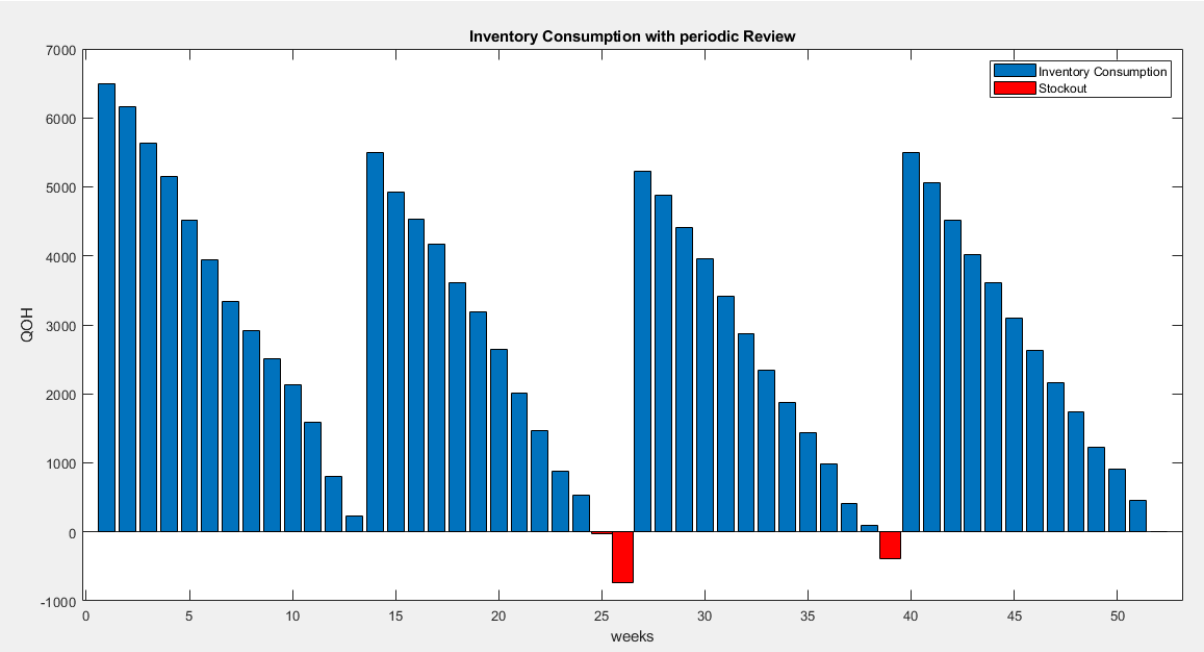


The Graph shows how the inventories are continuously reviewed and if it is found the quantity goes below it is ordered. Because the cycle time for making new inventory is 3 weeks, whenever inventory falls below the ROP, it will be ordered and restocked after 3 weeks. The graph shows no stockouts, but they could occur if there is an unexpectedly high demand. This is encountered, however, by taking a sufficient variance in weekly demand.

3.2.3 Category C Inventory Consumption

The Inventories in Category C is less important so it goes with the periodic review as it is handled previously. The period selected is the quarter or somehow near 13 weeks. This Inventory consumption may show some stockout but it can be manageable as the dollar volume is less for it

However, this project will give more benefit in term of saving holding cost while the stock out cost is not so significant.



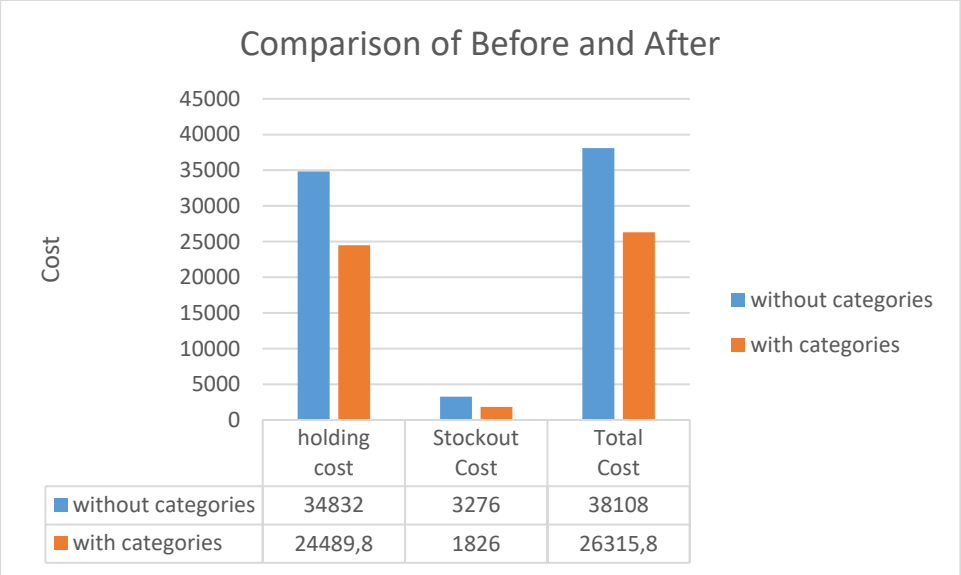
The Stockout here is less significant and it is shown by red colour however it will be more significant if this type of review is done for Category A and B inventories.

3.3 Comparison

The Inventory Holding is sufficiently reduced and how it is different with categories is shown below:

	Inventory Holding Cost	Category	Category Wise cost
Before	34832 $	Single	34832 $
After	24489 $	A	5151.1 $
		B	5553.7 $
		C	13785 $

The comparison of before and after is shown below:



4.Conclusion

The Data for the current year is forecasted with the help of previous two years data for the 21 shoes types. On the bases of dollar Volume, Holding cost and Stockout cost. Based on this criteria Inventories are classified into three categories. Every Category Consumption with periodic as well as continuous review policy is being modelled in MATLAB and it is shown above. Categorization of Inventories helps in reducing inventory holding cost by 30 percent and stockout cost to approximately 45 percent. Moving from Periodic review to Continuous Review policy for Top two categories causes the total inventory related cost to cut by 31 percent Maintaining the availability of inventory. New policies can handle uncertain demand more effectively rather the previous one Such that continuous review policies respond more effectively to change in demand.

References

Abdo Abouelrous, A. F. G., Yingqian Zhang. (2022). *Optimizing the inventory and fulfillment of an omnichannel retailer: a stochastic approach with scenario clustering*. Computers & Industrial Engineering.

Cobb, B. R. (2013). Inventory management with log-normal demand per unit time. *Computers & Operations Research*, 10.

D. Annie Rose Nirmala, V. K., M. Thanalakshmi, S. Joe Patrick Gnanaraj, M. Appadurai. (2022). *Inventory management and control system using ABC and VED analysis*. Materials Today: Proceedings.

D. Kim, Y. S. P., H.W. Kim, K.S. Park, I.K. Moon. (2022). *Inventory policy for postponement strategy in the semiconductor industry with a die bank*. Simulation Modelling Practice and Theory.

Ganeshan, R., Boone, T., & Stenger, A. J. (2001). The impact of inventory and flow planning parameters on supply chain performance: An exploratory study. *International Journal of Production Economics*, *71*(1-3), 111-118.

Hung, K.-C. (2016). Continuous review inventory models under time value of money and crashable lead time consideration. *Yugoslav Journal of Operations Research*, *21*(2).

Indrasan, Y., Rajput, V., & Chaware, K. (2018). ABC analysis: A literature review. *Journal For Advanced Research In Applied Sciences*, *5*(5), 134-137.

J. K. Ord, U. B. (2006). The truncated normal–gamma mixture as a distribution for lead time demand. *Naval Research Logistics Quarterly*, 7.

Jiapeng Liu, X. L., Wenhong Zhao, Na Yang. (2016). *A classification approach based on the outranking model for multiple criteria ABC analysis*. Omega.

Jun-Yeon Lee, L. B. S. (2009). *Leadtime management in a periodic-review inventory system: A state-dependent base-stock policy*. European Journal of Operational Research.

Kubasakova, I., Poliakova, B., & Kubanova, J. (2015). ABC analysis in the manufacturing company. Applied mechanics and materials,

Kumar, N. S., Rohan. (2017). *ABC Analysis in the Hospitality Sector: a Case Study* International Journal of Advanced Production and Industrial Engineering.

Kvon, G. M., Lushchik, I. V., Nikolaeva, Y. V., Nuretdinova, Y. V., Azitov, R. S., & Pavlushin, A. A. (2018). ABC-analysis technique of regional industrial investment development: theoretical and practical aspect. *Revista ESPACIOS*, *39*(22), 14.

Lwiki, T., Ojera, P. B., Mugenda, N. G., & Wachira, V. K. (2013). The impact of inventory management practices on financial performance of sugar manufacturing firms in Kenya. *International Journal of Business, Humanities and Technology*, *3*(5), 75-85.

Mahadevan, B., Pyke, D. F., & Fleischmann, M. (2003). Periodic review, push inventory policies for remanufacturing. *European Journal of Operational Research*, *151*(3), 536-551.

Nuzhna, O., Tluchkevych, N., Semenyshena, N., Nahirska, K., & Sadovska, I. (2019). Making managerial decisions in the agrarian management through the use of ABC-Analysis tool. *Independent Journal of Management & Production*.

Peter Berling, L. J., Johan Marklund. (2022). *Controlling inventories in omni/multi-channel distribution systems with variable customer order-sizes*. Omega.

Radasanu, A. C. (2016). Inventory management, service level and safety stock. *Journal of Public Administration, Finance and Law*(09), 145-153.

S. Nallusamy, R. B., S. Sundar. (2017). *Proposed Model for Inventory Review Policy through ABC Analysis* Trans Tech Publications, Switzerland.

Shrouty, V. A. (2019). The Study of various Tools and Techniques of Inventory Management and Experiment with use of ABC Analysis.

Stanisław Ambroszkiewicz, S. B. (2022). *Relatively optimal policies for stock management in a supply chain with option for inventory space limitation*. Applied Mathematical Modelling.

Tayur, S., Ganeshan, R., & Magazine, M. (2012). *Quantitative models for supply chain management* (Vol. 17). Springer Science & Business Media.