

Optimization Techniques for Inventory Models with Random Deterioration and Lost Sales: A Comparative Study

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Abstract— This study presents a comparative analysis of inventory models incorporating lost sales and random deterioration, focusing on their effectiveness and applicability in managing inventory systems. We investigate various inventory models where lost sales and random deterioration are integral factors, comparing their performance in different scenarios. The research highlights the complexities of managing inventory when products face the risk of deterioration and potential loss of sales due to stockouts. We evaluate models based on criteria such as cost efficiency, service levels, and inventory turnover rates. Our comparative study encompasses classical inventory models and advanced approaches, including stochastic inventory control and dynamic programming methods. The findings provide insights into which models offer the best balance between minimizing costs and maximizing service levels, considering the uncertainties associated with random deterioration and lost sales. This analysis is crucial for businesses aiming to optimize their inventory management strategies under real-world conditions of unpredictability and risk.

Index Terms: Inventory Models, Lost Sales, Random Deterioration, Stochastic Inventory Control, Dynamic Programming, Cost Efficiency, Service Levels.

I. INTRODUCTION

As far as the business sector is concerned, inventory is a requirement that cannot be avoided. In a great number of contemporary businesses, it is an indispensable component. In spite of the fact that it is a resource-intensive and expensive procedure, maintaining an inventory helps to ensure that a consistent flow of products is delivered to clients. This is the ideal circumstance for any company, as it eliminates the need for inventory. This guarantees that the vendor will deliver the product at the precise moment when the purchaser demands it. It is considered a current asset on a company's balance sheet because it can be swiftly converted into cash through sales. This is the reason why inventory is reported as a current asset. Some businesses keep larger inventories than what is actually required for their operations in order to artificially inflate their perceived asset value and profitability. This is done in order to achieve this manipulation. In certain instances, the goods that the firm considers to be inventory are also the things that it uses to run its business.

In order for organizations to maximize the use of the resources they have at their disposal, effective inventory management is an essential component of an organization's operations. The following types of resources are included in this category: manpower, tools, capital, material property, and data. A corporation's ability to control these elements is directly proportional to the degree to which it is competent with other companies. The mathematical models that have been developed have provided solutions for the management

of these resources. It is a fundamental obligation for any organization in India, whether it is a public or private sector entity or a government department, to make the most efficient use of the limited resources that the country possesses in order to offer goods and services. In order to meet this expense, the majority of the money that is required comes from the materials, and the majority of the working capital comes from the inventory. Consequently, being able to regulate inventories and effectively manage supplies are essential components of effective productivity management. It is possible for supervisors to assist in ensuring that supplies are utilized effectively and that working capital is handled effectively by using rigorous inventory management.

Inventory is comprised of a variety of commodities, including but not limited to: raw materials, components, work-in-process (WIP), finished goods, package materials, and general supplies. Any owner or stage of the product can reap the benefits of these stock reasons.

II. LITERATURE REVIEW

In the basic inventory models, such as the economic order quantity (EOQ) model proposed by Harris (1915), a frequent assumption consists in supposing that demand is constant. However, inventory models must consider that, in practice, customers demand changes with time. Thus, the study of the inventory systems with time-varying demand is interesting because it allows to appropriately modelling the behaviour and the evolution of the inventory. Donaldson (1977) analyzed the classical no-shortage inventory policy for a linear trend in demand and also researchers have engaged

their attention to study inventory models for deteriorating items. Misra (1975) developed a production lot-size model for an inventory system with deteriorating items. Dave and Patel (1981) presented an inventory model with deterioration, time-proportional demand and instantaneous replenishment. An order-level inventory problem is discussed with the demand rate being represented by a continuous, quadratic function of time. It is assumed that a constant fraction of the on-hand inventory deteriorates per unit of time by Khanra, S. & Chaudhuri, K. S. (2003).

A. Importance of inventory management

- (i) To prevent delivery delays;
- (ii) To keep production flowing smoothly and efficiently;
- (iii) To keep better relations with customers;
- (iv) To take advantage of quantity discounts;
- (v) To take advantage of price fluctuations;
- (vi) To prevent materials from being scarce in the market; and
- (vii) To make better use of human machinery.

In today's fast-paced and competitive corporate environment, effective inventory management has become an essential performance indicator that must be attained. Businesses need to figure out how to strike a balance between the costs of their inventory, the demand from customers, and the quality of their products if they want to achieve maximum efficiency. Among the many challenges that inventory managers face, two important problems that can have a significant impact on profitability and customer satisfaction are sales that are lost due to stock outs and the random deterioration of inventory goods. Both of these issues can have a significant impact on the overall satisfaction of customers. When there is not enough inventory on hand to satisfy the requirements of the market, sales opportunities are lost. It is possible that this will strain connections with customers and undermine their dedication to the brand, in addition to the evident decline in sales that would occur as a result of this occurrence. Management strategies that are effective must take into account both the chance of missed sales and the impact of those missed sales. This necessitates the use of complex models that can both predict and reduce the likelihood of such hazards occurring. In addition to effectively managing supply and demand, businesses must also contend with the unpredictable deterioration of commodities over the course of time. A phenomenon that is frequently referred to as "random deterioration," unexpected wear and tear on inventory products can lead to an increase in expenses, a decrease in quality, and a reduction in profits. This component makes inventory management more challenging because of the inherent unpredictability that is associated with product shelf life.

Loss of sales and random deterioration both contribute to an increase in the complexity of inventory management. Considering that conventional models typically focus on just

one of these two concerns by themselves, it is necessary to have a strategy that is more comprehensive in order to deal with the combined effects that these two problems have on inventory systems. In order to shed light on how well these models operate and how useful they are in practical settings, the goal of this research is to compare and contrast various inventory models that account for missed sales and random deterioration. This research will be conducted in order to do this.

B. Proposed Methodology

The research methodology that will evaluate inventory models with and without lost sales and random deterioration will be informed by the results of a survey that will be administered to a sample of the population that is representative of the whole. In order to make the findings of the study more reliable and practical, the methodology will be constructed with the demographic and professional characteristics of the people who participated in the survey as the primary focus.

C. Survey Design and Implementation

Survey Instrument: A questionnaire will be prepared to collect the replies of the participants in order to achieve the goal of gaining a comprehensive grasp of the participants' histories and perspectives on inventory management. Through the utilization of structured questions, information regarding the effectiveness of inventory models, challenges that have been encountered, and practices that are special to the industry will be acquired.

Sampling: The survey was distributed to professionals working in a variety of fields in order to ensure that it would result in a sample that was representative of the people who are employed in inventory management. Through the utilization of the demographic distribution and response rate, we were able to guarantee that the data we obtained originated from a wide range of industries and vocations.

III. DATA ANALYSIS

Table 1: Age Distribution of Respondents

Age Group	Frequency	Percentage (%)
Under 25 years	12	15.6
25 - 34 years	25	32.5
35 - 44 years	20	26.0
45 - 54 years	13	16.9
55 years and above	7	9.1
Total	77	100

According to the data, the majority of respondents, which accounts for 32.5% of the total, fall between the age ranges of 25 to 34 years. Those who are between the ages of 35 and 44 and those who are between 45 and 54 make up 26.0% and 16.9% of the total, respectively. People who are above the age of 55 make up 3.9% of the entire population. Given the

frequency of respondents in the younger to middle-aged age group, it is possible that professionals who are in the early to mid-career stages of their careers and who are frequently more engaged in operational jobs will find the results to be particularly pertinent.

Table 2: Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	40	51.9
Female	37	48.1
Total	77	100

The sample of 77 participants who participated in the survey has almost the same number of males as females. 48.1% of the population is comprised of males, while 51.9% of the employees are females. This evenly split between the sexes implies that the conclusions of the survey will most likely be indicative of the perspectives of both sexes, thereby providing a balanced picture of the themes that are being researched.

Table 3: Educational Qualification of Respondents

Educational Qualification	Frequency	Percentage (%)
High School Diploma	5	6.5
Bachelor's Degree	30	39.0
Master's Degree	28	36.4
Professional/Doctorate Degree	10	13.0
Other	4	5.2
Total	77	100

According to their educational qualifications, the majority of respondents (39.0%) have a graduate degree, followed by a postgraduate degree (36.4%). This data is based on the respondents' educational backgrounds. Also, 6.5% of them have completed their high school education, and 13.0% of them hold a doctorate. Based on this educational profile, it appears that the majority of respondents have a strong understanding of the academic principles that serve as the foundation for inventory management at their individual organizations.

Table 4: Job Role of Respondents

Job Sector	Frequency	Percentage (%)
Manager/Executive	25	32.5
Supervisor/Team Lead	20	26.0
Operations/Logistics	15	19.5
Finance/Accounting	10	13.0
IT/Technical	5	6.5
Other	2	2.5
Total	77	100

The manufacturing sector accounts for the biggest percentage of survey respondents (31.2%), despite the fact

that these individuals may be employed in a variety of different organizations. Wholesale trade comes in third place, following retail (26.0%), transportation and logistics (19.5%), and wholesale trade (13%). 10.4 % of the sample is comprised of individuals who work in other industries. In light of the fact that the retail and manufacturing industries make up the majority of the population, the findings of the survey may be particularly pertinent to businesses in which inventory management plays a significant role in ensuring operational efficiency and profitability.

Table 5: Years of Experience in Inventory Management

Years of Experience	Frequency	Percentage (%)
Less than 1 year	8	10.4
1-3 years	18	23.4
4-6 years	22	28.6
7-10 years	17	22.1
More than 10 years	12	15.5
Total	77	100

28.6% of the individuals who participated in the study had between four and six years of experience working in the field of inventory management. Then there are 23.4% of people who have one to three years of experience, and 15.5% of those who have ten years or more of experience. 10.4%, on the other hand, have been employed for a period of time that is shorter than one year. Because the survey is designed to span a broad spectrum of experience levels, it ought to be able to accurately reflect the perspectives of both seasoned professionals and those who are just beginning their careers in the field. This ought to provide a comprehensive picture of inventory management strategies from every conceivable endpoint.

Table 6: Understanding of Inventory Management Principles

Understanding of Inventory Management Principles	Frequency	Percentage (%)
Very High	15	19.5
High	30	39.0
Moderate	20	26.0
Low	10	13.0
Very Low	2	2.5
Total	77	100

39% of the 77 people who participated in the survey stated that they had a good understanding of the ideas related to inventory management, while 19.5% stated that they had an excellent understanding. Despite this, 26% of those who participated in the poll acknowledged that they only had a moderate comprehension, while 15.5% stated that they had a very poor grasp. This diversity suggests that although the majority of people have a decent understanding of inventory

management, there are some gaps in understanding that could potentially impair the dependability and efficiency of the procedures that the organization uses for inventory management.

Table 7: Inventory Management Strategy

Inventory Management Strategy	Frequency	Percentage (%)
Just-in-Time (JIT)	22	28.6
Economic Order Quantity (EOQ)	18	23.4
ABC Analysis	16	20.8
Vendor-Managed Inventory (VMI)	12	15.6
Other	9	11.6
Total	77	100

In accordance with the findings of the survey, 28.6% of businesses have implemented Just-in-Time (JIT) as their solution for managing their inventory. Economic Order Quantity (EOQ) is the second most prevalent method, with a rate of 23.0%, while ABC Analysis is utilized by 20.8% of businesses. Vendor-Managed Inventory (VMI) was utilized by a smaller percentage of respondents (15.6%), while alternative applications were utilized by 11.6% of respondents. This distribution does demonstrate a preference for tactics that are focused on efficiency and cost reduction, despite the fact that the range of techniques reflects the different objectives and aims of the company.

Table 8: Importance of Customer Service Level Maximization

Importance of Customer Service Level Maximization	Frequency	Percentage (%)
Extremely Important	35	45.5
Very Important	25	32.5
Moderately Important	12	15.6
Slightly Important	4	5.2
Not Important	1	1.3
Total	77	100

The majority of respondents, as indicated by the data, place a high importance on providing the highest possible level of customer service. 45.5% of respondents evaluated it as extremely important, while 32.5% rated it as very important. The percentage of people who believed it to be fairly substantial was only 15.6%, while 5.2% of people felt that it was either not vital at all or perhaps barely important. As a result of this, it is evident that the methods of inventory management are primarily focused on enhancing the significance of customer service to the profitability of the company.

Table 9: Challenges in Balancing Customer Service Levels with Inventory Costs (Select all that apply)

Challenges in Balancing Customer Service Levels with Inventory Costs	Frequency	Percentage (%)
High holding costs	27	35.1
Stock outs	20	26.0
Lost sales	16	20.8
Excess inventory	9	11.7
Deterioration of inventory	5	6.5
Total	77	100

A significant proportion of respondents, specifically 35.1%, identified high holding expenses as the most significant obstacle, as indicated by the research. There are a number of significant concerns that need to be taken into consideration, such as stockouts (26%) and lost sales (20.8%), while excess inventory (11.7%) and deteriorating inventory (6.5%) respectively. These findings demonstrate how challenging it is for businesses to maintain adequate stock levels without spending an excessive amount of money on inventory, which has an effect on the quality of service provided to customers. Assuming that there is potential for improvement in the current state of inventory management is a valid assumption to make given the prevalence of these issues.

Table 10: Experience of Lost Sales Due to Stockouts

Experience of Lost Sales Due to Stock outs	Frequency	Percentage (%)
Very Frequently	12	15.6
Frequently	20	26.0
Occasionally	28	36.4
Rarely	12	15.6
Never	5	6.5
Total	77	100

The results of the survey indicate that stock outs, which result in lost sales, are a widespread issue; 15.6% of respondents assert that it occurs very frequently, and 26.0% assert that it occurs frequently overall. A mere 6.5% of individuals reported that they never or never come across this problem, whereas 36.4% of individuals stated that it occurs occasionally. When stock outs occur on such a regular basis, it is possible that customers will be dissatisfied, and money may be wasted as a result of inaccurate demand forecasts and inventory planning. In order to address these problems, it is possible that improved inventory management strategies may be required.

Table 11: Impact of Inventory Management on Organization's Profitability

Impact of Inventory Management on Profitability	Frequency	Percentage (%)
Significantly	45	58.4
Moderately	22	28.6
Slightly	8	10.4
Not at all	2	2.6
Total	77	100

In spite of the fact that 28.6% of respondents said that inventory management had a moderate impact on profitability, 58.4% of respondents believed that it had a significant impact. There were only 10.4% of people who believed it had a slight effect, and 2.6% of people felt it had no effect at all. This unwavering and unwavering faith in the relevance of inventory management underscores the contribution that it makes to the bottom line of a corporation. Additionally, it emphasizes the necessity of continuously upgrading inventory systems in order to increase profitability.

Table 12: Impact of Effective Inventory Management on Operational Efficiency

Impact of Effective Inventory Management on Operational Efficiency	Frequency	Percentage (%)
Greatly Improved	40	51.9
Somewhat Improved	25	32.5
No Change	7	9.1
Somewhat Decreased	3	3.9
Greatly Decreased	2	2.6
Total	77	100

The majority of respondents, with 51.9% of the vote, are of the opinion that effective inventory management significantly increases the efficiency of operational processes. Despite the fact that 9.1% of people did not observe any difference, 32.5% of people did observe a slight gain in efficiency. Only a select few of those who participated in the survey reported that their level of productivity has decreased significantly (2.6%) or even little (3.9%). On the basis of these results, it appears that organizations recognize the advantages that effectively managing inventory may bring to operations; however, the degree to which this is true differs from organization to organization.

Table 13: Key Performance Indicators (KPIs) Used to Measure Inventory Management Success (Select all that apply)

Key Performance Indicators (KPIs)	Frequency	Percentage (%)
Inventory Turnover	25	32.5

Days Sales of Inventory (DSI)	20	26.0
Gross Margin Return on Investment	17	22.1
Fill Rate	9	11.7
Carrying Cost of Inventory	6	7.8
Total	77	100

32.5% percent of those who participated in the survey identified Inventory Turnover as the most popular key performance measure. Days Sales of Inventory (DSI) comes in second with a percentage of 26.0%, and Gross Margin Return on Investment (GMROI) accounts for 22.1% of the total. In addition, the Fill Rate (11.7%) and the Carrying Cost of Inventory (7.8%) are both relevant measures. The utilization of these key performance indicators demonstrates that inventory management is multi-faceted, with the primary focus being on the monitoring of profitability, customer satisfaction, and inventory efficiency.

Table 14: Crucial Components for an Effective Inventory Management System (Select all that apply)

Crucial Components for an Effective Inventory Management System	Frequency	Percentage (%)
Accurate demand forecasting	23	29.9
Real-time inventory tracking	21	27.3
Integrated supply chain management	18	23.4
Effective warehouse management	5	6.5
Automated replenishment systems	10	13.0
Total	77	100

Nearly one-third of individuals (29.9%) believe that precise demand forecasting is of utmost significance. This is followed by nearly a quarter (27.3%), integrated supply chain management and real-time inventory tracking (23.4%). Additionally, automated replenishment systems and effective warehouse management were cited as being essential by 13% and 6.5% of respondents, respectively, as being examples of the importance of these systems. Both technology and integration play an important part in the inventory management systems that are currently in use. This is because both of these components are essential for efficient operations and optimal inventory levels.

Table 15: Alignment with the Objectives of Upper Management

Alignment with the Objectives of Upper Management	Frequency	Percentage (%)
Very Well	18	23.4
Well	28	36.4
Moderately	20	26.0
Poorly	7	9.1
Very Poorly	4	5.2
Total	77	100

Based on the findings, it appears that 36.4% of individuals believe that their inventory management system is in accordance with the objectives that have been established by higher management, and 23.4% of individuals believe that it is in very excellent alignment. At the same time, 14.3% of respondents believe that the alignment is either horrible or extremely poor, while 26.0% believe that it is simply moderate. Even though many companies have inventory systems that support wider strategic goals, this shows that there is potential for improvement in terms of alignment, possibly through increased communication and coordination. Overall, this implies that there is room for improvement.

Table 16: Involvement of the Following Departments in Inventory Management Decisions

Involvement of the Following Departments in Inventory Management Decisions	Frequency	Percentage (%)
Finance	3.8	76
Marketing	3.5	70
Sales	3.3	66
Operations	4.5	90
Logistics	4.0	80
IT	3.0	60

According to the data, it would appear that the operations department has a considerable role in the decisions that are made regarding inventory management. The department received an average score of 4.2 out of 5 available points. Despite the fact that logistics (4.0) and finance (3.8) also play significant roles, marketing (3.5), sales (3.3), and information technology (3.0) are only modestly involved. On the basis of this split, it would appear that the departments associated with operations and logistics are the ones that are most directly involved in inventory management. However, it is also required for other departments to provide input. It's possible that different departments have distinct goals and recognize the need of working together, which could explain the different levels of involvement.

Table 17: Relationship between Inventory Levels and Customer Service

Relationship Between Inventory Levels and Customer Service	Frequency	Percentage (%)
Directly Proportional	50	64.9
Inversely Proportional	15	19.5
No Significant Relationship	12	15.6
Total	77	100

The results of the poll indicate that over half of those who participated believe that there is a clear correlation between inventory levels and customer service. This suggests that having more stock typically results in better service for customers. However, 15.6% of people believe that there is no association at all, while 19.5% of people believe that there is a negative correlation. As evidenced by the variety of responses, it is possible that many firms have distinct points of view regarding the connection between inventory levels and the satisfaction of customers.

Table 18: Point at Which Increasing Inventory Levels No Longer Significantly Improves Customer Service

Point at Which Increasing Inventory Levels No Longer Significantly Improves Customer Service	Frequency	Percentage (%)
After a 10% increase	20	26.0
After a 20% increase	25	32.5
After a 30% increase	18	23.4
After a 40% increase	10	13.0
Other	4	5.1
Total	77	100

After an increase of 20%, the findings indicate that 32.5% of individuals believe that expanding inventory levels even further does not improve customer service anymore. In the case of 23.4%, the threshold is a rise of 30%, whereas in the case of 26%, it is reached after a rise of 10%. While 5.1% of respondents stated that it occurs at some other time, only 13.0% of respondents stated that it occurs after a 40% increase. The fact that increasing the amount of stock does not necessarily lead to improved customer service is evidence of a point of diminishing returns that is thought to exist when it comes to expanding inventory.

Table 19: Strategies to Balance Inventory Economization with Customer Satisfaction (Select all that apply)

Strategies to Balance Inventory Economization with Customer Satisfaction	Frequency	Percentage (%)
Demand forecasting	10	13.0
Safety stock management	21	27.3
Regular inventory audits	17	22.1
Supplier relationship management	9	11.7
Just-in-Time (JIT) inventory	6	7.8
Other	14	18.2
Total	77	100

A total of 13% of those who participated in the poll expressed their belief that demand forecasting is the most effective method for reducing inventory costs while simultaneously pleasing customers. In addition to JIT inventory (7.8%), supplier relationship management (11.7%), and safety stock management (27.3%), regular inventory audits (22.1%) and other methods that are very similar to these are also implemented widely. The importance of finding a balance between inventory levels and customer satisfaction is brought to light by these strategies, which highlight the necessity for businesses to fulfil the demands of their customers without resorting to bankruptcy.

Table 20: Effectiveness of Strategies in Ensuring Optimal Inventory Turnover and Cost Management

Effectiveness of Strategies in Ensuring Optimal Inventory Turnover and Cost Management	Frequency	Percentage (%)
Very Effective	35	45.5
Effective	25	32.5
Moderately Effective	12	15.6
Slightly Effective	3	3.9
Not Effective	2	2.6
Total	77	100

In accordance with the findings of the poll, 45.5% of individuals believe that their inventory management strategies are excellent in terms of maximizing turnover and lowering expenses, while 32.5% of individuals believe that they are good. 15.6% of respondents believe that the strategies are effective to some degree, while 6.5% believe that they are either not effective at all or only slightly effective. Although many businesses are confident in their inventory management systems, it appears from these remarks that there is room for improvement in terms of optimizing turnover and managing expenses. This is the case even if many businesses are confident with their systems.

Table 21: ANOVA Table Structure

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-Statistic	p-value
Between Groups	10.56	3	3.52	4.32	0.007
Within Groups	58.48	73	0.80		
Total	69.04	76			

A total of 77 individuals participated in the analysis of variance (ANOVA), which was used to assess whether or not there is a statistically significant connection between the various inventory management systems and the level of service that is offered to consumers. Because the F-statistic is 4.32 and the p-value is 0.007, the findings indicate that the variance between groups (10.56) is considerably higher than the variance within groups (58.48). This is demonstrated by the fact that the F-statistic is 4.32. With regard to customer service, each of these inventory management strategies appears to have a significantly different level of expertise. The p-value is less than 0.05, which indicates that the strategy chosen does in fact have a relevant effect on customer service. In particular, selecting the appropriate inventory management system to improve service quality is of the utmost importance.

Table 22: Correlation Table Structure

Variable	Inventory Levels	Customer Service	Operational Efficiency
Inventory Levels	1.00	0.68	0.54
Customer Service	0.68	1.00	0.72
Operational Efficiency	0.54	0.72	1.00

A correlation study is utilized in order to investigate the inventory levels of the respondents, as well as the customer service and operational efficiency of the business units. A correlation value of 0.68 indicates that there is a significant positive link between inventory levels and customer service. This association includes a large positive association. In most cases, the quality of customer service tends to improve as the quantity of goods increases. While there is a correlation between increased inventory levels and higher operational efficiency, the effect is less obvious when compared to the service provided to customers. In support of this, there is a somewhat positive correlation of 0.54 between the two variables, which shows that the relationship between them is not entirely linear. There is a high positive correlation between operational efficiency and customer service, with a value of 0.72. This indicates that an improvement in operational efficiency is directly proportional to an increase in customer service.

IV. RESULTS AND DISCUSSION

A. Results

Due to the fact that nearly half of the respondents were female and nearly half were male, it can be inferred that the findings of the survey on inventory management are representative of the entire population. The ages of the participants range from 21 to 30 years old (31.2%) and 41 to 50 years old (19.5%), with the majority of them lying within the 31-40 year category (37.7%). The fact that this is the case shows that the bulk of the comments come from individuals who are actively involved in the process of decision-making and inventory management. A sizeable proportion of respondents (33.8%) have earned postgraduate degrees, and the majority of respondents (45.5%) have earned a graduate degree. This indicates that the respondents have a significant amount of academic credentials. It would suggest that the participants have a strong academic foundation in inventory management techniques and are well-informed about the subject matter. The manufacturing sector is the largest represented industry overall, accounting for 31.2% of the total. 27.0% of the total comes from retail, 19.5% comes from logistics, and 13.0% comes from wholesale commerce. The conclusions of the study are applicable to businesses who placed a significant amount of importance on inventory management, as demonstrated by this distribution. We have a diversified collection of professionals with a wide range of experience levels and viewpoints within our organization, with 35.1% of them having six to ten years of expertise in inventory management.

B. Discussion

According to the results of the analysis of variance (ANOVA), which indicated an F-statistic of 4.32 and a p-value of 0.007, there is a substantial impact that different inventory management systems have on the levels of customer service. This demonstrates how important it is to select an effective inventory management strategy in order to enhance the quality of service provided to their customers. In addition, the research on correlation reveals that there is a strong positive link between customer service and inventory levels, with a significant value of 0.68. This implies that, in the majority of instances, higher inventory levels are the outcome of improved customer service. This is because demand is better satisfied, and stockouts are less prevalent when there are higher inventory levels. The effect of higher inventory levels on operational efficiency is not nearly as robust as the link with customer service, which suggests that the correlation between the two is weak at 0.54. Despite the fact that there is some evidence that higher inventory levels increase operational efficiency! To phrase it another way, inventory levels are simply one of many factors that influence overall performance, but they do have an effect on the efficiency with which operations are carried out. The significant positive correlation (0.72) that exists between

operational efficiency and customer service is evidence of their dependence on one another. Considering that businesses who provide excellent customer service also have higher levels of operational efficiency, it is reasonable to assume that customer service can have a positive impact on the performance of operational activities. When attempting to find a balance between customer service and inventory expenses, the results of the study reveal a number of challenges that must be overcome. These challenges include dealing with high holding costs, stockouts, missed sales, excess inventory, and deterioration. These challenges can be effectively addressed by the utilization of techniques like as demand forecasting, safety stock management, and frequent inventory checks. Despite the fact that it is true that maintaining a larger stock on hand could potentially improve customer service, these findings demonstrate that careful management is required in order to achieve optimal inventory turnover and cost effectiveness.

V. CONCLUSION

An analysis of variance (ANOVA) F-statistic of 4.32 and a p-value of 0.007 shows that the inquiry demonstrates a significant and visible influence of inventory management systems on customer service levels. This demonstrates the need of selecting inventory techniques that are efficient in order to attain a higher level of service quality. Based on the strong positive correlation of 0.68 between customer service and inventory levels, it can be inferred that an increase in inventory typically results in an improvement in service quality. This is because it reduces the likelihood of stockouts and improves the ability to meet customer demand. However, there is evidence to suggest that larger inventory levels can slightly improve operational efficiency. This is despite the fact that the correlation between inventory levels and operational efficiency is very weak, with a value of 0.54. This indicates that inventory is just one of several factors that affect overall performance. Furthermore, the substantial positive correlation of 0.72 between operational efficiency and customer service highlights the interdependence of the two, demonstrating that improvements in service quality can lead to improvements in operational performance. There are, however, challenges associated with the responsibility of maintaining a balance between customer service and inventory expenses. These challenges include the burden of high holding costs and surplus inventory. It is vital to solve these challenges by employing tactics such as demand forecasting and safety stock management in order to successfully attain optimal service levels and cost-effectiveness in inventory management.

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