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TIME SERIES AND ABC CURVE - BUSINESS STRATEGIES IN THE CONTEXT OF THE COVID-19 PANDEMIC

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Abstract: The Covid-19 pandemic caused changes in the behavior of demand in some economic sectors, both in terms of the type of product and the quantity to be delivered. The causes associated with the need to keep stocks of any kind and in any company are random fluctuations in demands and waiting times, both variables have changed due to the pandemic. The general objective of this work is to analyze the current stock management system so that you can apply stock control tools and evaluate the possibility of forecasting demand in the main products of a supermarket. It is justified as the relevance of the present study, the management of inventories as competitive strategies for companies to be able to mitigate the impact of the economic crisis arising from the pandemic. This is a descriptive research based on the analysis of the inventory management of a supermarket in the city of Montes Claros-MG, in the period of 2020. A time series analysis was carried out and the ABC curve was elaborated. To improve the situation of the company's stock control, it was proposed to use management for stock control, secondly, to use software, correcting replenishment policies as competitive strategies during the Covid-19 health crisis.
Keywords: Covid-19 pandemic. Supermarket. Inventory Management.

INTRODUCTION

The Covid-19 pandemic caused changes in the behavior of demand in some economic sectors, both in terms of the type of product and the quantity to be delivered (WHO, 2020). Small and medium-sized companies in the supermarket retail trade had to readapt, they switched to digital delivery. An environment for innovation was created, with the need to realign supply chains. Faced with the great competitiveness of the market, the emergence of new technologies and the constant growth of the supermarket sector, companies are looking for alternatives that are a differential and positively improve their management, to maximize their quality and profitability.

The stock management area is becoming increasingly essential, as the implementation of an effective system helps in the development of activities, enables better stock planning such as purchases, storage of goods and return on invested capital, providing the alternative of carrying out your purchases according to your customers' demand. As a company keeps its inventory under control, it will tend to obtain better results compared to its competitors.

This work highlights the importance that a well-planned inventory management plays in the growth of companies, allowing an increase in revenue and a decrease in inventory-related costs, even in times of economic contraction caused by the coronavirus pandemic, designated SARS-CoV-2.

The research was carried out in a medium-sized establishment located in the city of Montes Claros, in the north of Minas Gerais. The company has been on the market for 40 years. Due to its growth, its inventory management failed to prove as effective as before the health crisis, with two constant problems that negatively influenced its turnover: the lack of products with high demand on the market in certain periods of the year and the loss of products due to expiry in stock. A detailed study was carried out, highlighting these two situations, and applying tools in the inventory management area, in order to remedy these two problems in the short term without large investments, maximizing profits and reducing losses.

In view of this, this work has the general objective of analyzing the current inventory management system of the supermarket studied so that inventory control tools can be applied, evaluating the possibility of using the demand forecast analysis in some of the main

products as part of the company's purchasing process, enabling greater organization and precision in terms of the quantity of products to be purchased.

In order to achieve the general objective, it was verified which products have the highest loss rate, the main products that present a variation greater than 4% in demand in certain periods of the year, measures that could minimize or eliminate the loss of products due to expired validity and the loss of sales due to lack of products, reducing the company's cost with inventory.

Justified as the relevance of the present study, inventory management as competitive strategies for companies to be able to mitigate the impact of the economic crisis arising from the Covid-19 pandemic. Inventory management is essential for every business that has inventory. Companies need to have stock, but in such quantity to avoid situations of unavailability and excess stock. Inventory management can improve the existing inventory control situation and lower the company's costs.

In this article, the situation of stock management is analyzed, two aspects are proposed - stock management with the aim of reducing the company's stock level and maintaining costs by avoiding stocks and applying the software system to automate processes of inventory management. React in advance to deviations from forecast demand, correcting replenishment policies.

THEORETICAL FOUNDATION

Companies seek to gain a competitive advantage over their competitors. Promptly serving your customers when they need it can be a big differentiator. For this, it is necessary to have an efficient administration of stock management, knowing how to identify what must remain in stock, when it must be replenished, identifying and controlling obsolete stock is one of the functions of stock management.

The objective, therefore, is to optimize investment, increasing the efficient use of financial resources, minimizing the need for capital invested in inventories" (DIAS, 2010, p. 7). Companies that do not have efficient planning, stocks are stagnant, or even products pass their expiration date, causing an increase in the organization's costs (POZO, 2010).

By inventory management we mean inventory planning, its control and its feedback on planning. An inefficient administration of stock management resources entails financial losses for the company, and may even interfere with its competitiveness in the market. Inventory control is fundamental in logistics and supply chain management, and the causes associated with the need to maintain inventories of any type and in any company are random fluctuations in demand and waiting time (SLACK et al., 2002).

CONTROL TOOLS

Discovering formulas to reduce inventories without affecting the production process and without increasing costs is one of the biggest challenges that businessmen are facing. The ABC Curve, just in time and PEPS Method techniques are presented.

CURVE ABC

The ABC technique is a way of classifying all inventory items in a given system of operations into three groups, based on their total annual use value (CORRÊA; GIANESE; CAON, 2011, p. 69). The ABC curve has been used for inventory management, for the ABC definition, the "preferential application of administrative management techniques is used, according to the importance of the items" (DIAS, 2010, p. 69).

The ABC curve is a very useful tool, as it is capable of identifying those items that deserve

greater attention in the decision-making process in inventory management. The curve is obtained by sorting the items according to their relative importance; and still according to the authors and following the Pareto law, which is the basic principle of the ABC curve, there is a small portion of the items (about 20%) being responsible for about 80% of the total value in stock and a large portion of about 80% of the items representing only 20% of the values stored (BRAGA; PIMENTA; VIEIRA, 2008).

JUST IN TIME

Justin in Time is a production system where it designates that nothing must be produced, purchased or transported before the right time. According to Corrêa and Gianesi (1993, p. 57) "The JIT (Just in Time) philosophy is to reduce inventories, so that problems become visible and can be eliminated through concentrated and prioritized efforts."

Unlike the traditional approach of production systems that "push" inventories, JIT is characterized by a system of "pulling" production along the process, according to demand. (DIAS, 2010 p. 69). To effectively achieve its objectives, JIT has a collection of tools and techniques that provide operational conditions, one of which is the Kanban technique (SLACK, CHAMBERS; JOHNSON, 2002).

METHOD PEPS

In this method, the first products to enter must be the first to leave. According to Warren et al. (2009, p. 87), "when the PEPS inventory valuation method is used, the costs are included in the cost of goods sold, in the order in which they were incurred. "

The evaluation by this method is done in the chronological order of the entries. Goods that are the first to leave stock are valued according to their first entry, thus, items that remain in stock are valued according to the last entry (ALMEIDA, 2010).

MATERIALS AND METHODS

This study is a descriptive research based on the analysis of the inventory management of a supermarket in the retail sector in the city of Montes Claros-MG. Its form of approach is characterized qualitatively and quantitatively, which evaluates and elucidates documents and financial data collected by the company's operating system, in the period of 2020, so that through the ABC curve it is possible to identify the main items of the stock, with the intention of prioritizing them. Mathematical methods are used to prepare the demand forecast, through time series that consist of a sequence of demand observations over time. Aiming, in a descriptive way, to prioritize and analyze data collection to find a better way to obtain a more effective inventory.

BIBLIOGRAPHIC RESEARCH

This research was carried out in a retail supermarket in the city of Montes Claros - MG that has been operating in the market for 40 years, has 10 direct employees who are divided into the cashier, financial, office and merchandise replenishers. The analysis was carried out through the collection of data from the operating system, and analysis of documents provided by the company.

The method adopted to carry out the research in loco was done through collection of documents, reports and consultation in the company's operating system. Bibliographic elements were used to complete the theoretical composition of this work, such as scientific articles and books related to the study area.

After collecting enough information, an analysis of the data and a comparison of the stock in different periods was carried out, observing the storage and sales made through an operational system. The ABC curve tool

was used, in which the most important products in the supermarket were determined according to the price and their financial return. The JIT (Just in Time) system was used, which determines that the purchase must be made according to demand.

The demand forecast was made through time series in which the characteristic used was the seasonality that took into consideration, changes above 4% in the demand for certain goods in certain periods of the year, so that the manager can plan his purchases in more efficient ways. efficient to have a balance between purchases and sales.

RESULTS AND DISCUSSION

In order to analyze the information regarding the company's inventory, samples of products were collected in different sections of the supermarket, according to their profitability. Company sales data and warehouse inventories were analyzed for the 2020 period. Analysis of prior year product quantity fluctuation data revealed that there were unsold items in stock in 2018.The results for these items were as follows: 16.69% of the total items (at the end of 2020) in deposit did not move that year, there was a reduction of 3.95%, due to the expiration of the term, 5.13% of the total unsold stock for the year 2020 have increased their quantity due to new products entering the market. There were some items whose purchased quantity was greater than that sold, however having a large quantity in stock, according to Graphic 1.

There were also items, whose stock level was high, while the company made new purchases, therefore the stock level was higher than the annual sales amount, at the end of 2020, Graphic 1. It was detected that a stock level was too high for some items, whose quantity in monthly sales was less than the safety stock, according to Graphic 2. It was noticed that a stock level for an item dropped to zero, which indicated an out-of-stock situation Graphic 2.

Effective inventory management consists of ABC classification, demand forecasting algorithms and replenishment policies. A software system can automate inventory management and timely react to forecast demand deviations, making corrections to replenishment policies (SLACK et al., 2002). The software system used by the company can be used in two modes: completely autonomous mode, when the manager performs all stock management operations: ABC classification, future demand forecast, definition of order replenishment policy or works as a system decision support.

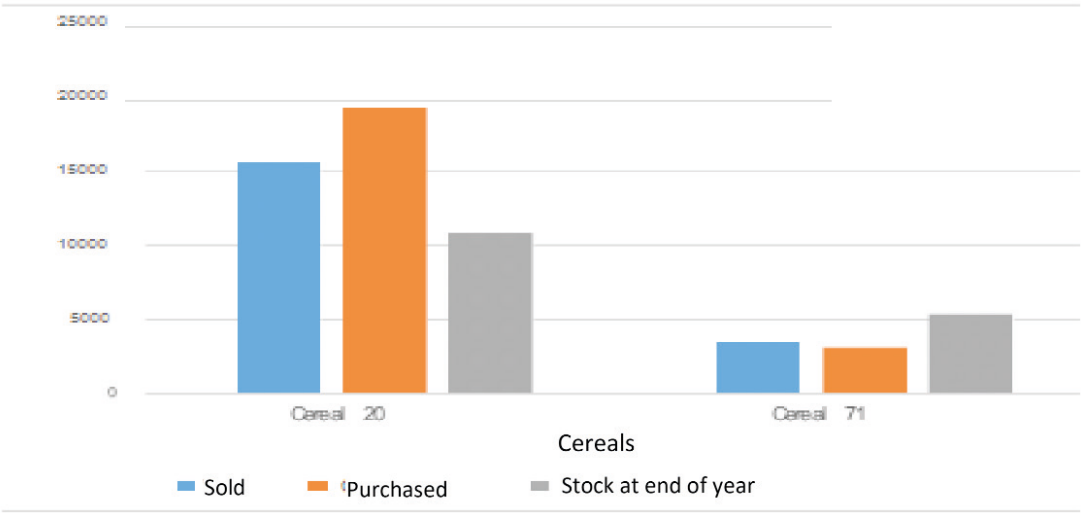
It is possible that the stock manager performs all the activities mentioned, except ordering, providing the results obtained for an inventory, so he decides whether or not to accept these recommendations. The ABC classification (or ABC analysis) allows you to assign priorities to management time and financial resources. ABC analysis is based on Pareto analysis, which says that 20% of items contribute to 80% of sales (SLACK et al., 2002). The calculations of the best-selling and highest yielding products are located in blocks "A" and "B".

The entire range of supermarket products for the year 2020 was divided into product groups, the total value of 60 items, as shown in Table 1.

Using the data in Table 1, a concentration curve was created, where the x axis is product groups arranged in descending order of their share in total sales, and the vertical axis is the size of the company's volume. Edge blocks "A", "B" and "C" were determined by tangent to curve analysis, Graphic 3.

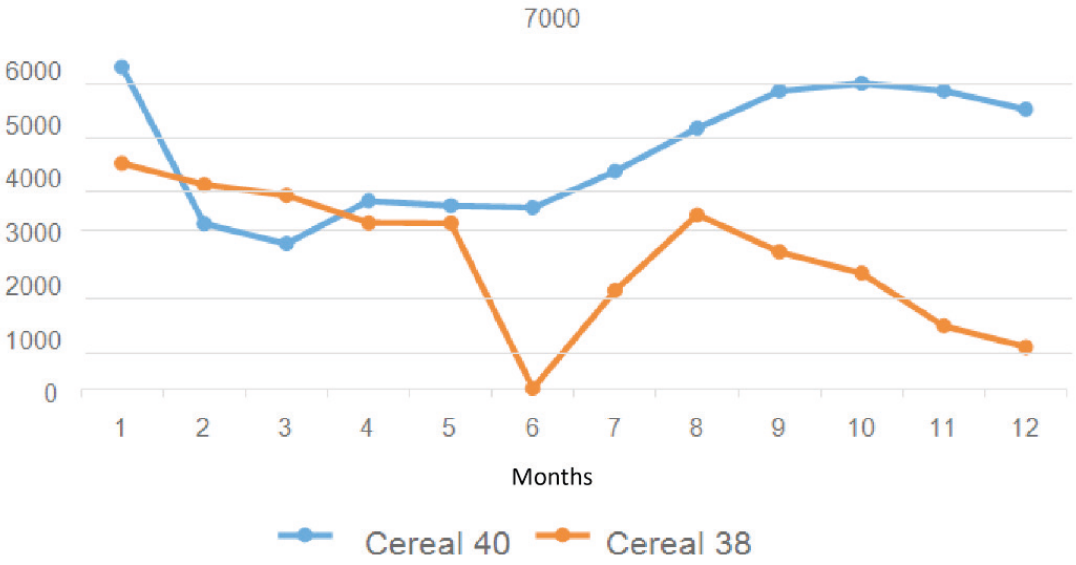
Through the results obtained, it is concluded that the most advantageous, from an economic point of view, for the supermarket is the sale of the first 11 groups of products in the list of Table 1, which are included in block

Graphic 1 - Annual operations of two cereals



Graphic 1 - Annual operations of two cereals

Source: Own elaboration (2021)



Graphic 2 - Two Grain Inventory Level

Source: Own elaboration (2021)

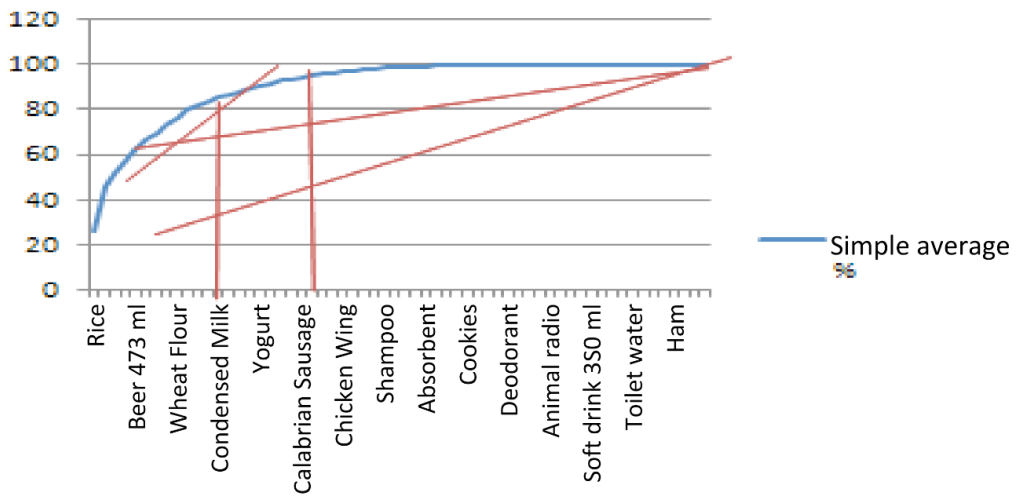
Assortment Position Number		Revenues in BRL	Specific sales volume %	Accumulated volume %	Classification
1.	Rice	73692	26,3	26,3	
2.	Bean	54440	19,45	45,75	
3.	Sugar	16213	5,76	51,51	
4.	Beer 300 ml	15642	5,5	57,01	
5.	Beer 473 ml	14436	5,15	62,16	
6.	Soft drink 2 l	11472	4,09	66,22	A
7.	Noodle	10070	3,59	69,81	
8.	Oil	9634	3,44	73,25	
9.	Wheat flour	9211	3,29	76,54	
10.	Frozen chicken	8246	2,94	79,48	
11.	Cereals	6800	2,42	81,9	
12.	Cooking gas	4902	1,75	83,65	B
13.	Condensed Milk	4367	1,56	85,21	
14.	Tomato sauce	3841	1,37	86,58	
15.	Coffee	3786	1,35	87,93	
16.	Soap	3786	1,35	89,28	
17.	Yogurt	3280	1,17	90,45	
18.	UHT milk	3163	1,13	91,58	
19.	Fish	3163	1,13	92,71	
20.	Eggs	2500	0,89	93,6	
21.	Pepperoni sausage	2324	0,83	94,43	
22.	Detergent	2324	0,83	95,26	
23.	Chicken wing	1757	0,62	95,88	
24.	Flour	1500	0,54	96,42	
25.	Wing stick	1411	0,5	96,92	
26.	Washing powder 500g	1333	0,47	97,3	
27.	Vegetables and fruits	1088	0,38	97,77	
28.	Olive oil	951	0,34	98,11	
29.	Shampoo	951	0,34	98,45	
30.	Salt	614	0,26	98,67	
31.	Matches	512	0,25	98,85	
32.	Household items	512	0,24	99,03	
33.	Absorbent	512	0,24	99,2	
34.	Cheese	495	0,23	99,37	
35.	Sweet products	241	0,22	99,4	
36.	Chocolate milk	186	0,22	99,42	
37.	Cookies	145	0,22	99,41	
38.	Salty producrs	110	0,21	99,42	C
39.	Special sauces	111	0,21	99,43	
40.	Butter	111	0,21	99,44	
41.	Deodorant	110	0,2	99,45	

Table 1 – General ABC Classification (Conclusion)

Assortment Position Number		Revenues in BRL	Specific sales volume %	Accumulated volume %	Classification
42	Softener	109	0,19	99,46	
43	Toilet paper	108	0,18	99,47	
44	Condtioner	100	0,17	99,48	
45	Pet food	98	0,16	99,49	
46	Toothpaste	80	0,15	99,5	
47	bar soap	85	0,14	99,51	
48	Energetic	70	0,13	99,	
49	350 ml soft drink	75	0,12	99,52	
50	Mineral water 20 L	60	0,11	99,53	C
51	Vodka	60	0,1	99,54	
52	Wines	60	0,09	99,55	
53	Bleach	55	0,08	99,56	
54	Olive oil	50	0,07	99,5	
55	Olive	50	0,06	99,6	
56	Canned corn	45	0,05	99,63	
57	Ham	40	0,04	99,62	
58	Chocolate	40	0,03	99,66	
59	Cake mix	30	0,03	99,67	
60	Corn meal	25	0,005	99,665	

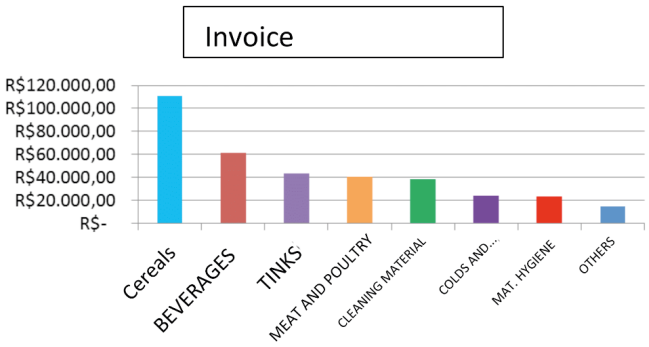
Table 1 – General ABC Classification (continuation)

Source: Own elaboration (2020)



Graphic 3 - Supermarket ABC Analysis - 2020 Annual Report

Source: Own elaboration (2021)



Graphic 4 - Annual revenue per product

Source: Own elaboration (2021)

Graphic 5- Actual demand and forecast demand for a cereal

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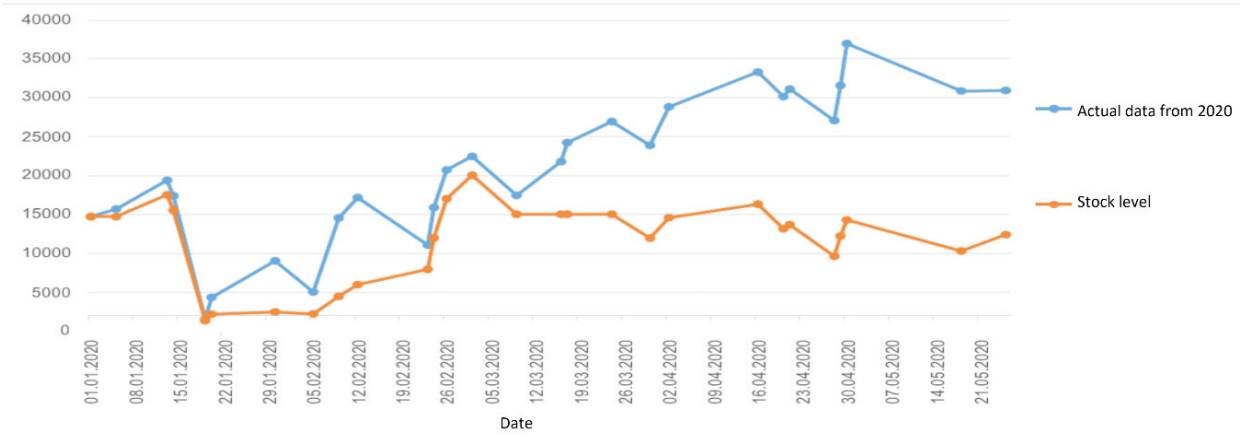
Source: Own elaboration (2021)



Graphic 6 - Comparison of the inventory management system with real data

Source: Own elaboration (2021)

"A". The "B" block is 9 product groups. It must not be forgotten that they are also beneficial for the trading company, but they provide a lower return than the profits from the sale of Block "A" goods.

Block "C" includes all the remaining items in Table 1, which represent almost 50% of the supermarket's total range. These products are not economically viable, but they cannot be missing, as many of them are needed by customers, who often visit supermarkets just for this group of products. Thus, the buyer who is going to acquire goods from merchandise group "C", will make a series of acquisitions of goods from block "A" or "B".

The results of the ABC classification were prepared using the total annual revenue for 2020, as shown in Table 2, in a reduced form.

Class	Products	Invoicing
A	20%	63%
B	30%	13%
C	50%	25%

Table 2 – ABC Classification - 2020

Source: Own elaboration (2021)

Table 2 indicates that the ABC classification is not up to standard, implying that a small portion of the items in stock do not contribute to maximum sales. Typically, less than 20% of items classified as Class A must contribute up to 80% of revenue. However, with the current inventory planning, class A contributes with 63%, requiring a review of products that require greater prioritization and attention with management and, thus, an analysis of more assertive acquisitions by the purchasing sector. The analysis of the company's revenue identified that the cereal sector has a greater contribution to revenue, in the amount of R$ 111,027.92 in the period of 2020, according to Graphic 4.

The cereal sector products were divided into 15 categories, according to the cereal labeling code in the system, the ABC analysis was carried out according to Table 3. For class C items with low (or zero) demand volume, it is proposed to use the acquisition-on-demand strategy (SLACK et al., 2002).

	Cereals	Classification ABC
1	Cereal 56	B
2	Cereal 71	A
3	Cereal 139	C
4	Cereal 49	C
5	Cereal 133	C
6	Cereal 33	A
7	Cereal 264	C
8	Cereal 471	C
9	Cereal 473	C
10	Cereal 38	C
11	Cereal 39	C
12	Cereal 40	A
13	Cereal 96	C
14	Cereal 620	B
15	Cereal 674	C

Table 3 – ABC Classification – Cereals

Source: Own elaboration (2021)

The Inventory Level Graphic with forecast results for Grade A cereals is shown in Graphic 5. The forecast measure calculations gave the appropriate forecast algorithm for this type of product. The above-mentioned forecasting methods were applied to all of the company's cereals. An inventory system provides the organizational structure and operational policies to maintain and control goods to be stored (SLACK et al., 2002).

Having forecast the demand, it is possible to calculate the safety stock and replacement points for each category of cereals, as shown in Table 4.

Cereals	Expected Demand	Safety stock	Re-order point
Cereal 33	1688	2081	3769
Cereal 40	12249	9096	21345
Cereal 20	1508	1603	3111
Cereal102	537	5927	6464
Cereal 465	3625	6363	9988

Table 4 - Fragment of forecast results, security points and reference points for cereals

Source: Own elaboration (2021)

The calculation-based analysis of future demand and replenishment policies, verification of inventory management results in real data, are portrayed in Graphic 6. The real data are the demand data in the first 5 months of 2020. The proposal is that the proposed quantities of stocks with results of replenishment policies are compared with actual demand, and the quantities of stocks are compared with the company's stocks, as per Graphic 6.

The analysis of Graph 6 showed the following results: the stock level decreased, the average stock level of actual data is 20,860 units of cereals, the average stock level of the inventory management system used by the company is 11,705 units. Analysis for another cereal showed that safety stock was used during the lead time because of unpredictable high demand - having an average monthly demand of 9,800 units, and the monthly demand is 17,789 units. This demand will be taken into consideration, in further safety stock calculations. The average stock level of the company based on actual data is 6,964 units, the average stock level of the inventory management system used by the company is 5,955 units. Another type of cereal has the following results: The company's average inventory level is 6,964 units; the average inventory level proposed by the system was 5,405 units.

At the end of June 2020, inventory levels showed the following results: Inventory management system based on management software showed the best results compared to inventory management and real data based on owner's intuition. This can be explained by the following: at the end of 2019, demand had an increasing trend, but in March 2020 it started to decrease; therefore, the management system took this change in demand into account.

FINAL CONSIDERATIONS

It is concluded that the proposed objective, to analyze the current stock management system, to apply stock control tools and evaluate the possibility of forecasting demand in the main products, was achieved. Inventory management came highly recommended for this company. In order to improve the company's existing inventory control situation, it was proposed, firstly, to use management for inventory control, and secondly, to use inventory software for inventory management, correcting the replenishment policies such as competitive strategies during the Covid-19 health crisis.

According to experiments, it can be concluded that the timely reaction to changes in the environment can propose better results. This can be done by the managers and make the decision based on the support system that compares the forecasted demand with the actual one and makes corrections in the orders.

Lastly, in today's turbulent market environment, forecasting demand volume and future development plays an irreplaceable role in company management. When forecasting supermarket demand, the choice of forecasting methods and information sources plays an important role, as does identifying all factors that could significantly affect future customer demand.

REFERENCES

BRAGA, L.M.; PIMENTA, C.M.; VIEIRA, J.G.V., **Gestão de armazenagem em um supermercado de pequeno porte.** Revista P&D em Engenharia de Produção, Viçosa, n. 08, p. 57-77, 2008.

CORRÊA, Henrique Luiz; GIANESI, Irineu Gustavo Nogueira; CAON, Mauro. **Planejamento, programação e controle da produção:** MRP II/ERP: conceitos, uso e implantação Base para SAP, Oracle Applications e outros Softwares Integrados de Gestão. 5. ed. São Paulo: Atlas, 2011.

DIAS, Marco Aurélio P. **Administração de materiais:** princípios, conceitos e gestão. 6. ed. São Paulo: Atlas, 2010.

GAITHER, N; FRAZIER, G. **Administração da produção e operações.** 8. ed. São Paulo: Thomson, 2005.

MARTINS, P. G.; ALT, P. R. C. **Administração de materiais e recursos patrimoniais**. 3. ed. Brasil: Editora Saraiva, 2011**.**

ORGANIZAÇÃO MUNDIAL DA SAÚDE - OMS. **Doença do coronavírus 2019** (Covid-19): relatório de situação 51. Gênova, 2020. Disponível em: ttps://apps.who.int/iris/bitstream/handle/10665/331475/ nCoVsitrep11Mar2020-eng.pdf. Acesso em 10 de fevereiro de 2021.

PEINALDO, Jurandir; GRAEML, Alexandre Reis**. Administração da produção:** operações industriais e de serviços. 1. ed. Curitiba: Unicenp, 2007.

POZO, H. **Administração de recursos materiais e patrimoniais:** uma abordagem logística. 6 ed. São Paulo: Atlas 2010.

TUBINO, Dalvio F. **Planejamento e Controle da Produção:** teoria e prática. 2. ed. São Paulo: Atlas, 2009.

WARREN, Carl S.; REEVE, James M.; DUCHAC, Jonathan E.; PADOVEZE, Clóvis Luís. **Fundamentos de Contabilidade:** Aplicações. 22. ed. São Paulo: Cengage Learning, 2009.

SLACK, NIGEL *et al.* **Administração da Produção**. 2. ed. São Paulo: Atlas, 2002.