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A comparative study of time series analysis models for the food market: The case of "E. J. Papadopoulou S.A."

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Patras, Greece, July 2023

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This endeavour would not have been possible without the valuable guidance of my supervisor Dr. Nikolaos Thomaidis who generously provided his knowledge and feedback. Additionally, I would like to express my gratitude to the management of the company "E. J. Papadopoulou S.A." for providing the commercial data without which this thesis would not have been possible. Thanks, should also go to my family for their support during this process.

"To my beloved daughter Fani"

Συγκριτική μελέτη μοντέλων ανάλυσης χρονοσειρών για την αγορά τροφίμων: Η περίπτωση του «Ε. Ι. Παπαδοπούλου Α.Ε.».

ΣΠΥΡΙΔΟΥΛΑ ΚΑΤΣΑΡΟΥ

Περίληψη

Ο απώτερος στόχος κάθε επιχείρησης είναι η επιτυχία που βασίζεται στον αποτελεσματικό στρατηγικό σχεδιασμό. Οι εταιρικές στρατηγικές βασίζονται σε προβλέψεις για το μέλλον και η αποτελεσματικότητά τους εξαρτάται από την ακρίβειά αυτών. Τα προηγμένα εργαλεία πρόβλεψης είναι ζωτικής σημασίας για το μέλλον της εταιρείας, καθώς παρέχουν πληροφορίες που μπορούν να χρησιμοποιηθούν στην διαδικασία λήψης αποφάσεων και τον στρατηγικό σχεδιασμό. Οι εταιρείες χρειάζονται συνήθως προβλέψεις σχετικά με τις πωλήσεις, τις δαπάνες και τα κέρδη ή τις ζημίες. Βάσει δομημένων προβλέψεων και δεδομένων παλαιότερων ετών, οι επιχειρήσεις μπορούν όχι μόνο να σχεδιάζουν το μέλλον και να θέτουν στόχους αλλά και να αξιολογούν την απόδοσή τους. Επιπλέον, οι προβλέψεις αποτελούν βασικό στοιχείο για την κατάρτιση του προϋπολογισμού μιας εταιρείας, καθώς βοηθούν στην απόφαση για την κατανομή των διαθέσιμων πόρων και το σχέδιο δράσης της. Επίσης, οι εύστοχες προβλέψεις μπορεί να υποστηρίξουν τις θέσεις μιας εταιρείας στην αγορά μέσω της παρουσίασης των τάσεων και να ενισχύσουν την ανταγωνιστικότητά της.

Στόχος της παρούσας διπλωματικής εργασίας είναι η ανάλυση των στατιστικών ιδιοτήτων των στοιχείων πωλήσεων μιας ελληνικής εταιρείας που δραστηριοποιείται τα τελευταία εκατό χρόνια στην αγορά της αρτοποιίας. Η εταιρεία κατέχει ηγετική θέση στην τοπική αγορά ενώ σημειώνει και σημαντική εξαγωγική δραστηριότητα. Η εταιρεία Ε. Ι. ΠΑΠΑΔΟΠΟΥΛΟΥ Α.Β.Ε.Ε. παρείχε τα στοιχεία πωλήσεων από το ERP σύστημα της και αφορούν τις περιόδους από τον Ιανουάριο του 2012 έως τον Δεκέμβριο του 2022. Το σύνολο των δεδομένων αποτελείται από μηνιαίες παρατηρήσεις, κατηγοριοποιημένες σε τέσσερις κύριες ομάδες προϊόντων. Οι

πωλήσεις της εταιρείας είναι B2B καθώς οι πελάτες της είναι οι χονδρέμποροι και όχι οι τελικοί καταναλωτές.

Συνοπτικά, οι στατιστικές ιδιότητες των χρονοσειρών θα αναλυθούν με τη μέθοδο της πολυγραμμικής παλινδρόμησης, καθώς είναι ένα εύχρηστο, ακριβές και ανέξοδο εργαλείο που μπορεί να χρησιμοποιηθεί από την διοίκηση στη διαδικασία λήψης αποφάσεων. Όλοι οι υπολογισμοί γίνονται στο Excel, με το εργαλείο ανάλυσης δεδομένων. Στη συνέχεια, με βάση τις στατιστικές ιδιότητες των ιστορικών παρατηρήσεων, θα αξιολογηθούν τα μοντέλα πρόβλεψης για τις τέσσερις κατηγορίες ως προς την απόκλιση από τις πραγματικές τιμές. Τα αποτελέσματα της παραπάνω ανάλυσης δείχνουν ότι τα μοντέλα πρόβλεψης δύνανται να εκτιμήσουν τις πωλήσεις σε ικανοποιητικό βαθμό και για τις τέσσερις κατηγορίες. Οι περιορισμοί αυτής της έρευνας αναφέρονται στο τέλος της διατριβής και ακολουθούν οι προτάσεις για μελλοντική έρευνα.

Λέξεις - Κλειδιά

Ανάλυση χρονολογικών σειρών, πρόβλεψη πωλήσεων, αγορά τροφίμων, δείκτης σφάλματος πρόβλεψης (MAE - MAPE).

Abstract

The goal of every business is success which can be achieved by efficient strategic planning. The strategies rely on predictions about the future and their effectiveness depends on their accuracy. Advanced forecasting tools are vital for the company's future as they provide input for the decision-making process and strategic planning. Companies usually need forecasts regarding sales, expenditures, and profit or losses. Based on structured forecasts and historical data, the entities cannot only plan the future and set goals but also evaluate their performance. Additionally, forecasts are a core input for the company's budget as they help to decide the sources allocation and its action plan. Furthermore, the updated predictions may support the market positions of a company by the trend capture and enhance its competitiveness.

The objective of this thesis is to analyze the statistical properties of the sales data by a Greek company which operates the last one hundred years in the bakery market. The company is a leader in the local market and has a significant growth in exports as well. The company, E. J. Papadopoulou S.A., provided the sales data from its ERP system and regard to the periods from January 2012 to December 2022. The data set consists of monthly observations, categorized to four main product groups. The company's sales are B2B as its customers are the wholesalers, not the final consumers.

In summary, the statistical properties of the time series will be analyzed by the multilinear regression method, as it is an easy-to-use, accurate, and costless tool that can be used by the managers for the decision-making process. All the calculations are done in the excel, with the data analysis tool. Then, based on the statistical properties of the historical observations, the forecasting models for the four categories were evaluated in terms of deviation from the actual values. The results of the above analysis indicate that the forecasting models predict the sales in a satisfactory lever for all categories. The limitations of this research are referred at the end of the thesis followed by the recommendations for future research.

Keywords

Times series analysis, sales forecasting, multilinear regression method, food industry, accuracy prediction index (MAE - MAPE).

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1. Introduction

The global business environment is characterized by uncertainty and volatility. The contemporary word is highly interconnected, provided to the companies access to enormous economies but at the same time enterprises became more vulnerable to various factors that cannot predict. In this uncertain business climate, a framework based on forecasting methods could be used to enhance the decision make process. The forecasting tools are broadly used to the economic and business decision-making despite the limitations and the uncertainty.

It is widely known that accurate forecasts enhance the financial soundness and enchant customers and employees (Moon *et al.*, 1998). Business entities naturally use forecasts for short-term or long-term decisions based on the historical data. Sales forecasts is the most common practice and usually they are the driver for the future investments, source allocating, marketing planning and making informed decisions. Although the sales forecasting is a common practice for decision making, there are several factors that cannot be predicted. Economic history abounds of unexpected recessions as for example the financial crisis at 2009, or surprising economic prosperity, as for example the Japan at 1980 (Makridakis, Hogarth and Gaba, 2009). The most recent unpredictable situation that affected the global economy is the COVID-19 pandemic which brought about to a lot realignments and risks for the business and social world.

The present thesis will examine the historical sales data of a food company to analyse the regression forecasting models and to compare the accuracy of these models to actual performance. Furthermore, there will be studied the influence of the unpredicted pandemic to the company's sales.

1.1 Study purpose and research topics.

The scope of the thesis is to analyze commercial sales data from the company E. J. Papadopoulou S.A. using an array of time series models. First, the statistical properties of the data will systematically be analyzed. Afterward, the accuracy of the forecasting models will be examined compared to the actual data, with the view of providing

efficient insights that can be used by the management team in the decision-making process. Company's sales data consist of monthly sales for the period 2012-2022 classified into four main categories.

This thesis aims at addressing the following research questions.

1. Examine the statistical properties of the time series (data).

2. Identify sales patterns and perform a comparative analysis of forecasting models.

3. Study whether the sales forecasts are valuable for the decision-making process.

1.2 Thesis structure

This thesis is organized in six chapters following the abovementioned topics. The first chapter is an introductive one, providing information on the topics of this thesis and the reason why they should be studied.

The second chapter will shortly present the company, its history, and the position in the domestic economy and the plans.

The next chapter will present the data set, the collection process, and the transformation in an efficient format, suitable for the current research.

The fourth chapter is the empirical analysis of the time series. The results of the regression analysis will be discussed in detail for each one of the four product categories. Furthermore, in this section we will examine the time lag of the dependent value by introducing delay terms. Finally, the effect of the covid pandemic will be examined in terms of statistical significance.

The fifth chapter contains the conclusions of the study regarding the questions set at the beginning of the thesis while the last chapter describes the limitations of the current study and provide guidelines for future research.

2. Company's profile

The company that provided all the above data is a leader in the bakery market. Although it is known for the biscuits it produces, the company has a wide range of products that are highly consumed. The company origins in Constantinople, back in 1926, but the entity in Greece was established in 1922. In the beginning, the company operated as a home workshop and in 1938 the first production plant was created in Attica. During the first world war the factory was ordered by the German army and its products were intended for their troops.

The year of 1957 is a milestone for the subsequent development of the company as the first large and modern factory is established in Attica. The 1970s bring new accomplishments. The company's logo is established, a second factory in Thessaloniki is being built and, in 1979, and the company's best-known product, Caprice, was launched. In the following decade, the company's third factory started operating, in Volos, and the company expanded its activity in the bakery sector. In the mid-1990s, the management of the company changed, and the company is now managed by Ioanna Papadopoulos, who has the reins to this day. A new development chapter started including investments and the new products launching. The fourth production plant is established in Oinofyta, Greece, and the position of the company grows further in the Greek market.

The company today, is present to sixty countries and its portfolio is rather broad as it includes both the company's traditional products and new products that meet the nutritional needs of consumers, such as sugar-free or gluten-free goods. The company owns the above-mentioned plants (located in Athens, in Thessaloniki, at Volos and in Oinofita), and a Logistics Center in the location of Aspropyrgos. The facilities are structured and operate based on quality standards.

The E. J. Papadopoulou S.A. is a Greek company that supports the society and the economy. It is known for the social contribution to vulnerable groups and for the implementation of actions to inform children regarding healthy eating habits. The company currently employs more than 1500 workers, and it is included in the ten best

employers in the country, while it has also been distinguished as the best supplier for the year 2021.

3. Data set

The first step for a regression analysis is the collection of the suitable data. The company provided the monthly sales for the period 2012-2022 per product, in euro. The information was retrieved from the ERP program of the company "E & J Papadopoulou S.A.". As the entity kindly requested to use the data without reference to the specific brands, the present study simply refer to the brands as Category A, Category B, Category C and Category D.

The data set, in its pure form, has no missing or extraordinary values. The amount of data due to the wide range of codes is excessive and difficult to manage. For this reason, the sales of the products were summed up in four categories, following the marketing structure of the company. Next, we transformed the monthly sales to the natural log of the actual data to dampen variations for the examined period.

The time series spans the period from 01.01.2012 to 31.12.2022 and the total amount of the sales is equal to the total revenue of the company. In this sense, the time series has accurate data and there are no missing values. The data set is adequate for the research as it includes five hundred and thirteen (513) monthly observations. The number of observations is one hundred and thirty-two for the categories B, C and D but for the category A the number of observations is one hundred and seventeen. For this category (Cat A) the available data are less, as the company has launched these products in April 2013.

The data set that will be examined to this thesis is presented at the table in the appendix. The data have been transformed to the natural logarithm form in excel using the formula LN(.). The sales are in euro and state the B2B activity, meaning the company's sales to the wholesalers, not to the final consumers.

3.1 Descriptive statistics

Descriptive statistics for each category are generated in Excel using the Data Analysis tool and the results are presented in the Table 1. Descriptive statistics allow the simple interpretation of time series and the visualization of a complex set of quantitative data. The main statistics to be reviewed is the mean, the standard deviation, and the distribution shape for each category. Category C is the one with the highest mean and dominates to the company's total sales. The lowest mean appears in the category B.

Analytically, the mean of the category A is 2.169.082,23, which indicates that this category is not the most important driver of total sales. The standard deviation (SD) is high, which indicates a significant volatility. Finally, the skewness of the cat A is close to zero, which means that the data set has a normal distribution with no outliers. This is also confirmed by the negative kurtosis which indicates that the tails of the distribution are thin.

	CAT A	CAT B	CAT C	CAT D
Mean	2.169.082,23 €	599.587,59 €	10.384.689,88 €	2.192.678,88 €
Standard Error	88.140,63 €	24.742,84 €	174.106,41 €	34.705,22 €
Median	2.237.806,00 €	540.706,06 €	10.225.256,37 €	2.180.857,89 €
Mode	#N/A	#N/A	#N/A	#N/A
Standard Deviation	953.386,67 €	284.273,61 €	2.000.330,34 €	398.732,63 €
Sample Variance	908.946.151.216,34 €	80.811.485.229,38 €	4.001.321.466.160,20 €	158.987.711.506,56 €
Kurtosis	-0,94	-0,61	0,54	0,72
Skewness	0,06	0,60	0,68	0,73
Range	4.066.833,57 €	1.136.085,15 €	10.221.944,68 €	1.902.530,64 €
Minimum	229.246,02 €	193.062,76 €	6.527.665,83 €	1.472.557,83 €
Maximum	4.296.079,59 €	1.329.147,91 €	16.749.610,51 €	3.375.088,47 €
Sum	253.782.621,12 €	79.145.561,87 €	1.370.779.063,58 €	289.433.611,74 €
Count	117	132	132	132

Table 1 Descriptive Statistics

The sales of the category B contribute less to the total sales and have the lowest mean. Although, the standard deviation is high for this category, is not important for the total sales. The skewness of this category's data set is also close to zero, which means that the data set has a normal distribution.

Category C includes the most acknowledge products of the company and has the highest mean, as these products contribute at almost 70% to the total sales. The standard deviation is also high and indicates that the observations are mostly far from the mean.

Skewness for this category is close to zero and verifies the normal distribution of the data set.

The products included in the category D have the second highest mean, although is significant far away from the category C. The contribution of this category to the total sales is close to the one of the category A. The standard deviation (SD) is small and indicates that the vulnerability of this category is insignificant. As the skewness points, the distribution of this data set is also the normal one.

As the Table 2 presents, all categories have the highest mean at the year 2022. The trend for the mean is upward for all categories as Figure 1 presents. The category C has the highest sales value throughout the period under review.

	CAT A		CAT B		CAT C		CAT D	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2012			252.332,28	59606,52	9.546.145,39	1442016,62	1.941.171,65	204079,51
2013	678.934,40	206.113,21	314.510,94	69.965,68	9.493.512,77	1.554.558,69	1.887.297,86	205.197,91
2014	1.048.172,75	165.551,33	375.788,48	51.798,68	9.552.389,53	1.637.423,46	1.975.447,66	235.588,71
2015	1.183.734,86	181.816,62	400.782,40	99.649,54	9.544.313,65	1.658.570,00	1.909.212,02	335.609,50
2016	1.675.140,44	338.491,37	470.564,04	84.661,49	9.650.282,03	1.691.005,92	2.004.872,99	261.629,78
2017	2.036.814,74	203.347,25	525.529,13	109.940,70	9.692.965,99	1.812.207,17	2.100.477,00	245.174,94
2018	2.315.998,89	328.526,64	678.244,47	134.976,15	9.985.303,62	2.109.562,67	2.182.554,77	249.666,25
2019	2.676.466,99	234.581,85	820.973,20	232.225,05	11.068.077,26	1.930.834,67	2.341.850,05	300.873,28
2020	2.909.674,02	208.356,95	838.625,72	206.741,78	11.403.827,78	1.365.845,67	2.449.686,05	367.967,26
2021	3.121.592,85	247.104,66	919.025,91	178.059,72	11.317.021,95	1.648.144,08	2.512.199,14	351.038,00
2022	3.671.755,43	427.624,52	999.086,93	159.373,12	12.977.748,66	2.272.251,37	2.814.698,47	337.536,10

Table 2 Descriptive Sales Analysis per year and category

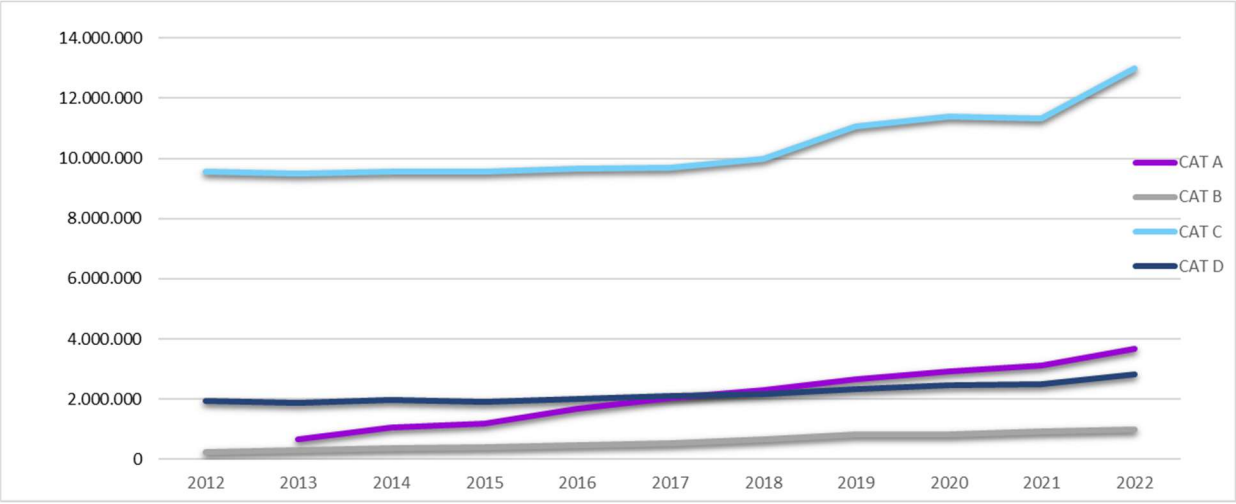

Figure 1 Mean per year and per category.

3.2 Time series properties

The most common features of the times series are the trend, the periodicity, the intercorrelation and the noise of the data set, which express the irregular fluctuation of the observations. The trend presents the tendency of the data set to go upwards or downwards through a long-time period. The periodicity is a special case of trend and regards to repeated patterns of behavior throughout the time periods. A special case of periodicity is the seasonality, where the time period is usually equal to a year (Thomaidis, 2021). The intercorrelation or cross dependence is the mutual connection between two or more variables, usually independent.

At the below section we will use the graphical analysis to present the above-mentioned characteristics of the sales data by category and to study the times series properties in order to understand the behavior of the variables and to identify any patterns.

Cat A

The observations of this data set are 117 as the company produced this category no sooner than the April of 2013. Although the products of this category were launched later, its contribution to the total sales at the reference period (2012-2022) is 12,73%. Observing the plot Figure 2, we can claim that there is a periodicity and there is an upward trend through the years. The monthly box plot, Figure 3, that follows demonstrates that the higher sales volume is in August and the lowest volume occurs in April. It will be safe to say that at the summer season the sales increased probably due to the increasement of the final consumers (tourist season). The sales are also high in November due to upcoming holiday season. The minimum points of the sales are occurred in April. The medians of the box plots are at the same level, but the distributions are different. Finally, there are some outliers in the sample.

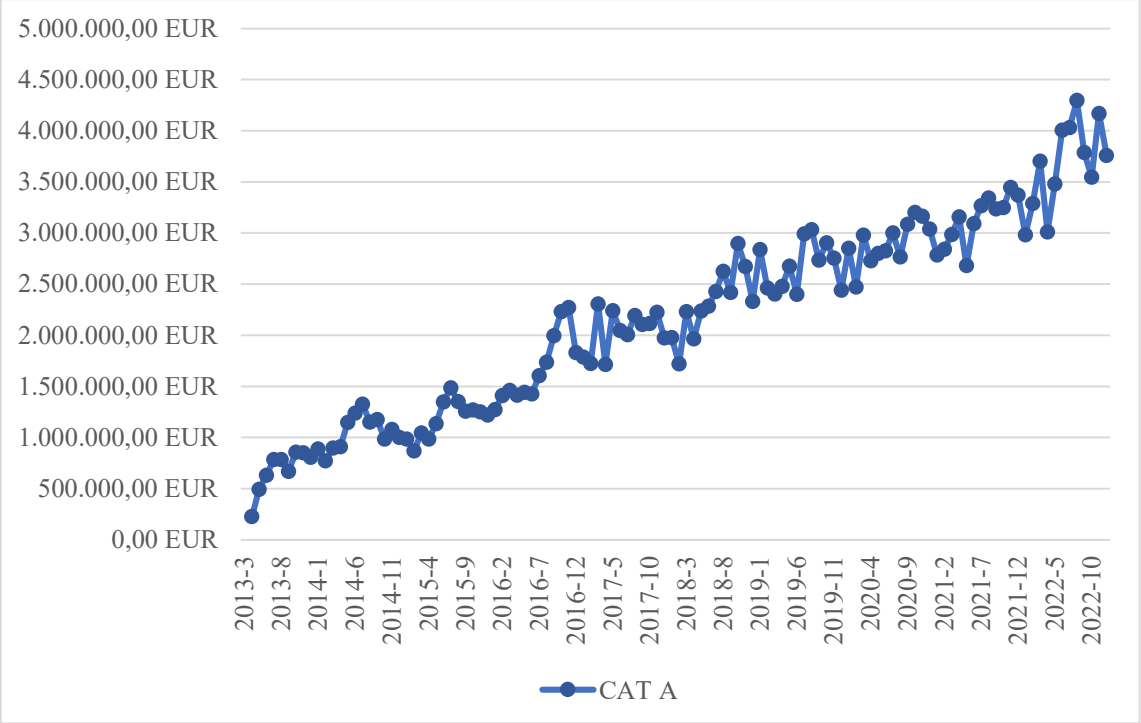

Figure 2 CAT A Sales over time

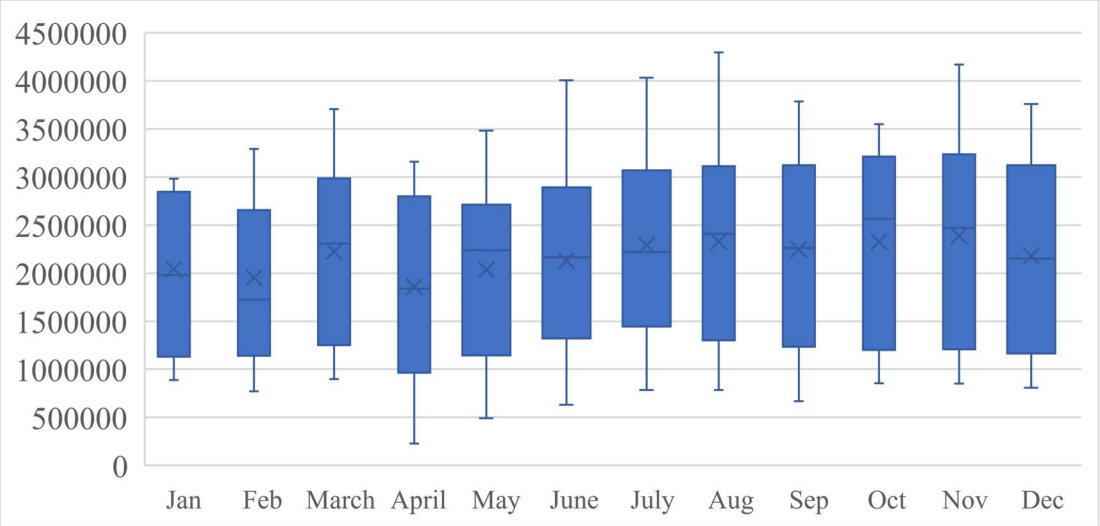

Figure 3 CAT A Sales over period

Cat B

The below plot, Figure 4, shows that there are no missing values and that there is an upward trend to this data set. The products of the category B have the lowest contribution to the total sales, 3.97%. The box plot for the category B, Figure 5, shows that the data set has outliers, and that the median varies through the months. The top

sales occurred in October and the lowest on August. Since the company is in the food market and as the summer the consumption increases, it will be interesting to examine the correlation of the specific product category with the sales of the other three categories to study whether the lowest sales levels of this category are related to the products or to the company's strategy due to limited resources. This will be implemented to the next section.

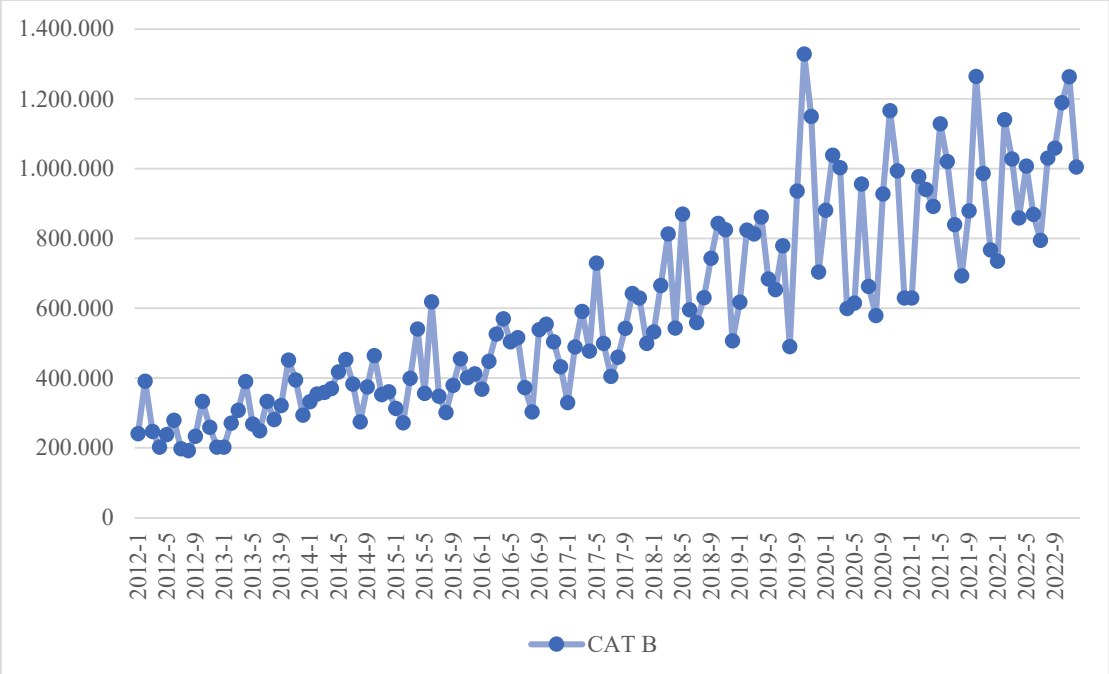

Figure 4 CAT B Sales over time

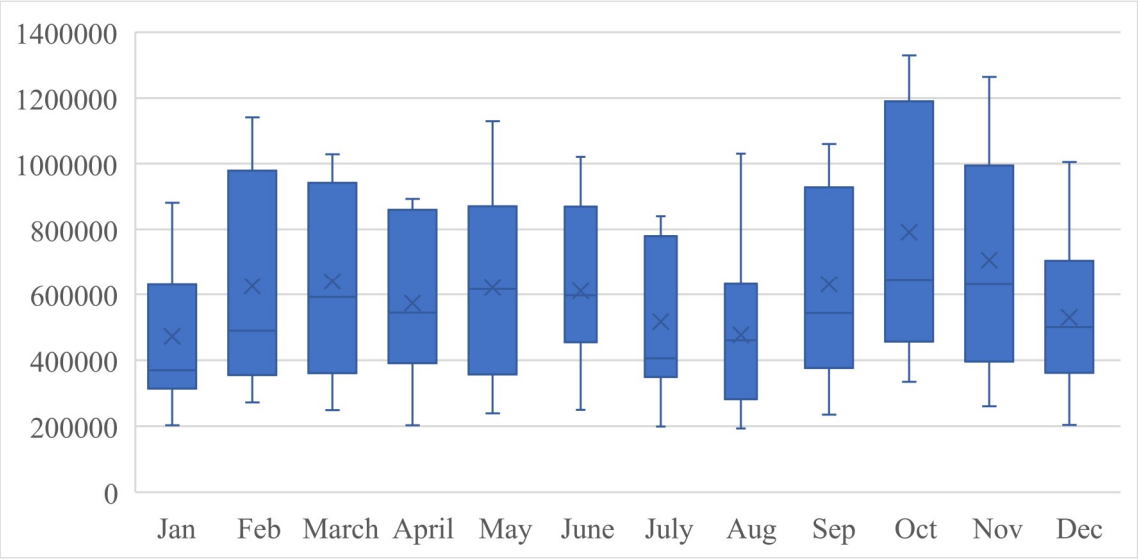

Figure 5 CAT B Sales over period

CAT C

Figure 6 presents the time evolution of sales (in euros) for the products of the category C. This category is the flagship of the company's brands as the 68.77% of the entity's total revenue was by the product of this category. The data set of the category C has zero missing observations. The trend is slightly upward, compared to the trend of the previous categories, CAT A and CAT B. There is also a periodicity which will be examined with advanced statistical tools at the next chapters.

The box chart of this category (Figure 7) has also differences compared to the above. The median is in several levels, the distributions are different, and the sample has outliers. The highest sales revenue is in July and the lowest one on January.

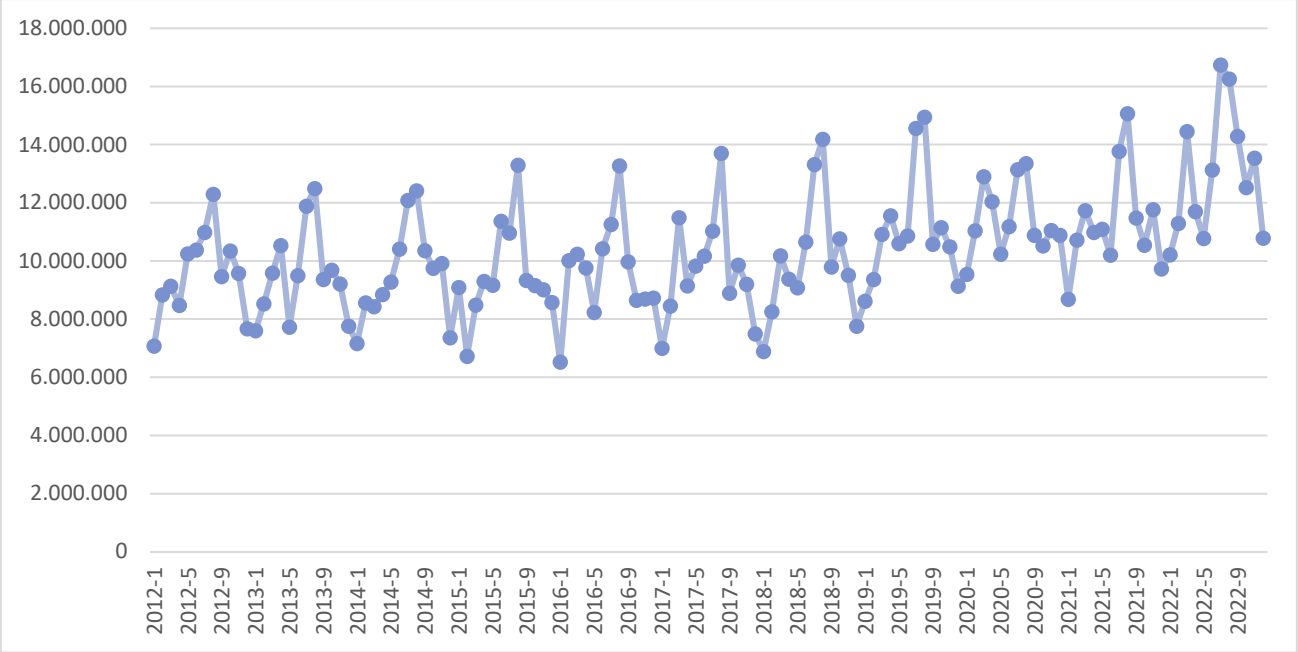

Figure 6 CAT C Sales over time

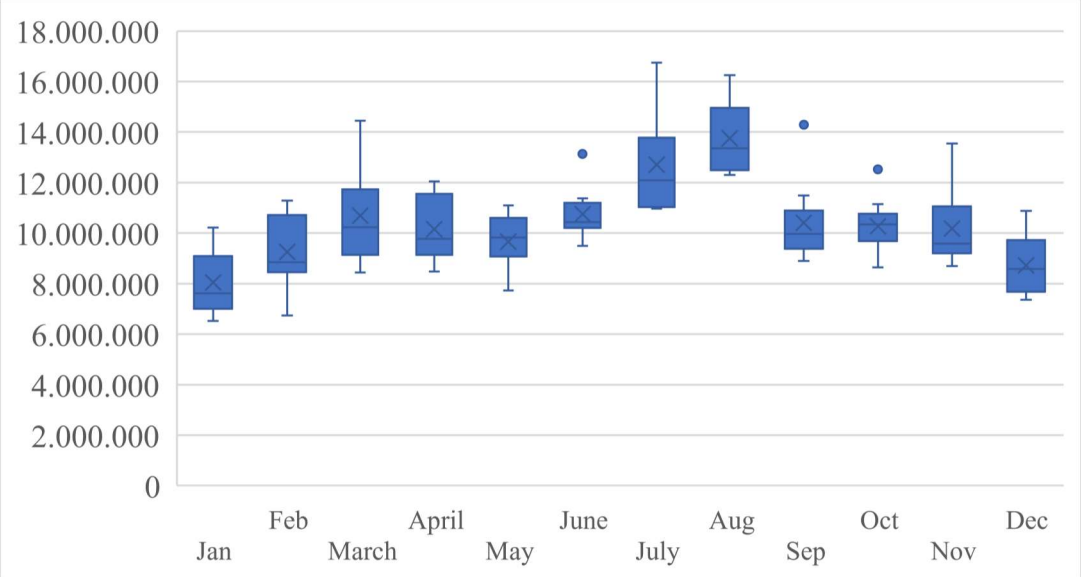

Figure 7 CAT C Sales over period

CAT D

The Figure 8 is the plot for the sales of the category D. The data set has zero missing values, and the trend is slightly upward. There are several fluctuations which are not constant during the reference period. The Figure 9 presents the box plot of the data set. The minimum of the data set is observed in February and the maximum on March. The sample has several outliers, the distribution and the median are different through the periods (months).

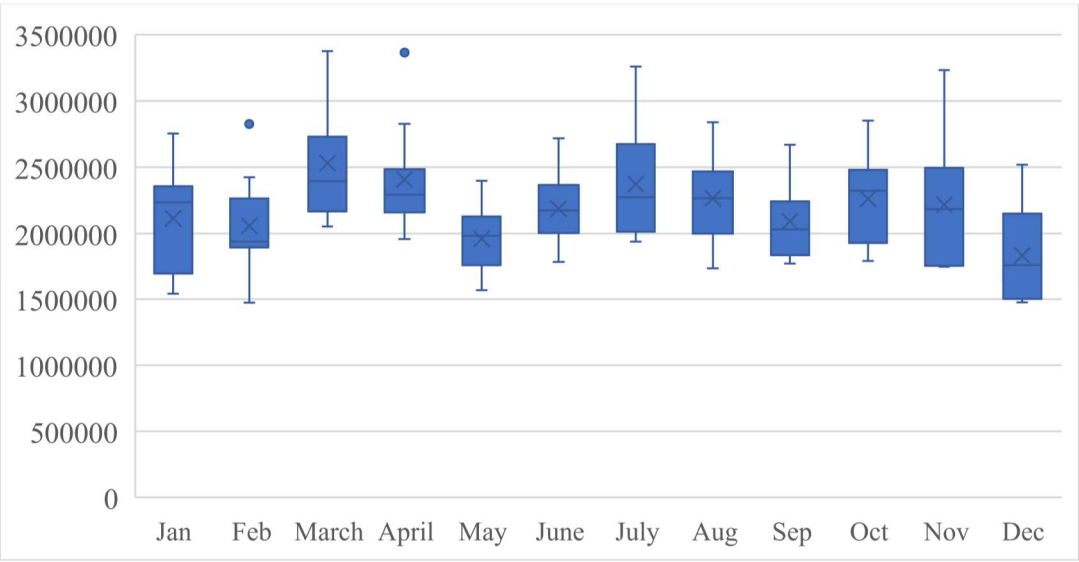

Figure 8 CAT D Sales over time

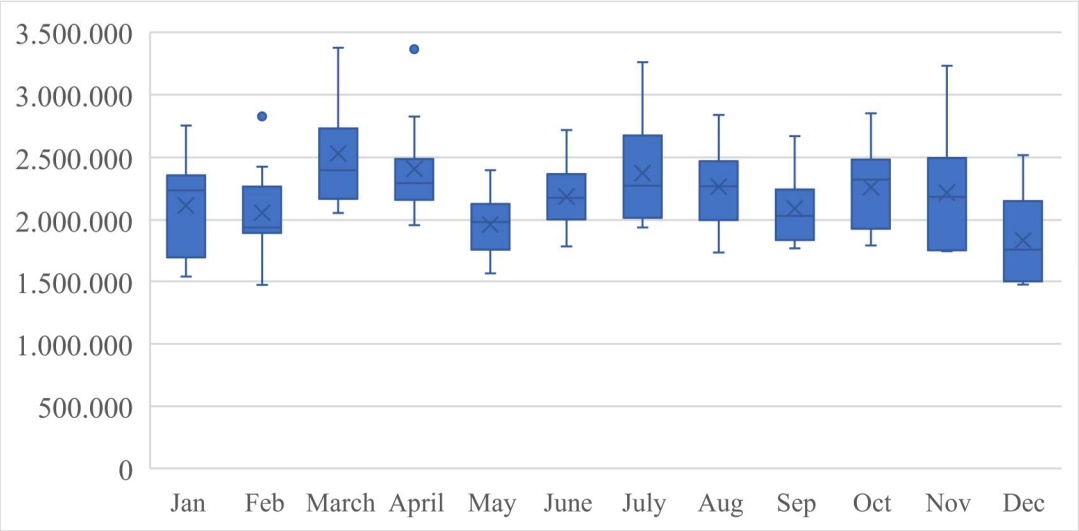

Figure 9 CAT D Sales over periods

3.3 Regression Analysis

This chapter presents the regression analysis results for the above-mentioned data sets and studies the statistical properties of the time series for each category.

The sales data are converted to the natural logarithm in excel using the function LN(.) to deflate the exponential increasements and reduce the heteroscedasticity.

To quantify the seasonality using the regression analysis we will use the below monthly dummy variables, Table 3. This variable takes the number one if the observation is related to this month, otherwise is equal to zero. As usual, one variable, here the M12 – December, is excluded to avoid the adverse effects of multicollinearity.

Month	*Index*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*	*M7*	*M8*	*M9*	*M10*	*M11*
1	10	1	0	0	0	0	0	0	0	0	0	0
2	11	0	1	0	0	0	0	0	0	0	0	0
3	12	0	0	1	0	0	0	0	0	0	0	0
4	13	0	0	0	1	0	0	0	0	0	0	0
5	14	0	0	0	0	1	0	0	0	0	0	0
6	15	0	0	0	0	0	1	0	0	0	0	0
7	16	0	0	0	0	0	0	1	0	0	0	0
8	17	0	0	0	0	0	0	0	1	0	0	0
9	18	0	0	0	0	0	0	0	0	1	0	0
10	19	0	0	0	0	0	0	0	0	0	1	0
11	20	0	0	0	0	0	0	0	0	0	0	1
12	21	0	0	0	0	0	0	0	0	0	0	0

Table 3 Monthly Dummy Variables

At the same regression model the time lagged variables are included, to study the time lag properties of the time series. Three variables added to the model, the Y_{t-1}, Y_{t-2} and $Y_{t-3,}$ which are equal to the sales of the same category of one month, two months or three months ago respectively.

The model that will be examined for all categories has the below formula:

$$Y_t = \beta_0 + \beta 1M1 + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 9M9 + \beta 10M10 + \beta 11M11 + a1Yt - 1 + a2Yt - 2 + a3Yt - 3 + \gamma t + et$$

where:

- β_o is the intercept
- M_i is the month index, for i = 1,2,3,4,5,6,7,8,9,10,11
- β_i are the coefficient for the monthly dummy variables
- Y_{t-1} is the sales of the previous period
- a_1 is the coefficient of the Y_{t-1} variable
- Y_{t-2} is the sales of two periods ago
- a_2 is the coefficient of the Y_{t-2} variable
- Y_{t-3} is the sales of three periods ago, the lagged variables
- a_3 is the coefficient of the Y_{t-3} variable
- γ_t is the coefficient for the linear trend, the slope

To examine the statistical significance of each independent variable we will use the p-value generated by the regression analysis. This approach is used to hypothesis testing and presents the measure of the evidence that will drive to reject or not the null hypothesis.

For the purposes of this study the hypothesis test is a two-tail t-test with the null hypothesis is that the above-mentioned coefficients (a_i, β_i) are equal to zero and the alternative hypothesis is that these coefficients are not equal to zero. This test is formulated as H_0:a_i,b_i = 0 and H_1:a_i,b_i $\neq$ 0. The significance level is equal to 5% and will be compared to the coefficient's p-value. If the p-value is greater than 5% the null

hypothesis cannot be rejected, and the coefficient is considered as statistically insignificant.

During the below analysis there will be cases where the p-value is in the interval of 5%-10%. In this case we can consider the variable statistically significant at 0.1 level of confidence and this assertion will be supported by the F-statistic. The F-statistic is used to test whether all the coefficients of the model, apart from the intercept, is equal to zero. A low F-statistic allows to reject the null hypothesis and consider that the coefficients are statistically significant.

CAT A

The summary output of the regression analysis is shown in the Table 4. The model explains the 97% of the variance of the dependent value, which is highly accepted.

By implementing the P-value test, we conclude that the coefficients of the M_1, M_2, M_4, M_9 and Y_{t-3} are statistical insignificant for a significance level 5% and should be excluded from the model.

The coefficients of the statistically significant independent variables (M_3, M_4, M_5, M_6, M_7, M_8, M_{10}, M_{11}, Y_{t-1} and Y_{t-2}) are greater than zero which means that affect positively (increase) the dependent variable.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,985
R Square	0,970
Adjusted R Square	0,965
Standard Error	0,089
Observations	114

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15	24,79962517	1,653308345	211,0280595	1,72323E-67
Residual	98	0,767785185	0,007834543		
Total	113	25,56741035			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,12	0,89	3,518	0,07%	1,360	4,880	1,360	4,880
Linear Trend	0,00	0,00	3,100	0,25%	0,001	0,005	0,001	0,005

β_1	0,06	0,04	1,481	14,17%	-0,021	0,147	-0,021	0,147
β_2	0,01	0,04	0,273	78,55%	-0,073	0,096	-0,073	0,096
β_3	0,17	0,04	4,080	0,01%	0,088	0,256	0,088	0,256
β_4	0,03	0,04	0,799	42,60%	-0,050	0,119	-0,050	0,119
β_5	0,14	0,04	3,231	0,17%	0,053	0,220	0,053	0,220
β_6	0,14	0,04	3,271	0,15%	0,054	0,222	0,054	0,222
β_7	0,18	0,04	4,420	0,00%	0,100	0,263	0,100	0,263
β_8	0,12	0,04	2,932	0,42%	0,038	0,197	0,038	0,197
β_9	0,06	0,04	1,389	16,80%	-0,024	0,134	-0,024	0,134
β_{10}	0,11	0,04	2,671	0,89%	0,028	0,187	0,028	0,187
β_{11}	0,11	0,04	2,816	0,59%	0,033	0,192	0,033	0,192
a_1	0,49	0,10	4,967	0,00%	0,295	0,689	0,295	0,689
a_2	0,24	0,11	2,193	3,06%	0,023	0,454	0,023	0,454
a_3	0,04	0,08	0,476	63,54%	-0,117	0,191	-0,117	0,191

Table 4 The regression Analysis Output for product CAT A Sales

CAT B

Using the Data Analysis tool in excel we received the regression results for the category B which are presented at the table below. The independent variables that are statistically significant variables, for 5% significance level, are the intercept, the linear trend, the coefficients of the dummy variables M_2, M_3, M_4, M_5, M_6, M_9, M_{10}, M_{11} and of the Y_{t-3}. The variable Y_{t-1}, the one that express the one period lag, is statistically significant for a significance level of 10%, as the p-value for this variable is 6.21%. The above variables have a positive impact to the dependent variable as they are greater than zero. The data fit very well to the regression model, as the R^2 is 90,7%. The dependent variables that are statistically insignificant and can be rejected are the M_1, M_7, M_8 and Y_{t-2}.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,952
R Square	0,907
Adjusted R Square	0,894
Standard Error	0,159
Observations	129

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15	27,56381725	1,837587816	73,0933147	7,21371E-51
Residual	113	2,840853834	0,025140299		
Total	128	30,40467108			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	7,588	1,720	4,413	0%	4,181	10,995	4,181	10,995
Linear Trend	0,007	0,002	4,455	0%	0,004	0,011	0,004	0,011
β_1	-0,016	0,077	-0,207	84%	-0,170	0,137	-0,170	0,137
β_2	0,240	0,081	2,947	0%	0,079	0,401	0,079	0,401
β_3	0,336	0,079	4,242	0%	0,179	0,493	0,179	0,493
β_4	0,224	0,071	3,170	0%	0,084	0,364	0,084	0,364
β_5	0,216	0,069	3,125	0%	0,079	0,353	0,079	0,353
β_6	0,204	0,071	2,870	0%	0,063	0,345	0,063	0,345
β_7	0,042	0,070	0,605	55%	-0,096	0,180	-0,096	0,180
β_8	-0,050	0,072	-0,694	49%	-0,193	0,093	-0,193	0,093
β_9	0,242	0,080	3,031	0%	0,084	0,401	0,084	0,401
β_{10}	0,446	0,080	5,546	0%	0,286	0,605	0,286	0,605
β_{11}	0,298	0,075	3,962	0%	0,149	0,446	0,149	0,446
a_1	0,172	0,091	1,884	6,21%	-0,009	0,352	-0,009	0,352
a_2	-0,013	0,090	-0,148	88%	-0,192	0,166	-0,192	0,166
a_3	0,216	0,090	2,409	2%	0,038	0,393	0,038	0,393

Table 5 The regression Analysis Output for product CAT B Sales

CAT C

The regression analysis for the data set of the category C is presented in the Table 6. The independent variables can explain the 81,9% of the variance of the dependent variable, which is a lower proportion compared to the previous categories but is still high. According to the P-Value test, the variables M_1, M_{10} and Y_{t-1} are statistically insignificant for a significant level of 5% and should not be included to the regression

model. The time lagged variables are statistically significant, and the corresponding coefficients are greater than zero which indicates that the sales of this category depend on the historical sales.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,905
R Square	0,819
Adjusted R Square	0,795
Standard Error	0,085
Observations	129

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15	3,685034568	0,245668971	34,0787491	6,41634E-35
Residual	113	0,814601312	0,007208861		
Total	128	4,49963588			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	7,160	2,028	3,532	0,1%	3,143	11,177	3,143	11,177
Linear Index	0,001	0,000	3,299	0,1%	0,000	0,002	0,000	0,002
β_1	-0,030	0,040	-0,763	44,7%	-0,110	0,049	-0,110	0,049
β_2	0,146	0,044	3,333	0,1%	0,059	0,232	0,059	0,232
β_3	0,324	0,044	7,280	0,0%	0,236	0,412	0,236	0,412
β_4	0,238	0,044	5,395	0,0%	0,151	0,326	0,151	0,326
β_5	0,131	0,038	3,459	0,1%	0,056	0,207	0,056	0,207
β_6	0,227	0,037	6,199	0,0%	0,154	0,299	0,154	0,299
β_7	0,396	0,037	10,619	0,0%	0,322	0,470	0,322	0,470
β_8	0,447	0,043	10,343	0,0%	0,361	0,532	0,361	0,532
β_9	0,093	0,048	1,937	5,5%	-0,002	0,187	-0,002	0,187
β_{10}	0,060	0,047	1,268	20,8%	-0,034	0,153	-0,034	0,153
β_{11}	0,096	0,045	2,155	3,3%	0,008	0,185	0,008	0,185
a_1	0,104	0,092	1,131	26,1%	-0,078	0,287	-0,078	0,287
a_2	0,234	0,091	2,585	1,1%	0,055	0,414	0,055	0,414
a_3	0,202	0,093	2,172	3,2%	0,018	0,386	0,018	0,386

Table 6 The regression Analysis Output for product CAT C Sales

CAT D

The output of the regression for the time series of the category D is presented in the Table 7. The coefficients of the time lag variables are statistically insignificant which means that sales in this category are not correlated with the sales of the previous periods. Regarding the seasonality, the M_5 is statistically insignificant at 5% significance level, but significant at 10%. Only the 69.7% of the variance of the dependent variable (sales) can be explained by the explanatory variables which indicates that there are other factors, not parametrized in this model, that affect the sales volume of this category's products. The explanatory variables have a positive effect on the expected sales of this category due to their positive sign.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,834753732
R Square	0,696813793
Adjusted R Square	0,656567836
Standard Error	0,104650869
Observations	129

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15	2,844273904	0,18961826	17,31388316	1,03468E-22
Residual	113	1,237553888	0,010951804		
Total	128	4,081827792			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	11,238	2,324	4,836	0,000	6,634	15,841	6,634	15,841
Index	0,003	0,001	4,688	0,000	0,001	0,004	0,001	0,004
β_1	0,164	0,050	3,263	0,001	0,064	0,263	0,064	0,263
β_2	0,145	0,051	2,851	0,005	0,044	0,246	0,044	0,246
β_3	0,374	0,049	7,677	0,000	0,277	0,470	0,277	0,470
β_4	0,298	0,048	6,248	0,000	0,204	0,393	0,204	0,393
β_5	0,086	0,048	1,810	0,073	-0,008	0,180	-0,008	0,180
β_6	0,172	0,050	3,427	0,001	0,072	0,271	0,072	0,271
β_7	0,262	0,048	5,416	0,000	0,166	0,358	0,166	0,358
β_8	0,231	0,046	5,055	0,000	0,141	0,322	0,141	0,322
β_9	0,136	0,045	2,992	0,003	0,046	0,226	0,046	0,226
β_{10}	0,203	0,046	4,376	0,000	0,111	0,295	0,111	0,295
β_{11}	0,179	0,046	3,913	0,000	0,089	0,270	0,089	0,270
a_1	0,018	0,094	0,191	0,849	-0,168	0,204	-0,168	0,204
a_2	0,060	0,095	0,635	0,527	-0,128	0,249	-0,128	0,249
a_3	0,127	0,095	1,330	0,186	-0,062	0,315	-0,062	0,315

Table 7 The regression Analysis Output for product CAT D Sales

3.4 Cross dependence study

This chapter will present the results from the analysis regarding the cross dependence between the sales in the four categories of products. To test cross correlation, whether the dependent variables move in coordination, a two tail hypothesis test will be run. The null hypothesis is that the coefficient of the explanatory variable is equal to zero and the alternative hypothesis is that this coefficient is not equal to zero. For the given data set the null hypothesis will be Ho: $a_i = 0$ and the alternative hypothesis is H_1: $a_i \neq 0$, for i=A, B,C,D. The dependence between these categories will be examined below through the regression analysis.

CAT A

First, will be examined whether the sales of the category A depend on the sales of the other categories. The model has the formulation:

$$Yt = \beta o + \beta 3M3 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 10M10 + a1Yt - 1 + a2Yt - 2 + aBYBt + aCYCt + aDYDt + \gamma t + et$$

and the regression analysis results are presented at the below table. The coefficient of the CATB sales, a_B, is statistically significant at 10% but insignificant at 5%. Regarding the correlation between the sales of category A and category C there are enough evidence to claim that there is no dependence. The coefficient of the CATD is statistically significant which means that if anything else is unchanged, if the sales of the category D increased per one unit, the forecasted sales of the category D will be increased by 0.196 units.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,986							
R Square	0,973							
Adjusted R Square	0,969							
Standard Error	0,085							
Observations	115							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	13	26,15	2,01	276,36	0,00			
Residual	101	0,74	0,01					
Total	114	26,89						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	0,44	1,67	0,26	0,79	-2,87	3,76	-2,87	3,76
Linear Trend	0,00	0,00	1,88	0,06	0,00	0,00	0,00	0,00
β_3	0,09	0,04	2,40	0,02	0,02	0,16	0,02	0,16
β_5	0,11	0,03	3,15	0,00	0,04	0,17	0,04	0,17
β_6	0,11	0,03	3,27	0,00	0,04	0,17	0,04	0,17
β_7	0,14	0,04	3,27	0,00	0,05	0,22	0,05	0,22
β_8	0,10	0,05	2,09	0,04	0,01	0,20	0,01	0,20
β_{10}	0,04	0,03	1,21	0,23	-0,03	0,11	-0,03	0,11
β_{11}	0,06	0,03	1,94	0,05	0,00	0,12	0,00	0,12
$Y_{A(t-1)}$	0,51	0,09	5,99	0,00	0,34	0,68	0,34	0,68
$Y_{A(t-2)}$	0,21	0,07	3,04	0,00	0,07	0,35	0,07	0,35
a_B	0,10	0,05	1,94	0,05	0,00	0,21	0,00	0,21
a_C	-0,05	0,09	-0,48	0,63	-0,23	0,14	-0,23	0,14
a_D	0,20	0,08	2,40	0,02	0,03	0,36	0,03	0,36

Table 8 Cross Dependence of Cat A to other categories

CAT B

The below table presents the regression output of the model $Yt = \beta o + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 9M9 + \beta 10M10 + \beta 11M11 + a1Yt - 1 + a3Yt - 3 + + aAYAt + aCYCt + aDYDt + \gamma t + et.$

The observations are one hundred and seventeen, because of the fewer available data regarding the category A.

As the p-value of the coefficients a_A, a_C, a_D is above the 10% there are not enough evidence to reject the null hypothesis. So, there is no evidence that the sales of the other categories affect the expected sales of the products included in the category B and the variables are not cross-depended.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,938							
R Square	0,879							
Adjusted R Square	0,863							
Standard Error	0,159							
Observations	117							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	14	18,68395592	1,33456828	53,06374725	2,5E-40			
Residual	102	2,565328904	0,025150283					
Total	116	21,24928482						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,506	2,627	1,716	0,089	-0,704	9,716	-0,704	9,716
Linear Trend	0,006	0,002	3,167	0,002	0,002	0,009	0,002	0,009
a_2	0,257	0,062	4,156	0,000	0,134	0,379	0,134	0,379
a_3	0,295	0,070	4,183	0,000	0,155	0,434	0,155	0,434
a_4	0,229	0,069	3,337	0,001	0,093	0,365	0,093	0,365
a_5	0,252	0,058	4,330	0,000	0,137	0,367	0,137	0,367
a_6	0,194	0,057	3,409	0,001	0,081	0,307	0,081	0,307
a_7	0,254	0,060	4,243	0,000	0,135	0,373	0,135	0,373
a_{10}	0,430	0,062	6,992	0,000	0,308	0,552	0,308	0,552
a_{11}	0,303	0,069	4,371	0,000	0,165	0,440	0,165	0,440
Yt-1	0,135	0,089	1,526	0,130	-0,041	0,311	-0,041	0,311
Yt-3	0,182	0,093	1,957	0,053	-0,003	0,367	-0,003	0,367
a_C	-0,001	0,111	-0,012	99%	-0,222	0,220	-0,222	0,220
a_D	0,208	0,155	1,342	18%	-0,099	0,515	-0,099	0,515
a_A	0,065	0,083	0,783	44%	-0,099	0,229	-0,099	0,229

Table 9 Cross Dependence of Cat B to other categories

CAT C

To examine the intercorrelation for the sales of the products on category C to the products of the other categories the regression for below model will be run in excel

$$Yt = \beta o + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 9M9 + \beta 11M11 + a2Yt - 2 + a3Yt - 3 + + aAYAt + aBYBt + aDYDt + \gamma t + et.$$

The summary output is presented below. Observing the P-value of the coefficients we have enough evidence to reject the null hypothesis for the coefficients a_B and a_D and state that the sales of the category C depend on the sales of the category B and the category D. On the contrary there is not enough evidence that the sales of the category A affect the sales of the category C, as the coefficient a_C is statistically insignificant.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,927							
R Square	0,859							
Adjusted R Squ	0,838							
Standard Error	0,077							
Observations	117							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	15	3,604637481	0,240309165	40,95727382	4,40543E-36			
Residual	101	0,592598663	0,005867313					
Total	116	4,197236145						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,8784	1,6149	3,0208	0,3%	1,6748	8,0820	1,6748	8,0820
Linear Trend	0,0002	0,0007	0,2955	76,8%	-0,0013	0,0017	-0,0013	0,0017
a_2	0,1036	0,0358	2,8956	0,5%	0,0326	0,1746	0,0326	0,1746
a_3	0,2298	0,0448	5,1315	0,0%	0,1410	0,3186	0,1410	0,3186
a_4	0,1804	0,0420	4,2915	0,0%	0,0970	0,2638	0,0970	0,2638
a_5	0,1103	0,0319	3,4544	0,1%	0,0470	0,1736	0,0470	0,1736
a_6	0,1866	0,0293	6,3747	0,0%	0,1285	0,2446	0,1285	0,2446
a_7	0,3798	0,0329	11,5372	0,0%	0,3145	0,4451	0,3145	0,4451
a_8	0,4706	0,0326	14,4345	0,0%	0,4059	0,5352	0,4059	0,5352
a_9	0,1079	0,0300	3,6009	0,0%	0,0484	0,1673	0,0484	0,1673
a_{11}	0,0711	0,0357	1,9891	4,9%	0,0002	0,1420	0,0002	0,1420
Yt-2	0,2415	0,0733	3,2958	0,1%	0,0961	0,3868	0,0961	0,3868
Yt-3	0,1540	0,0834	1,8458	6,8%	-0,0115	0,3195	-0,0115	0,3195
a_A	-0,0437	0,0416	-1,0487	29,7%	-0,1262	0,0389	-0,1262	0,0389
a_B	0,1139	0,0441	2,5809	1,1%	0,0264	0,2014	0,0264	0,2014
a_D	0,2627	0,0716	3,6710	0,0%	0,1207	0,4047	0,1207	0,4047

Table 10 Cross Dependence of Cat C to other categories' sales

CAT D

The regression model for this analysis is the below:

$$Yt = \beta o + \beta 1M1 + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 9M9 + \beta 10M10 + \beta 11M11 + \gamma t + et$$

The results are presented in the table 11. Following the regression analysis, the p-value of the coefficients a_A and a_B are rather high, and we do not have enough evidence to reject the null hypothesis. The coefficients are statistically insignificant and probably the sales of the category A and B are not affecting the estimated sales of the category D. On the other hand, the coefficient a_C is statistically significant and indicated that ceteris paribus if the sales of the category C, are increased by one unit, the estimated sales of the category D increased by 0.536 units.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,884							
R Square	0,781							
Adjusted R Square	0,749							
Standard Error	0,090							
Observations	117							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	15	2,92241124	0,194827416	24,082151	9,1649E-27			
Residual	101	0,817101804	0,008090117					
Total	116	3,739513044						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	4,643	1,826	2,543	1%	1,021	8,265	1,021	8,265
Linear Trend	0,001	0,001	1,171	24%	-0,001	0,003	-0,001	0,003
a_1	0,205	0,042	4,907	0%	0,122	0,288	0,122	0,288
a_2	0,074	0,043	1,707	9%	-0,012	0,159	-0,012	0,159
a_3	0,210	0,048	4,334	0%	0,114	0,306	0,114	0,306
a_4	0,180	0,045	4,016	0%	0,091	0,269	0,091	0,269
a_5	-0,001	0,043	-0,019	98%	-0,085	0,084	-0,085	0,084
a_6	0,056	0,047	1,208	23%	-0,036	0,149	-0,036	0,149
a_7	0,060	0,059	1,029	31%	-0,056	0,176	-0,056	0,176
a_8	-0,031	0,066	-0,463	64%	-0,162	0,101	-0,162	0,101
a_9	0,032	0,045	0,717	47%	-0,057	0,122	-0,057	0,122
a_{10}	0,097	0,047	2,050	4%	0,003	0,190	0,003	0,190
a_{11}	0,087	0,045	1,948	5%	-0,002	0,176	-0,002	0,176
a_A	0,021	0,048	0,430	67%	-0,075	0,117	-0,075	0,117
a_B	0,064	0,057	1,121	26%	-0,049	0,176	-0,049	0,176
a_c	0,536	0,105	5,114	0%	0,328	0,743	0,328	0,743

Table 11 Cross Dependence of Cat D to other categories' sales

3.4.1 Discussion of cross dependence

The regression analysis for the cross dependence of the category sales indicates that an intercorrelation between some categories exists but these relations are not bidirectional. The sales of the category A depend on the sales of the category D (for the significance level of 5%) and on the sales of the category B (for the significance level of 10%). Also, the sales of the products included in the category C move with the same direction with the sales of the category C and category D. Finally, the estimated sales of the products of the category D, are correlated to the sales of the category C, Table 12

	Explanatory	*Explanatory*	*Explanatory*	*Explanatory*
	CAT A	CAT B	CAT C	CAT D
Independent				
CAT A		√		X
CAT B				
CAT C		X		X
CAT D			X	

Table 12 Cross Dependence[1]

3.5 Covid-19 effect analysis.

This section attempts to identify the possible effect of the pandemic to the sales and the revenue of the company E. J. Papadopoulou S.A. To examine the effect of the Covid-19 to the sales, a new dummy variable was introduced to the model equation. The covid-19 dummy variable distinguishes the periods during which there are lock downs in Greece from the periods that there were not stringent policies for the pandemic. The period from Jan-2012 to Feb-2020 is a non-covid period as the first case of the Covid-19 in Greece was confirmed on 26th of February 2020. The period from March 2020 to June 2020, observations 99-102, the first lockdown was implemented to the country. Even if the restrictions were graduated lifted since May 2020, we consider that the situation was not very different before the July of the same year. New measures were put in place from November of 2020 until the May of 2021, where the restrictions where eased. The above-mentioned periods are considered as the months with lock down and the corresponding observations, 99-102 and 107-113, have the value 1 at the dummy variable.

The below sections present the regression analysis output for each category.

[1] √ Ho: Not rejected for 10% level of significance
x: Ho: Not rejected for 5% level of significance

CAT A

The Model for the category A, due to the significance tests of the previous chapter is the following: $Yt = \beta o + \beta 3M3 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \alpha t - 1\, Yt - 1 + at - 2\, Yt - 2 + \gamma Ct + et.$

The above-mentioned regression model can explain the 97% of variance of the sales, which is extremely satisfied. As expected, all the explanatory variables are statistically significant apart from the covid dummy variable, as shown at the Table 13. The p-value test is 0.158 which means that we don't have enough evidence to reject the null hypothesis and the coefficient is equal to zero. Thus, the sales of this category are not affected by the pandemic.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,985							
R Square	0,970							
Adjusted R Square	0,966							
Standard Error	0,089							
Observations	115							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	11	26,07206026	2,370187296	299,8607903	6,40874E-73			
Residual	103	0,814142093	0,007904292					
Total	114	26,88620235						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	3,984	0,786	5,071	0,000	2,426	5,542	2,426	5,542
Index	0,004	0,001	4,452	0,000	0,002	0,006	0,002	0,006
M3	0,141	0,033	4,215	0,000	0,075	0,208	0,075	0,208
M5	0,105	0,033	3,143	0,002	0,039	0,172	0,039	0,172
M6	0,117	0,033	3,561	0,001	0,052	0,182	0,052	0,182
M7	0,134	0,031	4,281	0,000	0,072	0,196	0,072	0,196
M8	0,076	0,032	2,399	0,018	0,013	0,139	0,013	0,139
M10	0,073	0,031	2,335	0,021	0,011	0,136	0,011	0,136
M11	0,080	0,031	2,585	0,011	0,019	0,142	0,019	0,142
LN Cat A t-1	0,507	0,088	5,751	0,000	0,332	0,682	0,332	0,682
LN Cat A t-2	0,199	0,070	2,866	0,005	0,061	0,337	0,061	0,337
Covid D.V.	-0,042	0,030	-1,421	0,158	-0,102	0,017	-0,102	0,017

Table 13 Regression Output - Cat A

CAT B

The Model for the category B, due to the significance tests of the previous chapter is the following: $Yt = \beta o + \beta t + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 9M9 + \beta 10M10 + \beta 11M11 + \alpha t - 1\, Yt - 1 + at - 3\, Yt - 3 + \gamma Ct + et$

The results of the regression analysis of the above-mentioned equation are shown in the Table 14. The model can explain the 90% of variance of the sales, which is satisfied. All explanatory variables are statistically significant for 10% significance level, except for the covid dummy variable which is marginally insignificant. According to the below findings, the covid-19 did not affect the sales volume of the category B. The statistically significant explanatory variables have a positive effect on the sales.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,952							
R Square	0,907							
Adjusted R Squar	0,897							
Standard Error	0,156							
Observations	129							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	12	27,57904865	2,298254054	94,34999795	6,20784E-54			
Residual	116	2,825622428	0,024358814					
Total	128	30,40467108						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	7,183	1,474	4,874	0%	4,265	10,102	4,265	10,102
Linear Trend	0,007	0,001	4,987	0%	0,004	0,010	0,004	0,010
M2	0,254	0,056	4,530	0%	0,143	0,365	0,143	0,365
M3	0,357	0,060	5,966	0%	0,238	0,475	0,238	0,475
M4	0,240	0,059	4,104	0%	0,124	0,357	0,124	0,357
M5	0,231	0,053	4,333	0%	0,126	0,337	0,126	0,337
M6	0,212	0,053	3,985	0%	0,107	0,318	0,107	0,318
M9	0,248	0,056	4,435	0%	0,137	0,359	0,137	0,359
M10	0,451	0,056	8,080	0%	0,340	0,561	0,340	0,561
M11	0,305	0,063	4,807	0%	0,179	0,430	0,179	0,430
Yt-1	0,183	0,082	2,224	3%	0,020	0,346	0,020	0,346
Yt-3	0,222	0,083	2,686	1%	0,058	0,386	0,058	0,386
Covid D.V.	-8,3%	0,053	-1,577	12%	-0,188	0,021	-0,188	0,021

Table 14 Regression Output – Cat B

CAT C

The Model for the category C, due to the significance tests of the previous chapter is the following: $Yt = \beta o + \beta t + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 9M9 + \beta 11M11 + \alpha t - 2\, Yt - 2 + at - 3\, Yt - 3 + \gamma Ct$

The above-mentioned regression model can explain the 81% of variance of the sales, which is satisfied. All the independent variables are statistically significant, for a significance level of 5%, apart from the covid dummy variable, as presented in the summary output, Table 15. All the independent variables have a positive effect on the

estimated sales. The sales of the products of this category were not affected by the pandemic.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,900							
R Square	0,810							
Adjusted R Square	0,789							
Standard Error	0,086							
Observations	129							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	13	3,645689385	0,280437645	37,76621764	2,26987E-35			
Residual	115	0,853946495	0,007425622					
Total	128	4,49963588						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	5,964	1,368	4,361	0,000	3,255	8,673	3,255	8,673
Linear Trend	0,001	0,000	3,471	0,001	0,000	0,002	0,000	0,002
M2	0,152	0,036	4,199	0,000	0,081	0,224	0,081	0,224
M3	0,360	0,040	9,021	0,000	0,281	0,440	0,281	0,440
M4	0,280	0,038	7,276	0,000	0,204	0,356	0,204	0,356
M5	0,143	0,033	4,336	0,000	0,078	0,209	0,078	0,209
M6	0,228	0,031	7,416	0,000	0,167	0,289	0,167	0,289
M7	0,418	0,032	13,168	0,000	0,355	0,481	0,355	0,481
M8	0,478	0,032	15,011	0,000	0,415	0,541	0,415	0,541
M9	0,108	0,032	3,390	0,001	0,045	0,172	0,045	0,172
M11	0,083	0,038	2,192	0,030	0,008	0,157	0,008	0,157
Yt-2	0,336	0,076	4,433	0,000	0,186	0,487	0,186	0,487
Yt-3	0,279	0,087	3,219	0,002	0,107	0,450	0,107	0,450
Covid D.V.	0,006	0,029	0,219	83%	-0,051	0,063	-0,051	0,063

Table 15 Regression Output – Cat C

CAT D

The Model for the category D, due to the significance tests of the previous chapter is the following: $Yt = \beta o + \beta t + \beta 1M1 + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 9M9 + \beta 10M10 + \beta 11M11 + \gamma Ct$, as the time lagged variables are not significant important.

The above-mentioned regression model can explain the 68,7% of variance of the independent variable, which suggests that the sales are affected from other variables. All the independent variables are statistically significant, for a significance level of 5%, apart from the covid dummy variable. All the independent variables have a positive effect on the estimated sales. The sales of the products of this category were not affected by the pandemic, as the coefficient of the covid dummy variable is statistical

insignificant for all levels of significant efficiency. The results of the regression analysis are presented in the Table 16.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,829							
R Square	0,687							
Adjusted R Square	0,652							
Standard Error	0,105							
Observations	132							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	13	2,828923145	0,217609473	19,9039539	6,06089E-24			
Residual	118	1,290091301	0,010932977					
Total	131	4,119014446						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	14,183	0,036	392,512	0,000	14,112	14,255	14,112	14,255
Index	0,003	0,000	12,226	0,000	0,003	0,004	0,003	0,004
M1	0,174	0,045	3,873	0,000	0,085	0,263	0,085	0,263
M2	0,147	0,045	3,292	0,001	0,059	0,235	0,059	0,235
M3	0,350	0,045	7,799	0,000	0,261	0,438	0,261	0,438
M4	0,301	0,045	6,710	0,000	0,212	0,389	0,212	0,389
M5	0,096	0,045	2,155	0,033	0,008	0,185	0,008	0,185
M6	0,200	0,045	4,483	0,000	0,112	0,288	0,112	0,288
M7	0,273	0,045	6,106	0,000	0,184	0,361	0,184	0,361
M8	0,224	0,045	5,012	0,000	0,135	0,312	0,135	0,312
M9	0,145	0,045	3,251	0,002	0,057	0,234	0,057	0,234
M10	0,218	0,045	4,875	0,000	0,129	0,306	0,129	0,306
M11	0,185	0,045	4,160	0,000	0,097	0,274	0,097	0,274
Covid D.V.	-0,011	0,035	-0,312	0,755	-0,081	0,059	-0,081	0,059

Table 16 Regression Output – Cat D

2.5.1 Discussion of covid-19 effect.

The above analysis indicates that the company's sales were not affected by the pandemic during the period 2020-2021. The dummy variable of the covid was not statistically significant in any level due to high value of the p-value. It is widely accepted that the pandemic changed what was considered as "normal" worldwide, including food purchasing decisions. In this aspect we could expect that the company's sales will changed significantly during the periods with lock down measures. The findings are not according to the expectations. The above results are in accordance with the surveys which reveal that the food industry was mainly increased due to the grocery expenditures while the far-away-from-home foods purchasing was not increased (Ellison *et al.*, 2021). As the company produce and sell packaged, ready-to-eat products the findings follow the behavior of the durable goods purchasing.

4. Sales Forecasting

This chapter will focus on quantitative analysis of the regression models that have been run at the previous chapters for each one of the four categories. Based on the statistical properties of the sales time series we will perform the regression analysis to examine the efficiency of the models to forecast the sales. For this purpose, the observations will be separated to estimated sample data and forecasting sample data. The observations from January of 2012 to December of 2020 will be the estimation sample while the observations from January 2021 to December of 2022 will be the forecasting sample.

4.1 In Sample Analysis

The sample for each category has different number of observations as the regression will be run according to the above statistical analysis. In this sense, if the model (M_i) includes one or more time lag variables, the observations will be fewer since the regression could not be run on empty cells. Furthermore, the sales of the Category A started on April of 2013, which means that the sample has fifteen observations less. The model that will be estimated in excel, using the regression analysis of the data tool is the below: $Yt = \beta o + \beta 1M1 + \beta 2M2 + \beta 3M3 + \beta 4M4 + \beta 5M5 + \beta 6M6 + \beta 7M7 + \beta 8M8 + \beta 9M9 + \beta 10M10 + \beta 11M11 + a1\,Yt-1 + a2\,Yt-2 + a3Yt-3 + et.$

CAT A

The results of the regression analysis for the sales of this category are shown at the Table 17. For statistical level of 5% we have enough evidence to accept the Ho hypothesis for the coefficients M_2, M_3, M_4, M_5, M_6, M_7, M_8, M_{10}, a_2 and a_3. The value of the statistically significant coefficients is presented at the below table. The sample has 91 observations and can explain the 96,3% of the variance of the dependent value (R-Square score). The summary output of the above equation is presented in the Table 17.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,982							
R Square	0,963							
Adjusted R Square	0,961							
Standard Error	0,091							
Observations	92							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	5	18,771	3,754	453,347	3,3674E-60			
Residual	86	0,712	0,008					
Total	91	19,483						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	6,454	0,683	9,453	0,000	5,097	7,812	5,097	7,812
Index	0,007	0,001	7,671	0,000	0,005	0,009	0,005	0,009
M1	-0,123	0,036	-3,411	0,001	-0,195	-0,051	-0,195	-0,051
M9	-0,131	0,034	-3,840	0,000	-0,199	-0,063	-0,199	-0,063
M11	-0,149	0,036	-4,119	0,000	-0,220	-0,077	-0,220	-0,077
Yat-1	0,529	0,051	10,450	0,000	0,428	0,630	0,428	0,630

Table 17 In Sample Analysis – Regression Output CAT A

CAT B

The regression results from the multilinear model for the sales of the category B are presented at the Table 18. The observations are 105 and the explanatory variables interpret the 86.5 % of the variance of the independent variable. The values of the statistically significant coefficients are greater than zero, meaning that they have a positive impact on the dependent variable.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,930							
R Square	0,865							
Adjusted R Square	0,852							
Standard Error	0,172							
Observations	108							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	9	18,54848888	2,060943209	69,59807708	1,35979E-38			
Residual	98	2,901982971	0,029612071					
Total	107	21,45047185						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	12,201	0,041	297,504	0,000	12,120	12,282	12,120	12,282
Index	0,013	0,001	23,552	0,000	0,011	0,014	0,011	0,014
M2	0,249	0,064	3,873	0,000	0,121	0,376	0,121	0,376
M3	0,299	0,064	4,662	0,000	0,172	0,426	0,172	0,426
M4	0,217	0,064	3,381	0,001	0,090	0,344	0,090	0,344
M5	0,211	0,064	3,290	0,001	0,084	0,338	0,084	0,338
M6	0,241	0,064	3,754	0,000	0,113	0,368	0,113	0,368
M9	0,211	0,064	3,296	0,001	0,084	0,339	0,084	0,339
M10	0,420	0,064	6,548	0,000	0,293	0,547	0,293	0,547
M11	0,271	0,064	4,224	0,000	0,144	0,398	0,144	0,398

Table 18 In Sample Analysis – Regression Output CAT B

CAT C

The Table 19 presents the summary output of the regression analysis for the sales data of the category C. The model captures only the 63.4% of the sale's variation. The statistically significant coefficients have a positive impact to the independent variable as they have a positive sign.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,796							
R Square	0,634							
Adjusted R Square	0,612							
Standard Error	0,109							
Observations	108							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	6	2,071	0,345	29,111	5,28743E-20			
Residual	101	1,198	0,012					
Total	107	3,269						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	15,914	0,023	689,608	0,000	15,868	15,959	15,868	15,959
Index	0,002	0,000	5,576	0,000	0,001	0,003	0,001	0,003
M3	0,115	0,039	2,972	0,004	0,038	0,192	0,038	0,192
M4	0,090	0,039	2,321	0,022	0,013	0,167	0,013	0,167
M6	0,156	0,039	4,019	0,000	0,079	0,233	0,079	0,233
M7	0,291	0,039	7,490	0,000	0,214	0,368	0,214	0,368
M8	0,385	0,039	9,929	0,000	0,308	0,462	0,308	0,462

Table 19 In Sample Analysis CAT C

CAT D

The forecasting model for the sales of the products included in the category D is presented at the Table 20. The eleven monthly coefficients are statistically significant, and they have a positive effect on the sales of the products. The R^2 for this model is only 59%, which is not satisfied as the explanatory variables can interpret only the 59% of the variance of the sales in this category. This index does not imply that the model is rejectable but as the independent variables are statistically significant, further factors should be examined as explanatory variables.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,768							
R Square	0,590							
Adjusted R Square	0,538							
Standard Error	0,104							
Observations	108							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	12	1,473	0,123	11,386	8,62761E-14			
Residual	95	1,024	0,011					
Total	107	2,496						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	14,194	0,040	358,038	0,000	14,116	14,273	14,116	14,273
Index	0,003	0,000	8,003	0,000	0,002	0,003	0,002	0,003
M1	0,203	0,049	4,133	0,000	0,105	0,300	0,105	0,300
M2	0,153	0,049	3,116	0,002	0,055	0,250	0,055	0,250
M3	0,361	0,049	7,354	0,000	0,263	0,458	0,263	0,458
M4	0,298	0,049	6,080	0,000	0,201	0,395	0,201	0,395
M5	0,127	0,049	2,587	0,011	0,029	0,224	0,029	0,224
M6	0,222	0,049	4,535	0,000	0,125	0,319	0,125	0,319
M7	0,282	0,049	5,763	0,000	0,185	0,379	0,185	0,379
M8	0,231	0,049	4,721	0,000	0,134	0,328	0,134	0,328
M9	0,162	0,049	3,302	0,001	0,064	0,259	0,064	0,259
M10	0,238	0,049	4,858	0,000	0,141	0,335	0,141	0,335
M11	0,186	0,049	3,794	0,000	0,089	0,283	0,089	0,283

Table 20 In Sample Analysis: CAT D

4.2 Forecasting Models

The previous subchapter provided all the necessary information to structure the forecasting models by deploying the multiple regression methodology (MLR). The forecasting sample concerns the periods from January of 2021 to December of 2022. The number of the observations are twenty-four for all categories. The forecasting

models will be formulated based on the statistical properties of the estimation sample regression models. The statistically significant coefficients will be deployed to designate the predicting models for the four categories.

The estimated monthly sales will be compared to the actual sales of the data set. The average of the absolute value of the difference between actual and estimated sales will give the indicators to measure the goodness of the model's fitting. These indicators are the Mean Absolute Error (MAE) and the Mean Absolute Percentage Errors (MAPE).

CAT A

The forecasting model for the sales of the products included in the category A will be the equation:

$$YtA = 6{,}45 + 0{,}01Trend - 0{,}12M1(t) - 0{,}13M9(t) - 0{,}15M11(t) + 0{,}53Yt - 1 \quad (M_a)$$

The above equation suggests that if all are the same the sales of the products in the category A are negatively affected at the months January, September, and November, and that there is a positive effect form the sales of the products of one period ago. It seems like the sales depend on their memory.

The Table 21 presents the output of sample analysis for the above-mentioned period and follows the graphical presentation of the actual sales and the estimated sales accordingly.

ACTUAL SALES	ESTIMATED SALES	Residuals	% Fcst Error
2.785.260,55	3.402.083,68	-616.823,13	-0,22
2.841.564,58	2.820.579,31	20.985,27	0,01
2.986.758,09	3.331.594,24	-344.836,15	-0,12
3.157.789,43	3.046.032,08	111.757,35	0,04
2.682.816,75	3.574.783,62	-891.966,87	-0,33
3.091.437,09	3.303.440,80	-212.003,71	-0,07
3.266.772,61	3.586.903,51	-320.130,90	-0,10
3.343.799,75	3.720.247,38	-376.447,63	-0,11
3.237.451,80	3.794.043,53	-556.591,73	-0,17
3.249.094,71	3.757.075,56	-507.980,85	-0,16
3.445.638,28	3.791.838,71	-346.200,43	-0,10
3.370.730,58	3.456.228,41	-85.497,83	-0,03
2.982.274,65	3.923.246,63	-940.971,98	-0,32
3.290.459,41	3.192.593,50	97.865,91	0,03
3.703.881,09	3.930.582,45	-226.701,36	-0,06
3.009.320,66	3.726.362,53	-717.041,87	-0,24
3.480.309,31	3.804.371,91	-324.062,60	-0,09
4.006.016,00	4.138.778,10	-132.762,10	-0,03
4.031.695,85	4.491.322,08	-459.626,23	-0,11
4.296.079,59	4.539.599,71	-243.520,12	-0,06
3.785.832,63	4.729.207,21	-943.374,58	-0,25
3.547.191,99	4.455.622,09	-908.430,10	-0,26
4.168.699,93	4.336.319,66	-167.619,73	-0,04
3.759.304,05	4.173.280,79	-413.976,74	-0,11
		415.298,97	**12,68%**
		MAE	**MAPE**

Table 21 MAE and MAPE Calculation – CAT A

The MAE indicator is 415.298,97 and the MAPE is 12,68%. The MAPE expresses the deviation of the actual values from the estimate in absolute terms. As so, the smallest the value, the better the fitting of the model. The value of 12,68% indicates a very good fitting of the model, which means that the model M_a has a very good performance. This statement is also pictured at the Figure 10.

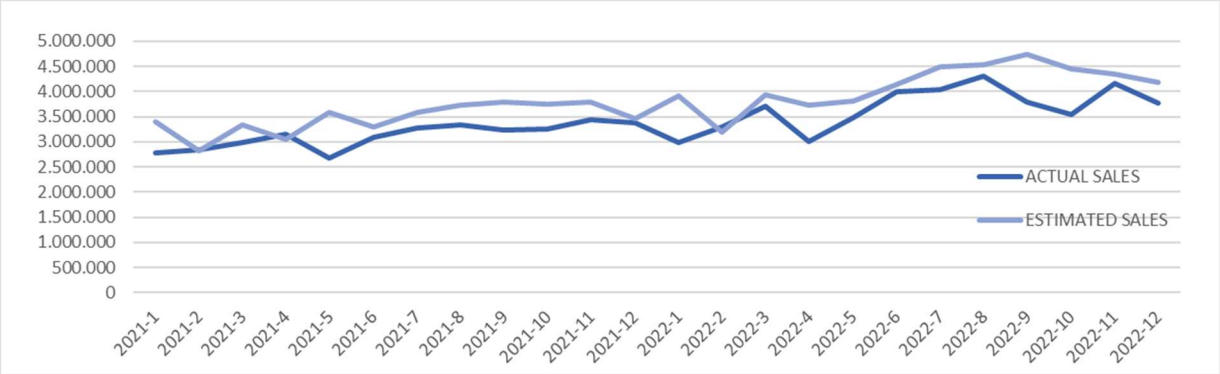

Figure 10 Actual and Forecasted Sales: CAT A

CAT B

The MLR model for the sales of the category B will be the below:

$$YtB = 12{,}20 + 0{,}01Trend + 0{,}25M2(t) + 0{,}30M3(t) + 0{,}22M4(t) + 0{,}21M5(t) + 0{,}24M6(t) + 0{,}21M9(t) + 0{,}42M10(t) + 0{,}27M11(t) \quad (M_b)$$

The calculations of the estimated sales for this category are presented at the Table 22 and the graphical presentation of the actual and estimated sales are presented in the Figure 11. This model has an efficient power as the indicator MAE is 145.450,40 and the MAPE is 15,95%, which indicates good predictability. The model follows the periodicity of the data and estimates the forecasts accurately.

ACTUAL SALES	ESTIMATED SALES	Residuals	% Fcst Error
630.528,13	781.697,29	-151.169,16	-23,98%
978.541,19	1.014.956,92	-36.415,73	-3,72%
941.706,98	1.081.095,56	-139.388,58	-14,80%
892.505,86	1.008.308,65	-115.802,79	-12,98%
1.129.611,74	1.015.083,37	114.528,37	10,14%
1.021.227,65	1.058.914,84	-37.687,19	-3,69%
840.356,60	842.846,83	-2.490,23	-0,30%
693.850,68	853.493,73	-159.643,05	-23,01%
879.717,61	1.067.751,75	-188.034,14	-21,37%
1.265.452,15	1.332.063,68	-66.611,53	-5,26%
987.092,33	1.162.195,73	-175.103,40	-17,74%
767.719,97	897.443,34	-129.723,37	-16,90%
735.623,12	908.779,90	-173.156,78	-23,54%
1.141.028,04	1.179.961,17	-38.933,13	-3,41%
1.028.990,43	1.256.852,15	-227.861,72	-22,14%
860.054,00	1.172.232,08	-312.178,08	-36,30%
1.008.022,36	1.180.108,19	-172.085,83	-17,07%
869.462,71	1.231.065,45	-361.602,74	-41,59%
795.587,76	979.870,69	-184.282,93	-23,16%
1.031.097,01	992.248,48	38.848,53	3,77%
1.060.093,88	1.241.339,00	-181.245,12	-17,10%
1.189.529,83	1.548.620,83	-359.091,00	-30,19%
1.264.160,35	1.351.136,99	-86.976,64	-6,88%
1.005.393,62	1.043.343,10	-37.949,48	-3,77%
		145.450,40	15,95%
		MAE	MAPE

Table 22 MAE and MAPE Calculation: CAT B

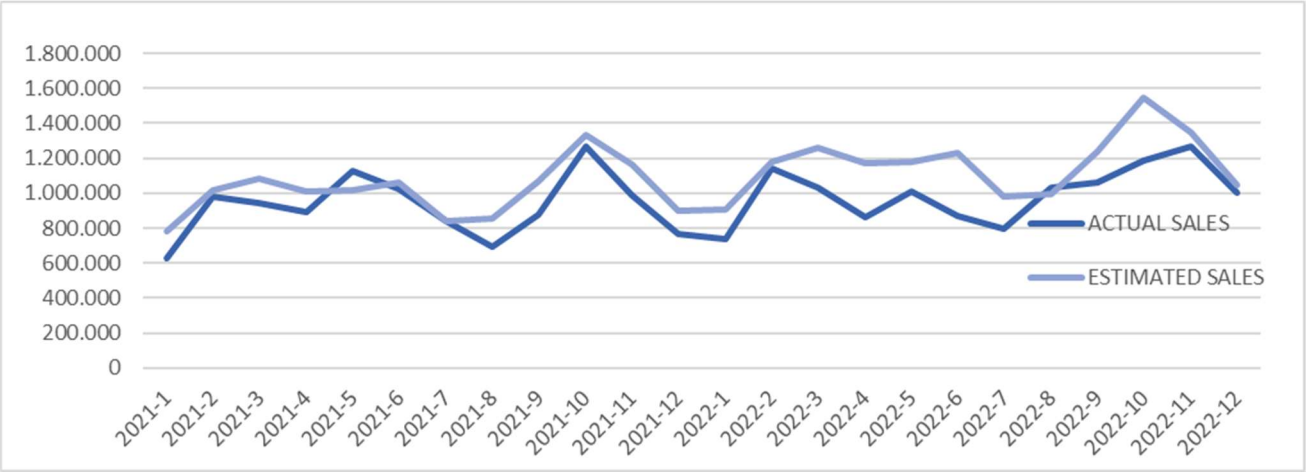

Figure 11 Actual and Forecasted sales: CAT B

CAT C

The prediction model for the category C will be formulated by the equation:

$$YtC = 15{,}91 + 0{,}12M3(t) + 0{,}09M4(t) + 0{,}16M6(t) + 0{,}29M7(t) + +0{,}39M8(t)\ (M_c)$$

All the coefficients in the above equation have a positive contribution to the estimated sales and there is no time lag dependence on the sales.

The MAE indicator for this model is 1.198.112,83 and the MAPE is 9,49%, as calculated in the Table 23. The model can accurately predict the sales of the products of the category C. The linear chart below (Figure 12 Actual and Forecasted salesFigure 12) also presents the goodness of fitting of this model. The seasonality is well captured, and the estimated sales are close to the actual ones.

ACTUAL SALES	ESTIMATED SALES	Residuals	% Fcst Error
8.684.851,52	9.999.241,91	-1.314.390,39	-0,15
10.719.560,96	10.018.020,23	701.540,73	0,07
11.735.373,39	11.264.856,86	470.516,53	0,04
10.985.054,65	11.003.799,95	-18.745,30	0,00
11.099.322,67	10.074.567,05	1.024.755,62	0,09
10.202.704,88	11.797.299,61	-1.594.594,73	-0,16
13.773.799,58	13.523.641,32	250.158,26	0,02
15.070.779,58	14.894.353,69	176.425,89	0,01
11.488.798,38	10.150.459,62	1.338.338,76	0,12
10.549.650,24	10.169.521,92	380.128,32	0,04
11.764.999,87	10.188.620,02	1.576.379,85	0,13
9.729.367,66	10.207.753,99	-478.386,33	-0,05
10.214.648,27	10.226.923,89	-12.275,62	0,00
11.292.452,48	10.246.129,79	1.046.322,69	0,09
14.453.500,31	11.521.356,80	2.932.143,51	0,20
11.704.107,54	11.254.355,64	449.751,90	0,04
10.780.901,08	10.303.964,18	476.936,90	0,04
13.129.321,92	12.065.923,23	1.063.398,69	0,08
16.749.610,51	13.831.573,61	2.918.036,90	0,17
16.255.413,24	15.233.497,00	1.021.916,24	0,06
14.287.875,90	10.381.584,82	3.906.291,08	0,27
12.525.604,83	10.401.081,17	2.124.523,66	0,17
13.545.173,03	10.420.614,13	3.124.558,90	0,23
10.794.374,82	10.440.183,78	354.191,04	0,03
		1.198.112,83	**9,49%**
		MAE	**MAPE**

Table 23 MAE and MAPE Calculation: CAT C

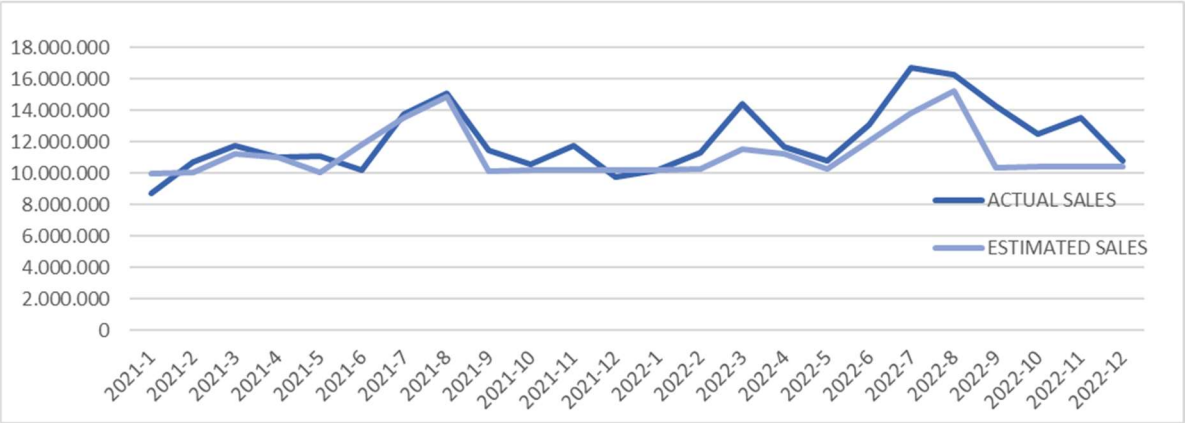

Figure 12 Actual and Forecasted sales: Cat C

CAT D

Consequently, the forecasting model for the sales of the category D will be formulated by the regression analysis of the table 25. The equation is the below:

$$YtC = 14{,}19 + 0{,}20M1(t) + 0{,}15M2(t) + 0{,}36M3(t) + 0{,}30M4(t) + 0{,}13M5(t) + 0{,}22M6(t) + 0{,}28M7(t) + 0{,}23M8(t) + 0{,}16M9(t) + + 0{,}24M10(t) + 0{,}19M11(t), (M_D).$$

This estimation model has not time lag dependence and all the coefficient has a positive effect on the estimated sales.

The MAE indicator is equal to 253.754 and the MAPE is 8,96%, which is below the 10% and indicates a good fitting of the model. The figure 13 presents the timeline of the actual and the forecasted sales. The estimated variable is close to the actual values and the periodicity is also well capture.

DATE	Actual Sales	Estimated Sales	Residuals	% Fcst Error
2021-1	2.356.997	2.370.049	-13.053	-0,006
2021-2	2.265.838	2.260.405	5.433	0,002
2021-3	2.730.991	2.789.445	-58.454	-0,021
2021-4	3.364.156	2.627.003	737.153	0,219
2021-5	1.983.057	2.219.322	-236.265	-0,119
2021-6	2.367.203	2.447.748	-80.544	-0,034
2021-7	2.620.045	2.606.008	14.037	0,005
2021-8	2.815.930	2.482.592	333.338	0,118
2021-9	2.380.507	2.321.986	58.521	0,025
2021-10	2.526.154	2.512.145	14.009	0,006
2021-11	2.495.932	2.390.805	105.128	0,042
2021-12	2.239.579	1.990.759	248.820	0,111
2022-1	2.274.700	2.444.580	-169.880	-0,075
2022-2	2.826.488	2.331.487	495.001	0,175
2022-3	3.358.242	2.877.164	481.078	0,143
2022-4	2.827.172	2.709.614	117.559	0,042
2022-5	2.398.023	2.289.113	108.910	0,045
2022-6	2.718.719	2.524.722	193.998	0,071
2022-7	3.260.260	2.687.959	572.301	0,176
2022-8	2.839.101	2.560.662	278.439	0,098
2022-9	2.670.764	2.395.005	275.759	0,103
2022-10	2.851.231	2.591.144	260.086	0,091
2022-11	3.232.509	2.465.988	766.522	0,237
2022-12	2.519.172	2.053.362	465.810	0,185
			253.754	8,96%
			MAE	MAPE

Table 24 MAE and MAPE Calculation: Cat D

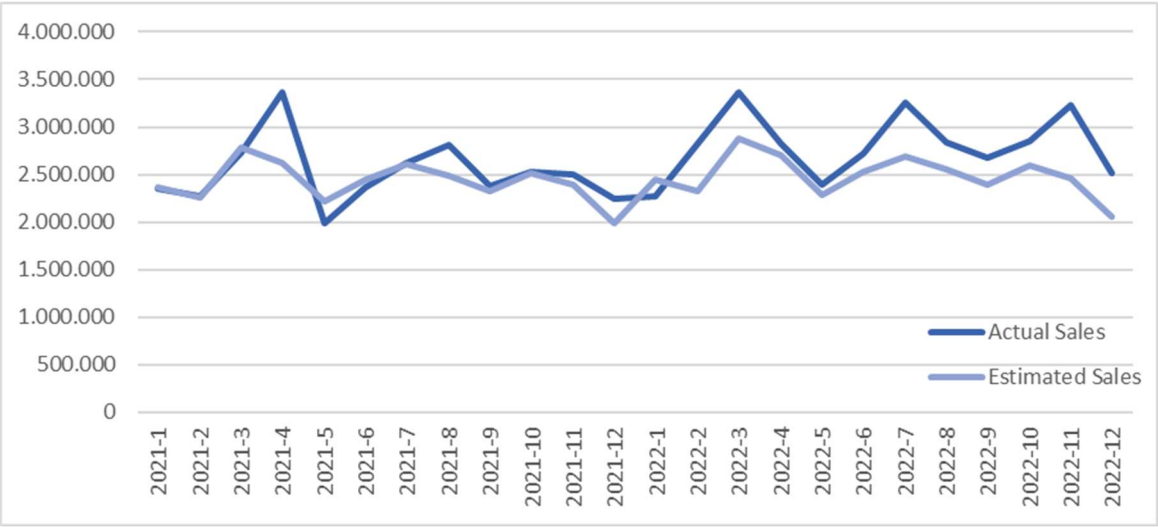

Figure 13 Actual and Forecasted sales: Cat D

4.3 Forecasting Performance

This chapter summarizes the findings of the above section regarding the accuracy of the forecasting models for the product categories A to D, also presented at the Table 25.

The linear regression model of the category A (M_A) has a highly explanatory ability as the R^2 is 96,34% and the accuracy of the predictions are also efficient, as the MAPE is 12.68%, which is highly acceptable. The MLR M_B has also a high R^2 and the fitting is good as the MAPE indicator is 15.95%. The regression model M_C has also a great fitting as the MAPE is 9.49% even with R^2 equal to 63.36%. This means that the model can estimate the monthly sales rather accurate and could be used to decision making process. Finally, the regression model M_D has the lowest R^2 and the lowest MAPE which indicates a great fitting, as the MAPE indicator is 8,96%, below 10%.

Forecasting Performance			
	R^2	**MAE**	**MAPE**
CAT A	96,34%	415.299	12,68%
CAT B	86,47%	145.450	15,95%
CAT C	63,36%	1.198.113	9,49%
CAT D	58,99%	253.754	8,96%

Table 25 Forecasting Performance

5. Main Findings and summary

At the current chapter will be discussed the results of the above experimental study and the findings from the analyses by category will be summarized. The empirical study provided enough information to answer the research questions, set at the first chapter of this dissertation. To summarize the findings and connect them to the thesis objectives the results will be presented below per question.

1. Examine the statistical properties of the time series (data) and their accuracy over longer time horizons.

At the first part of this thesis, the statistical properties are examined, using all the data per category. The descriptive statistics indicate that the driver of the sales for the company are the products included in the category C, while the category with the lowest sales, in euro, is the category B. The results are also presented at the Figure 14 Total Sales per categoryFigure 14. The indexes calculated by excel for the given data set is also presented to the Table 1 Descriptive Statistics The time series for the four categories has the normal distribution, with close to zero skew. This means that the observations are close to the mean and that outliers are unlikely.

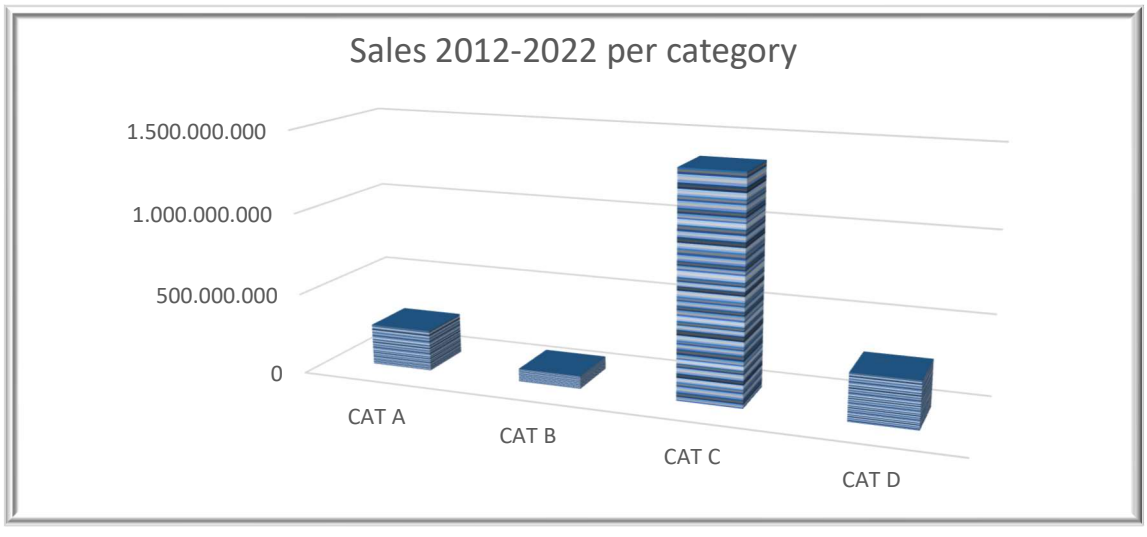

Figure 14 Total Sales per category

The trend for all categories is upward even if for the category C is smoother. Cat A has the highest trend. The sales have periodicity, which is also depicted at the Figure 15 Sales overtime

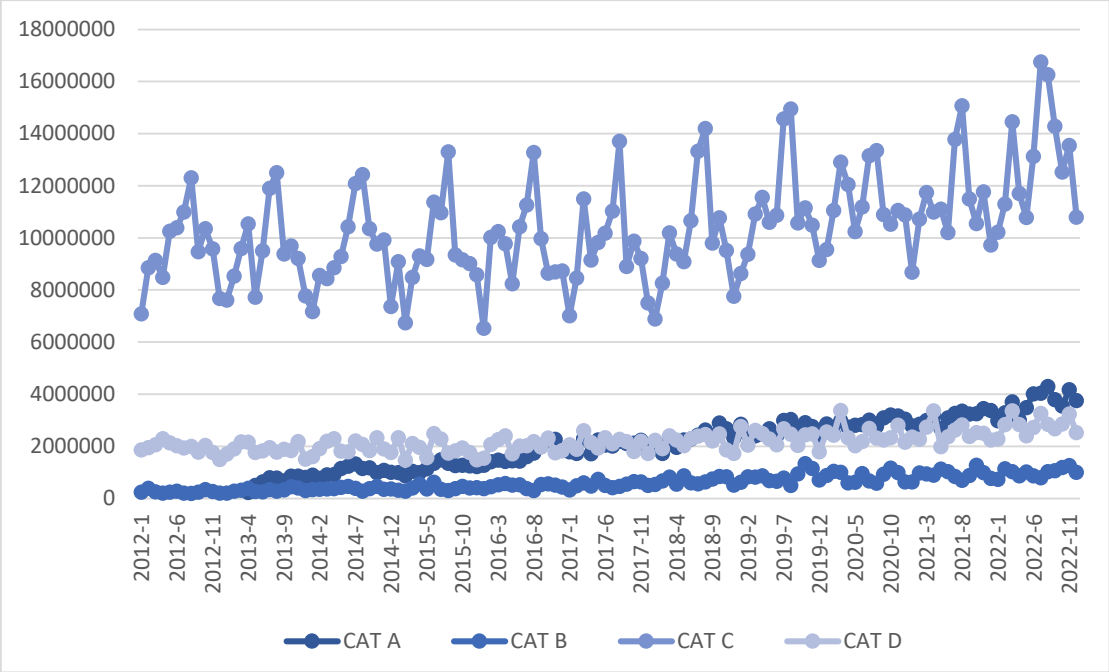

Figure 15 Sales overtime

2. Identification of the sales patterns and evaluation of the forecasting models in terms of accurateness.

The given data set provided enough information to examine the main characteristics of the sales by products categories. The identification of the sales patterns returns create a lot of benefits for the company including the informed decision-making process. The interpretation of the sales patterns implied to inventory control decisions and underlines the products potentiality. In this sense, it is more than important to recognize what are the main characteristics of the sales behavior and incorporate them into the long-term strategic planning.

To characterize the forecasts as a powerful tool for the managers, they should be close to the reality and reflect an accurate and realistic plan. The accuracy of the forecasts could be measured by several performance evaluators metrics. For the purposes of this study, the MAE and the MAPE are calculated to measure the absolute deviation of the estimated sales to the actual observations. As shown in the Table 25, the regression

model could predict the sales of four categories with high accuracy. The regression models had a good fitting and capture the periodicity of the actual data.

3. Study whether the sales forecasts are valuable for the decision-making process

The sales forecasts for manufacturing companies are tied to its success. Without an efficient and accuracy forecasting process the manufacturers could not be able to have enough products to meet the sales. The input of the forecasting process can be used to define the source allocation plan, the labor needs, and the required capacity (Wacker and Lummus, 2002). Furthermore, the sales forecasts are used to decisions regarding research or launching of new products. The historical data, the market trend and the phase of the product cycle are vital ingredients for creating accurate forecasting models and reduce the probability of a failure of a new product(Hassan, Badr and El-Ghazali, 2015).

The success of the forecasts is their accurateness. The main issue is that we are not able to know a priori which of the methods are the most truthful. The quantitative methods use the extrapolations from historical patterns. In this sense, they fit well in cases that the future is like the previous time periods, or if several factors are exterminated among themselves. When the quantitative methods are not working, then the human factor among with the scientific tools could restructure the model to improve its efficiency (Maricar, 2019) .

The current thesis proves that the forecasts for the sales are accurate and close to the actual data. Also, the data do not provide enough evidence to claim that the Covid-19 had affected the sales. The company's sales are characterized by the seasonality and by the correlation between the categories. These findings should be used for the future decision-making process. The company may allocate the sources to different production lines per season, to produce the necessary quantity to meet the expected demand of the categories. In the same direction, the production plan could be adjusted to meet the demand and to avoid overstocking. Furthermore, the trend of the product categories is a vital input for the strategic expansion of the company. It seems like the category A has an upward trend while the category C seems to increase with lower rate. Last, the cross dependence between the sales of some categories generates economies of scale in marketing or other promotional policies.

While the forecasts for all categories are rather accurate the errors for the category B are the highest and in the most periods the model overestimates the sales for the Category A and B, but underestimates the expected sales of the category C and D for the most periods. The abovementioned multilinear regression model has a good forecasting performance for all categories and is not constantly overestimate or underestimate the expected sales. The model achieves a good performance in terms of accuracy.

6. Conclusions and recommendations for future research

The Greek Food Industry is among the main pillars of the secondary sector of the domestic economy, remaining a key driver of its productive activity development and for the progress of the country. The food sector stands out for significant investments, growth prospects and significant export activity with a robust presence in both the European and global markets. Its performance affect not only other activities but also the entire domestic economy. The food industry is connected to the primary sector of the economy, but also to the service sector, such as restaurants, hotels, and tourism in general, make this sector fundamental for the economy.

The industry (food and beverage) accumulates the 28,8% of the domestic industrial sector and the 37.3% of the employees of the secondary sector. The number of people employed in the food and beverage industry exceeded the number of 137.7 thousand, increasing 15% compared to 2020, against a milder increase of 4% in total manufacturing (Economic, 2023).

This thesis is an attempt to examine and present the properties of the sales data of the company's products, as they were categorized into four main groups. Subsequently, sales forecasting models were created to support the decision-making process for the management of the E. J. Papadopoulou S.A. This study subjects to limitations due to time constraints as there is a specific time schedule and due to the unavailability of qualitative data according to company's privacy policy.

Further research could be encounter with the available data using different sales forecasting methods such as MA model and EWMA and compare the fitting of these models to the above analysed multiple linear regression models. Also, more advanced quantitative data analysis methods, such as neural networks or machine learning techniques, could be applied to identify complex (non-linear) characteristics of the sales dynamics and to identify non-linear characteristics of the data set (Thomaidis and Dounias, 2012). However, these techniques should be cautiously implemented due to the risk of poor performance at the out-of-sample analysis (overfitting). To avoid this phenomenon, it is recommended to adopt a model selection process that gives us the

optimal structure of a model for the specific set of observations (dataset) (Thomaidis and Dounias, 2011).

A most interesting field for future research could be the expansion of the forecasting models by examining the dependence of the sales on the basic economy indexes, such as the GDP or the inflation. Also, the sales sensitivity to the price change could be examined. Furthermore, qualitative variables could be added to investigate their impact to the sales. These variables could be the marketing plan, the budget allocation or the consumers' satisfaction. Finally, a comparative study of the company's sales with those of the competition could help to further understanding of the market behavior.

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7. Appendix

7.1 Original Data by Category

		GROSS SALES 1/1/2012 - 31/12/2022				
Index	Date	CAT A	CAT B	CAT C	CAT D	Total
1	2012-1		241.618,65 EUR	7.083.847,00 EUR	1.855.617,58 EUR	9.181.083,23 EUR
2	2012-2		392.345,04 EUR	8.846.425,27 EUR	1.941.378,35 EUR	11.180.148,66 EUR
3	2012-3		248.468,92 EUR	9.137.793,69 EUR	2.055.114,25 EUR	11.441.376,86 EUR
4	2012-4		202.810,14 EUR	8.481.500,88 EUR	2.288.648,13 EUR	10.972.959,15 EUR
5	2012-5		238.805,16 EUR	10.252.729,41 EUR	2.128.733,31 EUR	12.620.267,88 EUR
6	2012-6		280.280,68 EUR	10.384.280,62 EUR	2.025.438,22 EUR	12.689.999,52 EUR
7	2012-7		198.475,46 EUR	10.988.625,29 EUR	1.940.912,32 EUR	13.128.013,07 EUR
8	2012-8		193.062,76 EUR	12.300.974,19 EUR	1.999.882,21 EUR	14.493.919,16 EUR
9	2012-9		234.488,56 EUR	9.465.569,91 EUR	1.774.532,38 EUR	11.474.590,85 EUR
10	2012-10		334.396,38 EUR	10.352.613,41 EUR	2.033.724,80 EUR	12.720.734,59 EUR
11	2012-11		259.972,32 EUR	9.581.683,61 EUR	1.757.608,08 EUR	11.599.264,01 EUR
12	2012-12		203.263,25 EUR	7.677.701,44 EUR	1.492.470,18 EUR	9.373.434,87 EUR
13	2013-1		202.787,11 EUR	7.610.025,81 EUR	1.701.063,65 EUR	9.513.876,57 EUR
14	2013-2		271.920,94 EUR	8.529.030,21 EUR	1.896.364,69 EUR	10.697.315,84 EUR
15	2013-3		308.381,52 EUR	9.594.437,87 EUR	2.167.623,60 EUR	12.070.442,99 EUR
16	2013-4	229.246,02 EUR	390.763,04 EUR	10.533.927,42 EUR	2.160.924,68 EUR	13.314.861,16 EUR
17	2013-5	493.046,91 EUR	269.446,24 EUR	7.726.390,66 EUR	1.762.506,85 EUR	10.251.390,66 EUR
18	2013-6	631.225,75 EUR	249.750,34 EUR	9.498.163,53 EUR	1.818.346,04 EUR	12.197.485,66 EUR
19	2013-7	786.612,86 EUR	333.905,12 EUR	11.894.158,71 EUR	1.941.613,59 EUR	14.956.290,28 EUR
20	2013-8	785.729,88 EUR	281.918,40 EUR	12.495.893,26 EUR	1.780.847,33 EUR	15.344.388,87 EUR
21	2013-9	669.213,18 EUR	322.235,76 EUR	9.375.043,06 EUR	1.891.335,87 EUR	12.257.827,87 EUR
22	2013-10	856.581,77 EUR	452.495,36 EUR	9.685.990,94 EUR	1.840.478,20 EUR	12.835.546,27 EUR
23	2013-11	850.502,18 EUR	395.488,63 EUR	9.212.618,53 EUR	2.185.468,69 EUR	12.644.078,03 EUR
24	2013-12	808.251,05 EUR	295.038,84 EUR	7.766.473,24 EUR	1.501.001,10 EUR	10.370.764,23 EUR
25	2014-1	888.155,22 EUR	333.234,60 EUR	7.172.153,36 EUR	1.603.239,56 EUR	9.996.782,74 EUR
26	2014-2	772.749,98 EUR	355.213,16 EUR	8.561.961,97 EUR	1.912.470,55 EUR	11.602.395,66 EUR
27	2014-3	897.439,12 EUR	360.340,50 EUR	8.436.479,67 EUR	2.194.572,63 EUR	11.888.831,92 EUR
28	2014-4	909.384,55 EUR	370.832,73 EUR	8.849.471,37 EUR	2.293.851,57 EUR	12.423.540,22 EUR
29	2014-5	1.147.695,79 EUR	418.668,58 EUR	9.287.375,12 EUR	1.806.221,19 EUR	12.659.960,68 EUR
30	2014-6	1.239.762,39 EUR	454.913,93 EUR	10.419.831,84 EUR	1.788.073,34 EUR	13.902.581,50 EUR
31	2014-7	1.326.678,03 EUR	383.781,37 EUR	12.086.378,07 EUR	2.209.798,48 EUR	16.006.635,95 EUR
32	2014-8	1.151.171,64 EUR	275.361,52 EUR	12.423.643,94 EUR	2.070.471,84 EUR	15.920.648,94 EUR
33	2014-9	1.176.223,82 EUR	376.003,95 EUR	10.355.758,44 EUR	1.839.008,72 EUR	13.746.994,93 EUR
34	2014-10	987.389,81 EUR	465.707,29 EUR	9.757.786,78 EUR	2.324.177,84 EUR	13.535.061,72 EUR
35	2014-11	1.079.731,78 EUR	353.954,72 EUR	9.916.130,50 EUR	1.900.276,71 EUR	13.250.093,71 EUR
36	2014-12	1.001.690,89 EUR	361.449,46 EUR	7.361.703,34 EUR	1.763.209,50 EUR	10.488.053,19 EUR
37	2015-1	986.082,88 EUR	314.277,42 EUR	9.091.083,35 EUR	2.333.521,88 EUR	12.724.965,53 EUR
38	2015-2	869.866,85 EUR	273.232,17 EUR	6.733.762,88 EUR	1.472.557,83 EUR	9.349.419,73 EUR
39	2015-3	1.043.936,40 EUR	400.330,33 EUR	8.488.318,12 EUR	2.101.463,44 EUR	12.034.048,29 EUR
40	2015-4	985.276,25 EUR	541.933,51 EUR	9.308.484,78 EUR	1.958.905,36 EUR	12.794.599,90 EUR
41	2015-5	1.136.552,45 EUR	356.940,94 EUR	9.172.647,19 EUR	1.565.896,02 EUR	12.232.036,60 EUR
42	2015-6	1.347.487,94 EUR	619.143,38 EUR	11.369.861,35 EUR	2.483.331,85 EUR	15.819.824,52 EUR

43	2015-7	1.485.686,15 EUR	349.084,87 EUR	10.963.273,93 EUR	2.273.735,50 EUR	15.071.780,45 EUR
44	2015-8	1.351.236,43 EUR	302.513,94 EUR	13.300.115,45 EUR	1.738.848,38 EUR	16.692.714,20 EUR
45	2015-9	1.256.624,35 EUR	380.650,11 EUR	9.342.318,85 EUR	1.818.537,25 EUR	12.798.130,56 EUR
46	2015-10	1.271.419,69 EUR	456.084,17 EUR	9.165.492,78 EUR	1.929.855,85 EUR	12.822.852,49 EUR
47	2015-11	1.251.513,55 EUR	401.902,95 EUR	9.017.425,34 EUR	1.758.308,70 EUR	12.429.150,54 EUR
48	2015-12	1.219.135,37 EUR	413.294,97 EUR	8.578.979,81 EUR	1.475.582,17 EUR	11.686.992,32 EUR
49	2016-1	1.274.612,80 EUR	369.148,29 EUR	6.527.665,83 EUR	1.539.155,14 EUR	9.710.582,06 EUR
50	2016-2	1.410.530,78 EUR	449.143,03 EUR	10.015.837,48 EUR	2.071.870,88 EUR	13.947.382,17 EUR
51	2016-3	1.462.023,31 EUR	526.798,24 EUR	10.235.864,46 EUR	2.255.089,60 EUR	14.479.775,61 EUR
52	2016-4	1.413.164,71 EUR	570.517,36 EUR	9.771.264,52 EUR	2.395.788,41 EUR	14.150.735,00 EUR
53	2016-5	1.442.538,35 EUR	505.024,61 EUR	8.234.544,49 EUR	1.707.892,18 EUR	11.889.999,63 EUR
54	2016-6	1.427.958,32 EUR	516.461,99 EUR	10.429.846,61 EUR	2.005.600,07 EUR	14.379.866,99 EUR
55	2016-7	1.605.394,99 EUR	373.780,94 EUR	11.264.690,34 EUR	2.016.531,77 EUR	15.260.398,04 EUR
56	2016-8	1.735.498,88 EUR	303.687,82 EUR	13.274.629,06 EUR	2.186.834,31 EUR	17.500.650,07 EUR
57	2016-9	1.995.771,77 EUR	539.478,60 EUR	9.971.437,23 EUR	1.975.388,04 EUR	14.482.075,64 EUR
58	2016-10	2.231.085,27 EUR	555.002,95 EUR	8.649.346,08 EUR	2.320.545,31 EUR	13.755.979,61 EUR
59	2016-11	2.271.652,25 EUR	504.587,38 EUR	8.696.988,18 EUR	1.750.292,44 EUR	13.223.520,25 EUR
60	2016-12	1.831.453,81 EUR	433.137,30 EUR	8.731.270,12 EUR	1.833.487,70 EUR	12.829.348,93 EUR
61	2017-1	1.786.905,54 EUR	331.065,39 EUR	7.003.710,74 EUR	2.055.925,83 EUR	11.177.607,50 EUR
62	2017-2	1.723.626,79 EUR	489.831,76 EUR	8.456.903,52 EUR	1.884.755,40 EUR	12.555.117,47 EUR
63	2017-3	2.307.157,87 EUR	592.325,19 EUR	11.497.587,44 EUR	2.598.082,43 EUR	16.995.152,93 EUR
64	2017-4	1.715.280,23 EUR	478.502,65 EUR	9.144.825,26 EUR	2.144.226,32 EUR	13.482.834,46 EUR
65	2017-5	2.241.580,13 EUR	730.447,09 EUR	9.827.379,71 EUR	1.933.342,14 EUR	14.732.749,07 EUR
66	2017-6	2.046.056,63 EUR	500.094,19 EUR	10.177.304,95 EUR	2.334.138,58 EUR	15.057.594,35 EUR
67	2017-7	2.005.832,30 EUR	405.496,12 EUR	11.027.562,97 EUR	2.096.344,75 EUR	15.535.236,14 EUR
68	2017-8	2.194.119,69 EUR	460.448,62 EUR	13.703.268,47 EUR	2.268.574,85 EUR	18.626.411,63 EUR
69	2017-9	2.105.525,53 EUR	543.676,40 EUR	8.902.083,12 EUR	2.185.351,32 EUR	13.736.636,37 EUR
70	2017-10	2.116.543,78 EUR	643.210,36 EUR	9.868.049,04 EUR	1.795.913,38 EUR	14.423.716,56 EUR
71	2017-11	2.224.405,20 EUR	630.884,96 EUR	9.204.029,89 EUR	2.188.847,96 EUR	14.248.168,01 EUR
72	2017-12	1.974.743,15 EUR	500.366,79 EUR	7.502.886,71 EUR	1.720.220,98 EUR	11.698.217,63 EUR
73	2018-1	1.978.817,25 EUR	533.422,78 EUR	6.890.148,49 EUR	2.235.543,44 EUR	11.637.931,96 EUR
74	2018-2	1.722.773,02 EUR	666.089,10 EUR	8.261.674,36 EUR	1.906.467,74 EUR	12.557.004,22 EUR
75	2018-3	2.231.092,96 EUR	814.228,15 EUR	10.187.222,96 EUR	2.396.924,88 EUR	15.629.468,95 EUR
76	2018-4	1.964.366,37 EUR	544.100,11 EUR	9.376.558,40 EUR	2.242.789,24 EUR	14.127.814,12 EUR
77	2018-5	2.237.806,00 EUR	870.460,09 EUR	9.080.616,63 EUR	2.018.113,59 EUR	14.206.996,31 EUR
78	2018-6	2.285.050,11 EUR	596.952,66 EUR	10.657.764,22 EUR	2.285.829,09 EUR	15.825.596,08 EUR
79	2018-7	2.427.991,50 EUR	559.741,71 EUR	13.326.738,02 EUR	2.390.925,01 EUR	18.705.396,24 EUR
80	2018-8	2.624.467,33 EUR	631.864,22 EUR	14.196.841,85 EUR	2.446.700,15 EUR	19.899.873,55 EUR
81	2018-9	2.419.124,07 EUR	744.278,90 EUR	9.798.129,74 EUR	2.205.712,80 EUR	15.167.245,51 EUR
82	2018-10	2.897.714,46 EUR	844.538,06 EUR	10.770.268,43 EUR	2.481.285,43 EUR	16.993.806,38 EUR
83	2018-11	2.672.020,75 EUR	825.945,67 EUR	9.516.491,67 EUR	1.855.244,34 EUR	14.869.702,43 EUR
84	2018-12	2.330.762,85 EUR	507.312,18 EUR	7.761.188,62 EUR	1.725.121,55 EUR	12.324.385,20 EUR
85	2019-1	2.838.124,39 EUR	618.694,27 EUR	8.625.791,60 EUR	2.754.119,12 EUR	14.836.729,38 EUR
86	2019-2	2.462.645,03 EUR	824.620,65 EUR	9.370.747,78 EUR	2.043.254,37 EUR	14.701.267,83 EUR
87	2019-3	2.403.333,37 EUR	814.175,90 EUR	10.918.013,71 EUR	2.606.772,87 EUR	16.742.295,85 EUR
88	2019-4	2.479.494,53 EUR	862.770,54 EUR	11.559.586,75 EUR	2.486.800,57 EUR	17.388.652,39 EUR
89	2019-5	2.675.192,98 EUR	684.356,34 EUR	10.603.030,39 EUR	2.273.062,58 EUR	16.235.642,29 EUR
90	2019-6	2.399.490,78 EUR	654.685,71 EUR	10.862.697,34 EUR	2.056.028,60 EUR	15.972.902,43 EUR

91	2019-7	2.991.278,76 EUR	779.845,35 EUR	14.569.273,39 EUR	2.675.177,06 EUR	21.015.574,56 EUR
92	2019-8	3.033.027,08 EUR	491.348,56 EUR	14.952.018,29 EUR	2.468.550,35 EUR	20.944.944,28 EUR
93	2019-9	2.735.002,45 EUR	936.496,20 EUR	10.576.175,41 EUR	2.032.637,15 EUR	16.280.311,21 EUR
94	2019-10	2.905.511,44 EUR	1.329.147,91 EUR	11.149.576,96 EUR	2.441.402,44 EUR	17.825.638,75 EUR
95	2019-11	2.753.240,40 EUR	1.150.740,17 EUR	10.489.085,96 EUR	2.477.476,72 EUR	16.870.543,25 EUR
96	2019-12	2.441.262,64 EUR	704.796,82 EUR	9.140.929,54 EUR	1.786.918,76 EUR	14.073.907,76 EUR
97	2020-1	2.852.025,67 EUR	881.745,28 EUR	9.546.913,84 EUR	2.545.849,53 EUR	15.826.534,32 EUR
98	2020-2	2.471.418,08 EUR	1.039.378,62 EUR	11.048.800,78 EUR	2.424.925,20 EUR	16.984.522,68 EUR
99	2020-3	2.980.700,69 EUR	1.003.947,56 EUR	12.904.729,97 EUR	3.375.088,47 EUR	20.264.466,69 EUR
100	2020-4	2.729.795,20 EUR	600.595,46 EUR	12.047.728,70 EUR	2.323.218,22 EUR	17.701.337,58 EUR
101	2020-5	2.801.476,95 EUR	616.162,89 EUR	10.240.585,65 EUR	2.017.265,39 EUR	15.675.490,88 EUR
102	2020-6	2.825.899,58 EUR	957.109,86 EUR	11.191.527,37 EUR	2.176.364,45 EUR	17.150.901,26 EUR
103	2020-7	3.000.784,66 EUR	663.351,10 EUR	13.151.067,69 EUR	2.687.978,01 EUR	19.503.181,46 EUR
104	2020-8	2.765.293,58 EUR	580.500,68 EUR	13.354.816,66 EUR	2.314.655,87 EUR	19.015.266,79 EUR
105	2020-9	3.084.617,42 EUR	928.448,00 EUR	10.892.966,39 EUR	2.242.265,48 EUR	17.148.297,29 EUR
106	2020-10	3.200.645,62 EUR	1.166.663,04 EUR	10.524.157,85 EUR	2.333.918,64 EUR	17.225.385,15 EUR
107	2020-11	3.164.345,16 EUR	994.633,98 EUR	11.057.369,40 EUR	2.803.319,41 EUR	18.019.667,95 EUR
108	2020-12	3.039.085,60 EUR	630.972,13 EUR	10.885.269,05 EUR	2.151.383,88 EUR	16.706.710,66 EUR
109	2021-1	2.785.260,55 EUR	630.528,13 EUR	8.684.851,52 EUR	2.356.996,72 EUR	14.457.636,92 EUR
110	2021-2	2.841.564,58 EUR	978.541,19 EUR	10.719.560,96 EUR	2.265.837,61 EUR	16.805.504,34 EUR
111	2021-3	2.986.758,09 EUR	941.706,98 EUR	11.735.373,39 EUR	2.730.991,09 EUR	18.394.829,55 EUR
112	2021-4	3.157.789,43 EUR	892.505,86 EUR	10.985.054,65 EUR	3.364.155,98 EUR	18.399.505,92 EUR
113	2021-5	2.682.816,75 EUR	1.129.611,74 EUR	11.099.322,67 EUR	1.983.057,36 EUR	16.894.808,52 EUR
114	2021-6	3.091.437,09 EUR	1.021.227,65 EUR	10.202.704,88 EUR	2.367.203,31 EUR	16.682.572,93 EUR
115	2021-7	3.266.772,61 EUR	840.356,60 EUR	13.773.799,58 EUR	2.620.044,78 EUR	20.500.973,57 EUR
116	2021-8	3.343.799,75 EUR	693.850,68 EUR	15.070.779,58 EUR	2.815.930,48 EUR	21.924.360,49 EUR
117	2021-9	3.237.451,80 EUR	879.717,61 EUR	11.488.798,38 EUR	2.380.507,14 EUR	17.986.474,93 EUR
118	2021-10	3.249.094,71 EUR	1.265.452,15 EUR	10.549.650,24 EUR	2.526.154,02 EUR	17.590.351,12 EUR
119	2021-11	3.445.638,28 EUR	987.092,33 EUR	11.764.999,87 EUR	2.495.932,46 EUR	18.693.662,94 EUR
120	2021-12	3.370.730,58 EUR	767.719,97 EUR	9.729.367,66 EUR	2.239.578,69 EUR	16.107.396,90 EUR
121	2022-1	2.982.274,65 EUR	735.623,12 EUR	10.214.648,27 EUR	2.274.700,23 EUR	16.207.246,27 EUR
122	2022-2	3.290.459,41 EUR	1.141.028,04 EUR	11.292.452,48 EUR	2.826.487,84 EUR	18.550.427,77 EUR
123	2022-3	3.703.881,09 EUR	1.028.990,43 EUR	14.453.500,31 EUR	3.358.241,75 EUR	22.544.613,58 EUR
124	2022-4	3.009.320,66 EUR	860.054,00 EUR	11.704.107,54 EUR	2.827.172,20 EUR	18.400.654,40 EUR
125	2022-5	3.480.309,31 EUR	1.008.022,36 EUR	10.780.901,08 EUR	2.398.022,83 EUR	17.667.255,58 EUR
126	2022-6	4.006.016,00 EUR	869.462,71 EUR	13.129.321,92 EUR	2.718.719,17 EUR	20.723.519,80 EUR
127	2022-7	4.031.695,85 EUR	795.587,76 EUR	16.749.610,51 EUR	3.260.260,11 EUR	24.837.154,23 EUR
128	2022-8	4.296.079,59 EUR	1.031.097,01 EUR	16.255.413,24 EUR	2.839.101,34 EUR	24.421.691,18 EUR
129	2022-9	3.785.832,63 EUR	1.060.093,88 EUR	14.287.875,90 EUR	2.670.764,18 EUR	21.804.566,59 EUR
130	2022-10	3.547.191,99 EUR	1.189.529,83 EUR	12.525.604,83 EUR	2.851.230,51 EUR	20.113.557,16 EUR
131	2022-11	4.168.699,93 EUR	1.264.160,35 EUR	13.545.173,03 EUR	3.232.509,42 EUR	22.210.542,73 EUR
132	2022-12	3.759.304,05 EUR	1.005.393,62 EUR	10.794.374,82 EUR	2.519.172,07 EUR	18.078.244,56 EUR

Υπεύθυνη Δήλωση Συγγραφέα: Δηλώνω ρητά ότι, σύμφωνα με το άρθρο 8 του Ν.1599/1986, η παρούσα εργασία αποτελεί αποκλειστικά προϊόν προσωπικής μου εργασίας, δεν προσβάλλει κάθε μορφής δικαιώματα διανοητικής ιδιοκτησίας, προσωπικότητας και προσωπικών δεδομένων τρίτων, δεν περιέχει έργα/εισφορές τρίτων για τα οποία απαιτείται άδεια των δημιουργών/δικαιούχων και δεν είναι προϊόν μερικής ή ολικής αντιγραφής, οι πηγές δε που χρησιμοποιήθηκαν περιορίζονται στις βιβλιογραφικές αναφορές και μόνον και πληρούν τους κανόνες της επιστημονικής παράθεσης.