Sales Prediction For An SME Using An Artificial Neural Network

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Abstract— **The present investigation shows an application and analysis of a sales prediction applied to a small and medium-sized company dedicated to the sale of basic consumer goods through the use of artificial neural networks, with the aim of obtaining reliable information for making decisions that could affect business performance.**

The methodology that supports the research consists of five stages: data collection, data preprocessing, design and development of network topologies, network training and analysis of results. The backpropagation algorithm was used for network training and the sigmoidal function was used as the activation function.

Two topologies of artificial neural networks were developed, with the following architectures: 2-3-1 and 2-10-1. The results show a 100% learning of the network and a better fit of the data with the structure of 10 neurons in the hidden layer.

Keywords—Sales prediction, Artificial neural networks, Backpropagation and Sigmoidal function.

I. INTRODUCTION

The importance of small and medium-sized enterprises (SMEs) in Mexico has been increasing, during the last decade the great increase of these has been noticed, the hoarding that small companies have managed to have on society, this perhaps is due to the increase in the population that has existed in Mexico during all this time, which generates that people seek to undertake creating SMEs considering that these productive units are efficient levers in social development [1] and they also represent an important sector in its economic activity and in its social dynamics. [2] Therefore, SMEs are so important to Mexico that each of them must have clear control of what they do, since even the slightest movement can cause their disappearance.

A vitally important tool for SMEs are sales forecasts, these constitute the basis for deciding how much to spend on various activities such as advertising and personal sales, likewise with the basis of the anticipated sales the necessary amount of working capital is planned, the use of the plant and storage facilities. Likewise, the production schedule, the hiring of factory workers, and the purchase of raw materials depend on these forecasts.

In short, the sales forecast is of vital importance for company managers because it allows them to make marketing, production, supply and cash flow decisions. Therefore, it must be elaborated with great care, leaving aside the excessive optimum or the exaggerated moderation, because they can seriously affect the company as a whole [4].

One of the tools that allows us to perform sales predictions are artificial neural networks, at first, these did not have as much recognition given their difficulty at that time their application, but today it is one of the most important tools today Due to its high precision and reliability that it generates with its results, the main advantage of the neural network method is that it is capable of adapting very easily to any irregularity that occurs in the prediction and also that it is a practically automatic method. [3]

The case study is a small convenience store with 22 years of experience that has managed to remain in the taste of the local market, its success is based on the decisions it makes.

An important factor when making decisions within any organization is based on sales predictions, therefore, its preparation is of the utmost importance, it should be noted that currently the SME under study does not have a tool that allows it to prepare of a reliable sales forecast, so your decisions are made more by intuition than by supported information.

That said, this research corresponds to a study focused on improving decision making in SME through the design and development of a sales prediction through the use and application of an artificial neural network with the help of a spreadsheet in Excel that facilitate its development and application.

For the preparation of the sales forecast it was necessary to collect data, which refer to the sales presented months ago. Based on the registered data, the input variables were proposed, which will allow us to know our output data as the network develops.

II. LITERATURE REVIEW

This section shows the results of an exhaustive search on research with applications of Artificial Neural Networks for predictions in different areas.

Zhong, Orcid, Kang & Yang (2017) conducted an investigation on the precision that can be obtained to predict the rate of material elimination in ultrasonic machining through the application of ANN, the results show that its application provides better results at the time of predicting compared with other methods. [7] Kurt R, Karayilmazlar S & Cabuk Y (2017) made a forecast using artificial neural networks in the paper and cardboard industry in Turkey to determine the export figures, likewise, the authors highlight the importance of the increase in the use of this tool not common. [8] Rosales, Mora & Guada (2017) developed an investigation to make a prediction of the microclimate of the Hechicera Mérida Venezuela, based on the results the authors mention that they consider the use of ANN viable for the prediction of the microclimate in the short term, being able to extend its use to other locality, which could be useful for the development of disaster prevention plans, planting periods and in the prediction of energy supply in wind and solar plants. [9]

Rodríguez & Turias (2017) develop a comparison between artificial neural networks and classical methods for the prediction of mobility between transport zones, the objective of the research is to obtain an estimation procedure using simple and inexpensive input variables. They mention that, unlike traditional models, the alternative model works better with the input data used, better adjusting the expected results. The results are highly promising and therefore the ability of artificial neural networks to predict mobility between zones is demonstrated. [10] Jordán Expósito, MJ (2017) made a prediction in AR through artificial neural networks, this to predict the spread of the West Nile virus, which can become deadly causing a fatal disease in the nervous system, based on the results, the authors mention that with the information obtained it will be possible to foresee what happens with this virus. [11] Labiad, Berrado & Benabbou (2018) presented a short-term forecasting framework for securities markets based on artificial neural networks, to predict future trends in Moroccan securities markets and thus identify how they work. [12]

Tripatía (2018) carried out an investigation, where he predicted the price of from Indian stock market through the implementation of a neural network in a period of eight years, based on the results it was concluded that the exit data is very close to real data, furthermore, this information allows investors to make better decisions. [13] Manrique, Ramírez, Yail, Moreno, Soto & Núñez (2018) developed an investigation where they used a non-traditional method to predict prices, such the as neural networks, they also mention that ANNs require and provide more assertive and reliable information than other methods. [14] Benzer S & Benzer R (2018) developed a study that aims to compare the result of the prediction of the growth of the crayfish through two methods that are the length-weight relationships and the artificial neural networks of Lake Uluabat, based on the results, they concluded that ANNs can be a superior prediction tool compared to others. [15] Vega, Lazzús & Rojas (2018) carried out an investigation in where they combined an artificial neural network and a genetic algorithm in order to forecast the storm disturbance time index, based on the results obtained, the authors agreed and highlighted the importance of research and the use of ANNs, as well as their combination with other methods to make predictions. [16]

Jiménez, Gutiérrez & Celi (2018) carried out a study whose objective was to make a prediction of the El Niño phenomenon in Piura, Peru using artificial neural networks, the results of the study determined that neural networks are a highly reliable technique for find a pattern of behavior of rainfall. [17] Tomás Fontalvo, Efraín De La Hoz & Enrique De La Hoz (2018) carry out a study on the Data Envelopment Analysis and Neural Networks method in the Evaluation and Prediction of the Technical Efficiency of Small Exporting Companies, based on the results it was possible to classify to the companies according to the level of efficiency. They also highlight the participation of ANNs in the forecasts. [18] Morales, Y., Zamora, Y., Vásquez, P., Porras, M., Bárzaga, J., & López, R. (2018) carried out an investigation on a comparison between artificial neural networks and multiple regression for the prediction of the surface roughness in the dry turning, in the analysis it can be verified by the values of determination coefficients that the proposed models are capable of predicting the surface roughness. The models obtained show that the artificial neural network technique has better precision than multiple regression for this study. [19] Rodolfo Mosquera, Omar D. Castrillón & Liliana Parra (2018) made a prediction of Psychosocial Risks in Teachers of Colombian Public Schools using Artificial Intelligence Techniques, all this for the identification of the degree of risk in teachers of public schools, three were compared important machine learning models for prediction: artificial neural networks, decision trees and Naïve Bayes, reducing the dimensionality of the data, based on the results obtained it is concluded that the best prediction performance was obtained with the artificial neural network model with an effectiveness of 93%. [20]

Carrion Osnayo & Cristhian Jesús (2018) carried out an analysis, the objective of which has been to study the prediction of the recovery of the concentrator plant through the use of neural networks and, in turn, compare the results obtained with the real ones and establish the most suitable environments for their use. According to the results obtained, the authors determine that the linear regression model presents an unacceptable margin of error, however, the neural network model (backpropagation) is the one that best adjusts to the behavior of the variables and for the best prediction of recoveries. [21] Santamaría Vazquez, F. (2018). I perform a prediction of the behavior of financial markets to attract the attention of every investor in the Stock Market, thus aiming to obtain the highest possible return while assuming the least risk. [22]

Montañez, MAB, Hernández, AO, Barrera, JAM, & Castillo, SL (2018) carried out the development of a neural network in prediction of financial markets: an application in the Mexican stock market, based on the results, the Authors can provide useful information for those who wish to invest in the BMV. [23] Lingxian, Jiaqing & Shihuai (2019) implemented an investigation to determine a sales prediction using an integrated K-Mean and Neural Network framework on retail, where the results effectively showed the useful characteristics of the sales data online retailers. [24]

Akyuz (2019) made a sales projection through the use of ANNs for the wood industry in Turkey. He mentions that the most suitable ANN models were determined using performance criteria such as the mean absolute percentage error, the mean square error and the coefficient of determination (R-2) and finally highlights the excellent participation of ANN in making prognoses. [25] Álvarez, González & Otero (2019) carried out an investigation where they used non-linear methods to make a forecast of the international tourist demand from Spain, the two tools they used were ANNs and genetic programming, within this study the authors mention in based the results those nonlinear methods achieve slightly better predictions than those obtained by a traditional prediction technique. [26]

Vanegas, Bravo & Castillo (2019) carried out an artificial neural network for the prediction of calorific value (HHV) from the proximal analysis of carbonaceous residues, in said research the authors mention that based on the results obtained, the mean square error is lower when making the prediction with the ANNs, comparing them with other tools. [27] Zamudio Villanueva, J. C. (2019) carried out an investigation to obtain a prediction of the sales volume of a carbonated and non-carbonated beverage distributor in the city of Chimbote using artificial neural networks. The prediction was made for four most representative drinks of the brand: RNA-A, B, C and D with Backpropagation (BP) training algorithms and Levenberg-Marquadt (LM) weight adjustment, the results obtained are good and offer a lower error. [28]

Morales Castro, A., Ramírez Reyes, E., & Rodríguez Albor, G. (2019) made a sales forecast of the companies in the food sector: an application of neural networks. Based on the results, the authors mention that linear regression models predict more accurately in the short term than ANNs. [29] Martínez Barbero, X. (2019) made a prediction of the price of housing through artificial neural networks in the city of Madrid, based on the results, mentions that the models obtained predict the price of housing in euros and can be used in models of valuation automatic [30] Awami, Shakmak & Mohammed (2020) carried out a study where they used artificial neural networks to predict the temperature of the city of Benghazi, they mention and highlight the importance of weather forecasting for the development of human life, as well as the importance of adapt new prediction methods such as ANNs. [31] Cuhadar M (2020) conducted an

investigation on the development of a forecast of inbound tourism demand in Croatia using artificial neural networks and comparing it with other methods, based on the results obtained, mentions that ANNs produce prediction results successful compared to the results generated by conventional statistical methods. [32]

Khan N, Sachindra DA, Shahid S, Ahmed K, Shiru MS & Nawaz, N (2020) developed an investigation to predict droughts that could occur in Pakistan, with the aim of being able to alert people with limited resources. This research was developed through different tools, including artificial neural networks. [33] Montano IH, Marques G, Alonso SG, López Coronado M & Diez ID (2020) developed an investigation to reduce absenteeism and temporary disability through machine learning, based on the results, they mention that the efficacy and usefulness of neural networks artificial in prediction is much greater than other tools, in addition to this, ANNs are the most widely used method in both classification and regression models. [34] Mary Mouronte (2020) carried out research to predict the success of candidate projects to be executed in a large company in the ICT sector, as well as helping to improve business results and optimize the sales process. These variables were calculated separately using 4 ANNs. [35] Quizhpilema Lazo, IJ (2020) carried out an Implementation of a prediction model based on artificial neural networks for the classification of academic and research information from UNACH, the results obtained mention that the academic performance of the students is excellent when the gender is female, single, not foreign, does not work, does not have children, has siblings, practices sports and cultural activities. [36]

Koc E & Turkoglu M (2021) made a recent investigation on the development of a forecast to know the demand for medical equipment and the spread of Covid-19 outbreaks in Turkey through artificial neural networks, this tool allows to create very complete estimates. [37] Hopken W, Eberle T, Fuchs M & Lexhagen, M (2021) carried out an investigation on the development of a prediction of tourist arrivals, through the Big Data method and the use of ANNs. With the results obtained from the research, tourism companies can predict what is going to happen in the future. They conclude that within these two tools, the one that works best for the elaboration of predictions is the ANN despite being an unconventional method. [38]

Urgilés, Inga, Peralta, Ortega (2021) obtained a prediction of electricity consumption profiles using potential polynomials of degree one and artificial neural networks in smart metering infrastructure, through the prediction of the electricity consumption profile, it is plannedmaintenance and management of electricity demand to reduce operating costs from the final consumer to the electricity distribution manager, based on the results, the authors mention the good participation of the ANNs. [39] Aranda Arizmendi (2021) developed an investigation to obtain a prediction of the volumetric flow using artificial neural

networks, with the data obtained the author emphasizes her participation in the investigation of neural networks. [40]

Moscol Albañil, Peltroche Saavedra & Ruesta García (2021) carried out a study to obtain a prediction of quality parameters of fishmeal using Hyperspectral Images and Artificial Neural Networks, these researchers obtained as a result a good correlation between reflectance, provided by the hyperspectral image, and the main quality parameters after implementing a multilayer perceptron neural network algorithm. [41] Cesar Mayta, Jesús Valdivia, Fernando Rosales & Milca Gines (2021) developed a study to have a prediction of mortality due to Covid 19 in Peru using artificial neural networks, the results achieved had a mean square error of 0.0037 and a loss of 0.0480 addition to this, the results obtained throughout the article confirm the validity of this tool and its effectiveness in predicting the number of deaths due to COVID 19. [42]

José Benites (2021) carried out a study on the implementation of a sales forecasting system using artificial neural networks for the ceramic company Lambayeque Sac, said network has 4 input neurons, 12 hidden and one output, based on the results the author establishes that the magnitude of the error of the prediction made by the company is greater, while the prediction of the neural network has a very low level of error. [43] Laura, H., & Enrique, L. (2021) developed a prediction model for customers who will cancel the HFC service based on neural networks in the city of Moquegua, all this to provide the company with information that allows it to develop strategies for that your customers do not cancel the service. [44]

After analyzing each of the investigations, it is possible to identify the importance of artificial neural networks today in the face of society's problems.

Each researcher highlighted their point of view regarding ANNs in the development of predictions, but agreed that they provide a lower level of error compared to traditional methods. It should be noted that in most of the investigations the backpropagation algorithm was used since it provides better results; similarly, the same algorithm will be used in this investigation.

III. METHODOLOGY

This section presents the methodology used in this research work, it has different stages that aim to enrich the document, in addition to supporting it.

The methodology for the development of the tool begins with the collection of study data, continuing with the data preprocessing, continues with the design of the network topology, to later start the training of the network, which is divided into two stages: lhe first stage is known as forward propagation and the second stage is the backward propagation and to finish the methodology the results are obtained and the conclusions are given.

Next, the previously written steps are shown in a diagram, with the elaboration of this diagram the composition of the investigation can be seen in a clearer and more illustrative way.
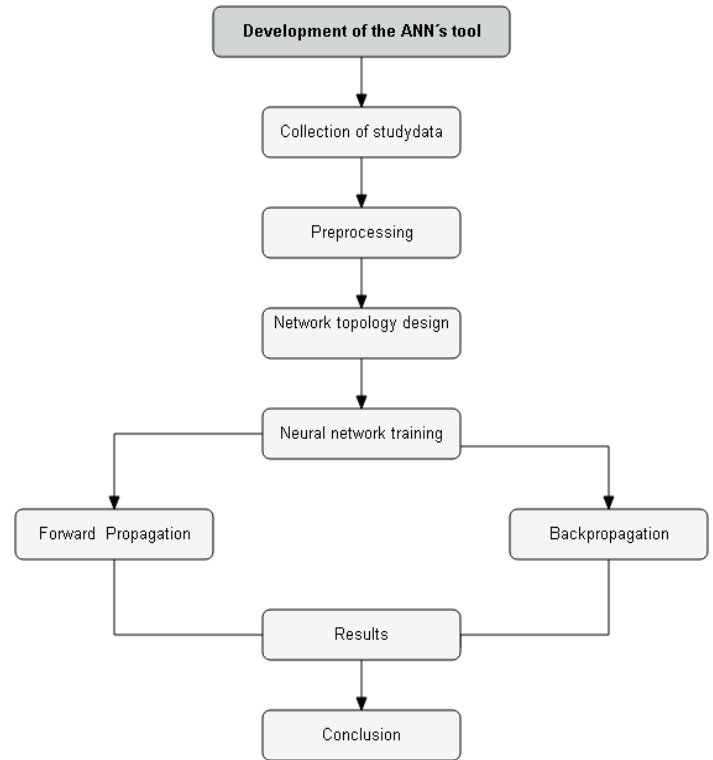

Fig. 1. Methodology of the tool used

IV. RESULTS AND DISCUSSION

As we know, a neural network has the purpose of solving problems in the same way as the human brain, so its application is of wide importance for the problems that occur in society.

A neural network is composed of 4 stages, the first is called "data collection", the second "data preprocessing", the third "forward propagation from left to right" and the fourth "backward propagation from right to left or Backpropagation", each of these stages has its purpose that allows to solve the existing problem.

As mentioned above, to start the development of the network, it is important to collect the sales data recorded in the last few months (sales in pesos). The sales record for the case under study was carried out from Monday to Sunday for approximately 4 months, through periodic visits to the SME.

Below is a table with the sales data recorded from the month of April to the month of July 2021; In it, it is possible to identify that the sales records are between $14,000 and $75,000 per day.

Table 1. Sales record.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
$ 72,565.20	$ 38,614.80	$ 40,720.84	$ 40,556.48	$ 65,259.52	$ 25,964.44	$ 44,909.72
$ 21,907.64	$ 23,280.88	$ 26,347.20	$ 30,808.08	$ 63,608.64	$ 23,809.76	$ 44,744.92
$ 54,239.96	$ 19,126.80	$ 24,231.80	$ 40,581.80	$ 75,499.16	$ 28,093.24	$ 39,773.68
$ 27,183.68	$ 21,690.84	$ 23,085.28	$ 44,920.92	$ 19,961.16	$ 17,908.64	$ 44,548.52
$ 24,888.12	$ 21,840.96	$ 15,001.32	$ 35,540.32	$ 26,732.68	$ 70,893.32	$ 45,908.44
$ 22,055.64	$ 21,383.72	$ 25,298.24	$ 41,748.56	$ 35,777.52	$ 69,247.88	$ 43,263.64
$ 15,838.24	$ 24,095.24	$ 27,921.76	$ 29,633.16	$ 37,052.56	$ 38,911.20	$ 29,908.76
$ 40,519.56	$ 34,524.00	$ 24,690.56	$ 39,651.84	$ 46,028.32	$ 42,855.32	$ 43,585.64
$ 35,654.32	$ 38,755.68	$ 28,984.72	$ 36,272.44	$ 38,063.24	$ 40,093.64	$ 47,042.28
$ 39,152.88	$ 44,289.16	$ 33,769.36	$ 23,149.56	$ 23,506.60	$ 24,823.48	$ 37,891.88
$ 28,862.36	$ 31,814.20	$ 39,103.64	$ 19,718.56	$ 35,148.32	$ 35,221.00	$ 44,881.60
$ 38,042.00	$ 36,514.36	$ 46,122.88	$ 52,576.96	$ 54,939.40	$ 43,056.32	$ 46,249.80
$ 47,331.68	$ 38,753.52	$ 39,626.24	$ 31,633.52	$ 22,949.48	$ 33,871.92	$ 30,794.00
$ 22,914.20	$ 22,650.12	$ 31,871.44	$ 27,965.04	$ 37,173.52	$ 24,037.68	$ 29,768.88
$ 26,469.56	$ 26,767.64	$ 24,730.88	$ 32,133.84	$ 38,224.00	$ 34,332.76	$ 45,573.20
$ 35,011.08	$ 37,583.60	$ 27,374.48	$ 23,945.88	$ 14,544.48	$ 33,118.24	$ 39,375.04
$ 18,151.36	$ 26,149.36	$ 39,349.20	$ 19,057.88	$ 34,995.72	$ 35,797.52	$ 47,403.72
$ 45,783.24	$ 37,619.60	$ 25,149.12	$ 36,452.76	$ 47,425.60	$ 46,744.52	$ 48,374.12
$ 51,399.68	$ 44,182.20	$ 29,049.52	$ 32,093.12	$ 38,330.48	$ 51,931.92	$ 43,625.76
$ 40,597.04	$ 33,575.68	$ 40,716.00	$ 26,344.00	$ 44,700.00	$ 49,940.00	$ 23,840.00

Data preprocessing

Something important that should be highlighted is that the design and development of this network can be made up of a series of combinations of any day of the week with 2 input variables and 1 output. Combination is presented below in which the data from Wednesday and Thursday will be taken into account as input variables and the data from Wednesday as output variables, so that this is possible it is important to data preprocessing as this way we can help the network to learn more easily.

The data preprocessing is done through a straight line, finding the value of a slope and an ordinate.

The formula for finding a straight line is:

$$y = mx + b$$

Where "m" represents the slope, "x" the value of the data that I want to preprocess and "b" represents the value of the ordinate.

To calculate the slope, the following equation is developed:

$$m = \left(\frac{Maximum\ value - Minimum\ value}{The\ maximum\ of\ the\ values\ I\ want\ to\ preprocess - The\ min}\right.$$

For its part, to calculate the ordinate, the following formula must be developed:

$$b = (Minimum\ value - (Pending\ x\ the\ minimum\ of\ the\ values\ I\ want\ to\ transform\ ))$$

Thus, for the first preprocessed value of Wednesday, the following is left:

$$Data\ preprocessing = (0.000032132\ x\ 40720.84) + (-0.482023395) = 0.826421298$$

This calculation is made for each of the registered sales data.

Next, the preprocessed data of the days under study are shown, that is, Wednesday, Thursday and Friday.

Table 2. Preprocessing of the registered veins of the last four months.

MONDAY		TUESDAY		WEDNESDAY		THURSDAY	
SLOPE	ORDINATE	SLOPE	ORDINATE	SLOPE	ORDINATE	SLOPE	ORDINATE
0.00001762	-0.279201	0.0000397	-0.760135	0.00003213	-0.482023	0.00002983	-0.5685681
1		0.774490151		0.826421298		0.641383952	
0.106993218		0.165091033		0.364566558		0.350552581	
0.676957129		0		0.296594387		0.642139343	
0.200000846		0.101899822		0.259754331		0.771591583	
0.159534021		0.107865876		0		0.491733067	
0.109602207		0.089694289		0.330861306		0.676948174	
0		0.197455247		0.415160423		0.315500306	
0.43508977		0.611913986		0.311335293		0.614395144	
0.349323849		0.78008899		0.449315523		0.513574955	
0.410997522		1		0.603055888		0.122070176	

0.229593125	0.504221385	0.774457322	0.019710565
0.391414594	0.691014674	1	1
0.555175881	0.780003148	0.791249539	0.375178555
0.124737162	0.140023432	0.542071798	0.265734024
0.187412123	0.303661501	0.312630858	0.390104979
0.33798462	0.733508304	0.397575186	0.145827391
0.040776379	0.279089879	0.782347672	0
0.527879513	0.734939012	0.326069773	0.518954578
0.626887815	0.995749206	0.451397681	0.388890149
0.436455611	0.574225947	0.826265778	0.217372315

Table 3. Continuation of the preprocessing of the registered veins of the last four months.

FRIDAY		SATURDAY		SUNDAY	
SLOPE	ORDINATE	SLOPE	ORDINATE	SLOPE	ORDINATE
0.000016406	-0.238611	0.00001887	-0.3379965	0.00004076	-0.9717079
0.832012243		0.152040175		0.858792571	
0.804928514		0.11137408		0.852075395	
1		0.192217826		0.649449827	
0.088864054		0		0.844070217	
0.199955114		1		0.899499962	
0.348341423		0.968944986		0.791699071	
0.36925926		0.396389296		0.247360003	
0.516512268		0.470828171		0.80482365	
0.385840103		0.418705935		0.945714784	
0.147029235		0.130506403		0.572748483	
0.338019		0.326742749		0.857646412	
0.66270416		0.474621721		0.913413646	
0.13788933		0.30128105		0.283441998	
0.371243685		0.115675701		0.241658556	
0.388477472		0.309978658		0.885835726	
FRIDAY		**SATURDAY**		**SUNDAY**	
0		0.287056561		0.633201435	
0.335515501		0.33762363		0.96044692	
0.539435528		0.544230521		1	
0.390224344		0.642134292		0.806458923	
0.49472034		0.604540029		0	

The topologies developed for each neural network are shown below.

Design and development of the network topology 2-3-1

This diagram shows how the network is shape together, we identify that it has 2 neurons in the input layer, 3 neurons in the hidden layer and one neuron in the output layer, this network has 9 connectors that are represented by W1 up to W9, it is also composed of 3 weighted sums represented by Nh1, Nh2 and Nh3 and their respective activation functions represented by Oh1, Oh2 and Oh3, it is also identified that the network has 4 biases represented by B1, B2, B3 and B4, likewise shown, the net input to the output neuron No1 and finally the output values are represented by Oo1.
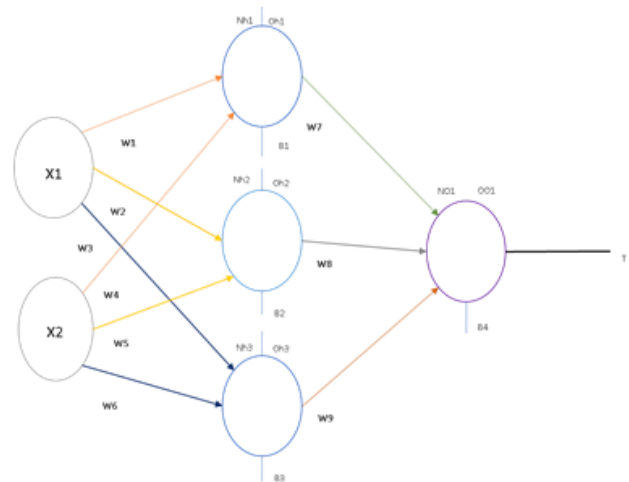

Fig.2. Neural network topology 2-3-1.

Design and development of the network topology 2-10-1

This diagram shows how the network is formed jointly, in it it is possible to identify in a general way that the network has 2 neurons in the input layer, 10 neurons in the hidden layer and one neuron in the output layer, in addition to have 30 connectors that are represented by W1 to W30, equally they are composed of 10 weighted sums represented by Nh1 to Nh10 and their respective activation functions represented by Oh1 to Oh10, in the same way that the red account with 11 biases is identified represented by B1 to B11 and finally the net input to the output neuron No1 and the output values that are represented by Oo1 are shown.
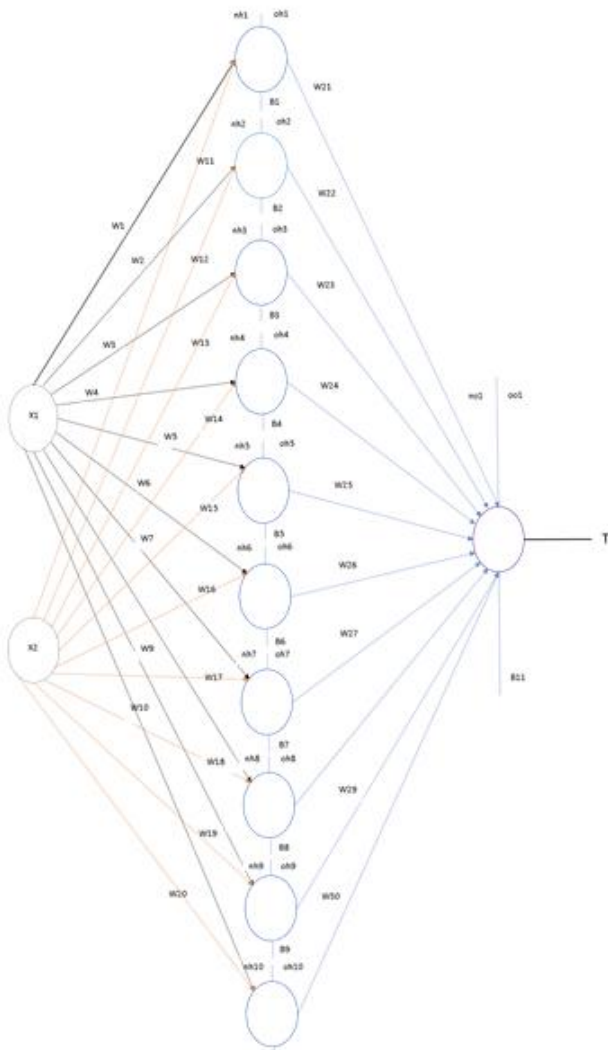
Fig. 3. Neural network topology 2-10-1.

Network training

Subsequently, for the training of the networks, an excel spreadsheet was used in which the propagation was carried out forward and backward, in said sheet the calculations corresponding to the different gradients necessary to carry out the backpropagation were made. Based on the calculations developed, the following results were obtained:
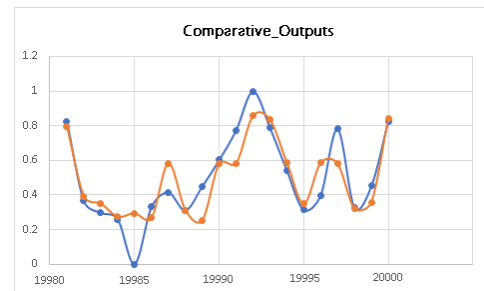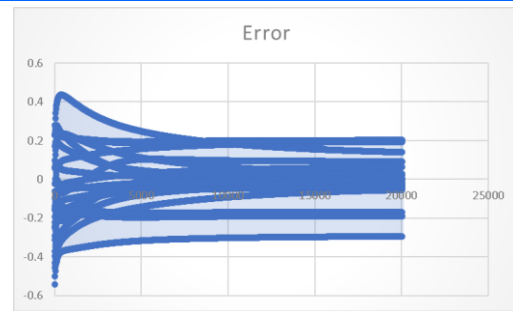
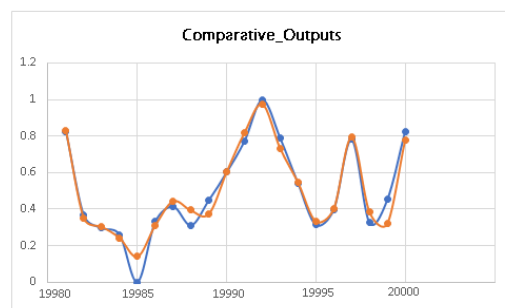Fig. 4. Comparative graphs of network outputs for the 2-3-1 network.

Fig. 5. Comparative graphs of network outputs for the 2-10-1 network.

Based on the comparison of the graphs, it can be seen that the second network provides better results, since it offers a lower level of error in its data, and with this information the company will make better decisions that will benefit it.

CONCLUSIONS

Based on the results obtained, it can be concluded that:

One of the most important aspects in the development of this research was undoubtedly the data collection, since without the help of the company the development and design of the networks would not have been possible. In the same way, the importance of data pre-processing is highlighted, since it allows us

a clearer control of the information and, in turn, helps the network to learn more easily.

The development of two topologies allows us to visualize their composition in greater detail, likewise, it allows us to make a comparison between both to recognize the one that gave us the best results.

The neural network that shows the best results for the case under study is the one with 10 neurons in the hidden layer, since the data it produces are closer to the objective data and it offers us a mean square error of 0.001551386.

For its part, sales predictions guarantee any business the option of anticipating everything that may happen, since it allows personalizing commercial management, easily adjusting a business's budget, offering the option of organizing sales operations and allowing refine campaigns. of marketing and even allows to attract more investors.

It is possible to implement unusual artificial intelligence tools in economic-administrative areas, as difficult as it may seem.

Artificial neural networks can help improve and correct processes more easily than other tools, thanks to the easy speed with which they learn and their easy adaptation. In the same way, we identify that the more neurons we find in a network, the better its results will be, since they provide us with a much smaller mean square error.

The information that results from the combination of these two tools (neural networks and sales predictions) will guarantee any company, regardless of its size and sector, validated and supported information for making decisions that will have a positive or negative impact on the company.

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