

Model and Artificial Neural System

Chukwudi Ikenna Anyanwu

Department of Computer Science Imo State University Owerri, Nigeria

Asso. Prof. Alphonsus Onyekachi Agbakwuru

Department of Computer Science Imo State University Owerri, Nigeria

Dr (Mrs) Ebele Leticia Elebiri

Department of Computer Science Imo State University Owerri, Nigeria

Abstract

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With the advancement of globalization, the market competition among enterprises has become increasingly intense. To win a good market, an enterprise must understand and grasp the laws of the market economy and accordingly predict the future of the market. Only by ensuring correct estimates can companies develop a right business plan and ultimately capture the market. The aim of this research work is to investigate into the problem of not making correct sales forecast as seen in most businesses today. The system at study in this work is the supermarket. The research work took place in Obowo LGA of Imo State, Nigeria. During the study, it was discovered that the management of the supermarket makes sales forecast using conventional means. The manager of the supermarket makes sales predictions relying on past sales data written in accounting books. This involves lots of paper work and also is time consuming. The purpose of this project is to develop a computer based sales forecasting system (software) for a supermarket, because the computer is faster and more accurate in processing data than humans, and this will help to solve the problems encountered in the traditional ways of sales forecasting which involves lots of paper work and also takes a lot of time to process. To achieve this, I have adopted two methodologies, the first method is the Linear Regression Model were by data from previous sales events are collected and stored in a database which can then be used as references when making decisions for future sales events. The second method is the Artificial Neural System also known as Machine Learning were by the computer behaves like humans by being able to collect and store data from previous sales events and also predict future sales without any human input. Two programming languages were used in developing the software: PHP and MYSQL, with php as front-end and mysql as the backend database. The system would be able to perform the following tasks: supplier registration and management, product registration and management, user management, customer management, sales report, receipt printing and sales forecasting. The resultant software is a sales forecasting system with an interface that is user-friendly whose data processing is very fast and accurate, with the ability to automatically update itself based on recent sales events. It can be entered using a username and password. It is accessible either by an administrator or staff.

Keywords: Linear Regression, Artificial Neural System, Sales Forecasting, Database, Software.

1. Introduction

Forecasting is the process of making predictions of the future based on past and present data and analysis of trends. Sales forecasting is the ability to forecast future sales based on past sales. Sales forecasting is an important aspect of many businesses today. Increasingly, companies are attempting to expand their forecasting abilities, in order to get the edge on their competitors. For example, a good forecasting model can enable a supermarket to hold just the right amount of inventory to satisfy the demand for their product.

Earlier supermarkets used to order goods without considering the number of sales and demand. Modern supermarkets require past and present sales data before ordering for goods to make profit. In today's highly competitive environment and dynamic consumer landscape, accurate and timely forecasting of future revenue or sales can offer valuable insight to supermarkets' orders, planning, stock management, growth, and decision-making.

Sales forecasting is particularly important because of the limited shelf-life of many household goods which leads to a loss of income in both shortage and surplus situations. Most supermarket managers make sales predictions randomly by the rule of the thumb, but in developed countries computer-assisted predictions can be more accurate than expert predictions. To achieve a computer system that plays a better managerial role is to try and model the professional managers' skills in a computer program.

Most large scale retailers have implemented computer assisted ordering to forecast future sales for accurate replenishment. These systems are usually based on time series of past order data. They see a large increase in sales during their events and this along with the consumer demand of fresh products makes accurate predictions of event sales. Predictions that are difficult to make due to the unpredictable behavior of human consumption.

When forecasting sales for specific event in a company, there has to be a team working with this specifically and they make their predictions based on past events sold quantities and their own experience. These predictions are on terminal level with a goal accuracy of about 20% absolute deviation from the realized sales, and are made preliminary some weeks ahead of the event. Some customers make their own preorders on how much they want delivered to them one or two weeks ahead of the event. The event team can then adjust their predictions in accordance with the collective preorders. The sales prediction and the preorders make the foundation for the quantities

of the item volume delivered to the terminal. Items are then distributed to the customers based on the store managers' final orders. These orders may deviate from the preorders and in the case when the demand is higher then the volumes stored in the terminal the items are being distributed on a first come first serve basis.

In this study, we have adopted two methodologies which are the linear regression model and the artificial neural system; these will enable us to timely and correctly make predictions on future sales events. Using the Linear Regression Method together with Machine Learning techniques with the available sales data and information, one can automatically develop accurate sales forecasting model. This approach is simpler and more flexible, and can adapt to data changes.

A mathematical model will be created that will adequately describe the total sales for each item during an event week. The results of the statistical analysis will be used to implement an Artificial Neural Network. Relevant factors from the linear regression analysis will be used as inputs and the data will be passed through a feed forward Neural Network with the event sales as target data. The advantage of using Neural Networks is that they can capture nonlinear relationships between input and output data. Nonlinear relationships in the data might for example be that the increase in sales generated by two items separately might differ from the increased sales generated when they are used in combination. Or that there is probably a nonlinear dependence between the event price and sales, intuitively there should be a jump in sales when the price hits certain levels. With this approach every prediction will be based on a larger amount of data. A top down approach will be taken as to what input factors are most relevant to the output and the trade off between reduced complexity and loss of accuracy will be discussed. This is a crucial topic since the models need to be rather generic in order to be able to be implemented in the company's forecasting system.

2. Literature Review

Gharoie, R. et al (2010) said that both linear regression and artificial neural networks can be used effectively for prediction and forecasting in various settings. In most cases, artificial neural networks, ANNs, seem to outperform linear regression, although some studies show minimal differences between the two.

Matsuura, C. et al (2014) said that one of the more common areas for linear regression is predictive analysis, modeling future opportunities, and any risks that might be involved. More specifically, it is often used in demand or sales forecasting.

Patel, H. et al (2015) said for most businesses, estimating the number of products that will be sold within a certain period of time is very beneficial. A stock out would be detrimental to the total sales, and another issue would be having too many copies of a product that never sells.

Mukhtiar, B. et al (2014) said for a business to remain competitive as a company, it is almost necessary to have a good idea of an optimal inventory quantity.

Ahangar, et al (2010) made use of neural network regression for stock price prediction. Moreover, they suggested that there is an increasing interest in ANNs for problems related to forecasting. The ability to capture nonlinear relationships and the complexity of new algorithms make them powerful. However, linear methods have primarily been used in the past because of their simplicity. In their study, 10 economic and 30 financial variables were used for a general regression neural network with 3 layers. From those variables, three economic and four financial ones were used to estimate the stock price using Independent Components Analysis (ICA). The study concluded that the neural network method is more efficient than linear regression.

3. Statement of Problem

- a) **Poor Forecasting in Logistics:** Some accountants do make calculations using specific sales model formula in forecasting on regular basis. Using these conventional method poses lots of constraint on sales forecasting as it takes lots of time forecasting using which ever model is adopted by either the sales manager or accountant or financial adviser.
- b) Irregular Demand: Customers have different requirements and needs depending on the region they live in. Demand changes its behavior as fast as global trends do. Hence, the consumer market has an unpredictable behavior toward outdated methods. Therefore, forecasting sometimes fails because businesses cannot see how the demand changes and at what time. These misunderstandings lead them to having <u>losses</u> and more stock than they need.
- c) **Regional forecasting:** Some businesses have a wide variety of geographical distribution centers and need to know how to group or ungroup the forecast geographically. As a result, the wrong product ends up in the wrong place. Therefore, forecasting method has to focus on each distribution center, keeping in mind the customer behavior, customs, trends, weather conditions, economy, etc.
- **d**) **Unstable inventory:** On the one hand, an undersupply erodes customer confidence, reduces profits, and results in competitors filling the market gap. On the other hand, an oversupply

increases inventory costs, as well as creates an imbalance between the cost of production and sales receipts. Either way, inventory problems can lead to poor forecasting, which seriously affects the business's cash flow and profit margins.

e) Variety of products: Forecasting problems are common when the variety and quantity of items exceed the rational management of systems, scheduling tools, and spreadsheets, exposing the company to inventory level imbalance.

4. Aim and Objective of Study

The aim of this study is to encourage businesses at all levels to own a computer based sales forecasting system in order to increase profitability and reduce losses.

This study is to develop a sales forecasting software for a business (supermarket) that will help to achieve the following:

- **Perform accurate financial planning** the business will acquire a better understanding of how they can use their capital and makes it possible to calculate what profit they can expect.
- **Plan sales activities** understanding how many salespeople to employ, for instance, and which quotas and targets to attribute to each of those salespeople.
- **Coordinate marketing** to show, for instance, that sales are waning and a bigger investment needs to be placed within marketing, or maybe it will show that a particular product or service is failing to deliver appropriate amounts of value.
- Control inventory to understand how much inventory business will need to purchase and retain.
- Avoid price fluctuations a poor sales forecast might mean that a business is forced to adjust its pricing unpredictably.

5. Significance of Study

This study provides a reliable way of handling sales forecasting in businesses (supermarkets) using a computer-based software. Using the method suggested in this study, business owners will be able to produce sales forecast more quickly and effectively, rapidly implement and seek data from any data source, and also increase revenue and profit opportunities.

6. Methodology

In this section, we are going to evaluate the data collected from the study of supermarket in Obowo LGA. This way we will be able to determine its strength and weakness and thus be able to develop a better new system.

(A). Fact Finding Techniques

The major facts finding techniques used in gathering data for the analysis are as follows:

- 1. Questionnaire: This technique involves collecting data using a set of written questions with a choice of answers.
- 2. Observation: In this technique, the research obtains data through participation in the operation of the firm, and observes critically the procedures that are undertaken in the firm.
- 3. Interview: This technique includes communication between the researcher and the respondents.

(B). Problem Definition

The following problems were identified during the course of the study:

- 1. **Poor Forecasting in Logistics:** Some accountants do make calculations using specific sales model formula in forecasting on regular basis. Using these conventional method poses lots of constraint on sales forecasting as it takes lots of time forecasting using which ever model is adopted by either the sales manager or accountant or financial adviser.
- 2. **Irregular Demand:** Customers have different requirements and needs depending on the region they live in. Demand changes its behavior as fast as global trends do. Hence, the consumer market has an unpredictable behavior toward outdated methods. Therefore, forecasting sometimes fails because businesses cannot see how the demand changes and at what time. These misunderstandings lead them to having <u>losses</u> and more stock than they need.
- 3. **Regional forecasting:** Some businesses have a wide variety of geographical distribution centers and need to know how to group or ungroup the forecast geographically. As a result, the wrong product ends up in the wrong place. Therefore, forecasting method has to focus on each distribution center, keeping in mind the customer behavior, customs, trends, weather conditions, economy, etc.

- 4. **Unstable inventory:** On the one hand, an undersupply erodes customer confidence, reduces profits, and results in competitors filling the market gap. On the other hand, an oversupply increases inventory costs, as well as creates an imbalance between the cost of production and sales receipts. Either way, inventory problems can lead to poor forecasting, which seriously affects the business's cash flow and <u>profit margins</u>.
- 5. Variety of products: Forecasting problems are common when the variety and quantity of items exceed the rational management of systems, scheduling tools, and spreadsheets, exposing the company to inventory level imbalance.

(C). Feasibility Study

Feasibility study is a detailed analysis of a system in order to know the likelihood of it succeeding. In this project, for us to successfully implement a sales forecasting system software for the supermarket, we will first make a feasibility study of the existing system (that is, they supermarket sales forecasting system already in use), then we will be able to improve on it so as to avoid losses and increase profit opportunities.

- 1. The supermarket is situated in Obowo town. It is by the main road and not difficult to access.
- 2. The supermarket has large number of people from the area that patronize it.
- 3. The major challenge the supermarket has is that there are no major dealers (whole sellers) in the obowo community. The owners of the supermarket have to travel long distance outside the obowo region to buy products.
- 4. Electricity power supply to the area is very unsteady. They stay days and even weeks without electric light. Because of this, most transactions in the supermarket a done manually.
- 5. The management of the supermarket use various books to keep records of the daily transactions.
- The books used for record keeping in the supermarket include: Accounting Book, Cash Book, Imprest Book (Petty), Store Record Book, and Staff Register.

(D). Organogram of the Present System



CEO: This is the Chief Executive Officer / Owner of the supermarket. He or she oversees all the activities of the supermarket. He is superior to the manager and directs the manager on what to do.

Manager: The manager is next in rank to the CEO. The receives instructions from the CEO and passes it on to the other staff. The manager instructs the storekeepers, the sales personnel and the accountant. The manager also advises the CEO on important issues.

Storekeepers: The storekeepers are responsible for arranging items for sale in their right positions. They direct the customer to the exact location of a good. They also report to the manager the conditions of goods on display.

Sales Personnel: The sales personnel relates with the customers. They receive the money paid for goods and issue a receipt.

Accountant: The accountant keeps record of financial transactions. He keeps record of goods bought and prices they were sold.

Customer: Customers are those who come to buy goods from the supermarket. They choose any item of their choice and pay at the counter to the sales personnel who issue them a receipt.

(E). Proposing a New System

Having acquired an understanding of the aspects of the present supermarket system, the need for a more accurate and reliable system becomes imperative. The problem with the present system in line with our course of study is that sales forecasting can only be possible through expert decision which are based on data that are manually written down in books. This method of sales forecasting can be resource intensive, time consuming and less accurate due to human imperfection.

There is need for a new sales forecasting system that will be computer based. This is because, computer has the ability to store vast amount of data and can process data much more faster and accurately than humans do.

(F). Expectations of the New System

The stock constitute a major part of the assets of the supermarket, and the computer is able to keep accurate records of information to satisfy the firm. To maintain this balance, the new system which is a sales forecasting system software is expected to provide up to date information at minimum stock level. The system should be capable of performing calculations at a very high speed and with higher degree of accuracy. The new system will be user friendly and with a graphical user interface that can serve even those who are novice in the use of computer.

(G). High-level Model of the Proposed System



7. Conclusion

In conclusion, it is obvious that sales forecasting improves business activities whether it is a large, medium or small scale enterprise. Hence it is advised that all business owners in Nigeria who are *A Publication of the Department of English and Literary Studies, IMSU, Owerri, Nigeria. July, 2024* 270

faced with the responsibility of managing sales activities on a daily bases should adopt the method suggested in this study which is more reliable, flexible and result oriented.

The sales forecasting software program developed in this paper would be of great benefit to the users be it individuals or group of people.

References

- Ahangar, et al (2012), "The Comparison of Methods, Artificial Neural Network with Linear Regression Using Specific Variable for Prediction Stock Price in Tehran Stock Exchange", Iran. Islamic Azad University, Babol.
- Gharoie, Reza et al (2010), "The Comparison of Methods Artificial Neural Network with Linear Regression Using Specific Variables for Prediction Stock Price in Tehran Stock Exchange".http://arxiv-org/abs/1003.1457.
- Matsuura, Kanichiro et al (2014), "Maize Yield Forecasting by Linear Regression and Artificial Neural Networks in Jilin, China". In: The Journal of Argricultural Science (May 2014). DOI: 1017/S0021859614000392.
- Mukhtiar, Bano et al (2014), "Introducing Economic Order Quantity Model for Inventory Control in Web Based Point of Sales Applications and Comparative Analysis of Techniques for Demand Forecasting in Inventory Management". In: International Journal of Computer Applications 107.19 (Dec. 2014). Full text available, pp. 1-8.
- Patel, Harsh et al (2015), "Short Term Load Forecasting of Indian System Using Linear Regression and Artificial Neural Network". England. Nirma University.