JOURNAL LA MULTIAPP

VOL. 05, ISSUE 01 (038-043), 2024
DOI: 10.37899/journallamultiapp.v5i1.1000

Design of Forecasting for Perishable Product with Artficial Neural Network

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Article Info

Article history:
Received 28 December 2023
Received in revised form 16 January 2024
Accepted 31 January 2024

Keywords:
Perishable Products
Raw Materials
Inventory Management
Continous Review
Artifcial Neural Network

Abstract

Raw materials are an important part of the manufacturing industry, especially for raw materials that do not last long or have a lifespan. To be able to produce good products, the raw materials used must be of good quality. This happened to company XYZ which operates in the cereal and snack food industry. Inventory control is quite a big challenge for companies. In this year the company experienced losses due to a shortage of finished snacks products, due to finished goods being obsolete due to a lack of accuracy in forecasting snack demand. The research raised forecasting using the Artificial Neural Network method. ANN is known to be able to produce good accuracy values in predicting sales.

Introduction

In an increasingly industrial era, each company continues to innovate and improve its business processes in order to compete with the market. One of the things that can be evaluated in the business process is the supply chain system. The supply chain system is one of the main parts of business to be able to optimize existing business processes (Amrina et al., 2023). The supply chain system is generally considered as a sequence of material procurement, production facilities, distribution services and customers where everything is interconnected (Delfmann & Albers, 2000). Inventory is an important part of the supply chain system which is considered to be able to control the process flow to make it more efficient (Singh & Verma, 2018). Inventory greatly influences a company's ability to meet customer demand so that inventory control becomes a quite difficult challenge for business people (Kittisak, 2023). One of the factors that influences inventory control is the level of accuracy in forecasting or forecasting demand (Zhou et al., 2023).

A low level of accuracy in demand forecasting will have a major impact on supplies. Inventory can be very high, causing high storage costs or conversely, inventory will be low, resulting in lost sales, both of which make the company lose money (Munyaka & Yadavalli, 2022). Effective inventory control will increase efficiency, increase customer satisfaction, and also reduce inventory costs.

Low control of raw material inventory will greatly affect service levels. Especially for companies operating in industries that produce products that have a shelf life or what are commonly known as perishable products. Demand for perishable products is increasing (Liu et al., 2021). Perishable products are products that have a shelf life such as fruit, vegetables, meat, medicines, food and blood (Lusiantoro et al., 2018). Products that have a shelf life and are easily damaged require good management (Duong et al., 2015). One of the challenges experienced by companies operating in the perishable product industry is storage. Perishable

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products Inventory control really needs to be paid attention to because products have a limited lifespan and quality that cannot last long. Due to certain characteristics of perishable products, it is necessary to control inventory and also policies regarding storage (Yudha, 2022).

This is what PT XYZ, which operates in the snack food and cereal industry, feels. PT Several raw materials are used together which can produce different products so that what needs to be improved is the level of accuracy of forecasting demand. The problem experienced by PT XYZ is the level of sufficient snack supplies

Previous literature states that the level of forecasting accuracy is a very important part of achieving inventory efficiency (Amrina et al., 2023). This research aims to design a forecasting model for snack products which begins by evaluating the level of accuracy of finished goods using the artificial neural network (ANN) method. Artificial neural networks are commonly applied in the fields of optimization, forecasting, decision making and simulation (Bhadouria & Jayant, 2017).

Methods

In completing the inventory control model. The thing that needs to be considered is the level of forecasting accuracy. Demand forecasting is a very important part because it will have an impact on inventory control or material planning. In this research, the forecasting used is an artificial neural network or commonly known as (ANN).

Stage 1: Forecasting Model

Artificial Neural Network or commonly known as Artificial Neural Network (ANN) is known to be able to carry out forecasting with much more accurate results when compared to other conventional methods (Mataram, 2008). This method has input and output that are connected to each other, where each weight can be changed according to needs.

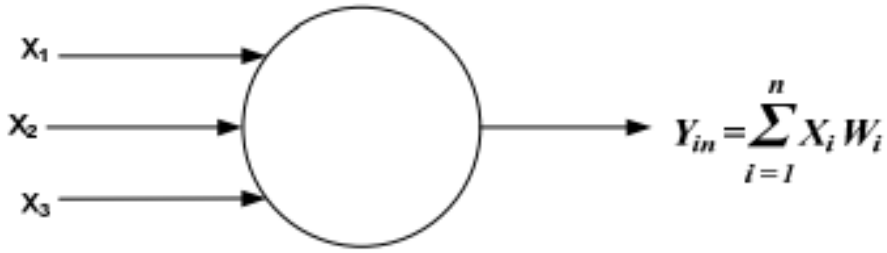

Figure 1. Artificial node model (fausett, 1994)

Figure 1 shows the artificial note mode where x_1,x_2,…,x_n are input. In this case, the expected output in this method is in the range 0 to 1. Before carrying out calculations using this method, past data needs to be transformed into a binary sigmoid function (Sofian, 2017). This model has several layers, such as input layer, hidden layer and output layer (Habibi & Riksakomara, 2017). The layer can be a single layer or multilayer. The output layer is the outer units which are the solution of the ANN method to a problem. The level of accuracy produced by the ANN method is based on the level of correlation between input and output. (Aminullah et al., 2022). There are three phases in network training using the ANN method, namely the forward calculation phase, the backward calculation phase and the weight change phase (Suyanto, 2021; Indwiarti et al., 2019). After getting an error value that is close to 0 or the desired target, then testing is carried out.

Results and Discussion

Forecasting using ANN is expected to obtain a high level of accuracy so that raw material inventory control can be optimal. Forecasting is carried out for Product A. In this case, training and testing data is needed. There are 30 historical request data, namely requests for March

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2021 – August 2023 which are then divided into 2 parts of data for training and testing, March 2021 – August 2022 as training and September 2022 – August 2023 as training.

Artificial Neural Network Forecasting

Forecasting is carried out on product A

Table 1. Historical Data on Product Demand A

Period	Period	Demand
Mar-21	1	117679
Apr-21	2	52607
May-21	3	123037
Jun-21	4	55183
Jul-21	5	60320
Aug-21	6	71946
Sep-21	7	49287
Oct-21	8	74079
Nov-21	9	37786
Dec-21	10	121532
Jan-22	11	71977
Feb-22	12	44227
Mar-22	13	52815
Apr-22	14	55937
May-22	15	90014
Jun-22	16	80276
Jul-22	17	119849
Aug-22	18	48146
Sep-22	19	126914
Oct-22	20	113753
Nov-22	21	31515
Dec-22	22	62872
Jan-23	23	70996
Feb-23	24	85044
Mar-23	25	66528
Apr-23	26	61114
May-23	27	59651
Jun-23	28	114365
Jul-23	29	48245
Aug-23	30	125175

The formation of network architecture using *backpropagtion* and determining the number of layers. The network layer used is 15-12-1 which produces the following forecasting results:

Table 2. Best Network Architecture Training Results

Product A				
Activation Function			**Training Functions**	**MSE**
Logsig	Logsig	Pureline	**trainlm**	**1.26E-26**
		Pureline	traincgp	7.16E-08
		Pureline	traincgb	2.56E-09

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Product A				
Activation Function			Training Functions	MSE
		Pureline	trainrp	3.26E-09
		Pureline	traingdx	1.02E-08
	Currently	Pureline	trainlm	2.72E-09
		Pureline	traincgp	2.00E-08
		Pureline	traincgb	4.71E-08
		Pureline	trainrp	3.29E-10
		Pureline	traingdx	2.72E-09
Currently	Logsig	Pureline	trainlm	3.67E-22
		Pureline	traincgp	9.81E-08
		Pureline	traincgb	1.56E-09
		Pureline	trainrp	6.10E-10
		Pureline	traingdx	5.32E-09
	Currently	Pureline	trainlm	2.26E-25
		Pureline	traincgp	1.68E-08
		Pureline	traincgb	1.07E-08
		Pureline	trainrp	1.80E-11
		Pureline	traingdx	3.78E-11

Table I displays the results of the best network architecture training for forecasting product A. It can be seen that the logsig, logsig activation function with the trainlm training function produces the smallest MSE value, namely 1.26E-26. So the training chosen is with the logsig activation function, logsig and the trainlm training function produce forecasting results for 12 periods as follows:

Table 3. Product Forecasting Results A

Period	Period	Request (month/ctn)
Sep-23	1	**116769**
Oct-23	2	**201502**
Nov-23	3	**276651**
Dec-23	4	**208016**
Jan-24	5	**36126**
Feb-24	6	**205451**
Mar-24	7	**219376**
Apr-24	8	**361756**
May-24	9	**384729**
Jun-24	10	**37228**
Jul-24	11	**57430**
Aug-24	12	**55993**

Conclusion

Today With the importance of internet for everybody whether in private life or in practical live, we can imagine the world with out of internet specially with the smart application that presented to us, all the objectives around our environment can be connected to internet with a large network containing different sensors with standard protocol for IoT, and it provides the chance for people to control things over distance Without the need to be in a specific place to deal with a specific device, hence the IoT system that is used in this work is successfully using raspberry pi as an IoT device and HTTP post request for transferring the captured image file and server for receiving and store image. The future work will be about processing the

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image that stored in the server using training system and robost algorithm for processing using also hardware platform.

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