Journal of Contemporary Issues in Business and Government Vol. 27, No. 3, 2021
https://cibg.org.au/

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.03.030

Techniques Using Artificial Intelligence to Solve Stock Market Forecast, Sales Estimating and Market Division Issues

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Abstract: This research paper would discuss the use of artificial intelligence (AI) in stock market modelling, sales forecasting, and market segmentation problems, with a focus on convolutional neural networks (CNN) and fuzzy logic. Backpropagation algorithms were used to solve the first two problems, while self-organizing maps were used to solve the third (SOM).

Keywords: Stock price prediction; sales forecasting; division; Fuzzy logic; backpropagation neural algorithm convolutional neural networks; self-organizing maps.

INTRODUCTION

Artificial intelligence (AI) is a branch of science that aims to assist computers in solving complex problems in a more human-like manner [1]. Artificial intelligence is becoming increasingly prevalent in a wide variety of applications. It quantifies the system's ability to operate with a knowledge base of facts and laws. The purpose of this article is to discuss the application of neural networks (NN) and fuzzy logic (FL) to stock and revenue forecasting.

Stock market analysis is a hot subject in finance that has piqued the interest of academics for years. It is based on the premise that historical public knowledge has a predictive relationship with potential stock returns [2]. Significant gains may be made by correctly forecasting future stock prices. Predicting the price, on the other hand, is much more difficult.

Sales forecasts are used to predict the company's sales in a specific period (usually the next fiscal year) in the near future. Obtaining accurate revenue predictions ahead of time will assist policy makers in calculating production and material costs, as well as determining sales rates and managing strategic operations [3]. To make accurate predictions, a dynamic machine is needed that can benefit from all of the lessons stored in previous records.

Market segmentation is a marketing technique that entails splitting a large target market into subsets of customers, businesses, or countries that share or are thought to share shared needs, preferences, and goals, and then designing and implementing strategies for each segment. A effective marketing and customer experience management approach needs market segmentation [4].

Market segmentation's simple purpose is to group consumers based on their shared interests and interests, and clustering is a powerful method for accomplishing this [5]. This paper proposes and applies a SOM-based visualization approach to consumer segmentation. Compared with other clustering methods, it has advantages, such as the ability to easily understand and reveal the interrelationship between different customer characteristic variables.

The structure of this article is as follows. Section 2 introduces the artificial intelligence technology used in this article. Section 3 introduces two forecasting problems-stock market and sales forecasting problems, while Section 4 discusses the use of SOM for market segmentation. Section 5 gives conclusions and then gives references.

BACK PROPAGATION ALGORITHM

The back - propagation algorithm contributes to the reduction of error to a bare minimum over time. Continue training until the weight difference between you and your partner is manageable. The backpropagation process employs two estimation movements: forward and backward movement. Following that, the network's effect would

be incrementally calculated without adjusting the link weight. When the outputs of the network are compared to the desired result, the network generates error signals for each neuron in the output layer. The error signal from the output neuron is sent backward through the network, and the weight update is applied in accordance with the optimization algorithm used. Neurons perform the recursive calculation one by one, modifying all connection weights until the error is negligible. This article was optimised using the Levenberg-Marquardt algorithm. 70% of the training samples were used to construct the neural network model for prediction, and 30% of the test samples were used to assess the model's generalizability. Twenty hidden layers comprise the theoretical neural network. The layer is hidden using the sigmoid colon activation feature. This technique is used in financial forecasting as well as sales forecasting.

ARTIFICIAL INTELLIGENCE TECHNIQUES

These advancements have shifted the focus of computation, learning, and artificial intelligence away from developing efficient computing capabilities and toward modelling the learning and functions of the human brain [6]. An artificial neural network is a theoretical framework based on a simulation of the biological central nervous system. The network is made up of a large number of closely integrated computing components (neurons) that work together to solve complex problems in real time. The key benefit of a neural network is that it can handle data that is incomplete, lost, or noisy. This is a non-parametric approach for mapping and/or approximating some complex nonlinear and/or continuous function [7]. Backpropagation algorithms and self-organizing maps are two examples of artificial neural networks used in the study.

Fuzzy Logic: For unpredictable and dynamic systems, fuzzy logic is a means to model flawed reasoning models (such as common-sense reasoning). In that it uses approximate knowledge and complexity to make judgments, fuzzy set theory is analogous to human reasoning. The biggest contribution of fuzzy control theory is its potential to work with a wide range of functional issues that traditional control approaches are unable to address effectively [8]. Fuzzy models are built on the identification of systems using rules. The relationship between variables is expressed using if-then rules with imprecise predicates in this case. Then, to make the model more operable, use fuzzy sets to describe variables more specifically. The membership function (represented by), which maps the elements of the universe under consideration to the unit interval [0, 1], defines the fuzzy set. State values or input-output data pairs are used in the proposed process. Starting with the initial conditions, the machine measures the difference between the system's current output and the required output. This error is used to change the membership function's value before applying the next feedback iteratively. The new equilibrium is obtained when no major changes in the membership function are seen. The resulting fuzzy model is a representation of the complex structure in operation.

Self-Organizing Maps: SOM is also an unsupervised artificial neural computation and mapping technology which can create organized variational projections of high-dimensional input feature vectors onto a low-dimensional (usually one- or two-dimensional) network. In the SOM algorithm's output, data points with identical attributes are clustered together. As a result, SOM can be used as a clustering mechanism. The SOM algorithm determines the winning neuron by calculating the distance between the data points and the weight vectors of all output layer neurons. Adjust the winning neuron's weight to bring it closer to the true data point. Additionally, the weights of adjacent neurons are altered to conform to the order of the input space. This accounts for SOM's topological preservation properties. This is done prior to allocating all of the data points to output neurons. This technique is used to customer segmentation. Instead of a wider function diagram, each data cluster is represented by a single and special Kohonen neuron. The Kohonen layer that results is a one-dimensional map of N neurons, where N denotes the number of data clusters (5 in the current case). In the self-organization method, there are 200 training iterations, which is an appropriate amount.

Formulation of the problem and simulation of the results for prediction

We compared neural networks and fuzzy logic using two related problems (stock market forecast and sales market forecast). Stock Market Forecast.

Data Set: All trading days from July 2, 2016 to February 17, 2020 were used to calculate the regular historical available prices of stocks listed on the Bombay Stock Exchange (BSE). The stock's opening price, as well as three other derivative variables (simple moving average, exponential moving average, and relative strength index), are fed into the model. Price at which the business will close.

Select it to reflect the expected index price. For teaching and assessment purposes, divide the data into a 70:30 ratio. Mean Square Error is used to reduce the output index (MSE).

RESULTS AND DISCUSSION

During the neural network test process, Figure 1 depicts the relationship between the real stock price and the expected stock price, while Figures 2(a) and 2(b) depict the relationship between the actual stock price and the

predicted stock price. (b) show the MSE for NN and fuzzy respectively.

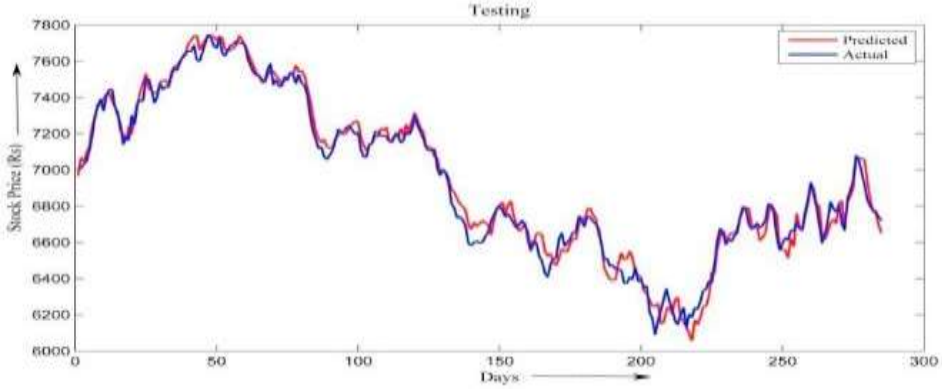
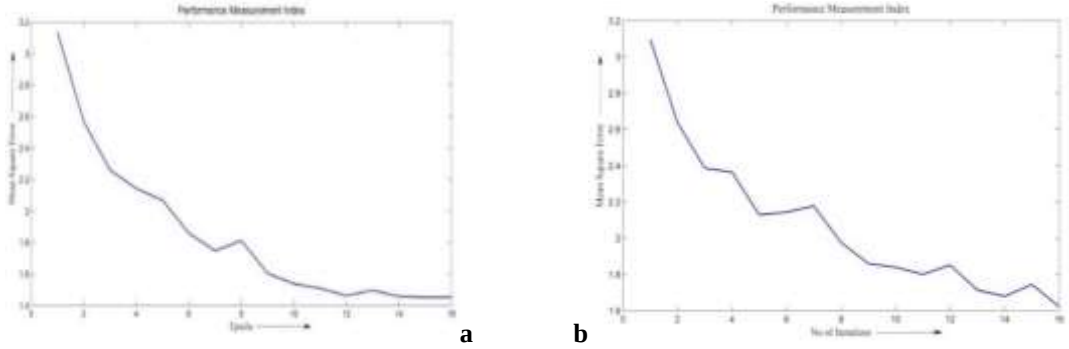


Fig.1: shows a graph of the real and expected market price during neural network research.



a **b**

Fig.2: Mean Square Errors (a) ANN (b) Fuzzy

The blue line in Figure 1 represents the target stock price, while the red line represents the expected red line. The red line (predicted output) entirely overlaps the blue line (target output), meaning that the forecast is correct. Using fuzzy logic, similar prediction results were obtained. The minimum value obtained by the square of the error between the target output and the expected output is used to compare the two prediction methods used here. MSE diagrams using neural networks and fuzzy logic are seen in Figures 2(a) and 2(b).

The findings indicate that these two technologies can accurately predict index prices, implying that past stock prices have predictive power and can be used to forecast future prices. Figures 2(a) and 2(b) clearly show that MSE is reduced to a lower value when NN is used. The minimum MSE for NN and FL is shown in Table 1.

As shown in Table 1, because the artificial neural network has a lower MSE and higher accuracy than the fuzzy system, the artificial neural network will use one month of historical data to predict the closing price of stocks on a specific day. Figure 3 shows the stock price forecast for June 2016.

Table 1: Performance comparison of prediction technology

Prediction Technique	Mean Square Error (MSE)	Accuracy
ANN	2.43	99.68
Fuzzy	2.64	99.04

Fig.3: Stock Price Prediction for June 2016.

Sales Calculating

Two databases were used to calculate sales.

Data Set I

We have two years' data of historical data (2017-2019) on numerous promotional campaigns and the revenues that resulted. The following 9 input parameters were chosen because they were found to have a substantial effect on revenue.

• Month of the year (1=January, 2=February, and so on)
• The number of television advertisements
• The number of radio advertisements
• The number of advertisements in the newspaper
• Number of billboards
• The number of flyers published
• Number of letters sent to prospective clients via direct mail
• Number of incoming calls to prospective customers- Telemarketing

Total promotional spending cost (in dollars)

The number of transactions (in $) in the month the promotional campaign acquired effect was forecasted using the above results. Figure 4 depicts the real vs. expected revenue over the ANN testing period. MSE plots for neural networks and fuzzy logic are seen in Figures 5(a) and 5(b), respectively.

MSE converges to a minimum value after two iterations, whereas fuzzy converges to a local minimum after the third iteration, as illustrated in the graphs.

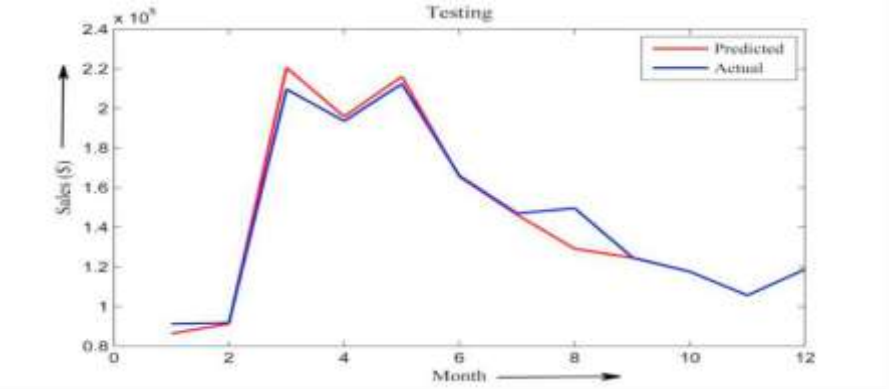
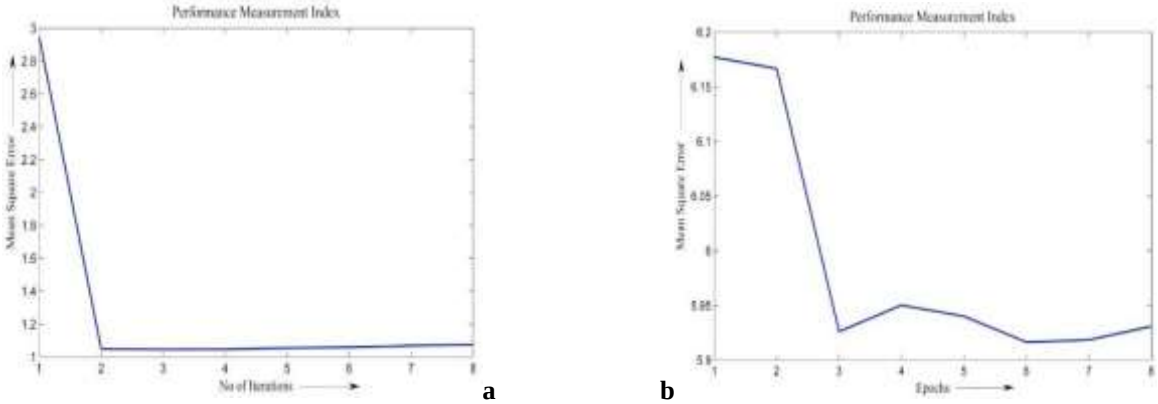


Fig.4: shows a plot of real and expected revenue through artificial neural research (Data Set I)



a **b**

Fig.5: Graphs of MSE vs. Number of Iterations for Data Set I, (a) ANN, (b) Fuzzy.

Table 2 compares the performance of the two strategies. For the given query, the study shows that ANN outperforms the Fuzzy scheme.

Table 2: compares the expected methods' performance for Data Set I.

Prediction Technique	Mean Square Error (MSE)	Accuracy
ANN	1.08	97.18
Fuzzy	5.94	92.36
3.2.2 Data Set II		

The previous five years' (2015-2020) output of Mobile Operators is analyzed using historical evidence. Five separate independent variable were defined as having a major effect on overall sales.
• Operator subscriptions •
Operator market share
• Operator gross additions
• MOU aggregated by operator
• Operator annual survival rate

The above inputs were used to forecast the total service income. During ANN research, Figure 6 shows the real vs. projected sales. Output index (MSE) plots for neuronal and fuzzy systems are seen in Figures 7(a) and 7(b).

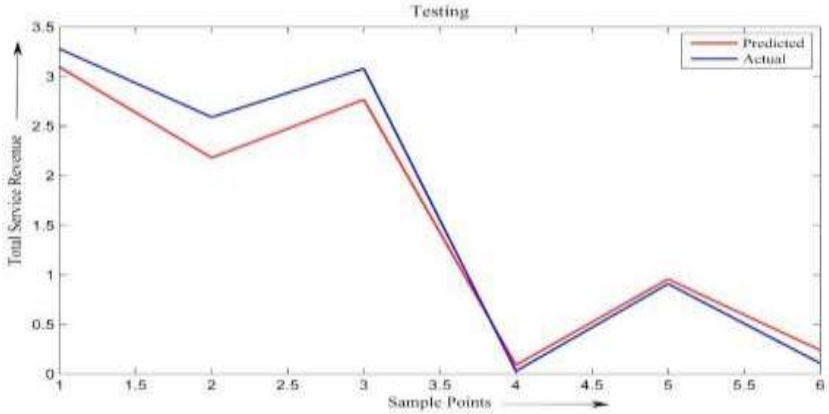
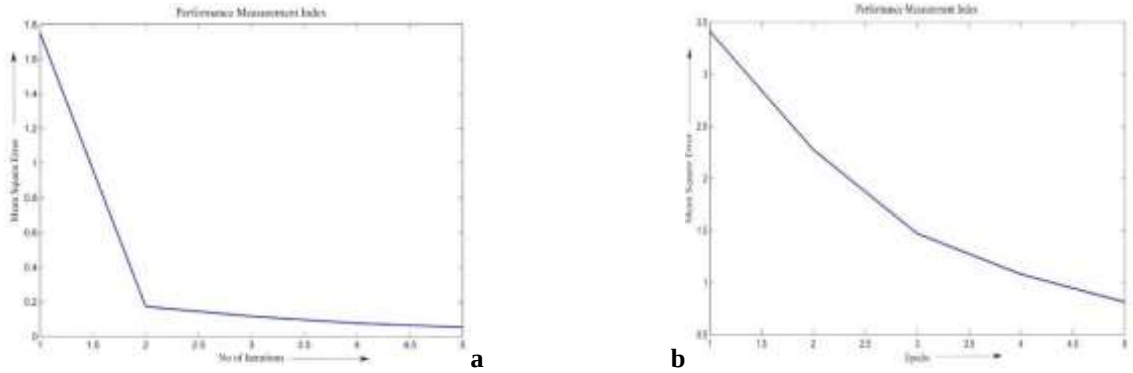


Fig.6: shows a comparison of real and expected sales during neural network research (Data Set II)



a **b**

Fig.7: Graphs of MSE vs. Iteration for Data Set II, (a) ANN (b) Fuzzy

Table 3 compares the two approaches. It can be shown that the fuzzy scheme has a lower MSE and higher precision than the ANN in this case. For Data Set II, Table 3 compares the efficiency of the predicted techniques.

Table 3: compares the expected techniques' performance for Data Set II.

Prediction Technique	Mean Square Error (MSE)	Accuracy
ANN	0.82	93.61
Fuzzy	0.06	97.9

Market Subdivision

i.Data

SOM was used to segment a network of physicians, which would aid in direct advertisements for a pharmaceutical firm developing a new diabetic medication. The following factors are taken into account when segmenting doctors:
• Doctor Specialty
• Early Adopter Status
• Physicians' Age
• Gender

Only numeric values can be fed into neural networks. Our inputs, on the other hand, include features that do not have numerical values. As a consequence, the data was changed, and each piece of text was assigned a numerical value. A SOM layer is depicted in Figure 8, with each neuron representing the number of input vectors it classifies. The SOM classifies the input space in Figure 9 by using blue-gray dots for each neuron's weight vector and red lines to connect neighboring neurons. The green dots represent the input vectors.

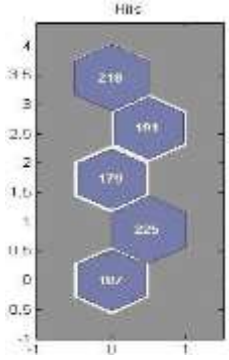


Fig.8: SOM Sampler Market leader

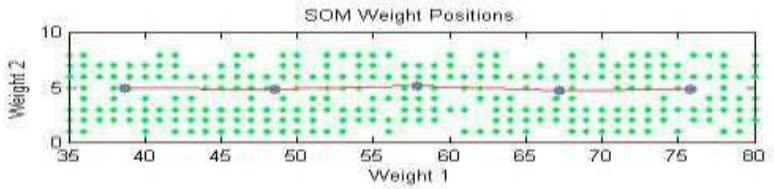


Fig.9: SOM Weight Points

Table four displays the grouping effects, showing the number of physicians in each chapter. This division of physicians hooked on minor groups of compatible individuals would assist the pharmaceutical industry in further understanding its main clients (the doctors) for the medication and developing unique marketing campaigns. This allows the organization to focus its efforts on the intended audience to achieve appropriate and successful performance.

Table 4: shows the number of physicians in each section.

Division no	Physicians no
Division 1	188
Division 2	226
Division 3	178
Division 4	192
Division 5	219

CONCLUSION

The present study compares neural networks and fuzzy logic for prediction and classification problems. Two prediction problems were examined (stock market price index and sales forecasting), as well as one classification problem (market segmentation). Both methods are accurate, but neural networks outperform other methods when it comes to minimising mean square error. SOM is a useful clustering tool for segmentation problems that produces understandable data.

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