UDC: 7203.01
LBC: 63.3(2)6-7; 65.497; 71; 71.1
MJ № 373
10.33864/2617-751X.2025.v8.i7.357-375

EVALUATION DE LA PERFORMANCE DES MODELES INTELLIGENTS DANS LA PREVISION DE L'INDICE BOURSIER DU QATAR PENDANT LA PANDEMIE DE COVID-19: UNE ETUDE EMPIRIQUE

Leila Hakoum[•]
Mehdi Zabat[••]

Abstract. This study aims to apply an Artificial Neural Network (ANN) model to forecast the movements of the Qatar Stock Market Index. The empirical analysis is based on a dataset comprising the daily closing prices of the index over the period from November 11, 2019, to December 9, 2021. For the purpose of forecasting, the study adopts a Multilayer Perceptron (MLP) network architecture, trained using the backpropagation algorithm. The modeling process involves data preprocessing, network design and training, and prediction evaluation. The results indicate that the ANN model demonstrates a strong capacity to accurately forecast short-term fluctuations in the Qatar Stock Market Index. The predictive values closely match the actual index values, validating the robustness and reliability of the proposed model. These findings highlight the effectiveness of neural networks in financial time series forecasting and their potential role in supporting decision-making processes in financial. The financial sector is considered one of the leading sectors in modern economies, not only due to its critical role in mobilizing local and foreign savings and financing investments- which form the backbone of economic activity- but also because it has become the most vital connection with the global economy. With its development and financial robustness, this sector has become a benchmark for assessing the soundness of economies and their ability to attract both domestic and foreign capital.

Keywords: Forecasting, Artificial Neural Network (ANN), Qatar Stock Market, Back propagation, Time Series

[•] Dr., University of Saida; Algeria
E-mail: leila.hakkoum20@yahoo.com
https://orcid.org/0009-0003-6246-8987
[••] Dr., University of Batna 1; Algeria
E-mail: mehdi.zabat@univ-batna.dz
https://orcid.org/0009-0006-1749-5822
To cite this article: Hakoum, L., & Zabat, M. [2025]. EVALUATION DE LA PERFORMANCE DES MODELES INTELLIGENTS DANS LA PREVISION DE L'INDICE BOURSIER DU QATAR PENDANT LA PANDEMIE DE COVID-19: UNE ETUDE EMPIRIQUE. *"Metafizika" journal, 8*(7), pp.357-375.
https://doi.org/10.33864/2617-751X.2025.v8.i7.357-375

Article history:
Received: 15.11.2024
Accepted: 26.12.2024
Published: 03.11.2025

"Metafizika" Journal *AcademyGate Publishing*
Vol 8, issue 7, serial 35, 2025. pp.357-375 *p-ISSN 2616-6879; e-ISSN 2617-751X*
УДК: 7203.01
ББК: 63.3(2)6-7; 65.497; 71; 71.1
MJ № 373
10.33864/2617-751X.2025.v8.i7.357-375

ОЦЕНКА ЭФФЕКТИВНОСТИ ИНТЕЛЛЕКТУАЛЬНЫХ МОДЕЛЕЙ В ПРОГНОЗИРОВАНИИ ФОНДОВОГО ИНДЕКСА КАТАРА В ПЕРИОД ПАНДЕМИИ COVID-19: ЭМПИРИЧЕСКОЕ ИССЛЕДОВАНИЕ

Лейла Хакум*
Мехди Забат**

Абстракт. Данное исследование направлено на применение модели искусственной нейронной сети (ANN) для прогнозирования изменений фондового индекса Катара. Эмпирический анализ основан на наборе данных, включающем ежедневные цены закрытия индекса за период с 11 ноября 2019 года по 9 декабря 2021 года. Для прогнозирования используется архитектура многослойного персептрона (MLP), обученная с помощью алгоритма обратного распространения ошибки. Процесс моделирования включает предварительную обработку данных, проектирование и обучение сети, а также оценку точности прогнозов. Результаты показывают, что модель ANN демонстрирует высокую способность точно прогнозировать краткосрочные колебания фондового индекса Катара. Прогнозные значения близки к фактическим значениям индекса, что подтверждает надежность и устойчивость предложенной модели. Полученные выводы подчеркивают эффективность нейронных сетей в прогнозировании финансовых временных рядов и их потенциальную роль в поддержке процессов принятия решений на финансовых рынках. Финансовый сектор рассматривается как один из ведущих секторов современной экономики. Это связано не только с его ключевой ролью в мобилизации внутренних и внешних сбережений и финансировании инвестиций, составляющих основу экономической деятельности, но и с тем, что он стал важнейшим связующим звеном с мировой экономикой. Благодаря своему развитию и финансовой устойчивости данный сектор стал ориентиром для оценки состояния экономики и ее способности привлекать как внутренний, так и иностранный капитал.

Ключевые слова: прогнозирование, искусственная нейронная сеть (ANN), фондовый рынок Катара, обратное распространение ошибки, временные ряды

* Д-р., Университет Саида; Алжир
E-mail: leila.hakkoum20@yahoo.com
https://orcid.org/0009-0003-6246-8987
** Д-р., Университет Батна 1; Алжир
E-mail: mehdi.zabat@univ-batna.dz
https://orcid.org/0009-0006-1749-5822

Цитировать статью: Хакум, Л., & Забат, М. [2025]. ОЦЕНКА ЭФФЕКТИВНОСТИ ИНТЕЛЛЕКТУАЛЬНЫХ МОДЕЛЕЙ В ПРОГНОЗИРОВАНИИ ФОНДОВОГО ИНДЕКСА КАТАРА В ПЕРИОД ПАНДЕМИИ COVID-19: ЭМПИРИЧЕСКОЕ ИССЛЕДОВАНИЕ. *Журнал «Metafizika», 8(7),* с.357-375.
https://doi.org/10.33864/2617-751X.2025.v8.i7.357-375

История статьи:
Статья поступила в редакцию: 15.11.2024
Отправлена на доработку: 26.12.2024
Принята для печати: 03.11.2025

UOT: 7203.01
KBT: 63.3(2)6-7; 65.497; 71; 71.1
MJ № 373
10.33864/2617-751X.2025.v8.i7.357-375

QƏTƏR FOND İNDEKSİNİN COVİD-19 PANDEMİYASI DÖVRÜNDƏ PROQNOZLAŞDIRILMASINDA AĞILLI MODELLƏRİN FƏALİYYƏTİNİN QİYMƏTLƏNDİRİLMƏSİ: EMPİRİK TƏDQİQAT

Leyla Hakum*
Mehdi Zabat**

Abstrakt. Bu tədqiqat Qətər Fond Bazarının İndeksindəki dəyişiklikləri proqnozlaşdırmaq üçün Süni Neyron Şəbəkəsi (ANN) modelinin tətbiqini hədəfləyir. Empirik təhlil 11 noyabr 2019-dan 9 dekabr 2021-dək dövrü əhatə edən indeksin gündəlik bağlanış qiymətlərindən ibarət verilənlər bazasına əsaslanır. Proqnozlaşdırma məqsədi ilə araşdırmada çoxqatlı perseptron (MLP) şəbəkə arxitekturası qəbul edilir və bu model geriyayılma (backpropagation) alqoritmi ilə öyrədilir. Modelləşdirmə prosesi məlumatların ilkin emalını, şəbəkənin dizayn və təlimini, həmçinin proqnozların qiymətləndirilməsini əhatə edir. Nəticələr göstərir ki, ANN modeli Qətər Fond İndeksində qısamüddətli dalğalanmaları dəqiq proqnozlaşdırmaq qabiliyyətinə malikdir. Proqnoz dəyərləri faktiki indeks göstəriciləri ilə yüksək səviyyədə üst-üstə düşür və bu da təqdim olunan modelin etibarlılığını və dayanıqlılığını təsdiqləyir. Tapıntılar maliyyə vaxt sıralarının proqnozlaşdırılmasında neyron şəbəkələrinin səmərəliliyini və maliyyə bazarlarında qərar qəbuletmə proseslərini dəstəkləməkdə potensial rolunu vurğulayır. Maliyyə sektoru müasir iqtisadiyyatların aparıcı sahələrindən biri hesab olunur. Bu, yalnız yerli və xarici yığımların səfərbər edilməsində və investisiyaların maliyyələşdirilməsində- hansı ki, iqtisadi fəaliyyətin əsasını təşkil edir- mühüm rol oynaması ilə deyil, həm də qlobal iqtisadiyyatla ən həyati əlaqəyə çevrilməsi ilə bağlıdır. İnkişafı və maliyyə sabitliyi ilə bu sektor iqtisadiyyatların sağlamlığını və daxili, həmçinin xarici kapital cəlbetmə qabiliyyətini qiymətləndirmək üçün mühüm meyar olmuşdur.

Açar sözlər: Proqnozlaşdırma, Süni Neyron Şəbəkəsi (ANN), Qətər Fond Bazarı, Geriyayılma, Vaxt Sıraları

* Dr., Səida Universiteti; Əlcəzair
E-mail: leila.hakkoum20@yahoo.com
https://orcid.org/0009-0003-6246-8987
** Dr., Batna 1 Universiteti; Əlcəzair
E-mail: mehdi.zabat@univ-batna.dz
https://orcid.org/0009-0006-1749-5822

Məqaləyə istinad: Hakum., L., & Zabat, M. [2025]. QƏTƏR FOND İNDEKSİNİN COVİD-19 PANDEMİYASI DÖVRÜNDƏ PROQNOZLAŞDIRILMASINDA AĞILLI MODELLƏRİN FƏALİYYƏTİNİN QİYMƏTLƏNDİRİLMƏSİ: EMPİRİK TƏDQİQAT. *"Metafizika" jurnalı, 8*(7), səh.357-375.
https://doi.org/10.33864/2617-751X.2025.v8.i7.357-375

Məqalənin tarixçəsi:
Məqalə redaksiyaya daxil olmuşdur: 15.11.2024
Təkrar işlənməyə göndərilmişdir: 26.12.2024
Çapa qəbul edilmişdir: 03.11.2025

1.Introduction

Among the key components of this sector is the financial market, which plays a pivotal role in absorbing surplus idle capital within the national economy and converting it into active, productive capital through individual or corporate investments in financial securities. Moreover, financial markets provide sound investment channels and opportunities for individuals, particularly small investors. They serve as a key driver for economic development in countries and generate numerous economic benefits such as ownership, usability, and appropriate investment returns. Additionally, they motivate listed companies to closely monitor their stock performance, enhance their operations, and increase profitability.

However, starting in December 2019, the world was struck by the unprecedented COVID-19 pandemic, which brought with it humanitarian, health, and economic crises. The virus quickly spread across the globe, affecting even the largest economies. Governments responded with various precautionary measures to contain the spread, yet these actions negatively impacted the stability of financial markets, causing volatility beyond expectations. Given this context, the need to forecast financial market trends and take timely precautions became increasingly vital.

1.1.Research Problem

Financial time series are characterized by high volatility and nonlinearity, making classical forecasting methods sometimes insufficient for accurate predictions. This study, therefore, explores the use of artificial intelligence techniques- specifically Artificial Neural Networks (ANNs)- as a more effective alternative. From this perspective, the main research question can be formulated as:

Can intelligent models, such as Artificial Neural Networks, efficiently forecast financial market indices, using the Qatar Stock Exchange as a case study?

1.2.Research Hypotheses

To answer the research question, the following hypothesis is proposed:

*Intelligent models, particularly Artificial Neural Networks (ANNs), are effective in forecasting the Qatar Stock Market Index due to their ability to process data without requiring a specific structure or assumptions related to probability distributions.

1.3.Importance of the Research

The importance of this study lies in identifying the most efficient and accurate models for investment decision-makers in financial markets. It also gains significance from the context of high uncertainty that characterized the financial market under study during the global spread of the COVID-19

pandemic, prompting a closer look at modern and advanced forecasting models.

1.4.Previous Studies

Researcher	Year Market	Study Period	Model Used	Main Findings
Tabrizi and Panahiam	2000 Tehran Stock Exchange (TSE)	1995 – 1999	Artificial Neural Networks and Autoregressive Models	The network was able to forecast and achieve higher annual returns than autoregressive models.
Deniz Akarim and Soner	2013 Istanbul Derivatives Exchange (ISE-30)	20/04/2004 – 17/06/2011	Artificial Neural Network and traditional models	The neural network outperformed traditional models.
Sutheebanjard and Premchaiswadi	2010 Thailand Stock Exchange	02/07/2004 – 30/12/2004	Backpropagation Neural Network	The network successfully predicted index direction with an error rate of only 2%.
Abas Vahdi	2012 Tehran Stock Exchange	2000 – 2008	Artificial Neural Networks	The prediction results showed that ANNs provided suitable and strong forecasting outcomes.
Desai and Joshi	2015 Indian Stock Market (NIFTY 50)	09/01/2013 – 30/04/2015	Artificial Neural Network	Achieved a 71% accuracy rate in forecasting the next day's index value.
Gandali.N and Amiri Ashkan	2013 Tokyo Stock Exchange	Not specified	Neural Networks, LSTM Models, and Hybrid Models	Results indicated the efficiency of ANN models in forecasting.
Al Shajaa	2017 Dow Jones Index	01/2010 – 09/2016	Hybrid Model of Nonlinear Autoregressive ANN with other algorithms	The hybrid ANN model produced more accurate forecasts and better performance.

Table (01): Previous Studies on Forecasting Stock Market Indices Using Artificial Neural Networks

Source: Prepared by the researchers based on a set of studies.

What distinguishes the current study from previous studies:

It applied intelligent models- specifically the Artificial Neural Network model- to an Arab market, which is rarely addressed in literature. Moreover, the study period corresponds to a critical phase in financial markets: the onset of the COVID-19 pandemic (4th generation), which necessitated forecasting more than any other period.

Section One: Forecasting Stock Market Indices – Theoretical Background

1.Financial Market:

A financial market is considered a platform or an organized system that brings together capital providers and seekers, aiming to channel surplus funds from some parties to cover the deficits of others under predefined conditions. These conditions regulate the expected returns from relinquishing liquidity, with the ultimate goal of contributing to the achievement of economic and social development objectives.

2.Market Index:

A market index is defined as "a technique that provides a numerical result using a relationship that illustrates the development of two variables over time (quantities or prices)." This result is used to evaluate the performance of a financial market, a specific economic sector, or a particular investment portfolio. It can also be compared to similar indices in the same or other markets[1].

Key Characteristics of Index Construction:

- **a. Sample Size:** The larger the sample, the more accurate and representative the results.
- **b. Representativeness:** The index should reflect the population from which the sample is drawn.
- **c. Weighting:** Each element in the sample should be assigned an appropriate weight.
- **d. Measurement Units:** The units used must be consistent and appropriate.

3.Forecasting:

Forecasting refers to a set of estimates and results concerning the future, developed based on scientific foundations, mathematical and statistical techniques, and historical financial data. The aim is to obtain forward-looking information to support decision-making in the face of future financial phenomena, events, and outcomes[2].

Steps in the Forecasting Process:

When conducting financial forecasting, several essential steps must be followed in sequence:

- Define the objective of the forecasting process.
- Develop the forecasting model.
- Test and evaluate the model prior to implementation.
- Apply the model.
- Evaluate the model post-implementation to assess the accuracy of the results[3].

With the development and diversification of forecasting techniques among researchers, artificial intelligence methods- especially Artificial Neural Networks (ANNs)- have gained prominence in financial forecasting. These models have demonstrated superior performance compared to traditional forecasting methods. Based on this, the researchers recognized the necessity and importance of building and utilizing an artificial neural network tailored to the nature and current composition of the Qatar Stock Exchange, with the goal of forecasting its trends and assessing the model's accuracy. This would help in understanding market directions and making informed investment decisions accordingly[4]

The Second Section: Forecasting Using the Neural Network Model

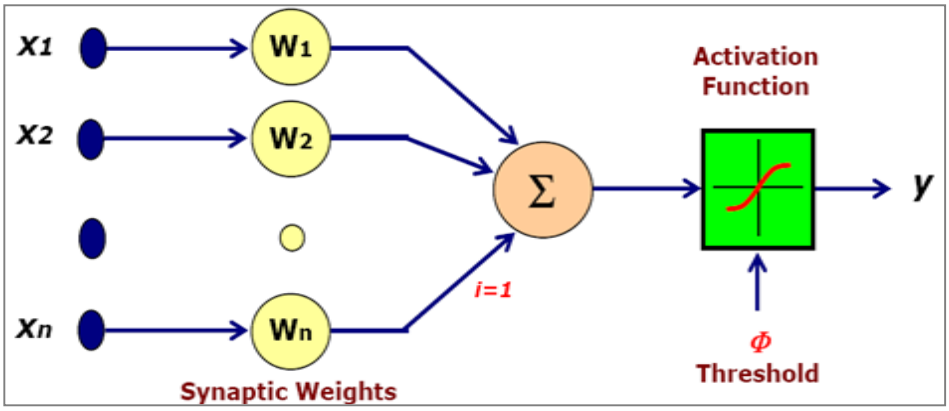
The availability of sufficient data to conduct a forecast of the Qatar Stock Exchange's direction during the pandemic also motivated the researchers to use a modern and precise method. This method surpasses many problems related to the statistical assumptions necessary to validate classical forecasting models, especially linear ones, due to their inability to detect the nonlinear relationships in stock market data.

Section Two: Forecasting Using Neural Network Model

Artificial Neural Networks (ANNs) are one of the fields of artificial intelligence that represent a significant development in the way human thinking is approached. The concept of neural networks revolves around simulating the brain using a computer. Much of the advancement in this field can be attributed to numerous studies in the domain of neural processing, which examines neural activity in the human brain. These studies attempt to simulate how the human mind solves problems through a self-learning process, benefiting from previous experiences to achieve better outcomes in the future.

Figure (01): Artificial Neural Network

Source: Omar Saber, "A Mathematical Analytical Study of Artificial Neural



Network Algorithms in Fitting a Model for Medical Diagnosis," The Fifth Scientific Conference on Information Technology, University of Iraq, 19-20 December (2012), *p.180.*

First: Components of Artificial Neural Networks

1. **Input Layer**: This is the layer through which the network receives data from external sources. The data is received by the processing units (neurons) that make up the network. This layer may consist of one or more processing units depending on the structure and inputs of the network. No computational processing of data is done in this layer.
2. **Output Layer**: This layer consists of processing units through which the final output of the network is produced. It may contain one or more processing units depending on the network architecture. The processing units in the output layer receive signals either directly from the input layer or from the hidden layer. After performing the required computations, the output signals are either sent as final outputs or fed back into the network as new inputs if the processing is incomplete. Usually, the network contains only one output layer.

Hidden Layer:

This layer is located between the input and output layers. Some neural network architectures may not include a hidden layer, while others may contain one or more hidden layers.

The hidden layer receives signals from the input layer through interconnections, processes these signals, and then transmits the results through connections to the output layer.

Interconnections (Weights):

These are the communication links between the various layers of the network. They connect the layers or units within each layer through associated weights. The function of these connections is to transfer weighted signals between processing units or layers.

Processing Units (Neurons):

Processing units, or neurons, are the components responsible for processing information in the neural network. These units are interconnected in various ways through interconnections.

A processing unit (or neuron) consists of the following fundamental components[7]:

A.Weight Parameters:

Weights are the core elements of artificial neural networks. They represent the various connections through which data is transmitted from one layer to another. A weight indicates the relative strength or importance of each input to a processing unit and is the main mechanism by which the network "remembers" patterns. The weight connecting processing units (i) and (j) is denoted by wijw_{ij}.

B.Summation Function:

The first computation performed by the processing unit is to calculate the weighted sum of the inputs it receives, using the summation function. This function computes the average weights of all inputs by multiplying each input value by its corresponding weight and then summing all the resulting products. Mathematically, this is represented as:

SJ=∑i=1nXi·WijS_J = \sum_{i=1}^{n} X_i \cdot W_{ij}

Where:

- SJS_J: is the summation result for processing unit jj
- XiX_i: is the input value coming from unit ii into unit jj
- WijW_{ij}: is the weight connecting unit jj to unit ii in the preceding layer

C.Transfer Function:

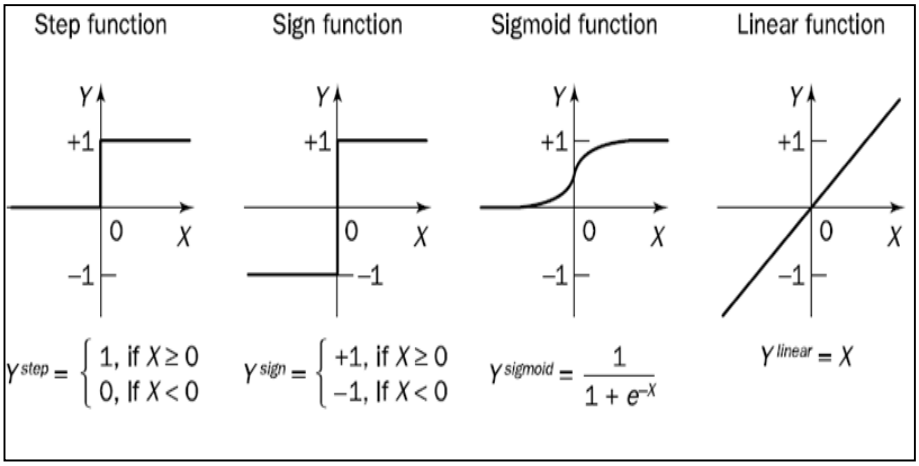
This step is performed using a **transfer function**, which transforms the weighted sum obtained in the first step into a value confined within a specific range. This is achieved by comparing the summation result with a threshold value, denoted by θ\theta, which helps determine the final output. Typically, an activation function is applied to the sum before comparison, and the network's outputs are primarily determined based on this function. Depending on the type of transfer or activation function used, the network can produce outputs within the range [0,1][0, 1] or [−1,+1][-1, +1].

The most common types of transfer or activation functions include:

- **Step Function**: The output value from the processing unit is either 0 or 1.
- **Sign Function**: The output value from the processing unit is either -1 or +1.
- **Linear Function**: The output is equal to the input, allowing for multiple and unlimited classifications.

- **Sigmoid Function**: This function transforms the output into a value between 0 and 1, and is referred to as the **binary sigmoid activation function**. Alternatively, it can transform the output into a value between -1 and +1, in which case it is called the **bipolar sigmoid activation function**.

Figure (02): Illustration of the Most Common Activation Functions:



Source: Omar Saber, *"A Mathematical Analytical Study of Artificial Neural Network Algorithms in Fitting a Model for Medical Diagnosis"*, Fifth Scientific Conference on Information Technology, University of Iraq, December 19-20, 2012, p.187.

2.Forecasting Steps Using Artificial Neural Networks

Forecasting using Artificial Neural Networks (ANNs) is a modern approach that has received widespread attention in various fields, including stock price prediction, currency exchange rates, and others. ANNs are widely used because they do not require strict statistical assumptions for forecasting and can model nonlinear data behavior. The process of forecasting using the backpropagation network can be summarized in the following steps:[8]

Step 1: Variable Selection: Variables must be selected carefully to ensure they represent the problem accurately.

Step 2: Data Processing: This involves performing preliminary operations on the data, such as identifying general trends and analyzing the data distribution.

Step 3: Divide Data into Sets: The available data is divided into three main groups:

- **Training Set**: Used to train the model and identify patterns in the data.
- **Testing Set**: Used to evaluate the generalization ability of the network.
- **Validation Set**: Used to conduct a final assessment of the network's performance.

Step 4: Define the Neural Network Paradigm: When defining the ANN structure, the following should be specified:

- The number of input neurons, which equals the number of independent variables.
- The number of hidden layers, which depends on the error value used in the network.
- The number of hidden neurons, which is determined experimentally.
- The number of output neurons, usually one.

Step 5: Evaluation Criteria: backpropagation networks is the **Mean Squared Error (MSE)**.

Step 6: Neural Network Training: This step includes:

- **Training the network**: Finding the set of weights between neurons that minimizes the error.
- **Backpropagation algorithm**: Used to reduce the gradient error during training.

Step 7: Implementation: This is one of the most important steps. The trained network is tested for adaptability, retraining capability, and its ability to reach the minimum error as new data is introduced[9].

First: Methodology and Tools

1.Study Sample:

The database used in this study consists of the daily closing prices of the Qatar Stock Exchange Index during the period from 11/11/2019 to 09/12/2021. The period from 01/12/2021 to 09/12/2021 (excluding holidays and weekends) was allocated for forecasting. The data was obtained from the website investing com.

Additionally, the Alyuda NeuroIntelligence software for artificial neural networks was used. This ready-made software, which emerged during the period 2002-2003, specializes in solving various complex problems, including forecasting, and is known for its speed and user-friendliness.

2.Choosing and Building the Neural Network Model:

After reviewing several previous studies on the subject, it was found that most researchers relied on the Multi-Layer Perceptron (MLP) network due to its superior forecasting capabilities in financial market indices.

The process of building the artificial neural network goes through the following stages:

A. Input Selection:

The first step in building an artificial neural network for forecasting purposes is to determine the number of inputs. Based on comparative analyses with previous studies, two inputs were selected: the original time series of the daily closing prices of the Qatar Stock Exchange Index and the return series given

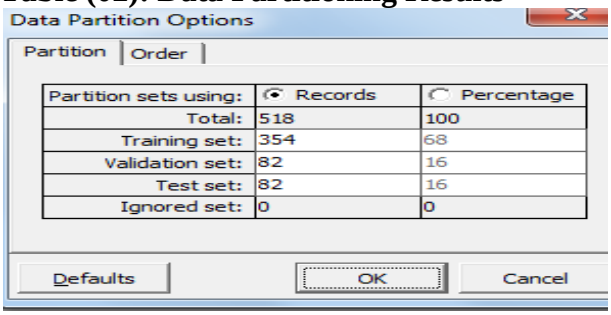
by the following formula: $r_t = (P_t - P_{t-1}) / P_{t-1}$
Where:

- r_t: return at time t
- P_t: closing price at time t
- P_{t-1}: closing price at time t-1

B. Data Partitioning:

After preparing and dividing the data, the results were as follows:

Table (02): Data Partitioning Results



Source: Prepared by the researchers based on the outputs of Alyuda NeuroIntelligence

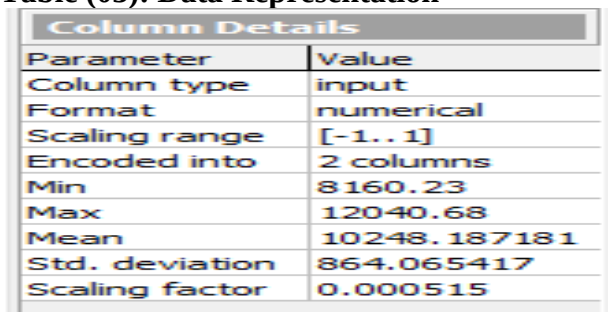
After preparing the data (totaling 518 observations) for forecasting using artificial neural networks, it was randomly divided into groups using the Alyuda NeuroIntelligence software, as shown in Table (02). The distribution was as follows:

- 354 observations (68%) as the training set
- 82 observations (16%) as the validation set
- 82 observations (16%) as the testing set

C. Data Processing:

The input data was normalized to a bipolar format (-1, 1), while the output was normalized to a binary format (0, 1). Using the Alyuda NeuroIntelligence software, the Data was represented as follows

Table (03): Data Representation



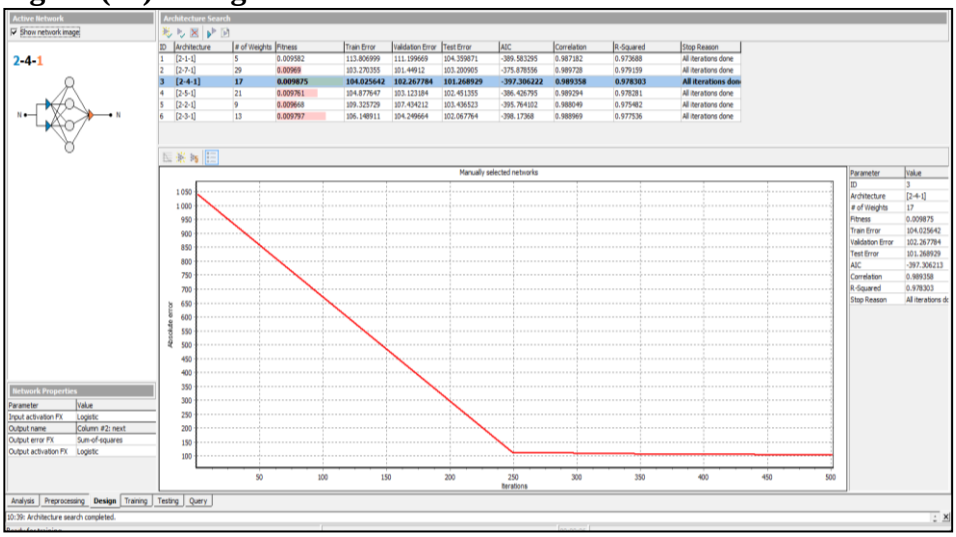
Column Details	
Parameter	Value
Column type	output
Format	numerical
Scaling range	[0..1]
Encoded into	1 columns
Min	8160.23
Max	12040.68
Mean	10248.187181
Std. deviation	864.065417
Scaling factor	0.000258

Source: Prepared by the researchers based on the Alyuda NeuroIntelligence software

D. Design Phase:

In this phase, the logistic function was used as the activation function in both the hidden and output layers. The Alyuda NeuroIntelligence software suggested a number of designs for forecasting the Qatar Stock Exchange Index.

Figure (03): Design Phase Results



Source: Prepared by the researchers based on the Alyuda NeuroIntelligence software

As shown in the figure, several architectures can be used to forecast the Qatar Stock Exchange Index. However, based on the lowest AIC criterion, goodness-of-fit measure, and coefficient of determination, the best architecture was [1-4-2], consisting of three layers:

- Input layer with two processing elements
- Hidden layer with four processing elements
- Output layer with one processing element

The number of weights in the preferred [1-4-2] network was 17, which aligns with the following formula: $P = (\alpha_i + 2) \times \alpha_u + 1$

Where:

α_i: number of input variables

α_u: number of neurons (units) in the hidden layer

P: total number of weights in the neural network

(c) Training Phase

The training process was conducted using the **Back Propagation Online Algorithm** to minimize the gradient. The learning rate was fixed at **0.1**, and the momentum constant was also set at **0.1**, with the number of iterations set at **1000**.

Figure (04): Training Results

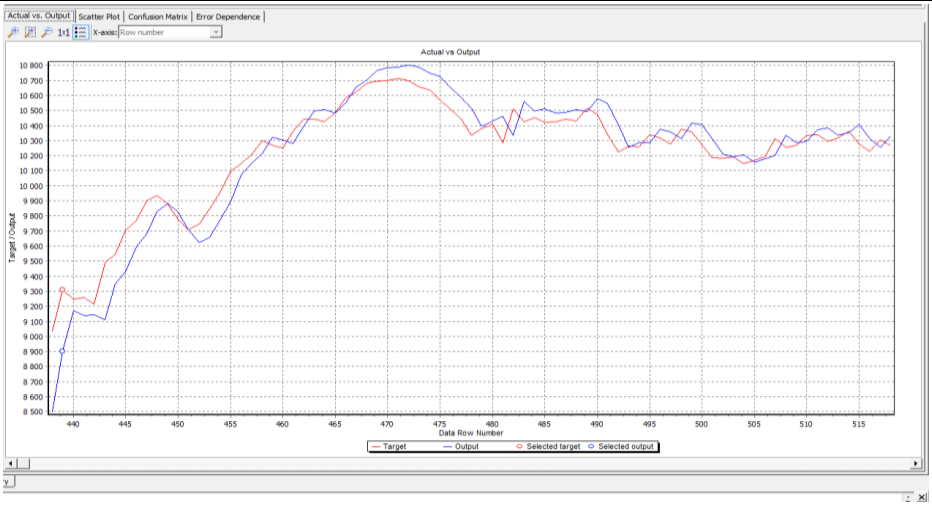
Source: Prepared by the researchers based on the Alyuda NeuroIntelligence software.

From the figure above, it is evident that the training set aligns well with the validation set. The optimal network was determined at **1000 iterations**. The network error and its distribution decreased as the number of iterations increased, stabilizing at around **900 iterations**, indicating that the network was well-trained and achieved statistically acceptable performance.

(d) Testing Phase

Using the **Alyuda NeuroIntelligence** software and the previous stages, the optimal network was selected from among six proposed architectures in the design phase. This network was trained using the backpropagation algorithm and then validated for its forecasting capability as follows:

Figure (05): Testing Results



Source: Prepared by the researchers based on the Alyuda NeuroIntelligence software.

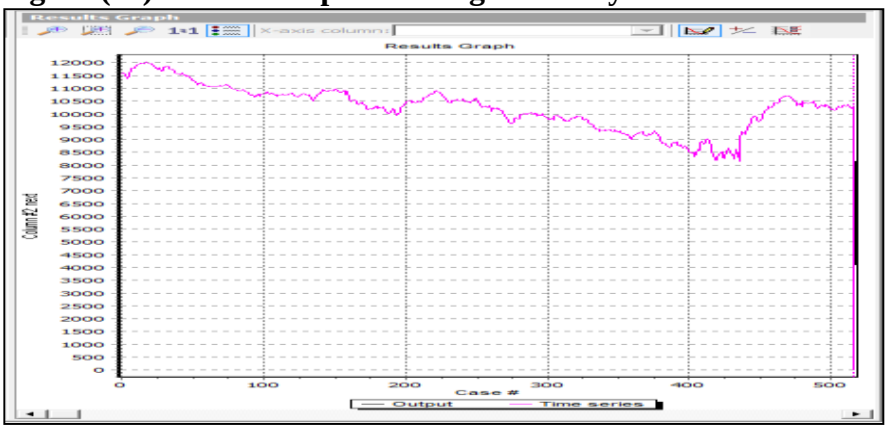
As shown in the figure above, the predicted values (outputs) perfectly match the actual values during the study period, with **100% accuracy**. The overlap between the two curves confirms this consistency. Thus, the testing or validation of the selected network was successful, and it can be reliably used for forecasting.

(e) Forecasting Phase

Using the daily closing prices and returns of the Qatar Stock Market Index during the period from **11/11/2019 to 09/12/2021** (excluding weekends and holidays), and based on the selected network architecture **[1-4-2]**, the index was forecasted for the short term. The forecasting period spanned from **01/12/2021 to 09/12/2021**.

The following figure shows the model outputs during the study period:

Figure (06): Model Outputs During the Study Period



Source: Prepared by the researchers based on the Alyuda NeuroIntelligence software.

The following table presents the actual and forecasted values of the Qatar Stock Market Index for the first week of December 2021:

Table (04): Actual and Forecasted Values from 01/12/2021 to 09/12/2021

Date	Actual Values	Forecasted Values
2021/12/01	11386.31	11552.97
2021/12/02	11552.42	11405.96
2021/12/05	11603.03	11369.08
2021/12/06	11586.74	11457.21
2021/12/07	11582.28	11479.90
2021/12/08	11626.11	11472.18
2021/12/09	11610.13	11472.47

Source: Prepared by the researchers based on the Alyuda NeuroIntelligence software.

Second: Results

In recent times, and in the aftermath of the COVID-19 pandemic, predicting the direction of financial markets has become a priority for investors, as it plays a critical role in making timely and successful investment decisions. Therefore, it has become more appropriate to rely on modern, fast, and efficient models.

Among these approaches, the Artificial Neural Networks (ANN) model was adopted to forecast the Qatar Stock Market Index for the period from **11/11/2019 to 30/11/2021**, with the period from **01/12/2021 to 09/12/2021** used to compare actual and predicted values. After going through the design stage, training the optimal network, and then testing it for forecasting, the resulting network consisted of three layers (input layer (2), hidden layer (4), and output layer (1)), which produced a ready-to-use model for forecasting future levels.

After comparing actual and predicted values, it was found that the artificial neural network model provided highly consistent results. Therefore, it can be said that the model possesses strong predictive capabilities, especially during crisis periods characterized by high volatility, in addition to the fact that it does not require any specific probability distribution assumptions.

Based on the above, the research hypothesis- which states that intelligent models, including artificial neural networks, are efficient in forecasting the Qatar Stock Market Index- is accepted.

By analyzing and observing the results presented in the previous figures, it is clear that the Qatar Stock Index experienced stable growth and followed a positive trend during the study period. The market was not significantly affected by the pandemic, except during the first quarter of 2020. This is also

evident from the forecasting period (the first week of December 2021). The rapid recovery of the Qatari financial market from the COVID-19 pandemic can be attributed to several factors:

- The Qatari government's proactive and precautionary measures, as well as its preparedness and ability to support the economy.
- The adaptability of listed companies, which adjusted their business models during the pandemic and capitalized on successful investment opportunities.
- As the saying goes, *"every cloud has a silver lining"*- many companies used the pandemic as an opportunity to invest in digital technologies, which flourished during that period.
- A report published by *The Economist Intelligence* indicates that digital investments in Qatar have been steadily growing, especially in cloud computing, which reached record levels.
- Additionally, reports indicate that in 2020, *Google* signed a strategic cooperation agreement to launch *Google Cloud* in Doha's free zones, marking its first branch in the Middle East.
- In April, the British website *IBS Intelligence* stated that Qatar is one of the key drivers of financial technology investments in Europe for the current year, both locally and internationally.

The resilience and growth of the market is further demonstrated by its inclusion in the **MSCI Emerging Markets Index** and the **FTSE Global Equity Index Series**.

Moreover, the validity of the obtained results is confirmed by a report published by the Qatar Stock Exchange in the *Economic Report of Arab Countries* dated 31/10/2021, which announced a **35.86%** increase in the profits of listed companies during the first nine months of 2021, amid the recovery of the Qatari economy from the effects of the pandemic.

It is also expected that the market will continue to grow steadily in the coming days and months, driven by increased activity in companies operating in the tourism, aviation, and hospitality sectors. This is largely due to Qatar's hosting of the Arab Cup and the FIFA World Cup, which is positively impacting market trends.

3.Recommendations:

Among the recommendations offered in this field:

- Rely on other artificial intelligence models such as fuzzy logic and expert systems.
- Attempt to integrate classical and intelligent methods in the form of hybrid models.

- It is recommended that stock exchange managers- particularly in Arab countries- benefit from these types of models due to their ease of application and the effectiveness of their results.

4.REFERENCES

1. Akarim, V. D., & Dumlupinar, S. A. (2013). A comparison of linear and nonlinear models in forecasting market risk: The evidence from Turkish derivative exchange. *Journal of Economics and Behavioral Studies, 5*(3), 164–172. https://doi.org/10.22610/jebs.v5i3.406

2. Bak, A. (2005). *Using artificial neural networks in time series forecasting: Application to electricity consumption in Mosul City* (Unpublished master's thesis). College of Science, University of Mosul, Iraq.

3. Ben Alaria, A., & Saous, S. (2018). Forecasting the Algerian Dinar exchange rates using artificial neural networks. *Journal of Economics and Business Management, 2*(6), 15.

4. Chatfield, C., & Faraway, J. (1998). Time series forecasting with neural networks: A comparative study using the airline data. *Applied Statistics, 47*(2), 240. https://doi.org/10.2307/2986130

5. Derbal, A. (2014). *An attempt to forecast stock market indicators using econometric models: A case study of the Dubai Financial Market* (Doctoral dissertation). University of Tlemcen.

6. Fadalah, A. A.-F. A. (1996). *Strategic financial statements*. Dar Al-Kutub Al-Ilmiyah Publishing.

7. Kadri, R., & Mekidche, M. (2015). A comparative study between artificial neural networks and the Box-Jenkins methodology for forecasting electricity sales: An applied study of Sonelgaz. *Journal of Economics and Business Management, 1*, 95.

8. Marhej, M. (2013). Predicting the values of the Damascus Stock Exchange index using neural networks. *Tishreen University Journal for Research and Scientific Studies, 10*.

9. Nazarian, F., Alikhani, G., Nadeir, N., & Ashkan, A. (2013). Forecasting stock market volatility: A forecast combination approach. *MPRA Paper*. https://mpra.ub.uni-muenchen.de/46786

10. Sinha, H. (2005, June 4). Designing a neural network for forecasting financial and economic time series (p. 593). INDE.

11. Topscallan, P. (1996). *Les indices boursiers un action*. Éditions Economica.

12. Vahedi, A. (2012). The predicting stock price using artificial neural network. *Journal of Basic and Applied Scientific Research, 2*(3), 2325–2328.

13. Jumaa, M. J. D. (n.d.). Effectiveness of forecasting the Palestine Exchange Index using artificial neural network model- Compared to the autoregressive model. *Al-Quds Open University Journal for Economic & Administrative Research*. https://journals.qou.edu/index.php/eqtsadia/article/view/2386