Data Recognition for Vehicles Insurance Data using ARIMA- Wavelet Transform

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Abstract

This study aim is to examine forecasting and events insurance data in stock market in Jordan, amman stock exchange "ASE" by using mixed methods the ARIMA and wavelet transform (OWT) in order the empower active participation of the insurance market and decision-makers in a position for forecasting the marketplace. Therefore, in the current study First, the series of price indexes became decomposed by way of wavelet transform, and then the smooth series anticipated by using the ARIMA. Furthermore, the comprehensive frequency parts of the signal are used in order to explore their events through the decomposed data, also, the current study provides an appropriate model with the aid of compounding the linear approach ARIMA with using WT, the outcomes suggest superiority of the designed system in predicting charge coverage time series records the usage of Daubechies Wavelet transform and ARIMA model.

Keywords: ARIMA model, Amman stock exchange, insurance data, Wavelet transform.

1. Introduction

Insurance stock market inclination are a tough undertaking, which many elements impact insurance stock market performance, includes political events, monetary conditions, and trader expectancies (Mohammad, 2022). Although, pokers and traders depend heavily on numerous sorts of intelligent systems to make their decisions, up to now their success has been limited (Abu-Mostafa et al., 1996). There is no consensus among specialists on the effectiveness of forecasting an insurance time series, economic specialists find it tough to make correct predictions and forecasts for the insurance stock market due to the fact it tends to be nonlinear, unsure, and non-stationary (Al-Smadi and Al-Smadi, 2021, L.A.Zadeh (1994), regression models, Refenes et al., 1994 and discriminate analysis model, Yoo,et al., 1993 ARIMA model). Generally, these prediction models directly without any transformation suffer limitations due to the giant noise and excessive dimensionality of stock price data. Other attempts have been made to forecast monetary markets that vary from traditional time series techniques to the usage of

ARIMA (Engle 2001). However, the main disadvantage of ARIMA model is the enormous difficulty of interpreting the results. This study diverges from previous attempts at forecasting stock prices by proposing a method that uses the Wavelet transforms (WT) combined with ARIMA, this process create a transparent architecture (Al- Rawashdi et al., 2015).

WT is an extraordinarily new area in sign processing, authors i.e. (Ramsey and Zhang,1997 and Cohen et al.,1993) explained that WT mathematical functions decompose data into different frequencies, and then each element is studied with a resolution matched to its scale, where a scale denotes a time horizon. WT filtering is closely associated with the volatile and time-varying traits of the actual global time collection and isn't always restrained by way of the stationarity assumption (Popoola and Ahmad 2006). The WT decomposes process into variance scales, making it useful in distinguishing seasonality, revealing structural breaks and volatility clusters, and identifying locally or globally dynamic characteristics of a manner at particular timescales, (Gencay et al., 2001).

WT analysis has been proven to be particularly useful in reading, modeling, and predicting of financial tools e.g. stocks and exchange rates, and interest rates, (Ramsey 1999 and Papagiannaki et al., 2005). This study applies wavelet transform using the orthogonal wavelet functions which are (Haar, Daubechies, Coiflet and symmelt) to decompose the insurance time series then combine the approximation coefficients with ARIMA model in order to make improve the forecasting accuracy then select the best wavelet function in forecasting. Then finally we compare the forecasting using the combined method with the forecasting using ARIMA model directly. The framework combines several statistical methods and soft computing techniques using MATLAB software and other statistical packages. The data used will be presented in next section. The next section of this study 2.0 will present the Literature review. While the methodology of the study that include data sample, model, and research framework will show in section 0.3 provide. section 0.4 will describes the experimental result that explained the effectiveness of WT. In last section which is 0.6 this study will show the conclusion and contribution.

2. Previous Study

Hsieh et al., (2011) provided a model for forecasting stock by using a compound of WT, recurrent neural community, and bee colony set of rules. First, disintegrated the price time series by using WT the forecasting changed into accomplished through recurrent neural network and the acquired weights of the neural network have been optimized by a bee colony set of rules and algorithms.

The presented model tested on data of Dow Jones Industrial Average, a 100 index London Stock Exchange, 225 Tokyo Stock Exchange and Taiex index, Taiwan Stock Exchange. the authors make a comparison to the given model of neural network and bee colony algorithm, vague time series and vague neural network. The suggested model had much less error than the other model in all cases.

Hadavandi, Shavandi, and Ghanbari (2010) Provided a new method for the forecasting of stock, through use of a compound of neural network and vague genetic, this model is applied in IT and airline industry of Newyork Stock Exchange. The suggested version became compared to ARIMA and genetic algorithm and neural network which had been utilized in prediction and in all instances it resulted better than the preceding fashions.

Chung and Lu (2008) utilize the fuzzy rule of TSK type to predict stock, which this rule considers technical index for all enter variables and the received result is a linear compound of input variables. This model has been tested from different data collected from Taiwan companies, the results showed that a precision is near 79.6% in TSE index and 98.08% in Media Tek, since the investors revise their predictions in line with the maximum latest prediction mistakes. Moreover, Chung et al., (2008) used the two-element Fuzzy model for prediction, by using the stock index and the amount of trade as elements that are effective in price index prediction. The result showed the high capability of this model to forecast of stock price index.

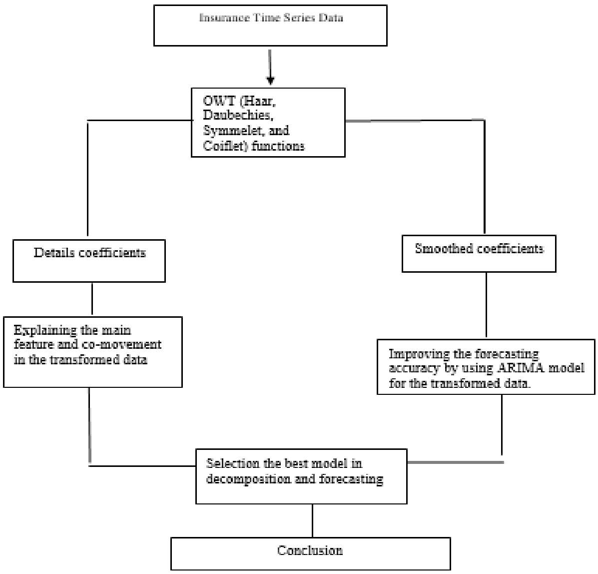
Chen et al., (2007) explored the predict stock price by utlizeing Fuzzy time series model on Fibonacci sequence, this study used 5 years' period to collect data on TSMC and used 13 years period for TAIEX. The obtained model is superior to the prevalent Fuzzy time series model. Furthermore, Lin et al., (2004) used NN5 model in stock price prediction in Hong Kong in 2007, on stock data of 2 banking stocks The model indicates a total success rate of more than 70% in predicting bankruptcy of companies.

A few researchers used different model i.e. (Farnsworth et al., 2004) used genetic making plans to expect each day output of S&P500 index quantity which suggests the hypothesis of marketplace efficiency. S&P500 is one of the maximum commonplace indexes that have been studied internationally. Furthermore, Refenes, Zapranis and Francis (2011) have been compared the characteristic of stocks price model with regression models via its modeling with the aid of neural network, which this networks are used as a substitution for classical statistic strategies on this studies and these networks were used to are expecting massive companies shares. The results imply that neural networks function higher than statistic strategies and that they provide advanced methods.

3. Methodology

Much of the previous research used technical evaluation, essential analysis, and linear regression to expect market direction, (Zhang et al., 2002). However, price forecasting is usually carried out using technical evaluation or fundamental evaluation. Technical evaluation focuses on market movement, while fundamental evaluation points to the supply and demand forces that push the rate moves. The basic hypotheses of this examination supported via research of the insurance time series (Al-Smadi et al., 2023).

To examine the link between the selected variables of this study, this work gives a mixed technique that integrates a wavelet (WT) and the ARIMA-based total forecasting scheme. (Fieger. 1) shows the fundamental methods of this approach. Wavelet theory is applied for information preprocessing, because the illustration of a wavelet can address the non-stationarity concerned in the financial time series (Ramsey 1999). The key characteristic of wavelets for financial analysis is decomposition by means of time scale. Economic and financial sectors incorporate variables that operate on diverse time scales simultaneously; thus, the link among variables may be different throughout time scales. which one of the many benefits of the wavelet technique is the flexibility in handling quite irregular facts series (Popoola and Ahmad 2006). This study uses the WT as the principle wavelet rework tool. A wavelet now not only decomposes the data inters of instances and frequency, but also appreciably reduces the processing time. "Let n"denote the time collection size, then the wavelet decomposition used in this observation can be determined in "O (n) time", (bramovich, et al., 2002). The following framework might summarize the study method for this study:



Fieger. 1 Research Framework

Wavelets theory is based on Fourier analysis, which represents any function as the sum of the sine and cosine functions. A wavelet is simply a function of time t that obeys a basic rule, known as the wavelet admissibility condition, (Gencay et al., 2002):

$$C_{\varphi} = \int_{0}^{\infty} \frac{|\varphi(f)|}{f} df < \infty \qquad (1)$$

Where $\varphi(f)$ is the Fourier transform and a function of frequency f, of $\varphi(t)$. The wavelet transform (WT) is a mathematical tool that can be applied to numerous applications, such as image analysis and signal processing. It was introduced to solve problems associated with the Fourier transform as they occur. This occurrence can take place when dealing with nonstationary signals, or when dealing with signals that are localized in time, space, or frequency. Depending on the normalization rules, there are two types of wavelets within a given function/family. Father wavelets describe the smooth and low-frequency parts of a signal, and mother wavelets describe the detailed and high-frequency components. In the following equations, (2a) represents the father wavelet and (2b) represents the mother wavelet, with j=1, ..., J in the J-level wavelet decomposition: (Ramsey 1999)

$$\phi j,k = 2^{-j/2}\phi(t - 2^{j}k / 2^{j})$$
$$\varphi j,k = 2^{-j/2}\varphi(t - 2^{j}k / 2^{j}) \qquad (2)$$

Where J denotes the maximum scale sustainable by the number of data points and the two types of wavelets stated above, namely father wavelets and mother wavelets, and satisfies:

$$\int \phi(t)dt = 1 \quad \text{and} \int \varphi(t)dt = 0 \qquad (3)$$

Time series data, i.e., function f(t), is an input represented by wavelet analysis, and can be built up as a sequence of projections onto father and mother wavelets indexed by both {k}, k = {0, 1, 2,. . .} and by{S}=2^{j}, {j=1,2,3,. . .J}. Analyzing real discretely sampled data requires creating a lattice for making calculations. Mathematically, it is convenient to use a dyadic expansion, as shown in equation (3). The expansion coefficients are given by the projections:

$$S_{j,k} = \int \phi_{j,k} f(t)dt, \quad d_{j,k} = \int \varphi_{j,k} f(t)dt, \qquad (4)$$

The orthogonal wavelet series approximation to f (t) is defined by:

$$F(t) = \sum Sj,k\phi j,k(t) + \sum dj,k\varphi j,k(t) + \sum dj-1,k\varphi j-1,k(t) + ... + \sum d1,k\varphi 1,k(t)$$
(5)

$$Sj(t) = \sum Sj,k\phi j,k(t)$$
$$Dj(t) = \sum dj,k\varphi j,k(t) \qquad (6)$$

through Eq. (5) WT method used a set of wavelets to find the coefficient of the approximation for a discrete signal. Where $Sj(t)$ and $Dj(t)$ are introducing the easy and information coefficients respectively. The coefficients reveal the maximum important functions of the data group and the info coefficients are used to discover the principle capabilities inside the dataset. (Al-afeef et al., 2024)

When the dataset pattern is random, the WT procedure is frequently applied. The goal of preprocessing is to reduce the Root Mean Squared Error (RMSE) among the signs before and after transformation. The noise within the authentic data can thus be eliminated. Importantly, the adaptive noise in the training style may additionally reduce the chance of becoming in the training process, (Patterson 1996). Thus, this study use WT twice to preprocess training data statistics.

3.1 Study population

Table 1. Statistical analysis

Mean	2.377e+06	Maximum	8.568e+06	Standard dev.	2.566e+06	L1 norm	7.13e+07
Median	1.209e+06	Minimum	4.363e+04	Median Abs. Dev.	7.941e+05	L2 norm	1.898e+07
Mean	1.857e+05	Range	8.524e+06	Mean Abs. Dev.	1.983e+06	Max norm	8.568e+06

the current study collected data 2005-2015 period from daily insurance stock market data, which use for statistical of 2500 data The above table (table, 1) shows the statistical data.

3.2 ARIMA Model

in the body of the previous study Application of nonlinear regression to price predictive has no longer been mentioned up to now. Other techniques of econometric modeling are univariate time series techniques i.e. (autoregressive moving average, ARMA) [3,9]. Moreover, ARMA is an appropriate model for stationary time series information, even though most of the software program uses least square estimation which calls for constant. To triumph over this issue and to permit ARMA model to address non-constant bound data. As well as, ARIMA is The model that functions by separating non-stationary data one or more times until the time series becomes stationary again and then finds the suitable model for the chosen data. ARIMA version has got very high interest inside the scientific region. This model was developed by (Box and Jenkins in 1970). ARIMA the method contains a large wide variety of models e.g. (p, q, d) "where: P: order of autoregressive part (AR), d: level of first differentiation (I) and q: order of the first moving element (MA). Note that, if there is no differencing been done (d = 0)". The general mathematical ARIMA model can be defined as [3,9]:

$$W_t = \mu + \frac{\beta(v)}{\varepsilon(v)} a_t .$$

Where:

Table 2: ARIMA model item

Item	Abbreviation
t	Indexes time
Wt	The response series Y_t
μ	The mean
v	The backshift operator
$\varepsilon(v)$ $\varepsilon(v) = 1 - \varepsilon_1(v) - ... - \varepsilon_p v^p .$	The autoregressive operator
$\beta(v)$ $\beta(v) = 1 - \beta_1(v) - ... - \beta_p v^p .$	The moving-average operator

a_t	The random error

The model that is built in the current study proceeds according to the following steps: 1- identify the suitable Model, 2- Model parameter estimation, 3- Model Diagnostics and Forecasting.

4. Results of the study

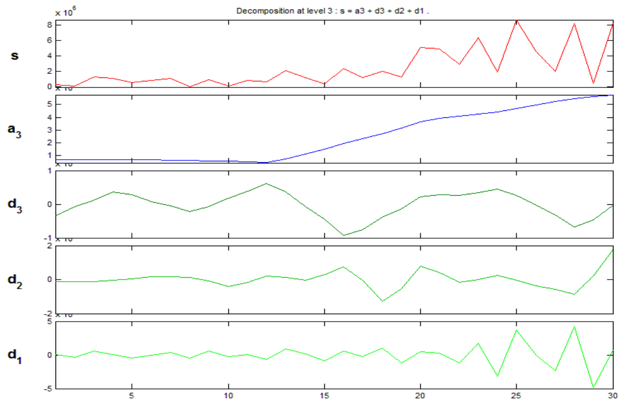


Fig1. Wavelet transform using Daubechies function

The applying of the Daubechies function of WT to the historic data decomposes them into different levels that divulge their vital structure and it generates detail coefficients at every one of the 3 decomposition stages, the 3 degrees of decomposition can be carried out via the Daubechies function of wavelet rework using the subsequent equation: S=a3+d3+d2+d1.Where S refers to the original signal. Then the next part consists of one approximation level (a3), a3 which shows the plot of the approximation coefficients for the transformed data using Daubechies function of wavelet transform. The following parts of d1, d2 and d3 represent the details levels, whereby, d1 is the plot of the first level of the details coefficients, d2 is the plot of the second level of the details coefficients and d3 is the plot of the third level of the details coefficients. Any of these three levels (d1, d2 and d3) can be adopted for explaining the data. in d2 the data becomes easier, and which quantity of the data will be decreased to reach the appropriate level in order to investigate the stock market trend.

In order to improve the forecasting accuracy then the following table shows that the accuracy have been improved and once we combine Daubechies function of wavelet transform with ARIMA model then give better results than the forecasting using ARIMA model directly based on mean absolute percentage error (MAPE). Table 3 shows that the difference in terms of percentage is significant since in this research, the first predictive way which is Daubechies function of wavelet transform with ARIMA achieved a MAPE of 4.6% compared ARIMA directly 12.18%. Therefore, the findings in this table indicate further that Daubechies function of wavelet transform gives more accurate results compared to other functions.

Table 3. MAPE

WT	ARIMA + WT	ARIMA directly
Haar	17.4%	13.5%
Db	4.6%	12.18%
Symm	7.35%	8.75%
Coef	7.3%	8.3%

5. Conclusion

This research applied the Daubechies function of wavelet transform on Amman stock exchange "ASE" insurance data. The achievement of this study is removing the outliers and irregular information. Therefore, in this study, the sample data set became experimentally examined in phrases of predictive accuracy, which is the purpose of doing so, first whether Daubechies function of wavelet remodel mixed with an appropriate ARIMA model produces more correct forecasting compared to ARIMA method without delay. Second, to find out which WT model, (HWT or DWT) is better at forecasting. In order to do that, HWT, DWT, Symm and Coef are combined with ARIMA model respectively and used to proactive insurance dataset. The findings of the use of statistical prediction standards MAPE have found out that Daubechies function of wavelet transform is more accurate at forecasting than different models.

WORKS CITED

Ahmad, A. Y. B., Kumari, D. K., Shukla, A., Deepak, A., Chandnani, M., Pundir, S., & Shrivastava, A. (2024). Framework for Cloud Based Document Management System with Institutional Schema of Database. International Journal of Intelligent Systems and Applications in Engineering, 12(3s), 672-678.

Ahmad, A. Y. B., Tiwari, A., Nayeem, M. A., Biswal, B. K., Satapathy, D. P., Kulshreshtha, K., & Bordoloi, D. (2024). Artificial Intelligence Perspective Framework of the Smart Finance and Accounting Management Model. International Journal of Intelligent Systems and Applications in Engineering, 12(4s), 586-594.

Ahmad, A., Abusaimeh, H., Rababah, A., Alqsass, M., Al-Olima, N., & Hamdan, M. (2024). Assessment of effects in advances of accounting technologies on quality financial reports in Jordanian public sector. Uncertain Supply Chain Management, 12(1), 133-142.

Ahmad Y. A. Bani Ahmad, "Firm Determinants that Influences Implementation of Accounting Technologies in Business Organizations," WSEAS Transactions on Business and Economics, vol. 21, pp. 1-11, 2024

Alhawamdeh, H., Al-Saad, S. A., Almasarweh, M. S., Al-Hamad, A. A.-S. A., Bani Ahmad, A. Y. A. B., & Ayasrah, F. T. M. (2023). The Role of Energy Management Practices in Sustainable Tourism Development: A Case Study of Jerash, Jordan. International Journal of Energy Economics and Policy, 13(6), 321–333. https://doi.org/10.32479/ijeep.14724

Allahham, M., & Ahmad, A. (2024). AI-induced anxiety in the assessment of factors influencing the adoption of mobile payment services in supply chain firms: A mental accounting perspective. International Journal of Data and Network Science, 8(1), 505-514.

A.Cohen, I.Daubechies, P.Vial, "Wavelets on the interval and fast wavelet transform", Applied and Computational Harmonic (1993)54–81.

A. N.Refenes, A.Zapranis, G.Francis, "Stock performance modeling using neural networks: a comparative study with regression models", Neural Networks (1994) 375–388.

A.Popoola, K.Ahmad, "Testing the suitability of wavelet preprocessing for TSK fuzzy models", in: Proceeding of FUZZ-IEEE: International Conference Fuzzy System Network (2006), pp.1305–1309.

Al-afeef, M. A., Al-Afeef, M. A. M., Al-Smadi, R. W., & Al-Smadi, A. W. (2024). The Impact of Covid-19 on Financial Markets Performance: An Empirical Study in Amman Stock Exchange. Calitatea, 25(199), 40-49.

Al-Smadi, A. W., & Al-Smadi, R. W. (2021). The Impact of Changes in Oil Prices on The Stock Market: Evidence from Jordan. Turkish Online Journal of Qualitative Inquiry, 12(7).

Al-Smadi, A. W., Al-Smadi, R. W., Al-Afeef, M. A., Al-Afeef, M. A. M., & Kalbouneh, N. Y.

(2023). Consequences to the Stock Market Caused by Currency Fluctuations: Jordanian Evidence. International Journal of Professional Business Review, 8(4), e01275-e01275.

B.Ramsey, "The contribution of wavelets to the analysis of economic and financial data", Philosophical Transactions of the Royal Society of London Series A-Mathematical Physical and Engineering Sciences (1999)2593–2606.

Cheng, C,H., Teoh, H, Jong., "Fuzzy time-series basedon Fibonacci sequence for stock price forecasting", Physica A 380(2007): 377–390.

Cheng, C, H., Chen, T, L., Jong Teoh, H., Chiang, C, H," Fuzzy time-series based on adaptive expectation model for TAIEX forecasting", Expert Systems with Applications 34(2008):1126–1132.

Chang, P, C., Liu, C, H,"A TSK type fuzzy rule based system for stock price prediction", Expert Systems with Applications 34(2008): 135–144.

Cheng, Congbin, Sayed Fayaz Ahmad, Muhammad Irshad, Ghadeer Alsanie, Yasser Khan, Ahmad Y. A. Bani Ahmad (Ayassrah), and Abdu Rahman Aleemi. 2023. "Impact of Green Process Innovation and Productivity on Sustainability: The Moderating Role of Environmental Awareness" Sustainability 15, no. 17: 12945. https://doi.org/10.3390/su151712945

Daoud, M., Taha, S., Al-Qeed, M., Alsafadi, Y., Ahmad, A., & Allahham, M. (2024). EcoConnect: Guiding environmental awareness via digital marketing approaches. International Journal of Data and Network Science, 8(1), 235-242.

D.W.Patterson, Artificial Neural Networks: Theory and Applications, Prentice Hall, 1996.

E, H adavandi, H, Shavandi , A, Ghanbari, "Integration of genetic fuzzy systems and artificial neural networks for stock price forecasting", Knowledge based system 23(2010), 800-808.

Abramovich, P.Besbeas, T.Sapatinas, Empirical, "Bayes approach to block wavelet function estimation", Computational Statistics and Data Analysis (2002) 435–451.

Fraihat, B. A. M., Ahmad, A. Y. B., Alaa, A. A., Alhawamdeh, A. M., Soumadi, M. M., Aln'emi, E. A. S., & Alkhawaldeh, B. Y. S. (2023). Evaluating Technology Improvement in Sustainable Development Goals by Analysing Financial Development and Energy Consumption in Jordan. International Journal of Energy Economics and Policy, 13(4), 348

Fransworth, G.V., Kelly, J,A., Othling, A,S., Pryor, R,J," Successful Technical Trading Agents Using Genetic Programming", (2004)Sandia National Laboratories.

Firas Muhammad Al- Rawashdi, S. Alwadi, and Mohammad Hasan Saleh (2015). Wavelet methods in forecasting for insurance companies listed in amman stock exchange. European Journal of Economics, finance and administrative sciences 54-59

J.B.Ramsey, Z.Zhang, "The analysis of foreign exchange data using wave form dictionaries", Journal of Empirical Finance (1997)341–372.

K.Papagiannaki, N.Taft, Z.-L.Zhang, C.Diot, "Long-term forecasting of internet backbone traffic", IEEE Transactions on Neural Networks (2005)1110–1124.

K.Parasuraman, A.Elshorbagy, "Wavelet networks: an alternative to classical neural networks", IEEE International Joint Conference on Neural Networks (2005) 2674–2679.

Lin, L., Cao, L., Wang, J., Zhang, Ch, "The Application of Genetic Algorithms in Stock Market Data Mining Optimization", Faculty of Information Technology, University of Technology,(2007) Sydney, NSW, Australia.

A.Zadeh, "The role of fuzzy logic in modeling, identification and control", Modeling Identification and Control (1994)191–203.

Lin, C., Ahmad, S. F., Ayassrah, A. Y. B. A., Irshad, M., Telba, A. A., Awwad, E. M., & Majid, M. I. (2023). Green production and green technology for sustainability: The mediating role of waste reduction and energy use. Heliyon, e22496.

Mohammad Salameh Almasarweh, Osama Mohammad Al-Rawashdeh, S.AL Wadi, Mahmoud Barakat Alnawaiseh, Firas Al-Rawashdeh,2022, Risk Management and Financial Performance of Insurance Companies in Jordan, Social space journal,Volume22,issue 1

Peiran Liang, Yulu Guo, Sohaib Tahir Chauhdary, Manoj Kumar Agrawal, Sayed Fayaz Ahmad, Ahmad Yahiya Ahmad Bani Ahmad, Ahmad A. Ifseisi, Tiancheng Ji,2024,"Sustainable development and multi-aspect analysis of a novel polygeneration system using biogas upgrading and LNG regasification processes, producing power, heating, fresh water and liquid CO2,"Process Safety and Environmental Protection,

Peiran Liang, Yulu Guo, Tirumala Uday Kumar Nutakki, Manoj Kumar Agrawal, Taseer Muhammad, Sayed Fayaz Ahmad, Ahmad Yahiya Ahmad Bani Ahmad, Muxing Qin, 2024. "Comprehensive assessment and sustainability improvement of a natural gas power plant utilizing an environmentally friendly combined cooling heating and power-desalination arrangement",Journal of Cleaner Production,Volume 436,,140387,

R.Engle, "GARCH101: the use of ARCH/GARCH models in applied econometrics", The Journal of Economic Perspectives (2001)157–168.

R.Gencay, F.Selcuk, B.Whitcher, "Differentiating intraday seasonalities through wavelet multi-scaling", PhysicaA (2001)543–556.

R.Gencay, F.Selcuk, B.Whitcher, "An Introduction to Wavelets and Other Filtering Methods in Finance and Economics", Academic Press, NewYork (2002).

Refenes A-P. N., Francis, G., and Zapranis A. D., "Stock Performance Modeling Using Neural Networks: A Comparative Study with Regression Models", Neural Networks Vol. 7, No. 2, (1994)375-388.

Rumman, G., Alkhazali, A., Barnat, S., Alzoubi, S., AlZagheer, H., Dalbouh, M., ... & Darawsheh, S. (2024). The contemporary management accounting practices adoption in the public industry: Evidence from Jordan. International Journal of Data and Network Science, 8(2), 1237-1246.

S.Adel, C.Martin, J.R.Heather, A.M.Jose, "The reaction of stock markets to crashes and events: a comparison study between emerging and maturemarkets using wavelet transforms", PhysicaA (2006)511– 521.

S.M.Chen, "Forecasting enrollments based on fuzzy time-series", Fuzzy Sets Systems (1996)11–319.

Salcedo-Sanz, S., Fernández-Villacañas, J,L.,Segovia-Vargas, M, J., andBousoño-Calzón, C, "Genetic programming for the prediction of insolvency in non-life insurance companies, Computer and operation", vol 32, issue 4: (2005) 749-765.

T. J, Hsieh, H. F, Hsiao, W. C, Yeh, "Forecasting Stock Market Using Wavelet Transform and neural networks: An Integrated system based on artificial bee colony alghoritm", Applied soft computing , (2010) Gmodel.

Tsang, P. M., Kwok, P., Choy, S.O., Kwan, R., Ng, S.C., Mak, J., Tsang, J., Koong, K., Wong, T,L," Design and implementation of NN5 for Hong Kong stock price forecasting", Engineering Applications of Artificial Downloaded from ijorlu.liau.ac.ir at 14:16 IRST on Saturday December 31st 2016 Intelligence 20,(2007)453–461.

V. Marmer, "Nonlinearity, nonstationarity, and spurious forecasts", Journal of Econometrics (2008)1–27.

William, P., Ahmad, A. Y. B., Deepak, A., Gupta, R., Bajaj, K. K., & Deshmukh, R. (2024). Sustainable Implementation of Artificial Intelligence Based Decision Support System for Irrigation Projects in the Development of Rural Settlements. International Journal of Intelligent Systems and Applications in Engineering, 12(3s), 48-56.

Y.S. Abu-Mostafa, A.F. Atiya, "Introduction to financial forecasting", Applied Intelligence (1996) 205-213.

Yoo,Y.n, G.Swales, T.M.Margavio, "A comparison of discriminate analysis versus artificial neural networks", Journal of the Operations Research Society (1993) 51–60.

Q.Zhang, S.Akkaladevi, G.Vachtsevanos, T.Y.Lin, "Granular neural Web agents for stock prediction", Soft ComputingJ ournal (2002)406–413.

Yahiya Ahmad Bani Ahmad (Ayassrah), Ahmad; Ahmad Mahmoud Bani Atta, Anas; Ali Alawawdeh, Hanan; Abdallah Aljundi, Nawaf; Morshed, Amer; and Amin Dahbour, Saleh (2023) "The Effect of System Quality and User Quality of Information Technology on Internal Audit Effectiveness in Jordan, And the Moderating Effect of Management Support," Applied Mathematics & Information Sciences: Vol. 17: Iss. 5, Article 12.DOI: https://dx.doi.org/10.18576/amis/170512

Yahiya, A., & Ahmad, B. (2024). Automated debt recovery systems: Harnessing AI for enhanced performance. Journal of Infrastructure, Policy and Development, 8(7), 4893.

Zhan, Y., Ahmad, S. F., Irshad, M., Al-Razgan, M., Awwad, E. M., Ali, Y. A., & Ayassrah, A. Y. B. A. (2024). Investigating the role of Cybersecurity's perceived threats in the adoption of health information systems. Heliyon, 10(1).