

Forecasting Stock Market Momentum in Nepal: Application of Fuzzy Logic Model

John Koirala¹ and Swachhanda Aabhas Rai²

¹Research Faculty, Nepal College of Management, Kathmandu University
email: johnkoirala@gmail.com

²Freelance researcher, corresponding
email: rswachhanda@ncm.edu.np/
raiswachhanda2056@gmail.com

Received on : Nov 10, 2021
Revised on : Dec 05, 2021
Accepted date: Dec 17, 2021

Cite this paper

Koirala, J. and Rai, S. (2021). Forecasting Stock Market Momentum in Nepal: Application of Fuzzy Logic Model. *International Research Journal of Management Science*, vol.6(1), pp. 17-28

Copyright © John Koirala
and Swachhanda Aabhas Rai

<https://doi.org/10.3126/irjms.v6i1.42335>

Abstract

Background: Stock market experts analyse various indicators to estimate the stock market, including historical prices, economic analysis, industry analysis and company analysis, but this study uses historical prices for the NEPSE index, making forecasting more precise.

Purpose: The purpose of this study is to explore short-term stock market momentum using fuzzy logic. The study also aims to establish a suitable fuzzy model to predict stock momentum, reduce the risk, and make the right investment decision.

Methodology/Design: This study employed exploratory research design to understand the problem of chaotic decision making in the stock market. The mathematical method employed in this study is membership functions, which are part of fuzzy logic. This includes only the commercial banks, as it has the highest market capitalization, 53.11% of total market capitalization. Using 14-day past data as a base, the suggested fuzzy model determines the stock index's momentum over the next 5 days.

Findings: The forecasted trend value for the Nabil, Civil, and Prime Commercial bank is 0.92, 0.92, and 0.80, which shows a bullish trend. Compared to previously collected data, the findings closely reflect the expected real-world values.

Keywords: Forecasting, Fuzzy logic, Market capitalization, Stock market momentum, Triangular and Trapezoidal membership function.

I. Introduction

The stock market is one of the attractive areas of the investment sector, especially for traders, to generate profit in both the long and short term (Baker & Stein, 2004). The public limited companies can also raise their capital through the stock market as it is the major primary source for them (Ijegwa et al. 2014). However, various risks are associated with the stock market (Gyourko & Keim, 1992) especially the decision-making process is complex. It is because the price of stocks changes frequently, and investors get confused regarding when to buy or sell the stocks (Gamil et al. 2007). Therefore, the investors have to gather the knowledge of some bases on taking right decisions while trading stock.

Stock market momentum is one of the vital information that investors should (Roy et al., 2015). Stock momentum is the change in the prices of stocks (Badrinath & Wahal, 2002). The stock price is an indicator that also measures the success of company management, where the market power on the stock market is indicated by the sale and purchase of the company's shares in the capital market (Gunadi et al. 2020). Therefore, an investor should collect brief financial historical information to gain profit in the stock market. The stock market momentum can be categorized into Bullish, Bearish, and Neutral (Roy et al., 2015). Bullish momentum is a condition in the financial market where the price of stocks is rising or contemplated to be rising in the future. Similarly, bearish momentum is a condition in the financial market where the price of stocks is decreasing or expected to be decreasing in the future. Furthermore, sellers dominate the market in bearish momentum. Neutral momentum is the condition in which both buyers and sellers control the stock markets, and prices remain within limits.

Stock market experts analyse various indicators to estimate the stock market, including historical prices, economic analysis, industry analysis and company analysis, (Ijegwa et al. 2014) but this study uses historical prices for the NEPSE index, making forecasting more precise. So to forecast the short-term stock market momentum, fuzzy logic can be used.

Fuzzy logic is a method to formalize the human capacity of imprecise reasoning or approximate reasoning (Ross, 2004). Fuzzy logic can analyze imperfect data and find approximate answers to issues that other systems struggle to address. There are various rules and models of fuzzy logic. In this study, mathematical methods of the fuzzy logic, membership function are used to forecast the stock market momentum. Every member of the fuzzy set has a membership value; thus, the fuzzy set and fuzzy logic helps forecast the short-term stock market momentum (Penawar & Rustom, 2017). The proposed fuzzy model aids in calculating the momentum of the index (bullish, neutral, or bearish). It may forecast short-term momentum by estimating future 5-day movement or momentum using 14-day historical data. After the sequential close-open figures are fuzzified to form a fuzzy momentum value, the momentum, whether bullish, bearish, or neutral, remains to some extent. The purpose of this study is to explore short-term stock market momentum using fuzzy logic. The study also aims to establish a suitable fuzzy model to predict stock momentum, reduce the risk, and make the right investment decision.

The reminder of the paper has been organized into the following sub-sections: review of literature is shown in section II, research methodology in section III, results in section IV, and conclusion along with future research implication are presented in section V.

II. Review of Related studies

Various empirical research has been carried out in this field of fuzzy logic to forecast stock market momentum. Some empirical studies that attempt to provide light on the problem.

Lee and Pan (2004) suggested an Intelligent Fuzzy Meeting Agent for Decision Support Systems. Meeting Negotiation Agent (MNA), Fuzzy Inference Sample (FIA), and Genetic Learning Agent are the three subagents in this system that perform intelligent meeting scheduling support. These three agents work together to calculate the result. The MNA collects and submits the meeting members' identities to the FIA, while the FIA and GLA assist the meeting host in holding the meeting. Furthermore, in the realm of distributed artificial intelligence, the rapid growth of intelligent agents and multi-agent technologies has sparked a new wave of distributed decision support system research.

Similarly, Gamil et al. (2007) proposed a multi-agent and fuzzy logic-based decision support system for the stock market. This technique aided stock market investors in making the best buy/sell/hold decisions possible. A fuzzy tuning mechanism was implemented to improve the accuracy of the decisions. This study included a discussion of the tuning approach, which employs genetic algorithms. For the system's implementation, a multi-agent framework is recommended. Similarly, an experimental simulation utilizing actual price data from the NASDAQ index was conducted to demonstrate the power of the proposed approach. The proposed fuzzy logic model produced satisfactory, although not precise, results. Zarandi and Yazdi (2008) introduced a type-2 fuzzy rule-based expert system for dealing with uncertainty in complicated issues like portfolio selection. The antecedent and consequent membership functions in a type-2 fuzzy expert system are both type-2. This study employs a fuzzy modeling approach with an indirect approach, in which the rules are derived automatically using a clustering approach. In order to create primary membership of type-2 membership functions, a new cluster analysis approach based on Fuzzy C-Means (FCM) has been developed. The Xie-Beni validity index is used to develop a new cluster validity index. Stock market factors (such as risk, return, dividend, and so on) are used as input variables in the suggested type-2 fuzzy model. On the Tehran Stock Exchange, this model has been tested (TSE). The program has effectively picked the most efficient portfolio for each investor based on extensive trial testing. The findings are promising and might be used in a stock trading system that trades in real-time. Roy et al. (2015) developed a fuzzy system that can forecast the Nifty-50 index's short-term momentum. For projecting future 5-day movement or momentum, 14-day historical data is used as the foundation. The goal was to obtain a list of successive close-open values, which was fuzzified. When closing values are higher than opening values, buyers become more active and push prices higher, resulting in positive momentum. When closing values are lower than opening values, sellers attempt to drive prices lower, resulting in a bearish feeling or bearish momentum in the market. The momentum, whether bullish, bearish, or neutral, endure to some extent, i.e., for a few days, and this concept aids in momentum forecasting. The proposed technique was tested for multiple sets of data from different years and effectively estimated the trend. The experimentation was successful with NIFTY-50 index values. The system can be enhanced in the future to predict precise figures for how many points the market will rise or fall, and it must also be tested for various markets, sectors, and stocks.

Peachavanish (2018) proposed a stock selection strategy based on dual time frame Relative Strength Index (RSI) momentum technical indicators using Mamdani-type fuzzy rule-based inference. The method is justified by well-known phenomena such as long-term trends and short-term momentum. The proposed strategy was evaluated on Thailand's SET100 constituents using price data from the previous five years, and it significantly beat the index benchmark.

Pai and Kar (2019) proposed a hybrid approach for forecasting time series of stock prices employing data discretization based on fuzzistics. Similarly, the cumulative probability distribution approach (CPDA) is employed to obtain intervals for the linguistic values. Rough set theory was used to generate first-order fuzzy rules and reduce rule sets. Following that, defuzzification utilizing a smaller rule base and historical evidence is used to compute predictions of time series data. The proposed strategy is tested on the closing prices of three stock indexes (BSE, NYSE, and TAIEX), and the results suggest that the method outperforms its competitors.

III. Research Methodology

In this study, the exploratory research design has been used to learn more about the problem of a chaotic system, meaning the behavioural traits of share prices are unpredictable and uncertain. As a result fuzzy logic has been used to diminish such unpredictability and uncertainty. The mathematical method that is employed in this study are membership functions, which are part of fuzzy logic. Therefore, this study is based on quantitative research method. This study combines historical share prices with fuzzy logic to develop a fuzzy indicator that forecasts bullish, neutral, and bearish momentum.

During this study, the population of interest is all commercial banks listed on the Nepal Stock Exchange (NEPSE) as of July 15. This study intends to include only the commercial banks, as it has the highest market capitalization, 53.11% of total market capitalization (NEPSE, 2020).

This study uses non-probability sampling. Furthermore, purposive sampling is used to select the samples. The three commercial banks are selected based on their share price as of July 15. Nabil bank has the highest share price, Civil Bank has the lowest share price, and Prime Commercial Bank has the average level of the highest and lowest share price as of July 15. Therefore these three banks represent all the high, low, medium priced shares of commercial banks.

Nabil Bank Limited	Rs. 1359
Civil Bank Limited	Rs. 286
Prime Commercial Bank Limited	Rs. 479

Proposed Methodology

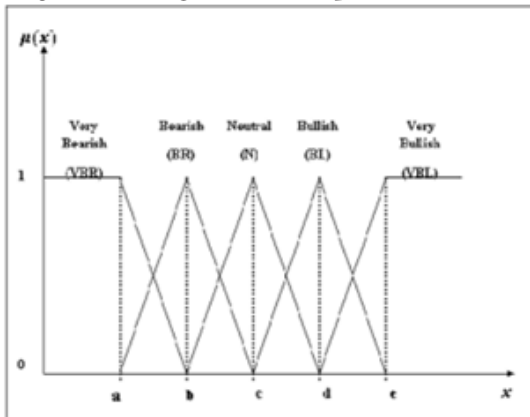
The price at which a stock is first traded and concluded on the same day is known as the open and close, respectively. Similarly, the maximum and minimum prices of a day are high and low. The day's open, high, low, close value is represented as O, H, L, C, respectively.

For projecting future 5-day momentum, 14-days historical data (O, H, L, C) is used as the foundation.

The goal is to obtain a list of successive close-open values, which are then be fuzzified. First, the average of individual day fuzzy momentum values is determined. This number serves as a representative momentum for the previous 14 days, indicating a trend that may persist for a few more days. $V_i^{op}, V_i^{hi}, V_i^{lo}, V_i^{cl}$ represents the open, high, low, close of the i^{th} day respectively. The difference between the open and close values on the i th day is $\Delta_i = V_i^{cl} - V_i^{op}$ where $i = 1, 2, 3 \dots 14$. The direction force of a stock's price movement is measured by its momentum value. The i -th day's momentum value is defined as $= |\Delta_i|$.

There are various types of momentum values. Bearish, neutral, and bullish are the three types that is explored in general. There are five different momentum intervals: Very Bearish, Bearish, Neutral, Bullish, and Very Bullish. a, b, c, d, and e are the limits used to limit the interval. The percentage values of the maximum value of the momentum, which are $a= 15 \%$, $b= 30 \%$, $c = 45 \%$, $d= 60 \%$, and $e= 75 \%$. Triangular and trapezoidal shapes are used to calculate the momentum membership value. The triangular and trapezoidal membership functions is employed are depicted in Fig.

1. Figure 1 Triangular and Trapezoidal Membership Function



Source: Triangular and Trapezoidal membership Function Adapted from (Penawar & Rustom, 2017)

This Equation defines the triangular and trapezoidal membership functions. The following is the process for creating the fuzzy model that has been proposed:

$$\mu(x)_{VBR} = \begin{cases} 1, & x \leq a \\ \frac{b-x}{b-a}, & a \leq x \leq b \\ 0, & x \geq b \end{cases}$$

$$\mu(x)_{BR} = \begin{cases} 0, & x \leq a \\ \frac{x-a}{b-a}, & a \leq x \leq b \\ \frac{c-x}{c-b}, & b \leq x \leq c \\ 0, & x \geq c \end{cases}$$

$$\mu(x)_N = \begin{cases} 0, & x \leq b \\ \frac{x-b}{c-b}, & b \leq x \leq c \\ \frac{d-x}{d-c}, & c \leq x \leq d \\ 0, & x \geq d \end{cases}$$

$$\mu(x)_{BL} = \begin{cases} 0, & x \leq c \\ \frac{x-c}{d-c}, & c \leq x \leq d \\ \frac{e-x}{e-d}, & d \leq x \leq e \\ 0, & x \geq e \end{cases}$$

$$\mu(x)_{VBL} = \begin{cases} 1, & x \geq e \\ \frac{x-d}{e-d}, & d \leq x \leq e \\ 0, & x \leq d \end{cases}$$

Each day’s fuzzy momentum value is represented as follows, and it is calculated as follows:

$$\delta_i = \max \{ \mu(x_i)_{VBR}, \mu(x_i)_{BR}, \mu(x_i)_N, \mu(x_i)_{BL}, \mu(x_i)_{BL} \}$$

From the k_{th} set of 14-day historical data, the forecasted fuzzy momentum value φ_k is calculated. It is the fuzziness of the momentum number that can be used to forecast market movement over the next five days.

$$\varphi_k = \frac{[\sum_{i=1}^{14} \delta_i]}{14}$$

The following equation can be used to evaluate the fuzzy linguistic interpretation γ_k of the φ_k values: Adapted from (Roy et al., 2015)

$$\gamma_k = \begin{cases} \text{Bearish,} & 0 \leq \varphi_k \leq 0.42 \\ \text{Neutral,} & 0.42 \leq \varphi_k \leq 0.6 \\ \text{Bullish,} & 0.6 \leq \varphi_k \leq 1.0 \end{cases}$$

IV. Results

In this study, Nabil Bank Limited, Prime Commercial Bank, and Civil bank are used as an example to estimate the 5 days’ momentum, 14 days of stock data from July are used. Only the commercial banks are selected, as it has the highest market capitalization, 53.11% of total market capitalization (NEPSE, 2020). The three commercial banks have been chosen based on their stock prices on July 15. As of July 15, Nabil Bank has the highest share price, Civil Bank has the lowest share price, and Prime Commercial Bank has the average of the two. The daily data is used here: Open, High, Low, and Close values are collected respectively from July 15 till 14 days. Such data are collected using various online portals like “Share Sansar,” the official site of the Nepal Stock Exchange (NEPSE), Nepal Stock Exchange Trade Management System, and so on.

Table 4.4 14 days fuzzy momentum value of Nabil Bank

Date	Open	High	Low	Close	δ
15/07/2021	1,350.00	1,361.00	1,349.00	1,359.00	1.00
14/07/2021	1,350.00	1,358.00	1,330.00	1,349.00	1.00
13/07/2021	1,275.00	1,355.00	1,275.00	1,347.00	1.00
12/07/2021	1,400.00	1,400.00	1,324.00	1,338.00	1.00
11/07/2021	1,317.00	1,353.00	1,317.00	1,345.00	0.59
08/07/2021	1,350.00	1,350.00	1,297.00	1,317.00	0.94
07/07/2021	1,309.00	1,309.00	1,297.00	1,299.00	1.00
06/07/2021	1,261.00	1,303.00	1,261.00	1,301.00	0.70
05/07/2021	1,360.00	1,360.00	1,295.00	1,297.00	1.00
04/07/2021	1,300.00	1,305.00	1,296.00	1,298.00	1.00
01/07/2021	1,296.00	1,305.00	1,293.00	1,297.00	1.00
30/06/2021	1,232.00	1,315.00	1,232.00	1,296.00	1.00
29/06/2021	1,310.00	1,310.00	1,295.00	1,296.00	0.70
28/06/2021	1,334.00	1,334.00	1,297.00	1,302.00	0.96
					12.91
			$\varphi_1 = 0.92$		
			$\gamma_1 = \text{Bullish}$		

Source: Authors’ own calculation

Table 4.5 Consecutive 5 days' daily data from above table 4.1

Date	Open	High	Low	Close
25/07/2021			1,488.00	1,500.00
22/07/2021			1,454.00	1,463.00
20/07/2021			1,480.00	1,490.00
19/07/2021			1,468.00	1,493.00
18/07/2021			1,368.00	1,440.00

Close – Open= 1499.5-1368
=131.5 points

Source: Sharesansar.com

Table 4.6 14 days fuzzy momentum value of Civil Bank

Date	Open	High	Low	Close	δ
15/07/2021	286	288	283	286	1.00
14/07/2021	300	300	284	286	1.00
13/07/2021	283	289	283	289	0.86
12/07/2021	290	293	281	285	0.62
11/07/2021	284	290	284	290	0.86
08/07/2021	280	283	280	282	1.00
07/07/2021	280	284	280	280	1.00
06/07/2021	80	285	280	282	1.00
05/07/2021	284	284	281	283	1.00
04/07/2021	271	292	271	284	1.00
01/07/2021	281	291	281	285	0.90
30/06/2021	286	286	278	284	1.00
29/06/2021	294	298	285	286	0.81
28/06/2021	300	305	291	294	0.86

$\delta = 12.90$

$\phi^2 = 0.92$
 $\gamma_-(2=\text{Bullish})$

Source: Authors' own calculation

Table 4.7 Consecutive 5 days' daily data from table 4.2

Date	Open	High	Low	Close
25/07/2021			301	309.9
22/07/2021			297	301
20/07/2021			296	301
19/07/2021			305	306.2
18/07/2021			290	301.5

Close- Open = 309.9-290
=19.9 points

Source: Sharesansar.com

IV. Results

In this study, Nabil Bank Limited, Prime Commercial Bank, and Civil bank are used as an example to estimate the 5 days' momentum, 14 days of stock data from July are used. Only the commercial banks are selected, as it has the highest market capitalization, 53.11% of total market capitalization (NEPSE, 2020). The three commercial banks have been chosen based on their stock prices on July 15. As of July 15, Nabil Bank has the highest share price, Civil Bank has the lowest share price, and Prime Commercial Bank has the average of the two. The daily data is used here: Open, High, Low, and Close values are collected respectively from July 15 till 14 days. Such data are collected using various online portals like "Share Sansar," the official site of the Nepal Stock Exchange (NEPSE), Nepal Stock Exchange Trade Management System, and so on.

Table 4.8 14 days fuzzy momentum value of Prime Commercial Bank

Date	Open	High	Low	Close	δ
5/07/2021	478	482	477	479	1.00
14/07/2021	474	482	474	478	0.95
13/07/2021	475	483	471	480	0.56
12/07/2021	482	490	474	479	0.54
11/07/2021	474	480	470	479	0.56
08/07/2021	460	467	458	467	0.59
07/07/2021	460	463	459	460	1.00
06/07/2021	460	463	459	460	1.00
05/07/2021	464	470	458	460	0.95
04/07/2021	69	469	461	462	0.59
01/07/2021	465	468	461	465	1.00
30/06/2021	465	466	459	462	0.54
29/06/2021	480	481	465	467	1.00
28/06/2021	475	480	470	473	0.97
					11.26

$\varphi_2=0.80$
 $\gamma_-(3=\text{Bullish})$

Source: Authors' own calculation

Table 4.9 Consecutive 5 days' daily data from above table

Date	Open	High	Low	Close
25/07/2021	519	530	515.1	529
22/07/2021	504	517	500.3	509.5
20/07/2021	510	510	497	504
19/07/2021	510	521	498	505
18/07/2021	480	503.8	480	501

Close- Open = 529-480=49 points

Source: Sharesansar.com

V. Conclusions

The forecasted trend value for the Nabil bank is 0.92, which shows a bullish trend. Similarly, bullish is reflected in the consecutive five days depicted in table 4.1b, where the opening value on July 18, 2021 is 1368, and the closing value after five days is 1499.5. With the given reference, the difference between closing value and opening value shows positive +131.5 points. Therefore, the momentum is as predicted before.

The Civil bank's predicted trend value is 0.92, indicating a bullish trend. Similarly, bullish is mirrored in the five days depicted in table 4.1b, where the opening value on July 18, 2021, is 290 and the closing value is 309.9 after five days showing the difference of positive +19.9 points with the specified reference. Likewise, the predicted trend value of Prime Commercial Bank is 0.80 results in a bullish trend. The consecutive 5 days also show the bullish trend as the difference between the opening and closing price is +49 points (529-480). As a result, the momentum is as expected.

Limitations and recommendation for future research

Investors have to be familiar to apply the established stock market forecasting models to reduce risk and increase accuracy. Such models can result them to take precise decision. Similarly, just a few studies have used fuzzy logic as the principal tool for predicting stock market momentum in Nepal. This study predicted short-term stock momentum using fuzzy logic. There are three categories of momentum: bearish, neutral, and bullish. However, the changing point of up or down has not been calculated in this study. This approach can be enhanced in the future to forecast the precise values by which the market will change. As a result, further system improvisation can foresee altering up or down points shortly. Future researchers and academicians can also test this model or system in other industries, markets, and so on, as this study just looked at the banking industry.

References

- Badrinath, S. G., & Wahal, S. (2002). Momentum trading by institutions. *The Journal of Finance*, 57(6), 2449-2478.
- Baker, M., & Stein, J. C. (2004). Market liquidity as a sentiment indicator. *Journal of financial Markets*, 7(3), 271-299.
- Gamil, A. A., Elfouly, R. S., & Darwish, N. M. (2007). Stock Technical Analysis using Multi Agent and Fuzzy Logic. In *World Congress on Engineering* (No. 4, p. 6).
- Gunadi, I. G. N. B., Putra, I. G. C., & Yuliasuti, I. A. N. (2020). The Effects of Profitabilitas and Activity Ratio Toward Firms Value with Stock Price as Intervening Variables. *International Journal of Accounting & Finance in Asia Pasific (IJAFAP)*, 3(1), 56-65.
- Gyourko, J., & Keim, D. B. (1992). What does the stock market tell us about real estate returns?. *Real Estate Economics*, 20(3), 457-485. <http://www.nepalstock.com/about-us/introduction>. Retrieved on June 10, 2021

- Ijegwa, A. D., Vincent, O. R., Folorunso, O., & Isaac, O. O. (2014). A Predictive Stock Market Technical Analysis Using Fuzzy Logic. *Comput. Inf. Sci.*, 7(3), 1-17.
- Lakshminarayanan, S. (2005). *An integrated stock market forecasting model using neural networks* (Doctoral dissertation, Ohio University).
- Lee, C.-S., & Pan, C.-Y. (2004). *An intelligent fuzzy agent for meeting scheduling decision support system. Fuzzy Sets and Systems*, 142(3), 467-488.S
- Nepal Stock Exchange Ltd. (2020). Annual Report 2076/77. Retrieved from <http://www.nepalstock.com/reports-by-category/7> on dated July 15, 2021.
- Nepal Stock Exchange Ltd. (2020). Annual Report 2076/77. Retrieved from <http://www.nepalstock.com/reports-by-category/7> on dated June 20, 2021.
- Nepal Stock Exchange. (2021). Introduction of Nepal Stock Exchange, retrieved from www.nepalstock.com on 15.12.2021.
- Peachavanish, R. (2018). Dual Time Frame Relative Strength Stock Selection Using Fuzzy Logic. In *International MultiConference of Engineers and Computer Scientists* (Vol. 2, pp. 14-16).
- Penawar, H. K., & Rustam, Z. (2017, July). A fuzzy logic model to forecast stock market momentum in Indonesia's property and real estate sector. In *AIP Conference Proceedings* (Vol. 1862, No. 1, p. 030125). AIP Publishing LLC.
- Ross, T. J. (2004). Logic and Fuzzy Systems. In *Fuzzy logic with engineering applications* (Vol. 2). New York: Wiley.
- Roy, P., Kumar, R., & Sharma, S. (2015). A Fuzzy Logic Model to forecast stock market momentum. *Int. J. Adv. Engg. Res. Studies/IV/II/Jan.-March*, 98, 101.
- Sharesansar. (2021). Price History of Civil Bank. <https://www.sharesansar.com/company/cbl>. Retrieved on July 15, 2021.
- Sharesansar. (2021). Price History of Nabil Bank. <https://www.sharesansar.com/company/nabil>. Retrieved on July 15, 2021.
- Sharesansar. (2021). Price History of Prime Commercial Bank. <https://www.sharesansar.com/company/pcbl>. Retrieved on July 15, 2021.
- Zadeh, L. A. (1988). Fuzzy logic. *Computer*, 21(4), 83-93.
- Zarandi, M. F., & Yazdi, E. H. (2008, December). A type-2 fuzzy rule-based expert system model for portfolio selection. In *Proceeding of the 11th Joint Conference On Information Sciences Published By Atlantis Press*.

Appendix A

Calculation of fuzzy momentum value of Nabil Bank

Open	High	Low	Close	eq1	eq2	eq3	eq4	eq5	del
1,350.00	1,361.00	1,349.00	1,359.00	1	0	0	0	0	1.00
1,350.00	1,358.00	1,330.00	1,349.00	1	0	0	0	0	1.00
1,275.00	1,355.00	1,275.00	1,347.00	0	0	0	0	1	1.00
1,400.00	1,400.00	1,324.00	1,338.00	0	0	0	0	1	1.00
1,317.00	1,353.00	1,317.00	1,345.00	0	0.40	0.59	0	0	0.59
1,350.00	1,350.00	1,297.00	1,317.00	0	0	0.94	0.05	0	0.94
1,309.00	1,309.00	1,297.00	1,299.00	1	0	0	0	0	1.00
1,261.00	1,303.00	1,261.00	1,301.00	0	0	0.29	0.70	0	0.70
1,360.00	1,360.00	1,295.00	1,297.00	0	0	0	0	1	1.00
1,300.00	1,305.00	1,296.00	1,298.00	1	0	0	0	0	1.00
1,296.00	1,305.00	1,293.00	1,297.00	1	0	0	0	0	1.00
1,232.00	1,315.00	1,232.00	1,296.00	0	0	0	0	1	1.00
1,310.00	1,310.00	1,295.00	1,296.00	0.70	0.29	0	0	0	0.70
1,334.00	1,334.00	1,297.00	1,302.00	0	0.03	0.96	0	0	0.96
									12.91
									0.92

Appendix B

Calculation of fuzzy momentum value of Civil Bank

Open	High	Low	Close	eq1	eq2	eq3	eq4	eq5	del
286	288	283	286	1	0	0	0	0	1.00
300	300	84	286	0	0	0	0	1	1.00
283	289	283	289	0	0.14	0.85	0	0	0.86
290	293	281	285	0	0.61	0.38	0	0	0.62
284	290	284	290	0	0.14	0.85	0	0	0.86
280	283	280	282	1	0	0	0	0	1.00
280	284	280	280	1	0	0	0	0	1.00
280	285	280	282	1	0	0	0	0	1.00
284	284	281	283	1	0	0	0	0	1.00
271	292	271	284	0	0	0	0	1	1.00
281	291	281	285	0.09	0.90	0	0	0	0.90
286	286	278	284	1	0	0	0	0	1.00
294	298	285	286	0	0	0.19	0.80	0	0.81
300	305	291	294	0	0.14	0.85	0	0	0.86
									12.90
									0.92

Appendix C

Calculation of fuzzy momentum value of Prime Commercial Bank

Open	High	Low	Close	eq1	eq2	eq3	eq4	eq5	del
478	482	477	479	1	0	0	0	0	1.00
474	482	474	478	0	0	0	0	1	1.00
475	483	471	480	0	0.14	0.85	0	0	0.86
482	490	474	479	0	0.61	0.38	0	0	0.62
474	480	470	479	0	0.14	0.85	0	0	0.86
460	467	458	467	1	0	0	0	0	1.00
460	463	459	460	1	0	0	0	0	1.00
460	463	459	460	1	0	0	0	0	1.00
464	470	458	460	1	0	0	0	0	1.00
469	469	461	462	0	0	0	0	1	1.00
465	468	461	465	0.09	0.90	0	0	0	0.90
465	466	459	462	1	0	0	0	0	1.00
480	481	465	467	0	0	0.19	0.80	0	0.81
475	480	470	473	0	0.14	0.85	0	0	0.86
									12.90
									0.92