Modelling and Forecasting Stock Prices of Three Leading Companies in Sri Lanka Using Time Series Analysis

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ABSTRACT

In this research work, we tend to select the best time series model to forecast the stock prices in three main companies in Sri Lanka. We select the stock prices of Sampath Bank, Commercial Bank and John Keels Holdings. In this work, we use Autoregressive (AR), Moving average(MA) and Autoregressive Integrated Moving average(ARIMA) models. We compare the performances of these thee time series models in terms of the predictions and mean square errors. In simulation study, we predict the stock prices for ten days and also calculate the mean square error of the predictions. Autoregressive-Moving average (ARMA) model was found as the best time series model by comparing the mean square error.

Keywords: Best Fitted Model, Stock Prices, Time series

Introduction and research problem/issue

The stock market can reflect the economy of a country and it plays a vital role in the economy of the country. Especially in Sri Lanka, the stock market is very small. The main difficulties in expanding the market are the unawareness of the public about it, its financial instruments, and its dynamics. If we can model and predict the stock prices, it will be a huge advantage for both the share buyers and the holders to manage the risk for their investments. Especially, as the selected companies in this study have shown a remarkable success in the last five years. Share buyers and holders of these kinds of companies may be eager to know the future stock prices to minimize the risk.

This paper proposes the most compatible time series to model and forecast the stock prices of three leading companies in Sri Lanka, namely Sampath Bank, Commercial Bank and John Keels Holdings. The main difficulty in modelling the stock price data by using the time series model is the stationary. Since the stock prices are not stationary, in this study, we consider both the returns and the log returns of the daily stock prices. We use the three time series models, Autoregressive(AR), Moving average(MA) and Autoregressive Integrated Moving average(ARIMA) models. We compare all three models for all three stock prices that we considered in this study in terms of the mean square error of the predictions. We use R soft ware for simulation study.

Research Methodology

Daily stock prices for five years (11/01/2011 to 02/12/2016) of three selected companies were obtained. Using the data of daily returns, *ln*(1+*Return*) was calculated.

$Return = \frac{(R_t - R_{t-1})}{R_t}$; where present day's return value is R_t and previous day's return value is R_{t-1}.

Best fitted AR(p), MA(q) and ARIMA(p,d,q) models were selected comparing the Akaike Information Criterion (AIC) values and those models were fitted to the first 1000 data points. Using the fitted models 1001th data point was forecasted. Including that data point to the first 1000 data points 1002nd data point was forecasted. Likewise 10 data points were forecasted by using each model. Forecasted returns were converted to predicted sock prices. Their mean square error was calculated using the original data. The best time series model to forecast each company's stock prices were pointed by considering the mean square error.

Results and findings

Sampath Bank

For the returns of Sampath Bank, best fitted Auto Regressive time series model is AR (2), the best fitted Moving Average time series model is MA (2) and the best fitted Autoregressive Integrated Moving average time series model is ARMA (1,0,1).

Predicted stock prices using those returns have been compared with the actual values in Table 1.

Table 2: Comparison table of actual stock prices & predicted stock prices for Sampath Bank

Actual Price	AR(2)		MA(2)		ARMA(1,0,1)	
	Predicted Value	Predicted Value **	Predicted Value	Predicted Value **	Predicted Value	Predicted Value **
270	274.951	274.9184	274.9588	274.9366	274.8064	274.5768
270	274.811	274.6148	274.8299	274.6588	274.6215	274.1793
270	274.8029	274.6183	274.8283	274.6765	274.4454	273.796
268.9	274.7936	274.6178	274.8268	274.6942	274.2771	273.4424

269	274.7911	274.6334	274.8252	274.7119	274.1208	273.1053
268.5	274.7888	274.6492	274.8237	274.7296	273.9723	272.7851
270	274.7867	274.6659	274.8221	274.7473	273.8291	272.4731
269.9	274.7848	274.6826	274.8205	274.765	273.6939	272.1776
269.5	274.7828	274.6993	274.819	274.4823	273.5662	271.8975
269.2	274.7808	274.7161	274.8174	274.4929	273.456	271.6274
MSE	28.43734	27.11608	28.75901	27.19937	21.30064	13.16162*

*Lowest Mean Square Error (MSE) value is written in red

**Predicted Value (Using *in*(1+Retun))

Commercial Bank

For the returns of Commercial Bank, the best fitted Auto Regressive time series model is AR (1). The best fitted Moving Average time series model is MA(1) and the best fitted Autoregressive Integrated Moving average time series model is ARIMA(4,0,4).

Predicted stock prices using those returns have been compared with the actual values in Table 2.

Table 2: Comparison table of actual stock prices and predicted stock prices for Commercial Bank

	AR(1)		MA(1)		ARIMA(4,0,4)	
Actual Price	Predicted Value	Predicted Value **	Predicted Value	Predicted Value **	Predicted Value	Predicted Value **
182	183.0682	183.0247	183.0779	183.029	183.0779	183.0264
182	183.1422	183.0515	183.1526	183.0558	182.5741	182.855

181	183.2168	183.0785	183.2274	183.0828	182.6976	182.873
179.5	183.2914	183.1055	183.3022	183.1098	182.5872	182.7951
179	183.3661	183.1326	183.377	183.1368	182.9409	182.9703
177	183.4408	183.1596	183.4519	183.1639	183.1361	182.9377
177.9	183.5155	183.1866	183.5268	183.1909	183.5498	183.0482
178	183.5903	183.2137	183.6017	183.218	183.8809	183.1189
177.4	183.6651	183.2407	183.6767	183.245	183.7993	182.985
172.5	183.7399	183.2678	183.7517	183.2721	184.0283	183.0622
MSE	31.06534	27.96846	31.17312	28.00724	30.74445	26.26293*

*Lowest Mean Square Error (MSE) value is written in red

**Predicted Value (Using *in*(1+Retun))

John Keels Holdings

For the returns of John Keels Holdings, the best fitted Auto Regressive time series model is AR(1). The best fitted Moving Average time series model is MA (1) and the best fitted Autoregressive Integrated Moving average time series model is ARIMA(3,0,3).

Predicted stock prices using those returns have been compared with the actual values in Table 3.

Table 3: Comparison table of actual stock prices and predicted stock prices for John Keels Holdings

	AR(1)		MA(1)		ARIMA(3,0,3)	
Actual Price	Predicted Value	Predicted Value **	Predicted Value	Predicted Value **	Predicted Value	Predicted Value **

207	204.1103	204.3238	204.1263	204.3305	203.6233	204.1148
207	204.0662	204.2967	204.1509	204.333	203.7024	204.1444
205	204.0794	204.2943	204.1756	204.3355	204.4426	204.3932
204.9	204.1021	204.296	204.2002	204.338	205.2759	204.7356
208	204.1264	204.2984	204.2248	204.3405	205.5813	204.853
206.7	204.1509	204.3008	204.2494	204.343	205.1503	204.6597
207	204.1755	204.3033	204.274	204.3455	204.3603	204.3157
207.5	204.2001	204.3058	204.2986	204.348	203.8726	204.0969
205.5	204.2247	204.3083	204.3233	204.3505	204.0545	204.1677
204.9	204.2493	204.3108	204.3479	204.353	204.775	204.4681
MSE	6.086133	5.403312	5.717193	5.254595	5.321109	5.168861*

*Lowest Mean Square Error (MSE) value is written in red

**Predicted Value (Using *in*(1+Retun))

Conclusions, implications and significance

The accuracy of results can be increased by taking natural log values of the returns. As we consider the MSE values of each table we can see ARMA (1,0,1), ARIMA(4,0,4), ARIMA(3,0,3) are the best fitted models to forecast stock prices for Sampath Bank, Commercial Bank and John Keels Holdings respectively. If we use return values, we can see that there is no difference (integrated value). Therefore, we can conclude that an Autoregressive-Moving average (ARMA) model may be best fitted to forecast stock prices of the three companies.

These results could help investors to make profitable investment decisions. With the results obtained ARMA models can compete reasonably well with emerging forecasting techniques in short-term predictions.

As Sri Lanka's stock market is not much bigger, it is difficult to forecast stock prices by linear time series models with high accuracy. Also, other factors such as political influence play a considerable role in the stock market in Sri Lanka. In the future, we hope to analyse the same data using the non-linear time series models to examine whether the non-linear models fit better than linear models.

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