International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-12, October 2019

Prediction of Stock Price Movements using Monte Carlo Simulation

K.Nagarajan, J. Prabhakara

Abstract:*Monte Carlo Simulation depends on random behaviour of events. When a variable takes values at random and becomes highly unpredictable due to its nature of randomness, the property of random numbers is made use of for predicting the future values that the variable may take. This property can be made use of for predicting share price movements, when the past share prices exhibit random behaviour, without exhibiting high fluctuations. This article explains the methodology of using Monte Carlo Simulation for predicting share price movements and explains the process with the help of an illustration taking the monthly share price data of ITC Limited for a period of 36 months, where the share prices have moved within a narrow band. Findings of the analysis show that it works well and that the method of prediction is reasonably accurate, showing only a minor deviation from the actual prices.*

Keywords : *This property can be made use of for predicting share price movements,*

I. INTRODUCTION

a. Technical Analysis For Predicting Share Price Movements

Technical Analysis deals with different chart patterns with respect to share price movements and these well-known chart patterns help us in predicting the likely movement of share price in the immediate future period. However, when the past data do not show any discernible trend or pattern and when the past data have not moved very much away from the mean value, we get struck up in using Technical Analysis. In the absence of any distinct pattern in the stock price movements during the past, predicting the future price cannot be done relying on the standard patterns of stock price movements identified by the Technical Analysis.

II. MONTE CARLO SIMULATION

Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to randomness in the movement of values. It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models. When the value of a variable moves in such a way that it exhibits some pattern, prediction of its future movements become relatively easy. But, when the movement does not exhibit any predictable pattern and when it performs a random walk, prediction of future values becomes somewhat difficult and uncertain.

Revised Manuscript Received on October 30, 2019.
***** Correspondence Author
Dr.K.Nagarajan*, Professor, School of Management, Sri Krishna College of Engineering and Technology, Coimbatore
Mr. J. Prabhakaran, Assistant Professor, School of Management, Sri Krishna College of Engineering and Technology, Coimbatore

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license http://creativecommons.org/licenses/by-nc-nd/4.0/

Monte Carlo simulation comes to our rescue in such situations. It tackles the problem by relying on random numbers. Since a set of numbers that are randomly generated does not show any discernable pattern (provided the set of numbers really exhibits randomness), they can be used to arrive at a model for the prediction of future movements of the share price, when the share price takes a random walk around a mean value and when there are no major deviations from the mean value.

Monthly stock price movements of ITC Limited, a leading FMCG company in Indiafor 36 months from August 2014 to July 2017 of are given in the table below. (Table –I)

Table-I: Monthly stock price movements of ITC Limited

S.No.	Date	Closing	Opening	High	Low	Volume	%
1	13-Aug-2014	204.65	227.73	231.4	189.08	282.18M	-9.66%
2	13-Sep-2014	225.67	205.52	237.34	194.64	250.99M	10.27%
3	13-Oct-2014	222.09	225.64	236.08	214.13	200.43M	-1.59%
4	13-Nov-2014	212.41	220.86	221.43	204.02	179.22M	-4.36%
5	13-Dec-2014	213.37	212.78	214.8	203.89	197.52M	0.45%
6	14-Jan-2015	215.53	213.67	220.33	205.75	194.28M	1.01%
7	14-Feb-2015	217.22	213.9	220.1	206.44	146.70M	0.78%
8	14-Mar-2015	233.92	217.32	241.98	216.16	215.91M	7.69%
9	14-Apr-2015	225.90	234.36	236.01	223.22	169.96M	-3.43%
10	14-May-2015	226.57	226.13	256.9	221.79	238.96M	0.30%
11	14-Jun-2015	215.49	226.73	227.46	207.17	274.45M	-4.89%
12	14-Jul-2015	236.05	217.18	241.65	214.8	250.38M	9.54%
13	14-Aug-2015	235.55	236.01	239.89	226.43	127.29M	-0.21%
14	14-Sep-2015	245.43	237.34	251.86	230.91	190.22M	4.19%
15	14-Oct-2015	235.48	245.29	245.29	227.69	140.88M	-4.05%
16	14-Nov-2015	240.75	236.61	251.13	231.14	195.77M	2.24%
17	14-Dec-2015	244.43	240.09	265.38	236.74	234.40M	1.53%
18	15-Jan-2016	244.33	243.7	247.25	229.45	296.54M	-0.04%
19	15-Feb-2016	239.56	243.3	271.78	231.04	266.53M	-1.95%
20	15-Mar-2016	216.02	237.34	237.34	208.9	386.48M	-9.83%
21	15-Apr-2016	213.70	216.02	237.74	212.94	220.77M	-1.07%
22	15-May-2016	216.85	214.4	222.69	207.34	234.53M	1.47%
23	15-Jun-2016	208.93	215.79	221.26	194.91	222.42M	-3.65%
24	15-Jul-2016	216.12	209	217.05	198.89	170.96M	3.44%
25	15-Aug-2016	215.56	216.12	221.1	200.88	229.87M	-0.26%
26	15-Sep-2016	217.98	213.8	218.68	203.53	194.15M	1.12%
27	15-Oct-2016	221.86	216.82	238.53	216.65	193.88M	1.78%
28	15-Nov-2016	227.10	220.76	234.02	216.85	179.25M	2.36%
29	15-Dec-2016	217.32	228.85	231.87	205.88	233.78M	-4.31%
30	16-Jan-2017	212.28	217.18	218.11	200.61	190.59M	-2.32%
31	16-Feb-2017	196.00	211.25	216.09	177.67	274.32M	-7.67%
32	16-Mar-2017	217.62	202.2	222.89	202.2	353.00M	11.03%
33	16-Apr-2017	215.43	216.19	224.31	207.17	185.91M	-1.01%
34	16-May-2017	234.03	214.3	241.32	202.86	269.41M	8.63%
35	16-Jun-2017	245.60	235.33	247.8	230.43	229.84M	4.94%
36	16-Jul-2017	252.45	243.3	259.75	242.2	196.41M	2.79%

Changes in the share price in a particular month with respect to the price in the previous month are shown in the last column of the table. An observation of the table values indicate that the share price moves at random, but within a narrow band. The closing price values in the table show that there is no predictable pattern and the monthly price movements are at random. Moreover, the deviations from the mean value are minimum. Such a situation is ideal for the use of Monte Carlo simulation for predicting the likely movement of share price in the future.

The monthly stock price movements are plotted and given in Fig. – I below:

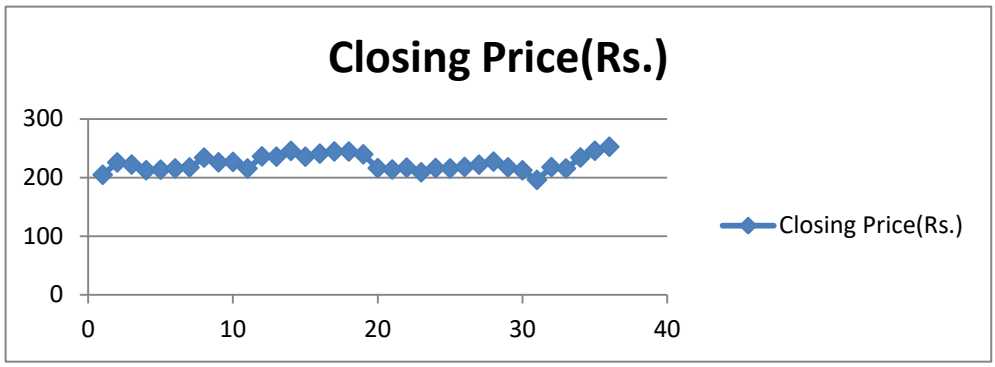

Fig.- I: Plot showing monthly stock price movements of ITC Limited for a period of 36 months

As seen from the plot, the price movements are at random, but the movements are closer to the mean value. The movement above and below the mean value are fairly equal. The mean value of the share price over a period of 36 months is found to be Rs. 224.42 (Mean of closing prices). The highest deviation above and below the mean value is only about 12%, Rs. 256.45 being the highest price and Rs. 196.00 being the lowest price. The remaining price movements fluctuate within 5% to 10% band above and below the mean value. Such a price movement is ideal for using Monte Carlo Simulation for the prediction of future share price movements.

Out of the closing prices available for 36 months from August 2014 to July 2017, the prices for the first 24 months (August 2014 to July 2016) are taken as the past data and Monte Carlo Simulation is used to predict the closing share prices of the remaining 12 months (from August 2016 to July 2017). The simulated closing prices arrived at for the 12 months periods from Aug. 2016 to July 2017 using Monte Carlo Simulation are compared with the actual closing price values for the corresponding periods.

Table – II: The related calculations for carrying out the simulation process.

S. No	Closing Price (arranged in increasing order)	Relative frequency (or) Probability	Cumulative Probability	% Cumulative Probability	% Cumulative Probability (Rounded off to an integer)	Two-digit Tag Number
1	196.00	0.04166	0.04166	4.166	4	00-03
2	204.65	0.04166	0.08332	8.332	8	04-07
3	208.93	0.04166	0.12498	12.498	12	08-11
4	212.28	0.04166	0.16664	16.664	17	12-16
5	212.41	0.04166	0.20830	20.83	21	17-20
6	213.37	0.04166	0.24996	24.996	25	21-24
7	213.70	0.04166	0.29162	29.162	29	25-28
8	215.43	0.04166	0.33328	33.328	33	29-32
9	215.49	0.04166	0.37494	37.494	37	33-36
10	215.53	0.04166	0.41660	41.66	42	37-41
11	215.56	0.04166	0.45826	45.826	46	42-45
12	216.02	0.04166	0.49992	49.992	50	46-49
13	216.12	0.04166	0.54158	54.158	54	50-53
14	216.85	0.04166	0.58324	58.324	58	54-57
15	217.22	0.04166	0.62490	62.49	62	58-61
16	217.32	0.04166	0.66656	66.656	67	62-66
17	217.62	0.04166	0.70822	70.822	71	67-70
18	217.98	0.04166	0.74988	74.988	75	71-74
19	221.86	0.04166	0.79154	79.154	79	75-78
20	222.09	0.04166	0.83320	83.32	83	79-82
21	225.67	0.04166	0.87486	87.486	87	83-86
22	225.90	0.04166	0.91652	91.652	92	87-91
23	226.57	0.04166	0.95818	95.818	96	92-95
24	227.10	0.04166	0.99984	99.984	100	96-99

Note: Table-II shows the closing prices for 24 months arranged in an increasing order. The probability of occurrence of each share price is calculated and given in the third column. Since no share price has occurred more than once, the probability of all the 24 share prices works out to the same, viz., 0.04166 (1/24 = 0.4166).

Cumulative probabilities and percentage cumulative probabilities are worked out and the percentage cumulative probability against each share price is rounded off to the nearest integer. As we are going to use a set of two-digit random numbers for simulation (i.e., random numbers in the range 00 to 99), Tag numbers are assigned for each share price and given in the last column of the table.

For simulating the share price movements for the following 12 months (from Aug. 2016 to July 2017), 12 two-digit random numbers are chosen and entered in as shown in Table-III. Against each random number, the corresponding Tag number band is located referring to Table-I and entered in Table-III. The simulated price for the 12 months is read from Table-I, by matching the Tag Number band with Table-I. For example, the first random number of 19 falls in the band of 17-20. Referring to Table-I, corresponding to the Tag Number band of 17-20, the closing price of share is Rs. 212.41, which is entered in table-III against Aug. 2016. On similar lines, the remaining share prices for the period from Sep. 2016 to July 2017 are simulated and entered in Table-III. As against the simulated prices for the twelve months, the actual closing prices of the share are marked in the last column of Table-III.

Table – III : Simulated vs. Actual price for 12 months

S. No	Month	Two Digit Random	Tag Number	Simulated	Actual monthly
1	Aug. 2016	19	17-20	212.41	215.56
2	Sep. 2016	70	67-70	217.62	217.98
3	Oct.2017	86	83-86	225.67	221.86
4	Nov. 2016	30	29-32	215.43	227.10
5	Dec.2016	42	42-45	215.56	217.32
6	Jan.2017	41	37-41	215.53	212.28
7	Feb.2017	92	92-95	226.57	196.00
8	Mar.2017	10	08-11	208.93	217.62
9	Apr.2017	21	21-24	212.41	215.43
10	May 2017	57	54-57	216.85	234.03
11	June 2017	25	25-28	213.70	245.60
12	July 2017	95	92-95	226.57	252.45

III. COMPARISON OF THE SIMULATED PRICE WITH THE ACTUAL PRICE

Simulation is done to understand how a variable will behave in the future and to forecast accordingly the future values of the variable. However, since past data for 36 months are available, the first 24 months data are used for predicting the next 12 month values. The predicted (simulated) values are compared with the actual prices and the accuracy of the prediction is studied, which is shown in the calculations below:

S.No.	Simulated Price	Actual Price
1	212.41	215.56
2	217.62	217.98
3	225.67	221.86
4	215.43	227.10
5	215.56	217.32
6	215.53	212.28
7	226.57	196.00
8	208.93	217.62
9	212.41	215.43
10	216.85	234.03
11	213.70	245.60
12	226.57	252.45
Average Price:	**217.27**	**222.77**
Standard Deviation:	5.898504	15.25593
% Deviation in between the simulated and actual prices in a span of 12 months (Based on the mean values)	$\frac{(222.77 - 217.27)}{217.27} \times 100$ =2.53%	

.

IV. CONCLUSION

Prediction of share prices through Technical Analysis relies more on the past behaviour pattern of share prices. It is especially helpful for predicting share price movements over long term. When the share price movements do not exhibit any discernable pattern, when the fluctuations in the share price movements are very small and when the share price makes a random walk around the mean,
the property of randomness can be made use of and Monte Carlo Simulation, which relies on random numbers, can be made use of for future prediction of share price movements. The illustration given in this article shows that prediction using Monte Carlo Simulation works really well, as evidenced by the smaller deviation of only 2.53% between the mean values of the simulated and actual prices in a period of 12months. Thus, when we need a tool for predicting the share price movements during short intervals of time (months, weeks etc.) and when the past behaviour of share prices does not indicate high fluctuations, Monte Carlo Simulation can be used as a reasonably reliable tool.

REFERENCES

1. Nick T. Thomopoulos, 'Essentials of Monte Carlo Simulation', Springer, 2012
2. Malvin H. Kalos and Paula A. Whitlock, 'Monte Carlo Methods', John Wiley & Sons, 2008
3. Robert D. Edwards, W.H.C. Bassetti, John Magee, 'Technical Analysis of Stock Trends', CRC Press, 2013
4. Adam Grimes, The art and Science of Technical Analysis', John Wiley & Sons, 2012

AUTHORS PROFILE

Prof. Dr. Nagarajan, is a Post Graduate in Structural Engineering and Post Graduate in Business Administration, with a Doctorate in Management. He is also a Certified Associate of the Indian Institute of Bankers (CAIIB). He served in the Tamilnadu Industrial Investment Corporation Limited, which is a Government sponsored State Financial Corporation, in various managerial capacities for about three decades and is in academia for the past eight years. He is the author of nine books in Business Management and allied subjects which are popular among the student community. He has contributed over 30 articles in reputed national and international journals.

J.Prabhakaran, has graduated in B.Sc. Computer Technology from PSG College of Technology – 2010, obtained his post graduatation in Business Administration with specialization in Finance and Human Resource in 2012, M.Sc. Applied Psychology in 2016 from Bharathiar University. He obtained M.Phil. degree in Management in Karpagam Academy of Higher Education in 2017, He is pursuing Ph.D. in Management in Bharathiar University with specialization in Finance, has submitted his thesis and is awaiting examination. He has academic experience of 7 years. He has effectively guided more than 80 MBA projects. He has presented 9 research papers in National Conferences, 8 research papers in International Conferences.. He made 8 Journal Publications and 2 Book Publications.