DETERMINATION OF THE BEHAVIOUR OF MARKET VALUE OF SHARES THROUGH SIMULATION TECHNIQUES

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ABSTRACT

Market value of a Share is very sensitive and is affected by many concomitant variables like Fiscal policies of Governments, Financial position of the Company, Demand & supply position, Bark rate, National & International political scenario, Industrial relations, Trade cycles, Climatic conditions, Natural calamities, like floods, draughts, earthquakes and so on. Thus determination of Market value of a share is complex problem and many variables are to be studied at a time, which are changing at different time points, hence Market value of a share is a stochastic variable and model proposed should include many influencing variables and solutions to such models are complicated. To overcome this difficulty an easiest method to should 'The behavior of Market Value of a Share through Simulation Techniques' is proposed in this paper.
Keywords: Stochastic variable, Simulation techniques, Market value of a Share, Generation of Random numbers.
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INTRODUCTION:

Market value of a share plays a vital role in Market Research and it is common interest of every investor, where to invest to get optimum dividends/returns. Even though Share Market has attractive returns but involves many risk factors. Hence a common investor has to think twice before investing in Share Market. Thus there is a necessity to study the behavior of Market value of a Share through sophisticated Statistical techniques. Since the Market value of a Share is a stochastic variable(changes along with the time 't') based on many interrelated variables, like Fiscal policies of Governments, Bank rate of interest, National & International political scenario, Financial position of a Company, Climatic conditions and natural calamities like floods, draughts, epidemics, earthquakes and so on. Hence modeling the Market value of Share involves lot of complexity and obtaining solutions to such models will be complicated. To overcome this difficulty there is a necessity to introduce simple and less complex Statistical methods. Simulation[1] is one such techniques which gives solutions to such problems what are required to simulated system is the art of generating 'Random Numbers'. In the present paper a Markov Chain model [2-4] is applied to simulate the future behavior of each Company share. For this purpose we collected values of Companies Infosys Ltd., Tata Consultancy Services Ltd., and Reliance Industries Ltd., from 1st November 2012 to 13October 2014 on daily basis. Next to apply χ^2 –test for testing validity. For ready reference transition frequency matrices are calculated by using the data 14th October -2014 to 19th December 2014 for different companies under consideration on working days in BSE.

APPROACH

First we propose a Markov Chain model for the daily market values of the company shares under consideration and *transition frequency matrices* are formed for these company shares. Then simulate the behavior of each Company share by using Monte-Carlo simulation technique. For applying Markov Chain model we define the following three states namely,

State"-1"represents a decrease in the Market value of the share from i^{th} *day to* $(i+1)^{th}$ *day* .

State"0" represents no change in the Market value of the share from i^{th} *day to* $(i+1)^{th}$ *day* .

State"1"represents an increase in the Market value of the share from i^{th} *day to* $(i+1)^{th}$ *day* .

Thus we obtain frequencies of '9' transitions expressed in the form (3×3) matrix as follows:

$$M = \begin{array}{c} \\ From \\ \\ \end{array} \begin{array}{c} \begin{array}{ccc} & To & \\ -1 & 0 & 1 \end{array} \\ \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \end{array} \begin{array}{c} \\ -1 \\ 0 \\ 1 \end{array}$$

Where a_{ij} represents number of transitions from state 'i' to state 'j' in the data collected.

Table 1: Frequencies of different transitions under study

S.No.	Transitions	Explanation
1	$-1\,to\,-1$	Two consecutive decreasing days in the Share Prices.
2	$-1\,to\,0$	Previous day a decreased and the next day maintain the same price.
3	$-1\,to\,1$	A decrease in the previous day and an increase in the next day.
4	$0\,to\,-1$	No change in the previous day and a decrease in the next day
5	$0\,to\,0$	No change in both days.
6	$0\,to\,1$	No change in the previous day and an increase in the next day.
7	$1\,to\,-1$	An increase in the previous day and a decrease in the next day.
8	$1\,to\,0$	An increase in the previous day and no change in the next day.
9	$1\,to\,1$	Two consecutive increasing days in the Share Prices.

Now a *Simulation Model* is proposed to study the future behavior of these company shares under consideration after forming the transition frequency matrices for each Company Share. For applying Simulation model we simulate the future behavior of each Company Share by using Monte-Carlo Simulation Technique is as follows:

Monte-Carlo Simulation Technique:

- Count the frequency for different transitions to be simulated
- Determine the probability distribution for each transition in step 1 and establish the cumulative distribution function.
- Set up the table and assign tag numbers, with the help of cumulative distribution function.
- Generate random numbers and choose the corresponding tag number. Then select the variable value corresponding to the tag number.

- Generate random numbers at many numbers of trials (given in the problem) and compute the values for different trials. The optimal solution will be the average values of different trials.

Now these simulated results are compared with actual daily Market values then to apply χ^2 –test for testing validity.

IMPLEMENTATION

Using the data on daily market Value of different Company Shares from 1st November 2012 to 13October 2014 the three states, namely $'-1','0','1'$ are identified and counting the number of transitions from different state to state are have the following (3×3) frequency matrices for each Company under consideration.

$$M_{INF} = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 109 & 2 & 110 \\ 2 & 0 & 3 \\ 110 & 3 & 141 \end{pmatrix} \end{array} \qquad M_{TCS} = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 96 & 2 & 119 \\ 1 & 0 & 4 \\ 120 & 3 & 135 \end{pmatrix} \end{array} \qquad M_{REL} = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 120 & 2 & 115 \\ 3 & 0 & 2 \\ 114 & 3 & 121 \end{pmatrix} \end{array}$$

In order to simulate the future behavior of the above Company Shares, we compute probability distribution, cumulative probabilities and ranges of Random Numbers for the three Companies are given by the following tables:

Table 2: Empirical Probability Distribution and Ranges for Random Numbers for Infosys Ltd., Company.

State from---to	Frequency	Probability	cumulative probability	Range of Random numbers
-1' to '-1'	109	0.2271	0.2271	0000-2270
-1 to 0	2	0.0042	0.2313	2271-2312
-1' to 1	110	0.2292	0.4605	2313-4604
0 to '-1'	2	0.0042	0.4647	4605-4646
0 to 0	0	0.0000	0.4647	-
0 to 1	3	0.0062	0.4709	4647-4708
1 to '-1'	110	0.2292	0.7001	4709-7000
1to 0	3	0.0062	0.7063	7001-7062
1 to 1	141	0.2937	1	7063-9999
Total	480			

Table3: Empirical Probability Distribution and Ranges for Random Numbers for TCS Company.

State from—to	Frequency	Probability	cumulative probability	Range of Random numbers
-1' to '-1'	96	0.2000	0.2000	0000-1999
-1 to 0	2	0.0042	0.2042	2000-2041
-1' to 1	119	0.2479	0.4521	2042-4520
0 to '-1'	1	0.0021	0.4542	4521-4541
0 to 0	0	0.0000	0.4542	-
0 to 1	4	0.0083	0.4625	4542-4624
1 to '-1'	120	0.2500	0.7125	4625-7124
1to 0	3	0.0062	0.7187	7125-7186
1 to 1	135	0.2813	1	7187-9999
Total	480			

Table 4: Empirical Probability Distribution and Ranges for Random Numbers for the Company Share Reliance Industries Ltd.

State from---to	Frequency	Probability	cumulative probability	Range of Random numbers
-1' to '-1'	120	0.2500	0.2500	0000-2499
-1 to 0	2	0.0042	0.2542	2500-2541
-1' to 1	115	0.2396	0.4938	2542-4937
0 to '-1'	3	0.0062	0.5000	4938-4999
0 to 0	0	0.0000	0.5000	-
0 to 1	2	0.0042	0.5042	5000-5041
1 to '-1'	114	0.2375	0.7417	5042-7416
1to 0	3	0.0062	0.7479	7417-7478
1 to 1	121	0.2521	1	7479-9999
Total	480			

For comparison of the future behavior of different Companies through Simulated Results two sets of Random numbers are generated. We have generated 44 Random numbers by using MS-Excel in each set because we have 44 working days for Stock Market from 14th October -2014 to 19th December 2014 are given below:

SET-I:

6578,7337,4572,3437,6916,326,6466,8445,7363,8851,2791,4091,3424,3801,9723,7652,3537,2577,

1627,9626,4807,3427,7452,7963,7466,4511,1878,5498,5414,1523,1316,6836,5170,1868,5510,562,5734,

584,4630,805,2440,7464,495,4181

SET-II

5894,2538,7654,8195,316,5779,394,9583,2135,9403,6824,7978,6823,6005,8807,8455,4813,2538,

8896,9913,3693,2670,3080,5795,1052,9561,5011,9219,9353,5836,1621,1013,989,2627,9237,7721,6106,

493,1966,1094,5454,7555,9416,6406.

Now these simulated results are compared with actual daily Market values for different companies under consideration. For ready reference transition frequency matrices are calculated by using the data 14th October -2014 to 19th December 2014 for above companies are as follows:

$$M_{INF} = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 15 & 0 & 9 \\ 0 & 0 & 0 \\ 8 & 0 & 12 \end{pmatrix} \end{array} \qquad M_{TCS} = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 10 & 0 & 11 \\ 0 & 0 & 0 \\ 10 & 0 & 13 \end{pmatrix} \end{array} \qquad M_{REL} = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 13 & 2 & 8 \\ 0 & 0 & 2 \\ 10 & 0 & 9 \end{pmatrix} \end{array}$$

The value of χ^2 for actual transition frequencies and simulated transition frequencies for different company shares along with critical value are given below:

Null Hypothesis (H_0): There is no significant difference between for actual transition frequencies and simulated transition frequencies.

i.e., The Markov Chain model is the best fit.

Infosys Ltd.			TCS Ltd.			Reliance Industries Ltd.		
O	S1	S2	O	S1	S2	O	S1	S2
15	10	10	10	10	9	13	11	10
0	0	0	0	0	0	2	0	2
9	12	6	11	12	7	8	13	5
0	1	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	2	0	1
8	10	12	10	10	12	10	11	10
0	0	0	0	0	0	0	3	0
12	11	16	13	11	16	9	6	16
	χ^2=4.22	χ^2=6.33		χ^2=0.67	χ^2=3.29		χ^2=5.34	χ^2=6.48
$\chi^2_{0.05}$=7.815 for 3 degree of freedom								

Here 'O' denote observed frequencies and 'S' denote simulated frequencies.

From the above table calculated value of χ^2 in two sets for each company is less than its corresponding critical value at 5% level of significance. Hence we conclude that there is no significant difference between simulated transitions frequencies and actual transition frequencies i.e., the Markov Chain model is the best fit for the company shares Infosys Ltd., Tata Consultancy Service Ltd., and Reliance Industries Ltd.

Results and Discussion

Based on the calculated values of χ^2 with corresponding critical values of χ^2, we accept Null hypothesis in all the three cases and conclude that our simulated results using '2' sets of Random numbers are close to the actual results for the Company shares considered in this paper. Similar type of exercise can be extended to other Company Shares can be predicted. This type of analysis will help a lot to common investor to take appropriate and more beneficial decisions before the investment in the Share Market.

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