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A stochastic analysis of stock price variation assessments in Oando Nigeria, Plc

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Abstract

This paper applied stochastic analysis of Markov chain in the closing stock price data of Oando Nigeria Plc (2017-2021). The stock prices were transformed into 3-steps transition probability matrix solution for each independent year. The criteria of obtaining future stock price changes of the year were considered. From the analytical solution of stochastic analysis, showed that the closing stock price of 2017 has the highest mean rate of returns and growth rates respectively: 2.4112 and 69%. Also stock prices of 2018 has the best probability of price not changing in the near future: 26% , which is a guide to investor for proper decision making. In all, the impact of future price changes were assessed which shows various levels of pricing effects on the aspect of percentage increase and decrease as it affects the original prices, Oando Nigeria PLC is profit making organization, hence the growth rates are all indexed in millions of naira.

Keywords: stock prices; stochastic analysis; Markov chain; Oando Nigeria Plc

1 Introduction

Stock market prices are highly violated; hence they are highly affected by some unforeseen circumstances. For instance, the rise and fall of dollar exchange rate political crisis and flooding etc . The impact of the activities can result to unstable nature of stock market price which causes panic buying of goods and services. So, it is worth developing a mathematical model which can enhance realistic result for the purpose of practical findings. Therefore, Markov chain is adopted to examine the closing stock price of Oando Nigeria Plc; since stock price is a formation of stochastic process. The stochastic analysis of these data of Oando Plc will aid investors to find prospects on the independent years of stock prices throughout the trading days.

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Nevertheless, a lots scholar has written extensively on the modeling stock price using Markov chain and results obtained in various ways. For instance, [8] examined stock market prices due to its fluctuations and influences in financial lives and economic health of a country. Their findings showed that stock price is a random work and no investor can alter the fairness and unfairness of a stock price as defined by expectation. [12] studied Markov process of stock market performance. In their result oil, India exhibits a higher chance of being stable with no significant increase or decrease. [9] considered Markov chain model on share price movement. Result showed GT Bank shares change hands more than the FB Bank. [2] examined the Markov chain model on forecasting of stocks prices in Nigeria. In their result Markov chain model was determined based on probability transition matrix. [4] Explored the stochastic analyses of Markov chain in finite states. Their work replicated the use of 3-states transition probability matrix which enables them to proffer precise condition of obtaining expected mean rate of return of each stock. ,[13] considered stochastic analysis of share prices. Results showed precise condition of determining expected mean return time for stock price; improving investment decision based on highest transition probabilities. In the same manner, [5] studied the behavior of stock market using Markov chain. The study reveals that regardless of bank's current share price steady state probabilities of share price remain the same all through the iteration. [8] Studied long run prospects of security prices in Nigeria where the data were collected from the randomly selected banks from the banking sector of Nigeria. The analysis suggested that the price level of Nigerian bank were likely to remain relatively stable in the long run irrespective of the current situations.[14] examined the long run behavior of the closing price of shares of eight Nigerian banks using Markov chain model. They computed limiting distribution transition probability matrix of the of share price and found that despite of the current situation in the market there is hope for Nigerian bank stocks. It was concluded that the results derive from the study will be useful to investors.

More so, because of unstable nature of stock price movements; which can be linked as stochastic processes. Therefore, the method of Markov chain was used to study the closing stock prices of Oando Nigeria plc for the period of 2017-2021. The stock price data replicated 3-states transition probability matrix solution for each independent year and the last three months of each year were used as row vector to determine the future stock price changes. From the analytical solution of stochastic analysis the mean rate of returns, growth rates and other price changes were considered. This paper extends the [5] by assessing the investment of Oando Nigeria independently for the period of (2017-2021), stating the future stock price changes and their investments growth rates of different years.

This paper is aimed at presenting transitions probability matrix solution of Oando Nigeria PLC for five independent states, to obtain the expected mean rate of returns, Growth rates, and the transition probability future changes of stock prices.

This paper is arranged: section 2 presents mathematical preliminaries, the problem formulation is seen in subsection 2.1, Results are pressed in section 3 and the paper is concluded in section 4.

2 Mathematical preliminaries

A stochastic process $X(t)$ is a relations of random variables $\{X_t(\gamma), t \in T, \gamma \in \Omega\}$, i.e, for each t in the index set T, $X(t)$ is a random variable. Now we understand t as time and call $X(t)$ the state of the procedure at time t. In view of the fact that a stochastic process is a relation of random variables, its requirement is similar to that for random vectors.

It can also be seen as a statistical event that evolves time in accordance to probabilistic laws. Mathematically, a stochastic process may be defined as a collection of random variables which are ordered in time and defines at a set of time points which may be continuous or discrete.

Definition 1: A stochastic process X is said to be a Markov chain if Markov property is satisfied:

$$P(X_{n+1} = j / X_0, X_1, \cdots, X_n) = P(X_{n+1} = j / X_n) \quad (1.1)$$

For all $n \geq 0$ and $i, j \in S$ (state space) .

It is sufficient to know that the Markov property given (1.1) is equivalent to easy of the following for each $j \in S$.

$$P(X_{n+1} = j / X_{n1}, X_{n2}, \cdots, X_{nk}) = P(X_{n+1} = j / X_{nk}) \quad (1.2)$$

(for any $n_1 < n_2 <, \cdots, n_k \leq n$).

Assuming $X_n = i$ implies that the chain is in the ith state at the nth step.it can also be said that the chain' having the value i' or ' being in state i'. The idea behind the chain is described by its transition probabilities:

$$P(X_{n+1} = j / X_n = i). \quad (1.3)$$

They are dependent on i, j and n.

Definition 2: The chain X is said to be homogeneous if the following are stated below

$$P(X_{n+1} = j / X_n = i) = P(X_1 = j / X_0 = i) \quad (1.4)$$

for all n, i, j.

The transition matrix $\mathrm{P} = (P_{ij})$ is $n \times n$ matrix of transition probabilities.

$$P_{ij} = P(X_{n+1} = j / X_n = i) \quad (1.5)$$

Hence, the transition probabilities with homogenous Markov chain are always stationary at a point.

Theorem 1: Suppose P is a stochastic matrix which implies the following:

i) P has non-negative entries or $\mathrm{P}_{ij} \geq 0$

(ii) $\sum_j P_{ij} = \sum_j P\left(X_{n+1} = j / X_n = i\right) = \sum_j P\left(X_1 = j / X_0 = i\right)$

which is stationarity or point of convergence.

Proof:(i) each associated entry in P is a transition probability P_{ij} and being probability $P_{ij} \geq 0$.

(ii) $\sum_j P_{ij} = \sum_j P\left(X_{n+1} = j / X_n = i\right) = \sum_j P\left(X_1 = j / X_0 = i\right)$

which is stationarity.

$P\left(X_i \in S / X_0 = i\right) = 1.$

Theorem 2 :(Chapman-Kolmogorov Equations).

$P_{ij(m+n)} = \sum_{r=i}^{n} P_{ir(m)} P_{rj(n)}$ Since $\mathrm{P}_{m+n} = \mathrm{P}_m \mathrm{P}_n$ and so on $\mathrm{P}_n = \mathrm{P}^n$ the *nth* power of P .

Proof:

$$
\begin{aligned}
P_{ij(m+n)} &= P\left(X_{m+n} = j / X_0 = i\right) \\
&\sum_r P\left(X_{m+n} = j, X_m = r / X_0 = i\right) \\
&\sum_r P\left(X_{m+n} = j / X_m = i / X_0 = i\right) P\left(X_m = r / X_0 = i\right)
\end{aligned}
$$

Using the following in probability rule:

$P\left(A \cap B / C\right) = P\left(A / B \cap C\right) P\left(B / C\right)$ and setting

$A = \left\{X_{m+n} = j\right\}, \mathrm{B} = \left\{X_m = r\right\}, \text{and } \mathrm{C} = \left\{X_0 = i\right\}$.

Using Markov property yields

$$
\begin{aligned}
P_{ij(m+n)} &= \sum_r P\left(X_{m+n} = j / \mathrm{X}_m = r\right) P\left(X_m = r / \mathrm{X}_0 = i\right) \\
&\sum_r P_{rj(n)} P_{ir(\mathrm{m})} \\
&\sum_r P_{1r(\mathrm{m})} P_{r1(\mathrm{n})}
\end{aligned}
$$

Hence $\mathrm{P}_{m+n} = \mathrm{P}_m \mathrm{P}_n$ and so $\mathrm{P}_n = \mathrm{P}^n$, the power *of* P.

2.1 Problem formulation

let $S_i(\mathrm{t})\ (i=1,2,...,N, t=1,2,...,n)$ be the of daily closing stock prices in naira of five different selected years of Oando'S $i-th$ asset at time t be defined as three state Markov processes in finite states. Let $N \times n$ data matrix associated with $S_i(t)\ be\ X_{it}$. We consider N closing prices over n months, time horizon. For each X_{it} we use the last three closing stock prices of each year (0ct.-Dec.) as row vector which measures the change in stock prices at time t ,where $t=0,1,2,\cdots,N$ and t is measured in weekly intervals, $t \in$. Therefore, the vector is defined such that

$$\theta_{0it} = \left(\theta_{i01}, \theta_{0i2}, \theta_{0i2}, \cdots, \theta_{0in}\right) \quad (1.6)$$

To obtain an estimate of the transition probability as follows

$$P_{ij} = P\left(X_t = j / X_{t-1} = i\right),\ for\ \ j = 0,1,2,3,\cdots,N$$

$$P_{ij} = \begin{cases} P \text{ if } \ j = 1 + j \\ q = 1 - P \text{ if } \ j = i - j \\ 0 \ \text{ otherwise} \end{cases}$$

where $k+1$ is the number of states.

$$\left.\begin{aligned} n_{ij} &= \sum_{i=1}^{n} P_{ij} \ \text{ for i j=0,2,3} \\ &\frac{n_{ij}}{n_i} \ \text{for } i\ j = 0,1,\cdots k \end{aligned}\right\} \qquad (1.7)$$

However, for $k=3$ is an estimate of the transition matrix.

$$\hat{P}ij(\text{Oando})_{2017-2021} = \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{03} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{22} \end{pmatrix} \qquad (1.8)$$

Setting $i\ \ j = 0,1,2$ for $k = 3$

$$\hat{P}_{ij}(\text{Oando:price changes}) = \begin{pmatrix} B_{11} & B_{12} & B_{13} \end{pmatrix} \begin{pmatrix} \hat{P}_{00} & \hat{P}_{01} & \hat{P}_{02} \\ \hat{P}_{10} & \hat{P}_{11} & \hat{P}_{12} \\ \hat{P}_{20} & \hat{P}_{21} & \hat{P}_{23} \end{pmatrix} = \begin{pmatrix} \phi_{11} & \phi_{12} & \phi_{13} \end{pmatrix} \qquad (1.9)$$

Assuming X_t has state space and transition probability matrix of (1.9) becomes

$$\hat{P}=\begin{pmatrix}\beta_1 & \phi & \theta\\ 1-\phi & \beta_2 & 1-\alpha\\ 1-\theta & \alpha & \beta_3\end{pmatrix}. \tag{1.10}$$

Also from where the transition matrices of independent years of Oando Nigeria, PLC is derived. Following the method of [5] The best three prices are chosen in terms of minimum value criterion

$$\left.\begin{aligned}\beta_1 &= \min\left(\alpha_1,\alpha_2,...,\alpha_n\right)\\ \beta_2 &= \min\left(\phi_1,\phi_2,...,\phi_n\right)\\ \beta_3 &= \min\left(\varphi_1,\varphi_2,...,\varphi_n\right)\end{aligned}\right\} \tag{1.11}$$

Thus each minimum value will be used as estimates, in order to determine the value of an economic asset such as stock; consideration should be made to identify some aspect of random variability which is the expected rate of returns and price of the underlying asset, [1]. Hence to determine the expected rate of returns for each stock for the period of trading days the following are defined as

$$\left.\frac{1-\phi}{\beta_1},\frac{1-\theta}{\beta_2}\ \text{ and }\ \frac{1-\alpha}{\beta_3}\right\} \tag{1.12}$$

However, the Growth rates of Oando Nigeria PLC were determined by considering the maximum and minimum value of each closing stock prices of associative years denoted as $S_N(t)$, $S_N(t)$ respectively. Therefore, we define Growth-rates, GR_t as:

$$GR_t=\frac{S_M(\mathrm{t})-S_N(t)}{S_M(\mathrm{t})}\times 100\% \quad (1.13).$$

From (1.9) the behavior of stock market, each is categorized as no-change in price, increasing in price and price decrease in near future. Also the impact of percentage increase and decrease of (1.9) were determined.

3 Analysis and results

To demonstrate the closing stock market price performance of Oando investments in finite states using Markov chain model. The daily prices covers from 2017-2021 retrievable from Nigeria Stock Exchange (NSE). From Jan.-Sept. of each year were used to form transition probability matrix while from Oct.-Dec. of each year were used to form a row vectors all for both companies.
Therefore, the 3-Step transition probability matrix and row vector of Onando Nigeria, PLC-2017.

$$Pij - 0\text{ando}_{(2017)} = \begin{pmatrix} 0.3503 & 0.3107 & 0.3390 \\ 0.3398 & 0.3582 & 0.3021 \\ 0.3727 & 0.3239 & 0.3034 \end{pmatrix}, V_{3:(2017)} = \begin{pmatrix} 6.01 & 5.98 & 5.94 \end{pmatrix}$$

$$Pij - 0\text{ando}_{(2017-\text{Price Changes})} = \begin{pmatrix} 6.01 & 5.98 & 5.94 \end{pmatrix} \begin{pmatrix} 0.3503 & 0.3107 & 0.3390 \\ 0.3398 & 0.3582 & 0.3021 \\ 0.3727 & 0.3239 & 0.3034 \end{pmatrix} = \begin{pmatrix} 4.5591 & 4.4144 & 4.5328 \end{pmatrix}$$

The 3-Step transition probability matrix and the row vector Onando Nigeria, PLC-2018

$$Pij(\text{Onando})_{(2018)} = \begin{pmatrix} 0.3562 & 0.2762 & 0.3676 \\ 0.2467 & 0.3979 & 0.3554 \\ 0.3576 & 0.3056 & 0.3368 \end{pmatrix}, V_{3:(2018)} = \begin{pmatrix} 5.01 & 3.79 & 4.7 \end{pmatrix}$$

$$Pij(\text{Onando})_{(2018-\text{Price Changes})} = \begin{pmatrix} 5.01 & 3.79 & 4.7 \end{pmatrix} \begin{pmatrix} 0.3562 & 0.2762 & 0.3676 \\ 0.2467 & 0.3979 & 0.3554 \\ 0.3576 & 0.3056 & 0.3368 \end{pmatrix} = \begin{pmatrix} 4.5591 & 4.4144 & 4.5328 \end{pmatrix}$$

The 3-Step transition probability matrix and the row vector Onando Nigeria, PLC-2019

$$Pij(\text{Onando})_{(2019)} = \begin{pmatrix} 0.3263 & 0.3338 & 0.3340 \\ 0.2645 & 0.3881 & 0.3474 \\ 0.3846 & 0.3293 & 0.2861 \end{pmatrix}, V_{3:(2019)} = \begin{pmatrix} 5.99 & 5.99 & 5.99 \end{pmatrix}$$

$$Pij(\text{Onando})_{(2019-\text{Price Changes})} = \begin{pmatrix} 5.99 & 5.99 & 5.99 \end{pmatrix} \begin{pmatrix} 0.3263 & 0.3338 & 0.3340 \\ 0.2645 & 0.3881 & 0.3474 \\ 0.3846 & 0.3293 & 0.2861 \end{pmatrix} = \begin{pmatrix} 5.9547 & 5.9900 & 5.9900 \end{pmatrix}$$

The 3-Step transition probability matrix and the row vector Onando Nigeria, PLC-2020

$$Pij(\text{Onando})_{(2020)} = \begin{pmatrix} 0.3333 & 0.3333 & 0.3333 \\ 0.4268 & 0.2972 & 0.2760 \\ 0.4923 & 0.3292 & 0.3138 \end{pmatrix}, V_{3:(2019)} = \begin{pmatrix} 5.45 & 4.7 & 5.00 \end{pmatrix}$$

$$Pij(\text{Onando})_{(2020-\text{Price Changes})} = \begin{pmatrix} 5.45 & 4.7 & 5.00 \end{pmatrix} \begin{pmatrix} 0.3333 & 0.3333 & 0.3333 \\ 0.4268 & 0.2972 & 0.2760 \\ 0.4923 & 0.3292 & 0.3138 \end{pmatrix} = \begin{pmatrix} 5.0495 & 5.1029 & 5.7993 \end{pmatrix}$$

The 3-Step transition probability matrix and the row vector Onando Nigeria, PLC-2021

$$Pij(\text{Onando})_{(2021)} = \begin{pmatrix} 0.2983 & 0.3616 & 0.3401 \\ 0.3768 & 0.3333 & 0.2899 \\ 0.3246 & 0.3421 & 0.3333 \end{pmatrix}, V_{3:(2021)} = \begin{pmatrix} 3.31 & 3.75 & 4.00 \end{pmatrix}$$

$$Pij(\text{Onando})_{(2021-\text{Price Changes})} = \begin{pmatrix} 3.31 & 3.75 & 4.00 \end{pmatrix} \begin{pmatrix} 0.2983 & 0.3616 & 0.3401 \\ 0.3768 & 0.3333 & 0.2899 \\ 0.3246 & 0.3421 & 0.3333 \end{pmatrix} = \begin{pmatrix} 3.7038 & 3.6567 & 3.6905 \end{pmatrix}$$

Company	p_{00} β_1	p_{01} ϕ	p_{02} θ	p_{10} $1-\phi$	p_{11} β_2	p_{12} $1-\alpha$	p_{20} $1-\theta$	p_{21} α	p_{23} β_3
(2017)	0.3503	0.3107	0.3390	0.6893	0.3398	0.6418	0.661	0.3582	0.3034
(2018)	0.3562	0.2762	0.3676	0.7238	0.2467	0.6021	0.6324	0.3979	0.3368
(2019)	0.3263	0.3338	0.334	0.6662	0.2645	0.6119	0.666	0.3881	0.2861
(2020)	0.3333	0.3333	0.3333	0.6667	0.4268	0.7028	0.6667	0.2972	0.3138
(2021)	0.2983	0.3616	0.3401	0.6384	0.3768	0.6667	0.6599	0.3333	0.3333

Table 1: Transition probability matrix of stock market prices of different years

Following the method of [5] gives the following conditions:

$$\beta_1 = Min(0.3503, 0.3562, 0.3263, 0.3333, 0.2983) = 0.2983$$
$$\beta_2 = Min(0.33981, 0.2467, 0.2645, 0.4268, 0.3768) = 0.2467$$
$$\beta_3 = Min(0.30341, 0.3368, 0.2861, 0.3138, 0.3333) = 0.2861$$

Hence we have $\beta_1 = 0.2983$, $\beta_1 = 0.2467$ and $\beta_3 = 0.2861$

Table 2: Expected mean rate of return for each stock

Companies	$\frac{1-\phi}{\beta_1}$	$\frac{1-\theta}{\beta_2}$	$\frac{1-\alpha}{\beta_3}$	Mean
$\text{Onando}_{(2017)}$	2.3108	2.6794	2.2433	2.4112
$\text{Onando}_{(2018)}$	2.4264	2.5634	2.1045	2.3648
$\text{Onando}_{(2019)}$	2.2333	2.6996	2.1388	2.3572
$\text{Onando}_{(2020)}$	2.235	2.7025	2.4565	2.4047
$\text{Onando}_{(2021)}$	2.1401	2.6749	2.3303	2.3818

Table 3: The Growth-rates and summary of stock price changes of Oando Nigeria, PLC

Year	Maximum Stock price	Minimum Stock Price	Growth(%)	Summary of	Stock price	Changes
2017	18.97	5.94	69	5.9769	5.9787	5.9790
2018	7.5	3.14	58	4.5591	4.4144	4.5328
2019	8.48	4.8	43	5.9547	5.9900	5.9900
2020	10.05	4.7	54	5.0495	5.1029	5.7993
2021	6.06	3.751	38	3.7038	3.6507	3.6905

Table 4: Onando transition probability matrix of limiting distribution of various years

$\text{Onando}_{(2017)}$	0.3503	0.3107	0.339
$\text{Onando}_{(2018)}$	0.3562	0.2762	0.3676
$\text{Onando}_{(2019)}$	0.3263	0.3338	0.334
$\text{Onando}_{(2020)}$	0.3333	0.3333	0.3333
$\text{Onando}_{(2021)}$	0.2983	0.3616	0.3401

Table 5: Assessing percentage increase in future price changes in Oando Nigeria, PLC.

Year	% Changes	Future Prices	Variation	of price	Changes
2017	0.05	5.9769	0.2988	0.2989	0.2981
	0.10	5.9787	0.5977	0.5977	0.5979
	0.15	5.9790	0.8965	0.8968	0.8985
	0.20		1.1954	1.1957	1.1958
	0.25		1.4942	1.4947	1.4948
2018	0.05	4.5591	0.2280	0.2207	0.2266
	0.10	4.4144	0.45591	0.4414	0.4533
	0.15	4.5328	0.6839	0.6622	0.6799

	0.20 0.25		0.9118 1.1398	0.8829 1.1036	0.9066 1.1332
2019	0.05 0.10 0.15 0.20 0.25	5.9547 5.9900 5.9900	0.2977 0.5955 0.8932 1.1909 1.4887	0.2995 0.599 0.8985 1.198 1.4975	0.2995 0.599 0.8985 1.198 1.4975
2020	0.05 0.10 0.15 0.20 0.25	5.0495 5.1029 5.7993	0.2525 0.5050 0.7574 1.0099 1.2624	0.2551 0.5103 0.7654 1.0206 1.2757	0.2899 0.5799 0.8699 1.1599 1.4498
2021	0.05 0.10 0.15 0.20 0.25	3.7038 3.6507 3.6905	0.1852 0.3704 0.5556 0.7408 0.9260	0.1825 0.3651 0.5476 0.7301 0.9127	0.1845 0.3691 0.5536 0.7381 0.9226

Table 6: Assessing percentage decrease in future price changes in Oando Nigeria, PLC.

Year	% Changes	Future Prices	Variation	of price	Changes
2017	0.25 0.20 0.15 0.10 0.05	5.9769 5.9787 5.9790	1.4942 1.1954 0.8965 0.5977 0.2988	1.4947 1.1957 0.8968 0.5977 0.2989	1.4948 1.1958 0.8985 0.5979 0.2981
2018	0.25 0.20 0.15 0.10 0.05	4.5591 4.4144 4.5328	1.1398 0.9118 0.6839 0.4560 0.2280	1.1036 0.8829 0.6622 0.4414 0.2207	1.1332 0.9066 0.6799 0.4533 0.2266
2019	0.25 0.20	5.9547 5.9900	1.4887 1.1909	1.4975 1.198	1.4975 1.198

	0.15 0.10 0.05	5.9900	0.8932 0.5955 0.2977	0.8985 0.599 0.2995	0.8985 0.599 0.2995
2020	0.25 0.20 0.15 0.10 0.05	5.0495 5.1029 5.7993	1.2624 1.0099 0.7574 0.5050 0.2525	1.2757 1.0206 0.7654 0.5103 0.2551	1.4498 1.1599 0.8699 0.5799 0,2899
2021	0.25 0.20 0.15 0.10 0.05	3.7038 3.6507 3.6905	0.9260 0.7408 0.5556 0.3704 0.1852	0.9127 0.7301 0.5476 0.3651 0.1825	0.9226 0.7381 0.5536 0.3691 0.1845

4 Discussion of results

It can be seen in Table 1 that the stock quantities were obtained row wise using the method of probability: 1-ϕ, 1-θ and 1-$\propto$. Column 5,7 and 8 respectively. So, by addition of columns: 3 and 5,4 and 8,7 and 9 gives a total probability of 1. This agrees with one of axioms of probability measure which can be used to improve efficiency in term of stock trading. The entire entry stipulates price changes for short- and long-term business plans. It is clear in Tables 2 and 3, the mean rate of returns. Growth rates and future stock price changes are all in indexed in millions of naira all through the trading days which implies that Oando Nigeria, Plc is profit making company.

More so in order to predict the future price of expected returns of investments. Oando (2017): 23% chance of reducing the expected rate of return; 27% chance of increasing its price in future and 22% chance of no change in expected rate of ret with mean rate of 24%. Oando (2018): 24% chance of reducing the expected rate of return; 25% chance of increasing its price in the near future and 21% chance of no change in expected rate of return with mean rate of 24%. Oando (2019): 22% chance of reducing the expected rate, 27% chance of increasing its price in the near future and 21% chance of no change in expected rate of return with mean rate of 24%. Oando (2020): 22% chance of reducing its expected rate,27% chance of increasing its price in the near future and 25% chance of no change in expected rate of return with mean rate of 24% Oando (2021): 21%chance of reducing the expected rate,27% chance of increasing its price and 23% chance of no change in expected rate of return with mean rate 24%.

However, in order to predict the future price of entire of investments of different years, we therefore have the following, Oando (2017): Has 35% of reducing its price; 31% chance of increasing its price in the near future;34% chance of no change in price.

Oando (2019): Has 33% chance of reducing its price; 34% chance of increasing its price and 33% chance of no change in price.
Oando(2020): Has 33% chance of reducing its price 33% chance of increasing its price and 33% Chance of no change in price .
Oando(2021): Has 30% chance of reducing its price ; 36% chance of increasing its price in the near future and 34% chance of no change in price.

The above assessment of Oando Nigeria plc (2017-2021) will provide an insight of these stochastic analysis that will enhancing their investment decision, having assessed the year independently.

Table 4, describes the probability changes of Oando investments which be specific at certain state of time; often converges to a limiting value which is independent of the initial state, hence this formation is a stochastic process.

In Table 5, the future price changes namely "no-change in price, the probability of price increasing in the near future and the probability of reducing in future" were varied by 5%-25% increase to assess the levels of this future price changes. It was discovered that the various levels of percentage changes dominantly indicate an increase over the trading period. This observation leads to good assessments on the part of Oando Nigeria PLC investments since they are been guided properly on the three levels of pricing effects.

However, the future price changes were also varied by 25%-5% decrease. it indicates percentage decrease in various future price changes over the stipulated trading period. In this scenario, it is also a guild to Oando investments over three levels of pricing effects assessment; the benefits of this assessment is to avert severe depletion of capital investments which may endanger profit making throughout the trading period, see Table 6.

6 Conclusion

An application of Markov chain is a mathematical tool for modeling stock price formation; since each finite state communicates for proper management policies. In this paper, stochastic analysis of Markov chain was applied in the closing stock price data of Oando Nigeria plc. The analytical solution of the stochastic analysis showed that the closing stock price of 2017 has the highest mean rate of returns and growth rates respectively :2 .4112 and 69%. Also, stock prices of 2018 have the best probability of price not changing in the near future: 26%. Thus, Oando Nigeria plc is profit making organization, since the growth rates are all indexed in millions of naira.

More so, comparing two or more companies and applying Markov chain in finite and infinite states with be an interesting study.

Reference

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