Set - 11 :Modelling stock price variations as a Bachelier-Wiener process

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I. MODEL

The forward relative change of a stock price, S, in a finite time interval, Δt, is given by

$$\frac{\Delta S}{S} = a\Delta t + b\Delta W \tag{1}$$

Under an idealized volatility-free condition, we set b = 0, and then integrate it in continuous time to get a steady compounded growth of S. The integral solution of S is exponential in time,

$$S = S_0 exp(at) \tag{2}$$

$$\Delta(lnS) = a\Delta t \tag{3}$$

The Gaussian function, with unity added to it, as

$$f(\delta) = 1 + f_0 exp[\frac{-(\delta-\mu)^2}{2\sigma^2}] \tag{4}$$

II. RESULTS

A. A

Fig. 1 shows stock price vs time.

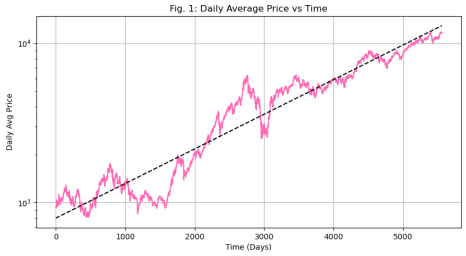

FIG. 1: The daily mean growth of the average price of the stock index, NIFTY (NSE, India).The straight line in this linear-log plot is fitted by the least-squares method, and indicates that the mean growth of S is exponential.With b = 0, the mean relative growth rate of stock values is a. For this plot $a = 0.05\%$ per day.

B. B

Fig. 2 shows daily percentage fluctuation of stock values vs time.

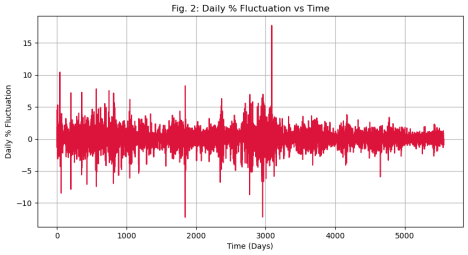

FIG. 2: The time series of the daily percentage fluctuation of prices in the stock index, NIFTY (NSE, India).The daily percentage fluctuation of prices is quantified by δ, which, over two decades, has an equal distribution of positive and negative values about $\delta = 0$.

C. C

Fig. 3 shows The unnormalized frequency distribution of the daily percentage fluctuation of prices in the stock.

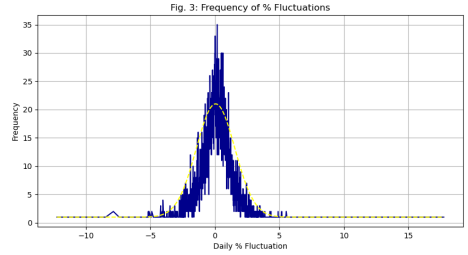

FIG. 3: The unnormalized frequency distribution of the daily percentage fluctuation of prices in the stock index, NIFTY (NSE, India).The distribution appears Gaussian, and is centred around a mean value, $\mu = 0.057$, with a standard deviation, $\sigma = 1.495$.

D. D

Fig. 4 shows The growth of the monthly average of lnS vs time.

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FIG. 4: The growth of the monthly average of lnS for NIFTY (NSE, India), as opposed to its daily growth in Fig(1).The straight line, showing the mean growth, is fitted by the least-squares method, and its slope is m = 0.01 per month.

E. E

Fig. 5 shows the variance of the monthly prices, vs time.

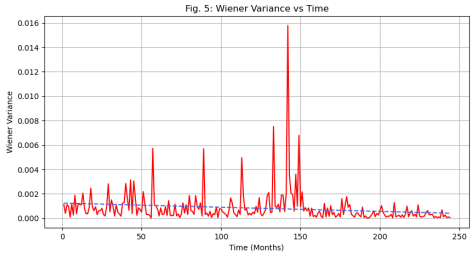

FIG. 5: The Wiener variance about the monthly average of lnS for NIFTY (NSE, India) decreases with time,(in months).The straight line, fitted by the least-squares method, traces the mean decline, with a slope of $w = 3.41 * 10^{-6}$ per month. With $w < 0$, volatility also reduces with time.

F. F

Fig. 6 shows the growth of the daily trade volume vs time.

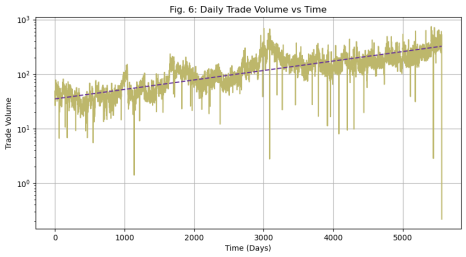

FIG. 6: The growth of the daily trade volume of the NIFTY (NSE, India) index.The straight line in this linear-log plot,fitted by the least-squares method, implies an exponential mean growth of N. The slope of the straight line, $v = 0.04\%$ per day, gives the mean relative growth rate of the daily volume of trade.

III. CONCLUSIONS

- The NIFTY market exhibits consistent growth, reflected in both stock prices and trading volumes, as indicated by the upward slope of the fitted lines in each plot.

- Over an extended period, stock values in the market tend to experience sustained growth, suggesting that prices generally increase over time.

- Simulation models offer investors and traders valuable insights into market behavior, enabling them to make informed decisions and manage risks more effectively.

[1] Abhin Kakkad, Harsh Vasoya and Arnab K. Ray, *'Regularities in stock markets'.*