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Probability distribution of financial returns in a model of multiplicative Brownian motion with stochastic diffusion coefficient ANTONIO SILVA, RICHARD PRANGE, VICTOR YAKOVENKO, University of Maryland — It is well-known that the mathematical theory of Brownian motion was first developed in the Ph. D. thesis of Louis Bachelier for the French stock market before Einstein [1]. In Ref. [2] we studied the so-called Heston model, where the stock-price dynamics is governed by multiplicative Brownian motion with stochastic diffusion coefficient. We solved the corresponding Fokker-Planck equation exactly and found an analytic formula for the time-dependent probability distribution of stock price changes (returns). The formula interpolates between the exponential (tent-shaped) distribution for short time lags and the Gaussian (parabolic) distribution for long time lags. The theoretical formula agrees very well with the actual stock-market data ranging from the Dow-Jones index [2] to individual companies [3], such as Microsoft, Intel, etc.

[1] Louis Bachelier, "Théorie de la spéculation," Annales Scientifiques de l'École Normale Supérieure, III-17:21-86 (1900).
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[3] A. C. Silva, R. E. Prange, and V. M. Yakovenko, "Exponential distribution of financial returns at mesoscopic time lags: a new stylized fact," Physica A **344**, 227–235 (2004). [cond-mat/0401225]

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