

Randomness plays a central role in determining financial risk. Even when asset prices follow the same statistical model with fixed parameters such as drift and volatility, the realized price paths can differ significantly. This is clearly observed in the simulated Geometric Brownian Motion paths, where each trajectory evolves differently despite identical starting conditions.

The key insight is that risk is not about predicting a single future price, but about understanding the range of possible outcomes. Volatility controls the dispersion of these outcomes: higher volatility leads to a wider distribution of final prices, increasing uncertainty. This means that two assets with the same expected return can have very different risk profiles depending on their volatility.

The histogram of final prices further highlights this idea. Instead of a single outcome, we observe a distribution of prices, emphasizing that risk should be measured probabilistically. In finance, randomness implies that losses are not anomalies but inherent possibilities within the system. Therefore, managing risk requires focusing on distributions, variability, and tail outcomes rather than relying on point forecasts.