



Statistics of Financial Markets

Chapter 4: The Random Walk Model



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Outline

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Random Walk Definition

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Random Walk Types (RW1, RW2, RW3)

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References

Motivation

- The random walk as a foundational model for asset prices
- Connection to the Efficient Market Hypothesis
- Why testing for random walks is central to financial econometrics

Random Walk Definition

- ▣ Formal mathematical definition of a random walk process
- ▣ $P_t = P_{t-1} + \varepsilon_t$ and its implications
- ▣ Relation to martingale processes

Properties

- Non-stationarity and unit root behavior
- Variance grows linearly with time
- Autocorrelation structure of returns

Random Walk Types (RW1, RW2, RW3)

- RW1: i.i.d. increments
- RW2: independent but not identically distributed increments
- RW3: uncorrelated increments (weakest form)
- Hierarchy and implications for testing

Testing for Random Walk

- ▣ Autocorrelation tests and Box–Pierce/Ljung–Box statistics
- ▣ Unit root tests (ADF, Phillips–Perron)
- ▣ Variance ratio tests (preview of Chapter 5)
- ▣ Runs tests and sign tests

Applications

- Testing the random walk hypothesis on stock indices
- Exchange rate random walk behavior
- Simulations and empirical examples in Python

 `SFM_ch4_random_walk`

Conclusions

- ▣ Summary of the random walk model and its variants
- ▣ Practical implications for market efficiency
- ▣ Limitations and open questions

References

- ▣ Campbell, J.Y., Lo, A.W., MacKinlay, A.C. (1997). The Econometrics of Financial Markets.
- ▣ Lo, A.W., MacKinlay, A.C. (1988). Stock market prices do not follow random walks.
- ▣ Fama, E.F. (1965). The behavior of stock-market prices.