



ST326 Week 1

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About me

Education and research

- ▶ Third year PhD student.
- ▶ Supervision under Prof. Clifford Lam and Dr. Yunxiao Chen.
- ▶ Research interests: high-dimensional time series analysis; latent factor models.
- ▶ BEcon in Economic Statistics from Beihang University (2023), and MSc in Statistics (Financial Statistics) from LSE (2024).

How to reach me

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Returns

Let $P_t > 0$ denote the asset price at time t , ignoring dividends for now.

One-period simple return

$R_t = (P_t - P_{t-1})/P_{t-1}$ is the proportional price change from $t - 1$ to t .

One-period log return

$r_t = \log(P_t) - \log(P_{t-1}) = \log(P_t/P_{t-1})$ is the change in log price.

Relationship

Since $1 + R_t = P_t/P_{t-1}$, $r_t = \log(1 + R_t)$ and $R_t = \exp(r_t) - 1$.

In this course, “return” means log return unless stated otherwise.

Multi-period returns

For $k \geq 1$, $R_t(k)$ and $r_t(k)$ denote returns from $t - k$ to t .

Simple returns compound

The k -period simple return is $R_t(k) = (P_t - P_{t-k})/P_{t-k}$, and

$$R_t(k) = (1 + R_t)(1 + R_{t-1}) \cdots (1 + R_{t-k+1}) - 1.$$

Log returns add; continuous compounding

The k -period log return is $r_t(k) = r_t + r_{t-1} + \cdots + r_{t-k+1}$. For a simple annual rate r compounded m times per year,

$$\lim_{m \rightarrow \infty} \left(1 + \frac{r}{m}\right)^m = e^r.$$

Thus r is the annual log return under continuous compounding.

Returns v.s. prices

Economic comparability

- ▶ Returns are proportional changes, so they are comparable across assets and investment sizes.
- ▶ They naturally account for the length of the holding period.

Statistical modelling

- ▶ Prices often trend and are typically non-stationary.
- ▶ Returns are usually more stable and provide a useful starting point for time-series models.

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Weak stationarity

Let $\{X_t\}$ be a time series and let h denote a time lag.

Definition

$\{X_t\}$ is weakly stationary if:

- ▶ its mean is constant: $\mathbb{E}(X_t) = \mu$ for every t ;
- ▶ its covariance depends only on the lag: $\text{Cov}(X_{t+h}, X_t) = \gamma(h)$, with $\gamma(0) < \infty$.