Basic Concepts in Time Series

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Random variable

Definition

- A **random variable** is a measurable function $f : \Omega \mapsto \mathcal{R}$ that assigns to a set of outcome Ω a **value**, often a real number.
- The probability of an outcome is equal to its **measure** divided by the measure of all possible outcomes
  - Example: measure of obtaining an even number by rolling a dice: $\{2, 4, 6\}$
  - Probability to obtain an even number by rolling a dice: $m(\{2, 4, 6\})/m(\{1, 2, 3, 4, 5, 6\}) = \frac{1}{2}$ *(here, the measure simply "counts" the outcomes with equal weights)*
- Random variables are the "building block" of statistics:
  - Random variables are characterized by their distribution (generating function, moments, quantiles, etc.)
  - The behavior of two or more random variables can be characterized by their dependence/independence, matrix of variance-covariance, joint distribution, etc.
  - The main theorem of statistics (law of large numbers, central limit theorem, etc.) leverage the properties of

Stochastic Process

Stationarity

Ergodicity

Moments

Estimator

Biais

Efficiency