Lecture #1 — Introduction

Aim of the courses:

- Formulation of a theory of probability:
  - Rigorous (axiomatic)
  - Application-oriented
  - Basics of future classes
- Focus on standard models
- Introduction to stochastic process and non-linear optimization

KOLMOGOROV'S HANDBOOK 1933

In discrete cases:

S

Sample space

$\Omega = \{1, 2, 3, 4, 5, 6\}$ → discrete example

$E_1 = \{1, 3, 5\}$ $\quad E_3 = \{1, 2, 3\}$

$E_2 = \{2, 4, 6\}$

→ Event set, a possible subset from Ω

Atomic event → a single possible outcome of a subset from Ω

$E_6 = \{6\}$

For the finite case:

$\Omega = [0, +\infty[$ → boundaries

PROBABILITY THEORIES exist when we only want to see the outcome without knowing the causations behind the results.

The probability function of an event is expressed

$P(E) = p$ ← modelling of the problem

STANDARD MODELS are tools to approximate the actual problem, and we only pick an interval or a set of points (or event a single point) as the event. For examples:

$E : [10, +\infty[$ $E : [0, 5]$

$E : [2, 3]$ $E = \{1.\}$

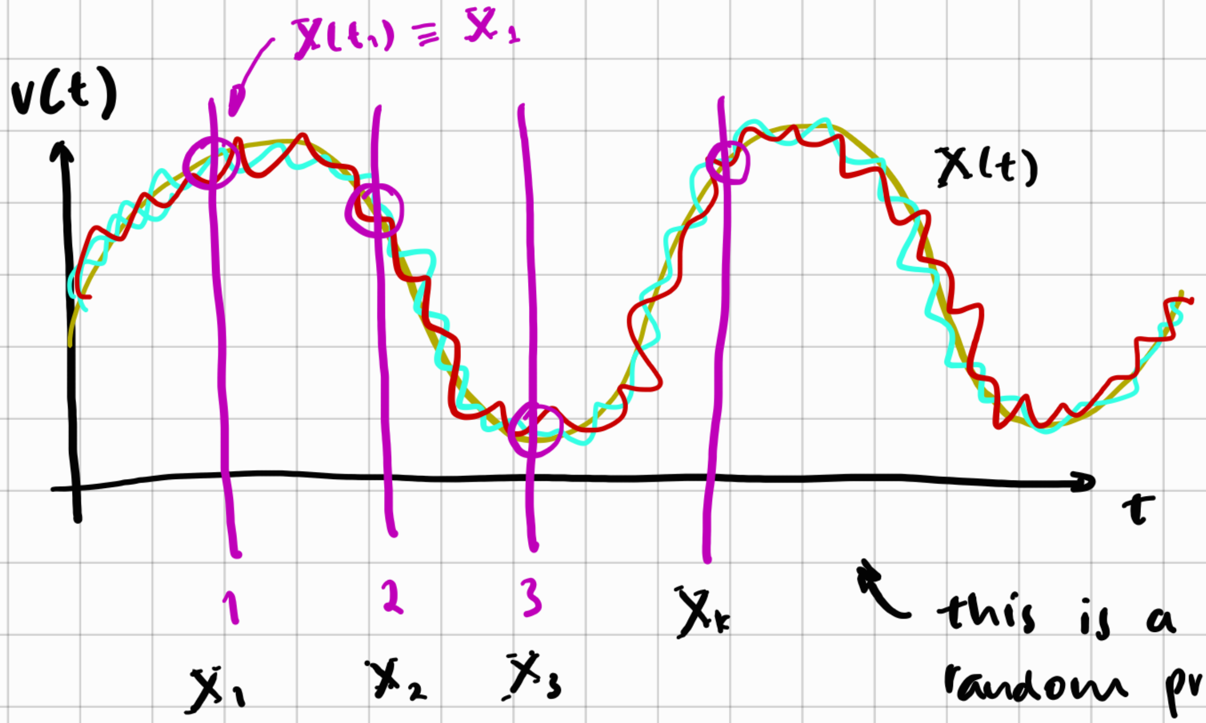
STOCHASTIC PROCESSES are aproaches using random variables / function

X → random variable

x → actual value of a variable

The function in engineering cases usualy are time-based (t)

$X(t)$



this is a random process

In stochastic problem, the variables are random and independent.

NON LINEAR OPTIMIZATION. Examples:

weight (%)

μ_1, σ_1 $A_1 \rightarrow w_1$

μ_2, σ_2 $A_2 \rightarrow w_2$

constraint

$$\boxed{w_1 + w_2 = 1}$$

we should determine the weight to produce the optimal outcome

$$S = \frac{\mu}{\sigma}$$

return

volatility

$$= \frac{w_1 \mu_1 + w_2 + \mu_2}{\sqrt{\mu \cdot \sigma \, \mu}}$$

EIGEN VALUES

EIGENVECTORS