

Stochastic Processes



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Stochastic Process

For each t , $t \in T$, let X_t be a random variable.
Then the collection of random variables

$$\{X_t, t \in T\}$$

is a stochastic process.

Generally, t represents a time parameter.

A stochastic process is classified as

discrete-parameter

if the index set $T = \{0, 1, 2, 3, \dots\}$

and

continuous-parameter

if $T = [0, +\infty)$, i.e., the set of non-negative real numbers.

The "State Space" of the process is the set of possible values that X_t may assume.

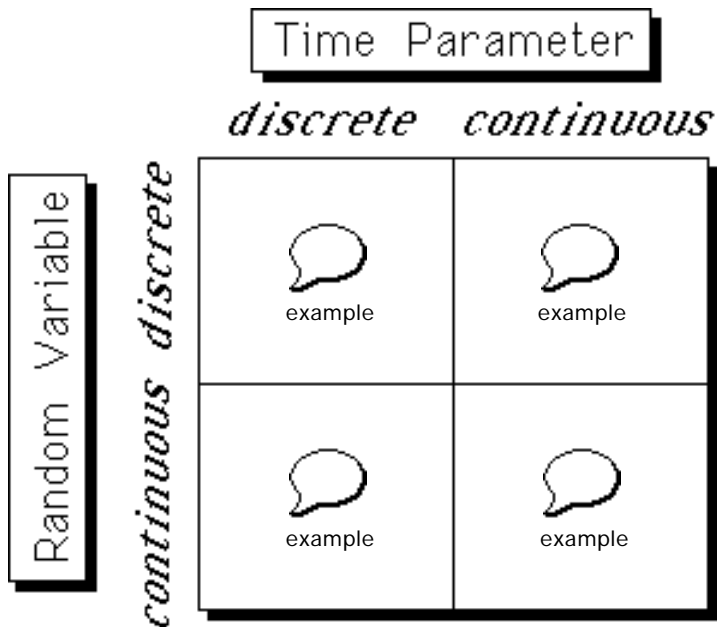
The process is classified as

discrete-valued

if the state space is a discrete set (e.g., the integers), and

continuous-valued

otherwise (e.g., if X_t may be any non-negative real number.)



Common Stochastic Processes

- ➡ Discrete-time Markov Chains
- ➡ Continuous-time Markov Chains
- ➡ Bernoulli Process
- ➡ Poisson Process
- ➡ Birth-death Process

*Examples:***Discrete-parameter, discrete-valued process:**

Let the index set T refer to customer numbers,

$$T = \{1, 2, 3, \dots, n, \dots\}$$

and let the random variable X_n be the number of customers in the system when service is completed for the n^{th} customer.



Continuous-parameter, discrete-valued process

Let the index set T refer to time (continuous)

$$T = [0, +\infty)$$

and let the random variable X_t be the number of customers in the system at time t .



Discrete-parameter, continuous-valued process

Let the index set T refer to customer number,

$$T = \{1, 2, 3, \dots, n, \dots\}$$

and let the random variable X_n be the waiting time of the n^{th} customer prior to service, so that

$$X_n \in [0, +\infty)$$



Continuous-parameter, continuous-valued process

Let the index set T refer to time (continuous), and let the random variable X_t be the amount of service (in minutes) which has been provided to the customer currently being served.

