# 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.

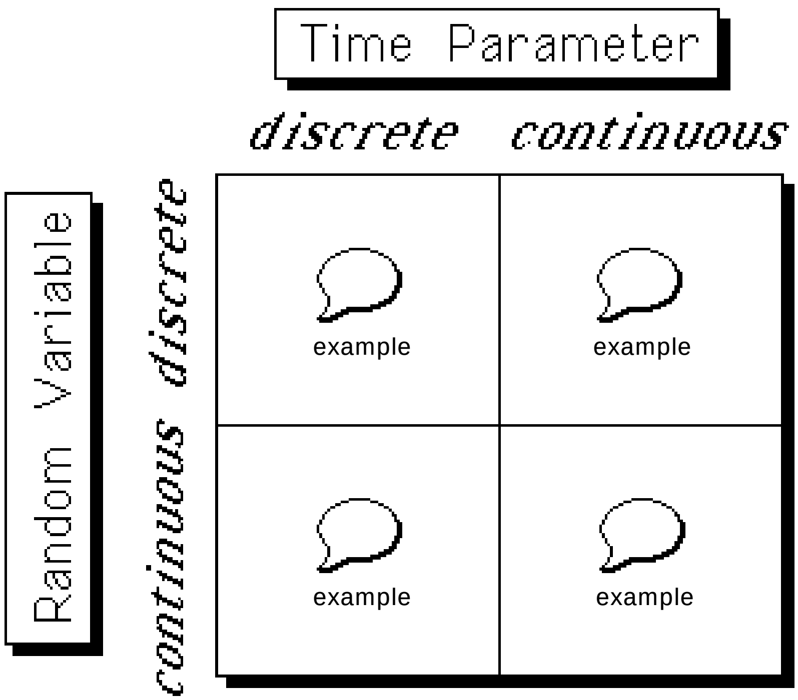
The process is classified as

***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,

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

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,

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

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

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

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## 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.

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