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

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

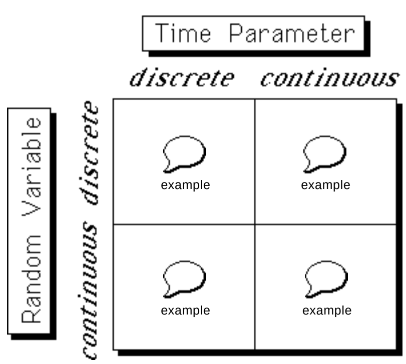
is a stochastic process.

Generally, t represents a time parameter.

A stochastic process is classified as ***discrete-parameter*** if the index set T = {0, 1, 2, 3, ... } 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, ... n, ... }
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

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

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.