Stochastic Processes

This Hypercard stack was prepared by:
Dennis L. Bricker,
Dept. of Industrial Engineering,
University of Iowa,
Iowa City, Iowa 52242
e-mail: dbricker@icaen.uiowa.edu

author

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 $T = \{0, 1, 2, 3, \ldots\}$

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.)

Time Parameter

Random Variable	Time Parameter: *discrete*	Time Parameter: *continuous*
discrete	example	example
continuous	example	example

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

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

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.