

# Temporal Characteristics of Random Processes

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Based on  
Probability, Random Variables and Random Signal Principles,  
P.Z. Peebles,Jr. and B. Shi

# Outline

## 1 Joint Distributions, Independence, and Moments

# First Order Distribution Function

$N$  Gaussian random variables

## Definition

For one particular time  $t_1$ , the distribution function associated with the random variable  $X_1 = X(t_1)$

$$F_X(x_1; t_1) = P\{X(t_1) \leq x_1\}$$

the density function

$$f_X(x_1; t_1) = dF_X(x_1; t_1)/dx_1$$

# Second Order Distribution Function

$N$  Gaussian random variables

## Definition

For one particular time  $t_1, t_2$ , the distribution function associated with the random variables  $X_1 = X(t_1)$  and  $X_2 = X(t_2)$

$$F_X(x_1, x_2; t_1, t_2) = P\{X(t_1) \leq x_1, X(t_2) \leq x_2\}$$

the density function

$$f_X(x_1, x_2; t_1, t_2) = \partial^2 F_X(x_1, x_2; t_1, t_2) / \partial x_1 \partial x_2$$

# $N$ -th Order Distribution Function

$N$  Gaussian random variables

## Definition

For one particular time  $t_1, t_2, \dots, t_N$ , the distribution function associated with the random variables  $X_1 = X(t_1), X_2 = X(t_2), \dots, X_N = X(t_N)$

$$F_X(x_1, \dots, x_N; t_1, \dots, t_N) = P\{X(t_1) \leq x_1, \dots, X(t_N) \leq x_N\}$$

the density function

$$f_X(x_1, \dots, x_N; t_1, \dots, t_N) = \partial^N F_X(x_1, \dots, x_N; t_1, \dots, t_N) / \partial x_1 \cdots \partial x_N$$



