Stationarity

Young W Lim

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

Outline

First Order Stationary

N Gaussian random variables

Definition

if the first order density function does not change with a shift in time origin

$$f_X(x_1; t_1) = f_X(x_1; t_1 + \Delta)$$

must be true for any timet_1 and any real number Δ if $X(t)$ is to be a first-order stationary

Consequences of stationarity
N Gaussian random variables

Definition

$f_X(x, t_1)$is independent of t_1
the process mean value is a constant

$$m_X(t) = \overline{X} = constant$$

the process mean value

N Gaussian random variables

Definition

$$m_X(t) = \overline{X} = constant$$

$$m_X(t_1) = \int_{-\infty}^{\infty} x f_X(x; t_1) dx$$

$$m_X(t_2) = \int_{-\infty}^{\infty} x f_X(x; t_2) dx$$

$$m_X(t_1) = m_X(t_1 + \Delta)$$

Second-Order Stationary Process

N Gaussian random variables

Definition

if the second order density function does not change with a shift in time origin

$$f_X(x_1, x_2; t_1, t_2) = f_X(x_1, x_2; t_1 + \Delta, t_2 + \Delta)$$

must be true for any timet_1, t_2 and any real number Δ if $X(t)$ is to be a second-order stationary