

1.FIRST & SECOND ORDER STATIONARY PROCESSES

2.WIDE SENSE STATIONARY PROCESSES

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Stationary Processes

- ▶ • A random process is stationary if its statistical properties do not change with time.
- ▶ • Properties include mean, variance, higher moments.
- ▶ • Stationarity may be defined at different orders.

First-Order Stationary Process

- ▶ • First-order stationarity: first-order PDF does not change with time.
- ▶ • Condition:
 - ▶ $f_X(x_1; t_1) = f_X(x_1; t_1 + \Delta t)$
- ▶ • Mean must be constant:
 - ▶ $E[X(t)] = \text{constant}$

Mean Invariance Proof

- ▶ • Let $X_1 = X(t_1)$, $X_2 = X(t_1 + \Delta t)$
- ▶ • $E[X_2] = \int x f_X(x; t_1 + \Delta t) dx$
- ▶ • For first-order stationary process:
 - ▶ $f_X(x; t_1 + \Delta t) = f_X(x; t_1)$
- ▶ • Therefore:
 - ▶ $E[X(t_1 + \Delta t)] = E[X(t_1)] = \text{constant}$

Second-Order Stationary Process

- ▶ • Second-order stationarity: joint PDF depends only on time difference.
- ▶ • Condition:
 - ▶ $f_X(x_1, x_2; t_1, t_2) = f_X(x_1, x_2; t_1 + \Delta t, t_2 + \Delta t)$
- ▶ • Autocorrelation depends only on $\tau = t_2 - t_1$:
- ▶ $R_{XX}(\tau) = E[X(t_1) X(t_1 + \tau)]$

Wide-Sense Stationary (WSS)

- ▶ • A second-order stationary process is WSS.
- ▶ • Conditions:
 - ▶ 1. $E[X(t)] = \text{constant}$
 - ▶ 2. $R_{XX}(t, t + \tau) = R_{XX}(\tau)$
- ▶ • Autocorrelation independent of absolute time.

THANK YOU

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect. The shapes are concentrated on the right side of the image, with some extending towards the left.