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:

▶ $E[X(t)] = constant$

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)] = $ 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. $E[X(t)]$ = constant

▶   2. $R_{XX}(t, t + \tau) = R_{XX}(\tau)$

▶ • Autocorrelation independent of absolute time.

THANK YOU