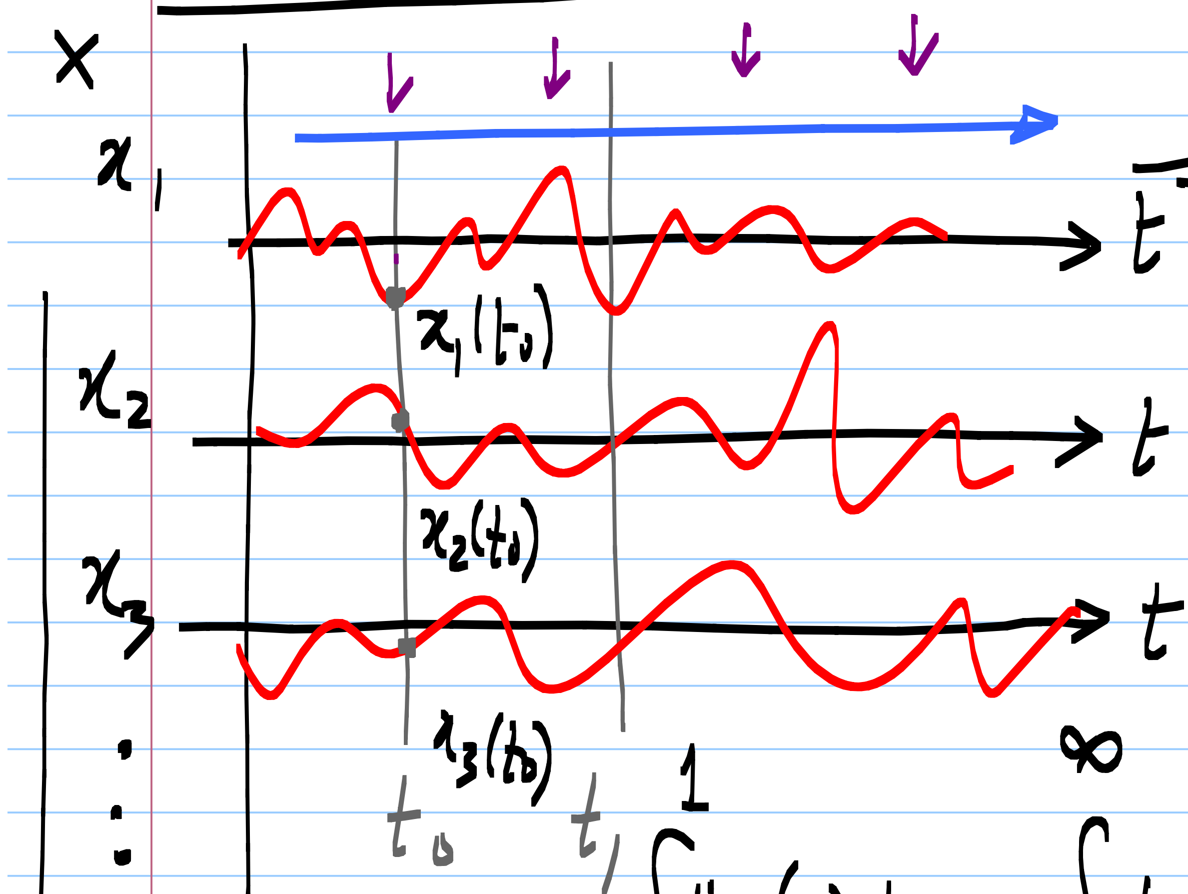
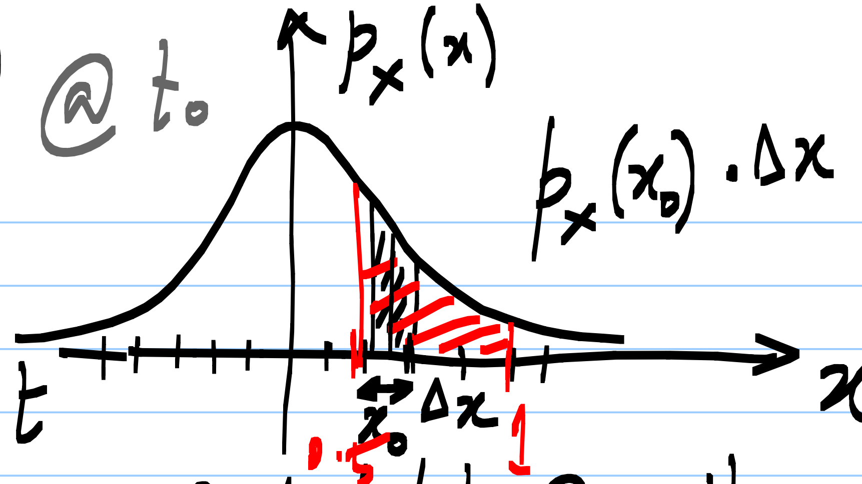
Noise (Random processes) @ t_0



Instances



$p_X(x_0) \cdot \Delta x$

Probability density

~n.

0.5 & 1

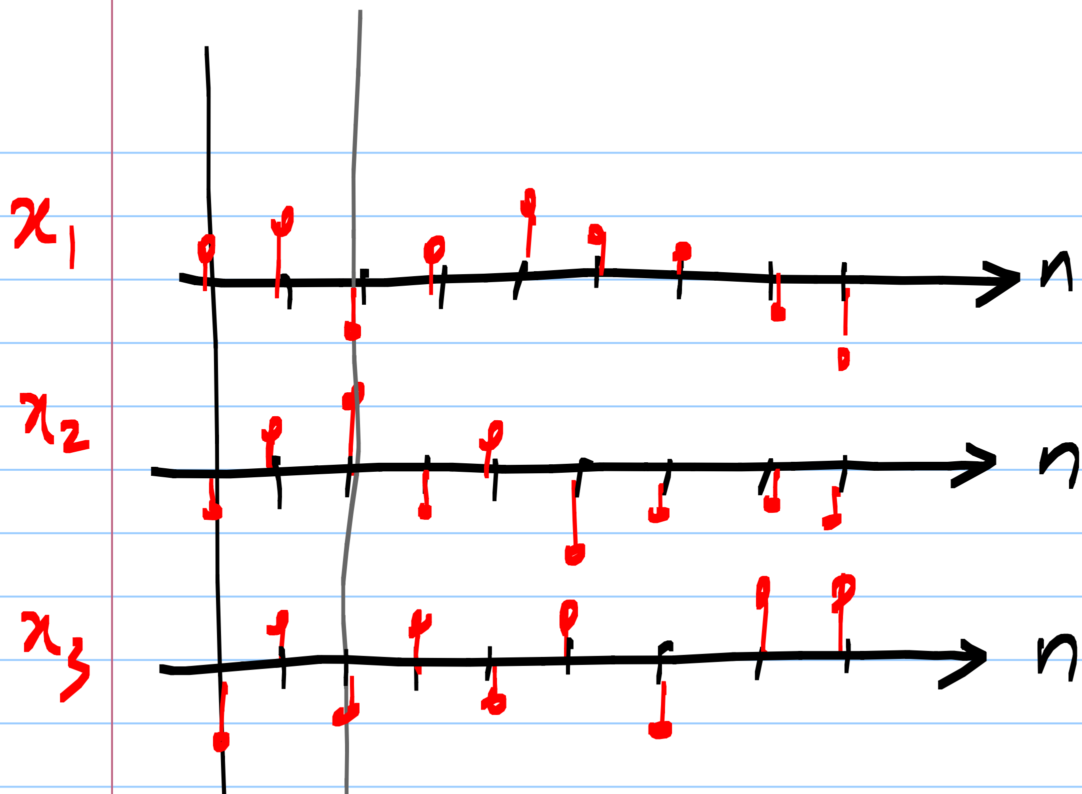
Probability that

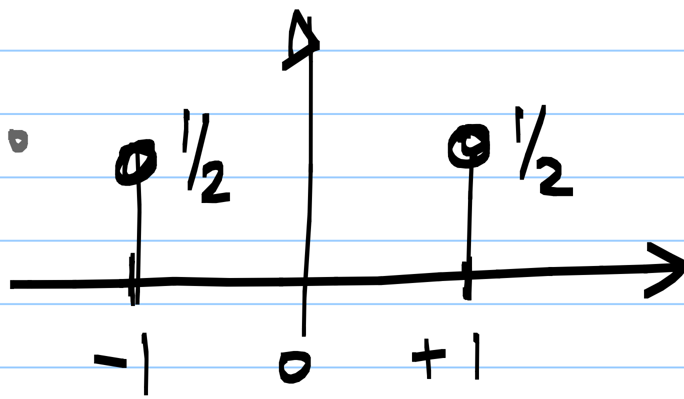
$0.5 \leq x < 1$

$$\int_{0.5}^{1} p_X(x)\,dx \qquad \int_{-\infty}^{\infty} p_X(x)\,dx = 1$$

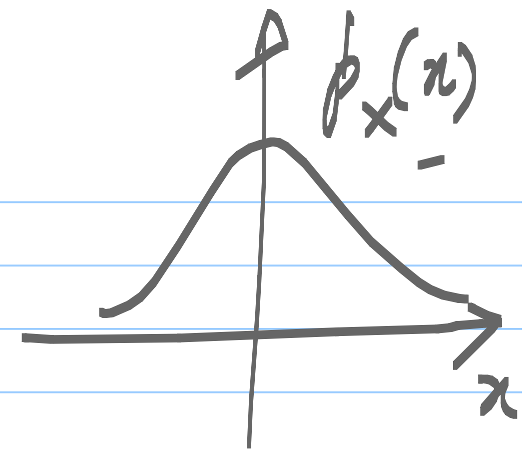
Deterministic signals

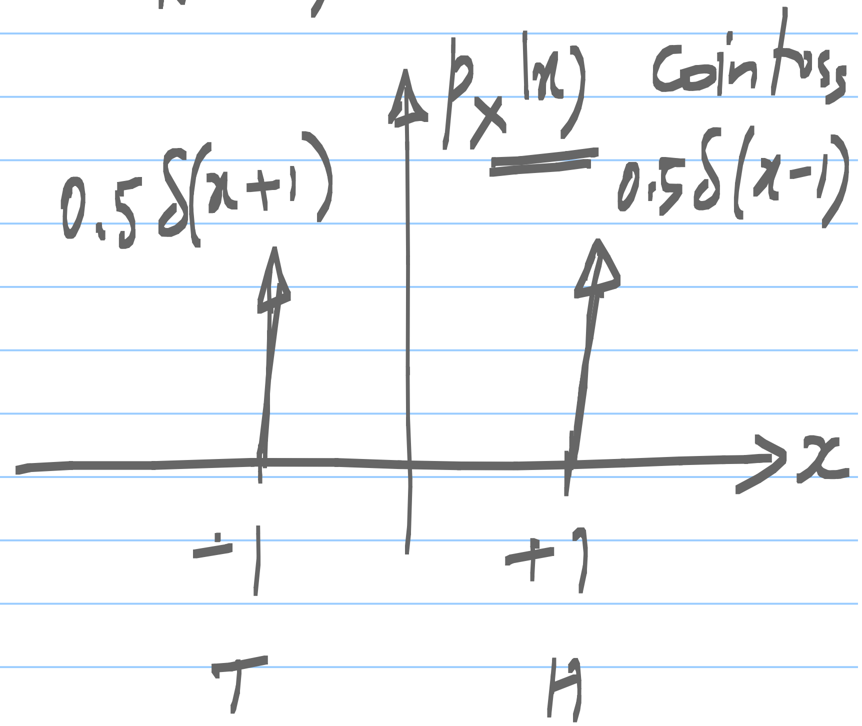
$$x(t) = \left.\begin{array}{l}\exp(-2t)\\ \sin(50t)\end{array}\right\}$$ values known exactly {at all t}



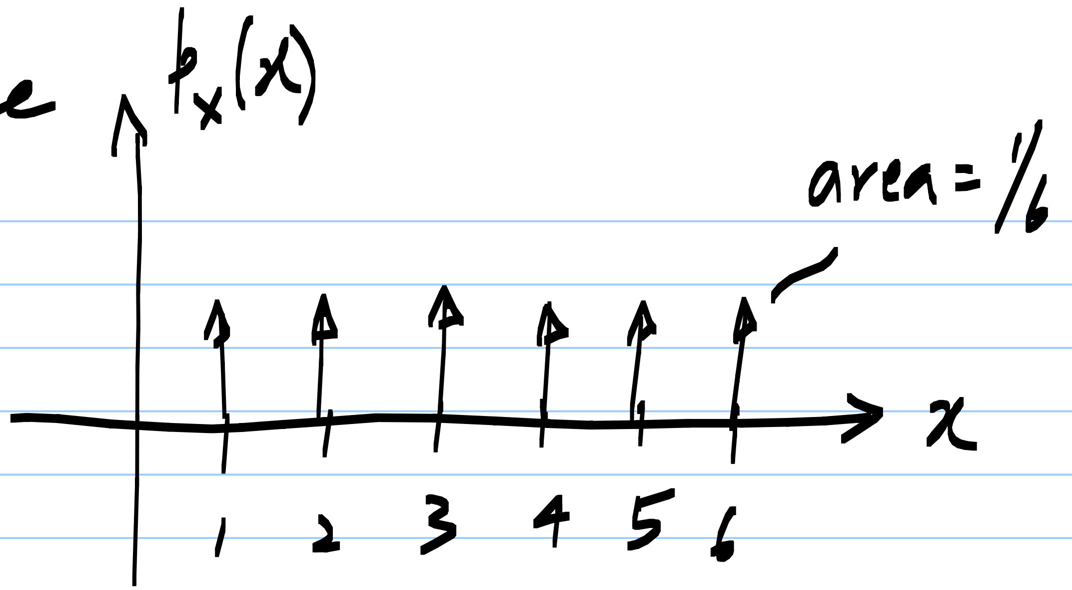


$x_1(n_0)$
$x_2(n_0)$
$\vdots$
$x_N(n_0)$

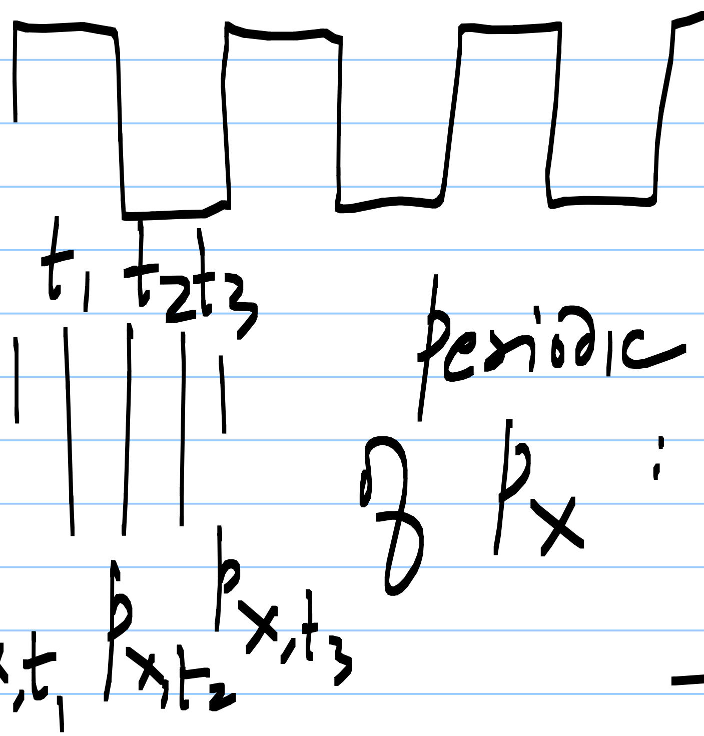




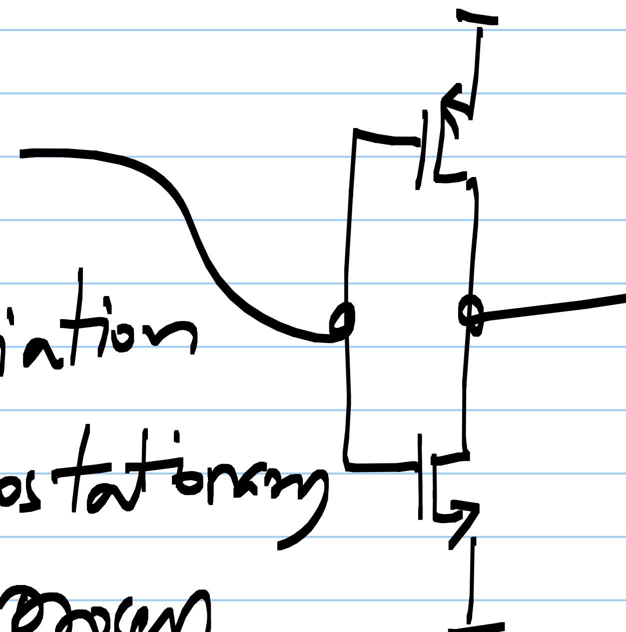
Dice

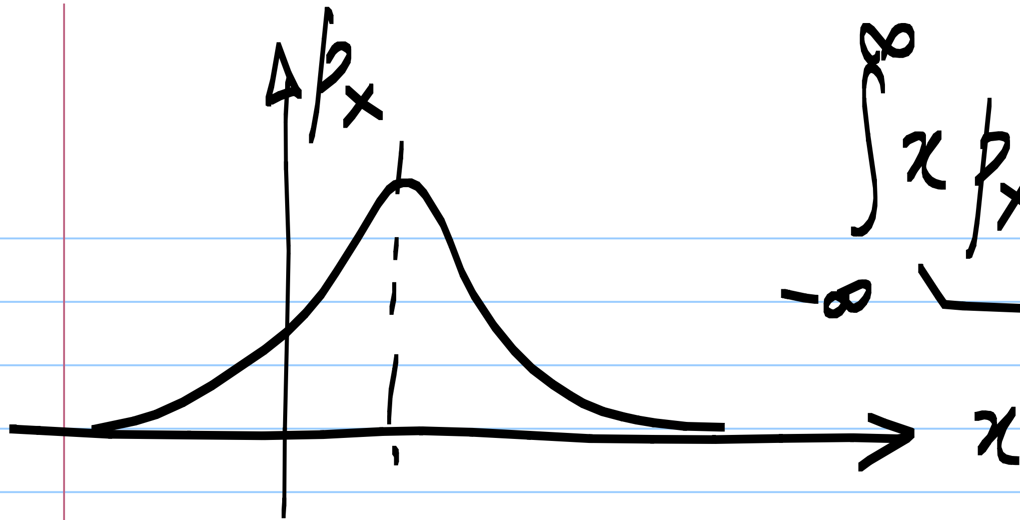


probability distribution (density function) same at all t. — stationary process



periodic variation of p_x : cyclostationary process



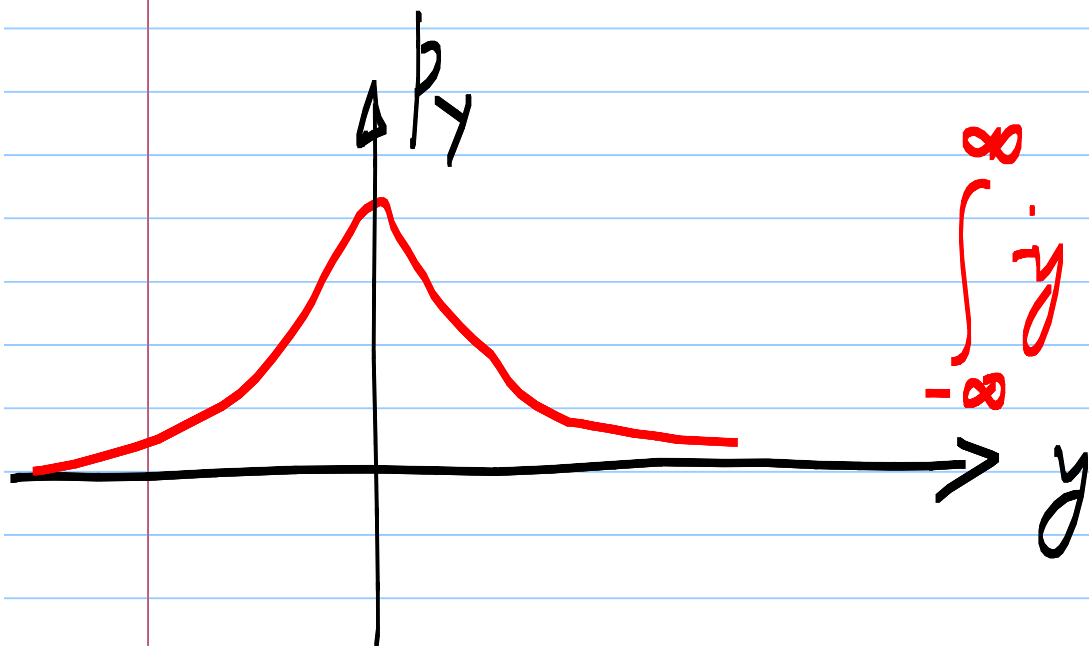


$$\int_{-\infty}^{\infty} \underbrace{x\, p_x(x)} \cdot dx = \underbrace{E[x]}_{\text{Expectation}}$$

Mean

$$Y = X - E_X$$

$$y = x - E(x)$$



$$\int_{-\infty}^{\infty} y\, p_y(y) \cdot dy = 0$$

Variance:

$$\int_{-\infty}^{\infty} [x - E(x)]^2 \cdot p_x(x)\, dx \;:\; \sigma_x^2$$

$$\sqrt{} = \sigma_x \;:\; \text{standard deviation}$$

$$E[F(x)] \;:\; \int_{-\infty}^{\infty} F(x) \cdot p_x(x) \cdot dx$$

Expectation

Mean: $E[x]$

Variance: $E[(x - E(x))^2]$

Zero mean: $E[x^2]$

$$x_1 : \lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} x_1(t)\, dt$$ Time average
dc value

$$\lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} x_1^2(t)\, dt$$ Mean-squared value

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Zero-mean, stationary processes, | Ergodic processes

Variance = Mean-squared value

Autocorrelation

$$R_x(\tau) = E\left[\underbrace{x(t)}\, x(t+\tau)\right]$$

$$\int_{-\infty}^{\infty} x(t) \cdot x(t+\tau)\, p_x(x)\, dx$$