Introduction to $\boxed{\text{Random Processes}}$

$X \rightarrow$ R.V.

What is a Random Process ?

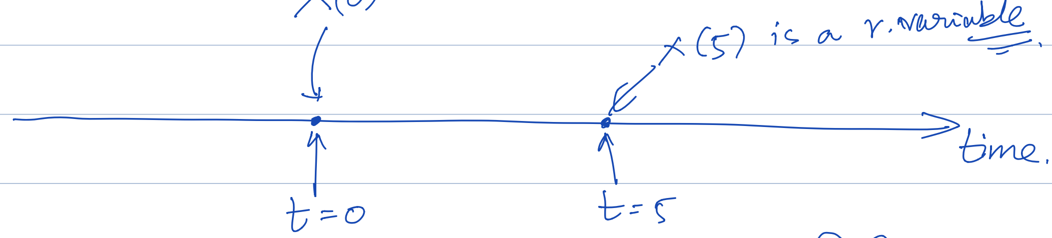
Notion of $\boxed{\text{Time}}$

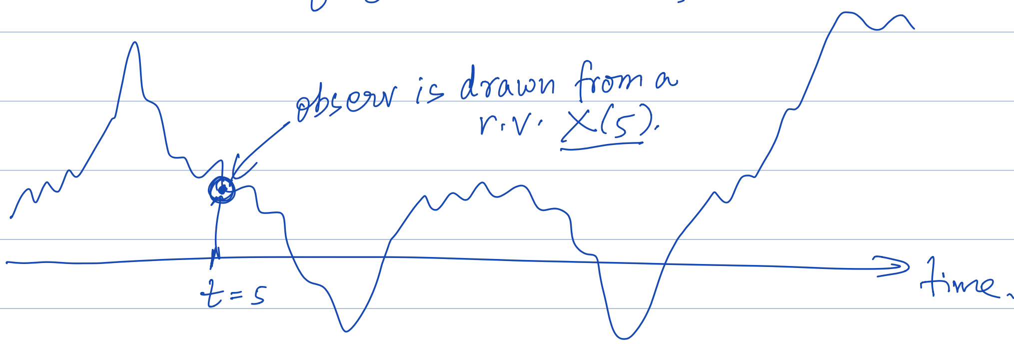
$\vec{X} \rightarrow$ Random vector

Random Process $\longrightarrow$ $X(t)$

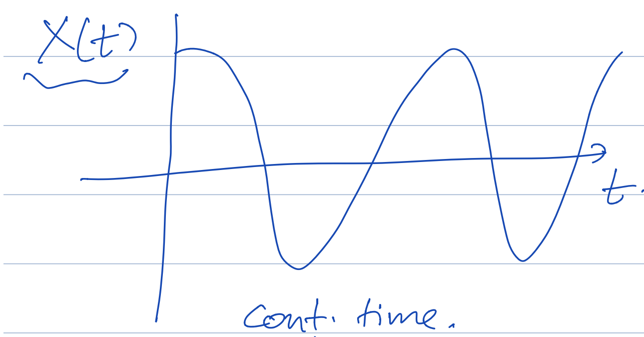
time.

$X(0) \rightarrow$ is a random variable.

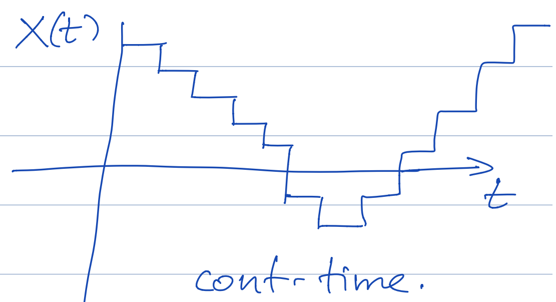




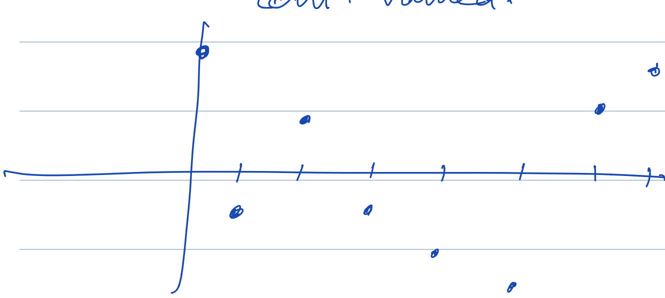
Classification of Random Processes



Cont. time.
cont. valued.



cont. time.
discrete valued.



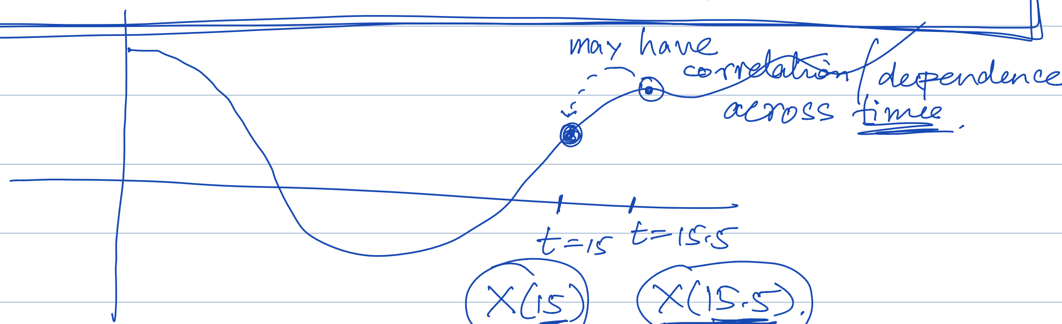
discrete
time
Random process.

How do we formally describe a Random Process ?

(Continuous time random process)

$X(15)$ ⟶ is a Random variable. ⟶ PDF or CDF.

for all times t, we can describe PDF/CDF of $X(t)$.



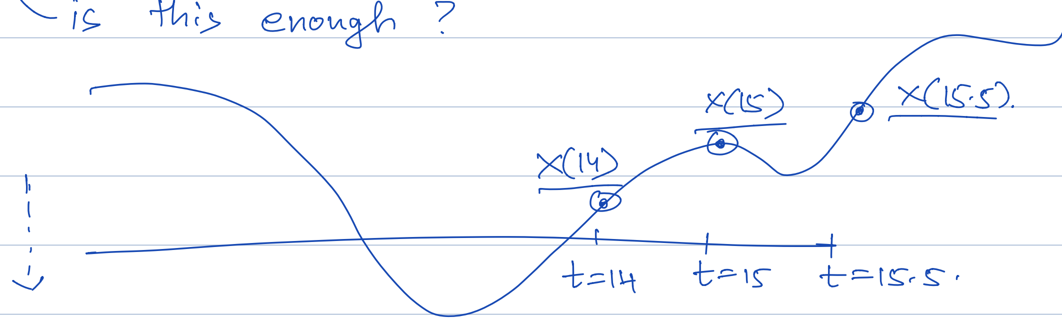
$X(15)$ $X(15.5)$

$$\boxed{f_{X(15),\,X(15.5)}(x_1, x_2)} \longleftarrow \text{Joint distrib of } X(15) \text{ \& } X(15.5).$$

$$\stackrel{?}{=} f_{X(15)} \times f_{X(15.5)} \quad ?$$

$$f_{X(t_1),\,X(t_2)}(x_1, x_2) \longleftarrow \text{Joint distrib of } X(t_1), X(t_2) \text{ for all } (t_1, t_2)$$

is this enough ?



Full description of a Random Process.

Pick any k, & pick any k times, $(t_1, t_2, \dots, t_k)$

$$f_{X(t_1), X(t_2), \dots, X(t_k)} \longrightarrow \text{J. D. of } (X(t_1), \dots X(t_k))$$

Describe this for every integer k, $\forall$ time tuples

What do we end up using in practice?

(1) First-Order PDF of a Random Process (R.P.)

PDF of $X(t)$ for all times t.

(2) Second-Order PDF of a R.P.

Joint PDF of $(X(t_1), X(t_2))$ for all pairs (t_1, t_2).