- when we talk about randomness, the main way we model it mathematically is by defining a probability space $(\Omega, P)$

where $\Omega$ is a set called sample space

$P : 2^\Omega \to [0,1]$ is a function that assigns probabilities to events: $\forall S \subset \Omega : P(S) \in [0,1]$

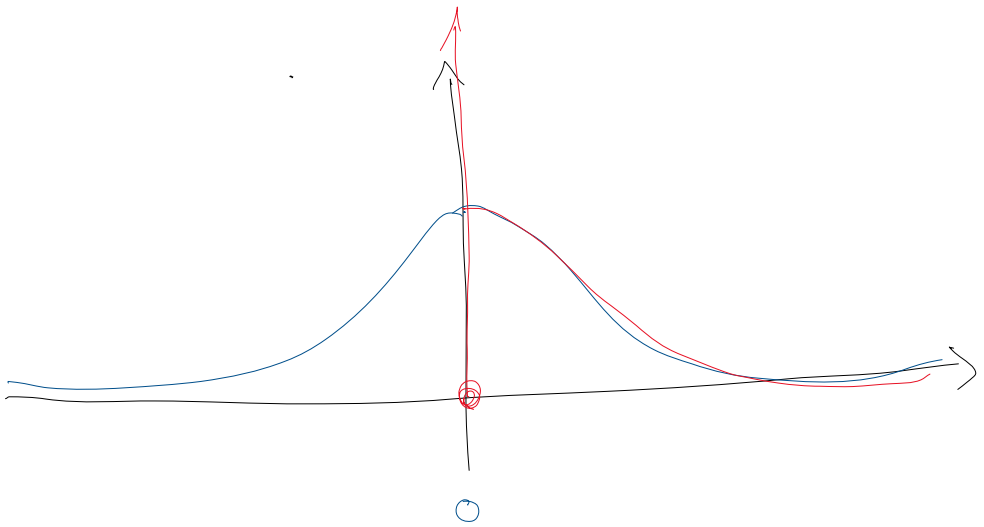
$S \in 2^\Omega$ = "power set"

ex: finite set $(|\Omega| < \infty)$: $\Omega = \{H, T\}$, $\Omega = \{1, \dots, n\}$

"flip a coin" "roll a die"

infinite set: $\Omega = \mathbb{R}^d$ ~> Gaussian random variable/vector

ex: let $x$ be Gaussian rv and $y = \begin{cases} x, & x \geq 0 \\ 0, & \text{else} \end{cases}$



what is (the) state?

def: ~~the~~ a state of a (model of a) dynamical/control system is any mathematical object that has all (and only) info needed to predict future

eg $\dot{x}/x^+ = f(x)$, $x \in \mathbb{R}^d$ + [median age of blue whales] is the state

$\dot{x} = Ax$ $\quad z = T^{-1}x \Rightarrow \dot{z} = T^{-1}\dot{x} = T^{-1}Ax = T^{-1}ATz$

$\dot{x}/x^+ \sim p(x)$