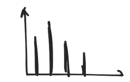
Probability and Poisson statistics!

random variable

- → continuous — momentum
- → discrete — # decays/hr



pmf / pdf → over a range of values (continuous)

→ exact prob. for each value (discrete)

$$\int_{-\infty}^{\infty} P(x)\, dx = 1$$

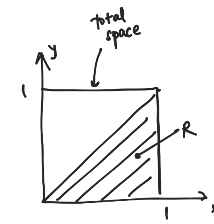
PDF $P(x)$: $p(a<x<b) = \int_a^b P(x)\, dx$

gaussian: $$P(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}\right)$$

Joint PDFs : multiple variables!

	1	2	3	...
1	1/36			
2				
3				
...				

- two dice
- discrete case
- prob of outcomes can be assigned



continuous case

$$p(x, y \in R) = \iint_R P(x,y)\, dx\, dy$$

$P(x,y) = P(x)\, P(y)$ ← independence of x, y if P can be factored

$P(x) = \int_{-\infty}^{\infty} P(x,y)\, dy$ marginalizing out y to get univariate distribution

$$p(x_1, x_2, \dots, x_k) = \frac{1}{(2\pi)^{k/2} \prod_i \sigma_i} \exp\left(-\frac{1}{2}\sum_i \frac{(x_i-\mu_i)^2}{\sigma_i^2}\right)$$

k-dim Gaussian

Poisson distribution

- discrete prob. distribution
- → number of events occurring in a fixed interval
- → constant mean rate
- → independently of the last event

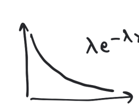
eg: snacks/hr while doing Zoom U

$$P(N=n) = e^{-\lambda} \cdot \frac{\lambda^n}{n!}$$

λ is the rate / intensity

Poisson process

intensity λ



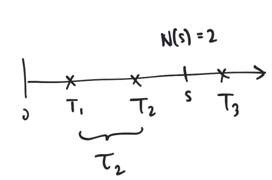
independent. exp. RVs → τ_i

$T_n = \sum_{i=1}^{n} \tau_i$ ← n^{th} arrival time.

$N(s) = \max(n : T_n \le s)$ ← # arrivals by s

(s: time)

⇒ T_n and $N(s)$ define the Poisson process.



τ_n : spacing

T_n : time of n^{th} event

$N(s)$: # events.

→ Poisson RV w/ λs