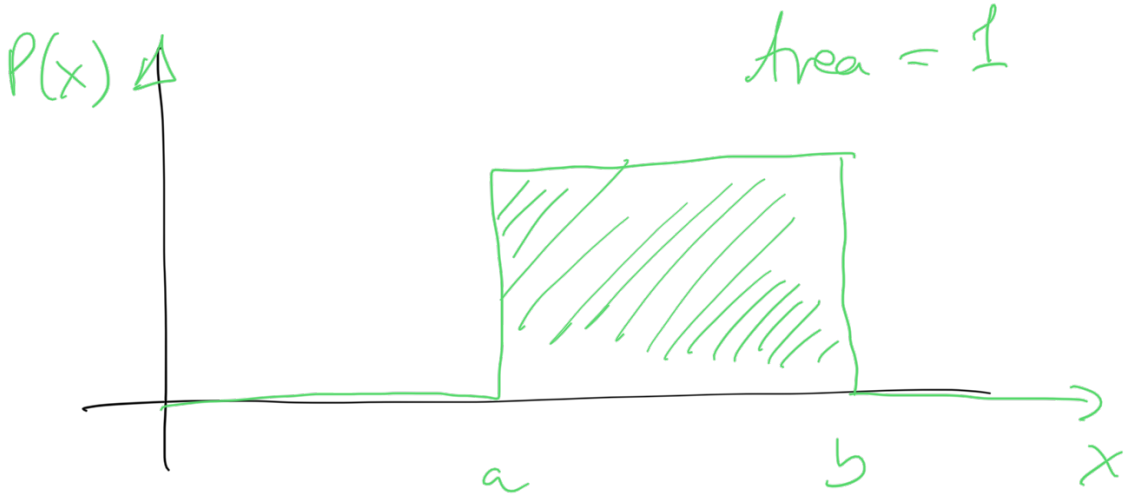
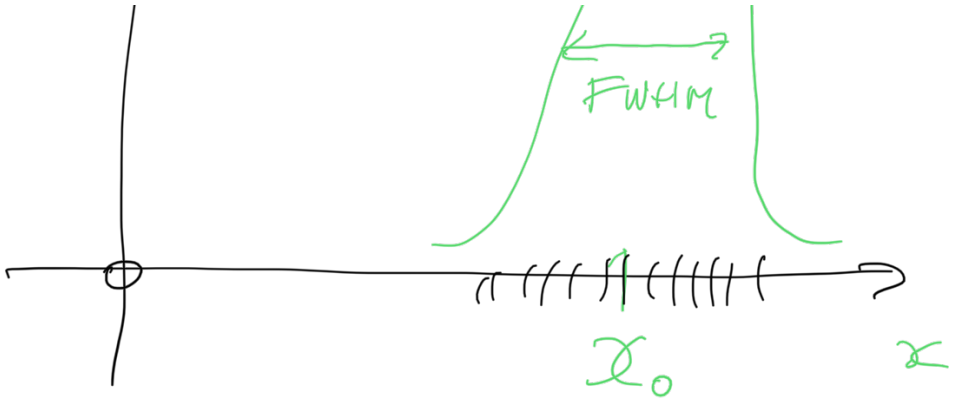
Physics 341 - Lecture 4

Probability Distributions

→ uniform



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



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

$$P(x) = \frac{1}{\sqrt{2\pi}\,\sigma}\, e^{-\frac{(x-x_0)^2}{2\sigma^2}}$$

$x = x_0$

$$P(x_0) = \frac{1}{\sqrt{2\pi}\,\sigma}$$

$$\frac{1}{2}\left(\frac{1}{\sqrt{2\pi}\,\sigma}\right) = \left(\frac{1}{\sqrt{2\pi}\,\sigma}\right) e^{-\frac{(x-x_0)^2}{2\sigma^2}}$$

$$-\ln(2) = -\frac{(x-x_0)^2}{2\sigma^2}$$

$$x = x_0 \pm \sigma\sqrt{2\ln(2)}$$

FWHM $\approx \frac{2\sqrt{2\ln(2)}}{2.35}\sigma$

Others

Discrete Probability Distributions

$x \rightarrow$ ~~continuous~~ discrete

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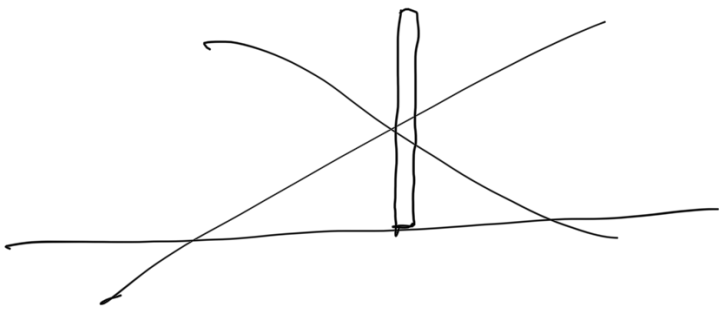
coin toss $\rightarrow$ 0 heads / 1 tails



toss a coin 12 times $\rightarrow$ # of heads

$x \rightarrow 0, \ldots, 12$

↳ discrete

Binomial Probability distribution

$N \rightarrow$ # of times that the experiment is performed

(12)

$p \rightarrow$ probability of outcome that you are interested in.

"success"

$\rightarrow k \rightarrow 0, \ldots, N$

(x)

$$P(k) = \frac{N!}{k!(N-k)!} p^k (1-p)^{N-}$$

$\binom{N}{k}$ → code int. overflow

$N = 10,000$

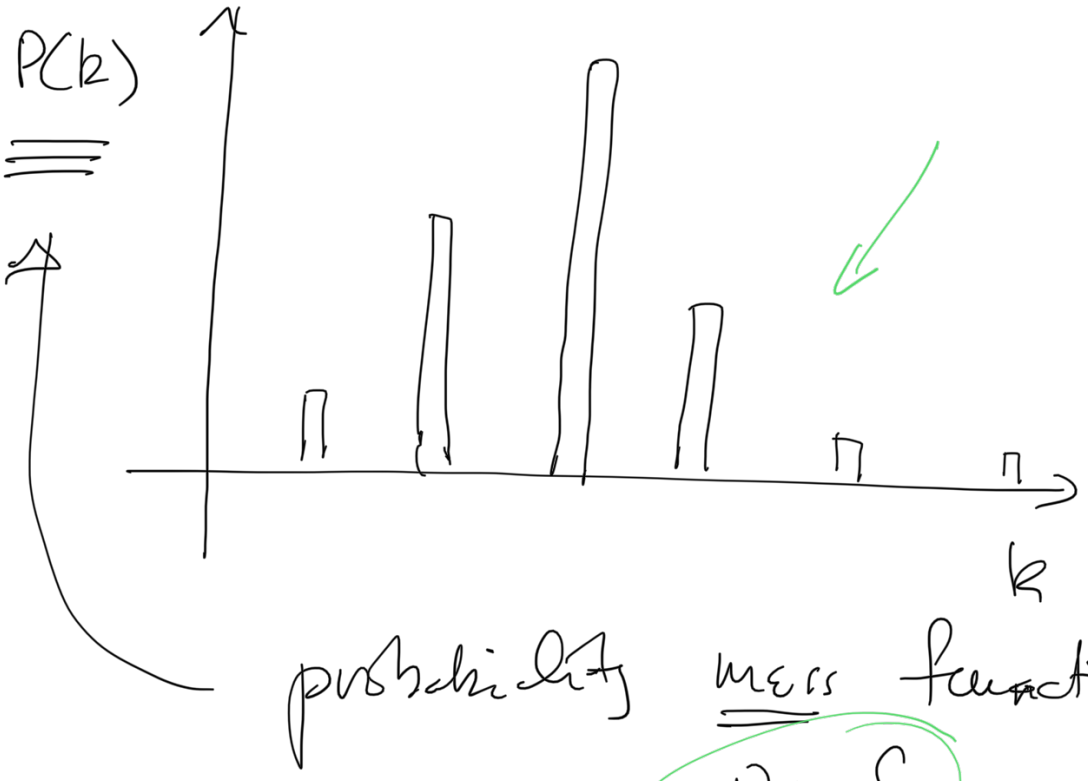
$p = \frac{1}{2}$

$k = 2150$ heads

$$P = \frac{10000!}{2150!\ 7850!} (.5)^{2150} (.5)^{78}$$

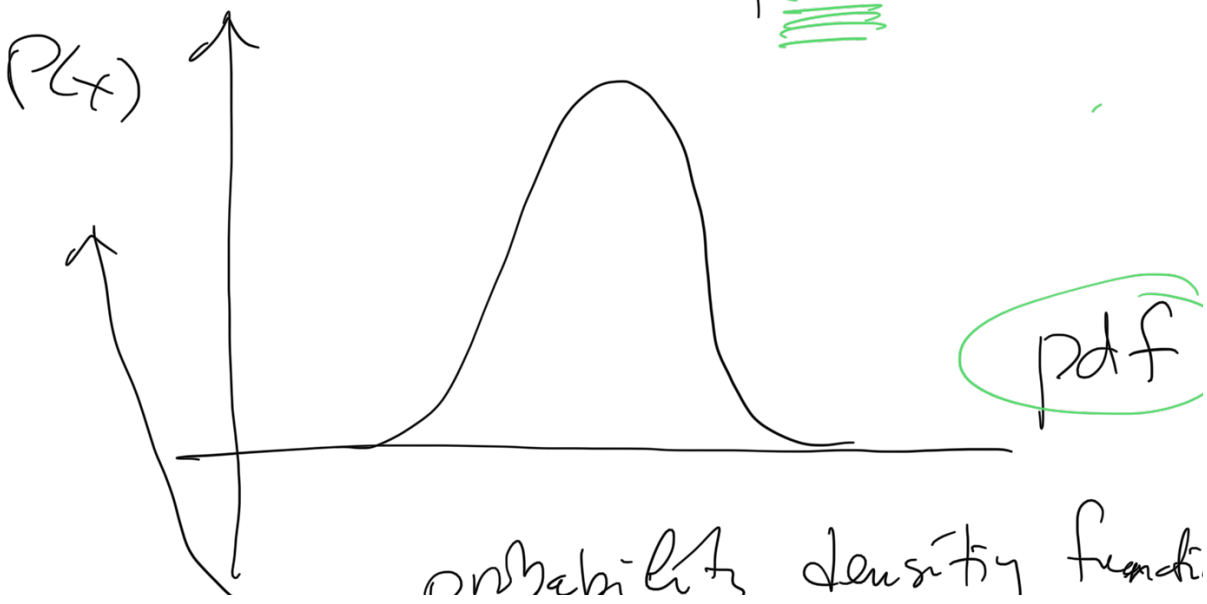
= Error

scipy.stats.binom



probability mass function

pmf



probability density functi

→ symmetric ($p = 0.5$)

small probabilities → HUMANS are FLAWED

12 → 12 heads

$1

I pay

$100,000

You Pay

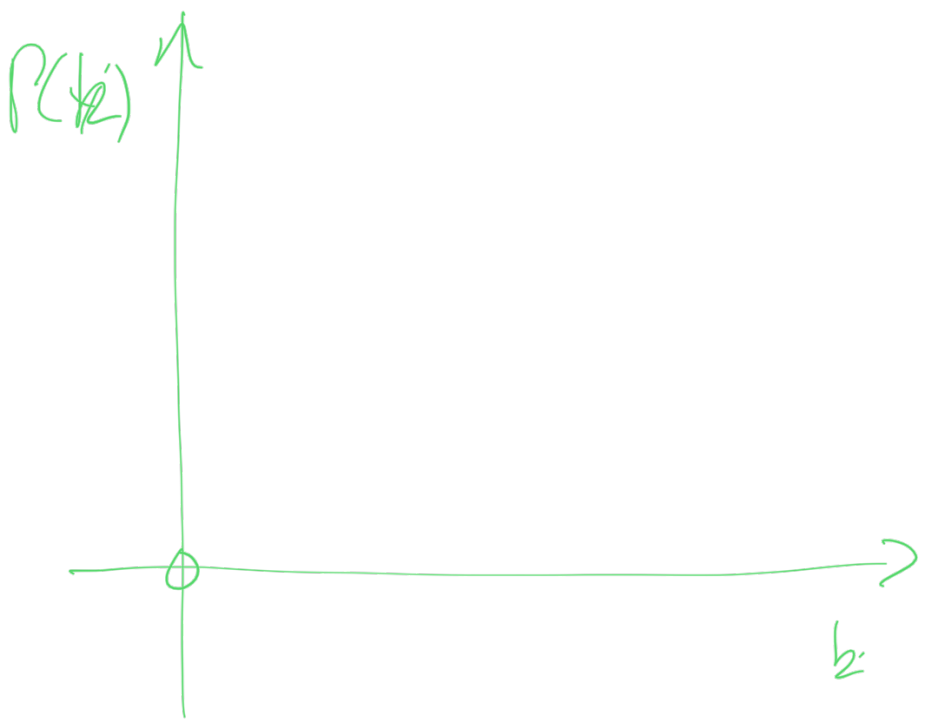
.02%

1 vs. 1 vs. 1

1000 10000 100 000

Conspiracy theories.

John Hardie → tin foil hat



$P(h) \quad P(x)$

$$\int_{5}^{} P(h)\, dh$$

$$\int_0^{} p(k)\,dk$$

$$p(0) + p(1) \cdots (Pb)$$

Cumulative Distribution Function

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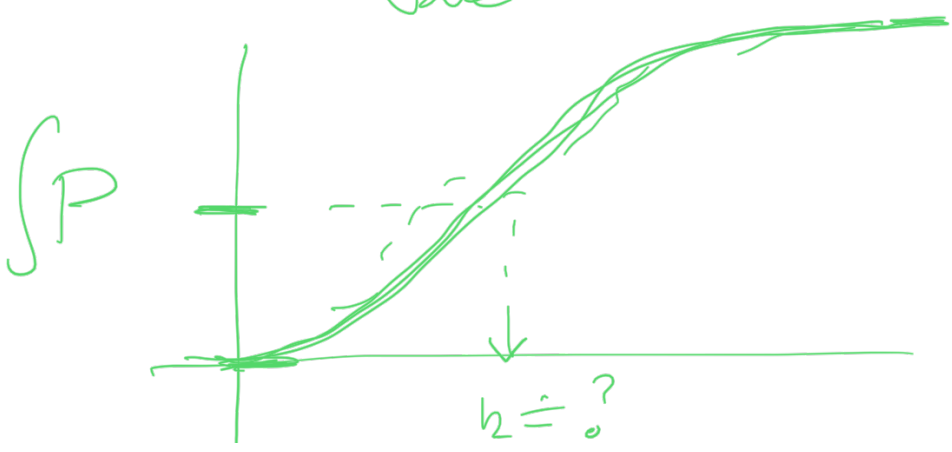
cdf

defined $\int_{\text{lowest possible value}}^{k/x} p(k/x)\,dk/x$

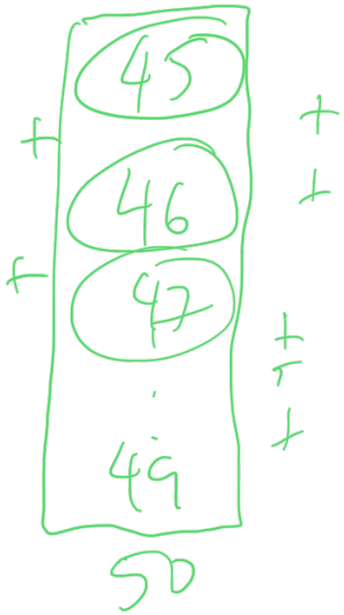


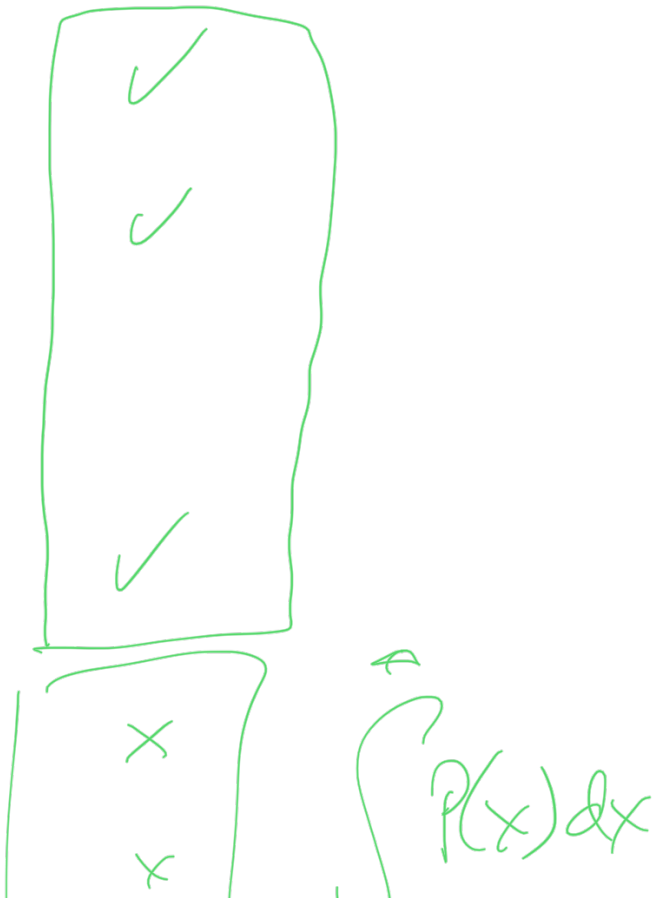
percentile point function

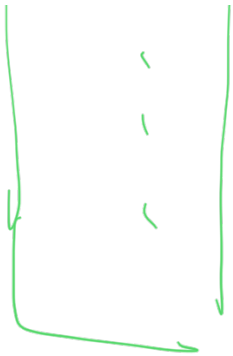
ppf

"~~Sometimes~~" always

Airlines are the antichrist!







$$(b) = 1 - (a)$$

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[

12000

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