MOD300 Anvendt Python programmering og modellering

Enrico Riccardi[1]

Department of Mathematics and Physics, University of Stavanger (UiS).[1]

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1. Recaps
2. MC method

Recaps

INFERENCE Probability distributions are a description of uncertainity (lack of knowledge).

DESCRIPTORS Probability distribution as description of a not-deterministic state (electrons moving).

Common property of Probability distributions:

$$\int_{-\infty}^{\infty} p(x)dx = 1. \tag{13}$$

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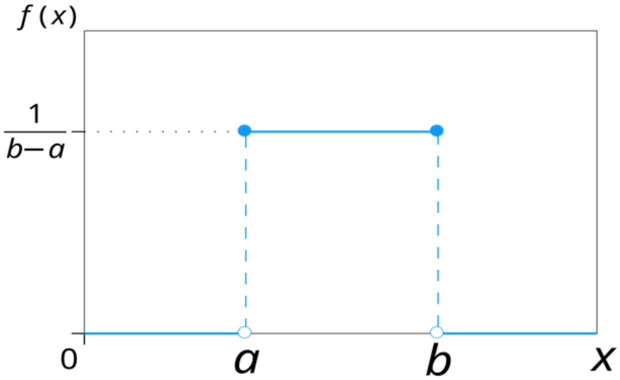
Uniform distribution function

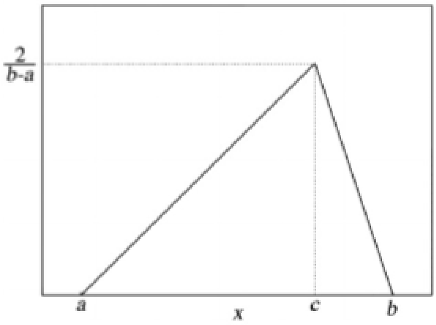
PDF: $f(x) =$

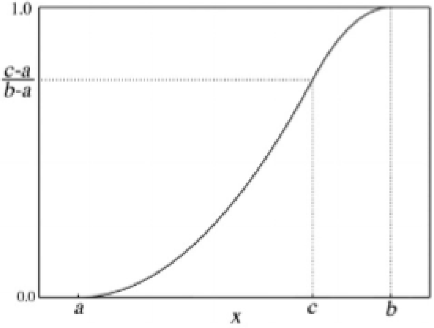
$\frac{1}{b-a}, a \leq x \leq b$



Triangular distribution function

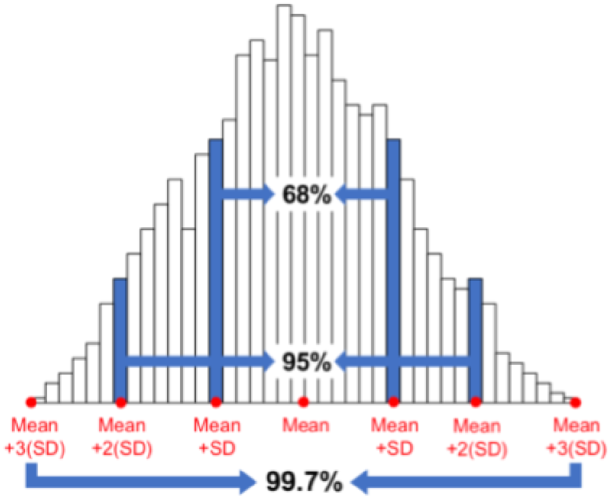
Notation: $X \sim T(a, b, c)$



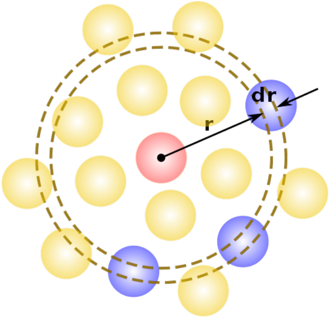


Normal Distribution

Notation: $X \sim G(\mu, \sigma)$



Radial distribution function



$$g(r) = \frac{dn_r}{4\pi r^2 dr \rho}$$

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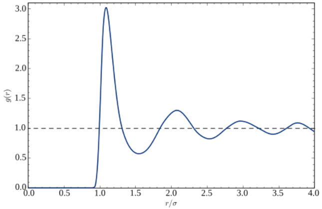
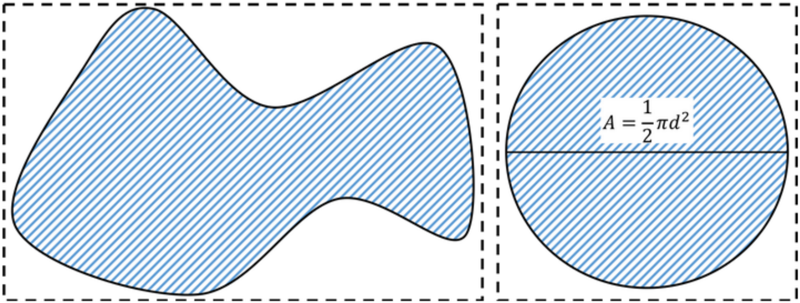
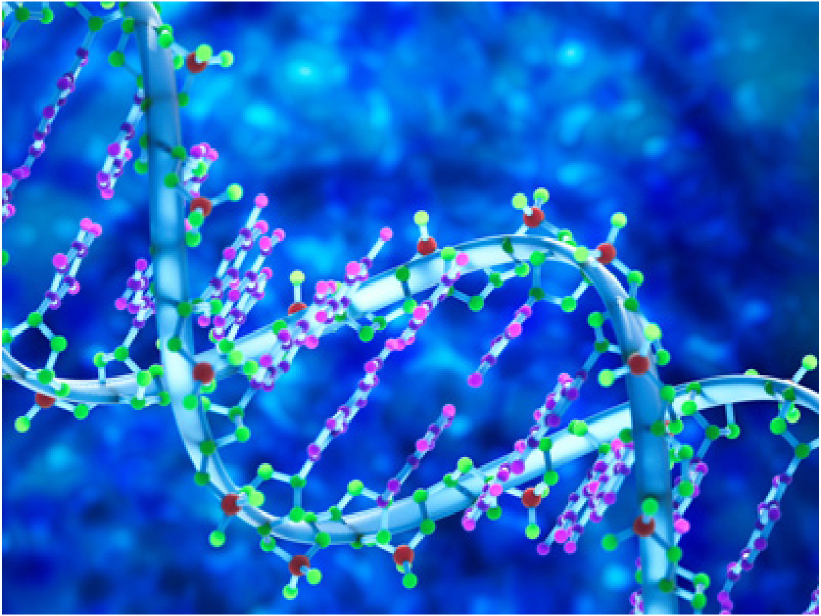


2D distributions



3D distributions



Hyper sphere

$$V(R) = \frac{\pi^{D/2}}{\Gamma(D/2+1)} R^D, \tag{20}$$

where D is the number of dimensions $\Gamma(D/2+1)$ is the gamma function, if n is an integer then $\Gamma(n) = (n-1)!$ and $\Gamma(n+1/2) = (2n)!/(4^n n!)\sqrt{\pi}$. You can easily verify that for $D = 2, 3$, $V(R) = \pi R^2, 4/3\pi R^3$, respectively

Random Numbers

HRNG: Hardware random number generator

PRNG: Pseudo Random number generator

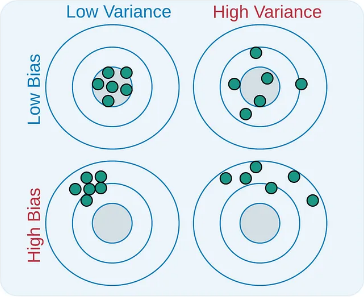
Make your random number!

MC method

Monte Carlo Integration "Hit and Miss"

Try and then count.

Bias and Variance?



Binomail distribution

Pond (p) or not pondi (q)? $p + q = p + (1 - p) = 1$

$$p(k) = \frac{n!}{k!(n-k)!} p^k (1-p)^{n-k}. \tag{2}$$

$p(k)$ is the probability that an event happens k times after n trials.

The mean, μ, and the variance, σ^2, of the binomial distribution is:

$$\mu = \sum_{k=0}^{n-1} kp(k) = np, \tag{3}$$

$$\sigma^2 = \sum_{k=0}^{n-1} (k-\mu)^2 p(k) = np(1-p). \tag{4}$$

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P and coins

What is the probability to get only heads after 4 tosses?

$$p(k=4) = \frac{4!}{4!(4-4)!}\frac{1}{2}^4(1-\frac{1}{2})^{4-4} = \frac{1}{2^4} = \frac{1}{16}. \qquad (5)$$

What is the probability to get 3 heads out of 4 tosses?

$$p(k=3) = \frac{4!}{3!(4-3)!}\frac{1}{2}^3(1-\frac{1}{2})^{4-3} = \frac{4}{2^4} = \frac{1}{4}. \qquad (6)$$

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Calculate pi from a circle:

$A = \pi * r^2$

How does it change as a function of the number of trials?

Calculate the Area of any object:

$A = N_{in}/N_{TOT} * A_{TOT}$

How does it change as a function of the number of trials?