

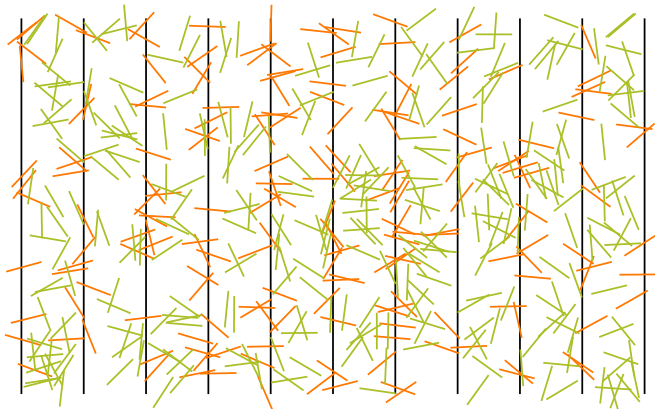
What are...Monte Carlo experiments?

Or: The shotgun method

Buffon and needles

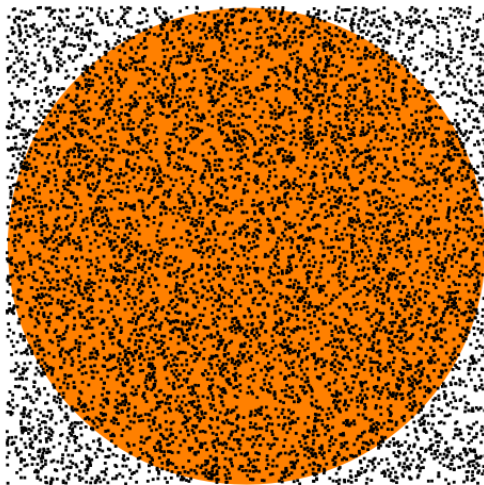
$$\text{hit ratio: } \frac{\text{hits}}{N} = \frac{189}{504} \approx 38\%$$

$$\pi \approx \frac{2 \times L \times N}{\text{hits}} = \frac{1}{189} (20.56) 504 \approx 2.98667$$



“Suppose we have a floor made of parallel strips of wood, each the same width (1 unit), and we drop a needle (L) onto the floor. What is the probability (p) that the needle will lie across a line between two strips?” It is $p = \frac{2L}{\pi}$

Shooting at circles



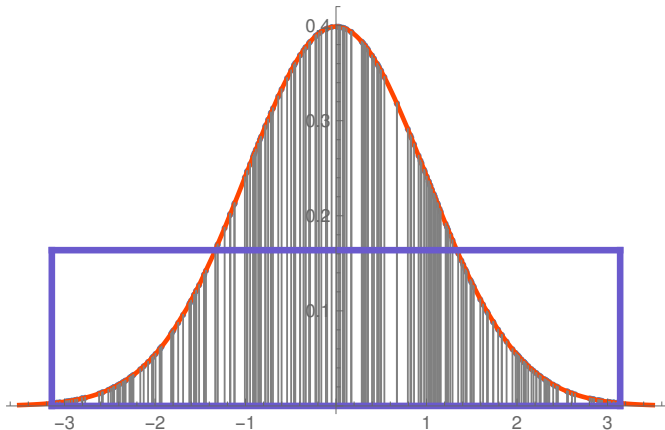
inside: 6377 outside: 1657 total: 8034
 $\pi \approx 4 \times 6377/8034 = 3.17501$

The probability (p) of a point landing in the circle is $p = \frac{\text{area}(\text{circle})}{\text{area}(\text{square})} = \frac{\pi}{4}$

Areas via $\int_a^b f(x) = (b - a)f(c)$

$$\int_a^b \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx = 0.998311$$

Monte Carlo estimate: 1.02878



Find $f(c)$ by averaging a random sample of $f(c)$

Enter, the theorem/philosophy!

A Monte Carlo experiment uses random sampling to get numerical results

Widely applicable

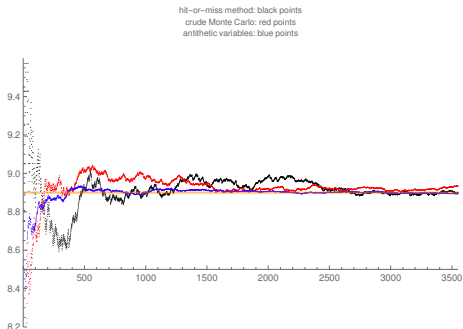
4 Applications

- 4.1 Physical sciences
- 4.2 Engineering
- 4.3 Climate change and radiative forcing
- 4.4 Computational biology
- 4.5 Computer graphics
- 4.6 Applied statistics
- 4.7 Artificial intelligence for games
- 4.8 Design and visuals
- 4.9 Search and rescue
- 4.10 Finance and business
- 4.11 Law

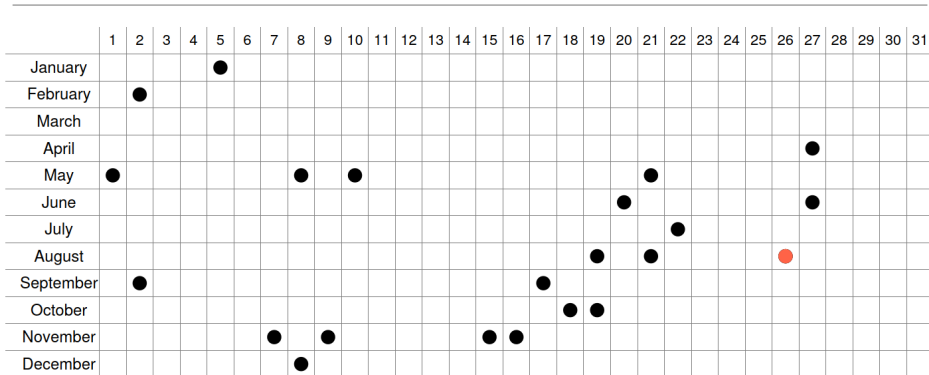
5 Use in mathematics

- 5.1 Integration
- 5.2 Simulation and optimization
- 5.3 Inverse problems
- 5.4 Philosophy

Comparison of convergence



Monte Carlo in discrete mathematics



	Double matching	Triple matching	Quadruple matching
Number of matchings	1	0	0
At least probabilities	0.5073	0.01271	0.00017

How often do people share the same birthday? Use Monte Carlo!

Thank you for your attention!

I hope that was of some help.