# Lecture 7: Basic Sampling

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## Pseudo-random number generators

PREDICTIVE
SCIENCE LABORATORY

# Pseudo-random number generators

- Computers are deterministic machines and therefore they cannot generate completely random numbers?
- Idea: Are there deterministic sequences of numbers that look random?
- Pseudo-random number generators do exactly that.
- We use statistical tests to see how good they are.

# Pseudo-random number generators

How do you generate a uniform random number?

**John von Neumann.**
**(Los Alamos)**

## The middle-square method

**412523**
*seed*

**170175225529**
*seed * seed*

**175225**
*output*

*output becomes seed*

The first, but it doesn't pass all statistical tests.

# Linear congruential generators

Seed $x_0$

take remainder of division by m

$$x_{i+1} = (ax_i + b) \mod m$$

big number, better if prime as well

- For every choice of a, b, and m we get a psendo-random number generator
- This method passes many statistical tests, but still not the best

# Mersenne Twister PRNG

- This is what is inside numpy.random.

- Details beyond the scope of this class.