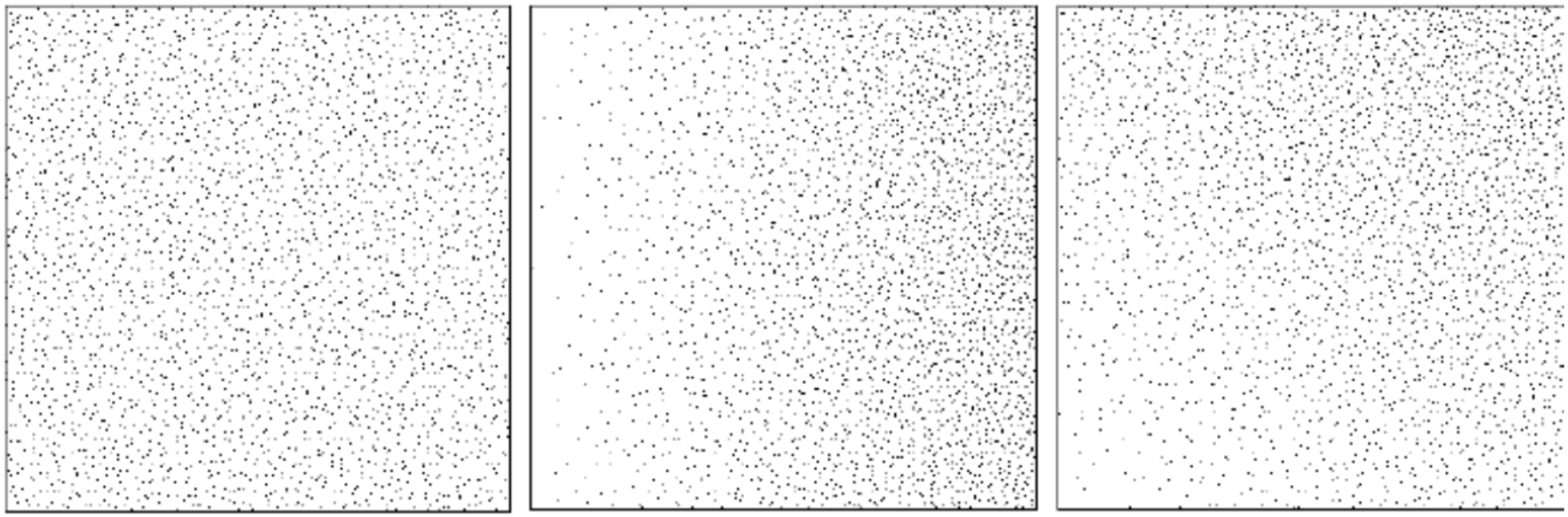
MATH 205: Statistical methods

Lab 4: Let's simulate a coin toss!

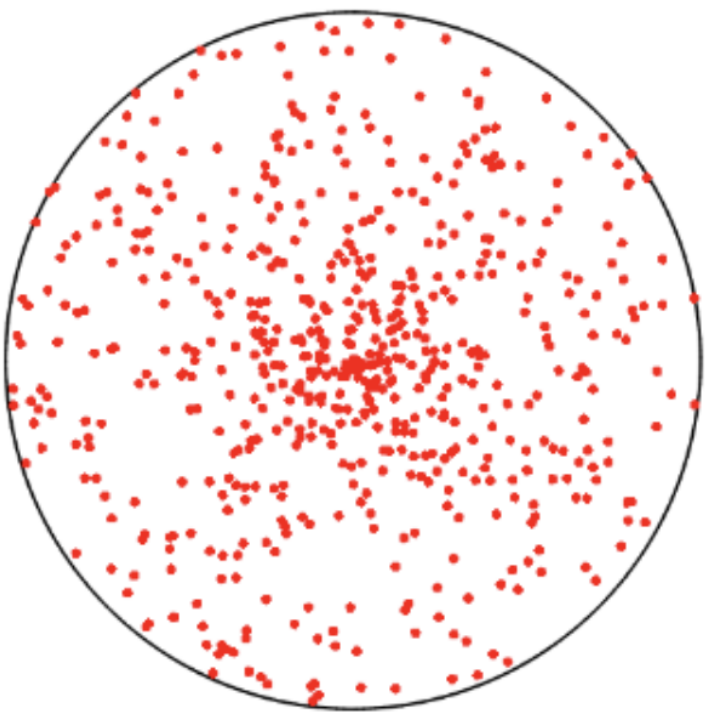
Goals: Generate random data

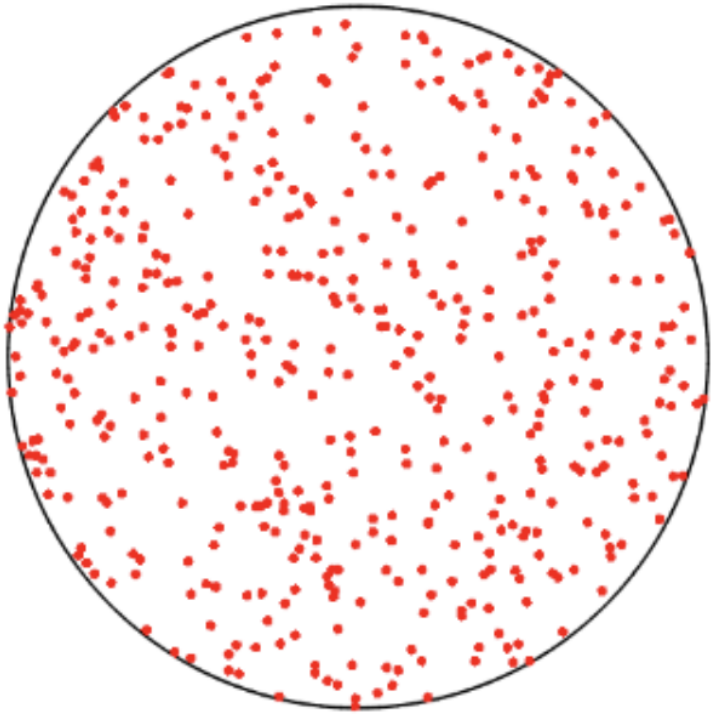
- Pseudo-random number generator
- Simulate random coins/dice
- Simulate a simple 2D random walk

Uniform distributions



Uniform distributions





Uniform distribution on the interval $[0, 1]$

- often denoted by $U(0, 1)$, where U stands for uniform distribution
- distributes probability for all points in $[0, 1]$ equally
- all intervals of the same length on $[0, 1]$ are equally probable
- in R: generated by a pseudo-random number generator
- to generate a sample of $U(0, 1)$, we use the function *runif*

Simulate a fair coin

- Step 1: Generate u from $U(0, 1)$
- Step 2: If $u < 0.5$, set outcome = 'head'; otherwise, set outcome = 'tail'

Problem 1: Simulate a biased coin

Problem

How do we simulate a biased coin which turns head 60% of the time?

Tasks: Simulate 10000 tosses of this coin and make a bar plot of the outcome.

Problem 2: A particle moving in a 2D plane

Assume there's a particle moving in a 2D plane. At each instant of time, the particle:

- moves up with probability 0.2
- moves down with probability 0.3
- moves left with probability 0.3
- moves right with probability 0.2

Tasks:

- Simulate the outcome of one run of this experiment
- Simulate 2000 experiments and record the outcomes in an array