Review

Random & Math

random.random()
random.choice(list)
random.sample(pop, k)
random.randint(a, b)

show math documentation

Import Statements

import [module]
import [module] as [alias]
from [module] import * (Dangerous, demonstrate)

Tuples

As multi return value
Example in multi_return.py

Stack Traces

Common Errors and their stack traces
Examples in stack_trace.py

Monte Carlo Simulations

Application of random

A somewhat more advanced topic (6.0002) but:
- It’s a cool application of the modules we learned
- Randomization lets you do cool things
- It has real world applications for problem modeling

Sometimes when things are complicated it’s hard to solve for the probability of certain events
- That’s when we use a Monte Carlo Simulation
- Simulate the situation on a computer for many trials
- Use the average as an estimation for the average outcome

Why It Works / Probability Concepts
Independence: Two events don’t affect each other. Trials are typically independent. e.g. drawing cards from a deck is not unless you reshuffle the card back in after each draw

Law of Large Numbers: As trials approaches infinity, average value of trials approaches expected value.
- Remember Independence, 1000 Tails in a row does not make Heads more likely (Gambler’s Fallacy), instead has infinitely long to approach expected value
- In Monte Carlo Simulation, we choose number of trials to be “large” so outcome approaches expectations
- Any finite value isn’t quite “large” enough, but we can do pretty well most of the time

Examples

Code for these examples in simulations.py

Sock Simulation

You have a drawer containing a pair of socks each in red, green, and blue. What is the probability of pulling out a matching pair on your first try? With replacement? Without?

Island Disease

100 people become stranded on an island and end up getting sick with Sylvan-itis, but there’s no doctor among them, so nobody knows how sick each of them are, or how many pills they need to survive. However, one of them remembers reading that the disease will require at most 5 pills to be completely cured in the worst case of the disease. Less severe cases could require anywhere between 1 and 4 pills to be cured, but need diagnosis by a doctor.

The ship they crashed from only has 320 pills, so if everyone is severely sick, not all of them can live. However, if everyone is only a little sick, they can all survive. It turns out they’re all selfish, though, so everyone wants to take all the pills they can. They agree on the following scheme:

- Everyone gets 5 tickets, since nobody will need more than 5 pills
- The total 500 tickets will be put into a hat, and 320 tickets will be pulled at random

Because they’re all selfish, they’ll immediately take any pills they get. On average, how many of the people will survive the outbreak of Sylvan-itis?