simulations. . . for the ~~working~~ lazy mathematician

math camp #1 day #4

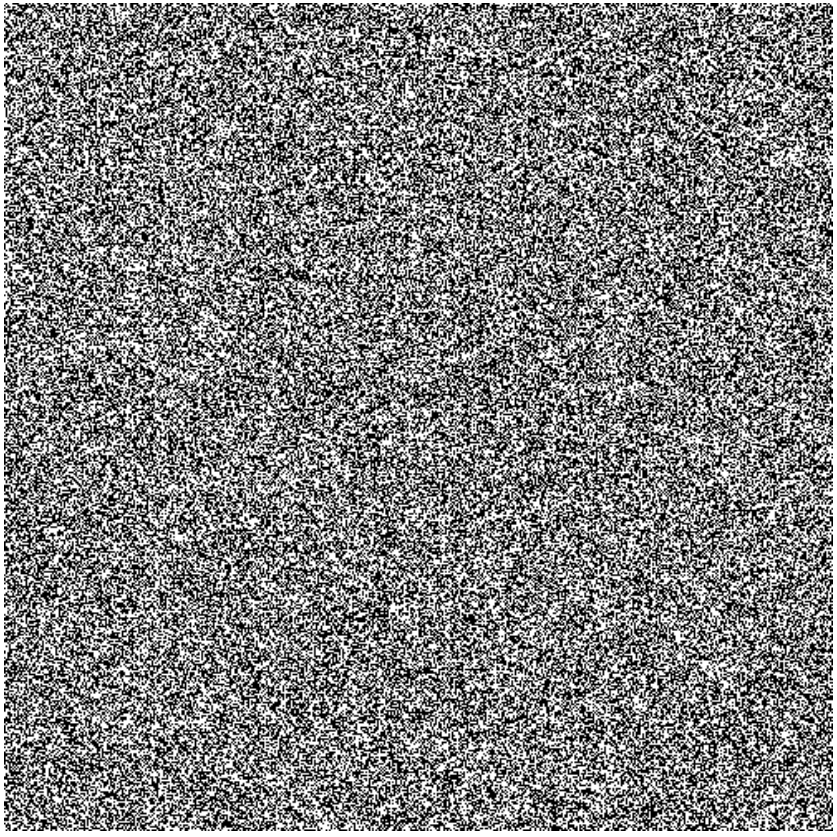
game plan

what is randomness?

simulations

- binomial simulations
- poker simulations

what is randomness?



let's write some ideas on the board...

random bits

take a minute to write down 25 random bits...
actually write them down on a piece of paper!

more random bits

people are notoriously bad at writing down random bits...
here are some random bits generated by the computer:

$$0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0$$

and here's the code in `python`:

```
import random
[random.randint(0,1) for i in range(25)]
```

how does a computer generate random bits?

does anyone know? please explain it to me! :)

in general this is difficult problem beyond today's scope

just rest assured that computers are *pretty good* at generating random bits

why do we care?

so what? who cares about random bits?!

but that's not all folks. . .

we can also use random numbers to *simulate* random phenomena

one thing this enables us to do is approximate probabilities that might otherwise be difficult to compute (seriously counting stuff is hard!)

we will also see later that simulations can be used to model interesting processes

OK so maybe we will convince you that simulations are more than just being lazy :)

binomial simulations

how might we simulate coin flips with random numbers. . . you ask?

$$0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0$$

a more complicated simulation

next we will also simulate a (simplified) poker game

but first we need to know some of the rules (it will make it more fun at least)

what is poker?

- poker is a card game with (in our case) 4 players (or teams)
- each player gets a **hand** (2 cards from the deck)
- the **board** is then randomly chosen from the remaining cards in the deck
- there is a round of **betting** *before* the board is revealed
- the betting creates a **pot** of money or chips which the players are playing for
- the players use the 2 cards from their hand and the 5 board cards (for a total of 7 cards) to make the best **5 card poker hand** and determine who gets the pot

5 card poker hand rankings

- straight flush e.g. 2♡3♡4♡5♡6♡
- four of a kind e.g. $J\spadesuit J\diamondsuit J\heartsuit J\clubsuit T\diamondsuit$
- full house e.g. $A\diamondsuit A\clubsuit K\heartsuit K\spadesuit K\clubsuit$
- flush e.g. 2♠$K\spadesuit A\spadesuit$5♠$J\spadesuit$
- straight e.g. $T\spadesuit J\clubsuit Q\clubsuit K\diamondsuit A\heartsuit$
- two pairs e.g. 3♣3♢5♣$K\diamondsuit K\heartsuit$
- one pair e.g. $A\clubsuit A\heartsuit$3♣4♣7♣
- high card e.g. $K\heartsuit$9♣2♢$J\spadesuit T\spadesuit$

any questions before we. . . simulate?

thanks for listening!

material from today can be found (for a limited time only!) at
`www.math.dartmouth.edu/~mjmusty/mathcamp1.html`