

Problem 4: (10 pts) Fibonacci numbers

Part I: Suppose 7 and 11 were consecutive Fibonacci numbers; what would be

a. the Fibonacci following 11?

b. the Fibonacci preceding 7?

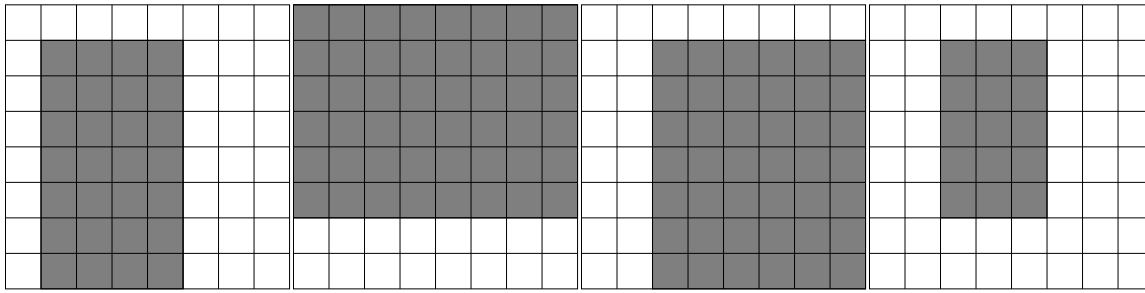
Part II: You're playing the game of Fibonacci nim:

a. What do you do if you are given the choice of going first or second given the starting value of 89 sticks?

b. Are you in a winning position if it is your turn, your opponent just took 3 sticks, and you are staring at 42 sticks?

Problem 5: (10 pts) Geometry Part I: Golden rectangles

a. Which of the following rectangles is the closest to golden?



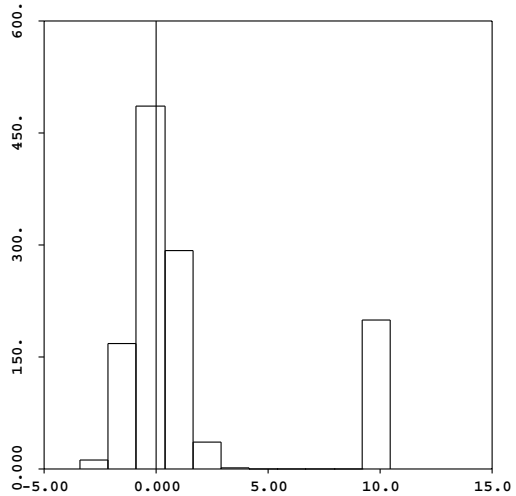
b. Given a golden rectangle: what do you get when you remove the largest square possible from the rectangle?

Part II: Complete the following table for the five platonic solids:

Solid Name	# of vertices	# of edges	# of faces
T			
C			
O			
I			
D			

Problem 6: (10 pts) Stats:

- a. For the following figure, indicate approximately the location of the mean and median. In particular, make sure that you have their *relative* positions correct.



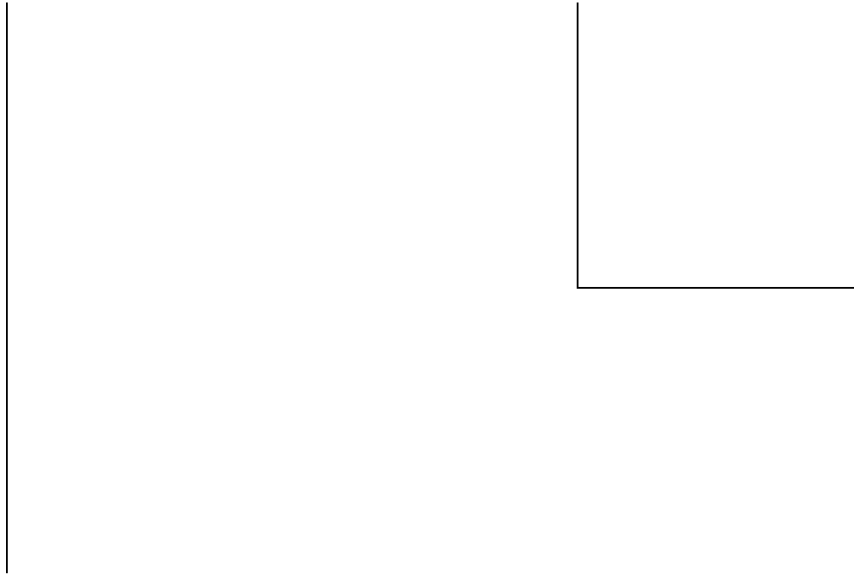
- b. What makes the statement “The average American has one testicle.” so (mathematically) amusing?

- c. What is the median number of ovaries of an American? Why?

- d. Draw (carefully!) a normal curve, and indicate the position of the mean and median.

Problem 7: (10 pts) Fractals

The following figure shows the initial line segment, and the line segment after application of a simple process. One could say that the initial stick has been broken into four equal sized line segments:



- a. (5 pts) Perform the next two iterations to the figure on the right.
- b. How many line segments will there be after n applications of the simple rule, starting from the single starting segment ($n = 0$)?
- c. If we continue this process forever, what will be the length of the resulting fractal?

Problem 8: (10 pts) Infinity

Part I: on the playground two kids are fighting: one says to the other, “I hate you an infinity amount!” The other responds, “Yeah? Well I hate you infinity plus one!” Explain to the second kid why he doesn’t hate any more than the first kid.

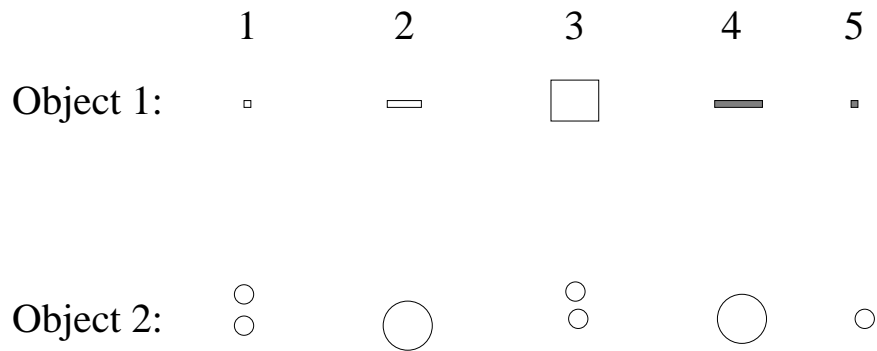
Part II:

a. Write an explicit one-to-one correspondence that illustrates that the set of natural numbers has the same cardinality as the the even natural numbers.

b. Explain how to create a set that has cardinality greater than the set of even natural numbers.

Problem 9: (10 pts) Dimension

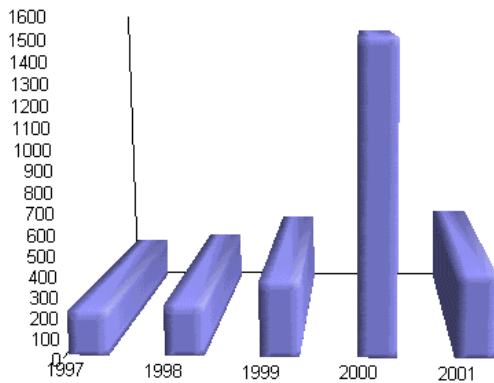
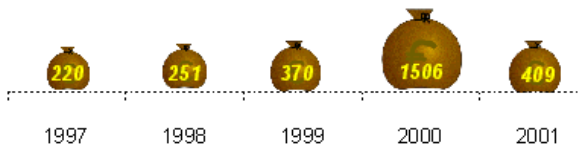
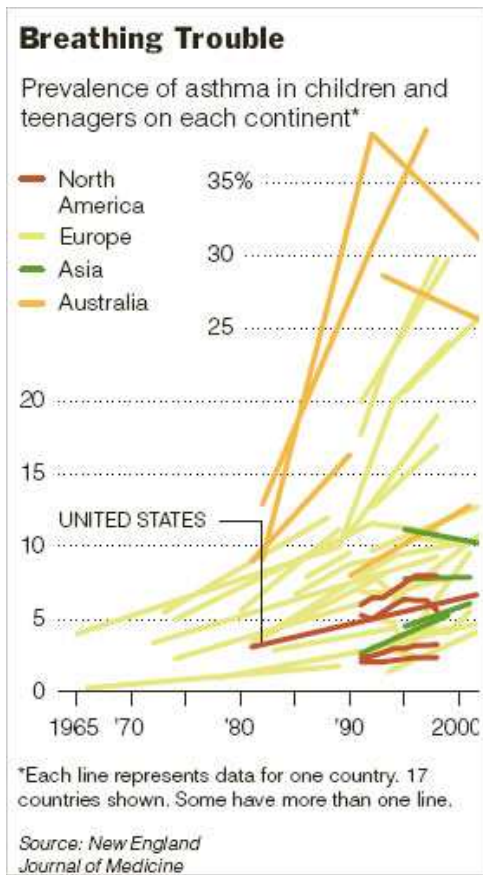
- a. For the object below, describe (by drawing) a three-dimensional object that could have made the impressions shown on a two-dimensional world as it passed through (stages 1 through 5).



- b. In the space below draw four qualitatively different impressions that a hollow cube could make on a two-dimensional world.

Problem 10: (10 pts) Graphs

For each graphic below, comment (to the right) on factors that make it good or bad:



Problem 11: (10 pts) Dynamics

Dr. Cushing introduced us to various notions in our unit on dynamics. Explain each of the following terms in the context of dynamical systems:

a. Equilibrium

b. Chaos

c. Bifurcation

d. Deterministic

Problem 12: (10 pts) Elections

a. What is the difference between a plurality and a majority in an election?

b. Describe the Electoral College, by which we choose our president.

c. (5 pts) Consider the following data, which represents six people voting on three candidates (1, 2, or 3), from “first to worst”. Describe two different reasonable voting schemes that would

Table 1:

Order of Candidate	Bob	Bill	Bjorn	Brenda	Bobbie	Billie
First	1	2	3	1	2	3
Second	2	3	1	3	1	2
Third	3	1	2	2	3	1

allow us to choose between what appear to be three very balanced candidates!

Problem 13: (10 pts)

Things that transpired during the show-n-tell sessions.

a. Name all the musical instruments that actually appeared in class during the project sessions.

b. Name (at least) three different computer-based projects.

c. Name at least three projects that focused on Fibonacci numbers or ideas related to Fibonacci numbers.

d. Name one project that included something that could be spilled.