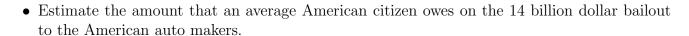
MAT115 Final (Fall 2008)

Name:

Directions: Show your work! Answers without justification will likely result in few points. Your written work also allows me the option of giving you partial credit in the event of an incorrect final answer (but good reasoning). Indicate clearly your answer to each problem (e.g., put a box around it). You may skip one problem from 1-12 (but not 13). Write "skip" on the problem. Good luck!

Problem 1: Estimation (10 pts)

Part I:



• What if we could spread the 14 billion over all the people in the world? How much would a "world citizen" owe?

Part II: Demonstrate that almost everyone has a "temporal twin" (that is, someone who was born the same day as you were born, and will die the same day as you do).

Problem 2: (10 pts) Financial Math

Part I: A house that would have cost \$10,000 in 1913 dollars would cost \$210,000 in 2008 dollars.

a. Explain why we speak of "1913 dollars" and "2008 dollars".

b. If a loaf of bread costs \$1.80 in 2008 dollars, what would you guess might have been the cost of a similar loaf in 1913?

Part II: You take out a loan of \$210,000 at 5% semi-annual compound interest.

$$P(t) = P_0(1 + r/n)^{nt}$$

a. What is the principal on your loan at the end of one year, if you don't make any payments against it?

b. How much would you owe if the principle had been \$21,000, rather than \$210,000?

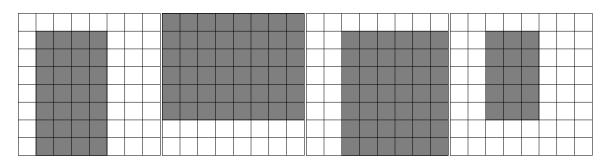
Problem 3: (10 pts) Number Composition

Write the number 1001 (here writt	en in base 10) in four different ways:
a. As a sum of powers of 10;	
b. In base 7;	
c. As a sum of non-consecutive Fib	onacci numbers;
d. As a product of prime numbers.	
-	

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 o 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?

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



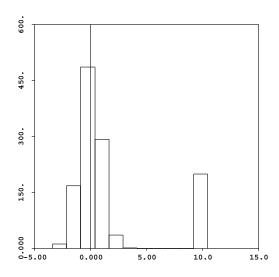
b. Given a golden rectangle: what do you get when you remove the largest square possible from the rectangle?

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

Solid Name	# of vertices	# of edges	# of faces
T			
С			
О			
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.



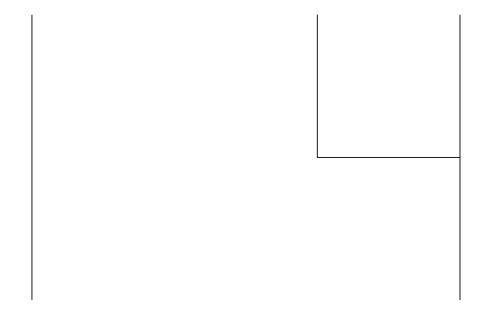
b. What makes the statement "The average American has one testicle." so (mathematically) amusing?

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)?

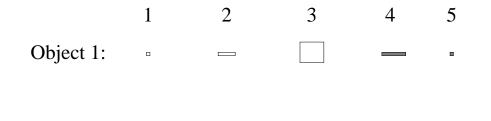
c. If we continue this process forever, what will be the length of the resulting fractal?

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).

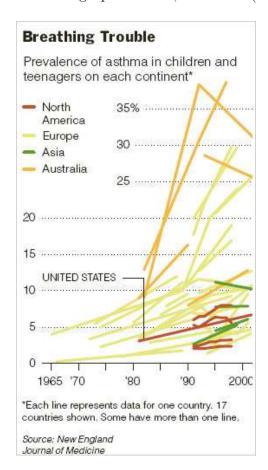


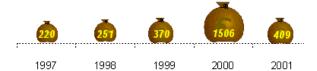
Object 2: \circ \circ \circ \circ

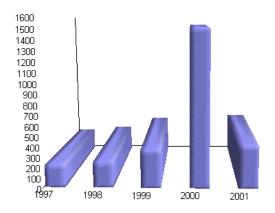
b. In the space below draw four qualitatively different impressions that a hollow cube could make on a two-dimensional world.

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.