MAT115 Test 2 (Spring 2009): Dimension, Geometry, Statistics

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). **Good luck!**
Remember to attach your homework from section 7.5 to this exam!

Problem 1: (15 pts)

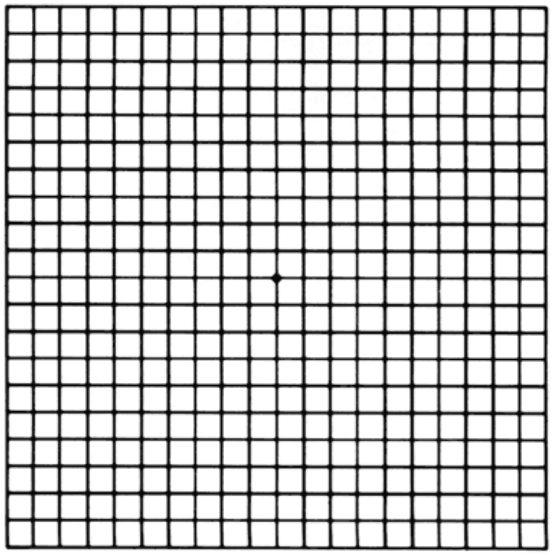
- (6 pts) Fill in the following table:

	vertices	edges	faces	faces at each vertex	edges on each face
Octahedron					
Hexahedron					

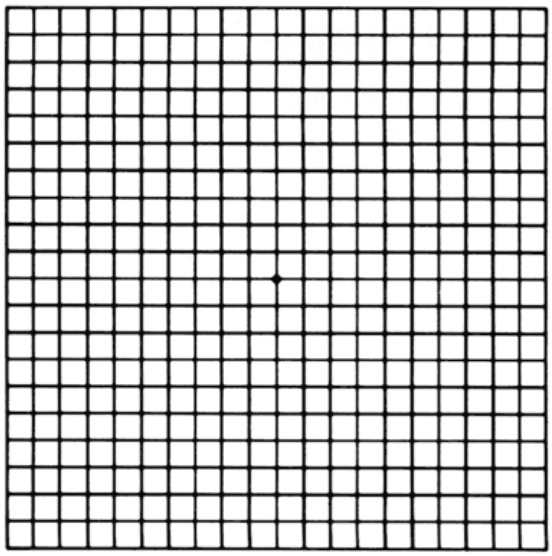
- (3 pts) Note any connection between the two rows of your table, and explain the significance.

- (6 pts) Name all the other Platonic solids.

Problem 2: (10 pts) Draw the best approximation possible to a golden rectangle using the grid below, longer side running left to right. In what ratio are the side lengths of a true golden rectangle found? Carve out from within your approximation the largest square you can. What can you conclude about the rectangle left over from the operation (include justification!)?



Problem 3: (10 pts) Use the grid below to demonstrate the construction of a logarithmic (or Fibonacci) spiral which generates successively better rectangular approximations of a golden rectangle. Use squares of side lengths given by Fibonacci numbers to contruct it: 1x1, 1x1, 2x2, 3x3, 5x5, etc.



Problem 4: (10 pts) Harper's Index reported in 1999 the following: "Chance that a Wyoming inmate under the age of 18 has used crystal meth more than once: 1 in 2." How could they get this information? Perhaps they used one of our statistical techniques. Suppose we ask 34 Wyoming inmates under the age of 18 the following: "Have you used crystal meth more than once?"

Formulas you might find useful:

$$r = \frac{4 * TY - N}{2 * N}$$

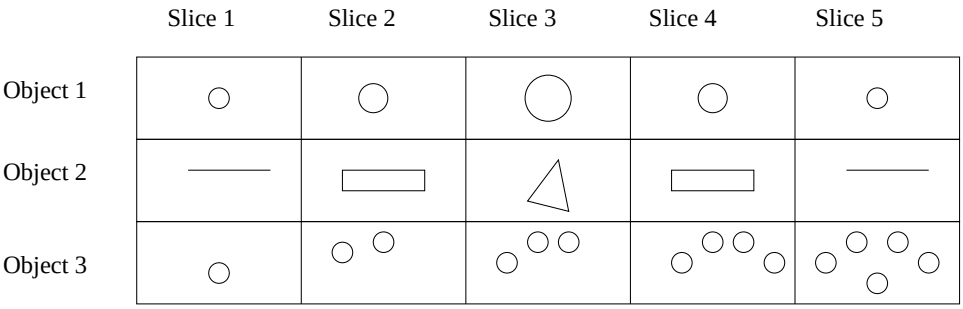
$$r = \frac{2 * Y - N}{N}$$

a. Describe the one-flip method of testing. Report the rate you obtain if you get 25 yesses.

b. Describe the two-flip method of testing. Report the rate you obtain if you get 18 yesses.

Problem 5: (18 pts)

a. (6 pts) Consider the following three slices of a 3-D object intersecting with a 2-D world. In each case draw or describe a well-known object that could have generated those slices.



Object 1:

Object 2:

Object 3:

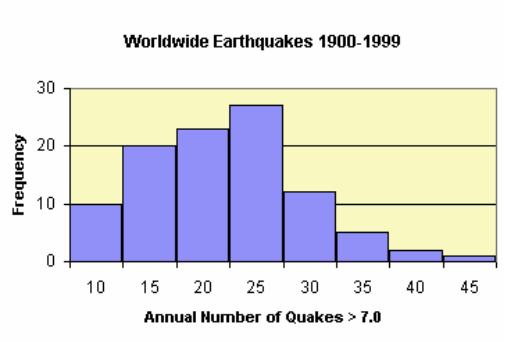
b. (3 pts) Describe a zero-dimensional world.

c. (3 pts) Illustrate how a three dimensional creature could perform surgery on a two-dimensional being to produce a "miracle cure" in the 2-D world.

d. (3 pts) In what sense can time be considered the fourth dimension? What are examples, advantages, or problems of considering it the fourth dimension?

e. (3 pts) How can one use a fourth spatial dimension (with which we are unfamiliar) to explain Ghosts and Angels?

Problem 6: (11 pts) Earthquakes that are magnitude 7 or above are often (though not always) very damaging earthquakes. The United States Geological Survey has compiled information on the number of earthquakes around the globe that have equaled or exceeded magnitude 7. The data are expressed as the number of earthquakes per year for the years 1900-1999.



a. (4 pts) Based on the histogram above, estimate the mean. (Explain <u>how</u> you got your answers!)

b. (4 pts) In which category will the median occur? (We can figure this out exactly!)

c. (3 pts) Which is the better estimate of the standard deviation: 1, 7, 14, or 21? Why?

Problem 7: (16 pts) Variety pack:

a. In class we made Borromean rings, using rubber bands and using 3x5 cards. Draw an illustration of Borromean rings, and describe their amazing property.

b. Why can't hexagons be used to construct any Platonic solids?

c. Describe how the golden ratio is related to Fibonacci numbers.

d. Why is architect Le Corbusier mentioned in section 4.3?