Name: _____

Math 114 Final
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Instructions

- Turn in your course wrapup document. (Do that now so you don't forget at the end of the exam.)
- You can find this exam at `http://www.cs.umb.edu/~eb/114/final/finals14.pdf`
- Write your answers on the exam paper whenever that's possible. Use the reverse side for more space.
- Do your Excel work in just one spreadsheet. Use separate tabs (worksheets) for separate problems.
- When you are done, email your spreadsheet to me at my gmail address

  `ebolker@gmail.com`

  with subject line

  `Math 114 final`

  Email a copy to yourself (or put your spreadsheet on your memory stick).
- Remember to show all your work, write full sentences (even paragraphs sometimes). Support your opinions with quantitative reasons.
- Round answers to the right number of significant digits.
- Use the internet only when you don't have the data you need in the problem statement.
- Please use your common sense.

1. On April 18, 2014 Leon Neyfakh wrote in *The Boston Globe* that property confiscated by the Cuban government in the 1959 revolution was

> ... originally valued at $1.8 billion, which at 6 percent simple interest translates to nearly $7 billion today. [1]

(a) Is the simple interest calculation in the quotation correct?

(b) What would the value be today at 6 percent compound interest?

(c) What would the value be today simply taking inflation into account?

(d) Discuss which of the three valuations makes the most sense?

[1] `http://www.bostonglobe.com/ideas/2014/04/18/cuba-you-owe-billion/jHAufRfQJ9Bx24TuzQyBNO/story.html`

2. Using Excel, construct a table for both a linear and an exponential model of the increase in value over time of the $1.8 billion in property confiscated by the Cuban government in the question above.

   - Set year $t = 0$ as 1959 (t = years since 1959).
   - Linear model: the $1.8 billion value in 1959 increases by $108 million per year.
   - Exponential model: the $1.8 billion value in 1959 increases by 6% per year.

   (a) Create a single properly labelled Excel chart that displays both your linear and exponential model.

   (b) Does viewing the table and chart suggest a different answer to question 1d above? If so explain why with reference to your Excel models. Put your answer here or in your spreadsheet.

3. If you follow Mass Ave from Boston to Cambridge you will cross the Charles River via the Harvard Bridge. Looking down you may notice that the bridge is marked off in *Smoots*. From one end to the other the length of the bridge is 364.4 Smoots. What is a Smoot you might ask? According to Wikipedia a Smoot is "a nonstandard unit of length created as part of an MIT fraternity prank. It is named after Oliver R. Smoot, a fraternity pledge to Lambda Chi Alpha, who in October 1958 lay on the Harvard Bridge and was used by his fraternity brothers to measure the length of the bridge."

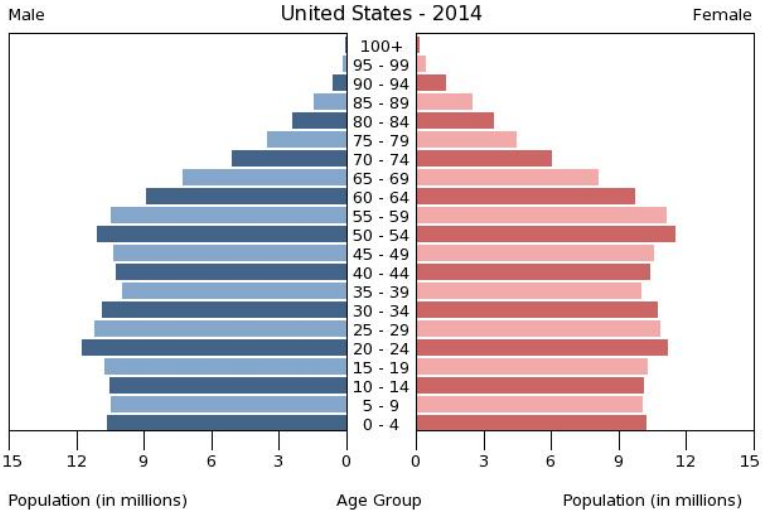
   (a) The length of the Harvard Bridge in standard English measure is 2035 feet. How tall was Oliver R. Smoot, in feet and inches?

   (b) How tall was Oliver R. Smoot, in meters? (Use only the right number of decimal places in your answer.)

   (c) Kelly Olynyk is the 7 feet tall starting center for the Boston Celtics. How long would the Harvard Bridge be in Olynyks?

   (d) What is the conversion rate between Smoots and Olynyks?

4. A Viagra ad on TV stated that more than 20 million men already use Viagra. Use the US population pyramid below to argue whether or not this claim seems reasonable. Be explicit about any assumptions you have made about the age groups of men who might typically use this drug.



5. The Math SAT scores for last years entering freshman class of 1412 students is given in the table below:

MSAT Score	Percent
450-499	32%
500-549	16%
550-599	12%
600-649	24%
650-699	8%
700-749	8%

(a) Construct a properly labeled histogram in Excel using this data.

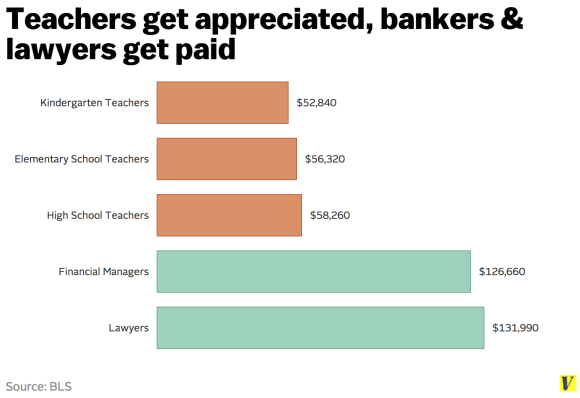
(b) Estimate the mode, median and mean MSAT scores for these students. Show your calculations, either on this paper or as formulas in your spreadsheet.

(c) How many students had an MSAT score higher than the median?

6. According to Vox.com, "the top 25 hedge fund managers earned a collective $21.1 billion this year." Vox.com put this figure into context, saying: "it's about 0.13 percent of total national income for 2013 being earned by something like 0.00000008 percent of the American population."

   (a) Use the data from Vox.com to estimate the total national income in 2013.

   (b) The same Vox.com article stated that the earnings of the 25 hedge fund managers was "about 2.5 times the income of every kindergarten teacher in the country combined." Use this information to estimate how many kindergarten teachers there were in 2013. To help you answer this question, use the chart below (from yet another Vox.com article that compared teachers' and lawyers' pay). Show all your calculations.



   (c) Can you verify Vox.com's estimated income comparison of hedge fund managers and kindergarten teachers by using the Internet? Show your calculations and fully explain your answer.

7. Here's a made up story. The dean at a fancy private high school is very worried. She suspects that about 20% of the 1000 students on campus are using drugs. She has asked all the parents to administer a home drug test to their kids (since it's a private school she can actually require them to do it). She has read on the web that

> With home drug testing methods believed to produce reliable and accurate results, many of us overlook the cases of false positives and draw conclusions on the suspect before reconfirming the result. But, researchers from the Boston University have found out that drug tests may produce false positives in 5-10% of cases and false negatives in 10-15% of cases. [2]

(I found several blogs that seem to report on this same study. None gives a link or a precise reference. I haven't been able to locate the original.)

Answer the following questions, assuming the worst cases (10% false positive rate, 15% false negative rate).

(a) Build the contingency table for this drug screening scenario. To do that you will have to figure out

- How many students are drug users.
- How many of the drug users test positive. How many test negative.
- How many students are drug free.
- How many of the drug free students test positive. How many test negative.

You may do the arithmetic with your calculator, or use the spreadsheet at `http://www.cs.umb.edu/~eb/114/final/ContingencyTable.xlsx`. If you use the spreadsheet, explain how the formula in cell `C10` does what it is supposed to.

Use the other side of the paper for the rest of the questions:

(b) What is the true positive rate?

(c) Student John Smith tested positive. What is the probability that he is really on drugs?

(d) Student Jane Doe tested negative. What is the probability that she is really drug free?

(e) Answer the previous two questions if you assume the best cases for reported false values in the Boston University study.

[2] `http://lapoliticaesotracosa.blogspot.com/2012/05/how-to-avoid-false-positives-while.html`