Math 114 Final

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General guidelines

- Open everything – book, notes, internet. That's the only way I can ask really interesting questions, and see how you would attack questions you encounter in the real world, not just those in a quantitative reasoning class.
- Some of the questions are common to all the Math 114 sections. They may not look familiar to you. Don't worry about that – just do the best you can.
- This is a three hour exam. Even so, there are probably too many questions. Use your time wisely – spend it on the ones you think you understand.
- Start each question on a new page in your blue book. You may use second blue book for scratch work (and turn it in).
- Some of the questions call for printing a spreadsheet or a Word document. If you use Word, put all your work in one document, carefully labelled. Try not to save all the printing for the last minute. For safety's sake, put your spreadsheets on a flash drive or email them to yourself, and email them to me at my gmail address: ebolker@gmail.com.
- Please remember how much *common sense* matters in quantitative reasoning.

1. The National Health Expenditures report, released in January 2010, stated that overall health care spending in the United States rose from $7,421 per person in 2007 to $7,681 per person in 2008.

   (a) Calculate the *absolute* change in health care spending per person from 2007 to 2008.

   (b) Calculate the *percentage* change in health care spending per person from 2007 to 2008.

   (c) Using 2007 as your starting year (2007 = year 0), determine an exponential function that models health care spending over time. Clearly identify the variable names and symbols in your function.

   (d) Using your function, predict when health care spending will reach a level of $10,000 per person in the United States.

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2. Spoons around the world.

   According to an Earth Day article in the Boston Metro, Americans throw out enough plastic utensils (knives, forks, and spoons) every year to circle the equator 300 times. [1]

   (a) Estimate the average number of plastic utensils each person throws out.

   (b) Is the article's assertion reasonable?

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3. On May 4, 2010 Olivia Judson wrote in *The New York Times* that

   > [Baba] Brinkman, a burly Canadian from Vancouver, is a latter-day wandering minstrel, a self-styled "rap troubadour," with a master's degree in English and a history of tree-planting (according to his Web site, he has personally planted more than one million trees).[2]

   How long would it take to personally plant a million trees? Is Brinkman's claim reasonable?

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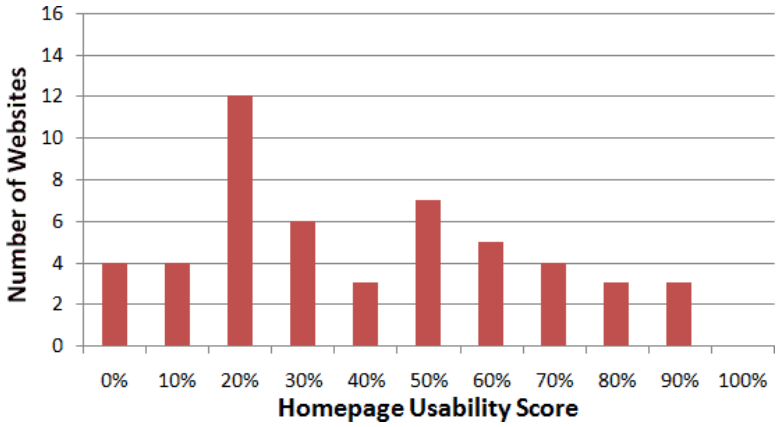
4. Web sites are often confusing.

   Jakob Nielsen evaluated the usability of voter information websites for the 2008 election for each of the fifty states and the District of Columbia. You can read his analysis later at `http://www.useit.com`, but don't spend any exam time doing that now. Here is some of what he discovered.

[1] I don't have a date for this reference.

[2] `http://opinionator.blogs.nytimes.com/2010/05/04/darwin-got-it-going-on/`

The following histogram of homepage quality across the 51 websites shows [that] . . . [some] sites have completely miserable homepages, whereas others are close to achieving all of the current best practices. [3]



(a) Reproduce this histogram in Excel. Turn it in.

(b) Estimate the mean usability score for these 51 home pages.

(c) What is the modal usability score for these 51 home pages?

(d) Estimate the median usability score for these 51 home pages.

(e) How many of these home pages have a usability score less than the the median score?

(f) If you visit the home page of a random one of these sites, what is the probability that its usability score will be 70% or more? What are the odds?

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5. Open the Excel data set `http://www.cs.umb.edu/~eb/114/final/FAM50.xls`, available both on the web and in the Excel Data Files folder on your classroom computer. This data set contains information extracted from the March 2006 Current Population Survey. Scroll across to see the headings. There is an explanation of the headings and the variables on the page titled "Data Dictionary" attached to the exam. (adapted from Exploration in College Algebra)

   (a) Look at the individual in row 7. This represents the 6th individual in the survey. Use the data dictionary to find out everything you can about this individual. Write a paragraph (in your blue book or in Word) that describes everything you know about this person based on the table.

   (b) Explain why there might be different values for Personal Total earnings, Personal Total Income, and Family Income.

[3] `http://www.useit.com/alertbox/quality-correlations.html`

(c) Using Excel find the mean and median for family income for all 50 individuals in the table.

(d) Which of these two statistical measures is most representative of the data set?. Be sure to back up you explanation by making specific reference to the data.

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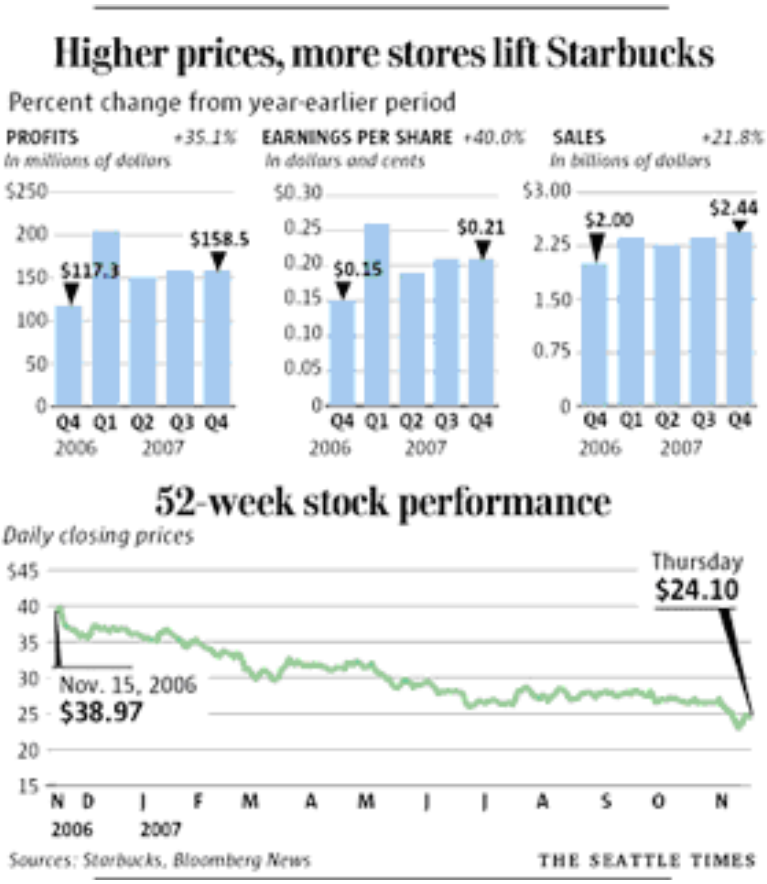
6. Consider the following collection of graphs that appeared in *The Seattle Times*:



(a) Over the time frame represented in these graphs, which one of the following statements is true?

i. Profits for Starbucks have dropped from \$38.97 to \$24.10.
ii. Profits for Starbucks have increased \$41.2 million.
iii. Sales at Starbucks have dropped from \$38.97 billion to \$24.10 billion.
iv. The price for a share of Starbucks stock has increased from \$0.15 to \$0.21.
v. The price for a share of Starbucks stock has decreased by \$24.10.

(b) What were total Starbucks profits during the year 2007?

(c) Write a paragraph that explains whether the graphs support the headline *Higher prices, more stores lift Starbucks*. Back up your explanation with specific reference to the graphs, including time intervals and values.

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7. Good to the last penny.

   On the Commonwealth of Massachusetts web page at `http://www.sec.state.ma.us/trs/trsbok/mod.htm` you can read that

   > The Massachusetts State House cornerstone was laid on the Fourth of July, 1795, by Governor Sam Adams and Paul Revere, Grand Master of the Masons. The stone was drawn by fifteen white horses, one for each of the states of the Union at that time. The cost of the original building? $133,333.33
   >
   > ...
   >
   > Paul Revere & Sons coppered the dome in 1802 to prevent water leakage. Some seventy years later the dome was gilded with 23 carat gold leaf for the first time. The cost was $2862.50; the most recent gilding, in 1997, cost $300,000. [4]

   (a) What's strange about the number $133,333.33 for the original cost of the State House? How do you think the person who wrote these paragraphs came up with that number?

   (b) Adjust the three dollar amounts in this quotation to take inflation into account. Have building and gilding gotten more or less expensive over the years?

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8. Open the file `http://www.cs.umb.edu/~eb/114/final/CollegeCosts2010.xls`, available both on the web and in the Excel Data Files folder on your classroom computer. This file shows the annual mean cost for tuition and fees at private and public four-year colleges in the U.S. between 1999 and 2010.

   (a) Insert a new column to the right of the "Years" column and label it "Years since 1999". Fill in the values for this column. Then make a scatter plot of years since 1999 versus mean private and public education costs. Remember to include a descriptive title, source, axis labels and your name. Add a linear trendline to both sets of data. Label and display both equations clearly. Print your chart and turn it in.

   (b) Write the equation for private education costs (round the numbers to one decimal place).

   (c) Write the equation for public education costs (round the numbers to one decimal place).

[4] `http://www.sec.state.ma.us/trs/trsbok/mod.htm`

(d) Interpret the numerical value of the slope in each trendline equation. Write your answer in a complete sentence and in relation to the costs of private and public education costs.

(e) Use your trendline equations to determine the projected mean tuition cost at both private and public four-year colleges for 2015. Label your answers clearly.

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9. A recent issue of the Mass Media reported on the proposed parking fee increase. The UMass Boston administration recommended gradually increasing the daily parking fee, starting at $7.00 in 2011 with a fifty cents increase each year after (call this Plan A). This is part of the campus Master Plan. Its purpose is to generate revenue to help pay for the construction of a new parking facility. Students have protested that this will place a financial burden on them. Two different student groups have proposed alternative plans. The first, Plan B, keeps the new base fee in 2011 at $7.00 but proposed an annual increase of 5% instead. The second, Plan C, doesn't raise the current daily fee in 2011. Instead it stays at $6.00, but the annual increase will be 8%.

   - Plan A: $7.00 daily fee starting 2011 with fifty cents increase each year after.
   - Plan B: $7.00 daily fee starting 2011 with 5% increase each year after.
   - Plan C: $6.00 daily fee in 2011 with 8% increase each year after.

   (a) Create a mathematical model for each of these three plans using Excel, then graph your results. Create an Excel spreadsheet for a period of 20 years with the following column headings. Let $t = 0$ for year 2011.

Years after 2011	Parking fee under Plan A	Parking fee under Plan B	Parking fee under Plan C
0	$7.00	$7.00	$6.00

   Print your spreadsheet and turn it in.

   (b) As a consultant to the campus administration, which plan would you recommend in order to generate the **m**ost revenue to help pay for construction of a new parking facility. Write a brief report justifying your recommendation and support your recommendation with reference to your spreadsheet and graph.

   (c) As a leader of the Student Senate, which plan would you recommend as having the **l**east financial impact on your fellow students. Write a brief report justifying your recommendation and support your recommendation with reference to your spreadsheet and graph.

