

Math 114 Exam 1

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General guidelines

- When you've solved a problem (perhaps on scrap paper), write the answer out neatly on the paper with the problem (you can use the other side too). Don't just circle a number. Show all units, and write complete sentences. If you've used any technology, say so.
- The purpose of this course is to help you learn how to use quantitative reasoning principles to solve real problems that matter to you. An exam can't test that well because you must answer the questions quickly. Here's a compromise. For homework for Thursday, rethink your answers. If you can write better ones, submit them. (Don't redo problems you got right the first time.) I will correct both the exam and the resubmissions. Getting a problem right the second time isn't worth as much as getting it right the first time, but it can make a difference in your grade. The exam is posted on the course web page at <http://www.cs.umb.edu/~eb/114/exam1/exam1.pdf>.

Work independently. You can email me with questions, but don't consult with friends or classmates or tutors.

- Google (and the internet), calculators, class notes and the text are all OK. Make sure you acknowledge any help of this kind. But take care. Time spent searching the web or shuffling through notes is time you're not using to answer the questions. Of course you can't use the computer to exchange email with your classmates during the exam. No text messages either, please.
- Remember to show only the number of significant digits (precision) in your answer justified by the numbers you start with and the estimates you make. Remember to use the equal sign *only between numbers that are equal*, not as a substitute for words that explain what the numbers mean and what you are doing.

Name:

1. (5 points) Read the general guidelines - particularly the first two about the form your answers should take, and the chance to improve your answers between now and Thursday. Write “I understand the instructions” here for a free 5 points.

2. (25 points) *Top official favors fare hike over service cut*

On Sunday, February 19, 2012 *The Boston Globe* reported that ¹

... [The MBTA] provides 1.3 million rides each weekday

...

The proposed increases - a one-way subway ride, now \$1.70 with the reloadable CharlieCard and \$2 with paper CharlieTicket, could rise to as much as \$2.40 and \$3, respectively - would be the largest by percentage since 1949,

...

the advisory group said fares should rise no more than 25 percent, acknowledging the need for more money but wary of pricing people off the system. Such a fare increase would generate about \$80 million ...

- (a) Compare the proposed increases in CharlieCard and CharlieTicket fares, in absolute and relative terms.

¹<http://bostonglobe.com/metro/2012/02/19/top-official-favors-fare-hike-over-service-cut/D08U1BCew6682ddN4FLFBL/story.html>

(b) Estimate how much extra revenue would be generated in a year from weekday rides if CharlieCard and CharlieTicket fares increased by just 25%.

(c) Compare your answer to the assertion in the quotation that a 25% increase in fares would yield \$80 million in new revenue.

3. (20 points) 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. ²

(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?

²<http://www.sec.state.ma.us/trs/trsbok/mod.htm>

4. (25 points) *13.4 million may get unexpected tax bills*

On December 17, 2010 *The Boston Globe* carried an Associated Press report saying that

The Internal Revenue Service reported that the average tax refund was \$2,892 in the 2010 filing season, up from \$2,663 in 2009. However, the number of refunds dropped by 3.5 percent, to 93.3 million. ³

(a) What was the percentage increase in the average tax refund from 2009 to 2010?

(b) How many refunds were there in 2009 and in 2010?

(c) The number of refunds decreased while the average refund increased, so you need some arithmetic to decide how the total amount refunded changed from 2009 to 2010. Find that change, in both absolute and percentage terms.

³http://www.boston.com/news/nation/washington/articles/2010/12/17/134_million_may_get_unexpected_tax_bills/

5. (25 points) Too many plastic bags,

An article from October 3, 2007 in *The Washington Post* about how paper and plastic bags impact the environment, states that: “Worldwide, an estimated 4 billion plastic bags end up as litter each year. Tied end to end, the bags could circle the Earth 63 times.”

(a) Are the numbers “4 billion plastic bags” and “circle the Earth 63 times” consistent?

(b) Use some estimation to convince yourself that the 4 billion plastic bag claim is too small by several orders of magnitude. Don’t answer the next part before you do this part.

(c) Confirm your estimate with a web search.