

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. (15 points) Counting birds.

(This is a version of Exercise 3.7 in *Common Sense*.)

In *The Boston Globe* on April 25, 2010 Juliet Eilperin wrote that birder Timothy Boucher said he had

... seen and identified 4,257 species of birds in his life. So his “life list,” as birders say, covers 43 percent of the bird species that exist. ¹

(a) If this report is correct, about how many bird species are there?

(b) Can you find independent evidence that your answer is right?

¹http://www.boston.com/news/science/articles/2010/04/25/new_atlas_shows_the_state_of_nature_as_well_as_the_nature_of_states/

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3. (30 points) Lots of gasoline.

(This is a version of Exercise 2.10 in *Common Sense*.)

In 2007, the weighted average combined fuel economy of cars and light trucks combined was 20.4 miles per gallon (FHWA 2008). The average vehicle miles traveled in 2007 was 11,720 miles per year. ²

(a) Convert the average fuel economy to gallons per hundred miles.

(b) Compute the amount of gasoline the average vehicle used in 2007.

(c) Estimate the number of cars and light trucks on the road in 2007.

(d) Estimate the total amount of gasoline used by cars and light trucks in 2007.

(e) The website <http://americanfuels.blogspot.com/2010/04/2009-gasoline-consumption.html> reports that the U.S. consumed 142,349,298,000 gallons of gasoline in 2007. Is that number consistent with your answer to the previous part of the problem?

²<http://www.epa.gov/cleanenergy/energy-resources/refs.html>

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4. (15 points) The MAA.

(This is a version of Exercise 4.16 in *Common Sense*.)

Annual dues for the Mathematical Association of America were \$3 in 1916. They were \$192 in 2011.

(a) How much would the \$3 dues in 1916 be in 2011 dollars?

(b) How much have dues gone up (or down) between 1916 and 2011, in 2011 dollars, in absolute and relative terms?

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5. (35 points) *Banks to Make Customers Pay Fee for Using Debit Cards*

This is the problem I promised from the current news. It appeared in both *The Boston Globe* and *The New York Times* on Friday, September 30.

Until now, [debit card] fees have been 44 cents a transaction, on average. The Federal Reserve in June agreed to cut the fees to a maximum of about 24 cents. While the fee amounts to pennies per swipe, it rapidly adds up across millions of transactions. The new limit is expected to cost the banks about \$6.6 billion in revenue a year .³

(a) Use the data in the article to estimate the number of debit card transactions in a year.

(b) What assumptions did you make in arriving at your estimate?

(c) Is the phrase “millions of transactions” a good way to describe the order of magnitude of your answer?

³www.nytimes.com/2011/09/30/business/banks-to-make-customers-pay-debit-card-fee.html

Name:

(d) What percentage of a \$10 debit card transaction does a merchant have to pay to the bank that issued the card? How will that percentage change when the new rule takes effect?

(e) Rewrite your estimate in (a) in transactions per day.

(f) Estimate the number of people in the United States who use a debit card. Then rewrite your answer to the previous problem in transactions per person per day.

(g) (Optional) Do you use a debit card? Did you know how much your use cost the merchant? Will you change your behavior if your bank charges \$5/month for debit card use?