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Hints and Solutions

**Hint for Exercise 1.8.3** To answer the question you’ll have to think about the size of the restaurant, the number of years it’s been open, the number of customers they serve in a day, and the fraction of those customers who order soup with matzoh balls (probably not a big fraction).

You may need to do some research if you don’t know what a matzoh ball is.

Please don’t contact the restaurant and ask them to answer the question for you.

**Hint for Exercise 1.8.11** For the second question you have to think about whether people trying in one minute are the same as people trying the next minute, or trying an hour later.

**Hint for Exercise b** If you didn’t catch it the first time, read the quote again. The data are for the month of May.

**Hint for Exercise 1.8.13** Compare the number to the number of people in the United States. You may also need to estimate the percentage of fingerprints of non-United States citizens.

**Hint for Exercise 1.8.20** By now you shouldn’t need this hint, but here it is: you will need to know the population of Peru to answer some of the questions.

**Hint for Exercise 1.8.32** Estimate how many cans or bottles you need to collect for one year’s tuition. How many is that per day or per hour? Do your answers seem reasonable? Do you have to think about how many days per year or hours per day you could (reasonably) spend collecting cans?

**Hint for Exercise 2.9.1**

From: Laura M Keegan <Laura.Keegan001@umb.edu>
To: "eb@cs.umb.edu" <eb@cs.umb.edu>
Subject: Homework Help
Date: Mon, 16 Sep 2013 03:21:07 +0000

Hello Professor Bolker,

I have a questions about number 2 on the homework, I have not been able to figure out exactly what I am supposed to do, I am not sure of the type of article I am supposed to be searching for or just how to get started looking for one? Sorry, this is kind of a silly
question but this part of the homework has taken me a really long time and I still can’t find/don’t know exactly what to look for.

Thank you,
Laura Keegan

From: Ethan Bolker <eb@cs.umb.edu>
To: Laura M Keegan <Laura.Keegan001@umb.edu>
Subject: Homework Help
Date: Mon, 16 Sep 2013 09:21:15 -0400 (EDT)

Laura

There really is no "exactly what [you are] supposed to do". Just read the newspaper or a magazine, find a story where numbers with units appear in several versions (miles per gallon and gallons per mile, dollars per hour and dollars per year, barrels of oil and liters of gasoline, accidents per week and accidents per person, ...) and show me that the arithmetic is right and the numbers make sense. You don’t need to discuss the whole article - just extract a paragraph or a sentence two with the numbers.

The exercises in the book suggest the kind of thing I have in mind. If you find a good one you (or I) can even post it on SCOPE.

There’s no particular "type of article" to look for. If you find one on a subject you’re interested in rather than just thinking of this as a homework problem you have to do you might even enjoy it.

Although I’d like to encourage you to read the newspaper, you can look on the net for a story.

Ethan

**Hint for Exercise 2.9.2**  *Warning*: it’s not 45 miles/hour.

The problem does not say how far it is from Here to There. You’re free to pick some convenient distance to work with if you like.

**Hint for Exercise 2.9.19**  Use the web to find the European tax rates. Then convert units as needed. Subtract the taxes from the price at the pump to find the cost of the gasoline.

**Hint for Exercise 2.9.25**  This is a hint about what *not* to do. A web search might lead you to this graphic from The New York Times, [http://www.nytimes.com/imagepages/2011/03/15/science/15food_graphic.html](http://www.nytimes.com/imagepages/2011/03/15/science/15food_graphic.html) which goes as far as 2008. It’s no real help. Nor will it help to spend (waste?) time scrolling through web postings that refer to this graphic.

**Hint for Exercise 2.9.29**  [http://www.census.gov/compendia/statab/2012/tables/12s1103.pdf](http://www.census.gov/compendia/statab/2012/tables/12s1103.pdf)
Hint for Exercise 2.9.42  The metric system will help: a cubic centimeter of water weighs one gram. You can convert pints to ounces and then to cubic centimeters; pounds to kilograms and then to grams.

Hint for Exercise 2.9.45  To make a number larger than what the calculator can display you can’t just enter it from the keypad. Try multiplying together two numbers each of which is nearly as large as possible.

Hint for Exercise 2.9.48  What was the population of Massachusetts in 2014? What’s a reasonable figure for the average size of a household? Are residential customers the only people who pay for electricity?

Hint for Exercise 3.10.6  Look up the Massachusetts budget for 2013, and the percentage of revenue that comes from this personal income tax.

Hint for Exercise 3.10.12  The answers to some of these questions will be very small numbers. Keep careful track of the decimal points.

For the last question, which is more informative, the absolute or the relative comparison?

Hint for Exercise 3.10.15  300 million is an underestimate now, but hasn’t always been.

Hint for Exercise 3.10.24  Leap years are a little more complicated than you think.

Hint for Exercise 3.10.25  You can do this problem with algebra, but you may find it easier by working with some definite numbers that aren’t given in the problem. So pretend that fuel economy before the increase is, say 20 miles per gallon and you will drive 100 miles. Then work out how much gas you save (in percentage terms) if that 20 miles per gallon increases 20% to 24 miles per gallon. For the second part of the problem, convert 20 miles per gallon to gallons per mile, or to gallons per hundred miles. Then a 20% improvement will decrease that number by 20%, since “improvement” means fewer gallons per mile.

Hint for Exercise 3.10.31  You can’t really get started on this problem if you don’t know what “wholesale price” and “markup” mean. If that’s the case, look them up.

Hint for Exercise 3.10.31  You may find it easier to work with a book whose wholesale price is $1 or $100.

Hint for Exercise 3.10.36  Read carefully. The $6.6 billion figure is what the banks will lose in revenue, not what they make now or will make after the cut takes effect.

Hint for Exercise 3.10.45  For the last part of the exercise you will need estimates for the student populations in each of those years. That number was growing, but not nearly as fast as the total debt.

Hint for Exercise 4.7.5  You won’t find any help visiting the State House web site.

The Bureau of Labor Statistics inflation calculator doesn’t go far enough back. What should you do?

Hint for Exercise 4.7.7  The inflation calculator can tell you the year when a nickel would buy what you need a dime for in 2011.
13.7. EXERCISES

**Hint for Exercise 4.7.11** Be careful when you move the decimal point to find the percent, which will be negative and pretty small.

**Hint for Exercise 4.7.14** One of the raises in this 2010 article hadn’t taken place when the article was written, so the inflation rate for that year wasn’t known then. But it is known now.

When you use the inflation calculator, remember that the base pay for these raises was the 2005 value, not the one in 2006. That was after the first raise.

**Hint for Exercise b** You will have to think about whether $190K is enough to raise a child today.

**Hint for Exercise 4.7.17** Consider computing with a particular salary and inflation rate as examples. Choose numbers that are easy to work with.

**Hint for Exercise 4.7.28** (a) Careful. Why isn’t the answer not 30%?

(b) Use trial-and-error. Guess an answer, test it using the argument from the first part of the exercise, adjust your answer until it’s right.

**Hint for Exercise 5.7.4** • You don’t need to fuss with how many courses make up the credits. Just imagine one course for 12 (or 9 or 6) credits in the new semester, with a numerical grade. For the past work, imagine one 55 credit course with a grade of 1.80. It doesn’t matter what particular courses led to that GPA. Then figure out the grade for the current course that makes the overall GPA at least 2.0.

• Another hint: you can do this with algebra, or by guess-and-check. Guess a grade for the new course, compute the new GPA, and see whether it’s too high, too low, or just right. Adjust your guess accordingly.

**Hint for Exercise 5.7.8** • You don’t have to know the numerical values that go with each letter grade.

• A good semester GPA with very few credits won’t change the year GPA much if there are lots of credits in the other semester.

**Hint for Exercise 5.7.9** There’s a fair amount of tedious arithmetic in parts (a) and (c). If you know how to use Excel (which *Common Sense Mathematics* takes up in the next chapter) you can save yourself some time and grief by entering the columns in Table 5.6 in a spreadsheet to answer (a), and then changing just the weights to answer (c).

**Hint for Exercise 5.7.10** Estimate the percentage of the U.S. population that’s urban in the Northeast by treating it as a Fermi problem. Combine reliable data you find on the net with some common sense.

When you have that percentage (call it $W$ for the moment) you can express the overall average inflation rate of 2.85% as a weighted average of the urban Northeast rate (2.58%) with the weight $W$ and the unknown inflation rate for the rest of the country with weight $100\% − W$.

**Hint for Exercise 5.7.15** If you find an “average” statistic for the last question you will need to think about which kind of average it is.
13.7. EXERCISES

Hint for Exercise 6.14.5  You may draw your bar chart neatly by hand, or use Excel.


If Excel wants to treat your salary ranges as dates, try formatting the cells as text.

To make the charts, copy the histogram that’s there, then find the place in Excel where you can change the source data to the new rows in columns D and E.

Hint for Exercise 6.14.18  When you enter the data in two columns in Excel put the categories (usability scores) on the left since they are the labels for the xaxis. Put the numbers of websites on the right since they are the values that go with the categories, and should plot vertically, on the yaxis.

If your Excel is anything like ours, it may well think that you want to display both columns on the yaxis, since both columns are numbers. If it does that it will label the xaxis with the numbers 1 to 10.

If that happens, delete the data series corresponding to the bars you don’t want (the percentages). Then right click on the chart and explore until you find the place that allows you to enter the fields you want to use as xaxis category labels.

Hint for Exercise b  This mean is not the AVERAGE of the amounts spent per person by each city. It’s wrong to average those numbers since they are already averages. You must weight them by the city populations in order to compute the total amount spent by all the people in all the cities. Then divide by the total population.

You can’t compute the median with Excel’s MEDIAN function for the same reason. Further hint: almost everyone lives in New York.

Hint for Exercise c  You can’t answer the first question by finding the mean of the twelve numbers in column C. Compute the mean correctly as a weighted average. You will probably want to start by creating a column labeled

 total Fire/EMS expenses

and fill in the value for each city.

Hint for Exercise d  Hint/warning: 2:30 is 2 hours and 30 minutes. That’s 2.5 hours, not 2.3 hours.

Hint for Exercise c  If you don’t know what “per capita” means, look it up.

Hint for Exercise 7.8.9  Finding the places where the lines in your Excel chart cross is the key to the last part of the problem.
Hint for Exercise 7.8.11  You may want to think in terms of hundreds of pages rather than pages.

The answer to the second question depends on how many pages you print over the lifetime of the printer.

Hint for Exercise 7.8.15  For part (a) you will have to look up the conversion factors among various forms of energy in order to convert watt-hours to gallons of gasoline. Part (c) is about pysics, not quantitative reasoning. Your answer might begin “The display is valuable because . . . On the other hand . . . ”

Hint for Exercise 7.8.17  We think this is a harder than usual Fermi problem.

Hint for Exercise 7.8.24  What did electricity cost in the spring of 2011?

Hint for Exercise 7.8.25  The graph should climb linearly from the origin (the tax on 0 income is 0) to a high point, and then become horizontal.

You may draw the graph neatly by hand, or use Excel.

Hint for Exercise f  Look at the data starting in about 1980.

Hint for Exercise 8.5.5  Try a Google search for

```
Per capita consumption of selected beverages in gallons
```

Hint for Exercise 8.5.19  For the second question, all you can really look for is the order of magnitude. If that doesn’t match, try to explain why.

Hint for Exercise 9.6.2  (a) Inflation is usually reported as a percent increase.

(b) No hint needed.

(c) No hint needed.

(d) Read this one carefully to think about what depends on what. Don’t just jump at the word “percent”.

(e) The washing happens over and over again on the same day – that’s how dirty they were.

(f) No hint needed.

(g) Interest on unpaid balances accumulates.

(h) What units would the weatherman use to report the rate at which snow was accumulating?

(i) Think about how the number of people exposed to germs depends on the number of people sick.

(j) (Electronic) word of mouth generates new subscribers from old ones.

Hint for Exercise 9.6.17  Use the ExponentialGrowth.xlsx spreadsheet, or find the answer by trying different values for T (# of years) in the formula until you find one that gets you close to $3000.)
13.7. EXERCISES

Hint for Exercise 9.6.18  Your computations should suggest that it won’t be infinite, which might have been your first guess.

Hint for Exercise 9.6.19  You can answer the first question using guess-and-check until you’re close enough. You’ll need a web search for the second and a very good web search for the third, which is open-ended.

Hint for Exercise 9.6.21  Guess a number of hours, try your guess in the two exponential equations, then adjust your guess up or down until the answers match.

Hint for Exercise 9.6.24  Compare the relative change in the number of e-mail accounts for the two time periods (early 1900s to end of 1999, end of 1999 to the time of the blog post).

Hint for Exercise 9.6.30  Why is an 0.06 percent increase every year for 100 years more than an increase of $100 \times 0.06 = 6$ percent?

Hint for Exercise 10.6.10  Start with the calculation $(1 + 0.0143)^{365}$. The answer is hard to believe.

Hint for Exercise 10.6.11  What annual interest rate would you need to turn $4,000 into $1.5$ million in 94 years? Compare that rate to the increase due just to inflation?

Hint for Exercise 11.9.6  You might want to do this exercise in Excel. Then you can see the odds for all the horses, and see how the payoffs change when you change the track’s take.

Hint for Exercise 11.9.10  Consider starting at [http://www.census.gov/govs/state/10lottery.html](http://www.census.gov/govs/state/10lottery.html). There may be a better site that gives you totals, or lets you download directly into a spreadsheet.

Hint for Exercise 11.9.14  You might find it easiest to answer this question by imagining that you played the lottery 100 days in a row.

Hint for Exercise 12.7.3  There are 36 equally likely outcomes. One possibility is that you roll a 3 with die A (5 ways) and your friend rolls a 2 with die B (3 ways). So there are 15 ways that can happen, for a probability of $15/36$ that you win that way. Now figure out the probabilities for the other possibilities.

Hint for Exercise 12.7.7  The answer is very small, but it’s not zero. Use the Google calculator to find it.

Hint for Exercise 12.7.13  You can get the state populations from the data in [http://www.cs.umb.edu/~eb/qrbook/HintsAndSolutions/cancerclusters.xls](http://www.cs.umb.edu/~eb/qrbook/HintsAndSolutions/cancerclusters.xls) or find it on the web and download it. We might do it for you in a later edition of this book.

Hint for Exercise 13.7.2  For (b), think about when a woman is likely to use a pregnancy test.

Hint for Exercise 13.7.6  Since you do not know the actual number of infected cattle, you can’t know exactly how many would test positive. But using the fact that the disease is rare, you can estimate the number of positive test results using the known false positive rate.
Hint for Exercise 13.7.8  Build the contingency table, based on a population of 1,000 women tested. You may do this by hand or with the spreadsheet http://www.cs.umb.edu/~eb/qrbook/HintsAndSolutions/ContingencyTable.xlsx.