MATH 251 SPRING 2025
WEEK 1 SUGGESTED PROBLEMS
"DUE" APRIL 7

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Recall: this homework will not be graded, but I will select approximately two problems from it for the quiz on Wednesday, April 9. (I will change the numbers in the problems slightly, so there's no point trying to memorize the answers.)

Quiz-Like Problems:
(Quiz problems drawn from these.)

- Section 2.1: 7, 8, 9, 18, 19.
- Section 2.2: 36, 37, 50–54, 77, 81.
- Section 2.3: 91, 95, 103, 109, 127
- Section 2.4: 133, 135, 136, 138, 151, 154.
- Section 2.5: 199.

If you got help with one of these problems, solve a similar one on your own!

Here are three more problems about the precise definition of continuity and error control. These kinds of problems will *not* be on an exam or quiz, except perhaps as bonus problems. (Problem 199 above and one of the WebWorks problems are also in this style; I wanted to make sure you have a few more available for practice.)

(1) I am driving from the Jordan Schnitzer Museum to the Portland Art Museum, a distance of 112 miles.
  (a) Let $f(s)$ be the time it takes me to drive there, If I drive at an average speed of s miles per hour. Write a formula for $f(s)$.
  (b) If I leave at 2:00 and want to arrive at 4:00, at what average speed should I drive? (Call this speed s_0.)
  (c) If I leave at 2:00 and need to arrive between 3:58 and 4:02, what range of speeds can I drive?
  (d) So, if I need to arrive at 4:00 plus or minus 2 minutes, how tightly do I need to control the speed? That is, I have to drive at average speed between $s_0 - r$ and $s_0 + r$ for some r; what is r?
  (e) Recall that $f(s)$ is continuous at x if for any $\epsilon > 0$ there is a $\delta > 0$ so that if $|x - s| < \delta$ then $|f(x) - f(s)| < \epsilon$. You could solve the previous part because $f(s)$ is continuous at what point x? What ϵ and δ were used in the previous part?

(2) I am measuring water for a recipe in a cylinder whose base has area 30 square centimeters. I need 120 mL of water, to within 0.5 mL. (Recall that 1 mL is 1 cubic centimeter. Ignore the fact that in reality there's a meniscus.)
  (a) What height of water should I aim for?

(b) How accurately do I need to measure it?
(c) How does this problem relate to the ϵ-δ definition of continuity? What are f, x, ϵ, and δ?

(3) A driver starts at rest (speed 0) and accelerates at a constant rate of 5 m/s^2 (meters per second per second). The driver can't measure distance, only time, and is supposed to honk the horn after going 122.5 meters.
(a) Write a function for the distance the driver travels in t seconds. (If you don't know how to do this, come back to this problem in a week.)
(b) After how many seconds should the driver honk the horn?
(c) To honk the horn between 122 meters and 123 meters, how precise does the driver have to be about the time? (The answer should be in the form of optimal time $\pm r$; you found the optimal time in the previous part, and here you're finding r.)
(d) How does this problem relate to the ϵ-δ definition of continuity? What are f, x, ϵ, and δ?

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