# Math 115 - Team Homework Assignment #1, Winter 2015

- **Due Date:** Your instructor will notify you of the due date and time.

- Remember to follow the guidelines from the "Doing Team Homework" and "Team HW Tutorial" links in the sidebar of the course website.

- Do not forget to rotate roles and include a reporter's page each week.

- Please show ALL work.

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1. Erin Pi is an outgoing Calculus student attending the University of Michigan. Erin is walking home from the milk bar one evening and stoops to tie her shoe in the Diag. She feels a light but assertive tap on the knee and hears a voice, saying, "Excuse me, Erin of House Pi." She looks up from her shoe but all she sees is a rather attentive squirrel peering at her. She looks around to see where the voice is coming from and hears it again, "Please, Erin, we need your help." This time, Erin notices the voice is coming from the squirrel. Erin sometimes gets light-headed when she drinks too much milk so she sets about calculating how much milk she had. Let $f(t)$ be the total amount of milk (in mL) Erin had consumed after t hours at the milk bar.

    (a) Write a practical interpretation of the equation "$f(2) = 400$".
    (b) Describe the domain and range of $f(t)$.
    (c) Erin figures out that she immediately had 200mL of milk when she first arrived at the milk bar and then 100mL every hour thereafter. Write a formula for $f(t)$.
    (d) In her experience Erin has only gotten light headed after drinking at least a liter of milk. Calculate $f^{-1}(1000)$ and give a practical interpretation of your solution.

2. Erin was only at the milk bar for 2 hours so she figures she is probably not hallucinating and decides to hear the squirrel out. She sits down in front of the squirrel. "My name is Sebastian," he begins, "and my people are in trouble." Erin soon learns that the population of squirrels in Sebastian's land has been decreasing exponentially for the last 3 weeks. Let $g(t)$ be the population of squirrels t days after Sebastian and Erin meet. Three weeks ago, the population was 500 squirrels and it is has been decreasing by 10% every week.

    (a) Find a formula for $g(t)$.
    (b) Sebastian figures that his squirrel race will be extinct when only 1 squirrel remains. Just to be safe he would like to save his race before the population drops below 2 squirrels. Calculate how long Erin and Sebastian have to save the squirrels.
    (c) Calculate the half life of the squirrel population in Sebastian's land.

3. Although Erin really feels for Sebastian, she is still a little hung up on the fact that he can talk. She asks him if all squirrels can talk. Sebastian tells her that a squirrel's probability of being about to talk depends on how much attention they receive from University of Michigan students. He also explains that this relationship has been changing lately. Let $f(x)$ be the probability that a squirrel born prior to 3 weeks ago is able to talk if x students have paid attention to that squirrel in their life. Below is a graph of the function $f(x)$.

1.0
probability
of being
able to talk 0.8
0.6
0.4
0.2

50 100 150 200 250 300 350 x (# of students)

$f(x)$
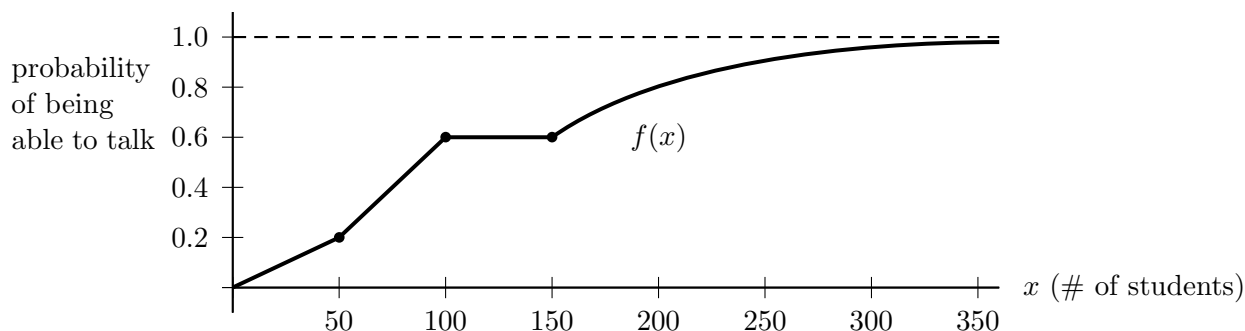
(a) Let $g(x)$ be the probability that a squirrel born within the last 3 weeks is able to talk if x students have paid attention to them in their life. A graph of $g(x)$ is given below.

1.0
probability
of being
able to talk 0.8
0.6
0.4
0.2

50 100 150 200 250 300 350 x (# of students)

$g(x)$
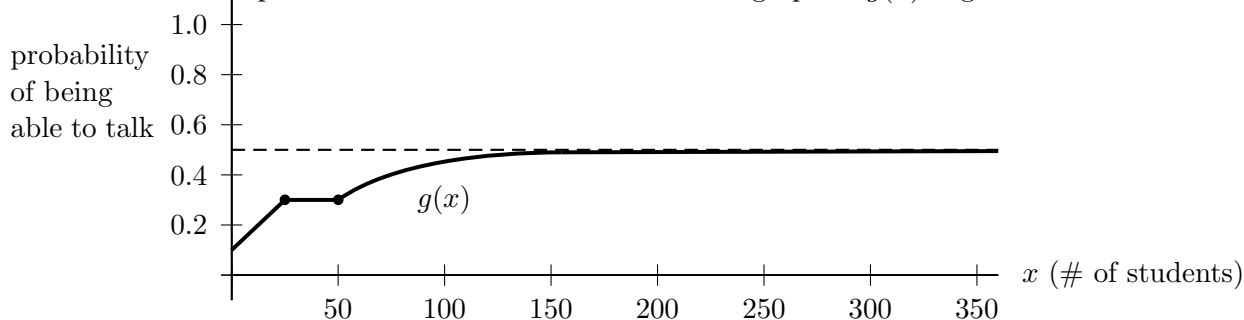
It turns out that for $x \geq 0$, $g(x)$ can be expressed as a transformation of $f(x)$. Write a formula for $g(x)$ as a transformation of $f(x)$.

(b) How much attention is paid to a squirrel is proportional to the cuteness of the squirrel. (Note that we measure cuteness in terms of cuteness units.) Let $h(y)$ be the number of students that pay attention to a squirrel over the duration of the squirrel's life if the squirrel has y cuteness units. Give a practical interpretation of the expression $g(h(8))$.

(c) Find a formula for $h(y)$ if a total of 100 students pay attention to a squirrel of 4 cuteness units during its life.

(d) Calculate $f(h(6))$.

4. Erin is a very compassionate person, so she agrees to help Sebastian. He leads her to a tree in the corner of the Diag where she notices a tiny doorknob on the trunk. Sebastian waves his tail in front of the knob and a small door appears. Another squirrel dressed as a doorman appears at the door. Sebastian tells Erin that squirrels are very bright and only want people who can do math inside their secret world, so she will have to correctly answer a question before the doorman will shrink her to fit through the door. "The following scroll contains a table with the height you will be t minutes after I shrink you. Will your height be shrinking according to an exponential function of time, a linear function of time, or neither?" asks the doorman before handing over a scroll. The data on the scroll is reproduced below. What answer should Erin give? (Remember to explain your reasoning.)

time (min)	0	1	3	4
height (cm)	175	124	73	22

After satisfactorily answering the doorman's question, Erin gains access to the squirrels' lair and begins her quest.