Math 371 ASSIGNMENT 14, WINTER 2016 **Due at the start of class 2/26**

1. On assignment 13 you found that, for the profit function $P(x) = -0.02x^2 + 45.3x - 8300$,

   - the marginal profit for the 800th Doo-dad was \$13.32
   - $P'(800)$, the derivative *evaluated* for the 800th Doo-dad, was \$13.30

   This shows us that, in this case, the derivative appears to be a good approximation for the marginal profit. If we wish to determine just how good it is we can calculate the **percent error**:

   $$percent\ error = \frac{|approximate\ value - actual\ value|}{actual value} \cdot 100$$

   Find the percent error when $P'(800)$ is used as an approximation for the marginal profit for the 800th Doo-dad. **Round to the nearest hundredth of a percent**.

Lucky Louie's Lemonade Stand is located in Nome, Alaska. Louie hires some consultants who find that Louie's profit is related to the number of cups of lemonade that he sells by the equation $P = -\frac{1}{2}x^2 + 12x - 40$, where x is the number of cups of lemonade sold and P is the profit *in cents*.

2. (a) Find the marginal profit for the 10th cup of lemonade.

   (b) Find the derivative function, and the derivative for $x = 10$, labelling each correctly.

   (c) Find the percent error in this case. How does it compare to the percent error from Exercise 1? **Answer this, with a complete sentence**.

3. Determine the average rate of change of profit from 2 cups of lemonade sold to 10 cups sold.

4. Determine the average rate of change of profit from 10 cups of lemonade sold to 16 cups sold.

5. We know that the graph of the profit function is a parabola opening downward, so there is a maximum profit, and it occurs at the vertex. At the vertex the slope of a tangent line, which is the derivative, is equal to zero. Set the derivative you found in Exercise 2(b) equal to zero and solve to find the number of cups that need to be sold to get the maximum profit. Then find the maximum profit.

6. You now know where the vertex of the parabola is, and you can easily find the y-intercept. Use this information to sketch the graph of the profit function **twice**. On the first graph, draw in the line whose slope is your answer to Exercise 3. On the second graph, draw in the line whose slope is the answer to Exercise 4. (Remember that these are called **secant** lines.