HW 9: Section 2.4

Due: Thursday, October 3rd in SQRC by 9pm

Learning Goals:

- Use the limit definition of derivatives to justify derivative rules.
- Use the product rule and quotient rule to compute derivatives.
- Apply the product rule in real world examples.

Questions:

1. Show that $\frac{d}{dx}[f(x) - g(x)] = \frac{d}{dx}f(x) - \frac{d}{dx}g(x)$ using the limit definition of derivative.
2. Use the power rule to compute the derivative of $f(x) = ax^3 + bx^2 + cx + d$ where a, b, c and d are constants.
3. Use the product rule to find the derivative of
$$(x+1)(\sqrt{x} + x^2)$$
4. Use the quotient rule to find the derivative of
$$\frac{x+1}{x-1}.$$
5. Use the quotient rule to find the derivative of
$$f(x) = \frac{x^2+1}{1+2x}.$$
6. Suppose that for some toy, the quantity sold $Q(t)$ at time t years decreases at a rate of 4%; explain why this translates to $Q'(t) = -0.04Q(t)$. Suppose also that the price increases at a rate of 3%; write out a similar equation for $P'(t)$ in terms of $P(t)$. The revenue for the toy is $R(t) = Q(t)P(t)$. Substituting the expressions for $Q'(t)$ and $P'(t)$ into the product rule $R'(t) = Q'(t)P(t) + Q(t)P'(t)$, show that the revenue decreases at a rate of 1%.
7. Suppose that the price of an object is \$14 and $12,000$ units are sold. The company wants to increase the quantity sold by 1200 units per year, while increasing the revenue by $\$20,000$ per year. At what rate would the price have to be increased to each these goals?