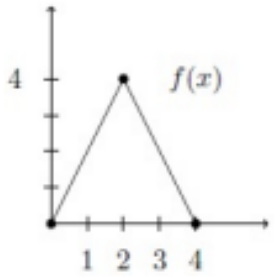
1. Determine where $f(x) = \arctan(x^2 - 2x)$ is increasing.

2. The graph of $f(x)$ is shown and the table gives values of $g(x)$ and $g'(x)$.



x	0	1	2	3
$g(x)$	4	3	2	1
$g'(x)$	-1.1	-0.9	-1.2	-0.8

(The function $f(x)$ is piecewise linear)

   (a) Given $h(x) = f(g(x))$, find $h'(1)$.
   (b) Given $k(x) = g(f(x))$, find $k'(3)$.
   (c) Given $l(x) = g(g(x))$, find $l'(2)$.
   (d) Given $m(x) = \sqrt{f(x)}$, find $m'(1)$.

3. The length of the day in Boulder (Latitude 40 N) can be modeled approximately by

$$l(t) = -3\cos\left(\frac{2\pi}{365}(t + 10)\right) + 12$$

   where l is given in hours and t is the day of the year.

   (a) Evaluate $l(355)$; fully interpret the result in the context of this problem, including units.
   (b) Evaluate $l'(265)$; fully interpret the result in the context of this problem, including units.
   (c) Calculate when $l'(t)$ is largest. Explain.

4. The U.S. gross domestic product can be modeled by

$$P(t) = 4.351e^{0.0368t}$$

   where P is given in billions of dollars and t is years since 1790.

   (a) Find $P(244)$; fully interpret the result in the context of this problem, including units.
   (b) When was the GDP one trillion dollars?
   (c) How many years does it take for the GDP to double?
   (d) What is $P'(224)$? Again, fully interpret (including units).

5. Find y' if $\tan^{-1}(xy) = 1 + x^2y$.

6. (a) Suppose f is a one-to-one differentiable function and its inverse function f^{-1} is also differentiable. Use implicit differentiation to show that

$$(f^{-1})'(x) = \frac{1}{f'(f^{-1}(x))}$$

provided that the denominator is not 0.

(b) If $f(4) = 5$ and $f'(4) = \frac{2}{3}$, find $(f^{-1})'(5)$.

7. (a) Show that $f(x) = 2x + \cos(x)$ is one-to-one.

(b) What is the value of $f^{-1}(1)$?

(c) Use the formula from part (a) of the previous problem to find $(f^{-1})'(1)$.

Optional Challenge Problems

Try this problem after you learn section 3.7.

Find the derivative of the function. Simplify where possible.

$$f(x) = x \ln(\arctan(x))$$