# Exercise 56

Use the method of Exercise 55 to compute $Q'(0)$, where

$$Q(x) = \frac{1 + x + x^2 + xe^x}{1 - x + x^2 - xe^x}$$

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### Solution

Using the method of Exercise 55, set

$$f(x) = 1 + x + x^2 + xe^x \qquad \rightarrow \qquad f(0) = 1$$

$$g(x) = 1 - x + x^2 - xe^x \qquad \rightarrow \qquad g(0) = 1.$$

Then

$$Q(x) = \frac{f(x)}{g(x)}.$$

Take the derivative using the quotient rule.

$$Q'(x) = \frac{f'(x)g(x) - g'(x)f(x)}{[g(x)]^2}$$

Set $x = 0$.

$$Q'(0) = \frac{f'(0)g(0) - g'(0)f(0)}{[g(0)]^2}$$

Take the derivative of $f(x)$ and $g(x)$.

$$f'(x) = 1 + 2x + e^x + xe^x \qquad \rightarrow \qquad f'(0) = 2$$

$$g'(x) = -1 + 2x - e^x - xe^x \qquad \rightarrow \qquad g'(0) = -2$$

Therefore,

$$Q'(0) = \frac{(2)(1) - (-2)(1)}{(1)^2} = 4.$$