Exercise WS6.1

1. For each of the following linear functions, calculate the difference quotient for the specified change in *x*. In each case, sketch the graph and indicate where you have measured the difference quotient.

(a) $y = -2x + 1$; $x_0 = 2,\ x_1 = 3$

(b) $y = \frac{x}{3} + 9$; $x_0 = 1,\ x_1 = 2$

2. Generalise question 1 above to the case of $y = ax + b$ with $x_0 = x_0^*$ and $x_1 = x_1^*$. Why in this case is the difference quotient $\frac{\Delta y}{\Delta x}$ independent of the values of x_0 and x_1, and also of the value of *b*?

Exercise WS6.2

Find the derivative of:

1. $y = x^3$

2. $y = 3x + 5$

3. $y = 8x^3 + 5x^2 + 12x$

4. $y = \frac{1}{x}$

5. $q = \frac{1}{p^{0.5}} + 2$

6. $y = 2x^{\frac{1}{2}} + \left(\frac{3}{2}\right)^2$

7. $y = ax^2 + bx + c$ (*a*, *b* parameters)

8. $y = x + x^{-1} - x^{0.5} + 5$

9. $z = 5y^3 - 3y^2 + 1$

10. $y = \frac{1}{2}u^2 + 5u$

Exercise WS6.3

Find the derivative of:

1. $y = (x^2 + 9x)^2$ (use function of a function rule)

2. $y = (x^2 + 3)(2x^3 + 5x)$ (use product rule)

3. $y = \dfrac{x^3 + 4x^2}{2x - 1}$

4. $y = (x^3 - 1)(x^2 + x)^{-1}$ (requires both function of a function and product rules)

5. $y = -\dfrac{1}{1 - x}$