Rates of Change

- **Practical Problems**
  If we know the derivative of a function, we can find the equation for that function by integrating
  If we know a value for the function under conditions, such as $x = 2$, we can find the constant C and thus the actual equation

  If $y = f(x)$ then the rates of change of y and x with respect to time t can be compared using the result:

  $$\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dx}{dt}$$

- **Exponential law of growth and decay**
  The solution $\frac{dQ}{dt} = kQ$ can be written as $Q = Q_0e^{kt}$

  where Q_0 is the initial value of Q.

  The exponential growth formula is: $N= N_0\ e^{kt}$
  The exponential decay formula is: $N= N_0\ e^{-kt}$
  where N_0 is the initial value of N (ie when $t = 0$ and k is the growth or decay constant for a particular population)

- **Further Growth and Decay**
  If the rate of change of N is given by:

  $$\frac{dN}{dt} = k(N - P)$$

  where K and P are constants, then the solution is given by:

  $N= P$(trival case)
  $N = P + Ae^{kt}$ where A is a constant