4.1 Handout

Tips:

- When analyzing a Pure-Time differential equation, be sure to imagine both the rate *and* solution simultaneously.
- When trying to solve a differential equation, a good place to start is with a guess and check method.

1. Suppose that the population of racoons grows at a constant rate of 20 racoons per year.

   (a) Express this as a differential equation.

   (b) Suppose that $P(0) = 300$. Find a solution to your differential equation.

2. For the differential equation

$$\frac{dy}{dt} = 3t$$

   (a) Make a sketch of the graph of the rate as a function of time.

   (b) Make a sketch of the graph of a solution with the initial condition $y(0) = 1$.

3. A cell starts at a volume of $600\,\mu\text{m}^3$ and loses volume at a rate of $2\ \mu\text{m}^3$ per second.

   (a) Write a differential equation that describes how the volume of the cell changes in time.

   (b) Find and graph the solution, and say whether the solution makes sense for all time.

4. Show that the function $f(t) = 3t^2 + 1$ is a solution to the differential equation

$$\frac{df}{dt} = 6t.$$

5. Consider the differential equation

$$\frac{dP}{dt} = e^{-t+1}, \qquad \text{with initial condition } P(0) = 0.$$

   Find the solution by the "guessing" method. Hint: start by taking the derivative of e^{-t+1}.