# Dynamics Worksheet 3

1. Suppose you roll five fair 50 sided dice which each have the numbers 5 through 54 written on them. What is the probability that the sum of the rolls is 50?

2. Recall the following example from lecture: the rate of infection of some disease depends on the product of the number of people currently infected and the number of people currently uninfected. In lecture, we saw how to write a differential equation to model this scenario. But we ignored the fact that diseases can cause the population to decline (because some people die of the disease). Suppose the death rate in the population is the sum of the regular death rate (a constant) plus the rate at which people are killed by the disease, which is proportional to the number of people infected. Suppose also that the birth rate is proportional to the current population size.
   (a) Write a pair of differential equations to express how the population size and number of infected people changes over time.
   (b) Suppose the birth rate is 0. Do you expect the population to grow or shrink over time? What about the number of infected people? Do you expect the rate at which the population is changing to speed up or slow down over time?

3. A 5 foot tall person is initially standing 3 feet from an 8 foot tall lamp. The person begins to walk forward at a rate of one foot per second. Write a differential equation to express how the length of their shadow changes as they walk.

4. Compute the following indefinite integrals.

$$\int \frac{t^2 - 29t + 5}{(t-4)^2(t^2+3)}\, dt$$

$$\int \frac{t^4 - 5t^3 + 6t^2 - 18}{t^3 - 3t^2}\, dt$$