Dynamics Worksheet 2

1. Suppose X is a random variable following the Poisson distribution. In independent trials, you observe the following values of X: 1, 5, 0, 3, 2, 2, 4, 3, 1, 2. Find the 95% confidence interval for the expected value of X.

2. When you are falling, your acceleration is the sum of your acceleration due to gravity and your deceleration due to drag. Acceleration due to gravity is constant and deceleration due to drag is proportional to your current velocity. Write a differential equation to express how your velocity changes as you fall. (Hint: acceleration is the derivative of velocity.)

3. Newton's second law states that the net force on an object is equal to the acceleration of the object times the mass of an object. Hook's law states that the force a spring exerts on an object is proportional to the distance of the end of the spring from its equilibrium point. Imagine there is a block attached to the end of a spring. Write a differential equation to express how the position of the block is changing (assume the only force on the block comes from the spring).

4. Find a solution to the following differential equations:
   (a) $\frac{dy}{dt} = t^3 + t$
   (b) $\frac{dy}{dt} = \sin(t) + e^t$
   (c) $\frac{dy}{dt} = e^{-t} + \frac{2t}{t^2-1}$
   (d) $\frac{dy}{dt} + y = e^{-t}$
   (e) $\frac{dy}{dt} + \frac{3y}{t} = \frac{e^t}{t^3}$
   (f) $t\frac{dy}{dt} - 2y = t^2$
   (g) $t\frac{dy}{dt} - 2y = t^4 \sin t$