1. a. Solve the logistic growth model given by

$$\frac{dP}{dt} = aP - bP^2.$$

b. Find the specific solution that satisfies the initial condition, $P(0) = P_0$.

2. Consider the damped harmonic oscillator given by

$$\frac{d^2y}{dt^2} + 0.4\frac{dy}{dt} + 4.04y(t) = 0.$$

a. Solve this differential equation.

b. With the initial conditions $y(0) = 0$ and $y'(0) = 2$, find the specific solution and create a graph showing its behavior for $t \in [0, 2\pi]$.

3. Consider the differential equation given by

$$\frac{d^2y}{dt^2} - ty(t) = 0.$$

a. Solve this differential equation using Maple. What functions are found from by Maple?

b. Use the series solution method to find the series solution for this equation with powers of t up to and including t^{10}.

4. The differential equation describing a damped pendulum can be written as the following system of differential equations:

$$\begin{aligned} \frac{dy_1}{dt} &= y_2 \\ \frac{dy_2}{dt} &= -4\sin y_1 - 0.2y_2 \end{aligned}$$

a. Show the vector field plot for $y_1 \in [-2\pi, 2\pi]$.

b. Show a phase plot that includes the vector field and includes the trajectories for $t \in [0, 20]$ that have the initial conditions:

$$(y_1(0), y_2(0)) = (0, 2), (4, 0), (-4, 0), (-6, 4).$$

Briefly describe the behavior that you see in this phaseportrait.

c. Find at least 2 equilibria for this system of differential equations. (There are infinitely many.) What are the eigenvalues for the linearized system about the origin?

5. In the example of the modified Lotka-Volterra model, there were three equilibria. Find the eigenvalues and eigenvectors for the third equilibrium $(10, 0)$ that was not solved on the Maple sheet.