MATH 448 — Homework 6

Exercise 9.1. Let $\alpha = 2$, $\beta = 1$, $\gamma = 1$, $\delta = 0.5$. Find the coexistence equilibrium and confirm, by computing T and D for the Jacobian there, that it is a center.

Exercise 9.2 (*computer exploration*) Using the MATLAB code below with the parameters from Exercise 9.1, plot the phase portrait starting from three different initial populations. Confirm each gives a distinct closed orbit, and estimate the period of one of them directly from the time-series panel.

```
al=1; be=0.5; ga=0.75; de=0.25; % change these to explore
f = @(t,z) [z(1)*(al-be*z(2)); z(2)*(de*z(1)-ga)];

figure
subplot(1,2,1)
[X,Y] = meshgrid(0:0.7:14, 0:0.2:3.2);
dX = X.*(al-be*Y); dY = Y.*(de*X-ga);
quiver(X,Y,dX,dY)
hold on
for x0 = [1 2 4 7]
    [t,Z] = ode45(f, [0 15], [x0;1]);
    plot(Z(:,1), Z(:,2))
end
xlabel('x (prey)'); ylabel('y (predator)')
title('Phase plane')

subplot(1,2,2)
[t,Z] = ode45(f, [0 15], [2;1]);
plot(t, Z(:,1), t, Z(:,2))
xlabel('t'); legend('prey x(t)', 'predator y(t)')
title('Time series')
```