Name: ________________________________

Math 3313 Homework -*Logistic Equation*

Instructions:

- Hand-drawn sketchs should be neat, clear, of reasonable size, with axis and tick marks appropriately labeled. All figures, hand drawn computer generated, should have a short caption explaining what they show and describe. Any figure without a caption will not be graded.
- *Staple or bind* all pages together. *DO NOT* dog ear pages as a method to bind.

Important Concepts:

- Experience using ode45, which uses a Runge-Kutta 45 solver. The solver is now a “black box”. We provide ICs and in provides the numerical solution. All the details of the numerial approximator/solver are “inside” ode45.
- Develop a habit of experimenting, probing and testing mathematical models just as one would a physical system. Change the experimental set up (initial conditions, parameters, model), observe results, reflect on why there are changes or perhaps not changes.

Problems:

Consider the Logistic Equation:

$$\frac{dx}{dt} = rx(K - x), \quad K = 1.$$

(a) Let $r = 0.5$. Set the initial condition below the carrying capacity and simulate. Then set the initial condition above the carrying capacity and simulated. Describe your results.
(b) Let $r = 2.0$. How do your results in (b) differ from (a)?
(c) Suppose we change the self-competition term to $dx/dt \sim -x^p$. That is,

$$\frac{dx}{dt} = rx(K - x^p)$$

Experiment by choosing $p < 1$ and $p > 1$ to determine which corresponds to weaker or greater competition. *Turn a figure for each case in c) that demonstrates your conclusion.*
(d) Reset the parameters as in (a) so that $r = 0.5$, $K = 1$ and $p = 1$. Let the initial condition be $x(0) = -1$. What happens? Does this make sense and why/why not?

Note, for each of the figures turned in, be sure to adjust the axis (*axis([* t_{min} t_{max} x_{min} x_{max}*])*) so that the solution fills most of the figure.