Math 2250-1 MAPLE assignment number 1.

Name:

INSTRUCTIONS: Write your name on the above line then go through line by line of this first MAPLE assignment and perform the requested operations. The red font is the actual MAPLE command code. As you go through the document, hit enter at each code line to run each command and modify the commands when necessary. The black font text is non-code that will give instructions for each code command. Usually after you run a command, the instructions will ask that you comment on the results by typing in the designated areas.

Once you have completed all the questions, re-save this file with a different filename that has your name appended to it (i.e., johnDoeAssignment1.mws) and send it to the instructor by email by Thursday May 23rd at 11:59PM. Every student must turn in their own work and in their own words that conveys that THEY understand the material and are not just mindlessly copying others' work. It will up to the student to maintain this ethic. However, I encourage people to work together to help each other to understandd the material.

Best,

Will

At the begining of the file, we always type "restart" to clear the internal memory and then will load the differential equations package "DEtools" into MAPLE's memory using the "with" command:

```
> restart;
> with(DEtools);
```

Make sure to hit enter for both the above commands.

Below we have defined a differential equation that is similar to the logistic DE.

```
> DE:=diff(y(t),t)=y(t)*(y(t)-1);
```

To "define" the above differential equation in MAPLE we used the colon-equals (":=") operator. This operator tells MAPLE enter the equation into memory with the label "DE". Also note the semicolon at the end of the statement which tells MAPLE that the statement is done. Once in memory, we can refer to the equation by simply typing DE to the comand prompt. Below, write out DE and then a semicolon, and then hit enter:

To understand the qualitatitve nature of the DE, we wish to plot out a slope field. To do so, we use the "dfieldplot' command as follows (make sure to hit enter)

```
> dfieldplot(DE,y(t),t=0..5,y=-1...2);
```

the above command takes several inputs, the first being the DE itself, the second tells MAPLE that we are interested in the solution y(t), and the final two inputs are the t and y ranges of the plot.

Question 1---Suppose we examine different initial conditions y(0) and mentally trace out solutions on the above slope field. What are the five solution behaviors that a solution y(t) can have as t goes forward in time depending on the initial condition? Write your answer below:

Question 2---If we interpret y(t) as a population, what condition on initial population must be true in order for the population to survive as time goes forward? Write your answer below in a short sentence:

Now we will ask MAPLE to plot solutions onto the slope field. Below we have defined a set of five initial conditions with the label "ivps" Right now, you can see that all of the initial conditions are written as "y(0)=XX". For each of the five behaviors that you had described in Question 1, replace the "XX" with five different initial conditions that you must pick that will achieve each of the five behaviors that you listed in Question 1, then hit enter.

```
> ivps:=[y(0)=XX,y(0)=XX,y(0)=XX,y(0)=XX,y(0)=XX];
```

To view the solution traces for each of the above initial conditions, hit enter on the "DEplot" command below:

```
> DEplot(DE,y(t),t=0...1.5,ivps);
```

Now look at the t-range in the above DEplot command "t=0...1.5". Change the t viewing window to be from 0 to 3 (hit return). For the solution of the IVP with y(0)>1, note that the growth of y(t) appears to diverge to infinity in finite time (t<infinity).

Now, below we have defined a function of t labeled "Solin" using the following command.

```
> Soln:=t->1/(1-A*exp(t));
```

$$Soln := t \to \frac{1}{1 - A\,e^{t}} \quad (1)$$

Check that it is a solution to the DE using the following command:

```
> DEcheck:=diff(Soln(t),t)-Soln(t)*(Soln(t)-1);
```

The answer is difficult to understand, so we use the "simplify" command:

```
> simplify(DEcheck);
```

$$0 \quad (2)$$

which verifies that Soln(t) is in fact a solution to the DE.

Question 3----For the ivps values that you have used above, write down the values of A that solve each of the five IVPs. Write your answer below. Note, that one of the A values is not finite!

Question 4----For the IVP value that you chose with y(0)>1, what time t does Soln(t) diverge to infinity?

Finally, Use the A value you chose for the diverging solution refered to in Question 4 by replacing the "XX" with the right number and plot the diverging solution over a appropriate time range

```
> A:=XX;
> plot(Soln(t),t=0..XX);
Error, (in plot) expecting a real constant as range endpoint but received XX
```