MATH 308 Sheet 1

Some syntax trouble spots:

multiplication	`3*t` for $3t$
powers	`x^2` for x^2
number π	`Pi`
Greek letter π	`pi`

`sin(x)`	for	$\sin x$
`abs(x)`	for	$\lvert x \rvert$
`cos(x)`	for	$\cos x$
`sqrt(x)`	for	$\sqrt{x}$
`tan(x)`	for	$\tan x$
`ln(x)`	for	$\ln x$
`exp(x)`	for	e^x

Maple can be used to plot direction fields and solution curves. You must load the DEtools package once on each worksheet:

```
> with(DEtools):
```

Note the colon will supress any output from Maple, whereas a semicolon will not.

Example 1. $\dfrac{dy}{dx} = -y$.

Assign the differential equation the name de for easy handling and **to avoid trouble, always type the dependent variable** y as $y(x)$.

```
> de:=diff(y(x),x)=-y(x);
> DEplot(de,y(x),x=-3..3,y=-3..3);
```

To plot the direction field and solution curves, for example the solutions satisfying $y(1) = 2$, $y(-1) = -1$ and $y(1) = 1$, proceed as follows:

```
> inits:=[[1,2],[-1,-1],[1,1]];
```

Here we're telling Maple the initial conditions in the appropriate form. Always be sure to enclose the list in square brackets.

```
> DEplot(de,y(x),x=-3..3,inits,y=-3..3);
```

You might need to play around with the x and y plot ranges to get a good plot.

If you just want a plot of the solution curves, include the arrows=none option:

```
> DEplot(de,y(x),x=-3..3,inits,y=-3..3,arrows=none);
```

NOTES

1. For good printouts, include the option linecolor=black to make the solution curves black.

2. If your solution curves appear jagged, include the option stepsize=h, where you choose h by trial and error to get a good plot. For instance, try .1, .05, .01 etc. Please note on exam, your solution will lose credit if your solution curves appear jagged. Place the option after the y range.

3. To resize Maple's plots, click on the graph and drag the corners with the mouse.

4. Use the initial conditions to help you pick the x and y plot ranges. For instance, if $y(-3) = -1$, use x=-6..0, y=-4..2 as a starting point and play around from there if necessary.

5. The command restart: will clear all values of variables. It's a good thing to try when things go wrong.

6. To type text in a Maple worksheet, hit the button with the T on it. To restore the Maple prompt, hit the button with the [> on it.

Example 2. $\dfrac{dy}{dx} = \sin(y)$. Plot the direction field using Maple. What happens to the solution satisfying

1. $y(0) = 1$ as $x \to \infty$.

2. $y(2) = -2$ as $x \to \infty$.

3. $y(0) = 7$ as $x \to \infty$.

Example 3. The population $p(t)$ in thousands of a certain species satisfies the differential equation $\dfrac{dp}{dt} = 3p - 2p^2$. Use Maple to sketch the direction field and use it to answer the following questions.

1. If the initial population is 2000 individuals (i.e., $p(0) = 2$), what is the limiting population?

2. If the initial population is 500 individuals, what is the limiting population?

3. Can a population of 3000 individuals ever decline to 500 individuals?

Example 4. For a bar magnet, the magnetic field lines satisfy the differential equation $\dfrac{dy}{dx} = \dfrac{3xy}{2x^2 - y^2}$. Plot the direction field. Does it remind you of anything?

Homework

Text: page 22/4, 7, 10 Use Maple on all these.

Lab Book: page 25/1b, 3c, 8, 10b