*Assignment Schedule:*

*Fri (in-class)* – *Test Prep 1*

*Fri (Canvas)* – *Welcome Survey*

*Tue (Webassign)* – *HW 1*

**Today: Motivating Examples and Slope Fields**

$\frac{dy}{dx} = rate\ldots$

*… and rates are everywhere!*

a) *Populations, Savings Accounts, Newton's Law of cooling, Mixing Problems, melting ice (see handout from last time)*

*Warm up*: You have $5,000 invested. You are told the account typically earns around 2% a year in interest.

$A(t)$ = "amount in account after t yrs"

How could we model this with a differential equation?

*b) Free-fall (no air resistance):*

$$mv' = F_g = -mg$$

***I**nitial **V**alue **P**roblem* (IVP)

$$v' = -g$$

$$v(0) = 0$$

*c)* …with air resistance

$$mv' = F_g + F_A = -mg - rv$$

$$v' = -g - \frac{r}{m}v$$

$$v(0) = 0$$

*d) Mass-Spring Example:*

$$Force = -kx$$

$$m\,x'' = -kx$$

It turns out that one solution to this is $x(t) = cos(\omega t)$

## ***Slope/Direction Fields***

*Recall:* $\frac{dy}{dx} = slope$

We can visualize slope!

*Example* 1:

$$\frac{dT}{dt} = 0.5(60 - T)$$

| | T=0 | T=30 | T=60 | T=90 |
|---|---|---|---|---|
| t=0 | | | | |
| t=10 | | | | |
| t=20 | | | | |
| t=30 | | | | |

*Slope field tips*

1. Find when slope = 0
2. Find when slope is undefined
3. Find when slope is pos/neg.

*Example 2*:

$$\frac{dy}{dx} = -\frac{x}{y}$$

| | y=-1 | y=0 | y=1 | y=2 |
|---|---|---|---|---|
| x=-1 | | | | |
| x=0 | | | | |
| x=1 | | | | |
| x=2 | | | | |

Given an initial condition in the slope field, we can roughly sketch what the solution curve might look like.

See handout with many examples:

sites.math.washington.edu/~aloveles/Math207Materials/SlopeFieldExamples.pdf

And feel free to play around with this basic slope field plotter (made my one of my TAs several years ago):

http://slopefield.nathangrigg.net/