MATH 420 Homework #3 Due: 23 Sept 2015 (Weds)

Instructions: A printed copy of your homework should be handed in at the start of class the day it is due. Supplementary electronic files (e.g. R scripts or wxMaxima files;) should be emailed to the instructor prior to class and named according to the format LASTNAME-HWX.EXT (ex: Hurtado-HW2.R).

1. How would you computationally find the maximum of f over $\mathbb{R}^2$ where

$$f(x,y) = \frac{(\sin(10x+5)\,\cos(10y-6)+2)}{\sqrt{x^2+y^2+1}}?$$

Use what you know, and perhaps look over other optimization options at
http://cran.r-project.org/web/views/Optimization.html
to **(a)** describe how you plan to tackle this problem. Next, **(b)** implement it in R for the objective function below (or something equivalent), and finally **(c)** provide your answer and some additional information or arguments that characterizes how much confidence you have that you found the maximum. Recall the 5-step method and related discussions from the start of the semester.

```
obj = function(z) {
  x=z[1]
  y=z[2]
  return(-(sin(10*x+5)*cos(10*y-6)+2)/sqrt(x^2+y^2+1))
}
```

2. If we let $N(0) = N_0 > 0$, the Ordinary Differential Equation (ODE)

$$\frac{dN(t)}{dt} = \lambda N(t)$$

has the solution

$$N(t) = N_0 \exp(\lambda t).$$

This implies

$$\log(N(t)) = \log(N_0) + \lambda\, t$$

Estimate parameters λ and N_0 from the following data in two ways: using `lm()` and by writing your own objective function to minimize the sum of squared error. Since `t()` is the transpose function in R, we will avoid confusion by using x in place of t:

```
x=1:10
N=c(1.21, 1.45, 1.83,  1.68, 2.71,  3.98,  2.71,  5.83, 5.84, 17.4)
```

Hint: Your objective function should take guesses at the two unknown parameter values in the form of a single vector, then calculate sum of squared differences between the given N values, and those of the line equation.