**Please submit your R code, latex files, and a bibtex file with your annotated bibliography. Please submit your files in a compressed folder with format Towers\_hwk1\_<first name>\_< last name>**

**The code in your R files should exhibit all of the good coding practices mentioned in** [**http://sherrytowers.com/2012/12/14/good-programming-practices-in-any-language/**](http://sherrytowers.com/2012/12/14/good-programming-practices-in-any-language/)

**All plots should exhibit all of the good practices in creating figures, mentioned in** [**http://sherrytowers.com/2013/01/04/good-practices-in-producing-plots/**](http://sherrytowers.com/2013/01/04/good-practices-in-producing-plots/)

**Question 1)**

Using Google Scholar, find and read at least three papers related to a modeling topic that interests you. Create a bibtex annotated bibliography of the papers describing the motivation and objective of each.

Prepare a short prospectus describing an idea for a research project that involves some source of **time series data (ie; data recorded at regular time intervals like days, weeks, months or years).** This can be disease data, population data, etc… whatever you like. Describe a simple compartmental model that can be fit to that data set. You can either extract the source of data using DataThief from one or more of the papers you’ve read (although for now just a screenshot of a graph of the data will do), or look for sources of data online (and download it from there or take a screenshot of a graph of the data), or perhaps get ideas from the web page of the lectures, describing lots of sources of free online sources of data <http://sherrytowers.com/2012/04/03/finding-sources-of-data-free-online-data/>

Compartmental models can be used to simulate many things. Disease is of course an example we’ve discussed in class. You can also simulate the spread of ideas as an infectious disease… these “ideas” can include things like the idea that committing a crime might be a good idea, or that smoking is desirable, not vaccinating your kids is a good idea, or being obese is OK… having friends who are criminals, smokers, drug users, anti-vaccinators, or obese can “infect” you with the idea to do the same.

The spread of memes in social media can also be simulated with a compartmental model. Or the number of hits over time on a YouTube video that goes viral. There are many, many things other than actual diseases that can be simulated with compartmental models for infectious disease.

Then there is population biology, where you can use compartmental models to simulate the change in populations, predator prey systems, wildlife management protocols, fisheries, etc.

In your prospectus (written in Latex, with bibtex references), give a few sentences **motivating** your proposed project, and then go on to describe your proposed **objective** (remember that “motive” is a description of why someone should be interested in your project, and why what has been done in the past is insufficient to really solve or understand the issue… “objective” is what you plan to do to address the problem). Discuss whether this topic has been studied before. Then describe your potential sources of data (give links and/or references). Describe your proposed model, including a compartmental flow diagram and the model equations. Describe which parameters are known from the literature (give references!) and which must be obtained by fitting to the data.

In your latex file, include a plot of the data time series (either write the R code to make the plot with data you download, or include a screenshot from one of the papers you read, or a website that has a graph or relevant data). Put a descriptive caption with the figure.

Note that I want you to consider only *simple* models… consider at most fitting for three model parameters.

Also note that you don’t have to do any of the model fitting or analysis at this point… you are just proposing a potential project on a topic that interests you.

The PDF files of these prospectus proposals will be circulated to other students in the class as part of Hwk#2, and students will use a rubric to score several prospectuses (prospecti?) each, and the feedback will be returned to you.

**This proposed project does not have to become an MTBI research project.**  The aim of this homework is to get you thinking about possible research topics that might interest you either now or in the future, and how to properly express motive and objective.

**Question 2:**

Note: this question can be combined with Question 1, if you would like to include these tasks as part of your prospectus.

Using one of the free online sources of time series data (ie; data recorded at regularly spaced time intervals like days, weeks, months, or years) mentioned on the page <http://sherrytowers.com/2012/04/03/finding-sources-of-data-free-online-data/>, download a data time series that is of interest to you that you believe you would be able to describe with a **simple** compartmental mathematical model of population dynamics or contagion dynamics (no more than four compartments!). Note that not just diseases are contagious… crime can be thought of as contagious ideas can be contagious, etc.

In a latex file, give a thorough description of the data, including what the data represents, the web page from which you downloaded it, the date you accessed the web page, where and how that web page collected the data, etc.

In R, create a properly labeled plot displaying the data.

In the latex file, include your plot of the data, with an appropriate descriptive caption. You my find the R scripts in this module useful: <http://sherrytowers.com/2012/12/11/the-basics-of-the-r-statistical-progamming-language/#read>

Give a brief description of what kind of model might be appropriate for the data. Name the compartments of the model. In the latex file, provide the model equations. Include a table with the description of the model parameters.

What compartment does the data represent?

For a set of model parameters that you think might be reasonable, write the R code to numerically solve the model, and obtain the estimate for the time dependence of the compartment that you believe represents the data. Plot the result in a properly labeled graph, and include the figure in your latex file with an appropriate caption.

You may find the R scripts in this module helpful: <http://sherrytowers.com/2012/12/11/simple-epidemic-modelling-with-an-sir-model/>