Assignment 2:
Introduction to *Mathematica*

Introduction to Data Analysis for Physics

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Spring 2014

Submission Requirements

Submit the assignment to data.analysis.physics@gmail.com by Wednesday at 5pm. Just submit the *Mathematica* document you create (typically a .nb file).

Problem 1

To start, let's make a simple set of data and use some of the stylistic options to make a graph exactly the way we want. Start with

```
data = Table[{i, Sin[.1 i]}, {i, 0, 100}]
```

and create a plot that matches the one in Figure 1. You may find the `Style` function useful (updated in reading - just above the Practice Problem for Simple Plots). To create the plot, I had to use `PlotStyle, PlotRange, AxesLabel, PlotLabel`, and `AxesStyle`.

Problem 2

Combinatorics are an important facet of probability, which occasionally shows up for physics problems in quantum mechanics / thermodynamics / etc. The `Binomial[n,m]` function is the same as

$$\left(\begin{array}{c} n \\ m \end{array} \right) = \frac{n!}{m!(n-m)!}$$

To better explore matrix operations (and maybe learn some combinatorics), let's create a 10x10 matrix with binomial coefficients:

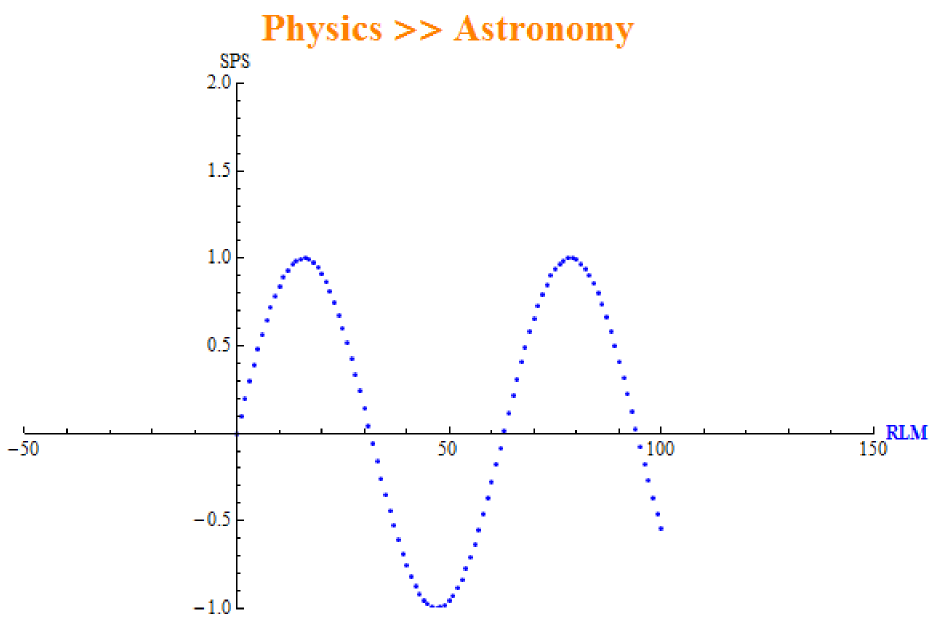

Figure 1: Graph to imitate.

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & \\ 1 & 1 & 0 & 0 & 0 & \\ 1 & 2 & 1 & 0 & 0 & \cdots \\ 1 & 3 & 3 & 1 & 0 & \\ 1 & 4 & 6 & 4 & 1 & \\ & & \vdots & & & \ddots \end{pmatrix}$$

In other words, that $A_{r,c} = \binom{r-1}{c-1}$, where r is the row (starting at 1) and c is the column (starting at 1). Use the `Binomial` function to create this matrix (will need to also use the `Table` command). In the problems below, use the `Total` command with sections of the matrix to compute the following quantities. Each is left as a function of k, an integer corresponding to the total number of elements in the section. So, to check your work, just plug in different values of k to make sure the quantity you're trying to compute with the matrix matches the mathematical result of sums of the binomial distribution. (*Note:* in *Mathematica*, with the `Binomial[n,m]` function, if $m > n$, the function is just 0)

a

$$\sum_{i=0}^{k} \binom{i}{1} = \frac{k(k+1)}{2}$$

b

$$\sum_{i=0}^{k} \binom{k}{i} = 2^k$$

Problem 3

With the data below, find a way to plot the relationship between the second grade (taken at the end of the semester for this fictional class) and the first grade multiplied by attendance (scale attendance from a percent to a fraction while you're at it). For clarity, go ahead and make the points `Medium` in size, and label the graph appropriately.

```
class = {{"Name", "Grade 1", "Grade 2", "Attendance"},
   {"Michael", 95, 93, 20},
   {"George", 95, 87, 90},
   {"Oscar", 50, 78, 60},
   {"Lucille", 100, 0, 10},
   {"Lindsay", 40, 40, 40},
   {"Steve", 0, 0, 100},
   {"Barry", 50, 50, 50},
   {"Ron", 100, 100, 57},
   {"Rita", 10, 20, 97},
   {"Sally", 100, 100, 100},
   {"Maggie", 77, 76, 75}};
```