PHYS 301
HOMEWORK #7

Due : Wed., 12 March 2014

For this programming assignment, you will look up the RandomReal function on Mathematica. Using this function, write a short Mathematica program that will generate random numbers between 0 and 1, and compute the average of those numbers. Do trials for nterms = 100, 1000, 10000, 100000 and 1, 000, 000. (Remember to create a data array to store previously computed values of your variable).

What value do you expect to get for the average? Next, compute the standard deviation for each of these trials. For this assignment, email me your Mathematica .nb file at dslavsk@luc.edu. You must send this email from your Loyola account.

This assignment will be based out of 40 points.

Solution : There are many ways of using RandomReal to generate a series of random numbers between zero and 1. We could use RandomReal[], or RandomReal[{0, 1}] or RandomReal[1] to generate random numbers between 0 and 1.

In the program below, nterms represents the number of random numbers we generate :

```
Clear[x, xavg, stdev, nterms]
nterms = 100;
x[n_] := x[n] = RandomReal[]
xavg = Sum[x[n], {n, nterms}] / nterms;
Print["The average for ", nterms, " randomly generated numbers between 0 and 1 is ", xavg]
```

```
The average for 100 randomly generated numbers between 0 and 1 is 0.501211
```

We can compute the standard deviation using the equation :

$$\sigma = \sqrt{\frac{\Sigma_{n=1}^{nterms} (x[n] - xavg)^2}{nterms - 1}}$$

and we code this equation as:

```
stdev = Sqrt[Sum[(x[n] - xavg)^2, {n, nterms}] / (nterms - 1)];
Print["The standard deviation for these ", nterms, " numbers is ", stdev]
```

```
The standard deviation for these 100 numbers is 0.292657
```

And you could execute this program five times to produce results for nterms = 100, 1000, 10000, 100000, 1000000 terms. Below, I show how you can write a single Do loop to do all five computa-

tions at once :

```
Clear[x, xavg, stdev, nterms]
nterms = 100;
x[n_] := x[n] = RandomReal[]
Do[xavg = Sum[x[n], {n, nterms}] / nterms;
 Print["The average for ", nterms, " randomly generated numbers between 0 and 1 is ",
  xavg]; stdev = Sqrt[Sum[(xavg - x[n])^2, {n, nterms}] / nterms];
 Print["The standard deviation for these ", nterms, " numbers is ", stdev];
 nterms = 10 nterms, {m, 5}]
```

```
The average for 100 randomly generated numbers between 0 and 1 is 0.525203

The standard deviation for these 100 numbers is 0.284752

The average for 1000 randomly generated numbers between 0 and 1 is 0.506599

The standard deviation for these 1000 numbers is 0.294518

The average for 10 000 randomly generated numbers between 0 and 1 is 0.499335

The standard deviation for these 10 000 numbers is 0.289139

The average for 100 000 randomly generated numbers between 0 and 1 is 0.500174

The standard deviation for these 100 000 numbers is 0.289032

The average for 1 000 000 randomly generated numbers between 0 and 1 is 0.499758

The standard deviation for these 1 000 000 numbers is 0.288798
```

In this program, the body of the Do Loop begins with xavg = ... and ends with nterms = 10 nterms, . The semi - colons separate different steps that are executed within the Do Loop. The code “nterms = 10 nterms” rescales the value of nterms by a factor of 10.