PHYS 328
HOMEWORK #4

Due : 26 Sept. 2013

Questions 3 and 4 require the use of *Mathematica* and may be submitted as hard copy or via email as a .nb file (be sure to use your Loyola address). Strive for efficiency and clarity in your programs. A portion of your score (20 %) will be based on the efficiency of your programs. The rest of the assignment must be submitted in hard copy at the beginning of class on Th. As always, all answers must show complete work.

For the probability questions, use the techniques and equations studied in Ch. 2 of the text.

Finally, I remind you once again that peer grades for group work are due via email no later than 5 pm on the day following the group work. I have not yet deducted the penalty from anyone who has submitted their grades late, but I will begin doing so for all remaining assignments this semester.

1. The national powerball lottery uses two sets of balls. The first set consists of 59 sequentially numbered balls; the second set consists of 35 sequentially numbered balls. Assume equal probability of choosing any ball, and that all the balls are differently numbered. Five balls are chosen without replacement from the set of 59. Then one ball is chosen from the set of 35. Calculate the number of ways these six balls can be chosen (and thus your probability of winning the grand powerball prize).

2. Consider 100 flips of a fair coin :

a) How many possible microstates and macrostates are there? (10 pts)

b) How many ways are there of obtaining 50 heads and 50 tails? (5)

c) What is the probability of obtaining exactly 50 heads? Of obtaining exactly 60 heads?

d) How does the second answer in part c) compare to the probability of getting 6 heads out of 10 coin flips? Why are the answers so different? (10)

3. Write a short Mathematica program that will calculate the probability of obtaining n heads out of N flips of a fair coin. Plot the probability of obtaining n heads as a function of n for N=10, 100, and 1000. Make sure all data points are visible. (10)

4. Amend your program to calculate the value of n such that the probability of obtaining n heads is equal to 1/e of the maximum probability. (You may assume without proof that the maximum probability occurs when n = N/2). Calculate the "efolding value of n" for cases where N = 10, 100, 1000, 10000. Can you find a simple relationship for the spread between N/2 and n (efolding) as a function of N? (i.e., something like n (efolding) = N/100; this is not the correct relationship, but shows the format I am requesting). (20)

5. Problem 2.8 in the text, all parts. (All parts 5 points).