Math 4330, Homework 10, Due 4/14/2014 [1]

1. Let $m = 1120437$. Implement a linear congruential generator with this modulus and your choice of a, c, X_0.

2. Let
$$f(x) = \begin{cases} 0, & \text{if } 0 \leq x < m/2, \\ 1, & \text{if } m/2 \leq x < m. \end{cases}$$
Perform the following 16000 times: generate the next 4 outputs $X_{4n+1}, X_{4n+2}, X_{4n+3}, X_{4n+4}$ from your PRNG and apply f to them to obtain a 4-tuple
$$\Big(f(X_{4n+1}), f(X_{4n+2}), f(X_{4n+3}), f(X_{4n+4})\Big).$$
There are 16 possible values for this 4-tuple: $(0,0,0,0), (0,0,0,1), \ldots, (1,1,1,1)$. Keep track of how many times each of these 16 possibilities occurs among all 10000 iterations, and report the results.

3. If your PRNG was generating truly random numbers, how many times would you expect each of the 16 possibilities to occur? What would be the standard deviation?

4. Apply a statistical test to determine if this test distinguishes your sequence from a truly random sequence. Explain carefully.