Random number generation

Exercises

1. Generate 1000 random numbers using the following algorithm given on page 79 of the Notes:

$$r_{i+1} = (a \times r_i) \bmod m$$

Use the following values a=5, m=37, r₁=1 to generate r_i (where i=2,3,4….1000).

Note: please check in the Notes what the "mod" operation refers to.

a. Do the random numbers generated using the above algorithm satisfy the "basic criteria" of random numbers (*Hint:* criteria are given on the same page)?

b. Plot the 1000 generated random numbers as a frequency distribution. (*Note:* In the frequency distribution, x-axis, i.e. r_i , range should be 0 - 40, with bin width of 1. And y-axis is the number of times a given random number is generated.). Does the distribution look uniform?

c. What is the periodicity of the above algorithm, i.e. after how many iterations the same set of random numbers get generated?

d. Figure out the values of the "a" and "m" to generate 100,000 random numbers which satisfy the basic criteria of random number generation.

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2. Which inbuilt function of the C programming language can be used for generating the random numbers, which satisfy the basic criteria of random number generation?

e. Generate 10000 random numbers using the above algorithm between 0 and 1. (Does the inbuilt random number generator generate the random numbers between 0 and 1? If not, then you may need to use a method for converting those random numbers to lie in the range of 0 to 1.)

    f.   Plot the frequency distribution of the generated 10000 random numbers.(x-axis range should be 0 to 1. You may use bin width of 0.1)

    g.   Redo part (b) of this question with bin-width of (a) 0.01 and (b) 0.001. What is the effect of changing the bin width?

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    3.   Distribution of Sum of Random Variables:

Case 1

1. Let $M_i = a_i$ be marks of "n" students in one subject, i=1,2,...n (n=10000).

2. Let a_i be the uniformly distributed random numbers between 0 and m (m is the maximum marks=10). Use the inbuilt generating function of C language to generate these random numbers.

3. Find the frequency distribution of M.

Case 2

1. Let $M_i = a_i + b_i$ be total marks of n students in TWO subjects, i=1,2,...n (n=10000).

2. Let each of a_i and b_i be the uniformly distributed random numbers between 0 and m (m is the maximum marks of each subject=5). Use the inbuilt generating function of C language to generate these random numbers.

3. Find the frequency distribution of M.

Case 3

1. Let $M_i = a_i + b_i + c_i + d_i + e_i + f_i + g_i + h_i + j_i + k_i$ be total marks of n students in TEN subjects, i=1,2,...n (n=10000).

2. Let each of a_i, b_i, c_i, ...k_i be the uniformly distributed random numbers between 0 and m (m is the maximum marks of each subject=1). Use the inbuilt generating function of C language to generate these random numbers.

3. Find the frequency distribution of M.

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