How to use Excel® spreadsheet to carry out Monte Carlo simulation?

Monte Carlo simulation (MCS) is a method for iteratively evaluating a deterministic probability model using a very large population of random numbers as inputs.   It has been proposed to be a supplement of the "Bottom-up" GUM method for evaluation of measurement uncertainty.

We can use a statistical software to generate such vast number of random numbers, such as Matlab® , based on a given probability distribution function.   An Excel spreadsheet can also be used to carry out such calculation although it has a limited number of inputs, with a maximum of 48576 rows.   However, for practical purposes, these inputs are good enough to display the probability distribution in question.

For example, given a mean of 35.5 and its standard deviation of 2.3 under the normal distribution function, we can generate some 48574 random data based on the Excel function "=**NORMINV(RAND(),35.5,2.3)**"

Series	Data
1	33.1849
2	38.6867
3	34.9856
4	34.9793
5	36.0362
6	37.4078
7	34.9509
~	~
48571	38.6312
48572	38.1210
48573	29.5783
48574	34.1466

A histogram can be generated using the Excel Data Analysis tool tab as follows:

Bin	Frequency	Bin	Frequency	Bin	Frequency	Bin	Frequency
26.5	3	31.5	743	36.5	3960	41.5	207
27.0	4	32.0	1061	37.0	3595	42.0	118
27.5	7	32.5	1649	37.5	3134	42.5	67
28.0	7	33.0	2092	38.0	2587	43.0	33
28.5	37	33.5	2630	38.5	2113	43.5	15
29.0	57	34.0	3129	39.0	1555	44.0	7
29.5	100	34.5	3637	39.5	1135	45.5	6
30.0	184	35.0	3806	40.0	776	More	1
30.5	315	35.5	4295	40.5	512		
31.0	524	36.0	4185	41.0	288		
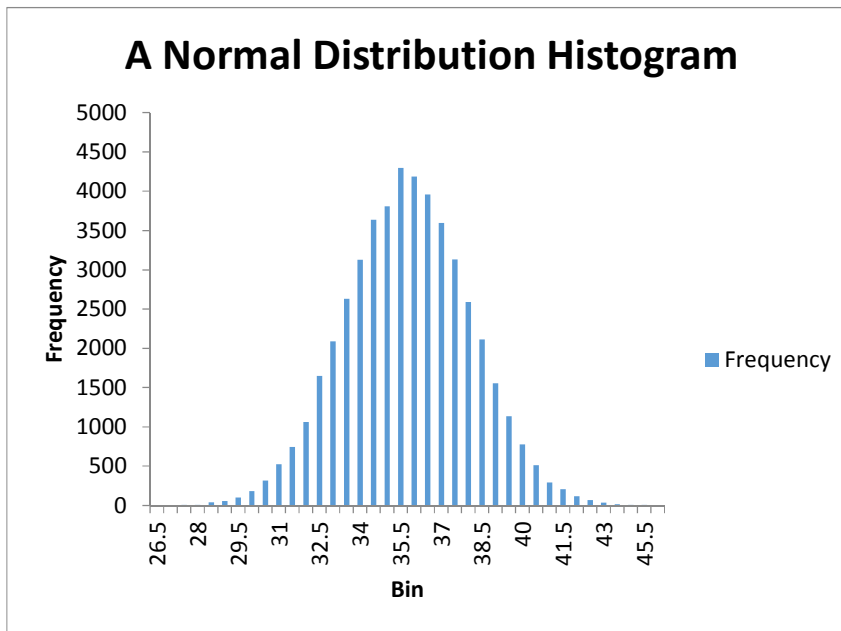
For a rectangular distribution function where the uncertainties are given by maximum bound within which all values are equally probable, we also can use the Excel spreadsheet to plot its data spread as described below.

For example, if we have a mean of 100 with an upper bound limit (UL) of 104 and a lower bound limit (LL) of 96 (i.e. uncertainty of $\pm$4), then we can use the function "=96+(104−94)*RAND())" to generate thousands of random figures bounded by 96 and 104, as show in the following chart which has accumulated some 1800 data:

Series	Data
1	96.077
2	103.419
3	100.317
4	96.077
5	102.801
6	99.975
7	98.261
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1797	101.021
1798	99.421
1799	99.567
1800	99.121

Rectangular Probability Distribution Data