Monte Carlo Simulation: Nuts and Bolts

All Monte Carlo simulation begins by transforming uniformly distributed random numbers into random numbers that follow some specified distribution. Then these random numbers are used to calculate some other number that resembles. or "simulates" a real-world quantity (like profit) that we are interested in.

Up until some time in the 1960s, the uniformly distributed random numbers came from printed tables of random numbers. Since then, tabulated random numbers are still used in textbooks and exams (including yours) but computerized pseudo-random number generators are used for all practical simulation.

Using given ("tabulated") random numbers to do simulation by hand:

We will call the tabulated random numbers "r" and the numbers from the desired distribution (such as demand) "x"

lay out five columns on a piece of paper

In the first column, put the various possible values of the desired random number x, like demand levels. in order from lowest to highest.

In the second column, put the probability of each possible value of x.

In the third column, put the probability that x is less than the number in the first column. For the lowest possible value, this is zero. The probability that the random value x is less than any particular possible X* is the sum of the probabilities of the possible values of x lower than X*.

In the fourth column, put the probability that the random number x is less or equal to than the number in the first column. For the lowest possible value of x, this is the same as the probability that x is equal to that value. The probability that the x is less than any particular possible value X* is the sum of the probabilities of the possible values lower than X*, plus the probability of X* itself.

the fifth column is the same as the first column, for the sake of convenience and as a prelude to the computer method.

Put a decimal point before each given number if it's not already there.

To convert the given (uniformly distributed) random r number to a random number x from the specified distribution, look down the third column of you table to find the largest number in that column that is NOT larger than r. The value of x in the first and fifth columns of that row is the corresponding value.

Plug the value of x into your model, save the results, and repeat using the next given value of r.

You will need to do this on the final, so I will also require it on your last in-class exam to help you get ready.

In the Los Gatos tab of the spreadsheet Ex18p218-Hand.xls,

the possible values of x are 1, 2, 3, 4, and 5 found in cells A4 to A8 (first column) and again in E4 to E8 (fifth column)

The probability of each of these demand levels (in trucks) are found in cells B4 to B8. these probabilities are given in the book.

Look at the formulas in cells C4 to C8 to see how the lower bounds are computed.

Look at the formulas in cells D4 to D8 to see how the upper bounds are computed

Cell E8 is an example of a uniformly distributed random number "r". To see another example, strike f9

Cell E9 gives the corresponding random demand level "x." It's the row of the table whose entry in column C comes closest to the random number "r" WITHOUT GOING OVER.