

FinPak

Simulation

Quick Start

Manual

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FinPak comes with an extensive help file that discusses many of the issues related to doing a simulation.

Introduction

Simulation is a technique that probably has been used to solve problems since human race appeared on the planet. In the simplest case it is pretending. If you had a pretend friend as a child you were simulating a friend. How often have you heard: “Put yourself in their position?” Again it is suggested you simulate “their” position. In fact one might argue that a sociopath is someone who fails to perform that simulation, i.e. they can feel no empathy for someone else.

For some situations simulation is absolutely necessary to learn. Flight simulators are used to train pilots, in some cases the only time a pilot might experience something is in the simulator. Some events are so rare or dangerous that pilots are generally only exposed to them in the simulator. Even if the event is rare passengers would like to believe that if the rare event occurs, the pilot knows how to handle the situation.

NASA uses simulators extensively to train astronauts. They would not be capable of behaving correctly in space, if the first time they experienced weightlessness was in space. NASA uses a variety of techniques to simulate this experience here on earth. Neutral buoyancy in a water tank is one of those simulators. There are many other simulation techniques used by NASA.

Thus simulation should not be something foreign to you. Simulation is used whenever it is impossible to do the actual event, too expensive to do or too dangerous to do or all three. Businesses face similar decisions. Simulation is a way to emulate the decision without having to face the consequences. Investments are an example of the decision that have to be made and the consequences are frequently serious for the investors. These serious consequences sometimes mean a “good consequence” and other times a “bad” one. Unfortunately it is very difficult to sort these consequences out. Simulation in this case is used to try and

understand the consequences without having to bear them.

A second reason for simulation's use in business is to solve problems that are very difficult to solve analytically. It may be easier to solve for the integral of a function using a simulation process than to try and solve the problem using conventional mathematics. Option pricing models are a good examples of this type of problem. Thus simulation is a member of a broad class of numerical solutions to problems.

Simulation works on two bases, one is that the problem can be described with a mathematical representation and second we can determine the outcome by applying sampling theory. This sampling process must meet the requirement that it be representative of the actual distribution of outcomes. In order to get an accurate feel for the underlying outcomes we must sample from the entire possible distribution in a way that represents the distribution.

To implement the simulation you build a spreadsheet that describes the situation you want to simulate. Once this step is completed FinPak helps you run the simulation and provides output that describes the results of the simulation. Of course the results are only as good as the model you build. Given the design of FinPak's output you are able to modify the summary measures if you wish to.

How is FinPak different from other simulation add-ins?

In many respects FinPak is just like the other, frequently very expensive, add-ins. It provides a way for you simulate a model with relative ease. But there are several differences. One is that process is less of a "black box." This has both its advantages and disadvantages. From a learning standpoint this is very useful since you begin to understand how a simulation is put together. Some have suggested that the most valuable part of a simulation is

the process of building the model since you are forced to think about the nature and the interaction of the variables in the model.

The output from FinPak is more robust than the output from most other simulation add-ins because the entire result set is available. If you are not satisfied with the summary statistics it is easy to compute other summary statistics, or to compute statistics for only a partial sample. This is generally not possible with many simulation add-ins without rerunning the simulation. Finpak allows you to combine two simulation runs into a single result. (This of course only works when the two models are the same.) This enables you to run the simulation in pieces, rather than one single run. It is also possible to generate a report that compares two runs from different simulations. Finally FinPak is free for personal use on personal machines.

An Example: A Roll of the Dice

Simulating the roll of dice does not tell us anything we don't already know. We know that if we roll the dice we will get one of six values on each dice. And that chance of each is $1/6$. In fact if we don't get these results we would suspect something was wrong with the simulation. (Note: That a simulation would not answer the question of whether the die is fair (i.e. has a $1/6$ chance each value. It is possible to setup an unfair die roll in a simulation, but a simulation cannot answer the question of whether or not a real process is fair, since we can only model what we setup.)

But, using a die is a place to start. The Excel workbook, *Dice.xls*, shows a setup for this simulation. You can load this workbook and look how to set it up Figure 1 shows part of this workbook. In column C through E, rows 6 through 31 are 26 simulated coin tosses. You can think of this as 26 toss of one coin or tossing 26 coins at once. We already know the answer to how many

	A	B	C
1	Roll the Dice		
2	Die 1	Die 2	Sum
3	=fsintegerinv(1,6)	=fsintegerinv(1,6,)	=A3+B3
4			
5			

heads we expect and what the standard deviation should be and what the distribution will look like. So the simulated outcome is not a surprise. But suppose it is a surprise. What does that tell us? Only that we may have set the simulation up badly and therefore our simulation does not really reflect how a coin will behave.

The above snippet of a sheet shows that a Finpak function is entered in cell A3 and B3. This is the FinPak function that generates integer numbers between 1 and 6 inclusive. Each number has an equal chance of occurring. In cell C3 the these two

occur.
 To do this simulation make sure that FinPak is loaded. The first button is the simulation button click on it. This will start the simulation process. First a series of input boxes will appear asking about various aspects of what you want to do.
 The length of time the simulation takes depends on the speed of your computer and what else is going on. It also depends upon the complexity of the spreadsheet you are simulating, the number of sheets in the Workbook you have open and the number of Workbooks you have open. It is best to close all workbooks you don't need, and to make the simulation workbook as small as possible. It is best to delete old results and re-save the worksheet and then do the simulation. To simulate this spreadsheet for 10,000 simulations took approximately 200 seconds (using cells A3, B3 and C3) to do this on the test machine. The test machine was not a particularly fast computer and there were other programs loaded in background. So the simulation does not take an inordinate length of time to complete.

FinPak Inputs

The first input required from the user is the a title for the output. This is useful if you plan to run different version of similar models. The default name is simply "Simulation." Change it to whatever you want or leave the default.

The second input box will ask for the

	A	B	C	D
1	Roll the Dice			
2	Die 1	Die 2	Sum	
3	1	5	6	
4				
5				

are added together.

If you were to do this in Excel each time you pressed F9, the spreadsheet would recalculate and a new roll of the dice would

name of the output sheet. The output from FinPak will automatically be placed in a new sheet, the default sheet name is: "Result." You may change it to any other name

that you wish.

The next box will ask about the missing value code. It is recommended that you use the standard Excel function NA() for any errors

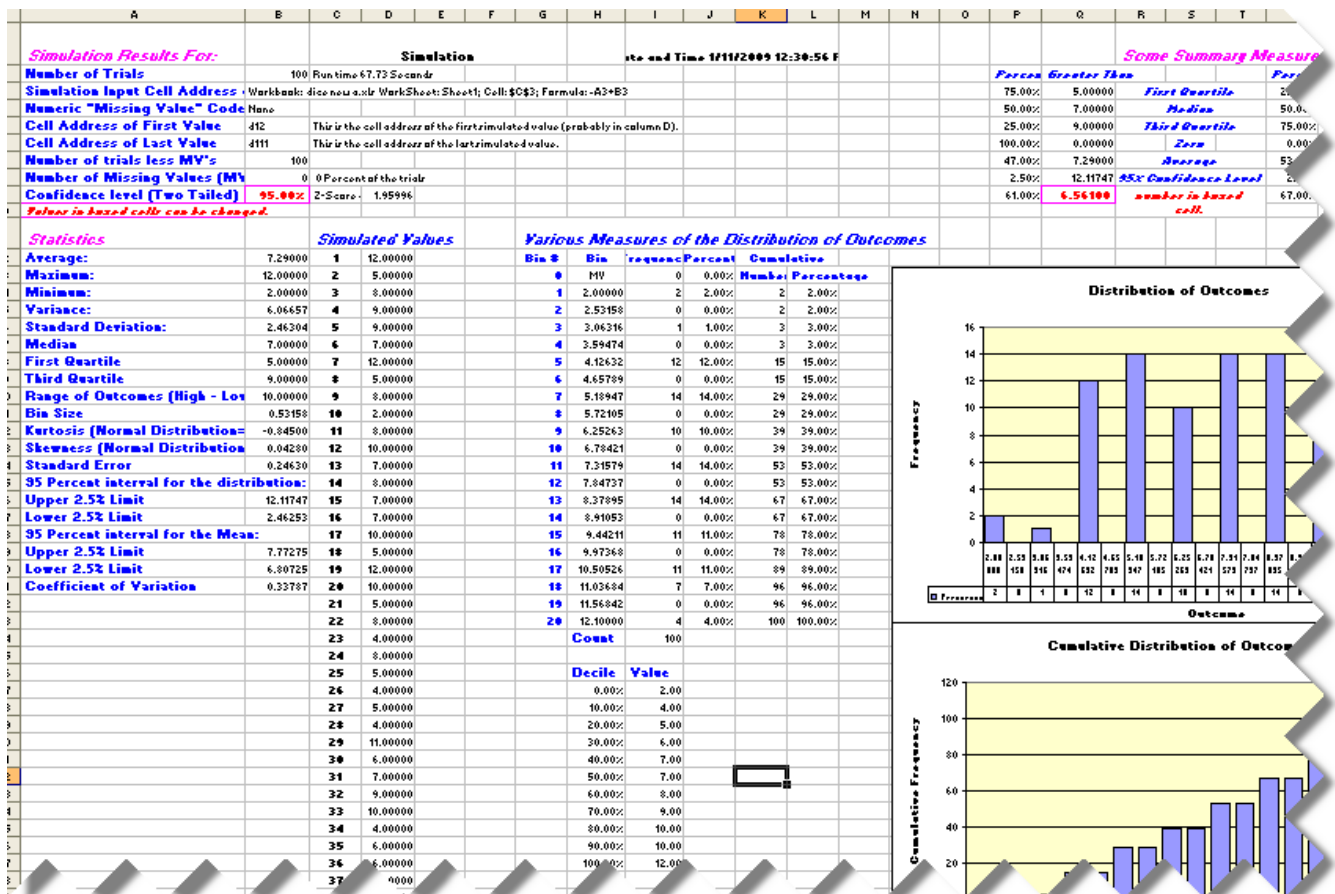
The next box requests the number of trials. This number cannot exceed 50,000 for any single simulation. You can run larger trial by combining two or more set of results, so the upper limit is not really fixed. There is no harm in testing your model by using a small number of runs and taking a look at the output to see if any major problem is apparent. Then run the much larger number of trials or samples.

The next message box will appear and request the cell address of the first variable (or perhaps only variable) to be simulated. The box will allow you to select the cell address by mouse. In the coin toss example above it would be cell "C3" After the first cell is selected the program will ask if there are additional variable that you want to

simulate. You might to keep track of both die so you could choose to also keep track of cells "A3" and "B3". Each additional variable will be assigned a new worksheet with the same name you gave to output sheet with a dash letter appended to the name.

Once you complete the selection FinPak will begin by setting up the output sheets. One for each variable that you are simulating. A box will show the progress and the sheet that it is working on. Most of the underlying data will show as #NA since none values have been computed yet. This should take about 15 seconds or so per variable. After this completes the simulation will begin. The degree of completion will be shown by a progress bar.

You can judge the progress of the simulation from the progress bar and percent completed. Once the simulation completes there will be one final step that fills in the output sheet(s) that were created, as well creating some charts of the results.



The bottom of the previous pages shows part of the output sheet for the dice rolls simulation. You can see the actual output in a workbook that is distributed with FinPak. The sheet is live in the sense that all of the simulation data is on the sheet and the formulas for computing the summary are all available and can be modified if you wish. Thus you can change the histograms by changing the bin values or you can choose to change the confidence level, or even how the various statistics are computed, either by sample size or formula.

Additional Menu Options in FinPak.

Freeze: The Freeze option will convert all of the results for a simulation run to numbers, i.e. it eliminates the formulas by converting them to their numerical equivalent. Once this is done all of the results are “frozen,” this is convenient when convert the output to reports since parts of the output can be move or eliminated without changing the results. If the formula are not remove then copying or editing the results will result in values changing.

Combine: The number of simulation trials or runs is limit for any instance to 50,000. (It is not necessary the number of simulations be at the maximum, in fact they don’t even have to be the same number of runs to combine them, but they do have to be same simulation for the combination to make any sense.) If you want to exceed this number you can rerun the same simulation several times, be sure to save the results in new worksheet each time. If you do it four times you will have a total of 200,000 trials. You obtain a single set of statistics for these four simulations by using the “Combine” option.

Add sheet/Combine: This option allows you to add another sheet to an existing “Combined” sheet. The rules are basically the same as for the combine function. Again FinPak makes a rudimentary attempt to determine that sheet you are adding to is a

an existing “Combined” sheet as well as that the sheets you are adding are output from a simulation.

Compare: This option allows you to compare two simulation outcomes to see how they are different or the same. Again it is important that you compare two things that are comparable; FinPak has no way to determine whether two simulations are in fact comparable. The logical comparison may be between two simulations using different parameter values for essentially the same model. It could also be used to see if two simulation of the same basic model are really different from each other, or if it is just sampling variation.

Input Distribution: Is a wizard to help in creating custom distributions. This allows you to create any distribution you can describe. An example spreadsheet is included with FinPak.

Replace MV’s: The allows you to replace missing values (MV) in the output so you can test the impact on the statistics of missing values.

Reset: Resets the random number sequence so that a simulation can be repeated This requires that Randseq was used in the design of the simulation.

Functions in FinPak.

There are several functions that you can invoke when using FinPak. These are designed to perform some activities that are not available with built-in Excel functions. The first one is used during simulations only, the remaining ones can be used in any spreadsheet and are available if PinPak is loaded.

FSrandseq(seed): The random number generator in Excel as well as in the FinPak gets a seed value from the system timer and then generates a sequence of random numbers from that. Thus it is very unlikely that you would ever get the same sequence of random numbers. Use of this function allows you repeat the sequence of random

numbers.

Distributions available (In addition to the Custom distribution):

FSCorrand(): Allows the generation of two correlated random numbers and events

FSMulticorr(): Allows the generation of multiple correlated numbers and events.

FSIntegerinv(): This function provides integer random numbers over a chosen range

FSTriangle(): This function provides random value drawn from a triangle distribution (i.e. Low, Likely and High)

FSNorminv(): Provides values selected from the normal distribution

FSLognorminv(): Provides values selected from the log normal distribution

FSBinomialinv(): Provides values selected from the binomial distribution

FSPoissoninv(): Provides values selected from the Poisson distribution

FSExponinv(): Provides values selected from the exponential distribution

The native Excel Beta and Gamma distributions can also be used.

The following financial functions that are part of FinPak.

NETPV: Computes the NPV of a set cash flow using the same assumption as the IRR function and also allows for the half-year convention.

HIRR: Computes the internal rate of return for a series using the half year convention, consistent with NETPV.

BSOPM: Computes the value of an option on a non-dividend paying stock using the Black-Scholes model. Also provides output about the sensitivity of the option.

BSOPMTEXT: Provides a way to label the output from BSOPM

BSDOPM: Computes the value of an option on a dividend paying stock using the Black-Scholes model. Also provides output

about the sensitivity of the option

BSDOPMTEXT: Provides a way to label the output from BSDOPM

BSVOPM: Estimates the implied variance of the rate or return on the underlying security if you have information about a call option and the underlying security. It is a useful way to get the market's estimate of the standard deviation.

BIOPM: This function calculates an option value based on the Binomial Option Pricing Model. Like Black-Scholes it assumes a European Option.

BIOPMTEXT: Provides a way to label the output from BIOPM

BIYOPM: This function calculates an option value based on the Binomial Option Pricing Model. It might be easier to supply the inputs since the values are in an annual form and it supplies an estimate of the Standard Deviation given the values for the Up and Down States

BIYOPMTEXT: Provides away to label the output from BIYOPM

BIAOPM: This function calculates an option value based on the Binomial Option Pricing Model. This version could be called the Binomial Approximation to the Black Scholes model and uses exactly the same inputs. You only need the standard deviation and function will estimate the Up and Down steps

BIAOPMTEXT: Provides a way to label the output from BIAOPM

celltext(cell): Provide the text value of the cell, handy for showing what is contain in a formula cell without having to edit the cell. Has no other function and can be used in any spreadsheet as long as FinPak is loaded.