

One-Minute Spotlight

Crystal Ball: Precision Control

Am I running enough trials?

Ever wonder whether or not you've run enough trials? Ever have someone else call into question the accuracy of your simulation results? One way to find out is to use **Precision Control**.

Precision Control lets you define the accuracy you need for a particular statistic (e.g., the mean). Crystal Ball then runs a sufficient numbers required to achieve that level of accuracy. This Spotlight is a quick review of how Precision Control works.

The model below is a simple example of valuation, strategic planning, and capital appropriation decisions, created by David T. Hulett, Ph.D. of Hulett and Associates. It calculates an Internal Rate of Return (IRR) in cell C23 for the five-year operating period.

The screenshot shows an Excel spreadsheet titled "Microsoft Excel - irr_50.xls". The main content is a "Project Present Value Calculation with Risk" model. It features an "Assumptions" table, a cash flow table, and a calculated "Internal Rate of Return" of 17.2%.

Assumptions			
	Baseline	Low	High
Starting Revenue (\$)	18,367	17,500	19,100
Revenue Growth (%)	10.0%	9.5%	10.5%
Starting Op Cost (\$)	15,096	14,700	15,500
Op Cost Growth (%)	10.0%	9.5%	10.5%
Total Project Cost	26,731	22,500	31,000
Discount Rate	15%		

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Revenues		18,367	20,203	22,224	24,446	26,891
Operating Cost		15,096	16,606	18,267	20,093	22,102
Cash Flow		3,270	3,597	3,957	4,353	4,788
		Going concern Residual Value				31,921
Project Cash Flow	-26,731	3,270	3,597	3,957	4,353	36,709

Internal Rate of Return	17.2%
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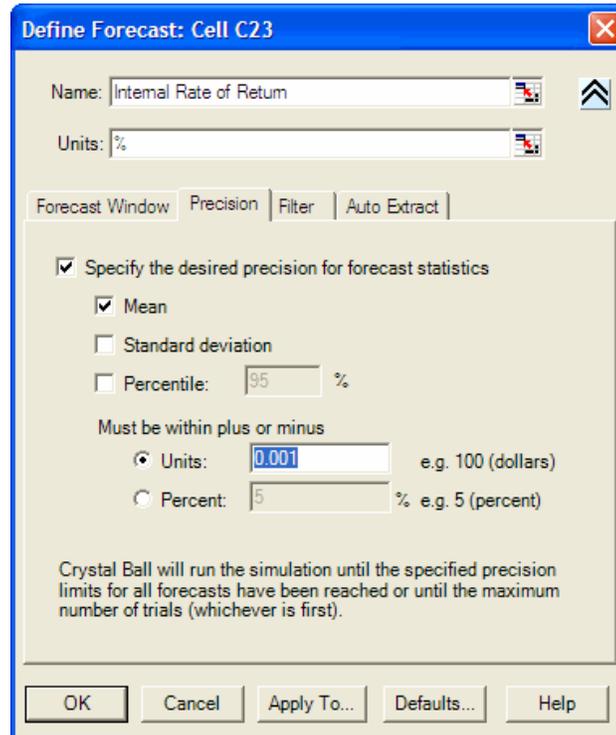
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The model contains assumptions in cells D9:D13 to describe uncertainty in revenue and cost variables. The base case yields an IRR of 17.2%.

Setting the Forecast Accuracy

For this example, you only want Crystal Ball to run enough trials so that you can be 95% confident that the mean IRR value will be accurate within +/- 0.1%.

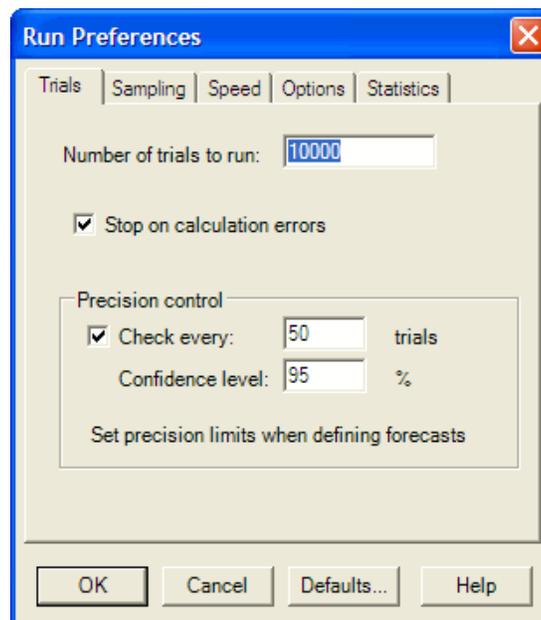
Setting up Precision Control involves two steps. First, select the IRR forecast cell and choose Define Forecast. In the expanded Precision dialog (shown below), select Specify the desired precision for forecast statistics, the Mean statistic and Units 0.001. Then save these options by clicking OK.



Setting the Run Preferences

Next, in the Run Preferences Dialog (shown below), select the Precision Control option and enter a Confidence Level of 95%. The higher the level of confidence, the more trials Crystal Ball will need to run.

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Finally, enter a high number of trials so that you are sure that Crystal Ball will reach your level of accuracy before the maximum trials have been run.

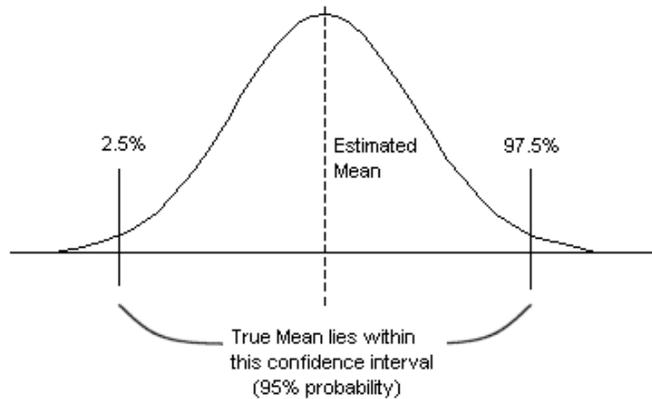
NOTE: Precision Control is on by default. Running simulations with Precision Control on but with no precisions defined for any of your forecasts will have no effect on your simulation results.

Using Confidence Intervals (behind the scenes)

Since Monte Carlo simulation is a technique that uses random sampling to estimate model results, the statistics computed on these results will always contain some kind of error. A confidence interval (CI) is a bound calculated around a statistic that attempts to measure this error with a given level of probability.

In this example, the result of the simulation will be an estimated mean. The more trials you run, the closer the estimated mean comes to the true mean. With Precision Control, a 95% CI around the mean statistic is defined as a 95% certainty that the true mean will be contained within the specified interval. Conversely, there is a 5% chance that the mean will lie outside the interval.

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As you run more trials, the confidence interval narrows and the statistics become more accurate. During a simulation, you can actually see this happening by viewing the forecast statistics.

Running Precision Control

In this example, you can watch the mean precision in the third column decrease until it reaches the desired accuracy. Crystal Ball then posts a message that tells you the precision has been achieved.

	Statistic	Forecast	Precision
▶	Trials	6,100	
	Mean	16.8%	0.1%
	Median	16.9%	0.1%
	Mode	---	
	Standard Deviation	4.0%	0.1%
	Variance	0.2%	
	Skewness	-0.14068	
	Kurtosis	2.91	
	Coeff. of Variability	0.23625	
	Minimum	1.9%	
	Maximum	29.1%	
	Mean Std. Error	0.1%	

Statistics shown in color are tested for 0.1% precision at 95.00% confidence

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To reach your desired level of precision of +/- 0.1% for the IRR mean, Crystal Ball ran 6,100 trials. The simulated mean was 16.8%, and you are 95% confident that the true mean will lie between 16.7% and 16.9%.

By helping you to achieve a desired level of confidence in your forecasts, Precision Control can improve the accuracy of your simulation results and the quality of the decisions you make.

For more information or to contact us, browse to <http://www.oracle.com/crystalball>.