

## One-Minute Spotlight

### THE BOOTSTRAP TOOL

Bootstrapping is a simple technique that estimates the accuracy of forecast statistics. The term bootstrap comes from the saying, "to pull oneself up by one's own bootstraps," since this method uses the raw data itself to analyze the statistics' accuracy.

The Bootstrap tool works by randomly sampling the forecast data and then creating distributions of the statistics from each sampling. For example, to test the accuracy of the mean statistic of a forecast, this tool can run 500 simulations of 1000 trials each, save the mean values from all 500 simulations, and then let you analyze the statistics of those 500 mean values (e.g., you can see the mean of the mean).

The example model below calculates an internal rate of return (IRR) in cell C26 for the five-year operating period. How confident are you in the accuracy of the IRR mean from your simulation?

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cost/Package		\$6.00	\$6.05	\$6.10	\$6.17	\$6.22
# Sold		802,000	967,000	1,132,000	1,297,000	1,462,000
Gross Revenues		\$4,812,000	\$5,850,350	\$6,905,200	\$7,998,167	\$9,088,767
Cost of Revenues		\$3,609,000	\$4,387,763	\$5,178,900	\$5,998,625	\$6,816,575
Gross Income		\$1,203,000	\$1,462,588	\$1,726,300	\$1,999,542	\$2,272,192
Operating Costs		\$120,300	\$146,259	\$172,630	\$199,954	\$227,219
Net Income Before Taxes		\$1,082,700	\$1,316,329	\$1,553,670	\$1,799,588	\$2,044,973
Taxes		\$346,464	\$421,225	\$497,174	\$575,868	\$654,391
Initial Investment	-\$3,400,000					
Net Income	-\$3,400,000	\$736,236	\$895,104	\$1,056,496	\$1,223,720	\$1,390,581
NPV		\$502,080				
IRR		15%				

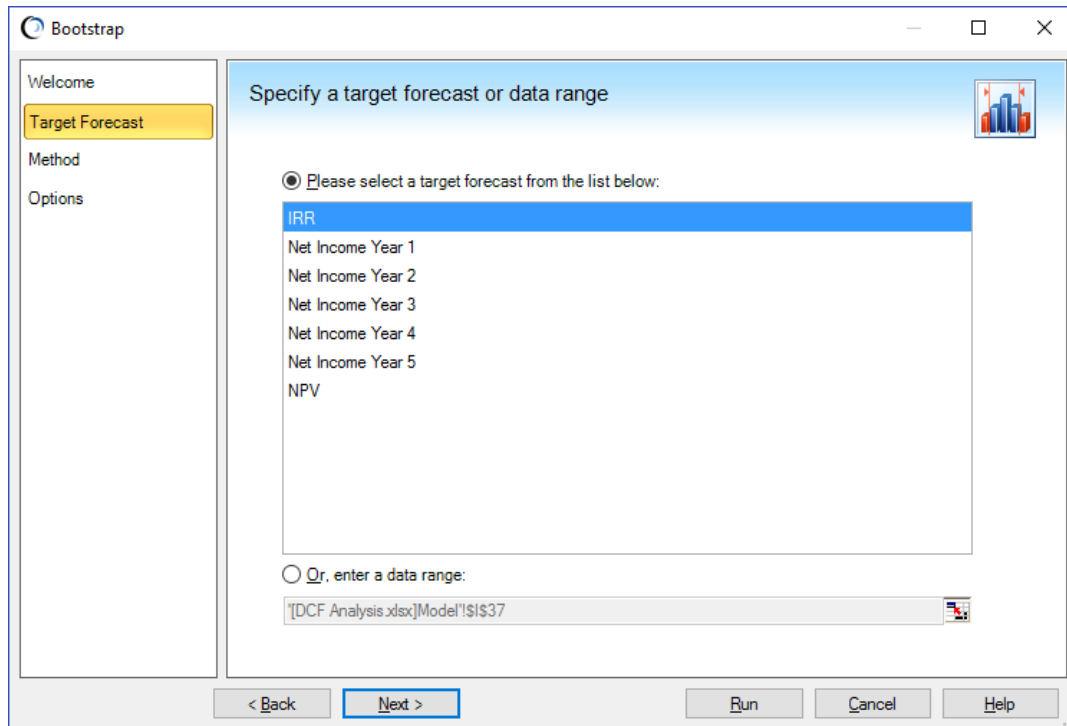
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Bootstrap, continued

## OPENING THE TOOL AND SELECTING A FORECAST

You can open the Bootstrap tool through the Run -> Tools menu.

When the tool opens, you will see a Welcome screen. Click on Next. In the Target Forecast dialog, select the IRR forecast from the list of forecasts. Click on Next to move to the Method dialog.



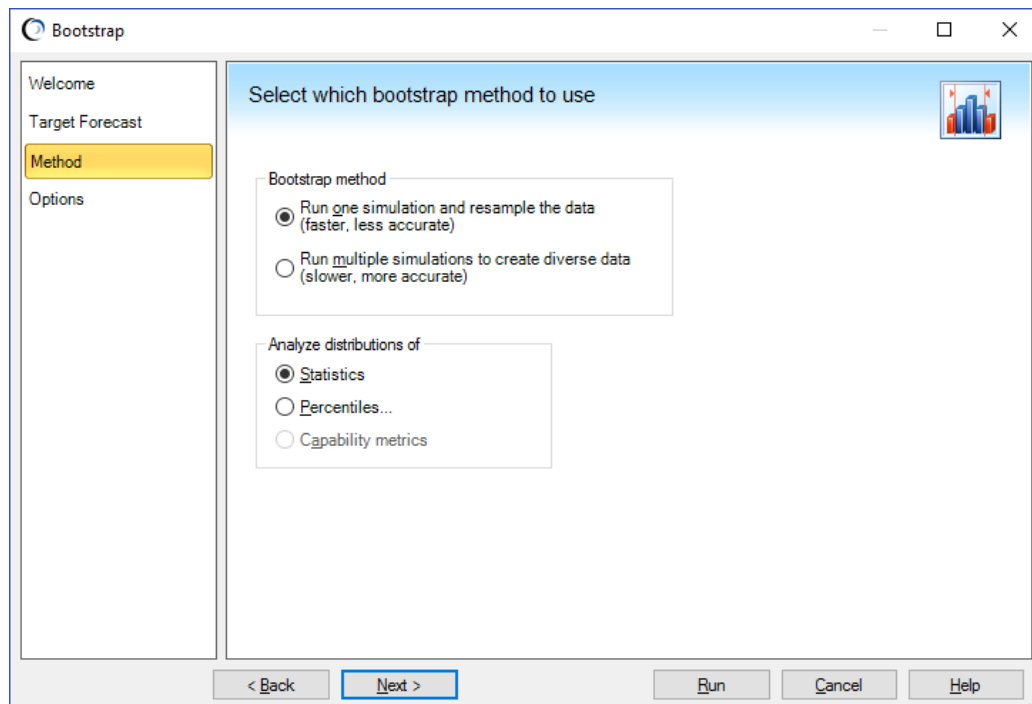
Bootstrap, continued

## SPECIFYING THE BOOTSTRAP METHOD

This step lets you select one of two available bootstrap methods.

The first method simulates the model once (creating the original sample) and then repeatedly resamples those simulation trials (the original sample values). This quicker method assumes only that the original simulation data accurately portrays the true forecast distribution, which is likely if the sample is large enough.

The second method repeatedly simulates the model to generate completely different samples. This method is more accurate than the first method, but it takes much longer to run.

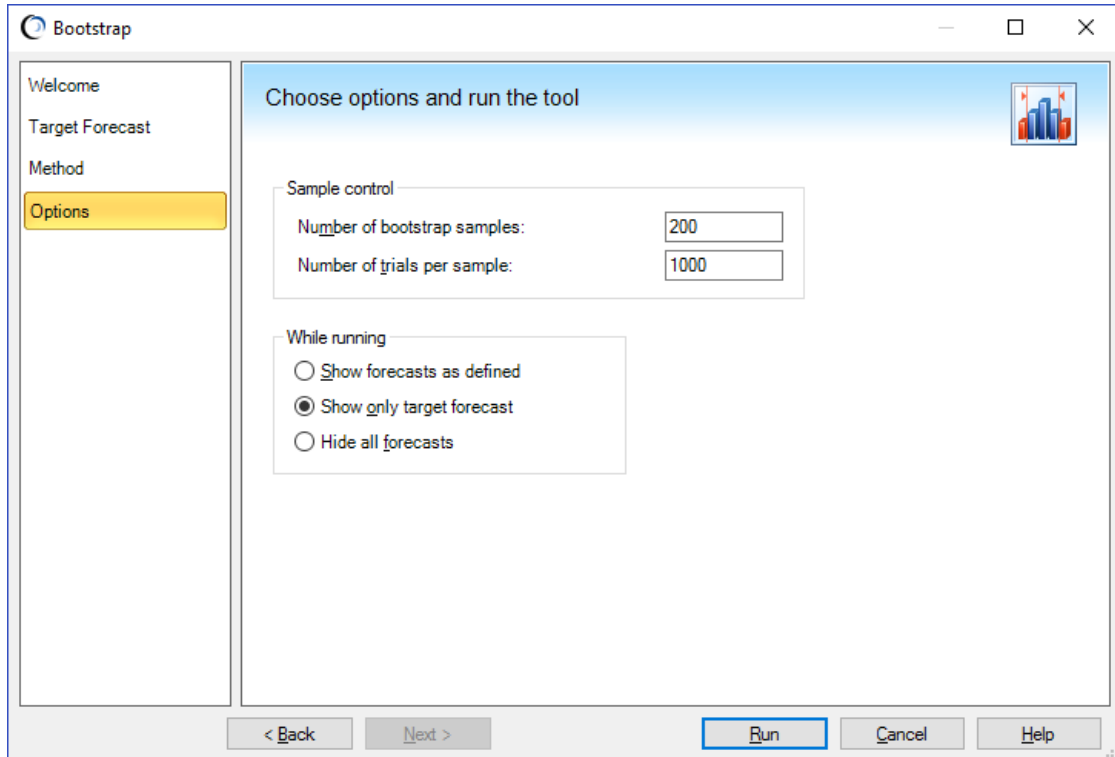


You can also choose what distributions to analyze, the statistics or the percentiles. In this example, you choose Statistics. Click on Next to go to the final step.

Bootstrap, continued

## SELECTING THE OPTIONS

In this step, you determine the number of bootstrap samples (i.e., the number of simulations you want to run) and the number of trials per sample you want the tool to run.



The screenshot shows a software window titled "Bootstrap" with a sidebar on the left containing the following menu items: "Welcome", "Target Forecast", "Method", and "Options" (which is highlighted in yellow). The main area of the window is titled "Choose options and run the tool" and contains the following settings:

- Sample control**
  - Number of bootstrap samples: 200
  - Number of trials per sample: 1000
- While running**
  - Show forecasts as defined
  - Show only target forecast
  - Hide all forecasts

At the bottom of the window, there are four buttons: "< Back", "Next >", "Run", "Cancel", and "Help".

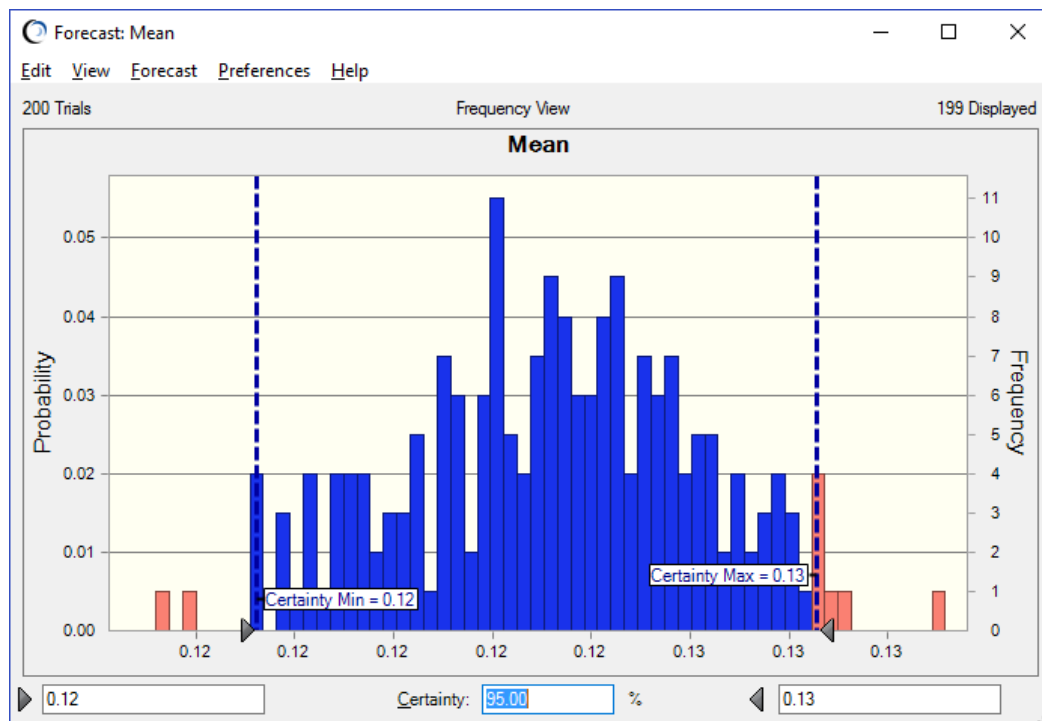
Because you selected the one-simulation method, the tool will run one 1000-trial simulation and then resample from those 1000 values for the next 199 simulations. Click on Run to use the tool.

Bootstrap, continued

## ANALYZING THE OUTPUT

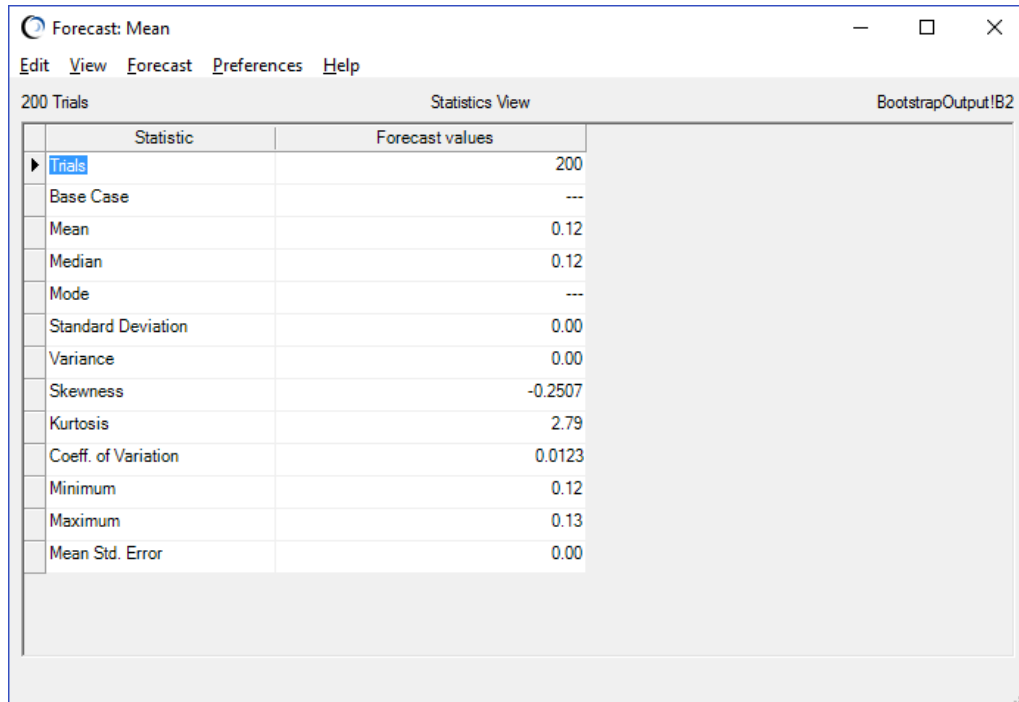
The Bootstrap tool displays sampling distributions in forecast charts for the mean, median, standard deviation, variance, skewness, kurtosis, and coefficient of variability statistics. The forecast charts visually indicate the accuracy of each statistic.

A narrow and symmetrical distribution is usually better than a wide and skewed distribution because a tight distribution means that most values are centered around the sampling distribution's mean, or the statistic's approximated "true" value. Shown below is the forecast chart for the mean values from all 200 simulations.



## Bootstrap, continued

You can learn more from the statistics view.



The screenshot shows a window titled "Forecast: Mean" with a menu bar containing "Edit", "View", "Forecast", "Preferences", and "Help". Below the menu bar, it indicates "200 Trials" and "Statistics View". The main content is a table with two columns: "Statistic" and "Forecast values". The "Trials" row is expanded, showing a value of 200. Other statistics listed include Base Case, Mean, Median, Mode, Standard Deviation, Variance, Skewness, Kurtosis, Coeff. of Variation, Minimum, Maximum, and Mean Std. Error.

Statistic	Forecast values
Trials	200
Base Case	---
Mean	0.12
Median	0.12
Mode	---
Standard Deviation	0.00
Variance	0.00
Skewness	-0.2507
Kurtosis	2.79
Coeff. of Variation	0.0123
Minimum	0.12
Maximum	0.13
Mean Std. Error	0.00

The standard deviation (standard error of the statistic) and coefficient of variability are very small, so the forecast mean is an accurate estimate of the actual mean. To gain even more confidence in your results, you could use the Bootstrap tool again with a larger number of trials and simulations or with the multiple-simulation method.

For more information or to contact us, browse to

<http://www.oracle.com/technetwork/middleware/crystalball/overview/index.html>.