Using Crystal Ball with Invest for Excel

A white paper by

DataPartner

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Table of content

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Introduction

The purpose of this paper is to give a short introduction on how to use Decisioneering Inc's Crystal Ball with Invest for Excel. The simulation example explained here is very basic and does not utilize all of the many possibilities of Crystal Ball. The method should however apply to most of the simulations of Crystal Ball.

Step 1: Build a model

Here is an example of a simple investment calculation:

INVESTMENTS (-) / REALIZATIONS (+)

1000 Eur	Depr.-%	1/2005	12/2005	12/2006	12/2007	12/2008	12/2009	Residual
Months per interval			12	12	12	12	12	(12/2009)
1	15,00%	-100 000						25 000
Depreciation (straight line)			-15 000	-15 000	-15 000	-15 000	-15 000	
Book value		100 000	85 000	70 000	55 000	40 000	25 000	0
Book value		100 000	85 000	70 000	55 000	40 000	25 000	0

PROFIT CALCULATION

1000 Eur	1/2005	12/2005	12/2006	12/2007	12/2008	12/2009	Residual
Months per interval		12	12	12	12	12	(12/2009)
Sales		40 000	40 800	41 616	42 448	43 297	0
+ Sales units		1 000	1 000	1 000	1 000	1 000	
* Income per unit		40,00	40,80	41,62	42,45	43,30	
Income		**40 000**	**40 800**	**41 616**	**42 448**	**43 297**	**0**
Variable costs		-2 000	-2 030	-2 060	-2 091	-2 123	0
Raw materials and consumables		-2 000	-2 030	-2 060	-2 091	-2 123	0
+ Sales units		1 000	1 000	1 000	1 000	1 000	
* Cost of sales per unit		-2,00	-2,03	-2,06	-2,09	-2,12	
Gross margin		**38 000**	**38 770**	**39 556**	**40 357**	**41 175**	**0**
Fixed costs		-10 000	-10 100	-10 201	-10 303	-10 406	0
Fixed costs		-10 000	-10 100	-10 201	-10 303	-10 406	
EBITDA; Operating income before depreciation		**28 000**	**28 670**	**29 355**	**30 054**	**30 769**	**0**
Depreciation	0	-15 000	-15 000	-15 000	-15 000	-15 000	0
EBIT; Operating income	**0**	**13 000**	**13 670**	**14 355**	**15 054**	**15 769**	**0**
Income tax	0	-3 380	-3 554	-3 732	-3 914	-4 100	0
Net income for the period	**0**	**9 620**	**10 116**	**10 622**	**11 140**	**11 669**	**0**

Net Present Value (NPV)	15 611

Step 2: Identify uncertain variables

In the example we assume that the investment payment is fixed, so the uncertain variables are:

- Sales units
- Income per unit
- Cost of sales per unit
- Fixed costs

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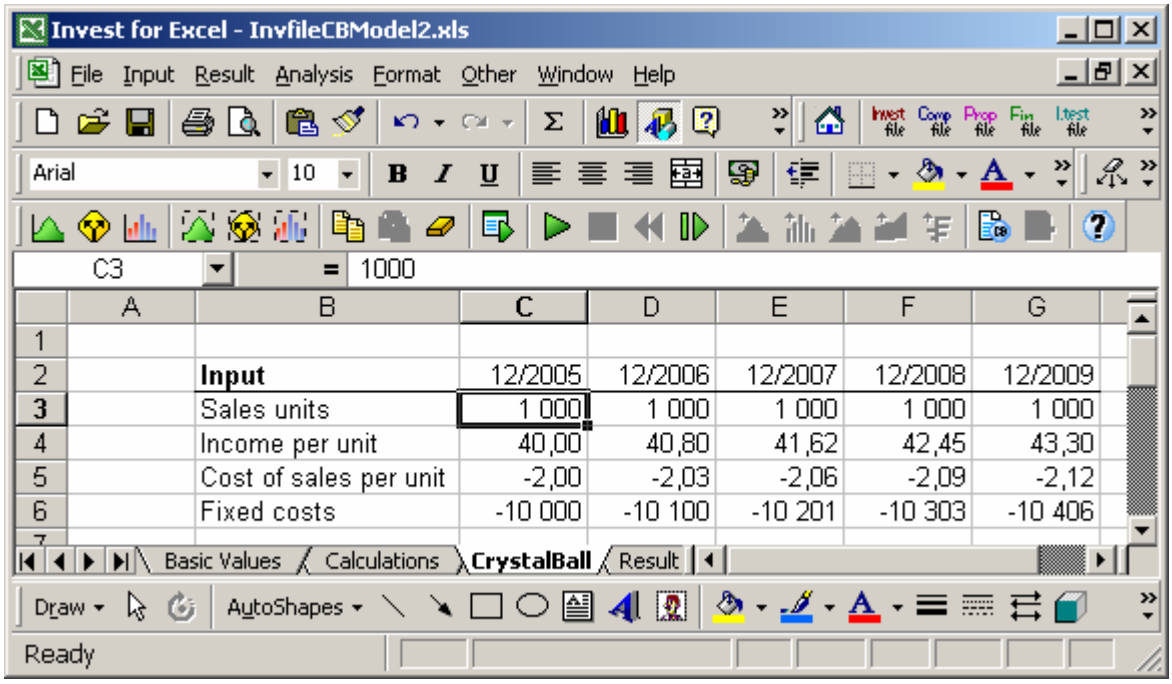
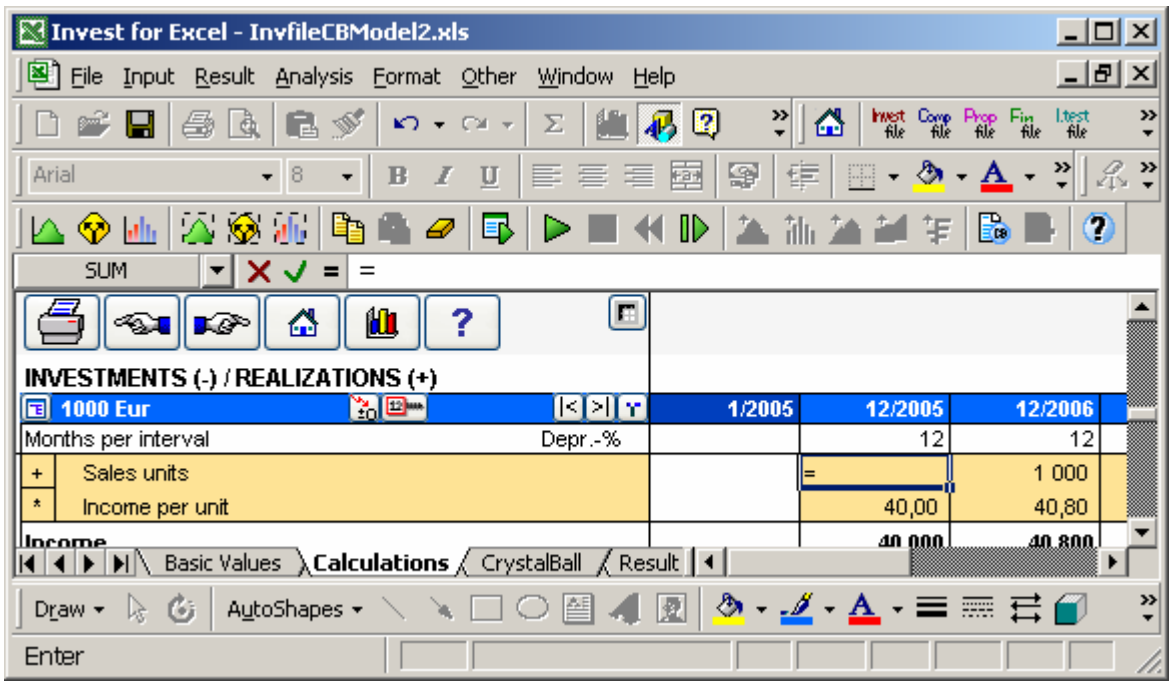
Step 3: Define assumptions for uncertain variables

Before defining assumptions for Crystal Ball simulation, it may be wise to store the file with a new name, so that the original model stays intact.

Since Invest for Excels "Calculations" sheet is locked, we need to insert a new worksheet (here called "CrystalBall") and prepare the model for use with Crystal Ball:



Texts and values for the uncertain variable cells have been copied to the "CrystalBall" sheet. Next we need to create references from the "Calculations" sheet to the "CrystalBall" sheet:



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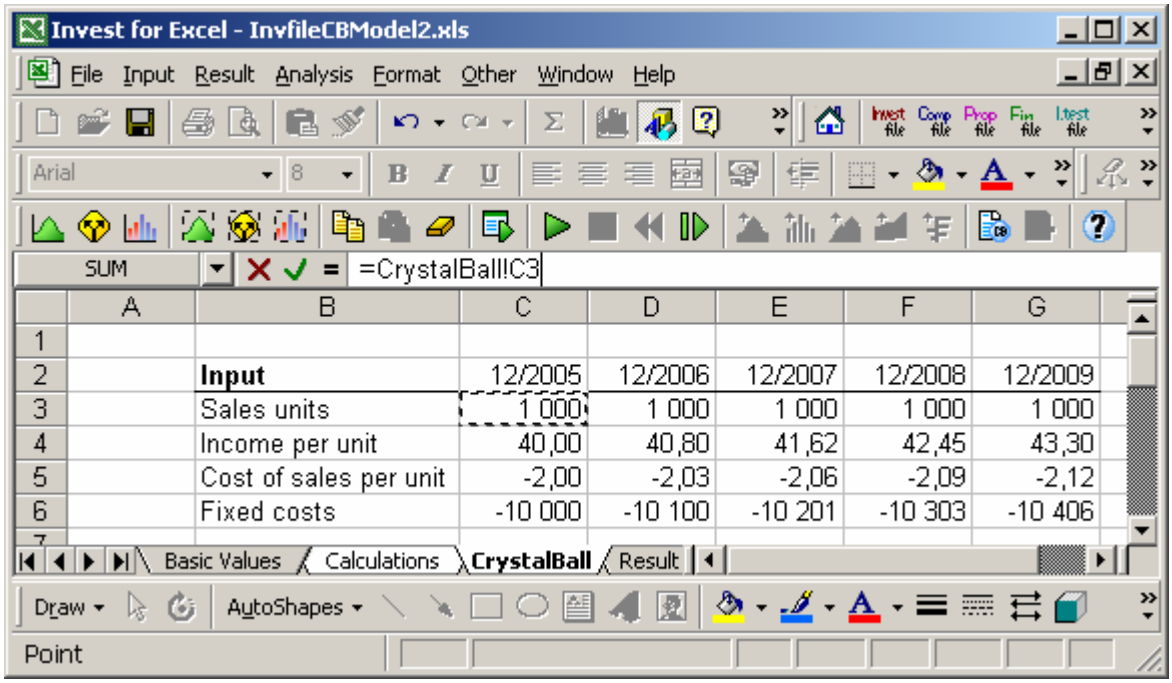
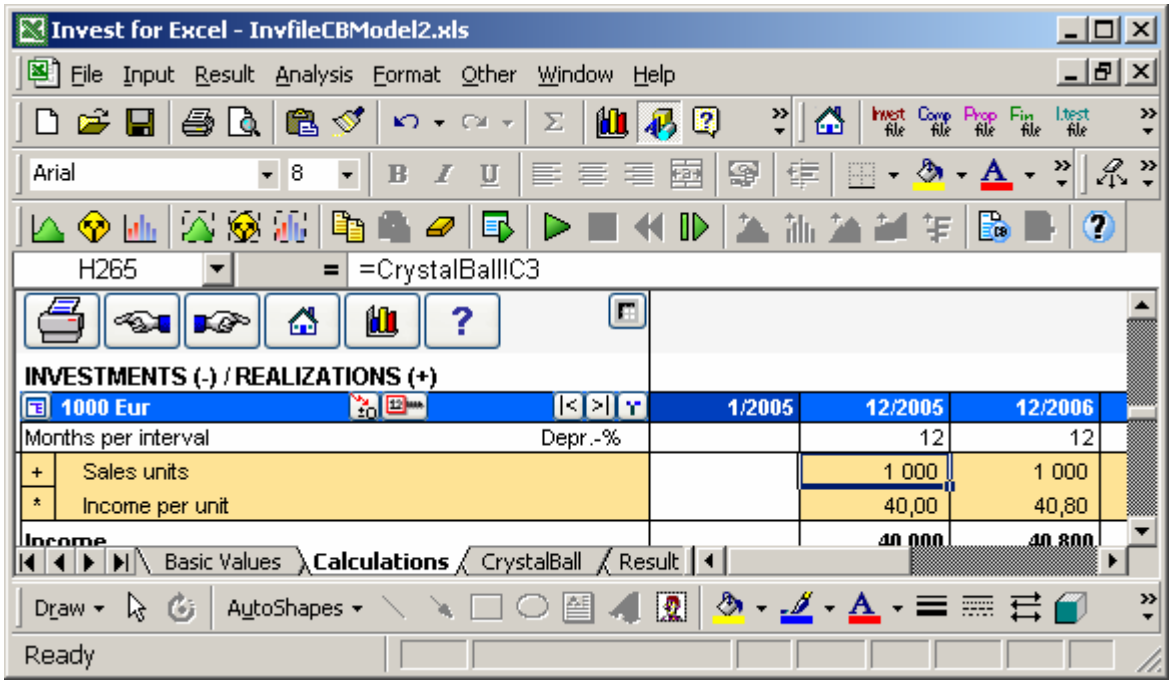


	A	B	C	D	E	F	G
1							
2		**Input**	12/2005	12/2006	12/2007	12/2008	12/2009
3		Sales units	1 000	1 000	1 000	1 000	1 000
4		Income per unit	40,00	40,80	41,62	42,45	43,30
5		Cost of sales per unit	-2,00	-2,03	-2,06	-2,09	-2,12
6		Fixed costs	-10 000	-10 100	-10 201	-10 303	-10 406



Repeat this for each uncertain cell. Copy and fill functions can also be used.

Open Crystal Ball if it is not open at this stage.

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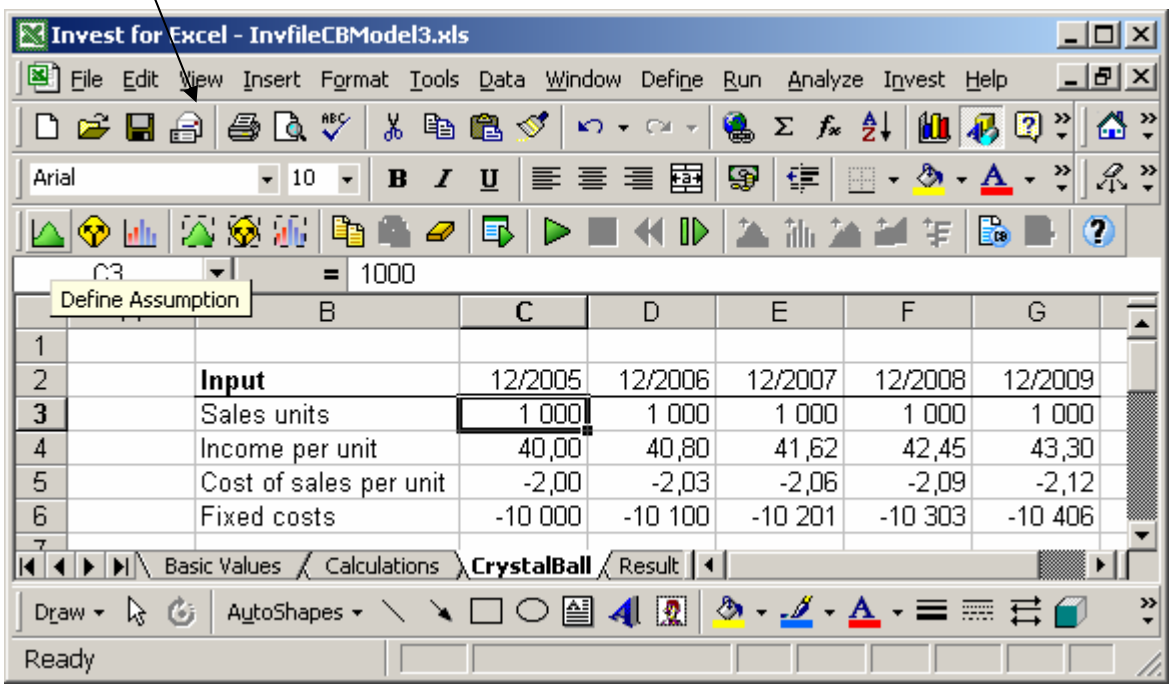
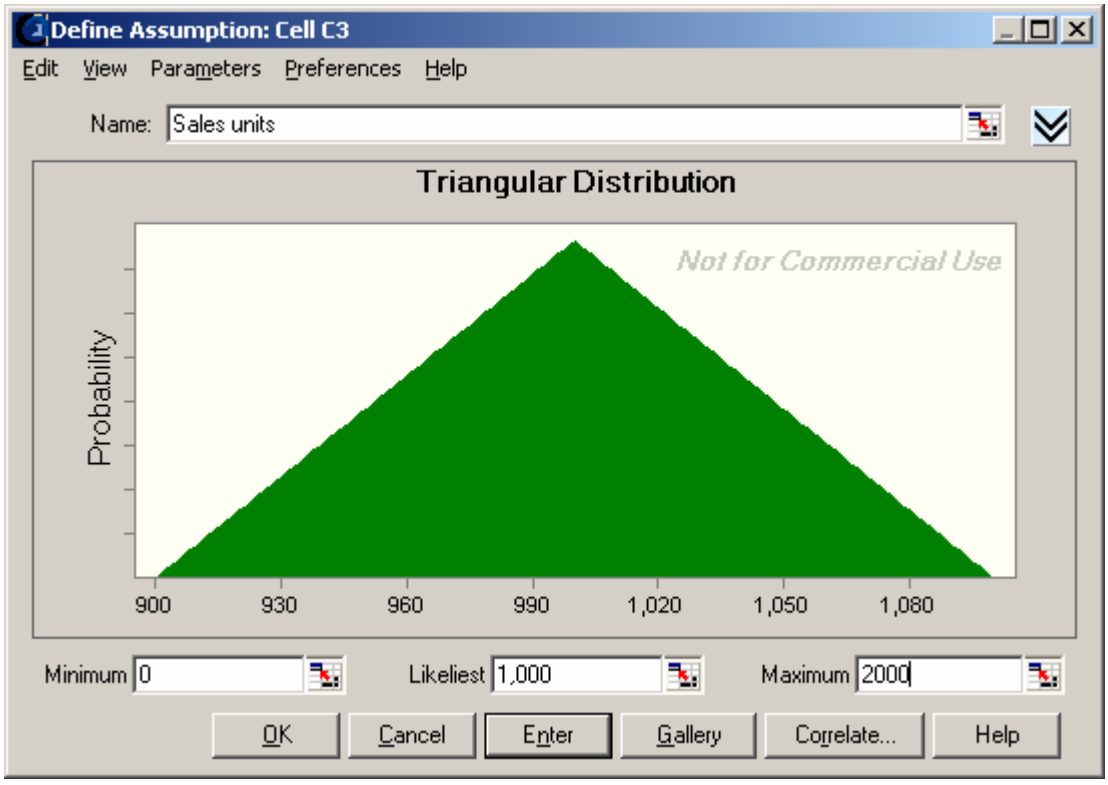
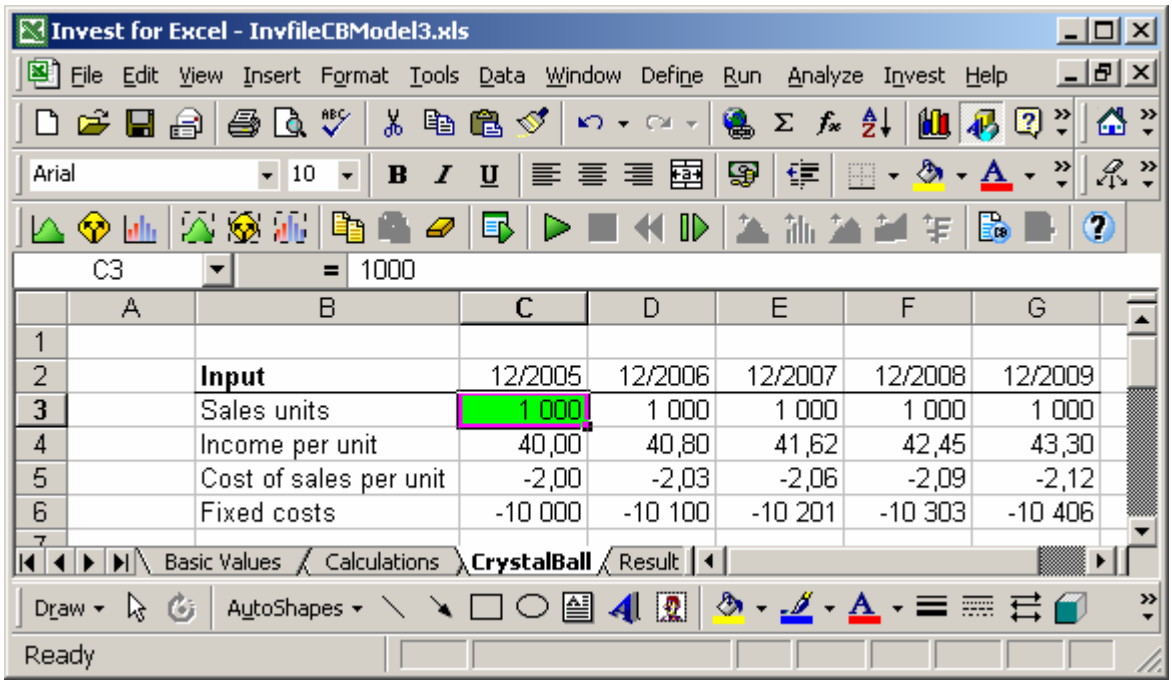
Define assumptions for uncertain variables by activating each cell and pressing the Crystal Ball “Define assumptions…” button:



As an example we define sales units for period 12/2005 to be triangular distributed with a minimum of 0, a likeliest value of 1000 a maximum of 2000:

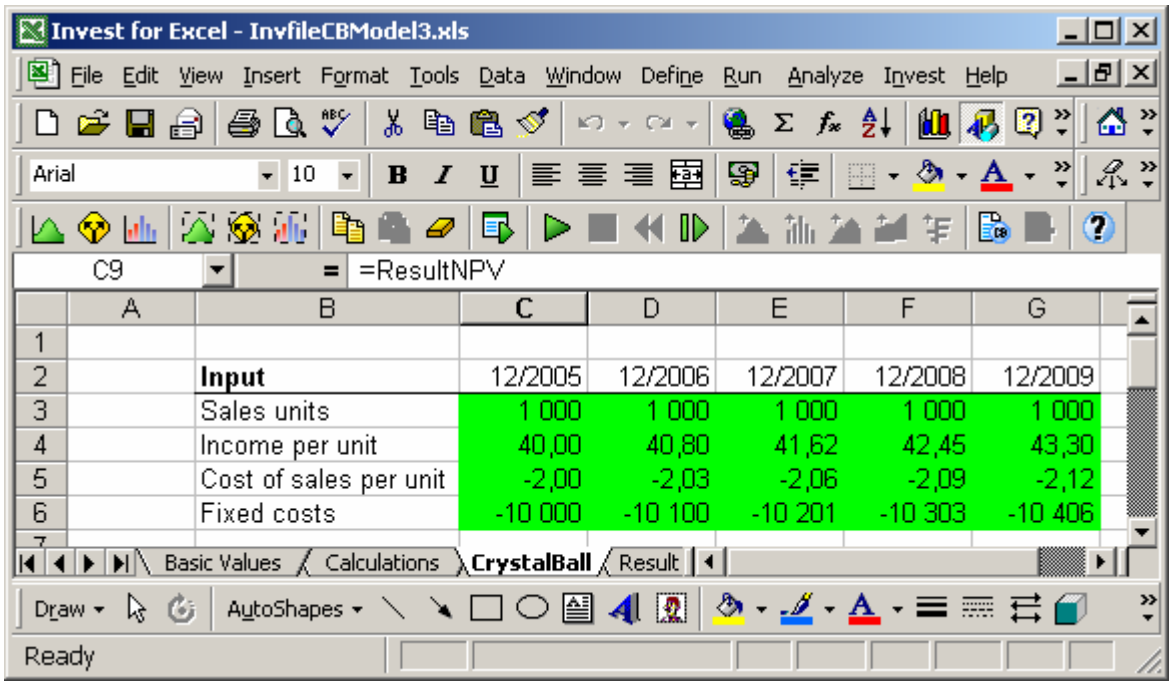


The assumption shows as a green cell (or selected other color):



	A	B	C	D	E	F	G
1							
2		**Input**	12/2005	12/2006	12/2007	12/2008	12/2009
3		Sales units	1 000	1 000	1 000	1 000	1 000
4		Income per unit	40,00	40,80	41,62	42,45	43,30
5		Cost of sales per unit	-2,00	-2,03	-2,06	-2,09	-2,12
6		Fixed costs	-10 000	-10 100	-10 201	-10 303	-10 406

Prepare distributions for each uncertain cell in the “CrystalBall” sheet in the same manner. Refer to Crystal Ball documentation for possibilities in defining assumptions. All the cells in the Input part of the “CrystalBall” sheet should be marked as assumptions when you’re ready:



	A	B	C	D	E	F	G
1							
2		**Input**	12/2005	12/2006	12/2007	12/2008	12/2009
3		Sales units	1 000	1 000	1 000	1 000	1 000
4		Income per unit	40,00	40,80	41,62	42,45	43,30
5		Cost of sales per unit	-2,00	-2,03	-2,06	-2,09	-2,12
6		Fixed costs	-10 000	-10 100	-10 201	-10 303	-10 406

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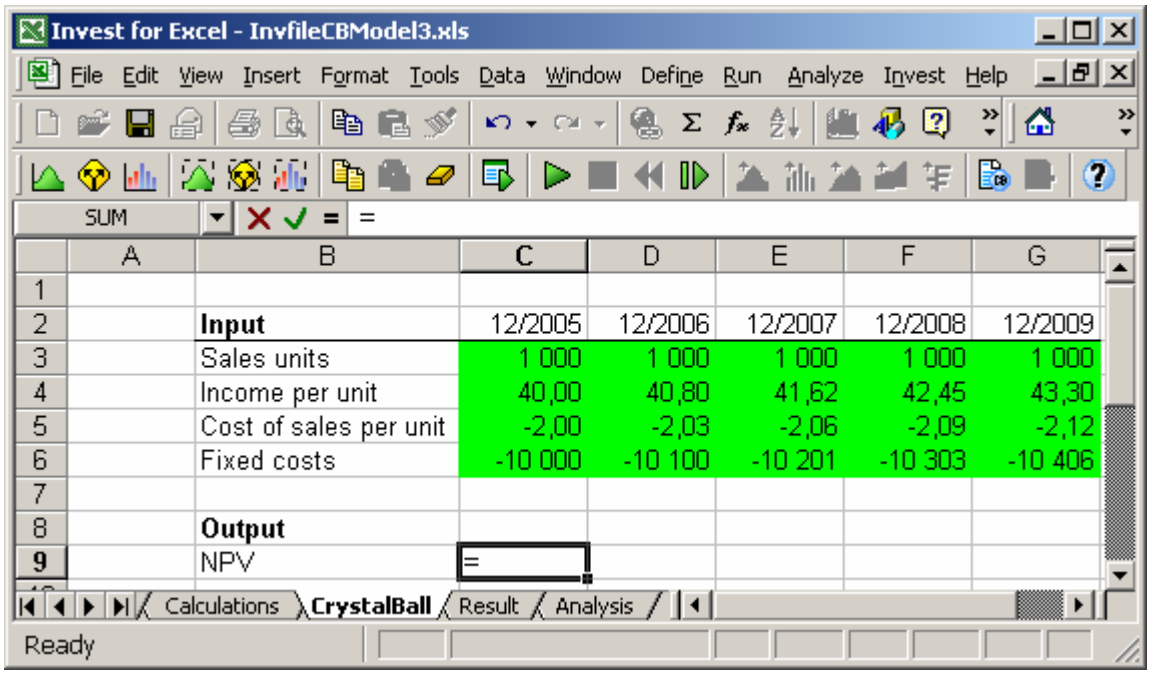
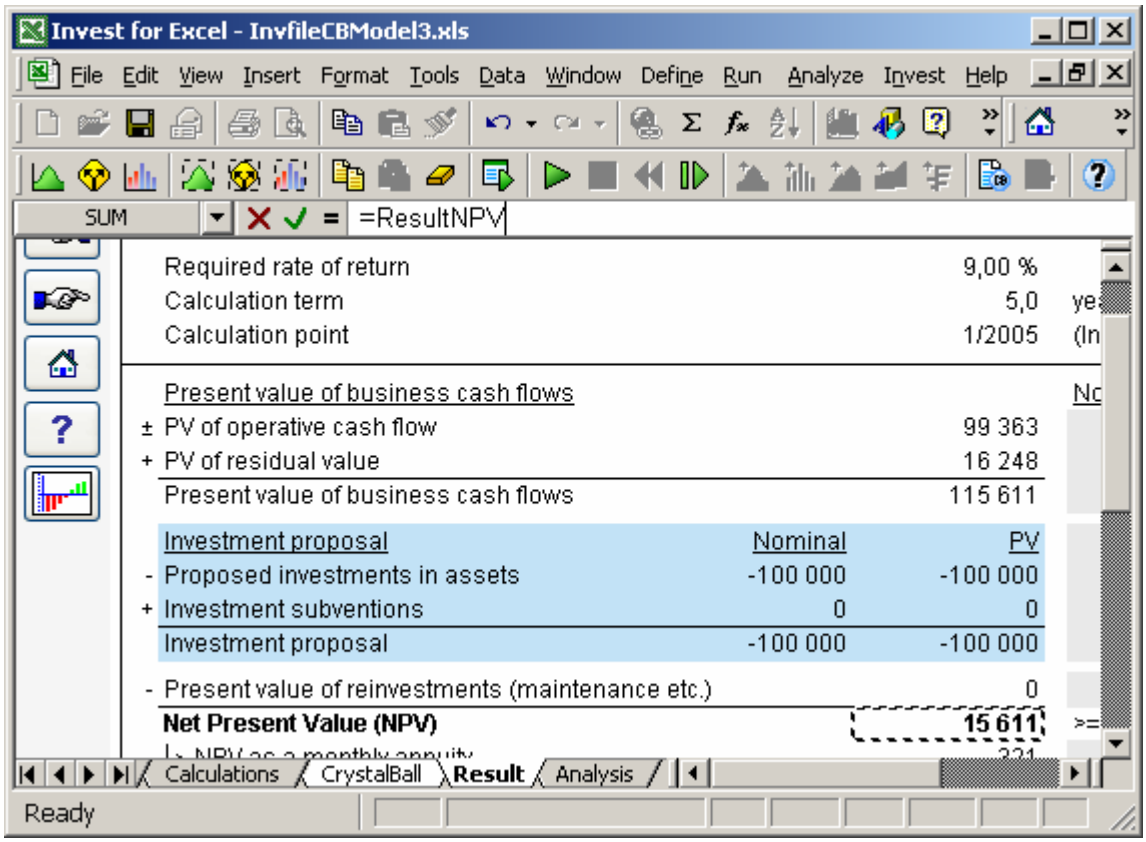
Step 4: Define forecast elements

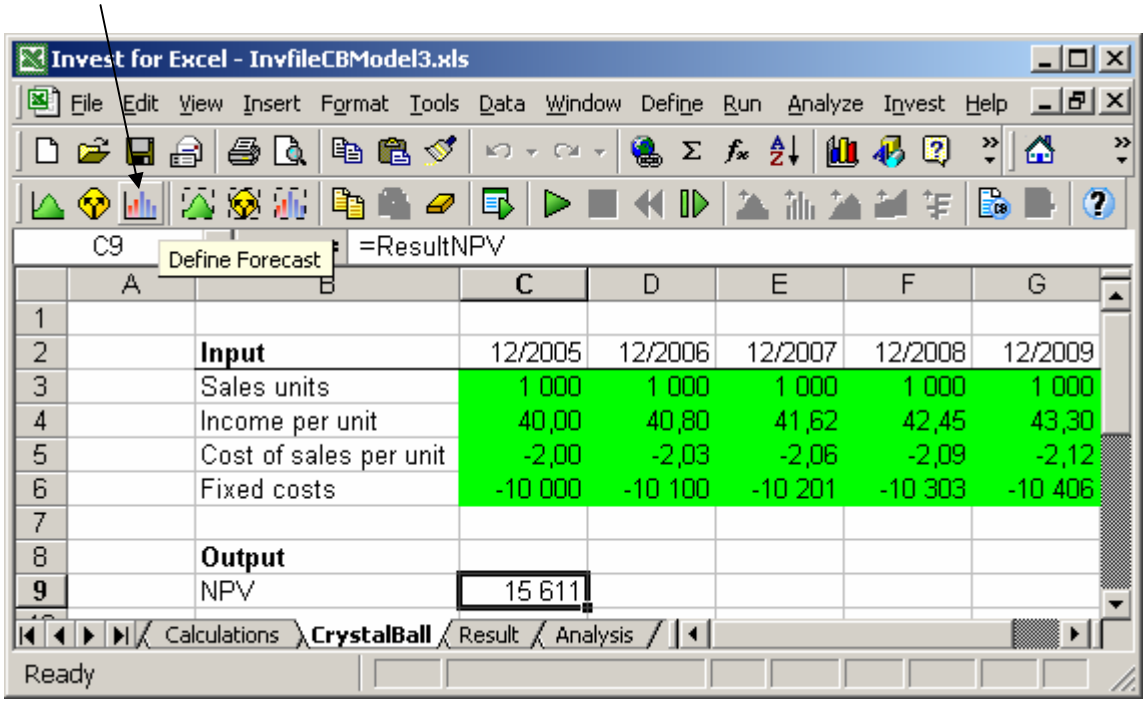
Next forecast elements should be defined. In this example we use only NPV as forecast element. Since the NPV formula on the Result sheet of the investment calculation is locked, we prepare an output cell in the added “CrystalBall” sheet and create a reference to the NPV cell on the Result sheet:

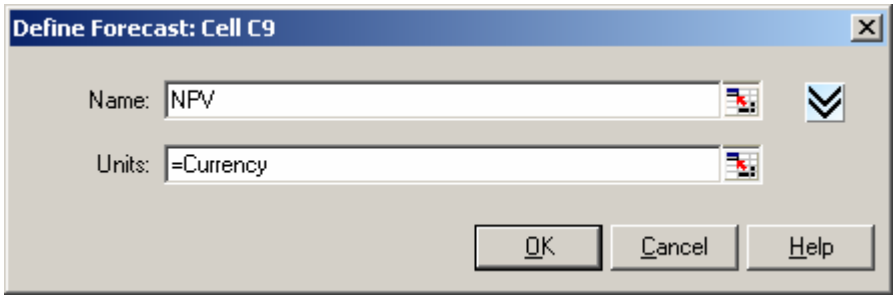




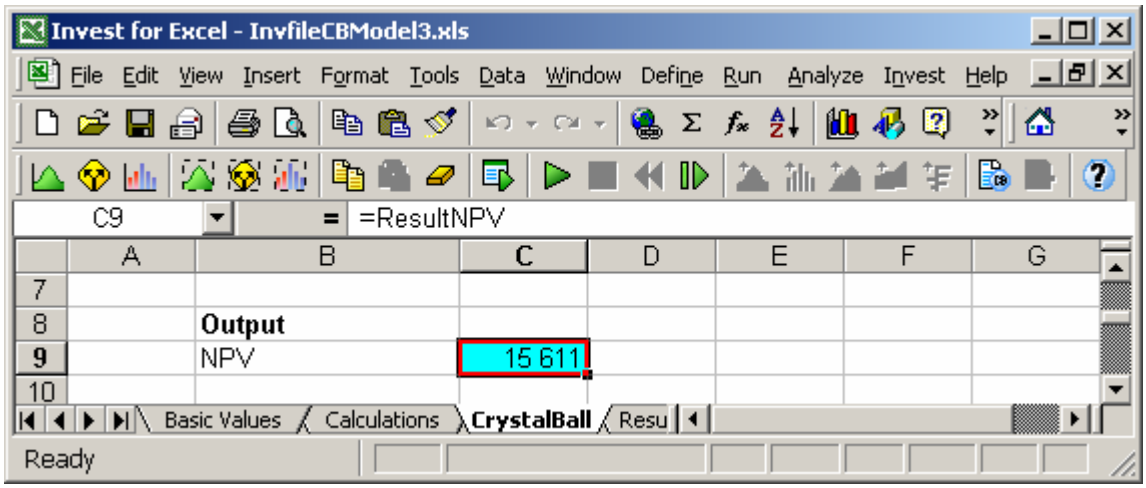
Note that this preparation of the "CrystalBall" sheet was done in an opposite manner compared to preparing assumptions.

Next we define this cell in the Crystal Ball sheet as forecast by selecting it and pressing the Crystal Ball "Define forecast" button:



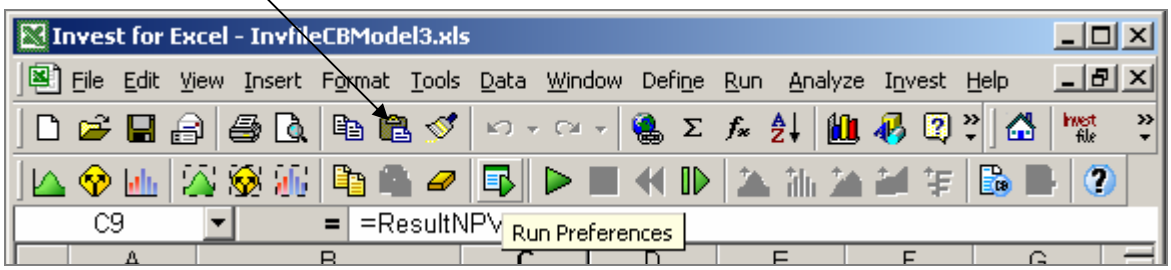


The cell is marked as forecast cell when you press "OK":

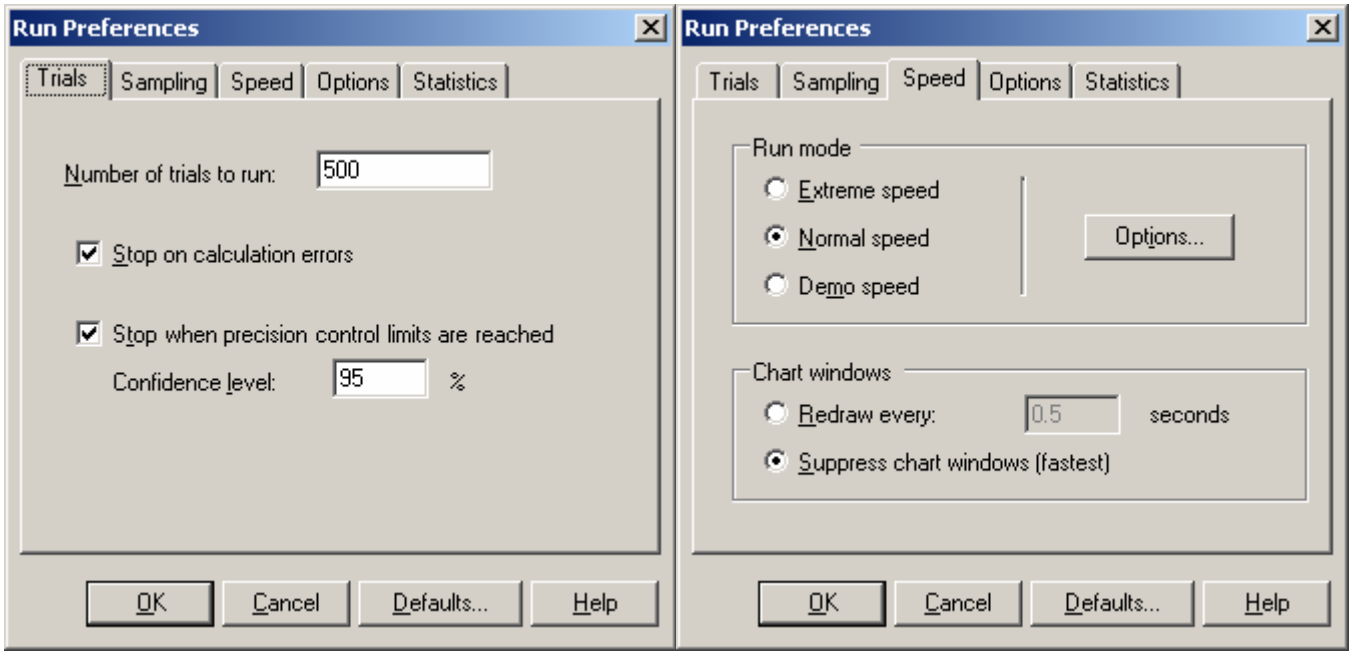


Step 5: Define run preferences and run simulation

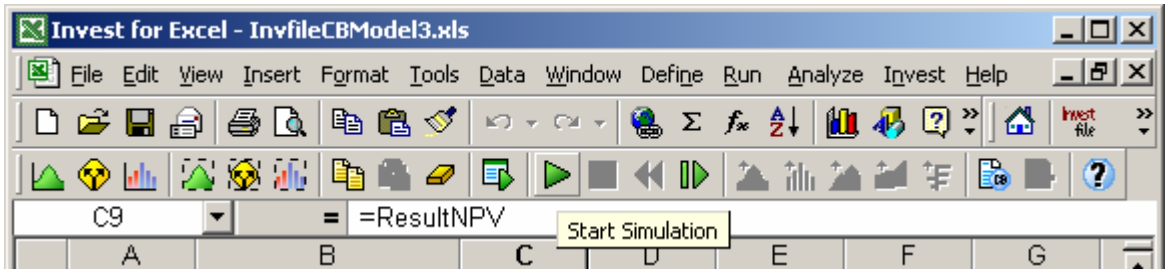
In this example we run the simulation 500 iterations to get an adequate distribution of NPVs for assessing the risk involved. This is defined in the “Run preferences” window that can be opened by pressing the Crystal Ball “Run preferences” button:



Set number of trials, switch speed to “normal” and suppress chart windows:



Start the simulation by pressing the “Start Simulation” button:



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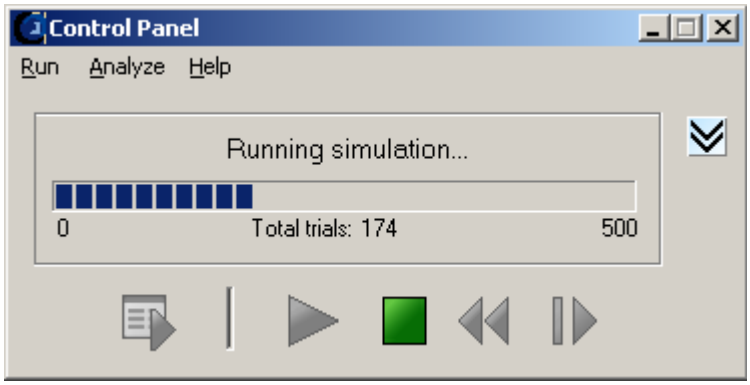
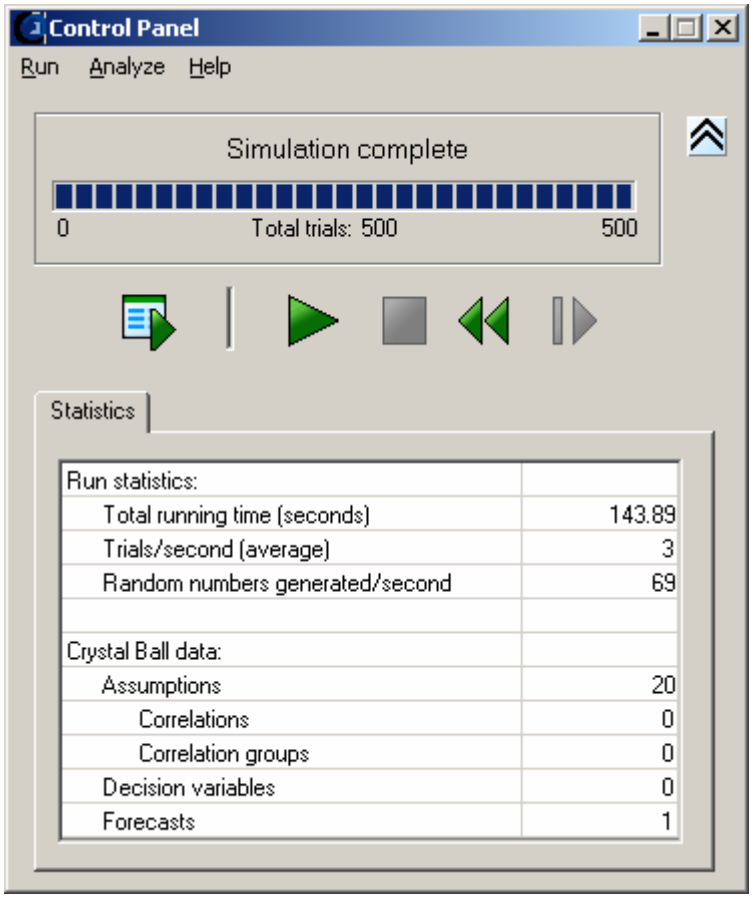
A progress bar will show how the simulation proceeds:



Note that the simulation can take several minutes. The time and other info is shown in the expanded view of control panel:



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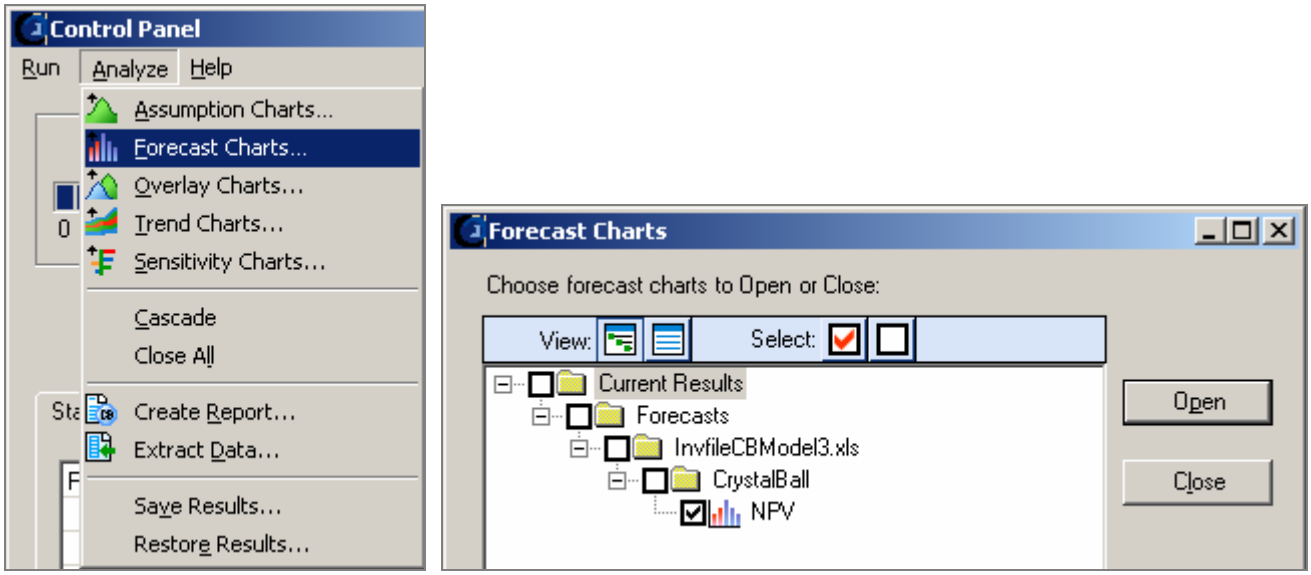
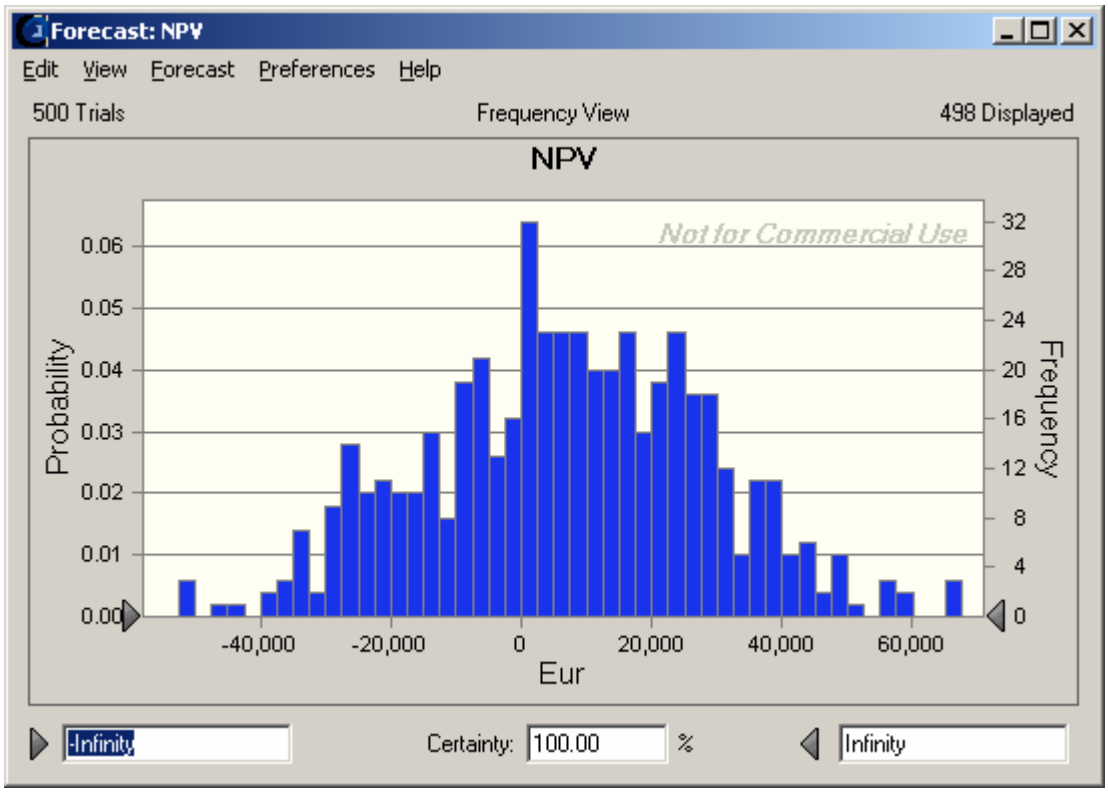
Step 6: Interpret the result of the simulation

A Crystal Ball simulation holds a lot of useful information about the risk involved in the model. We can, for example, take a look at the forecast chart of NPV:



The forecast chart shows a histogram of this simulation:



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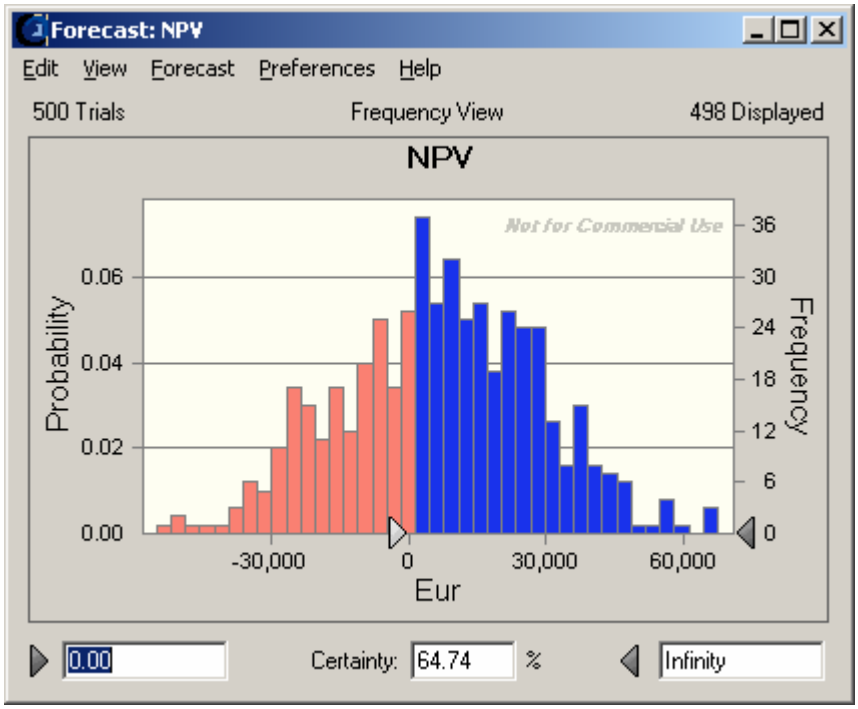
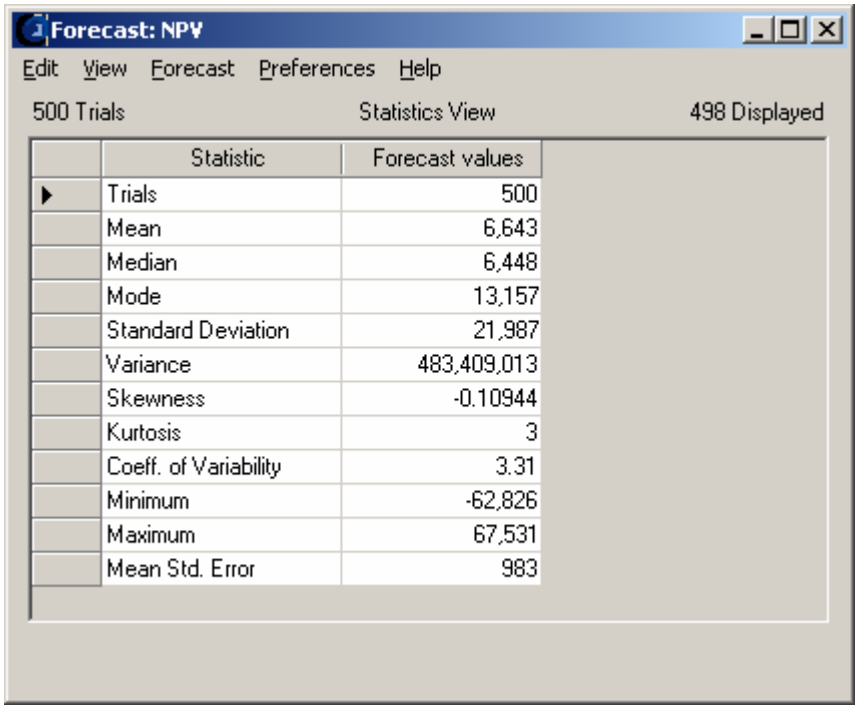
By changing the left certainty field to zero, we can see that there is a 64,7 % chance that the NPV will be positive:



Next we switch to the Statistics view:



Statistic	Forecast values
Trials	500
Mean	6,643
Median	6,448
Mode	13,157
Standard Deviation	21,987
Variance	483,409,013
Skewness	-0.10944
Kurtosis	3
Coeff. of Variability	3.31
Minimum	-62,826
Maximum	67,531
Mean Std. Error	983

We can see that the mean NPV is 6643, the minimum NPV –62826, the maximum NPV 67531 and the standard deviation is 21987. All in all, the project seems quite risky.

The simulation provides a lot more information about the risk involved in the model. Please refer to the Crystal Ball documentation about the possibilities.

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