Using @Risk with Invest for Excel

A white paper by

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Introduction

The purpose of this paper is to give a short introduction on how to use Palisade Corporations @Risk with Invest for Excel. The simulation example explained here is very basic and does not utilize all of the many possibilities of @Risk. The method should however apply to most of the simulations of @Risk.

Step 1: Build a model

Here is an example of a simple investment calculation:

INVESTMENTS (-) / REALIZATIONS (+)

1000 Eur		1/2005	12/2005	12/2006	12/2007	12/2008	12/2009	Residual
Months per interval	Depr.-%		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

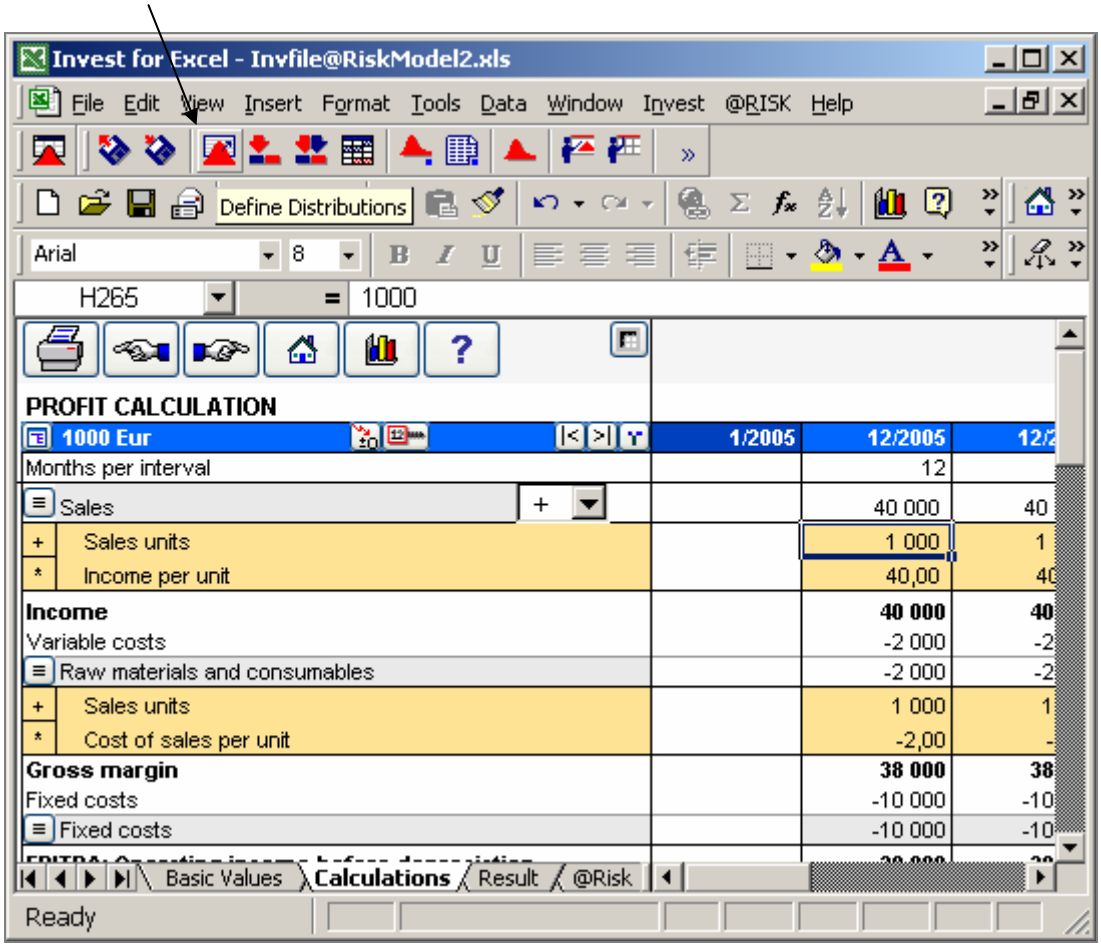
In the example we assume that the investment payment is fixed, so the uncertain variables are:

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

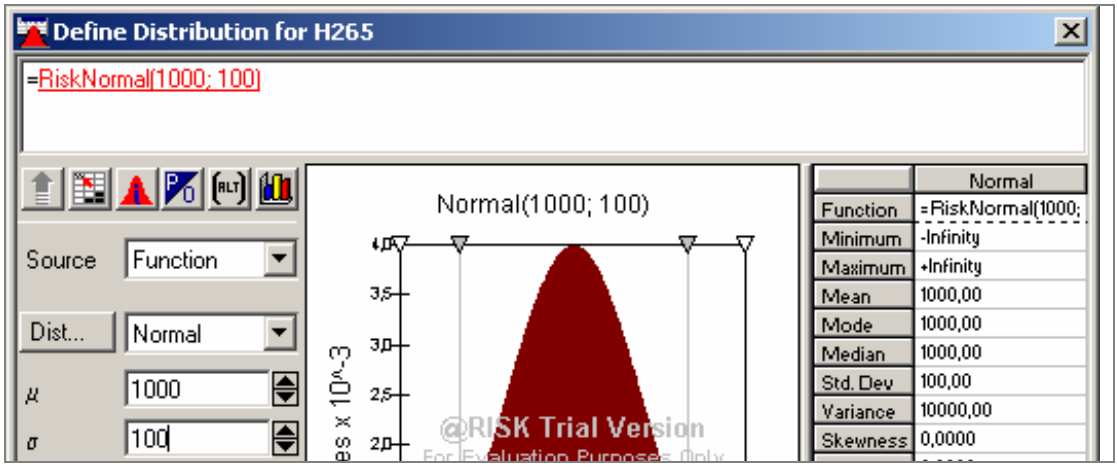
Step 3: Prepare distributions for uncertain variables

Before preparing distributions for @Risk simulation, it may be wise to store the file with a new name, so that the original model stays intact. Open @Risk if it is not open at this stage.

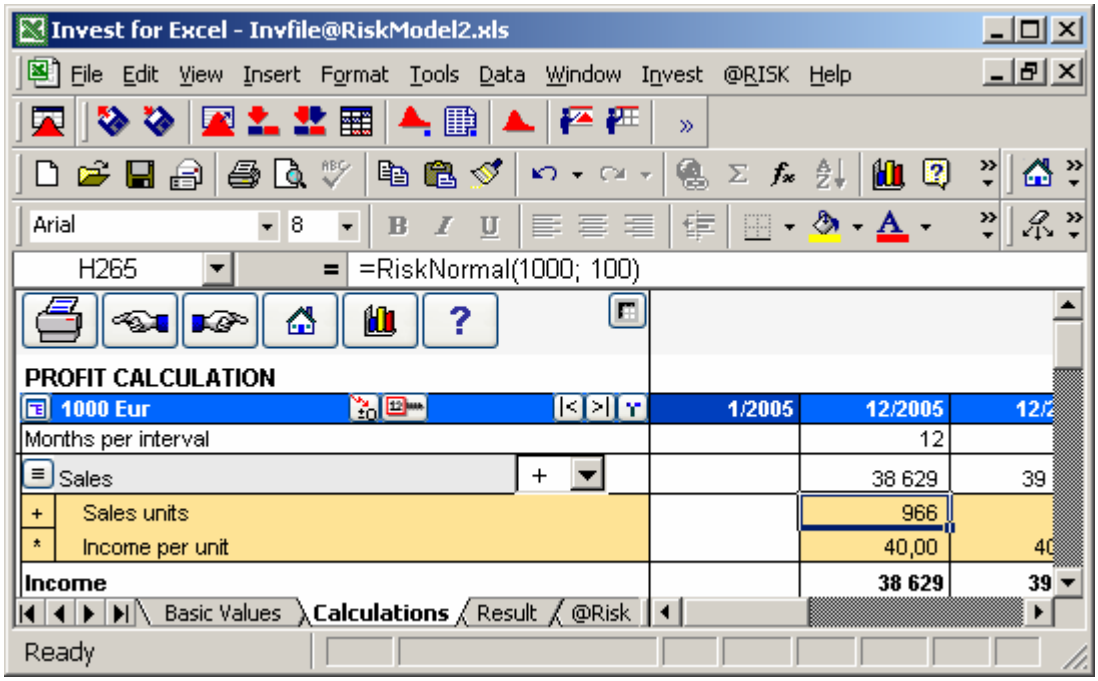
Prepare distributions for uncertain variables by activating each cell and pressing the @Risk "Define distributions…" button or select "Model – Define distribution…" from the @Risk menu:



As an example we define sales units for period 12/2005 to be normal distributed with a mean of 1000 a standard deviation of 100:



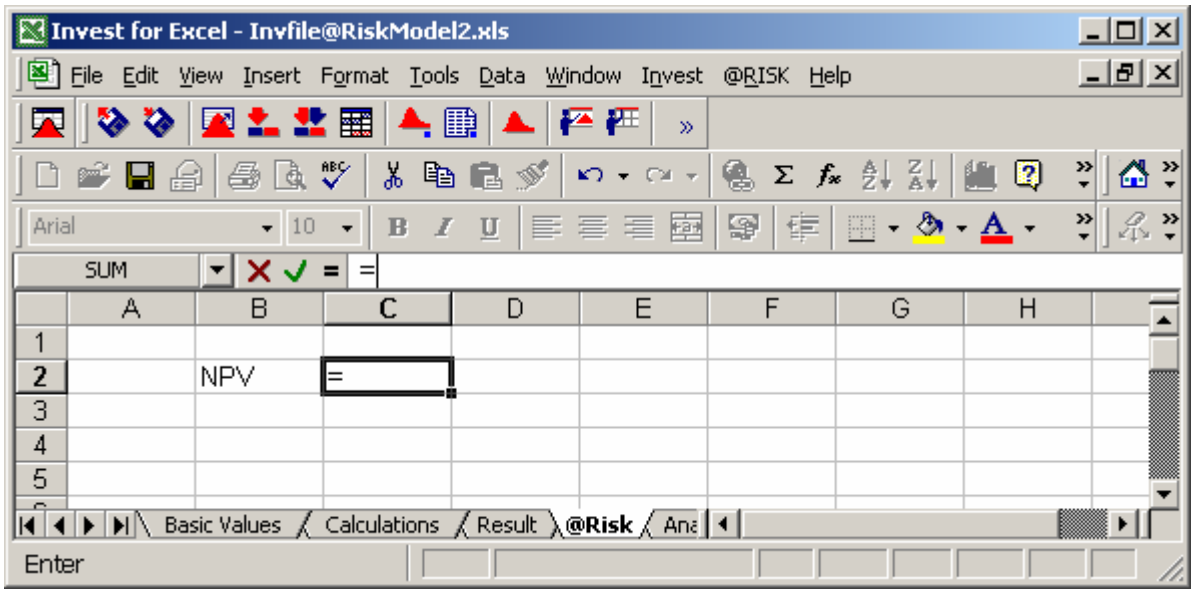
The distribution shows as a RiskNormal function in the cell formula and the cell value changes on each calculation of the model:

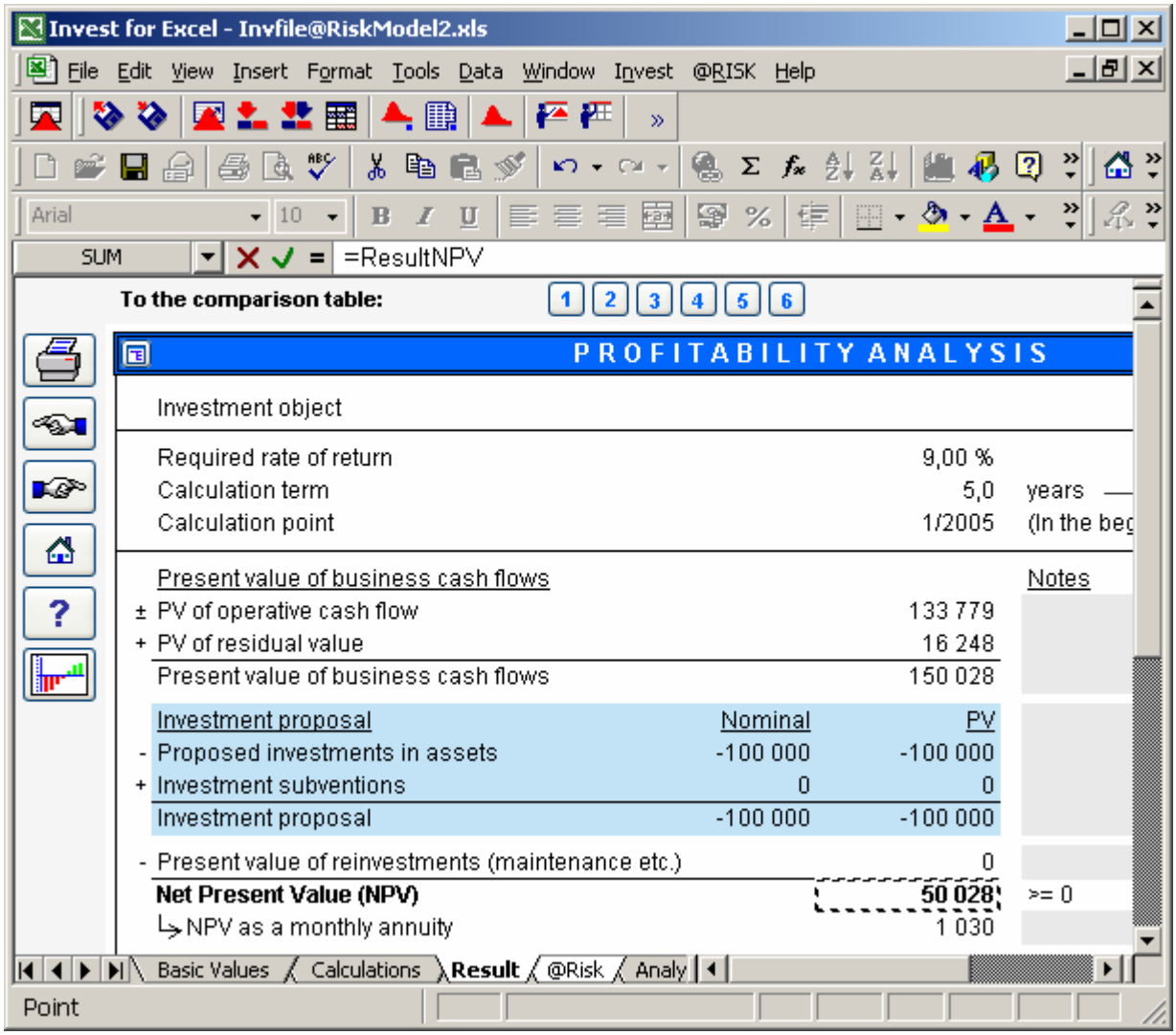


Prepare distributions for each uncertain cell in the same manner. @Risk functions can also be added/ edited directly in the cell formula. Refer to @Risk documentation for possibilities in defining distributions. Note that distributions should be defined to input values in unlocked cells.

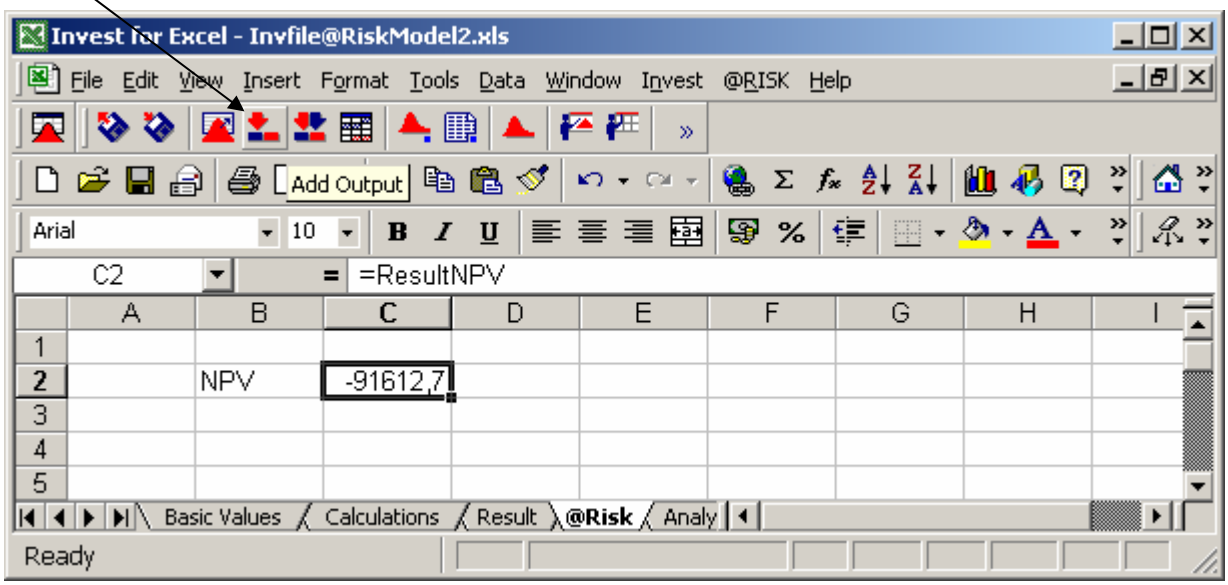
Step 4: Define output elements

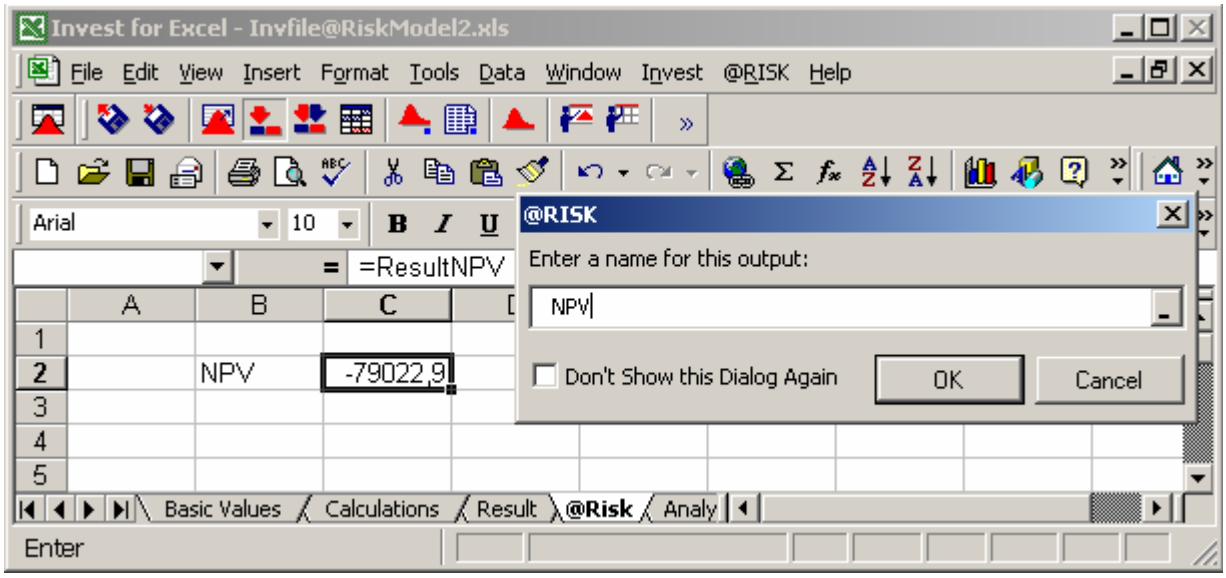
Next output variables should be defined. In this example we use only NPV as output variable. Since the NPV formula on the Result sheet of the investment calculation is locked, we insert a new worksheet (called "@Risk") and create a reference to the NPV cell on the Result sheet:



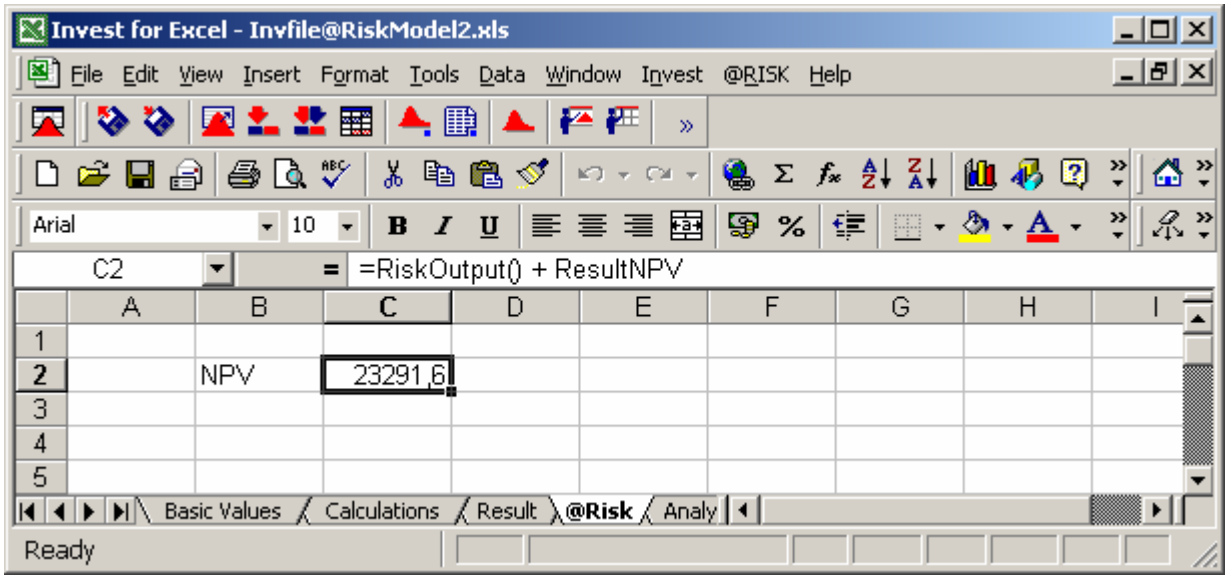


Next we define this cell in the @Risk sheet as output variable by pressing the @Risk "Add output" button:



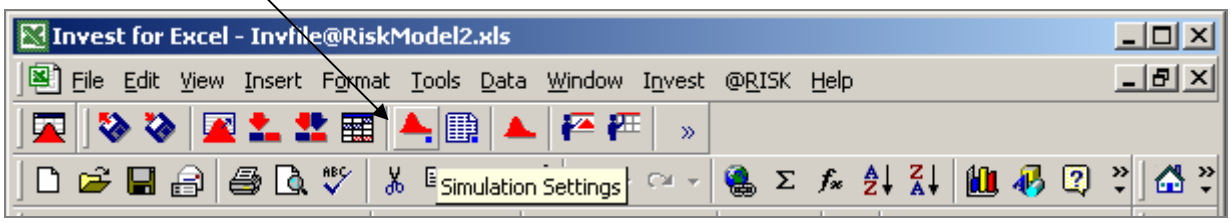


A RiskOuput() function is added to the cell:

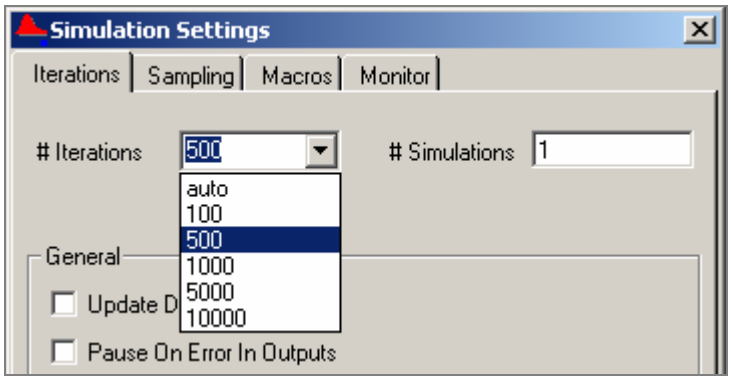


Step 5: Define simulation settings and run simulation

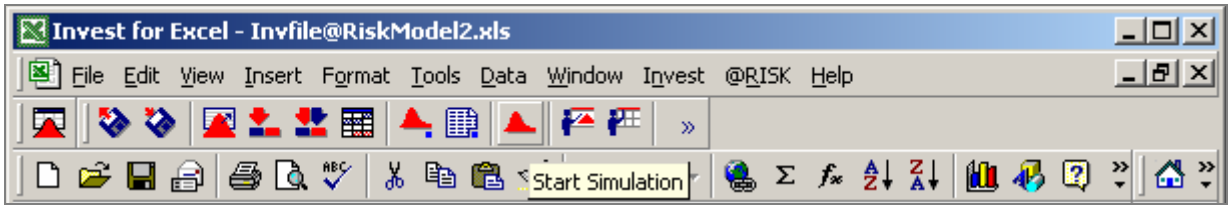
In this example we run the simulation 500 iterations to get an adequate distribution of NPVs for assessing the risk involved. This is defined in the Simulation Settings window that can be opened by pressing the @Risk "Simulation Settings" button:



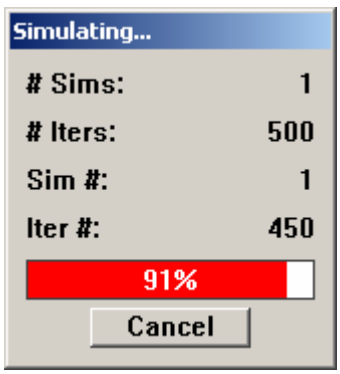
Set number of iterations and any other settings:



Start the simulation by pressing the "Start Simulation" button:



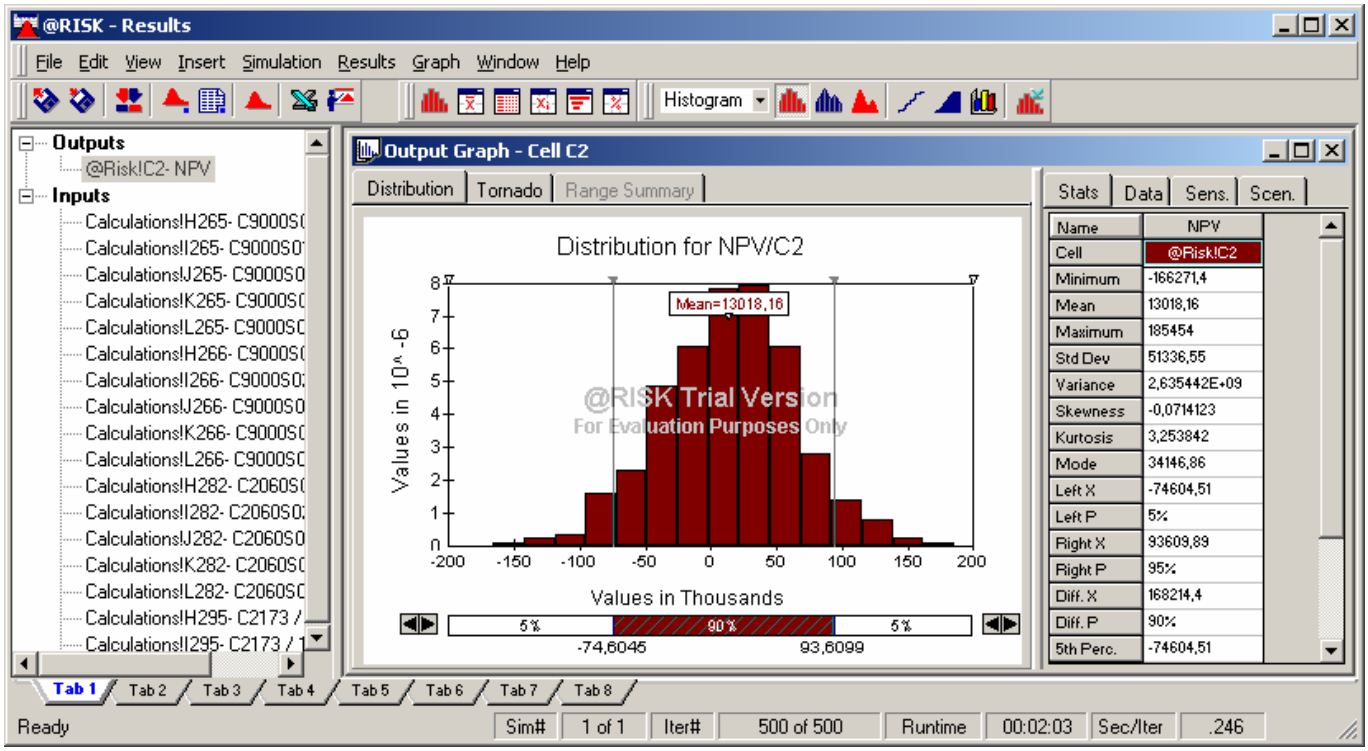
A progress bar will show how the simulation proceeds:



Note that the simulation can take several minutes.

Step 6: Interpret the result of the simulation

An @Risk simulation holds a lot of useful information about the risk involved in the model. Here is the histogram and key factors page of this simulation:



We can see that the mean NPV is 13018, the minimum NPV –166271, the maximum NPV 185454 and the standard deviation is 51336. All in all, the project seems quite risky. By changing the left X parameter (x1) to zero, we can see that there is a 37,7 % chance that the NPV will be negative:

	Name	Worksheet	Cell	Mean	Maximum	x1	p1
Output 1	NPV	@Risk	C2	13018,16	185454	0	37,70948%

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