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Capital Budgeting Exercise using Simulation

The exercise is a simulation of the value of an investment project whose outcome is uncertain. The uncertainty lies primarily in the level of sales in the first year of the project and in the growth rate of sales thereafter. The model uses @Risk, an Excel add-in, to simulate the uncertainty facing the bidder using Monte Carlo analysis.¹ This note describes the process to download, install, and run the model. Other discussion materials describe the essence of Monte Carlo analysis and the specifics of the case study. Once @Risk and the required spreadsheet are downloaded and installed, the model can be run without any additional setup. For more information about @Risk, you can refer to the @Risk menu (@Risk > Help > Online Manual) or online documentation from Palisade <http://www.palisade.com> which includes links to other demo models and sites about simulation, and decision analysis, as well as other supplementary materials.

Using the Simulation Model

Review the Spreadsheet Model

1. First open Excel. If @Risk is installed properly, Excel will open with @Risk toolbars appended to the regular Excel toolbars.² In this case, you can ignore the rest of the paragraph. If you did **not** see the @Risk toolbars appended to the regular Excel toolbars, you need to check if @Risk is installed properly. To do this, click on *Tools > Add-Ins* from the menu bar. Look for Risk in the dialog box. If you see it, put a check mark in the small box to the left of Risk, then click OK to save and exit. At this point, Excel should load @Risk, and you should see the @Risk toolbars. If Risk is not listed as an available add-in, you will need to look for the underlying files. Click on Browser and tell Excel where you installed it. If you are not sure where the file is located, from the Windows toolbar, select *Start > Find > Files or Folders*. Search for "Risk.xls" and use that location for the browser dialog box in the Excel add-in dialog box. If you cannot find Risk.xls, then @Risk was not installed properly. Before calling for help, make sure that you ran the executable file.

¹ There are other commercial packages that allow one to carry out simulation analyses within spreadsheets or as stand-alone applications.

² Once you do check Risk as an add-in, it will automatically load when you open Excel. To stop this, go back to the add-ins dialog box and remove the check next to Risk.

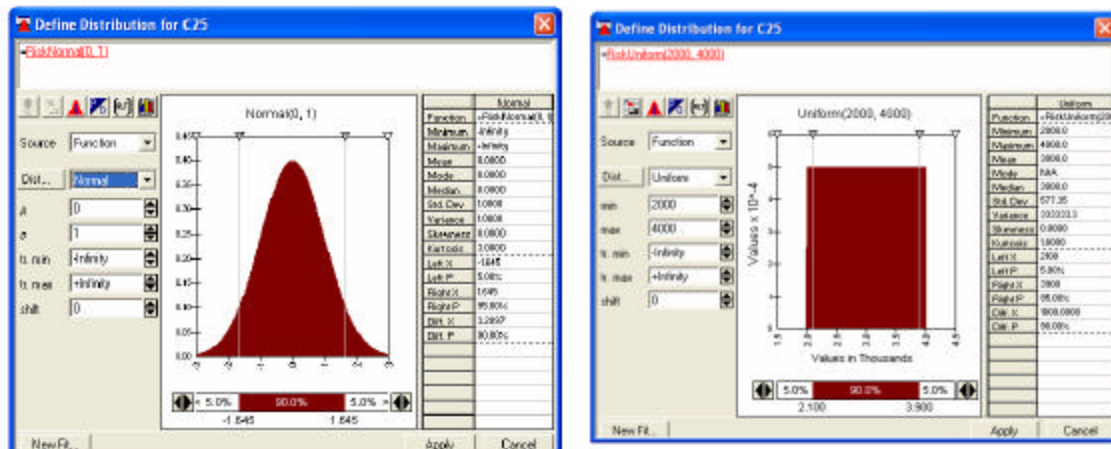
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2. Open the file “capital budgeting exercise using simulation.xls.” Before using @Risk, you should work through the model. How do you calculate Free Cash Flows? How do you calculate the present value of cash flows and the NPV?
3. The spreadsheet allows you to enter the distribution of sales over the life of the project.

Run the Simulation

4. Before beginning the simulation, you need to know about two kinds of cells that @Risk uses. *Input cells* (purple background) are random variables. In this model, the year sales and the exponential growth rate of sales are random variables. Input cells themselves use placeholders that are numeric values, as opposed to formulas, and @Risk replaces these placeholders as it draws new values from a distribution. Click on C25 to define the distribution of sales in year 1. On the Excel menu bar, select @Risk > Model > Define Distributions. Click the Dist button and select Uniform. Set the min value to 2000 and the max value to 4000. If the shift window has a non zero entry, change it to zero. Then click apply. See Screen 1.

Screen 1 Define Distributions



Next, click on D21 to define the distribution of sales growth rate in year 2. On the Excel menu bar, select @Risk > Model > Define Distributions. Click the Dist button and select Normal. Set the mean value to 4% and the standard deviation to 2%. If the shift window has a non zero entry, change it to zero. Then click apply. Next, click on E21 to define the distribution of sales growth rate in year 3. On the Excel menu bar, select @Risk > Model > Define Distributions. Click the Dist button and select Normal. Set the mean value to 4% and the standard deviation to 2%. If the shift window has a non-zero entry, change it to zero. Then click apply.

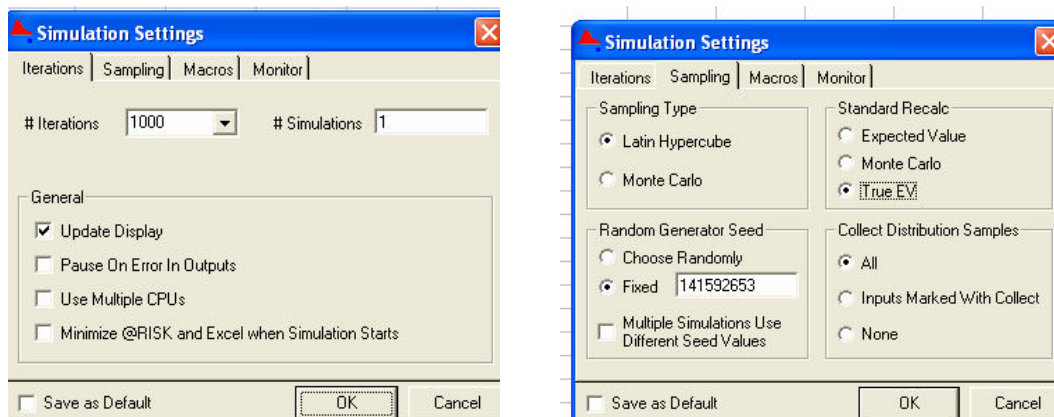
5. *Output cells* (brown background) are the forecasts of the model, or the things we are interested in understanding. @Risk runs a simulation by repeatedly selecting random variables for each of the input cells and recalculating the spreadsheet for each draw of the random variables. @Risk then stores the values of the *output cells* so that it can report the distribution. To define the present value of future cash flows as an output cell, click on B37. On the Excel menu bar, select @Risk > Model > Add Output. You will be prompted to provide a name for the output cell. Then click OK to save and exit. Now click on C38.

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On the Excel menu bar, select *@Risk > Model > Add Output*. You will be prompted to provide a name for the output cell. Then click OK to save and exit. Finally, click on B42. On the Excel menu bar, select *@Risk > Model > Add Output*. You will be prompted to provide a name for the output cell. Then click OK to save and exit.

- This model is already set up to run, but you need to tell @Risk how many trials (sets of random variables) it will draw. To do this, from the Excel menu bar select *@Risk > Simulation > Settings* and enter 1,000 or some other number as the “# Iterations.” See **Screen 2**. Click the Iterations tab if you do not see these selections. Then click on the Sampling Tab and check True EV in the Standard Recalc Menu. Next, check Fixed in the Random Generator Seed Menu and enter 141592653. Click OK to save and exit.

Screen 2 Simulation Settings



- You are now ready to run the simulation. Click on *@Risk > Simulation > Start*. You will probably see a number of @Risk-Results windows open up and they will be continually updated until you get to the number of trials you specified.³ If the results windows do not appear, open them from the *@Risk > Results > Show Results Window*. If @Risk is running then the @Risk Results window will be updated at the frequency specified in the Monitor tab of the Simulation Settings dialog box. When the simulation is done, @Risk displays the results in graphical or table formats. At the @Risk Results window, click on *Insert > Detailed Statistics*. You will see a table like Screen 3.

³ To see one single trial each time, check the “Monte Carlo” Standard Recalc option in the Settings tab of the Simulation Settings dialog box. The spreadsheet will be recalculated each time you hit F9. However, the resulting output will not be saved for analysis.

Screen 3 Detailed Statistics

Name	PV(Remaining CFs) / Year	LN(PV1+CF1) / Year1	NPV / Year 0	Sales growth rate / Year	Sales growth rate / Year	Sales / Year 1
Description	Output	Output	Output	RiskNormal(4%, 2%)	RiskNormal(4%, 2%)	RiskUniform(200
Cell	B37	C38	B42	D21	E21	C25
Minimum	2379.859	7.870107	879.8593	-3.614196E-02	-2.184965E-02	2001.53
Maximum	3911.9	8.357088	2411.9	0.1039855	0.1024023	3998.017
Mean	3131.115	8.135298	1631.115	0.0399894	3.999616E-02	2999.99
Std Deviation	420.7682	0.1380742	420.7682	2.003325E-02	1.999886E-02	577.6292
Variance	177045.9	1.851619E-02	177045.9	4.013298E-04	3.996754E-04	333655.4
Skewness	6.394651E-03	-0.1593663	6.394676E-03	-1.631205E-02	-3.994179E-03	7.326377E-05
Kurtosis	1.809602	1.842505	1.809602	3.046008	2.936883	1.800088
Cross Calculated	0	0	0	0	0	0
Mode	3531.019	8.113329	2031.019	3.675135E-02	4.377648E-02	2550.079
5% Perc	2474.279	7.909014	974.2787	8.96717E-03	6.959623E-03	2098.152
10% Perc	2596.905	7.941863	1056.905	1.436688E-02	1.425635E-02	2198.336
5% Perc	2620.158	7.9663	1120.159	0.0192487	1.922968E-02	2299.413
90% Perc	2890.216	7.992687	1190.216	2.310574E-02	2.310163E-02	2399.396

In this table, the mean of output cell B37 provides an estimate of the present value of expected cash flows of the project. The standard deviation of output cell C38 provides an estimate of project volatility. The mean of output cell B42 provides an estimate of the project NPV.

- Simulation results may be reported directly in Excel using *@Risk > Results > Report Setting*, at which point you should see Screen 4. Choose the options you want for the report and click on the *OK* button. *@Risk* will generate a report in a new spreadsheet that you can print out. You can save the results using *@Risk > File > Save* from the menu bar. The next time you open the Excel file, you will have the option to reload the saved simulation results.

Screen 4 Report Settings

@RISK Reports

At the End of Each @RISK Simulation

Show Interactive @RISK Results Window

Generate Excel Reports Selected Below

Excel Reports

Quick Summary Quick Output Report

Simulation Summary Detailed Statistics

Output Data Summary Graphs

Input Data Output Graphs

Sensitivities Input Graphs

Scenarios Tornado Graphs

Template Sheet myTemplate

Place Excel Reports in

New Workbook

Active Workbook

Graph Format

Metafile

Native Excel

Generate Reports Now

Save as Default