

# Introduction: @RISK 5.5

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# Risk Analysis: Applications

- » Assessing Exposure of Long-Term Decisions
- » Discounted Cash Flows
- » Strategic Planning
- » Operational Uncertainty, Operating Profits
- » Engineering or R&D Risk Assessment
- » Portfolio Management and Optimization
- » Environmental Hazards
- » Failure Analysis
- » Quality Risk
- » Population Safety Assessment
- » Epidemiology Prediction and Control

# Point Forecasts

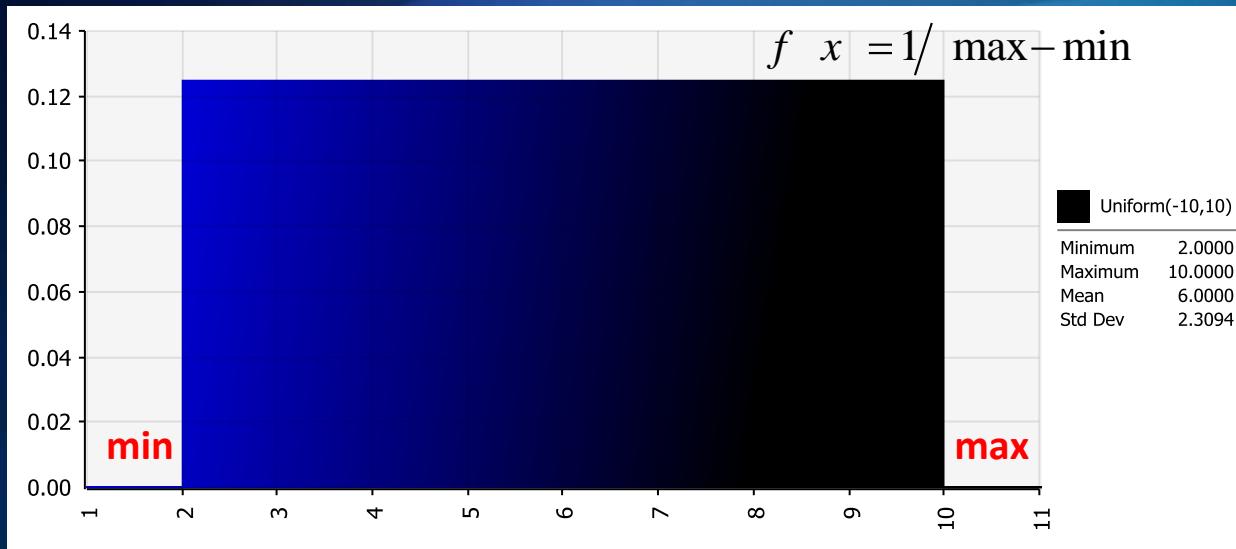
- » Establish a guideline of expectations
- » Approximation
  - average
  - optimistic base case
  - most likely
  - not clearly defined
  - SWAGs
- » Are often wrong

# Why Monte Carlo Simulation?

- » Evolve “point estimate” spreadsheets for more robust analysis
- » To capture the effect of changes to the inputs, especially in contexts where traditional sensitivity analysis is weak:
  - Quantify both the magnitude *and the probability* of outcomes (traditional sensitivity analysis looks at magnitude only)
  - When there are *more than two uncertain variables* which need to be simultaneously varied
  - When there is a *non-linearity* or *barrier* in your model (e.g. IF statements)
- » To capture *relationships* between variables
- » To build *genuine simulation models* i.e. models that do not have any value in a deterministic sense because outcomes change as a result of different input combinations

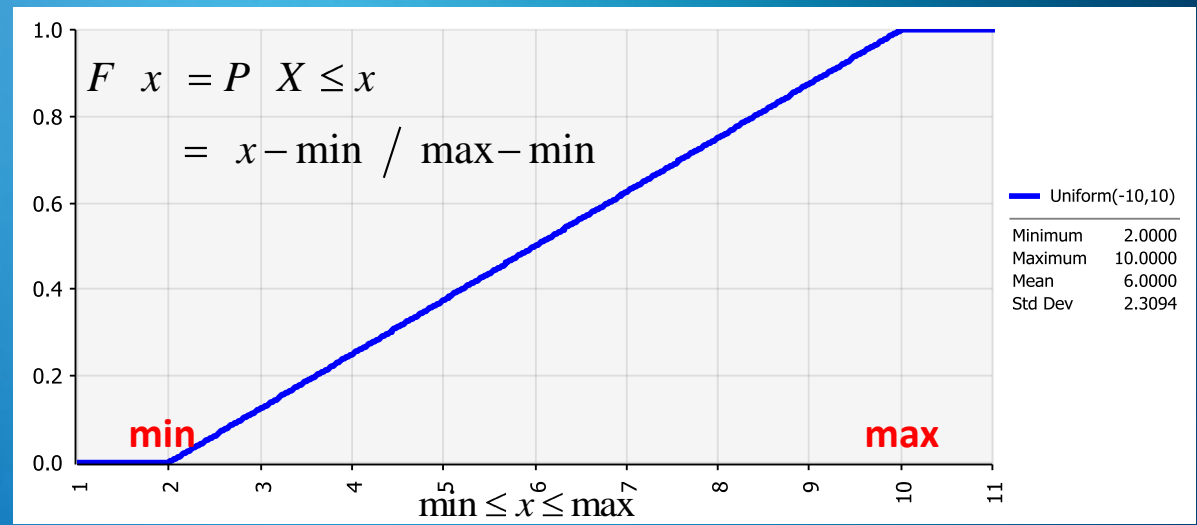
# How MCS works...

Let's use a *Uniform* distribution as an example:

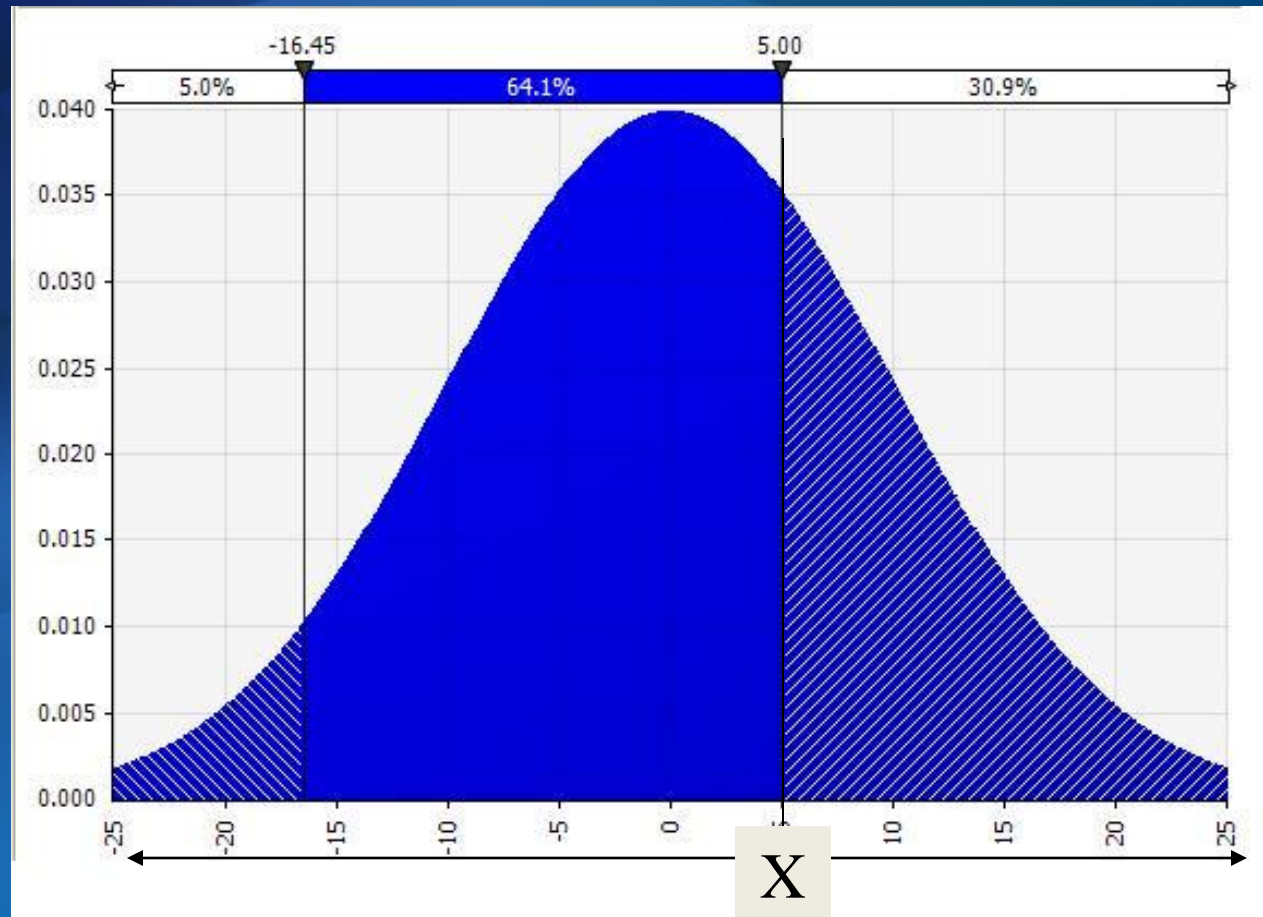


Probability  
Density Function  
(PDF)

Cumulative  
Distribution  
Function (CDF)

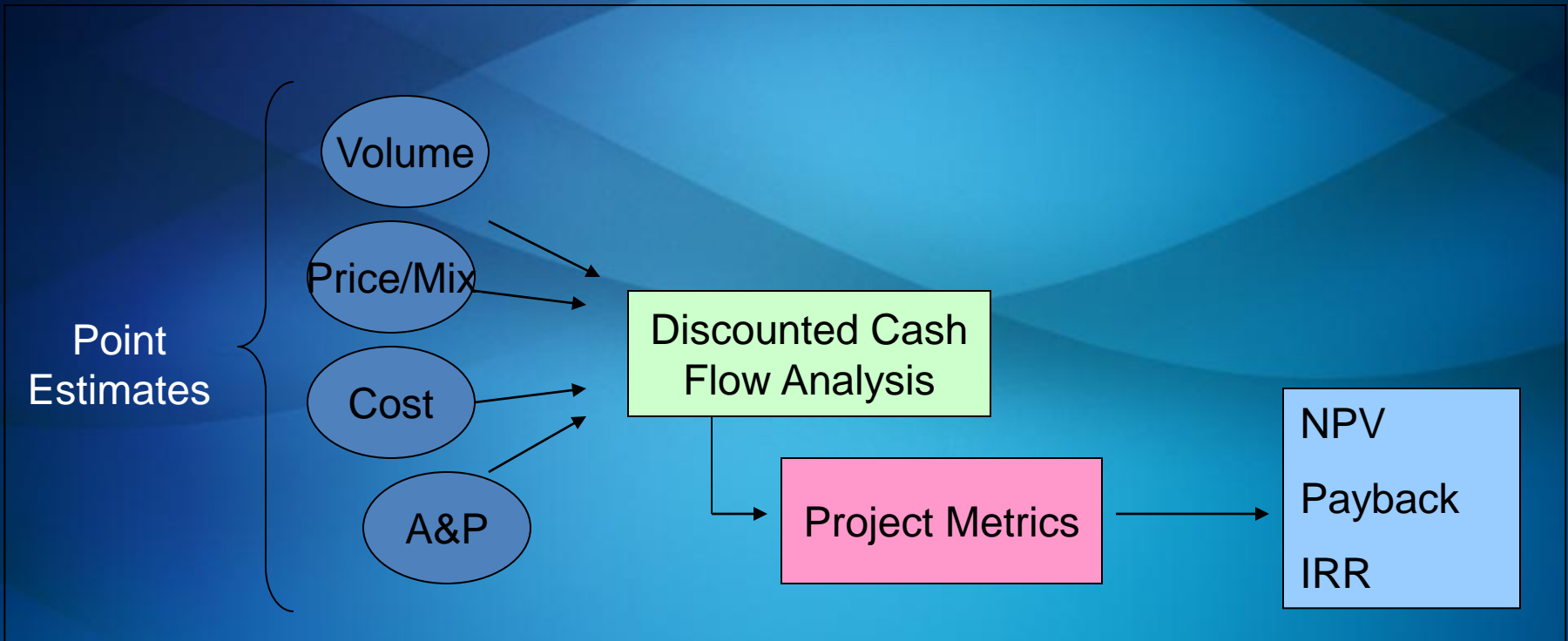


# Monte Carlo Simulation



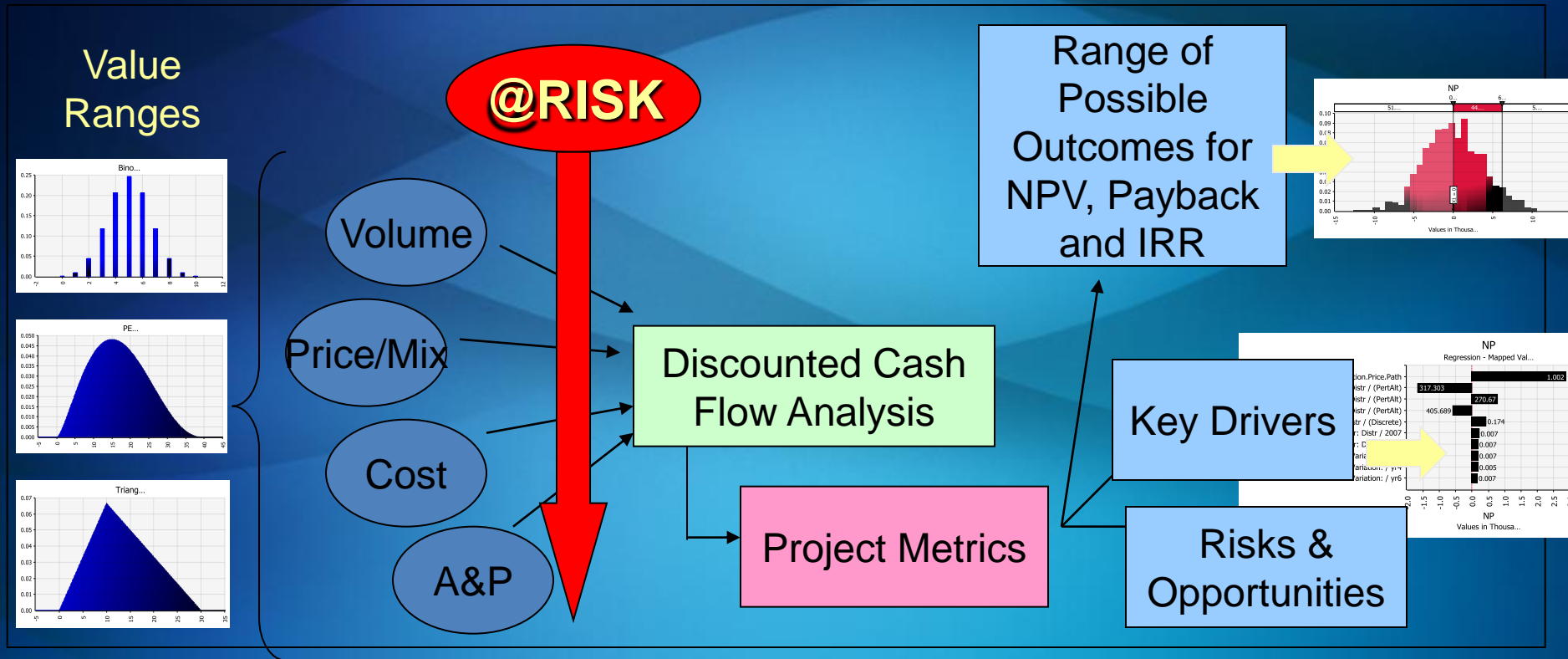
# Traditional Approach – “Valuation”

Outcome is based on the single value for each defined assumption



# Risk Management Approach

Outcome is a range of possible values generated from applying simulation techniques to key assumptions using business developed probabilities



Analysis role becomes more value added through increased collaboration and communication with project team on key drivers and risks & opportunities

# Risk Analysis: Summary

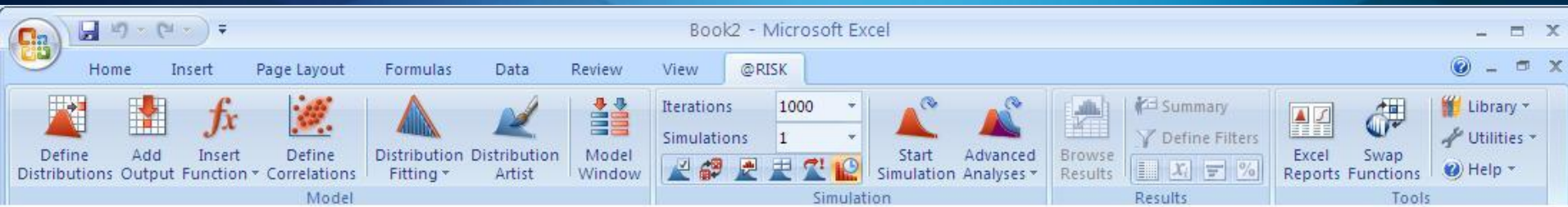
- » Risk Analysis Generates:
  - Expected Values of the Decision
  - Exposure Associated With the Decision
- » Adjust Decisions Based on the Risk Analysis:
  - Value a Decision Based on Expectations
  - Mitigate Based on Exposure and Risk Appetite

# @RISK: Interface



- » Toolbar
- » Define Distributions
- » Model Window
- » Simulation Settings
- » Results Window
- » Report Settings

# @RISK Ribbon in Excel 2007



# Define Distributions

The image shows a screenshot of Microsoft Excel with the @RISK ribbon selected. The ribbon contains several groups of icons: 'Model' (Define Distributions, Add Output Function, Insert Correlations, Distribution Fitting, Distribution Artist, Model Window) and 'Simulation' (Iterations, Simulations, Start Simulation Analyses, Advanced Simulation Analyses). A red arrow points to the 'Define Distributions' icon. Below the ribbon, the Excel grid shows cell A1 selected. A blue arrow points from cell A1 to the 'Define Distribution: A1' dialog box. The dialog box has fields for 'Name' and 'Cell Formula'. Below these fields is a section titled 'Select the distribution to add to this formula:' with tabs for 'Common', 'Favorites', 'Discrete', 'Continuous', 'Alt. Parameters', 'Special', '@RISK Library', and 'All'. The 'Common' tab is active, showing a grid of distribution icons: BetaGener..., Binomial, Cumul, Discrete, Expon, Gamma, General, Histogram, Lognorm, Normal, Pert, Poisson, Triang, TriGen, Uniform, and Weibull. At the bottom of the dialog are buttons for 'Make Favorite', 'Select Distribution', and 'Cancel'.

# Define Distributions



The screenshot shows the @RISK software interface. The main window is a spreadsheet with columns A, B, and C, and rows 1 through 25. Cell B3 is selected and highlighted in light blue. A dialog box titled '@RISK - Define Distribution: B3' is open over the spreadsheet. The dialog box has the following fields and options:

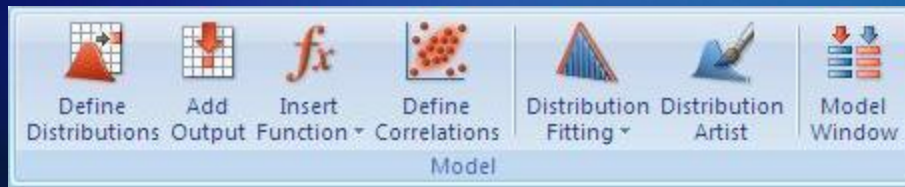
- Name: (empty)
- Cell: `=RiskTriang(-10,0,10)`
- Formula: (empty)
- Function: Triang(-10,0,10)
- Parameters: Standard
- Min: -10
- M. likely: 0
- Max: 10

Below the parameters is a graph of a triangular distribution. The x-axis ranges from -15 to 15, and the y-axis ranges from 0.00 to 0.12. The distribution is a blue triangle with its peak at 0. The 5.0% and 90.0% percentiles are marked at -6.84 and 6.84, respectively. The 90.0% percentile is highlighted in a darker blue. A legend on the right side of the graph shows a blue square next to the text 'Triang(-10,0,10)'. Below the graph, the following statistics are listed:

- Minimum: -10.0000
- Maximum: 10.0000
- Mean: 0.0000
- Std Dev: 4.0825

At the bottom of the dialog box, there are buttons for 'Add Overlay', 'OK', and 'Close'.

# Model Window



@RISK - Model

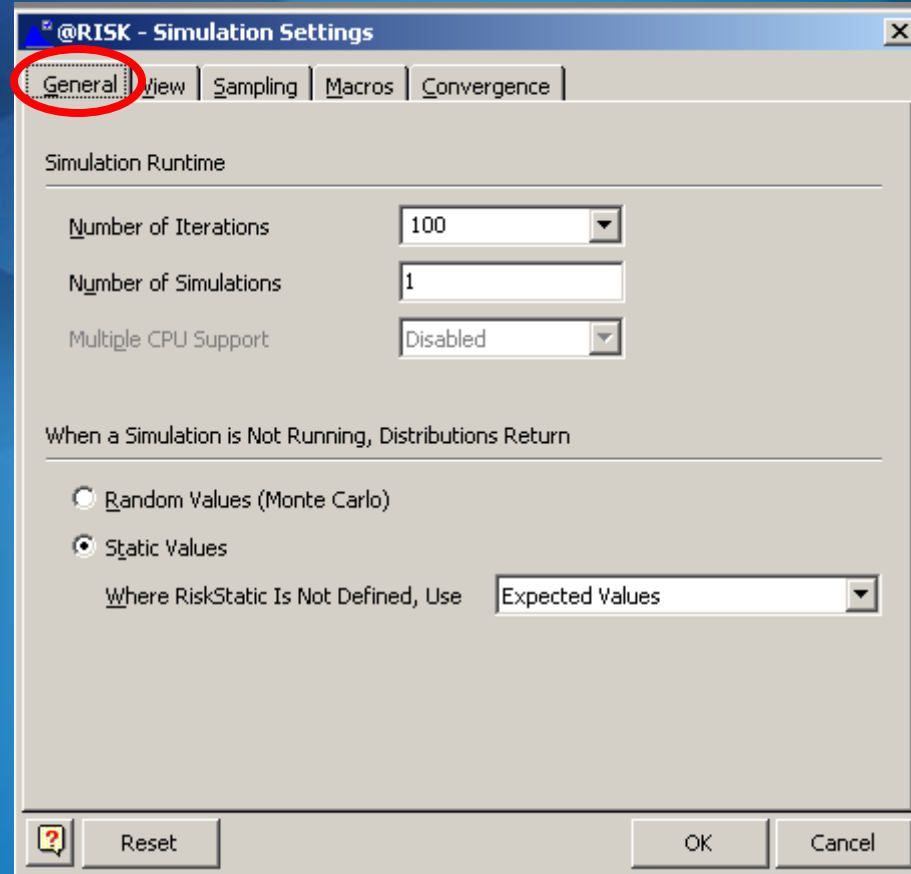
Inputs | Outputs | Correlations |

Model Inputs in Open Workbooks: Inputs= 22, Outputs= 11

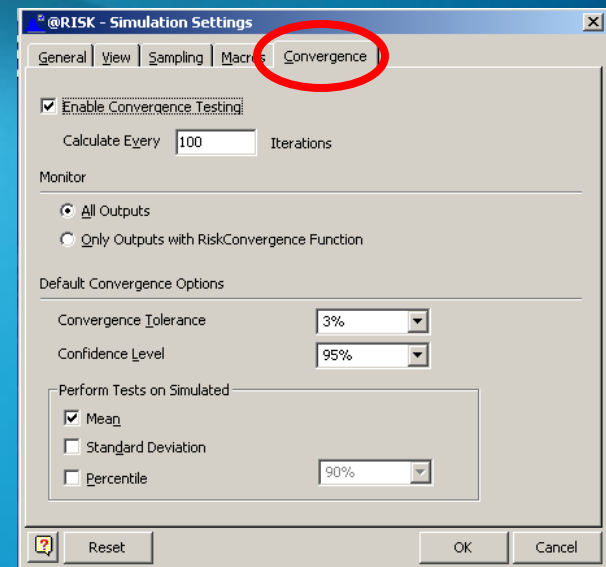
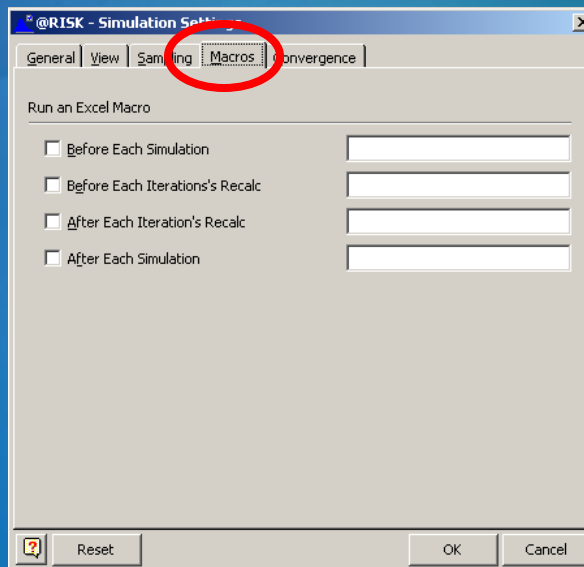
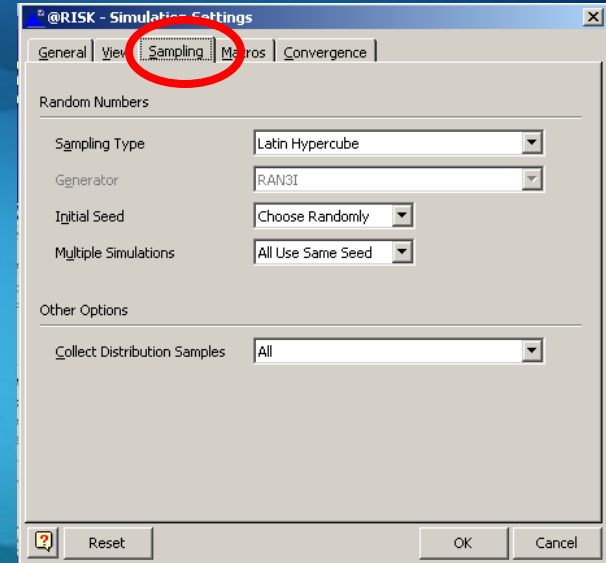
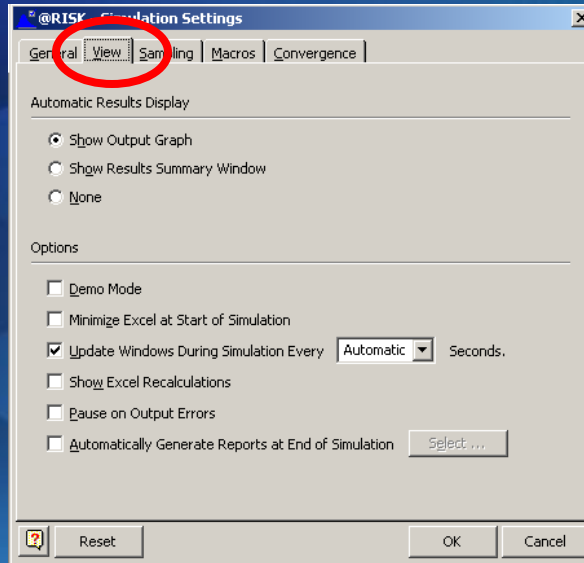
Name	Cell	Graph	Function	Min	Mean	Max
Number of Competitors / 2016	K25		RiskDiscrete({-1,0,1},{1,1,1})	-1	0	1
Number of Competitors / 2017	L25		RiskDiscrete({-1,0,1},{1,1,1})	-1	0	1
- Category: Product Development						
Product Development / 2008	C35		RiskNormal(50000,10000)	-∞	50000	+∞
Product Development / 2009	D35		RiskNormal(20000,2000)	-∞	20000	+∞
Product Development / 2010	E35		RiskNormal(10000,1000)	-∞	10000	+∞
- Category: Sales Volume						
Sales Volume / 2010	E32		RiskNormal(3000,1000)	-∞	3000	+∞
Sales Volume / 2011	F32		RiskNormal(5000,1000)	-∞	5000	+∞

OK   Cancel

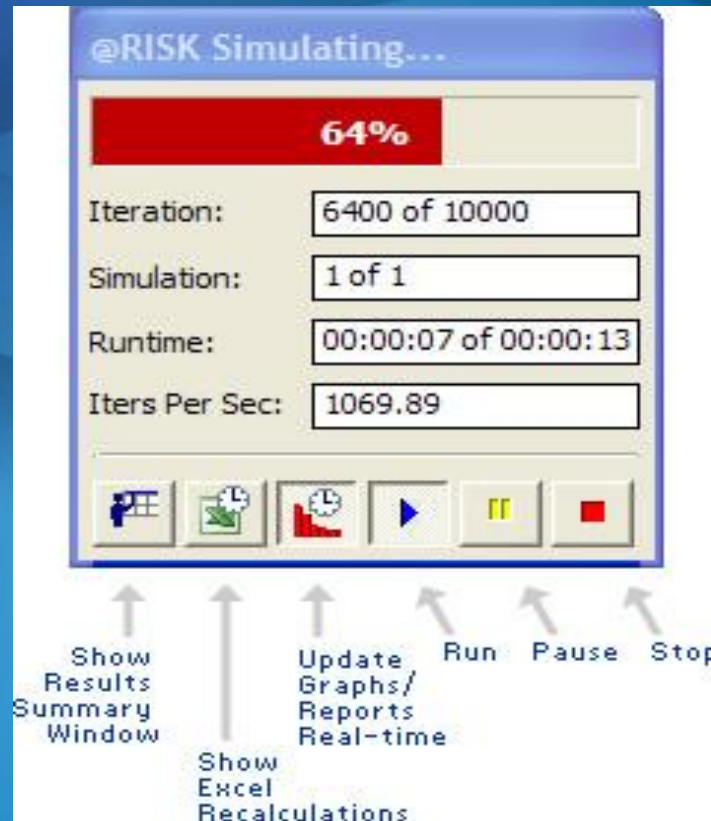
# Simulation Settings



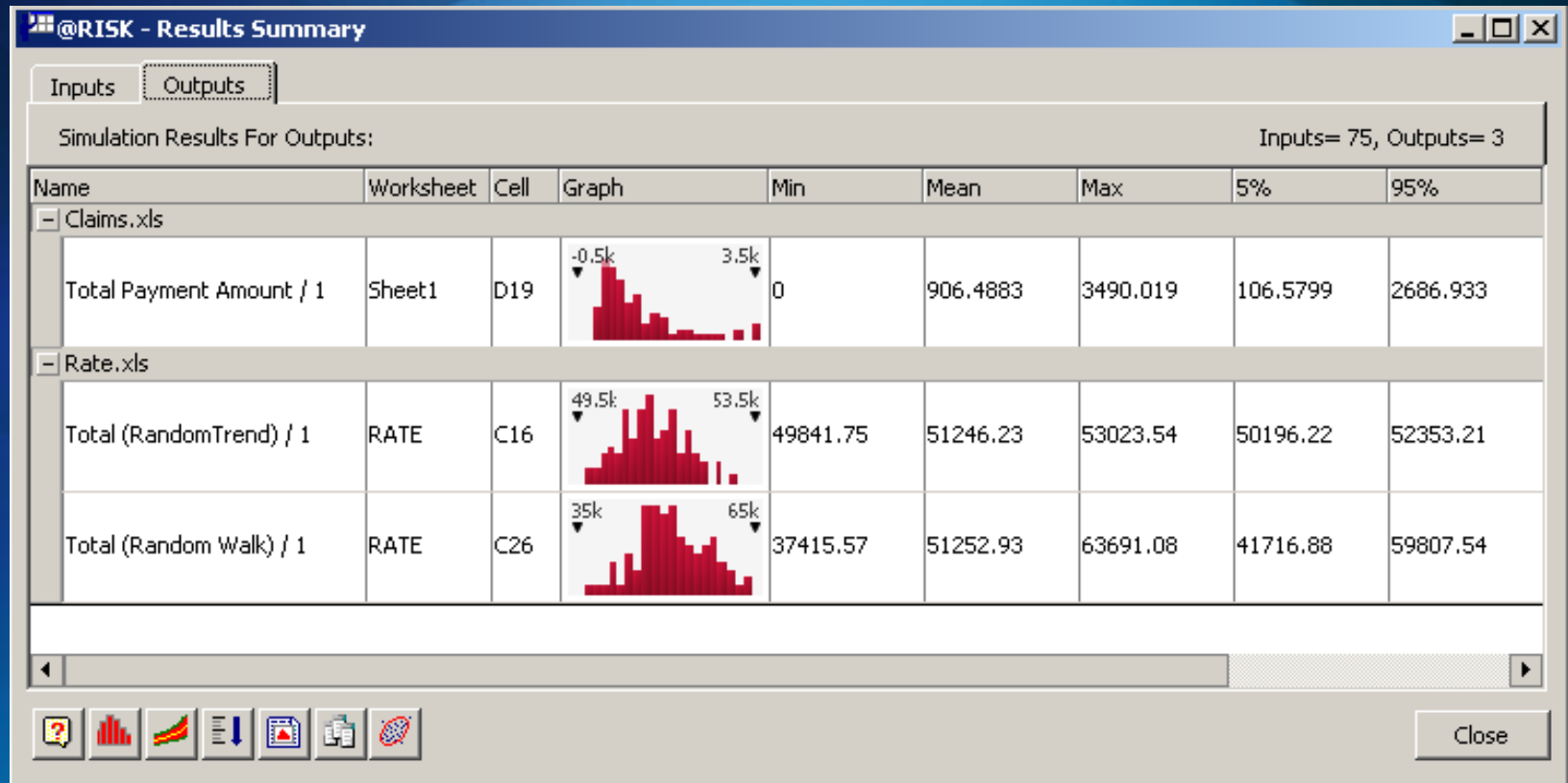
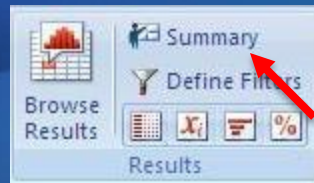
# Simulation Settings



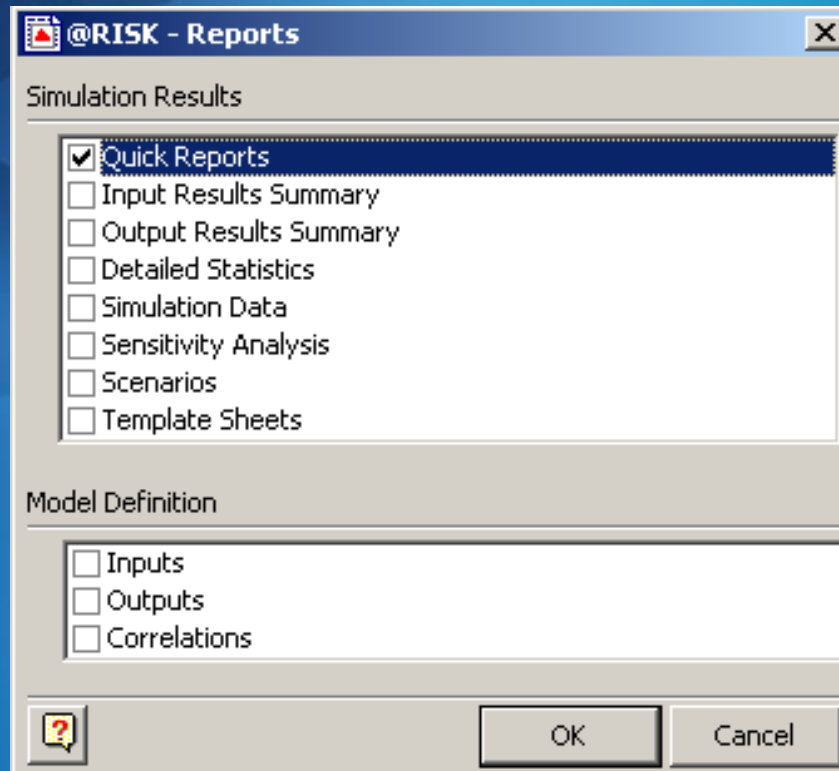
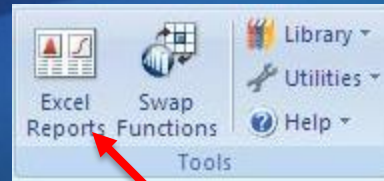
# Simulation Progress Window



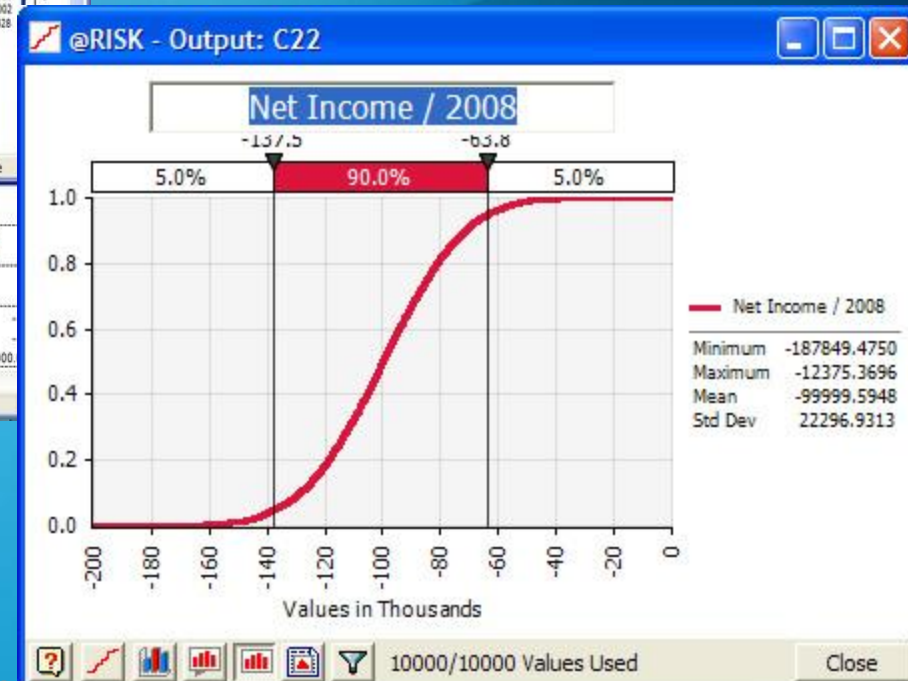
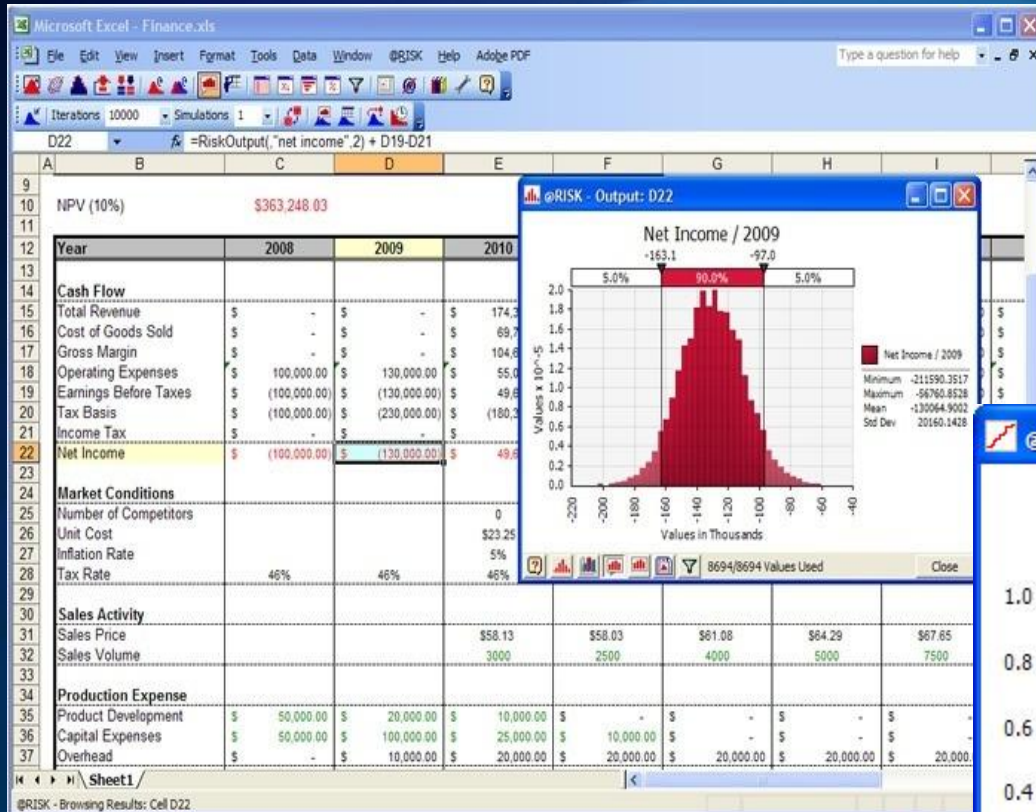
# Results Summary Window



# Report Settings



# Graphing Results



# Distribution Fitting



- » Sample data
- » Density data
- » Continuous data
- » Discrete data
- » 100K data points

# Fitting Data

- » Tests used:
  - MLEs
  - Chi-square
  - Anderson-Darling
  - Komolgorov-Smirinov
  - Root Mean Square Error
- » Statistics
- » Goodness of Fit
- » Ranking

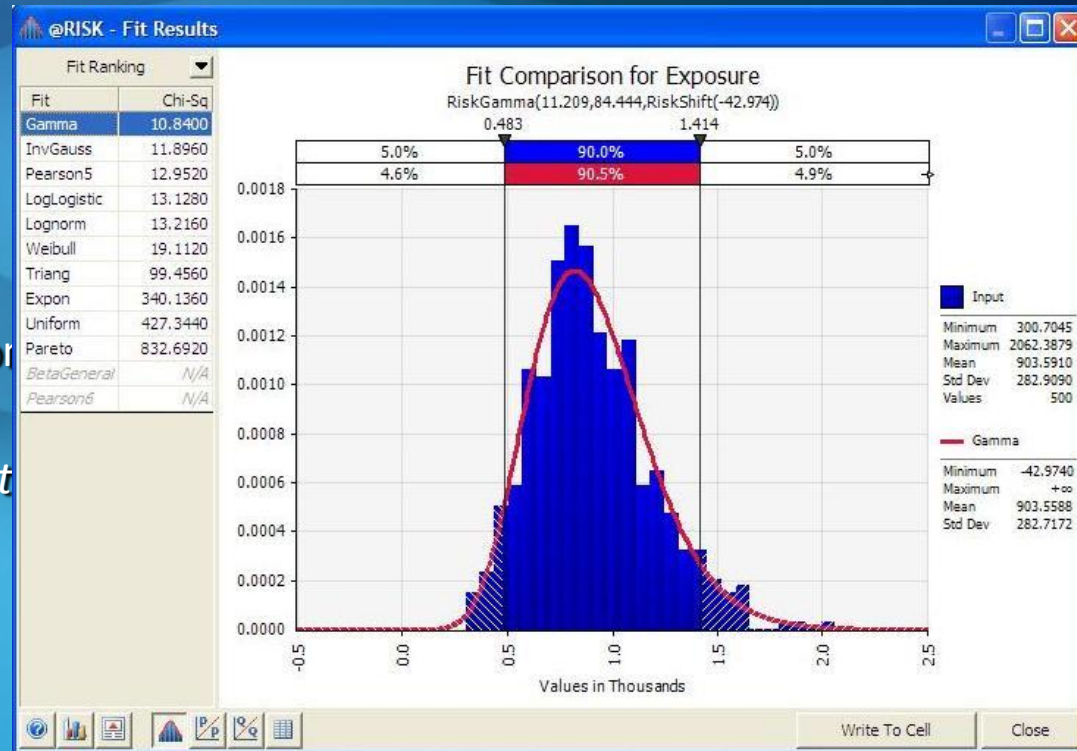
# Distribution Fitting

## » Description

- Effective for describing distribution by aligning it to existing data
- Combines effects of multiple assumptions into one assumption
- *It is important to remove any trend or seasonality from the data*

## » Examples

- Historical waste data
- Historical market prices
- Any distribution needing to be aligned to existing data



## Inputs

- Source data

# Correlation

- » Correlation exists between probability distributions
  - Not applicable to intermediate calculations
- » Correlation matrix structure

# Correlation

## » Description

- Specifies the relationship between two or more input variables
- For analysis and risk assessment it is important to account for correlation between variables

## » Examples

- Material Load vs. Fatigue
- Pricing vs. Volume
- Supply vs. Demand
- Weather vs. Claims Losses

@RISK - Define Correlations: RISKCorrelations

Matrix Name: RISKCorrelations  
Description:   
Location: \$B\$10:\$E\$13  
 Add Heading Row/ Column and Format

Instance:   
[Add] [Delete] [Reset]

	US Interest Rate Cell D17	\$/Pound Cell D18	\$/Euro Cell D19
US Interest Rate Cell D17	1	-0.7	-0.5
\$/Pound Cell D18	-0.7	1	-0.9
\$/Euro Cell D19	-0.5	-0.9	1

[?] [Add] [Delete] [OK] [Cancel]  
Add Inputs Delete Matrix OK Cancel

# Exercise: Exposure in Long-Term Decisions

- » The Key Result: NPV and IRR Variation
- » The Key Uncertain Components
  - Price Over Time
  - Quantity of Product/Service Over Time
  - Production in Year 1
  - Competitor Action
  - Capital Cost
  - Raw Materials Costs
  - Other Variable Costs

# Sources of help

- » On-line tutorials
- » Help menu within the software
- » Software manuals (PDF)
- » Palisade web-site [www.palisade.com](http://www.palisade.com)
- » Helpdesk: <http://helpdesk.palisade.com/>
- » Forum: <http://forums.palisade.com/>
- » Your Palisade Sales Representatives
- » Palisade Technical Support: [tech-support@palisade.com](mailto:tech-support@palisade.com)



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