Financial Models for Laboratory Decision Making

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Introduction

Laboratory personnel are periodically confronted with complex decisions such as buy versus lease, add a new test to the menu or bring a reference test in-house. Such decisions are often made with simple models that do not adequately capture risk, incorporate alternative courses of action, or allow for sequential decisions that evolve over time. As a result, decision makers often obtain suboptimal results.

In this webinar, cutting edge techniques that incorporate risk, facilitate the comparison of multiple alternatives, and provide insight into common laboratory decisions will be presented. Attendees will receive training in building financial models using Microsoft Excel and Palisade Decision Tools, a popular add-in.

Participants will learn to use decision trees and simulation models and then apply their knowledge to analyze whether to perform a test in house or send it to a reference laboratory.

Learning Objectives

- Determine when advanced modeling techniques are likely to be helpful
- Explain how simulation models are used to incorporate risk analysis in decisions
- Build simple models using Excel add-ins to analyze problems using decision trees and simulation

Session Faculty
Robert Schmidt, MD, PhD, MBA

- Medical Director, ARUP Laboratories

- Areas of Expertise
  - Quantitative Analysis/Modeling
  - Clinical Epidemiology
  - Operations Management
  - Diagnostic Testing
    - Cost Effectiveness Analysis
    - Meta-Analysis
    - Literature Evaluation
    - Laboratory Utilization

- Past Life
  - Assistant Professor, Operations Management, University of Minnesota
  - Associate Professor, Operations Management, University of Southern California

Session Faculty
Suzanne Carasso, MBA, MT (ASCP)
Director, Business Solutions Consulting, ARUP Laboratories

- Consulting Director, ARUP Laboratories

- Areas of Expertise:
  - Healthcare strategies for transitioning from volume to value based care
  - Laboratory legal structure and business models
  - Value analysis and development of lab value proposition
  - Strategy/business planning
  - Market, operations and financial analyses

- Education
  - B.S. Medical Technology, University of Tennessee
  - MBA, University of Colorado at Denver

The purpose of this webinar is to educate participants to *make better decisions* in the clinical and anatomic pathology laboratory using financial models and risk-based analysis.

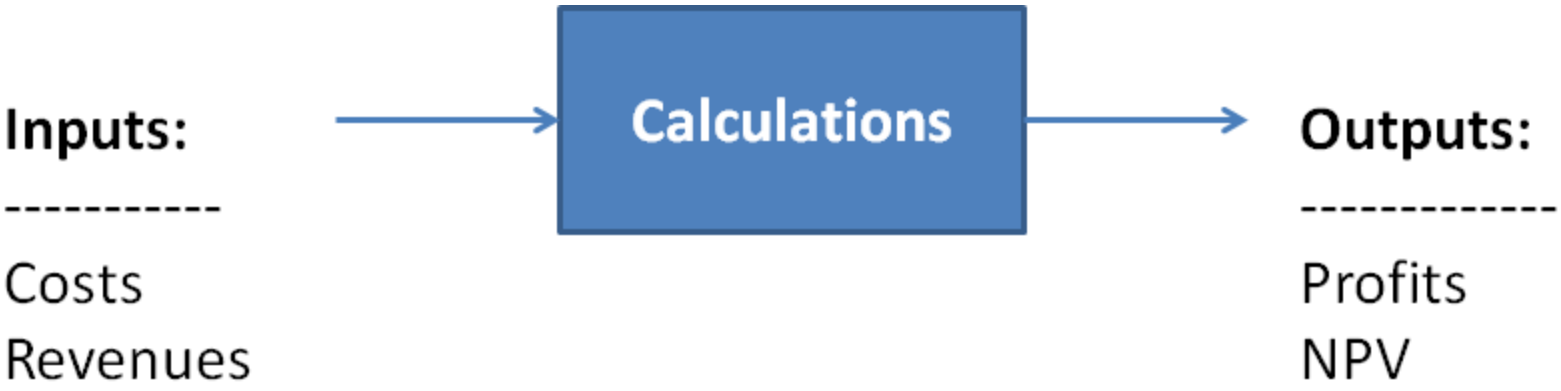
- Understand financial models
- Analyze risk
- Demonstrate tools for risk analysis

What is a financial model?

Total Revenue		$750,000	$2,700,000	$5,100,000	$7,500,000	$9,900,000	$25,950,000
Expenses	Pre-launch	Year 1	Year 2	Year 3	Year 4	Year 5	
Outreach Program Manager (Pre=1)	$124,800	$128,544	$132,400	$136,372	$140,463	$144,677	
Marketing/Sales Rep (Yr2=1, Yr3=2)			$66,560	$135,117	$139,170	$143,345	
Commissions			$58,500	$72,000	$72,000	$72,000	
IT Development/Customer Support (Pre=0.5, Yr2=2)	$31,200	$63,336	$127,636	$131,465	$135,409	$139,471	
PSC Phlebotomists (Yr1=2.4, Yr2=4.8, Yr3=7.2)		$119,808	$243,210	$366,720	$377,722	$389,054	
Benefits @ 25%	$39,000	$77,922	$157,077	$210,419	$216,191	$222,137	
Total Salary Expense	$195,000	$389,610	$785,383	$1,052,093	$1,080,956	$1,110,685	
Cost/Test (supplies/disposables/reagents)		$194,890	$701,603	$1,325,251	$1,948,898	$2,572,545	
Reference Testing		$50,100	$180,361	$340,681	$501,002	$661,323	
Billing	Evaluate/Select	$60,000	$202,500	$357,000	$525,000	$693,000	
Sales Entertainment/Expenses			$12,000	$24,000	$24,000	$24,000	
Sales - cell phones		$1,200	$2,400	$2,400	$2,400	$2,400	
Mileage			$8,250	$16,500	$16,500	$16,500	
Courier	Evaluate/Select	$45,000	$162,000	$306,000	$450,000	$594,000	
IT Solution	$100,000	$42,000	$42,000	$42,000	$42,000	$42,000	
Client EMR Interface Estimates		$60,000	$75,000	$75,000	$75,000	$75,000	
Client IT Hardware		$4,800	$6,000	$6,000	$6,000	$6,000	
Marketing Expenses		$5,000	$5,000	$5,000	$5,000	$5,000	
Office Supplies		$10,000	$10,000	$10,000	$10,000	$10,000	
Patient Service Center Leases		$140,000	$280,000	$420,000	$420,000	$420,000	
Total Operating Expenses	$100,000	$612,990	$1,687,114	$2,929,832	$4,025,800	$5,121,768	
Total Expenses	$295,000	$1,002,600	$2,472,497	$3,981,925	$5,106,756	$6,232,452	$19,091,231
Contribution	($295,000)	($252,600)	$227,503	$1,118,075	$2,393,244	$3,667,548	$6,858,769

Financial Model

Financial Model



Financial Models

- Always wrong
- Sometimes useful

Examples of “Wrong” Models

- Ideal gas laws
- Newtonian fluids
- Laws of motion (ignore friction, point masses)
- Perfect competition

How are models useful?

- Eliminate bad ideas
- Provide insight
  - Relationships between variables
  - Uncertainty
- Provide predictions
  - Don’t need to be perfect
  - “fit for use”

Simple Example

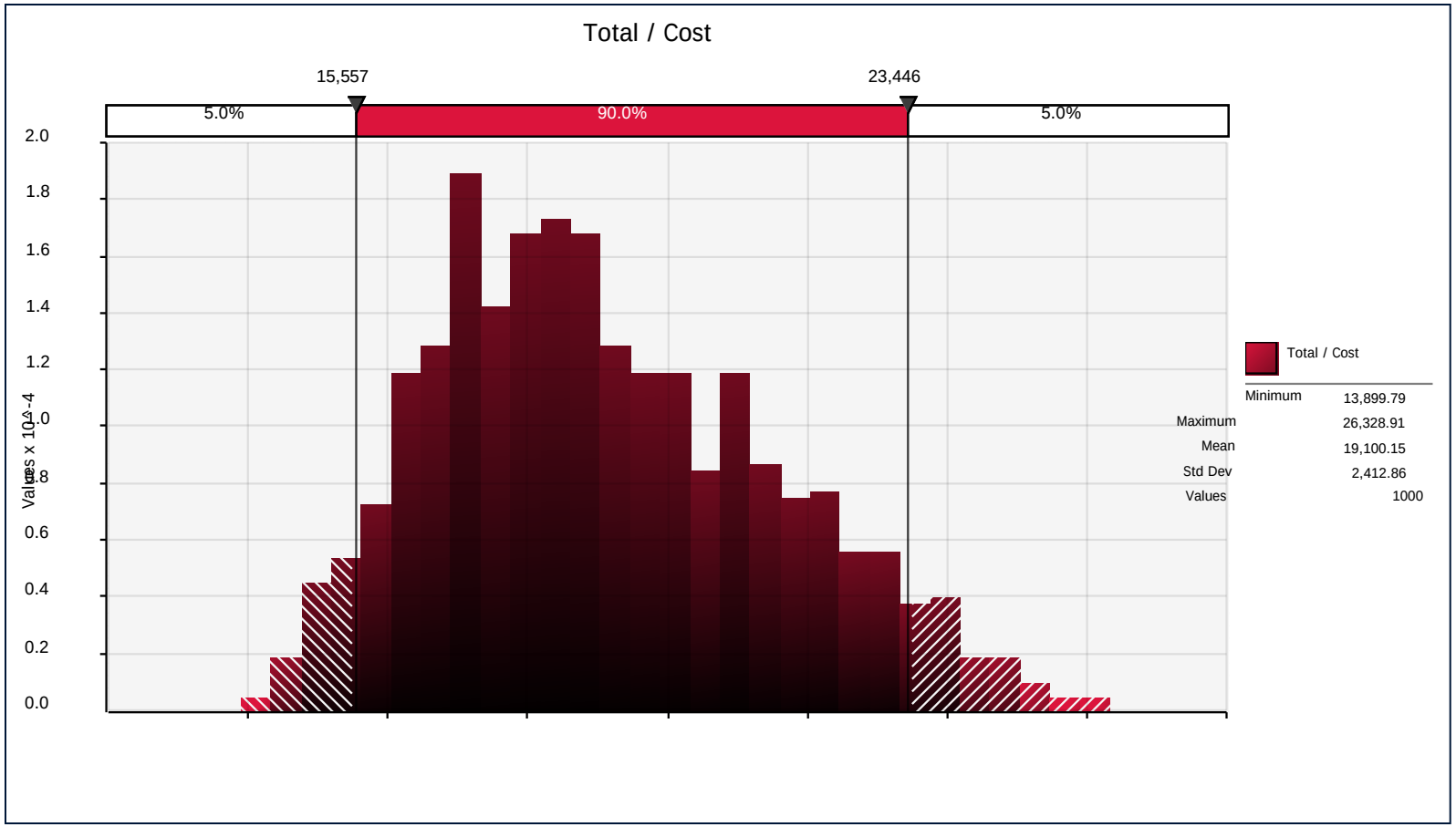
Cost = Labor + Reagents + Overhead

Item	Cost
Labor	10,000
Reagents	5,000
Supplies	2,000
Total	**17,000**

What about uncertainty?

Item	Cost	min	most likely	max
Labor	10,000	7,000	10,000	18,000
Reagents	5,000	4,000	5,000	6,500
Supplies	2,000	1,800	2,000	3,000
Total	**17,000**			

Distribution of Total Cost

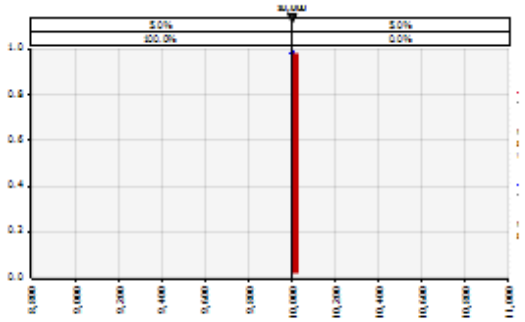


Old Way (point estimate)

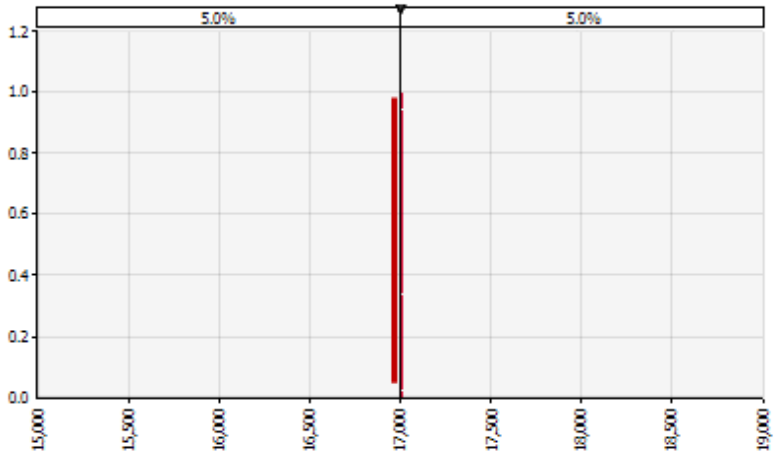
Item	Cost
Labor	10,000
Reagents	5,000
Supplies	2,000
Total	**17,000**

Calculations

Labor cost

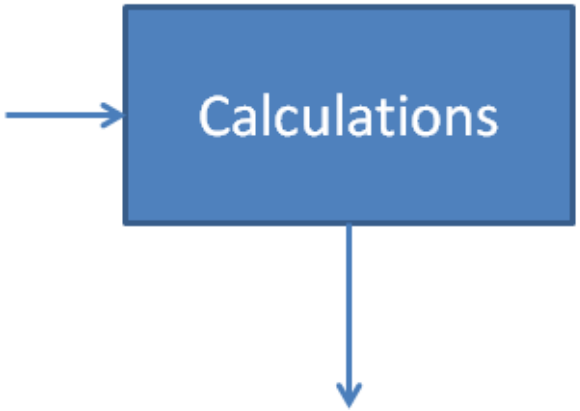


Total cost

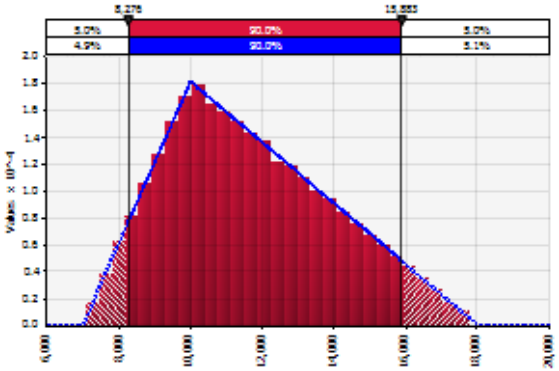


New Way (probabilistic estimate)

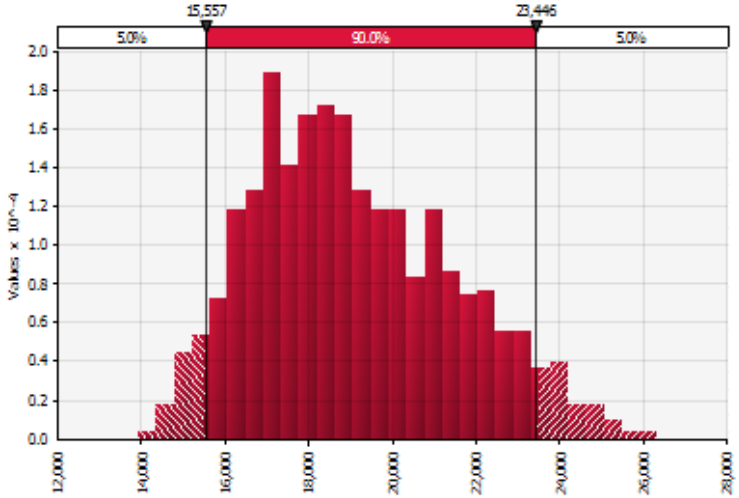
Item	Cost	min	most likely	max
Labor	10,000	7,000	10,000	18,000
Reagents	5,000	4,000	5,000	6,500
Supplies	2,000	1,800	2,000	3,000
Total	**17,000**			



Labor cost

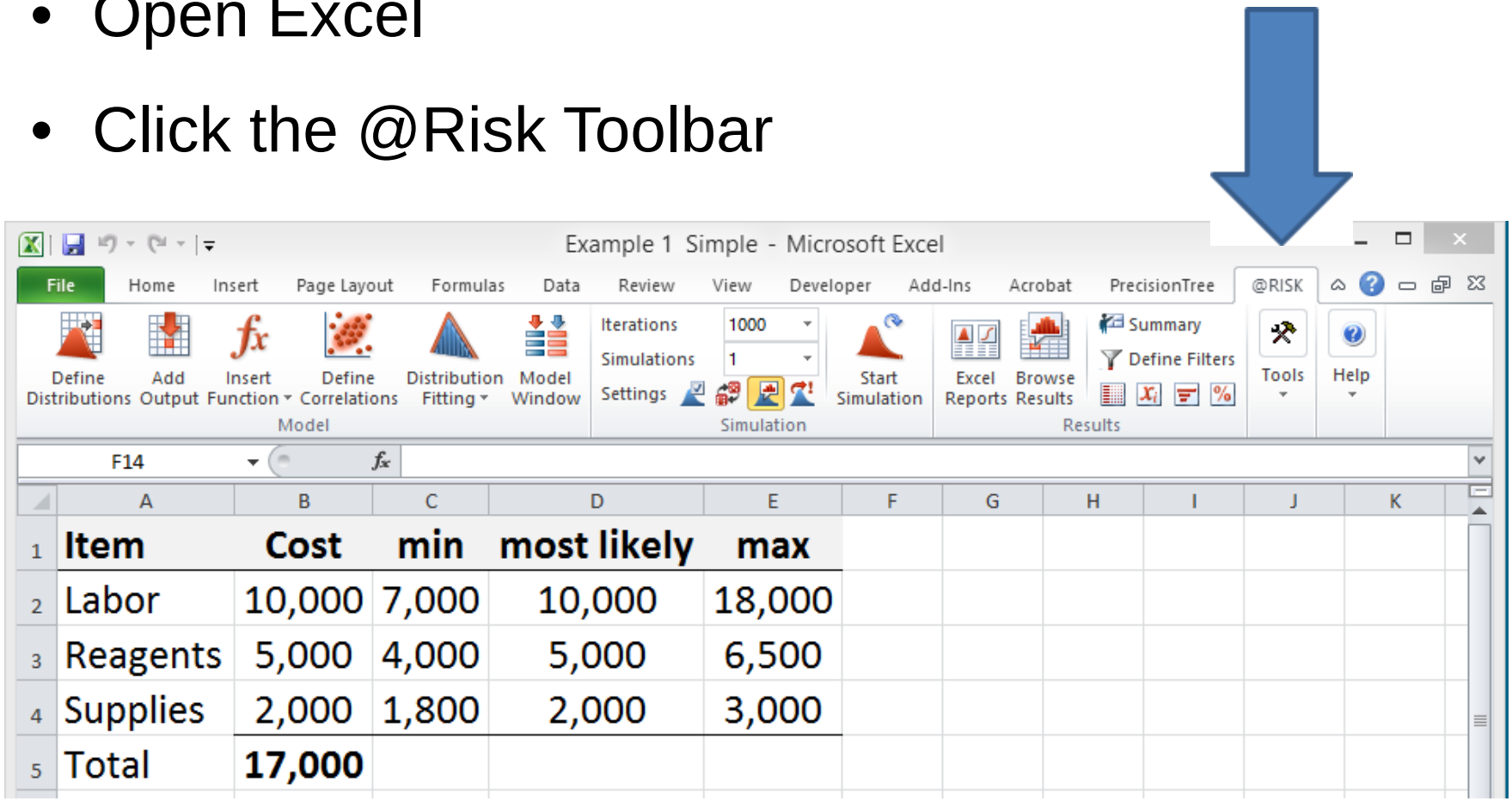


Total cost



How to do it (continued)

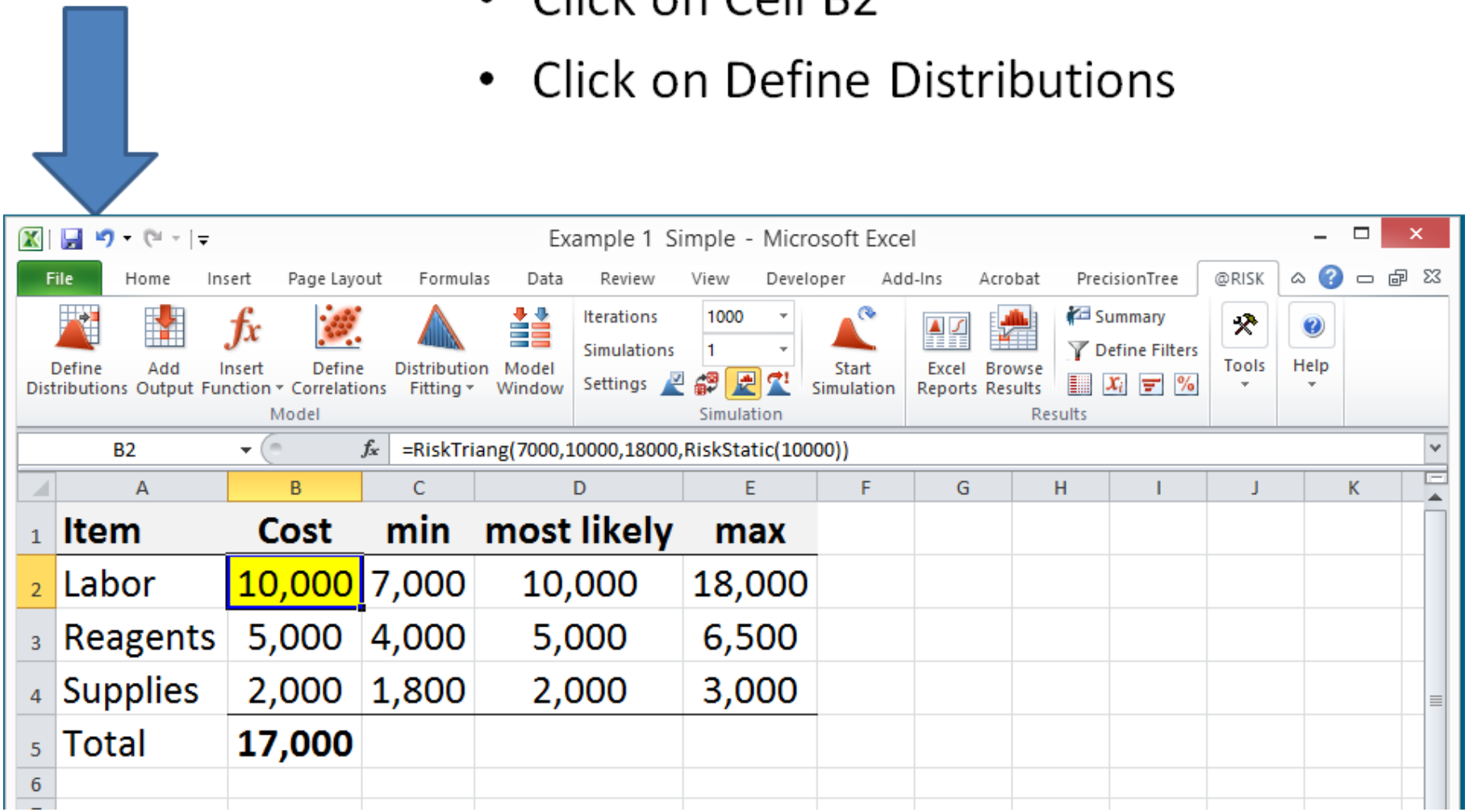
- Open Excel
- Click the @Risk Toolbar



	A	B	C	D	E
1	**Item**	**Cost**	**min**	**most likely**	**max**
2	Labor	10,000	7,000	10,000	18,000
3	Reagents	5,000	4,000	5,000	6,500
4	Supplies	2,000	1,800	2,000	3,000
5	Total	**17,000**			

How to do it (continued)

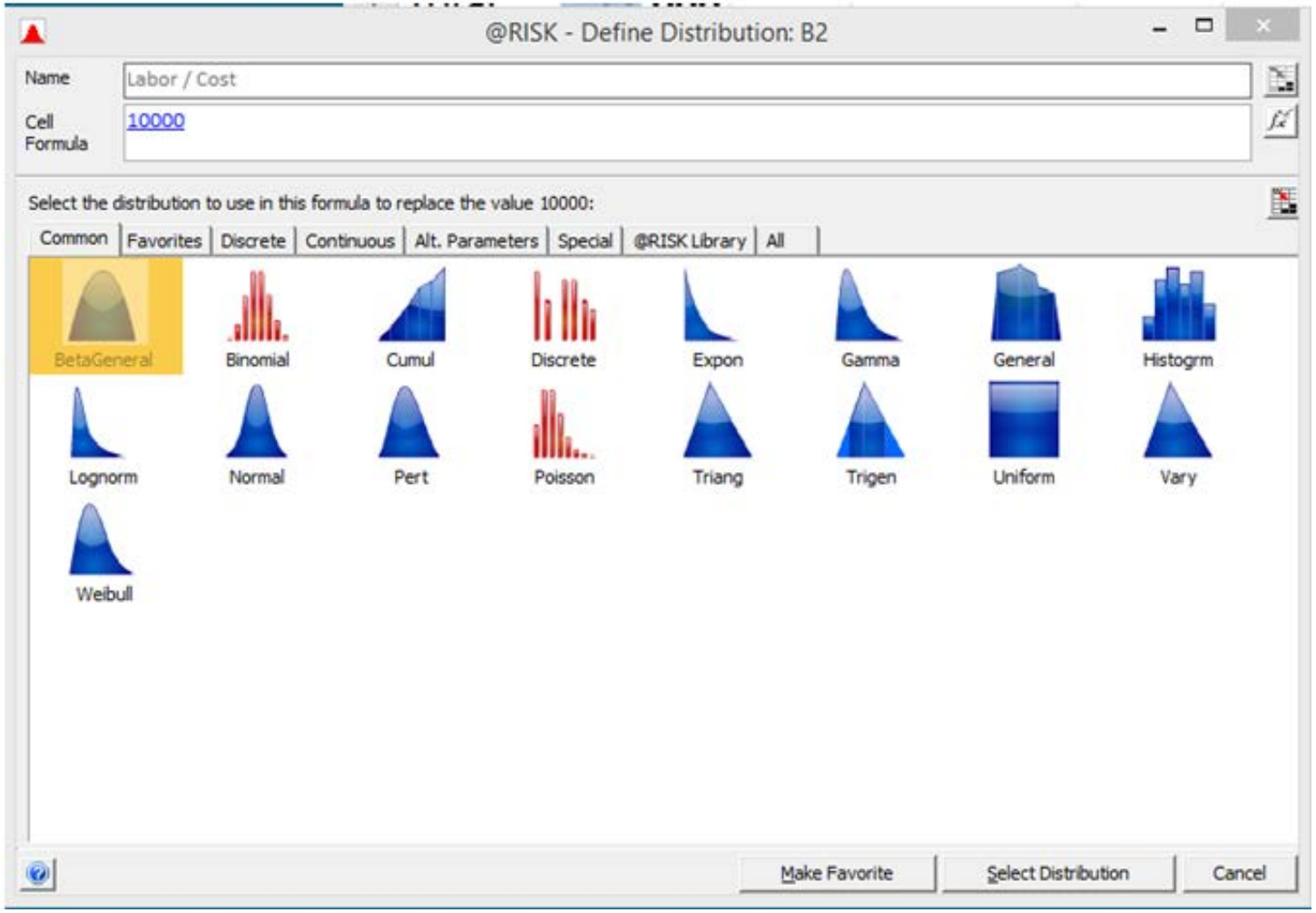
- Click on Cell B2
- Click on Define Distributions



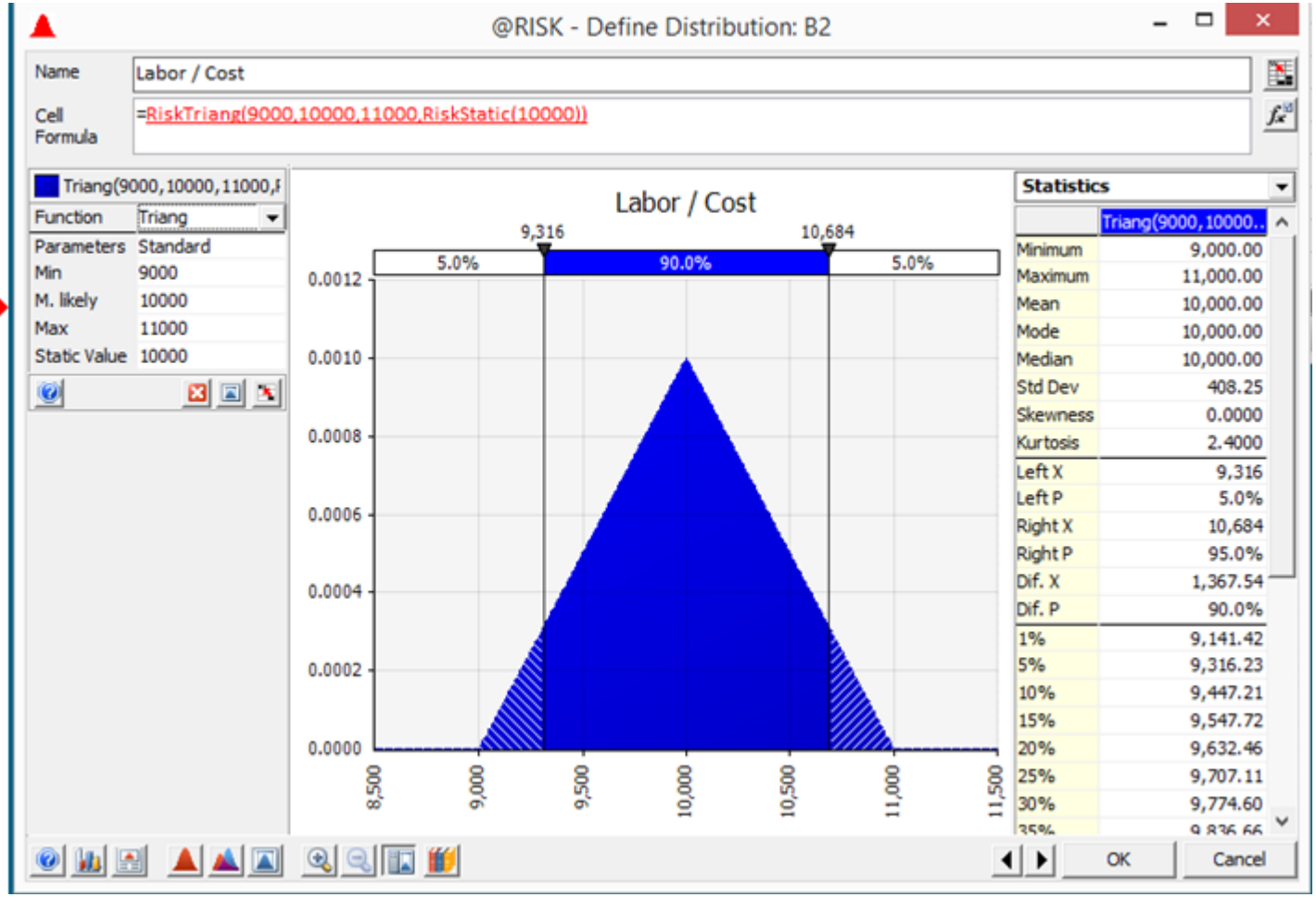
	A	B	C	D	E
1	**Item**	**Cost**	**min**	**most likely**	**max**
2	Labor	10,000	7,000	10,000	18,000
3	Reagents	5,000	4,000	5,000	6,500
4	Supplies	2,000	1,800	2,000	3,000
5	Total	**17,000**			
6					

How to do it (continued)

Click on Triang

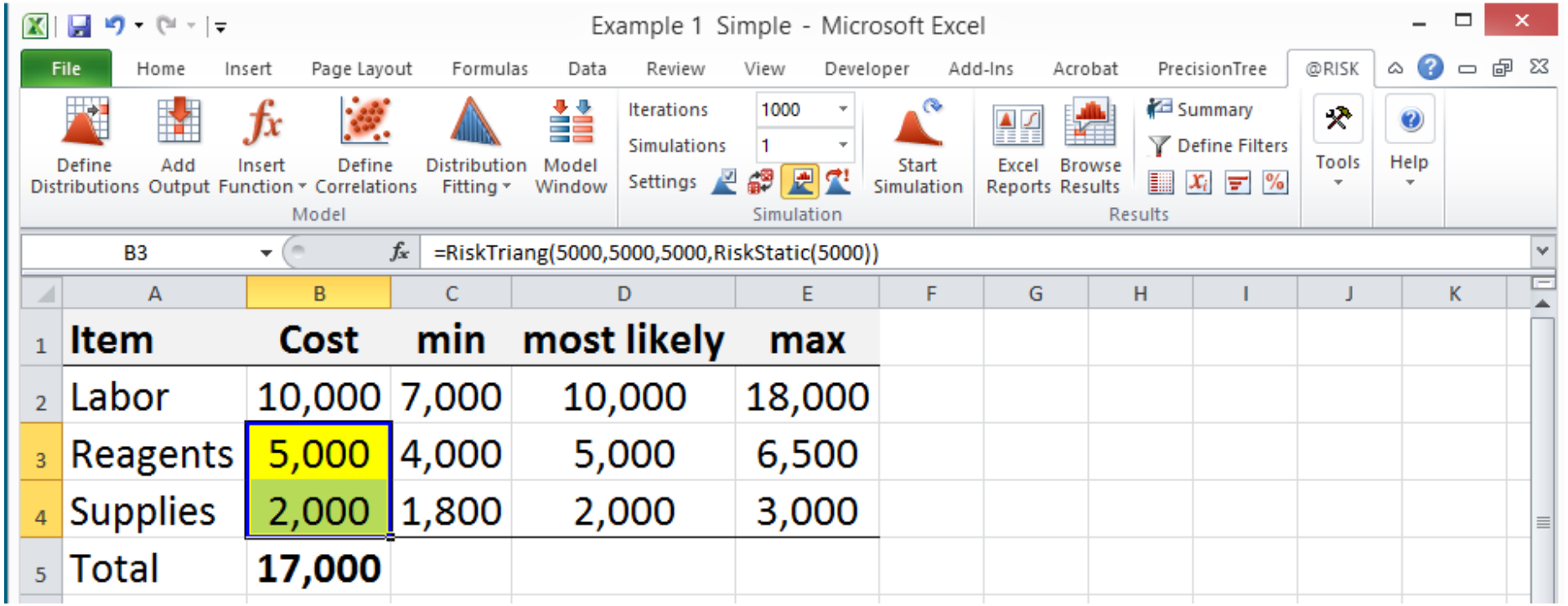


How to do it (continued)
Enter minimum, most likely, maximum



How to do it (continued)

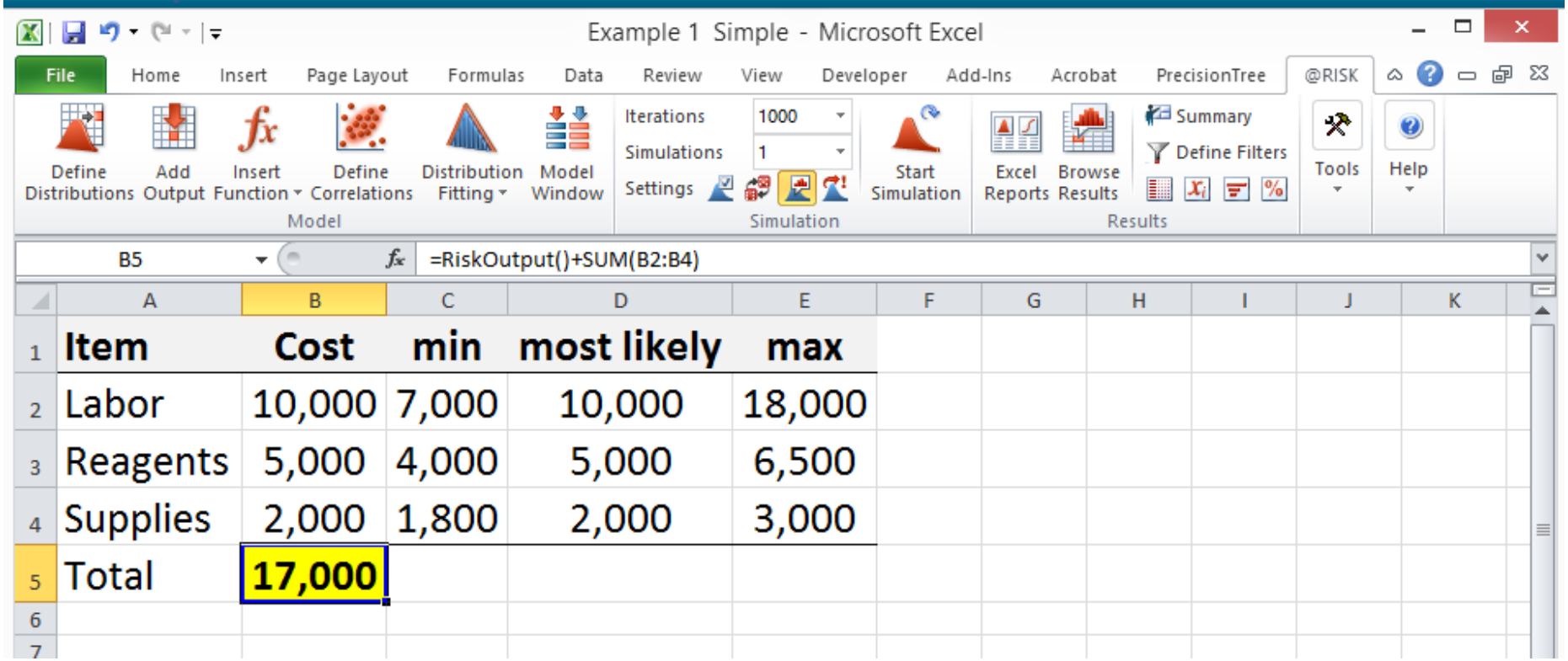
- Repeat for Reagent Costs
- Repeat for Supplies
  - Enter min, most likely, max



	A	B	C	D	E
1	**Item**	**Cost**	**min**	**most likely**	**max**
2	Labor	10,000	7,000	10,000	18,000
3	Reagents	5,000	4,000	5,000	6,500
4	Supplies	2,000	1,800	2,000	3,000
5	Total	**17,000**			

How to do it (continued)

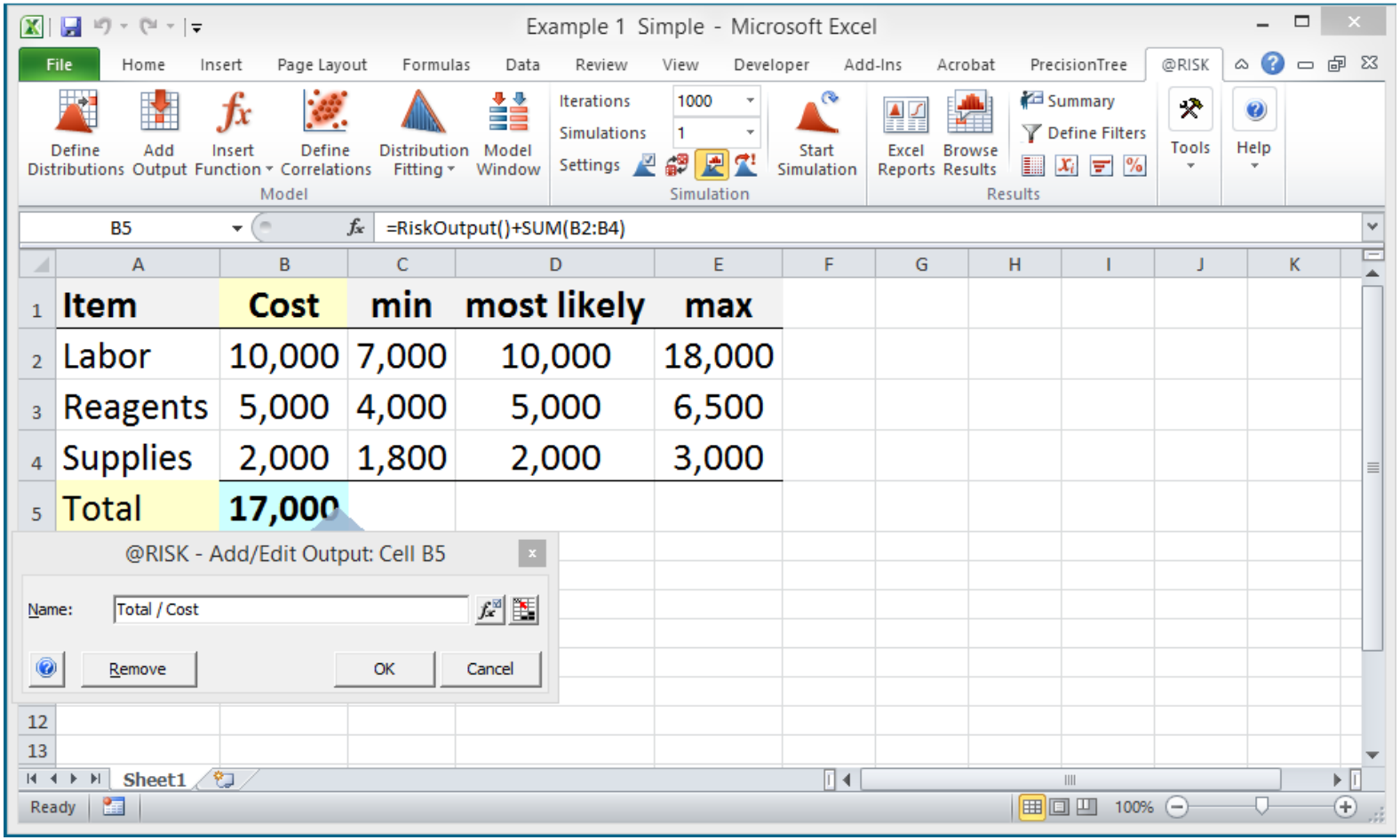
- **Designate Output Cell**
  - Click on B5 (Total)
  - Click on Add Output



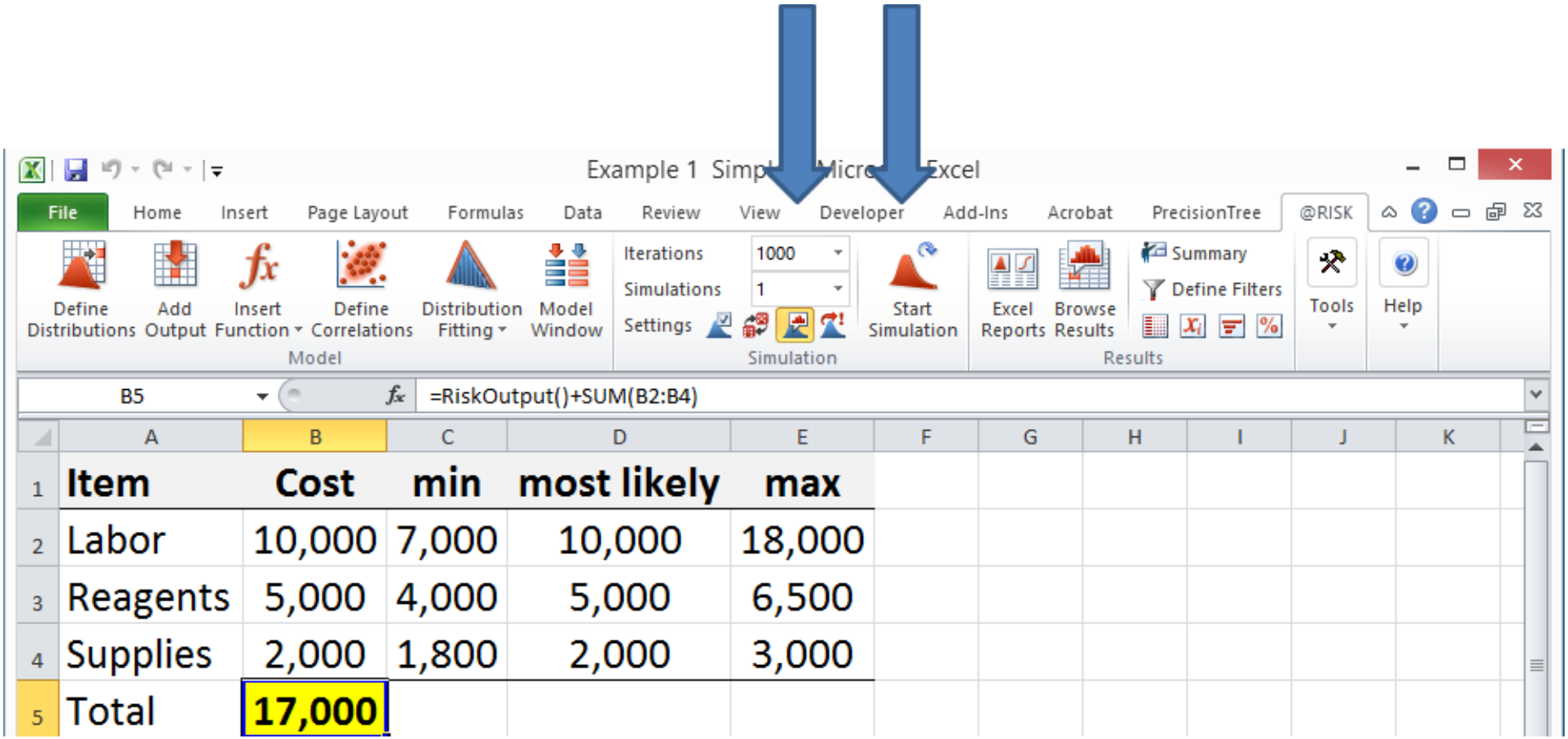
	A	B	C	D	E
1	**Item**	**Cost**	**min**	**most likely**	**max**
2	Labor	10,000	7,000	10,000	18,000
3	Reagents	5,000	4,000	5,000	6,500
4	Supplies	2,000	1,800	2,000	3,000
5	Total	**17,000**			

How to do it (continued)

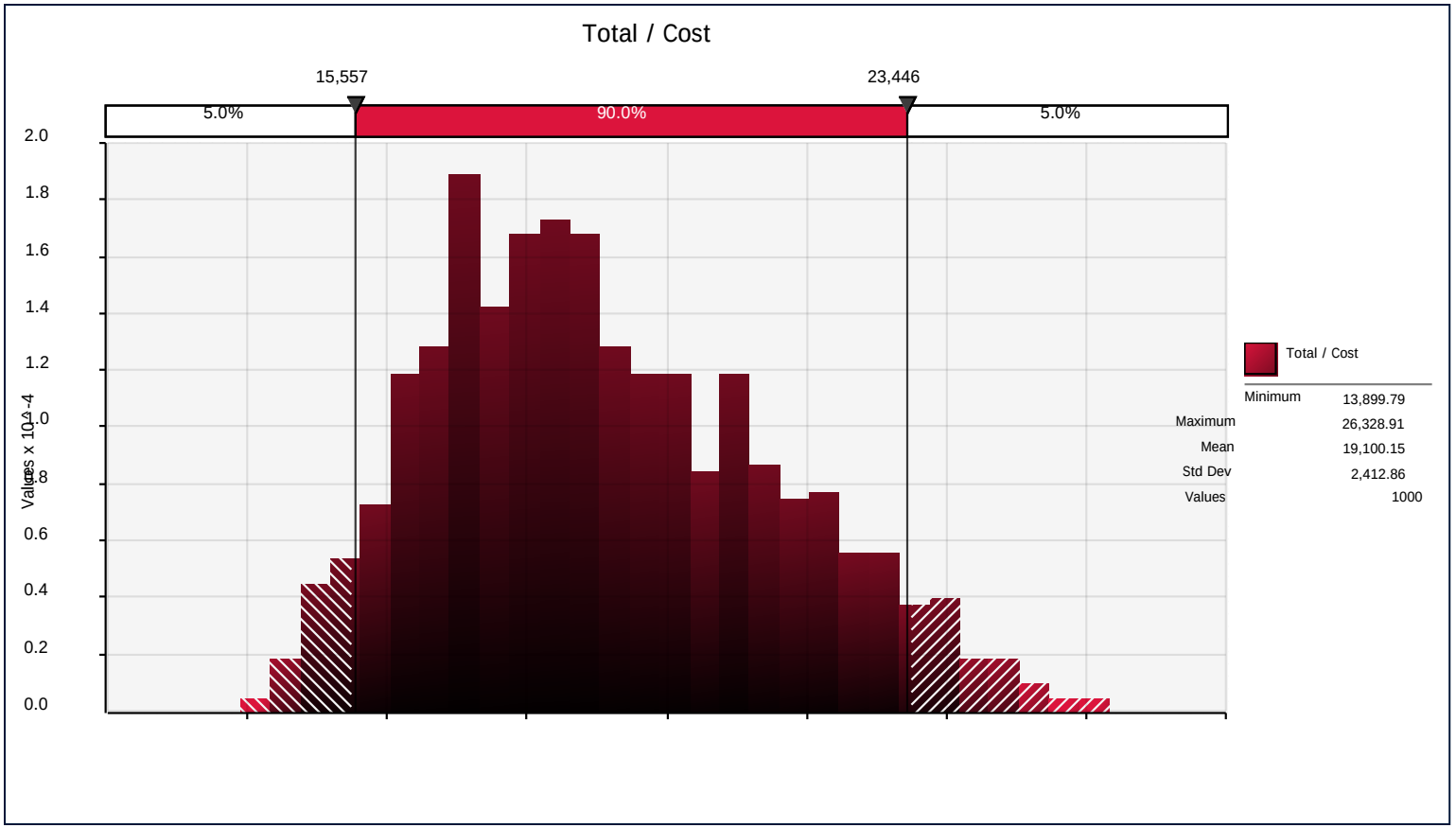
Click OK on dialog box



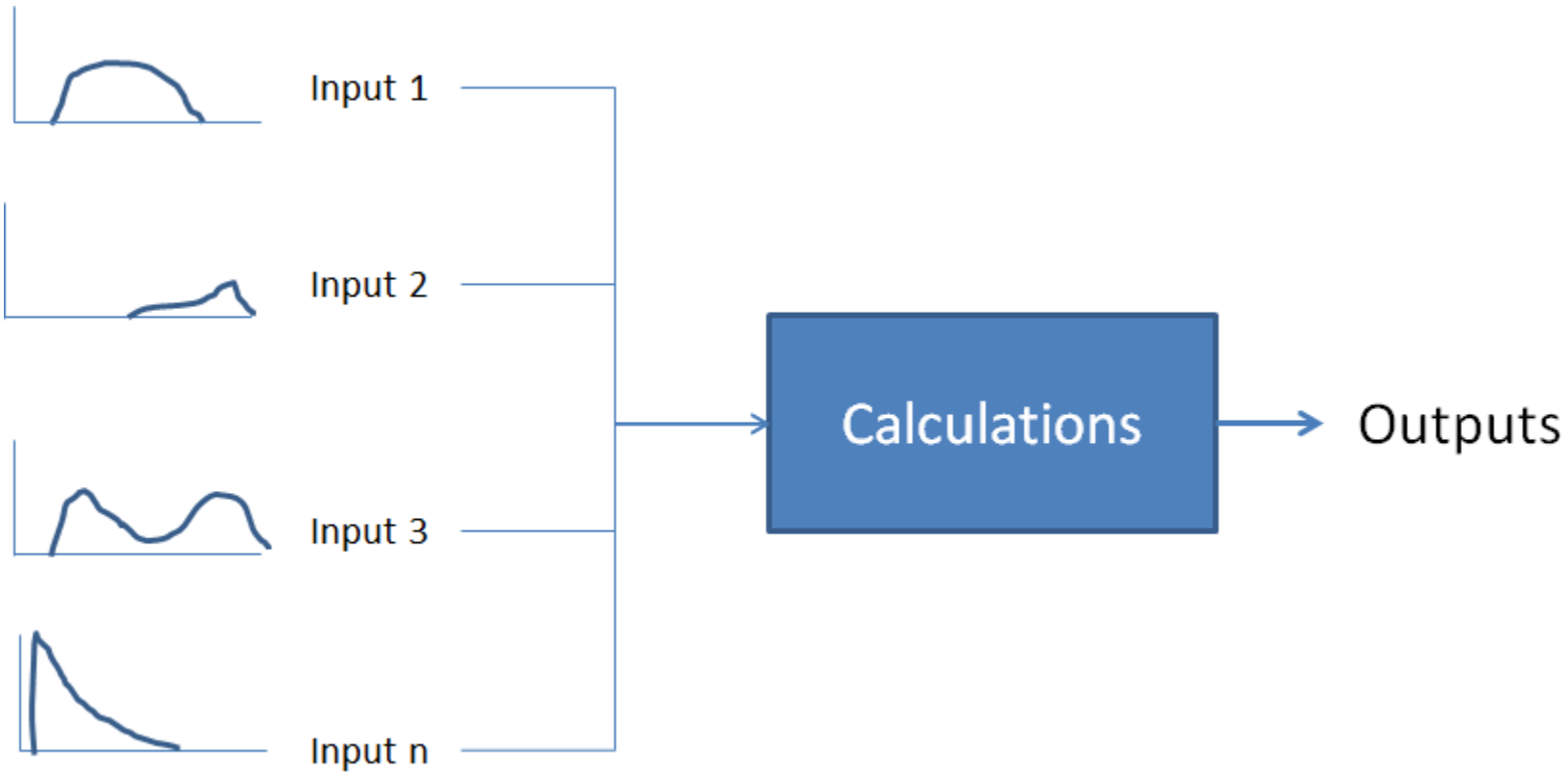
How to do it (continued)
Set the iterations to 1000
Click “Start Simulation”



Voila!


Total / Cost
15,557
23,446
5.0%
90.0%
5.0%
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Values x 10^-4
Total / Cost
Minimum 13,899.79
Maximum 26,328.91
Mean 19,100.15
Std Dev 2,412.86
Values 1000

Each input has a distribution



Repeat calculations 1,000 times

obtain inputs from distributions

Trial	Total Cost	Labor	Reagents	Supplies
1	15,125	8,578	4,165	2,381
2	20,386	12,685	5,344	2,358
3	18,825	12,745	4,061	2,019
4	17,812	10,168	5,594	2,050
5	22,887	15,754	4,769	2,363
6	18,497	11,668	4,256	2,573
7	17,962	10,822	4,484	2,655
8	17,584	11,084	4,592	1,908
9	19,706	12,833	4,694	2,179

The Question:

How can we apply this theory to a realistic laboratory scenario?

The Answer:

Create a realistic scenario.

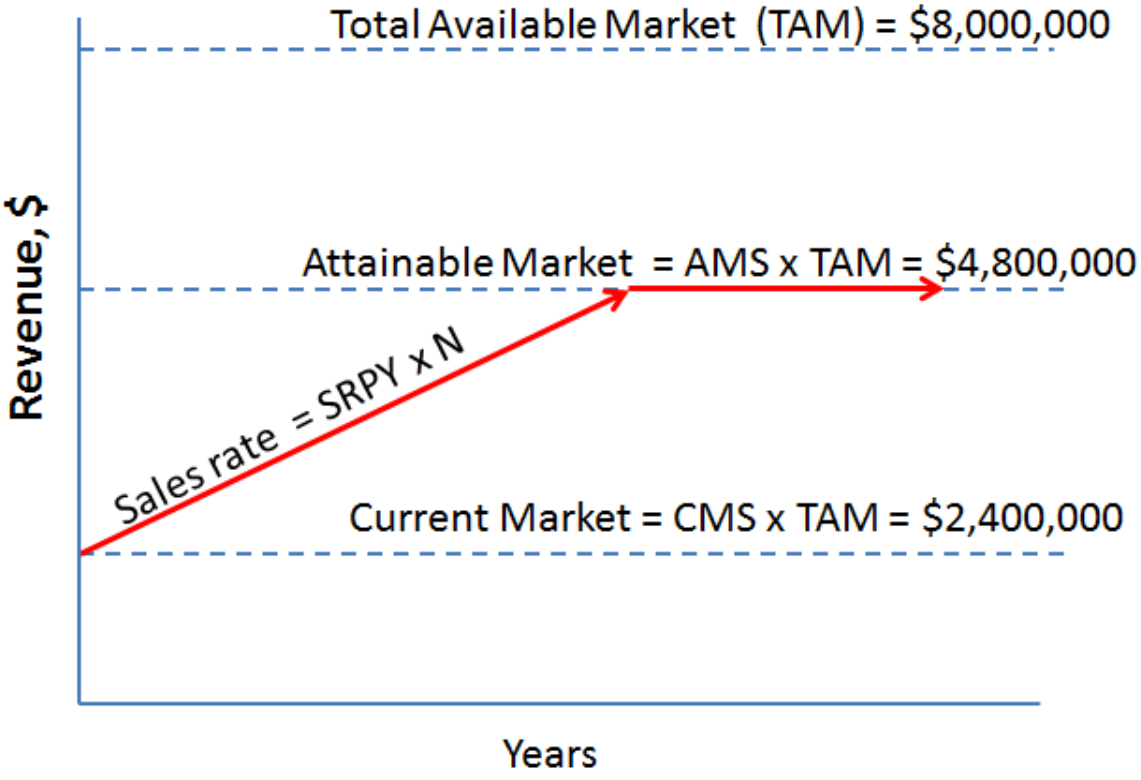
The Scenario:
Build a financial model using a sales forecast and five-year proforma to determine the rate at which the laboratory sales team will capture the attainable market

The Process:

- Define inputs for sales forecast
- Identify sources of uncertainty in sales forecast
- Develop 5-year forecast and financial projections
- Evaluate net present value
- Analyze one-way sensitivity analysis: Tornado Diagram
- Analyze two-way sensitivity analysis: Strategy Map

Sales Forecast requires five inputs

- Total Available Market (TAM)
- Attainable Market Share (AMS)
- Current Market Share (CMS)
- Sales Rate per person year (SRPY)
- Number of sales persons (N)



Sales Forecast – Sources of Uncertainty

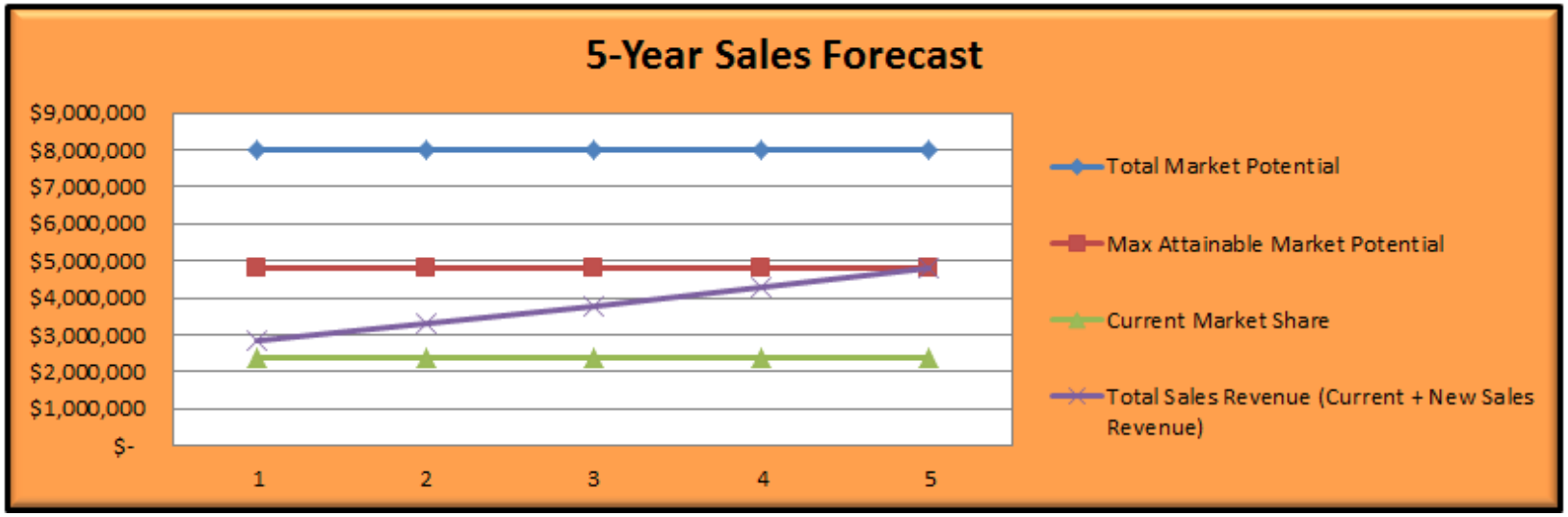
Sales Forecast Inputs	Input Value	Minimum	Most Likely	Maximum
Total Available Market (TAM)	$8,000,000	$7,000,000	$8,000,000	$9,000,000
Attainable Market Share (AMS)	60%	50%	60%	70%
Current Market Share (CMS)	30%	25%	30%	35%
Sales Rate per person year (SRPY)	$73,333	$50,000	$70,000	$100,000
Number of sales people (N)	6			
YEAR 1: Sales per year (SRPY x N)	$440,000			

Salary and Operation Inputs	Input Value	Minimum	Most Likely	Maximum
Investment Cost	$ 60,000	$ 40,000	$ 60,000	$ 80,000
Total Salary Expense/yr	$ 366,000	$ 50,000	$ 60,000	$ 73,000
Total Operating Expense/yr	$ 3,000,000	$ 1,000,000	$ 3,000,000	$ 5,000,000
Revenue Growth Rate:	5%	3%	5%	7%
Inflation Rate	3%	2%	3%	5%
Discount Rate	15%			

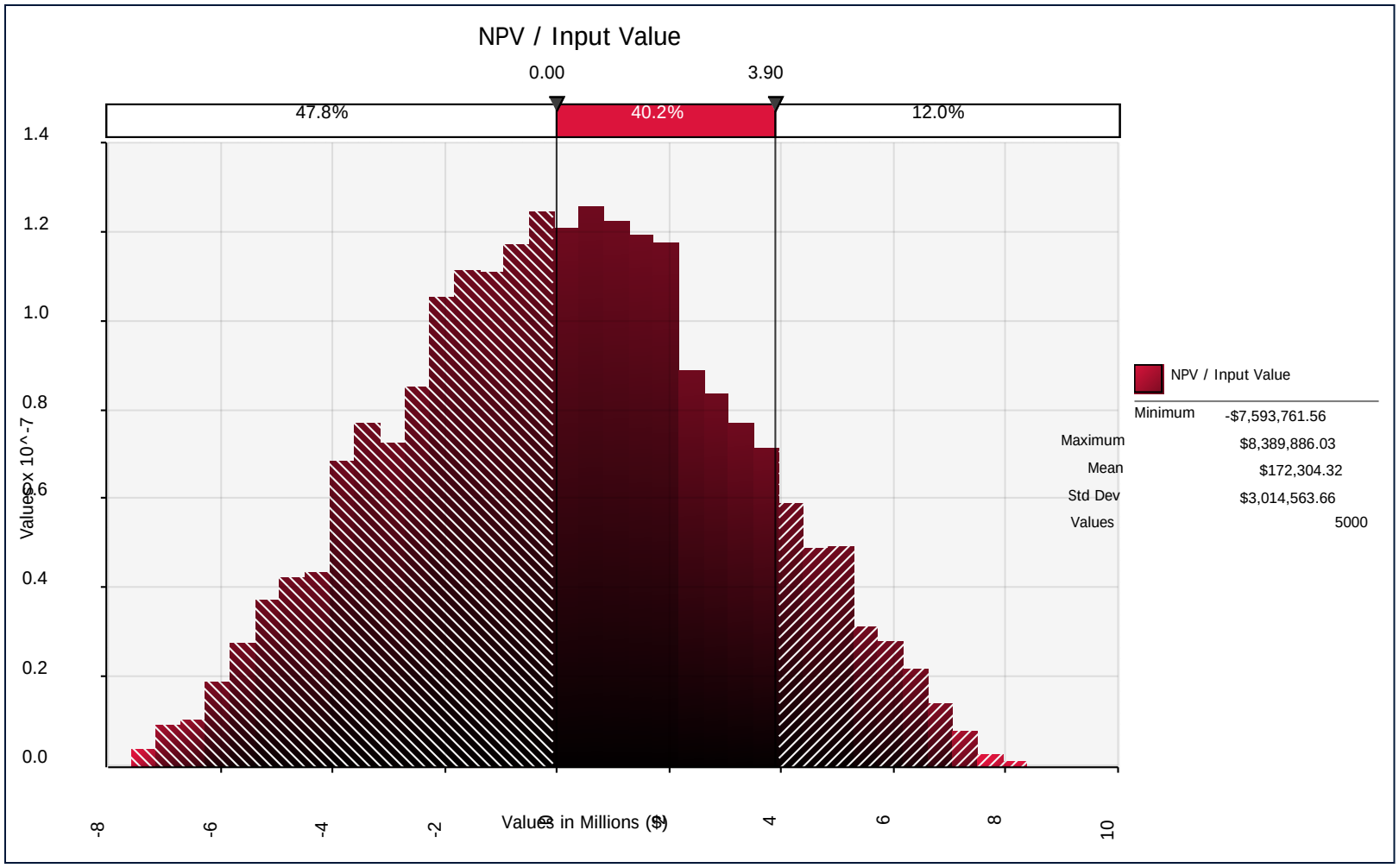
Pro-Forma Financial Statement

Estimated Financial Pro-forma							
Revenue		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Current Revenue		$ 2,400,000	$ 2,400,000	$ 2,400,000	$ 2,400,000	$ 2,400,000	
Incremental New Sales Revenue		$ 440,000	$ 902,000	$ 1,387,100	$ 1,896,455	$ 2,400,000	
Total Sales Revenue (Current + New Sales Revenue)		$ 2,840,000	$ 3,302,000	$ 3,787,100	$ 4,296,455	$ 4,800,000	$19,025,555
Expenses		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Initial Investment	$ (60,000)	-	-	-	-	-	($60,000)
Total Salary Expense		$ 366,000	$378,200	$390,807	$403,834	$417,295	$1,956,135
Total Operating Expense		$ 3,000,000	$3,100,000	$3,203,333	$3,310,111	$3,420,448	$16,033,893
Total Expenses	$ (60,000)	$3,366,000	$3,478,200	$3,594,140	$3,713,945	$3,837,743	$17,930,027
Cash Flow	$ (60,000)	($526,000)	($176,200)	$192,960	$582,510	$962,257	$975,528

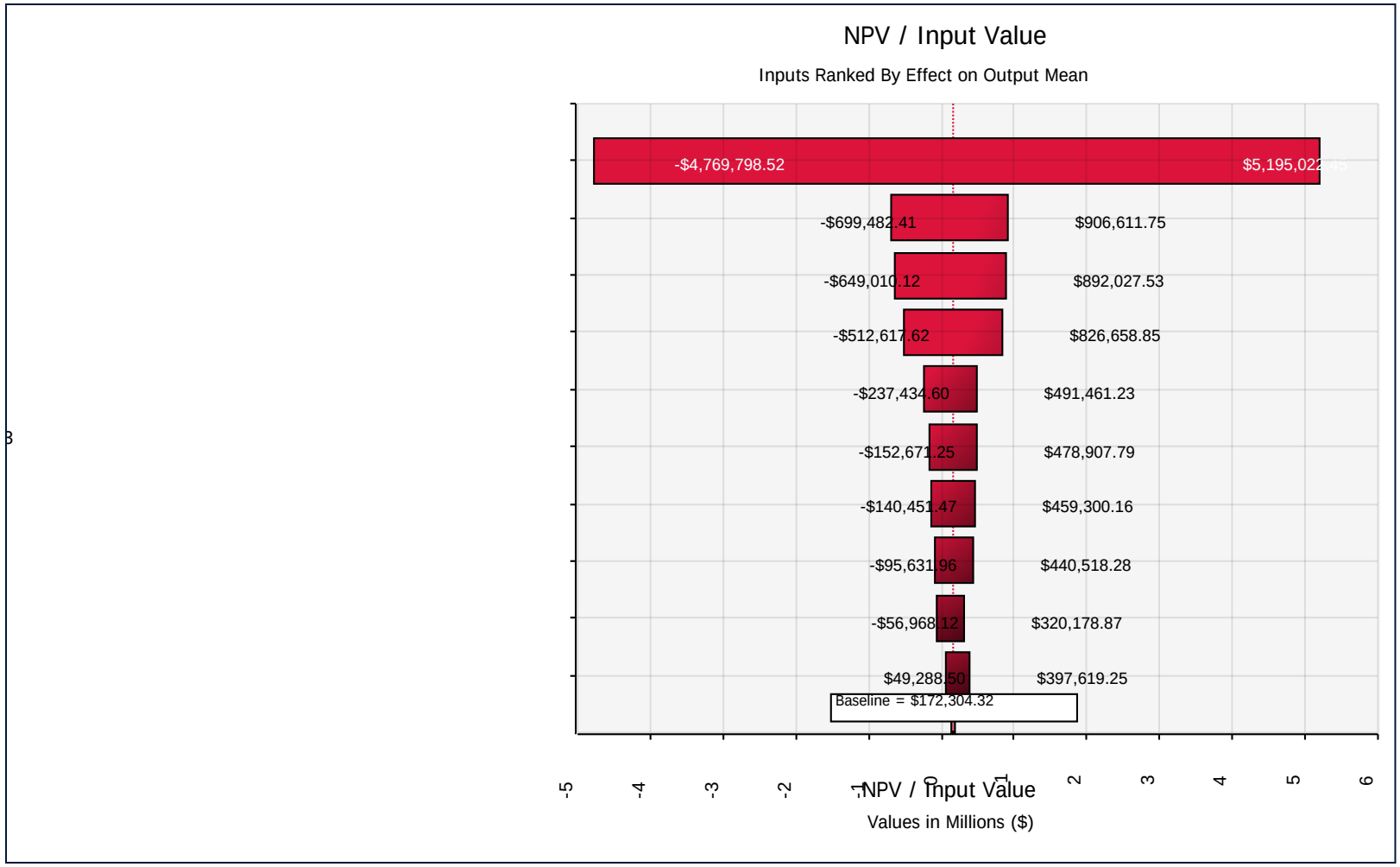
Return Analysis	
Discount Rate	15%
NPV	$287,715



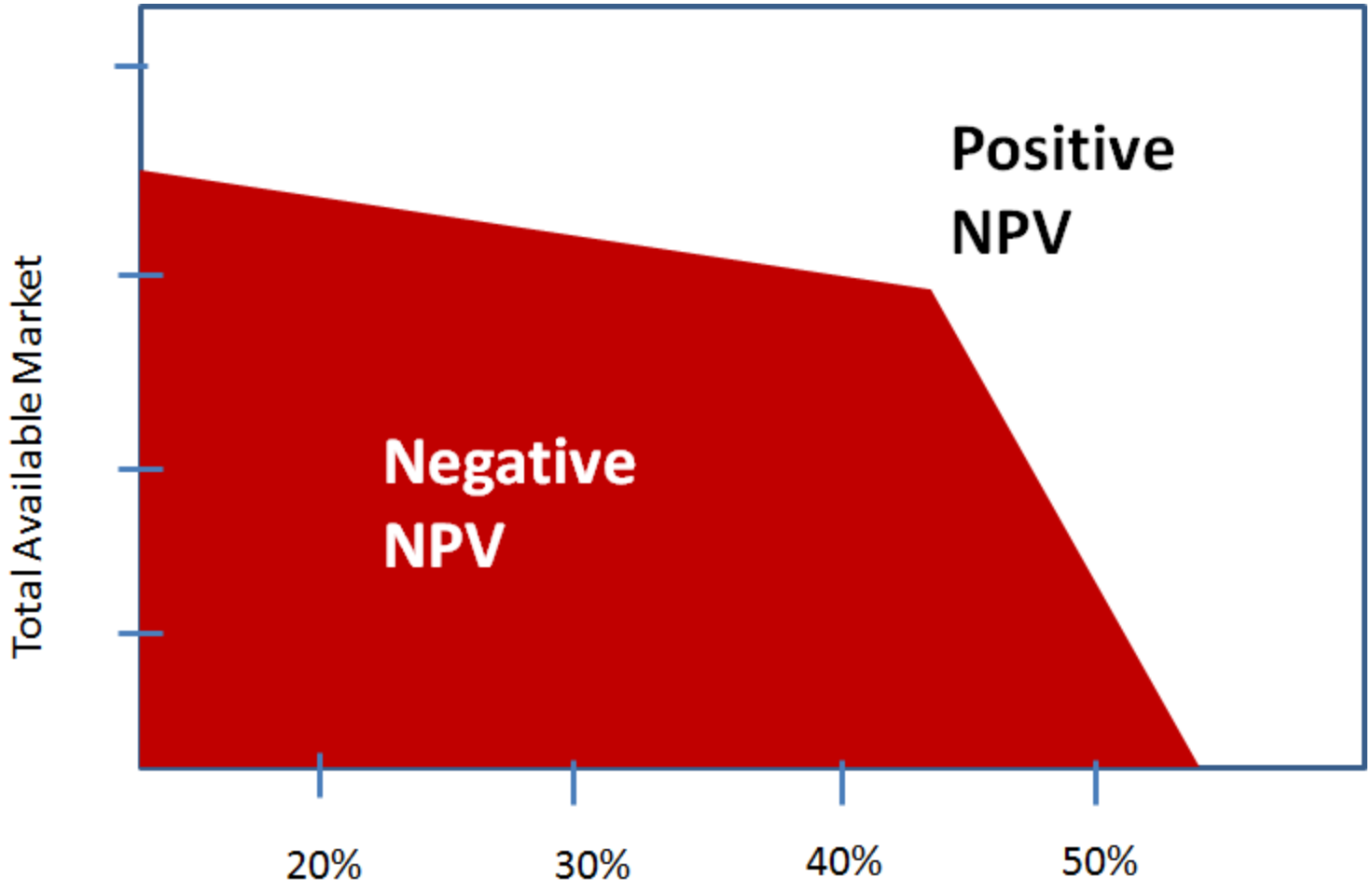
Estimated Net Present Value



Tornado Diagram
(One-Way Sensitivity Analysis)

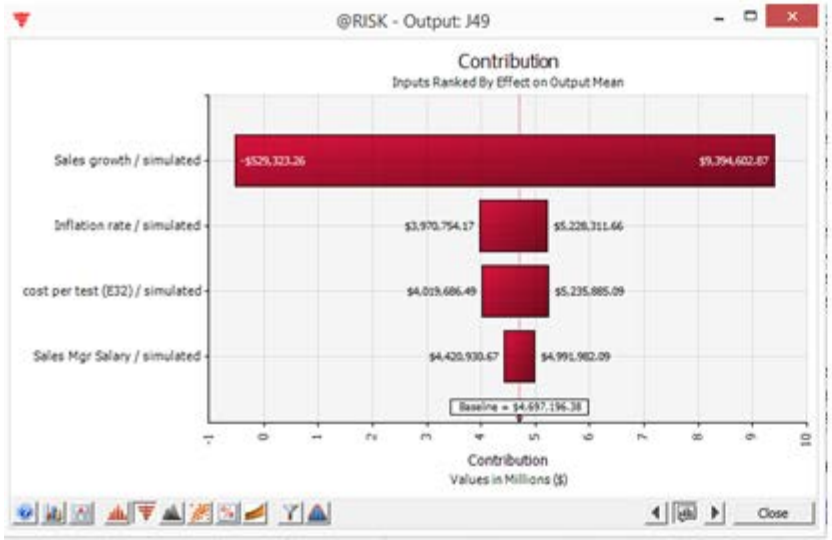


Strategy Map
(Two Way Sensitivity Analysis)

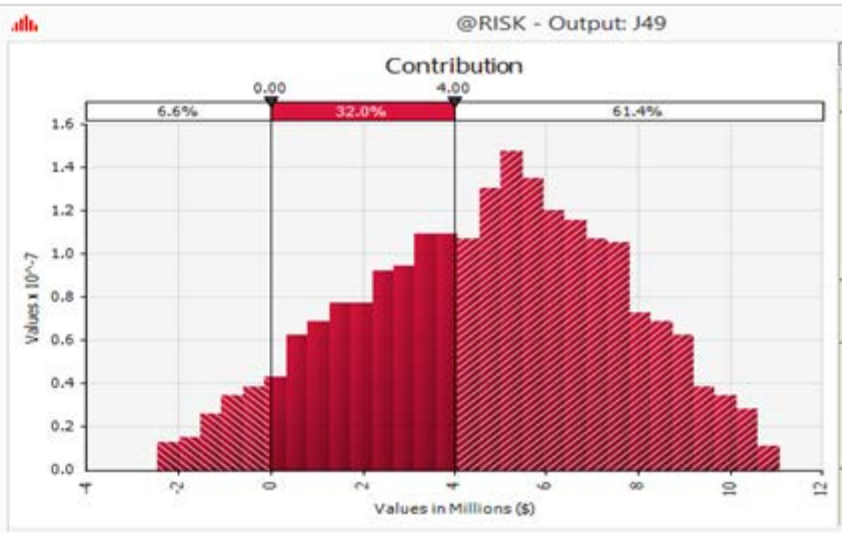


Value of Information

Tornado Diagram



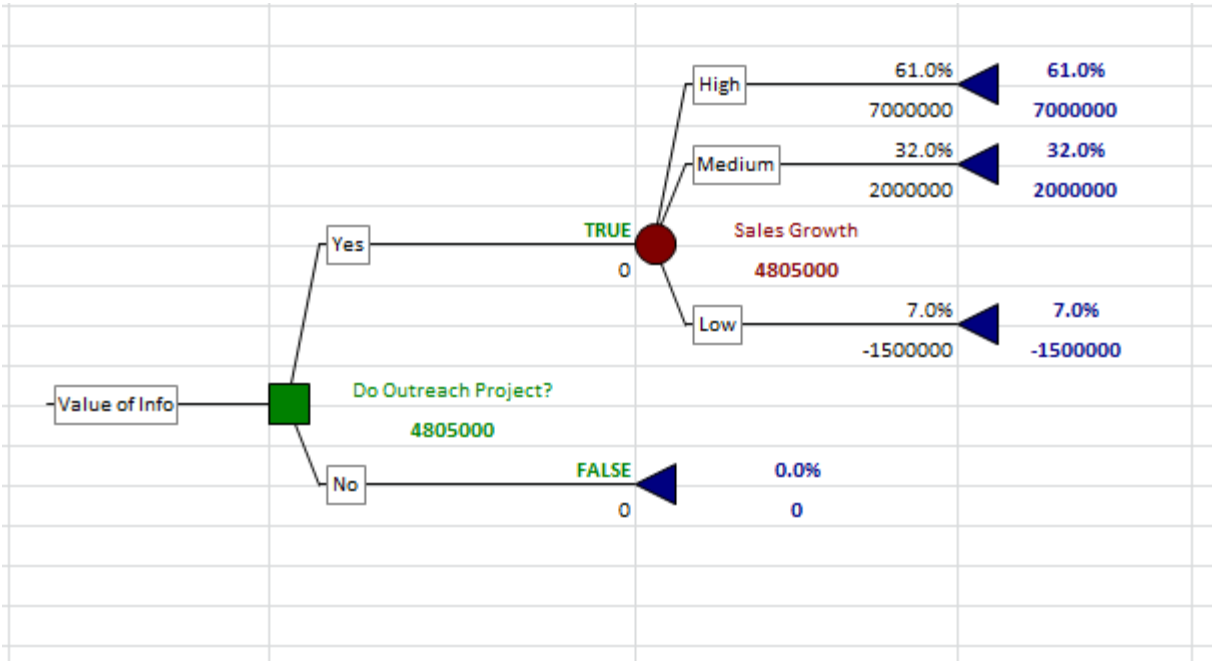
Profit Distribution



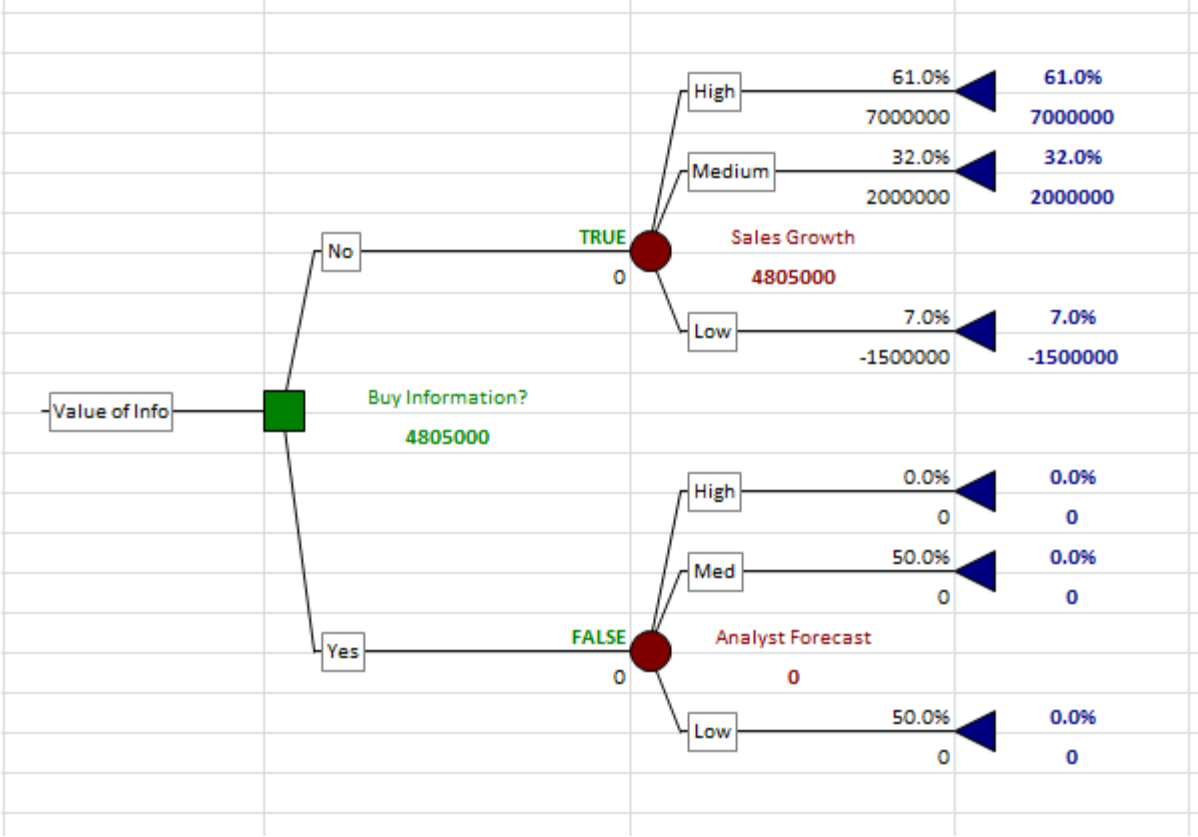
Uncertainty in Sales Forecast

- Driven by Uncertainty in sales
- Market Research reduces uncertainty
- How to evaluate?

Decision Scenario



Value of Information



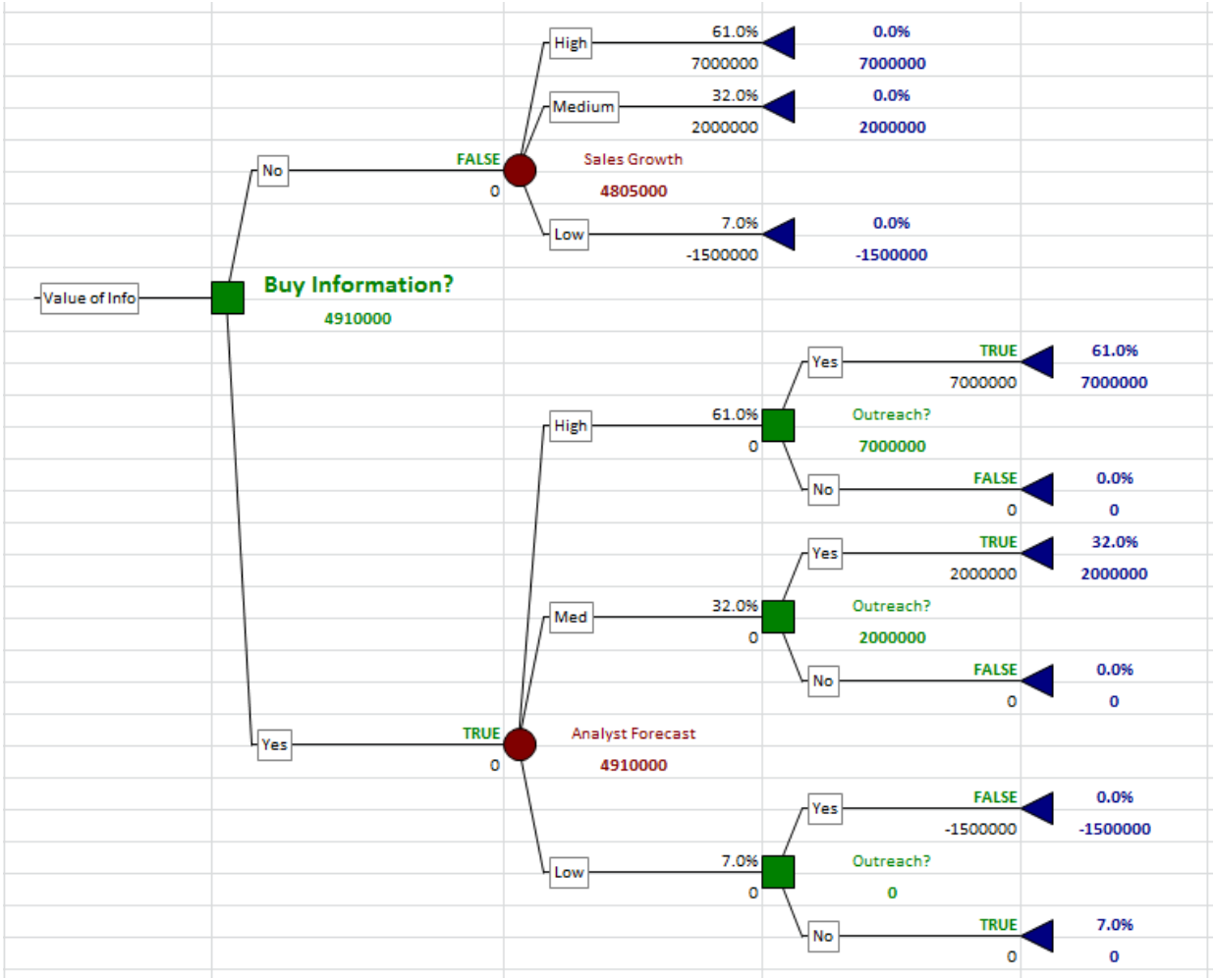
Value of Information

Analyst 1

Analyst 2 (well connected)

Value of Perfect Information

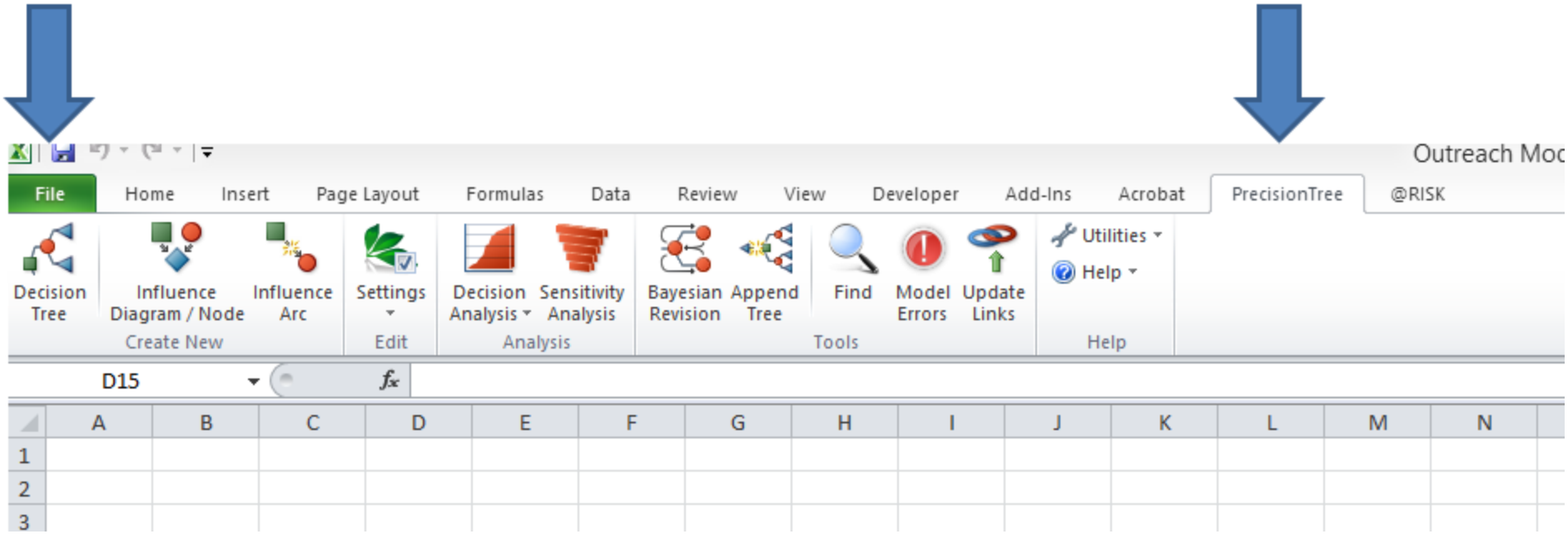
What is the most you would pay Analyst 2?



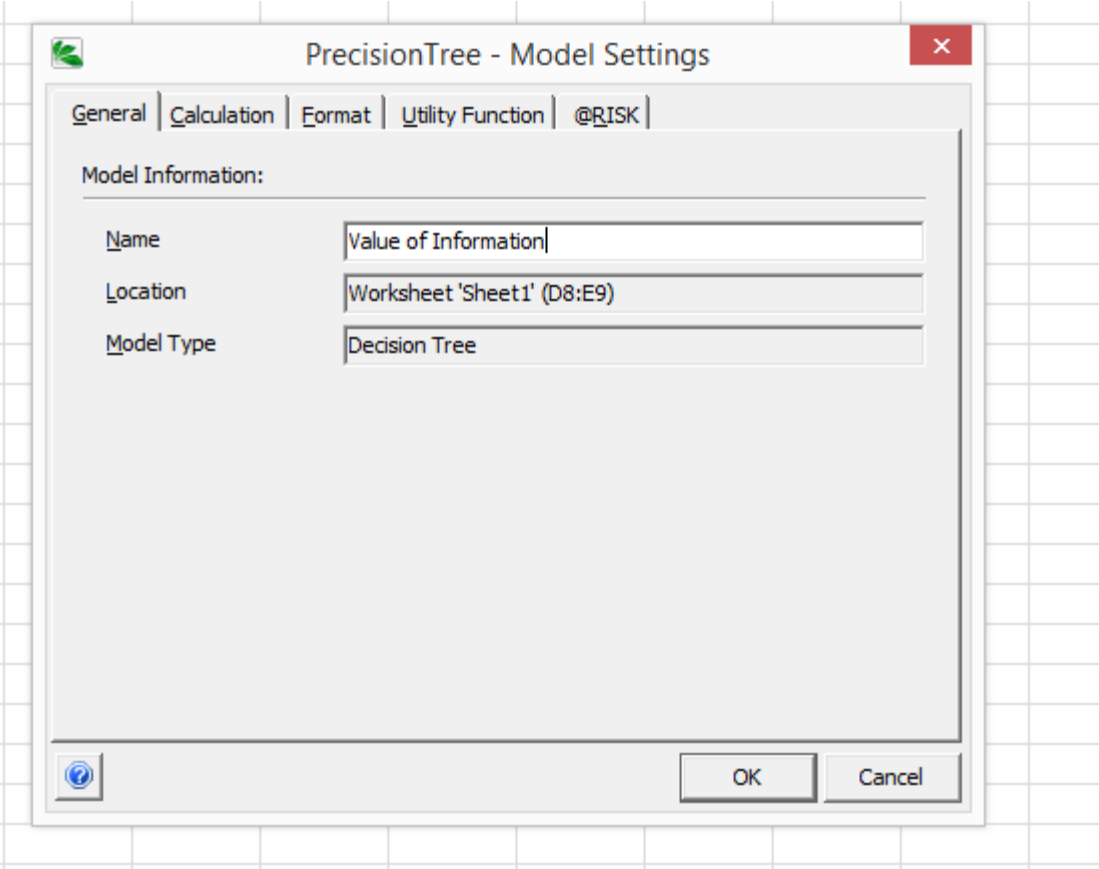
Value of Perfect Info = 4,910,000 – 4805000 = 105,000

How to build a decision tree

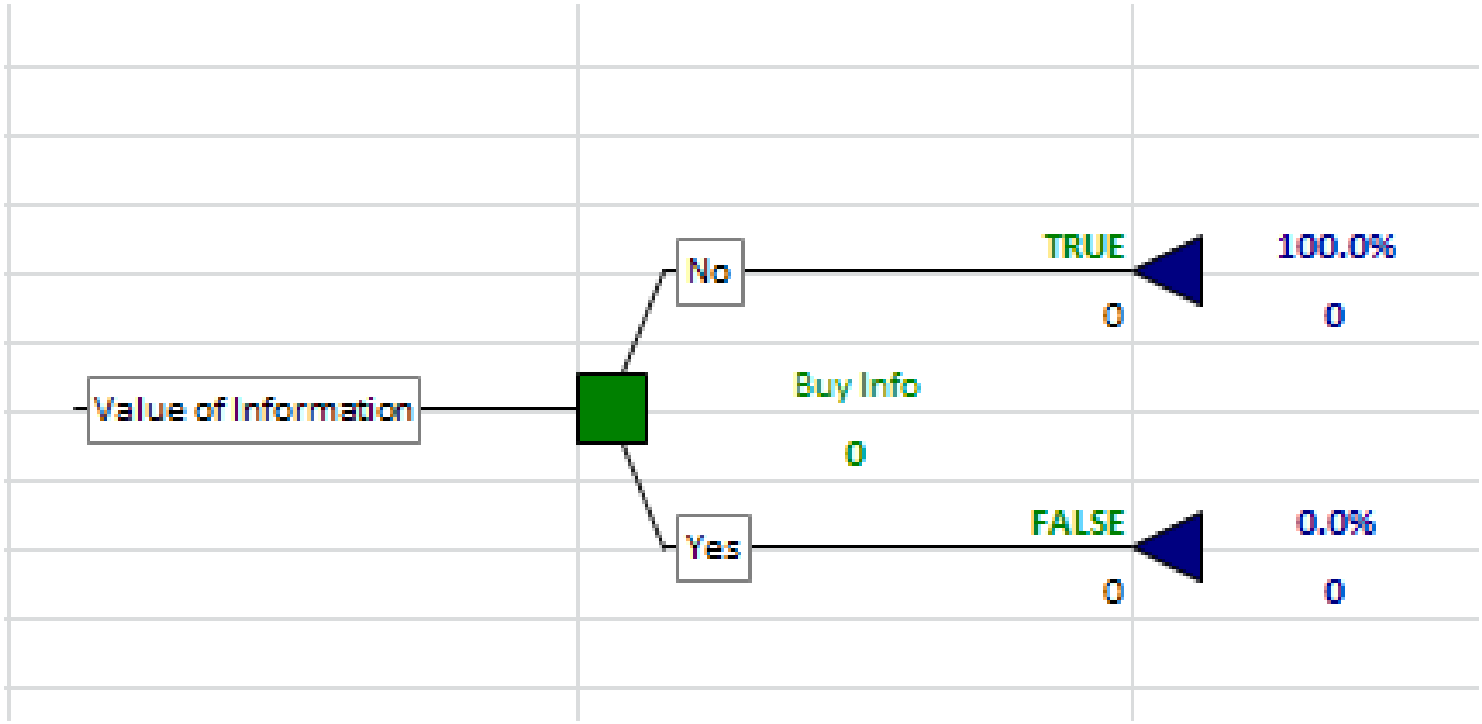
- Open Decision Tree Example
- Open Precision Tree
- Click on any cell
- Click on Decision Tree
- Click OK



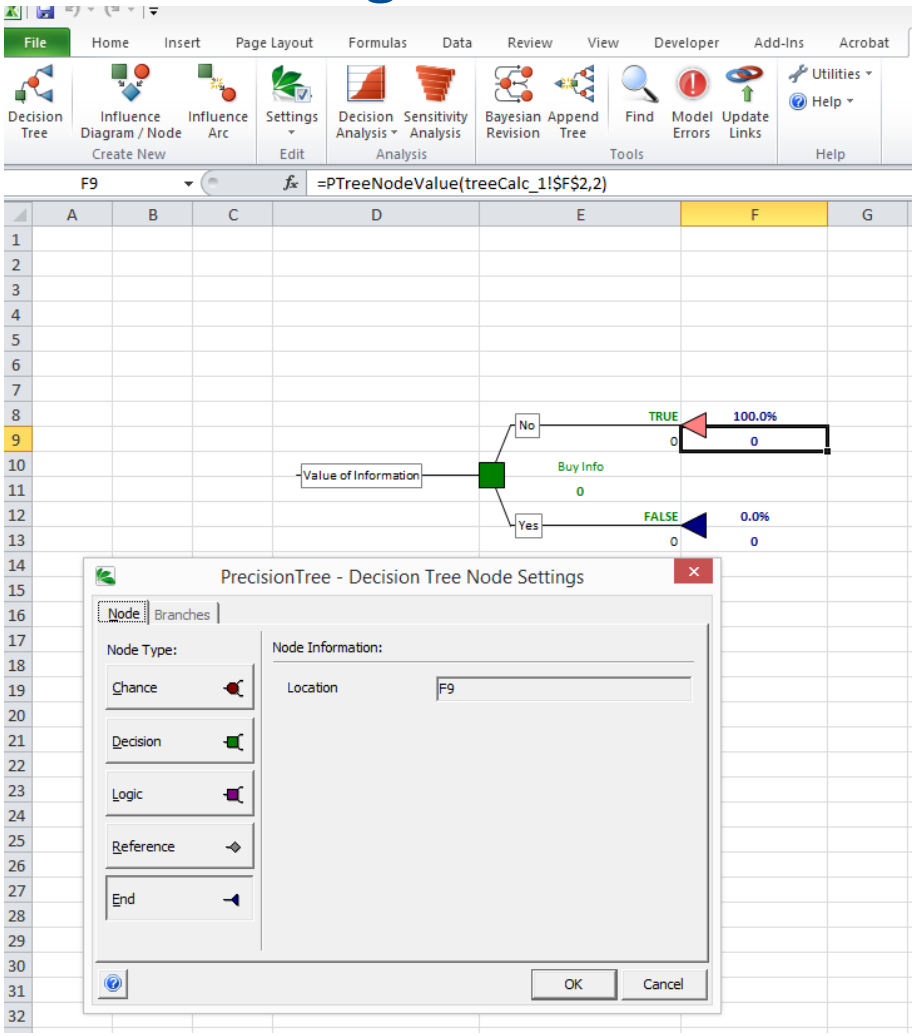
Give the tree a name
Click OK



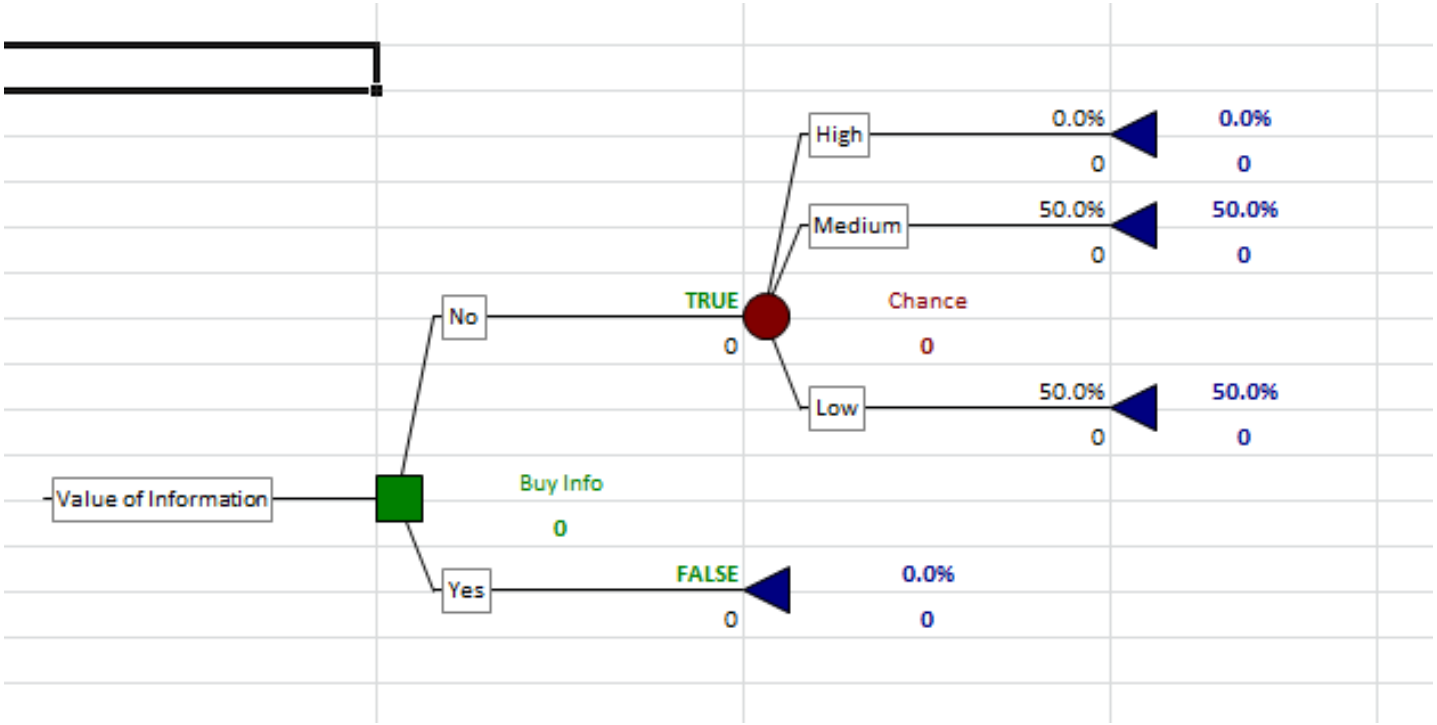
Name the Decision “Buy Info”
Name the branches yes and no



Right click on upper terminal node
Click “node settings”
Change to chance



Right Click chance node
Add branch
Rename branches high medium low



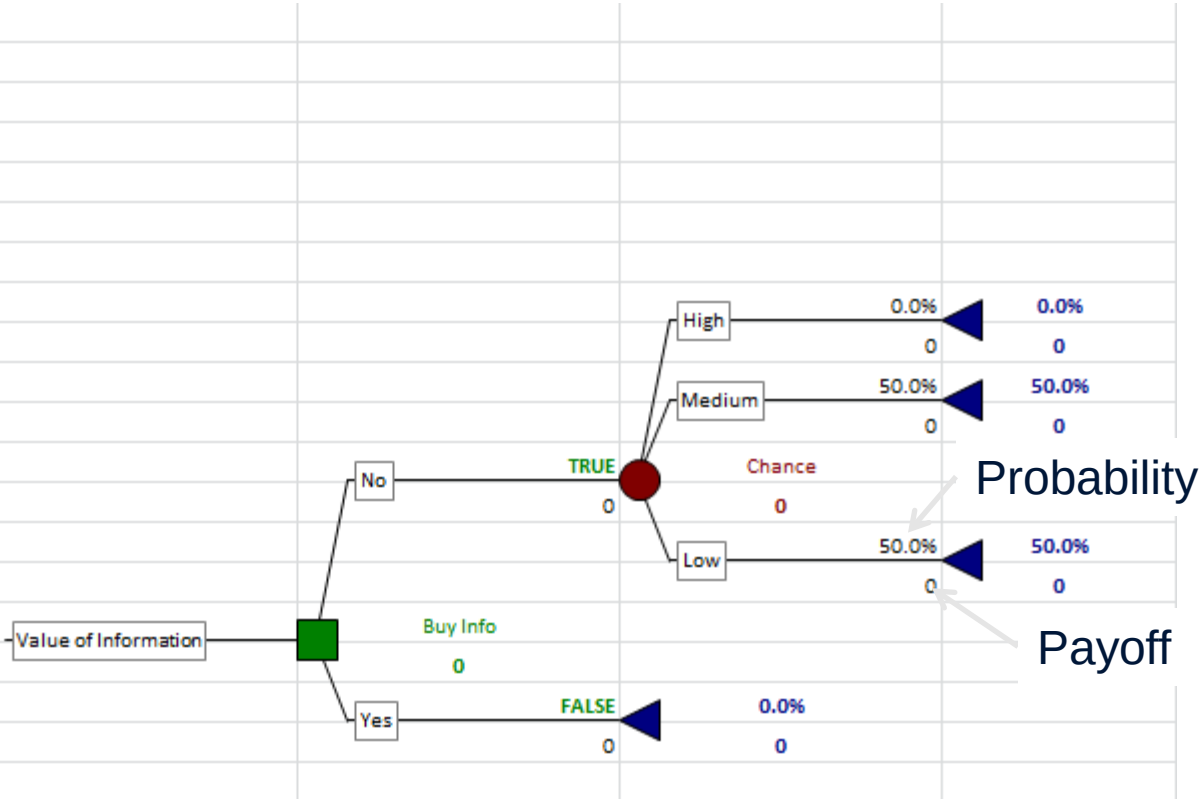
Link to the probabilities and payoffs

probabilities above the line

payoffs below

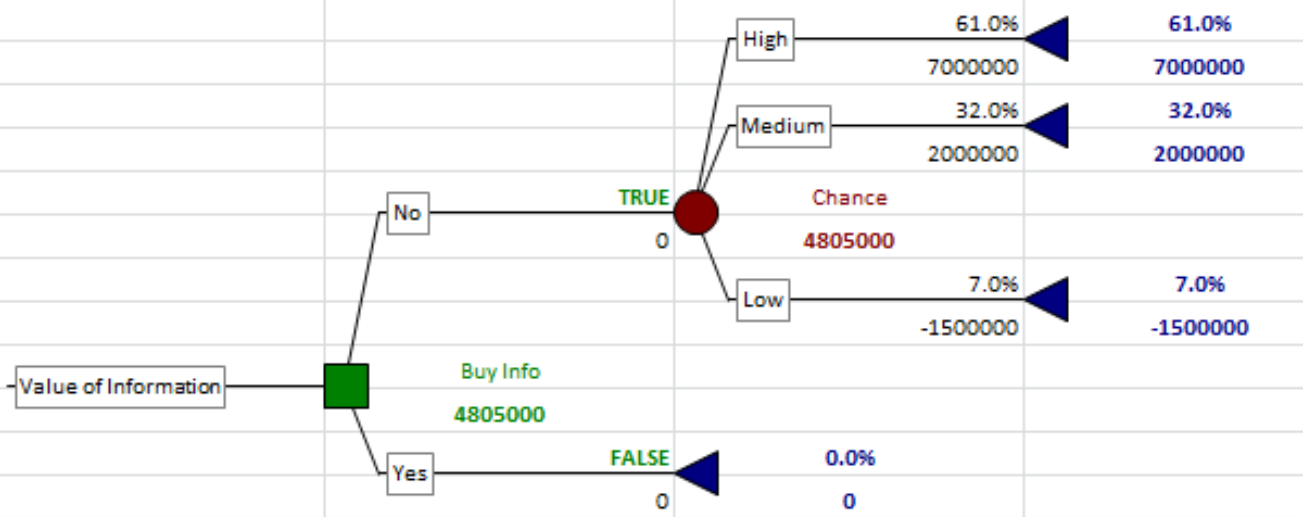
Use absolute references (click F4)

	Prob	Payoff
High	61	7000000
Medium	32	2000000
Low	7	-150000

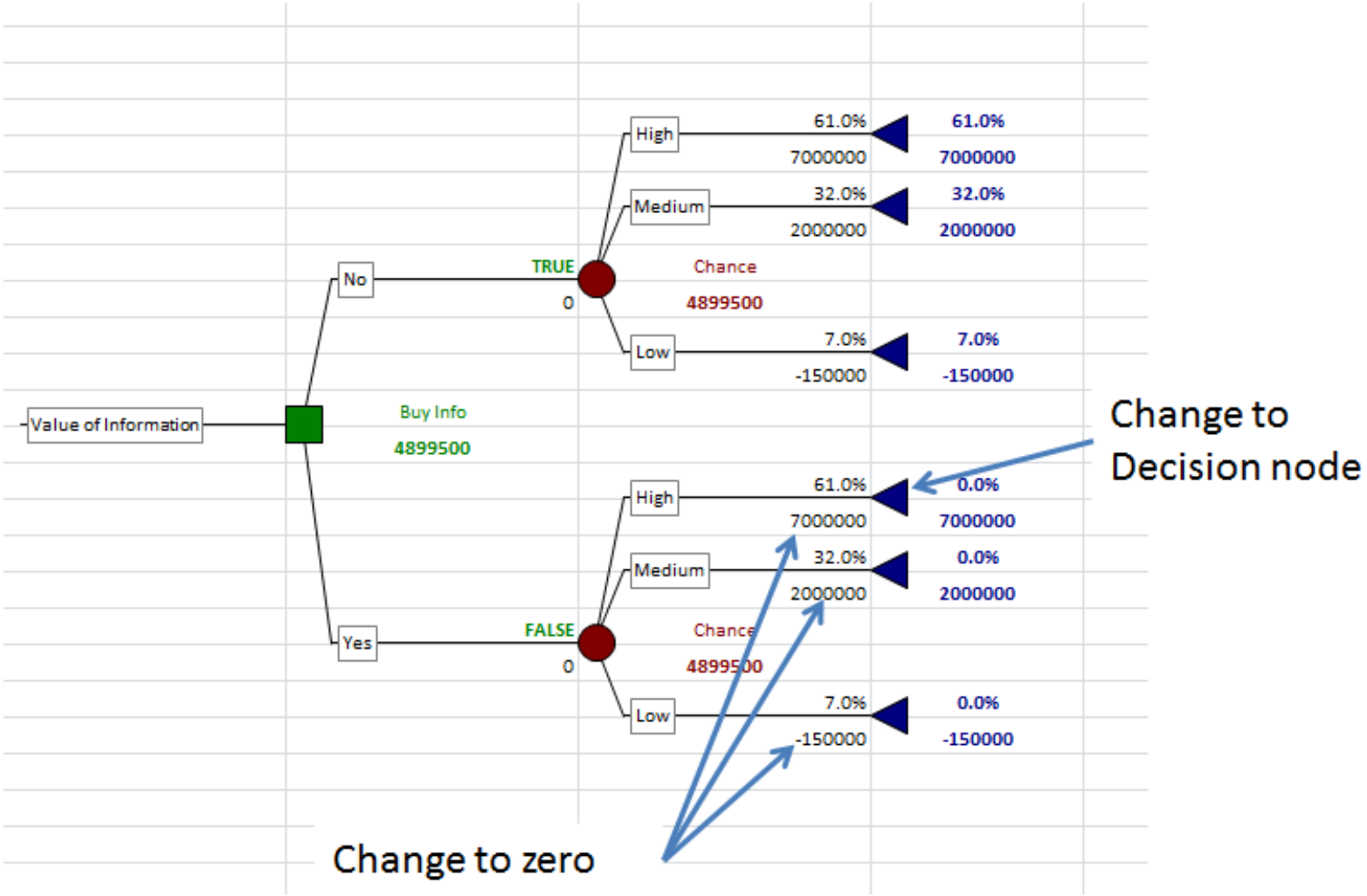


Right click on the chance node
Copy Subtree
Right click on end node of “Yes” Branch
Paste subtree

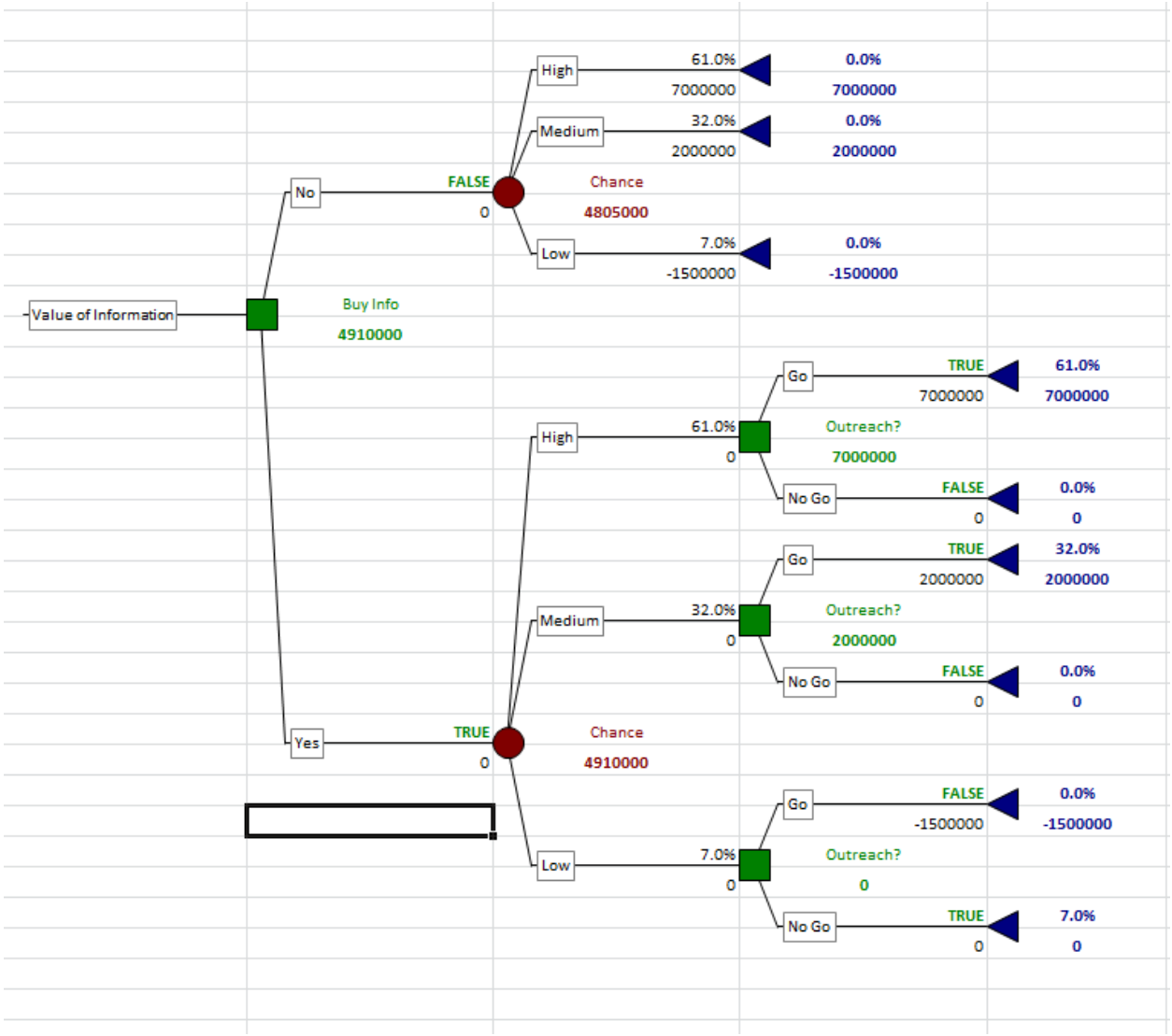
	Prob	Payoff
High	0.61	7000000
Medium	0.32	2000000
Low	0.07	-1500000



Change the payoffs on the lower subtree to zero change each end node on the lower subtree to a “go vs no go” decision



Voila!


Value of Information
Buy Info
4910000
No
FALSE
0
High
61.0%
7000000
0.0%
7000000
Medium
32.0%
2000000
0.0%
2000000
Chance
4805000
Low
7.0%
-1500000
0.0%
-1500000
Yes
TRUE
0
Chance
4910000
High
61.0%
0
Outreach?
7000000
Go
TRUE
7000000
61.0%
7000000
No Go
FALSE
0
0.0%
0
Medium
32.0%
0
Outreach?
2000000
Go
TRUE
2000000
32.0%
2000000
No Go
FALSE
0
0.0%
0
Low
7.0%
0
Outreach?
0
Go
FALSE
-1500000
0.0%
-1500000
No Go
TRUE
0
7.0%
0

Predicting the Impact of the FDA ruling on LDTs

Test Category	Risk	Approval	Approval Cost
1	Low	none	0
2	Medium	510k	50-250k
3	High	PAM	2.5-5.0M

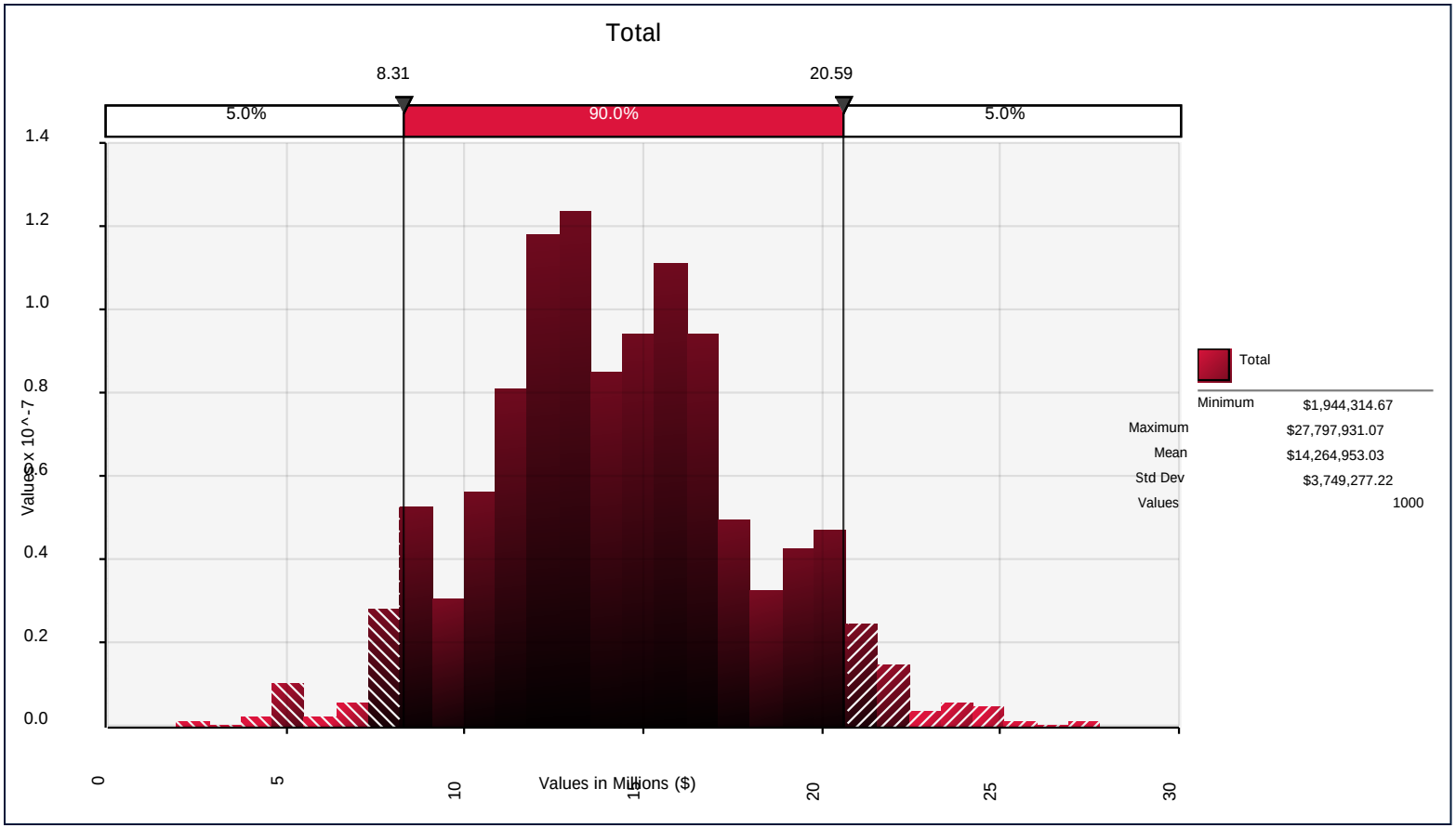
Classification Probability

Test	Class 1	Class 2	Class 3
1	90	10	
2		50	50
3		90	10
4	80	20	
.....			
100		10	90

Cost of Approval Process

	Minimum	Most Likely	Maximum
Class 1	0	0	0
Class 2	50,000	150,000	250,000
Class 3	2,000,000	3,500,000	5,000,000

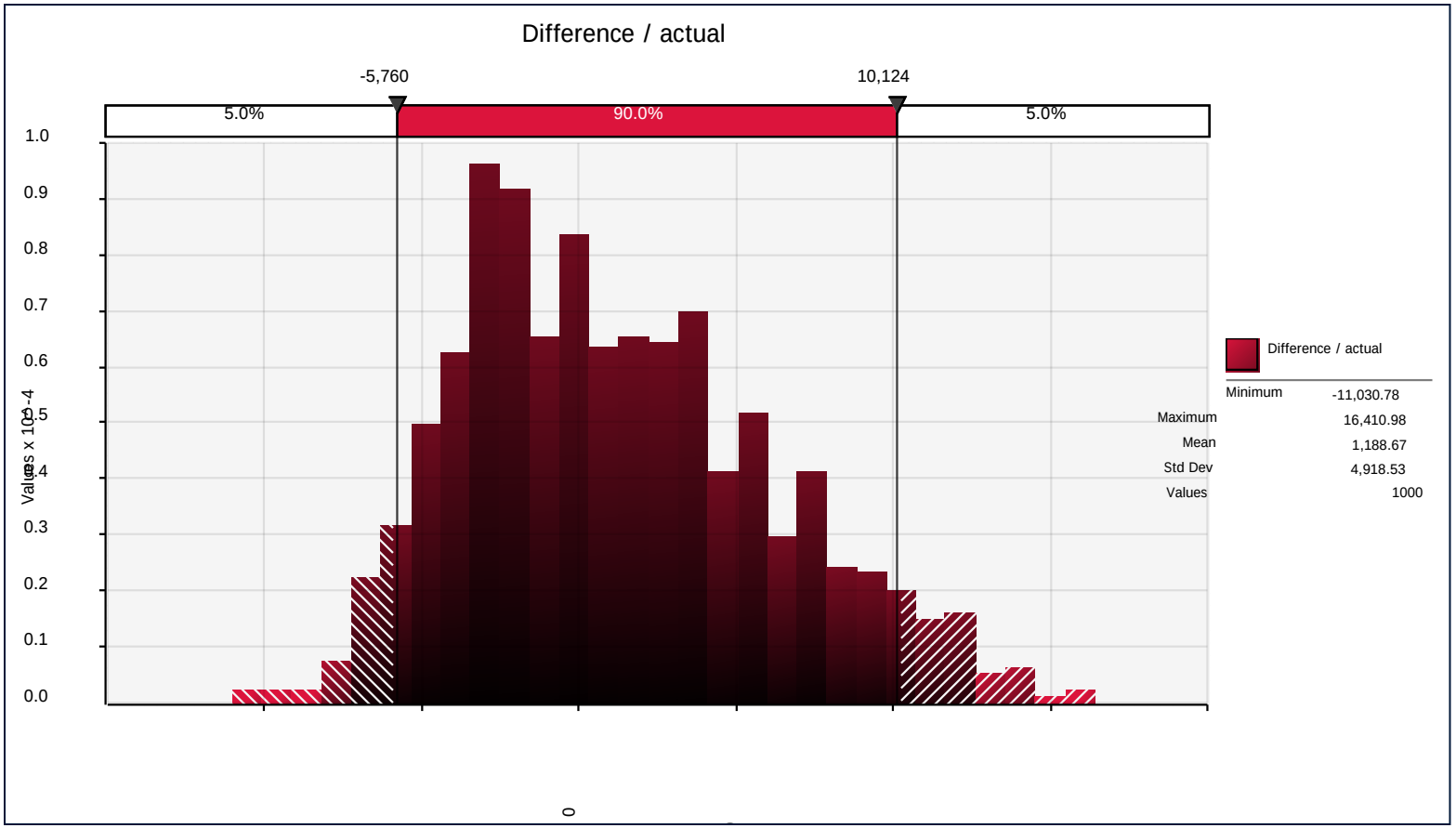
Distribution of Approval Cost



Should we perform this test in-house?

	actual	min	likely	max
demand	1833	1000	1500	3000
price	34	32	34	36
send out cost	30	29	30	32
reagent cost	20	19	20	22
QC volume	843	730	800	1000
Revenue	62,333			
In House Cost	54,426			
Send Out Cost	55,611			
In House Profit	7,908			
Send Out Profit	6,722			
Difference	1,186			

Difference (In-house vs send-out)



Quick Review

- Financial Modeling
  - Risk Analysis
    - Uncertainty in inputs
    - Uncertainty in outputs
  - Identify Risk Drivers
  - Value of Information

Is it worth the trouble?

- Easy to do
- Gain insight
  - Focus on the important stuff
  - Ignore the trivia
- Manage Risk
  - Identify weak spots
  - Develop options
- Increase Value

Sources for Simulation Software

- Crystal Ball (Oracle)
- @Risk (Palisade)
- Risk Solver Pro (Frontline Systems)
- Many others

Discussion:
Where can this be applied?

What problems would you like to see solved?

Summary

- Financial Modeling Adds Value
  - Can be applied to many problems
  - Simple tools are available
- We would like to know:
  - What risky decisions do you make?

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