

## **Project Plan - Completion and Requirements**

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### **Today**

- Review of Spreadsheet Use (But See WWW Site!)
- Review of MAU Assessment
- Recap of Project

### **Thursday**

- Utility Assessments - By Group (see WWW site)
- By Appointment During Class Sessions

### **Next Tuesday**

- Workshop - Preliminary Analysis Results and Proposed Strategy
- Working Session

### **Next Thursday**

- Final Presentations By Groups

### **Next Friday**

- Final Individual Reports Due

## **Final Project**

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**Problem:** Business Plan/Project Viability

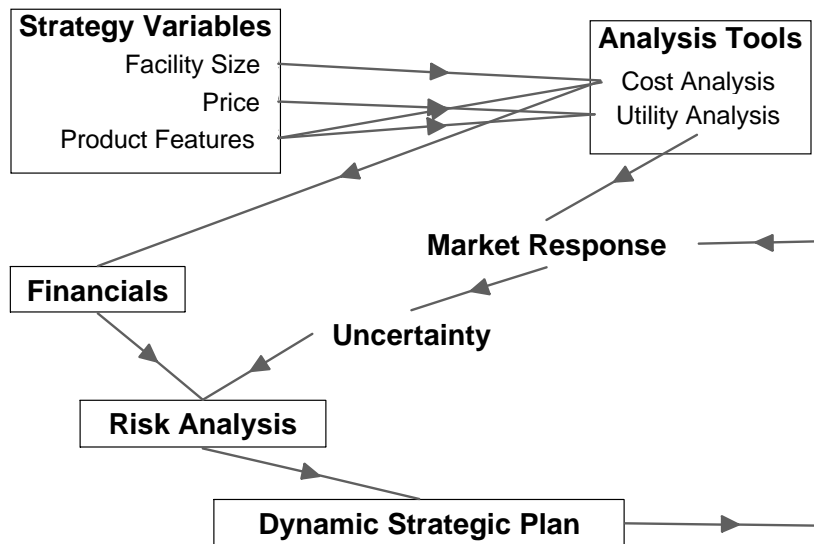
**Complications:** Developing Technology  
Uncertain Market  
Existing Competitive Product (?)

**Opportunities:** Product Cost & Performance Tailoring  
Potential Performance Advantages

**Goals:** Gain Market Share  
Make Money

**Available Tools:** Technical Cost Model  
Utility Analysis  
Risk Analysis  
Financial Analysis

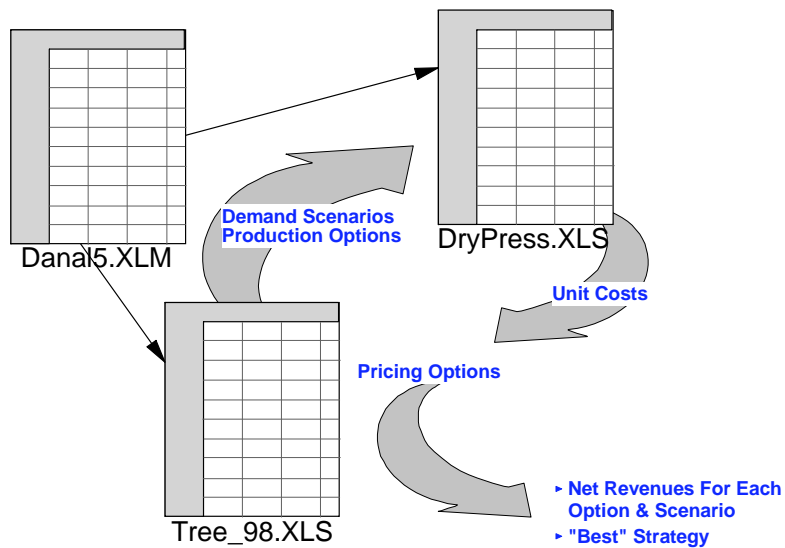
## Overview



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## Tools On Hand



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## DRYPRESS.XLS - Ceramic Processing Model

- Technology For Producing Alumina Parts
- Key Parameters Given In Case Writeup
  - Mass
  - Material
- Strategic Parameters
  - Plant Size - Production Capacity
  - Part Performance - MTBF
  - Selling Price
- Uncertain Parameters
  - Annual Production

## DRYPRESS Model Inputs (in blue)

	BO	BP	BQ	BR	BS	BT
5	By FRField, 1991					
6	*****					
7	<b>NOTE:</b> The parameters upon which we want you to focus your efforts					
8	are presented below. You will find that there are a large number					
9	of parameters in this model, but most of them are outside of					
10	scope of this case study.					
11	*****					
12	<b>INPUTS</b>					
13		Total Plant Capacity	5,000,000	parts/year		
14		Annual Part Production	5,000,000	parts/year		
15		Operating Days/Year	230	days		
16		Part Material	0	(0- Al2O3;1-Si3N4)		
17		Current Material Price	\$8.00	\$/lb		
18		Material Price Override	\$0.00	\$/lb (0-no o.ride)		
19		Part Weight	0.018	lbs		
20		Number of Shifts	2			
21		Part MTBF (relative to steel)	0.80	(1 = steel)		
22		Years To Recover Investment	10	years		
23		Opportunity Cost of Capital	12.0%	/year		
24		Dedicated/Non-Dedicated Production	0	(0-ded;1-not ded)		
25		Cost of Labor	\$22.00	\$/hr incl benefits		
26	*****					
27	<b>MODEL OUTPUTS</b>					

## DRYPRESS Model Outputs (1)

A	BO	BP	BQ	BR	BS	BT
29	<b>CAPITAL</b>					
30		Materials Preparation	\$50,364			
31		Spray Drying	\$0			
32		Isopressing	\$123,500			
33		Green Machining	\$283,152			
34		Drying	\$52,780			
35		Firing	\$342,820			
36		Finishing	\$625,564			
37		Inspection	\$82,174			
38						
39		<b>Total Cost of Facilities</b>	<b>\$1,560,355</b>			
40						
41	<b>YIELDS</b>	Materials Preparation	99.0%			
42		Spray Drying	100.0%			
43		Isopressing	98.0%			
44		Green Machining	89.0%			
45		Drying	100.0%			
46		Firing	100.0%			
47		Finishing	99.0%			
48		Inspection	97.0%			
49						
50		<b>Total Yield</b>	<b>82.9%</b>			

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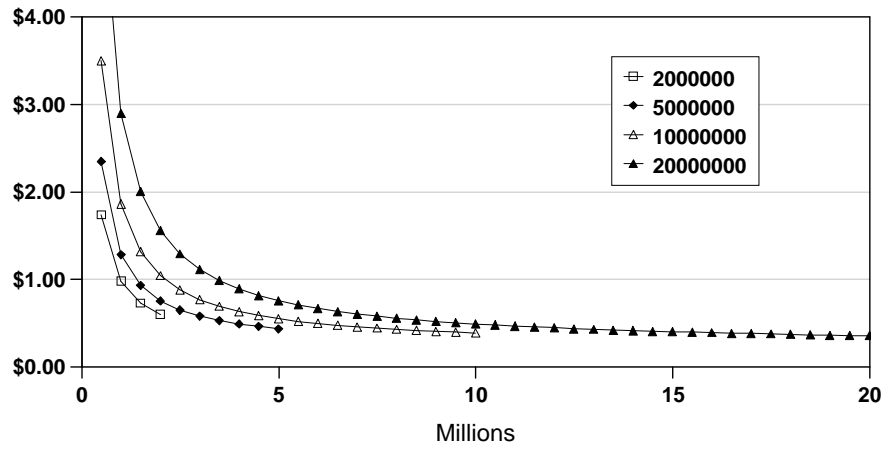
## DRYPRESS Model Outputs (2)

A	BO	BP	BQ	BR	BS	BT
52	<b>COSTS BY OPERATION</b>		<b>\$/piece</b>	<b>% of total</b>		
53						
54		Material	\$0.1748	39.7%		
55		Spray Drying	\$0.0000	0.0%		
56		Isopress	\$0.0296	6.7%		
57		Green Mach	\$0.0342	7.7%		
58		Drying	\$0.0028	0.6%		
59		Firing	\$0.0342	7.8%		
60		Finishing	\$0.1440	32.7%		
61		Inspection	\$0.0212	4.8%		
62						
63		<b>Total Cost</b>	<b>\$0.4408</b>	<b>100.0%</b>		
64						
65	<b>COSTS BY FACTORS</b>					
66						
67		Materials	\$0.2282	51.8%		
68		Energy	\$0.0062	1.4%		
69		Labor	\$0.1229	27.9%		
70		Capital	\$0.0571	12.9%		
71		Other	\$0.0264	6.0%		
72						
73		<b>Total Cost</b>	<b>\$0.4408</b>	<b>100.0%</b>		

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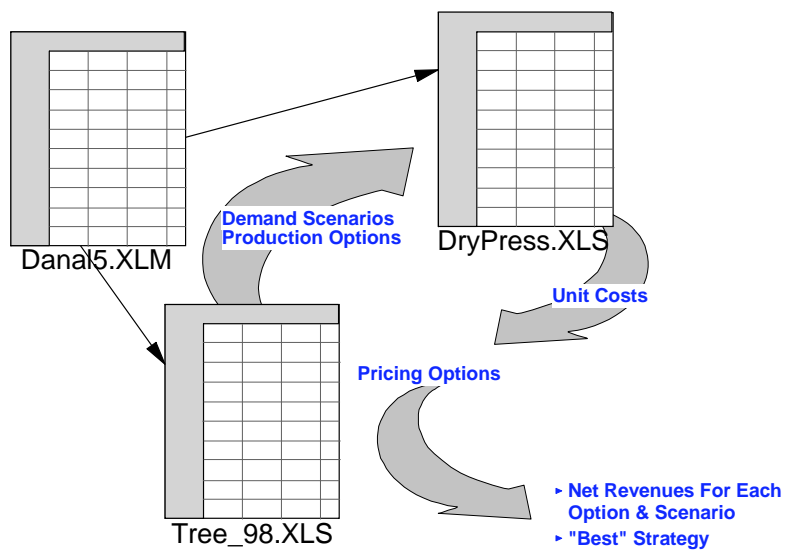
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## Cost/Production Relationships



Note efficiencies of scale as well as capacity utilization

## Tools On Hand



## Setting Demand Scenario Probabilities - TREE 98

- Two Prices To Offer Product
  - High & Low
- Demand Will Be Effected
  - High, Medium & Low
- Relationship Is Probabilistic
  - Specify It In Spadsheet
- Implicit Elasticities of Demand
  - Calculated to Test You Inputs

TREE_98.XLS						
<b>Probabilities</b>						
Enter the probabilities for low, medium and high growth in the first period for price1 and price 2						
		Prob P1	Prob P2		Expected Demand at prices	
					P1	7965900
	low	20.00%	50.00%		P2	7089990
	medium	30.00%	30.00%			
	high	50.00%	20.00%	elasticity of demand ~		-1.358959604
At the end of the first period, you will know the growth rate in the first period. Given that, specify the probabilities for low, med, and high growth in the second period for each of the possible first period growth rates.						
Growth in period 1	low	low	medium	medium	high	high
period 2	Prob P1	Prob P2	Prob P1	Prob P2	Prob P1	Prob P2
low	10.00%	70.00%	10.00%	60.00%	50.00%	20.00%
medium	20.00%	20.00%	30.00%	30.00%	30.00%	30.00%
high	70.00%	10.00%	60.00%	10.00%	20.00%	50.00%
Expected Demand at Prices			Approximate elasticities of demand			
	P1	P2				
Per1-low	18353145	11805351			-6.40	
Per1-med	17552710	11929548			-5.19	
Per1-high	13054181	16428078			2.26	

TREE_98.XLS						
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Growth in period 1	low	low	medium	medium	high	high
period 2	Prob P1	Prob P2	Prob P1	Prob P2	Prob P1	Prob P2
low	10.00%	70.00%	10.00%	60.00%	50.00%	20.00%
medium	20.00%	20.00%	30.00%	30.00%	30.00%	30.00%
high	70.00%	10.00%	60.00%	10.00%	20.00%	50.00%
Expected Demand at Prices			Approximate elasticities of demand			
	P1	P2				
Per1-low	18353145	11805351			-6.40	
Per1-med	17552710	11929548			-5.19	
Per1-high	13054181	16428078			2.26	

## Demand Scenarios - Growth Oriented

TREE_98.XLS						TREE_98.XLS					
H	I	J	K	L	M	H	I	J	K	L	M
1	PHASE I: 1998-2002					33	PHASE II: 2003-2007				
2						34					
3						35					
4	PERIOD ONE -- PART DEMAND					36	PERIOD TWO -- PART DEMAND				
5						37	ENTER GROWTH RATE FOR PERIOD 1				
6						38	(LOW-0, MED-1, HIGH-2) <span style="float: right;">1,464,100</span>				
7	TOTAL MARKET FOR PART(YR)= <span style="float: right;">100,000,000</span>					39	TOTAL MARKET FOR PART(YR)= <span style="float: right;">100,000,000</span>				
8						40					
9						41					
10		Year	Market Share	Market	Total Units	42		Year	Market Share	Market	Total Units
11	Scenario		Growth Rate	Share	Projected/yr	43	Scenario		Growth Rate	Share	Projected/yr
12						44					
13	<b>LOW</b>	1998	N/A	1.0%	1,000,000	45	<b>LOW</b>	2003	10%	1.6%	1,610,510
14		1999	10%	1.1%	1,100,000	46		2004	10%	1.8%	1,771,581
15		2000	10%	1.2%	1,210,000	47		2005	10%	1.9%	1,948,717
16		2001	10%	1.3%	1,331,000	48		2006	10%	2.1%	2,143,589
17		2002	10%	1.5%	1,464,100	49		2007	10%	2.4%	2,357,948
18		TOTAL			6,105,100	50		TOTAL			9,832,325
19	<b>MEDIUM</b>	1998	N/A	1.0%	1,000,000	51	<b>MEDIUM</b>	2003	20%	1.8%	1,756,920
20		1999	20%	1.2%	1,200,000	52		2004	20%	2.1%	2,108,304
21		2000	20%	1.4%	1,440,000	53		2005	20%	2.5%	2,529,865
22		2001	20%	1.7%	1,728,000	54		2006	20%	3.0%	3,035,958
23		2002	20%	2.1%	2,073,600	55		2007	20%	3.6%	3,643,149
24		TOTAL			7,441,600	56		TOTAL			13,074,296
25	<b>HIGH</b>	1998	N/A	1.0%	1,000,000	57	<b>HIGH</b>	2003	50%	2.2%	2,196,150
26		1999	40%	1.4%	1,400,000	58		2004	50%	3.3%	3,294,225
27		2000	30%	1.8%	1,820,000	59		2005	30%	4.3%	4,282,493
28		2001	20%	2.2%	2,184,000	60		2006	20%	5.1%	5,138,991
29		2002	20%	2.6%	2,620,800	61		2007	20%	6.2%	6,186,789
30		TOTAL			9,024,800	62		TOTAL			21,076,648

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TREE_98.XLS					
H	I	J	K	L	M
1	PHASE I: 1998-2002				
2					
3					
4	PERIOD ONE -- PART DEMAND				
5					
6					
7	TOTAL MARKET FOR PART(YR)= <span style="float: right;">100,000,000</span>				
8					
9					
10		Year	Market Share	Market	Total Units
11	Scenario		Growth Rate	Share	Projected/yr
12					
13	<b>LOW</b>	1998	N/A	1.0%	1,000,000
14		1999	10%	1.1%	1,100,000
15		2000	10%	1.2%	1,210,000
16		2001	10%	1.3%	1,331,000
17		2002	10%	1.5%	1,464,100
18		TOTAL			6,105,100
19	<b>MEDIUM</b>	1998	N/A	1.0%	1,000,000
20		1999	20%	1.2%	1,200,000

TREE_98.XLS						
	H	I	J	K	L	M
33	PHASE II: 2003-2007					
34						
35						
36		PERIOD TWO -- PART DEMAND				
37	ENTER GROWTH RATE FOR PERIOD 1					0
38	(LOW-0, MED-1, HIGH-2)					1,464,100
39	TOTAL MARKET FOR PART(YR)=					100,000,000
40						
41						
42		Year	Market Share	Market	Total Units	
43	Scenario		Growth Rate	Share	Projected/yr	
44						
45	LOW	2003	10%	1.6%	1,610,510	
46		2004	10%	1.8%	1,771,561	
47		2005	10%	1.9%	1,948,717	
48		2006	10%	2.1%	2,143,589	
49		2007	10%	2.4%	2,357,948	
50		TOTAL			9,832,325	
51	MEDIUM	2003	20%	1.8%	1,756,920	
52		2004	20%	2.1%	2,100,204	

**Points of Linkage:  
Size of Facility, Production Volume, and Unit Costs**

TREE_98.XLS					
	A	B	C	D	E
21	+++++				
22	Linked Cells From	+++++			
23	Spreadsheets	Note that all input and output linking is done through the macro spreadsheet, DANAL5.XLM. Please update the cells & sheet names there!!!!!!			
24					
25	Inputs TO the Cost Spreadsheet				
26		Total Plant Capacity	9,000,000		WARNING: Move these cells and you *MUST* edit the DANAL5.XLM macro sheet. Otherwise, the LINK_UPDATE macro will yield unpredictable (and useless) results!!!!!!!!!!!!!!!!!!!!!!!!!!!!
27		Annual Production	3,000,000		
28					
29					
30	Outputs FROM the Cost Spreadsheet				
31		Piece Cost	\$10.0752		
32					
33					
34	+++++	+++++	+++++	+++++	+++++
35	Row starts with	R	<<< These should match the values in the		
36	Column starts with	C	<<< DANAL5.XLM file.		
37	+++++	+++++	+++++	+++++	+++++
38					
39	Discount Rate		10.00%	per year	



## Production and Pricing Options

TREE_98.XLS							
	F	G	H	I	J	K	L
63	=====	=====	=====	=====	=====	=====	=====
64	Manufacturing & Pricing Scenario Inputs						
65	Enter colored values only						
66							
67			Price 1	Price 2			Capacity
68			-----	-----			-----
69	Table 2.1		\$10.00	\$11.00			3,000,000
70	Table 3.1		\$10.00	\$11.00			6,000,000
71	Table 4.1		\$10.00	\$11.00			9,000,000
72			-----	-----			-----
73							
74			-----	-----			-----
75	Table 2.2		\$10.00	\$11.00			3,000,000
76	Table 3.2		\$10.00	\$11.00			6,000,000
77	Table 4.2		\$10.00	\$11.00			9,000,000
78	Table 5.2		\$10.00	\$11.00			15,000,000

Scenarios & Links / Period One

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TREE_98.XLS							
	F	G	H	I	J	K	L
63	=====	=====	=====	=====	=====	=====	=====
64	Manufacturing & Pricing Scenario Inputs						
65	Enter colored values only						
66							
67			Price 1	Price 2			Capacity
68			-----	-----			-----
69	Table 2.1		\$10.00	\$11.00			3,000,000
70	Table 3.1		\$10.00	\$11.00			6,000,000
71	Table 4.1		\$10.00	\$11.00			9,000,000
72			-----	-----			-----
73							
74			-----	-----			-----
75	Table 2.2		\$10.00	\$11.00			3,000,000
76	Table 3.2		\$10.00	\$11.00			6,000,000
77	Table 4.2		\$10.00	\$11.00			9,000,000
78	Table 5.2		\$10.00	\$11.00			15,000,000

Scenarios & Links / Period One

## Linking DRYPRESS To TREE 98

(Taken from [http://msl1.mit.edu/rdn/tree\\_98.shtml](http://msl1.mit.edu/rdn/tree_98.shtml))

- Three Files Needed
  - DANAL5.XLM - macros for spreadsheet manipulation
  - TREE\_98.XLS - prebuilt tree with decision scenario manager
  - DRYPRESS.XLS/cost model
- Each Sheet Has Specific Functions and Yields Specific Results
- Linkages Among These Sheets Managed Through Macros

## Name The Sheets In Your System

	K	L	M	N
1	Spreadsheet Linking			
2		Type	Name	
3		Decision Tree	TREE_98.XLS	
4		Cost Model	COSTSKEL.XLS	
5		Macro Sheet	DANAL5.XLM	
6				
7	LINK CELLS			

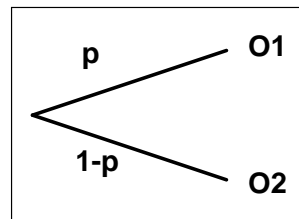
- Note that you are likely to change the Cost Model entry, although all three can be changed
- Pathnames are not needed - the name must match the names that appear in the heading of the Excel window containing the spreadsheet

## Linkage Definitions - DANAL5.XLM

DANAL5.XLM					
	O	P	Q	R	S
1	Internationalization				
2					
3	"Row" starts with:	R			
4	"Col" starts with:	C			
5					
6					
7					
8	LINK Cells Locations	From Decision Tree		To Cost Model	
9		Row	Col	Row	Col
10	1-Plant Capacity	26	3	5	2
11	2-Annual Production	27	3	6	2
12	3				
13					
14		From Cost Model		To Decision Tree	
15	1-Piece Cost	38	2	31	3
16	2				
17	3				
18					

## Problem: Making Lotteries "User Friendly"

"What'll you give me for this?  
What's it worth to you?"



## Semantic Issues: The Meaning of the Question

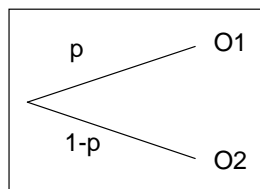
- Value To Whom ?
  - Organizational Scale
    - *Individual, Working Group, Firm, etc.*
  - Context
    - *Market Value, Social Value, Performance Value, etc.*
  - Ideal Action vs. Actual Practice
- Utility Is About Identifying Individual Preferences
- Imputing Wider Meaning Requires Structural Understanding Outside Of The Scope Of The Utility and the Interview
- Implication:
  - Utility Evaluation Requires Substantial Understanding By Both The Analyst And The Interview Subject

## Procedural Issues: Guards Against Mis-Understanding

- Questionnaire Design and Preparation
  - Structures the Interview
  - Establishes Context of Valuation
  - Reassures Interview Subject
- Introduces of Uncertainty As Natural Aspect Day-to-Day Activity
  - Frequently **The** Reason For Developing The Questionnaire
  - A Concept That Many Professionals Resist In Their Own Field
  - Must Be Developed By Interview Structure
  - Only Then Can The Lottery Be Introduced

??

vs.



## Procedural Issues (continued)

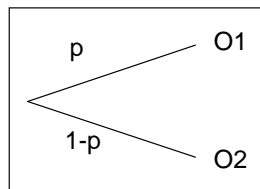
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- Question Forms:

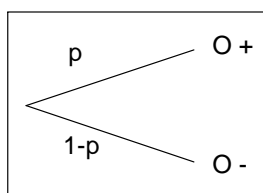
- Certainty Equivalent

**X for sure**

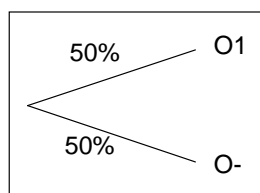
versus



- Lottery Equivalent



versus



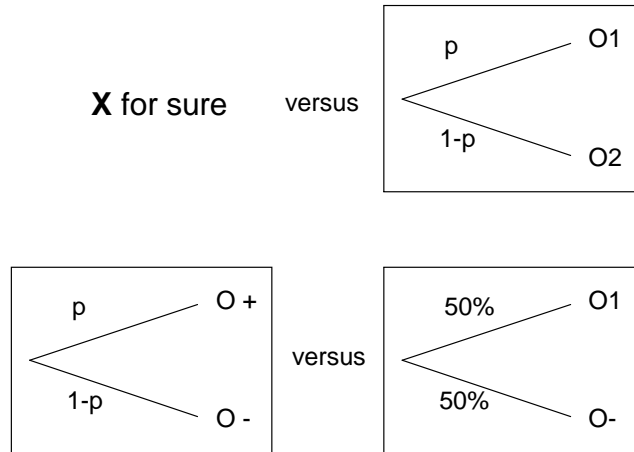
## Procedural Issues

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- Buying or Selling of Lotteries?
  - Selling Lotteries Is Only Really Practical Method
- Questions Reflecting Lotteries:
  - Certainty Equivalents: Would you take A for sure, or a chance of getting the better state B, given that you may instead get the worse case C?
  - Lottery Equivalents: Would you take the uncertain situation (best, 50%; worst) or would you take the uncertain situation (O1, p; worst)?

## What To Vary In The Lottery?

- Outcomes, Probabilities,.....



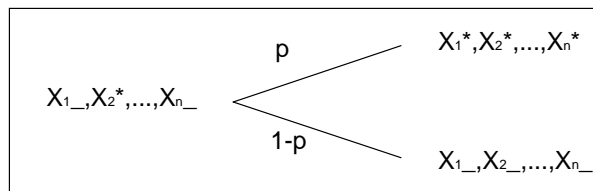
## Typical Questionnaire Format

- Introduction To Interview Objectives and Method
  - Basis For Analysis
  - Introduction To Basic Lottery Problems
  - Introduction To Nonlinearity of Response
  - Introduction To Basic Question Format/Situation
- Establishing Attributes Of Interest and Range Of Interest
- Single Attribute Assessment For Each Attribute
- Multi-Attribute Assessment
  - Assessement of Corner Points; k
  - Verification Of Independence Assumptions
  - Additional, Consistency Questions

## 'k' Assessment

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- Probably The Hardest Part Of The Process
- Although Lottery Equivalent Process Is Possible, Framing The Question Is Nightmarishly Difficult
- Usually Certainty Equivalent Method Employed, Although Other Methods Are Possible, Especially With Computer Tools
- Format Of Certainty Equivalent Question:



## Attribute Selection and Range

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- Attribute Selection
  - Should Be Important To Decision/Choice
  - A Range Of Acceptable Values, Rather Than Cutoffs
  - Should Reflect The Alternatives Being Studied  
(weight may be real important, but should not be measured if all the alternatives under consideration have the same weight)
- Practical Limitations To Number Of Attributes
  - Time To Interview
  - Complexity Of Questions
  - Actual Decisionmaking Practice
- Range Of Attributes
  - Should Reflect Reality/Physical Or Practical Limits
  - Should Reflect The Range Of The Alternatives Being Studied

## Doing the Analysis

- Spreadsheet - MAUA\_WKS.XLS
- Takes your interview results
- Calculates Multi-Attribute Utility of Specific Attribute Combinations
- Calculates Attribute Needed to Achieve a Specific Multi-Attribute Utility

## Data Inputs

	I	J	K	L	M	N	O	P	Q	R
1	Attribute			1		2		3		K
2				Cost		Weight		MTBF		
3	Scaling ks			0.20		0.40		0.50		-0.2709
4	# Points			6		2		2		
5										
6				Cost		Weight		MTBF		
7	Point	1		0.50		0.30		0.80		1
8	Point	2		0.75		2.00		1.50		2
9	Point	3		1.00						3
10	Point	4		2.00						4
11	Point	5		3.00						5
12	Point	6		4.00						6
13	Point	7								7
14	Point	8								8
15										
16	Attribute			Cost		Weight		MTBF		
17				Utilit		Utilit		Utilit		
18	Point	1		1.000		1.000		0.000		1
19	Point	2		0.800		0.000		1.000		2
20	Point	3		0.700						3
21	Point	4		0.500						4
22	Point	5		0.300						5



	I	J	K	L	M	N	O	P	Q	R
1	Attribute			1		2		3		K
2				Cost		Weight		MTBI		
3	Scaling ks			0.20		0.40		0.50		-0.2709
4	# Points			6		2		2		
5										
6				Cost		Weight		MTBI		
7	Point	1		0.50		0.30		0.80		1
8	Point	2		0.75		2.00		1.50		2
9	Point	3		1.00						3
10	Point	4		2.00						4
11	Point	5		3.00						5
12	Point	6		4.00						6
13	Point	7								7
14	Point	8								8
15										
16	Attribute			Cost		Weight		MTBF		
17				Utilit		Utilit		Utilit		
18	Point	1		1.000		1.000		0.000		1
19	Point	2		0.800		0.000		1.000		2
20	Point	3		0.700						3
21	Point	4		0.500						4
22	Point	5		0.300						5
23	Point	6		0.000						6

## Analysis Results

	I	J	K	L	M	N	O	P	Q	R
24	Point	7							7	
25	Point	8							8	
26										
27	Attribute			1		2		3		
28	Attribute Values			0.834		1		1.3		
29	Single Attr. Utility			0.7664		0.5882		0.7143		
30										
31	Multi-Attribute Utility					0.6993				
32										
33										
34		Set/Variable				Supplied		Resulting		
35	Attribute	(1/0)				Values		Values		
36										
37	Cost			1		0.834		0.834		
38	Weight			0		1		0.6009		<- Calculated
39	MTBF			1		0.85		0.85		
40	MAUtilit			1		0.5		0.5		
41										
42										
43										

