Opportunities & Pitfalls in Project Economic Evaluation – Comision Minera

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Synopsis

- Project evaluation is based on a collection of facts, estimates, assumptions and many times, emotion, ego and faith.
- Metal prices, consumable costs and exchange rates are then fixed at a number of levels. To these parameters a basically flawed methodology is then employed to establish measurements of project performance under various scenarios.
- The results of such analysis are often treated as “gospel” and major investment, acquisition and divestiture decisions are made.
- This presentation will cover these aspects and talk about ways in which a degree of realism can be introduced into the process.

Presentation overview

- Mining & Metals consulting & the Financial Services team
- Guideline metal prices and exchange rates
- Basic evaluation tools
- Financial modeling & economic analysis
- Targeted spending analyses
- Capital escalation & de-escalation
- Capital contingency analysis
- Issues with conventional valuation
- Simulation and Monte Carlo analysis
- Flexible valuation
- Summary

> If you have two economists in a room, you will get at least three opinions.

Mining & Metals Consulting, Financial Services

- AMEC
  - 23,000 employee engineering services firm
  - 2,000 involved with mining
- Mining & Metals Consulting
  - 9 offices, each with a local Manager
  - 5 Technical Directors: Mining, Process, Geology, Geostatistics, Financial Services (Mineral Economics)
- Financial Services was created to provide advanced economic analysis, simulation and risk management services to the natural resource industries
  - exploration and mining project valuations
  - operating policy studies
  - valuation audits
  - professional development courses in valuation

Financial Modeling & Economic Analysis

- Library of over 100 models built, covering most types of mining & processing
- Targeting, scoping, pre-feasibility, feasibility, trade-offs, opportunity & risk analysis, optimization, audits, due diligence, etc.
- Numerous country environments
- Strict modelling standards
- Focus on peer review
- Emphasis on building the model early
- Follow through the project
- Perform regular reality checks

Metal Prices & Exchange Rates

Metal Price Guidelines

Metal & WTI Oil prices, Exchange Rates **June 10, 2009**
Long-term guideline rates for use in cash flow models

Mineral	Units	Spot price (June 9, 09)	3-year moving average	AMEC long-range guideline prices Previous CF		Current CF	Resource
Gold	US$/oz	954	771	725	▲	750	865
Silver	US$/oz	15.39	13.60	10.00	▲	11.00	12.65
Platinum	US$/oz	1,267	1,340	1,000	▶	1,000	1,150
Palladium	US$/oz	262	327	250	▶	250	290
Copper	US$/lb	2.35	3.01	1.70	▲	1.80	2.07
Nickel	US$/lb	6.98	12.09	5.50	▲	6.00	6.90
Zinc	US$/lb	0.73	1.17	0.70	▶	0.70	0.80
Molybdenum (MOX)	US$/lb	10.13	26.35	10.00	▶	10.00	11.50
Lead	US$/lb	0.79	0.91	0.50	▶	0.50	0.58
Cobalt 99.3%	US$/lb	14.00	27.59	14.00	▶	14.00	16.10
Uranium (U_3O_8)	US$/lb	50.00		50.00	▲	55.00	63.25
WTI Oil	US$/bbl	70.02	73.07	60.00	▶	60.00	60.00

Exchange rates:	From	To		
	USD	CAD	divide by	0.90
	USD	CLP	multiply by	575
	USD	ZAR	multiply by	8.00

Notes: Uranium price is measured in terms of U_3O_8
Prices of all other metals (including MOX) are measured in terms of metal content
Converting oil price to diesel price varies by location - contact FSG for further details

Metal Price Guidelines

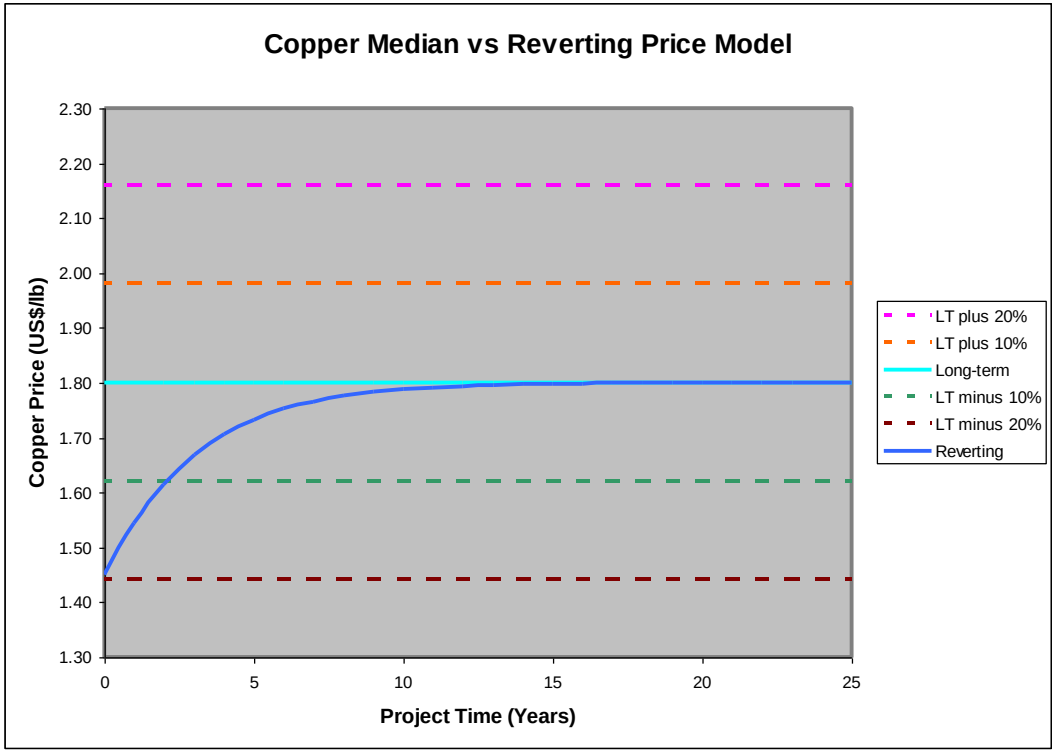
- Focus on long-term (10 years +) trends
- Avoid the tendency to react to short-term changes
  - e.g. US$3.50/lb copper
- Look only at **reliable** sources of information – avoid the hype
  - What are credible engineering companies using?
  - On what prices are the majors basing their assumptions?
  - What do the banks consider reasonable when supplying finance?
  - Are mining analysts credible sources?
- SEC mandates a maximum of the 3-year trailing average
  - This is a MAXIMUM, not a requirement or a recommendation
  - When prices have changed dramatically the 3-year trailing average is not of much use
- Consider floor metal prices
  - These are prices below which low-cost (lower quartile) mines will stop producing
  - At what price can a large, low-grade operation build and operate?

Cash Cost

- One rule of thumb often quoted is that an operator needs a metal price of double their cash cost (use average cash cost of low-cost mines)
- Cash cost is defined as the total production cost, including:
  - Mining, ore freight and milling costs.
  - Ore purchase and freight costs from third parties.
  - Mine-site administration and general expenses.
  - Concentrate freight, smelting and smelter general and administrative costs.
  - Product freight, refining and refinery general and administrative costs.
  - Marketing costs (freight and selling).
  - Less revenues from sale of by-products (known as secondary metal credits)
- Cash cost per pound is the total of the above divided by the number of pounds sold

Reverting Price Model

- Consider use of models that start at current spot and revert to a reasonable long-term price
  - Measure reversion speed and volatility directly from market data
  - Make adjustments based on experience & reasonableness



Real Price Versus Nominal Price

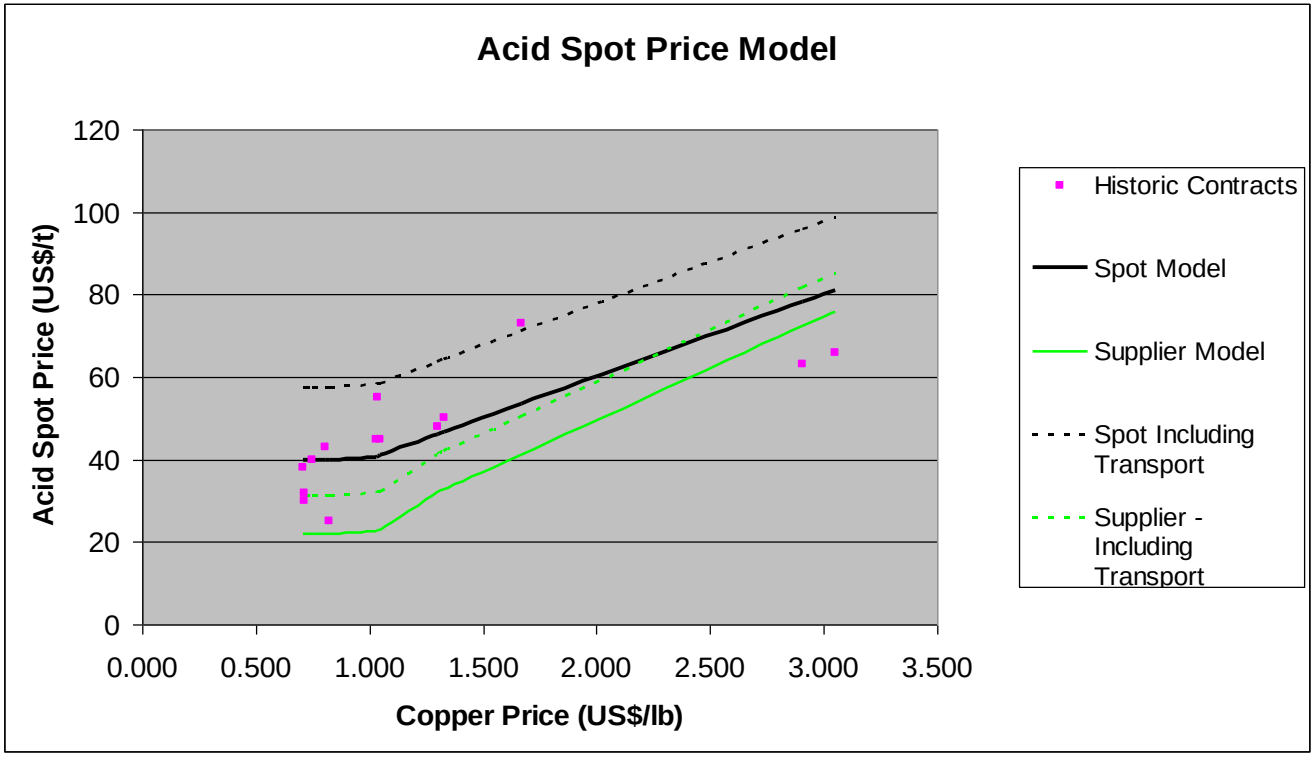
- Use Real prices instead of Nominal prices
- Nominal prices are adjusted to real terms by using the Consumer Price Index (CPI) ratio

Consumable Commodities

- Prime commodities are fuel, power, reagents and grinding media
- Prices rise and fall based on supply and demand
- Labour cost, while also dependent on supply and demand, tends to be “sticky”
  - Prices rise when supply doesn’t keep up with demand
  - Prices are less inclined to fall with over-supply (however, efficiency tends to rise)
- Focus on long-term (10 years +) trends
- Use real dollar prices instead of nominal dollar prices
- Look only at **reliable** sources of information
- Consider use of reverting price models

Consumable Commodities

- Consider use of correlation models that link product price with consumed item
  - e.g. sulphuric acid consumed in the process of leaching copper

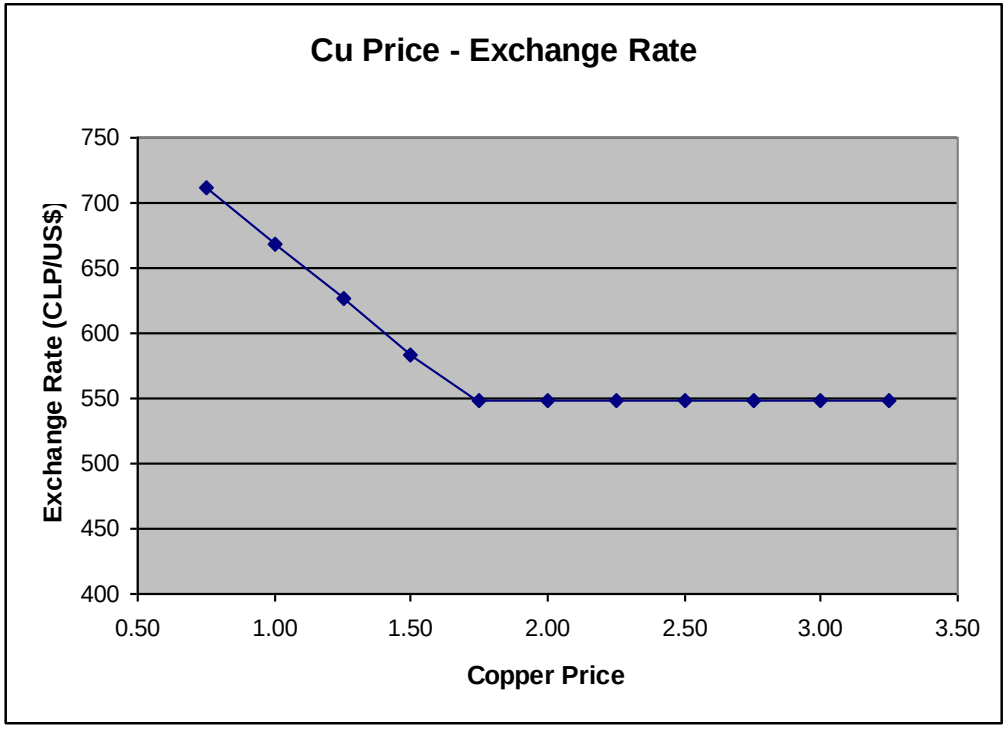


Exchange Rates

- Use rates that apply in “normal” conditions as opposed to boom times
- Rate changes can have enormous impact on the cost of capital
  - e.g. Recent change in USD/EUR rate
- Consider federal bank tendency to manage exchange rates
  - e.g. Reserve Bank of Canada tends to manage CAD to 90% of USD

Exchange Rate Correlation Models

- Consider use of correlation models that link product with exchange rate
  - e.g. Chilean Peso and copper price



Financial Tools

What is the Purpose of Valuation?

- Establish a measure by which a project can be compared with other possible projects.
- Allow for informed decision-making
- Make the best allocation of limited resources between competing projects
- Major, Mid-tier and Junior mining companies can have very different motives. A good outcome for one is not necessarily a good outcome for another

If You Could Choose, Which Option Would be Yours?

1. $2,000 today
2. $1,000 today and $1,100 this time next year
3. $1,000 today and $1,500 two years from now
4. Zero today and $3,000 five years from now

Basic Financial Tools

- Net Present Value
  - NPV
- Internal Rate of Return
  - IRR
  - DCF IRR
  - DCF ROR (discounted cash flow rate of return)
- Profitability Index
  - PI
  - PIR (profit investment ratio)
  - VIR (value investment ratio)
- Payback Period

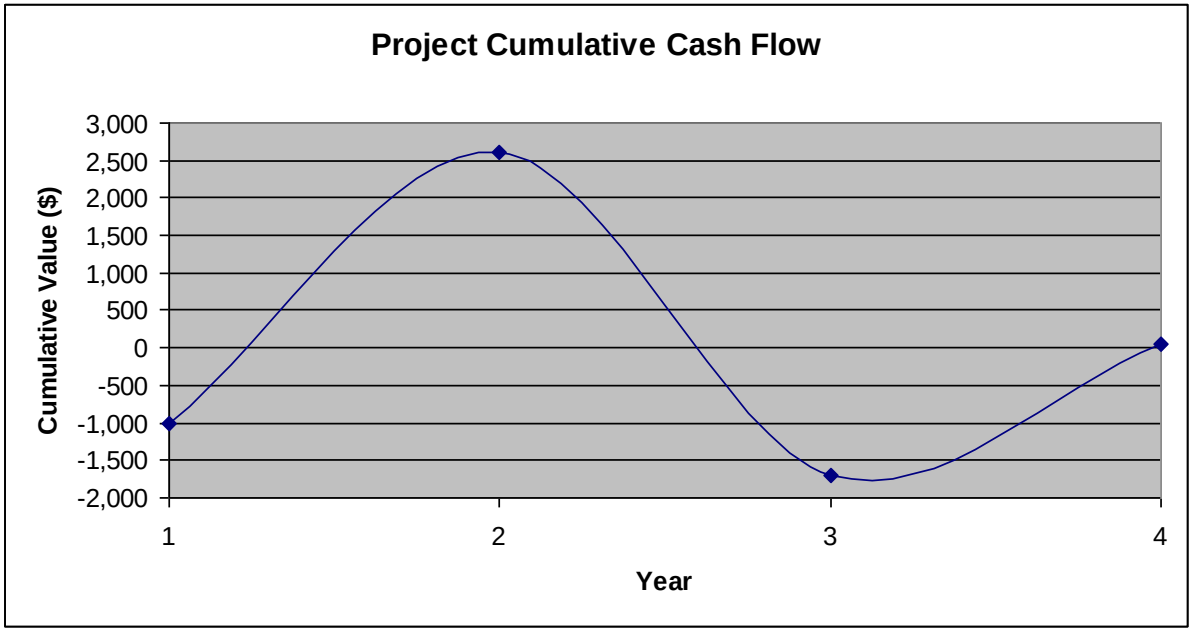
A good return?

- Would you consider a project to be good if it had a 60% Internal Rate of Return?
- Check for reasonableness of outcomes.

A Good Return?

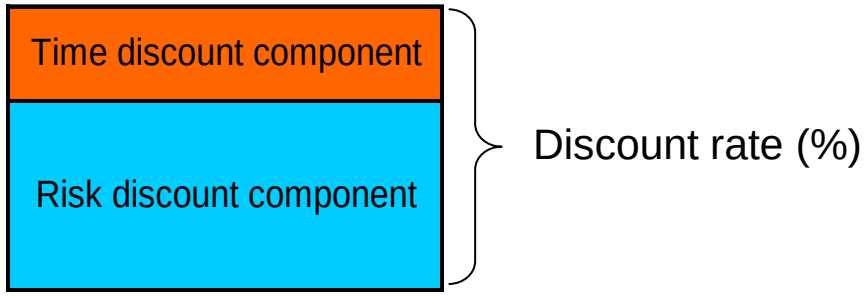
Year	1	2	3	4
Annual	(1,000)	3,600	(4,300)	1,760
Cumulative	(1,000)	2,600	(1,700)	60
IRR	60%			

A good return?



Appropriate Discount Rate

- Taking into account the time value of money
  - Is the value of one dollar given today the same as the promise of one dollar given to you in 3 months?
- Taking into account the risk averse attitude of investors
  - Is it the same thing to lend a dollar to the bank as it is to lend it to your 15 year old brother?



Financial Modeling & Economic Analysis

Capital & Operating Expenditure

- Recent huge increases in capital expenditure
  - Some pullback most recently
- Most low-cost, high-grade deposits have been claimed
- Low grade deposits require high throughput rates
  - Remote locations
  - Expensive access
  - Limited skilled resources – low productivity
- Indirect costs have increased - difficult locations result in more engineering over a longer period

Trade-off Studies

- Numerous opportunities during studies, detailed engineering & beyond
- Sometimes only simple, comparative analysis required
- Impact on other aspects is often far-reaching
- Recommend the use of integrated economic modelling
- Build economic model early
- Follow through the project
- Perform continuous reality checks

Targeting Analysis (Targeted Spending)

Targeting Analysis

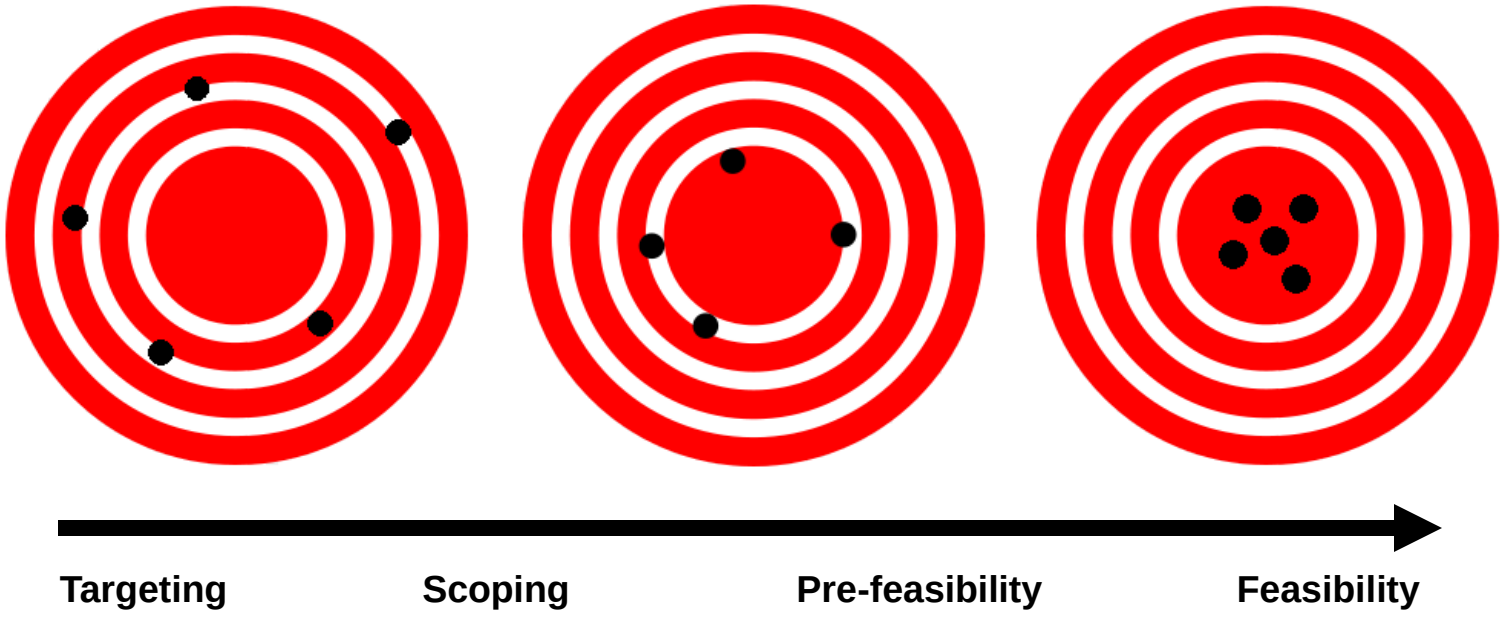
- Numerous junior mining companies with visions of big profits
- Often have unrealistic expectations
- The “devil is in the detail”
- Over-optimistic price & recovery estimates
- Smelter terms misunderstood, underestimated or even ignored
- Confusion over units
- Client regularly disappointed with the outcome
- Majors and mid-tier companies are not immune to these mistakes

Targeting Analysis

Objective

Common Result

Targeting Analysis

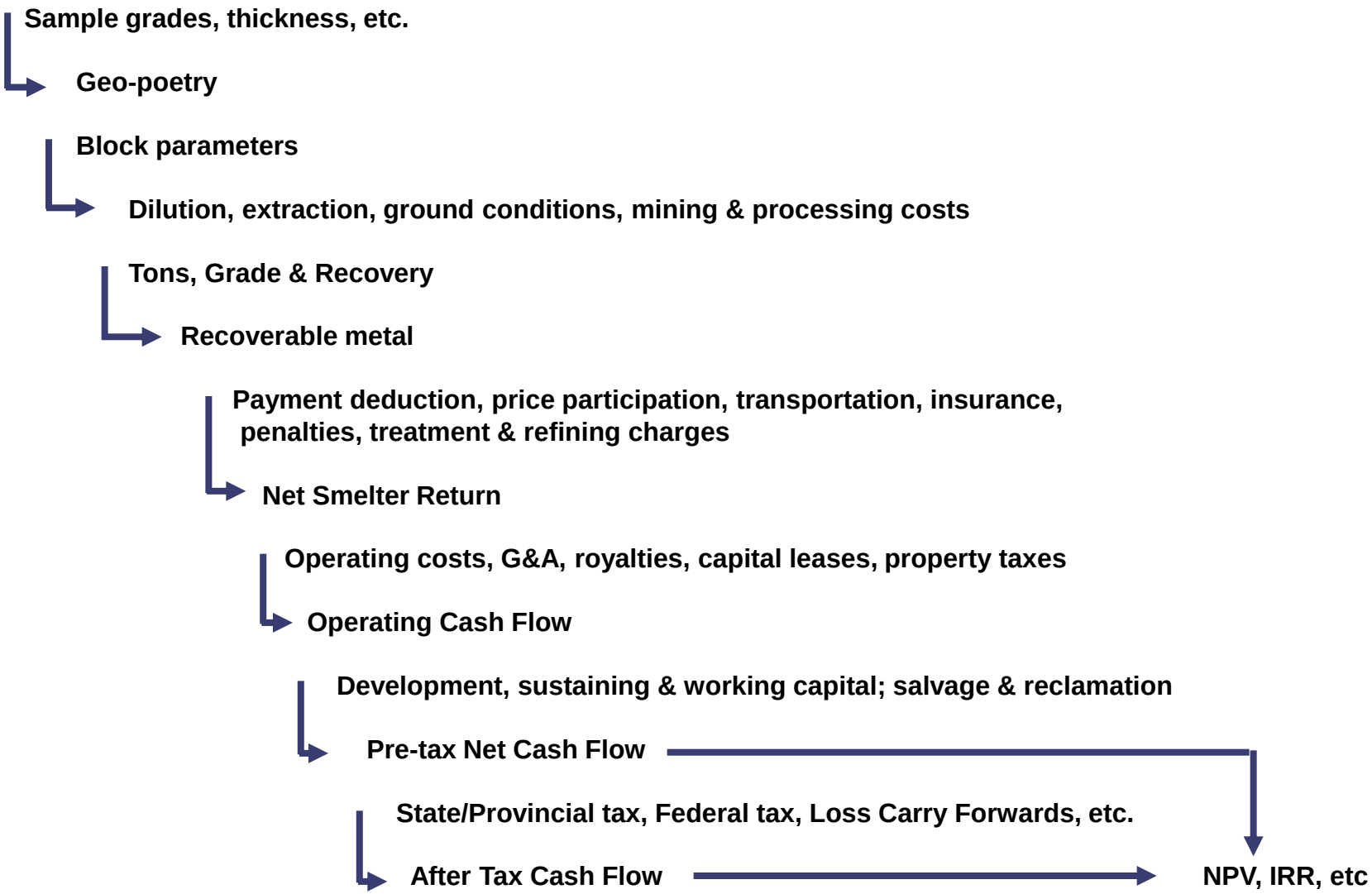


Targeting Analysis

Why Is The Target Often Missed?

- Linear approach to project evaluation:
  - Geology
  - Resource modeling
  - Process selection
  - Resource delineation
  - Mining schedule
  - Engineering
  - Financial model
- Many decisions are taken early without proper evaluation

Building The Cash Flow



Reversing The Cash Flow

- Choose the required outcome (IRR)
  - If the outcome is “after tax” then add back estimated taxes
    - Pre-tax Net Cash Flow
      - Estimate throughput, life of mine and required capital
        - Generate theoretical Operating Cash Flow
          - Calculate margin required to support capital
            - Add operating costs, G&A, royalties, etc
              - Required NSR
                - Add back smelter costs & deductions
                - Invert recovery and convert back to block grades
                - Hocus Pocus
                - Sample grades

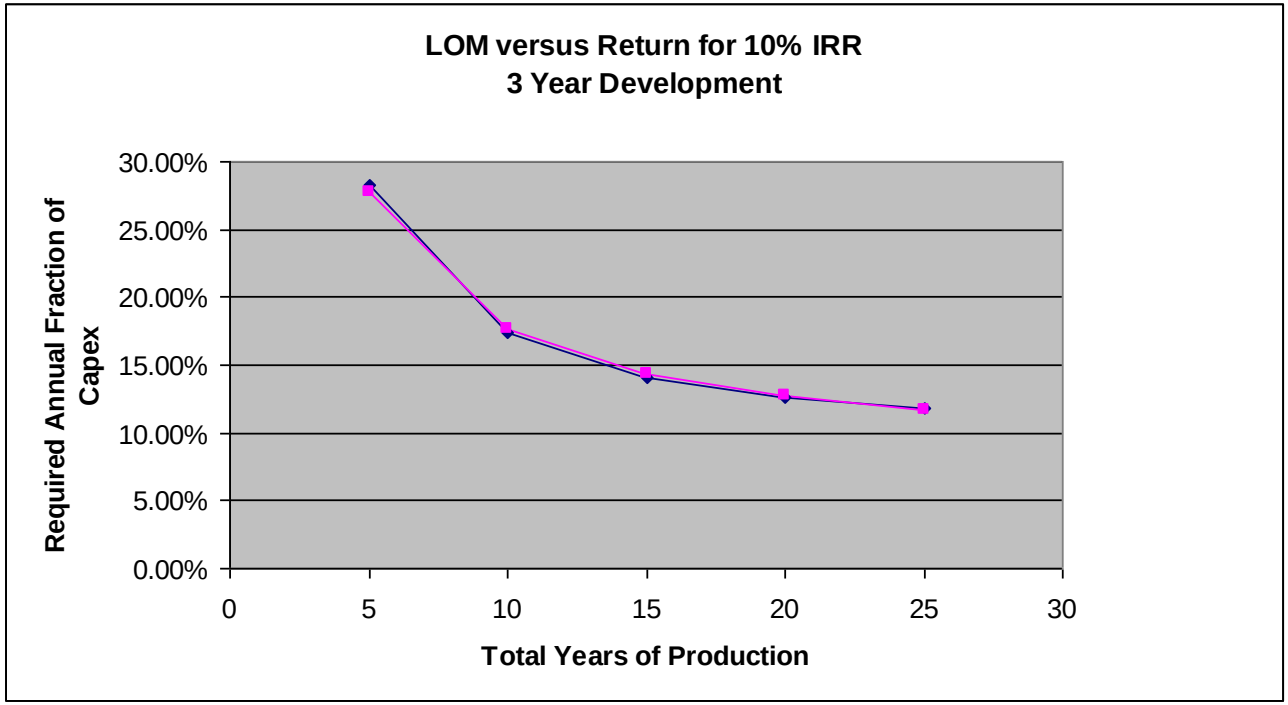
Targeting Analysis - Required Return
(Specific example – not for general use)

Required Return	Total CAPEX ($ million) ==========> 500	1,000	1,500	2,000	2,500	3,000
5%	0.49	0.97	1.46	1.94	2.43	2.91
6%	0.53	1.07	1.60	2.14	2.67	3.20
7%	0.59	1.17	1.76	2.34	2.93	3.51
8%	0.64	1.28	1.92	2.56	3.20	3.83
9%	0.70	1.39	2.09	2.79	3.48	4.18
10%	0.76	1.51	2.27	3.03	3.78	4.54
11%	0.82	1.64	2.46	3.28	4.10	4.92
12%	0.88	1.77	2.65	3.54	4.42	5.31
13%	0.95	1.91	2.86	3.81	4.77	5.72
14%	1.02	2.05	3.07	4.10	5.12	6.15
15%	1.10	2.20	3.29	4.39	5.49	6.59

Notes:

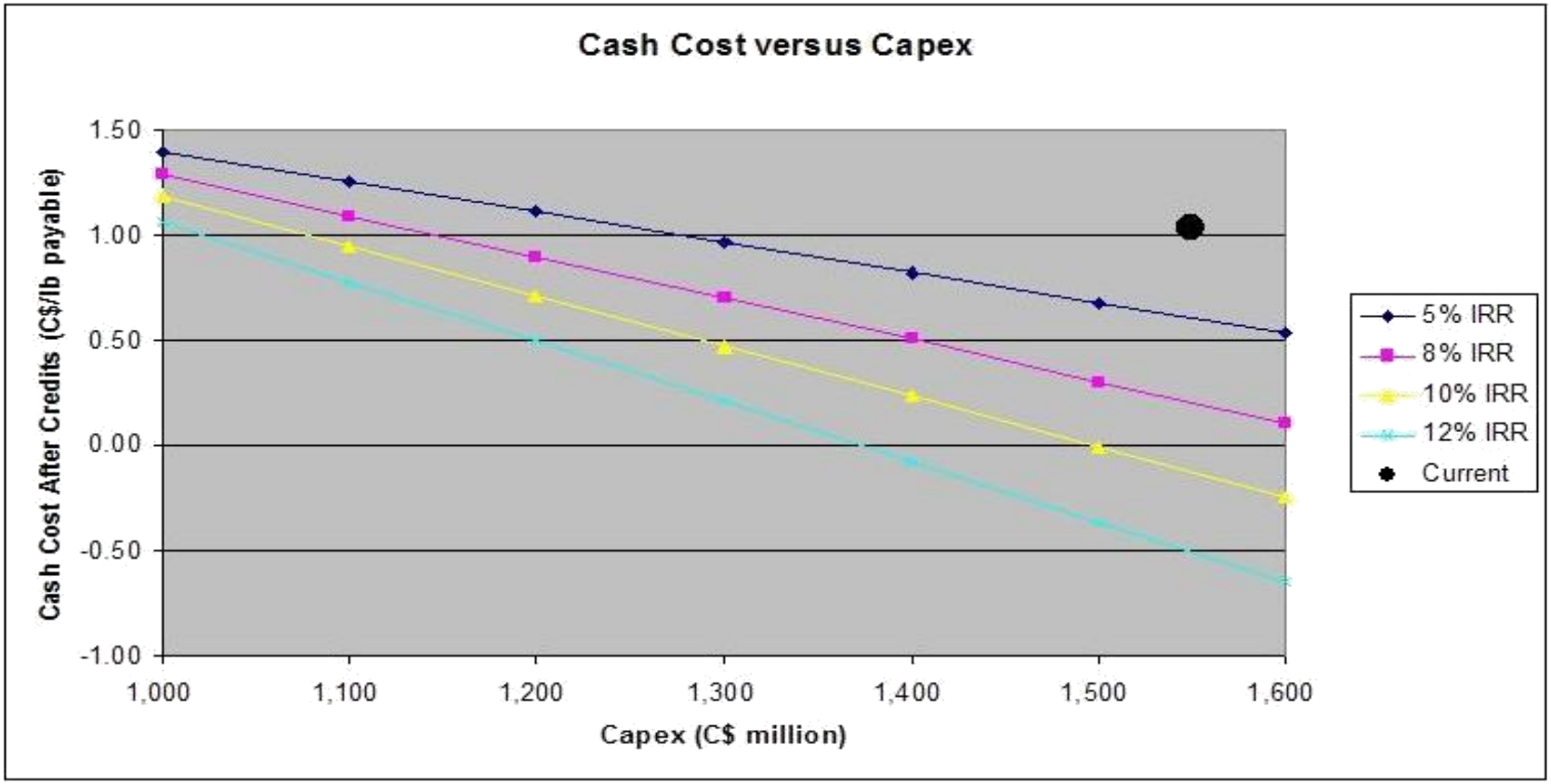
1	Margin is defined as mean NSR minus mean operating cost.
2	There is no front-end loading of grade. Average grade is used throughout.
3	This rate table is not intended for general use. It relates to a specific throughput rate, LOM, ramp-up and CAPEX schedule.
4	Cash flows occur at the end of each period.

Targeting Analysis – Example
(Specific example – not for general use)



$$M = \left[0.06 + \frac{y_d}{177} + \frac{1}{y_p} \right] * Capex$$

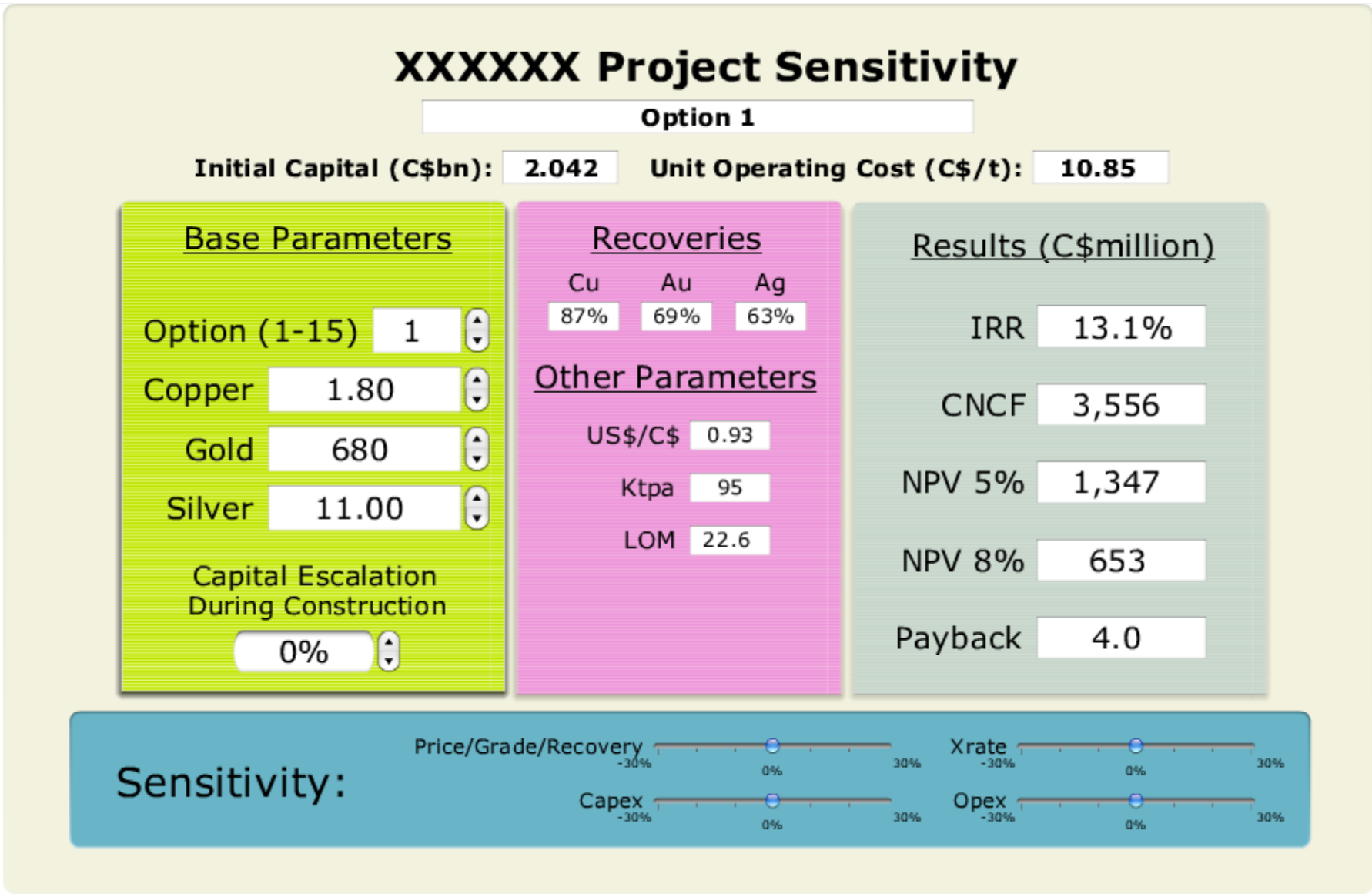
Targeting Analysis – Capex vs Cash Cost
Example (Specific example – not for general use)



Targeting Analysis – Multiple Case Scenario
(Specific example – not for general use)

Case number		1	2	3	4	5	6	7	8	9	10
Mineralized material	Kdmt	3,500	3,502	3,502	3,669	3,669	3,669	5,355	5,355	5,610	5,610
Throughput rate	tpd	1,000	1,000	1,200	857	1,000	1,200	857	1,200	857	1,200
Uranium grade	%U	1.000%	0.340%	0.340%	0.325%	0.325%	0.325%	0.261%	0.261%	0.249%	0.249%
Recoverable U3O8	Mlbs	84.62	28.79	28.79	28.79	28.79	28.79	33.77	33.77	33.77	33.77
		Internal Rate of Return (%)									
U3O8 Price (US$/lb)											
30		64.3%	5.6%	5.7%	3.6%	4.1%	4.3%				
40		86.5%	19.5%	20.5%	16.6%	17.8%	18.8%	10.6%	12.9%	9.1%	11.3%
50		106.6%	30.7%	32.6%	26.9%	28.7%	30.5%	19.4%	22.9%	17.7%	21.1%
60		125.2%	40.6%	43.2%	36.0%	38.3%	40.8%	27.0%	31.6%	25.2%	29.6%
70		142.5%	49.7%	52.9%	44.3%	47.1%	50.2%	34.1%	39.5%	32.0%	37.3%
80		158.9%	58.2%	62.0%	52.2%	55.4%	59.0%	40.8%	47.0%	38.5%	44.5%
90		174.4%	66.3%	70.6%	59.7%	63.2%	67.4%	47.2%	54.1%	44.7%	51.4%
100		189.1%	74.1%	78.8%	66.9%	70.7%	75.3%	53.4%	60.9%	50.7%	58.0%
110		203.3%	81.5%	86.6%	73.8%	78.0%	83.0%	59.3%	67.5%	56.4%	64.4%
120		216.9%	88.7%	94.2%	80.5%	85.0%	90.3%	65.1%	73.8%	62.0%	70.5%
		Undiscounted Cumulative Net Cash Flow (US$million)									
U3O8 Price (US$/lb)											
30		1,690	86	86	59	65	66	(39)	(8)	(76)	(42)
40		2,509	365	364	337	344	345	288	319	251	285
50		3,328	644	643	616	623	623	615	646	578	612
60		4,147	922	922	895	901	902	942	973	905	939
70		4,966	1,201	1,200	1,173	1,180	1,181	1,269	1,300	1,232	1,266
80		5,786	1,480	1,479	1,452	1,459	1,459	1,596	1,627	1,559	1,593
90		6,605	1,758	1,758	1,731	1,737	1,738	1,923	1,954	1,886	1,919
100		7,424	2,037	2,036	2,009	2,016	2,017	2,250	2,281	2,213	2,246
110		8,243	2,316	2,315	2,288	2,295	2,295	2,577	2,608	2,540	2,573
120		9,062	2,594	2,594	2,567	2,574	2,574	2,904	2,935	2,867	2,900

Targeting Analysis



Capital Escalation & De-escalation

Capital Escalation & De-Escalation

- Matrix analysis using Monte Carlo simulation
- Broken down by construction area (process mechanical, bulk earthworks, architectural, etc.)
- Multiple contraction elements (cable, steel, concrete, plastic, other bulk materials, fuel, freight, ……., demand influence)
- Exchange rate variability & correlation
- Initially constructed to deal with de-escalation during the downturn, using four currencies
- Now generalized to cover both de-escalation and re-escalation using all ten major currencies

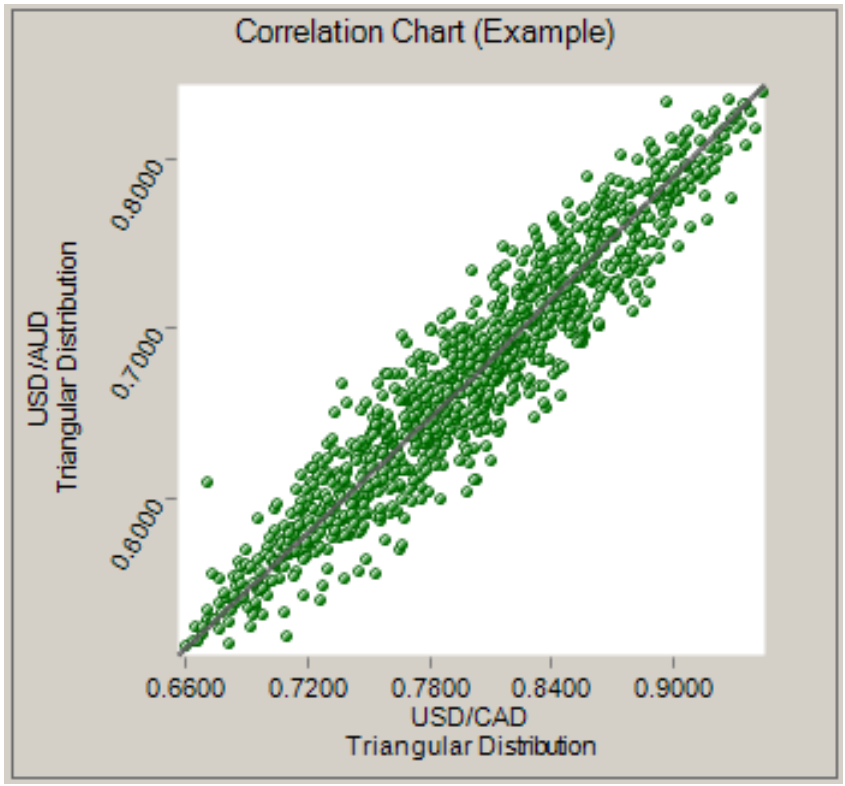
Capital Escalation & De-Escalation

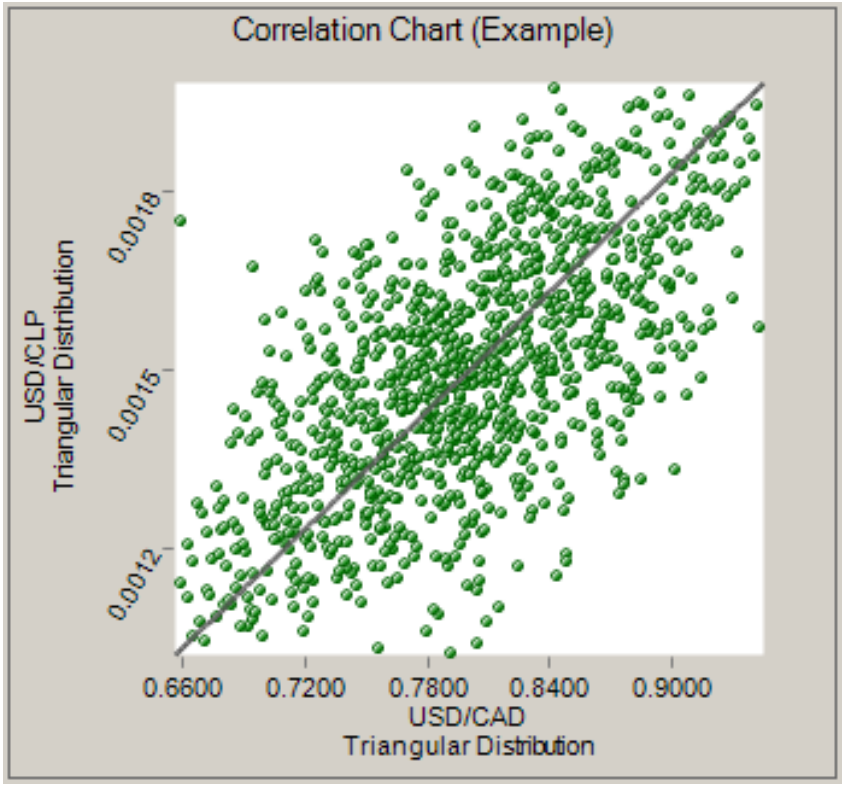
Estimated Q3 2008 Factor Breakdown		F(x)	<<<<<<<<<<<<<<< Bulk materials >>>>>>>>>>>>>>> Cable	Steel	Concrete	Plastic	Other
Process mechanical							
	AUD	0.7358	-0.1141	-0.3020	-0.4530	-0.6040	-0.7550
	CAD	0.8349	-0.0758	-0.2089	-0.3134	-0.4179	-0.5224
	EUR	0.5574	-0.0055	-0.1397	-0.2095	-0.2794	-0.3492
	USD	0.0445	10.0764	-0.0813	-0.1220	-0.1627	-0.2033
Process mechanical - tanks							
	CAD	0.8713	-0.0190	-0.0907	-0.1360	-0.1814	-0.2267
	USD	0.3112	0.1759	-0.0611	-0.0916	-0.1222	-0.1527
Mining - Prestrip		0.8997	-0.0356	-0.0712	-0.1068	-0.1424	-0.0545
Mining - Equipment		0.4814	-0.0269	-0.0538	-0.0807	-0.1076	0.2970
Bulk earthworks		0.3770	-0.0231	-0.0462	-0.0693	-0.0924	-0.1155
Detailed earthworks		0.1803	-0.0187	-0.0374	-0.0561	-0.0748	-0.0935
Concrete		0.6792	-0.0227	0.0630	0.3655	-0.0908	-0.0051
Structural steel		0.5300	-0.0197	1.3845	-0.0591	-0.0788	-0.0984
Architectural							
	CAD	0.5811	-0.0177	0.7050	-0.0530	-0.0706	0.6521
	USD	0.2215	-0.0136	5.0691	-0.0407	-0.0543	5.0284

Capital Escalation & De-Escalation

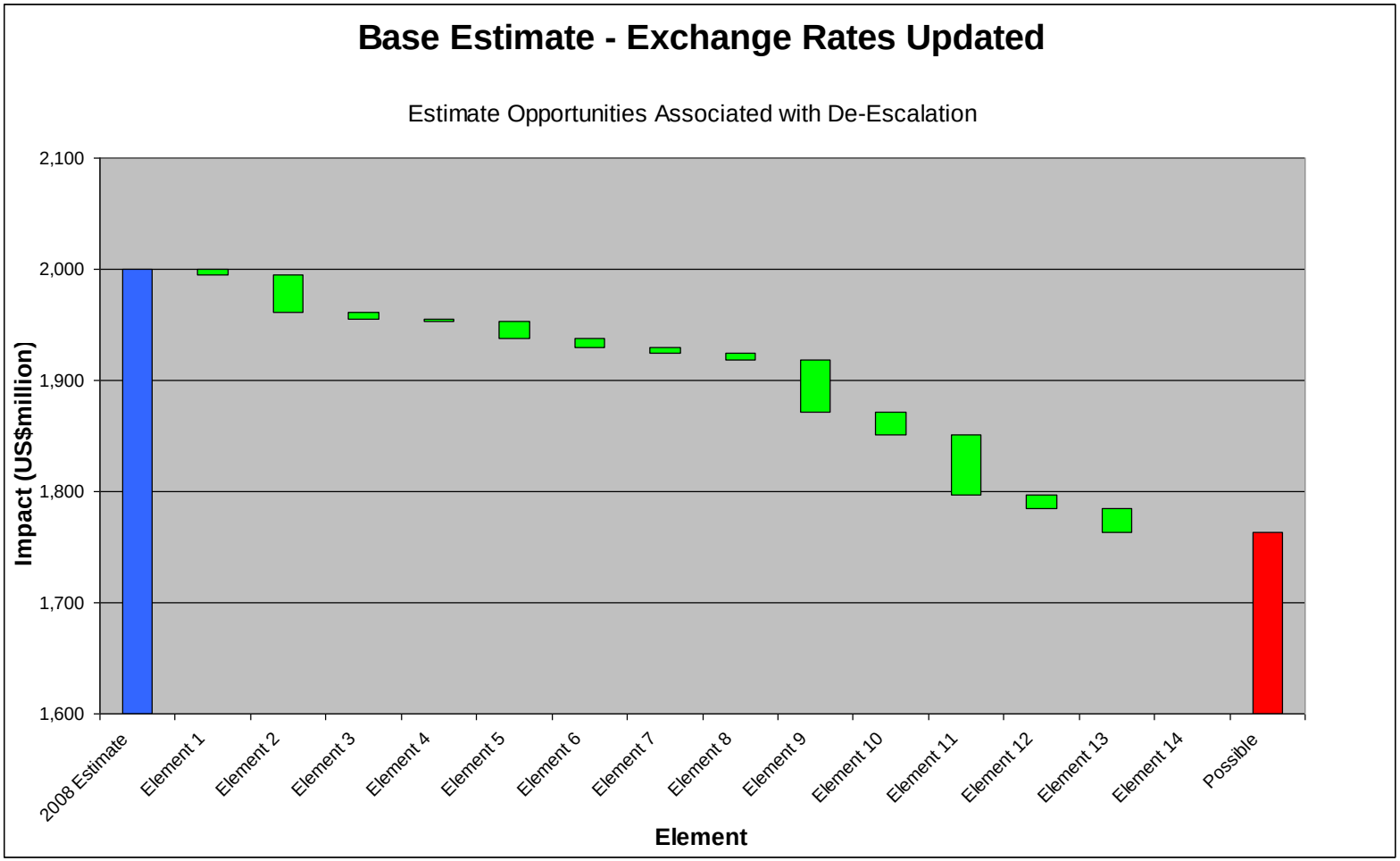
Exchange Rates	Relationship	Basis of Estimate	Recent or Simulated Rate	Correlation to USD/CAD
Australia	USD/AUD	0.6500	0.6657	0.9387
Canada	USD/CAD	0.8000	0.8015	
Europe	USD/EUR	1.4000	1.3290	0.9231
United States	USD/USD	1.0000	1.0000	

Capital Escalation & De-Escalation





Capital Escalation & De-Escalation



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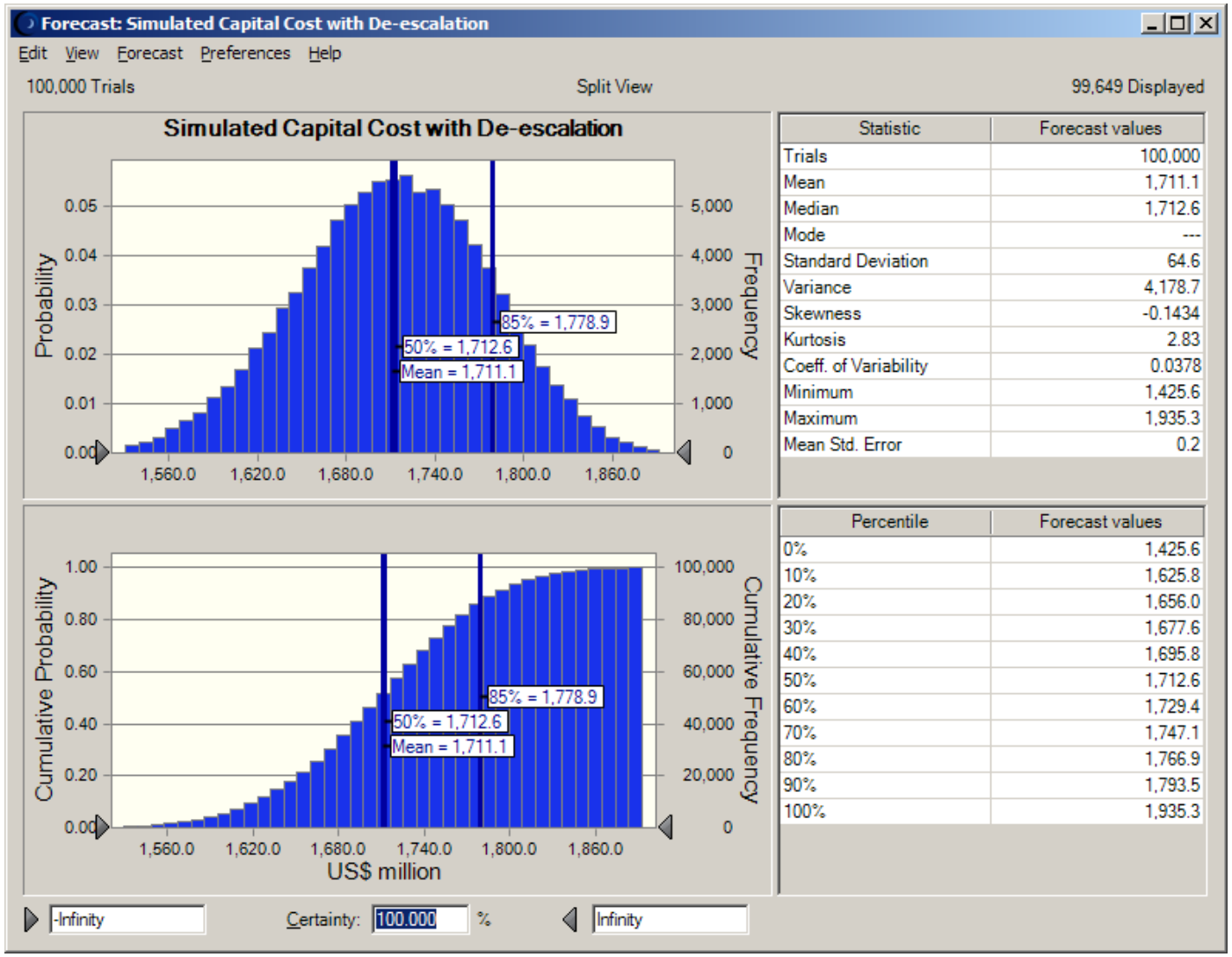
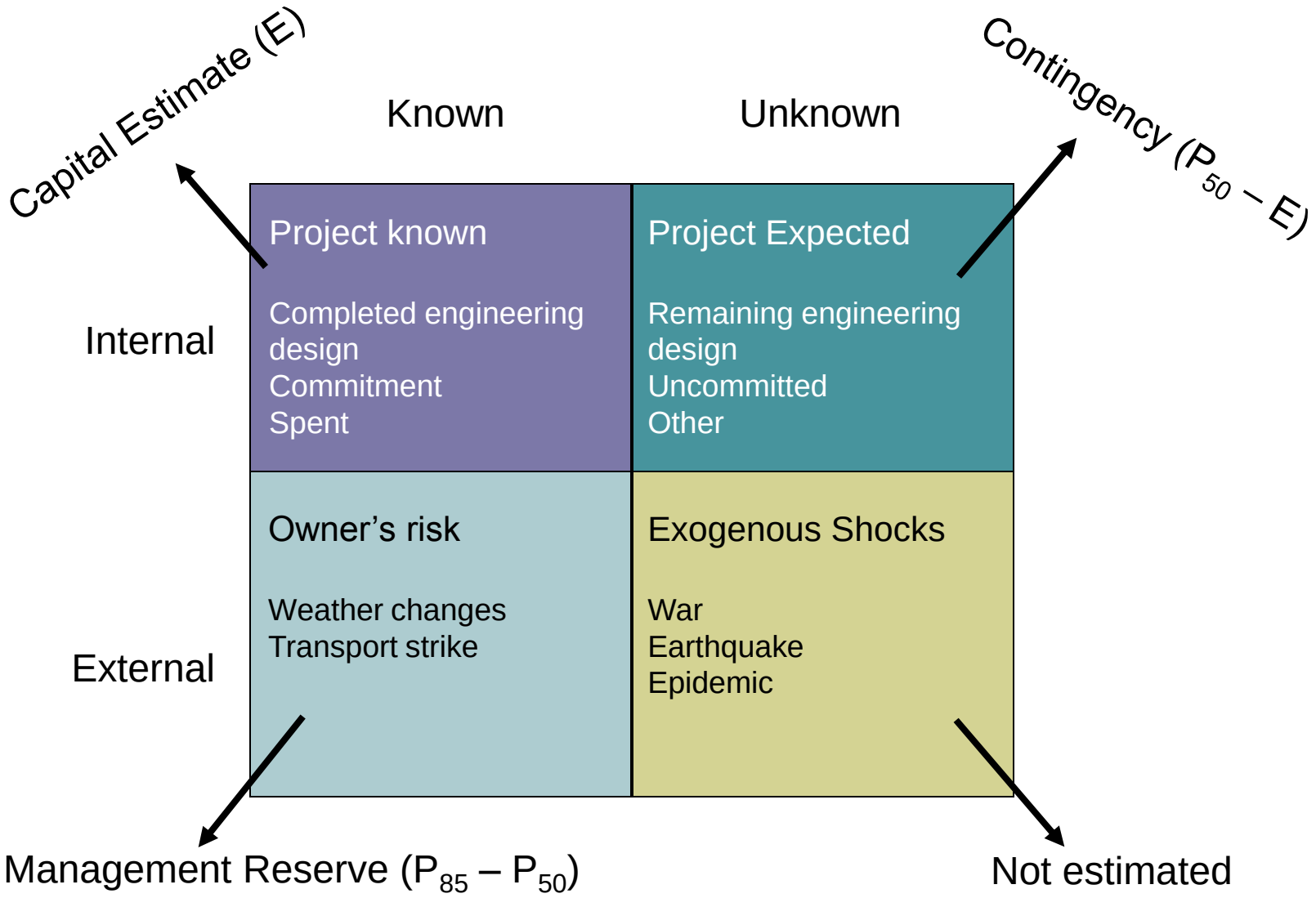


Statistic	Forecast values
Trials	100,000
Mean	1,711.1
Median	1,712.6
Mode	---
Standard Deviation	64.6
Variance	4,178.7
Skewness	-0.1434
Kurtosis	2.83
Coeff. of Variability	0.0378
Minimum	1,425.6
Maximum	1,935.3
Mean Std. Error	0.2

Percentile	Forecast values
0%	1,425.6
10%	1,625.8
20%	1,656.0
30%	1,677.6
40%	1,695.8
50%	1,712.6
60%	1,729.4
70%	1,747.1
80%	1,766.9
90%	1,793.5
100%	1,935.3

Capital Contingency Analysis

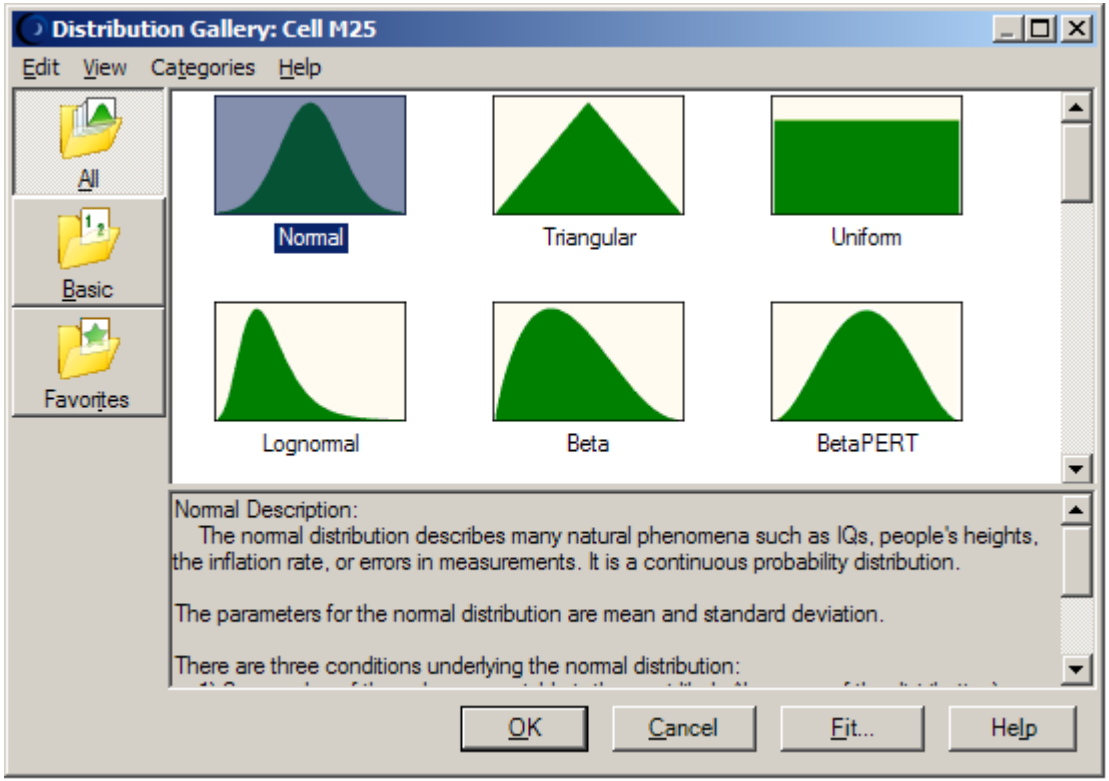
Capital Contingency Analysis



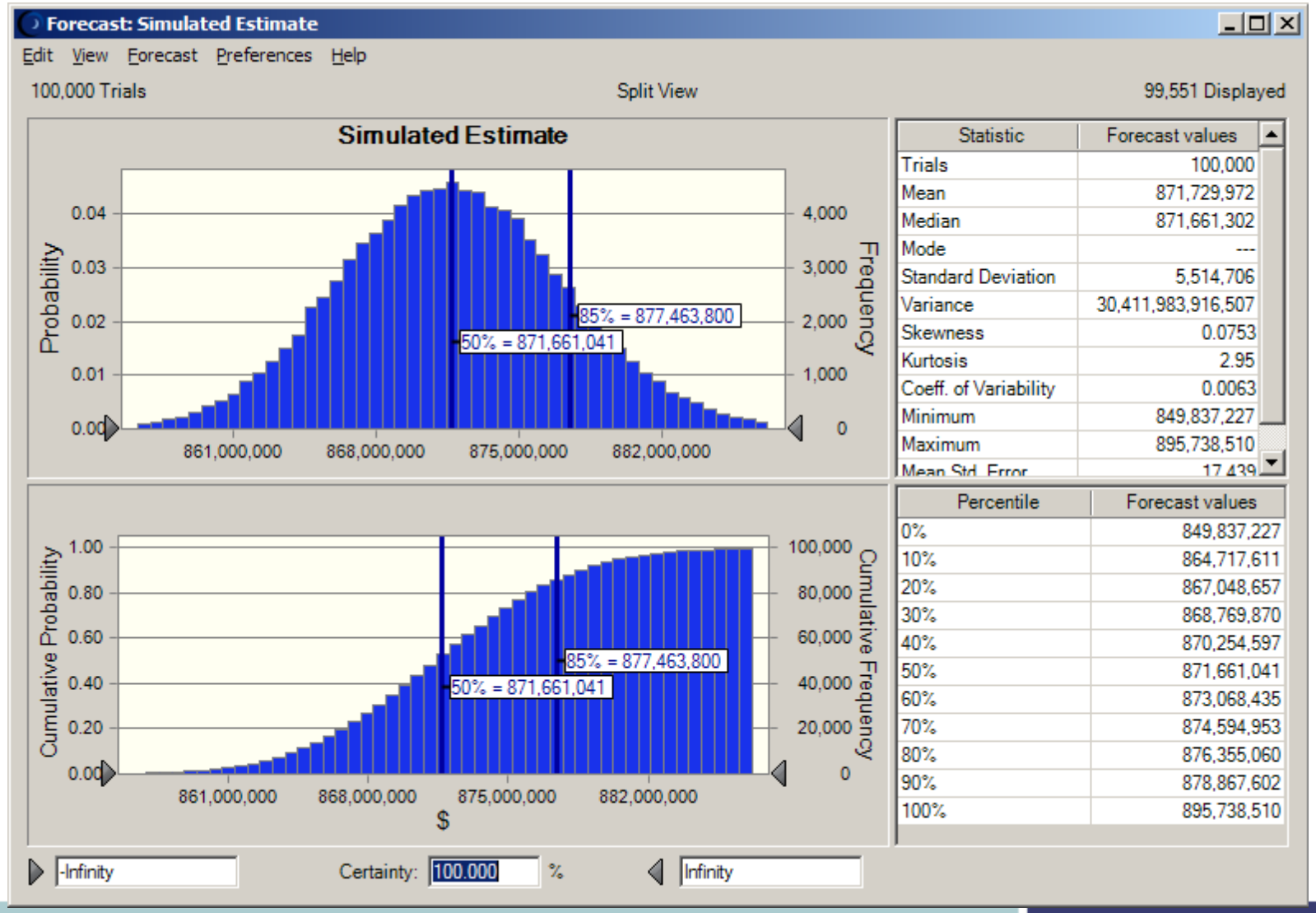
Capex Contingency - Monte Carlo Analysis

Risk Area	Risk Commodity Category	Data Total Cost	Lower Limit	Upper Limit	Mean	Lower Limit	Upper Limit	Simulated Value	Difference From Estimate	
Raw Ore	Civil	1,655,277	85%	110%	98%			1,597,193	(58,084)	
	Concrete	2,235,575	80%	100%	93%			1,927,375	(308,200)	
	Electrical (Non-Tagged)	1,426,611	100%	150%	117%			1,781,470	354,859	
	Eleactrical (Tagged)	94,755	100%	150%	117%			136,447	41,692	
	Instrumentation & Controls	483,129	100%	110%	103%			514,773	31,645	
	Insulation & Coatings	66,965	90%	110%	100%			70,222	3,257	
	Mechanical (Non-Tagged)	1,316,267	100%	125%	108%			1,354,885	38,619	Estimated
	Mechanical (Tagged)	3,857,087	100%	125%	108%			4,468,231	611,144	27,675,358
	Piling	3,190,102	50%	100%	83%			2,620,585	(569,517)	Simulated
	Piping	423,004	90%	110%	100%			413,224	(9,780)	28,720,207
	Structural & Architectural	1,280,329	90%	110%	100%			1,355,555	75,226	(P85-E)/E
	Structures	11,646,257	100%	150%	117%			12,480,246	833,990	13.0%
Mill	Civil	6,190,407	85%	110%	98%			6,414,276	223,869	
	Concrete	12,603,957	90%	105%	98%			12,640,167	36,210	
	Electrical (Non-Tagged)	19,434,054	100%	150%	117%			24,141,102	4,707,048	
	Eleactrical (Tagged)	16,309,357	90%	110%	100%			15,822,731	(486,626)	
	Instrumentation & Controls	10,136,683	100%	150%	117%			10,284,977	148,294	
	Insulation & Coatings	9,764,023	90%	110%	100%			9,756,977	(7,046)	
	Mechanical (Non-Tagged)	32,920,439	90%	105%	98%			32,663,267	(257,172)	Estimated
	Mechanical (Tagged)	66,161,536	98%	102%	100%			66,947,432	785,896	248,304,106
	Piling	4,750,152	99%	101%	100%			4,748,702	(1,450)	Simulated
	Piping	15,496,312	90%	125%	105%			15,249,675	(246,637)	254,072,429
	Structural & Architectural	7,933,750	90%	110%	100%			7,958,554	24,804	(P85-E)/E
	Structures	46,603,435	95%	105%	100%			47,444,571	841,136	3.4%

Capex Contingency - Monte Carlo Analysis



Capex Contingency - Monte Carlo Analysis



Statistic	Forecast values
Trials	100,000
Mean	871,729,972
Median	871,661,302
Mode	---
Standard Deviation	5,514,706
Variance	30,411,983,916,507
Skewness	0.0753
Kurtosis	2.95
Coeff. of Variability	0.0063
Minimum	849,837,227
Maximum	895,738,510
Mean Std. Error	17,439

Percentile	Forecast values
0%	849,837,227
10%	864,717,611
20%	867,048,657
30%	868,769,870
40%	870,254,597
50%	871,661,041
60%	873,068,435
70%	874,594,953
80%	876,355,060
90%	878,867,602
100%	895,738,510

Capex Contingency - Monte Carlo Analysis

Statistic	Percentage	Value
Initial capex (E)		857,270,065
P50		950,393,506
P85		988,279,746
Contingency (P50-E)	10.9%	93,123,441
Owner's risk (P85-P50)	4.4%	37,886,240
Conting. + OR (P85-E)	15.3%	131,009,681

Capex Contingency - Monte Carlo Analysis

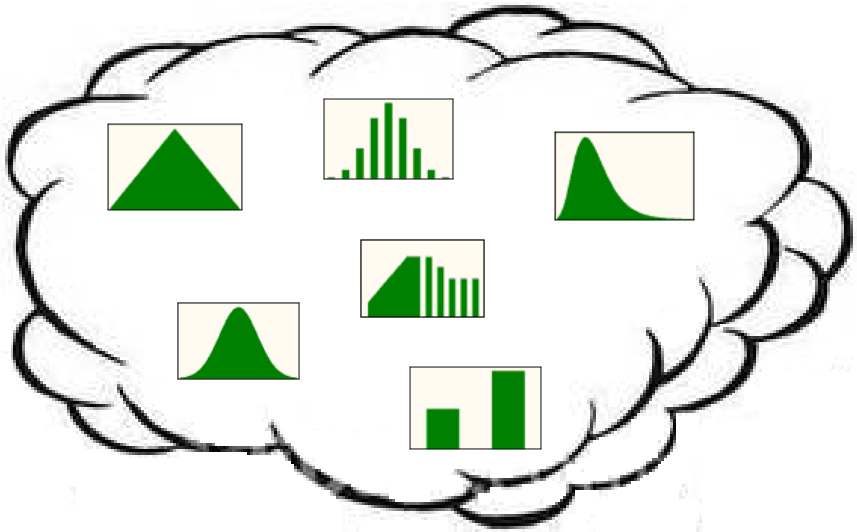
Risk Area	Risk Commodity Category	Data Total Cost	Lower Limit	Upper Limit	Mean	Lower Limit	Upper Limit	Simulated Value	Difference From Estimate	
Raw Ore	Civil	1,655,277	85%	110%	98%			1,597,193	(58,084)	
	Concrete	2,235,575	80%	100%	93%			1,927,375	(308,200)	
	Electrical (Non-Tagged)	1,426,611	100%	150%	117%			1,781,470	354,859	
	Eleactrical (Tagged)	94,755	100%	150%	117%			136,447	41,692	
	Instrumentation & Controls	483,129	100%	110%	103%			514,773	31,645	
	Insulation & Coatings	66,965	90%	110%	100%			70,222	3,257	
	Mechanical (Non-Tagged)	1,316,267	100%	125%	108%			1,354,885	38,619	Estimated
	Mechanical (Tagged)	3,857,087	100%	125%	108%			4,468,231	611,144	27,675,358
	Piling	3,190,102	50%	100%	83%			2,620,585	(569,517)	Simulated
	Piping	423,004	90%	110%	100%			413,224	(9,780)	28,720,207
	Structural & Architectural	1,280,329	90%	110%	100%			1,355,555	75,226	(P85-E)/E
	Structures	11,646,257	100%	150%	117%			12,480,246	833,990	13.0%
Mill	Civil	6,190,407	85%	110%	98%			6,414,276	223,869	
	Concrete	12,603,957	90%	105%	98%			12,640,167	36,210	
	Electrical (Non-Tagged)	19,434,054	100%	150%	117%			24,141,102	4,707,048	
	Eleactrical (Tagged)	16,309,357	90%	110%	100%			15,822,731	(486,626)	
	Instrumentation & Controls	10,136,683	100%	150%	117%			10,284,977	148,294	
	Insulation & Coatings	9,764,023	90%	110%	100%			9,756,977	(7,046)	
	Mechanical (Non-Tagged)	32,920,439	90%	105%	98%			32,663,267	(257,172)	Estimated
	Mechanical (Tagged)	66,161,536	98%	102%	100%			66,947,432	785,896	248,304,106
	Piling	4,750,152	99%	101%	100%			4,748,702	(1,450)	Simulated
	Piping	15,496,312	90%	125%	105%			15,249,675	(246,637)	254,072,429
	Structural & Architectural	7,933,750	90%	110%	100%			7,958,554	24,804	(P85-E)/E
	Structures	46,603,435	95%	105%	100%			47,444,571	841,136	3.4%

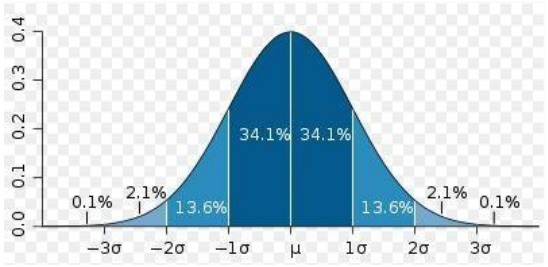
Monte Carlo Analysis & Flexible Valuation

Issues with Conventional Valuation

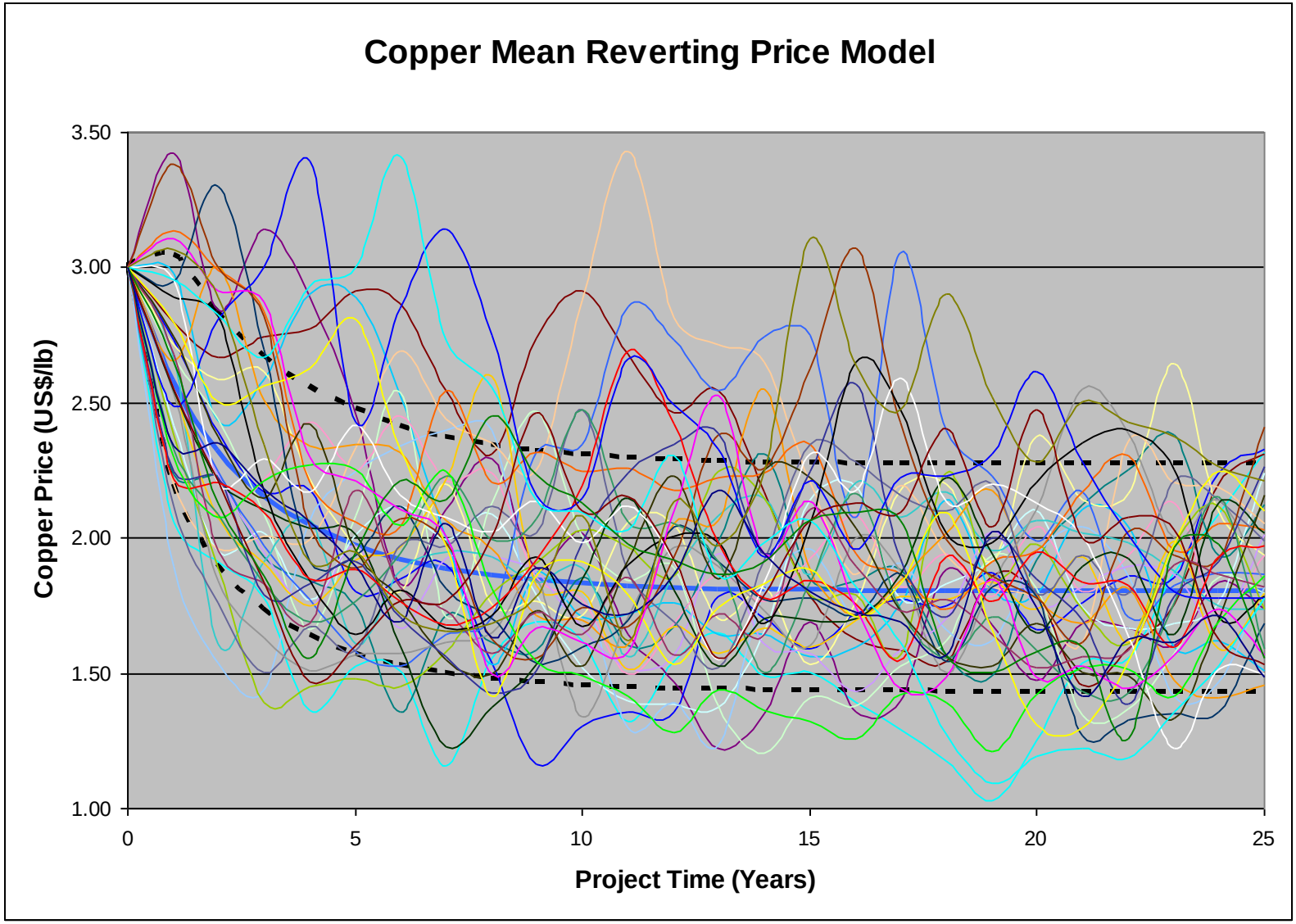
- Elements of a valuation model
  - Project structure
  - Project Uncertainty
- Standard DCF approach tend to fix these elements
- As time goes by project structure and uncertainty will change
  - Economic parameters are dynamic
  - Project structure evolves as more information becomes available
  - Project scope can change
- All those changes will impact the value estimation
- How can a model take those possible outcomes into account

Monte Carlo Simulation



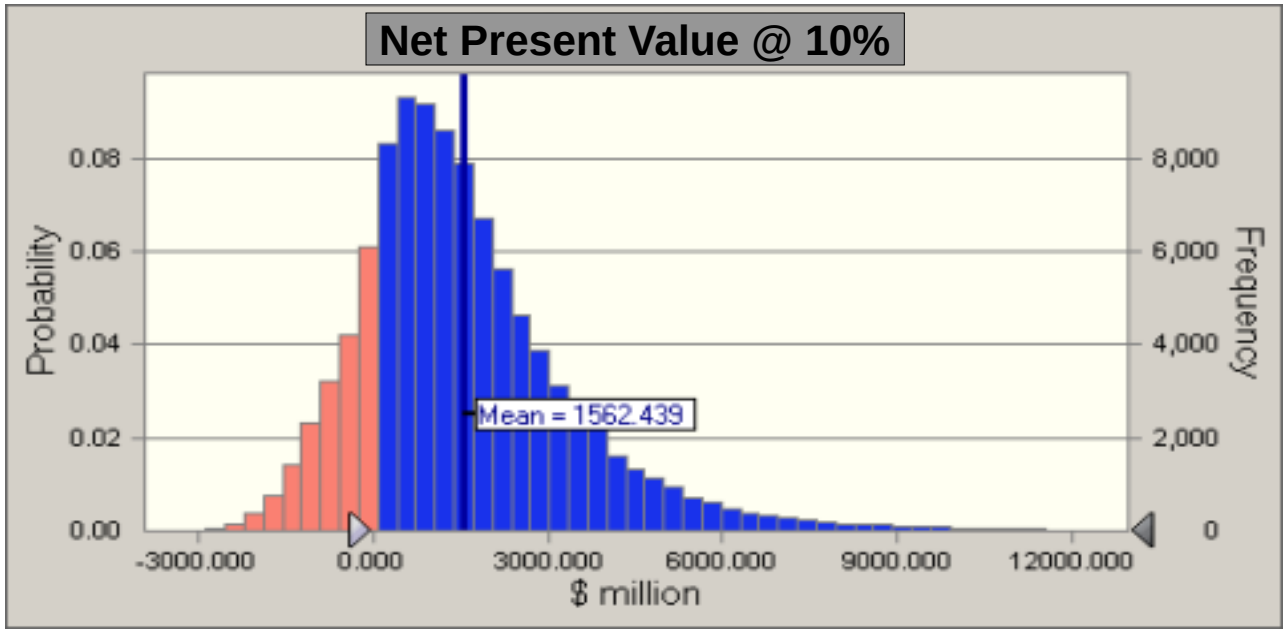


Stochastic Processes & Monte Carlo Simulation

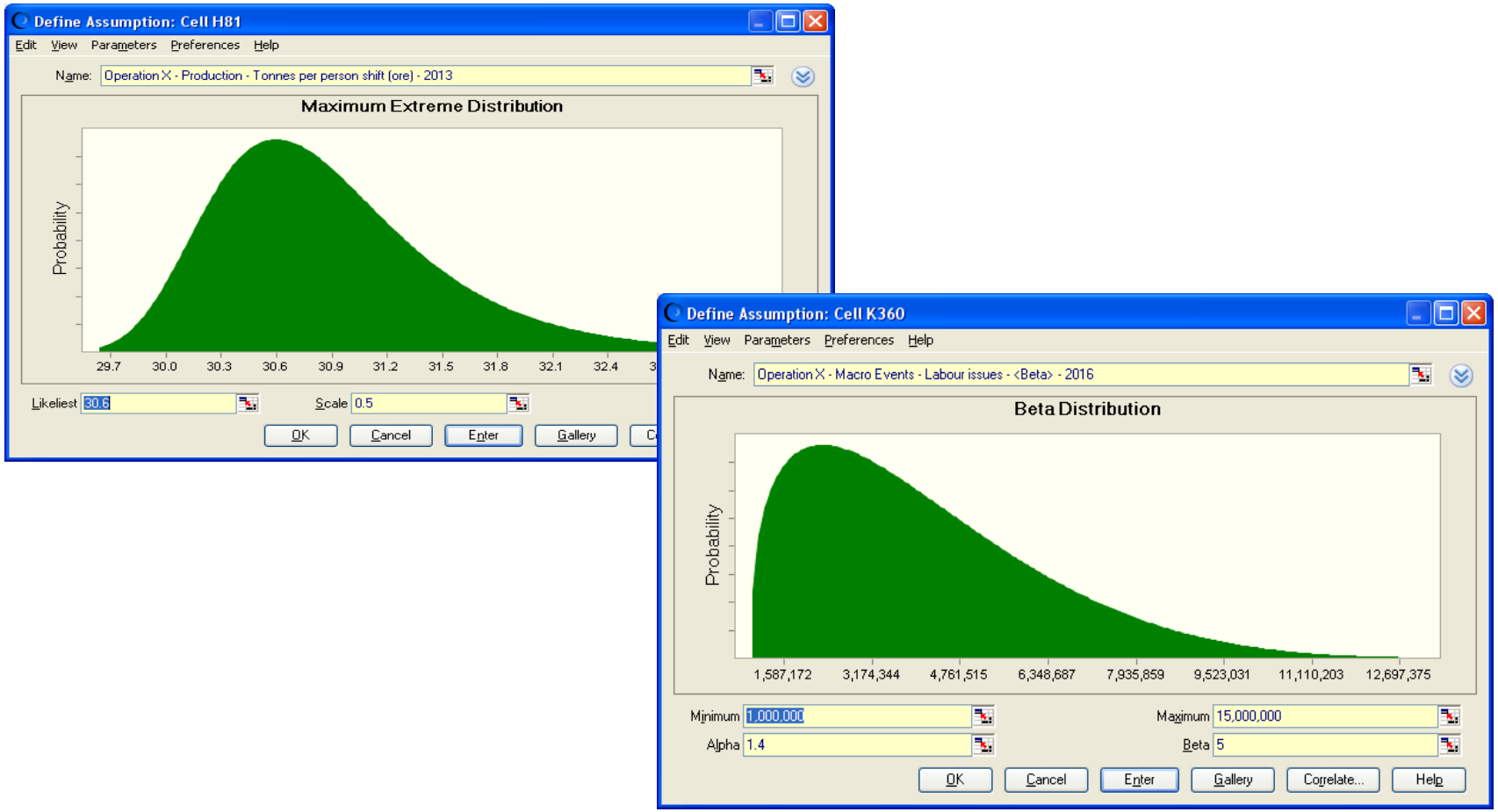


Monte Carlo Simulation

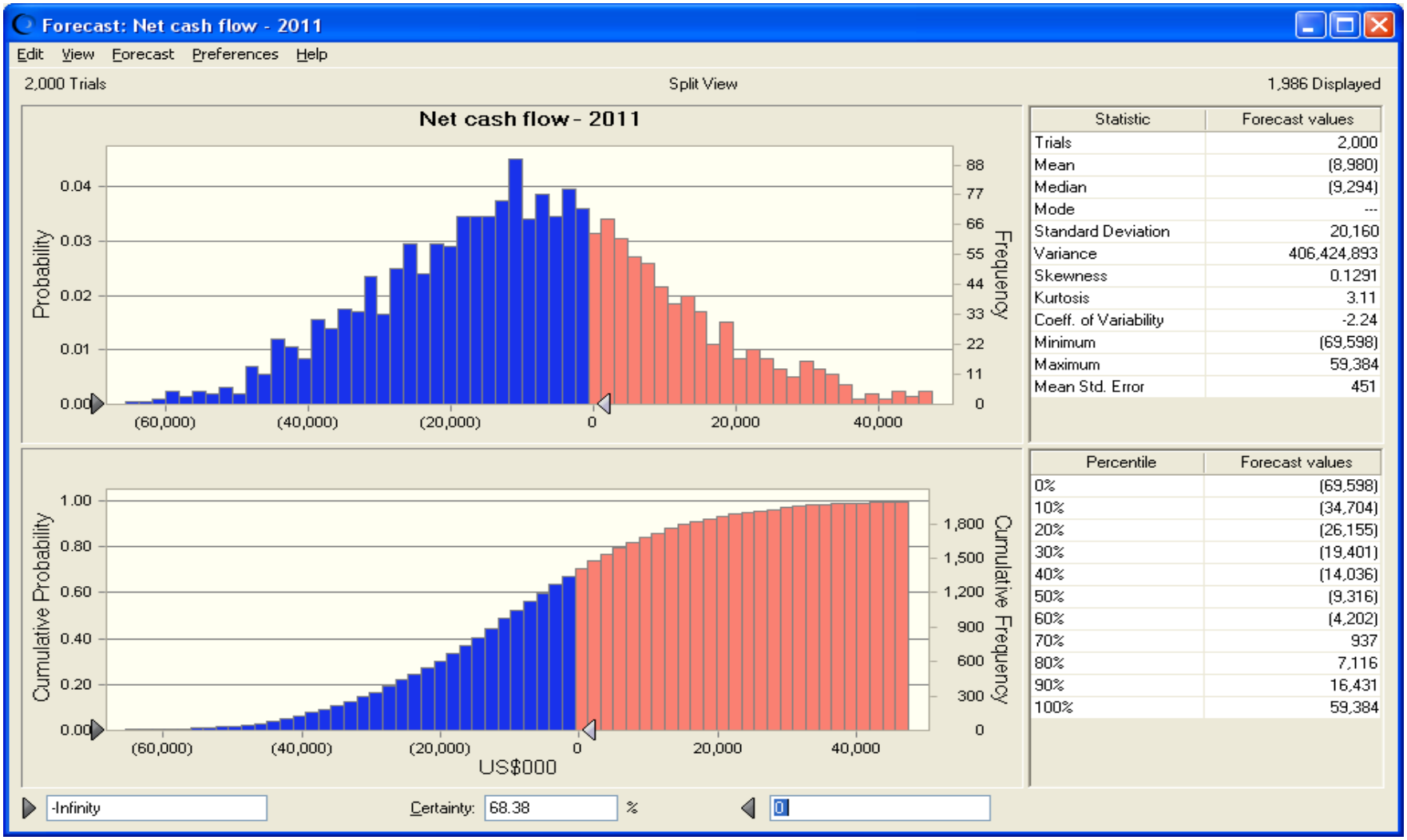
- Allows us to produce a profile of possible project outcomes
- Measures the probability of a positive cash flow
- Measure the lowest and highest likely boundaries of the cash flow



Risk/Opportunity Evaluation



Risk/Opportunity Evaluation



Statistic	Forecast values
Trials	2,000
Mean	(8,980)
Median	(9,294)
Mode	---
Standard Deviation	20,160
Variance	406,424,893
Skewness	0.1291
Kurtosis	3.11
Coeff. of Variability	-2.24
Minimum	(69,598)
Maximum	59,384
Mean Std. Error	451

Percentile	Forecast values
0%	(69,598)
10%	(34,704)
20%	(26,155)
30%	(19,401)
40%	(14,036)
50%	(9,316)
60%	(4,202)
70%	937
80%	7,116
90%	16,431
100%	59,384

Flexible Valuation

- Typical industry practice is to calculate an NPV for each design alternative on a stand alone basis.
  - Each alternative is treated as a mutually exclusive investment for which the development decision must be made immediately.
- Flexibility is important because it allows managers to limit the consequence of adverse business conditions and to capture the benefits of favourable conditions.
  - Expansion
  - Early closure
  - Cancel investment
- Allows risk to be adjusted at source.
- Highest value added in marginally positive projects.

Summary

- Model the cash flow early
- Use an integrated economic model from the project beginning
- Manage expectations
- Be realistic in your assumptions
- Question everything
- If it looks too good to be true – it is too good to be true!

Thank you