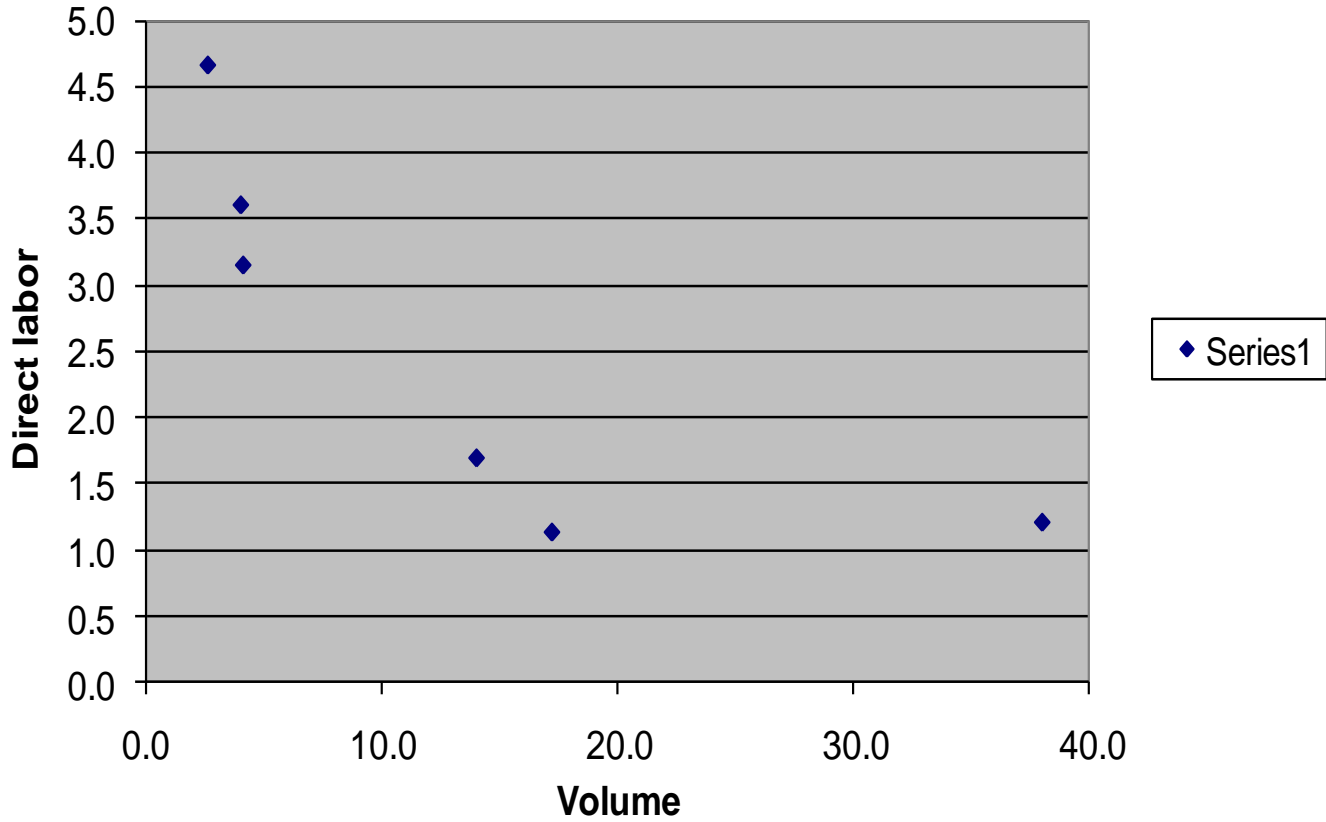


Applichem cost and analysis

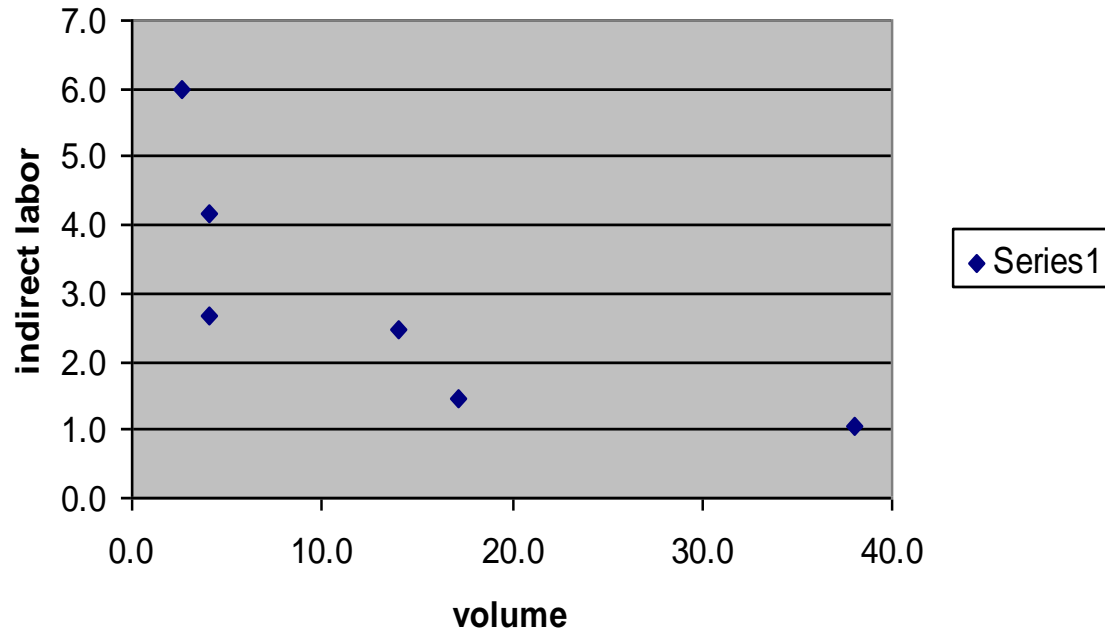
Labor, yield and cost data

	Volume	DL/lb	Indir/lb	Tot lab/lb	yield A	cost wo pack
Mexico	17.2	1.1	1.4	2.6	94.7	92.63
Canada	2.6	4.7	6.0	10.7	91.1	93.25
Venezuala	4.1	3.1	2.7	5.8	91.7	112.31
Frankfurt	38.0	1.2	1.1	2.3	98.9	73.34
Gary	14.0	1.7	2.5	4.2	90.4	89.15
Sunchem	4.0	3.6	4.2	7.8	98.8	149.24

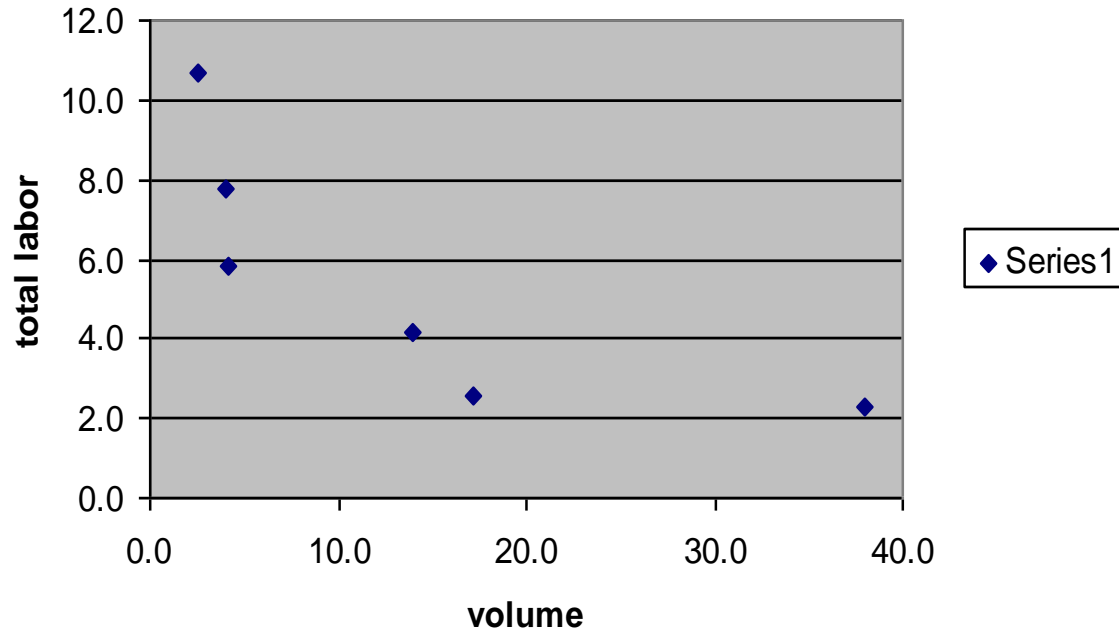
Unit Direct labor vs volume



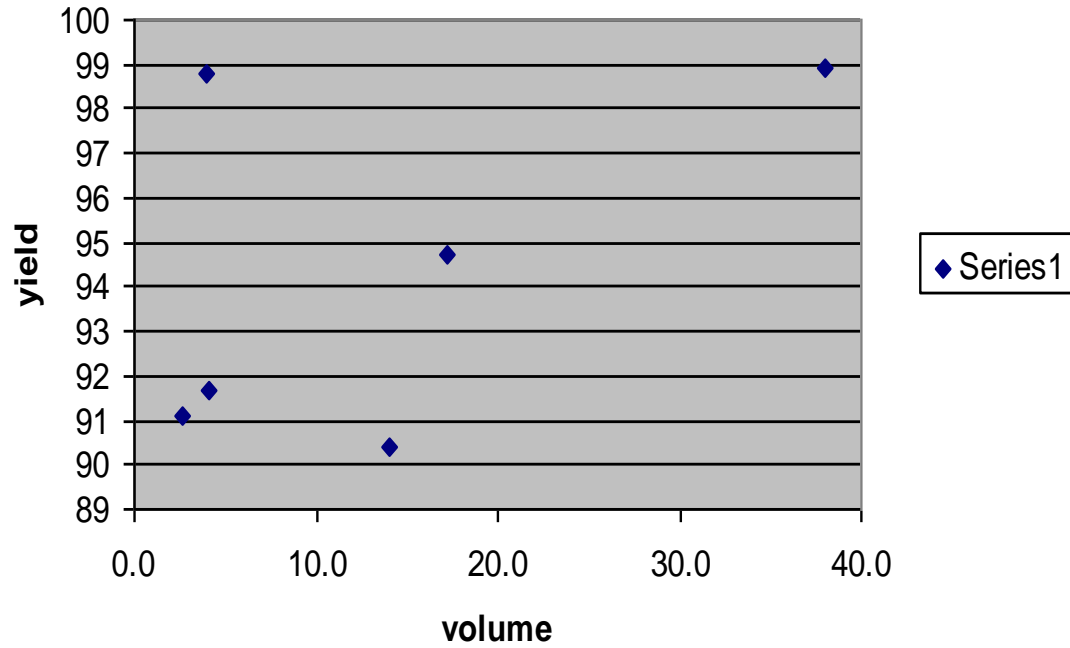
Unit Indir labor vs volume



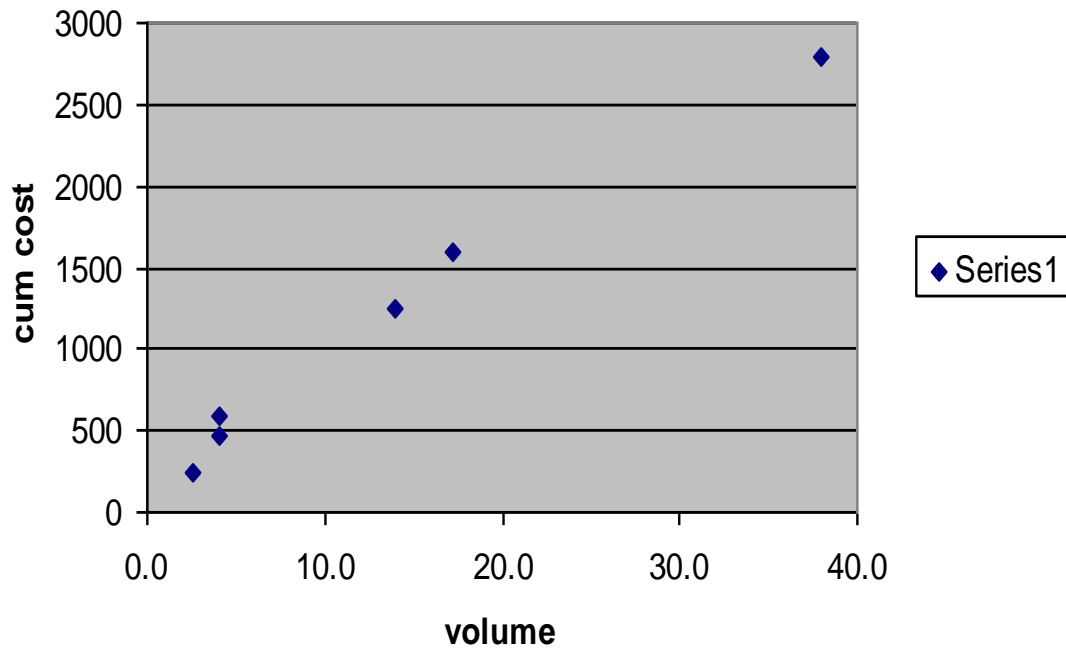
Unit Total Labor vs volume



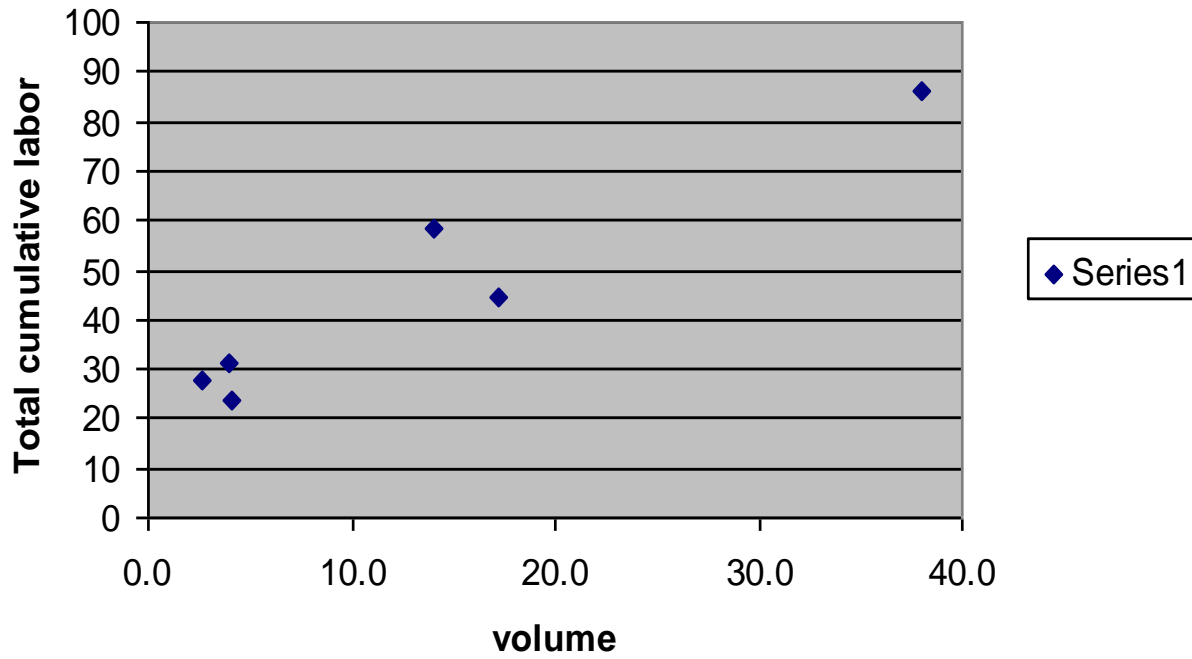
Yield versus volume



Cumulative cost wo pack vs vol



Cumulative Total labor vs vol



Model

Minimize

$$\sum_{k=1}^6 \sum_{j=1}^6 c_k x_{kj} + \sum_{j=1}^6 \sum_{k=1, k \neq j}^6 d_{kj} x_{kj} + \sum_{k=1}^6 \sum_{j=1}^6 t_{kj} x_{kj}$$

Cost: Operating costs + duties + Transportation costs

subject to

$$\sum_{j=1}^6 x_{kj} \leq P_k \quad k = 1, \dots, 6 \quad (\text{capacity constraints})$$

$$\sum_{k=1}^6 x_{kj} \geq D_j \quad j = 1, \dots, 6 \quad (\text{fulfill demand})$$

$$x_{kj} \geq 0 \quad j, k = 1, \dots, 6 \quad (\text{produce positive amounts})$$

x_{kj} - amount in hundreds of pounds of Release ease produced in plant k and shipped to market region j

c_k - cost in USD of producing 100 pounds of release ease in plant k

d_{kj} - cost of importing 100 pounds of release ease from plant k into market j (equals full cost in plant k times duty rate of market j)

t_{kj} - cost in USD of transporting 100 pounds of release ease from plant k into market j

Modeling operating costs

- Consider 3 alternatives for variable costs
 1. Use all the information provided as manufacturing costs
 2. Use only: Raw material costs +
Direct labor, salary, and fringes +
1/2 utilities cost
 3. Same as two but no duties
- Assume breakdown for NA market (26.4 US, 2.6 Canada, 3.0 Mexico)

Alternative 2: Consider only Raw material, Direct labor, .5 utilities

- Total Costs in USD per hundred pound of product

Send to market

Produce	Send to market					
	Mexico	Canada	Venezuela	Frankfurt	Gary	Sunchem
Mexico	80	91	134	100	95	100
Canada	148	78	136	99	89	97
Venezuela	172	105	95	119	111	116
Frankfurt	118	73	112	62	76	79
Gary	144	78	134	92	72	91
Sunchem	216	123	199	139	130	110

- Output from the model (hundreds of pounds)

Send to market

Produce	Send to market						Cap. Used
	Mexico	Canada	Venezuela	Frankfurt	Gary	Sunchem	
Mexico	30000	0	0	0	32000	0	28%
Canada	0	26000	0	0	11000	0	100%
Venezuela	0	0	45000	0	0	0	100%
Frankfurt	0	0	115000	200000	36000	119000	100%
Gary	0	0	0	0	185000	0	100%
Sunchem	0	0	0	0	0	0	0%

Alternative 3: Consider only Raw material, Direct labor, .5 utilities, but no duties

- Total Costs in USD per hundred pound of product

Send to market

Produce	Mexico	Canada	Venezuela	Frankfurt	Gary	Sunchem
	Mexico	80	91	87	91	91
Canada	89	78	87	90	84	91
Venezuela	102	105	95	108	105	109
Frankfurt	72	73	74	62	73	75
Gary	82	78	83	82	72	85
Sunchem	124	123	122	124	123	110

- Output from the model (million pounds)

Send to market

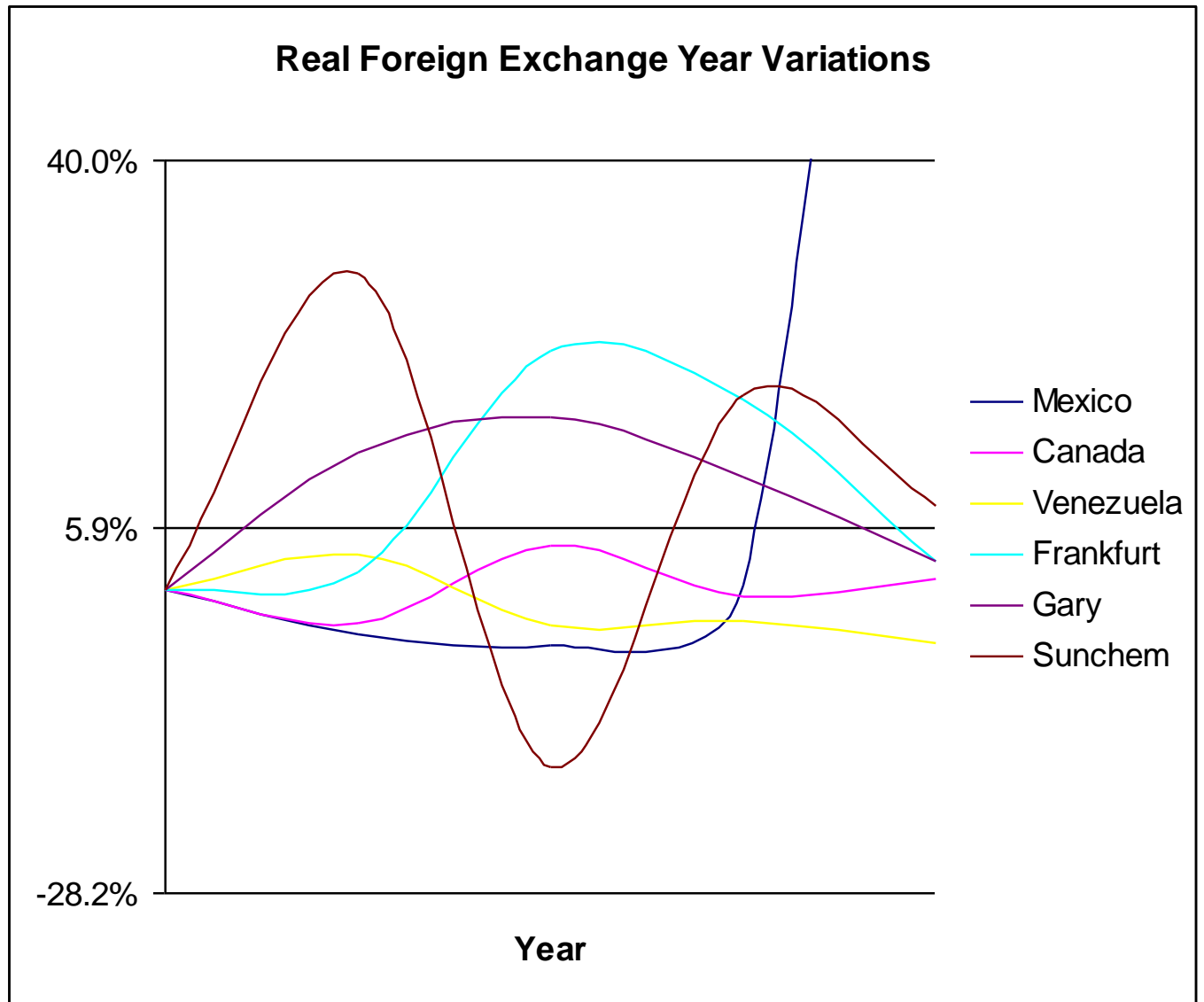
Produce	Mexico	Canada	Venezuela	Frankfurt	Gary	Sunchem	Cap. Used
	Mexico	30000	0	77000	0	0	0
Canada	0	26000	0	0	11000	0	100%
Venezuela	0	0	0	0	0	0	0%
Frankfurt	0	0	83000	200000	68000	119000	100%
Gary	0	0	0	0	185000	0	100%
Sunchem	0	0	0	0	0	0	0%

Alternative 1: All manufacturing costs



Image by MIT OpenCourseWare.

Changes with
exchange rate
scenarios



Correlation					
	<i>Mexico</i>	<i>Canada</i>	<i>Venezuela</i>	<i>Frankfurt</i>	<i>Sunchem</i>
Mexico	1				
Canada	0.32	1.00			
Venezuela	-0.83	-0.53	1.00		
Frankfurt	0.56	0.59	-0.85	1.00	
Sunchem	0.59	0.18	-0.48	0.63	1

Year-to-year exchange rate changes

	Mexico	Canada	Venezuela	Frankfurt	Gary	Sunchem
1982	142.6%	1.1%	-4.9%	2.7%	2.8%	7.9%
1981	0.4%	-0.5%	-2.8%	17.8%	10.6%	18.2%
1980	-5.1%	4.1%	-3.3%	22.4%	16.1%	-16.5%
1979	-4.2%	-3.0%	3.4%	1.7%	12.8%	29.5%
1978	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Annual Variations Real FX vs USD

(cost in mm USD)

Mexico 1981 to 1982: 23.29 to 56.50!

Impact of exchange rates on allocations and costs: Assume costs changes similar to years following (eg 81 to 82)
 Base case is 78.92. Assume 35% of materials and other costs vary

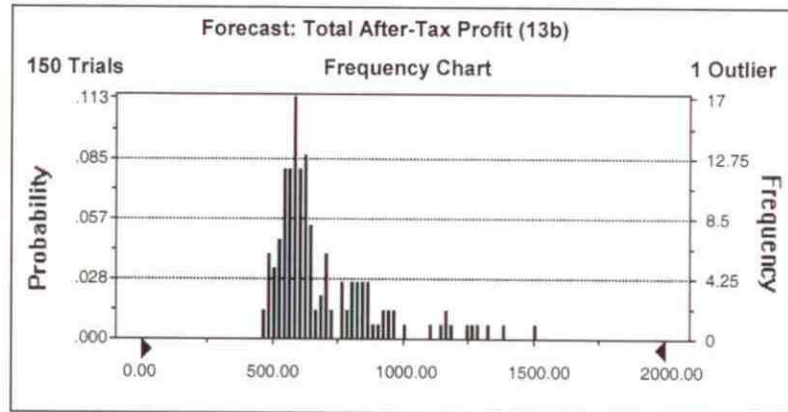
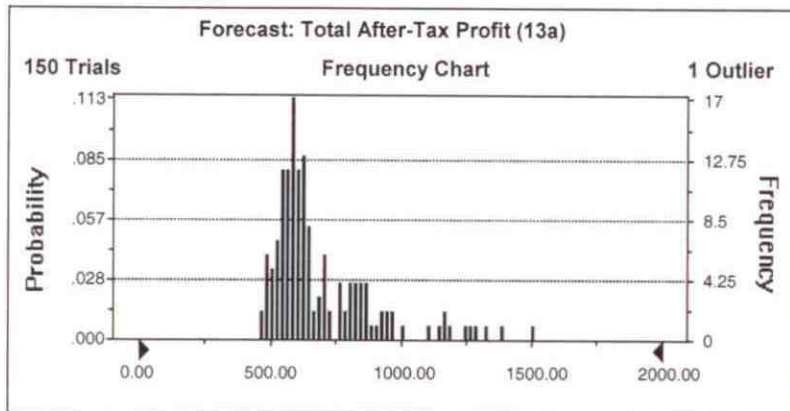
	Base	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Expected Costs	78.92	72.33	69.39	66.63	66.58	68.03
Utilization						
Mexico	28%	100%	100%	100%	100%	100%
Canada	100%	70%	70%	70%	70%	70%
Venezuela	100%	100%	100%	100%	100%	100%
Frankfurt	100%	100%	100%	100%	100%	100%
Gary	100%	21%	21%	21%	21%	21%
Sunchem	0%	0%	0%	0%	0%	0%

Impact of exchange rates on allocations and costs: Assume costs changes similar to preceding years (eg 82 to 81)

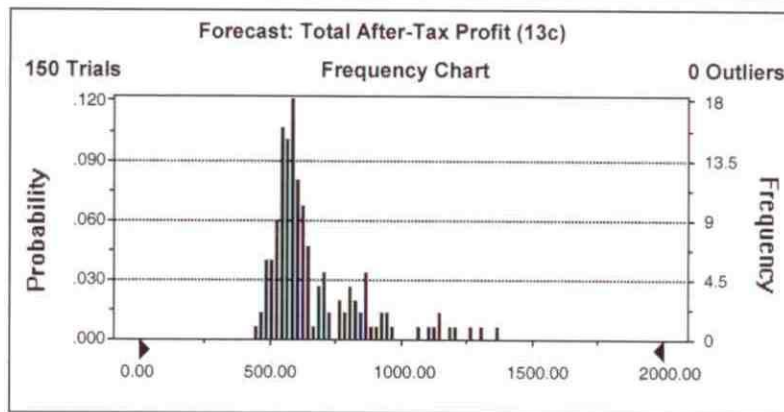
	Base	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10
Expected Costs	78.92	81.13	84.38	87.71	87.96	86.79
Utilization						
Mexico	28%	28%	28%	28%	28%	28%
Canada	100%	100%	100%	100%	100%	100%
Venezuela	100%	100%	100%	100%	100%	100%
Frankfurt	100%	100%	100%	100%	100%	100%
Gary	100%	100%	100%	100%	100%	100%
Sunchem	0%	0%	0%	0%	0%	0%

Local Pricing Strategy

Accounting for risk in both market demand and prices/exchange rate risk, the option value of managerial flexibility can be captured



6 plants open



5 plants open
Optimal!

3 plants open

Some summary points

- **Strategy issues**
 - Scale and cost issues
 - Local issues (production, presence)
 - Plant roles
 - Flexibility
 - Technology transfer
- **Analysis issues**
 - Use of measures (plant and system)
 - Role of fixed costs
 - Optimization or allocation analysis
 - Analyzing flexibility (e.g. scenario generation)

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15.769 Operations Strategy
Fall 2010

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