Spreadsheet Model Manipulation Exercise

Problem Statement

You have in hand a technical cost model of the injection molding process, implemented as an Excel spreadsheet. You have been asked to perform a series of analyses of the costs of making a small part with the following characteristics:

Part Material:	Generic Polypropylene (homopolymer) - #4
Part Mass:	250 grams
Maximum Wall Thickness:	5 mm
Average Wall Thickness:	4 mm
Projected Area:	400 sq cm
Annual Production Volume:	250,000 units/year
Years of Production:	5 years

Key Questions To Answer:

1. What is the cost to produce this part? What is the breakdown between fixed and variable costs? How does this breakdown vary as production volume varies between 25,000 and 500,000 units per year?
2. The base case analyses are done assuming a two shift operation. How do they change if the production is done on a one shift basis? A three shift basis?
3. How does the cost structure change with changes in the production lifetime of the product? (range from 3 to 8 years)

Format of Your Responses:

We would prefer that you answer question 1 using a single pie chart and a single area plot; question 2 with a single X-Y plot; and question 3 we leave to your discretion.

Exercise Objectives:

The objectives of this exercise are:

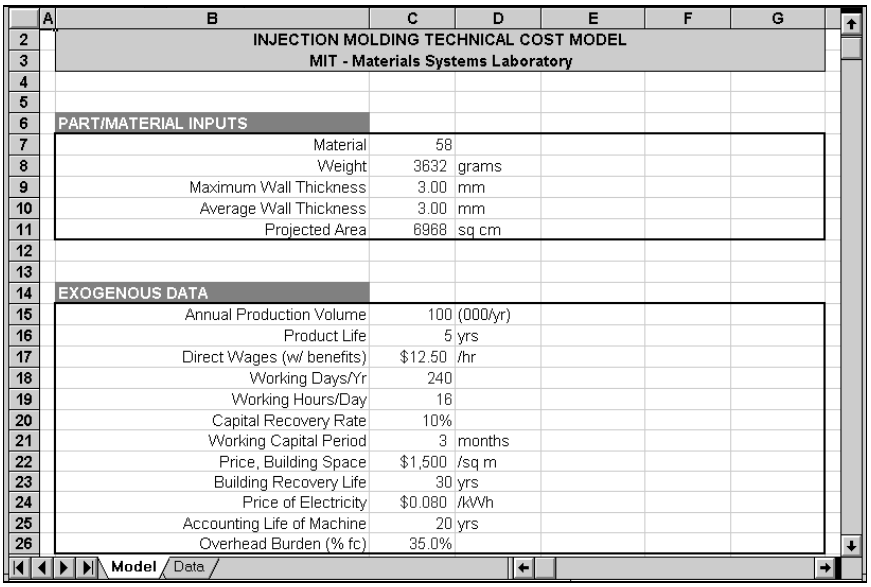
1. To give you a hands-on experience with a robust technical cost model
2. To assess your facility with spreadsheet analysis methods
3. To assess your facility with spreadsheet presentation tools
4. To evaluate your ability to turn numbers into meaningful conclusions.

Injection Molding Cost Model Summary

The following two figures show the inputs for the technical cost model. Your efforts will focus upon those inputs labeled "PART/MATERIAL INPUTS" and "EXOGENOUS DATA."

Figure 1:

First set of Injection Molding Model Inputs



	B	C	D
2	INJECTION MOLDING TECHNICAL COST MODEL		
3	MIT - Materials Systems Laboratory		
6	PART/MATERIAL INPUTS		
7	Material	58	
8	Weight	3632	grams
9	Maximum Wall Thickness	3.00	mm
10	Average Wall Thickness	3.00	mm
11	Projected Area	6968	sq cm
14	EXOGENOUS DATA		
15	Annual Production Volume	100	(000/yr)
16	Product Life	5	yrs
17	Direct Wages (w/ benefits)	$12.50	/hr
18	Working Days/Yr	240	
19	Working Hours/Day	16	
20	Capital Recovery Rate	10%	
21	Working Capital Period	3	months
22	Price, Building Space	$1,500	/sq m
23	Building Recovery Life	30	yrs
24	Price of Electricity	$0.080	/kWh
25	Accounting Life of Machine	20	yrs
26	Overhead Burden (% fc)	35.0%	

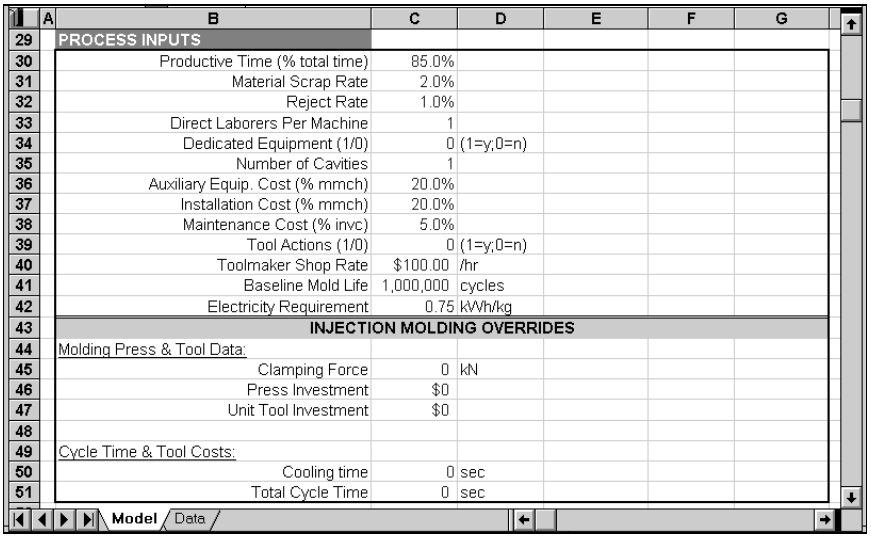
Model | Data

Generally speaking, the labels on the inputs should be sufficient to document the meaning of the required values. A few are described in more detail below:

- Material: This number corresponds to the record in a table on the "Data" sheet of this model. See Figure NN
- Projected Area: The projected area of the part in the plane of the press bed - the area of the shadow that the part would project if illuminated from above.
- Product Life: The years over which production of the part will occur (not the service life of the product!)
- Capital Recovery Rate: The model calculates capital costs on the basis of the opportunity cost of the invested capital. The capital recovery rate is defined here as the opportunity cost of capital. Similarly, the other "Life" terms are used to calculate the amortization periods appropriate to each of these opportunity costs.

Figure 2:

Second set of Injection Molding Model Inputs



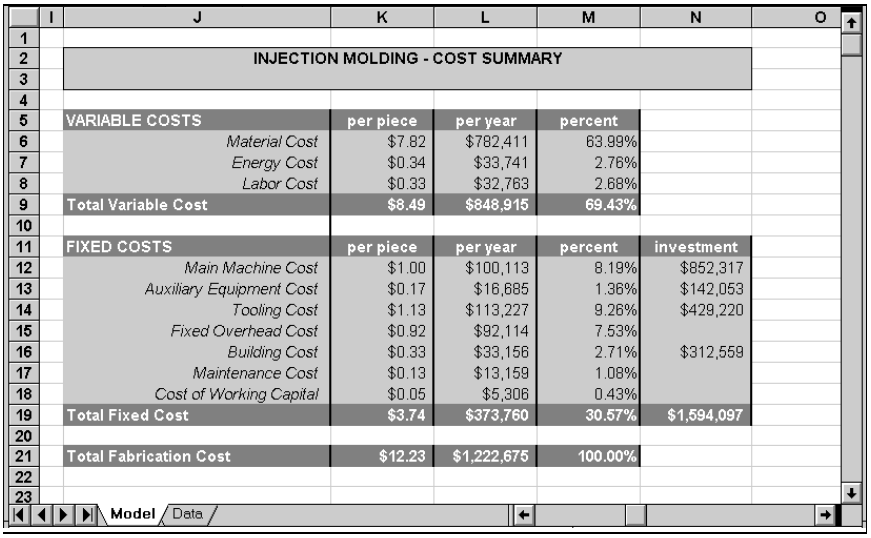
	B	C	D
29	PROCESS INPUTS		
30	Productive Time (% total time)	85.0%	
31	Material Scrap Rate	2.0%	
32	Reject Rate	1.0%	
33	Direct Laborers Per Machine	1	
34	Dedicated Equipment (1/0)	0	(1=y;0=n)
35	Number of Cavities	1	
36	Auxiliary Equip. Cost (% mmch)	20.0%	
37	Installation Cost (% mmch)	20.0%	
38	Maintenance Cost (% invc)	5.0%	
39	Tool Actions (1/0)	0	(1=y;0=n)
40	Toolmaker Shop Rate	$100.00	/hr
41	Baseline Mold Life	1,000,000	cycles
42	Electricity Requirement	0.75	kWh/kg
43	INJECTION MOLDING OVERRIDES		
44	Molding Press & Tool Data:		
45	Clamping Force	0	kN
46	Press Investment	$0	
47	Unit Tool Investment	$0	
48			
49	Cycle Time & Tool Costs:		
50	Cooling time	0	sec
51	Total Cycle Time	0	sec

Model / Data

Generally speaking, the overrides should ALL be set to zero. You may wish to explore the implications of machine dedication on part costs.

Figure 3

Primary Cost Summary Injection Molding Model



	J	K	L	M	N
2	INJECTION MOLDING - COST SUMMARY				
5	VARIABLE COSTS	per piece	per year	percent	
6	*Material Cost*	$7.82	$782,411	63.99%	
7	*Energy Cost*	$0.34	$33,741	2.76%	
8	*Labor Cost*	$0.33	$32,763	2.68%	
9	**Total Variable Cost**	**$8.49**	**$848,915**	**69.43%**	
11	FIXED COSTS	per piece	per year	percent	investment
12	*Main Machine Cost*	$1.00	$100,113	8.19%	$852,317
13	*Auxiliary Equipment Cost*	$0.17	$16,685	1.36%	$142,053
14	*Tooling Cost*	$1.13	$113,227	9.26%	$429,220
15	*Fixed Overhead Cost*	$0.92	$92,114	7.53%	
16	*Building Cost*	$0.33	$33,156	2.71%	$312,559
17	*Maintenance Cost*	$0.13	$13,159	1.08%	
18	*Cost of Working Capital*	$0.05	$5,306	0.43%	
19	**Total Fixed Cost**	**$3.74**	**$373,760**	**30.57%**	**$1,594,097**
21	**Total Fabrication Cost**	**$12.23**	**$1,222,675**	**100.00%**	

Model / Data

Figure 3 presents the basic cost estimate, broken down by cost element and shown on a per piece and per year basis. Where appropriate, the total capital costs are also given.

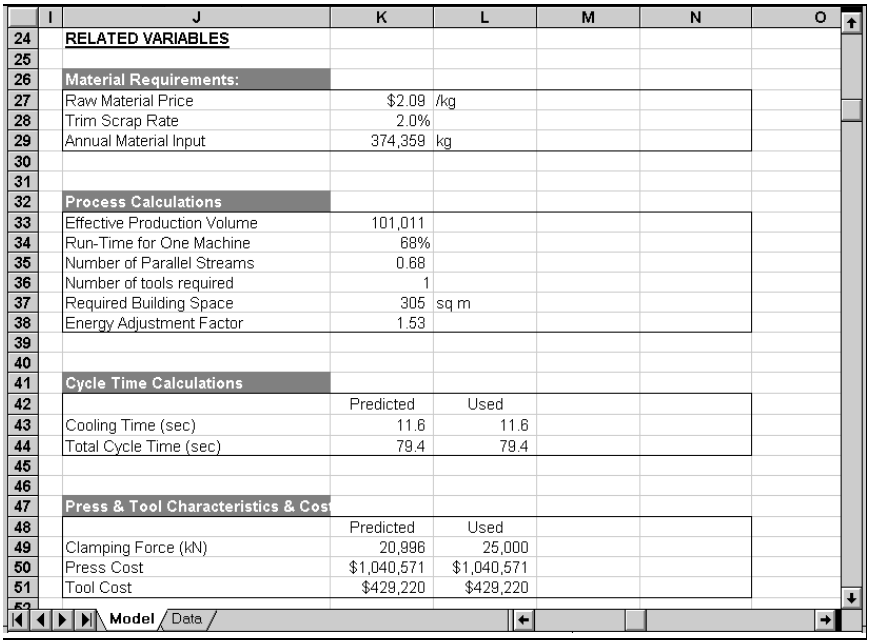
Directly below this cost summary is a table shown in Figure 4, where supplemental calculation results are presented. These computations include:

- estimated cycle times (the time to process a single part
- estimated press tonnages
- capacity utilization

These values can be useful in determining the basis for some of the cost results given in Figure 3.

Figure 4

Suplemental Cost Estimation Outputs



	J	K	L
24	**RELATED VARIABLES**		
25			
26	**Material Requirements:**		
27	Raw Material Price	$2.09	/kg
28	Trim Scrap Rate	2.0%	
29	Annual Material Input	374,359	kg
30			
31			
32	**Process Calculations**		
33	Effective Production Volume	101,011	
34	Run-Time for One Machine	68%	
35	Number of Parallel Streams	0.68	
36	Number of tools required	1	
37	Required Building Space	305	sq m
38	Energy Adjustment Factor	1.53	
39			
40			
41	**Cycle Time Calculations**		
42		Predicted	Used
43	Cooling Time (sec)	11.6	11.6
44	Total Cycle Time (sec)	79.4	79.4
45			
46			
47	**Press & Tool Characteristics & Cost**		
48		Predicted	Used
49	Clamping Force (kN)	20,996	25,000
50	Press Cost	$1,040,571	$1,040,571
51	Tool Cost	$429,220	$429,220

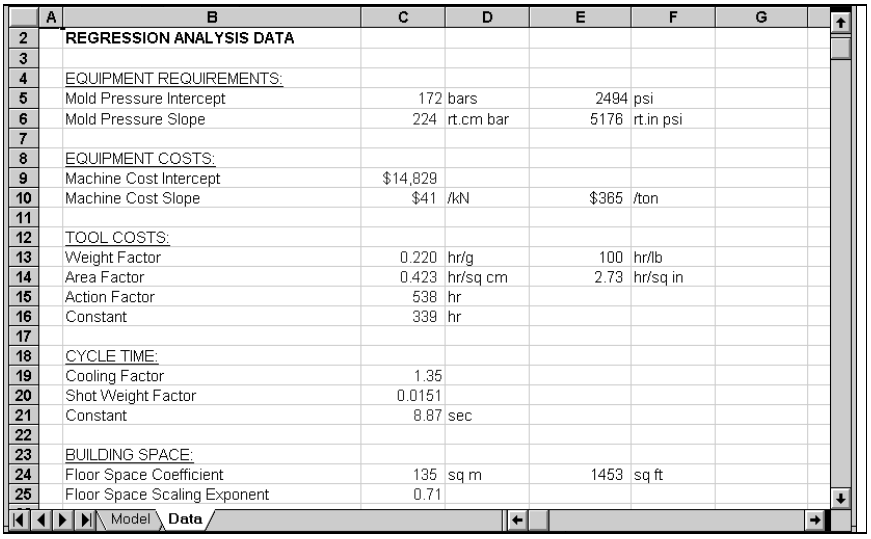
Model | Data

In addition to the cost estimation sheet, there is a "Data" sheet, where the parameters used for certain internal calculations are set. Generally speaking, these data are changed only following specific analyses.

However, Figure 6 shows a table that may undergo frequent revision. This is the database of injection moldable materials and includes not only the prices and names of these materials, but also several physical and processing characteristics. The index number for each of these materials is used as an input in the "Material" cell shown in Figure 1.

Figure 5

Regression Analysis Data - Basis For Internal Cost Estimations

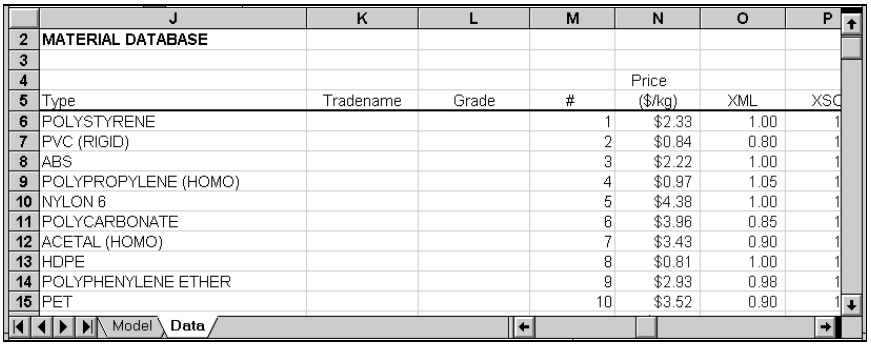


	B	C	D	E	F
2	**REGRESSION ANALYSIS DATA**				
3					
4	EQUIPMENT REQUIREMENTS:				
5	Mold Pressure Intercept	172	bars	2494	psi
6	Mold Pressure Slope	224	rt.cm bar	5176	rt.in psi
7					
8	EQUIPMENT COSTS:				
9	Machine Cost Intercept	$14,829			
10	Machine Cost Slope	$41	/kN	$365	/ton
11					
12	TOOL COSTS:				
13	Weight Factor	0.220	hr/g	100	hr/lb
14	Area Factor	0.423	hr/sq cm	2.73	hr/sq in
15	Action Factor	538	hr		
16	Constant	339	hr		
17					
18	CYCLE TIME:				
19	Cooling Factor	1.35			
20	Shot Weight Factor	0.0151			
21	Constant	8.87	sec		
22					
23	BUILDING SPACE:				
24	Floor Space Coefficient	135	sq m	1453	sq ft
25	Floor Space Scaling Exponent	0.71			

Model | Data

Figure 6

Injection Molding
Materials Database



	J	K	L	M	N	O	P
2	**MATERIAL DATABASE**						
3							
4					Price		
5	Type	Tradename	Grade	#	($/kg)	XML	XSC
6	POLYSTYRENE			1	$2.33	1.00	1
7	PVC (RIGID)			2	$0.84	0.80	1
8	ABS			3	$2.22	1.00	1
9	POLYPROPYLENE (HOMO)			4	$0.97	1.05	1
10	NYLON 6			5	$4.38	1.00	1
11	POLYCARBONATE			6	$3.96	0.85	1
12	ACETAL (HOMO)			7	$3.43	0.90	1
13	HDPE			8	$0.81	1.00	1
14	POLYPHENYLENE ETHER			9	$2.93	0.98	1
15	PET			10	$3.52	0.90	1

Model | Data