

3.044 Problem Set 3

Economics of Materials Processing
Due March 2, 2005

Problem 1

For each of the following set of paired alternatives identify whether you would prefer option A, B, or that you are indifferent. For each case, assume a discount rate of 10%.

- \$1000 today vs. \$1200 in 2 years
- \$385.54 today vs. \$1000 in 10 years
- Consider the two sets of cash flows represented in the following table

Time Period	Option 1	Option 2
0	-\$100	-\$100
1	\$10	\$70
2	\$30	\$50
3	\$50	\$30
4	\$70	\$10

Problem 2

Compute the value of 10 equal payments which would have the same value as \$10,000 received (or expended) today. Assume a discount rate of 8% / period

Problem 3

Consider a three step process (Process A → Process B → Process C) as described below:

Process Characteristics

	Cycle Time (sec)	Yield	Equipment Cost
Process A	60	95%	\$1,000,000
Process B	90	95%	\$500,000
Process C	45	95%	\$2,000,000

- How many units must per processed through A to create a net of 100,000 good parts through the whole process?
- If it were possible to improve the yield of one process which would have the largest effect on Total process yield? Cost?

Problem 4

Consider the polymer extrusion processing described in Problem 4 from problem set #2. In order to ensure proper dimensional control the extrusion must remain on a carefully designed runout table before being cut to length. Assume the following information describing this process.

Overall Scenario Description		
Annual Production Goal	1,000,000	good parts
Product Length	3	m
Product Diameter	0.02	m
Extrusion rate	0.1	m/s
Cooling time	20	sec
General financial parameters		
Operating conditions		
Days per year	365	
Hours per day	24	
Discount rate	12%	
Average equipment life	12	years
Processing Characteristics		
Extruded part reject rate	5%	
Cost of extruder	\$1,000,000	
Cost per runout	\$1,000	\$/m
Material Properties		
Density	920	kg/m ³
Price	\$1	/kg

- How long of a runout table is required?
- How much extrusion time is required to meet the production goal?
- How many extruders will be required to meet the production goal?
- Assuming that the only investment involves the extruder and the runout tables, how much capital investment will be required for this facility?
- Assuming that this part only pays for the machine time that it uses (i.e., non-dedicated equipment), what will be the cost of equipment per 3m part? What will this figure be if this plant only produces this one part (i.e., dedicated equipment)?
- For an idealized plant (i.e., one with just enough equipment to meet production goals) plot out materials cost, dedicated equipment cost, and non-dedicated equipment cost for the following production volumes: 100,000; 500,000; 1 million and 10 million.
- Polymer supplier ABC has a new material which will allow you to increase extrusion rate by 25%. How much more should you be willing to pay for this new material?