2-20 Let X = number of weeks to delay harvesting
and R = total revenue as a function of X

R = (1,000 bushels + 1,000 bushels • X) (\$3.00/bushel - \$0.50/bushel • X)

$R = \$3,000 + \$2,500X - \$500X^2$

$$\frac{dR}{dX} = 2,500 - 1,000X = 0$$

So $X^* = 2.5$ weeks

$$\frac{d^2R}{dX^2} = -1,000$$ so, we have a stationary point, X^*, that is a maximum.

Maximum revenue = $\$3,000 + \$2,500(2.5) - 500(2.5)^2$ = \$6,125

2-22
$$C_T = C_o + C_c = knv^2 + \frac{\$1,500n}{v}$$

$$\frac{dC_T}{dv} = 0 = 2kv - \frac{1,500}{v^2} = kv^3 - 750$$

$$v = \sqrt[3]{\frac{750}{k}}$$

To find k, we know that

$$\frac{C_o}{n} = \$100\text{/mile at } v = 12 \text{ miles/hr}$$

$$\frac{C_o}{n} = kv^2 = k(12)^2 = 100$$

and

$$k = 100/144 = 0.6944$$

so, $$v = \sqrt[3]{\frac{750}{0.6944}} = 10.25 \text{ miles/hr}.$$

The ship should be operated at an average velocity of 10.25 mph to minimize the total cost of operation and perishable cargo.

Note: The second derivative of the cost model with respect to velocity is:

$$\frac{d^2C_T}{dv^2} = 1.388n + 3,000\frac{n}{v^3}$$

The value of the second derivative will be greater than 0 for $n > 0$ and $v > 0$. Thus we have found a minimum cost velocity.

2-26 Relevant costs: tool cost, operator, tool changer, overhead
Criterion: Minimum cost per piece
Assumption: All output can be used

Cycle = Production time + Tool grinding time

Carbon Steel: Cycle = 3 hours + 1 hour = 4 hours
Number of cycles = 10

Tool cost	= $400/10 cycles	= $40 / cycle
Operator	= ($14/hr)(4 hrs/cycle)	= $56 / cycle
Tool Changer	= ($20/hr)(1 hr/cycle)	= $20 / cycle
Overhead	= ($28/hr)(4 hrs/cycle)	= $112 / cycle
		$228 / cycle

$$\text{Cost / piece} = \frac{\$228 \text{ / cycle}}{(3 \text{ hrs / cycle})(100 \text{ pc / hr})} = \$0.76 \text{ / piece}$$

Tool Steel: Cycle = 6 hours + 1 hour = 7 hours
Number of cycles = 5

Tool cost	= $1200/5 cycles	= $240 / cycle
Operator	= ($14/hr)(7 hrs/cycle)	= $98 / cycle
Tool Changer	= ($20/hr)(1 hr/cycle)	= $20 / cycle
Overhead	= ($28/hr)(7 hrs/cycle)	= $196 / cycle
		$554 / cycle

$$\text{Cost / piece} = \frac{\$554 \text{ / cycle}}{(6 \text{ hrs / cycle})(130 \text{ pc / hr})} = \$0.71 \text{ / piece}$$

Assuming all else equal (quality, etc.) choose tool steel to minimize cost/piece.

2-32 Strategy: Select the design which minimizes total cost for 95,000 units/year (Rule 2). Ignore the sunk costs because they do not affect the analysis of future costs.

(a) Design A

Total cost/95,000 units = (16 hrs/1,000 units)($18.60/hr)(95)
+ (4.5 hrs/1,000 units)($16.90/hr)(95)
= $35,497, or $0.37365/unit

Design B

Total cost/95,000 units = (7 hrs/1,000 units)($18.60/hr)(95)
+ (12 hrs/1,000 units)($16.90/hr)(95)
= $31,635, or $0.333/unit

Select Design B

(b) Savings of Design B over Design A are:

Annual savings (95,000 units) = $35,497 - $31,635 = $3,862/yr.

Or, savings/unit = $0.37365 - $0.333 = $0.04065/unit.

2-36 Profit/oz. (Method A) = $350/oz. - ($220/t-water)/(0.9 oz./t-water)(0.85)
= $62.42/oz.

Profit/oz. (Method B) = $350/oz. - ($160/t-water)/(0.9 oz./t-water)(0.65)
= $76.50/oz.

Select Method B