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Solutions for H.W. Set #3

3.8

For the manual operation, there is no fixed cost and the variable cost per unit is

$$2 \times \$9.00/hr \div 36 \text{ units}/hr = \$0.5/\text{unit}$$

So the total cost is $0.5Q$, where Q is the no. of units.

For the automated operation, the fixed cost is

$$\$125{,}000\,(A/P,\ 25\%,\ 4) + \$3{,}000$$

$$= \$125{,}000 \times 0.4235 + \$3{,}000$$

$$= \$55{,}938$$

and the variable cost per unit is

$$\$0.05/kWh \times 50\ kW \div 100 \text{ units}/hr = \$0.025/\text{unit}$$

So the total cost is $55{,}938 + 0.025Q$

At the breakeven point,

$$55{,}938 + 0.025Q = 0.5Q$$

$$\therefore Q = 117{,}763 \text{ units/year}$$

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3.12 (a) Use two machines

Here we assume that the operator is able to operate both machines at the same time. Since there are two machines, the production rate becomes 40 units/h.

$$\text{fixed cost} = 2 \times \$22{,}930 = \$45{,}860$$

$$\text{Variable cost} = (\$10/h \div 40 \text{ units}/h)(1+0.3)$$

$$= \$0.325/\text{unit}$$

$$\text{Total cost} = 45{,}860 + 0.325Q$$

$$\text{Unit cost} = \frac{45{,}860}{Q} + 0.325$$

To find the breakeven point, let

$$Q = 45{,}860 + 0.325Q$$

$$Q = 67{,}940 \text{ units}$$

It takes $67{,}940/40 = 1{,}698$ hours to reach the breakeven point. Since $1698 < 2{,}000$, profits can be generated with this alternative if the annual demand is higher than 67,940 units.

(b) Use a two-shift operation

The labor cost per unit for the second shift is

$$[\$10 \times (1+0.3) + 0.2]/20 = \$0.66$$

Considering both shifts, the labor cost per unit is

$$\frac{1}{2}(0.65+0.66) = 0.655/\text{unit}$$

Total cost $= 22{,}930 + 0.655Q$

Unit cost $= \dfrac{22{,}930}{Q} + 0.655$

To reach the breakeven point,

$$Q = 22{,}930 + 0.655Q$$

$$Q = 66{,}464 \text{ units}$$

It takes $\dfrac{66{,}464}{20} = 3{,}323$ hours to reach the breakeven point. Since there are two shifts, and $3{,}323 < 4{,}000$, profits can be generated with this alternative if the annual demand is higher than 66,464 units

(c) Use overtime at time-and-a-half labor rate

The labor cost per unit for overtime is

$$[\$10 \times (1+0.3) + \$5]/20 = \$0.9/\text{unit}$$

Overtime is needed after $Q > 40{,}000$. Thus for $Q > 40{,}000$

Total cost $= 22{,}930 + 0.65(40{,}000) + 0.9(Q - 40{,}000)$

$= 12{,}930 + 0.9Q$

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$$\text{Unit cost} = \frac{12{,}930}{Q} + 0.9 \quad (\text{for } Q > 40{,}000)$$

To find the breakeven point, let

$$Q = 12{,}930 + 0.9Q$$

$$\therefore Q = 129{,}300 \text{ units}$$

It takes $129{,}300/20 = 6{,}465$ hours to produce so many units. Apparently one operator cannot work so many hours, and the use of overtime is not a viable alternative.

3.13 (a) The annual cost of storage floor space is

$$500{,}000(A/P, 25\%, 20) - 100{,}000(A/F, 25\%, 20) + 120{,}000$$

$$= 500{,}000 \times 0.2529 - 100{,}000 \times 0.0029 + 120{,}000$$

$$= 246{,}160$$

The floor space cost per unit area is

$$\frac{246{,}160}{16{,}000 \times 80\%} = \$19.23/ft^2$$

The storage space cost for 5 ft^2 is

$\$19.23 \times 5 = \$96.15$ per year

The interest cost for \$125 is

$\$125 \times 25\% = \$31.25$ per year

The cost to store the item for 3 months is

$$(\$96.15 + \$31.25) \times \frac{3}{12} = \$31.85$$

(b) The storage rate is

$$s = \frac{96.15}{125} = 77\%$$

The holding cost rate is

$$h = i + s = 25\% + 77\% = 102\%$$

(c) Since the annual cost of storage space is \$246,160, the storage rate is 77%, and the holding cost rate is 102%, the total cost of inventory in the warehouse on an annual basis is

$$\$246{,}160\left(\frac{102}{77}\right) = \$326{,}080$$