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

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

so the total cost is \(0.5Q\), where \(Q\) is the no. of units.

For the automated operation, the fixed cost is

\[ \$125,000 \left( \frac{A/F}{100 \%, 25\%, 4} \right) + \$3,000 \]

\[ = \$125,000 \times 0.4235 + \$3,000 \]

\[ = \$55,938 \]

and the variable cost per unit is

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

so the total cost is \(55,938 + 0.025Q\)

At the breakeven point,

\[ 55,938 + 0.025Q = 0.5Q \]

\[ \therefore Q = 117,763 \text{ units/yr} \]
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/hr.

\[
\text{fixed cost} = 2 \times 22,930 = 45,860
\]
\[
\text{Variable cost} = \left( \frac{\$0.30}{\text{hr}} \div 40 \text{ units/hr} \right) (1+0.3) = 0.325/\text{unit}
\]
\[
\text{Total cost} = 45,860 + 0.325Q
\]
\[
\text{Unit cost} = \frac{45,860 + 0.325Q}{Q}
\]

To find the break-even point, let
\[
Q = 45,860 + 0.325Q
\]
\[
Q = 67,940 \text{ units}
\]

It takes 67,940/40 = 1,698 hours to reach the break-even point. Since 1,698 < 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
\[
\left[ \$10 \times (1+0.3) + 0.2 \right]/20 = \$0.66
\]
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 = \(\frac{22,930}{Q} + 0.655\)

To reach the breakeven point,
\[Q = 22,930 + 0.655Q\]
\[Q = 66,464 \text{ units}\]

It takes \(\frac{66,464}{20} = 3,323\) 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
\[66,464 \text{ units}\]

(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 = \(22,930 + 0.65(40,000) + 0.9(Q - 40,000)\)
\[= 12,930 + 0.9Q\]
Unit cost = \( \frac{12,930}{Q} + 0.9 \)  \( \text{for } Q > 40,000 \)

To find the breakeven point, let

\[ Q = 12,930 + 0.9 Q \]

\[ Q = 129,300 \text{ units} \]

It takes \( \frac{129,300}{20} = 6,465 \) 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

\[ 500,000 \times (A^p, 25\%, 20) - 100,000 \times (A^p, 25\%, 20) \]

\[ + 120,000 \]

\[ = 500,000 \times 0.2529 - 100,000 \times 0.0029 + 120,000 \]

\[ = 246,160 \]

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

\[ $19.23 \times 5 = $96.15 \text{ per year} \]

The interest cost for $125 is

\[ $125 \times 25\% = $31.25 \text{ per year} \]
(H.W. Set #3)

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

\[h = i + S = 25\% + 77\% = 102\%\]

annual

(c) Since the 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

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