4.11  a. Which alternative is best?

\[
TC = FC + v(Q)
\]

\[
TC_{\text{Buy}} = 18.60(185,000) = $3,441,000
\]
\[
TC_{\text{Man.}} = 260,000 + 16.75(185,000) = $3,358,750 ****
\]
\[
TC_{\text{Auto.}} = 875,000 + 16.25(185,000) = $3,881,250
\]

The company should produce the part using manual assembly.

b. At what annual volume of the part would the company be indifferent between buying the part and producing the part with automated assembly?

\[
TC_{\text{Buy}} = TC_{\text{Auto}}
\]

\[
0 + 18.60(Q) = 875,000 + 16.25(Q)
\]

\[
2.35(Q) = 875,000
\]

\[
Q = 372,340 \text{ parts}
\]

c. At what annual volume of the part would the company be indifferent between producing the part with manual assembly and with automated assembly?

\[
TC_{\text{Man}} = TC_{\text{Auto}}
\]

\[
260,000 + 16.75(Q) = 875,000 + 16.25(Q)
\]

\[
0.50(Q) = 615,000
\]

\[
Q = 1,230,000 \text{ parts}
\]

d. What other considerations should be important in the decision?

Product quality, dependability and speed of delivery, flexibility.
4.12  a. If Q = 125,000, which copier should be purchased, based on annual cost?

\[ TC = FC + v(Q) \]

\[ TC_Z = 2,760 + .061(125,000) = \$10,385 \]

\[ TC_M = 4,135 + .052(125,000) = \$10,635 \]

If Q = 125,000 the Zenon copier should be purchased.

b. If Q = 165,000, which copier should be purchased, based on annual cost?

\[ TC_Z = 2,760 + .061(165,000) = \$12,825 \]

\[ TC_M = 4,135 + .052(165,000) = \$12,715 \]

If Q = 165,000 the Matrox copier should be purchased.

c. At what annual volume would Mr. Bordoli be indifferent to the two machines, based on annual cost?

\[ TC_Z = TC_M \]

\[ 2,760 + .061(Q) = 4,135 + .052(Q) \]

\[ 1,375 = .009Q \]

\[ Q = 152,777.8 \text{ copies} \]

d. For what range of volumes would each machine be preferred?

Purchase Zenon if 0-152,777 copies expected annually.
Purchase Matrox if 152,778+ copies expected annually.

e. What factors other than annual cost should be considered?

Copy quality, copy speed, machine reliability, maintenance requirements, and other performance features of each copier.
4.14  a. If $Q = 125,000$, which copier should be purchased, based on annual cost?

\[ TC = FC + v(Q) \]

\[ TC_Z = 2,760 + .061(125,000) = $10,385 \]
\[ TC_M = 4,135 + .052(125,000) = $10,635 \]
\[ TC_C = 4,865 + .043(125,000) = $10,240 \]

If $Q = 125,000$ the Cantrell copier should be purchased.

b. If $Q = 165,000$, which copier should be purchased, based on annual cost?

\[ TC_Z = 2,760 + .061(165,000) = $12,825 \]
\[ TC_M = 4,135 + .052(165,000) = $12,715 \]
\[ TC_C = 4,865 + .043(165,000) = $11,960 \]

If $Q = 165,000$ the Cantrell copier should be purchased.

c. At what annual volume would Mr. Bordoli be indifferent to the following pairs of machines, based on annual cost?

\[ TC_1 = TC_2 \]
\[ TC = FC + v(Q) \]

Zenon vs. Matrox: \( (TC_Z = TC_M) \)
\[ 2,760 + .061(Q) = 4,135 + .052(Q) \]
\[ 1,375 = .009Q \]
\[ Q = 152,777.8 \text{ copies} \]

Matrox vs. Cantrell: \( (TC_M = TC_C) \)
\[ 4,135 + .052(Q) = 4,865 + .043(Q) \]
\[ .009Q = 730 \]
\[ Q = 81,111.1 \text{ copies} \]

Zenon vs. Cantrell: \( (TC_Z = TC_C) \)
\[ 2,760 + .061(Q) = 4,865 + .043(Q) \]
\[ .018Q = 2,105 \]
\[ Q = 116,944.4 \text{ copies} \]
4.14  Continued

d. For what range of volumes would each machine be preferred?

<table>
<thead>
<tr>
<th></th>
<th>Zenon vs Matrox</th>
<th>Matrox vs Cantrell</th>
<th>Zenon vs Cantrell</th>
<th>Final Choice</th>
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<tr>
<td>0 - 81,111</td>
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<td>Matrox</td>
<td>Zenon</td>
<td>Zenon</td>
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<td>81,112 - 116,944</td>
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<td>Cantrell</td>
<td>Zenon</td>
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<tr>
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<td>Cantrell</td>
<td>Cantrell</td>
<td>Cantrell</td>
</tr>
<tr>
<td>152,777 or more</td>
<td>Matrox</td>
<td>Cantrell</td>
<td>Cantrell</td>
<td>Cantrell</td>
</tr>
</tbody>
</table>

Purchase Zenon if 0-116,944 copies expected annually.
Purchase Cantrell if 116,945 or more copies expected annually.
There is no annual copy volume for which the Matrox copier would be preferred.

An alternative way of making the above determination is to construct a table of annual volumes and costs for the three machines, using values in between the quantities of indifference found in part c, as a way to help identify the preferred range for each machine. This is in view of the linear behavior of the total cost function for each alternative.

<table>
<thead>
<tr>
<th></th>
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<th>Unit Variable Cost</th>
<th>Quantity</th>
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<tbody>
<tr>
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<td>0</td>
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<tr>
<td>Zenon</td>
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<tr>
<td>Cantrell</td>
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</tbody>
</table>

e. What factors other than annual cost should be considered?

Copy quality, copy speed, machine reliability, maintenance requirements, and other performance features of each copier.