21-18  Capital budgeting methods, no income taxes.

The table for the present value of annuities (Appendix A, Table 4) shows:
10 periods at 14% = 5.216

1a. Net present value = $28,000 (5.216) – $110,000
   = $146,048 – $110,000 = $36,048

b. Payback period = $110,000 = 3.93 years
   $28,000

c. For a $110,000 initial outflow, the project generates $28,000 in cash flows at the end of each of years one through ten.
   Using either a calculator or Excel, the internal rate of return for this stream of cash flows is found to be 21.96%.

d. Accrual accounting rate of return based on net initial investment:
   Net initial investment = $110,000
   Estimated useful life = 10 years
   Annual straight-line depreciation = $110,000 ÷ 10 = $11,000
   Accrual accounting rate of return = $28,000 – $11,000
   $110,000
   = $17,000 = 15.45%
   $110,000

 e. Accrual accounting rate of return based on average investment:
    Average investment = ($110,000 + $0) / 2
    = $55,000

    Accrual accounting rate of return = $28,000 – $11,000
    $55,000
    = 30.91%.

2. Factors City Hospital should consider include:
   a. Quantitative financial aspects.
   b. Qualitative factors, such as the benefits to its customers of a better eye-testing machine and the employee-morale advantages of having up-to-date equipment.
   c. Financing factors, such as the availability of cash to purchase the new equipment.
21-19  Capital budgeting, income taxes.

1a. Net after-tax initial investment = $110,000

Annual after-tax cash flow from operations (excluding the depreciation effect):

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual cash flow from operation with new machine</td>
<td>$28,000</td>
</tr>
<tr>
<td>Deduct income tax payments (30% of $28,000)</td>
<td>8,400</td>
</tr>
<tr>
<td>Annual after-tax cash flow from operations</td>
<td>$19,600</td>
</tr>
<tr>
<td>Income tax cash savings from annual depreciation deductions</td>
<td>$3,300</td>
</tr>
<tr>
<td>30% × $11,000</td>
<td></td>
</tr>
</tbody>
</table>

These three amounts can be combined to determine the NPV:

Net initial investment;
$110,000 × 1.00  $110,000

10-year annuity of annual after-tax cash flows from operations;
$19,600 × 5.216  102,234

10-year annuity of income tax cash savings from annual depreciation deductions;
$3,300 × 5.216  17,213

Net present value  $9,447

b. Payback period

\[
\text{Payback period} = \frac{\$110,000}{(\$19,600 + \$3,300)}
\]

\[
= \frac{\$110,000}{\$22,900}
\]

= 4.80 years
c. For a $110,000 initial outflow, the project now generates $22,900 in after-tax cash flows at the end of each of years one through ten.

Using either a calculator or Excel, the internal rate of return for this stream of cash flows is found to be 16.17%.

d. Accrual accounting rate of return based on net initial investment:

$$AARR = \frac{22,900 - 11,000}{110,000} = \frac{11,900}{110,000}$$

$$= 10.82\%$$

e. Accrual accounting rate of return based on average investment:

$$AARR = \frac{22,900 - 11,000}{55,000} = \frac{11,900}{55,000}$$

$$= 21.64\%$$

2a. Increase in NPV.
To get a sense for the magnitude, note that from Table 2, the present value factor for 10 periods at 14% is 0.270. Therefore, the $10,000 terminal disposal price at the end of 10 years would have an after-tax NPV of:

$$10,000 \times (1 - 0.30) \times 0.270 = 1,890$$

b. No change in the payback period of 4.80 years. The cash inflow occurs at the end of year 10.

c. Increase in internal rate of return. The $10,000 terminal disposal price would raise the IRR because of the additional inflow. (The new IRR is 16.54%.)

d. The AARR on net initial investment would increase because accrual accounting income in year 10 would increase by the $7,000 ($10,000 gain from disposal, less $30\% \times $10,000) after-tax gain on disposal of equipment. This increase in year 10 income would result in higher average annual accounting income in the numerator of the AARR formula.

e. The AARR on average investment would also increase, for the same reasons given in the previous answer. Note that the denominator is unaffected because the investment is still depreciated down to zero terminal disposal value, and so the average investment remains $55,000.
Exercise 21-24

Annual after tax cash flows from operations:
- Increase in operating cash flows $36,000
- Tax on change in OI $14,400
- After-tax cash flows from operations $21,600

Annual income tax savings from depreciation
- Depreciation expense (($88,000-8,000) ÷ 4) $20,000
- Income tax rate 0.40
- After-tax cash inflows $8,000

Annual cash inflows: Years 1-3
- After-tax cash flows from operations $21,600
- Cash savings from depreciation $8,000
- Total after-tax cash inflows years 1-3 $29,600

Cash inflows: Year 4
- After-tax cash flows from operations $21,600
- Cash savings from depreciation $8,000
- After-tax inflow from terminal disposal of new machine $8,000
- Total after-tax cash inflows year 4 $37,600

After-tax cash flow from terminal disposal of new machine:
- Terminal disposal value of new machine $8,000
- Deduct book value at end of year 4 8,000
- Gain/loss on disposal of machine $-
- Terminal disposal value of new machine $8,000
- Tax effect of gain/loss $-
- After-tax inflow from terminal disposal of new machine $8,000

1b. Payback period:

<table>
<thead>
<tr>
<th>Period</th>
<th>Cash Savings</th>
<th>Cash Savings</th>
<th>Unrecovered Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$29,600</td>
<td>$29,600</td>
<td>$88,000</td>
</tr>
<tr>
<td>1</td>
<td>29,600</td>
<td>29,600</td>
<td>58,400</td>
</tr>
<tr>
<td>2</td>
<td>29,600</td>
<td>59,200</td>
<td>28,800</td>
</tr>
<tr>
<td>3</td>
<td>29,600</td>
<td>88,800</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>37,600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Payback period = 2 years + \( \frac{28,800}{29,600} \times 1 \text{ yr} = 2.97 \text{ years} \)
Discounted payback period:

<table>
<thead>
<tr>
<th>Period</th>
<th>Cash Savings</th>
<th>Discount Factor</th>
<th>Discounted Cash Savings</th>
<th>Discounted Cash Unrecovered</th>
<th>Cum. Discounted Savings</th>
<th>Discounted Unrecovered Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>$88,000</td>
<td>12%</td>
<td>$88,000</td>
<td>$88,000</td>
</tr>
<tr>
<td>1</td>
<td>29,600</td>
<td>0.893</td>
<td>26,433</td>
<td>12%</td>
<td>26,433</td>
<td>61,567</td>
</tr>
<tr>
<td>2</td>
<td>29,600</td>
<td>0.797</td>
<td>23,591</td>
<td>12%</td>
<td>50,024</td>
<td>37,976</td>
</tr>
<tr>
<td>3</td>
<td>29,600</td>
<td>0.712</td>
<td>21,075</td>
<td>12%</td>
<td>71,099</td>
<td>16,901</td>
</tr>
<tr>
<td>4</td>
<td>37,600</td>
<td>0.636</td>
<td>23,914</td>
<td>12%</td>
<td>83,914</td>
<td>61,567</td>
</tr>
</tbody>
</table>

Discounted payback period = 3 years + \( \frac{\$16,901}{\$23,914} \times 1 \text{yr} \) = 3.71 years

a. Net Present Value:

<table>
<thead>
<tr>
<th>Years</th>
<th>After-Tax Discount Present Cash Flow</th>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Net initial investment</td>
<td>(88,000)</td>
<td>$  (88,000)</td>
</tr>
<tr>
<td>1</td>
<td>After-tax cash inflow from operations</td>
<td>21,600</td>
<td>1 to 4</td>
</tr>
<tr>
<td>2</td>
<td>Tax savings from depreciation</td>
<td>8,000</td>
<td>1 to 4</td>
</tr>
<tr>
<td>3</td>
<td>Cash inflow from disposal of new machine</td>
<td>8,000</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Net Present Value</td>
<td></td>
<td>$  6,983</td>
</tr>
</tbody>
</table>

c. Internal rate of return:

Since the cash flows are not uniform, we cannot use the formula to estimate IRR. However, to determine where NPV = 0, we can assume uniform cash flows to find a starting point.

\[
\text{Net initial investment} = (\text{Average annual increase in cash flows}) \times F
\]

\[
\text{Net initial investment} = (\$21,600 + \$8,000) + \$8,000/4 = \$88,000 = \$31,600 \times F
\]

\[
F = 2.785
\]

Using Table 4, 2.785 falls between 16% and 18%. Using the trial and error approach to determining IRR we will calculate the present value of the cash inflows at 16% and 18%.
NPV at 18% = $83,752 - $88,000 = ($4,248)
We find the NPV at 16% is still negative,
NPV at 16% = $87,237 - $88,000 = ($763)
so we need to calculate the NPV at 14%.
NPV at 14% = $90,961 - $88,000 = $32,561
It is positive, so we can now interpolate.

\[
IRR = 14\% + \left( \frac{32,561}{32561 - (763)} \right) \times 2\% = 15.9542\%
\]

IRR calculation using Excel: [Formula: =IRR(D114:D118,15)]
Cash flows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($88,000)</td>
</tr>
<tr>
<td>1</td>
<td>$29,600</td>
</tr>
<tr>
<td>2</td>
<td>$29,600</td>
</tr>
<tr>
<td>3</td>
<td>$29,600</td>
</tr>
<tr>
<td>4</td>
<td>$37,600</td>
</tr>
</tbody>
</table>

IRR = 15.58%

2. Accrual Accounting Rate of Return:

\[
AARR = \frac{\text{Increase in expected avg annual after-tax OI}}{\text{Net initial investment}}
\]

\[
= \frac{$29,600 - $20,000}{88,000} = 10.91\%
\]

\(a\ $21,600 + $8,000 = $29,600\)