

# Chapter 25

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## Pre-Lecture Videos

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1. Which of the following steps is considered the first step in the managerial decision-making process?
  - **Identify the objective of the decision**
2. An analysis that evaluates differential revenues and costs in order to determine the differential impact on income of two alternative courses of action is called **incremental** analysis.
3. **Sunk** costs are costs that have been incurred in the past, cannot be recouped, and are not relevant to future decisions.
4. The revenue that is forgone from an alternative use of an asset, such as cash, is called **an opportunity cost**.
5. All of the following are cost-plus methods to determine selling price *except* **fixed cost concept**.
6. Which of the following determine normal selling price?
  - **Cost amount per unit plus markup**
7. Target cost is computed by **expected selling price minus desired profit**.
8. A point in the manufacturing process where the demand for the company's product exceeds the ability to produce the product is known as **production bottleneck**.
9. In a production bottleneck operation, the best measure of profitability is the **unit contribution margin per production bottleneck constraint**.
10. The last step when applying the total cost concept would be to **determine the normal selling price by adding the markup per unit to the cost per unit**.
11. Under the **variable cost concept**, only costs that change are included in the cost amount per unit to which the markup is added.

## Mini Quiz

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1. **The theory of constraints** is a manufacturing strategy that focuses on reducing the influence of bottlenecks on the production process.
2. For an airline, all of the following are mostly fixed costs per flight: **crew salaries, airport fees paid by the airline, and plane depreciation**.
3. For a particular Rocky Airlines flight, the plane has 250 seats, 220 tickets have been sold for an average price of \$140, the fixed costs per flight are \$20,000, and the variable costs per passenger are \$40. What is the contribution margin per passenger?
  - $140 - 40 = 100$
4. Muy Bueno Bakery sells its special chocolate cake for \$35. The total cost to produce the cake is \$26. Of this amount, \$4 per unit is selling costs. The total variable cost is \$17. The desired profit is \$9 per unit. What is the markup percentage on product cost?
  - $\frac{9+4}{22} = 59\%$
5. Which of the following statements is not true when a company has a production bottleneck?
  - **The product with the lowest unit contribution margin per production bottleneck hour is the most profitable product per bottleneck hour.**

6. Differential profit (loss) is the **difference between the differential revenue and the differential costs that are expected from a course of action compared to an alternative.**
7. Under product costing, the normal selling price is determined by **adding the markup per unit to the product cost per unit.**
8. For high-fixed-cost services businesses, during periods when the demand on fixed capacity is high, **prices are higher.**
9. Rumba Dance Hall is considering offering a wedding reception package that includes the ballroom rental, decorations, a wedding cake, punch, and paper goods for \$6,000. Currently, the company is renting the ballroom with no extras at \$4,500. The extras will cost \$800. Is the new package profitable and, if so, by how much?
  - **Increases profits by**  $6000 - 4500 - 800 = 700$
10. Muy Bueno Bakery sells three different products. Currently, it is not able to meet all of its customer demand. Using the following information, what is the most profitable product?

	<b>Cake</b>	<b>Pie</b>	<b>Cookies</b>
Contribution margin	\$18	\$11	\$3
Production hours	2	1.5	0.25
Unit contribution margin per bottleneck hour	$\frac{18}{2} = 9$	$\frac{11}{1.5} = 7.33$	$\frac{3}{.25} = 12$

- **Cookies**
11. Under the product cost method, which costs are included in the cost amount per unit?
    - **Only the costs of manufacturing the product**
  12. In a differential analysis report, the third amount column contains the **differential effects of choosing Alternative 2 over Alternative 1.**
  13. When a company has a production bottleneck, it should use **unit contribution margin** to determine how to maximize its profits.
  14. A bottleneck occurs when production is slowed down **within a process that is not able to meet the amount of production required.**
  15. Muy Bueno Bakery sells three different products. Currently, it is not able to meet all of its customer demand. Using the following information, what price of the cake is needed to meet the same contribution margin as the cookies?

	Cake	Pie	Cookies
Unit contribution margin	\$18	\$11	\$3
Production bottleneck hours	2	1.5	0.25
Variable cost	\$12	\$7	\$1
Unit contribution margin per bottleneck hour	\$9	\$7.33	\$12
Current selling price	\$30	\$18	\$5

$$\begin{aligned}
 12 &= \frac{x - 12}{2} & (1) \\
 24 &= x - 12 \\
 x &= 24 + 12 \\
 x &= 36
 \end{aligned}$$

16. Muy Bueno Bakery sells three different products. Currently, it is not able to meet all of its customer demand. Using the following information, what price of the cake is needed to meet the same contribution margin as the pie?

	Cake	Pie	Cookies
Unit contribution margin	\$18	\$11	\$3
Production bottleneck hours	3	1	0.30
Variable cost	\$12	\$7	\$1
Unit contribution margin per bottleneck hour	\$6	\$11	\$10
Current selling price	\$30	\$18	\$5

$$\begin{aligned}
 11 &= \frac{x - 12}{3} & (2) \\
 33 &= x - 12 \\
 x &= 33 + 12 \\
 x &= 45
 \end{aligned}$$

17. The unit contribution margin per bottleneck constraint is expressed by which of the following formulas?
- Unit contribution margin / bottleneck process hours per unit

## Practice Exercises

- Plymouth Company owns equipment with a cost of \$600,000 and accumulated depreciation of \$375,000 that can be sold for \$300,000, less a 4% sales commission. Alternatively, Plymouth Company can lease the equipment for four years for a total of \$320,000, at the end of which there is no residual value. In addition, the repair, insurance, and property tax expense that would be incurred by Plymouth Company on the equipment would total \$40,000 over the four-year lease.

1. Prepare a differential analysis on August 7 as to whether Plymouth Company should lease (Alternative 1) or sell (Alternative 2) the equipment

■

<b>Differential Analysis Lease Equipment (Alt. 1) or Sell Equipment (Alt. 2) August 7</b>	<b>Lease Equipment (Alternative 1)</b>	<b>Sell Equipment (Alternative 2)</b>	<b>Differential Effects (Alternative 2)</b>
Revenues	320000	300000	$300000 - 320000 = -20000$
Costs	-40000	$300000 * 4\% = -12000$	$-12000 - -40000 = 28000$
Profit (Loss)	$320000 - 40000 = 280000$	$300000 - 12000 = 288000$	$-20000 + 28000 = 8000$

2. Should Plymouth Company lease (Alternative 1) or sell (Alternative 2) the equipment?

■ **Sell the equipment**

2. Product Tango has revenue of \$1,150,000, variable cost of goods sold of \$850,000, variable selling expenses of \$275,000, and fixed costs of \$125,000, creating an operating loss of \$(100,000).

1. Prepare a differential analysis as of February 13 to determine if Product Tango should be continued (Alternative 1) or discontinued (Alternative 2), assuming fixed costs are unaffected by the decision. If an amount is zero, enter "0". If required, use a minus sign to indicate a loss.

■

<b>Differential Analysis Continue Product Tango (Alt. 1) or Discontinue Product Tango (Alt. 2) February 13</b>	<b>Continue Product Tango (Alternative 1)</b>	<b>Discontinue Product Tango (Alternative 2)</b>	<b>Differential Effects (Alternative 2)</b>
Revenues	1150000	0	$0 - 1150000 = -1150000$
Costs:			
Variable cost of goods sold	-850000	0	$0 - -850000 = 850000$
Variable selling and admin. expenses	-275000	0	$0 - -275000 = 275000$
Fixed costs	-125000	-125000	$-125000 - -125000 = 0$
Profit (Loss)	-100000	-125000	$-125000 - -100000 = -25000$

2. Determine if Product Tango should be continued (Alternative 1) or discontinued (Alternative 2).

■ **Continued**

3. A company manufactures various-sized plastic bottles for its medicinal product. The manufacturing cost for small bottles is \$55 per unit (100 bottles), including fixed costs of \$12 per unit. A proposal is offered to purchase small bottles from an outside source for \$36 per unit, plus \$3 per unit for freight.

1. Prepare a differential analysis dated January 25 to determine whether the company should make (Alternative 1) or buy (Alternative 2) the bottles, assuming fixed costs are unaffected by the decision. If an amount is zero, enter "0".

■

<b>Differential Analysis Make Bottles (Alt. 1) or Buy Bottles (Alt. 2) January 25</b>	<b>Make Bottles (Alternative 1)</b>	<b>Buy Bottles (Alternative 2)</b>	<b>Differential Effects (Alternative 2)</b>
Unit costs:			
Purchase price	0	36	$36 - 0 = 36$
Freight	0	3	$3 - 0 = 3$
Variable costs	$55 - 12 = 43$	0	$0 - 43 = -43$
Fixed factory overhead	12	12	$12 - 12 = 0$
Total unit costs	55	51	$51 - 55 = -4$

2. Determine whether the company should make (Alternative 1) or buy (Alternative 2) the bottles.

▪ **Buy the bottles**

4. A machine with a book value of \$80,000 has an estimated five-year life. A proposal is offered to sell the old machine for \$50,500 and replace it with a new machine at a cost of \$75,000. The new machine has a five-year life with no residual value. The new machine would reduce annual direct labor costs from \$11,200 to \$7,400.

1. Prepare a differential analysis dated April 11 on whether to continue with the old machine (Alternative 1) or replace the old machine (Alternative 2). If an amount is zero, enter "0". If required, use a minus sign to indicate a loss.

▪

<b>Differential Analysis Continue Old Machine (Alt. 1) or Replace Old Machine (Alt. 2) April 11</b>	<b>Continue with Old Machine (Alternative 1)</b>	<b>Replace Old Machine (Alternative 2)</b>	<b>Differential Effects (Alternative 2)</b>
Revenues:			
Proceeds from sale of old machine	0	50500	$50500 - 0 = 50500$
Costs:			
Purchase price	0	-75000	$-75000 - 0 = -75000$
Direct labor (5 years)	$-11200 * 5 = -56000$	$-7400 * 5 = -37000$	$-37000 - -56000 = 19000$
Profit (Loss)	$0 - 56000 = -56000$	$50500 - 75000 - 37000 = -61500$	$-61500 - -56000 = -5500$

2. Should the company continue with the old machine (Alternative 1) or replace the old machine (Alternative 2)?

▪ **Continue with the old machine**

5. Product J19 is produced for \$11 per gallon. Product J19 can be sold without additional processing for \$18 per gallon, or processed further into Product R33 at an additional cost of \$7 per gallon. Product R33 can be sold for \$24 per gallon.

1. Prepare a differential analysis dated April 30 on whether to sell Product J19 (Alternative 1) or process further into Product R33 (Alternative 2). If required, use a minus sign to indicate a loss.

■

Differential Analysis Sell Product J19 (Alt. 1) or Process Further into Product R33 (Alt. 2) April 30	Sell Product J19 (Alternative 1)	Process Further into Product R33 (Alternative 2)	Differential Effects (Alternative 2)
Revenues, per unit	18	24	$24 - 18 = 6$
Costs, per unit	-11	$-11 - 7 = -18$	$-18 - -11 = -7$
Profit (loss), per unit	$18 - 11 = 7$	$24 - 18 = 6$	$6 - 7 = -1$

2. Should Product J19 be sold (Alternative 1) or processed further into Product R33 (Alternative 2)?

■ **Sell Product J19**

6. Product A is normally sold for \$9.60 per unit. A special price of \$7.20 is offered for the export market. The variable production cost is \$5.00 per unit. An additional export tariff of 15% of revenue must be paid for all export products. Assume there is sufficient capacity for the special order.

1. Prepare a differential analysis dated March 16 on whether to reject (Alternative 1) or accept (Alternative 2) the special order. *Round your answers to two decimal places.* If an amount is zero, enter "0".

■

Differential Analysis Reject Order (Alt. 1) or Accept Order (Alt. 2) March 16	Reject Order (Alternative 1)	Accept Order (Alternative 2)	Differential Effects (Alternative 2)
Revenues, per unit	0	7.20	$7.2 - 0 = 7.20$
Costs:			
Variable manufacturing costs, per unit	0	-5.00	$-5 - 0 = -5.00$
Export tariff, per unit	0	$-7.2 * 15\% = -1.08$	$-1.08 - 0 = -1.08$
Profit (loss), per unit	0	$7.2 - 5 - 1.08 = 1.12$	$1.12 - 0 = 1.12$

2. Should the special order be rejected (Alternative 1) or accepted (Alternative 2)?

■ **Accept the special order**

7. Green Thumb Garden Tools Inc. produces and sells home and garden tools and equipment. A lawnmower has a total cost of \$230 per unit, of which \$160 is product cost and \$70 is selling and administrative expenses. In addition, the total cost of \$230 is made up of \$120 variable cost and \$110 fixed cost. The desired profit is \$58 per unit.

Determine the markup percentage on product cost.

◦  $\frac{58+70}{230-70} = 80\%$

8. Product K has a unit contribution margin of \$120. Product L has a unit contribution margin of \$100. Product K requires five furnace hours, while Product L requires four furnace hours.

Determine the unit contribution margin per production bottleneck hour for each product, assuming the furnace is a bottleneck constraint.

◦ Product K:  $\frac{120}{5} = 24$

Product L:  $\frac{100}{4} = 25$

9. On August 1, Rantoul Stores Inc. is considering leasing a building and purchasing the necessary equipment to operate a retail store. Alternatively, the company could use the funds to invest in \$1,000,000 of 4% U.S. Treasury bonds that mature in 15 years. The bonds could be purchased at face value. The following data have been assembled:

Item	Value
Cost of store equipment	\$1,000,000
Life of store equipment	15 years
Estimated residual value of store equipment	\$50,000
Yearly costs to operate the store, excluding depreciation of store equipment	\$200,000
Yearly expected revenues—years 1–6	\$300,000
Yearly expected revenues—years 7–15	\$400,000

*Required:*

- Prepare a differential analysis as of August 1 presenting the proposed operation of the store for the 15 years (Alternative 1) as compared with investing in U.S. Treasury bonds (Alternative 2). If an amount is zero, enter "0".

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Differential Analysis Operate Retail (Alt. 1) or Invest in Bonds (Alt. 2) August 1	Operate Retail (Alternative 1)	Invest in Bonds (Alternative 2)	Differential Effects (Alternative 2)
Revenues	5400000	600000	$600000 - 5400000 = -4800000$
Costs:			
Costs to operate store	-3000000	0	$0 - -300000 = 3000000$
Cost of equipment less residual value	-950000	0	$0 - -950000 = 950000$
Profit (loss)	$5400000 - 3000000 - 950000 = 1450000$	600000	$600000 - 1450000 = -850000$

- Based on the results disclosed by the differential analysis, should the proposal be accepted?

■ **Yes**

- If the proposal is accepted, what would be the total estimated operating income of the store for the 15 years?

■  $5400000 - (3000000 + 950000) = 1450000$

## Homework Exercises

1. Hill Co. can further process Product O to produce Product P. Product O is currently selling for \$60 per pound and costs \$42 per pound to produce. Product P would sell for \$82 per pound and would require an additional cost of \$13 per pound to produce.

The differential revenue of producing Product P is \$22 per pound.

- $82 - 60 = 22 \rightarrow$  **True**

2. Make-or-buy options often arise when a manufacturer has excess productive capacity in the form of unused equipment, space, and labor.

- **True**

3. When a bottleneck occurs in a process used in the production of multiple products, the company must determine the contribution margin for each product and give priority to the product that has the lowest contribution margin per bottleneck hour.

- **False**

4. Under the variable cost method, only variable costs are included in the cost amount per unit to which the markup is added.

- **True**

5. The amount of increase or decrease in cost that is expected from a particular course of action as compared with an alternative is **differential cost**.

6. Delaney Company is considering replacing equipment that originally cost \$600,000 and has accumulated depreciation of \$420,000 to date. A new machine will cost \$790,000 and the old equipment can be sold for \$8,000. The sunk cost in this situation is  $600000 - 420000 = 180000$

7. Starling Co. is considering disposing of a machine with a book value of \$12,500 and estimated remaining life of five years. The old machine can be sold for \$1,500. A new high-speed machine can be purchased at a cost of \$25,000. It will have a useful life of five years and no residual value. It is estimated that the annual variable manufacturing costs will be reduced from \$26,000 to \$23,500 if the new machine is purchased. The five-year differential effect on profit from replacing the machine is a(n) **decrease of**  $12500 - 23500 = (11000)$

8. Mallard Corporation uses the product cost method of product pricing. Below is cost information for the production and sale of 45,000 units of its sole product. Mallard desires a profit equal to a 12% return on invested assets of \$800,000.

Item	Value
Fixed factory overhead cost	\$82,000
Fixed selling and administrative costs	45,000
Variable direct materials cost per unit	5.50
Variable direct labor cost per unit	7.65
Variable factory overhead cost per unit	2.25
Variable selling and administrative cost per unit	0.90

The unit selling price for the company's product is 21.25



9. Widgeon Co. manufactures three products: Bales, Tales, and Wales. The selling prices are 55, 78, and \$32, respectively. The variable costs for each product are \$20, \$50, and \$15, respectively. Each product must go through the same processing in a machine that is limited to 2,000 hours per month. Bales take 5 hours to process; Tales 7 hours; and Wales 1 hour.

Assuming that Widgeon Co. can sell all of the products it can make, the maximum contribution margin it can earn per month is 34000

10. Swan Company produces its product at a total cost of \$43 per unit. Of this amount, \$8 per unit is selling and administrative costs. The total variable cost is \$30 per unit, and the desired profit is \$20 per unit.

The markup percentage on variable cost is 110%.

## Accept Business at Special Price

11. Product A is normally sold for \$47 per unit. A special price of \$31 is offered for the export market. The variable production cost is \$26 per unit. An additional export tariff of 14% of revenue must be paid for all export products. Assume there is sufficient capacity for the special order.

1. Prepare a differential analysis dated March 16 on whether to reject (Alternative 1) or accept (Alternative 2) the special order. *If required, round your answers to two decimal places.* If an amount is zero, enter "0".

■

Differential Analysis Reject Order (Alt. 1) or Accept Order (Alt. 2) March 16	Reject Order (Alternative 1)	Accept Order (Alternative 2)	Differential Effect on Income (Alternative 2)
Revenues, per unit	0	31	$0 - 31 = 31$
Costs:			
Variable manufacturing costs, per unit	0	26	$0 - 26 = -26$
Export tariff, per unit	0	$31 * 14\% = 4.34$	$0 - 4.34 = -4.34$
Income (Loss), per unit	0	$31 - 26 - 4.34 = .66$	$.66 - 0 = .66$

2. Should the special order be rejected (Alternative 1) or accepted (Alternative 2)?

■ **Accept the special order**

## Differential Analysis Involving Opportunity Costs

12. On July 1, Coastal Distribution Company is considering leasing a building and buying the necessary equipment to operate a public warehouse. Alternatively, the company could use the funds to invest in \$740,000 of 5% U.S. Treasury bonds that mature in 14 years. The bonds could be purchased at face value. The following data have been assembled:

Item	Value
Cost of store equipment	\$740,000
Life of store equipment	14 years
Estimated residual value of store equipment	\$75,000
Yearly costs to operate the warehouse, excluding depreciation of store equipment	\$175,000
Yearly expected revenues—years 1-7	\$280,000
Yearly expected revenues—years 8-14	\$240,000

Required:

1. Prepare a differential analysis as of July 1 presenting the proposed operation of the warehouse for the 14 years (Alternative 1) as compared with investing in U.S. Treasury bonds (Alternative 2). If an amount is zero, enter "0". If required, use a minus sign to indicate a loss.

Differential Analysis Operate Warehouse (Alt. 1) or Invest in Bonds (Alt. 2) July 1	Operate Warehouse (Alternative 1)	Invest in Bonds (Alternative 2)	Differential Effects (Alternative 2)
Revenues	$(280000 * 7) + (240000 * 7) = 3640000$	$(740000 * 5\%) * 14 = 518000$	$3640000 - 518000 = 3122000$
Costs:			
Costs to operate warehouse	$-175000 * 14 = -2450000$	0	$-2450000$
Cost of equipment less residual value	$-740000 + 75000 = -665000$	0	$-665000 - 0 = -665000$
Profit (loss)	$3640000 - 2450000 - 665000 = 525000$	518000	$3122000 - 2450000 - 665000 = -7000$

2. Based on the results disclosed by the differential analysis, should the proposal be accepted?

■ Yes

3. If the proposal is accepted, what is the total estimated operating income of the warehouse for the 14 years?

■  $3640000 - (2450000 + 665000) = 525000$

## Discontinue a Segment

13. Product Tango has revenue of \$194,700, variable cost of goods sold of \$114,000, variable selling expenses of \$31,100, and fixed costs of \$60,100, creating an operating loss of \$(10,500).

1. Prepare a differential analysis as of February 13 to determine if Product Tango should be continued (Alternative 1) or discontinued (Alternative 2), assuming fixed costs are unaffected by the decision. If an amount is zero, enter "0". If required, use a minus sign to indicate a loss.

■

<b>Differential Analysis</b> <b>Continue Product Tango (Alt. 1) or</b> <b>Discontinue Product Tango (Alt. 2)</b> <b>February 13</b>	<b>Continue Product Tango</b> <b>(Alternative 1)</b>	<b>Discontinue</b> <b>Product Tango</b> <b>(Alternative 2)</b>	<b>Differential Effect on</b> <b>Income (Alternative 2)</b>
Revenues	194700	0	$0 - 194700 = -194700$
Costs:			
Variable cost of goods sold	-114000	0	$0 - -114000 = 114000$
Variable selling and admin. expenses	-31100	0	$0 - -31100 = 31100$
Fixed costs	-60100	-60100	$-60100 - -60100 = 0$
Profit (Loss)	$194700 - 114000 - 31100 - 60100 = -10500$	-60100	$-60100 - -10500 = -49600$

- Determine if Product Tango should be continued (Alternative 1) or discontinued (Alternative 2).

■ **Continued**

## Lease or Sell

- Kincaid Company owns equipment with a cost of \$362,900 and accumulated depreciation of \$53,100 that can be sold for \$273,700, less a 3% sales commission. Alternatively, Kincaid Company can lease the equipment for three years for a total of \$287,600, at the end of which there is no residual value. In addition, the repair, insurance, and property tax expense that would be incurred by Kincaid Company on the equipment would total \$14,900 over the three year lease.

- Prepare a differential analysis on August 7 as to whether Kincaid Company should lease (Alternative 1) or sell (Alternative 2) the equipment. If required, use a minus sign to indicate a loss.

■

<b>Differential Analysis</b> <b>Lease Equipment (Alt. 1) or Sell</b> <b>Equipment (Alt. 2)</b> <b>August 7</b>	<b>Lease Equipment</b> <b>(Alt 1)</b>	<b>Sell Equipment (Alt 2)</b>	<b>Differential Effect on Income</b> <b>(Alt 2)</b>
Revenues	287600	273700	$273700 - 287600 = -13900$
Costs	14900	$273700 * 3\% = 8211$	$14900 - 8211 = 6689$
Income (Loss)	$287600 - 14900 = 272700$	$273700 - 8211 = 265489$	$-13900 - 6689 = -20589$

- Should Kincaid Company lease (Alternative 1) or sell (Alternative 2) the equipment?

■ **Lease the equipment**

## Make or Buy

- A company manufactures various-sized plastic bottles for its medicinal product. The manufacturing cost for small bottles is \$148 per unit (100 bottles), including fixed costs of \$33 per unit. A proposal is offered to purchase small bottles from an outside source for \$103 per unit, plus \$9 per unit for freight.

- Prepare a differential analysis dated January 25 to determine whether the company should make (Alternative 1) or buy (Alternative 2) the bottles, assuming fixed costs are unaffected by the decision. If an amount is zero, enter "0".

■

<b>Differential Analysis</b> <b>Make Bottles (Alt 1) or Buy Bottles</b> <b>(Alt 2)</b> <b>January 25</b>	<b>Make Bottles (Alt 1)</b>	<b>Buy Bottles (Alt 2)</b>	<b>Differential effect on</b> <b>income (Alt 2)</b>
Sales price	0	0	0
<b>Unit Costs:</b>			
Purchase price	0	−103	−103
Freight	0	−9	−9
Variable costs	$−148 − −33 = −115$	0	−115
Fixed factory overhead	−33	−33	0
Income (Loss)	−148	$−33 − 103 − 9 = −145$	$−148 − −145 = −3$

- Determine whether the company should make (Alternative 1) or buy (Alternative 2) the bottles.

■ **Buy the bottles**

## Process or Sell

- Product J19 is produced for \$3.38 per gallon. Product J19 can be sold without additional processing for \$4.01 per gallon, or processed further into Product R33 at an additional cost of \$0.36 per gallon. Product R33 can be sold for \$4.32 per gallon.

- Prepare a differential analysis dated April 30 on whether to sell Product J19 (Alternative 1) or process further into Product R33 (Alternative 2). *Round your answers to the nearest cent.* If required, use a minus sign to indicate a loss.

■

<b>Differential Analysis</b> <b>Sell Product J19 (Alt. 1) or Process</b> <b>Further into Product R33 (Alt. 2)</b> <b>April 30</b>	<b>Sell Product J19</b> <b>(Alternative 1)</b>	<b>Process Further into</b> <b>Product R33 (Alternative 2)</b>	<b>Differential</b> <b>Effects</b> <b>(Alternative 2)</b>
Revenues, per unit	4.01	4.32	$4.32 − 4.01 = .31$
Costs, per unit	3.38	$3.38 + .36 = 3.74$	.36
Profit (loss), per unit	$4.01 − 3.38 = .63$	$4.32 − 3.74 = .58$	$.31 − .36 = −.05$

- Should Product J19 be sold (Alternative 1) or processed further into Product R33 (Alternative 2)?

■ **Sell Product J19**

## Replace Equipment

- A machine with a book value of \$247,500 has an estimated six-year life. A proposal is offered to sell the old machine for \$217,400 and replace it with a new machine at a cost of \$283,900. The new machine has a six-year life with no residual value. The new machine would reduce annual direct labor costs from \$50,000 to \$40,000.

- Prepare a differential analysis dated April 11 on whether to continue with the old machine (Alternative 1) or replace the old machine (Alternative 2). If an amount is zero, enter "0". If required, use a minus sign to indicate a loss.

■

Differential Analysis Continue Old Machine (Alt. 1) or Replace Old Machine (Alt. 2) April 11	Continue with Old Machine (Alternative 1)	Replace Old Machine (Alternative 2)	Differential Effects (Alternative 2)
Revenues:			
Proceeds from sale of old machine	0	217400	−217400
Costs:			
Purchase price	0	−283900	−283900
Direct labor (6 years)	$50000 * 6 = 300000$	$40000 * 6 = 240000$	$300000 - 240000 = 60000$
Profit (Loss)	$0 - 300000 = -300000$	$217400 - 283900 - 240000 = -306500$	$-306500 - -300000 = -6500$

2. Should the company continue with the old machine (Alternative 1) or replace the old machine (Alternative 2)?

■ **Continue with the old machine**

## Quiz

1. Magpie Corporation uses the total cost method of product pricing. Below is cost information for the production and sale of 60,000 units of its sole product. Magpie desires a profit equal to a 25% return on invested assets of \$700,000.

Item	Value
Fixed factory overhead cost	\$38,700
Fixed selling and administrative costs	7,500
Variable direct materials cost per unit	4.60
Variable direct labor cost per unit	1.88
Variable factory overhead cost per unit	1.13
Variable selling and administrative cost per unit	4.50

The markup percentage on total cost for Magpie's product is  $\frac{700000 * 25\%}{38700 + 7500 + [(4.6 + 1.88 + 1.13 + 4.5) * 60000]} = 22.6\%$

2. All of the following should be considered in a make-or-buy decision **quality issues with the supplier**, **future growth in the plant and other production opportunities**, and **cost savings**.

3. The amount of increase or decrease in revenue that is expected from a particular course of action as compared with an alternative is **differential revenue**.
4. Carmen Co. can further process Product J to produce Product D. Product J is currently selling for \$20.00 per pound and costs \$15.75 per pound to produce. Product D would sell for \$38.00 per pound and would require an additional cost of \$8.55 per pound to produce.

The differential revenue of producing Product D is  $38 - 20 = \textbf{\$18.00 per pound}$ .

5. Dotterel Corporation uses the variable cost method of product pricing. Below is cost information for the production and sale of 35,000 units of its sole product. Dotterel desires a profit equal to an 11.2% return on invested assets of \$350,000.

Item	Value
Fixed factory overhead cost	\$105,000
Fixed selling and administrative costs	35,000
Variable direct materials cost per unit	4.34
Variable direct labor cost per unit	5.18
Variable factory overhead cost per unit	0.98
Variable selling and administrative cost per unit	0.70

The dollar amount of desired profit from the production and sale of Dotterel's product is  
 $350000 * 11.2\% = 39200$

6. Widgeon Co. manufactures three products: Bales, Tales, and Wales. The selling prices are \$55, \$78, and \$32, respectively. The variable costs for each product are \$20, \$50, and \$15, respectively. Each product must go through the same processing in a machine that is limited to 2,000 hours per month. Bales take 5 hours to process; Tales 7 hours; and Wales 1 hour.

Assuming that Widgeon Co. can sell all of the products it can make, the maximum contribution margin it can earn per month is

o

	Bales	Tales	Wales
Unit selling price	\$55	\$78	\$32
Unit variable cost	(20)	(50)	(15)
Unit contribution margin	\$35	\$28	\$17
Processing time per unit	÷5	÷7	÷1
Unit contribution margin per processing bottleneck hour	\$7	\$4	\$17

$$2000 * 17 = 34000$$

7. Stryker Industries received an offer from an exporter for 15,000 units of product at \$17.50 per unit. The acceptance of the offer will not affect normal production or domestic sales prices. The following data are available:

Item	Value
Domestic unit sales price	\$20
Unit manufacturing costs:	
Variable	11
Fixed	1

The amount of profit or loss from acceptance of the offer is a

o

Differential Analysis Reject Order (Alternative 1) or Accept Order (Alternative 2)	Reject Order (Alternative 1)	Accept Order (Alternative 2)	Differential Effect on Income (Alternative 2)
Revenues	\$0	$15000 * 17.5 = 262,500$	\$262,500
Costs	0	$15000 * -11 = -165,000$	(165,000)
Profit (loss)	\$0	\$97,500	<b>97500 profit</b>

8. Mighty Safe Fire Alarm is currently buying 50,000 motherboards from MotherBoard, Inc., at a price of \$65 per board. Mighty Safe is considering making its own boards. The costs to make the board are as follows: direct materials, \$32 per unit; direct labor, \$10 per unit; and variable factory overhead, \$16 per unit. Fixed costs for the plant would increase by \$75,000. Which option should be selected and why?

o

Differential Analysis Make (Alternative 1) or Buy (Alternative 2) Motherboards	Make Motherboard (Alternative 1)	Buy Motherboard (Alternative 2)	Differential Effects (Alternative 2)
Unit costs:			
Purchase price	\$0.00	\$(65.00)	\$(65.00)
Direct material	(32.00)	0.00	32.00
Direct labor	(10.00)	0.00	10.00
Variable factory overhead	(16.00)	0.00	16.00
Fixed costs	$\frac{75000}{50000} = -1.5$	0.00	1.50
Total unit costs	\$(59.50)	\$(65.00)	\$(5.50)

**If making them...  $5.5 * 50000 = 275000$  increase in profits**

9. Differential revenue is the amount of profit that would result from the best available alternative proposed use of cash.
- **False**
10. Which of the following methods of applying the cost-plus approach to product pricing includes only total manufacturing costs in the cost amount to which the markup is added?
- **product cost method**
11. The revenue that is forgone from an alternative use of an asset, such as cash, is called **opportunity cost**.
12. Contractors who sell to government agencies would be most likely to use which of the following cost methods in pricing their products?
- **total costmethod**
13. Flyer Company sells a product in a competitive marketplace. Market analysis indicates that its product would probably sell at \$48 per unit. Flyer management desires a 12.5% profit margin on sales. Flyer's current full cost for the product is \$44 per unit.
- If the company cannot cut costs any lower than they already are, the profit margin on sales to meet the market selling price would be  $\frac{48-44}{48} = 8.3\%$
14. Mallard Corporation uses the product cost method of product pricing. Below is cost information for the production and sale of 45,000 units of its sole product. Mallard desires a profit equal to a 12% return on invested assets of \$800,000.

Item	Value
Fixed factory overhead cost	\$82,000
Fixed selling and administrative costs	45,000
Variable direct materials cost per unit	5.50
Variable direct labor cost per unit	7.65
Variable factory overhead cost per unit	2.25
Variable selling and administrative cost per unit	0.90

The unit selling price for the company's product is

$$\frac{775000}{45000} + \left( \frac{(12\% \cdot 800000) + [(0.9 \cdot 45000) + 45000]}{(5.5 \cdot 45000) + (7.65 \cdot 45000) + [(2.25 \cdot 45000) + 82000]} \right) \cdot 17.22 = 21.25$$

15. The condensed income statement for Hayden Corp. for the past year is as follows:



	Product T	Product U
Sales	\$680,000	\$320,000
Costs:		
Variable costs	\$(540,000)	\$(220,000)
Fixed costs	(145,000)	(40,000)
Total costs	\$(685,000)	\$(260,000)
Income (loss)	\$(5,000)	\$60,000

Management is considering the discontinuance of the manufacture and sale of Product T at the beginning of the current year. The discontinuance would have no effect on the total fixed costs and expenses or on the sales of Product U. The amount of change in profit for the current year that will result from the discontinuance of Product T is a

o

Differential Analysis Continue Product T (Alternative 1) or Discontinue Product T (Alternative 2)	Continue Product T (Alternative 1)	Discontinue Product T (Alternative 2)	Differential Effects (Alternative 2)
Revenues	$680000 + 320000 = 1,000,000$	\$320,000	\$(680,000)
Costs:			
Variable costs	$540000 + 220000 = -760,000$	(220,000)	540,000
Fixed costs	$145000 + 40000 = -185,000$	(185,000)	0
Profit (loss)	\$55,000	\$(85,000)	<b>140000 decrease</b>

16. Farris Company is considering a cash outlay of \$500,000 for the purchase of land, which it could lease for \$40,000 per year. If alternative investments are available that yield a 15% return, the opportunity cost of the purchase of the land is  $500000 * 15\% = 75000$
17. Keating Co. is considering disposing of equipment that cost \$50,000 and has \$40,000 of accumulated depreciation to date. Keating Co. can sell the equipment through a broker for \$25,000 less a 5% commission. Alternatively, Gunner Co. has offered to lease the equipment for five years for a total of \$48,750. Keating will incur repair, insurance, and property tax expenses estimated at \$8,000 over the five-year period. At lease-end, the equipment is expected to have no residual value. The net differential profit or loss from the sell alternative is a

o

Differential Analysis Lease Equipment (Alternative 1) or Sell Equipment (Alternative 2)	Lease Equipment (Alternative 1)	Sell Equipment (Alternative 2)	Differential Effects (Alternative 2)
Revenues	\$48,750	\$25,000	\$(23,750)
Costs	(8,000)	$25000 * 5\% = -1250$	6,750
Profit (loss)	\$40,750	\$23,750	<b>17000 loss</b>

18. Delaney Company is considering replacing equipment that originally cost \$600,000 and has accumulated depreciation of \$420,000 to date. A new machine will cost \$790,000. The sunk cost in this situation is  $600000 - 420000 = 180000$
19. Magpie Corporation uses the total cost method of product pricing. Below is cost information for the production and sale of 60,000 units of its sole product. Magpie desires a profit equal to a 25% return on invested assets of \$700,000.

Item	Value
Fixed factory overhead cost	\$38,700
Fixed selling and administrative costs	7,500
Variable direct materials cost per unit	4.60
Variable direct labor cost per unit	1.88
Variable factory overhead cost per unit	1.13
Variable selling and administrative cost per unit	4.50

The dollar amount of desired profit from the production and sale of Magpie's product is  $700000 * 25\% = 175000$

## Chapter 26

### Pre-Lecture Videos

- Which of the following capital investment evaluation methods use present values?
  - Net present value method**
- A common characteristic found in capital investment evaluation methods that use present values is **an interest rate**.
- Assume that management is evaluating the purchase of a new machine as follows:
  - Cost of new machine: \$800,000
  - Residual value: \$0
  - Estimated total income from machine: \$300,000
  - Expected useful life: 5 years

The average rate of return of a new equipment is **15%**.

4. All of the following are advantages of using the average rate of return method: **it is easy to compute, it includes the entire amount of income earned over the life of the proposal, it emphasizes accounting income, which is often used by investors and creditors in evaluating management performance.**
5. Which of the following is a disadvantage of using the net present value method of evaluating an investment proposal?
  - **It assumes cash flows can be reinvested at the minimum desired rate of return.**
6. The present value index is computed as **total present value of net cash flow divided by amount to be invested.**
7. **Internal Rate of Return (IRR)** method of evaluating an investment proposal uses present value concepts to compute the rate of return based on the investment's expected net cash flows.
8. A general increase in price levels is called **inflation.**
9. Qualitative considerations that may influence capital investment analysis include the investment proposal's impact on all of the following except **income taxes.**
10. The process by which management allocates funds among competing capital investment proposals is called **capital rationing.**
11. With capital rationing, alternative proposals are initially screened by establishing minimum standards and applying which of the following methods?
  - **Cash payback and average rate of return methods**

## Mini Quiz

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1. Which of the following factors does not have an impact on the outcome of a capital investment decision?
  - **Equal proposal lives**
2. In capital rationing, alternative proposals that survive initial screening by cash payback and average rate of return methods are further analyzed using **net present value and internal rate of return methods.**
3. All of the following are advantages of using the average rate of return: **the average rate of return method emphasizes accounting income, which is often used by investors and creditors in evaluating management performance, the average rate of return method includes the entire amount of income earned over the life of the proposal, and the average rate of return is easy to compute.**
4. Which of the following is a method of analyzing capital investment proposals that ignores present value?
  - **Cash payback**
5. All of the following are factors that may complicate capital investment analysis: **currency exchange rates, qualitative factors, and revenue estimates.**
6. The management of Cooper Corporation is considering the purchase of a new machine costing \$420,000. The company's desired rate of return is 10%. The present value factors for \$1 at compound interest of 10% for 1 through 5 years are 0.909, 0.826, 0.751, 0.683, and 0.621, respectively. In addition to this information, use the following data in determining the acceptability of the proposed purchase:

Year	Operating Income	Net Cash Flow
1	\$100,000	\$180,000
2	40,000	120,000
3	20,000	100,000
4	10,000	90,000
5	10,000	90,000

What is the present value index for this investment?

$$\frac{(180000 \times .909) + (120000 \times .826) + (100000 \times .751) + (90000 \times .683) + (90000 \times .621)}{420000} = 1.08$$

7. A disadvantage of the net present value method is that **it is more complex to use than methods that do not use present value.**
8. Which of the following statements regarding capital investments is not true?
  - **They involve investments of an immaterial amount.**
9. At the end of the capital rationing process, **proposals that are selected for funding are included in the capital expenditures budget, unfunded proposals may be reconsidered if funds later become available, and accepted proposals are ranked and compared with the funds available.**
10. Based on the following sensitivity analysis of a proposed investment in equipment, which of the following statements is true?

Estimated Annual Net Cash Flow	300,000 400,000	\$500,000
Present value of annual net cash flows (× 4.487)	1,346,100 1,794,800	\$2,243,500
Present value of residual value	22,600	22,600
Total present value	1,368,700 1,817,400	\$2,266,100
Amount to be invested	(1,300,000)	(1,300,000)
Net present value	68,700  517,400	\$ 966,100

- **The investment in the equipment is justified at any level of cash flows estimated in the analysis.**
11. The expected average rate of return for a proposed investment of \$44,000 in a fixed asset using straight-line depreciation, with a useful life of 4 years, no residual value, and an expected total net income of \$11,000, is **12.5%.**
  12. The interest rate used in net present value analysis is referred to as the **hurdle rate.**
  13. One of the complicating factors of capital investment analyses is the uncertainty related to estimating **cash flows, revenues, and expenses.**
  14. Two managerial accounting tools useful in considering the uncertainty of estimates are **sensitivity analysis and expected value analysis.**

15. The process by which management plans, evaluates, and controls long-term investment decisions involving fixed assets is called **capital investment** analysis.
16. Capital rationing uses all of the following measures to determine the funding of projects **considering qualitative factors, ranking the proposals with the available funds, and establishing minimum standards by applying the cash payback and the average rate of return.**
17. In capital rationing, alternative proposals are initially screened by establishing minimum standards, using **cash payback and average rate of return methods.**
18. Given the following incomplete sensitivity analysis, what is the net present value of annual cash flows of \$300,000?

Estimated Annual Net Cash Flow	300,000 400,000	\$500,000
Present value of annual net cash flows (× 4.487)	?? 1,794,800	\$2,243,500
Present value of residual value	24,000	24,000
Total present value	?? 1,818,800	\$2,267,500
Amount to be invested	(1,500,000)	(1,500,000)
Net present value	?? 318,800	\$767,500

- **\$(129,900)**

19. The expected value of the annual net cash flows is determined by multiplying each of the possible annual net cash flows by its **probability of occurring.**

## Practice Exercises

### Average Rate of Return

1. Determine the average rate of return for a project that is estimated to yield total income of \$936,000 over eight years, has a cost of \$1,200,000, and has a \$100,000 residual value.

- $$\frac{\frac{936000}{8}}{\frac{1200000+100000}{2}} = 18\%$$

2. The following data are accumulated by Watershed Inc. in evaluating two competing capital investment proposals:

	Project A	Project Z
Amount of investment	\$55,000	\$50,000
Useful life	12 years	15 years
Estimated residual value	\$5,000	\$6,000
Estimated total income over the useful life	\$57,600	\$63,000

Determine the expected average rate of return for each project.

$$\begin{aligned} \text{Project A: } & \frac{\frac{57600}{12}}{\frac{55000+5000}{2}} = 16\% \\ \text{Project Z: } & \frac{\frac{63000}{15}}{\frac{50000+6000}{2}} = 15\% \end{aligned}$$

## Cash Payback Period

3. A project has estimated annual net cash flows of \$42,500. It is estimated to cost \$374,000.

Determine the cash payback period. *Round your answer to one decimal place.*

$$\frac{374000}{42500} = 8.8$$

## Cash Payback Period for a Service Company

4. Jane's Clothing Inc. is evaluating two capital investment proposals for a retail outlet, each requiring an investment of \$975,000 and each with a seven-year life and expected total net cash flows of \$1,050,000. Location 1 is expected to provide equal annual net cash flows of \$150,000, and Location 2 is expected to have the following unequal annual net cash flows:

Year	Value
1	\$275,000
2	225,000
3	180,000
4	175,000
5	120,000
6	40,000
7	35,000

Determine the cash payback period for both location proposals.

$$\text{Location 1: } \frac{975000}{150000} = \mathbf{6.5 \text{ years}}$$

$$\text{Location 2: } 275000 + 225000 + 180000 + 175000 + 120000 = \mathbf{5 \text{ years}}$$

## Internal Rate of Return

5. A project is estimated to cost 463,565 and provide annual net cash flows of \$115,000 for nine years.

Present Value of an Annuity of \$1 at Compound Interest						
Year		6%	10%	12%	15%	20%
1		0.943	0.909	0.893	0.870	0.833
2		1.833	1.736	1.690	1.626	1.528
3		2.673	2.487	2.402	2.283	2.106
4		3.465	3.170	3.037	2.855	2.589
5		4.212	3.791	3.605	3.353	2.991
6		4.917	4.355	4.111	3.785	3.326
7		5.582	4.868	4.564	4.160	3.605
8		6.210	5.335	4.968	4.487	3.837
9		6.802	5.759	5.328	4.772	4.031
10		7.360	6.145	5.650	5.019	4.192

Determine the internal rate of return for this project, using the *Present Value of an Annuity of \$1 at Compound Interest* table shown above.

- $\frac{463565}{115000} = 4.031 \rightarrow$  cross check with table  $\rightarrow$  **20%**

## Internal Rate of Return Method

- The internal rate of return method is used by Testerman Construction Co. in analyzing a capital expenditure proposal that involves an investment of \$113,550 and annual net cash flows of \$30,000 for each of the six years of its useful life.

Present Value of an Annuity of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192

1. Determine a present value factor for an annuity of \$1, which can be used in determining the internal rate of return. *If required, round your answer to three decimal places.*

- $\frac{113550}{30000} = 3.785$

2. Using the factor determined in part (a) and the present value of an annuity of \$1 table above, determine the internal rate of return for the proposal.

- *cross check with table -> 15%*

## Net Present Value

7. A project has estimated annual net cash flows of \$80,000 for seven years and is estimated to cost \$325,000. Assume a minimum acceptable rate of return of 6%. Use the **Present Value of an Annuity of \$1 at Compound Interest** table below.



Present Value of an Annuity of \$1 at Compound Interest						
Year		6%	10%	12%	15%	20%
1		0.943	0.909	0.893	0.870	0.833
2		1.833	1.736	1.690	1.626	1.528
3		2.673	2.487	2.402	2.283	2.106
4		3.465	3.170	3.037	2.855	2.589
5		4.212	3.791	3.605	3.353	2.991
6		4.917	4.355	4.111	3.785	3.326
7		5.582	4.868	4.564	4.160	3.605
8		6.210	5.335	4.968	4.487	3.837
9		6.802	5.759	5.328	4.772	4.031
10		7.360	6.145	5.650	5.019	4.192

Determine (a) the net present value of the project and (b) the present value index. If required, use the minus sign to indicate a negative net present value.

1. Net present value of the project *round to the nearest dollar*:  $(80000 * 5.582) - 325000 = 121560$
2. Present value index *round to two decimal places*:  $\frac{446560}{325000} = 1.37$

## Net Present Value Method

8. The following data are accumulated by Geddes Company in evaluating the purchase of \$150,000 of equipment, having a four-year useful life:

	Net Income	Net Cash Flow
Year 1	\$42,500	\$80,000
Year 2	27,500	65,000
Year 3	12,500	50,000
Year 4	2,500	40,000

Present Value of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	0.890	0.826	0.797	0.756	0.694
3	0.840	0.751	0.712	0.658	0.579
4	0.792	0.683	0.636	0.572	0.482
5	0.747	0.621	0.567	0.497	0.402
6	0.705	0.564	0.507	0.432	0.335
7	0.665	0.513	0.452	0.376	0.279
8	0.627	0.467	0.404	0.327	0.233
9	0.592	0.424	0.361	0.284	0.194
10	0.558	0.386	0.322	0.247	0.162

- Assuming that the desired rate of return is 15%, determine the net present value for the proposal. **If required, round to the nearest dollar.** Use the table of the present value of \$1 presented above.
  - Present value of net cash flow:  
 $(80000 * .87) + (65000 * .756) + (50000 * .658) + (40000 * .572) = 174520$
  - Amount to be invested: 150000
  - Net present value:  $174520 - 150000 = 24520$
- Would management be likely to look with favor on the proposal?
  - Yes**, because the net present value indicates that the return on the proposal is **greater** than the minimum desired rate of return of 15%.

## Net Present Value—Unequal Lives

- Project 1 requires an original investment of \$125,000. The project will yield cash flows of \$50,000 per year for 10 years. Project 2 has a computed net present value of \$135,000 over an eight-year life. Project 1 could be sold at the end of eight years for a price of \$8,000.

Use the *Present Value of \$1 at Compound Interest* and the *Present Value of an Annuity of \$1 at Compound Interest* tables shown below.

Present Value of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	0.890	0.826	0.797	0.756	0.694
3	0.840	0.751	0.712	0.658	0.579
4	0.792	0.683	0.636	0.572	0.482
5	0.747	0.621	0.567	0.497	0.402
6	0.705	0.564	0.507	0.432	0.335
7	0.665	0.513	0.452	0.376	0.279
8	0.627	0.467	0.404	0.327	0.233
9	0.592	0.424	0.361	0.284	0.194
10	0.558	0.386	0.322	0.247	0.162

Present Value of an Annuity of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192

- Determine the net present value of Project 1 over an eight-year life, with residual value, assuming a minimum rate of return of 12%. If required, round to the nearest dollar.

- $$(50000 * 4.968) + (8000 * .404) - 125000 = 126632$$

2. Which project provides the greatest net present value?

▪ **Project 2**

## Net Present Value Method, Internal Rate of Return Method, and Analysis for a Service Company

10. The management of Advanced Alternative Power Inc. is considering two capital investment projects. The estimated net cash flows from each project are as follows:

Year	Wind Turbines	Biofuel Equipment
1	\$280,000	\$300,000
2	280,000	300,000
3	280,000	300,000
4	280,000	300,000

The wind turbines require an investment of \$887,600, while the biofuel equipment requires an investment of \$911,100. No residual value is expected from either project.

Present Value of an Annuity of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192

*Required:*

1.

1. Compute the net present value for each project. Use a rate of 6% and the present value of an annuity of \$1 in the table above. If required, round to the nearest dollar.

■

	Wind Turbines	Biofuel Equipment
Present value of annual net cash flows	$280000 * 3.465 = 970200$	$300000 * 3.465 = 1039500$
Less amount to be invested	887600	911100
Net present value	$970200 - 887600 = 82600$	$1039500 - 911100 = 128400$

2. Compute a present value index for each project. If required, round your answers to two decimal places.

■

	Present Value Index
Wind Turbines	$\frac{970200}{887600} = 1.09$
Biofuel Equipment	$\frac{1039500}{911100} = 1.14$

2. Determine the internal rate of return for each project by (a) computing a present value factor for an annuity of \$1 and (b) using the present value of an annuity of \$1 in the table above. If required, round your present value factor answers to three decimal places and internal rate of return to the nearest whole percent.

■

	Wind Turbines	Biofuel Equipment
Present value factor for an annuity of \$1	$\frac{887600}{280000} = 3.170$	$\frac{911100}{300000} = 3.037$
Internal rate of return	10%	12%

3. The net present value, present value index, and internal rate of return all indicate that the **biofuel equipment** is/are a better financial opportunity compared to the **wind turbines**, although both investments meet the minimum return criterion of 6%.

## Homework Exercises

1. Care must be taken when making capital investment decisions, since a long-term commitment of funds is involved and operations could be affected for many years.
  - **True**
2. The methods of evaluating capital investment proposals can be grouped into two general categories referred to as (1) the average rate of return and (2) the cash payback methods.
  - **False**
3. The excess of the cash flowing in from revenues over the cash flowing out for expenses is termed net discounted cash flow.
  - **False**
4. The expected period of time between the date of an investment and the recovery in cash of the amount invested is called the discount period.

- **False**

5. A company is planning to purchase a machine that will cost \$24,000, have a 6-year life, and have no salvage value. The company expects to sell the machine's output of 3,000 units evenly throughout each year. Total operating income generated over the life of the machine is estimated to be \$12,000. The machine will generate net cash inflows of \$6,000 per year. The average rate of return for the machine is 16.7%.

- **True**

6. Which of the following methods of evaluating capital investment proposals uses the concept of present value to compute a rate of return?

- **internal rate of return**

7. The management of Nebraska Corporation is considering the purchase of a new machine costing \$490,000. The company's desired rate of return is 10%. The present value factors for \$1 at compound interest of 10% for 1 through 5 years are 0.909, 0.826, 0.751, 0.683, and 0.621, respectively. In addition to the foregoing information, use the following data in determining the acceptability:

Year	Operating Income	Net Cash Flow
1	\$100,000	\$180,000
2	40,000	120,000
3	40,000	100,000
4	10,000	90,000
5	10,000	120,000

The cash payback period for this investment is **4 years**.

8. Which of the following statements regarding the cash payback period is true?

- **The shorter the payback, the possibility of obsolescence will be less likely.**

9. The formula for determining the present value factor for an annuity of \$1 is **amount to be invested / equal annual net cash flows**.

10. The rate of earnings is 12% and the cash to be received in 2 years is 10, 000. *Determine the present value amount, using the following partial table of present value of 1 at compound interest.*

Year	6%	10%	12%
1	0.943	0.909	0.893
2	0.890	0.826	0.797
3	0.840	0.751	0.712
4	0.792	0.683	0.636

- **7970**

## Average Rate of Return

11. Determine the average rate of return for a project that is estimated to yield total income of \$264,000 over five years, has a cost of \$459,400, and has a \$68,600 residual value. Round to the nearest whole number.

$$\circ \frac{\frac{264000}{5}}{\frac{459400+68600}{2}} = 20\%$$

12. The following data are accumulated by Watershed Inc. in evaluating two competing capital investment proposals:

	Project A	Project Z
Amount of investment	\$84,000	\$32,000
Useful life	4 years	5 years
Estimated residual value	0	0
Estimated total income over the useful life	\$8,400	\$7,200

Determine the expected average rate of return for each project. Round your answers to one decimal place.

$$\circ \text{Project A: } \frac{\frac{8400}{4}}{\frac{84000}{2}} = 5\%$$

$$\text{Project Z: } \frac{\frac{7200}{5}}{\frac{32000}{2}} = 9\%$$

## Cash Payback Period

13. A project has estimated annual net cash flows of \$38,500. It is estimated to cost \$146,300.

Determine the cash payback period. *Round your answer to one decimal place.*

$$\circ \frac{146300}{38500} = \mathbf{3.8 \text{ years}}$$

## Cash Payback Period for a Service Company

14. Jane's Clothing Inc. is evaluating two capital investment proposals for a retail outlet, each requiring an investment of \$225,000 and each with an eight-year life and expected total net cash flows of \$360,000. Location 1 is expected to provide equal annual net cash flows of \$45,000, and Location 2 is expected to have the following unequal annual net cash flows:

Year	Value
Year 1	\$101,000
Year 2	77,000
Year 3	47,000
Year 4	43,000
Year 5	32,000
Year 6	24,000
Year 7	19,000
Year 8	17,000

Determine the cash payback period for both location proposals.

- Location 1: **5 years**
- Location 2: **3 years**

## Internal Rate of Return

15. A project is estimated to cost \$379,080 and provide annual net cash flows of \$90,000 for five years.

Present Value of an Annuity of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192



Determine the internal rate of return for this project, using the *Present Value of an Annuity of \$1 at Compound Interest* table shown above.

- $\frac{379080}{90000} = 4.212 \sim \mathbf{6\%}$

## Internal Rate of Return Method

16. The internal rate of return method is used by Testerman Construction Co. in analyzing a capital expenditure proposal that involves an investment of \$20,790 and annual net cash flows of \$6,000 for each of the four years of its useful life.

<b>Present Value of an Annuity of \$1 at Compound Interest</b>					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192

- Determine a present value factor for an annuity of \$1 which can be used in determining the internal rate of return. *If required, round your answer to three decimal places.*
  - $\frac{20790}{6000} = 3.465$
- Using the factor determined in part (a) and the present value of an annuity of \$1 table above, determine the internal rate of return for the proposal.
  - *consult table...6%*

## Net Present Value

17. A project has estimated annual net cash flows of \$12,500 for two years and is estimated to cost \$37,500. Assume a minimum acceptable rate of return of 12%. Use the **Present Value of an Annuity of \$1 at Compound Interest** table below.

Present Value of an Annuity of \$1 at Compound Interest						
Year		6%	10%	12%	15%	20%
1		0.943	0.909	0.893	0.870	0.833
2		1.833	1.736	1.690	1.626	1.528
3		2.673	2.487	2.402	2.283	2.106
4		3.465	3.170	3.037	2.855	2.589
5		4.212	3.791	3.605	3.353	2.991
6		4.917	4.355	4.111	3.785	3.326
7		5.582	4.868	4.564	4.160	3.605
8		6.210	5.335	4.968	4.487	3.837
9		6.802	5.759	5.328	4.772	4.031
10		7.360	6.145	5.650	5.019	4.192

Determine (a) the net present value of the project and (b) the present value index. If required, use the minus sign to indicate a negative net present value.

1. Net present value of the project *round to the nearest dollar*:  $(12500 * 1.69) - 37500 = -16375$
2. Present value index *rounded to two decimal places*:  $\frac{37500 - 16375}{37500} = .56$

## Net Present Value Method

18. The following data are accumulated by Geddes Company in evaluating the purchase of \$149,500 of equipment, having a four-year useful life:

	Net Income	Net Cash Flow
Year 1	\$44,000	\$75,000
Year 2	27,000	58,000
Year 3	13,000	44,000
Year 4	(1,000)	29,000

Present Value of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	0.890	0.826	0.797	0.756	0.694
3	0.840	0.751	0.712	0.658	0.579
4	0.792	0.683	0.636	0.572	0.482
5	0.747	0.621	0.567	0.497	0.402
6	0.705	0.564	0.507	0.432	0.335
7	0.665	0.513	0.452	0.376	0.279
8	0.627	0.467	0.404	0.327	0.233
9	0.592	0.424	0.361	0.284	0.194
10	0.558	0.386	0.322	0.247	0.162

- Assuming that the desired rate of return is 6%, determine the net present value for the proposal. Use the table of the present value of \$1 presented above. *If required, round to the nearest dollar.* If required, use the minus sign to indicate a negative net present value.
  - Present value of net cash flow:  
 $(75000 * .943) + (58000 * .89) + (44000 * .84) + (29000 * .792) = 182273$
  - Amount to be invested: 149500
  - Net present value:  $182273 - 149500 = 32773$
- Would management be likely to look with favor on the proposal?
  - Yes**, because the net present value indicates that the return on the proposal is **greater** than the minimum desired rate of return of 6%.

## Net Present Value—Unequal Lives

- Project 1 requires an original investment of \$62,100. The project will yield cash flows of \$10,000 per year for 10 years. Project 2 has a computed net present value of \$14,600 over a eight-year life. Project 1 could be sold at the end of eight years for a price of \$48,000.

Use the *Present Value of \$1 at Compound Interest* and the *Present Value of an Annuity of \$1 at Compound Interest* tables shown below.

Present Value of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	0.890	0.826	0.797	0.756	0.694
3	0.840	0.751	0.712	0.658	0.579
4	0.792	0.683	0.636	0.572	0.482
5	0.747	0.621	0.567	0.497	0.402
6	0.705	0.564	0.507	0.432	0.335
7	0.665	0.513	0.452	0.376	0.279
8	0.627	0.467	0.404	0.327	0.233
9	0.592	0.424	0.361	0.284	0.194
10	0.558	0.386	0.322	0.247	0.162

Present Value of an Annuity of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192

- Determine the net present value of Project 1 over a eight-year life with residual value, assuming a minimum rate of return of 10%. If required, round to the nearest dollar.

- $$(10000 * 5.335) + (48000 * .467) - 62100 = 13666$$

2. Which project provides the greatest net present value?

▪ **Project 2**

## Net Present Value Method, Internal Rate of Return Method, and Analysis for a Service Company

20. The management of Style Networks Inc. is considering two TV show projects. The estimated net cash flows from each project are as follows:

Year	After Hours	Sun Fun
1	\$320,000	\$290,000
2	320,000	290,000
3	320,000	290,000
4	320,000	290,000

*After Hours* requires an investment of \$913,600, while *Sun Fun* requires an investment of \$880,730. No residual value is expected from either project.

Present Value of an Annuity of \$1 at Compound Interest					
Year	6%	10%	12%	15%	20%
1	0.943	0.909	0.893	0.870	0.833
2	1.833	1.736	1.690	1.626	1.528
3	2.673	2.487	2.402	2.283	2.106
4	3.465	3.170	3.037	2.855	2.589
5	4.212	3.791	3.605	3.353	2.991
6	4.917	4.355	4.111	3.785	3.326
7	5.582	4.868	4.564	4.160	3.605
8	6.210	5.335	4.968	4.487	3.837
9	6.802	5.759	5.328	4.772	4.031
10	7.360	6.145	5.650	5.019	4.192

*Required:*

1.

1. Compute the net present value for each project. Use a rate of 10% and the present value of an annuity of \$1 in the above table. *If required, round to the nearest dollar.*

■

	After Hours	Sun Fun
Present value of annual net cash flows	$320000 * 3.170 = 1014400$	$290000 * 3.170 = 919300$
Amount to be invested	913600	880730
Net present value	$1014400 - 913600 = 100800$	$919300 - 880730 = 38570$

2. Compute a present value index for each project. *If required, round your answers to two decimal places.*

■

	Present Value Index
Wind Turbines	$\frac{1014400}{913600} = 1.11$
Biofuel Equipment	$\frac{919300}{880730} = 1.04$

2. Determine the internal rate of return for each project by (a) computing a present value factor for an annuity of \$1 and (b) using the present value of an annuity of \$1 table above. *If required, round your present value factor answers to three decimal places and internal rate of return to the nearest percent.*

■

	After Hours	Sun Fun
Present value factor for an annuity of \$1	$\frac{913600}{320000} = 2.855$	$\frac{880730}{290000} = 3.037$
Internal rate of return	15%	12%

3. The net present value, present value index, and internal rate of return all indicate that the **After Hours** TV show is a better financial opportunity compared to the **Sun Fun** TV show, although both investments meet the minimum return criterion of 10%.

## Quiz

1. The management of River Corporation is considering the purchase of a new machine costing \$380,000. The company's desired rate of return is 6%. The present value factor for an annuity of \$1 at interest of 6% for 5 years is 4.212. In addition to the foregoing information, use the following data in determining the acceptability of this investment:

Year	Operating Income	Net Cash Flow
1	\$20,000	\$95,000
2	20,000	95,000
3	20,000	95,000
4	20,000	95,000
5	20,000	95,000

The cash payback period for this investment is  $\frac{380000}{95000} = 4 \text{ years}$

2. An analysis of a proposal by the net present value method indicated that the present value of future cash inflows exceeded the amount to be invested. Which of the following statements best describes the results of this analysis?
  - **The proposal is desirable, and the rate of return expected from the proposal exceeds the minimum rate used for the analysis.**
3. The excess of the cash flowing in from revenues over the cash flowing out for expenses is termed net discounted cash flow.
  - **False**
4. All of the following qualitative considerations may influence capital investment analysis except the investment proposal's impact on **manufacturing sunk cost**.
5. The process by which management plans, evaluates, and controls investments in fixed assets is called capital investment analysis.
  - **True**
6. All of the following are factors that may complicate capital investment analysis: **federal income tax ramifications, changes in price levels, and possible leasing alternatives**.
7. Following is a table for the present value of \$1 at compound interest:

Year	6%	10%	12%
1	0.943	0.909	0.893
2	0.890	0.826	0.797
3	0.840	0.751	0.712
4	0.792	0.683	0.636
5	0.747	0.621	0.567

Following is a table for the present value of an annuity of \$1 at compound interest:

Year	6%	10%	12%
1	0.943	0.909	0.893
2	1.833	1.736	1.690
3	2.673	2.487	2.402
4	3.465	3.170	3.037
5	4.212	3.791	3.605

Using the tables provided, the present value of \$8,000 to be received 1 year from today, assuming an earnings rate of 12%, is  $8000 * .893 = 7144$

8. The management of California Corporation is considering the purchase of a new machine costing \$400,000. The company's desired rate of return is 10%. The present value factors for \$1 at compound interest of 10% for 1 through 5 years are 0.909, 0.826, 0.751, 0.683, and 0.621, respectively. In addition to the foregoing information, use the following data in determining the acceptability of this investment:

Year	Operating Income	Net Cash Flow
1	\$100,000	\$180,000
2	40,000	120,000
3	20,000	100,000
4	10,000	90,000
5	10,000	90,000

The present value index for this investment is

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Year	Present Value of \$1 at 10%	Net Cash Flow	Present Value of Net Cash Flow
1	0.909	\$180,000	\$163,620
2	0.826	120,000	99,120
3	0.751	100,000	75,100
4	0.683	90,000	61,470
5	0.621	90,000	55,890
Total		\$580,000	\$473,830

$$\frac{500000}{473830} = 1.14$$



9. Which of the following provisions of the Internal Revenue Code can be used to reduce the amount of the income tax expense arising from capital investment projects?

- **depreciation deduction**

10. The management of Wyoming Corporation is considering the purchase of a new machine costing \$375,000. The company's desired rate of return is 6%. The present value factor for an annuity of \$1 at interest of 6% for 5 years is 4.212. In addition to the foregoing information, use the following data in determining the acceptability of this investment:

Year	Operating Income	Net Cash Flow
1	\$18,750	\$93,750
2	18,750	93,750
3	18,750	93,750
4	18,750	93,750
5	18,750	93,750

The average rate of return for this investment is  $\frac{18750}{\frac{375000}{2}} = 10\%$

11. The **average rate of return** method of analyzing capital investment proposals divides the estimated average annual income by the average investment.
12. The amount of the average investment for a proposed investment of \$120,000 in a fixed asset with a useful life of 4 years, straight-line depreciation, no residual value, and an expected total income of \$21,600 for the 4 years is  $\frac{120000}{2} = 60000$
13. Tennessee Corporation is analyzing a capital expenditure that will involve a cash outlay of \$109,332. Estimated cash flows are expected to be \$36,000 annually for 4 years. The present value factors for an annuity of \$1 for 4 years at interest of 10%, 12%, 14%, and 15% are 3.170, 3.037, 2.914, and 2.855, respectively. The internal rate of return for this investment is
- $\frac{109332}{36000} = 3.037$  ...**check problem for interest at rate of return** -> 12%
14. Following is a table for the present value of \$1 at compound interest:

Year	6%	10%	12%
1	0.943	0.909	0.893
2	0.890	0.826	0.797
3	0.840	0.751	0.712
4	0.792	0.683	0.636
5	0.747	0.621	0.567

Following is a table for the present value of an annuity of \$1 at compound interest:

Year	6%	10%	12%
1	0.943	0.909	0.893
2	1.833	1.736	1.690
3	2.673	2.487	2.402
4	3.465	3.170	3.037
5	4.212	3.791	3.605

Using the tables provided, the present value of \$30,000 to be received 3 years from today, assuming an earnings rate of 6%, is  $30000 * .830 = 25200$

15. Which of the following is a method of analyzing capital investment proposals that ignores present value?

- **average rate of return**

16. Which of the following is *not* an advantage of the average rate of return method?

- **takes into consideration the time value of money**

17. Following is a table for the present value of \$1 at compound interest:

Year	6%	10%	12%
1	0.943	0.909	0.893
2	0.890	0.826	0.797
3	0.840	0.751	0.712
4	0.792	0.683	0.636
5	0.747	0.621	0.567

Following is a table for the present value of an annuity of \$1 at compound interest:

Year	6%	10%	12%
1	0.943	0.909	0.893
2	1.833	1.736	1.690
3	2.673	2.487	2.402
4	3.465	3.170	3.037
5	4.212	3.791	3.605

Using the tables provided, if an investment is made now for \$23,500 that will generate a cash inflow of \$8,000 a year for the next 4 years, the net present value of the investment, assuming an earnings rate of 10%, is  $(8000 * 3.170) - 23500 = 1860$

18. The production department is proposing the purchase of an automatic insertion machine. It has identified 3 machines and has asked the accountant to analyze them to determine which of the proposals (if any) meet or exceed the company's policy of a minimum desired rate of return of 10% using the net present value method. Each of the assets has an estimated useful life of 10 years. The accountant has identified the following data:

	Machine A	Machine B	Machine C
Present value of future cash flows computed using 10% rate of return	\$305,000	\$295,000	\$300,000
Amount of initial investment	300,000	300,000	300,000

Which of the investments are acceptable?

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	Machine A	Machine B	Machine C
Present value of future cash flows computed using 10% rate of return	\$305,000	\$295,000	\$300,000
Amount of initial investment	300,000	300,000	300,000
Net present value	$305000 - 300000 = 5000$	$295000 - 300000 = -5000$	$300000 - 300000 = 0$

**Machines A and C**