Chapter 4

Establishing the Planning Horizon & MARR

Systematic Economic Analysis Technique

1. Identify the investment alternatives
2. Define the planning horizon
3. Specify the discount rate
4. Estimate the cash flows
5. Compare the alternatives
6. Perform supplementary analyses
7. Select the preferred investment

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Determining the Planning Horizon

- Least common multiple of lives
- Longest life
- Shortest life
- Standard horizon
- Organizational need
- Infinitely long

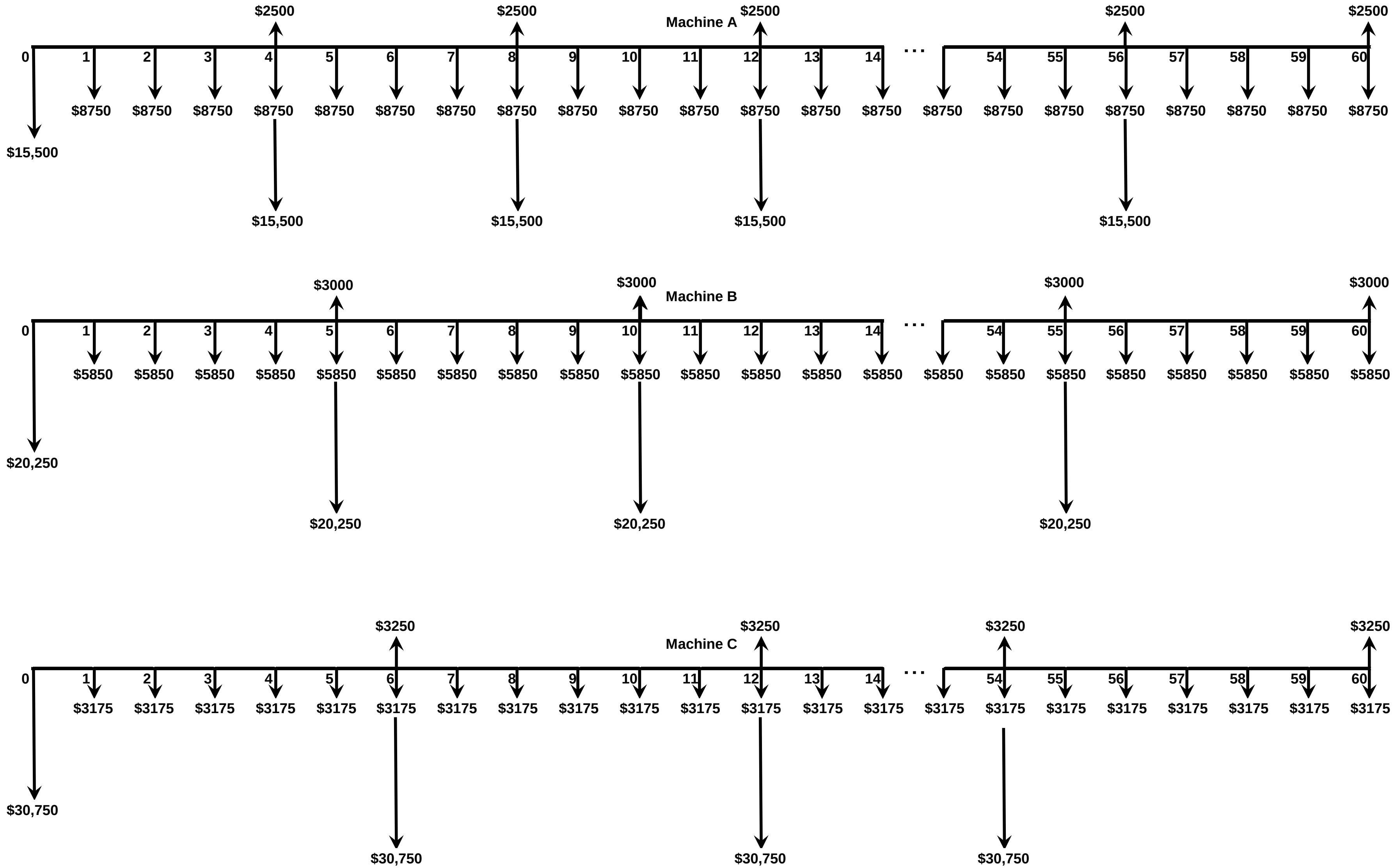
Example 4.1

Three production machines are being considered. The pertinent data are as follows:

Production Equipment	Useful Life	Initial Investment	Annual Operating Cost	Terminal Salvage Value
A	4 yrs	$15,500	$8,750	$2,500
B	5 yrs	$20,250	$5,850	$3,000
C	6 yrs	$30,750	$3,175	$3,250

Based on the least common multiple of the lives, the planning horizon is 60 years; based on the shortest life, the planning horizon is 4 years; based on the longest life, the planning horizon is 6 years; and based on the firm's "standard", the planning horizon is 10 years.

CFD for Least Common Multiple of Lives



Example 4.1: 60-Year Planning Horizon

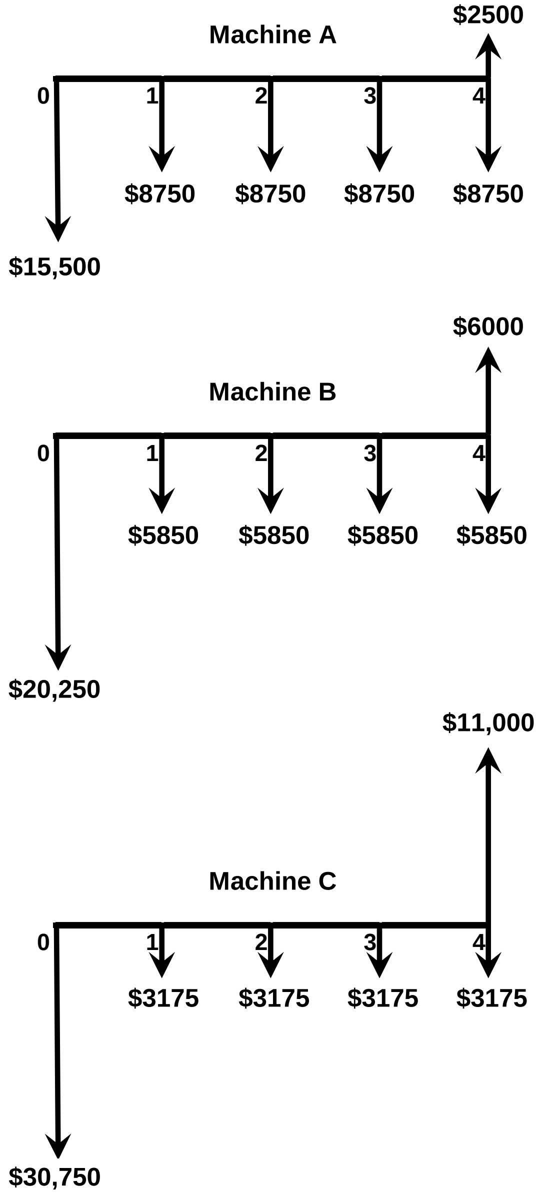
With a 60-yr planning horizon, it is assumed the successive replacements will have identical cash flow profiles. MARR = 12%

$$PW_A(12\%) = -\$15{,}500 - \$8{,}750(P|A\ 12\%,60) + \$2{,}500(P|F\ 12\%,60)$$
$$- \$13{,}000[(P|F\ 12\%,4) + (P|F\ 12\%,8) + \dots + (P|F\ 12\%,56)]$$
$$= -\$110{,}959.97$$

$$PW_B(12\%) = -\$20{,}250 - \$5{,}850(P|A\ 12\%,60) + \$3{,}000(P|F\ 12\%,60)$$
$$- \$17{,}250[(P|F\ 12\%,5) + (P|F\ 12\%,10) + \dots + (P|F\ 12\%,55)]$$
$$= -\$91{,}525.57$$

$$PW_C(12\%) = -\$30{,}750 - \$3{,}175(P|A\ 12\%,60) + \$3{,}250(P|F\ 12\%,60)$$
$$- \$27{,}500[(P|F\ 12\%,6) + (P|F\ 12\%,12) + \dots + (P|F\ 12\%,54)]$$
$$= -\$85{,}352.36$$

CFD for "Shortest Life" Planning Horizon



Example 4.1: 4-Year Horizon

With a 4-yr planning horizon, it is assumed the salvage value for B will be $6,000 and the salvage value of C will be $11,000. MARR = 12%

PW_A(12%) = -$15,500 - $8,750(P|A 12%,4) + $2,500(P|F 12%,4)

= -$15,500 - $8,750(3.03735) + $2,500(0.63552) = -$40,488.01

=PV(12%,4,8750,-2500)-15500 = -$40,488.01

PW_B(12%) = -$20,250 - $5,850(P|A 12%,4) + $6,000(P|F 12%,4)

= -$20,250 - $5,850(3.03735) + $6,000(0.63552) = -$34,205.38

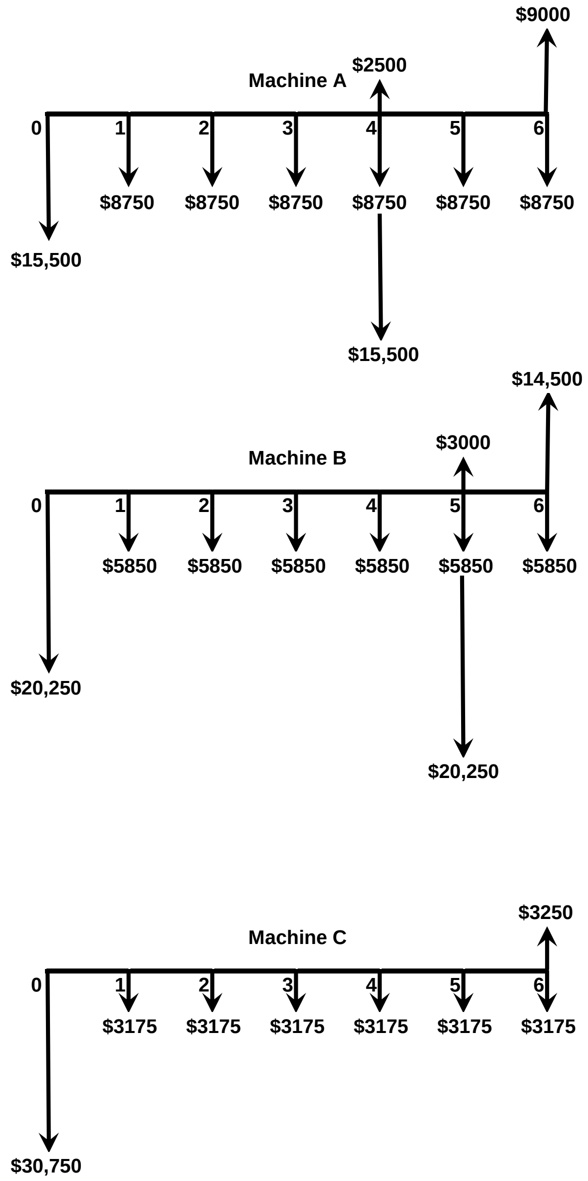
=PV(12%,4,5850,-6000)-20250 = -$34,205.39

PW_C(12%) = -$30,750 - $3,175(P|A 12%,4) + $11,000(P|F 12%,4)

= -$30,750 - $3,175(3.03735) + $11,000(0.63552) = -$33,402.87

=PV(12%,4,3175,-11000)-30750 = -$33,402.89

CFD for "Longest Life" Planning Horizon



Example 4.1: 6-Year Horizon

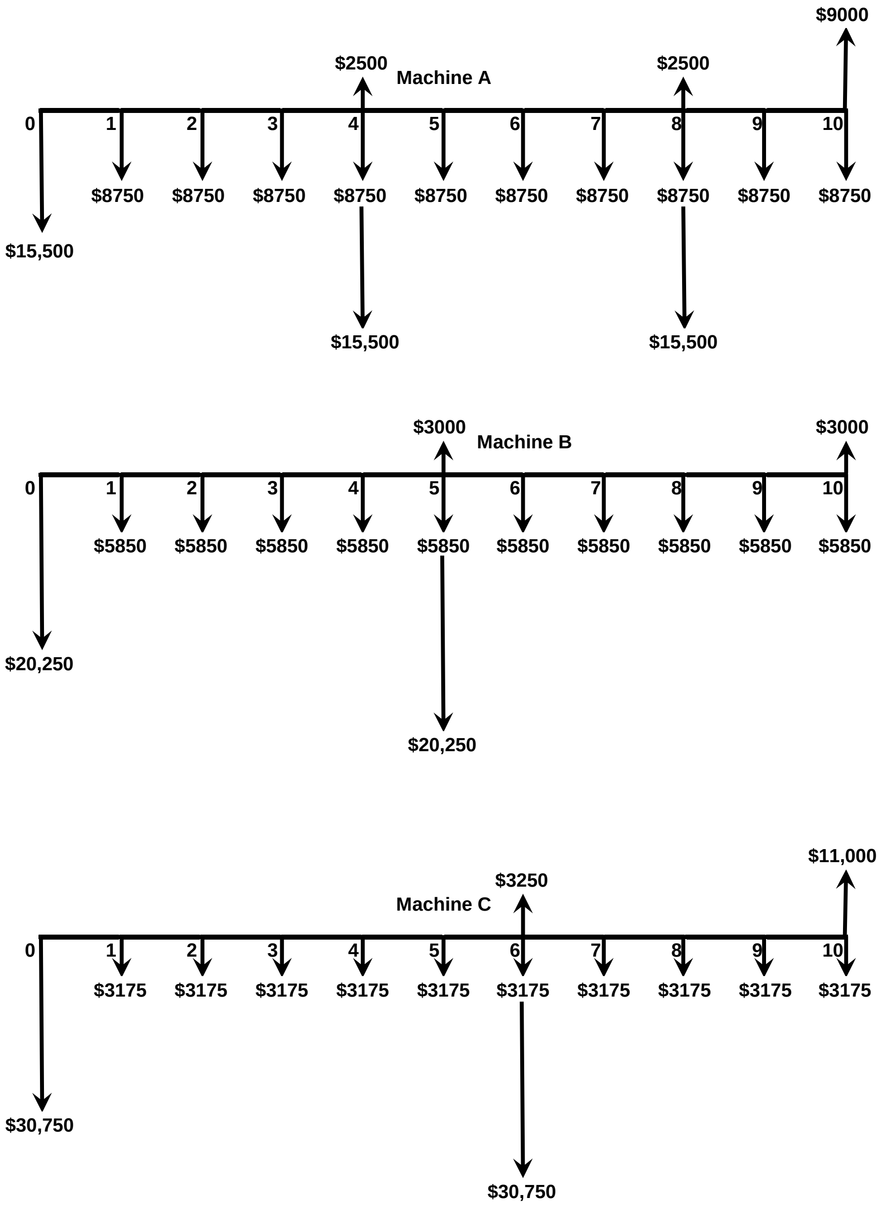
With a 6-yr planning horizon, it is assumed A will be replaced with an identical machine and have a $9,000 salvage value; similar assumptions are made for B, including a $14,500 salvage value.

$PW_A(12\%)$ =PV(12%,6,8750,-9000)-15500+PV(12%,4,,13000)
= -$55,176.87

$PW_B(12\%)$ =PV(12%,6,5850,-14500)-20250+PV(12%,5,,17250)
= -$46,743.69

$PW_C(12\%)$ =PV(12%,6,3175,-3250)-30750 = -$42,157.17

CFD for 10-Year Planning Horizon



Example 4.1: 10-Year Horizon

With a 10-yr planning horizon, it is assumed A will be replaced with an identical machine and have a $9,000 salvage value; for B, two complete life cycles occur; and for C, a salvage value of $11,000 is assumed.

$PW_A(12\%)$ =PV(12%,10,8750,-9000)-15500+PV(12%,4,,13000)
+PV(12%,8,,13000) = -$75,553.91

$PW_B(12\%)$ =PV(12%,10,5850,-3000)-20250+PV(12%,5,,17250)
= -$62,126.00

$PW_C(12\%)$ =PV(12%,10,3175,-11000)-30750+PV(12%,6,,27500)
= -$59,080.11

Example 4.1: Infinitely Long Horizon

With an indefinitely long planning horizon, we assume successive replacements have identical cash flow profiles, as with the LCML approach.

Here, we compute the annual worth for an individual life cycle (LC), recognizing the annual worth will occur indefinitely.

AW_A(12%)=PMT(12%,4,15500,-2500)-8750 = -$13,330.05

AW_B(12%)=PMT(12%,5,20250,-3000)-5850 = -$10,995.32

AW_C(12%)=PMT(12%,6,30750,-3250)-3175 = -$10,253.71

Observation

Consider the ratios of annual worths for the indefinitely long planning horizon versus the ratios of present worths for the least common multiple of lives planning horizon.

$AW_A(12\%)/AW_B(12\%) = -\$13,330.05/-\$10,995.32 = 1.212$

$AW_A(12\%)/AW_C(12\%) = -\$13,330.05/-\$10,253.71 = 1.300$

$AW_B(12\%)/AW_C(12\%) = -\$10,995.32/-\$10,253.71 = 1.072$

$PW_A(12\%)/PW_B(12\%) = -\$110,959.97/-\$91,525.57 = 1.212$

$PW_A(12\%)/PW_C(12\%) = -\$110,959.97/-\$85,352.36 = 1.300$

$PW_B(12\%)/PW_C(12\%) = -\$91,525.57/-\$85,352.36 = 1.072$

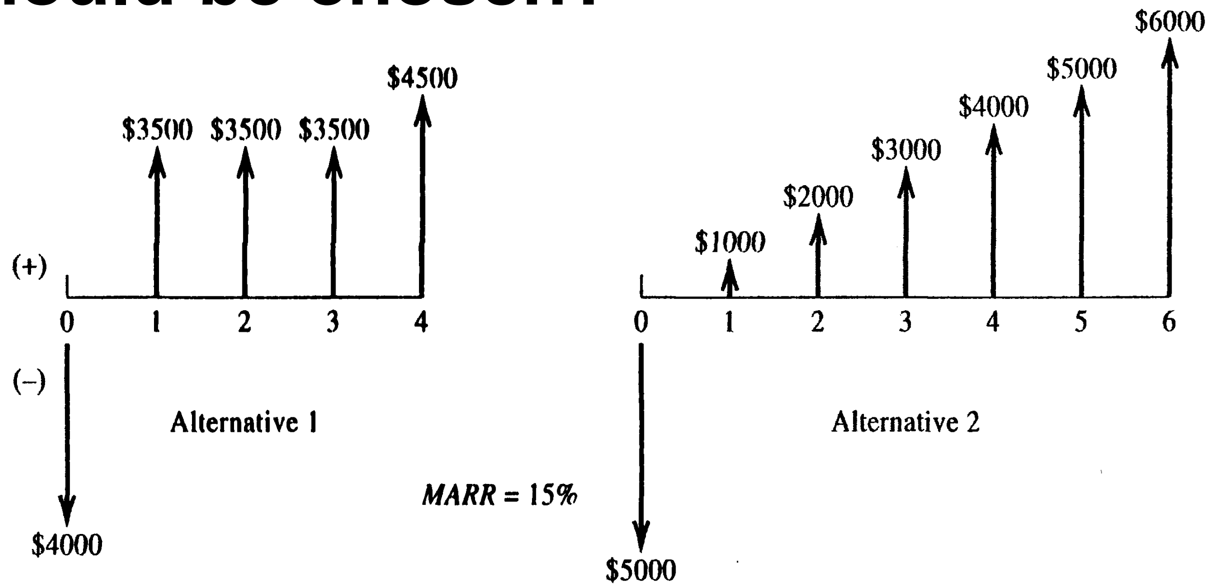
Observations

1. **Evaluating alternatives based on a LCML planning horizon will yield the same recommendations as for an infinitely long planning horizon *under the assumption of identical replacements over the planning horizon*.**
2. **When we consider capitalized worth and capitalized cost in the next chapter, we will explicitly consider an infinitely long planning horizon, because we will be interested in knowing the magnitude of the present worth for an infinitely long planning horizon.**
3. **PW(LCML) = AW(LC)(P|A MARR,LCML)**

   The present worth over a LCML horizon equals the product of the annual worth for a life cycle and the P|A factor for a period of time equal to the LCML. (See the text for the calculations for Example 4.1.)

Example 4.2: One-Shot Investments

Consider the two investments shown below, only one of which can be chosen. They are one-shot investments. Given a MARR of 15%, which (if either) should be chosen?



PW_1(15%) =PV(15%,4,-3500,-1000)-4000 = $6564.18

PW_2(15%) =NPV(15%,1000,2000,3000,4000,5000,6000)-5000
= $6721.26

Example 4.2: One-Shot Investments (Continued)

If we had assumed LCML for the planning horizon, then

$AW_1(15\%)$ =1000*PMT(15%,4,4,-1)+3500

= $2,299.20

$AW_2(15\%)$ =1000*PMT(15%,6,5-NPV(15%,1,2,3,4,5,6)) = $1,776.01

With one-shot investments, use a longest life planning horizon and assign $0 to “missing years” for the shorter lived alternatives.

Pit Stop #4—Take a Deep Breath

1. True or False: When dealing with multiple alternatives having unequal lives, the planning horizon equals the least common multiple of lives.
2. True or False: The MARR should be at least as great as the firm's weighted cost of capital and should reflect the opportunity cost for money.
3. True or False: Among the various sources of capital, U.S. large cap equities have a lower cost of capital than do U.S. small cap equities.
4. True or False: The most common method of valuing the cost of equity capital is to divide the annual dividend by the average market value of a share of stock.
5. True or False: The cost of debt capital needs to reflect the tax deductibility of costs of debt.
6. True or False: The Eastman hurdle rate calculator can be used for any company and under any conditions that are specifically targeted by the calculator.
7. True or False: A company's beta can be used to accurately forecast its stock price during the coming year.
8. True or False: Historical beta values are not impacted by rare events that might adversely affect a firm's stock price.
9. True or False: The Federal Reserve Bank's prime lending rate should be used for the risk-free rate in the capital asset pricing model.
10. True or False: When using the Eastman hurdle rate calculator, if venture capital is being sought, the hurdle rate obtained will not be affected by ownership, plant site, or technology profiles.

Pit Stop #4—Take a Deep Breath

1. True or False: When dealing with multiple alternatives having unequal lives, the planning horizon equals the least common multiple of lives. False
2. True or False: The MARR should be at least as great as the firm's weighted cost of capital and should reflect the opportunity cost for money. True
3. True or False: Among the various sources of capital, U.S. large cap equities have a lower cost of capital than do U.S. small cap equities. True
4. True or False: The most common method of valuing the cost of equity capital is to divide the annual dividend by the average market value of a share of stock. False
5. True or False: The cost of debt capital needs to reflect the tax deductibility of costs of debt. True
6. True or False: The Eastman hurdle rate calculator can be used for any company and under any conditions that are specifically targeted by the calculator. False
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9. True or False: The Federal Reserve Bank's prime lending rate should be used for the risk-free rate in the capital asset pricing model. False
10. True or False: When using the Eastman hurdle rate calculator, if venture capital is being sought, the hurdle rate obtained will not be affected by ownership, plant site, or technology profiles. True