

Chapter 9

Mutually Exclusive Alternatives

9-1

Using a 10% interest rate, determine which alternative, if any, should be selected, based on net present worth.

Alternative	<u>A</u>	<u>B</u>
First Cost	\$5,300	\$10,700
Uniform Annual Benefit	1,800	2,100
Useful life	4 years	8 years

Solution

Alternative A:

$$\begin{aligned} \text{NPW} &= 1,800(P/A, 10\%, 8) - 5,300 - 5,300(P/F, 10\%, 4) \\ &= \$683.10 \end{aligned}$$

Alternative B:

$$\begin{aligned} \text{NPW} &= 2,100(P/A, 10\%, 8) - 10,700 \\ &= \$503.50 \end{aligned}$$

Select alternative A

9-2

Three purchase plans are available for a new car.

Plan A: \$5,000 cash immediately

Plan B: \$1,500 down and 36 monthly payments of \$116.25

Plan C: \$1,000 down and 48 monthly payments of \$120.50

If a customer expects to keep the car five years and her cost of money is 18% compounded monthly, which payment plan should she choose?

Solution

128 Chapter 9 Mutually Exclusive Alternatives

$$i = 18/12 = 1\frac{1}{2}\%$$

$$PW_A = \$5,000$$

$$PW_B = 1,500 + 116.25(P/A, 1\frac{1}{2}\%, 36) = \$4,715.59$$

$$PW_C = 1,000 + 120.50(P/A, 1\frac{1}{2}\%, 48) = \$5,102.18$$

Therefore Plan B is the best plan.

9-3

Given the following three mutually exclusive alternatives

	<u>Alternative</u>		
	<u>A</u>	<u>B</u>	<u>C</u>
Initial Cost	\$50	\$30	\$40
Annual Benefits	15	10	12
Useful Life (years)	5	5	5

What alternative is preferable, if any, assuming $i = 10\%$?

Solution

$$PW_A = -50 + 15(P/A, 10\%, 5) = \$6.87$$

$$PW_B = -30 + 10(P/A, 10\%, 5) = \$7.91$$

$$PW_C = -40 + 12(P/A, 10\%, 5) = \$5.49$$

Choose C

9-4

Consider two investments:

1. Invest \$1,000 and receive \$110 at the end of each month for the next 10 months.
2. Invest \$1,200 and receive \$130 at the end of each month for the next 10 months.

If this were your money, and you want to earn at least 12% interest on your money, which investment would you make, if any? Solve the problem by annual cash flow analysis.

Solution

$$\text{Alternative 1: } EUAW = EUAB - EUAC = 110 - 1,000(A/P, 1\%, 10) = \$4.40$$

$$\text{Alternative 2: } EUAW = EUAB - EUAC = 130 - 1,200(A/P, 1\%, 10) = \$3.28$$

Maximum EUAW, therefore choose alternative A.

9-5

A farmer must purchase a tractor using a loan of \$20,000. The bank has offered the following choice of payment plans each determined by using an interest rate of 8%. If the farmer's minimum attractive rate of return (MARR) is 15%, which plan should he choose?

Plan A: \$5,010 per year for 5 years

Plan B: \$2,956 per year for 4 years plus \$15,000 at end of 5 years

Plan C: Nothing for 2 years, then \$9,048 per year for 3 years

Solution

$$PWC_A = 5,010(P/A, 15\%, 5) = \$16,794$$

$$PWC_B = 2,956(P/A, 15\%, 4) + 15,000(P/F, 15\%, 5) = \$15,897$$

$$PWC_C = 9,048(P/A, 15\%, 3)(P/F, 15\%, 2) = \$15,618$$

Plan C is lowest cost plan

9-6

Projects A and B have first costs of \$6,500 and \$17,000, respectively. Project A has net annual benefits of \$2,000 during each year of its 5-year useful life, after which it can be replaced identically.

Project B has net annual benefits of \$3,000 during each year of its 10-year life. Use present worth analysis, and an interest rate of 10% to determine which project to select.

Solution

$$PW_A = -6,500[1 + (P/F, 10\%, 5)] + 2,000(P/A, 10\%, 10) = \$1,754.15$$

$$PW_B = -17,000 + 3,000(P/A, 10\%, 10) = \$1,435.00$$

Select A because of higher present worth

9-7

A manufacturing firm has a minimum attractive rate of return (MARR) of 12% on new investments. What uniform annual benefit would Investment B have to generate to make it preferable to Investment A?

Year	<u>Investment A</u>	<u>Investment B</u>
0	- \$60,000	- \$45,000
1 - 6	+15,000	?

Solution

$$\begin{aligned} \text{NPW of A} &= -60,000 + 15,000(P/A, 12\%, 6) \\ &= \$1,665 \end{aligned}$$

$$\begin{aligned} \text{NPW of B} &\geq 1,665 = -45,000 + A(P/A, 12\%, 6) \\ \therefore A &= 11,351 \end{aligned}$$

Annual Benefit > \$11,351 per year

130 Chapter 9 Mutually Exclusive Alternatives

9-8

The city council wants the municipal engineer to evaluate three alternatives for supplementing the city water supply. The first alternative is to continue deep well pumping at an annual cost of \$10,500. The second alternative is to install an 18" pipeline from a surface reservoir. First cost is \$25,000 and annual pumping cost is \$7000.

The third alternative is to install a 24" pipeline from the reservoir at a first cost of \$34,000 and annual pumping cost of \$5000. Life of all alternatives is 20 years. For the second and third alternatives, salvage value is 10% of first cost. With interest at 8%, which alternative should the engineer recommend? Use present worth analysis.

Solution

Fixed output, therefore minimize cost.

<u>Year</u>	<u>DEEPWELL</u>	<u>18" PIPELINE</u>	<u>24" PIPELINE</u>
0		-25,000	-34,000
1-20	-10,500	-7,000	-5,000
20		+2,500	+3,400

Deepwell: $PWC = -10,500(P/A, 8\%, 20) = -\$103,089$

18" Pipeline: $PW \text{ of Cost} = -25,000 - 7,000(P/A, 8\%, 20) + 2,500(P/F, 8\%, 20) = -\$93,190$

24" Pipeline: $PW \text{ of Cost} = -34,000 - 5,000(P/A, 8\%, 20) + 3,400(P/F, 8\%, 20) = -\$82,361$

Choose 24" Pipeline

9-9

An engineering analysis by net present worth (NPW) is to be made for the purchase of two devices A and B. If an 8% interest rate is used, recommend the device to be purchased.

	<u>Cost</u>	<u>Uniform Annual Benefit</u>	<u>Salvage</u>	<u>Useful Life</u>
Device A	\$600	\$100	\$250	5 years
Device B	700	100	180	10 years

Solution

Device A:

$$NPW = 100(P/A, 8\%, 10) + 250(P/F, 8\%, 10) - 600 - [600 - 250](P/F, 8\%, 5) = -\$51.41$$

Device B:

$$NPW = 100(P/A, 8\%, 10) + 180(P/F, 8\%, 10) - 700 = \$54.38$$

Select device B

9-10

Chapter 9 Mutually Exclusive Alternatives 131

Two alternatives are being considered for recovering aluminum from garbage. The first has a capital cost of \$100,000, a first year maintenance cost of \$15,000, with maintenance increasing by \$500 per year for each year after the first.

The second has a capital cost of \$120,000, a first-year maintenance cost of \$3000, with maintenance increasing by \$1,000 per year after the first.

Revenues from the sale of aluminum are \$20,000 in the first year, increasing \$2,000 per year for each year after the first. Life of both alternatives is 10 years. There is no salvage value. The before-tax MARR is 10%. Using present worth analysis, determine which alternative is preferred.

Solution

$$\text{Alternative 1: NPW} = -100,000 + 15,000(P/A, 10\%, 10) + 500(P/G, 10\%, 10) = \$3,620.50$$

$$\text{Alternative 2: NPW} = -120,000 + 17,000(P/A, 10\%, 10) + 1,000(P/G, 10\%, 10) = \$7,356.00$$

Choose Alternative 2 → Maximum. NPW

9-11

A brewing company is deciding between two used filling machines as a temporary measure, before a plant expansion is approved and completed. The two machines are:

- (a) The Kram Filler. Its initial cost is \$85,000, and the estimated annual maintenance is \$8000.
- (b) The Zanni Filler. The purchase price is \$42,000, with annual maintenance costs of \$8000.

The Kram filler has a higher efficiency, compared with the Zanni, and it is expected that the savings will amount to \$4000 per year if the Kram filler is installed. It is anticipated that the filling machine will not be needed after 5 years, and at that time, the salvage value for the Kram filler would be \$25,000, while the Zanni would have little or no value.

Assuming a minimum attractive rate of return (MARR) of 10%, which filling machine should be purchased?

Solution

Fixed output, therefore minimize costs

Kram:

$$\begin{aligned} \text{NPW} &= 25,000(P/F, 10\%, 5) - 85,000 - 4,000(P/A, 10\%, 5) \\ &= -\$84,641.5 \text{ (or a PWC } \$84,641.50) \end{aligned}$$

Zani:

$$\begin{aligned} \text{NPW} &= -42,000 - 8,000(P/A, 10\%, 5) \\ &= -\$72,328 \text{ (or a PWC of } \$72,328) \end{aligned}$$

Therefore choose the Zani filler.

9-12

Two technologies are currently available for the manufacture of an important and expensive food

132 Chapter 9 Mutually Exclusive Alternatives

and drug additive. The two can be described as follows:

Laboratory A is willing to release the exclusive right to manufacture the additive in this country for \$50,000 payable immediately, and a \$40,000 payment each year for the next 10 years. The production costs are \$1.23 per unit of product.

Laboratory B is also willing to release similar manufacturing rights. They are asking for the following schedule of payments:

On the closing of the contract, \$10,000

From years 1 to 5, at the end of each year, a payment of \$25,000 each

From years 6 to 10, also at the end of each year, a payment of \$20,000.

The production costs are \$1.37 per unit of product.

Neither lab is to receive any money after 10 years for this contract. It is anticipated there will be an annual production of 100,000 items for the next 10 years. On the basis of analyses and trials, the products of A and B are practically identical in quality. Assuming a MARR of 12%, which lab should be chosen?

Solution

Laboratory A: The annual production cost = $1.23 \times 100K = \$123K$

$$PWC = 50,000 + [40,000 + 123,000](P/A, 12\%, 10) = \$970,950$$

Laboratory B: The annual production cost = $1.37 \times 100K = \$137K$

$$PWC = 10,000 + [25,000 + 137,000](P/A, 12\%, 5) \\ + [20,000 + 137,000](P/A, 12\%, 5)(P/F, 12\%, 5) = \$915,150$$

Therefore choose Laboratory B.

9-13

A company decides it must provide repair service for the equipment it sells. Based on the following, which alternative for providing repair service should be selected?

<u>Alternative</u>	<u>NPW</u>
A	-\$9,241
B	-6,657
C	-8,945

Solution

None of the alternatives look desirable, but since one of the alternatives must be chosen (the do nothing alternative is not available), choose the one that maximizes NPW (in this case minimizes net present costs). Thus the best of the three alternatives is B.

9-14

McClain, Edwards, Shiver, and Smith (MESS) LLC is considering the purchase of new automated cleaning equipment. The industrial engineer for the company, David "The Dirtman" R. has been

Chapter 9 Mutually Exclusive Alternatives 133

asked to calculate the present worth of the two best alternatives. The data for each are presented below.

	<u>Mess Away</u>	<u>Quick Clean</u>
First Cost	\$65,000	\$78,000
Annual Savings	20,000	24,000
Annual Operating Costs	4,000	2,750
Scheduled Maintenance	\$1,500 at the end of 3 rd Year	\$3,000 at the end of 3 rd Year
Annual Insurance*	2,000	2,200
Salvage Value	10% of First Cost	12.5% of First Cost
Useful Life	5 Years	5 Years

* Assume beginning of period payments

David is so busy cleaning his office he has asked you to help with the work. If interest is 8%, determine which equipment should be purchased.

Solution

Mess Away

<u>Yr</u>		
0	First Cost	(65,000)
1-5	Annual Net Savings 16,000(P/A, 8%, 5)	63,888
0-4	Annual Insurance 2,000 + 2,000(P/A, 8%, 4)	(8,624)
3	Scheduled Maintenance 1,500(P/F, 8%, 3)	(1,191)
5	Salvage Value 6,500(P/F, 8%, 5)	4,424
		<u>\$(6,503)</u>

Quick Clean

<u>Yr</u>		
0	First Cost	(78,000)
1-5	Annual Net Savings 21,250(P/A, 8%, 5)	84,851
0-4	Annual Insurance 2,200 + 2,200(P/A, 8%, 4)	(9,486)
3	Scheduled Maintenance 3,000(P/F, 8%, 3)	(2,381)
5	Salvage Value 10,000(P/F, 8%, 5)	6,806
		<u>\$ 1,790</u>

Choose Spit 'N' Shine.

9-15

Be-low Mining INC. is trying to decide whether it should purchase or lease new earth-moving equipment. If purchased, the equipment will cost \$175,000 and is expected to be used six years at which time it can be sold for \$72,000. At the midpoint of its life (year 3) an overhaul costing \$20,000 must be performed. The equipment can be leased for \$30,000 per year. Be-low will not be responsible for the mid-life over haul if the equipment is leased. If the equipment is purchased it will be leased to other mining companies whenever possible; this is expected to yield revenues of \$15,000 per year. The annual operating cost regardless of the decision will be approximately equal. What would you recommend in the MARR is 6%?

134 Chapter 9 Mutually Exclusive Alternatives**Solution**Lease

(Recall that lease payments are beginning of period cash flows.)

$$\begin{aligned}
 P &= -30,000 - 30,000(P/A, 6\%, 5) \\
 &= -\$156,360
 \end{aligned}$$

Buy

$$\begin{aligned}
 P &= -175,000 + 72,000(P/F, 6\%, 6) - 20,000(P/F, 6\%, 3) + 15,000(P/A, 6\%, 6) \\
 &= -\$67,277
 \end{aligned}$$

9-16

Cheap Motors Manufacturing must replace one of its tow motors. The NPW of alternative A is -\$5,876, alternative B -\$7,547 and alternative C -\$3,409. Alternatives A and B are expected to last 12 years and alternative C is expected to last six years. If Cheap's MARR is 4% the alternative that should be chosen is

- A
- B
- C
- No alternative should be chosen, all NPW are negative.

Solution

A 12-year analysis period is necessary.

$$NPW_{A12} = -\$5,876$$

$$NPW_{B12} = -\$7,547$$

$$\begin{aligned}
 NPW_{C12} &= -3,409 + 3,409(P/F, 4\%, 6) \\
 &= -\$6,103
 \end{aligned}$$

An alternative must be chosen, minimize the PW of costs, therefore the answer is a.

9-17

The following data are associated with three grape crushing machines under consideration by Rabbit Ridge Wineries LLC.

	<u>Smart Crush</u>	<u>Super Crush</u>	<u>Savage Crush</u>
First Cost	\$52,000	\$63,000	\$105,000
O & M Costs	15,000	9,000	12,000
Annual Benefits	38,000	31,000	37,000
Salvage Value	13,000	19,000	22,000
Useful Life, in Years	4	6	12

If Rabbit Ridge uses a MARR of 12%, which alternative, if any, should be chosen?

Solution

A 12-year analysis period is necessary.

Smart Crush

$$\begin{aligned} NPW_4 &= -52,000 + 23,000(P/A, 12\%, 4) + 13,000(P/F, 12\%, 4) \\ &= \$26,113 \end{aligned}$$

$$\begin{aligned} NPW_{12} &= 26,113 + 26,113(P/F, 12\%, 4) + 26,113(P/F, 12\%, 8) \\ &= \$53,255 \end{aligned}$$

Super Crush

$$\begin{aligned} NPW_6 &= -63,000 + 22,000(P/A, 12\%, 6) + 19,000(P/F, 12\%, 6) \\ &= \$37,067 \end{aligned}$$

$$\begin{aligned} NPW_{12} &= 37,067 + 37,067(P/F, 12\%, 6) \\ &= \$55,845 \end{aligned}$$

Savage Crush

$$\begin{aligned} NPW_{12} &= -105,000 + 25,000(P/A, 12\%, 12) + 22,000(P/F, 12\%, 12) \\ &= \$54,497 \end{aligned}$$

Maximize NPW, choose Super Crush.

9-18

Morton and Moore LLC (M^2) is trying to decide between two machines which are necessary in their manufacturing facility. Data concerning the two machines are presented below. If M^2 has a minimum attractive rate of return (MARR) of 15%, which machine should be chosen?

	<u>Machine A</u>	<u>Machine B</u>
First Cost	\$45,000	\$24,000
Annual Operating Costs	31,000	35,000
Overhaul in Years 2 and 4	-	6,000
Overhaul in Year 5	12,000	-
Salvage Value	10,000	8,000
Useful Life	8 years	6 years

Solution

$$\begin{aligned} EUAC_A &= -45,000(A/P, 15\%, 8) - 31,000 - 12,000(P/F, 15\%, 5)(A/P, 15\%, 8) \\ &\quad + 10,000(A/F, 15\%, 8) \\ &= -\$41,632 \end{aligned}$$

$$\begin{aligned} EUAC_B &= -24,000(A/P, 15\%, 6) - 35,000 - 6,000[(P/F, 15\%, 2) + (P/F, 15\%, 4)](A/P, 15\%, 6) \\ &\quad + 8,000(A/F, 15\%, 6) \\ &= -\$42,532 \end{aligned}$$

Minimize EUAC, therefore choose Machine A.

9-19

The town of Dry Hole needs an additional supply of water from Duck Creek. The town engineer has selected two plans for comparison. The gravity plan would divert water at a point ten miles up

136 Chapter 9 Mutually Exclusive Alternatives

Duck Creek and carry it through a pipeline by gravity to the town. A system using a pumping station would divert water at a point closer to town and pump it into the town. The pumping plant would be built in two stages, with 75% of its capacity installed initially and the remaining 25% installed ten years later. The engineer has assumed that each plan will last 40 years and be worthless at the end of its life. Using the data presented below and an interest rate of 8%, what is the maximum that should be paid for the gravity plan?

	<u>Gravity</u>	<u>Pumping</u>
Initial Investment	\$?????	\$1,800,000
Completion Cost in 10 th Year		350,000
Annual Operating and Maintenance Costs*	\$10,000	\$25,000
Annual Power Costs		
Average the first 10 years*	0	\$ 50,000
Average the next 30 years*	0	\$100,000

Solution

Gravity

$$\text{EUAC} = X(A/P, 8\%, 40) - 10,000$$

$$= .0839X - 10,000$$

Pumping

$$\text{EUAC} = 1,800,000(A/P, 8\%, 40) + 350,000(P/F, 8\%, 10)(A/P, 8\%, 40) + 25,000$$

$$+ [50,000(P/A, 8\%, 10) + 100,000(P/A, 8\%, 30)(P/F, 8\%, 10)](A/P, 8\%, 40)$$

$$= \$261,521$$

Setting the two alternatives equal

$$.0839X - 10,000 = 261,521$$

$$X = \$2,997,867$$

9-20

The Tennessee Department of Highways is trying to decide whether it should “hot-patch” a short stretch of an existing highway or resurface it. If the hot-patch method is chosen, approximately 500 cubic meters of material would be required at a cost of \$800/cubic meter (in place). If hot-patched, the shoulders will have to be improved at the same time at a cost of \$24,000. The shoulders must be maintained at a cost of \$3,000 every two years. The annual cost of routine maintenance on the patched road is estimated to be \$6,000.

Alternatively, the state can resurface the road at a cost of \$500,000. This surface will last 10 years if maintained properly at a cost of \$2,000 per year beginning in the second year. The shoulders would require reworking at the end of the fifth year at a cost of \$15,000. Regardless of the method selected the road will be completely rebuilt in 10 years. At an interest rate of 9%, which alternative should be chosen?

Solution

Hot-Patch

$$\begin{aligned} \text{EUAC} &= 500(800)(A/P, 9\%, 10) + 24,000(A/P, 9\%, 10) \\ &\quad + 3,000(A/F, 9\%, 2)(P/A, 9\%, 8)(A/P, 9\%, 10) + 6,000 \\ &= \$73,297 \end{aligned}$$

Re-surface

$$\begin{aligned} \text{EUAC} &= 500,000(A/P, 9\%, 10) + 15,000(P/F, 9\%, 5)(A/P, 9\%, 10) \\ &\quad + 2,000(P/A, 9\%, 9)(P/F, 9\%, 1)(A/P, 9\%, 10) \\ &= \$81,133 \end{aligned}$$

Minimize EUAC, choose the hot-patch alternative.

9-21

Dorf Motors Manufacturing must replace one of its tow motors. The net present cost of alternative A is \$8,956, alternative B \$5,531 and alternative C \$4,078. Alternative A is expected to last 12 years and alternative B has an expected life of seven years, alternative C is expected to last five years. If Dorf's MARR is 5% the alternative that should be chosen is

- A
- B
- C
- No alternative should be chosen, all economic measures are negative.

Solution

Annual worth analysis is appropriate because of the different useful lives.

$$\begin{aligned} \text{EUAC}_A &= 8,956(A/P, 5\%, 12) \\ &= \$1,010.23 \end{aligned}$$

$$\begin{aligned} \text{EUAC}_B &= 8,956(A/P, 5\%, 7) \\ &= \$955.76 \end{aligned}$$

$$\begin{aligned} \text{EUAC}_C &= 8,956(A/P, 5\%, 5) \\ &= \$942.02 \end{aligned}$$

Minimize EUAC therefore the answer is c.

9-22

Johnny on the Job portable toilets must purchase new portable toilets that will be rented to construction companies for job site use. The toilet model they are planning to purchase costs \$275/unit. The company plans to purchase 50 toilets. Each month the service and upkeep for the toilets is estimated to cost \$ 8.75/unit. Every six months the toilets must undergo cleaning and sanitizing that is contracted to cost \$250 for all 50 toilets. The cleaning and sanitizing must also be performed before the company can dispose of the units. The units will have a salvage value of \$50/toilet. JOJ wishes to make \$5/unit in addition to covering all costs. If the MARR for JOJ is 6%, how much should be charged (to the nearest \$) per toilet per month for rental. Assume all toilets are rented and can be used for 2 years.

Solution

138 Chapter 9 Mutually Exclusive Alternatives

$$i = 6/12 = 1/2\% \quad n = (12)(2) = 24$$

$$\begin{aligned} \text{EUMC} &= 275(50)(A/P, 1/2\%, 24) + 8.75(50) + 250(A/F, 1/2\%, 6) - 50(50)(A/F, 1/2\%, 24) \\ &= \$989.53 \end{aligned}$$

$$\begin{aligned} \text{Cost per unit} &= 989.53/50 \\ &= 19.79 \end{aligned}$$

$$\begin{aligned} \text{Profit} &= \frac{5.00}{\$24.79} \rightarrow \text{Rent for } \$25/\text{unit} \end{aligned}$$

9-23

Data for tractors A and B are listed below. With interest of 12%, which tractor would be selected based on equivalent uniform annual cost (EUAC)?

	<u>A</u>	<u>B</u>
First cost	\$30,000	\$36,000
Annual maintenance	1,500	2,000
Salvage value	5,000	8,000
Useful life	6 years	6 years

Solution

$$\text{EUAC} = P(A/P, i\%, n) - S(A/F, i\%, n) + \text{Other Costs}$$

TRACTOR A:

$$\begin{aligned} \text{EUAC} &= 30,000(A/P, 12\%, 6) - 5,000(A/F, 12\%, 6) + 1,500 \\ &= \$8,180 \end{aligned}$$

TRACTOR B:

$$\begin{aligned} \text{EUAC} &= 36,000(A/P, 12\%, 6) - 8,000(A/F, 12\%, 6) + 2,000 \\ &= \$9,770 \end{aligned}$$

Since criteria is to minimize EUAC select tractor A

9-24

According to the manufacturers' literature, the costs of running automatic grape peelers, if maintained according to the instruction manuals, are:

<u>Manufacturer:</u>	<u>Slippery</u>	<u>Grater</u>
First Cost	\$500	\$300
Maintenance	\$100 at end of years 2, 4, 6 and 8	Year 1 - \$ 0 2 - 50 3 - 75 4 - 100 5 - 125
Useful Life	10 years	5 years

Which alternative is preferred if MARR = 15%?

Solution

Slippery :

$$\begin{aligned} \text{EUAC} &= [500 + 100(\text{A/F}, 15\%, 2)(\text{P/A}, 15\%, 8)](\text{A/P}, 15\%, 10) \\ &= \$141.24 \end{aligned}$$

Grater:

$$\begin{aligned} \text{EUAC} &= [300 + 25(\text{P/G}, 15\%, 5) + 25(\text{P/A}, 15\%, 4)(\text{P/F}, 15\%, 1)](\text{A/P}, 15\%, 5) \\ &= \$151.07 \end{aligned}$$

Therefore, choose Slippery with lower EUAC.

9-25

A semiconductor manufacturer has been ordered by the city to stop discharging acidic waste liquids into the city sewer system. Your analysis shows you should select one of the following three systems.

<u>System</u>	<u>Installed Cost</u>	<u>Annual Operating Cost</u>	<u>Salvage Value</u>
CleanH ₂ O	\$30,000	\$6,000	\$2,000
AcidFree	35,000	5,000	5,000
Evergreen	80,000	1,000	40,000

If the system is expected to last and be used 20 years and money is worth 8%, which system should be purchased?

Solution

$$\begin{aligned} \text{CleanH}_2\text{O} \quad \text{EUAC} &= 6,000 + 30,000(\text{A/P}, 8\%, 20) - 2,000(\text{A/F}, 8\%, 20) \\ &= \$9,013 \end{aligned}$$

$$\begin{aligned} \text{AcidFree} \quad \text{EUAC} &= 5,000 + 35,000(\text{A/P}, 8\%, 20) - 5,000(\text{A/F}, 8\%, 20) \\ &= \$8,456 \end{aligned}$$

$$\begin{aligned} \text{Evergreen} \quad \text{EUAC} &= 1,000 + 80,000(\text{A/P}, 8\%, 20) - 40,000(\text{A/F}, 8\%, 20) \\ &= \$8,276 \end{aligned}$$

Purchase system with lowest EUAC, Evergreen.

9-26

The following alternatives describe possible projects for the use of a vacant lot. In each case the project cost includes the purchase price of the land.

	<u>Parking Lot</u>	<u>Gas Station</u>
Investment Cost	\$50,000	\$100,000
Annual Income	35,000	85,000
Annual Operating Expenses	25,000	70,000 in Year 1, then increasing by 1,000/yr
Salvage Value	10,000	10,000
Useful Life	5 years	10 years

- If the minimum attractive rate of return (MARR) equals 18%, what should be done with the land?
- Is it possible the decision would be different if the MARR were higher than 18%? Why or why not? (No calculations necessary.)

Solution

$$\begin{aligned}
 \text{a. } \text{EUAW}_{\text{P.L.}} &= (35,000 - 25,000) - 50,000(A/P, 18\%, 5) + 10,000(A/F, 18\%, 5) = -\$4,592 \\
 \text{EUAW}_{\text{G.S.}} &= (85,000 - 70,000) - 100,000(A/P, 18\%, 10) + 10,000(A/F, 18\%, 10) \\
 &\quad - 1,000(A/G, 18\%, 10) = -\$10,019
 \end{aligned}$$

Since both EUAW's are negative, leave lot vacant.

- No. Higher MARR favors lower cost projects and the lowest cost project (do nothing) has already been chosen.

9-27

Given the following information about possible investments being considered by the ABC Block Company, what is the best choice at a minimum attractive rate of return (MARR) of 10%?

	<u>A</u>	<u>B</u>
Investment Cost	\$5,000	\$8,000
Annual Benefits	1,200	800
Useful Life	5 years	15 years

Solution

Since the useful lives are different, use equivalent annual worth analysis.

$$EUAW_A = 1,200 - 5,000(A/P, 10\%, 5) = -\$119.00$$

$$EUAW_B = 800 - 8,000(A/P, 10\%, 15) = -\$252.00$$

Choose the do nothing alternative.

9-28

You are considering purchasing the Press-o-matic or Steam-it-out model automatic ironing system to allow you to handle more dry cleaning business. Either machine will cost the same amount, \$5,000. The Press-o-matic will generate a positive cash flow of \$1,300 per year for 5 years and then be of no service or salvage value. The Steam-it-out will generate a positive cash flow of \$800 per year for 10 years and then be of no service or salvage value. You plan to be in the dry cleaning business for the next 10 years. How would you invest the \$5,000 you have in your hand if you feel the time value of money is worth the same as your high interest bank account offers, which is

- 8%?
- 12%?

Solution

$$\begin{aligned} \text{a) Press EUAW} &= 1,300 - 5,000(A/P, 8\%, 5) = \$47.50 \\ \text{Steam EUAW} &= 800 - 5,000(A/P, 8\%, 10) = \$55.00 \end{aligned}$$

Choose highest EUAB, Steam-it-out

$$\begin{aligned} \text{b) Press EUAW} &= 1,300 - 5,000(A/P, 12\%, 5) = -\$87.00 \\ \text{Steam EUAW} &= 800 - 5,000(A/P, 12\%, 10) = -\$85.00 \end{aligned}$$

Choose neither option because both have a negative annual worth.

9-29

Data for Machines X and Y are listed below. With an interest rate of 8%, which machine should be selected based upon equivalent uniform annual cost (EUAC)?

	<u>X</u>	<u>Y</u>
First Cost	\$5,000	\$10,000
Annual Maintenance	500	200
Salvage Value	600	1,000
Useful Life	5 years	15 years

Solution

Machine X:

142 Chapter 9 Mutually Exclusive Alternatives

$$EUAC = 5,000(A/P, 8\%, 5) - 600(A/F, 8\%, 5) + 500 = \$1,650.20$$

Machine Y:

$$EUAC = 10,000(A/P, 8\%, 15) - 1,000(A/F, 8\%, 15) + 200 = \$1331.20$$

Decision criterion: minimize EUAC, therefore choose Y

9-30

Consider Projects A and B. Which project would you approve if a project must be selected? The expected period of service is 15 years, and the interest rate is 10%.

	<u>Project A</u>	<u>Project B</u>
Initial Cost	\$50,000	\$75,000
Annual Operating Costs	15,000	10,000
Annual Repair Costs	5,000	3,000
Salvage Value	5,000	10,000

Solution

Project A:

$$EUAC_A = 50,000(A/P, 10\%, 15) + 20,000 - 5,000(A/F, 10\%, 15) = \$26,417.50$$

Project B:

$$EUAC_B = 75,000(A/P, 10\%, 15) + 13,000 - 10,000(A/F, 10\%, 15) = \$22,547.50$$

Choose least cost: project B

9-31

Assuming a 10% interest rate, determine which alternative should be selected.

	<u>A</u>	<u>B</u>
First Cost	\$5,300	\$10,700
Uniform Annual Benefit	1,800	2,100
Salvage Value	0	200
Useful Life	4 years	8 years

Solution

Alternative A:

$$\begin{aligned} EUAW &= 5,300(A/P, 10\%, 4) - 1,800 \\ &= \$127.85 \end{aligned}$$

Alternative B:

$$\begin{aligned} \text{EUAW} &= 10,700(A/P, 10\%, 8) + 200(A/F, 10\%, 8) - 2,100 \\ &= \$112.30 \end{aligned}$$

Choose alternative A

9-32

A company must decide whether to buy Machine A or Machine B. After 5 years A will be replaced with another A.

	<u>Machine A</u>	<u>Machine B</u>
First Cost	\$10,000	\$20,000
Annual Maintenance	1,000	0
Salvage Value	10,000	10,000
Useful Life	5 years	10 years

With the minimum attractive rate of return (MARR) = 10%, which machine should be purchased?

Solution

$$\text{EUAW}_A = -10,000(A/P, 10\%, 5) - 1,000 + 10,000(A/F, 10\%, 5) = -\$2,000$$

$$\text{EUAW}_B = -20,000(A/P, 10\%, 10) + 10,000(A/F, 10\%, 10) = -\$2,627$$

Therefore Machine A should be purchased.

9-33

The construction costs and annual maintenance costs of two alternatives for a canal are given below. Using equivalent uniform annual cost (EUAC) analysis, which alternative would you recommend? Assume 7% interest and infinite life. What is the capitalized cost of maintenance for the alternative you choose?

	<u>Alternative A</u>	<u>Alternative B</u>
Construction Cost	\$25,000,000	\$50,000,000
Annual Maintenance Costs	3,500,000	2,000,000

Solution

$$\begin{aligned} \text{a) Alternative A} \quad \text{EUAC} &= A + Pi = 3.5M + 25M(0.07) = \$5,250,000 \\ \text{Alternative B} \quad \text{EUAC} &= A + Pi = 2.0M + 50M(0.07) = \$5,500,000 \end{aligned}$$

Fixed Output \therefore minimize cost; choose A

$$\text{b) } P = A/i = 3,500,000/0.07 = \$50,000,000$$

144 Chapter 9 Mutually Exclusive Alternatives

9-34

The manager of Cats-N-The-Pond, Inc. is trying to decide between two alternative designs for an aquacultural facility. Both facilities produce the same number of fish for sale. The first alternative costs \$250,000 to build, and has a first-year operating cost of \$110,000. Operating costs are estimated to increase by \$10,000 per year for each year after the first.

The second alternative costs \$450,000 to build, and has a first-year operating cost of \$40,000 per year, escalating at \$5000 per year for each year after the first. The estimated life of both plants is 10 years and each has a salvage value that is 10% of construction cost.

Assume an 8% interest rate. Using equivalent uniform annual cost (EUAC) analysis, which alternative should be selected?

Solution

	<u>Alternative 1</u>	<u>Alternative 2</u>
First Cost	\$250,000	\$450,000
Uniform Annual Costs	110,000	40,000
Gradient	10,000	5,000
Salvage Value	25,000	45,000

$$\begin{aligned}\text{Alternative 1: EUAC} &= 250,000(A/P, 8\%, 10) - 25,000(A/F, 8\%, 10) + 110,000 \\ &\quad + 10,000(A/G, 8\%, 10) \\ &= \$184,235\end{aligned}$$

$$\begin{aligned}\text{Alternative 2: EUAC} &= 450,000(A/P, 8\%, 10) - 45,000(A/F, 8\%, 10) + 40,000 \\ &\quad + 5,000(A/G, 8\%, 10) \\ &= \$123,300\end{aligned}$$

Fixed Output (same amount of fish for sale) \therefore Minimize EUAC

Choose Alternative 2

9-35

The plant engineer of a major food processing corporation is evaluating alternatives to supply electricity to the plant. He will pay \$3 million for electricity purchased from the local utility at the end of this first year and estimates that this cost will increase at \$300,000 per year. He desires to know if he should build a 4000 kilowatt power plant. His operating costs (other than fuel) for such a power plant are estimated to be \$130,000 per year. He is considering two alternative fuels:

- WOOD. Installed cost of the power plant is \$1200/kilowatt. Fuel consumption is 30,000 tons per year. Fuel cost for the first year is \$20 per ton and is estimated to increase at a rate of \$2 per ton for each year after the first. No salvage value.
- OIL. Installed cost is \$1000/kw. Fuel consumption is 46,000 barrels per year. Fuel cost is \$34 per barrel for the first year and is estimated to increase at \$1/barrel per year for each year after the first. No salvage value.

If interest is 12%, and the analysis period is 10 years, which alternative should the engineer

choose? Solve the problem by equivalent uniform annual cost analysis (EUAC).

Solution

	<u>Do</u>			
	<u>Nothing</u>		<u>Wood</u>	<u>Oil</u>
First Cost	0		4,000 x 1,200 = 4,800,000	4,000 x 1,000 = 4,000,000
Annual Oper. Costs	0		130,000	130,000
Annual Energy Costs	3,000,000		30,000 x 20 = 600,000	46,000 x 34 = 1,564,000
Gradient	300,000		30,000 x 2 = 60,000	46,000 x 1 = 46,000

Do Nothing:

$$EUAC = 3,000K + 300K(A/G, 12\%, 10) = \$4,075,500$$

Wood:

$$EUAC = 4,800K(A/P, 12\%, 10) + 130K + 600K + 60K(A/G, 12\%, 10) = \$1,794,700$$

Oil:

$$EUAC = 4,000K(A/P, 12\%, 10) + 130K + 1,564K + 46K(A/G, 12\%, 10) = \$2,566,190$$

Minimize EUAC choose wood

9-36

Two alternatives are being considered by a food processor for the warehousing and distribution of its canned products in a sales region. These canned products come in standard cartons of 24 cans per carton. The two alternatives are:

Alternative A. To have its own distribution system. The administrative costs are estimated at \$43,000 per year, and other general operating expenses are calculated at \$0.009 per carton. A warehouse will have to be purchased that costs \$300,000.

Alternative B. To sign an agreement with an independent distribution company that is asking a payment of \$0.10 per carton distributed.

Assume a study period of 10 years, and that the warehouse can be sold at the end of this period for \$200,000.

- a) Which alternative should be chosen, if they expect that the number of cartons to be distributed will be 600,000 per year?
- b) Find the minimum number of cartons per year that will make the alternative of

146 Chapter 9 Mutually Exclusive Alternatives

having a distribution system (Alt A.) more profitable than to sign an agreement with the distribution company (Alt B.)

Solution

- a) For 600,000 cartons/yr.

Alternative A:

$$\text{Capital Expenses} = 300,000(A/P, 10\%, 10) - 200,000(A/F, 10\%, 10) = \$36,270$$

Annual Costs:	Administration:		\$43,000
	Operating Expenses:	$.009 \times 600,000$	5,400
		=	
	Capital Expenses		<u>36,270</u>
		Total =	\$84,670

\therefore Total annual costs = \$84,670.00

Alternative B:

$$\text{Total annual costs} = 0.10 \times 600,000 = \$60,000$$

\therefore Sign an agreement for distribution Alternative B.

- b) Let M = number of cartons/yr.

$$\text{The EUAC for alternative B (agreement)} = \text{EUAC}_{\text{AGREEMENT}} = 0.10M$$

$$\text{The EUAC for alternative A (own system)} = \text{EUAC}_{\text{OWN}} = 43,000 + 0.009M + 36,270$$

$$\text{We want } \text{EUAC}_{\text{OWN}} < \text{EUAC}_{\text{AGREEMENT}}$$

$$43,000 + .009M + 36,270 < 0.10M$$

$$79,270 < (0.10 - 0.009)M$$

$$79,270/0.091 < M$$

$$871,099 < M$$

\therefore Owning the distribution system is more profitable for 871,100 or more cartons/year.

9-37

Sugar-N-Spice, a cookie factory, needs a new cookie cutter machine. They have narrowed their choices to three machines. Information concerning each machine is presented below.

	<u>A</u>	<u>B</u>	<u>C</u>
Cost	\$18,000	\$25,000	\$15,000

Chapter 9 Mutually Exclusive Alternatives 147

Annual Net Savings	1,055	2,125	1,020
IRR	7%	9%	8%

Each machine has a twenty-five year useful life with no salvage value. If the MARR for Sugar-N-Spice is 10%, which choice should be chosen?

Solution

Incremental analysis is required for IRR.

NPW = 0 at IRR

$$\begin{aligned}
 \text{IRR}_{B-A} \quad 0 &= [-25,000 - (-18,000)] + (2,125 - 1,055)(P/A, i\%, 25) \\
 (P/A, i\%, 25) &= 7,000/1,070 \\
 &= 6.5421 \qquad \qquad \qquad 12\% < \text{IRR} < 15\% \quad \text{Choose most expensive, B}
 \end{aligned}$$

$$\begin{aligned}
 \text{IRR}_{B-C} \quad 0 &= [-25,000 - (-15,000)] + (2,125 - 1,020)(P/A, i\%, 25) \\
 (P/A, i\%, 25) &= 10,000/1,070 \\
 &= 6.5421 \qquad \qquad \qquad 8\% < \text{IRR} < 9\% \quad \text{Choose least expensive, C}
 \end{aligned}$$

9-38

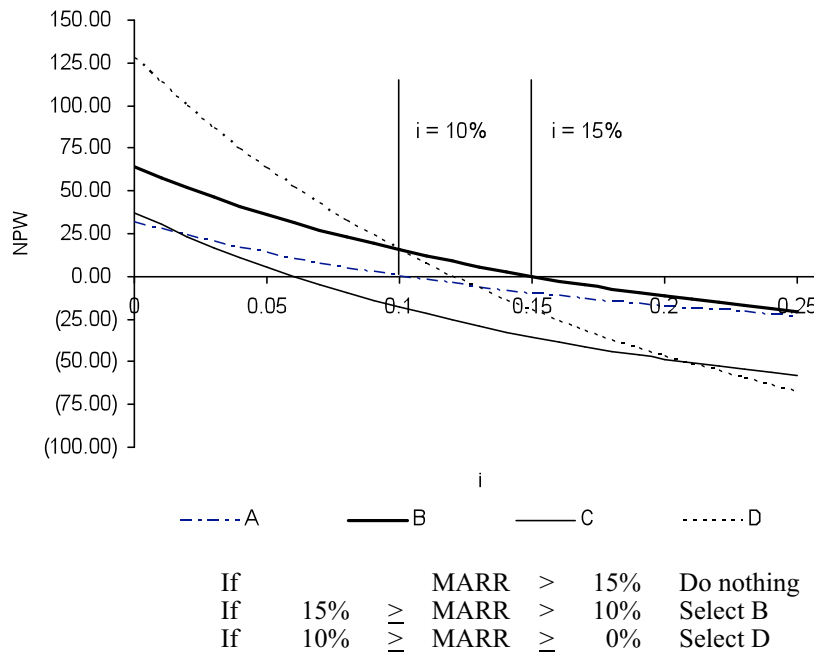
Barber Brewing is considering investing in one of the following opportunities.

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
First Cost	\$100.00	\$130.00	\$200.00	\$330.00
Annual Income	100.00	90.78	160.00	164.55
Annual Cost	73.62	52.00	112.52	73.00

Each alternative has a five year useful life. Using net present worth, prepare a choice table.

Solution

148 Chapter 9 Mutually Exclusive Alternatives



9-39

Hayes, Angle, Reed, and Davis (HARD) a local concrete finishing company is considering investing in newer, more productive curb forming equipment. Data concerning the three best alternatives are presented below.

	<u>A</u>	<u>B</u>	<u>C</u>
Initial Investment	\$50,000	\$22,000	\$15,000
Annual Net Income	5,093	2,077	1,643
Computed IRR	8%	7%	9%

Each alternative has a twenty year useful life with no salvage value. If the MARR for HARD is 7%, which alternative should be chosen?

Solution

Incremental analysis is required for IRR.

NPW = 0 at IRR

IRR_{A-B}

$$0 = [-50,000 - (-22,000)] + (5,093 - 2,077)(P/A, i\%, 20)$$

$$(P/A, i\%, 20) = 28,000/3,016$$

$$= 9.284$$

8% < IRR < 9% Choose most expensive, A

IRR_{A-C}

$$0 = [-50,000 - (-15,000)] + (5,093 - 1,643)(P/A, i\%, 20)$$

$$(P/A, i\%, 20) = 35,000/3,450$$

Chapter 9 Mutually Exclusive Alternatives 149

= 10.145 7% < IRR < 8% Choose most expensive, A

9-40

Abby W. is considering investing in one of the following investment projects.

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
First Cost	\$100.00	\$130.00	\$200.00	\$330.00	\$000.00
Annual Income	150.00	130.78	185.00	184.55	00.00
Annual Cost	123.62	92.00	137.52	93.00	00.00

Each alternative has a five-year useful life. If Abby requires at least an 8% return on her investments, which alternative should she select?

Solution

NPW = 0 at IRR.

0 = -First cost + net income (P/A, i%, n) Therefore (P/A, i%, n) = First cost/net income

IRR _A	P/A = 100/26.38 = 3.791	IRR = 10%	
IRR _B	P/A = 130/38.78 = 3.352	IRR = 15%	
IRR _C	P/A = 200/47.48 = 4.212	IRR = 6%	Eliminate, does not meet MARR
IRR _D	P/A = 330/91.55 = 3.605	IRR = 12%	
IRR _E		IRR = 0%	Eliminate, does not meet MARR

Incremental analysis required

IRR _{D-B}	P/A = 200/52.77 = 3.790	IRR = 10%	Choose D
IRR _{D-A}	P/A = 230/65.17 = 3.529	12% < IRR < 15%	Choose D

9-41

Two mutually exclusive investment projects have been presented to your company. Project A's rate of return is 6% and project B's rate of return is 8%. The cost of project A is less than the cost of project B. Incremental analysis yields a rate of return of 4%. If both alternatives have the same useful life which project should be chosen if the MARR is 5%?

- a. A
- b. B
- c. Neither
- d. Both

Solution

Since $ROR_{B-A} < MARR$ choose the least expensive.

The answer is a.

150 Chapter 9 Mutually Exclusive Alternatives

9-42

E and A Construction must replace a piece of heavy earth moving equipment. Information concerning the two best alternatives is summarized below. Both alternatives are expected to last six years. If E and A has a minimum attractive rate of return (MARR) of 11%, which alternative should be chosen? Use IRR analysis.

	<u>Cat</u>	<u>Volvo</u>
First Cost	\$15,000	\$22,500
Annual Operating Cost	3,000	1,500
Salvage Value	2,000	4,000

Solution

$$\text{IRR}_{\text{Volvo-Cat}}$$

NPW = 0 at the rate of return

Try 10%

$$\begin{aligned}\text{NPW} &= -7,500 + 1,500(P/A, 10\%, 6) + 2,000(P/F, 10\%, 6) \\ &= \$161.50\end{aligned}$$

Try 12%

$$\text{NPW} = -\$320.30$$

$$10\% < \text{IRR} < 12\% \quad \therefore \text{interpolate} \quad \text{IRR} = 10.67\% < 11\%$$

Therefore choose the least expensive, Cat

9-43

Horizon Wireless must rebuild a cell tower recently destroyed by a tornado. If made of normal steel, the tower will cost \$30,000 to construct and should last 15 years. Maintenance will cost \$1,000 per year. If corrosion resistant steel is used, the tower will cost \$36,000 to build and the annual maintenance cost will be reduced to \$250 per year. Determine the IRR of building the corrosion resistant tower. If Horizon requires a return of 9% on its capital projects, which tower should they build?

Solution

$$\text{NPW}_{\text{NS}} = -30,000 - 1000(P/A, i\%, 15)$$

$$\text{NPW}_{\text{CRS}} = -36,000 - 250(P/A, i\%, 15)$$

$$-30,000 - 1000(P/A, i\%, 15) = -36,000 - 250(P/A, i\%, 15)$$

$$6000 - 750(P/A, i\%, 15) = 0$$

$$(P/A, i\%, 15) = 8.000$$

$$\text{@}9\% \quad P/A = 8.061$$

$$\text{@}10\% \quad P/A = 7.606$$

$$9\% < i < 10\% \quad \therefore \text{interpolate} \quad i = 9.13\% \quad \therefore \text{Build the tower using corrosion resistant steel}$$

(the most expensive alternative).

Choose B

9-44

Four projects are under consideration by Haunted Vaults Inc. The NPW of project A is \$3,429. The B/C ratio of project B is .98. The AW of project C is \$554.00. The IRR of project D = 6.85%. If all projects have a 10-year life and Haunted's MARR is 7% which project should be selected?

- a. A
- b. B
- c. C
- d. D

Solution

Eliminate project B ($B/C < 1.0$) and project D ($IRR < 7\%$ MARR).

$$NPW_A = \$3,429$$

$$NPW_C = 554(P/A, 7\%, 10) = \$3,891$$

The correct answer is c.

9-45

Cash-out Casinos is considering purchasing new slot machines. The PW of Alternative A is \$19,437, the AW of Alternative B is \$8,352, the FW of Alternative C is \$20,439, and the ROR of Alternative D is 5%. Assuming all alternatives have a 3-year useful life and that the MARR for Cash-out is 9%. The alternative that should be chosen is

- a. A
- b. B
- c. C
- d. D

Solution

Eliminate project D ($IRR < 9\%$ MARR).

$$PW_B = 8,352(P/A, 9\%, 3) = \$21,139$$

$$PW_C = 20,439(P/F, 9\%, 3) = \$15,783$$

The correct answer is b.

9-46

SeaSpray Cranberry must replace its bog water whipping equipment. The PW of Alternative A is

152 Chapter 9 Mutually Exclusive Alternatives

\$(32,782), the FW of Alternative B is \$(131,295), and the AW of Alternative C is \$(2,959). Assuming all alternatives have a 15-year useful life and that the MARR for SeaSpray is 8%. The alternative that should be chosen is

- a. A
- b. B
- c. C
- d. Do nothing.

Solution

$$PW_B = 131,295(P/F, 8\%, 15) = \$-41,384$$

$$PW_C = 2,959(P/A, 8\%, 15) = \$-25,236$$

The correct answer is c.

9-46

If the following information is known about four alternatives, which alternative should be chosen? Alternative A has a present worth that is negative, Alternative B has a $ROR > MARR$, Alternative C has a B/C ratio < 1 , and Alternative D has a $ROR < MARR$.

- a. A
- b. B
- c. C
- d. D
- e. Do nothing.

Solution

$ROR_A < MARR$ due to negative PW \therefore Eliminate

$ROR_B > MARR$

$ROR_C < MARR$ due to $B/C < 1 \therefore$ Eliminate

The correct answer is b.

9-47

Sulfur Swamp Tours is considering the purchase of new boating equipment. The following information is known about the different alternatives. If the MARR is 4%, which alternative should be chosen?

Alternative A $AW = \$113$ Useful life = 7 years

Alternative B	AW = \$125	Useful life = 8 years
Alternative C	PW = \$721	Useful life = 9 years
Alternative D	PW = \$665	Useful life = 10 years

- A
- B
- C
- D

Solution

Use AW because of unequal useful lives.

$$AW_C = 721(A/P, 4\%, 9) = \$97$$

$$AW_D = 665(A/P, 4\%, 9) = \$82$$

The correct answer is b.

9-48

A number of investment opportunities have been presented to the township of Castle Rock. The PW of Alternative A = \$553, the AW of Alternative B = \$125, the ROR of Alternative C = 8%, and the B/C ratio for Alternative D = 0.98. All opportunities have a five-year life and Castle Rock's MARR = 9%. The alternative that should be chosen is

- A
- B
- C
- D
- Do nothing.

Solution

Eliminate project C ($IRR < 9\%$ MARR) and project D ($B/C < 1.0$).

$$NPW_A = \$553$$

$$NPW_C = 125(P/A, 9\%, 5) = \$486$$

The correct answer is a.

9-50

Turner Donut's is considering a new frying vat for its Martin shop. The following information concerning the costs and ROR's of the four best alternatives is known.

$$ROR_A = 10\% \quad ROR_B = 10\% \quad ROR_C = 12\% \quad ROR_D = 14\%$$

$$ROR_{C-B} = 12\% \quad ROR_{D-C} = 9.5\% \quad ROR_{D-B} = 10\%$$

$$FC_A = FC_B < FC_C < FC_D$$

154 Chapter 9 Mutually Exclusive Alternatives

If all alternatives have equal lives and the MARR is 10%, the alternative that should be chosen is

- a. A
- b. B
- c. C
- d. D
- e. Need more information

Solution

$ROR_{D-C} < MARR \therefore$ Choose C.

$ROR_{C-B} > MARR \therefore$ Choose C.

The correct answer is c.

9-51

Eagle Golf is considering new shaft extruding equipment. The ROR of Alternative A is 8%, the FW of Alternative B is \$17,234, the PW of Alternative C is \$10,146, and the AW of Alternative D is \$2,948. Assume all alternatives have a 5 year useful life and that the MARR for EG is 10%. The alternative that should be chosen is

- a. A
- b. B
- c. C
- d. D

Solution

Eliminate alternative A ($ROR < 10\%$ MARR).

$$PW_B = 17,234(P/F, 10\%, 5) = \$10,700$$

$$PW_D = 2,948(P/A, 10\%, 5) = \$11,176$$

The correct answer is d.

9-52

Whitewash Inc. must purchase new bleaching equipment. The PW of Alternative A is \$(10,340) with a life of 6 years, the AW of Alternative B is \$(1,239) with a life of 9 years, the FW of Alternative C is \$(10,045) with a life of 5 years, and the FW of Alternative D is \$(13,158) with a life of 8 years. The MARR for Whitewash is 6%. The alternative that should be chosen is

- a. A
- b. B
- c. C
- d. D

Solution

$$AW_A = 10,340(A/P, 6\%, 6) = \$-2,103$$

$$AW_C = 10,045(A/P, 6\%, 5) = \$-1,782$$

$$AW_D = 13,158(A/P, 6\%, 8) = \$-1,329$$

The correct answer is b.