Chapter 6

Annual Cash Flow Analysis

6-1
While in college Ellen received $10,000 in student loans at 5% interest. She will graduate in June and is expected to begin repaying the loans in either 5 or 10 equal annual payments. Compute her yearly payments for both repayment plans.

6-2
Suppose you wanted to buy a $100,000 house. You have $20,000 cash to use as the down payment. The bank offers to loan you the remainder at 6% nominal interest. The term of the loan is 20 years. Compute your monthly loan payment assuming the payment is the same for all months.

6-3
Lester Peabody decides to install a fuel storage system for his farm that will save him an estimated 1.7 cents/litre on his fuel cost. He uses an estimated 75,600 litres/year on his farm. Initial cost of the system is $10,000 and the annual maintenance is a uniform gradient amount of $25. After a period of 10 years the estimated salvage is $3,000. If money is worth 12%, is it a wise investment?

6-4
The returns for a business for five years are as follows: $8,250, $12,600, $9,750, $11,400, and $14,500. If the value of money is 12%, what is the equivalent uniform annual benefit for the five-year period?

6-5
The local loan shark has loaned you $1,000. The interest rate you must pay is 20%, compounded monthly. The loan will be repaid by making 24 equal monthly payments. What is the amount of each monthly payment?

6-6
Several companies offer "instant cash" plans to holders of their credit cards. A typical plan permits card holders to "draw" cash up to a preset limit. At the time the cash is drawn, a special charge of 4% of the amount drawn is charged to the card holder's account. Then the card holder repays the debt (the original amount drawn plus the special charge) by making a series of equal monthly payments. Each month the company adds a finance charge of 1½% of the previous month's unpaid balance to the account balance. If the card holder "draws" $150, a $6 special charge will be made and the card holder will make a series of monthly payments of $9.95.

(a) How many payments will be required?
(b) What "true" (effective) annual interest rate does the card holder pay?

6-7
If $15,000 is deposited into a savings account that pays 4% interest compounded quarterly, how much can be withdrawn each quarter for five years?

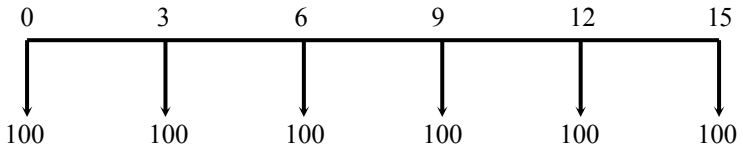
6-8
What uniform annual payment for 12 years is equivalent to receiving all of these:

$ 3,000	at the end of each year for 12 years
20,000	today
4,000	at the end of 6 years
800	at the end of each year forever
10,000	at the end of 15 years

Use an 8% interest rate.

6-9
For the following cash flow diagram, which equation properly calculates the uniform equivalent?

(a) A = 100(A/P, i, 3) + 100(A/F, i, 3)
(b) A = 100(A/P, i, 15)
(c) A = 100(A/F, i, 3) + 100(A/P, i, 15)
(d) A = 100(A/F, i, 3) + 100(A/F, i, 15)
(e) A = 100(A/F, i, 3)



6-10
A project has a first cost of $75,000, operating and maintenance costs of $10,000 during each year of its 8 year life, and a $15,000 salvage value. What is its equivalent uniform annual cost (EUAC) if the interest rate is 12%?

6-11
A land surveyor just starting in private practice needs a van to carry crew and equipment. He can lease a used van for $3,000 per year, paid at the beginning of each year, in which case maintenance is provided. Alternatively, he can buy a used van for $7,000 and pay for maintenance himself. He expects to keep the van three years at which time he could sell it for $1,500. What is the most he should pay for uniform annual maintenance to make it worthwhile buying the van instead of leasing it, if his MARR is 20%?

6-12
A foundation supports an annual seminar on campus by using the earnings of a $50,000 gift. It is felt that 10% interest will be realized for 10 years, but that plans should be made to anticipate an interest rate of 6% after that time. What uniform annual payment may be established from the beginning, to fund the seminar at the same level into infinity?

6-13
A consumer purchased new furniture by borrowing $1,500 using the store's credit plan which charges 18% compounded monthly.

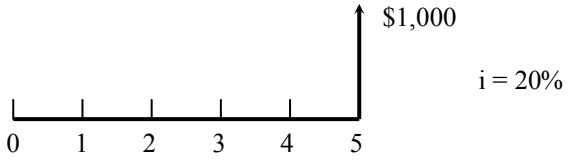
(a) What are the monthly payments if the loan is to be repaid in 3 years?
(b) How much of the first payment is interest?
(c) How much does the consumer still owe just after making the 20th payment?

6-14
A 30-year mortgage of $100,000 at a 6% interest rate had the first payment made on September 1, 1999. What amount of interest was paid for the 12 monthly payments of 2002?

6-15
A grateful college graduate makes a donation of $2,000 now and will pay $37.50 per month for 10 years to establish a scholarship. If interest in the fund is computed at 9%, what annual scholarship may be established? Assume the first scholarship will be paid at the end of the first year.

6-16
A rich folk singer has donated $500,000 to endow a university professorial chair in Bohemian Studies (B.S.). If the money is invested at 8.5%, how much can be withdrawn each year, ad infinitum, to pay the Professor of B.S.?

6-17
For the cash flow shown below, what would an equivalent sum of money be
(a) Now?
(b) Two years from now?
(c) As a five year annuity, starting at the end of the first year?



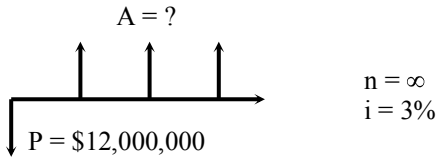
6-18
A project requires an initial investment of $10,000 and returns benefits of $6,000 at the end of every 5^{th} year thereafter. If the minimum attractive rate of return (MARR) is 10%, should the project be undertaken? Show supporting calculations.

6-19

On January 1st an engineering student projects a need of $2,400 on December 31st. What amount must be deposited in the credit union each month if the interest paid is 3%, compounded monthly?

6-20

Given:



$n = \infty$
$i = 3\%$

Find: A

6-21

Assuming monthly payments, which would be the better financing plan on the same $9,000 car?

(a) 6% interest on the full amount for 48 months, compounded monthly.
(b) A $1,000 rebate (discount) and 12% interest on the remaining amount for 48 months, compounded monthly.

6-22

The initial cost of a pickup truck is $11,500 and will have a salvage value of $4,000 after five years. Maintenance is estimated to be a uniform gradient amount of $150 per year (first year maintenance = zero), and the operation cost is estimated to be 30 cents per mile for 300 miles per month. If money is worth 12%, what is the equivalent uniform annual cost (EUAC) for the truck expressed as a monthly cost?

6-23

Twenty five thousand dollars is deposited in a bank trust account that pays 18% interest, compounded semi-annually. Equal annual withdrawals are to be made from the account, beginning one year from now and continuing forever. Calculate the maximum amount of the equal annual withdrawal.

6-24

A truck, whose price is $18,600, is being paid for in 36 uniform monthly instalments, including interest at 10 percent. After making 13 payments, the owner decides to pay off the remaining balance of the purchase price in one lump sum. How much is the lump sum?

6-25

If the interest rate is 10% and compounding is semi-annual, what series of equal annual transactions is equivalent to the following series of semi-annual transactions? The first of the equal annual transactions is to occur at the end of the second year and the last at the end of the fourth year.

Time (yr)	0		1		2		3		4		5	5½
Period	0	1	2	3	4	5	6	7	8	9	10	11
Cash Flow	$0	600	500	400	300	200	100	300	500	700	900	1,100

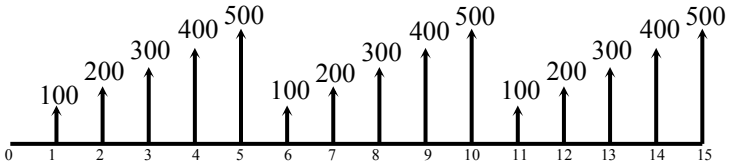
6-26
A tractor costs $12,500 and will be used for five years when it is estimated a salvage value of $4,000 will be appropriate. Maintenance cost is estimated to be a $100 the first year and increase by $100 each year thereafter. If a 12% interest rate is used, what is the equivalent uniform annual cost (EAC) for the tractor?

6-27
If Zoe won $250,000 the last week in February, 1996, and invested it by March 1, 1996, in a "sure thing" which pays 8% interest, compounded annually, what uniform annual amount can he withdraw on the first of March for 15 years starting in 2004?

6-28
A machine, with a first cost of $20,000, is expected to save $1,500 in the first year of operation and the savings should increase by $200 every year until (and including) the ninth year, thereafter the savings will decrease by $150 until (and including) the 16th year.

Using equivalent uniform annual worth, is this machine economical? Assume a minimum attractive rate of return of 10%.

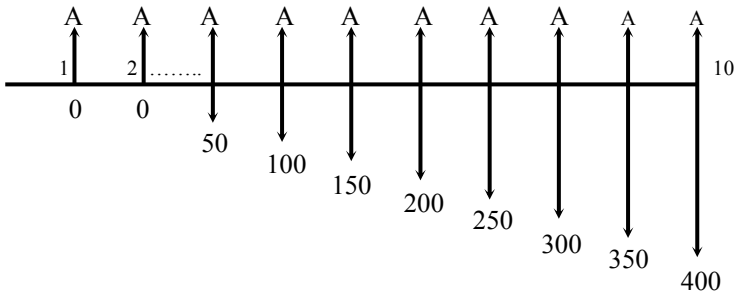
6-29
Calculate the equivalent uniform annual cost of the following schedule of payments.



6-30
A college is willed $100,000 to establish a permanent scholarship. If funds are invested at 6% and all funds earned are disbursed yearly, what will be the value of the scholarship in the 6th year of operation?

6-31
The UNIFORM EQUIVALENT of the cash flow diagram shown is given by which one of the following five answers?

(a) 50(A/G, i, 8)
(b) 50(A/G, i, 9)
(c) 50(A/G, i, 10)
(d) 50(A/G, i, 9)(F/A, i, 9)(A/F, i, 10)
(e) 50(P/G, i, 8)(P/F, i, 1)(A/P, i, 10)



6-32
To get started, Econ Engineering has just borrowed $500,000 that will be paid off in 20 end-of-quarter payments. If interest is 18% compounded monthly, what will be the size of each loan payment?

6-33
The cost of an automobile is $9,000 and after a period of three years it will have an estimated salvage value of $5,200. A down payment of $1,000 will be used to purchase the car. It is desired to make the monthly payments, at 12% interest, a value such as to reduce the unpaid balance to exactly the amount of the salvage value after three years. What is the amount of the monthly payment?

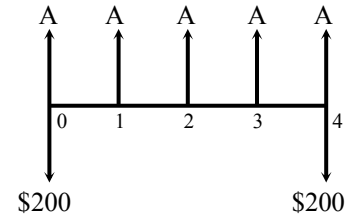
6-34
Joyce and Bill purchased a four unit apartment house and as part of the financing obtained a $100,000 loan at 9% nominal annual interest, with equal monthly payments for 20 years.

What is their monthly payment?

6-35
The initial cost of a van is $12,800 and will have a salvage value of $5,500 after five years. Maintenance is estimated to be a uniform gradient amount of $120 per year (with no maintenance costs the first year), and the operation cost is estimated to be 22.4 cents/km for 643.6 km/month. If money is worth 12%, what is the equivalent uniform annual cost (EUAC) for the van, expressed as a monthly cost?

6-36
An engineering student purchased a 2-year-old car that sold new for $8,000. The car depreciated 25% per year. The student made a down payment of $1000 and obtained a 36-month loan at 15% interest, compounded monthly. What were the monthly payments?

6-37



If i = 20%, find A.

6-38

A(n)(fill in your major) student bought a car at a used car lot on 4th street for $2,000, including tax and insurance. He was to pay for the car by making 19 equal monthly payments, with the first payment to be made when the car was delivered (a down payment). Interest on the loan was charged at the rate of 12% compounded monthly. After 11 payments (the down payment and 10 end-of-month payments) were made, a second buyer agreed to buy the car from the student and to pay a cash amount to pay off the loan in full at the time the next payment was due. If there is no payoff penalty for the early payoff, what amount will be required to pay off the loan?

6-39

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)?

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

6-40

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

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

Which alternative is preferred if MARR = 15%?

6-41
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.

System	Installed Cost	Annual Operating Cost	Salvage value End of 20 yrs
Clean H_2O	$30,000	$6,000	$2,000
Acid-Free	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?

6-42
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.

	Parking Lot	Gas Station
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

(a) If the minimum attractive rate of return (MARR) equals 18%, what should be done with the land?

(b) Is it possible the decision would be different if the MARR were higher than 18%? Why or why not? (No calculations necessary.)

6-43
Given the following information about possible investments, what is the best choice at a minimum attractive rate of return (MARR) of 10%?

	A	B
Investment Cost	$5,000	$8,000
Annual Benefits	1,200	800
Useful Life	5 years	15 years

6-44
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

(a) 8%?
(b) 12%?

6-45

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

	X	Y
First cost	$5,000	$10,000
Annual maintenance	500	200
Salvage value	600	1,000
Useful life	5 years	15 years

6-46

Consider Projects A and B. Which project would you approve, if the income to both were the same. The expected period of service is 15 years, and the interest rate is 10%.

	Project A	Project B
Initial cost	$50,000	$75,000
Annual operating costs	15,000	10,000
Annual repair costs	5,000	3,000
Salvage value after 15 years	5,000	10,000

6-47

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

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

6-48
A company must decide whether to buy Machine A or Machine B. After 5 years A will be replaced with another A.

	Machine A	Machine B
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?

6-49
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?

	Alternative A	Alternative B
Construction cost	$25,000,000	$50,000,000
Annual Maintenance costs	3,500,000	2,000,000

6-50
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, which costs $300,000.

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

6-51
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:

(a) 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.

(b) 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).

6-52

The manager of F. Roe, Inc. is trying to decide between two alternative designs for an aqua cultural 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 $5,000 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?

6-53

Two alternative investments are being considered. What is the minimum uniform annual benefit that will make Investment B preferable over Investment A? Assume interest is 10%.

Year	A	B
0	-$500	-$700
1-5	+150	?

6-54

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.

6-1 Solution

5 YEARS	10 YEARS
A = P(A/P, i, n)	A = P(A/P, i, n)
= 10,000(A/P, 5%, 5)	= 10,000(A/P, 5%, 10)
= $2,310.00	= $1,295.00

6-2 Solution

Amount of loan: $100,000 - $20,000 = $80,000

i = 6%/12 = ½% per month n = 20 × 12 = 240 periods

A = 80,000(A/P, ½%, 240)
= $572.80 per month

6-3 Solution

EUAC = (10,000 - 3,000)(A/P, 12%, 10) + 3,000(0.12) + 25(A/G, 12%, 10)
= $1,688.63

EUAB = 75,600(0.017) = $1,285.2

EUAW = -$403.43 ∴ not a wise investment

6-4 Solution

PW = 8,250(P/F, 12%, 1) + 12,600(P/F, 12%, 2) + 9,750(P/F, 12%, 3)
+ 11,400(P/F, 12%, 4) + 14,500(P/F, 12%, 5)
= $39,823

EUAB = 39,823(A/P, 12%, 5) = $11,047

6-5 Solution

A = 1,000(A/P, 20%/12, 24)

There is no 1⅔% compound interest table readily available. Therefore the capital recovery factor must be calculated.

$(A/P, 1.666\%, 24) = [0.01666(1.01666)^{24}] / [(1.01666)^{24} - 1] = 0.050892$

A = 1,000(0.050892) = $50.90

6-6 Solution

(a) 9.95(P/A, 1½%, n) = 156
(P/A, 1½%, n) = 15.678

From compound interest tables n = 18 + a very slight amount
PW of payments = 9.95(P/A, 1½%, 18) = $155.95 for 18 payments
FW of balance = 0.05(F/P, 1½%, 19) = $0.07
So there are 18 payments of $9.95 and a final payment of 7 cents.

(b) 150 = 9.95(P/A, i%, 18) + 0.07(P/F, i%, 19)

solve for i, solution using tables:
try i = 1¾% NPW = -150 + 9.95(P/A 1¾%, 18) + 0.07(P/F, 1¾%, 19) = $2.55

try i = 2% NPW = -150 + 9.95(P/A, 2%, 18) + 0.07(P/F, 2%, 19) = -$0.78

interpolate: i = 1¾% + [(2.55 - 0)/(2.55 – (-0.78)](¼%) = 1.9414%

Effective annual interest rate = $(1 + 0.019414)^{12} - 1 = 0.2595 = 25.95\ \%$

6-7 Solution

i = 4%/4 = 1% per quarter n = 5 × 4 = 20 periods

A = 15,000(A/P, 1%, 20)
= $831.00 per quarter

6-8 Solution

A_1 = $3,000
A_2 = 20,000(A/P, 8%, 12) = $2,654
A_3 = 4,000(P/F, 8%, 6)(A/P, 8%, 12) = $334.51
A_4 =(800/.08)(A/P, 8%, 12) = $1,327
A_5 = 10,000(P/F, 8%, 15)(A/P, 8%, 12) = $418.27

$$\sum_{i=1}^{n} A_i = 3{,}000 + 2{,}654 + 334.51 + 1{,}327 + 418.27 = \$7{,}733.78$$

6-9 Solution

The correct equation is (c).

6-10 Solution

EUAC = 75,000(A/P, 12%, 8) + 10,000 - 15,000(A/F, 12%, 8) = $23,878.00

6-11 Solution

Lease:

EUAC = 3,000(F/P, 20%, 1) = 3,000(1.20) = 3,600

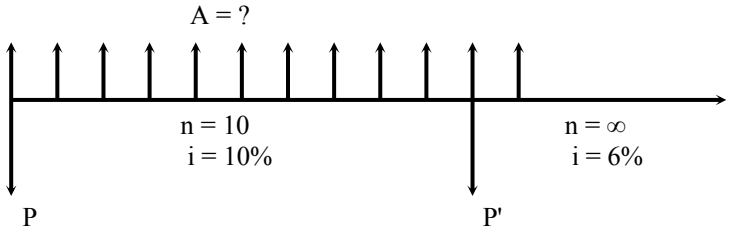
Buy:

EUAC = 7,000(A/P, 20%, 3) + M - 1,500(A/F, 20%, 3)

M = 3,600 - 2,910.85

= $ 689.15

6-12 Solution



Assume first seminar occurs at time of deposit.

P' = A/i = A/0.06

P = A + A(P/A, 10%, 10) + P'(P/F, 10%, 10)

50,000 = A + 6.145A +(A/.06) × 0.3855

13.57A = 50,000

A = $3,684.60

6-13 Solution

(a) i = 18%/12 = 1½% per month, n = 12 × 3= 36 periods

A = 1,500(A/P, 1½%, 36)

= $54.30 per month

(b) Int. = Principal × Monthly interest rate

Int. = 1,500 × 0.015

= $22.50

(c) P = 54.30(P/A, 1½%, 16)

= $767.31

6-14 Solution

Monthly payment A = 100,000(A/P, ½%, 360) = $599.55

Interest periods remaining Jan 1, 2002 = 331

Jan 1, 2003 = 319

P' = 599.55(P/A, ½%, 331) = 599.55(161.624) = 96,901.67

P'' = 599.55(P/A, ½%, 319) = 599.55(159.257) = 95,482.53

Interest = 599.55(12) - (96,901.67 – 95,482.53) = $5,775.46

6-15 Solution

P = 2,000 + 37.50(P/A, ¾%, 120)
= 4,960.33
A = P × i
= 4,960.33(0.09)
= $446.43 scholarship

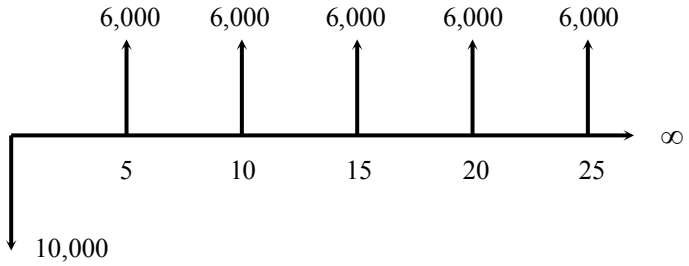
6-16 Solution

A = 500,000(A/P, 8.5%, ∞) = 500,000(0.085) =$42,500

6-17 Solution

(a) PV = $1,000(P/F, 20%, 5) = $401.90
(b) $401.90(F/P, 20%, 2) = $578.74
(c) A = $1,000(A/F, 20%, 5) = $134.40

6-18 Solution



EUAW = 6,000(A/F, 10%, 5) - 10,000(A/P, 10%, ∞)
= - $17.20

The project should not be undertaken.

6-19 Solution

A = 2,400(A/F, ¼, 12)
= $197.28

6-20 Solution

A = Pi
= 12,000,000(0.03)
= $360,000

6-21 Solution

(a) A = 9,000(A/P, ½%, 48) = $211.50/mo.

(b) A = 8,000(A/P, 1%, 48) = $210.40/mo.

Choose plan b.

6-22 Solution

EUAC = (11,500 - 4,000)(A/P, 1%, 60) + 4,000(0.01) + [150(A/G, 12%, 5)]/12 + 300(0.30)
= $318.69 per month

6-23 Solution

i =18%/2 = 9% per semi-annual period

A = P × i = 25,000(0.09) = 2,250

W = 2,250(F/A, 9%, 2) = $4,702.50

6-24 Solution

In problems like this the lump sum is the present worth of all the future (unpaid) payments. So to solve the problem compute the payment and then compute the PW of the unpaid payments at the stated interest rate.

A = 18,600(A/P, 0.83%, 36)
= $18,600[(0.00833(1 + 0.00833)^{36})/((1 + 0.00833)^{36} - 1)]$
= $600.22

After 13 months: 36 - 13 = 23 payments remain

P = 600.22(P/A, 0.83%, 23)
= $600.22[((1 + 0.00833)^{23} - 1)/(0.00833(1 + 0.00833)^{23})]$
= $12,515.45

6-25 Solution

P = 600(P/A, 5%, 5) - 100(P/G, 5%, 5) + [100(P/A, 5%, 6) + 200(P/G, 5%, 6)](P/F, 5%, 5)
= 4,046.80

Effective i = $(1 + 0.10/2)^2 - 1 = 10.25\%$

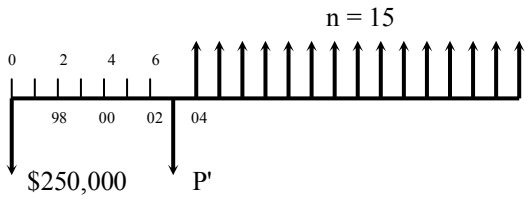
Sum at end of Year 1: F = P(F/P, 10.25%, 1) = 4,461.60

Equal Annual Payments: A = 4,461.60(A/P, 10.25%, 3) = $1,802.04

6-26 Solution

EUAC = 12,500(A/P, 12%, 5) + 100 + 100(A/G, 12%, 5) - 4,000(A/F, 12%, 5)
= $3,115.40

6-27 Solution



P' = 250K(F/P, 8%, 7) = $428,500
A = 250K(F/P, 8%, 7)(A/P, 8%, 15) = $50,048.80

6-28 Solution

There are a number of equations that could be written.
Here's one:

EUAW = -20,000(A/P, 10%, 16) + [1,500(P/A, 10%,9) + 200(P/G, 10%, 9)](A/P, 10%, 16)
+ [1,450(P/A, 10%, 7) - 150(P/G, 10%, 7)](P/F, 10%, 9)(A/P, 10%, 16)
= -$676.79, the machine is not economical

6-29 Solution

Since payments repeat every five years, analyze for 5 years only.

A = 100 + 100(A/G, 8%, 5) = $284.60

6-30 Solution

A = P × i = 100,000(0.06) = $6,000 for any year

6-31 Solution

Note these two concepts:
1) The G series is 9 periods long
2) The uniform equivalent is 10 periods long

The answer is (d)

6-32 Solution

i = 18%/12 = 1½% n = 60 monthly interest periods

P = 500,000 = X(A/F, 1½%, 3)(P/A, 1½%, 60)
= X(0.3284)(39.380)
X = $38,663

6-33 Solution

PW of Salvage = 5,200(P/F, 1%, 36) = $3,634.28

P = 9,000 - 3,634.28 = $5,365.72

A = 5,365.72(A/P, 1%, 36)
= $178.14 monthly payment

6-34 Solution

i = 9%/12 = ¾% per month n = 20 × 12 = 240 periods

A = 100,000(A/P, ¾%, 240)
= $900 per month

6-35 Solution

EUAC = (12,800 - 5,500)(A/P, 12%, 5)+(5,500)(0.12) + 120(A/G, 12%, 5)+0.224(643.6)(12)
= 4,626/12
= $385.50/month

6-36 Solution

year 1 depreciation = (0.25)(8,000) = 2,000 8,000 - 2,000 = $6,000
year 2 depreciation = (0.25)(6,000) = 1,500 6,000 - 1,500 = $4,500 sale price

if down payment = 1,000 ; loan = 3,500

i = 15%/12 = 1¼% n = 12 × 3 = 36 periods

A = $3,500(A/P, 1¼%, 36)
= $121.45

6-37 Solution

F = $200 + $200(F/P, 20%, 4) = $614.80
A = $614.80(A/F, 20%, 5) = $82.63

6-38 Solution

P = A(P/A, 1%, 18) + A
2,000 = A(17.398269)
A = 2,000/17.398269
= $114.95

Payoff = 114.95(P/A, 1%, 7) + 114.95
= 114.95(6.728) + 114.95
= $888.33

6-39 Solution

S = Salvage value
A = Annual maintenance
P = First cost
i = 12 %
n = 6

EUAC = P(A/P, i %, n) - S(A/F, i %, n) + Other Costs

TRACTOR A:

EUAC = 30,000(A/P, 12%, 6) - 5,000(A/F, 12%, 6) + 1,500
= $8,180

check: EUAC = (P - S)(A/P, i %, n) + Si + Other Costs
= $8,180

TRACTOR B:

EUAC = 36,000(A/P, 12%, 6) - 8,000(A/F, 12%, 6) + 2,000
= $9,770

check: EUAC = (P - S)(A/P, 12%, 6) + S(0.12) + Other Costs
= $9,770

Since criteria is to minimize EUAC select tractor A

6-40 Solution

Slippery :

EUAC = [500 + 100(A/F, 15%, 2)(P/A, 15%, 8)](A/P, 15%, 10)
= $141.24

Grater:

EUAC = [300 + 25(P/G, 15%, 5) + 25(P/A, 15%, 4)(P/F, 15%, 1)](A/P, 15%, 5)
= $151.07

Therefore, choose slippery with lower EUAC.

6-41 Solution

Clean H_2O EUAC = 6,000 + 30,000(A/P, 8%, 20) - 2,000(A/F, 8%, 20)
= $9,013

Acid-Free EUAC = 5,000 + 35,000(A/P, 8%, 20) - 5,000(A/F, 8%, 20)
= $8,456

Evergreen EUAC = 1,000 + 80,000(A/P, 8%, 20) - 40,000(A/F, 8%, 20)
= $8,276

Purchase system with lowest EUAC, Evergreen

6-42 Solution

(a) $EUAW_{P.L.}$ = (35,000 - 25,000) - 50,000(A/P, 18%, 5) + 10,000(A/F, 18%, 5) = -$4,592

$EUAW_{G.S.}$ = (85,000 - 70,000) - 100,000(A/P, 18%, 10) + 10,000(A/F, 18%, 10)
- 1,000(A/G, 18%, 10) = -$10,019

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

(b) No. Higher MARR favours lower cost projects and the lowest cost project (null) has already been chosen.

6-43 Solution

Equivalent annual worth is easier since the useful lives are different.

$EUAW_A$ = 1,200 - 5,000(A/P, 10%, 5) = -$119.00
$EUAW_B$ = 800 - 8,000(A/P, 10%, 15) = -$252.00

Although A is better than B, the Do-Nothing (Null) alternative is best.

6-44 Solution

(a) Press EUAW = 1,300 - 5,000(A/P, 8%, 5) = $47.50
Steam EUAW = 800 - 5,000(A/P, 8%, 10) = $55.00

Choose highest EUAB, Steam-it-out

(b) Press EUAW = 1,300 - 5,000(A/P, 12%, 5) = -$87.00
Steam EUAW = 800 - 5,000(A/P, 12%, 10) = -$85.00

Choose neither option because both have a negative annual worth.

6-45 Solution

Method 1 EUAC = P(A/P, i %, n) - S(A/F, i %, n) + other costs
Method 2 EUAC = (P - S)(A/P, i %, n) + Si + other costs

Machine X:

Method 1 EUAC = 5,000(A/P, 8%, 5) - 600(A/F, 8%, 5) + 500 = $1,650.20
Method 2 EUAC = (5,000 - 600)(A/P, 8%, 5) + 600 (0.08) + 500 = $1,650.20

Machine Y:

Method 1 EUAC = 10,000(A/P, 8%, 15) - 1,000(A/F, 8%, 15) + 200 = $1331.20
Method 2 EUAC = (10,000 - 1,000)(A/P, 8%, 5) + 1,000(0.08) + 200 = $1331.20

Decision criterion: minimize EUAC, therefore choose Y.

6-46 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

6-47 Solution

Alternative A:

EUAW = (5,300 - 0)(A/P, 10%, 4) - 1,800
= $127.85

Alternative B:

EUAW = (10,700 - 200)(A/P, 10%, 8) + 200(0.1) - 2,100
= $112.30

Choose alternative A

6-48 Solution

$EUAW_A$ = - 10,000(A/P, 10%, 5) - 1,000 + 10,000(A/F, 10%, 5) = -$2,000

$EUAW_B$ = - 20,000(A/P, 10%, 10) + 10,000(A/F, 10%, 10) = -$2,627

Therefore Machine A should be purchased.

6-49 Solution

(a) Alternative A EUAC = A + (P × i) = 3.5M + 25M(0.07) = $5,250,000
Alternative B EUAC = A + (P × i) = 2.0M + 50M(0.07) = $5,500,000

Fixed Output ∴ minimize cost; choose A

(b) P = A/i = 3,500,000/0.07 = $50,000,000

6-50 Solution

(a) For 600,000 cartons/yr.

Alternative A :

Annual Costs:	Administration:		$43,000
	Operating Expenses:	0.009 x 600,000 =	5,400
	Capital Expenses*		36,270
		Total =	$84,670

*EUAC = (P - S)(A/P, i, n) + Si
= (300,000 - 200,000)(A/P, 10%, 10) + 200,000(0.1) = $36,270

∴ Total annual costs = $ 84, 670.00

Alternative B:

Total annual costs = 0.10 × 600,000 =$ 60,000

∴ Sign an agreement for distribution (Alt. B)

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

The EUAC for alternative B (agreement) = $EUAC_{AGREEMENT}$ = 0.10×M

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

We want $EUAC_{OWN} < EUAC_{AGREEMENT}$

$$43{,}000 + 0.009M + 36{,}270 < 0.10 \times M$$
$$79{,}270 < (0.10 - 0.009)M$$
$$79{,}270/0.091 < M$$
$$871{,}099 < M$$

$\therefore$ Own distribution is more profitable for 871,100 or more cartons/year.

6-51 Solution

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

6-52 Solution

	Alternative 1	Alternative 2
First Cost	$250,000	$450,000
Uniform Annual Cost for 10 years	110,000	40,000
Gradient	10,000	5,000
Salvage in year 10	25,000	45,000

Alternative 1: EUAC = 250,000(A/P, 8%, 10) - 25,000(A/F, 8%, 10) + 110,000
+ 10,000(A/G, 8%, 10) = $184,235

Alternative 2: EUAC = 450,000(A/P, 8%, 10) - 45,000(A/F, 8%, 10) + 40,000
+ 5,000(A/G, 8%, 10) = $123,300

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

Choose Alternative 2

6-53 Solution

$NPW_A = NPW_B$

$-500 + 150(P/A, 10\%, 5) = -700 + X(P/A, 10\%, 5)$

$X = \$202.76$

Alternate Solution:

$EUAW_A = EUAW_B$

$-500(A/P, 10\%, 5) + 150 = -700(A/P, 10\%, 5) + X$

$X = \$202.76$

6-54 Solution

EUAW Analysis:

Alternative 1: EUAB - EUAC = 110 - 1,000(A/P, 1%, 10) = \$4.40
Alternative 2: EUAB - EUAC = 130 - 1,200(A/P, 1%, 10) = \$3.28

Maximum EUAB – EUAC, therefore choose alternative A.