

ENGINEERING ECONOMICS

Factor Name	Converts	Symbol	Formula
Single Payment Compound Amount	to F given P	$(F/P, i\%, n)$	$(1 + i)^n$
Single Payment Present Worth	to P given F	$(P/F, i\%, n)$	$(1 + i)^{-n}$
Uniform Series Sinking Fund	to A given F	$(A/F, i\%, n)$	$\frac{i}{(1 + i)^n - 1}$
Capital Recovery	to A given P	$(A/P, i\%, n)$	$\frac{i(1 + i)^n}{(1 + i)^n - 1}$
Uniform Series Compound Amount	to F given A	$(F/A, i\%, n)$	$\frac{(1 + i)^n - 1}{i}$
Uniform Series Present Worth	to P given A	$(P/A, i\%, n)$	$\frac{(1 + i)^n - 1}{i(1 + i)^n}$
Uniform Gradient ** Present Worth	to P given G	$(P/G, i\%, n)$	$\frac{(1 + i)^n - 1}{i^2(1 + i)^n} - \frac{n}{i(1 + i)^n}$
Uniform Gradient † Future Worth	to F given G	$(F/G, i\%, n)$	$\frac{(1 + i)^n - 1}{i^2} - \frac{n}{i}$
Uniform Gradient ‡ Uniform Series	to A given G	$(A/G, i\%, n)$	$\frac{1}{i} - \frac{n}{(1 + i)^n - 1}$

NOMENCLATURE AND DEFINITIONS

- A Uniform amount per interest period
 B Benefit
 BV Book Value
 C Cost
 d Combined interest rate per interest period
 D_j Depreciation in year j
 F Future worth, value, or amount
 f General inflation rate per interest period
 G Uniform gradient amount per interest period
 i Interest rate per interest period
 i_e Annual effective interest rate
 m Number of compounding periods per year
 n Number of compounding periods; or the expected life of an asset
 P Present worth, value, or amount
 r Nominal annual interest rate
 S_n Expected salvage value in year n

Subscripts

- j at time j
 n at time n
 ** $P/G = (F/G)/(F/P) = (P/A) \times (A/G)$
 † $F/G = (F/A - n)/i = (F/A) \times (A/G)$
 ‡ $A/G = [1 - n(A/F)]/i$

NON-ANNUAL COMPOUNDING

$$i_e = \left(1 + \frac{r}{m}\right)^m - 1$$

Discount Factors for Continuous Compounding

(n is the number of years)

$$(F/P, r\%, n) = e^{-rn}$$

$$(P/F, r\%, n) = e^{-rn}$$

$$(A/F, r\%, n) = \frac{e^r - 1}{e^{rn} - 1}$$

$$(F/A, r\%, n) = \frac{e^{rn} - 1}{e^r - 1}$$

$$(A/P, r\%, n) = \frac{e^r - 1}{1 - e^{-rn}}$$

$$(P/A, r\%, n) = \frac{1 - e^{-rn}}{e^r - 1}$$

BOOK VALUE

$$BV = \text{initial cost} - \sum D_j$$

DEPRECIATION**Straight Line**

$$D_j = \frac{C - S_n}{n}$$

Accelerated Cost Recovery System (ACRS)

$$D_j = (\text{factor}) C$$

A table of modified factors is provided below.

CAPITALIZED COSTS

Capitalized costs are present worth values using an assumed perpetual period of time.

$$\text{Capitalized Costs} = P = \frac{A}{i}$$

BONDS

Bond Value equals the present worth of the payments the purchaser (or holder of the bond) receives during the life of the bond at some interest rate i .

Bond Yield equals the computed interest rate of the bond value when compared with the bond cost.

RATE-OF-RETURN

The minimum acceptable rate-of-return is that interest rate that one is willing to accept, or the rate one desires to earn on investments. The rate-of-return on an investment is the interest rate that makes the benefits and costs equal.

BREAK-EVEN ANALYSIS

By altering the value of any one of the variables in a situation, holding all of the other values constant, it is possible to find a value for that variable that makes the two alternatives equally economical. This value is the break-even point.

Break-even analysis is used to describe the percentage of capacity of operation for a manufacturing plant at which income will just cover expenses.

The payback period is the period of time required for the profit or other benefits of an investment to equal the cost of the investment.

INFLATION

To account for inflation, the dollars are deflated by the general inflation rate per interest period f , and then they are shifted over the time scale using the interest rate per interest period i . Use a combined interest rate per interest period d for computing present worth values P and Net P . The formula for d is

$$d = i + f + (i \times f)$$

BENEFIT-COST ANALYSIS

In a benefit-cost analysis, the benefits B of a project should exceed the estimated costs C .

$$B - C \geq 0, \text{ or } B/C \geq 1$$

MODIFIED ACRS FACTORS				
	Recovery Period (Years)			
	3	5	7	10
Year	Recovery Rate (Percent)			
1	33.3	20.0	14.3	10.0
2	44.5	32.0	24.5	18.0
3	14.8	19.2	17.5	14.4
4	7.4	11.5	12.5	11.5
5		11.5	8.9	9.2
6		5.8	8.9	7.4
7			8.9	6.6
8			4.5	6.6
9				6.5
10				6.5
11				3.3