1. PRESENT VALUE

There are many available financial decision criteria. The most useful of these recognize the time value of money. This concept reflects that we value $1 in hand more than $1 to be received at some future time. This presumes that one can put money to productive use now, loan it out to earn interest, or pay down debt to reduce interest charges. For this discussion we will ignore risks that may affect the size and timing of cashflows.

Note: This common formula assumes end-of-year cashflows.

Present value (PV) is the sum of discounted future cash flows. PV is also sometimes called *present worth*. Many like to indicate that the cash flow is net of investment cost, hence *net present value* (NPV). Present value is perhaps the most widely used decision criterion. Assuming cash flows occur at the end of yearly periods, the PV formula is:

(1)

where cf_j is the cashflow amount, or future value, at the end of year j, and i is the annual interest rate for discounting.

The company's cost of capital is commonly used for the PV discount rate (i). The discount rate is usually computed as a weighted average of the company’s sources of capital. Thus, the discount rate lies between the company's *cost of debt* and its *cost of shareholder equity*.

capital investment decisions

For routine capital investment decisions, the most common value measure is PV of after-tax net cashflow discounted at the after-tax marginal cost of capital. A project having a PV=0 earns just enough to pay back the investment plus interest at the cost of capital rate. Because the cost of capital depends, in part, upon inflation, the discount rate should be consistent with the inflation assumption.

PV is often adjusted by altering the cashflow definition (e.g., adding overhead burdens), increasing the discount rate, or by applying a *risk factor*. A typical valuation formula is:

fair market value

Fair market value = .75 × PV of pre-tax future net cash flow discounted at Prime Interest Rate

Note that such risk factors and risk-adjusted discount rates are inferior to the decision analysis approach of separating risk (using probabilities) from time preference.

Mid-Year Discounting.

The typical discounting formula (1) assumes cashflows occur at year-ends. If the timing is different, one should use a suitable discount time interval for the t variable. For example, a cash receipt 20 months from now would have a discount factor of $(1+i)^{-20/12}$.

Cashflows are often paid and received continuously during the projection periods. For most purposes, an excellent approximation is to compute the present value as if the entire cashflow for a given year (or other period) occurs at mid-year. Assuming now (time=0) is the start of your project and you have an annual cashflow projection with 12 months in the first year, the present value is computed as follows:

$$PV = cf_0 + \frac{cf_1}{(1+i)^{0.5}} + \frac{cf_2}{(1+i)^{1.5}} + \ldots$$

Internal Rate of Return

Internal rate of return (IRR, sometimes called simply, "rate of return") is the discount rate that yields a present value of zero. IRR is often used to rank alternative investments. Since most companies earn less than 15% (post-tax) return on their assets, one should beware of basing decisions on much higher IRR values. Also, some investments, such as those having a large negative cashflow late in project life, can have multiple IRR solutions. If you use IRR as an investment criterion, you should check the results with PV and other decision criteria.

Many companies use an IRR "hurdle rate" to select opportunities for further consideration. Companies often raise the hurdle for riskier investments. Though widely used, this approach is inferior to the expected value technique of decision analysis.

Examples of the Present Value Concept

1. If the PV discount rate is 10% per year, then a cashflow received one year in the future is discounted by a factor of 0.9091 = 1/(1+.10). For a cash flow lump sum two years in the future, the discount factor is $0.8264 = \left(\frac{1}{1.1}\right)^2$. Note that with this power calculation, discounting is analogous to interest compounding.

2. The ***future value*** of $1000 five years from now with a 10% interest rate compounded annually is:

$$\$1000\ (1.10)^5 = \$1610.51$$

Conversely, the present value of $1610.51 five years from now discounted at 10% per year is:

$$\$1610.51\ \frac{1}{(1.10)^5} = \$1610.51\ (1.10)^{-5} = \$1000.00$$

3. When used as a value measure, present value assumes that cash can be obtained or invested at the discount rate. A good way to illustrate this is with an example bank loan. A loan amortization schedule is shown below. $1 million is borrowed at 10% interest and is repaid with 5 annual <u>end-year</u> payments of $263,797 each:

Amounts are in $000s

START YEAR	YR END BALANCE	TOTAL PAYMENT	INTEREST PAYMENT	PRINCIPAL PAYMENT	PV @ 10% OF TOT PAYMENT
2001	1000.0	263.8	100.0	163.8	239.8
2002	836.2	263.8	83.6	180.2	218.0
2003	656.0	263.8	65.6	198.2	198.2
2004	457.8	263.8	45.8	218.0	180.2
2005	239.8	263.8	24.0	239.8	163.8
		1319.0	319.0	1000.0	1000.0

4. Most investments have an up-front cost (negative cashflow) for the acquisition. The following table illustrates a hypothetical $1 million investment. For simplicity, cashflows are assumed to occur at year starts. Assuming the 10% discount rate is the marginal cost of capital, this investment opportunity is worth $209,000. The PV discounted at 20.3% shows that this is the Internal Rate of Return (IRR). The last column shows mid-year discounting which would approximate cashflows distributed continuously in each year period instead of at year-ends.

Amounts are in $000s

YEAR	YEAR START NCF1	10% PRESENT VALUE DISCOUNT FACTOR	10% PV	20.3% PV DISC FACTOR	20.3% PV	YEAR START NCF2	20.3% PV	10% M-Y PV
2000	-1000	0 = 1	-1000	1	-1000	--	--	-953
2001	500	$1/1.1^1$ = .9091	455	.8313	416	500	416	433
2002	400	$1/1.1^2$ = .8264	331	.6910	276	400	276	315
2003	300	$1/1.1^3$ = .7513	225	.5744	172	300	172	215
2004	200	$1/1.1^4$ = .6830	137	.4775	95	200	95	130
2005	100	$1/1.1^5$ = .6209	62	.3969	40	100	40	59
	500		209		0	1500	1000	199

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