Chapter 7: Net Present Value and Other Investment Criteria

Project evaluation involves:

1- Estimating the cash flows associated with the investment project (ch. 8)
2- Determining the (discount rate, opportunity cost of capital, or the required rate of return) on the project according to its risk level. (FIN302)
3- Evaluating the stream of the cash flows associated with the project (ch. 7).

How Projects are Classified

- **Independent**
  - Acceptance or rejection does not directly eliminate other projects
- **Mutually exclusive**
  - Acceptance of one project precludes the acceptance of alternative proposals

Availability of Funds: Funds constraint ==➔ Capital rationing

Capital Budgeting Criteria:

- ✓ Net present value (NPV)
- ✓ Internal rate of return (IRR)
- ✓ Profitability index (PI)
- ✓ Payback period (PB)

Net Present Value (NPV) :

NPV is the PV of the stream of future CFs from a project minus the project's net investment. The cash flows are discounted at the firm's required rate of return or cost of capital.

$$NPV = CF_o + \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + ... + \frac{CF_n}{(1+k)^n}$$

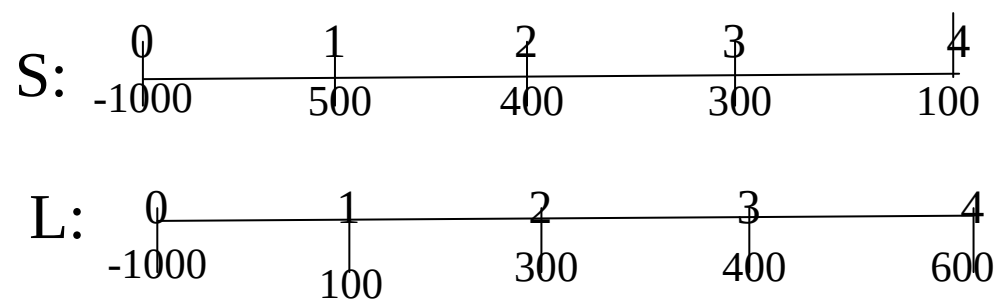
NPV = PV of future cash flows – Investment

NPV Decision Rule:
If NPV ≥ 0 then accept
For Mutually exclusive investments, Select the project with the largest NPV

Example:

We will consider projects S and L, and their projected cash flows. Both projects are equally risky.

	Expected After-Tax Cash Flows, CF_t	
Year (t)	**Project S**	**Project L**
0 (today)	($1,000)	($1,000)
1	500	100
2	400	300
3	300	400
4	100	600

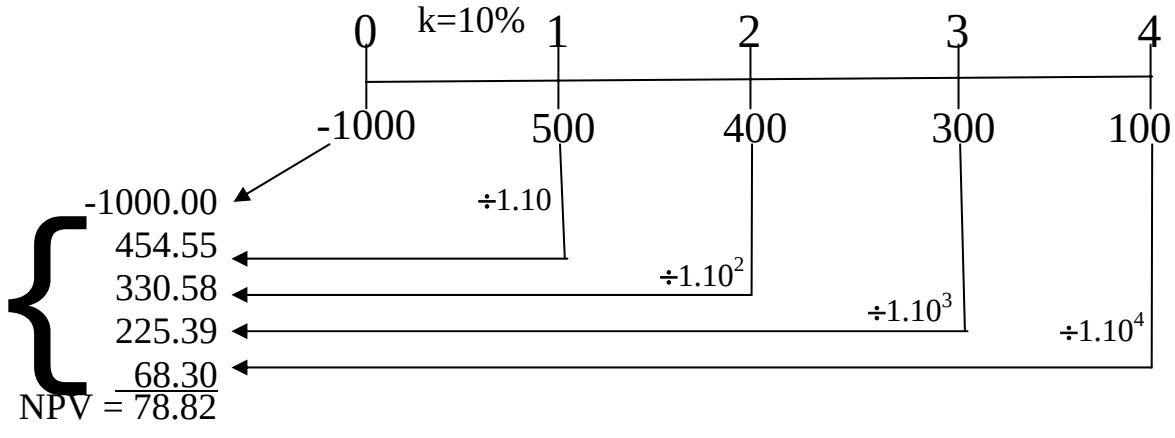


Procedure:

NPV is the present value of all cash flows generated by a project.

1) Find the PV of each cash flow (both inflows and outflows)
2) Add up all the PV's to get NPV.
3) Accept the project if NPV > 0. If two projects are mutually exclusive, pick the one with the higher positive NPV.

Computation of NPV for project S: (assume cost of capital is 10%)



NPV_S = $78.82 > 0, so we would accept the project.

Similarly, NPV_L = $49.18.
(Work this out on your own, using a 10% cost of capital.)

(This can be easier with a financial calculator.)

Advantages and Disadvantages of the NPV Method:

- ***Advantages***
  - Consistent with shareholder wealth maximization: Added net present values generated by investments are represented in higher stock prices.
  - Consider both magnitude and timing of cash flows
  - Indicates whether a proposed project will yield the investor's required rate of return
- ***Disadvantage***
  - Many people find it difficult to work with a dollar return rather than a percentage return

Internal Rate of Return IRR

IRR is the rate of discount that equates the PV of net cash flows of a project with the NINV.
Or , IRR is the discount rate at which NPV is zero.

- When the cost of capital equals the IRR, NPV=0
- When k > IRR, NPV < 0 ➔ Reject
- When k < IRR, NPV > 0 ➔ accept

$$CF_o + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_n}{(1+IRR)^n} = 0$$

By far, the best way to compute IRR is using a financial calculator.

IRR_S = 14.5%
IRR_L = 11.8%

Since k = 10.0% we would accept both projects if S and L are independent.

If S and L are mutually exclusive, the IRR method would tell us to accept project S, since 14.5% > 11.8%.

The IRR is a project's expected rate of return. If it exceeds the cost of capital, then shareholder wealth is increased by the project.

IRR Decision Rule:
If IRR ≥ discount rate then accept.
For Mutually exclusive investments, select the project with the largest IRR

Advantages and Disadvantages of IRR

- **Advantages**
  - People feel more comfortable with IRR
  - Considers both the magnitude and the timing of cash flows
- **Disadvantage**
  - Multiple internal rates of return with unconventional cash flows
    Any change in sign (+,-) in period cash flows produces as many IRR's as there are changes in the cash flow directions of the investment.
  - lending or borrowing. The IRR does not distinguish between a lending (investing) or a borrowing (borrow and invest) situation, whereas the NPV clearly points out the negative aspects of the borrowing strategy.

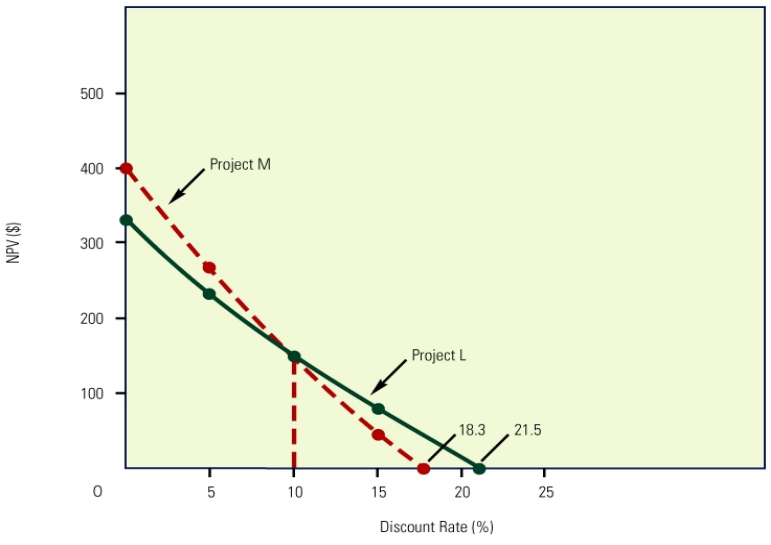
See examples in P. 192-193

NPV versus IRR

- **Reinvestment assumption**
  - NPV method assumes that CFs are reinvested at the cost of capital K
  - IRR method assumes that CFs are reinvested at IRR
  - Can lead to conflicts in ranking of mutually exclusive projects
  - Crossover
- **NPV is superior to IRR when choosing among mutually exclusive investments**

NPV v. IRR for Mutually Exclusive Alternatives

	Project L	**Project M**
NINV	$1,000	$1,000
CF1	667	0
CF2	667	1,400
NPV(at 5%)	240	270
IRR	21.6%	18.3%



Here, for discount rate (reinvestment) rate below 10% project M has higher NPV than project L and therefore is the preferred project. For discount rates greater than 10%, project L is preferred using both NPV and IRR methods.

Generally, the cost of capital is considered to be a more realistic reinvestment rate than the computed IRR because the cost of capital is the opportunity cost of capital of the firm. To change the reinvestment rate in IRR calculation, we can use Modified IRR (MIRR) function in excel.

Profitability Index

The profitability index is the ratio of the sum of present values of the project divided by the initial cost of the investment. It is a relative measure of the value (present value) of a project compared to its cost. The higher profitability index projects have higher PV's relative to the scarce capital invested.

PI = NPV /Investment

Profitability Index Decision Rule

- **Mutually exclusive investments with capital rationing**
  Choose the project with the highest PI.

Capital rationing exists if there is a limit on the amount of funds available for investment. There are two forms of capital rationing: soft rationing and hard rationing.

Only use PI if there is capital rationing.

See example in P. 200

Payback Period

- **Number of years for the cumulative net cash flows from a project to equal the initial cash outlay**

Example:

For project S:

- After year 2, $900 revenue has been received.
- After year 3, $1,200 revenue has been received, so payback happens during the third year.
- Assuming the cash flows come evenly during year 3, we get:

Payback Period$_S$ =

$$\begin{pmatrix}\text{Year before}\\ \text{full recovery}\end{pmatrix} + \frac{\text{Unrecovered cost at beg. of year}}{\text{Cash flow during year}}$$

$$= 2 + \frac{\$100}{\$300} = 2.33 \text{ years}$$

For project L:

$$\text{Payback Period}_L = 3 + \frac{\$200}{\$600} = 3.33 \textit{years}$$

Shorter payback periods are better.

If S and L are *mutually exclusive*, then only one project can be accepted. (It would be project S by this method.)

If S and L are independent projects, then either or both could be done, if so desired

Advantages and Disadvantages of PB:

- ***Advantages***
  - Measure of risk and liquidity
  - Useful for evaluating small projects
- ***Disadvantages***
  - Ignores the time value of money
  - Ignores cash flows after the payback period
  - Objective not consistent with shareholder wealth maximization

MORE EXAMPLES OF MUTUALLY EXCLUSIVE PROJECTS

The capital budgeting decision analyses, to this point in the chapter, have considered mutually exclusive alternatives. In either Project A *or* Project B, the proper decision rule was to select the project with the higher NPV. There are other mutually exclusive decision analysis considerations that occur frequently that complicate our simple NPV rule. *Three* situations are discussed below.

Investment Timing

When to make an investment is a difficult decision in a dynamic world.
You need to calculate the NPV, then fine the present value of it Today.
The decision rule for investment timing is to choose the investment date with the highest NPV today.

See example in P. 196-197

Long-Lived versus Short-Lived Equipment

When comparing mutually exclusive projects that have unequal project lives, one must Calculate the **equivalent annual cost** of those projects.

Decision Rule: Accept the project with the lowest equivalent annual cost.

The equivalent annual cost is the annual (annuity or payment) project cost that equates the present value cost of the project (outlay and annual costs) at the opportunity rate of return.

See examples in P. 197-199