Lesson 12 – Future Worth and Benefit Cost Redux

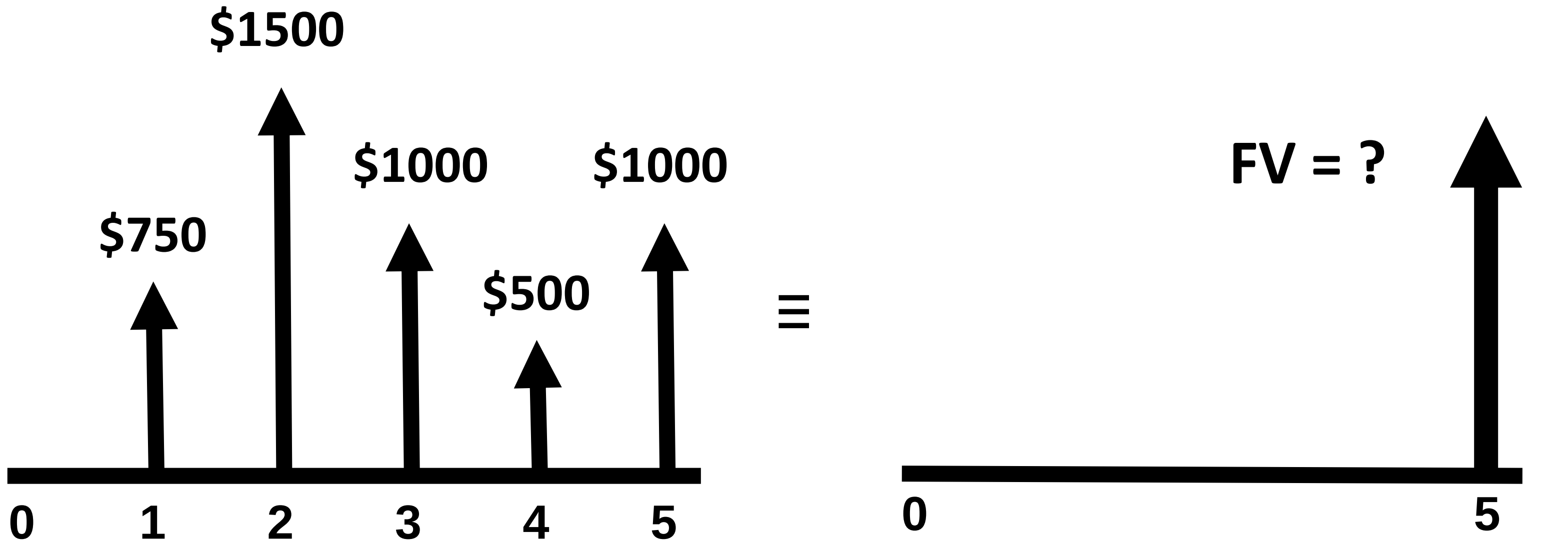
Future Worth Analysis (or Net Future Value, NFV)

- In contrast to present worth analysis, one might want to know the value of a set of alternatives at any point in time in the future.
- Future worth analysis is very similar to present worth analysis but the analysis exists at some future point in time.
- As in present worth analysis, the evaluation of alternatives must be over the same time period.
  - <u>This implies that the use of LCM or a specified time period is needed.</u>

Present and future value methods

- Net present value (NPV)
  - Project cash flows are discounted and combined to produce a net value at the start of the project or the present time (see Chapter 5).
  - The NPV is the value added at time zero
- Net future value (NFV)
  - Project cash flows are converted to a future value and combined to produce a net value at the end of the project or a designated future point in time.
  - The NFV is the amount that remains at the end of a project after the annual cash flows have been accumulated into the unrecovered capital, plus the required returns, throughout the project.

Future Value



Find the value of the cash flows at the end of the 5th year if the rate of return is 11% compounded annually. (Answer = $5977)

NFV and independent projects

- Select projects with non-negative net future values, i.e.
  - if NFV > 0, accept project
  - if NFV < 0, reject project
  - if NFV = 0, marginally accept project
- If all projects have NFV < 0, select the status quo (do nothing) option; ultimately, seek other projects that offer a return that is ≥ the MARR.
- The selection of independent projects is usually constrained by a limited capital budget (see Chapter 15).

	Situation	***Criterion***
Fixed input	Amount of capital available is fixed	Maximize future value of benefits
Fixed output	Amount of benefits is fixed	Minimize future value of costs
Neither fixed	Neither capital nor benefits is fixed	Maximize net future value (NFV)

Future value and present value analysis

Parameters	***Project A***	***Project B***	***Project C***
Investment	\$2500	\$3500	\$5000
Annual cost	\$900	\$700	\$1000 + (G=\$100)
Salvage value	\$200	\$350	\$600
Life (years)	5	5	5
Annual revenue	\$1800	\$1900	\$2100 (15% growth)
MARR	10%	10%	10%

Future value and present value analysis …

- Calculate the NPV and the NFV for Projects A, B, and C
- NPV_A = -\$2500 + (1800-900)(P/A, 10%, 5) + 200(P/F, 10%, 5)
- NFV_A = -\$2500(F/P, 10%, 5) + (1800-900)(F/A, 10%, 5) + \$200
- NPV_B = -\$3500 + (1900-700)(P/A, 10%, 5) + 350(P/F, 10%, 5)
- NFV_B = -\$3500(F/P, 10%, 5) + (1900-700)(F/A, 10%, 5) + \$350
- NPV_C = -\$5000 + (\$2100)(P/g, 15%, 10%, 5) - (\$1000)(P/A, 10%, 5) - \$100(P/G, 10%, 5) + \$600(P/F, 10%, 5)
- NFV_C = ?? NFV_C = NPV_C(F/P, 10%, 5)

- NPV_A = \$1035.89; NFV_A = \$1668.32.
- NPV_B = \$1266.27; NFV_B = \$2039.34.
- NPV_C = \$1349.16; NFV_C = \$2172.83.

Useful lives ≠ analysis period

- Project A has a three-year life. Project B has a four-year life. Both projects are valid since each has NFV > $0 using MARR of 10%.
- Which project is better?

Year	***Project A***	***Project B***
0	–$1000	–$2000
1	$500	$720
2	$500	$720
3	$500	$720
4		$720
NFV	$324.00	$413.32

Useful lives ≠ analysis period …

- Because Projects A and B have different lives, the NFV criterion requires that they be evaluated over a common analysis period (the LCM is twelve years).
- Hence, Project A will be repeated four times (after the initial invest-ment at t=0) and Project B three times.

Year	Project A	Project B
0	–$1000	–$2000
1	$500	$720
2	$500	$720
3	–$500	$720
4	$500	–$1280
5	$500	$720
6	–$500	$720
7	$500	$720
8	$500	–$1280
9	–$500	$720
10	$500	$720
11	$500	$720
12	$500	$720
NFV	$2093.20	$1904.45

Benefit–Cost Ratio Analysis

- We looked at Benefit-Cost ratio with current costs and benefits
- Can also be done with Present and Future Values

Benefit–Cost Ratio Analysis

- At a given MARR an alternative that would be acceptable when:
  - PW of benefits – PW of costs ≥ 0
    FW of benefits – FW of costs ≥ 0
  - EUAB – EUAC ≥ 0

This makes sense as the benefits outweigh the costs for a net positive benefit at MARR over a specified lifetime. These stated as **Benefit–Cost Ratios** are:

PW of benefits/PW of costs ≥ 1

FW of benefits/FW of costs ≥ 1

EUAB/EUAC ≥ 1

Benefit–Cost Ratio Analysis

Process improvement A will cost you $3500 to implement, but save $1250 per year in productivity gains. Option B will cost $3,500 as well, but produce variable savings. Using B/C ratio, which one should you implement? Interest = 9%

Year	Option A	Option B
0	-$3500	-$3500
1	$1250	$2000
2	$1250	$1500
3	$1250	$1000
4	$1250	$500

Benefit–Cost Ratio Analysis: Solution 2

Device A:

$PW_C \quad = \$3500$

$PW_B \quad = \$1250(P/A, 9\%, 4) = 1250(3.240) = \$4050$

$B/C = PW_B / PW_C = 4050/3500 = \mathbf{1.16}$

Device B:

$PW_C \quad = \$3500$

$PW_B \quad = 2000(P/A, 9\%, 4) – 500(P/G, 9\%, 4)$

$= 2000(3.24) – 500(4.511) = 6480 – 2256 = \$4224$

$B/C = PW_B / PW_C = 4224/3500 = \mathbf{1.21}$

To maximize the benefit-cost ratio, select Device B.