June 25, 2019

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*** • Capital Budgeting (CB hereafter)

CB is the process of evaluating/identifying capital projects that (positive or negative) cash flows to the firm will be received over a period typically longer than a year!

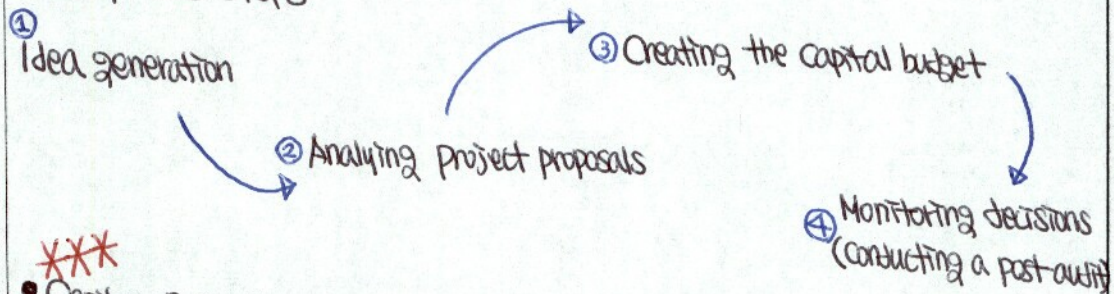
* • Why "CB" is "important"?

① Long-term future success of a firm; CB decisions generally involve the purchase of costly long-term assets with lives of many periods/years.

② Corporate decisions : CB decisions closely relate to corporate decisions such as firm's capital management and M&A strategies

③ Main goal of financial management ; CB decisions are consistent with a primary goal of financial management/financial managers.

• CB process steps



*** • Capital Budgeting process/decisions are based on cash flows, "not" accounting profit/income. (Why? review previous notes!!:) Few rules below;

① Sunk costs can't be avoided, even if the project is not undertaken. Because these are not affected by the accept/reject decision, * Sunk costs must not be included in the CB analysis; "CF(x)"

② * Financing costs will not be considered (when the firm measures/estimates incremental cash flows) ; "CF(x)"

③ * opportunity costs are cash flows that a firm will lose by taking the project; "CF(o)"

④ * Externalities are (side) effects / consequences from the acceptance of a project; "CF(o)"...

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* Cannibalization is a negative externality (ex? Soft drink Company, Pepsi, now provides super healthy juices)

*** How to choose good/bad project(s)? *** NPV (Best), ** IRR, PP, DPP, PI

① Net Present Value (NPV)

$$NPV = CF_0 + \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \cdots + \frac{CF_n}{(1+k)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$

CF_0: initial cash investment; CF_t: after-tax CF at time t; k: required rate of return

* Example?

Year, t	Project A	Project B
0	-1000	-1000
1	800	300
2	200	700
3	300	400

given information, compute the NPV of each projects cash flows and make a decision (accept/reject). Assume that the cost of capital is 6%.

$$NPV_A = -1000 + \frac{800}{(1.06)^1} + \frac{200}{(1.06)^2} + \frac{300}{(1.06)^3} = 184.60$$

$$NPV_B = -1000 + \frac{300}{(1.06)^1} + \frac{700}{(1.06)^2} + \frac{400}{(1.06)^3} = 241.86$$

*
If projects are independent, take both projects since they are positive
If projects are mutually exclusive, take project B because 241.86 > 184.60

* Make sure that NPV is the sum of all present values of expected incremental cash flows when a project is taken. * A main advantage of NPV is that it is a "direct measure" of the expected increase in the firm's value. However, it does not consider the "size of the project!"

② Internal Rate of Return (IRR)

* The IRR is the discount rate that makes the PV of (estimated) cash inflows equal to the PV of (estimated) cash outflows. That is...

PV(Cash inflows) = PV(Cash outflows)

* ∨ The IRR is the discount rate for which NPV is equal to ∅. That is

$$NPV = \emptyset = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \cdots + \frac{CF_n}{(1+IRR)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t}$$

* (If IRR > required rate of return, accept the project
If IRR < required rate of return, reject the project)

∨ A main advantage of IRR is that it shows the return on each dollar invested in the project. Multiple IRRs and no IRR will be critical disadvantages.

∨ Is it true that if NPV > 0, IRR > required rate of return? Why?

*** ∨ Why we prefer NPV to IRR?

ⓐ NPV has a realistic assumption that cash flows can be reinvested at the discount rate.

ⓑ NPV is closely related to stock prices because it is a direct measure of the expected change in firm value from a project.

∨ NPV and IRR are related to firm's* profitability.

③ Payback Period (PP)

∨ Payback period is the # of years it takes to recover the initial investment cost (CF_0).

∨ PP = full years until recovery + $\frac{\text{unrecovered cost at the beginning last year}}{\text{cash flow during the last year}}$

∨ We don't like/use PP because ① it does not take into account the TVM and ② cash flows beyond the PP.

∨ PP is a measure of* liquidity. Shorter is better?

④ Discounted Payback Period (DPP)

∨ This considers ① TVM, but still doesn't consider any cash flows beyond the PP.

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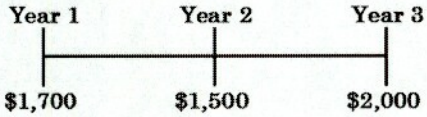
Shin's Korean BBQ is considering the purchase of a microwave that costs $3,500. Assume a required rate of return of 9% and the following cash flow schedule:



1. Calculate NPV.

$$NPV = -3500 + \frac{1700}{(1.09)^1} + \frac{1500}{(1.09)^2} + \frac{2000}{(1.09)^3} = {}^{*}866.52$$

2. Calculate IRR.

$$NPV = \emptyset = -3500 + \frac{1700}{(1+IRR)^1} + \frac{1500}{(1+IRR)^2} + \frac{2000}{(1+IRR)^3}$$

$^{*}IRR = 22.0482 \approx 22.05$

*** PI > 1 → $1 + \frac{NPV}{CF_0} > 1$ → NPV > 0 → IRR > CC

3. Caculate Payback Period.

Year t	Year ø	Year1	Year2	Year3
Net Cash flow(s)	-3500	1700	1500	2000
Cumulative NCF	-3500	-1800	-300	+1700

$$PP = 2 + \frac{300}{2000} = {}^{*}2.15$$

4. Calculate Discounted Papyback Period.

Year t	Year ø	Year1	Year 2	Year3
Net cash flow(s)	-3500	1700	1500	2000
Discounted NCF	-3500	1559.63	1262.52	1544.36
Cumulative DNCF	-3500	-1940.37	-677.85	866.51

$$DPP = 2 + \frac{677.85}{1544.36} = {}^{*}2.44$$

5. Calculate PI = Profitability Index = PV of future cash flows / $CF_0 = 1 + \frac{NPV}{CF_0}$

$$PI = 1 + \frac{866.52}{3500} = 1.25$$

* (if PI > 1, accept the project; if PI < 1, reject the project)

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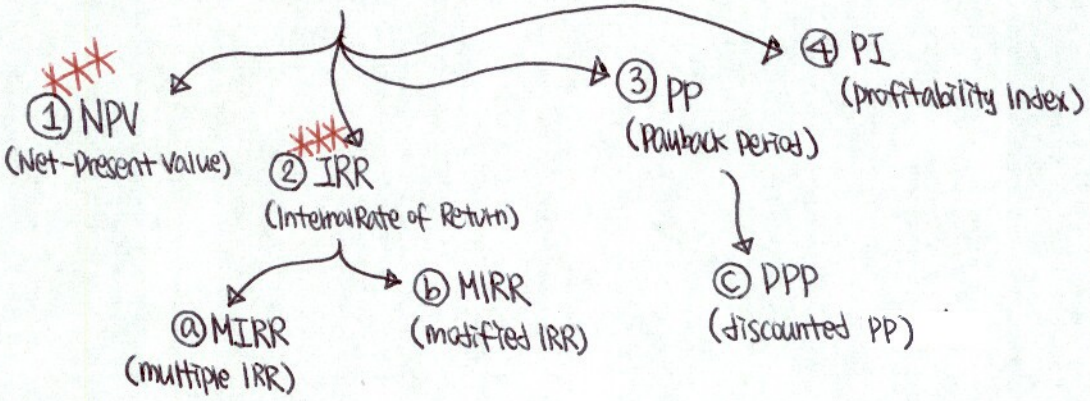
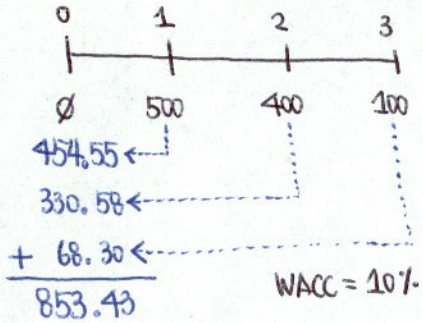
Capital Budgeting decision Criteria

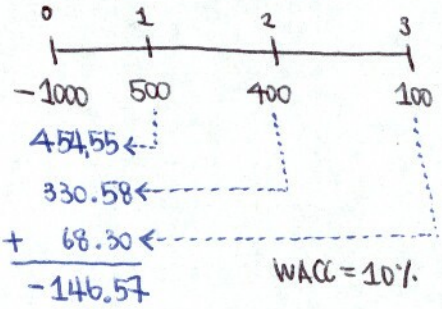


① NPV is a method of ranking investment proposals using the NPV, which is equal to the present value of the project's free cash flows discounted at the *Cost of capital.

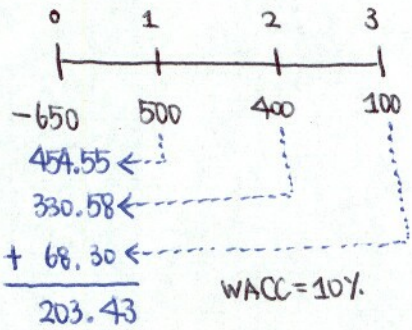
Case 1) Simple CFs Concept (Best)



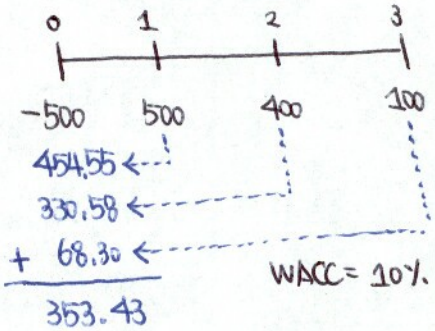
Case 2) Idiot project



Case 3) Good Project



Case 4) Better Case



-X- How to discount your cash flows? ($P_1 = \frac{500}{(1+10\%)^1}$, $P_2 = \frac{400}{(1+10\%)^2}$, $P_3 = \frac{100}{(1+10\%)^3}$)

(Please review TVM)

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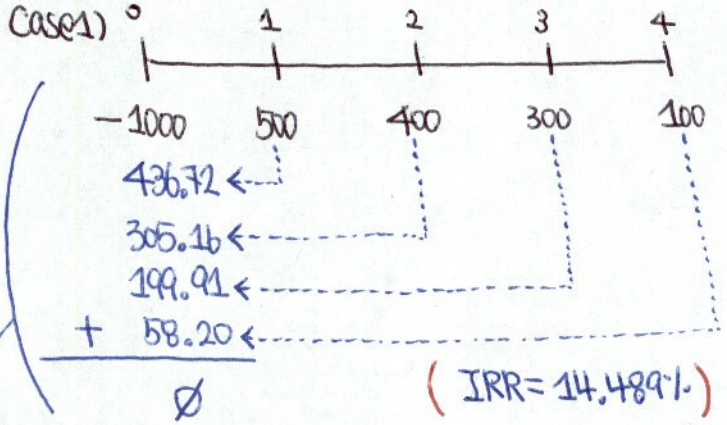
$$NPV = CF_0 + \frac{CF1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \cdots + \frac{CF_N}{(1+r)^N}, \; r = WACC$$

② IRR is the discount rate that forces a project's NPV to equal ∅

Case1)



$$NPV = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \cdots + \frac{CF_N}{(1+IRR)^N} = \emptyset$$

$$NPV = -1000 + \frac{500}{(1+0.14489)^1} + \frac{400}{(1+0.14489)^2} + \frac{300}{(1+0.14489)^3} + \frac{100}{(1+0.14489)^4} = \emptyset$$

***

NPV and IRR decision rule ; review previous notes!! ☺

IRR

ⓐ MIRR (multiple IRR)

The situation where a project has two or more IRRs

(IRR ; ⊖⊕⊕⊕ or ⊖⊖⊕⊕
MIRR ; ⊖⊕⊕⊖ or ⊖⊕⊖⊕)

Example)

Year(t)	CFs($)
0	-1.6
1	10.00
2	-10.00

$$NPV = \emptyset = -1.6 + \frac{10}{(1+IRR)^1} + \frac{-10}{(1+IRR)^2}$$

IRR = 25% or 400% two IRRs!

ⓑ MIRR (modified IRR) is the discount rate at which the PV of a project's cost is equal to the PV of its terminal value, where the terminal value is found as the sum of the FV of the cash flows, compounded at the firm's cost of capital.

Example) WACC = 10%

Year(t)	CFs($)
0	-1000
1	500
2	400
3	300
4	100

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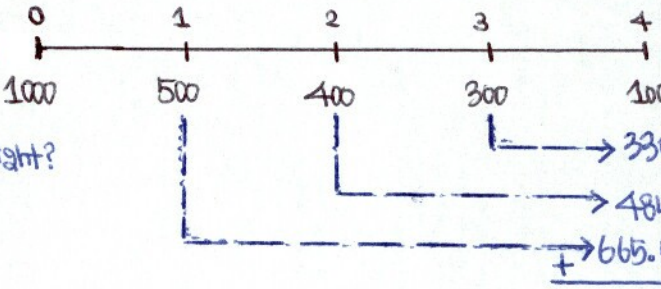
First of all, draw time line(s) and find terminal value, and then MIRR!

(Step 1)



(Step 2) Terminal value 1579.50

(Step 3) Calculate MIRR

$(TV = CF_0 \times (1 + MIRR)^N)$

$1579.50 = +1000 \times (1 + MIRR)^4$

N	I/Y	PV	PMT	FV
4	?	-1000	Ø	1579.5

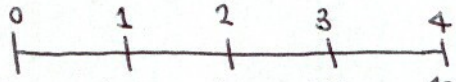
MIRR = 12.66%

* it looks like $FV = PV \times (1 + interest)^N$ right?

③ Payback Period (PP) is defined as the length of time required for an investment's cash flows to cover its costs.

$$PP = \#\text{ of years prior to full recovery} + \frac{\text{uncovered cost at start of year}}{\text{cash flow during full recovery year}}$$

Case 1) Barry Inc.

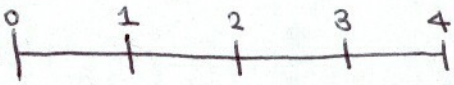


CF	-1000	500	400	300	100
Cumulative CF	-1000	-500	-100	200	300

WACC = 10%.

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

Case 2) Kristen Corporation



CF	-1000	100	300	400	675
Cumulative CF	-1000	-900	-600	-200	475

WACC = 10%.

$$PP = 3 + \frac{200}{675} = 3.3 \text{ years}$$

* Payback Period ignores cash flows occuring after the cost is recovered and time value of money. In order to alleviate the second concern, the discounted Payback period was developed, which incorporates the PV of cash flows received.

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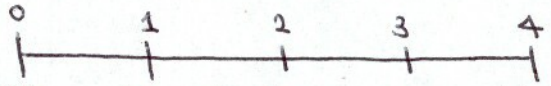
Case 1) Symone Inc.

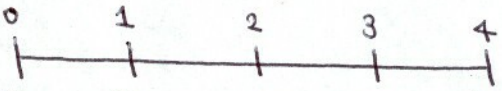


WACC = 10%.

	0	1	2	3	4
CF	-1000	500	400	300	100
Discounted CF	-1000	455	331	225	68
Cumulative discounted CF	-1000	-545	-214	+11	+79

$$\text{Discounted PP} = 2 + \frac{214}{225} = 2.95 \text{ years}$$

* Case 2) Shea Inc.



	0	1	2	3	4
CF	-1000	100	300	400	675

WACC = 10%.

Please find DPP :)

***

Conclusions on Capital Budgeting!!

The diffent methods provide diffent tupes of information.

① NPV is the best method because it provides a direct measure of value the project adds to shareholders' wealth.

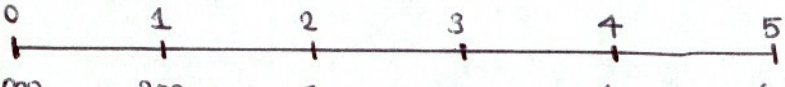
② IRR (or MIRRs) measure the firm's profitability expressed a percentage rate of return. It also contains information concerning a project's "safety margin"

③ Payback and discounted payback provide indications of a project's liquidity and risk. A long year payback means that investment $s will be locked up for a long time!

For most decisions, the greatest weight should be given to the NPV, but not always! consider others!

***

Exit Question? Find NPV, IRR, MIRR, PP, DPP and PI and suggest Accept/reject this project. WACC = 14%.



	0	1	2	3	4	5
(CFs)	-1000	300	300	200	400	630