1.011 Project Evaluation
Comparing Alternatives
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1. Capital Budgets and Hurdle ROI
2. Mutually Exclusive Alternatives
3. Dealing With Projects with Unequal Lives

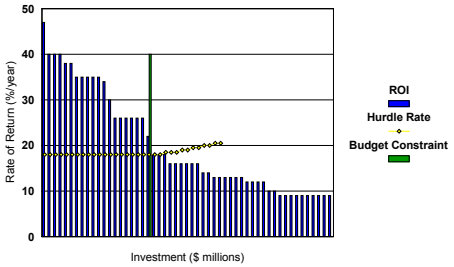
What is an Acceptable Investment?

- PW is greater than zero, which is equivalent to both AW > 0 and FW > 0
  - Note that ranking of investment options will be the same whether PW, AW, or FW is used.
    - If we are given i and N, thenPW is proportional to AW and FW
    - If PW(option 1) > PW(option 2) then
      - AW(option 1) = k*PW1 > k* PW2 = AW(option 2) and
      - FW(option 1) > FW(option 2)
- This is a very convenient property! Use PW, AW, or FW and choose the options with the highest values (go for the "biggest bang for the buck")

Capital Budgets & Hurdle Rates

- In general, we expect to have many investment opportunities where PW > 0
- BUT! We almost certainly won't have enough capital to fund them all (our banker, our partners, or our stockholders eventually get nervous!)
- SO: companies tend to ration their capital and to select the best projects using a hurdle ROI and a capital budget
  - Hurdle rate > or = MARR
  - Capital budge determines how much we can do

Selecting Projects Based Upon a Hurdle Rate of Return



Assumptions for this Capital Budgeting Process

- We know the MARR
  - *In principle we should, but this is a little fuzzy!*
- We know the limits for capital expenditures
  - *This is always a negotiated limit - who has the power in the corporation? who can convince the board to go along with the project? who can convince people to buy bonds?*
- We have an ordered list of ALL feasible projects, none of which are mutually exclusive
  - *Highly unlikely! No one who has seriously considered design assumes they can EVER know ALL of the alternatives, many of which are mutually exclusive!*

The Inconsistent Ranking Problem

- There may be a problem with this methodology
  - We advised ranking by PW, AW or FW to get proper rankings of projects
  - BUT: the capital budget typical ranks by IRR (and we would argue for using ERR)
  - Will ranking by IRR give the best project?

An Example of Inconsistent Rankings

(E.E. Section 5.4.2.1)

	A	B	A-B
Capital Investment	-$60,000	-$73,000	-$13,000
Revenue - Expense	$22,000/yr	$26,225/yr	$4,225/yr
PW	$9,738	$10,131	
IRR	17.3%	16.3%	
Project life	4 years	4 years	

How Do We Resolve the Inconsistency?

Is the smaller investment acceptable? Yes, PW > 0

Is the INCREMENTAL investment of $13,000 justified by the incremental return?

$4,225 extra for four years, at MARR = 10%

PW = $4225 * (P/A,10%,4) = $4,225*3.169
= $13,393 > $13,000

The PW of the INCREMENTAL investment is positive, so the incremental investment is better, even though the IRR is lower!

Example 1: Lesson

- Of all the options with PW > 0, let the base case be the option with the lowest capital cost
- Consider the next largest investment if the incremental return on the incremental investment is greater than the MARR
  - This means that the IRR on the incremental investment exceeds the MARR
- Recommend the largest investment where the incremental investment is justifiable

Example 2: More Options

(Amounts in $1000s)

		Invest	Net Income
Park	Parking Lot	$200	$22
B1	1 Story Building	4,000	$600
B2	2 Story Building	5,500	$720
B3	3 Story Building	7,500	$960

Example 2: Incremental Analysis

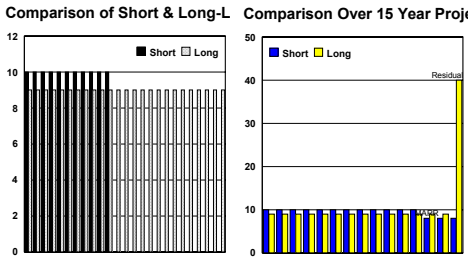
(Amounts in $1000s)

	B1-P	B2-B1	B3-B1
□ K□	-$3,800	-$1,550	-$3,500
□Inc	$578	$120	$360
□IRR	15.2%	7.7%	10.3%
	OK	NDG!	OK

If Project Lives Are Different

- Use a longer life that is an integral multiple of both lives, e.g. use a 20 year life to compare projects of 4, 5, or 10 years duration
- Estimate a residual value for the project with a longer life and use the life of the shorter-lived project
- Use a sufficiently long life that the differences will be neglible
- Use the AW method (and assume that you would replace your project with one that is at least that good)
- Use common sense and do sensitivity analysis if you are in doubt! There is NO right method!

Comparing Projects With Unequal Lives Using MARR & Residual Value



Summary

- The equivalent worth methods are computationally less cumbersome to use and to understand
- Both the equivalent worth and the IRR/ERR methods will give the correct choice if used properly
- IRR/ERR methods will give the WRONG choice if a manager insists on the highest return rather than ensuring that the incremental IRR is greater than the MARR