Lecture 14. Decision criteria – payback period and net present value

FOR 2022. Financial Analysis for Natural Resources.

UAM
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Arkansas Forest Resources Center

Decision criteria

- Criteria that provide assistance in deciding whether or not a project is financially advisable
- Many criteria for evaluating a project financially:
  - How fast do I get my money back (Payback period)?
  - Does the project earn a rate of return higher than my marginal acceptable rate of return (MARR)?
    - Earning rate
    - Internal rate of return (composite rate of return or realizable rate of return)
  - At a particular rate of return, which project has the highest net present value (NPV)?
  - Which project has the highest ratio of benefits to costs (benefit cost ratio)?
  - Which project, if repeatable, has the highest bare land value (soil expectation value or land expectation value)
  - If a project's returns are converted into an equivalent annual annuity (EAA), what is that value?
- Important to remember that financial criteria are an important part of the decision making process, but considerations of sustainability and ecological security are paramount!

Payback period

- The simplest measure of time required to recover the initial investment
- All costs and returns are *undiscounted*
- The shorter the period of time required, the better – shorter payback periods are indicative of less risk
- Cash flows beyond payback period are not considered in this criteria

$$Payback\_period = \frac{initial\_investment}{net\_return\_per\_period}$$

- DECISION RULE: CHOOSE PROJECT WITH SHORTEST PAYBACK PERIOD

An example of payback period

Year	Cash Flow	
	Project S	Project L
0	($100)	($100)
2	$50	$25
4	$50	$25
6	$50	$50
8	$50	$300
Payback period:	4 years	6 years

But payback period *ignores* cash flows *after* payback.

Same project, but let's sum the present values of ALL cash flows at 6%...

Year	Cash Flow	
	Project S	Project L
0	($100)	($100)
2	$50	$25
4	$50	$25
6	$50	$50
8	$50	$300

Project S…

$$V_0^S = (\$100)(1.06)^0 + \$50\left[\frac{(1.06)^{4x2} - 1}{[(1.06)^2 - 1](1+i)^{4x2}}\right] = \$50.72$$

Project L…

$$V_0^L = (\$100)(1.06)^0 + \$25(1.06)^{-2} + \$25(1.06)^{-4} + \$50(1.06)^{-6} + \$300(1.06)^{-8} = \$165.52$$

At 6% cost of capital, project L is worth $165.52 to me today, project S is worth only $50.72.

Net present value (NPV)

- AKA..
  - Present net value (PNV)
  - Net present worth (NPW)
  - Present net worth (PNW)
- Definition
  - The present value of all expected returns minus the present value of all expected costs. All costs and returns are discounted by the appropriate interest rate and number of discount periods.
  - Assumes that any intermediate returns can be reinvested at the same cost of capital used for discounting

A "general" formula for NPV

$$NPV = \sum_{t=0}^{n} R_t(1+i)^{-t} - C_t(1+i)^{-t}$$

Where, R_t = a return in year t of a project
C_t = a cost in year t of a project
i = applicable interest rate (tied to discount period)
n = length of project (number of discount periods)
t = discounting periods when cash flow occurs

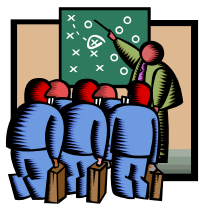
Some caveats:

- Both returns and costs are in positive dollars (subtract costs)
- Assumes all cash flows are "single payment" and uses simple present value formula

DECISION RULE: ACCEPT PROJECTS WHERE NPV $\geq$ 0
- They earn at or above the cost of capital used

REJECT PROJECTS WHERE NPV < 0
- They fail to earn the cost of capital used

Some important points!



- Five "M" of management
  - Money
  - Manpower
  - Machines
  - Methods
  - Materials
- Capital, money, resources, all refer to assets we can use to complete projects that help us reach our goals in life.
- We convert them into constant units (dollars) to make financial analysis easier!
  - We can convert worker time (manpower) into dollars of labor cost
  - We can convert materials (chemicals, seedlings, land) into dollars by determining their cost
  - We can convert machines or tools used into dollar costs for purchase, maintenance, and use.
  - We can convert methods (the way in which manpower, machines, and materials are combined) into deriving total costs

Some important points!

- You have heard many terms used to express the interest rate charged to a project
  - Time preference for resources, “cost of capital,” “hurdle rate,” “alternative rate of return”

While these will be discussed more when we talk about “capital theory,” some points can be made now

- Whenever we consider one use for resources (money), there are always alternatives
  - If we spend $10,000 growing trees, we are not putting that money into the bank, stock market, growing beans, or paying off any debts we might have. This is the OPPORTUNITY COST of capital.
  - The term, alternative rate of return (ARR) refers to returns we would get from the best alternative project to the one we are analyzing
  - So, we discount at this alternative rate for our project in question and we know, if NPV $\geq$ 0, then we are doing at least as well or better than all other alternative projects.

An example of net present value

- We have 40 acres of old field, which we currently rent to a cattleman for $600 per year
  - NPV = $8571 @ 7%
- We are considering converting this land into a pine plantation with the following actions and expected cash flows
- If we don’t’ invest this money into a forestry option, the best alternative investment is to pay off a big loan which currently cost 7% per year in compound finance charges.

Year	Activity	Cash flows for 40 acres
0	Site prep (rip and bed)	($7000)
1-30	Annual management costs	($200)
1	Plant trees and suppress competition	($4800)
8	Precommerical thinning	($3400)
18	Pulpwood thinning	$10,000
24	Pulpwood and CNS thinning	$35,000
30	Final Harvest	150,000

NPV of forestry project

Year	Activity	Cash flows for 40 acres	Present Value Formula	Present Value using ARR=7%
0	Site prep (rip and bed)	($7000)	$V_0 = V_n(1+i)^{-n}$	($7,000)
1-30	Annual management costs	($200)	$V_0 = a\left[\frac{1-(1+i)^{-n}}{i}\right]$	($2,482)
1	Plant trees and suppress competition	($4800)	$V_0 = V_n(1+i)^{-n}$	($4,486)
8	Precommerical thinning	($3400)	$V_0 = V_n(1+i)^{-n}$	($1,979)
18	Pulpwood thinning	$10,000	$V_0 = V_n(1+i)^{-n}$	$2,959
24	Pulpwood and CNS thinning	$35,000	$V_0 = V_n(1+i)^{-n}$	$6,900
30	Final Harvest	150,000	$V_0 = V_n(1+i)^{-n}$	$19,705

Net Present Value =$13,617

DECISION: PINE PLANTATION HAS HIGHER NPW THAN PASTURE RENTAL

Next lecture…

Determining the rate of return on an investment.