



Lecture 17. Benefit cost ratio

FOR 2022. Financial Analysis for Natural Resources.



School of Forest Resources



Benefit / Cost Ratio

- B/C Ratio (B/C) is the present value of all benefits (returns) divided by the present value of all costs
 - Need discount rate
 - All values in positive dollars
 - $B/C \geq 0.0$
- A measure of efficiency
 - For every dollar invested in a project, B/C ratio is the number of dollars returned
- Decision Criteria
 - All projects with $B/C \geq 1.0$ have benefits greater than or equal to costs and are acceptable
 - Reject projects with $B/C < 1.0$

$$B/C = \frac{PV(Returns)}{PV(Costs)}$$

An example of benefit/cost ratio

Year(s)	Cash Flow
0	(\$50,000)
1-25	(\$3,000)
5,10,15,20,25	\$35,000
25	\$200,000

Present value at 7%...

$$V_0 = (\$50,000)(1.07)^{-0} = (\$50,000)$$

$$V_0 = (\$3,000) \left[\frac{1 - (1.07)^{-25}}{0.07} \right] = (\$34,961)$$

$$V_0 = \$35,000 \left[\frac{(1.07)^{5 \times 5} - 1}{(1.07^5 - 1)(1.07^{5 \times 5})} \right] = \$70,926$$

$$V_0 = \$200,000(1.07)^{-25} = \$36,850$$

$$B/C = \frac{\$70,926 + \$36,850}{\$50,000 + \$34,961} = 1.27$$

Relationship between NPV, IRR, and B/C Ratio

- IF NPV = 0, then
 - B/C Ratio = 1.0
 - IRR = ARR (discount rate)
- IF NPV > 0, then
 - B/C Ratio > 1.0
 - IRR > ARR
- IF NPV < 0, then
 - B/C Ratio < 1.0
 - IRR < ARR





Let's test the comparison between NPV, IRR, and B/C ratio

Project analyzed in previous lecture, IRR = 11%...

Year	Cash Flow	4%	8%	12%	10%	11%
0	(\$5,145)	(\$5,145)	(\$5,145)	(\$5,145)	(\$5,145)	(\$5,145)
1	(\$1,520)	(\$1,462)	(\$1,407)	(\$1,357)	(\$1,382)	(\$1,369)
20	\$8,500	\$3,879	\$1,824	\$881	\$1,263	\$1,054
30	\$125,000	\$38,540	\$12,422	\$4,172	\$7,164	\$5,460
		\$35,813	\$7,693	(\$1,449)	\$1,900	\$0

NPV = 7,693, B/C Ratio = 2.17, ARR (8%) is less than IRR (11%)

NPV = (\$1,449), B/C Ratio = 0.78, ARR (12%) is greater than IRR (11%)

NPV = 0, B/C Ratio = 1.00, ARR (11%) is equal to IRR (11%)

NTLS



Test your knowledge

- You are investigating the benefits of establishing a new road through the Ozark-St. Francis National Forest. The construction costs of this 25.5 mile road are \$5,737,500. Over the next twenty-five years, the road will need to be graded yearly, at a cost of \$25,500. Every five years, the road will need additional maintenance at a cost of \$15,000. Expected benefits from the use of this road for forest recreation, forest protection, and timber production are estimated to be \$500,000 each year. If the government wants a 4% rate of return on it's investment, determine the B/C ratio of this public project over a 25-year lifespan.

$$B/C = \frac{\$500,000 \frac{1-1.04^{-25}}{0.04}}{5,737,500(1.04)^{-0} + 25,500 \frac{1-1.04^{-25}}{0.04} + 15,000 \frac{(1.04)^{25} - 1}{(1.04^5 - 1)(1.04^{25})}} = \frac{\$7,811,040}{5,737,500 + 398,363 + 50,959} = 1.26$$



Next lecture...

Equivalent annual annuity...