ECNS 432
Ch. 6

Discounting Benefits and Costs in Future Time Periods

- Because pvt. and public projects can have important consequences that extend over time, we often have to compare benefits and costs across time periods.
- To do this, we discount future costs/benefits so that all are in a common metric…which is???

  Present value

- Present Value Analysis
  - Compares the current equivalent value of a project, with the current equivalent value of the best alternative project, given prevailing interest rates

Discounting Benefits and Costs in Future Time Periods

- Ex. Suppose the purchase of a plot of land will be worth $11 million in one year's time. Also suppose the money could be invest at a 5% return.
  - Q. What is the PV of the land?
    - PV = $11,000,000/(1 + 0.05) = $10,476,190
  - In general, if the prevailing interest rate is *i*, then the PV of an amount received in one year, Y, is given by

    $$PV = Y/(1 + i)$$

    where Y is referred to as a "future value"
- B/c we want to consider both benefits and costs in present value terms, we will often calculate the Net Present Value (NPV) of a project

$$NPV = PV_{benefits} - PV_{costs}$$

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- Generally, we need to consider calculating PVs over multiple time periods
  - PV of an amount received in 1 year:

$$PV = Y/(1 + i)$$

  - PV of an amount received in 2 years:

$$PV = [Y/(1 + i)]*[1/(1 + i)] = Y/(1 + i)^2$$

  - PV of an amount received in 3 years:

$$PV = [Y/(1 + i)]*[1/(1 + i)]*[1/(1 + i)] = Y/(1 + i)^3$$

  - PV of an amount received in n years:

$$PV = Y/(1 + i)^n$$

where $1/(1 + i)^n$ is the "discount factor"

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- If a project yields benefits over many time periods, then we adjust our PV calculation in the following manner

$$PV_{benefits} = B_0/(1+i)^0 + B_1/(1+i)^1 + \ldots + B_{n-1}/(1+i)^{n-1} + B_n/(1+i)^n$$

$$= \sum_{t=0}^{n} \frac{B_t}{(1+i)^t}$$

- Thus, the NPV of a project over multiple time periods is

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

- NOTE: This is a very useful component to add to your term paper if you are analyzing a project that will likely have long lasting benefits (and/or costs)

Discounting Benefits and Costs in Future Time Periods

Exercise #1 from Ch. 6

- Highway Dept. is considering building a temporary bridge to cut travel time during the 3 yrs. it will take to build a permanent bridge
  - Temporary bridge can be put up in a few weeks at a cost of $750,000. At the end of 3 yrs., it would be removed and steel sold for scrap. The real net costs of this would be $81,000
  - Based on estimated time savings and wages, fuel savings, and reductions in accident risks, analysts predict benefits in real dollars would be:

    1st yr.: $275,000

    2nd yr.: $295,000

    3rd yr.: $315,000
  - Dept. regulations require use of a real discount rate = 4%

- A.) Calculate the PV of Net Benefits (NBs) assuming the benefits are realized at the end of each of the 3 yrs.

  [work through on board]

- B.) Now, assume the benefits are realized at the start of each year

  [work through on board]

- C.) Assume benefits accrue at mid-year

  [work through on board]

- D.) Does the temp bridge pass the net benefits test?
  - Ans. Depends on when benefits are assumed to occur
  - In practice, they are likely to accrue throughout the year, so method c.) is perhaps most appropriate.