1.011 Project Evaluation
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Assignment 3
Equivalence of Cash Flows

Create a Spreadsheet for Equivalence Analysis (20%)

Create a spreadsheet that you can use to estimate equivalent cash flows for arbitrary sequences of cash flows over 50 periods.   You want to be able to use this spreadsheet to convert any sequence of cash flows into a present worth, a future worth at any time t, or an annuity over N periods. You want to be able to do this using both discrete and continuous compounding factors, and you want to be able to compute effective interest rates. Take some care in designing your spreadsheet so you can easily do sensitivity analysis on interest rates and N, and so you can easily print out a compact and attractive report showing results to questions such as those shown below. Figures 3-27, 3-28, and 3-29 suggest how to incorporate the various discrete and continuous compounding factors and how to calculate effective interest rates.

Spreadsheet Applications (10% each)

1. Salvage value: you are involved with a project that is expected to last 50 years and have a salvage value of $10 million. A consultant has advised your company that an expenditure of only $100,000 at the end of every 5 years will double the salvage value. Your company generally uses an MARR of 15% - do you buy the consultant's recommendation?

2. Bonds: A bond has an initial purchase price of $1,000 and an interest rate of 6% paid at the end of each year for 30 years. At the end of the 30th year, you also receive the initial payment of $1,000.   You buy the bond, and after a few years, interest rates change.   As a result, the market value of the bond will change - even though the planned 6% interest will still be paid on the bond and the principal payment will still be returned at the end of 30 years. In general, as interest rates go up, the value of the bond declines, and vice versa. To appreciate this, calculate the following:

    a. What is the value of the bond at the beginning of year 6 to someone with a MARR of 7%? At the beginning of year 29?
    b. What is the value of the bond at the beginning of year 6 to someone with a MARR of 5%? At the beginning of year 29?

Financing a Major Project (all remaining questions are 10% except that Question 7 counts for 20%):

You are considering whether or not to bid on a project involving the construction of a toll bridge. The city is prepared to provide the land that is required, and the contractor will be able to charge tolls for the life of the project. The contractor will own and operate the bridge for a

period of at least 20 and at most 50 years. At the end of the project life, the bridge and its tolls will be turned over to the city.   Your bid must specify the initial toll, the allowable increases in tolls, and the life of the project.

3. What is the PW of the construction costs as of the beginning of month 1, assuming that you will use company funds to construct the bridge, your MARR is 15%, and the major costs will be as follows:
    a. $24 million for engineering design work (months 1-24)
    b. $100 million for construction of the bridge (months 25- 72)
    c. $10 million for construction of the toll plaza (months 60-72)

4. The traffic volume on the bridge is expected to be average 40,000 vehicles per day for the first year when the bridge is open. This estimate assumes a toll of $2 per vehicle. If tolls are constant, traffic growth for the bridge is expected to be 2% per year for the indefinite future. What is the PW at time 0 of the toll revenues that you expect to collect if you operate the bridge for a 20, 30, 40 or 50 year period?

5. If a different toll is charged, traffic volumes will also change. An increase of 25% in the toll to $2.50 is expected to result in a 10% decline in traffic; likewise, a decrease of 25% in the toll to $1.50 per vehicle is expected to lead to a 10% increase in traffic.   If tolls are changed in the future, then traffic volumes are expected to change as well (in economic terms, this means that the elasticity of volume with respect to price is expected to be about -.4; this means that an X% change in price is expected to lead to a –0.4X% change in traffic). What is the PW at time 0 of the toll revenues that you expect to collect over a 50-year operating period assuming that you charge a toll of $1.50? of $2.50?

6. The contribution to overhead and profit (i.e. the difference between annual toll revenues and annual expenses) is an important financial measure. This is your profit if you finance the bridge yourself, and it is the amount you have available to pay off the loans if you borrow money. You will be responsible for maintaining the bridge and paying for toll operations. Bridge maintenance costs are expected to be $2 million per year for routine maintenance plus an additional $10 million for rehabilitation in year 15, 30 and 45. Toll costs are primarily related to the toll collectors; costs are expected to be $0.5 million per year. If the toll is $2, what is your expected annual contribution to overhead and profit?

7. Structure your bid for building, operating, and transferring this bridge. Specify the initial toll, your strategy for raising tolls, and the time you intend to operate the bridge (20, 25, 30, 40, or 50 years). Explain why you think this is the best approach.

Resource: Project Evaluation: Essays and Case Studies
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