

B0684

Economic Engineering Analysis

Introduction



Contact details

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Instant response in class through DingTalk

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Please indicate clearly which module (e.g., Economic Engineering Analysis) your query is about.

Please **bring your laptop**

- We will demonstrate economic calculations in Excel!

Please **engage actively in class!!**

- Answer questions
- Participate in polls
- Ask questions

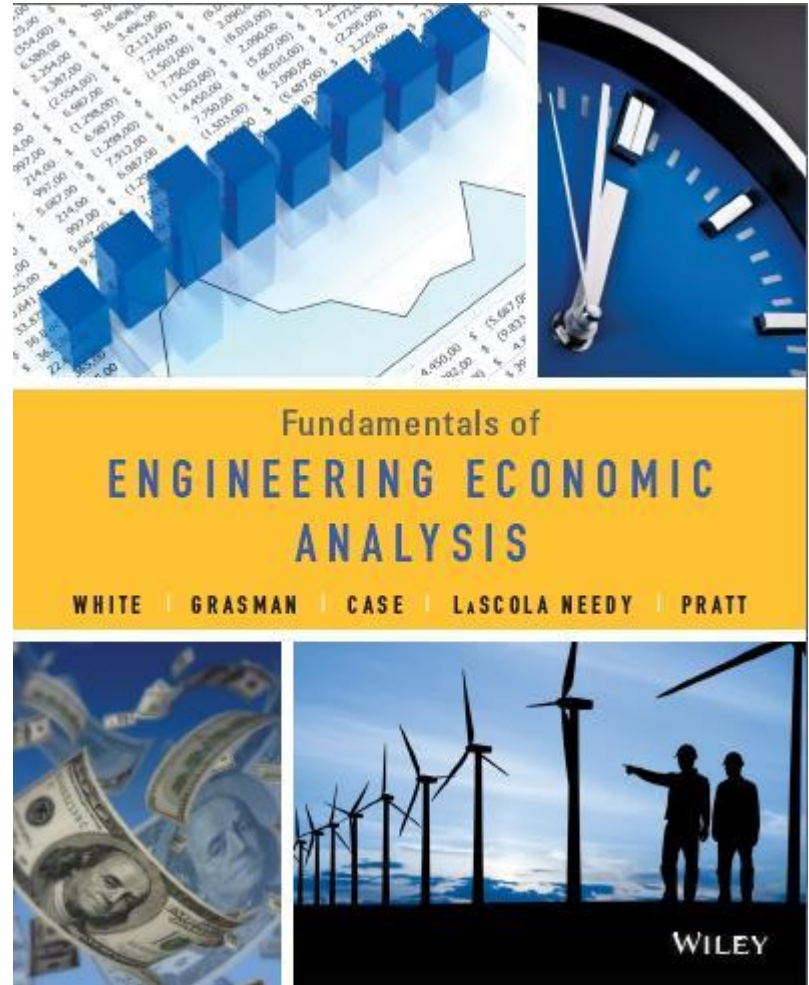
Assessment	Weighting	Due date
Participation	10%	Registered every lecture
Midterm Exam	30%	TBA (around Week 9)
Final Exam	60%	TBA (Week 18-20)

Exam

- **MCQ**
- **Short answer**
- **Calculation**

Textbook:

White et al. (2019).
Fundamentals of Engineering
Economic Analysis, Wiley.



- What is engineering economic analysis?
- Using a combination of quantitative and qualitative techniques to analyze economic differences among engineering design alternatives in selecting the preferred design.
- Purpose: to select preferred plan/project
- Criteria: certain desired economic outcomes
- Technique: **cash flow approach**
 - money received and money dispersed (spent or paid) constitutes a cash flow.

- What decides the value of money?
 - Someone is rich. Some country is affluent.
 - They have a great **amount** of money.
- What else?
 - What you bought with 100\$ 10 years ago=what you buy with 100\$ now?
 - 100\$ 10 years ago is more valuable than 100\$ now.

TIME VALUE OF MONEY

- Money has a time value.
- The value of a given sum of money depends on both the amount of money and **the point in time** when the money is received or paid.
- Money has time value even in the absence of inflation.
- Money has “earning power”
 - If you own money and someone else needs it, you can loan it to them. And charge interest!
 - You can get from the bank on your deposit – interest.

Illustration

Suppose a wealthy individual approaches you and tells you,

“Because of your outstanding ability to manage money, I am happy to present you with a tax-free gift of \$1,000. If you prefer, however, I will postpone the presentation for a year, at which time I will guarantee that you will receive a tax-free gift of \$X.” (assume that the guarantee is risk-free.)

In other words, you can choose to receive \$1,000 today or receive \$X 1 year from today.

Which would you choose if X equals

- (A) \$1,000,
- (B) \$1,200,
- (C) \$2,000,
- (G) \$10,000?

- Some may have a very strong need for money NOW. they do not believe they can wait a year to receive the money, even if they will receive significantly more at that time.
- Some may be skeptical regarding the guarantee of the money being available a year later — bird in the hand, versus many birds in the bush.
- Corporate managers/executives exhibit similar tendencies when faced with current versus deferred choices.

- If a student is indifferent when X equals \$1,200, then we conclude that \$1,200 received **1 year from now** has a present value or present worth of \$1,000 for that particular student in his/her current circumstances.
- $F_0=1000 = F_1=1200$
- We would conclude that this student's TVOM is 20%, that is $(1200-1000)/1000$.

TVOM is sometimes referred to as

- opportunity cost
- interest rate
- discount rate
- hurdle rate
- minimum attractive rate of return
- cost of capital

- Please remember these terms!
- They mean the same thing!!

Discounted Cash Flow (DCF)

- Using the TVOM to convert all future cash flows to a **present single sum** equivalent.
- Or more broadly, any movement of money **backward** or **forward** in time.

Four DCF rules

1. Money has a time value.
2. Quantities of money can NOT be added or subtracted
unless they occur at the same point in time!!
3. To move money **forward** one time unit, multiply by 1
plus the discount/interest rate.
4. To move money **backward** one time unit, divide by 1
plus the discount/interest rate.

$$F_1 = F_0 * (1 + TVOM)$$

$$F_0 = F_1 / (1 + TVOM)$$

Example

Recall in the previous example, the student's TVOM was 20%.

Suppose the student is guaranteed to receive \$1,100 one year from today, if \$1,000 is invested today in a particular venture.

What is the return on the student's investment? (How much does he earn)

100\$? WRONG

It would be a mistake to subtract the \$1,000 investment from the \$1,100 return, and conclude that the investment yielded a net positive return of \$100.

Why?

Rule 1 establishes that money has a time value; for this student, it can be represented by a 20% annual rate.

Rule 2 establishes that the \$1,000 investment cannot be subtracted from the \$1,100 return, because they occur at different points in time.

Using **Rule 3**, the student would conclude that the future value/worth of the \$1,000 investment, based on a 20% TVOM, equals $\$1,000 \times (1 + 20\%)$, or \$1,200 one year later.

- Because the \$1,000 was an expenditure or investment, it is a **negative** cash flow, whereas the \$1,100 return on the investment was a **positive** cash flow.
- Hence, the net future worth of the investment is $-\$1,200 + \$1,100$, or **-\$100**.
- Because *the future worth is negative*, the investment would not be *considered a good one* by the student.
- Here we **move money forward** in time, or **compound**.

Or using **Rule 4**, the student would conclude that the present value or present worth of \$1,100 a year from now equals $\$1,100/(1+20\%)$, or \$916.67.

- Therefore, the \$1,000 investment yields *a negative net present value of -83.33\$* $(-1,000+916.67)$.
- Likewise, the student should conclude that *the investment was not a good one*.
- Here we **move money backward** in time, or **discount**.

What if the student's TVOM had been 8% instead of 20%? Please calculate.

S1: compounding

$$F1' = -1000 * (1 + 8\%) = -1080, F1 = -1080 + 1100 = 20$$

Alternatively,

S2: discounting

$$F0' = 1100 / (1 + 8\%) = 1018.5, F0 = -1000 + 1018.5 = 18.5$$

Both answers are correct.

As the net present worth $F0$ (or the net future worth $F1$) is positive, the investment is considered a good one!