رویکردی جامع برای ارزیابی اقتصادی در پروژه
همراه با آموزش مدلسازی در اکسل (Excel)

بخش اول:

مقدمه: معرفی مبحث آموزشی

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

کامبیز کردانی

(M.Sc.)

مقدمه

- اخذ تصمیم های سودآور اقتصادی یکی از مهترین مباحثی است که برای ادامه حیات و رشد تمامی سازمان ها بخصوص سازمان های پروژه محور الزام آور است. اهمیت این موضوع زمانی بیشتر خواهد بود که متوجه شویم تصمیمهای اقتصادی تنها معطوف به تصمیم گیری برای سرمایه گذاری در بین گزینه های متعدد نبوده و باید در تمامی تصمیم گیری های سازمان، اعم از سرمایه گذاریهای جدید، تصمیم گیری بین خرید یا اجاره، نگهداری یا جایگزینی و سایر موارد اجرایی سازمان استفاده گردد.
- چالش این تصمیم ها در جایی که شرایط اقتصادی دچار تلاطم بوده نیز بیشتر شده و تصمیم گیری را برای مدیران سخت مینماید. از اینرو تمام تصمیم ها بعد از ارزیابی اقتصادی به تحلیل حساسیت و بررسی ارزیابی ها تحت عدم قطعیت و مطالعات ریسک نیاز دارند.
- یک نکته مهم دیگر در این دوره آنست که شما مدلسازی تمامی این مبانی را قدم به قدم و در هر سرفصل در اکسل نیز آموخته و یاد میگیرید که چگونه این مبانی را در محیط Excelدر هر مرحله پیاده سازی نمایید. در نهایت و در جلسه انتهایی نیز یک نمونه از پروژه به شکل کامل در اکسل مدلسازی شده تا انواع تحلیلهای فراگرفته شده را بر روی یک پروژه نمونه پیاده سازی نماییم.

معرفی سرفصلها

1. **مقدمه**
   - معرفی دوره آموزشی
   - کلیات مفاهیم ارزیابی اقتصادی
2. **ارزیابی اقتصادی**
   - مفاهیم ارزش زمانی پول
   - تصمیم‌گیری بین گزینه های مختلف سرمایه گذاری
   - تصمیم‌گیری بین نگهداری یا جایگزینی
   - تصمیم‌گیری بین خرید، اجاره یا لیزینگ
   - ارزیابی اقتصادی با در نظر گرفتن تورم
   - استهلاک و مالیات در ارزیابی اقتصادی
   - ارزیابی اقتصادی پروژه های دولتی
3. **تحلیل حساسیت، سر به سر، عدم قطعیت و ریسک**
   - تحلیل حساسیت ارزیابی های اقتصادی
   - تجزیه و تحلیل سر به سر
   - تصمیم‌گیری در شرایط عدم قطعیت
   - تصمیم‌گیری تحت ریسک
   - تصمیم گیری به کمک مدل درختی
4. **مدلسازی و ارزیابی اقتصادی یک پروژه نمونه تحت حساسیت**
   - تشریح یک طرح توجیهی، ارائه پروژه نمونه، آماده سازی قالب نرم افزار اکسل، مدلسازی جریانات نقدینگی، تشریح و محاسبه شاخصهای مالی و اقتصادی NPV، IRR، ERR و غیره، محاسبات استهلاک، مدلسازی ماشین آلات، بررسی مالیات و تورم و تحلیل جایگزینی، تحلیل حساسیت و حل معادلات چندمجهولی و ارائه مدل آنالیز نقطه سربه سر و نواحی توجیه پذیری پروژه

آنچه خواهید آموخت

- شما در این دوره روشهای ارزیابی اقتصادی را از پایه و با روشی ساده می آموزید و یاد میگیرید هم به صورت دستی و هم با استفاده از نرم افزار Excel آنها را مدلسازی و ارزیابی نمایید.
- با یادگیری تکنیک‌ها و روش های این مبحث قادر خواهید بود تا بین گزینه های متعدد سرمایه گذاری، گزینه مناسبتر را انتخاب کنید. همچنین قادر خواهید بود تا با استفاده ازین روش‌ها، ارزیابی اقتصادی را در تمامی تصمیمات مدیریتی و اجرایی سازمان و پروژه ها لحاظ کرده تا در نهایت منجر به افزایش سود و منفعت برای پروژه و سازمان گردید.
- همچنین، در این دوره به صورت عملی و کاربردی یک پروژه نمونه را از ابتدا تا انتها با بررسی تمامی عوامل تاثیر گذار اقتصادی و مالی و ارزش زمان پول، به کمک نرم افزار صفحه گسترده اکسل مدلسازی مینماییم تا شرایط جامعی را تجربه نمایید.

موسسه مهندسی و مدیریت ساخت علوی پور

تهران، بلوار فردوس شرق، بعد از خیابان حسن آباد، مجتمع آبگینه، طبقه سوم اداری، واحد C42

+۹۸۲۱۴۶۱۰۰۴۵۰

+۹۸۲۱۴۶۱۰۰۴۴۵

www.dralavipour.com

info@dralavipour.com

@Acemi_social

@Alavipour_pm

youtube.com/channel/UC2vltk3T9m1X69hSWUwfp2Q

www.linkedin.com/company/iranacemi

رویکردی جامع برای ارزیابی اقتصادی در پروژه
همراه با آموزش مدلسازی در اکسل (Excel)

بخش دوم:

مقدمه: کلیات مفاهیم ارزیابی اقتصادی

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

کامبیز کردانی

(M.Sc.)

ACEMI

What we will learn?

- Why project is defined?
- What is the basis for financial evaluation and economic analysis?
- Decisions' formulation
- Engineering economics: Description and role in decision making
- Engineering economy study
- Classification of costs

Why project is defined?

- Needs?
- Objectives? Social, economical, political, humanitarian, etc.
- **Is it doable?** Do we have **resources**? **Budget**? **Feasibility study**

- **Economic planning** and **economic feasibility** is done in **pre-design phase**

- **Meeting** the **agreed-upon financial measures documented** in the **business case** is one of the **project success criteria**.

What is the basis for financial evaluation and economic analysis?

- **Public or private sectors**

1. **Public sectors**
   - ✓ To answer the needs of society
2. **Private sectors**
   - ✓ To earn profit

Difference between financial evaluation and economic analysis?

Let's see!

What is the basis for financial evaluation and economic analysis?

- **Financial evaluation** is carried out from the **perspective of the project**
  - The **purpose of financial evaluation** is to assess the **ability of the project** to **generate adequate incremental cash flows** to recover **its financial costs:**
    1. **Capital**
    2. **Recurrent costs**

    without external support.

What is the basis for financial evaluation and economic analysis?

- **Financial evaluation** is carried out from the **perspective of the project to:**

1. **Fulfill investors' objectives**
2. **Find** the **best alternative**
3. **Assess** the ability of the project to **generate adequate incremental cash flows** to **recover its financial costs** (capital and recurrent costs) **without external support.**

What is the basis for financial evaluation and economic analysis?

- **Economic analysis** is carried out from the **perspective of the entire economy**
  - The **purpose of project economic analysis** is to assess whether a **project is economically viable for the country.**

What is the basis for financial evaluation and economic analysis?

- **Economic analysis** is carried out to:
  - **Ensure** that **scarce resources** are **allocated efficiently**
  - **Ensure** that **investment brings benefits** to a **country** and **raises** the **welfare of its citizens**.
  - **Ensure** to **achieve** the **benefit** **above opportunity costs**.
    - **All resource inputs** used by a project have an **opportunity cost** because, **without the project**, they could **create value elsewhere** in the **economy**.

What is the basis for financial evaluation and economic analysis?

An economically viable project requires that:

1. It **represents** the **least-cost** or **most efficient** **option** to **achieve** the **intended project outcomes**
2. It **generates** an **economic surplus** **above** its **opportunity cost**
3. It will **have** **sufficient funds** and the **necessary institutional structure** for **successful operation** and **maintenance**.

Decisions' formulation

1. Creative step
2. Definition step
3. Conversion step
4. Decision step

Decisions' formulation – Creative step

- **Abraham Maslow** believes **everybody** has **five different level of needs**.
- **What brings creativity?**
- **Results: Define** the **needs** and **specify initial alternatives** (**no need to be explicit**)

Decisions' formulation – Definition step

- **Definition step**
  - **Define alternatives resulted** from **creative step**
    1. **Define each alternative** based on **activities** (**define the process**)
    2. **Qualify** the **expected inputs** and **outputs** of the **process**
    3. **Quantify** the **expected inputs** and **outputs** of the **process**

For example:

*If we want to open a **cement factory,** we have to select the best place. Considering **all alternatives** could be **very costly**. Doing **comparative economic analysis** and **geological analysis** for **all options** would be **too difficult** and **non-economic**.*

*Therefore, we have to **narrow down** our **alternatives** to **reduce** the **cost of analysis** to **achieve the success of venture**.*

Decisions' formulation – Conversion step

- **Conversion step**
  - **Convert alternatives** to **comparable items (value based on the money)**

1. **Determine cash inflow** and **outflow** using **quantified expected inputs** and **outputs** prepared in **definition step**

2. **Convert** the **cash flow** to **comparable scale**

3. **Prepare** a **report**
   - *Don't forget to perform sensitivity analysis*

Decisions' formulation – Decision step

- **Decision step**
  - **Make decision** considering **qualified** and **quantified** items prepared in **conversion step**:
    1. **Calculate profit** using **cash flow forecast**
    2. **Consider qualified items**

Engineering economics: Description and role in decision making

- **Engineering economy** is at the **heart** of **making decisions** that involves the **fundamental elements** of:
  1. **Cash flows of money**
  2. **Time**
  3. **Interest rates**

Engineering economics: Description and role in decision making

- **Decisions** are made **routinely** to choose **one alternative over another** by individuals in **everyday life** by:
  1. **Engineers** on the **job**
  2. **Managers** who **supervise** the **activities of others**
  3. **Corporate presidents** who **operate a business**
  4. **Government officials** who work for the **public good**

Engineering economics: Description and role in decision making

- **Most decisions** involve **money**, called **capital** or **capital funds**, which is usually **limited** in amount.

- **Engineers** play a **vital role** in **capital investment decisions** based upon their **ability** and **experience** to **design**, **analyze**, and **synthesize**.

- The **factors** upon which a **decision** is based are commonly a **combination of :**
  1. **Economic** elements
  2. **Noneconomic** elements

- **Engineering economy** deals with the **economic factors**.

Engineering economics: Description and role in decision making

By definition, engineering economy involves:

1. **Formulating**
2. **Estimating**
3. **Evaluating**

the expected economic outcomes of alternatives designed to accomplish a defined purpose.

Mathematical techniques simplify the economic evaluation of alternatives.

Engineering economics: Description and role in decision making

- Because the **formulas** and **techniques** used in **engineering economics** are **applicable** to **all types of money matters**, they are **equally useful** for :
  1. **Business and government**
  2. **Individuals**

Note: Therefore, **besides applications to projects**, what you learn from **this course** well offer you an **economic analysis tool** for making **personal decisions** such as **car purchases**, **house purchases**, **major purchases on credit**, e.g., furniture, appliances, and electronics.

Engineering economics: Description and role in decision making

The **numbers** used in **engineering economy** are **best estimates of what is expected to occur**.

The **estimates** and the **decision** usually involve **four essential elements**:

1. **Cash flows**
2. **Times of occurrence of cash flows**
3. **Interest rates for time value of money**
4. **Measure of economic worth for selecting an alternative**

Engineering economics: Description and role in decision making

- Since the **estimates** of **cash flow amounts** and **timing** are about the **future**, they will be somewhat different than what is **actually observed**, due to **changing circumstances** and **unplanned events**.

- The **variation** between an **amount** or **time** **estimated now** and that **observed in the future** is caused by the **stochastic (random) nature of all economic events.**

Sensitivity analysis is utilized to determine how a decision might change according to varying estimates, especially those expected to vary widely.

ACEMI

Engineering economy study

Implementing a **structured procedure** is the **best approach** to select the **best solution** to the problem. The **steps** in an **engineering economy study** are as follows:

STEP 1: Identify and **understand** the **problem** and **objective** of the **project**

STEP 2: Collect relevant and **available data** and **define viable solution alternatives**

STEP 3: Make realistic cash flow estimates

STEP 4: Identify an **economic measure of worth criterion** for **decision making**

STEP 5: Evaluate each alternative; **consider noneconomic factors**; **use sensitivity analysis** as **needed**

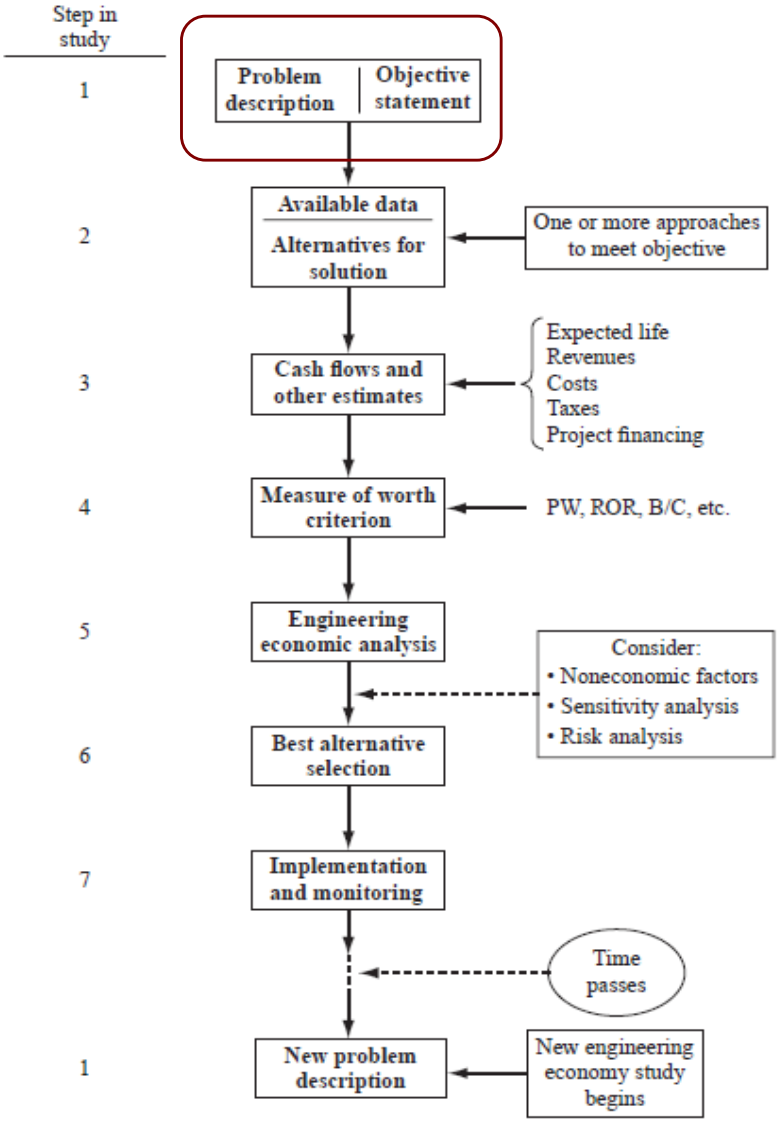
STEP 6: Select the **best alternative**

STEP 7: Implement the **solution** and **monitor** the **results**

STEP 1: Problem description and objective statement

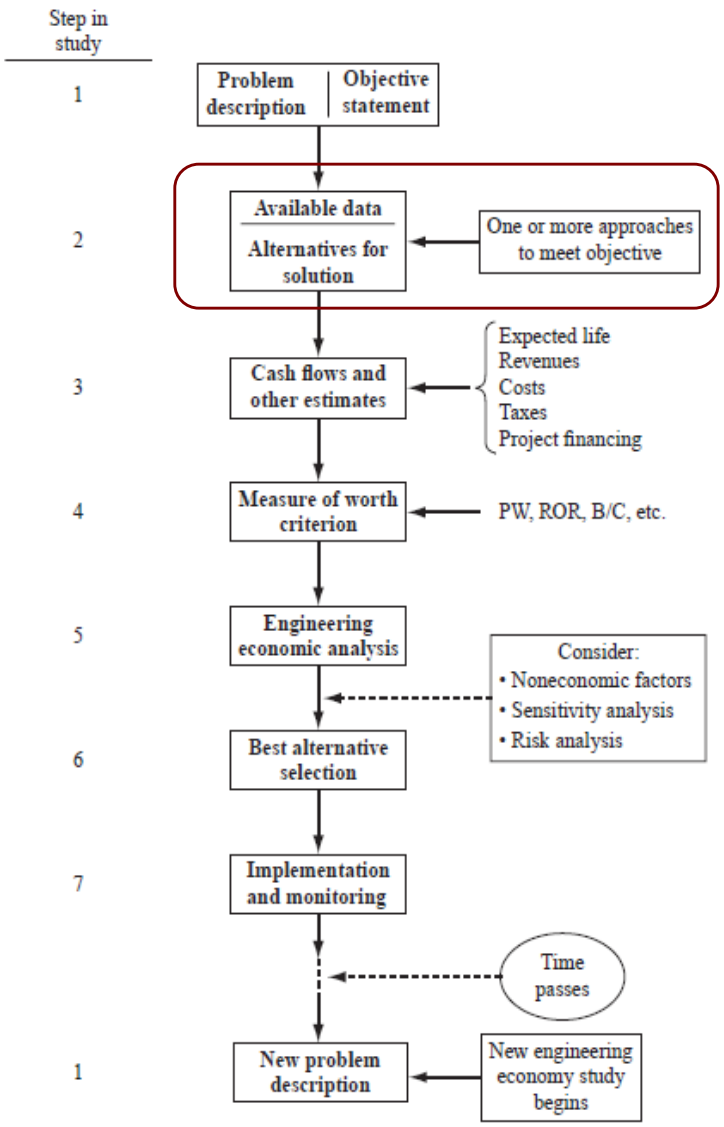
1. A **brief statement** of the **problem**
2. A **brief statement** of **primary objective(s)**

- **Problem:** As an illustration, **assume** the **problem** is that a **coal-fueled power plant** must be **shut down by 2024 due** to the **production of excessive sulfur dioxide**.
- **Objectives:** The objectives may be to **generate** the **forecasted electricity needed** for 2024 and beyond, **plus** to **not exceed all the projected emission allowances** in **these future years**.



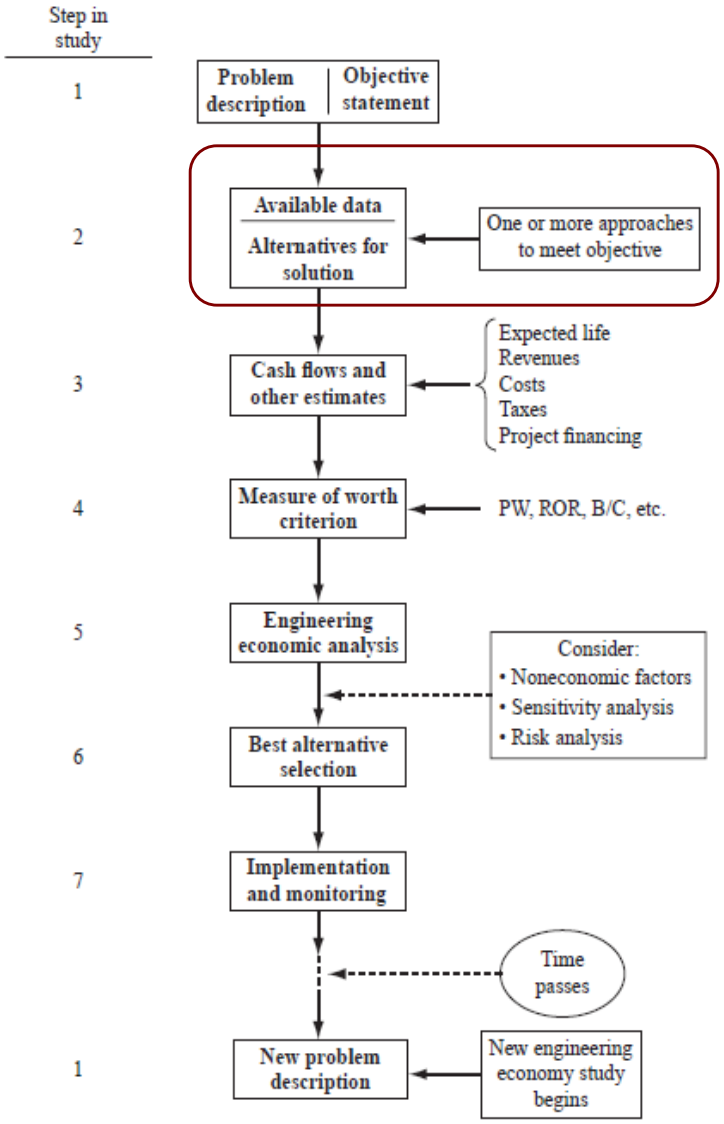
STEP 2: Collect data and define alternatives

- **Alternatives** are **descriptions** of **viable solutions to problems** that can **meet the objectives.**
  - **Words**, **pictures**, **graphs**, **equipment** and **service descriptions**, **simulations**, etc. can be included.
- **Detailing all viable alternatives** at this stage is **crucial**.
- If **changes** in **income (revenue)** and **expenditures** may occur, these **parameters** must be **estimated**.



STEP 2: Collect data and define alternatives

- **Alternatives** are **descriptions** of **viable solutions to problems** that can **meet the objectives.**
  - **Some parameters** include:
    1. **Equipment first cost**
    2. **Expected life**
    3. **Salvage value** (estimated trade-in resale, or market value),
    4. **Annual operating cost** (AOC) which can also be termed ***maintenance and operating* (M&O) *cost***,
    5. **Subcontract cost** for specific services



ACEMI

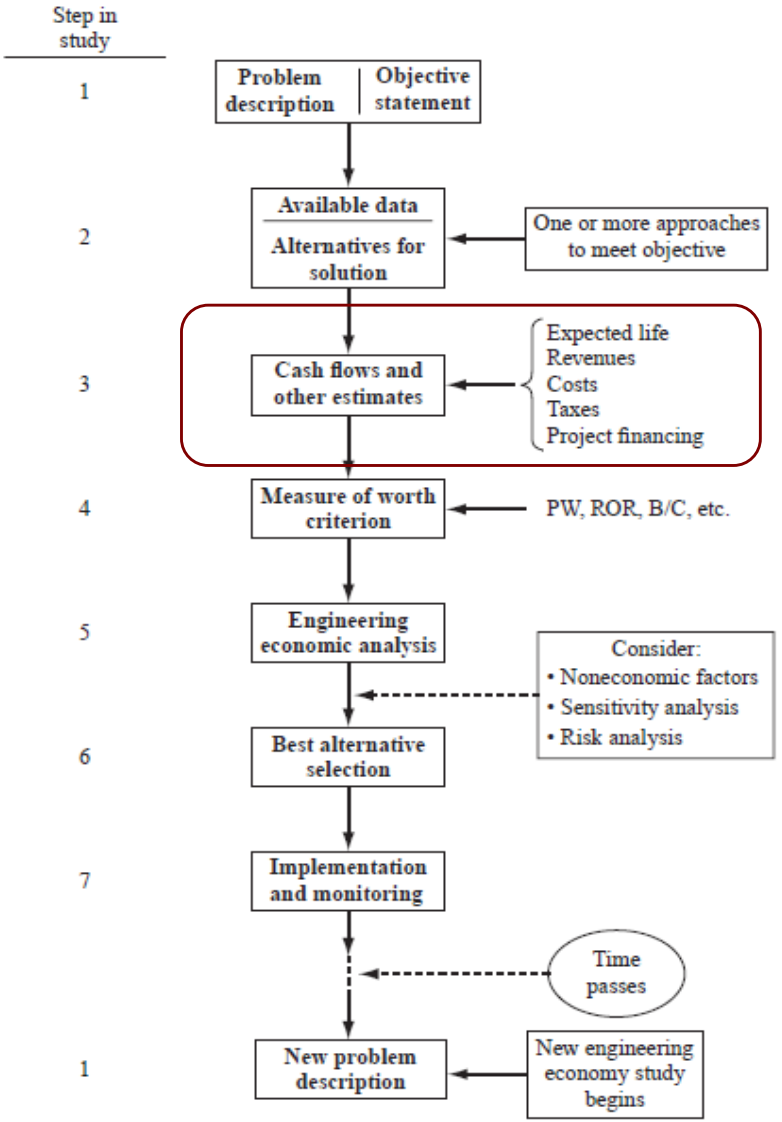
STEP 3: Develop cash flow forecast

- **All cash flows** are **estimated** for **each alternative**.

- Since **these are future expenditures** and revenues, the **results of STEP 3** usually **prove** to be **inaccurate** when **an alternative** is **actually** in **place** and **operating**.

What is the solution?

See next slide…



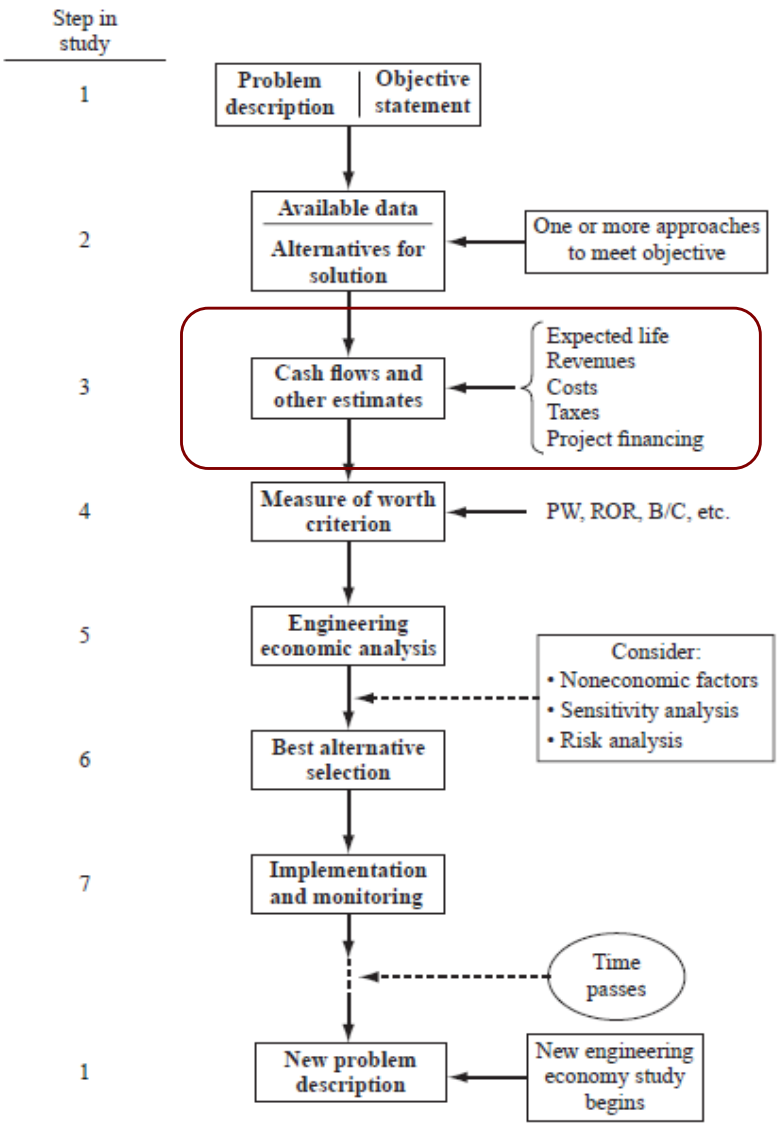
ACEMI

STEP 3: Develop cash flow forecast

- **When cash flow estimates** for specific parameters are **expected to vary significantly** from a ***point estimate* made now**:
  1. Risk (STEP 5)
  2. Sensitivity analysis (step 5)

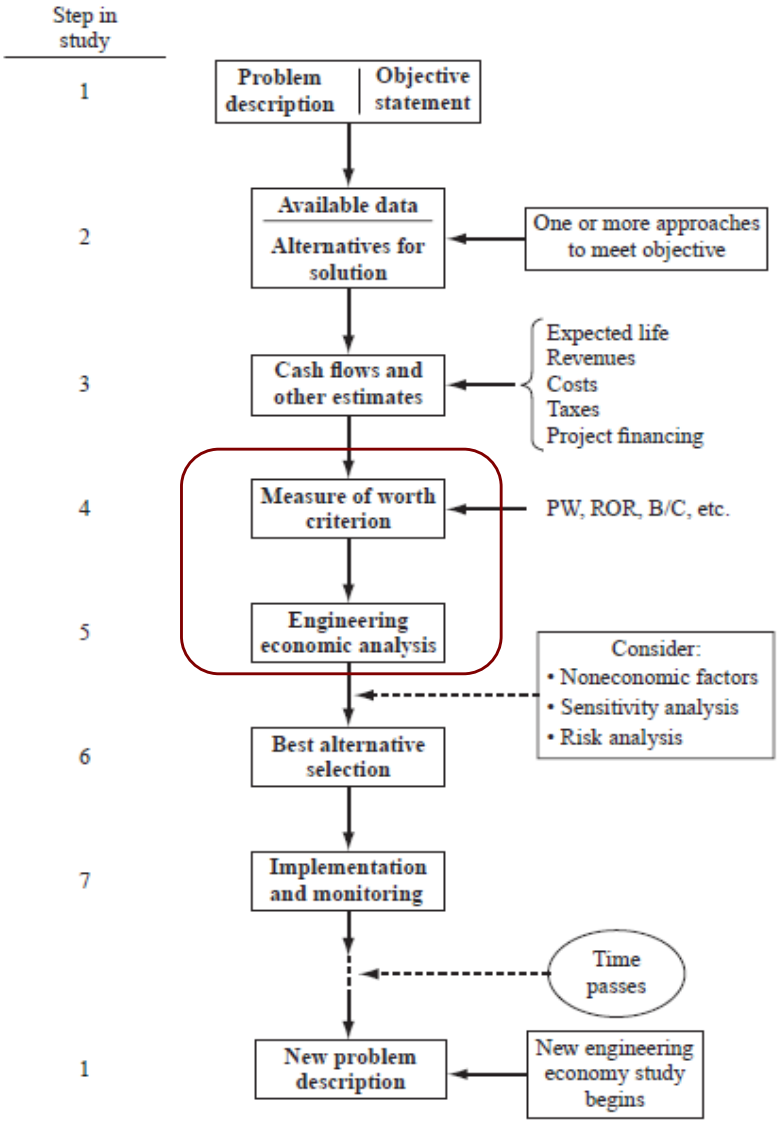
  are **needed** to **improve** the **chances of selecting** the **best alternative**.

Sizable variation is usually expected in estimates of revenues, AOC, salvage values, and subcontractor costs.



STEPS 4 and 5: Engineering economy analysis

- **Before** an **economic analysis technique** is applied to the **cash flows**, some **decisions about:**
  - **What to include** in the **analysis** must be made, especially **taxes** and **inflation**.
- **An after-tax analysis** includes **some additional estimates** and **methods** **compared** to a **before-tax analysis**.
  - If the **impact of inflation over time** is **important** to the decision, an **additional set of computations** must be **added** to the analysis.



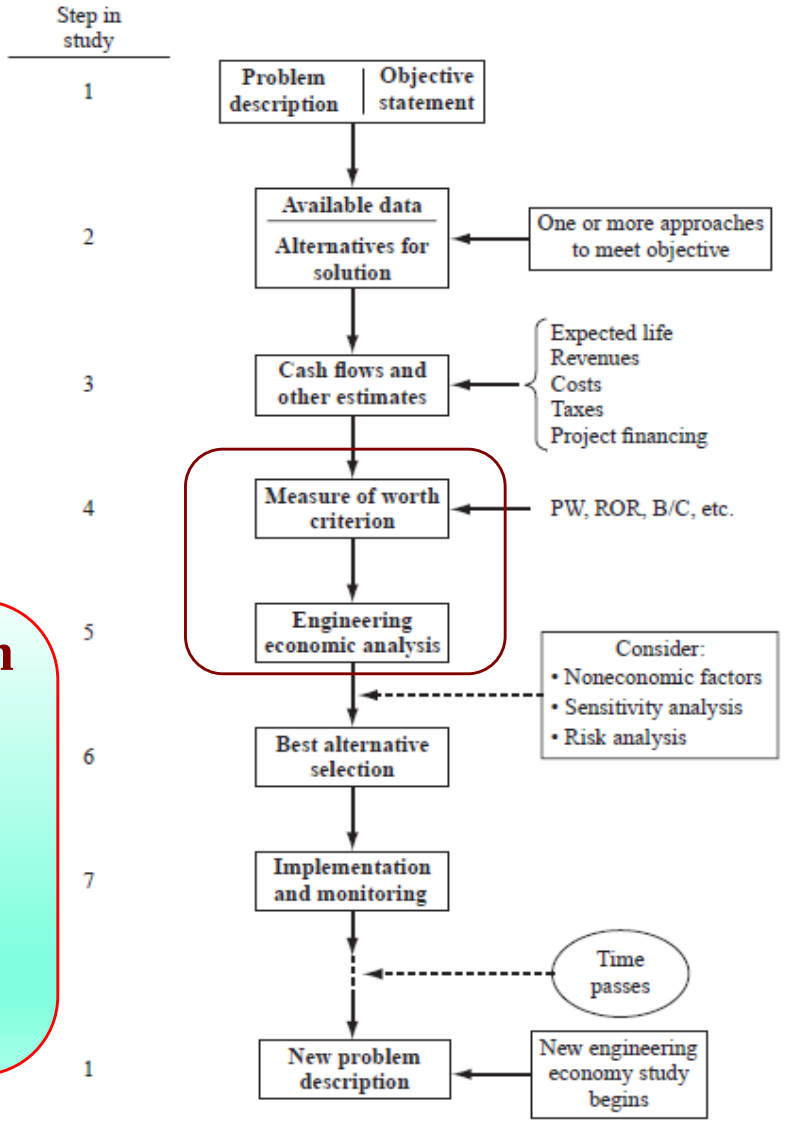
STEPS 4 and 5: Engineering economy analysis

- The **result of the analysis** will be **one or more numerical values**.

- **In the end**, a **selected measure of worth** will be used to **select the best alternative**.
  - *BUT….DO NOT FORGET….*

The **techniques you learn** will utilize the **cash flow estimates**, **time value of money**, and a **selected measure of worth**.

Also, you will learn additional consideration



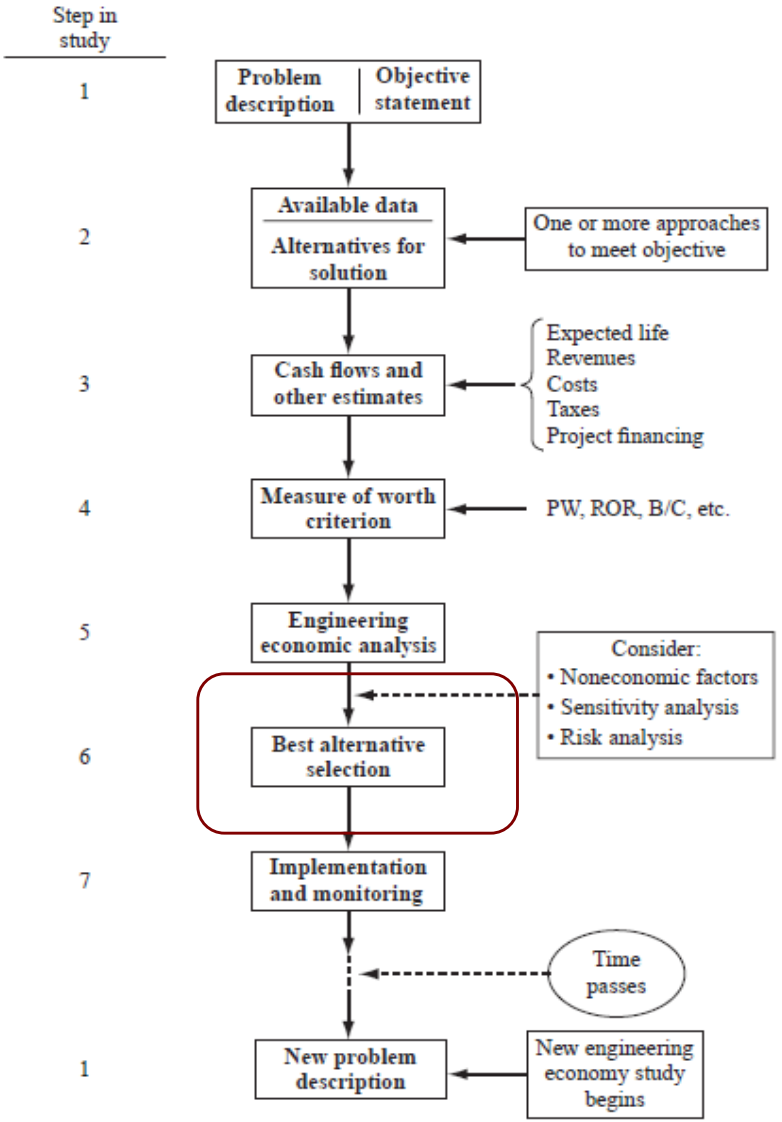
ACEMI

STEP 6: Selection of the best alternative

- The **measure of worth** is a **primary basis** for **selecting** the **best economic alternative**.
  - **For example**, if **alternative A** has a **rate of return (ROR)** of **15.2% per year** and **alternative B** will result in an **ROR of 16.9% per year, B is better economically**.

*However, there can always be **noneconomic** or **intangible factors**.*

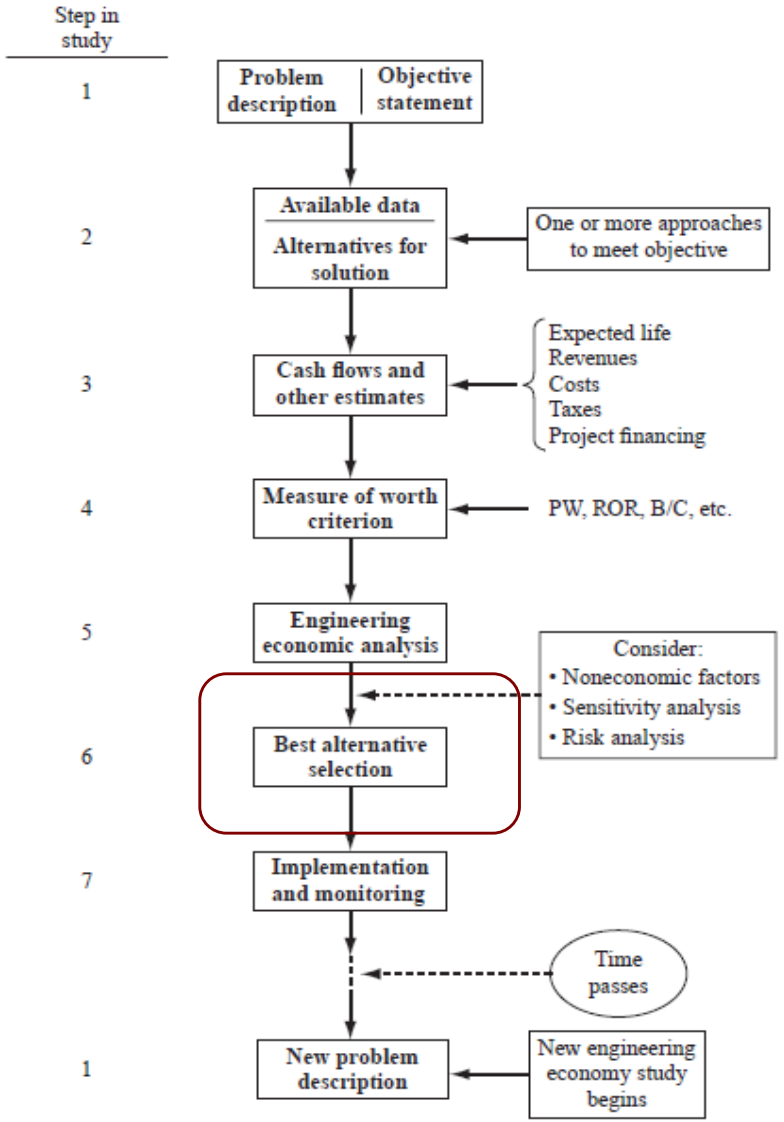
What are some typical factors?



ACEMI

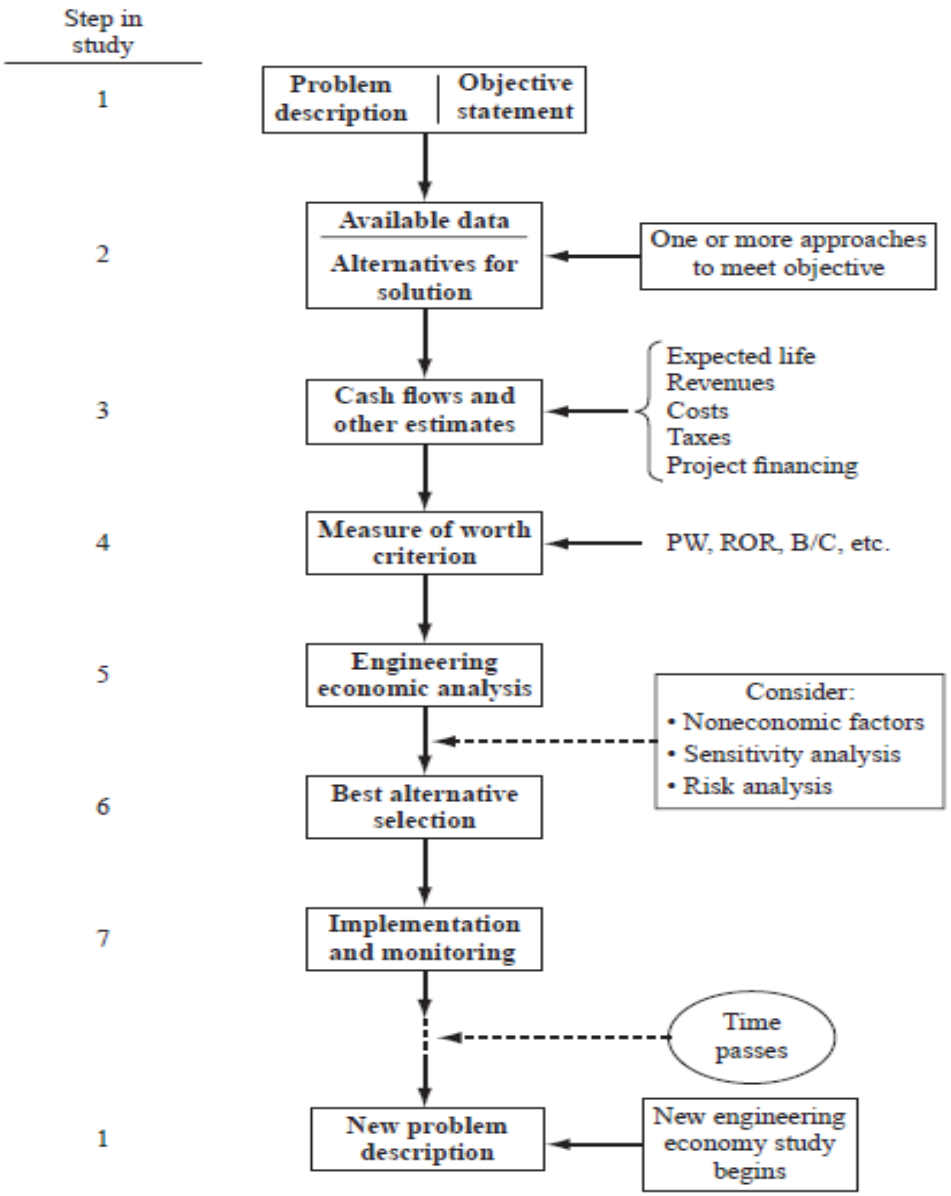
STEP 6: Selection of the best alternative

- Some typical ***noneconomic factors*** are:
  1. **Market pressures**, such as **need** for an **increased international presence**
  2. **Availability of certain resources**, e.g., **skilled labor force**, **water**, **power**, **tax incentives, etc.**
  3. **Government laws** that dictate **safety**, **environmental**, **legal**, or **other aspects**
  4. **Corporate management's** or the **board of director's interest** in a **particular alternative**
  5. **Goodwill** offered by **an alternative** toward a **group**: **employees**, **union**, **county**, etc.



Engineering economy study

Technically, the last step **(STEP 7)** is not **part of the economy study**, but it is, of course, **a step needed** to **meet the project objective**.



ACEMI

STEP 6: Selection of the best alternative

- **Once all**
  1. Economic factors
  2. Noneconomic factors
  3. Risk analysis
  4. Sensitivity analysis

  have been **evaluated**, a **final decision** of the **"best" alternative** is made.

  ***At times**, **only one viable alternative** is identified*

- The **do nothing (DN) alternative** may be **chosen** provided the **measure of worth** and **other factors** result in the alternative being a **poor choice**.

Classification of costs

- Direct cost
- Indirect cost
- Fixed cost
- Variable cost
- First cost
- Operation & maintenance cost
- Retirement and disposal cost
- Incremental (marginal) cost
- Sunk cost
- Life cycle cost

ACEMI

Classification of costs

Classifying costs **as direct or indirect cost is one way of cost classification** whereas classifying costs on the basis of their behavior **as fixed or variable costs is just another way of classification of costs**.

*Both classifications **are separate** and **must not be confused together***

موسسه مهندسی و مدیریت ساخت علوی پور

تهران، بلوار فردوس شرق، بعد از خیابان حسن آباد، مجتمع آبگینه، طبقه سوم اداری، واحد C42

+۹۸۲۱۴۶۱۰۰۴۵۰

+۹۸۲۱۴۶۱۰۰۴۴۵

www.dralavipour.com

info@dralavipour.com

@Acemi_social

@Alavipour_pm

youtube.com/channel/UC2vltk3T9m1X69hSWUwfp2Q

www.linkedin.com/company/iranacemi

رویکردی جامع برای ارزیابی اقتصادی در پروژه
همراه با آموزش مدلسازی در اکسل (Excel)

بخش سوم:

ارزیابی اقتصادی: کلیات مفاهیم ارزش زمانی پول

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

کامبیز کردانی

(M.Sc.)

What we will learn?

- Time value of money
- How lenders and borrowers make decision
- Measure of worth
- Interest rate
- Terminology and symbols
- Cash flow
- Simple interest
- Compound interest
- Nominal and effective interest rates
- How to solve problems using EXCEL

Time value of money

- Offer to **give you $1,000 today** or **$1,000 a year from now**. Which would you take?
- Offer to give you **$1,000 today** or **$1,050 a year from now**. Which would you take?

1. If we decide to **invest capital (money)** in a **project today**, we **inherently** expect to have **more money** in the **future than we invested**.

2. If we **borrow money today**, we expect to **return the original** amount **plus some additional amount of money**.

Time value of money

- When we **check** the **time value of money**, we **consider**:
  1. Purchasing power
  2. Earning power

It is a well-known fact that money makes money.

The time value of money explains the change in the amount of money over time for:

1. **Funds that are owned (invested)**
2. **Funds that are owed (borrowed)**

This is the most important concept in engineering economy.

How lenders and borrowers make decision?

- By **assessing** the **percentage of**:
  1. Risk of lost from borrowers (e.g., 3%)
  2. Administrative expenses (e.g., 2%)
  3. Losing the interest of investing in another business or putting money on the bank (e.g., 6%)
  4. Inflation (in developing countries)

How lenders and borrowers make decision?

1. If the **earning power of money** is justifiable

   And

2. If the **money** will be **earned by borrower** > **money** will be **paid alongside the interest**

- It could be a **good idea to borrow money**

From the **borrower's perspective**:

When we have **inflation**, but we do **not have recession**:

It can be a good idea to **borrow money**, **especially** if the **interest rate is lower than inflation**.

Measure of worth

- The **criterion** used to **select an alternative in engineering economy** for a specific set of estimates is called a **measure of worth**.
- The **measures** developed and used in this **course** are:

Present worth (PW)	Future worth (FW)	Annual worth (AW)
Rate of return (ROR)	Benefit/cost (B/C)	Capitalized cost (CC)
Payback period	Economic value added (EVA)	Cost Effectiveness

All these measures of worth account for the fact that money makes money over time.

This is the concept of the time value of money

Measure of worth – Key terms

- **Minimum attractive rate of return (MARR):**
  - It is a **reasonable rate of return** established for the **evaluation** and **selection** of **alternatives**.
  - A project is **not economically viable** unless it is **expected to return at least the MARR.**
  - MARR is also referred to as the ***hurdle rate***, ***cutoff rate***, ***benchmark rate***, and ***minimum acceptable rate of return***.

Measure of worth – Key terms

❑ Cost of capital

- ❖ Although the **MARR** is used as a **criterion to decide** on **investing in a project**, the size of **MARR is fundamentally connected** to **how much it costs** to **obtain** the **needed capital funds**.
  - ✓ It always **costs money** in the **form of interest** to **raise capital**.
    - o The **interest**, expressed as a **percentage rate per year**, is called the **cost of capital**.

Measure of worth – Key terms

❑ Cost of capital

❖ As an **example on a personal level**, if you want to **purchase a new widescreen HDTV**, but do **not have sufficient money (capital)**:

1. You could **obtain a bank loan** for, say, a **cost of capital of 9% per year** and **pay for the TV in cash now**.
2. You might choose to use **your credit card** and **pay off the balance** on a **monthly basis**. This approach will probably **cost you at least 15% per year**.
3. You could use **funds from your savings** account that **earns 5% per year** and **pay cash**.

The 9%, 15%, and 5% rates are your cost of capital estimates to raise the capital for the system by different methods of capital financing.

Measure of worth – Key terms

- **Weighted average cost of capital (WACC)**
  - **Combinations** of **debt-equity financing**
    - ✓ If the **HDTV is purchased** with **40% credit card** money at **15% per year** and **60% savings account** funds earning **5% per year**, the weighted average cost of capital is **0.4(15) + 0.6(5) = 9%** per year.

ACEMI

Question

- Which inequality is correct when ones make decision?

1. ROR > WACC > MARR
2. ROR > MARR > WACC
3. MARR > ROR > WACC
4. WACC > MARR > ROR

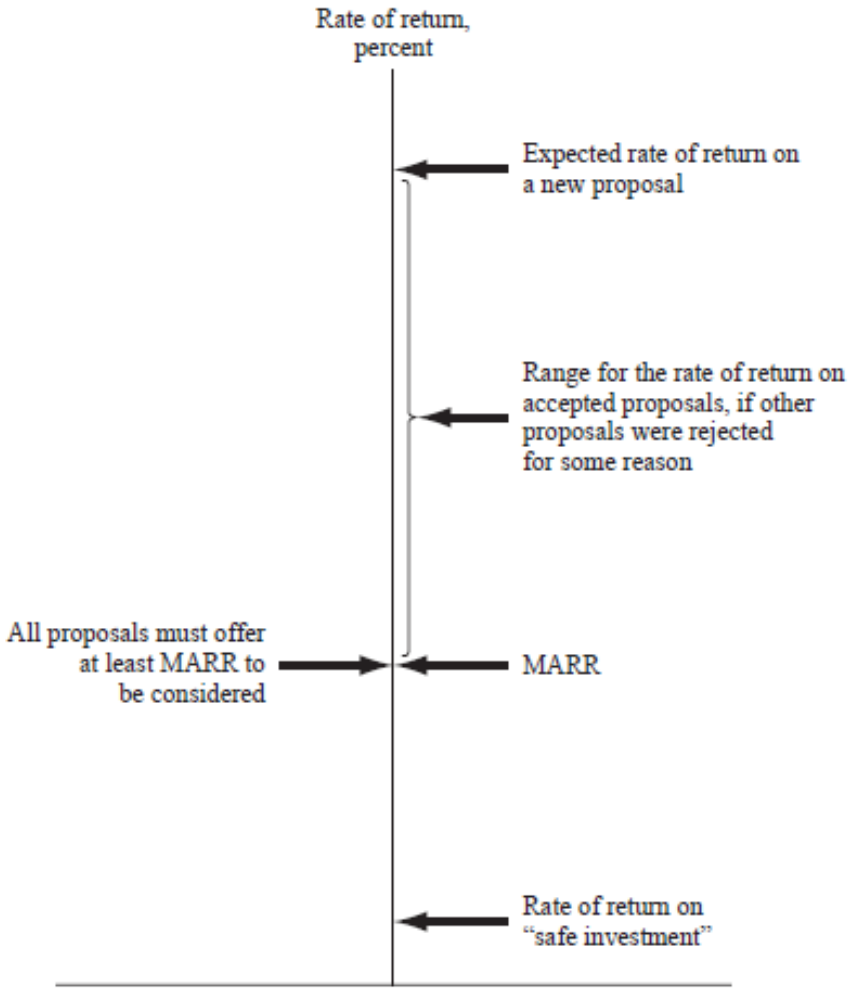
Measure of worth – Key terms

For a corporation, the ***established MARR*** used as a criterion to **accept or reject** an investment alternative will usually be ***equal to or higher than*** *the* ***WACC*** that the corporation must bear to obtain the necessary capital funds.

So the inequality:

ROR > MARR > WACC

Measure of worth – Key terms



Size of MAAR relative to other rate of return values.

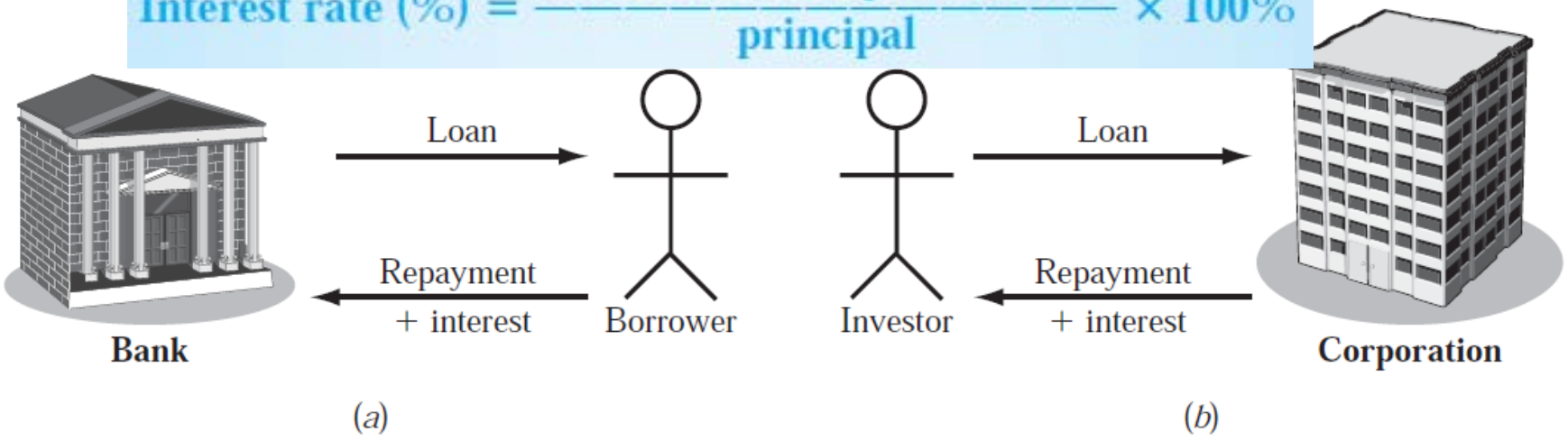
Measure of worth – Key terms

- **Opportunity cost**
  - It is the **rate of return** of a **forgone opportunity** caused by the **inability to pursue a project**.
    - ✓ Numerically, it is the **largest rate of return of all the projects not accepted (forgone) due to the lack of capital funds or other resources.**
  - When **no specific MARR** is established, the **MARR is the opportunity cost**, i.e., the **ROR of the project not undertaken due to unavailability of capital funds**.

Interest rate

- **Computationally**, **interest** is the **difference** between an **ending amount of money** and the **beginning amount**.
- The **time unit** of the rate is called the **interest period.**
- **Common interest period** is **1 year**. **Shorter time periods** can be used, such as **1% per month.**
- If **only the rate** is stated, for example, **8.5%,** a **1-year interest period** is **assumed**.

$$\text{Interest rate (\%)} = \frac{\text{interest accrued per time unit}}{\text{principal}} \times 100\%$$



(*a*) Interest paid over time to lender. (*b*) Interest earned over time by investor.

Interest rate – Example 1

EXAMPLE

An employee at LaserKinetics.com borrows $10,000 on May 1 and must repay a total of $10,700 exactly 1 year later. Determine the interest amount and the interest rate paid.

Solution

The perspective here is that of the borrower since $10,700 repays a loan. Apply Equation [1.1] to determine the interest paid.

$$\text{Interest paid} = \$10{,}700 - 10{,}000 = \$700$$

Equation [1.2] determines the interest rate paid for 1 year.

$$\text{Percent interest rate} = \frac{\$700}{\$10{,}000} \times 100\% = 7\% \text{ per year}$$

ACEMI

Cash flow

- Cash inflows are revenue, plus sign
- Cash outflows are costs, negative or minus sign

$$Net\ cash\ flow = cash\ inflows - cash\ outflows = NCF = R - D$$

- The **end of period convention** means that all cash inflows and all cash outflows are assumed to take place at the **end of interest period** in which they **actually occur**.

- When **several inflows and outflows occur** within the same period, the **net cash flow is assumed** to occur at the **end of the period** (for example, monthly or annual cash flows).
  - ***Basis of banking equations***

Cash flow – Example

Cash Inflow Estimates

Income: $150,000 per year from sales of solar-powered watches

Savings: $24,500 tax savings from capital loss on equipment salvage

Receipt: $750,000 received on large business loan plus accrued interest

Savings: $150,000 per year saved by installing more efficient air conditioning

Revenue: $50,000 to $75,000 per month in sales for extended battery life iPhones

Cash flow – Example

Cash Outflow Estimates

Operating costs: $230,000 per year annual operating costs for software services

First cost: $800,000 next year to purchase replacement earthmoving equipment

Expense: $20,000 per year for loan interest payment to bank

Initial cost: $1 to $1.2 million in capital expenditures for a water recycling unit

Terminology and symbols

$P =$ value or amount of money at a time designated as the present or time 0. Also P is referred to as present worth (PW), present value (PV), net present value (NPV), discounted cash flow (DCF), and capitalized cost (CC); monetary units, such as dollars

$F =$ value or amount of money at some future time. Also F is called future worth (FW) and future value (FV); dollars

$A =$ series of consecutive, equal, end-of-period amounts of money. Also A is called the annual worth (AW) and equivalent uniform annual worth (EUAW); dollars per year, euros per month

$n =$ number of interest periods; years, months, days

$i =$ interest rate per time period; percent per year, percent per month

$t =$ time, stated in periods; years, months, days

Difference between NPV and PV?

Simple interest – Example 2

Example 2: A contractor borrows $2,000 from a bank. What are the dollar amounts of interest to be made by the contractor if 10% annual simple interest applies?

Borrow = &2,000

i= 10% per year

For 1 year

I=pni = $2000 * 1 (year) * 0.1 = $200

Simple interest – Example 3

Example 3: A contractor borrows $2,000 from a bank on Feb 1 and should repay on April 12. What are the dollar amounts of interest to be made by the contractor if 10% annual simple interest applies?

Borrow = &2,000

Feb 1 to Apr 12

For 1 year

$$I = pni = \$2000 * [\frac{30+30+12}{360}] * 0.1 = \$40$$

Simple interest – Example 4

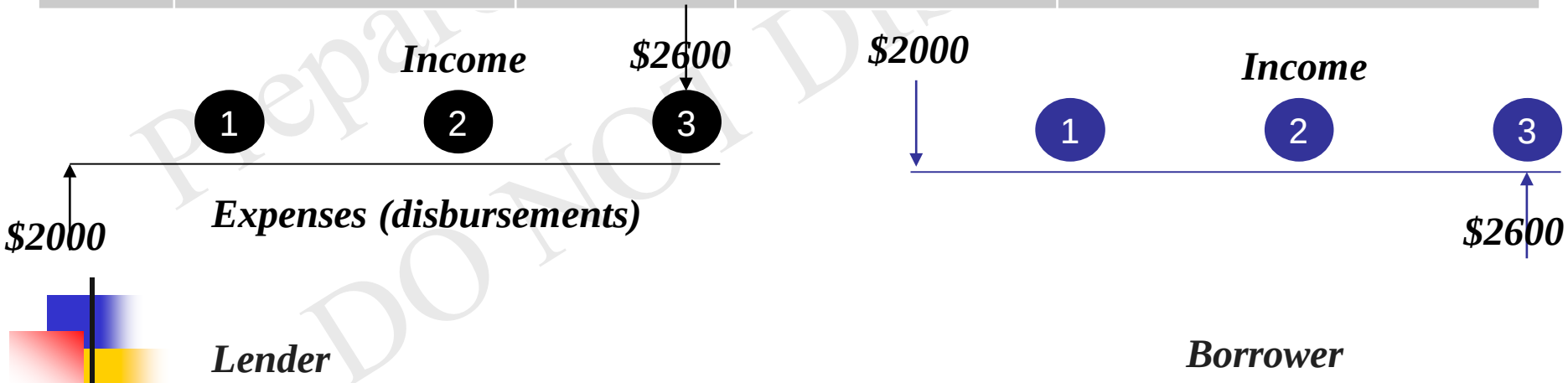
Borrow = &2,000

i= 10% per year

For 3 year

I=pni = $2000 * 3 (year) * 0.1 = $600

Year	Amount owed at beginning of the year	Interest	Amount owed at the end of the year	Amount to be paid by borrower at the end of the year
1	$2000	$200	$2000	0
2	$2000	$200	$2000	0
3	$2000	$200	$2000	$2600



Simple interest – Example 5

Example 5: A contractor borrows $40,000 from a bank. According to the agreement between them, the contractor will pay the bank $10,000 plus accrued interest at the end of the first year, and $30,000 plus accrued interest at the end of the fourth year. What are the dollar amounts of these two payments to be made by the contractor if 8% annual simple interest applies?

At end of 1st year= $10,000+interest= $10,000 + ($40,000*1*0.08)=$13,200

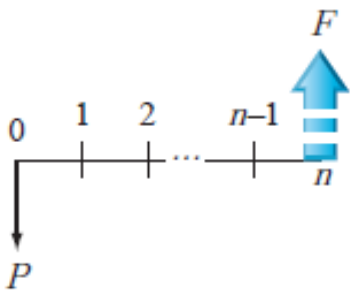
At end of 4th year=$30,000+interest= $30,000+ ($30,000*3*0.08)=$37,200

Because we paid 1st year ***Because we paid $10,000***

Compound interest – single amount

- Single payment-compound amount factor (SPCFA)
(ضریب مقدار مرکب پرداخت یگانه)

- Single payment-present worth factor
(ضریب ارزش فعلی پرداخت تکی)

Single Amount	F/P Compound amount	$(F/P,i,n) = (1+i)^n$	$F = P(F/P,i,n)$	
	P/F Present worth	$(P/F,i,n) = \frac{1}{(1+i)^n}$	$P = F(P/F,i,n)$	

ACEMI

Tables of interest rates

- See File #1

0.25% TABLE 1 Discrete Cash Flow: Compound Interest Factors 0.25%

	Single Payments		Uniform Series Payments				Arithmetic Gradients	
n	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.0025	0.9975	1.00000	1.0000	1.00250	0.9975		
2	1.0050	0.9950	0.49938	2.0025	0.50188	1.9925	0.9950	0.4994
3	1.0075	0.9925	0.33250	3.0075	0.33500	2.9851	2.9801	0.9983
4	1.0100	0.9901	0.24906	4.0150	0.25156	3.9751	5.9503	1.4969
5	1.0126	0.9876	0.19900	5.0251	0.20150	4.9627	9.9007	1.9950

Compound interest – single amount – Example 6

Example 6: A contractor borrows $2,000 from a bank for 3 years. What are the dollar amounts of payments to be made by the contractor if 10% annual compound interest applies?

Year	Amount owed at beginning of the year	Interest to be added to loan at end of year	Amount owed at the end of the year	Amount to be paid by borrower at the end of the year
1	$2000	$2000*0.1=$200	$2000+$200=$2200 $=\$2000(1+0.1)^1$	0
2	$2200	$2200*0.1=$220	$2200+$220=$2420 $=\$2000(1+0.1)^2$	0
3	$2420	$2420*0.1=$242	$2420+$242=$2662 $=\$2000(1+0.1)^3$	$2662

Compound interest – single amount

- Same result?

Interest Factors for 10.00%

	Single Payment		Uniform Series			
	Compound-Amount Factor	Present-Worth Factor	Compound-Amount Factor	Sinking-Fund Factor	Present-Worth Factor	Capital-Recovery Factor
	Convert *P* to *F*	Convert *F* to *P*	Convert *A* to *F*	Convert *F* to *A*	Convert *A* to *P*	Convert *P* to *A*
n	(*F*/*P*,*i*,*n*)	(*P*/*F*,*i*,*n*)	(*F*/*A*,*i*,*n*)	(*A*/*F*,*i*,*n*)	(*P*/*A*,*i*,*n*)	(*A*/*P*,*i*,*n*)
1	1.1000	0.9091	1.0000	1.0000	0.9091	1.1000
2	1.2100	0.8264	2.1000	0.4762	1.7355	0.5762
3	1.3310	0.7513	3.3100	0.3021	2.4869	0.4021
4	1.4641	0.6830	4.6410	0.2155	3.1699	0.3155
5	1.6105	0.6209	6.1051	0.1638	3.7908	0.2638
6	1.7716	0.5645	7.7156	0.1296	4.3553	0.2296
7	1.9487	0.5132	9.4872	0.1054	4.8684	0.2054
8	2.1436	0.4665	11.4359	0.0874	5.3349	0.1874
9	2.3579	0.4241	13.5795	0.0736	5.7590	0.1736
10	2.5937	0.3855	15.9374	0.0627	6.1446	0.1627
11	2.8531	0.3505	18.5312	0.0540	6.4951	0.1540
12	3.1384	0.3186	21.3843	0.0468	6.8137	0.1468
13	3.4523	0.2897	24.5227	0.0408	7.1034	0.1408
14	3.7975	0.2633	27.9750	0.0357	7.3667	0.1357
15	4.1772	0.2394	31.7725	0.0315	7.6061	0.1315
16	4.5950	0.2176	35.9497	0.0278	7.8237	0.1278
17	5.0545	0.1978	40.5447	0.0247	8.0216	0.1247
18	5.5599	0.1799	45.5992	0.0219	8.2014	0.1219
19	6.1159	0.1635	51.1591	0.0195	8.3649	0.1195
20	6.7275	0.1486	57.2750	0.0175	8.5136	0.1175
21	7.4002	0.1351	64.0025	0.0156	8.6487	0.1156
22	8.1403	0.1228	71.4027	0.0140	8.7715	0.1140
23	8.9543	0.1117	79.5430	0.0126	8.8832	0.1126
24	9.8497	0.1015	88.4973	0.0113	8.9847	0.1113
25	10.8347	0.0923	98.3471	0.0102	9.0770	0.1102
26	11.9182	0.0839	109.1818	0.0092	9.1609	0.1092
27	13.1100	0.0763	121.0999	0.0083	9.2372	0.1083
28	14.4210	0.0693	134.2099	0.0075	9.3066	0.1075
29	15.8631	0.0630	148.6309	0.0067	9.3696	0.1067
30	17.4494	0.0573	164.4940	0.0061	9.4269	0.1061
35	28.1024	0.0356	271.0244	0.0037	9.6442	0.1037
40	45.2593	0.0221	442.5926	0.0023	9.7791	0.1023
45	72.8905	0.0137	718.9048	0.0014	9.8628	0.1014

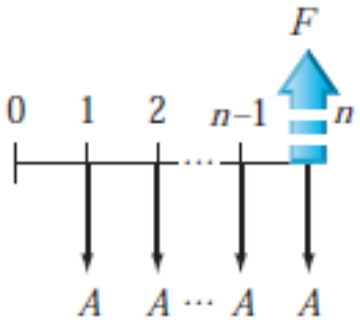
Compound interest – Uniform series – Relation between F and A

- Uniform series-compound amount factor (equal payment series-compound amount factor)

(ضریب مقدار مرکب مجموعه پرداختهای مساوی)

- Uniform series-sinking fund factor (equal payment series-sinking fund factor)

(ضریب وجوه پس اندازی مجموعه پرداختهای مساوی)

F/A Compound amount	$(F/A,i,n) = \frac{(1+i)^n - 1}{i}$	$F = A(F/A,i,n)$	
A/F Sinking fund	$(A/F,i,n) = \frac{i}{(1+i)^n - 1}$	$A = F(A/F,i,n)$	

Uniform series - Relation between F and A – Example 7

Example 7: A building will be constructed in five years.

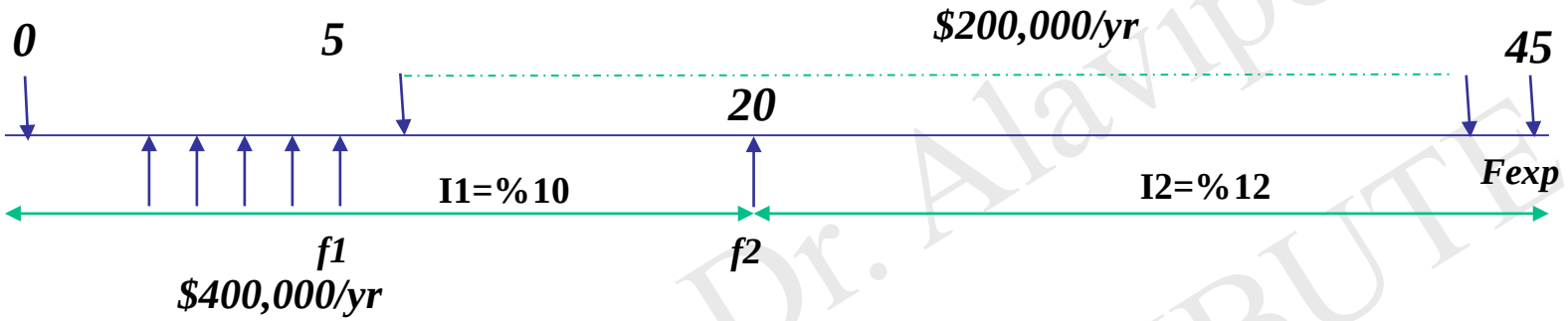
The yearly construction expenditures during these five years are expected to be $400,000 per year. The building's life is 40 years after the end of construction.

The yearly net rental income during these 40 years is anticipated to be $200,000.

Assuming an interest rate of 10% in the first 20 years (including 5 years of construction time and 15 years of the building's life) and an interest rate of 12% in the remaining 25 years of the building's life,

calculate the future equivalent of incomes and expenditures at the end of its life.

Uniform series - Relation between F and A – Example 7



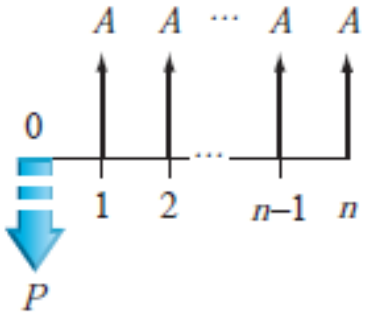
$$F_{exp} = \$400,000\left(\frac{F}{A},10\%,5\right)\left(\frac{F}{P},10\%,15\right)\left(\frac{F}{P},12\%,25\right) = \$173,416,141$$

$$F_{inc} = \$200,000\left(\frac{F}{A},10\%,15\right)\left(\frac{F}{P},12\%,25\right) + \$200,000\left(\frac{F}{A},12\%,25\right)$$
$$= \$134,693,915$$

Compound interest – Uniform series – Relation between P and A

- Uniform series-present worth factor (equal payment series-present worth factor)
(ضریب ارزش فعلی مجموعه پرداختهای مساوی)

- Uniform series-capital recovery factor (equal payment series-capital recovery factor)
(ضریب بازیافت سرمایه‌ی مجموعه پرداختهای مساوی)

P/A Present worth	$(P/A,i,n) = \frac{(1+i)^n - 1}{i(1+i)^n}$	$P = A(P/A,i,n)$	
A/P Capital recovery	$(A/P,i,n) = \frac{i(1+i)^n}{(1+i)^n - 1}$	$A = P(A/P,i,n)$	

Uniform series – Relation between P and A – Example 8

Example 8: An engineer is called upon to examine a quarry which is for sale and to advise his employer regarding its value.

He estimates the amount of rock to be 440,000 tons and will base his value on this figure.

The existing facilities will permit the removal of about 55,000 tons of rock per year.

He estimates that the quarrying and transportation costs will total about $5.75 per ton of rock and that the gross income per ton quarried will be $11.75.

Administrative expenses will amount to an additional $30,000 per year.

What is the present value of the quarry to yield a 15% annual return on the investment throughout its life?

Uniform series – Relation between P and A – Example 8

$$\frac{440,000ton}{55,000ton} = 8years$$

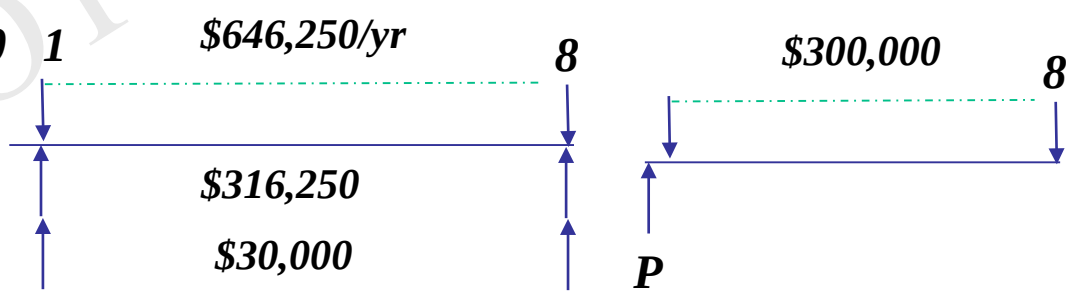
Expenditures:

$$1)\ Excavation + trans = 5.75\frac{\$}{\text{ton}} * 55000\frac{\text{ton}}{\text{yr}} = \$316,250\ \text{per year}$$

$$2) Administrative\ expenses = \$30,000\ per\ year$$

$$Income: 11.75\frac{\$}{\text{ton}} * 55,000\ \frac{\text{ton}}{\text{yr}} = \$646,250\ \text{per year}$$

$$P = A\left(\frac{P}{A}, i, n\right) = \$1,346,190$$



Compound interest – Arithmetic gradient factors

- Arithmetic gradient series-present worth factor
(ضریب ارزش فعلی مجموعه با شیب یکنواخت)

- Uniform series-capital recovery factor
(ضریب بازیافت سرمایه‌ی مجموعه با شیب یکنواخت)

Compound interest – Arithmetic gradient factors

$\frac{Find}{Given}$

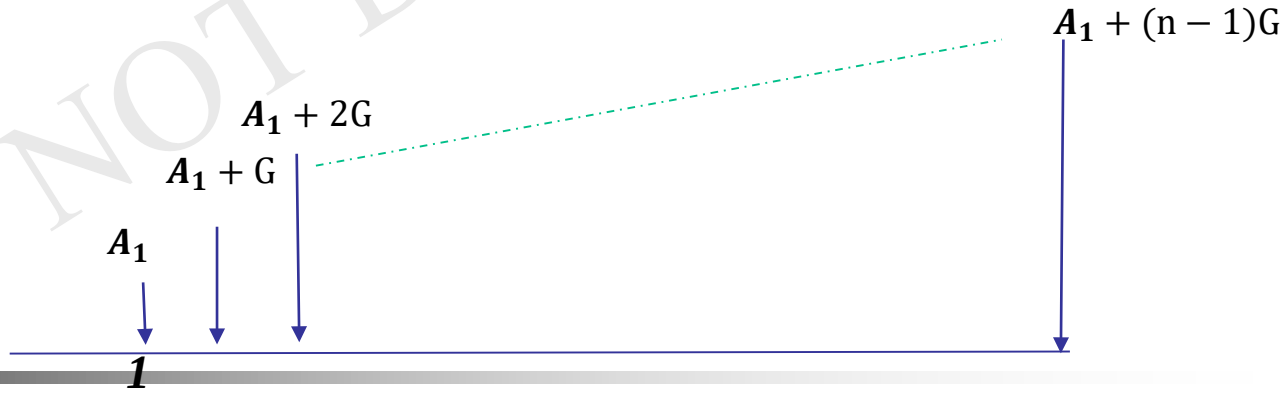
Note: If the slope in the cash flow decreases, the minus should be used in the formulas.

$$\frac{P_G}{G}(Present\ Worth\ factor) \Longrightarrow P = A_1(\frac{P}{A_1}, i, n) \pm G[\frac{(1+i)^n - in - 1}{i^2(1+i)^n}]$$

$$= A_1(\frac{P}{A_1}, i, n) \pm G(\frac{P}{G}, i, n)$$

$$\frac{A_G}{G}(Uniform\ Series) \Longrightarrow A = A_1 \pm G\left(\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right) = A_1 + G\left(\frac{A}{G}, i, n\right)$$

A_1 **for the first year**



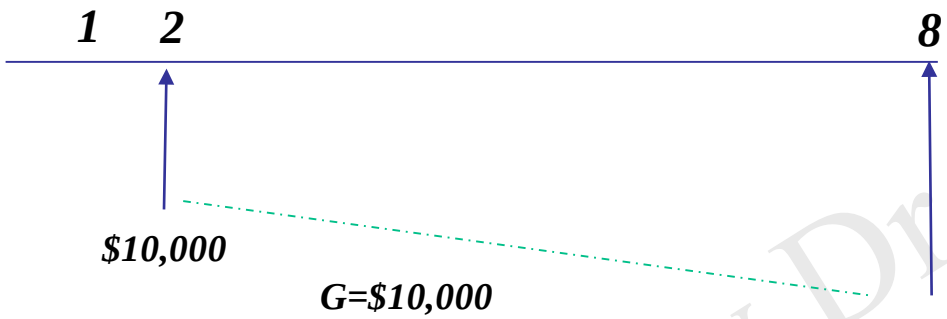
Arithmetic gradient factors – Example 9

Example 9: Operating expenditures for a gravel pit are expected to be 0 (zero) at the end of the first year, $10,000 at the end of the second year, and to increase by $10,000 at the end of each year thereafter until the end of the eighth year.

It is desired to find the equivalent payments at the end of each year if the interest rate is 10% compounded annually.

Use the uniform gradient series factor in your calculations.

Arithmetic gradient factors – Example 9



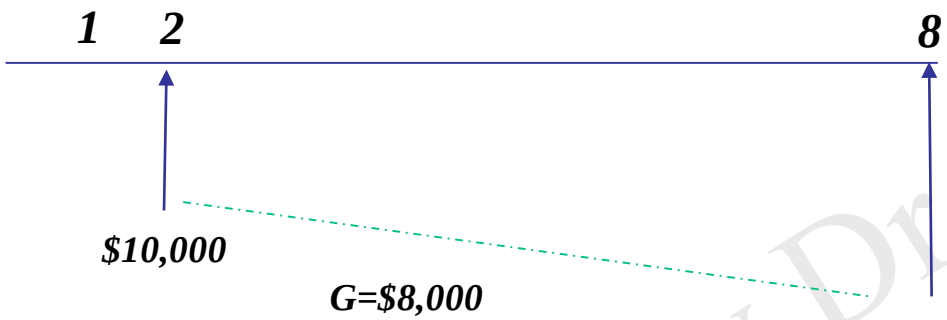
$$If\ G = \$10,000: \longrightarrow A = A_1 + G\left(\frac{A}{G}, i, n\right) = 0 + \$10,000\left(\frac{A}{G}, 10\%, 8\right)$$

$$= \$30,045\ per\ year$$

Example 9: What if G = 8,000/year?

Arithmetic gradient factors – Example 9

Example 9: What if G = 8,000/year?

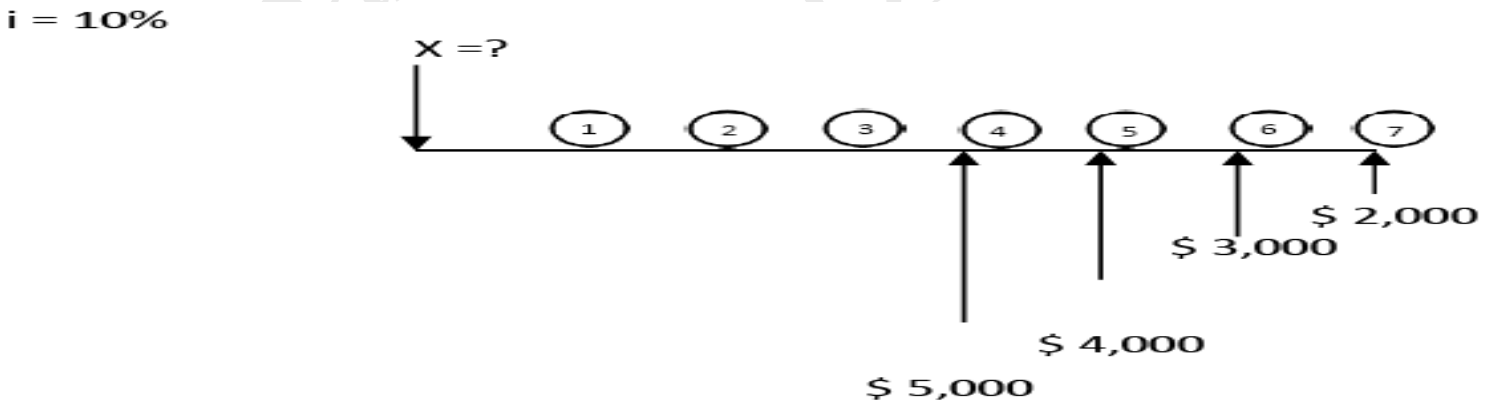


$$If\ G = \$8000 \longrightarrow A = [\$10000 + \$8000\left(\frac{A}{G}, 10\%, 7\right)](\frac{F}{A}, 10\%, 7)(\frac{A}{F}, 10\%, 8)=.....$$

Arithmetic gradient factors – Example 10

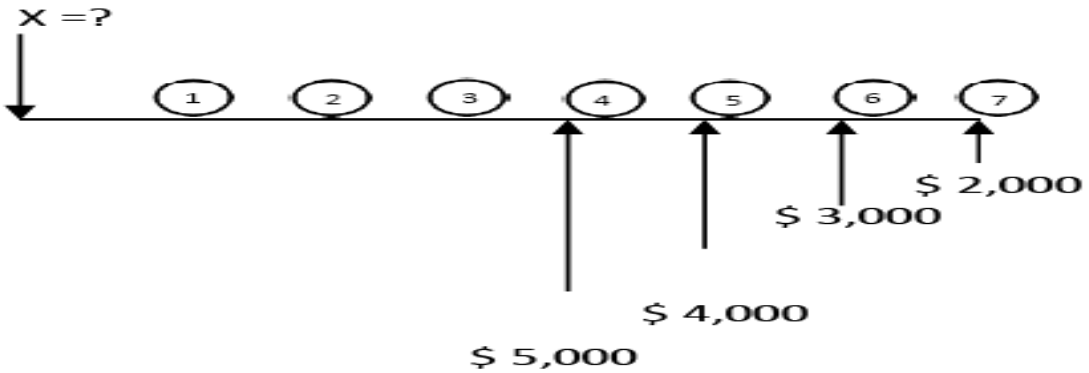
Example 10: A debt of $X is incurred at the purchase of a plot of land by a building developer.

It is agreed that payments of $5,000, $4,000, $3,000, and $2,000 made at the end of the 4th, 5th, 6th, and 7th years respectively will satisfy the debt if an interest rate of 10% compounded annually is the appropriate interest rate. By using the uniform gradient series factor and any other relevant interest factor(s), determine the amount of $X.



Arithmetic gradient factors – Example 10

i = 10%



X = [A1 (P/A,10,4) – G (P/G,10,4)] (P/F,10,3)

= [(5,000 x 3.1699) – (1,000 x 4.3781)] x 0.7513

= (15,849.50 – 4,378.10) x 0.7513

= 11,471.40 x 0.7513

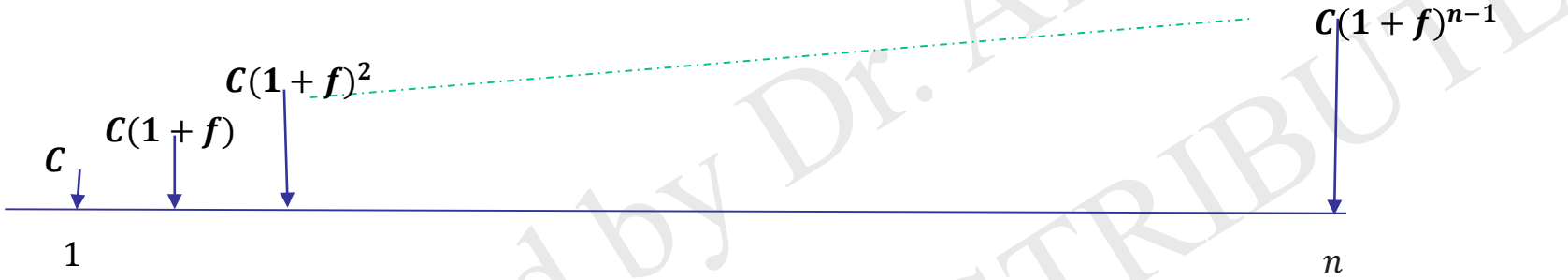
= $ 8,618.46

Compound interest – Geometric gradient series factors – Scenario 1

FIND/GIVEN

P/C

(Present Worth factor)



$$\textbf{when } f > i \longrightarrow P = \frac{C}{1+i} * \left(\frac{F}{A}, W, n\right); \textbf{where} \quad W = \frac{1+f}{1+i} - 1$$

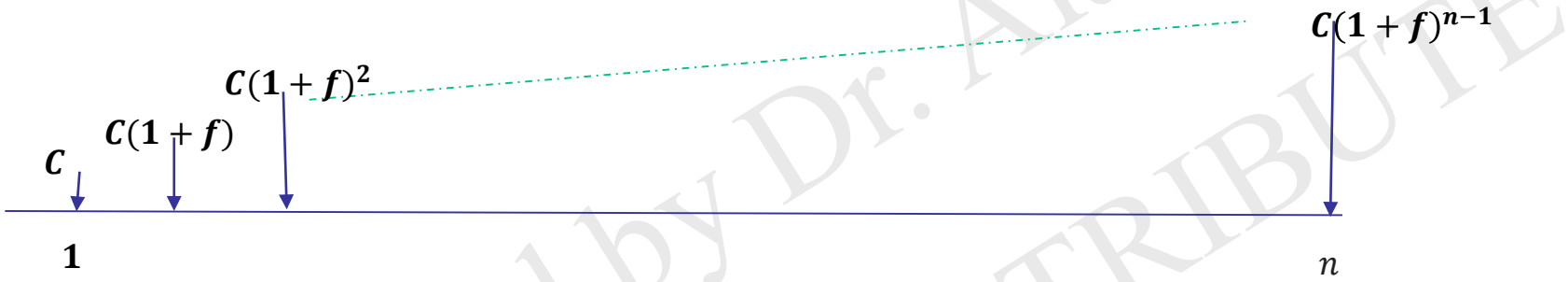
$$A = \frac{C}{1+i} * \left(\frac{F}{A}, W, n\right)\left(\frac{A}{P}, i, n\right); \textbf{where} \quad W = \frac{1+f}{1+i} - 1$$

Compound interest – Geometric gradient series factors – Scenario 1

FIND/GIVEN

P/C

(Present Worth factor)



$$\textbf{when } f < i \longrightarrow P = \frac{C}{1+f} * \left(\frac{P}{A}, W, n\right); \textbf{ where } \quad W = \frac{1+i}{1+f} - 1$$

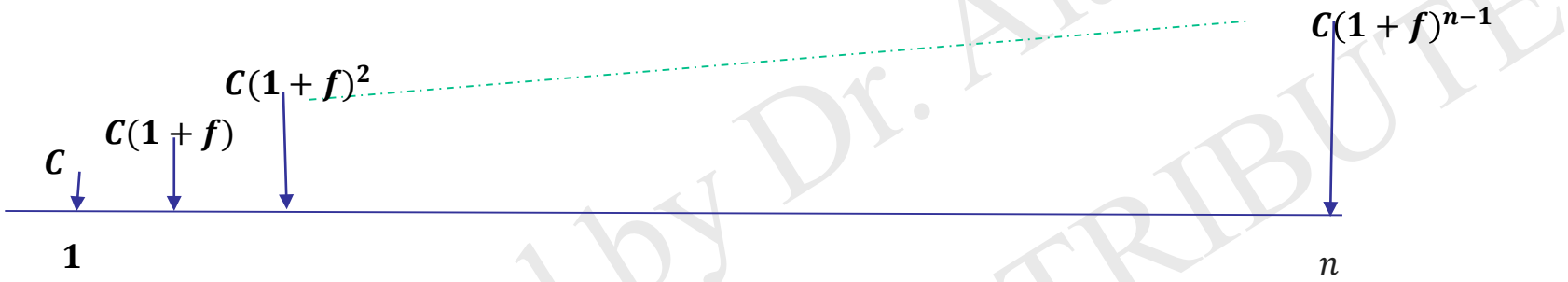
$$A = \frac{C}{1+f} * \left(\frac{P}{A}, W, n\right)\left(\frac{A}{P}, i, n\right); \textbf{ where } \quad W = \frac{1+i}{1+f} - 1$$

Compound interest – Geometric gradient series factors – Scenario 1

FIND/GIVEN

P/C

(Present Worth factor)



$$when\ f = i \longrightarrow P = \frac{nc}{1+f}$$

$$A = \frac{nc}{1+f} * (\frac{A}{P}, i, n)$$

Compound interest – Geometric gradient series factors – Scenario 1

- When $f > i$;
  - $P = (C / (1 + i))\,(F/A, W, n)$; $W = ((1 + f) / (1 + i)) - 1$
  - $A = (C / (1 + i))\,(F/A, W, n)\,(A/P, i, n)$; $W = ((1 + f) / (1 + i)) - 1$

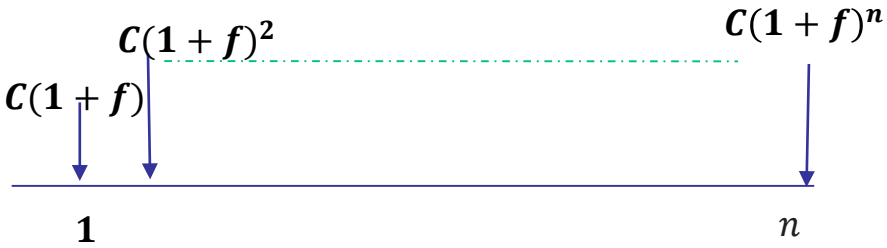
- When $f < i$;
  - $P = (C / (1 + f))\,(P/A, W, n)$; $W = ((1 + i) / (1 + f)) - 1$
  - $A = (C / (1 + f))\,(P/A, W, n)\,(A/P, i, n)$; $W = ((1 + i) / (1 + f)) - 1$

- When $f = i$;
  - $P = n\left(C(1 + f)\right)$;
  - $A = n\,(C / (1 + f))\,(A/P, i, n)$;

- Note: How to interpolate?

$$y = y_1 + \left[\frac{x - x_1}{x_2 - x_1}\right](Y_2 - Y_1)$$

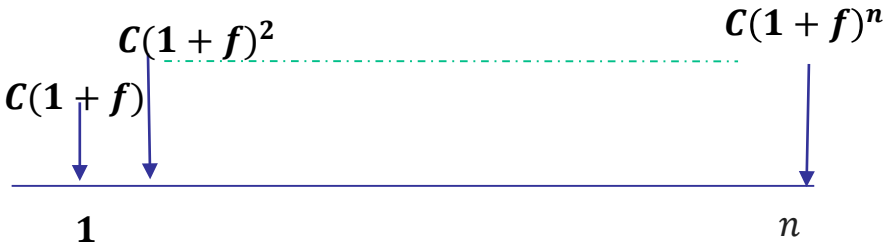
Compound interest – Geometric gradient series factors – Scenario 2



$$when\ f > i \longrightarrow P = C(1+W)\left(\frac{F}{A}, W, n\right); where \quad W = \frac{1+f}{1+i} - 1$$

$$A = C(1+W)\left(\frac{F}{A}, W, n\right)\left(\frac{A}{P}, i, n\right); where \quad W = \frac{1+f}{1+i} - 1$$

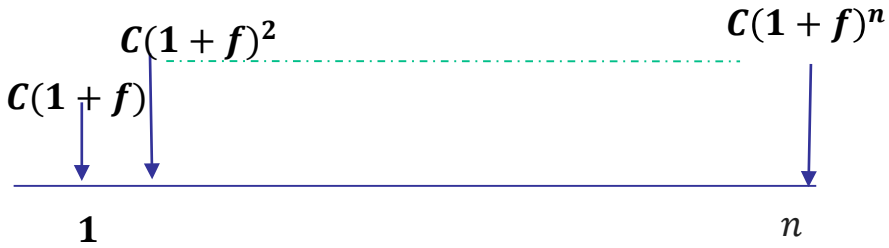
Compound interest – Geometric gradient series factors – Scenario 2



$$when\ f < i \longrightarrow P = C\left(\frac{P}{A}, W, n\right); where \quad W = \frac{1+i}{1+f} - 1$$

$$A = C\left(\frac{P}{A}, W, n\right)\left(\frac{A}{P}, i, n\right) \longrightarrow w = \frac{1+i}{1+f} - 1$$

Compound interest – Geometric gradient series factors – Scenario 2



$$when\ f = i \longrightarrow P = nc$$

$$A = nc\left(\frac{A}{P}, i, n\right)$$

Compound interest – Geometric gradient series factors – Scenario 2

- When $f > i$;
  - $P = (C\,(1 + W))\,(F/A, W, n)$; $W = ((1 + f) / (1 + i)) - 1$
  - $A = (C\,(1 + W))\,(F/A, W, n)\,(A/P, i, n)$; $W = ((1 + f) / (1 + i)) - 1$

- When $f < i$;
  - $P = C\,(P/A, W, n)$; $W = ((1 + i) / (1 + f)) - 1$
  - $A = C\,(P/A, W, n)\,(A/P, i, n)$; $W = ((1 + i) / (1 + f)) - 1$

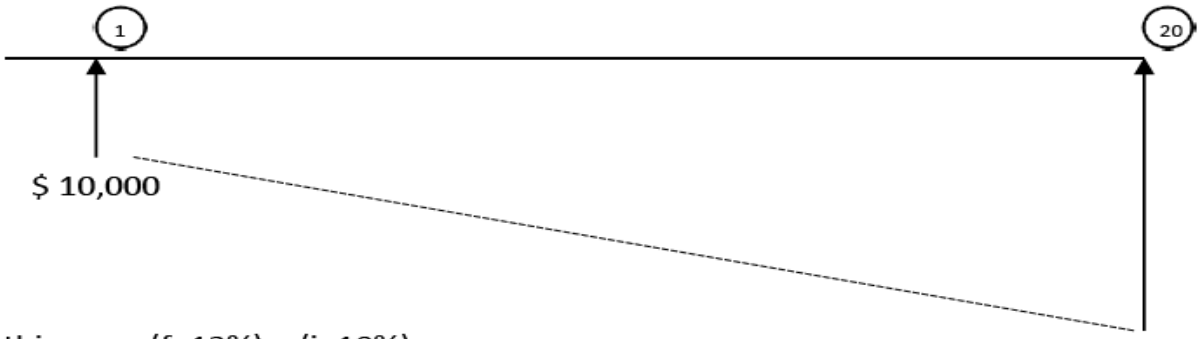
- When $f = i$;
  - $P = n\,C$;
  - $A = n\,C\,(A/P, i, n)$;

Geometric gradient series factors – Example 11

Example 11: The fuel cost for operating a building's heating system for the coming year is expected to be $10,000. The building's estimated life is 20 years and the desired rate of return is 10%. The price of fuel is anticipated to increase at a rate of 12% per year in the remaining 19 years.

a) What is the annual equivalent cost of fuel?

a)



In this case; (f=12%) > (i=10%)

So: $W = \frac{1+f}{1+i} - 1$

$W = \frac{1+0.12}{1+0.10} - 1$

$= 0.018$

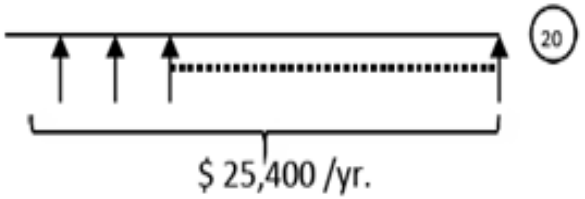
$A = \frac{C}{(1+i)}$ (F/A,W,n) (A/P,i,n)

$A = \frac{10,000}{(1+0.10)}$ (F/A,1.8%,20) (A/P,10,20)

$= \frac{10,000}{1.10}\left[\frac{(1+0.018)^{20}-1}{0.018}\right] \times 0.1175$

= $ 25,400 per year.

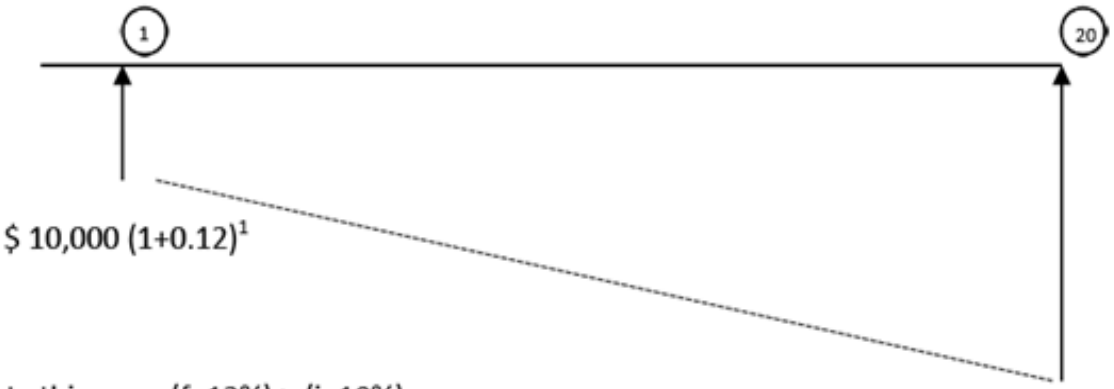
≈



Geometric gradient series factors – Example 11

Example 11: b) What is the annual equivalent cost of fuel if the present day cost is $10,000 and if the price of fuel increases at a rate of 12% per year in the coming 20 years? (Assume again year-end payments).

b)



In this case; (f=12%) > (i=10%)

So: $W = \frac{1+f}{1+i} - 1$

$W = \frac{1+0.12}{1+0.10} - 1$

$= 0.018$

A = C (1+W) (F/A,W,n) (A/P,i,n)

= 10,000 (1+0.018) (F/A,1.8%,20) (A/P,10,20)

$=10{,}000 \times 1.018 \times \left[\frac{(1+0.018)^{20}-1}{0.018}\right] \times 0.1175$

= $ 28,491.48 per year.

Nominal and effective interest rate statement

- Here we discuss ***nominal*** *and* ***effective*** ***interest rates***, which have the **same basic relationship**.
  - The **difference** here is that the **concepts** of **nominal** and **effective** must be used when **interest** is **compounded more than once each year**.
    - ✓ For example, if an interest rate is expressed as **1% per month**, the terms ***nominal*** and ***effective*** interest rates **must be considered**.

The interest amounts for loans, mortgages, bonds, and stocks are commonly based upon interest rates compounded more frequently than annually.

Solve problems using EXCEL

In **economic analysis** **spreadsheets** may be **helpful for a number of purposes**:

1.Constructing tables of cash flows

2.Using annuity **functions** to **calculate *P, F, A, n, or i.***

3.Using a **block function** to find the **present worth** or **internal rate of return** for a table of **cash flows**

4.Making **graphs for analysis** and **presentations**

5.Calculating **"what-if"** for various problem variables.

موسسه مهندسی و مدیریت ساخت علوی پور

تهران، بلوار فردوس شرق، بعد از خیابان حسن آباد، مجتمع آبگینه، طبقه سوم اداری، واحد C42

+۹۸۲۱۴۶۱۰۰۴۵۰

+۹۸۲۱۴۶۱۰۰۴۴۵

www.dralavipour.com

info@dralavipour.com

@Acemi_social

@Alavipour_pm

youtube.com/channel/UC2vltk3T9m1X69hSWUwfp2Q

www.linkedin.com/company/iranacemi

ارزیابی اقتصادی در پروژه
(با تمرکز بر سازمان‌های پروژه‌محور)

مروری بر توابع ارزیابی اقتصادی در نرم افزار اکسل

ارائه دهندگان:

سید محمدرضا علوی‌پور

(PhD, PMP, CMIT)

دانشگاه Illinois Tech آمریکا

کامبیز کردانی

کارشناس ارشد مدیریت صنعتی

کارشناس اقتصاد

What is Excel

- **Excel definition**: a software program created by Microsoft that uses spreadsheets to organize numbers and data with formulas and functions. Excel analysis is ubiquitous around the world and used by businesses of all sizes to perform financial analysis.

Why using Excel for modeling?

- Among the computer programs which exist, Microsoft Excel is one of the most important because of the key role it plays in many sectors. It is the most used spreadsheet program in many business activities, classwork and even personal data organization. Excel was first released in the year 1985

What is an Excel model

- An **Excel model** is a spreadsheet that makes quantitative estimates or predictions based on a set of underlying assumptions.
- What are Excel modeling skills?
  - Understanding how to build a forecast. A logical framework for problem-solving. Attention to detail. Ability to distill large amounts of data into a simple format.

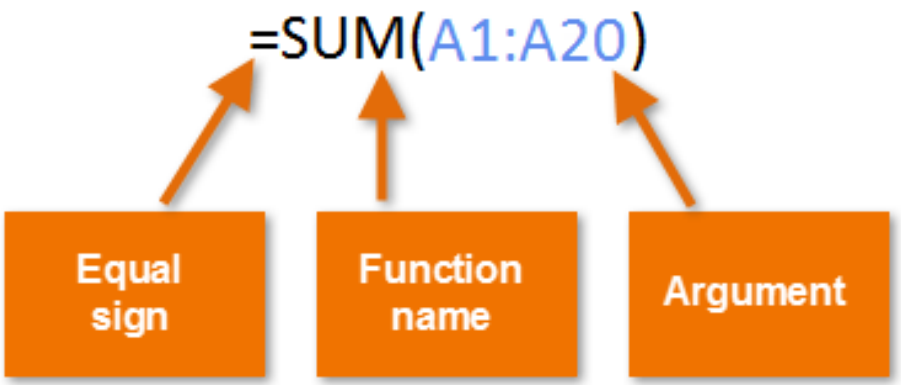
ACEMI

Difference between function & formula

- **Formula** is an expression that calculates values in a cell or in a range of cells. For example, =A2+A2+A3+A4 is a formula that adds up the values in cells A2 through A4. **Function** is a predefined formula already available in Excel
- There are two types of cell references: **relative** and **absolute**. **Relative** and **absolute** references behave differently when copied and filled to other cells. Relative references change when a formula is copied to another cell. Absolute references, on the other hand, remain constant no matter where they are copied.

The parts of function in Excel

- **equals sign (=)**
- **function name** (SUM, for example)
- Parentheses
- one or more **arguments**



What is financial model?

- A financial model is simply a tool that's built in spreadsheet software such as MS Excel to forecast a business' financial performance into the future. The forecast is typically based on the company's historical performance, assumptions about the future, and requires preparing an income statement, balance sheet, cash flow statement, and supporting schedules (known as a 3 statement model). From there, more advanced types of models can be built such as discounted cash flow analysis (DCF model), and sensitivity analysis.

Important functions for this course

- **Present Value:**
  - **Structure:**
  - **=PV(rate ,nper, pmt,[fv],[type])**
  - **Rate = نرخ بهره**
  - **Nper = تعداد دوره های پرداخت**
  - **pmt = پرداخت هر دوره**
  - **Fv = ارزش آینده سرمایه گذاری**
  - **Type = نوع پرداخت**

Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponents	^

Important functions for this course

- **Future Value:**
  - **Structure:**
  - **=FV(rate ,nper, pmt,[pv],[type])**
  - **Rate = نرخ بهره**
  - **Nper = تعداد دوره های پرداخت**
  - **pmt = پرداخت هر دوره**
  - **Pv = ارزش کنونی سرمایه گذاری**
  - **Type = نوع پرداخت**

Important functions for this course

- **Net present Value:**
  - **Structure:**
  - **=NPV(rate,value1,[value2],…)**
  - **Value = درآمد کسب شده به ترتیب زمان**
  - **=XNPV(rate,values,dates)**
  - **Dates = تاریخ های دریافت یا پرداخت**

Important functions for this course

- **Payment Functions**
  - **Structure:**
  - **=NPV(rate,value1,[value2],…)**
  - **Value = درآمد کسب شده به ترتیب زمان**
  - **=XNPV(rate,values,dates)**
  - **Dates = تاریخ های دریافت یا پرداخت**

Important functions for this course

- **Rate Functions**
  - **Structure:**
  - **=Rate(nper,pmt,pv,[fv],[type],[guess]**
  - **=IRR(values,[guess])**
  - **=XIRR(values,dates,[guess])**
  - **=Nper(rate,pmt,pv,[fv],[type])**
  - **=MIRR(values,finance_rate,reinvest_rate)**

Important functions for this course

- **Depreciation Functions**
  - **Structure:**
  - **=SLN(cost,salvage,life)**
  - **=SYD(cost,salvage,life,per)**
  - **=DB(cost,salvage,life,period,[month])**
  - **=DDB(cost, salvage, life, period, [factor])**