

INTRODUCTION TO ENGINEERING ECONOMICS



• A. J. Clark School of Engineering • Department of Civil and Environmental Engineering

by

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ENCE 202

Spring 2000

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University of Maryland

ENCE 202
Eng. Econ
Handout 6

Introduction



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■ Definition of Engineering

Engineering is the profession in which knowledge (math and natural sciences gained by study, experience and practice) is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind.

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Introduction

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- Two environments are needed for the work of an engineer
 - physical and
 - economical environments
- An engineer needs to establish efficiency in both environments that are not independent



Introduction

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- Engineering Process
 - Determination of objectives
 - Identification of strategic factors
 - Determination of means (engineering proposals)
 - Evaluation of engineering proposals
 - Assistance in decision making



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■ Engineering Economic Studies

- Creative step
- Definition step
- Conversion step to same scale to facilitate comparative evaluation
- Decision step



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■ EXAMPLES:

- Infrastructure expenditure decision
- Replace versus repair decisions
- Selection of inspection method
- Selection of a replacement for an equipment



Fundamental Economic Concepts

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- Economics deals with the behavior of people

- Utility
 - “Utility is the power of a good or service to satisfy human needs”



Fundamental Economic Concepts

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- Value
 - Value designate the worth that a person attaches to an object or service
 - Value is a measure or appraisal of utility in some medium of exchange.
 - Value is not the same as cost or price



Fundamental Economic Concepts

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■ Consumer and Producer Goods

- Consumer goods are the goods and services that directly satisfy human wants. For example, TV, shoes, houses.
- Producer goods are the goods and services that satisfy human wants indirectly as a part of the production or construction process. For example, factory equipment, industrial chemicals and materials.



Fundamental Economic Concepts

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■ The Utilities of Goods

- Consumer goods: Basic human needs of food, clothing and shelter. In commercial advertisements, emphasis is given to senses not reasoning. The utility in this case is considered objectively and/or subjectively.
- Producer goods: The utility stems for their means to get to an end. The utility in this case is considered objectively.



Fundamental Economic Concepts

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■ Economy of Exchange

- Economy of exchange occurs when utilities are exchanged by two or more people.
- It is possible because consumer utilities are evaluated subjectively.
- Mutual benefit in exchange
- Persuasion in exchange. Salesperson



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■ Economy of Organization

- Through organizations, ends can be attained or attained more economically by:
 1. Labor saving
 2. Efficiency in manufacturing or capital use



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■ Classification of Cost (cont'd)

- First (or initial) cost: Cost to get activity started such as property improvement, transportation, installation, and initial expenditures)
- Operation and maintenance cost: They are experienced continually over the useful life of the activity



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■ Classification of Cost (cont'd)

- Fixed cost: It does not depend on output volume (cost of management for example).
- Variable cost: It is per unit produced.
- Incremental or marginal cost: Cost per unit or production increase. It is determined from the variable cost.



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■ Classification of Cost (cont'd)

- Sunk cost: It cannot be recovered or altered by future actions. Usually this cost is not a part of engineering economic analysis.
- Life-cycle cost: Feasibility, design, construction, operation and disposal costs



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■ Supply and Demand

- Demand curve shows the number of units people are willing to buy and cost per unit (decreasing curve).
- Supply curve shows the number of units that vendors will offer for sale and unit price (increasing curve).
- The intersection defines the exchange price.



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■ Supply and Demand (cont'd)

- Elasticity of demand. Price changes and their effect on demand changes. It depends on whether the consumer product is a necessity or a luxury.
- Law of diminishing return. A process can be improved at a rate with a diminishing return. Example: cost of inspection to reduce cost of repair and lost production.



Fundamental Economic Concept

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■ The Interest Rate

- Called also the rate of capital growth, it is the rate of gain received from an investment.
- It is expressed on an annual basis.
- For the lender, it consists, for convenience, of (1) risk of loss, (2) administrative expenses, and (3) profit or pure gain.
- For the borrower, it is the cost of using a capital for immediately meeting his or her needs.



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- **The Time Value of Money (TVM)**
 - As a result of the earning power of money (through interest), time increases the purchasing power of money by its increase through earning



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- **The Time Value of Money (TVM)**
 - Money has a time value
 - One dollar today is worth more than \$1 tomorrow
 - Failure to pay the bills results in additional charge termed interest



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■ The interest i

- Interest is usually expressed as a percentage of the amount owed
- It is due and payable at the close of each period of time involved in the agreed transaction (usually every year or month).



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■ The interest i

– EXAMPLE:

- If \$ 1,000.00 is borrowed at 14% interest, then interest on the principal of \$ 1,000.00 after one year is $0.14 \times 1,000$, or \$140.00
- If the borrower pays back the total amount owed after one year, she will pay \$1,140.00



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■ The interest i

– EXAMPLE (cont'd):

- If she does not pay back any of the amount owed after one year, then normally the interest owed, but not paid, is considered now to be additional principal, and thus the interest is compounded
- After two years she will owe $\$1,140.00 + 0.14 \times 1,140.00$, or 1,299.60.



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■ Equivalency

- The banker in the previous example normally does not care whether you pay him \$1,140.00 after one year or \$1,299.60 after two years. To him, the three values (\$1,000, \$1,140, and \$1,299.60) are equivalent.
- \$ 1,000 today is equivalent to \$1,140 one year from today,
- \$ 1,000 today is equivalent to \$1,299.60 two years from today.



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■ Equivalency

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- \$ 1,000 today is equivalent to \$1,140 one year from today,
- \$ 1,000 today is equivalent to \$1,299.60 two years from today.

NOTE: The three values are not equal but equivalent



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■ Equivalency

– It is to be noted that:

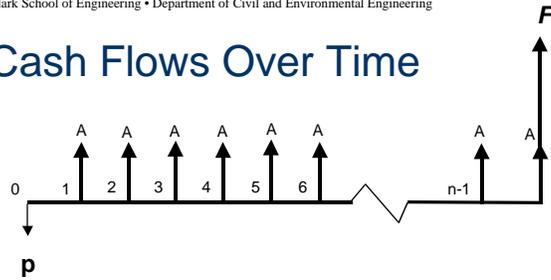
- 1.The concept of equivalence involves time and a specified rate of interest. The three preceding values are only equivalent for an interest rate of 14%, and then only at the specified times.
- 2.Equivalence means that one sum or series differs from another only by the accumulated interest at rate i for n periods of time.



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■ Cash Flows Over Time



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■ Cash Flows Over Time

– Symbols

P = a present single amount of money

F = a future single amount of money, after n periods of time

A = a series of n equal payments

i = the rate of interest per interest period (usually one year)

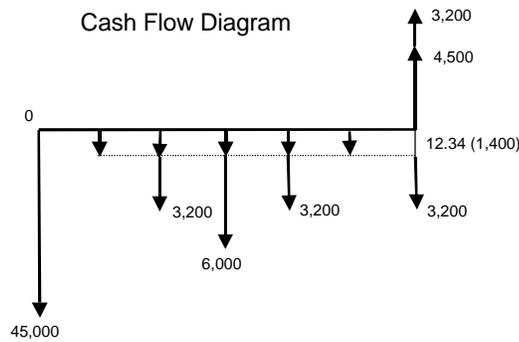
n = the number of periods of time (usually years)



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Cash Flows Over Time – Example



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- Financial Analysis
 - Single payment
 - Uniform series of payments
 - Discounted present worth analysis
 - Rate of return analysis



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- The earning power of money
 - This power is there because money can be exchanged by production tools
- The purchasing power of money
 - The prices of goods and services can go upward or downward, therefore the purchasing power of money can change with time



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- Example Economic Studies
 - Design and Economy
 - Elimination of overdesign should not be an objective.
 - Designing for economic production
 - Economy in the design of producer goods
 - Design for the economy of maintenance
 - Design for the economy of shipping
 - Economy of interchangeable design



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- **Example Economic Studies**
 - Economy of Material Selection
 - Standardization and Simplification
 - Selection of Personnel
 - Range of human capacities
 - Economy of proficiency
 - Economy of specialization
 - Economy of dependability