- **Course Title:** Engineering Cost Analysis & Economy (ENGR 222)
- **Session:** Fall 2024
- **Instructor:** Sudipta Chowdhury (chowdhurys@marshall.edu)
- **Class Time: TR 9.30 AM-10.45 AM**
- **Office hours: TR 11.00 AM-12.30 PM**

Breakeven Analysis (Two or More Alternatives)

The procedure to follow for two alternatives is as follows:

- Define the common variable and its dimensional units.
- Use AW or PW analysis to express the total cost of each alternative as a function of the common variable. (Use AW values if lives are different).
- Equate the two relations and solve for the breakeven value of the variable.
- If the anticipated level is below the breakeven value, select the alternative with the higher variable cost (larger slope). If the level is above the breakeven point, select the alternative with the lower variable cost.

- The same type of analysis can be performed for three or more alternatives.
- Then, compare the alternatives in pairs to find their respective breakeven points.
- The results are the ranges through which each alternative is more economical.

Breakeven Between Two Alternatives

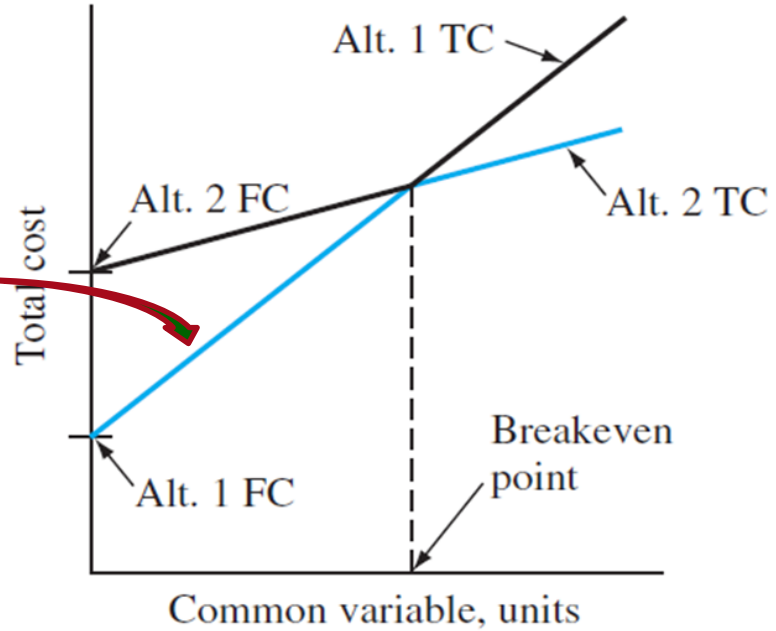
To determine value of common variable between 2 alternatives, do the following:

1. **Define the common variable**
2. **Develop equivalence PW, AW or FW relations as function of common variable for each alternative**
3. **Equate the relations; solve for variable. This is breakeven value**

Selection of alternative is based on anticipated value of common variable:

Value BELOW breakeven;
select higher variable cost

Value ABOVE breakeven;
select lower variable cost



Example 1: Two Alternative Breakeven Analysis

Perform a make/buy analysis where the common variable is X, the number of units produced each year. AW relations are:

$$\mathbf{AW_{make} = -18,000(A/P, 15\%, 6) + 2,000(A/F, 15\%, 6) - 0.4X}$$

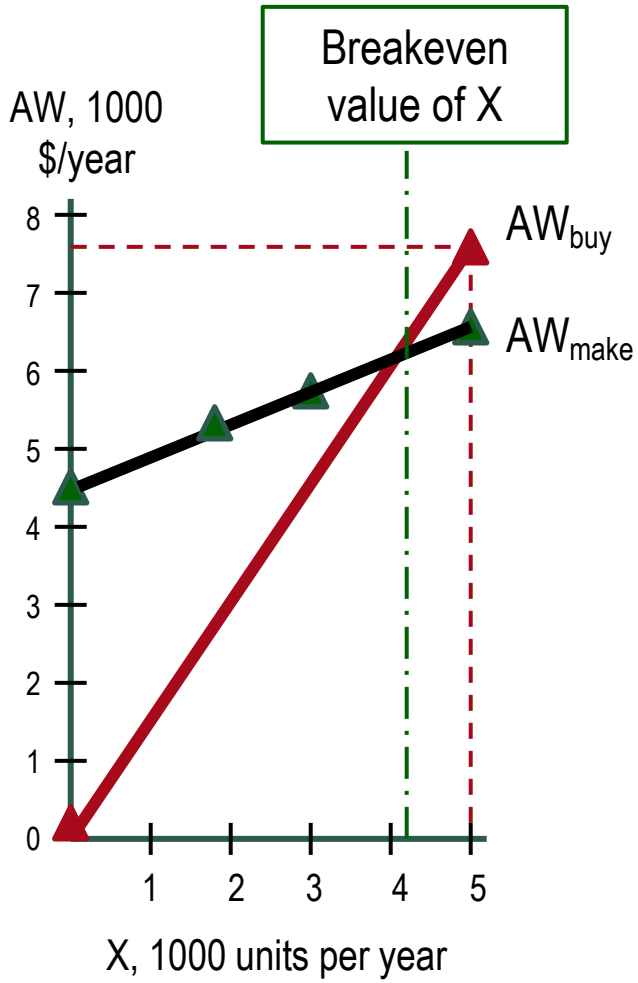
$$\mathbf{AW_{buy} = -1.5X}$$

Solution: Equate AW relations, solve for X

$$\mathbf{-1.5X = -4528 - 0.4X}$$

$$\mathbf{X = 4116 \text{ per year}}$$

If anticipated production $>$ 4116, select make alternative (lower variable cost)



Example 2. A Textile company is evaluating the purchase of an automatic cloth-cutting machine. The machine will have a first cost of $22000, a life of 10 years, and a $500 salvage value. The annual maintenance cost of the machine is expected to be $2000 per year. The machine will require one operator at a total cost of $24 an hour. Approximately 1500 meters of material can be cut each hour with the machine.

Alternatively, if human labor is used, five workers, each earning $10 an hour , can cut 1000 meters per hour.
If the company's MARR is 8% per year , and 180,000 meters of material is to be cut every year should the company buy the automatic machine or use human labor instead?

At how many meters cloth-cutting per year will the two alternatives breakeven?

Example 3. Two types of pumps are available. Pump X costs $800 and has a life of 3 years. It also requires rebuilding after 2000 operating hours at a cost of $300. Pump Y costs $1900 and is expected to last 5 years. It also requires overhaul after 8000 hours of operation at a cost of $700. If the operating cost of each pump is $1 per hour, how many hours per year must the pump be required to justify the purchase of pump Y? (Interest rate = 10% per year).

Example 3. Machine A has a fixed cost of $40000 per year and a variable cost of $60 per unit. Machine B has an unknown fixed cost, but with this process 200 units can be produced each month at a total variable cost of $2000. If the total costs of the two machines break even at a production rate of 2000 units per year, what is the fixed cost of machine B?

QUESTIONS?