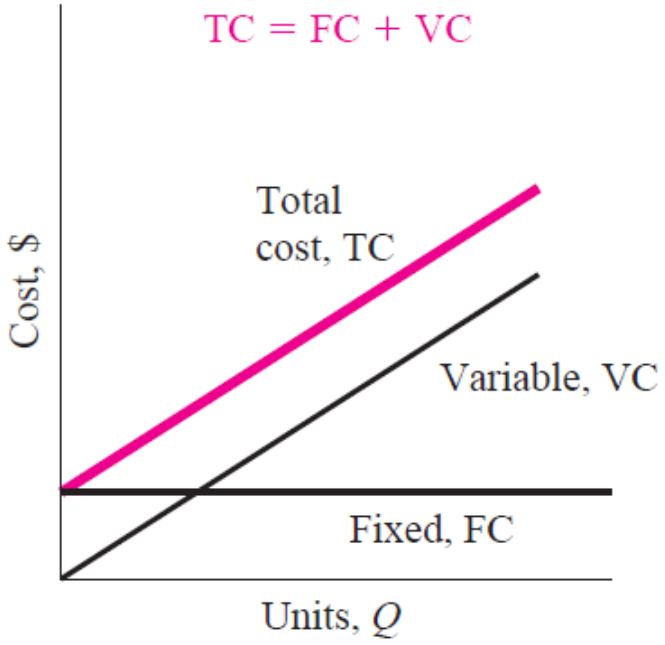
Faculty of Engineering
Mechanical Engineering Department

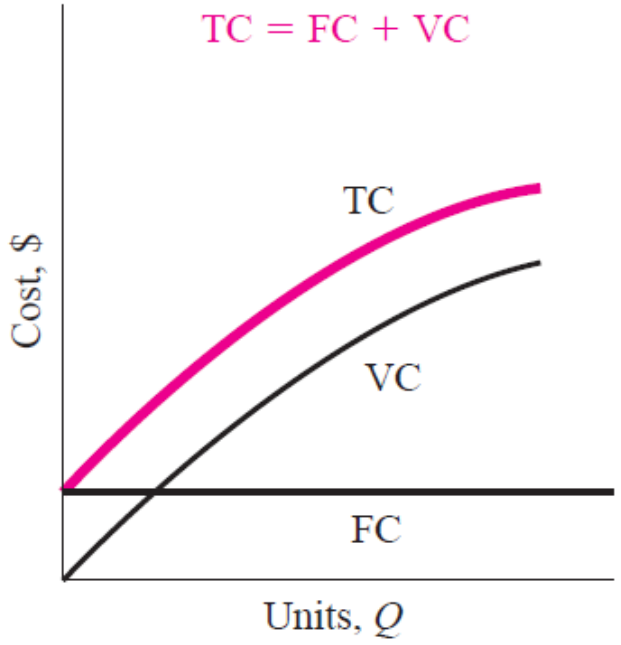
Breakeven and Payback Analysis

Breakeven Analysis

- Breakeven analysis determines the value of a parameter or decision variable that makes two relations equal.
- There are many forms of breakeven analysis; some equate PW or AW equivalence relations, some involve equating revenue and cost relations, others may equate demand and supply relations.
- However, they all have a common approach, that is, to equate two relations, or to set their difference equal to zero, and solve for the breakeven value of one variable that makes the equation true.

Linear and Nonlinear Costs





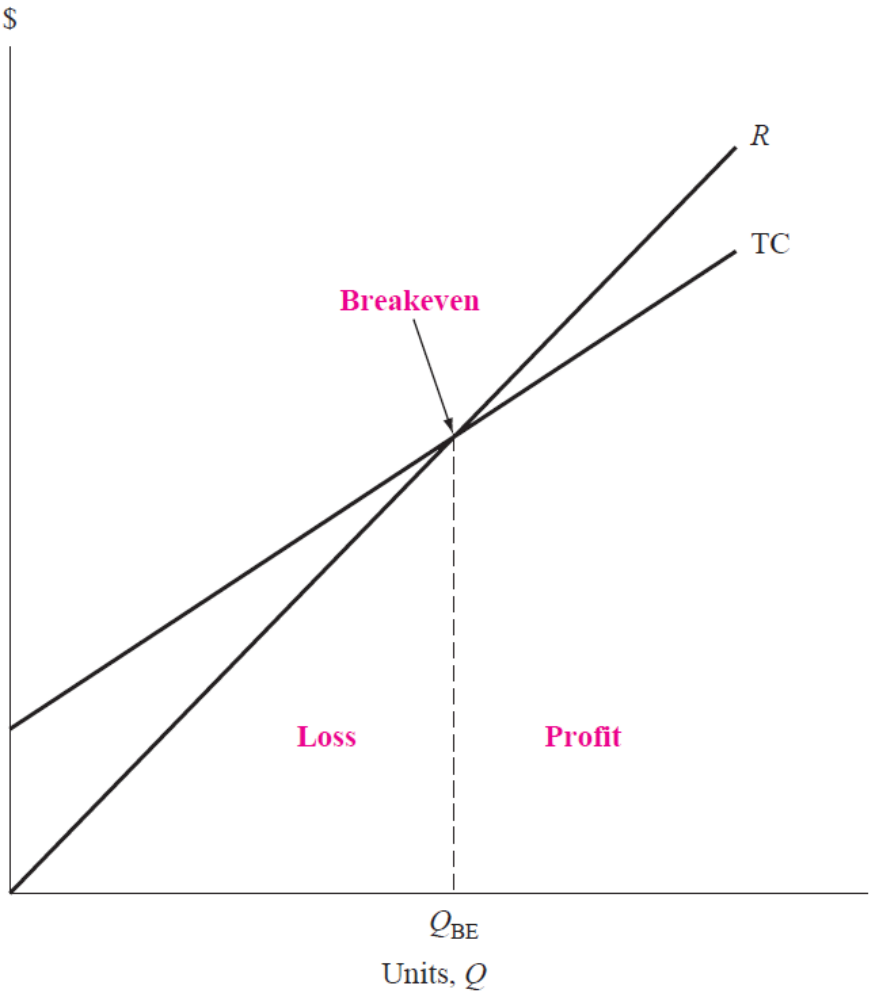
Fixed and Variable Costs

- Fixed Costs (FC)
  - buildings,
  - insurance,
  - minimum level of labor,
  - information systems.
- Variable Costs (VC)
  - direct labor,
  - subcontractors,
  - materials,
  - advertisement,
  - warranty.

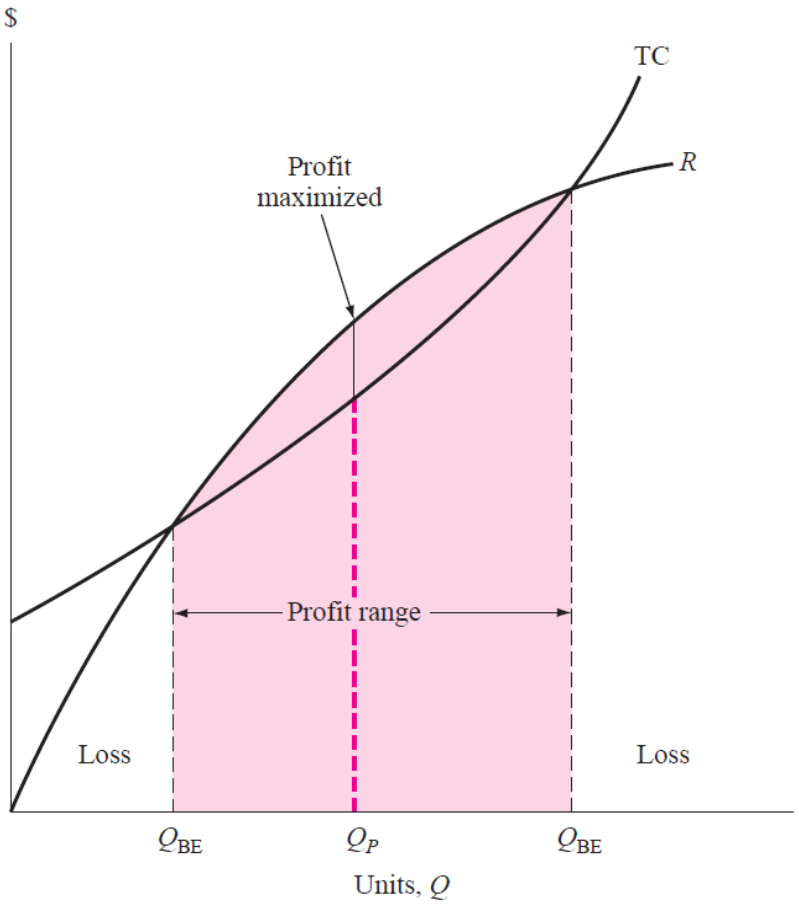
Breakeven Analysis for a Single Project

$$Q_{BE} = \frac{FC}{r - v}$$

Where: r = revenue per unit
v = variable cost per unit



Breakeven Analysis for a Single Project



Example 1

- The average monthly fixed cost for Nicholea Water LLC is $900, while each gallon costs 18¢ to purify and sells for 30¢. Determine the monthly sales volume needed to break even.
- **Solution**
- To determine the monthly breakeven quantity:

$$Q_{BE} = \frac{900}{0.30 - 0.18} = 7500$$

Payback Period Analysis

- Payback analysis is another form of sensitivity analysis that uses a PW equivalence relation.
- The payback period n_p is the time, usually in years, it will take for estimated revenues and other economic benefits *to recover the initial investment P and a specific rate of return i%*.
- To find the payback period at a stated rate i%, calculate the years n_p that make the following expression correct.

$$0 = -P + \sum_{t=1}^{t=n_p} \text{NCF}_t(P/F,i,t)$$

Example 2

- This year the founder of J&J Health allocated a total of $18 million to develop new treatment techniques for sickle cell anemia. The results are estimated to positively impact net cash flow starting 6 years from now and for the foreseeable future at an average level of $6 million per year. As an initial screening for economic viability, determine the payback period at i = 10%.

Example 2

- **Solution**

- The NCF for years 1 through 5 is $0 and $6 million thereafter. Let x = number of years beyond 5 when NCF > 0. For for i = 10%, and $ million units,

$$i = 10\%: \quad 0 = -18 + 5(0) + 6(P/A,10\%,x)\,(P/F,10\%,5)$$

$$(P/A,10\%,x) = \frac{18}{6\,(0.6209)} = 4.8317$$

$$x = 6.9$$

$$n_p = 5 + x = 5 + 7 = 12 \text{ years (rounded up)}$$