1.011 Project Evaluation

Cost & Revenue Functions

- Topics
  - Breakeven volume for making a profit (if prices are known and you are a "price taker")
  - Identifying a range of prices for which you can make a profit (assuming that demand varies with price)
  - Choosing prices to maximizing profit
  - Supply/demand/equilibrium - an overview
  - Present economy

Conditions for Profitability- Simple Linear Cost & Revenue Functions

- Cost = a + bV
- Price = P
- Revenue = PV
- Profit = PV - a - bV = (P-b)V - a
- Breakeven Volume = a/(P-b)
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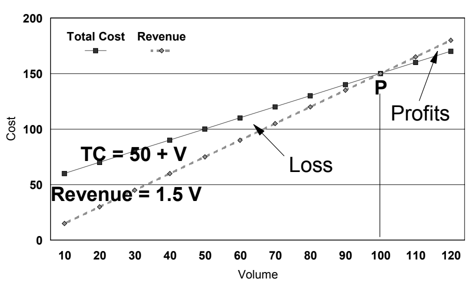
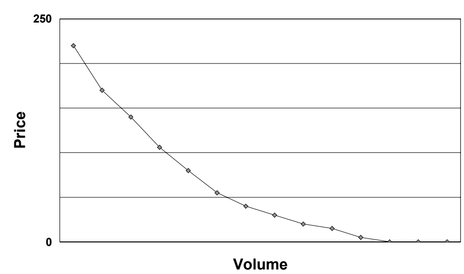
- Conditions for Positive Profits:
  - Price > variable cost
  - Volume greater than breakeven volume

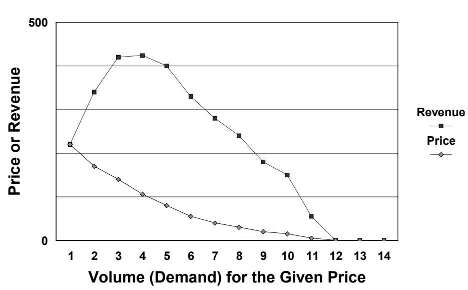
Breakeven Volume for Profitability Breakeven point P is where TR = TC



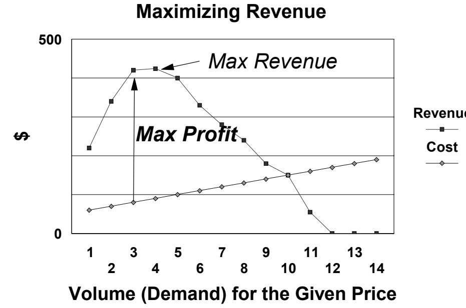
In General, Volume Varies With Price: The lower the price, the higher the volume



Total Revenue Also Varies With Price: Revenue Declines if Price is Too High or Too Low



Maximizing Profit is not the Same as Maximizing Revenue



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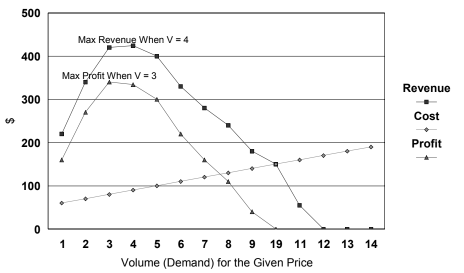
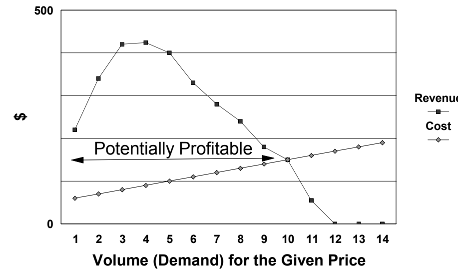
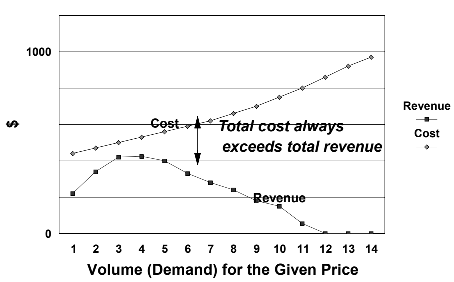


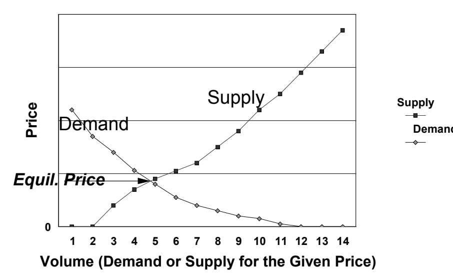
A Company Will Produce Only if its Expected Market Share Will Allow It to Make a Profit for Some Range of Prices



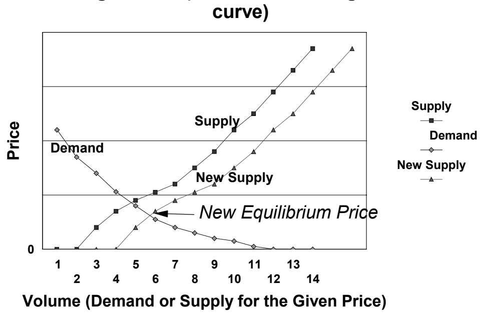
If costs are very high, then a company will be unable to make a profit for any range of prices



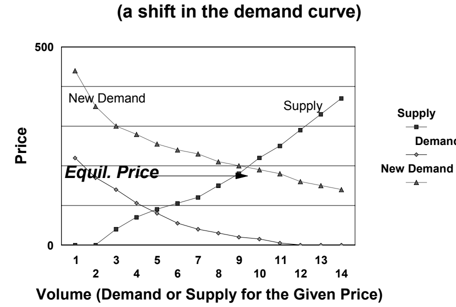
Prices Reflect an Equilibrium Between Supply and Demand



Investment may allow suppliers to offer lower prices, increasing volume (a movement along the demand curve)



Population Growth, Advertising, Higher Incomes, or other Factors May Cause an Increase in Demand (a shift in the demand curve)



How Does the Equilibration Work?

- If demand increases, and there isn't enough supply, then prices rise (or, in the case of some types of infrastructure, congestion and service delays get worse)
- If prices rise, then suppliers make more profits and are willing to increase production
- If production increases, then there may be some producers willing to cut prices to get more market share
- If demand declines, then prices drop and inefficient producers leave the business

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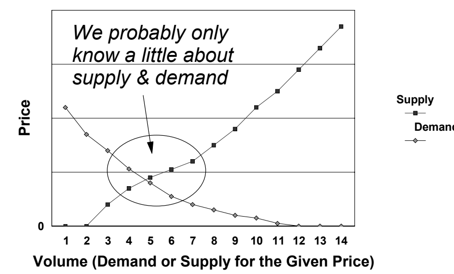

"Present" Economy

- A "present economy" study seeks to change the supply function by improving the production capabilities of the organization
- The term "Present" is used to indicate that we don't have to worry about expenditures over a long time horizon
- All costs and revenues are therefore in the same "current" dollars
- With a better supply function, we may be able to underprice competitors or create a new, profitable service

Cost Driven Optimization

- A basic design question may arise when some costs vary directly and others vary inversely with a particular, important design parameter (which is known as a "cost driver")
- Example 2-9 in Eng. Economy:
  - How fast should a scheduled aircraft fly?
    - Time is inversely proportional to speed
    - Cost increases with speed raised to the 3/2 power
  - Create an equation of total cost (actually, just consider the costs that vary with speed)
  - Use calculus to find the optimum

How Fast to Fly?

Cost Operations = $k\,v^{1.5}$, where v is speed in mph
= \$300/mile @ 400 mph
so that $k = \$300/(400^{1.5}) = \$0.0375$

If passenger time is \$300,000/hr, then

Pax time cost/flight = \$300,000 (miles/v)

$TC = \$0.0375(\text{miles})v^{1.5} + 300{,}000\ (\text{miles}/v)$

$d(TC)/dv = 0$ when $1.5\ (0.0375)\ v^{0.5} = 300{,}000/v^2$

$V^* = 491$ mph

How Fast to Fly?

- We are willing to spend more money to fly faster so long as the incremental value of time saved (and therefore the incremental price that we can charge the passengers) is higher)
- We can express our result as an equation:

$$v^* = [(\text{Pax Time Value/hr})/k]^{2/5}$$

Complicating Factors for Projects

- Long lives
  - Demand can change substantially
  - Competition from other suppliers and new technologies can be expected
  - The time value of money becomes critical
  - Externalities are important
- Unique projects
  - Difficult to test supply & demand
- Equilibration takes place through what may be slowly evolving changes in land use and location decisions by firms and individuals