# Introduction to Location Theory

ECON 166

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Lecture 4

# Agenda for Lecture 4

- Tales of Three Other Cities
- Introduction to Location Models

# Tales of Three Other Cities

- Develop a table similar to Tables 1.1-1.3 for one of the following three cities:
  - San Jose
  - San Francisco
  - Oakland
- Identify the sources of data and describe in sufficient detail the basis for disignating the "inner ring counties" and the "outer ring counties"
- Compare the results for the city you select with the results discussed in the text for NYC, LA, and Chicago

# Tale of Three Other Cities

- Replicate Table 1.4 for one of the following:
  - San Jose
  - San Francisco
  - Oakland

# Location Decisions, Agglomeration Economies, and the Origins of Cities

- Lessons in Basic Location Theory for a Firm
- Other Factors in the Location Decision
- Agglomeration Economies
- Static Theory of External Economies and Diseconomies
- Economic Origins of Urban Areas in the U.S.

# Lessons in Basic Location Theory for a Firm

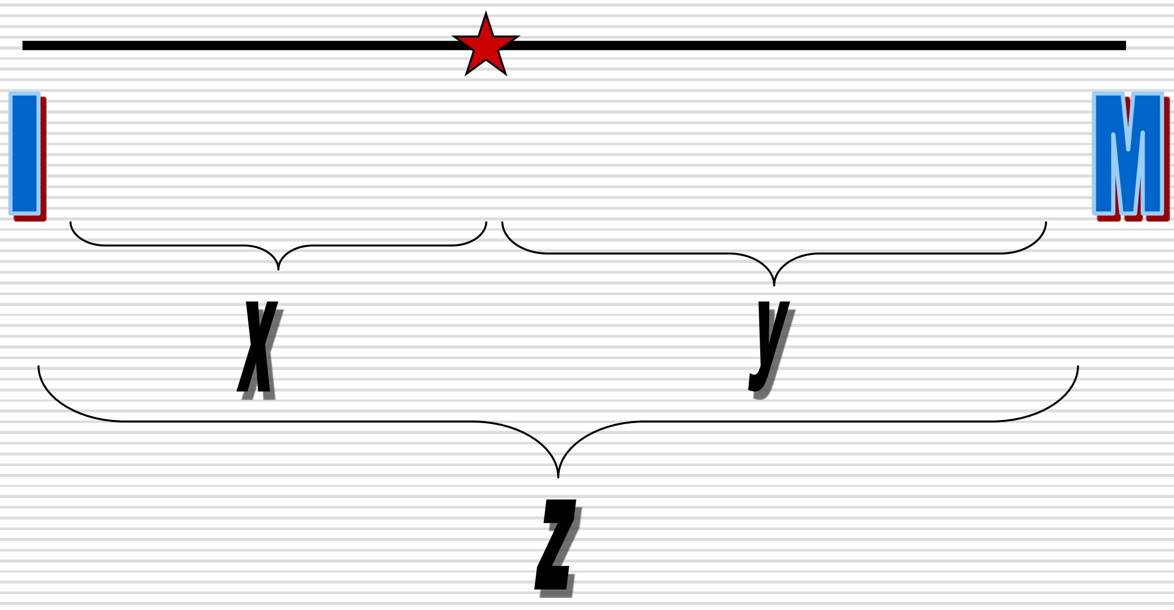
- Choose location that is the most profitable for
  - Assembling output from inputs
  - Distributing output to customers
- Simple models
  - One input, customers all located in one place
  - Input suppressed, customers in various locations

# One Input, One Market Model*

- Inputs are located at "I"
- Market is located at "M"
- Transportation cost per mile of moving 1.2 tons of raw lumber one mile): *a*
- Transportation cost per mile of moving 1.0 tons of firewood one mile): *b*

*** Assumes a 20% weight-losing process.**

# One Input, One Market Model



# One Input, One Market Model

continued

- $p$ = price of output at the market, point "M"
- $a$ = cost per mile of transporting 1.2 tons of raw lumber
- $b$ = cost per mile of transporting 1 ton of firewood
- $w$ = wage rate per unit of labor
- $L$ = amount of labor needed for one ton of firewood
- $R$ = price of raw lumber at the forest, point "I"
- $x$ = distance raw lumber is transported
- $y$ = distance firewood is transported
- $z = x + y$ = distance from "I" to "M"
- $Q$ = output of the firm
- $g$ = weight gain/loss factor (not included in Appendix model)

**Teaser Question:** **which of these variables are "endogenous" and which are "exogenous"?**

# One Input, One Market Model
continued

- Profit = TR – TC
  $=pQ-1.2RQ-wLQ-Q(1.2ax+by)$
- TR = $pQ$
- TC consists of
  - $1.2RQ$ = Cost of raw lumber
  - $wLQ$ = cost of labor
  - $Q(1.2ax+by)$ = transportation cost

# One Input, One Market Model
continued

- Profit Maximizing output $Q^*$ determined by:

  $$MR = MC$$

- $MR = p + Q(\Delta p/\Delta Q)$

- $MC = 1.2R + wL + 1.2ax + by$

# One Input, One Market Model
continued

- Profit Maximizing location corresponds to that location that minimizes transportation costs per unit of output

- Transportation cost per unit of output
  $= 1.2ax + by = 1.2ax + b(z\text{-}x)$
  $= (1.2a - b)x + bz$

- Graph the equation above
  - **Where is profit-maximizing location?**
  - **What determines the profit-maximizing location?**
  - **What can cause profit maximizing location to change?**

# More about Profit Maximization

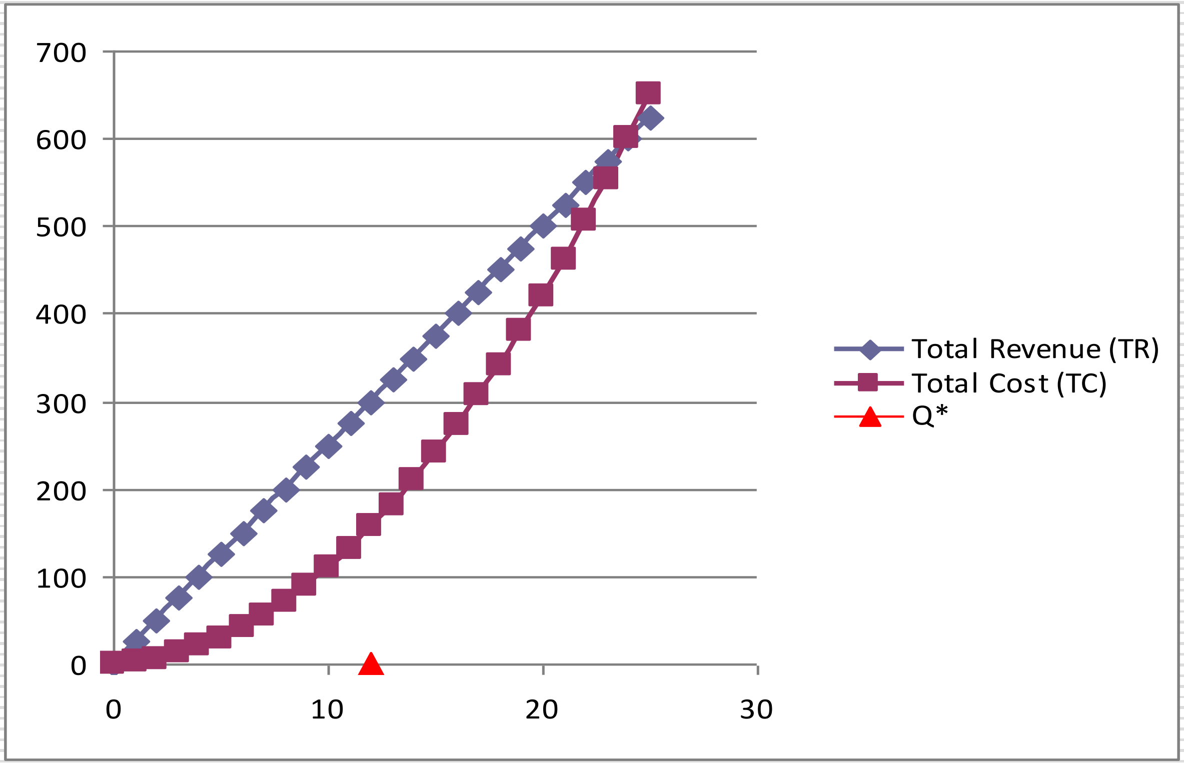
- Profit maximization when price depends on quantity (market-powerful firm)

- Profit maximization when price is given (independent of quantity) – perfectly competitive firm

# Profit Maximization

## Perfectly Competitive Firm – see ue_lecture_4.xls

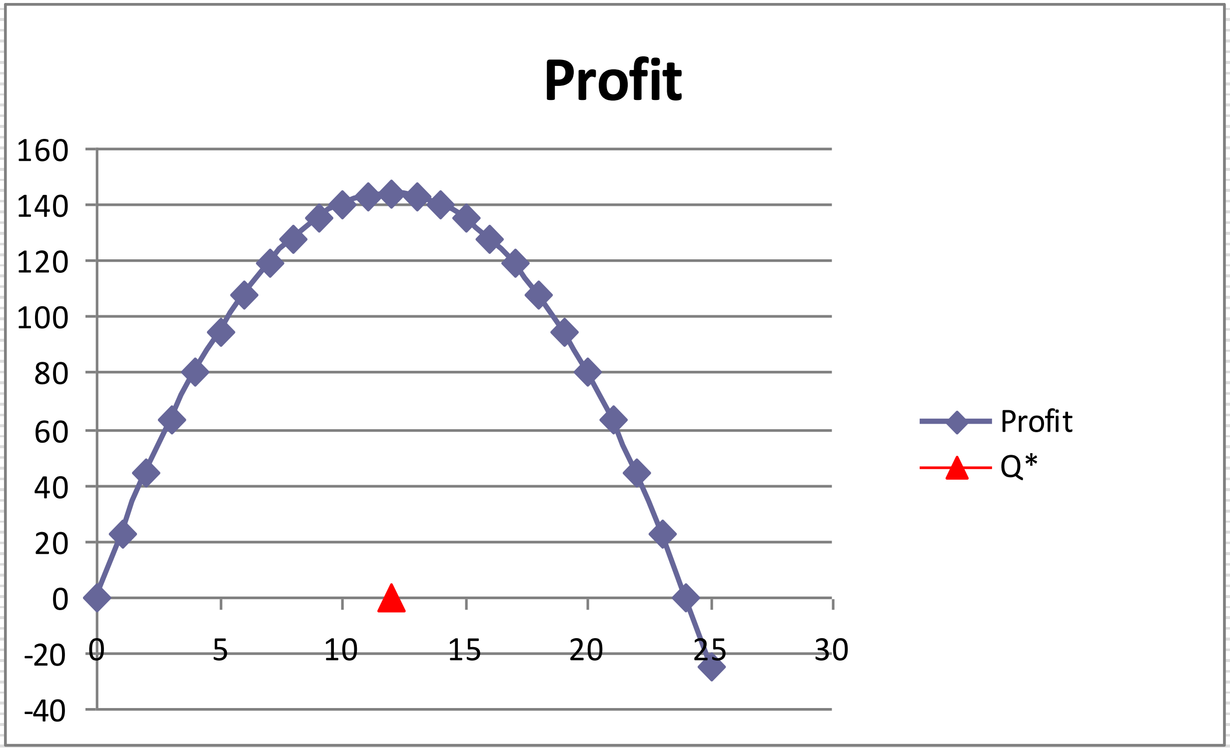
Total Revenue = *pQ*, where *p* is a constant, so TR is a straight line



# Profit Maximization

Perfectly Competitive Firm

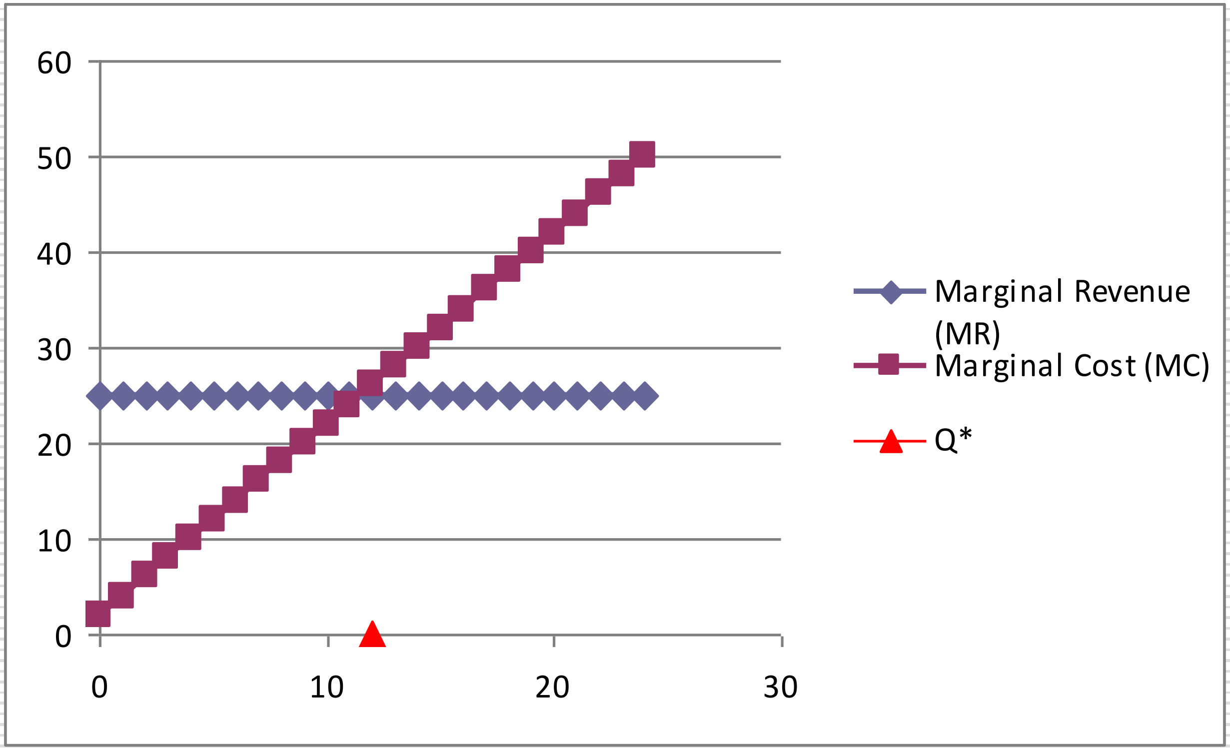
Profit = TR - TC



# Profit Maximization

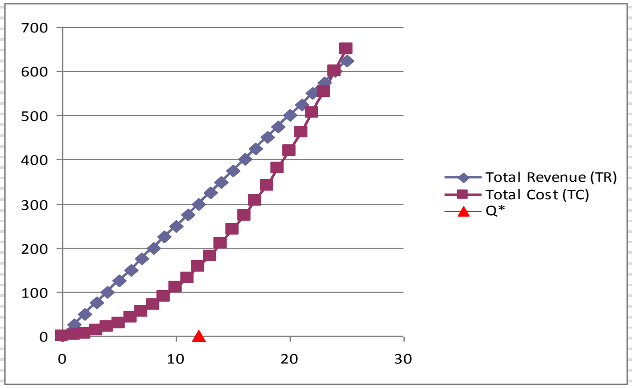
## Perfectly Competitive Firm

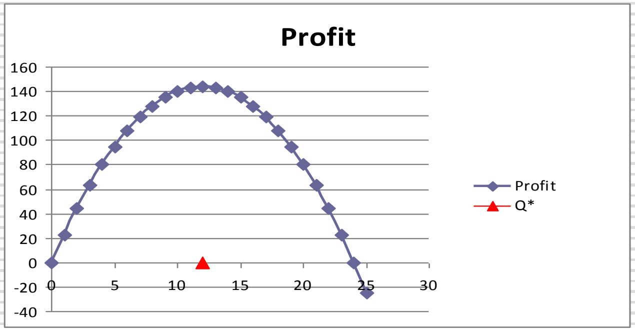
Marginal Revenue (MR)= Marginal Cost (MC)
Marginal Revenue is constant (horizontal line); Marginal Cost is increasing

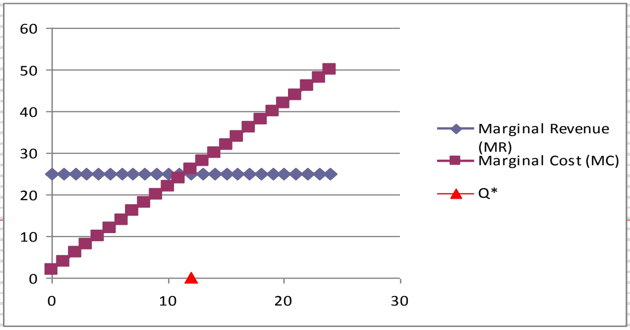


# Profit Maximization

## Perfectly Competitive Firm



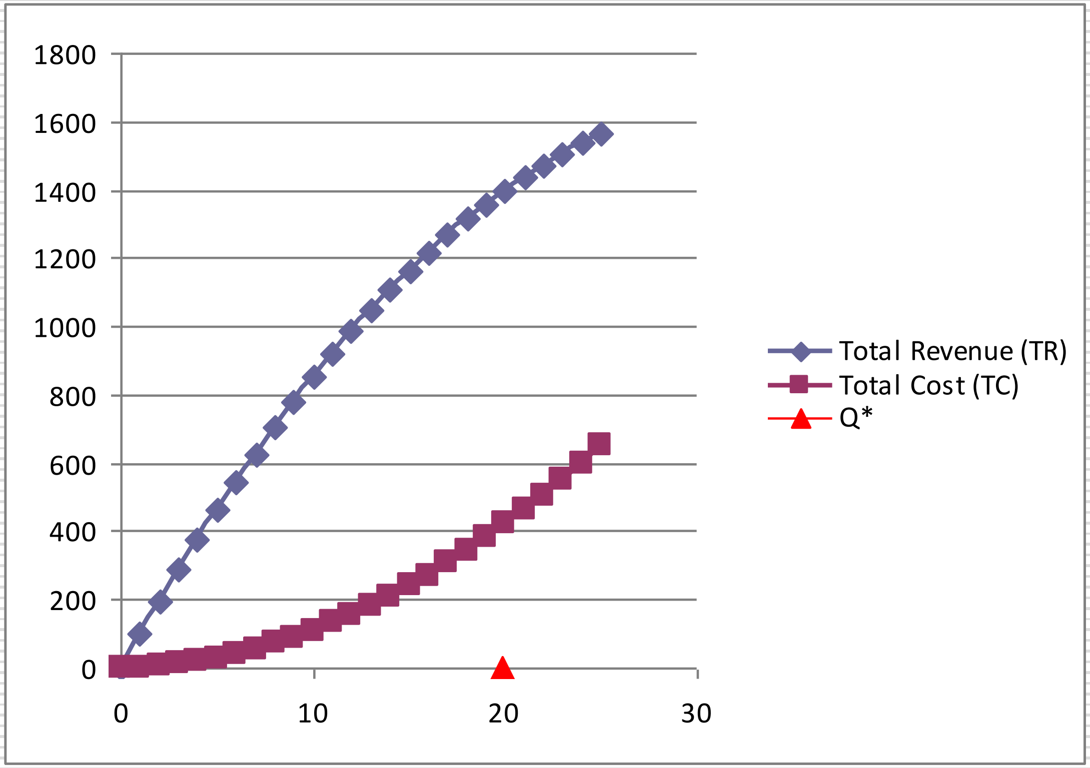



# Profit Maximization

## Market-Powerful (e.g., Monopolistically Competitive) Firm – see ue_lecture_4.xls

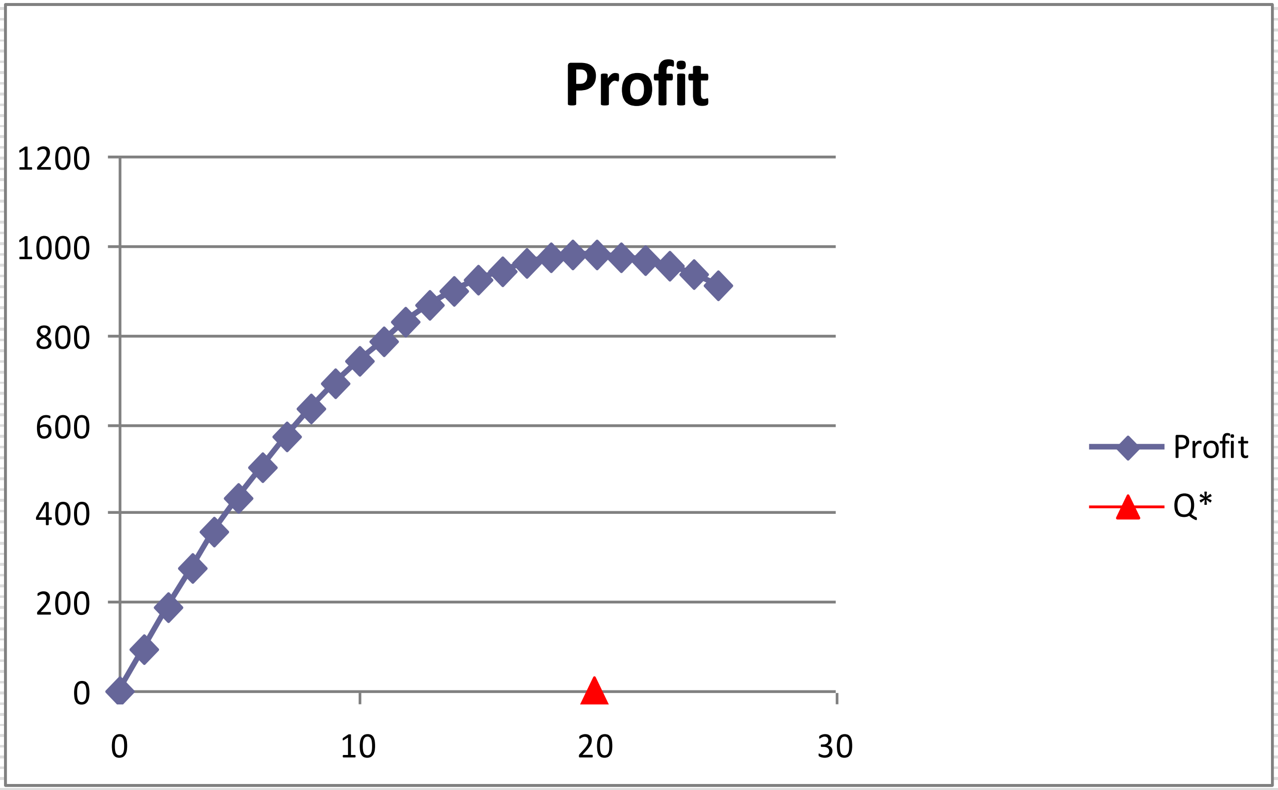
Total Revenue = *pQ*, where *p* depends on Q (the inverse demand curve), so TR is not a straight line



# Profit Maximization

## Market-Powerful (e.g., Monopolistically Competitive) Firm

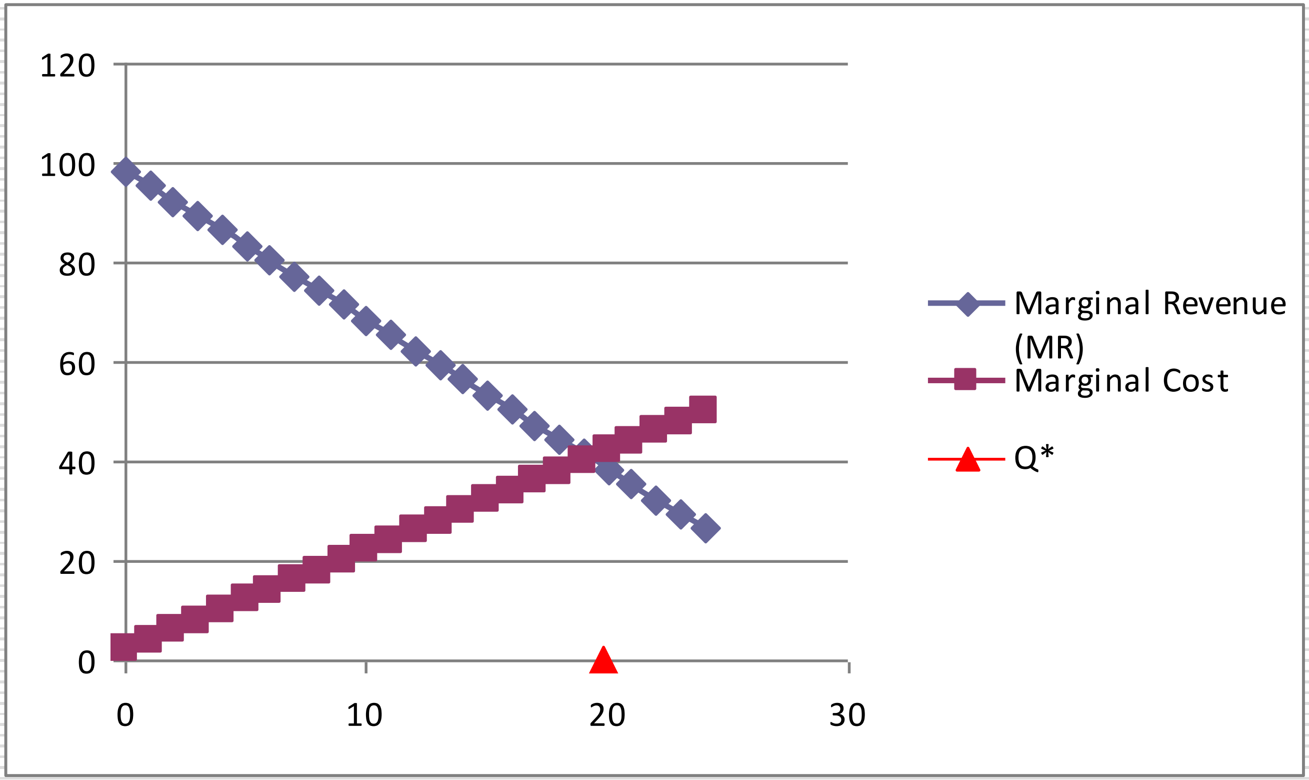
Profit = TR - TC



# Profit Maximization

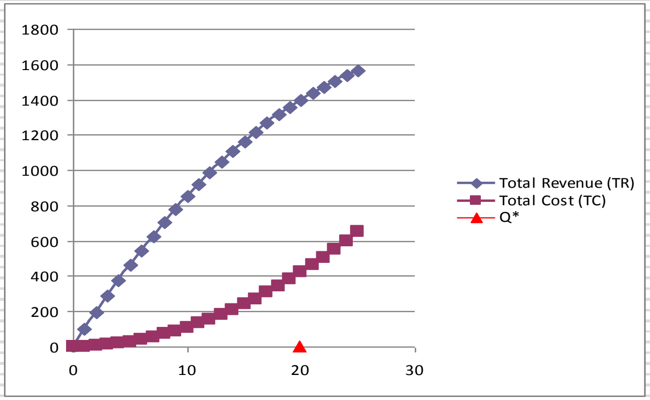
## Market-Powerful (e.g., Monopolistically Competitive) Firm

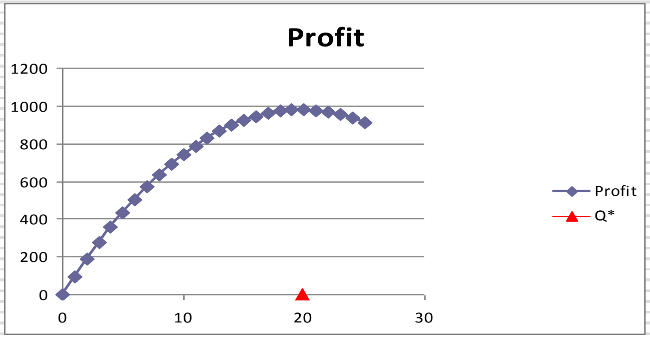
Maximum Profit occurs where MR = MC; MR is not constant

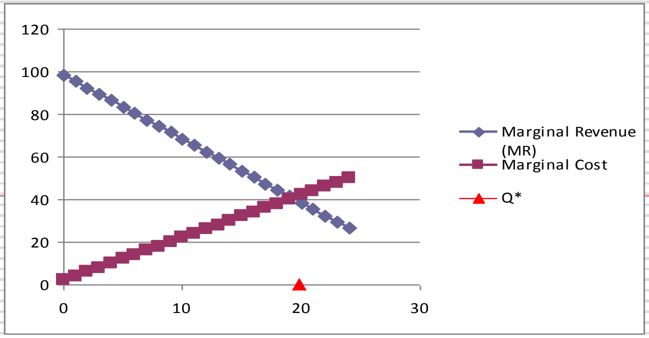


# Profit Maximization

## Market-Powerful (e.g., Monopolistically Competitive) Firm



# Long-run Equilibrium of the Firm

Long-run is that period of time when two conditions* are satisfied:

- *All* inputs are variable; in the short-run only *some* inputs are variable. This implies that in the long-run there is zero fixed cost.
- In the long-run entry has taken place; positive economic profits in the short-run are the signal for entry, so in the long-run there are zero economic profits (the Zero Profit Condition)

*** It is possible to conceptually distinguish these two conditions, so some people talk about the long-run as the period in which one or the the other but not both conditions are satisfied.**

# Long-run Equilibrium of the Firm

**continued**

- Nature of “economic profits” as opposed to “accounting profits”

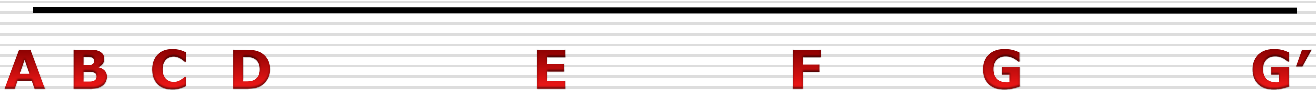
- How does *Zero Profit Condition* Work?

$$\text{Profit}(Q) = TR(Q) - TC(Q) = 0$$

**basically, p in TR expression adjusts downward with entry until economic profits are reduced to zero**

# Firms that distribute output to customers at various locations

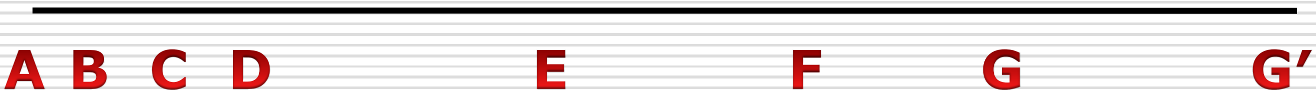
- Assumptions:  input and production costs do not vary by location
- Customers located along straight line (see illustration)




- Firm must choose *one* location for production
- One delivery per trip

# Principle of Median Location

- Transportation costs are minimized when the firm is located at the median location (ignoring G′ this is D)

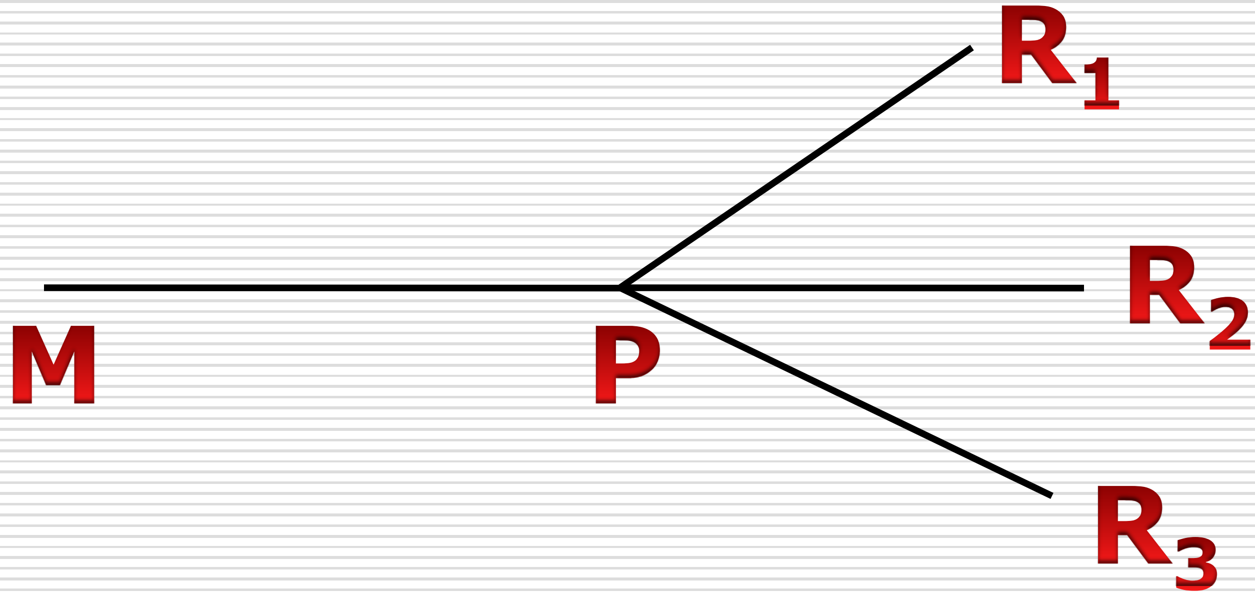



- Why does the principle of median location hold?*

# Lessons from the Principle of Median Location

- Location of the most distant customer does not alter the optimal location (if G moves to G′)
- Median location is indeterminate if there are an *even* number of customers
- Principle of median location can be reconciled with One Input, One Market Model
- Principle of median location gives rationale for growth of cities

# Port Cities



# Other Factors in Location Decisions*

- Labor Costs
- Other inputs:  energy, capital, land
- Intermediate inputs
- The knowledge input
- Taxes and public services

# Agglomeration Economies

- Agglomeration economies (traditional definition and categorization)
  - Economies of scale within the firm
  - Localization economies
  - Urbanization economies
  - Interindustry linkages
- Rosenthal and Strange (2003)
  - Industry (continuum)
  - Geographic (distance)
  - Temporal
  - Organization (structure) of industry

# Economies of Scale within the Firm

- Average cost declines when output increases at a given location
- What would an economy without scale economies be like?
- Implications of extent of scale economies for size of cities

# Localization Economies

- External to firm, related to size of local industry
- Definition of "industry"
- Specific to particular industries
- Shopping effects
- Economies of scale in the provision of inputs (labor, capital, services)

# Urbanization Economies of Scale

- Shopping economies
  - Diversity of goods and services
- Provision of inputs not specific to an industry
  - Diversity of goods and services
  - Urban infrastructure
    - Transportation facilities
    - WiFi network?
    - Cultural  and recreational amenities

# Empirical Evidence

- Henderson (1986)
- Rosenthal & Strange (2001)
- Henderson (2003)

# Static Theory of External Economies and Diseconomies

- Distinction between private costs/benefits and social costs/benefits
- Examples:
  - Pollution
  - congestion

# Localization Economies

- $TC = n(tc)$, where $n$ is the number of firms and $tc$ is the total cost of each firm
- $tc = q(ac)$, where $q$ is the output of each firm and $ac$ is the average cost of each firm
- $AC = TC/n = tc(n)/nq = tc/q = ac$
- $\Delta TC = \Delta nq(ac) + \Delta ac(nq) + \Delta qn(ac)$

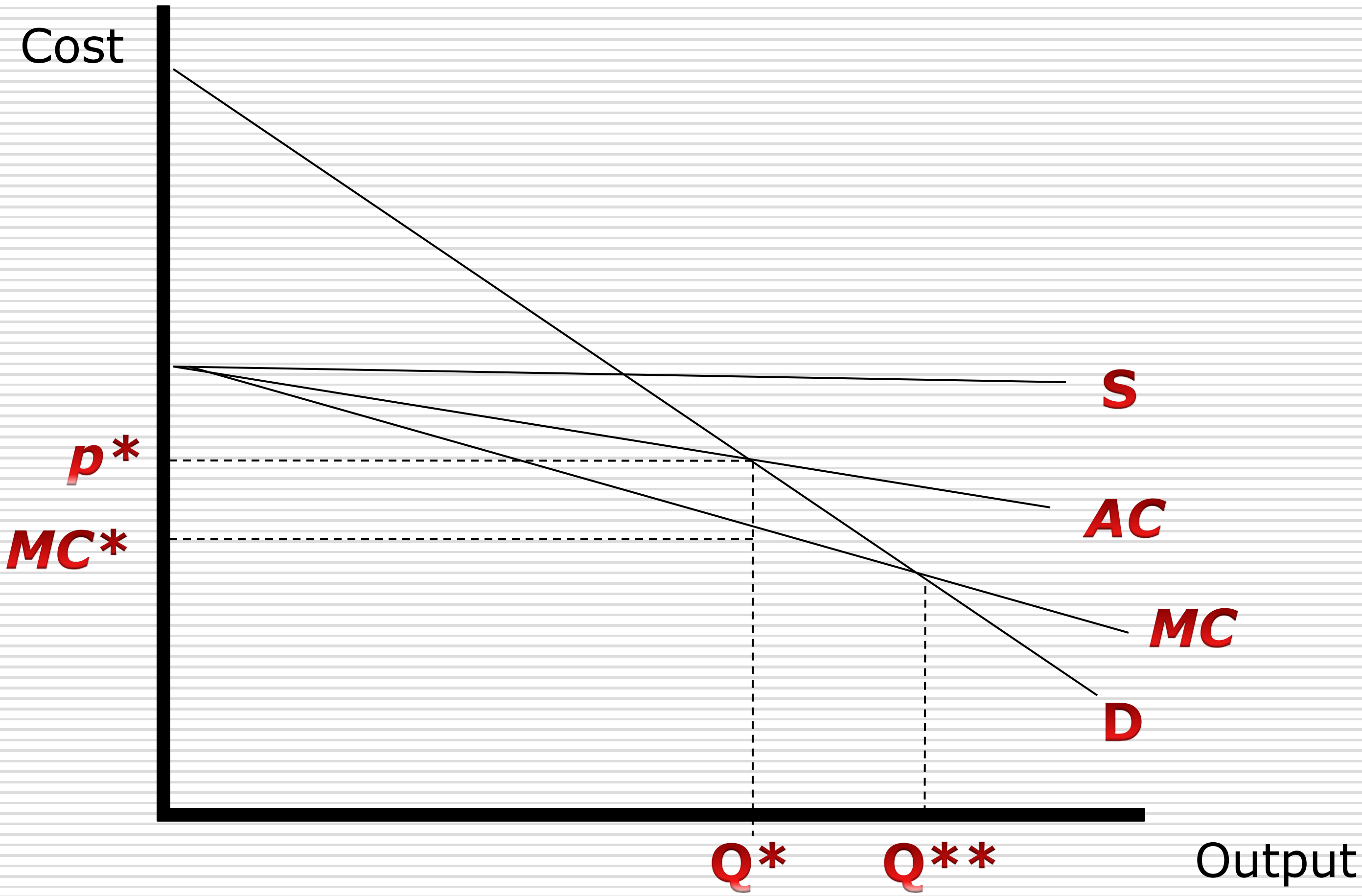
# Localization Economies **continued**

- $MC = (\Delta TC/\Delta n)/q$

  $= q(ac)/q + (\Delta ac/\Delta n)(nq)/q$

  $= AC + n(\Delta ac/\Delta n)$

# Localization Economies Figure 3.7



# End of Lecture 4