ECON 180

# Introduction to Principles of Microeconomics and Financial Project Evaluation

## Lecture 16: Supply and Demand

October 13, 2021

Version 1

# Required Reading

- Topic 3: Supply, Demand and Equilibrium in Hutchinson, E. (n.d.). *Principles of Microeconomics*. https://pressbooks.bccampus.ca/uvicecon103/
- Besanko/Brauetigam Chapter 2, section 2.1 (only) (Click on 'Chapters 1-8' for PDF
- Available for free at http://bcs.wiley.com/he-bcs/Books?action=chapter&bcsId=2164&itemId=0471457698&chapterId=14997

# Optional Readings

- Supply, demand and market equilibrium [Web Page]. (n.d.). https://www.khanacademy.org/economics-finance-domain/microeconomics/supply-demand-equilibrium
  - **Good for a 'second opinion' overview of the core ideas**.
- Their Uses before Alfred Marshall. *Federal Reserve Bank of Richmond Economic Review*, Mar/Apr 1992, 3-23. https://www.richmondfed.org/publications/research/economic_review/1992/er780201
  - **The early history of supply and demand diagrams.**

# Engineering Case Studies


- Bekkering, J., Broekhuis, A. A., van Gemert, W. J. T. & Hengeveld, E. J. (2013). Balancing gas supply and demand with a sustainable gas supply chain – A study based on field data. *Applied Energy, 111*, 842-852. https://doi-org.ezproxy.library.uvic.ca/10.1016/j.apenergy.2013.05.073
- Cardenas, L. M., Franco, C. J. & Dyner, I. (2016). Assessing emissions-mitigation energy policy under integrated supply and demand analysis: the Colombian case. *Journal of Cleaner Production, 112,* 3759-3773. https://doi-org.ezproxy.library.uvic.ca/10.1016/j.jclepro.2015.08.089
- Jiang, B. et al. (2020). Land management to reconcile ecosystem services supply and demand mismatches—A case study in Shanghai municipality, China. *Land Degradation & Development, 31*(17), 2684-2699. https://doi-org.ezproxy.library.uvic.ca/10.1002/ldr.3614
- Kikuchi, J., Kanematsu, Y., Ugo, M., Hamada, Y. & Okubo, T. (2015). Industrial Symbiosis Centered on a Regional Cogeneration Power Plant Utilizing Available Local Resources – A Case Study of Tanegashima. *Research and Analysis, 20*(2), 276-288. https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.12347
- Mi, L., Huang, L., Han, Z., Miao, H. & Wu, F. (2021). Forecasting and evaluating emerging technologies based on supply and demand matching – a case study of China's gerontechnology. *Technology Analysis & Strategic Management*. https://doi-org.ezproxy.library.uvic.ca/10.1080/09537325.2021.1895982
- Staffell, I. & Pfenniger, S. (2018). The increasing impact of weather on electricity supply and demand. *Energy, 145*, 65-78. https://doi-org.ezproxy.library.uvic.ca/10.1016/j.energy.2017.12.051

# Learning Objectives

- Understand what a market is.
- Understand what a demand curve is, and why it slopes upward.
- Understand what a supply curve is, and why it slopes downward.
- Be able to draw a simple supply and demand diagram.
- Understand the significance of and be able to find the market equilibrium price and quantity.
- Understand what happens if there is a price floor.
- Understand what happens if there is a price ceiling.

# Relevant Solved Problems

- Besanko/Brauetigam, Chapter 2: See Coursespaces for a large number of original solutions to relevant end-of-chapter problems in this text. They're found in the same folder as the publisher solutions for the main textbook.

# ESSENTIALS (18 slides)

# Where do prices come from? Road map

- As an engineer and person, you'll buy stuff and you'll sell stuff.
- You have to pay for that stuff – either in cash, or in giving up something else.
- There's always a *price*, and those prices keep changing.
- Over the next few lectures, we'll develop tools to help you tell *how* those prices will change, *why*, and who'll end up shouldering most of a higher cost or enjoying the benefits of cheaper production.
- First, today: buyers, sellers, what happens when they meet, and what happens when you tell them not to stand so close (metaphorically).
- Next: what happens when you throw random events into the mix.
- Finally: how to tell how much *your* costs will rise when your supplier faces higher production costs, and how to measure inflation (a rise in *all* prices).

# What's a market?

- A **market** is where **sellers** meet **buyers** to trade **a good** (or service).
- It doesn't have to be a literal meeting!
- Also, a literal market usually isn't a market in this sense:
  *the market for toothpaste* includes toothpaste sold everywhere.
- The result of this meeting: a **quantity**, **Q**, of a good is sold at a **price**, **P**.
- (It gets MUCH more complicated than this – we're sticking to the basics.)
- Lots of stuff is involved in buying and selling a good.
- For this lecture, all we're going to care about is **P**.

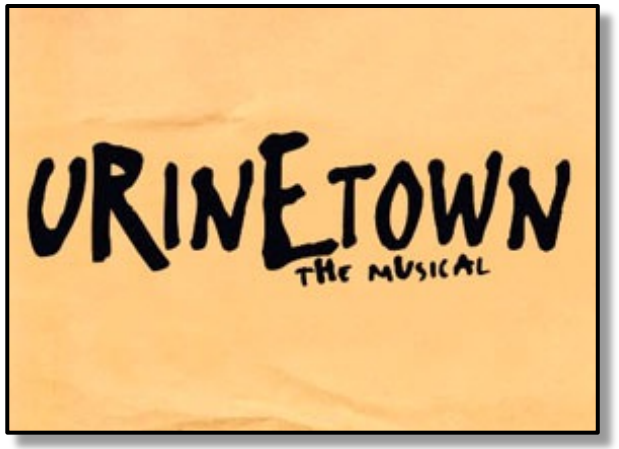
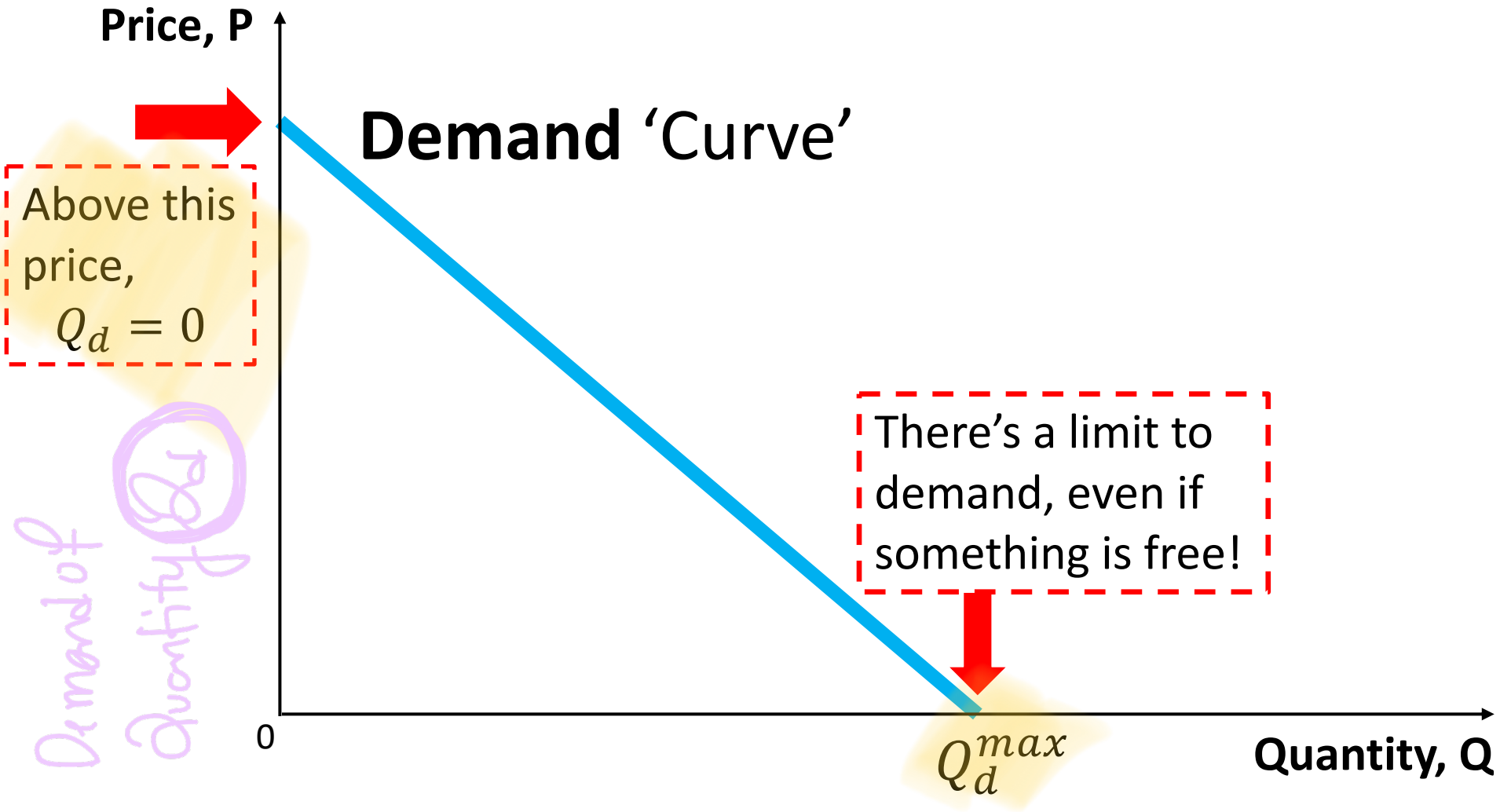



Image Source: https://www.josef-weinberger.com/musicals/musical/urinetown.html

# How buyers behave

- Buyers **demand** goods that are affordable (or they wouldn't be buyers) and that they want (or they wouldn't bother buying).
- That's important: in a market, there's only **demand** for a good if buyers are willing *and* able to buy it. (Starving AND broke? You don't demand food.)
- Buyers LIKE cheap or free stuff, and DISLIKE high prices.
- The lower the price, the higher the **quantity demanded** (the 'Law of Demand')
- Apples are half off at Thrifty's? People who buy apples at full price may now buy MORE apples, and people who bought pears may switch to apples.
- In math: Quantity demanded = $Q_d(P)$, and $\frac{dQ_d(P)}{dP} \leq 0$

# Buyer behavior graphed ($P(Q_d)$, or *inverse demand*)



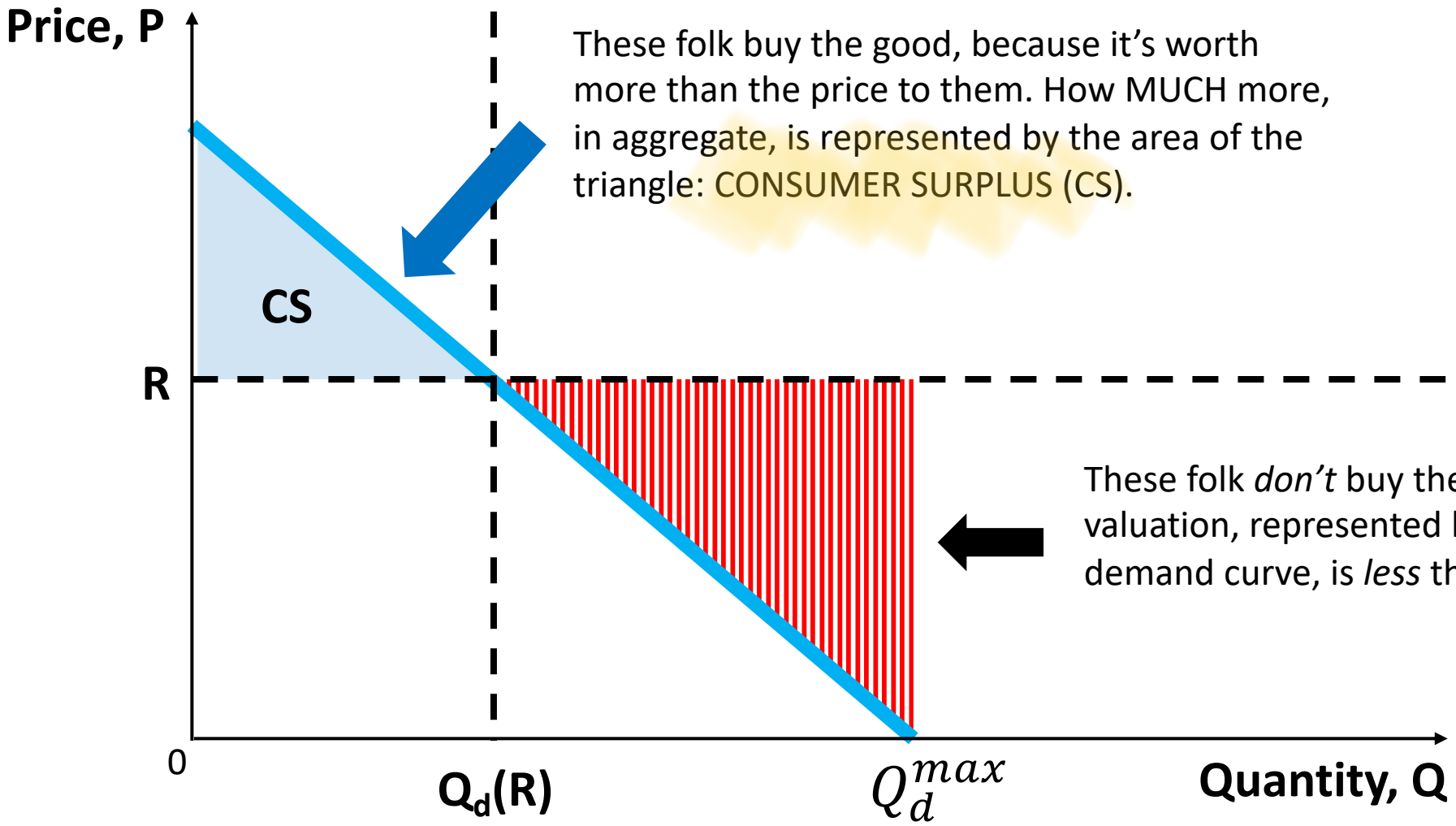

**Augustine Cournot**

He's why we plot P(Q), not Q(P).
(It seemed like a good idea at the time.)

# A crucial point: What determines the slope?

- If someone shows up on our demand curve, it's because…
- *Their opportunity costs are being met*.
- (I'll show exactly what I mean by this on the next slide with a diagram.)
- If they're on the demand curve, then it's because of ALL the possible uses of their resources (for our diagrams, usually $), THIS is the best one.
- If they have something better to do with their resources, they wouldn't show up on our diagram – they'd show up on some other market's diagram.
- The more things a consumer sees as *substitutes* for your good, the flatter the demand curve is: raise price a little bit and they'll go to the next best option.
- The more *options* a consumer has of things to do with their resources, the flatter the demand curve is: if you raise your price too far, maybe they'll buy an imported good, or pay for an online course, or sponsor a local food bank.
- We'll look at this in a lot more depth next lecture. For now, it's fine to focus on the demand curve being downward-sloping.

# Suppose the price is R>0 such that $Q_d(R)>0$



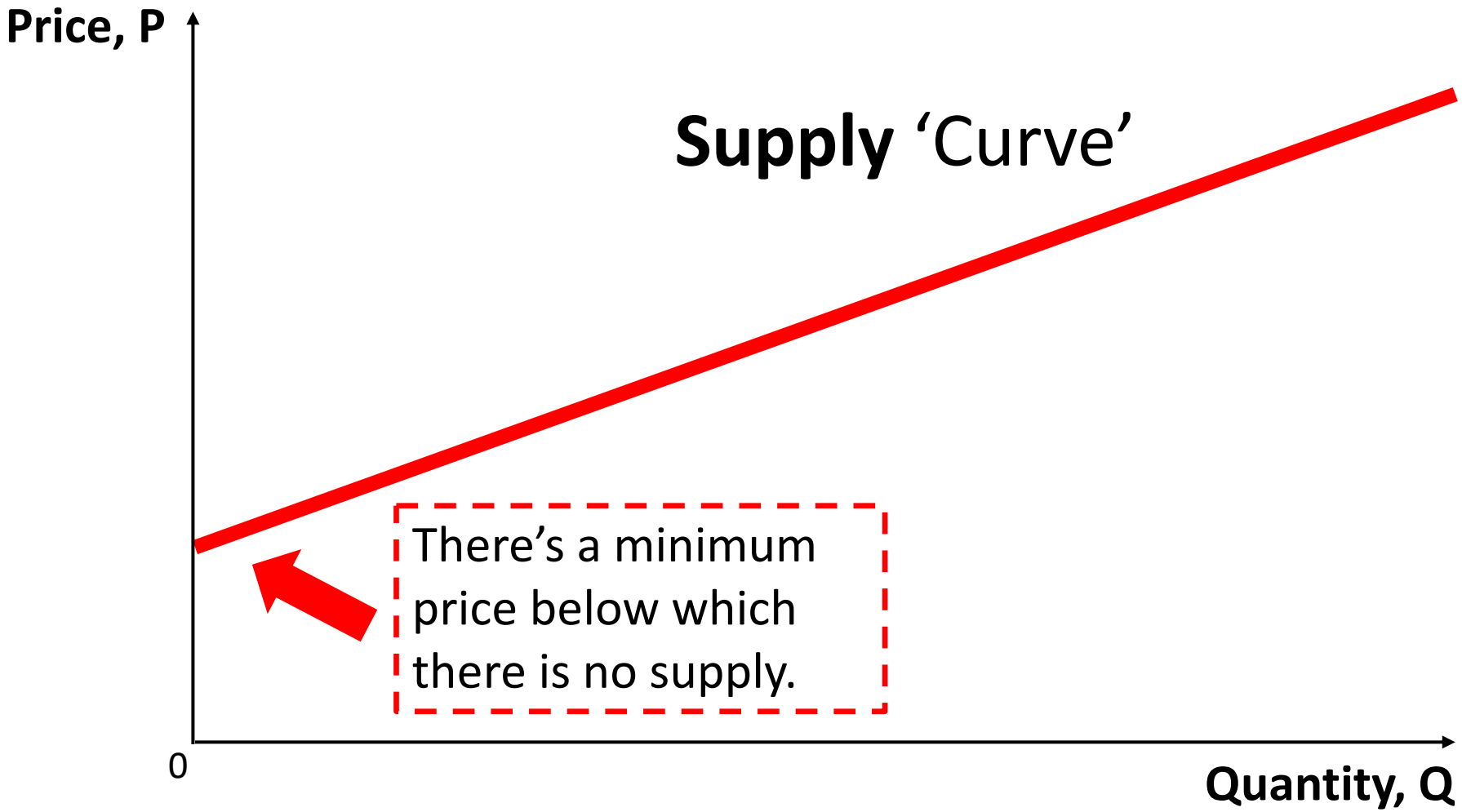

These folk buy the good, because it's worth more than the price to them. How MUCH more, in aggregate, is represented by the area of the triangle: CONSUMER SURPLUS (CS).

These folk *don't* buy the good, because their valuation, represented by the height of the demand curve, is *less* than the price R.

# How sellers behave

- Sellers **supply** goods they are willing and able to offer for sale. (Do most Kickstarter projects supply anything? Something to think about!)
- Sellers LIKE to get paid high prices for their goods, and they DISLIKE low prices, especially if those prices are below cost.
- At very low prices, only the lowest-cost sellers can make a profit, and even they may have better things to do. The **quantity supplied** is low.
- As prices rise, higher-cost sellers are able to offer the good, and sellers who were able to supply the good at lower prices may expand production. **Quantity supplied** rises.
- In math: Quantity supplied = $Q_s(P)$, and $\frac{dQ_s(P)}{dP} \geq 0$

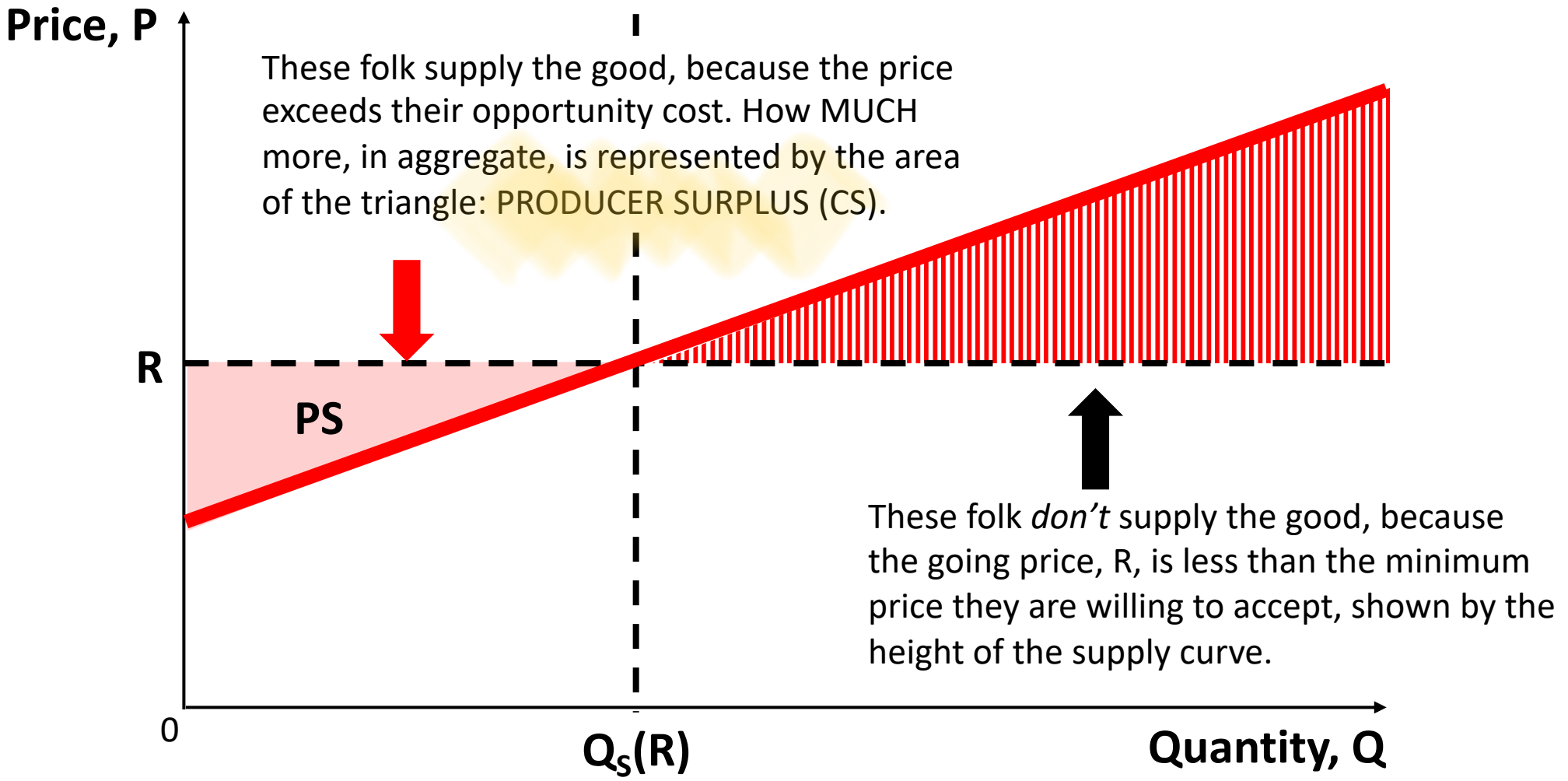
# Seller behavior graphed ($P(Q_s)$, or *inverse supply*)



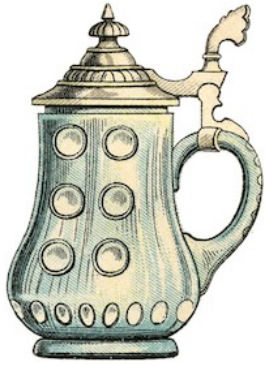
# A crucial point: what determines the slope?

- If a seller shows up on our supply curve, it's because…
- *Their opportunity costs are being met*.
- (I'll show exactly what I mean by this on the next slide with a diagram.)
- If they're on the supply curve, then it's because of ALL the possible uses of their resources, THIS is the best one. (They're earning at least the MARR.)
- If they had a better option, they wouldn't show up on our supply diagram – they'd be doing THAT, instead.
- The fewer *options* firms have of things to do with their resources, the steeper the supply curve is: if you know you planted a field of wheat, and you have to sell all the wheat you harvest, no matter what, then you're always going to supply the same quantity of wheat, even if there's a big price drop.
- (In some cases, we might perversely see MORE quantity supplied, as people scramble to obtain the bare minimum of cash they need to survive.)
- But if sellers have LOTS of options? Maybe they're owners of versatile factories that can be easily re-tooled? If fidget spinners are out and selfie sticks are in, you'll exit the fidget spinner market and switch to selfie sticks.
- We'll look at this in a lot more depth next lecture. For now, it's fine to focus on the supply curve being upward-sloping.

# Suppose the price is R>0 such that $Q_S(R)>0$

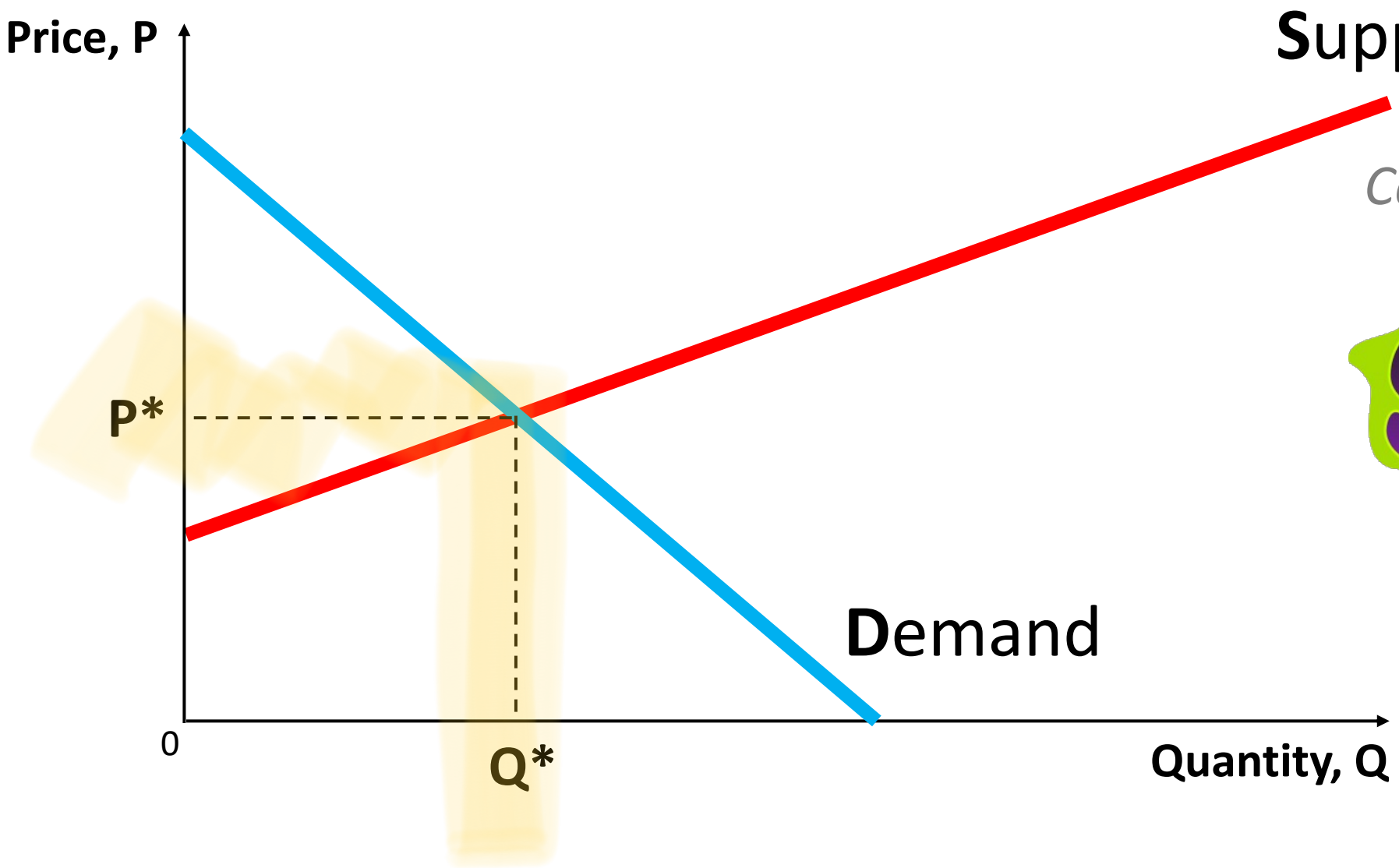


# How buyers + sellers behave



- Let's put our buyers and sellers of, say, beer steins together.
- Suppose we start at a price of $0. A finite but large number of people, even non-beer-drinkers, will **demand** the free mug. They are able to pay nothing ($0), and they want it. However, few if any sellers will be willing and able to **supply** the mug for free.
- When **P** = $0, **Quantity demanded** is greater than **quantity supplied**. $Q_d > Q_s$
- Now suppose a beer stein – ANY beer stein, since we're looking at *the* market for beer steins – costs $1,000,000.
- A finite but large number of people, even non-ceramics-workers, will happily **supply** the free mug. For $1,000,000, they can make it work. However, very few (if any) people will be willing and able to buy the stein.
- **Quantity supplied** is greater than **quantity demanded**.
- When P = $1m, quantity supplied is greater than quantity demanded. $Q_s > Q_d$
- Let's connect the dots.

# Let’s graph it




*Can’t remember it?*

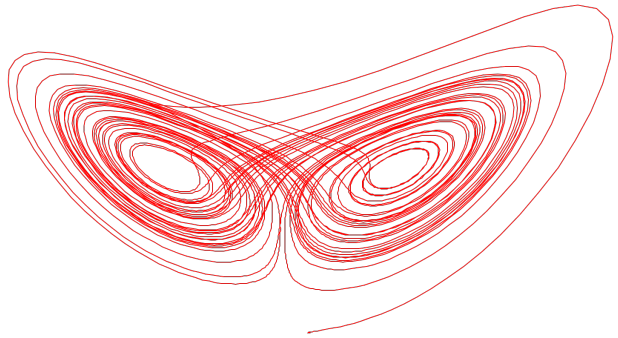



*Not even for a Scooby Snack?*

# Equilibrium

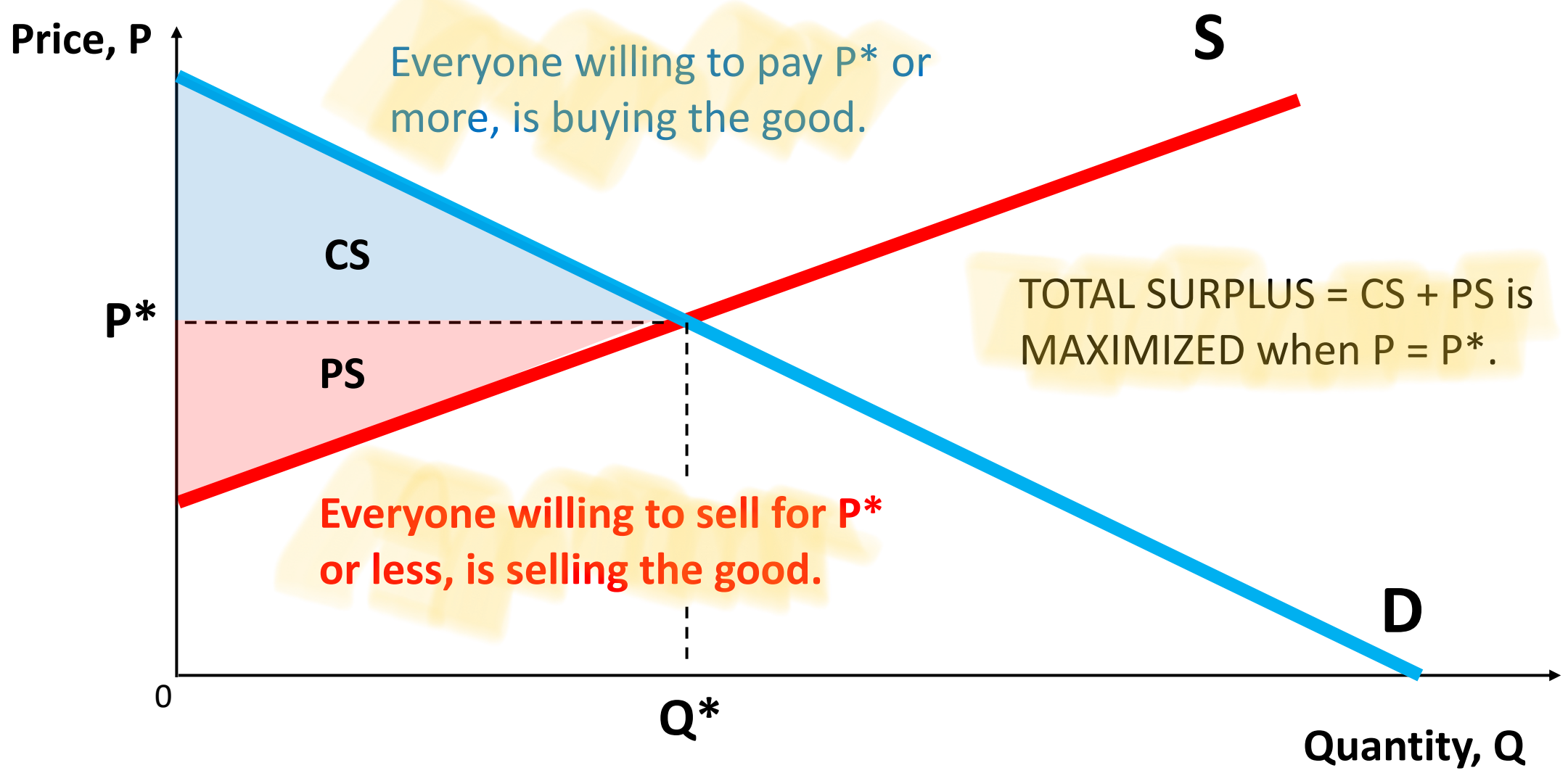
- Where **Quantity Supplied** = **Quantity Demanded**,we have equilibrium.
- P* and Q* are the **equilibrium price** and **equilibrium quantity**.
- From the Latin: *aequi* + *libra* = equal + weights
- We have two equations, and two unknowns → we can solve the system for equilibrium values.
- Wait… don't we only have *one* equation, $Q_s(P^*) = Q_d(P^*)$ ?
- We also have $Q^* = Q_s\ (P^*)$ and $Q^* = Q_D\ (P^*)$. Either will work.
- Since quantity demanded falls with price, and quantity supplied rises with price, in our examples we'll have one solution (if any).

# Equilibrium is stable



- The supply and demand equilibrium is a stable attractor.
- (As long as only price and quantity have the freedom to change. More later.)
- If the market *isn't* at equilibrium, it will try to move toward it.
- That's huge!  It lets us predict what will happen to prices and quantities sold.
- Suppose we start with P < P*.  People want to buy more than is available for sale.  There's a shortage of goods.  Some buyers will offer to pay more. P rises.
- Suppose P > P*.  More goods are for sale than people are willing to pay for. Unsold inventory piles up.  Sellers run sales to move unsold stock (especially perishables!).  P falls.
- In both cases, P naturally moves toward P*

# Equilibrium and Surplus



# *This* equilibrium maximizes surplus

- Remember what economics studies: the allocation of limited resources among unlimited needs & wants.
- Suppose a well-meaning planner wants to set the appropriate quantity of a particular good or service for society to produce. What basic rules should they follow?
- A first step: Anyone who is values the good at more than it costs to produce, should be able to get the good.
- The surplus to *society* (buyers + sellers) from an exchange between a buyer and a seller is (valuation of the buyer) – (cost of the resources)
- (Ideally, you'd measure the *opportunity cost* of the resources, and include things like the cost of pollution, poor working conditions, etc. in the 'cost of resources'. In practice, this is not done as often as it should be.)
- Total benefit = (benefit to consumers) + (benefit to producers)
- Total benefit = Consumer Surplus + Producer Surplus
- Total benefit = (Valuation – Price) + (Price – Cost) = Valuation – Cost.

# So you want to maximize society's surplus…

- You happen to have accurate lists of valuations and opportunity costs for each of the potential buyers & potential sellers.
- How would you make sure you maximized society's total benefit?
- (Society = Everyone: here, buyers + sellers; richer models can include other stakeholders.)
- You want to maximize (valuation – opportunity cost of resources)…
- →Ask the buyers to stand in a line in descending order of valuation, and the sellers to stand in a line in ascending order of cost.
- Then you ask them to pair off in order.
- The first pair would give you the highest total surplus (highest valuation paired with lowest cost), the next would bring in less…
- And you'd STOP when the valuation and cost were JUST equal, because the next pair would have a valuation LESS than cost.
- This is pretty much what we're doing with our supply & demand curves.

# What happens if we *don't* see P=P*?

- We'll find out next lecture!

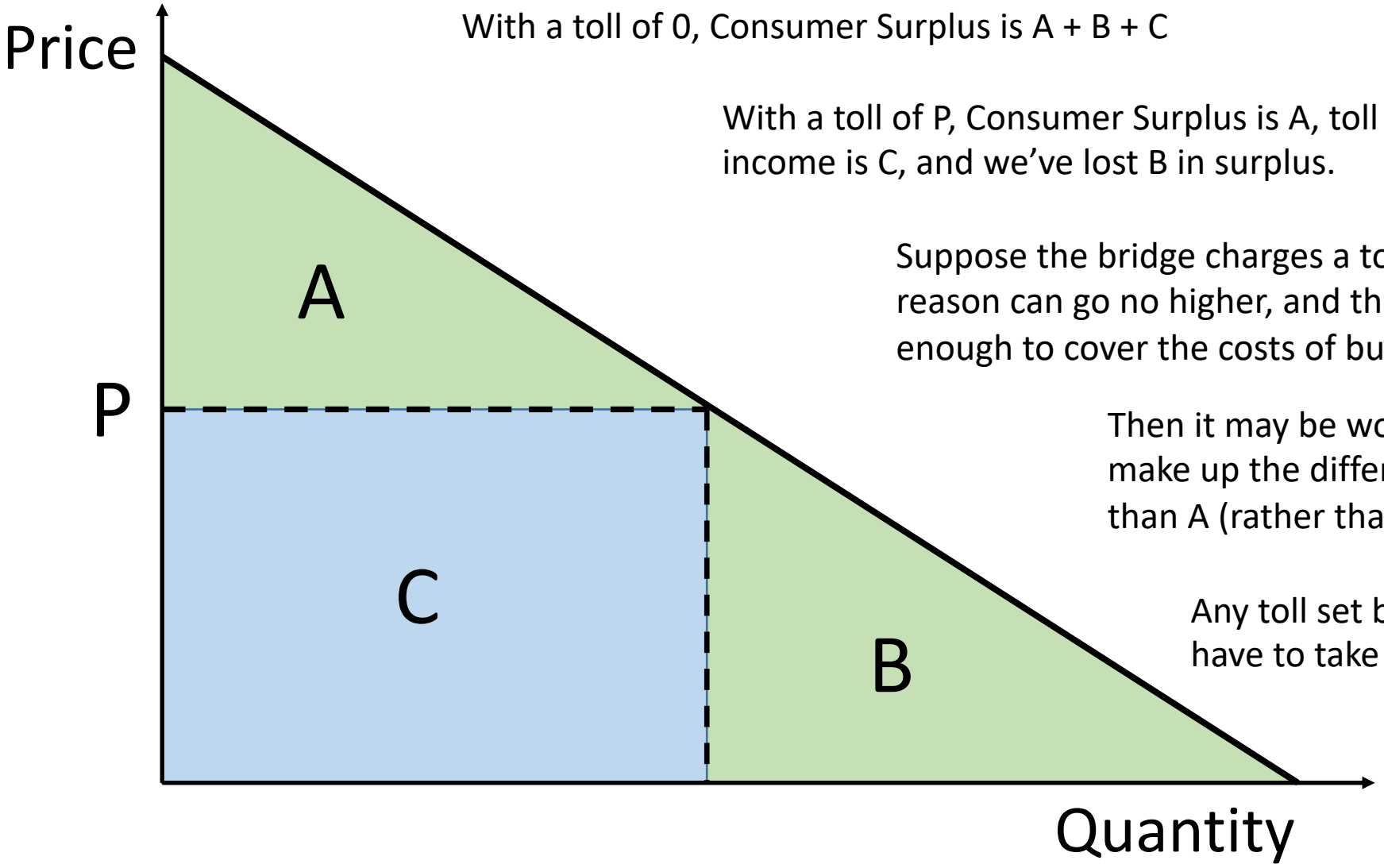
# AFTER HOURS

- The trouble with consumer surplus (6 slides)

# Consumer Surplus and its origins

- Consumer surplus is often used (e.g. in competition law) as a measure of the well-being, or 'welfare', of consumers.
- First developed for a cost-benefit analysis…
- ...by a French engineer named Jules Dupuit in the 1840s!
- He was trying to justify the building of public works (such as a bridge).
- Even if tolls were to be charged on the bridge, they wouldn't pay for the cost of construction for a long time…
- ...BUT, intuitively, society would benefit.
- Dupuit pictured travellers lining up at the bridge each morning, with their place in line depending on how much they valued crossing the bridge...

# Consumer Surplus Illustrated




With a toll of 0, Consumer Surplus is A + B + C

With a toll of P, Consumer Surplus is A, toll income is C, and we've lost B in surplus.

Suppose the bridge charges a toll P, for some reason can go no higher, and this is STILL not enough to cover the costs of building it…

Then it may be worth for the government to make up the difference, as long as it's less than A (rather than go without the bridge).

Any toll set by the government would also have to take the lost surplus B into account.

# Problems with Consumer Surplus (CS)

- Suppose there are two goods (products), X and Y.
- You can lower the price of X by 10%, but only by raising the price of Y by 15%. Should you?
- You model changes in consumer surplus, and find the following:
- Rise in CS from cheaper X: $600
- Fall in CS from more expensive Y: $400
- Total change in CS: $600 - $400 = $200 > 0
- Since CS rises, we SHOULD change the prices… right?
- (From the title of the slide, you know it’s not that simple…)

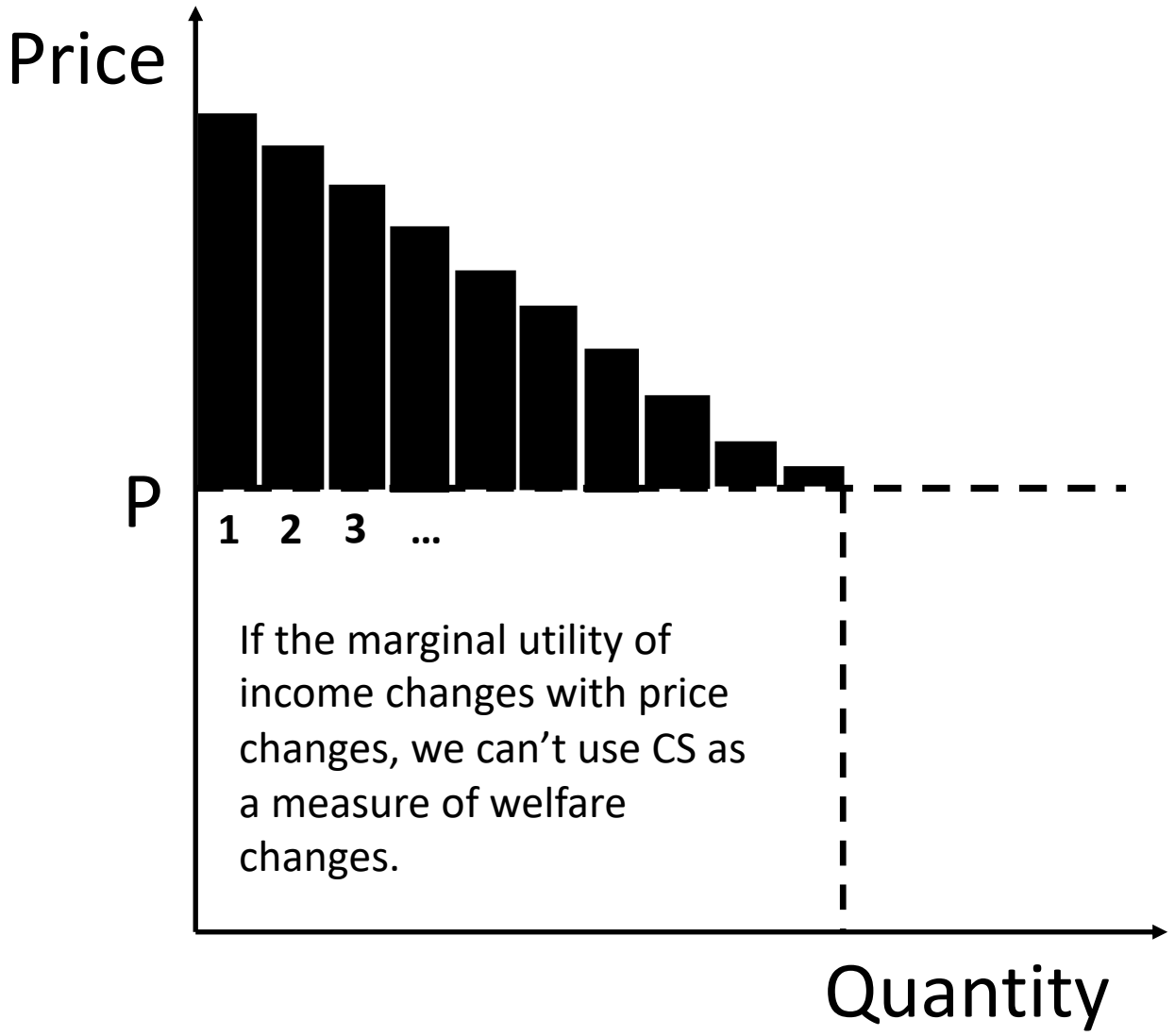
# Some relevant info

- Consumer Surplus is measured in DOLLARS… but what we actually care about is utility (happiness/satisfaction), measured in ‘utils’.
- Marginal utility of income tends to fall with income.
- Marginal utility of income = added satisfaction from the next $ of income
- Translation: the more $ you have, the less an additional $ contributes to your happiness.
- Suppose there are two types of people: Rich and Poor.
- Rich people get 4 utils/$.  Poor people get 10 utils/$.
- Suppose half of good X is bought by Rich people, and half by Poor people.  Also suppose the same is true of Good Y.
- Utils gained from cheaper X: 300 x 4 + 300 x 10 = 4,200
- Utils lost from more expensive Y: 200 x 4 + 200 x 10 = 2,800
- Total utils gained: 4,200 – 2,800 = 1,400 > 0
- So... We’re fine, right?

# No, we're not fine.

- Suppose only Rich people buy Good X, and only Poor people buy Good Y.
- Rise in CS from cheaper X = $600
- Rich people get 4 utils/$ → rise in utils of 600 x 4 = 2,400
- Fall in CS from more expensive Y = $400
- Poor people get 10 utils/$ → fall in utils of 400 x 10 = 4,000
- Total change in utils = 2,400 – 4,000 = -1,600 < 0
- **If a different 'mix' of consumers is buying each good, Consumer Surplus is NOT a reliable measure of welfare (well-being) changes!**

# It gets worse.




- Left: traditional way of teaching consumer surplus & demand curves.
- When the price is $10, Abby will buy only 1 apple. If the price is $9.50, Abby will buy 2 apples … etc.
- BUT these price changes have more than one effect.
- If the price of apples falls, Abby's income in terms of purchasing power has gone up:
- Apples being cheaper means Abby can buy their regular groceries & still have money left over: in that sense, income rises.
- And the marginal utility of income changes with income...
- So, each of those bars may have a DIFFERENT amount of utils/$!