Topic A1:
Key concepts in pricing analytics

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What is "demand"?

- We saw that optimal pricing requires us to know "quantity sold at each of all possible prices". We called it "demand".
- However, "demand" is a broadly-defined term. You may have heard terms like "economic value analysis", "willingness to pay", "elasticity", etc. Are they also "demand", or not?
- Let's go through some exercises about these concepts - making clear what we are measuring is absolutely important.

What is "demand"?

- Consider the following example:
- Suppose that you want to sell Coke in a small village with 300 people.
- There is a rival firm (Pepsi) operating in the same market.

What is "demand"?

- Each consumer values a can of Coke and Pepsi differently. Specifically, there are two segments of consumers.
  - "loyal segment" (100 consumers) value a can of Coke at \$2.50 and Pepsi at \$0.
  - "ordinary segment" (200 consumers) value Coke at \$1.50 and Pepsi at \$1.49.
  - anyone can choose not to buy either and this gives value \$0.
- Suppose that Pepsi is priced at \$0.99.

Willingness to pay (economic value)

- Each consumer's product valuation is called "willingness to pay" (or "economic value").
  - e.g. A loyal consumer's willingness to pay for a can of coke is $2.50.
- Is this "demand"? - or equivalently, can we derive "quantity sold at each possible price" if we know the info in the previous slide?

Questions

- For each segment of consumers, derive the difference in economic value between Coke and Pepsi.
- For each segment of consumers, derive the maximum Coke price at which they choose Coke over Pepsi.

Segment 1: Coke \$2.50, Pepsi \$0. Segment 2: Coke \$1.50, Pepsi \$1.49. Pepsi price \$0.99.

Questions

- For each segment of consumers, derive the difference in economic value between Coke and Pepsi.

  \$2.50 for loyal segment, \$0.01 for ordinary segment

- For each segment of consumers, derive the maximum Coke price at which they choose Coke over Pepsi.

  \$2.50 for loyal segment, \$1.00 for ordinary segment (or one cent less than that)

Questions

- Steps to answer to question 2 for ordinary segment:
- Think about how consumers choose between options. Suppose that they choose the option that gives them the highest surplus (value left to them after the purchase).
- If they choose Pepsi, they receive value of $1.49 and they pay $0.99. They are left with value of $0.50.
- In order for them to choose Coke, they need to receive at least $0.50 value from Coke (or $0.51, depending on how you believe the tie gets solved).

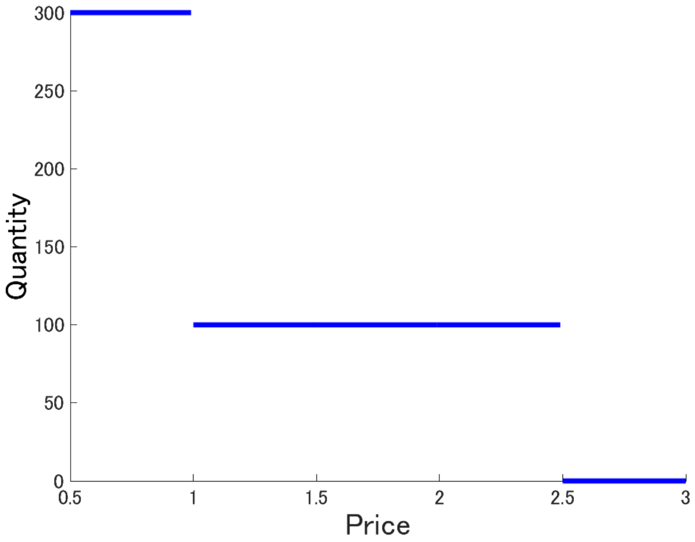
Questions

- As ordinary segment values Coke at \$1.50, the maximum price at which the sale occurs is \$1.00 (or \$0.99).
- In this course, I assume that if there's a tie, consumers will buy from you (I will make it explicit whenever it matters).
- Again, whether a consumer buys your product depends on "value from your product - your price" vs "value from the best alternative - the price from that alternative". We call them "surplus".

Question: derive demand for coke

- Now we know that loyal consumers buy coke if the price is less than \$2.50, and ordinary consumers buy one if the price is less than \$1.00.
- What is the demand for Coke? Draw on Price-Quantity space.

Demand for Coke



Demand and willingness to pay

- We started from "willingness to pay" (or "economic value") of each consumer segment and derived demand. Hence knowing the distribution of willingness to pay is equivalent to knowing demand.
- Put differently, "willingness to pay" and "demand" are two different ways of looking at the value of the product. "Willingness to pay" is from the perspective of a consumer, while "demand" is from the perspective of the firm.

Optimal price

- Given the demand, let's set the optimal price.
- Suppose that your cost is as follows:
  - Unit cost: \$0.5 per can
  - Fixed cost: \$100 for land/labor/managerial (does not depend on the number of cans produced)
- What is the profit-maximizing price?

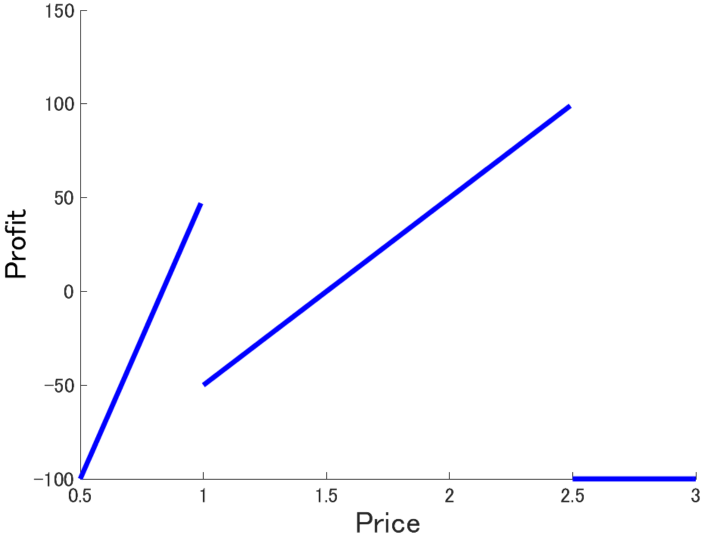
Optimal price

- Flat demand function for the most part - many different prices result in the same quantity sold.
- Hence two possible choices:
  - Set $P = 1$ and sell 300 units. Then the profit is

$$\begin{aligned} & \textit{Quantity} \times \textit{Price} - \textit{Quantity} \times \textit{Unit cost} - \textit{Fixed cost} \\ & = 1 \times 300 - 0.5 \times 300 - 100 \\ & = 50. \end{aligned}$$

  - Set $P = 2.5$ and sell 100 units. Then the profit is 100.
- Hence the optimal price is 2.5.

Optimal price



Optimal price

- You may say this example is too simplistic, which I completely agree with.
- But one general lesson - to find the right price, we need to calculate profit at all possible prices we could set, and compare them.
- In this example, we calculate profit at only two points because of the unique demand structure. In practice, we likely need to calculate profit at many points, meaning, we need to know quantity sold at many points.
- Another way of putting it, we know it's a simple two-point comparison because we know the whole demand.

Elasticity

- So far we have seen that knowing demand is sufficient to set the optimal price in a stylized environment. We also clarified that demand and willingness to pay are two different ways to measure the value of the product.
- The other relevant term showing up frequently is "elasticity". Is "elasticity" also considered as "demand"? i.e. knowing elasticity sufficient to recover the quantity sold at every possible price?

Elasticity

- Price elasticity is the percentage change in quantity as a result of a percentage change in price.
- Formally,

$$-\frac{\partial Q/Q}{\partial P/P},$$

where ∂ ("partial") means a small change in the variable. Hence $\partial Q/Q$ means "percentage change in Q".

- Side: some people use $\Delta Q/Q$, dQ/Q or $\left(Q' - Q\right)/Q$. These are different notations that refer to (almost) the same thing.

Question

- At Coke price = \$2, what is the demand elasticity if we change the price to \$2.02?
- If price changes from \$2 to \$1, what is the demand elasticity?

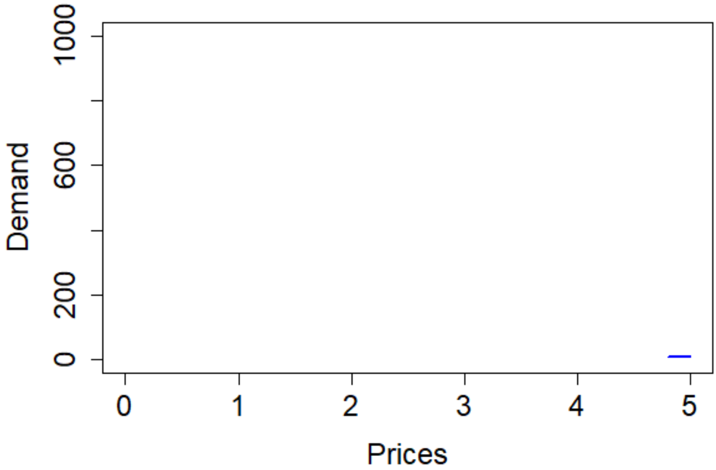
Question

- At Coke price = \$2, what is the demand elasticity if we change the price to \$2.02?
  $-\frac{\partial Q/Q}{\partial P/P} = -\frac{0}{0.01} = 0.$
- If price changes from \$2 to \$1, what is the demand elasticity?
  $-\frac{\partial Q/Q}{\partial P/P} = -\frac{(300-100)/100}{(1-2)/2} = 4.$

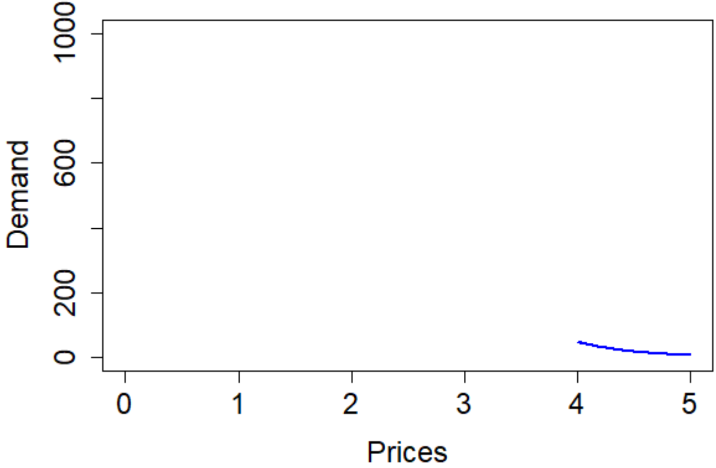
Question

- Elasticity is a local concept - the measured elasticity varies depending on the original price and the new price.
- Nevertheless, if we know the elasticity at every single point, we (almost) know the entire demand.
- Our "demand" concept is "the *levels* of Q at all P". If we know the *changes* in Q at all P, we can trace out the levels of Q starting from a really high P such that $Q = 0$.

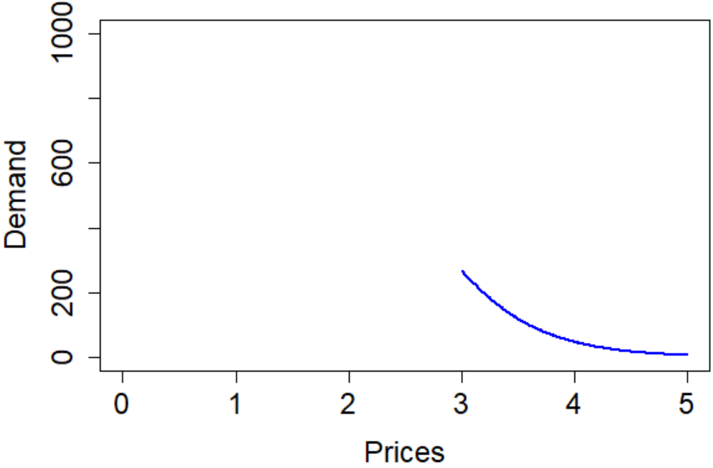
Recovering demand from elasticity



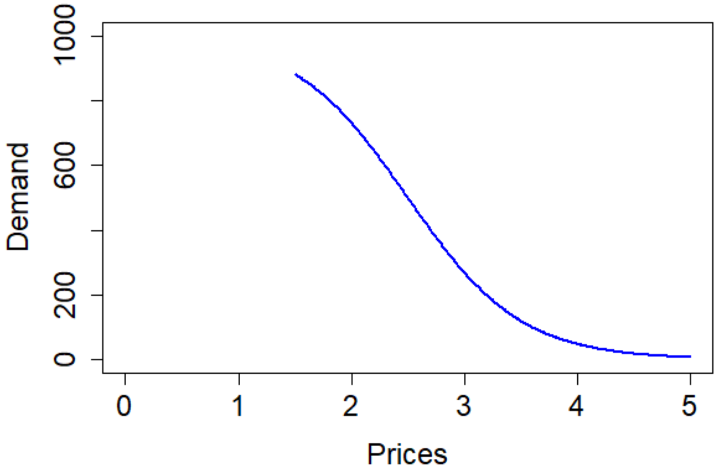
Recovering demand from elasticity



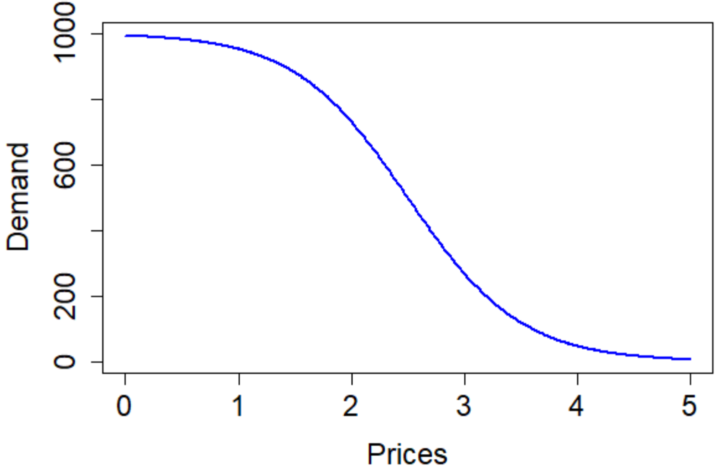
Recovering demand from elasticity



Recovering demand from elasticity



Recovering demand from elasticity



Elasticity

- Again, elasticity is yet another way of looking at "demand". Our original concept looks at the level of sales, while elasticity looks at the changes.
- In this course, I mostly use our original demand concept (quantity sold at all possible prices) in drawing figures and tables.
- However, keep in mind that you can present the same thing in the forms of willingness to pay and elasticity. Switching between these concepts may help improve clarity when you report your results.