

Intro to Economic Analysis: Microeconomics

EC 201 - Day 4 Slides

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6 October 2021

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- ▶ The outline must contain a brief summary of the article you read, as well as responses to the discussion questions that were at the end of your Cengage News Analysis

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- ▶ Later in the course, we will explore in more detail how these cost structures generate a supply curve

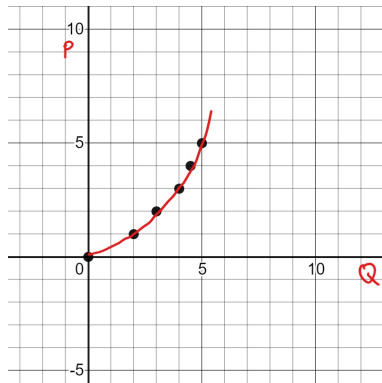
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- For now, we will simply take as given that these structures influence the following supply schedule *for a producer*:

Price	Quantity Supplied
\$0	0
\$1	2
\$2	3
\$3	4
\$4	4.5
\$5	5

Individual Supply Curve

- This set of points can be used to establish the producer's individual supply curve



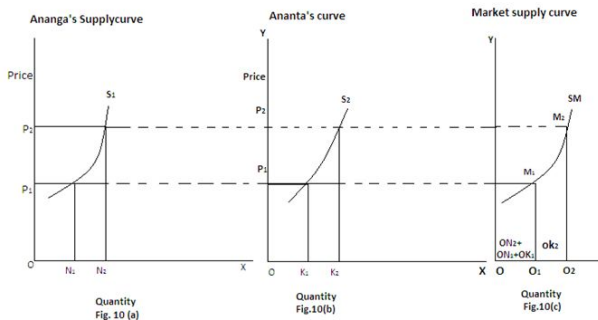
- Once again, the exact reasoning for the shape of this curve is motivated by possible cost structure: the producer may have to incur high costs of their own just to produce 5 coffees (say, per 15 minutes)

Market Supply

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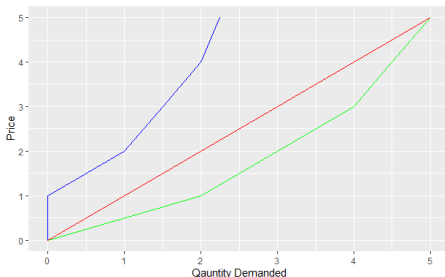
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 - That is, if the market consists of 3 producers, who each supply q_1 , q_2 , and q_3 iced coffees at a price of \$1, then the market supply for iced coffee at \$1 is $Q_M = q_1 + q_2 + q_3$



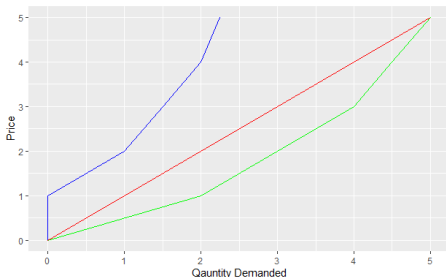
Market Supply Simulation

- For example, if I am one supplier in the economy, and I have two of you as members of the economy, so that our three individual supply curves look like the this (left):



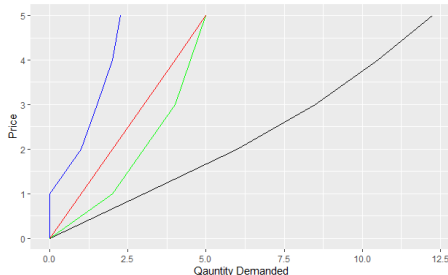
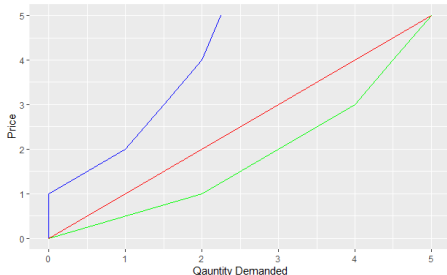
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- Then our market supply will look like this (right)

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 - It's upward sloping
- ▶ This says that the relationship between price and quantity demanded is positive: as the price goes up, you (or the market) generally are willing to supply more of the good in question
- ▶ This is formally known as the **Law of Supply**: “Other things being equal, when the price of a good rises, the quantity supplied of the good also rises, and when the price falls, the quantity supplied falls as well”

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- ▶ Economists will often not compare supply curves across these different tiers, but it is not out the question (for example, when studying a specific firm with few types of services, like Uber)

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- ▶ The biggest topic in this chapter relating to the supply curve will be shifting it, or moving along it


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 - Ex: If we say that we will heavily tax producers for extracting oil 1 year from now, they will likely extract more today and in the next 364 days

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Changes in Price

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- ▶ Once again, changes in the the price of good x only lead to a movement along the supply curve, rather than a shift in the curve
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- ▶ When supply rises, we say that the supply curve shifts to the right (rightward)

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 1. Since demand slopes downward, it often creates a closed region in the positive quadrant, so shifting in/out makes sense. This does not happen with supply
 2. Additionally, with supply, an shift downward in the b value of $y = mx + b$ actually corresponds to an *increase* in supply. Again, this is due to supply being upward sloping: imagine a curve starting at the origin sloping up. If we

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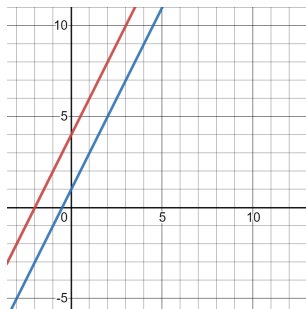
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- ▶ We also may just say that supply rises or falls²

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Visualizing Changes in Price

- ▶ Suppose I gave you the equation $y = mx + b$, for instance, $y = 2x + 4$
- ▶ A shift in supply is akin to changing the value of b , say from $b = 4$ to $b = 1$:



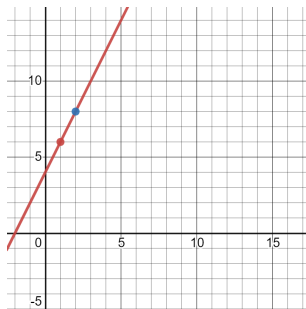
- ▶ Again, notice that the quantity supplied at $P = \$4$ (using P instead of y) rises from 0 to 1.5 on the graph

Changes in Price (cont.)

- ▶ However, suppose that I instead said that y changed from 6 to 8. How do I move the curve?

Changes in Price (cont.)

- ▶ However, suppose that I instead said that y changed from 6 to 8. How do I move the curve?
- ▶ A: I don't. If $y = 6$, then I know that we are at the point $(1, 6)$ on the curve. If the y value rose to 8, then I just move along the curve to $(2, 8)$



Summary of Supply Shifts

Variable	A Change in This Variable . . .
Price of the good itself	Represents a movement along the supply curve
Input prices	Shifts the supply curve
Technology	Shifts the supply curve
Expectations	Shifts the supply curve
Number of sellers	Shifts the supply curve

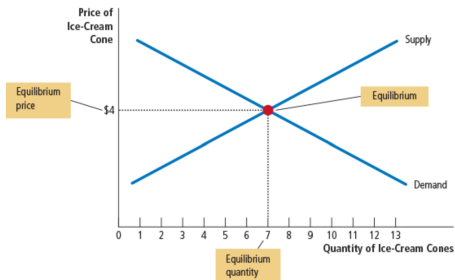
- ▶ When supply shifts, it is best to say that “the supply curve shifts” or that “supply shifts”
- ▶ When there is a movement along the curve, it you should make this clear by saying something to the effect of a “movement along the supply curve”, or you can say that quantity demanded goes up or down (but you should make clear that you mean a movement not a curve shift)
- ▶ In short, do not say in either case that “supply moves”, be clear about what you mean, and use the terminology presented; otherwise I will assume you do not know what you are talking about

Combining the Curves

- ▶ As one might imagine, we are now going to combine the supply and demand curves
- ▶ When we graph supply and demand together, their intersection is known as **market equilibrium**
- ▶ In this case, the price at which the curves intersect is called **equilibrium price** (or *market price*) and the common point where quantity supplied equals quantity demanded (that is, the quantity where the curves intersect) is the **equilibrium quantity**
 - Generally, equilibrium objects are denoted: P^* , P_e , P^E
 - When considering more than one equilibrium, you may write P_0 or P_1 for the initial equilibrium, and then index up by 1, or you may write P and add primes, i.e. P' , P'' , etc. Just make sure it is clear to your grader that you understand the concept
- ▶ When the market is in equilibrium, it is also said that the market *clears*, and the former instances of 'equilibrium' are replaced with 'market clearing'

Market Equilibrium

- ▶ “At the equilibrium price, the quantity of the good that buyers are willing and able to buy exactly balances the quantity that sellers are willing and able to sell” – Mankiw



- ▶ If you report the equilibrium as a point, make sure to indicate which is P and which is Q ³
 - E.g. $(P^*, Q^*) = (4, 7)$

³Usually, points are recorded (x, y) , but equilibria are often recorded at (P^*, Q^*) , so just make it clear

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- ▶ We may say that the price of ice cream is \$5 in the above figure, and ask you to solve for Q_d and Q_s

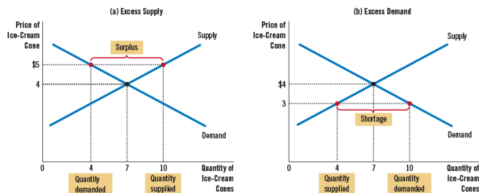
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- ▶ Don't get stuck on what's visually appealing: we can instigate that a market is in dis-equilibrium
- ▶ We may say that the price of ice cream is \$5 in the above figure, and ask you to solve for Q_d and Q_s
- ▶ However, we generally believe as economists (and in this model) that the market will corrects itself, by moving along each curve back to the equilibrium

Market Dis-equilibrium (cont.)

- This is covered in more detail in the book, as evidenced by the following picture. We will cover surpluses and shortages in finer detail in a later chapter

Markets Not in Equilibrium



In panel (a), there is a surplus. Because the market price of \$5 is above the equilibrium price, the quantity supplied (10 cones) exceeds the quantity demanded (4 cones). Producers try to increase sales by cutting the price of a cone, which moves the price toward its equilibrium level. In panel (b), there is a shortage. Because the market price of \$3 is below the equilibrium price, the quantity demanded (10 cones) exceeds the quantity supplied (4 cones). With too many buyers chasing too few goods, producers can take advantage of the shortage by raising the price. Hence, in both cases, the price adjustment moves the market toward the equilibrium of supply and demand.

Math Review

- ▶ By now, we have practiced a little algebra and graphing skills, and there was the intro refresher
- ▶ I want to formally cover some important mathematical concepts in detail
- ▶ If you feel you need more practice, I would encourage seeking out resources online, or coming to office hours
 - Kahn Academy is a good resources
 - Paul's Online Math Notes are fantastic
 - Purple Math, also just googling "algebra resources" or "algebra help" or something similar will pull up numerous great resources
- ▶ Homework is also another form of practice
- ▶ What we will cover today is not necessarily comprehensive, and you should be familiar with everything that is in the algebra cheat sheet I posted online

Math Review – Fractions

- ▶ Consider the fraction $\frac{a}{b}$
- ▶ $\frac{b}{a}$ is called the reciprocal, and is equal to $\frac{1}{a/b}$, or $(\frac{a}{b})^{-1}$
- ▶ $\frac{a}{b} \cdot c = \frac{a \cdot c}{b}$
- ▶ $\frac{a}{b} \div c = \frac{a}{b \cdot c}$
- ▶ $\frac{a}{b} \cdot \frac{c}{d} = \frac{a \cdot c}{b \cdot d}$
- ▶ Consequently,

$$\frac{a}{b} = \frac{a}{b} \cdot 1 = \frac{a}{b} \cdot \frac{c}{c} = \frac{a \cdot c}{b \cdot c}$$

- ▶ To add fractions, they have to be of common denominator. When they have a common denominator, $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$
- ▶ Examples of adding fractions:

- $\frac{1}{3} + \frac{1}{9} = \frac{3}{9} + \frac{1}{9} = \frac{4}{9}$

-

$$\frac{6}{19} + \frac{4}{13} = \frac{6 \cdot 13}{19 \cdot 13} + \frac{4 \cdot 19}{13 \cdot 19} = \frac{78}{247} + \frac{76}{247} = \frac{154}{247}$$

Math Review – Arithmetic and Algebra

- ▶ $\sqrt[n]{a} = a^{1/n}$
- ▶ $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ and $\sqrt{ab} = \sqrt{a}\sqrt{b}$
- ▶ $a^n b^n = (ab)^n$, $a^n a^m = a^{n+m}$, and $(a^n)^m = a^{n \cdot m}$
- ▶ $\frac{a^n}{b^n} = \left(\frac{a}{b}\right)^n$ and $\left(\frac{a}{b}\right)^{-n} = \frac{b^n}{a^n}$
- ▶ $a^{-n} = \frac{1}{a^n}$, $\frac{1}{a^{-n}} = a^n$, and $\frac{a^n}{a^m} = a^{n-m}$
- ▶ $(-x)^2 = x^2$. Notice that $(-3)^2 = 9$ but $-(3^2) = -9$
- ▶ If $ax^2 + bx + c = 0$, then the quadratic formula can be used to solve for x :

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Note that this will yield two values, and we will not use complex (imaginary) numbers in this class, so choose the value that makes sense⁴

⁴Unless specified otherwise, prices and quantities will not be negative

Math Review – Basic Algebra

- ▶ Recall that dividing by a fraction is the same as multiplying by the reciprocal, e.g.

$$\frac{5}{13}y = 2x \implies y = \frac{13}{5}(2x) = \frac{26}{5}x$$

- ▶ In general, when solving a single equation for a variable, you should aim to get that variable by itself by performing the same action to both sides, e.g.

$$\begin{aligned}\frac{2}{3}P + \frac{5}{6}Q &= 10 \\ \implies \frac{2}{3}P &= 10 - \frac{5}{6}Q \\ \implies P &= 10 \left(\frac{3}{2} \right) - \left(\frac{5}{6} \right) \left(\frac{3}{2} \right) Q \\ \implies P &= \frac{30}{2} - \frac{15}{12}Q \\ \implies P &= 15 - \frac{5}{4}Q\end{aligned}$$

Math Review – Solving Two Variable Systems of Equations

- Suppose

$$ax + by = c$$

$$sx + ty = u$$

Where x and y are variables, and the rest of the numbers are constants

- The two ways to solve for this are:
 1. [Method of Substitution]: Solve one equation for one variable in terms of the other (i.e. x in terms of y or y in terms of x). Then, plug whatever you solved for into the other equation, to solve for one variable. Plug this back in to solve for the other
 2. [Method of Elimination]: Get to a point where you can add/subtract some multiple of one equation to the other to eliminate one variable. Solve for this variable, and use one of the equations to back out the other
- Note that one “version” of the method of substitution is just to solve both equations for one variable, then set them equal to each other to get one variable, and then use this to get the other. For instance, solve both equations for x in terms of y , then set them equal to get one equation in terms of y . Solve for y and use this and one of the equations for x in terms of y to get x

Math Review – Method of Substitution

► Example:

$$2x + 6y = 8 \quad (1)$$

$$x - 2y = 15 \quad (2)$$

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$$2(2y + 15) + 6y = 8$$

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- ▶ Solve for y :

$$\begin{aligned} 4y + 30 + 6y &= 8 \\ \implies 10y &= -22 \\ \implies y &= -\frac{22}{10} = -\frac{11}{5} \end{aligned}$$

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- ▶ Solve for x , using known y and first step:

$$x = 2y + 15 = 2\left(-\frac{11}{5}\right) + 15 = -\frac{22}{5} + \frac{75}{5} = \frac{53}{5}$$

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$$-2x + 4y = -30 \quad (3)$$

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- ▶ Solve for y : $y = -\frac{22}{10} = -\frac{11}{5}$

- ▶ Solve for x , using known y and equation (2):

$$\begin{aligned} x - 2y = 15 &\implies x - 2\left(-\frac{11}{5}\right) = 15 \implies x + \frac{22}{5} = 15 \\ &\implies x = \frac{75}{5} - \frac{22}{5} = \frac{53}{5} \end{aligned}$$

Exercise 1

- Suppose supply and demand are given by

$$S : 4P - Q - 4 = 0$$

$$D : P - 18 = -4Q$$

Find the market equilibrium (note that this means to find equilibrium quantity and price)

Solution 1

- I will rewrite the equations as

$$S : P = \frac{1}{4}Q + 1$$

$$D : P = -4Q + 18$$

- Setting them equal, we get

$$\frac{1}{4}Q + 1 = -4Q + 18 \implies Q \left(4 + \frac{1}{4} \right) = 17$$

$$\implies Q \left(\frac{16}{4} + \frac{1}{4} \right) = 17 \implies Q (17/4) = 17$$

$$\implies Q^* = 4$$

Plugging this into demand, we get $P^* = 2$

Exercise 2

- Suppose supply and demand are given by

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$$D : \sqrt{P - 3} = Q - 4$$

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$$D : \sqrt{P - 3} = Q - 4$$

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Solution 2

- Solve supply and demand for P in terms of Q :

$$S : P = \frac{1}{Q - 4} + 3 \quad D : P = (Q - 4)^2 + 3$$

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- Solving:

$$\frac{1}{Q-4} = (Q-4)^2 \implies 1 = (Q-4)^3 \implies 1^{1/3} = Q-4$$

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- Solving:

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- Plug into supply equation:

$$P^* = \frac{1}{5-4} + 3 = 1 + 3 = 4$$

Math Review – Graphing

- ▶ Recall that points of the form (a, b) communicate that the x value is a and the y value is b on a graph
- ▶ To calculate the slope of a line which crosses through points (x_1, y_1) and (x_2, y_2) , you compute

$$s = \frac{y_2 - y_1}{x_2 - x_1}$$

which is referred to as rise over run. This means that the line moves up (or down, if s is negative) s for every 1 unit of x moved

- ▶ If $y = f(x)$ is a function, then $y = f(x) + a$ is that same function, translated up (or down, if a is negative) by a units
- ▶ If $y = f(x)$ is a function, then $y = f(x - a)$ is that same function, translated right (or left, if a is negative) by a units (this should seem backwards, but it is correct)

Exercise 3

- Suppose demand for candy is given by $P = 1/Q$. Upon buying any amount of candy, you are given 2 extra pieces (units) for free, which shifts demand right by 1. Additionally, the government gives you 3 dollars as a subsidy, whenever you buy candy; this shifts demand up by 3

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- ▶ What is the new demand equation?

Solution 3

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- ▶ You might be wondering why getting a piece of candy means we subtract 2 from Q . Before, at \$1, we demanded 1 piece. Now, at \$1, we demand 3 pieces, 2 of which are given for free

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- ▶ You might be wondering why getting a piece of candy means we subtract 2 from Q . Before, at \$1, we demanded 1 piece. Now, at \$1, we demand 3 pieces, 2 of which are given for free
- ▶ Also, note that subsidizing effectively subtracts \$3 from the price. Subtracting \$3 from P in the demand equation, and then resolving for $\$P$ in terms of $\$Q$, will yield a +3 on the other side

Math Review – Graphing with Desmos

- ▶ desmos.com/calculator
- ▶ You can write equations and $y =$ is assumed, so you just write in terms of x
- ▶ You can also write $y =$ explicitly, or write equations in terms of $x =$
- ▶ Play around with exponents, fractions, graphing implicit equations (such as $x^2 + y^2 = 1$), and constants ($y = ax$)
- ▶ You can use colors and inequalities, just explore

Exercise 4

- ▶ Repeat exercises 1 & 2 using desmos, but solve the supply and demand equations for P in terms of Q , for practice (no solution slide, make sure your answers match the exercises)

Exercise 5

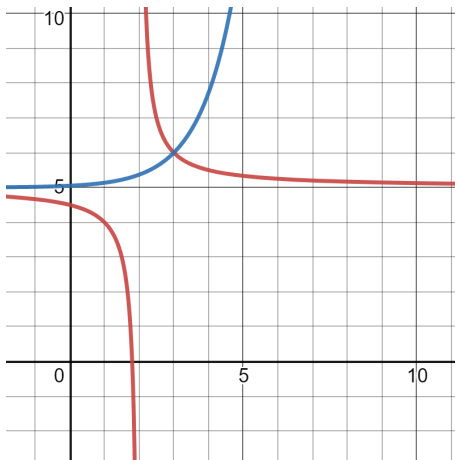
- Suppose supply and demand are given by

$$D : P = \frac{1}{x - 2}$$

$$S : P = e^{x-3}$$

Plot each of these curves and find market equilibrium and price

Solution 5



► $(P^*, Q^*) = (6, 3)$

Exercise 6

- Suppose supply and demand are given by

$$S : Q = \frac{1}{2}P$$

$$D : \frac{1}{2}P + Q = 12$$

Find the market equilibrium

- Suppose that Demand shifts left by 4 units. Find the new equation representing demand, and find the new market equilibrium

Solution 6

- Supply and demand are given by

$$S : P = 2Q$$

$$D : P = -2Q + 24$$

and the new Demand equation is given by

$$P = -2(Q + 4) + 24 = -2Q + 16$$

Solution 6

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$$D : P = -2Q + 24$$

and the new Demand equation is given by

$$P = -2(Q + 4) + 24 = -2Q + 16$$

- Use desmos to check your answers

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- ▶ That being said, any of these and more are fair game on a test