Budget Slides

Econ 360

Summer 2025

BINGHAMTON UNIVERSITY
STATE UNIVERSITY OF NEW YORK

Learning Outcomes

1. Derive algebraic expression to describe a consumer's set of feasible choices.

2. Graphically depict a consumer's set of feasible choices.

3. Explain graphically and intuitively how a consumer's set of feasible choices changes when income and prices change.

Set of Affordable Bundles

- Suppose Bill is thinking about all the feasible bundles of snacks he can consume while watching a movie.
- What makes some of those bundles NOT feasible?
  - Budgetary: Bill only has so much money.
  - Time: The movie is only so long.
  - Other: i.e. Bill gets full when he eats a certain amont of snacks at once.
- We are going to focus on the Budgetary constraint in these slides.

Budget Notation

- Bill has lots of different snacks he can choose from. You can think of each snack as a different "commodity".
  - i.e. Doritos and Cheetos are two commodities, x_1 and x_2.
- We call Bill's choice of snacks his Consumption Bundle and would denote it (x_1, x_2).
  - We could have more snacks to choose from, and the consumption bundle would become $(x_1, x_2, ..., x_n)$ if there were n different commodities.
- We represent prices for each commodity with $p_1, p_2, ..., p_n$ where p_1 is the price of commodity x_1, p_2 is the price of x_2, and so on.
  - i.e. If the price of Doritos is \$2, and the price of Cheetos is \$4, $p_1 = 2$ and $p_2 = 4$.

Deriving the Budget: Intuitive Example

- Suppose Target sells Doritos for $2 and Cheetos for $4.
- Suppose you have $10 in your pocket.
- Is the bundle (1,2) affordable?
- How do you know?

Deriving the Budget: Intuitive Example

- You figured out the cost of the consumption bundle is $10, which is exactly how much money you had.
- You bought 1 Doritos at $2 per Dorito, which cost $2.
- You bought 2 Cheetos at $4 per Cheeto, which cost $8.
- The total you spent was $10.
- **Question**: Can you use our general notation to write an equation to tell you which bundles are affordable?

Deriving the Budget: Notation

- **Budget Set Equation**=$p_1 \cdot x_1 + p_2 \cdot x_2 \leq w$
- $p_1 \cdot x_1 + p_2 \cdot x_2$ tells us our total expenditure.
  - $p_1 \cdot x_1$ told us we spent \$2 on Doritos.
  - $p_2 \cdot x_2$ told us we spent \$8 on Cheetos.
- w represents our amount of money/wealth we had to spend.
  - This is the \$10 we walked into Target with.
- A bundle is affordable if the money we spent was less than or exactly equal to the amount of money we had to spend.

Deriving the Budget: Set Notation

- **Budget Set Equation**=$p_1 \cdot x_1 + p_2 \cdot x_2 \leq w$

- Budget Set Notation:
  $\{(x_1, x_2, ..., x_n) | x_1 \geq 0, ..., x_n \geq 0, p_1 \cdot x_1 + ... + p_n \cdot x_n \leq w\}$.

Budget Constraint vs Budget Set

- The Budget **Set** is all affordable bundles.
- The Budget **Constraint** are all bundles **that are just BARELY affordable**.
- By barely affordable we mean you had to spend all your money to buy that bundle.
- Consider our Doritos/Cheetos example, where you have $10, Doritos cost $2 and Cheetos cost $4.
  - The bundle (1,1) is in the Budget Set because it costs $6, and we had $10. It was affordable but we did not spend all our our money. The bundle (1,1) is NOT on the Budget Constraint.
  - The bundle (1,2) is also in the Budget Set because it costs $10, and we had $10. The bundle (1,2) is on the Budget Constraint.
- **Key Takeaway**: All bundles on the Budget Constraint are in the Budget Set, but not all bundles in the Budget Set are on the Budget Constraint.

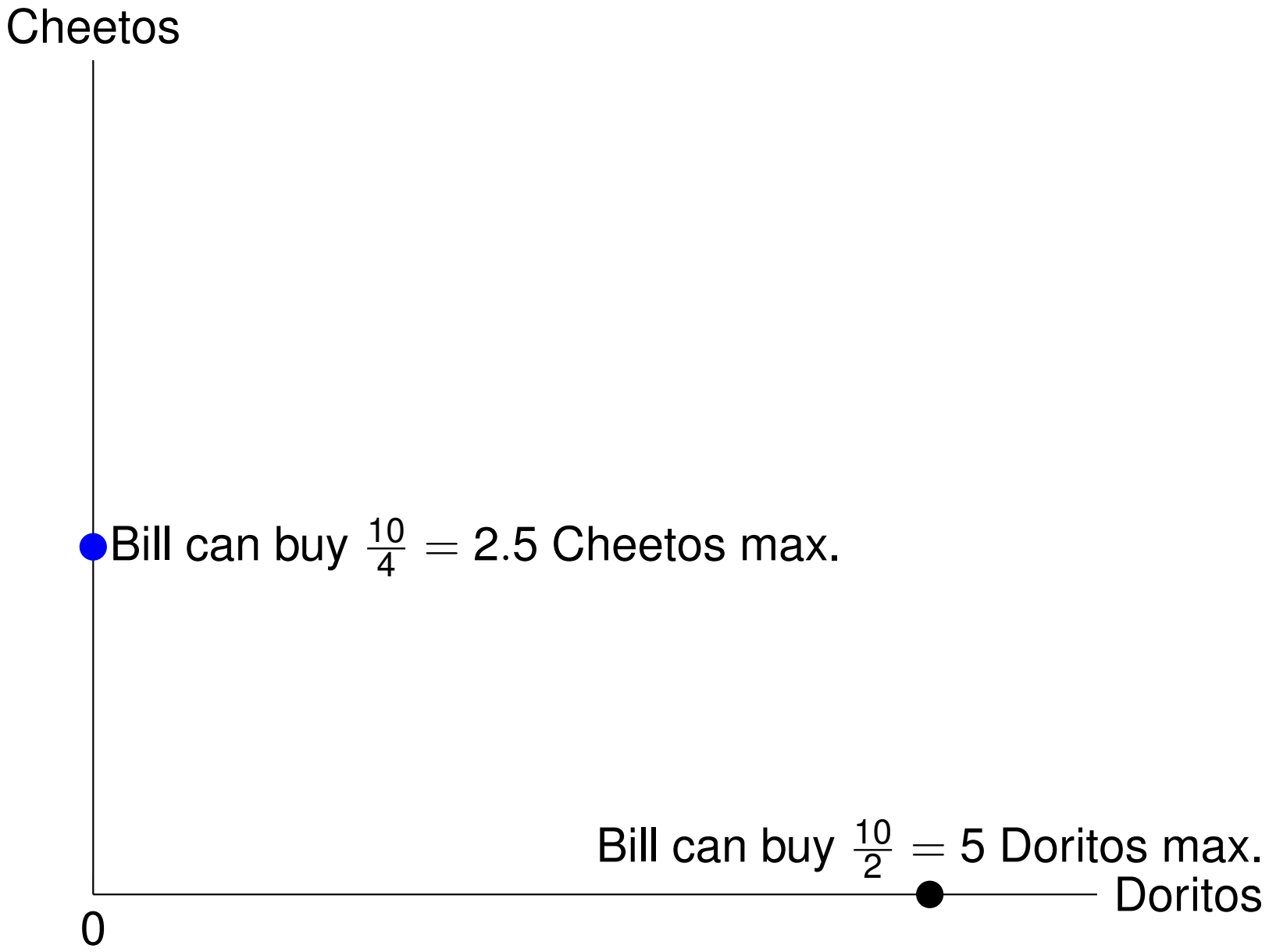
From Algebra to Graphing

- The Budget Constraint tells us the bundles that are just barely affordable.
- Therefore any bundle cheaper than the bundles on the Budget Constraint are affordable, and therefore in the Budget Set.
- If we want to graph the set of affordable bundles, we can use the Budget Constraint to help us.
- Let's start by again using the Doritos/Cheetos Target example. You have $10, Doritos cost $2 and Cheetos cost $4.

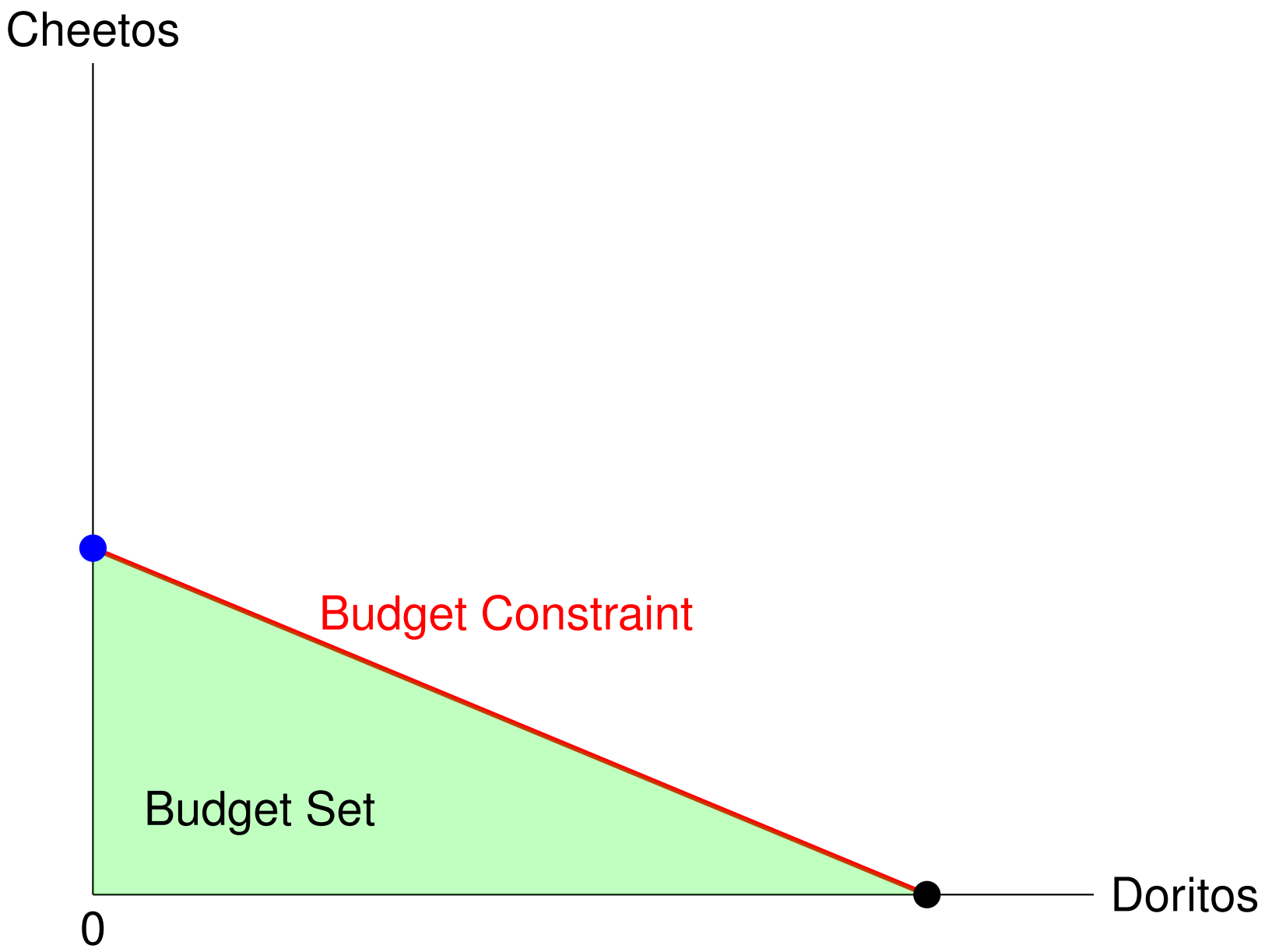
From Algebra to Graphing

1. First, we will figure out how many Doritos we can buy if we spend all our money on Doritos.
2. Then, we will figure out how many Cheetos we can buy if we spend all our money on Cheetos.
3. The Budget Constraint will be the line connecting those two points.
4. The Budget Set will be the Budget Constraint and all bundles "under" the Budget Constraint.
   - **Question**: Let's calculate 1 and 2 using our notation. That is, how much of x_1 and x_2 could Bill buy with w dollars given prices p_1 and p_2 if:
     - Bill only buys x_1.
     - Bill only buys x_2.

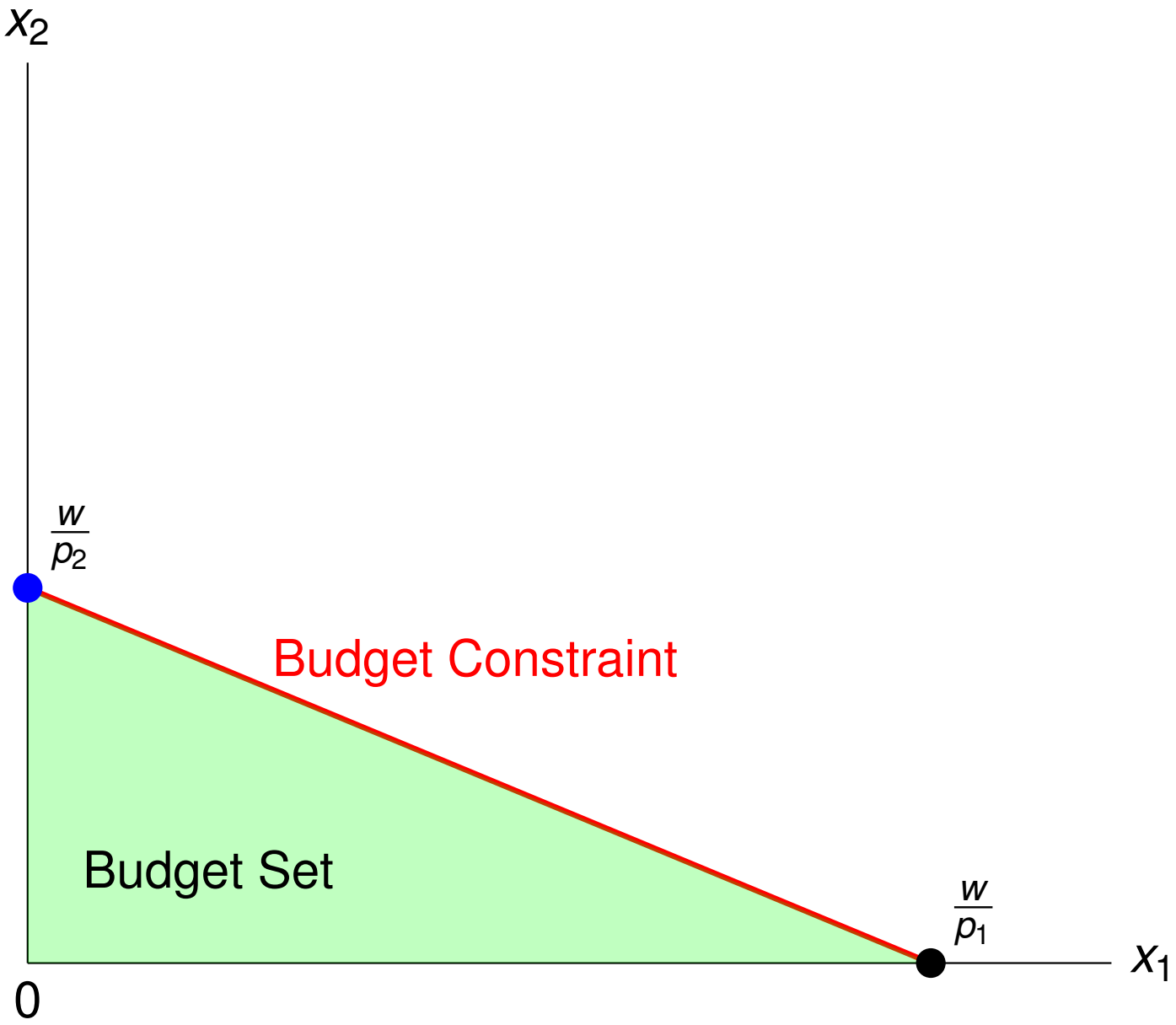
Graphing an Example Budget Constraint



Graphing an Example Budget Constraint



More General Example



The Slope of the Budget Constraint

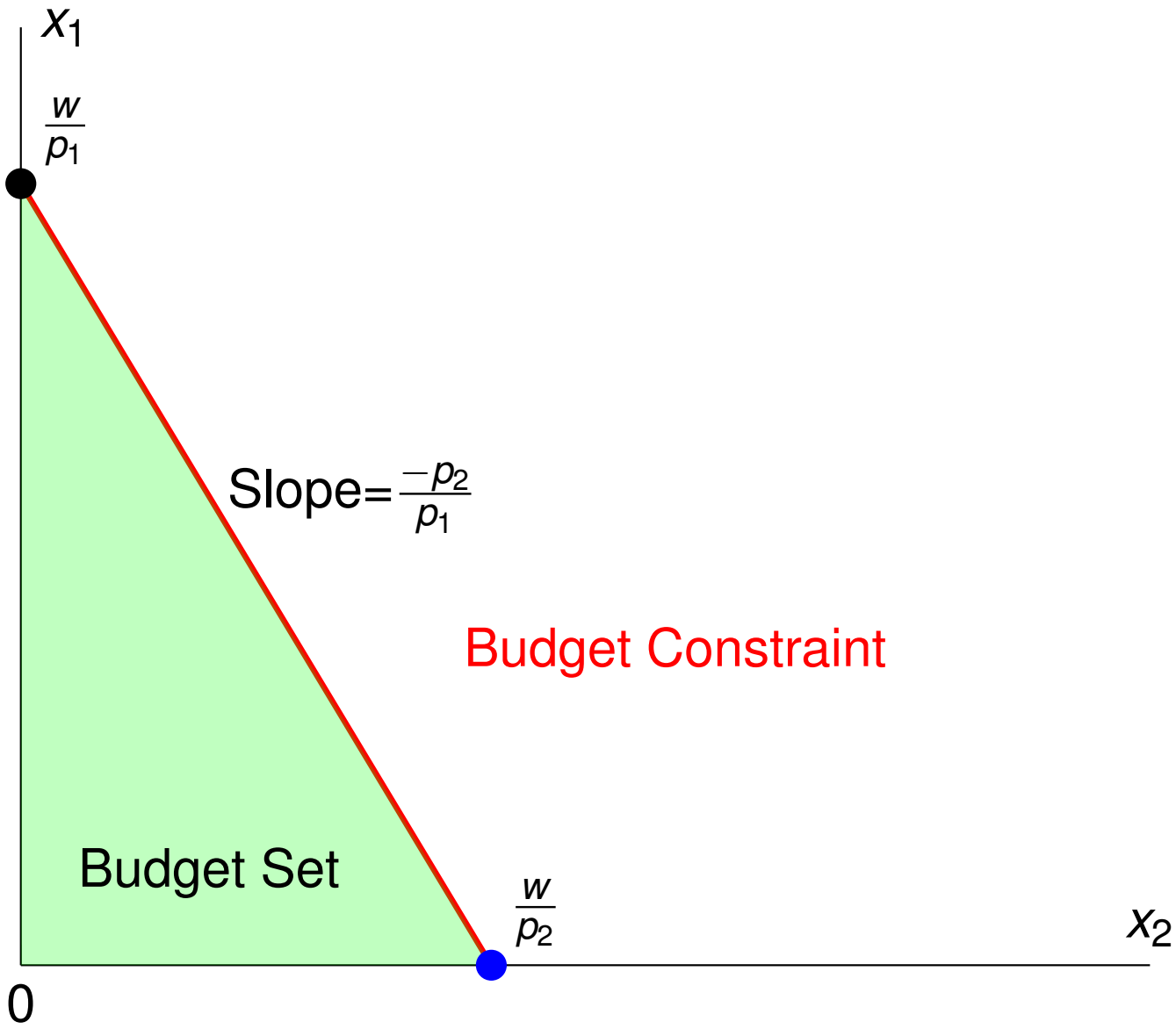
- What is the slope of the budget constraint in our Target example?
- x_2 is like our "y" variable and x_1 is like our "x" variable.
- Goal: Solve "y" = m"x" + b.
- $\implies$ solve $x_2 = m \cdot \text{“}x_1\text{”} + b$.

$$
\begin{aligned}
p_1 \cdot x_1 + p_2 \cdot x_2 &= w \\
p_2 \cdot x_2 &= w - p_1 \cdot x_1 \\
x_2 &= \frac{w}{p_2} - \frac{p_1}{p_2} x_1 \\
x_2 &= -\frac{p_1}{p_2} \cdot x_1 + \frac{w}{p_2}
\end{aligned}
$$

The Slope of the Budget Constraint

- The slope is the ratio of the prices.
- The slop also represents a tradeoff between the two goods.
- **Why is this true?**
  - In our example, the price ratio is $\frac{2}{4} = \frac{1}{2}$.
  - For Bill, every time he gives up one Cheeto he gets \$4 additional dollars to spend.
  - Since Cheetos cost \$2, Bill can use those \$4 and buy 2 additional Doriots.
  - Therefore: his tradeoff is 1 Cheeto: 2 Doritos, or $\frac{1}{2}$.
- The ratio $\frac{p_1}{p_2}$ ALWAYS tells you the tradeoff between the two goods for the bundles that are just barely affordable.
- **Question**: What if we drew this same graph but with x_2 on the "x"-axis and x_1 on the "y"-axis?

Alternative Graphing of the Budget Set



How Does the Budget Constraint Change?

- The set of affordable bundles depend on prices $p_1, p_2, ..., p_n$ and the amount of money w that we have.

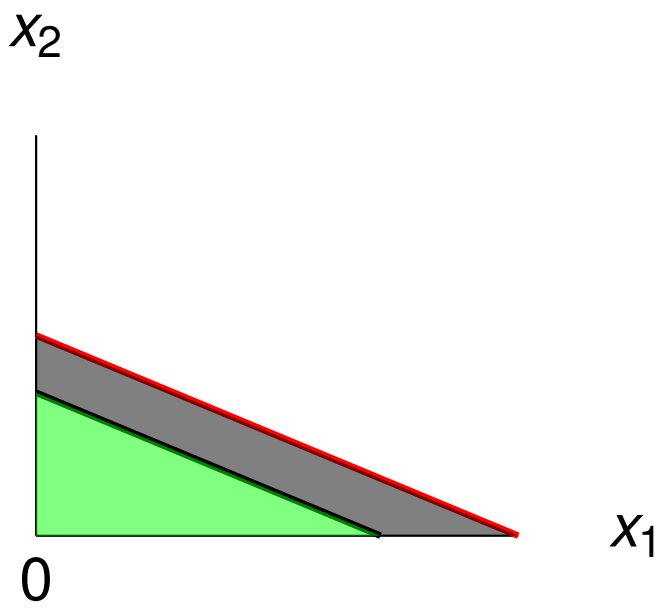
- Look back at Slide 17, and think about what would happen to the Budget Constraint **intuitively** if:
  - The amount of money you have to spend changed, but prices stayed the same.
  - The price of commodity 1 changed, but the price of commodity 2 stayed the same.
  - The price of commodity 2 changed, but the price of commodity 1 stayed the same.

The Budget Constraint When w Changes

- Intuitively, if w increases, then the set of affordable bundles should increase. I have more money and so bundles that used to not be affordable to me should now be affordable.
- For example, if I spend all my money on x_1, the amount $\frac{w}{p_1}$ increases as w increases.
- The same is true for x_2.
- If w decreases, my set of affordable bundles should shrink.
- Let's see that on a graph.

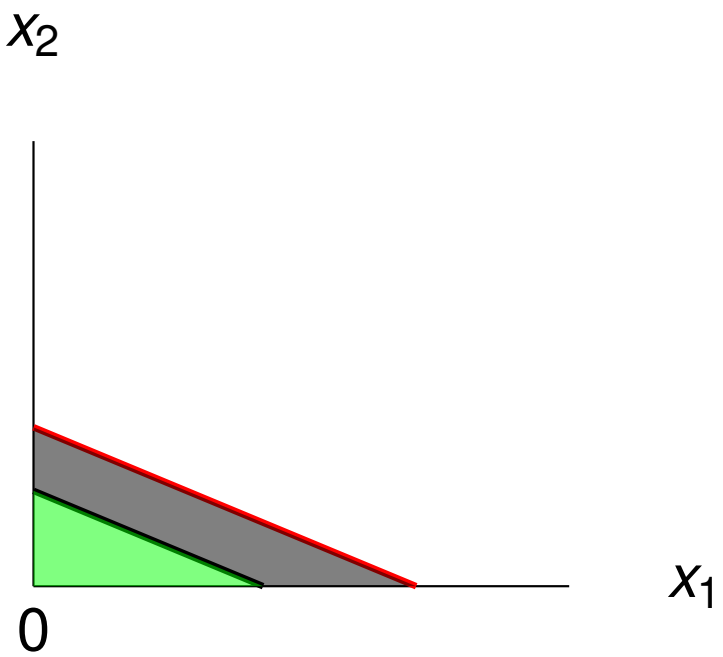
The Budget Constraint When w Increases

- When w increases, the Budget Constraint shifts out (the black line to the red line).
- The price ratio has not changed, so the new Budget Constraint is parallel to the old one.
- The Budget Set is also now larger (green area to green and black areas) under a larger w.



The Budget Constraint When w Decreases

- When w decreases, the Budget Constraint shifts in (red line to the black line).
- The price ratio has not changed, so the new Budget Constraint is parallel to the old one.
- The Budget Set is also now smaller (black and green areas to green area) under a smaller w.



The Budget Constraint When Prices Change

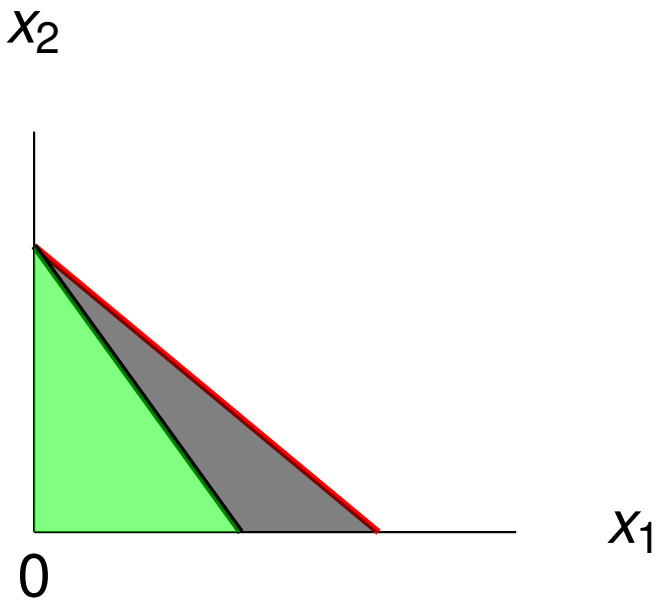
- When w changes, the slope remained constant since the tradeoff between x_1 and x_2 did not change.

- If only the price of one commodity changes, the tradeoff, and therefore the slope of the Budget Constraint, will change.
  - Note: if the prices of both commodities change by the same factor, the slope does not change!

  - i.e. If the prices of commodity 1 and commodity 2 both double, then the price ratio and the slope of the Budget Constraint remains the same.

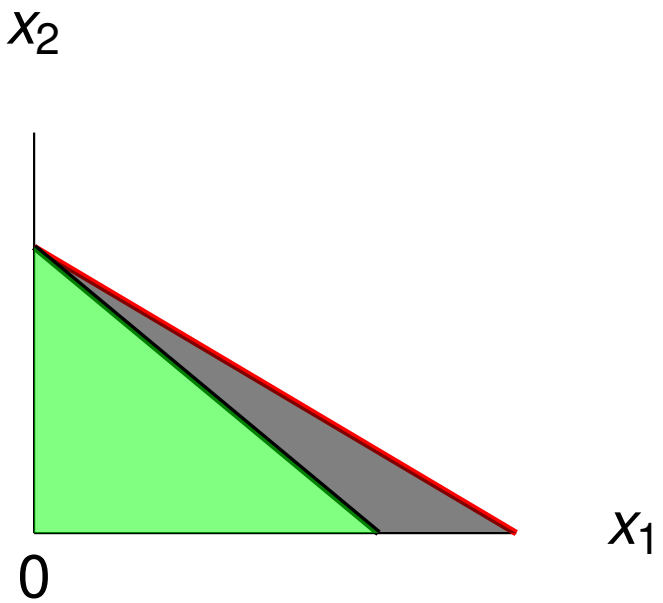
The Budget Constraint When One Price Changes

- If p_1 increases, then spending all our money on x_1 gets us fewer x_1.
- We can still buy the same amount of x_2 as before if we spend all our money on x_2.
- This is because only the price of x_1 changes.
- The Budget Constraint pivots from the red line to the black line, the Budget Set changes from the green and grey area to just the green area.



The Budget Constraint When One Price Changes

- If p_1 decreases, then spending all our money on x_1 gets us more x_1.
- We can still buy the same amount of x_2 as before if we spend all our money on x_2.
- This is because only the price of x_1 changes.
- The Budget Constraint pivots from the black line to the red line, the Budget Set changes from the green area to the green and gray areas.



Items to Think About For Class

1. What if you got a quantity discount if you bought more than x of x_1?

2. What if you had multiple constraints? What would your budget set and constraint look like?

3. What if one of your constraints was a minimum quantity you had to buy? What about a maximum?