Economics 201
Intermediate Microeconomics

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Fall 2024

Contents

Lecture 1

What is Microeconomics?

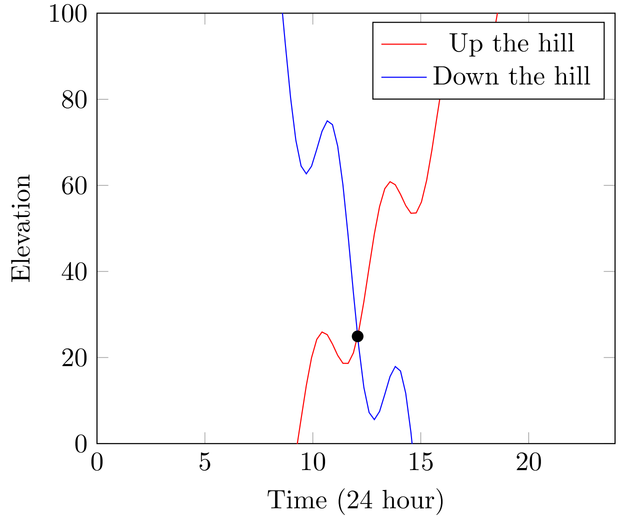
Microeconomics	Macroeconomics
Studies the behaviour of individual decision makers - Consumers - Firms - Government	Studies the performance of national and global economies - GDP - Inflation - Unemployment

What is different about intermediate microeconomics?

- Less memorization
- Learn the basic approach to solving economic problems
  - Use this to derive facts and "curves" from ECON 101

The Cow on a Hill

A cow starts walking along a mountain path at 9:00am one morning and eventually makes its way to the top of the mountain by 6:00pm. The cow sleeps for the night, but starts out early the next morning at 8:30am and is down at the bottom by 2:00pm.
Is there a spot on the path where the cow was at the same time each day?



At $t*$ and $e*$, the cow was at the same place at the same time.

Models

What is a model?
A model is a purposeful simplification of the real world, examples include:

- Globe
- Roadmap
- Topographical map
- Subway map
- Satellite map

What makes a "good model"?

1. Formal : explicit about assumptions
2. Simple : Simple models give clearer insight as long as they don't ignore important factors
3. Testable : Able to be proven wrong if it is wrong

The Economic Model

Assumptions	Constraints
Maximization	Prices
Substitution	Income
Preferences	Laws
Costs	Technology

Constraints allow us to make predictions about behaviour.

Variables in models

Exogenous Variables : Values taken as given, parameters, contraints. (Prices, Income, . . .)
Endogenous Variables : Values determined inside the model, answers, choice variables. (Quantity demanded)

3 Main Tools

1. Constrained Optimization
   - The method by which a decision maker makes the best (i.e., optimal) choice, given limitations.
   - Ex. An individual likes relaxing and eating
     - He earns $15/hr mowing lawns
     - He can work up to 16hrs/day
     - He can only relax when he's not working
     - He can only eat with money earned working
     - **Exogenous variables** : Wage rate, prices, work time, preferences
     - **Endogenous Variables** : Time spent working
2. Equilibrium
   - A state of endogenous variables that will continue indefinitely as long as exogenous factors dont change.
   - A solution to a constrained optimization problem.
   - Ex. (previous problem) The individual chooses to work for 6 hours, and relax for 10 hours.
3. Comparative Statics
   - How equilibria change when we change exogenous variables.
   - Ex. Wage rate goes up to $20/hr, the individual now chooses to work 8 hours, and relax 8 hours.

Lecture 2

Variables

A variable is a letter that stands in the place of a number.

- Most commonly : x or y

Exponents

Exponents represent repeated self-multiplication.

- $x^2 = x * x$
- $x^6 = x * x * x * x * x * x$

Rules of Exponents

1. Multiplication : $x^a * x^b = x^{a+b}$
2. Division : $\frac{x^a}{x^b} = x^{a-b}$
3. Powers of Powers : $(x^a)^b = x^{a*b}$
4. Special Rules
    - Anything to the power of $0 = 1$, $x^0 = 1$
    - Negative exponents represent a reciprocal, $x^{-1} = \frac{1}{x}$
    - $\sqrt{x} = x^{\frac{1}{2}}$

Solving Equations

When you have one equation with one unknown variable, you can "solve" the equation by isolating the variable.

$$2x + 3 = 11 \rightarrow x = 4$$

With two equations and two unknowns, we can solve the equations together.

$$x + y = 10$$

$$2x + y = 13$$

$$x = 3,\ y = 7$$

Functions

A function is a rule that shows the relationship between variables.

$$y = 4x$$

$$y = f(x)$$

Straight Lines (Linear Functions)

The slope of a straight line is calculated as $\frac{\text{rise}}{\text{run}}$, or $\frac{\Delta y}{\Delta x}$.

Calculus

Calculus is all about finding the slope of curves. If $y = f(x)$, then the equation for its slope is called the derivative, and written as $\frac{dy}{dx}$ or $f'(x)$ or "the derivative of y with respect to x."

Rules of Calculus

1. Constant Rule
   - If y is constant, then $\frac{dy}{dx}$
2. Power Rule
   - If $y = a * x^b$, then $\frac{dy}{dx} = b * a * x^{b-1}$
3. Additive Rule
   - When a function has multiple parts added together, you take the derivative of each part individually and add them together. $\frac{d}{dx}\left[f(x) + g(x)\right] = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$

Partial Derivatives

If we have a function with more than one variable, such as $u = f(x, y)$, we can differentiate with respect to either x or y. $\frac{\partial u}{\partial x}$ is the partial derivative of u with respect to x, treating y as a constant.

$$u = 3x^2 + 4y^5$$

$$\frac{\partial u}{\partial x} = 6x$$

$$\frac{\partial u}{\partial y} = 20y^4$$

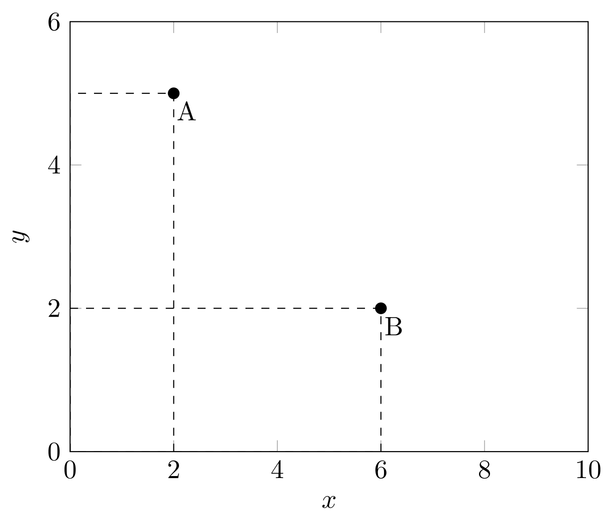
Lecture 3

Preferences and "Utility"

Preferences independent of what things cost

- Over bundles of goods

In most examples, we have two goods: x and y.



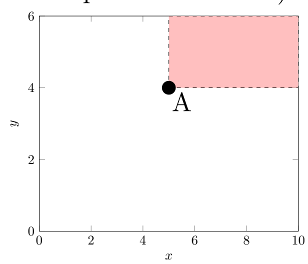
Here, bundle A has 2 units of x and 5 units of y in it.
We assume people have preferences over bundles of goods that satisfy the following assumptions.

1. Completeness : Consumers can rank any two bundles
    - Notation : If a consumer prefers bundle A to bundle B, we write $A \succ B$, or $B \succ A$ if they prefer B, or $A \sim B$ if they are indifferent.
    - So "completeness" means that for any bundles A and B, either $A \succ B$, $A \prec B$ or $A \sim B$.
    - A violation of this would be "I don't know".

2. Transitivity : "Consistency"

   - If a person has preferences such that $A \succ B$ and $B \succ C$, then $A \succ C$.
   - A violation of this would be $C \succ A$.

3. "More is better" : People prefer to have more to less (would prefer to be in the pink area over A)



Note: If people's preferences satisfy assumptions (1) and (2), then we can represent them with a utility function.

Utility Functions

A utility function for a set of preferences is a function that gives a number ("rank") to each bundle of goods such that, if:

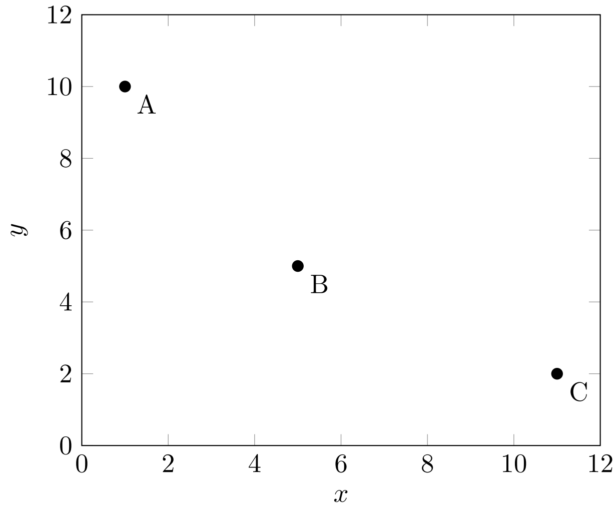
- $A \succ B$ then $U(A) > U(B)$
- $B \succ A$ then $U(A) < U(B)$
- $A \sim B$ then $U(A) = U(B)$

Note: Utility Functions are ordinal, not cardinal.

- Ordinal : Only ranks matter, the numbers themselves have no interpretation
- Cardinal : Numbers matter

Note: Utility $\neq$ happiness, and utilites can't be compared between people

For example, consider a person's preferences over bundles of x and y can represented by the utility function $U = xy$



How would they rank the bundles?

$$A = (1, 10)$$
$$B = (5, 5)$$
$$C = (2, 11)$$

Here,

$$U(A) = 1 * 10 = 10$$
$$U(B) = 5 * 5 = 25$$
$$U(C) = 11 * 2 = 22$$

So, for this person, $B \succ C \succ A$.

What if the utility function was:

$$\left.\begin{aligned} &U = xy + 100 \\ &U = 5xy \\ &U = (xy)^2 \end{aligned}\right\} \text{No difference, same ranking}$$

Monotonic Transformations

Adding or subtracting, multiplying by a positive number or raising to a positive exponent do not change order.

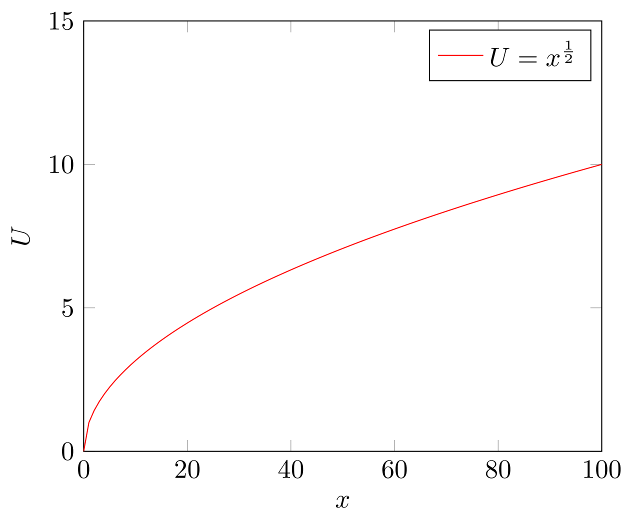
For example, Suppose Dr. Rosborough has a pile of midterms ordered by grade (highest on the top, lowest on the bottom)

Grade Change	Order Affected
Add 10 marks	No
Subtract 10 marks	No
Multiply by 2	No
Multiply by -2	Yes
Square Grades	No
Exponent of -1	Yes

Marginal Utility

Suppose there is only 1 good, hamburgers (x) and an individual has preferences over amounts of x represented by

$$U = x^{\frac{1}{2}}$$



Marginal Utility

- How utility changes when consumption of x is increased by a small amount.
- (Slope / Derivative)

Here, marginal utility of x (MU_x) is

$$MU_x = \frac{dU}{dx} = \frac{1}{2}x^{-\frac{1}{2}} = \frac{1}{2x^{\frac{1}{2}}}$$

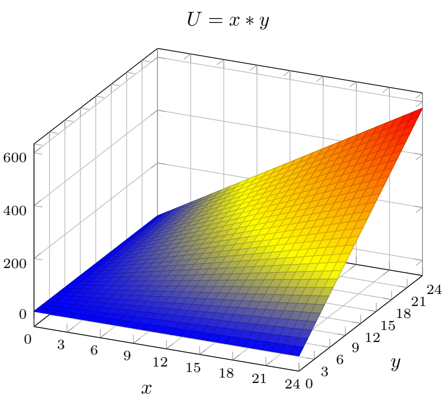
What does marginal utility mean?

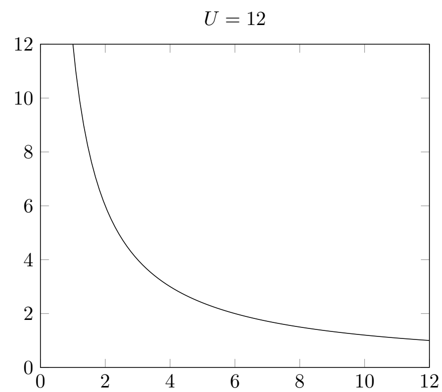
- Nothing

Lecture 4

Indifference Curves (ICs)

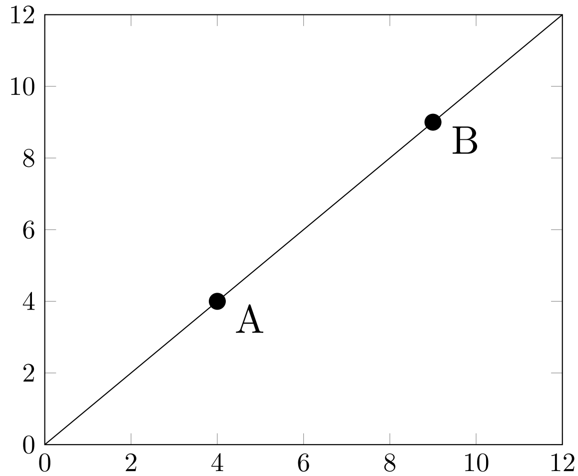
Lines that connect bundles of goods that give the same amount of utility



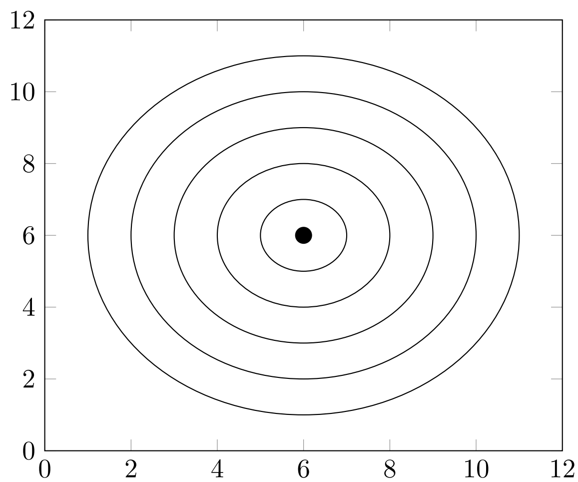


Assumptions on preferences determine indifference curve properties

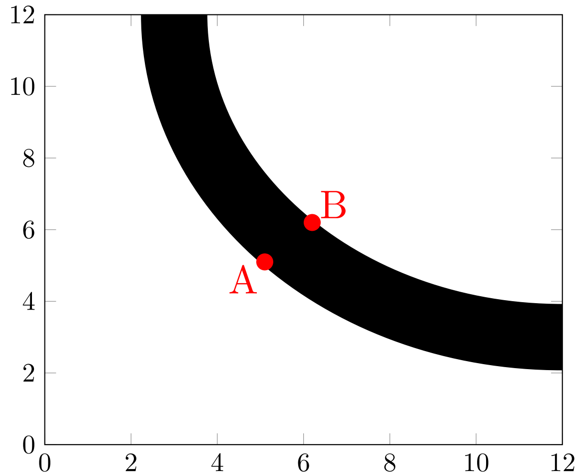
- Completeness: Every bundle of goods is on an IC
- Transitivity: IC's can't cross each other
- "More is better": IC's must be downwards sloping and cant be "thick" (curves not areas)



B has more of all goods than A, but $A \sim B$



There is a point of satiation.



B has more of all goods than A, but $A \sim B$

Marginal Rate of Substitution (MRS)

The rate at which a consumer is willing to trade one good for another, holding utility constant
MRS: The amount of y and individual is willing to give up to get a bit more x

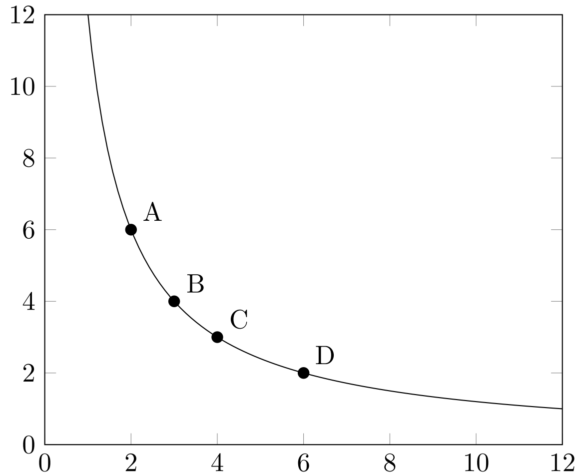
$$\text{MRS} = \frac{MU_x}{MU_y}$$

Ex. $U = xy$, what is this persons MRS?

$$MU_x = y$$

$$MU_y = x$$

$$\text{MRS} = \frac{y}{x}$$



Bundle	MRS
A	$6/2 = 3$
B	$4/3$
C	$3/4$
D	$2/6 = 1/3$

The Principle of Diminishing MRS

The more of a good you have, the less you are willing to trade for an additional unit

- People generally prefer variety
- Indifference curves bow in towards the origin

Important note:

- MRS shows people's willingness to make tradeoffs
- Many utility functions can represent the same preferences (monotonic transformations)
- Ex. $U = xy$ is the same as $U = (xy)^2$, but all these utility functions will have the same MRS

An example:

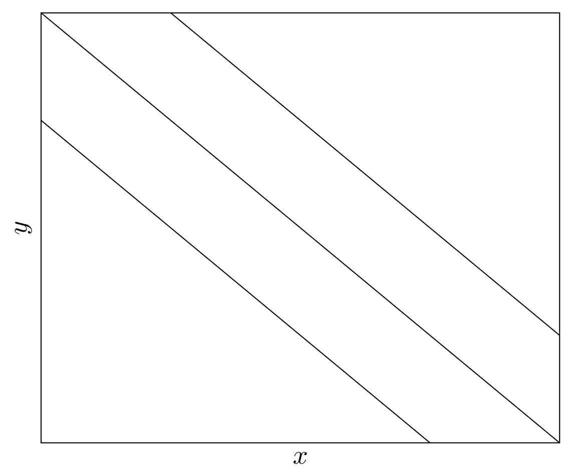
$U = xy$	$U = x^2y^2$
$MU_x = y$	$MU_x = 2xy^2$
$MU_y = x$	$MU_y = 2x^2y$
$\text{MRS} = \frac{y}{x}$	$\text{MRS} = \frac{2xy^2}{2x^2y} = \frac{y}{x}$

Lecture 5

Special Utility Functions

1. Perfect Substitutes: Individual is always willing to trade the aame amount of one good for another.

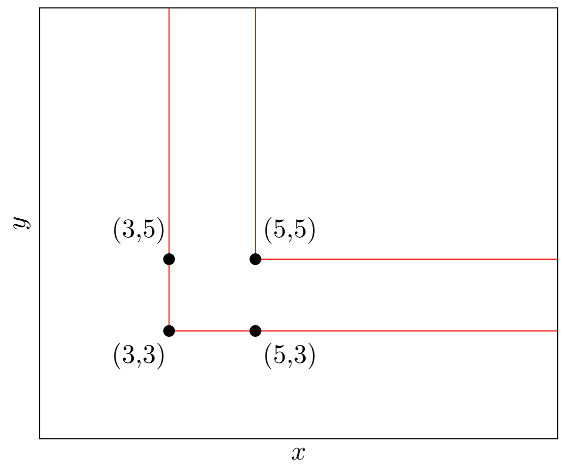
    - General form: $U = ax + by$, a and b are some numbers.
    - Ex. x = coke, y = pepsi $\rightarrow U = x + y$ ($a = 1$, $b = 1$)
    - $\text{MU}_x = 1$
    - $\text{MU}_y = 1$
    - $\text{MRS} = \frac{\text{MU}_x}{\text{MU}_y} = 1$ (Note: this is constant)

    - Slope = -1

2. Perfect Compliments: Individual only consumes the two goods together in fixed proportions

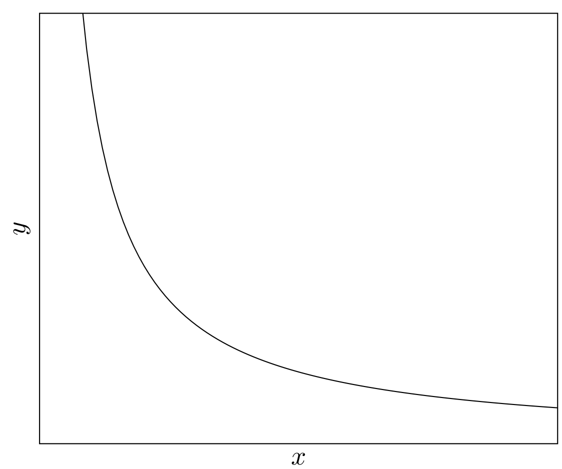
    - General form: $U = \min\{ax, by\}$, a and b are some numbers.
    - Ex. x = coffee, y = sugar $\rightarrow U = \min\{x, y\}$ ($a = 1$, $b = 1$)
    - MU_x, MU_y, and MRS are not defined.



- $x = 3$, $y = 3$, $U = \min\{3, 3\} = 3$
- $x = 5$, $y = 3$, $U = \min\{5, 3\} = 3$
- $x = 3$, $y = 5$, $U = \min\{3, 5\} = 3$
- $x = 5$, $y = 5$, $U = \min\{3, 3\} = 5$

3. Cobb-Douglas

- Most common type of utility function
- Satisfies all of our assumptions
- Flexible and easy to work with
- General form: $U = c \cdot x^a y^b$, a, b, and c are some numbers.
- Ex. $U = xy$, ($a = 1$, $b = 1$, $c = 1$)



Trick for Cobb-Douglas

If $U = c \cdot x^a y^b$, then

$$\text{MRS} = \frac{ay}{bx}$$

- Ex. $U = xy$

$$\text{MU}_x = y,\ \text{MU}_y = x$$
$$\text{MRS} = \frac{y}{x}$$

- Ex. $U = 2x^3y^4$

$$\text{MU}_x = 6x^2y^4,\ \text{MU}_y = 8y^3x^3$$
$$\text{MRS} = \frac{3y}{4x}$$

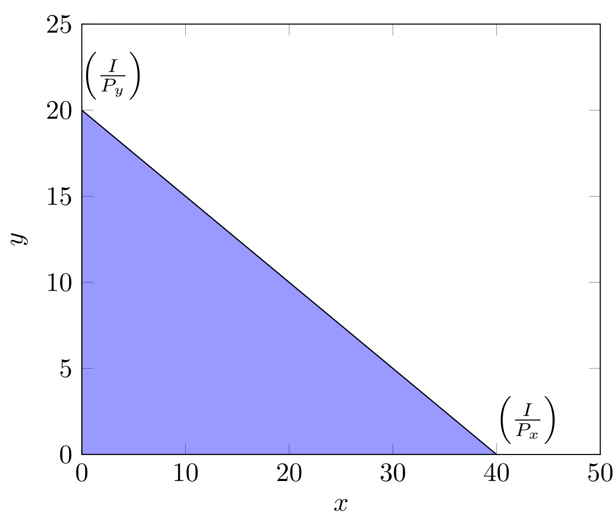
- Ex. $U = 27x^5y^9$

$$\text{MRS} = \frac{5y}{9x}$$

The Budget Constraint

For a given set of prices and income, the budget constraint determines the set of all bundles the individual can afford.

Ex. Suppose an indiviual has an income of $I = 800$, the price of x is $P_x = 20$ and the price of y is $P_y = 40$. Draw the budget constraint.



Everything in blue is affordable.

Slope $= -\frac{P_x}{P_y} = -\frac{1}{2}$

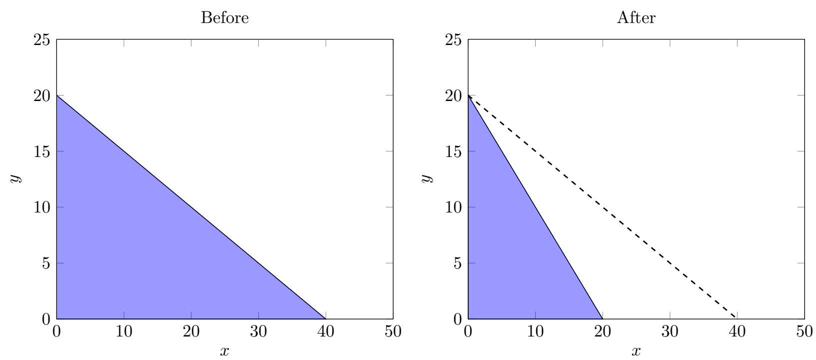
The Budget Line:

$$P_x \cdot x + P_y \cdot y = I$$

Changes in the Budget Constraint

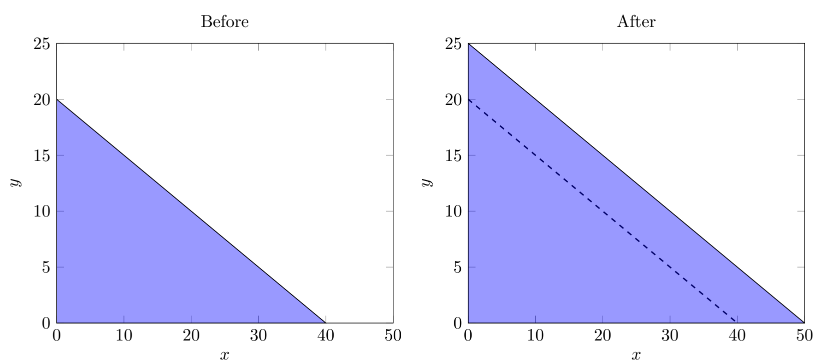
1. Changes in one of the prices

   Suppose P_x increases from $P_x = 20$ to $P_x = 40$.



2. Changes in income

   Suppose incomes changes from $I = 800$ to $I = 1000$



This is the same slope, just a parallel shift.

Putting it all together : The Consumer's Problem