Behavioral Economics

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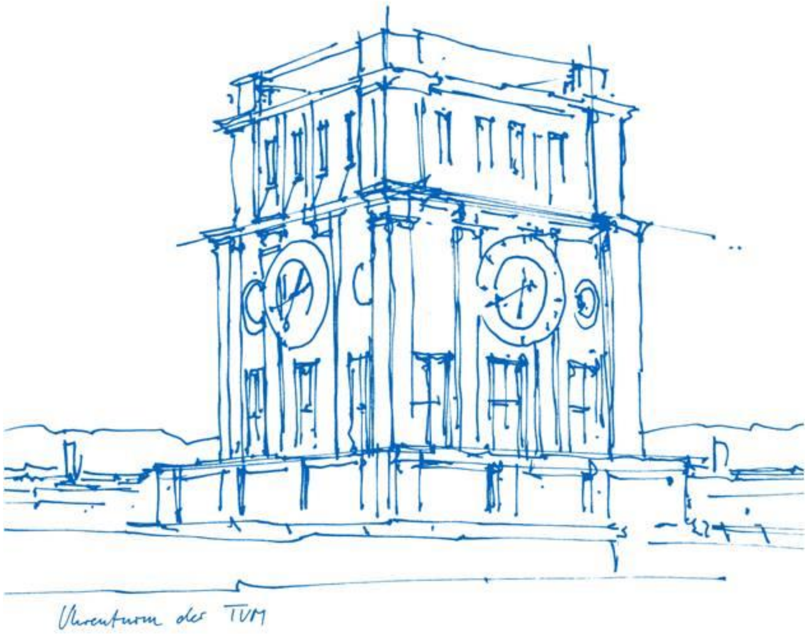


Semester Plan

Course Overview

I. What is Behavioural Economics

II. Principles of Experimental Economics

III. The Standard Economic Model: Consumer Theory

IV. Reference dependence & departures from the standard model

V. Decisions Under Risk and Uncertainty

VI. Intertemporal Choice

VII. Interaction with others: Game Theory

VIII. Interaction with others: Social Preferences

Semester Plan

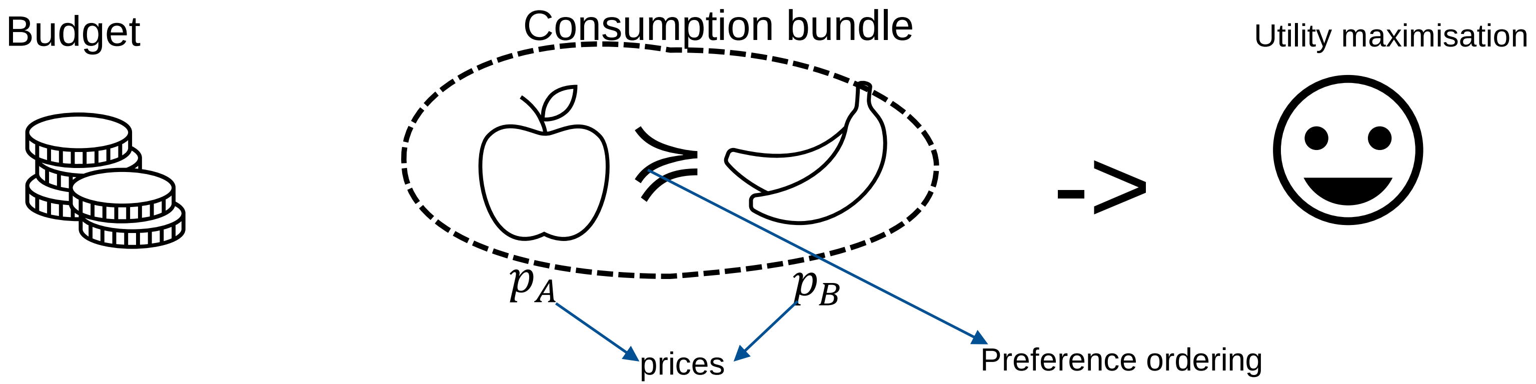
III. The Standard Economic Model: Consumer Theory

1. Consumer Preferences
2. Consumer Utility
3. Indifference Curves
4. Marginal Utility
5. Budget Constraints
6. Consumer Choice
7. Exercise: putting everything together
8. Discussion

Fundamental economics concepts

Economists want to answer questions such as:

Given a budget and prices what combination of goods makes a consumer the happiest?



Today‘s course

III. The Standard Economic Model: Consumer Theory

1. Consumer Preferences
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Preference notation: $\succcurlyeq$

- A preference is a relation.
- Take for example the (preference) relation between bananas (b) and apples (a).
- We formally denote the statement: “I like **bananas** at least as much as I like **apples**” as:

$$b \succcurlyeq a$$

- Where $\succcurlyeq$: “at least as much as”, declares a weak preference.
  - NB. Do not mistake $\succcurlyeq$ with $\geq$. The former refers to preference between goods. The latter to a comparison of numerical quantities.
  - We will see later how we can conveniently make the transition between those two symbols through a very important (representation) theorem!

Extending preference notation

- We can derive “strict preference”:
  - $\mathrm{b} \succ a$ if $\mathrm{b} \succcurlyeq a$ But Not $\mathrm{a} \succcurlyeq b$.
- We can also express indifference:
  - $b{\sim}a$, if $\mathrm{b} \succcurlyeq a$ AND $\mathrm{a} \succcurlyeq b$

Axiom 1: Preferences are complete

- Formally: Completeness of $\succcurlyeq$ is satisfied if

  $x \succcurlyeq y$ or $y \succcurlyeq x$ or both, for all x, y
- In words: Preferences are always defined. You must always prefer either apples to bananas or bananas to apples or be indifferent between the two. You are not allowed to not know what you prefer.

Axiom 2: Preferences are transitive

- Formally: Transitivity of preferences is satisfied if
$$x \succcurlyeq y \; and \; y \succcurlyeq z \Rightarrow x \succcurlyeq z \; (for\ all\ x, y, z)$$
  - Correspondingly: $x \sim y \; and \; y \sim z \Rightarrow x \sim z$
  - Also: $x \succ y \; and \; y \succ z \Rightarrow x \succ z$
- In words: if during your breakfast you prefer coffee to tea and tea to lemonade, then you must also prefer coffee to lemonade.

Rational preferences

- Definition: $\succcurlyeq$ is ‘rational’ iff (if and only if) it satisfies completeness (Axiom 1) and transitivity (Axiom 2)
- Consider someone with the following preference ordering:
  - $a \succ b \text{ and } b \succ c \text{ but } c \succ a$. Assume that he starts with a unit of c.
  - Because $b \succ c$, he would be willing to pay $x to trade c for b. Moreover:
  - Because $a > b$, he would be willing to pay $y to trade b for a. Moreover:
  - Because $c \succ a$, he would be willing to pay $z to trade c for a. But then:
  - He has paid $(x+y+z) to obtain what he started with – eventually, a person with intransitive preferences will go bankrupt…
- But, are all violations of these axioms ‘irrational’? We shall return to this point in the Discussion.

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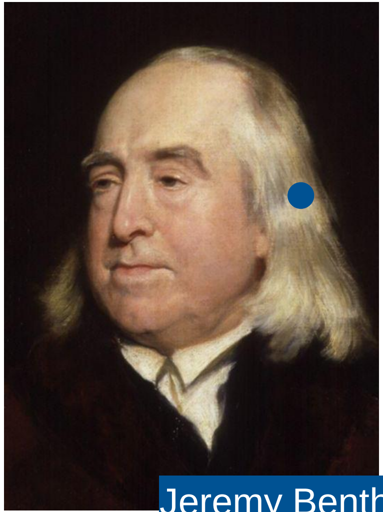
Utility and utilitarianism



Jeremy Bentham (1748 – 1832)

Hedonic Calculus:
the value of a pleasure or pain, considered by itself, can be measured according to its intensity, duration, certainty/uncertainty and propinquity/remoteness

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Utility and utilitarianism

*"Pleasure and pain are undoubtedly the ultimate objects of the Calculus of Economics. To satisfy our wants to the utmost with the least effort … in other words, to **maximise** pleasure, is the problem of Economics."*

William S. Jevons (1835 – 1882)

From preferences to a utility function

- It would be very convenient if we could represent preferences through a utility function $u()$
- Then we could easily find what is the most preferred item in a bundle: the one with the highest utility (just a number)
- For example, if u(apple)=4 and u(banana)=2, then we know that this person prefers apples over bananas.
  - Instead of $\text{a} \succ b$ we can now say $u(a) > u(b)$
- We could also apply all sorts of tools from calculus (take derivatives, etc.) to find out how to **maximise** utility
- Turns out: we can!

Axiom 3: Continuity of $\succcurlyeq$ and representation theorem

- We skip the formal (mathematical) expression of continuity in $\succcurlyeq$ (outside the scope of the material)
- In words: if you prefer x to y (say x= 330ml apple-juice and y= 330ml orange juice) then ‘sufficiently close’ to x (330ml - ϵ) must also be preferred to y.

- **Theorem 1**: if preferences are rational (i.e. complete and transitive) and continuous then there is a continuous function $u(\,.\,): R \to R$ representing $\succcurlyeq$, such that:

$$x \succ y \Leftrightarrow u(x) > u(y)$$
$$x \sim y \Leftrightarrow u(x) = u(y)$$

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Ordinal vs. cardinal

- Ordinal: if we **only** care about the **ranking** of the numbers.
- Cardinal: if we **also** care about the **magnitude** of the numbers.
- Example:

League: Bundesliga — Season: 2019–20

	Club	MP	W	D	L	GF	GA	GD	Pts	Last 5
1	Bayern	34	26	4	4	100	32	68	82	✓ ✓ ✓ ✓ ✓
2	Dortmund	34	21	6	7	84	41	43	69	✗ ✓ ✗ ✓ ✓
3	RB Leipzig	34	18	12	4	81	37	44	66	✓ ✗ – ✓ –
4	Mönchenglad…	34	20	5	9	66	40	26	65	✓ ✓ ✓ ✗ ✗
5	Leverkusen	34	19	6	9	61	44	17	63	✓ ✗ ✓ – ✗

  - Bayern was 1st in last year's Bundesliga while Dortmund was 2nd.
  - The numbers 1 and 2 are **ordinal**: they tell us that Bayern "beat" Dortmund but do not tell us "how much better".
  - The final standing shows that Bayern collected 82 points while Dortmund 69. These numbers are cardinal.

Utility functions are ordinal

- Theorem 1 is ordinal: when comparing two goods, all that matters is the ranking of the utilities; the actual numbers themselves carry no significance.
  - The fact that I assign utility: u(Bieber)=1 and u(Radiohead)=100 does not mean that I prefer listening to Radiohead… 100 times more than listening to Justin Bieber
    - *(in fact, I enjoy it much more!)*
- **Theorem 2**: Suppose $u(x)$ represents the agent's preferences, $\succcurlyeq$, and $f : R \rightarrow R$ is a strictly increasing function. Then the new utility function $v(x) = f(u(x))$ also represents the agent’s preferences $\succcurlyeq$.

Convenient transformations of utility

Implication of theorem 2:

$$u(x,y) = -\frac{3}{(x^{0.5}+y^{0.5})^3}$$

And

$$v(x,y) = x^{0.5} + y^{0.5}$$

Are equivalent.

- Since u(x) and v(x) preserve the rankings of the goods, they represent the same preferences.
- As a result, the agent will make the same choices with utility u(x) and v(x).
- This is useful since it is much simpler to solve the agent's choice problem using v(x) than u(x).

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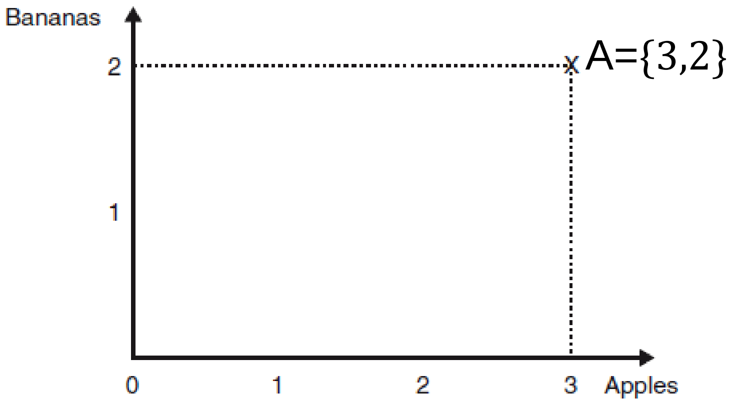
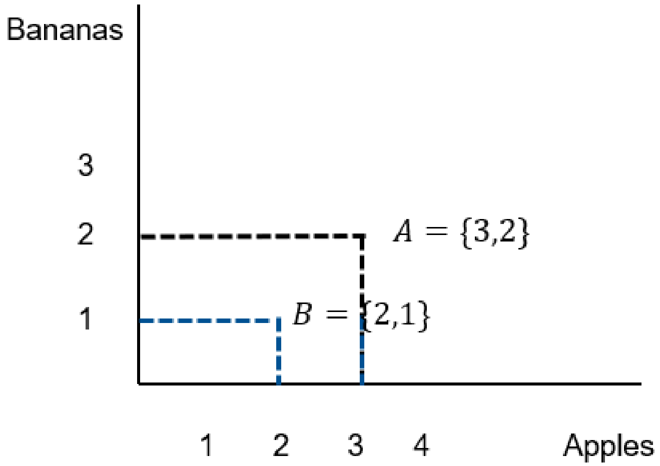
Consumption Bundle

- Economists focus on preferences over consumption bundles – collection of goods.
- Consider for example a consumption bundle of 3 apples (a) and 2 bananas (b). We notate this as $\{a, b\} = \{3, 2\}$
- Imagine you have some money to spend on a healthy snack. The only healthy options in the canteen are apples and bananas. How will you allocate your budget between apples and bananas?
    - What is the consumption bundle that *maximizes your utility?*



Axiom 4: More is (strictly) better than less

$A \succ B$



Implication: Utility functions are (strictly) monotonically increasing

So, if $x_1 > x_2 \Rightarrow u(x_1) > u(x_2)$

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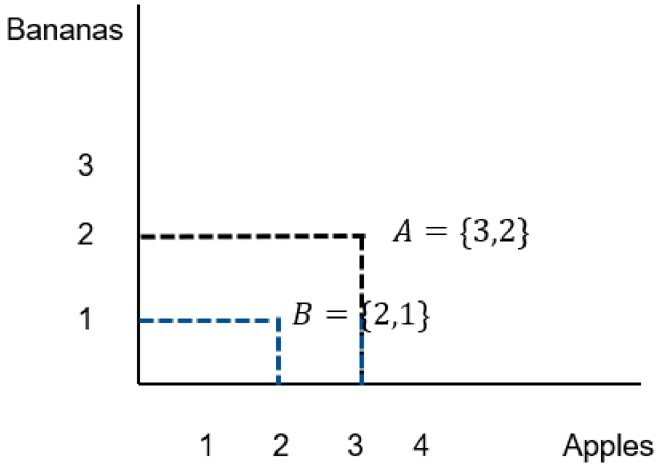
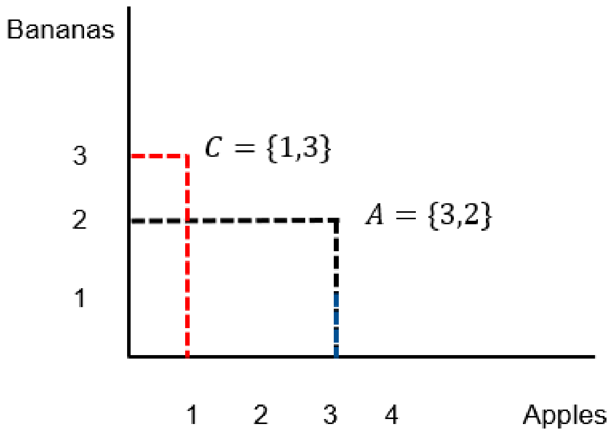
Not always that easy to tell

$A \succ B$



$A ? C$



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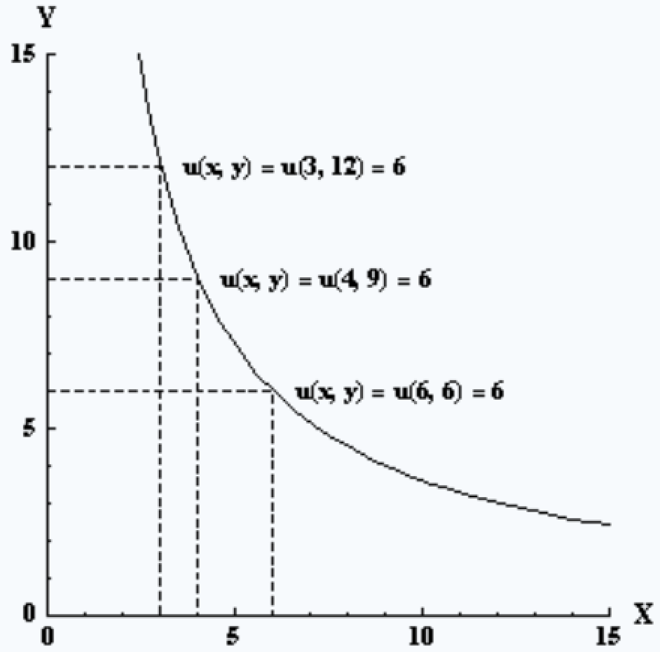
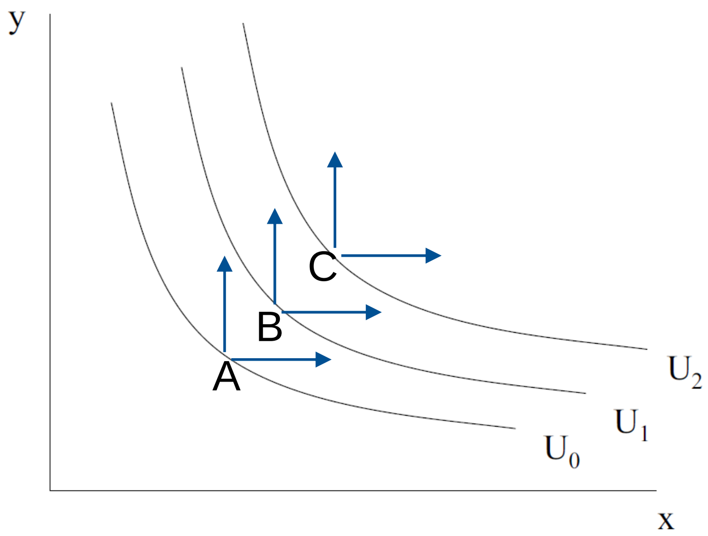
Indifference curve (IC): locus of bundles with equal utility



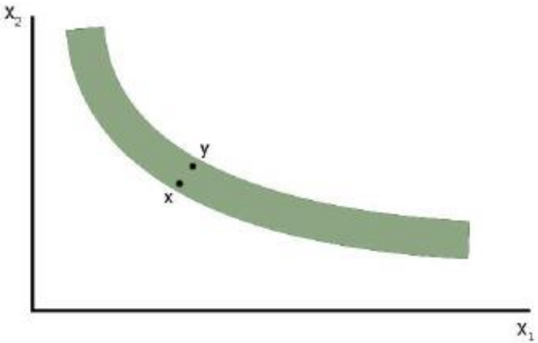
Indifference curve u(x, y) = 6 for the utility function $u(x, y) = x^{0.5} y^{0.5}$.

Property 1: Higher utility up and to the right



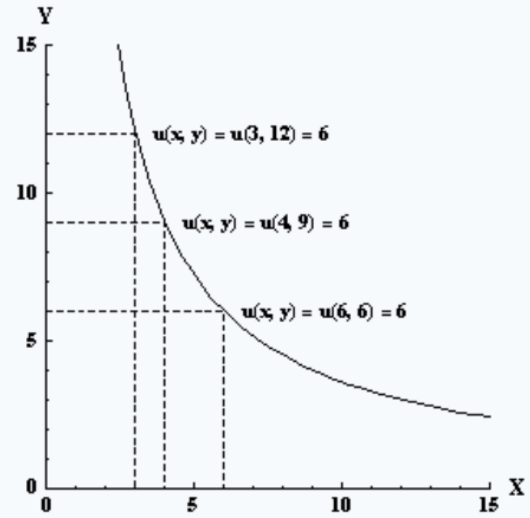
- Following Axiom 4: more is better than less
- $U_2 > U_1 > U_0$

Property 1 (implication): ICs are “thin”



- Bundle y is “up and to the right” of bundle x (so has more of x_1 and x_2
- Therefore, it has to correspond to an IC with higher utility.

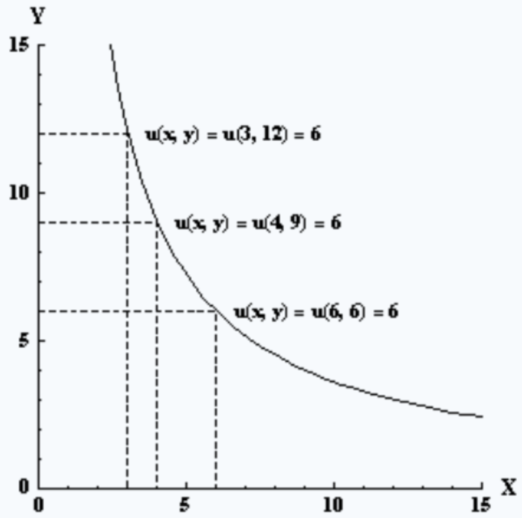
Property 2: Downward sloping



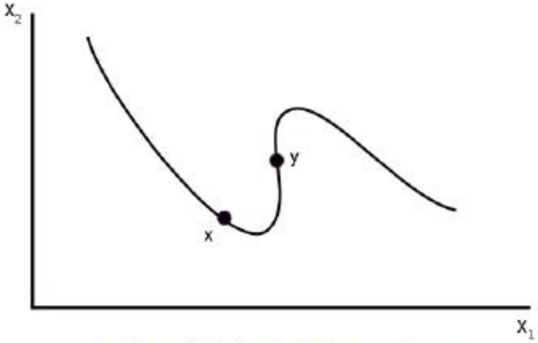
Indifference curve u(x, y) = 6 for the utility function $u(x, y) = x^{0.5} y^{0.5}$.

- If utility is to remain the same at all points along the **curve**, a reduction in the quantity of the good on the vertical axis must be counterbalanced by an increase in the quantity of the good on the horizontal axis (or vice versa).

Property 2: Downward sloping



Indifference curve u(x, y) = 6 for the utility function $u(x, y) = x^{0.5} y^{0.5}$.



An Upward Sloping Indifference Curve.

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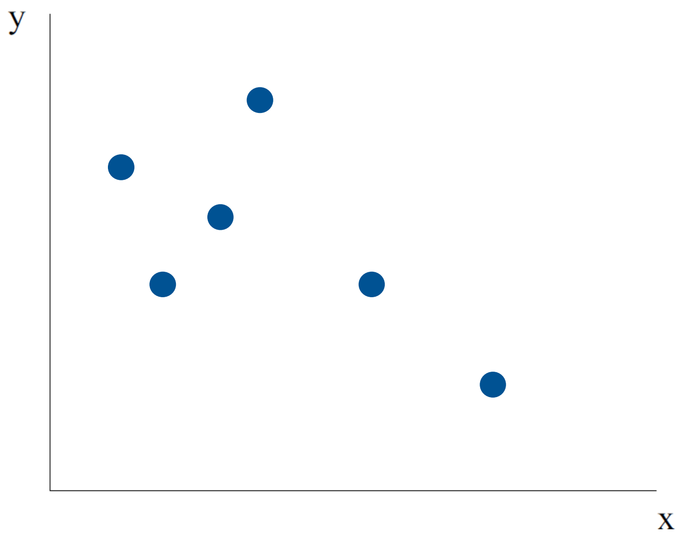
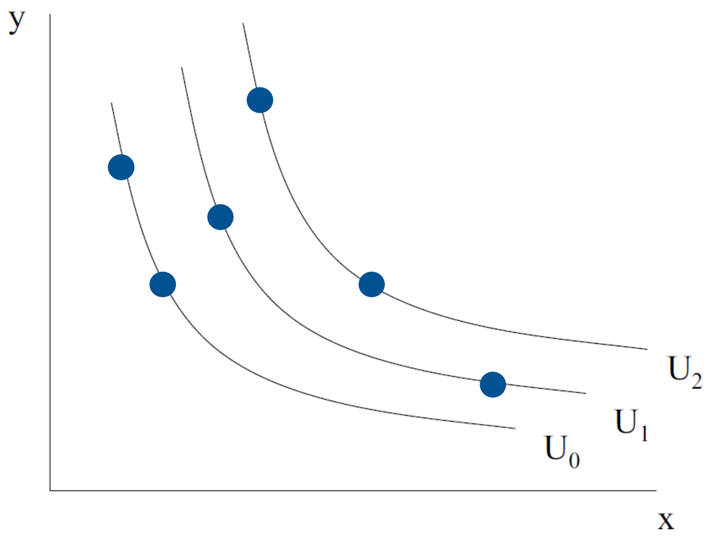
Property 3: Indifference curve through every possible bundle

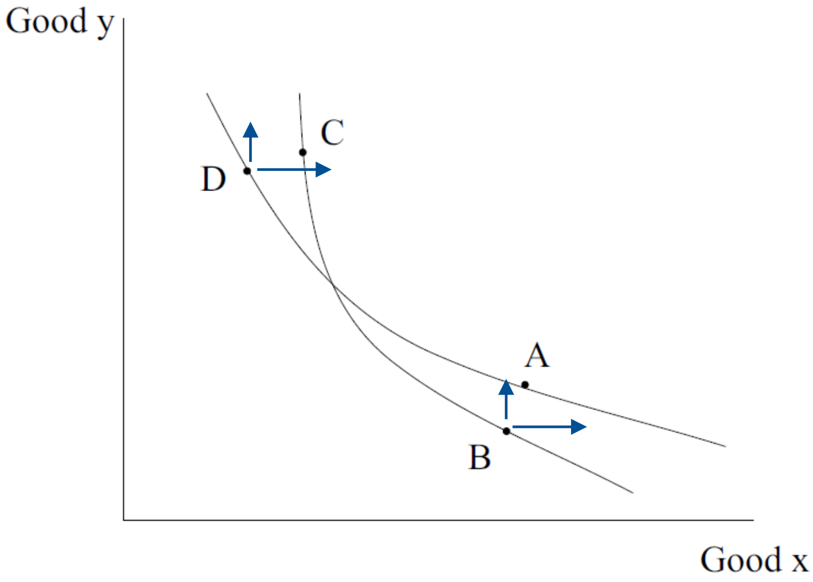


Property 3: Indifference curve through every possible bundle



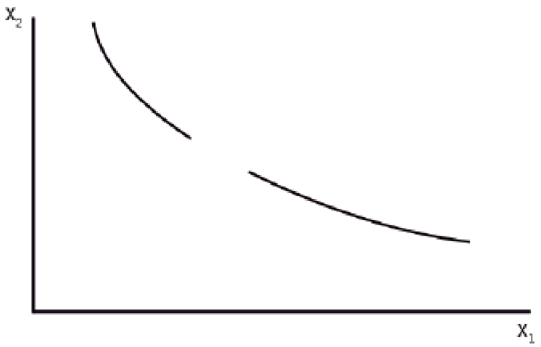
- Following Axiom 1 – completeness of ≽

Property 4: Indifference curves cannot cross



- A≻B and B~C , so A≻C (by transitivity)
- C≻D and A~D , so C≻A (by transitivity)
- But A cannot be at the same time strictly preferred to C and C be strictly preferred than A.

Property 5: Continuous, with no gaps



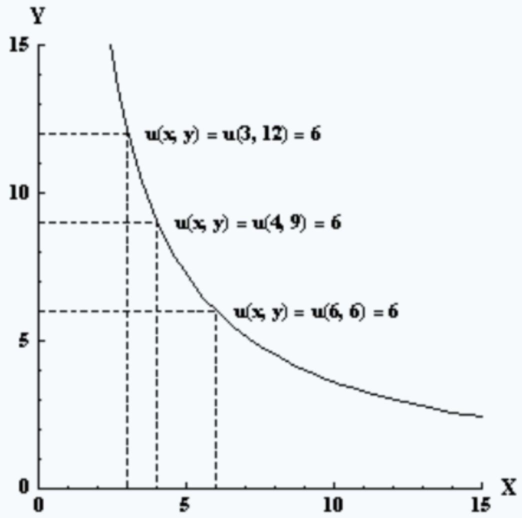
An Indifference Curve with a Gap.

- Follows from Axiom 3: continuity of preferences (and corresponding utility function)

Indifference curves: properties

1. Bundles on indifference curves farther from the origin (more up and to the right) are preferred to those on indifference curves closer to the origin (more down and to the left).
   - Axiom 4: More is (strictly) better than less
   - An implication: indifference curves are „thin“
2. Indifference curves slope downward.
   - **Indifference curves slope downward** because, if utility is to remain the same at all points along the **curve**, a reduction in the quantity of the good on the vertical axis must be counterbalanced by an increase in the quantity of the good on the horizontal axis (or vice versa).
3. There is an indifference curve through every possible bundle.
   - Axiom 1: completeness axiom
4. Indifference curves cannot cross.
   - Axiom 2: transitivity
5. Indifference curves are continuous with no gaps
   - Axiom 3: continuity

Case 1: Symmetric "Cobb Douglas" preferences



Indifference curve u(x, y) = 6 for the utility function u(x, y) = $x^{0.5}$ $y^{0.5}$.

- $u(x,y) = x^{\alpha}y^{1-a}, 0 < a < 1$
- In this case $a = \frac{1}{2}$
- Most common form of utility but not the only one…

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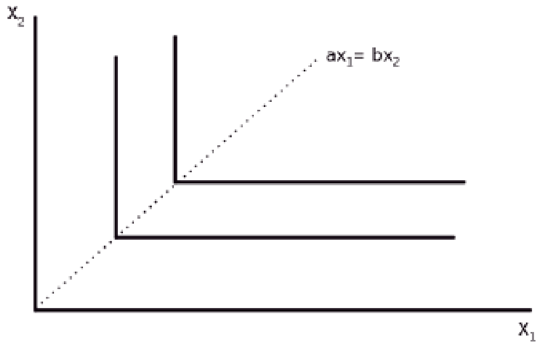
Case 2: Perfect complements

- Consider an agent with remote controls (x_1) that need batteries (x_2).
- Every remote control needs exactly 2 batteries to function
  - Remote controls and batteries are perfect complements
- The agent draws utility only from functioning remote controls
  - If she has 1 remote control with 3 batteries then the 3rd battery is worthless
  - Similarly, if she has 3 remotes with 2 batteries then the last 2 remote controls are worthless



Perfect Complements. These indifference curves are L–shaped with the kink where $\alpha x_1 = \beta x_2$.

- $u(x_1, x_2) = \min\{ax_1, bx_2\}$
- In this example, $a = 2, b = 1$
- Those L-shaped preferences are also known as “Leontief preferences”

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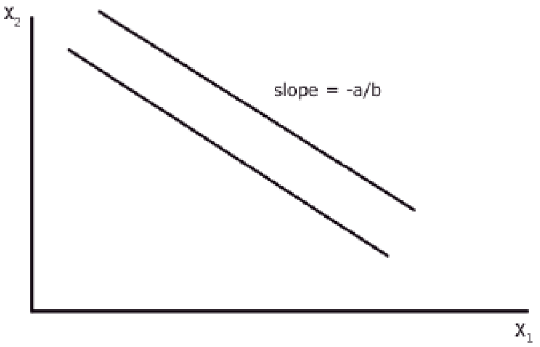
Case 3: Perfect substitutes

- Consider an agent buying pizzas (x_1) and Flammkuchen (x_2) for a party.
- She wants enough food for the party and considers 2 flammkuchen to be **always**, **exactly** equivalent to one pizza.



Perfect Substitutes. These indifference curves are linear with slope $-\alpha/\beta$.

- $u(x_1, x_2) = ax_1 + bx_2$
- In this example, $a = 2, b = 1$

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Marginal utility

marginal utility

Additional satisfaction obtained from consuming one additional unit of a good

diminishing marginal utility

Principle that as more of a good is consumed, the consumption of additional amounts will yield smaller additions to utility.

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Example: Diminishing Marginal Utility

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Example: Diminishing Marginal Utility

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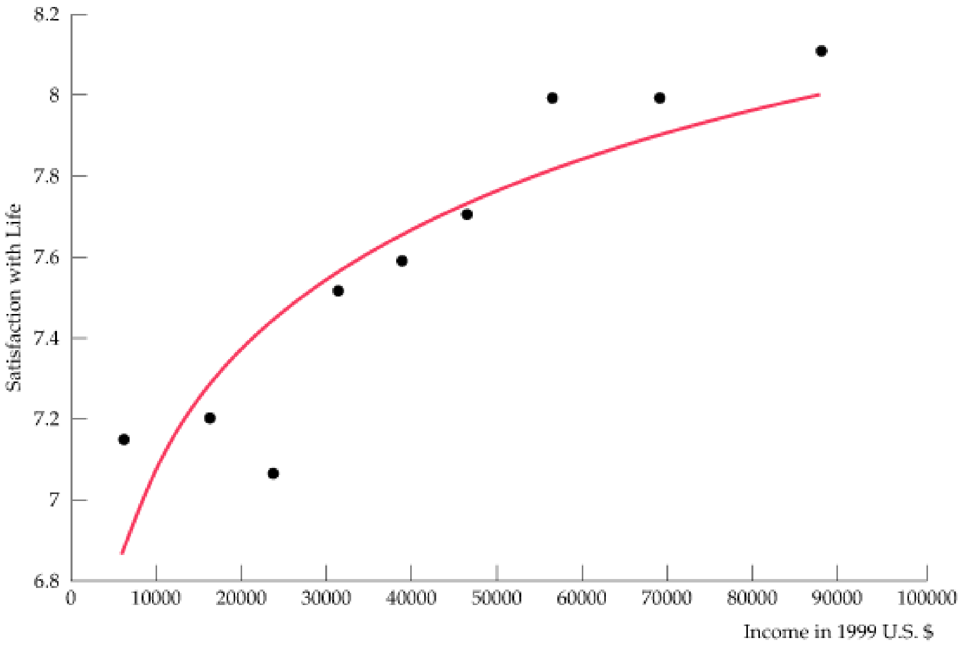
Example: Income

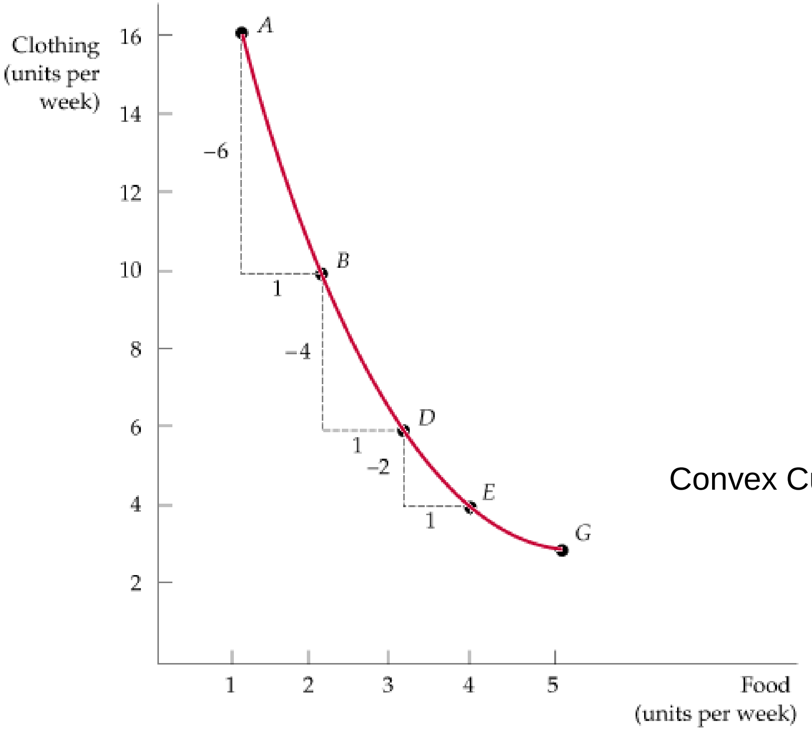


Indifference Curves - Assumptions

We assume that an indifference curve is continuous without gaps and they have the following four important properties:

1. Bundles on indifference curves farther from the origin (more to the right) are preferred to those on indifference curves closer to the origin (more to the left).
2. There is an indifference curve through every possible bundle.
3. Indifference curves cannot cross.
4. Indifference curves slope downward.

Marginal rate of substitution



Convex Curve

Equal Marginal Principle

All points of an indifference curve generate the same utility. Thus, a gain in utility (higher consumption of food) must be balanced by the loss in utility (lower consumption of food):

$$0 = MU_F \Delta F + MU_C \Delta C$$

$$\Rightarrow -\frac{\Delta C}{\Delta F} = \frac{MU_F}{MU_C}$$

Marginal rate of substitution

marginal rate of substitution (MRS)

Maximum amount of a good that a consumer is willing to give up in order to obtain one additional unit of another good. It is the magnitude of the slope of an indifference curve

$$\text{MRS} = -\frac{\Delta C}{\Delta F}$$

Equal Marginal Principle

All points of an indifference curve generate the same utility. Thus, a gain in utility (higher consumption of food) must be balanced by the loss in utility (lower consumption of food):

$$0 = MU_F \Delta F + MU_C \Delta C$$

$$\Rightarrow -\frac{\Delta C}{\Delta F} = \frac{MU_F}{MU_C}$$

Marginal Rate of Substitution: How much am I willing to give up of one good to get the other good:

$$MRS = -\frac{\Delta C}{\Delta F}$$

Diminishing Marginal Rate of Substitution

diminishing marginal rate of substitution

Indifference curves are usually convex (bowed inward). The term convex means that the the slope of the indifference curves increases (i.e. becomes less negative) as we move down along the curve.
We assume that most indifference curves have diminishing marginal rates of substitution. As more and more of one good is consumed we expect that a consumer will prefer to give up fewer and fewer units of a second good to get additional units of the first one.

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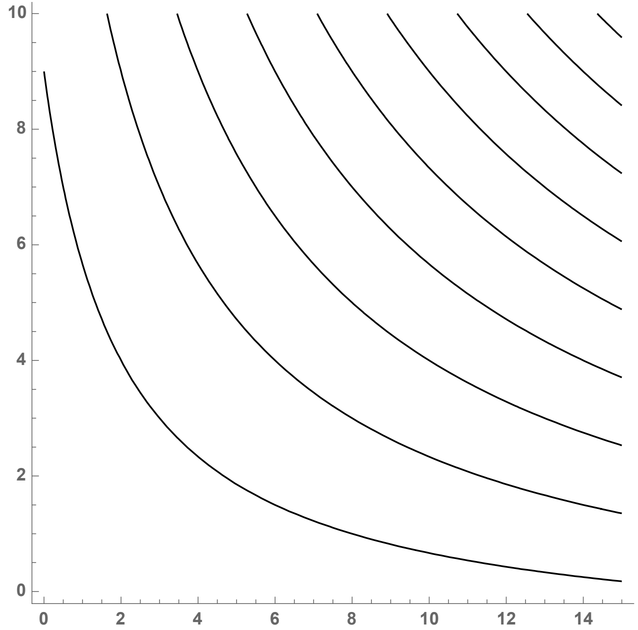
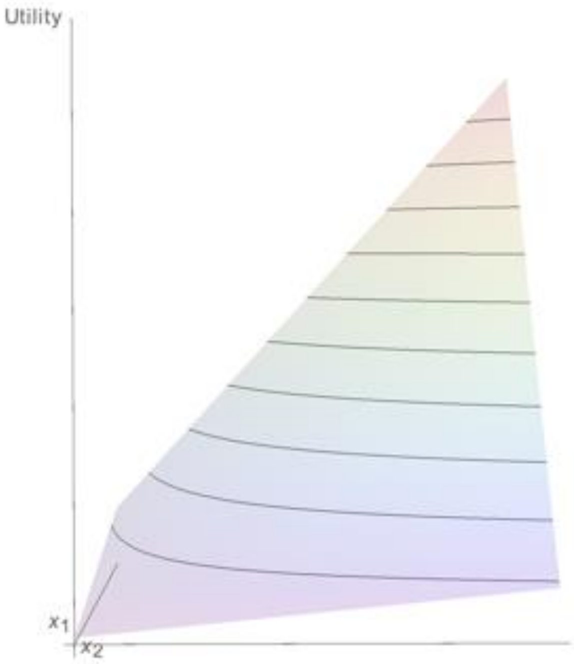
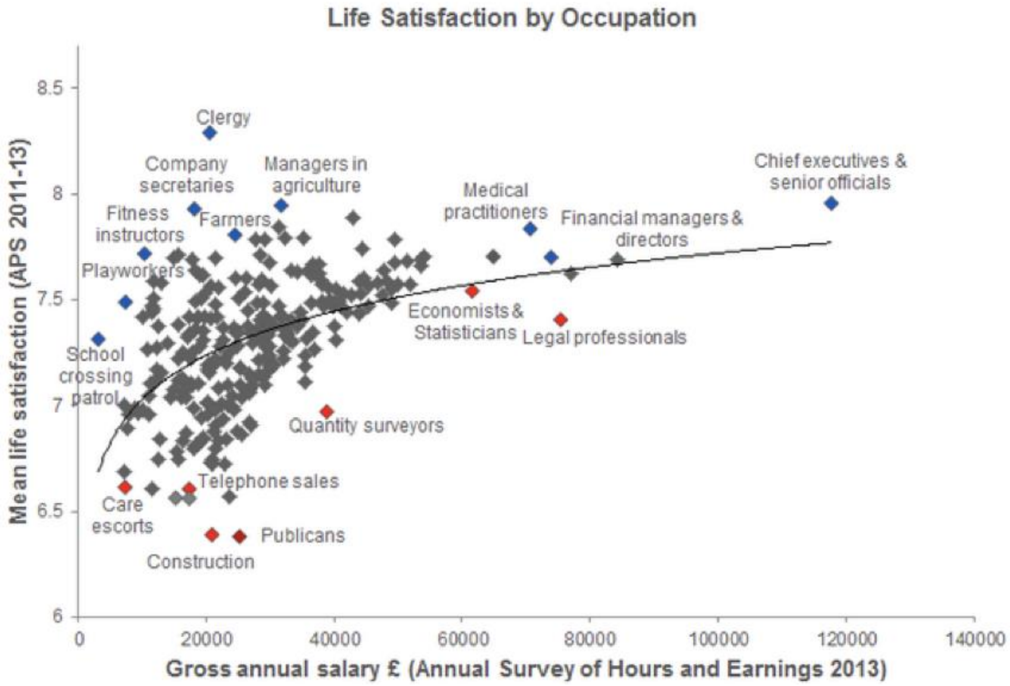
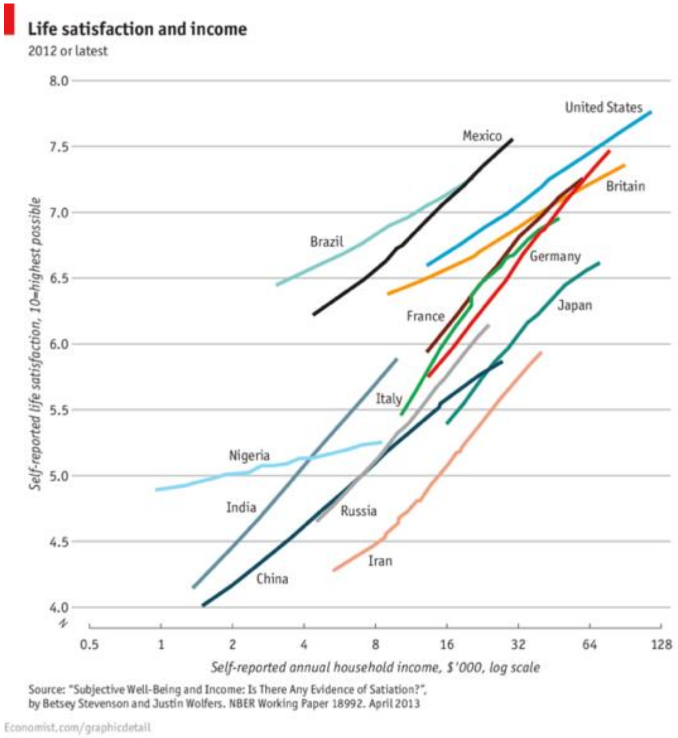
Utility Functions and Indifference Curves






Life Satisfaction by Occupation
Mean life satisfaction (APS 2011-13)
Gross annual salary £ (Annual Survey of Hours and Earnings 2013)
8.5
8
7.5
7
6.5
6
0
20000
40000
60000
80000
100000
120000
140000
Clergy
Company secretaries
Managers in agriculture
Fitness instructors
Farmers
Playworkers
School crossing patrol
Medical practitioners
Chief executives & senior officials
Financial managers & directors
Economists & Statisticians
Legal professionals
Quantity surveyors
Telephone sales
Care escorts
Publicans
Construction


Life satisfaction and income
2012 or latest
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
United States
Mexico
Britain
Brazil
Germany
Japan
France
Italy
Nigeria
India
Russia
Iran
China
Self-reported life satisfaction, 10=highest possible
0.5
1
2
4
8
16
32
64
128
Self-reported annual household income, $'000, log scale
Source: "Subjective Well-Being and Income: Is There Any Evidence of Satiation?",
by Betsey Stevenson and Justin Wolfers. NBER Working Paper 18992. April 2013
Economist.com/graphicdetail

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Budget Constraints

budget constraints

Constraints that consumers face as a result of limited incomes.

budget line

All combinations of goods for which the total amount of money spent is equal to income

Budget Constraints

Bundle	Food (F)	Clothing (C)	Total Spending
A	0	40	80 €
B	20	30	80 €
D	40	20	80 €
E	60	10	80 €
G	80	0	80 €

P_F: 1 € per unit; P_C: 2 € per unit

Budget Constraints

$$P_F F + P_C C = I \quad \rightarrow \quad F + 2C = \$80$$

Bundle	Food (F)	Clothing (C)	Total Spending
A	0	40	80 €
B	20	30	80 €
D	40	20	80 €
E	60	10	80 €
G	80	0	80 €

P_F: 1 € per unit; P_C: 2 € per unit

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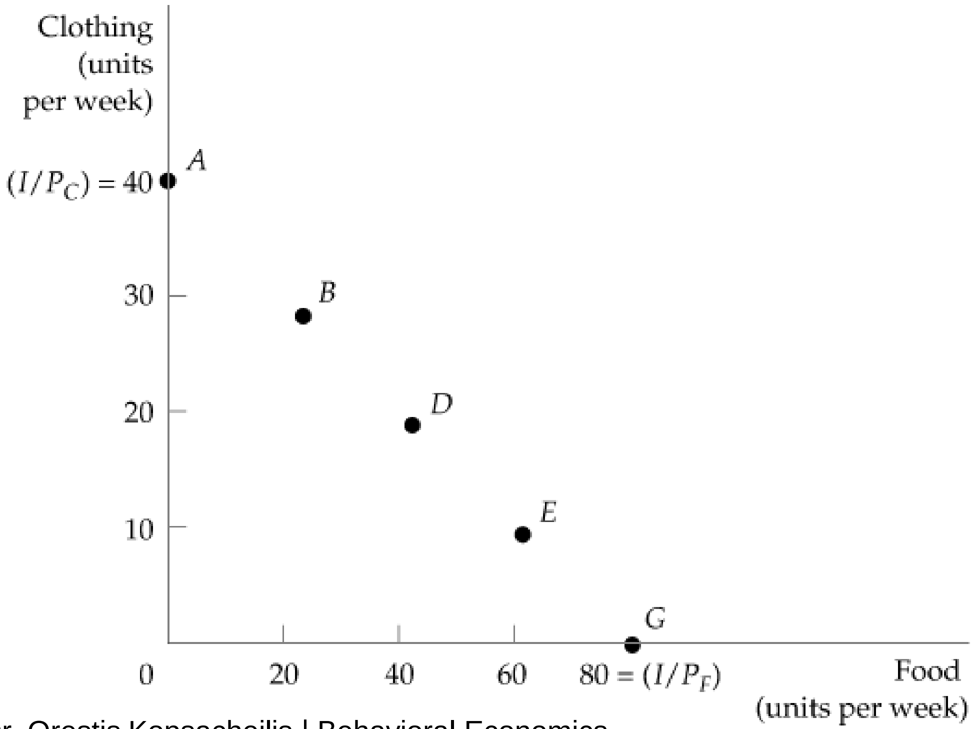
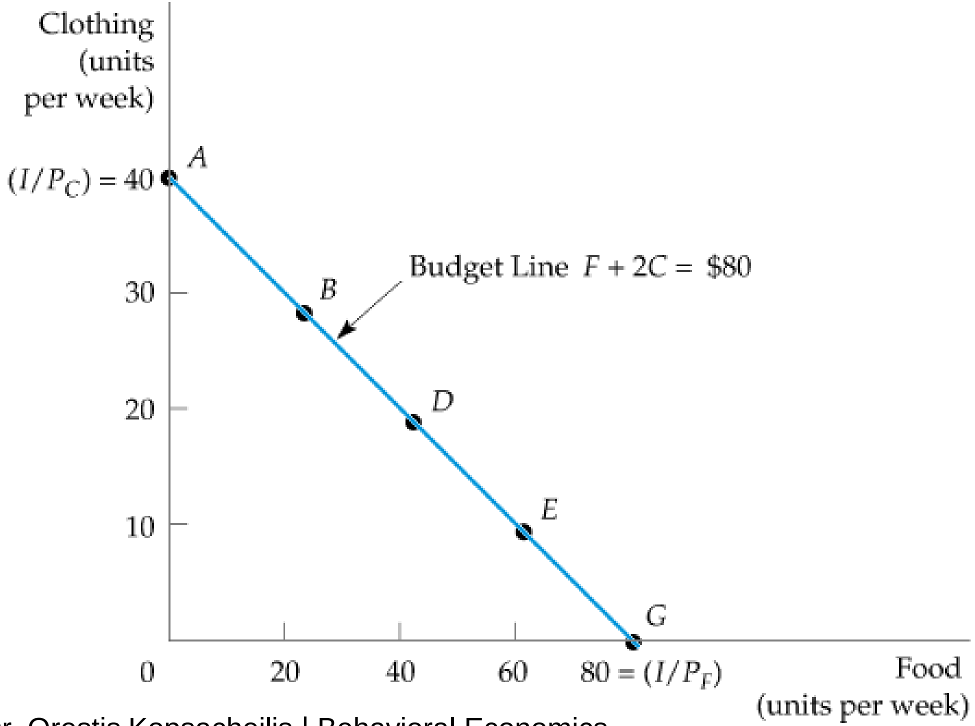
Budget Constraints



Budget Constraints



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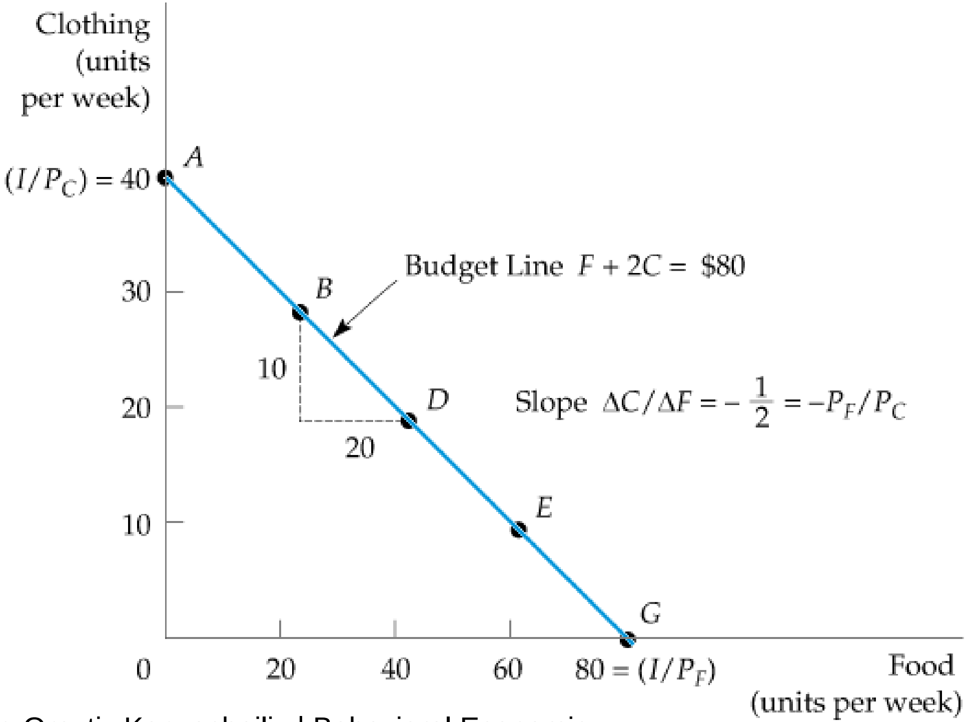

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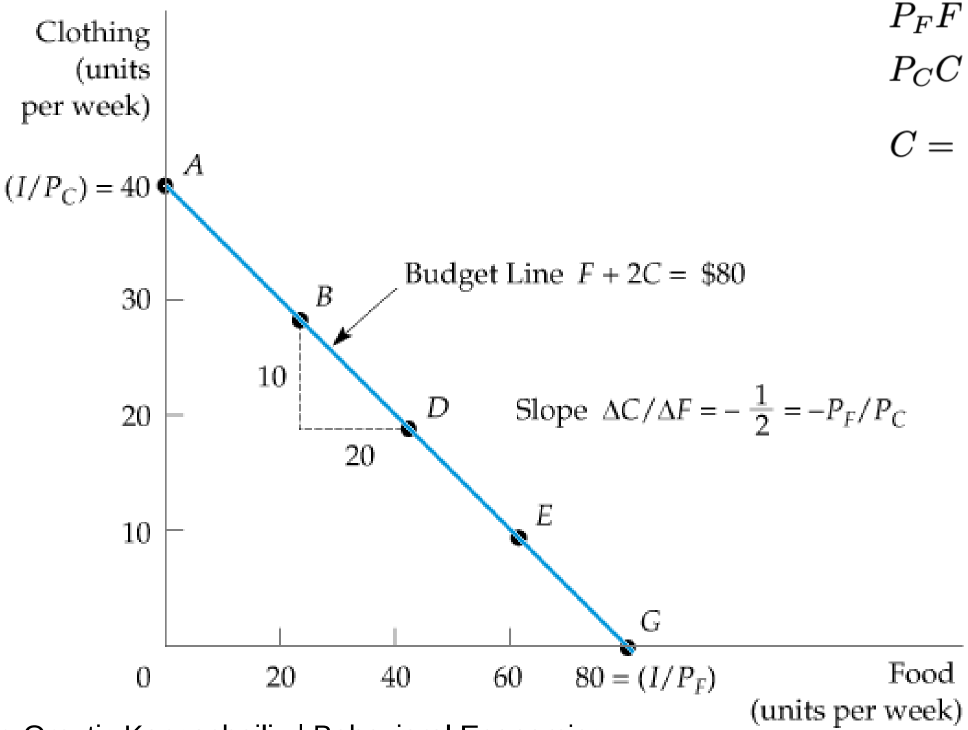

$$P_F F + P_C C = I$$

$$P_C C = I - P_F F$$

$$C = \frac{I}{P_C} - \frac{P_F}{P_C} F$$

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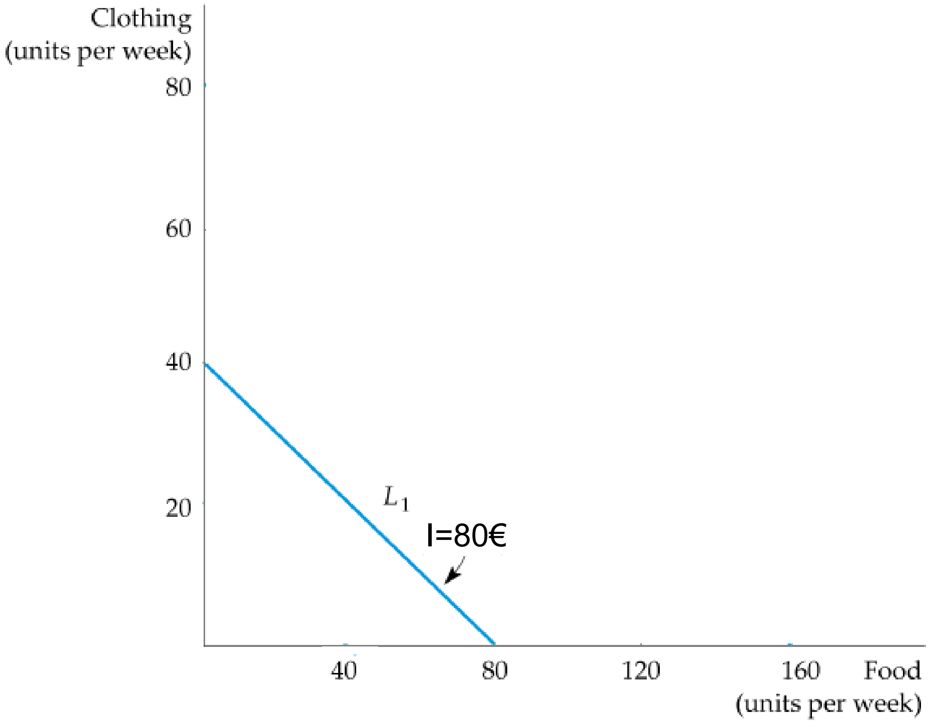
Budget Constraints



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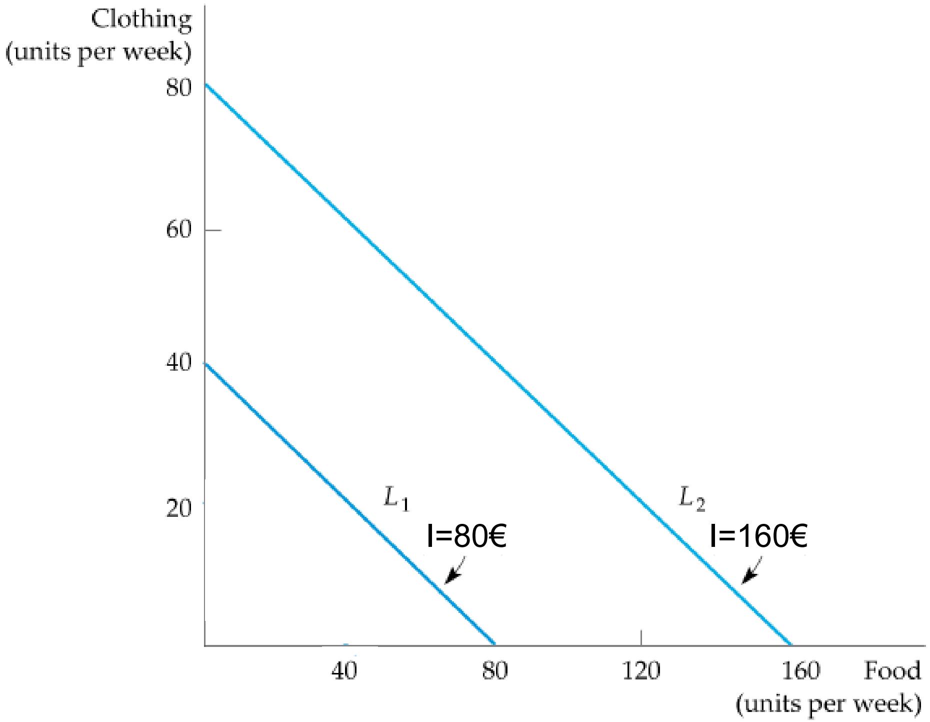

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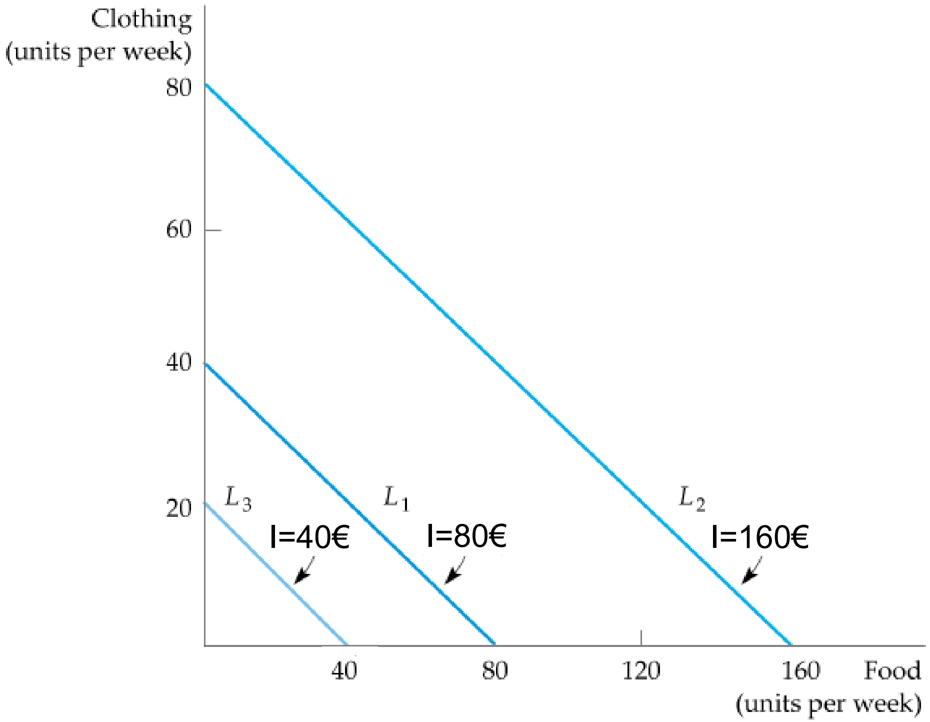

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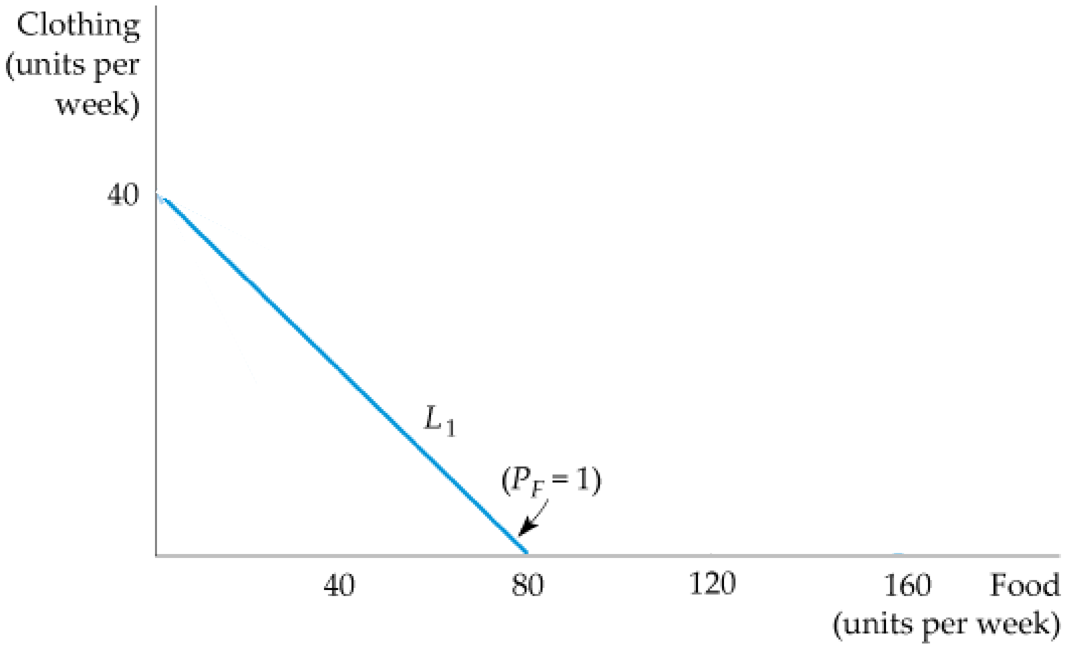

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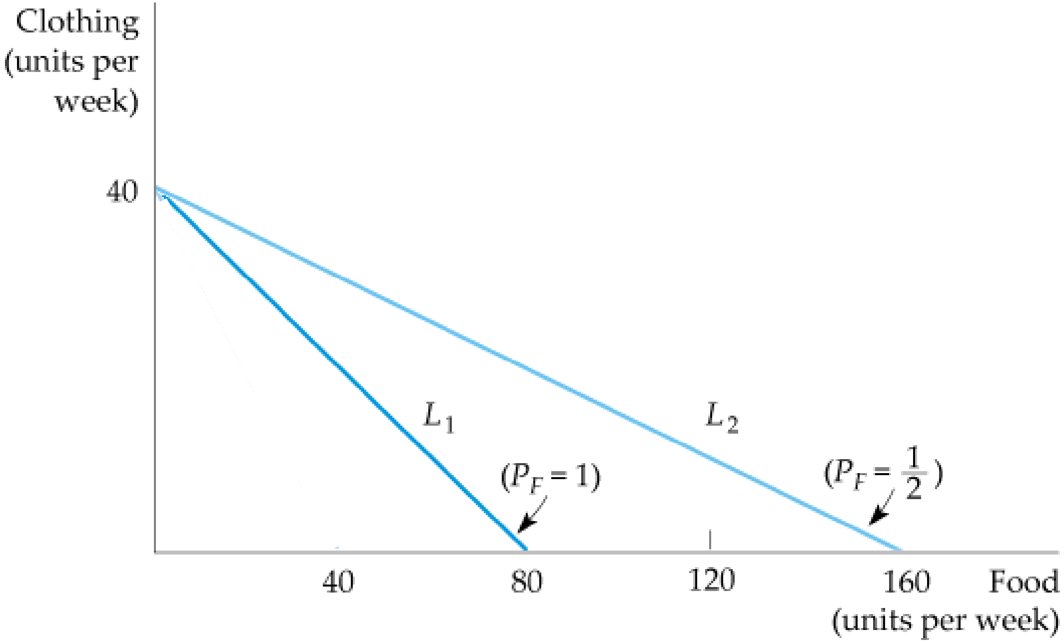

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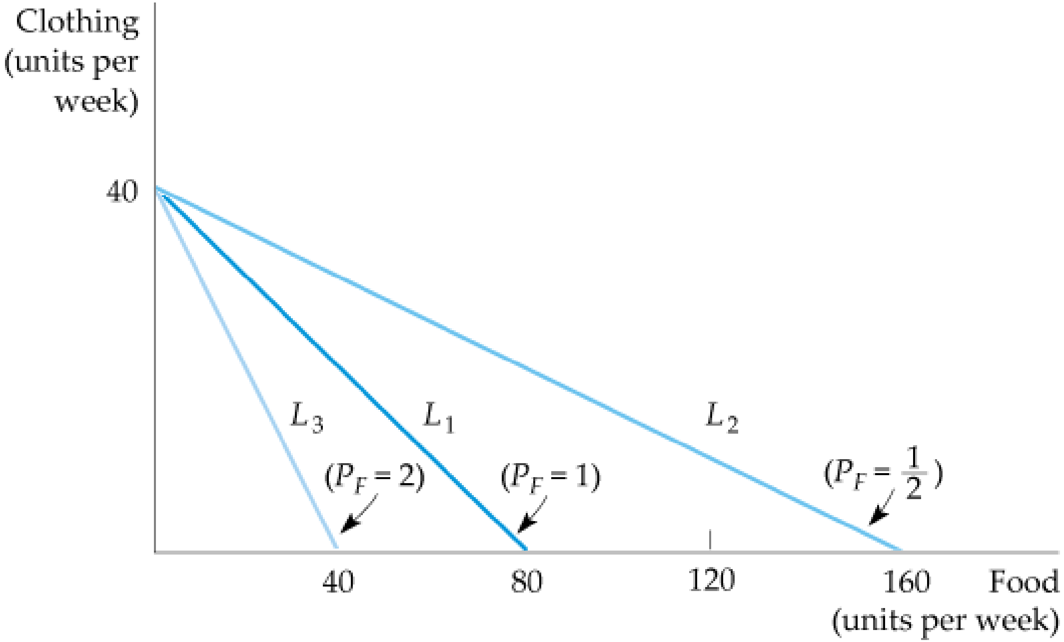
Budget Constraints



Today‘s course

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(Rational) Consumer Choice

Imagine you won 20,000 € in the lottery; you decide to go buy a vintage Fiat Multipla for 8,000 €

(btw, because of your car preferences and your Justin Bieber affinity, you've pretty much lost all of your friends).

(Rational) Consumer Choice

Imagine you won 20,000 € in the lottery; you decide to go buy a vintage Fiat Multipla for 8,000 €

In scenario 1, you are held up on your way to the dealership, and the guy runs off with exactly 8000 €. In scenario 2, you buy the car but before you even get inside, a piano falls out of the sky and crushes it. You didn't sign up for the optional piano insurance and the damage is not covered under the dealer's limited warranty.

Thankfully the car dealer has exactly one more car of the same model.

In scenario 1, would you buy another car?
In scenario 2, would you buy another car?

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In scenario 1, would you buy another car?
In scenario 2, would you buy another car?

There is no right answer! However, your answers (assuming you're economically rational) should be the same in either scenario. Ultimately, your decision should be derived from your (stable) preferences and your budget.

Thinking at the Margin

Satisfaction is maximized when the marginal benefit is equal to the marginal cost

The benefit associated with the consumption of one additional unit of food

=

the cost of the additional unit of food.

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Consumer Choice

Assumption: Consumers maximize their satisfaction!

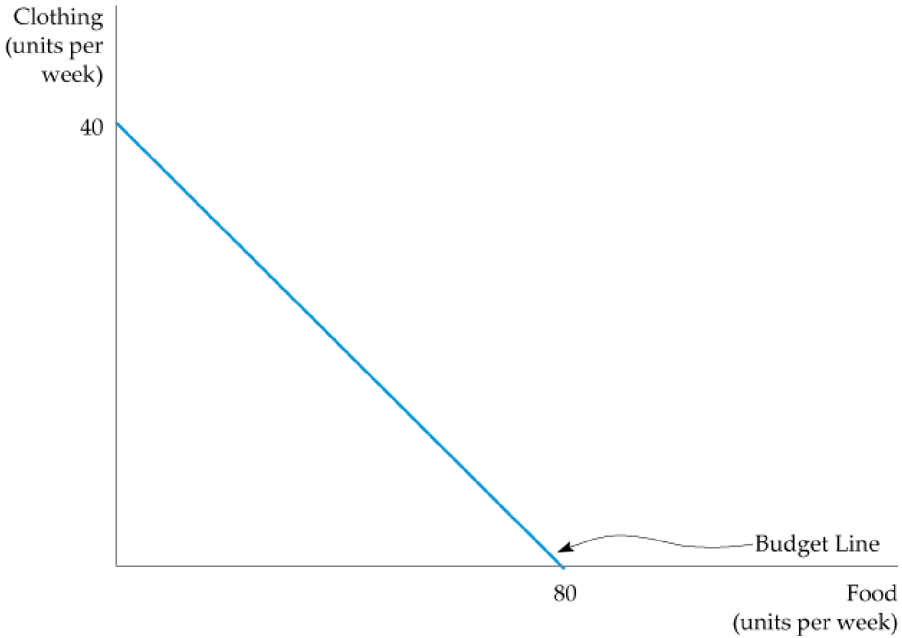
Consumer Choice

Assumption: Consumers maximize their satisfaction!

The maximizing basket must satisfy two conditions:

1. It must be located on the budget line
2. It must give the consumer the most preferred combination of goods and services

Consumer Choice



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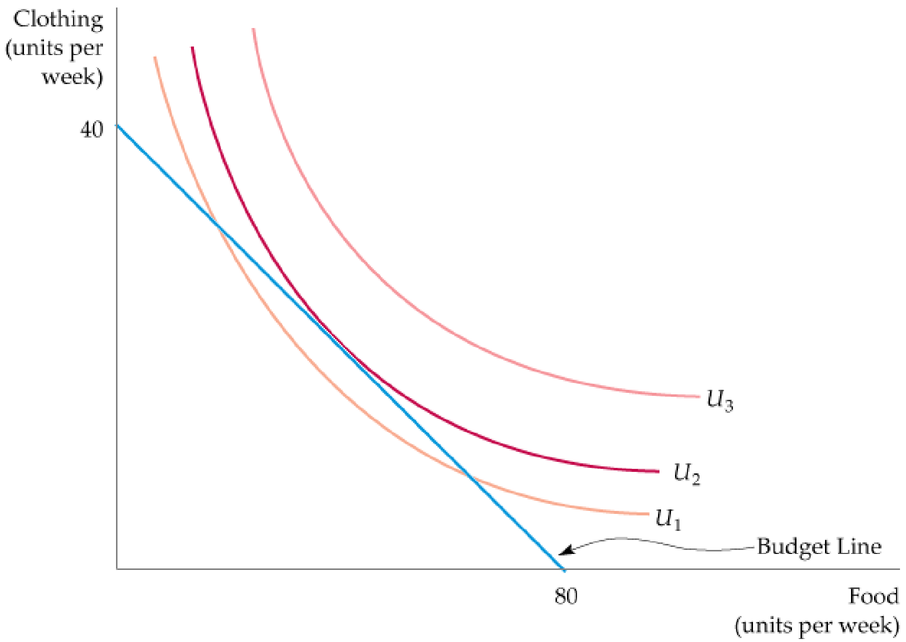
Consumer Choice



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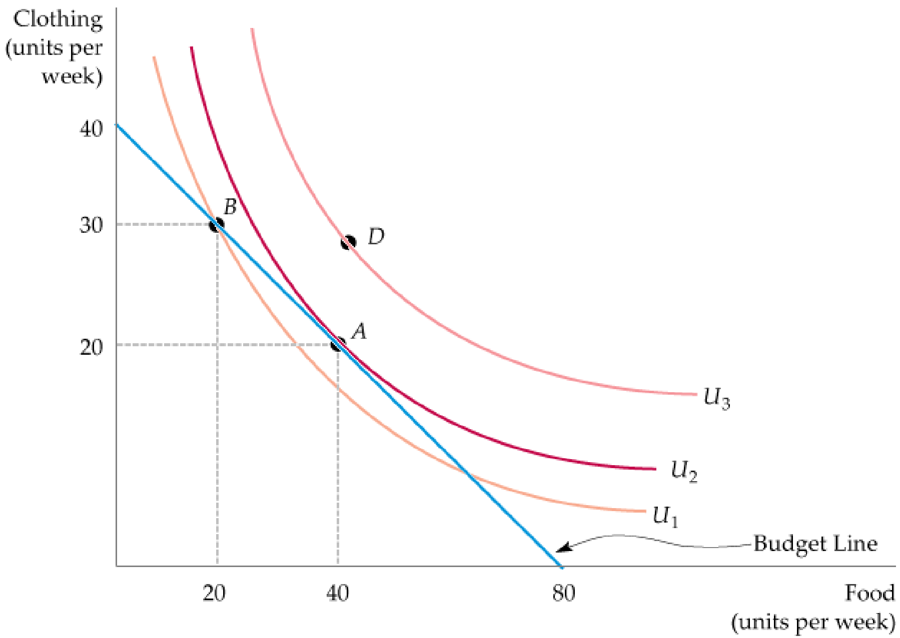
Consumer Choice



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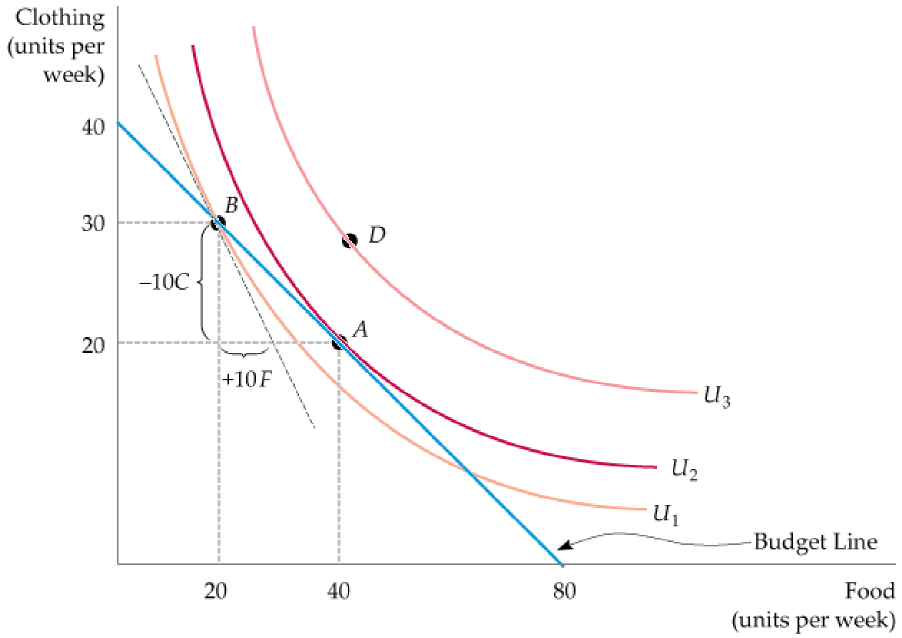
Consumer Choice



Consumer Choice

Satisfaction is maximized (given the budget constraint) at the point where:

$$\text{MRS} = \frac{P_F}{P_C}$$

Equal Marginal Principle

equal marginal principle

Principle that utility is maximized when the consumer has equalized the marginal utility per Euro of expenditure across all goods.

$$\frac{MU_F}{P_F} = \frac{MU_C}{P_C}$$

Consumer Choice

So far we have compared two goods. However, nobody spends their entire income on only two goods.

How do we examine bundles involving more than two goods?

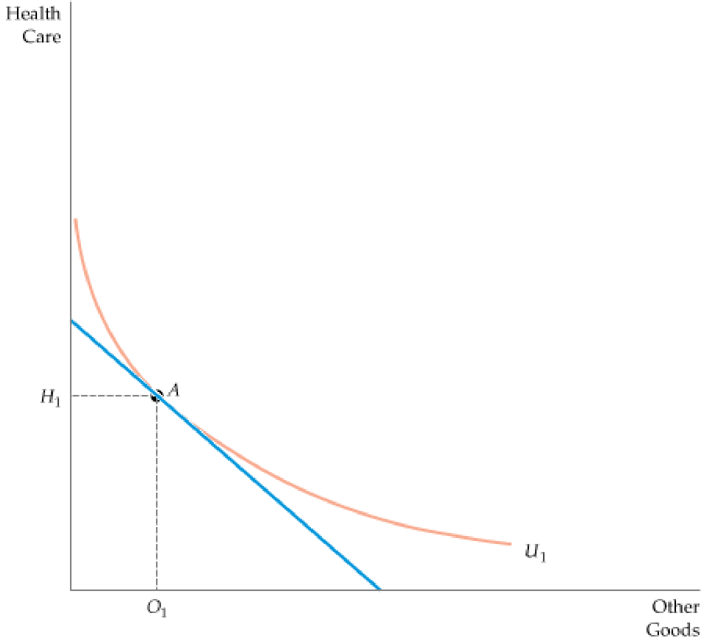
Consumer Choice

So far we have compared two goods. However, nobody spends their entire income on only two goods.

How do we examine bundles involving more than two goods?

- We pick out one good at a time.
- All other goods magically become a **composite good**.
- Assume price per unit of composite good is 1 (to make this as easy as possible mathematically)

Examples: Consumer Choice of Health Care



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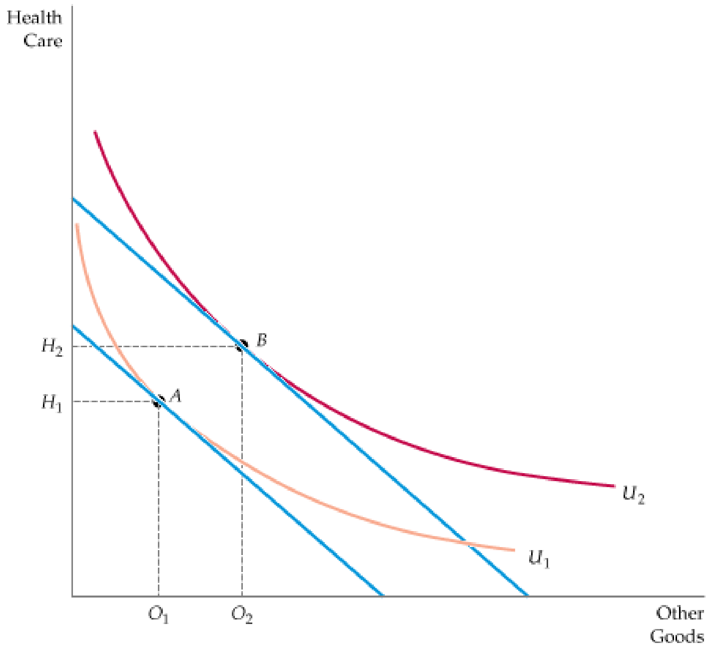
Examples: Consumer Choice of Health Care



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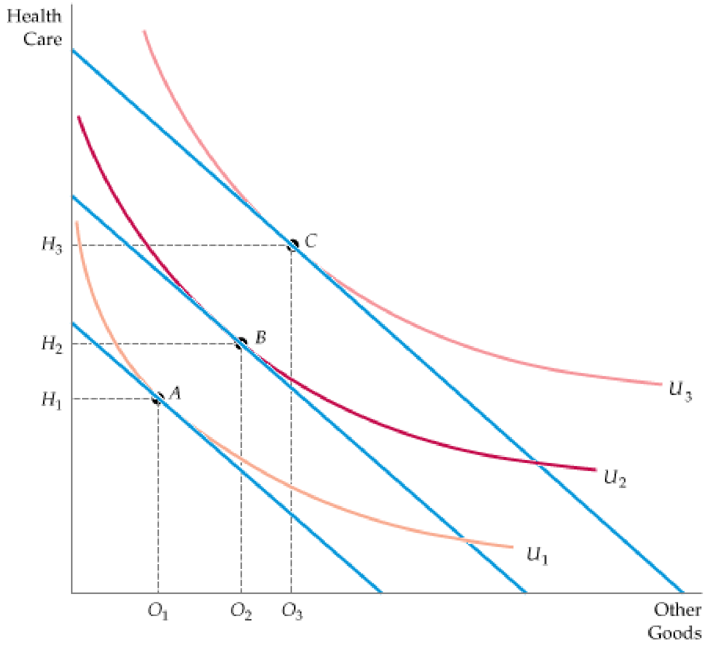
Examples: Consumer Choice of Health Care



Example: Indifference curves and budgets

Suppose that Ulli and Fritz have each decided to allocate 1000€ per year to an entertainment budget. They each must decide how much to spend on attending football games and how much to spend on attending rock concerts. They each like both football and rock music, so they would like to attend some of each. However, Ulli prefers football a little bit more than concerts, while Fritz prefers concerts a little bit more than he prefers football.

Draw an example budget line with football tickets on the vertical axis and concert tickets on the horizontal axis.

1. On the same graph, draw an indifference curve representing the preferences of Ulli.
2. Also on the same graph, draw an indifference curve representing the preferences of Fritz.
3. Indicate a bundle that would be chosen by Ulli, and a bundle that would be chosen by Fritz.
4. How do the bundles compare?

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Example: Indifference curves

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Peter‘s problem

- Peter consumes two goods: hot-dogs and burgers
  - *(Yes, Peter is a student who orders out every day!!)*
- His utility function is given by the following expression:

$$u(h, b) = h^{\alpha} b^{1-a}, 0 < a < 1$$

  - h: the amount of hot dogs he consumes per month
  - b: the number of burgers he consumes per month and
  - Peter has a monthly budget of 500 for food.
  - Hot dogs cost 5 per item/ Burgers cost 10 per item

Question 1: Derive an expression for Peter's budget

Let I be Peter's budget, p_b be the price per burger and p_h be the price per hot dog.

$$I = p_h h + p_b\, b$$

Substituting for income and price information, we get:

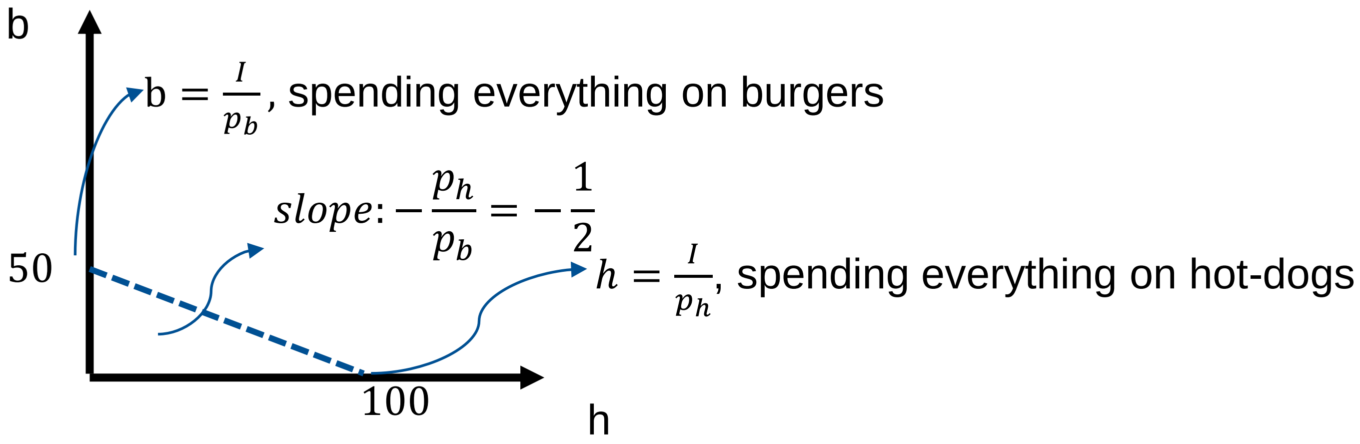
$$500 = 5h + 10b$$

Question 2: Draw Peter's Budget constraint

Hint: Find the intersection with the axes!

X-intercept: consumption of burgers is 0: $500 = 10 * 0 + 5 * h \Rightarrow 500 = 5h \Rightarrow h = 100$

Y-intercept: consumption of hot-dogs is 0: $500 = 10b + 5 * 0 \Rightarrow 500 = 10b \Rightarrow b = 50$



Question 3: Find Peter's optimal consumption

- Peter faces a constrained maximisation problem:
- Given his budget constraint, preferences and prices, he wants to find the optimal quantity of burgers and hot dogs that maximise his utility

Formally:

$$\max u(h,b) = h^a b^{1-a}$$
$$subject\ to\ I = p_b * b + ph * h$$

- Notice that his utility function is continuous and twice differentiable.
- Therefore, his preferences are rational and continuous. We can guarantee a solution to Peter's problem!
- Two approaches:
  - Substitution method
  - Lagrangian

Question 3: Substitution method

- It is possible to "substitute" the constraint into the objective function (the function being maximized) to create a new composite function that fully reflects the effect of the constraint.
- Solving the budget constraint for $b = \frac{I - p_h h}{p_b}$
- Plugging in the objective function we can express everything in terms of h:
  - $u(h) = h^{\alpha} \left(\frac{I - p_h h}{p_b}\right)^{1-a}$
- Differentiating with respect to h allows us to characterize the utility maximizing quantity of h as:

$$\frac{du(h)}{dh} = 0 \Rightarrow$$

Question 3: Substitution method (continued)

$$ah^{\alpha-1}\left(\frac{I-p_h h}{p_b}\right)^{1-a} - (1-a)h^{\alpha}\left(\frac{I-p_h h}{p_b}\right)^{-a}\frac{p_h}{p_b} = 0 \Rightarrow \cdots solve\ for\ h$$

$$h^* = \frac{aI}{p_h},$$

Assuming $a = 0.5$ and substituting I=500 and $p_h = 5$ we get

$h^* = 50$ – quantity of hot dogs that maximises utility

Plugging in h=50 to the constraint, we get that $b^* = 25$

Peter's optimal consumption bundle is $\{h^*, b^*\} = \{50, 25\}$

Notice, that Peter exhausts his budget (more is better).

Question 3: Lagrangian method

- Transform all of constraints into a form that equals 0:

$$I - p_h h - p_b b = 0$$

- Create a new objective function, the Lagrangian by multiplying each constraint by λ_i and adding the result to the objective function:

$$L = u(h, b) + \lambda(I - p_h h - p_b b)$$

- Take the First Order Conditions with respect to all the control variables: (h, b, λ)

$$(I): \frac{dL}{dh} = 0 \Rightarrow MU_h = \lambda p_h$$

$$(II): \frac{dL}{db} = 0 \Rightarrow MU_b = \lambda p_b$$

$$(III): \frac{dL}{d\lambda} = 0 \Rightarrow I = p_h h + p_b b$$

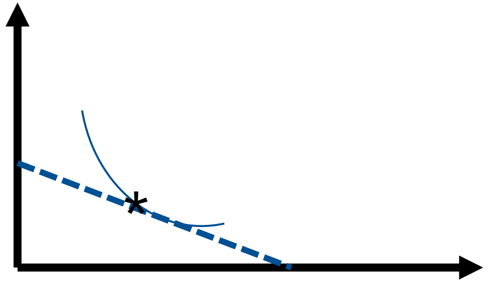
- Notice, the consumer does not have control over prices and budget – these are assumed to exogenous.

Question 3: Lagrangian method (continued)

- Solution algorithm: Divide I with II, solve for either h or b and plug in III
- Notice by dividing I with II we get the familiar relation:

$$\frac{MU_h}{MU_b} = \frac{p_h}{p_b}$$

- Remember that $\frac{MU_h}{MU_b} = Marginal\ Rate\ Substitution$
- This relation reminds us that the optimal level of consumption arises when the slope of the indifference curve meets the slope of the budget constraint:



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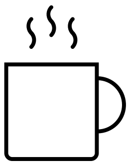
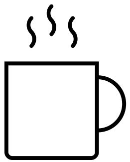
Rational preference theory

- Axiomatic theory
- Axioms: basic propositions that cannot be proven – taken for granted
  - But we can still evaluate them!
- “Econs” refer to violations of such axioms as “irrational”.
- Behavioral economics tests these axioms. Systematic violations -> call to action. Either relax assumptions or build new theories.

Transitivity revisited

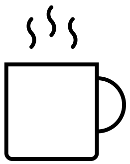


Coffee 1:
1 grain of sugar



Coffee 2:
2 grains of sugar

...



Coffee 1000:
1000 grains of sugar

Transitivity and imperceptible differences

- Most people are indifferent between Coffee 1 (1 grain of sugar) and Coffee 2 (2 grains of sugar). In fact they are usually indifferent between any 2 consecutive coffees.
- Formally: $c_1 \sim c_2 \sim \ldots \sim c_{1000}$
- But, when comparing between the first coffee and the last there is a clear preference:
- $c_1 \succ c_{1000}$
- This is a violation of transitivity

Transitivity and framing

Imagine that you are about to purchase a stereo for €125 and a calculator for €15.

- Scenario 1: The salesman tells you that the calculator is on sale for €5 less at the other branch of the store, located 20mins away. The stereo is the same price there. Would you make the trip to the other store?
- Scenario 2: The salesman tells you that the stereo is on sale for €5 less at the other branch of the store, located 20mins away. The calculator is the same price there. Would you make the trip to the other store?
- Scenario 3: Because of a stockout you must travel to the other store to get the two items, but you will receive €5 off on either item as a compensation. Do you care on which item the discount is given?

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Transitivity and framing

Most people:

- Travel to the other store in Scenario 1 (calculator discount)
- Don’t travel in Scenario 2 (stereo discount)
- Are indifferent between the two discounts

Let:

- x: Travel to the other store and get a €5 discount on the calculator
- y: Travel to the other store and get a €5 discount on the stereo
- z: Buy both items at the first store

According to the first two choices:

- $x \succ z$ and $z \succ y$

But the third choice:

- $x \sim y$ -> violation of transitivity