CONSUMER BEHAVIOR AND PREFERENCES

1

THE THEORY OF CONSUMER BEHAVIOR

Description of how consumers allocate incomes among different goods and services to maximize their wellbeing.

Three steps to describing consumer behavior

- Consumer preferences
- Budget constraints
- Consumer choices

2

HOW DO CONSUMERS CHOOSE A MARKET BASKET?

Market basket – specific quantities of one or more goods.

Market basket	Burgers	Fries
A	1	5
B	2	5
C	1	2
D	1	10
E	10	10
F	10	1

Consider Antonio and his potential market baskets containing burgers and fries…

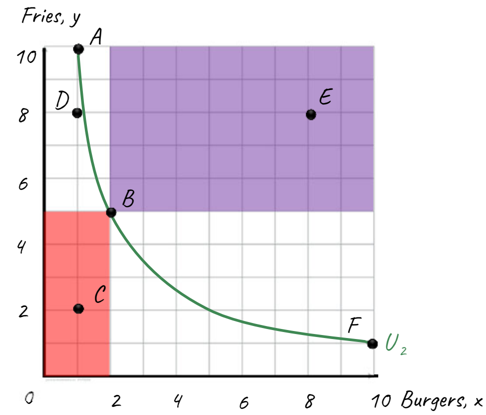
BASIC ASSUMPTIONS ABOUT PREFERENCES

1. Completeness
   - Consumers can compare and rank all possible baskets.
2. Transitivity
   - If A is preferred to B, and B is preferred to C, then A must be preferred to C.
3. More is better than less
   - Consumers are never satisfied; more is always better.

INDIFFERENCE CURVES

Graphical representation of preferences, shows all combinations of market baskets that provide a consumer with the same level of satisfaction.

Market basket	Burgers	Fries
A	1	10
B	2	5
C	1	2
D	1	8
E	8	8
F	10	1

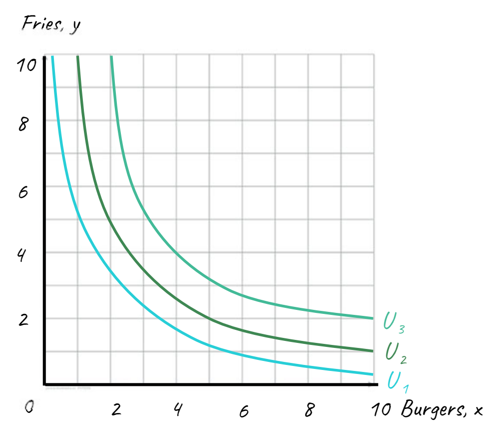


INDIFFERENCE MAPS

Graph containing the set of indifference curves showing the market baskets among which a consumer is indifferent.

Properties of Indifference curves…

1. Downward sloping (If the consumer likes both goods)
2. Cannot intersect
3. Higher is better
4. Every consumption basket lies on only one indifference curve.
5. Cannot be thick
6. Convex to the origin (more on this is a bit!)



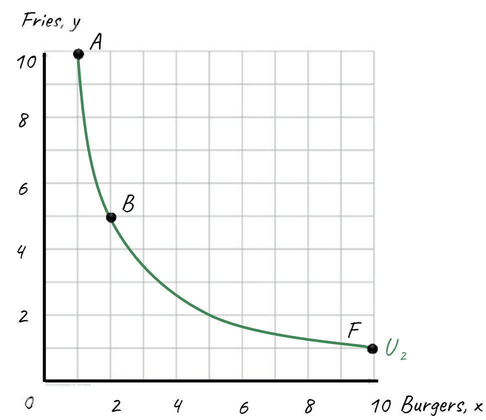
MARGINAL RATE OF SUBSTITUTION (of x for y)

The rate at which a consumer will give up **y** to get one more unit of **x**, holding satisfaction constant.

Equal to the magnitude of the slope of the indifference curve…

$$-\frac{\Delta y}{\Delta x} = -\frac{dy}{dx}$$

Measures the value the individual places on 1 additional unit of x in terms of good y.



A FOURTH BASIC ASSUMPTION ABOUT PREFERENCES…

***$MRS_{x,y}$* falls as we move down the indifference curve…**

Diminishing Marginal Rate of Substitution

Indifference curves are usually **convex** (bowed inward).

the slope of the indifference curve increases (becomes less negative) as we move down along the curve.

Intuition for this assumption…

as more of a good is consumed, the consumer places less value on additional units of the good.

UTILITY AND MARGINAL UTILITY

Utility - Numerical value representing the satisfaction that a consumer gets from a market basket.

Utility Function

Formula that assigns a level of utility to each market basket.

Typical format:

$$u(x, y)$$

Input: amounts of the two (or more) goods.

Output: a number representing satisfaction.

Marginal Utility

The additional satisfaction obtained from consuming one more unit of a good, ***holding consumption of the other good constant.***

$$MU_x = \frac{\partial u(x, y)}{\partial x}$$

$$MU_y = \frac{\partial u(x, y)}{\partial y}$$

Principle of Diminishing Marginal Utility:

as more of a good is consumed, additional consumption yields smaller additions to utility.

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Principle of Diminishing Marginal Utility:

as more of a good is consumed, additional consumption yields smaller additions to utility.

How do we confirm the properties of marginal utility mathematically?

<u>To confirm "more is better"</u>

We need the marginal utility to be positive.

$$MU_x = \frac{\partial u(x,y)}{\partial x} > 0, \qquad MU_y = \frac{\partial u(x,y)}{\partial y} > 0$$

<u>To confirm diminishing marginal utility</u>

We need the "rate of change" of marginal utility to be negative.

$$\frac{\partial MU_x}{\partial x} < 0, \qquad \frac{\partial MU_y}{\partial y} < 0$$

RELATIONSHIP BETWEEN MARGINAL UTILITY AND MARGINAL RATE OF SUBSTITUTION

The $MRS_{x,y}$ is the magnitude of the slope of the indifference curve.

How do we compute $MRS_{x,y}$ if we have a specific utility function?

Its easy!

$$\boldsymbol{MRS_{x,y} = \frac{MU_x}{MU_y}}$$

(you can find a derivation of this result on Canvas if you are interested)

We can say even more about $MRS_{x,y}$

Imagine we are sliding down an indifference curve.

As the consumer gives up y to obtain more x

1. MU_x falls
2. MU_y increases.

(because of the law of diminishing marginal utility)

As a result, the $MRS_{x,y}$ is diminishing.

LET'S CONSIDER A SPECIFIC UTILITY FUNCTION

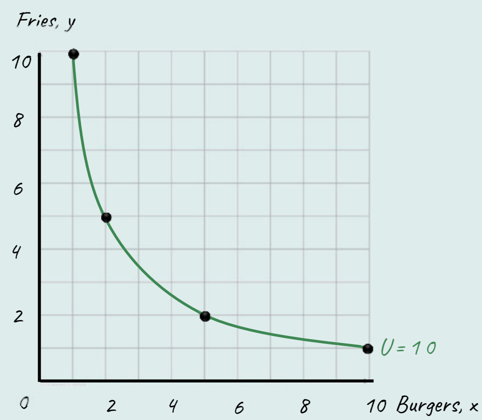
Back to Antonio…

Antonio consumes Burgers (x) and Fries (y).

His utility is given by: $u(x, y) = xy$

1. Would baskets $x = 1, y = 10$ and $x = 2, y = 5$ be on the same indifference curve?

2. Calculate the indifference curve for utility $= 10$. Sketch it.



LET'S CONSIDER A SPECIFIC UTILITY FUNCTION

Back to Antonio…

Antonio consumes Burgers (x) and Fries (y).

His utility is given by: $u(x, y) = xy$

3. Calculate the MU_x and MU_y.
4. Does this utility function exhibit the more is better property? How do you know?

LET'S CONSIDER A SPECIFIC UTILITY FUNCTION

Back to Antonio…

$MU_x = y, \quad MU_y = x$

Antonio consumes Burgers (x) and Fries (y).

His utility is given by: $u(x, y) = xy$

5. Calculate the marginal rate of substitution of x for y.
6. Does this utility function exhibit diminishing marginal rate of substitution? How do you know?

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BUDGET CONSTRAINT

Constraints that consumers face as a result of limited income.

Represented by a **Budget Line**

- indicates all combinations of two goods for which total expenditure is equal to available income.
- Standard form:

$$P_x x + P_y y = I$$

Back to Antonio…

Suppose the price of a **Burger** (x) is \$5 and the price of an order of **Fries** (y) is \$2.

Antonio has **income** of \$20.

What is his Budget Line?

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GRAPHING THE BUDGET LINE

Antonio's Budget Line:

$$P_x x + P_y y = I, \qquad 5x + 2y = 20$$

1. **Graph his budget line.**

   y intercept $= \frac{I}{P_y} =$

   x intercept $= \frac{I}{P_x} =$

2. **Find the slope of the budget line.**

   Rearrange the budget line…

$$y = \frac{I}{P_y} - \frac{P_x}{P_y} x$$

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

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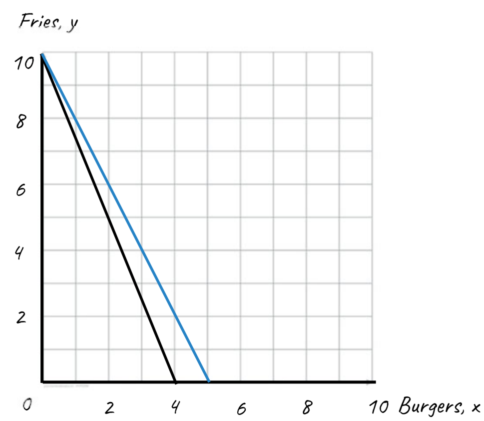
CHANGES IN THE BUDGET LINE… $5x + 2y = 20$

Change in Income

Income falls from \$20 to \$10

Change in the price of a good

P_x falls from \$5 to \$4



CONSUMER CHOICE (AKA Constrained Utility Maximization)

Given preferences and budget constraints…

a consumer will choose goods to maximize the satisfaction they can achieve given the limited budget available to them.

The maximizing market basket must

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

Convoluted way of saying "on the highest achievable indifference curve"

AN INTERIOR SOLUTION

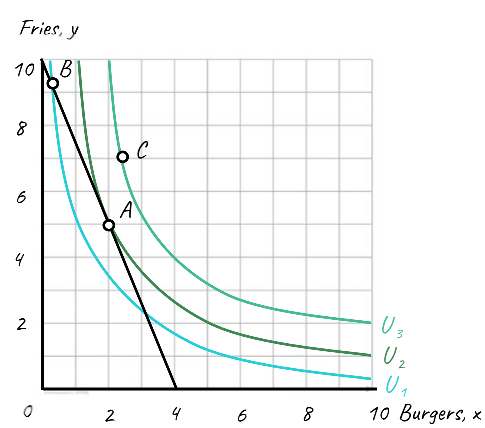
The consumer purchases positive amounts of all goods at the optimal basket.

Occurs where the indifference curve is tangent to the budget line…

Point A

Why not point B?

Why not point C?



BASIC MATHEMATICAL PROCESS

1. Indifference Curve is tangent to the Budget Line.

$$\frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

Magnitude of the slope of the indifference curves

Magnitude of the slope of the budget line

2. Basket is on the Budget Line.

$$P_x x + P_y y = I$$

Rearrange to form the…

Equal Marginal Principle

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

Utility is maximized when the marginal utility per dollar of expenditure is equalized across all goods.

DETERMINING ANTONIO'S OPTIMAL CHOICE

Recall Antonio…

His utility over Burgers (x) and Fries (y) is

$$u(x, y) = xy$$

$$MRS_{x,y} = \frac{MU_x}{MU_y} = \frac{y}{x}$$

The price of a **Burger** is \$5 and the price of an order of **Fries** is \$2.

Antonio has **income** of \$20.

His budget line is $5x + 2y = 20$

Slope of budget line $= -\frac{P_x}{P_y} = -\frac{5}{2}$

Find Antonio's optimal choice of Burgers and Fries.

Tangency Condition.

$$\frac{y}{x} = \frac{5}{2} \rightarrow y = \frac{5}{2}x, \quad (1)$$

Substitute (1) into the Budget line.

$$5x + 2\left(\frac{5}{2}x\right) = 20$$

$$10x = 20 \rightarrow x = 2, \quad (2)$$

Substitute $x = 2$ into (1) to find y.

$$y = \frac{5}{2}(2) = 5$$

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REVISITING PREFERENCES

"More is Better"

Monotonic preferences – ones in which having more is always better.

Two types of monotonicity

1. **Weak monotonicity**: if basket A has <u>more of every good</u> than basket B then A is strictly preferred to B.
   - Indifference curves can be horizonal or vertical
2. **Strict monotonicity**: if basket A has <u>more of at least one good</u> and no less of any good than basket B, then A is strictly preferred to B.
   - Indifference curves will be strictly downward sloping

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REVISITING PREFERENCES

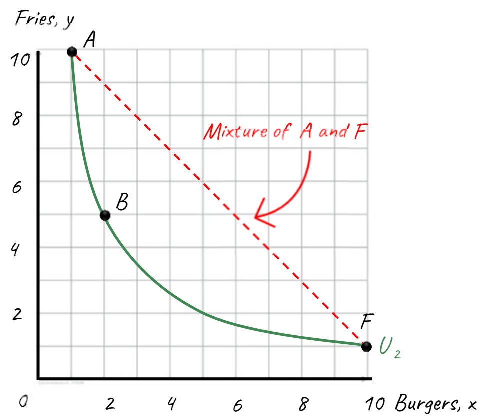
"Diminishing Marginal Rate of Substitution"

Convexity – roughly speaking, mixtures of baskets are preferred to the baskets themselves.

Mixture of basket A and $B = \alpha A + (1 - \alpha)B$, where $0 \leq \alpha \leq 1$

Example:

Any mixture of A and F is strictly preferred to A and to F



REVISITING PREFERENCES

"Diminishing Marginal Rate of Substitution"

Two types of Convexity

1. **Weakly Convex**: if a consumer is indifferent between basket A and basket B, then any mixture of A and B is *weakly preferred* to either.
   - indifference curves may be linear or have linear segments.
   - MRS is weakly decreasing as x increases.
2. **Strictly Convex**: if a consumer is indifferent between basket A and basket B, then any mixture of A and B is *strictly preferred* to either.
   - indifference curves must be bowed towards the origin.
   - MRS is strictly decreasing as x increases.

PERFECT SUBSTITUTES (strictly monotonic, weakly convex)

When two goods are substitutable for one another at some fixed rate

(occurs when the $MRS_{x,y}$ is a constant).

General Format

$$u(x,y) = \alpha x + \beta y$$

Where α and β are positive constants.

For Example…

You view rotis (r) and naan (n) as perfect substitutes

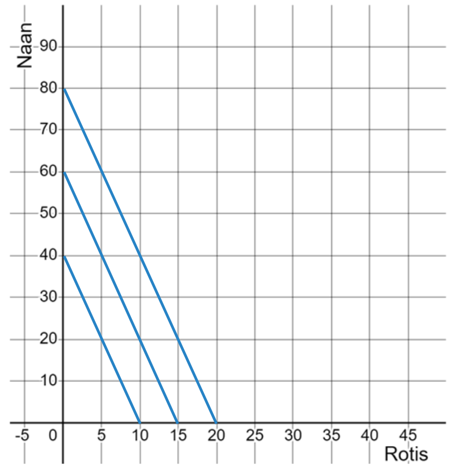
$$u(r,n) = 4r + n$$

$$MU_r = 4$$

$$MU_n = 1$$

$$MRS_{r,n} = \frac{4}{1} = 4$$

One roti (r) is a perfect substitute for four naan (n).
(because they yield the same amount of utility)



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General Format

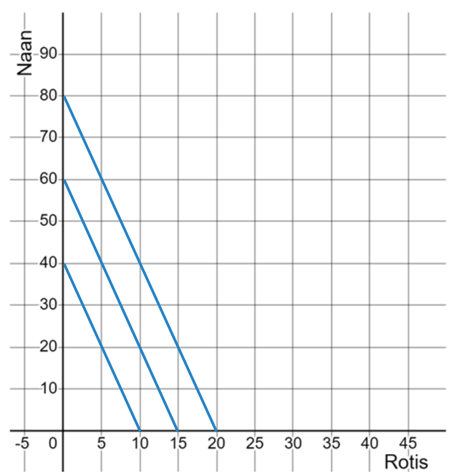
$$u(x,y) = \alpha x + \beta y$$

Where α and β are positive constants.

This utility function represents preferences that are…

1. Strictly monotonic
   (indifference curves are downward sloping)

2. Weakly convex
   (indifference curves are linear)



PERFECT COMPLEMENTS (weakly monotonic, weakly convex)

When two goods are only valuable if they are consumed in some fixed proportion.

General Format

$$u(x, y) = \min(\alpha x, \beta y)$$

Where α and β are positive constants.

What does this function mean???

Utility is equal to the **smaller** of the two values αx and βy.

Why???

Because you want to consume x and y such that $\alpha x = \beta y$

Which ever value is smaller is the limiting factor.

PERFECT COMPLEMENTS (weakly monotonic, weakly convex)

Suppose you get one unit of utility from each serving of **tea and biscuits** you consume.

You need to eat two biscuits **(b)** for each cup of tea **(t)** you drink.

If you have one cup of tea and four biscuits...

- Then you get one unit of utility

  (the extra two biscuits are "wasted")

If you have two cups of tea and two biscuits...

- Then you get one unit of utility

  (the extra cup of tea is "wasted")

If you have one cup of tea and two biscuits...

- Then you get one unit of utility

  (nothing is "wasted")

What do the indifference curves look like?

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Suppose you get one unit of utility from each serving of **tea and biscuits** you consume.

You need to eat two biscuits **(b)** for each cup of tea **(t)** you drink

Functional Representation…

$$u(t,b) = \min\left(t, \frac{b}{2}\right)$$

Observe…

When $t = \frac{b}{2}$ nothing is wasted.

(This will turn out to be important later)

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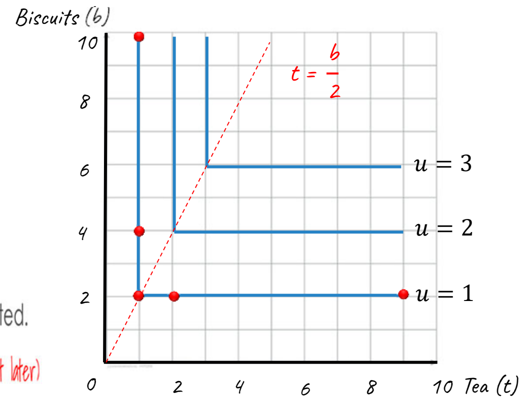

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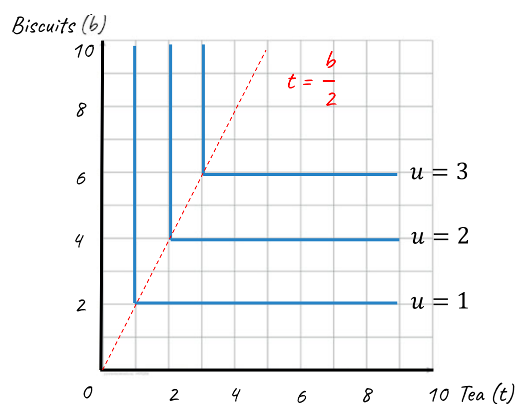
Where α and β are positive constants.

Tea and Biscuits…

$$u(t,b) = \min\left(t, \frac{b}{2}\right)$$

If $t > \frac{b}{2}$ $\longrightarrow$ $MU_t = 0$ and $MRS_{t,b} = \frac{MU_t}{MU_b} = 0$

If $t < \frac{b}{2}$ $\longrightarrow$ $MU_b = 0$ and $MRS_{t,b} = \frac{MU_t}{MU_b} \to \infty$



PERFECT COMPLEMENTS (weakly monotonic, weakly convex)

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General Format

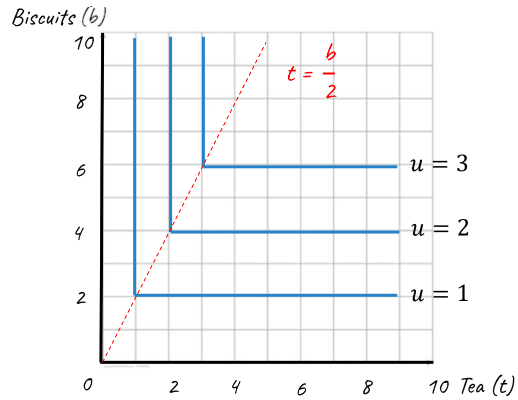
$$u(x, y) = \min(\alpha x, \beta y)$$

Where α and β are positive constants.

This utility function represents preferences that are…

1. Weakly monotonic
   (indifference curves are not everywhere downward sloping)

2. Weakly convex
   (indifference curves have linear segments)



COBB-DOUGLAS UTILITY (Strictly monotonic, strictly convex)

General Format

$$u(x, y) = Ax^{\alpha}y^{\beta}$$

Where A, α, and β are positive constants.

For Example…

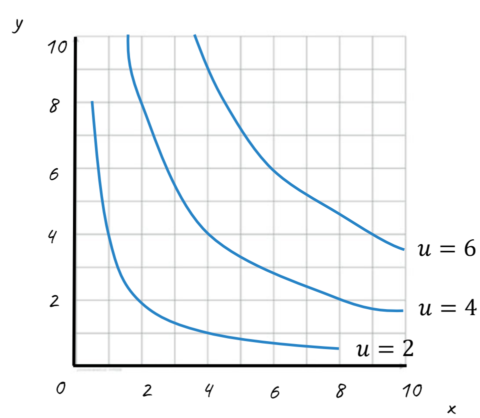
$$u(x, y) = x^{0.5}y^{0.5}$$

Then,

$$MU_x = 0.5x^{-0.5}y^{0.5}$$

$$MU_y = 0.5x^{0.5}y^{-0.5}$$

$$MRS_{x,y} = \frac{0.5x^{-0.5}y^{0.5}}{0.5x^{0.5}y^{-0.5}} = \frac{y}{x}$$



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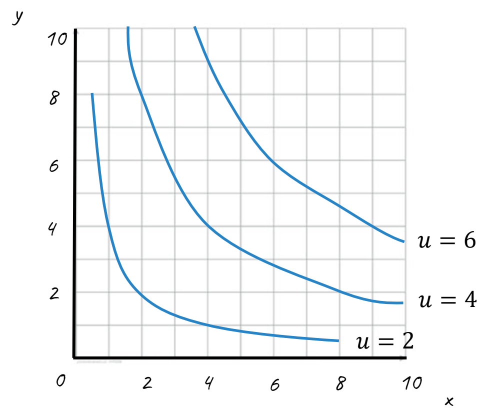
2. Strictly convex
   (indifference curves are "bowed" towards the origin)



Cobb-Douglas Utilities are used often because
(1) Both MU are positive, (2) IC are downward sloping, and (3) MRS is diminishing.

QUASI-LINEAR UTILITY (strictly monotonic, strictly convex)

A utility function that is linear in at least one of the goods consumed, but may be a non-linear function of the other goods

General Format

$$u(x,y) = v(x) + by$$

Where b is a positive constant and $v(x)$ is a function that increases in x.

$$MU_x = v'(x)$$

$$MU_y = b$$

Distinguishing characteristic

For a fixed x value, the MRS is constant across all y values.

$$MRS_{x,y} = \frac{v'(x)}{b}$$

Quasi-linear utilities are used often because
1. They simplify the mathematics
2. Economic studies suggest they are a reasonable approximation of consumer preferences in many settings

QUASI-LINEAR UTILITY (strictly monotonic, strictly convex)

A utility function that is linear in at least one of the goods consumed, but may be a non-linear function of the other goods

For Example…

$$u(x, y) = 4x^{0.5} + 2y$$

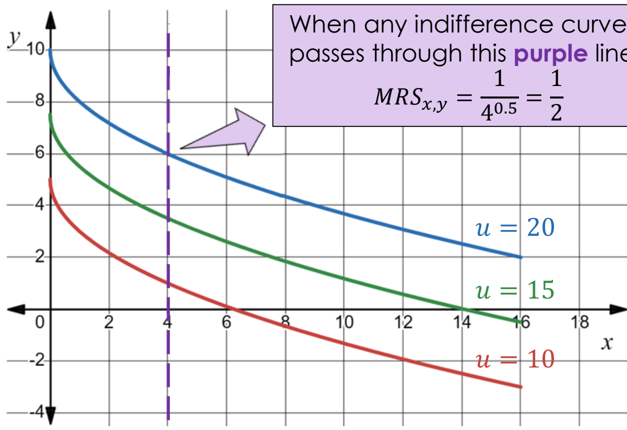
Then,

$$MU_x = 2x^{-0.5}$$

$$MU_y = 2$$

$$MRS_{x,y} = \frac{2x^{-0.5}}{2} = \frac{1}{x^{0.5}}$$

When any indifference curve passes through this **purple** line, $MRS_{x,y} = \frac{1}{4^{0.5}} = \frac{1}{2}$



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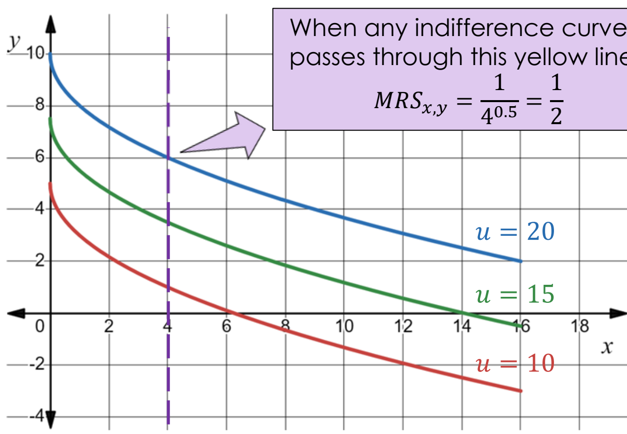

ORDINAL VS. CARDINAL UTILITY

Ordinal Utility Function

A utility function that generates a ranking of market baskets in order of most to least preferred

Cardinal Utility Function

A utility function describing by how much one market basket is preferred to another.

We work only with ordinal utility

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OPTIMAL CHOICE WITH PERFECT COMPLEMENTS

(a different kind of interior solution)

Let's revisit our tea and biscuits utility function

Suppose that Margaret has $8.00 available to spend on tea and biscuits, her utility over these two goods is given by:

$$u(t, b) = \min\left(t, \frac{b}{2}\right)$$

The price of a cup of tea is $2.00 and the price of a biscuit is $1.00.

Goal: Determine Margaret's optimal basket of tea and biscuits.

How do we solve this question?

Budget Line

$$2t + b = 8$$

Tangency Condition

…doesn't exist here

An "L-shaped" indifference curve can't have the same slope as a linear downward sloping budget line!

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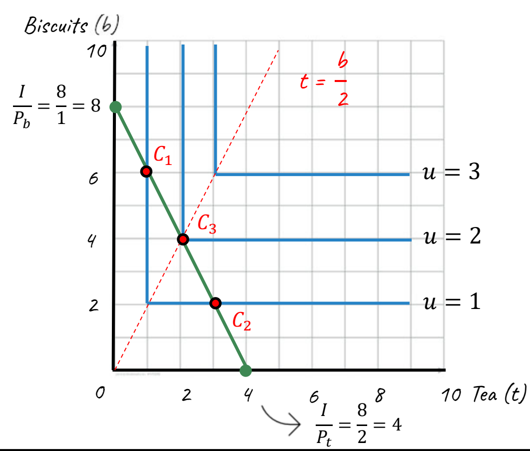


OPTIMAL CHOICE WITH PERFECT COMPLEMENTS
(a different kind of interior solution)

Let's revisit our tea and biscuits utility function

How do we solve this question?

Budget Line

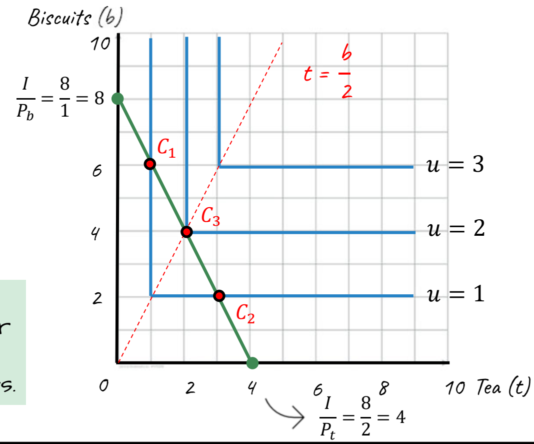
$$2t + b = 8$$

Replace Tangency Condition with

"No-Waste" Condition

$$t = \frac{b}{2}$$

This guarantees that Margaret's choice has her preferred ratio of one tea for every two biscuits.



OPTIMAL CHOICE WITH PERFECT COMPLEMENTS
(a different kind of interior solution)

Optimal Choice?
$t = 2, \; b = 4$

Let's revisit our tea and biscuits utility function

How do we solve this question?

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Replace Tangency Condition with

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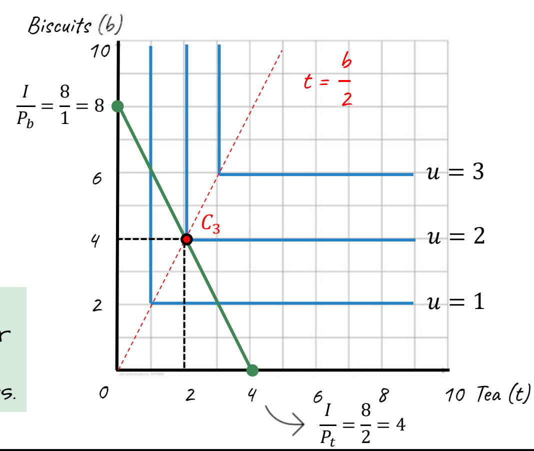

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The price of a cup of tea is $2.00 and the price of a biscuit is $1.00.

Goal: Determine Margaret's optimal basket of tea and biscuits.

We've seen the graph, lets do the math!

Budget Line	**"No-Waste" Condition**
$2t + b = 8$	$t = \frac{b}{2}$

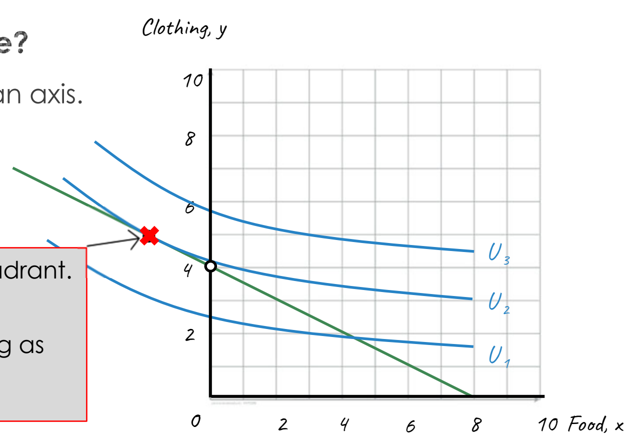
A CORNER POINT SOLUTION

A consumer's optimal choice involves some goods not being consumed at all, so that the optimal basket lies on an axis.

When is a corner point solution possible?

A convex indifference curve that crosses an axis.

- $u(x, y) = x^{0.5} + y$
- $(x, y) = xy + 10x$



Tangency point exists, but it is in the wrong quadrant.

Actual solution…

Consume no food ($x = 0$) and as much clothing as you can afford $\left(y = \frac{I}{P_y}\right)$

OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a different kind of corner point solution)

Suppose that Samira has a weekly income of \$40 that she uses to purchase two goods, rotis and naan.

The price of one roti is $P_r = \$2$ and the price of one naan is $P_n = \$1$.

Her utility over the consumption of these two goods is given by $u(r,n) = 4r + n$, where r is rotis and n is naan.

Goal: Determine Samira's optimal basket of rotis and naan.

How do we solve this question?

Budget Line

$$2r + n = 40$$

Tangency Condition

…doesn't exist here

Slope of budget constraint $= -\frac{P_r}{P_n} = -\frac{2}{1} = -2$

Slope of indifference curve $= -\frac{MU_r}{MU_n} = -\frac{4}{1} = -4$

OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a different kind of corner point solution)

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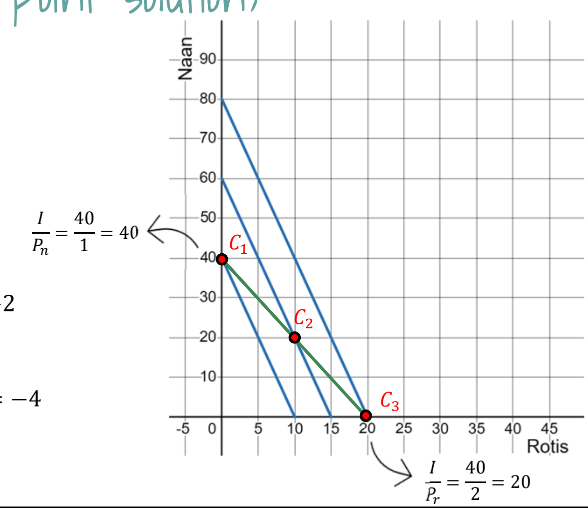


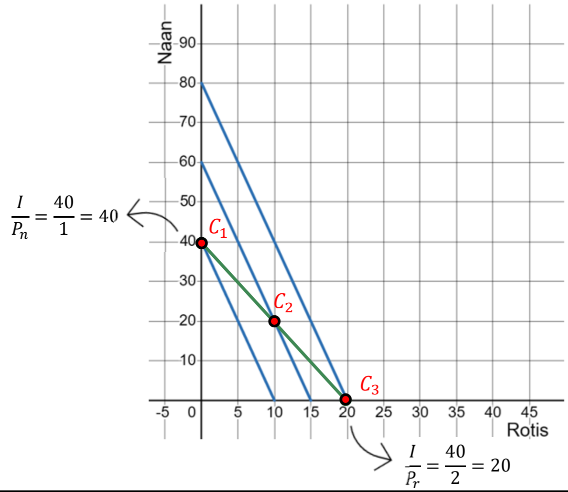
OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a different kind of corner point solution)

How do we solve this question?

Remember the goal…

Get to the highest indifference curve (the one farthest from the origin) that is within Samira's budget.

Optimal Choice?
$r = 20,\ n = 0$



OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a different kind of corner point solution)

Suppose that Samira has a weekly income of \$40 that she uses to purchase two goods, rotis and naan.

The price of one roti is $P_r = \$2$ and the price of one naan is $P_n = \$1$.

Her utility over the consumption of these two goods is given by $u(r, n) = 4r + n$, where r is rotis and n is naan.

Goal: Determine Samira's optimal basket of rotis and naan.

Is there a faster way to solve this problem?

Yes!

Compare $\frac{MU_r}{P_r}$ to $\frac{MU_n}{P_n}$

Which ever is **larger** is the good that Samira should consume exclusively.

Once we know what good she is going to consume, we use the budget line to determine how much she can afford.

OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a different kind of corner point solution)

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Goal: Determine Samira's optimal basket of rotis and naan.

Let's solve it…

Step 1: Compare $\frac{MU_r}{P_r}$ to $\frac{MU_n}{P_n}$

$$\frac{4}{2} > \frac{1}{1}$$

Step 2: Conclude that Samira should consume only rotis.

Step 3: Determine how many rotis she can afford.

$$r = \frac{I}{P_r} = \frac{40}{2} \quad \Rightarrow r = 20, n = 0$$

OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a very special case – infinite solutions)

Suppose that Samira has a weekly income of \$40 that she uses to purchase two goods, rotis and naan.

The price of one roti is $P_r = \$4$ and the price of one naan is $P_n = \$1$.

Her utility over the consumption of these two goods is given by $u(r, n) = 4r + n$, where r is rotis and n is naan.

Goal: Determine Samira's optimal basket of rotis and naan.

Let's see what happens now…

Step 1: Compare $\frac{MU_r}{P_r}$ to $\frac{MU_n}{P_n}$

$$\frac{4}{4} = \frac{1}{1}$$

Step 2: Panic! (just kidding)

Think about what is going on…

Slope of budget line $= -\frac{P_r}{P_n} = -\frac{4}{1} = -4$

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OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
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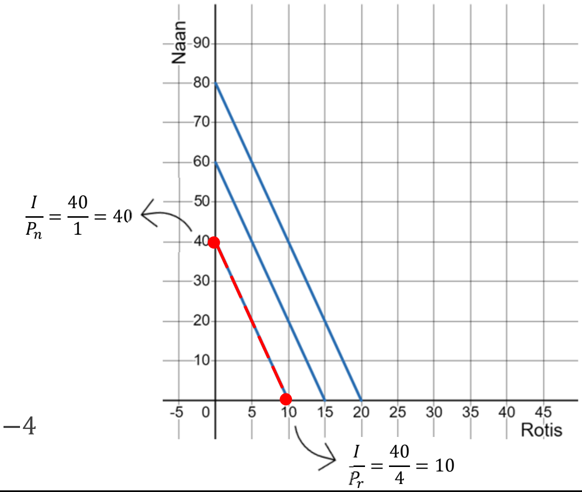

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OPTIMAL CHOICE WITH PERFECT SUBSTITUTES
(a very special case – infinite solutions)

Is there even a solution here?

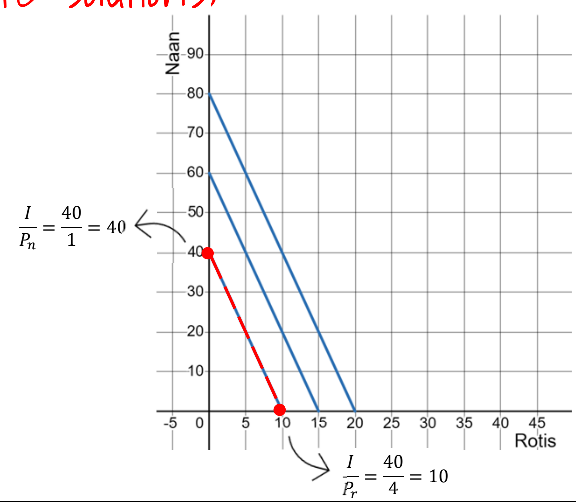
Yes, there are infinite solutions!

What does that mean?

Any basket of rotis and naan that Samira can afford is optimal.

To put it more formally, the solution is…

$$\text{Any basket where } \underbrace{4r + n = 80}_{\substack{\text{Budget line} \\ rP_r + nP_n = I}}$$



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