EE211
PRINCIPLES OF MICROECONOMICS

Topic 6:

The Theory of Consumer Choice

After Midterm.

- Consumer choice
  - → Utility, MU
  - → Consumer's Util max'zn.
  - ⇒ Derive Demand
- Production
  - → SR, LR <
    - Cost: TC, MC, AC
    - Production.
      : TP, MP, AP
  - ⇒ Supply
- Market structure → Price
  - Perfect comp'n
  - Monopoly
- Factor market

Topics

- Utility Theory (Cardinal Approach)
  - Utility
  - Marginal utility
  - Law of diminishing marginal utility

"Preference" → Consumer's choice.

- Indifference Curve Theory (Ordinal Approach)
  - Indifference curve
  - Marginal rate of substitution
  - Budget line → constraint
  - Consumer equilibrium "optimal" choice
- Demand curve derivation
- Applications

Part I: Utility Theory (Cardinal Approach)

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- **Utility** is the *satisfaction* or *well-being* that a consumer receives from consuming some good or service.
  - Economists assume that, in making their choices, consumers are motivated to maximize their utility.

- **Total utility** is the total satisfaction resulting from consumption of a given commodity by a consumer.

(MU_x = Marginal utility of consuming Good x).

- **Marginal utility** is the *additional satisfaction* obtained by a consumer from consuming one *additional unit* of a commodity.

(x is Quantity of good x). ↖ unit

- $MU_x = \frac{\Delta U}{\Delta X} \approx \frac{dU}{dx}$

Example: Utility Schedules

Q_x (unit) (TU) $MU_x = \frac{\Delta U}{\Delta Q_x}$

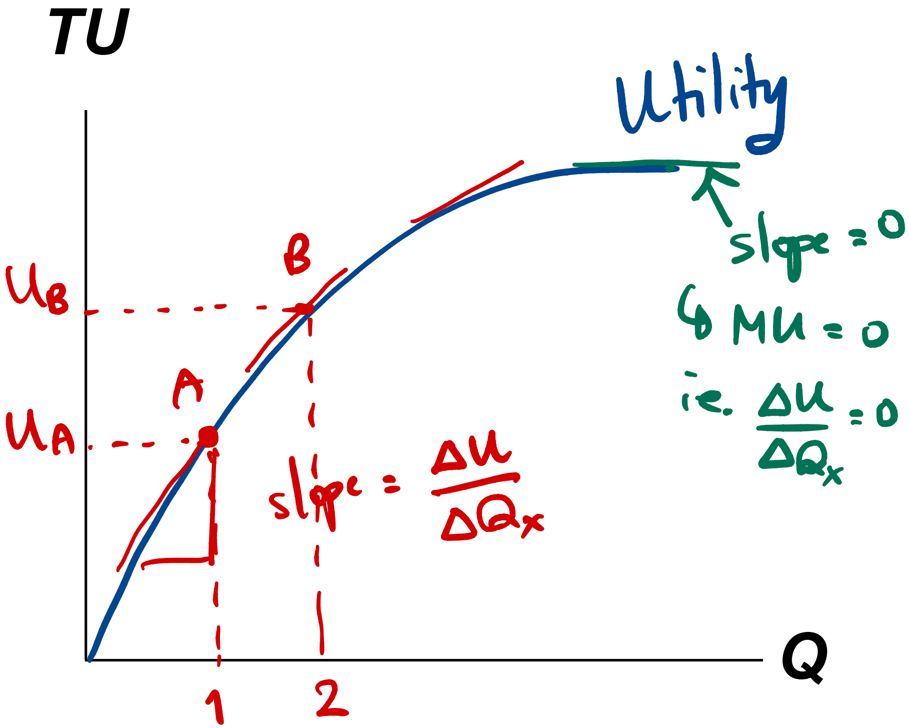
Number of Coffee Tom Drinks per day	Tom's Total Utility	Tom's Marginal Utility
0	0	$MU_{x=1} = 30$ (utils)
1	30	$MU_{x=2} = 20$ "
2	50	$MU_{x=3} = 15$ "
3	65	$MU_{x=4} = 10$
4	75	$MU_{x=5} = 8$
5	83	$MU_{x=6} = 6$
6	89	

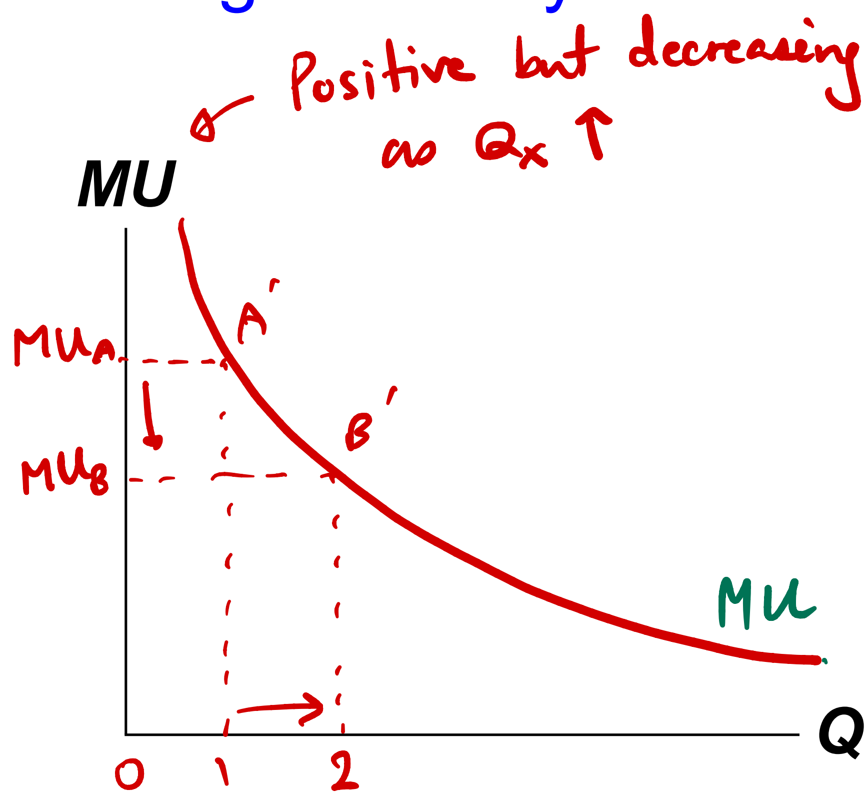
Big

small

Example: Utility Graphs

- Total Utility
- Marginal Utility





Total utility rises, but marginal utility decreases, as consumption rises. (ie. Utility increases at a decreasing rate.)

Diminishing Marginal Utility

- ***Law of diminishing marginal utility***

"The utility that any consumer derives from *successive* units of a particular product consumed over some period of time *diminishes* as total consumption of the product increases, if the consumption of all other products is unchanged."

Maximizing Utility

- The consumer's decision:

A utility-maximizing consumer allocates expenditures so that the utility obtained from the last dollars spent on each product is equal.

Mathematically,

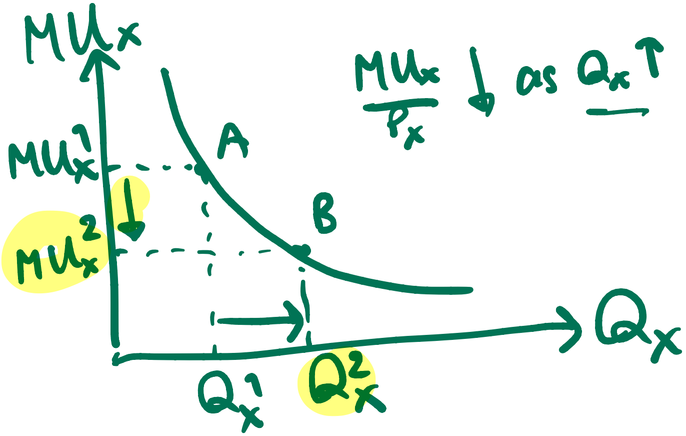
$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$ *

Alternatively,

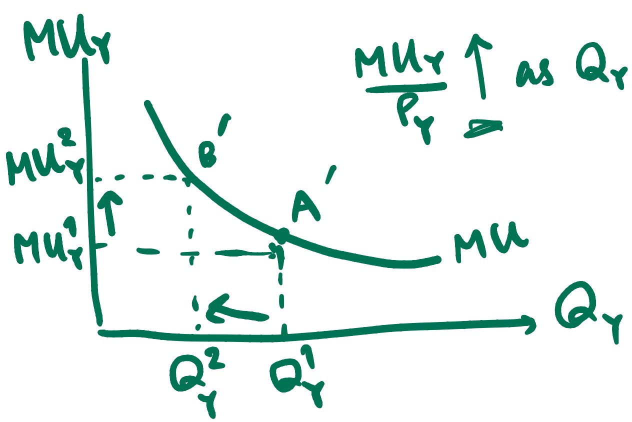
$$\frac{MU_X}{MU_Y} = \frac{P_X}{P_Y}$$

What if $\frac{MU_X}{\$P_X}\downarrow > \frac{MU_Y}{\$P_Y}\uparrow$? $\Rightarrow \frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$

$\Rightarrow Q_X\uparrow$ & $Q_Y\downarrow$



$\frac{MU_X}{P_X}\downarrow$ as $Q_X\uparrow$



$\frac{MU_Y}{P_Y}\uparrow$ as $Q_Y\downarrow$

$\frac{MU_X}{P_X} < \frac{MU_Y}{P_Y}$

$\Rightarrow Q_Y\uparrow$ & $Q_X\downarrow$

$\rightarrow MU_Y\downarrow$ $\qquad$ $\rightarrow MU_X\uparrow$

$\rightarrow \frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$

$\frac{MU_{diet}}{P_{diet}} > \frac{MU_{Exercise}}{P_{Exercise}}$

$\Downarrow$ $\qquad$ $\Downarrow$

$\uparrow Q_{diet} \Rightarrow MU_{diet}\downarrow$ $\qquad$ $\downarrow Q_{Exercise} \Rightarrow MU_{Ex}\uparrow$

Example: Utility Maximization

- Suppose you are buying Good X for $1 each and Good Y for $3 each, and the marginal utility of each good is the following.

P_x

P_y

$P_x = \$1$

$P_y = \$3$

# of X Q_x	MU_x	MU_x/P_x
1	30	30
2	21	21
3	15	15

# of Y Q_Y	MU_y	MU_y/P_y
1	60	20
2	51	17
3	45	15

How many units of goods X and Y should you buy in order to maximize your utility?

$Q_x = 3$ & $Q_Y = 3$ b/c $\frac{MU_x}{P_x} = \frac{MU_Y}{P_Y} = 15$

Consider if $Q_x = 3$, $Q_Y = 2$?

Part II. Indifference Curve Theory (Ordinal Approach)

"Ranking"

- There is **no** numerical value attached to consumer's utility.
- Instead, consumer is asked which bundle is preferred to which.

combination of cons^{n} of 2 goods.

- **Indifference curve** shows consumption bundles that give the consumer the same level of satisfaction.
- With 2 products X and Y, a bundle is represented by a point in diagram.

Utility : $U = f(X, Y)$

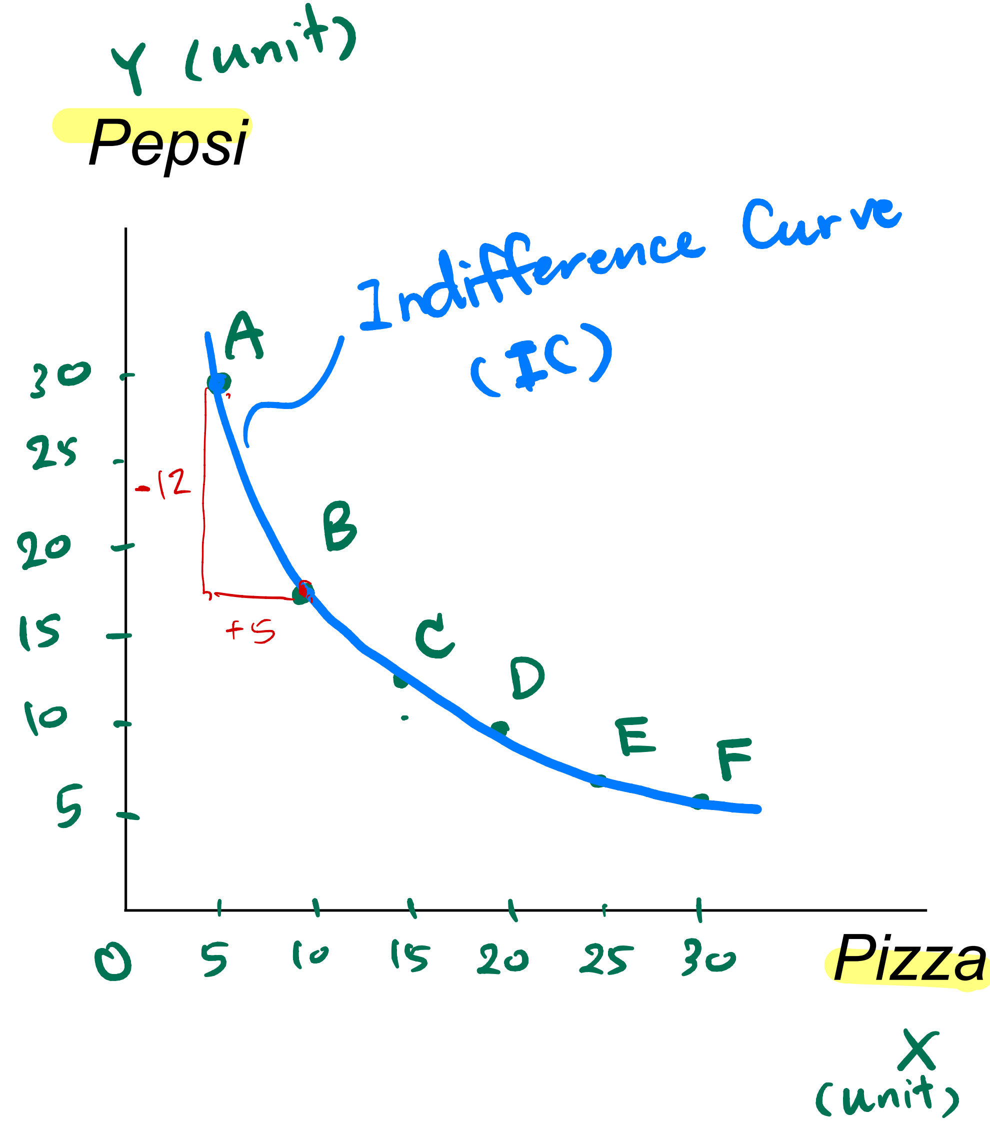
$U = U(X, Y)$

Example: Indifference Curve

Quantities

Bundle	Pepsi	Pizza
A	30	5
B	18	10
C	13	15
D	10	20
E	8	25
F	7	30

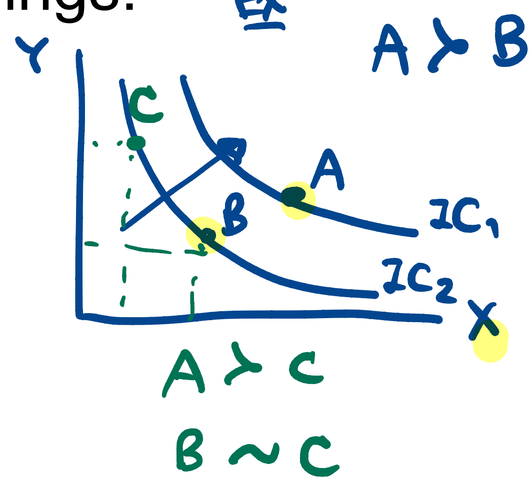
Same satisfaction (i.e. same level of utility) → "equally happy"



Assumptions

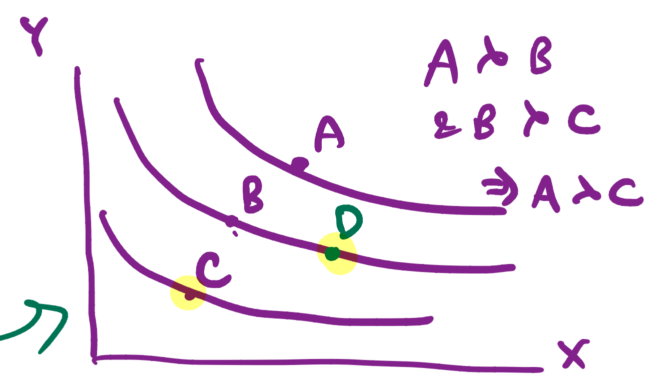
- Given any 2 bundles A & B, the consumer's preference is assumed to be exactly one of the followings:
  1. A is preferred to B ($A \succ B$), OR
  2. B is preferred to A ($B \succ A$), OR
  3. A & B are indifferent ($A \sim B$).

Ex

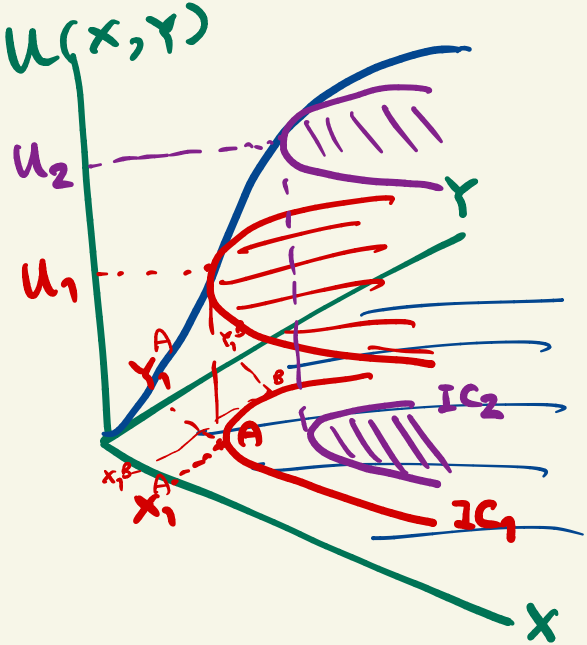


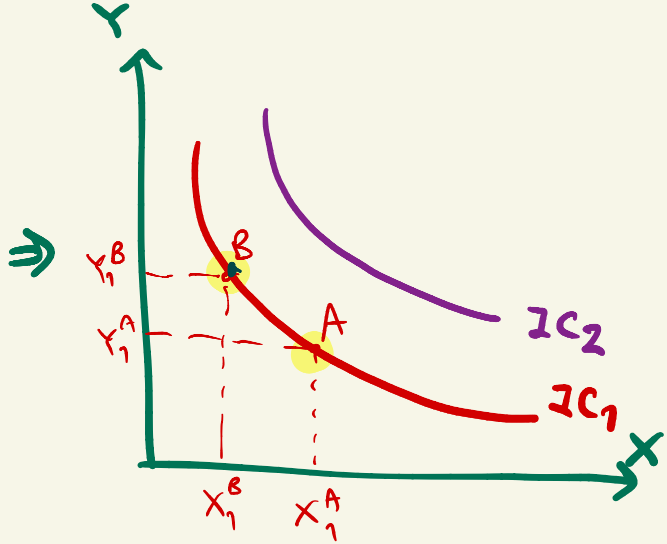
- Consumer is assumed to be rational.
  - More is preferred to less.
  - If $A \succ B$ and $B \succ C$, then $A \succ C$.

If $B \sim D$ & $D \succ C$, then $B \succ C$.



2 Goods : X, Y $\Rightarrow$ Satisfaction : U(X, Y)





U = U(x)

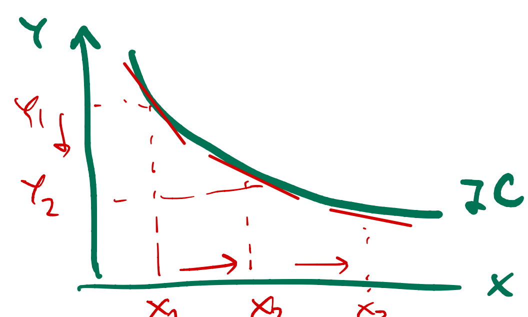
Marginal Rate of Substitution

slope of IC = $\frac{\Delta Y}{\Delta X}$

- **Marginal rate of substitution (MRS)** is the rate at which a consumer is willing to trade one good for another. U is constant.
- Also, it is the slope of the indifference curve.

- Basic assumptions of indifference curve theory:

1. The algebraic value of the MRS between two goods is always negative. b/c IC is downward sloping.
2. The MRS is diminishing (i.e. any indifference curve becomes flatter as the consumer moves downward and to the right along the curve).



Example: Indifference Curve& MRS

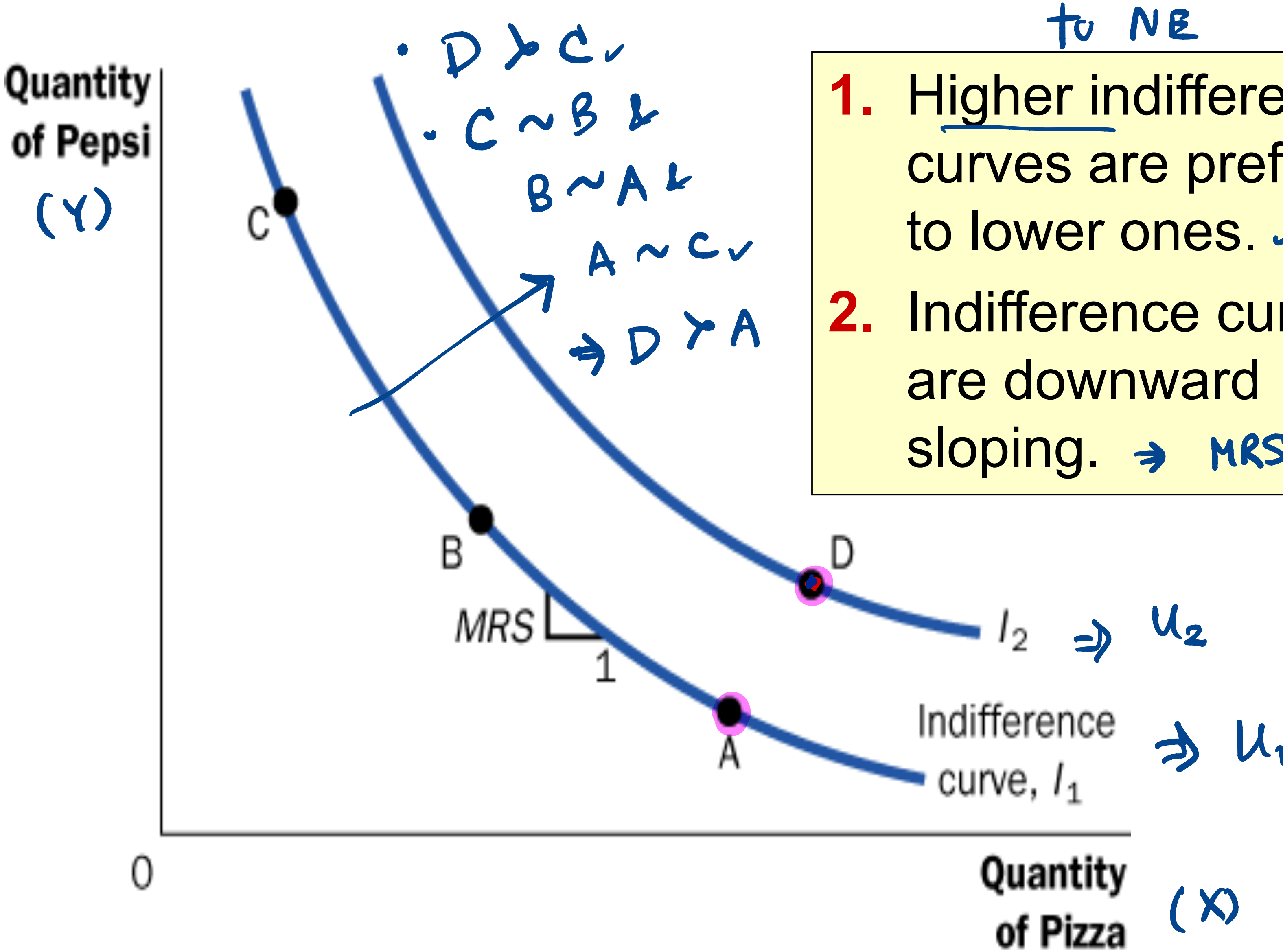
same utility

Bundle	Pepsi (Q_Y)	Pizza (Q_X)
A	30	5
B	18	10
C	13	15
D	10	20
E	8	25
F	7	30

Change	Change in Pepsi (ΔQ_Y)	Change in Pizza (ΔQ_X)	MRS ($\frac{\Delta Q_Y}{\Delta Q_X}$)
A→B	-12	+5	-2.4
B→C	-5	+5	-1
C→D	-3	+5	-0.6
D→E	-2	+5	-0.4
E→F	-1	+5	-0.2

$\therefore$ MRS is -ve (negative). & |MRS| is smaller as $Q_X \uparrow$.

Properties of Indifference Curve

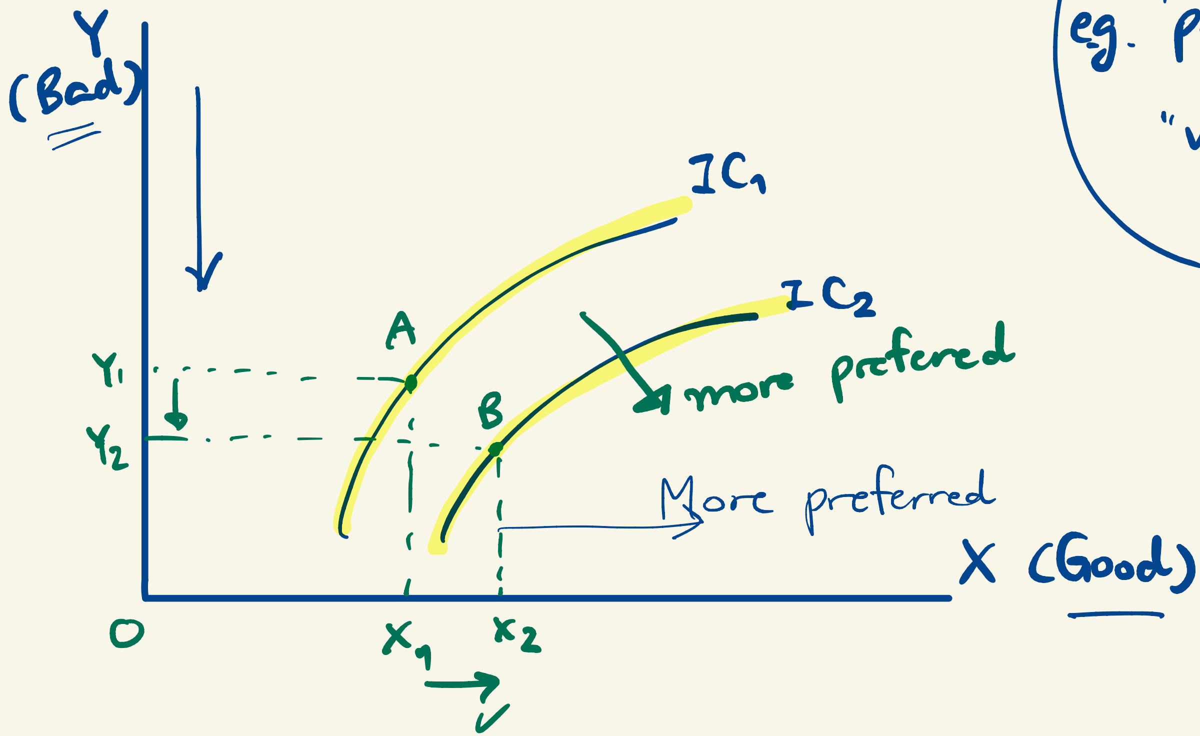


to NE

1. Higher indifference curves are preferred to lower ones. ✓
2. Indifference curves are downward sloping. ⇒ $MRS = \frac{\Delta Y}{\Delta X} < 0$

What if X is a Good, and Y is a "Bad"?

eg. "pollution"
"virus"
less is preferred.

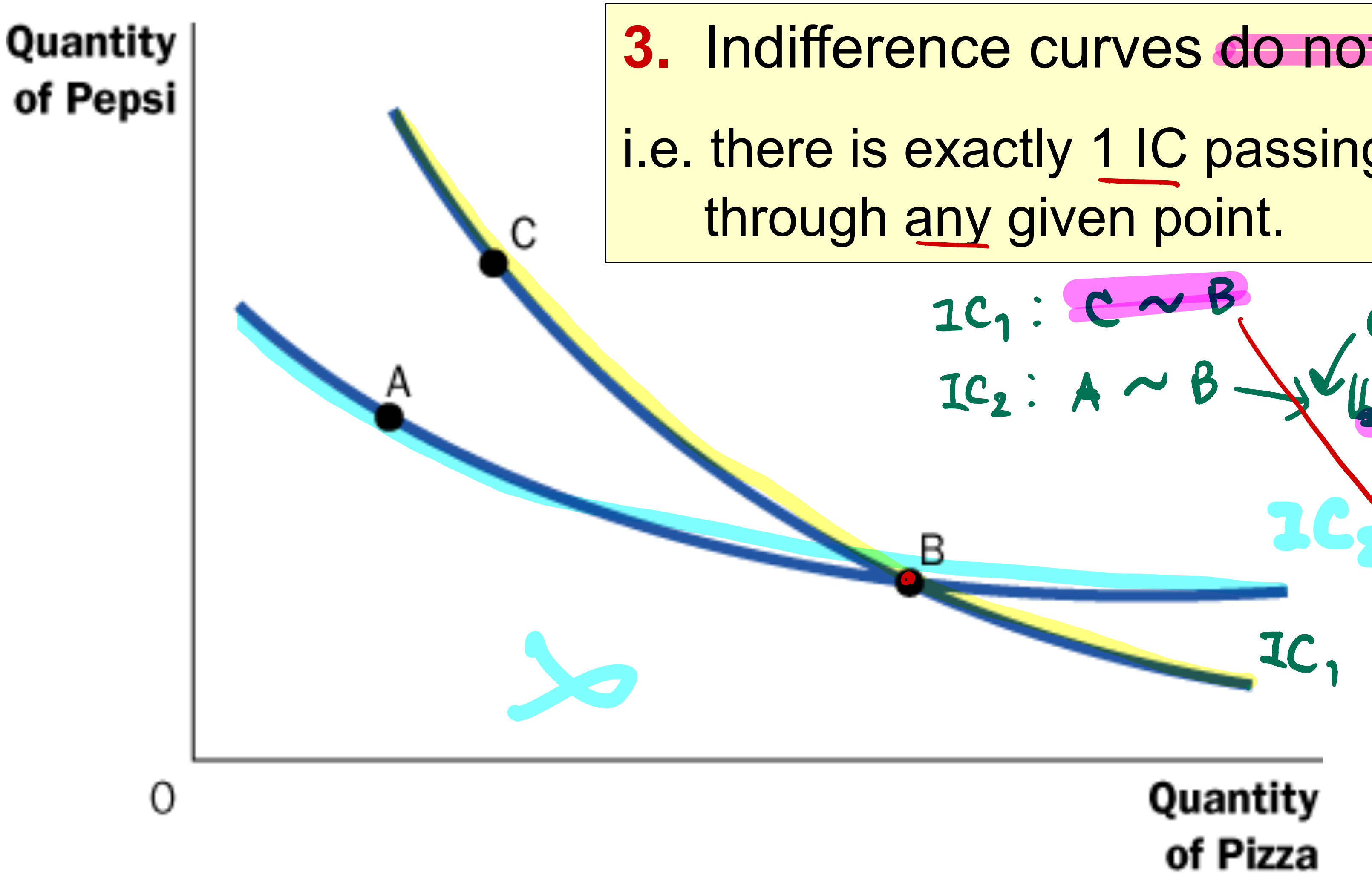


"Unusual IC's"

Properties of Indifference Curve

3. Indifference curves do not cross.

i.e. there is exactly 1 IC passing through any given point.



IC1 : C ~ B

IC2 : A ~ B

C ≻ A

⇓

C ≻ B

contradictn

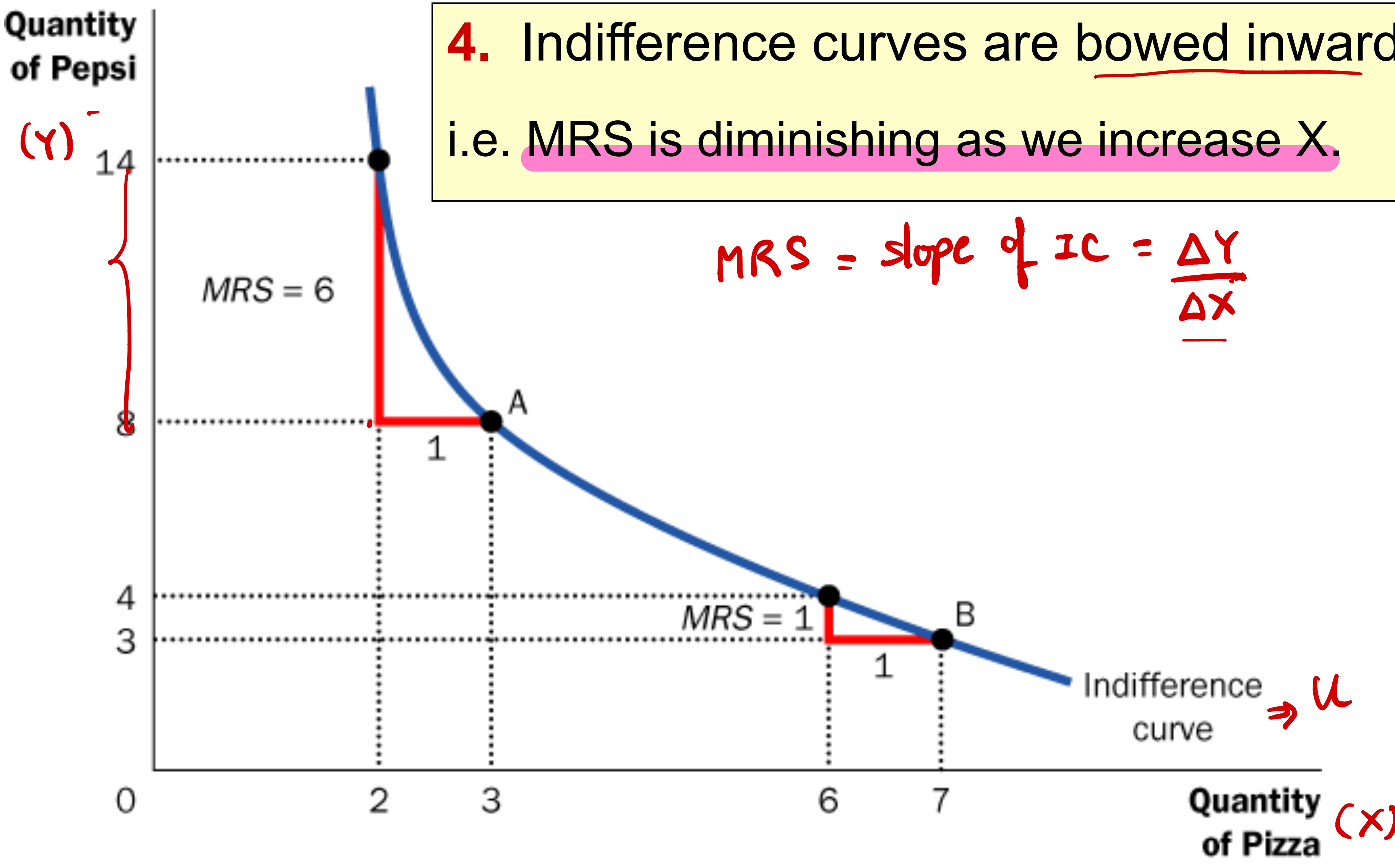
×

Properties of Indifference Curve (Convex)

4. Indifference curves are bowed inward.

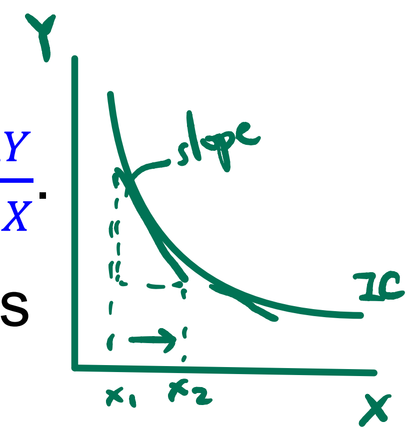
i.e. MRS is diminishing as we increase X.

MRS = slope of IC = $\frac{\Delta Y}{\Delta X}$



Extra Notes on Indifference Curve (1)

- MRS is the slope of the indifference curve, and MRS is diminishing (in absolute value) as X increases.



- At any point on indifference curve, the slope is $\frac{\Delta Y}{\Delta X}$.
- As the consumer consumes more X and reduces consumption of Y, her utility changes by:

$$\Delta X > 0 \rightarrow \Delta U_x \approx MU_x \times \Delta X$$

$$\Delta Y < 0 \rightarrow \Delta U_y \approx MU_y \times \Delta Y$$

$U(X,Y)$

$$\Delta U = \Delta U_X + \Delta U_Y = \frac{\Delta U}{\Delta X} \cdot \Delta X + \frac{\Delta U}{\Delta Y} \cdot \Delta Y$$

- But on the an indifference curve, the utility is the same:

$$\Delta U = \rightarrow \Delta U_x + \Delta U_y = 0$$

$$du = \underbrace{\frac{\partial u}{\partial x}}_{MU_x} \cdot dx + \underbrace{\frac{\partial u}{\partial y}}_{MU_Y} \cdot dy$$

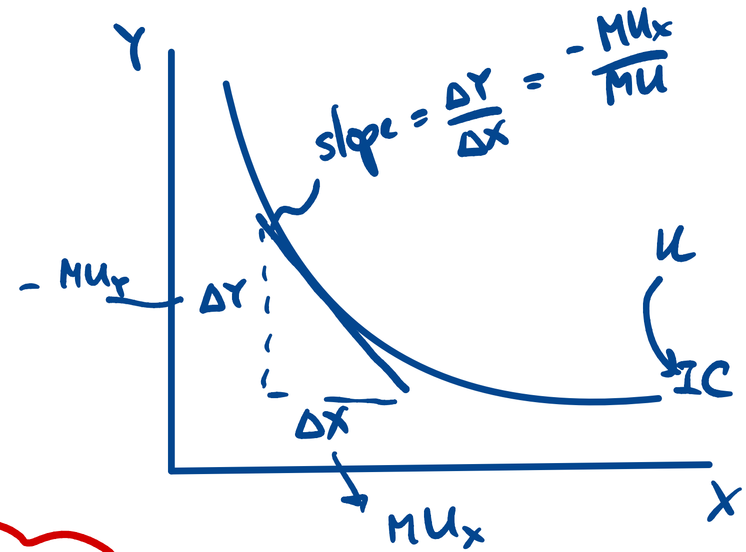
Extra Notes on Indifference Curve (2)

$\Delta U = MU_x \cdot \Delta X + MU_y \cdot \Delta Y = 0$ only for IC

- So,

$$\Delta U_x = -\Delta U_y$$

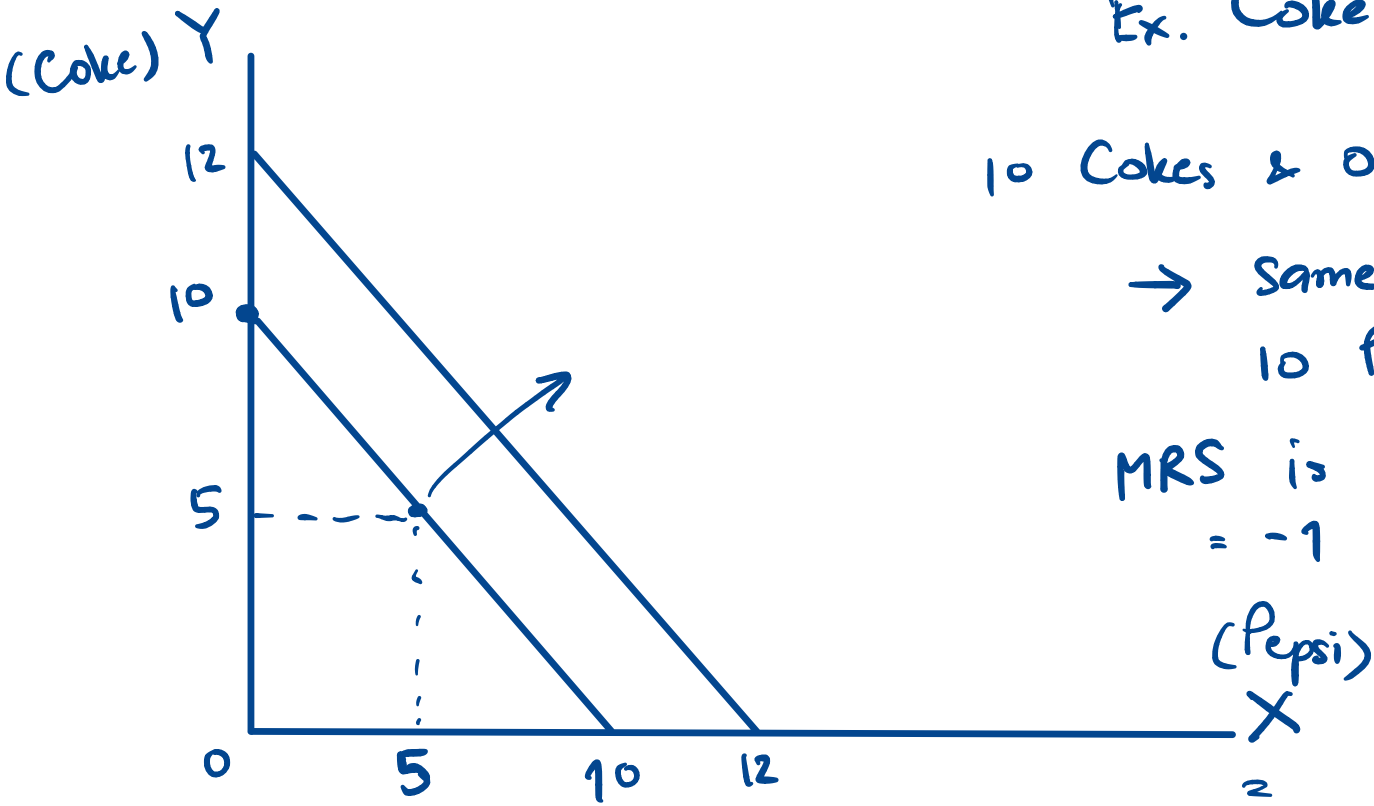
$$\mathrm{MU_x}\Delta X \approx -\mathrm{MU_y}\Delta Y$$



➔ $$\frac{\Delta Y}{\Delta X} \approx -\frac{MU_x}{MU_y}$$

➔ $$\frac{dY}{dX} = -\frac{MU_x}{MU_y}$$: MRS

Extreme Case: Perfect Substitutes



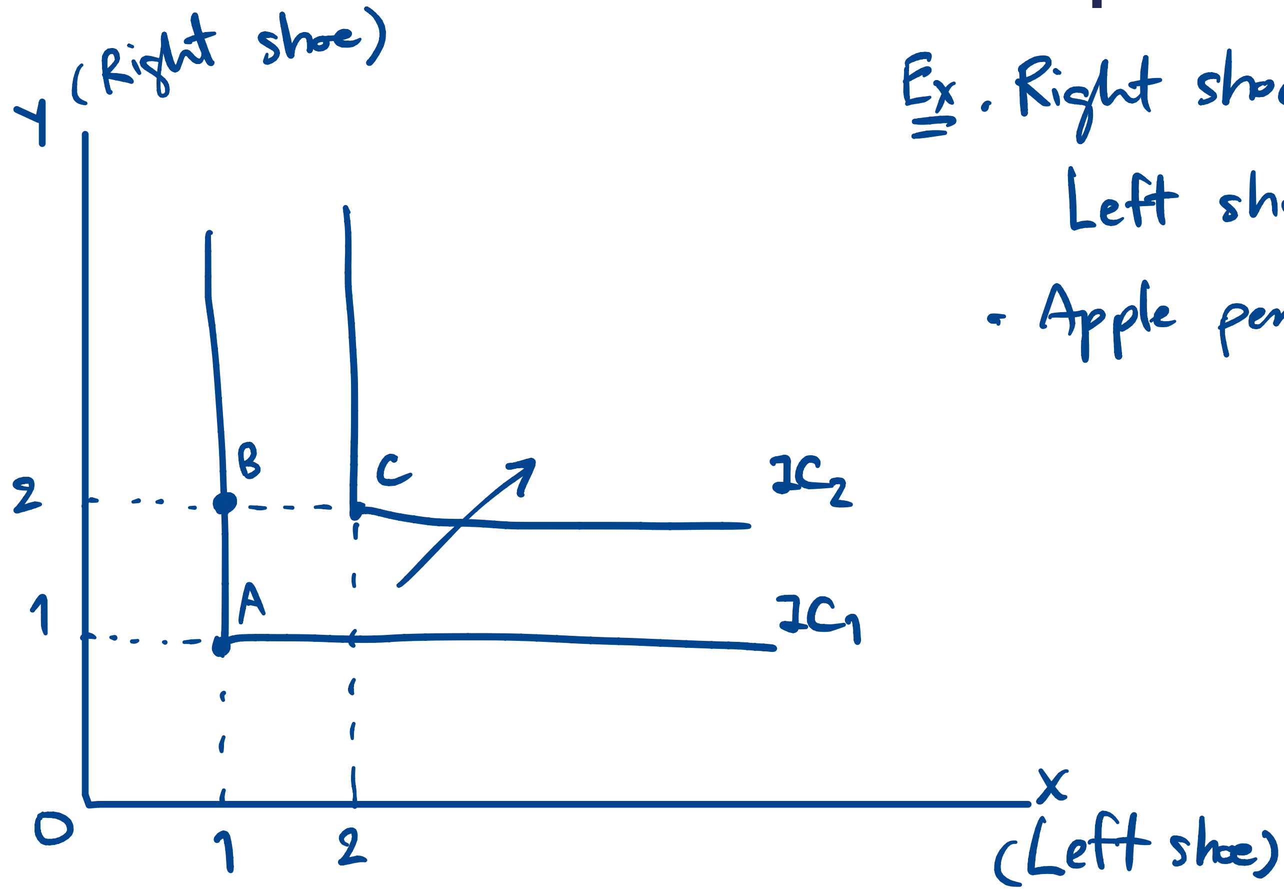
Ex. Coke & Pepsi

10 Cokes & 0 Pepsi

→ same utility as 10 Pepsi & 0 Coke.

MRS is constant!
= −1

Extreme Case: Perfect Complements

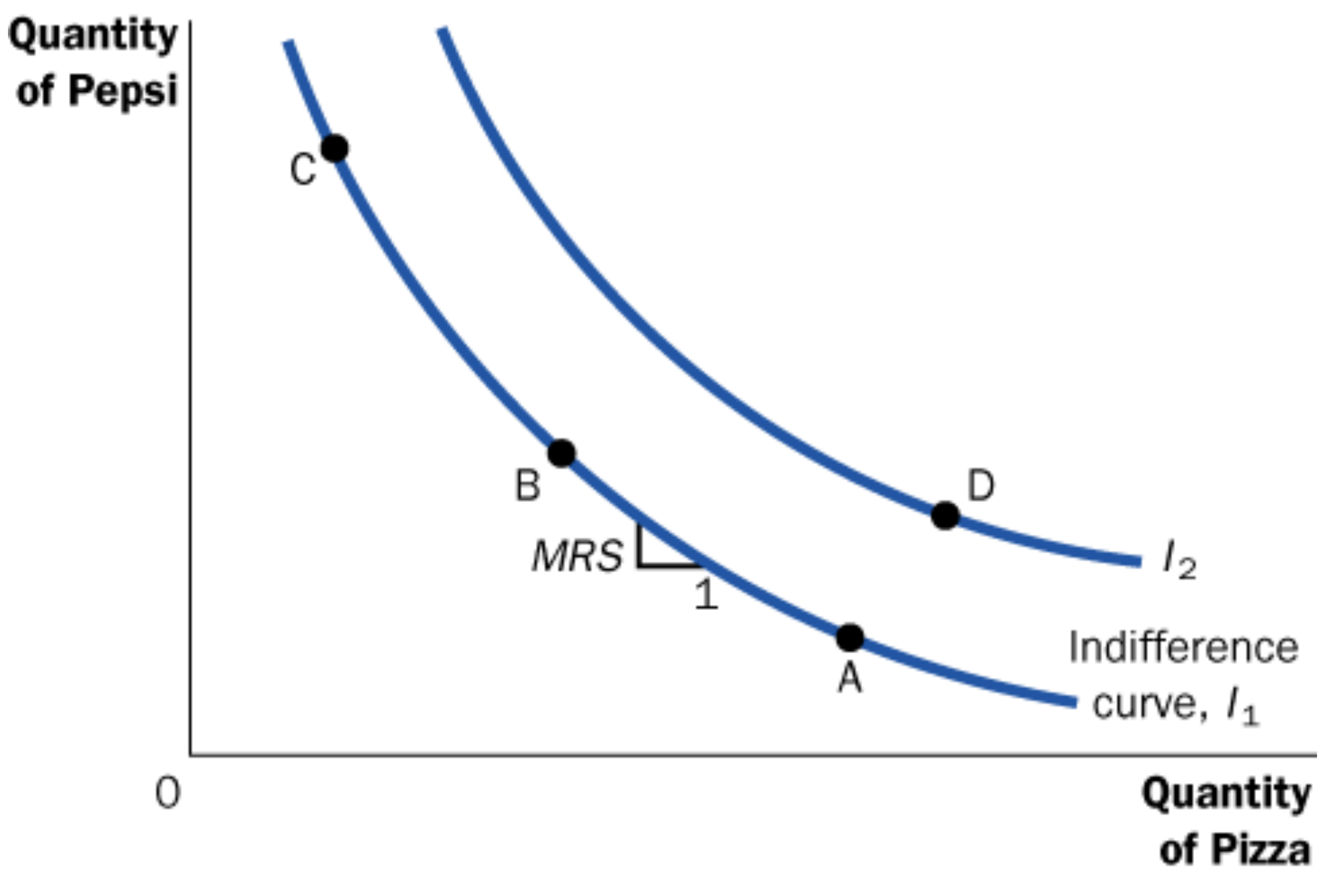


Ex. Right shoe & Left shoe

- Apple pencil & Ipad

Part III. Consumer's Equilibrium

- Recall: **Indifference curve** shows consumption bundles that give the consumer the same level of satisfaction.



Budget Constraint

- **Budget constraint (or budget line)**: the limit on the consumption bundles that a consumer can afford.
  - It shows all combinations (bundles) of the two goods that the consumer can afford to buy.
- Consider the case of 2 goods: Pizza (X) and Pepsi (Y). Suppose P_x = \$10, P_y = \$2, and budget (B) = \$1000.
- The budget line can be written as:

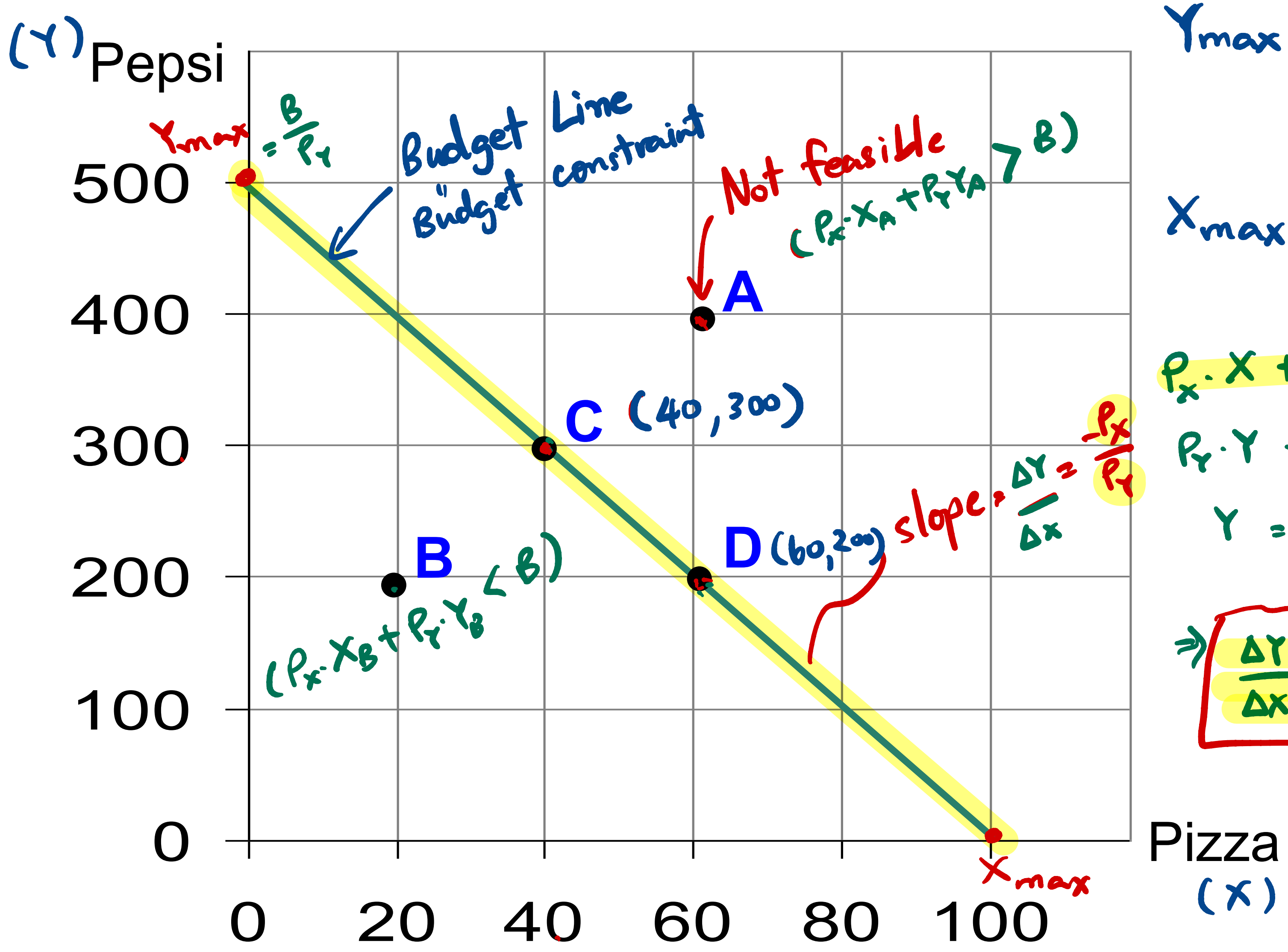
No savings
No borrowing

$$\underbrace{P_x X + P_y Y}_{\text{total expenditure}} = \underbrace{B}_{\text{total income}}$$

Graph: Budget Constraint

$P_X = \$10$, $P_Y = \$2$

$B = 1000$



$$Y_{max} = \frac{B}{P_Y} = \frac{1000}{\$2} = 500 \text{ unit}$$

$$X_{max} = \frac{1000}{\$10} = 100 \text{ units}$$

$$P_X \cdot X + P_Y \cdot Y = B$$

$$P_Y \cdot Y = B - P_X \cdot X$$

$$Y = \frac{B}{P_Y} - \frac{P_X}{P_Y} \cdot X$$

$$\Rightarrow \boxed{\frac{\Delta Y}{\Delta X} = \frac{-P_X}{P_Y}}$$

Slope of the Budget Constraint

- The slope of the budget constraint equals:
  - the rate at which the consumer can trade Pepsi for pizza
  - the opportunity cost of pizza in terms of Pepsi
  - the relative price of pizza.

That is:

$$Slope\ of\ Budget\ line = -\frac{P_x}{P_y}$$

Change in Budget Constraint: Higher Income

- Suppose budget increases to \$1200. (B')

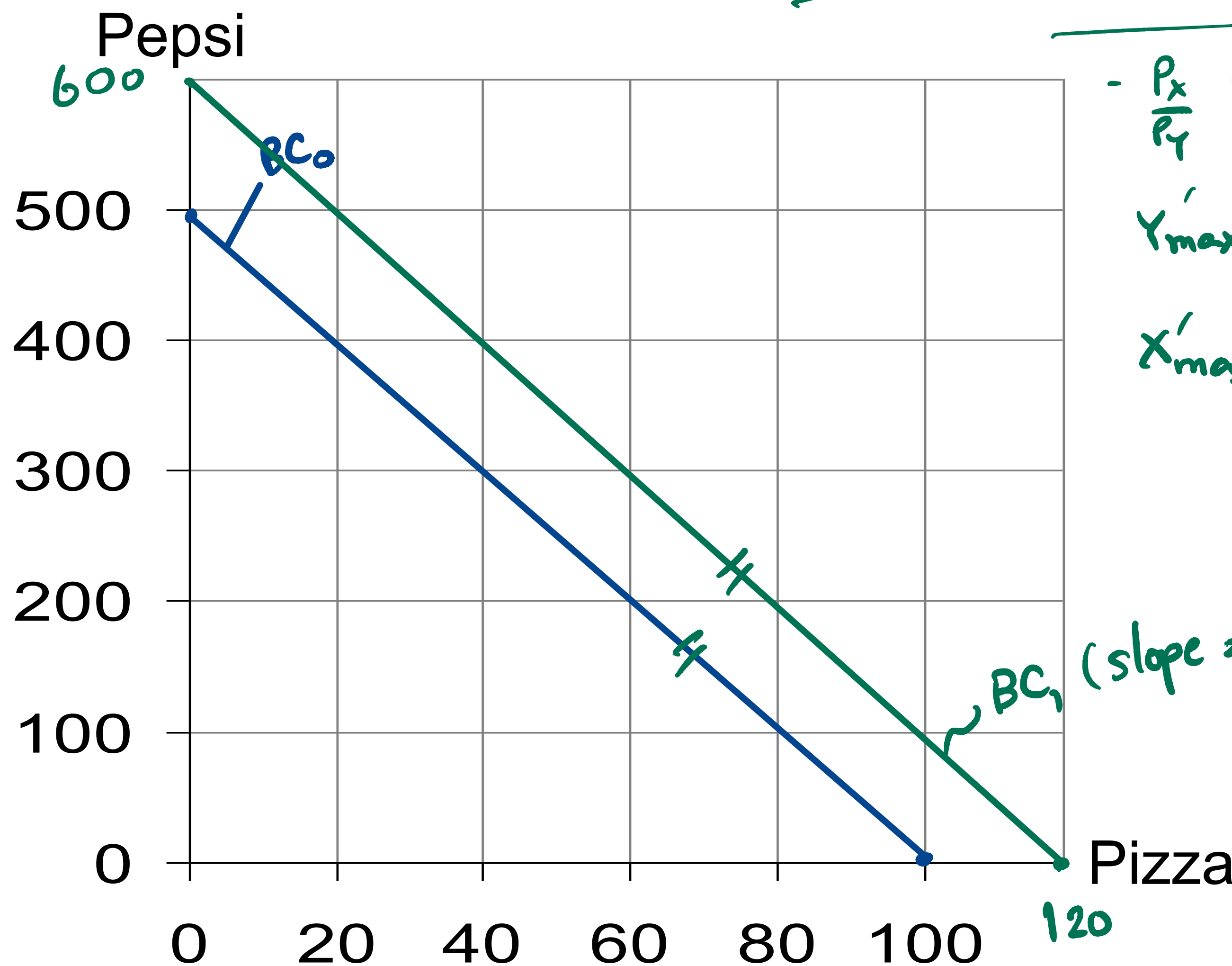
$B_0 = 1000$

$P_x = \$10$, $P_Y = \$2$

$-\frac{P_x}{P_Y} = -5$

$Y'_{max} = \frac{1200}{2} = 600$

$X'_{max} = \frac{1200}{10} = 120$



What if $B = 1000$, $P_X = 10$, $P_Y' = 4$?

$$Y'_{max} = \frac{1000}{\$4} = 250$$

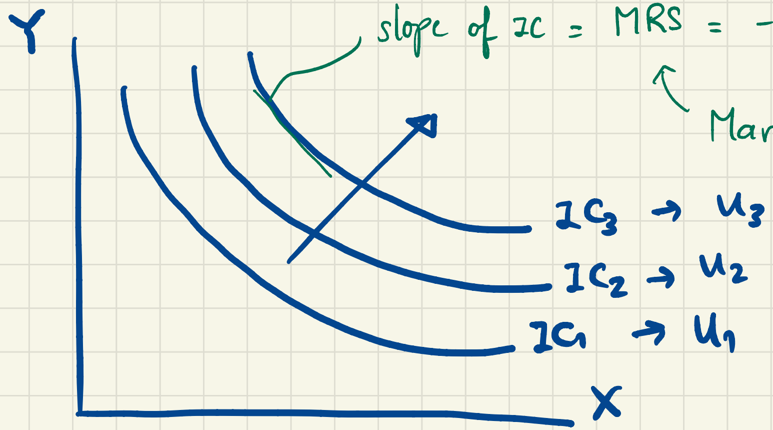
What if $P_X' = 8$, $P_Y' = 1$, $B = 1000$?

(Before $P_X = 10$, $P_Y = 2$)

→ Write budget lines before and after the price changes. Also, calculate the slope of each budget line and label correctly.

Recall Consumer's choice

- **Utility** : $U = U(X, Y) \rightarrow$ Indifference Curve.



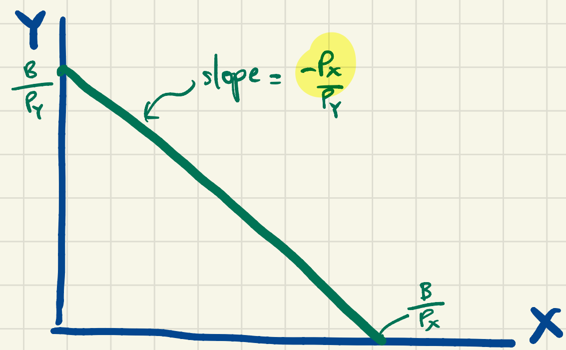
slope of IC $= MRS = -\dfrac{MU_X}{MU_Y}$

MRS: Marginal Rate of Substitution

- **Budget constraint** : P_X, P_Y, B (B = Budget (Income; Y))

$$P_X \cdot X + P_Y \cdot Y = B$$

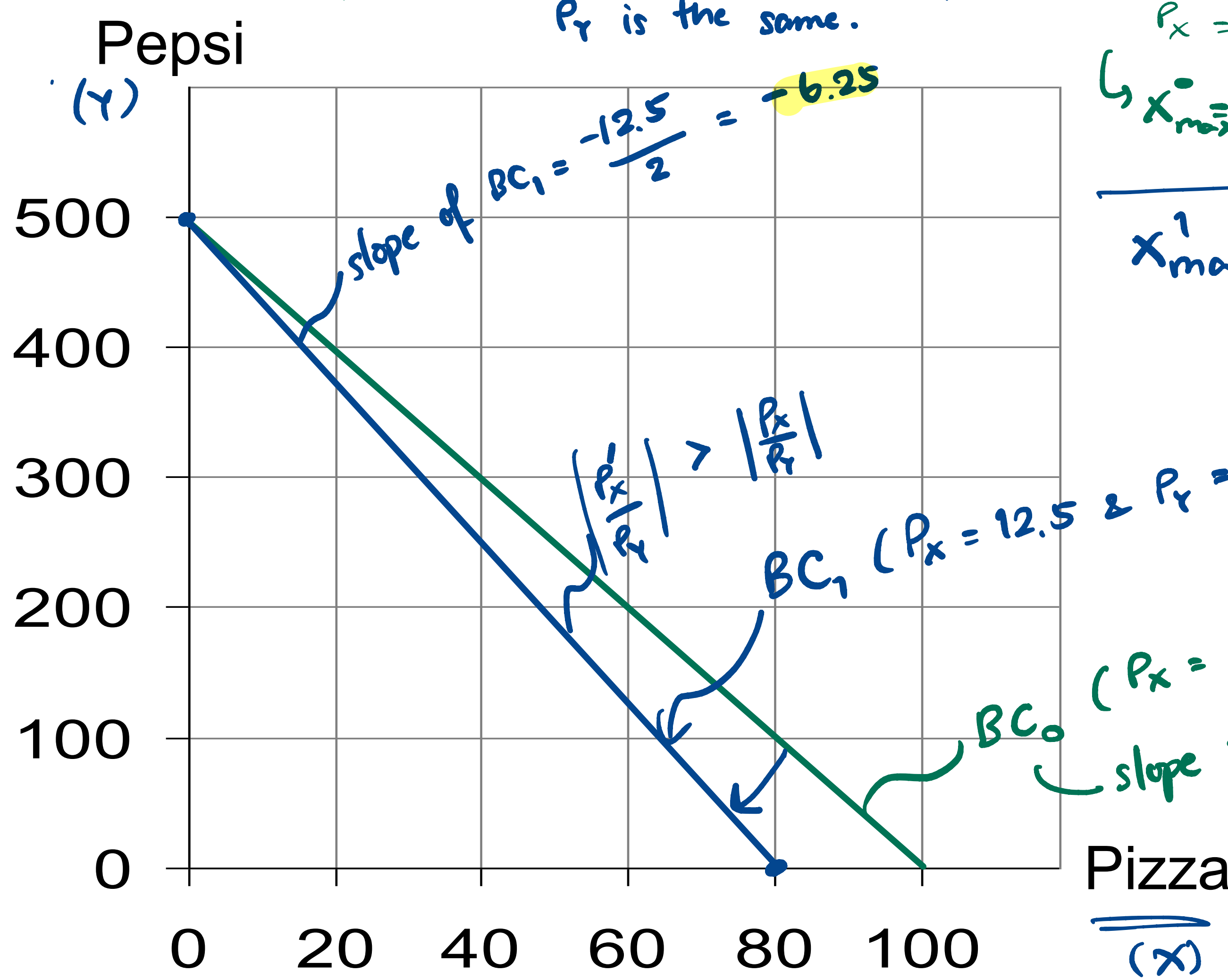
$$Y = \frac{B}{P_Y} - \frac{P_X}{P_Y} \cdot X$$



Change in Budget Constraint: Px changes.

- Suppose P_x increases from \$10 to \$12.5.

P_Y is the same.



BC_0 ($P_x = 10$, $P_Y = 2$)

slope $= \frac{-10}{2} = -5$

Initial Situation:

$B = \$1000$

$P_x = 10$, $P_Y = 2$

$\hookrightarrow X^0_{max} = 100$, $Y^0_{max} = 500$

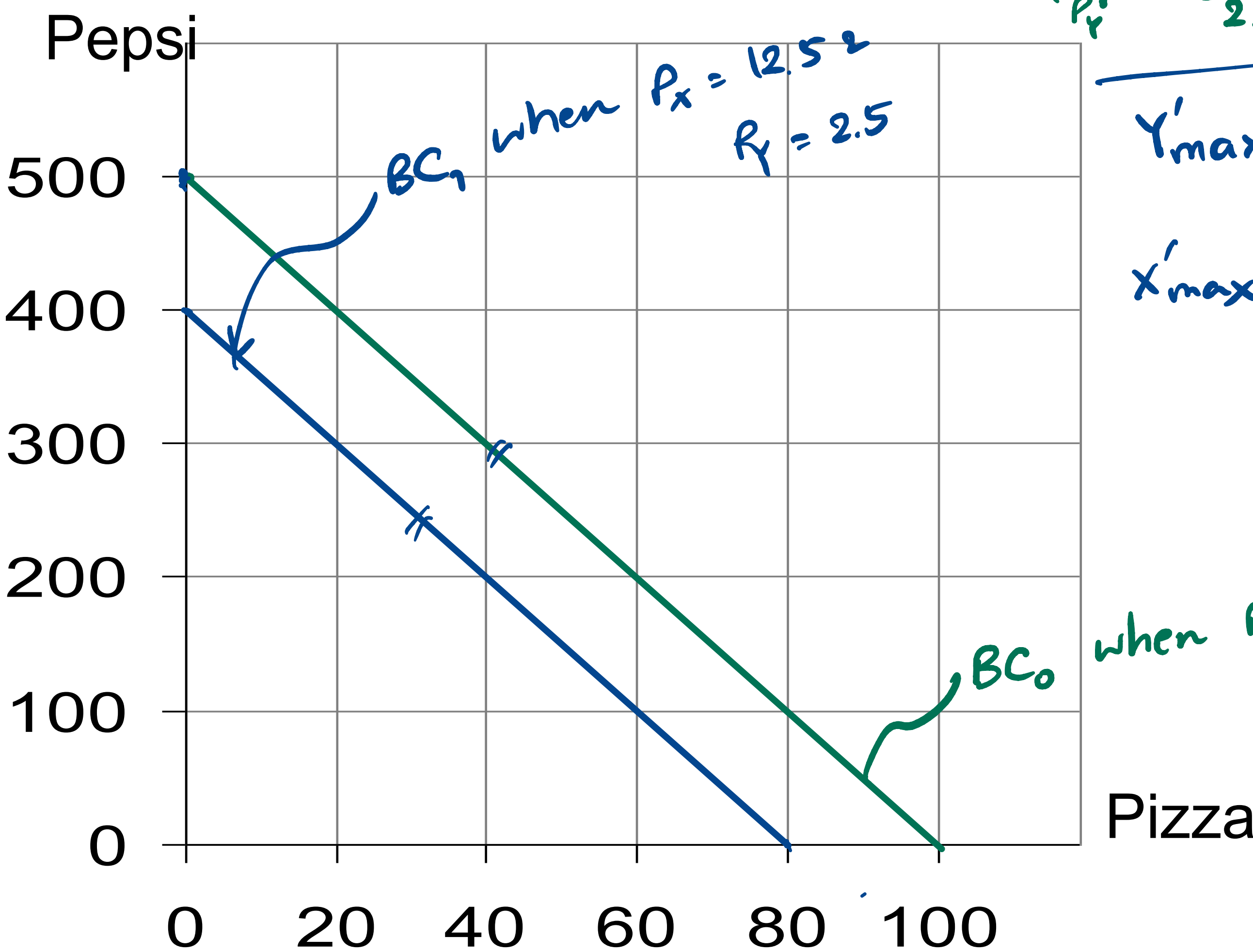
$X^1_{max} = \frac{1000}{12.5} = 80$

Change in Budget Constraint:
Px & Py change by the same proportion.

$P_x = \$10$ $P_Y = \$2$ $\rightarrow -\frac{P_x}{P_Y} = -5$

- Suppose $P'_x = \$12.5$ and $P'_y = \$2.5$.

$-\frac{P'_x}{P'_Y} = \frac{-12.5}{2.5} = -5$



$Y'_{max} = \frac{1000}{2.5} = 400$

$X'_{max} = \frac{1000}{12.5} = 80$

Consumer's Problem: Optimization

$\max_{X,Y} U(X,Y)$ subject to $P_X \cdot X + P_Y \cdot Y = \bar{B}$

- Consumer's problem is to maximize his/her utility (i.e. satisfaction) under the budget constraint.
- The **optimal bundle** is at the point where the budget constraint touches the highest indifference curve.

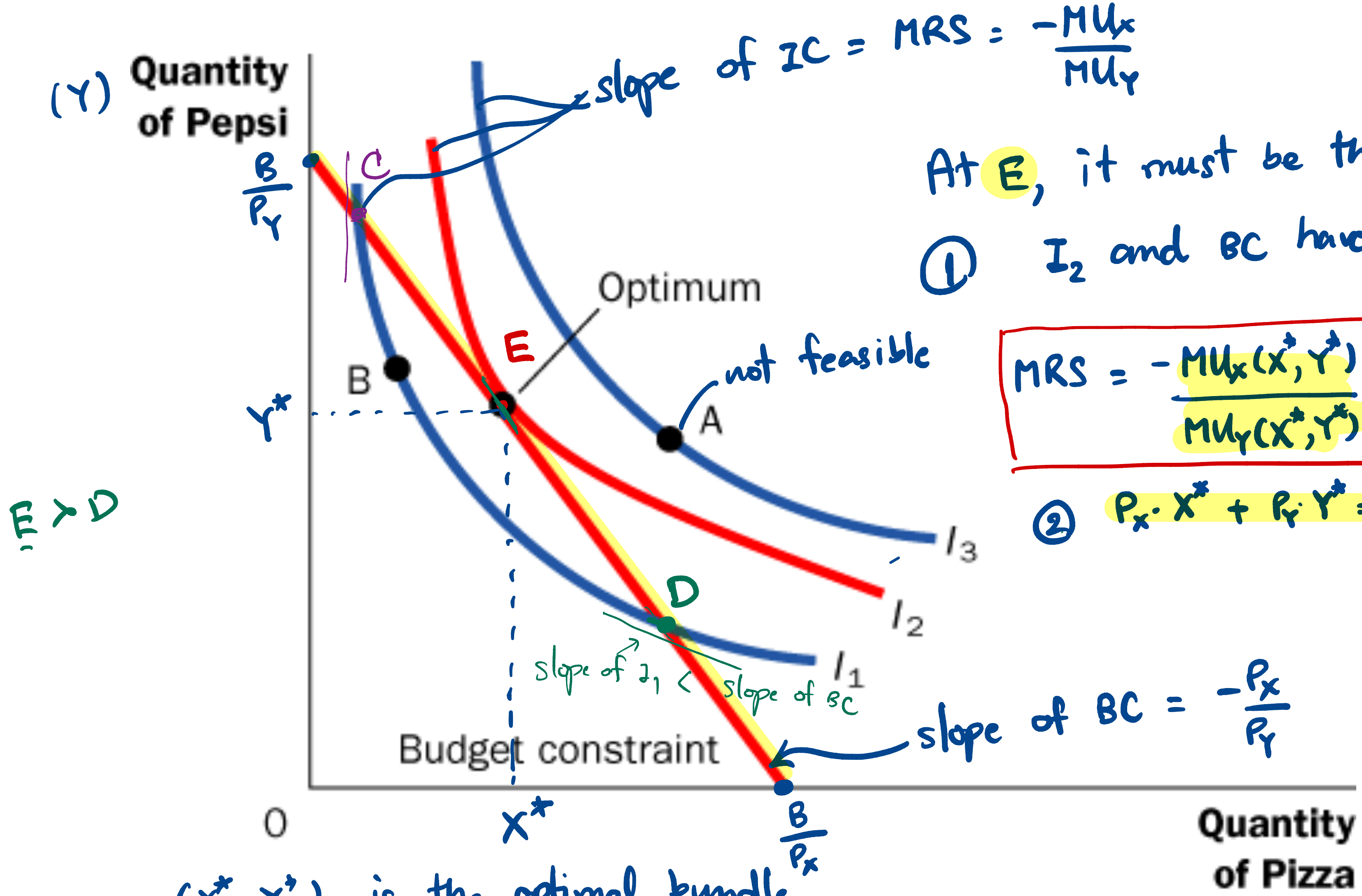
  tangent

  - i.e., the indifference curve and budget constraint have the same slope.

$-\frac{MU_X}{MU_Y}$ //

- Since the slope of IC is the MRS and the slope of the budget constraint is the relative price, the optimal bundle is where: $\frac{P_x}{P_y} = \frac{MU_x}{MU_y}$ $\Leftrightarrow$ $\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$

Graph: Consumer's Optimal Choice



At E, it must be that:

① I_2 and BC have same slope:

$$\boxed{MRS = -\frac{MU_X(X^*,Y^*)}{MU_Y(X^*,Y^*)} = -\frac{P_X}{P_Y}}$$

② $P_X \cdot X^* + P_Y \cdot Y^* = B$

(X^*, Y^*) is the optimal bundle.

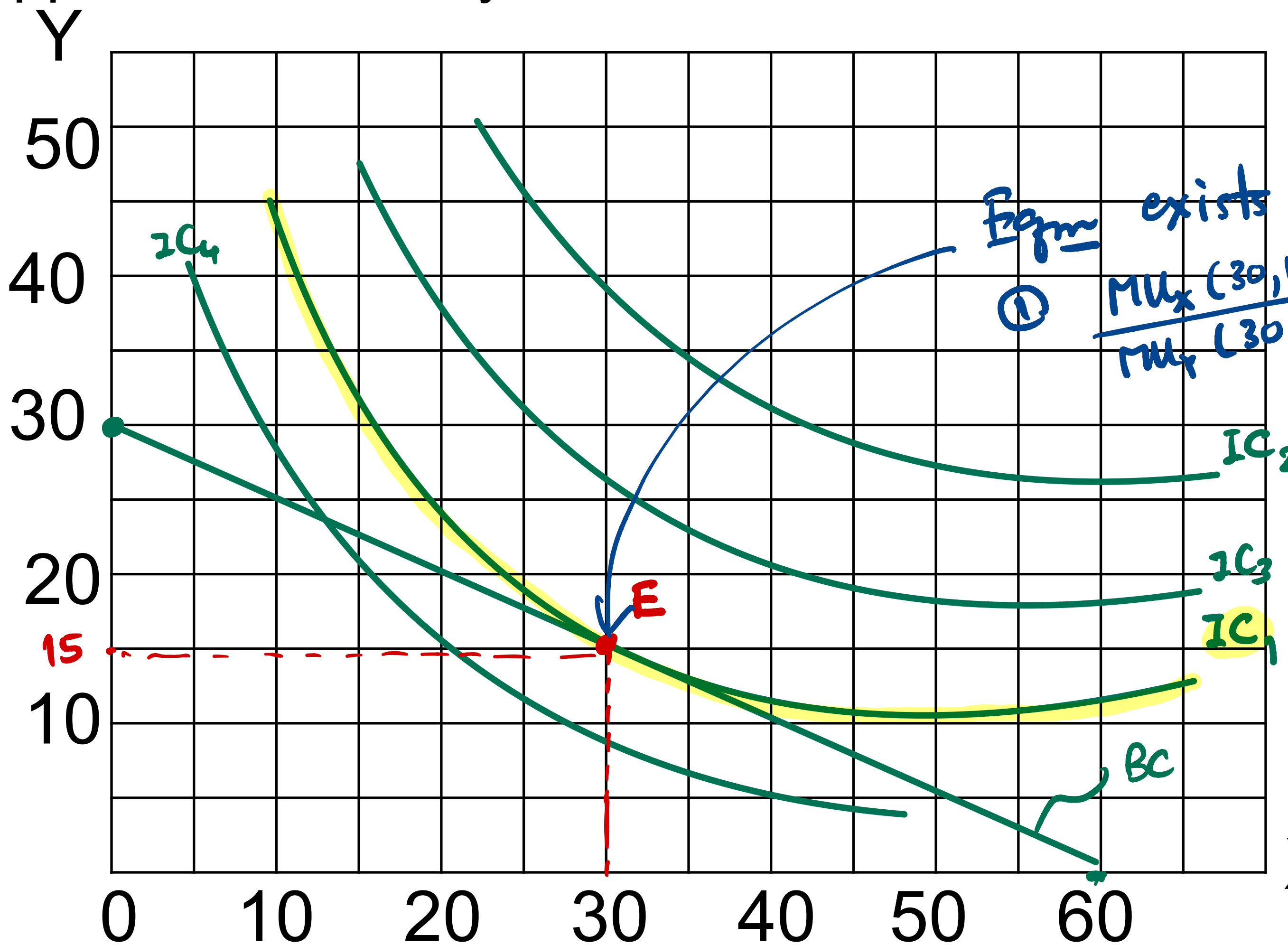
Example: Optimization

Find the optimal (X^*, Y^*)

$Y_{max} = \frac{120}{4} = 30$

$X_{max} = \frac{120}{2} = 60$

- Suppose Px = \$2, Py = \$4, and B = \$120.



Eqm exists when

① $\frac{MU_x(30,15)}{MU_y(30,15)} = \frac{P_x}{P_y} = \frac{2}{4} = \frac{1}{2}$

② $P_x \cdot X + P_y \cdot Y = 120$

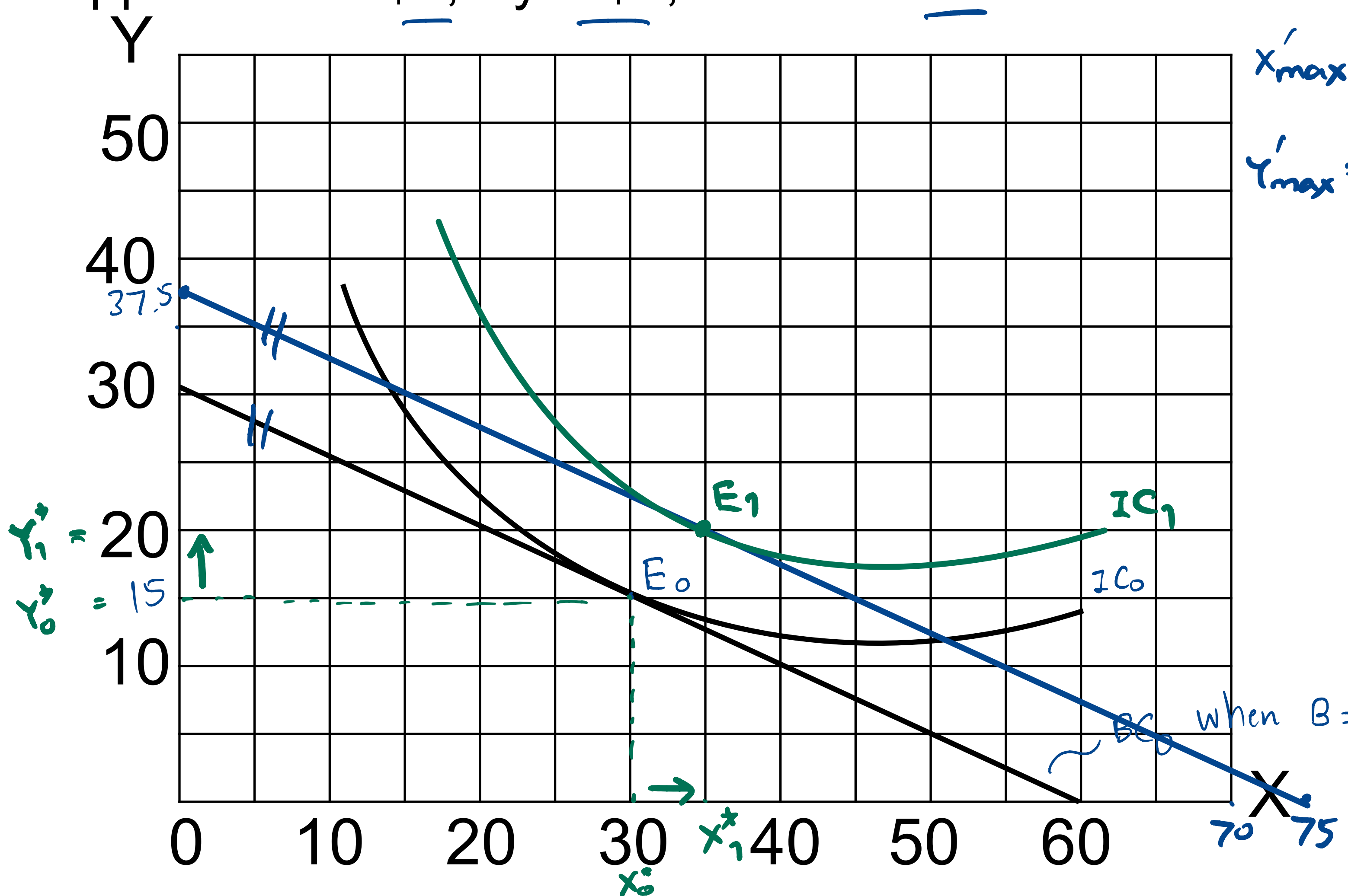
$(\$2)(30) + (\$4)(15) = 120$ ✓

Example: Effect of Income Increase

- Suppose Px = $2, Py = $4, and B = 150. → Find new (x^*, y^*)

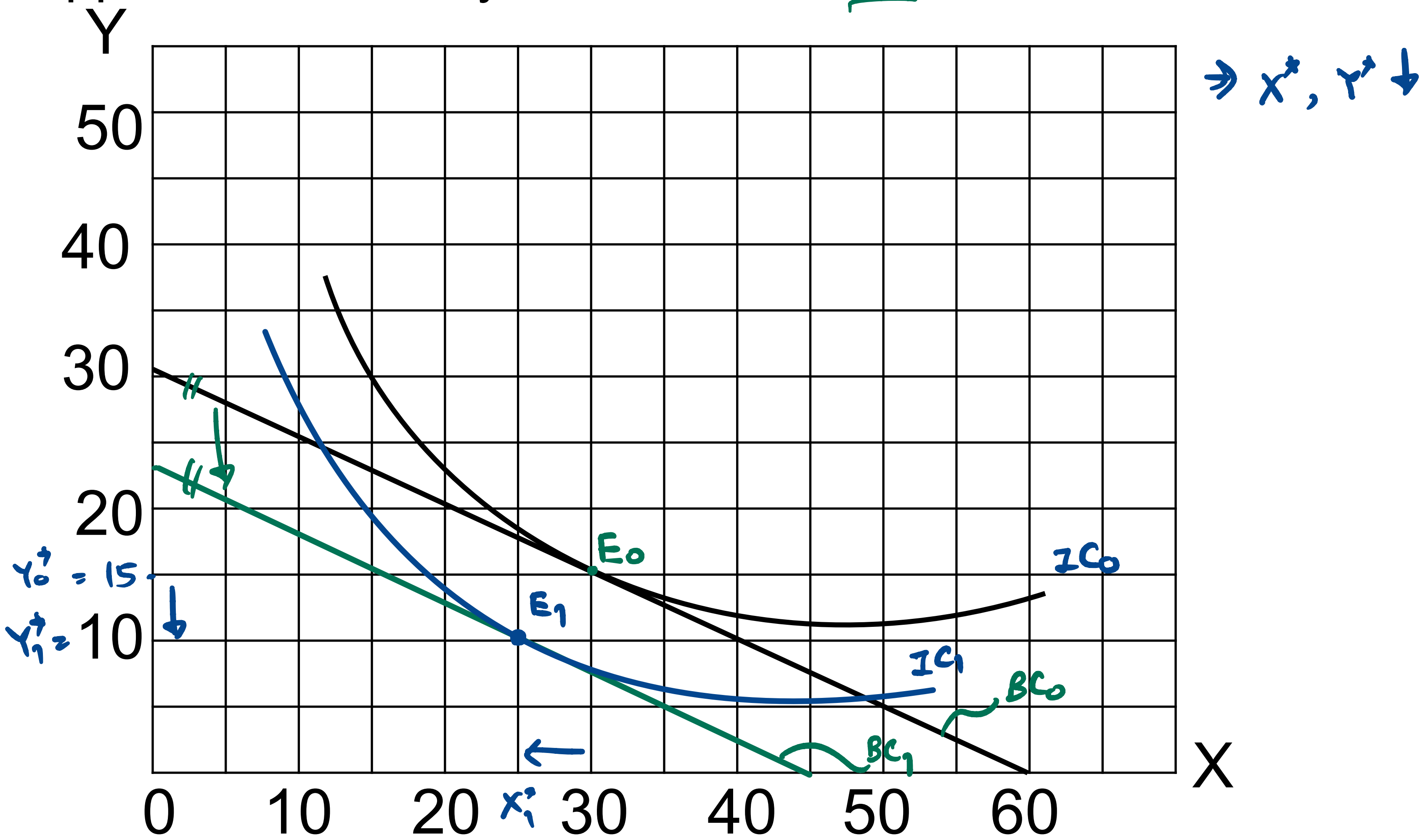
$x'_{max} = \frac{150}{2} = 75$

$y'_{max} = \frac{150}{4} = 37.5$



Example: Effect of Income Reduction

- Suppose Px = \$2, Py = \$4, and B = 90. → $X'_{max} = 45$, $Y'_{max} = 22.5$



Income Consumption Curve (ICC)

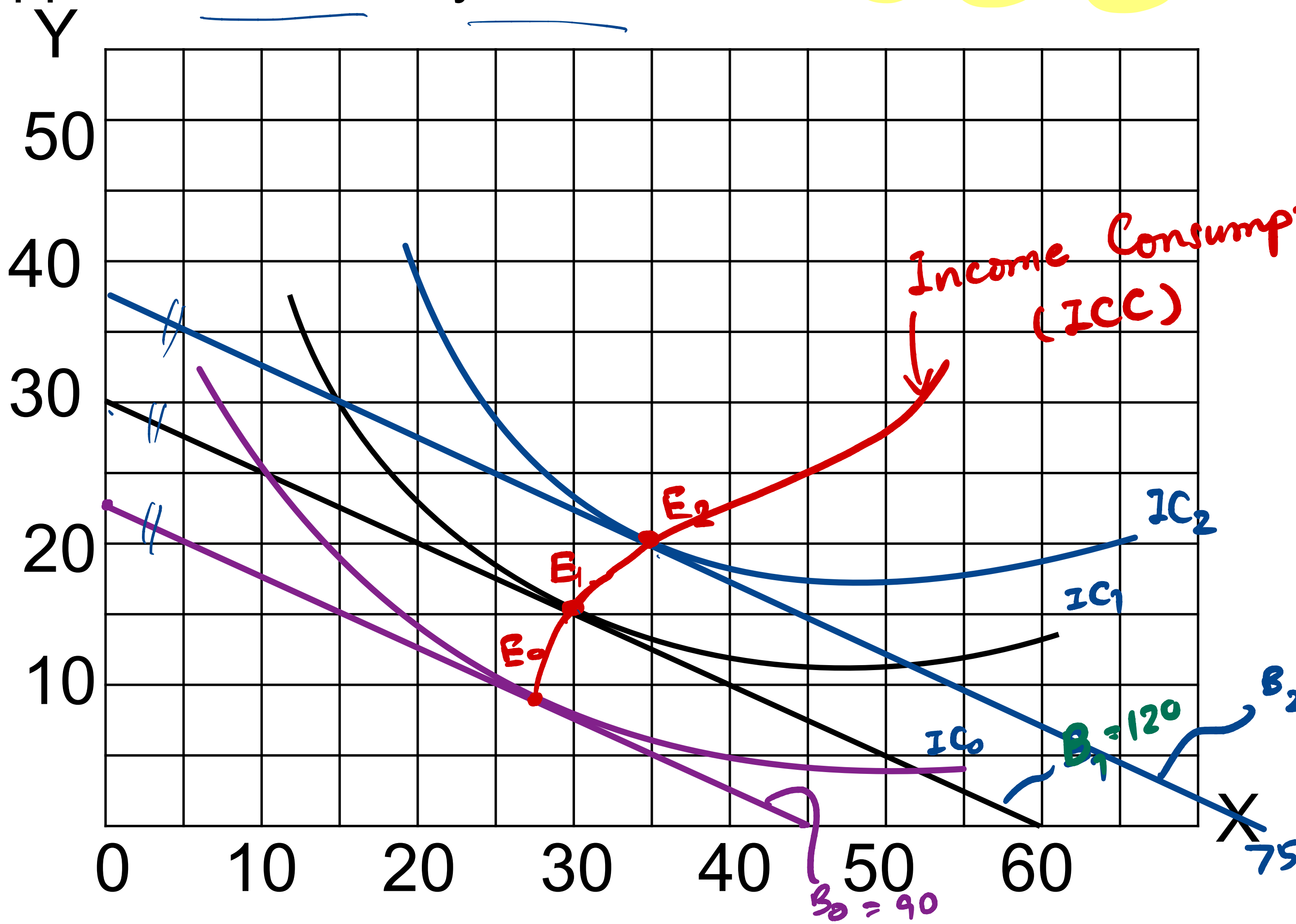
- A change in income, *ceteris paribus*, will shift the consumer’s budget constraint.
- For each level of income, there will be a utility maximizing points where IC is tangent to the relevant budget line.
- **Income Consumption Curve (ICC)** is the line that connects all the utility-maximizing points for different levels of income, given prices Px and Py constant.
- I.e. , ICC shows how the consumer’s purchases react to a change in money income with relative prices being held constant.

Graph: ICC

As income increases, X^* and Y^* increase.
⇒ X and Y are NORMAL goods.

- Suppose Px = \$2, Py = \$4, and B = 90, 120, 150.

B_0 = 90, B_1 = 120, B_2 = 150

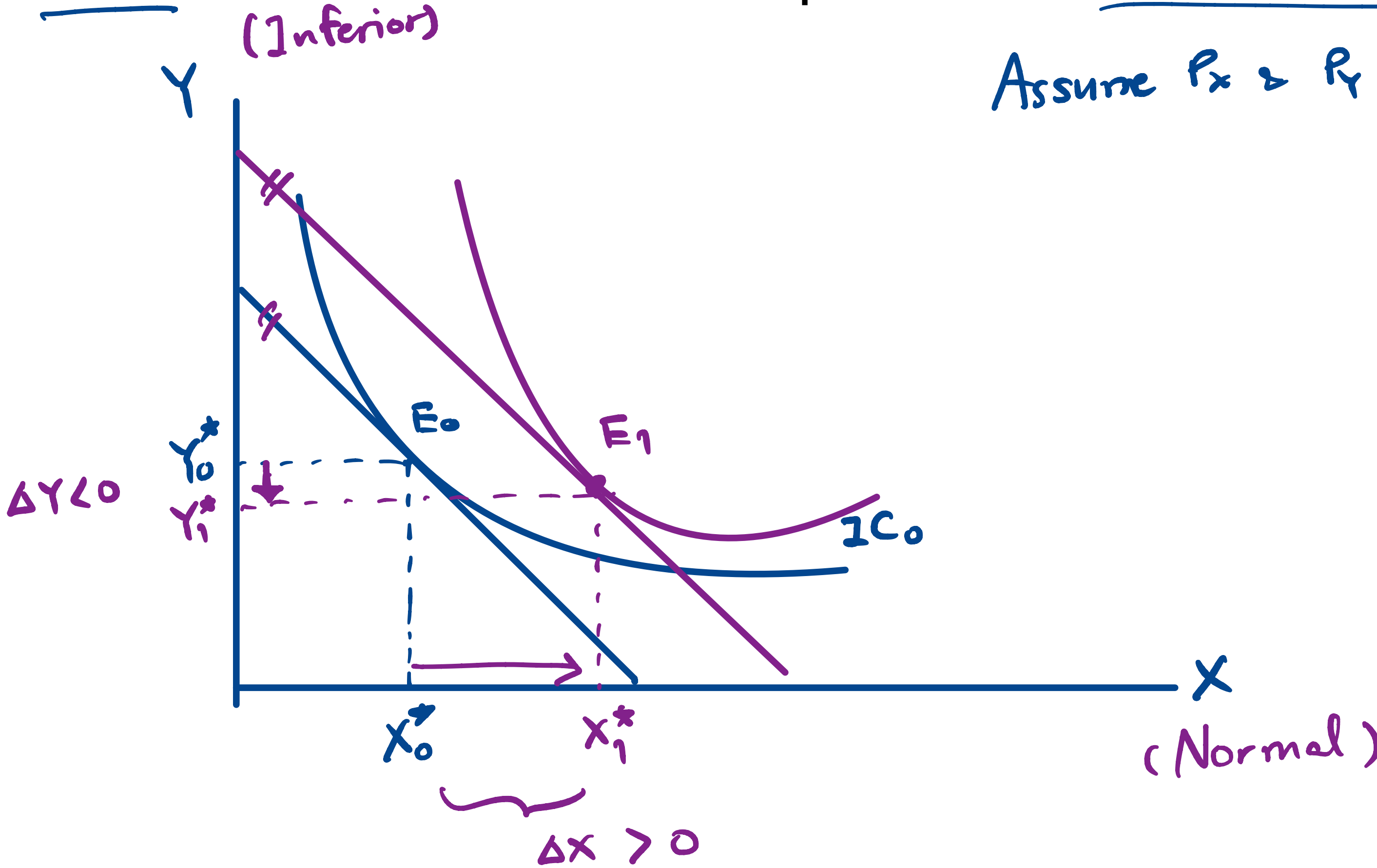


Exercise: Inferior good

$\varepsilon_I > 0$ $\varepsilon_I < 0$

- Suppose X is a normal good but Y is an inferior good.
- Use a diagram to show the effects of an increase in income on the consumer's optimal bundle of X and Y.

Assume P_X & P_Y are constant.



Example: Effect of Price Change (1)

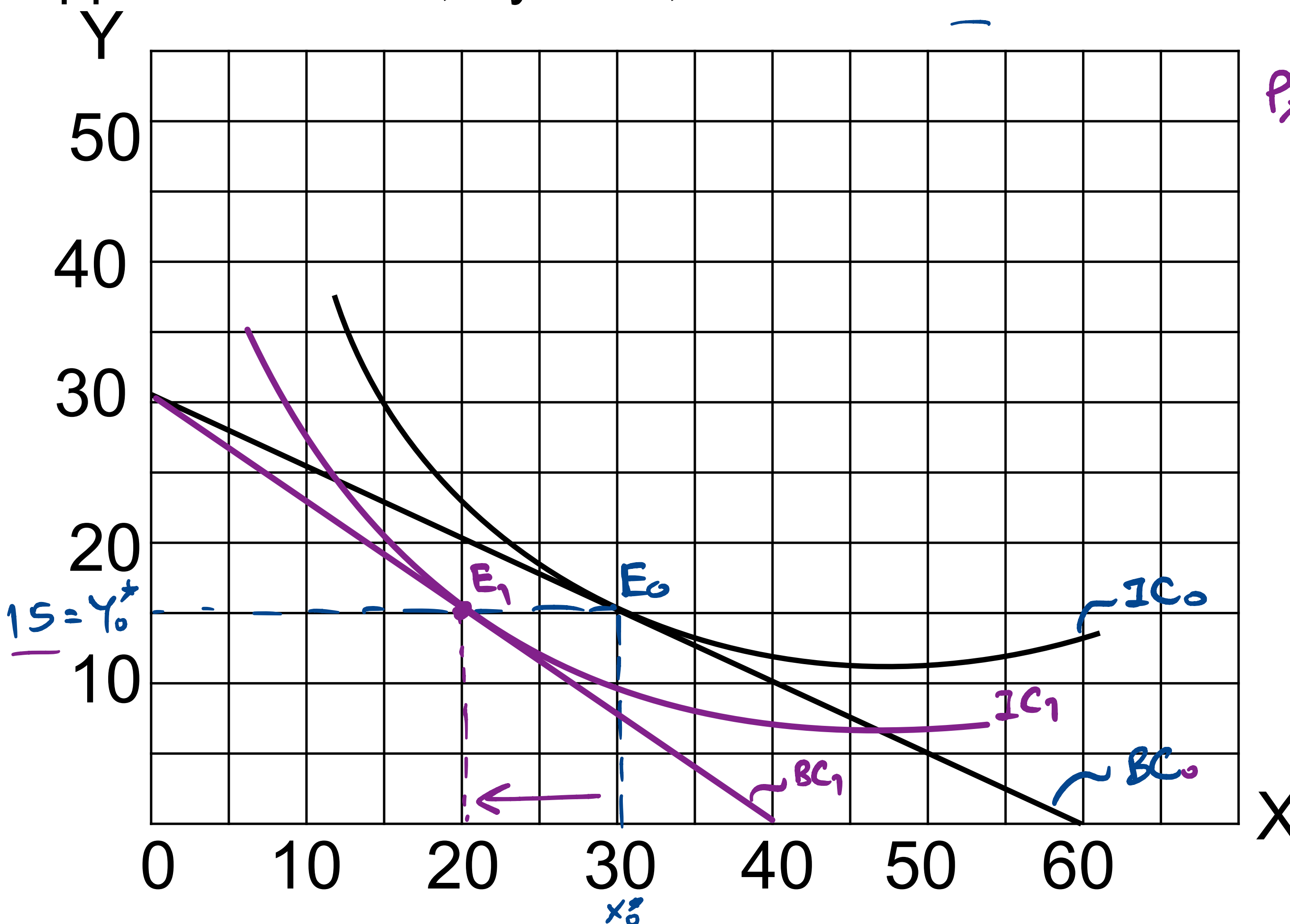
$P_x = \$2$

$X'_{max} = \frac{120}{3} = 40$

- Suppose P’x = \$3, Py = \$4, and B = 120.

$P_x \uparrow \Rightarrow X^* \downarrow$

$\hookrightarrow Y^* ?$

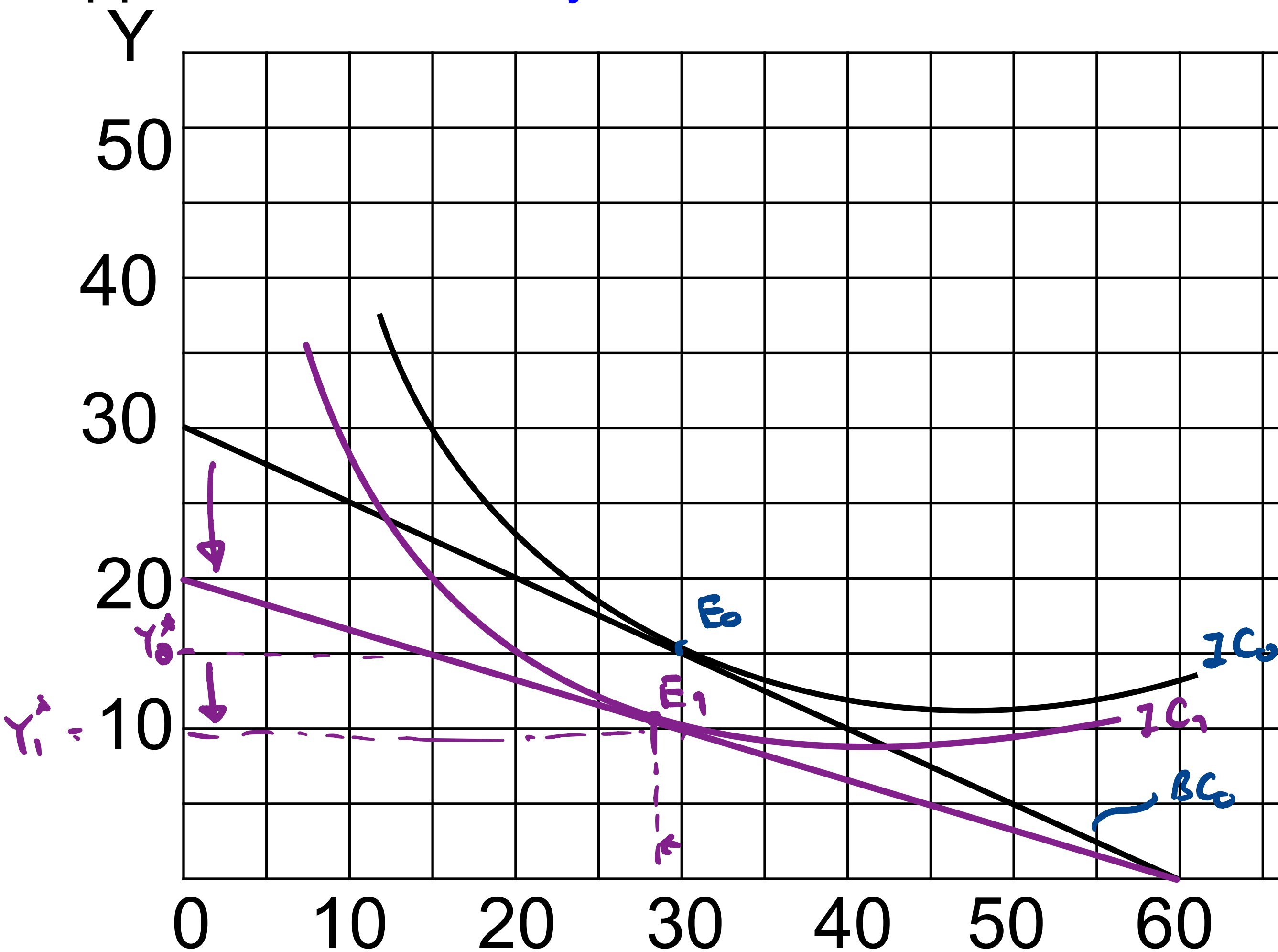


Example: Effect of Price Change (2)

$P_Y = 4$

- Suppose Px = \$2, P'y = \$6, and B = 120.

$\rightarrow Y'_{max} = \frac{120}{6} = 20$



$P_Y \uparrow \Rightarrow Y^* < 0$

$\hookrightarrow x^* ?$

Price Consumption Curve

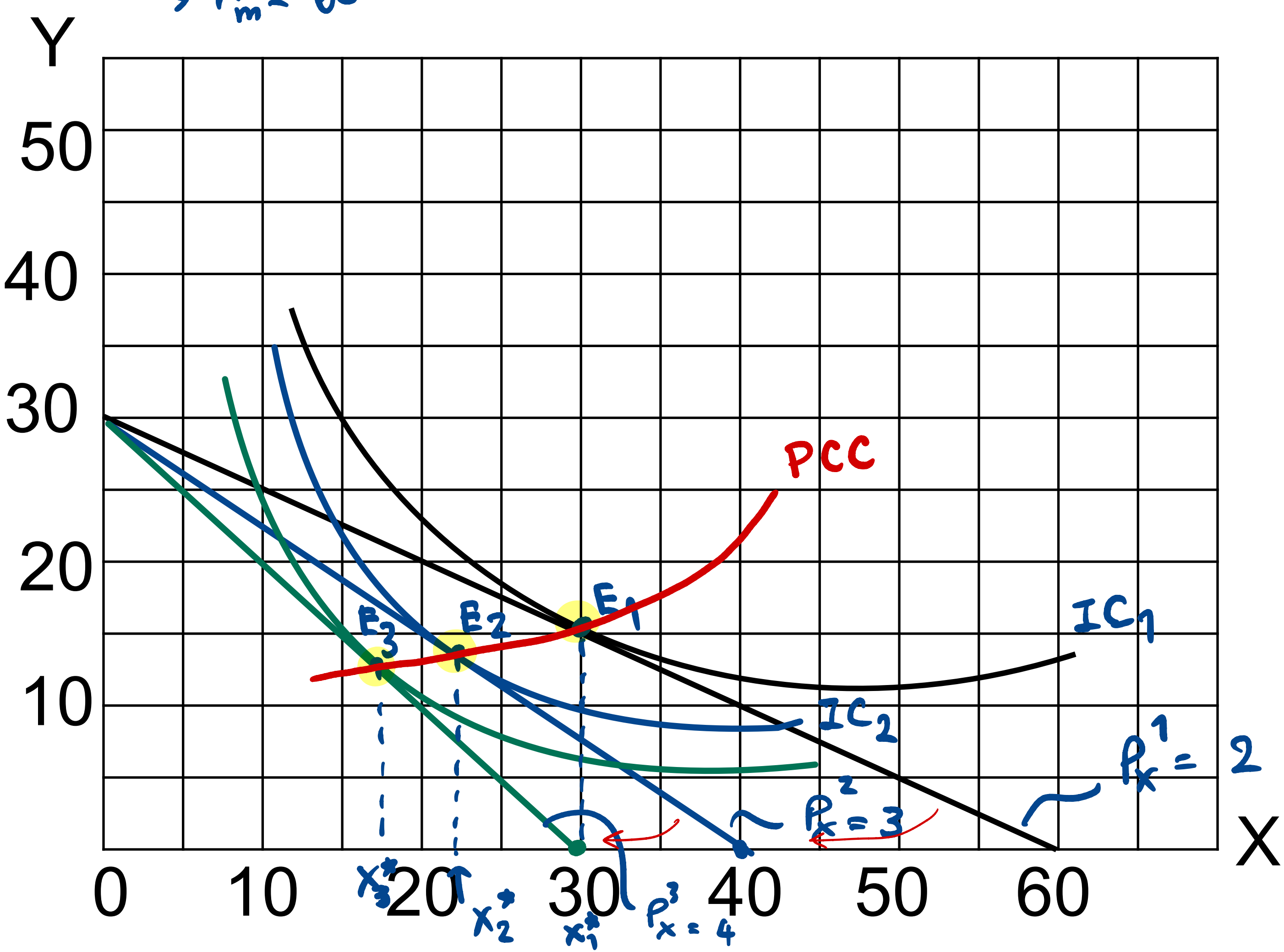
- A change in relative prices of two goods changes the slope of the budget constraint.
- Suppose Px changes while Py is constant. For each Px, there is a different utility-maximizing consumption bundle.
- **Price Consumption Curve (PCC)** is the line that connects all the utility-maximizing points for different Px's, given income and Py constant.
- I.e. , PCC shows how the consumer's purchases react to a change in one price with income and other prices being held constant.

Graph: PCC

$x_m = 40$ $\quad x_m = \frac{120}{4} = 30$

- Suppose Px = \$2, \$3, \$4, Py = \$4, and B = 120.

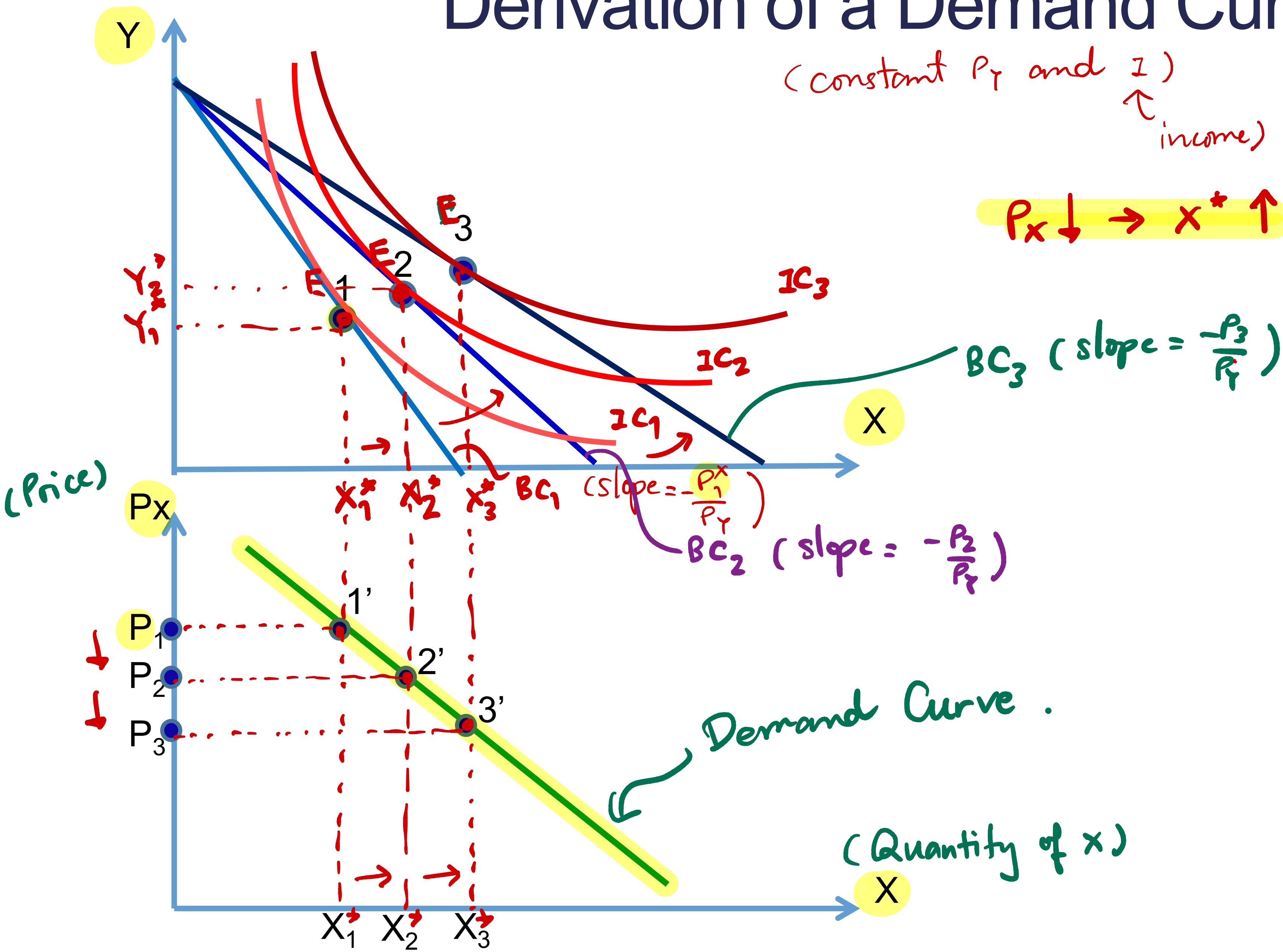
$y \; x_m = 60$ $\qquad P_x \uparrow \rightarrow x^* \downarrow$



Derivation of a Demand Curve

(constant P_Y and I ← income)

$P_x \downarrow \rightarrow x^* \uparrow$



Income and Substitution Effects

- A fall in Px has two effects:

Substitution effect ("Price" effect)

➢ Change in X due to change in relative price with *real income* unchanged

➢ A fall in Px makes Y more expensive relative to X, causing consumer to buy more X and less Y

(Note: Real income is kept unchanged by staying on the original IC.)

Income effect

➢ Change in X due to change in real income

➢ A fall in Px increases the consumer's purchasing power, allowing him to reach a higher IC

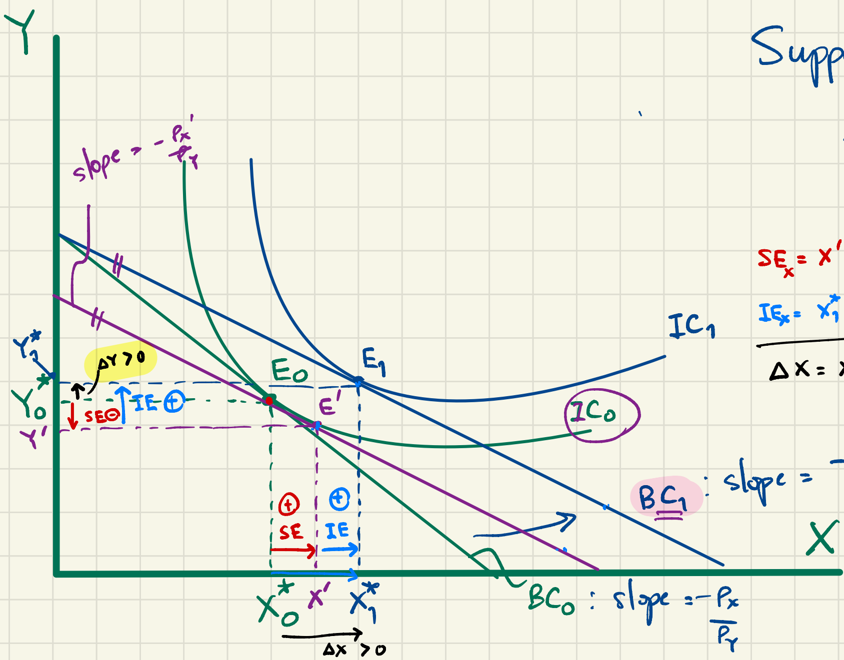
Suppose P_x decreases, ceteris paribus.

$\Rightarrow \Delta X = X_1^* - X_0^*$

$SE_x = X' - X_0^* > 0$; $SE_Y = Y' - Y_0^* < 0$

$IE_x = X_1^* - X' > 0$; $IE_Y = Y_1^* - Y' > 0$

$\Delta X = X_1^* - X_0^* > 0$; $\Delta Y = Y_1^* - Y_0^* > 0$



To identify the income effect and substitution effect:

Step 1: Draw the new budget line (BC_1) and determine the new eq^m (E_1), which is a result the given exogenous change (eg. $P_x \downarrow$)

Step 2: Draw a hypothetical budget line that is tangent to old IC (IC_0), but has the new slope. → Call $E'(X', Y')$

Step 3: Identify SE from $X' - X_0^*$ and IE from $X_1^* - X'$.

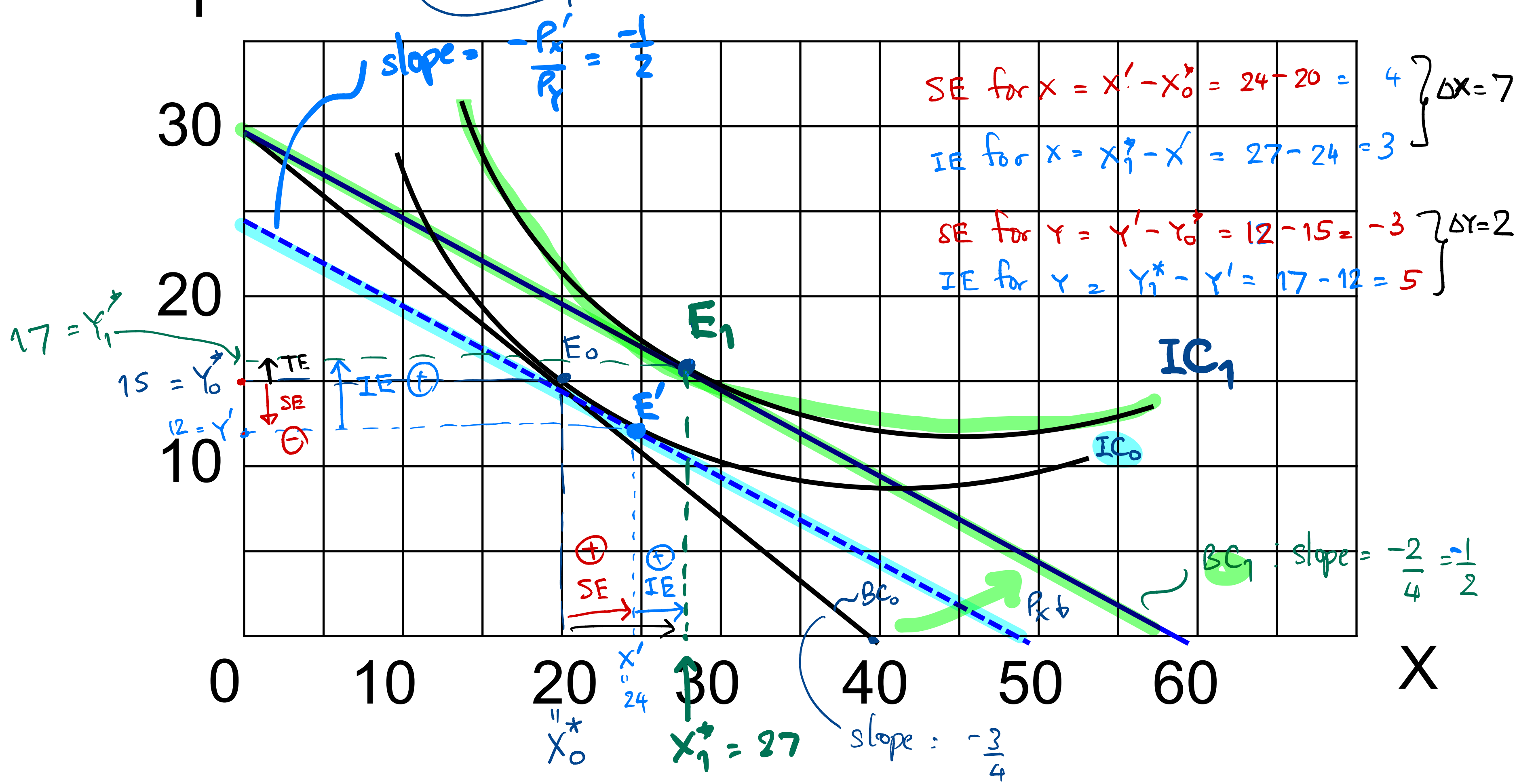
$\Delta X^* = X_1^* - X_0^* = 27 - 20 = 7$

4 SE, 3 IE

Graph

$X_{max} = \frac{120}{3} = 40$ $Y_{max} = \frac{120}{4} = 30$

- Suppose Px = \$3, P'x = \$2, Py = \$4, and B = 120.



Applications of Utility Maximization Problem

- Giffen good
- Subsidy
- Vouchers
- Work & leisure
- Intertemporal consumption

Application 1: Giffen Good

$\varepsilon_I = \frac{\%\Delta Qd}{\%\Delta I} < 0$

$I \uparrow \rightarrow Qd \downarrow$

- Giffen good is a special case of *inferior good*.
- It is a good at which quantity demanded decreases when its price is lower, which is not consistent with the law of demand.

$P \downarrow \rightarrow Qd \downarrow$

- This is possible when income effect (negative) is greater than substitution effect (positive).
- Example: Suppose there are two goods – potatoes (X) and meat (Y).

Giffen good

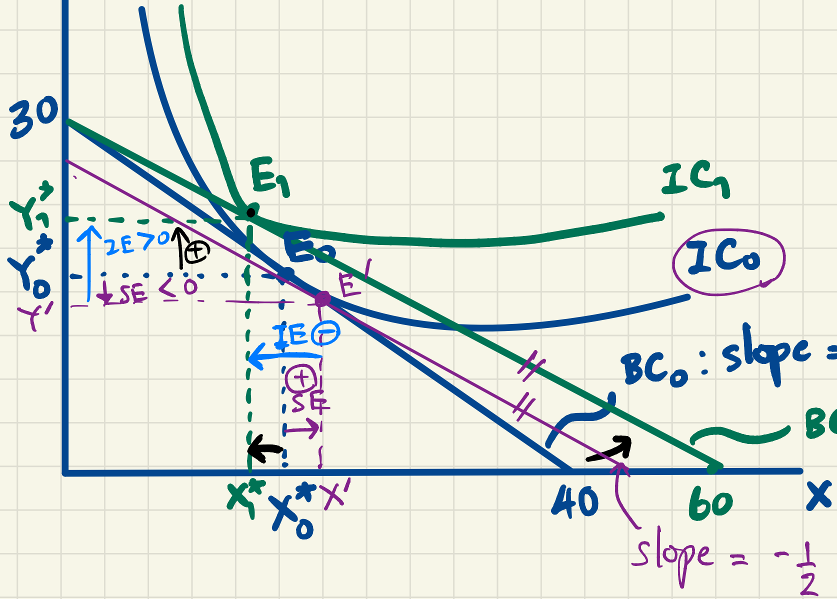
Let P_X=3, P_Y=4, and B = 120. If P_X decreases to 2, X* will decrease.

$Y_{max} = 30$

$X_{max} = 40$

$\frac{P_x}{P_y} = \frac{3}{4}$

"Giffen Good"



$P_x \uparrow$ $(P_x = 3 \rightarrow P_x' = 2)$

New $\dfrac{P_x'}{P_Y} = \dfrac{2}{4} = \dfrac{1}{2}$

$P_x \downarrow \rightarrow Q_x^* \downarrow$

SE for X $= X' - X_0^* > 0$

IE for X $= X_1^* - X' < 0$

TE for X $= \Delta X = X_1^* - X_0^* < 0$

$\underbrace{\text{TE for X}}_{\text{SE + IE}}$

SE for Y $= Y' - Y_0^* < 0$

IE for Y $= Y_1^* - Y' > 0$

TE for Y $=$ SE + IE $= \Delta Y = Y_1^* - Y_0^* > 0$

$\therefore$ As $P_x \downarrow$, x^* decreases because $\overset{\ominus}{\text{IE}} > \overset{\oplus}{\text{SE}}$.

Application 2: Per-Unit Subsidy

Assume x and y are normal goods.

Ex: Suppose the gov't gives a $2 per-unit subsidy for good X.

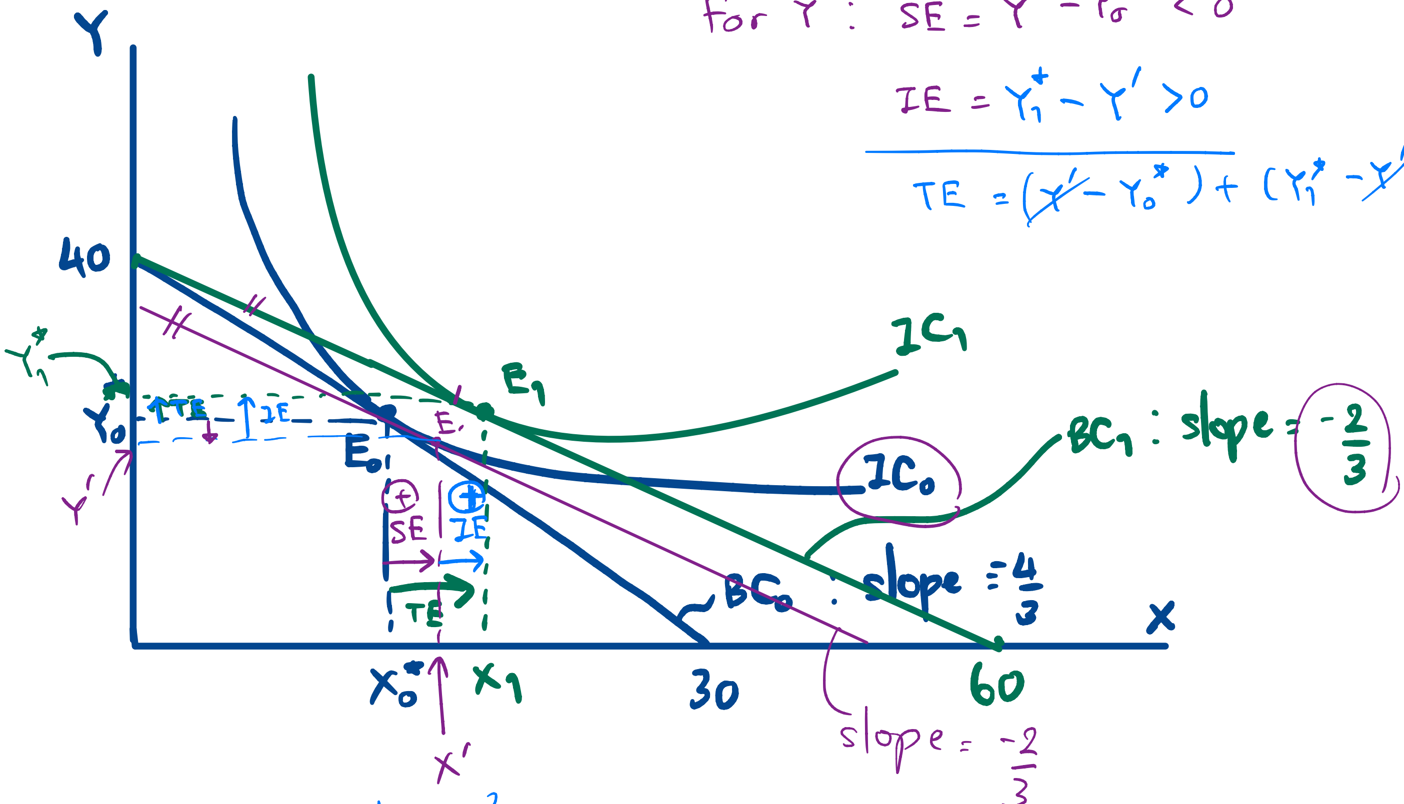
Let $P_x = 4$, $P_y = 3$, $B = 120$. $\Rightarrow$ $P_x' = 4 - s = 4 - 2 = \$2$

↳ same effect as price reduction.

For Y : $SE = Y' - Y_0^* < 0$

$IE = Y_1^* - Y' > 0$

$TE = (\cancel{Y'} - Y_0^*) + (Y_1^* - \cancel{Y'}) = Y_1^* - Y_0^* > 0$



$TE = SE + IE > 0$

Application 3: Voucher

"Food Stamp": can be spent on X only.

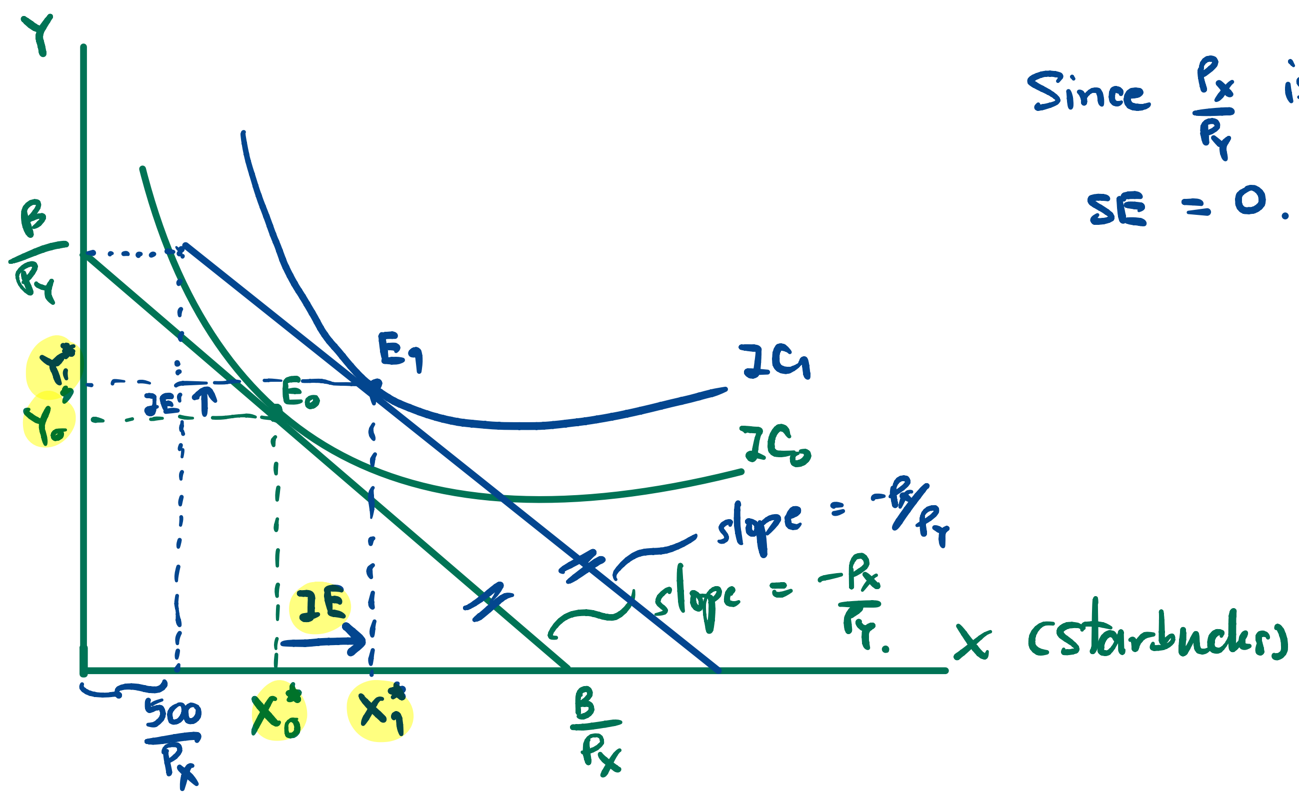
Ex: Suppose you receive a ฿500 starbucks coupon.

(X is starbucks coffee ; Y is other goods.)

$X = \frac{500}{P_X}$

* P_X & P_Y don't change.

$\Rightarrow \frac{P_X}{P_Y}$ is the same.



Since $\frac{P_X}{P_Y}$ is the same,

SE = 0.

Application 4: Work-Leisure Analysis

- Suppose consumer's utility depends on consumption of all goods (c) and leisure (ℓ). Constraint is time, say 24 hours.
- We can write utility function as U(c, *l*).

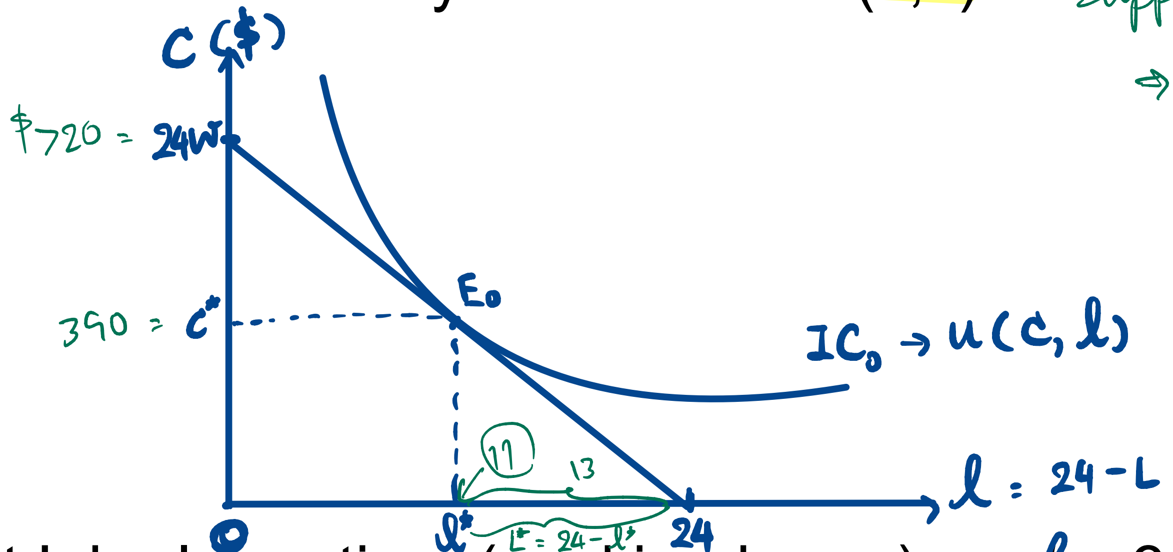
Suppose $w = \$30/\text{hr}$.

$\Rightarrow$ Max $c = 24 \times \$30 = \$720$.

Suppose $\ell^* = 11$.

$\hookrightarrow L^* = 24 - 11 = 13$.

$\hookrightarrow c^* = 13 \times \$30 = 390$



- Let L be labor time (working hours), so $\ell = 24 - L$. $\Rightarrow L = 24 - \ell$
  Suppose the wage rate per hour is *w*. The constraint can be written as:

total income $= wL \Rightarrow$ max income $= 24 \times w$.

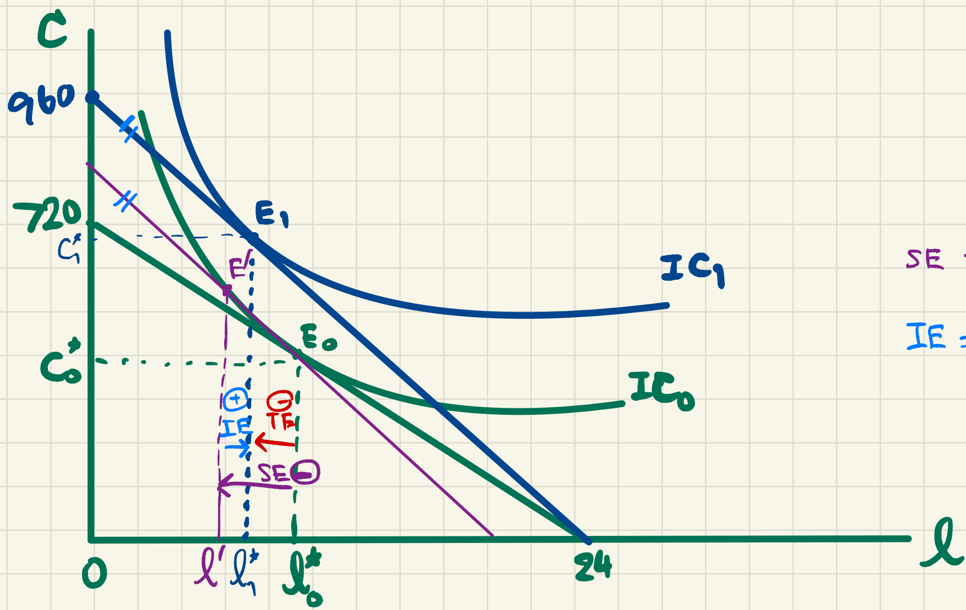
total expenditure $= P_c \cdot C$. Assume $P_c = \$1$. $\rightarrow$ TExp $= C$.

BC: $C = wL = w(24 - \ell) = 24w - w\ell$

① IE < SE : Suppose $w\uparrow$ from $w_0 = \$30/\text{hr.}$ to $w_1 = \$40/\text{hr.}$

↳ $C_{max} = \$720$
(24×30).

$24 \times \$40$
$= \$960$



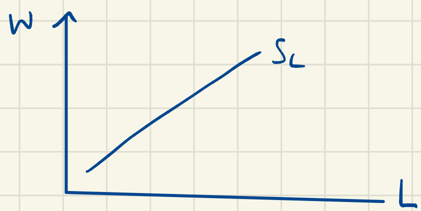
$SE = l' - l_0^* < 0$ $(w\uparrow \Rightarrow l\downarrow ; L\uparrow)$

$IE = l_1^* - l' > 0$ $(w\uparrow \rightarrow l\uparrow)$

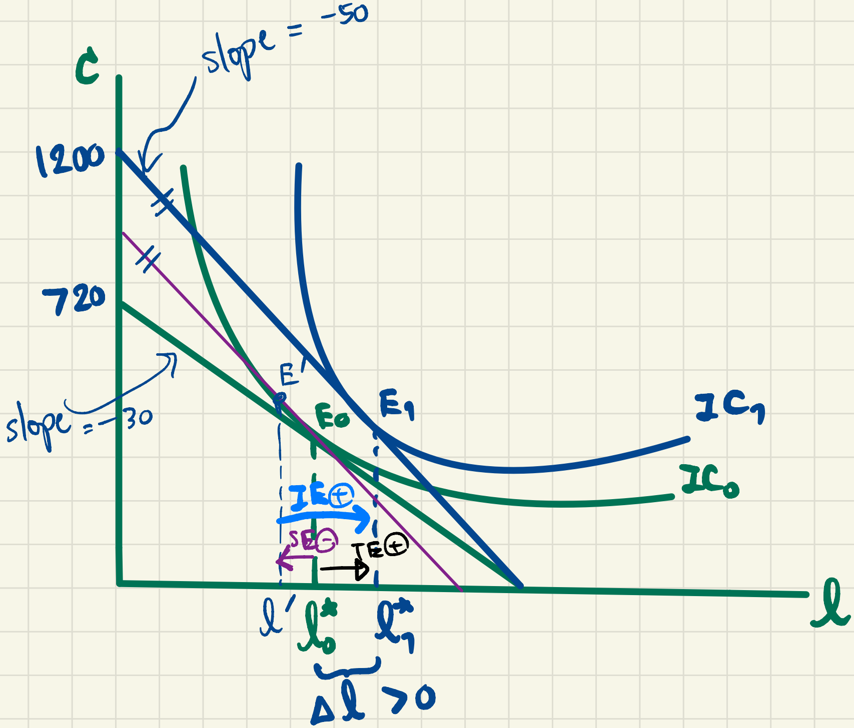
$|SE| > |IE|$
⊖ ⊕

$TE = (\cancel{l'} - l_0^*) + (l_1^* - \cancel{l'})$
$= l_1^* - l_0^* < 0$

∴ As wage increases, optimal leisure decreases (ie. optimal work hours↑)



② SE < IE : Suppose $w_0 = \$30/hr.$, $w_2 = \$50/hr.$).
↳ max $C = \$1200$ ($\$50 \times 24$).

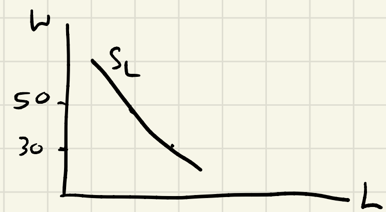


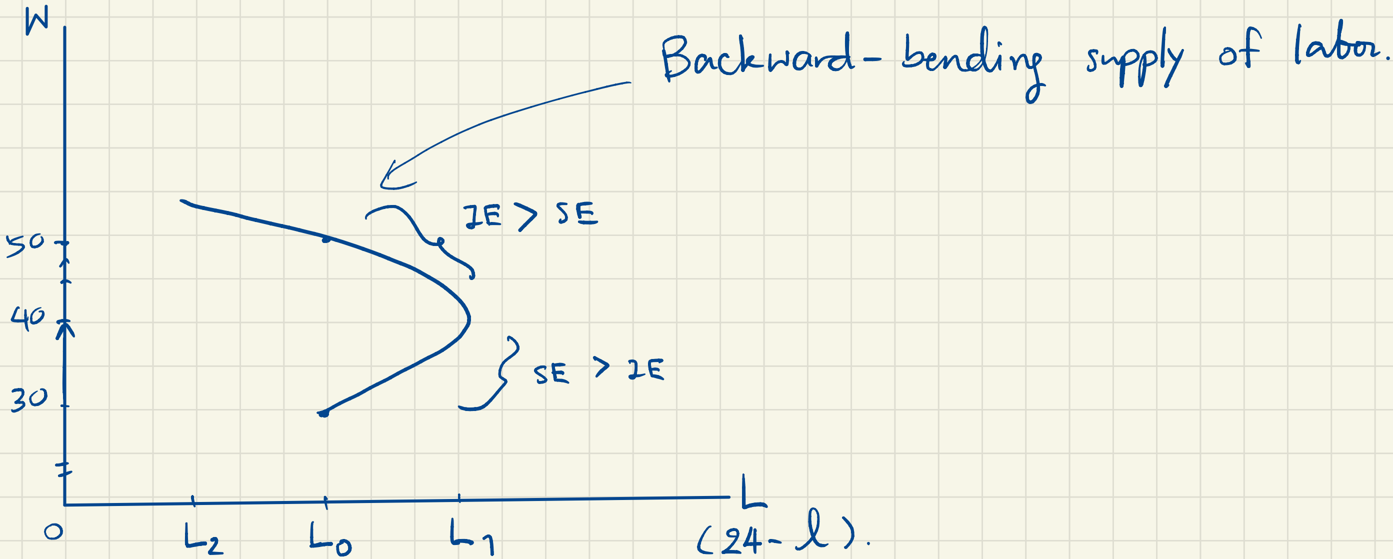
SE on $\ell = \ell' - \ell_0^* < 0$

IE on $\ell = \ell_1^* - \ell' > 0$

TE on $\ell =$ SE + IE
$= \ell_1^* - \ell_0^* > 0$

∴ As $w \uparrow$, $\ell^* \uparrow$ ($L^* \downarrow$)





Backward-bending supply of labor.
W
50
40
30
IE > SE
SE > IE
0
L2
L0
L1
L
(24- l).

Application 5: Intertemporal Consumption