Economics

# Elasticity of demand and supply

## Elasticity of demand

Elastity of Demand = $\dfrac{\text{relative (or percentage) change in quantity demanded}}{\text{relative (or percentage) change in determinants of demanded}}$

$\frac{\Delta Q}{\Delta P} \times \frac{1}{Q}$ ⟵⟶ Point elasticity

$\cancel{\dfrac{\frac{\Delta Q}{\frac{Q_1+Q_2}{2}}}{\frac{\Delta P}{\frac{P_1+P_2}{2}}}}$ ⟵⟶ mid-point elasticity

(1) Price Elasticity of Demand

$$\varepsilon^P = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

| P | Q |
|---|---|
| 5 | 20 |
| 10 | 15 |

$\Delta Q = 15 - 20 = -5$

$\Delta P = 10 - 5 = 5$

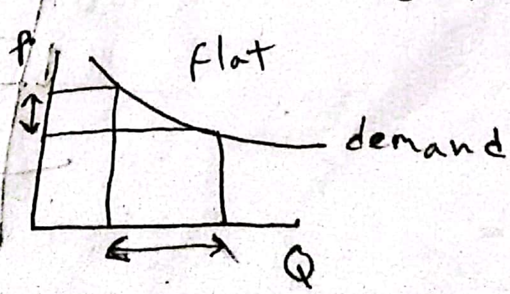
$$\varepsilon^P = \frac{-5}{5} \times \frac{5}{20} = -\frac{1}{4}$$

When we interprete, we take absolute value.

Five types

→ Relatively Elastic demand ($\varepsilon^P > 1$)

Pizza, Fast-food, luxarious commodities

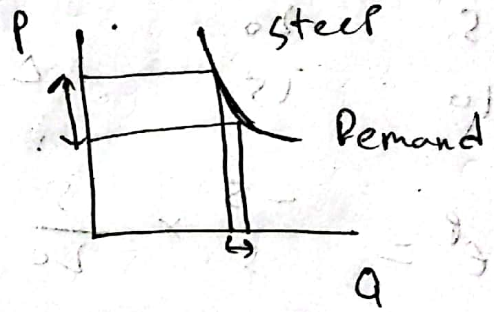



[Consumer তাই অনেক bergaining power থাকে]

→ Relatively Inelastic Demand ($\epsilon^p < 1$)

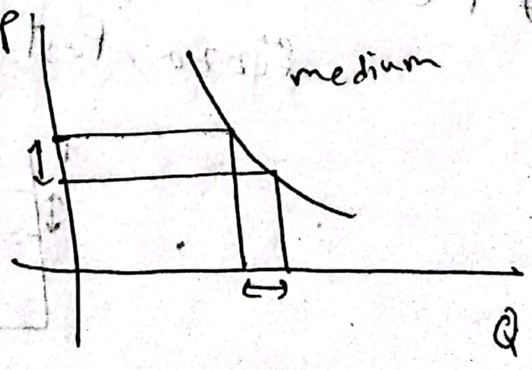
Rice, Oil, Pulses,
necessary commodities

[এ ধরনের market এ বিক্রেতার
bargaining power থাকে]



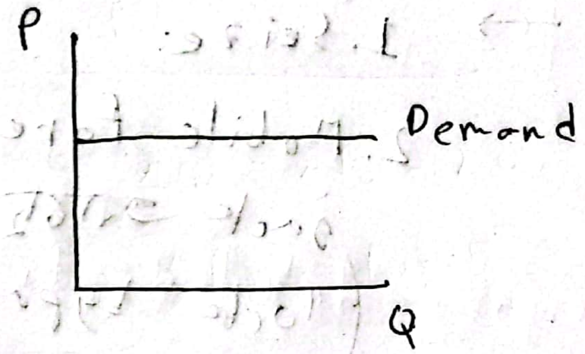

→ Unitary Elastic Demand ($\epsilon^p = 1$)

Recreation, cinema / movie



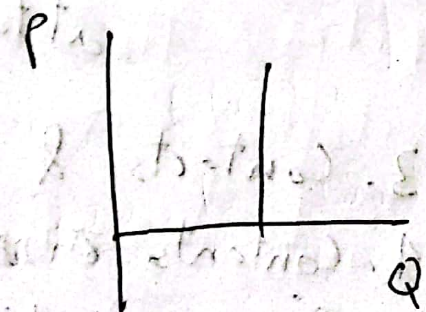
→ Perfectly Elastic Demand ($\varepsilon^P = \infty$)

Perfect substitute (exact substitute)
like coca-cola and pepsi, Loan
at low interest




→ Perfectly Inelastic Demand ($\epsilon^P = 0$)

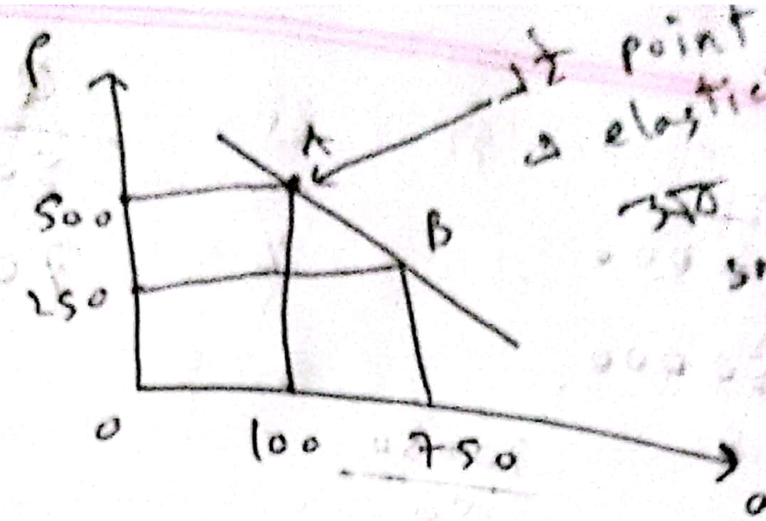
Salt, insulin, kemotherapy



| P | Q |
|---|---|
| 500 | 1000 |
| 250 | 750 |

Point, $$\epsilon_p = \frac{\frac{750-1000}{1000}}{\frac{250-500}{500}} = -13$$

mid-point, $$\epsilon_p = \frac{\frac{750-1000}{850/2}}{\frac{250-500}{750/2}} = -2.294$$




এই point এ elasticity হবে বেশি। অন্য point এ elasticity same না।

- Normally commodities গুলোর high price এর দিকে elastic, নীচের দিকে inelastic হয়। মধ্য বরাবর একক elasticity থাকে।

Point elasticity initial point এ হয়।
এবং mid-point initial আর final এর average এ হয়।

Income elasticity of demand

$$\epsilon = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta Y}{Y}}$$

| Y | Q |
| --- | --- |
| 70 000 | 50 |
| 50 000 | 70 |

$$\epsilon = \frac{\frac{70-50}{50}}{\frac{50\,000-70\,000}{70000}} = -1.4$$

| Y | Q |
| --- | --- |
| 10000 | 75 |
| 15 000 | 100 |

$$\epsilon = \frac{\frac{100-75}{75}}{\frac{15000-10000}{10000}} = 0.67$$

# Income elasticity negative means inferior goods. positive means normal good.

"Since $\epsilon_d^Y < 0$, the commodity is an inferior good. & since $|\epsilon_d^Y| > 1$, the demand for the commodity is relatively elastic with respect to income."

Cross Price Elasticity

$$\epsilon = \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_Y}{P_Y}}$$

| $P_Y$ | $Q_x$ |
| --- | --- |
| 70 | 50 |
| 50 | 70 |

$$\epsilon = \frac{\frac{70-50}{50}}{\frac{50-70}{70}} = -1.4$$

| $P_Y$ | $Q_X$ |
|---|---|
| 10 | 75 |
| 15 | 100 |

$$\epsilon = \frac{\frac{100-75}{75}}{\frac{15-10}{10}} = 0.67$$

# negative হলে complementary,
positive হলে substitute.

"Since $\epsilon_d^c < 0$, the commodities are complementary & since $|\epsilon_d^c > 1|$, the demand for the commodity X is relatively elastic with respect to the price of Y."

Scan-line Algorithm:

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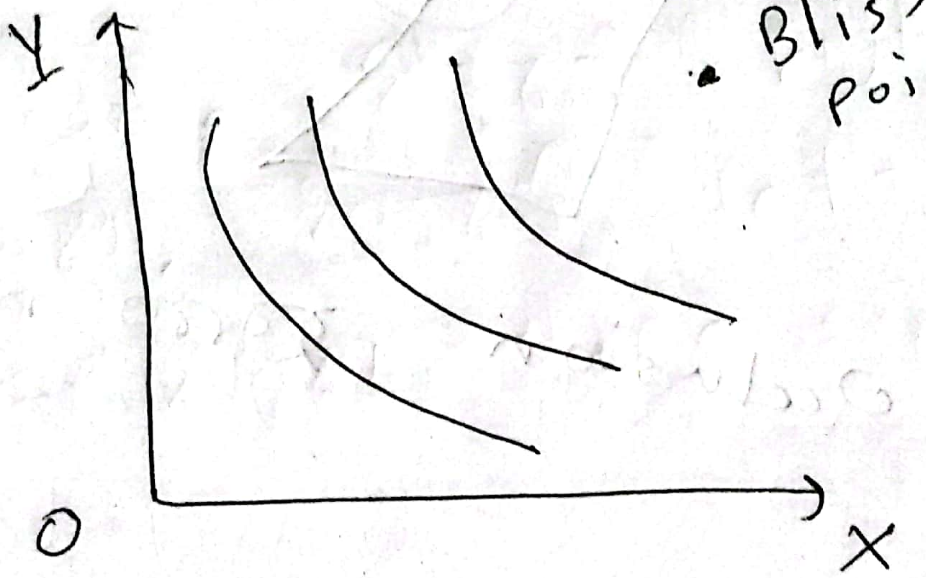
# Economics

Cost minimization + utility maximization

Limitations : price and income




• Bliss point → সন্তুষ্টির সর্বোচ্চ সীমা [এরপর আর ডাইনে যাবে না বা অসন্তুষ্টি তৈরি হতে পারে।]

Constraint / Limitation না থাকলে bliss point পর্যন্ত consume করা হত।

* Budget Constraint → income and price of commodity.

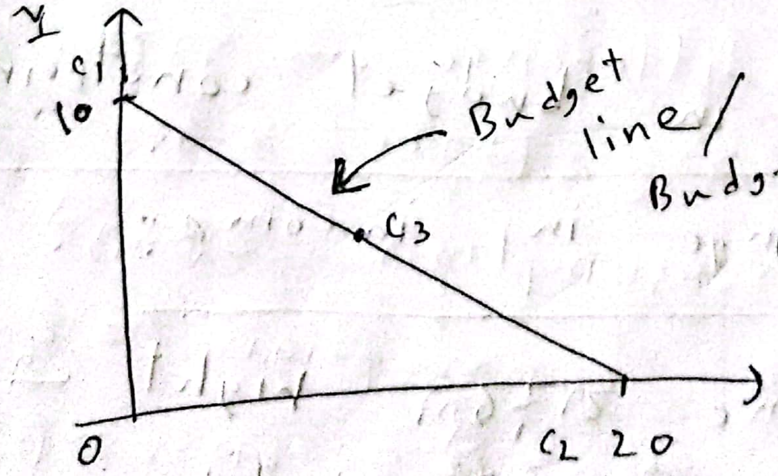
$M = 100, \quad P_X = 5, \quad P_Y = 10$

$C_1 = (0, 10)$

$C_2 = (20, 0)$

$C_3 = (10, 5)$

[যেই line এ total income exhausted হয়, তাকে budget line]




Budget constraint (এর বাইরে purchase করতে পারবে না।)

$P_X X + P_Y Y = M$

$P_Y Y = M - P_X X$

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

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

Relative price of two commodities

$\frac{M}{P_y}$ → Real income with respect to commodity Y.

<u>Change in budget constraint due to change in price:</u>

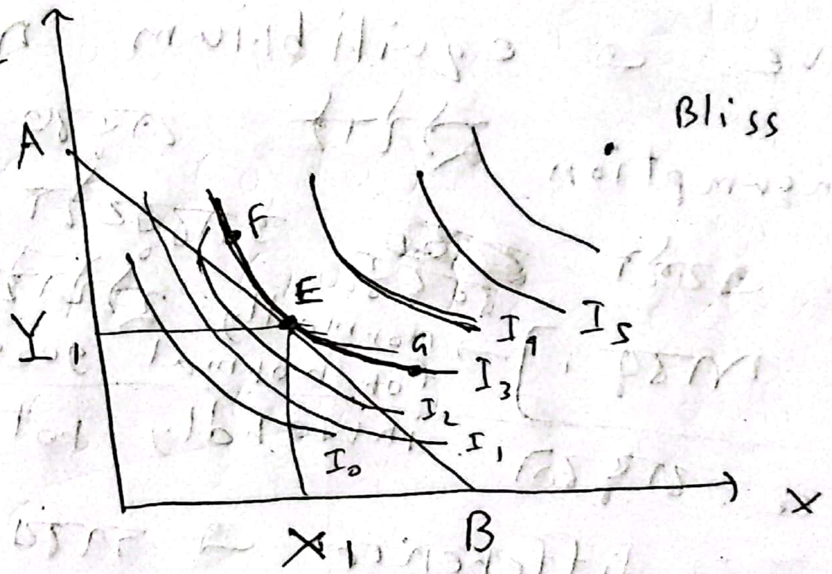
→ যেই commodity এর দাম বাড়বে, ঐ axis এ budget line inwardly rotate করবে, কমলে outwardly rotate করবে।

<u>Change in budget constraint due to change in income:</u>

→ Income বাড়লে right এ shift করবে, কমলে left এ shift করবে, slope same থাকবে।

ii) $\frac{P_x}{P_Y}$ = Relative price of x wrt Y

## Equilibrium :




Utility maximization

At E, $\boxed{MRS = \frac{P_x}{P_Y}}$

At F, $MRS > \frac{P_x}{P_Y}$ ; x ব্যবহারে benefit, relative cost এর বেশি, So, x এর consumption বাড়িয়ে rational being x এর right এ সরতে চাবে। (towards E)

At G, MRS < $\frac{P_x}{P_y}$. So, benefit হবে। Left এ যেতে হবে।

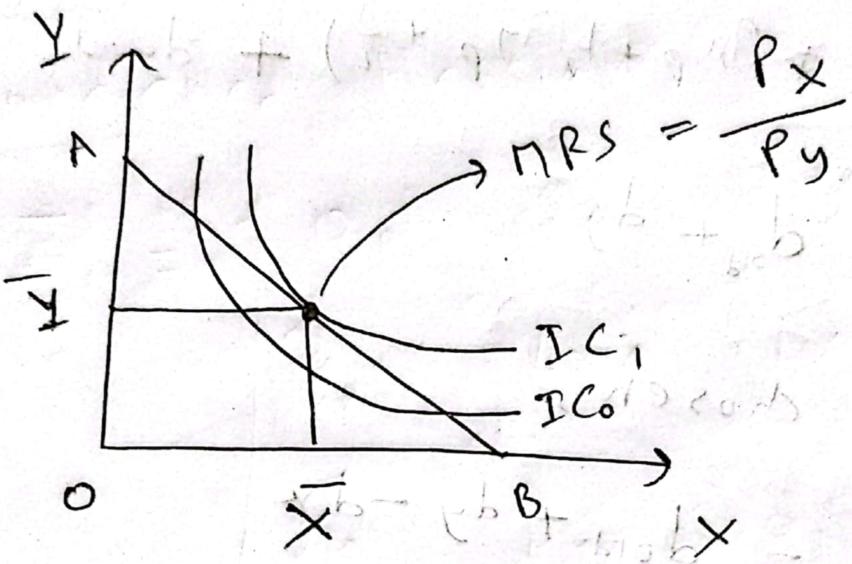
• Income বাড়লে, higher indifference curve এ equilibrium আসবে।
[Consumption দুইটাই বাড়তে পারে; আরেকটা কমবে একটা ~~বাড়বে~~ বাড়বে, দুইটাই ~~কমে~~ বাড়তে পারে।] → Normally for normal goods. কমলে inferior goods.

• price বাড়লে inwardly rotate করবে low indifference এ যাবে, price যদি price ~~বাড়ে~~ বাড়লে বাড়লে consumption অবশ্যই কমবে, তবু consumption অবশ্যই price কমলে consumption অবশ্যই ~~বাড়বে~~, অন্যটির consumption বাড়বে, ambiguous.

μ

# Economics

## Consumer's Equilibrium :




## Constraint Optimization:

Constraint না থাকলে free optimization Bliss এ চলে যেত।

objective function: $\max\ U = xy$

Constrained function: $2x+3y = 120$

To optimize, we have to construct the Lagrangian function,

As এটা 0, L actually U ই. So, L max হওয়া U max হবে।

$$L = xy + \lambda(120 - 2x - 3y) \quad \cdots \text{(i)}$$

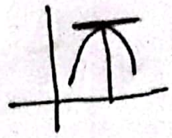
or,

$$L = xy - \lambda(2x + 3y - 120)$$

first order necessary condition requires that,

To get the critical point (max or min)

$$L_x = L_y = L_\lambda = 0$$



$$L_x = y - 2\lambda = 0$$

$$\therefore \lambda = \frac{y}{2} \quad \ldots \text{(ii)}$$

$$L_y = x - 3\lambda = 0$$

$$\therefore \lambda = \frac{x}{3} \quad \ldots \text{(iii)}$$

$$L_\lambda = 120 - 2x - 3y = 0 \quad \text{(iv)}$$

$$120 - 3\lambda \cdot 2 - 3 \cdot 2\lambda = 0$$

$$\therefore \lambda = 10$$

$$\therefore x = 30$$

$$y = 20$$

Second order sufficient condition requires to construct the bordered Hessian,

constraint function's $x$ derivative

$$|\bar{H}| = \begin{vmatrix} 0 & g_x & g_y \\ g_x & L_{xx} & L_{xy} \\ g_y & L_{yx} & L_{yy} \end{vmatrix}$$

Bordered Hessian → Bordered Hessian is constructed with all the second order direct and cross-partial derivatives with second order direct partial in principal diagonal and cross partials in off diagonal starting with 0 and bordered by coefficients of the constraint function.

$g(x, y) = 2x + 3y - 120$

$g_x = 2, \quad g_y = 3$

$L_{xx} = 0, \quad L_{yy} = 0$

$L_{xy} = 1, \quad L_{yx} = 1$

$$|\bar{H}| = \begin{vmatrix} 0 & 2 & 3 \\ 2 & 0 & 1 \\ 3 & 1 & 0 \end{vmatrix}$$

$$= 12$$

Decision rules of the bordered Hessian:

1. If determinant's value is positive, the objective function will be at maximum.
2. If determinant's value is negative, the objective function will be at minimum.

$f$ $\cancel{f}$

3. If 0, the test is inconclusive.
[Inflection point or saddle point]

(i) Find the optimum value of the objective function.

$$U = xy = 30 \times 20$$
$$= 600$$

(ii) Interpret the value of $\lambda$ (Lagrangian multiplier).

Here the value of lambda states that, if income is increased by \$1, The value of the objective function/utility will be increased by 10 units.

[Same will be for expenditure minimization problem]

objecttive
Min, $E = 2x + 3y$

Constrained, $xy = 600$

That is to get 600 utility, how to minimize expenditure

$$L = 2x + 3y + \lambda(600 - xy)$$

20/1/2

Graphics

algorithm.