

Bullets for Economics (1 to 20)

- Envelope theorem → Applied to Producer theory and auction theory.
- Roy's Identity :- → Applied to Marshallian demand functions.
- Shephard's Lemma → Relation b/w Cost/Expenditure function and demand function.
- $Y = a + bX$ is mathematical model
- $Y = a + bX + e$ is Econometric model
- National Income in 4 sector economy:
 $GDP = C + I + G + (X - M)$
- Exogenous variables shift the ^{relationship} ~~curve~~ of endogenous variables.
e.g. Income can shift the demand curve either inward or outward.
- ^{Improved Technology} can shift supply curve
- Range of numerical constant $(-\infty \text{ to } +\infty)$
- Value of parameters can change but within restrictions. Therefore it is also called parametric constant.
e.g. $0 \leq MPC \leq 1$, $0 \leq MPS \leq 1$
- T, C, G, T, M are all constant functions

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$$\rightarrow C = C_0 + MPC \cdot (Y)$$

C and Y are endogenous
 C_0 is exogenous

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$$\Rightarrow C = C_0 + MPC \cdot (Y)$$

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$$\rightarrow C = C_0 + MPC(Y)$$

C and Y are endogenous
C₀ is exogenous

MPC is parameter

$\rightarrow$ Logic (Art of reasoning) ^{Logic which means}

$\rightarrow$ Ingredients of Logic $\Rightarrow$ ① Proposition &
② Implication

Propositions = assertions that are true or false

Implication = Concatenates the proposition in logical reasoning using implication arrows ($\Rightarrow$)

$$x > 2 \Rightarrow x^2 > 4$$

$$xy = 0 \Rightarrow x = 0 \text{ or } y = 0$$

x is square $\Rightarrow$ x is rectangle.

Reverse is also true.

So

$$A \Leftrightarrow B \text{ (A is equivalent to B)}$$

MC cuts MR from below $\Leftrightarrow X_{max}$

$$\frac{2}{3} = 0.66666 \dots \text{ (Rational)}$$

$$\pi = 3.141592653 \dots \text{ (Irrational)}$$

$$A^c = \bar{A} = A' \text{ (complement)}$$

In Cartesian coordinate system,
order of coordinates is not
interchangeable $(x, y) \neq (y, x)$

Function = Power to act in a
specific way.

→ Plotting a function gives a locus of
points hence called mapping.

→ Function also converts values of
independent variable into that of
dependent variable called
transformation.

→ Function passes vertical line test
while relation does not.

→ A vertical line cuts a function
on one point only while it
cuts a relation on multiple points.

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$$158 + 169$$

$$\rightarrow R - C \Rightarrow PQ - C. \approx R - PQ.$$

Index curve: Govt. Revenue $\propto$ P.Tax & R.T.

- 158+169
- $\pi = R - C \Rightarrow PQ - C. \approx R - PQ.$
- Laffer curve: Govt. Revenue = $f(\text{Tax Rate})$
- Constant function: where the power of independent variable is 0
e.g., $y = f(x) = ax^0 = a.$
- Linear Functions - $y = a_0 + a_1x$ (at $n=1$)
 $a_1 > 0$ -ve slope
 $a_1 < 0$ -ve slope
- Quadratic Function:- $y = a_0 + a_1x + a_2x^2$ (at $n=2$)
 Quadratic function gives a parabola / curve with a single bump or wiggle.
 $a > 0$ open upward
 $a < 0$ open downward
- Condition for maximization of quadratic function / parabola:-
 If $a < 0$ then $f(x)$ has its maximum at $x = -b/2a$.
- Cubic Functions - (at $n=3$)
 $y = ax^3 + bx^2 + cx + d$
 Cubic function gives curve with two bumps / wiggles.

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→ Maximization condition for cubic function:-
 if $a > 0, b < 0, c > 0, d > 0$ then
 $3ac > b^2$.

→ Rational Function:- Ratio of two polynomial functions.

$$y(x) = \frac{a_0 + a_1x + a_2x^2 + \dots + a_nx^n}{a_0 + a_1x + a_2x^2 + \dots + a_mx^m}$$

→ Vertical asymptotes:- is at such value of x that turns y into infinity.

→ Horizontal asymptote:- is at such value of y that turns x into infinity.

→ Equation of rectangular hyperbola is $xy = k$
 If $k > 0$ then asymptotes in quadrants I and III
 If $k < 0$ then asymptotes in II & IV

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→ Non-Algebraic exponential function:-

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→ Non-Algebraic exponential function:-

Independent variable occurs as a root or power

e.g, $f(x) = Aa^x$ where $A > 0, a > 0$
If $x = 0$ it becomes constant function.

Exponential function can either have growth or decay.

→ Non-Algebraic natural exponential function:-

represented by using e in the base of the exponent.

e = exponential ($e = 2.718$)

It is also called magical number

e.g, $f(x) = e^x$

① $e^{-2} \approx 0.1353$ ② $e^{-1} \approx 0.3679$

③ $e^1 \approx 2.7183$ ④ $e^2 \approx 7.3891$

→ Non-Algebraic logarithmic function:-

"Exponents in disguise"

Out put is an exponent.

If $a^x = N$ is index/exponent form then
 $\log_a N = x$ is its logarithmic form

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→ Natural logarithmic function:-

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→ Natural Logarithmic function

A logarithm to the base e (2.71828) presented by $\ln$ instead $\log$.

→ The Cobb-Douglas Production Function:-

→ The Cobb-Douglas Production function.

$$Q_i = B_1 L_i^{B_2} K_i^{B_3}$$

Can be transformed into linear model by taking natural log of

$$\ln Q_i = \ln B_1 + B_2 \ln L_i + B_3 \ln K_i$$

→ The slopes coefficients can be interpreted as elasticities.

→ If $(B_2 + B_3) = 1$ we have constant return to scale.

→ If $(B_2 + B_3) > 1$ increasing return to scale.

→ If $(B_2 + B_3) < 1$ decreasing return to scale.

→ Inverse Function:-

"A reciprocal of a function"

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if f is $y = f(x)$ then

$$x = f^{-1}(y) \quad \text{or} \quad x = g(y)$$

→ Demand for sugar in United State by T.H. Schultz formula:-

$$x = 108.83 - 6.0294p + 0.164w - 0.6217t$$

→ Demand for beer in UK by R. Stone formula:-

$$x = 1.058 x_1^{0.136} x_2^{0.727} x_3^{0.914} x_4^{0.816}$$

→ Surfaces and Distances

→ $f(x, y, z)$ makes a point in graph

→ $g(x, y, z)$ make a surface in graph

→ The general equation for a plane in space is $ax + by + cz = d$

→ Examples of Equations:-

→ Demand $D = \alpha - \beta \cdot P$

→ Production $Q = A \cdot L^\alpha \cdot K^\beta$

→ ~~MR~~

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- Cost $C = w \cdot L + r \cdot K$
- Optimization Condition $MC = MR$
- Market Equilibrium $Q_d = Q_s$
- Identities = Mathematical equations that are true for all values of x .
e.g. $I = S + G + CA + Q + D$ and $T = R - C$
- Fiscal Deficit =
$$\text{Fiscal Deficit} = \text{Govt. Revenue} - \text{Govt. Expend.}$$

$$\text{Fiscal Deficit} = \text{Govt. Revenue} - \text{Govt. Expenditure} < 0$$

while (former is smaller than latter)
$$FD = GR - GE < 0$$
- Fiscal Surplus = $\text{Govt. Revenue} - \text{Govt. Expend.}$
while (former greater than latter)
$$FD = GR - GE > 0$$
- neither Fiscal nor surplus
" " = 0

Price of factor is PS = all Tax / PS = all Tax
Price of factor is D = all consumer / D = all consumer

Price of factor 2 is $\frac{\partial S}{\partial \text{Tax}}$ $\frac{\partial S}{\partial \text{Tax}}$ $\frac{\partial S}{\partial \text{Tax}}$
 Price of factor 1 is $\frac{\partial D}{\partial \text{Tax}}$ $\frac{\partial D}{\partial \text{Tax}}$ $\frac{\partial D}{\partial \text{Tax}}$

Behavioural equation:-

Specifies the manner in which dependent variable behaves in response to changes in independent variables

Human behaviour: $C = C_0 + \text{MPC} \cdot Y$

Non-human behaviour: $TC = FC + VC$
 $TC = a + b \cdot Q$

Conditional equation:-

Specifies a requirement to be satisfied. Two famous equilibrium conditions are $\Rightarrow Q_d = Q_s$, $S = I$ and $MC = MR$

Structural and Reduced form equations:-

$Y = C + I$ (i) $\rightarrow$ Structural (for eq.)
 $C = a + bY$ (ii) $\rightarrow$ Reduced eq.
 $Y = a + bY + I$
 $Y - bY = a + I$
 $Y(1-b) = a + I \Rightarrow Y = \frac{a + I}{1-b}$

$\rightarrow Q_d = Q_s = 0$ (Excess demand is equal to zero)

$\rightarrow$ Behavioural eq of Q_d & Q_s are

$Q_d = a - bP$
 $Q_s = -c + dP$

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Q = c + d + p

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Less Matrices

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→ If a Matrix appears with single row or column it is called vector.

single row → Row vector

single column → Column vector

If $m=1$ and $n>1$ it is row vector

If $m>1$ and $n=1$ it is column vector

→ Matrix cannot be divided ($\div$)

→ Matrix can only be solved in linear algebra

In matrices $A \cdot B \neq B \cdot A$

If Matrix ^(vector) and its Transpose are multiplied we get sum of squares of elements.

→ Transpose of adjugate = Adjoint.

Identity Matrix → It is an $n \times n$ with diagonal of 1's and all other elements 0's

Relation b/w Minors & Cofactors

$$|C_{ij}| = (-1)^{i+j} |M_{ij}|$$

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Economics

$$|G_j| = (-1)^{i+j} |M_{ij}|$$

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Economics

Lec # 10-20.

$$Q_d - Q_s = 0 \quad (\text{Excess demand is equal to zero})$$

$$Q_d = a - b \cdot P$$

$$Q_s = -c + d \cdot P$$

Equilibrium Price:-

$$P^* = \frac{a+c}{b+d}$$

Income can shift the demand curve to right side.

Improved Technology can shift the supply curve to the right side.

$$X = C + I_0 + G_0$$

$$C = a + bY$$

$$Y = a + bY + I_0 + G_0$$

$$Y - bY = a + I_0 + G_0$$

$$Y(1-b) = a + I_0 + G_0$$

$$Y = \frac{a + I_0 + G_0}{1-b}$$

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Imp rules for Transposition:-

- (a) $(A')' = A$
- (b) $(A+B)' = A' + B'$
- (c) $(\alpha A)' = \alpha A'$
- (d) $(AB)' = B'A'$

→ The Co-factor matrix is called as adjugate matrix.

Transpose of adjugate = adjoint.

Input Coefficient Matrix:-

Assumptions

- ① Each industry has homogenous output or jointly product in fixed proportion.
- ② Each industry has fixed input ratio for output.
- ③ CRS in each industry: k -fold inputs $\rightarrow k$ -fold output

⑤ CRS in each industry: k -fold $\uparrow$ inputs $\rightarrow k$

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$$\text{Input Coefficient} = \frac{\text{Input in PKR}}{\text{Output in PKR}}$$

→ Limits A point or level beyond
→ which something does not or may
not extend or pass.

→ Derivative is also the slope of a function

→ $y = \frac{dy}{dx}$ is Leibniz's notation of derivative

average revenue $\uparrow$ $\Rightarrow AR = \frac{TR}{Q} \rightarrow$ Total revenue

$$\Rightarrow TR = AR \times Q$$

$$\Rightarrow \frac{d(TR)}{dQ} = MR$$

average cost $\uparrow$ $\Rightarrow AC = \frac{TC}{Q} \rightarrow$ Total cost

$$\Rightarrow TC = AC \times Q$$

fold $\uparrow$ in output. $\Rightarrow \frac{d(-TC)}{dQ} = MC$

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