Econ201 Course Notes

mzx!

July 10, 2019

Contents

Chapter 1

Technology

1.1 Inputs and Outputs

Definition 1.1.1

Inputs to production are called $\boxed{\text{Factors of production}}$
Physical Capitals

- Land
- Labor
- Capital
  - Physical Capital
    - Tractor
    - Buildings
    - Computers
    - Machines of one sort
  - Financial Capital
    - Money
    - Stocks
    - Bonds
- Raw Materials

1.2 Technology Constraints (Single Input)

Definition 1.2.1

Production Set All combinations of inputs and outputs that are technologically feasible

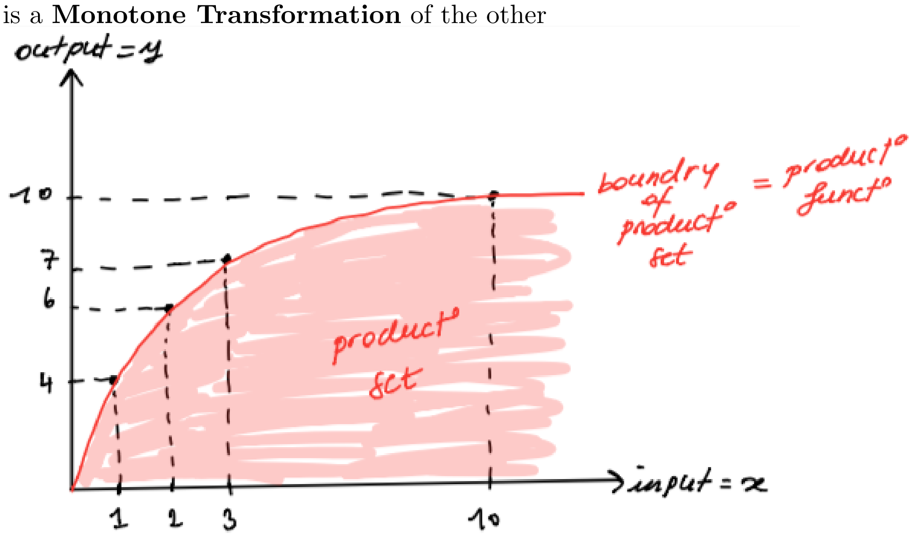
Definition 1.2.2

Production Function A function describinig the **Boundary of Production Set**

$$y = f(x)$$

x = amount of inputs
y = amount of output

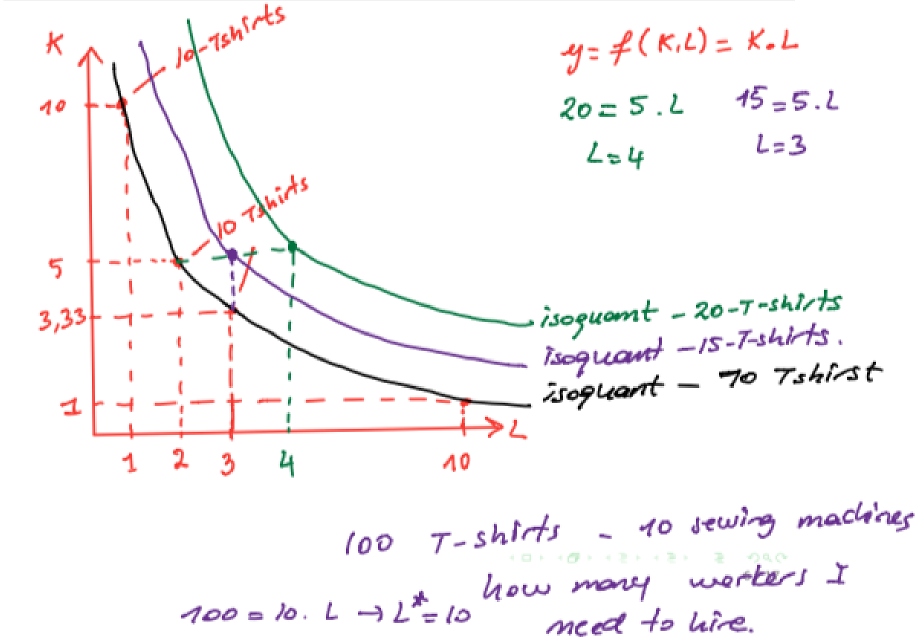
Two production functions do not represent the same technology even if one is a **Monotone Transformation** of the other



1.3 Technology Constraints (Multiple Inputs)

We consider the case of **Two Inputs**, the production function $f(x_1, x_2)$ would measure the maximum amount of output y that we could get if we had x_1 units of input 1. and x_2 units of input 2

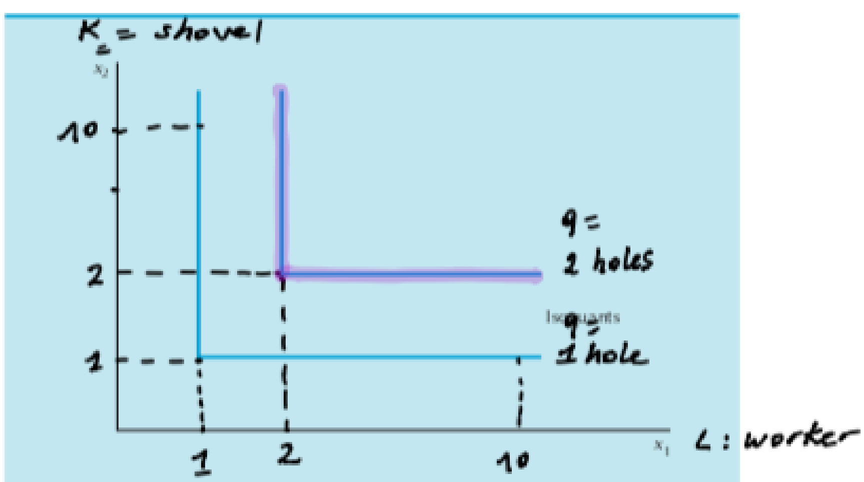
Isoquant In the two-input case, there is a convenient way to depict production relations known as the isoquant



1.4 Example of Technology

1.4.1 Fixed Proportion

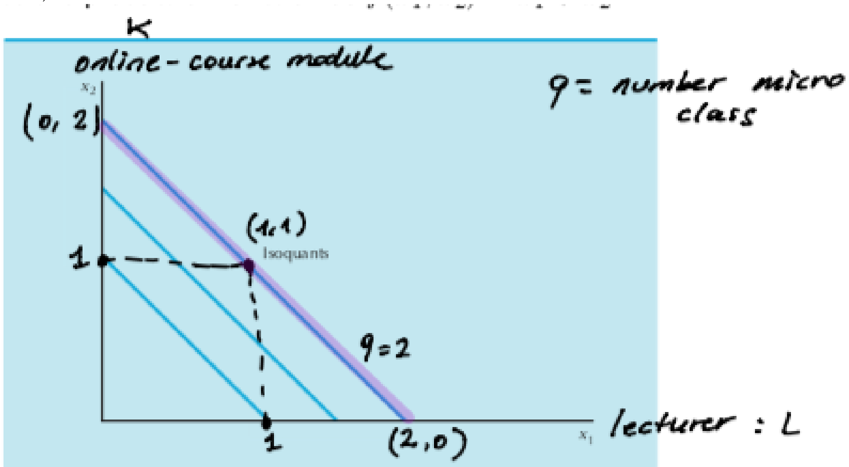
$f(x_1, x_2) = min(x_1, x_2)$



Fixed proportions. Isoquants for the case of fixed proportions.

1.4.2 Perfect Substitutes

$f(x_1, x_2) = x_1 + x_2$



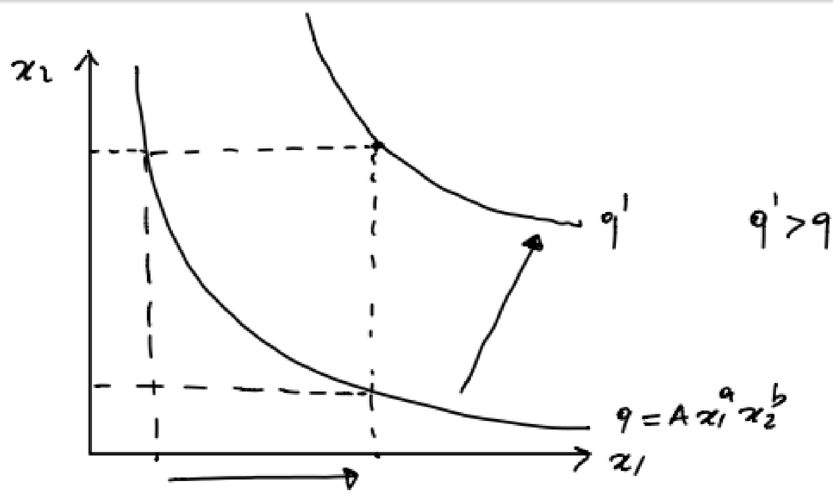
Perfect substitutes. Isoquants for the case of perfect substitutes.

1.4.3 Cobb Douglas

$q = f(x_1, x_2) = Ax_1^a x_2^b$

A: Scale of Production (how much output we would get if we sued on unit of each input)

a.b: The amount of output responds to changes in the inputs



1.5 Properties of Technology

Definition 1.5.1

- Technology is monotonic
- Technology is convex

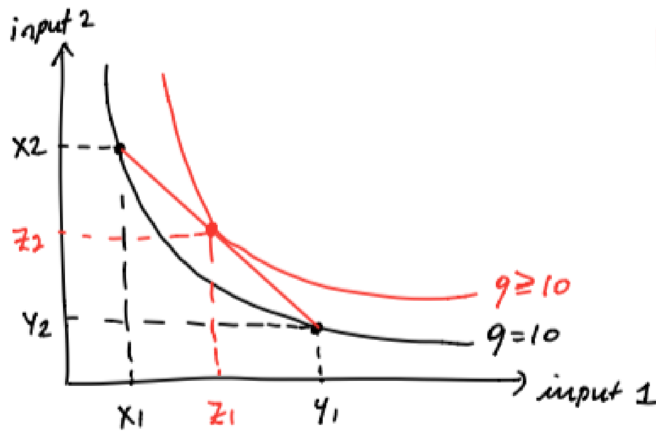
Monotonic If you increase the amount of at least one of the inputs, it should be possible to produce at least as much output as you were producing originally

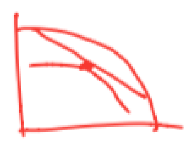
Convex If you have two ways to produce y units of output, (x_1, x_2) and (z_1, z_2), then their weighted average will produce at least y units of output

10 T-shirt → 5 W and 5 machine.

↓

At <u>least</u> 10 T-sh: 8 W and 5 machi





1.6 Marginal Product

Definition 1.6.1

Marginal Product of Factor 1

$$MP_1(x_1, x_2) = \frac{\Delta y}{\Delta x_1} = \frac{f(x_1 + \Delta x_1, x_2) - f(x_1, x_2)}{\Delta x_1}$$

or

$$MP_1 = \frac{\partial y(x_1, x_2)}{\partial x_1}$$

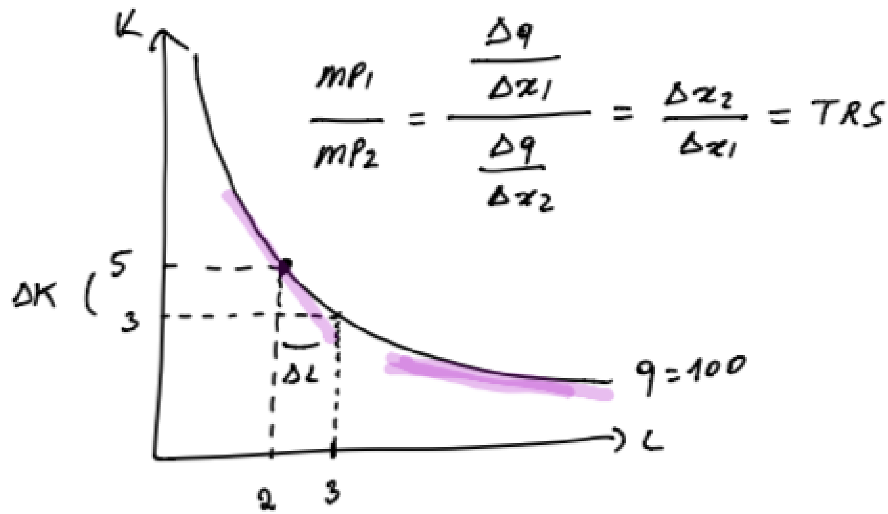
∂: Partial Derivative. If ∂x_1, then treat x_2 as constant value
$f(x_1, x_2) = 2x_1x_2$,then we have $MP_1 = \frac{\partial y(x_1,x_2)}{\partial x_1} = 2x_2$

1.7 Technical Rate of Substitution

Suppose that we are operating at $f(x_1, x_2) = y$, at some input level x_1, x_2 and output level y. We want to adjust $x_1, x_@$ (ie,add x_1, less x_2), to get the same output level y.

Definition 1.7.1

$$TRS(x_1, x_2) = \frac{\Delta x_2}{\Delta x_1} = \frac{-MP_1(x_1, x_2)}{MP_2(x_1, x_2)}$$



1.8 Diminishing Marginal Product

Law of Diminishing Marginal Product As long as we have a monotonic technology, we know that the total output will go up **As we increase the amount of factor 1**
But we expect that it will go up at a **Decreasing Level**

1.9 Long Run and Short Run

Definition 1.9.1

Short Run **Some Factors** are fixed
Long Run **All factors** can be varying

1.10 Returns to scale

Scale the amount of all inputs up by some constant factor
This is called the case of **constant returns to scales**

Definition 1.10.1

constant return to scale

$$tf(x_1, x_2) = f(tx_1, tx_2)$$

for some constant t

Definition 1.10.2

Increasing return to scale

$$tf(x_1, x_2) < f(tx_1, tx_2)$$

for some constant t

Definition 1.10.3

Decreasing return to scale

$$tf(x_1, x_2) > f(tx_1, tx_2)$$

for some constant t

Generalization $f(x_1, x_2) = Ax_1^a x_2^b$, then

- $a + b = 1 \to$ constant R.S
- $a + b > 1 \to$ Increasing R.S
- $a + b < 1 \to$ Decreasing R.S

$y = f(x_1,x_2) = 2 \cdot x_1^{0,3} \cdot x_2^{0,5}$

$f(tx_1, tx_2) = 2(tx_1)^{0,3} \cdot (tx_2)^{0,5}$

$= 2 \cdot t^{0,3} x_1^{0,3} \cdot t^{0,5} \cdot x_2^{0,5}$

$= t^{0,8} \cdot \underbrace{2 \cdot x_1^{0,3} \cdot x_2^{0,5}}_{f(x_1,x_2)=y} = t^{0,8} \cdot y$

$t^1 > t^{0,8}$

If $t=2 \longrightarrow 2^1 = 2 > 2^{0,8} = 1.74$

I doubled the input, output increased by 1.74 times.

$y = f(x_1,x_2) = \min\{x_1, x_2\}$

$f(2x_1, 2x_2) = \min\{2x_1, 2x_2\}$

$= 2 \cdot \underbrace{\min\{x_1,x_2\}}_{f(x_1,x_2)=y} = 2 \cdot y.$

CST Returns to Scale.

Chapter 2

Profit Maximization

2.1 Profits

Definition 2.1.1

Profits are defined as **Revenues** minus **Cost**

$$\pi = p \times q - w_1 x_1 - w_2 x_2$$

- p = price of output
- q = output
- w_1 = price of input 1
- w_2 = price of input 2

$$\pi = \sum_{i=1}^{n} p_i y_i - \sum_{i=1}^{m} w_i x_i$$

$$\pi = \underbrace{p_1 \cdot y_1 + p_2 \cdot y_2 + \cdots + p_n \cdot y_n}_{\text{Total Revenue}} - \underbrace{(w_1 \cdot x_1 + w_2 x_2 + \cdots + w_m \cdot x_m)}_{\text{Total Cost}}$$

2 / 12

$$\pi = \sum_{i=1}^{m} p_i \cdot y_i - \sum_{i=1}^{m} w_i \cdot x_i$$

↳ 2 inputs → 1 output.

x_1 x_2 — y

w_1 w_2 — p

$$\rightarrow \pi = p \cdot y - (w_1 x_1 + w_2 x_2)$$

$$\boxed{\pi = py - w_1 x_1 - w_2 x_2}$$

T-shirt producer produces 100 T-shirt

Selling price at the market = \$20 / per T-shirt.

Earn: 100 × 20 = \$2000 = Revenue

Cost of production = \$10 / each

Cost: 100 × 10 = \$1000 = Cost.

Profit = π = Revenu − Cost

3 / 12

= 2000 − 1000 = \$1000

2.2 Short-Run Profit Maximization

Definition 2.2.1

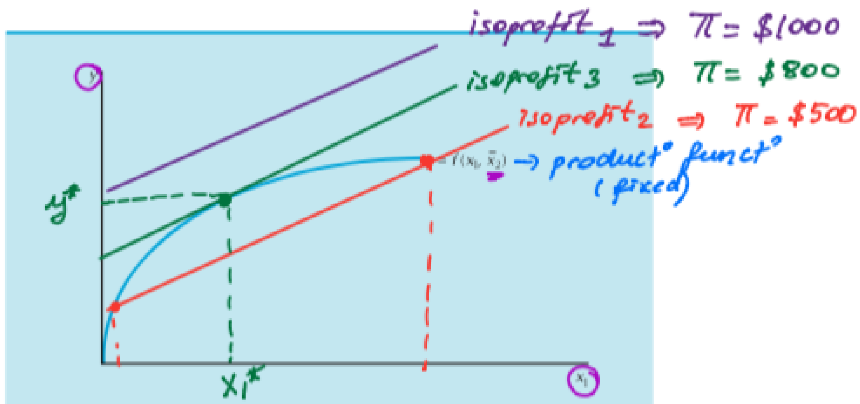
$$pMP_1(x_1^*, x_2) = w_1$$

- p = Output Price
- MP_1 = Marginal Product of factor 1
- x_1^* = the profit_maximizing choice for factor 1
- w_1 = the price of factor 1

Recall

Generalized

- $pMP_1 > w_1 \rightarrow$ Should Increase x_1
- $pMP_1 = w_1 \rightarrow$ Keep x_1
- $pMP_1 < w_1 \rightarrow$ Should Decrease x_1



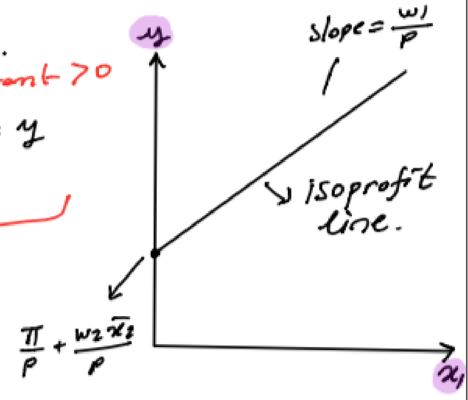
Production function. This is a possible shape for a short-run production function.

$$\pi = p\cdot y - w_1 x_1 - w_2 \bar{x}_2$$

$$\pi + w_1 x_1 + w_2 \bar{x}_2 = p\cdot y.$$

$$\underbrace{\underbrace{\frac{\pi}{p}}_{\text{constant} > 0} + \underbrace{\frac{w_2\cdot \bar{x}_2}{p}}_{\text{constant}} + \overbrace{\frac{w_1}{p}}^{\text{constant} > 0}\cdot x_1 = y}_{\text{linear funct}^{\circ}}$$

$$ax + b = y$$



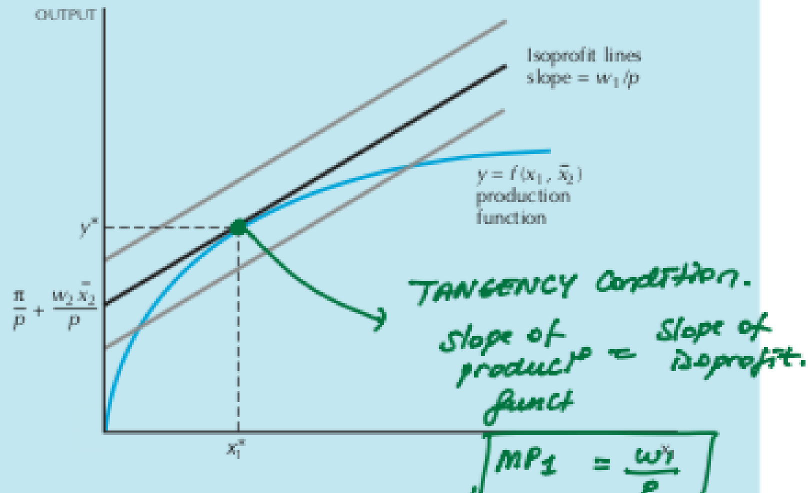
2.2.1 Tangency Condition

The slope of the production function should equal the slope the isoprofit line

$$MP_1 = \frac{w_1}{p}$$

or

$$pMP_1 = w_1$$



Profit maximization. The firm chooses the input and output combination that lies on the highest isoprofit line. In this case the profit-maximizing point is (x_1^*, y^*).

2.3 Long-Run Profit Maximization

In the Long-Run, we are free to choose $\boxed{\text{Level of All Inputs}}$

Definition 2.3.1

Long-Run Profit-Maximization

$$\max_{x_1, x_2} pf(x_1, x_2) - w_1x_1 - w_2x_2$$

Generalize

- $pMP_1(x_1^*, x_2^*) = w_1$
- $pMP_2(x_1^*, x_2^*) = w_2$

In Long Run Additional Revenue from x_i = Additional Cost of x_i

2.4 Inverse Factor Demand Curves

Factor Demand Curves measures the relationship between the $\boxed{\text{price of a factor}}$ and the $\boxed{\text{profit-maximizing choice}}$ of that factor