



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

## **Lecture 5**

# **Factor-Product Relationship Determination of Optimum Input and Output**



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

# Determination of Optimum Input and Output

## **Law of diminishing returns and the three stages of production**

The law of diminishing returns describes the relationship between output and the variable input when other inputs are held constant.



Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities...

# Definition:

• If increasing amounts of one input are added to a production process while all other inputs are held constant, the amount of output added per unit of variable input will eventually decrease. It is also known as law of diminishing productivity or the law of variable proportions. Application of the law of diminishing returns to the production concept can result in a production function of classical type. It displays increasing marginal returns first and then decreasing marginal returns.



Centurion  
UNIVERSITY  
*Shaping Lives...  
Empowering Communities...*

# Three stages of production

The classical production function can be divided into three regions or stages, each being important from the standpoint of efficient resources use.

**Stage-I** occurs when marginal physical product (MPP)  $>$  average physical product (APP). APP is increasing throughout this stage, indicating that the average rate at which X is transformed into Y, increases until APP reaches its maximum at the end of Stage-I.



Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities...

## Stage-II

occurs when MPP is decreasing and is less than APP but greater than zero. The physical efficiency of the variable input reaches a peak at the beginning of Stage-II. On the other hand physical efficiency of fixed input is greatest at the end of Stage-II. This is because the number of fixed input is constant and therefore the output/unit of fixed input must be the largest when the total output from the production process is maximum.



**Centurion**  
**UNIVERSITY**  
*Shaping Lives...  
Empowering Communities...*

## Stage-III

occurs when MPP is negative. Stage III occurs when excessive quantities of variable input are combined with the fixed input, so much, that total physical product (TPP) begins to decrease.



Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities...

# Relationship between TPP & MPP

Since MPP is a measure of rate of change, therefore

- (i) when TPP is increasing, MPP will be +ve,
- (ii) when TPP is constant MPP will be zero,
- (iii) when TPP decreases, MPP will be -ve.



**Centurion**  
**UNIVERSITY**  
*Shaping Lives...  
Empowering Communities...*

- 2. So long MPP moves upward, TPP increases at an increasing rate.
- 3. When MPP remains constant, TPP increases at a constant rate.
- 4. When MPP starts declining, TPP increases at a decreasing rate.
- 5. When MPP is zero, TPP will be at maximum.





Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities...

# Relationship between MPP & APP

- 1. When MPP is increasing, APP is also increasing. So long as MPP is above APP, the APP keeps increasing.
- 2. When MPP curve goes below APP curve, APP starts declining, that is, when AP is decreasing the MP is always less than APP.
- 3. When  $MP = AP$ , AP will be at maximum. Here MP curve must intersect AP curve from above at its highest point.
- So when  $MP > AP$   $AP \uparrow$
- $MP < AP$   $AP \downarrow$
- $MP = AP$  AP is at maximum.



Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities...

# Elasticity of production:

- The elasticity of production is a concept that measures the degree of responsiveness between output and input. It is independent of the units of measurement.
- $E = \frac{\% \text{ change in output}}{\% \text{ change in input}}$