

## Hand-out week 5

- This week:** 2. Theory of the Firm - general remarks
- 2.1. Technology
    - production function, isoquants, production set
    - marginal product, average product, MRTS
    - returns to scale
  - 2.2. Cost minimization
    - conditional factor demands, cost function
    - returns to scale and the cost function
    - long run vs. short run
  - 2.3. Profit maximization
    - unconditional factor demands
    - profit function

**Readings:** Varian chapters 18, 19, and 20.

### Practice Problems:

1. Let output  $Y$  be produced from a single input  $K$  according to some production function  $Y = f(K)$ . Conceptually, what is the marginal product, which question does it answer? How would you calculate it mathematically? Give three examples of a production function  $f(K)$  - one exhibiting diminishing marginal product, a second one for increasing MP, and a third for constant MP - and graph them. What about returns to scale in each case?
2. Let  $f(K, L) = K^{2/3} L^{2/3}$ . Depict this production technology by sketching the isoquants for 1, 2, and 3 units of output. Does it exhibit increasing, decreasing, or constant returns to scale - can you see this from your diagram? Calculate the marginal products - are they diminishing? Calculate the MRTS - how does it change along the isoquants? Can a production function have diminishing marginal product in each factor and still exhibit increasing returns to scale?
3. What is the idea behind returns to scale? How does it diver from the MP(s)? Give examples of companies or sectors which exhibit increasing/decreasing/constant returns to scale.
4. Compute the conditional factor demands and the cost function of a company with production function  $f(K, L) = K^a L^a$ . Calculate the marginal cost. How does it change as the parameter  $a$  changes? How does this relate to returns to scale?
5. Now let the company be able to choose its output. Compute the unconditional factor demands and the output supply function. Does this work for any  $a$ ? Explain what goes wrong for  $a > 0.5$  and what happens when  $a = 0.5$ .