

# Economics 101A

## (Lecture 14)

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## Outline

1. Time Inconsistency II
2. Health Club Attendance
3. Production: Introduction
4. Production Function
5. Returns to Scale
6. Two-step Cost Minimization

# 1 Time Inconsistency II

- Alternative specification (Akerlof, 1991; Laibson, 1997; O'Donoghue and Rabin, 1999)

- Utility at time  $t$  is  $u(c_t, c_{t+1}, c_{t+2})$  :

$$u(c_t) + \frac{\beta}{1 + \delta} u(c_{t+1}) + \frac{\beta}{(1 + \delta)^2} u(c_{t+2}) + \dots$$

- Discount factor is

$$1, \frac{\beta}{1 + \delta}, \frac{\beta}{(1 + \delta)^2}, \frac{\beta}{(1 + \delta)^3}, \dots$$

instead of

$$1, \frac{1}{1 + \delta}, \frac{1}{(1 + \delta)^2}, \frac{1}{(1 + \delta)^3}, \dots$$

- What is the difference?
- *Immediate gratification*:  $\beta < 1$

- Back to our problem: **Period 1.**

- Maximization problem:

$$\begin{aligned} \max U(c_1) + \frac{\beta}{1 + \delta} EU(c_2) \\ \text{s.t. } c_1 + \frac{1}{1 + r} c_2 \leq M'_1 + \frac{1}{1 + r} M_2 \end{aligned}$$

- First order conditions:

- Ratio of f.o.c.s:

$$\frac{U'(c_1^*)}{EU'(c_2^*)} = \beta \frac{1 + r}{1 + \delta}$$

- Now, **period 0** with commitment.

- Maximization problem:

$$\begin{aligned} \max & U(c_0) + \frac{\beta}{1 + \delta} U(c_1) + \frac{\beta}{(1 + \delta)^2} EU(c_2) \\ \text{s.t.} & c_1 + \frac{1}{1 + r} c_2 \leq M'_1 + \frac{1}{1 + r} M_2 \end{aligned}$$

- First order conditions:

- Ratio of f.o.c.s:

$$\frac{U'(c_1^{*,c})}{EU'(c_2^{*,c})} = \frac{1 + r}{1 + \delta}$$

- The two conditions differ!

- Time inconsistency:  $c_1^{*,c} < c_1^*$  and  $c_2^{*,c} > c_2^*$

- The agent allows him/herself too much immediate consumption and saves too little

- Ok, we agree. but should we study this as economists?
  
- YES!
  - One trillion dollars in credit card debt;
  - Most debt is in teaser rates;
  - Two thirds of Americans are overweight or obese;
  - \$10bn health-club industry
  
- Is this testable?
  - In the laboratory?
  - In the field?

## 2 Health Club Attendance

- Health club industry study (DellaVigna and Malmendier, 2002)
- 3 health clubs
- Data on attendance from swiping cards
- Choice of contracts:
  - Monthly contract with average price of \$75
  - 10-visit pass for \$100
- Consider users that choose monthly contract. Attendance?

- Attend on average 4.8 times per *month*
- Pay on average over \$17
- Average delay of 2.2 months (\$185) between last attendance and contract termination
- Over membership, user could have saved \$700 by paying per visit

- Health club attendance:

- immediate cost  $c$

- delayed benefit  $b$

- At sign-up (attend tomorrow):

$$NB^t = -\frac{\beta}{1+\delta}c + \frac{\beta}{(1+\delta)^2}b$$

- Plan to attend if  $NB^t > 0$

$$c < \frac{1}{(1+\delta)}b$$

- Once moment to attend comes:

$$NB = -c + \frac{\beta}{(1 + \delta)}b$$

- Attend if  $NB > 0$

$$c < \frac{\beta}{(1 + \delta)}b$$

- Interpretations?
- Users are buying a commitment device
- User underestimate their future self-control problems:
  - They overestimate future attendance
  - They delay cancellation

### 3 Production: Introduction

- Second half of the economy. **Production**
  
- Example. Ford and the Minivan (Petrin, 2002):
  - Ford had idea: "Mini/Max" (early '70s)
  - Did Ford produce it?
  - No!
  - Ford was worried of cannibalizing station wagon sector
  - Chrysler introduces Dodge Caravan (1984)
  - Chrysler: \$1.5bn profits (by 1987)!

- Why need separate treatment?
- Perhaps firms maximize utility...
- ...we can be more precise:
  - Competition
  - Institutional structure

## 4 Production Function

- Nicholson, Ch. 7, pp. 183–190; 195–200 [OLD: Ch. 11, pp. 268–275; 280–285]
- Production function:  $y = f(\mathbf{z})$ . Function  $f : R_+^n \rightarrow R_+$
- Inputs  $\mathbf{z} = (z_1, z_2, \dots, z_n)$ : labor, capital, land, human capital
- Output  $y$ : Minivan, Intel Pentium III, mangoes (Philippines)
- Properties of  $f$ :
  - no free lunches:  $f(0) = 0$
  - positive marginal productivity:  $f'_i(\mathbf{z}) > 0$
  - decreasing marginal productivity:  $f''_{i,i}(\mathbf{z}) < 0$

- Isoquants  $Q(y) = \{\mathbf{x} | f(\mathbf{x}) = y\}$
- Set of inputs  $\mathbf{z}$  required to produce quantity  $y$
- Special case. Two inputs:
  - $z_1 = L$  (labor)
  - $z_2 = K$  (capital)
- Isoquant:  $f(L, K) - y = 0$
- Slope of isoquant  $dK/dL = MRTS$

- Convex production function if convex isoquants
- Reasonable: combine two technologies and do better!
- Mathematically,  $d^2K/d^2L =$

## 5 Returns to Scale

- Nicholson, Ch. 7, pp. 190–193 [OLD: Ch. 11, pp. 275–278]

- Effect of increase in labor:  $f'_L$

- Increase of all inputs:  $f(t\mathbf{z})$  with  $t$  scalar,  $t > 1$

- How much does input increase?

- Decreasing returns to scale: for all  $\mathbf{z}$  and  $t > 1$ ,

$$f(t\mathbf{z}) < tf(\mathbf{z})$$

- Constant returns to scale: for all  $\mathbf{z}$  and  $t > 1$ ,

$$f(t\mathbf{z}) = tf(\mathbf{z})$$

– Increasing returns to scale: for all  $\mathbf{z}$  and  $t > 1$ ,

$$f(t\mathbf{z}) > tf(\mathbf{z})$$

- Example:  $y = f(K, L) = AK^\alpha L^\beta$
- Marginal product of labor:  $f'_L =$
- Decreasing marginal product of labor:  $f''_L =$
- $MRTS =$
- Convex isoquant?
- Returns to scale:  $f(tK, tL) = A(tK)^\alpha (tL)^\beta = t^{\alpha+\beta} AK^\alpha L^\beta = t^{\alpha+\beta} f(K, L)$

## 6 Two-step Cost minimization

- Nicholson, pp. 212–220 [OLD, Ch. 12 , pp. 298–307]
- Objective of firm: Produce output that generates maximal profit.
- Decompose problem in two:
  - Given production level  $y$ , choose cost-minimizing combinations of inputs
  - Choose optimal level of  $y$ .

# 7 Next Lecture

- Continue Cost Minimization
- Solve an Example
- Cases in which s.o.c. are not satisfied
- Start Profit Maximization