Economics 101A
(Lecture 13)

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Outline

1. Time Consistency
2. Time Inconsistency
3. Health Club Attendance
4. Production: Introduction
5. Production Function

1 Time consistency

- Intertemporal choice

- Three periods, $t = 0$, $t = 1$, and $t = 2$

- At each period i, agents:

  - have income $M_i' = M_i$+savings/debts from previous period

  - choose consumption c_i;

  - can save/borrow $M_i' - c_i$

  - no borrowing in last period: at $t = 2$ $M_2' = c_2$

- Utility function at $t = 0$

$$u(c_0, c_1, c_2) = U(c_0) + \frac{1}{1+\delta}U(c_1) + \frac{1}{(1+\delta)^2}U(c_2)$$

- Utility function at $t = 1$

$$u(c_1, c_2) = U(c_1) + \frac{1}{1+\delta}U(c_2)$$

- Utility function at $t = 2$

$$u(c_2) = U(c_2)$$

- $U' > 0$, $U'' < 0$

- Question: Do preferences of agent in period 0 agree with preferences of agent in period 1?

- **Period 1**.

- Budget constraint at $t = 1$:

$$c_1 + \frac{1}{1+r}c_2 \leq M_1' + \frac{1}{1+r}M_2$$

- Maximization problem:

$$\max U(c_1) + \frac{1}{1+\delta}U(c_2)$$
$$s.t.\ c_1 + \frac{1}{1+r}c_2 \leq M_1' + \frac{1}{1+r}M_2$$

- First order conditions:

- Ratio of f.o.c.s:

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

- Back to **period 0**.

- Agent at time 0 can commit to consumption at time 1 as function of uncertain income M_1.

- Anticipated budget constraint at $t = 1$:

$$c_1 + \frac{1}{1+r} c_2 \leq M_1' + \frac{1}{1+r} M_2$$

- Maximization problem:

$$\max U(c_0) + \frac{1}{1+\delta} U(c_1) + \frac{1}{(1+\delta)^2} U(c_2)$$
$$s.t.\ c_1 + \frac{1}{1+r} c_2 \leq M_1' + \frac{1}{1+r} M_2$$

- First order conditions:

- Ratio of f.o.c.s:

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

- The two conditions coincide!

- **Time consistency.** Plans for future coincide with future actions.

- To see why, rewrite utility function $u(c_0, c_1, c_2)$:

$$
\begin{aligned}
& U(c_0) + \frac{1}{1+\delta} U(c_1) + \frac{1}{(1+\delta)^2} U(c_2) \\
= \; & U(c_0) + \frac{1}{1+\delta} \left[U(c_1) + \frac{1}{1+\delta} U(c_2) \right]
\end{aligned}
$$

- Expression in brackets coincides with utility at $t = 1$

- Is time consistency right?
  - addictive products (alcohol, drugs);
  - good actions (exercising, helping friends);
  - immediate gratification (shopping, credit card borrowing)

2 Time Inconsistency

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

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

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

- Discount factor is

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

instead of

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

- What is the difference?

- *Immediate gratification:* $\beta < 1$

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

- Maximization problem:

$$\max U(c_1) + \frac{\beta}{1+\delta} U(c_2)$$
$$s.t.\ c_1 + \frac{1}{1+r} c_2 \leq M_1' + \frac{1}{1+r} M_2$$

- First order conditions:

- Ratio of f.o.c.s:

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

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

- Maximization problem:

$$\max U(c_0) + \frac{\beta}{1+\delta}U(c_1) + \frac{\beta}{(1+\delta)^2}U(c_2)$$

$$s.t.\ c_1 + \frac{1}{1+r}c_2 \leq M_1' + \frac{1}{1+r}M_2$$

- First order conditions:

- Ratio of f.o.c.s:

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

- 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?

3 Health Club Attendance

- Health club industry study (DellaVigna and Malmendier, *American Economic Review*, 2006)

- 3 health clubs

- Data on attendance from swiping cards

- Choice of contracts:

  - Monthly contract with average price of $75

  - 10-visit pass for $100

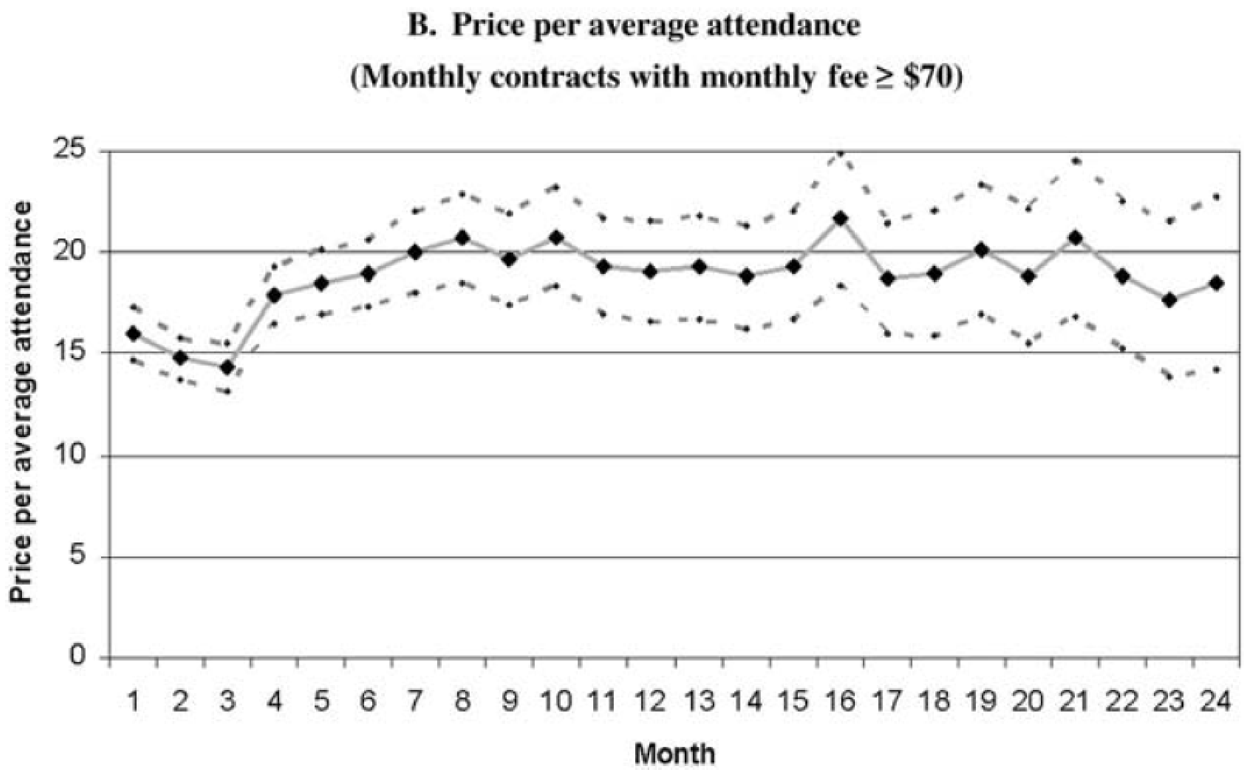
- Consider users that choose monthly contract. Attendance?

Table 3—Price per Average Attendance at Enrollment

	Sample: No subsidy, all clubs		
	Average price per month (1)	Average attendance per month (2)	Average price per average attendance (3)
	Users initially enrolled with a monthly contract		
Month 1	55.23 (0.80) $N = 829$	3.45 (0.13) $N = 829$	16.01 (0.66) $N = 829$
Month 2	80.65 (0.45) $N = 758$	5.46 (0.19) $N = 758$	14.76 (0.52) $N = 758$
Month 3	70.18 (1.05) $N = 753$	4.89 (0.18) $N = 753$	14.34 (0.58) $N = 753$
Month 4	81.79 (0.26) $N = 728$	4.57 (0.19) $N = 728$	17.89 (0.75) $N = 728$
Month 5	81.93 (0.25) $N = 701$	4.42 (0.19) $N = 701$	18.53 (0.80) $N = 701$
Month 6	81.94 (0.29) $N = 607$	4.32 (0.19) $N = 607$	18.95 (0.84) $N = 607$
Months 1 to 6	75.26 (0.27) $N = 866$	4.36 (0.14) $N = 866$	17.27 (0.54) $N = 866$
	Users initially enrolled with an annual contract, who joined at least 14 months before the end of sample period		
Year 1	66.32 (0.37) $N = 145$	4.36 (0.36) $N = 145$	15.22 (1.25) $N = 145$

- 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

4 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

5 Production Function

- Nicholson, Ch. 9, pp. 303-310; 313-318
- Production function: $y = f(\mathbf{z})$. Function $f : R^n_+ \to R_+$
- Inputs $\mathbf{z} = (z_1, z_2, ..., z_n)$: labor, capital, land, human capital
- Output y: Minivan, Intel CPU, 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, convex isoquants if $d^2K/d^2L > 0$

- Solution:

$$\frac{d^2K}{d^2L} = -\frac{f''_{L,L}f'_K - 2f''_{L,K}f'_L + f''_{K,K}\left(f'_L\right)^2/f'_K}{\left(f'_K\right)^2}$$

- Hence, $d^2K/d^2L > 0$ if $f''_{L,K} > 0$ (inputs are complements in production)

6 Next Lecture

- Production

- Cost Minimization