

The Standard Model: Exponential Discounting

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Motivation

- ▶ Which would you rather have?
 - ▶ \$100 today OR \$95 one month
 - ▶ \$100 today OR \$97 one month
 - ▶ \$100 today OR \$99 one month
 - ▶ \$100 today OR \$101 one month
 - ▶ \$100 today OR \$103 one month
 - ▶ \$100 today OR \$105 one month
- ▶ If you value money today more than the same amount of money in the future, then we say you are *impatient*

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Consumption Over Time

- ▶ Stream of consumption (or wealth or income) over T time periods, starting with period 1:

$$c = (c_1, c_2, c_3, \dots, c_T)$$

- ▶ Example: $T = 3$ periods: $(c_1, c_2, c_3) = (\$5, \$10, \$0)$
- ▶ Utility is function of the entire stream of income:

$$U(c) = f(c_1, c_2, c_3, \dots, c_T)$$

- ▶ If impatient, then would prefer to have an extra dollar today rather than tomorrow, implying

$$\frac{\partial U}{\partial c_t} > \frac{\partial U}{\partial c_{t+1}}$$

or equivalently:

$$\frac{\frac{\partial U}{\partial c_{t+1}}}{\frac{\partial U}{\partial c_t}} < 1$$

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Exponential Discounting Model

- ▶ A popular model used in many fields of economics to represent impatient preferences
- ▶ Utility of consumption stream c :

$$U(c) = \sum_{t=1}^T \delta^{t-1} u(c_t)$$

$$= u(c_1) + \delta u(c_2) + \delta^2 u(c_3) + \dots + \delta^{T-1} u(c_T)$$

- ▶ δ is called *discount factor*, where $0 < \delta < 1$
- ▶ Consumer will choose consumption stream that maximizes $U(c)$
- ▶ Is this utility function is impatient?

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Example: Doing Your Laundry

- ▶ Suppose your utility each day is proportional to how many clean outfits you have to wear
- ▶ On Friday that you have just 2 clean outfits left
- ▶ You can do laundry on Friday, Saturday, or Sunday, or Monday
- ▶ Doing laundry is annoying: -5 utils the day you choose to do it
- ▶ Doing laundry gets you 5 clean outfits, but you use one each day
- ▶ In summary:

	Utility on day			
	F	Sa	Su	M
Do laundry Fri	-3	5	4	3
Do laundry Sat	2	-4	5	4
Do laundry Sun	2	1	-5	5
Do laundry Mon	2	1	0	-5

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When Do You Do Your Laundry?

- ▶ From Friday's perspective, what is overall utility of doing laundry on

Friday?

Saturday?

Sunday?

Monday?

- ▶ Utilities under various values of δ :

		Total utility if $\delta =$			
		1	0.6	0.52	0.25
Do laundry Fri	9*	2.09	1.10	-1.45	
Do laundry Sat	7	2.27*	1.83	1.38	
Do laundry Sun	3	1.88	1.87*	2.02	
Do laundry Mon	-2	1.52	1.82	2.17*	

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Checking Follow Through

- ▶ Suppose your $\delta = 0.6$, so on Friday you decide to do laundry on Saturday
- ▶ Saturday morning comes, and you re-evaluate your choices
- ▶ Note that "today", ie period 1, is now Saturday
- ▶ From Saturday's perspective, what is utility of doing laundry on

Saturday?

Sunday?

Monday?

- ▶ Will you follow through with plan?

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Time Consistency

- ▶ Consider decision maker planning consumption in future states
- ▶ If, when they arrive at the future state, they will not want to change their plan, then they are *time consistent*
- ▶ A formal definition
 - ▶ Let consumption for period τ chosen at period $t \leq \tau$ be $c(\tau|t)$
 - ▶ DM is *time consistent* if $c(\tau|t) = c(\tau|\tau)$ for any $t \leq \tau$
- ▶ Any exponential-discounting decision maker will be time-consistent

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Evidence of Time Inconsistency

How Do We Measure Time Preferences?

- ▶ Suppose you are indifferent between \$100 today and \$X in one month
- ▶ Utility of \$100 today: $u(\$100)$
- ▶ Utility of \$X next month: $\delta u(\$X)$ (assuming monthly discount factor)
- ▶ Thus we must have $u(\$100) = \delta u(\$X)$, which implies

$$\delta = \frac{u(\$100)}{u(\$X)}$$

- ▶ If we make the assumption that $u(x) = x$, then

$$\delta = \frac{100}{X}$$

- ▶ Thus we can estimate time preferences by looking at switch point on price list

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Time Inconsistency

- ▶ In actuality, we observe much behavior that is *time inconsistent*
 - ▶ That is, consumers make a different choice for tomorrow's consumption when asked today vs when asked tomorrow
 - ▶ Such consumers will have a *self-control problem*
- ▶ Also, we see that some people are aware of their time inconsistency
 - ▶ A *naïve* agent believes (incorrectly) that he will follow through on his plans
 - ▶ A *sophisticated* agent knows that she may not follow through, so she may look for ways to *commit* herself to the plan

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Lab Evidence: McClure et al (2007)

- ▶ Subjects told to come into the lab thirsty
- ▶ Experiment lasts at least 30 minutes
- ▶ Treatment 1 (immediate): choose either
 - ▶ 1 juice now (early) OR
 - ▶ 2 juices in 5 minutes (later)
- ▶ Treatment 2 (delay): choose either
 - ▶ 1 juice in 20 minutes (early) OR
 - ▶ 2 juices in 25 minutes (later)
- ▶ Subjects know this is their only chance to get a drink during the experiment

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Results

- ▶ What behavior do we expect from discounted exponential utility model?
- ▶ What actually happened?
 - ▶ Treatment 1 (immediate):
 - ▶ Treatment 2 (delay):

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Field Evidence: Read, Loewenstein, and Kalyanaraman (1999)

- ▶ Subjects get vouchers from certain movies off of a list
- ▶ List includes “high brow” and “low brow” movies
 - ▶ “High brow” movies: Schindler’s List, Like Water for Chocolate
 - ▶ “Low brow” movies: The Mask, Mrs. Doubtfire
- ▶ Treatment 1 (immediate): Subjects pick movie for tonight
- ▶ Treatment 2 (delay): Subjects pick movie for one week from now
- ▶ Expect results from discounted exponential model?
- ▶ Results:
 - ▶ Treatment 1 (immediate):
 - ▶ Treatment 2 (delay):

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