AREC 815: Experimental and Behavioral Economics

Time Preferences & Present Bias

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The Discounted Utility Model

The Intertemporal Choice Problem

- Consider an individual with well-defined preferences over consumption, represented by $u(c_t)$
- The individual expects to live forever, and will consume $c_0, c_1, c_2, \ldots, c_t, \ldots$ in periods $0, 1, 2, \ldots, t, \ldots$, respectively
- Utility from consumption is additively separable across periods
- The individual's decision problem is to choose a **consumption path** $(c_0, \ldots, c_t, \ldots)$ which maximizes her total utility

$$U(c_0, \ldots, c_t, \ldots) = \sum_{t=0}^{\infty} d_t u(c_t),$$

where d_t is the weight placed on consumption in period t

The Intertemporal Choice Problem

Why delay gratification? Why not just maximize today's utility?

- Need to eat in all periods
- Anticipatory utility

Why not treat all periods equally? Why not just set $d_t = 1$?

- Uncertainty of human life
- Self control, or lack thereof

The Intertemporal Choice Problem

"Such pleasures as may now be enjoyed generally awaken a passion strongly prompting to the partaking of them. The actual presence of the immediate object of desire in the mind by exciting the attention, seems to rouse all the faculties, as it were to fix their view on it, and leads them to a very lively conception of enjoyment which it offers to their instant possession."

— Rae (1834)

The Intertemporal Choice Problem

- Irving Fisher (1930) first reframed the problem as a technical one, substituting between periods as one would between goods
- Samuelson (1937) proposed the restriction $d_t = \delta^t$
- One sensible interpretation:

$$\delta = \frac{1}{1+r},$$

  where r is the market interest rate
- Samuelson (1937): *"It is completely arbitrary to assume that the individual behaves so as to maximize an integral of the form envisaged... any connection between utility as discussed here and any welfare concept is disavowed."*

Properties of the Exponential Discounting Model

- Utility, consumption independence: rule out complementarities across time, preferences for sequences of consumption
- Discount rate constant across consumption goods
- Stationarity, constant discounting, time consistency
  - Formally, for any $(c_1, c_2, \ldots)$ and $(c_1', c_2', \ldots)$ where $c_1 = c_1'$,

$$U^1(c_1, c_2, \ldots) \geq U^1(c_1', c_2', \ldots) \Leftrightarrow U^2(c_2, \ldots) \geq U^2(c_2', \ldots)$$

Violations

- Thaler (1981) was one of the first to report evidence that empirically estimated discount factors depend on the time period examined
- Imagine you can either receive amount x today, or a larger amount in 3, 12, or 36 months. How big would the later prize have to be to make you precisely indifferent?

Median Responses

Today	3 months	12 months	36 months
\$15	\$30 0.794	\$60 0.891	\$100 0.947
\$250	\$300 0.941	\$350 0.972	\$500 0.981

Violations

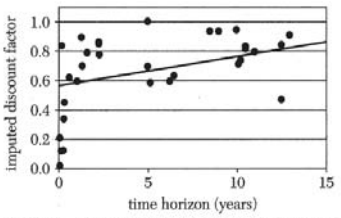


Figure 1a. Discount Factor as a Function of Time Horizon (all studies)

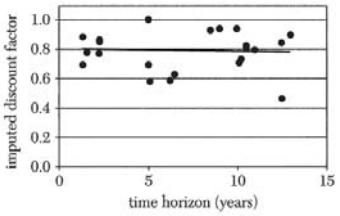


Figure 1b. Discount Factor as a Function of Time Horizon (studies with avg. horizons > 1 year)

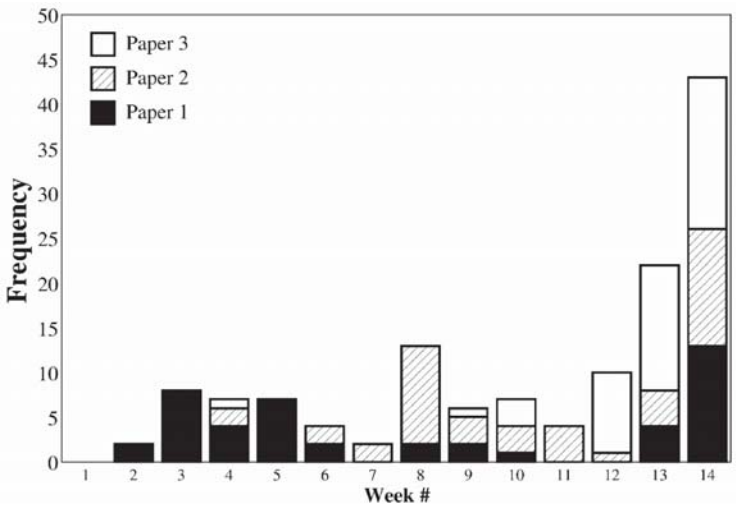
Self Control, Procrastination, and Marshmallows

Mischel, Shoda, and Rodriguez (Science, 1989): children able to exert self control (by not eating a marshmallow) turn out better later in life

- Children who are able to exert self control turn out better later in life

"Those children who delayed longer as preschoolers were rated in adolescence by their parents as significantly more attentive and able to concentrate, competent, planful, and intelligent. They were also seen as more able to pursue goals and to delay gratification, better in self-control, more able to resist temptation, to tolerate frustration, and to cope maturely with stress."

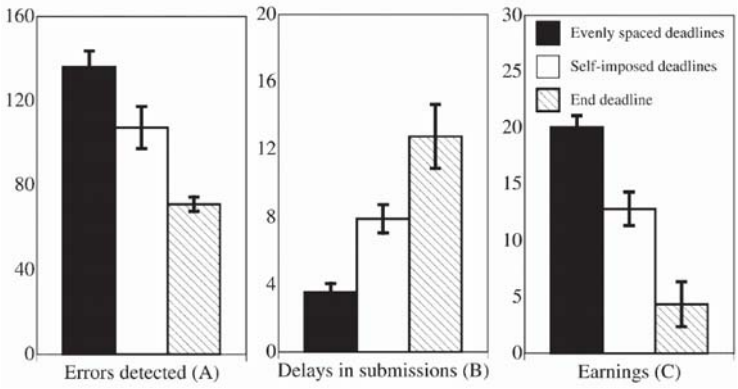
Procrastination, Deadlines, and Performance



Procrastination, Deadlines, and Performance

" 'Sexual identity is intrinsically impossible,' says Foucault; however, according to de Selby, it is not so much sexual identity that is intrinsically impossible, but rather the dialectic, and some would say the stasis, of sexual identity. Thus, D'Erlette holds that we have to choose between premodern dialectic theory and subcultural feminism imputing the role of the observer as poet."

Procrastination, Deadlines, and Performance



Quasi-hyperbolic discounting

Quasi-hyperbolic Discounting

- Following Laibson (1994), assume preferences can be represented by the utility function

$$U^t(c_t, c_{t+1}, \ldots, c_T) = \delta^{t-1} u(c_t) + \beta \sum_{\tau=t+1}^{T} \delta^{\tau-1} u(c_\tau)$$

  for some $\beta \in (0, 1]$ and $\delta \in (0, 1]$.

- Time consistency $\Leftrightarrow \beta = 1$

Quasi-hyperbolic Discounting: An Example

- Homer's consumption utility of doughnuts in each period is:

$$u(\text{eating zero doughnuts}) = 0$$

$$u(\text{eating one doughnut}) = 1$$

$$u(\text{eating two doughnuts}) = \frac{3}{2}$$

Quasi-hyperbolic Discounting: An Example

- Homer's utility is given by

$$\text{doughnuts}_1 + \beta\delta\text{doughnuts}_2 + \beta\delta^2\text{doughnuts}_3 + \ldots$$

- If $\beta = 1/2$ and $\delta = 1$, what happens when Homer is given a choice between one doughnut in period t and two doughnuts in $t+1$?
- Homer prefers one doughnut now to two doughnuts tomorrow
- When asked about it today, Homer also prefers two doughnuts the day after tomorrow to one doughnut tomorrow
- However, when asked about it tomorrow, Homer will prefer one doughnut tomorrow to two doughnuts the day after tomorrow

Time-inconsistency and Individual Welfare

- **Time-inconsistency**: today, Homer tells you that he prefers two doughnuts in two days to one doughnut tomorrow; tomorrow, he changes his mind and opts for immediate doughnut gratification
- What constitutes "utility maximization" for an individual with time-inconsistent preferences?
  - **Pareto criterion**: c dominates c' if and only if it is weakly preferred at all points in time, and strictly preferred at least one point in time
  - **Long-run welfare criterion**: c dominates c' if and only if

$$\sum_{t=1}^{\infty} \delta^{t-1} u\left(c_t\right) > \sum_{t=1}^{\infty} \delta^{t-1} u\left(c_t'\right)$$

Self-Awareness: Sophisticates vs. Naifs

- An individual with time-inconsistent preferences may or may not be aware of her time-inconsistency
- Let $\hat{\beta}$ denote beliefs about the future value of β
  - An individual is a **sophisticate** if $\hat{\beta} = \beta$
  - An individual is a **naif** if $\hat{\beta} = 1$
  - An individual is **partially naive** if $\beta < \hat{\beta} < 1$

Tying Homer to the Mast: An Example

- On Thursday, Homer will choose to eat one doughnut (on Thursday) over waiting until Friday to receive two doughnuts
- On Wednesday, he's given the option to pay $p > 0$ to commit to receiving two doughnuts on Friday and none on Thursday
  - What is the maximum price that sophisticate Homer would pay?
  - What about naive Homer?

Immediate Costs vs. Immediate Rewards

- General framework: some task must happen exactly once over the course of many periods $1, \ldots, T$
- Task either pleasant (reward) or unpleasant (cost)
- In this setting, a **perception-perfect strategy** tells us whether the individual would complete the task in each period, if it were not already complete by that time, given beliefs about future actions

$$s = (s_1, s_2, \ldots, s_T)$$

Immediate Costs: Fibonacci's Fine Arts Cinema

- Penny and Paige must each **miss** one movie at the film festival:
  - **Friday**: The Birds (possibly Hitchcock's worst) - 3 utils
  - **Saturday**: Strangers on a Train (good) - 5 utils
  - **Sunday**: Rear Window (good) - 8 utils
  - **Monday**: North by Northwest (Cary Grant!) - 13 utils
- Cannot pre-commit; must make decisions day by day

Immediate Costs

- Paige is a sophisticate: she knows $\hat{\beta} = \beta = \frac{1}{2}$ and $\delta = 1$
- On **Monday**, Paige will see North by Northwest if she can
- On **Sunday**, she compares her (current period) utility if she skips Rear Window to her utility if she's forced to skip NxNW

$$\begin{aligned} U^{\text{SUN}}(\text{skipping RW}) &< U^{\text{SUN}}(\text{skipping NxNW}) \\ \Leftrightarrow 0 + \frac{1}{2}(13) &< 8 + \frac{1}{2}(0) \\ \Leftrightarrow 6.5 &< 8 \end{aligned}$$

$\Rightarrow$ So she won't skip Rear Window

Immediate Costs

- On **Saturday**, she compares her utility if she skips Strangers to her utility if she doesn't, knowing that she will / won't skip RW

$$\begin{aligned} U^{\text{SAT}}(\text{skipping SoaT}) &> U^{\text{SAT}}(\text{not skipping SoaT}) \\ \Leftrightarrow 0 + \frac{1}{2}(8+13) &> 5 + \frac{1}{2}(8+0) \\ \Leftrightarrow 10.5 &> 9 \end{aligned}$$

$\Rightarrow$ So, unless she has already skipped a movie by Saturday, she will skip Strangers on a Train

Immediate Costs

- On **Friday**, she compares her utility if she skips The Birds to her utility if she doesn't, knowing that she will / won't skip Strangers

$$U^{\text{FRI}}(\text{skipping TB}) < U^{\text{FRI}}(\text{not skipping TB})$$
$$\Leftrightarrow 0 + \frac{1}{2}(5+8+13) < 3 + \frac{1}{2}(0+8+13)$$
$$\Leftrightarrow 13 < 13.5$$

  - $\Rightarrow$ So she will / won't skip The Birds?
- Paige's perception-perfect strategy: (N, Y, N, Y)
- She skips the second (and second worst) movie

Immediate Costs

- Penny is a naif: $\hat{\beta} = 1$
  - Each day, she believes her future-period selves will be time consistent, making plans and sticking to them
- On **Monday**, Penny will see North by Northwest if she can
- On **Sunday**, she compares her Sunday utility if she skips Rear Window to her Sunday utility if she's forced to skip NxNW

$$U^{\text{SUN}}(\text{skipping RW}) < U^{\text{SUN}}(\text{skipping NxNW})$$
$$\Leftrightarrow 6.5 < 8$$

  - $\Rightarrow$ Like Paige, she won't skip Rear Window

Immediate Costs

- On **Saturday**, she thinks her Sunday utility will be:

$$\widetilde{U}^{\text{SUN}}(\text{skipping RW}) = 0 + 13 = 13$$
$$\widetilde{U}^{\text{SUN}}(\text{not skipping RW}) = 8 + 0 = 8$$

- On **Saturday**, she compares her utility if she skips Strangers to her utility if she doesn't, thinking that she will skip RW

$$U^{\text{SAT}}(\text{skipping SoaT}) < U^{\text{SAT}}(\text{not skipping SoaT})$$
$$\Leftrightarrow 0 + \frac{1}{2}(8 + 13) < 5 + \frac{1}{2}(0 + 13)$$
$$\Leftrightarrow 10.5 < 11.5$$

Immediate Costs

- On **Friday**, what does the believe she will do on Saturday and Sunday? She compares skipping The Birds to what?

$$\widetilde{U}^{\text{SAT}}(\text{skipping Strangers}) = 0 + 8 + 13 = 21$$
$$\widetilde{U}^{\text{SAT}}(\text{skipping RW}) = 5 + 0 + 13 = 18$$

- On **Friday**, she compares her utility if she skips The Birds to her utility if she doesn't, "knowing" that she will then skip Strangers

$$U^{\text{FRI}}(\text{skipping TB}) < U^{\text{FRI}}(\text{not skipping TB})$$
$$\Leftrightarrow 0 + \frac{1}{2}(5 + 8 + 13) < 3 + \frac{1}{2}(0 + 8 + 13)$$
$$\Leftrightarrow 13 < 13.5$$

Immediate Costs

- Penny's perception-perfect strategy:
- She skips the
- When costs are immediate and rewards come later, the sophisticate takes the action before the naif
- What can we say about Paige and Penny's welfare?

Immediate Rewards

- Suppose Penny and Paige can only see one of the movies
- They still cannot pre-commit; must make decisions day by day
- The action now involves immediate benefits, rather than costs
- Strategies have same structure as before

Immediate Rewards

- What about our naive friend Penny?

Immediate Rewards

- Penny's perception-perfect strategy:
- She sees the _____ movie
- What is Penny's long-run welfare?
- When rewards are immediate and rewards costs occur later, the sophisticate takes the action before the naif

Immediate Rewards

- Intuitive Result:
  - Whatever "it" is, sophisticates do "it" (weakly) first
- What if they had to buy their tickets in advance?
  - It should be obvious that they'd make the same choice(s)
- What if they *could* buy their tickets in advance?

Conclusions: Doing It Once

- Action happens once over the course of T periods
- If rewards are immediate and costs delayed, naive types do the action at least as early as time-consistent types
- If costs are immediate and rewards delayed, naive types do the action (weakly) later than time-consistent types
- For both immediate costs and immediate rewards, sophisticates take the action at least as early as naive types
- These examples don't allow for over- or under- consumption