The Trade Between Money and Time
Model Selection for Intertemporal Choice

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MACSS Project Proposal

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Introduction

Decisions involving consequences at different time points are referred to as *intertemporal choice* (Frederick, Loewenstein, & O'Donoghue, 2002).

Intertemporal choice is also known as *temporal discounting*, *delay discounting*, *time preference*, or *time discounting*.

What model has the best prediction for money-earlier-or-later (MEL) decisions / intertemporal choices?

Literature

- Exponential model
- Hyperbolic model
- Quasi-Hyperbolic model / $\beta - \delta$ discounting model
- Fixed cost model (Benhabib, Bisin, & Schotter, 2009)
- Exponential time (Roelofsman, 1996)
- Discounting-by-intervals (DBI) (Scholten and Read, 2006)
- Constant sensitivity (Ebert and Prelec, 2007)
- Discounting fractions (Read, 2001)
- Hyperboloid model (Green & Myerson, 1995)
- Generalized Hyperboloid model (Loewenstein & Prelec, 1992)
- Constant absolute decreasing impatience (Bleichrodt et al., 2009)

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Data

Marzilli Ericson, K. M., White, J. M., Laibson, D., & Cohen, J. D. (2015). Money earlier or later? Simple heuristics explain intertemporal choices better than delay discounting does. Psychological science, 26(6), 826-833.

- The amount of data: 23500
- 940 participants; 25 questions for each participants
- Money range: $0.01 to $100,000.00
- Time range: 0 weeks to 6 weeks

Experiment

- Standard *money-earlier-or-later*(MEL) format
(e.g., \$5 today vs. \$10 in 4 weeks)

- Absolute money value, delay framing
(e.g., \$5 today vs. \$5 plus an additional \$5 in 4 weeks)

- Relative money value, delay framing
(e.g., \$5 today vs. \$5 plus an additional 100% in 4 weeks)

- Absolute money value, speedup framing
(e.g., \$10 in 4 weeks vs. \$10 minus \$5 today)

- Relative money value, speedup framing
(e.g., \$10 in 4 weeks vs. \$10 minus 50% an additional 100 % today)

ITCH Model

A simple heuristics model, *intertemporal choice heuristic* (ITCH) model outperformed the traditional utility-discounting models. (Ericson, White, Laibson, & Cohen, 2015)

The outcome is binary variable:
0 represents smaller sooner option, 1 represents larger later option.

L(x) represents the inverse logistic function of x:
$L(x) = (1 + e^{-x})^{-1}$

ITCH model:
$P(LL) = L(\beta_I + \beta_{xA}(x_2 - x_1) + \beta_{xR}\frac{x_2 - x_1}{x^*} + \beta_{tA}(t_2 - t_1) + \beta_{tR}\frac{t_2 - t_1}{t^*})$

Models

- Exponential model: $P(LL) = L(a(x_2\delta^{t_2} - x_1\delta^{t_1}))$

- Hyperbolic model: $P(LL) = L(a(x_2(1+\alpha t_2)^{-1} - x_1(1+\alpha t_1)^{-1}))$

- Quasi-hyperbolic model:
$P(LL) = L(a(x_2\beta^{I(t_2>0)}\delta^{t_2} - x_1\beta^{I(t_1>0)}\delta^{t_1}))$

- Tradeoff model:
$P(LL) = L(a((log(1+\gamma_x x_2)/\gamma_x - log(1+\gamma_x x_1))/\gamma_x - k(log(1+\gamma_t t_2 - log(1+\gamma_t t_1)/\gamma_t))))$

- DRIFT model:
$P(LL) =$
$L(\beta_0 + \beta_1(x_2 - x_1) + \beta_2\frac{x_2-x_1}{x_1} + \beta_3((\frac{x_2}{x_1})^{\frac{1}{t_2-t_1}} - 1) + \beta_4(t_2 - t_1))$

- ITCH model:
$P(LL) = L(\beta_I + \beta_{xA}(x_2 - x_1) + \beta_{xR}\frac{x_2-x_1}{x^*} + \beta_{tA}(t_2 - t_1) + \beta_{tR}\frac{t_2-t_1}{t^*})$

Method

- What are the features in each of these models?
- Why heuristic models outperform traditional utility-discounting models?
- Why ITCH model outperforms the other models?
- What are the most important terms?
- Develop a new model which is nested in the traditional utility-discounting models and the heuristics model

- Cross-validation analysis
- Maximum likelihood estimation techniques

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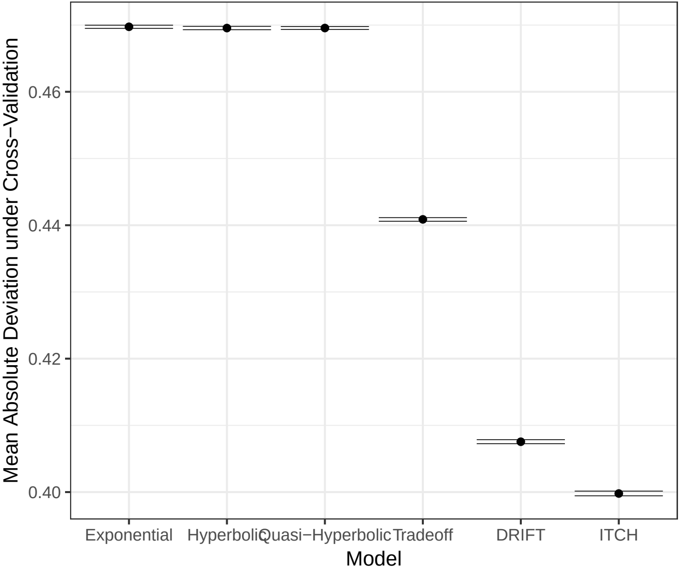
Results


Mean Absolute Deviation under Cross−Validation
0.46
0.44
0.42
0.40
Exponential
Hyperbolic
Quasi−Hyperbolic
Tradeoff
DRIFT
ITCH
Model

Future directions

- May design new experiments based on specific conditions to compare the models' performance across conditions
- May design new experiments to examine the indifference point between the larger-later option and smaller-sooner option

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