Estimating Social Preferences From Dictator Game Data
估計社會偏好: 以獨裁分配實驗結果為例

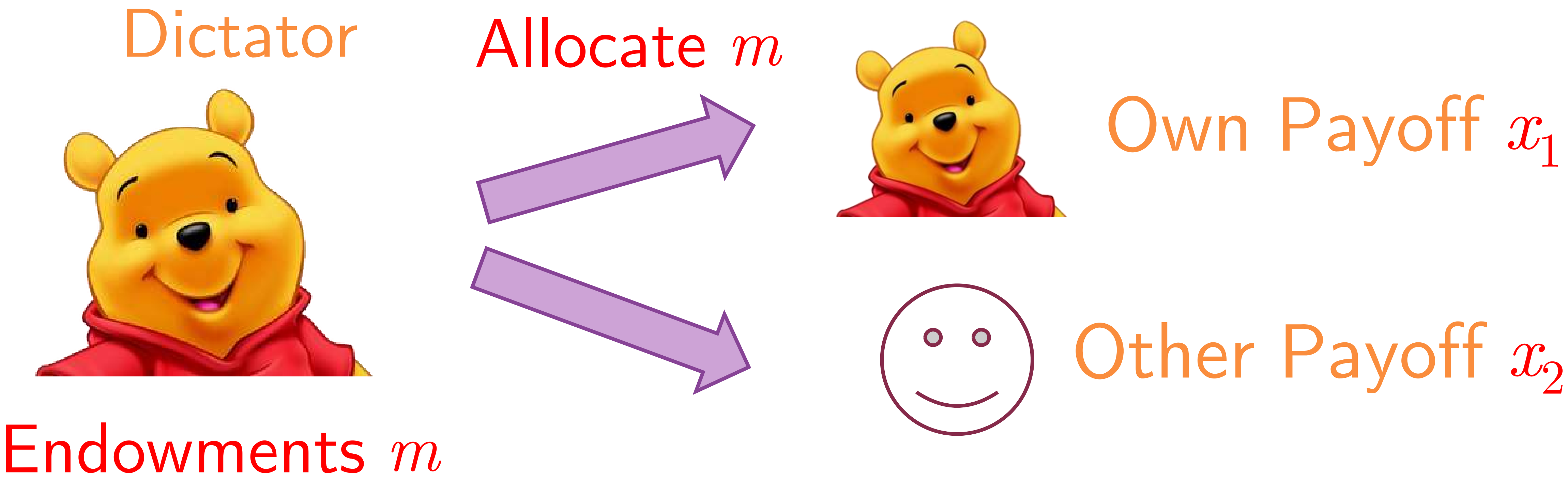
Joseph Tao-yi Wang (王道一)

EE-BGT, Lecture 3c (Experimetrics Module 4)

Part I: Dictator Game with Prices
第一部分: 不同價格下的獨裁分配

Joseph Tao-yi Wang (王道一)
Experimetrics Lecture 5 (實驗計量第五講)

The Dictator Game



- One Subject Chooses Allocation for Both
  - The Dictator

The Dictator

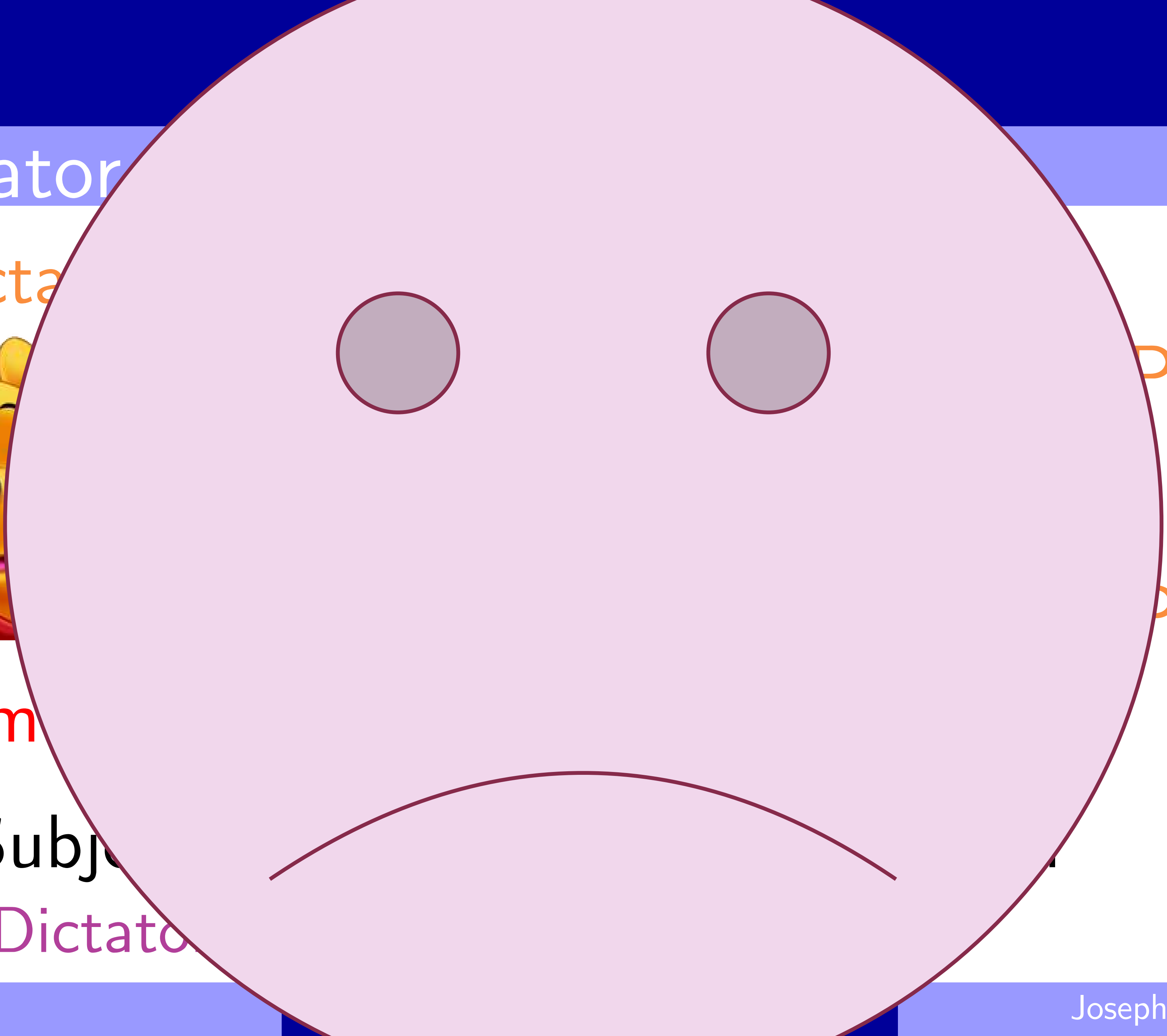
Dicta

Payoff x_1

Payoff x_2

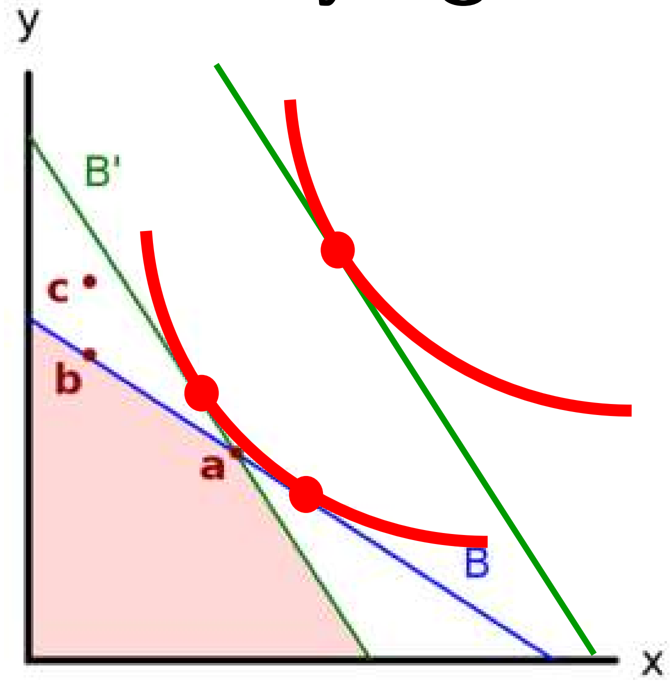
Endowm

- One Subj
  - The Dictato



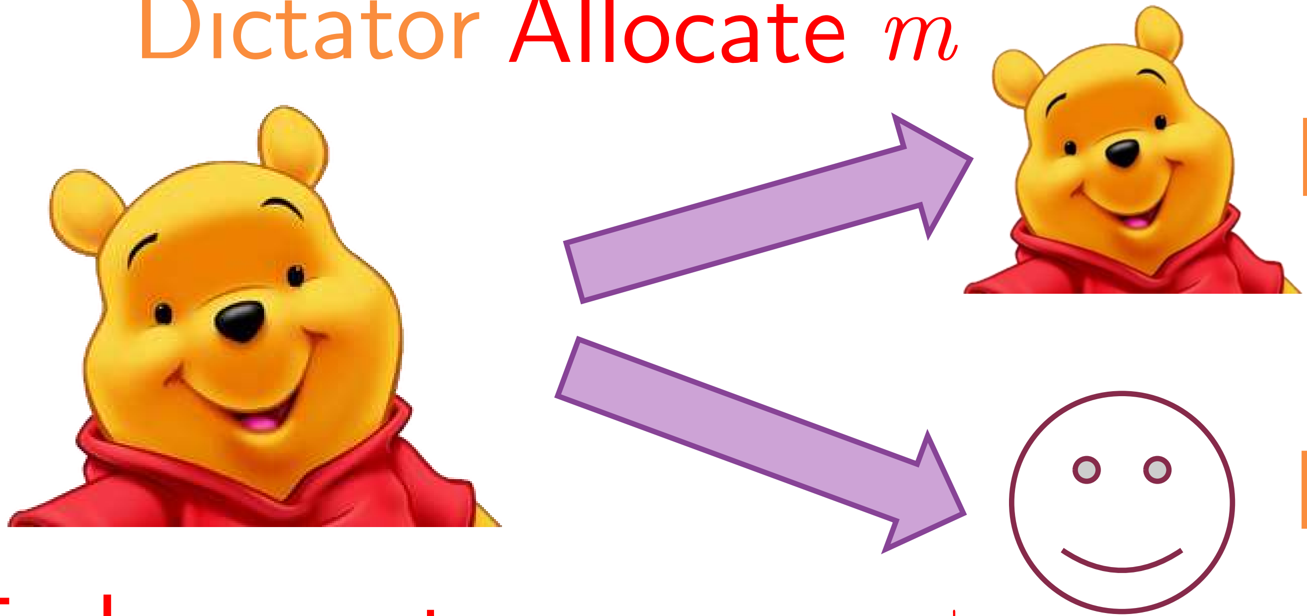
Involving Prices: Andreoni and Miller (2002)

- Alter Endowment m, Prices of Keeping p_1 and Giving p_2
- To test if choice data x_1 and x_2 is Rationalizable
- If yes, can estimate underlying utility function
  - Satisfy GARP?



The Dictator Game with Prices

Dictator Allocate m



Directed to Self $p_1 x_1$

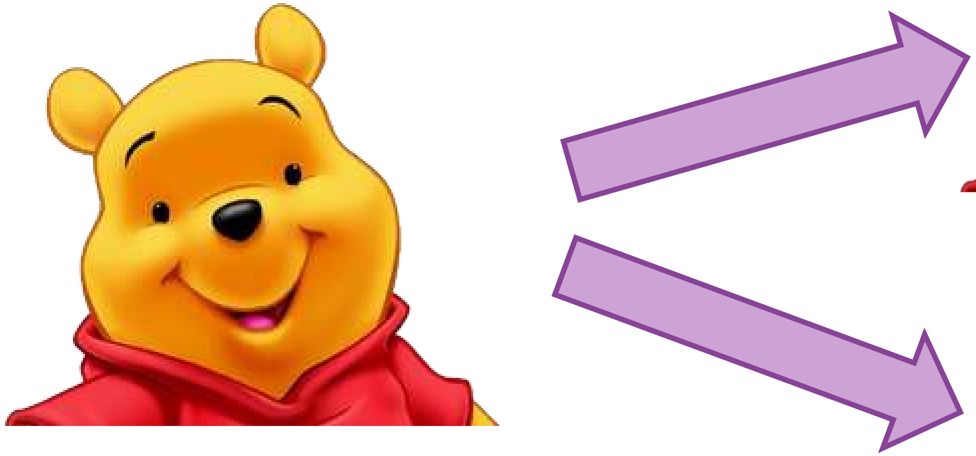
Directed to Other $p_2 x_2$

Endowments $m = p_1 x_1 + p_2 x_2$

- One Subject Chooses Allocation for Both
  - The Dictator

The Dictator Game with $(p_1, p_2) = (1/3, 1)$

Dictator Allocate 40



Directed to Self $(1/3)x_1$

Directed to Other $1x_2$

Endowments $m = 40$

- If $1x_2 = 30$, $(1/3)x_1 + 1x_2 = 40$
- Then $(1/3)x_1 = 40 - 30 = 10$

So, $x_1 = 30!$

Data of Andreoni and Miller (2002)

- Choose p_1x_1 Directed to Self
  - Amount Received by Self x_1 (and Price of Keeping p_1)
- Choose p_2x_2 Directed to Other
  - Amount Received by Other: x_2 (and Price of Giving p_2)
- Subject to Budget Constraint: $p_1x_1 + p_2x_2 \leq m$
  - Since BC binds, choose only p_2x_2 and $p_1x_1 = m - p_2x_2$
- Define Budget Shares $w_1 = \frac{p_1x_1}{m}, \; w_2 = \frac{p_2x_2}{m}$
  - N=176: `garp.dta`

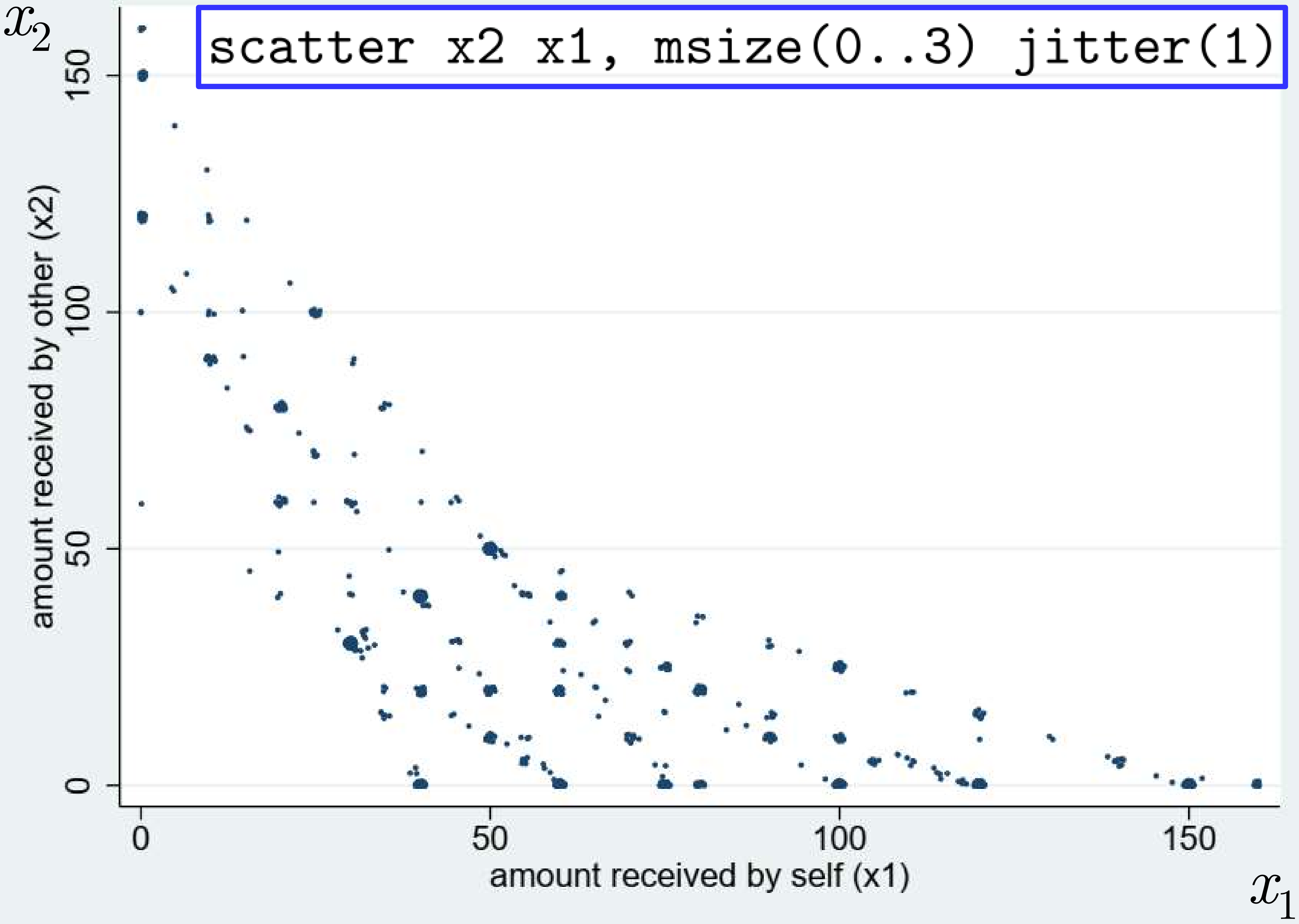
11 Budget Sets Presented in Random Order

Budget	m	p_1	p_2	Observations	Mean amount sent to other
1	40	0.33	1	176	8.02
2	40	1	0.33	176	12.81
3	60	0.5	1	176	12.67
4	60	1	0.5	176	19.40
5	75	0.5	1	176	15.51
6	75	1	0.5	176	22.68
7	60	1	1	176	14.55 $/60 = 24\%$
8	100	1	1	176	23.03 $/100 = 23\%$
9	80	1	1	34	13.5$/80 = 17\%$
10	40	0.25	1	34	3.41
11	40	1	0.25	34	14.76

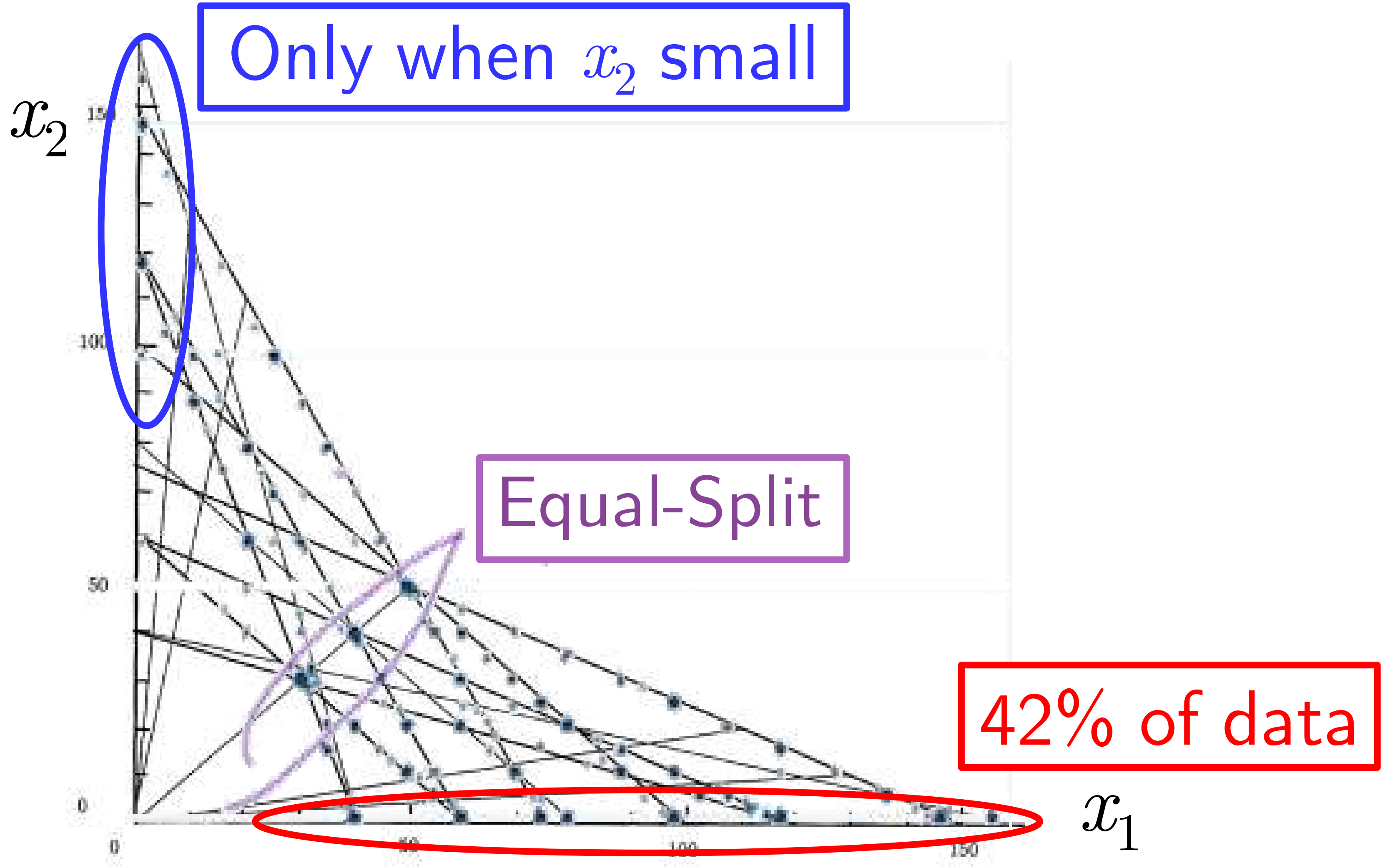
Give 17-24% in standard, (1,1)-dictator games consistent with Camerer (2003)

Property 1:

- STATA Results:

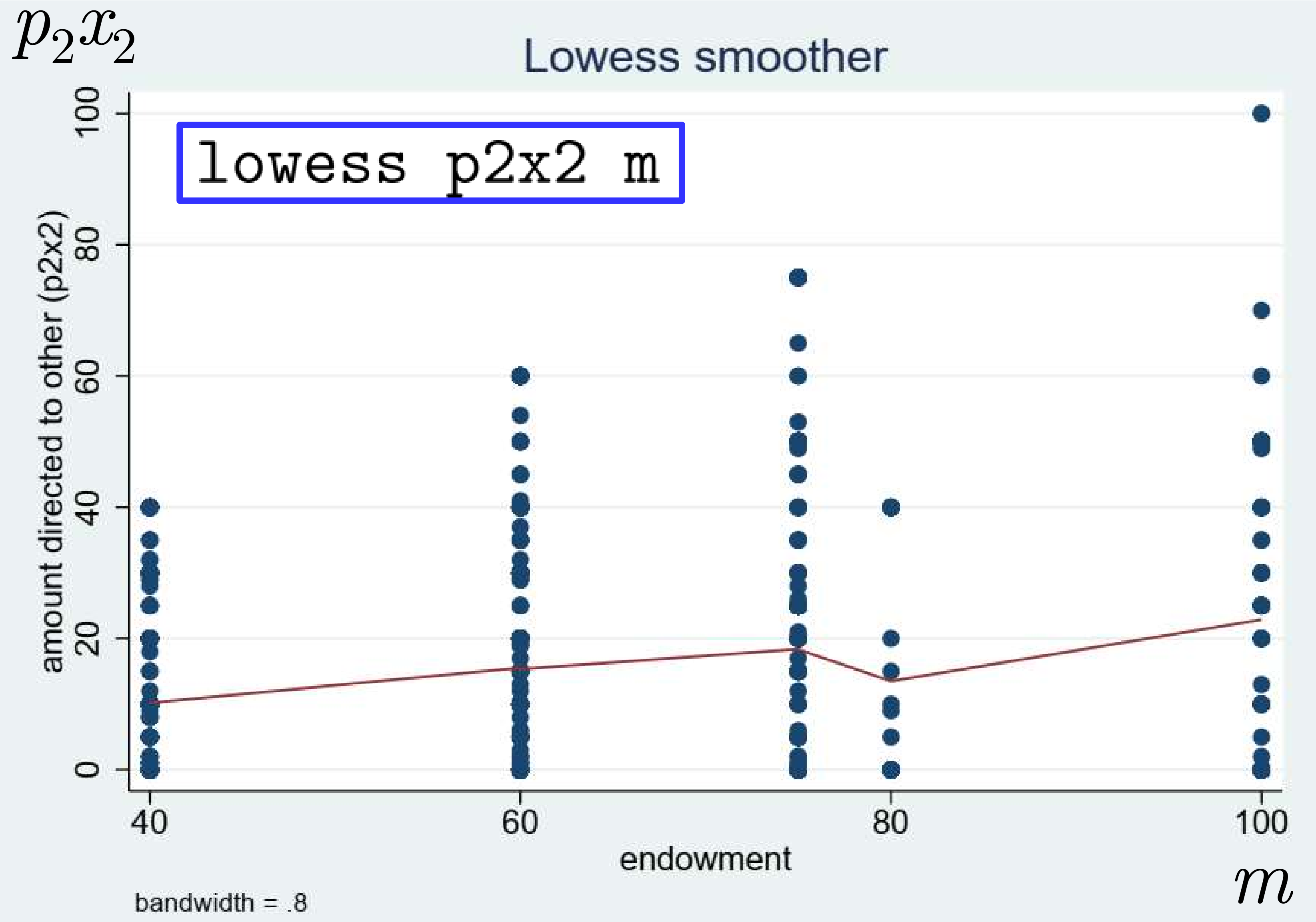


Property 1: Bias Toward Giving-to-Self



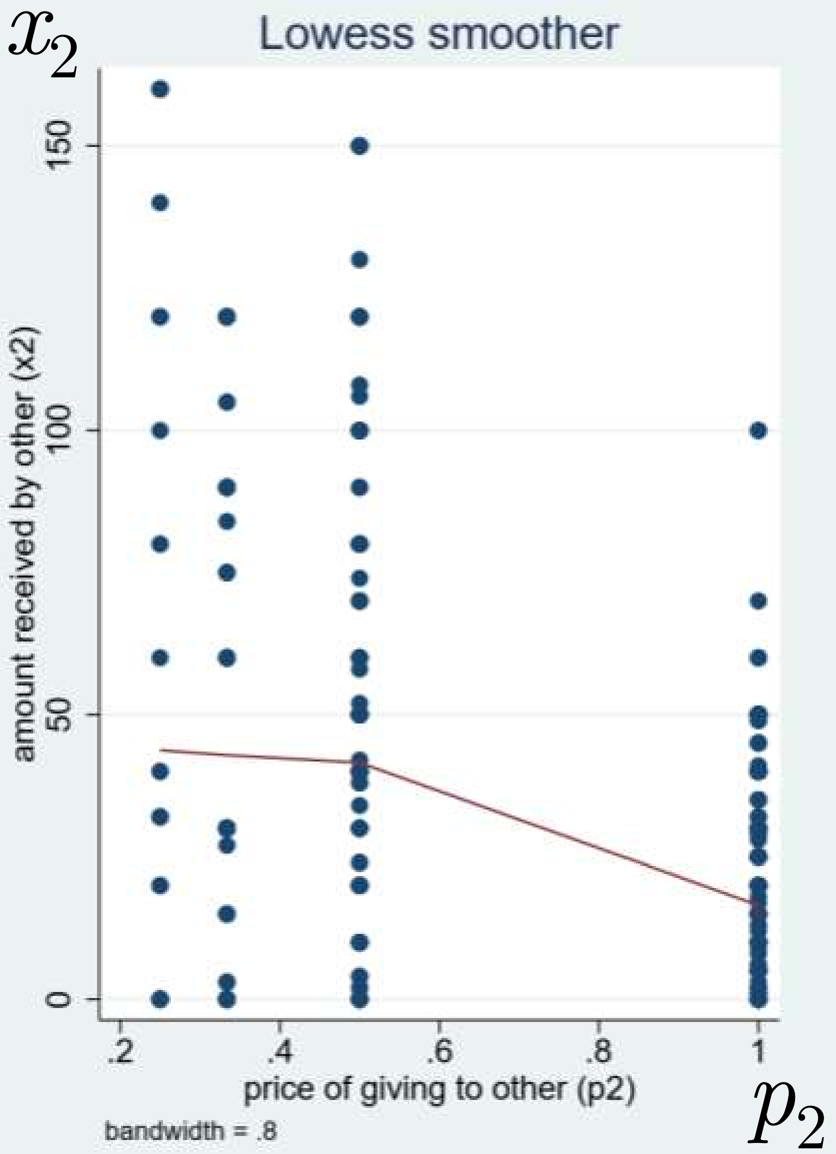
Property 2: Giving (x_2) is a Normal Good

- STATA Results:



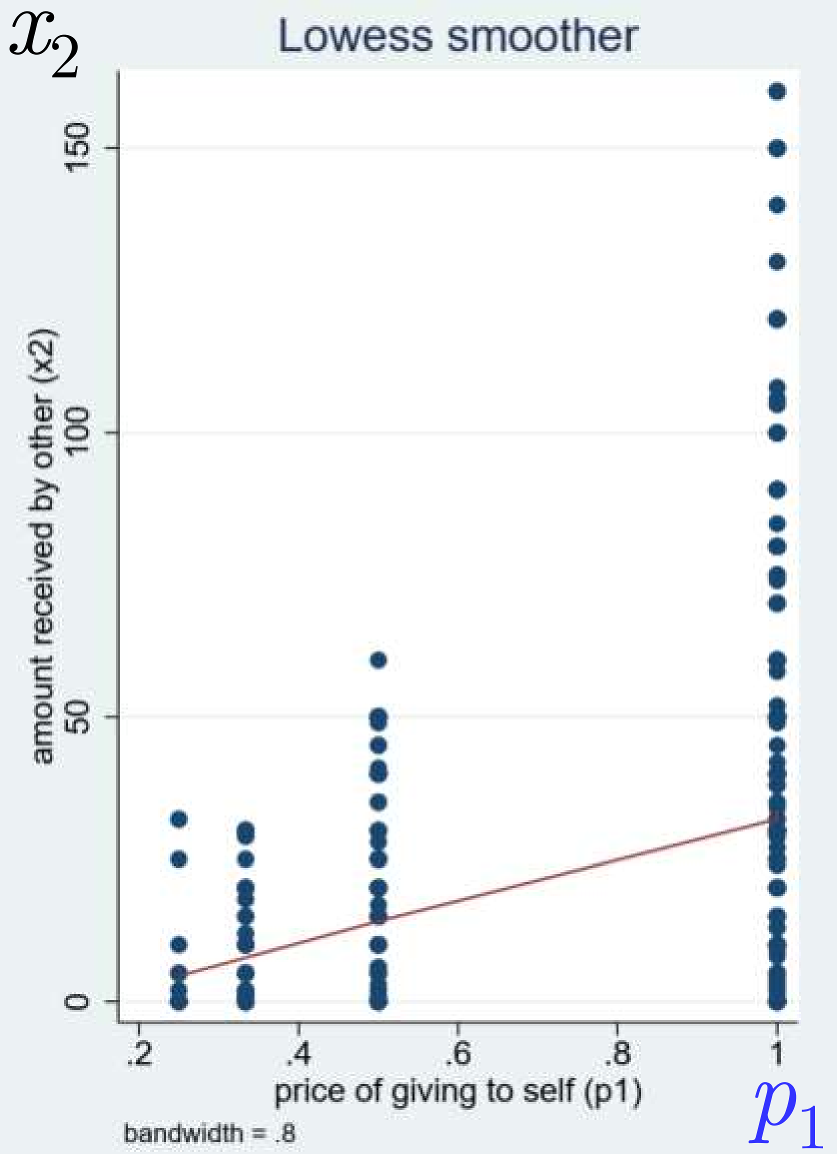
Property 3: Giving (x_2) Obeys Law of Demand

- STATA Results: `lowess x2 p2`



Property 4: Giving (x_2) & Keeping (x_1) are Substitutes

- STATA Results: `lowess x2 p1`



Property 3 and 4: Linear Regression

- STATA `regress x2 p2 p1, vce(cluster i)`
  Results:

```
Linear regression                               Number of obs     =       1510
                                                F(  2,   175)     =      61.20
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1847
                                                Root MSE          =     28.661

                                  (Std. Err. adjusted for 176 clusters in i)
------------------------------------------------------------------------------
             |               Robust
          x2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          p2 |  -39.00726   4.934956    -7.90   0.000    -48.74695   -29.26757
          p1 |   14.47704   1.664276     8.70   0.000      11.1924    17.76167
       _cons |   43.95138   4.663821     9.42   0.000     34.74681    53.15596
------------------------------------------------------------------------------
```

Giving Obeys Law of Demand ($t =$ -7.90)

Giving and Keeping are Substitutes ($t = 8.70$)

Property 2: Adding Income to the Linear Regression

- STATA `regress x2 p2 p1 m, vce(cluster i)` Results:

Giving is a Normal Good ($t = 9.57$): When m Increases by 1, Giving Increases by 0.265

p_1 Highly Correlated with m and No Longer Significant (Previously Served as its Proxy)

```
Linear regression                               Number of obs   =       1510
                                                F(  3,   175)   =      61.25
                                                Prob > F        =     0.0000
                                                R-squared       =     0.1976
                                                Root MSE        =     28.441

                                 (Std. Err. adjusted for 176 clusters in i)
------------------------------------------------------------------------------
             |               Robust
          x2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          p2 |  -52.12677   5.063235   -10.30   0.000    -62.11964   -42.13391
          p1 |   1.357528   1.783083     0.76   0.447    -2.161587    4.876643
           m |    .265248   .0277023     9.57   0.000     .2105744    .3199216
       _cons |   47.92717   4.707122    10.18   0.000     38.63713     57.2172
------------------------------------------------------------------------------
```

Tobit Regression: Account for 42% Giving Zero

- STATA Results: `tobit x2 p2 p1 m, vce(cluster i) ll(0)`

```
Tobit regression                                Number of obs     =       1510
                                                F(   3,    1507)  =      54.33
                                                Prob > F          =     0.0000
Log pseudolikelihood =  -5027.146               Pseudo R2         =     0.0256

                               (Std. Err. adjusted for 176 clusters in i)
------------------------------------------------------------------------------
             |               Robust
          x2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          p2 |   -67.1347   7.049639    -9.52   0.000    -80.96285   -53.30656
          p1 |    10.8052   3.910197     2.76   0.006     3.135191    18.4752
           m |   .3322818   .0380964     8.72   0.000     .2575541    .4070095
       _cons |   34.41715   6.122105     5.62   0.000      22.4084    46.4259
-------------+----------------------------------------------------------------
      /sigma |   42.59774    2.46888                      37.75494    47.44055
------------------------------------------------------------------------------
  Obs. summary:        628  left-censored observations at x2<=0
                       882     uncensored observations
                         0 right-censored observations
```

Stronger Overall Results!

Tobit Coefficient for p_1 (10.81, t=2.76) is 8 Times Larger than OLS (1.36, t =0.76)

Random Effect Tobit Regression: Panel Data

- STATA Results:

```
xtset i t
xttobit x2 p2 p1 m, ll(0)
```

```
Random-effects Tobit regression                 Number of obs      =      1510
Group variable: i                               Number of groups   =       176

Random effects u_i ~ Gaussian                   Obs per group: min =         8
                                                               avg =       8.6
                                                               max =        11

Integration method: mvaghermite                 Integration points =        12

                                                Wald chi2(3)       =    605.11
Log likelihood  = -4663.2072                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          x2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          p2 |  -75.14353   4.942489   -15.20   0.000    -84.83063   -65.45643
          p1 |   9.896787   5.060785     1.96   0.051    -.0221691    19.81574
           m |   .3672872   .0639333     5.74   0.000     .2419803    .4925941
```

Random Eff

- STATA Results:

Even Stronger Results!

Between-Subject Heterogeneity is Large (44.06) and Significant (t=13.45)

```
Random-effects Tobit regression                 Number of obs      =      1510
Group variable: i                               Number of groups   =       176

Random effects u_i ~ Gaussian                   Obs per group: min =         8
                                                               avg =       8.6
                                                               max =        11

Integration method: mvaghermite                 Integration points =        12

                                                Wald chi2(3)       =    605.11
Log likelihood  = -4663.2072                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          x2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          p2 |  -75.14353   4.942489   -15.20   0.000    -84.83063   -65.45643
          p1 |   9.896787   5.060785     1.96   0.051    -.0221691    19.81574
           m |   .3672872   .0639333     5.74   0.000     .2419803    .4925941
       _cons |   32.68706   6.512942     5.02   0.000     19.92193     45.4522
-------------+----------------------------------------------------------------
    /sigma_u |    44.0585   3.276081    13.45   0.000      37.6375     50.4795
    /sigma_e |   28.67666   .7433699    38.58   0.000     27.21968    30.13364
-------------+----------------------------------------------------------------
         rho |   .7024244   .0320737                      .6367994    .7620325
------------------------------------------------------------------------------
```

Constant Elasticity of Substitution Utility Function

- Andreoni and Miller (2002) Estimate Social Preference via
- CES: Constant Elasticity of Substitution Utility Function

$$U(x_1, x_2) = [\alpha x_1^\rho + (1-\alpha) x_2^\rho]^{\frac{1}{\rho}}$$

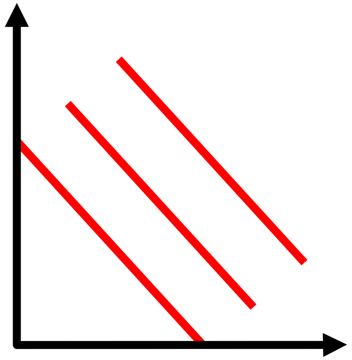
- Selfishness: $0 \leq \alpha \leq 1$
  - Willingness to Trade Off Equity and Efficiency: $-\infty \leq \rho \leq 1$
- Elasticity of Substitution: $\sigma = \dfrac{1}{1-\rho}$
- Estimate $\hat{\alpha}, \hat{\rho}$ from behavior in Dictator Game

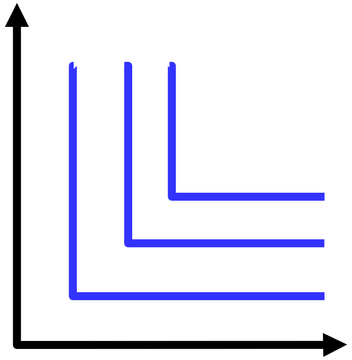
Constant Elasticity of Substitution Utility Function

- CES Utility Function $U(x_1, x_2) = [\alpha x_1^\rho + (1-\alpha)x_2^\rho]^{\frac{1}{\rho}}, \sigma = \frac{1}{1-\rho}$

1. Perfect Substitutes (Linear):
   - Focus on Efficiency: $\sigma \to \infty, \Rightarrow \rho \to 1$

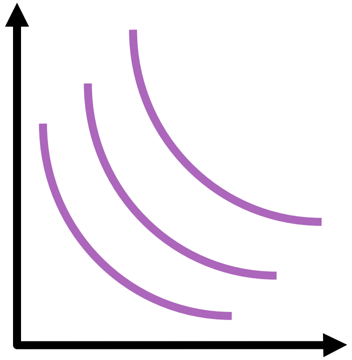
   $\Rightarrow U(x_1, x_2) \to \alpha x_1 + (1-\alpha)x_2$





2. Perfect Complements (Leontief):
   - Focus on Equity: $\sigma \to 0, \Rightarrow \rho \to -\infty$

   $\Rightarrow U(x_1, x_2) \to \min\{\alpha x_1, (1-\alpha)x_2\}$



3. Cobb-Douglas: $\sigma \to 1, \Rightarrow \rho \to 0$

   $\Rightarrow U(x_1, x_2) \to x_1^\alpha x_2^{1-\alpha}$

Demand Function Derived From CES Utility Function

- Consumer Problem with CES Utility Function

$$\max_{x_1,\, x_2} U(x_1, x_2) = [\alpha x_1^\rho + (1-\alpha)x_2^\rho]^{\frac{1}{\rho}} \text{ s.t. } p_1x_1 + p_2x_2 \le m$$

$$\mathcal{L} = [\alpha x_1^\rho + (1-\alpha)x_2^\rho]^{\frac{1}{\rho}} - \lambda\,(p_1x_1 + p_2x_2 - m)$$

$$\text{FOC: } \frac{\partial \mathcal{L}}{\partial x_1} = \frac{1}{\rho}[\alpha x_1^\rho + (1-\alpha)x_2^\rho]^{\frac{1}{\rho}-1} \cdot \rho\alpha x_1^{\rho-1} - \lambda p_1 \le 0, x_1 \ge 0$$

$$\frac{\partial \mathcal{L}}{\partial x_2} = \frac{1}{\rho}[\alpha x_1^\rho + (1-\alpha)x_2^\rho]^{\frac{1}{\rho}-1} \cdot \rho(1-\alpha)x_2^{\rho-1} - \lambda p_2 \le 0, x_2 \ge 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = p_1x_1 + p_2x_2 - m \le 0, \lambda \ge 0$$

Demand Function Derived From CES Utility Function

- Constraint binds; x_1 and x_2 are positive (increasing U):

$$(1) = \frac{1}{\rho}\left[\alpha x_1^\rho + (1-\alpha)x_2^\rho\right]^{\frac{1}{\rho}-1} \cdot \rho\alpha x_1^{\rho-1} = \lambda p_1$$

$$(2) = \frac{1}{\rho}\left[\alpha x_1^\rho + (1-\alpha)x_2^\rho\right]^{\frac{1}{\rho}-1} \cdot \rho(1-\alpha) x_2^{\rho-1} = \lambda p_2$$

$$(3) = p_1 x_1 + p_2 x_2 = m$$

$$\Rightarrow \frac{(2)}{(1)} = \frac{(1-\alpha)}{\alpha}\left(\frac{x_2}{x_1}\right)^{\rho-1} = \frac{p_2}{p_1} \Rightarrow \left(\frac{p_2}{p_1}\cdot\frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}} = \frac{x_2}{x_1}$$

Demand Function Derived From CES Utility Function

$$\Rightarrow x_2 = \left(\frac{p_2}{p_1} \cdot \frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}} \cdot x_1$$

$$(3) = m = p_1 x_1 + p_2 x_2 = x_1 \cdot \left[p_1 + p_2 \left(\frac{p_2}{p_1} \cdot \frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}}\right]$$

$$\Rightarrow x_1^* = \frac{m}{p_1 + p_2\left(\frac{p_2}{p_1} \cdot \frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}}} = \frac{m p_1^{\frac{1}{\rho-1}}}{p_1^{\frac{\rho}{\rho-1}} + p_2^{\frac{\rho}{\rho-1}}\left(\frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}}}$$

$$\Rightarrow w_1^* = \frac{p_1 x_1^*}{m} = \frac{p_1^{\frac{\rho}{\rho-1}}}{p_1^{\frac{\rho}{\rho-1}} + p_2^{\frac{\rho}{\rho-1}}\left(\frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}}}, \qquad w_2^* = 1 - w_1^*$$

Estimating CES Demand via Non-Linear Least Square

- Hence, we estimate Non-Linear Least Square (NLLS):

$$w_1 = \frac{p_1^{\frac{\rho}{\rho-1}}}{p_1^{\frac{\rho}{\rho-1}} + p_2^{\frac{\rho}{\rho-1}} \left(\frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}}} + \epsilon$$

  - For a sample of size n, consisting of w_{1i}, p_{1i}, p_{2i}
  - Find $\hat{\alpha}, \hat{\rho}$ to minimize squared random error:

$$\sum_{i=1}^{n} \left[w_{1i} - \frac{p_{1i}^{\frac{\rho}{\rho-1}}}{p_{1i}^{\frac{\rho}{\rho-1}} + p_{2i}^{\frac{\rho}{\rho-1}} \left(\frac{\alpha}{1-\alpha}\right)^{\frac{1}{\rho-1}}} \right]^2$$

Estimating CES Demand via Non-Linear Least Square

- STATA Command: `nl`

{rho} and {aa} in {} are to be estimated

```
. nl (w1 = (p1^({rho}/({rho}-1)))/((p1^({rho}/({rho}-1))) ///
> +(({aa}/(1-{aa}))^(1/({rho}-1)))*(p2^({rho}/({rho}-1))))), ///
> initial(rho 0.0 aa 0.5) vce(cluster i)
```

Provide Starting Values for NL Optimization (Required to Run!)

Cluster-Robust Standard Errors

- Applied to Andreoni and Miller (2002) data, we have...

Estimating CES Demand via Non-Linear Least Square

- STATA Results:

```
Iteration 0: residual SS = 122.2299
Iteration 1: residual SS = 115.4766
Iteration 2: residual SS = 115.4615
Iteration 3: residual SS = 115.4615
Iteration 4: residual SS = 115.4615

Nonlinear regression                          Number of obs =       1510
                                              R-squared     =     0.8804
                                              Adj R-squared =     0.8798
                                              Root MSE      =   .2767056
                                              Res. dev.     =   403.0932

                              (Std. Err. adjusted for 176 clusters in i)
------------------------------------------------------------------------------
             |               Robust
          w1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        /rho |    .272248   .0479813     5.67   0.000     .1775515    .3669445
         /aa |   .6918387   .0150264    46.04   0.000     .6621824     .721495
------------------------------------------------------------------------------
```

Need to Use Delta Method to Recover Elasticity of Substitution

Subjects take about 69.2% for themselves (Relatively Selfish as C.I. > 50%)

Estimate Elasticity of Substitution

- With $\hat{\rho}$

w1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
/rho	.272248	.0479813	5.67	0.000	.1775515	.3669445
/aa	.6918387	.0150264	46.04	0.000	.6621824	.721495

- Can Calculate Elasticity of Substitution:

$$\hat{\sigma} = \frac{1}{1-\hat{\rho}} = \frac{1}{1-0.272248} = 1.37 > 1$$

Efficiency > Equality

- STATA: `nlcom sigma: 1/(1- _b[rho:_cons])}`

(s.e./CI via Delta Method)

sigma: 1/(1- _b[rho:_cons])

w1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sigma	1.374095	.0905952	15.17	0.000	1.196531	1.551658

Part II: Using Discrete Choice Models
第二部分: 使用離散選擇模型

Joseph Tao-yi Wang (王道一)
Experimetrics Lecture 5 (實驗計量第五講)

Dictator Game with Discrete Choice

- Engelmann and Strobel (2004)
- Ask Subjects to Choose Among Several Allocations
  - To Estimate Utility Function of Own vs. Other Payoffs
  - (As Person 2)
  - Use Discrete Choice Models

Allocation	A	B	C
Person 1	8	6	10
Person 2	8	6	7
Person 3	4	6	7
Total	20	18	24

Various Types of Social Preferences

- Selfish Types: Chooses A to earn \$8
  - Better than B (\$6) or C (\$7)
- Inequity-Averse Types: Choose B to let all earn \$6
  - Guilt if A: \$8 > \$4 of Person 3
  - Envy if C: \$7 < \$10 of Person 1
- Efficiency Types: Choose C to maximize total surplus = \$24
  - Not Pareto Dominant!

Allocation	A	B	C
Person 1	8	6	10
Dictator	8	6	7
Person 3	4	6	7
Total	20	18	24

Discrete Choice Models

- Efficiency: $$EFF_j = \sum_{k=1}^{3} x_{jk}$$
  - $EFF_A = 20$; $EFF_B = 18$; $EFF_C = 24$
- Minimax: $$MM_j = \min_{k=1,2,3} x_{jk}$$
  - $MM_A = 4$; $MM_B = 6$; $MM_C = 7$
- Self: $$SELF_j = x_{j2}$$

$SELF_A = 8$; $SELF_B = 6$; $SELF_C = 7$

x_{jk} = Payoff of Person k in Allocation j

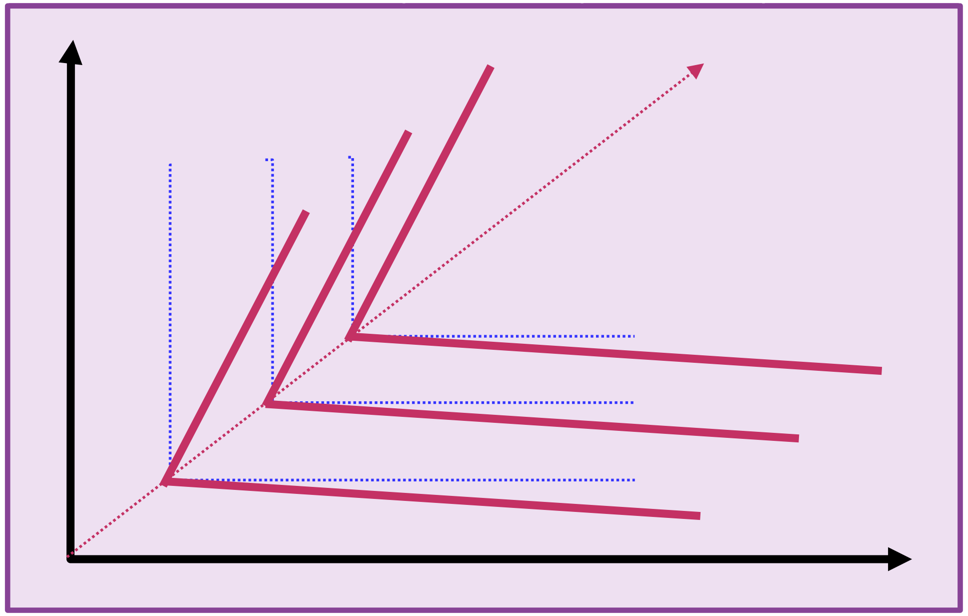
Allocation	A	B	C
Person 1	8	6	10
Dictator	8	6	7
Person 3	4	6	7
Total	20	18	24

Discrete Choice Models: Fehr and Schmidt (1999)

- F-S Utility Function: (n Players; x_i = Person i Payoff)

$$u_i = x_i - \frac{\alpha_i}{n-1}\sum_{k\neq 1}\max(x_k - x_i, 0) - \frac{\beta_i}{n-1}\sum_{k\neq 1}\max(x_i - x_k, 0)$$

- Envy α_i
  - Disadvantageous Inequality
- Guilt β_i
  - Advantageous Inequality
- Envy greater than Guilt: $\alpha_i > \beta_i$



Discrete Choice Models: Fehr and Schmidt (1999)

$$u_i = x_i - \frac{\alpha_i}{n-1}\sum_{k\neq 1}\max(x_k - x_i, 0) - \frac{\beta_i}{n-1}\sum_{k\neq 1}\max(x_i - x_k, 0)$$

(n Players; x_i = Payoff of Person i)

- Disadvantageous Inequality ($ENVY_j$):
  - FSD_A = 0; FSD_B = 0; FSD_C = -3/2

$$FSD_j = -\tfrac{1}{2}\sum_{k\neq 2}\max(x_{jk} - x_{j2}, 0)$$

- Advantageous Inequality (GLT_j):
  - FSA_A = -2; FSA_B = 0; FSA_C = 0

$$FSA_j = -\tfrac{1}{2}\sum_{k\neq 2}\max(x_{j2} - x_{jk}, 0)$$

Allocation	A	B	C
Person 1	8	6	10
Dictator	8	6	7
Person 3	4	6	7
Total	20	18	24

Conditional Logit Model (CLM)

- Simulated Engelmann and Strobel (2004): `ES_sim.dta`
- J=3 rows per subject: `asclogit` (Alternative-Specific CLM)
- Utility of Subject i for Allocation j is

$$U_{ij} = \alpha_1 FSD_{ij} + \alpha_2 FSA_{ij} + \alpha_3 EFF_{ij} + \alpha_4 MM_{ij} + \epsilon_{ij}$$

$$= \underline{\vec{z}_{ij}'\vec{\alpha}} + \underline{\epsilon_{ij}}$$

Random Component

Deterministic Component

- Intercept Not Identified (Does not affect behavior!)

Conditional Logit Model (CLM)

- $y_{ij} = 1$: Chosen if $U_{ij} = \max(U_{i1}, U_{i2}, \ldots, U_{iJ})$
- $y_{ij} = 0$: Not Chosen otherwise

$$y_{ij} = 1 \Leftrightarrow \vec{z}_{ij}'\vec{\alpha} + \epsilon_{ij} > \vec{z}_{ik}'\vec{\alpha} + \epsilon_{ik},\ \forall k \neq j$$
$$\Leftrightarrow \epsilon_{ik} - \epsilon_{ij} < \vec{z}_{ij}'\vec{\alpha} - \vec{z}_{ik}'\vec{\alpha},\ \forall k \neq j$$

- The Conditional Logit Model yields:

$$\Pr(y_{ij} = 1) = \frac{\exp(\vec{z}_{ij}'\vec{\alpha})}{\sum_{k=1}^{J} \exp(\vec{z}_{ik}'\vec{\alpha})}$$

(aka Gumbel distribution)

- Maddala (1983): ϵ_{ij}'s iid Type I Extreme Value distribution

Conditional Logit Model (CLM)

- Assume ϵ_{ij}'s are iid Type I Extreme Value distribution with pdf: $f(\epsilon) = \exp(-\epsilon - \exp(-\epsilon)),\ -\infty < \epsilon < \infty$
- And cdf: $F(\epsilon) = \exp(-\exp(-\epsilon)),\ -\infty < \epsilon < \infty$
- Then: $\Pr(y_{ij} = 1) = \dfrac{\exp(\vec{z}_{ij}'\vec{\alpha})}{\sum_{k=1}^{J} \exp(\vec{z}_{ik}'\vec{\alpha})}$
  - Likelihood: $L_i(\alpha) = \dfrac{\sum_{k=1}^{J} y_{ik} \exp(\vec{z}_{ik}'\vec{\alpha})}{\sum_{k=1}^{J} \exp(\vec{z}_{ik}'\vec{\alpha})}$
- Log-Likelihood: $\log L(\alpha) = \sum_{i=1}^{n} \ln L_i(\alpha)$

Alternative-Specific Conditional Logit Model (CLM)

- STATA Command: `asclogit y FSD FSA EFF MM, case( i) alternatives(j) noconstant`
- STATA Results:

```
Iteration 0: log likelihood = -317.10088
Iteration 1: log likelihood = -308.55197
Iteration 2: log likelihood = -308.51212
Iteration 3: log likelihood = -308.51212

Alternative-specific conditional logit          Number of obs      =        990
Case variable: i                                Number of cases    =        330
Alternative variable: t                         Alts per case: min =          3
                                                               avg =        3.0
                                                               max =          3


                                                   Wald chi2(4)    =      80.96
Log likelihood = -308.51212                        Prob > chi2     =     0.0000
------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

Alternative-S

- STATA Commar
- STATA Results:

```
Iteration 0:  log likelihood = -317.10088
Iteration 1:  log likelihood = -308.55197
Iteration 2:  log likelihood = -308.51212
Iteration 3:  log likelihood = -308.51212

Alternative-specific conditional logit         Number of obs      =       990
Case variable: i                               Number of cases    =       330
Alternative variable: t                        Alts per case: min =         3
                                                              avg =       3.0
                                                              max =         3

                                                  Wald chi2(4)    =     80.96
Log likelihood = -308.51212                       Prob > chi2     =    0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
t            |
         FSD |   .3267221   .1405881     2.32   0.020     .0511745    .6022697
         FSA |   .3447768   .1688655     2.04   0.041     .0138065    .6757472
         EFF |   .1879009   .0714842     2.63   0.009     .0477943    .3280074
          MM |   .0804075   .0895162     0.90   0.369    -.0950409     .255856
------------------------------------------------------------------------------
```

Both Inequality Aversions Matter! ($z = 2.32/2.04$)

Excluded SELF because of multicollinearity

Efficiency Even More Important! ($z = 2.63$)

Observed Heterogeneity in CLM

- Add Interactions in CLM to
  - Explain subject differences with subject characteristics
  - $male_i = 1$ if male; $= 0$ if female

$$U_{ij} = \alpha_1 FSD_{ij} + \alpha_2 \underline{FSD_{ij} \times male_i} + \alpha_3 FSA_{ij} + \alpha_4 \underline{FSA_{ij} \times male_i} + \alpha_5 EFF_{ij} + \alpha_6 MM_{ij} + \epsilon_{ij}$$

  - STATA Command:

```
asclogit y FSD male_FSD FSA male_FSA EFF MM,
            case( i) alternatives(j) noconstant
```

Observed Heterogeneity in CLM

- STATA Results:

Male exhibit more Envy ($z = 1.98$)

Female exhibit more Guilt ($z = -2.99$)

```
Alternative-specific conditional logit         Number of obs      =       990
Case variable: i                               Number of cases    =       330

Alternative variable: j                        Alts per case: min =         3
                                                              avg =       3.0
                                                              max =         3

                                                  Wald chi2(4)    =     85.42
Log likelihood = -299.6794                        Prob > chi2     =    0.0000
------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------

         FSD |   .1907648   .1552983     1.23   0.219    -.1136143     .495144
    male_FSD |   .2535549   .1281861     1.98   0.048     .0023147     .504795
         FSA |   .5649655   .1879811     3.01   0.003     .1965293    .9334017
    male_FSA |  -.5760542    .192775    -2.99   0.003    -.9538863   -.1982221
         EFF |   .1606768   .0741216     2.17   0.030     .0154012    .3059525
          MM |   .1170375    .091562     1.28   0.201    -.0624207    .2964958
------------------------------------------------------------------------------
```

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