Estimation and Prediction Codes of the IPEV model

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Sample files

File name	Description
IPEV.gss	GAUSS code for estimation (require maxlik)
IPEVmt.gss	GAUSS code for estimation (require maxlikmt)
IPEV_c.out	Output file of estimation using closed-form probability
IPEV_s.out	Output file of estimation using simulation
DEMAND.gss	GAUSS code for demand and welfare prediction
DEMAND.out	Output file of prediction
data.txt	sample data (text file)
data.xls	sample data (Excel file)
manual.pdf	This file

Sample data set

Column	Variable	Description
1	ID	ID Number
2-6	x	Consumption of inside goods (x_k)
7-11	Psi1	Individual or good specific attributes (Psi1: constant, $\mathbf{z_k}$)
12-16	Psi2	Individual or good specific attributes ($\mathbf{z_k}$)
17-21	Psi3	Individual or good specific attributes ($\mathbf{z_k}$)
22	Income	Respondents' income (E)
23-27	Price	Price of inside goods (p_k)

Preference Specification

Model Code	Utility Function
`U_FUNCTION = 1`	α-profile: Set all $\gamma_k = 1$. $$U(x) = \frac{\psi_1}{\alpha_1} x_1^{\alpha_1} + \sum_{k=2}^{K} \frac{\psi_k}{\alpha_k}\{(x_k + 1)^{\alpha_k} - 1\}$$
`U_FUNCTION = 2`	γ-profile: Set all $\alpha_k = 0$ for $k \geq 2$. $$U(x) = \frac{\psi_1}{\alpha_1} x_1^{\alpha_1} + \sum_{k=2}^{K} \gamma_k \psi_k \ln\left(\frac{x_k}{\gamma_k} + 1\right)$$
`U_FUNCTION = 3`	Hybrid profile: Set all $\alpha_1 = \alpha_k = \alpha$. $$U(x) = \frac{\psi_1}{\alpha} x_1^{\alpha} + \sum_{k=2}^{K} \frac{\gamma_k \psi_k}{\alpha}\left\{\left(\frac{x_k}{\gamma_k} + 1\right)^{\alpha} - 1\right\}$$
`U_FUNCTION = 4`	α-profile without fixed effect: Set $\gamma_k = 1$ for all k and $\alpha_k = \alpha$ for $k \geq 2$. $$U(x) = \frac{\psi_1}{\alpha_1} x_1^{\alpha_1} + \sum_{k=2}^{K} \frac{\psi_k}{\alpha}\{(x_k + 1)^{\alpha} - 1\}$$
`U_FUNCTION = 5`	γ-profile without fixed effect: Set $\alpha_k = 0$ for $k \geq 2$ and $\gamma_k = \gamma$ for all k. $$U(x) = \frac{\psi_1}{\alpha_1} x_1^{\alpha_1} + \sum_{k=2}^{K} \gamma \psi_k \ln\left(\frac{x_k}{\gamma} + 1\right)$$
`U_FUNCTION = 6`	Hybrid profile without fixed effect: Set $\alpha_1 = \alpha_k = \alpha$ and $\gamma_k = \gamma$ for all k. $$U(x) = \frac{\psi_1}{\alpha} x_1^{\alpha} + \sum_{k=2}^{K} \frac{\gamma \psi_k}{\alpha}\left\{\left(\frac{x_k}{\gamma} + 1\right)^{\alpha} - 1\right\}$$

Setting parameters of the estimation code (`IPEV.gss`)

```
@ Number of goods (including an outside good) @
N_GOODS = 6;

@ Nubmer of Psi variables @
N_PSI = 3;

@ Function form @
@ U_FUNCTION = 1; alpha profile @
@ U_FUNCTION = 2; gamma profile @
@ U_FUNCTION = 3; hybrid profile @
@ U_FUNCTION = 4; alpha profile without fixed effect @
@ U_FUNCTION = 5; gamma profile without fixed effect  @
@ U_FUNCTION = 6; hybrid profile without fixed effect  @

U_FUNCTION = 1;
```

```
@ Estimation using closed-form or simulation @
SIMULATE = 0;  @ 0: closed-form, 1: simulation @

@ Number of iterations of simulated likelihood @
N_SIM = 100;

@ HALT = 1 if Halton sequences, 0 otherwise @
HALT = 1;
```

Theoretical constraints require $\alpha \leq 1$, $\gamma > 0$, and $\sigma > 0$. In the estimation code, we use the transformation $\alpha = 1 - \exp(\hat{\alpha})$, $\gamma = \exp(\hat{\gamma})$, and $\sigma = \exp(\hat{\sigma})$, where $\hat{\alpha}$, $\hat{\gamma}$, and $\hat{\gamma}$ are the estimated parameters. After the convergence, the code calculates the reparameterized parameters (α, γ, and σ). Table 1 reports the estimation results of the reparameterized parameters with `U_FUNCTION = 1`.

Table 1. Estimation Results (`U_FUNCTION = 1`)

	Closed-form (`SIMULATE = 0`)			Simulation (`SIMULATE = 1`)		
Variables	Estimates	Est./s.e.	Prob.	Estimates	Est./s.e.	Prob.
PSI01	-0.2351	-1.744	0.081	-0.2306	-0.650	0.516
PSI02	0.1081	7.238	0.000	0.1084	7.179	0.000
PSI03	-0.1119	-7.806	0.000	-0.1116	-7.522	0.000
Alpha01	0.7080	46.204	0.000	0.7088	18.889	0.000
Alpha02	0.2818	7.473	0.000	0.2819	8.501	0.000
Alpha03	0.2153	5.312	0.000	0.2153	5.945	0.000
Alpha04	0.2186	5.272	0.000	0.2186	6.024	0.000
Alpha05	0.2103	4.296	0.000	0.2104	5.796	0.000
Alpha06	0.2012	3.802	0.000	0.2009	5.286	0.000
Sigma	0.5837	35.723	0.000	0.5839	42.515	0.000
LogL	-7368.5			-7369.22		

Setting parameters of the prediction code (`DEMAND.gss`)

```
@-------------------------@
@   Estimated Parameters  @
@-------------------------@

@ Reparameterized values @
B = {…};  @ Vector of estimated coefficients @
VCOV = {…}; @ Variance-covariance matrix @
```

```
@-------------------------@
@        Scenarios         @
@-------------------------@

{ X_INSIDE, PSIDATA, INCOME, PRICE, XOUT1, CSET_INSIDE } = mydata(DATA) ;
/*
Data matrices and vectors.
All matrices and vectors have N_OBS rows.
X_INSIDE    : Consumption of inside goods, (N_GOODS - 1) columns
PSIDATA     : Psi data, (N_GOODS - 1) * N_PSI columns
INCOME      : Income, 1 column
PRICE       : Price of inside goods, (N_GOODS - 1) columns
XOUT1       : Consumption of outside good, 1 column
CSET_INSIDE : Dummy matrix of choice set (=1 if included in choice set,
             =0 otherwise), (N_GOODS - 1) columns
*/


@ Scenario #1: Adding $10 to price of alternative 1 @

PRICE1 = PRICE ;
PRICE1[.,1]   = PRICE1[.,1] + 10;
PSIDATA1 = PSIDATA ;
CSET_INSIDE1  = CSET_INSIDE ;

@ Scenario #2: Removing alternrative 2 @
PRICE2 = PRICE ;
PRICE2[.,2]   = ones(rows(PRICE),1).*100000000 ;
PSIDATA2 = PSIDATA ;
CSET_INSIDE2  = CSET_INSIDE ;

@ Scenario #3: Adding $10 to the prices of all alternatives @
PRICE3 = PRICE + 10 ;
PSIDATA3 = PSIDATA ;
CSET_INSIDE3  = CSET_INSIDE ;

@-------------------------@
@       OTHER SETTING      @
@-------------------------@

@ Number of iterations of simulated likelihood @
N_SIM = 10;

@ Random seed @
SEED1 = 12345;
```

```
@ Number of Krinsky-Robb iterations @
N_KR = 1 ; @ N_KR = 1: point estimates, N_KR > 1: Krinsky-Robb iterations @
```

Output of point estimates (N_KR = 1)

```
Time (in minutes):                  0.089959350
Total Generated Draws:                 10.000000

Mean for Demand
      BASELINE        SCENARIO #1     SCENARIO #2     SCENARIO #3
      2.7090000       2.3163000       2.1734000      0.95490000


      GOODS           BASELINE        SCENARIO #1     SCENARIO #2     SCENARIO #3

      1.0000000      0.60500000      0.21170000      0.60525000      0.21180000
      2.0000000      0.53650000      0.53665000       0.0000000      0.18430000
      3.0000000      0.53500000      0.53515000      0.53515000      0.19170000
      4.0000000      0.53550000      0.53560000      0.53560000      0.18855000
      5.0000000      0.49700000      0.49720000      0.49740000      0.17855000


Mean for WTP
      SCENARIO #1     SCENARIO #2     SCENARIO #3
     -3.5419271      -6.1512202      -15.912885
```

Output of a Monte Carlo Simulation (N_KR = 100)

```
*****************************************************************
      Krinsky-Robb Monte Carlo Simulation, U_FUNCTION: 1
*****************************************************************
Time (in minutes):                    9.0460649
Number of Krinsky-Robb Iterations:     100.00000
Total Generated Draws:                 10.000000


Demand (Scenario #0 means the baseline)
      SCENARIO          MEAN          SD             95%lower        95%upper

      0.0000000       2.7090000   2.6779587e-15       2.7090000       2.7090000
      1.0000000       2.3154975    0.0095123534       2.2992000       2.3336500
      2.0000000       2.1735015   0.00023809588       2.1730500       2.1739500
      3.0000000      0.95343300     0.040000457      0.87685000       1.0293000


Demand for Each Good (Scenario #0 means the baseline)
      SCENARIO          GOOD            MEAN           SD             95%lower        95%upper

      0.0000000       1.0000000      0.60499850   1.1135075e-05      0.60495000      0.60500000
      0.0000000       2.0000000      0.53650100   1.0000000e-05      0.53650000      0.53655000
      0.0000000       3.0000000      0.53500050   5.0000000e-06      0.53500000      0.53500000
      0.0000000       4.0000000      0.53550000   1.0050378e-05      0.53550000      0.53550000
```

0.0000000	5.0000000	0.49700000	5.5790806e-17	0.49700000	0.49700000
1.0000000	1.0000000	0.21102100	0.0095503270	0.19475000	0.22925000
1.0000000	2.0000000	0.53661200	7.5918617e-05	0.53650000	0.53680000
1.0000000	3.0000000	0.53512550	7.9612382e-05	0.53500000	0.53530000
1.0000000	4.0000000	0.53562050	8.8218908e-05	0.53550000	0.53585000
1.0000000	5.0000000	0.49711850	8.5768952e-05	0.49700000	0.49730000
2.0000000	1.0000000	0.60526200	0.00011351145	0.60505000	0.60550000
2.0000000	2.0000000	0.0000000	0.0000000	0.0000000	0.0000000
2.0000000	3.0000000	0.53523950	0.00010547990	0.53510000	0.53540000
2.0000000	4.0000000	0.53575750	0.00010645220	0.53555000	0.53595000
2.0000000	5.0000000	0.49724250	0.00012479782	0.49705000	0.49755000
3.0000000	1.0000000	0.21111850	0.0095538100	0.19490000	0.22930000
3.0000000	2.0000000	0.18341100	0.0098784803	0.16280000	0.20145000
3.0000000	3.0000000	0.19186050	0.010572972	0.17530000	0.21255000
3.0000000	4.0000000	0.18824150	0.012931324	0.15850000	0.20960000
3.0000000	5.0000000	0.17880150	0.013501839	0.15120000	0.20225000

WTP

SCENARIO	MEAN	SD	95%lower	95%upper
1.0000000	-3.5423039	0.069632509	-3.6655675	-3.4198478
2.0000000	-6.1473089	0.42888335	-6.9674729	-5.3195009
3.0000000	-15.921517	0.29089441	-16.496975	-15.368635