Illustration 1

Aim:

- Explaining annual health care expenditures (med) and the annual number of medical consultations (mdu) as a function of health insurance characteristics ($lcoins$), socio-economic factors ($female, age,\ lfam,\ child$) and health status variables ($ndisease$)

Details:

- Cameron and Trivedi (2005), ch. 16.6

Illustration 1 – Question 1

```
. summarize med

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
         med |      20186    171.5892    698.2689          0   39182.02

. summarize med if med>0

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
         med |      15733    220.1551    784.1543   .4276146   39182.02
```

- Non-negative outcome
- High proportion of zeros: 4453 observations (22.1% of the sample units)

Illustration 1 – Question 2.1

```
. drop if year!=1
(14548 observations deleted)

. poisson med lcoins ndisease female age lfam child, robust
(…)

------------------------------------------------------------------------------
             |               Robust
         med |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0478877   .0245805    -1.95   0.051    -.0960646    .0002892
    ndisease |   .0281757   .0060746     4.64   0.000     .0162696    .0400817
      female |   .2263111   .1192456     1.90   0.058     -.007406    .4600282
         age |   .0097846    .003701     2.64   0.008     .0025307    .0170384
        lfam |  -.0928784   .0882497    -1.05   0.293    -.2658446    .0800879
       child |  -.4112285   .2444742    -1.68   0.093    -.8903892    .0679321
       _cons |   4.631177   .2039135    22.71   0.000     4.231514     5.03084
------------------------------------------------------------------------------

. estimates store poisson
```

Illustration 1 – Question 2.2

```
. poisson med lcoins ndisease female age lfam child if med>0, robust
note: you are responsible for interpretation of noncount dep. variable
(…)

Poisson regression                                Number of obs   =       4451
                                                  Wald chi2(6)    =      66.48
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1087511.2                 Pseudo R2       =     0.0657

------------------------------------------------------------------------------
             |               Robust
         med |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0200287   .0246889    -0.81   0.417     -.068418    .0283606
    ndisease |   .0210867   .0062785     3.36   0.001     .0087812    .0333923
      female |   .1474704   .1177851     1.25   0.211    -.0833842    .3783249
         age |   .0087803   .0036967     2.38   0.018     .0015349    .0160258
        lfam |  -.0823594   .0902764    -0.91   0.362    -.2592978    .0945791
       child |  -.3678983   .2481063    -1.48   0.138    -.8541777    .1183811
       _cons |    4.91825   .2098069    23.44   0.000     4.507036    5.329464
------------------------------------------------------------------------------
. estimates store poisson0
```

Illustration 1 – Question 2.3

```
. gen lmed=log(med)
(1187 missing values generated)

. regress lmed lcoins ndisease female age lfam child if med>0, robust
(…)

------------------------------------------------------------------------------
             |               Robust
        lmed |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |   -.054901    .0099633    -5.51   0.000    -.0744341   -.0353679
    ndisease |    .030717    .0030927     9.93   0.000     .0246537    .0367803
      female |   .1199091    .0417646     2.87   0.004     .0380298    .2017885
         age |   .0072817    .0020791     3.50   0.000     .0032055    .0113578
        lfam |  -.1357759    .0442937    -3.07   0.002    -.2226136   -.0489382
       child |  -.4972463    .0737896    -6.74   0.000    -.6419107   -.3525819
       _cons |   3.954487    .1043663    37.89   0.000     3.749877    4.159096
------------------------------------------------------------------------------

. estimates store log0
```

Illustration 1 – Question 2.4

```
. gen lmed1=log(med+1)

. regress lmed1 lcoins ndisease female age lfam child, robust
(…)

------------------------------------------------------------------------------
             |               Robust
       lmed1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.1485372   .0126915   -11.70   0.000    -.1734174   -.1236569
    ndisease |   .0584591   .0039132    14.94   0.000     .0507878    .0661304
      female |   .3064252   .0535977     5.72   0.000      .201353    .4114974
         age |   .0089512   .0027704     3.23   0.001     .0035202    .0143821
        lfam |  -.1806985   .0556686    -3.25   0.001    -.2898305   -.0715666
       child |  -.4759264   .0946324    -5.03   0.000    -.6614425   -.2904103
       _cons |   3.000465   .1346348    22.29   0.000     2.736529    3.264401
------------------------------------------------------------------------------

. estimates store log1
```

Illustration 1 – Question 2 (summary)

```
. estimates table poisson poisson0, b star(0.1 0.05 0.01)

---------------------------------------------
    Variable |    poisson        poisson0    
-------------+-------------------------------
      lcoins | -.04788772*      -.0200287     
    ndisease |  .02817566***    .02108674*** 
      female |  .22631112*      .14747037    
         age |  .00978456***    .00878032**  
        lfam | -.09287836      -.08235938    
       child | -.41122852*     -.3678983     
       _cons |  4.6311773***    4.9182498*** 
---------------------------------------------
           legend: * p<.1; ** p<.05; *** p<.01

. estimates table log0 log1, b star(0.1 0.05 0.01)

---------------------------------------------
    Variable |     log0            log1      
-------------+-------------------------------
      lcoins | -.05490096***   -.14853716*** 
    ndisease |  .03071698***     .0584591*** 
      female |  .11990912***     .3064252*** 
         age |  .00728165***    .00895117*** 
        lfam | -.13577591***   -.18069853*** 
       child |  -.4972463***   -.47592639*** 
       _cons |  3.9544865***    3.0004653*** 
---------------------------------------------
```

Illustration 1 – Question 3.1

```
. summarize mdu
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
         mdu |      5638    2.877971    4.332918          0         69

. tabulate mdu

     number |
face-to-fac |
e md visits |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |      1,729       30.67       30.67
          1 |      1,047       18.57       49.24
          2 |        814       14.44       63.68
          3 |        511        9.06       72.74
          4 |        385        6.83       79.57
          5 |        271        4.81       84.37
          6 |        188        3.33       87.71
          7 |        156        2.77       90.48
          8 |        134        2.38       92.85
          9 |         80        1.42       94.27
         10 |         56        0.99       95.26
         11 |         56        0.99       96.26
         12 |         32        0.57       96.83
(…)
```

Illustration 1 – Question 3.2.1

```
. poisson mdu lcoins ndisease female age lfam child

Poisson regression                                Number of obs   =       5638
                                                  LR chi2(6)      =    2296.50
                                                  Prob > chi2     =     0.0000
Log likelihood = -17173.058                       Pseudo R2       =     0.0627

------------------------------------------------------------------------------
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0682563   .0038214   -17.86   0.000    -.0757462   -.0607665
    ndisease |     .03538   .0010286    34.40   0.000     .0333639     .037396
      female |   .1276798   .0164078     7.78   0.000     .0955211    .1598386
         age |   .0041167   .0007841     5.25   0.000     .0025798    .0056536
        lfam |   -.141855   .0154716    -9.17   0.000    -.1721789   -.1115312
       child |    .056673   .0278998     2.03   0.042     .0019903    .1113557
       _cons |   .7463066   .0385653    19.35   0.000       .67072    .8218932
------------------------------------------------------------------------------

. estimates store cpoissonml
```

Illustration 1 – Question 3.2.2

```
. poisson mdu lcoins ndisease female age lfam child, robust

Poisson regression                              Number of obs    =       5638
                                                Wald chi2(6)     =     388.20
                                                Prob > chi2      =     0.0000
Log pseudolikelihood = -17173.058               Pseudo R2        =     0.0627

------------------------------------------------------------------------------
             |               Robust
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0682563    .0094538    -7.22   0.000    -.0867854   -.0497273
    ndisease |     .03538     .002696    13.12   0.000     .0300959    .0406641
      female |   .1276798      .04043     3.16   0.002     .0484385    .2069211
         age |   .0041167    .0019155     2.15   0.032     .0003624     .007871
        lfam |   -.141855    .0336317    -4.22   0.000     -.207772   -.0759381
       child |    .056673    .0625248     0.91   0.365    -.0658734    .1792194
       _cons |   .7463066    .0861806     8.66   0.000     .5773956    .9152175
------------------------------------------------------------------------------

. estimates store cpoissonqml
```

Illustration 1 – Question 3.2.3

```
. nbreg mdu lcoins ndisease female age lfam child, dispersion(constant)

Negative binomial regression                    Number of obs   =       5638
                                                LR chi2(6)      =     529.02
Dispersion     = constant                       Prob > chi2     =     0.0000
Log likelihood = -12128.041                     Pseudo R2       =     0.0213

------------------------------------------------------------------------------
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |   -.076432   .0069326   -11.02   0.000    -.0900197   -.0628442
    ndisease |   .0309127   .0019493    15.86   0.000     .0270922    .0347333
      female |   .1447002    .029679     4.88   0.000     .0865305    .2028699
         age |   .0027029   .0014494     1.86   0.062    -.0001378    .0055436
        lfam |  -.1235042   .0276393    -4.47   0.000    -.1776761   -.0693323
       child |  -.0049686   .0499784    -0.10   0.921    -.1029245    .0929873
       _cons |   .8537349   .0697031    12.25   0.000     .7171195    .9903504
-------------+----------------------------------------------------------------
    /lndelta |   1.278115   .0319841                      1.215427    1.340802
-------------+----------------------------------------------------------------
       delta |   3.589865   .1148187                      3.371733    3.822109
------------------------------------------------------------------------------
Likelihood-ratio test of delta=0:  chibar2(01) = 1.0e+04 Prob>=chibar2 = 0.000

. estimates store cnegbin1
```

Overdispersion test: the hypothesis of correct specification of the Poisson mode is rejected

Illustration 1 – Question 3.2.4

```
. nbreg mdu lcoins ndisease female age lfam child, dispersion(mean)

Negative binomial regression                      Number of obs   =       5638
                                                  LR chi2(6)      =     459.10
Dispersion     = mean                             Prob > chi2     =     0.0000
Log likelihood = -12163.001                       Pseudo R2       =     0.0185

------------------------------------------------------------------------------
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0719827   .0083402    -8.63   0.000    -.0883292   -.0556362
    ndisease |   .0391488    .002618    14.95   0.000     .0340175    .0442801
      female |   .1229883   .0350213     3.51   0.000     .0543479    .1916288
         age |   .0035899   .0017692     2.03   0.042     .0001223    .0070574
        lfam |  -.1834739    .036481    -5.03   0.000    -.2549754   -.1119723
       child |   .0842864   .0621692     1.36   0.175    -.0375631    .2061359
       _cons |   .7638038    .087809     8.70   0.000     .5917012    .9359063
-------------+----------------------------------------------------------------
    /lnalpha |   .2193579   .0274111                      .1656333    .2730826
-------------+----------------------------------------------------------------
       alpha |   1.245277   .0341344                       1.18014    1.314009
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0:  chibar2(01) = 1.0e+04 Prob>=chibar2 = 0.000

. estimates store cnegbin2
```

Overdispersion test: the hypothesis of correct specification of the Poisson model is rejected

Illustration 1 – Question 3.2 (summary)

```
. estimates table cpoissonml cpoissonqml cnegbin1 cnegbin2, b star(0.1 0.05
0.01)

------------------------------------------------------------------------------
    Variable |  cpoissonml       cpoissonqml       cnegbin1          cnegbin2
-------------+----------------------------------------------------------------
mdu          |
      lcoins | -.06825635***   -.06825635***   -.07643198***    -.0719827***
    ndisease |  .03537998***    .03537998***    .03091273***    .03914881***
      female |  .12767984***    .12767984***     .1447002***    .12298834***
         age |   .0041167***     .0041167**      .0027029*      .00358987**
        lfam | -.14185505***   -.14185505***    -.1235042***   -.18347387***
       child |  .05667301**     .05667301      -.00496864        .0842864
       _cons |  .74630658***    .74630658***    .85373493***    .76380377***
-------------+----------------------------------------------------------------
lndelta      |
       _cons |                                  1.2781147***
-------------+----------------------------------------------------------------
lnalpha      |
       _cons |                                                  .21935795***
------------------------------------------------------------------------------
                                         legend: * p<.1; ** p<.05; *** p<.01
```

Illustration 1 – Question 3.3

```
. estimates restore cpoissonml
(results cpoissonml are active now)
```

Formulas:

$$Pr(Y_i = y|x_i) = \frac{e^{-\lambda_i}\lambda_i{}^y}{y!}, \qquad \lambda_i = E(Y|X) = exp(x_i'\beta)$$

- $Pr(Y_i = 0|x_i) = e^{-\lambda_i}$
- $Pr(Y_i = 1|x_i) = e^{-\lambda_i}\lambda_i$
- $Pr(Y_i \geq 2|x_i) = 1 - Pr(Y_i = 0|x_i) - Pr(Y_i = 1|x_i)$

```
. scalar lambda0 = exp(_b[_cons] + _b[lcoins]*log(1) + _b[age]*50 +
_b[lfam]*log(3))

. scalar lambda1 = exp(_b[_cons] + _b[lcoins]*log(51) + _b[age]*50 +
_b[lfam]*log(3))

. scalar lambda2 = exp(_b[_cons] + _b[lcoins]*log(101) + _b[age]*50 +
_b[lfam]*log(3))
```

Note that lcoins is defined in the dataset as ln(coins+1) to avoid discarding 0's

Illustration 1 – Question 3.3 (cont.)

```
. display lambda0
2.2173168

. display lambda1
1.695412

. display lambda2
1.6181549

. display exp(-lambda0)
.10890092

. display exp(-lambda1)
.18352361

. display exp(-lambda2)
.19826418
```

```
. display exp(-lambda0)*lambda0
.24146784

. display exp(-lambda1)*lambda1
.31114812

. display exp(-lambda2)*lambda2
.32082215

. display 1-0.10890092-0.24146784
.64963124

. display 1-0.18352361-0.31114812
.50532827

. display 1-0.19826418-0.32082215
.48091367
```

Illustration 1 – Question 3.3 (cont.)

$coins$:	0	50	100
$E(mdu\|\ldots)$	2.2	1.7	1.6
$Pr(mdu = 0\|\ldots)$	10.9	18.4	19.8
$Pr(mdu = 1\|\ldots)$	24.1	31.1	32.1
$Pr(mdu \geq 2\|\ldots)$	65.0	50.5	48.1

Illustration 1 – Question 4.1

```
. xtset id year
       panel variable:  id (unbalanced)
        time variable:  year, 1 to 5, but with gaps
                delta:  1 unit

. xtdescribe

      id:  125024, 125025, ..., 632167                        n =       5908
    year:  1, 2, ..., 5                                       T =          5
           Delta(year) = 1 unit
           Span(year)  = 5 periods
           (id*year uniquely identifies each observation)

Distribution of T_i:   min      5%     25%       50%       75%     95%     max
                         1       2       3         3         5       5       5

     Freq.  Percent    Cum. |  Pattern
 ---------------------------+---------
     3710     62.80   62.80 |  111..
     1584     26.81   89.61 |  11111
      156      2.64   92.25 |  1....
      147      2.49   94.74 |  11...
       79      1.34   96.07 |  ..1..
       66      1.12   97.19 |  .11..
       33      0.56   97.75 |  ..111
       33      0.56   98.31 |  .1111
       29      0.49   98.80 |  ...11
       71      1.20  100.00 | (other patterns)
 ---------------------------+---------
     5908    100.00         |  XXXXX
```

Illustration 1 – Question 4.2.1

```
. poisson mdu lcoins ndisease female age lfam child, vce(cluster id)

Poisson regression                              Number of obs   =      20186
                                                Wald chi2(6)    =     476.93
                                                Prob > chi2     =     0.0000
Log pseudolikelihood = -62579.401               Pseudo R2       =     0.0609
                                  (Std. Err. adjusted for 5908 clusters in id)
------------------------------------------------------------------------------
             |               Robust
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0808023   .0080013   -10.10   0.000    -.0964846   -.0651199
    ndisease |   .0339334   .0026024    13.04   0.000     .0288328     .039034
      female |   .1717862   .0342551     5.01   0.000     .1046473    .2389251
         age |   .0040585   .0016891     2.40   0.016      .000748    .0073691
        lfam |  -.1481981   .0323434    -4.58   0.000      -.21159   -.0848062
       child |   .1030453   .0506901     2.03   0.042     .0036944    .2023961
       _cons |    .748789   .0785738     9.53   0.000     .5947872    .9027907
------------------------------------------------------------------------------

. estimates store pooled
```

Note that s.e. are almost 4 times larger than their standard version, that overlooks overdispersion

Illustration 1 – Question 4.2.2

```
. xtpoisson mdu lcoins ndisease female age lfam child, re
(…)

------------------------------------------------------------------------------
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lcoins |  -.0878258   .0068682   -12.79   0.000    -.1012873   -.0743642
    ndisease |   .0387629   .0022046    17.58   0.000      .034442    .0430839
      female |   .1667192   .0286298     5.82   0.000     .1106058    .2228325
         age |   .0019159   .0011134     1.72   0.085    -.0002663    .0040982
        lfam |  -.1351786   .0260022    -5.20   0.000     -.186142   -.0842152
       child |   .1082678   .0341477     3.17   0.002     .0413396    .1751961
       _cons |   .7574177   .0618346    12.25   0.000     .6362241    .8786112
-------------+----------------------------------------------------------------
    /lnalpha |   .0251256   .0209586                     -.0159526    .0662038
-------------+----------------------------------------------------------------
       alpha |   1.025444   .0214919                       .984174    1.068444
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0: chibar2(01) =  3.9e+04 Prob>=chibar2 = 0.000

. estimates store RE
```

Illustration 1 – Question 4.2.3

```
. xtpoisson mdu lcoins ndisease female age lfam child, fe
note: 265 groups (265 obs) dropped because of only one obs per group
note: 666 groups (2130 obs) dropped because of all zero outcomes
note: lcoins dropped because it is constant within group
note: ndisease dropped because it is constant within group
note: female dropped because it is constant within group
(…)

                                                Wald chi2(3)      =     19.24
Log likelihood  = -24173.211                    Prob > chi2       =    0.0002

------------------------------------------------------------------------------
         mdu |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0112009   .0039024    -2.87   0.004    -.0188494   -.0035523
        lfam |   .0877134   .0554606     1.58   0.114    -.0209874    .1964141
       child |   .1059867   .0437744     2.42   0.015     .0201905    .1917829
------------------------------------------------------------------------------

. estimates store FE
```

Illustration 1 – Question 4.2 (summary)

```
. estimates table pooled RE FE, b star(0.1 0.05 0.01)

-------------------------------------------------------------
    Variable |    pooled           RE               FE
-------------+-----------------------------------------------
mdu          |
      lcoins | -.08080226***   -.08782576***
    ndisease |   .0339334***    .03876295***
      female |  .17178621***    .16671918***
         age |  .00405853**     .00191594*      -.01120087***
        lfam |  -.1481981***   -.13517858***     .08771336
       child |  .10304526**     .10826785***     .10598669**
       _cons |  .74878896***     .7574177***
-------------+-----------------------------------------------
lnalpha      |
       _cons |                  .02512562
-------------------------------------------------------------
                      legend: * p<.1; ** p<.05; *** p<.01
```

Note that relative to pooled and RE results, FE:

- Coefficients differ substantially (allow correlation between individual heterogeneity and time-varying covariates)
- Tend to present larger s.e. for identified coefficients (less significance)

Illustration 1 – Question 4.3

```
. hausman FE RE

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       EF           EA         Difference          S.E.
-------------+----------------------------------------------------------------
         age |   -.0112009     .0019159       -.0131168        .0037402
        lfam |    .0877134    -.1351786        .2228919        .0489874
       child |    .1059867     .1082678       -.0022812        .0273886
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtpoisson
            B = inconsistent under Ha, efficient under Ho; obtained from xtpoisson

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       29.73
                Prob>chi2 =      0.0000
```

The hypothesis of random effects is rejected

Illustration 2 – Question 1

```
. drop if LE==1
(1922 observations deleted)

. summarize LEV_LT1

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     LEV_LT1 |      30304    .0734047    .1668595          0    .9982489

. count if LEV_LT==0
23027

. display 23027/30304
.75986668
```

Illustration 2 – Question 2

```
. glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE, family(binomial) link(logit)
vce(cluster id)
(…)

                                                  AIC             =  .4259979
Log pseudolikelihood =  -6448.71996               BIC             = -304709.7

                                  (Std. Err. adjusted for 4995 clusters in id)
------------------------------------------------------------------------------
             |               Robust
     LEV_LT1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .3160809   .0150444    21.01   0.000     .2865946    .3455673
     COLLAT2 |    .453255   .1394787     3.25   0.001     .1798818    .7266282
       PROF1 |  -3.629699   .2667238   -13.61   0.000    -4.152469    -3.10693
     GROWTH2 |   .0004846   .0002476     1.96   0.050    -6.89e-07    .0009699
         AGE |  -.0045993   .0017012    -2.70   0.007    -.0079335   -.0012651
       _cons |  -6.823869   .2264392   -30.14   0.000    -7.267681   -6.380056
------------------------------------------------------------------------------

. estimates store LOGIT
```

Illustration 2 – Question 3.1, 3.2 & 3.3

3.1 Logit model:

$$E(LEV\_LT_i|x_i) = \frac{e^{x_i'\beta}}{1+e^{x_i'\beta}}$$

```
. estimates restore LOGIT
(results LOGIT are active now)

. scalar xb = _b[_cons] + _b[SIZE2]*13.54 + _b[COLLAT2]*0.41 + _b[PROF1]*0.07 +
_b[GROWTH2]*15.03 + _b[AGE]*19

. display exp(xb)/(1+exp(xb))
.06341858
```

3.2 By definition, it is approximately equal to one

3.3 By definition, $E(LEV\_LT_i|x_i, Y_i > 0) \approx E(LEV\_LT_i|x_i)$

Illustration 2 – Question 4

```
. quietly glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE, family(binomial)
link(logit) vce(cluster id)

. predict xbL, xb

. gen xbL2=xbL^2

. gen xbL3=xbL^3

. quietly glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE xbL2 xbL3 ,
family(binomial) link(logit) vce(cluster id)

. test xbL2 xbL3

 ( 1)  [LEV_LT1]xbL2 = 0
 ( 2)  [LEV_LT1]xbL3 = 0

           chi2(  2) =  131.99
         Prob > chi2 =    0.0000
```

Illustration 2 – Question 4

```
. quietly glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE, family(binomial)
link(probit) vce(cluster id)

. predict xbP, xb

. gen xbP2=xbP^2

. gen xbP3=xbP^3

. quietly glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE xbP2 xbP3 ,
family(binomial) link(probit) vce(cluster id)

. test xbP2 xbP3

 ( 1)  [LEV_LT1]xbP2 = 0
 ( 2)  [LEV_LT1]xbP3 = 0

           chi2(  2) =  120.35
         Prob > chi2 =    0.0000
```

Illustration 2 – Question 4

```
. quietly glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE, family(binomial)
link(logit) vce(cluster id)
. margins, dydx (SIZE2 COLLAT2 PROF1 GROWTH2 AGE) atmean
Conditional marginal effects                    Number of obs     =     30,304
Model VCE     : Robust
Expression    : Predicted mean LEV_LT1, predict()
dy/dx w.r.t. : SIZE2 COLLAT2 PROF1 GROWTH2 AGE
at            : SIZE2           =    13.53998 (mean)
                COLLAT2         =    .4105925 (mean)
                PROF1           =    .0678864 (mean)
                GROWTH2         =      15.034 (mean)
                AGE             =    19.38932 (mean)
------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .0188751   .0008384    22.51   0.000     .0172319    .0205184
     COLLAT2 |   .0270666   .0080893     3.35   0.001      .011212    .0429213
       PROF1 |  -.2167517   .0160444   -13.51   0.000    -.2481981   -.1853052
     GROWTH2 |   .0000289   .0000148     1.95   0.051    -9.42e-08     .000058
         AGE |  -.0002747   .0001021    -2.69   0.007    -.0004747   -.0000746
------------------------------------------------------------------------------
```

Illustration 2 – Question 4

```
. margins, dydx (SIZE2 COLLAT2 PROF1 GROWTH2 AGE)

Average marginal effects                        Number of obs     =     30,304
Model VCE     : Robust

Expression    : Predicted mean LEV_LT1, predict()
dy/dx w.r.t. : SIZE2 COLLAT2 PROF1 GROWTH2 AGE

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .0210336   .0010403    20.22   0.000     .0189947    .0230724
     COLLAT2 |   .0301618   .0091286     3.30   0.001       .01227    .0480536
       PROF1 |  -.2415379   .0185096   -13.05   0.000     -.277816   -.2052598
     GROWTH2 |   .0000322   .0000165     1.95   0.051    -8.76e-08    .0000646
         AGE |  -.0003061   .0001139    -2.69   0.007    -.0005292   -.0000829
------------------------------------------------------------------------------
```

Illustration 2 – Question 4

```
. quietly glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE xbP2 xbP3 ,
family(binomial) link(probit) vce(cluster id)
. margins, dydx (SIZE2 COLLAT2 PROF1 GROWTH2 AGE) atmean
Conditional marginal effects                    Number of obs     =     30,304
Model VCE      : Robust
Expression     : Predicted mean LEV_LT1, predict()
dy/dx w.r.t. : SIZE2 COLLAT2 PROF1 GROWTH2 AGE
at             : SIZE2           =    13.53998 (mean)
                 COLLAT2         =    .4105925 (mean)
                 PROF1           =    .0678864 (mean)
                 GROWTH2         =      15.034 (mean)
                 AGE             =    19.38932 (mean)
------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .0201057   .0009364    21.47   0.000     .0182704    .0219409
     COLLAT2 |   .0245778    .008263     2.97   0.003     .0083827     .040773
       PROF1 |  -.2265281    .017486   -12.95   0.000    -.2608001   -.1922561
     GROWTH2 |   .0000398   .0000184     2.17   0.030     3.79e-06    .0000758
         AGE |  -.0002937   .0001078    -2.72   0.006    -.0005049   -.0000824
------------------------------------------------------------------------------
```

Illustration 2 – Question 4

```
. margins, dydx (SIZE2 COLLAT2 PROF1 GROWTH2 AGE)

Average marginal effects                        Number of obs     =     30,304
Model VCE    : Robust

Expression   : Predicted mean LEV_LT1, predict()
dy/dx w.r.t. : SIZE2 COLLAT2 PROF1 GROWTH2 AGE

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .0213241   .0010521    20.27   0.000      .019262    .0233862
     COLLAT2 |   .0260673   .0088125     2.96   0.003      .008795    .0433395
       PROF1 |  -.2402559   .0189853   -12.65   0.000    -.2774664   -.2030453
     GROWTH2 |   .0000422   .0000195     2.17   0.030     4.04e-06    .0000804
         AGE |  -.0003115   .0001144    -2.72   0.006    -.0005357   -.0000873
------------------------------------------------------------------------------

.
```

Illustration 2 – Question 5

```
. xtset id YEAR
       panel variable:  id (unbalanced)
        time variable:  YEAR, 1995 to 2001, but with gaps
                delta:  1 unit
. gen LEVt= LEV_LT1/(1- LEV_LT1)

. xtpoisson LEVt SIZE2 COLLAT2 PROF1 GROWTH2 AGE, fe vce(bootstrap)
(…)
Conditional fixed-effects Poisson regression    Number of obs      =     13245
Group variable: id                              Number of groups   =      2048
(…)
                                   (Replications based on 2048 clusters in id)
------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
        LEVt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |  -.2563746   .1857317    -1.38   0.167     -.620402    .1076529
     COLLAT2 |   .7169194   .4518515     1.59   0.113    -.1686932    1.602532
       PROF1 |  -1.205703   2.287238    -0.53   0.598    -5.688608    3.277201
     GROWTH2 |   .0024675   .0016065     1.54   0.125    -.0006813    .0056162
         AGE |   .0402399   .0242907     1.66   0.098     -.007369    .0878487
------------------------------------------------------------------------------
```

Illustration 2 – Question 5

```
. gen LEVtlink=ln(LEV_LT1/(1- LEV_LT1))
(23027 missing values generated)

. xtreg LEVtlink SIZE2 COLLAT2 PROF1 GROWTH2 AGE, fe vce(bootstrap)
(running xtreg on estimation sample)
(…)
Fixed-effects (within) regression               Number of obs      =      7277
Group variable: id                              Number of groups   =      2064
(…)
                                 (Replications based on 2064 clusters in id)
------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
    LEVtlink |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |  -.0741736    .0541096    -1.37   0.170    -.1802265    .0318793
     COLLAT2 |  -.1839106    .1936327    -0.95   0.342    -.5634237    .1956025
       PROF1 |  -1.928813    .4180013    -4.61   0.000     -2.74808   -1.109545
     GROWTH2 |   .0017424    .0005736     3.04   0.002     .0006181    .0028667
         AGE |  -.0132349    .0073683    -1.80   0.072    -.0276765    .0012067
       _cons |   .4652777    .8023379     0.58   0.562    -1.107276    2.037831
-------------+----------------------------------------------------------------
(…)
```

Illustration 3 – Question 1.1

```
. gen DIVIDA=LEV_LT1>0

. probit DIVIDA SIZE2 COLLAT2 PROF1 GROWTH2 AGE, vce(cluster id)
(…)
Probit regression                                 Number of obs   =      30304
                                                  Wald chi2(5)    =    1125.30
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -14363.976                 Pseudo R2       =     0.1401

                                  (Std. Err. adjusted for 4995 clusters in id)
------------------------------------------------------------------------------
             |               Robust
      DIVIDA |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .3309445    .011001    30.08   0.000      .309383    .3525061
     COLLAT2 |    .754961     .07028    10.74   0.000     .6172147    .8927074
       PROF1 |  -2.114841    .176704   -11.97   0.000    -2.461175   -1.768508
     GROWTH2 |    .000226   .0001309     1.73   0.084    -.0000307    .0004826
         AGE |   .0011396   .0011065     1.03   0.303     -.001029    .0033082
       _cons |  -5.510938   .1548431   -35.59   0.000    -5.814425   -5.207451
------------------------------------------------------------------------------
. estimates store DP1
```

Illustration 3 – Question 1.1 (cont.)

```
. glm LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE if LEV_LT>0, family(binomial)
link(logit) vce(cluster id)
(…)

                                                  AIC             =  .8776548
Log pseudolikelihood = -3187.347033               BIC             = -63243.49

                               (Std. Err. adjusted for 2064 clusters in id)
------------------------------------------------------------------------------
             |               Robust
     LEV_LT1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   -.185588   .0140524   -13.21   0.000    -.2131301   -.1580459
     COLLAT2 |  -.7261906   .0998168    -7.28   0.000    -.9218279   -.5305533
       PROF1 |  -1.523694   .2894609    -5.26   0.000    -2.091027   -.9563615
     GROWTH2 |   .0030029   .0004916     6.11   0.000     .0020395    .0039663
         AGE |  -.0071666   .0013872    -5.17   0.000    -.0098856   -.0044477
       _cons |   2.389845   .2057352    11.62   0.000     1.986611    2.793078
------------------------------------------------------------------------------

. estimates store DP2
```

Illustration 3 – Question 1.2

```
. tobit LEV_LT1 SIZE2 COLLAT2 PROF1 GROWTH2 AGE, ll(0) vce(cluster id)
(…)
                                  (Std. Err. adjusted for 4995 clusters in id)
------------------------------------------------------------------------------
             |               Robust
     LEV_LT1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .1228862   .0040375    30.44   0.000     .1149725       .1308
     COLLAT2 |   .2341081   .0318929     7.34   0.000     .1715967    .2966195
       PROF1 |  -.9789402   .0758608   -12.90   0.000    -1.127631   -.8302498
     GROWTH2 |   .0001581   .0000812     1.95   0.052    -1.13e-06    .0003173
         AGE |  -.0003276   .0004359    -0.75   0.452    -.001182     .0005267
       _cons |  -2.064098   .0565249   -36.52   0.000    -2.174889   -1.953306
-------------+----------------------------------------------------------------
      /sigma |   .4669837   .0080894                      .4511282    .4828392
------------------------------------------------------------------------------
  Obs. summary:      23027  left-censored observations at LEV_LT1<=0
                      7277     uncensored observations
                         0 right-censored observations

. estimates store TOBIT
```

Illustration 3 – Question 2.2

```
. gen DIVIDA=LEV_LT1>0

. probit DIVIDA SIZE2 COLLAT2 PROF1 GROWTH2 AGE, vce(cluster id)
(…)
Probit regression                                 Number of obs   =      30304
                                                  Wald chi2(5)    =    1125.30
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -14363.976                 Pseudo R2       =     0.1401

                                  (Std. Err. adjusted for 4995 clusters in id)
------------------------------------------------------------------------------
             |               Robust
      DIVIDA |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       SIZE2 |   .3309445    .011001    30.08   0.000      .309383    .3525061
     COLLAT2 |    .754961     .07028    10.74   0.000     .6172147    .8927074
       PROF1 |  -2.114841    .176704   -11.97   0.000    -2.461175   -1.768508
     GROWTH2 |    .000226   .0001309     1.73   0.084    -.0000307    .0004826
         AGE |   .0011396   .0011065     1.03   0.303     -.001029    .0033082
       _cons |  -5.510938   .1548431   -35.59   0.000    -5.814425   -5.207451
------------------------------------------------------------------------------
. estimates store DP1
```

Illustration 3 – Question 2.1

Two-part model:

$$E(LEV\_LT_i|x_i) = \Phi(x_i'\theta)\frac{e^{x_i'\beta}}{1+e^{x_i'\beta}}$$

```
. estimates restore DP1
(results DP1 are active now)

. scalar xb1 = _b[_cons] + _b[SIZE2]*13.54 + _b[COLLAT2]*0.41 + _b[PROF1]*0.07
+ _b[GROWTH2]*15.03 + _b[AGE]*19

. estimates restore DP2
(results DP2 are active now)

. scalar xb2 = _b[_cons] + _b[SIZE2]*13.54 + _b[COLLAT2]*0.41 + _b[PROF1]*0.07
+ _b[GROWTH2]*15.03 + _b[AGE]*19

. display normal(xb1)*exp(xb2)/(1+exp(xb2))
.06985232
```

Illustration 3 – Question 2.1 (cont.)

Tobit model:

$$E(LEV\_LT_i|x_i) = \Phi\left(\frac{x_i'\beta}{\sigma}\right)x_i'\beta + \sigma\phi\left(\frac{x_i'\beta}{\sigma}\right)$$

```
. estimates restore TOBIT
(results TOBIT are active now)

. scalar xbt = _b[_cons] + _b[SIZE2]*13.54 + _b[COLLAT2]*0.41 + _b[PROF1]*0.07
+ _b[GROWTH2]*15.03 + _b[AGE]*19

. display normal(xbt/_b[/sigma])*xbt+_b[/sigma]*normalden(xbt/_b[/sigma])
.05549759
```

Illustration 3 – Question 2.2

Two-part model:

$$Pr(LEV\_LT_i > 0|x_i) = \Phi(x_i'\theta)$$

```
. display normal(xb1)
.19950111
```

Tobit model:

$$Pr(LEV\_LT_i > 0|x_i) = \Phi\left(\frac{x_i'\beta}{\sigma}\right)$$

```
. estimates restore TOBIT
(results TOBIT are active now)

. display normal(xbt/_b[/sigma])
.20998609
```

Illustration 3 – Question 2.3

Two-part model:

$$E(LEV\_LT_i|x_i, Y_i > 0) = \frac{e^{x_i'\beta}}{1 + e^{x_i'\beta}}$$

```
. display exp(xb2)/(1+exp(xb2))
.35013498
```

Tobit model:

$$E(Y_i|x_i, Y_i > 0) = x_i'\beta + \sigma\lambda\left(\frac{x_i'\beta}{\sigma}\right)$$

```
. estimates restore TOBIT
(results TOBIT are active now)

. display xbt+_b[/sigma]*normalden(xbt/_b[/sigma])/normal(xbt/_b[/sigma])
.26429175
```

Illustration 4

Description of share2:

```
. summarize share2
    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      share2 |       2724    .0122429     .024919          0    .1927609

. count if share2==0
 1688

. display 1688/2724
.61967695
```

Illustration 4 – Question 1

```
. tobit share2 age nadults nkids nkids2 lnx agelnx nadlnx, ll(0)
Tobit regression                                  Number of obs   =       2724
                                                  LR chi2(7)      =     170.18
                                                  Prob > chi2     =     0.0000
Log likelihood =  758.70053                       Pseudo R2       =    -0.1263
------------------------------------------------------------------------------
      share2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.1258528   .0241782    -5.21   0.000    -.1732624   -.0784432
     nadults |     .01537   .0380475     0.40   0.686    -.0592349     .089975
       nkids |   .0042697   .0013247     3.22   0.001     .0016723    .0068671
      nkids2 |  -.0099719   .0054713    -1.82   0.068    -.0207002    .0007565
         lnx |  -.0444314   .0068893    -6.45   0.000    -.0579402   -.0309225
      agelnx |   .0088221   .0017832     4.95   0.000     .0053256    .0123187
      nadlnx |  -.0006007   .0027501    -0.22   0.827    -.0059933    .0047918
       _cons |   .5899797   .0934268     6.31   0.000     .4067849    .7731745
-------------+----------------------------------------------------------------
      /sigma |   .0479951   .0011832                      .0456751    .0503151
------------------------------------------------------------------------------
  Obs. summary:       1688  left-censored observations at share2<=0
                      1036     uncensored observations
                         0 right-censored observations
```

Illustration 4 – Question 2

```
. probit d2 age nadults nkids nkids2 lnx agelnx nadlnx
(…)
Probit regression                                 Number of obs   =       2724
                                                  LR chi2(7)      =     101.68
                                                  Prob > chi2     =     0.0000
Log likelihood = -1758.5011                       Pseudo R2       =     0.0281
------------------------------------------------------------------------------
          d2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -2.479476   .5573451    -4.45   0.000    -3.571853     -1.3871
     nadults |   .6532982   .8664414     0.75   0.451    -1.044896    2.351492
       nkids |   .0878242   .0305731     2.87   0.004      .027902    .1477463
      nkids2 |  -.2184835   .1224591    -1.78   0.074    -.4584988    .0215319
         lnx |  -.6162177   .1615998    -3.81   0.000    -.9329476   -.2994879
      agelnx |   .1732215   .0410448     4.22   0.000     .0927751    .2536678
      nadlnx |  -.0365886   .0625613    -0.58   0.559    -.1592064    .0860293
       _cons |   8.077725   2.197003     3.68   0.000     3.771679    12.38377
------------------------------------------------------------------------------
```

Illustration 4 – Question 2

```
. reg share2 age nadults nkids nkids2 lnx agelnx nadlnx if share2>0
      Source |       SS       df       MS              Number of obs =    1036
-------------+------------------------------           F(  7,  1028) =   26.73
       Model |   .15794176     7  .022563109           Prob > F      =  0.0000
    Residual |  .867670386  1028  .000844037           R-squared     =  0.1540
-------------+------------------------------           Adj R-squared =  0.1482
       Total |  1.02561215  1035   .00099093           Root MSE      =  .02905
------------------------------------------------------------------------------
      share2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0314662   .0205632    -1.53   0.126    -.0718168    .0088844
     nadults |  -.0130266   .0324149    -0.40   0.688    -.0766334    .0505803
       nkids |   .0012847   .0010541     1.22   0.223    -.0007837    .0033531
      nkids2 |  -.0034369    .004556    -0.75   0.451    -.0123771    .0055033
         lnx |  -.0335767   .0054672    -6.14   0.000    -.0443049   -.0228484
      agelnx |   .0022097    .001516     1.46   0.145     -.000765    .0051844
      nadlnx |   .0011125    .002345     0.47   0.635     -.003489    .0057141
       _cons |   .4896596   .0740595     6.61   0.000     .3443345    .6349847
------------------------------------------------------------------------------
```

Illustration 4 – Question 3

```
. probit d2 age nadults nkids nkids2 lnx agelnx nadlnx bluecol whitecol
(…)
Probit regression                                 Number of obs   =       2724
                                                  LR chi2(9)      =     108.91
                                                  Prob > chi2     =     0.0000
Log likelihood =  -1754.886                       Pseudo R2       =     0.0301
------------------------------------------------------------------------------
          d2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -2.482997   .5596009    -4.44   0.000    -3.579794   -1.386199
     nadults |   .4852072   .8717378     0.56   0.578    -1.223367    2.193782
       nkids |   .0812827   .0308297     2.64   0.008     .0208575    .1417078
      nkids2 |  -.2116622   .1230496    -1.72   0.085     -.452835    .0295106
         lnx |  -.6320797   .1631954    -3.87   0.000    -.9519368   -.3122225
      agelnx |   .1747353   .0413054     4.23   0.000     .0937781    .2556924
      nadlnx |  -.0253409   .0629228    -0.40   0.687    -.1486674    .0979856
     bluecol |   .2064198   .0834317     2.47   0.013     .0428967    .3699428
    whitecol |   .0215348    .069428     0.31   0.756    -.1145416    .1576111
       _cons |   8.244464   2.211077     3.73   0.000     3.910833    12.57809
------------------------------------------------------------------------------
```

Illustration 4 – Question 3

```
. predict xb, xb
. gen Mills=normalden(xb)/normal(xb)
. reg share2 age nadults nkids nkids2 lnx agelnx nadlnx Mills if share2>0
      Source |       SS       df       MS              Number of obs =    1036
-------------+------------------------------           F(  8,  1027) =   23.40
       Model |  .158145344     8  .019768168           Prob > F      =  0.0000
    Residual |  .867466802  1027  .000844661           R-squared     =  0.1542
-------------+------------------------------           Adj R-squared =  0.1476
       Total |  1.02561215  1035   .00099093           Root MSE      =  .02906
 ------------------------------------------------------------------------------
      share2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0172991   .0354385    -0.49   0.626    -.0868392     .052241
     nadults |  -.0174379   .0336488    -0.52   0.604    -.0834661    .0485903
       nkids |   .0007643   .0014951     0.51   0.609    -.0021695    .0036982
      nkids2 |  -.0020755    .005335    -0.39   0.697    -.0125443    .0083932
         lnx |  -.0301094   .0089325    -3.37   0.001    -.0476375   -.0125814
      agelnx |   .0012243   .0025157     0.49   0.627    -.0037122    .0061608
      nadlnx |    .001365   .0024016     0.57   0.570    -.0033476    .0060775
       Mills |  -.0090179   .0183686    -0.49   0.624    -.0450622    .0270263
       _cons |   .4515814   .1072597     4.21   0.000     .2411081    .6620547
------------------------------------------------------------------------------
```

Illustration 5 – Question 1

```
. gen y=log( hrrate)>log(3.6)
. gen socd1234=socd1+socd2+socd3+socd4
. gen  empmont= empmon/10
. logit  y empmont part socd1234 hqd6 married size25 lppltw
(…)
 Logistic regression                              Number of obs   =       4095
                                                 LR chi2(7)       =     421.39
                                                 Prob > chi2      =     0.0000
Log likelihood = -1223.9981                      Pseudo R2        =     0.1469
------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     empmont |   .0266874   .0079159     3.37   0.001     .0111725    .0422024
        part |  -1.178631   .1154354   -10.21   0.000    -1.404881   -.9523821
    socd1234 |   1.142527   .1865971     6.12   0.000     .7768034    1.508251
        hqd6 |  -.6375414   .1134435    -5.62   0.000    -.8598866   -.4151962
     married |   .3557298   .1093082     3.25   0.001     .1414897    .5699699
      size25 |   1.023301   .1089946     9.39   0.000     .8096759    1.236927
      lppltw |  -1.127114   .4766336    -2.36   0.018    -2.061298   -.1929288
       _cons |   1.847127   .1300033    14.21   0.000     1.592325    2.101929
------------------------------------------------------------------------------
```

Illustration 5 – Question 1

```
. predict xbLogit,xb
. gen xbLogit2= xbLogit^2
. gen xbLogit3= xbLogit^3

. quietly logit  y empmont part socd1234 hqd6 married size25 lppltw  xbLogit2
xbLogit3

. test  xbLogit2 xbLogit3

 ( 1)  [y]xbLogit2 = 0
 ( 2)  [y]xbLogit3 = 0

           chi2(  2) =    5.72
         Prob > chi2 =    0.0574
```

Illustration 5 – Question 1

```
. probit  y empmont part socd1234 hqd6 married size25 lppltw
(…)

Probit regression                                 Number of obs   =       4095
                                                  LR chi2(7)      =     413.14
                                                  Prob > chi2     =     0.0000
Log likelihood = -1228.1222                       Pseudo R2       =     0.1440

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     empmont |   .0130406   .0038505     3.39   0.001     .0054937    .0205876
        part |  -.5965585   .0590365   -10.10   0.000    -.7122678   -.4808491
    socd1234 |   .5665749    .088828     6.38   0.000     .3924751    .7406747
        hqd6 |  -.3519214    .061924    -5.68   0.000    -.4732903   -.2305525
     married |   .1857742   .0584009     3.18   0.001     .0713105    .3002379
      size25 |    .532082    .057272     9.29   0.000     .4198309    .6443332
      lppltw |  -.6578885   .2947191    -2.23   0.026    -1.235527   -.0802496
       _cons |   1.066556   .0682845    15.62   0.000      .932721    1.200391
------------------------------------------------------------------------------
```

Illustration 5 – Question 1 & 2.1

```
. predict xbProbit,xb

. gen xbProbit2= xbProbit^2

. gen xbProbit3= xbProbit^3

. quietly probit  y empmont part socd1234 hqd6 married size25 lppltw xbProbit2
xbProbit3

. test  xbProbit2 xbProbit3

 ( 1)  [y]xbProbit2 = 0
 ( 2)  [y]xbProbit3 = 0

           chi2(  2) =   13.60
         Prob > chi2 =    0.0011
```

2.1

- Logit model: robust to CB sampling – slope parameter consistent
- Probit model: CB sampling renders standard ML estimators inconsistent
- It is likely that the results of the RESET test reflect these issues

Illustration 5 – Question 2.2

```
. gmm ((.055/.1118*(1-y)+(1-.055)/(1-.1118)*y)
*normalden({beta1}*empmont+{beta2}*part+{beta3}*socd1234+{bet
a4}*hqd6+{beta5}*married+{beta6}*lppltw+{beta7}*size25+{beta0
})*(y-
normprob({beta1}*empmont+{beta2}*part+{beta3}*socd1234+{beta4
}*hqd6+{beta5}*married+{beta6}*lppltw+{beta7}*size25+{beta0})
)/(normprob({beta1}*empmont+{beta2}*part+{beta3}*socd1234+{be
ta4}*hqd6+{beta5}*married+{beta6}*lppltw+{beta7}*size25+{beta
0})*(1-
normprob({beta1}*empmont+{beta2}*part+{beta3}*socd1234+{beta4
}*hqd6+{beta5}*married+{beta6}*lppltw+{beta7}*size25+{beta0})
))), instruments(empmont part socd1234 hqd6 married lppltw
size25)
```

Illustration 5 – Question 2.2

```
GMM estimation
Number of parameters =   8
Number of moments    =   8
Initial weight matrix: Unadjusted                    Number of obs  =    4095
GMM weight matrix:     Robust
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
/beta1	.011869	.0041029	2.89	0.004	.0038274	.0199106
/beta2	-.5463279	.052858	-10.34	0.000	-.6499277	-.4427281
/beta3	.5181078	.0827541	6.26	0.000	.3559127	.6803029
/beta4	-.3183259	.0567416	-5.61	0.000	-.4295373	-.2071144
/beta5	.1730612	.0533727	3.24	0.001	.0684527	.2776697
/beta6	-.6414934	.25315	-2.53	0.011	-1.137658	-.1453286
/beta7	.4859684	.0504227	9.64	0.000	.3871417	.5847952
/beta0	1.458513	.0584018	24.97	0.000	1.344048	1.572978

```
Instruments for equation 1: empmont part socd1234 hqd6 married lppltw size25
_cons
```