Estimating effects from extended regression models

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Extended regression models

Extended regression model (ERM) is a Stata term for a class of regression models

- The outcome can be continuous (linear), probit, orderded probit, or censored (tobit)
- Some of the covariates may be endogenous
  - The endogenous covariates may be continuous, probit, or ordered probit
- Endogenous sample-selection may be modeled
- Exogenous or endogenous treatment assignment may be modeled
- The new-in-Stata-15 commands `eregress`, `eprobit`, `eoprobit`, and `eintreg` fit ERMs

Extended regression models

- Some of the covariates may be endogenous
  - The endogenous covariates may be continuous, binary, or ordinal
  - Polynomial terms and interaction terms constructed from the endogenous covariates are allowed
  - Interactions among the endogenous covariates and interactions between the endogenous covariates and the exogenous covariates are allowed

Outline

- I cannot do justice to ERMs in this short talk
- I discuss examples in which I
  - define some of the terms that I have already used
  - illustrate some command syntax
  - illustrate how to estimate some effects using postestimation commands

- Fictional data on wellness program from large company

```
. use wprogram
. describe
Contains data from wprogram.dta
  obs:         3,000
 vars:             6                          28 Jul 2017 07:13
 size:        72,000
-------------------------------------------------------------------------------
              storage   display    value
variable name   type    format     label      variable label
-------------------------------------------------------------------------------
wchange         float   %9.0g      changel    Weight change level
age             float   %9.0g                 Years over 50
over            float   %9.0g                 Overweight (tens of pounds)
phealth         float   %9.0g                 Prior health score
prog            float   %9.0g      yesno      Participate in wellness program
wtprog          float   %9.0g      yesno      Offered work time to participate
                                                in program
-------------------------------------------------------------------------------
Sorted by:
```

- Weight change levels and program particiation

```
. tabulate wchange prog
```

Weight change level	Participate in wellness program No	Yes	Total
Loss	239	909	1,148
No change	468	605	1,073
Gain	593	186	779
Total	1,300	1,700	3,000

- Program appears to help
- But this data is observational
  - Table does not account for how observed covariates and/or unobserved errors that affect program participation also affect the outcome variable

- If only observed covariates age over and phealth affect program participation and wchange (with or without program), we could use an ordinal probit model

```
. eoprobit wchange prog age over phealth, vsquish nolog
Extended ordered probit regression              Number of obs     =      3,000
                                                Wald chi2(4)      =     736.09
Log likelihood = -2866.5688                     Prob > chi2       =     0.0000
------------------------------------------------------------------------------
     wchange |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        prog |  -.8668405   .0460018   -18.84   0.000    -.9570023   -.7766787
         age |    .097322   .0677733     1.44   0.151    -.0355113    .2301552
        over |   .3433724   .0360858     9.52   0.000     .2726456    .4140992
     phealth |  -.3983531   .0385081   -10.34   0.000    -.4738276   -.3228786
-------------+----------------------------------------------------------------
        cut1 |  -.8871706   .0539205                     -.9928528   -.7814885
        cut2 |   .2358913   .0522019                      .1335775    .3382051
------------------------------------------------------------------------------
```

```
. eoprobit wchange prog age over phealth, vsquish nolog
Extended ordered probit regression              Number of obs     =      3,000
                                                Wald chi2(4)      =     736.09
Log likelihood = -2866.5688                     Prob > chi2       =     0.0000
```

wchange	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
prog	-.8668405	.0460018	-18.84	0.000	-.9570023	-.7766787
age	.097322	.0677733	1.44	0.151	-.0355113	.2301552
over	.3433724	.0360858	9.52	0.000	.2726456	.4140992
phealth	-.3983531	.0385081	-10.34	0.000	-.4738276	-.3228786
cut1	-.8871706	.0539205			-.9928528	-.7814885
cut2	.2358913	.0522019			.1335775	.3382051

$$\mathbf{x}\boldsymbol{\beta} = \beta_2 \texttt{age} + \beta_3 \texttt{over} + \beta_4 \texttt{phealth}$$
$$\mathbf{w}\boldsymbol{\beta} = \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta}$$

$$wchange = \begin{cases} \text{“}Loss\text{”} & \text{if } \mathbf{w}\boldsymbol{\beta} + \epsilon \leq cut1 \\ \text{“}No\ change\text{”} & \text{if } cut1 < \mathbf{w}\boldsymbol{\beta} + \epsilon \leq cut2 \\ \text{“}Gain\text{”} & \text{if } cut2 < \mathbf{w}\boldsymbol{\beta} + \epsilon \end{cases}$$

$$
\begin{aligned}
\mathbf{x}\boldsymbol{\beta} &= \beta_2 \texttt{age} + \beta_3 \texttt{over} + \beta_4 \texttt{phealth} \\
\mathbf{w}\boldsymbol{\beta} &= \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta}
\end{aligned}
$$

$$
wchange = \begin{cases} \text{“}\textit{Loss}\text{”} & \text{if } \qquad \mathbf{w}\boldsymbol{\beta} + \epsilon \leq cut1 \\ \text{“}\textit{No change}\text{”} & \text{if } cut1 < \mathbf{w}\boldsymbol{\beta} + \epsilon \leq cut2 \\ \text{“}\textit{Gain}\text{”} & \text{if } cut2 < \mathbf{w}\boldsymbol{\beta} + \epsilon \end{cases}
$$

$\epsilon \sim N(0,1)$ yields

$$
\begin{aligned}
\Pr(wchange = \text{“}\textit{Loss}\text{”}) &= \Phi(cut1 - \mathbf{w}\boldsymbol{\beta}) \\
\Pr(wchange = \text{“}\textit{No change}\text{”}) &= \Phi(cut2 - \mathbf{w}\boldsymbol{\beta}) - \Phi(cut1 - \mathbf{w}\boldsymbol{\beta}) \\
\Pr(wchange = \text{“}\textit{Gain}\text{”}) &= 1 - \Phi(cut2 - \mathbf{w}\boldsymbol{\beta})
\end{aligned}
$$

- I want to estimate the how changing `prog=0` to `prog=1` changes each of the probabilities
  $\Pr(\text{wchange} = \text{“Loss”})$
  $\Pr(\text{wchange} = \text{“No change”})$
  $\Pr(\text{wchange} = \text{“Gain”})$

When I type

```
eoprobit wchange prog age over phealth, vsquish nolog
```

I am assuming that prog is independent of ϵ in

$$wchange = \begin{cases} \text{"}\mathit{Loss}\text{"} & \text{if } \qquad \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta} + \epsilon \le cut1 \\ \text{"}\mathit{No\ change}\text{"} & \text{if } cut1 < \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta} + \epsilon \le cut2 \\ \text{"}\mathit{Gain}\text{"} & \text{if } cut2 < \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta} + \epsilon \end{cases}$$

In other words, I am assuming that prog is exogenous

If prog is not independent of ϵ, prog is endogenous

If prog is endogenous, I must model the dependence.
Consider

$$wchange = \begin{cases} \text{"\textit{Loss}"} & \text{if } \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta} + \epsilon \leq cut1 \\ \text{"\textit{No change}"} & \text{if } cut1 < \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta} + \epsilon \leq cut2 \\ \text{"\textit{Gain}"} & \text{if } cut2 < \beta_1 \texttt{prog} + \mathbf{x}\boldsymbol{\beta} + \epsilon \end{cases}$$

$$prog = (\mathbf{x}\boldsymbol{\gamma} + \gamma_1 \texttt{wtime} + \eta > 0)$$

$$\epsilon \text{ and } \eta \text{ are joint normal}$$

$$\mathbf{x}\boldsymbol{\gamma} = \gamma_2 \texttt{age} + \gamma_3 \texttt{over} + \gamma_4 \texttt{phealth}$$

Fit by:
```
eoprobit wchange age over phealth ,
    endog(prog = age over phealth wtime, probit)
```

```
. eoprobit wchange age over phealth ,                             ///
>         endog(prog = age over phealth wtprog, probit) ///
>         vsquish nolog
Extended ordered probit regression                Number of obs     =      3,000
                                                  Wald chi2(4)      =     409.97
Log likelihood = -4401.0952                       Prob > chi2       =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
wchange      |
         age |   .2155906   .0705048     3.06   0.002     .0774037    .3537776
        over |   .4349946   .0387185    11.23   0.000     .3591078    .5108814
     phealth |  -.4933361   .0411866   -11.98   0.000    -.5740603    -.412612
        prog |
         Yes |  -.3624996   .1031408    -3.51   0.000    -.5646519   -.1603473
-------------+----------------------------------------------------------------
prog         |
         age |  -.9341234   .0840002   -11.12   0.000    -1.098761   -.7694861
        over |  -1.058621   .0514252   -20.59   0.000    -1.159412   -.9578294
     phealth |   .9001108   .0504804    17.83   0.000      .801171    .9990507
      wtprog |   1.631615   .0780834    20.90   0.000     1.478574    1.784656
       _cons |   .0090842   .0535434     0.17   0.865     -.095859    .1140274
-------------+----------------------------------------------------------------
/wchange     |
        cut1 |  -.5897304   .0781626                     -.7429264   -.4365345
        cut2 |   .5029323    .068292                      .3690825    .6367821
-------------+----------------------------------------------------------------
 corr(e.prog,|
   e.wchange)|  -.3478179   .0604422    -5.75   0.000    -.4603282   -.2243109
------------------------------------------------------------------------------
```

cut2	.5029323	.068292			.3690825	.6367821
corr(e.prog, e.wchange)	-.3478179	.0604422	-5.75	0.000	-.4603282	-.2243109

- The nonzero correlation between `e.prog` and `e.wchange` indicates that `prog` is endogenous
- Those who are more likely to participate are more likely to lose weight

```
. margins r.prog,                                          ///
>         predict(fix(prog) outlevel("Loss"))              ///
>         predict(fix(prog) outlevel("No change"))         ///
>         predict(fix(prog) outlevel("Gain"))              ///
>         contrast(nowald)

Contrasts of predictive margins
Model VCE    : OIM

1._predict   : Pr(wchange==Loss), predict(fix(prog) outlevel("Loss"))
2._predict   : Pr(wchange==No change), predict(fix(prog) outlevel("No
               change"))
3._predict   : Pr(wchange==Gain), predict(fix(prog) outlevel("Gain"))

---------------------------------------------------------------------
                |            Delta-method
                |   Contrast   Std. Err.     [95% Conf. Interval]
----------------+----------------------------------------------------
  prog@_predict |
(Yes vs No) 1   |   .1259899   .0356631      .0560914    .1958883
(Yes vs No) 2   |  -.0185024   .0055583     -.0293965   -.0076084
(Yes vs No) 3   |  -.1074874   .0306512     -.1675628   -.0474121
---------------------------------------------------------------------
```

- When everyone joins the program instead of when no one participants in the program,
  - On average, the probablity of “Loss” goes up by .13
  - On average, the probablity of “No change” goes down by .02
  - On average, the probablity of “Gain” goes down by .11

- `predict(fix(prog))` tells `margins` to specify `fix(prog)` to `predict` when computing each predicted probability

- `fix(prog)` causes the value the value of prog not to affect ϵ, eventhough they are correlated
  - `fix(prog)` specifies that ϵ should be held fixed when prog changes
  - `fix(prog)` gets us the effect of the program that is not contaminated by the selection effect/correlation between ϵ and η that increases the participation among people more likely to lose wieght

- This type of prediction is sometimes called the structural prediction or an average structural function; see Blundell and Powell (2003), Blundell and Powell (2004), Wooldridge (2010), and Wooldridge (2014),
- The difference between the mean of the average of the structural predictions when `prog=1` and the mean of the average of the structural predictions when `prog=0` is an average treatment effect (Blundell and Powell (2003) and Wooldridge (2014))

Standard errors for population versus sample

- The delta-method standard errors reported by `margins` hold the covariates fixed at their sample values
  - The delta-method standard errors are for a sample-average treatment effect instead of a population-averaged treatment effect
  - The sample-averaged treatment effect is for those individuals that showed up in that run of the treatment
  - The population-averaged treatment effect is for a random draw of individuals from the population
- To get standard errors for the population-average treatment effect, specify `vce(robust)` to the estimation command and specify `vce(unconditional)` to `margins`

```
. quietly eoprobit wchange age over phealth ,                ///
>         endog(prog = age over phealth wtprog, probit) ///
>         vce(robust)

. margins r.prog,                                    ///
>         predict(fix(prog) outlevel("Loss"))        ///
>         predict(fix(prog) outlevel("No change")) ///
>         predict(fix(prog) outlevel("Gain"))        ///
>         contrast(nowald) vce(unconditional)

Contrasts of predictive margins

1._predict   : Pr(wchange==Loss), predict(fix(prog) outlevel("Loss"))
2._predict   : Pr(wchange==No change), predict(fix(prog) outlevel("No
               change"))
3._predict   : Pr(wchange==Gain), predict(fix(prog) outlevel("Gain"))

------------------------------------------------------------------
                |            Unconditional
                |   Contrast   Std. Err.      [95% Conf. Interval]
----------------+-------------------------------------------------
 prog@_predict  |
(Yes vs No) 1   |    .1259899   .0349061      .0575753    .1944045
(Yes vs No) 2   |   -.0185024   .0054389     -.0291624   -.0078424
(Yes vs No) 3   |   -.1074874   .0300866     -.1664561   -.0485188
------------------------------------------------------------------

. matrix b = r(b)
```

Endogenous treatment model

```
. eoprobit wchange (age over phealth) ,              ///
>         entreat(prog = age over phealth wtprog ) ///
>         vce(robust) vsquish nolog
Extended ordered probit regression              Number of obs     =      3,000
                                                Wald chi2(6)      =     236.09
Log pseudolikelihood = -4389.0839               Prob > chi2       =     0.0000
------------------------------------------------------------------------------
             |               Robust
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
wchange      |
  prog#c.age |
         No  |   .3318583   .1010243     3.28   0.001     .1338543    .5298624
        Yes  |   .0991993   .0944861     1.05   0.294     -.08599     .2843886
 prog#c.over |
         No  |   .4241221   .0527011     8.05   0.000     .3208298    .5274144
        Yes  |   .4310345    .051217     8.42   0.000     .3306509    .5314181
       prog# |
   c.phealth |
         No  |  -.3323793   .0665871    -4.99   0.000    -.4628875   -.201871
        Yes  |  -.5973977   .0486921   -12.27   0.000    -.6928325   -.501963
-------------+----------------------------------------------------------------
prog         |
         age |  -.9365184   .0828734   -11.30   0.000    -1.098947   -.7740895
        over |  -1.058259   .0499251   -21.20   0.000     -1.15611   -.9604071
     phealth |   .8938228   .0498157    17.94   0.000     .7961859    .9914598
      wtprog |   1.632994   .0760053    21.49   0.000     1.484026    1.781961
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
wchange						
prog#c.age						
No	.3318583	.1010243	3.28	0.001	.1338543	.5298624
Yes	.0991993	.0944861	1.05	0.294	-.08599	.2843886
prog#c.over						
No	.4241221	.0527011	8.05	0.000	.3208298	.5274144
Yes	.4310345	.051217	8.42	0.000	.3306509	.5314181
prog# c.phealth						
No	-.3323793	.0665871	-4.99	0.000	-.4628875	-.201871
Yes	-.5973977	.0486921	-12.27	0.000	-.6928325	-.501963
prog						
age	-.9365184	.0828734	-11.30	0.000	-1.098947	-.7740895
over	-1.058259	.0499251	-21.20	0.000	-1.15611	-.9604071
phealth	.8938228	.0498157	17.94	0.000	.7961859	.9914598
wtprog	1.632994	.0760053	21.49	0.000	1.484026	1.781961
_cons	.0130243	.0531604	0.24	0.806	-.0911683	.1172168
/wchange						
prog#c.cut1						
No	-.438465	.0907758			-.6163823	-.2605477
Yes	-.3395413	.0697649			-.4762781	-.2028046
prog#c.cut2						
No	.5647753	.0811816			.4056623	.7238883
Yes	.849572	.0817844			.6892775	1.009867
corr(e.prog, e.wchange)	-.3419207	.0610844	-5.60	0.000	-.4556747	-.2171783

prog#c.age						
No	.3318583	.1010243	3.28	0.001	.1338543	.5298624
Yes	.0991993	.0944861	1.05	0.294	-.08599	.2843886
prog#c.over						
No	.4241221	.0527011	8.05	0.000	.3208298	.5274144
Yes	.4310345	.051217	8.42	0.000	.3306509	.5314181
prog# c.phealth						
No	-.3323793	.0665871	-4.99	0.000	-.4628875	-.201871
Yes	-.5973977	.0486921	-12.27	0.000	-.6928325	-.501963
prog						
age	-.9365184	.0828734	-11.30	0.000	-1.098947	-.7740895
over	-1.058259	.0499251	-21.20	0.000	-1.15611	-.9604071
phealth	.8938228	.0498157	17.94	0.000	.7961859	.9914598
wtprog	1.632994	.0760053	21.49	0.000	1.484026	1.781961
_cons	.0130243	.0531604	0.24	0.806	-.0911683	.1172168
/wchange						
prog#c.cut1						
No	-.438465	.0907758			-.6163823	-.2605477
Yes	-.3395413	.0697649			-.4762781	-.2028046
prog#c.cut2						
No	.5647753	.0811816			.4056623	.7238883
Yes	.849572	.0817844			.6892775	1.009867
corr(e.prog, e.wchange)	-.3419207	.0610844	-5.60	0.000	-.4556747	-.2171783

```
. estat teffects
Predictive margins                              Number of obs     =      3,000
ATE_Pr0         : Pr(wchange=0=Loss)
ATE_Pr1         : Pr(wchange=1=No change)
ATE_Pr2         : Pr(wchange=2=Gain)
```

	Margin	Unconditional Std. Err.	z	P>|z|	[95% Conf.	Interval]
ATE_Pr0						
prog (Yes vs No)	.1087061	.038293	2.84	0.005	.0336531	.1837591
ATE_Pr1						
prog (Yes vs No)	.0288781	.0190952	1.51	0.130	-.0085478	.0663039
ATE_Pr2						
prog (Yes vs No)	-.1375842	.0322663	-4.26	0.000	-.200825	-.0743433

- When everyone joins the program instead of when no one participants in the program,
  - On average, the probablity of "Loss" goes up by .11
  - On average, the probablity of "No change" does not change
  - On average, the probablity of "Gain" goes down .14

```
. margins r.prog,                                        ///
>         predict(fix(prog) outlevel("Loss"))            ///
>         predict(fix(prog) outlevel("No change"))       ///
>         predict(fix(prog) outlevel("Gain"))            ///
>         contrast(nowald) vce(unconditional)

Contrasts of predictive margins

1._predict    : Pr(wchange==Loss), predict(fix(prog) outlevel("Loss"))
2._predict    : Pr(wchange==No change), predict(fix(prog) outlevel("No
                change"))
3._predict    : Pr(wchange==Gain), predict(fix(prog) outlevel("Gain"))

------------------------------------------------------------------
                |             Unconditional
                |   Contrast   Std. Err.     [95% Conf. Interval]
----------------+-------------------------------------------------
 prog@_predict  |
(Yes vs No) 1   |   .1087061    .038293      .0336531    .1837591
(Yes vs No) 2   |   .0288781   .0190952     -.0085478    .0663039
(Yes vs No) 3   |  -.1375842   .0322663      -.200825   -.0743433
------------------------------------------------------------------
```

Endogenous sample selection

- Reconsider our fictional weight-loss program
  - Some program participants and some nonparticipants will not show up for the final weigh in
    This is commonly known as lost to follow up
  - If unobservables that affect whether someone is lost to follow up
    - are independent of the unobservables that affect program participantion
    - and they are independent of the unobservables that affect the outcomes with and without the program,
  - the previously discussed estimator consistently estimates the effects
- Any dependence among the unobservables must be modeled

$$
\begin{aligned}
insamp &= (\mathbf{x}\boldsymbol{\alpha} + \alpha_1 \texttt{wtsamp} + \xi > 0) \\
Pr(\texttt{wchange} &== \text{``}\textit{No change}\text{''}) \\
&= \begin{cases} Pr(cut1_0 < \mathbf{x}\boldsymbol{\beta}_0 + \epsilon \leq cut2_0) & \text{if } prog == 0 \\ Pr(cut1_1 < \mathbf{x}\boldsymbol{\beta}_1 + \epsilon \leq cut2_1) & \text{if } prog == 1 \end{cases}
\end{aligned}
$$

(Analogously define probabilities Loss, and Gain)

$$
\begin{aligned}
prog &= (\mathbf{x}\gamma + \gamma_1 \texttt{wtprog} + \eta > 0) \\
&\xi, \epsilon \text{ and } \eta \text{ are joint normal}
\end{aligned}
$$

Fit by:
```
eoprobit wchange (age over phealth) ,
        entreat(prog = age over phealth wtprog )
        select(samp = age over phealth wtsamp )
        vce(robust)
```

Data

```
. use wprogram2
. describe
Contains data from wprogram2.dta
  obs:         3,000
 vars:             8                          28 Jul 2017 07:13
 size:        96,000
-------------------------------------------------------------------------------
              storage   display    value
variable name   type    format     label      variable label
-------------------------------------------------------------------------------
wchange         float   %9.0g      changel    Weight change level
age             float   %9.0g                 Years over 50
over            float   %9.0g                 Overweight (tens of pounds)
phealth         float   %9.0g                 Prior health score
prog            float   %9.0g      yesno      Participate in wellness program
wtprog          float   %9.0g      yesno      Offered work time to participate
                                                in program
wtsamp          float   %9.0g                 Offered work time to participate
                                                in sample
insamp          float   %9.0g                 In sample: attended initial and
                                                final weigh in
-------------------------------------------------------------------------------
Sorted by:
```

```
. eoprobit wchange (age over phealth) ,        ///
>         entreat(prog = age over phealth wtprog ) ///
>         select(insamp = age over phealth wtsamp )  ///
>         vce(robust) vsquish nolog
Extended ordered probit regression              Number of obs     =      3,000
                                                      Selected    =      1,884
                                                      Nonselected =      1,116
                                                Wald chi2(6)      =     180.18
Log pseudolikelihood = -4484.2347               Prob > chi2       =     0.0000
------------------------------------------------------------------------------
             |               Robust
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
wchange      |
   prog#c.age |
          No |   .3833806   .1306121     2.94   0.003     .1273856    .6393756
         Yes |  -.0630257   .1084828    -0.58   0.561    -.2756482    .1495967
  prog#c.over |
          No |   .4734046   .0775788     6.10   0.000      .321353    .6254561
         Yes |   .2110918   .0774768     2.72   0.006     .0592401    .3629436
        prog# |
    c.phealth |
          No |  -.3910086   .0839247    -4.66   0.000    -.5554981   -.2265192
         Yes |  -.8192438   .0675175   -12.13   0.000    -.9515757   -.6869119
-------------+----------------------------------------------------------------
insamp       |
          age |  -.0239454   .0805554    -0.30   0.766     -.181831    .1339403
         over |  -.7639015    .045083   -16.94   0.000    -.8522626   -.6755404
      phealth |   .7762507   .0467149    16.62   0.000     .6846911    .8678104
       wtsamp |   2.614852   .2666563     9.81   0.000     2.092215    3.137489
        _cons |   .2834801   .0516434     5.49   0.000     .1822608    .3846994
```

c.phealth						
No	-.3910086	.0839247	-4.66	0.000	-.5554981	-.2265192
Yes	-.8192438	.0675175	-12.13	0.000	-.9515757	-.6869119
insamp						
age	-.0239454	.0805554	-0.30	0.766	-.181831	.1339403
over	-.7639015	.045083	-16.94	0.000	-.8522626	-.6755404
phealth	.7762507	.0467149	16.62	0.000	.6846911	.8678104
wtsamp	2.614852	.2666563	9.81	0.000	2.092215	3.137489
_cons	.2834801	.0516434	5.49	0.000	.1822608	.3846994
prog						
age	-.9366997	.0818766	-11.44	0.000	-1.097175	-.7762245
over	-1.062399	.0491499	-21.62	0.000	-1.158731	-.9660671
phealth	.8913551	.0494733	18.02	0.000	.7943892	.988321
wtprog	1.645957	.0729847	22.55	0.000	1.502909	1.789004
_cons	.016411	.0527191	0.31	0.756	-.0869166	.1197386
/wchange						
prog#c.cut1						
No	-.3561706	.1278314			-.6067155	-.1056258
Yes	-.4668053	.0986098			-.660077	-.2735335
prog#c.cut2						
No	.6304983	.1309562			.3738289	.8871677
Yes	.721275	.1430156			.4409696	1.00158
corr(e.insamp, e.wchange)	-.5691458	.0901455	-6.31	0.000	-.7199754	-.366975
corr(e.prog, e.wchange)	-.5310186	.0707529	-7.51	0.000	-.6553935	-.3786047
corr(e.prog, e.insamp)	.4757458	.0296034	16.07	0.000	.4156943	.5316674

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corr(e.prog, e.insamp)	.4757458	.0296034	16.07	0.000	.4156943	.5316674

- Nonzero correlation between `e.insamp` and `e.wchange` implies endogenous sample selection for outcomes
- Nonzero correlation between `e.prog` and `e.wchange` implies endogenous treatment assignment

```
. estat teffects
Predictive margins                              Number of obs     =      3,000
ATE_Pr0       : Pr(wchange=0=Loss)
ATE_Pr1       : Pr(wchange=1=No change)
ATE_Pr2       : Pr(wchange=2=Gain)
```

	Margin	Unconditional Std. Err.	z	P>|z|	[95% Conf.	Interval]
ATE_Pr0						
prog (Yes vs No)	.1552606	.051808	3.00	0.003	.0537189	.2568024
ATE_Pr1						
prog (Yes vs No)	.006893	.0300435	0.23	0.819	-.0519913	.0657772
ATE_Pr2						
prog (Yes vs No)	-.1621536	.038066	-4.26	0.000	-.2367616	-.0875457

- When everyone joins the program instead of when no one participants in the program,
  - On average, the probablity of "Loss" goes up
  - On average, the probablity of "No change" does not change
  - On average, the probablity of "Gain" goes down

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