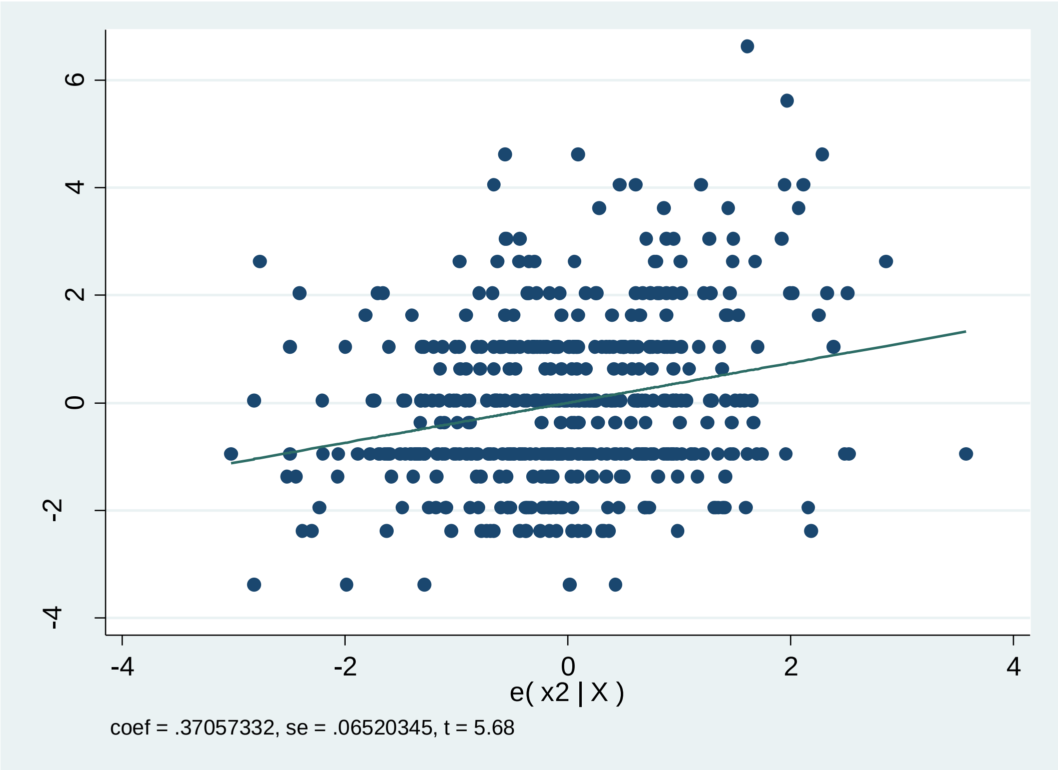
Poisson Regression Model

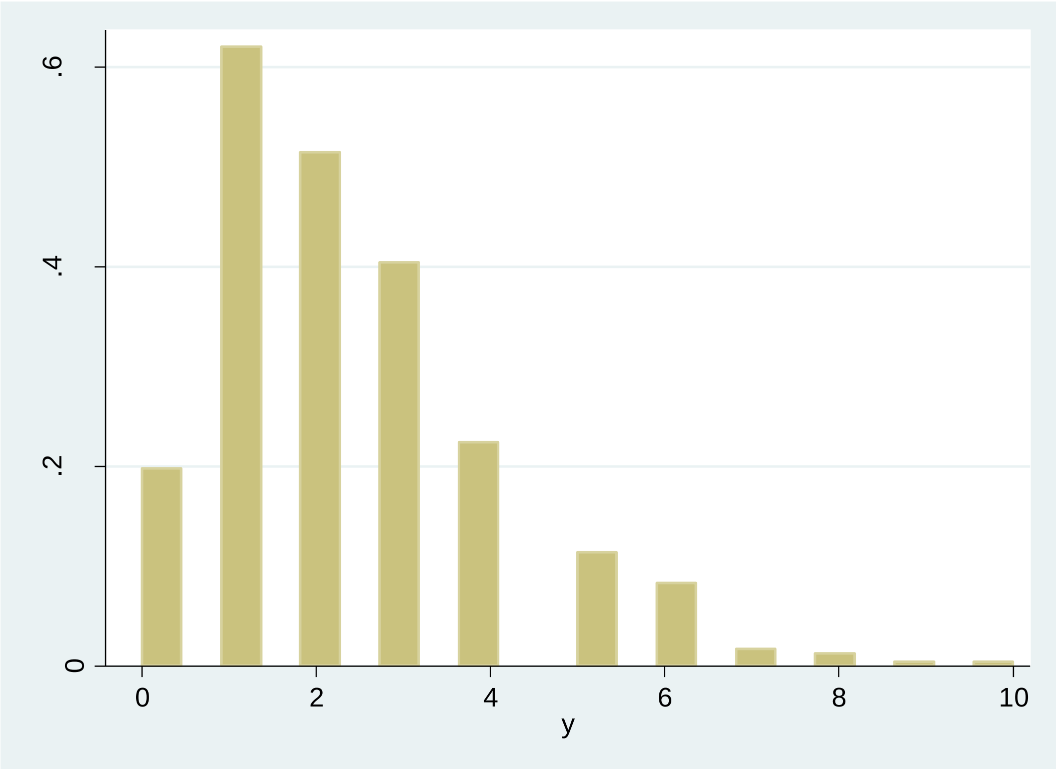
Simulated Data

```
set obs 500
set seed 12345
g x1=(runiform()>0.7)
g x2=rnormal(0,1)
g i=0.7+0.5*x1+0.2*x2
g mu=exp(i)
g y=rpoisson(mu)
```

```
. reg y x1 x2

      Source |       SS           df       MS      Number of obs   =       500
-------------+----------------------------------   F(2, 497)       =     59.63
       Model |  274.451872         2  137.225936   Prob > F        =    0.0000
    Residual |  1143.74813       497  2.30130408   R-squared       =    0.1935
-------------+----------------------------------   Adj R-squared   =    0.1903
       Total |      1418.2       499  2.84208417   Root MSE        =     1.517

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.465322   .1526516     9.60   0.000       1.1654    1.765244
          x2 |   .3705733   .0652034     5.68   0.000     .2424649    .4986817
       _cons |   1.925688   .0796609    24.17   0.000     1.769174    2.082202
------------------------------------------------------------------------------

. avplot x2, recast(scatter)
```



```
. histogram y
```




```
. poisson y x1 x2, nolog

Poisson regression                                Number of obs     =        500
                                                  LR chi2(2)        =     110.76
                                                  Prob > chi2       =     0.0000
Log likelihood = -871.26736                       Pseudo R2         =     0.0598

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .5638447   .0599408     9.41   0.000     .4463629    .6813266
          x2 |   .1567641   .0280064     5.60   0.000     .1018725    .2116557
       _cons |   .6449654   .0380948    16.93   0.000      .570301    .7196299
------------------------------------------------------------------------------

. poisson y x1 x2, ir nolog

Poisson regression                                Number of obs     =        500
                                                  LR chi2(2)        =     110.76
                                                  Prob > chi2       =     0.0000
Log likelihood = -871.26736                       Pseudo R2         =     0.0598

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.757416    .105341     9.41   0.000     1.562618    1.976498
          x2 |    1.16972   .0327597     5.60   0.000     1.107242    1.235722
       _cons |   1.905921   .0726057    16.93   0.000     1.768799    2.053673
------------------------------------------------------------------------------

. lincom x1, ir

 ( 1)  [y]x1 = 0

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   1.757416    .105341     9.41   0.000     1.562618    1.976498
------------------------------------------------------------------------------
```

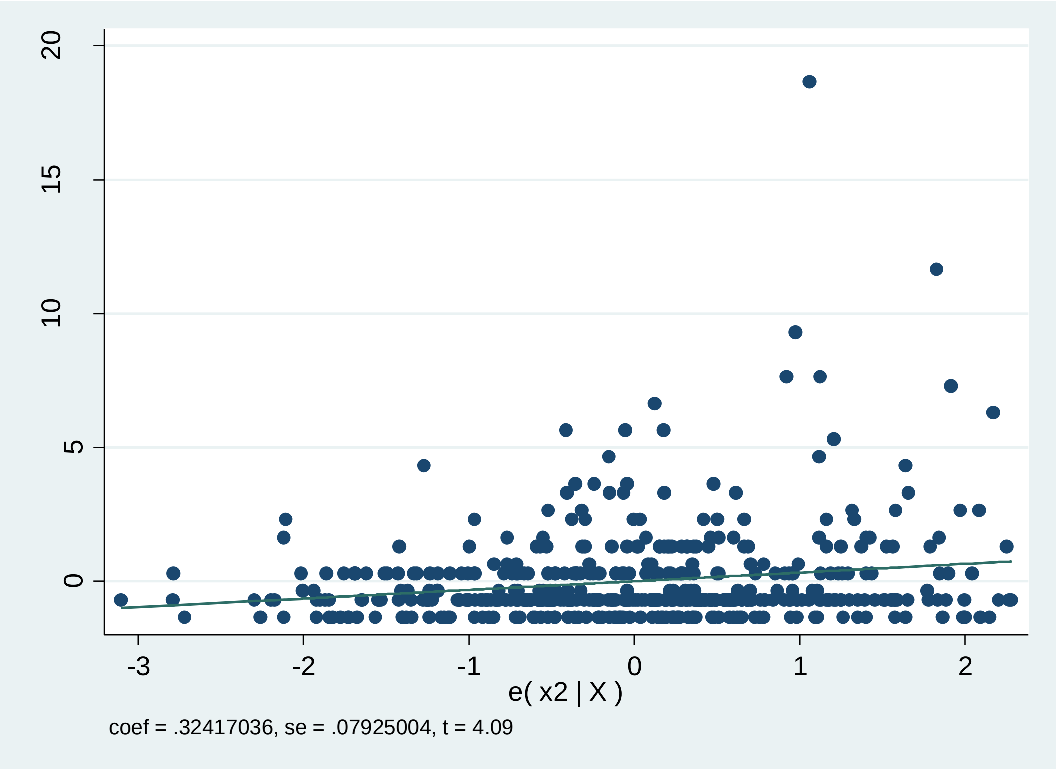
```
. lincom x2, ir

 ( 1)  [y]x2 = 0

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |    1.16972   .0327597     5.60   0.000     1.107242    1.235722
------------------------------------------------------------------------------

. estat gof

         Deviance goodness-of-fit =  517.6865
         Prob > chi2(497)         =    0.2520

         Pearson goodness-of-fit  =  462.5796
         Prob > chi2(497)         =    0.8636

. mfx

Marginal effects after poisson
      y  = Predicted number of events (predict)
         =  2.2366776
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1*|   1.453223      .17306    8.40   0.000   1.11403  1.79241       .272
      x2 |   .3506308      .06189    5.67   0.000   .229336  .471926    .042486
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1

. margins , at(x1=(0 1)) atmeans

Adjusted predictions                              Number of obs     =        500
Model VCE    : OIM

Expression   : Predicted number of events, predict()

1._at        : x1              =           0
               x2              =    .0424864 (mean)

2._at        : x1              =           1
               x2              =    .0424864 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         _at |
          1  |   1.918658   .0727248    26.38   0.000      1.77612    2.061196
          2  |    3.37188   .1576509    21.39   0.000      3.06289     3.68087
------------------------------------------------------------------------------
```

Negative Binomial Regression Model

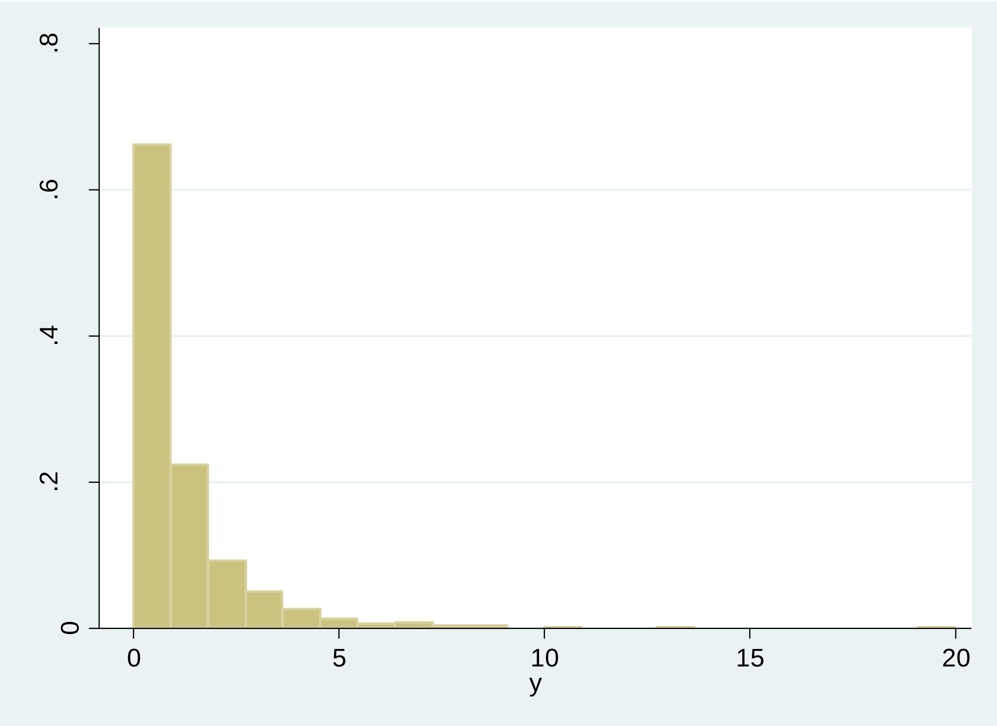
Simulated Data

```
set obs 500
set seed 5555
g x1=(runiform()>0.7)
g x2=rnormal(0,1)
g e=rgamma(0.5,0.8)
g u=ln(e)
g i=0.5+0.7*x1+0.3*x2+u
g mu=exp(i)
g y=rpoisson(mu)
```

```
. reg y x1 x2

      Source |       SS           df       MS      Number of obs   =       500
-------------+----------------------------------   F(2, 497)       =     15.95
       Model |  100.462651         2  50.2313254   Prob > F        =    0.0000
    Residual |  1565.66535       497  3.15023209   R-squared       =    0.0603
-------------+----------------------------------   Adj R-squared   =    0.0565
       Total |    1666.128       499  3.33893387   Root MSE        =    1.7749

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .6181471   .1705049     3.63   0.000      .283148    .9531463
          x2 |   .3241704     .07925     4.09   0.000     .1684639    .4798768
       _cons |   .7024186   .0962587     7.30   0.000     .5132945    .8915428
------------------------------------------------------------------------------

. avplot x2, recast(scatter)
```



```
. histogram y
```




```
. poisson y x1 x2, nolog

Poisson regression                                Number of obs   =        500
                                                  LR chi2(2)      =     106.47
                                                  Prob > chi2     =     0.0000
Log likelihood =  -762.5963                       Pseudo R2       =     0.0653

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .608821   .0941509     6.47   0.000     .4242886    .7933533
          x2 |   .3558912   .0474573     7.50   0.000     .2628766    .4489057
       _cons |  -.4139544   .0666517    -6.21   0.000    -.5445893   -.2833195
------------------------------------------------------------------------------

. estat gof

         Deviance goodness-of-fit =  1026.931
         Prob > chi2(497)         =    0.0000

         Pearson goodness-of-fit  =  1320.657
         Prob > chi2(497)         =    0.0000

. nbreg y x1 x2, nolog

Negative binomial regression                      Number of obs   =        500
                                                  LR chi2(2)      =      34.30
Dispersion     = mean                             Prob > chi2     =     0.0000
Log likelihood = -626.96136                       Pseudo R2       =     0.0266

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |    .578498   .1630038     3.55   0.000     .2590164    .8979795
          x2 |    .339791   .0793079     4.28   0.000     .1843504    .4952317
       _cons |  -.3991611   .0997148    -4.00   0.000    -.5945986   -.2037236
-------------+----------------------------------------------------------------
    /lnalpha |    .605714   .1379337                      .3353689     .876059
-------------+----------------------------------------------------------------
       alpha |    1.83256   .2527718                      1.398456    2.401417
------------------------------------------------------------------------------
LR test of alpha=0: chibar2(01) = 271.27              Prob >= chibar2 = 0.000
```

```
. nbreg y x1 x2, ir nolog

Negative binomial regression                      Number of obs     =        500
                                                  LR chi2(2)        =      34.30
Dispersion     = mean                             Prob > chi2       =     0.0000
Log likelihood = -626.96136                       Pseudo R2         =     0.0266

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.783358   .2906941     3.55   0.000     1.295655    2.454639
          x2 |   1.404654   .1114002     4.28   0.000     1.202437    1.640878
       _cons |   .6708826    .066897    -4.00   0.000      .551784    .8156878
-------------+----------------------------------------------------------------
    /lnalpha |    .605714   .1379337                      .3353689     .876059
-------------+----------------------------------------------------------------
       alpha |    1.83256   .2527718                      1.398456    2.401417
------------------------------------------------------------------------------
LR test of alpha=0: chibar2(01) = 271.27              Prob >= chibar2 = 0.000

. mfx

Marginal effects after nbreg
      y  = Predicted number of events (predict)
         =  .81733998
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1*|   .5320673      .17083    3.11   0.002   .197249  .866885       .32
      x2 |   .2777248      .06556    4.24   0.000   .149225  .406224   .036321
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1

. margins , at(x1=(0 1)) atmeans

Adjusted predictions                              Number of obs     =        500
Model VCE    : OIM

Expression   : Predicted number of events, predict()

1._at        : x1              =           0
               x2              =    .0363213 (mean)

2._at        : x1              =           1
               x2              =    .0363213 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         _at |
          1  |   .6792137   .0675899    10.05   0.000       .54674    .8116874
          2  |   1.211281   .1575355     7.69   0.000     .9025171    1.520045
------------------------------------------------------------------------------
```

Example 1

The model $\Pr[Y = y] = \frac{e^{-\mu}\mu^{y}}{y!}$ and $\mu_i = \exp(x_i'\beta)$

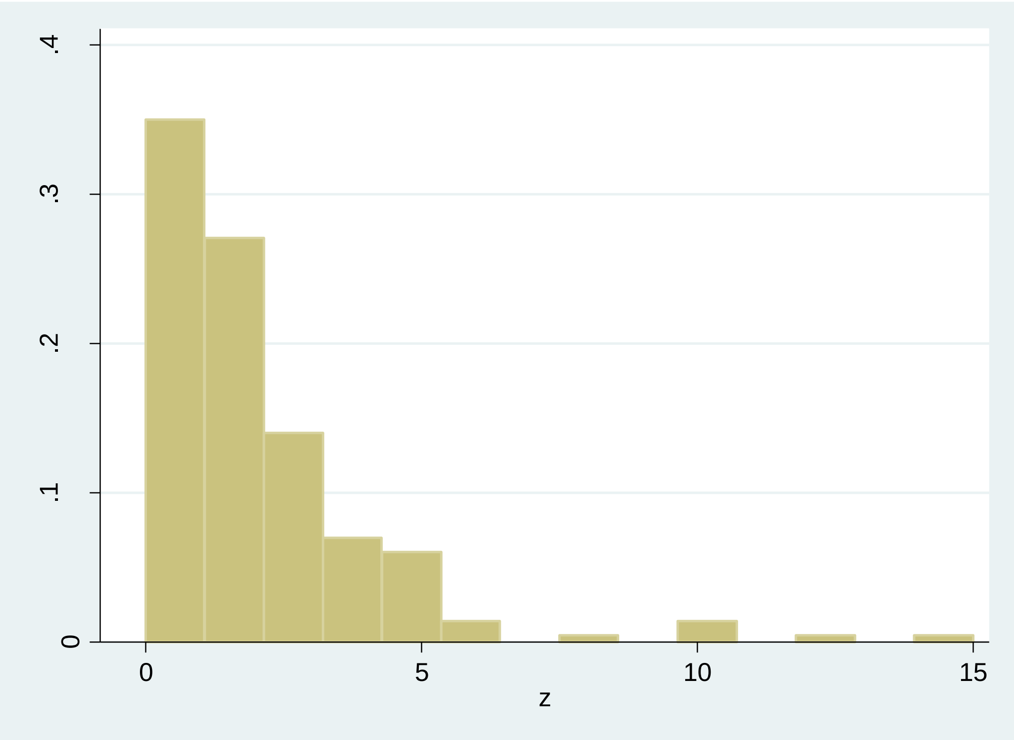
where:

y = Number of times respondent going out to watch movie at the theater each month.

and x_i is matrix of independent variables include:

dinc is dummy variable = 1 if audience's salary is less than 10,000 Baht.
dsex is dummy variable = 1 if audience is female
dedu is dummy variable = 1 if audience's education is lower than bachelor degree
dsta is dummy variable = 1 if audience is single.
form is perception of audience on the movie.

```
. histogram z
(bin=14, start=0, width=1.0714286)
```




```
. reg z dinc dsex dedu dsta form

      Source |       SS       df       MS              Number of obs =     200
-------------+------------------------------           F(  5,   194) =    3.89
       Model |  72.1606046     5  14.4321209           Prob > F      =  0.0022
    Residual |  719.119395   194  3.70680101           R-squared     =  0.0912
-------------+------------------------------           Adj R-squared =  0.0678
       Total |      791.28   199  3.97628141           Root MSE      =  1.9253

------------------------------------------------------------------------------
           z |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dinc |  -.9274258   .2916378    -3.18   0.002    -1.502614   -.3522381
        dsex |  -.4259839   .2881238    -1.48   0.141    -.9942411    .1422733
        dedu |  -.6331845   .4504681    -1.41   0.161    -1.521628    .2552591
        dsta |   .8493393   .3582055     2.37   0.019     .1428622    1.555816
        form |   .2355107   .1379162     1.71   0.089     -.036497    .5075184
```

```
       _cons |   2.511279   .3957344     6.35   0.000     1.730785    3.291774
------------------------------------------------------------------------------

. poisson z dinc dsex dedu dsta form

Iteration 0:   log likelihood =  -365.2093
Iteration 1:   log likelihood =  -365.2093

Poisson regression                                Number of obs   =        200
                                                  LR chi2(5)      =      29.80
                                                  Prob > chi2     =     0.0000
Log likelihood =  -365.2093                       Pseudo R2       =     0.0392

------------------------------------------------------------------------------
           z |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dinc |  -.3793193   .0978647    -3.88   0.000    -.5711307    -.187508
        dsex |  -.1710311   .0936989    -1.83   0.068    -.3546775    .0126152
        dedu |  -.2672999   .1585634    -1.69   0.092    -.5780785    .0434787
        dsta |   .3685056   .1296941     2.84   0.004     .1143099    .6227014
        form |   .0969804    .046308     2.09   0.036     .0062184    .1877424
       _cons |   .8719971   .1389398     6.28   0.000     .5996802    1.144314
------------------------------------------------------------------------------

. estat gof

         Goodness-of-fit chi2  =  210.5588
         Prob > chi2(194)      =    0.1973

. mfx

Marginal effects after poisson
      y  = Predicted number of events (predict)
         =  2.3658003
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
   dinc*|  -.8841442      .22276   -3.97   0.000  -1.32074 -.447545       .445
   dsex*|  -.4156465      .23338   -1.78   0.075  -.873064  .041771        .65
   dedu*|  -.5714722      .30478   -1.88   0.061  -1.16884  .025895        .11
   dsta*|   .7821038      .24474    3.20   0.001   .302415  1.26179        .81
    form |   .2294362      .10909    2.10   0.035   .015627  .443245   4.9e-08
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

Example 2

The model $\Pr\left[Y=y\right]=\dfrac{e^{-\mu}\mu^{y}}{y!}$ and $\mu_i = \exp(x_i'\beta)$

where:

y = Number of times student going out at night a year.

and x_i is matrix of independent variables include:

program = Program of study = 1 for international program and 0 for Thai program.
sex = Gender of student.
grade = Grade point average of student.
sta = Status of student's family.
dom = Dummy variable = 1 if stay in dormitory and 0 otherwise.
ex = Year of experience in drinking alcohol.
belief = Level of religion belief.
inc = Annual income of student.
pv = Average spending on alcohol beverage each time.
ttc = Average travelling expenditure each time.
ttt = Average travelling time each time (hour).
tst = Average time spending each time (hour).
costt = Annual gross consumption expenditure of student.
cbeer = Annual alcohol spending of student.
zother2 = Annual other leisure spending.
tother2 = Annual other entertainment spending.

Linear regression model

```
. reg y program sex grade sta dom ex belief inc pv ttc t_tt t_st costt c_beer
z_other2 t_other2

      Source |       SS       df       MS              Number of obs =     312
-------------+------------------------------           F( 16,   295) =    6.76
       Model |  26413.1369    16  1650.82106           Prob > F      =  0.0000
    Residual |  71997.2092   295  244.058336           R-squared     =  0.2684
-------------+------------------------------           Adj R-squared =  0.2287
       Total |  98410.3462   311  316.431981           Root MSE      =  15.622

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     program |  -7.527872   2.754987    -2.73   0.007    -12.94979   -2.105953
         sex |  -1.050771   1.989969    -0.53   0.598    -4.967106    2.865564
       grade |   .3519506   2.282883     0.15   0.878     -4.14085    4.844752
         sta |   .4516989   2.919159     0.15   0.877    -5.293317    6.196715
         dom |   .6303185    2.09929     0.30   0.764    -3.501164    4.761801
          ex |   2.349775   .4679602     5.02   0.000     1.428812    3.270739
      belief |  -1.488547   .4739794    -3.14   0.002    -2.421357   -.5557379
         inc |    .000056   .0000336     1.67   0.097    -.0000102    .0001222
          pv |  -.0012581   .0061199    -0.21   0.837    -.0133023    .0107861
         ttc |  -.0022699   .0151408    -0.15   0.881    -.0320675    .0275277
        t_tt |  -4.329307   2.405923    -1.80   0.073    -9.064255    .4056412
        t_st |   3.793012   1.273737     2.98   0.003     1.286249    6.299774
       costt |  -.0000676   .0000515    -1.31   0.190     -.000169    .0000338
      c_beer |   .0004575   .0001372     3.34   0.001     .0001876    .0007275
    z_other2 |   .0000254   .0000233     1.09   0.276    -.0000204    .0000712
    t_other2 |  -.0031929   .0013218    -2.42   0.016    -.0057943   -.0005916
       _cons |   15.36305   10.13627     1.52   0.131    -4.585514    35.31161
------------------------------------------------------------------------------
```

Poisson regression model

```
. poisson y program sex grade sta dom ex belief inc pv ttc t_tt t_st costt
c_beer z_other2 t_other2

Iteration 0:   log likelihood = -2728.4595
Iteration 1:   log likelihood = -2707.9118
Iteration 2:   log likelihood = -2707.8069
Iteration 3:   log likelihood = -2707.8069

Poisson regression                                Number of obs   =        312
                                                  LR chi2(16)     =    1871.54
                                                  Prob > chi2     =     0.0000
Log likelihood = -2707.8069                       Pseudo R2       =     0.2568

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     program |  -.6122153   .0478042   -12.81   0.000    -.7059098   -.5185208
         sex |  -.0946098   .0389511    -2.43   0.015    -.1709527    -.018267
       grade |  -.0632803   .0397681    -1.59   0.112    -.1412243    .0146637
         sta |   .0769079   .0562114     1.37   0.171    -.0332644    .1870801
         dom |   .1129061   .0405919     2.78   0.005     .0333474    .1924648
          ex |   .1841726   .0083343    22.10   0.000     .1678378    .2005075
      belief |  -.1156058   .0083492   -13.85   0.000    -.1319699   -.0992418
         inc |   4.11e-06   5.69e-07     7.23   0.000     3.00e-06    5.23e-06
          pv |  -.0002181   .0001203    -1.81   0.070    -.0004539    .0000177
         ttc |   .0002749   .0002735     1.01   0.315    -.0002612     .000811
        t_tt |   -.499294   .0573647    -8.70   0.000    -.6117268   -.3868612
        t_st |   .1915786   .0202995     9.44   0.000     .1517923    .2313649
       costt |  -5.32e-06   8.44e-07    -6.30   0.000    -6.97e-06   -3.66e-06
      c_beer |   .0000181   1.61e-06    11.22   0.000     .0000149    .0000213
    z_other2 |   2.04e-06   3.63e-07     5.61   0.000     1.33e-06    2.75e-06
    t_other2 |  -.0002584    .000027    -9.56   0.000    -.0003114   -.0002055
       _cons |   3.307107   .1826709    18.10   0.000     2.949079    3.665135
------------------------------------------------------------------------------

. estat gof

         Goodness-of-fit chi2  =  5530.444
         Prob > chi2(303)      =    0.0000

. mfx

Marginal effects after poisson
      y  = Predicted number of events (predict)
         =  9.6471698
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
 program*|  -7.342441      .69422  -10.58   0.000  -8.70308  -5.9818   .830128
     sex*|  -.9069866      .37078   -2.45   0.014   -1.6337  -.18027   .429487
   grade |  -.6104762      .38331   -1.59   0.111  -1.36175  .140801   2.84212
     sta*|   .7201405      .51056    1.41   0.158  -.280529  1.72081   .891026
     dom*|   1.089014      .39086    2.79   0.005   .322952  1.85508    .50641
      ex |   1.776745      .07717   23.02   0.000   1.62549  1.92799   2.75962
  belief |  -1.115269      .07952  -14.03   0.000  -1.27112 -.959422   5.17949
     inc |   .0000397      .00001    7.25   0.000   .000029   .00005   64401.9
      pv |  -.0021043      .00116   -1.81   0.070  -.004377  .000169   366.275
     ttc |   .0026521      .00264    1.01   0.315  -.002517  .007821   88.5439
    t_tt |  -4.816774      .54623   -8.82   0.000  -5.88736 -3.74619   .730004
    t_st |   1.848192      .19635    9.41   0.000   1.46336  2.23302     3.553
   costt |  -.0000513      .00001   -6.31   0.000  -.000067 -.000035   47913.9
  c_beer |   .0001747      .00002   11.18   0.000   .000144  .000205   2480.15
z_other2 |   .0000196      .00000    5.63   0.000   .000013  .000026     33390
t_other2 |  -.0024933      .00026   -9.65   0.000     -.003 -.001987   2827.45
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

Alternative command for Linear regression model

```
. glm y program sex grade sta dom ex belief inc pv ttc t_tt t_st costt c_beer
z_other2 t_other2
```

```
Iteration 0:   log likelihood =  -1291.564

Generalized linear models                          No. of obs      =       312
Optimization     : ML                              Residual df     =       295
                                                   Scale parameter =  244.0583
Deviance         =  71997.20924                    (1/df) Deviance =  244.0583
Pearson          =  71997.20924                    (1/df) Pearson  =  244.0583

Variance function: V(u) = 1                        [Gaussian]
Link function    : g(u) = u                        [Identity]

                                                   AIC             =  8.388231
Log likelihood   = -1291.564016                    BIC             =  70303.02

------------------------------------------------------------------------------
             |                 OIM
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     program |  -7.527872   2.754987    -2.73   0.006    -12.92755   -2.128197
         sex |  -1.050771   1.989969    -0.53   0.597    -4.951039    2.849497
       grade |   .3519506   2.282883     0.15   0.877    -4.122418    4.826319
         sta |   .4516989   2.919159     0.15   0.877    -5.269747    6.173145
         dom |   .6303185    2.09929     0.30   0.764    -3.484214    4.744851
          ex |   2.349775   .4679602     5.02   0.000      1.43259    3.266961
      belief |  -1.488547   .4739794    -3.14   0.002     -2.41753   -.5595649
         inc |    .000056   .0000336     1.67   0.096    -9.91e-06    .0001219
          pv |  -.0012581   .0061199    -0.21   0.837    -.0132529    .0107367
         ttc |  -.0022699   .0151408    -0.15   0.881    -.0319453    .0274055
        t_tt |  -4.329307   2.405923    -1.80   0.072    -9.044829    .3862155
        t_st |   3.793012   1.273737     2.98   0.003     1.296533     6.28949
       costt |  -.0000676   .0000515    -1.31   0.189    -.0001686    .0000334
      c_beer |   .0004575   .0001372     3.34   0.001     .0001887    .0007264
    z_other2 |   .0000254   .0000233     1.09   0.275    -.0000202     .000071
    t_other2 |  -.0031929   .0013218    -2.42   0.016    -.0057836   -.0006023
       _cons |   15.36305   10.13627     1.52   0.130    -4.503673    35.22977
------------------------------------------------------------------------------
```

Alternative command for Poisson regression model

```
. glm y program sex grade sta dom ex belief inc pv ttc t_tt t_st costt c_beer
z_other2 t_other2, family(poisson) link(log)

Iteration 0:   log likelihood = -2860.0678
Iteration 1:   log likelihood = -2708.9239
Iteration 2:   log likelihood = -2707.8074
Iteration 3:   log likelihood = -2707.8069
Iteration 4:   log likelihood = -2707.8069

Generalized linear models                          No. of obs      =       312
Optimization     : ML                              Residual df     =       295
                                                   Scale parameter =         1
Deviance         =  4548.291553                    (1/df) Deviance =  15.41794
Pearson          =  5311.074618                    (1/df) Pearson  =  18.00364

Variance function: V(u) = u                        [Poisson]
Link function    : g(u) = ln(u)                    [Log]

                                                   AIC             =  17.46671
Log likelihood   = -2707.806856                    BIC             =  2854.106

------------------------------------------------------------------------------
             |                 OIM
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     program |  -.6122153   .0478042   -12.81   0.000    -.7059097   -.5185208
         sex |  -.0946098   .0389511    -2.43   0.015    -.1709527    -.018267
       grade |  -.0632803   .0397681    -1.59   0.112    -.1412243    .0146637
         sta |   .0769079   .0562114     1.37   0.171    -.0332644    .1870801
         dom |   .1129061   .0405919     2.78   0.005     .0333474    .1924648
          ex |   .1841726   .0083343    22.10   0.000     .1678378    .2005075
      belief |  -.1156058   .0083492   -13.85   0.000    -.1319699   -.0992418
         inc |   4.11e-06   5.69e-07     7.23   0.000     3.00e-06    5.23e-06
          pv |  -.0002181   .0001203    -1.81   0.070    -.0004539    .0000177
         ttc |   .0002749   .0002735     1.01   0.315    -.0002612     .000811
        t_tt |   -.499294   .0573647    -8.70   0.000    -.6117268   -.3868612
```

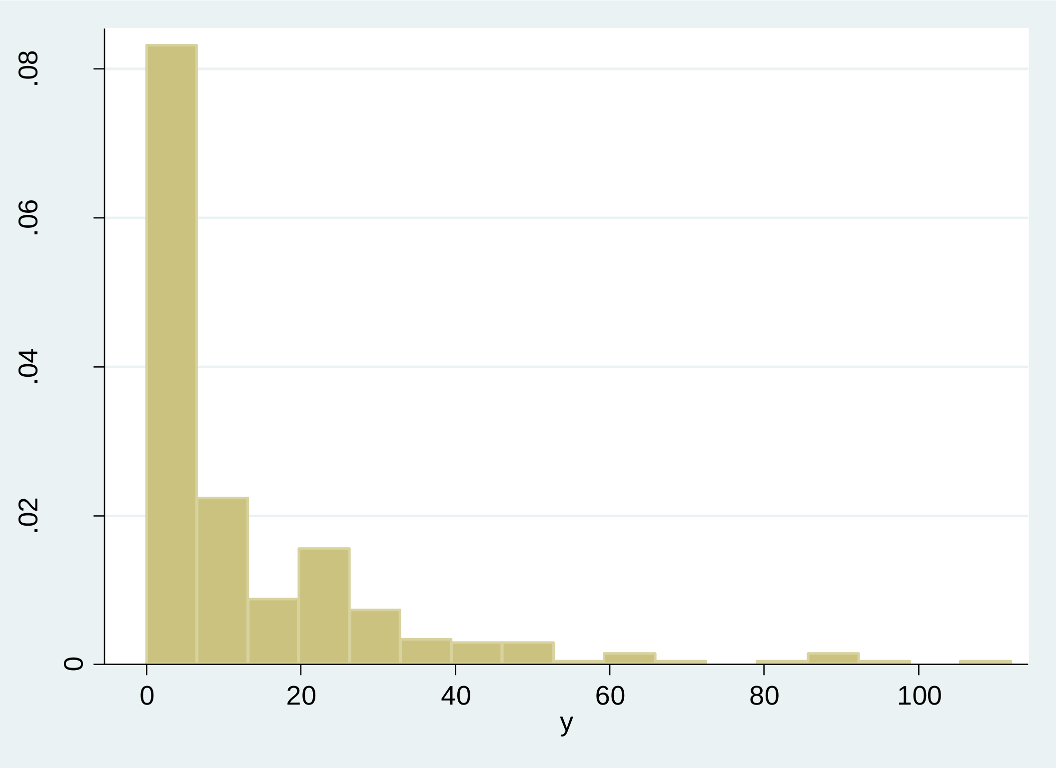
```
       t_st |   .1915786   .0202995     9.44   0.000     .1517923    .2313649
      costt |  -5.32e-06   8.44e-07    -6.30   0.000    -6.97e-06   -3.66e-06
     c_beer |   .0000181   1.61e-06    11.22   0.000     .0000149    .0000213
   z_other2 |   2.04e-06   3.63e-07     5.61   0.000     1.33e-06    2.75e-06
   t_other2 |  -.0002584    .000027    -9.56   0.000    -.0003114   -.0002055
      _cons |   3.307107   .1826709    18.10   0.000     2.949079    3.665135
------------------------------------------------------------------------------
```

Negative binomial regression model

```
. nbreg y program sex grade sta dom ex belief inc pv ttc t_tt t_st costt c_beer
z_other2 t_other2

Fitting Poisson model:

Iteration 0:   log likelihood = -2728.4595
...
Iteration 3:   log likelihood = -2707.8069

Fitting constant-only model:

Iteration 0:   log likelihood = -1103.2879
...
Iteration 4:   log likelihood = -1009.9302

Fitting full model:

Iteration 0:   log likelihood = -989.50145
...
Iteration 4:   log likelihood =  -969.5487

Negative binomial regression                      Number of obs   =        312
                                                  LR chi2(16)     =      80.76
Dispersion     = mean                             Prob > chi2     =     0.0000
Log likelihood = -969.5487                        Pseudo R2       =     0.0400

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     program |  -.3898534   .2760147    -1.41   0.158    -.9308322    .1511255
         sex |  -.1288375   .2122094    -0.61   0.544    -.5447602    .2870852
       grade |    .169173   .2551819     0.66   0.507    -.3309743    .6693203
         sta |   .0300347   .2971865     0.10   0.920    -.5524402    .6125095
         dom |  -.0102337   .2069429    -0.05   0.961    -.4158343    .3953669
          ex |   .4768634   .0735502     6.48   0.000     .3327077     .621019
      belief |  -.1058805   .0517931    -2.04   0.041    -.2073931   -.0043679
         inc |   4.17e-06   4.00e-06     1.04   0.297    -3.67e-06     .000012
          pv |  -.0009809   .0005992    -1.64   0.102    -.0021553    .0001935
         ttc |  -.0004837   .0012703    -0.38   0.703    -.0029734    .0020061
        t_tt |   -.142558   .1920595    -0.74   0.458    -.5189876    .2338716
        t_st |   .1466567   .1117141     1.31   0.189    -.0722989    .3656123
       costt |  -1.62e-06   5.65e-06    -0.29   0.774    -.0000127    9.46e-06
      c_beer |   .0000311   .0000162     1.92   0.055    -6.18e-07    .0000628
    z_other2 |   1.28e-06   2.03e-06     0.63   0.527    -2.69e-06    5.26e-06
    t_other2 |  -.0002077   .0001176    -1.77   0.077    -.0004382    .0000228
       _cons |    1.51107    1.00422     1.50   0.132    -.4571661    3.479306
-------------+----------------------------------------------------------------
    /lnalpha |   .8080556   .0977188                      .6165303    .9995809
-------------+----------------------------------------------------------------
       alpha |   2.243541   .2192362                      1.852489    2.717143
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0:  chibar2(01) = 3476.52 Prob>=chibar2 = 0.000

. mfx

Marginal effects after nbreg
      y  = Predicted number of events (predict)
         =  8.5030321
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
program*|  -3.794166      3.08225   -1.23   0.218  -9.83526  2.24693   .830128
    sex*|  -1.086353      1.77792   -0.61   0.541  -4.57101   2.3983   .429487
   grade |   1.438484       2.1729    0.66   0.508  -2.82032  5.69728   2.84212
    sta*|   .2524134      2.46848    0.10   0.919  -4.58572  5.09055   .891026
```

```
     dom*|  -.0870237      1.7599    -0.05   0.961  -3.53637  3.36232    .50641
      ex |   4.054784      .70836     5.72   0.000   2.66643  5.44314   2.75962
  belief |  -.9003054      .44663    -2.02   0.044  -1.77569  -.02492   5.17949
     inc |   .0000355      .00003     1.04   0.299  -.000031  .000102   64401.9
      pv |  -.0083407      .00514    -1.62   0.105  -.018413  .001731   366.275
     ttc |  -.0041126      .01081    -0.38   0.704  -.025294  .017069   88.5439
    t_tt |  -1.212175     1.63612    -0.74   0.459  -4.41891  1.99456   .730004
    t_st |   1.247027      .95574     1.30   0.192  -.626191  3.12024     3.553
   costt |  -.0000138      .00005    -0.29   0.774  -.000108   .00008   47913.9
  c_beer |   .0002646      .00014     1.90   0.058  -8.8e-06  .000538   2480.15
z_other2 |   .0000109      .00002     0.63   0.528  -.000023  .000045     33390
t_other2 |  -.0017661      .00101    -1.75   0.081  -.003747  .000215   2827.45
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
. histogram y
(bin=17, start=0, width=6.5882353)
```



Zero inflated poisson regression model

```
. zip y program grade sta dom ex belief inc t_tt t_st costt c_beer z_other2
t_other2, inflate(dom ex pv) vuong

Fitting constant-only model:

Iteration 0:   log likelihood = -2476.4912
...
Iteration 5:   log likelihood = -2066.6059

Fitting full model:

Iteration 0:   log likelihood = -2066.6059
...
Iteration 4:   log likelihood = -1625.5224

Zero-inflated Poisson regression                  Number of obs   =        312
                                                  Nonzero obs     =        198
                                                  Zero obs        =        114

Inflation model = logit                           LR chi2(13)     =     882.17
```

```
Log likelihood  = -1625.522                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y            |
     program |  -.4891019   .0463289   -10.56   0.000    -.5799048    -.398299
       grade |  -.0732467   .0403027    -1.82   0.069    -.1522385    .0057451
         sta |   .1413059   .0557201     2.54   0.011     .0320964    .2505153
         dom |  -.1053156   .0400339    -2.63   0.009    -.1837806   -.0268506
          ex |   .0450504   .0096875     4.65   0.000     .0260632    .0640376
      belief |  -.1119621   .0084534   -13.24   0.000    -.1285305   -.0953936
         inc |   4.04e-06   6.10e-07     6.62   0.000     2.84e-06    5.23e-06
        t_tt |  -.3349799   .0450537    -7.44   0.000    -.4232834   -.2466763
        t_st |   .2043139   .0180036    11.35   0.000     .1690274    .2396004
       costt |  -5.46e-06   8.43e-07    -6.47   0.000    -7.11e-06   -3.81e-06
      c_beer |   9.32e-06   1.54e-06     6.04   0.000     6.30e-06    .0000123
    z_other2 |   1.48e-06   3.31e-07     4.48   0.000     8.35e-07    2.13e-06
    t_other2 |  -.0002147   .0000271    -7.92   0.000    -.0002678   -.0001615
       _cons |   3.838944   .1848651    20.77   0.000     3.476615    4.201273
-------------+----------------------------------------------------------------
inflate      |
         dom |  -.5846571   .3032645    -1.93   0.054    -1.179045    .0097304
          ex |  -.8348106   .0989515    -8.44   0.000    -1.028752   -.6408693
          pv |   .0013891   .0008184     1.70   0.090     -.000215    .0029931
       _cons |   1.193482   .4236727     2.82   0.005     .3630984    2.023865
------------------------------------------------------------------------------
Vuong test of zip vs. standard Poisson:            z =     8.44  Pr>z = 0.0000

. mfx

Marginal effects after zip
      y  = Predicted number of events (predict)
         =  11.536871
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
 program*|  -6.697791      .80233   -8.35   0.000  -8.27034 -5.12524   .830128
   grade |  -.8450383       .4661   -1.81   0.070  -1.75857  .068498   2.84212
     sta*|   1.543878      .58021    2.66   0.008   .406684  2.68107   .891026
     dom*|    .744751     1.11733    0.67   0.505  -1.44518  2.93468    .50641
      ex |   3.308446      .32428   10.20   0.000   2.67288  3.94402   2.75962
  belief |  -1.291692      .11296  -11.43   0.000   -1.5131 -1.07029   5.17949
     inc |   .0000466      .00001    6.38   0.000   .000032  .000061   64401.9
    t_tt |   -3.86462      .54495   -7.09   0.000  -4.93271 -2.79653   .730004
    t_st |   2.357143      .23783    9.91   0.000   1.89101  2.82328     3.553
   costt |   -.000063      .00001   -6.21   0.000  -.000083 -.000043   47913.9
  c_beer |   .0001075      .00002    5.83   0.000   .000071  .000144   2480.15
z_other2 |   .0000171      .00000    4.41   0.000   9.5e-06  .000025     33390
t_other2 |  -.0024765      .00033   -7.47   0.000  -.003126 -.001827   2827.45
      pv |  -.0046403      .00274   -1.70   0.090  -.010002  .000721   366.275
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```