1. Estimate models for yi assuming that the model is traditional linear regression model. Interpret your estimated result.

```
reg y x1 x2 x3 x4
```

```
      Source |       SS           df       MS      Number of obs   =       232
-------------+----------------------------------   F(4, 227)       =      5.96
       Model |  44.7298499         4  11.1824625   Prob > F        =    0.0001
    Residual |  425.748598       227  1.87554449   R-squared       =    0.0951
-------------+----------------------------------   Adj R-squared   =    0.0791
       Total |  470.478448       231  2.03670324   Root MSE        =    1.3695

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .1016201   .0435073     2.34   0.020     .0158904    .1873499
          x2 |   .1345044   .0462142     2.91   0.004     .0434407     .225568
          x3 |  -.0748194   .0480457    -1.56   0.121    -.1694919    .0198531
          x4 |   .1684563   .0688243     2.45   0.015     .0328401    .3040725
       _cons |   .9568064    .107007     8.94   0.000     .7459523     1.16766
------------------------------------------------------------------------------
```

- sign and meaning: x1, x2, x4 have positive sign but x3 have negative sign.

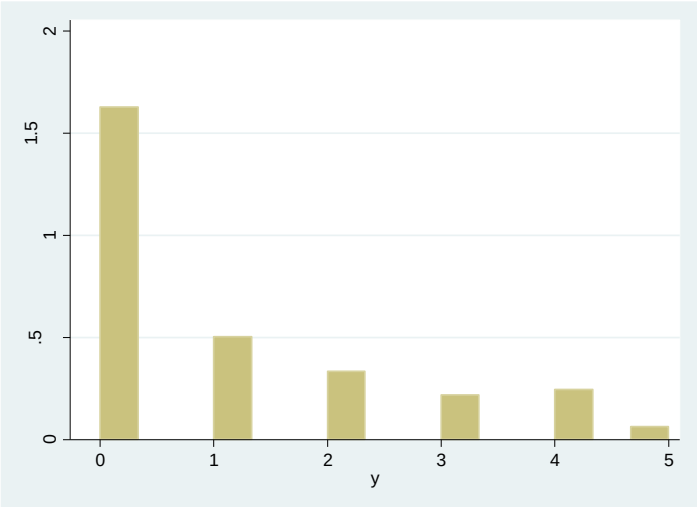
- overall test: since p-value is less than 0.05. the model is significant.

- R-square is quite low (0.0951)

- individual test: 0nly x3 is insignificant

2. Create histogram for yi. Determine whether there is limitation of dependent variable in this case. If yes, what type of limitation is it?

```
. histogram y
(bin=15, start=0, width=.33333333)
```



From the histogram we can see that the data is counted data and there are a lots of zeros, so Zero Inflated Poisson Regression Model should be applied.

3. Estimate models for yi assuming that the probability functions follow Poisson probability distribution. Perform GOF test and determine whether Poisson is appropriated in this case. Interpret the estimated result (sign and meaning (in term of incidence-rate ratios), overall test, individual test, pseudo R^2, marginal effects).

```
poisson y x1 x2 x3 x4, nolog
```

```
Poisson regression                              Number of obs     =        232
                                                LR chi2(4)        =      43.33
                                                Prob > chi2       =     0.0000
Log likelihood = -342.88107                     Pseudo R2         =     0.0594

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .0971474   .0306762     3.17   0.002     .0370231    .1572717
          x2 |   .1293024   .0330916     3.91   0.000      .064444    .1941607
          x3 |  -.0715533   .0342177    -2.09   0.037    -.1386187   -.0044879
          x4 |   .1734482   .0507707     3.42   0.001     .0739395    .2729569
       _cons |  -.1284876   .0849064    -1.51   0.130     -.294901    .0379259
------------------------------------------------------------------------------
```

```
. estat gof
```

```
         Deviance goodness-of-fit =  409.4921
         Prob > chi2(227)         =    0.0000

         Pearson goodness-of-fit  =  423.3541
         Prob > chi2(227)         =    0.0000

. poisson y x1 x2 x3 x4, ir nolog

Poisson regression                              Number of obs     =        232
                                                LR chi2(4)        =      43.33
                                                Prob > chi2       =     0.0000
Log likelihood = -342.88107                     Pseudo R2         =     0.0594

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.102023   .0338059     3.17   0.002     1.037717    1.170314
          x2 |   1.138034   .0376594     3.91   0.000     1.066566    1.214291
          x3 |   .9309467   .0318548    -2.09   0.037     .8705599    .9955222
          x4 |   1.189399   .0603866     3.42   0.001     1.076742    1.313844
       _cons |   .8794245   .0746687    -1.51   0.130     .7446053    1.038654
------------------------------------------------------------------------------

. mfx

Marginal effects after poisson
      y  = Predicted number of events (predict)
         =  .95621703
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1 |    .092894      .02882    3.22   0.001   .036403  .149385  -.317697
      x2 |   .1236411       .0308    4.01   0.000   .063277  .184005   .812709
      x3 |  -.0684205      .03246   -2.11   0.035   -.13204 -.004801  -.818103
      x4 |   .1658541      .04736    3.50   0.000   .073022  .258686   -.28275
```

- According to GOF test, null hypothesis of the test is rejected, so the data are not poisson distributed.
- Sign and meaning : positive mfx sign and irr>1 forx1, x2, x4 and negative mfx sign and irr<1 for x3.
- overall test: the model is significant.
- Pseudo R-square is quite low
- individual test: all significant

4. Estimate models for yi assuming that the probability functions follow Negative Binomial probability distribution. Determine whether Negative Binomial regression model is appropriated in this case. Interpret your estimated result (sign and meaning (in term of incidence-rate ratios), overall test, individual test, pseudo R^2, marginal effects).

```
. nbreg y x1 x2 x3 x4, nolog

Negative binomial regression                    Number of obs     =        232
                                                LR chi2(4)        =      21.24
Dispersion     = mean                           Prob > chi2       =     0.0003
Log likelihood = -317.49278                     Pseudo R2         =     0.0324

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .1285534   .0506934     2.54   0.011     .0291962    .2279106
          x2 |    .151011   .0506477     2.98   0.003     .0517434    .2502785
          x3 |  -.0672859   .0481376    -1.40   0.162    -.1616339    .0270621
          x4 |   .1726312   .0707035     2.44   0.015      .034055    .3112075
       _cons |  -.1435596   .1177204    -1.22   0.223    -.3742874    .0871682
-------------+----------------------------------------------------------------
    /lnalpha |   .0479945   .2389531                     -.4203449    .5163339
-------------+----------------------------------------------------------------
       alpha |   1.049165   .2507012                      .6568202    1.675872
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0:  chibar2(01) =   50.78 Prob>=chibar2 = 0.000
```

According to LR test of alpha, Ho is rejected indicating that Negative Binomial regression model is more appropriated than Poisson regression model.

```
. nbreg y x1 x2 x3 x4, ir nolog

Negative binomial regression                    Number of obs     =        232
```

```
                                                LR chi2(4)        =      21.24
Dispersion     = mean                           Prob > chi2       =     0.0003
Log likelihood = -317.49278                     Pseudo R2         =     0.0324

------------------------------------------------------------------------------
           y |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.137182   .0576476     2.54   0.011     1.029627    1.255973
          x2 |   1.163009   .0589037     2.98   0.003     1.053105    1.284383
          x3 |   .9349279   .0450052    -1.40   0.162     .8507526    1.027432
          x4 |   1.188428    .084026     2.44   0.015     1.034641    1.365072
       _cons |   .8662692   .1019776    -1.22   0.223     .6877792     1.09108
-------------+----------------------------------------------------------------
    /lnalpha |   .0479945   .2389531                     -.4203449    .5163339
-------------+----------------------------------------------------------------
       alpha |   1.049165   .2507012                      .6568202    1.675872
------------------------------------------------------------------------------
Likelihood-ratio test of alpha=0:  chibar2(01) =   50.78 Prob>=chibar2 = 0.000

. mfx

Marginal effects after nbreg
      y  = Predicted number of events (predict)
         =  .94607122
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      x1 |   .1216207      .04796    2.54   0.011    .02763  .215611  -.317697
      x2 |   .1428671      .04796    2.98   0.003   .048862  .236872   .812709
      x3 |  -.0636573      .04556   -1.40   0.162  -.152956  .025642  -.818103
      x4 |   .1633214      .06686    2.44   0.015   .032269  .294374   -.28275
------------------------------------------------------------------------------
```

- Sign and meaning : positive mfx sign and irr>1 forx1, x2, x4 and negative mfx sign and irr<1 for x3.
- overall test: the model is significant.
- Pseudo R-square is quite low.
- individual test: only x3 is insignificant.

5. Estimate models for yi assuming that the model is Zero Inflated Poisson (x1i, x2i, and x3i are independent variables in Poisson model and x4i is independent variable in Inflated (Logit) model). Interpret your estimated result. Determine which model (Linear regression model, Poisson, Negative Binomial, or ZIP) is the most appropriated model in this case? Why? (provide the tests).

```
zip y x1 x2 x3, inflate(x4) vuong nolog

Zero-inflated Poisson regression               Number of obs     =        232
                                               Nonzero obs       =        106
                                               Zero obs          =        126

Inflation model = logit                        LR chi2(3)        =      10.35
Log likelihood  = -312.6158                    Prob > chi2       =     0.0158

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y            |
          x1 |   .0805446   .0398159     2.02   0.043     .0025068    .1585824
          x2 |   .0857883   .0372107     2.31   0.021     .0128567    .1587199
          x3 |  -.0672468   .0357098    -1.88   0.060    -.1372367     .002743
       _cons |   .4589728   .1106031     4.15   0.000     .2421947    .6757508
-------------+----------------------------------------------------------------
inflate      |
          x4 |  -.2738532   .1212311    -2.26   0.024    -.5114618   -.0362446
       _cons |  -.3379298   .1908217    -1.77   0.077    -.7119334    .0360738
------------------------------------------------------------------------------
Vuong test of zip vs. standard Poisson:           z =     3.92  Pr>z = 0.0000
```

According to Vuong test, Ho is rejected, thus, Zero Inflated Poisson regression model is more appropriated than Poisson regression model.

```
mfx
Marginal effects after zip
      y  = Predicted number of events (predict)
         =   .9868501
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
```

```
      x1 |   .0794855      .03893    2.04   0.041   .003192  .155779  -.317697
      x2 |   .0846602      .03606    2.35   0.019   .013992  .155328   .812709
      x3 |  -.0663626      .03507   -1.89   0.058  -.135102  .002377  -.818103
      x4 |   .1176249      .05326    2.21   0.027   .013231  .222019   -.28275
------------------------------------------------------------------------------
```

- Sign and meaning : positive mfx sign for x1, x2, x4 and negative mfx sign for x3.
- Overall test : significant
- Individual test : only x3 is insignificant.

6. According to the above (1-5), determine the most appropriated model for this case. Give explanation why?

According to Vuong test, Ho is rejected meaning that Zero Inflated Poisson regression model is more appropriated than Poisson regression model and Histogram also shows that Zero Inflated Poisson regression model should be applied. Therefore, we choose Zero Inflated Poisson regression model.