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Assignment 10

1. Estimate models for Y1i, Y2i, and Y3i assuming that the probability functions follow separate normal distribution function.

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. probit y1 x1 x2 x3
Iteration 0:   log likelihood = -45.533775
Iteration 1:   log likelihood =  -35.05321
Iteration 2:   log likelihood = -34.122847
Iteration 3:   log likelihood = -34.092095
Iteration 4:   log likelihood =  -34.09209
Iteration 5:   log likelihood =  -34.09209

Probit regression                                 Number of obs     =         67
                                                  LR chi2(3)        =      22.88
                                                  Prob > chi2       =     0.0000
Log likelihood =  -34.09209                       Pseudo R2         =     0.2513

------------------------------------------------------------------------------
          y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   2.574932   .7958181     3.24   0.001     1.015157    4.134707
          x2 |  -.5031798    .297949    -1.69   0.091    -1.087149    .0807895
          x3 |   .3449061   .1616015     2.13   0.033      .028173    .6616392
       _cons |  -2.186903   .6334447    -3.45   0.001    -3.428432   -.9453743
------------------------------------------------------------------------------
Note: 1 failure and 0 successes completely determined.

. probit y2 x1 x2 x3
Iteration 0:   log likelihood = -22.432361
Iteration 1:   log likelihood = -19.734461
Iteration 2:   log likelihood = -19.678976
Iteration 3:   log likelihood = -19.678766
Iteration 4:   log likelihood = -19.678766

Probit regression                                 Number of obs     =         67
                                                  LR chi2(3)        =       5.51
                                                  Prob > chi2       =     0.1382
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Log likelihood = -19.678766                     Pseudo R2         =     0.1228

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          y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.196021   .8449952     1.42   0.157    -.4601389    2.852182
          x2 |  -.1604507   .1166507    -1.38   0.169    -.3890818    .0681804
          x3 |   .1023406   .2083685     0.49   0.623    -.3060541    .5107354
       _cons |   .5275558   .5565448     0.95   0.343     -.563252    1.618364
------------------------------------------------------------------------------


. probit y3 x1 x2 x3
Iteration 0:   log likelihood = -39.952416
Iteration 1:   log likelihood = -35.846932
Iteration 2:   log likelihood = -35.496676
Iteration 3:   log likelihood = -35.486934
Iteration 4:   log likelihood = -35.486933

Probit regression                               Number of obs     =         67
                                                LR chi2(3)        =       8.93
                                                Prob > chi2       =     0.0302
Log likelihood = -35.486933                     Pseudo R2         =     0.1118

------------------------------------------------------------------------------
          y3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   1.549326   .6925982     2.24   0.025     .1918581    2.906793
          x2 |    -.33157   .2931093    -1.13   0.258    -.9060538    .2429137
          x3 |   .0952456   .1142564     0.83   0.404     -.128693    .3191841
       _cons |  -1.713771   .5536004    -3.10   0.002    -2.798808   -.6287342
------------------------------------------------------------------------------
```

Interpret your estimated result (sign and meaning, overall test, pseudo R2, individual test)

From model Y1i, firms with a **higher x1 and/or x3** and/or **lower x2** are associated with a higher likelihood of choosing to restructure its capital structure.

From model Y2i, interpretation should not be made as all coefficients are insignificant. This model should not be applied.

From model Y3i, firms with a **higher x1 and/or x3** and/or **lower x2** are associated with a higher likelihood of choosing to issue new stocks.

For the individual test, I have highlighted the insignificant independent variables in red. Model Y1i and Y3i are overall significant, but model Y2i is not. Pseudo R2 of model Y1i is the largest, meaning that its independent variables can explain the dependent variable best when compare with model Y2i and Y3i. Model Y1i has the best goodness of fit.

2. Estimate models for Y1i, Y2i, and Y3i assuming that the probability functions follow multivariate normal probability distribution function (MV Probit models). Determine whether MVProbit is appropriated. Why?

```
. mvprobit ( y1 x1 x2 x3 )( y2 x1 x2 x3 )( y3 x1 x2 x3 )

Iteration 0:   log likelihood = -89.257789

Iteration 1:   log likelihood = -88.984177

Iteration 2:   log likelihood = -88.982664

Iteration 3:   log likelihood = -88.982663


Multivariate probit (MSL, # draws = 5)            Number of obs   =         67
                                                  Wald chi2(9)    =      25.03
Log likelihood = -88.982663                       Prob > chi2     =     0.0029

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y1           |
          x1 |   2.592376   .8023984     3.23   0.001     1.019704    4.165048
          x2 |  -.5314422   .3036422    -1.75   0.080     -1.12657    .0636857
          x3 |   .3491611   .1619024     2.16   0.031     .0318383    .6664839
       _cons |  -2.194319   .6357735    -3.45   0.001    -3.440412   -.9482253
-------------+----------------------------------------------------------------
y2           |
          x1 |   1.221734   .8478931     1.44   0.150    -.4401059    2.883574
          x2 |  -.1557306   .1180077    -1.32   0.187    -.3870215    .0755604
          x3 |   .1054215   .2100288     0.50   0.616    -.3062274    .5170703
       _cons |   .5119029   .5577948     0.92   0.359    -.5813547    1.605161
-------------+----------------------------------------------------------------
y3           |
          x1 |   1.535622   .6913496     2.22   0.026     .1806018    2.890642
          x2 |  -.3542075   .2987204    -1.19   0.236    -.9396887    .2312737
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          x3 |   .0956571   .1143892     0.84   0.403    -.1285416    .3198557
       _cons |  -1.691533   .5520363    -3.06   0.002    -2.773504   -.6095614
-------------+----------------------------------------------------------------
    /atrho21 |   .1028098    .306035     0.34   0.737    -.4970077    .7026274
-------------+----------------------------------------------------------------
    /atrho31 |   .1399288   .2264305     0.62   0.537    -.3038669    .5837245
-------------+----------------------------------------------------------------
    /atrho32 |   .1014794    .268692     0.38   0.706    -.4251472     .628106
-------------+----------------------------------------------------------------
       rho21 |   .1024491   .3028229     0.34   0.735    -.4597606    .6060328
-------------+----------------------------------------------------------------
       rho31 |   .1390226   .2220542     0.63   0.531    -.2948474    .5253672
-------------+----------------------------------------------------------------
       rho32 |   .1011325   .2659439     0.38   0.704    -.4012578    .5567467
------------------------------------------------------------------------------
Likelihood ratio test of  rho21 = rho31 = rho32 = 0:

             chi2(3) =  .550251   Prob > chi2 = 0.9077
```

As the p-value is more than 0.05, we cannot reject the null hypothesis that rho equals to zero. Thus, there is no evidence that multivariate probit model is more appropriate than separate probit ones.