Assignment 4

From the data set `assign4.dta`:

The study on bankruptcy firm employs the following regression model.

$$z_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_4 x_{4i} \qquad (1)$$

The log-likelihood function of this model is as follows:

$$\ln L = \begin{cases} \ln \Phi(z_i) \text{ if } y_i = 1 \\ \ln \Phi(-z_i) \text{ if } y_i = 0 \end{cases} \qquad (2)$$

where: y_i = 1 for bankruptcy firm and 0 otherwise.

x_{1i} = Debt coverage ratio of firm i

x_{2i} = Liquidity ratio of firm i

x_{3i} = Profitability index of firm i

x_{4i} = Solidity ratio of firm i

Let $\Phi(.)$ = Logistic probability distribution function. $\Phi(z_i) = \dfrac{1}{1+e^{-z_i}}$

From the given data set (`assig8-2.dta`):

a. Estimate the above models using MLE with Newton-Ralphson algorithm.
b. Perform hypothesis testing whether $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ using LR-test and Wald test.
c. Estimate the above models using MLE with BHHH algorithm, make comparison of the estimated result with the result from (1), and give explanation why are they different?

Let $\Phi(.)$ = Cumulation standard normal probability distribution function and

$$z_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} \qquad (3)$$

d. Estimate the models using MLE with Newton-Ralphson algorithm.

Assume that there exists heteroskedasticity in the model as: $\sigma_i^2 = \exp(\gamma x_{4i})^2$, then,

$\Phi(.)$ = Cumulation standard normal probability distribution function $\Phi\ z_i / \exp(\gamma x_{4i})$

e. Estimate the models with heteroskedasticity using MLE with Newton-Ralphson algorithm. Perform LR-test whether there exists significant heteroskedasticity.

a.)

```
. ml model lf ml_logit (y = x1 x2 x3 x4)

. ml maximize

initial:       log likelihood = -90.109133
Iteration 7:   log likelihood = -54.627603

                                                Number of obs     =        130
                                                Wald chi2(4)      =      22.79
Log likelihood = -54.627603                     Prob > chi2       =     0.0001

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .4835128   .1686119     2.87   0.004     .1530395     .813986
          x2 |   1.454009   .5001373     2.91   0.004     .4737577     2.43426
          x3 |   2.173186   .7757021     2.80   0.005      .652838    3.693535
          x4 |   1.855464   .7138855     2.60   0.009     .4562738    3.254653
       _cons |  -1.400447   .5531237    -2.53   0.011    -2.484549    -.316344
------------------------------------------------------------------------------
```

b.) Wald test

```
. test (x1=0) (x2=0) (x3=0) (x4=0)

 ( 1)  [eq1]x1 = 0
 ( 2)  [eq1]x2 = 0
 ( 3)  [eq1]x3 = 0
 ( 4)  [eq1]x4 = 0

           chi2(  4) =   22.79
         Prob > chi2 =    0.0001
```

LR-test

```
initial:       log likelihood = -90.109133
alternative:   log likelihood = -86.130008
rescale:       log likelihood = -86.130008
Iteration 0:   log likelihood = -86.130008
Iteration 1:   log likelihood = -86.129902
Iteration 2:   log likelihood = -86.129902

                                                Number of obs     =        130
                                                Wald chi2(0)      =          .
Log likelihood = -86.129902                     Prob > chi2       =          .

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _cons |   .5026289   .1809802     2.78   0.005     .1479141    .8573436
------------------------------------------------------------------------------

. est store res

. lrtest unres res

Likelihood-ratio test                                 LR chi2(4)  =     63.00
(Assumption: res nested in unres)                     Prob > chi2 =    0.0000
```

c.)

```
initial:       log likelihood = -90.109133
alternative:   log likelihood = -86.130008
rescale:       log likelihood = -86.130008
Iteration 0:   log likelihood = -86.130008
Iteration 1:   log likelihood = -64.805009
Iteration 25:  log likelihood = -54.627605

                                                Number of obs     =        130
                                                Wald chi2(4)      =      16.34
Log likelihood = -54.627605                     Prob > chi2       =     0.0026

------------------------------------------------------------------------------
             |                 OPG
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .4833318   .1542635     3.13   0.002      .180981    .7856827
          x2 |   1.453275     .597925     2.43   0.015     .2813639    2.625187
          x3 |   2.172641   .8589781     2.53   0.011      .489075    3.856207
          x4 |   1.854961   .7142729     2.60   0.009     .4550117     3.25491
       _cons |  -1.400063   .5625155    -2.49   0.013    -2.502573   -.2975527
------------------------------------------------------------------------------
```

The different of the algorithm affect the value of estimator to be changed, also the $\log(L)$, S.E., z-value, χ^2, etc, even though the changes is very small.

d.)

```
initial:       log likelihood = -90.109133
alternative:   log likelihood = -87.504336
rescale:       log likelihood = -86.291737
Iteration 0:   log likelihood = -86.291737
Iteration 1:   log likelihood = -78.555778
Iteration 2:   log likelihood =  -65.28309
Iteration 3:   log likelihood = -60.753707
Iteration 4:   log likelihood = -60.695531
Iteration 5:   log likelihood = -60.695503
Iteration 6:   log likelihood = -60.695503

                                                Number of obs     =        130
                                                Wald chi2(2)      =      22.61
Log likelihood = -60.695503                     Prob > chi2       =     0.0000

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x1 |   .3592444   .0871351     4.12   0.000     .1884627    .5300262
          x2 |   1.139607   .3224845     3.53   0.000     .5075491    1.771665
       _cons |  -.7729211   .2765064    -2.80   0.005    -1.314864   -.2309785
------------------------------------------------------------------------------
```

e.)

```
initial:       log likelihood = -90.109133
alternative:   log likelihood = -83.932039
rescale:       log likelihood = -83.932039
rescale eq:    log likelihood =  -70.42663
Iteration 0:   log likelihood =  -70.42663
Iteration 1:   log likelihood = -69.416382
Iteration 11:  log likelihood = -59.404451

                                                Number of obs     =        130
                                                Wald chi2(2)      =      16.42
Log likelihood = -59.404451                     Prob > chi2       =     0.0003

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
eq1          |
          x1 |   .2921402   .0773775     3.78   0.000      .140483    .4437974
          x2 |   .9417315   .2800569     3.36   0.001     .3928299    1.490633
       _cons |  -.6388427   .2144265    -2.98   0.003    -1.059111   -.2185744
-------------+----------------------------------------------------------------
eq2          |
          x4 |    1.18393    .585199     2.02   0.043     .0369609    2.330899
------------------------------------------------------------------------------

. est store hetres

. lrtest unres hetres

Likelihood-ratio test                                 LR chi2(1)  =      9.55
(Assumption: hetres nested in unres)                  Prob > chi2 =    0.0020
```

H_0: heteroskedasticity

H_a: Otherwise

$Prob > \chi^2 = 0.002 < 0.05 = \alpha$

$\therefore H_0$ is rejected at 5% level

Heteroskedasticity is not exist.