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Assignment 4

From the data set `assign4.dta`:

The study on bankruptcy firm employs the following regression model.

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

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

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

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

$$z_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} \tag{3}$$

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 $\Phi\left(z_i / \exp(\gamma x_{4i})\right)$

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

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a. Estimate the above models using MLE with Newton-Ralphson algorithm.

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

11 . ml maximize

  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 = -66.355929
  Iteration 2:   log likelihood = -63.390498
  Iteration 3:   log likelihood = -57.771054
  Iteration 4:   log likelihood = -55.042146
  Iteration 5:   log likelihood = -54.628566
  Iteration 6:   log likelihood = -54.627603
  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	.6528381	3.693535
x4	1.855464	.7138855	2.60	0.009	.4562739	3.254653
_cons	-1.400447	.5531237	-2.53	0.011	-2.484549	-.316344

$$Z_i = -1.4 + 0.484X_1 + 1.454X_2 + 2.173X_3 + 1.855X_4$$

b. Perform hypothesis testing whether $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ using LR-test and Wald test.

```
16 . lrtest unres res

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

LR test : LR = 63 which p-value < $\alpha = 0.05$
so, we reject the H_0 which mean that
the model is jointly significant

Wald test $W = 22.79$ which P-value < $\alpha = 0.05$
so, we reject the H_0 which mean that
the model is jointly significant

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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?

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

y	Coef.	OPG 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

$Z_i = -1.4 + 0.483X_1 + 1.454X_2 + 2.173X_3 + 1.855X_4$

it's not have significant different however the algolrith can possibly change the value of the estimated result.

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

		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

$Z_i = -0.773 + 0.359X_1 + 1.139X_2$

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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.

```
                                                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	.0773776	3.78	0.000	.140483	.4437975
x2	.9417319	.2800569	3.36	0.001	.3928305	1.490633
_cons	-.6388431	.2144265	-2.98	0.003	-1.059111	-.2185748
eq2						
x4	1.183929	.5851989	2.02	0.043	.0369603	2.330898

$Z_i = -0.639 + 0.292X_1 + 0.942X_2$

```
28 . lrtest unres2 res2

  Likelihood-ratio test                                 LR chi2(2)  =     21.14
  (Assumption: res2 nested in unres2)                   Prob > chi2 =    0.0000
```

LR test : LR = 21.14 which p-value < α = 0.05

So, we reject the H0 which mean that the model is jointly significant