

Assignment 3 Solution

The model

In the study of default probability of the borrower, a bank employ binary choice model to determine the probability of the its clients.

The study employs the following model:

$$Prob(Y=1|X) = f(X1, X2, X3)$$

Where $Y_i = 1$ if the borrower is nonperforming loan (NPL).
 $= 0$ otherwise.
 $X1, X2, X3$ are independent variables.

Strategic NPLs can be determined as the case where the borrower is expected to be good loan but in practice that borrower turned out to be bad loan or NPL.

Requirements:

1. Estimate the model assuming that the probability function is cumulative normal distribution function. Interpret your estimated result (overall test, individual test, pseudo R2, counted R2).
2. Compute marginal effect at mean and at median.
3. Determine the number of Strategic NPLs firms in this case using the threshold of predicted value = 0.5
4. Determine the number of Strategic NPLs firms in this case using the threshold of predicted value = 0.3

1. Estimate the model assuming that the probability function is cumulative normal distribution function. Interpret your estimated result (overall test, individual test, pseudo R2, counted R2).

```
. probit y x1 x2 x3
```

```
Iteration 0: log likelihood = -137.41698
Iteration 1: log likelihood = -112.03395
Iteration 2: log likelihood = -111.06348
Iteration 3: log likelihood = -111.0579
Iteration 4: log likelihood = -111.0579
```

```
Probit regression
```

```
Number of obs = 200
LR chi2(3) = 52.72
Prob > chi2 = 0.0000
Pseudo R2 = 0.1918
```

```
Log likelihood = -111.0579
```

y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
x1	-.0273333	.0052002	-5.26	0.000	-.0375256	-.017141
x2	-.0711115	.0289392	-2.46	0.014	-.1278314	-.0143917
x3	.3943366	.102055	3.86	0.000	.1943125	.5943607
_cons	.5412754	.2866078	1.89	0.059	-.0204656	1.103016

```
. fitstat
```

```
Measures of Fit for probit of y
```

Log-Lik Intercept Only:	-137.417	Log-Lik Full Model:	-111.058
D(196):	222.116	LR(3):	52.718
		Prob > LR:	0.000
McFadden's R2:	0.192	McFadden's Adj R2:	0.163
ML (Cox-Snell) R2:	0.232	Cragg-Uhler(Nagelkerke) R2:	0.310
McKelvey & Zavoina's R2:	0.370	Efron's R2:	0.227
Variance of y*:	1.586	Variance of error:	1.000
Count R2:	0.665	Adj Count R2:	0.247
AIC:	1.151	AIC*n:	230.116
BIC:	-816.354	BIC':	-36.823
BIC used by Stata:	243.309	AIC used by Stata:	230.116

2. Compute marginal effect at mean and at median.

```
. mfx
```

```
Marginal effects after probit
y = Pr(y) (predict)
= .42555135
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]		X
x1	-.010714	.00203	-5.28	0.000	-.014689	-.006739	1.69923
x2	-.027874	.01131	-2.46	0.014	-.050044	-.005704	9.595
x3	.1545702	.03991	3.87	0.000	.076346	.232794	-.000573

```
. mfx, at(median)
```

```
Marginal effects after probit
y = Pr(y) (predict)
= .44871004
```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]		X
x1	-.0108142	.00206	-5.26	0.000	-.014845	-.006784	.511002
x2	-.0281346	.01149	-2.45	0.014	-.050648	-.005621	9
x3	.1560156	.04025	3.88	0.000	.077131	.234901	-.041146

3. Determine the number of Strategic NPLs firms in this case using the threshold of predicted value = 0.5
4. Determine the number of Strategic NPLs firms in this case using the threshold of predicted value = 0.3

```
. predict phat,p
. g yhat1=0 if phat<=0.5
(80 missing values generated)
. replace yhat1=1 if phat>0.5
(80 real changes made)
. g yhat2=0 if phat<=0.3
(135 missing values generated)
. replace yhat2=1 if phat>0.3
(135 real changes made)
. tab yhat1 y
```

yhat1	y		Total
	0	1	
0	82	38	120
1	29	51	80
Total	111	89	200

```
. tab yhat2 y
```

yhat2	y		Total
	0	1	
0	56	9	65
1	55	80	135
Total	111	89	200

```
. estat clas, cutoff(0.5)
```

Probit model for y

Classified	True		Total
	D	~D	
+	51	29	80
-	38	82	120
Total	89	111	200

Classified + if predicted $\Pr(D) \geq .5$
True D defined as $y \neq 0$

Sensitivity	$\Pr(+ D)$	57.30%
Specificity	$\Pr(- \sim D)$	73.87%
Positive predictive value	$\Pr(D +)$	63.75%
Negative predictive value	$\Pr(\sim D -)$	68.33%
False + rate for true ~D	$\Pr(+ \sim D)$	26.13%
False - rate for true D	$\Pr(- D)$	42.70%
False + rate for classified +	$\Pr(\sim D +)$	36.25%
False - rate for classified -	$\Pr(D -)$	31.67%
Correctly classified		66.50%

```
. estat clas, cutoff(0.3)
```

Probit model for y

Classified	True		Total
	D	~D	
+	80	55	135
-	9	56	65
Total	89	111	200

Classified + if predicted $\Pr(D) \geq .3$
 True D defined as $y \neq 0$

Sensitivity	$\Pr(+ D)$	89.89%
Specificity	$\Pr(- \sim D)$	50.45%
Positive predictive value	$\Pr(D +)$	59.26%
Negative predictive value	$\Pr(\sim D -)$	86.15%
False + rate for true ~D	$\Pr(+ \sim D)$	49.55%
False - rate for true D	$\Pr(- D)$	10.11%
False + rate for classified +	$\Pr(\sim D +)$	40.74%
False - rate for classified -	$\Pr(D -)$	13.85%
Correctly classified		68.00%