Multiple Logistic Regression

Now, we expand the regression model, adding in more covariates. Add gender to your model.

1. First, assume no effect modification by gender. State the model.

   Define $Y_i = 1$ if individual i visited the doctor in the last 12 months, 0 otherwise; $X_{1i} = 1$ if the individual is **above** the poverty line, 0 otherwise; $X_{2i} = 1$ if female, 0 if male. Then, our model is $Y_i \sim Bernoulli(p_i)$, where

   $$logit(p_i) = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i}$$

2. Fit the model.

```
. logit doctor nopov female

Iteration 0:   log likelihood =  -247.4035
Iteration 1:   log likelihood = -229.36247
Iteration 2:   log likelihood = -228.56747
Iteration 3:   log likelihood = -228.56462
Iteration 4:   log likelihood = -228.56462

Logistic regression                               Number of obs   =        500
                                                  LR chi2(2)      =      37.68
                                                  Prob > chi2     =     0.0000
Log likelihood = -228.56462                       Pseudo R2       =     0.0761

------------------------------------------------------------------------------
      doctor |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       nopov |    .997763   .3245721     3.07   0.002     .3616134    1.633913
      female |   1.384033   .2549714     5.43   0.000     .8842978    1.883767
       _cons |  -.0321554   .3246122    -0.10   0.921    -.6683837    .6040729
------------------------------------------------------------------------------
```

   The fitted regression model is $logit(\hat{p}_i) = -.0322 + .998X_{1i} + 1.384X_{2i}$.

3. Is there evidence of effect modification by gender?

   Now, we fit the model

   $$logit(p_i) = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{1i} X_{2i}$$

   and test whether $\beta_3 = 0$.

```
. xi: logit doctor i.nopov*female
i.nopov           _Inopov_0-1         (naturally coded; _Inopov_0 omitted)
i.nopov*female    _InopXfemal_#       (coded as above)

Iteration 0:   log likelihood =  -247.4035
Iteration 1:   log likelihood = -229.89318
```

```
Iteration 2:   log likelihood = -228.56544
Iteration 3:   log likelihood = -228.55916
Iteration 4:   log likelihood = -228.55916

Logistic regression                               Number of obs   =        500
                                                  LR chi2(3)      =      37.69
                                                  Prob > chi2     =     0.0000
Log likelihood = -228.55916                       Pseudo R2       =     0.0762

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      doctor |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   _Inopov_1 |   .9619012    .472267     2.04   0.042      .036275    1.887528
      female |   1.329136   .5835434     2.28   0.023     .1854119     2.47286
_InopXfemal_1 |   .0678287   .6489728     0.10   0.917    -1.204135    1.339792
       _cons |  -3.76e-15   .4472136    -0.00   1.000    -.8765225    .8765225
------------------------------------------------------------------------------
```

There is no evidence of effect modification by gender.

4. Is there evidence of confounding by gender?

Without gender: $\hat{\beta}_1 = 0.671$
With gender: $\hat{\beta}_1 = 0.998$
Yes, there is evidence of confounding by gender.