Example of Functional Form

```
. reg food income

Source |       SS       df       MS                  Number of obs =      10
---------+------------------------------                F(  1,     8) =   17.44
Model |  58.8774834     1  58.8774834               Prob > F      =  0.0031
Residual |   27.003764     8   3.3754705               R-squared     =  0.6856
         |                                                                 Adj R-squared =  0.6463
Total |  85.8812475     9  9.54236083               Root MSE      =  1.8372

------------------------------------------------------------------------------
food |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
income |   .0844788   .0202274      4.176   0.003       .0378343    .1311233
  _cons |   4.618667   1.255078      3.680   0.006       1.724453    7.512881

Regression suggests (since income and food expenditure measured in £) that £1 increase in income will raise food expenditure by 8.4 pence.

. predict fhat
. predict reshat, resid

. gra food fhat income, c(.m)

But graph of fitted and actual values suggests regression line does not fit data very well. Actual relationship between food and income seems to lie on a curve but fitted model is a straight line. Graph of residuals also suggests systematic pattern (negative then positive then negative – should be suspicious of this.

. gra reshat income, yline(0) xlab ylab
```
Try alternative specification of regressing food on the reciprocal of income

Food = a + b(1/Income) + u
(1)

(this implies a non-linear relationship between Food expenditure and Income. If the coefficient b is <0 then as income rises so will food expenditure, but at a diminishing rate until it asymptotes toward a level given by the estimated value of the constant).

```
g oneinc=1/income
```

```
. reg food oneinc

Source |       SS       df       MS                  Number of obs =      10
---------+------------------------------                F(  1,     8) =  286.10
Model |  83.5451507     1  83.5451507               Prob > F      =  0.0000
Residual |  2.33609679     8  .292012098               R-squared     =  0.9728
---------+------------------------------                Adj R -squared =  0.9694
Total |  85.8812475     9  9.54236083               Root MSE      =  .54038

------------------------------------------------------------------------------
food |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
oneinc  |  -109.8865   6.496573    -16.915   0.000      -124.8677   -94.90542
    _cons |   12.48354   .2557512     48.811   0.000       11.89378    13.07331
------------------------------------------- -----------------------------------
```

Note R² much higher than before – says model is better fit (as does higher value of F test). Coefficient now says if income increases by £1, food expenditure changes by

\[
d\text{Food}/d\text{Income} = -b/\text{Income}^2
\]

(just differentiate the Food eqn.)

(non-linear effect so not constant as value of income changes)
Now look at predicted values and residuals compared with linear specification.

```
predict f2hat
.predict res2hat, resid
```

Graph of fitted and actual values now suggests a better fit (actual values closer to fitted line).

```
. gra food f2hat oneinc, c(.m) xlab ylab
```

As does graph of residuals (more random and smaller in absolute value – comparable because dependent variable is the same in both regressions).

```
. gra res2hat oneinc, yline(0) xlab ylab
```