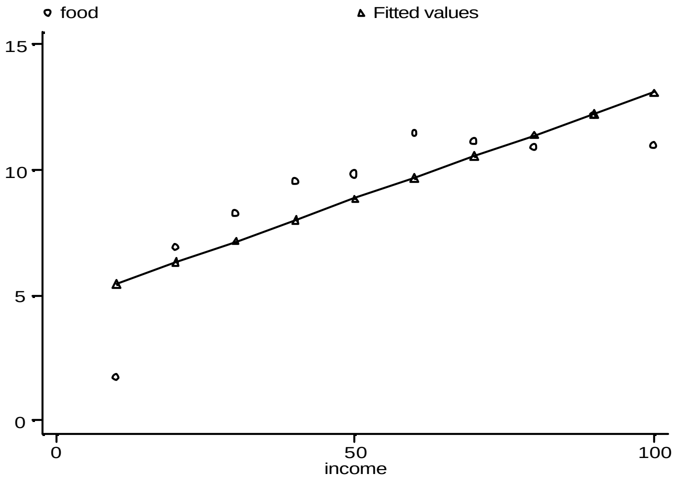
Example of Functional Form

```
. 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
------------------------------------------------------------------------------
```

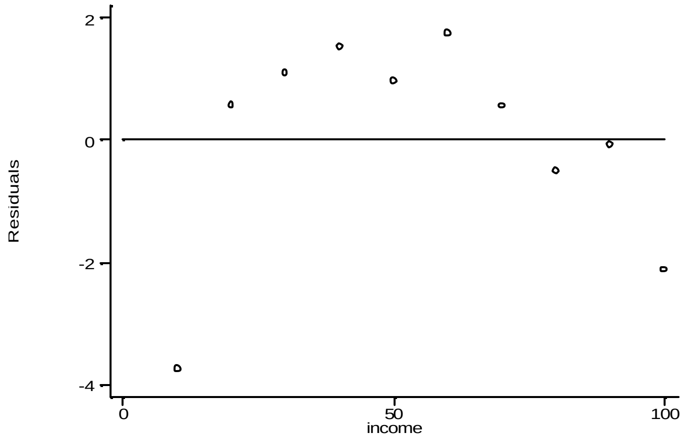
Regression suggests (since income and food expenditure measured in £) that £1 increase in income will raise food expenditure by 8.4 pence

```
. 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
```



```
. list
```

	hhold	food	income	fhat	reshat
1.	1	1.71	10	5.463455	-3.753455
2.	2	6.88	20	6.308243	.5717574
3.	3	8.25	30	7.15303	1.096969
4.	4	9.52	40	7.997818	1.522182
5.	5	9.81	50	8.842607	.9673943
6.	6	11.43	60	9.687394	1.742606
7.	7	11.09	70	10.53218	.5578184
8.	8	10.87	80	11.37697	-.5069697
9.	9	12.15	90	12.22176	-.0717578
10.	10	10.94	100	13.06655	-2.126546

Try alternative specification of regressing food on the **reciprocal** of income

$$Food = a + b(1/Income) + u \qquad (1)$$

(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 R^2 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

$$dFood/dIncome = -b/Income^2$$

(just differentiate the Food eqn.)

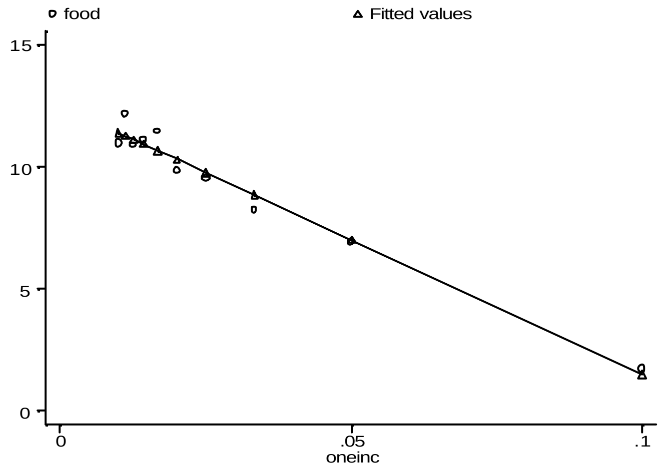
(non-linear effect so not constant as value of income changes)

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
```