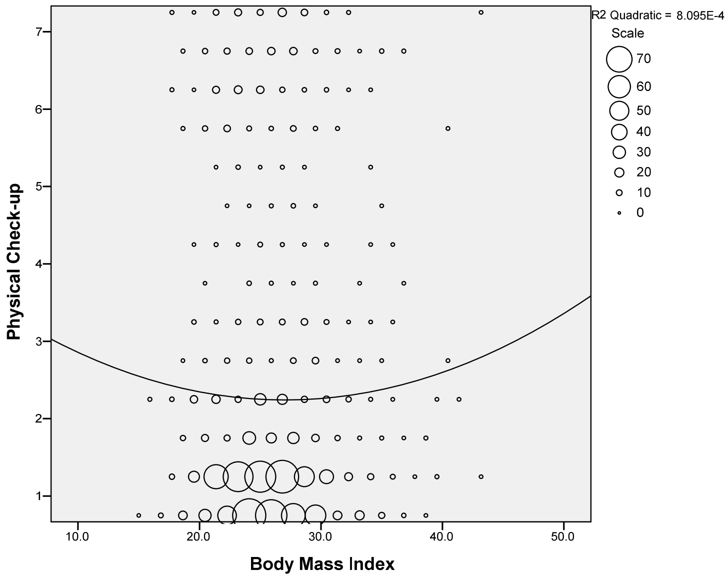
Curvilinear Regression Example
Canadian NPHS Check-up Recency Regressed on Weight

SPSS

Plot

```
graph
  /scatterplot(bivar)=checkup with weight.
```

The chart editor let's you select some different markers, like these bubbles, which are larger with higher frequency.



Syntax

```
output close *.

get file='c:\jason\spsswin\da2\hbs_2.sav'.
*  Random sample of approx 1200 older adults from the Canadian NPHS.

*make sure n the mean is based on is the same used in the regression model.
count nmiss=checkup weight (missing).
select if nmiss=0.

*mean center the weight variable.
aggregate  /mweight=MEAN(weight).
compute cweight=weight - mweight.

*compute quadratic effect variable.
compute cweight2=cweight*cweight.

regression vars=checkup cweight cweight2
    /descriptives=mean stdev n sig corr
    /statistics=anova r coeff ses cha ci(95)
    /dependent=checkup
    /method=enter cweight cweight2
  /scatterplot (*zresid *zpred).
```

Output
Regression

Descriptive Statistics

	Mean	Std. Deviation	N
checkup Physical Check-up	2.28	2.027	1191
cweight	.00000	4.114211	1191
cweight2	16.91252	29.174028	1191

Correlations

		CHECKUP Physical Check-up	CWEIGHT	CWEIGHT2
Pearson Correlation	CHECKUP Physical Check-up	1.000	.000	.027
	CWEIGHT	.000	1.000	.361
	CWEIGHT2	.027	.361	1.000
Sig. (1-tailed)	CHECKUP Physical Check-up	.	.496	.179
	CWEIGHT	.496	.	.000
	CWEIGHT2	.179	.000	.
N	CHECKUP Physical Check-up	1191	1191	1191
	CWEIGHT	1191	1191	1191
	CWEIGHT2	1191	1191	1191

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.028[a]	.001	-.001	2.028	.001	.481	2	1188	.618

a. Predictors: (Constant), CWEIGHT2, CWEIGHT

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.959	2	1.979	.481	.618[a]
	Residual	4886.375	1188	4.113		
	Total	4890.334	1190			

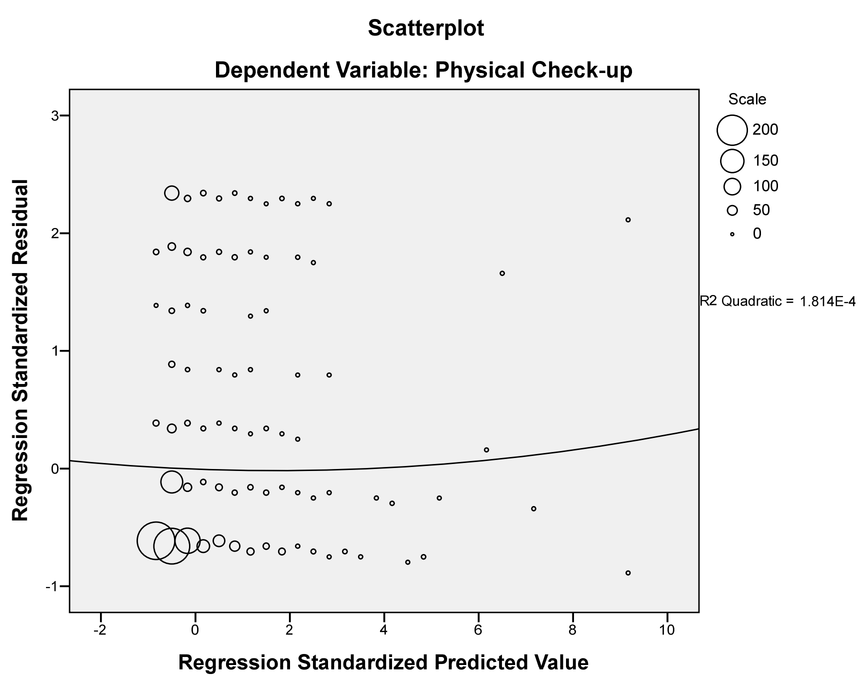
a. Predictors: (Constant), CWEIGHT2, CWEIGHT

b. Dependent Variable: CHECKUP Physical Check-up

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			
Model		B	Std. Error	Beta	Std. Error	t	Sig.
1	(Constant)	2.245	.069			32.436	.000
	CWEIGHT	-.005	.015	-.011	.031	-.344	.731
	CWEIGHT2	.002	.002	.031	.031	.981	.327

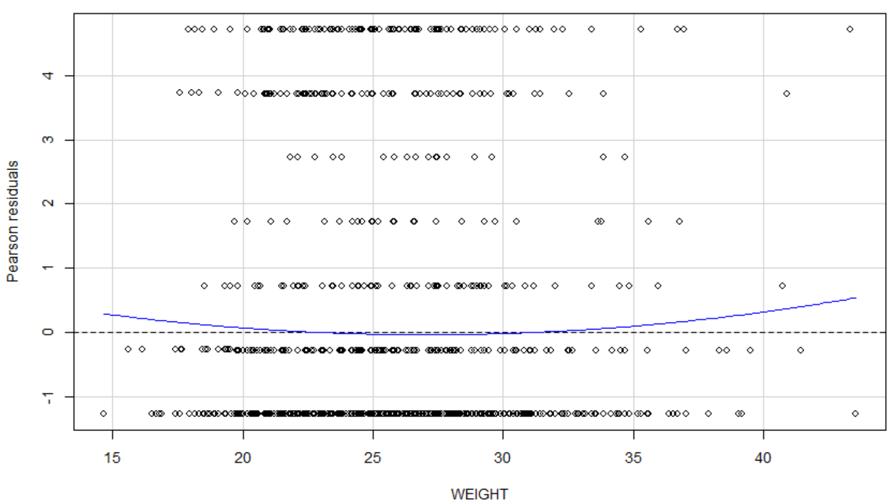
a. Dependent Variable: CHECKUP Physical Check-up



R (some output omitted for brevity)

```
>#clear active frame from previous analyses
>rm(d)

>library(haven)
>d = read_sav("c:/jason/spsswin/da2/hbs_2.sav")
> #Random sample of approx 1200 older adults from the Canadian NPHS.

> #need to convert data types in order to compute a correlation in R-base R function
> d$CHECKUP = as.numeric(d$CHECKUP)

> library(car)
> #test simple regression first and examine residual plot
> residualPlots(lm(CHECKUP ~ WEIGHT, data = d), fitted=FALSE)
```

Initial Plot of the Residuals from Linear Regression



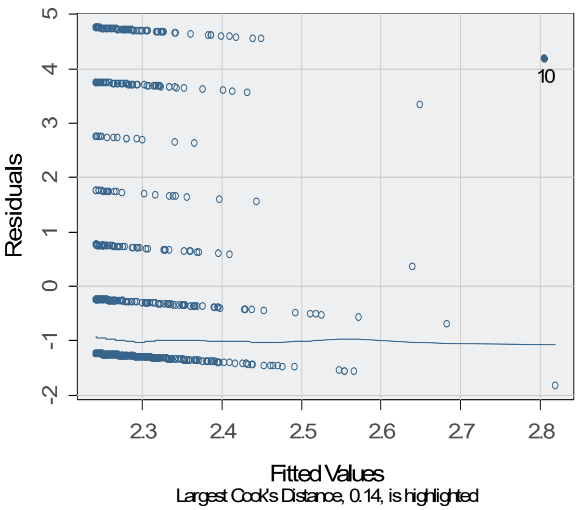

```
> #listwise deletion to match n from regression when centering
> library(dplyr)
> d <-filter(d,WEIGHT != 'NA' & CHECKUP!='NA')
> #describe(d)

> #mean center WEIGHT
> d$cweight <- scale(d$WEIGHT, center = TRUE, scale = FALSE)

>#check that mean of cweight is zero
>#library(psych)
>#describe(d)

> #compute quadratic effect variable
> d$cweight2=d$cweight^2

> #test linear with quadratic effect
> Regression(CHECKUP ~ cweight + cweight2)

Response Variable: CHECKUP
Predictor Variable 1: cweight
Predictor Variable 2: cweight2

Number of cases (rows) of data:  1191
Number of cases retained for analysis:  1191


  BASIC ANALYSIS

-- Estimated Model for CHECKUP

             Estimate    Std Err  t-value  p-value   Lower 95%   Upper 95%
(Intercept)     2.245      0.069   32.436    0.000       2.109       2.380
    cweight    -0.005      0.015   -0.344    0.731      -0.035       0.025
   cweight2     0.002      0.002    0.981    0.327      -0.002       0.006

-- Model Fit

Standard deviation of CHECKUP: 2.027

Standard deviation of residuals:  2.028 for 1188 degrees of freedom
95% range of residual variation:  7.958 = 2 * (1.962 * 2.028)
```

```
R-squared:  0.001    Adjusted R-squared:  -0.001    PRESS R-squared:  -0.005

Null hypothesis of all 0 population slope coefficients:
  F-statistic: 0.481     df: 2 and 1188     p-value:  0.618

-- Analysis of Variance

             df    Sum Sq   Mean Sq   F-value   p-value
  cweight     1     0.000     0.000     0.000     0.991
 cweight2     1     3.958     3.958     0.962     0.327

Model         2     3.959     1.979     0.481     0.618
Residuals  1188  4886.375     4.113
CHECKUP    1190  4890.334     4.110
```

Residual Plot for Model with Quadratic Effect

From the lessR regression output. You could also use the residualPlots function above but with quadratic effect added to the model.

(flat fit line, but, ooh, I don't like those outliers much!)




```
> #get standardized solution (lm.beta package/function also works for this)
> #standardized coefficients--ignore significance tests
> d$zweight = scale(d$WEIGHT)
> d$zcheckup = scale(d$CHECKUP)
> d$zweight2 = d$zweight^2
>
> Regression(zcheckup ~ zweight + zweight2, brief=TRUE)

BASIC ANALYSIS

-- Estimated Model for zcheckup

               Estimate     Std Err  t-value  p-value     Lower 95%    Upper 95%
(Intercept) -0.01768303  0.03413621   -0.518    0.605   -0.08465701   0.04929095
    zweight -0.01068976  0.03109388   -0.344    0.731   -0.07169480   0.05031527
   zweight2  0.01769789  0.01804062    0.981    0.327   -0.01769715   0.05309292
```

Example Write-up

A regression model was used to test whether BMI had a quadratic relationship to medical check-up frequency. The BMI variable was first centered before computing the quadratic term to reduce nonessential multicollinearity (Cohen et al., 2003), and both the linear and quadratic terms were included in the model together. Results indicated that neither the linear effect nor the quadratic effect were significant, B = -.01, SE = .02, p = .73, 95%CI[-.04,.02] and B = .00, SE = .00, p = .33, 95%CI[-.00,.01], respectively. The total variance accounted for in check-up frequency was only approximately .1%, R^2 = .001, which was not significant, F(2,1188) = .481,p = .618.