Compton scattering CERN data

See "Compton Scattering of Quasi-Real Virtual Photons at LEP," arxiv.org/abs/hep-ex/0504012.

x	y
-0.74	13380
-0.60	7720
-0.47	6360
-0.34	4600
-0.20	4310
-0.07	3700
0.06	3640
0.20	3340
0.33	3500
0.46	3010
0.60	3310
0.73	3330

For columns x and y we have

$$x = \cos\theta, \quad y = \frac{d\sigma}{d\cos\theta}$$

This is the differential cross section in the center of mass frame.

$$\frac{d\sigma}{d\cos\theta} = 2\pi\frac{d\sigma}{d\Omega} = \frac{\pi\alpha^2}{s}\left(\frac{\cos\theta+1}{2} + \frac{2}{\cos\theta+1}\right) \times (\hbar c)^2$$

Let $\hat{y}$ be predicted values. The factor 10^{40} converts square meters to picobarns.

$$\hat{y}_i = \left.\frac{d\sigma}{d\cos\theta}\right|_{\cos\theta = x_i} = \frac{\pi\alpha^2}{s}\left(\frac{x_i+1}{2} + \frac{2}{x_i+1}\right) \times (\hbar c)^2 \times 10^{40}$$

The following table shows $\hat{y}$ for $s = (40\,\mathrm{GeV})^2$.

x	y	$\hat{y}$
-0.74	13380	12573
-0.60	7720	8358
-0.47	6360	6491
-0.34	4600	5401
-0.20	4310	4661
-0.07	3700	4204
0.06	3640	3884
0.20	3340	3643
0.33	3500	3486
0.46	3010	3375
0.60	3310	3295
0.73	3330	3248

The coefficient of determination R^2 measures how well predicted values fit the data.

$$R^2 = 1 - \frac{\sum(y - \hat{y})^2}{\sum(y - \bar{y})^2} = 0.97$$

The result indicates that the model $d\sigma$ explains 97% of the variance in the data.