

Geiger and Marsden scattering data

The following scintillation counts are from Geiger and Marsden's 1913 paper "The Laws of Deflexion of α Particles through Large Angles."

θ	Silver	Gold
150	22.2	33.1
135	27.4	43.0
120	33.0	51.9
105	47.3	69.5
75	136	211
60	320	477
45	989	1435
37.5	1760	3300
30	5260	7800
22.5	20300	27300
15	105400	132000

The authors model the data as proportional to $1/\sin^4(\theta/2)$ which is equivalent to

$$\hat{y} = \frac{d\sigma}{d\Omega} = \frac{\beta}{(1 - \cos \theta)^2}$$

Using ordinary least squares we obtain $\beta = 122.0$ for silver and $\beta = 153.4$ for gold. Then the following \hat{y} are obtained.

θ	Silver	Gold
150	35.0	44.0
135	41.9	52.6
120	54.2	68.2
105	77.0	96.8
75	222	279
60	488	614
45	1423	1788
37.5	2858	3592
30	6799	8545
22.5	21062	26471
15	105111	132104

The coefficient of determination R^2 is given by

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

The result is $R^2 > 0.999$ for both gold and silver indicating that 99.9% of the variance in the data is explained by \hat{y} .

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