

Bhabha scattering SLAC data

The following Bhabha scattering data is from SLAC-PUB-1501.

k	x_k	x_{k+1}	y
1	0.6	0.5	4432
2	0.5	0.4	2841
3	0.4	0.3	2045
4	0.3	0.2	1420
5	0.2	0.1	1136
6	0.1	0.0	852
7	0.0	-0.1	656
8	-0.1	-0.2	625
9	-0.2	-0.3	511
10	-0.3	-0.4	455
11	-0.4	-0.5	402
12	-0.5	-0.6	398

Column k is the bin number, column y is the number of scattering events, and

$$x_k = \cos \theta_k$$

The cumulative distribution function for this experiment is

$$F(\theta) = \frac{I(\theta) - I(\theta_1)}{I(\theta_{13}) - I(\theta_1)}$$

where

$$\theta_{13} = \arccos(-0.6), \quad \theta_1 = \arccos(0.6)$$

The scattering probability P_k is

$$P_k = F(\arccos(x_{k+1})) - F(\arccos(x_k))$$

Multiply P_k by total scattering events to obtain predicted number of events \hat{y}_k .

$$\sum y_k = 15773, \quad \hat{y}_k = 15773 P_k$$

The following table shows the predicted scattering events \hat{y} .

k	x_k	x_{k+1}	y	\hat{y}
1	0.6	0.5	4432	4598
2	0.5	0.4	2841	2880
3	0.4	0.3	2045	1955
4	0.3	0.2	1420	1410
5	0.2	0.1	1136	1068
6	0.1	0.0	852	843
7	0.0	-0.1	656	689
8	-0.1	-0.2	625	582
9	-0.2	-0.3	511	505
10	-0.3	-0.4	455	450
11	-0.4	-0.5	402	411
12	-0.5	-0.6	398	382

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

$$R^2 = 1 - \frac{\sum(y - \hat{y})^2}{\sum(y - \bar{y})^2} = 0.997$$

The result indicates that $F(\theta)$ explains 99.7% of the variance in the data.