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

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

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.

Eigenmath script