Computer Methods

Example: Hand Calculation

Table 6-2 Experimental data for a determination of the counting rate C in a detector as a function of time t (the starting times for the intervals Δt during which the counts are accumulated)

Trial i	Time t_i, sec	Counts C_i, per 15 sec	$\frac{1}{C_i}$ ($\frac{1}{\sigma_i^2}$)	$\frac{t_i}{C_i}$	$\frac{t_i^2}{C_i}$	$a + bt_i$
1	0	106	0.00944	0.0	0.0	104.4
2	15	80	0.01250	0.188	2.81	95.2
3	30	98	0.01020	0.306	9.18	86.1
4	45	75	0.01333	0.600	27.00	76.9
5	60	74	0.01351	0.811	48.65	67.8
6	75	73	0.01370	1.027	77.06	58.6
7	90	49	0.02041	1.837	165.31	49.5
8	105	38	0.02632	2.763	290.13	40.3
9	120	37	0.02703	3.243	389.19	31.2
10	135	22	0.04546	6.136	828.41	22.0
SUM	675	652	0.19190	16.911	1837.74	

$$\Delta = \sum \frac{t_i^2}{C_i} \sum \frac{1}{C_i} - \left(\sum \frac{t_i}{C_i}\right)^2 = 1837.74(.1919) - (16.911)^2 = 66.66$$

$$a = \frac{N\Sigma(t_i^2/C_i) - \Sigma t_i \Sigma(t_i/C_i)}{\Delta} = \frac{10(1837.74) - 675(16.911)}{66.66} = 104.4$$

$$b = \frac{\Sigma t_i \Sigma(1/C_i) - N\Sigma(t_i/C_i)}{\Delta} = \frac{675(.1919) - 10(16.911)}{66.66} = -.61/\text{sec}$$

$$\sigma_a^2 \simeq \frac{\Sigma(t_i^2/C_i)}{\Delta} = \frac{1837.74}{66.66} = 27.6 \qquad \sigma_a \simeq 5.3$$

$$\sigma_b^2 \simeq \frac{\Sigma(1/C_i)}{\Delta} = \frac{.1919}{66.66} = 0.00288 \qquad \sigma_b \simeq 0.054/\text{sec}$$

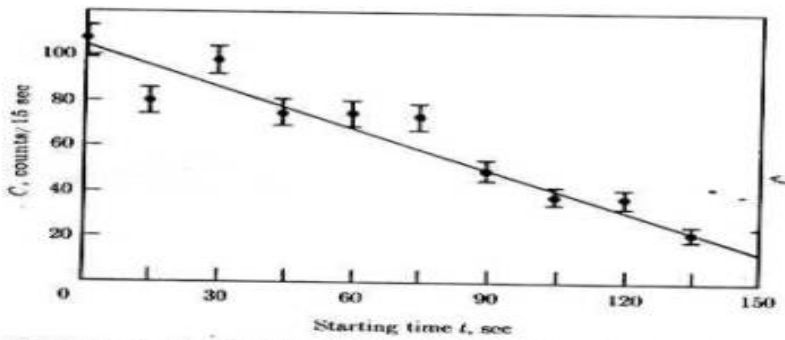

FIGURE 6-2 Graph of the number of counts C per 15 seconds in a detector vs. the starting time t of each 15-sec interval for the data of Table 6-2. Probable error for data points from statistics P.E. $= 0.67\sigma_i$ ($\sigma_i^2 = 1/C_i$). Straight-line fit is for $C = 104.4 - 0.61t$/sec.