Example 1: Original Data-Alpha Decay of Americium-241 (Berkson, 1966). The experimenters recorded **10,220** times between successive emissions. The first two columns of the following table display the counts, n, that were observed in 1207 intervals, each of length **10** sec. Our aim is to estimate the mean emissions rate per sec (or per 10 sec).

Emissions (n)	Observed Counts	Expected Counts
0	1	0.27
1	4	2.30
2	13	9.63
3	28	26.95
4	56	56.54
5	105	94.90
6	126	132.73
7	146	159.12
8	164	166.92
9	161	155.64
10	123	130.62
11	101	99.65
12	74	69.69
13	53	44.99
14	23	26.97
15	15	15.09
16	9	7.91
17	3	3.91
19	1	0.80
	1207	1207

The Poisson distribution is frequently used as a model for radioactive decay based on three assumptions:

(1) the underlying rate at which the events occur is constant in space or time;

(2) events in disjoint intervals of space or time occur independently;

(3) there are no multiple events.

The probability function of Poisson is

$$P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}.$$

Since λ is equal to

$$E(X) = \sum_{k=0}^{\infty} k P(X = k),$$

based on the second column, we have an estimated $P(X = k)$, which is Observed

Counts(k)/1207. Then the estimator of λ,

$$\hat{\lambda} = \sum_{k=0}^{19} k \times Observed\ Counts(k)/1207 = 8.367$$

which is 0.8367 per sec, which is close to 0.8392 obtained by Berkson (1966) by recording **10,220** experimenters.

The estimated probability function of $P(X = k)$ is

$$\frac{\hat{\lambda}^k e^{-\hat{\lambda}}}{k!},$$

shown in the third column "Expected Counts" based on the estimated value 0.8392 of λ.