Poisson goodness of fit and the non-randomness of daily mortality

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Reading the paper by Zweig and Csank (1978) prompted me to write the following note.

The authors have attempted to adjust a Poisson distribution to the daily mortality at six Montreal hospitals. They, in fact, succeeded in their attempt as far as large hospitals are concerned. Therefore, Zweig and Csank concluded that the daily deaths 'may be said to occur at random and independently . . .'.

However, this may not be the case if the probability of an event occurring varies among trials and among experiments to the same extent. Here we may assume that the experiments and the trials stand respectively for the days and the various time periods during a day. Therefore, it may be shown (Edwards, 1960) that if the probability of a death varies among the days of a year, the variance of the observed distribution of daily deaths is increased by:

\[ N(N-1) \cdot V(p) \]

where \( V(p) \) is the variance of the probability between experiments. On the other hand, if it happens that the probability of a daily death varies from trial to trial, then the variance of the observed distribution is reduced by:

\[ \sqrt{N} \cdot V'(p) \]

where \( V'(p) \) is the variance of the probability between trials. Since both phenomena reflect opposite trends, it may occur that they be of equal strength. It thus follows that the observed variance complies with a Poisson variance whereas, in fact, the events are not random.

Needless to add, both variations in the probability of daily deaths may occur simultaneously due to seasonal peaks and also due to day-night changes in hospital care. The fact that the authors' daily mortality does not follow a Poisson law in small hospitals may suggest that the several factors responsible for the variability of the probability cannot reach the appropriate equilibrium within a small sample.

To sum up, compliance of an observed distribution with the theoretical model of a binomial or Poisson process must not lead one to assume the independence of the studied event. It is appropriate to recall here Murphy's message (1978) that statistics do not replace thoughtful hypotheses.

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References

