Use of the Poisson Distribution to Relate Time-intervals and Random Events

The Poisson distribution is a statistical distribution which allows the calculation of the average number of random, isolated events likely to occur during a time-interval and the standard error or deviation of the prediction. Conversely, it relates the length of a time-interval to the average number of isolated events which occur during it. The assumption is that the isolated events occur randomly in a continuum.

The larger the time-interval, the greater the number of events which are likely to occur during it and the less the error of the prediction. Conversely, the larger the number of events included in calculating the average, the less the error with which the length of the time-interval can be predicted. A number of events to be averaged can be selected which gives an acceptable standard error or deviation.

For example, the distribution has been used to predict the number of lightning flashes to be expected in a time-interval and the annual number of deaths from horse-kicks likely to happen in the cavalry.

The decay of radioactive species occurs by the decay at random of individual nuclei, and so it appears superficially that the Poisson distribution may be applied. Each decay event is an emission which can be counted. For a particular radioactive material the average number of decay events which take place over a period of time such as a tenth of a second can be measured, together with its standard deviation. From this the length of a time-interval with its standard error can be predicted for similar samples by counting the appropriate number of decay events.

The process of establishing the average number of decay events in a time-interval requires a stopwatch calibrated in some multiple or fraction of a second, and so the time-interval is calculated to the required accuracy in SI units of time-interval.

The problem is that the Poison distribution is based on the assumption that the average number of emissions in a time-interval is constant i.e. the phenomenon continues at the same level. What is being measured is the error of the estimate of this constant. However, the whole point of radioactive decay is that the average number of emissions declines exponentially with time. Exponential decay for this method of timekeeping is not therefore a feature of radioactivity to be exploited, but instead a problem. What the method needs is a radioactive source which gives off isolated, random emissions, but does not decay, which is a contradiction in terms.

The solution offered by proponents of the Poisson method is to compensate for the exponential decline by external means. Two methods are proposed. The first is to use a counter method to adjust the average count number required to mark a time-interval as the timekeeping proceeds, by estimating from the decay curve using the well known radioactive decay constants. These constants are themselves measured in the laboratory using the second, the SI unit of time-interval, and so the time eventually estimated by the procedure is in seconds.

The other proposal, which is cruder, is to estimate how many counts need to be added to the actual count to compensate for decline, and simply to add them.

Thus the Poisson procedure is geared to the SI time-interval, the second, and its limitations. The accuracy of the procedure decreases with time elapsed from manufacture. Exponential decay of the radioactive source is an embarrassment for the Poisson calculations, and needs to be compensated for.

By contrast, the methodology and procedure of my invention are such that it gives time-intervals which are Absolute and Universal, the same everywhere in space at all times. The accuracy which they give increases with time, rather than decreasing. The process of exponential decay is not a problem; far from it, it is the crux of my invention.

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