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Population and Public Health Branch (PPHB)



## Commentary

# Horse kicks, anthrax and the Poisson model for deaths

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Most epidemiologists use the Poisson model for deaths. In the old days we used it (and a slide rule) to calculate the standard errors of death rates and indirect standard mortality ratios. Now you can get exact limits from the Internet<sup>1</sup> and Poisson regression analysis<sup>2</sup> has made multivariate analyses of mortality and incidence data possible. It seems reasonable to ask who first introduced the model.

Most people would think of Bortkiewicz,<sup>3</sup> since his data on deaths from horse kicks in the Prussian army have been used as examples in many statistical textbooks, e.g., Yule and Kendall<sup>4</sup> and Fisher.<sup>5</sup> Kendall and Stuart<sup>6</sup> also cite Bortkiewicz' data on suicide. Frank Haight,<sup>7</sup> in his extensive bibliography of the Poisson distribution, claims that there was a gap in the literature between the publication of the German edition of Poisson's book<sup>8</sup> in 1841 and Bortkiewicz' book in 1898. Anderson<sup>9</sup> states that "the first application of the distribution to real data was the now famous example of death in the Prussian Army caused by horse kicking."

Though Bortkiewicz was the first to publish, another author, apparently independently, had the idea of using deaths to illustrate the Poisson distribution. In one of the oldest textbooks on statistics, first published in 1901, Bowley<sup>10</sup> fitted a Poisson distribution to deaths from splenic fever in the years 1875-1894 and showed a reasonable "consilience" with the theory. Bowley adds: "The general principle that small numbers show a certain constancy is well exemplified. Specialists in all professions, from the doctor who treats only one obscure disease of the ear, to the dealer in curiosities, make their livelihood dependent on this principle of small numbers." However, Bowley adds in a footnote: "Since writing this section my attention has been called to a treatise by Dr. Bortkewitsch [sic] ... where the close agreement of the records of accidents and other occasional events to the binomial expansion is dealt with in a more exhaustive and analytical manner."

Splenic fever, by the way, was, at that time, a synonym for anthrax. In the light of recent events it is interesting to note that there were, on average, 10 deaths from anthrax in the years 1875-1894 (presumably in England and Wales).

Biographies of Bortkiewicz and Bowley are readily available. Neither was medically qualified. Apart from the horse kicks, Bortkiewicz is best known for his correction of Marx's proposed solution to the problem of deriving prices from values, Bowley for his work on poverty.

A final note: it appears<sup>13</sup> that the "Poisson" distribution was first derived by de Moivre, but a change of name at this stage seems unlikely.

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