The Thatched Cottage
Clement Place
Cambridge
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(1942)

Dear Fisher,

Do you know anything about the following problem? It turns up pretty often, but I have just had it again in a rediscussion of H. S. Jones's determination of the mass of the moon. We have two sets of estimates of x, with different standard errors, estimated from n_1 & n_2 observations. There is no doubt about whether the two estimates of x refer to the same thing, so it is an estimation problem. The question is, how to allow for the difference of the estimates in finding the uncertainty of the combined estimate of x? The exact solution is

$$P(dx\,|\,\theta H) \propto dx\left(1+\frac{(x-\bar{x}_1)^2}{s_1^2}\right)^{-\frac{1}{2}n_1}\left(1+\frac{(x-\bar{x}_2)^2}{s_2^2}\right)^{-\frac{1}{2}n_2}$$

so that it is the Behrens Fisher rule with the two s's the same & no integration therefore ~~will suggest~~ to get a distribution for the probability of their difference. But can we get a useful approximation to this anyhow? The point is that in my problem $\bar{x}_1$ & $\bar{x}_2$ are based on $n_1, n_2 = 13$ but differ by a shade under twice the standard error of their difference. This is really some evidence that s_1 & s_2 are estimated a little too low & we could get a better idea of the uncertainty of $\bar{x}_2$ by allowing for the other degree of freedom expressed by $\bar{x}_2 - \bar{x}_1$. If only the standard errors in the two sets were equal it would be easy, but they aren't.

I see you have a new paper on this sort of thing but ~~the~~ it can't be borrowed yet & I don't know exactly what you've done.

Yours sincerely

Harold Jeffreys

By the way would you tell Haldane I should like his negative binomial paper?