19/1/40

Dear Fisher

I have been posed the following problem by Gover. When infected in a certain manner all mice died if untreated. After treatment α, a out of A mice die.

" " β, b out of B mice die.

" treatments α and β combined, c out of C mice die.

Now if ~~A~~ α and β are independent, so that β merely saves a fraction $\frac{B-b}{B}$ of the mice which would otherwise have died in spite of treatment α, it is clear that $E(c) = \frac{abC}{AB}$. The order in which treatments α and β is given is clearly irrelevant. In fact they are given simultaneously. This is ~~the~~ found to be so when two ~~drugs are ingest~~ sera are injected. E.g. $A=B=C=30$. $a=b=27$, $c=24$, $E(c)=24.3$.

But with a serum and a drug together there is certainly interaction E.g. $A=30$, $B=29$, $C=30$, $a=28$, $b=27$, $c=4$, $E(c)=26.1$.

I have not the faintest doubt that the two treatments interact significantly, but I do not see how to find the distribution of $(ABc-abC)$ or its square in terms of elementary probability theory! Is there a treatment analogous to the exact treatment of the four-fold contingency table? When all the values are (including $A-a$, etc, are large enough, no doubt one can use χ^2.

If you can let me know by the end of the month, I shall be glad. By the way, Bell's data for spastic paraplegia show partial sex-linkage for the recessive cases. The dominants and the other diseases do not, though the recessives have a strong suggestion of it.

Yrs sin

JBS Haldane