160 Huntingdon Rd

Jan 20 (?)

Dear Fisher,

Very nice, but I had to find out as I went along what the problem was. You don't define l_1, l_2, l_3! I suggest:

Let there be two sets of directions given by l_{ri}, l'_{ri} with regard to axes Ox_i; let Ox_i be rotated to Oa, Ob, Oc, with direction cosines given by - - - with respect to Ox_i, carrying l'_{ri} with it, but not l_{ri}. Then the direction cosines of the second set with respect to Ox_i are l''_{ri}, given by - - - ; and the cosine of the angle between a direction of the first set and the corresponding one of the second set after rotating the latter is

$$\cos\theta = l_{r1} l''_{r1} + \dots$$

(a displacement cannot be an angle!).

It isn't clear as you present it what you are keeping fixed and what is allowed to vary — or rather it becomes clear on p. 4.

I think the writing could be shortened a bit. Write $a_i\, b_i\, c_i$ as m_{ik}; then the thing to be maximized is

$$S_r\, m_{ik}\, l_{ri}\, l'_{rk}.$$

$S_r\, l_{ri}\, l'_{rk}$ is a symmetrical tensor & the novel feature is that m_{ik} is an orthogonal matrix instead of, as usual, something of the form $x_i x_k$.

Yours

Harold Jeffreys

Put $S\, l_{ri}\, l'_{rk} = P_{ik}$; then $m_{ik} P_{ik} = \max$. Use principal axes of P_{ik}. Then

$$m_{11}P_{11} + m_{22}P_{22} + m_{33}P_{33} = \max$$

& solutions are $m_{11}, m_{22}, m_{33} = \pm 1$ according to signs of P_{11}, P_{22}, P_{33}.