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LETTER TO THE EDITOR

Dear Sir,

I am observing with some astonishment and growing embarrassment the fervent statements in the RoA vs AoR debate. I might have missed some point, but I feel both the actions and the reactions somewhat exaggerated, all the more, since in my opinion the two supposedly contradictory approaches are, in fact, special cases of the same general procedure.

The problem is as follows: there is a set of items, each characterized by an additive (in physical terms, extensive) measure (in the classical example publications are characterized by their citation count). For each item we have a measured ("actual") value (let us denote it with X-s) and also an estimated ("expected") one (the Y-s). The quotient of the two, $Q=X/Y$, is a kind of performance ratio, the relative measure of the actual value as compared to the expected one. So far, so good.

Having an aggregated set of items, one may wonder about the overall performance ratio, Q, of the whole set. The debate is whether the ratio of the average actual and expected values are to be formed (ratio of averages, RoA), or the individual ratios should be formed first and their average is to be taken (average of ratios, AoR).

I do not want to recapitulate the arguments and counter-arguments here, and do not want to qualify them, either. I only want to call the readers' attention to a simple and fundamental relation.

In the "real world", outside the realm of pure mathematics, the proper way of averaging is most infrequently the simple arithmetic averaging, since the items to be averaged (e.g. measurement points) are not necessarily equivalent, they may have different weights. Generally speaking, the weights go parallel with the importance or the reliability of the measurements.

The averaging procedure suggested by the AoR advocates is the simple unweighted arithmetic averaging. Q of the aggregate is calculated as $Q = (\sum Q_i) / N = (\sum X_i/Y_i) / N$, where lower index i denotes the values concerning the individual items and N is the number of items in the aggregate.

If weighting is introduced, the formula is modified to $Q = (\sum w_iQ_i) / (\sum w_i)$, where w_i denotes the weight of the i-th item. Obviously, for the arithmetical average, each $w_i = 1$.

Let us consider now the case when the weights are the Y_i-s themselves. This choice, though first may seem haphazard, is not quite unreasonable, indeed. It attributes greater importance to items of greater expected value (i.e., papers published in higher impact factor journals) and depreciates (in extreme case, nullify) those published in journals of insignificant, almost zero impact factor.

The overall performance measure will now be $Q = (\sum Y_iQ_i) / (\sum Y_i) = (\sum X_i) / (\sum Y_i) = (\sum X_i/N) / (\sum Y_i/N)$, i.e., we have exactly the ratio of averages, the AoR advocates struggle against.

The question is, therefore, not so much about the choice between two alternatives, but about the choice of a proper weighting scheme. Like in all similar cases in the sciences or social sciences, practically never exists an all-purpose optimal weighting scheme; optimal solutions can be searched for only for definite purposes. It is the applier's subtle task to select and justify a proper weighting scheme, whether unit weights (AoR), Y_i-s (RoA) or any other choice is considered.

From the interpretation given here it can be seen that the unweighted scheme overemphasizes items with low expected value (at least as compared with the AoR version); in extreme cases, when some Y_i-s approaches zero, the overall Q may diverge. By using Y_i-s as weights this problem is solved, but this is an arbitrary choice, as well; the decision about the suitability – let alone, optimality – of which requires careful consideration. Reciting Woody Allen: "One path leads to despair and utter hopelessness, the other to total extinction. Let us pray that we have the wisdom to choose correctly."

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