ASSESSING PROBABILITIES WITH MINIMAL CALCULATIONS

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Thinking probabilistically in an uncertain world is a valued skill that makes for better decision making. In particular, whatever does happen should not surprise the decision maker (DM) as he/she has prepared ahead of time , even if a low probability event does manifest itself.

The difficult task is to easily assess the relative likelihoods of the possible eventualities. This note outlines how tentative ideas on relative likelihoods can be transformed into probabilities initially designated as the "ballpark" probability distribution. Ballpark here means a first pass at calculations that can be amended with new information or revised judgments as the DM sees fit. That is, the daunting task initially of transforming tentative qualitative ideas into a quantitative probability distribution can be easily and routinely accomplished, although not necessarily producing the final distribution.

The methodology is best illustrated by example. We take the current war in Ukraine as the situation to be analyzed. Recent analysis by *The Economist* postulated three possible outcomes:

- CRT : Ceasefire with terms favourable to Russia
- CUT : Ceasefire with terms favourable to Ukraine
- STM : Stalemate on the battlefield along current lines

No probabilities were given in the article except to state that STM was "far more likely" than the other two outcomes. We take "far more likely" here to mean STM is 4 – 5 times more likely than either of the other two possibilities. This pairwise range can be easily altered as shown below. CRT and CUT we take to be equally likely using a pairwise range of 1 – 1 to express this fact. The pairwise ranges for the three events in the above order are then 1 – 1 (base), 1 – 1 (equally likely) and 4 – 5 (far more likely). Either CRT or CUT can be taken as the least likely event and STM is the most likely event, and the ordering above is then from least to most likely. Two distributions can now be calculated. Using the low end of the ranges we get 1 (base), 1 x 1 or 1 for CUT and 1 x 1 x 4 or 4 for STM. Total weights are the sum or 6 with corresponding probabilities 1/6, 1/6 and 4/6. That is, STM is 4 times more likely than CUT (or in this case CRT as well). Using the high end of the ranges, the weights become 1, 1 and 5 with sum 7 and respective probabilities 1/7, 1/7 and 5/7. Average probabilities from the two distributions are then 0.155, 0.155 and 0.69 or in percentage terms 15%, 15% and 70% or possibly 16%, 16% and 68%. Either distribution can be considered the "ballpark" distribution with further amendments by the DM into a final distribution, as necessary. For example, the DM on reflection may feel that the current situation in Ukraine gives that country a slight edge over Russia in any negotiations with a final distribution of 14% (CRT), 16% (CUT) and 70% (STM).

Note that using mid-points of the pairwise ranges produces almost the same distribution with one calculation but without the information the probability ranges may provide. Also, when revising probabilities from a previous analysis with new information, it may be instructive to accommodate a sentiment, bias, climate etc., change (i.e., feelings or intuitions over facts) with a changed pairwise range in the first instance, rather than attempting a change in probabilities directly. Resulting probability ranges may help to crystallize ideas before arriving at final probabilities.

Suppose the “slight edge” judgment above uses a pairwise range of 1.1 – 1.2 or CUT is judged to be 10% to 20% more likely than CRT. The pairwise ranges now become respectively 1 – 1, 1.1 – 1.2 and 4 – 5. Resulting probabilities are shown below, along with sensitivities of probabilities to different pairwise ranges for the “far more likely” judgment.

SENSITIVITY OF PROBABILITIES TO THE “FAR MORE LIKELY” JUDGMENT

STM/CUT Pairwise Range	Percentage Probabilities			Percent Sum	More Likely Values*	
	CRT	CUT	STM		CUT/CRT	STM/CUT
3 – 4	16	19	65	100	1.19	3.42
4 – 5	14	16	70	100	1.14	4.38
5 – 6	12	14	74	100	1.17	5.29
10 – 12	7	8	85	100	1.14	10.63

*The more likely values are calculated using the percentage probabilities and not say 3 decimal probabilities

In deciding on the pairwise ranges at each point in the ordering, relativities could be used in making the initial decisions. For example, if the first pairwise range must reflect a “significantly more likely” judgment, this could result in the use of a 3 – 4 range. If the second pairwise judgment is not quite so significantly more likely, a 2 – 3 or 1.5 – 2.5 range may be judged appropriate relative to the first range, and so on. Then, if the low chance events turn out to have a too high or too low a probability for the DM, appropriate changes in the ranges can be made that preserve the relative “more likely” ranges made initially. Note that in the table above, doubling a range from 5 – 6 to 10 – 12 for the most likely event, almost halves the probabilities of the preceding, lower chance events. Of course, probabilities can be changed directly at any stage.

Note too that the DM may not be able to document exactly why one event is “slightly more likely” than another. The range of 1.1 – 1.2 as above does lead , however, to a numeric probability reflecting this rudimentary judgment and two other probabilities for consideration. But if he/she does not agree with this resulting probability, the direction of change is now clear from the three “ballpark” probabilities derived for the “slightly more likely” event.

In employing conventional Bayesian revision for specific real-world developments, the event likelihoods dependent on the state of the world (SOW) could be estimated using this same technique. Of course, the event likelihood ranking could differ from that of the prior SOW probabilities.

Likelihood ranges for events as in the table above may be useful in finalizing probabilities. The procedure outlined transforms rudimentary ideas on the relative likelihoods on all possible outcomes into a “ballpark” distribution that can then be further modified, as necessary. This undemanding technique can be used by anyone wishing to think probabilistically.

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