A RATIONALE FOR THE "MORE LIKELY" APPROACH TO PROBABILITY ASSESSMENT

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BASIC METHODOLOGY

Suppose we have two events/scenarios A and B where the decision-maker (DM) believes B to be twice as likely as A. This could be written as P(B)/P(A) = 2 or simply B/A = 2 where a pairwise judgment on the relative likelihoods for A and B (more likely) is understood. The resulting "more likely" value is necessarily ≥ 1. Equal likelihood would be denoted by 1. The data could be summarized as:

Event/Scenario	Weight	Probability
A	1	1/3 = 0.33
B	2	2/3 = 0.67

Here we have a base value of 1 for the less (least) likely event with the value 2 reflecting how much more likely B is than A. Suppose now the DM considers B could be as much as 3 times more likely than A. Similar arguments to the above then yield P(A) at 25% and P(B) at 75%. The calculations can be summarized in the following table.

PROBABILITIES FOR A "MORE LIKELY" RANGE OF 2 – 3 FOR THE B/A LIKELIHOOD GAIN

Event/Scenario	Range	Low Weight	High Weight	P(Low)	P(High)	P(Average)	More Likely Value
A	Base ⇒ 1	1.00	1.00	1/3 = 0.33	1/4 = 0.25	0.29	Base ⇒ 1
B	B/A	2.00	3.00	2/3 = 0.67	3/4 = 0.75	0.71	0.71/0.29 = 2.45
		3.00	**4.00**	**1.00**	**1.00**	**1.00**	

The more likely assessment could be expressed as a percentage as in 50% "more likely" with 1.5 the "more likely" value in this case. To illustrate the calculations for more than two events or scenarios, event C is introduced below with a pairwise range for the likelihood gain over B of 1.25 – 1.75 or C is assessed as moderately "more likely" than B.

CALCULATIONS FOR A 3-EVENT PROBLEM – CL = COMPOUND LIKELIHOOD

Event/Scenario	Range	Low	High	CL(Low)	CL(High)	P(Low)	P(High)	P(Average)	More Likely Value
A	Base ⇒ 1	1.00	1.00	1.00	1.00	0.18	0.11	0.15	Base ⇒ 1
B	B/A	2.00	3.00	2.00	3.00	0.36	0.32	0.34	0.34/0.15 = 2.27
C	C/B	1.25	1.75	2.50	5.25	0.46	0.57	0.51	0.51/0.34 = 1.50
				5.50	**9.25**	**1.00**	**1.00**	**1.00**	

The compound likelihoods for event C are respectively 1*2*1.25 or 2.5 and 1*3*1.75 or 5.25 with resulting probabilities of 2.5/5.5 or 0.46 and 5.25/9.25 or 0.57. Note that the resulting "more likely" value for C/B at 1.5 is exactly half-way between the two end points of the range assessment of 1.25 – 1.75. Also note that using a pairwise range results in three distributions. This means the DM can consider whether P(A) is closer to 0.18 or 0.11 from the calculations above and make any necessary changes as required. This may be more easily achieved with an axiomatically correct "ballpark" distribution in the background.

CONCLUSIONS

If we assume that after allowing for the processing of all relevant information a "correct" distribution does exist then a ranking of all outcomes from least to most likely can be constructed and a "correct" list of resulting "more likely" values also exists. And if the DM's pairwise assessments encompass these "correct" values, simulations indicate errors of ± 1% from estimated to "correct" probabilities are possible. The narrower the pairwise interval encompassing the true "more likely" value, the more "correct" the estimates will be. Percentage probabilities should suffice to ensure "correct" decision-making in most cases. To avoid any criticism of spurious accuracy (given the inexactitude of the range assessments), the DM could report the above analysis with a final distribution of 15%, 35% and 50%.

It may be envisaged theoretically that a DM in calculating probabilities for the various events involved can delineate all causes and interactions in the situation under review (micro-configurations). Any comprehensive and sophisticated AHP hierarchy of such cause and effect leading to resulting likelihoods for respective events is judged to be beyond the capabilities of the typical DM. But he/she can intuitively (at varying levels of sophistication) synthesize these micro-configurations into an overall percentage gain in likelihood for one event over another in a holistic comparison. Using "more likely" pairwise ranges makes this easier. The result is numeric judgments as to whether one event is slightly (1 – 1.25, or up to 25%), moderately (1.25 – 1.75) or significantly (1.75 – 2) "more likely" than another event.