Combining Multiple Sets of Evidence

Larry Darryl Lee Jr.

March 25, 2024

Introduction

This following tables can be used to weigh evidence. Given some evidence $E_0, E_1, \ldots, E_n$ and a hypothesis H, you can determine the probability that the hypothesis is true given the evidence $P(H|E_0 \wedge E_1 \wedge \ldots \wedge E_n)$ by following these steps:

1. calculate the weight w_i of each piece of evidence E_i.
2. add up the weights of all of the evidence $w = \sum_{i=0}^{n} w_i$.
3. calculate the probability that H is true given evidence whose total weight is w.

To calculate the weight of each piece of evidence, use the "Evidence Weights" table. To determine the probability that H is true, use the "Posterior Probabilities" table.

Evidence Weights

The following table shows the weight of a given body of evidence E with respect to a hypothesis H given that the probability of observing E when H is true equals $P(E|H)$ and the probability of observing E when H is false equals $P(E|\neg H)$. This table uses probability classes. Accordingly, the minimum w_{min}, maximum w_{max}, and typical w weights associated with E, given that the input probabilities fall within the stated probability classes, are also given.

Evidence Weights

$P(E\|H)$	$P(E\|\neg H)$	w_{min}	w	w_{max}
Blue	Blue	-0.0513	0	0.0513
Blue	Green	0	0.1082	0.2231
Blue	Yellow	0.1718	0.6678	1.6094
Blue	Orange	1.5581	2.0541	2.9957
Blue	Red	2.9444	3.6636	∞
Green	Blue	-0.2231	-0.1082	0
Green	Green	-0.1718	0	0.1718
Green	Yellow	0	0.5596	1.5581
Green	Orange	1.3863	1.9459	2.9444
Green	Red	2.7726	3.5553	∞
Yellow	Blue	-1.6094	-0.6678	-0.1718
Yellow	Green	-1.5581	-0.5596	0
Yellow	Yellow	-1.3863	0	1.3863
Yellow	Orange	0	1.3863	2.7726
Yellow	Red	1.3863	2.9957	∞
Orange	Blue	-2.9957	-2.0541	-1.5581
Orange	Green	-2.9444	-1.9459	-1.3863
Orange	Yellow	-2.7726	-1.3863	0
Orange	Orange	-1.3863	0	1.3863
Orange	Red	0	1.6094	∞
Red	Blue	$-\infty$	-3.6636	-2.9444
Red	Green	$-\infty$	-3.5553	-2.7726
Red	Yellow	$-\infty$	-2.9957	-1.3863
Red	Orange	$-\infty$	-1.6094	0
Red	Red	$-\infty$	0	∞

Evidence Weights (Aminas)

To simplify calculations, we consider 0.75 nats worth of evidence equal to 1 amina and report the weight of evidence in Aminas.

$P(E\|H)$	$P(E\|\neg H)$	w_{min}	w	w_{max}
Blue	Blue	-1	0	1
Blue	Green	0	0	1
Blue	Yellow	0	1	3
Blue	Orange	2	3	4
Blue	Red	3	5	∞
Green	Blue	-1	0	0
Green	Green	-1	0	1
Green	Yellow	0	1	3
Green	Orange	1	3	4
Green	Red	3	5	∞
Yellow	Blue	-3	-1	0
Yellow	Green	-3	-1	0
Yellow	Yellow	-2	0	2
Yellow	Orange	0	2	4
Yellow	Red	1	4	∞
Orange	Blue	-4	-3	-2
Orange	Green	-4	-3	-1
Orange	Yellow	-4	-2	0
Orange	Orange	-2	0	2
Orange	Red	0	2	∞
Red	Blue	$-\infty$	-5	-3
Red	Green	$-\infty$	-5	-3
Red	Yellow	$-\infty$	-4	-1
Red	Orange	$-\infty$	-2	0
Red	Red	$-\infty$	0	∞

Posterior Probabilities

The following table shows the probability $P(H|E)$ that a given hypothesis H is true given a body of evidence E whose collective weight equals w, measured in Aminas, given that the probability that H was true before we saw the new evidence E was $P(H)$.

$P(H)$	w	$P(H\|E)_{min}$	$P(H\|E)$	$P(H\|E)_{max}$
Blue	-10	Red	Red	Blue
Blue	-9	Red	Red	Blue
Blue	-8	Red	Orange	Blue
Blue	-7	Orange	Orange	Blue
Blue	-6	Orange	Yellow	Blue
Blue	-5	Yellow	Yellow	Blue
Blue	-4	Yellow	Yellow	Blue
Blue	-3	Yellow	Green	Blue
Blue	-2	Green	Green	Blue
Blue	-1	Green	Green	Blue
Blue	0	Green	Blue	Blue
Blue	1	Blue	Blue	Blue
Blue	2	Blue	Blue	Blue
Blue	3	Blue	Blue	Blue
Blue	4	Blue	Blue	Blue
Blue	5	Blue	Blue	Blue
Blue	6	Blue	Blue	Blue
Blue	7	Blue	Blue	Blue
Blue	8	Blue	Blue	Blue
Blue	9	Blue	Blue	Blue
Blue	10	Blue	Blue	Blue
Green	-10	Red	Red	Red
Green	-9	Red	Red	Red
Green	-8	Red	Red	Red
Green	-7	Red	Red	Orange
Green	-6	Red	Orange	Orange
Green	-5	Orange	Orange	Yellow
Green	-4	Orange	Yellow	Yellow
Green	-3	Yellow	Yellow	Yellow
Green	-2	Yellow	Yellow	Green
Green	-1	Yellow	Yellow	Green
Green	0	Green	Green	Green
Green	1	Green	Green	Blue
Green	2	Green	Blue	Blue
Green	3	Blue	Blue	Blue
Green	4	Blue	Blue	Blue
Green	5	Blue	Blue	Blue
Green	6	Blue	Blue	Blue

$P(H)$	w	$P(H\|E)_{min}$	$P(H\|E)$	$P(H\|E)_{max}$
Green	7	Blue	Blue	Blue
Green	8	Blue	Blue	Blue
Green	9	Blue	Blue	Blue
Green	10	Blue	Blue	Blue
Yellow	-10	Red	Red	Red
Yellow	-9	Red	Red	Red
Yellow	-8	Red	Red	Red
Yellow	-7	Red	Red	Red
Yellow	-6	Red	Red	Red
Yellow	-5	Red	Red	Orange
Yellow	-4	Red	Red	Orange
Yellow	-3	Red	Orange	Yellow
Yellow	-2	Orange	Orange	Yellow
Yellow	-1	Orange	Yellow	Yellow
Yellow	0	Yellow	Yellow	Yellow
Yellow	1	Yellow	Yellow	Green
Yellow	2	Yellow	Green	Green
Yellow	3	Yellow	Green	Blue
Yellow	4	Green	Blue	Blue
Yellow	5	Green	Blue	Blue
Yellow	6	Blue	Blue	Blue
Yellow	7	Blue	Blue	Blue
Yellow	8	Blue	Blue	Blue
Yellow	9	Blue	Blue	Blue
Yellow	10	Blue	Blue	Blue
Orange	-10	Red	Red	Red
Orange	-9	Red	Red	Red
Orange	-8	Red	Red	Red
Orange	-7	Red	Red	Red
Orange	-6	Red	Red	Red
Orange	-5	Red	Red	Red
Orange	-4	Red	Red	Red
Orange	-3	Red	Red	Red
Orange	-2	Red	Red	Orange
Orange	-1	Red	Orange	Orange
Orange	0	Orange	Orange	Orange
Orange	1	Orange	Yellow	Yellow
Orange	2	Orange	Yellow	Yellow
Orange	3	Yellow	Yellow	Yellow
Orange	4	Yellow	Yellow	Green
Orange	5	Yellow	Green	Green
Orange	6	Green	Green	Blue
Orange	7	Green	Blue	Blue
Orange	8	Blue	Blue	Blue

$P(H)$	w	$P(H\|E)_{min}$	$P(H\|E)$	$P(H\|E)_{max}$
Orange	9	Blue	Blue	Blue
Orange	10	Blue	Blue	Blue
Red	-10	Red	Red	Red
Red	-9	Red	Red	Red
Red	-8	Red	Red	Red
Red	-7	Red	Red	Red
Red	-6	Red	Red	Red
Red	-5	Red	Red	Red
Red	-4	Red	Red	Red
Red	-3	Red	Red	Red
Red	-2	Red	Red	Red
Red	-1	Red	Red	Red
Red	0	Red	Red	Orange
Red	1	Red	Orange	Orange
Red	2	Red	Orange	Orange
Red	3	Red	Orange	Yellow
Red	4	Red	Yellow	Yellow
Red	5	Red	Yellow	Yellow
Red	6	Red	Yellow	Green
Red	7	Red	Green	Green
Red	8	Red	Green	Blue
Red	9	Red	Blue	Blue
Red	10	Red	Blue	Blue

Needed Evidence Weights

The following table shows the weight w of evidence E needed to change the probability that a given hypothesis H is true from $P(H)$ to $P(H|E)$. The probabilities are reported using probability classes, accordingly, the minimum w_{min}, maximum m_{max}, and typical w weights needed to shift the probabilities are given.

Evidence Weights

$P(H)$	$P(H\|E)$	w_{min}	w	w_{max}
Blue	Blue	$-\infty$	0	∞
Blue	Green	$-\infty$	-1.7177	0
Blue	Yellow	$-\infty$	-3.6636	-1.5581
Blue	Orange	$-\infty$	-5.6095	-4.3307
Blue	Red	$-\infty$	-7.3271	-5.8889
Green	Blue	0	1.7177	∞
Green	Green	-1.5581	0	1.5581
Green	Yellow	-4.3307	-1.9459	0
Green	Orange	-5.8889	-3.8918	-2.7726
Green	Red	$-\infty$	-5.6095	-4.3307
Yellow	Blue	1.5581	3.6636	∞
Yellow	Green	0	1.9459	4.3307
Yellow	Yellow	-2.7726	0	2.7726
Yellow	Orange	-4.3307	-1.9459	0
Yellow	Red	$-\infty$	-3.6636	-1.5581
Orange	Blue	4.3307	5.6095	∞
Orange	Green	2.7726	3.8918	5.8889
Orange	Yellow	0	1.9459	4.3307
Orange	Orange	-1.5581	0	1.5581
Orange	Red	$-\infty$	-1.7177	0
Red	Blue	5.8889	7.3271	∞
Red	Green	4.3307	5.6095	∞
Red	Yellow	1.5581	3.6636	∞
Red	Orange	0	1.7177	∞
Red	Red	$-\infty$	0	∞

Evidence Weights (Aminas)

$P(H)$	$P(H\|E)$	w_{min}	w	w_{max}
Blue	Blue	$-\infty$	0	∞
Blue	Green	$-\infty$	-2	0
Blue	Yellow	$-\infty$	-5	-2
Blue	Orange	$-\infty$	-7	-5
Blue	Red	$-\infty$	-10	-7
Green	Blue	0	2	∞
Green	Green	-3	0	3
Green	Yellow	-6	-3	0
Green	Orange	-8	-5	-3
Green	Red	$-\infty$	-7	-5
Yellow	Blue	2	5	∞
Yellow	Green	0	3	6
Yellow	Yellow	-4	0	4
Yellow	Orange	-6	-3	0
Yellow	Red	$-\infty$	-5	-2
Orange	Blue	5	7	∞
Orange	Green	3	5	8
Orange	Yellow	0	3	6
Orange	Orange	-3	0	3
Orange	Red	$-\infty$	-2	0
Red	Blue	7	10	∞
Red	Green	5	7	∞
Red	Yellow	2	5	∞
Red	Orange	0	2	∞
Red	Red	$-\infty$	0	∞