

General phenomena about the probability something good happens before something bad happens.

Classify trials into three types: good, bad, or neutral. Neutral type is not necessary; if not used, just set its probability equal to 0.

In a sequence of trials, each of has the following:

“good result” happens with probability  $g$

“bad result” happens with probability  $b$

and a “neutral result” happens with probability  $u$

We need to have  $g + b + u = 1$  for this to work, of course.

Now let us find the probability that the first occurrence of something good happens sometime before the first occurrence of something bad. (Not necessarily immediately before.)

This probability is found by noting that we need exactly  $n - 1$  occurrences of the neutral type of trial, for some  $n \geq 1$ , followed by a good trial. So the desired probability is

$$\sum_{n=1}^{\infty} u^{n-1} g = g \frac{1}{1-u} = \frac{g}{1-(1-g-b)} = \frac{g}{g+b}$$

Intuitively, this makes sense, because we just set aside the neutral trials, in our mind, and look at the first occurrence that is either good or bad, and we want to ensure that it turns out to be good, to compute our desired probability.