

Some Thoughts and Solutions

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1 Problem (Sunrise Problem) Consider we know nothing about sunrise but the fact that the sun has risen once a day for N days, what is the probability of the sun also rising tomorrow? Because we have no idea the probability p of the sun rising on any given day, we only the situation with p uniformly distributed in $[0, 1]$.

Proof Let event A indicate the sun rises tomorrow and event B indicate the sun has risen once a day during the past N days. Similar to Bayes' law in discrete form, we have the following equation, where dp is the distribution of p .

$$\begin{aligned}
 P(A|B) &= \frac{P(A \cap B)}{P(B)} \\
 &= \frac{\int_0^1 p^{N+1} dp}{\int_0^1 p^N dp} \\
 &= \frac{N+1}{N+2}
 \end{aligned}$$