1 Chapter 2: Using Bayes' Rule

Problem 2.6 ***Explain intuitively why likelihoods do not need to sum to 1, whereas priors and posteriors do.***

Priors and posteriors must sum to 1 because they represent probability distributions over possible hypotheses (i.e., parameter values). The prior probability distribution reflects our initial belief about different hypotheses before observing any data, while the posterior probability distribution updates these beliefs after incorporating the observed data using Bayes' theorem. Since probabilities quantify relative certainty across all possible hypotheses, they must sum to 1 to ensure a coherent and complete probability distribution.

The likelihood function does not represent a probability distribution over hypotheses. Instead, it quantifies how well each hypothesis explains the observed data. More formally, the likelihood function is proportional to the probability of the observed data given a particular hypothesis, but it is not a probability distribution over the hypotheses themselves. Since likelihoods serve as a comparative measure rather than a normalized probability distribution, they do not need to sum to 1. Their values are relative, meaning that only their ratios matter when updating our beliefs via Bayes' theorem.