Bayesian Inference Calculations

1 Problem Context

Before selecting the final case, a voting process was conducted. Carine, Eve Nice, Thierry, and Christian all chose the medical case. As a result, the topic "Medical practicalities using Bayes' Theorem" received unanimous approval from all group members. Group 20 we are going to chose a real-world problem where Bayesian probability is applicable is in medicine, defining calculating Bayesian inference to update the probability of a hypothesis (having a disease) given new evidence (a positive test result).

2 Assumed Probabilities

- P(H) (Prior probability of having the disease): 0.01 (1
- P(not H) (Probability of not having the disease): 0.99
- P(E/H) (Likelihood of positive test given disease, sensitivity): 0.95
- P(E/not H) (False positive rate, 1 - specificity): 0.05

3 Calculations

3.1 Step 1: Total Probability of Evidence (P(E))

Calculating total probability of evidence using the law of total probability: P(E) = [P(E/H) * P(H)] + [P(E/not H) * P(not H)] P(E) = (0.95 * 0.01) + (0.05 * 0.99) P(E) = 0.0095 + 0.0495 = 0.059

3.2 Step 2: Posterior Probability (P(H/E))

Calculating posterior probability using Bayes' theorem: P(H/E) = (P(E/H) * P(H)) / P(E) P(H/E) = (0.95 * 0.01) / 0.059 P(H/E) = 0.0095 / 0.059 approx 0.1610 (16.10

4 Interpretation

Calculating posterior probability of having the disease given a positive test is approximately 16.1

5 Table of Probabilities

Probability	Value
P(H) (Prior)	0.01
P(not H)	0.99
P(E/H) (Sensitivity)	0.95
P(E/not H) (False Positive)	0.05
P(E) (Total)	0.059
P(H/E) (Posterior)	0.1610

Table 1: Probabilities Used in Bayesian Inference