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CS2402 - Lecture10 - In-Class Exercise

Q1. You know that your neighborhood returns to his home every 10 days in 30 days. If he returns home, the probability that the dog barks is 0.8. And if he does not return home, the probability that his dog barks is 0.1. What is the probability that he returns home given that his dog barks?

Hypotheses: H_1 : your neighborhood returns home.

Hypotheses: H_2 : your neighborhood does not return home.

Solution:

- Initial (priori) odds: $P(H_1) : P(H_2) = ?$ $1 : 2$
- Evidence, E = His dog barks.
- Likelihood Ratio of Evidence under different hypotheses:

$$P(E|H_1) : P(E|H_2) = ? \quad 8 : 1$$

- Posteriori ratio that your neighborhood returns home

$$P(H_1|E) : P(H_2|E) = ? \quad 8 : 2$$

$$P(H_1|E) = ? \quad \frac{8}{10} = 0.8$$

Q2. A sport club has 5 basketball players and 11 football players. All basketball players and 2/11 football players are higher than 190cm. When a player is higher than 190cm, what is the probability that he is a football player?

H_1 : football H_2 : basketball

$$P(H_1) : P(H_2) = 11 : 5$$

$$E : > 190$$

$$P(E|H_1) : P(E|H_2) = 1 : \frac{2}{11}$$

$$P(H_1|E) : P(H_2|E) = 11 : 2$$

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In-Class Exercises - Lecture 10

$$P(H_1|E) = \frac{\frac{10}{11}}{11 + \frac{10}{11}} = \frac{10}{121 + 10} = \frac{10}{131}$$

$$\frac{2}{7}$$

$$\frac{2}{145}$$



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Q3. Suppose you have two fair coins and five unfair coins. The fair coin yields a head with a probability of 0.5, and the unfair coin yields a head with a probability of 0.2. You choose a random coin among these seven coins and play this coin two times, and both rounds yield a head.

What is the posterior probability that this coin is fair/unfair?

$$H_1: \text{fair} \quad H_2: \text{unfair} \quad E: 2 \text{ head}$$

$$P(H_1) : P(H_2) = 2 : 5$$

$$P(E|H_1) : P(E|H_2) = \frac{1}{2} \times \frac{1}{2} : \frac{1}{5} \times \frac{1}{5}$$

$$P(H_1|E) : P(H_2|E) = \frac{1}{2} : \frac{1}{5}$$

$$\therefore P(H_1|E) = \frac{5}{7} \quad P(H_2|E) = \frac{2}{7}$$

Q4. You are planning to go hiking tomorrow. You know that, in recent ten days, it has rained two days. If it actually rains, the probability of weather forecast predicts rain is 0.9. And if it does not rain, the probability of weather forecast predicts rain is 0.1.

What is the posterior probability that tomorrow will be a rainy day, given the weather forecast predicts rain?

$$H: \text{rainy} \quad E: \text{rain}$$

$$P(H) : P(\bar{H}) = 1 : 4$$

$$P(E|H) : P(E|\bar{H}) = 9 : 1$$

$$P(H|E) : P(\bar{H}|E) = 9 : 4$$

$$P(H|E) = \frac{9}{13}$$

$$P(E|H) = 0.9$$

$$\frac{P(E|H)}{0.1 P(\bar{H})} = 0.9$$

$$= 0.8 \times 0.1$$

$$P(E|H) = 0.18$$

$$P(E|\bar{H}) = 0.08$$

$$\frac{P(H|E)}{0.26} = \frac{0.18}{0.26}$$

Q5. Two companies sell the same kind of product. Company A/B sells 1000/200 products for a year. The probability of a defective product from Company A/ B is 0.3 and 0.2.

(a) If a product is chosen randomly, what is the probability of this product is from company A?

(b) If a product is chosen randomly, what is the probability of this product is defective?

(c) If a randomly chosen product is defective, what is the probability of this product is from company A?



$$(a) P(A) : P(B) = 5 : 1$$

$$\therefore \frac{5}{6}$$

$$(b) P = \frac{5}{6} \times 0.3 + \frac{1}{6} \times 0.2 = \frac{1.5}{6} + \frac{0.2}{6} = \frac{1.7}{6} = \frac{17}{60}$$

$$= 0.3 \times \frac{5}{6} + 0.2 \times \frac{1}{6}$$

$$(c) P(A) : P(B) = 5 : 1$$

$$P(E|A) : P(E|B) = 0.3 : 0.2$$

$$P(A|E) : P(B|E) = 1.5 : 0.2$$

$$\therefore P(A|E) = \frac{15}{17}$$

