

AI5002 - Assignment 3

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To find probability that both children are males, given at least one of the children is male can be represented by Bayes theorem as

Problem 2.5

A couple has two children,

- i. Find the probability that both children are males, if it is known that at least one of the children is male.
- ii. Find the probability that both children are females, if it is known that the elder child is a female.

$$P(E | F) = \frac{P(E \cap F)}{P(F)} \quad (0.0.3)$$

Also, we get $E \cap F = \{(b, b)\}$.

Thus,

$$P(E \cap F) = \frac{1}{4} \quad (0.0.4)$$

Solution

Let a boy be denoted by 'b' and girl be denoted by 'g'.

As given a couple has two children then the possible set of combinations of children can be represented by this set

$$S = \{(b,b), (b,g), (g,b), (g,g)\}.$$

i) Let 'E' be the event of both children to be males and 'F' be the event of at least one children to be male.

'E' represents the set $\{(b,b)\}$.

The probability of 'E' is given by

$$P(E) = \frac{1}{4}. \quad (0.0.1)$$

'F' represents the set $\{(b,b), (b,g), (g,b)\}$.

The probability of 'F' is given by

$$P(F) = \frac{3}{4}. \quad (0.0.2)$$

Using (0.0.4) and (0.0.2) into (0.0.3), we get,

$$P(E | F) = \frac{\frac{1}{4}}{\frac{3}{4}} = \frac{1}{3} \quad (0.0.5)$$

ii) Let 'E' be the event of both children to be females and 'F' be the event of elder child being a female.

'E' represents the set $\{(g,g)\}$.

The probability of 'E' is given by

$$P(E) = \frac{1}{4}. \quad (0.0.6)$$

'F' represents the set $\{(b,g), (g,g)\}$.

The probability of 'F' is given by

$$P(F) = \frac{2}{4} = \frac{1}{2}. \quad (0.0.7)$$

To find probability that both children are females, given that the elder child is a female can be represented by Bayes theorem as

$$P(E | F) = \frac{P(E \cap F)}{P(F)} \quad (0.0.8)$$

From the set contents of 'E' and 'F', we get $E \cap F = \{(g, g)\}$.

Thus,

$$P(E \cap F) = \frac{1}{4} \quad (0.0.9)$$

Using (0.0.9) and (0.0.7) into (0.0.8) we get,

$$P(E | F) = \frac{\frac{1}{4}}{\frac{1}{2}} = \frac{1}{2} \quad (0.0.10)$$