Probability: Worked Example

An electronics assembly subcontractor receives resistors from two suppliers: Deltatech provides 70% of the subcontractors's resistors while another company, Echelon, supplies the remainder.
1% of the resistors provided by Deltatech fail the quality control test, while 2% of the resistors from Echelon also fail the quality control test.

1. What is the probability that a resistor will fail the quality control test?

2. What is the probability that a resistor that fails the quality control test was supplied by Echelon?

Probability: Worked Example

Firstly, let's assign names to each event.

- D : a randomly chosen resistor comes from Deltatech.
- E : a randomly chosen resistor comes from Echelon.
- F : a randomly chosen resistor fails the quality control test.
- P : a randomly chosen resistor passes the quality control test.

We are given (or can deduce) the following probabilities:

- $P(D) = 0.70$,
- $P(E) = 0.30$.

Probability: Worked Example

We are given two more important pieces of information:

- ▶ The probability that a randomly chosen resistor fails the quality control test, given that it comes from Deltatech: $P(F|D) = 0.01$.

- ▶ The probability that a randomly chosen resistor fails the quality control test, given that it comes from Echelon: $P(F|E) = 0.02$.

Probability: Worked Example

The first question asks us to compute the probability that a randomly chosen resistor fails the quality control test. i.e. $P(F)$.

All resistors come from either Deltatech or Echelon. So, using the **law of total probability**, we can express $P(F)$ as follows:

$$P(F) = P(F \cap D) + P(F \cap E)$$

Probability: Worked Example

Using the **multiplication rule** i.e. $P(A \cap B) = P(A|B) \times P(B)$, we can re-express the formula as follows

$$P(F) = P(F|D) \times P(D) + P(F|E) \times P(E)$$

We have all the necessary probabilities to solve this.

$$P(F) = 0.01 \times 0.70 + 0.02 \times 0.30 = 0.007 + 0.006 = 0.013$$

Probability: Worked Example

- ▶ The second question asks us to compute probability that a resistor that fails the quality control test was supplied by Echelon.

- ▶ In other words; of the resistors that did fail the quality test only, what is the probability that a randomly selected resistor was supplied by Echelon?

- ▶ We can express this mathematically as $P(E|F)$.

- ▶ We can use **Bayes' theorem** to compute the answer.

Probability: Worked Example

Recall Bayes' theorem

$$P(A|B) = \frac{P(B|A) \times P(A)}{P(B)}$$

$$P(E|F) = \frac{P(F|E) \times P(E)}{P(F)} = \frac{0.02 \times 0.30}{0.013} = 0.046$$