Question

Let A and B be two events associated with an experiment such that P(A) = 0.4 and P(A ∪ B) = 0.7 .

Compute P(B) when

i) A and B are mutually exclusive;

ii) A and B are independent.

Solution

    i)   If events A and B are mutually exclusive **[1]**, then
$$P(A \cap B) = 0.$$

The probability of the union of two events **[2]** is
$$P(A \cup B) = P(A) + P(B) - P(A \cap B),$$

hence
$$P(B) = P(A \cup B) - P(A) = 0.7 - 0.4 = 0.3.$$

ii) If events A and B are independent **[3]**, then
$$P(A \cap B) = P(A)P(B).$$

Next,
$$P(A \cup B) = P(A) + P(B) - P(A \cap B) = P(A) + P(B) - P(A)P(B),$$

hence
$$P(B) = \frac{P(A \cup B) - P(A)}{1 - P(A)} = \frac{0.7 - 0.4}{1 - 0.4} = 0.5.$$

Answer: i) 0.3; **ii)** 0.5.

References

1. CK-12. Basic Probability and Statistics Concepts. A full Course. Section 1.4: Mutually Exclusive events. Retrieved from http://www.ck12.org/book/CK-12-Basic-Probability-and-Statistics-Concepts-A-Full-Course/section/1.4/
2. CS 21/ Math 19- Course Notes. Section 6.2 Unions and Intersections. Retrieved from https://math.dartmouth.edu/archive/m19w03/public_html/Section6-2.pdf
3. CK-12. Basic Probability and Statistics Concepts. A full Course. Section 1.2: Independent Events and Sample Spaces. Retrieved from http://www.ck12.org/book/CK-12-Basic-Probability-and-Statistics-Concepts/section/1.2/

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