Probability Rules Applications

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Exercises

1. Let A, B and C be events such that $\mathrm{P}(A) = 0.5$, $\mathrm{P}(B) = 0.3$, and $\mathrm{P}(C) = 0.4$. Also, we know that $\mathrm{P}(A \cap B) = 0.2$, $\mathrm{P}(B \cap C) = 0.12$, $\mathrm{P}(A \cap C) = 0.1$, and $\mathrm{P}(A \cap B \cap C) = 0.05$. Find the following:

   a) $\mathrm{P}(A \cup B)$

   b) $\mathrm{P}(A \cup B \cup C)$

   c) $\mathrm{P}(B' \cap C')$

   d) $\mathrm{P}(A \cup (B \cap C))$

   e) $\mathrm{P}((A \cup B \cup C) \cap (A \cap B \cap C)')$

   f) Advanced: Find $\mathrm{P}(A|B)$, the probability of A given we know B has occurred.

2. Consider the example of the family in the reading. What is the probability that the family has at least one boy?

3. The Birthday Problem Revisted.

   a) Suppose there are $n = 20$ people in a classroom. My birthday is April 3rd. What is the probability that at least one other person shares my birthday? Assume only 365 days in a year and assume that all birthdays are equally likely.

   b) In `R`, find the probability that at least one other person shares my birthday for each value of n from 1 to 80. Plot these probabilities with n on the x-axis and probability on the y-axis. At what value of n would the probability be at least 95%?