

## Épreuve de section européenne

## A dialogue on probabilities

- Anna : Lucy, did you find the solution to the first problem given by our teacher ? The text was : « In a certain population, the probability a woman lives to at least seventy years is 0.70 and is 0.55 that she lives to at least eighty years of age. If a woman is seventy years old, what is the conditional probability she survives to eighty years of age ? »

- Lucy : It was too easy ! Let  $A$  be the event “she lives at least to seventy” and  $B$  the event “she lives to at least eighty”. Hence,  $P(B|A) = P(A \cap B) / P(A) = P(B) / P(A)$ . Then you just have to calculate.

- Anna : Ok ! Can you now help me on the second exercise? “Two fair dice are rolled, a blue one and a green one. What is the probability that the blue one turns up 6, given that the sum of two dice is  $k$ , for each  $k = 2$  to 12?” I have no idea...

- Lucy : For this question, I just wrote : “Let  $A_6$  be the event “the blue die is a six” and  $S_k$  be the event “the sum is  $k$ ”. Of course,  $A_6 \cap S_k = \emptyset$  for  $k \leq 6$  ! Then,  $P(A_6 \cap S_k) = 1/36$  and  $P(S_k) = 6/36; 5/36; 4/36; 3/36; 2/36; 1/36$  for  $k = 7$  to 12, respectively. Thus, the conditional probabilities are easy to find for  $k = 7$  to 12.



From [www.cnx.org](http://www.cnx.org)

## Questions

1. Anna's first exercise.
  - a) Give Lucy's notation for the probability  $P_A(B)$  and for  $P(A \cap B)$ .
  - b) For the first problem, explain why  $P(AB) = P(B)$ .
  - c) Give the result.
2. Anna's second exercise
  - a. Explain what « fair » means for dice. Give an example of non-fair dice.
  - b. Why is the probability  $P(A_6 \cap S_k)$  equal to 0 for  $k \leq 6$  ?
  - c. Prove the sentence “ $P(S_k) = 6/36; 5/36; 4/36; 3/36; 2/36; 1/36$  for  $k = 7$  to 12”.
  - d. Give the final conditional probabilities.