Épreuve de section européenne

The conjunction fallacy (*)

The conjunction fallacy can be seen at work in numerous places: in the 1970s, Nobel Prize winner Daniel Kahneman and his colleague Amos Tversky presented college students with several problems. One of them was the Linda Problem:

Linda is 31 years old, single, outspoken, and very bright. She majored in Philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and she also participated in anti-nuclear demonstrations.

Subjects were asked to rank these statements based on how likely they were to be true:

1. Linda is a teacher in elementary school.
2. Linda works in a bookstore and takes Yoga classes.
3. Linda is active in the feminist movement.
4. Linda is a psychiatric social worker.
5. Linda is a member of the League of Women Voters.
6. Linda is a bank teller.
7. Linda is an insurance salesperson.
8. Linda is a bank teller and is active in the feminist movement.

Kahneman and Tversky (and many others who have since replicated their work) found that people ranked option 8 (a bank teller active in the feminist movement) as being more likely than option 6 (a bank teller). This is because option 8 provides more information, which seems to be more representative of Linda. Because we expect her to be politically active, but we don't expect her to be a bank teller, it seems as though the only way she could be a bank teller is if she is also politically active.

However, we know that 8 can never be more likely than options 3 or 6, because if we imagine all people active in the feminist movement, a subset of them will be bank tellers. Likewise, if we imagine all of the bank tellers in the world, a subset (again, perhaps a small one) will be active in the feminist movement.

The probability of two events occurring together cannot be more likely than one of them occurring alone. Most people, however, even though they are rational, intelligent decision makers, will be drawn toward sentences that are conjunctions (i.e., that list two separate "facts"), as if the listing of the "facts" together makes them more likely to be true. Even if, and maybe especially if, the second "fact" by itself seems unlikely.

Adapted from *Probability demystified*, by Alan G. Bluman and *Statistics Hacks* by Bruce Frey

(*) fallacy: error based on a false reasoning

Questions

1. Explain the experiment carried out by Kahneman and Tversky.
2. Using diagrams, develop the reasoning presented in the last but one paragraph.
3. Explain the word “conjunction”.
4. In probabilities the conjunction rule states that for any events A and B, such that $P(A) \neq 0$,
$$P(A \cap B) = P(A) \times P_A(B) .$$
Use the conjunction rule to prove that ‘*The probability of two events occurring together cannot be more likely than one of them occurring alone’*.