Lecture 5: Conditional Probability

COMS10014 Mathematics for Computer Science A

cs-uob.github.io/COMS10014/ and github.com/coms10011/2020_21

November 2020

The Nobel Prize for Literature is sexist.

- 117 individuals have won the Nobel Prize for Literature.
- Sixteen woman have won.
- $16/117 \approx 0.14$.

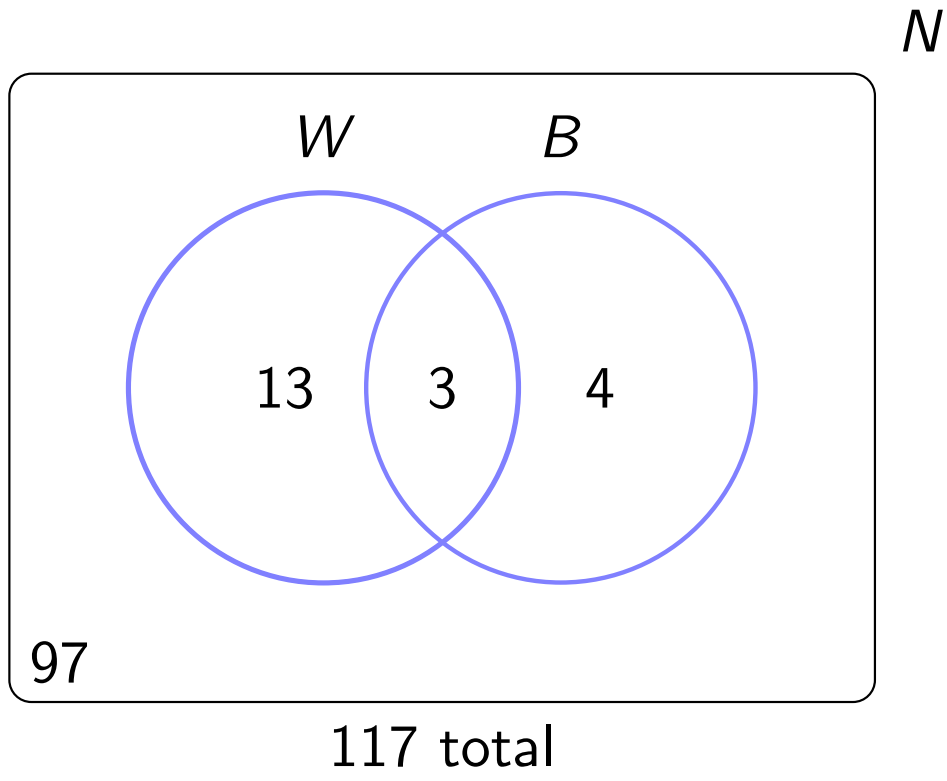
$$P(\text{woman}) = 0.14$$

The Booker Prize is less sexist?

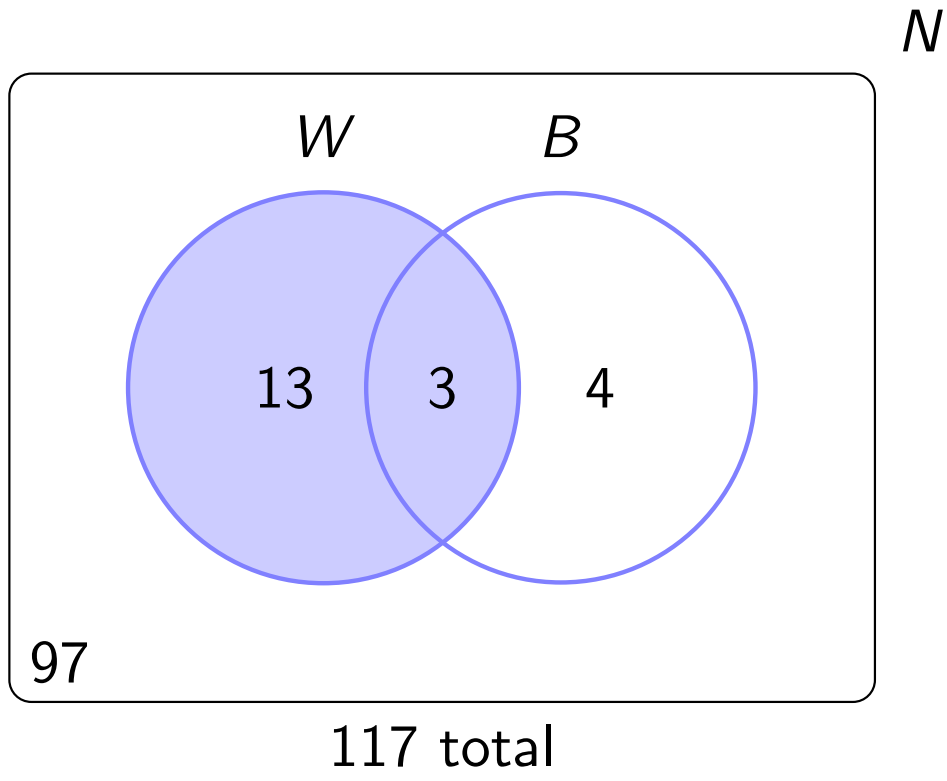
- Seven people have won both the Booker Prize and the Nobel Prize for Literature.
- Of that seven three were women.
- $3/7 \approx 0.43$.

Doris Lessing / Alice Munro / Nadine Gordimer

Nobel Prize probabilities

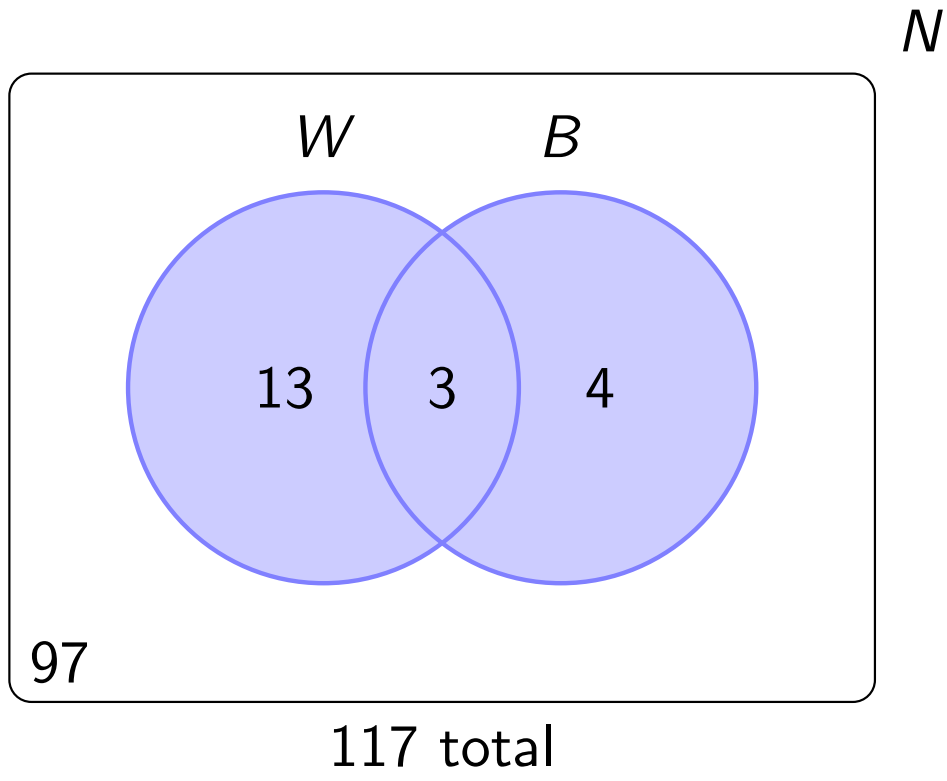


Nobel Prize probabilities - woman



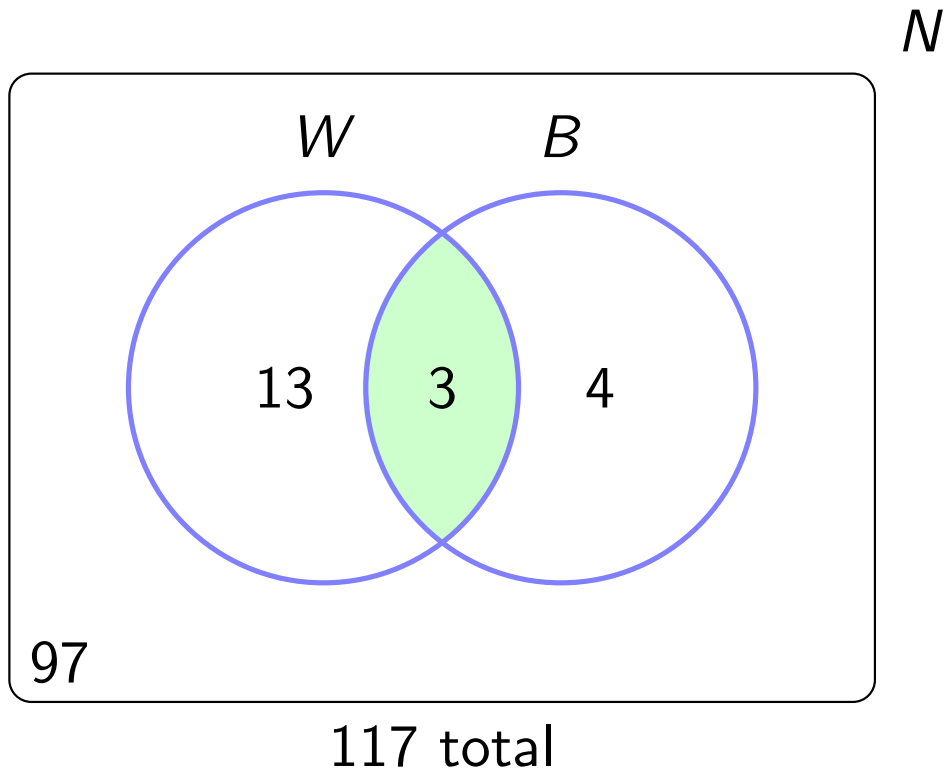
$$P(W) = 16/117 \approx 0.14$$

Nobel Prize probabilities - woman or booker



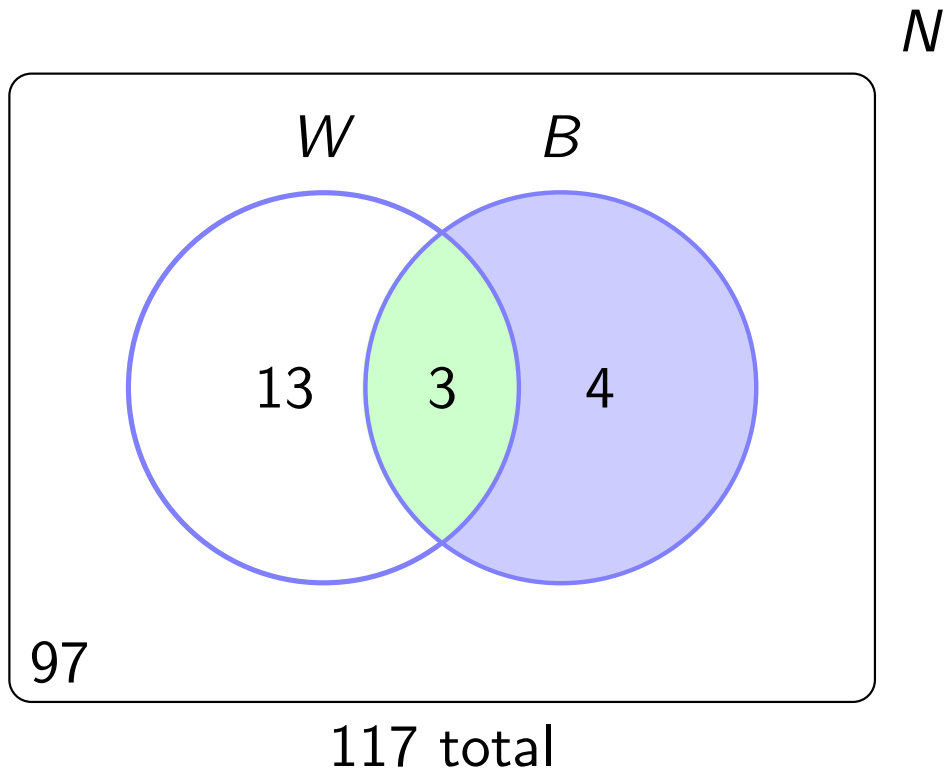
$$P(W \cup B) = 20/117 \approx 0.17$$

Nobel Prize probabilities - woman and booker



$$P(W \cap B) = 3/117 \approx 0.03$$

Nobel Prize probabilities - woman given booker



$P(W \text{ given } B) = 3/7 \approx 0.43$

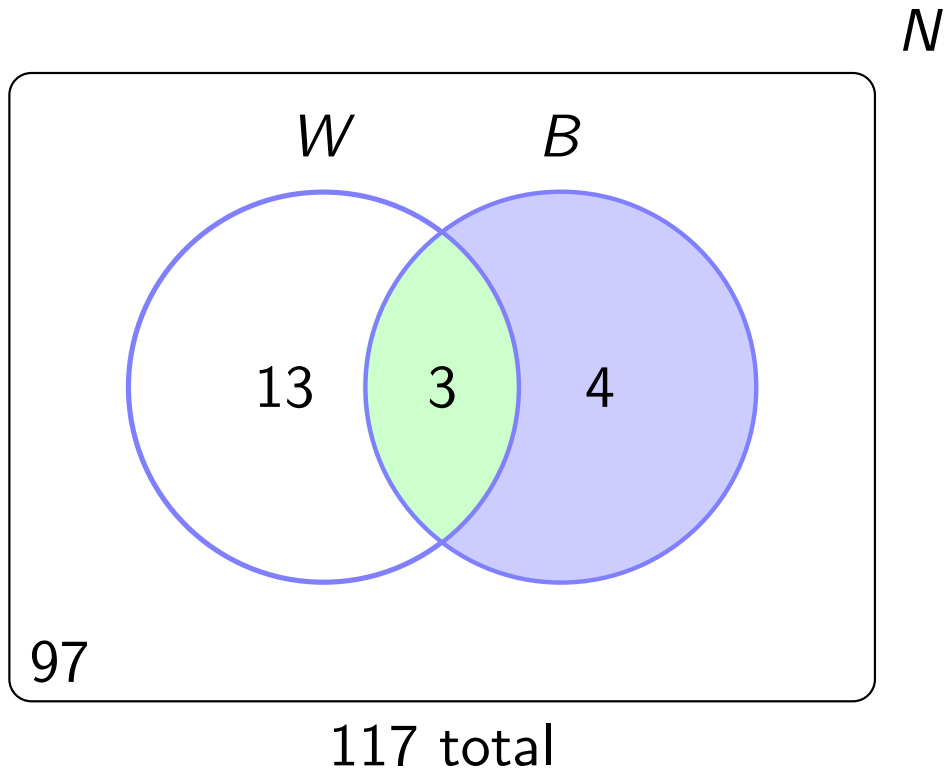
Conditional probability

If we have two events A and B then

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

is the probability of A given B. This is the **conditional probability**.

Nobel Prize probabilities - woman given booker



$$P(W|B) = \frac{P(W \cap B)}{P(B)} = \frac{3/117}{7/117} = \frac{3}{7} \approx 0.43$$

Conditional probability

$$P(A \cap B) = P(A|B)P(B)$$

means the probability of A **and** B is the probability of B multiplied by the probability of A **given** B.