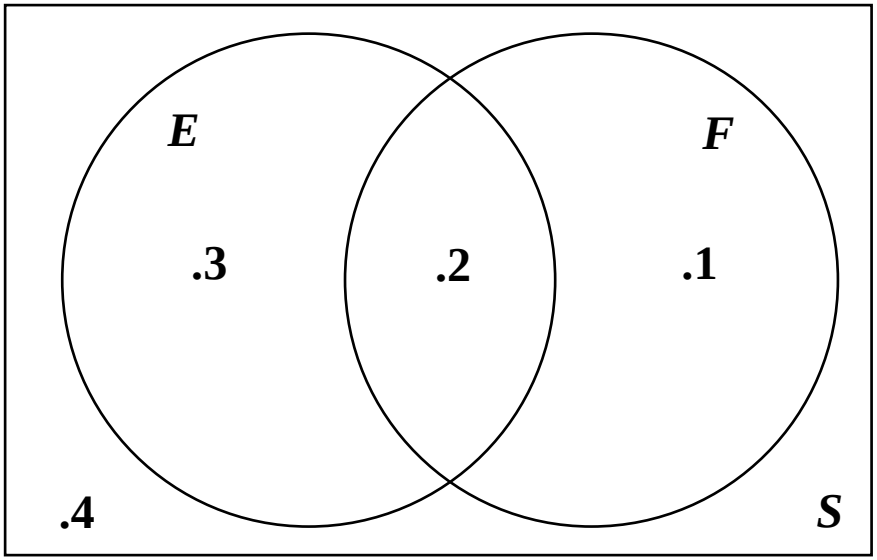
Probability Diagrams and Probability Formulas:

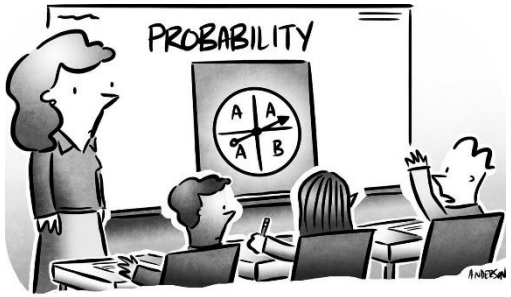
A probability diagram is like a specialized Venn Diagram in which the probabilities of different events in the sample space are labelled.



The sum of all the probabilities that make up all the disjoint regions of *S* must be 1.

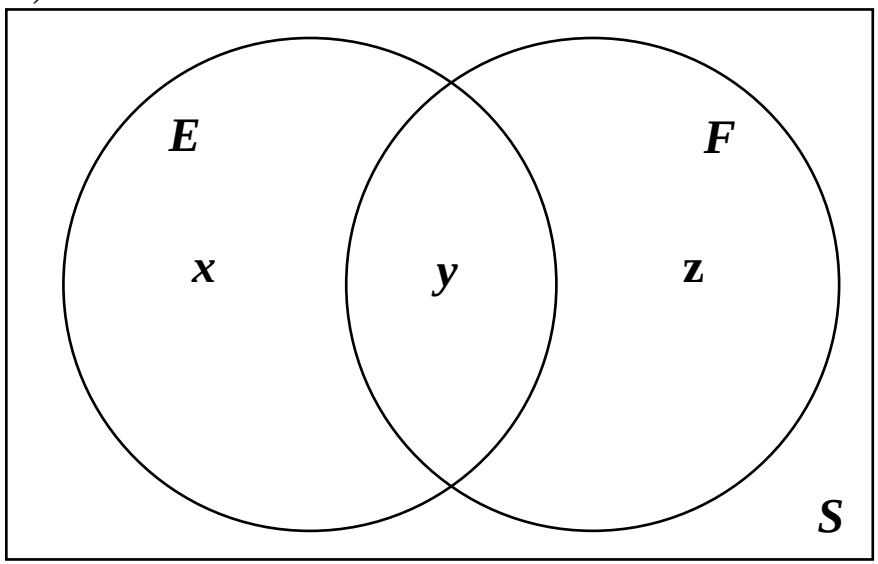
$P(E) =$ $P(F) =$ $P(E \text{ and } F) = P(E \cap F) =$

$P(E \text{ or } F) = P(E \cup F) =$ $P(\text{not } E) = P(E') =$ $P\left((E \cup F)'\right) =$



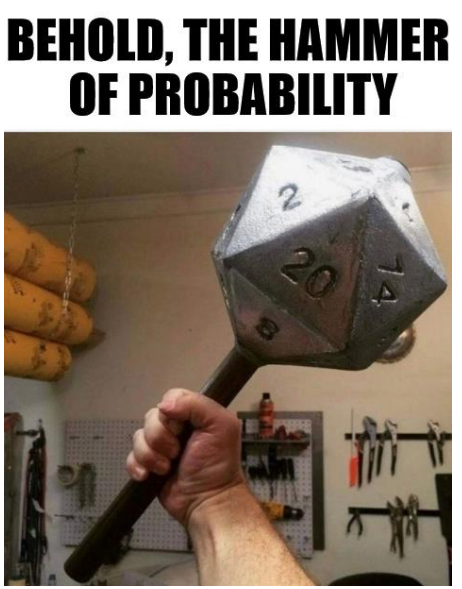
"I know mathematically that A is more likely, but I gotta say, I feel like B wants it more."

A formula for $P(E \cup F)$:

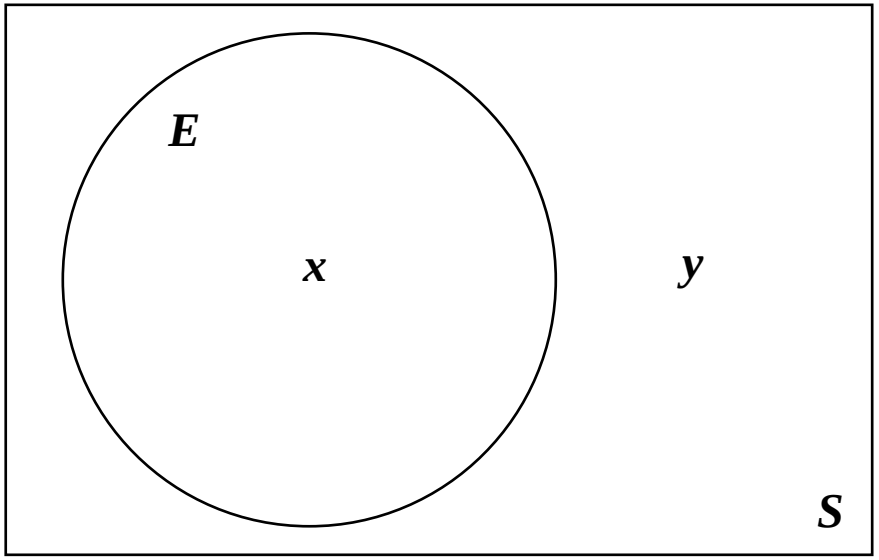


$$P(E \cup F) = x + y + z = x + y + y + z - y$$
$$= (x + y) + (y + z) - y$$
$$= P(E) + P(F) - P(E \cap F)$$

If $E \cap F = \phi$, then it's impossible for both events to occur, and they are called mutually exclusive events. In this case, $P(E \cup F) = P(E) + P(F)$



Formulas involving $P(E')$:



$$1 = P(S) = x + y = P(E) + P(E')$$

So

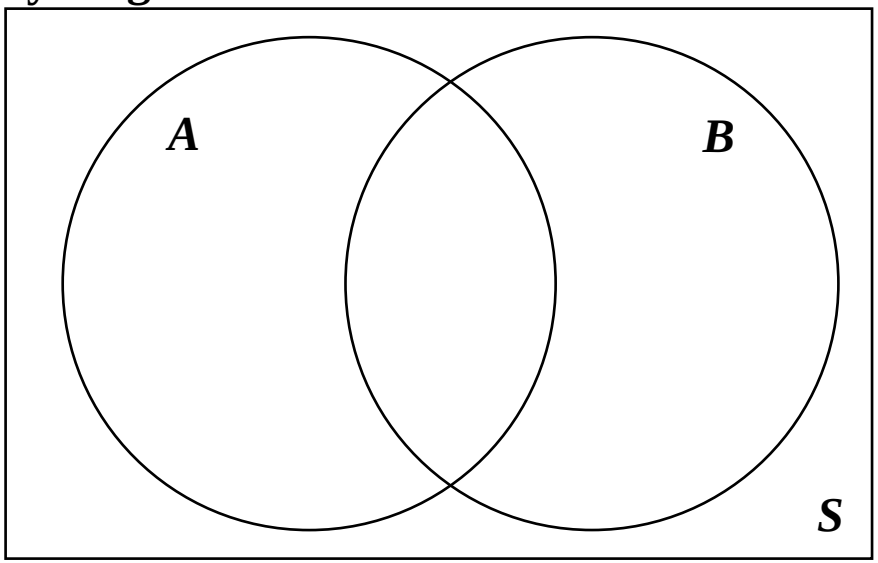
$$P(E) = 1 - P(E')$$

$$P(E') = 1 - P(E)$$

Out of context example:

Suppose $P(A)=.7$**,** $P(B)=.4$**, and** $P(A\cap B)=.3$**.**

Complete the probability diagram:



Behold, my other hammer of probability

Find

$P(A\cup B)$ $P(A')$ $P\left((A\cup B)'\right)$

$P(A\cap B')$ $P(B\cap A')$ $P\left((A\cap B)'\right)$

In context examples:

1. A card is randomly selected from a standard 52-card deck.

$P(\text{ace or a heart})$

$P(\text{ace or king})$

$P(\text{face card or a club})$

2. A survey of North Harris students had the following results.

	Pepperoni	Sausage	Mushroom	Total
Freshman	**25**	**15**	**5**	**45**
Sophomore	**30**	**20**	**5**	**55**
Total	**55**	**35**	**10**	**100**

A student from the survey is *selected at random*.

a) $P(\text{sausage or mushroom})$

b) $P(\text{freshman or pepperoni})$

Odds and Probability:

The odds in favor of an event *E* is the ratio of the probability that *E* will occur to the probability that *E* won't occur.

Odds in favor of E: $P(E) : P(E')$ **or** $P(E)$ to $P(E')$

The odds are usually expressed as a ratio of whole numbers.

Example:

If $P(E) = \frac{2}{5}$**, then find the odds in favor of *E*.**

"I wish we hadn't learned probability 'cause I don't think our odds are good."

The odds against an event E is the ratio of the probability that *E* won't occur to the probability that *E* will occur, i.e. the reversal of the odds in favor.

Odds against E: $P(E'):P(E)$ **or** $P(E')$ to $P(E)$

Example:

If $P(E)=\frac{3}{7}$**, then find the odds against *E*.**

Sometimes you'll want to go from odds to probability. If the odds in favor of *E* is *a* to *b*, then $\frac{P(E)}{P(E')}=\frac{a}{b}\Rightarrow\frac{P(E)}{1-P(E)}=\frac{a}{b}$**. Cross-multiplying leads to**

$bP(E)=a-aP(E)\Rightarrow(a+b)P(E)=a$**.**

Example:

If the odds in favor of *E* is 4 to 7, then find $P(E)$**.**