"Either/Or" Probability with Venn Diagrams and Two-Way Tables

by Sophia

WHAT'S COVERED

In this tutorial, you're going to learn about solving “or” probability for overlapping events in Venn diagrams and tables. Our discussion breaks down as follows:

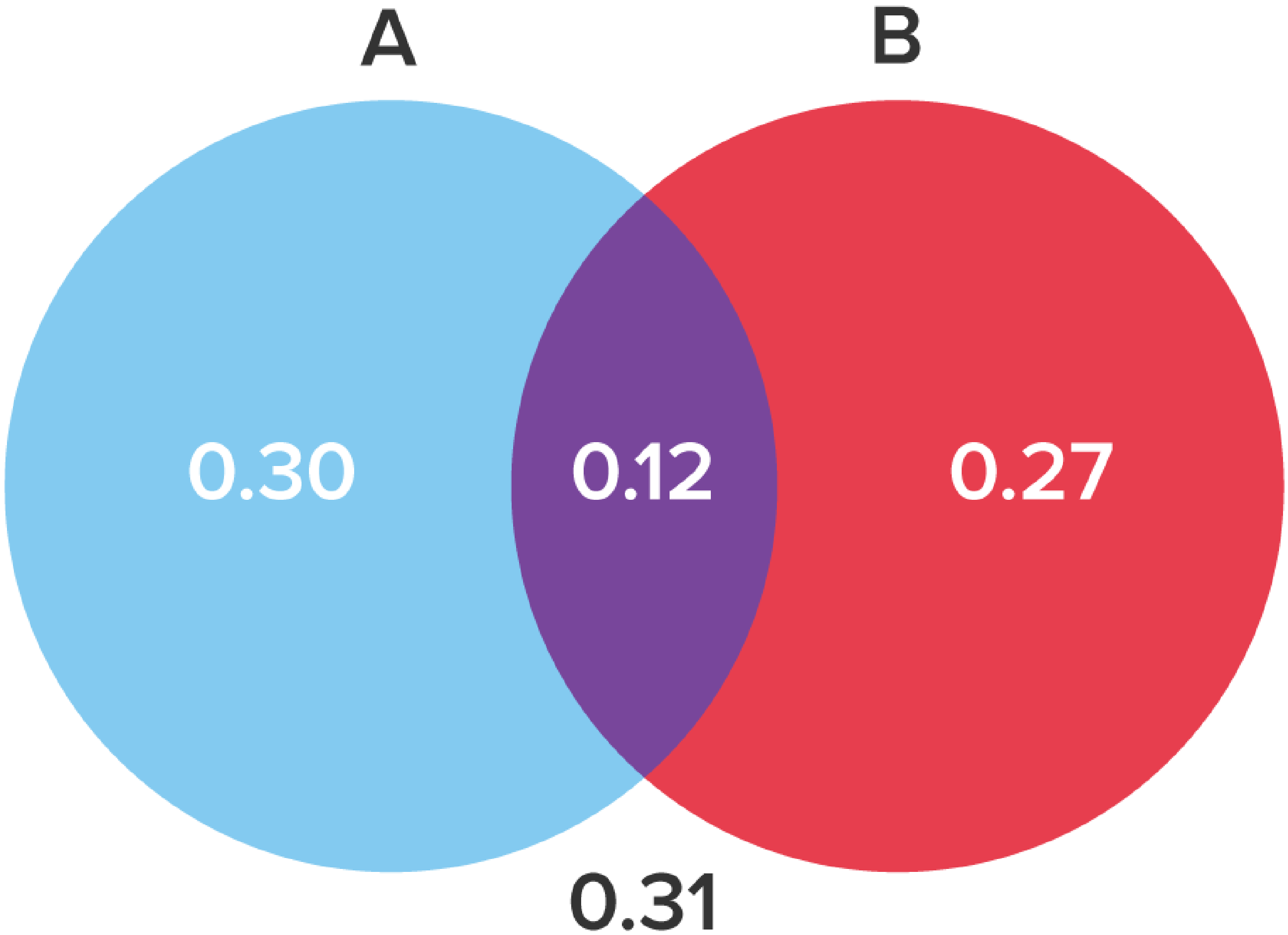
1. Either/Or Probability for Overlapping Events With Venn Diagrams

Let's see how we can calculate the either/or probability for overlapping events using data from Venn Diagrams.

HINT

Venn diagrams are particularly helpful for visualizing why you need to subtract the overlapping probability for these calculations.

EXAMPLE



Using this Venn diagram, find the probability that event A or event B occurs.

Here we have overlapping events so we can note that:
$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

The probability that A happens is the whole circle of A, or:
$P(A) = 0.30 + 0.12 = 0.42$

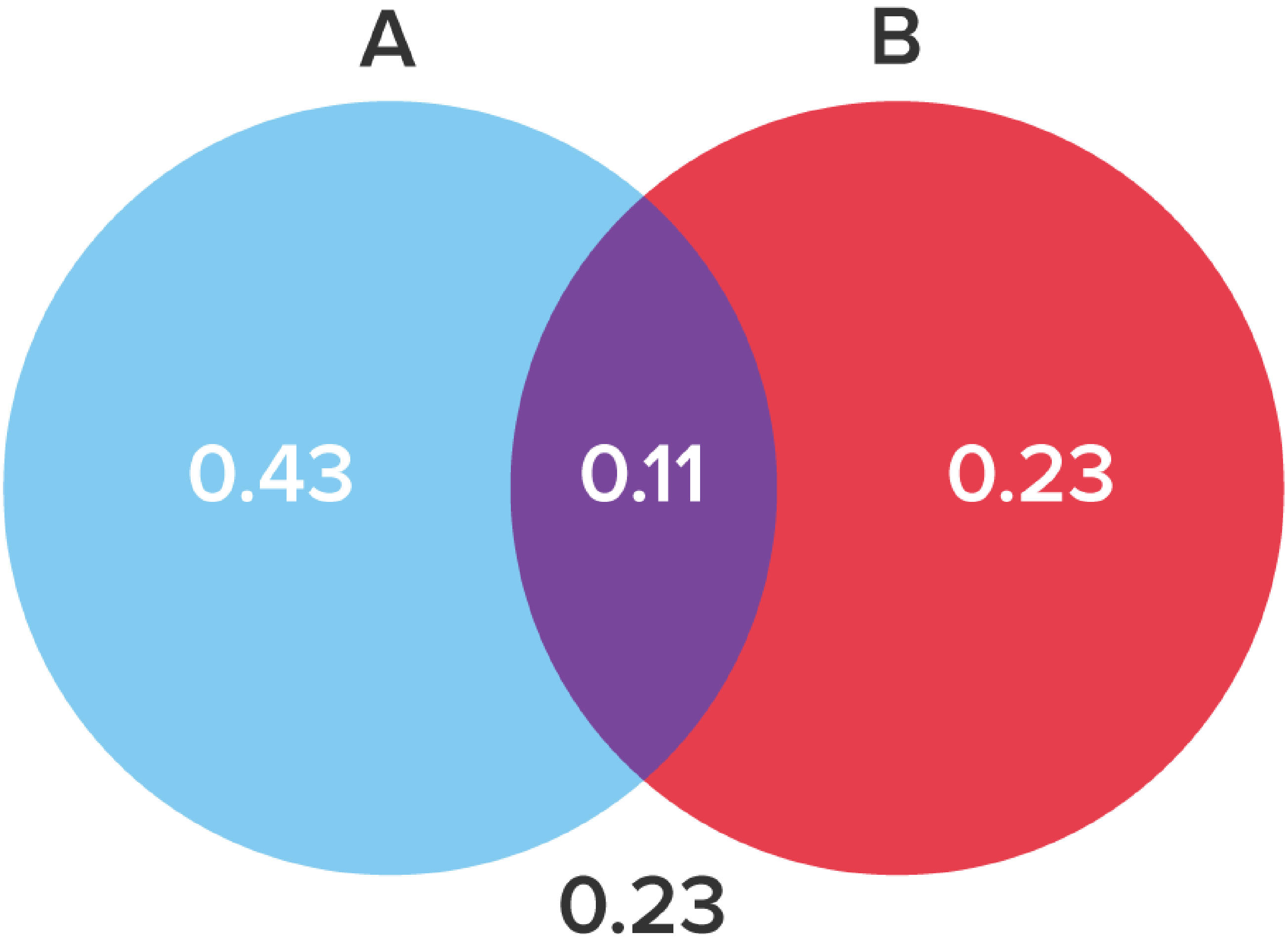
The probability that B happens is the whole circle of B, or:
$P(B) = 0.27 + 0.12 = 0.39$

The probability that A and B happens is the overlap of the Venn diagram, or:
$P(A \text{ and } B) = 0.12$

Plugging these values into the formula, we get:
$P(A \text{ or } B) = 0.42 + 0.39 - 0.12 = 0.69$

You can also note that if you simply add up all the parts, 0.30 + 0.12 + 0.27, you can also get the final result.

TRY IT



Using this Venn diagram, what is the probability that event A or event B occurs?

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To find the probability that event A or event B occurs, we can use the following formula for overlapping events:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = 0.54 + 0.34 - 0.11 = 0.77$$

The probability of event A is ALL of circle A, or 0.43 + 0.11 = 0.54.
The probability of event B is ALL of circle B, or 0.23 + 0.11 = 0.34.
The probability of event A and B is the intersection of the Venn diagram, or 0.11.

We can also simply add up all the parts 0.43 + 0.11 + 0.23 = 0.77.

2. Either/Or Probability for Overlapping Events With Two-Way Tables

Let's look at another example using a two-way table, shown below. Students in the middle school were asked about their dominant hand. Some are right-handed sixth graders, left-handed sixth graders, etc.

		Dominant Hand			
		Right	Left	Ambidextrous	
Grade	6th	99	9	2	110
	7th	90	31	0	121
	8th	93	11	3	107
		282	51	5	338

What's the probability that a student is either in eighth grade or left-handed?

The probability of eighth grade or left-handed is equal to the probability of being an eighth grader plus the probability of being a left-handed student minus the probability of both.

$$P(8 \text{ or } L) = P(8) + P(L) - P(8 \text{ and } L)$$
$$P(8 \text{ or } L) = \frac{107}{338} + \frac{51}{338} - \frac{11}{338}$$
$$P(8 \text{ or } L) = \frac{147}{338}$$

Why minus the probability of both? Because you counted the left-handed eighth graders in the eighth-grade row *and* in the left-hand column. We double counted those 11 students, and you only want to count them once. Add and subtract those probabilities as shown below, and you end up with 147/338.
The other way to approach this is by simply adding up the cells that are either left-handed or eighth grade.

		Dominant Hand			
		Right	Left	Ambidextrous	
Grade	6th	99	9	2	110
	7th	90	31	0	121
	8th	93	11	3	107
		282	51	5	338

You would add up all the left-handed sixth graders, left-handed seventh graders, left-handed eighth graders, right-handed eighth graders, and ambidextrous eighth graders. These added together equal 147 out of the total number of students, 338.

TRY IT

Dietary Preference

		Meat-Eater	Vegetarian	Vegan	
Hair Texture	Curly Hair	80	30	10	120
	Straight Hair	100	50	20	170
		180	80	30	

According to these data, what is the probability a person has curly hair or eats meat? +

$$P(Curly\ or\ Meat) = P(Curly) + P(Meat) - P(Curly\ and\ Meat)$$

$$P(Meat\ or\ Curly) = \frac{180}{290} + \frac{120}{290} - \frac{80}{290} = \frac{220}{290}\ or\ 0.76\ or\ 76\%$$

If a student is selected at random, what is the probability that the student is a girl who chose apple as her favorite fruit? Answer choices are rounded to the hundredth place.

SUMMARY

Either/or probability for overlapping events is calculated by adding the probabilities of the two events, then subtracting their joint probability. The reason you subtract out the joint probability is that it is counted in both of their individual probabilities. You don't want to count it twice; you only want it counted once. With mutually exclusive (non-overlapping) events, the joint probability is zero, and it simplifies down to the special addition rule, which is a special case of the general addition rule.

Good luck!

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TERMS TO KNOW

Either/Or Probability for Overlapping Events

The probability that either of two events occurs is equal to the sum of the probabilities of the two events, minus the joint probability of the two events happening together. Also known as the "General Addition Rule".

FORMULAS TO KNOW

Either/Or Probability for Overlapping Events

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$