

"And" vs. "Or" Probability

by Sophia



WHAT'S COVERED

This tutorial will explore the ideas of probabilities that involve the word "and" versus probabilities that involve the word "or." Our discussion breaks down as follows:

1. "And" Probability
2. "Or" Probability

1. "And" Probability

In probability, sometimes you want to find the likelihood of two events happening at the same time or the probability that two events happen consecutively. This is called **joint probability**, also referred to as **"and" probability**. It can be expressed as either "A and B", or A and B joined by an intersect symbol. Both are accepted notations.

$$A \text{ and } B = A \cap B$$

⇒ EXAMPLE On the roulette wheel, suppose we want the event black and event even.

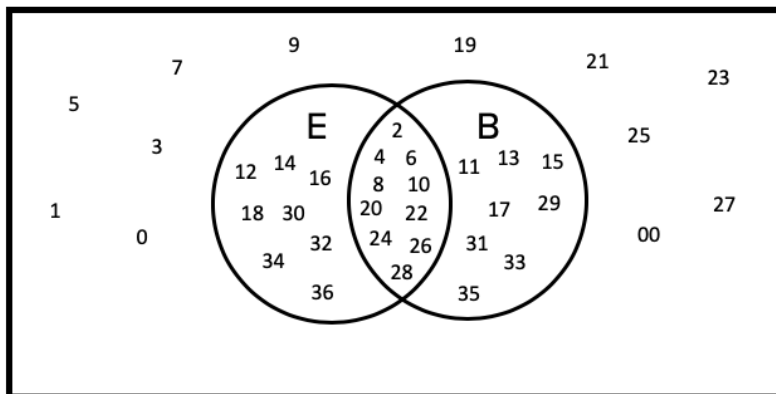


The number two is a black sector and also even. Four and six are also black and even. However, not all of the blacks are even numbers, like 29, and not all the even numbers are black, like 12. We can list them out to represent black and even, or $B \cap E$.

$$B \cap E = \{2, 4, 6, 8, 10, 20, 22, 24, 26, 28\}$$

All the other evens are red, and all the other blacks are odd.

In a Venn diagram, we can represent "and" probabilities with this middle section.



The numbers in the middle part are included in the even bubble *and* in the black bubble--they're both even and black. The other sectors fall somewhere else.

The remaining evens (12, 14, 16, 18, etc.) are all even but not black, and the remaining black numbers (11, 13, 15, 17, etc.) are black but not even.

All of the ones outside of the bubbles are either green (0 and 00) or odd and red (1, 3, 5, 7, etc.).



TERM TO KNOW

Joint Probability/"And" Probability

The probability of two events A and B both occurring.

2. "Or" Probability

There are two different ways to think of an "or" statement:

Type of "Or" Statements	Description	Example
Exclusive "Or"	Sometimes you use the word "or" to say either this, or that, but not both.	I will have chicken <i>or</i> fish for dinner. This says I'm going to have chicken for dinner, or I'll have fish for dinner, but I'm not going to eat both chicken and fish for dinner. Do you want to buy these shoes <i>or</i> those shoes?
Inclusive "Or"	This "or" would include either this, or that, or both.	I need a seven or a spade to win this poker hand. You could get a seven to win, a spade to win, <i>or</i> you could get a card that's both a seven and a spade.

Perhaps it's picture day, and you need to wear a black shirt or a button-down shirt. You might wear a button-down shirt that isn't black, a black shirt that isn't a button-down shirt, *or* you might wear a black button-down shirt.



TRY IT

Here is a between a waitress and Paul at a cafe.

Waitress: "Do you want coffee or tea, sir?"

Paul: "Coffee, please."

Waitress: "Would you like cream or sugar?"

Paul: "Both, please."

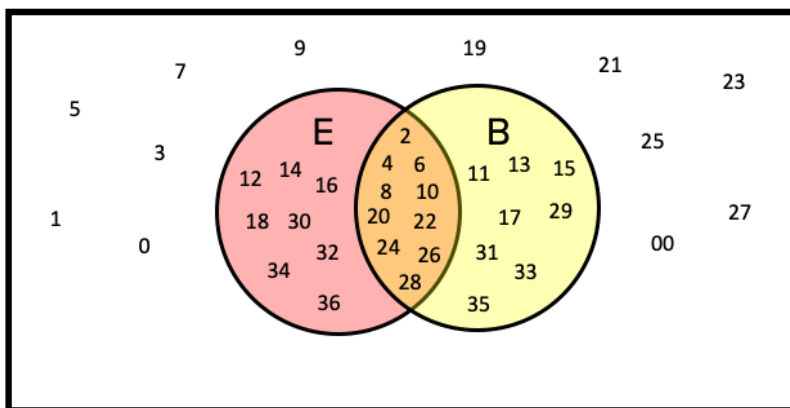
Notice the two "or's" here. Is the first "or" question inclusive or exclusive? Is the second "or" question inclusive or exclusive?

Well, the first "or" about coffee or tea was exclusive. He's not going to order both tea and coffee. So she's giving him a choice of coffee or tea, but not both.

The second "or" about cream or sugar was inclusive. You can have cream in your coffee, sugar in your coffee, *or* you can get both in your coffee.

In statistics, "**or**" **probability** will always mean the inclusive "or". When you are finding the event of A or B, this will mean either A, or B, or both. When you say even or black, you mean the ones that are black, or the ones that are even, or the ones that are both black and even.

This idea of "or" actually encompasses three regions in the Venn diagram-- the region of even only, the region of black only, and the region of both. Even only, black only, or both--all of these are in the event even or black.



For the notation, E or B, you can also use this symbol that looks like an upside down intersect symbol (and it is)-- E union B. Union means putting them together.

$$A \text{ or } B = A \cup B$$

IN CONTEXT

Students were asked, "What is the most important thing about school?", versus their school location. Are grades the most important thing? Is being popular the most important thing? Or is being good at sports the most important thing? The results are below:

		School Locations			
		Rural	Suburban	Urban	
Goal	Grades	57	87	24	168
	Popular	50	42	6	98
	Sports	42	22	5	69
		149	151	35	335

How many students are in rural schools *or* said that grades are the most important?

This will be any student who goes to a rural school, or any student who said that grades were the most important, or both.

- Grades refers to all of the students on the top row.
- Rural refers all of the students in the first column
- Both grades and rural refers to the 57--the ones that said that grades were most important *and* live in a rural area.

		School Locations			
		Rural	Suburban	Urban	
Goal	Grades	57	87	24	168
	Popular	50	42	6	98
	Sports	42	22	5	69
		149	151	35	335



TERM TO KNOW

"Or" Probability

The probability that at least one of two events, A or B, occur.



SUMMARY

"And" probability requires that both conditions be satisfied so that the outcome belongs to both of the two events A and B. The notation is the word "and," or the intersect symbol. "Or" probability requires that at least one of the events be occurring, so either A only, or B only, or both. We use the word "or," or the union symbol, and we can visualize both "and" and "or" probabilities in Venn diagrams and two-way tables.

Good luck!

Source: THIS TUTORIAL WAS AUTHORED BY JONATHAN OSTERS FOR SOPHIA LEARNING. PLEASE SEE OUR [TERMS OF USE](#).



TERMS TO KNOW

"Or" Probability

The probability that at least one of two events, A or B, occur.

Joint Probability/"And" Probability

The probability of two events A and B both occurring.