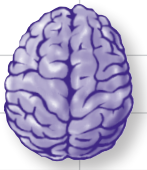
A Brain-Friendly Guide

Head First Statistics

Discover easy cures for chart failure



Make statistical concepts stick to your brain

Avoid embarrassing sampling mistakes

Improve your season average with the standard deviation

Beat the odds at Fat Dan's Casino

Find out how statistics can conceal the facts

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Dawn Griffiths

Head First Statistics

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No horses, mangos, or kung fu masters were harmed in the making of this book.

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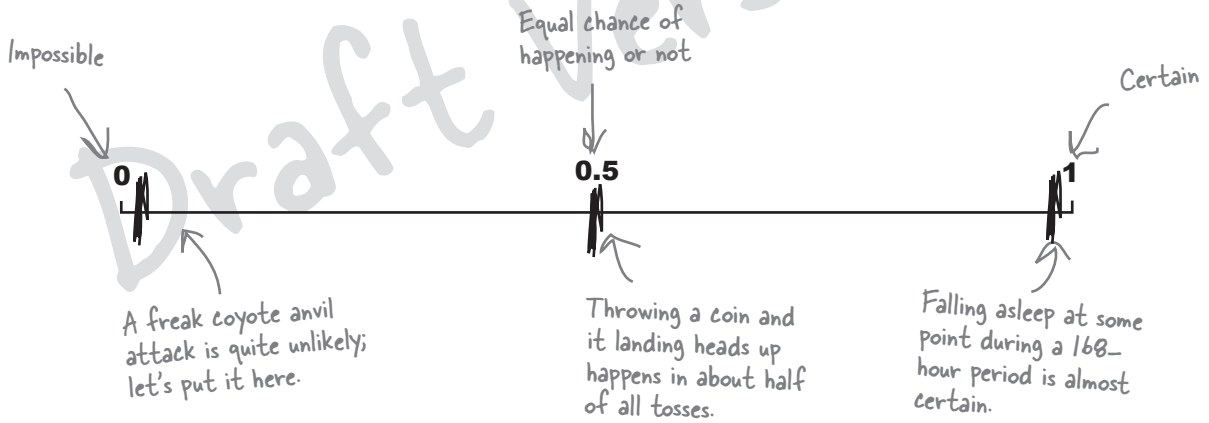
What are the chances?

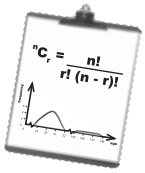
Have you ever been in a situation where you've wondered "Now, what were the chances of *that* happening?" Perhaps a friend has phoned you at the exact moment you've been thinking about them, or maybe you've won some sort of raffle or lottery.

Probability is a way of measuring the chance of something happening. You can use it to indicate how likely an occurrance is (the probability that you'll go to sleep some time this week), or how unlikely (the probability that a coyote will try to hit you with an anvil while walking through the desert). In stats-speak, an ***event*** is any occurance that has a probability attached to it—in other words, an event is any outcome where you can say how likely it is to occur.

Probability is measured on a scale of 0 to 1. If an event is impossible, it has a probability of 0. If it's an absolute certainty, then the probability is 1. A lot of the time, you'll be dealing with probabilities somewhere in between.

Here are some examples on a probability scale.





Vital Statistics

Event

An outcome or occurrance that has a probability assigned to it

Can you see how probability relates to roulette?

If you know how likely the ball is to land on a particular number or color, you have some way of judging whether or not you should place a particular bet. It's useful knowledge if you want to win at roulette.

Sharpen your pencil

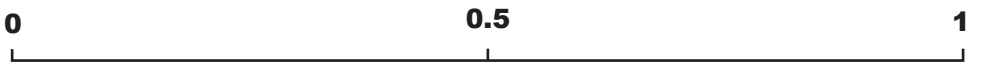
Let's try working out a probability for roulette, the probability of the ball landing on 7. We'll guide you every step of the way.

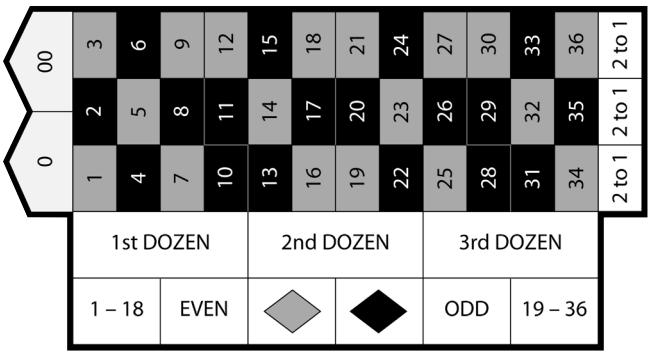
1. Look at your roulette board below. How many pockets are there for the ball to land in?

2. How many pockets are there for the number 7?

3. To work out the probability of getting a 7, take your answer to question 2 and divide it by your answer to question 1. What do you get?

4. Mark the probability on the scale below. How would you describe how likely it is that you'll get a 7?





Sharpen your pencil Solution

You had to work out a probability for roulette, the probability of the ball landing on 7. Here's how you calculate the solution, step by step.

1. Look at your roulette board. How many pockets are there for the ball to land in?

There are 38 pockets. ← Don't forget that the ball can land in 0 or 00 as well as the 36 numbers.

2. How many pockets are there for the number 7?

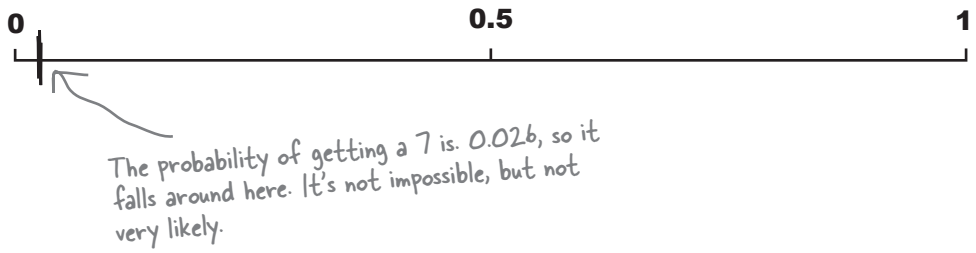
Just 1

3. To work out the probability of getting a 7, take your answer to question 2 and divide it by your answer to question 1. What do you get?

$$\text{Probability of getting 7} = \frac{1}{38}$$

$$= 0.026$$ ← Our answer to 3 decimal places

4. Mark the probability on the scale below? How would you describe how likely it is that you'll get a 7?



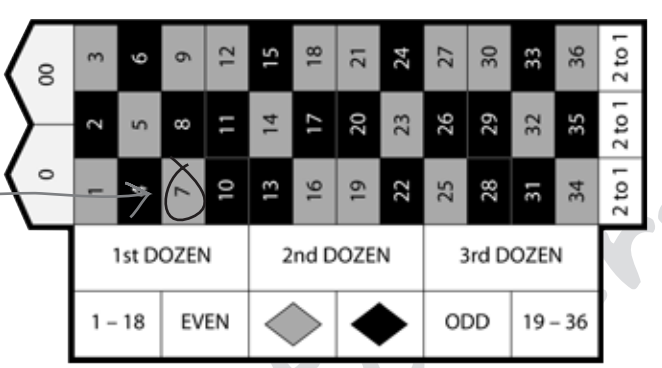
The probability of getting a 7 is. 0.026, so it falls around here. It's not impossible, but not very likely.

Find roulette probabilities

Let's take a closer look at how we calculated that probability.

Here are all the possible outcomes from spinning the roulette wheel. The thing we're really interested in is winning the bet—that is, the ball landing on a 7.

There's just one event we're really interested in: the probability of the ball landing on a 7.



These are all possible outcomes, as the ball could land in any of these pockets.

To find the probability of winning, we take the number of ways of winning the bet and divide by the number of possible outcomes like this:

$$\text{Probability} = \frac{\text{number of ways of winning}}{\text{number of possible outcomes}}$$

There's one way of getting a 7, and there are 38 pockets.

We can write this in a more general way, too. For the probability of any event A:

$$P(A) = \frac{n(A)}{n(S)}$$

Probability of event A occuring

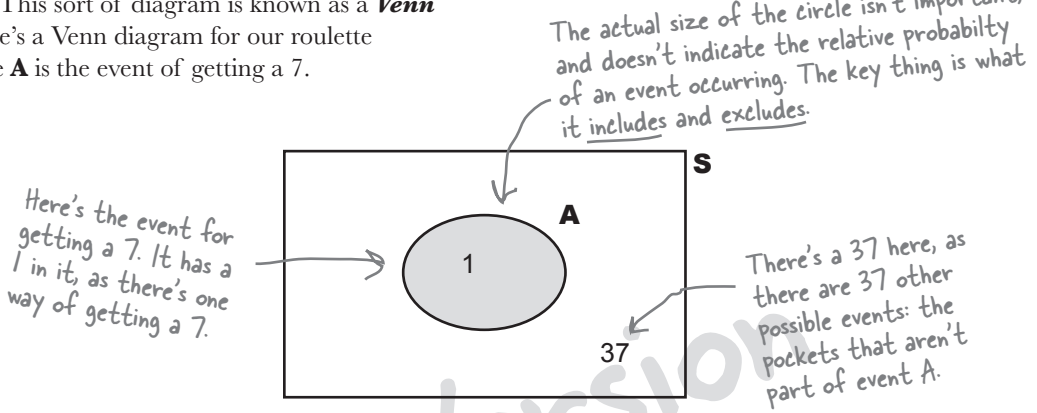
Number of ways of getting an event A

The number of possible outcomes

S is known as the ***possibility space***, or ***sample space***. It's a shorthand way of referring to all of the possible outcomes. Possible events are all subsets of S.

You can visualize probabilities with a Venn diagram

Probabilities can quickly get complicated, so it's often very useful to have some way of visualizing them. One way of doing so is to draw a box representing the possibility space **S**, and then draw circles for each relevant event. This sort of diagram is known as a ***Venn diagram***. Here's a Venn diagram for our roulette problem, where **A** is the event of getting a 7.



Very often, the numbers themselves aren't shown on the Venn diagram. Instead of numbers, you have the option of using the actual probabilities of each event in the diagram. It all depends on what kind of information you need to help you solve the problem.

Complementary events

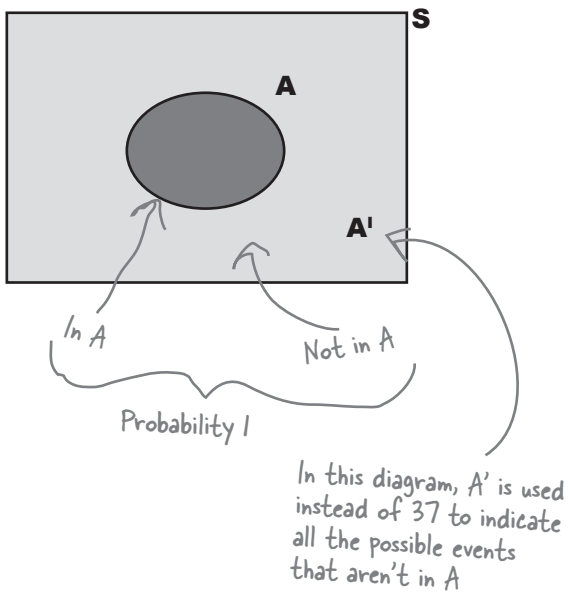
There's a shorthand way of indicating the event that A does not occur—A^{I}. A^{I} is known as the ***complementary*** event of A.

There's a clever way of calculating $P(A^{I})$. A^{I} cover every possibility that's not in event A, so between them, A and A^{I} must cover every eventuality. If something's in A, it can't be in A^{I}, and if something's not in A, it must be in A^{I}. This means that if you add P(A) and $P(A^{I})$ together, you get 1. In other words, there's a 100% chance that something will be in either A or A^{I}. This gives us

$$P(A) + P(A^{I}) = 1$$

or

$$\mathbf{P(A^{I}) = 1 - P(A)}$$



BE the croupier

Your job is to imagine you're the croupier and work out the probabilities of various events. For each event below, write down the probability of a successful outcome.

P(9)

P(Green)

P(Black)

P(38)

BE the croupier Solution

Your job was to imagine you're the croupier and work out the probabilities of various events. For each event you should have written down the probability of a successful outcome.

P(9)

The probability of getting a 9 is exactly the same as getting a 7, as there's an equal chance of the ball falling into each pocket.

$$\text{Probability} = \frac{1}{38}$$

$$= 0.026 \text{ (to 3 decimal places)}$$

P(Green)

2 of the pockets are green, and there are 38 pockets total, so:

$$\text{Probability} = \frac{2}{38}$$

$$= 0.053 \text{ (to 3 decimal places)}$$

P(Black)

18 of the pockets are black and there are 38 pockets, so:

$$\text{Probability} = \frac{18}{38}$$

$$= 0.474 \text{ (to 3 decimal places)}$$

P(38)

This event is actually impossible—there is no pocket labeled 38. The probability is therefore 0

The most likely event out of all these is that the ball will land in a black pocket.