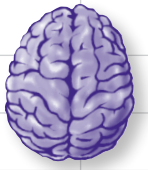
A Brain-Friendly Guide

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

O'REILLY®

Dawn Griffiths

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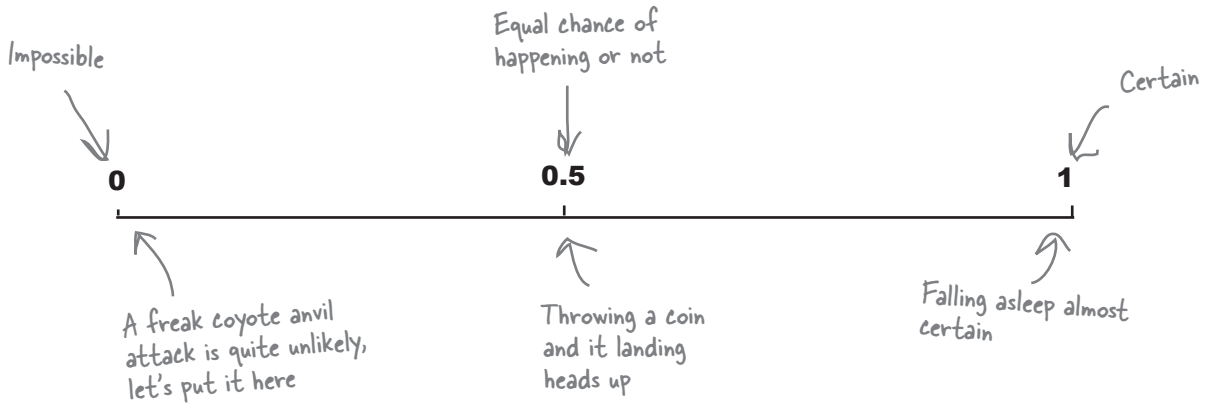
What are the chances?

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 prize draw or lottery.

Probability is a way of measuring likelihood. You can use it to indicate how likely an event 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).

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.



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

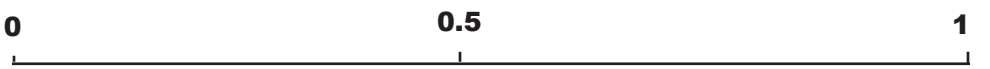
Let's have a go at working out a probability for roulette, the probability of the ball landing on 7. We'll guide you every step of the way.

1. Look at your roulette board. 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 the likelihood of getting a 7?



Sharpen your pencil Solution

It's time to have a go at calculating the probability of an event. Let's work out the probability of the ball landing on 7.

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?

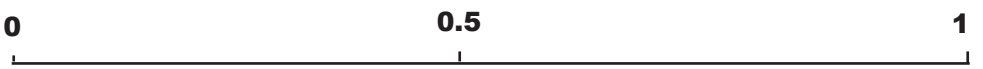
Just 1

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?

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

= 0.026 (to 3 decimal places)

4. Mark the probability on the scale below? How would you describe the likelihood of getting a 7?



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

Finding 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 i.e. the ball landing on a 7.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
0	00				

There's just one event we're really interested in, we want 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 1 way of getting a 7, and there are 38 pockets

We can write this in a more general way too.

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

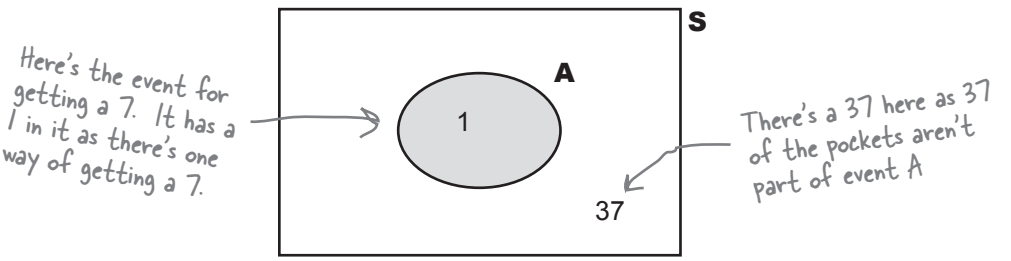
Number of ways of getting an event A

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.

Visualizing probabilities

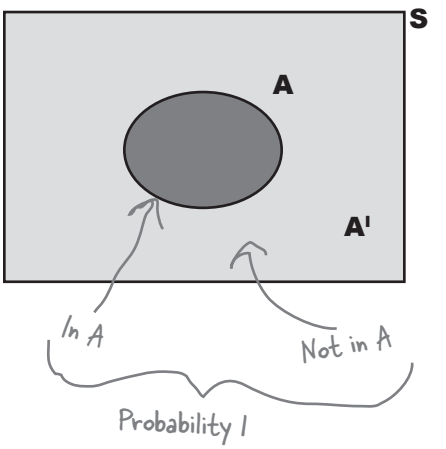
It's sometimes useful if you have some way of visualizing them. One way of doing this is to draw a box representing the possibility space S, and then to draw circles for each relevant event. This sort of diagram is known as a ***Venn diagram***. Here's a Venn diagram for our roulette problem, where A is the event of getting a 7.



Very often, the numbers themselves aren't shown on the Venn diagram - it all depends how much 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.

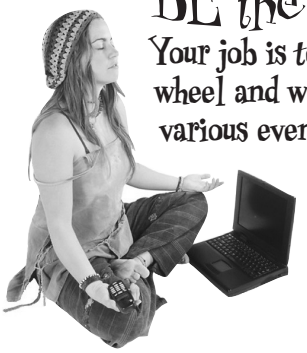


There's a clever way of calculating $P(A^{I})$. The probability of an absolutely certain event is 1, and it's certain that any outcome will either be in A or A^{I}. This means that

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

or

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



BE the roulette wheel

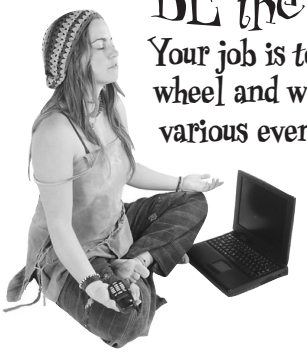
Your job is to play like you're the roulette wheel and work out the probabilities of various events. For each event below, write down the probability of a successful outcome. Which of these events is the most likely to happen?

P(9)

P(Green)

P(Black)

P(38)



BE the roulette wheel

Your job is to play like you're the roulette wheel and work out the probabilities of various events. For each event below, write 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. To find the probability

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

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

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 labelled 38. The probability is therefore 0

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