

Heads or tails? A mathematician breaks down the odds

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A paddle used to hold coins during a game of two-up. Credit: Shutterstock

With punters preparing to mark Anzac Day with a game of two-up, a mathematician from The Australian National University (ANU) has revealed some of the game's statistical secrets.

The traditional Australian game involves a "spinner" throwing coins in the air, while players bet on whether the coins will land on heads or tails.

Associate Professor Dale Roberts says something as simple as flipping a coin can have a "surprising amount" of mathematical depth to it.

"People have been studying the mathematics of probability theory for hundreds of years," he said.

"What makes two-up interesting is you're usually not just flipping one coin, you're flipping two or three. Suddenly it is a lot more complex.

"For example, if you're looking at the average number of flips for four 'heads' in a row to appear, it takes around 30 flips for that to happen with just one coin. With two-up you're looking at more like 340 flips for it to occur, if you take into account the flips that fall on 'Odds.'

"So, if you're at the pub waiting for someone to toss four heads in a row, you might be waiting all afternoon. This is the reason why three coins are sometimes used—it removes the redundant throws. As a [mathematician](#), you start to wonder if this changes the odds, or how would you design the game if you flipped five [coins](#) at a go or 100 and so forth."

A lot of players go into a [game](#) of two-up with a clear strategy, but according to Associate Professor Roberts people can often be little too eager to see patterns in the data.

"Some people get a feeling they are on a run. It's not unlike a basketballer who starts hitting three-pointers and is said to have hot hands. But statistically, with [coin](#) flips, each flip is independent of the last one," he said.

"People might think after a run of heads they've overdue for a pair of tails, but that's not how it works."

Unsurprisingly, a question that comes up frequently when two-up is involved is how to avoid going bankrupt.

It turns out math might have the answer.

"There is what's called the Martingale strategy, where you double your bet with every loss—so if you play \$5 first up and don't win, you double your bet to \$10, and so on," Associate Professor Roberts said.

"You might expect to eventually break even this way, but there's a high chance you'll go bust first.

"Mathematically, if you're betting on a 50-50 outcome such as a heads or tails, the best bet is to not bet at all.

"However, if the odds are not 50-50, which may occur if you are repeatedly making more exotic side bets such as two heads in a row, then a smart strategy might be to bet half your money each time you bet. If you had \$50 to spend, you'd bet \$25 first up.

"Of course, there's still always a risk you'll go bust, but it's statistically more likely to pay off."

Provided by Australian National University

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