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Can you beat the system?

GambleAware

NSW GOVERNMENT

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Activity introduction

Quick summary

Betting systems have existed since around the 17th or 18th centuries. They are a set of rules that determine how much, and on what, you should bet to maximise your winnings at any particular game. They may be very simple rules such as ‘never split tens’ and ‘always split aces’ when playing blackjack. Or they may be so complex that they fill an entire book.

In fact, one of the very first systems was invented by a casino owner, to instruct gamblers how to never lose at the roulette wheel.

Why would a casino owner, of all people, encourage gamblers to bet with a supposedly certain system?

Such systems, and the sunk cost fallacy of continuing to gamble to win back losses rather than walking away, can lead to people gambling more than they can afford to lose.

In this lesson, students will calculate the average expected value of losses on a roulette wheel over time, and use these values to analyse the cost of gambling on these games. They will also study the flaws inherent in betting systems to determine whether these systems are weighted in the favour of game operators making a profit. Finally, students will use these learnings to reflect on gambling behaviour and whether they can be used to determine how much people can afford to risk on gambling.

Learning intentions

Students will:

- understand how systems cannot be used to consistently win money.

Syllabus outcomes

- **MAO-WM-01** develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly
- **MA4-PRO-C-01** solves problems involving the probabilities of simple chance experiments
- **MA4-FRC-C-01** represents and operates with fractions, decimals and percentages to solve problems
- **MA4-RAT-C-01** solves problems involving ratios and rates, and analyses distance-time graphs.

The identified Life Skills outcomes that relate to this activity are **MALS-LAN-01** recognises language that represents number, **MALS-LAN-02** responds to and uses language that represents number, **MALS-FRC-01** demonstrates knowledge of fractions in everyday contexts, **MALS-PRO-01** applies chance and probability to everyday events, **MALS-FIN-01** demonstrates knowledge of money in everyday contexts, and **MALS-FIN-02** plans and manages personal finances.

Capabilities and priorities

Numeracy
Critical and creative thinking
Ethical understanding

Topic
Gambling probability

Unit of work
Mathematics Stage 4

Time required
40 minutes

Level of teacher scaffolding
High - Students will require strong scaffolding through the explicit instruction on calculating probabilities, but will be able to perform the tasks independently.

Resources required

- Appendix A: Roulette returns table
- Whiteboard

Keywords
Gambling, betting, sports, casino, money, wellbeing, gaming.

Teacher worksheet

Teacher preparation

Gambling can be a high-risk activity and is a priority concern for young people. Therefore, before conducting the lesson on gambling, it is recommended that teachers read the Facilitator Pack. The pack provides teachers and parents with essential information about gambling harm amongst young people and clarifies the nature of gambling-related behaviours and how to approach sensitive topics.

Learning intentions

Students will:

- understand how systems cannot be used to consistently win money.

Success criteria

Students can:

- analyse betting systems and find their flaws.

Teaching sequence

15 minutes - Part A: What happens at a roulette table?

15 minutes - Part B: Can you beat the wheel?

10 minutes - Reflection

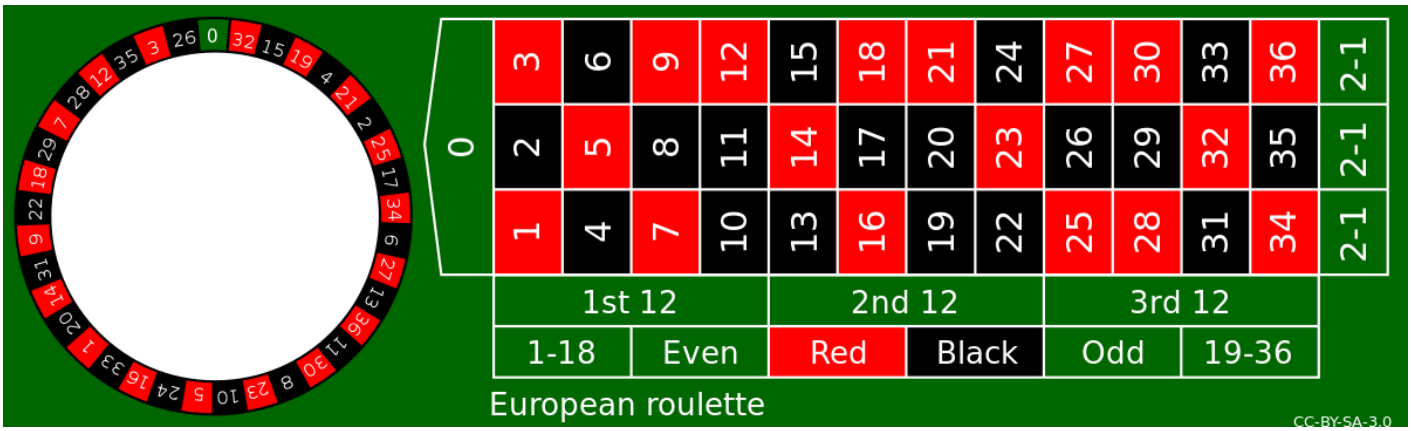
Part A: What happens at a roulette table?

Work through this resource material in the following sequence:

Step 1

Ask your class if any of them are familiar with roulette wheels.

- What do you know about them?
- Where have you seen them?
- How do they work?
- How do you win or lose on them?
- Do they require skill or luck to win at?



(Source: https://commons.wikimedia.org/wiki/File:European_roulette.svg*)*

Step 2

Explain to your students how the game is played in a casino, using the following information:

A roulette wheel is a large, wooden wheel with 37 spaces around the circumference, numbered zero to 36. Numbers 1 to 36 are evenly divided between red and black, while the zero is green. (This applies to European wheels, which we use in Australia. American wheels also include a double-zero space, which make the odds significantly worse for the player). The wheel is spun and a croupier throws a ball which spins around the edge of the wheel, finally landing in one of the 37 spaces.

Players bet on where the ball will land. Betting options include:

- *red/black*
- *odd/even*
- *high/low*
- *1-12 / 13-24 / 25-36*
- *all numbers within the same:*
  - *row*
  - *column*
  - *pair*
  - *group of four*
- *a single number.*

Independently, students calculate the probability of spinning the wheel and having it land on a red number. You can use the roulette image to help them.

There are 37 outcomes in total, and 18 red spaces.

$$P(\text{red}) = \frac{\text{Number of red spaces}}{\text{Number of spaces}} = \frac{18}{37} = 0.4865$$

Step 3

Using the fact that the sum of all probabilities must be 1, calculate the probability of **not** landing on a red space (**Note:** this is different to the probability of landing on black!):

$$P(\text{not red}) = 1 - \frac{18}{37} = \frac{19}{37} = 0.5135$$

Step 4

Finally, students convert these probabilities to percentages, as sometimes that helps to understand the situation better:

$$P \text{ (landing on red):} \ 0.4865 \times 100\% = 48.65\%$$

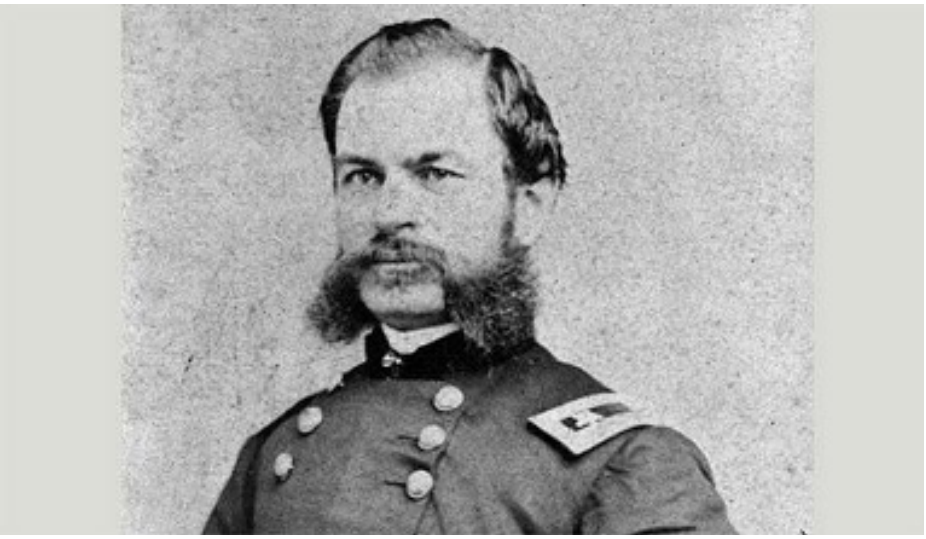
$$P \text{ (not landing on red):} \ 0.5135 \times 100\% = 51.35\%$$

Part B:
Can you beat the wheel?

Step 1

Explain to students that 'betting systems' have existed since around the 17th or 18th centuries. They are a set of rules that determines how much, and on what, you should bet to maximise your winnings at any particular game. They may be very simple rules such as 'never split tens' and 'always split aces' when playing blackjack. Or they may be so complex that they fill an entire book.

One of the most popular and persistent of these is the Martingale System.



(Source: roulletteguide.online/martingale-strategie/ *)*

In the 1900s, a man called John Henry Martingale owned a casino in London. He had heard of a betting system designed for roulette and, having an excellent grasp of mathematics and human behaviour, realised it was perfect. It was easy to follow, looked too good to be true, and would make him a fortune. Being also somewhat unscrupulous, Martingale encouraged his loyal customers to follow this system. So much so that it is now named after him.

Here are the rules:

1. Double your bet whenever you lose.
2. Return to betting the minimum whenever you win.

That's it. The idea is that by doubling your bet after a loss, a win will recoup it all.

This system is based on the assumption that red has a 50% chance of being spun on a roulette wheel, as does black, and that the law of averages means that eventually the balance of red and black results will be equal over time.

Optional: Watch a demonstration using blackjack and sugar cubes.

Step 2

As a class, let's test Martingale's system:

- We place a bet of $20 on red at a roulette wheel at 2:1 odds.
- We lose.
- Rule 1: Double your bet.
- We bet $40 on red.
- We lose.
- We bet $80 on red.
- We win!
- As we have just won a bet we start again with a $20 bet.

Our profit loss statement looks like this:

Bet	Overall Profit / Loss	Result	Overall Profit / Loss
$20	- $20	Lose $20	- $20
$40	- $60	Lose $40	- $20
$80	- $140	Win $160	+ $20

Step 3

Ask students:

- Why would a casino owner encourage people to use this system, if it seems to win all the time?
- What real-life factors prevent it from actually working?

There are a number of factors which ensure the casino doesn't lose on this system:

- Red/black isn't a 50/50 bet, because of the green 0.
- Casinos have limits on your maximum bet.
- Once you run out of money, you can't double your bet anymore to try and win it back.
- Gamblers might lose their nerve when asked to bet potentially $340 on one spin!

This system would only work if the green zero didn't exist on a roulette wheel, you could bet infinitely large sums of money, and you had access to infinite amounts of money, and if you kept following the system, even after 10 losses in a row.

Step 4

Independently, students run through another simulation, with a few rules in place:

- the roulette wheel has a minimum bet of $10
- the roulette wheel has a maximum bet of $150

In this case we will see what happens if you lose five times in a row (around 60% likely to occur in one hour of play)

This table is available in Appendix B for student use, with the answers provided for your convenience.

Bet	Overall Profit / Loss	Result	Overall Profit / Loss
$10	- $10	Lose $10	- $10
$20	- $30	Lose $20	- $30
$40	- $70	Lose $40	- $70
$80	- $150	Lose $80	- $150
$150	- $300	Lose $150	- $300

Explain to your class that once we reach this point, there is no way of recouping our losses from a single bet.

$150	- $450	Win $300	- $150

Which makes this a potentially risky gamble, as we're not guaranteed to make back our bet, like Mr Martingale promised...

Explain to your class that casinos essentially have unlimited money. If the table you are playing on runs out of chips, they just bring in more.

If you run out of chips, you either go home or have to withdraw more from your bank. Either way you could be looking at a massive loss.

Step 5

Explain to your class that behavioural economics has a concept known as the *sunk cost fallacy*. This is where you continue to invest in an activity or behaviour based on what you have *previously* lost.

The thought process goes like this:

'I've already spent thousands of dollars on my antique thimble collection. I'm no longer interested but it would be a waste of money to stop now.'

When gambling it is very difficult to stand up and walk away when you have lost a significant amount. Imagine that you have lost $500 at a blackjack table. You could (and should) remove yourself from the casino and go home so that you don't risk losing more. However, this can be very difficult in reality. There is an enormous temptation to think 'I should keep playing at least until I have won my money back.' Of course, the longer you play, the more you stand to lose - as our expected value table in Part A proved. You will most likely wind up losing even more money in an attempt to break even.

As a class, have a class discussion about the sunk cost fallacy.

- Can students think of any examples (real or otherwise) where the best but hardest thing to do is to quit?

Reflection

Independently, students write down a paragraph or two about what they have learned in this lesson.

Prompt their thinking by asking:

- Given how a roulette wheel works, do they think that other casino games operate in the same way?
- In Part A we saw that you could be expected to lose $15 an hour when betting $10 on red each spin. Is this an acceptable loss? Do you think this is a reasonable amount to pay for an hour of roulette?
- Do you think you could limit yourself to one hour, or to only playing with a small sum of money and still be able to walk away after losing it all?

Teacher reflection

Take this opportunity to reflect on your own teaching:

What did you learn about your teaching today?

What worked well?

What didn't work so well?

What would you share?

Where to next?

How are you going to get there?

Appendix A: Roulette returns table

Bet	Overall Profit / Loss	Result	Overall Profit / Loss
		Lose	
		Lose	
		Lose	
		Lose	
		Lose	
		Win	