7

Two-up – The fairest game of all?

GambleAware

NSW
GOVERNMENT

Activity introduction

Quick summary

The game of Two-up is believed to have been played on the goldfields, but was cemented into 'Aussie' folklore by the soldiers during the first and second world wars.

The appeal of the game is that it is simple, fair and requires almost no specialised equipment.

Casinos have created an in-house version where the odds have been organised so the operator makes a profit.

In this lesson, students look at the history and mathematics of the game, exploring why it is considered such a fair game, and how the 'boxer' or game runner makes a profit.

Learning intentions

Students will:

- understand that the operator of the game arranges the odds so that the operator will make a profit.

21st-century skills

Critical thinking

Cultural understanding

Digital literacy

Ethical behaviour

Problem solving

Syllabus outcomes

Mathematics Standard (Year 11)

- **MS11-8** solves probability problems involving multistage events.

Stage 6 Mathematics Syllabus Statements

Students develop awareness of the applicability of algebra in their approach to everyday life. Students analyse different financial situations, to calculate the best options for given circumstances, and solve financial problems. They develop the ability to make informed financial decisions, to be aware of the consequences of such decisions, and to manage personal financial resources effectively. Students develop an ability to justify various types of financial decisions which will affect their life now and into the future.

Knowledge of statistical analysis enables the careful interpretation of situations and raises awareness of contributing factors. Study of statistics is important in developing students' understanding of the contribution that statistical thinking makes to decision-making in society and in the professional and personal lives of individuals.

Topic
Probability

Unit of work
Mathematics Stage 6

Time required
55 minutes

Level of teacher scaffolding
Low.

Resources required

- Article - Anzac 100: The mathematics behind two-up - physical or digital copies – one per student

- Device capable of showing a video to the class

- Individual devices capable of accessing the internet – one per student (optional)

- Geobra simulator

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

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 and parents 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.

The game of Two-up is important in Australian folklore. Casinos have created an inhouse version where the odds have been organised so the operator makes a profit.

The intention of the lesson is to look at the history and mathematics of the game but **not to play** a simulation. Because Two-up is so easily replicable in the school yard, please ensure you do not encourage students towards this game in an unregulated environment.

Teacher content information

Before computers were available to handle large calculations instantaneously, the chances of an event were often expressed in the form of odds.

Odds of 10:1 means the operator puts $10 into the pool and the gambler puts in $1. The winner takes the $11 total. A bookmaker, or more recently gambling company, would offer this sort of odds on an event they believe is unlikely to occur so they offer generous odds in the hope of attracting extra bets on an unlikely event.

Odds of 6:4 means the operator puts $6 into the pool and the gambler puts in $4. The winner takes the $10 total. The bookmaker offers this sort of odds on an event they believe is quite possible to happen. The small odds discourage more bets and at the same time reduce the payout on each winning bet.

Odds of 1:2 means the operator puts $1 into the pool and the gambler puts in $2. The winner takes the $3 total. The bookmaker offers these short odds on events they believe are almost certain to happen. The short odds discourage more bets and at the same time reduce the payout on each winning bet.

The probability of tossing HH is ¼ but the odds are 3:1. (3 + 1 = 4)

With the advent of quick calculations prizes are now more usually quoted as a return on a $1 investment. The lower the price the more likely the event is to happen.

e.g. a $1.50 chance is more likely than a $5 chance.

Calculating the equivalent odds.

$1.50 is 50 cents from the operator and $1 from the gambler. Divide both by 50 cents to get them in the same unit gives 1:2 odds.

$5 is $4 from the operator and $1 from the gambler. 4:1 odds.

When the chance of an event is referred to as "odds on", it means the operator is risking less money than the gambler.

Learning intentions

Students will:

- understand that the operator of the game arranges the odds so that the operator will make a profit.

Success criteria

Students can:

- explain the history of Two-up as a game and its importance to Australia's war veterans

- calculate the fair payouts for each outcome of Two-up

- explain how the operator has arranged the odds of Two-up to give themselves a profit in the casino version.

Teaching sequence

15 minutes - Part A: Introduction to Two-up

10 minutes - Part B: Calculating the odds and profit

10 minutes - Part C: Not a simulation

10 minutes - Part D: The casino version

5 minutes - Part E: Reflection

Part A:
Introduction to Two-up

Work through this resource material in the following sequence:

Step 1

This iconic Australian gambling game was first recorded in 1854. Two-up is believed to have been played on the goldfields, but was cemented into 'Aussie' folklore by the soldiers during the first and second world wars.

The appeal of the game is that it is simple, fair and requires almost no specialised equipment.

In 1989, the NSW government passed the *Gaming and Betting (Amendment Act) 1989*, which declared that playing Two-up on Anzac Day was not illegal in NSW.

Today Two-up games can legally be conducted in NSW on Victory in the Pacific Day (August 15) and Remembrance Day (11 November) but only after midday[1]. It can also be played in Broken Hill at any time of the year.

Step 2

Watch: TWO-UP on ANZAC DAY la tradicion Australiana que solamente este día es legal jugarlo

Link: youtube.com/watch?v=753EgJcl6Go

Step 3

Direct students to read more about the history of Two-Up within the armed forces and eyewitness accounts of it being played during active service.

Link: https://www.smh.com.au/national/anzac-100-the-mathematics-behind-twoup-20150414-1mkygh.html

Alternatively, you can explain the game below:

Rules:

• 2 coins are tossed at the same time.

• People bet on the result - whether they will come up as 2 heads or 2 tails.

• If 1 of each is tossed, then the coins are tossed again.

Two-up has its own set of language to describe the equipment and the various participants.

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[1] Source: liquorandgaming.nsw.gov.au/__data/assets/pdf_file/0007/858562/fs3098-two-up-factsheet.pdf

Part A: Introduction to Two-up

Equipment:

2 coins: the heads and tails sides are clearly marked so the result of tossing the coins can be clearly seen by all and there is no dispute about the result.

Kip: a piece of wood on which the coins are placed for spinning. Using the kip takes out the possibility of someone substituting the coins or tossing them in a way to influence the result.

Image from: diggerhistory.info/pages-asstd/two_up.htm

Ring: the area in which the coins must land. All those betting must remain outside the ring. Note the ring is not always circular, it depends upon the location of the game.

People

School: everybody participating in the game is known collectively as the school. A particular game is referred to as a Two-up School.

Boxer: is the owner of the game.

Ringer: is the organiser of the activity.

Spinner: the person whose job it is to toss the coins at least 3m into the air using the KIP.

Cockatoo: not an official part of the game but used when played illegally. Their job was to stand outside and watch for police. They warn the players so they can disperse before the police arrive.

The Rules

In the first game of the night the Ringer (organiser) invites a member of the crowd to be the Spinner (person who tosses the coins).

The Ringer places the two coins tails up on the kip and passes it to the Spinner.

An iconic Australian expression is "Come in Spinner". This is the call from the Ringer after all bets are made and the Ringer is ready for the coins to be tossed. No further bets can be made after the call.

The Spinner must toss the coins at least 3m in the air and the coins must land inside the ring.

Tossing 2 heads is a winner.

Tossing 2 tails is a loser.

Tossing 1 of each means you toss again. (This is just to build the tension. More recently 3 coins have been tossed to speed the game up as there is always a result. A win is a majority heads and a loss is a majority tails).

The same spinner stays tossing the coins until they lose. The kip is passed onto the next person in the ring in a clockwise direction.

The betting

There are 2 sets of gambling taking place at the same time within each individual game.

The Spinner must place a bet on heads which can be matched by any other player (or players, if the bet is too large for one person). Other spectators bet amongst themselves.

Spinner v Boxer

The Spinner is betting against anyone who wants to match their bet but when the Spinner wins the Boxer (owner of the game) takes out a 10% commission. The spectators covering the spinners bet do not pay any commission if they win. This is the only way the Boxer makes any money from the game. The Spinner therefore is at a slight disadvantage compared to the spectators who do not have to pay any percentage to the Boxer. However, being a successful Spinner gains a lot of attention and positive feedback, especially from the winners, so is seen as quite rewarding. After 3 wins the Spinner may choose to "toss the kip", which means to give up the role of spinner, and take their winnings, less 10% for the Boxer of course.

In the normal run of things, after the Spinner has lost, the roll of Spinner rotates around the ring in a clockwise direction so that everyone takes their turn at being slightly disadvantaged.

Spectator betting

A spectator wanting to bet on tails holds their bet, in cash, above their head until another spectator matches the bet. The money is placed in front of the tails better and taken by whichever of them ends up winning. It is a straight even bet with both gamblers risking the same amount of money. No-one is taking a cut of the pool, and 100% of bets are returned to the gamblers, who both have an equal chance.

Step 4

Discuss:

- **Why was Two-up such a popular game?**
  No special equipment is required and it can be played anywhere.

- **Why is Two-up known as a very fair game?**
  In bets between spectators, they both have an equal chance of winning.
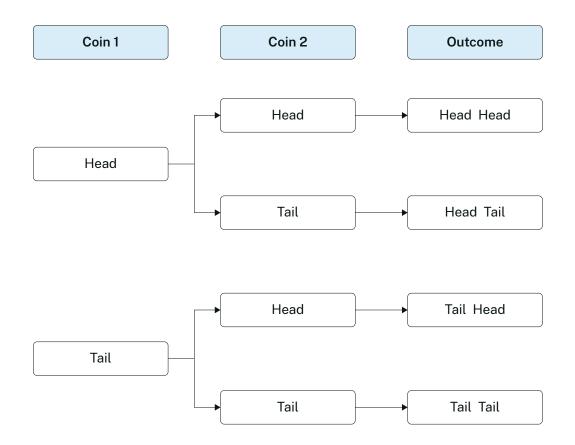
Part B: Calculating the odds and profit

Step 1

Discuss the chance of the spinner winning by tossing 2 heads on the first toss?

Step 2

The 3 possible outcomes (i.e. the sample space) are 2 heads, 2 tails or 1 of each. Some students think that this makes the probability of winning 1 in 3 but in this case not each outcome is equally likely.

Step 3

Independently, students produce a tree diagram to demonstrate all possible outcomes. There are 4 outcomes, only one of which is HH, so the chances of winning on the first toss is 1 in 4.

Coin 1	Coin 2	Outcome

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                    Head ──────────► Head  Head
Head ──┐
       └────────────
                    Tail ──────────► Head  Tail


                    Head ──────────► Tail  Head
Tail ──┐
       └────────────
                    Tail ──────────► Tail  Tail
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Teacher note: See the teacher content information above for information on how to express these odds.

Step 4

Discuss the chance of the spinner winning by tossing 2 heads before tossing 2 tails?

Step 5

Keep in mind that a sequence such as HT, TH, HT, HH is still a win. The first 3 throws here just mean the spinner must toss again.

Since the TH or HT outcomes only prolong the event but do not affect who wins the only two outcomes of interest are the HH and the TT. Each is equally likely, so the chance of winning is 1 in 2 of tossing a HH before a TT.

Step 6

Remind students that the Boxer, owner of the game, only makes money by taking 10% of any winnings the Spinners make.

If we assume that each round (a single throw before any respins) takes 1 minute to complete and the spinner bets $10 per round, what would be the expected profit for the Boxer per hour?

Independently, students work on this calculation.

Step 7

With those assumptions there will be 60 games played in the hour.

Using the known odds, In the long run, *60 × ¼ = 15* will result in HH and a win.

$$15 \times \$10 \times 10\% = \$15 \text{ per hour}$$

$15 an hour is not a great return for owning the game as the Boxer would need to provide a venue and pay the Ringer and Cockatoo. Often players will give the Boxer a "sling", which is a tip, from their winnings at the end of the session. This is another reason Two-up is seen as a fair game.

Part C:
Not a simulation

Important: The attraction of Two-up lies in the simple equipment required and the ease of playing. There is no complicated mathematics to calculate the odds or commission and all bets are equal odds between two people. In the short term with an enthusiastic group, it can be fun.

As a teacher you need to remember that all forms of gambling are illegal for minors. The very things that made Two-up popular on the battlefield may have the same effect on your students. It is not out of the question that a student may decide to run their own Two-up game at break time, after learning the rules and how to in your class. Consequently, you would be held responsible for this.

You may be tempted to run a simulation using a Ringer, Spinner, real coins with each student allocated a pile of imaginary tokens to bet with. It sounds like fun and probably will be, however ask yourself if you want to be responsible for Two-up starting amongst the students because of your lesson.

Step 1

An alternative to a simulation is to use the Geobra simulator which can be used to simulate the results of a game by showing the total number of heads produced when 2 coins are tossed.

Step 2

Choose 2 coins, and set the Pr (H) = 0.5, then press reset.

Step 3

You can choose 1 or 10 flips multiple times, or you can hit the white button and the simulation will run automatically until you hit the pause button.

Again, do not have students simulating betting on the outcomes. The intention is to show them that the probability we calculated in the last section will work out in the trials.

The larger the number of trials the more the probability approaches the theoretical answers. Generating 120 flips to start with will give you a nice data spread (equivalent to 2 hours playing).

Step 4

Discuss:

In your simulation which of the following groups would have ended up winning?

- the Boxer
- the Spinner
- someone always betting on heads
- someone always betting on tails
- someone who changed bets between heads and tails as the game progressed

Step 5

Explain that the Boxer makes a profit, because he never gambles his own money but sometimes wins his commission from the spinner. However, they do not make much - only 10% of the Spinner's winnings.

Depending upon the results of the simulation, if more heads have come out then those betting heads would win. If more tails have come out then those betting tails would win. But the chances of either group winning exactly the same amount is the most likely option and in the long run both groups are expected to come out with no net win or loss.

Changing your bet each time does not affect the probability of winning, as both HH and TT have the same likelihood of occurring so in the long run this strategy would also result in no net win or loss.

Part D:
The casino take on Two-up

Step 1

Explain to students that at any given time Two-up may be available in some Australian casinos.

As it is basically a fair game, they have introduced new rules and types of bets that tip the odds in their favour.

All bets must be made with the casino. There are no side bets between players allowed.

Step 2

One of the bets on offer is to bet on 5 splits (one head and one tail) in a row.

This pays odds of 25 to 1.

Step 3

Independently, students calculate the odds the casino should be paying on this bet.

Refer students back to their tree diagram to find the chance of a split occurring: 0.5.

Explain to students that **and** means multiply in probability.

Five splits in a row would be split **and** split **and** split **and** split **and** split.

$$\text{So,} \quad \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{32}$$

The odds in a 'fair' game should therefore be 31:1.

The casino is only offering odds of 25:1. They are keeping the extra as profit.

Step 4

Another option is that the spinner must toss 3 HH combinations before a TT or 5 splits are thrown.

Step 5

Independently, students calculate the odds of this occurring.

$$\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{64}$$

If not, they lose all their winnings. There is no option to "toss the kip" or pass the kip onto another spinner before tossing 3HH combinations. This put the odds slightly in favour of the casino.

Step 6

Despite its historical appeal, casinos have found that the Two-up game is seen as a bit dull for the gamblers and they offer only a small profit for the owner. This is why they are not a major attraction at most casinos.

Discuss as a class a few ways a casino could make the game more interesting to play so more people will gamble. Remember that the casino must always make a profit.

Suggestions might include:

- Bet on 2 HH in a row.
- Bet on 0 HH in the first 4 throws.

Students could also comment upon the physical setting, e.g. more colorful, play up the ANZAC tradition.

Step 7

Independently, students calculate the odds of their suggested bets. They should also demonstrate how these bets favour the casino.

Part E: Reflection

Two-up is an Australian gambling game with historical significance, especially for our returned soldiers.

One of the reasons it became popular is that it is fair to all players. It also has the advantage that it is hard to cheat.

Discuss:

- How do students feel about casinos not being keen on running this game given that it represents a low profit margin for them?

- Put another way, should gambling with a greater payout for winning be more common in casinos?

- How do students feel about the cultural aspects of Two-up (the nationalistic pride, the associations with the diggers and ANZAC day) being affiliated with this gambling? Does it influence students more or less to want to play this game?

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?