

## Assessment task 1

# The house always wins

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# Activity introduction

## Quick summary

Throughout this unit, students have studied a variety of gambling games. All of these games have one thing in common: they are designed in such a way that the game operator always makes a profit in the long run, and gamblers always lose in the long run.

To demonstrate this understanding, students will design their own gambling game which adheres to this principle. Acting as the house and using their knowledge of probability, students will manipulate the odds of the game to create a house 'edge', resulting in a profit for the house. Using appropriate mathematical terminology, they will demonstrate the expected average loss of the gambler over time. Finally, students will explain their game, including how the game is psychologically impactful to keep players gambling even when the probability of winning is against them.

This assessment includes a number of scaffolded tasks, as well as an assessment rubric, to enable students to demonstrate their understanding and learning across this unit.

## Activity introduction

### Learning intentions

Students will:

- demonstrate an understanding of how game design profits the game operator through the setting of payout amounts.

### Success criteria

Students can:

- calculate the probability of certain outcomes or events occurring in a game, using a tree diagram or table
- calculate the odds of a game
- create a system of odds that result in a house edge
- create a game that adjusts the house odds to make the game appealing to players
- explain the ways in which the game would make money over time
- creatively design a game.

### 21st-century skills

Communicating

Creative thinking

Critical thinking

Ethical behaviour

Problem solving

### Syllabus outcomes

#### Probability 1 - Statistics and Probability

- **MA4-1WM** communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols
- **MA4-2WM** applies appropriate mathematical techniques to solve problems

- **MA4-21SP** represents probabilities of simple and compound events.

#### Number and Algebra - Fractions, Decimals and Percentages

- **MA4-5NA** operates with fractions, decimals and percentages.

#### Life Skills (Mathematics)

- **MALS-38SP** recognises and uses the language of change in a range of contexts
- **MALS-39SP** recognises the elements of chance and probability in everyday events
- **MALS-8NA** recognises and compares fractions in everyday contexts
- **MALS-9NA** represents and operates with fractions, decimals or percentages in everyday contexts
- **MALS-14NA** reads and writes amounts of money.

#### General capabilities

Literacy

Numeracy

Critical and creative thinking

Personal and social capability

Ethical understanding

Intercultural understanding

### Relevant parts of Year 7 and 8 achievement standards

Students solve problems involving percentages and all four operations with fractions and decimals. They compare the cost of items to make financial decisions. Students represent numbers using variables. Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a

## Activity introduction

fraction or percentage of another. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes.

Students solve everyday problems involving rates, ratios and percentages. Students solve problems involving profit and loss. They choose appropriate language to describe events and experiments. Students determine the probabilities of complementary events and calculate the sum of probabilities.

### Stage 4 Mathematics Syllabus Statement

Students use mathematical terminology, algebraic notation, diagrams, text and tables to communicate mathematical ideas, and link concepts and processes within and between mathematical contexts. They apply their mathematical knowledge, skills and understanding in analysing real-life situations and in systematically exploring and solving problems using technology where appropriate. Students operate competently with integers, fractions, decimals and percentages, and apply these in a range of practical contexts. Students calculate the probability of simple and complementary events in single-step chance experiments.

#### Topic

Gambling probability

#### Unit of work

Mathematics Stage 4

#### Time required

60 minutes

#### Resources required

- Assessment rubric
- Calculators – one per student
- Dice
- Playing cards
- Student workbook

#### 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.

*Work through this resource material in the following sequence:*

### Task 1

This task requires students to create a gambling game, where they act as the house (another term for a casino). This game will favour the house, resulting in an average loss overtime for the players and an average profit overtime for the house. They will do this by creating an unfair game. The odds will need to be calculated precisely, and students should aim to make the house edge between 1-10%.

They will first need to select a chance mechanism. Options include:

- a spinning wheel
- picking a card from a deck
- rolling two dice.

Your students will need to create a sample space for their mechanism. They will also need to calculate the probabilities of each event occurring. They may wish to construct a tree diagram (useful for cards or coin tosses) or a table (useful for dice).

### Task 2

Once the sample space is finished, students should work out the *odds* of each event.

$$\text{Odds} = \frac{1}{\text{Probability of event}}$$

For example, the chances of rolling a combined total of ten on two six-sided dice is  $\frac{1}{12}$ . Therefore, the odds are:

$$\text{Odds} = 1 \div \frac{1}{12} = 12$$

### Task 3

Students should decide what events they will allow players to bet on, and what odds they will offer, and create a table to show these events. The table should include the Event or Outcome, Probability, Fair Odds, House Odds, and House Edge. The house edge is calculated by:

$$\text{House Edge} = (\text{Fair Odds} - \text{House Odds}) \times \text{Probability of Success} \times 100\%$$

The key to making a game unfair is to pay your players less than a fair amount. In the previous example, a fair payout would be 12 times the original bet. Anything less would make the game unfair -but this is what we want, as it ensures the house makes a profit.

Students should decide what odds to offer by lowering the fair odds a small amount to create the house odds. For example, their game might involve betting on the sum of two dice:

Event: sum of two dice	Probability	Fair odds	House odds	House edge
2	$\frac{1}{36}$	36	35	$(36 - 35) \times \frac{1}{36} \times 100\% = 2.78\%$
3	$\frac{1}{18}$	18	17	$(18 - 17) \times \frac{1}{18} \times 100\% = 5.56\%$
4	$\frac{1}{12}$	12	11	$(12 - 11) \times \frac{1}{12} \times 100\% = 8.33\%$
5	$\frac{1}{9}$	9	8	$(9 - 8) \times \frac{1}{9} \times 100\% = 11.11\%$
6	$\frac{5}{36}$	7.2	6	$(7.2 - 6) \times \frac{5}{36} \times 100\% = 16.67\%$
7	$\frac{1}{6}$	6	5	$(6 - 5) \times \frac{1}{6} \times 100\% = 16.67\%$
8	$\frac{5}{36}$	7.2	6	16.67%
9	$\frac{1}{9}$	9	8	11.11%
10	$\frac{1}{12}$	12	11	8.33%
11	$\frac{1}{18}$	18	17	5.56%
12	$\frac{1}{36}$	36	35	2.78%

## Teacher worksheet

In this example, the house edge for rolling a 6-8 is probably too high, which might discourage players from gambling on this game. If students encounter something like this in their game they should consider making the house odds a little higher. Alternatively, they could offer fair odds, then include an event that lowers all the probability (such as the zero in roulette).

### Task 4

Students create an expected value table to calculate what they (the casino) should expect to win per turn. Here is an example if the odds given for rolling a ten were 11.00 (remember that profit is *bet - payout*):

Outcome	Probability of outcome	Money won	Product
Win	$\frac{1}{12}$	\$10	\$0.8333
Lose	$\frac{11}{12}$	-\$1	-\$0.9167
Expected value (sum of products):			-\$0.0833

### Task 5

Students write down the rules of the game. They must include a table that shows the fair odds of each event, the odds their game will give, and the expected value per bet.

### Task 6

Students write a few paragraphs explaining:

- how their game will result in losses over time
- why they think people will continue to play
- what extra bits of 'bling' could be added to the game that have no impact on its outcome, but make it feel more attractive to players?



Assessment rubric:

	Exemplary 4	Accomplished 3	Developing 2	Beginning 1	Not Attempted 0
<b>Application</b> <ul style="list-style-type: none"> <li>• Sample space</li> <li>• probabilities</li> <li>• house odds</li> <li>• house edge</li> <li>• expected value</li> </ul>	All calculations performed accurately and thoroughly.	Most calculations performed accurately and thoroughly.	Some calculations performed accurately and thoroughly.	A few calculations performed accurately and thoroughly.	Calculations not attempted.
<b>Analysis</b>	The house odds were adjusted accurately to make the game more appealing to players.	An attempt was made to adjust the odds in order to make the game more appealing to players.	Some minor adjustments were made to the house odds.	The house odds were adjusted, but not in a way that made the game more appealing.	The house odds were not adjusted.
<b>Evaluation</b>	The written components explained in detail the way in which the game would make money over time. It featured a thoughtful discussion on the psychological aspects of gambling behaviour.	The written components explained in general the way in which the game would make money over time. It featured a discussion on the psychological aspects of gambling behaviour.	The written components explained in a simple way the game's profitability. It mentioned some of the psychological aspects of gambling behaviour.	An attempt was made to discuss the game's profitability, and psychological aspects of gambling behaviour.	No attempt at a written component was made.
<b>Creativity</b>	The designed game was inventive, had several different betting options, and was appealing to players.	The designed game was creative, had several different betting options, and was mostly appealing to players.	The designed game had several different betting options, and was somewhat appealing to players.	The designed game was somewhat appealing to players.	No attempt was made to design a game.