Assessment task 2
Sideshow hustler

GambleAware

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 show sideshow style game which adheres to this principle. Acting as the game operator and using their knowledge of probability, students will design a game in which the odds favour the game operator. While the game must involve an element of skill, students will test the game to calculate the experimental odds of winning, and use those odds to determine what prizes to offer, ultimately resulting in a profit for the operator.

Using appropriate mathematical terminology, they will demonstrate the expected average loss of the player 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

- demonstrate an understanding of independent and dependent variables.

Success criteria

Students can:

- calculate the probability of certain outcomes or events occurring in a game, using a tree diagram

- calculate the odds of a game

- set payout values which based on these odds which result in an average profit over time for the game operator

- explain the psychology of gambling games which encourages players to sometimes gamble more than they can afford to lose.

- 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

Community engagement

Creative thinking

Critical thinking

Entrepreneurship

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.

Number and Algebra - Financial Mathematics

- **MA4-6NA** solves financial problems involving purchasing goods.

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

- **MALS-15NA** calculates with money

- **MALS-16NA** makes informed decisions about purchasing goods and services

- **MALS-17NA** plans and manages personal finances.

Activity introduction

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 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

· Sporting equipment – basketball etc.

· 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 sideshow game, where they act as the game operator. This game will favour the game operator, resulting in an average loss over time for the collective of players and an average profit over time for the game operator. To do this, students will use their knowledge of probability to set the prize payouts for this game.

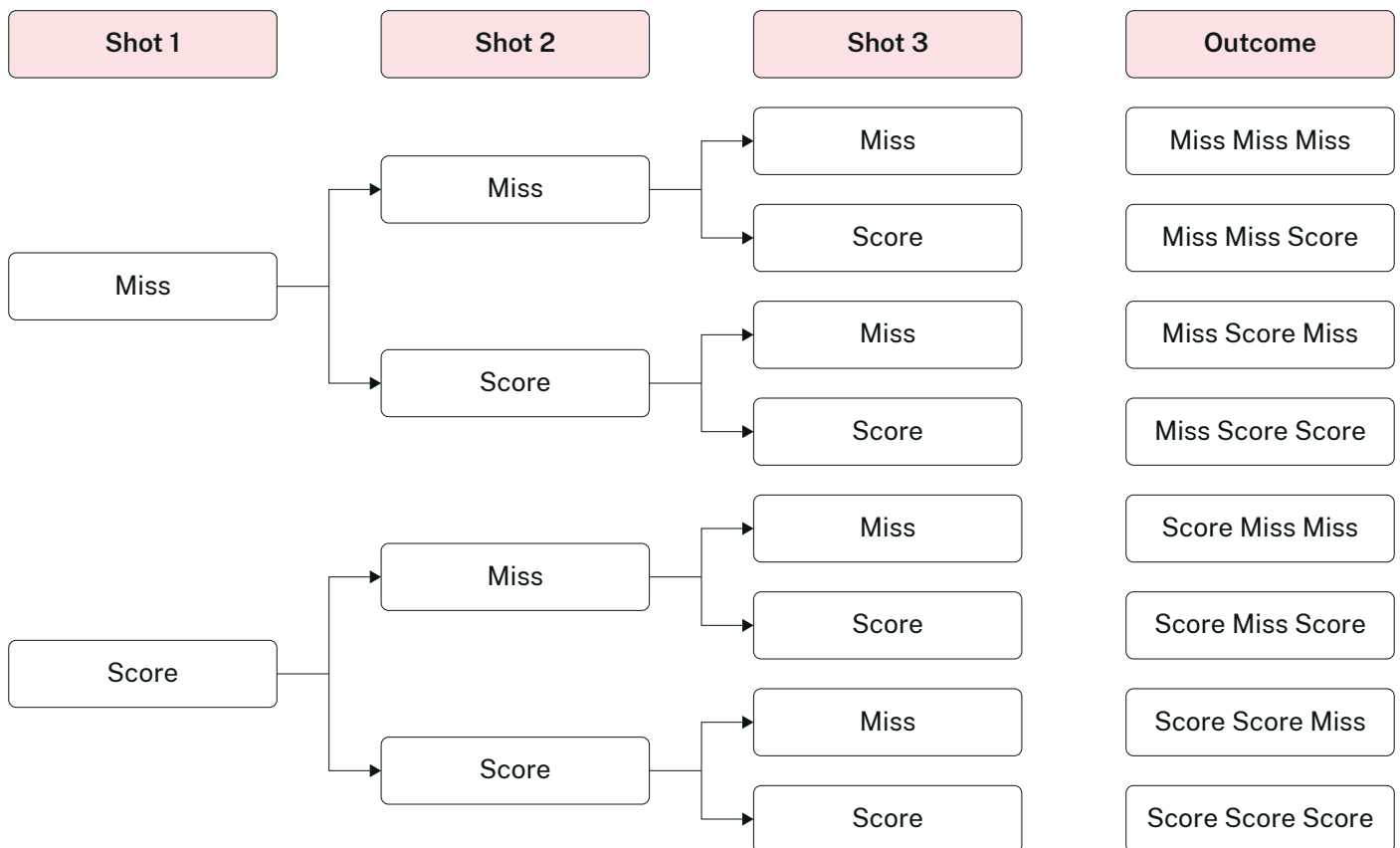First, students will need to decide on a game mechanism.

Typical carnival games include The Basketball Hoop (try to score baskets, with a deceptively oval-shaped hoop), The Milk Bottle Pyramid (try to knock them over, despite the bottom row being extra-heavy), and The Balloon Dart Throw (try to pop the balloons, but the balloons are slightly deflated so darts bounce off).

Students might choose one of these games, adapt it, or design their own brand new game.

Task 2

Students create a decision tree to determine all possible outcomes of the game.

For example, the following tree is for a basketball throwing game where you get three shots per game.

Shot 1	Shot 2	Shot 3	Outcome
Miss	Miss	Miss	Miss Miss Miss
		Score	Miss Miss Score
	Score	Miss	Miss Score Miss
		Score	Miss Score Score
Score	Miss	Miss	Score Miss Miss
		Score	Score Miss Score
	Score	Miss	Score Score Miss
		Score	Score Score Score

Task 3

Students test the game to work out the actual odds of winning. They should conduct as many tests as possible, and use the simple probability formula to determine the odds of a win.

$$P(Win) = \frac{Number\ of\ Wins}{Number\ of\ Attempts}$$

$$Odds = \frac{1}{P(Win)}$$

If students are unable to test the game (possibly due to a lack of equipment), then have them instead invent, within reason, probabilities of winning.

Task 4

Students fill these results into the following table. For example, say that getting a win in your game has a probability of ¼:

Score	Different ways to achieve this	Probability	Fair odds
0	MMM	¾ × ¾ × ¾ = $^{27}/_{64}$	$^{64}/_{27}$ = 2.37
1	SMM, MSM, MMS	¼ × ¾ × ¾ × 3 = $^{27}/_{64}$	$^{64}/_{27}$ = 2.37
2	SSM, SMS, MSS	¼ × ¼ × ¾ × 3 = $^{9}/_{64}$	$^{64}/_{9}$ = 7.11
3	SSS	¼ × ¼ × ¼ = $^{1}/_{64}$	64

Task 5

Students decide how much a game costs, and what the value of the prizes should be. The value of a prize must be less than the fair odds.

For example, continuing with the above game, if the cost for three shots is $1, you get a prize worth $3 if you get two shots in, or a $15 prize for sinking all three.

Score	Ticket price	Cost of prize
0	$1	$0
1	$1	$0
2	$1	$3
3	$1	$15

Task 6

Using these values, students can calculate the expected value for each game:

Score	Probability	Operator profit (Ticket price - Cost of prize)	Fair odds
0	$\frac{27}{64}$	$1.00	$\frac{27}{64} \times 1 = \$0.42$
1	$\frac{27}{64}$	$1.00	$\frac{27}{64} \times 1 = \$0.42$
2	$\frac{9}{64}$	-$2.00	$\frac{9}{64} \times -2 = -\$0.28$
3	$\frac{1}{64}$	-$14.00	$\frac{1}{64} \times -14 = -\$0.22$
		Expected value (sum of products):	$0.34

Task 7

Students list some independent variables that could affect results, similar to sport, such as weather, the skill of the player, etc.

Task 8

Students write a few paragraphs explaining:

- how their game will result in losses over time

- why they think people will continue to play their game (explaining their knowledge of the psychology of big jackpots)

- 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
Application • Sample space • probabilities • house odds • house edge • expected value	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.
Analysis	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.
Evaluation	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.
Creativity	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.