VCE VOCATIONAL MAJOR –
NUMERACY

UNIT 2

WHAT ARE THE CHANCES?

Acknowledgements

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Contents

BE AHEAD OF THE GAME

Introduction

What is Be Ahead of the Game?

Be Ahead of the Game is a school education program about the risks of gambling. Drawing on the latest research, the program's free, curriculum-aligned resources support the whole school community to help students navigate the rapidly evolving gambling landscape and avoid harm from gambling.

Be Ahead of the Game resources are co-developed by the Victorian Responsible Gambling Foundation and Victorian teachers and education professionals. It's one of the ways the Foundation works towards reducing harm from gambling in our communities. The Be Ahead of the Game program offers:

- face-to-face information sessions for teachers, parents and students about the risks of gambling and gaming
- curriculum-aligned teaching resources covering a variety of subject areas
- tools for parents, teachers and schools to develop a gambling harm prevention strategy.

To find out more, visit **beaheadofthegame.vic.gov.au**.

What's the issue?

Gambling has never been more heavily promoted and accessible to young people. Saturation levels of advertising during sport makes it feel like a normal part of the game, while online games and apps put gambling and simulated gambling within easy reach of all age groups. Be Ahead of the Game helps young people cut through the myths and the marketing to be able to think critically about gambling and gaming.

If you are concerned that gambling is affecting a student or someone they know, you can refer them to our free and confidential Gambler's Help Youthline support service on 1800 262 376 or visit gamblershelp.com.au/youthline

Educators and parents can also contact this service for advice or visit gamblershelp.com.au for more information.

Be Ahead of the Game resources for VCE Vocational Major

The Victorian Responsible Gambling Foundation (the Foundation) provides resources to support the delivery of the Victorian Certificate of Education Vocational Major (VCE VM) subjects. VCE VM is accredited at two levels: Year 11 Units 1 and 2, and Year 12 Units 3 and 4. The qualification levels cater for a range of students with different abilities and interests, and support development of personal, workplace and subject-specific skills, knowledge, and attributes. They are designed to help students make informed choices about employment and education pathways.

The Foundation's VCE VM resources support the achievement of outcomes in:

- Literacy
- Numeracy
- Personal development skills.

The following table lists the resources, curriculum areas, units and outcomes that are supported. Detailed curriculum alignment can be found in each resource.

	Literacy							
	Unit 1		Unit 2		Unit 3		Unit 4	
Outcome	1	2	1	2	1	2	1	2
Love the game	●	●						
Potential influences					●	●		

	Personal development skills											
	Unit 1			Unit 2			Unit 3			Unit 4		
Outcome	1	2	3	1	2	3	1	2	3	1	2	3
Knowing the score					●	●						
Knowing when it's a concern										●	●	●

	Numeracy											
	Unit 1			Unit 2			Unit 3			Unit 4		
Outcome	1	2	3	1	2	3	1	2	3	1	2	3
Finances and gambling	●	●	●									
What are the chances?				●	●	●						
Earnings, expenditure, and gambling							●	●	●			
Odds and probability										●	●	●

Note: Not all learning outcomes from a VCE VM unit are covered in each resource.

Resource overview of this unit

Resource focus

What are the chances (Numeracy - Unit 2) covers a range of topics to help students understand the concepts of chance, probability and odds related to gambling and betting.

In the first of three activities, students are introduced to the concepts and language of probability and chance. The second activity supports students to be able to read, understand and interpret odds, and analyse the likelihood of winning or losing money when gambling. The third activity explores risk and encourages students to consider what they are likely to lose if they gamble.

Using the activities and worksheets, students will explore the issue of gambling, through an understanding of odds and probability, and real-world data on how Victorians gamble.

Students may work individually, in groups, or as a class to complete the activities. Educators are encouraged to use the worksheets in a manner that both suits student needs and meets the requirements of the VCE Vocational Major curriculum.

The resources in this unit model the approach outlined in the VCE Vocational Major Numeracy Study Design. Further information about the design is available at the Victorian Curriculum and Assessment Authority (VCAA) **website**.

For assessment guidelines and practices, refer to the **VCE Vocational Major Numeracy section** of the website.

Resource elements

This resource consists of:

- information for teachers about how to deliver the supplied activities
- worksheets, templates, and resources for students.

There are three separate activities and 10 associated worksheets in this resource.

- Activity 1 - Chance and probability
  - Worksheet 1A - Introduction to chance
  - Worksheet 1B - Coin experiment
- Activity 2 - Odds
  - Worksheet 2A - Introduction to odds
  - Worksheet 2B - Odds at the racetrack
  - Worksheet 2C - Odds with pokies
  - Worksheet 2D - An experiment with odds
- Activity 3 - Risk and review
  - Worksheet 3A - Risk
  - Worksheet 3B - Review and reflections

Resource requirements

For the learning activities described in this resource, teachers will need to ensure that students have access to:

- an internet-connected device
- a calculator or a device with calculation software
- a random number generator application (e.g. **Calculator Soup**)
- software for creating a report or presentation such as PowerPoint, Prezi or Canva.

Assessment

Student competence in What are the chances? (Numeracy - Unit 2) learning outcomes can be assessed by:

- class discussions
- worksheets and related documents
- results of spreadsheet tasks
- research findings
- observations of students' participation in individual activities and team collaborations
- reports and presentations
- feedback on activities.

Meeting VCE Vocational Major Numeracy requirements

What are the chances (Numeracy - Unit 2) addresses the learning outcomes from VCE Vocational Major Numeracy Unit 2.

The VCE Vocational Major Numeracy units support students to develop numerical and mathematical skills for use in everyday life. This resource requires the student to understand and interpret a range of common numerical data by applying relevant calculation skills. Financial literacy skills are also addressed.

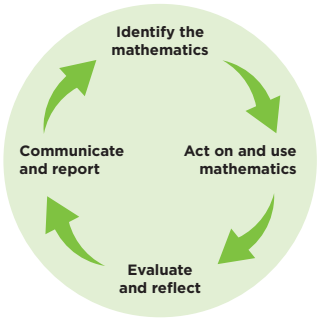
The structure of the VCE Vocational Major - Numeracy includes four components:

Outcome 1. Six different numeracy contexts:

- personal numeracy
- civic numeracy
- financial numeracy
- health numeracy
- vocational numeracy
- recreational numeracy.

Outcome 2. The four-stage problem-solving cycle required to solve a real-world mathematical problem:

- identify the maths
- act on and use the maths
- evaluate and reflect
- communicate and report.



Problem-solving cycle

Outcome 3. The development and use of a mathematical toolkit as students undertake numeracy activities and tasks.

Areas of Study. These cover a range of mathematical skills to be applied across the three outcomes. The areas are:

1. number
2. shape
3. quantity and measures
4. relationships
5. dimension and direction
6. data
7. uncertainty
8. systematics.

Curriculum links

The activities in this resource support the development of all three learning outcomes and one main area of study from Unit 1.

Unit	Outcome 1	Outcome 2	Outcome 3	Main Area of Study
2	• Personal • Civic • Financial	●	●	Uncertainty

Below is a summary of how this resource and the associated activities can meet the study design requirements.

Outcome 1

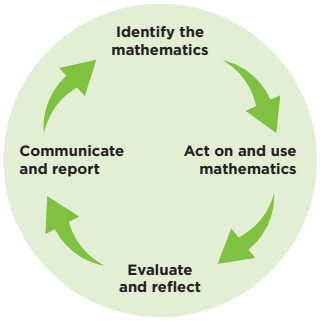
The content of this resource may be used in relation to three numeracy contexts from Unit 2: personal, civic or financial.

- **Personal numeracy** relates to the mathematical requirements for personal organisational matters involving numbers, data, money, time, and travel.
- **Civic numeracy** relates to participating in civic life by understanding government, political and social information through interpretation of quantitative and statistical information.
- **Financial numeracy** relates to understanding and undertaking financial transactions and making informed judgments and decisions regarding the use and management of money.

Outcome 2

All four stages of the problem-solving cycle can be covered by this resource, which details the following four stages and activities:

- identifying the mathematics to be used
- acting on and using mathematics to solve the problem
- evaluating and reflecting on the results
- communicating and reporting the outcomes.



Problem-solving cycle

Outcome 3

This resource requires students to use various tools and applications from their mathematical toolkit to undertake activities and calculations. These tools or applications could include:

- online access to a range of data sources
- calculators
- spreadsheet software
- report or presentation software.

Areas of study covered

The focus of the resource is **uncertainty**. Students will explore the basic concepts and everyday language of chance and will be required to make mathematical predictions about the likelihood of common and familiar events occurring or not occurring. The ability to understand and make conclusions and inferences from familiar known events or data will also be required. They will select the appropriate method of calculating probability and communicate their ideas, as well as perform calculations both manually and with software tools.

Some aspects of the 'Area of study 6: Data' are covered in this resource, although not explicitly. These materials could easily be adapted and extended to also cover the Data area of study for Unit 2.

Key knowledge

In this resource, students will need to understand:

- the likelihood of common and familiar events or occurrences happening
- common and familiar language of chance, and its relationship to common numerical values associated with chance
- simple and familiar unconditional probability events with elements of randomness and chance
- simple inferencing from likelihood estimates intended to inform decision making in relation to common and familiar events.

Key skills

Students will need to:

- estimate and identify likelihood of common and familiar events occurring using simple fractions, decimals, or percentages
- identify sample spaces or options for common and familiar events or occurrences
- recognise that the likelihood of events occurring can differ
- develop an understanding of how to reduce or increase the likelihood of an event occurring.

Additional information on activities and learning outcomes are detailed in the following section. However, the activities are broad and can be undertaken in different ways. The alignment shows what is possible. It is up to teachers to check the students work against the curriculum.

Outline of activities

The tables below detail each of the activities and worksheets and how they meet the VCE Vocational Major Study design.

Overview of Activity 1. Chance and probability

- Worksheet 1A - Introduction to chance
- Worksheet 1B - Coin experiment

This activity looks at chance and probability, and their role in everyday life. It discusses the language and idea of theoretical and experimental probability, and how they can be calculated.

Worksheet 1A - Introduction to chance covers Stage 1 of the problem-solving cycle of Outcome 2, introducing the concepts to students and identifying what mathematical skills will be required for the subject. Students will be advised of key terms relating to the subject with the assistance of this resource's supplied glossary.

The first activity addresses the language of chance and probability, and the numerical values and associated calculations associated with different probabilities. Students will be informed on knowledge and skills required for this unit, as well as revise and practice their own calculation skills.

Progressing to Stage 2 of the problem-solving cycle of Outcome 2, students apply their maths skills to chance events through an experiment with dice.

Worksheet 1B - Coin experiment continues to work through Stage 2 by conducting an experiment with coins and finishes with a reflective exercise (Stage 3 of the problem-solving cycle of Outcome 2).

Resource requirements:

- butcher's or A3-size paper
- sticky notes
- set of dice
- calculator or calculation software
- worksheets
- whiteboard or screen sharing device.

Outcome 1	Outcome 2	Outcome 3	Area of Study: Uncertainty
• Personal • Civic • Financial	• identify the maths • act on and use the maths • evaluate and reflect.	• calculator • spreadsheet software (optional) • report or presentation software.	• the likelihood of common and familiar events or occurrences happening • the common and familiar language of chance, and its relationship to common numerical values associated with chance • simple and familiar unconditional probability events with randomness and chance • simple inferencing from likelihood estimates to inform decision making in relation to common and familiar events.

Overview of Activity 2. Odds

- Worksheet 2A - Introduction to odds
- Worksheet 2B - Odds at the racetrack
- Worksheet 2C - Odds with pokies
- Worksheet 2D - An experiment with odds

Activity 2. Odds looks at the concept of odds and works through a series of tasks and questions relating to the understanding and application of odds.

Worksheet 2A - Introduction to odds details how odds work, how they relate to probability, the maths skills required to understand how odds are calculated. It explains to students how odds are expressed as ratios, what the ratio means, and how the ratio can be expressed as a percentage.

Using the example of horse racing, students learn the different ways odds are used and presented, and the advantages and disadvantages associated with odds. A key aim of this activity is to be able to identify, name and explain the different mathematical operations required when using odds. This directly supports stage 1 of the problem-solving cycle of Outcome 2.

Students are advised on how odds are written, calculated, and how they relate to other ways of defining chance and probability. This addresses and supports the requirements of stage 1 of Outcome 1.

It is critical to use student responses to Worksheet 2A to ensure they will be able to apply the different number concepts described in the Uncertainty Area of Study. Additional advice and practice may be required before moving on to Worksheet 2B.

Worksheet 2B - Odds at the racetrack requires students to calculate payouts and losses through the use of a 'day at the racetrack' scenario, as well as reflect on risk in relation to gambling. A class discussion about risk in relation to betting and gambling is recommended to close this exercise.

In **Worksheet 2C - Odds with pokies**, students learn about low odds by conducting an experiment using a random number generator. The concept of how maths is used in poker machines to generate profits is also explored.

In **Worksheet 2D - An experiment with odds**, students study a graph to deduce odds, answer related questions, and conduct their own experiment using dice to combine their knowledge.

Worksheets 2A to 2D cover the requirements of all stages 1 through 3 of Outcome 2.

Resource requirements:

- set of dice
- calculator or calculation software
- worksheets
- whiteboard or screen sharing device.

Outcome 1	Outcome 2	Outcome 3	Area of Study: Uncertainty
• Personal • Civic • Financial	• identify the maths • act on and use the maths • evaluate and reflect	• online access to a range of data sources • calculator • random number generator software • spreadsheet software (optional) • report or presentation software.	• the likelihood of common and familiar events or occurrences happening • the common and familiar language of chance and its relationship to common numerical values associated with chance • simple and familiar unconditional probability events with randomness and chance • simple inferencing from likelihood estimates to inform decision making in relation to common and familiar events

Overview of Activity 3. Risk and review

- Worksheet 3A - Risk
- Worksheet 3B - Review and reflections

This activity discusses the concept of risk using odds.

In **Worksheet 3A - Risk**, students use their maths skills and knowledge to read and interpret data about chance and risk. Students order cards detailing various scenarios (from least to most risky) to learn about the high risk associated with gambling.

In Student **Worksheet 3B - Review and reflections**, students are asked to reflect on the data and information in this unit. They will review the maths they have used and applied across all worksheets, document their work and reflections by preparing a presentation. This last activity covers stage 4 of the problem-solving cycle.

Resource requirements:

- set of risk cards (see Worksheet 3A for instructions)
- calculator or calculation software
- worksheets
- whiteboard or screen sharing device.

Outcome 1	Outcome 2	Outcome 3	Area of Study: Uncertainty
• Personal • Civic • Financial	• identify the maths • act on and use the maths • evaluate and reflect • communicate and report.	• online access to a range of data sources • calculator • random number generator software • spreadsheet software (optional) • report or presentation software.	• the likelihood of common and familiar events or occurrences happening • the common and familiar language of chance and its relationship to common numerical values associated with chance • simple and familiar unconditional probability events with randomness and chance • simple inferencing from likelihood estimates to inform decision making in relation to common and familiar events.

ACTIVITY 1. CHANCE AND PROBABILITY

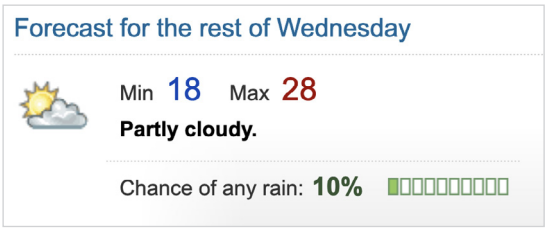
Worksheet 1A – Introduction to chance

The terms **chance** and **probability** are often used together. Chance is a more informal word, while probability is more formal and mathematics based. **Note:** Key words and terms in bold are explained in the glossary at the end of the unit.

Probability is the chance that something will happen, or how likely it is that some event will occur.

Here are some examples:

Event	Event
Predicting the weather: the chance of rain	The chance of rolling a six on a die[1]



When talking about probability and chance, sometimes we use words such as impossible, unlikely, possible, even chance, likely and certain.

For example: 'It is *unlikely* to rain tomorrow.'

We can also give a value to probability with a number like 10 per cent (%) chance, or 50:50 chance.

For example: 'There is a *10% chance* it will rain tomorrow.'

We use numbers to indicate the likelihood, chance, or probability of something happening.

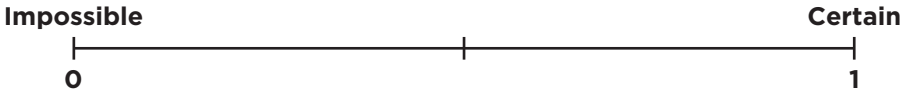
- The probability of an 'impossible' event is 0.
- The probability of a 'certain' event is 1.
- Therefore, the range of numerical values that we could give to the probability of any event is somewhere between 0 and 1.

For example, we would say that the chance that pigs can fly is impossible, so we give it a value of 0, or 0%.

Or, we would say that it is certain that the sun will come up tomorrow and give this certainty a value of 1 or 100%.

1 The singular word for dice is die, while dice is plural.

We can show the range of numerical values for the probability of an event on a number line:



Chance can also be referred to as 'likelihood. Therefore, this number line is often called the **likelihood** line.

Task A: The likelihood line

For this exercise, you will need:

- butcher's or A3 size paper
- sticky notes.

In small groups, work your way through the following questions and tasks. What do the words 'probability', 'likelihood' and 'chance' mean to you?

What do you know about the likelihood or chance of events happening or not happening?

1. Draw a long likelihood line across the middle of your piece of paper.
2. What word or words about chance could you use for halfway along the likelihood line? Write the words on one of your sticky notes and place it there on the line. We can give the value to this halfway point as a fraction (½), a decimal (0.5) or as a percentage (50%). Write these numbers on your number line.
3. As a group think about other words or phrases for other chance events, like 'unlikely' and 'highly unlikely'. Where would you place these words on the number line? Write them on sticky notes and place the sticky notes along the line.
4. Think about other chance words or expressions. Add them to your likelihood line and add numerical values against them.
5. What are some examples of events that are impossible?
6. What are some examples of events that are certain to happen?

7. Write down five different events on five sticky notes, but don't put them on your number line or share them with your group. You need to think of at least one event that is:
   - impossible to occur
   - unlikely to occur
   - about evenly likely to occur or not
   - likely to occur
   - certain to occur.

   These events can be examples like 'Australia is going to win the next World Cup', or 'I am going to do my maths homework tonight', or 'The chance of rolling a six on a die'.

8. Swap the sets of sticky notes with someone else in the group and place each other's notes on the likelihood line. Discuss any discrepancies or differences of opinion about the placement of the events on the likelihood line.

Task B: Calculations about probability and chance

Think about what mathematical calculations you might need to use and apply throughout this unit of work, and answer the following questions

Maths skill	**Will you need to use this skill?**
Understanding and comparing different numbers: decimal, fractions, and percentages	YES ☐ NO ☐
Undertaking calculations such as +, -, ×, and ÷	YES ☐ NO ☐
Working out simple proportions and ratios of one value compared to another, including to express them as a fraction or percentage.	YES ☐ NO ☐
Estimating and identifying likelihood of common and familiar events occurring using simple fractions, decimals, or percentages.	YES ☐ NO ☐
Identifying the different options for common and familiar events or occurrences	YES ☐ NO ☐
Recognising that the likelihood of events occurring can differ and develop an understanding of how to reduce or increase the likelihood of an event occurring.	YES ☐ NO ☐

NOTE: You will need to use and apply these skills throughout this unit of work. Please make sure you ask your teacher for help and advice if you are unsure.

Task C: Calculating the probability of an event

There are two ways to work out or estimate the probability or chance of an event:

- **experimental probability**
- **theoretical probability**.

Experimental probability

Experimental probability is found by repeating an experiment (like tossing a coin or rolling dice), observing the results, and calculating the proportion (as a fraction, decimal or percentage) of times the event occurs.

The formula for experimental probability of an event is:

$$P(\text{event}) = \frac{\text{Number of times event occurs}}{\text{Total number of trials}}$$

Example: A coin is tossed 10 times. Heads come up six times and tails come up four times.

$$P(\text{head}) = \frac{6}{10} = \frac{3}{5} = 0.6 \text{ or } 60\%$$

$$P(\text{tail}) = \frac{4}{10} = \frac{2}{5} = 0.4 \text{ or } 40\%$$

Theoretical probability

The theoretical probability of an event is what is expected based on a mathematical interpretation of the event. This equals the expected number of known ways the event can occur (favourable outcomes) divided by the number of total outcomes. As with experimental probability, this is calculated as a proportion (as a fraction, decimal or percentage).

Note: In calculating theoretical probabilities, it is usually assumed that there is an equal chance of success for all the outcomes of an event. For example, when rolling a normal six-sided die, each number has the same chance of showing. These are called **equiprobable** outcomes.

The formula for theoretical probability of an event is:

$$P(\text{event}) = \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}}$$

Example: A coin is tossed. There are only two possible outcomes — a head or a tail.

$$P\ (head) = \frac{1}{2} = 0.5 \text{ or } 50\%$$

$$P\ (tail) = \frac{1}{2} = 0.5 \text{ or } 50\%$$

Note: The total number of possible outcomes makes up what is called the **sample space**. For tossing a coin, this was heads or tails, so there are two options or alternative outcomes in total. When rolling a six-sided die, the sample space is the set of numbers {1, 2, 3, 4, 5, 6}.

Use the two formulae for experimental probability and theoretical probability to answer the following questions.

9. Think about rolling a six-sided die. Use the formula for theoretical probability to work out each of the following probabilities. Express your answer as a fraction, a decimal fraction (rounded to two decimal places) and as a percentage (rounded to a whole number percentage).

   a) What is the probability of rolling a six?

   b) What is the probability of rolling an even number?

An experiment with rolling a die

10. Conduct an experiment to calculate the experimental probability for these two events when rolling a six-sided die.

11. Using the following table, roll your die 50 times and record which numbers come up each time. Tally them up to summarise the results, and then use this data to calculate your experimental probabilities for the two events.

12. Express your answers as a fraction, a decimal fraction (rounded to two decimal places) and as a percentage (rounded to a whole number percentage).

Summary of the data:

Number on dice	**1**	**2**	**3**	**4**	**5**	**6**
Total number of times this value occurred						

a) What is the experimental probability of rolling a six?

b) What is the experimental probability of rolling an even number?

13. Compare your experimental probability with the theoretical probability. How close were they? What do you think might happen if you did 100 or 1000 rolls of the die?

14. Complete the following sentences using the following chance words.

'expected'	*'not expected'*	*'likely'*	*'unlikely'*

a) If the chance or probability of an event is less than a half (for example, 1/4) this means that:

The event is _____ to occur.

This is _____ to happen.

b) If the chance or probability of an event is closer to 1 (for example, 2/3) this means that:

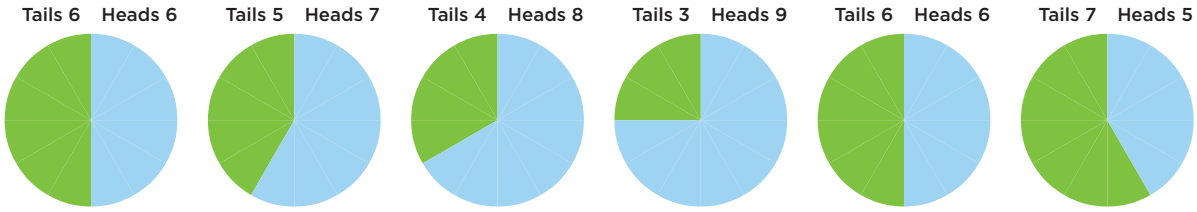
The event is _____ to occur.

This is _____ to happen.

Worksheet 1B – Coin experiment

In this activity, you will conduct an experiment with a coin and make predictions about the chance of an event occurring.

1. Zack tossed a coin 12 times and recorded the results in a pie graph. They did this experiment a total of six times and graphed the results as follows:



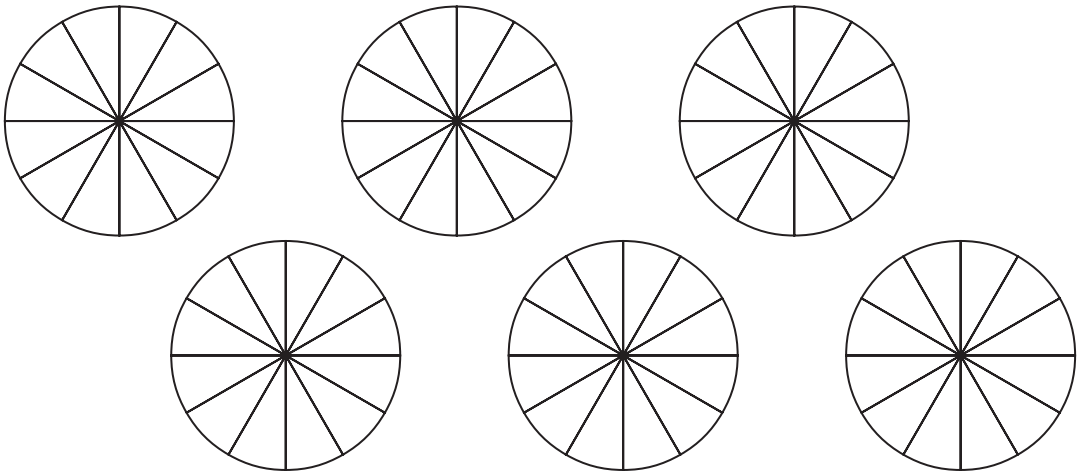
Zack was pleased that there were more heads than tails thrown and regarded this as lucky. Do you think Zack was lucky in this experiment? Why?

2. Repeat Zack's experiment with a partner or in a group and record your results in the following pie graphs. Before you begin, predict the number of heads you think you will toss (out of 72 tosses) and state why you chose this number.

Prediction: _____

Reason: _____

Now record your results in the diagrams by colouring heads in red and tails in blue.



3. Compare your prediction for the number of heads you would get (out of 72 tosses) to the actual number of heads you got. What is your explanation for any difference between your prediction and the actual result?

4. Do you think luck played a part in your experiment? Discuss your response with a classmate or your teacher.

Note: Long run relative frequency and probability

The probability of an event associated with a random phenomenon such as rolling a die or tossing a coin can be interpreted as a long run proportion or long run relative frequency. This is the proportion of times that the event is expected to occur in a very large number of repetitions of the random event. In this activity, when you have calculated the experimental probabilities when tossing a coin or rolling a die, you are working out the relative frequency of the outcome.

Relative frequency is the frequency of a specific outcome compared to the total number of outcomes. This is similar to the calculation for working out the experimental probability. Relative frequency can be expressed as a decimal, but it is usually expressed as a percentage to make comparisons easier.

ACTIVITY 2. ODDS

Worksheet 2A – Introduction to odds

Odds are another way of stating the likelihood or chance of an event occurring. The term 'odds' is commonly used in relation to gambling and betting, particularly for horse-racing and sports betting. The outcomes of racing and sporting events are often described in terms of the odds (or chances) of winning or losing.

It is important to remember that in the gambling industry, odds are calculated to ensure profit for the gambling company or bookmaker.

The odds are defined as the probability that the event will occur divided by the probability that the event will not occur.

Odds are commonly shown as a fraction separated by a forward slash (for example, 2/1) or as a ratio (for example, 2:1). This would be stated as, 'odds of two to one.' The first number is the estimated number of times you can expect to lose, versus the second number which is the number of times you can expect to win.

Usually, the chances of winning are smaller than the chances of losing, so it's often called the odds against (winning).

How to read and calculate probability and betting odds

Odds of 2/1 or 2:1 (against) mean that there is one chance of winning (W) compared to two chances of losing (L).

We can represent the odds or ratios by using boxes. For example, odds of 2/1 or 2:1 would be represented by:

Compared to working out normal values for probability, this means that there are a total of three possible outcomes or options – one for winning and two possible outcomes for losing.

Using our formula for calculating probability:

$$P\ (event) = \frac{Number\ of\ favourable\ outcomes}{Total\ number\ of\ possible\ outcomes}$$

$$P\ (winning) = \frac{1}{1+2} = \frac{1}{3} = 0.33 \text{ or } 33\%$$

The method for calculating probability from odds is most easily explained by taking the two numbers that appear in the odds and replacing them with letters. For example, 2/1 becomes A/B. The formula is:

$$P\ (event) = \frac{Number\ of\ favourable\ outcomes}{Total\ number\ of\ possible\ outcomes} = \frac{B}{A + B}$$

Here are some examples of betting odds converted into fractions and percentages to find out the probability.

- 10/1 can be calculated as 1/ (10 + 1) = 1/11 = 0.09 – there is a 9% chance this outcome will happen
- 4/1 can be calculated as 1/ (4 + 1) = 1/5 = 0.20 – there is a 20% chance this outcome will happen
- 1/1 can be calculated as 1/ (1+1) = 1/2 = 0.5 – there is 50% chance this outcome will happen. This is often called "evens".

Odds on versus odds against and favourites

Any odds in which the first number is bigger than the second (for example, 10/1) your chance of winning is low (less than 50%). We often call this **odds against** winning (or the odds on losing).

When the first number is smaller than the second, these are often called **odds on**. This means it is considered to be more likely (greater than a 50% chance) of winning.

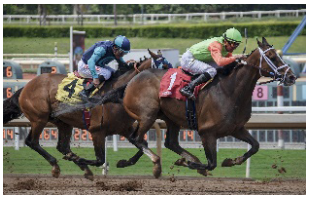
Most betting odds will be **odds against**, as the chances of winning are usually small.

When the odds are odds on, this means the horse (or car, or whatever is being bet upon) is a favourite to win.

Bookies will offer much lower payouts on favourites, as there is a higher probability that a favourite will win.

Some further examples

A. What are the odds of tossing a coin and getting a head or a tail?	
 **A coin toss has odds of 1:1** There are 2 possible outcomes with: • 1 chance of obtaining a head • 1 chance of obtaining a tail	Heads : Tails 1/1 1:1 50% to 50% Even odds Even or equal chance 50:50 chance

B. What are the odds of a car winning a race?	
 **A car in the race had odds of 9/1 against winning.** There are 10 possible outcomes with: • 1 chance in (9+1) 10 of winning • 9 chances in (9+1) 10 of losing	Losing : Winning 9/1 9:1 90% to 10% Uneven odds Unequal chance 1 chance in 10 of winning
C. What are the odds of a horse winning a race?	
 **A horse in the race had odds of 1/4 on winning.** There are 5 possible outcomes with: • 4 chances in (4+1) 5 of winning • 1 chance in (4+1) 5 of losing.	Losing : Winning 1/4 1:4 20% to 80% Uneven odds Unequal chance 4 chances in 5 of winning This horse would be considered a favourite!

Questions

Answer the following questions on odds and probability.

1. For each case of odds, work out the probability or chance of winning as a fraction and as a percentage.

   a) 25/1 against

b) 1/3 on

c) 3/1 against

d) 100/1 against

Payouts

Payouts are calculated based on odds. For example:

- 4/1 odds mean that for every $1 bet, you can win $4. Winning is unlikely (1 chance in 5). This would not be a favourite.

Conversely:

- 1/4 odds mean that for every $4 bet, you can only win $1. Winning is more likely (4 chances in 5). This would be a favourite.
- What are the disadvantages of betting on the favourite?

2. What are the disadvantages of betting on something that is not the favourite?

3. Explain the risk and challenge of betting on something that is not the favourite.

4. Reflect on the mathematical calculations you have used throughout this worksheet. Indicate below if you had to use and apply the following skills or not.

Maths skill	**Did you use this skill?**
Understand and compare different numbers: decimals, fractions, and percentages.	YES ☐ NO ☐
Undertake calculations such as +, -, ×, and ÷.	YES ☐ NO ☐
Work out simple proportions or ratios, including to express them as a fraction or percentage.	YES ☐ NO ☐
Estimate and identify likelihood of common and familiar events occurring using simple fractions, decimals, or percentages.	YES ☐ NO ☐
Identify the different options for common and familiar events.	YES ☐ NO ☐
Recognise that the likelihood of events occurring can differ and develop an understanding of how to reduce or increase the likelihood of an event occurring.	YES ☐ NO ☐

FACTS ABOUT SPORT AND RACE BETTING

People are spending, and losing, more on sport and race betting in Victoria than ever before. It is the fastest-growing form of gambling and is popular among young people, especially men aged 18–24. Sports betting apps make it easier than ever to bet anywhere, any time.

You are more likely to lose

Sport and race betting companies are not there to help you make money. In fact, sports betting companies make a lot of money from Australians who likely thought they could beat the odds. In 2023, **wagering company Sportsbet estimated the Australian sports betting market is worth $8.2 billion a year**.

Gambling companies use clever marketing tactics and inducements like 'cash back' offers to make people think winning is easy but in reality, betting on sports and racing is more likely to result in losing money.

Chance or skill?

It's impossible to know all the factors that can influence the outcome of a match or race. While you may feel like you have a skill for picking winners, you can never control the odds. Winning is a matter of chance, not skill.

What's the real cost of sport and race betting?

In 2021-22, **Victorian sport and race bettors lost an estimated $2.58 billion**. Collectively, sport and race betting account for 10 per cent of gambling harm in Victoria.

$2.58 BILLION

To find out more about the facts of gambling, visit **responsiblegambling.vic.gov.au**

Worksheet 2B – Odds at the racetrack

As we saw in the previous worksheet, racing odds are typically expressed as a fraction or as a ratio. In this activity you will make calculations with ratios through a 'day at the races' scenario. You will consider the risks involved and learn about commissions.

Payouts and spending in horse racing

The payout = the odds **×** the amount you spend **+** your original spend back.

Example 1:	**Example 2:**
A bet of $20 with odds at 2/5 on	A bet of $20 with odds at 5/1 against
Potential payout = (2/5 × $20) + $20 (*your money back too*) = $8 + $20	Potential payout = (5/1 × $20) + $20 (*your money back too*) = $100 + $20
Payout = $28 **if your horse wins**	Payout = $120 **if your horse wins**
Profit = $8 as the original bet was $20	Profit = $100 as the original bet was $20
However, if your horse loses, it means you lose your entire bet.	However, if your horse loses, it means you lose your entire bet.
Loss = $20	Loss = $20

1. Consider the following bets on different horse races on the same day and calculate the payouts — and either the profit or loss — for each race. The first calculation is done as an example.

	Race	Bets and result	Result	Cost of bet	Payout if win	Profit (+) or Loss (-)
a)	1	A bet of $50 with odds at 3/5 on	The horse wins	$50	(3/5 × $50) + $50 = $80	+ $30
b)	2	A bet of $50 with odds at 5/1 against	The horse loses			
c)	3	A bet of $50 with odds 1/2 on	The horse wins			
d)	4	A bet of $50 at 3/1 against	The horse loses			
e)	5	A bet of $100 with evens or 1/1 odds	The horse wins			
f)	6	A bet of $100 with 25/1 odds	The horse loses			

2. How much money has been paid out for the day? (sum of bets)

3. How much money was won from winning bets on the day?

4. How much profit has been made for the day? (Profit = total payouts - costs of the bets)

Risk

5. What do you think risk means in relation to gambling? Write your own definition of risk.

6. In the previous scenario, were any of the bets risky?

7. What are some factors that can increase risk in relation to gambling?

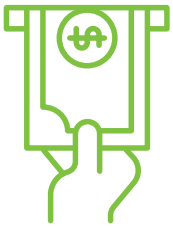
8. Is betting on the favourite more or less risky? Why?

FACTS ABOUT POKIES

Electronic gaming machines, or pokies, are found in hotels, registered clubs and casinos. There are 488 pokies venues in Victoria. Each gaming machine has a built-in computer program that randomly generates thousands of possible outcomes every second.

Pokies are designed to take your money

Poker machines are not designed to make money for players. They are there to make money for venue owners. Even if you have a win or two, over time you are much more likely to lose money. Pokies use lights, sounds, and other psychological techniques to create excitement and keep you gambling... even if you're losing.



Pokies don't care if you're feeling lucky

The odds of winning a typical $5,000 prize on a $1 poker machine are 9,700,000 to 1. You can never predict the outcome of a bet on the pokies. It doesn't matter how long it has been since the machine last paid out a win, or whether you are wearing your lucky shirt – the odds always favour the house.

What's the real cost of pokies?

- Victorians lost $3.022 billion on pokies in 2022-23*.
- There are 26,380 pokies machines in Victoria (in 2023).
- Pokies machines are available in disproportionately higher numbers in disadvantaged Victorian suburbs.
- Pokies are the most common form of betting for Victorians who have issues with gambling (38%).

*Victorian Gambling and Casino Control Commission figures on pokies expenditure between 1 July 2022 and 30 June 2023.

THE ODDS OF WINNING $5,000 ON A $1 POKER MACHINE ARE

9,700,000 / 1

To find out more about the facts of gambling, visit **responsiblegambling.vic.gov.au**

Worksheet 2C – Odds with pokies

In this worksheet you will learn how pokies operate using random number generators, and how chance determines if you win or lose.

Task A. How many attempts to get five numbers selected

Working with another student, use a random number generator to see how many attempts it takes for certain numbers to all come up for you to "win". You will choose five different numbers between 0 and 100.

1. How many times do you think you need to play the random generator in order for your five numbers to all come up? Have a guess - give an estimate.

Instructions

- On your calculator, phone or internet device, open a random number generator.
- With a partner, choose five different numbers between zero and 100, and write these down.
- Using the random number generator, see how many attempts are needed before each of your numbers are displayed.
- Keep a tally of the number of spins it takes to get to the five numbers all coming up.

Example: the number 83 was chosen by a pair of students. Fourteen spins were needed before the number 83 was selected by the random number generator. These 14 attempts were recorded as follows.

2. How many times did you have to play for all your five numbers come up? How close was your guess?

3. How would you describe the chance or odds of your numbers occurring?

4. Give a possible reason why a gambling machine might be programmed to always pay less to the customer.

Pokies example

This example assumes the pokies machine only has three spinning reels, each with an equal number of 50 symbols.

REMEMBER! Modern electronic pokies often have up to five 'reels', and no guarantee that all the reels are identical. This is called 'weighted reels' and it's one of the ways pokies are designed to make money for the venue.

Each time you place a bet, the reels spin around before randomly stopping on a symbol. If the symbols displayed in the window match one of the displayed winning combinations, the machine pays out money.

On each reel, there is only one cherry symbol. So, the probability of obtaining one cherry is 1/50 (1 out of 50 chances).

Therefore, the probability of obtaining three cherries is $1/50 \times 1/50 \times 1/50 = 1/125{,}000$.

The probabilities are different for each winning combination of symbols. These probabilities are deliberately set on the machine to maximise profit for the venue.

5. Complete the following table for a slot machine.

Note: For this example, there are more bananas on each reel than apples, more apples than oranges, more oranges than watermelons, and more watermelons than cherries.

Combination	**Winnings**	**Probability of the outcome** *This is the probability of all three of the same symbols occurring at the same time.*	**The machine return** *This is proportional to each dollar the casino pays out to all customers over a long period of time = winnings × probability of the outcome*
3 cherries	$2,000	1/125,000	$2,000 × 1/125,000 = 0.016
3 watermelons	$1,000	3/20,000	
3 oranges	$400	1/2,000	
3 apples	$50	1/200	
3 bananas	$5	1/14	
		TOTAL ODDS (sum of the returns)	

6. Why are some returns higher than others? For example, why are the odds better for bananas than for cherries?

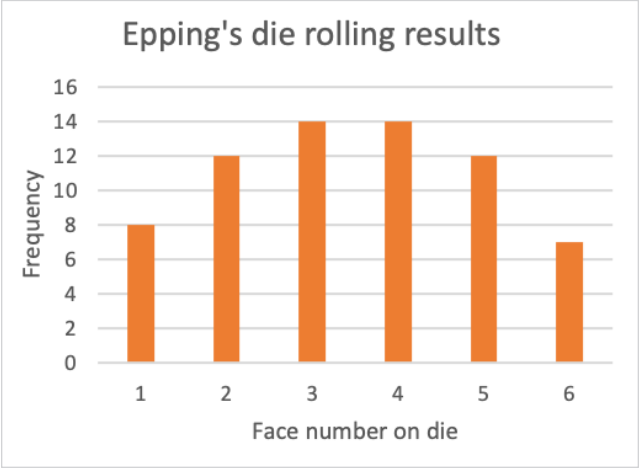
7. Why do the odds not add up to one?

Worksheet 2D – An experiment with odds

Chance can be investigated by conducting an experiment with dice. In this activity, you will use a six-sided die to make predictions about outcomes and see if these predictions have a mathematical pattern.

Epping rolled a six-sided die 60 times. The results of the experiment were recorded in the following table and used to create a column graph.

Face number on die	Tally	Frequency
1	𝍸 /	6
2	𝍸 𝍸 //	12
3	𝍸 ////	9
4	𝍸 𝍸 ////	14
5	𝍸 𝍸 //	12
6	𝍸 //	7
	TOTAL	60



1. In creating this column graph, Epping made two mistakes. What were they?

2. Epping was happy with the result, as they had chosen 4 as a lucky number. Do you think being a 'lucky number' influenced the result? State your reason.

3. Repeat Epping's experiment with a partner and record the results in the following table. Before you begin, predict the number of sixes you think you will toss.

   Prediction: _____

Face number on die	Tally	Frequency
1		
2		
3		
4		
5		
6		
	TOTAL	**60**

4. Compare your prediction to what actually happened. Draw a column graph of the data. What is your explanation for any difference between your prediction and the actual result?

5. Reflection: Do you think 'lucky people' can influence or predict the result of a roll of a die, or do you believe that people have no control over the result?

ACTIVITY 3. RISK AND REVIEW

Worksheet 3A – Risk

Risk is the probability of an undesired outcome. We consider risk to help us decide whether the possible negative outcomes of an activity outweigh the positive outcomes.

Risk cards

Instructions:

- Using scissors, cut out the 12 risk cards below.
- Work in pairs or small groups to discuss the scenarios on each risk card.
- Place the cards in order of what you think is the lowest risk (or chance) of occurring, to the highest risk of occurring.

Risk of death from riding a horse in Australia is 0.13 deaths per 100,000 population	1 in 12,000 is the chance of being struck by lightning in Australia	The individual odds of winning the lotto jackpot are 1 in 8,145,060
Chance of injury while base jumping is 0.4%	One in half a million is your chance of dying whilst bungee jumping	Odds of dying from a cycling accident are 1 in 4,486
Odds of dying in a cataclysmic storm are 1 in 66,335	0.3% chance of getting seriously ill or dying from an infectious or parasitic disease in Australia	Odds of winning an Oscar are 1 in 11,500
Odds of being born with 11 fingers or toes is 1 in 500	1 in 451,822,158 are the odds of winning a million dollars in the McDonald's Monopoly game	Odds of being injured by a toilet worldwide is 1 in 10,000

1. In pairs or as a class, discuss why you chose the order you did.

2. What makes an activity more or less risky?

3. Thinking about the different types of gambling (pokies, sports and race betting, casinos, lotteries), how risky would you rate these activities and why? Can you rank them from least risky to most risky? Discuss this in pairs or with your class.

Worksheet 3B – Review and reflections

Aims and overview

In this final worksheet, you will reflect on the work you have done on chance, probability, and odds.

Reflections

1. What were some of the key things you learnt about chance and odds through undertaking this unit?

2. Consider this statement by Aristotle: 'It is a part of probability that many improbable things will happen.' What do you think his key message was, and the point(s) he was making?

3. Reflect on and review what you have learnt about chance, probability, and odds. especially related to the chances of winning when you gamble. What were you surprised to find?

4. What new information did you learn?

5. What do you think some of the key issues and challenges are in relation to gambling?

6. Reflect on the mathematical calculations you have used throughout this worksheet. Indicate below if you had to use and apply the following skills or not.

Maths skill	**Did you use this skill?**
Understand and compare different numbers: decimals, fractions, and percentages.	YES ☐ NO ☐
Undertake calculations such as +, -, ×, and ÷.	YES ☐ NO ☐
Work out simple proportions or ratios, including to express them as a fraction or percentage.	YES ☐ NO ☐
Estimate and identify likelihood of common and familiar events occurring using simple fractions, decimals, or percentages.	YES ☐ NO ☐
Identify the different options for common and familiar events.	YES ☐ NO ☐
Recognise that the likelihood of events occurring can differ and develop an understanding of how to reduce or increase the likelihood of an event occurring.	YES ☐ NO ☐

7. Indicate how often you had to use and apply a range of different methods for calculating or using different technologies.

Method used for calculating	Did you use this skill?		
In your head	A little ☐	Quite a bit ☐	A lot ☐
Using pen-and-paper	A little ☐	Quite a bit ☐	A lot ☐
Using a calculator/technology	A little ☐	Quite a bit ☐	A lot ☐
Using a spreadsheet	A little ☐	Quite a bit ☐	A lot ☐

8. Did the activity and the questions help you to better understand how you use mathematics, in our lives and at work? In what areas and ways?

Your report

Write and present a summary of what you have learnt from this unit and the previous worksheets about chance, probability, odds, and their relation to betting and gambling. The summary may be in the form of a one- or two-page report, a presentation, or poster.

You should include:

- the key information and knowledge about chance, probability, odds, and their relation to betting and gambling that you have learned
- a summary of what sorts of mathematics and what calculations you needed to undertake
- what technology and tools you used
- any surprising and interesting new information you discovered when completing the unit.

Glossary

Term	Meaning
Certain	A probability of 1 or 100%. For example, the sun will rise tomorrow morning.
Chance	The general possibility that something could happen. For example, there is a chance that someone in your class walked to school today.
Equiprobable	When there is an equal chance of success for all outcomes of an event. For example, rolling a normal die.
Experimental probability	Probability that is determined on the basis of the results of an experiment repeated many times. $$P(\text{event}) = \frac{\text{Number of times event occurs}}{\text{Total number of trials}}$$
Frequency	The number of times you observe a particular outcome.
Impossible	A probability of 0 or 0 per cent. For example, rolling a 7 on a normal six-sided die.
Likelihood	Similar to **chance**. Likelihood is mostly used descriptively when talking about the chance of something happening. 'Unlikely' indicates a low probability and 'likely' indicates a high probability.
Long-term data	Used to make informed predictions about the chance or likelihood of events occurring. For example, health, finance, the environment, and the changing climate.
Odds	The ratio of the number of ways something can occur to the number of ways it cannot occur. Odds are often used in betting on sports and races. Odds of 4-to-1 or 4/1 means the lose: win ratio is 4:1, so the probability of success is 1/5. See also **probability**.
Outcome	The result of an experimental trial.
Probability	The chance or likelihood that something will happen, or how likely it is that some event will occur. Probability is measured with numerical values in the range from 0 to 1, or in the range from 0% to 100%.
Random sample	Where each possible item or outcome has an equal chance of being selected.
Relative frequency	The number of times a particular outcome happens divided by the total number of trials. This relates to **experimental probability**.
Risk	The level of possibility that an action or activity will lead to a loss or to an undesired outcome. Risk can be expressed as **probability**.
Sample space	The sample space of an experiment or random trial is *the set of all possible outcomes or results of that experiment*. For example, for rolling a six-sided die it is the set of numbers 1, 2, 3, 4, 5 and 6.

Term	Meaning
Theoretical probability	Probability that is determined on the basis of reasoning. $$P(\text{event}) = \frac{\text{Number of favourable outcomes}}{\text{Total number of possible outcomes}}$$
Trials	When an experiment is repeated a number of times.

Answers

Activity 1. Chance and probability

Q#	Student worksheet 1A: Introduction to chance
1 to 8	No single correct answer(s). Check with your teacher.
9	a) 1/6 = 0.17 = 17% b) 3/6 = 1/2 = 0.5 = 50%
10	a) No single correct answer(s). Check with your teacher. b) No single correct answer(s). Check with your teacher.
11	No single correct answer(s). Check with your teacher.
12	a) The event is expected to occur. This is likely to happen. b) The event is not expected to occur. This is unlikely to happen.
Q#	**Student worksheet 1B: Coin experiment**
1	No single correct answer(s). This is all dependent on chance, not luck. Check with your teacher.
2	No single correct answer(s). Check with your teacher.
3	No single correct answer(s). Predictions are hard to get correct, as this is all dependent on chance. Check with your teacher.
4	No single correct answer(s). Predictions are hard to get correct, as this is all dependent on chance. Check with your teacher.

Activity 2. Odds

Q#	Student worksheet 2A: Introduction to odds
1	a) 1/26 or 3.8% b) 3/4 or 75% c) 1/4 or 25% d) 1/101 or 0.1%
2	Betting on 'the favourite' gives lower returns, or payout.
3	Betting on 'not the favourite' has a higher risk of losing your bet money.
4	The risk and challenge of betting on 'not the favourite' is that you have a higher risk, but potentially greater reward if you win.

5	No single correct answer(s). Check with your teacher.
Q#	**Student worksheet 2B: Odds at the racetrack**
1	a) Answer done: Payout: $80. Profit of $30 b) Payout: $0. Loss of $50 c) Payout: $75. Profit of $25 d) Payout: $0. Loss of $50 e) Payout: $200. Profit of $100 f) Payout: $0. Loss of $100
2	$400
3	$355
4	There was a loss of $45 over the day.
5	Definitions of risk will vary. Elements of chance with reference to potential losses or gains.
6	All bets carry risk. The ones with longer odds like 25/1 carry the biggest risk of losing.
7	Poor odds or longer odds, lead to higher risk
8	Favourites carry less risk as there is a higher chance they will win – they have shorter odds but pay much less return.
Q#	**Student worksheet 2C: Odds with pokies**
1	No single correct answer(s). Check with your teacher.
2	No single correct answer(s). Check with your teacher.
3	This is all dependent on chance. There is no certainty of the numbers appearing, in what order, or whether they are repeated. This could take many spins for all five numbers to appear.
4	Machines are programmed so that they always favour the owner of the machine. Their purpose is to return a profit to the owner/company.
5	a) 3 cherries: $2,000 × 1/125,000 = 0.016 b) 3 watermelons: $1,000 × 3/20,000 = 0.15 c) 3 oranges: $400 × 1/2000 = 0.2 d) 3 apples: $50 × 1/200 = 0.25 e) 3 bananas: $5 × 1/14= 0.36 f) TOTAL ODDS (sum of the returns): 0.975 for each dollar spent is returned to customers
6	Cherries have a high payout and so are programmed to have a low chance of occurring. Bananas are programmed to have a higher chance of winning and so the payout is small.
7	The odds do not add up to one as the machines are weighted. If the total of the odds (the sum of the expected returns) added to one or higher, the punters would win more often. When the machines are weighted, the punter is much more likely to lose, meaning the machines make more money.
Q#	**Student worksheet 2D: An experiment with odds**
1	The first face number '1' should have a frequency of 6, and the number '3' should have a frequency of 9.
2	No single correct answer(s), but a key issue here is that choosing a 'lucky number' has **no** impact on the chance of the number coming up. It is recommended that you have a discussion of risk with the whole class around this activity.
3	No single correct answer(s). Check with your teacher.

4	No single correct answer(s). Check with your teacher.
5	No single correct answer(s), but like question 2, a key issue here is that a 'lucky person' has **no** impact on the chance of any number coming up or of winning in any gambling situation. It is recommended that you have a discussion of risk with the whole class around this activity.

Activity 3. Risk and review

Q#	**Student worksheet 3A: Risk**
1	See answer below.
2	Discuss the mathematical probabilities stated with the whole class and the teacher.
3	All students will have a different perspective on what constitutes risk. Discuss the mathematical probabilities with the whole class and the teacher.
4	No single correct answer(s). Check with your teacher.
Q#	**Student worksheet 3B: Review and reflections**
1	No single correct answer(s). Check with your teacher.
2	No single correct answer(s). Check with your teacher.
3	No single correct answer(s). Check with your teacher.
4	No single correct answer(s). Check with your teacher.
5	No single correct answer(s). Check with your teacher.
6	No single correct answer(s). Check with your teacher.

Student worksheet 3A: Risk

Answer to Question 1: Risk cards

1 in 451,822,158 are the odds of winning a million dollars in the McDonald's Monopoly game	Lowest value risk (or lowest chance of occurring)
The individual odds of winning the lotto jackpot are 1 in 8,145,060	
One in half a million is your chance of dying whilst bungee jumping	
Risk of death from riding a horse in Australia is 0.13 deaths per 100,000 population	
Odds of dying in a cataclysmic storm are 1 in 66,335	
1 in 12,000 is the chance of being struck by lightning in Australia	
Odds of winning an Oscar are 1 in 11,500	
Odds of being injured by a toilet worldwide is 1 in 10,000	
Odds of dying from a cycling accident are 1 in 4,486	
Odds of being born with 11 fingers or toes is 1 in 500	
Chance of injury while base jumping is 0.4%	
0.3% chance of getting seriously ill or dying from an infectious or parasitic disease in Australia	Highest value risk (the most likely to happen)

VCE VOCATIONAL MAJOR –

NUMERACY

UNIT 2

WHAT ARE THE CHANCES?

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