RICH MATHEMATICAL TASK BOOKLET

PROBABILITY

YEAR 7-8

Teacher Booklet

Task 1

TV3 is running a 'best goals in netball' competition.

To enter, you need to order the goals from A to E. There are five to list:

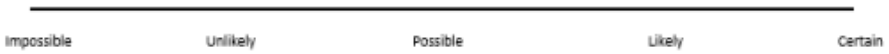
Goal A – Irene van Dyk
Goal B – Maria Tutaia
Goal C – Temepara Bailey
Goal D – Grace Nweke
Goal E – Maia Wilson

What are all the different ways that the goals could be ordered?

How many entries would you need to cover all the possibilities?

Teacher Notes

Before you launch the task, show the students the probability continuum:



Ask the students to consider where they would think that 0%, 25%, 50%, 75% and 100% chance would go on the continuum. Ask them to think of things that they do on the weekend and put these on the continuum for themselves:
Sleep - Go ice-skating - Read a book
Listen to music - See a live dragon - Play sports
Do some chores - Build a sandcastle - Shopping

Ask different students to share their continuum and discuss why they might be different.

Notice whether students are able to systematically record the different options for the order of the best goals and work out how many different combinations are possible. It is important for students to realise that the order matters for the goals.

The possibility of each combination of order of best goals could be linked to fractions in relation to the chance of each combination.

Expect students to use the language of probability with terms such as more likely, less likely, small chance, greater chance and connect this to the probability continuum and percentages.

Big Ideas

When there is a chance-based situation, there are sets of possible outcomes that can be arranged into events. Probability is the chance of an event occurring. This can be represented with language or values (e.g., 0% - impossible or 100% certain).

If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction where the numerator is the number of ways the event can happen, the denominator is the total number of possible outcomes.

Data visualisations can be used to show what outcomes are possible and more likely. They can also be used to represent the results of a probability investigation.

Shareback

Select students to share that have worked systematically to find all the possible combinations.

Select students to share who have used a tree diagram to organise the information.

Connect

What is the probability that Goal B – Maria Tutaia will be the second in the list?

Can you write a rule to find a solution for any number of goals?

Suggested Learning Outcomes

Represent the different outcomes for an event.
Use a tree diagram to represent the different outcomes for an event.
Find all of the possible outcomes for an event.
Find the probability for an event.

Independent Tasks

In the table tennis singles championships, the semi-finalists were:

Santiago, Lia, Chaewon, Sunil, and Pania.

All of the players had to play each other once. How many matches were played altogether?

In the table tennis doubles, the players below had to partner each other for one game:

Reuben, Sally, Sesimani, Hone, Lisa, and Wee-Tiong

How many games would have to be played?

Curriculum Links

During Year 7 ***and Year 8***

Conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:

- identifying and systematically listing possible answers to the investigative question

- creating data visualisations for the distribution of observed outcomes ***and for all possible outcomes for theoretical probability models where they exist***

- describing what these visualisations show

- answering the investigative question

Mathematical Language

Probability, chance, unlikely, possible, likely, certain, equal chance.

Anticipations

Solutions, Misconceptions

Task 2

At the school fair, one of the stalls has a coin toss. To win you have to predict the outcome of tossing three coins. If your coin toss matches the prediction, you win a prize.

What are the possible outcomes? What is the chance of getting each outcome and likelihood of winning a prize?

Use the coin and test the game by trialling tossing the coins for ten trials. Record your results in the table and represent them on a column graph.

Now test the game by trialling tossing the coins 40 more times and record the results and total the outcomes.

Make statements about what you notice.

Teacher Notes

During the launch remind students how to record outcomes using a tally chart.

Have dice available and squared paper to create graphs.

Notice whether students are recording the results accurately and systematically and support them to do this.
Support students to make connections between probability and fractions. Facilitate them to represent the chance of as both a fraction and a percentage.

The connect in this task focuses attention on the difference between theoretical probability and experimental probability and a comparison of this from trials. Support the students to notice that you can have different results for the same trial. Also, that the more trials (the greater the sample size) the more likely the distribution of the experimental probability will be closer to the theoretical probability.

For the independent activity, have coins available to toss and squared paper to develop graphs.

Big Ideas

When there is a chance-based situation, there are sets of possible outcomes that can be arranged into events. Probability is the chance of an event occurring. This can be represented with language or values (e.g., 0% - impossible or 100% certain).

For some situations or games, the chance or probability of particular outcomes can be calculated (theoretical probability). Theoretical probability and what happens in an experiment will differ.

For some situations or games using repeated testing can give a sense of which outcomes are more likely (experimental probability).

A probability experiment involves repeated trials. Results can differ in different trials.

If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction where the numerator is the number of ways the event can happen, the denominator is the total number of possible outcomes.

Data visualisations can be used to show what outcomes are possible and more likely. They can also be used to represent the results of a probability investigation.

Shareback

Select students to share that have worked out the possible ways that the three coins could land and can correct the possibilities to fractions.

For the second part of the task, choose students to share that have recorded their outcomes systematically.

Add the results from different students to a table of possible outcomes and collate the results.

Connect

What do you notice about your prediction (introduce term theoretical probability) and the outcome of ten trials (introduce term experimental probability)?

What do you notice about the outcome when the trials are added together and the sample size is extended?

What does this tell you about probability.

Suggested Learning Outcomes

Identify possible outcomes in a chance situation.
Compare the likelihood of events and represent these as a fraction.
Make a prediction about a chance situation.
Collect and record data for a chance investigation.
Compare theoretical probability with experimental probability.
Recognise theoretical probability is influenced by a smaller sample of trials.

Curriculum Links

During Year 7 ***and Year 8***

Conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:

identifying and systematically listing possible answers to the investigative question

– collecting and recording data

– creating data visualisations for the distribution of observed outcomes ***and for all possible outcomes for theoretical probability models where they exist***

- describing what these visualisations show

- finding the probability estimates for the different outcomes

- answering the investigative question

- reflecting on anticipated outcomes

Mathematical Language

Chance, unfair, fair, equal chance, trial, tally chart, variation, theoretical probability, experimental probability, sample size.

Independent Tasks

At the school fair, one of the stalls has a coin toss. To win you have to predict the outcome of tossing four coins. If your coin toss matches the prediction, you win a prize.

What are the possible outcomes? What is the chance of getting each outcome and likelihood of winning a prize?

Use the coin and test the game by trialling tossing the coins for ten trials. Record your results in the table and represent them on a column graph.

Now test the game by trialling tossing the coins 40 more times and record the results and total the outcomes.

Make statements about what you notice.

Anticipations

Solutions, Misconceptions

Task 3

You have an opportunity to create your own Bingo card with 9 different numbers from 1 to 12.

To play Bingo, the numbers will be generated from adding the scores on two dice.

The winner is the first to complete a row column or diagonal.

After the first Bingo game, you have a chance to modify your grid.

Explain what you have changed and why and justify your new choices.

Teacher Notes

Have dice available for the students to use.

For the first part of the lesson in designing the Bingo sheet, simply ask the students to complete the grid without scaffolding them to inquire deeply.

Play Bingo with the whole group or class and once it has been playing once, then position students to reflect on what happened and consider how a tree diagram or accurate form of listing can help them ensure that they map out the different possibilities when rolling two dice.

Notice whether students realise that specific numbers will be generated more and that these should be placed strategically.
Expect students to use the language of probability with terms such as more likely, less likely, greater chance.

For the independent task, have dice available.

Big Ideas

When there is a chance-based situation, there are sets of possible outcomes that can be arranged into events. Probability is the chance of an event occurring. This can be represented with language or values (e.g., 0% - impossible or 100% certain).

For some situations or games, the chance or probability of particular outcomes can be calculated (theoretical probability). Theoretical probability and what happens in an experiment will differ.

For some situations or games using repeated testing can give a sense of which outcomes are more likely (experimental probability).

A probability experiment involves repeated trials. Results can differ in different trials.

If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction where the numerator is the number of ways the event can happen, the denominator is the total number of possible outcomes.

Data visualisations can be used to show what outcomes are possible and more likely. They can also be used to represent the results of a probability investigation.

Shareback

After the first game of Bingo and reflection time, select students to share who notice that you can increase your chance of winning by choosing specific numbers and ordering these in certain ways.

Students should be able to explain that particular numbers are more likely to be the sum of adding both dice by listing the possibilities and working out the probability and fraction related to this.

Connect

Where is it best to place the totals that are rolled most often?

What would be the optimal Bingo grid to be able to win?

Suggested Learning Outcomes

Identify possible outcomes in a chance situation.
Compare the likelihood of events and represent these as a fraction.
Make a prediction about a chance situation.
Collect and record data for a chance investigation.
Compare theoretical probability with experimental probability.

Independent Tasks

If you roll three dice, would the sum of the dice be more likely to add to 9 or to 10?

Use a representation or diagram to support your answer.

Now, test your prediction for three dice by rolling the dice and trialling this at least 40 times. Record and represent your results.

What do you notice?

Curriculum Links

During Year 7 ***and Year 8***

Plan and conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:

- anticipating what outcomes are possible and which of them are more or less likely to occur

- identifying and systematically listing possible answers to the investigative question

- collecting and recording data

- creating data visualisations for the distribution of observed outcomes ***and for all possible outcomes for theoretical probability models where they exist***

- describing what these visualisations show

- answering the investigative question

- reflecting on anticipated outcomes

Mathematical Language

Chance, unfair, fair, more likely, less likely, trial, tally chart, variation, theoretical probability, experimental probability, sample size.

Anticipations

Solutions, Misconceptions

Task 4

A game uses a set of digit cards from 5 to 9 (5, 6, 7, 8, 9).

To play, you randomly pick two cards out of the bag and add the numbers together.

If the total is odd then you win.

If the total is even then you lose.

Is this a fair game?

Test your prediction using the digit card at least 40 times and add the total. Record and represent the results.

Teacher Notes

Before launching this task, ask students to brain-storm games that they play that involve chance. This could include games such as Yahtzee, Monopoly, Game of Life, card games.

Ask them to brainstorm questions related to the games that they could investigate, this could include the likelihood of different outcomes in Yahtzee, the probability of rolling doubles in monopoly, the spinner landing on specific sets of numbers for Game of Life or the likelihood of turning over particular cards.

Record the questions that could be investigated on the board for the students to select from. This will be the basis of the independent activity and a probability investigation. Let students know that they can either work by themselves or with a partner for the investigation.

Have digit cards and feely-bags available for the students to use.

Expect students to use a tree diagram or accurate form of listing to ensure that they map out the different possibilities and whether they are odd or even numbers when selecting the two digit cards.

Notice students who are able to record and represent the results of the trials accurately using tally marks. Expect students to use the language of probability with terms such as more likely, less likely, greater chance, theoretical probability, experimental probability.

Shareback

Select students to share who notice and explain that odd numbers are more likely to be the sum of adding both digit cards by listing the possibilities and working out the probability and fraction related to this. For the second part of the task, choose students to share that have recorded their outcomes systematically.

Big Ideas

When there is a chance-based situation, there are sets of possible outcomes that can be arranged into events. Probability is the chance of an event occurring. This can be represented with language or values (e.g., 0% - impossible or 100% certain).

For some situations or games, the chance or probability of particular outcomes can be calculated (theoretical probability). Theoretical probability and what happens in an experiment will differ.

For some situations or games using repeated testing can give a sense of which outcomes are more likely (experimental probability).

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If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction where the numerator is the number of ways the event can happen, the denominator is the total number of possible outcomes.

Data visualisations can be used to show what outcomes are possible and more likely. They can also be used to represent the results of a probability investigation.

Connect

Here are two more sets of digit cards. Would you choose either option to maximise your chance of winning?

7, 5, 9, 3, 6
8, 7, 6, 4, 5, 2

Suggested Learning Outcomes

Identify possible outcomes in a chance situation.
Compare the likelihood of events and represent these as a fraction.
Make a prediction about a chance situation.
Collect and record data for a chance investigation.
Compare theoretical probability with experimental probability.

Independent Tasks

You can work with a buddy or by yourself for this activity.

Select a question about a game from the questions that were brainstormed with your teacher at the beginning of the mathematics lesson.

Begin by considering how you will investigate the question.

What outcomes are possible in relation to your question?

What is the theoretical probability of the different outcomes?
Develop a representation that shows this including a graph.

Write a plan for how you will investigate the experimental probability of the outcomes. This will need to have trials with different sample sizes. Develop representations that show these results including graphs.

Make statements about what you have found out.

Make a poster that has the following information;
An introduction including what you choose to investigate.
The theoretical probability and related representations.
The plan to investigate the probability outcomes.
The outcomes of your trials with different sample sizes and the related representations.
Statements related to your findings.
A conclusion.

Curriculum Links

During Year 7 ***and Year 8***

Plan and conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:

- anticipating what outcomes are possible and which of them are more or less likely to occur

- identifying and systematically listing possible answers to the investigative question

- collecting and recording data

- creating data visualisations for the distribution of observed outcomes ***and for all possible outcomes for theoretical probability models where they exist***

- describing what these visualisations show

- answering the investigative question

- reflecting on anticipated outcomes

Mathematical Language

Chance, unfair, fair, more likely, less likely, trial, tally chart, variation, theoretical probability, experimental probability, sample size.

Anticipations

Solutions, Misconceptions

Task 5

Mele and Sima like to play Suipi but they think they need a better understanding of the probability of drawing certain cards.

They list some possibilities and then marked them on the probability scale below:

A club
A King
A black card
A black Queen
A picture card
A diamond
A heart or spade.
Where would each be marked on the scale?

0% 25% 50% 75% 100%

Teacher Notes

Launch the task by ensuring that all students are aware that there are 52 cards in a standard deck of cards.

Have packets of cards available for the students to use if necessary and calculators available if they need these to work out the percentages.

Expect students to use the language of probability with terms such as more likely, less likely, greater chance, theoretical probability, and to connect the task with fractions and percentages.

Shareback

Select students to share who qualify their statements and provide evidence for their decisions. This should include the related fractions and percentages for the theoretical probability.

Big Ideas

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For some situations or games, the chance or probability of particular outcomes can be calculated (theoretical probability). Theoretical probability and what happens in an experiment will differ.

If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction where the numerator is the number of ways the event can happen, the denominator is the total number of possible outcomes.

Connect

If a card is used in the game, how does that change the probability for the next card? Explain the impact for each of the scenarios in the task.

Suggested Learning Outcomes

Identify possible outcomes in a chance situation.
Compare the likelihood of events and represent these as a fraction.
Compare theoretical probability with experimental probability.

Independent Tasks

You can work with a buddy or by yourself for this activity.

Select a question about a game from the questions that were brainstormed with your teacher at the beginning of the mathematics lesson.

Begin by considering how you will investigate the question.

What outcomes are possible in relation to your question?

What is the theoretical probability of the different outcomes?
Develop a representation that shows this including a graph.

Write a plan for how you will investigate the experimental probability of the outcomes. This will need to have trials with different sample sizes. Develop representations that show these results including graphs.

Make statements about what you have found out.

Make a poster that has the following information;
An introduction including what you choose to investigate.
The theoretical probability and related representations.
The plan to investigate the probability outcomes.
The outcomes of your trials with different sample sizes and the related representations.
Statements related to your findings.
A conclusion.

Curriculum Links

During Year 7 ***and Year 8***

Conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:

- identifying and systematically listing possible answers to the investigative question

- collecting and recording data

- creating data visualisations for the distribution of observed outcomes ***and for all possible outcomes for theoretical probability models where they exist***

- proposing possible theoretical outcomes and associated probabilities, for situations where no theoretical model exists

Mathematical Language

Chance, more likely, less likely, trial, tally chart, variation, experimental probability, sample.

Anticipations

Solutions, Misconceptions

Task 6

Read the statements below and discuss whether you agree or disagree with them.

When playing Lotto, never choose six numbers all from the same group (e.g., single digits, multiples of ten)	If you flip a coin and tails comes up 8 times in a row then it is more likely tails will come up again.
A game is fair if you follow the rules.	When playing Lotto, always pick some higher numbers in the 30s
On a spinner with half red and half black, if red comes up a lot then black is more likely to come up next.	If you buy lots of lotto tickets, you will win a prize.

Everyone in your group must agree and you should provide a range of reasons for your argument.

Teacher Notes

During the launch, ensure that the students understand that they need to come to agreement in their groups and that they should have a convincing argument for their decision.

Monitor for students who may indicate misconceptions about probability and independent events, for example, stating if you land on red lots of times then it means black is more likely the next time. These misconceptions should be surfaced and discussed during the large group discussion and sharing back.

Notice students who qualify their statements further by providing quantification to support their arguments. For example, they may map out all the possibilities when tossing a coin and show that there is an equal chance for both heads and tails.

Expect students to use the language of probability in their discussion and to provide thoughtful arguments for their responses to the statements.

Shareback

Select students to share who qualify their statements and provide evidence for their decisions. This might include statements such as tossing a coin is independent of the first toss so it is always half chance or 50% for heads or tails.

Big Ideas

When there is a chance-based situation, there are sets of possible outcomes that can be arranged into events. Probability is the chance of an event occurring. This can be represented with language or values (e.g., 0% - impossible or 100% certain).

For some situations or games, the chance or probability of particular outcomes can be calculated (theoretical probability). Theoretical probability and what happens in an experiment will differ.

If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction where the numerator is the number of ways the event can happen, the denominator is the total number of possible outcomes.

Curriculum Links

During Year 7 ***and Year 8***

Plan and conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:

- posing an investigative question

- anticipating what outcomes are possible

- identifying and systematically listing possible answers to the investigative question

Connect

Create your own statements for other students to discuss.

Suggested Learning Outcomes

Agree or disagree with statements related to the probability of an event.
Provide reasons including quantification to support their argument.
Find the fraction and probability for an independent event (e.g., 50% chance of heads and 50% chance of tails).

Independent Tasks

Finish developing your chance investigation and poster so it is ready to present tomorrow.

Make a poster that has the following information;
An introduction including what you choose to investigate.
The theoretical probability and related representations.
The plan to investigate the probability outcomes.
The outcomes of your trials with different sample sizes and the related representations.
Statements related to your findings.
A conclusion.

Curriculum Links continued

- collecting and recording data

- creating data visualisations for the distribution of observed outcomes ***and for all possible outcomes for theoretical probability models where they exist***

- describing what these visualisations show

- finding the probability estimates for the different outcomes

- proposing possible theoretical outcomes and associated probabilities, for situations where no theoretical model exists

- answering the investigative question

- identifying similarities and differences between their findings and those of others

- reflecting on anticipated outcomes

- comparing findings from the probability experiment and associated theoretical probabilities, as appropriate

- identifying similarities and differences between findings from the probability experiment and associated theoretical probabilities, as appropriate

Mathematical Language

Probability, chance, unlikely, possible, likely, certain, equal chance, independent event.

Anticipations

Solutions, Misconceptions

Task 7

Read your classmates' probability experiment posters.
Make notes on each poster about:

What is interesting?
What is something you have learned from the poster?
What is a question that you have about their experiment?

Teacher Notes

To launch this task, display the posters (independent activity from earlier tasks) detailing the completed probability experiments around the classroom with a piece of paper for feedback next to them.

Put the students into groups and set up a bus-stop activity where they read the poster together and then write responses to the prompts in the paper. After the timer goes off then students go to the next poster and repeat the process.

To conclude, provide students with opportunities to read the feedback about their poster and develop a reflection.

Shareback

After the students have completed the bus-stop activity and written feedback, provide the students with time to look at the comments and feedback related to their poster.

Connect

Ask them to reflect and share on what they learned and what they would do differently if planning the experiment again.

Big Ideas

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For some situations or games using repeated testing can give a sense of which outcomes are more likely (experimental probability).

Data visualisations can be used to show what outcomes are possible and more likely. They can also be used to represent the results of a probability investigation.

Suggested Learning Outcomes

Identify possible outcomes in a chance situation.
Make a prediction about a chance situation.
Critique and analyse the posters produced by other students detailing their probability experiments.
Ask questions about probability experiments and chance situations.

Independent Tasks

Select one or more of the following assessment tasks (attached at the end of the document) as the independent activity:

Task 1: Digit cards

Task 2: Non-transitive dice

Curriculum Links

During Year 7 ***and Year 8***

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- identifying and systematically listing possible answers to the investigative question

- collecting and recording data

- creating data visualisations for the distribution of observed outcomes

- describing what these visualisations show

- finding the probability estimates for the different outcomes

- answering the investigative question

- proposing possible theoretical outcomes and associated probabilities, for situations where no theoretical model exists

- reflecting on anticipated outcomes

- comparing findings from the probability experiment and associated theoretical probabilities, as appropriate

Mathematical Language

Chance, more likely, less likely, trial, tally chart, variation, experimental probability, sample.

Anticipations

Solutions, Misconceptions

Assessment Task 1 - Probability - Year 7 & 8

John invents a game with four-digit cards numbered 1 to 4. To play you choose two of the cards and multiply the numbers together. If you get an odd number, you win a point. If you get an even number then John wins a point.
Is the game fair? Show all the possible outcomes and the chance of each.

Now test your predictions by using the digit cards and drawing out two each time. Choose how many times you will trial game. Record and represent your results. What do you notice? Make statements.

Assessment Task 2 - Probability - Year 7 & 8

Tia invents a game with some dice that she has made. It has 6 faces which she has labelled 1, 2, 3, 5, 7, 9. To play you roll both dice and add the numbers together. If the sum is an odd number, you win a point. If the sum is an even number then Tia wins a point.
Is the game fair? Show all the possible outcomes and the chance of each.

Now test your predictions by using the dice and rolling both each time. Choose how many times you will trial game. Record and represent your results. What do you notice? Make statements.