# Fakes on trial

Students explore randomness when flipping a coin and try to detect if a set of results are fake or real by investigating the relative frequency and comparing observed probabilities with theoretical probabilities.

## Visible learning

### Learning intentions

* To understand and recognise randomness in the outcome of an event.
* To be able to find and explore observed probability.

### Success criteria

* I can explain randomness in the outcome of an event.
* I can make a prediction for the outcome of an event.
* I can justify a prediction of an event.
* I can find the observed probability.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* represents and operates with fractions, decimals and percentages to solve problems **MA4-FRC-C-01**
* solves problems involving the probabilities of simple chance experiments
**MA4-PRO-C-01**

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## Activity structure

### Launch

1. Display the following table for students to see.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| H | T | T | T | T | H | T | H | T | H |
| T | T | H | H | H | T | T | T | H | T |
| H | T | H | H | T | H | H | H | T | H |
| T | H | H | T | T | T | T | H | H | H |
| H | H | H | T | T | T | T | H | H | T |

1. Gradually ask students the following questions one by one, allowing thinking. Select some students to share their thinking with the class:
2. What do you notice? What do you wonder? ([bit.ly/noticewonderstrategy](https://bit.ly/noticewonderstrategy))
3. A student was asked to flip a coin 50 times. She couldn’t be bothered though and decided to fake her results. Could you tell? If yes, justify why.

### Explore

#### Initial exploration

1. Use the Fakes on trial PowerPoint with the whole class to explore which of the following results from 3 students are real and which are fake:
* Student 1

HHHHH|HHHHH|HTHHH|HHHTT|THTHT|THTHT|TTHHH|THHTH|HTTHH|TTHTT

* Student 2

HHHHH|HTTTT|TTTHH|HHHHH|TTHTT|HHHTT|HHTHT|HHTTT|HTTHH|HTHHT

* Student 3

HTHTH|THTHT|HTHTH|THTHT|TTHHT|HTTTH|TTTTT|THHHH|TTTHT|TTHHH

1. The presentation explicitly defines observed probability and compares it to the theoretical probability of tossing a coin, using visual representations.
2. Students use this knowledge to decide which of the above are fakes and which are real.

#### Exploring further

1. In pairs students will investigate through simulations, whether faked results can be detected. Students will need:
2. [Appendix B](#_Appendix_B) a handout
3. Access to Fakes on trial spreadsheet. Refer to [Appendix A](#_Appendix__A) for hints on using spreadsheets with a class.
4. Firstly, students play a game where Player 1 fakes results for flipping a coin 20 times and Player 2 has to guess what they flipped. In each round, if Player 2 guesses correctly, Player 2 gets one point. If Player 2 guesses incorrectly, Player 1 gets one point. Students record this using [Appendix B](#_Appendix_B).
5. At the conclusion of the game, students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) ([bit.ly/DLSthinkpairshare](https://bit.ly/DLSthinkpairshare)) and discuss their strategies using the following questions:
6. As Player 1, share your strategy for trying to make your fakes look as real as possible.
7. As Player 2, share the strategy you used when trying to guess what occurred each round.
8. As a pair, did you have any strategies in common?
9. After the Think-Pair-Share ask some students to share their strategies with the class.
10. Students then use the Fakes on trial spreadsheet to simulate flipping a coin 50 times. They then refresh the data and repeat this experiment 4 times. The instructions for this are in the spreadsheet and listed for students in [Appendix B](#_Appendix_B).
11. Students then examine the data collected by looking at:
12. what the total number of heads and tails are in each trial
13. what the longest run of heads or tails was in each trial
14. how often the trial changed between heads and tails.
15. They record these results on [Appendix B](#_Appendix_B) and reflect on the following questions with a partner:
16. Could you have faked these results rather than use the simulation?
17. Could you have flipped a coin manually and gathered similar results?
18. Are the simulated results different to the results Player 1 faked?

### Summarise

1. Conduct a whole class discussion and collect some data from the whole class.
2. Conduct a [Mentimeter](https://www.mentimeter.com/) poll or similar ([mentimeter.com/](https://www.mentimeter.com/)) to see the largest number of heads and tails within the class.
3. Repeat this for the biggest streaks and the mean streak
4. Ask the students how these results compare to their own.
5. Make a list of strategies that students could use to make ‘fake results’ look as real as possible.

### Apply

1. Individually, students are to create their own fake results for rolling a die 60 times, trying to make them as undetectable as possible. They should consider some of the strategies discussed in the previous section and how they could adapt them to cater for dice rather than coins. Questions to consider include:
2. What is the theoretical probability of rolling each number on the dice?
3. What could the relative frequency be for each outcome?
4. Students then share their results with a partner and each explain the strategies they used to make their fake results undetectable.
5. As a class, discuss the following question:
6. Could we ever really know for certain that a set of results were ‘fakes’?
7. Students to share their answers and explain their reasoning.

## Assessment and Differentiation

### Suggested opportunities for differentiation

**Launch**

* A notice and wonder strategy is used where there is no correct answer so that all students can participate in the discussion.
* Students may need to be reminded of the theoretical probability of tossing a coin as well as multiple visual representations of a half.

**Explore**

* All students will be able to gather the data but may analyse it at different depths.

**Apply**

* Students could fake their own set of data for flipping a coin rather than rolling a die. This means that they can directly use the strategies discussed in the Summarise section without having to adapt them to the new dice context.

### Suggested opportunities for assessment

* Monitor responses in class discussions to check for student understanding of the relationship between observed and theoretical probability.
* Students will demonstrate their working mathematically skills in discussions and justifications.
* Students could submit their fake results from the Apply section, along with a statement explaining the strategies they used.

## Appendix A

### Using the spreadsheet file

This file contains macros and needs the desktop version of Microsoft Excel to run correctly.

The file has been password protected. If teachers wish to make changes, they can unlock the spreadsheet using the password ‘fakes23’.

### Sharing spreadsheet files with your class

#### Whole class activities

Cloud storage is most suitable when you want your whole class to be entering and viewing data in the one spreadsheet file.

##### Cloud storage – Google Drive

Visit [t4l.schools.nsw.gov.au/resources/professional-learning-resources/google-resources/google-drive.html](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/google-resources/google-drive.html) to watch a short video explaining how to share Google Drive files with others (0:57).

##### Cloud storage – One Drive

Visit [t4l.schools.nsw.gov.au/resources/professional-learning-resources/microsoft-resources/microsoft-onedrive.html](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/microsoft-resources/microsoft-onedrive.html) to watch a short video explaining how to share One Drive files with others (1:11).

#### Individual student activities

Assignments in either Google Classroom or Microsoft Teams are useful when you want students to work on their own individual spreadsheet file.

##### Assignments in Microsoft Teams

Visit [t4l.schools.nsw.gov.au/resources/professional-learning-resources/microsoft-resources/microsoft-teams/using-assignments-in-teams.html](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/microsoft-resources/microsoft-teams/using-assignments-in-teams.html) to learn how to create and manage assignments in Microsoft Teams.

##### Assignments in Google Classroom

Visit [t4l.schools.nsw.gov.au/resources/professional-learning-resources/google-resources/google-classroom0/using-assignments-in-google-classroom.html](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/google-resources/google-classroom0/using-assignments-in-google-classroom.html) to learn how to create and manage assignments in Google Classrooms.

##### Other alternatives

Files may also be shared with students via email attachments or your school’s learning management system, for example Canvas, Moodle.

Information on how to use Microsoft Outlook can be found at [t4l.schools.nsw.gov.au/resources/professional-learning-resources/microsoft-resources/outlook--staff-email-.html](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/microsoft-resources/outlook--staff-email-.html).

## Appendix B

### Fakes on trial

1. In pairs assign one person Player 1 and one person Player 2.
2. Player 1 completes column 2 of the table below, faking the results for flipping a coin 20 times, on their own handout.
3. Player 2 then predicts what Player 1 chose for each round – heads or tails.
4. If they predict correctly, Player 2 gets one point. If they predict incorrectly, Player 1 gets one point.

|  |  |  |  |
| --- | --- | --- | --- |
| Round | Player 1 faked results | Player 2 prediction | Points record |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |
| 11 |  |  |  |
| 12 |  |  |  |
| 13 |  |  |  |
| 14 |  |  |  |
| 15 |  |  |  |
| 16 |  |  |  |
| 17 |  |  |  |
| 18 |  |  |  |
| 19 |  |  |  |
| 20 |  |  |  |

1. At the end of the 20 guesses, in pairs discuss each player’s strategy:
2. As Player 1, share your strategy to try to make your fakes look as real as possible.
3. As Player 2 share the strategy you used when trying to guess what occurred each round.
4. As a pair, did you have any strategies in common?

### Examining the real data

1. Open the Fakes on trial spreadsheet. This spreadsheet is used to simulate flipping a coin 50 times.
2. Press the Refresh button to generate new results and then press Copy data set 1. Repeat this process 3 more times using the Copy data set 2, 3 and 4 to save the results.



1. Complete the table below using the data simulated. For each data set:
2. count the number of heads and tails
3. record the longest run of heads or tails in each data set, this is called the maximum streak length
4. record how often each data set changes between heads and tails, this is called the mean streak length. For example, for the results below:

H H T T T H T H T

The total number of heads is 4, the total number is tails is 5, the longest run of heads is 2, the longest run of tails is 3, the mean streak length is calculated by: (2 + 3 + 1 + 1 + 1 + 1) $÷ $6 = 1.5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Data set | Total number of heads | Total number of tails | Longest run of heads | Longest run of tails | Mean streak length |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |

1. Consider the following questions and share your thoughts with your partner:
2. Could you have faked these results rather than use the simulation?
3. Could you have flipped a coin manually and gathered similar results?
4. Are the simulated results different to the results Player 1 faked?

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