

# 4 Statistics and probability

## Teaching support and guidance

### Concepts

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- Modelling
- Patterns
- Validity
- Representation

### Outcomes

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Students will collect, analyse and represent data to aid interpretation. They will utilize different forms of representation and test hypotheses. Students will also utilize probability to quantify the likelihood of events. Questioning the validity of both statistical calculations and probabilities should be the focus throughout.

### Conceptual understandings

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- Organizing, representing, analysing and interpreting data, and utilizing different statistical tools facilitates prediction and drawing of conclusions.
- Modelling and finding structure in seemingly random events facilitate prediction.
- Different statistical techniques require justification and the identification of their limitations and validity.

### Inquiry questions

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- Factual: What is the difference between information and data?
- Conceptual: How easy is it to be misled by statistics?
- Debatable: What is a 'fair' game?

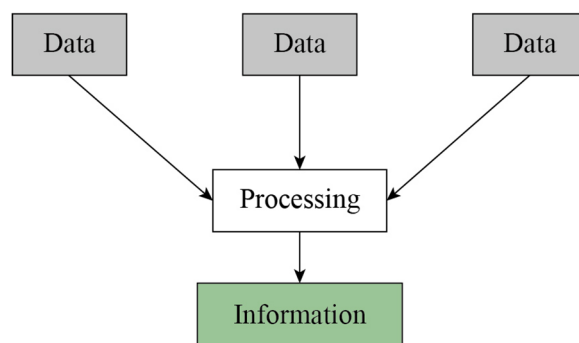
# Factual: What is the difference between information and data?

**Concepts:** Modelling, Validity

## Standard Level

### PowerPoint: Sampling techniques (S4.1)

Information is created from data



Further questions:

- What process (or processes) does data go through for it to become information? How can we be sure our data is valid?
- Discuss with students the process of sampling. How can we be sure that a random sample is truly random?

### Activity: Statistical analysis project (S4.1, S4.2, S4.3, S4.4)

When teaching the Sections 4.1 to 4.4, I recommend that students collect and analyse their own data. This can be intertwined with the content from the sections. As students finish a section in class, they can use the techniques on their own data. This will engage students as they will be working with data that interests them.

It is also another opportunity to use the adapted exploration criteria when grading their work. This is similar to the old mathematical studies project.

Ideas for data collection are listed on the student information sheet, as is the grading rubric should you want to use it.

## Conceptual: How easy is it to be misled by statistics?

**Concept:** Validity

### Standard Level

#### PowerPoint: Misleading data (S4.1)

Using the PowerPoint provided, discuss with students how data can be used to mislead people. It discusses five common methods of misleading uses of statistics. This is by no means an exhaustive list and students may have other ideas during the discussion.

If a student completes their exploration piece using statistics then data misuse must be commented on.

Discuss with students the TOK issues presented on the final slide.

## Debatable: What is a 'fair' game? (S4.5, S4.6, S4.7)

**Concept:** Patterns, Modelling, Representation

### Standard Level

#### Link: Higher or lower? (S4.5, S4.6, S4.7)

You might want to introduce the following TOK questions before beginning this activity:

- What do we mean by a 'fair' game?
- Is it fair that casinos should make a profit?

Play a very simple game of 'higher or lower' with the entire class. The aim is to go from one side of a row of cards to the other side by predicting whether the next card will be higher or lower than the previous.

- Here is a link to the rules:  
<https://ourpastimes.com/card-game-rules-higher-lower-6719324.html>
- This link takes you to an online version of the game:  
<https://www.mathsisfun.com/games/higher-or-lower.html>

Alternatively, you can play it in class with a real pack of cards.

Have students calculate the probability of the next card being higher or lower than the previous – this will help them calculate their chances of winning.

The extra challenge is to analyse a game that is played in a casino. The emphasis should be on the fact that when the mathematics becomes more difficult a player has more chance of losing.

## Higher Level

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### PowerPoint: Markov chains and transition matrices (H4.19)

The PowerPoint introduces the concept of modelling using Markov chains. It leads with a nice example that can be discussed among the class and easily applied to other scenarios.

Markov chains enable mathematicians to hop from one state of representation to another when modelling mathematics.

### Links: The gambler's ruin (H4.18)

The link below provides an introduction to the gambler's ruin problem:

<https://probabilityandstats.wordpress.com/2017/04/08/the-gamblers-ruin-problem/>

The students can simulate the scenario described to obtain their own results, which will lead into a discussion of the calculations and thought process behind the actual gambler's ruin problem.

Emphasis should be on class discussion. Few resources are necessary and the simulation can be run on a spreadsheet package using random number generators, or with real coins.