

Teaching Notes for Dragon Card Lesson Plan: Types of Sampling Curriculum Level 6

Overview

Achievement Objectives

S6-1: ... managing sources of variation, including through the use of random sampling ...

Purpose

This lesson is designed to illustrate how the use of random sampling can reduce potential bias in a sample used to estimate population parameters.

Specific Learning Outcomes

- Gain experience in some sampling methods.
- Appreciate that random sampling can reduce bias in a sample.

Outline

- Types of Sampling video [Full class, 5 min]
- Small dragon height story [Full class, 5 min]
- Convenience sample - [Groups, 10 min]
- Random sampling methods - [Groups, 10 min]
- Method comparison - [Groups, 10 min]
- Wrap up - [Full class, 10 min]

Equipment

- Enough dragon cards for about 90 cards per 4 students (2-3 packs)
- Some way for students to record and share their results
- Sets of counters numbered 1-100 for about half the groups

Preparation

Divide the dragon cards into packs of about 90 cards, one for each group of three to four students. The lesson needs at least two groups. The packs should have a similar make-up of dragons and different but similar numbers of cards.

It is important for the lesson to **stack each pack so the red dragons are mostly at the top or bottom**. This will ensure the convenience method creates a bias, illustrating the weakness of this method.

Set up about half the packs to have mostly red dragons on top and the other half with mostly green dragons on top. This means convenience sampling will apparently show a height difference between islands.

Key Vocabulary

Cluster sample, convenience sample, population, random sample, sample size, sampling frame, simple random sample, stratified sample, systematic sample

Teacher Notes

Timings are approximate.

The statistics strand of the New Zealand mathematics curriculum is made up of three threads: Statistical Investigation, Statistical Literacy and Probability at all curriculum levels. This lesson is a part of the Statistical Investigation thread. The Statistical Enquiry Cycle underlies that thread. While it is used to structure this lesson it is not the main focus of the lesson. Instead the clear focus of the lesson is to introduce students to different methods of sampling and random sampling.

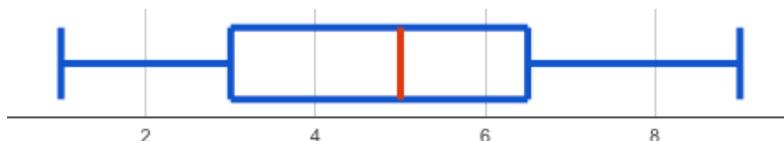
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Small island dragon height

A statistical investigation is more than just the analysis. It is important to have a context, which will give the investigation its purpose. This will inform the statistical questions to ask, the appropriate analyses and give meaning to the conclusions. In a statistical investigation (or lesson) it should be easy to answer the “why are we doing this” questions.

The story is intended to provide context and purpose. It is an important part of the lesson.

This lesson will work best if the baseline (mainland) results used are the students’ results from a previous lesson (StatsLC lesson plan LP5A-Lesson Plan Sample Estimates is ideal). If students have investigated dragon heights previously, use those results. Otherwise the plot below can be used; it is based on a simple random sample.



You may want to remind students that sampling can be used to estimate population parameters.

Before starting the statistical investigation, let the students know that this lesson will switch between applying a statistical investigation and activities for learning. The activities for learning will repeat parts of the same statistical investigation in different ways. It is important to emphasise that this is not the way a statistical investigation runs. It is a way of learning some things about different choices in sampling. **A statistical investigation will only take one sample and only use one sampling method.**

The population pile of dragon cards represents the sampling frame. In practice if the sampling frame included the dragon heights, the whole population would be used – not a sample. For the purpose of the lesson assume the heights are not given in the sampling frame. Instead, there would need to be a separate process of measuring heights for the chosen dragons.

Convenience sample - [Groups, 10 min]

The mechanism for taking a convenience sample (and each of the other sampling methods used in this lesson) has been designed to highlight particular advantages and disadvantages. It is important that the population packs are not shuffled before the sample is taken.

Since the population packs have been stacked with mainly red or mainly green dragons at the top the dragon heights from the sample should be generally lower or generally taller than those from the mainland population. This illustrates the potential for bias in convenience sampling. This aspect of the sample will not become apparent until a random sample has been taken.

Analysis and conclusion – convenience sample

The analysis process will be the same for each sample. It is important for students to draw a conclusion from each sample. A visual comparison is sufficient for this lesson.

Discussion

A convenience sample can lead to bias. However, it is impossible to tell from one sample how much the results reflect the population and how much they are biased.

Random sampling methods - [Groups, 10 min]

Having taken a sample, applied analysis and drawn conclusion the groups have finished a statistical investigation. It is important to make it clear to the class that the next part of the lesson is not a part of a statistical investigation. Instead, it involves students learning about

types of sampling. **A statistical investigation will only take one sample and only use one sampling method.**

Allocate a method to each group so as to cover all methods. The mechanism described for each sampling method has been designed to highlight particular advantages and disadvantages.

Make copies of the cards on the last page of the Lesson Plan to hand out to the groups. These give step-by-step instructions for applying each method.

If you have sufficient time it may be useful to have groups apply more than one random sampling method.

Simple random sample

While a spreadsheet or random numbers from a calculator can be used to determine the sample card's place it is not easy to implement selection without replacement.

For a simple random sample, each member of the population should have equal chance of being chosen for the sample. This usually requires knowing the population size.

Cluster sample

It is fine for the clusters to have different numbers of cards. This is usual in cluster sampling. The sample size will depend on the number of cards in the clusters chosen. The sample size will depend on the number of cards in each cluster selected.

If the population size used is much smaller or much bigger than 90, you may need to adjust the number of clusters chosen and/or the number of clusters created to suit your target sample size.

For a cluster sample, each cluster should have equal chance of being chosen for the sample.

Stratified sample

This sampling method is likely to take the longest. It involves multiple simple random samples. Due to rounding, the actual sample size might be a little different from the planned sample size.

In this stratified sample the proportion of behaviours in the sample matches the proportions in the population. As there is a relationship between height and behaviour in the main population, this would tend to reduce the sampling variation.

Systematic sample

If the population size used is much smaller or much bigger than 90, you may need to adjust the selection system to suit your target sample size.

Due to the random choice of starting card, each card is equally likely to be selected. This method can lead to bias if there is a pattern within the population that matches the selection system.

Analysis and conclusion – random sample

The students should first try to draw a conclusion from their random sample as if this was the only sample taken. That is, they should not refer to their convenience sample results at first.

Method comparison - [Groups, 10 min]

Students cannot tell which sample is most like the population without investigating the population. Instead they should think about the process for each sampling method and consider how the make-up of the population might cause bias for that method.

When considering applying their sampling methods to a real population it might be useful for the students to have some real populations in mind. For example, everyone on the electoral roll, every Year 13 student in New Zealand, every house on a single street, every river or stream in New Zealand.

Wrap up - [Groups, 10 min]

As well as running through the sampling methods and bias, remind students that the lesson was not a statistical investigation. Statistical investigations do not involve multiple samples.

A large project might involve multiple phases with a different method of sampling in different phases. For example a preliminary study using convenience sampling then the main study using simple random sampling or stratified sampling. However, each phase is a separate statistical investigation.

Further activities and resources are provided on <http://Shop.StatsLC.com>

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