Session 11: Introduction to sampling and administration of large scale assessments.

13:30 till 15:00 Day 3

Presented by Jim Tognolini
Introduction to sampling and administration of large scale assessments.

During this session we will

• introduce sampling and administration of large scale assessments through a national case study based on the sampling design of PISA used;

• conduct a practical exercise to choose a sample to assess citizenship across the Kingdom of Bhutan.
A case study on sampling – Year 6
Science Literacy

The construct

"...encompasses the use of broad conceptual understandings of science for making sense of the world, understanding natural phenomena, interpreting media reports about scientific issues. It also encompasses competencies related to asking investigable questions, conducting investigations, collecting and interpreting data and making decisions."

The science items and instruments therefore assess outcomes that contribute to scientific literacy such as conceptual understandings (rather than facts) and investigation competencies within realistic situations. As such, it relates to the ability to think scientifically in a world in which science and technology are increasingly shaping children’s lives.
A case study on sampling – Year 6 Science Literacy

Three strands of scientific literacy were assessed.

**STRAND A:** formulating or identifying investigable questions and hypotheses, planning investigations and collecting evidence.

**STRAND B:** interpreting evidence and drawing conclusions, critiquing the trustworthiness of evidence and claims made by others, and communicating findings.

**STRAND C:** using science understandings for describing and explaining natural phenomena, interpreting reports, and for decision-making.

There was a conscious effort to develop assessment items that relate to everyday contexts rather than to laboratory situations.
The sampling process
Outline of the sampling process

1. Define the target population
2. Describe the sampling frame
3. Choose the appropriate sampling technique
4. Determine the sample size
5. Carry out the sampling process
Sampling

1. Sampling is the process of selecting a small group (called the sample) from a larger defined target group (called the target population) such that the information gathered from the small group will allow judgments to be made about the larger.

2. The purpose of sampling is to determine a target population’s characteristics by directly observing only a small (or sample) of the target population. We obtain a sample rather than a complete.

3. Reasons for sampling include economy, timeliness, minimise disruptiveness, size of population, inaccessibility of target population and accuracy.
Reasons for sampling

1. Economy
2. Timeliness
3. The large size of many populations
4. Inaccessibility of some of the population
5. Accuracy (more controlled sample better than sloppy cohort)
The case study
The case study  
Step 1 : Define the target population  

The target population for the study was Year 6 students across Australia enrolled in schools. A year (grade)-based population was chosen.
The case study

Step 2 : Describe the sampling frame

A sampling frame is a complete list of everyone in the target population that we wish to study. This is describing of everyone who will be eligible to be in the sample (e.g. All Year 6 students in Australia) and then making explicit exclusions (e.g. Students who have a moderate to severe permanent physical disability such that he/she cannot perform the test. Students who have a mental or emotional disability and are cognitively delayed such that they cannot perform in the test.)
The case study

**Step 3 : Choose the appropriate sampling technique**

1. Probability sampling where there is an equal chance of being included in the sample (random) OR
2. Non-probability sampling where there is unequal chance of being included in the sample (non-random)
The case study
Step 3 : Choose the appropriate sampling technique (Continued)

Types of Probability sampling:

1. **Simple random sampling**: is a method in which every one in the sampling frame has an equal nonzero chance of being selected (e.g. random number generator)

2. **Systematic random sampling**: is a method in which the defined target population is ordered and the sample is selected first selecting a fixed starting point in the target population and then obtaining subsequent people by using a constant interval between samples taken (e.g. if the total population was 1,000 and a sample of 100 people was required within that population then the process would involve observing every 10th person)
Types of Probability sampling:

3. **Stratified random sampling**: is where the chosen sample is forced to contain people from each of the segments, or strata, of the target population which are considered important by the researcher (e.g. school type, school location, gender). The process involves dividing the population into mutually exclusive and exhaustive groups (strata) based on appropriate population characteristics (e.g. country, province, school, age, gender) as defined by the questions that have been posed for the research survey. Simple random samples are then drawn from each stratum. This sampling ensures representativeness when proportional sampling used
**Strata for scientific literacy Example**

**Level 1:** What is the achievement level of scientific in Year 6 primary school children in Australia?

**Level 2:** What is the achievement level of scientific in Year 6 primary school children across states in Australia?

**Level 3:** What is the achievement level of scientific in Year 6 primary school children in different sectors across states in Australia?
The case study
Step 3: Choose the appropriate sampling technique (Continued)

Types of Probability sampling:

4. **Cluster sampling**: is where clusters of the target population are selected at random and then all or some randomly chosen units in the selected clusters are studied. The target population is divided into mutually exclusive and exhaustive subgroups, or clusters and then a simple random sample of a few clusters is selected (e.g. school districts within a province).
The case study
Step 3: The case study simplified

The design implemented for this exercise is a stratified random sample.

The sampling units consisted of students across the state. All students from across two states (NSW and Victoria) represented in the sampling frame.

The sample frame was partitioned into 6 strata (2 states and 3 sectors within each state).
**Level 1**
What is the achievement level of scientific in Year 6 primary school children in Australia?

**Level 2**
What is the achievement level of scientific in Year 6 primary school children across states in Australia?

**Level 3**
What is the achievement level of scientific in Year 6 primary school children in different sectors across states in Australia?
Step 4 : Determine the sample size

The sample size is the size of the sample needed to achieve the desired level of accuracy or confidence level. Usually the confidence levels are set at either 95% or 99%.

In the example that is being considered the intention is to a-priori set a sample size of 10%. This is quite high for a random sample design but it has been politically designated. That is the sample size will be 15,449 (approximately).
### Strata for scientific literacy Example

<table>
<thead>
<tr>
<th>State</th>
<th>Sector</th>
<th>Year 6 Enrolment</th>
<th>% of Total</th>
<th>Target Sample</th>
<th>Number achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New South Wales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td></td>
<td>63,182</td>
<td>40.9</td>
<td>6,318</td>
<td>6,118</td>
</tr>
<tr>
<td>Catholic</td>
<td></td>
<td>17,585</td>
<td>11.4</td>
<td>1,758</td>
<td>1,632</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td>8,457</td>
<td>5.5</td>
<td>846</td>
<td>817</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>89,226</strong></td>
<td><strong>57.8</strong></td>
<td><strong>8,922</strong></td>
<td><strong>8,567</strong></td>
</tr>
<tr>
<td><strong>Victoria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td></td>
<td>44,424</td>
<td>28.8</td>
<td>4,442</td>
<td>4,319</td>
</tr>
<tr>
<td>Catholic</td>
<td></td>
<td>14,631</td>
<td>9.5</td>
<td>1,463</td>
<td>1,424</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td>6,210</td>
<td>3.9</td>
<td>621</td>
<td>612</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>65,265</strong></td>
<td><strong>42.2</strong></td>
<td><strong>6,526</strong></td>
<td><strong>6,355</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>154,491</strong></td>
<td><strong>100</strong></td>
<td><strong>15,449</strong></td>
<td><strong>14,992</strong></td>
</tr>
</tbody>
</table>
The case study
Step 5: Carry out the sampling process

Implement sampling method and collect the data.

In the Science literacy example, a sampling frame consisting of numbers 1 to 63,182 was produced. New South Wales Government Schools were then represented by the number of Year 6 students in the school. For example, if there were 145 students in school A in the Government Sector in New South Wales, a line was ruled across under 145. Then if there were another 100 students in school B in the Government Sector in New South Wales numbers 146 to 245 were allocated to school B; etc.

The same exercise was carried out for each of the sector level strata.
The case study
Step 5 : Carry out the sampling process

A random number generator then produced 5 digit numbers from 1 to 63,182. If there were repeat numbers then another number was generated. When the number was generated that number was crossed off in the table of numbers.

This process was continued for the first strata until 6,318 (actually about 10 per cent more for absentees) numbers had been crossed off. The school data were then summarised as “your sample consists of 12 students. The numbers corresponding to students in the school i.e. 5th, 19th, ... were sent to the school.

Each school was given an instruction to order their students numerically by their surname and choose the 5th, 19th, ... to sit the test. There were also some reserves if some students were absent.
Some results from the science literacy example

<table>
<thead>
<tr>
<th>State/ Territory</th>
<th>Level 2 and below</th>
<th>Level 3.1</th>
<th>Level 3.2</th>
<th>Level 3.3</th>
<th>Level 4 and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>3.4</td>
<td>33.7</td>
<td>52.6</td>
<td>10.1</td>
<td>0.1</td>
</tr>
<tr>
<td>95pcc.i. (+/-)</td>
<td>0.8</td>
<td>2.1</td>
<td>2.4</td>
<td>1.6</td>
<td>0.2</td>
</tr>
<tr>
<td>VIC</td>
<td>4.4</td>
<td>36.9</td>
<td>52.3</td>
<td>6.3</td>
<td>0.0</td>
</tr>
<tr>
<td>95pcc.i. (+/-)</td>
<td>1.0</td>
<td>2.7</td>
<td>2.7</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>ALL</td>
<td>4.6</td>
<td>37.2</td>
<td>50.5</td>
<td>7.6</td>
<td>0.1</td>
</tr>
<tr>
<td>95pcc.i. (+/-)</td>
<td>0.4</td>
<td>0.9</td>
<td>0.9</td>
<td>0.5</td>
<td>0.1</td>
</tr>
</tbody>
</table>
A practical exercise
A practical exercise

1. Background

1. As part of the monitoring exercise conducted by the Assessment and Monitoring Division, Bhutan Council for School Examinations and Assessment (BCSEA), on behalf of the Bhutanese Government, schools have to assess their students on citizenship (which includes indicators as to whether the students are relatively law-abiding, comply with morality, honesty, environmental awareness, participate in public events, information literacy and have an international perspective).

2. As part of the national monitoring program BCSEA has been asked to select a sample and administer the program of assessment which involves selecting a sample of 15% of schools with Grades 4 and/or 8; observing a random sample of 10 students from within these schools, in different circumstances over a period of 1 month; completing an assessment against a standardised rubric; and uploading the results to the Monitoring Committee.
A practical exercise

2. Exercise

1. Design a sampling frame for the Bhutan.
2. Identify the strata levels that you believe would be required for such a study.
3. Explain how you would carry out a sampling exercise to select a two-stage cluster sample with the cluster size to be 10 children from each of Grades 4 and 8.
4. Describe some of the threats to the sampling exercise and how you would go about addressing these threats.