TEACHING & LEARNING RESEARCH INITIATIVE
NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

PO Box 3237
Wellington, New Zealand
e-mail: tlri@nzcer.org.nz

"Bootstrapping" statistical inferential reasoning

TRLI grant holders: Maxine Pfannkuch, Auckland University, Sharleen Forbes, Victoria University, and John Harraway, Otago University.

Project start date: January, 2011 **Project Finish date:** January, 2013

Introduction

The project team will develop innovative dynamic visualisation approaches in order to improve students' intuitive understanding of statistical inference. Approximately 2000 Stage One Statistics students, 40 workplace students, 150 Year 13 students, 11 university lecturers, and 13 Year 13 teachers will be involved in the study.

Aims

We aim to build on our current research into the development of a conceptual pathway for statistical inferential reasoning across Years 10 to 12. In Year 13 and introductory statistics courses, research has consistently demonstrated that formal statistical inferential reasoning remains elusive to the majority of students. Many statisticians and researchers conjecture that the problem lies with the fact that inference is grounded in mathematics and that the mathematical manipulations act as obstacles to understanding the thinking behind inference. Some statisticians believe that methods such as bootstrapping, which are increasingly part of statistical practice, will help students better understand inferential concepts. The gap in the existing knowledge base is the extent to which techniques such as bootstrapping will allow students to have access to inferential concepts. Our conjecture is that the devising of learning trajectories that include conceptually accessible visualizations together with new verbalisations, without the need for complex mathematical manipulations, will allow students to understand and successfully use inferential reasoning.

We are interested in finding out:

- When students experience methods such as bootstrapping and visualisations what new issues arise in their reasoning processes?
- How can students be stimulated to develop inferential concepts and what type and level of inferential reasoning can they achieve?
- What learning trajectories will facilitate students' conceptual access to the ideas behind statistical inference using bootstrapping and randomisation methods?

Why is this research important?

Current teaching of statistical inference, grounded in mathematical theory and calculations, makes the reasoning inaccessible to the majority of students. Computer intensive techniques, particularly bootstrapping and dynamic visualisations, show promise for allowing access to the big ideas of inference earlier and to a much wider spectrum of students. In the real world survey and experimental data is increasingly being used in evidence based decision-making. To correctly interpret these data requires a conceptual understanding of statistical inference. This is currently not widespread in the workplace. To achieve equitable employment and pro-societal data-informed decision-making outcomes this learning should be available at all levels of education: schools, university and in the workplace.

What we plan to do

Data

In the first year we will collect data from a pilot study involving some Stage One and Year 13 statistics students. Data will be: student pre and post-tests and interviews, videos of teaching implementation, and reflections and observations of the project team on the implementation.

In the second year pre and post-test achievement data will be collected from all students. Some students from Stage One, the workplace and Year 13 will be interviewed before and after the teaching intervention. We will observe and video some classes during the implementation. Reflections from teachers on the implementation will also be gathered.

Analysis

The achievement data will include multi-choice and free responses. Using an assessment framework based on the SOLO taxonomy, free response data will be scored. Standard statistical analysis techniques will be used to determine the level and type of reasoning achieved.

We will use thematic analysis techniques for qualitative data to examine student conceptualisations of statistical inference and hence identify patterns of reasoning and how these might be linked to the learning trajectories.

Our partners:

The project team includes the following partners:

Core development team from the Department of Statistics, The University of Auckland – Conceptual developer: Chris Wild. Resource developers: Matt Regan and Ross Parsonage. Practitioner researcher: Stephanie Budgett

Eleven introductory statistics university lecturers from Auckland, Victoria and Otago.

Thirteen Year 13 Statistics Teachers from a variety of New Zealand schools.

Four New Zealand mathematics teacher professional development facilitators from Auckland, Christchurch and Palmerston North.

Contact details
Dr Maxine Pfannkuch
Department of Statistics
Auckland University
Private Bag 92019
Auckland 1142
m.pfannkuch@auckland.ac.nz
Phone: 64 9 923 8794
TLRI web page