Statistics education Early 21st Century New Zealand

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Bevan Werry Presentation

Problem

- **What are the big ideas in Statistics Education in the early 21st Century…**
  - According to Pip Arnold Bevan Werry Presentation November 2008

Problem

- Statistical investigation cycle
- Has at its heart a starting point based on a problem.
- Four or five phases.
  - Wild & Pfannkuch, 1999
  - Graham, 2006
  - Franklin & Garfield, 2006

Problem

- My theory is that there is *question posing* and *question asking*.
- Question posing results in a question being formally structured,
- Whereas question asking is a continual spontaneous interrogative process.

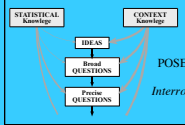
Posing questions

- Question posing arises as a result of having a problem that needs to be addressed using a statistical investigation.
- Investigative question
  - The question being asked of the data
- Survey question
  - The question asked to get the data

Asking questions

- The *interrogative* questions – questions that are asked as checks within the cycle (the problem, the plan, the data (given data sets), the analysis, the conclusion);
- The *analysis* questions that are asked about the statistics, graphs and tables to develop a description of and an inference about what is noticed (the analysis).

PROBLEM



Motivating situation/question/idea.

Could be either a survey or experiment situation.

POSE *investigative* question.

Interrogate investigative question.

PLAN

Develop measurement instruments and data collection procedures.

POSE *survey* questions.

Interrogate plan.

(Wild & Pfannkuch, 1999, p. 228)

Update investigative question as appropriate and as necessary based on planning.

DATA
Collect data.

Revisit the investigative question updating if necessary (maybe pose new investigative questions that have become apparent after collecting the data).

ANALYSIS
Calculate statistics, draw graphs, create tables as appropriate.

ASK *analysis* questions about the statistics, graphs and tables and describe what is noticed.

Revisit the investigative question updating if necessary (maybe pose new investigative questions that have become apparent after analysing the data).

CONCLUSION
Write the conclusion answering the investigative question(s). Use supporting evidence from the analysis. Make inferences about the population.

Interrogate the conclusion.

POSE further investigative questions as a result of conclusion.

DATA/PLAN
Data set given.

Explore the data given, how it was collected, who it was collected from etc. Find out the *survey* questions if used. Identify the variables of interest, identify the population of interest.

Interrogate the data.

PROBLEM
Motivating situation/question/idea.

POSE *investigative* question.

Interrogate investigative question.

ANALYSIS
Calculate statistics, draw graphs, build tables as appropriate.

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Types of Investigative Questions

- Summary
  - A description of the data, usually a single data set
- Comparison
  - Comparing two (or more) sets of data across a common variable
- Relationship
  - Interrelationship between two paired variables

Pfannkuch & Horring, 2005; Graham, 2006

Problem

- What is the population?
  - Yr 11, NZ, 2007, C@S database
- Average/typical/range do these all mean the same?
- a, the, nothing (a boy, the boys, boys)
  - Sample/population
  - Individual/aggregate
- What is typical?

Problem

- What is the population?
  - Yr 11, NZ, 2007, C@S database
- (1)I wonder… what the typical height of a year 11 girls is from the 2007 NZ C@S database.

Problem

- Average/typical/range do these all mean the same?
- (1)I wonder… what the typical height of a year 11 girls is from the 2007 NZ C@S database.
- (3)I wonder on average how many languages a year 11 can speak from the 2007 NZ C@S database.

Problem

- a, the, nothing (a boy, the boys, boys)
  - Sample/population
  - Individual/aggregate
- (4)I wonder if the typical height of a year 11 girl is higher than a year 11 boy from the 2007 NZ C@S database.
- I wonder if the boys are taller than the girls.
- (5)I wonder if on average year 11 girls speak more languages than year 11 boys from the 2007 NZ C@S database.

Problem

- What is typical?
- (13) What is the height of the typical NZ year 11 student.

Problem

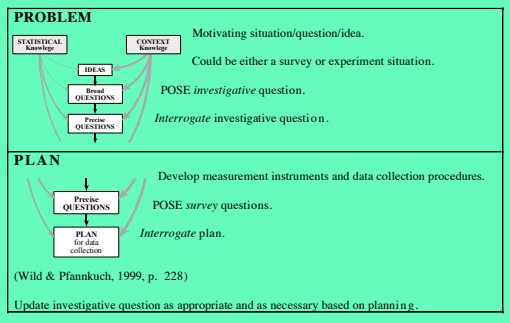
- Discuss the questions in pairs.
- What do you notice?

What makes a good question?

- can be answered with the data
  - Sample size, variable(s) available
- population of interest is clear
  - a, the, nothing
    - sample v target population
    - Indvidual v aggregate
- variable(s) of interest is/are clear
- intent is clear
  - summary, comparison, relationship
  - What is typical? is clear
- one that we are interested in the answer

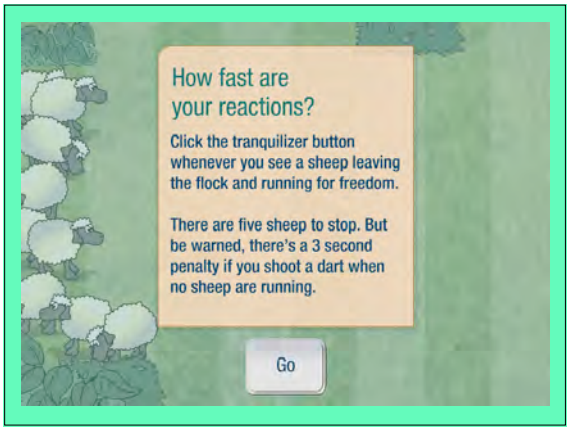
Plan

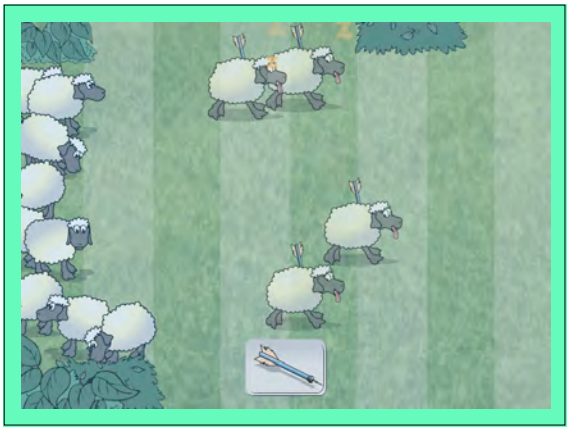
- Planning where the data is collected.
  - Happens once the problem is set.
- Planning where the data is given.
  - Happens as part of the problem setting process.
  - Exploring the planning that was done.
  - Understanding the situation.

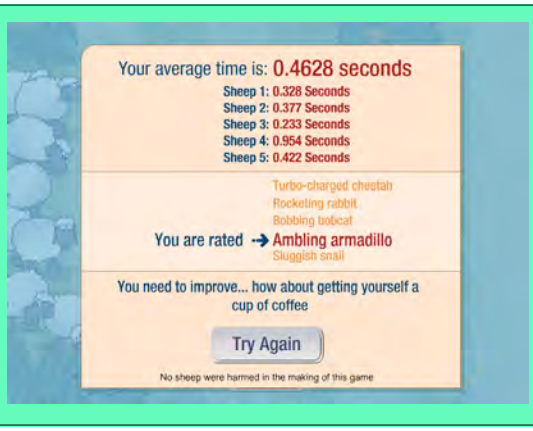


Reaction times

- Problem: Do my reaction times tend to be faster than my partners?
- Plan:
  - How to measure reaction time?
  - Decide to use sleeping sheep.
  - Go to web page.







Reaction times

- How many measures will they take?
- Will they allow a practice run?
- How will they deal with penalty shots?
- How do we know everyone has done the same trialing?
- Will we collect individual results or averages?

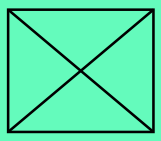
DATA/PLAN Data set given. Explore the data given, how it was collected, who it was collected from etc. Find out the *survey* questions if used. Identify the variables of interest, identify the population of interest. *Interrogate* the data .
PROBLEM Motivating situation/question/idea. POSE *investigative* question. *Interrogate* investigative questi o n .
ANALYSIS Calculate statistics, draw graphs, build tables as appropriate. ASK *analysis* questions about the statistics, graphs and tables and describe what is noticed. Revisit the investigative question updating if necessary (maybe pose new investigative questions that have become apparent after analysing the data).
CONCLUSION Write the conclusion answering the investigative question(s). Use supporting evidence from the analysis. Make inferences about the population. *Interrogate* the conclusion. POSE further investigative questions as a result of conclusion .

Being typical

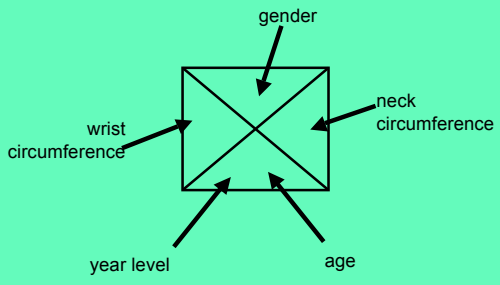
- Students are given data to work with.
- Use data cards.
- Give each group a different sample.
- What do we know about the data on the cards?
- Taken from Census at School database, Questions about You.

Being typical

- Take a few data cards each.
- Discuss in pairs/groups what you think the variables might be.



Being typical



Being typical

- Are you: male/female
- What is your wrist circumference in cm?
- What is your neck circumference in cm?
- Year level was by default - based on teacher entry.
- How old are you?

Being typical

- Take one card and describe the person on it to your neighbour.
- Now **write** the description down!

Being typical

- This student is a boy. He is in Year 9 and is 14 years of age. His wrist circumference is 15cm and his neck circumference is 30cm.
- Draw a data card to show this student's data.

Being typical

- Students need to understand that each card is a person.
- They need to become familiar with the context.
- They need to know what the questions were that were asked to get the data.

Websites for data

- CensusAtSchool NZ
  - http://www.censusatschool.org.nz/
- CensusAtSchool International
  - http://www.censusatschool.ntu.ac.uk/
- Statistics NZ
  - http://www.stats.govt.nz/schools-corner/default.htm
- Exploring data
  - http://exploringdata.cqu.edu.au/datasets.htm

CensusAtSchool

- 2003
  - 18,000 participants; 682 schools
  - 26 variables; Year 5-10
- 2005
  - 33,205 participants; 18,516 girls; 14,689 boys
  - 32 variables; Year 5-10
- 2007
  - 25,007 participants; 13,578 girls; 11,429 boys
  - 31 variables; Years 5-13

census at school new zealand

CensusAtSchool

3 March 2009 until 9 April 2009

- Register online
- http://www.censusatschool.org.nz/2007/register/
- If you have previously registered, you won't need to register again. You should have already received an email to confirm this.

census at school new zealand

CensusAtSchool

NEW FOR 2009

- Teachers will get their class results back if they choose.
- Early in year so 2009 data can be used for 2009 teaching.

Cleaning Data

- Sort the data you have in your bag.
- Identify any data that you think is unusual.
  - What makes it unusual?
  - Do you think it is "correct" data? Why? Why not?
  - What will you do with the data that is "not correct"?

Sampling variation

- CensusAtSchool and other databases provide an opportunity to give students different samples from the same population.
- The data sets you have are all from the same population (2005 NZ C@S database) but are different samples. There are six samples altogether.

CensusAtSchool

- Simple analysis tools
  - Data viewer
  - Summary tables
- New for 2009
  - PPDAC structured worksheet (online)
  - Go to PPDAC page.

Ideas for summary

- *I notice…*
- Describe
  - Shape
  - Spread
  - Middle group(s)
  - Anything unusual
- Remember context. If I cover any labels can I still tell what the graphs are showing.

Ideas for comparison

- *I notice …*
- Describe
  - Shape
  - Spread
  - Middle 50%
  - Summary statistics
  - Anything unusual

Analysis

- Need to model.
- Need to give structure.
- Need to remember context.
- Need to do in class.
- Need to describe not just answer question.

Analysis

- Inference
- Informal comparative reasoning - Pfannkuch et al 2008
- Informal statistical inference - Wild

Conclusion

- Some starting points for conclusions.
  - Answer the question.
  - Provide supporting evidence from your analysis.
  - Generalise to the population of interest.

Conclusion

- **What are the big ideas in Statistics Education in the early 21st Century…**

Conclusion

- Problem is critical.
  - Variables of interest
  - Population of interest
  - Intention
  - Able to be answered by the data
  - Answer is of interest to someone
- Don't hurry this part. Take time to establish the context - link to planning for given data sets.

Conclusion

- Planning is an often over looked aspect of the cycle.
- With given data sets it is important to provide background information about how the data was collected; what were the survey questions, who was surveyed.
- Context - students need to be familiar with the context.

Conclusion

- Use real multivariate data sets.
- Give groups different samples from the same population. Compare and contrast outcomes.

Conclusion

- Analysis is about describing the data.
- *I notice …*
- What is it that the data tells you?
- Look at the shape, spread, middle group, anything unusual.
- Remember to relate to the context.
- Make inferential statements when you can.

Conclusion

- Answer the problem.
- Give supporting evidence.
- Generalise to the population.

- MODEL, MODEL, MODEL