Statistical literacy for all: teaching *Critical Thinking with Data*

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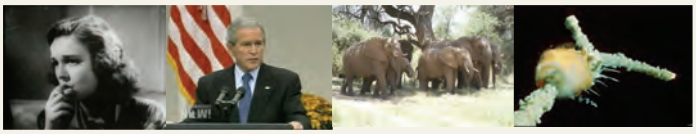
Critical thinking with data

We aim to teach

- the relevance of statistical literacy
- the fundamentals of statistical science
- critical evaluation of statistical information and arguments
- the purpose and logic of data-based investigations
- processes involved in conducting data-based investigations
- the disposition of an enquiring statistical consultant
- generic skills relating to presentation, written communication, and teamwork
- in an innovative way that avoids a formal mathematical treatment

Critical thinking with data is a University of Melbourne breadth subject available to all first year students under the *Melbourne Model*.

Engaging students



movies

Royal Auto, March 2008

images

news articles

the best of the web

We engage students with

- rich, interesting, diverse content from medicine, commerce, land & food science, ecology, biology, environmental science, and more
- examples, cases studies and materials from the contemporary local media and academic contexts

- beautiful historical examples and case studies: for example, trials of the Salk vaccines, the Challenger disaster, John Snow's mapping of the 1854 cholera epidemic
- guest lecturers from applied disciplines

- learning in depth about the context

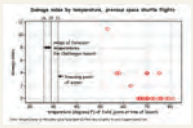
Curriculum design

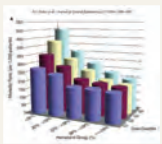
- identified learning outcomes topic by topic
- tailored lecture material, tutorial activities and assessment to the types of knowledge, skills and dispositions we wanted to teach
- presented statistical content
  - conceptually but in depth
  - without relying on computation or production of 'output'
  - in a way that was substantially different from standard courses
- included standard topics as well as experimental design, risk, meta-analysis and psychological influences on probability

An example: teaching graphics

Lectures
- good and bad graphical practices
- features of good graphs
- research on interpretation of graphs
- critiquing, improving graphical displays
- five principles of good graphs
- standard graphical forms to use
- Edward Tufte, William Cleveland

Some case studies and examples
- New York Times graphics
- Academic publications
- Royal Auto graph
- Challenger disaster
- Gapminder





Learning activities and assessment
- producing simple graphs by hand
- interpreting and critiquing graphs
- producing a Gapminder graphic
- recognising graphical forms fit for purpose

Assessing students

Online tests and quizzes
- multiple choice, multiple answers, numerical, matching, ordering, hot spot questions

200 word assignments
- critical evaluation of a data-based argument; write a letter, email or commentary

Poster and verbal presentation
- group work on genuine published research

1200 word study review and evaluation
- critical evaluation of the same study

Examination
- multiple choice, short and long answer

Feedback from 2008 cohort

In 2008: "I have developed my capacity to think about quantitative information" (81% agreed)
"I feel confident that I can critically evaluate newspaper articles reporting quantitative research data" (78% agreed)

In 2010, their advice to students considering the course:
"*Critical thinking with data* is definitely one of the most useful subjects I've done in my 3 years at university."
"Make the most of *Critical thinking with data*, because the lessons you learn can be used throughout your degree, & potentially the rest of your life."
"*Critical thinking with data* will change the way you think and analyse in general and not only in relation to data."

Thanks to Robyn Pierce and Robert Maillardet for the follow up survey.