

# Service teaching statistics to non-statisticians: opportunities and challenges

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## Overview

- Case studies of service teaching Statistics at Lancaster University
- Using technology in service teaching Statistics and E-learning
- Recommendations & Conclusions



## Service Teaching Statistics: Problem Areas

- Students do not necessarily have **an interest in the subject**:
  - Unhappy memories of school mathematics
  - Expecting statistics to be boring or incomprehensible or both
- It is well documented in the literature that statistics courses often generate **anxiety** (Garfield, 1995).
- There is a general feeling that today's students are not as well prepared for college level science and mathematics courses as they were 20-30 years ago. (We are living in a **numerically illiterate society**?)
- Service course classes tend to be large.

## Successful Service Course?

- One aim of a service course could be to enable a student to interpret the statistics that are found in that **subject's publications**...
- All service courses face problem of poor **motivation**. One of our major problems is how to motivate students, particularly on service courses, to want to learn ...
- In many ways it is **assessment** that drives student learning ...

# Case Study 1: “Social Data Analysis”

- 2<sup>nd</sup> year course
- Faculty of Arts & Social Sciences.
- Delivery structure: 1 lecture + 1 practical per week, 10 weeks
- **Method: Team teaching**
  - Types of team teaching
  - Interdisciplinary team teaching



## Team Teaching: How we do it

- Two instructor model: statistician & social scientist (one with technical skills, one with long experience of quantitative research in social sciences)
- Joint lecturing
- Input from subject specialist: a lot of examples from subject area

Students learn statistics in the context of their subject...

# Team Teaching: Benefits and Challenges

## Students feedback

*“The module enjoyable for the most part. The split between lecture and practical session for one hour each is also very effective. As many in the group are not statisticians, it is useful that the lecturers’ disciplines differ as their explanations also differ and ensure that everyone understands.”*

*“The ‘Statistician and Social Scientist’ routine worked well as a paradigm for the theory-practice progression.”*

*“Watching instructors debate using different methodological approaches allows students to see the advantages of different disciplines...”*

# Team Teaching: Benefits and Challenges

## Some recommendations...

1. It's much better to work with someone you know well and like.

Team teaching requires a high level of co-operation and of trust, and working with the wrong person can prove a discouraging experience!

2. Careful planning is essential.

Team teaching requires different preparation than traditional single-instructor course, particularly concerning the organisational aspects of course management.

3. You don't have to do team teaching all the time.

It may be that only part of the lesson really benefits from the presence of more than one teacher in the classroom.

## Case Study 2: “Measuring Crime”

- 2<sup>nd</sup> year course
- Faculty of Arts & Social Sciences.
- Delivery structure: 1 lecture + 1 computer workshop per week, 10 weeks
- 5 Assignments (25%) + Course work (25%) + Exam (50%)
- **Motivating students** by using real life crime data and case studies



# “Measuring Crime” Course

“One of the major problems is how to motivate students to want to learn”

## Main concepts of the course:

1. Using real data (British Crime Survey, ESRC UK Data Archive, Police recorded statistics, Home Office, criminal and court statistics...)

2. Learning basic concepts in numeracy (Emphasis on conceptual understanding. Avoid teaching mathematics in isolation...)

*Lecture 1: “It is a course on data, not on statistics”*

3. Real life applications  
(Problem-Based approach...)

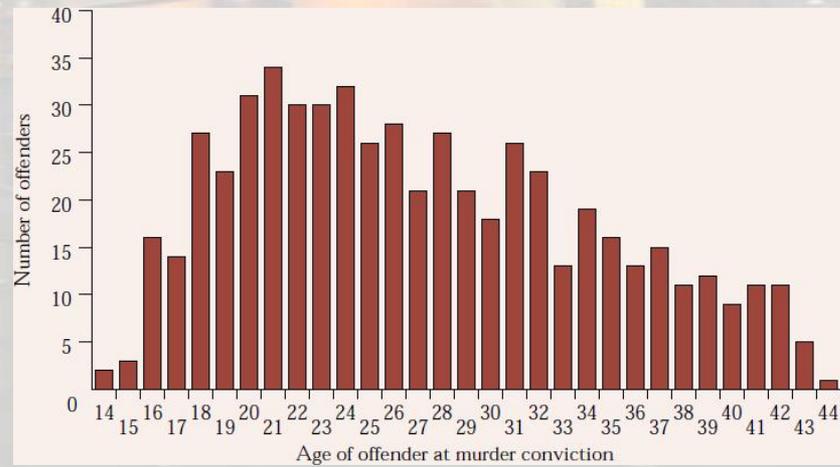


# “Measuring Crime”

## 4. Using **graphics**: illuminating the subject material



*100 years of homicide and attempted murder*



*Age of 569 offenders convicted of murder*

# “Measuring Crime” Course

## Students feedback

Q: What were the most valuable parts of the module?

“Looking at crime from a different perspective, and looking at statistics analysis instead of looking at more theoretical factors.”

“Looking at understanding criminological statistics and what they really mean...”

“Although a challenging course and difficult at times to understand, this module was interesting and aided other modules in the course.”

## Case Study 3: “Analysing and Interpreting Data”

- 4<sup>th</sup> year course for Psychology students
- Faculty of Science and Technology
- Delivery structure: 1 lecture + 1 practical per week, 10 weeks
- Some Psychology students comments:
  - “ I don’t need statistics to be a psychologist”
  - “ What worries me more is that my math skills isn’t good enough”
  - “ I think I won’t understand anything at all”

## Teaching Statistics for Psychology students

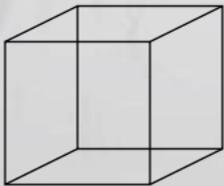
- Group work
- Lectures are followed by Practical sessions
- Statistics as a way of describing psychology in another language
- To make students more interested in statistics, help them see the **importance of using statistics** in psychology research.

# Teaching Statistics for Psychology students

## Two 'controversial' approaches:

1. Focus on **learning statistical concepts**
  - More traditional approach
  - "Not sensible to include examples from students' area since teacher is not expert in that field"
  - Motivate students by use of real data, media, graphics
2. Focus is on learning **statistics integrated with a psychology**
  - Use students interests and motivation in Psychology
  - Learning statistics in the context of the serviced discipline:

Example of research problem: "Examine the number of reversals for 30 students when they examine the [Necker \(1832\)](#) cube. In other words, the number of times a person shifts between seeing one kind of cube to see the other kind of cube. Design an experiment and examine if there is a difference between men and women."



## Case Study 4: “Genomics: Technologies and Data Analyses”

- **On-line course** for general audience
- **Comprises**
  - 10 hours of video lectures
  - One day workshop at Lancaster University
- **Focuses on several genomics technologies and most commonly used statistical analysis tools for each technology**

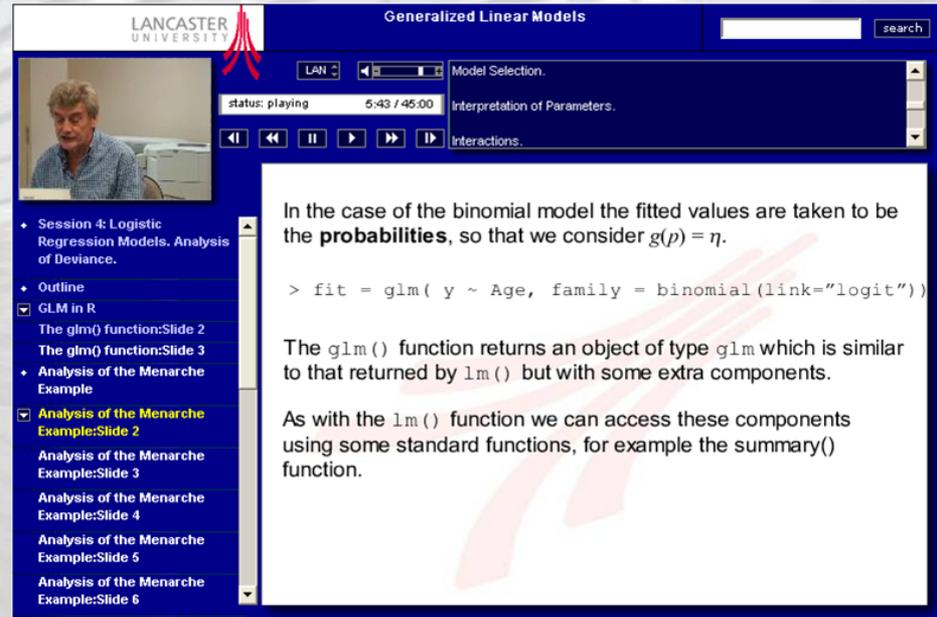
(T. Jaki, 2009; Jaki, T. and Autin, M. A., 2009)

## E-learning & Self-learning (1)

- Web-resources
  - “The Internet: a new dimension in teaching Statistics”
- Statistical software
- Innovative ways of teaching statistics:
  - On-line tutorials
  - On-line e-learning courses
- Computer-aided assessment

# E-learning & Self-learning (2)

- Podcasting
- PRS facilities
- Video-lecturing



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Generalized Linear Models

LAN

status: playing 5:43 / 45:00

Model Selection.

Interpretation of Parameters.

Interactions.

In the case of the binomial model the fitted values are taken to be the **probabilities**, so that we consider  $g(p) = \eta$ .

```
> fit = glm( y ~ Age, family = binomial(link="logit"))
```

The `glm()` function returns an object of type `glm` which is similar to that returned by `lm()` but with some extra components.

As with the `lm()` function we can access these components using some standard functions, for example the `summary()` function.

- Session 4: Logistic Regression Models. Analysis of Deviance.
- Outline
- ▾ GLM in R
  - The `glm()` function:Slide 2
  - The `glm()` function:Slide 3
- Analysis of the Menarche Example
- ▾ Analysis of the Menarche Example:Slide 2
  - Analysis of the Menarche Example:Slide 3
  - Analysis of the Menarche Example:Slide 4
  - Analysis of the Menarche Example:Slide 5
  - Analysis of the Menarche Example:Slide 6

<http://psc.maths.lancs.ac.uk/e-learning/>

## 'Teaching Bits': Resources for Teaching of Statistics

- David Spiegelhalter's project page:  
<http://understandinguncertainty.org/>
- Ben Goldacre website '*Bad Science*':  
<http://www.badsience.net/>
- Hans Rosling 'Gapminder' project for animating datasets:  
<http://www.gapminder.org/>
- '*Teaching Statistics: A Bag of Tricks*' (A. Gelman, D. Nolan, 2002)

# Final Recommendations & Conclusions

*“You read and you forget  
You see and you remember  
You do and you learn”*

*Lao Tse*

## Some Key Points

1. **Active learning**, with components including laboratory exercises, group work, work with class-generated data, and student written and oral presentations, increases student enthusiasm for, and learning of, statistics.
2. **Using news and other media** to provoke discussions or serve as a basis for classroom activities or student projects

# Final Recommendations & Conclusions

3. Learning statistics in the context of the **serviced discipline**
4. Idea of **data-driven learning in statistics**. Students are more motivated and better understand concepts when **real** (and student-gathered) **data sets** are used.
5. Experimenting with teaching style: **problem-based learning, team teaching ...**
6. Important to **use technology** to emphasize statistical literacy (rather than tedious calculations)
7. Continuity of lecturing person...



Biology students work in teams to design experiments and to collect and analyze data

## References

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