



Centre for  
Statistical Education

# Solving the Problem of Teaching Statistics?

Liz Gibson, John Marriott and Neville Davies

*Royal Statistical Society Centre for Statistical Education  
(RSSCSE)*

[www.rsscse.org.uk](http://www.rsscse.org.uk)

*Nottingham Trent University*

[Elizabeth.Gibson@ntu.ac.uk](mailto:Elizabeth.Gibson@ntu.ac.uk) [John.Marriott@ntu.ac.uk](mailto:John.Marriott@ntu.ac.uk)  
& [Neville.Davies@ntu.ac.uk](mailto:Neville.Davies@ntu.ac.uk)

*An earlier version of this paper was presented at ISI2007 Lisboa*

# Summary

- i. Background to the review of statistics and handling data in the curriculum
- ii. Results:
  - a. re-thinking the teaching of statistics
  - b. using a problem solving approach
  - c. exemplar resource
- iii. Applications to undergraduate teaching
- iv. Introducing statistics to undergraduate social science students

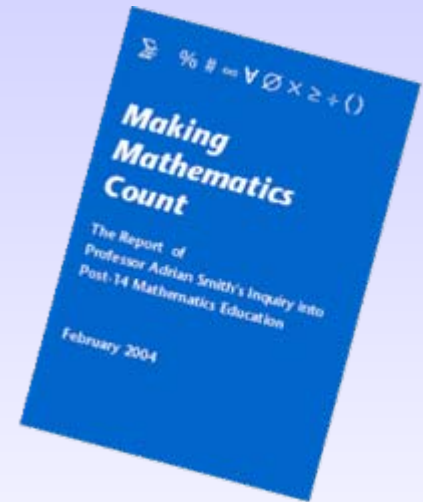
# RSSCSE-QCA Project Statistics and Handling data



## *Adrian Smith's Post-14 Maths Inquiry*

recommendation 4.4:

“(i) ...restore more time to the mathematics curriculum ...and (ii) [recognise] the key importance of Statistics and Data Handling as a topic in its own right and the desirability of its integration with other subject areas .”



QCA decided to review the S&HD content of GCSE maths.

To determine:

- what should remain core
- what may be beneficially seeded through other subjects

RSSCSE commissioned to complete the research



# Outcomes: re-thinking the teaching of statistics

## *Stage one (Apr – Dec '05)*

20% sample of schools surveyed

5 recommendations made to the QCA

### Key recommendations...

Teach statistics through **real world examples** within the mathematics curriculum.

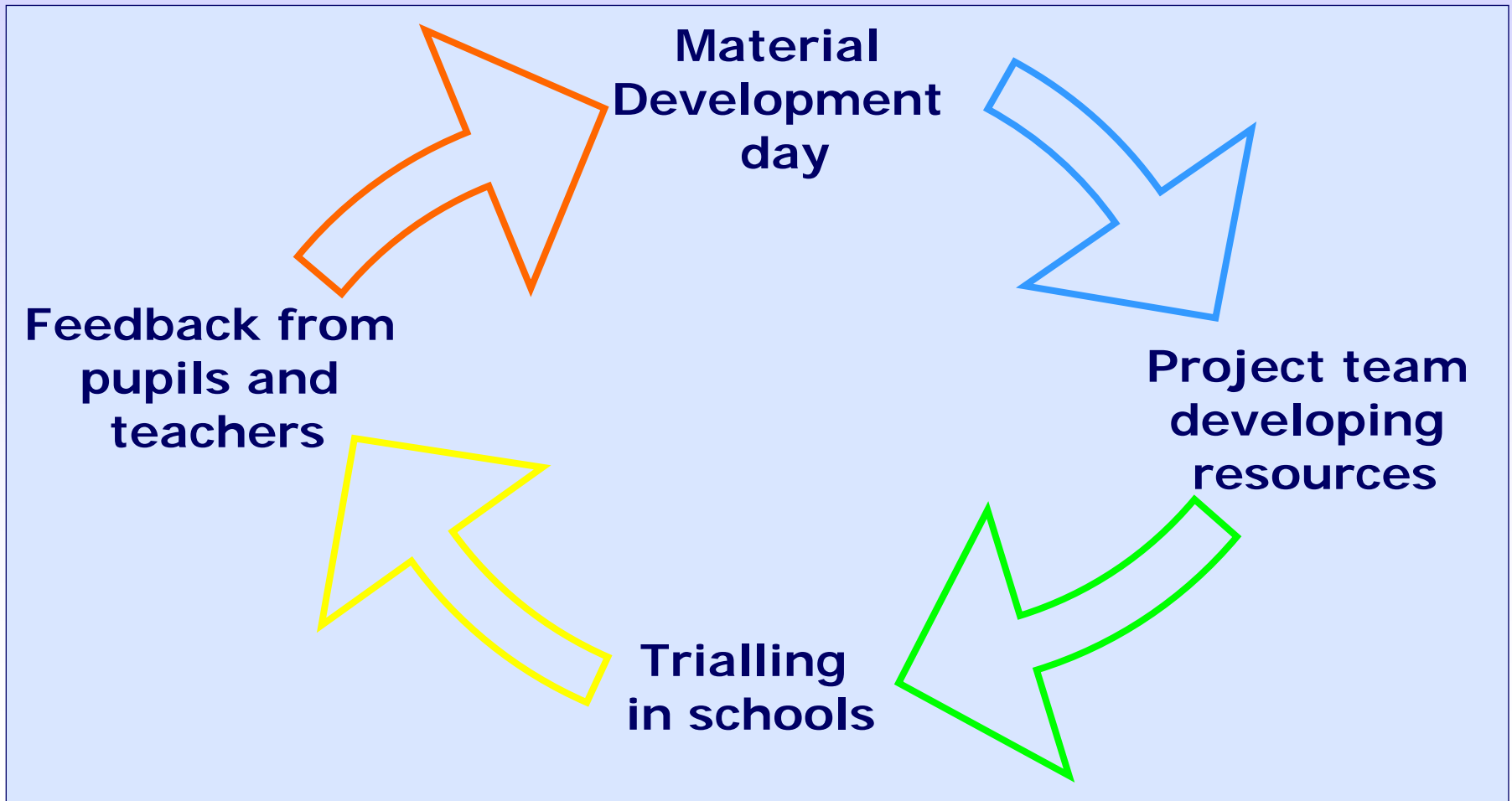
Trial new ways of assessing the statistics and handling data coursework

Develop a freely available comprehensive range of teaching materials using *real data*

The materials should teach through a *statistical problem solving approach (PSA)*.

# Stage two (Jan – Dec '06)

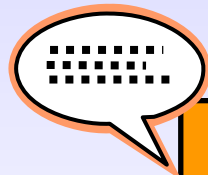
Creating and trialling resources and an assessment regime based on the **problem solving approach (psa)**



# Outcomes: using a Problem Solving Approach

## *Problem solving approach*

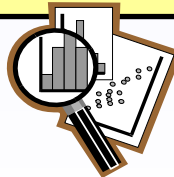
We report back what we found – and compare it with what we expected.



**Discuss**

Then we examine our data and make it easier to understand.

**Process**

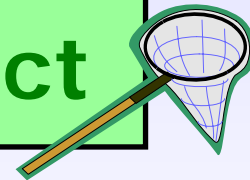


**Plan**



First we decide what problem to solve and what data we need

**Collect**



Then we collect suitable data.

# Resources on website (www.rsscse.org.uk/qca)



## QCA - RSS Centre Review of Handling Data and Statistics in GCSE Mathematics

NOTTINGHAM  
TRENT UNIVERSITY

### Homepage

[Introduction](#)

### Resources

[How safe is your area?](#)

[Crime Scene Evidence](#)

[Virtual Reality Gloves](#)

[Where's worst?](#)

[How far, fast and high?](#)

[How old is your height?](#)

[What's in your bowl?](#)

[World Population](#)

### Software



## How safe is your area?

This task uses a **Problem-Solving Approach** and is designed to take approximately 3 hours of teaching time.

The resource enables teachers to help pupils consider the problem of safety of an area for living in. It involves the use of primary and secondary data.

- [More detail](#)



### For Teachers

Please start here by looking at the online guidance and teachers notes before looking at other materials.

- [Online guidance](#)
- [Teacher's overview](#)
- [QCA scheme of work](#)
- [Teacher Feedback](#)

To download any of these materials, right click on the link and select 'Save as...'

### Lesson Materials

Please select a version:

- [Powerpoint version](#)
- [OHP version](#)

### For Pupils

- [Pupil worksheet 1](#)
- [Pupil questionnaire](#)
- [Pupil feedback](#)

### Data sheets

First select a region

then select data required

then select type of file:

pdf  csv

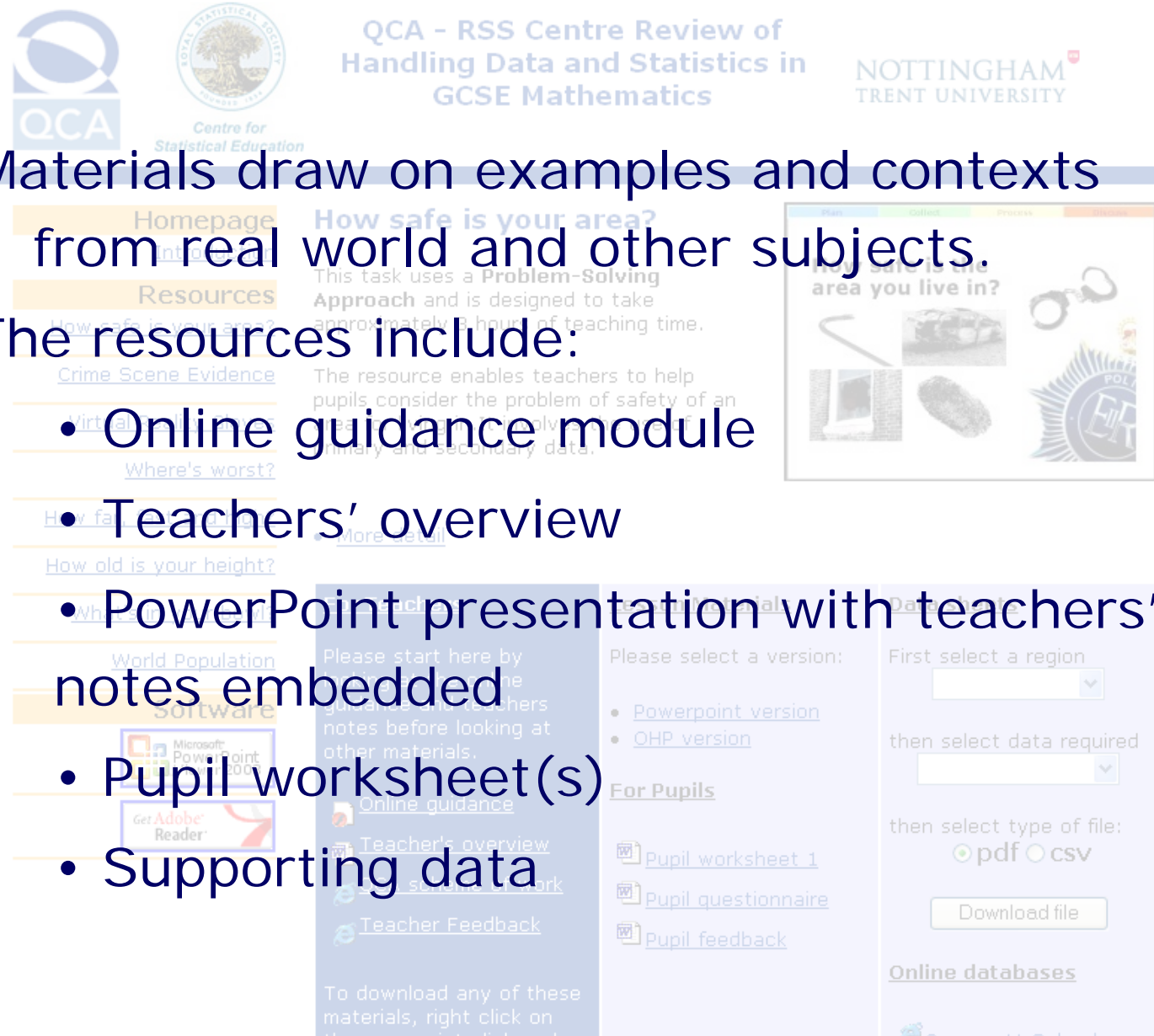
### Online databases

# Resources on website (www.rsscse.org.uk/qca)

Materials draw on examples and contexts from real world and other subjects.

The resources include:

- Online guidance module
- Teachers' overview
- PowerPoint presentation with teachers' notes embedded
- Pupil worksheet(s)
- Supporting data



## Stage two (Jan – Dec '06)

- Eight problems made available with supporting documents
- All materials properly trialled/refereed
- Regime trialled for assessing the cycle *as a whole*

# Outcomes: Exemplar resource



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First select a region

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then select type of file:

pdf  csv

### Online databases

[Gangus At School](#)

# How safe is your area?

Plan

Collect

Process

Discuss

## How safe is the area you live in?



# Setting the Scene

Plan



Collect

Process

Discuss

## How safe is the area you live in?

TV, radio and newspapers regularly report crimes and crime statistics.

**In the past four months, 25 people have been shot in England and Wales**

2007-08: there were 7,302 recorded gun crimes in England and Wales, including 59 deaths  
2002-03: 5,514 crimes (201 shooting)  
2001-02: 5,206 crimes (201 shooting)  
2000-01: 5,889 crimes (217 shooting)

**London**  
The capital has seen a 10% increase in gun crime since 2005. The number of gun crimes in London rose from 1,200 in 2005 to 1,320 in 2006. The number of gun crimes in London rose from 1,200 in 2005 to 1,320 in 2006. The number of gun crimes in London rose from 1,200 in 2005 to 1,320 in 2006.

**Manchester**  
The north's biggest city has seen a 10% increase in gun crime since 2005. The number of gun crimes in Manchester rose from 1,200 in 2005 to 1,320 in 2006. The number of gun crimes in Manchester rose from 1,200 in 2005 to 1,320 in 2006.

**Cardiff**  
The south Wales capital has seen a 10% increase in gun crime since 2005. The number of gun crimes in Cardiff rose from 1,200 in 2005 to 1,320 in 2006. The number of gun crimes in Cardiff rose from 1,200 in 2005 to 1,320 in 2006.

**Nottingham**  
The city has become a distribution centre for handguns. Nottingham police have made 100 arrests and recovered 22 firearms and 21 million worth of drugs since September 2005.

**Nottingham, March 2004**  
Teenage Stephen Lawrence passed away in the aftermath of a car crash for which he was charged with manslaughter.

**London, April 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, May 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, June 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, July 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, August 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, September 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, October 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, November 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

**London, December 2003**  
The 11-year-old boy was killed by a car that was driven by a 17-year-old boy.

bbc.co.uk Home TV Radio Talk Where I Live A-Z Index

### BBC NEWS

News Front Page World UK **England** Northern Ireland Scotland Wales Business Politics Health Education Science/Nature Technology Entertainment

#### South East is 'safest' place

The South East is the safest place to live in England, according to new crime figures.

The government statistics which were released on Thursday show the region has the lowest rates of criminal damage, burglary and theft.

Surrey has proved to be the safest county in the region and in England with 65 crimes per 1,000 people over the past year.

In Kent the figure per 1,000 people is 83 and the statistic for Sussex is 88 which compare with the national average of 113.

A different system is being used to compile the figures this year

TUESDAY, JUNE 26, 2007 SECTION 4

### Gang suspect freed from jail

**SPRINGFIELD**

## Crime drops by 10%

44 What we are looking for is the re-birth of Springfield. We want to reinvigorate the neighborhoods that are the heart and soul of your

**20 VICTIMS OF VIOLENT CRIME EACH DAY**

# Collecting Data

## Homepage

[Introduction](#)

## Resources

[How safe is your area?](#)

[Crime Scene Evidence](#)

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### Data sheets

First select a region

East Midlands

then select data required

- 
- Last 6yrs Statistics
  - **2005/06 Statistics**
  - 2004/05 Statistics
  - 2003/04 Statistics
  - 2002/03 Statistics
  - 2001/02 Statistics
  - 2000/01 Statistics
  - Survey of pupils

On

- [Census At School](#)
- [Crime statistics UK](#)

# Data Downloaded from Website

How safe is your area?

Plan



Collect



Process



Discuss



## East Midlands

### Crime Statistics

2005-06	Population	Violence	Sexual	Robbery	Burglary	Theft of a vehicle	Theft from a vehicle
<b>Derbyshire</b>	979,226	15,960	1,117	772	4,133	2,693	7,174
Amber Valley	118,193	1,764	136	36	409	308	730
Bolsover	73,252	1,132	75	23	337	236	469
Chesterfield	99,737	2,121	138	60	506	257	590
Derby	233,741	5,300	394	490	1,408	820	2,253
Derbyshire Dales	69,863	685	41	4	135	103	420
Erewash	109,979	1,675	131	80	465	404	1,168
High Peak	90,554	1,436	81	28	270	167	491
North East Derbyshire	97,412	972	61	22	341	201	534
South Derbyshire	86,495	875	60	29	262	197	519
<b>Leicestershire</b>	945,480	21,000	1,361	1,244	5,147	2,566	7,413
Blaby	91,581	982	74	42	300	195	585
Charnwood	157,477	3,044	174	145	957	404	1,157
Harborough	79,857	750	49	13	268	141	342
Hinckley and Bosworth	102,231	1,601	107	43	489	290	561
Leicester	285,097	11,156	729	925	2,284	1,032	3,293
Melton	48,332	660	40	5	158	130	365
North West Leicestershire	88,271	1,534	107	32	388	239	731
Oadby & Wigston	56,107	932	50	37	183	74	232

# Processing the Data

Plan

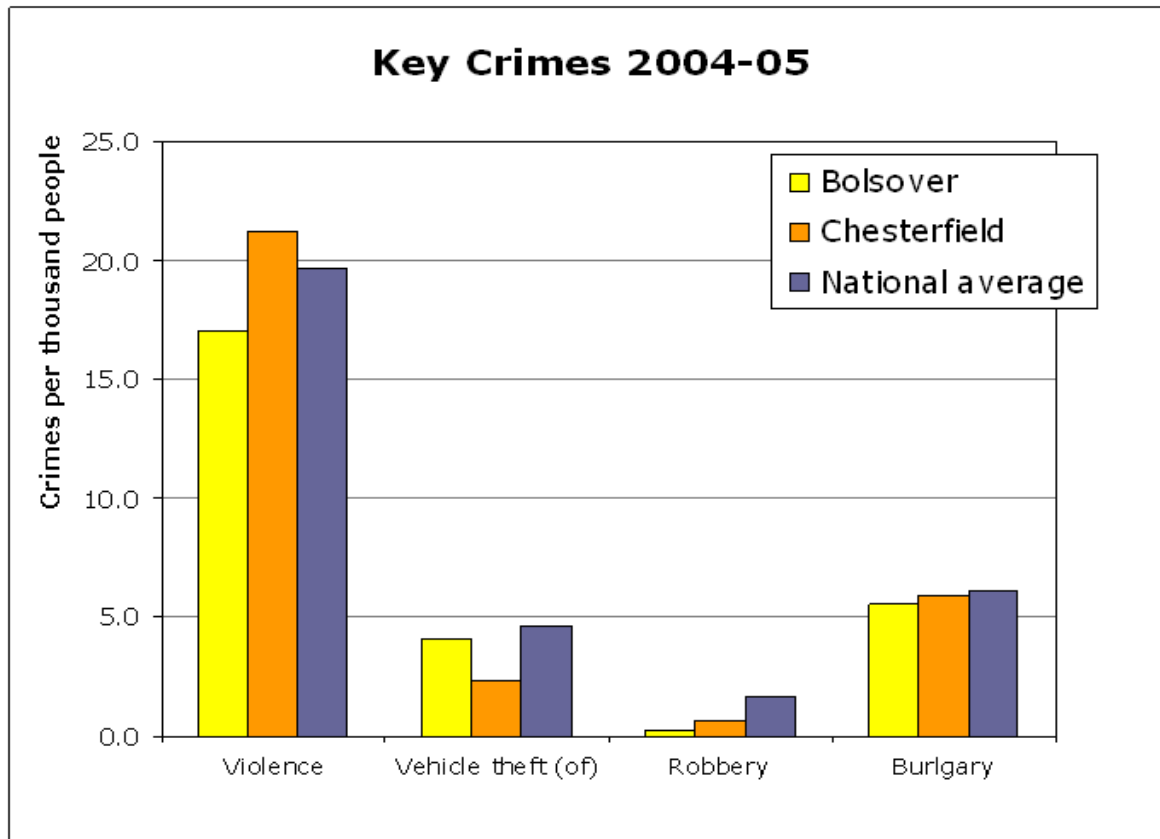
Collect



Process

Discuss

## Using Crime Statistics



# Discussing the Results

Plan

Collect

Process



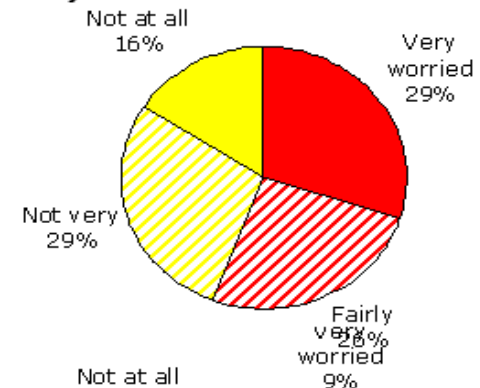
Discuss

## How safe is the area you live in?

Here are a random sample of results from a questionnaire of pupils (living in the South West of England).

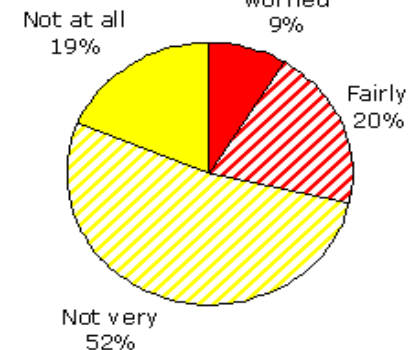
### Victim of violence

Very worried	<b>21</b>	29%
Fairly worried	<b>18</b>	26%
Not very worried	<b>20</b>	29%
Not at all	<b>11</b>	16%



### Being Insulted

Very worried	<b>6</b>	9%
Fairly worried	<b>14</b>	20%
Not very worried	<b>37</b>	52%
Not at all	<b>13</b>	19%



# The PSA and undergraduate teaching

Support for Problem solving/case study scenarios in undergraduate teaching:

- Business and Industry - Stuart (2003)
- Agresti and Franklin (2007) provide excellent examples
  - Non-specialist students, typically HE level 1

Exemplar materials from the RSSCSE schools project provide a useful template for HE

# Applications to undergraduate teaching

## *2001 enquiry into using data sets in HE*

Commissioned by the Joint Information Systems

Committee Rice et al (2001) recommended:

- Promoting subject-based statistical literacy for students
- Corresponding support for teaching staff
- Development of high quality teaching materials using major UK datasets

# Problems faced by social science undergraduates

- Murtonen and Lehtinen (2003)
  - many social science students have problems with quantitative methods
- Williams et al (2004)
  - Crisis in the production of quantitative academic output in UK Sociology
  - A “societal problem of numeracy”

# Economic and Social Research Council Response

Corpor Cytifwr Arlywod  
Uwch Cymru

hefcw

Higher Education Funding  
Council for Wales

Call for Tenders

## SCOPING STUDY TO IDENTIFY QUANTITATIVE METHODS CAPACITY BUILDING NEEDS IN WALES

Deadline for Tenders: Monday 24<sup>th</sup> July 2006

Introduction

1. The ESRC and the Funding Councils recognise that there is evidence that highlights the need to develop quantitative skills of career development, to ensure that there is a sufficient trained social science researchers entering the academic sectors.
2. To meet this need the ESRC is working with the Funding Councils to develop an integrated strategy which aims to improve the supply of quantitatively trained social scientists. To inform the development of this strategy the ESRC and the Funding Councils have commissioned a scoping study to identify quantitative capacity building needs in Wales. Tenders are currently being sought from individuals or teams interested in undertaking the study.

Background Context

3. A quantitative 'deficit' amongst UK social scientists has been a policy concern for the Government and Research Councils for more than a decade. The ESRC has itself launched a number of initiatives to address this concern, including the Research Methods, the Understanding Population Trends and Process Initiative, the Researcher Development Initiative and the strengthening of generic skills training in quantitative methods at the postgraduate level.
4. To date, these initiatives have tended to run in parallel and have concentrated on select parts of the academic life course rather than taking a holistic approach. The ESRC has therefore decided to more fully integrate its quantitative methods in order to develop a strategy which addresses the needs of social scientists significantly up-scale efforts to improve the stages of the academic life-course.



ESRC National Centre  
Assessment of Needs for  
the UK Social Sciences

Rose Wiles, GA



Scottish Funding Council  
Promoting further and higher education

Call for Tenders

## SCOPING STUDY TO IDENTIFY QUANTITATIVE METHODS CAPACITY BUILDING NEEDS IN SCOTLAND

Deadline for Tenders: Monday 18<sup>th</sup> September 2006

Introduction

1. The Economic and Social Research Council (ESRC) and the Funding Councils recognise that there is a growing body of evidence that highlights the need to develop quantitative skills amongst the earliest stages of career development, to ensure that there is a sufficient supply of quantitatively trained social science researchers entering the academic, public and voluntary sectors.
2. To meet this need the ESRC is working with the Funding Councils to develop an integrated strategy which aims to improve the supply of quantitatively trained social scientists. To inform the development of this strategy the ESRC and the Funding Council (SFC) wish to commission a scoping study to identify the particular quantitative capacity building needs in Scotland. Tenders are currently being sought from individuals or teams interested in undertaking the study.

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# Economic and Social Research Council Response

In 2006 there were calls for proposals to develop undergraduate curricula that:

- use real data to show the value of quantitative methods
- show students they have the foundation skills that can build on their school experience
- encourage students to collect their own data and analyse them
- encourage students to carry out their own research projects using data

# Social Sciences and the PSA

- Approach social science problems through evidence-based decision making
- Teach the 'social scientific research method'
- Use the problem solving approach to engage HE students in real social science problems
- Employ real data collected by the undergraduates themselves
- Employ relevant secondary data and introduce undergraduates to UK social science data bases

# Motivating/engaging new undergraduates

- New undergraduates will be concerned about the town where they are attending university
- Social Science students will, at some stage, consider the social effects of crime
- The 'How safe is your area' problem developed for the RSSCE/QCA project is an example that is of interest to social science undergraduates

# The first quantitative methods lecture

- Introduce the problem
- Discussion
- Student questions
- Choose data
- Reminder of the PSA

# Introduce the problem

Plan



Collect

Process

Discuss

## How safe is the area you live in?

TV, radio and newspapers regularly report crimes and crime statistics.



bbc.co.uk Home TV Radio Talk Where I Live A-Z Index

**BBC NEWS**

News Front Page World UK England Northern Ireland Scotland Wales Business Politics Health Education Science/Nature Technology Entertainment

Have Your Say Magazine In Pictures Week at a Glance Country Profiles

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The government statistics which were released on Thursday show the region has the lowest rates of criminal damage, burglary and theft.

Surrey has proved to be the safest county in the region and in England with 65 crimes per 1,000 people over the past year.

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A different system is being used to compile the figures this year

**Gang suspect freed from jail**

TUESDAY, JUNE 16, 2008 SECTION 4

**SPRINGFIELD**

### Crime drops by 10%

44 What we are looking for is the re-birth of Springfield. We want to reinvigorate the neighborhoods that are the heart and soul of your

**20 VICTIMS OF VIOLENT CRIME EACH DAY**

# Discussion

Are the crime figures as bad as some of the newspapers suggest?

Where in the UK is the 'safest' place to live?



In which areas of the UK is crime increasing?

What are the crime figures like in your area?

Are crime figures increasing each year?

Which places are improving?

Where is the 'crime capital' of the UK?

Should people be more/less concerned about certain crimes?

# Questions of Interest

**Plan**



**Collect**

**Process**

**Discuss**

## How safe is the area you live in?

When crime statistics are reported, newspapers and other media concentrate on *particular* crimes:

These are called the  
**Six Key Crimes.**

**Burglary**

**Robbery**

**Sexual offences**

**Theft from a vehicle**

**Theft of a vehicle**

**Violence**

# Choosing data

**Plan**



**Collect**

**Process**

**Discuss**

## How safe is the area you live in?

The question 'how safe is your area' can be looked at in two ways- by finding out the actual crime figures and by looking at how worried people are about crime.

Which approach will you use?

Local crime  
figures

**Select**



People's perceptions  
of crime

**Select**



# The First Seminar/Workshop

## - Collect

- The students complete a short questionnaire (online)
- The questionnaire comprises
  - Three demographic questions including date of birth
  - Four questions taken from the British Crime Survey ([www.statistics.gov.uk/ssd/surveys/british\\_crime\\_survey.asp](http://www.statistics.gov.uk/ssd/surveys/british_crime_survey.asp))

# The First Seminar/Workshop

## – Process and Discuss

- Students revise data summary presentation
  - use their collective seminar data for this
  - summarise their seminar group's perceptions
- Students draw tentative conclusions
  - limitations of the seminar 'sample' discussed
  - possibility of using the whole module group's responses in next seminar session discussed

# The Second and Subsequent Lectures

- From the start the students have been involved in
  - the formulation of the problem being investigated
  - their own data being collected
- The impetus is maintained by
  - reminding the students of the PSA
  - using their data to illustrate the *Process* and *Discuss* stages of the PSA
  - just introducing the statistical tools/techniques they need *in the context of their data* and at the time it is required

# The Second Seminar/Workshop

- **Process** – produce summaries for the whole cohort and subgroups
- **Discuss** - comparison of different perceptions with respect to
  - seminar group
  - gender
- Return to the questions raised in the lecture and refine the Plan
  - **Plan** how they would re-write the questionnaire and construct additional questions

# Subsequent Seminar/Workshops

## What do other people think?

- **Plan and Collect**
  - Design their own questionnaire and Collect data by conducting a survey
- **Process** the survey data
- **Discuss**
  - Consider the results from their survey
  - Access the British Crime Survey data and compare with the perceptions from their sample

# Subsequent Seminar/Workshops

## What is the crime profile of their area?

- Plan

- Decide what are the key questions about the safety of their university town they want to answer and what data they need

- Collect

- Secondary data sources, for example the Crime Statistics for England and Wales

([www.crimestatistics.org.uk/output/Page1.asp](http://www.crimestatistics.org.uk/output/Page1.asp))

# The way forward

- University departments with an interest in teaching statistics:
  - biosciences; medicine; health sciences;  
business/finance; economics; sociology/social admin;  
psychology; geography; built environment;  
engineering; leisure and sport; legal studies; .....
- Prepare exemplar materials for HE
- Approach HEA subject centres to jointly develop and distribute materials

# Conclusion

- The psa can be used to engage pupils and teach statistics in schools
- With some imagination problems that engage undergraduates can be developed
- Using the psa will introduce undergraduates to the “evidence based decision making” approach in their discipline