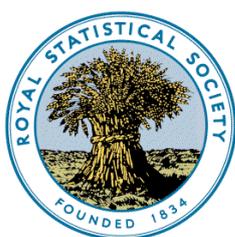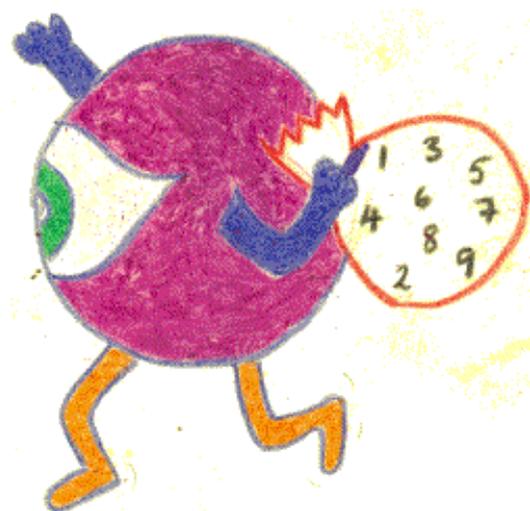# Relevant & Engaging

Statistics & Data Handling

This booklet offers help to make your statistics lessons more relevant and engaging for both you and your learners!

ROYAL STATISTICAL SOCIETY
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Centre for
Statistical Education

Setting the Scene

This booklet is aimed at all secondary level teachers: there are hints and tips that
we hope will be useful to support the teaching and learning of statistics and data
handling. We hope that you find the material useful. Please email or write to us
with suggestions for improvements. We will try to respond to all communications.

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2009

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Setting the Scene

The National Curriculum [1] (2007) splits mathematics into three main areas: Number & Algebra, Geometry & Measures and Statistics.

While these three areas have some distinct differences the overriding principle is that the study of mathematics should enable pupils to apply their knowledge, skills and understanding to relevant real world situations. Statistics, in particular, lends itself to this beautifully with a wealth of interesting and relevant data out there just waiting for our learners to discover things from. Your learners themselves are also the source of amazing amounts of data and they will revel in experimenting and producing data - so we really have no excuse! As teachers we need to ensure that statistics lessons are fun, engaging and motivating and that our learners learn how to enquire, predict, find out, interpret and analyse using the real and relevant data for each task.

The statistics section of the National Curriculum is split into 4 areas:

- The handling data cycle
- Presentation and analysis of data
- Measures of central tendency and spread
- Probability

Each of these areas cannot exist without the others and the overriding concern of teachers should be to allow their learners to understand this and also how to connect and interlink the areas. For a learner who is taught about averages without an understanding of variability and how the average itself can be misleading is being taught nothing of any use. For example – what is the average number of legs on a human being living in the UK? The answer is of course 1.999 since some unfortunate people have lost one or indeed both legs due to accident or disease and no-one, to my knowledge, has more than 2 legs so the average will always work out to be less then 2.

Likewise the teacher who teaches a class how to construct a cumulative frequency diagram or a histogram with bars of unequal width without, at the very least, explaining a suitable context or realistic reason for their class to be taught this technique is only doing their pupils a disservice and doing untold damage to the reputation of the teaching of statistics. Unless learners see a need for the use of a particular technique there is surely no need for it to be mentioned at all! The start of the process must be a question or problem that needs to be answered or explored and the techniques themselves must take their place only if a need for them is discovered along the way.

The increase in the use and availability of technology must also be acknowledged and sensible use made of spreadsheets and other software that can ease the burden of techniques and allow the individual to enjoy the exploration of the problem itself. Far too many lessons, which are intended to be teaching some aspect of statistics, do not teach anything at all about how the science of statistics can help to solve real world problems; rather they often simply show how a mathematical technique works in isolation.

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[1] The National Curriculum. Statutory requirements 2007, DCSF/QCA crown copyright

A good example of this is taken from the government's own documentation. In the *Framework for teaching mathematics: Years 7, 8 and 9*[2]. The following is given as an example of what should be taught to year 7 learners to meet the objective of **"Calculate statistics from data, using ICT as appropriate, finding the mode, mean, median and range"**

> "I can catch either a Direct bus or a Transit bus to go home. For my last five journeys on each bus, this is how long I had to wait:
>
> Direct bus 10 min 8 min 5 min 9 min 8 min
> Transit bus 16 min 1 min 2 min 15 min 1 min
>
> Calculate the mean of the waiting time for each bus. Decide which bus it would be more sensible to catch. Explain why".

Think carefully about this question – What is the really sensible answer? Do you actually need some more information? Do both buses go equally near your home? Do they take the same route? Do they go from the same bus stop? Are the fares the same?

And of course once you start thinking about it, the only sensible answer to give is that you would catch the first bus that turns up at the bus stop! In the real world there is no way you would stand at a bus stop and when the bus to take you home turns up say "Oh no! Your range of times is too varied, I'm waiting for the more consistent bus." And yet we constantly expect the learners in our schools to think that this is how statistics is used in the real world?

This is a classic case of why learners end up not understanding why they are being asked to carry out these kinds of tasks in the classroom and fail to see the relevance of what the teacher is asking them to do. Unless we ensure that contexts are real and relevant we stand little chance of improving the current unsatisfactory situation.

We also need to stop teaching statistics in small irrelevant chunks. Asking learners to work out 50 means from lists of numbers invented by the teacher or from a text book may make them remember the rule that you add them all up and divide by the number of numbers but they will not have a clue as to why you would ever want to do this in the real world or why this could ever be useful to them. This often results in them asking "Why are we doing this?" Many teachers struggle to come up with any answer to this question apart from "Because it might come up in your exam." and then we wonder why learners do not have the levels of engagement and interest in their mathematics lessons that we would like!

Take a look at your current textbook or scheme of work and consider whether the current diet you are giving your learners is really helping them to see how the tools you are introducing them to in their data handling lessons are ones that they will be able to apply and use in the real world.
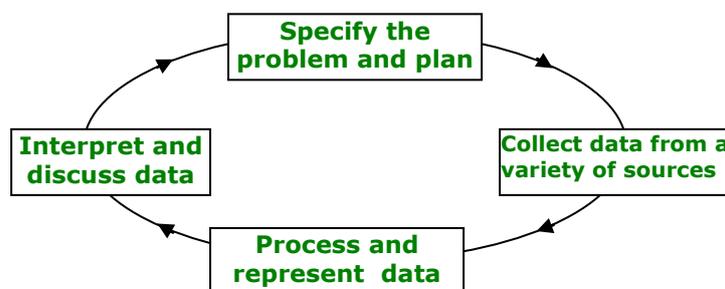
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[2] The Framework for Teaching Mathematics, 1999 DFES crown copyright

This booklet aims to try and give you some examples and ideas of how to, if not completely solve, at least improve the current situation a little. It is also worth noting that many other subjects and areas such as Science, History, Geography and Citizenship that make use of statistics and statistical techniques often do it in a far more coherent way than we as mathematics teachers do. They also use the data handling cycle implicitly and set realistic contexts that learners can relate to.

The national curriculum states that the study of mathematics should include the handling data cycle and goes on to say that this is closely linked to the mathematical key processes. In fact, the vast majority of curricula across the world also expound that all statistics should be taught through this handling data cycle or problem solving approach.

Worryingly, the recent review of the positioning of statistics within the mathematics curriculum, by the RSSCSE [3], found that 60% of heads of mathematics surveyed either 'never' or 'seldomly' used the handling data cycle in their teaching. Within chapter 1 of this booklet we will show, with an example, how using a problem solving approach can benefit both the teaching and learning of statistics.

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              ┌─────────────────┐
              │   Specify the   │
              │ problem and plan │
              └─────────────────┘
   ┌──────────────┐         ┌──────────────────┐
   │ Interpret and │         │ Collect data from a │
   │ discuss data  │         │ variety of sources │
   └──────────────┘         └──────────────────┘
              ┌─────────────────┐
              │  Process and    │
              │ represent  data │
              └─────────────────┘
```

The national curriculum also makes it very clear that the teaching and learning of statistics should make appropriate use of ICT both for presentation and analysis and to simulate experiments and probability models. In chapters 4 and 7 we show how to make better use of widely available software such as the all encompassing Excel and also how to integrate the use of specialist mathematical software such as Autograph in stimulating and engaging ways.

Having run the well known CensusAtSchool Project for the last eight years we are well aware of the impact that using real data can have on the teaching and learning of statistics and have much evidence that this is one of the simplest and most effective ways to get engagement from children - by including their own data within the lesson and comparing themselves to others. Children are naturally ego-centric and by making use of this and generating primary data we can make statistics both real and very relevant to the learner. Relevant and purposeful data can also lead to more cohesive results and meaningful and trustworthy conclusions and are interesting for both the teacher and the learner.

In chapter 2 we show some straightforward ideas of how to do this in the classroom and explain in more detail how to use the CensusAtSchool project in your classroom.

All of the materials in this booklet are intended to help teachers support students in Data Handling and Statistics. They are designed to be flexible and adaptable with the *data* providing the stimulation for interrogation and enquiry.

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[3] The Royal Statistical Society Centre for Statistical Education