Real data, real learning and the London Olympics

The Olympic and Paralympic Games are coming to London in 2012, and there will be huge interest, especially among the young. Could the Games be used to involve students of all ages in a large scale project that involves and interests them to break down their fear of statistics and to motivate learning? Neville Davies of the Royal Statistical Society Centre for Statistical Education appeals for help in a major teaching and learning initiative based on the London Olympics. Significance is proud to announce the launch of a scheme that could bring thousands of students, nationally and internationally, to appreciate and value the usefulness of statistics.

Statistics is hard, useless and boring. These are opinions that I have heard expressed regularly about statistics during 34 years of teaching. They apply both to the data collected and the tools of analysis. Why do many people think one or more of these “bad” things about statistics? Over the last 10 years or so many UK universities have closed or reduced their mathematics or statistics departments as a direct response to a reduced demand from students wanting to study statistics, mathematics and mathematics-based subjects. Why should this be happening?

There are no simple answers, but some say it starts in school. Prior to, and following the 2004 Smith report on mathematics education after the age of 14, schoolteachers have expressed similar sentiments, especially those who teach GCSE mathematics. It has even been argued that mathematics at that level should be purged of its data handling and statistics content and those aspects either taught elsewhere or postponed until students are older. There are several reasons given for wanting this to happen. They include a low regard for statistics as a subject; the time taken up in each project in handling data; teachers not having been adequately trained to teach it; not appreciating the subject’s wide applicability; and believing it is a trivial part of mathematics. This last view, at best, is unfortunate and, at worst, shows a misunderstanding of what statistics is for.

Unlike some parts of mathematics, statistics does not exist for itself, but rather it provides a toolkit for specialists and non-specialists to derive information from data that come from other disciplines; it yields a paradigm for problem solving and scientific enquiry; it crosses disciplines and is needed within disciplines to make sense of the world. Furthermore, processing and analysis of everyday data are an integral part of modern living. Put simply, society cannot do without statistics.

So what causes so many negative vibes around learning a subject that is so important for real people to make real sense of data? Many of us increasingly believe that the key to addressing the problems some people have with statistics starts and ends with “data.” If the data are interesting, the statistics may become so. Not just any old data will do; we need real data collected for a real purpose. By this I mean that we ask some clearly posed real question that the students find interesting, perhaps as part of a more general problem to be solved. We collect...
real data that can lead to a purposeful investigation. Only then can data-informed real answers be produced, and the purposes and fascinations of statistics be made plain.

Getting real

To learn many subjects, including statistics, several levels of cognitive skills are necessary. Bloom’s taxonomy of learning provides a convenient summary of six possible educational learning outcomes: knowledge; comprehension; application; analysis; synthesis; evaluation. The first three tend to be easier to achieve and assess compared with the last three—indeed, experience suggests that these last three are where most difficulties and controversies occur in teaching, learning and assessing statistics. Finding ways to raise students’ skill levels by connecting all six of these outcomes can be a real challenge for teachers of statistics at all levels.

There is much research-based evidence that the best way for people to learn is through having their interest sparked by seeing and doing activities that they can relate to. In statistics there is further research showing that students of all ages are motivated by real data that relate to features and characteristics about themselves and their peers; they are also motivated by subjects they are interested in2,3,4. When the same data are used to create teaching and learning resources that marry a variety of information and communication technology techniques, particularly the Internet, teachers are stimulated to improve their own skills, knowledge and pedagogy. This, in turn, can have very positive knock-on effects on students’ attitudes to mathematics and applications of statistics5.

Snee6 noted that “the collection and analysis of data is at the heart of statistical thinking. Data collection promotes learning by experience and connects the learning process to reality.” He also recommended that “we must change the content and delivery of statistical education to enable students to experience the use of statistical thinking and methods in dealing with real-world problems and issues”. This summarises succinctly what teachers of statistics can and should do to prevent the “hard”, “useless” and “boring” labels being applied to the subject.

The Olympics

So what do all these questions about, and criticisms of, statistics have to do with the Olympic and Paralympic Games being held in London in 2012? The answer, of course, is real data! London hosting the Games is sure to motivate people of all ages. The young, in particular, will find fresh aspirations to participate and succeed in sporting activities—some barely into their teens as we write may become competitors by 2012. Moreover, students and their teachers are likely to be stimulated by Olympics-related activities that are fun to do, and that also promotes a designed approach to participating in sports. Measuring and keeping track of their own “personal best” performances is just one example. Doing all these requires a serious amount of design, data collection, analysis and interpretation. But that is what statistics is for!
Evidence already exists that projects designed around collecting meaningful data can help improve knowledge, skills and statistical thinking for students. The International CensusAtSchool Project (www.censusatschool.otago.ac.nz) is a real-data-based project that started in the UK in 2000. It collects data from and about school students in a class “census” unit and then, via the Internet, freely returns the raw data and specially designed teaching and learning resources to students and teachers. The project has been implemented in four other countries—South Africa, Australia, New Zealand and Canada, as well as in the UK—and is a great motivator in all types of schools in the primary and secondary sectors of these countries. Over 220 000 UK students have contributed data. These motivate learning and emphasise how real data and information are important for many subjects across the school curriculum.

I believe that a data-driven project that uses the Internet to collect meaningful data on variables that students can relate to—and which are also relevant to some or all of the Olympic sports—will have real benefits for everyone involved. Similarly to CensusAtSchool, the proposal is that, following the creation of a number of clearly posed and meaningful questions, sport-related and lifestyle data within the Olympics context should be collected from students themselves and the problem-solving paradigm used to carry out purposeful investigations. To illustrate the potential, we could ask the general question: “What can you do to become better at participating in sports?” To solve this problem, a number of related questions need to be carefully planned to obtain useful data. Variables such as diet, health, lifestyle, fitness, dedication and enjoyment can affect performance in sports. Data production for these variables, and relating them to Olympic values, will produce a wide range of activities for people of all ages to become involved in.

In practice, questions will be designed and constructed after consultation with representatives from the Olympics and Paralympics moves; past Olympic athletes and colleagues from subjects including sports science, physical and biological sciences, citizenship, mathematics and statistics. Getting schools, colleges and universities engaged in the project will be a key objective. To illustrate, here are a few examples of simple questions that could provide a starting point for producing useful data.

- In what ways will the London Olympic and Paralympic Games motivate you to take part/improve in sports?
- What sport(s) do you like best (i) taking part in, and (ii) watching?
- How many hours of exercise do you do per week?
- How many portions of fruit and vegetables do you eat per day/week?
- What is your pulse rate (i) at rest, and (ii) after 2 minutes of exercise? What is your time to recovery?
- How fast can you run 20/50/100/200 metres?

Other questions could, of course, be targeted at specific Olympic sports. But all the data collected will offer support and opportunities to carry out case studies based on interesting questions posed by students and teachers. This will be done by interrogating the database of responses, which will grow as the project progresses. Participating students and teachers could, in turn, provide knock-on benefits through carrying out related cross-curricular activities. Associated learning and teaching resources will be created to enrich education in many subjects, not just mathematics and statistics. These will be freely returned to teachers and students for teaching and learning purposes.

“The proposed Olympic project will cause young people to connect with statistics. Teachers, students and researchers can find the most promising athletes”

To a young student, a project based on an event six years into the future may seem impossible long term. But, in his budget speech in March, the Chancellor of the Exchequer announced that the government will be supporting annual schools Olympics events, starting in Glasgow this year and taking place in other UK cities right up to 2012. This gives annual incentives and staging posts to maintain students’ interest; and such early support from the Chancellor for schools to work towards the London Olympics means that now is the time to hit the ground running with a project that will also relate sports to other curriculum subjects.

Conclusions
Understanding and learning statistics requires a combination of skills that require some high-level thinking, including the ability to apply critical judgement to the context and meaning behind the data and to inferences that can be drawn. Similarly, the pedagogy of statistics requires more than just an ability to communicate the mathematical tools or recipes necessary to do the statistics—for example, the teaching of the thinking behind the planning and design for trustworthy data production. Thus, a complex set of procedures is often needed in teaching and learning statistics, so these procedures need to be motivated in a special way. Using real and meaningful data is crucial.

The proposed Olympics project will be ground in real data, it will help to spread the message about the importance of all aspects of statistics and it has the potential to connect with, inspire and unite young people to take on Olympic values. One legacy could be to provide educational benefits across the curriculum through the application of mathematics, statistics and many other subjects. Participation in the project will help some students to get closer to their sporting aspirations, with the collection and analysis of appropriate data being a motivator for them to work by themselves or with their teachers.

Added value for the country’s success at the Games could come from more advanced applications of statistics, which could help to identify talented athletes through scrutiny of appropriate data collected for each sport. For example, teachers, students and researchers at university level could become involved and use the data for scientific inquiry into finding the most promising athletes.

Students and teachers at all levels could benefit from participating in an Olympics-related project implemented over the next six years and beyond. In the short and long term it could help to make statistics a more motivating subject and improve its image in the eyes of many people.

If anyone is interested in being involved, please contact me on the email address below. I am particularly keen to hear from organisations that would like to invest in or to sponsor the data-based project that I am proposing.

References

Neville Davies is Director of the Royal Statistical Society Centre for Statistical Education at the School of Computing and Informatics, Nottingham Trent University. He can be contacted at neville.davies@ntu.ac.uk.