STUDENT SURVEYS IN THE UNITED KINGDOM ANNUAL APPLIED STATISTICS COMPETITION

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In 1983, the Annual Applied Statistics Competition was established in the United Kingdom by Anne Hawkins. An entry to the Competition must take the form of a report of an applied statistics project, planned and executed by a team of students. Adjudication is based on entries from three age-groups; 9+ to 13 years, 13+ to 16 years, and 16+ to 19 years. Cross-disciplinary work is encouraged, as is the use of computing resources.

In the four years since its inception, the Competition has attracted a preponderance of survey projects, but not to the exclusion of some interesting experimental studies and simulations. In the limited time available, some of the problem areas of the students' survey work will be explored. This does not imply poor standards overall. Some of the projects submitted are of outstanding quality, as has been documented elsewhere (e.g. Hawkins, 1984, 1985, 1986).

Table 1: Selection of Students' Survey Topics

A = Attitudinal,
O = Opinion,
F = Fact-finding,
P = Policy Research.

Social Surveys

Use/Abuse of Alcohol AOF; Sexism (various aspects) AOFP; School Gas & Electricity Consumption FP; Local Traffic Congestion - Causes & Remedies AP; Media & 'Pop' Studies (various aspects) AOF; Local Facilities & Community Spirit AOFP; etc.

Scientific Surveys

Ecology of Rocky Shore F; Nutritional Values of School/Home Lunches F; Food Additives FP; Geography Fieldwork F; Composition of Aluminium Alloys F; etc.

Commercial Surveys

Shops & Shopping Behaviour AOF; Tuckshop Stock Control FP; Sweet-eating Habits F; School Drinks Machine - Market Research AOFP; Product Research AOF; TV Rentals/Purchase - Forecasting Demand FP; etc.

Table 1 gives some indication, albeit limited, of the range of investigations undertaken by students. The three main categories (Social, Scientific and Commercial research) should not be seen as being mutually exclusive nor exhaustive. The sub-divisions of Attitudinal, Opinion, Fact-finding and Policy research are also somewhat artificial. Often the work undertaken crosses a number of areas. Social surveys based on questionnaires are the most frequent entries. This perhaps says something about the students', or their teachers', perception of the role of statistics.

In the main, projects are submitted under the umbrella of the mathematics area of the curriculum. They rarely appear to involve collaboration with teachers in other discipline areas. It is, in fact, difficult to attract the attention of other teachers even though their disciplines abound in ready-made research contexts. To distributors of publicity material within schools and colleges, it would seem that "Stats. is Maths!".

The mathematics staff themselves seem to see the exercise as extra-curricular, despite U.K. examination changes which dictate that their own teaching programmes will incorporate more practical project work. Nor do they generally utilise the existing statistical project work which regularly features in other disciplines. As a result, projects tend to explore areas from initial speculative conjectures, rather than expanding existing areas of knowledge.

There are exceptions to these general comments. For example, there have been scientific surveys of a very high standard submitted based on fieldwork undertaken in the contexts of Geography and Biology. E.g. "A study of the Afon [River] Kenfig", a comprehensive and beautifully illustrated report of a geography field-trip. "Exposure stunts your growth" involved a meticulous survey of the ecology of shore life, comparing the physical characteristics of organisms from different localities. Such work tends to come from the older students following academic rather than general studies courses, and is often characterised by smaller teams of researchers. The commercially-oriented surveys are often based on some aspect of market or product research, both of which are "pastures new" as far as the school curriculum is concerned. However, projects based on shopping facilities and shoppers' behaviour patterns might well grow from work within the geography or social studies courses. Some of these projects have also been used by schools to establish work-experience opportunities for the students, building up liaisons with local firms and enabling students to gain insight into sales forecasting, stock control and the like.

As one would expect, the scope of the survey work undertaken varies from project to project. In objective terms, students rarely display an insight into ways of enhancing the efficiency of their work. Statistical considerations of appropriate sample size (and design) are low, or non-existent, on the list of priorities at the planning stages. Given this, it is interesting to look at some examples to illustrate the sheer quantity of research work undertaken. Some involve enormous amounts of data, and some very large sample sizes. E.g. "Left- and right-handedness", a survey (or rather a census) of 1519 students from the same school as the researchers. "Bar Hill: a Questionnaire Survey" had a sample size of 800, with response rate of 579, comprising local Bar Hill residents. (Perhaps this high response rate resulted from the [over-]polite use of "Are you a lady or a gentleman?" form of question, rather than the more conventional "Male/female?". Researchers take note!)

Measures taken to ensure data reliability tend to be somewhat arbitrary. The best studies incorporate pilot work, but these are relatively few in number. Less good studies still sometimes discuss steps taken, including modifications to the wording of questions, although here the decisions tend to be made on the basis of group intuition rather than on the results of actual pilot work. The weakest studies ignore the whole issue. Either students are oblivious to such issues, or choose not to incorporate comment on them in their report.

One division which is very apparent in the social survey work, and to some extent in the commercial projects, relates to coverage. Many of the projects are internal surveys, which take as the sample, members of the same educational institutions. E.g. "Options and sexism towards subjects in schools". Others are more ambitious and involve the researchers in contacts further afield. E.g. "The effects of a new Tesco", a survey of shoppers' opinions and changes in their behaviour with the introduction of a new super-store in the locality.

The middle age-group tend to undertake the most trivial studies, for example "Exam. results and star sign", "Attitudes towards spots" (as if anyone would have positive feelings towards acne!). It is probably the case that leaving such students to their own devices is premature for this age-group, who conceive of research ideas which are often beyond their competencies. They are also less practised in using study skills and in learning through project work. Consequently, some of their efforts fall by the wayside, or collapse into chaos because the students are unable to engage unsupervised in the necessary collaborative team-work. No specific guidelines were given to define the extent of teachers' involvement in their students' projects. The adjudicators welcomed the fact that most entries were student- rather than teacher-oriented, but this did not necessarily mean that teachers should abandon their students entirely!

The youngest children have more recently come from an educational situation where project work is the order of the day. They also tend to attract more teacher guidance, working in much larger (often at least whole class, sometimes whole year-) groups. It is fair to say that the quality of some of the youngest students' work is superior to that of the middle and oldest age-groups. They often display more flair and resourcefulness, sometimes engaging in very significant studies with far-reaching (policy) implications. Even though restricted to relatively basic statistical techniques, a group of twelve-year-olds surveyed the use of gas and electricity in their school, providing the local authority with very clear recommendations for money-saving changes which could be implemented. Another interesting project from this age-group looked into the possibility that having a surname at the beginning of the alphabet might lead to educational disadvantage. The students showed a remarkable grasp of the interacting variables in this context which might lend credance to such an apparently bizarre association. Only data collection, compilation and presentation techniques were available for this ambitious debate.

A major difficulty for students, particularly those in the middle age-group is that of operationally defining the research subject. There are also weaknesses in deciding on the most appropriate data to answer the research question. Data sources are not often used to the best advantage. Few projects have relied on secondary data alone, even if this would be appropriate. On the other hand, few have achieved an appropriate balance between the use of primary and secondary sources. To many students, an applied statistics project is seen as "Get [or have] data, will travel!". Sadly, however, their travel is often via uninterpreted charts, tables and diagrams which lead them nowhere.

There seems to be a popular misconception among such students, and possibly among their teachers as well, that an applied statistics project is synonymous with an exercise in the collection and compiling of statistical data. The adjudicators want more than that. They are looking for a clear rationale to the research and relevant discussion and interpretation of the results. The students in the middle age-group seem to find these aspects particularly difficult.

Nor is it merely a matter of using more sophisticated analytical techniques. Some of the oldest age-group projects fail because they are little more than a collection of correlation coefficients, Chi-squared values, or t-test significances, with no apparent understanding of their relevance or appropriateness. Again, it is not unusual for the youngest students' simplistic common-sense and elegant reasoning to score over such entries in the minds of the adjudicators, even though not in direct competition with them. E.g. "The school drinks machine" (ibid.), a highly professional market research study with subsequent research of implemented changes, all based on tabulation, pie-charts and histograms.

Adjudicating the projects is made difficult because the ability and statistical attainment levels of the pupils, even within age-groups, differ considerably. Also, the research topics vary across a wide range of applications. In objective terms, each project has to be assessed against its own aims and intentions. Adjudicators have to determine whether, given these, the researchers have made sensible research decisions and followed logical reasoning to arrive at useful conclusions. In the case of projects where the aims and objectives are not stated, a common failing, the adjudicators' task is made harder. In a sense, the adjudicators must turn a blind eye to naive or incorrect premises which sometimes threaten to undermine an entire project (for example, one school used incorrect probabilities in establishing a simulation study of strategies in playing 'Monopoly'). In such cases, the adjudicators must look at the intent as much as the technical flaws. This is not to say that such a flawed project is likely to win. Competition from other projects is of course keen. However, the project cannot be disregarded because of that flaw alone.

The type of student collaboration differs. The adjudicators look for evidence that there has been real teamwork. A group project should be more than merely a collection of individual presentations. There has to be a synthesis of skills and ideas, not merely work-sharing for the sake of it. Nor should there be unnecessary replication and duplication of effort.

The resources available to, and used by, the researchers also differ. For example, some surveys have been analysed using one of the popular micro-computer analysis packages, such as QUEST. Such facilities have to be taken into account in judging the worth of a project but it cannot be assumed that all teams would have had access to a computer. This year, a special category of award is to be made to the team making the most interesting use of a computer in their applied statistics project, assessed in terms of appropriateness, efficiency and originality. It will be interesting to see what, if any, difference this makes to the use of computers in this year's entries.

The impact of the Competition on Statistical Education in the U.K. has been discussed in other publications, (ibid.). To sum up, however, it is worth pointing out how gratifying it is to hear the enthusiasm of teachers and students alike, and to witness particular pedagogic changes being made as a result of their taking part in the Competition. In addition, of course, it is wonderful to receive a "good" project, and it should be noted that this can come from the most unlikely, and possibly unprepossessing, source.

Feedback suggests that participating in the Competition can be a useful learning experience. However, it should not be a one-off event. The skills that may be acquired are needed by students who face newer forms of practical assessment. Such skills do not develop merely because students are taught (theoretical) statistics, which they then, as if by magic, apply to practical problems. (If they did, much of this paper could be dispensed with!) Nor do they "rub off" merely by encountering one piece of project work. They should be taught just as any other skills are taught, especially if they are to be used to assess students' success in a statistics course.

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