those connected with research. The 12-month salary does reduce pressure on researchers to seek summer support and beginners may especially benefit. There are obvious drawbacks to this system however.

NSERC, the primary source of support for statistical researchers in Canada, does not pay for teaching release. Operating grants are typically for 3 years, only a brief progress report is required at the end of period, and decisions about refunding a grantee are made almost entirely on the quality of completed research. The quality of the proposal is secondary. Consequently, proposals are brief and, in fact, are limited to about half a dozen pages. This contrasts markedly with the proposals I have reviewed and submitted to United States agencies.

There is a lot of flexibility in the way NSERC funds are used. Researchers, who are not themselves eligible for NSERC funding, may be hired for periods as long as several months or a year without justification in the original proposal, for example. Travel is limited only by the size of the grant although justification has to be made at the end of the day, of course. NSERC (and I believe each of the other Canadian federal granting agencies) pays no overhead to universities so the typical university research service office is quite modest.

The NSERC system is particularly advantageous to beginning researchers without track records. Those whose applications get reasonably good supporting letters, usually based on Ph.D. research, will almost automatically get a 1–3 year grant of about $10,000 per year. Many of the tactics in Dr. Trumbo's paper are not needed by such applicants.

NSERC statistical research fund granting decisions, based upon a peer adjudication system, are ultimately decided on the recommendation of a committee of seven statistical researchers appointed by NSERC and broadly representative of statistical research fields and geographical subregions of the country. Policy decisions likewise are based on the recommendations by the scientific community as a whole through representatives, like the Group Chairman, who are appointed for a term of several years. Like all systems which have evolved over time, the NSERC system is complex and has a personality all of its own. My impression is it is well suited to its mission of supporting and fostering good research in Canada.

Overall, the North American system of research and development funding has worked well although I do have some concerns about present trends, which are echoed in my comments above. I am amazed by the enormous number of hours donated to its service by unpaid volunteers (reviewers and so on) and I am sure the success of the system has depended on their great but largely unrecognized efforts in search of excellence. Dr. Trumbo's very timely article, by assisting applicants in the preparation of their proposals, and reviewers thereby, must be viewed as a substantial contribution toward that goal.

ADDITIONAL REFERENCE

GILMAN, W. (1965). *Science: U.S.A.* Viking, New York.

Comment

Adrian F. M. Smith

The Editor has asked me to comment on this article from the perspective of statistics (including probability) research grant funding possibilities in the United Kingdom. However, because the current British system is substantially different from that in the United States, my discussion will largely take the form of a description of our system, rather than a detailed analysis of Trumbo's paper.

Research funds for academics in higher education establishments in the United Kingdom are distributed by research councils. These consist of the Science and Engineering Research Council (SERC), Economic and Social Research Council (ESRC), Medical Research Council (MRC), Natural Environment Research Council (NERC) and Agricultural and Food Research Council (AFRC).

It is, in theory, possible for statisticians to apply for funding from any of these research councils. However, SERC is the appropriate council for most statistical research involving substantial methodological issues. Approaches to other research councils would typically only involve statisticians as part of a team proposing essentially applied investigations in a substantive area covered by the respective council. The remainder of my discussion will therefore focus on the mechanisms currently operating within the SERC, which is

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charged with promoting basic research across the whole spectrum of science and engineering.

Detailed decision-making about grant assessment and support takes place within SERC Committees, which, in turn, are subject to financial and other constraints determined by boards, which themselves report to the council. Statistics comes under the auspices of the Mathematics Committee, which is a committee of the Science Board. The annual budget of the latter is currently around £100M of which about £6.7M is allotted to the support of mathematics (compared with, for example, £12.6M to physics, £18.5M to biology and £19.0M to chemistry).

The bulk of the support provided by the SERC takes one of the following forms: funding of (typically 1-year) M.Sc. studentships, currently about 330 new science students per annum in total, approximately 200 of whom are in mathematics, with around 65 in statistics; funding of (3-year) Ph.D. studentships, currently about 1400 new students per annum in total, approximately 200 of whom are in mathematics, with around 25 in statistics; funding of research assistants (either of postdoctoral or programmer status) and/or equipment, and/or travel and/or overseas visitors to support a detailed, specific research program.

Individual university (or polytechnic) departments bid (biennially) for M.Sc. quota allocations; departments bid to a central pool for funding for Ph.D. students, who will have picked a supervisor at a specific university on an individual basis; individual academics (or groups of academics) write detailed proposals for project grants, describing the topic and proposed research in much the same way as their American counterparts. However, the major difference is that an academic in the United Kingdom cannot apply for personal salary because he or she will have a 12-month salary from his or her employing university (or polytechnic). A typical application therefore consists of a request for a postdoctoral (or programming) assistant for 3 years, plus some travel money. The total amount of money available for project grants in mathematics is currently about £2.5M; a typical grant as just described would be for about £50K.

However, the good news for United Kingdom statisticians is that the total of £2.5M includes about £0.5M specifically ear-marked by the Science Board for the support of a so-called special initiative in Complex Stochastic Systems. The objectives of the latter are stated to be:

> "... to provide a sound theoretical basis for the solution of problems arising from developments in information technology and automated data collection and processing, which are resulting in increasingly complex systems and data structures which pose novel problems of stochastic modelling, exploratory statistical data analysis and more formal statistical inference. As well as requiring traditional statistical and mathematical expertise, the basic research is typically highly computer intensive, and a further objective is to develop strategies in numerical and graphical experimentation in structures under investigation."

Among the specific topics instanced are: data exploration and visualization, model fitting involving computer-intensive methodology, image processing, time series and signal processing, telecommunications networks, molecular modeling and population genetics, chemometrics, simulation, knowledge representation and expert systems.

Typical grants awarded under the auspices of this initiative include the provision of sophisticated graphics workstation facilities, and over the next 5 years should ensure that a number of centers with frontier computational facilities are consolidated in the United Kingdom.

In addition to the specific ear-marked funding provided by the initiative, which is administered by a specialist panel, applications for other areas of stochastic modeling and data analysis, and probability, are considered alongside all other mathematics grant applications by the Mathematics Committee. The total share of the £2.5 committee spend on project grants received by the general statistics community is currently of the order of 30%.

The refereeing process for grant applications is not dissimilar to that in the United States. When an application is sent to the Mathematics Committee Secretariat, it gets passed to an appropriate committee member (there are currently two statisticians), who selects at least four referees. The latter provide a report together with an overall grade ($\alpha+$, α, $\alpha-$, β, reject), now further broken down into a numerical scale. At the meeting of the Committee (or Initiative Panel), the referees' reports are collated and the appropriate committee member is asked to summarize these and suggest a consensus overall grade. The latter defines a constrained subrange of the numerical scale and committee members then individually (secretly) assign a mark in this range (possibly separately to subcomponents of the original full grant application). These are averaged to give an overall grade (or grades—for example, provision of a research assistant may sometimes be voted on separately from the provision of equipment). All proposals considered at the meeting are then ranked and funding is assigned by working down the ranking until the budget is exhausted. Applicants failing to obtain support are then given a summary feedback on the committee reaction to their proposal (but actual referees' reports are not sent in toto).

There is no specific system for "young researchers" in the context of United Kingdom project grant funding. However, the nature of the Complex Stochastic Systems Initiative described above is such that one anticipates comparatively little of the funding going to the more senior members of the community and most going to an up-and-coming younger generation, who combine traditional mathematical and statistical skills with equal expertise in computation and graphics.

I happen to be the current Chairman of the Mathematics Committee and so had better conclude by issuing the disclaimer that I am contributing this discussion as a private individual, rather than in my "official" capacity.

Comment

Giorgio Dall'Aglio

My first reaction on reading the paper by B. E. Trumbo has been to appreciate the mechanism for assigning grants by NSF. Possibly, the author's attachment to that work has embellished his description of it; but even allowing for this, there remains the feeling of a well-organized apparatus, served by efficient and serious people, in which the allocation of funds is made on the basis of a thorough examination of the projects presented.

This is, I think, the first and most important piece of information for those who plan to apply. The knowledge that the decision will derive from a serious and accurate examination of the project automatically implies that the first requisite of the project must be a good idea, clearly described.

Many of the tips given in the paper are corollaries of this "main proposition," and could be inferred by common sense. Of course they are not useless: even for people already trained in deduction in mathematics, deduction in real life is not easy.

In this context, I do not fully understand the practice of excluding as referees people who have worked with the applicant. They should be acquainted with the applicant's competence. The fear of "conflict of interest" should be outweighted by reliance on the substantial honesty of the reviewer (the applicant's honesty is taken for granted in the paper, not to mention that of the final judge). Moreover the final judge must appraise the judgments of the reviewers, and this includes, as hinted in the paper, an evaluation of the reviewer's personality.

The remaining information in the paper relates to administrative aspects. Among these, I find that the most relevant is the usual size of the grants that are awarded. This allows the potential applicant to evaluate the impact of the grant (if given) on the organization of his work and of his life.

The clear and thorough information given in the paper is not only useful for applicants, but also in general to understand the purpose, scope and way of operating this NSF program. (I wonder whether the real aim of paper is to instruct young applicants or rather to inform the scientific community and even to suggest how projects should be evaluated more generally).

From the paper it appears clear that this NSF program is intended to produce scientific results (and not to train students in research), operating on single, limited projects, and that this aim is pursued by allowing extra earnings to people who already have an academic position. The 1988 budget of 7 million dollars for probability and statistics is per se large, but it is difficult to appraise its real value with no reference to the sum spent for people who do permanent research work or (more importantly) to the part of the university salary, if any, which is usually intended for research as distinct from teaching.

My remarks on the paper are obviously conditioned by experience in my country, and some notes about the funding of research in Italy is not out of place.

One of the differences is that there is no separate program for probability and statistics, so that research in this field is administered in connection with other sciences, i.e., with mathematics or social sciences. There is a separation between probability and statistics, which goes back to the 1940s, augmented by war isolation but due chiefly to the strong personality of Corrado Gini. He gave the Italian statistical school a descriptive orientation connected with the social sciences, although probabilists such as Francesco Paolo Cantelli and Bruno de Finetti were more associated with actuarial science.

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