project is judged by a peer system, often involving non-Spanish referees. Approved budgets typically run about US$3000 per person a year, plus justified small equipment and/or computing expenses.

3. INTERNATIONAL COLLABORATION

CICYT also runs a project designed to bring qualified researchers to work in Spain for a limited period of time. Paperwork is initiated in Spain by the center issuing the invitation and requires a short summary of the research project and a vita of the candidate. Special arrangements exist when the visitor is on sabbatical leave.

Spain has bilateral agreements on scientific and technical collaboration with very many countries, including all those in the European community and most Latin American countries. The agreement with the United States was discontinued because of a lack of understanding on defense matters, but it is expected to be resumed next year. Those programs consist of bilateral research projects and provide funding for trips and per diem (typically twice a year in each direction) for about 3 years. Specific information may be obtained from the Subdirección General de Cooperación Internacional, Paseo del Prado 28, 28014 Madrid or from the Spanish embassies in the countries concerned.

Comment

N. Flournoy

Congratulations to Professor Trumbo for this exposé of the National Science Foundation's (NSF) Program in Statistics and Probability and his advice to the young statistical scientist who is considering whether or not to submit a grant application. Trumbo has effectively organized a miscellany of details that are important, often critical, to the managers of grant applications at funding agencies and to the reviewers, and thereby to the applicant. We have here a valuable resource document. It only covers one funding agency in one country and it is directed toward the special group of young researchers, but it is a beginning. For Trumbo calls our attention to the fact that his description of the status quo is not a defense of it. Yet the first step in organizing to change the status quo is to understand it, and Trumbo's article is useful to the entire statistical community in this regard. Many topics he covers invite peripheral discussion and analysis and I have selected only a few for further discourse.

Trumbo's paper provides cogent instruction for his selected audience of individual young researchers and it contains some information for others. However, I trust that it will also provoke. I sense an agitation, involving our professional identity and the resources available for our work, rising among the broad community of statistical scientists that can only succeed with a cohesive thoughtful community effort. Trumbo contributes information concerning the status quo that can be used to our advantage, as I shall discuss later. I firmly believe that the health of our field depends on a farsighted, broadly defined, well articulated and disseminated vision of what is engaging us and its significance.

The first point that Trumbo makes is that the competition for funds is keen. He then deals with ways in which the young statistician can optimize her or his chances of successfully competing for an award. I reiterate: the National Science Foundation's (NSF) budget for research in statistics and probability is approximately 7 million dollars. Before my term as a rotating Program Director at NSF, I was Director of Clinical Statistics at the Fred Hutchinson Cancer Research Center in Seattle, Washington with an annual operating budget on the order of $700,000. I want to emphasize the point that the national budget for the basic sciences of statistics and probability is a mere 10 times greater than a single budget for statistical support services at a single research institution. It is unequivocal that existing funding levels are inadequate to preserve the vitality of the statistical research community at this time of expanding societal and industrial need for statistical knowledge, help and innovation. However, I believe that we bear the responsibility for improving our resources, that we have the opportunities to do so and that others will not do it for us.

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Because we are unorganized in our search for resources, we are fragmented as subdisciplines are born and mature. We compete strenuously among ourselves for the federal funds that have been allocated for research in the statistical sciences, whereas the significant competition is outside of our own community. Our closest external competition is with scientists of other disciplines such as medicine and physics, to name two of the relatively wealthy disciplines. Medical scientists are highly organized and play directly on the heartstrings of the general public. The budget of the National Institutes of Health is four times that of the National Science Foundation. And, although it supports some basic science, it selects projects consistent with its mission and is not concerned with the development of other fields per se. Who's criticizing the distribution of the federal budget for the sciences? We can all thank Bailar and Smith (1986) for their efforts in this regard. They got the attention of the popular scientific press when they exposed misinformation that was, for years, disseminated by the medical community for the purposes of public image and political gain. Without organized support from the statistical community, however, the impact of their efforts falls short of its potential. With regard to the physics community, I have heard it said that they ride the prestige gained with the discovery of the nuclear bomb. Is the continuation of their relative wealth warranted? Obviously no discipline will give us resources without a fight.

Although the federal deficit remains uncontrolled, society needs statistics to look beyond the competition of other sciences and obtain resources at the expense of other federal programs. How else will we support the active faculty that is required to produce the statisticians, and the statistically literate, that are needed in our data-driven society today? Every year in the recent administration, the presidential budget request of Congress for the National Science Foundation has been traded off against the budget for Housing and Urban Development, NASA, etc. Where is the pressing argument that more money for statistics matters? A single scientist crying to his congressman when his proposal has been declined is easily ignored.

So what is the scenario for our field if we are not successful in obtaining additional support for faculty research and for graduate students? I predict that statistics will atrophy in vitality. Subdisciplines will break off and be subsumed within other disciplines. The core community of other disciplines will consider appropriate statistical functions to be service or technical functions. Chemostatistics will be a subfield of chemistry. Statistics, narrowing around that part of community that is responsible for educating the coming generation, will become increasingly introverted as exciting new subdisciplines are scattered throughout the academic infrastructure, leaving statistics isolated from the challenges that arise from the new data structures and from new classes of scientific inquiry. A report of the Institute of Mathematical Statistics has recently been released that provides an in-depth discussion of the need for cross-disciplinary research to sustain the vitality of statistics, a discussion of current scientific opportunities that will be lost without community action and recommendations for such action (Olkin and Sacks, co-chairmen and editors, 1988).

One common initial response to the knowledge of limited federal funds is depression and fatalism with regard to obtaining a piece of the pie (another common response that I'll say no more about is anger and indignation). In some cases this response results from repeated proposal applications being declined and, in others, the odds are enough to dissuade a statistician from preparing an application at all. Because this response is most common among two groups of statisticians for very different reasons, I shall discuss my concerns for each group separately.

The first group is the young, untenured faculty. I want to voice a deeply held concern for the way in which I understand departments and universities to be using awards in their tenure and promotion decisions. I find it deplorable that, all too often, the concern applicants express is not for the lost resources that an award would have provided, but for its effect on promotions and tenure prospects. I think the extent to which federal funding plays a significant role in promotion and tenure decisions needs to be documented. If it is as I suspect, our societies and community leaders should go on record denouncing this tendency. Undoubtedly, there are many implications of this tendency to look to federal agencies for judgment of excellence and I shall elaborate on a few. One implication is that universities are passing the authority and responsibility for recognizing quality to a few remote individuals whose judgments are based on criteria that are inconsistent with most established criteria for promotion and tenure. There are two concerns here. The first involves the transfer of power to individual program directors and federal agencies without their acceptance of the responsibility. In fact, it is not in their power to execute this responsibility even if they wanted it. Another concern involves the substantive difference in criteria for obtaining an award and for being a valuable and productive member of a faculty.

A second implication of universities looking to federal agencies for judgment of excellence results from the sheer lack of funds available to award meritorious research. The expectations of university administrations are unrealistic. This becomes clear from a

perusal of the list of principal investigators funded by the NSF Statistics and Probability Program (see Trumbo's reference to NSF publication [3]). Search for investigators within 6 years of receiving their Ph.D. There aren't very many! What information is available to describe the population to which they belong? How many faculty in statistics are within 6 years of their degree? What are their credentials? Do we witness a disruptive musical chairs at 6 years following the receipt of Ph.D., or is the process working effectively?

The second group being depressed by a lack of support are those whose research interests derive from the problems of other sciences, rather than from problems intrinsic to statistics or from statistical problems that are interdisciplinary with subfields of mathematics. Balanced opportunities for cross-disciplinary research by young and by senior scientists alike is a community responsibility. When money becomes tight, a natural response is to become territorial. It occurs when there is a redistribution of funds from senior to junior investigators and it occurs when scientific thrusts do not fit within existing program boundaries at NSF. To turn inward, as individuals or as a discipline, is counterproductive. It is time to nurture our own, channel our frustrations and project our destiny as we wish it to be.

I want to thank Professor Trumbo again for adding information to the literature on the statistical community and the factors affecting our growth and development. May we use them to good advantage.

ADDITIONAL REFERENCES

BAILAR, J. C. and SMITH E. M. (1986). Progress against cancer? *New England J. Med.* **314** 1226–1232.

OLKIN, I. and SACKS, J., eds. (1988). *Cross-disciplinary Research in the Statistical Sciences.* IMS, Hayward, Calif.

Comment

Yashaswini Mittal

Writing proposals and receiving federal funding for research is a long and arduous process even for the most experienced and certainly for the novice. The informational booklets published by all the funding agencies are most often not sufficient to allow the reader to grasp the crucial points being made. Thus the above article will be very useful to the beginners as well as the more experienced scientist.

In this discussion I only want to reiterate some points of the article for stress and provide some latest information on the program as supporting documentation. Similar to the author, I am a past program director (though a more recent one) at the National Science Foundation (NSF), and base my comments on that experience, but they are not official in any capacity.

A program director, who sees numerous proposals and reviews each year, gains a unique vantage point which, if shared by all investigators, could be very valuable. How to share this point of view with the investigators themselves without compromising the confidentiality of the program and the peer review system is not an easy problem. Articles such as this are attempts toward a solution. I also feel that more and better data from the program will provide crucial help as well. I have collected some data that I thought to be pertinent, from my part of the Statistics and Probability (S&P) program at NSF in the 1988 fiscal year (FY88). The following discussion will refer to parts of it in places. It should be considered preliminary at best because the size of the data is too small at the moment. However, if such data collection is continued, it will show some interesting insights and trends over the years. The proliferation of electronic hardware and software at the foundation is relatively new. I am confident that in the future, these added tools will bring drastic improvements in collection and reporting of data for all programs at NSF.

Even though a really good research idea is the crucial ingredient of a research proposal, other aspects are important as well. To be precise, a research proposal proposes concrete problems of current relevance and utility, makes a case that this can be done successfully by the proposer in the proposed duration and realistically estimates the cost of doing this research. Each aspect of this description is important, as is indicated by the four stated criteria for selection of a proposal, not just one. The best problem or a set of

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