

5–10% inflation factor is built into the continuing projects reducing funds available for new projects to between say \$240,000–\$600,000. Perhaps 50% of the investigators with projects finishing will successfully compete for funding for new projects, reducing available funding for totally new investigators to perhaps \$120,000–\$300,000. At an average contract size of \$80,000 this means one to four new projects. Thus, although the overall budget for a program may seem large, the actual discretionary funds available for new principal investigators is comparatively small.

The advice given by Professor Trumbo is based on the perspective of a person who has served as program officer very ably a number of times. He deserves the

thanks of the community both for the service rendered as program officer at NSF and for sharing his insights in the present article. The reader may also be interested in several other references related to research funding, notably Solomon and Wegman (1985) and Wegman (1986, 1987).

#### ADDITIONAL REFERENCES

- SOLOMON, H. and WEGMAN, E. J. (1985). Military statistics. *Encyclopedia of Statistical Sciences* 5 494–501. Wiley, New York.
- WEGMAN, E. J. (1986). Midcourse musings. *IMS Bull.* 15 238–241.
- WEGMAN, E. J. (1987). Commentary on defense funding. *Notices Amer. Math. Soc.* 34 616–618.

## Rejoinder

B. E. Trumbo

The discussants have gone beyond the scope of my paper in several useful directions; it is a pleasure to thank them all for their thoughtful comments. Professor Wegman has given a clear account of the differences in philosophy and practice between NSF and the DoD agencies in the United States. Professors Zidek, Smith, Dall'Aglio and Bernardo have provided valuable insights into grants processes in Canada, the United Kingdom, Italy and Spain. Apparently, each national system for research support has attractive features that might profitably be emulated in other countries.

In addition to these descriptions of various funding programs, the discussions deal with a wide variety of important and controversial topics. On many of these I am content to let the discussants have the last word, but I have selected a few topics on which I would like to agree, disagree or speculate.

#### COST-BENEFIT ANALYSIS

Professor Zidek urges prospective applicants to consider whether the disadvantages of research support outweigh the advantages. This is valuable advice; the benefits of getting a grant are so clear that it is worthwhile to note the potential difficulties, both practical and philosophical. However, the overall tone of this section of his commentary is too negative for my taste. This is partly because not all of the potentially unfavorable factors in his long list are likely to affect any one applicant and partly because I think several of them are overdrawn, especially in the con-

text of the paper. I offer the following perspectives:

- It does take time and thought to write a good proposal, but (as I have already said and as Dr. Sunley reiterates) much of this work is beneficial to the applicants' research program—whether or not the proposal is funded.
- It is hard to imagine that the kind of grant a young investigator is most likely to get (e.g., summer salary, some computer time or equipment, a little money for travel, etc.) will impose onerous administrative burdens. Furthermore, grants administrators at some universities are really quite helpful in dealing with the paperwork that is necessary.
- Investigators need not pursue topic-oriented funding programs that might divert them from “free inquiry” into their real research interests, “erode the quality of education” in their universities or violate their consciences. Perhaps the ideal “strategy” is for each researcher to decide what kind of research he or she does most expertly, enthusiastically and proudly, and then to seek support for it from all available sources. The vast majority of NSF funding is for **unsolicited proposals** on topics of the applicant's choosing.
- As Professor Wegman points out, the mission agencies support a great deal of basic theoretical research, which from the investigator's point of view may be quite unrelated to any application, military or otherwise. (I strongly suspect that

more of this happens when the program officer is a dedicated and knowledgeable scientist such as Ed Wegman.) These are often projects that NSF would fund if other agencies did not. Thus, in practical effect, funds do not remain in tidy pigeon holes, some “pure” and some “military.”

### THE AGONY OF DEFEAT

At the end of her excellent commentary, Dr. Sunley urges applicants not to invest too much of their self-esteem in the disposition of any one proposal. As with so much good advice, hers may be hard to implement.

There is, of course, the worry that young researchers, in particular, may be discouraged by unfavorable reviews. Although success is clearly easier to take than failure, I do not see why getting a proposal declined should be fundamentally more discouraging than getting a paper rejected. In the case of the declined proposal, the critical comments may save the researcher time and effort by showing the way to a more productive research program before much of the work is done.

As several discussants mention, the scientific community owes proposal reviewers a great debt of gratitude. Whatever difficulties one may find with the details of the reviewer selection process, the facts are that most of those who are asked respond and that most of those who respond do a fine job. Deserving of particular commendation are the many reviewers who take care to be especially tactful, encouraging and helpful in commenting on the proposals of young researchers—even on those occasions when they must frankly point out deficiencies or give less than an enthusiastic rating.

Professor Mittal discusses some interesting statistical approaches to quantifying the “discouragement factor” for unsuccessful applicants. Even though her current data are for only 1 year and for only the “probability half” of the S&P program, her conclusions reinforce my intuitive impressions. (Reference [4] of the paper contains more extensive survey data on several questions that are related to this issue.)

### GRANTS AND TENURE

I join Professors Zidek and Flournoy in deploring the way in which some North American universities have apparently begun to regard acquisition of grants as a criterion for promotion and tenure. Any overt proposal to give government agencies such control over academic decision making would be met with outrage and indignation.

On the other hand, it is clear that some of the information in a faculty member’s grant history may

be relevant to his or her consideration for tenure or promotion. We can only hope that this information is generally used in more appropriate ways than to require a grant as a condition of tenure or to use total grant dollars as an index for ranking promotion candidates.

### CHANGES

The closing section of my paper and several of the commentaries look forward to possibilities for broader support in the future. My hope is that someone reading the paper and associated commentaries several years from now will find much that seems narrow, quaint and out of date.

Dr. Sunley’s comments deserve particular notice in this regard. She envisions a new flexibility in the interpretation of existing programs and looks forward to emerging opportunities that could have profound consequences for how NSF supports research in statistics and probability. We can hope that any such changes will be backed by additional resources, that they will make it easier for young mathematical scientists to get deserved support and that they will promote a more reliable and even-handed funding climate for creative applications of statistics and probability—without decreasing the support for theoretical work.

Professor Flournoy looks beyond existing structures to offer a stimulating analysis of several issues crucial to the future vitality of our discipline. The diversity and fragmentation of the statistical sciences has posed organizational problems in universities and in funding agencies that have yet to be solved satisfactorily. (Should all statistical activity be housed in the same administrative unit? Can statistics thrive “under” mathematics?)

As a diverse profession, we have sometimes lacked focus and leadership in representing our interests in various forums. Often we have left it to biologists, sociologists, etc. to defend our interests in the Federal funding arenas. Perhaps one reason we have been so complacent is that these proxies have not always done badly by us. I agree with Professor Flournoy that the time has come for us to set our own goals and to make our own case in a coherent way.

Unity is not enough. I think we all take it for granted that statistics and probability are worthwhile endeavors. Most of us believe that research across the board in probability theory, mathematical statistics, statistical methodology, applied statistics and applied probability needs to be supported at increased levels. Generalized claims that a field is valuable to society (however valid and forcefully made) are not very effective in increasing the overall level of funding for

work in that field. Such pleas are usually lost in a chorus of similar ones from other disciplines.

One approach that *has* worked in other fields is to identify a specific enterprise and to show, preferably in nontechnical terms, how funding it is in the national interest. (Is there a statistical equivalent of mapping the human DNA molecule or building a superconducting supercollider?) Even though such projects may directly and immediately benefit only a

part of the relevant field of science, they often receive broad, enthusiastic support at the lobbying stage. They provide funds for scientists who would ordinarily compete for grants from other sources, and thus they increase opportunity across the discipline. Perhaps even more important, they make the discipline more visible and better understood among those who must decide at the highest levels how public funds will be spent in the future.