Recruitment, Training and Retention of Statisticians in the U.S. Federal Statistical Agencies

Clyde Tucker[1]

Over the last twenty-five years the recruitment and retention of technically qualified statisticians by government statistical agencies has become far more difficult. Focusing on experiences in the U.S. Federal government, this article explores some of the reasons why and offers a number of possible solutions to the problem. It begins by describing the three major cross-cutting divisions within the community of statisticians in the Federal statistical agencies: production vs. research; survey statistics vs. other statistical applications; mathematical statisticians vs. other statisticians. The discussion of recruitment focuses on the skills and other characteristics of desirable job candidates, advantages and disadvantages of a career in government, and (perhaps most importantly) the institutional barriers that make recruiting such a difficult task. Subjects with respect to training include mentoring, career goals, the importance of developing communication skills, and different career paths depending on job classification and the emphasis on production or research. Retention is discussed in terms of lifelong learning, advancement, continuous challenges, and the incentive and reward system. Recommendations for improvement in all of these areas are offered.

Key words: Succession planning; human resources; employee satisfaction.

1. Introduction

Over the last twenty-five years the recruitment and retention of technically qualified statisticians by government statistical agencies has become far more difficult. Focusing on experiences in the U.S. Federal government, this article explores some of the reasons why and offers a number of possible solutions to the problem. However, to truly understand the issues involved here, one needs to know about the various dimensions of statistical activity in the Federal government. Thus, the next section outlines three major cross-cutting divisions within the community of statisticians in the Federal statistical agencies: production vs. research; survey statistics vs. other statistical applications; mathematical statisticians vs. other statisticians.

The section on recruitment discusses the skills and other characteristics of desirable job candidates, advantages and disadvantages of a career in government, and (perhaps most importantly) the institutional barriers that make recruiting such a difficult task. The section on training focuses on mentoring, career goals, the importance of developing communication skills, and different career paths depending on job classification and the

[1] Bureau of Labor Statistics, 2 Massachusetts Ave., NE, Room 1950, Washington, DC 20212, U.S.A. Email: tucker.clyde@bls.gov

focus on production or research. Retention is discussed in terms of lifelong learning, advancement, continuous challenges, and the incentive and reward system. Of course, the subject of retention leads to one of the most important topics of concern in the Federal statistical community – succession planning. The final section offers some recommendations in all of these areas.

2. Divisions of Labor

As Dillman (1996) pointed out, some statisticians work in a production capacity and others are more research oriented. These are not fixed categories, and sometimes statisticians from one area contribute in the other; but, from my perspective, government statisticians either are involved in the day-to-day operations of the agency that results in the basic product of the agency or they spend their time on more long-term research and development projects that may or may not eventually lead to new methods of operation. Often the production statisticians work on very specific programs within an agency, while the research statistician is involved with issues that can cut across various agency programs or offices. Research statisticians often have more technical training than their counterparts on the production side. That is, the research statistician is more likely to have an advanced degree (especially a Ph.D.).

In its report on preparing statisticians for careers in the Federal government, the American Statistical Association's Section on Statistical Education Committee on Training of Statisticians for Government (Eldridge et al. 1982) made it clear that, although the government needs statisticians with a variety of technical specialties, a sizable majority of government statisticians are in some way involved in data collection activities, primarily survey research. Survey sampling was cited as being of critical importance in Federal statistical agencies (a topic I will return to in a moment). Of course, there are a growing number of government statisticians doing work in epidemiology, clinical trials, and other areas of biostatistics; but even here, sampling and other data collection activities often play a central role. The other major areas in which statisticians are employed by the Federal government are engineering, operations research, and quality control, such as in the departments of Defense and Transportation (see Snee 1982). The main point here is that most of this article draws on the experiences of government statisticians involved with data collection, although some of the same observations probably could be made about all government statisticians.

The concept of "total survey error" (TSE) was first discussed as early as the 1950s by Deming (1950), and it also was addressed in the 1960s by Hansen et al. (1961 and 1964) and Kish (1962 and 1965). Both Kish (1965) and Zarkovich (1966) defined data quality in terms of the extent of TSE. The evaluation of TSE became a serious area of study in the 1970s (see Kalsbeek and Lessler 1977; Andersen et al. 1979) and explored even more thoroughly by Groves a decade later (1989). Over time, statistical organizations, including government agencies, developed conceptual frameworks for identifying all of the sources of error (see Groves and Lyberg 2010).

The notion that error in surveys (or any form of data collection, for that matter) is not just a function of sampling error but also depends on the amount of nonsampling error has led to the entrance of social scientists into the field of survey methodology in large

numbers over the last thirty years. Unlike sampling error, nonsampling error is less amenable to mathematical theory and closed-form solutions. Instead, the underpinnings of the study of this type of error relies more on psychological and sociological theories of human behavior as they apply to the survey context. As a result, the community of Federal statisticians has broadened considerably.

There has always been a distinction made between those government statisticians with a strong academic background in mathematics (mathematical statisticians), U.S. Federal occupation series 1529, and other government statisticians (occupation series 1530). The former are in more demand and their numbers are smaller. In many cases, the mathematical statisticians had undergraduate degrees in math and advanced degrees in statistics, and statisticians had undergraduate degrees in other fields like business or the social sciences with some courses in statistics and possibly a Master's degree in business, management, public administration, or a related field. Although some government mathematical statisticians concerned themselves with nonsampling errors such as nonresponse (Hansen and Hurwitz 1958) and even interviewer effects (Hansen, Hurwitz, and Bershad 1961) early on, with the growth of interest in nonsampling error a number of social scientists with advanced degrees, in many cases a Ph.D. and a good deal of training in social statistics, became government statisticians. Although they often did not have a strong background in mathematics, they did have the knowledge of psychology and sociology that research mathematical statisticians usually lacked. Many of these new government statisticians began referring to themselves as "survey methodologists" rather than statisticians. In fact, many mathematical statisticians in the Federal government also called themselves survey methodologists. These social scientists, unlike the earlier series 1530 statisticians, were less likely to be involved in operations and more likely to conduct research, like many of the mathematical statisticians. In fact, they often found themselves having more in common with research mathematical statisticians than regular statisticians working on production.

3. Recruitment

One of the most perplexing problems that arises in the attempt to hire statisticians in the Federal government is the number of institutional barriers that must be overcome. These barriers are less when hiring at the lower grade levels and when hiring series 1530 statisticians, but they still exist. Let us begin with those barriers common in all cases. Just developing and advertising a position often takes much longer than in the private sector, because it has to pass through a number of layers of bureaucracy. Added to that is the cumbersome application process. It is much more formalized and rule-bound in the government compared to the private sector in order to guard against any bias on the part of the hiring agency, especially with respect to political persuasion. While understandable, the process can be long and drawn out and require the applicant to devote a great deal more time to seeking any single government position than one in the private sector. For statistician positions in particular, the application review process can be quite complicated. Personnel specialists must conduct the first review to determine those applicants that are minimally qualified, but they usually do not have the technical

qualifications to make such determinations without some guidance, as they might with less technical occupations.

The hiring officials also have a number of constraints. They often must select candidates according to a ranking by the personnel department, even if they do not agree with the judgments of the candidates' qualifications used in establishing the rankings. The hiring officials have very limited room to bargain with the candidate in terms of salary or other benefits and do not have the authority to directly make an offer. These constraints make it difficult for hiring officials to hire the candidates they believe are best for their job openings.

As already mentioned, the difficulty in hiring statisticians for government does differ across the dimensions discussed in the previous section. Not only are lower-level statisticians easier to hire because the government salaries are more competitive at that level, but Series-1530 statisticians usually are easier to hire than mathematical statisticians, especially at the Ph.D. level. There are a number of reasons for this state of affairs. Mathematical statisticians are in greater demand in the private sector (especially in the biopharmaceutical industry) than are other statisticians. Also, at the Ph.D. level, social scientists do not command the salary levels in either academia or industry that statisticians do. Furthermore, the Federal government generally only hires U.S. citizens, and many Ph.D. level statisticians in this country are not U.S. citizens. Finally, although there are now a number of programs offering Ph.D.'s in survey methods (see Lyberg 2002), the fact is that many of the students in those programs are not being trained in mathematical statistics. Some of the traditional mathematics and statistics departments in major universities do not offer many courses in sampling or other areas of survey statistics. The coursework is more theoretically oriented. Federal statistical agencies less interested in survey statisticians may find students in these programs with the proper training, but they still have to contend with the citizenship requirement, salaries that are not competitive at the Ph.D. level, and the lengthy hiring process.

One of the more interesting aspects of recruiting for statisticians in the Federal government concerns the interviewing process on university campuses and at statistical meetings. In the first place, statisticians do not always make the best interviewers. A common problem (to be discussed again later) is that government statisticians have difficulty establishing rapport with job candidates, since this is not their traditional role. Secondly, as Currie et al. (1986) describe it, the interview for a government statistical position can almost seem like an oral examination. Certainly, it is important to gain some understanding of the job candidate's technical knowledge and abilities, but it is unclear that this is the best way to do it. Based on my experience, if the hiring official is uncomfortable with the whole recruitment enterprise, it makes it less likely that he or she will maximize the efforts necessary to find the best candidates.

4. Training

If there is one topic in government statistics that has been written on extensively it is the training of government statisticians (Eldridge et al. 1982; Currie et al. 1986; Killion 1999; Hole et al. 1995; Morganstein and Marker 1997; U.S. Federal Committee on Statistical Methodology 1998; Lyberg 2002). Some of this work outlines programs or

recommendations for improving the skills of government statisticians (both by enhancing or changing already existing academic programs and by creating in-house programs within the statistical agencies themselves). Others describe some of the new programs already underway for improving the training of government statisticians. Still others detail what skills a government statistician needs to possess.

The focus here will be on the desires of statistical agencies and what the realities are in the marketplace. Perhaps the best summary statement of the desires of statistical agencies is given by Currie et al. (1986). Statistical agencies look foremost for statisticians with a blend of training both in theoretical and applied statistics, with some ability to do computer programming. For agencies that are involved in survey research, courses in sampling are particularly important. However, across the board, government agencies are interested in statisticians who know how to approach real-world problems analytically and use their statistical training to solve them. Writing and communication skills also are emphasized.

Unfortunately, the academic training of statisticians does not always live up to these ideals, but the bigger question may be whether any statistics program, undergraduate or graduate, can be expected to provide such a product. While there are ways in which statistics programs can move closer to the ideal (both Snee 1982 and Zahn 1982 suggest students get involved in more statistical consulting), statistics programs may not be capable of turning out such well-rounded individuals as the agencies would like to see. After all, English majors are not expected to both communicate well and do calculus. Moreover, statistics may be a field which attracts students who are comfortable primarily working alone. Much of the coursework in math and statistics is abstract and divorced from real-world problems. Also, university professors usually make their academic reputations in theoretical and not applied areas. Furthermore, if writing and communication skills were to be taught, who would do the teaching? It is unlikely to happen in statistics departments. For undergraduate statistics or math majors planning to go on to graduate school, the advice they are likely to receive is to take the most rigorous courses available. Once in graduate school, these types of courses probably are emphasized even more. So the expectation of statistical agencies and the realities of university education are not necessarily compatible.

In 1978 (see Savage 1978), the American Statistical Association (ASA) did hold a conference on fostering more interaction between academic and government statisticians. The conference's recommendations included temporary exchanges of personnel between government agencies and universities, the development of materials and data packages describing and simulating government applications that could be used in applied statistical courses, and providing greater access to government statistics on university campuses. Clearly, the latter goal has been accomplished with the introduction of the internet, but the development of training packages that can be accessed over the internet probably has not been done to any appreciable extent. A number of agencies, working through the National Science Foundation (NSF) and ASA, offer fellowships to academicians to spend time at an agency and conduct research that is of interest to both the agency and the academic. It is not clear, however, that this has become a two-way street. Government employees are much less likely to take up residence at a university purely to do research without pursuing a degree.

Lyberg (2002) provides a comprehensive overview of recent developments in the area of training survey statisticians, and he lists a number of university programs in several countries designed to train government survey statisticians. Much of the coursework in these programs is of an applied nature and covers very specific steps in the survey process. Many of the programs are at the Master's level, but a few do offer a Ph.D. in survey methodology. From looking at their curriculums, it is clear that they serve the Series 1530 statisticians and the social science survey methodologist well. It is less clear, however, whether some of these programs would provide the advanced training needed for research mathematical statisticians.

While Currie et al. (1986) call on universities to provide the training needed by government statisticians, they do point to a different model developed in Britain in which the government itself undertakes the responsibility of training its statisticians, at least when it comes to improving their communications skills. Lyberg also discusses the training efforts on the part of various national governments. These include the French national statistical institute (INSEE), the European Statistical Training Program (TES) for European Union statisticians, the International Programs Center (IPC) of the U.S. Census Bureau, and the Graduate School of the U.S. Department of Agriculture. Although some of these courses are quite rigorous, many of them focus on the day-to-day duties of the survey statistician, such as the analysis and dissemination of survey data.

5. Retention

Very little has been written on the retention of statisticians in government service. Two aspects of retention will be discussed. The first, of course, is the methods that have been devised to retain statisticians. The second, however, is quite different. If statisticians can be retained, especially over the longterm, how can both the statisticians and agencies maximize their benefits? This latter subject will lead naturally into the last topic – succession planning.

After the first few years of government service, salaries for statisticians become less competitive than those in the private sector. Mathematical statisticians receive higher salaries, but only for those in mid-level positions. Even at this level, my experience in hiring statisticians for the U.S. Bureau of Labor Statistics over the last two decades has been that industry has the ability to pay more than the government to get a good person. Certainly, a new Ph.D. is likely to be offered more by industry and, sometimes, by academic institutions.

Once statisticians move into the senior ranks, including supervisory positions, their salaries start falling behind those of their counterparts in private industry. Of course, other aspects of their job or lifestyle (e.g., regular hours, interesting problems to study, and job security) can offset this salary differential, but it is in these years when many of them will begin to raise families and buy homes. So their relative expenses are increasing while their relative incomes are decreasing.

Agencies have found a number of ways to persuade statisticians to remain in government service. Retention bonuses are given in some cases to keep highly regarded statisticians who are being recruited by the private sector. Educational benefits in the form of both tuition and even sabbaticals are offered to those who wish to pursue advanced

degrees in statistics or survey methodology. The employee often agrees to remain in government service for a certain number of years in exchange for some of these benefits, especially sabbaticals. Providing greater challenges can be a reward in itself, so a rotational assignment that offers the statistician the opportunity to broaden his or her experience is another way to convince a statistician to remain with the agency. Of course, a promotion not only means a higher salary but also increased responsibility, and this is what some statisticians desire, particularly those on the production side. For research statisticians, having access to the wealth of data collected by a Federal statistical agency is very enticing, and being able to conduct research without the pressure of "publish or perish" makes it all the better.

If the agencies persuade their statisticians to stay, where do they go from there? Whether the statistician is on the production or the research side, is a mathematical statistician or not, he or she is likely to be given greater responsibility over time. With this greater responsibility will come more exposure and opportunities to consult with other offices in the agency and, possibly, even other agencies. The statistician also is likely to lead (if not supervise) the activities of groups of junior staff.

It is at this point that training in communications skills becomes so important. Killion (1999) states that, among the opportunities offered for growth to statisticians in government agencies, this is frequently a neglected area. She emphasizes that these skills become increasingly important as the statistician moves up the career ladder. A highly qualified technical statistician cannot successfully make the transition to senior technical advisor, team leader, or supervisor without being able to communicate his or her knowledge to others. In addition, that statistician must be able to interact well with both those above and those below. So, interpersonal skills necessarily go hand-in-hand with communication skills. Thus, both the agency and the statistician will benefit in the long run by fostering the growth of not only the statistician's technical skills but also his or her social skills. It is far better to have leaders with both types of skills.

6. Succession Planning

It is impossible to catalogue all of the newspaper and magazine articles that have been written on succession planning in the last few years. Walsh (2006) points out that succession is a particular problem in the Federal government, because the largest group of workers is in their fifties while the largest group in the private sector is in their early forties. This difference may reflect changing attitudes toward government service and the emphasis on smaller government that became popular in the 1980s.

In any case, there is less material to work with, but statistical agencies obviously will have to make do, to a large extent, with those statisticians they have been able to retain over the long term. Recruiting qualified mid-career statisticians from outside can be difficult if only because of the salary differential. How good the mid-career staff is will depend a lot upon the three steps that have gone before – recruitment, training, and retention. If the agency had in place an effective recruiting program that attracted some of the best candidates at the time, if the agency's training program not only expanded the recruit's technical knowledge over time but also provided opportunities to develop the practical analytical skills needed by a government statistician, if at the same time

the maturing statistician was able to develop the communication and interpersonal skills needed for leadership, then the agency is in a better position when it comes to succession planning. Otherwise, the transition in the coming years will be a difficult one.

7. Recommendations

Although these recommendations probably come too late to help with the transition from the post Second World War baby-boom generation in the U.S., they may prove useful in the future to statistical agencies.

7.1. Recruiting

1. Develop recruiting materials that offer a favorable contrast between the public and private sector. These materials would emphasize the lifestyle advantages of government employment as well as the long-term benefits and security. In addition, the materials should focus specifically on the careers of statisticians and the variety of opportunities offered in government service, especially the ability to pursue advanced education in relevant areas. Discussion of advancement also should be included.
2. An agency needs a corporate image that helps to sell it in the marketplace, not only to its customers but also to potential employees. That means developing a marketing strategy that trades on the agency's history and reputation. Job candidates need to know the agency by name, what it does, and what it stands for. Aggressive advertising should be accompanied by aggressive recruiting strategies. Hiring marketing consultants may be a cost-effective approach in the longrun to achieving this name recognition.
3. For mathematical statisticians, hiring bonuses as well as escalated pay scales in the form of built-in retention bonuses for more than entry-level positions will be needed to attract the best and most ambitious students.
4. A more streamlined hiring process is needed. Perhaps the statisticians in the agency's program offices can work more closely with human resources to make this a reality.
5. Statisticians should partner with their counterparts in human resources (HR) to do everything possible to attract interested candidates. In the case of Ph.D.s, both social scientists and mathematical statisticians, the supervisory research statisticians should vigorously pursue recruiting by going beyond simply posting job openings. They should network at conferences and universities to identify potential hires.
6. Supervisory statisticians should develop interviewing skills if they are deficient in that area. An alternative strategy would be for statisticians and HR staff to be paired on recruiting trips. Although statisticians have the advantage of being able to converse with job candidates about substantive topics, they could learn a lot from HR staff about effective recruiting techniques. Another possibility is to identify statisticians that already have good interviewing skills to do the hiring.

7.2. Training

1. It should be recognized that it will be impossible for an academic institution to produce exactly the product that a statistical agency desires. Thus, it is up to the statistical agency to mold the new hire into the employee it wants. To do this, the first step is to assign a mentor to the statistician from the beginning. A new employee should not be left to flounder, not knowing his or her role or what to do.
2. In-house courses tailored to statisticians that not only outline the goals of the agency but also describe what the statistician's role is in achieving these goals should be a first priority.
3. Each new hire's academic background (no matter what the educational level) should be reviewed with an eye to the job he or she is expected to perform, and the new hire should receive training (academic or otherwise) in areas that were not covered by prior education. When appropriate, new employees also should be encouraged to pursue advanced degrees with tuition and release time provided by the agency. Clearly, the current trend toward the development of graduate programs for government statisticians should continue.
4. The road between the government agency and academia should be more of a two-way street and busier. Currently, there are not enough opportunities for government statisticians to spend time working on research at universities, and there is not enough money to fund joint endeavors. Perhaps the National Science Foundation or the National Academies of Science could foster such programs.

7.3. Retention

Of course, the economic incentives are important, but only one other point needs to be made here. During mid-career, if not before, some way of teaching communication and interpersonal skills to the best technical statisticians is essential. Not only will it make them better leaders but also better recruiters of younger statisticians. The central question is whether or not these skills can be taught or are they a part of core personality traits. To the extent they can be learned, those who already have them must serve as mentors to others. This is too important to ignore.

8. References

Andersen, R., Kasper, J., Frankel, M.R., and Associates (1979). Total Survey Error. San Francisco: Jossey-Bass.

Currie, S.G., Gough, J.H., Hole, G.J.C., Krotki, K.P., Lussier, R., and Maranda, F. (1986). Preparing Mathematical Statisticians for Statistical Agencies. Journal of Official Statistics, 2, 315–328.

Deming, W. (1950). Some Theory of Sampling. New York: Wiley.

Dillman, D.A. (1996). Why Innovation Is Difficult in Government Surveys (with Discussions). Journal of Official Statistics, 12, 113–198.

Eldridge, M.D., Wallman, K.K., Wulfsberg, R.M., Bailar, B.A., Bishop, Y.M., Kibler, W.E., Orleans, B.S., Rice, D.S., Schaible, W., Selig, S.M., and Sirken, M.G. (1982).

Preparing Statisticians for Careers in the Federal Government. The American Statistician, 36, 69–81.

Groves, R.M. (1989). Survey Errors and Survey Costs. New York: Wiley.

Groves, R.M. and Lyberg, L.E. (2010). Total Survey Error: Past, Present, and Future. (Forthcoming).

Hansen, M.H. and Hurwitz, W.N. (1958). The Problem of Nonresponse in Sample Surveys. Journal of the American Statistical Association, 517–529, December.

Hansen, M.H., Hurwitz, W.N., and Bershad, M.A. (1961). Measurement Errors in Censuses and Surveys. Bulletin of the International Statistical Institute, 38, 359–374.

Hansen, M.H., Hurwitz, W.N., and Pritzker, L. (1964). The Estimation and Interpretation of Gross Differences and Simple Response Variance. In Contributions to Statistics, C. Rao (ed.). Oxford: Pergamon Press, 111–136.

Hole, G., Lee, G., and Jones, T. (1995). Development of Mathematical Statisticians in Statistical Agencies. Proceedings of the Joint Statistical Meetings: American Statistical Association, Government Statistics Section, 204–209.

Kalsbeek, W.D. and Lessler, J.T. (1977). Total Survey Design: Effects of Nonresponse Bias and Procedures for Controlling Measurement Errors. Proceedings of the Second Biennial Conference on Health Surveys, 19–42.

Killion, R.A. (1999). Developing the Affective Side of Technicians: Consulting and Management Skills. Proceedings of the Joint Statistical Meetings: American Statistical Association, Government Statistics Section, 198–203.

Kish, L. (1962). Studies of Interviewer Variance for Attitudinal Variables. Journal of the American Statistical Association, 92–115.

Kish, L. (1965). Survey Sampling. New York: Wiley.

Lyberg, L. (2002). Training of Survey Statisticians in Government Statistical Agencies. Proceedings of the Joint Statistical Meetings: American Statistical Association, Section on Survey Research Methods, 2209–2217.

Morganstein, D. and Marker, D.A. (1997). Continuous Quality Improvement in Statistical Agencies. In Survey Measurement and Process Quality, L. Lyberg, P. Biemer, M. Collins, E. De Leeuw, C. Dippo, N. Schwarz, and D. Trewin (eds). New York: Wiley, 475–500.

Savage, R.I. (1978). Exchanges of Statisticians. In Report of the American Statistical Association Conference on the Transfer of Methodology Between Academic and Government Statisticians. Washington: American Statistical Association, 116–129.

Snee, R.D. (1982). Comment on Eldridge et al. The American Statistician, 36, 82–87.

U.S. Federal Committee on Statistical Methodology (1998). Training for the Future. Statistical Policy Working Paper 27. Washington, DC: U.S. Office of Management and Budget.

Walsh, T. (2006). Succession Planning. Government Leader, 1, 7, Post-Newsweek Media.

Zahn, D.A. (1982). Comment on Eldridge et al. The American Statistician, 36, 88–89.

Zarkovich, S. (1966). Quality of Statistical Data, Food and Agricultural Organization of the United Nations, Rome, Italy.