New Researchers’ Survival Guide

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1. Introduction

Statistics is a wonderfully diverse profession and graduate students making career choices have many options - especially in light of the dearth of students moving into the statistical sciences today. The three main career paths at the Ph.D. Ievel ar e in academics, industry/business and government. Each of these job types offers its own mix of intellectual challenge, financial reward, pressure and security. How a new researcher selects (or is selected by) a specific occupation in the statistical scie nces sometimes seems more a function of luck than of conscious decision making. This consideration was one of the first concerns addressed by the New Researchers Committee (NRC) of the Institute of Mathematical Statistics in 1988, and this guide is the pr oduct of our thinking. We believe that if students were better informed about their choices, they would be less apprehensive, pursue their goals more effectively and, ultimately, be far more likely to find positions for which they are well suited. Similar ly, if doctoral students were generally more familiar with various aspects of professional life, the entire statistical community would benefit.

Among the transitional facts of life with which we believe new researchers should be acquainted are:

I. mechanisms for applying for jobs,

II. the expectations associated with different types of jobs,

III. techniques for initiating an active research program,

IV. methods of becoming more involved with the broader statistical community.

The Survival Guide addresses these issues, but it also offers advice on a variety of other topics which new researchers may wish to consider as they prepare to leave graduate school. A summary of this guide and the 1990 NRC report to the IMS Council appears in Statistical Science (1991).

2. Graduate School

Graduate school preparation is the foundation for a successful career in statistics, and students preparing to enter the profession with a Ph.D. are well encouraged to take some time to examine their goals before they finish. Having a clear idea as to which path you wish to pursue after graduation allows you to work consciously towards the lifestyle y ou desire. While most people reading this guide will already be well on their way towards graduation, it's worth mentioning the importance of the selection of a graduate program to the chance of success in a certain sub-area of the discipline. The most fa mous graduate schools, for example, focus on fostering the next generation of statistical researchers. Their programs emphasize theoretical statistics and often encourage a high degree of specialization. Less famous programs aim at producing more applied statisticians who hope to find jobs in industry and government. Of course, many eminent researchers have been spawned by programs not mentioned near the top of the latest rankings, but if your aim is to do research at one of these highly ranked department s, your best bet is to come from one as well. If your goals aren't so focused on where you do your work, any of the top fifty should give comparably good training.

This section outlines the kinds of preparation one should undertake in graduate school. Much of the discussion is geared towards academic careers, but there is specific advice for other paths, and many suggestions are broadly applicable.

2.1 Courses to Take

For any career in statistics, one has to build a broad base in applied and theoretical statistics. Virtually all departments steer students through the necessary classes, and we urge you to trust your advisor in selecting among the available options. Besides the traditional core curriculum, students can chart their course work with an eye to future emp loyment. Don't delay graduation excessively, but it often helps in the early years to have strength in a complementary discipline. A few outside courses are often sufficient to accomplish this goal.

I. For academic research, it is wise to study as much mathematics as possible. Details depend on one's interests, but popular choices are functional analysis, measure theory, combinatorics, and differential geometry. Real analysis and linear algebra are basic requirements. If one has an interest in biostatistics, then medicine and biology are comparably valuable. For teaching positions, it often helps one's marketability if one can teach basic courses in mathematics, such as linear algebra or differenti al equations. The value of such capability may have diminished recently, since statistics courses are gaining on mathematics for time in the undergraduate curriculum.

II. For industrial positions, it is a benefit to have a detailed understanding of the technology. Pharmaceutical companies are delighted to hire statisticians who know chemistry and biology; similarly, other organizations prefer candidates with a business or engineering background. If one targets a career in a specific industry, doing a little relevan t course work is sensible preparation. For government positions, appropriate background depends on the objective. To work with the Environmental Protection Agency, one might study biology or chemistry; for the Census Bureau, knowledge of demography/socio logy would be useful, and for the Commerce Department, it would be appropriate to know a little finance.

One can sometimes glean relevant experience through consulting. Be alert to such opportunities in one's department.

2.2 Skills to Acquire

Graduate school is the best place to attain computer literacy, professional writing skills, and experience in teaching and consulting. After graduation, there is little time or assistance for acquiring these skills. Most degree programs attempt to fo ster such breadth, and students should actively seek such opportunities.

2.2.1 Computer Skills

Computer literacy is a sine qua non for a modern career in statistics. Some students focus exclusively on elegant math rather than confront the frustrations of computer hacking, but this is unwise. It is better to recognize the computational imperati ve early; in the long run, it saves time and improves the quality of one's work. Because of the rapid developments in computing, no specific hardware or software can be recommended. The most important computer skill is the ability to move easily between different computing environments. These environments consist of different sub systems, and competent statisticians can typically handle at least one of each of the following:

- Operating Systems. These create and manage computer files, and they link all the other facets of the computing environment. As one travels about in one's profession, one is likely to encounter different systems, but the key concepts are fairly transpor table. These days, a working knowledge of UNIX will take you almost anywhere, although if your current departmental system is not UNIX based, you will obviously need to familiarize yourself with its system as well.

- Text Editors. There is usually little choice as to a basic text editing system, and it is best to adopt whatever is in common use in the department.
- Electronic Mail. There are many mailers, and they all interconnect. You should become comfortable with your department's e-mail system early, since it is a window on the scientific world, and enables long distance collaborations that are otherwise impo ssible. For example, this Survival Guide was written by many different people, most of whom have never met.
- Programming Languages The major choices are FORTRAN, C, LISP and Pascal. FORTRAN is ugly, clumsy and unforgiving, but it is currently the fundamental language of scientific computing, particularly because so many useful subroutines and public domain so ftware are uniquely available in FORTRAN; however, this is rapidly changing.
- Statistical Software Packages. There are a number of packages differing somewhat in their capabilities, but all basically offering the standard analysis techniques, as well as various routines for special analyses such as clustering. Many are available on both mainframes and microcomputers.
- Statistical Programming Languages These are packages used to write new statistical routines, and do simulation studies. Usually, they offer built-in graphics, matrix manipulation and other useful features. Some are statistical packages in their own rig ht.
- Document Preparation Packages. Skill with a document preparation package such as TEX has become a professional necessity. These enable one to write professional quality letters, spiffy curriculum vita and articles with complicated mathematical expressions.
- Symbolic Manipulation Routines. A recent development is software that can handle symbolic algebra, differentiation and integration. Some of the more useful packages also graph equations and perform matrix operations.

Few statisticians master this entire suite of skills, but most have strength in each category. Ultimately, time invested in getting friendly with the computer is not wasted.

2.2.2 Writing Skills

Graduate school is the last chance to polish one's writing style before public and professional embarrassment. Fortunately, statistics is a discipline in which an adequate writing style can be achieved without excessive effort. There is generally a stock phrase in the literature for many standard situations. For review articles or topics that dem and a discursive tone, one must rely on one's natural skill and such manuals as Strunk and White's The Elements of Style or The Chicago Style Guide. The main rules for professional prose are Be brief and Be simple.

Keep in mind that a well written paper is likely to make a bigger impact and is usually worth the effort. It will also make the referees happy while they read it. A well written article is the product of many revisions. No matter how eager you are to submit your article it pays to set it aside for a couple of weeks so that you can give it one last revision before sending it out to the journal. If at all possible, get someone to read your article before it goes out for review. The best way to get some one to do this for you is to first do it for them. Foreign students face greater difficulties. They are strongly advised to work at improving their spoken and written English throughout their career, since that is usually their single greatest obstacle in all professional interactions. Both the IMS and the ASA are sincerely sympathetic with such difficulties, and the editors take special pains to hel p polish good articles written in poor English. Most universities offer English as a second language programs for foreign students, and all non-native speakers should enroll immediately, and participate throughout their graduate careers. Also, when writin g an article, curriculum vita or letter, foreign students should invariably ask a sympathetic native speaker to proofread the work before it is distributed. As a graduate student, one can benefit from refereeing an article with the help of your advisor. Usually one's advisor will be delighted to delegate such tasks. The customary formula for a referee report is to

- summarize the content of the article and its context in the literature (one to three paragraphs);
- point out flaws in methods, concepts, proofs and coverage;
- point out smaller errors of fact, style, grammar, citation and spelling;
- if the article has potential, make constructive suggestions for the minimum necessary improvement; if it is not salvageable, indicate this in a socially graceful way;
- in a separate letter addressed to the associate editor, make a specific recommendation as to whether the article should be published immediately (very rare), published after certain specific revisions have been accomplished (more common), reconsidered after substantial change or extensions (even more common), or rejected entirely (quite common).

Naturally, this paradigm depends upon the journal. An article can be inappropriate for the Annals of Statistics, but entirely suited for The American Statistician.

2.2.3 Other Skills

Other skills that are useful to practice while still in graduate school include teaching, consulting, and giving seminars. These are discussed in the later sections.

2.3 Writing a Dissertation

A dissertation is supposed to be a new contribution to the field. An important test of its success is publication. Publications tend to be most important in academics, but they can also accelerate one's rise in industry and government. A good rule, t herefore, is to write the dissertation with-the goal of producing papers.

Typically, the milestones in one's progress on the dissertation are:

- Choosing the thesis advisor. This should be done in conformity with one's career path. For those planning academic careers, the ideal advisor is someone you can work with, someone whose research interests match your own, and someone who is well known. For those aiming at industry or government careers, an advisor's reputation is probably less critical.
- Choosing the topic. One should explore a bit before settling on the topic, and one should be flexible on the results one seeks. Some students ask their advisors for a thesis problem, but this is stultifying and should be avoided. Seeking out one's own problem diminishes the likelihood of being directed towards a topic which represents a straightforward untangling of minor details of the advisor's ongoing research. The best way to proceed is to start doing small scale research in an interesting area, an d write smallscale papers for your advisor (always with an eye to publication). Out of this, a strong dissertation will usually emerge.
- Presenting the thesis proposal. At most institutions the thesis proposal is a major milestone, but elaborate preparation is probably a waste of time. If one is already doing research and writing minipapers, then the proposal will evolve naturally. When your advisor says you are ready, just tie your ongoing work together and you probably have a very ade quate proposal.
- Selecting the committee. The usual committee is a group of four, including the thesis advisor and a member of another academic department. The committee should be chosen with an eye to future letters of recommendation and complementary research strengt hs. Some faculty are notorious for not reading dissertations in a timely manner, and such people are an aggravation.
- Writing the dissertation. If possible, write articles, not a dissertation. If the rules of your university allow, give your articles separate chapter numbers, write a literature review chapter for the front- and a future research chapter for the back. Investigate this possibility with your advisor and the graduate school at an early stage in your career.
- Defending the dissertation. If your articles have already been submitted, then the referee reports will have you well-armed for the defense. Almost surely, your advisor won't let you schedule until success is certain. But do a practice talk for some k nowledgeable friends and your advisor, and try to be relaxed, confident and mentally nimble at your defense. Probably someone will throw a curve ball question, but even if you choke they'll try to pass you.

Some people feel that the thesis advisor has the right to expect that your research will lead to a joint publication, and that a student should desire this too. Not only does it give you a start in your career and improve the odds of the paper’s bei ng accepted, but it also puts the advisor’s reputation on the line besides your own. An added advantage of publishing with your thesis advisor is that you’ll have the moral support of an experienced professional as you steer your maiden effort through the pitfalls of publication. Perhaps equally many people believe that it is undesirable to make your initial publication a joint effort with your advisor. A single author publication quells suspicion that the research was more the work of the advisor than of the student. Furthermore, working toward an independent publication puts you in the driver’s seat early on, and encourages your growth as a creative researcher.

2.4 Leaving with a Bang

When you start your job, research will compete with teaching, consulting, meetings and projects for your time. (Post-doctoral positions are a pleasant exception.) For this reason, having a running start from graduate school is a big boost to your pro fessional career. There are several things you can do to give yourself this boost. One is to cultivate relationships with others in your field, both fellow students and professors. The more people you know, the more chances you have for collaboration and interaction. Also, most employers want three letters of recommendation, so you’ll want friendly relations with faculty other than your thesis advisor. Finally, it helps to have a collaborative effort underway before leaving graduate school; this broadens your research and enables a more rapid publication rate. For academics, the most important part of a good start is to have some articles already submitted to journals. These usually come from your thesis; however, it is also possible to engage in oth er small projects concurrent with your thesis which can be submitted while you are in graduate school. Many book-length theses do not lend themselves to the extraction of publishable articles. In this case, it is doubly urgent that some of the article wri ting be finished in graduate school.

Having said all this, it is worth emphasizing that many successful statisticians did not leave school with published articles and a network of collaboration. Funding and the seasonality of the job market are major factors that hurry one along. The po ints in this section represent strategy rather than requirements.

3. Finding a Job

One applies for research jobs in academics, government and industry in different ways. If one wants an academic position, then the job search should start in the November preceding graduation. Most universities bind themselves to January or February deadlines for applications, but a few are as early as mid-December. Industrial jobs are available throughout the year, though some are tied to the fiscal cycle. Research positions in government agencies depend on Congress, the federal budget, and other ra ndom factors; they generally require a time-consuming amount of high-level approval.

The following comments are largely aimed at academic employment, but the spirit applies more broadly. In general, serious researchers are urged to seek university employment first; from there, it is relatively easy to migrate to other sectors accord ing to one's tastes. Many universities offer job-hunting seminars that can help you in your job search.

3.1 Organizing the Search

It requires great organizational skills to manage more than 10-15 job applications. You should consult with your advisor, weigh the extra-academic and academic criteria and do your utmost to construct a list of places that you would like to work at and who might consider hiring you. This list should include a mix of schools, but give realistic weight to your own values. Not everyone is a star researcher, and not all stars are willing to pay t he high price that success demands. Also, bear in mind that the reputation of a statistics department partially depends on the broader reputation of the university.

Academic job postings appear in the Amstat News and the IMS Bulletin, published by the ASA and IMS, respectively. Some government and industry positions are also listed there, and similar announcements appear on departmental bulletin boards. Many ind ustrial, and some government and academic, recruiters attend the ASA annual meetings; this is an excellent time to do comparison shopping. Potential employers post job descriptions, and applicants can (but need not) post their qualifications and requireme nts. Also, there are professional employment services (Robert Wilkinson and Associates is ubiquitous) that work to match statisticians with a constantly updated file of industrial positions. It is wise to check possibilities with your advisor or other fac ulty members; they may even suggest a position or a post-doe opportunity that matches your interests.

After your targets are chosen, send them an application package consisting of a cover letter, a list of professional references, a dissertation abstract, your curriculum vita and possibly one or more reprint or preprints. All documents must be typewr itten (laser printed), free of typos, clear and succinct. The cover letter introduces yourself and indicates the job for which you are applying. Emphasize research interests and relevant experience; tailor your letter to the specific announcement. Avoid duplication of material in the curriculum vita. The le tter should be simple, direct and conservative; this is the first impression the search committee has of you and it must sound professional.

The reference list gives the names, titles, addresses and telephone numbers of three to five faculty members (sometimes it is sensible to include a non-academic statistician) who are familiar with your current work and capabilities. Don't list someon e until you have obtained their permission. Only list people who will give a good recommendation; it's better to have three superb references than five mediocre ones. Often it is your responsibility to ask these references to send letters of recommendatio n to the target employers; if so, make it easy on the references by providing a list of addresses and some background on the job you want.

The curriculum vita is an academic's resume; ask your advisor for a model. By custom, the following three sections appear first, in the following order:

- Personal Data. List your name, address, phone numbers, citizenship, and visa type (if pertinent).
- Education. Give your degrees and universities in reverse chronological order (you may indicate summa cum laude or magna cum laude if appropriate).
- Professional Experience. List your professional employment experience in reverse chronological order. Don't give job descriptions, as the position titles should speak for themselves.

After this, the order and types of sections are flexible. Most people include most of the following:

- Publications. Give references for all published or submitted manuscripts.
- Honors and Awards. List invited talks, teaching awards, fellowships, grants, etc.
- Professional Activities. Indicate committee work, manuscript and grant review (don't breach the confidentiality of the review process, just indicate the journals or agencies that you have assisted and how often).
- Teaching. Give course titles and semesters for each class you've taught; don't go back more than four years.
- Memberships. List the professional societies to which you belong.
- Presentations. Give the titles of your recent talks, the place and month.
- Research Support. List your function (principal investigator, project coordinator), title of grant, funding agency, project period.

Send the application ahead of the deadline. Departments are legally bound to respect these deadlines, and may disregard late applicants. You need not include items that were not requested, such as reprints, preprints or transcripts.

3.2 Interviewing Your Employer

Part of the interview process is to discover whether the prospective employer meets your criteria.For example, with positions in biostatistics departments, expectations for teaching, research and collaboration varies greatly across universities. Do s ome background research on potential employers before initiating the application, and do more detailed preparation if you are invited to interview. For academic jobs, most of the relevant information can be obtained from their university catalog, a recent copy of which is always available at your university. Also, your advisor can probably put you in contact with someone who has a good sense of the current situation. When all of this homework has been done, the remaining questions may be put directly to t he chair of the search committee. For industry, business or government jobs, it usually happens that the only convenient source of information about the job is the contact person designated in the announcement. Don't hesitate to ask this person very speci fic questions about the nature of the job, the salary, course-loads and other duties, research expectations, the organization, the history of the organization, your potential colleagues, consulting opportunities, the location, fringe benefits, day care, f lex-time, and so forth.

A common dilemma in our profession is the two-body problem. Graduate students are often married, and enter the job market together. If they are in the same field, it is virtually impossible for both to be hired at the same university, and it is nearl y as bad when they work in different areas. It is not quite so difficult for industry or government, but similar issues obtain. In general, the first university to creatively solve the two-body problem will hold options on many tremendously gifted people. Until then, you should apprise your potential employer of any marital constraints, and ask them to help you find a suitable accommodation.

In all these contacts it is entirely professional to have a clear sense of what you want. If a group does not match your needs, then it wastes everyone's time to pursue the matter.

3.3 Interviewing

Before you visit to interview, get a list of the people you will meet. For academic posts you will generally meet with most of the faculty, in one-on-one hour-long blocks. A faculty list is available from the college catalog. You should check out the ir areas of interest, and familiarize yourself with their recent publications. Look especially for points of contact between your work and theirs.

For other jobs you will have to ask the search chair to describe the interview format and whom you will meet. If any of them publish, examine their work; otherwise, ask the chair about people whose activities overlap with your research.

Some of your talks with people you meet while interviewing will not be technical. You can hold general discussions about research interests, fun applications, computer facilities, current trends in statistics, departmental initiatives and such. With one or two interviewers, you may be able to speak more substantively. If you cannot find common ground, ask the interviewer about his or her research and listen intently. In all these conversations, you should express energy and enthusiasm, both for the w ork and the institution.

Frequently, the interview includes a social gathering, such as dinner or a cocktail hour, with one's future colleagues. To some extent, this is to encourage you to look favorably on the department. To some extent it is to help the interviewers decide if they could bear to work with you for the next twenty years. Remember, this is part of the interview. Be convivial, but don't offer personal information you didn't plan to reveal (for example, your plans to take a year off to see the world) and don't o ver-indulge.

3.4 Your Talk

For academic jobs, and some other positions, you will be expected to give a seminar about your research. Advice on giving talks is given in Section 4.3. However, there are some special items to note about job talks. The main purpose of any seminar is to convey information about your research. For a job talk, the audience will not only be interested in the technical merit of the work, but also they will want to see your style, your sense of organization, and your ability to deal with difficult questions. The best way to prepare for tough questions is to ask yourself the questions ahead of time. Most people don't perform well under pressure. Those that appear brilliant on the spot have done their homework.

It is better to err on the side of being over-prepared, and on the side of being very simple; wowing the crowd with your technical depth is not as good as wowing them with your capacity to make complex arguments intuitively clear. Give them something to talk about with you during the rest of your visit. Practice in front of a live audience is invaluable. If you cannot speak in your own department seminar, volunteer to speak at the nearest university, or, at the very least, to your committee or fellow graduate students. If necessary, practice your talk aloud without an audience. The only way you can judge whether you have the right amount of materi al is to practice. Absolutely, do not exceed the fifty minute time slot. Give yourself at least a week to prepare your talk. You will need time to revise your slides after your practice talk.

3.5 Negotiating an Offer

When an offer is made, you should be ready to negotiate freely, frankly and fairly. You should know your approximate market value (ask your advisor and consult the Amstat News salary surveys, published each spring) and indicate the things that would make employment compellingly attractive. Even in government and academic jobs, salary is frequently negotiable, so it is worth asking about this.

In academic positions, you might ask for a light teaching load in the first few semesters, to ensure a good start on publication; also, you might ask for summer support for a year or two, while building a reputation that supports future funding. You can also request start-up funds for equipment purchases, travel for a conference or two, and moving expenses. If you have family responsibilities, requesting a terminal for home use can be enormously convenient; similarly, you might want to ensure that th ere will be sufficient flexibility in your teaching schedule so that it conforms, for example, with a child care center's hours.

Government employers have little negotiating flexibility. Business has more, and you might ask for programming support, special equipment and skilled secretarial help. It is important to make such requests early-often your department can obtain funds more easily when it is part of the hiring process. Ask your contact person to mention the special arrangements in writing, when they send a letter confirming the starting salary.

It is in everybody's best interest to make your final decision promptly, but it is wise not to allow yourself to be pressured into a decision at too early a point in the interviewing season. Also, while it's unlikely that you will be prepared to comm it during the first telephone offer, you should attempt to specify a date by which you will make your decision. This date, like all else, should be negotiable, but you should be as fair and honest in your interactions with search committees or department chairs as possible. If you are waiting to hear about a job you prefer, and which you have a reasonable chance of obtaining, then it is reasonable to call the preferred institution and inform them that you have an offer, and need to hear from them soon. Ev eryone incurs risks during the interview season, and common courtesy suggests that all players avoid stringing others along unnecessarily.

4. The First Few Years

Starting any professional job is hard. At a research university, you can expect to work long hours, but still not manage to do all that is needed as well as all that you want. The same sort of pressure can be found in some business and industrial pos itions, with diminution as moves towards less competitive niches and governmental posts. Besides doing good statistics, one is always expected to energetically shoulder new responsibilities, initiate new projects, help senior colleagues increase their sta

nding, work doggedly with students/clients/extra-departmentals, participate in ASA and IMS activities, pursue funding, and be an enthusiastic team player.

This section describes strategies for juggling one's career obligations. Perfect success is never

possible, but professional recognition is like an exam that gives partial credit.

4.1 Teaching

The first time one teaches, it is ordeal by fire. For most conscientious people, it eats all their time and leaves them emotionally exhausted. But, with experience, one's ability improves. Eventually, it can become a very satisfying facet of one's pr ofession.

Government and industry statisticians, not just academics, often teach regularly. Moreover, the public presentation skills that one acquires during your education are valuable for all standard statistical careers. Thus one is well-advised to volunteer to teach while a graduate student. Ideally, one should try to teach the same course several times. It is amazing how much better one gets the second time around. Usually, a normal teaching load is two courses of three hours a week per semester. It can be lower in some (research) institutions, while it is sometimes higher in others. Note that you can often negotiate a lower teaching load for the first few seme sters. A reduction in teaching load in the first few years is highly desirable. Mainly it should be used to write articles from your dissertation or to do new research. Depending on the financial situation of the institution, you might be helped by one or several teaching assistants. TA's usually grade homeworks and sometimes grade midterms and final exams. In some cases, TA's also lead a section in which they give examples, display computer software, or solve problems in class. If the number of students is judged to be too low, then no such help will be available.

Typically, you will be totally responsible for your courses. You have to choose the textbook (usually months before the course begins). The first time that you teach a course it is wise to use the same textbook that was last used, especially if you h ave little or no experience. That way, you should be able to benefit from the previous experience of a colleague in planning the course; you might even be able to borrow notes. Of course, you are likely to modify them, but at least these will give you an idea of the pace to follow and the level at which to teach. The next time that you teach the same course (preferably the next year, so as to minimize the number of courses to prepare), you could contemplate making major changes in the course to suit your own taste. The first time around, however, you should try to play it safe. In most universities, you will be left alone as far as teaching goes, although there are notable exceptions to that rule. Still, many institutions have an office which sponsors teaching workshops and has counselors who can help you with your teaching duties. The same help is usually also available to teaching assistants. It might be wise to attend su ch workshops while you are still a graduate student. This is especially important for foreign students who have plans to stay in the U.S. or Canada. The initial teaching encounters of non-native English speakers tend to be far more difficult than those of their English speaking counterparts. Nevertheless, potential employers regard teaching experience as strong evidence of linguistic capability and commitment, so it is important to jump in as soon as the opportunity to gain experience presents itself. As a rule, anyone having difficulties with teaching should seek help, either from colleagues or from counselors. Try not to be overly discouraged by harsh student reviews; undergraduates have little sympathy for all beginners, and less tact. Teaching might not count much in the tenure process, but the thirty some years that you are likely to teach might seem extremely long if you know that you are a lousy teacher. Good teaching usually takes time. While each person has their own style, we mention a few approaches that will not only save you time, but also make you a better teacher. Always prepare carefully. Preparing too much material for a lecture is not lost as long as it can be used in the next one. On the other hand, overly preparing a lecture by trying to find an answer to each possible question that you can think of is li kely to be inefficient. Instead, don't be shy to tell them that you do not know the answer to that question, that you will look it up, and give the answer the next time.

Try to keep good notes of your lectures so that you can use them again in the future. Jotting down a few notes after each lecture can also be useful. For instance, you can note the questions that were asked, what seemed to be misunderstood, or remind yourself that example 4 should be replaced by a more useful one. Such notes can be saved in a computer file. These can be invaluable in iteratively improving your courses. Aim for the upper 75th percentile of the class. The bottom 10% are unlikely to have the skills to keep up no matter how slowly you go, and you will only bore the others if you aim too low. If you aim too high, you may inspire a few students, but you run a high risk of turning the majority off altogether.A few other points to consider:

- Undergraduates need lots of homework and quizzes; these are major learning tools. It is reasonable to give a quiz in every fourth lecture.
- Seem confident and relaxed; demonstrate enthusiasm for the subject.
- Keep office hours faithfully; do not cancel class except at extreme need.
- Listen sympathetically and don't voice devastatingly harsh judgments. Undergraduates can have very fragile self-esteem.
- Cultivate a stimulating stage presence; try not to be dull.
- Don't take things too seriously.
- Maintain a professional distance between yourself and the students.
- Be clear and consistent about grades. Document everything. If you suspect cheating, photocopy the evidence and talk to your chairman about appropriate procedures.
- Don't forget to protect your own research time. Teaching can be quite intrusive, and you must not allow it to take up too much attention.

4.2 Consulting

There is a difference between consulting and collaboration. Collaboration involves equals, on the same footing, each contributing his/her expertise to the problem. It involves communication about all aspects of the work and some give-and-take. It inv olves a learning experience for both parties. It takes time to establish the trust required for a good professional working relationship with someone. On the other hand, consulting is more service-oriented. Generally, the statistician is there to advise t he client about design, about which tests are appropriate, and so on. The role of the statistician depends on both the problem and the type of work that is rewarded by your department.

4.2.1 Departmental Policy

Find out what your department's expectations are with respect to consulting. Do they value collaborative research or is consulting a service your department provides to other researchers? Will your effort count towards promotion? Your level of commitment should take this into consideration.

4.2.2 Responsibilities

The researcher is responsible for his/her own data entry, data management and, preferably, analyses. If the researcher cannot handle this, they should hire a research assistant, preferably a statistics graduate student who will learn from the experi ence, or seek help from the computing center. The statistician must take the responsibility to understand enough of the problem to give good advice, but is not ultimately responsible for the quality of someone else's research.

Consulting comes in three flavors. Some problems deserve only basic package methods, others merit a more thoughtful modification of standard techniques, and a few demand sophisticated research attention. The last category, if taken seriously, will be come collaborative research. There are many reasons why a problem might deserve only primitive statistics. Sometimes it happens that the experiment is completely clean, all the assumptions are sensible, and a standard statistical test is appropriate. More often, the client has s o completely botched the experiment that any time investment on your part is senseless, or the client's audience (a major professor or a journal) will only accept certain standard analyses. This leads to awkward situations that one must square with one's professional conscience.

Points to consider when deciding the extent of one's participation include:

I. Will your professional reputation be attached to the conclusions?

II. Will your efforts improve the accuracy of the outcome?

III. Are you receiving funding for your consulting assistance?

IV. Is there a long term educational or research goal that may be jeopardized by your withdrawal?

The plurality of opinion in our profession is reflected in the report of the ASA Ad Hoc Committee on Professional Ethics (1983), and subsequent discussion.

If a client's problem demands nonstandard techniques or considerable effort, then it is proper to ask for publication credit - preferably before investing much time. Sometimes a problem has deep statistical merit. These are valuable opportunities, and one should rise to the challenge. The chief difficulty is that the time required may interfere with other obligations.

For conducting a consulting session, the following suggestions may be helpful.

I. Reserve certain days or hours for consulting work and stick to this rigorously - otherwise, you will quickly be overwhelmed.

II. Don't run more than an hour for each session, and spend most of the time listening.

III. Don't be pressured into an unrealistic schedule. Everyone wants the work done by Friday. This is fine, but you pick which Friday.

IV. Avoid the temptation to formulate the problem too quickly. Make sure you know exactly what the aims of the study are and do not give any advice until the researcher has been explicit about this. (Don't be surprised if the researcher has difficulty wit

h this part.)

V. Invite the principal investigator to the first meeting; thereafter, restrict the group to the key players.

VI. If it is an on-going project, after each session, write up a short statement of your understanding of the discussion, who is going to do what, and the deadlines. Mail this to the client for approval.

4.2.3 Co-authorship

If you write any part of the paper, contribute substantially to the analysis, or put in a substantial amount of time, you have a right to co-authorship. This should be established unequivocally from the time you start doing anything more than giving oral advice, or after the third meeting. This should always be the case, if the client is a researcher, but may be more problematic if the client is a graduate student doing dissertation research. In the latter case, ask for co-authorship on any papers co ming from the dissertation which involve your part of the work.

If you are a co-author, insist on reviewing the final draft of the paper or report to ensure accurate representation of the statistical analyses. If you are not a co-author, avoid acknowledgements or other recognition of your contribution unless the investigators did precisely what you suggested. Otherwise, you will have no say in what was written, and you will not receive credit for your work, but you may be blamed if something went wrong.

As co-author, the statistician generally writes the statistical methods and results sections of the paper. This can be submitted to the client as a final report, prior to writing the paper, but should be in a format suitable for publication, including relevant tables and plots.

4.3 Giving a Seminar

The first step is to outline your talk. It should begin with motivation, an overview, and/or an illustrative example; this first ten minutes should be at the level that most graduate students can understand without excessive effort. Then give the substance of the talk, always in the least abstract language that the topic permits. At the end one can point out technical generalizations, simulation results that support the work, or open questions tha t the current research has raised. Summarize the points you have made, so that the audience is left with a clear sense of your contribution. Armed with the outline, prepare your slides. There should be about 15 to 25 for a fifty minute talk; plan to sp end at least two minutes on each. Slides should generally be handwritten, very legibly, with lots of color, pictures and graphs (don't forget to label axes). If you must use printed slides, use at least a 24 point font size. Don't put too much informatio n on a slide, and don't be too complete; the slide should complement, not duplicate, your oral explanation.

Except in special cases, plan to let the audience see the entire slide. Similarly, never show a page of numbers, such as commonly summarizes a large simulation experiment. Always avoid presenting dense tables of numbers; at absolute need, you can pro vide a handout. Similarly, a handout might carry details of a proof that are not covered in the talk, a set of references, or other dry material. If your hands sweat when you are nervous, be sure to use waterproof ink. It is good strategy to structure the talk so that you can skip or add a few pages, depending on time.

One should never run beyond the time limit; always stop a little earlier. Avoid proving anything; if it is essential to your research, you may sketch a part of the proof of the major theorem (academic audiences are far more impressed by an understand ing of proof heuristics than by careful picking of nits). Use humor effectively but sparingly. (If you cannot deliver a joke, try a cartoon on your slides.)

Always practice your talk before delivery. For beginners, there is absolutely no substitute for a dry- in front of a real audience; after you become a polished orator, the practice can be accomplished through an interior monologue. Look at your audie nce as you talk; speak clearly, loudly, and not too quickly. Stand on one side of the projector and stay on that side. It helps to have the first few sentences memorized so that you can start well even if you're very nervous.

When fielding audience questions, try for brevity, precision and wit. Be sure that you understand the point of the question; if necessary, ask for clarification. When someone asks something that is very complex or entirely tangential, give a brief re sponse and say that you'd be happy to talk further after the general discussion ends. Be prepared to answer questions about what you did not do; e.g., why you didn't address a certain class of models in your study, why you didn't use a certain alternate a pproach, and so forth.

4.4 Mentors

A mentor is a more experienced colleague who helps your career. Mentors can tell you what the unwritten rules are, offer advice on how to promote yourself, introduce you to their colleagues, help get you invited to speak at meetings or write comments on invited papers, and write papers and grant proposals with you. The above description may sound like Santa Claus. What is in it for the mentor? To a large extent they genuinely want you to succeed. They can also ask you to fill in for them in speaking roles, organizing sections of meetings, talking to scientists about their statistical problems and other such things that might be chores for them but great opportunities for you. So both of you win, even though it seems that you win more. It would be a big mistake to think that having a mentor entitles you to a free ride. When they delegate something to you, they will have had to explain it to whoever asked them for the favor. Then the work you do will reflect on both of you. You owe it to yourself and your mentor to do a great job.

Mentors are fairly hard to come by. You don't find them under M in the phone book. They are likely to be people who are good at working with people and to a large extent they will find you. To get found, it helps to show that you are energetic and en thusiastic. For your part, you can find an experienced colleague or former teacher with whom you feel comfortable and ask for advice from time to time. Also, as a junior faculty member, you can start functioning as a mentor yourself to students in your de partment: sharing with them what you have learned about job searches and publishing, asking them to referee papers, getting them invited to speak or attend at conferences, getting them involved in grant proposals, and so on.

4.5 Paper Revisions

After what may seem an eternity you will receive referees' comments on your article. (By the way, it is fair to write the editor a polite letter asking about your article if more than 6-8 months have passed.) The comments come with a letter from the editor indicating what the journal will do. They may: accept your article as is, reject it outright or ask for revisions before they make a final decision (only the second two really happen.) A rejection is almost certainly final. Usually you will have received constructive criticism from the referees and the associate editor. Occasionally the comments will be rather abusive. In any case, if you still think the article is worth pursuing, try to understand the critical comments of the referees. If possible, correct the problems they mention, or change the wording so that nobody could ever again misunderstand your work the way they did. Then send the article to another journal. Don't get di scouraged too easily. They have not rejected you, just your article. The vindictiveness that appears to be aimed at you is probably sparked by impatience with having to review anything at all. If you don't feel like rewriting it now, maybe you will in a f ew weeks.

Referees' reports are supposed to spell out the changes they think are necessary in order to make the article publishable. They may also list a number of discretionary changes that they would like to see. Generally the best thing is to just make th e changes that they have told you to make, some or all of the discretionary changes, and no other changes. In your reply explain how you have met the requests, or why you did not meet them.

Resist the temptation to introduce new material into the article after it has been reviewed. This can slow down the review, so it is better to save it for the next article. (Some judgement is necessary on this point.)

One reason for not making a change is that a referee might not have understood what you are doing; the suggested change might introduce an error. Though the referee may know less about the subject than you, he or she is likely to know more about it t han most of the readers will. If the referee has misunderstood a point, then try to figure out exactly what was confusing. You should rewrite part of the article in order to clear it up. Then in your letter explain the misunderstanding and how you have ch anged your article so that the point is clearer. Needless to say this has to be done well or your article can be delayed further. Absolutely, do not insult the referee in your rebuttal.

Sometimes the referees disagree with each other on what you should do. In that case you get a choice. Mention to the losing referee that you had instructions from another referee. In the letter to the associate editor, explain your reasons for the choice you made. Sometimes the referees' comments are vague. If they have not spelled out clearly what they want, you should spell out clearly what you did and how it meets their requirements. Vague requests can be met in many more ways than precise ones can, so you get some flexibility.

A common request is to shorten the article. Referees will often suggest what to take out. Proofs can be shortened by describing sequences of steps instead of spelling them out; descriptions of simulations can be cut back to the bare bones necessary f or somebody else to replicate them, and of course the main results.

4.6 Service Work

Never volunteer for committee work. It will find you. When you do get assigned to committees, delegate like crazy. (For example, new faculty are often assigned to colloquium management; to control this time sink, structure things so that each visitor has one of your colleagues as the designated host, charged with responsibility for making all arrangements for entertainment, lodgings and local meetings.) Women and minorities need to be especially vigilant regarding committee work as they may be asked to serve on committees more as representatives of their gender or race than because of their potential contributions. On the other hand, you need to do your fair share. When possible, choose service work that you can benefit from. For instance, as colloquium chairperson, you have a chance to meet people and frequently these people will return the invitation. Try to do your committee work during those times of the day when your intellectual faculties are not at their peak.

Universities, industries, business and government all have different levels of committee work. In universities (especially research universities), it is rarely useful to be active above the departmental level; university-wide committees can consume m uch time without giving the remotest chance for winning any credit towards your professional goals. In contrast, for industries, business and government, committee work at higher levels than your department offers potential for executive contacts and docu ments a team-player spirit. This can redound to your advantage when promotions are made.

Professional societies, such as the ASA and the IMS, also have committees (the authors of this report are an example). We think and hope that this committee work has some positive influence on our careers, but that influence is probably not commensurate with the time required. Nonetheless, from the standpoint of doing one's fair share, it is social ly responsible to participate in one society committee; there is little value in working with two, unless both reflect areas to which you have a strong personal commitment.

4.7 Getting Funding

Research funding is important to academic statisticians, but not those in industry or government. Any academic who seeks funding should read Trumbo (1989) and the ensuing discussion. It weighs the pros and cons, gives specific advice, and lists the m ajor INS. grantor institutions and their criteria. The discussion provides similar details for Canada, England, Italy and Spain.The main reasons for writing grant proposals are:

1. Many universities offer only nine months of salary each year; the remaining two months are up to you.

2. Funding success makes tenure committees smile.

3. One can acquire books, travel money, money for publication costs, hardware and software.

4. One can support graduate students, soft-money research positions, programmers and secretaries.

5. At some universities you can buy relief time from teaching.

The biggest reason for not writing a proposal is that it requires a major time investment, and often the grant doesn't come through. Don't write one if your ideas are not fully developed. A poor quality grant proposal reflects badly on the proposer.

On balance, most academic statisticians seek funding. For those who are new to the game, it is generally smartest to team up with a senior colleague; failing that, one should write modest proposals for only one or two summers of personal support.

Women and minorities should inquire about the special programs available to them. Most departments have an administrator who superintends budget preparation, coordinates the details with university policy and sometimes maintains a list of possible funding sources. You should be very nice to that person, and give them as much lead time as possible. Also, one should seek advice from experienced faculty, and examine their successful proposals. Finally, don't hesitate to call the director of the granting agen cy if you have questions that you can't find answers to elsewhere. They can give advice about whether you should submit a solo grant, and whether any special special programs are available to you. Some agencies target topics that they are interested in fu nding.

Most universities require proposals to include an overhead charge to the funding agency; this accounts for one's office space, computer support and other institutional costs. The overhead can be as much as 60% of the total. Sometimes one can recover part of this money, for example by asking the university to provide matching funds for hardware pur chases.

The bulk of the proposal is a description of the intended research. An impressive description almost requires one to have completed the research project before writing the proposal. It is generally wise to be very far down the road on the research be fore applying for the grant; successful proposers often underemphasize the results already in hand, in order to be sure that the final report shows significant progress.

4.8 Time Management

Your professional time must be allocated between teaching and research, and since tenure is mainly, if not exclusively, decided on the basis of your research record, you have to leave sufficient time for research activities in your schedule. Therefor e scheduling becomes a very important part of your career. Some specific suggestions to help you manage your time are listed below.

Maintain regular office hours which are totally devoted to the students. If you don't, students will come into your office all the time and interrupt your work. Such a policy is an important aspect of a more general closed door policy which some use.

It consists of reserving time slots, when no one is allowed in your office. The restrictions can apply to students, teaching and research assistants, and even colleagues. Some people filter their phone calls during these periods. The advantage is that yo u have a chunk of time to work undisturbed. The disadvantage is that you will get a reputation of not being available. If you do it in a tactful way, the advantages will undoubtedly outweigh the disadvantages.

Ensure that there are blocks of time dedicated to research in your schedule. If you don't, and if you take your teaching and committee work seriously, then you are likely to end up having very little time left for research. Spend at least one hour ea ch day (or one day a week) on the research activity nearestto completion. Try not to compromise on these periods.

5. Your Family

The unmarried statistician can best focus on career. If you have a family, it takes an abundance of determination and organization to meet familial responsibilities while pursuing tenure at a research university. To many people, this is the strongest disincentive to a strenuously academic career. Usually, business and industry are slightly less demanding, while government agencies and non-research universities are much less demanding.

However, successful career and family life are not mutually exclusive. People without children are often unduly apprehensive about balancing the two. It can be done with efficient time management and above all a cooperative spouse. It is helpful if b oth partners have a clear understanding of the difficulties that will be encountered. A family has obvious compensations, and they can reflect positively in your career as well.

6. Conclusions

No guide can cover everything, and no single piece of advice suits all circumstances, so don't take this document too literally. Nonetheless, hard work and brilliance are professional trump cards, and it never hurts to be popular too. We urge you all to give serious thought to the realities of your career choices, but follow your heart as well as your head.

Good luck in all things!

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