

Some Thoughts on the Importance of Internships as Part of an Undergraduate Program

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This white paper (and other related resources) can be found at
<http://www.amstat.org/education/curriculumguidelines.cfm>.

Abstract: *We review some key benefits of internships highlighted by the ASA/NSF sponsored InGenIOus panel, and reported by interns. We discuss ways institutions can develop successful on-going relationships with host organizations, and key principles and understandings between the university, host, and student that should be followed for the internship to be successful.*

Overview:

It is increasingly clear that internships with industrial, nonprofit, or governmental organizations are valuable experiences for both the student and the hosting organization. Internship experiences bridge academic preparation in statistics with real-world applied research/data science applications. Students learn how to clean messy data, reorganize files, and most importantly, structure research questions in ways that make it possible to answer them with the data that are accessible. It is difficult for students to gain these skills solely from coursework. They often lack the ability to pull together the messy threads of a research question and the available data, and often the experience in an internship gives them the experience to apply research methods in ways that connect those dots.

The intern gains valuable work experience such as:

- Opportunity to participate in a “real world” project and gain experience with actual day-to-day research.
- An experience that might help hone in on a career choice.
- Multidisciplinary teamwork experience that is so important in science.

- Led to a job offer at the company/laboratory after graduation.
- A bridge to industry.
- A real confidence builder to be able to tackle something with which there was no previous experience.
- Networking with many professionals who can give great advice.
- Experience with professional written communication, such as application, resume, abstract, poster, paper, and proposal.
- Experience with professional communication with others.
- Working at an industry site.
- Enhanced resumé.
- Project expanded into Ph.D. research.
- Travel to another part of the country/world.
- Social activities involving students with similar interests from around the country or world.
- Learning to work in an environment with deadlines.
- Opportunity to use coursework in applied setting.

Additional benefits from an internship can be found in the InGenIous theme report attached to this paper. The National Science Foundation and the ASA amongst others supported a project entitled: Strategies for Advancing the Mathematics and Statistics Workforce. A three-day workshop was held in July 2013 at ASA in Alexandria VA entitled: the Next Generation through Innovations and Other Strategies (INGenIOus). One theme explored in workshop was fostering internships for students at all levels. The report on this theme that is attached points out that internships give graduates experience that can make a student stand out against other job applicants in the labor market. Graduate schools sometimes require research experience which graduate can gain through an internship. They also note that graduates who have had internships are more confident in their abilities, knowledgeable about expectations and experienced in the profession. Internships can be a vital part of the undergraduate learning experience.

Not to be ignored, the host organization gets a project completed and is able to evaluate in depth a potential future employee.

Some comments from interns on their experiences:

- “An internship with JPSM is a chance to work with and/or learn from some of the most knowledgeable individuals in the field of survey methodology. Take advantage of this opportunity, even if you are only slightly interested in a career in the field. Not only can it open your eyes to a world of exciting and productive work, but it can also show you how to get there.”

- “So far my internship has been going really well! I'm getting the opportunity to apply many of the concepts I have learned in my classes to real life scenarios. I've been able to build a great set of skills and make solid connections with coworkers and other companies in my field of interest”
- I've had a very good experience with the internship I've had. As a freshman I started working on a project with my college's Institutional Research department, partially supervised by the staff in the department. The project I worked on was a test for assessing students' quantitative skills, so it has a section with math and stats questions and a section regarding how the students feel about their own skills. The project culminated last spring in a presentation analyzing the difference between the first-years' and seniors' scores. I now continue to work for the IR office, but in a more general capacity. I think one of the most valuable things about this has been the experience with handling real data. We've administrated the assessment on multiple platforms (Moodle and Qualtrics), each with their own difficulties, and the bulk of the work I've done has been cleaning and arranging the data for analysis. Needless to say, the stats classes I had taken previously had never used real "messy" data, so I feel I have a much better grasp of what it means to do statistical work in the real world.

Internships can be successfully completed with students from high school through PhD programs. Internships programs vary from 10-12 week summer programs to part time efforts during the academic year. They can be volunteer efforts or paid. Quite often an initial volunteer experience can result in a paid follow-up experience. If a university has a flexible curriculum, internships can be facilitated in non-summer months or for longer periods of time. Industry, nonprofits or governments might find these types of situations appealing as it takes a while for an intern to learn about the project, people and organization to be very effective.

Hosting Organizational Responsibilities for Internships:

Many internships require a student to possess reasonable computer skills using software packages. SAS is quite standard but not universal. MatLab, R might be also good skills to have. Social science organizations quite often use SPSS over SAS. Key principles that an organization should follow in a student's internship experience are:

- Have staffing in place before committing to an internship program.
- Provide support for local housing when a student is not within commuting distance to the host organization.
- A dedicated mentor should be assigned to each intern and be available to the intern.
- The mentor should reassure the student before hand.
- Have a backup mentor in mind in case the assigned mentor does not work out.
- Have a well-defined project in advance of the intern's arrival.
- Need to give clear guidance; need regular communication with intern.
- Informal interactive experiences, such as brown-bag lunches, could provide opportunities

for students to exchange ideas and experiences.

- Avoid reassigning students from their projects to help meet an organization deadline.
- Equipment for the student should be arranged before starting the internship.
- Give student's upfront knowledge of what the internship involved.
- Need discussion of how student's knowledge and education would be utilized.
- Student was not trusted to do anything more than menial work.
- Regular communication of academic department with interns and company mentors of interns.
- Should emphasize the need for honest feedback from intern regarding whether the internship is going well and get that feedback periodically so that remedial action can be taken promptly if needed.

Additional principles that should be followed for an internship can be found in the InGenIous theme report attached to this paper.

Typical Internships:

Research Assistant Job Description

Office of Institutional Research

This position will work with the executive and assistant directors of Institutional Research on surveys, data analysis, and office management projects. The research assistant will collect institutional data from sources across campus, prepare charts, graphs, and tables, and perform data entry, numerical proofing, word processing tasks as well as miscellaneous office work.

Working hours will be set, but the schedule may occur at any time Monday - Friday 8:30-4:30

Junior Fellows Program at the University of Maryland

The JPSM junior fellow program is a cooperative venture of the Interagency Council on Statistical Policy and the [Joint Program in Survey Methodology](#). The graduate faculty of the Joint Program in Survey Methodology devotes their teaching careers to teaching the multidisciplinary tools that are needed for large-scale Federal surveys and censuses.

This is a unique internship experience that gives a student a paid research assistantship with an assignment in a Federal statistical agency, plus educational benefits that can expand your horizons of what you can do in your career.

See attachment 2 for more details.

Typical project assignments for Interns:

1. Analyze a survey data file analyzing trends in post doc appointments. The analysis was dependent on 2 supplemental questionnaires about a decade apart. The result was an information sheets available to the public.
2. Analyze response pattern data for survey respondents that were collected in an institution survey to better understand how data was gathered together for responding.
3. Survey analysis, including table and graph design and writing executive summaries
4. Analysis of institutional data, merging and restructuring transactional database files in order to analyze cohort outcomes, course-taking patterns, and post-graduate outcomes
5. Qualitative research, including in-depth interviewing, focus group moderating, coding, and thematic qualitative analysis

Steps to Set up Internships:

It must be recognized by both the host and student's organizations that internships have a cost to run. Significant effort will be needed from the mentor and host organization in terms of space, equipment, expert's time, potential training and travel costs, etc. The university will have to devote resources to set up and maintenance relationships with host organizations. Having a coordinator for internships would be very beneficial. The university must also constantly determine changes that need to be made to enhance the student's experience.

The first critical step for a University to pursue internships is to contact potential industry, nonprofit, or government sources. It is also possible that units within the university are possibilities for internships. Contacts can be made at professional meetings, e.g. conferences, or through local professional societies such as ASA chapters/sections. Use of social network sites such as LinkedIn has possibilities. Students can attend job fairs or look through professional newsletters as another source for finding internships. ASA maintains a list of internship openings with a small number open to undergraduates. A student might consider applying to an internship even if the announcement calls for some graduate school education or to non-statistical organizations that seems interesting to his/her goals such as an environmental organization.

Students/advisors can use university resources such as placement services as another way to identify potential organizations for internships. Discussions with faculty who research interests matches the student for possible leads the faculty member might have.

Once a relationship is established, a university should try and maintain a stream of students all the time to maintain the relationship with the industrial/nonprofit/governmental organization. Initial successful relationships are important to maintain an on-going relationship.

It is important for the university to know exactly what skills the host organization requires from the student. Certainly, the need to pick up some on the job training (OJT) is fine and necessary but massive OJT will probably not work. For example, if you need somebody with extensive SAS skills, an intern with

limited skills probably will not work. The intern will get frustrated and the host organization discouraged.

In summary, as noted above, once an internship is set up it should be recognized that by both the host organization and the university:

- Assignments should be doable in the time frame that intern will be with the host organization and match the intern's abilities.
- It is important that the host organization and university are sure the intern's skills match what is needed in the project the intern is to be assigned. Another option is to see that the host organization has assignments that match the intern's skills.
- It is important that the host organization is committed to have a mentor for each intern. Depending on the assignment and the intern's background, significant time might have to be carved out for mentoring.
- The critical thing to remember, if an intern is an undergraduate do not expect to get skills you would see in a PhD. Expectations should match the intern's CV. The more relevant experience the intern has, the higher the host organization's expectations could be for independence.

Attachment: <http://www.ingeniousmathstat.org/pdfs/NSF-DMS-Internship-Report.pdf>

Attachment: <http://jpsm.umd.edu/undergraduate/junior-fellow-program-overview>

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InGenious Theme Report

Fostering Internships for Students at All Levels

by

Angela Shiflet and Bob Starbuck

Promotion of internships should be a major component of workforce development for the next generation of mathematics and statistics graduates. Reasons for this recommendation include:

- Graduate schools often require that those who they accept have research experience.
- Most fellowships opportunities are only available to those with research in their backgrounds.
- Employers are more likely to hire graduates that have had internships in their or other organizations.
- Graduates who have had internships are usually more confident in their abilities, knowledgeable about expectations, and experienced in the profession.

Participants in the online panel came from a variety of backgrounds and brought a variety of experiences to the discussion:

- Tom Gerig, Professor of Statistics at NC State University, was co-founder of the Graduate Industrial Trainee program, which involves NC State and numerous industry partners.
- MathhiasGobbert, Professor of Mathematics at the University of Maryland, is co-Principal Investigator for an “Interdisciplinary Program in High Performance Computing,” an NSF Research Experiences for Undergraduates.
- Amanda Marvelle, Biology Instructor and Director of Digital Media Learning at the Research Triangle High School (TRHS), helped found this STEM charter school, which enables Research Triangle Park industry internships and projects for its students. Before obtaining her Ph.D. in Genetics and Molecular Biology, she had a variety of internships.
- Debbie McCoy is recently retired from Oak Ridge National Laboratory, where she was Director of the Research Alliance in Math and Science (RAMS) Program for underrepresented students (African American, Hispanic American, Native American, and female American).
- Frank Seelos, Planetary scientist at Johns Hopkins Applied Physics Laboratory, had internships as an undergraduate and helps students with their internships.
- Wei Shen, Senior Director, Global Statistical Sciences at Eli Lilly and Company, is in charge of internships for statisticians.

- Angela Shiflet (co-lead), Larry H. McCalla Professor of Mathematics and Computer Science at Wofford College, for eleven summers participated in faculty research experiences at various government laboratories. The Emphasis in Computational Science, which she was instrumental in establishing, requires a summer internship involving computation in the sciences.
- Bob Starbuck (co-lead), Assistant Vice President for Special Projects at Wyeth Research (retired), is a statistician with 32 years in the pharmaceutical industry and has helped numerous students with internships.

Value of Internships

Panelists enumerated a long list of “What things were particularly good about your experiences?”

- Opportunity to participate in a “real world” project and gain experience with real day-to-day research.
- Better able to make career choice.
- Multidisciplinary teamwork experience that is so important in science.
- Led to NSF or other fellowship.
- Led to a job offer at the company/laboratory after graduation.
- A bridge to industry.
- Seeing all the different facets of a company.
- A real confidence builder to be able to tackle something with which there was no previous experience.
- Honing skills.
- Networking with many professionals who can give great advice.
- Experience with professional written communication, such as application, resume, abstract, poster, paper, and proposal.
- Enhanced the work of the organization.
- Experience with professional communication with others.
- Experience giving professional presentations at conference or school afterwards.
- Working at an industry site.
- Enhanced resume.
- Project expanded into Ph.D. research.
- Traveled to another part of the country/world.
- Social activities involving students with similar interests from around the country or world.
- As an employee of the university, ability to work as a foreign student intern in industry (could not do this as an industry employee due to visa restrictions)
- Learning to work in an environment with deadlines.
- Opportunity to use coursework in applied setting.
- Publishing work with company professionals.

Improving Internship Experience

The group also elaborated on “How would you improve upon your experiences?” or “What went wrong?”

- Have staffing in place before committing to an internship program.
- In individual internships, being the only student with no one with whom to interact
- The logistics of finding housing for internships not within commuting distance of the academic campus. Providing support for local housing is very helpful.
- A dedicated mentor should be assigned to each intern and be available to the intern.
- The mentor should reassure the student before hand. Students are usually panicked about not knowing everything and need to hear that they do not need to know everything, just be willing to ask questions. It is much better to ask a question and find out what to do quickly than to accomplish nothing, suffering in silence for a week. (Of course, the student should make an honest attempt to figure it out or “Google” it first and should not be a pest.)
- Sometimes a mentor was not available or not helpful. Have a backup mentor in mind in case the assigned mentor does not work out.
- Well-defined project not identified in advance.
- Lack of guidance; need regular communication with intern.
- Personality differences. For this issue, panelists stated that students should be prepared to ask for help from a director if things not going well. Informal interactive experiences, such as brown-bag lunches, provide opportunities for students to exchange ideas and experiences.
- Students were taken from their projects to help meet an organization deadline.
- Equipment for the student was not arranged before starting the internship.
- Needed better upfront knowledge of what the internship involved.
- Needed discussion of how student's knowledge and education would be utilized.
- Student was not trusted to do anything more than menial work.
- Difficulty of separating student's desire for pay from need for meaningful collaboration on practical use of academic subject matter.
- Regular communication of academic department with interns and company mentors of interns.
- Should emphasize the need for honest feedback from intern regarding whether the internship is going well and get that feedback periodically so that remedial action can be taken promptly if needed.

Establishing & Maintaining Internships

Internships have been successfully conducted with students ranging from high school through Ph. D. programs. Internship programs vary from summer (typically 12 weeks in duration) to year long internships, where a student works at a local industry site for two days a week and does coursework for the rest of the week. A key to placing students successfully into internships is making contacts with industry personnel. A good place to make such contacts is at conferences and professional society meetings. If one hears an interesting presentation, meet with the speaker following the talk, tell the speaker about your academic program, and give the speaker your professional card, and get the speaker's card. Later, the faculty member can email the speaker telling about a particular student, including the student's resumé, and inquiring about the possibility of an internship. One faculty member at West Chester University has successfully used LinkedIn to manage contacts. She created a LinkedIn group "Friends of West Chester University Actuarial Science and Mathematical Finance." She has current students, alumni, and anyone who previously worked with their students join. They may post to the group about internship or even job opportunities, or at least they email her when one arises because the visibility of the group reminds them. She has also had recruiters join the group as well. It has been a win-win situation! When internship search time comes around, try to match students with industry contacts. Write the industry contact, telling about the student and attaching the student's resumé.

Another approach is to look on university websites for professors who are active in research. The student or advisor can email the professor, telling about the student, attaching a resumé, and asking if the professor has or knows of someone who has an intern position. Frequently, active researchers have NSF money and can apply for supplemental funds for an intern.

Maintaining a steady supply of students qualified to participate as interns is advised. That enables a continuing internship relationship between the academic institution and the industrial organization.

Please be aware that export controls (and associated sanctions) can impact research, especially when there is some form of proprietary or security restrictions impacting the open publication of or access to research results by foreign nationals. Be sure to understand institutional policies and the responsible offices for compliance so that a violation of export control laws does not occur when arranging internships for foreign national students; civil and criminal penalties for violating these laws can be significant and personal.

A flexible curriculum helps to enable internships to occur in non-summer months or longer (e.g., 6-month) internships. These less traditional internships may be more attractive to industry, especially the longer versions, since the first month or two of an internship may be consumed by learning the systems and people.

One of the "must haves" for mathematics and statistics student interns is computational skill using a software package. Some industries utilize standard

software; e.g., in the pharmaceutical industry, SAS is a standard. A student seeking an internship in a particular industrial setting should be informed or become aware of the preferred software packages utilized in that setting and acquire some proficiency in that software package. This skill is easier to accomplish if the academic curriculum requires computer science coursework, since learning one computer language facilitates learning another computer language. The sooner students acquire this skill, the sooner they become eligible for internships.

Finally, students who participate in internships in high school are typically better prepared to participate in internships while in college.

Junior Fellows Program at the University of Maryland

Overview <http://jpsm.umd.edu/undergraduate/junior-fellow-program-overview>

As the United States moves closer and closer to a full information society, there are enormous career opportunities for those who have the knowledge and skills to design, collect, and analyze large scale data bases. All that the country knows about its population growth and migration, its health, criminal victimization, traffic patterns, educational performance, labor and job markets, prices of daily goods, agricultural production, air and water quality, and income distributions is based on sample surveys and censuses, as well as administrative data systems.

Staff who create and control these information systems literally determine what the country knows about itself. Their work leads to information that moves billions of dollars in the stock market, shapes public opinion about what challenges are faced by the country, and determines what issues state and Federal governments tackle. In addition, the staff of Federal statistical agencies have the assurance that their work is of public service. Their efforts help serve the country and the people of the United States, supplying the information that an informed electorate uses to shape its future.

The knowledge they need is not found in a single academic discipline, but rather a mix of substantive fields, including statistics, sociology, economics, epidemiology, and psychology. The work involves the use of statistics, to guide the design of data collection efforts and ways to summarize the information obtained; psychology, to construct survey questions so that they are comprehended as intended for the information system; and computer science, to aid in the collection, processing, and analysis of data.

Because the field is a mix of various traditional disciplines undergraduates rarely learn about this career path. The JPSM junior fellow program is a chance to learn about the career opportunity at a time when you can still shape your undergraduate curriculum.

A Highly Competitive Program for a Select Few

The JPSM junior fellow program is a cooperative venture of the Interagency Council on Statistical Policy and the [Joint Program in Survey Methodology](#). The Joint Program in Survey Methodology is funded primarily by the Interagency Council on Statistical Policy to provide graduate educational programs for the next generation of technical staff in the Federal Statistical System. Its graduate faculty devote their teaching careers to teaching the multidisciplinary tools that are needed for large scale surveys and censuses.

This is a unique internship experience that gives you a paid research assistantship, plus educational benefits that can expand your horizons of what you can do in your career.