Alpha Seminar:
A Course for New Graduate Students in Statistics

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Abstract

The accumulation of technical knowledge is the central focus of graduate programs in statistics. However, student success does not depend solely on acquiring such knowledge. Rather, students must also understand the rigors of graduate study to complete their degree. And, they need to understand the statistics profession to prepare for a career after graduation. The purpose of the one-credit hour Alpha Seminar course at the University of Nebraska-Lincoln is to educate graduate students in these non-technical areas. Students are required to enroll in Alpha Seminar during their first semester of study. In addition to advisement on courses and graduation requirements, Alpha Seminar features topics on career paths, ethical obligations, professional accreditation, internships, and professional societies. Alumni also meet with the class to discuss how to be successful in the program and in a future career. This paper discusses course topics, examines assignments, and provides assessment results from student cohorts. The corresponding course website is available at `www.chrisbilder.com/stat810`.

Key Words: Career, Curriculum, Education, Ethics, Internships, Professionalism

1. Introduction

Every graduate program in statistics focuses on developing the technical knowledge (e.g., modeling approaches and coding in R) that students need for educational and career success. Often lost in graduate programs is non-technical knowledge, like basics about the program itself and potential career paths, that is needed for success as well. These important topics can be omitted for many reasons, including poor advisement or incorrect assumptions about student familiarity with them. As a result, students can be left in the unfortunate situation where "they don't know what they don't know," so that they are unable to inquire further.

A few departments of statistics/biostatistics offer courses on non-technical topics. Examples are North Carolina State University's *Ethics in Statistics* and the University of Kansas' *Professionalism, Ethics, and Leadership in the Statistical Science* that are required for their PhD students. Leadership alone can be the focus in these types of courses too. Gibson (2018) discusses the importance of leadership skill development among statisticians and highlights the University of North Carolina's *Leadership in Biostatistics*. Vance (2015) and Gibson (2018) also discuss the importance of consulting experience. Corresponding courses tend to include instruction on non-technical skills, such as communication with subject-matter experts, in addition to applying technical skills for data analysis. Examples are the University of Nebraska-Lincoln's (UNL) *Principles of Statistical Consulting and Interdisciplinary Collaboration* and the University of Iowa's *Statistical Consulting* that are required for their MS students.

As Graduate Chair for the UNL Department of Statistics, I helped lead a comprehensive revision of the course requirements for the MS and PhD programs. One of the courses that I developed was a course named *Alpha Seminar* to addresses non-technical topics outside of those covered in a consulting course. *Alpha Seminar* is a required course for new graduate students that is taken during their first semester in the program. The course is one-credit hour and meets 50 minutes per week. The overall course grade is pass/fail based on points earned through completing assignments given during the semester. The goals of the course are to help students acclimate to graduate school, to build relationships among the new students, and to provide the non-technical knowledge needed for success in the program and beyond.

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Table 1: Weekly schedule for *Alpha Seminar*.

Week	Topics
1	Introduction to program
2	Career paths
3	Career paths
4	Career paths, Productivity tools
5	Guest speaker
6	Professional societies
7	Professional societies, Next semester courses
8	Guest speaker
9	Conferences
10	Conferences, Ethics
11	Ethics
12	Guest speaker
13	Internships
14	Internships, Accreditation
15	Accreditation, Next semester goals

Table 1 provides a week-by-week summary of the content in *Alpha Seminar*. The corresponding course website is available at `www.chrisbilder.com/stat810`. Motivation for the content originated from two separate sources. First, the University of Iowa offers a course by the same name for its new statistics graduate students.[1] While the course has similarities to the implementation at UNL (e.g., introduction to the program and career paths), there are considerable content differences (see Section 4). Also, Iowa's course typically does not meet for the whole semester. The second source was the book *A Career in Statistics: Beyond the Numbers* by Hahn and Doganaksoy (2012). This book discusses career opportunities for statisticians and provides additional content that every new statistician needs to know, like ethical obligations.

The remainder of this paper is organized as follows. Section 2 provides more detail regarding the topics given in Table 1. Section 3 describes assessments performed on two separate student cohorts. The paper concludes in Section 4 with a discussion regarding teaching challenges and alternative topics for the course.

2. Topics

2.1 Program

The first day of the course begins with is an introduction to the graduate program. I present an overview of the university system and the department. Steps to complete a MS and/or PhD are outlined. These steps include when to take specific courses, when to seek out a permanent advisor (a Graduate Committee member initially serves as an advisor), and when to take qualifying/preliminary exams. I also discuss program expectations of students. This includes general guidelines for the number of hours per week that one should spend on coursework. Students are strongly encouraged to build connections with other students through formal/informal study groups and to participate in the Statistics Graduate Student Association of the department. For MS students considering to continue on for a PhD, I provide specific recommendations for how to determine whether to pursue the degree and how best to prepare for the program. We also cover tips for success from other students and faculty.

At the end of the first day, I give students an assignment to complete a draft *program of studies* document. This document requires students to list all courses that they plan to take during their degree program. Within a year, most students will need to submit a final version of it to the university's Office of Graduate Studies. On this same assignment, students describe what their initial job plans

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[1] `https://stat.uiowa.edu/syllabi-stat5090-22s170-alpha-seminar`

are once they complete their degree. This allows me to learn more about each student (in addition what is stated on their admission application), so that I can point them in the right direction for our program and for their career.

Throughout the remainder of the course, I cover additional aspects of the program to help students succeed. This is completed through a combination of answering student questions and through pre-planned class discussions. Included are course options available for next semester once class schedules are posted. Courses from the Department of Statistics are detailed relative to the material covered and how these courses can help students prepare for future courses, research, and employment. Courses from other departments are examined as well. This includes those available from different campuses in the university system, like those from the Department of Biostatistics at the University of Nebraska Medical Center, that can be taken online or are within a reasonable driving distance. At the end of the semester, we discuss student goals for next semester along with reminders of the most important items for the following academic year.

2.2 Careers

Students need to know about the variety of career opportunities available to graduates. This allows them to match their goals better with the courses and experiences available during graduate school. Also, understanding these opportunities may improve their job satisfaction after graduation. Early in the semester, I define potential career paths for students. This is followed later in the semester with a discussion of internship opportunities.

2.2.1 Paths

I separate out potential career paths into three areas: industry, government, and academics. Throughout the discussion, I emphasize the need to have good communication skills because statisticians likely will work with people from other disciplines.

The industry discussion begins by examining where our department's graduates have found employment. This leads us to look at jobs available in areas like agriculture, banking, marketing, and technology. We examine more deeply the pharmaceutical industry by discussing clinical vs. non-clinical work and the type of work for a statistician in the area. Throughout the discussion, differences in roles for a MS and PhD graduate are presented.

The government discussion begins with a definition of official statistics. Examples of where our graduates have found employment are provided again. While Washington-based federal government jobs have the largest number of opportunities in the United States, other options, such as working for a Department of Energy research laboratory, are discussed as well.

The academic discussion is meant not only to help students decide whether to pursue employment in this area, but also to help them work with faculty and to understand the structure of academia. The discussion begins with a general categorization of statisticians working as 1) professors at research universities, 2) professors at teaching universities, and 3) support staff at universities. We discuss job expectations and MS/PhD degree requirements for the different categorizations. For example, professors at a teaching university often teach eight courses per academic year, while those at a research university may teach only three but have much higher research expectations. The types of research available–statistical, collaborative, and consulting–are defined for students and how one or more of these correspond to particular types of academic positions.

Focusing on professorial positions, we cover the three levels of assistant, associate, and full. Extra discussion is given for the assistant level due to new graduates starting there. Because assistant professors will have many opportunities for teaching/research/service involvement, time management is the focus. Material discussed in class include a comic by Jorge Cham of PhD Comics that provides a humorous portrayal of how professors spend their time (Cham 2008), an invited conference presentation given to soon-to-be and recent graduates that discusses when to say "yes" and when to say "no" (Bilder 2014), and a blog post by Rahika Nagpal that describes her experiences at Harvard University (Nagpal 2013). These topics transition into a discussion about time management for graduate students now. Additional professorial topics include tenure vs. non-tenure track

positions, promotion and tenure, 9 vs. 12-month appointments, and options available if a job search fails.

The assignment focuses on students finding a job announcement in each of the three main areas, describing what a statistician would likely do for that job, and stating what a potential starting salary would be. I provide students a list of resources, including the American Statistical Association's (ASA) JobWeb and the ASA's salary survey, to help them complete the assignment. Also for this assignment, students join LinkedIn and send a connection request to me. The purpose is to help them begin forming professional connections and be exposed to the large number of job announcements available through this resource.

2.2.2 Internships

Experience outside of coursework is an important part of a student's education. Internships provide a way for students to obtain this experience by working with data and individuals from other disciplines. While consulting-based research assistantships may provide somewhat similar experiences, internships provide a different environment because the goal is usually something other than publishing. The purpose of the internship portion of the course is to provide information about how to obtain an internship, how to get the most out of an internship, and what to do after an internship. The information provided to students is based on past student experiences and my own four separate internships as a student.

The discussion begins with where to find companies or government agencies that are interested in hiring an intern. This involves locations for announcements, such as the December issue of *AMSTAT News* (ASA 2020); online job websites, like Indeed.com; and direct inquires with companies. Next, we discuss what a résumé should look like. This includes stylistic aspects as well as highlighting important experiences, such as particular courses and communication skills. The cover letter is discussed with emphasis on how to make a letter stand out from others and how to tailor it to an organization. I provide example résumés and cover letters to students.

We discuss the interview process next relative to potential employers wanting to 1) evaluate technical knowledge of the student and 2) determine if the student is a good fit for the organization. A general understanding of the organization helps students prepare for questions associated with these two items. Students are encouraged to not let questions like "Do you have any questions?" be answered with "No." Preparation for the interview leads to good questions. Finally, we cover appropriate salary levels and temporary housing options for when a job offer is made.

Once on the internship, it is important to make the job as beneficial as possible. I emphasize learning about what employees do and about the organization itself. In particular, interns can initiate one-on-one meetings with statisticians and non-statisticians in the organization for this purpose. We also discuss earning course credit for the internship. This is especially important for international students in the United States so that they can obtain permission to work through the Curricular Practical Training program. Once the internship concludes, students can use ideas obtained during it to develop research topics. Students can also present a departmental seminar so that others can learn from their experiences too.

Students find an internship announcement of interest for an assignment. They are asked to construct a résumé and cover letter for the corresponding position. I critique these items and offer suggestions for improvement. If desired, students will apply for the internship.

2.3 Guest speakers

Students indicate that a highlight of the course is meeting guest speakers. These speakers are typically alumni of the program, and each is given an entire class period to meet with students. Speakers are purposely chosen to represent a variety of backgrounds relative to MS or PhD graduate, their employment, and their number of years since graduation.

I provide speakers with a general list of potential topics to discuss, including:

- Experiences since graduation

- Items learned in graduate school that were most helpful on the job

- Items you wish would have been taught in graduate school

- Opportunities for new graduates

- Tips for success

Because most speakers are not located nearby, online meeting software programs are used often for class visits. I request speakers to give a prepared presentation of no longer than 30 minutes so that time is available for student questions. Students not taking the course are invited to attend the class as well.

Prior to speakers meeting the class, students perform a short investigation into the speakers as an assignment. I provide students with the LinkedIn user profile and résumé of the speaker along with additional background as needed. Students develop at least one question from their investigation that they can ask during the class period.

2.4 Professional societies

Most professions have professional societies to promote and advance their interests. Statisticians have a number of societies for this purpose and are very often members of more than one. The purpose of this portion of the course is to discuss how these statistical societies help students achieve their career goals now and in the future.

Focus is on the ASA. I outline the ASA structure in terms of its sections, chapters, and committees. Specific time is spent on aspects of the ASA that are of most interest to students, including STATtr@k, student awards, and scholarships. Professional accreditation is covered, including how students can obtain a GStat designation. I also briefly cover other professional societies for statisticians, such as the International Biometric Society and the International Statistical Institute (ISI). Differences among societies are highlighted, especially those corresponding to a society's statistical focus.

This discussion provides an opportunity to examine statistics journals and magazines because many of these are associated with professional societies. I highlight publications like *Significance* and *Chance* because their topics and statistical level can be more suitable for new graduate students. *AMSTAT News* and other membership magazines/newsletters are included in the discussion to encourage students to learn about current events and items of interest to members. We also briefly examine the publication review process.

Students obtain a one-year membership to a statistical professional society as part of an assignment. This membership is paid for by our department. Also, students examine the ASA more closely for an assignment by investigating a section and a committee not discussed in class.

2.5 Conferences

The professional societies portion of the course provides a lead into a discussion about conferences. I focus on the Joint Statistical Meetings (JSM) with topics organized similar to Bilder (2019). Information is provided about how to prepare for the conference. This includes descriptions of the different types of presentations, like invited, contributed topic, and contributed, so that a student knows how to submit their own research and understand what presentations to attend. Cost considerations to attend JSM are covered along with potential funding sources.

We discuss opportunities for what to do at JSM from arrival to departure. Emphasis is placed on how a conference is more than attending research presentations. Activities of specific student interest are discussed, including the JSM First-Time Attendee Orientation and Reception, the JSM Career Service, and how to attend a continuing education course for free. I include pictures from a previous JSM at corresponding parts of the discussion to help students visualize the experience. Once JSM has concluded, it is important that what happens at JSM does not stay at JSM! We discuss how one should summarize their activities to determine what to follow-up on. Also, the submission of a proceedings paper is discussed.

Many other statistical conferences are mentioned briefly, including the ENAR Spring Meeting, useR!, and the United States Conference on Teaching Statistics. Due to when this portion of the course is covered, students construct a budget to attend the ENAR Spring Meeting as part of an assignment. Other parts of the assignment include examining the most recent JSM program to find presentations by the department's faculty and in the student's own areas of interest.

2.6 Ethics

The course spends approximately 1.5 class periods covering ethical obligations for statisticians. This is not enough time for a thorough discussion, so I focus on specific parts of the ASA's Ethical Guidelines for Statistical Practice (ASA 2018) and the ISI's Declaration of Professional Ethics (ISI 2010). We discuss plagiarism by examining a very similarly written paragraph that appeared in two separate journal articles (Ebert et al. 2010, Montesinos-López et al. 2012). This leads to a discussion about how the paragraph could be rewritten to avoid problems. Additional guidance is given to avoid plagiarism in general. We also discuss the integrity of data and the corresponding methods used to analyze data, such as how to handle unusual or influential observations.

We cover the importance of the reproducibility of research. The evolving journal standards for reproducibility are examined as well as how tools like R Markdown can help (students receive the technical knowledge on dynamic document creation in a concurrent course). I also emphasize the need to "tell the whole story" when doing research rather than focus only on those research results that support a hypothesis. An example given corresponds to the RV 144 HIV vaccine clinical trial that was original hailed as the first vaccine to show efficacy, but evidence released later reduced excitement about it (Maugh 2009).

Students watch the main segment of a *Last Week Tonight with John Oliver* episode[2] that discusses problems with scientific studies and how the news media reports on these studies. A corresponding assignment has students answer questions like "Why are there pressures on scientists to publish?" and "What is 'p-hacking'?" Students also read the ASA and ISI's ethics documents and discuss a few items from these documents not addressed in class as part of the assignment.

3. Assessment

The first student cohort enrolled in fall 2016 and most of these students have since graduated with a MS and/or PhD in statistics. An e-mail was sent individually to these students in 2021 to obtain feedback about the course. Students were asked to comment about the course and to describe how they benefited from it (if at all). Below are quotes from three separate students:

> The thing that benefited me the most from the course was the internships section. One of our assignments was to prepare our résumé and make a LinkedIn profile and you provided feedback on our résumé. You also encouraged us to apply for internships and if it had not been for this course I would not have done any of those things. I did not get an internship in the US but I did do an internship in <country> that summer and it was helpful to me.

> I really enjoyed STAT 810. It was a great class to have at the start of my graduate career. This course provided information about opportunities outside of the classroom to get involved with during my graduate career and gave me insight into the numerous career paths after graduation.

> I enjoyed the guest speaker sessions. The information there was not obvious in school.

For the fall 2019 student cohort, I administered a pre- and post-test on the first and last days of the course, respectively. Tests included 14 questions corresponding to material discussed in the course. For example, one question asked about the typical length of time it takes to earn a PhD. Both tests were closed book and closed note and given during class. Students were told the purpose of the

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[2]May 8, 2016; `https://youtu.be/0Rnq1NpHdmw`

pre-test was for me to understand student knowledge of the material prior to starting the course. The average grade on the pre-test was 30% indicating a significant knowledge deficit. The graded pre-tests were neither returned nor directly discussed in any subsequent class during the semester.

Without students knowing beforehand, the post-test was exactly the same as the pre-test. During the last class period prior to the post-test, I encouraged students to lightly review the course material. Students averaged 83% on the post-test indicating a significant amount of knowledge gained from the course.

4. Discussion

Alpha Seminar is a statistics course covering many of the non-technical topics that students may not examine during graduate school. The course website at `www.chrisbilder.com/stat810` provides course notes, assignments, and a schedule with class recordings.

As remarked in Section 1, this course was created during a comprehensive revision of MS and PhD program requirements. The uniqueness of the course led to significant faculty discussion during its consideration. This discussion not only included its content, but also if the course was needed. One faculty member not involved with its development summed up the need for the course with "It's all about student retention." Students who understand the program, job opportunities, and *how* to be a statistician are more likely to complete the program. Still, debate remains among faculty about the course and its content. Another faculty member taught the course early in the implementation of the revised MS/PhD program. Topics included how to read a statistics journal article and general statistics topics that required some technical knowledge. As part of feedback given by the Graduate Statistics Student Association regarding the revised MS/PhD program, students provided negative comments about those types of topics, noting that "some of the material was too advanced for students" and students "felt like it was a lost opportunity to learn about the field in general."

Other topics could be included in an *Alpha Seminar* course. The University of Iowa's course includes the history of statistics and introductions to their faculty's research areas. History is not included at UNL for time considerations. Faculty research areas are not included at UNL because similar introductions are given each year as part of one presentation in our weekly seminar series. Additional potential topics not discussed in either course include those on controversies involving statistics. For example, the recently publicized p-value controversy could be included because all students will have seen a p-value prior to starting the program. An instructor could draw from Nuzzo (2014) and Wasserstein and Lazar (2016) to introduce the topic at an appropriate level. Current events involving statistics could have a place in the course too. For example, news media accounts of COVID-19 vaccine effectiveness would be ideal to include, especially if students do not have access to a course where these topics would fit in well (e.g., categorical data analysis or pharmaceutical statistics). Students can also be introduced to blogging and participating in online forums that feature statistics content. For example, blogging can be used to write a white paper on a topic, similar to those commonly found through the R-bloggers aggregator.[3] Lastly, a potential topic involves screening the first PhD Comics movie[4] or discussing additional comics from PhD Comics.[5] While PhD Comics presents experiences of graduate students in a humorous way, it also can lead to discussions about more serious challenges facing graduate students, like imposter syndrome, mental health, and problems encountered by teaching assistants.

References

ASA (2018). Ethical guidelines for statistical practice. `https://www.amstat.org/ASA/Your-Career/Ethical-Guidelines-for-Statistical-Practice.aspx`. Retrieved September 23, 2021.

ASA (2020). 2021 internships. *AMSTAT News* **522,** 34–40.

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[3] `https://www.r-bloggers.com`
[4] `https://www.phdmovie.com`
[5] `https://www.phdcomics.com`

Bilder, C. (2014). Yes! Yes, but... NO! Western North American Region/Institute of Mathematical Statistics Conference. June 15-18. `http://www.chrisbilder.com/wnar`. Retrieved September 23, 2021.

Bilder, C. (2019). New to JSM? Read this before you go. *AMSTAT News* **503,** 14–16.

Cham, J. (2008). How professors spend their time. `http://phdcomics.com/comics/archive.php?comicid=1060`. Retrieved September 23, 2021.

Ebert, T., Brlansky, R., and Rogers, M. (2010). Reexamining the pooled sampling approach for estimating prevalence of infected insect vectors. *Annals of the Entomological Society of America* **103,** 827–837.

Gibson, E. (2018). Leadership in statistics: Increasing our value and visibility. *The American Statistician* **73,** 109–116.

Hahn, G. and Doganaksoy, N. (2012). *A Career in Statistics: Beyond the Numbers*. John Wiley & Sons.

ISI (2010). ISI declaration on professional ethics. `https://www.isi-web.org/about-isi/policies/professional-ethics/isi-declaration`. Retrieved September 23, 2021.

Maugh, T. (2009). Results of AIDS vaccine trial 'weak' in second analysis. *Los Angeles Times,* October 20. `https://www.latimes.com/nation/la-sci-aids-vaccine20-2009oct20-story.html`.

Montesinos-López, O., Montesinos-López, A., Crossa, J., and Eskridge, K. (2012). Sample size under inverse negative binomial group testing for accuracy in parameter estimation. *PloS One* **7,** 1–11.

Nagpal, R. (2013). The awesomest 7-year postdoc or: How I learned to stop worrying and love the tenure-track faculty life. *Scientific American.* `https://blogs.scientificamerican.com/guest-blog/the-awesomest-7-year-postdoc-or-how-i-learned-to-stop-worrying-and-love-the-tenure-track-faculty-life`. Retrieved September 23, 2021.

Nuzzo, R. (2014). Scientific method: Statistical errors. *Nature* **506,** 150–152.

Vance, E. (2015). Recent developments and their implications for the future of academic statistical consulting centers. *The American Statistician* **69,** 127–137.

Wasserstein, R. and Lazar, N. (2016). The ASA's statement on p-values: Context, process, and purpose. *The American Statistician* **70,** 129–133.