

# 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, ethics, 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 evaluations from student cohorts. The corresponding course website is available at [www.chrisbilder.com/stat810](http://www.chrisbilder.com/stat810).

*Keywords:* Career; Curriculum; Education; Ethics; Internships; Professionalism

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# 1. Introduction

Every graduate program in statistics focuses on developing the technical knowledge, like modeling approaches and coding in R, that students need for educational and career success. Often missing from graduate programs is the development of non-technical knowledge, like basics about the program itself, ethical obligations, and potential career paths, that is needed for success as well. Programs may omit these important topics for many reasons, including inconsistent advisement or incorrect assumptions about students' familiarity with them. As a result, students can be left in the unfortunate situation of "they don't know what they don't know," so that they are unable to inquire further.

Given the haphazard approach to instruction on non-technical topics, there are very few statistics/biostatistics departments that teach courses on them. North Carolina State University's *Ethics in Statistics* is one example where instruction does occur. This one-credit hour course is required for their PhD students and focuses on ethics. Leadership can be the focus in these types of courses too, and its importance is highlighted well in [Gibson \(2018\)](#). The University of Kansas' *Professionalism, Ethics, and Leadership in the Statistical Science* includes leadership along with other topics like ethics and communication. This is a three-credit hour course that is required for their PhD students. To illustrate the overall paucity of other non-technical topic courses in general, only two of the Big 10 statistics departments—the University of Iowa and the University of Nebraska-Lincoln (UNL)—offer these types of courses in their graduate statistics programs. Both departments have only one course, and it shares the same name: *Alpha Seminar*. The purpose of my paper is to describe this unique type of course as it is offered at UNL.

I developed *Alpha Seminar* when I was Graduate Chair for UNL's Department of Statistics. This course is required for new graduate students and is taken during their first semester in the program. Most students are at the MS level, and many of them will continue on for a PhD. The course is one-credit hour only and meets 50 minutes per week. The overall course grade is pass/fail based on points earned through completing assignments. The goals of the course are to help students acclimate to graduate school, to build relationships among the students, and to provide students the non-technical knowledge needed for success in the program and beyond.

Table 1 provides a week-by-week summary of the content in *Alpha Seminar*. The corresponding course website is [www.chrisbilder.com/stat810](http://www.chrisbilder.com/stat810). Motivation for the content originated from two

separate sources. First, the University of Iowa began offering their course by this same name prior to UNL (<https://stat.uiowa.edu/syllabi-stat5090-22s170-alpha-seminar>). This course is one-credit hour and taken by their new statistics graduate students as well. While it has similarities to the implementation at UNL (e.g., introduction to the program and career paths), there are important content differences as described in Section 4. Also, Iowa’s course typically does not meet for the entire semester. The second motivational source was the book *A Career in Statistics: Beyond the Numbers* by Hahn and Doganaksoy (2012). This book discusses career opportunities for statisticians and introduces additional content that every new statistician needs to understand, like professional societies and ethics.

The remainder of this paper is organized as follows. Section 2 provides more detail regarding the topics given in Table 1. Section 3 describes evaluations of the course corresponding to two separate student cohorts. The paper concludes in Section 4 with a discussion regarding teaching challenges, including those relative to the COVID-19 pandemic, and alternative topics for the course.

## 2. Topics

### 2.1. Program

I begin the course with an introduction to the graduate program and an overview of the university system and the department. Next, I outline the steps that students need to complete for a MS and/or PhD. 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 for students. This includes general guidelines for the number of hours per week that one should devote to coursework. I strongly encourage students 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 a PhD is a good option for them 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 initially 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 also describe to me their anticipated job plans once they complete their degree. This allows me to learn more about each student (beyond what is stated on their admission application), so that I can point them in the right direction for our program and for their career.

Pointing students in the right direction can be especially helpful this early in their graduate program. While students know they want to go into statistics, many have not received focused advisement corresponding to their interests. A frequent example involves students planning for a career in sports analytics. This area became highly publicized after the release of *Money Ball: The Art of Winning an Unfair Game* (Lewis 2004) and now is an integral part of individual/team sports. While statisticians work in this area, it may be the most difficult statistics career to get into and salaries can be lower than for other statistics careers. I visit with students about these issues and share recommendations about how to get into the area (e.g., our athletic department offers unpaid internships and sports analytics conferences allow one to connect with current professionals in the area). I also encourage these students to explore other statistics career opportunities in case sports analytics does not work out.

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. Once the course schedule for our department is available for next semester, we discuss course options 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 our 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 goals for next semester and review 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, so that they can align their goals 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 potential career paths into three areas: industry, government, and academics. Throughout the discussion, I emphasize the importance of strong communication skills, because statisticians likely will work with people from other disciplines. Experiences of our graduates and other resources, like the ASA's first survey of MS graduates (George et al. 2019), are drawn upon for this content, in addition to my personal experience. No particular career path is shown favor during this section or other sections of the course.

We begin the industry discussion by examining where our department's graduates found employment. This leads us to look at jobs available in areas like agriculture, banking, marketing, and technology. We also discuss the differences in roles for a MS and PhD graduate. For a more in-depth example, we examine the pharmaceutical industry by discussing clinical vs. non-clinical aspects, pharmaceutical company vs. contract research organization, and the type of work for a statistician in the area.

Our government discussion begins with a definition of official statistics. Similar to the industry career path, I provide examples of where our graduates have found employment and MS/PhD graduate roles are presented. While Washington-based federal government jobs have the largest number of opportunities in the United States, we also discuss other options such as working for a Department of Energy research laboratory.

The academic discussion is meant not only to help students decide whether to pursue employment in this area, but also to help them understand academia because they are part of it! This latter aspect is especially important to help students work with faculty through coursework and research. Our 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 courses but have much higher research expectations. I define the types of research available—statistical, collaborative, and consulting—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. I

provide extra content for the assistant level due to new graduates starting there. Because assistant professors will have many opportunities for teaching/research/service involvement, I highlight time management. 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 requires students to find a job announcement in each of the three main areas. Students describe what a statistician would likely do for that job, provide MS/PhD degree expectations, and state 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. As part of this assignment, students also join LinkedIn and send a connection request to me. This helps them begin forming professional connections and access the large number of job announcements available through LinkedIn.

### **2.2.2. Internships**

Experience outside of coursework is an important part of a student’s education. Internships provide an opportunity for students to gain this experience by working with data and people 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 internship portion of the course provides 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.

We begin by discussing 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 *AM-STAT News* ([ASA 2021](#)); online job websites, like Indeed.com; and direct inquiries with companies. Next, we discuss how to create a strong résumé. This includes stylistic aspects as well as highlighting important experiences, such as particular courses and communication skills. I emphasize the

importance of the cover letter by describing 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 next discuss the interview process 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. I encourage students to research the organization ahead of time and to prepare their own questions. This is to make sure that questions from the interviewer like “Do you have any questions?” are not answered with “No,” which can make a poor impression. 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 the importance of learning about what employees do and about the organization itself to better understand the particular career path. In particular, interns should 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. After the internship, students can use ideas from it to develop research topics. Students can also give a departmental seminar so that others can learn from their experiences too. Furthermore, this seminar provides students with important presentation giving experience that is in a less stressful environment than what may occur when presenting their thesis or dissertation work.

Students find an internship announcement of interest for an assignment, and they 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. Past speakers include alumni who work for an insurance company, a Major League Baseball team, and the National Institutes of Health, with the last example involving a postdoc scholar.

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

- Career path 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 local, we use online meeting software programs for most class visits. I request speakers to give a prepared presentation of no longer than 30 minutes so that time is available for student questions. Departmental students not enrolled in the course are invited to attend these classes as well.

Prior to speakers meeting the class, students perform a short investigation into the speakers as an assignment. I provide students with the speaker's LinkedIn user profile and résumé 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 several societies for this purpose and are often members of more than one. The professional societies portion of the course discusses how these statistical societies can help students achieve their career goals now and in the future.

We primarily focus on the ASA. I outline the ASA's structure with respect to 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. We discuss professional accreditation, including how students can obtain a GStat designation now and a PStat designation after graduation. 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. We discuss the *Journal of Statistics and Data Science Education* as well because many students are graduate teaching assistants. Highlighting these publications also means briefly discussing papers within them, including those by faculty in the department. Assignments tailored to these papers can be given to allow for more in-depth examination of their content. *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.

To help students engage with the statistics community, students are given a free, one-year membership to a statistical professional society of their choice. This membership is paid for by the department. Students present verification of their membership as part of an assignment. Students also examine the ASA more closely for this assignment by investigating a section and a committee not discussed in class.

## 2.5. Conferences

The professional societies portion of the course naturally leads into a discussion about conferences. My discussion given next in the paper is how I approach discussing an in-person, pre-COVID-19 pandemic format for conferences. However, modifications should be included in any current course situation to describe online formats. It is difficult to project into the future exactly when in-person formats will return or if online/hybrid formats will become the standard.

I focus on the Joint Statistical Meetings (JSM) with topics organized similar to [Bilder \(2019\)](#). We start with how to prepare for the conference. This includes descriptions of the different types of presentations, like invited, contributed topic, and contributed, so that students know how to submit their own research and understand which 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. I emphasize that a conference is more than attending research presentations. Activities of specific student interest are discussed, including the JSM First-Time Attendee Orientation and Reception and how to attend a continuing education course for free. I introduce the JSM Career Service so that students are aware of this very useful tool for finding employment upon graduation and/or when looking to change jobs after graduation. 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 students should summarize their activities to determine what to follow-up on. We also discuss the submission of a proceedings paper.

I briefly mention other statistical conferences, including the ENAR Spring Meeting, useR!, and the United States Conference on Teaching Statistics. Emphasis is given to which types of statisticians may be interested in particular conferences. 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. This helps students begin thinking about topics that they may be interested in along with potential advisors.

## 2.6. Ethics

I use approximately 1.5 class periods to cover ethics relative to 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 begin with a discussion on plagiarism by comparing two paragraphs from separate papers that were published two years apart. Both paragraphs describe the same statistical method. Without quotation marks or a citation, the paragraph published second replicates the same style, language, and phrasing as the paragraph published first. This leads to a discussion about how the second 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 focusing on only those research results that support a hypothesis. This leads into an example involving the RV 144 HIV vaccine clinical trial. The vaccine was originally hailed as the first vaccine to show efficacy ([PBS News Hour 2009](#)), but statistical evidence released one month later reduced excitement about it ([Maugh 2009](#)). The main issues addressed in class relative to this example are the importance of stating

all results and how to correctly interpret p-values.

Students watch the main segment of a *Last Week Tonight with John Oliver* episode (May 8, 2016; <https://youtu.be/ORnq1NpHdmw>) that discusses problems with scientific studies and how the news media reports on these studies. I give an assignment corresponding to this episode that asks students 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 topics not addressed in class as part of this assignment.

### 3. Course evaluation

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 and to measure its potential impact on their education and early careers. 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 [*Alpha Seminar*]. 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. I told students the purpose of the pre-test was for me to understand their knowledge of the material prior to starting the course. The average grade on the pre-test was 30% indicating a significant knowledge deficit. I did not return the graded pre-tests to the students nor directly discuss them in any subsequent class during the semester.

Without students knowing beforehand, the post-test was exactly the same as the pre-test. During the class period prior to the post-test, I encouraged students to lightly review the course material. Students averaged 83% on the post-test, indicating they gained a significant amount of knowledge from the course. If one considers these test scores as coming about through a random sample, a paired t-test can be performed using a one-sided alternative hypothesis that the post-test population mean is larger than the pre-test population mean. The p-value is less than 0.0001 indicating the increase in the mean scores would be quite unusual if equality or a decrease in the mean scores was true.

## 4. Discussion

*Alpha Seminar* is a statistics course covering many of the non-technical topics that students may not examine otherwise during graduate school. The course website at [www.chrisbilder.com/stat810](http://www.chrisbilder.com/stat810) provides course notes, assignments, and a schedule with class recordings. While its one-credit hour format does not provide enough time for comprehensive investigations into the topics covered, the course provides students with an introduction to these topics and with the tools needed to learn more about them. Furthermore, this short format makes it easier to incorporate into the current curriculum of a graduate program, either as an add-on to other first semester courses or to replace a portion of a three-credit hour course.

Consulting courses also address non-technical topics. In particular, these courses provide important instruction on communication and how to run a meeting, while also teaching students how to apply technical skills for data analysis. Vance (2015) and Gibson (2018) discuss the importance of consulting experience for students. Current examples of these courses include the University of Indiana and the University of Iowa's *Statistical Consulting* that is required for their MS students. Fortunately, consulting courses have become much more prevalent over the last 20 years. Prior to their existence, students might have obtained consulting experience through research assistantships

or through a faculty member allowing them to tag along on consulting sessions. Such opportunities though were often unevenly distributed among graduate students, if they existed at all. Topics found in *Alpha Seminar* are somewhat at this same development stage in most departments. It is my hope that a course like *Alpha Seminar* will follow a similar path as the evolution of consulting courses by becoming common within statistics/biostatistics departments. *Alpha Seminar* ensures all students have access to its important topics.

I developed *Alpha Seminar* as part of a comprehensive revision of the MS/PhD statistics program in my department. Its one-credit hour was paired with a new two-credit hour statistical computing course so that it fit well within the standard three-credit hour per course system at UNL. 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 remained 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 Statistics Graduate 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.”

*Alpha Seminar* is adaptable to changing conditions of statistics and society in general. The COVID-19 pandemic has been by far the largest example of it. As for teaching format, UNL has required fully in-person instruction while the course has been taught, so its format did not need to change. With respect to course content, guest speakers provide information about the evolving work environments to accommodate safety measures. Some topics, like conference formats, have temporarily changed during the pandemic, so these changes are important to incorporate into the course as well. Other topics though, like program expectations, ethics, and accreditation, have not needed change. Outside of the pandemic, the course has evolved with newer online employment websites, curriculum changes within the program, and incorporation of results from the ASA’s first survey of MS graduates ([George et al. 2019](#)).

Other topics could be included in an *Alpha Seminar* course, while some potentially could be removed. 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 one presentation in our weekly seminar series. The University of Iowa does not include ethics in their course and has included topics like how to read a statistics journal article in past implementations. Additional potential topics not discussed in either course include those on controversies involving statistics. For example, the class could discuss the recently publicized p-value controversy 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. In particular, COVID-19 vaccine effectiveness and test accuracy 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). Instructors could also introduce 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 (<https://www.r-bloggers.com>). Lastly, a potential topic involves screening the first PhD Comics movie (<https://www.phdmovie.com>) or discussing additional comics from PhD Comics (<https://www.phdcomics.com>). 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.

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Table 1: Weekly schedule for UNL's *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