Mentoring as a Statistical Educator Within the Context of a Christian College

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Messiah University is a Christian university of the liberal and applied arts and sciences. Our mission is to educate men and women toward maturity of intellect, character and Christian faith in preparation for lives of service, leadership and reconciliation in church and society.
Mentoring as a Statistical Educator

Within the Context of a Christian College

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April 2011
The Mentor and the Mentee

A Gift from a Former Mentee – Lilianne Kim

October 2003
1. Introduction

In this paper, we present principles based on the author’s 25 years of intentional mentoring as a statistical educator at Messiah College, a Christian college of the liberal and applied arts and sciences. Messiah’s statistics program includes a six-course minor that was initiated in 1985. The first cycle of the program was completed in 1987. In its relatively short history, this program has achieved notable success and national recognition. This success led to our selection to be part of two task forces sponsored by the American Statistical Association (ASA), the largest professional association of statisticians in the world: CRAFTY Task Force on Statistics and Strengthening Connections between Liberal Arts Colleges and Graduate Programs in Statistics (Moore (2006)). The second task force, along with the Statistics in Liberal Arts Workshop, commissioned the creation of two products: Eby (2006a) and Eby (2006b). The success of our program also led to two invited presentations, one at the Joint Statistical Meetings (JSM) in Toronto (2004) and the other at the JSM in Salt Lake City (2007). (The JSM is the largest international gathering of statisticians in the world.)

One measure of the success at Messiah College is the unusually large number of strong students who have decided to pursue graduate work in a statistics-related field. To date, 33 students have done so at 19 schools. A complete listing of these students, along with other relevant information about them, is given in Appendix A.

In reflecting on reasons for the success of the statistics program at Messiah College, it is clear that mentoring plays a significant role. Our thesis is that this mentoring is efficacious due to two factors: the setting – a Christian college – and the discipline – statistics. Several years ago, one of our graduates encapsulated these two factors as follows.

“There are just a few pivotal moments in my life that have been transformational, and you have been part of two of them – encouraging me in the field of statistics (both to take the minor and to pursue graduate studies) and helping me to reconcile the secular and the sacred in my life’s pursuits. I would be foolish to think I have arrived where I am today because of myself; that’s why I like to take the opportunity to thank those who have given me a hand up
along the way, like you.”

We assume that the reader already has some appreciation of the role of mentoring in higher education. For those who do not, perhaps because they were never mentored themselves, we encourage consulting the rich body of literature which espouses the benefits of mentoring in higher education. We direct the interested reader to Brown’s (2007) thorough consideration of the topic which includes an extensive list of references. Zachary (2000) considers the higher education setting, as well as business and nonprofit settings, and also includes an extensive list of references.

It is known that individuals who have benefitted from being mentored are more likely to become mentors themselves. Just last year, a former mentee told us that he was eager to move into mentoring because it would expand his sphere of influence more so than being a prolific publisher in his own right.

“Good mentoring relationships (mentorships) in academic settings are dynamic, reciprocal, personal relationships in which a more experienced faculty mentor acts as a guide, role model, teacher, and sponsor of a less experienced student (protégé)” (Brown (2007: ix)). Mentoring is much more than academic advising. Many of our most significant mentoring relationships involved students who were not our formal academic advisees.

The mentoring relationship that begins in an academic setting can be a lifelong relationship. It does not need to end when the mentee graduates. The friendships resulting from mentoring relationships are some of our most cherished friendships. As time goes on, the line between mentor and mentee becomes blurred. Even in a single instance of communication, both persons can take on both roles.

While mentoring is done to some extent at all undergraduate institutions, religious or secular, and in all disciplines, statistics or otherwise, the nature of mentoring can depend on the type of institution and the discipline involved. For example, if the spiritual dimension is included, mentoring at a religious institution can be more comprehensive than that at a secular institution.

The intended audience for this paper consists of educators in Christian colleges, in general, and statistical educators in Christian colleges, in particular. While readers from wider audiences
can benefit from the ideas presented in this paper, those from the target audiences should benefit the most.

We develop our thesis by focusing on the setting in Section 2 and the discipline in Section 3. In Section 2, we discuss distinctives of the Christian college setting that have a positive impact on mentoring in any discipline. We consider the mentor, the mentee, and the pervading campus atmosphere. In Section 3, we focus on mentoring as a statistical educator by specifically considering the following: attracting students to the discipline of statistics, preparing students for careers using statistics, and preparing students for graduate study in a statistics-related field. For each, we consider principles of successful mentoring in statistics at the undergraduate level regardless of the type of institution and then how these principles can be expanded within the context of a Christian college. We conclude by revisiting the thesis of this paper in Section 4.

2. The Christian College as a Setting for Mentoring

2.1 An Overview

In this section, we focus on a particular type of mentoring – between a Christian educator and a Christian student within a Christian college. We look at the Christian college as a setting for mentoring by considering the key factors – the mentor, the mentee, and the campus atmosphere – that influence the mentoring process rather than the process itself.

That Christian institutions of higher education recognize the importance of these factors can be seen by exploring their websites, particularly those of their admissions offices. The three factors considered in this section are often presented as appealing distinctives of Christian colleges. The actual terms that we use may not be mentioned, but the general concept of the factors is presented with words describing what we will discuss more specifically in this section.

For the mentor, consider the following quotes from Messiah College’s (2010a) website. “Enjoying a student-faculty ratio of 13:1, Messiah students personally interact with mentors who know them and understand their goals. Again and again, students attest to how Messiah’s faculty have made a difference in their lives. Our professors invest their time and a part of themselves into every student they teach. ... We select our educators for their Christian commitment as well as their proven teaching ability. They are outstanding scholars and experts in their chosen fields.
Faith and learning are natural extensions of their commitment to faith-based education.”

Gordon College (2010) appeals to the mentee. “You seek a life of meaning. Your adventure is defined by your faith in Christ and where that can and will take you. At Gordon, ranked among the top accredited Christian colleges, you can continue your adventure in a community of mentors and peers that are living lives of creative meaning.”

The campus atmosphere of the Christian college is addressed by Westmont College (2010). “At Westmont, Jesus Christ holds preeminence. With our commitment to historic Christianity, we encourage students to integrate their beliefs with their studies and to live out their faith in service to others. Rooting the liberal arts in Christ means that we educate the whole person and encourage students to develop biblically based, intellectually strong convictions and worldviews.”

In describing mentoring in Christian higher education, Penner (2001: 9) asserts that the Christian college is a natural setting for mentoring. “The Christian community has incentive to be a mentoring community based on its nature as a caring family, explicit directives for spiritual elders to equip youngsters, and the mentoring examples of Barnabas and Paul. At heart, mentoring is about being concerned not only with one’s own success but also that of one’s colleagues and students. Much of such successful facilitating requires not only the transmission of information but also the care and encouragement of persons. To the extent we are able to do this well, we will achieve the end goal of education.”

2.2 The Mentor

In this paper, we focus only on mentors who are educators. In an explicitly Christian college, we will assume each educator has a personal faith commitment to Christianity that can be articulated. Such a commitment can be expected to shape each part of the educator’s life, private and professional. Using Jesus Christ as their example, all Christians are urged to strive to attain qualities or virtues such as selflessness, humility, gentleness, graciousness, and patience (Ephesians 4:2, Philippians 2:3, Colossians 3:12). These virtues are included in Engstrom and Jenson’s (2005) nine essential characteristics of an effective mentor: encouragement, self-discipline, gentleness, affection, communication, honesty, servanthood, godliness, and
confrontation. Although they consider mentoring in a broader Christian setting, these characteristics are applicable in the context of a Christian college. _When these qualities are reflected in the life of the educator, that educator's mentoring will be mentee-centered._ That is, mentoring will focus on what is best for the mentee, not on what is best for the mentor (e.g., developing a personal professional portfolio.) Such an approach not only benefits the mentee. It also benefits the mentee’s college. A student who graduates from X College will always be a graduate of X College. However, if an educator leaves X College, that educator’s personal professional portfolio also leaves the College.

The Christian educator who is an effective mentor could be partially characterized by Heie’s incarnational component of the integration of faith and learning, “where faith commitment informs a teacher’s dealings with students, evidenced by deep care and concern for their well-being, both in and out of class, and by modeling the highest moral standards and aspirations for spiritual growth” (Heie (2002: 98)).

_Hopefully, Christian educators think of their position as a calling or vocation, not a career._ With this view, an educator at a Christian college is in that position because he or she sensed a calling to teach in a Christian college, not just to teach in a college. That deliberate choice of this type of teaching venue should shape how educators view their responsibilities to their students. Appropriately telling students of this choice sends them a powerful message.

_The mentor is more likely to appreciate a mentee’s other interests and motivations such as vocational Christian service or ministry as well as the fact that materialistic concerns may have little influence on one’s choice of a vocation._ The mentor also understands the concept of a tent maker. That is, mentees called to vocational Christian service or ministry may need to develop expertise in academic disciplines that can provide income (e.g., being a school or college teacher) while they are beginning their vocational Christian ministry. In fact, the academic discipline could actually be used in the ministry. Recognizing the importance of the individual, the Christian mentor should not adopt a one-size-fits-all approach and can help the mentee navigate through the discipline/ministry decisions.

_Because Christians are instructed to live with an eternal perspective, a Christian mentor has a deeper understanding of what is at stake in the mentoring process, the potential of_
having a life-changing impact on the life of the mentee – an idea affirmed by the graduate’s comment at the end of Section 1. Others of our graduates have affirmed that the educator’s impact is not just in the academic world but also for the Kingdom of God and that a Christian mentor is also more likely to see the importance of being a role model in all areas of life.

One goal of a Christian educator should be that mentees become able to function unapologetically in the real (i.e., secular and non-Christian) world. This requires the mentor to model confidence as a Christian professional. Our greatest satisfaction results from seeing how our mentees live for Christ. Elzinga, whose calling is as a Christian faculty member in a secular university but considers himself to be a friend of Christian higher education, describes this satisfaction: “Students in Christian higher education need to know that the faculty values this: that professors admire godliness; that the faculty’s deepest satisfaction as professors comes from seeing students become what God wants them to be – people for whom Jesus Christ is preeminent” (Elzinga (2005)).

Of course, a Christian mentor has the ultimate example of a mentor, Jesus Christ, and the ultimate example of a mentoring relationship, Jesus and His twelve disciples.

2.3 The Mentee

In this paper, we focus only on mentees who are students. In general, in an explicitly Christian college, one cannot assume each student has a personal faith commitment to Christianity that can be articulated. However, in this paper, we assume that the students being mentored will have such a personal faith commitment. One manifestation of this commitment is that students should have a keen sense that their natural abilities are God-given, that God expects them to be good stewards of those abilities (Matthew 25:14-30), and that God has a plan for how those abilities should be used vocationally. This perspective helps them through the tough times when they might otherwise doubt the path they have chosen (e.g., while in graduate school).

The idealism which incoming students bring into college often has a “save-the-world” theme. If a Christian student combines this idealism with the example and call of Jesus Christ to be a servant, the student can be motivated by a mentor in expanded ways. Examples in the
discipline of statistics will be given in the next section.

For most students, a major factor in the choice to attend a Christian college instead of a secular one is that the college is Christian. While likely not fully understanding the nature of a mentoring relationship, or perhaps not even being familiar with the word “mentoring,” these students expect to relate to faculty members in a Christian college differently than they would in a secular institution. Thus, these students enter college with an expected appreciation of at least some of the distinctives that a Christian mentor provides.

2.4 Campus Atmosphere

When educator-student mentoring is done in a Christian college, it most likely will involve a Christian mentor with a Christian mentee. As noted before, this is the nature of the mentoring relationship we assume in this paper. A Christian with Christian pairing can occur on a secular campus, but it will occur with much less frequency.

A significant factor that makes Christian with Christian mentoring on a Christian campus different from that on a secular campus is the pervasive Christian atmosphere that exists on the Christian campus. The messages that are conveyed in the Christian with Christian relationship are reinforced by those messages conveyed in most, if not all, aspects of the student’s curricular and cocurricular life.

One such message is the importance of a sense of vocation. It is easy for students to confuse the concept of career with life calling or vocation. Johnson (2007: 121), writing from a secular perspective, notes, “An essential developmental task for the college student is determining one’s ‘life calling.”’ The conveyance of the concept of vocation is more likely to be deliberate in a Christian college, and the concept of Christian vocation is unique to the Christian college setting. For example, in 2001, Lilly Endowment Inc. awarded two million dollars to Messiah College to implement a five-year project on Christian vocation with the goal of integrating a rich understanding of Christian vocation throughout its educational program. The concept of Christian vocation should be more motivating to Christian students than the concept of vocation in general because it combines the concept of vocation with the concept of Christian responsibility.
In a Christian college setting, the mentor and mentee are more likely to share core values resulting in the mentee trusting more of what the mentor says. This trust is based on something more than expertise. Shared core values can extend the mentor-mentee relationship into a friendship and/or fellowship relationship. While a mentoring relationship involving non-Christians can extend to a friendship relationship, it is likely that the friendship relationship involving Christians will be stronger and deeper due to the broader foundation (e.g., shared core values) of the relationship.

Closely related to the shared core values in a Christian college setting is the holistic nature of mentoring there. In a Christian college, mentoring can address the academic, personal, and spiritual components of a student’s life while in a secular college, mentoring at best addresses the academic and partially, the personal. This distinction is crucial in the mentor’s modeling of a sense of vocation. In broad terms, the academic component involves the mentor’s profession or career while the personal and spiritual components involve the mentor’s calling or vocation. Thus, the setting of a Christian college is more conducive to the mentor instilling a sense of vocation in the mentee. An appreciation of holistic mentoring, particularly the spiritual aspect, was found by Wieland (2005) in her research of graduate students in a Christian institution of higher education. Holistic mentoring should not be confused with discipleship. Discipleship is a special type of mentoring focusing on the spiritual component. However, holistic mentoring has the spiritual as one of several foci.

Sometimes in a college, professional jealousy and selfishness can exist among educators in various disciplines, either in the same department or different departments. These jealousies can create turf wars which can create an overly competitive atmosphere in attempting to attract students to the respective disciplines. This can easily deteriorate into educators focusing more on their own interests than on those of the students. While professional jealousies do exist in Christian colleges, hopefully they are less prevalent and intense than in secular colleges. In Subsection 3.1, we consider the potential for professional jealousy between mathematicians and statisticians.

3. Mentoring as a Statistical Educator
3.1 An Overview

A substantial part of the statistics literature on mentoring deals with one statistician mentoring another (i.e., where both the mentor and mentee are professional statisticians). Reflecting this trend, almost all papers that are presented at a JSM, which consider mentoring, fall into this category. For example, Allen (2005) is recognized for his expertise in mentoring and was the first recipient of the Jeanne E. Griffith Mentoring Award which was established to encourage mentoring of junior staff in the Federal statistical system. His experience is primarily in the statistician-statistician context. His insights on mentoring are based on “40 years of observing individuals who achieved solid mentoring results” (Allen (2005: 9)) and the principles he presents are applicable in a wide variety of fields.

In the statistics education literature, mentoring is usually considered only in a limited sense, at best touching on one of the three areas in the following subsections, 3.2 through 3.4. There is no attempt to pull all three areas together.

An exception is the literature describing the five-year $1.3 million National Science Foundation grant awarded to Legler, Roback, and Richey (2004) at St. Olaf College. St. Olaf already had a well-developed undergraduate statistics program prior to the awarding of this grant. The goals of this grant address four areas: the three areas in Subsections 3.2 through 3.4 and a fourth area which is one of two primary goals for the project, attracting statistics Ph.D.’s to faculty careers in four-year colleges. Because of the ever-increasing demand for statisticians with graduate degrees, the other primary goal of the project is to increase the number of graduates from four-year colleges who pursue graduate study in a statistics-related field. Legler, Roback, et al. (2010) report on one work product resulting from this grant, the creation of an interdisciplinary undergraduate research program. This program complements the already-existing robust student research programs at St. Olaf, particularly in the sciences, and builds on the relatively unique interdisciplinary collaborative nature of the field of statistics.

Mentoring by a statistical educator is facilitated if statistics is a respected discipline within the college. Rarely at the undergraduate level is statistics housed in its own department. It is usually combined in a department with at least mathematics where it is not uncommon for statisticians to be regarded as somewhat “second-class citizens” by mathematicians. Some of
this is due to mathematicians not understanding what makes professional endeavors (e.g., scholarly research) in statistics different from those in mathematics. This treatment can also be fueled by professional jealousy or selfishness. As can be seen in Subsection 3.2 and elsewhere, there are aspects of statistics that may make it more attractive to students as a career option than mathematics.

Hopefully, this mathematics-statistics alienation is not present, or is at most minimal, in Christian colleges. A refreshing example is our experience at Messiah College where statistics is housed in an information and mathematical sciences department consisting of the disciplines of mathematics, information sciences, physics, and statistics. Instead of alienation, we have experienced a very supportive environment. Our mathematician colleagues are happy for the success of our statistics graduates and do not resent their choice of statistics over mathematics. Through their teaching of mathematics, they are an integral part of their academic preparation.

3.2 Attracting Students to the Discipline of Statistics

One may tend to think of mentoring taking place with students that are already part of one’s program or discipline, but as noted by Gray (2005), mentoring can be used to recruit students into one’s discipline. Landes (2009) considers problems and solutions in recruiting individuals into the profession of statistics. While he recognizes the importance of attracting students to the discipline of statistics, his paper is broader in scope than the topic addressed in this section. He deals with the public’s misperception of a statistician’s professional activities. He defines “public” as those outside of the statistics profession. Landes organizes the problems and solutions drawn from his extensive review of the statistics literature on these issues. He also suggests some strategies drawn from a more general body of literature, including literature specific to other disciplines, that may be applicable for statistics. Landes cites Eby (2006a) as providing a helpful list of suggestions that statistical educators can use to attract students to the discipline of statistics and cites some of the suggestions specifically. Eby (2006a) wrote to a secular audience, and thus does not suggest ideas unique to the context of a Christian college. We now consider such ideas in this section. However, we first consider when mentoring should begin.
It is important to start early. One can start recruiting students even before they begin college by speaking to high school classes. This is particularly helpful in the discipline of statistics because, as Landes (2009) notes, most individuals have little or no understanding of a professional statistician’s activities. A more formal mentoring relationship begins in college. The educator must take the initiative in establishing the mentoring relationship. As Johnson (2007: 119), writing from a secular perspective, notes, “… owing to developmental immaturity and low awareness of the value of mentoring, undergraduates may be less assertive and intentional in pursuing potential mentors. In spite of these obstacles, mentoring college students can be deeply rewarding for faculty and genuinely life-altering for undergraduates. Rarely will you have the opportunity to more profoundly shape both a student’s life and career path than in the context of bachelor education.” Understanding the idea expressed in the last sentence should strongly motivate Christian educators.

One of the more attractive features of statistics to students is the increasing gap between the demand of professionally trained statisticians and the supply of such professionals. Lindsay, Kettenring, and Siegmund (2004: 406) address the seriousness of this shortage in their report on the future of statistics. Dixon and Legler (2003) focus on the serious shortage of statisticians needed to work on applications in the biological sciences. Such statisticians are called biostatisticians. Students can combine love of statistics with love of biological sciences. Biostatisticians are involved in the development of new drugs, the evaluation of the effectiveness of medical procedures, efforts in fighting disease and other public health problems, and environmental issues. Knowing that there is a greater likelihood of being employed in one’s actual field allows students to be more focused in their preparation. It is appropriate for them to think that what they are doing now in college will likely be closely related to what they will be doing later. The Christian student who has a sense of God-given abilities and the responsibility to use them for His glory can especially appreciate this opportunity to develop his or her abilities in a purposeful manner. Particular care needs to be exercised in the Christian college setting so that, in presenting this message, the emphasis is opportunity-driven (i.e., the many opportunities that exist to use one’s God-given abilities) rather than career- or dollar-driven.

This shortage of professionally trained statisticians also allows a statistical educator (mentor)
to recruit students into the discipline with integrity, something which should be quite important to the Christian educator. One would expect all educators to be very enthusiastic about their respective disciplines. A statistical educator can say, with integrity, to a perspective student, “If you pursue this discipline and do well in your studies, there is very great likelihood, particularly with a graduate degree, that you will find a meaningful professional position.” That cannot be said by educators in all disciplines. Even if the bachelor’s degree is the terminal degree, there is a greater likelihood of employment in a discipline-related field, in this technological and data-driven age, for the student with preparation in statistics.

Another attractive feature of statistics is the breadth of application. Wherever there are data with variability, there is the opportunity for the application of statistics. There is virtually no discipline devoid of data. No other scientific discipline can be applied in more discipline areas than can statistics. With the ever increasing presence of data-driven research, this supremacy is likely to be maintained. Beginning in introductory statistics classes, the educator should deliberately make the students aware of the breadth of application. Seeing real-life examples helps the students see a purpose in studying the discipline. Having statistical consulting experience is particularly beneficial for an educator since an overview of some of the diverse applications encountered in those experiences can be presented in class. Outside speakers can speak of statistical applications in their areas. Practitioners not only bring relevance to their presentations, but they tend to also be enthusiastic about their discipline. Possible speakers are graduates from your institution who are now in graduate school in a statistics-related field or have already earned a graduate degree; professional statisticians from academia, industry, or government; and current students with statistics-related internships. Choose speakers who will describe statistical applications, promote statistics as a career, and/or encourage graduate study in statistics. When the speakers are Christians (e.g., former students), have them include the concept of Christian vocation in their presentations. Former students are particularly effective recruiters because current students often perceive themselves to be more similar to former students from your institution than to faculty members. Thus, they may be more open to their encouragement and suggestions. Also, these former students likely were involved in a mentoring relationship during their undergraduate years and can help current students see the value of such
relationships.

*The breadth of application should be particularly attractive to Christian students who may have more diverse interests than other students.* Not only can Christian students have interest in most typical areas of application, they can also be interested in all sorts of ministry-type applications. Presentations about ministry-type applications can be well received by students in a Christian college. For example, their statistical skills can be used in church and parachurch organizations who need help in designing studies and analyzing data. Some specific examples of ministry-type applications are presented in the following sections.

As noted in Subsection 2.3, many students enter college with a desire to make a difference. Christian students can have an especially strong desire to work on “things that really matter.” By its breadth of application, statistics is a discipline where that can be done. The following two examples reflect this desire and its discipline fulfilment in statistics.

One of our former students, who is quantitatively strong, entered college with the career goal of “helping people.” He initially chose to major in one of the behavioral sciences because he did not see how he could use his quantitative strengths to achieve his goal. While taking the introductory statistics course for nonmajors, he learned otherwise. Sometime later, he switched his major to mathematics and took several statistics courses. He then pursued graduate study in statistics. Today, he is a Ph.D. statistician in the foremost cancer research center in the world. As a young professional, he has already made numerous significant contributions in his field and has given invited presentations on six continents.

Another former student entered college with the goal of being a mathematics teacher. Along the way, she was introduced to, and chose to minor in, statistics. Initially, she had no graduate school plans, but through several statistics-related internships, listening to professional statisticians speak in her classes, participation in a collaborative research project, and extensive mentoring, she saw the benefits of graduate study in statistics. Today, she is pursuing her doctorate in biostatistics. Upon completion, she plans to use her expertise to work on world health issues (e.g., infectious diseases).

*Since students often have the misperception that a statistician works alone or only with other statisticians, it is essential to communicate to students that statistics is very much a
collaborative discipline. Its collaborative nature is emphasized by Brown and Kass (2009). In fact, its collaborative nature is relatively unique. A statistician can be part of virtually any research effort since most involve data. This cannot be said of any other discipline. As mentioned before, real-life examples should be presented to show the diversity of statistical application. Such examples should also be used to show the discipline diversity among team members on a collaborative project. Being part of a collaborative effort in another discipline requires the statistician to learn something about that discipline. For those students with a real love of learning, the prospect of doing this professionally is very appealing. Christian students can see this as an opportunity to continue learning, using their God-given abilities. Collaborative work allows the professional impact of a statistician to be much wider. A Christian can also see this as an opportunity for the personal impact through one’s profession to be widened. One of our graduates reports that his being a successful statistical scientist provides him opportunities to share his faith in situations that would be otherwise closed to him.

Since most real world problems have data associated with them, students can more easily envision their being involved in their solution by using their statistical skills in a collaborative setting. For Christian students, these real world problems can be in ministry-type situations. Thus, they can see using their professional skills as a statistician to build on their Christian call and commitment to service.

Another appealing aspect of being a statistician is that one must be a holistic professional. This goes against the popular misperception of a statistician as a “nerd.” Statistics is very much a people-related discipline, a feature that is attractive to the Christian student who has a strong commitment to reflect Christ in every aspect of his or her life and wishes to interact with others frequently. A successful statistician needs good communication skills – written, oral, and interpersonal. Being able to work with others on a team is essential.

While ethical and expertise considerations are present in all disciplines, they are very highly important in the application of statistics because data-driven research leads to decisions affecting every area of life. First, we consider expertise. There is something about the discipline of statistics that too often tempts individuals with insufficient statistical training to perform statistical work. Such individuals are more likely to do things inappropriately out of ignorance;
hence, the importance of statistical training. That importance should be stressed to students, particularly those in beginning courses. Students in these courses should also be cautioned about independently attempting to do too much statistically. The syllabus for our introductory course contains the following paragraph: “My goal is not to make you a statistical practitioner but rather an intelligent consumer of statistical information. Knowing that valid research results are very much dependent on careful consideration of the statistical aspects will lead you to seek professional statistical help in most major research projects and, also, to review the research results of others with appropriate caution and skepticism.”

Second, we consider the ethical. Individuals, regardless of level of training, can willfully do things inappropriately. These are ethical violations. It is very important to talk of these dangers in class. Since Christians are called to be people of integrity, they should be especially sensitive to ethical considerations, and a discipline that regards such considerations seriously could be attractive to them. More about ethical considerations will be discussed in the next section.

It should be noted that most people cannot distinguish between results based on insufficient statistical training and those based on ethical violations, but the impact of either type of erroneous result can be quite serious.

Attempts to attract students to the discipline of statistics (i.e., recruiting) can be done corporately in class situations and individually with students having quantitative potential. The personal or individual contact by the statistical educator is especially impressive to the student.

Statistical educators should not become discouraged. Successful recruiting can be a slow process. Be persistent. There may be only a few recruits initially. However, success breeds success. Some of the most effective recruiters are students who have already been recruited into the discipline. Think of recruiting efforts as “planting the seed,” a concept familiar to many Christians. One can be pleasantly surprised by the results of these efforts, not knowing where they will take effect and maybe not seeing the results for years.

3.3 Preparing Students for Careers Using Statistics

In this section, we consider preparation applicable to all statistics students – those who attend
graduate school and those who do not. As much as possible, this preparation should be attentive to those features of statistics that attract students to the discipline. A major component of the preparation is the coursework. As long as other appropriate courses are taken, a student will never be criticized for taking too many statistics courses. ASA (2001a), Dixon and Legler (2003), and Eby (2007) give course suggestions. We believe strongly that a mathematics-based statistics minor provides a better preparation for a career using statistics than does a statistics major. This does not imply that all statistics minors need to be mathematics majors, but they must be quantitatively strong.

The ASA Undergraduate Statistics Education Initiative (USEI) (ASA (2001a)) curriculum guidelines for undergraduate programs in statistical science (ASA (2001b)) recommend development of the following five skills: statistical, mathematical, computational, nonmathematical, and substantive area.

The first three skills should be primarily developed through the coursework required by the statistics program. Nonmathematical skills include written, oral, and interpersonal communication skills which are so necessary for a holistic professional. These should be primarily developed through the general education requirements, if they are strong, of all undergraduate programs. They can also be further developed through the coursework required for the statistics program, statistics-related internships, and/or collaborative projects. Development of skills in a substantive area can be accomplished through a second major, minor, concentration, and/or work on an interdisciplinary collaborative project. Study in this substantive area can provide a good foundation for current or future interdisciplinary work.

In Subsection 3.1, we briefly described the work of Legler, Roback, et al. (2010) at St. Olaf’s College, the creation of an interdisciplinary undergraduate research program called the Center for Interdisciplinary Research (CIR). In the CIR, statistics students work collaboratively on a variety of interdisciplinary research projects. Each research team consists of a statistical educator mentor and a faculty member mentor from the primary discipline of the project. These authors see the CIR as an effective recruiting tool for the discipline of statistics, a means of providing preparation for a career in statistics, and primarily a way of encouraging students to pursue graduate study in a statistics-related field.
With respect to the transportability of the St. Olaf CIR model, it appears that relatively few colleges possess the necessary infrastructure in student-involved interdisciplinary research to support the full CIR model. However, there are possibilities for more modest forms of the model. At Messiah College, the “Collaboratory for Strategic Partnerships and Applied Research is an organization of Christian students, educators, and professionals affiliated with Messiah College,” whose mission is to “partner with organizations, businesses and communities in our region and around the world for projects in mathematical and information sciences, engineering, and business that serve disadvantaged people and care for the earth; and to develop our members’ abilities and vocational vision for lifelong servant-leadership, and the courage to act on convictions” (Messiah College (2010b: 1)).

Over the years, several of our statistics students have become involved in Collaboratory projects requiring statistical expertise. Two students were involved in the multi-year Mali Water and Disabilities Project in Mali, West Africa. The project had goals of assisting disabled individuals in three ways – accessing and using hand pumps, transporting and using water domestically, and accessing and using latrines. A major sponsor of this project was the Conrad N. Hilton Foundation. One of the statistics students was a member of one of the site teams visiting Mali during the project. Her role on that trip was to begin the statistical assessment of water access by conducting survey work. That student is now pursuing her doctorate in biostatistics with the goal of using her expertise to work on world health issues. The second statistics student on that project is a current Messiah student who hopes to pursue graduate study in a statistics-related field.

Another statistics student was part of the Collaboratory Education Group working on the Strengthening Mathematics Literacy Project, a two-year project of curriculum development and teacher interaction in Burkina Faso. Her project required her to travel with a site team to Burkina Faso to conduct a statistical survey of educational practices and levels in three regions of the village. Her work was summarized in a departmental honors paper, “Educational Assessment in Burkina Faso, West Africa.” This student hopes to use her statistical expertise in working with a national or international organization focusing on needs in third world countries.

Still another student provided statistical expertise for the Collaboratory Water Group on the
Village Water Ozonization System (VWOS) Project. The goal of this project is to develop and implement a simple small-scale water purification system to meet the needs of partnering Honduran communities. This student is now pursuing his doctorate in applied mathematics.

While no statistical educator was a formal member of any of these Collaboratory teams, statistical educators were consulted from time to time on all of these projects.

Whenever possible and relevant, Christian values should be incorporated in the presentation of topics. In statistics, a primary way of doing this is by considering ethical issues. In the previous section, we noted that ethical considerations are very important in the application of statistics, more so than in many other disciplines. The pressures to compromise in grant-driven and profit-motivated research environments are strong and Christians need to be able to withstand them. The ASA’s ethical guidelines can be found on its web site (ASA (1999)).

In a Christian college setting, educators have the opportunity to take the consideration of ethics to a higher level by adding morality to the consideration. The ethical code is the code of conduct for the profession. The moral code is the code of conduct for all of life. Thus, a Christian’s moral code should exceed, and include, his or her ethical code. Suppose a statistician’s expertise is solicited as an expert witness, which is not at all unusual. A Christian statistician should not be a “hired gun.” The Christian should not only consider the ethical aspects of the project but also the moral aspects. For example, there may not be anything ethically wrong with a statistician providing expertise in a study of the economic viability of a proposed location for a state-sponsored gambling facility. However, many Christian statisticians feel it would be morally wrong to participate in such a study.

3.4 Preparing Students for Graduate Study in a Statistics-related Field

An obvious part of preparing students for graduate study is coursework. In an invited presentation at the 2007 JSM, Eby (2007) provided guidelines for courses that should be part of the undergraduate preparation for graduate study. Dixon and Legler (2003) and Legler, Roback, et al. (2010) also give course suggestions. *If necessary, supplement students’ programs with independent studies and/or special topics courses.* Since directing independent studies often is not rewarding remuneratively, these efforts require some professional sacrifice and selflessness.
At St. Olaf’s, “mentoring undergraduates in the field of statistics with the aim of encouraging them to attend graduate school in statistics has been the overarching goal of our program” (Legler, Roback, et al. (2010: 61)). We recommend a broader view of mentoring. **Mentoring should include all statistics students, not just those intending to pursue graduate study.** Not all students have graduate school potential. However, because of the wide spectrum of graduate programs in statistics, more students are capable of pursuing graduate studies than one might realize. **The goal should be to match the student with the graduate program that is most appropriate for him or her.** Consideration of what is best for the student is paramount. While one would love to see students enter prestigious graduate programs, such programs are certainly not the best fit for every student with graduate school potential. Hopefully, the Christian statistical educator will be selfless and able to focus primarily on the student’s need and not so much on one’s professional or undergraduate statistics program reputation.

Not all students with graduate school potential will pursue graduate study. **The statistical educator must respect the student’s sense of calling and unconditionally accept it if that calling leads the student somewhere other than graduate school.** Because of shared core values, the Christian mentor should be better equipped to respect and accept the student’s calling. The overarching goal should be what is best for the student, whether or not he or she goes to graduate school.

Several years ago, one of our students who was eminently qualified to pursue graduate study in a statistics-related field chose instead to accept a position in full-time ministry. Two years later, she told us how much she appreciated our support of her call into full-time ministry even though she had skills to do graduate study.

Another student, the one quoted in Section 1, with a ministry-sensitive heart chose to pursue graduate study. He and his wife, who grew up on a foreign mission field, had a ministry to international students while in graduate school. Now that he is a professor, that ministry continues through their involvement in an international church. As an undergraduate, we mentored him about incorporating the academic (e.g., statistics) with his call to and love of ministry.

*Perhaps the greatest area where a mentor needs to encourage is in convincing students*
that they have graduate school potential. An experienced mentor has the advantage here. If you have a record of former students achieving success in graduate study, ask current students to rely on your judgement in assessing graduate school potential. That is, you are asking them to trust you. That should be relatively easy for them to do if you have demonstrated your trustworthiness to them throughout the mentoring relationship. If you do not yet have a record of former students achieving success in graduate study, use your ability as a graduate student and that of your graduate school peers as your frame of reference.

The example of one of our former students summarizes well the role of mentoring particularly with respect to preparation for graduate study. She is appreciative of the opportunities to study the extra things she needed for graduate school but did not know that she needed. She regards the persistent encouragement, particularly with respect to graduate study, as a very positive factor in her experience, stating that she probably would never have considered that option if we had not continually put the thought in her head. Today, she is a biostatistics professor in an R1 university.

4. Conclusions

As we conclude, we revisit our thesis. This mentoring is efficacious due to two factors: the setting – a Christian college – and the discipline – statistics.

In Section 2, we considered the positive impact that a Christian college setting has on a mentoring relationship. Specifically, we showed the impact on the mentor, mentee, and campus atmosphere. We showed how these impacts allow the mentoring relationship to move to a higher and fuller level.

Successful mentoring by a Christian educator should be characterized by the following.

- The mentoring will reflect Christian virtues thus making it mentee-centered.
- The mentor’s sense of responsibility to students is based on the view that his or her position is a calling or vocation, rather than a career.
- The mentor is more likely to appreciate a mentee’s other interests and motivations such as vocational Christian service or ministry.
- Because of an eternal perspective, a Christian mentor has a deeper understanding of what is at stake in the mentoring process, the potential of having a life-changing impact on the life of the mentee.
A Christian student who is mentored can have the following characteristics.

- Based on a faith commitment, the student has a keen sense that natural abilities are God-given and that one is expected to be a good steward of them.
- When a Christian student combines youthful idealism with the example and call of Jesus Christ to be a servant, the student can be motivated by a mentor in expanded ways.
- While perhaps not having “mentoring” in his or her vocabulary, a student enters a Christian college with an expected appreciation of at least some of the distinctives that a Christian mentor provides.

The campus atmosphere of a Christian college should have the following characteristics that enhance the mentoring relationship.

- The messages that are conveyed in a mentoring relationship with a Christian mentor and a Christian mentee are reinforced by those messages conveyed in most, if not all, aspects of the mentee’s curricular and cocurricular life.
- There is an important sense of Christian vocation.
- The mentor and mentee are more likely to share core values.
- Mentoring is holistic addressing the academic, personal, and spiritual.
- There should be less professional jealousy and selfishness among educators in various disciplines.

In Section 3, we turned our attention to the discipline of statistics. In 3.2, we discussed aspects of the discipline that attract students, in general, to it. We then considered how these aspects could be especially appealing to Christian students. In 3.3 and 3.4, we showed how good methods of preparing students for careers in statistics or graduate study in a statistics-related field, respectively, can be enhanced by a Christian statistical educator in the context of a Christian college.

Aspects of the discipline of statistics that can be especially appealing to Christian students include the following.

- Knowing that there is an increasing gap between the demand of professionally trained statisticians and the supply of such professionals allows students to be more focused and purposeful in their preparation.
- The breadth of application should be particularly attractive to Christian students who may have more diverse interests (e.g., ministry-type applications) than other students.
- Statistics is a collaborative discipline which requires continued learning and can expand one’s personal impact.
- Statistics is a people discipline which requires a statistician to be a holistic professional.
• Ethical considerations are very important in the application of statistics.

Effective preparation of students for careers using statistics or graduate study in a statistics-related field should be characterized by the following.

• As much as possible, this preparation should be attentive to those features of statistics that attract students to the discipline.
• As long as other appropriate courses are taken, a student cannot take too many statistics courses.
• When possible, provide opportunities for students to work on interdisciplinary collaborative projects.
• Ethical and moral considerations should be included in course work.
• When necessary, supplement student preparation with an independent study or a special topics course.
• Mentoring should include all statistics students, not just those intending to pursue graduate study.
• For those students planning to pursue graduate study, the mentor’s goal should be to match the student with the graduate program that is most appropriate for him or her.
• For any student with graduate school potential, the statistical educator must respect the student’s sense of calling and unconditionally accept it if that calling leads the student somewhere other than to graduate school.
• The greatest area where a mentor needs to encourage may be in convincing students that they have graduate school potential.

We close with the author’s vocational life verse which he embraced early in his career at Messiah College. “You yourselves are our letter, written on our hearts, known and read by everybody” (2 Corinthians 3:2 New International Version). This verse shows the regard of a mentor for the mentee and the disseminative nature of mentoring. Several years ago, a former mentee affirmed the author’s life calling by independently quoting this verse to him. Soli Deo Gloria!
# Appendix A: Messiah College Alumni with Graduate Work in Statistics

## Graduate Schools

Baylor University  
Case Western Reserve University  
College of William and Mary  
Colorado State University  
Johns Hopkins University  
Kansas State University  
North Carolina State University  
Pennsylvania State University  
Texas A & M University  
The Ohio State University  
University of Florida  
University of Maryland - Baltimore County  
University of North Carolina - Chapel Hill  
University of Pennsylvania  
University of South Carolina  
University of Waterloo  
University of Wisconsin - Madison  
Villanova University  
Virginia Polytechnic Institute and State University

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**Brittney Bailey**  
- The Ohio State University; Statistics

**Sarah (Loyer) Baxter**  
- Kansas State University; M.S. – Statistics (2001)

- *Gloucester County College, Division of Mathematics and Sciences, Sewell, NJ*

**Paul Bernhardt**  
- North Carolina State University; Statistics

**Rebekkah (Dann) Brown**  
- University of North Carolina - Chapel Hill; Dr.P.H. – Biostatistics (2006: Gary Koch)

  *GlaxoSmithKline, Research Triangle Park, NC*

- Gertrude M. Cox Scholarship – 2001
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution and Details</th>
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<tbody>
<tr>
<td>Bryan Crissinger</td>
<td>Pennsylvania State University; M.S. – Statistics (2001)</td>
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<td></td>
<td>*University of Delaware, Department of Mathematical Sciences</td>
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<tr>
<td>Christie (Kennedy) Finch</td>
<td>Baylor University; Statistics</td>
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<tr>
<td>Alicia (Cocks) Fisher</td>
<td>University of Wisconsin - Madison; M.S. – Statistics (1996)</td>
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<td>*University of Wisconsin, Department of Ophthalmology and Visual Sciences</td>
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<td>Carrie (Holt) Gale</td>
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<td>Corey Gelbaugh</td>
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<td>Jonathan Hartzel</td>
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<tr>
<td>Nathan James</td>
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<td>*Johns Hopkins University, School of Medicine, Department of Surgery</td>
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<tr>
<td>Lilianne Kim</td>
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<td>Vernon Chinchilli)</td>
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<td>Benjamin Leiby</td>
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<td>Have / Kevin Lynch)</td>
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<td></td>
<td>**Thomas Jefferson University, Division of Biostatistics, Department of Pharmacology</td>
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<td></td>
<td>and Experimental Therapeutics**</td>
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<tr>
<td>Jeffrey Morris</td>
<td>Texas A &amp; M University; Ph.D. – Statistics (2000: Raymond Carroll)</td>
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<tr>
<td></td>
<td><strong>The University of Texas M. D. Anderson Cancer Center, Department of Biostatistics</strong></td>
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<td>H. O. Hartley Award – 2009</td>
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<td>Brenda (Horst) Phillips</td>
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**Note**
- Each full-time student received an assistantship and/or fellowship.
- Only the current, or most recent related, *employer* is listed.

*Updated March 18, 2011*
Bibliography


