

## The SUM Project: A Statistics Undergraduate Mentoring (SUM) Project

### OVERVIEW AND ORGANIZATION OF PROPOSAL

The Statistics Undergraduate Mentoring (SUM) Project addresses two critical transition points in the career path of statisticians:

- The transition from undergraduate to graduate studies.
- The transition from PhD work to a tenure-track position in an undergraduate institution.

The goals of the project are to (1) increase the number of well-prepared undergraduate students who pursue graduate study in statistics or biostatistics and (2) to increase the number of statisticians who successfully secure tenure-track positions at undergraduate institutions. In the *Introduction*, we describe the rationale for focusing on statistics in undergraduate institutions in general, and St. Olaf College in particular. We then present *Highlights* of the SUM Project and its potential for impact beyond St. Olaf College. Next, we give a *Timetable* for the project. The next section delineates some of the *Barriers* to transitioning students in statistics; specifically, we identify barriers to recruiting undergraduates to study statistics, barriers to continuation into graduate study in statistics, and barriers to attracting new PhDs into tenure-track faculty positions at undergraduate institutions. Next, *Key Principles* for the design of our program are outlined followed by a description of *Objectives* and specific *Program Activities* for each transition point. Lastly, plans for assessment, resource allocation, and dissemination are presented.

### Introduction

Statistics is at the center of advances in science in the 21st century—almost every area of modern science depends on it in some form. Advances in methodology, especially in computational techniques, have helped to solve many old problems and posed many new challenges, changing the very nature of the practice and field of statistics. Scientists from other disciplines, notably biology (see BIO2010), have come to recognize the need for much closer connections to statistics. The 21<sup>st</sup> century opens with an unprecedented demand for statisticians – a demand that has gone largely unmet (Dixon and Legler 2003). A recent NSF report (NSF 2003) ranked filling the pipeline with students for graduate study in statistics as a top priority to address the critical shortages of statisticians in science, medicine, industry, government, and academia. This proposal describes a program at St. Olaf College which establishes how undergraduate statistics programs can help to fill the pipeline by addressing two critical transition points in the career paths of statisticians.

Undergraduate institutions are a rich source of talented students who can and do enter the statistics pipeline. Of each year's 1000 Ph.D.s in the mathematical sciences, almost half originate from a baccalaureate institution (NSF Survey of Earned Doctorates, 2001 and WebCaspar).

St. Olaf College has been especially successful in producing students who go on to earn advanced degrees in mathematics and statistics. Between 1991 and 2000, approximately 50 St. Olaf students went on to earn a PhD in mathematics or statistics, placing the college first among all Undergraduate Liberal Arts (UGLA) colleges of origin of such doctorates and, eleventh among *all* schools (NSF Survey of Earned Doctorates, 2001). Over the last decade the St. Olaf statistics program has averaged over 16 concentrators each year, many of whom have gone on to earn advanced degrees in statistics (since 1988, over 50 have earned advanced degrees at Iowa State alone).

St. Olaf is a significant contributor to the undergraduate statistics conversation. We are recipients of a PEW Midstates Foundation grant for hosting a conference November 7-9, 2003 on the upper level statistics curriculum at undergraduate institutions. A team of St. Olaf statistics faculty and students have been invited by the American Statistical Association to participate in the first Stat/Math Teacher Education: Assessment, Methods, and Strategies (TEAMS) conference in Atlanta in October 2003. Legler, the project's PI, is an advisory board member of the Consortium to Advance Statistics Education (CAUSE), on the Regional Executive Committee (RECOM) of the Eastern North American Region (ENAR) of the International Biometrics Society (IBS), and a member of an ad hoc committee of ENAR which has as its goal increasing the biostatistics workforce. She has recently published an article on this need targeted to undergraduate statistics students (Dixon and Legler 2003).

Our contributions are recognized outside of St. Olaf. This year, two statisticians—Tom Moore from Grinnell College and Beth Chance from California State Polytechnic University—have elected to spend their sabbaticals in our department. Joan Garfield at the University of Minnesota has selected St. Olaf as a site for her project on Lesson Study in Teaching Statistics during Spring, 2004.

### Highlights

Despite many past successes, undergraduate institutions must respond to the changing practice of statistics, different backgrounds of the incoming students, and the increased demand for statisticians. We will need to be more

intentional about recruiting and mentoring statistics students and new faculty in order to sustain and enhance our program. To that end, our proposed five-year project will have three main foci:

- A **Center for Interdisciplinary Research (CIR)**, which brings together undergraduate statistics students, new and experienced statistics faculty, and researchers from other disciplines that use statistics in their work. In the CIR, students will work closely with researchers (student and faculty) from other disciplines. They will see how statistics is inherently collaborative and contributes to research in fields ranging from the natural sciences to areas such as political science and sociology. As well, the CIR will provide faculty, both new and experienced, with research opportunities and interactions with undergraduate research students.
- **Course development** with the goal of increasing the number of students who pursue advanced statistics. Initiatives here include development of a new introductory course aimed at advanced incoming students and the creation of quantitative modules that will be integrated into courses from other disciplines (e.g., biology and psychology).
- Two (consecutive) **post-doctoral associates** in statistics who will direct the CIR, supervise undergraduate research projects, and learn the ins-and-outs of life as a faculty member in an undergraduate statistics program. As well, the associates will bring to the program a background in current practices in statistics. Importantly, we intend that the associates will take what they have learned at St. Olaf to a tenure track position at another undergraduate institution.

Other aspects of the program include additional initiatives to attract students to statistics, to mentor them once they have identified statistics as an area of interest, and to advise them as to their post-undergraduate options. An important aspect of our project is a plan for attracting traditionally underrepresented groups to statistics. There are two programs in place at St. Olaf that demonstrate the College's commitment to diversity and that will be an integral part of our recruiting and mentoring project.

- The College's Student Support Services (SSS) has provided support and encouragement to students from traditionally underrepresented groups at St. Olaf.
- The Consortium for a Strong Minority Presence (CSMP, <http://www.grinnell.edu/offices/dean/csmp/>), of which St. Olaf College has recently become a member, will provide us with a pool of post-doctoral students from underrepresented groups with an interest in teaching in four-year colleges.

Our project is designed specifically to impact the community beyond St. Olaf College. The first transition point component of the program aims to increase the number of St. Olaf students seeking advanced degrees in statistics and hence entering the statistics community at large. The second component will send post-doctoral associates to positions at other undergraduate institutions with the skills and programmatic perspectives they have gained from their time at St. Olaf. As well, we include a plan for disseminating our work to the broader statistics community through talks, papers, and a summative workshop.

This proposal describes a five-year project. However, if successful, we will pursue funding for continuing the project beyond five years.

### **Timetable**

Below are the major activities in each year of the proposal.

- Year One:
  - The Project Administrator will organize the CIR, strengthen relationships with colleagues in other disciplines in preparation for collaborative research teams, and initiate many of the key student-oriented activities.
  - Potential summer research projects will be identified.
  - Course development work will begin.
  - Current statistics concentrators become initial cohort of statistics mentees.
  - Mentoring of current and recruitment of future mentees.
  - Recruitment and hiring of the first post-doctoral associate.
- Summer One:
  - Recruitment of future mentees, especially directed towards new St. Olaf students from underrepresented groups.
  - First group (two students) of summer research students will join inter-disciplinary research teams.
- Year Two:
  - Under the direction of the first post-doctoral associate, CIR will become operational.
  - A new introductory statistics course will be piloted, as will the first quantitative modules.
  - The first mentees staff the CIR.
  - Identification of future summer research projects and mentoring of future research students.

- Summer Two:
  - Summer recruitment continues.
  - Full cohort (four students) of summer research students join interdisciplinary research teams.
- Year Three:
  - New introductory course fully implemented. Development and piloting of quantitative modules continues.
  - CIR continues under the direction of post-doctoral associate, mentoring continues.
  - Recruitment (and hiring) of second post-doctoral associate, this time with assistance of current associate.
- Summer Three: Same as Summer Two.
- Year Four:
  - New post-doctoral associate takes over CIR.
  - CIR continues under the direction of post-doctoral associate, mentoring continues.
  - Initial dissemination activities: workshop, presentations at regional and national meetings.
  - Initial investigation of future funding opportunities
- Summer Four: Same as Summer Two.
- Year Five:
  - Final dissemination activities; paper appropriate for major journal prepared and submitted, more presentations. Summative workshop hosted.
  - Additional funding opportunities pursued, grant proposal(s) submitted with the goal of continuing post-doctoral position beyond this project period.
  - CIR continues under the direction of post-doctoral associate, mentoring continues.
- Summer Five: Same as Summer Two.

### **Barriers**

Statistics is an inherently exciting and collaborative discipline. Unfortunately, many students are simply unaware of the role of statisticians in science and the associated career potential for themselves. A lack of exposure to statistics is a significant contributing factor to the under-representation of minority students, particularly at younger ages when career goals and objectives are being considered (NSF 2003). In addition, many students now take statistics in high school, e.g., an AP Statistics course, and consider themselves “done with statistics” before even starting their undergraduate education. Students who take their first statistics course in college often do not consider further study of statistics an option.

For many students with some exposure to advanced statistics, graduate study is not considered a viable option. Many students experience statistics predominantly in the classroom, with few opportunities to engage in the types of activities that characterize the modern practice of statistics. This leads to the misperception that statistical work is boring or isolating and gives students a false impression about the nature of graduate study in statistics. Furthermore, students also often lack information about the critical need for statisticians and the financial support that is available for graduate study. Lack of confidence, particularly on the part of women and minorities, is another barrier to advanced study.

New PhD statisticians often do not pursue careers at an undergraduate institutions. They see this as stifling, consisting of mostly teaching introductory statistics courses along with the occasional upper-level course for mathematics majors. Coming from a vibrant, interactive research setting, they do not perceive an undergraduate institution as offering the type of opportunities they need to feel fulfilled in their career. Another significant barrier to attracting new PhDs to undergraduate institutions is the large (by academic standards) salaries offered by industry, particularly the pharmaceutical industry. It is not surprising that in this environment, new PhDs often do not consider an undergraduate institution an attractive option.

This does not have to be the case. At St. Olaf College and a growing number of other undergraduate institutions, a robust statistics program exists. The ingredients required to reproduce this include:

- **Statistics taught by statisticians:** Often, faculty from other disciplines (psychology, economics, biology, and mathematics) teach statistics courses, leading to what Hahn and Hoerl (1998) have termed “statistics without statisticians.” Paradoxically, this is partially an outcome of the intense demand for statisticians from outside academe.
- **A well-developed upper-level statistics curriculum:** This allows students to learn advanced techniques that can be applied to problems in other areas and helps keep faculty motivated and more involved.
- **A strong undergraduate research program in the natural and social sciences:** This will generate problems and demonstrate the connections between statistics and other disciplines, thus encouraging

students to consider additional statistics courses and creating opportunities for collaborations between faculty in different disciplines.

St. Olaf College has all of these ingredients. Our statistics program is lead by two full-time doctoral level statisticians, both with extensive consulting experience. As mentioned above, we have had a statistics concentration (similar to a minor) for over twenty years and offer several upper-level courses annually. St. Olaf has demonstrated that it can attract large numbers of motivated, talented students to statistics. Lastly, we have a long-standing, robust undergraduate research program in the sciences. For the last twelve years, with the support of the Howard Hughes Medical Institute (HHMI) and other sources, we have had approximately forty undergraduate research students (under the supervision of twenty-five faculty) in the natural sciences each summer. The mathematics department has endowed funds to support two full-time summer research students and we offer a course (the Mathematics Practicum) each January in which students often work on statistical consulting problems. International study programs are also a source of potential research collaborations; nearly two-thirds of each graduating class study abroad.

Building on this strong foundation, our goals are to significantly promote and enhance our program leading to a greater number of students entering the statistics pipeline, to develop new faculty committed to a career in undergraduate statistics, and to create an exemplary model for other institutions. The design for our program is based on four key principles.

### **Key Principles**

- **Simultaneously mentoring the transition of undergraduates to graduate school and PhDs to tenure-track positions is efficient and mutually beneficial.**

The presence of a post-doctoral associate will be inspiring to undergraduates and stimulating for faculty, thereby invigorating the statistics program and providing another attractive source of mentoring for undergraduates. The post-doctoral associate's recent experience at a research institution where collaborative relationships with other disciplines are common will contribute to the conceptualization and implementation of mentoring program activities. The postdoctoral associate will have the opportunity to be mentored by statisticians and have the experience of working in an undergraduate institution with a strong statistics program.

- **Recruitment and mentoring are critical components for each of the two transition points.** Once in the program, it is expected that both students and the post-doctoral associate will need guidance about choices, areas of studies, and interactions with researchers from other disciplines.
- **The program must emphasize active, discovery-based learning in statistics, both in and out of the classroom. Collaborative undergraduate research must be a critical component of this effort.**

Many statistics courses and classroom activities at St. Olaf (and elsewhere) already incorporate some of inquiry-based instruction. However, even more is needed. We intend to refine our curriculum in key places and create new courses to address the changing needs of the incoming students and the field of statistics. Notably, the Center for Integrative Research will provide a formal structure for collaborative interaction between faculty and students from different disciplines, replacing the *ad hoc*, inefficient manner in which such collaborations normally occur.

It is crucial that all statistics faculty must be comfortable in a collaborative, interactive research setting. The current statistics faculty at St. Olaf have this experience and it is expected that the post-doctoral associate will become actively involved as well. Increased interaction between the natural sciences and the mathematical sciences with emphasis on statistics—partially in response to BIO2010—is part of the College's strategic plan. At St. Olaf, the Associate Dean for the Natural Sciences and Mathematics Division has expressed strong support for this initiative asking mathematics faculty to become directly involved in the undergraduate research program in biology and psychology, currently supported primarily by HHMI. We look forward to enhancing our already good relationship with biology, both providing some needed statistical expertise to their established research program and acquiring a source of collaborative statistical experiences for our students and faculty. Current initiatives include:

- A project involving large volumes of microarray gene expression data to help identify patterns of gene expression relevant to TB latency.
- A bioinformatics workshop for faculty (given by Jaques Cohen of Brandeis University) and new bioinformatics course (taught by Laurent Trilling from University of Grenoble).
  - Global health projects generated by students' work in South India.
  - Environmental science projects including longitudinal analysis of tree growth and core sampling of lake beds.

- **This program must have impact beyond St. Olaf College.**  
All of the SUM Project activities will be specifically designed for implementation at four-year institutions. The Project goals and activities will be in line with the resources and mission of four-year colleges. Results of this project will be disseminated through a variety of venues including four-year college conferences.

### **St. Olaf Program**

St. Olaf College has a student enrollment of approximately 3000 students and is located midway between the Minneapolis/St. Paul metropolitan area and Rochester, MN (home of the Mayo Clinic). St. Olaf has a particularly vibrant undergraduate science program; about one third of all graduates major in mathematics, biology, chemistry, physics, or psychology (many are double majors). A large proportion goes on to advanced degrees. Among 200 Baccalaureate-Liberal Arts colleges ranked according to their number of future Ph.D.s in 1991-2000, St. Olaf ranks 6<sup>th</sup> in the biological sciences, 5<sup>th</sup> in chemistry, 6<sup>th</sup> in physics, 24<sup>th</sup> in psychology, and 1<sup>st</sup> in mathematics and statistics (NSF Survey of Earned Doctorates).

The statistics program at St. Olaf resides within the Department of Mathematics (15.0 FTE total faculty) and consists of two permanent statisticians (Legler and Roback) along with a small number of non-continuing, part-time instructors. Each year, St. Olaf offers nine sections of introductory statistics, three sections of probability, two of mathematical statistics, one of linear models, and one experimental design. As well, there are occasionally capstone statistics seminars (e.g. Latent Variable Modeling was offered in 2002-2003) and numerous independent studies and research projects. A concentration in statistics consists of probability, mathematical statistics, and two more advanced courses (often linear models and experimental design). There were 19 concentrators in 1999-2000, 14 in 2000-2001, 16 in 2001-2002, and 21 in 2002-2003.

The standard faculty load (1 FTE) at St. Olaf is six courses per year. The standard student load is nominally 35-4.5 course credits per year.

## **THE TRANSITION FROM UNDERGRADUATE TO GRADUATE STUDIES**

### **Recruitment Component**

The transition from undergraduate studies to graduate school will be one of the most challenging and most critical transition points addressed by the goals of “Enhancing the Mathematical Sciences Workforce.” Without people in the pipeline, it is of little use to provide elaborate programs at the graduate level. Similarly, if good students never take a college level statistics course, an innovative program to convince students to study statistics in graduate school will be ineffective. *The students in first courses in statistics in college will serve as a critical conduit in our pipeline for creating a pool of potential statistics mentees.* A successful program aimed at increasing the number of undergraduates who will eventually take up graduate study in statistics must be attentive to the issue of recruiting *early on*.

The recruitment component of the Statistics Undergraduate Mentoring (SUM) Project has 4 objectives.

1. To increase the awareness of the field of statistics and the benefits of the continued study of statistics at the college level.
2. To get students to “take just one more statistics course” beyond the high school or introductory level.
3. To increase the number of students declaring a statistics concentration, particularly among students majoring in fields other than mathematics.
4. To increase the number of undergraduate concentrators who continue on to graduate school in statistics or biostatistics.

These objectives will be addressed by a careful reconsideration and refining of the statistics offerings in response to the changes in the discipline and the changing backgrounds of the incoming students.

### **Recruiting Program Activities**

#### *Pre-College Recruitment*

These program activities target junior and senior high school students in the Midwest with the objective of increasing the awareness of incoming students about the field of statistics and the opportunities and benefits of initiating or continuing the study of statistics at the college level. Special populations of interest are students from underrepresented minorities and students who have taken an AP statistics course or AP Mathematics course.

#### *Activities*

**Brochures:** Attractive brochures detailing the benefits of continued study of statistics at the college level will be created and distributed during visits to high schools and visits by high school students to campus. These brochures will be modeled after similar ones created as part of an NSF-funded project that Co-PI Roback was part of at Connecticut College (NSF 0123078).

**High School Visits:** St. Olaf Admissions staff members participate in career days at high schools in the Midwest. Statistics faculty and undergraduate statistics mentees with an interest in K-16 education will accompany admissions staff on a selected number of visits to describe the advantages of considering a career in statistics and to provide recommendations for high school preparation. Particular efforts will be made to arrange visits to schools with concentrations of underrepresented minorities. Through its U.S. DoE-funded TRIO program, St. Olaf has a long-standing relationship with several area high schools with large numbers of students from traditionally underrepresented groups. We will take advantage of this relationship as part of our recruiting efforts.

**On-campus recruitment of underrepresented groups:** Through its Student Support Services (SSS) program, St. Olaf College has long provided support for approximately 40 low-income and first generation students from underrepresented groups enrolled in the college. The starting point is a five-week summer program held in August before the start of their first year. At this time, students learn about various aspects of college academic and social life. A critical component of this program is a specially designed first course in biology. Historically, approximately 20-25% of these students indicate an interest in a science and/or pre-health major. Work has already started on introducing more quantitative aspects to this summer course. We propose to contribute modules illustrating the role of statistics in biology. As well, we will provide the students with information about career opportunities in the statistical sciences.

**Mailings:** We will send letters and information packets to all students admitted to St. Olaf College who have identified themselves as members of an underrepresented group or who have taken an AP Statistics course to inform them of statistics courses open to them, to encourage them to consider taking a statistics course early in their college career, and to provide them with information about careers in statistics.

**One day in-service with AP Statistics HS teachers:** St. Olaf College was one of the colleges invited to TEAMS for the American Statistical Association (ASA) sponsored TEAMS Workshop in Atlanta in the fall of 2003. One of the outcomes of this workshop will be to design and conduct an in-service for AP Statistics teachers in our area. This will provide a venue for sharing the information with AP Statistics teachers about the critical need for filling the statistics pipeline and the value of continued statistics study at the college level. We will publicize this workshop through the Minnesota Council of the Teachers of Mathematics (the past president, Martha Wallace, is a member of the St. Olaf Mathematics Department).

To support these activities, we will ask for funds to cover administrative costs, material costs, and other miscellaneous expenses. To support the development of modules for the summer biology, we will ask for modest stipends for faculty.

#### *College Level Recruiting*

The objectives of the SUM college-level recruiting activities are to continue the pre-college recruiting objectives of increasing the number of students who take a statistics course during their first two years in college. Our approach is to encourage students to take “just one more statistics course” either beyond the statistics they may have had in high school or beyond a required introductory statistics course for a major. This initiative is based on a similar, successful initiative to recruit mathematics majors at St. Olaf. Using the strategy of “just one more math course,” the St. Olaf mathematics department has built one of the most successful undergraduate programs in the country, averaging almost 60 senior majors (8% of the graduating class, compared to a national average of 1.25%) each year for the last five years.

Three activities will form the focus of the efforts at recruiting statistics students.

- Creating a climate of awareness about statistics.
- Enhancing first course offerings for incoming students so that they take a statistics course early in their college careers.
- Enhancing courses offered in other majors with quantitative modules.

These activities will be supported by an effort to increase advisor awareness of the statistics course offerings.

#### *Activities*

**First course in statistics:** Getting students—especially those with quantitative talents—to take one more statistics course will not be successful if their first statistics course is uninspiring and not linked to modern statistics practice. Hence, with support from this proposal, we will devote resources to the enhancement of students’ first statistics courses at the college level.

One challenge, but also an opportunity, is the increased preparation of incoming college students. High schools have increasingly incorporated statistics throughout the K-12 curriculum: students often see least squares regression line fitting by 6<sup>th</sup> grade and  $\chi^2$  tests by 8<sup>th</sup>.

High school students have increased access to statistical calculators and computing packages. Furthermore, increasing numbers of students take AP exams and receive credit for college-level statistics before they arrive on campus. These are often the students who would benefit the most from more exposure to statistics but are disinclined to take a course that does not meet any graduation or credentialing requirement. The NSF Report (2003) notes that “...many students [are now] entering college with exposure to statistics that may even surpass the

introductory course. ...The leap into a mathematical statistics course or into a specialized course within a major is not the answer. There is a growing recognition for a natural sequel, a "Stat 102," that will help students to continue to learn about data analysis, modeling, statistical computing, and experimental design—practical skills that will prepare them for success in particular application domains." (NSF 2003)

This new, so-called "Stat 102" will be a critical component of our recruitment efforts. Unlike existing introductory statistics courses, it will be targeted at students with an interest in the natural and social sciences, solid quantitative skills, and some background in statistics (either via AP statistics in high school or exposure to statistical ideas in a laboratory science course). Instead of being viewed as a last statistics course, we hope to make it their first of many statistics courses.

This course will emphasize active learning with real data coupled with a strong emphasis on technology. In the statistics community, there is already work on this type of course. Beth Chance, Alan Rossman, and Karla Ballman, with support from the National Science Foundation CCLI grant #DUE-9950476, have developed materials for such a course. We are fortunate to have Beth Chance as a sabbatical visitor during the Spring of 2004, during which time she will incorporate this approach into an existing introductory course at St. Olaf. We intend to build on her visit and the work of her collaborators when we develop additional statistics courses.

This "Stat 102" will necessarily make heavy use of computing technology, ideally with a wireless classroom network of laptops. As Moore pointed out in his 2000 JSM address "Technology has changed statistics, so that our field has moved somewhat away from mathematics back toward its roots in data analysis and scientific inference. Technology is driving demand for quantitative skills, including statistical skills. Technology is now the most important tool for all the sciences and applied sciences, displacing both mathematics and statistics from traditional roles...It is now familiar and seems almost obviously true: students learn through their own activities, not by passive information transfer." (Moore, 2002) As an example, simulations could be used not simply for demonstration purposes, but as an investigative tool for the purpose of modeling and statistical inference. Students will be able to experience the excitement of the rapidly changing practice of statistics with more confidence and link it more closely with the practice of statistics in interdisciplinary settings.

Students in "Stat 102" will see how statistics is the "language of science" and how it can be a basis for all that they study throughout their college and professional careers. They will learn practical computing skills as well as see statistical methods applied across the disciplines. "Stat 102" will play a crucial role in creating a pool of potential statistics mentees. We intend to offer this course for the first time in the second year of the project and expect that it will enroll approximately 25 students.

This activity is closely related to other work by the PIs in the area of undergraduate statistics education. In November of 2003, the PIs are hosting a workshop on upper level statistics sponsored by the PEW Foundation. Roback has published work on offering an applied statistics course for a diversely prepared audience at the undergraduate level (Roback 2003). Legler is a member of the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE) which provides access to resources for such a course as well as providing access to an efficient forum for disseminating course development materials.

In order to facilitate the development of the new "Stat 102" course, we will ask for a course release in each of the first two years of the project to develop the course materials and a course release in the last year to support its initial offering. We also ask for support to equip one of our current teaching rooms with enough laptop computers, together with a wireless network and appropriate software, to enable this essential use of technology in this course (as well as for use in other statistics courses).

**Quantitative Work Across the Curriculum:** Quantitative Work Across the Curriculum (QWAC) is a process by which quantitative/statistical modules will be added to existing courses in the natural and social sciences. Students in a course with a QWAC component can elect to participate in an additional weekly class meeting focusing on a quantitative/statistical concept relevant to the topic studied in their main class.

The goal is to expose students from other disciplines to the use of statistics and, hopefully, attract them to statistics. Instead of competing with other disciplines for a place on a student's schedule, we will collaborate, enhancing the students' educational experience through multiple perspectives and providing an entrée to the field of statistics. Of course, our aim is to entice them to take an advanced statistics course in which they can learn more about the ideas encountered in a QWAC module. Examples of course to which we intend to add QWAC modules include Ecological Principles (biology), Animal Physiology (biology), and Biophysical Chemistry (chemistry). Eventually, we intend to apply this approach to courses in other disciplines such as psychology, economics, and political science. This spring the mathematics department will bring QWAC to an environmental biology course, focusing primarily on mathematical modeling. Feedback from this will be used to refine future efforts with courses during the grant period.

QWAC is modeled after a St. Olaf College program called Foreign Languages Across the Curriculum (FLAC), which enhances humanities courses in a similar way through foreign language exposure. As with FLAC, students would receive a .25 class credit for attending the QWAC weekly class.

We ask for one course release in each year of the project to develop and pilot QWAC modules. In addition, we ask for ½ course equivalent (.085 FTE) per year, starting in the third year, to support the implementation of mature modules.

**Web site:** Today's students are extremely comfortable on the Internet and they have grown accustomed to turning to it as a source of information. The Society for Actuaries (SOA) has been very effective at gaining the attention of young students in mathematics with an attractive, well-designed web site. At St. Olaf, mathematics students regularly refer to the SOA web site, [www.beanactuary.org](http://www.beanactuary.org), when they come in to discuss related careers. This proposal would create a similarly attractive website for statistics students which will provide information about careers in statistics in an appealing and accessible format. The majority of the materials will be compiled from information available on the ASA web site.

To create and maintain the web site, we will ask for funds to cover the time and expenses of our local Informational and Institutional Technologies staff.

**Student colloquia:** Statistics Program student colloquia will become a regular feature of the already well-established and well-attended Mathematics Department Colloquium Series. The objective of the Statistics Series is to have all of the mathematics students, statistics students, and students from other leading disciplines, such as biology and psychology, be exposed to the kinds of problems statisticians work on, the types of methods used, and the associated career potential. Featured speakers will include statisticians from academia and industry as well as alumni graduate student panels.

We will ask for funds for speakers and other miscellaneous expenses.

### ***Mentoring Component***

The objectives of the mentoring component of the SUM Project are:

- 1. To increase statistics students' participation in statistical inquiry and activity outside of the classroom.**
- 2. To provide a capstone experience for every statistics mentee.**
- 3. To maintain contact with statistics mentees following graduation to continue to encourage students to attend a mathematical science graduate program.**

Once a student has been successfully recruited and declares a statistics concentration, the battle is only half won. Formidable challenges remain in transitioning from an undergraduate statistics program to graduate studies in statistics. Assuming acceptable course work, we will welcome students declaring a statistics concentration as designated Statistics Undergraduate Mentees. We anticipate the numbers to be similar to or greater than past years and therefore in the range of 10 to 20 new mentees each year making for a total of 30 to 50 sophomore, junior and senior mentees. As a result of this support, mentees will be able to avail themselves of a system of mentoring activities that will generate excitement about statistics and enthusiasm for continued study.

Our philosophy for generating the excitement and enthusiasm for statistics is to actively integrate students into problem-centered, interdisciplinary undergraduate research. Our goal is to introduce students to the epistemology or "ways of knowing" of statistics. They will learn that modern research calls on the expertise of many disciplines and the value of oral and written communication skills in addition to learning statistical methods.

The mentoring portion of the SUM Project recognizes the importance of actively engaging students in the field of statistics by involving them in interdisciplinary undergraduate research teams, challenging and exposing them to the excitement of advanced work in statistics in a capstone course, and continuing to encourage uncommitted students following graduation to consider attending graduate school. Recognizing that many students now take time between undergraduate and graduate school, it is important that we maintain a connection with our graduates and continue to provide them with information and encouragement.

An infrastructure to facilitate interdisciplinary communication is critical. At St. Olaf College, we have a thriving summer research program in the natural sciences. Responding to the BIO2010 report, there is increased importance placed on incorporating quantitative disciplines such as mathematics, statistics and computer science into the undergraduate science research program. The timing is fortuitous—the mathematical sciences at St. Olaf are poised to meet this directive and welcome the opportunity to become active members of undergraduate research teams. Our approach is a problem-centered, interdisciplinary research-team approach, similar to that employed in larger research settings such as the National Institutes of Health (NIH). The PI spent eight years at NIH and is experienced with and enthusiastic about implementing this approach. The first step is communicating with colleagues in other disciplines to learn about compelling problems of common interest. The next step is creating undergraduate research teams with two or more disciplines represented, one of which comes from the quantitative sciences.

To encourage students to attend graduate school in statistics, a capstone course is needed. In such a course, students have an opportunity to reinforce and extend their knowledge of statistical methods in a variety of settings and to explore an area of interest in more depth. This experience can provide students with the confidence needed and generate enthusiasm for attending graduate school.

*Activities*

The misperception that statisticians work in isolation can quickly be corrected by involving undergraduates in interdisciplinary research. Each undergraduate statistics mentee will have the opportunity to work closely with doctoral level faculty mentors on research in a variety of settings: as a member of an interdisciplinary research team, acting as a resource person for on-campus consultation, or as a participant in off-campus opportunities with professionals in industry, medicine, and the government. The variety of opportunities is key so that students may experience the diversity of applications statisticians encounter. Strong ties to alumni will facilitate continuing to encourage post-graduate 'undergraduate' statistics mentees to attend graduate school through different mechanisms.

**Center for Interdisciplinary Research (CIR):** The CIR will serve as a focal point of all interdisciplinary activity on campus involving statistics. It will be under the direction of the post-doctoral associate and faculty mentor and staffed by undergraduate mentees (CIR "associates"). The CIR will be the first stop for students and faculty in need of statistical expertise. The services provided by the CIR will be varied:

- Quick (one or two visit) consultations on statistical or software issues.
- Collaborations involving data analysis and inference from an ongoing research project (multi-week or more).
- Long term collaborations on experimental design and implementation of statistical aspects of research projects (year-long or more).

Students, under the guidance of the faculty statisticians, will provide a great deal of the expertise needed. They will learn first-hand how to function in a collaborative, inter-disciplinary setting.

The CIR will hold evening workshops for CIR associates and statistics concentrators to provide background and instruction on working in a collaborative environment. These will be led by the faculty statisticians as well as by invited alumni/ae who have been involved in collaborative research activities in their professional work. Student associates in the CIR will receive 0.50 course credits for workshop attendance and their work as consultants.

Examples of projects this past year at St. Olaf College that would have been suitable for the CIR include:

- Projects resulting from our Biology Department's course in South India, in which students study public health issues. One project involved an interrater agreement study on diagnosing the progress of leprosy with readily accessible instruments.
- A project in environmental science involving a longitudinal analysis of young tree growth measured over the past 15 years in several transects.

The CIR is a critical component to a successful inter-disciplinary research program involving statistics. For many years, there has been an identified need for statistical expertise in research projects from other disciplines. True, faculty often consult and collaborate with the local statistician(s) and, on occasion, students are brought into these projects. However, the system is inefficient and not sustainable. In this model, there will be the advantage of trained student associates to help with many of the projects and professional statisticians to oversee the entire process. Importantly, there will be appropriate compensation for this work. Students will receive course credit and the director will have sufficient course release time to supervise the CIR. This formalized structure is necessary if one hopes to involve statistics in undergraduate interdisciplinary research efforts. While this involvement has been widely recognized as valuable, most undergraduate institutions do not have the means to properly support the faculty time needed to supervise this type of work.

**Interdisciplinary Research Team (IRT):** For undergraduate statistics mentees, involvement in a substantial summer inter-disciplinary research project could well prove to be the primary motivator for continued study of statistics. We will take advantage of the College's well-established summer research program as a means of introducing more statistics students to this activity. In an IRT, mentees and students from a collaborative discipline will join together to work on a problem of common interest. The mentee will be a full member of the team, contributing in every possible way—gathering data, feeding animal subjects, building hardware, cleaning test tubes, etc. As part of the natural division of labor, mentee will have primary responsibility for designing and analyzing the data from the project as well as recommending and describing additional appropriate statistical methods that may be useful but possibly beyond the scope of the summer project.

To join an IRT, mentees must first identify an appropriate project in another discipline. To do so, during the Fall semester before the summer research, they will attend already established research seminars in other sciences, talk to faculty and students about potential projects, or work with a statistics mentor directly. Upon identifying an appropriate research project, mentees will find (or be assigned) relevant readings in order to properly prepare for the upcoming summer project. In some cases, we expect that these readings can be integrated into an upper-level statistics course taken during the Spring semester. In other cases, this will require faculty time to guide the student in their reading. In either case, mentees will work closely with a statistic mentor on the readings throughout the remaining school year.

During the summer, the statistics mentees will join a research team under the direction of a researcher in the allied discipline. As well, they will work closely with statisticians on the statistical aspects of their project. They

will have primary responsibility for designing and analyzing the data from the project as well as recommending and describing additional appropriate statistical methods that may be useful but possibly beyond the scope of the summer project. An important component of this process will be the opportunity for mentees to present work at a variety of venues including oral presentations at the concluding summer research seminar, a poster at the St. Olaf Science Day Symposium, and other professional venues, as appropriate. On occasion, it is expected that publications suitable for undergraduate journals will result. Because St. Olaf is a member of PEW, funding is available for students to present their work at the annual PEW Consortium for Undergraduate Research as well as at the annual National Council on Undergraduate Research conference.

We will ask for support for two undergraduate summer research students the first year and four in each of years two through five. We will also request support each summer for the post-doctoral associates and one of the permanent faculty.

**QWAC Associate:** Another opportunity for mentees is to work closely with statistics faculty working on QWAC modules. For each QWAC module we create, we will pair a statistics mentee with the faculty member developing the materials. The mentee will play a key role in the design of the materials by judging appropriateness of ideas and providing input on student backgrounds and perspective. As well, the mentee can assist with the presentation of QWAC materials.

We expect that QWAC project will serve as a source of potential research projects. Mentees' involvement with QWAC course modules may lead to "post-QWAC" collaborations that, in turn, may lead to the creation of an Interdisciplinary Research Team (IRT).

We will ask for modest stipends for the student QWAC associates.

**Capstone course:** Every other year, we will offer an advanced, capstone course in statistics emphasizing independent project-centered learning. Projects may originate from a paper in the literature or a research project requiring an advanced method in statistics. This course will allow students to prepare for or follow up on work associated with a summer research project or explore an entirely new area. With support allowing a biennial offering, all Statistics Undergraduate Mentees will have the opportunity to take a capstone course.

The current staffing plan for the mathematics department calls for an applied upper-level statistics seminar every fourth year. As part of their teaching load, we will ask the post-doctoral associate to teach one capstone course during their two-year appointment, allowing us to offer this course every other year.

**Post-graduation activities:** Four-year colleges tend to maintain close ties to alumni, thereby enhancing the potential for post-graduate participation. The objective of these activities will be to encourage graduates not yet attending graduate school to consider doing so and for alumni engaged in the mathematical sciences to mentor SUM Project participants. The SUM Project will provide for a statistics career event series that will feature panels with alumni who are attending graduate school in statistics, practicing statisticians from academia, industry, and government. We will hold these at two different times of year – in the Fall to coincide with Homecoming and in the Spring. The audience for these gatherings will be both current students and invited alumni. Statistics Mentee graduates will also receive regular updates on graduate school opportunities and activities via an electronic newsletter.

We will ask for funding for administration related to arranging for these events and modest travel grants to participants

**Field trips.** Mentees will make on-site visits to local organizations employing statisticians to learn about the kind of work they are doing and about possible internship positions. Examples include Medtronic, Thrivent Financial Services, and the University of Minnesota statistics-related programs. There are also regular outings to hear lectures at nearby colleges and universities.

**Other Opportunities:** In addition to the supported activities above, here we list several existing opportunities for statistics mentees for which we are not requesting NSF funding.

**The Mathematics Practicum.** The Mathematics Practicum is one of the most distinctive offerings of the St. Olaf mathematics program—and one graduates often mention years after leaving the college. The goal of the Practicum, offered during our January interim session, is to give our students experience working in teams while addressing mathematical problems from the "real world." Through the years, we have worked with many Minnesota businesses, government agencies and non-profit organizations. In the recent past we have worked with the Mayo Clinic, Cargill, Pillsbury, Honeywell, Northwest Airlines, and Target. Students taking the practicum are normally junior and senior mathematics majors, often with statistics concentrations. At the end of the January term each group gives an hour-long group presentation of their results at the "client's" workplace.

**Internships.** There is a large potential pool of willing organizations as a result of St. Olaf's long history of successful Practicum experiences. In the spring of 2003, student internships included the Mayo Clinic (working with Dr. Mariza de Andrade), Mutual of Omaha, and the AIDS Research Center at the University of Minnesota. We are actively seeking more internship opportunities for statistics students..

## THE TRANSITION FROM PHD TO A TENURE-TRACK POSITION IN AN UNDERGRADUATE INSTITUTION.

Our plan for addressing transitioning PhDs in statistics or closely related fields to tenure-track positions in undergraduate institutions consists of two major components: recruitment and mentoring.

The SUM Project plan for post-doctoral statistics associates (PSAs) includes 5 specific, related objectives.

1. **To convince a pool of new PhDs in the statistical sciences to consider teaching at an undergraduate institution through recruiting efforts directed at participants (faculty and students) in statistics graduate programs.**
2. **To provide associates with first hand experience teaching at an undergraduate institution.**
3. **To provide an opportunity for associates to participate in undergraduate research.**
4. **To balance time commitments of the associates to allow them to pursue independent research and other professional activity.**
5. **To provide mentors who are permanent faculty with doctorates in statistics.**

This statistics post-doctoral associate is closely modeled on a similar project at St. Olaf in the 1990's. Under the support of the Fund for the Improvement of Post-secondary Education (FIPSE), the mathematics department hired a series of post-doctoral faculty in mathematics and statistics. The goal of this program was to encourage talented, research-oriented new PhDs in the mathematical sciences to consider a career at an undergraduate institution. Four post-doctoral faculty were hired and all went on to tenure-track positions at undergraduate institutions (Macalester College, University of Santa Clara, Rensselaer Polytechnic, and University of New Hampshire).

This statistics postdoctoral position will provide recent PhDs the opportunity to experience first-hand an undergraduate institution without the pressure of a tenure-track appointment. The teaching duties will be limited, so as to allow time for the associate to mentor student researchers, concentrate on their own research and to direct the CIR. In addition, the associate will benefit from the relatively rare opportunity to have two doctoral level statisticians onsite to mentor them throughout the year. We will work closely with the associate as they prepare their search for a tenure-track position after their association with St. Olaf

The postdoctoral position not only allows the associate to learn from a strong, healthy statistics program, but—importantly—to contribute to the program. The associate will take in the process of refining and updating the statistics program as it seeks to better integrate research and education, to respond to the differing preparation of incoming students, and to update the curriculum to link more closely pedagogy and practice. We expect that the post-doctoral associates will add to the vitality the statistics program by presenting and exchanging ideas about some of the newest statistical methods and lines of research. Of course, we also expect that the associate will contribute to the broader statistics community. We will encourage the PSAs to travel to appropriate meetings and workshops, specifically American Statistical Association national meeting in August and the national ENAR meeting in the Spring and to submit accounts of their experiences to appropriate professional journals.

In many ways, the post-doctoral associate is a “linchpin” for the SUM Project program. Clearly, the presence of the PSA directly addresses the second transition point, but a PSA plays a key role in the first transition point in several ways:

- As a mentor and role model for enthusiastic undergraduates in a variety of settings.
- As a conduit to new methods and approaches in statistics for experienced faculty.
- As a catalyst for the development of the new introductory courses and the QWAC modules.

The current proposal calls for two consecutive two-year post-doctoral associates. To allow a full year of recruiting, the first appointment would be made in the second year of the project. We will request the maximum allowed support for this positions as well as support for recruiting.

### **Recruiting Component**

#### *Activities*

Recruitment of the post-doctoral associate will follow closely the department's method for hiring tenure-track faculty. In addition to advertisements in the standard publications (e.g. AMSTAT News), we will contact graduate schools with a reputation for developing new PhDs with an interest in undergraduate teaching (e.g., Johns Hopkins, Iowa State, North Carolina State University). Mailings of letters and other information will play an important role in this process. Whenever possible, we will take advantage of personal contacts at graduate programs to identify potential candidates.

An important enhancement of our search process will be a series of recruiting visits by the St. Olaf faculty to statistics graduate programs. The goal will be to meet with statistics graduate students and faculty and educate them about the life at an undergraduate institution. Two of these visits will be in the Fall of the first year. We will target areas with clusters of top-level programs (e.g. Boston/New England area, Washington D.C., the bay area of California). The second recruiting trip will include the first post-doctoral associate.

St. Olaf College has already received a commitment for one graduate program (Johns Hopkins) stating that they would happily direct students who would like to get experience teaching at an undergraduate institution to St. Olaf.

(See letter from Johns Hopkins School of Public Health). This proposal would allow us to be more intentional about our outreach efforts to graduate institutions.

We will pay special attention to the recruitment of individuals from underrepresented groups. This will not be a special effort for this post-doctoral associate; rather it is consistent with the College's overall philosophy and goal of making our community more inclusive. As mentioned earlier, St. Olaf is now a member of the Consortium for a Strong Minority Presence (CSMP). Membership provides access to a pool of postdoctoral students (from all disciplines) from underrepresented groups who are specifically interested in teaching at four-year colleges. As part of CSMP, the College has committed to interviewing at least one—and hopefully more—post-doctoral candidates (from any discipline) over the next three years and is committed to hiring at least one of these very qualified individuals. Once hired, mentoring is an important component of the College's commitment to this individual.

The PI's of this proposed project will work closely with our Dean of Community Life and Diversity as we go through the search and hiring process for the post-doctoral associate in statistics. In addition to the CSMP, we will take advantage of personal contacts such as Louise Ryan who supervises a program for minority students at Harvard, the ASA Committee on Minorities in Statistics, and the ENAR Diversity Caucus.

Recruitment efforts aimed at new PhDs will focus on the many positive aspects of a career at a four-year college:

- **Quality-of-life, not salary:** Viable candidates will have an enthusiasm for teaching and appreciate the satisfactions and quality-of-life that go along with the lifestyle at an undergraduate institution. Because many positions at four-year colleges are 9-month appointments, there are opportunities to supplement a faculty salary, but it is important to be realistic about one's priorities.
- **Research is not only possible, but also desirable:** Advances in communication technology and travel have made research collaborations across the country as well as across the globe possible. These technological advances have also facilitated the feasibility of collaborations between researchers at geographically diverse sites. The value of integrating research and education is now widely recognized at all levels; undergraduate through graduate school, (for example, see BIO2010). Programs are encouraged to maintain a healthy undergraduate research programs. Criteria for tenure and promotion at St. Olaf (and elsewhere) recognize the value of collaborative research with undergraduates.
- **Community is an important part of the job:** Smaller colleges and universities value greatly collegiality and personal interactions. Life in a smaller department has the benefit of closer relationships with both colleagues and students.

We will request support for travel and miscellaneous expenses related to recruitment of the post-doctoral associate.

### ***Mentoring Component***

Once selected, we will work closely with each associate to ensure his or her experience is successful. Specific mentoring initiatives include:

- Assignment of a senior mentor (either Legler or Roback) who will work closely with the associate on a regular basis. This mentor-mentee relationship will closely follow the mathematics department long-standing mentoring policy. It is expected that the mentor and mentee will meet regularly to discuss all aspects of professional life: teaching, research, job search issues, inter-personal relationships, etc. We will intentionally pair the mentor and mentee in at least one introductory statistics class each semester of the first year in order that they might discuss methods and approaches to the subject. We expect that the associate will work closely with their mentor and contribute to the development of the previously mentioned "Stat 102" course.
- The associate will be expected to attend the mathematics department bi-weekly education seminar. At this seminar, faculty discuss a wide-range of issues relating to pedagogy. (Coincidentally, the education seminar was started during our FIPSE post-doctoral program in the 1990's. It proved to be so successful and popular with the faculty that we have retained it ever since.)
- Early in the associate's second year, we will conduct a professional review in a manner similar to reviews for tenure-track faculty in their second year. These reviews are used to help tenure-track faculty "steer" their activities, identify strengths and weaknesses, and generally obtain a better understanding of how they are doing. We feel that similar information will be particularly helpful to the post-doctoral associates, especially as they enter the tenure-track job market.

Lastly, we expect that the PSA will benefit tremendously from time spent in the St. Olaf mathematics department. As one of the most vibrant, active, and recognized departments in the country, one could not expect a better training ground for a new faculty member in the mathematics sciences. In various ways, we expect all members of the department to contribute to the mentoring of the post-doctoral associate during their stay at St. Olaf.

### *Activities*

The post-doctoral associate will be engaged in a variety of activities during their stay at St. Olaf. As mentioned above, first and foremost, we expect that they will interact directly with students interested in learning more about how statistics is used in modern science.

**Reduced teaching load:** The normal teaching load at St. Olaf is six classes per year. We feel that four classes per year (0.67 FTE) for the post-doctoral associate strikes the proper balance between allowing sufficient time for other activities and also allowing the associate to develop appropriate classroom skills, as well as meeting a large cross-section of statistics students. One class each year will be a team-taught (with the mentor) introductory statistics course.

**Direct the Center for Interdisciplinary Research (CIR):** The CIR is a centerpiece of this proposal and is a focus of mentoring activities for postdoctoral associate. Through involvement with the CIR, the postdoctoral associate will be a part of an innovative interdisciplinary research program at the undergraduate level. The associate will be responsible (with guidance from the Project Administrator) for the overall management of the CIR, assigning projects to the student CIR associates, consulting on projects with students and faculty, and overseeing the allocation of the center's resources. This responsibility will account for the remaining 0.33 FTE of the associate's appointment.

**Provide mentoring for the undergraduate statistics mentees:** This is an excellent way for students to learn about current trends in the field and an excellent opportunity to learn about graduate school.

**Participate in summer undergraduate research activities:** The post-doctoral associate will be available for one month during the summer to direct statistical activities relating summer research by the Interdisciplinary Research Teams.

**Develop their own independent research program:** It is expected that the associate will devote a significant amount of their remaining summer time to work on their own research program. Of course, in a best case scenario, they will work on joint projects with St. Olaf faculty (and perhaps students) developed out of relations started in the CIR.

**Disseminate the SUM Project to another undergraduate institution:** A postdoctoral associate will play a crucial role in our efforts to disseminate the successful elements of St. Olaf's undergraduate statistics mentoring system to other undergraduate institutions. We will expect that the associate will prepare talks for presentation at national statistics and mathematics meetings and papers for publication in suitable journals (e.g. Journal of Statistics Education).

## FACULTY

Below are the permanent faculty at St. Olaf who will be involved in this project.

- **Julie Legler, Sc.D. (biostatistics):** As Project Administrator, her primary responsibilities will include mentoring undergraduate and post-doctoral associates, course development, program administration and supervision. Legler has been at St. Olaf since 2001, having previously been at NIH (1994-2001). She is currently the director of the statistics program at St. Olaf.
- **Paul Roback, Ph.D. (statistics):** His primary responsibilities will include mentoring undergraduate and post-doctoral associates, course development, program administration and supervision. Roback is in his first year at St. Olaf having previously been at Bucknell University and Connecticut College.
- **Matthew Richey, Ph.D. (mathematical computing, MCMC methods):** His primary responsibilities will include mentoring undergraduate and post-doctoral associates, course development, program administration and supervision. Richey has been at St. Olaf since 1987 and has been the chair of the mathematics department since 1997.

## DISSEMINATION WORKSHOP

In addition to other dissemination activities, in the spring of the fifth year of the project, we will host a workshop at St. Olaf focusing on how other undergraduate institutions can enhance their statistics programs and hence contribute to the process of increasing the number of students and faculty in the undergraduate statistics pipeline. The workshop will feature presentations by St. Olaf faculty as well as invited addresses from nationally recognized individuals in statistics. The explicit goal of the workshop will be to provide participants with a better idea of how to attract both students and PhD statisticians to their programs.

We will ask for support for workshop expenses, including two invited speakers, a modest stipend for workshop preparation, and miscellaneous expenses. We will not ask for support for participants (other than the invited speakers).

## FACULTY RESOURCE ALLOCATION

The table below describes the project timeline, indicating activities, sequences, resources required, and an initial assignment of individual responsibilities (JL=Legler, PR=Roback, MR=Richey, PD=Post-doctoral associate).

Activity	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Administration</b>	.33 FTE JL	.33 FTE JL	.33 FTE JL	.33 FTE JL	.33 FTE JL
<b>“Stat 102”</b>	Development .17 FTE PR	Develop/Pilot .17 FTE PR	Pilot .17 FTE PR		
<b>QWAC</b>	Develop.17 FTE MR	Develop.17 FTE Implement .085 FTE MR	Develop.17 FTE Implement .085 FTE MR	Develop.17 FTE Implement .085 FTE MR	Develop.17 FTE Implement .085 FTE MR
<b>IRT</b>	.11 FTE JL (Summer)	.22 FTE PR,PD (Summer)	.22 FTE MR,PD (Summer)	.22 FTE PR,PD (Summer)	.22 FTE PR,PD (Summer)
<b>CIR</b>		.33 FTE PD	.33 FTE PD	.33 FTE PD	.33 FTE PD
<b>Total FTE (+summer)</b>	<b>1.00 + .22</b>	<b>1.085 + .22</b>	<b>1.085 + .22</b>	<b>0.915 + .22</b>	<b>0.915 + .22</b>

### Timeline Notes:

- **Project Administration:** Oversight of all project activities, including assignment of faculty responsibilities, creation and maintenance of alumni/ae network, colloquium series, and assessment. The project administrator will also coordinate all mentoring activities for students and serve as the mentor for the post-doctoral associate. The project administrator will assist the post-doctoral associates in the creation and management of the CIR. During the first year, the Project Administrator will have full responsibility for the establishment of CIR.
- **“Stat 102” development:** Year 1—development of appropriate materials, syllabus, book selection. Year 2—pilot implementation and additional material development. Year 3—Full implementation of course.
- **QWAC:** Development of QWAC materials in each year. Support for initial QWAC implementation in the last two years (.5 course equivalent each year).
- **IRT:** Consultation with statistics mentees involved in IRT’s during summer research. This is shared between one continuing faculty and the post-doctoral associates.
- **CIR:** Directing the CIR is the responsibility of the post-doctoral associates (with assistance from the project administrator). Activities include leading consulting workshops for undergraduate CIR associates and overseeing all CIR research projects with faculty and students from other disciplines.

## ASSESSMENT ACTIVITIES

Although not explicitly called for by the by the EMWS21 Program Solicitation, we will collect the following information over the course of the project. This information will be used to both help us guide the project and as part of the dissemination effort. Year 0 refers to 2003-2004, the year before the onset of the project.

- Survey incoming students of Year 1 regarding awareness of and interest in a variety of fields including statistics. Compare to results of exit surveys of graduating students at the end of Year 5.
- Document the number of students who received credit for AP Statistics who take a statistics course at St. Olaf from Year 0 to Year 5.
- Document number of students who take a course beyond introductory statistics from Year 0 to Year 5.
- Document the number of students declaring a statistics concentration, particularly among students majoring in fields other than mathematics from Year 0 to Year 5.
- Document the number of students from under-represented groups who complete a statistics concentration at St. Olaf from Year 0 to Year 5.

- Document the number of undergraduate concentrators who continue on to graduate school in statistics or biostatistics from Year 0 to Year 5.
- Document the number of statistics students who participate in statistical inquiry and activity outside of the classroom from Year 0 to Year 5
- Document the number of statistics mentees who participate in a capstone experience (either an advanced seminar or research project).
- Document the number of contacts with statistics mentees following graduation to continue to encourage students to attend a graduate program in statistics or biostatistics and record number of St. Olaf graduates who decide to attend graduate school in statistics or biostatistics.
- Document each post-doctoral associate's post-SUM Project employment.
- Provide a copy of each post-doctoral associate's two-year review.
- Provide summaries of each post-doctoral associate's participation in undergraduate research.
- Provide summary of each post-doctoral associate's research and other professional activity.