

November 14, 2000

Dr. Pellegrini,

The Keck Foundation and Augsburg College have the opportunity to provide leadership in the reform of statistical education at the undergraduate level. The goal of this project is to reform the teaching of statistics to include the use of observational statistics as evidence in arguments about causality. This interdisciplinary project has the potential to bridge the gap between formal mathematical statistics and material critical thinking, between experimental studies and observational studies in the physical sciences, and between the social sciences and the humanities.

A grant of \$1.2 million can further Augsburg's vision of interdisciplinary education and allow us to serve as a model for other institutions that are seeking to integrate critical thinking and the use of statistical evidence into their curriculum. This grant will assist in initiating the reform of statistical education in the humanities, the social sciences and the physical sciences.

#### AUGSBURG HISTORY:

Augsburg maintains a strong focus on the skills associated with a liberal education. Augsburg graduates are required to complete courses that qualify for a separate designation in both critical thinking and quantitative reasoning.

#### PROJECT BACKGROUND:

Many of our public debates entail the use of statistics; the web is increasing the availability and utilization of statistics. Yet many college graduates are not adequately prepared to evaluate the strength of a statistic in supporting the truth of a disputable claim.

In the US, approximately one million students study statistics each year. Typically, this is a course in statistical inference (chance-based statistics) involving sampling distributions, confidence intervals and hypothesis tests. Such a course is certainly necessary in a research environment or where the data sets are small. But in sociology, political science, history, communications and business, the statistics are primarily observational – not experimental. And often the data sets are large (cf. the 12,000 people involved in the National Longitudinal Study of Youth). In many cases, chance is far less important than the bias introduced by confounding factors.

The use of observational data is increasing in the physical sciences. In Physics, astronomical data and astrophysical data are observational. As researchers study signals that are little more than noise, the use of statistics is required. Statistical literacy is becoming more important.

Augsburg College has pioneered in the development of a radically different course: GST 200: *Statistical Literacy*. This course was developed by Dr. Milo Schield and has been offered for the past three years. After teaching Augsburg's critical thinking course, he recognized the need to apply critical thinking to statistics. Having taught traditional statistics for years, he was in a good position to attempt the design of this new course in statistical literacy.

Statistical Literacy focuses on the use of statistics as evidence in arguments about causation. Supporters of using statistics as evidence about causation include faculty in statistics (Dr. Donald Rubin, Harvard University) and in computer-science (Dr. Judea Pearl, UCLA).

Augsburg's course in statistical literacy has been cited by the US Department of the Census as being outstanding in its focus on reading and interpreting data. As an acknowledgment, the Census Bureau is sending free copies of the US Statistical Abstract to students in GST 200.

This course has been the topic of seminars at both the national and international level in statistical education. Those supporting this unique program include epidemiologists (Dr. John Bailar, III, University of Chicago, and Dr. Abramson, University of Israel) and statisticians (Dr. Tom Moore, Grinnell College, and Dr. George Cobb, Mount Holyoke College).

There have been previous attempts to use of statistics as evidence in arguments – the NSF-funded Chance project. However, according to the director (Laurie Snell), that project did not result in a substantial change in teaching because it did not involve the production of teaching materials and the training (or retraining) of teachers of statistics to handle the new paradigm. Thus the production of teaching materials is a central outcome of this proposal, along with videos and conference proceedings on the teaching of statistical literacy.

Dr. Schield will be the project manager of this project. He is a tenured professor at Augsburg with a Ph.D. in Space Physics (Rice University); he teaches in the Management Information Systems unit within the Department of Business Administration. He has organized seminars on statistical literacy at annual meetings of the American Statistical Association for the past three years. He has given talks on statistical literacy at conferences in the US (Making Statistics More Effective in Schools of Business, Association of Public Data Users, the American Mathematics Association of Two Year Colleges, and the US Bureau of Labor Statistics) and worldwide (International Conference on Teaching Statistics, Singapore, and the International Conference on Mathematics Education, Tokyo). He has given invited talks in England, Scotland, Wales, China, and Australia. He will give an invited talk at the next International Conference on Teaching Statistics (South Africa) where the theme will be Statistical Literacy.

#### PROJECT DESCRIPTION AND IMPACT

The goal of this project is to reform the teaching of statistics to include the use of statistics as evidence in arguments about causality and public policy, thereby bridging the longstanding gap between formal mathematical statistics and material critical thinking (the gap between the social sciences and the humanities) in relation to decision making and policy making.

We envision a three-phase project. Phase I focuses on the development of appropriate teaching materials. Phase II focuses on restating the relation between statistics and causality. Phase III focuses on the training of teachers to teach statistical literacy.

Phase I: Guided by a strategic vision for Augsburg's future, *Augsburg 20004: Extending the Vision*, the Faculty Development office, with a grant from the Keck Foundation, will select faculty to teach statistical literacy. These Keck Research Fellows will construct the course goals, learning outcomes, and assessment tools and will test teaching materials while they teach the course. The primary goal of this phase is to develop teaching materials that can be used by faculty having a wide variety of teaching styles. Dr. Schield will have the responsibility of developing the materials, for summarizing the feedback from teachers, and for communicating the results to the academic community. These teaching materials will include both print-based and web-based materials. Augsburg faculty have already indicated their interest in participating in this endeavor. These include Dr. Kenneth Kaminski (Mathematics/Statistics), Dr. J. Ambrose Wolf (Physics), Dr. William Jasperson (Physics), Dr. Cass Dalglish (English - Quantitative Journal-

ism), Dr. Bruce Reichenbach (Philosophy), Dr. David Lapakko (Communications), and Dr. Beverly Stratton (Religion). In addition to the development of field-tested teaching materials, this phase includes the development of two videos. The first, a short 3-5 minute video documents the interdisciplinary aspects of this course and its implementation at Augsburg College. The second, a longer 10-15 minute video, designed for use by college faculty teaching in statistics, documents the features of the course and some of the challenges and rewards involved.

Phase II. Conferences will be held at Harvard (hosted by Dr. Donald Rubin, author of *Contrasts and Effect Sizes*), at UCLA (hosted by Dr. Judea Pearl, author of *Causality*), and at Augsburg College (hosted by Dr. Schield). Conferences will be 2 to 3 days and involve 20 invited attendees. Invited attendees will include philosophers interested in probabilistic causality (e.g., Dr. Kenneth Clatterbaugh, University of Washington, author of *The Causation Debate*), those interested in the philosophy of science as applied to observational studies, authors of introductory statistics textbooks and leaders in statistical education. The goal of each conference is a workbook or guidebook on the teaching of causality and statistics to undergraduates.

Phase III. The Section on Statistical Education of the American Statistical Association will offer workshops to give those teaching statistics an opportunity to experience the teaching of Statistical Literacy. These may be conducted as part of the national Joint Statistical Meetings of the American Statistical Association or as part of related conferences (MAA, etc.). Workshops will involve 10-20 invited attendees and will be a mixture of short course (half day to full day) or longer courses (two to three days) so the participants can experience the thrust of the new course and develop some proficiency in teaching the materials. The goal is a conclusion by statisticians on their interest in – and their ability to – teach statistical literacy at the undergraduate level.

#### TIMETABLE FOR IMPLEMENTATION

In Fall of 2001, Keck Research Fellows will be identified by Augsburg's Faculty Development Office. Phase I will continue for three years within Augsburg with annual reports on the status of the teaching materials and the teaching evaluations. Phase II could begin as early as the Summer/Fall 2001. This activity will involve a relatively small group of those involved in statistics and the philosophy of science. The goal is to present and discuss position papers on the teaching of causality in the introductory courses in statistics. Phase III could begin as early as the Fall 2001 with Continuing Education workshops at the American Statistical Association.

#### JUSTIFICATION OF W.M. KECK FOUNDATION'S SUPPORT

W.M Keck has indicated a dual interest in science and in new directions in education. This project integrates the mathematical strengths of science into a completely new direction in education. Seldom is there the opportunity to innovate in the development of a completely new course of study a new discipline uniting aspects of mathematics, and the observational aspects of psychology and the physical sciences together with the philosophy (epistemology), the social sciences and the humanities. We invite the Keck Foundation to investigate the possibility of partnering with Augsburg College, the American Statistical Association and leading faculty at UCLA and Harvard in this pioneering effort.

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Dr. William Frame, President

**ATTACHMENTS:**

- A. Professional References
- B. Budget Summary
- C. Copy of 503C Public Charity Determination Letter
- D. Augsburg Certified Audited Financial Statements

**A. PROFESSIONAL REFERENCES:**

The following have agreed to serve as professional references as to the general thesis of this proposal. Discussions on the particular means of accomplishing objectives would be held if the Keck Foundation sees merit in this general proposal. Professional references are saying that this area is an important area and this approach is worthy of consideration and further discussion.

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ATTACHMENT B.  
BUDGET SUMMARY

<b>Phase I</b>	<b>Augsburg College</b>	<b>\$450,000</b>
	Faculty Development: Course release time (\$8,000) and stipend (\$4,000) for Keck Research Fellows to teach and reflect on critical thinking and statistical literacy. (10 stipends at \$12,000 each).	120,000
	Course Materials: Course release time (\$10,000/course, 3 courses per year for three years) for Keck Project Manager (Dr. Schield) to develop teaching materials in print and web-based formats. Expense reimbursement (\$10,000 per year for 3 years).	120,000
	Faculty Development: Stipend (\$2,000) for faculty to incorporate statistical literacy into existing departmental courses (5 stipends)	10,000
	Faculty Development: Program oversight, workshops on goals, assessment techniques, student evaluations, etc.	40,000
	Development of two videos on Augsburg's course in Statistical Literacy: One for public awareness to a general audience, the second specifically for those interested in teaching such a course.	40,000
	Special statistical literacy classroom with web access, statistical analysis tools, data libraries and presentation tools.	120,000
<b>Phase II</b>	<b>UCLA, Harvard and Augsburg College</b>	<b>\$400,000</b>
	Program Coordination: Dr. Rubin, Dr. Pearl and Dr Schield	40,000
	Three seminars on the integration of causation, statistics and inductive reasoning in statistical literacy and associated courses (\$10,000@).	30,000
	Keck Research Fellowships (conference fee, travel, room, board and stipend) for attendees (\$4,000 each for 60 fellows).	240,000
	Preparation and publication of each Conference Proceedings (3 total)	60,000
	Courses at UCLA, Harvard and Augsburg on problem of induction in relation to probabilistic causation and the relation between the mathematics, the social sciences and the humanities (3 courses, \$10,000 @).	30,000
<b>Phase III</b>	<b>Section on Statistical Education, American Statistical Association</b>	<b>\$350,000</b>
	Program Coordination and Oversight of teacher-training workshops	20,000
	Workshop presentations (Rubin, Pearl, Schield) at ASA. ICOTS, ICME, MAA, AMATYC, MSMESB (\$5,000@ 3 workshops /year, 3 years.)	45,000
	Keck Research Fellowships (100) for invited statisticians and statistical educators to attend workshops (\$2,000@)	200,000
	Summarization and publication of responses concerning the importance of statistical literacy in departments of mathematics and statistics.	40,000
	Development of two videos on teacher-education responses to this course (short video on highlights; longer video on details).	45,000