

# Statistical Education Outreach = Unlimited Learning

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## Abstract

The Department of Statistics began a distance education initiative in 1994. This initiative includes the delivery of courses in the practice of statistics to off-campus students at over 20 companies. As part of this initiative, courses leading to a Master of Science in Statistics are presented to students at General Motors, 3M and the Mayo Clinic. This paper discusses this distance education initiative including its successes and shortcomings. Difficulties encountered by students and instructors are presented. Suggestions for avoiding these difficulties are given. Performance of students, on and off campus, is evaluated and compared.

Le Departement de Statistiques a Iowa State University a initie un programme d'education a distance en 1994. Dans cette initiative, des cours sur la pratique statistique sont offerts a des etudiants dans plus de 20 societes dans plusieurs villes americaines et dans autres pays. Ces cours sont offerts dans le contexte d'une programme de "Master of Science" en Statistiques a des etudiants a Gneral Motors, 3M et Mayo Clinic. Cette presentation discutera l'initiative d'education a distance, y compris ses avantages et d'esavantages. Les difficultes rencontrees par les etudiants et les instructeurs seront discutees, et des suggestions por eviter ces difficultes seront faites. Les resultats des etudiants dans les cours traditionels et a distance seront compares.

## Introduction

In 1994 the Department of Statistics at Iowa State University entered into an agreement with General Motors' Technical Education Program (GM-TEP) to deliver statistics courses to employees of General Motors (GM) in North America. This agreement led to the development of a two-semester series of courses, Applied Statistics for Industry. In addition, many GM employees were admitted to the graduate program in Statistics at Iowa State University as distance education students. Over the past seven years, this distance education initiative has expanded by offering the Master of Science degree program to employees of several other companies and a research organization. Over 300 students from twenty companies have taken one or both of the courses in the Applied Statistics for Industry series. The outreach is truly international with students in Mexico, Canada, Australia and Hong Kong.

This paper will discuss the distance education initiative in Statistics at Iowa State University. In particular, we present some of the difficulties encountered by students and instructors. Suggestions for avoiding these difficulties are given. Performance of students, on- and off-campus, is evaluated and compared.

## The Initiative

The Department of Statistics at Iowa State University has offered statistics courses to off-campus students for many years. Usually an instructor would drive, or fly, once a week to a location in Iowa to deliver the course. It was not until 1992, when representatives of General

Motors Technical Education Program (GM-TEP) approached the Department, that we began to look at the broader opportunities in distance education. At that time, GM-TEP asked if we would offer our complete Master of Science (MS) program via videotape to employees of General Motors. The initial response of the faculty was not positive. There were concerns that such a venture would take time and resources away from our efforts to provide high quality statistical education on campus. There was also a concern that the students from General Motors would be poorly prepared and would not have sufficient time to learn the material. There was the fear that such a distance education MS program would become a watered down version of the program on campus.

After much discussion, and some pressure from the University's higher administration, we decided to proceed. The one proviso was that the distance education program would be the same as the on-campus program. The actual on-campus courses would be videotaped. The distance education students would take the courses, with a one-week delay for delivery of tapes, within the structure of a regular semester. Distance education students would take the same written masters examination, prepare a creative component (mini-thesis) and come to campus for a final oral examination.

In addition to the MS program courses, General Motors wanted additional new courses for their employees. These courses would serve two purposes. The first purpose was to introduce engineers and managers to the practice of statistics in an industrial setting. The second was to provide a preview of the MS program. A two-semester sequence of courses, Applied Statistics for Industry I & II, was developed. In these courses statistical thinking and statistical methods provide the framework and tools for solving problems and building knowledge involving industrial processes and products. The first year (1994-95) these courses were offered, 60 students from General Motors enrolled in the first semester course and 40 students continued on to the second semester. Of these, 30 decided to pursue an MS degree in Statistics in our distance education program.

Our full time on-campus MS students take two MS core courses (one on theory the other on methods) plus additional course work in each of their first two semesters. They take a written MS examination covering the core theory and methods at the end of their first year. Their second year is devoted to elective courses in statistics and work on their creative component. Most of these students can finish the MS degree in two years.

Recognizing the already considerable demands on their time as full time employees of General Motors, we decided that the distance education students should take only one MS core course per semester. The theory core courses would be offered one year and the methods core courses the next. This alternating sequence allows distance education students to enter the program at the beginning of any academic year. Distance education students would take the written MS examination in two parts. One part would be taken at the end of their first year and the second at the end of their second year. Statistics elective courses such as Design of Experiments, Multivariate Statistical Methods, Quality Control, Reliability and Statistical Methods for Counts and Proportions would be offered as distance education courses on a regular basis. We envisioned that a distance education student would take from 4 to 5 years to complete the MS degree.

### **Student Numbers and Retention**

As mentioned earlier, 30 students from General Motors began the distance education MS program in Statistics in fall 1995. The first MS core course they took was Statistical Methods. This 4-credit course includes a 2-hour lab. Many distance education students were not prepared for the difficulty nor the time required of the course. The idea that the instructor expected two hours of work outside of class time for every credit came as a surprise to many students. Only 16 of the 30 distance education students completed the course and enrolled in the second core class, Linear Models. Only eight of the 16 completed the linear models' course. Of those, six took the Methods part of the MS examination and only three passed. This high attrition rate could be attributed to several factors. The rigor of the courses and the instructors' expectations were the same for distance education and on-campus students. This is not always the case, with distance education courses often perceived as less demanding. Many of the distance education students showed weakness in

their knowledge of the prerequisite mathematics. The Applied Statistics for Industry sequence had given them some practical applications of statistics. It did not, nor was it intended to, provide the prerequisite knowledge of mathematics and linear algebra.

As a result of these observations, efforts were made to assure that students contemplating the distance education MS program had the appropriate prerequisites. Emphasizing that a strong quantitative background was essential for success lowered the number of distance education students attempting the MS program. Because of the dwindling number of distance education MS students from General Motors, we decided to search for additional distance education partners. Employees of 3M and the Mayo Clinic are now enrolled in the program. With the increased attention to prerequisites and additional distance education partners, the students who enter the program are more likely to be successful. Of the last seven distance education students to enter the program, all seven passed the first part of the written MS examination.

### **Challenges and Suggested Solutions**

The Office of Extended and Continuing Education at Iowa State University coordinates the videotaping and administration of the distance education courses for the Department of Statistics. This office also deals with most administrative issues such as student registration, payment of tuition and fees, adds, drops, etc. The distance education partner companies and organizations provide a coordinator at each distance education site. The coordinator receives and distributes the videotapes and other materials and administers the examinations. Seven years ago, the University provided virtually no assistance in the development of materials for distance education. More recently, workshops have been provided by the Instructional Technology Center. However, production of materials is still largely the responsibility of the instructor.

Faculty members who teach a distance education course receive credit for teaching two courses, an on-campus section and a distance education section. For some of the larger enrollment courses this does not cover the increase in time needed to produce materials, maintain web pages, answer e-mail and telephone questions, and deal with assignments and exams. It is not easy to convince University administrators that the simultaneous delivery of on-campus and distance education sections of a course costs more than the addition of a few extra students to an on-campus course. Because of the one-week delay for distance education students, semesters are at least one week longer.

The number of on-campus students is sometimes too large for the technology-enhanced room where the videotapes are made. To overcome this problem on-campus students can watch the lecture on monitors in a separate room or a second live lecture can be offered at a different time. We have opted for the latter, which further increases the workload on the instructor. However, some on-campus students greatly appreciate the opportunity to take courses in a smaller, less intimidating environment provided by the second live lecture. We have not made a serious attempt to assess the impact of making on-campus students attend lectures in the videotaping environment. One general observation is that students are very reluctant to raise questions during the videotaping of a lecture.

One of the biggest challenges revolves around computational and logistical issues. In the core methods course we introduce students to SAS software. In addition to the three hours of lecture per week there is a two-hour laboratory where assignments and the effective use of SAS software are discussed. This is intended to be a very interactive session and so is not well suited for videotaping. In addition, many distance education students do not have access to SAS but do have access to Minitab. We tape a separate "lab session" for distance education students. In these videotapes, the effective use of both Minitab and SAS are demonstrated. In the second core methods course on linear models, students are introduced to Splus. Some distance education students have access to Splus at their workplaces, but many do not. The first two times the linear models course was offered, distance education students used a student version of Splus because it was relatively inexpensive to purchase. This caused problems because the student version could not perform all of the analyses that were available in the newer, full version being used by on-campus students. We recently acquired a site license that allows the distance education students to download the on-

campus version of Splus to their personal computers. Providing access to the same software for all students has solved many problems.

Distance education students face special challenges of isolation, access to help and the demands of full time employment and family life. On-campus students tend to form study groups to go over homework and reinforce what they have learned in lecture. Distance education students are often isolated and studying the material on their own. Job demands make it difficult to find times for live chat groups, either via the web or satellite connections. Our solution is to hold telephone office hours at times most convenient to the distance education students and to use e-mail. Questions and responses are collected and e-mailed to all students in the course. On-campus students tend to ask questions about the current assignment. Because of the one-week delay, distance education students are just being introduced to the material. The distance education students soon realize that the on-campus students also have questions. E-mail seems to be more effective than simply posting solutions to questions on the course web page. Accommodating travel schedules, emergencies, major project deadlines associated with their employment, requires flexibility with respect to examination dates and deadlines for submission of assignments.

The creative component provides the distance education students with an opportunity to apply statistical methods to the solution of a real world problem, ideally related to their employment. The initial proposal was to have the creative component jointly supervised by a company statistician and one faculty member. Distance education students have aggressively taken advantage of the creative component to work on interesting problems in the work place, e.g. assessing sources of variability in monitoring passenger compartment noise levels, projecting survival times of emission control devices, analyzing error rates made by providers of health care information. The supervision of these projects has fallen almost exclusively on the shoulders of the faculty. As more distance education students complete the MS program, these individuals can serve as mentors for future students.

## **Conclusions**

Although there are considerable challenges related to statistics distance education for people in the work place there are also some significant benefits. Connections with industry have been established or enhanced. Interesting, real world, problems have been brought back to campus as classroom examples and research problems. We have been challenged to more carefully think about the structure and content of our MS program in Statistics and how to more effectively teach all of our courses. Overcoming some of the challenges arising from distance education has resulted in significant improvements in our program. Our distance education program was a major factor in obtaining a National Science Foundation grant for partnership with industry that enabled three of our faculty members to spend extended periods of time working with researchers at General Motors.

We plan to continue our MS program distance education initiative. However, should the number of students drop off, costs may outweigh the benefits. Finding additional industrial partners would increase the pool of potential MS candidates and secure the future of this program.

## **REFERENCE**

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## **RESUME**

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