ENRICHING INTRODUCTORY STATISTICS COURSES THROUGH COMMUNITY AWARENESS

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In this paper we will present ways in which we have improved our introductory statistics courses by making connections with our community. We focus on three primary approaches: course structure, course content, and bringing in outside contacts and experiences. Changes to course structure include things like course projects and assignments that form an explicit part of the course workload for students. Our discussion of course content will consist of examples we use to illustrate learning objectives through a community connection. We then discuss how we incorporate consulting and other outside contacts to improve our courses. We also discuss student feedback and reactions.

INTRODUCTION

The approaches described in this article represent one aspect of our efforts to improve introductory statistics courses within broader changes and innovations as described in Schaeffer, Gnanadesikan, Watkins and Witmer (1996), Rossman (1996), Cobb (1992), Moore, Cobb, Garfield and Meeker (1995). We view these approaches as complementary to our existing instructional framework. The methods and approaches in this article involve notions of community, but are not necessarily community service or service learning in the sense of Anderson and Sungur (1999) or Root and Thorme (2001). Community service or service learning are natural extensions of what we describe here.

It is our belief that students are more interested in the class, and thus learn better, when course content and course structure involve a variety of interesting problems, situations, and contexts. Incorporating notions of community into the course is one way to accomplish this goal. In addition to our own teaching experiences, and those of other instructors, there is considerable theoretical support for our assertion. Previous work by Lovett and Greenhouse (2000), and Garfield (1995) suggest that cognitive theory supports our assertion that exposing students to problems and concepts in a variety of contexts facilitates student learning. Learning statistics through notions of community also enables students to bring their own community experiences and interests to support the constructivist view of learning new material, Von Glasersfield (1987).

COURSE BACKGROUND

Our institution is the University of Minnesota, Morris (UMM). We are a public liberal arts college and a part of the University of Minnesota system. Our campus is located in Morris Minnesota, a rural community of about 5000 residents located in west-central Minnesota. We have approximately 1900 undergraduate students with academic programs in the sciences (including major and minor programs in statistics), social sciences, humanities, and education. Our students typically come from smaller or mid-sized communities in the Midwest, or from the Minneapolis – St. Paul metropolitan area. We also have a substantial number of international students, and students from many other states.

The introduction to statistics course at our university is designed as a service course for a variety of academic majors, and a way to fulfill a quantitative general education requirement. We currently use the text by Moore and McCabe (1999). The course is taught by three faculty members from the statistics discipline. We typically enroll about 360 students in a two semester academic year.

COURSE STRUCTURE

A community awareness component can be integrated into the course structure in many ways. Classroom examples, homework and exam questions, learning checks, required or optional chapter or course projects, and classroom discussions are a few. It could be a required or optional

part of the course. Also, such a component may be introduced to the course directly or indirectly. Table 1 lists these components. The checked components are ones we have tried in our courses.

Table 1
Course Components

Component	**Required**	**Optional**	**Direct**	**Indirect**
Homework	√		√	√
Exam	√		√	√
Learning Checks		√	√	√
Quizzes	√ (Some Instructors)	√ (Some Instructors)		√
Examples	N.A.(Not Applicable)	N.A.	√	√
Chapter Projects		√		√
Course Projects	√	√ (5% extra points offered)	√	√
Classroom Discussions	N.A.	N.A.	√	√

The distinction between the direct and indirect community awareness component is driven from how the problem is identified and presented. In some cases a community organization directly introduces and brings the problem; in other cases a third party, typically a faculty member from another discipline, receives a community-related problem. For example, a faculty member from the biology discipline studied how to best manage the remaining tracts of prairie to maintain diversity, prevent invasion of exotic species and woody vegetation, and promote their use by native wildlife. She was also interested in whether native prairie can be used to provide an economic benefit to its owners (e.g., through its use as pasture for livestock) without radically changing its species composition, or eroding its ability to support wildlife. The data collected by the investigator were analyzed fully by Applied Nonparametric Statistics students and partially by Introduction to Statistics students. This is an example of using an indirect community service component in a course.

Classroom discussions can involve the presentation of a problem by a community member and/or principal investigator. They could be a city official, a faculty member, a local business, or a community development representative. The information/data that is obtained can be easily integrated within the course structure. Even though students might be informed at the beginning of the class and on the course syllabus about the inclusion of a community awareness component we prefer not to. Replacing what one does in our classes with examples and questions related to the community does not require a change in the policies and procedures of the course.

From a course procedure point of view, a community awareness component could be introduced at various levels. We could provide students everything they need, or on the other extreme they might formulate research questions and collect all the information needed. Thus, teaching approaches can range from practice-based learning to inquiry-based learning. These approaches and community awareness connections are summarized in Figure 1 and Table 2.

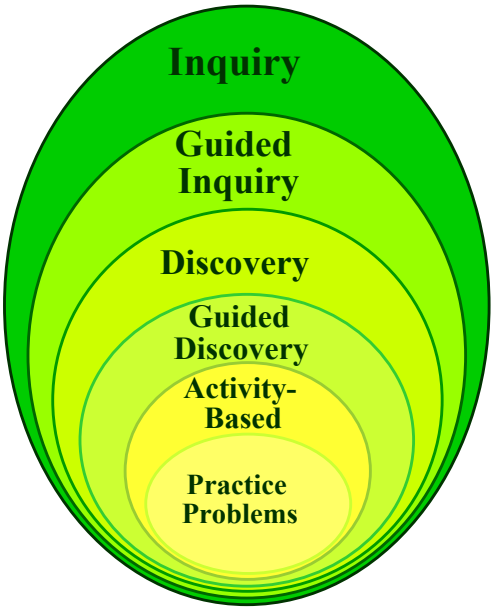

Figure 1. Diagram of Teaching Approaches

Table 2
Guide to Teaching Approaches and Community Awareness Components

Teaching Approach	**Community Awareness Component**
Practice Problems/Drilling	Students are given a community related data set and asked to use pre-determined statistical methods and techniques.
Activity-Based	Students are given a community related data set and asked to carry out activities related to application of appropriate statistical methods and techniques to the data.
Guided Discovery	Students are given a community related problem and data asked to follow step-by-step instructions to select an appropriate statistical method or technique.
Discovery	Students are given a community related problem and data and are asked to select an appropriate statistical method or technique.
Guided Inquiry	Students are informed about a community related issue in general, and asked to follow step-by-step instructions on identification of a problem, on collecting or generating all required information/data, and analyzing the data by using appropriate statistical methods and techniques.
Inquiry	Students are asked to identify a community related problem, collect or generate all the required information/data and analyze using appropriate statistical methods and techniques.

COURSE CONTENT

Another way to incorporate community data or community issues into an introductory statistics course is through interesting examples, homework problems, projects, or exam questions. The examples provided in this section are meant to illustrate our approach.

Domestic Violence

During 1997, adult women seeking care were surveyed in eight medical clinics and 17 WIC program sites in nine counties of west-central Minnesota, Kershner, Long and Anderson (1998). In the survey women were asked about their experiences with abuse within the past 12 months (current abuse) and experiences before they were age 18. In class, a bar graph displays the percentage that responded having experienced the type of abuse in each time period. This graph, given in Figure 2, reveals interesting aspects about violence against women. Students quickly observe that emotional/verbal abuse is the most prevalent form in our study; both before age 18 and in the past 12 months. Students also observe the large difference in the heights of the bars in the sexual abuse section of the graph. This typically generates discussion about the shockingly high extent of sexual abuse before age 18. The great disparity between the percentages experiencing sexual abuse currently and before age 18 provides an opportunity to discuss the idea of duration of exposure to risk in this study and other situations like the number of traffic fatalities over long holiday weekends versus a conventional two-day weekend travel period.

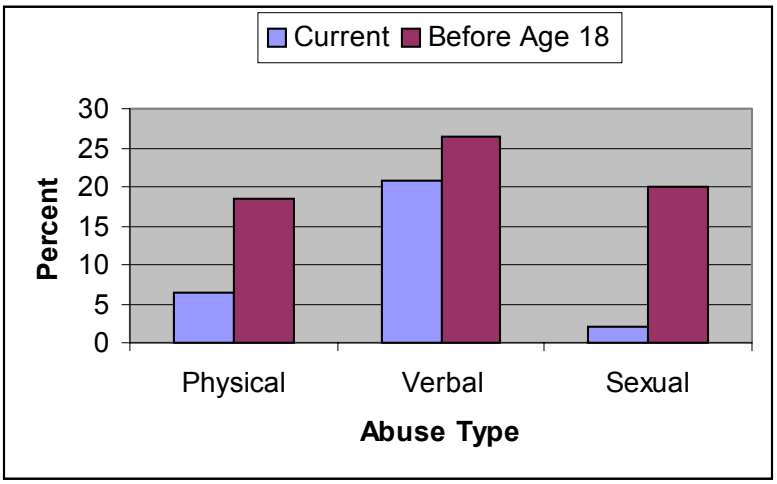

Figure 2. Bar Graph of Domestic Violence Data

A discussion of confounding, or lurking variables is another way to use these domestic violence data. The relationship between annual income and any type of current abuse shows that as annual income decreases the percent abused increases. However, after a careful adjustment for important variables like age, the relationship between income and abuse is no longer apparent. These data provide another example to motivate the concern we should have for potentially confounding variables. The example also provides an effective place to promote advanced courses in statistics where these kinds of adjustment techniques are taught.

Local Voting Patterns

Stevens County is located in a rural, heavily agricultural part of west-central Minnesota. The county has a few small towns of under 800 residents and the population center of Morris with about 5400 people including the University of Minnesota, Morris. The year 2000 presidential election results in Stevens County have the same interesting pattern as found in the rest of the United States: rural America tended to vote for Bush, urban America for Gore. In Morris voting locations, the more urban locations in the county, tended to vote for Gore. The more rural township locations were overwhelmingly voting for Bush. After the election, these data were discussed in class, and then the class went to a national election website to observe the same rural versus urban voting behavior across the rest of the USA.

2000 Census Data and Rural Communities

The 2000 US census data are becoming available for use at a very slow rate, especially for rural communities. In addition, rural communities do not have readily available resources to carry out appropriate analyses to reach useful conclusions. Some of the students in our

introductory statistics course obtained the 2000 census data for west-central Minnesota and analyzed it. Even if the project was optional to receive extra credit, participation in our summer offering was close to 71%. Again, students expressed satisfaction in helping their community with a project that their community would not be able to do it by itself.

Introduction to Statistics students have completed projects for the following benefactors: University of Minnesota's West Central Research and Outreach Center, U.S. Fish & Wildlife Service Morris Wetland Management District Headquarters, Stevens County Soil and Water Conservation District, UMM and Morris Public libraries, and the UMM admissions office. Some of our outside contacts are arranged through the UMM Center for Small Towns, a center dedicated to assisting Minnesota's small towns.

COURSE SURVEY RESULTS

Toward the end of fall semester 2001, three sections of Introduction to Statistics at the University of Minnesota, Morris participated in a course survey designed to examine many of the issues discussed in this paper. The three sections each had a different instructor, and there were 104 responses to the survey. The survey contained demographic questions concerning sex, academic year, and population size of home area. The remainder of the survey asked about the perceived importance of learning objectives and the interest students have in course content related to the concept of community.

The high importance ratings given to being able to apply statistical methods to coursework in their major demonstrates the impact of being able to show students the applicability of statistics in many different contexts and academic areas. Students also expressed importance for using statistics to address societal problems and everyday life experiences. We also noted a strong sense of connection with their "home" community.

Being able to apply statistical methods to problems in sports, the campus community, the Morris community, and for their home state were not rated as important to the students, but when we consider confounding variables, useful information is present. First, we note that the importance rating for sports is being influenced by a large number of female responses. Male students placed significantly more importance on applications to sports than female students. This has important implications for instructors. The impact of sports examples and course content is very mixed. Too much or too little sports content will probably not be as successful as some moderate amount of sports-related content.

We also found that the academic year of the student was significantly associated with the importance of solving campus and Morris area problems with statistics. As might be expected, we found that older students that had been on campus longer were significantly more likely to respond that solving campus and local community problems was important. This finding poses interesting problems for an instructor in this course because students tend to be first and second year students who may not have yet developed a strong connection to the campus or local community.

Sections of the survey asked students about the interest they would have in examples or course projects relating to concepts of community. We formulated questions that concerned community on several levels: United States, California, vague (no location specified), Minnesota, Greater Minnesota (outside Minneapolis-St. Paul metropolitan area), Rural Minnesota, West-Central Minnesota, their home community, Morris community, and campus community. We found that students are most interested in examples and projects that reflect their sense of community. Examples about the United States, unspecified locations, or California are significantly less interesting than those for Minnesota or their home state. Students from smaller communities found examples relating to rural areas or Greater Minnesota particularly interesting. The data shows that examples involving the student's home community, campus community, and Morris community to be the most interesting examples and project topics.

SUMMARY

Our course survey results suggest that students are utilitarian, and find value in the usefulness of statistics to their lives. A relevant, successful course is more likely to occur if instructors are aware of student interests, concerns, and backgrounds. We have found that a

student survey at the beginning of the semester helps give interesting data for course examples, and a way to learn about the class composition more generally. Course materials that cover a broad range of societal and liberal arts contexts would be appropriate for our students. The selection of examples and course materials would naturally change across institutions depending on the students and the educational mission of the course and institution.

Our student survey also suggests that students have very different senses of community. There is clear evidence of connection to their "home" communities, but as they spend more time at college their sense of community seems to change and include the campus and local community in addition to their "home" community.

The course structures and course materials relating to community issues and concerns described in this paper complement and facilitate student learning. These approaches are consistent with the findings of our student survey and our own teaching experiences. Our belief is that students like and learn best from examples and projects that are interesting and relevant to them. Community data and projects are consistent with our beliefs because they naturally will have some interesting academic, social, or scientific basis. Such data and projects also bring in a sense of ownership or understanding based on the community identities and affiliations the students bring to the course.

We have provided evidence about what students like and find interesting and important in the course through our student survey. We will continue to refine and collect information on these issues. We find these approaches to be interesting and effective. We think other instructors can use their own consulting, research, and community interests within this framework and obtain similar results.

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