Student Projects

Notes from Tom Moore.  
These come from the Chance Instructor’s Guide  
For more information on the Chance Project and Courses, see  
http://www.dartmouth.edu/~chance/

Student projects are a long-term assignment where students ask a question, devise a plan to collect data to answer the question, collect and analyze the data, and tell me and the class about the results in written and oral reports.

Why one might assign student projects.

Student projects are not an idea I invented, and although I have used them for the past 15 years I am by no means an expert on them. Partly this stems from my basic naiveté about matters of educational theory. So I'll break this section into two parts:

- My reasons  
- Support from the experts

A personal experience sparked my enthusiasm for doing student projects. In 1980 I took a regression course from Professor Ledolter at the University of Iowa. He had us do a project and I analyzed data from that year's University of Iowa men's basketball team, the last year they went to the Final Four. I had a great deal of fun doing it and felt it was the best learning experience in an otherwise excellent course. I felt like I learned how to do regression when I tackled this project. I recall Professor Ledolter asking me if I thought that the coach would fully appreciate the log transformation. As imperfect as my project was, it was a great learning experience. I think two principles were in operation:

1. The Fun Principle: Bob Hogg has for years, in very public ways -- including an editorial in the Des Moines Register -- advocated that our courses need to be fun, and projects inject this feature into the course.

2. The Do Principle: Projects make students experience more fully what it means to do statistics. They get to see a problem from its inception to the reporting of a data analysis that in part at least answers the question.

The reading I've done of authors more knowledgeable than myself tends to support these principles. The Fun principle is given credence in a paper in the Journal of Statistics Education:


where the authors delineate the importance of a positive attitude in the student if he or she is to learn effectively.
The Do Principle is at the heart of what is usually called authentic assessment. The paper:


summarizes the theoretical justification for authentic assessment and also gives many excellent, practical guidelines for implementing various forms of assessment. I highly recommend it. In this paper Garfield gives two guiding principles for good assessment:

- The Content Principle -- assessment should reflect the statistical content that is most important for students to learn, and

- The Learning Principle -- Assessment should enhance the learning of statistics and support good instructional practice.

Projects, it seems to me, adhere to both principles: (1) projects help teach an important content goal of the course -- the overall problem solving process, and (2) Projects do more than help the teacher assess what the student has learned, but they also teach the student statistical principles.

Extended example: In the spring of 1992 (and this date is important), two students, Meredith Goulet and Jennifer Wolfson, wanted to find out if male and female students differ with respect to political knowledge, interest, participation, and philosophy. They proposed this idea to me, we had a short consultation about it, and they decided to do a phone survey using a short questionnaire including a small set of political awareness questions. I suggested they discuss the latter with one of their political science teachers, which they did. They carried out their survey with a simple random sample of 60 Grinnell students, using a very persistent call-back scheme so that they got 59 respondents.

The first question on their 3-question quiz was: "Can you tell me who H. Ross Perot is?"

The choices were: (a) Prime minister of France, (b) Director of the National Right to Life Committee, (c) Possible US presidential candidate, or (d) don't know. Figure 4 gives the results. (The P-value is 0.2%.)

**Who is H. Ross Perot?**

<table>
<thead>
<tr>
<th></th>
<th>Wrong answer</th>
<th>Right answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>7</td>
</tr>
</tbody>
</table>

They asked the question: "How informed do you consider yourself to be about national/international politics, on a scale of 1 to 5?", where 1 was "generally uninformed" and 5 was "very well informed". Figure 5 shows that generally males thought they were more informed (P-value of 4.4%).

**How informed are you?**

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Average</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>4</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>13</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Goulet and Wolfson

To get another read on being informed they asked the question, "How often do you read newspapers or news magazines other than the comics or sports sections?". Figure 6 suggests that male students engaged in these activities more frequently (P-value of 0.1%).

**Read newspaper or news magazine?**

<table>
<thead>
<tr>
<th>Times per Week</th>
<th>1 or fewer</th>
<th>2 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Females</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Goulet and Wolfson

To get an idea about the student's philosophy they asked, "Do you believe that national and international politics ought to be ruled by moral and ethical considerations or by practical power considerations? On a scale of 1 to 5 how would you rate your beliefs?", where 1 was "purely moral/ethical" and 5 was "purely by practical power". The results, given in Figure 7, show the men to be the pragmatists and the women to be the idealists (P-value is 0.01%).

**What philosophy guides politics?**

<table>
<thead>
<tr>
<th>Moral &lt;-------------------------&gt;Practical</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>(31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7</td>
<td>11</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>(28)</td>
</tr>
</tbody>
</table>

Source: Goulet and Wolfson
Then the students asked the question on participation, asking the subject if he/she was eligible to vote, was registered to vote, and had ever voted. Figure 8 summarizes the surprising results: Male students at Grinnell, despite some evidence that they may be better informed about political matters, are less likely to participate in the electoral process than their more idealistic female classmates. (A P-value of 5.5%)
Participation in the electoral process

<table>
<thead>
<tr>
<th>Eligible only</th>
<th>Registered</th>
<th>Has voted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Goulet and Wolfson

This was not an easy project for these students and the survey was not of professional quality, but I still feel they gained much from the assignment. Consider the steps required of the students in solving their problem:

- They had to identify the questions of interest.
- They had to develop operational definitions of variables.
- They had to ask for subject matter expertise, i.e., the political scientist.
- They had to choose a survey design.
- They had to consider and obtain informed consent.
- They had to decide on a proper data analysis.
- They had to present and interpret quantitative information, orally and in a written report.

These are issues not brought out by standard textbook exercises and suggest the kinds of lessons I hope students gain from the project experience. As in anything we do, some gain more than others.

Nuts and Bolts.

Here are my suggestions as to what will make for a successful implementation:

1. Have the students work in teams. Self-chosen teams of 2 or 3 is my preference. My main rationale for this is that by working together students do better projects and learn more. They experience more of the problem solving process in working together than they would if they came to me every time they got stuck.

2. Give importance to the projects. Make it known on day one that projects are an integral part of the course. Give the assignments as early as possible. Use former projects for course examples.

3. Structure the assignment. I suggest intermediate due dates for the various stages of the project. For example:
   a. project description -- brief, conversation starter.
b. formal project proposal -- describing details of the population or process under study, variables to be collected, method of producing the data, plans for analysis, expectations about results, etc.

c. data and codebook
d. rough draft (I make this optional)
e. oral report
f. written report

This structure helps ensure progress and improves team relations.

(4) Use a scoring rubric to assign points to different components of the project. I actually didn't try this until last year and it is a wonderful tool. Joan Garfield discusses rubrics in the aforementioned paper. For example, on my written reports, I used the categories:

a. description of the data and variables (10 points)
b. statistical correctness (20 points)
c. quality of graphics (15 points)
d. organization of report (10 points)
e. overall quality of writing (15 points)

(5) Assign two reports. My students convinced me last fall that we should have two projects instead of one and it worked beautifully. The first project asked them to find a data set with several variables from an almanac, statistical abstract, or some such source, and to describe some interesting relationships. I used the same scoring rubric, but the assignment counted for far less of the final grade than the second project. This provided the students with a lower stress first opportunity to write a statistical report and to learn about my expectations. The point here is to give the students more than once Chance to do something you deem important. Other ways to do this would be to give other kinds of data analysis or data presentation assignments.

Conclusion.

I think projects are a fine addition to a statistics course. I use them at the upper level as well as the introductory level and others have written about them in other settings (some are included in my bibliography). I enjoy reading projects; they contain a lot more variety than an hourly exam, and there are always some pleasant surprises.

A Partial Bibliography for Student Projects and Related Issues

These papers provide guidelines and motivation for conducting projects in a variety of settings:

Includes a 10 page chapter on student projects and a list of 35 sample projects.


The author describes the use of projects in an introductory course for non-science students. She gives practical advice on managing the projects and includes sample student projects.


Provides very practical guidelines for doing student projects and gives some sample projects as well.


This may be the seminal paper on the use of student projects for teaching statistics.


Describes using student projects in a large introdutory course for business students.


Here the course is one for science and mathematics students. Projects are experiments. The authorbeautifully examines the educational motivations for assigning projects. Even if you aren’t teaching lots of experimental design, this paper is a “must read” if you are considering student projects in your teaching.


These “notes on projects” above are essentially a draft of this paper.

To the query, “How can experienced teachers get started on projects?” Roberts answers, “Just jump in and do them, and learn as you go.” Fortunately this article gives you some solid advice backed by Roberts’s many years teaching introductory statistics, primarily to MBA students. Roberts figures course grades solely on student projects.


Sevin gives excellent advice for managing student projects, including the use of interim reports, frequent feedback, and peer review. She also gives samples of actual assignments.


Short and Pigeon describe ways to engage students in the often-overlooked planning stages of a study. They describe both short assignments and student projects more in the mold of other works in this bibliography.


If you write Zahn he will send you (for copying costs) an annotated bibliography of resources and his extensive instructions, including a 33 page set of instructions for term projects. Dept. of Statistics, Florida State University, Tallahassee, FL 32306-3033.

**These papers discuss important teaching issues that relate to using projects:**


