Provost’s Learning Innovations Grant for Faculty
Request for Full Proposal
2005-2006

Please hand-deliver your completed grant proposal (4 pages, plus attachments),
the original plus 15 copies, to:
Susan DeWoody, 1530 Wallace (5)
by 4:30 p.m.
Monday, March 14, 2005.
No hand written proposals will be accepted.
Notification of awards will be made by Friday, April 8, 2005.

Project Title: Bootstrapping Modules for Introductory Statistics Courses

Applicant(s):

<table>
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<th>Name</th>
<th>Telephone</th>
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<tr>
<td>Peter Bajorski</td>
<td>475-7889</td>
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<th>Dept.</th>
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<td>CQAS</td>
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Full Proposal

1. Title and summary of proposed project.

**Bootstrapping Modules for Introductory Statistics Courses**

**Summary**

It is proposed that a set of computer modules be developed to allow use of bootstrapping in several contexts. The modules will be interactive programs creating specific scenarios for the purpose of solving a specific statistical problem. They will be used during hands-on computer lab sessions within the applicable courses. The modules will be written as MINITAB macros, making them easy to access by students and instructors. They will also contain instructions on how to use them as well as practical guidelines on in-class implementation.

Bootstrapping is a relatively new statistical tool that facilitates efficient statistical inference. The method does not need to rely on assumptions of a specific parametric model, and it is very universal in its applications. Conceptually, bootstrapping is quite elementary and could be used in teaching statistics at an introductory level. Unfortunately, the method is not used for two main reasons:

1. Bootstrapping is still quite new, and instructors are not comfortable with using it or may not be familiar with it.
2. The method is very computationally intensive.

This is why computer modules are necessary in order to use bootstrapping in class.

The following topics for the modules have been identified, but more might be added at a later time:

1. Estimation of variance of a statistic using bootstrapping
2. Construction of confidence intervals using bootstrapping
3. Comparison of the bootstrapping inference with the one based on the assumed model
4. Bootstrapping in regression models
5. Bootstrapping for inferences in small samples.

2. Targeted learners or population (include cluster, departments, year level, number of learners impacted).

The main audience is the students in introductory statistics courses (such as Fundamentals of Statistics II (0307-712-70, 0307-712-90), Probability and Statistics for Engineers II (0307-362), and other similar courses). Most students take these courses in their third or fourth year.

3. The number of students who will be affected.

90 students per year
4. Anticipated impact on teaching and/or learning.

Using bootstrapping would be very forward-looking and progressive in teaching statistics courses because it simply has not been attempted before in the statistics courses at RIT (and I am not aware of other places that have implemented it). In addition to giving students a useful and universal tool for solving statistical problems, this approach also allows an innovative look at the relationship between the population and sample, which is at the core of understanding statistical inference.

This new approach would considerably improve the students’ understanding of statistics.

5. How will your project impact student success (i.e., retention)?

I am confident that the bootstrapping modules will make statistical courses more stimulating and interesting for students. This enhancement would be in line with RIT’s goal of providing its students with a cutting-edge pedagogical experience. Such improvements certainly help students in achieving success, which in turn should lead to improved retention.

6. How you will measure the impact, how you will report your findings, and what you will share about your project in a faculty forum.

The impact of the bootstrapping modules will be measured by a set of survey instruments. Students will be surveyed both at the beginning and at the end of the course. A parallel section of the same or a similar course not using the bootstrapping modules will also be surveyed as a control group. The students will be asked about their understanding of basic statistical concepts. The group using the bootstrapping modules will also be asked about the effectiveness of this new tool and their satisfaction with the course. Results and conclusions will be presented in the final report for this project (submitted to the PLIG committee), which will be disseminated to the faculty by

- Informal exchange of information during the project
- Distribution of the final report copies
- Oral presentation, if needed
- Distribution of computer files for bootstrapping modules to any instructors interested in adopting these tools

7. Present a rationale for your project, as it ties to the intent of the grant, including:
   a. why it is not part of regular college business

   As a new approach and a new tool for teaching statistics courses, bootstrapping modules are not part of the regular college courses.

   b. its relevance to required cluster, college, and/or department competencies

   It is the department’s obligation to provide courses in statistics that are accessible and attractive for students, so that they can increase their knowledge and be able to apply it in practice. This project will enhance our ability to provide these kinds of courses.
c. describe how your project is relevant to other faculty and what you think it would take to transfer your success to other faculty

The bootstrapping modules will be easy to use, and they will not require intensive planning and programming effort.

The simulation modules will include instructions on how to use them, so that they will be easy to implement. The interest of faculty will be gained through informal interactions during the project and a formal presentation at the end of this project.

d. relevant credentials, experience of involved faculty/staff

Dr. Peter Bajorski has 23 years of experience in teaching, research, and consulting in statistics. He has 28 research publications in scientific journals with international circulation and has given more than 50 talks to the professional community. He has received several awards for his contributions to research and teaching. He has served as a referee for four statistical journals and wrote numerous book reviews for book publishers and for professional journals. He is President of the Rochester Chapter of the American Statistical Association.

Peter Bajorski is very active in introducing innovative tools for teaching and learning. He has successfully implemented a narrative case-study approach to teaching statistics in several courses. He also introduces many innovations in his distance-learning courses. Recently, he became involved in the blended-learning pilot program.

e. describe how this innovation is in your discipline or program

Bootstrapping is a relatively new statistical tool, and it would be very innovative in teaching statistics courses because it simply has not been attempted before in the statistics courses at RIT (and I am not aware of other places that have implemented it).

8. Provide a timetable of the development of the project.

The work will be done in the Winter and Spring Quarters AY 2005 according to the following schedule:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Timing</th>
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<tbody>
<tr>
<td>1</td>
<td>Identify topics for which the modules should be written. Decide on the</td>
<td>January 2005</td>
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<tr>
<td></td>
<td>programming platform to be used and investigate its flexibility for practical</td>
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<tr>
<td></td>
<td>implementation</td>
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<td>2</td>
<td>Plan the scope, functionality, and features for the simulation modules (and</td>
<td>February 2004</td>
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<td></td>
<td>document it in flow charts)</td>
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<td>3</td>
<td>Write the Bootstrapping modules as computer programs</td>
<td>March-April 2005</td>
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<td>4</td>
<td>Prepare the documentation for the modules. Write the final report.</td>
<td>May 2005</td>
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