Provost's Learning Innovations Grant for Faculty
Request for Full Proposal
2002-2003

Please send your completed grant proposal (4 pages, plus attachments), one original and eleven copies, to
Linda Jones, 4000 Eastman
by 4:30 p.m.
Wednesday, February 20, 2002.
No hand written proposals will be accepted.
Notification of awards will be made by Friday, March 22, 2002.

Project Title:

Applicant(s):
Name: DR. CAROL MARCHETTI Telephone: 5-2515
Department: Mathematics + Statistics College: COS
Name: DR. VINNIE GUPTA Telephone: 5-2158
Department: Mechanical Engineering College: COE
Name: ____________________________________ Telephone: __________
Department: __________________________________ College: __________
Name: ____________________________________ Telephone: __________
Department: __________________________________ College: __________
ENGINEERING MODULES FOR STATISTICS COURSES

Carol Marchetti (Mathematics & Statistics)
Vinnie Gupta (Mechanical Engineering)

February 20, 2002

1.0 Summary

This proposal seeks support to develop and deliver six engineering modules for use in these statistics courses: 314 (Engineering Statistics), 351 and 352 (Probability & Statistics I & II). 314 is a mandatory course for all mechanical engineering students whereas 351 & 352 are mandatory for all industrial engineering students, and recommended science electives for mechanical engineering students. The six modules, two each, will be in three different formats: engineering kits, videos, and case studies. Statistics instructors can then choose one or more formats for inclusion in their courses depending on their course structure, teaching style, and their students’ learning styles. The modules will concentrate on examples from two Materials Processing and Science courses (343 and 344) that all BSME and BSIE students must take in their first two years of study. The project will be evaluated by two separate surveys: one of statistics instructors using one or more modules, and the other of engineering students taking these statistics courses. The details of engineering modules and the survey results will be presented in a faculty forum organized by the Provost’s Learning Innovations Grant Committee. The project has full and unqualified endorsement of the Heads of the Mathematics & Statistics Department and the Mechanical Engineering Department.

2.0 Targeted Learners

In order to teach well, every instructor should be ready to answer a student’s (often unasked) question: “Why should I learn this?”. In fact, an instructor should have several different and persuasive answers to this question that help provide students a context where they might use the course material as well as motivate them to learn it better.

This project is targeted towards mechanical engineering students who take 1016-314: Engineering Statistics and 1016-351: Probability & Statistics I. It will also benefit the instructors of 314 and 351 in providing a persuasive answer to the simple question above. 314 is a mandatory course for all mechanical engineering students in the BSME program (approximately 140 students/year) whereas 351 is among the list of recommended science electives, and is taken by approximately 30 BSME students each year. Instructional materials developed in this project will be equally relevant to Industrial Engineering students in BSIE program who must take both 351 and 352: Probability & Statistics II. Each year, approximately 30 BSIE students enroll in 351 and 352. The table below summarizes the enrollment statistics:
<table>
<thead>
<tr>
<th>Enrolled in</th>
<th>Matriculated in</th>
<th>Type of Course</th>
<th>#/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>314: Statistics</td>
<td>Mechanical Engineering</td>
<td>Mandatory</td>
<td>140</td>
</tr>
<tr>
<td>351: Probability &amp; Statistics I</td>
<td>Mechanical Engineering</td>
<td>Science Elective</td>
<td>30</td>
</tr>
<tr>
<td>351: Probability &amp; Statistics I</td>
<td>Industrial Engineering</td>
<td>Mandatory</td>
<td>30</td>
</tr>
<tr>
<td>352: Probability &amp; Statistics II</td>
<td>Industrial Engineering</td>
<td>Mandatory</td>
<td>30</td>
</tr>
</tbody>
</table>

The six engineering modules proposed will be based on concepts and laboratory experiments from two courses: 0304-343: Materials Processing, and 0304-344: Materials Science. 343 is a 1st year course, and 344 is a 2nd year course. Both are mandatory courses for mechanical as well as industrial engineering students. Having seen the concepts and experiments already, the modules will actively engage students in applying statistical methods to known engineering problems.

3.0 Anticipated Impact on Teaching and Learning

This project resulted from bi-weekly lunch conversation series that the two PIs had about their teaching styles and their impact on the learning outcomes of students. Carol expressed the concern that even though the current textbooks did have engineering problems, often the problems were simplistic in nature and did not provide sufficient engineering background to build a student’s motivation. She also confided that she was not fully conversant in the engineering concepts to help students appreciate how statistics was being meaningfully applied to the textbook’s engineering problem. Vinnie, on the other hand, was frustrated that students having taken 314 still struggled with statistical analyses of experimental data in later engineering courses.

The two PIs concluded that by developing and delivering six engineering modules in three different formats (engineering kits, videos, and case studies) they could:

- help educate the statistics instructors about engineering applications;
- provide high-quality resources to statistics instructors for easy integration into their 314, 351 and 352 courses;
- begin a collaboration among statistics and engineering faculty that teach the same sets of students; and
- provide engineering students the motivation to learn statistics well, and be able to apply their statistical skills to engineering data in a meaningful and productive way.

We anticipate that by actively engaging the engineering students in applying statistical methods to engineering problems, they will be more motivated to learn the material, will see the connections between their courses in Statistics and Engineering, and will be better prepared for subsequent engineering courses.

The modules will provide statistics faculty with an additional resource (besides the textbook) that is customized to RIT engineering students they teach. We also anticipate that given instructional materials and appropriate training support, statistics faculty will be more inclined to adopt/adapt the modules to their courses.
4.0 Measuring the Impact and Disseminating the Results

Each of the six modules will have two sets of survey instruments: one for the instructor and the other for the students. Questions on the survey instruments will address both the learning innovation and motivation.

The results of these surveys will be summarized and analyzed. The results will be disseminated in the following ways:

- A written report will be submitted to the Provost and the Provost’s Learning Innovations Grants Committee;

- The descriptions of the engineering modules and the survey results will be presented at a Faculty Forum organized by the Provost’s Leaning Innovations Grants (PLIG) Committee; and

- We will present the results of this project at an ASEE (American Society for Engineering Education) and/or MAA (Mathematics Association of America) conferences where both of the PIs are active participants.

5.0 Rationale for the Project

(a) Both the departments of Mathematics & Statistics as well as Mechanical Engineering endorse our project (see enclosed letters of support from the respective department heads) fully without any reservations. 314, 351 & 352 are service courses for the Department of Mathematics & Statistics, and the department is unable to assign its meager curricular development resources to support these service courses. The Department of Mechanical Engineering recognizes that the proposed efforts will benefit its students but also cannot spend its limited curricular development resources on courses that are taught by another department. Thus, the PIs recognize that this project falls ideally in the Provost’s Learning Innovations Grants program. In fact, in the budget the PIs are seeking a summer stipend instead of an equivalent course release time during summer since the two supporting departments are unable to contribute the difference between the adjunct salary scales and the actual faculty salary in each of the two colleges. It is our hope that the PLIG committee will work with the Provost to remedy this injustice.

(b) The proposed modules focus on courses taught by statistics faculty that are mandatory (and/or science electives) for mechanical engineering students (the largest program in KGCOE) and industrial engineering students (the most popular program among female engineering students). These modules will contribute to the success and retention of KGCOE students. They will keep RIT on the forefront of innovative teaching, and promote cross-disciplinary collaboration.

(c) We envision these modules as a resource for the statistics faculty. To ensure their success across the instructors teaching sections of 314, 351 & 352, we will seek their input in the planning stages, share with them each module as we finish it, and will seek their help in critiquing it so that it is inviting to as many statistics instructors for adoption/adaptation as possible.

(d) Carol Marchetti is an Assistant Professor of Mathematics and Statistics, and the winner of the 1998 Provost’s Award for Excellence in Teaching. Her resume is available at www.rit.edu/~cemmsma. Vinnie Gupta is a Professor of Mechanical Engineering and Materials
Science & Engineering, and the winner of the 2000 Eisenhart Award for Excellence in Teaching. His resume is available at www.rit.edu/~skgerme/vita.pdf - the username is "read" and the password is "sdrc ideas". Both PIs are members of the Institute Effective Teaching Committee.

(e) This innovation is in combining the teaching of statistics and mechanical engineering concepts. The statistics courses provide scientific methods that can produce meaningful and productive results to engineering problems. An engineering problem, in turn, identifies a need and seeks assistance from the statistical methods that can answer the question with a probability-based solution.

6.0 Timetable for the Project

We plan to construct six engineering application modules for use in the statistics courses identified in section 2.0. The applications will be taken from students' background in Materials Processing, and Materials Science. Each stand-alone module will contain the background and a detailed description of the engineering problem. We will develop two of each of the following: engineering kits, videos and case studies. With kits, students will perform data collection themselves; in other modules the data will be provided. Statistical processing of data, presentation of reduced results, and the interpretation of results will be a part of each module. Each module will contain a handout for the instructor. The modules will be designed to encourage critical thinking, and to motivate students with applications from their major. The experiments that the modules will be based on include Rockwell Hardness Tests, Micro-hardness Tests, X-Ray Diffraction, Sintering, CNC Machining, and Grinding of Bearing Balls.

In June 2002, the PIs will meet for 2 hours/week to identify the experimental focus of each of the six modules, and develop plans for the responsibility and collection of the hardware, data, and the software techniques for each module. In July 2002, they would have collected and synchronized the information for each of the six modules. In August 2002, the PIs would assemble the information in each of the three formats: engineering kits, videos, or case studies, and produce the final version of each module.

The modules will be presented to the Statistics faculty in Fall'02 for adoption in Winter'02. It is our hope that they find them attractive and useful for adoption in Winter'02, Spring'03, and Summer'03. We will collect their survey results, and be prepared for a presentation at the end of Fall'03 for a PLIG Faculty Forum and/or an ASEF and/or a MAA Regional Conference.
Funds can be used for release time, student workers, and for purchasing supplies and services (such as CD pressing, video production, digitizing, photography). Funds will generally not be available for activities consistent with normal college business, doctoral research, equipment purchase or travel (though the latter will be considered if a clear connection can be demonstrated between the project and a given conference or workshop).

<table>
<thead>
<tr>
<th>Start End Date</th>
<th>Total Amount</th>
<th>Budget Officer</th>
<th>Verification</th>
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<tbody>
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<td>1/1 - 9/30/02</td>
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<td>WM 2/10/02</td>
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<tr>
<td>Vinnie</td>
<td>6/1 - 9/30/02</td>
<td>$4,000</td>
<td></td>
</tr>
</tbody>
</table>

Salaries:

Faculty Compensation:
(Use college guidelines for adjunct teaching pay-scale should be used.)

3

4

If you are requesting adjunct faculty money, include 8% of the salary dollars requested to cover the associated benefits.

640

If you or another full-time faculty or staff member will be paid from the grant, the rate is 22.8% for benefits.

Student Assistants:
There are no benefits for graduate assistants or student workers.

Other:
(Professional services, consultant, staff support)

Salaries Total

$8,640

Materials:
Give kind, quantity, cost:

Ball Bearings,
Hardness Blocks, Polishes,
Hardness Blocks, CDs for Video,
Miscellaneous Supplies.

Materials Total

$8,000

Services:
Attach appropriate estimates.

Educational Technology Center:

Other:
(Describe)

Services Total

$0

Total Budget Request

$9,440

College Support:
Support provided by college in addition to grant request, if applicable.
(Explain)