

Finding applications is the student's job
or
How to be integrative without really trying

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- Applications are important in mathematics courses
- It's hard to find interesting applications for a lecture
- Possible solution: Student projects
- My experience in a particular course at Cornell University

- **Course:** Upper-division course in probability and stochastic processes
- Markov chains, martingales, random walk, queueing theory, etc.
- Models widely used in the sciences
- **Students:** Majoring in math, stats, economics, CS, biology, engineering, etc

The Problem

- Students want to know about real-life applications in econ, CS, bio, engineering, etc.
- I'm not an expert in those fields!
- Applications in one field may not interest students in another
- Difficult and time-consuming to present realistic applications in lecture (along with needed background!)

The project

- Have students discover interesting applications for themselves!

Assignment

Find an article in a peer-reviewed journal in your area of interest which uses a stochastic process as a model for some “real-life” behavior. Write a review giving a summary and critique of the approach used in the article.

Questions to address

- What real-life behavior are the authors trying to study? Why is it important? (Please remember I am not an expert in your field.)
- Describe the mathematical model, in terms that a classmate could understand.
- Why did the authors choose this model? What other models have been proposed?
- What aspects of the real-life behavior does the model describe well?
- What aspects does it *not* describe well? How might it be improved?

Grading rubric

- 20%: Submission of a complete first draft (I returned with comments)
- 25%: Addressing the listed questions
- 25%: Showing a reasonable understanding of the article
- 30%: Clear, well-organized, professional, and mechanically correct writing

Examples of chosen topics

- Nanoparticle synthesis
- Mutation of cancer cells
- Natural language processing
- Default risk for construction companies
- Pitch selection in baseball

- Each student can focus on own area of interest / expertise
- Real-life examples, not oversimplified toy problems
- Critical thinking: does the paper present a good model? (Many do not!)
- Practice in accessing and reading the literature
- Practice in technical writing
- *I* get to learn about interesting applications! (For use in future classes)

Challenges

- Some students struggled with writing: clarity, mechanics, ESL issues
- Not always easy to assist the students (I would have to try to understand the paper they chose!)
- Balancing accessibility and depth
- Grading fairly but with an open mind
- Reading Microsoft Word (though I encouraged L^AT_EX)

Conclusion

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This project was an effective way to introduce students to applications in their own fields, as well as to give them practice with writing, critical thinking, and other essential scientific skills.

The End

Thanks for listening!
And thanks to the session organizers!

These slides and the complete project description are on my web site at
<http://www.math.cornell.edu/~neldredge/>
(or Google “Nate Eldredge”)
under **Teaching**.