Undergraduate Research

Joe Gallian
University of Minnesota Duluth
Title of this panel is “Enhanced opportunities for highly motivated undergraduates”

Math has traditionally under utilized two ways that the sciences have been using for many decades: undergraduate search and internships.
My focus at this meeting is to encourage more undergraduate research during the academic year in one's own department, be it Harvard or Slippery Rock State.

Both of these schools are not doing as much as they should be doing.
How widespread is undergraduate research?

Study by Diamantopoulos, Dorff, and Richardson published in 2014 AMS Notices estimated that in 2010-2011 approximately 4.6% (4500 students) doing research.

2500 presentations
1300 papers
What is undergraduate research?

- New knowledge
- Does not have to be publishable
- Can be professional level
Worthwhile to review progress

See growth via JMM
Joint meetings poster sessions

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<th>Year</th>
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<td>2001</td>
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*Limited by space considerations
Talks by Undergrads at JMM

• 1995 not listed in AMS Notices

• 1996  6 total (4 from Duluth REU)

• 1997  23     2003  50     2009  94

• 1998  22     2004  38     2010  95

• 1999  23     2005  51     2011  137

• 2000  35     2006  43     2012  152

• 2001  15     2007  64     2013  187

• 2002  38     2008  62     2015  199
Undergrads at Joint Meetings

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* MAA provided some funding

I set MAA goal of 1000 by 2015
Undergrad attendance Mathfest

• 2000 96     2006 158     2012 235*
• 2001 122    2007 255     2013 295*
• 2002 149    2008 269*   2014 303*
• 2003 123    2009 247*   2015 464*
• 2004 182    2010 336*
• 2005 166    2011 279*

• I set MAA goal of 500 by 2015

*MAA provided some funding
MAA NSF Regional Undergraduate Conferences

$600,000

Between 2003-2014, over 7900 talks by undergraduates

24,000 undergraduates attended
Explosion in the number of faculty involving undergraduate students in research
JMM minicourse and Project NExT workshop for faculty

22 years over 1400 participants
Reasons for growth

- More pressure on faculty to do research at undergrad only schools
- Pipeline effect
- Research now expected by leading graduate programs
- MIT/Princeton/Minneapolis/Michigan/Yale/Cornell, etc.
- AIM/DIMACS
How to find support

• Dean and department head
• Supplement to existing NSF grant (these are under utilized in math)
• Ask people in sciences
How to “pay” students?

• Money: grant, UROP
• Credits: independent study, honors course, honors project, senior project, capstone experience
• Grades: Make it part of a course
Remarks

• Require original research
• Have high expectations
• Expect much frustration
• Must write a paper
• Must present results
• Have possible publication in mind
• Many successful models
What about math students who are not strong at proofs or original thinkers?

This is the large majority at my school.
“Applied research”

Use existing math methods and ideas to gain insight and understanding of practical situations.
Three examples from UMD students in 2015

- Obesity and injuries in the emergency room
- Mathematical modeling of the Ebola virus
- Analyzing Google flu trends
At UMD about 20% of math/stat majors (60-70) per year do research projects

UMD should be about 35%

At elite schools it should be much higher
Advantages to students who are not going to grad school?

- Challenge
- Something different
- Better recommendation
- Better resume
- Helps to get a better job
- Better prepared to do team projects
- More like what students will do on job
Advantages to students who are going to grad school?

• Helps to get into better grad school
• Better prepared for grad school
• More likely to get a PhD
• Learn to pose questions
• Learn to make conjectures
• Learn to deal with open problems
• Learn to deal with frustration
• Learn about writing a research paper
• Learn about the publication process
Advantages to all students

• Develops self confidence
• Develops research skills
• Improves communications skills
• Learn to pose questions
• **Introduction to the profession**
Advantage to adviser

- Fun!
- Job satisfaction
- Niche
- Merit raises
- Tenure/promotion
- Helps your research
- Recognition off campus
- Strengthens grant proposals
Advantage to department/school

- Recruiting aid
- May help getting funding
- Better jobs/grad school for your students is good for your department
Thank you