

Internships, Careers, and Undergraduate Research

Michael Dorff

Brigham Young University

Mathematical Association of America

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Studies about the benefits of undergraduate research

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- B. Nagda, S. Gregerman, J. Jonides, W. von Hippel, J. Lerner, *Undergraduate student-faculty research partnerships affect student retentions*, 1998.

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- E. Seymour, A.-B. Hunter, S. L. Laursen, T. DeAntoni, *Establishing the benefits of research experiences for undergraduates: First findings from a three-year study*, 2004.

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- A. Barlow, M. Villarejo, *Making a difference for minorities: Evaluation of an educational enrichment program*, 2004.

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- R. S. Hathaway, B. A. Nagda, S. R. Gregerman, *The relationship of undergraduate research participation to graduate and professional educational pursuit: An empirical study*, 2002.

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CUR, the Council on Undergraduate Research, is a great source for references.



What are some benefits of undergraduate research?

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- gains in students' knowledge and skills

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- improvement in students' grades

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- increased retention rates of students

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- increased students' personal growth

What are some benefits of undergraduate research?

- gains in students' knowledge and skills
- improvement in students' grades
- increased retention rates of students
- increased students' personal growth
- increased number of students attending graduate school

Often we think:

Often we think: UR

Often we think: UR → graduate school

Often we think: UR → graduate school → professor

Often we think: UR → graduate school → professor

I want to talk about:

Often we think: UR → graduate school → professor

I want to talk about: UR

Often we think: UR → graduate school → professor

I want to talk about: UR → non-teaching careers

Often we think: UR → graduate school → professor

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Implication for Jennifer's question:

Often we think: UR → graduate school → professor

I want to talk about: UR → non-teaching careers

Implication for Jennifer's question:

"What are some strategies that your institution has used to enable undergraduate research without federal dollars?"

According to the national reports:

"Mathematicians Land Top Spot in New Ranking of Best ... Occupations in the U.S."

- from "Doing the Math to Find the Good Jobs"
Sarah Needleman, Wall Street Journal, Jan 6 2009.



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"The top 15 highest-earning college degrees all have one thing in common – math skills."

- from "Most Lucrative College Degrees"
Julianne Pepitone, CNNMoney magazine, July 24 2009.

"Careers in Mathematics" speakers series

2009 "Career in Mathematics" Seminar

Find answers to questions such as "What can you do with a degree in mathematics besides teaching?" and "How does your mathematics training help you in your career?"

Presenters

September 3rd Dr. Joy Lind (Communications)



Ph.D. in mathematics from the University of Montana. Formerly worked for Level 1 Communications which is a leading international provider of fiber-based telecommunications services and Arista Networks, Inc. is a global provider of communication systems, applications, and services. Currently she is the Vice President of Marketing of the company of Fiberx.

| | |
|--|---|
| | September 17th Laruitz Petersen (National Security Agency) |
| | B.S. and M.S. in mathematics from RPI. Currently works for the National Security Agency in Washington, DC which is the largest single employer of mathematicians in the US. |

October 8th Dr. Alan Ashton (Business and Computer Science)



B.A. in mathematics and Ph.D. in electrical engineering from the University of Utah. Former professor of C.S. at RPI. Co-founder and former President and CEO of World Perfect Corp., which was acquired by Comshare. After Comshare was acquired by Novellus Systems, Inc., he joined Novellus Systems, Inc. where it was acquired by Novell. Founder of Thanksgiving Point, and interim president of Canada Vancouver West Mission 2004-2007.

| | |
|--|--|
| | October 22nd Professor Stephen Black (Law) |
| | B.S. in mathematics from RPI and J.D. from RPI. Professor of Law at the Franklin Pierce Law School. His research interests include law and its importance in federal taxation. Before he began teaching, he was a principal shareholder in a tax boutique and was involved in domestic and international tax planning. |

October 29th Dr. Carol Meyers (Operations Research)



B.S. in mathematics from Pomona College and a Ph.D. from MIT in operations research. Currently a professor of operations research at Rensselaer Polytechnic Institute. She has been a member of the faculty in the Engineering Sciences section within the Engineering Directorate dealing with optimization and probabilistic modeling in support of projects in counterterrorism and homeland stewardship.

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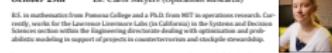
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- 5-7 career speakers

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• 5-7 career speakers

- a degree in math
- a non-teaching job

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- 5-7 career speakers

- a degree in math
- a non-teaching job

- Average attendance is 125 students

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- a degree in math
- a non-teaching job

- Average attendance is 125 students

- Dinner with speaker and 10 students

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actions such as "What can you do with a degree in mathematics besides teaching
and TELL me more mathematics courses before we go to your class?"

www.scholarone.com

• 第二部分 • 100

Ph.D. in mathematics from the Univ. of Kentucky. Formerly worked for Level 3 Communications which is a leading international provider of fiber-based telecommunications services and, before that, he was a staffed leader in corporate strategic systems, telecommunication, and software development.



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October 29

Dr. Carol Myers (Operations Research)



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B.S. in mathematics from BYU (1971). From BYU Professor of Law at the Franklin Pierce Law School (1975-2008). While at BYU he was involved with the Math Department and served as a principal shareholder in an investment firm and was involved in domestic and international law planning.

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B.S. in mathematics from Pomona College and a Ph.D. from MIT in operations research. Currently serves as the Director of the Center for Industrial and Applied Mathematics at the University of Wyoming. Her research interests include optimization problems within the Engineering disciplines dealing with optimization and probabilistic modeling in support of projects in counterterrorism and homeland stewardship.

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- 5-7 career speakers
 - a degree in math
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Internship Panel

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- Panel: math majors who did summer internships

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- Audience: 100 math majors

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- Internship highlights:
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 - Problems from industry
 - Need programming skills
 - Guaranteed job after graduation

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Internships for Mathematics Majors

These companies offer internships for undergraduate students majoring in mathematics. Summer internships provide students with career experience, summer salary, and often a job offer after graduation.

GOVERNMENT

National Security Agency

- National security, cryptography, and data mining
- http://www.msia.gov/careers/opportunities_4_w/students/index.shtml

Lawrence Livermore National Laboratory

- Bio-security, counterterrorism, defense, energy, and science and technology.
- <http://internships.llnl.gov/>

Los Alamos National Laboratory

- Energy, science, and engineering.
- <http://www.lanl.gov/education/undergrad/internships.shtml>

Argonne National Laboratory

- Energy issues and scientific research.
- http://www.anl.gov/pmp/undergrad_spring.htm

National Aeronautics and Space Administration (NASA)

- Astronomy.
- <http://nasa.unr.edu/>

Naval Surface Warfare Center, Dahlgren Division (NSWCDD)

- Defense systems.
- <http://www.nswc.navy.mil/www/dahlgren/RECRUIT/student.aspx>

FINANCE

Goldman Sachs

- <http://www.goldmansachs.com/careers/how-to-apply/internships-and-entry-level-positions/index.html>

Bank of America

- <http://careers.bankofamerica.com/campusrecruiting/intern/internships.asp>

Citigroup

- <http://internships.about.com/od/banks/p/citiinternships.htm>

COMPUTERS AND TECHNOLOGY

IBM

- http://www.w-03.ibm.com/employment/us/us_intern_exams.shtml

Microsoft

- <http://research.microsoft.com/research/circles/intern/default.aspx>

Careers that employ math graduates:

Careers that employ math graduates:

- Engineer



Careers that employ math graduates:

- **Engineer**
 - Raytheon



Careers that employ math graduates:

- **Engineer**
 - Raytheon
 - General Dynamics



Careers that employ math graduates:

- **Engineer**

- Raytheon
- General Dynamics
- Bell Helicopter



Careers that employ math graduates:

- Engineer
- Programmer



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- FAST Enterprises



Careers that employ math graduates:

- **Engineer**
- **Programmer**
 - FAST Enterprises
 - Epic Systems



Careers that employ math graduates:

- **Engineer**
- **Programmer**
 - FAST Enterprises
 - Epic Systems
 - SirsiDynix



Careers that employ math graduates:

- **Engineer**
- **Programmer**
 - FAST Enterprises
 - Epic Systems
 - SirsiDynix
 - SAIC - Scientific Applications International Corp.



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 - FAST Enterprises
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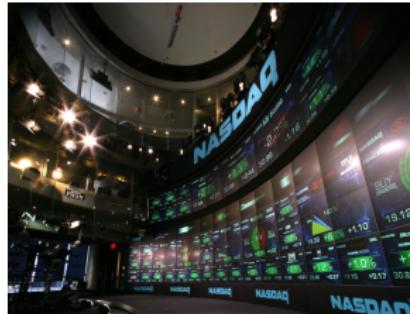
Careers that employ math graduates:

- Engineer
- Programmer
- Financial analyst



Careers that employ math graduates:

- Engineer
- Programmer
- Financial analyst
- Goldman Sachs



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- **Financial analyst**
 - Goldman Sachs
 - RBS Global Banking and Markets



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- **Financial analyst**
 - Goldman Sachs
 - RBS Global Banking and Markets
 - Capital One



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- **Financial analyst**
- **Operations research analyst**



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- **Financial analyst**
- **Operations research analyst**
 - Lawrence Livermore Labs



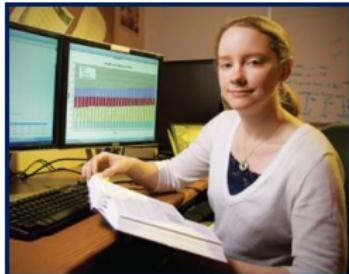
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- **Programmer**
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 - Department of Defense



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 - Level 3 Communications



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- **Financial analyst**
- **Operations research analyst**
- **Medical Researcher**



Careers that employ math graduates:

- **Engineer**
- **Programmer**
- **Financial analyst**
- **Operations research analyst**
- **Medical Researcher**
 - Center for Disease Control



Careers that employ math graduates:

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- **Operations research analyst**
- **Medical Researcher**
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Careers that employ math graduates:

- Engineer
- Programmer
- Financial analyst
- Operations research analyst
- Medical Researcher
- Cryptanalyst



Careers that employ math graduates:

- Engineer
- Programmer
- Financial analyst
- Operations research analyst
- Medical Researcher
- Cryptanalyst
- Actuary



Careers that employ math graduates:

- Engineer
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- Data mining and management

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- Cryptanalyst
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- Data mining and management
 - Google

$$\begin{aligned} & \frac{(y f(2x + 3) y_1 + c_1(x) y_2 + c_3(x) y_3)}{(x+1)} \\ &= \left(\frac{x(x-2)}{2} \right) 1 + (x(x-1)) 0 + \left(\frac{x(x-1)}{2} \right) \\ &= \left(\frac{(x-1)(x-2)}{2} \right) 1 + (x(x-1)) 0 + \left(\frac{x^2}{2} \right) \\ &\quad f_2(x, y) \\ &= \frac{y^2(y + 6x + 9)^4(2y^2 + 8x)^2(y + 2x + 6)^4(y + 1)^2}{1)(x + 6)^4(x + 9)^4} \\ &\quad x(x + 6)^2(y + 2x + 6)^2 \\ &\quad -9b + \sqrt{3}\sqrt{4a^3 + 27b^2} \sqrt[3]{4 + 6x}^2(y + 10x + 9)^2x + 1 \\ &\quad 2^{11}3^{2/3} \\ &\quad x(x + 6)^2(y + 9x + 6)^2 \\ &\quad (1 - i\sqrt{3})(-9b + \sqrt{3}\sqrt{4a^3 + 27b^2})^{1/3} \\ &\quad 48\sqrt{4a^3 + 9} \\ &\quad (y + 8x)^2(y + 7x + 9)^4(y + 1)^2 \end{aligned}$$

Careers that employ math graduates:

- Engineer
- Programmer
- Financial analyst
- Operations research analyst
- Medical Researcher
- Cryptanalyst
- Actuary
- Data mining and management
 - Google
 - Philadelphia Eagles

$$\begin{aligned} \frac{(y f(2x+3) + k)(y^2)}{(x+1)^2} y_1 + c_1(x)y_2 + c_3(x)y_3 \\ = \left(\frac{x(x-2)}{2}\right) 1 + (x(x-1)) 0 + \left(\frac{x(x-1)}{2}\right) \\ = \left(\frac{(x-1)(x-2)}{2}\right) 1 + (x(x-1)) 0 + \left(\frac{x(x-1)}{2}\right) \\ = \frac{f_2(x,y)}{y^2(y+6x+9)} (y+6x+8x^2)(y+7x+6)^4 (x+1) \\ (x+6)^4 (x+9)^3 (x+10)^2 (x+8)^2 (x+7)^2 (x+6)^2 (x+5)^2 \\ -9b + \sqrt{3} \sqrt{4a^3 + 27b^2} \sqrt[3]{4 + 6x}^2 (y+10x+9)^2 (x+1) \\ 2^{11} 3^{2/3} x(x+6)^2 (y+9x+8)^2 (y+8x+7)^2 (y+7x+6)^2 (y+6x+5)^2 \\ (1-i\sqrt{3})(-9b + \sqrt{3} \sqrt{4a^3 + 27b^2})^{1/3} (y+8x+7)^2 (y+8x+6)^2 \\ i\beta + \end{aligned}$$

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$$\begin{aligned} & \frac{(y f(2x+4y) y_1 + c_1(x) y_2 + c_3(x) y_3)}{(x+1)} \\ &= \left(\frac{x(x-2)}{2} \right) 1 + (x(x-1)) 0 + \left(\frac{x(x-1)}{2} \right) \\ &= \left(\frac{(x-1)(x-2)}{2} \right) 1 + (x(x-1)) 0 + \left(\frac{x^2}{2} \right) \\ &\quad f_2(x, y) \\ &= \frac{y^2(y+6x+9)^2(2y^2+8x)^2(y+2x+6)^4(y+1)}{1)(x+6)^4(x+9)} \\ &\quad x(x+6)^2(y+2x+6)^2 \\ &\quad -9b+\sqrt{3}\sqrt{4a^3+27b^2} \sqrt[3]{4+6x)^2(y+10x+9)^2x+1} \\ &\quad 2^{11}3^{2/3} \\ &\quad x(x+6)^2(y+9x+ \\ &\quad (1-i\sqrt{3})(-9b+\sqrt{3}\sqrt{4a^3+27b^2})^{1/3} \\ &\quad i\beta + \frac{(y+8x)^2}{48\sqrt{4x+9}} \end{aligned}$$

Careers that employ math graduates:

- Engineer
- Programmer
- Financial analyst
- Operations research analyst
- Medical Researcher
- Cryptanalyst
- Actuary
- Data mining and management
 - Google
 - Philadelphia Eagles
 - Palantir
 - EMC

$$\begin{aligned} & \frac{(y f(2x+3) + 4b^2 y^2)}{(x+1)} y_1 + c_1(x) y_2 + c_3(x) y_3 \\ & \frac{y^2}{y^2} = \left(\frac{x(x-2)}{2}\right) 1 + (x(x-1)) 0 + \left(\frac{x(x-1)}{2}\right) \\ & = \left(\frac{(x-1)(x-2)}{2}\right) 1 + (x(x-1)) 0 + \left(\frac{x^2}{2}\right) \\ & f_2(x, y) \\ & y^2 (y + 6x + 9)^4 (2x^2 + 8x)^2 (y + 2x + 6)^4 (y + 1) \\ & (x + 6)^4 (x + 9)^4 x(x + 1)^2 (x + 2)^2 (x + 3x + 2)^2 \\ & -9b + \sqrt{3} \sqrt{4a^3 + 27b^2} \sqrt[3]{4 + 6x}^2 (y + 10x + 9)^2 x + 1 \\ & 2^{11} 3^{2/3} x(x + 6)^2 (y + 9x + 1)^2 \\ & (1 - i\sqrt{3})(-9b + \sqrt{3} \sqrt{4a^3 + 27b^2})^{1/3} (y + 8x + 1)^2 \\ & i\beta + \frac{(y + 8x)^2}{4b^2 (y + 9)^2} (y + 8x + 1)^4 (y + 1)^2 \end{aligned}$$

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Ira Pramanick
Google, Inc.

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40+ CAREERS

| Career | Median Salary |
|-----------------------------|---------------|
| Physician | \$321,686 yr |
| Attorney | \$166,400 yr |
| Actuary | \$160,399 yr |
| Cryptanalyst | \$112,780 yr |
| Operations Research Analyst | \$118,130 yr |
| Political Scientist | \$74,574 yr |
| Mathematical Biophysicist | \$129,510 yr |
| Foreign Exchange Trader | \$139,517 yr |
| Chirologist | \$127,100 yr |
| Hydrogeologist | \$105,010 yr |

Figure represents salary potential.

Quote Of The Day

"Three points... first, mathematics is everywhere... from steam jets to nuclear power plants to devators. Second, mathematics is hard work. Third, mathematics is for everyone... people. So, if you like researchers, computers, and all that stuff, go for it! It will be worth the effort."

Bruce A. Poole
Managing Director
One University Center

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Sharks Use Math To Hunt

The great white shark is famous for catching what it was going — to the closest pair of plump legs around. But where might it hunt if it didn't have a tasty human victim in its sights?

A new study suggests that some sharks and other marine predators follow mathematical patterns when hunting. Especially when food is scarce, these marine animals follow what researchers...

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Quote Of The Day

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09 FEB '11

The great white shark is the king of the ocean. But it was going — to the closest pair of plump legs around. But where might it hunt? If it didn't have a tasty human meal in its sights?

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Accordng to the Wall Street Journal:
Mathematics is considered the Best Job of All Jobs.
Mathematicians median annual income was pegged at \$94,160.
The top 3 jobs on the list were:
1. Mathematician
2. Actuary
3. Statistician

5 of the 6 "Best Jobs" in terms of low stress, high compensation,祚economy, and being demand in the "Job Related Almanac" by Les Koenig are math related.

"The top 15 highest-earning college degrees all have one thing in common -- math skills. That's according to a recent survey from the National Association of Colleges and Employers, which tracks college graduates' job offers." [read more](#)

The following is a list of careers that use math and their respective high-end salaries. Click on a career title for more information.

| | |
|------------------------|--------------|
| Actuary | \$160,780 yr |
| Air Traffic Controller | \$161,031 yr |
| Attarct | \$116,390 yr |
| Architect | \$121,220 yr |
| Astronaut | \$91,000 yr |
| Attorney | \$166,400 yr |
| Biologist | \$67,300 yr |
| Biostatistician | \$144,400 yr |
| Budget Analyst | \$100,360 yr |

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Careers & Math Used



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What the employers have said

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- problem-solving skills
- attention to detail
- ability to abstract

What the employers have said

They want math students, because of their

- problem-solving skills
- attention to detail
- ability to abstract
- diversity in a group

What the employers have said

They recommend that students should

What the employers have said

They recommend that students should

- learn programming language

What the employers have said

They recommend that students should

- learn programming language
- develop good communication skills

What the employers have said

They recommend that students should

- learn programming language
- develop good communication skills
- do an **undergraduate research** project or a summer internship

Conclusions

- The world is becoming more math-oriented,

Conclusions

- The world is becoming more math-oriented, and there are a lot of exciting careers for people who understand math.

Conclusions

- The world is becoming more math-oriented, and there are a lot of exciting careers for people who understand math.
- Let your undergraduate research students know about these careers.

Conclusions

- Business and industry can and will fund undergraduate research projects if they are related to their interest.

Conclusions

- Business and industry can and will fund undergraduate research projects if they are related to their interest.
- Undergraduate research is a great experience for students who want a non-teaching career.

Thank you!

Michael Dorff
mdorff@math.byu.edu