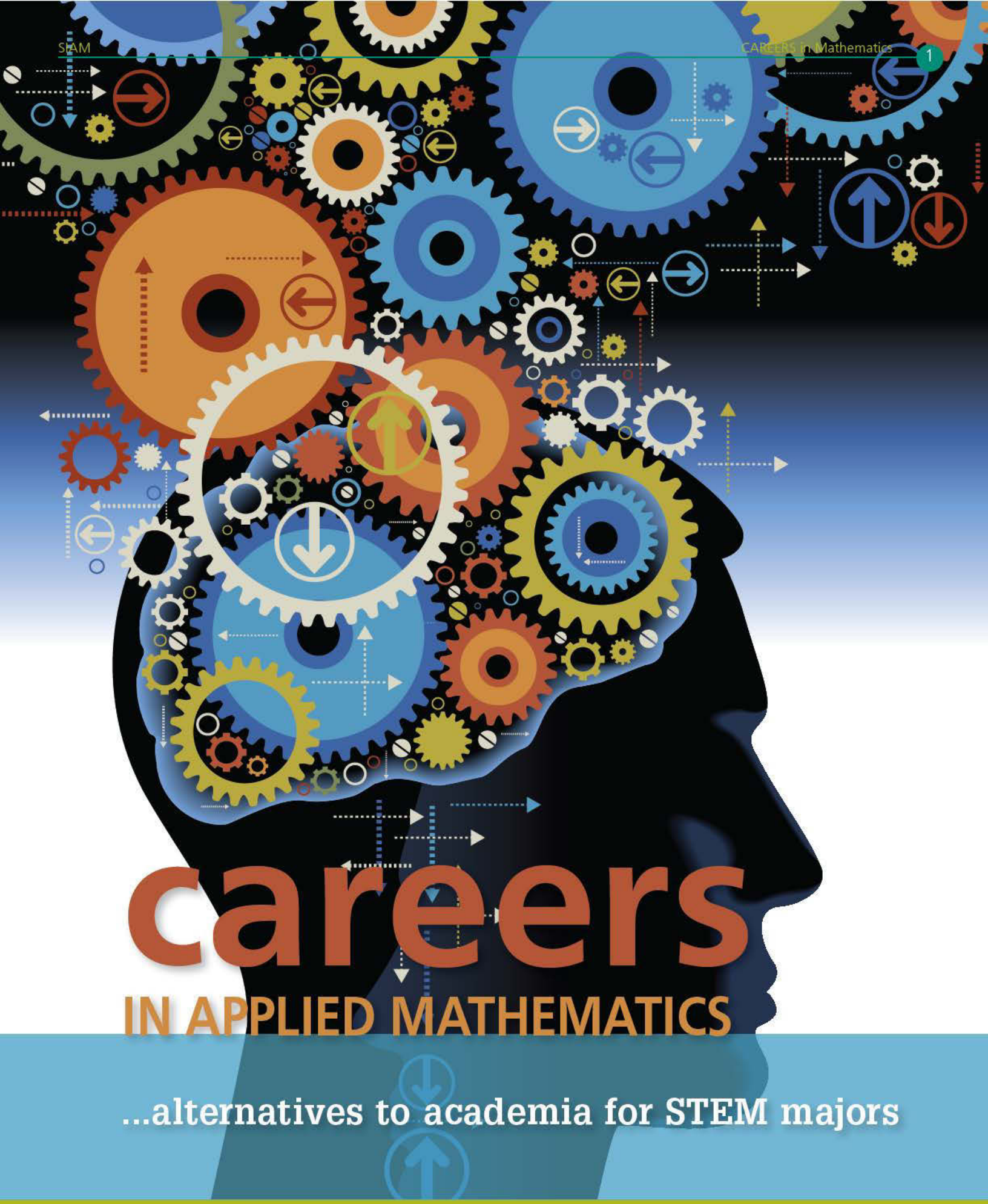


careers IN APPLIED MATHEMATICS

...alternatives to academia for STEM majors

siam. Society for Industrial and Applied Mathematics

Applied mathematics is mathematics for which I happen to know an application. This, I think, includes almost everything in mathematics.

– Henry O. Pollak

[Austrian-American mathematician, well known for his contributions to information theory]

Mathematics and computational science are utilized in almost every discipline of science, engineering, industry, and technology.

New application areas are constantly being discovered and established techniques are being applied in new ways and in emerging fields. Consequently, a wide variety of career opportunities are open to people with mathematical talent and training.

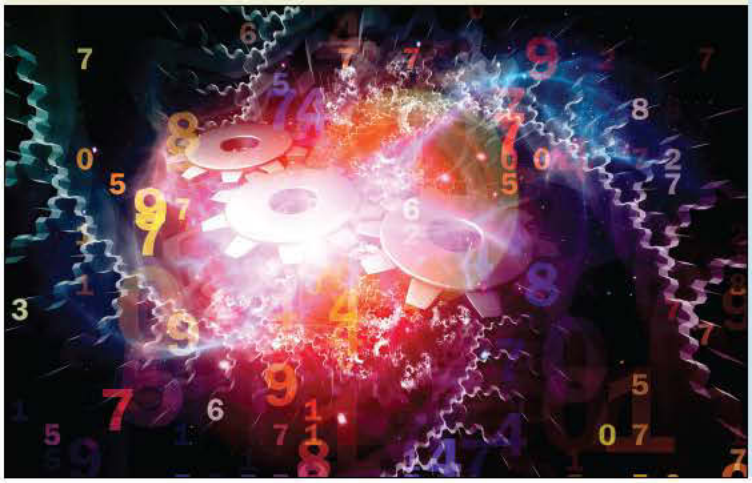
Mathematical careers outside of academia rarely carry a simple title of "mathematician." The very idea of a career in mathematics has evolved and diversified and is often coupled with a specialty or area of research interest. Mathematics plays a major role in the bottom line of industrial organizations, and helps companies perform better in today's data-driven marketplace.

In this guide, you will find answers to questions about careers in applied mathematics and computational science and profiles of professionals working in a variety of environments for which a strong background in mathematics is necessary for success.

Where can I work?

Many different types of organizations hire mathematicians and computational scientists. You can easily search the websites of organizations and corporations that interest you to learn more about their location(s), mission statement and objectives, history, and job requirements. Experience gained through internships and work-study opportunities can help you determine your personal preferences regarding a workplace, such as non-profit or for-profit, large or small, working independently or on a team, and how much customer contact you prefer to have.

Here are some examples of organizations, corporations, and research institutions that hire mathematicians and computational scientists:



- Government labs, research offices and agencies
- Federally funded contractors
- Engineering research organizations
- Computer information and software firms
- Energy systems firms
- Electronics and computer manufacturers
- Consulting firms
- Aerospace and transportation equipment manufacturers
- Financial service and investment management firms
- Transportation service providers
- Communications services providers
- Chemical or pharmaceutical manufacturers
- Medical device companies
- Producers of petroleum and petroleum products
- Academic institutions and research institutes
- Consumer products companies

For a full list of organization types with examples, please visit the link below:

www.siam.org/careers/thinking/organizations.php

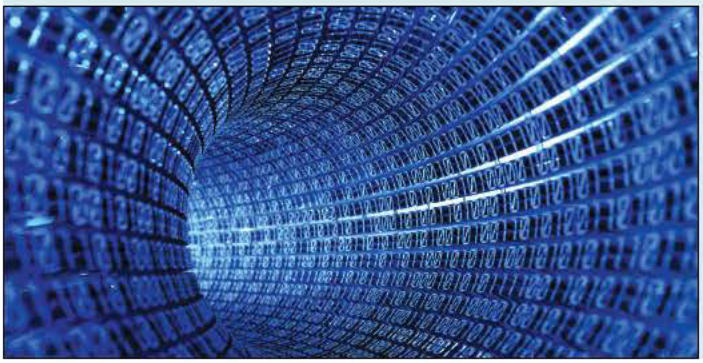
What kinds of problems might I work on?

While they may differ widely by discipline and job title, one thing remains constant among careers in mathematics–problem solving. Some potential problems that someone with mathematical training might encounter are briefly discussed below. It may be useful to note which of them you find most intriguing, and why.

- How can an airline use smarter scheduling to reduce costs of aircraft parking and engine maintenance?
- How can one design a detailed plan for a clinical trial? Building such a plan requires advanced statistical skills and sophisticated knowledge of the design of experiments.
- Is ethanol a viable solution for the world's dependence on fossil fuels? Can biofuel production be optimized to combat negative implications on the world's economy and environment?
- How can automotive systems become more efficient and reduce emissions as mandated by U.S. public policy?
- How do we use major advances in computing power to incorporate knowledge about interactions between the oceans, the atmosphere and living ecosystems into models used to predict long-term change?

- How can automotive and aircraft companies test performance, safety, and ergonomics, while at the same time lowering the cost of construction and testing prototypes?
- A pharmaceutical company wants to search a very large database of proteins to find one that is similar in shape or activity to one they have discovered. What's the most efficient way to do so?
- How might disease spread in populated areas in the event of a bioterrorism incident, and how would it be contained?
- How do you design a robotic hand to grip a coin and drop it in a slot?
- How can you mathematically model the spread of a forest fire depending on weather, ground cover and type of trees?
- How can you allocate an investment among various financial instruments to meet a risk/reward trade-off?
- Can mathematical models be coupled with efficient computational implementations to obtain practical, low-cost simulations to guide computer chip design and manufacture?
- Since a chemical company cannot test potential new products by releasing them into the atmosphere, it must develop models of atmospheric chemistry that simulate the complex chemical reactions in the atmosphere. Can computational simulations show sufficient detail to capture the effects of the chemicals, but still be fast enough to permit studies of many different chemicals?
- How can genome sequencing analysis help in making clinical decisions based on a personalized medicine approach?
- Recommendation algorithms provide users of e-commerce systems with unique ratings and recommendations of items and products based on their past purchases, behavior and interests. How can mathematics improve rating prediction performance and help enhance the consumer experience?

Part of the preparation for your future is obtaining a solid foundation in mathematical and computational knowledge—tools like differential equations, probability, combinatorics, applied algebra, and matrices, as well as the art of abstraction and advanced computing and programming skills. Preparation for a career in applied mathematics and computational science also involves being able to apply these skills to real-life problems, and achieving practical results. Mathematical and computational skills are a huge career asset that can set you apart and open doors.



What's out there for someone with my talents, interests, and background?

Growing fields to consider

Systems Biology

A career in this field might include the application of a wide range of mathematical and computational methods. For example, mapping and understanding the human genome relies on the use of sophisticated mathematical and computational tools. Newer and better tools make research quicker and cheaper, resulting in the creation of new career opportunities in technology, medicine, and drug development and design.

Data Mining and Data Privacy

Data mining allows the discovery of patterns and previously unknown information in large data sets. Emerging career opportunities can be found in applications of data mining in fields such as security, forensics, e-commerce, bioinformatics and genomics, astrophysics, medicine, and chemical and electrical engineering.

Materials Science

Materials science is the study of the properties, processing, and production of a broad range of existing and new materials, including metallic alloys, composites, liquid crystals, biological materials, and thin films. The rational design and analysis of materials depends on mathematical models and computational tools. Career opportunities abound in science, manufacturing, and materials design for applications in fields such as aerospace, engineering, electronics, biology, and nanotechnology.

Computer Animation and Digital Imaging

The Fields Institute in Toronto describes computer animation as "an eclectic science that uniquely combines mathematics, computer science, fine art, classical animation, physics, biomechanics, and anatomy, to name but a few fields. Algorithms for computer animation rely heavily on techniques from scientific computation, statistics, signal processing, linear algebra, control theory, and computational geometry." With a diverse and exciting set of applications to such areas as medical diagnostics, entertainment (film, television, and video games), and fine arts (dancing, sculpture, painting), there are many avenues and career opportunities to explore.

Finance and Economics

Financial mathematics is the development of quantitative techniques and computational models used in the financial industry. Banks, insurance companies, investment and securities firms, energy companies and utilities, multinationals, corporations, government regulatory institutions, and other industries have come to rely on applied mathematics and computational science. Sophisticated math models and the computational methods and skills needed to implement them are used to support investment decisions, to develop and price new securities, to manage risk, and for portfolio selection, management, and optimization.

Ecology/Epidemiology/Environment

Professionals in these fields might look at populations and their interactions and model them as systems of differential equations that can be used to model diseases in human populations (i.e. the spread of infection under various immunization protocols). Other applications in these fields include the management of ocean fisheries and the study of insect population growth, spread, and reaction to insecticides.

Climatology

Climatology depends on simulating the component forces that drive the climate, for example, ocean circulation and heat exchange between land, air, and ocean. It requires very sophisticated models based on physical principles, expressed as complex partial differential equations. These are implemented in very large-scale numerical codes on high-performance computers, and use data from observations of satellites, ocean buoys, and other monitoring equipment to drive the solutions.

How do I get started?

Choose a major

Look for degree programs in the mathematical sciences and academic disciplines that require mathematical and computational skills, such as engineering disciplines, applied and natural mathematical sciences, life science related fields, public health sciences, computer and information sciences, statistical sciences, financial mathematics, earth sciences, and physical sciences.

Use your university's resources

Many universities offer resources and counseling to students through their career services and human resources departments. At the very least, services such as career assessments can help you narrow your search to suit your personality and interests. Other resources offered may include resumé help, interview preparation, and job opening announcements.

Arnie Kohen is a career counselor at Drexel University's Steinbright Career Development Center. "The career center has several events throughout the year at which students can make contacts and network with employers: they can receive employer resume reviews, go to career fairs, participate in on-campus recruiting, attend various networking functions and information sessions, and access our online job postings," says Kohen. "If a student doesn't take advantage of these services, they are probably missing out on understanding the current job market."

Explore internships, summer jobs, and work-study

What better way to determine the range of opportunities and explore possible areas of interest than to actually be in the workplace? Internships and work-study opportunities are a great way to start on your career path by allowing yourself to get a realistic feel for the field in which you are interested. They provide opportunities to network and forge connections for future job possibilities. Many internships turn into permanent positions, and even if they don't, the experience will broaden your perspective and help narrow your career search. Check with your university's career center and online job portals, as well as the career and job resources on the SIAM website at www.siam.org/careers.

The National Science Foundation and other groups offer programs such as Research Experiences for Undergraduates (REUs) that support active research participation by undergraduate students in many research areas. According to the NSF, these projects involve students in meaningful ways in ongoing research programs or projects. A directory of active NSF REU sites and contact information can be found at:
http://www.nsf.gov/crssprgm/reu/reu_search.cfm

Build a network of contacts

Join a professional organization. Attend conferences, symposia, lectures, and meetings to connect with other individuals in your field. SIAM conferences provide venues for meeting with mathematicians and computational scientists working in industry, and hearing about their work. Volunteer for committees or community service opportunities.

The *SIAM Report on Mathematics in Industry 2012* details the types of industries using computational scientists, job requirements, work environments, and future opportunities. It can be found at:
http://www.siam.org/reports/mii/2012/index.php

Published research articles, which can be accessed through university libraries and academic databases, provide a window to the research and activities that take place within an industrial organization.

View a list of organizations and societies related to applied math and computational science here:
http://www.siam.org/careers/thinking/amcs.php

You can view a list of books that give guidelines and ideas on careers in mathematical sciences here:
http://www.siam.org/careers/thinking/books.php

Profiles of Professional Mathematicians

Clas A. Jacobson

Chief Scientist, Controls
United Technologies Corporation (UTC)
Hartford, Connecticut

B.S. computer and systems engineering, Rensselaer Polytechnic Institute, Troy, New York
M.Eng., PhD electrical engineering, Rensselaer Polytechnic Institute, Troy, New York

Job characteristics

I work for the senior vice president, science & technology, at UTC (known in most companies as the CTO). I work broadly in the area of systems engineering and controls. It is my responsibility to ensure technical soundness of ongoing programs as well as to be aware of and help insert appropriate technology needed for future programs. So a typical day combines these two thrusts—working with ongoing programs as well as outside companies, universities, and consortia to understand the technology landscape.

> Work hard at communication. Up, down, laterally and to different audiences. Work hard at writing things down in English and not PowerPoint.
>
> **— Clas A. Jacobson**

Background

I taught electrical engineering at Northeastern University from 1986-1995. In the early 1990s, a group was being assembled at the United Technologies Research Center (UTRC) in Connecticut that was focused on deploying methods of control across a very broad range of applications. The people involved and the range of work offered opportunities to learn that I could not pass up. I joined the team in 1995.

I led the Controls group at UTRC (research arm of UTC, which designs, manufactures and maintains aerospace and building components and system solutions) and helped form the Systems Department in 2000. I moved to lead the Carrier program office (Carrier Corporation was acquired by UTC in 1979) at UTRC in 2005. In 2007, I took my current position of Chief Scientist, Controls for all of UTC.

Applied math in the industry

Systems engineering and controls is a broad multidisciplinary area. Mathematics is key in this area—coupled with domain knowledge of the application area. Computation is also key—particularly modeling and simulation—as are many aspects of analysis.

Career advice and expectations

- Do internships and other activities that widen your network.
- Seek to broaden your technical base. If you do mainly theoretical work, try to seek some computational and laboratory experience.
- Work hard at communication. Up, down, laterally and to different audiences. Work at writing things down in English and not PowerPoint.
- Deliver—or overdeliver—on your commitments, but don't sandbag what your goals are.

Salary

Typical mid to senior level salaries are $100,000 to $150,000.

J. Evan Edinger

Loss Forecasting Executive
Bank of America,
Newark, Delaware

B.S. electrical engineering, University of Notre Dame, South Bend, Indiana
M.A., applied economics, Johns Hopkins University, Washington, DC (expected: 2014)

Job characteristics

As loss forecasting executive in the consumer and small business banking group, I manage a team of 25 associates who produce domestic loss forecasts for Bank of America's credit card and small business portfolios.

I would describe my position as a mix between economics, mathematics, and computer science because it involves extracting internal portfolio performance data and applying macro-economic forecasts to produce future projections.

My typical day has evolved over the last 11 years as I've moved from having analyst level responsibilities into managerial functions. As an analyst, I spent much of my time working with data to influence our risk strategies. As a manager, I spend more time planning projects and translating asset quality trends into digestible content to inform the broader strategic direction.

Background

I was interested in math at a very early age because anything related to numbers came easily to me. Hence, I gravitated towards mathematics/statistics/engineering courses as an undergraduate and knew that I wanted to develop a career rooted in quantitative problem-solving and economic trend analysis. While I majored in electrical engineering, my course load included a high volume of calculus and advanced mathematics classes. I was fortunate to have two helpful internships while in college that provided an avenue to apply my knowledge in a real-world setting. I also worked for about a year as a systems engineer at Lockheed Martin. The pivotal moment for me was migrating into the corporate banking environment, which established the foundation to move toward economics and statistical applications of math.

Applied math in the industry

Business analytics are heavily reliant on evaluating numerical-based outcomes of business operations. Those in the field also work with sophisticated models that require an understanding of logistic regression modeling techniques for application into loss forecasting and risk strategies.

Career advice and expectations

Two very important skills for a person pursuing this profession are the ability to extract and manipulate data and the ability to translate data into meaningful, succinct management information systems.

Early on in your career, don't be afraid to explore different opportunities and obtain additional schooling if you think it will help supplement your current skill set.

> Early on in your career, don't be afraid to explore different opportunities and obtain additional schooling if you think it will help supplement your current skill set.
>
> **— J. Evan Edinger**

Salary

Starting level: ~$65,000-$75,000; mid-level:~$100,000; senior positions >$140,000.

Kevin Wadleigh

Mathematician
Convey Computer Corporation
Richardson, Texas

M.S. applied mathematics, University of Tulsa, Oklahoma
Ed.D. mathematics, Oklahoma State University, Stillwater, Oklahoma

Job characteristics

Most of my career has involved some type of math library. These collections of software routines allow developers of high performance computing applications to leverage optimized algorithms instead of having to develop these themselves. When you work for a computer vendor, performance is very important since it gives the company a competitive advantage. Performance has multiple components: choosing/developing the best algorithm for a particular architecture, coding the algorithm, and finally, optimizing the code for even better performance. If you understand the architecture, you know exactly what the maximum performance is—the "speed of light" for a particular problem. It is satisfying to optimize an algorithm and know you've achieved a high percentage of the theoretical peak of the computer.

Background

Growing up, I assumed I would be a scientist, but I didn't know what kind. I became a math major partly because math is used by all of the sciences. Eventually, I took numerical analysis classes and started using computers to solve problems. It was fun to read a journal article and then write a program to implement the featured algorithm.

While in school, I worked for a chemistry group at a large petroleum company. I wrote routines that used X-ray diffraction and fluorescence data to determine minerals in core samples. After graduation, I worked for a defense contractor coding signal processing algorithms on supercomputers. The algorithms used in these two jobs had nothing in common, but what's nice about math is that you can apply it to very different disciplines.

> "There are many jobs in industry for mathematicians, but they don't always have the word "math" in the job title."
>
> **— Kevin Wadleigh**

Career advice and expectations

When looking for a position in industry, read beyond the job title to find out how much math is needed. Jobs in industry for mathematicians don't always have the word "math" in the job title. The further you progress in any field, the more likely it is that you will get over specialized. However, applied math is an area where knowledge of other areas will make you more marketable. So, in addition to your required math courses, take science courses that require a lot of math. A thorough understanding of computer architecture and expertise in multiple programming languages is especially valuable. Always strive to improve your skills and toolkit of techniques.

Salary

Starting salaries vary widely depending on qualifications and the cost of living in an area and may be anywhere from $70,000 to $150,000.

Dustin Grzeskowiak

Actuarial Analyst
Universal American Corp.
Houston, Texas

B.S. mathematics, Clarkson University, Potsdam, New York

Job characteristics

I am currently working as an actuary in the pricing department for a national Medicare Advantage company. Our department is responsible for the annual development, completion, and submission of Medicare Advantage bids to the federal government. These bids provide complete mathematical and statistical justification for the rates that we will be charging in the coming year to provide health insurance to Medicare beneficiaries.

My job responsibilities mostly include: developing financial projections and claims experience studies, creating and maintaining actuarial models and databases, preparing actuarial reports, and analyzing new business development opportunities. A typical day at work for me may involve: developing SQL code to extract and model claims data, creating or updating sophisticated spreadsheets to project actuarial or financial results, developing VBA (Visual Basic for Applications) code to automate actuarial calculations, or explaining—in a business sense—the impact of various management decisions made in house, or policy decisions coming from Washington.

Background

I became very interested in mathematics in high school, particularly during my trigonometry and pre-calculus classes. A teacher of mine suggested that I pursue a degree in actuarial science, as it was frequently cited as a top career path and was a great fit for those interested in math.

Career advice and expectations

For someone interested in an actuarial career, I would recommend attempting the first of many actuarial examinations. The exam covers probability theory and math stats in ways not generally covered in undergraduate coursework. It is the first of many difficult exams along the way to becoming an associate in either the Society of Actuaries or the Casualty Actuarial Society, and is probably a good measure of whether or not you will be interested in the work and can make it through the rest of the exams.

Salary

DW Simpson publishes annual actuarial salary surveys. The 2011 year-end survey for health actuaries lists the following ranges: entry level: $48,000-$55,000; mid level: $84,000-$120,000; upper level: $150,000. The full survey is at http://www.dwsimpson.com/2012_Actuarial_Salary_Survey.pdf.

More information

More information about the profession can be found online at:

http://www.soa.org

http://www.beanactuary.org

http://www.actuarialoutpost.com

Jamie Davis

General Parallel File System Software Tester
IBM Corporation
Poughkeepsie, New York

B.S. computer science, B.S. mathematics,
Clarkson University, Potsdam, New York

Job characteristics

I am currently a software tester for IBM. I work to test the enormously complex work of a dozen Ph.D.s and their assorted minions. The product I work on is a file system. I am principally responsible for developing and carrying out plans to test one or two areas of the product every three months, and writing new tools and improving existing ones to automate test tasks in order to make my own work and the work of the rest of the team easier. I decided on my current position as it offered me a challenging work environment in addition to an opportunity to reason mathematically—as opposed to simply programming robotically.

I like the fact that I work in a field full of complex concepts and algorithms. It makes each day an opportunity for learning, discovery, and, yes, making mistakes. I also enjoy the fact that the vast majority of computer scientists work on things that improve the lives of their users in meaningful ways. What we do has a big impact on the world. The part of my job I like least, however, is that much of my work is done alone and at a computer.

I typically work between 40 and 45 hours a week. IBM offers a lot of flexibility in terms of work environment and hours—I can work from the office, home, from Starbucks, or from the beach, provided I get my work done in a timely fashion. I think I have a good work/life balance, and my wife agrees. Those who have been working in my department for 10+ years work between 50 and 70 hours a week.

Background

I was always pretty good at mathematics, but it was not until halfway through college that I realized just how far-reaching a subject it is. During my sophomore and junior years, I took courses in computer programming (applied mathematics), theoretical computer science (theoretical mathematics sneakily disguised as a computer science course), real analysis (seems totally useless until you realize that it's necessary for calculus to work), and mathematical modeling (which made me begin to analyze all sorts of everyday situations with a mathematical eye). Suddenly, it seemed to me that everything could benefit from mathematical treatment, and that computers were not only a great way to kill time, but also offered me a way to view and study the world. I had to find a career which involved mathematics.

My most memorable mathematics course in college helped too—it was real analysis under Professor Scott Fulton, who taught me to think about problems deeply and fully, to engage with them in different ways (pictorially, graphically, numerically, and symbolically), and not to rush through my work. I approach my problems at work with the eye of a mathematician, and it allows me to solve them precisely and succinctly.

Applied math in the industry

File system developers try to squeeze every possible ounce of speed out of their code as they possibly can, because the faster the file system, the happier the end users. Their efforts take them into the realms of algorithm research and optimization, fields fraught with peril for the non-mathematician. But more generally, in algorithmic development, there are easy-to-think-of (and usually slower) ways to do things and there are much harder to come up with (but often significantly better) solutions, just waiting for the dedicated researcher-programmer to think of. The same techniques you use to write proofs or to develop numerical methods lend themselves to algorithmic development.

> "In algorithmic development, there are easy-to-think-of (and usually slower) ways to do things and there are much harder to come up with (but often significantly better) solutions, just waiting for the dedicated researcher-programmer to think of."
>
> **— Jamie Davis**

Career advice and expectations

I got to my senior year knowing that I enjoyed mathematics and computer science, with one summer spent doing research and another as an intern developing software, but without having a firm grasp of what the day-to-day work of someone with my qualifications actually was.

To those pursuing a degree in applied mathematics or computer science, I would strongly recommend reaching out to contacts in industry or academia (professors, alumni of their university, friends and family) and asking them a few questions about what they do, and whether or not they like it.

And to anyone pursuing a career as a programmer: learn a new language, preferably one unlike any that you currently know. It will give you another great tool for your toolbox, and it will show prospective employers that you can learn new things. I would also have found it helpful to work on computer science or math projects outside of my coursework.

Salary

The average starting salaries in my field (software engineering, bachelor's degree) range from $60,000 to $70,000. Mid-level salaries are $85,000 to $100,000, and senior positions might make up to $140,000.

Mary Beth Hribar

Program Manager
Microsoft Corporation
Redmond, Washington

B.A. mathematics, Albion College, Albion, Michigan
M.S. and Ph.D., computer science, Northwestern University, Evanston, Illinois

Job characteristics

As a program manager at Microsoft, my job responsibilities involve talking to customers and leading strategic plans for the analytics software our group produces. I very much enjoy talking to customers, learning their problems, and then designing software solutions for them. I made the switch to program manager from being a software developer and manager to have more contact with customers and to be more involved in planning.

Background

For as long as I can remember, I have loved math. Starting at a very early age, I remember asking my mother to explain mathematical concepts to me. I saw math as a language that I wanted to understand as much as I wanted to learn to read. I also viewed math as something that women understood better than men since my father was hopeless at it. In college, mathematics was the natural major for me.

However, I had originally planned to be an attorney and not continue with math after graduation. My internship at Oak Ridge National Lab changed that. I programmed algorithms on the Intel iPSC/860 and was hooked on parallel programming. I wanted to continue learning about parallel algorithms and numerical analysis. So I applied to many graduate programs. I ended up researching algorithms to solve nonlinear optimization problems while also learning computer architecture.

After finishing my Ph.D., I completed postdoctoral research and planned to take a job at a small college. I was not completely satisfied with the job offer and decided to take a risk and interview in industry. I am very happy to have chosen a career in industry instead. It has been very fulfilling to write software that is used to solve real-world problems.

Career advice and expectations

My applied mathematics background along with my knowledge of hardware design and computer science gives me a very strong technical foundation. My math skills, in general, help me to abstract concepts to better design software and solve problems. I am able to talk to a wide range of customers from different fields because of the common language of math. More importantly, I've found that my experience with numerical algorithms and software is not common, especially in the software industry.

Salary

Salary ranges are typically between $75,000 and $150,000; the top technical leaders of a software company will make much more than that.

> "I've found that my math background is the most valuable asset that I have. My math skills, in general, help me to abstract concepts to better design software and solve problems. I am able to talk to a wide range of customers from different fields because of the common language of math."
>
> **— Mary Beth Hribar**

Andrea Levy

Research Analyst
Acumen, LLC.
Burlingame, California

B.S. mathematics, Harvey Mudd College, Claremont, California

Job characteristics

Acumen is a public policy research firm specializing in quantitative healthcare policy research. We leverage Medicare and Medicaid data to answer questions for our government clients. Specifically, I would describe my job as having four major components: translating broad questions posed by our clients into quantitative statistical analyses; implementing the analyses using a statistical programming language (e.g. SAS); determining and interpreting the results of the analysis; and interfacing with our client to answer the initial question.

Each aspect of the work that I do presents a puzzle: from formulating and efficiently programming an analysis, to interpreting the results. Some of the work I do relies on a foundation of statistics, but all of it relies on being analytical and creative.

Background

I've always enjoyed puzzles and math problems. Growing up, my parents would give me word problems and logic puzzles to keep me entertained on long car rides. To me, math is still what it was back then--creativity and problem solving.

In college, I particularly enjoyed my statistics and operations research courses, which demonstrated some applications of mathematics to real-world problems. It was clear to me that I wanted to find a way to apply the tools in my mathematical toolbox to tackle real problems, and have a positive impact on the world around me. That is what led me to Acumen.

Applied math in the industry

There will always be a future for quantitative analysis in the public policy consulting field. Unbiased, data-driven research can inform future policy decisions and determine the effect of past policy changes.

Career advice and expectations

The applications of math are broad enough that you should be able to find an overlap between math and another one of your interests. If you can work in that intersection, you'll be stimulated by the work that you do and excited about its impact.

> The applications of math are broad enough that you should be able to find an overlap between math and another one of your interests.
>
> **— Andrea Levy**

Salary

Starting: $45,000 to $55,000; mid-level: $80,000 to $90,000; senior positions: $140,000.

More information

Check out the work of government offices such as the Medicare Payment Advisory Commission (MedPAC) and the U.S. Government Accountability Office (GAO).

Peter Rimshnick

Advisory Software Engineer
IBM T. J. Watson Research Center
Yorktown Heights, New York

B.S. operations research and industrial engineering (minor in applied mathematics), Cornell University, Ithaca, New York
M. Eng. operations research and industrial engineering, Cornell University, Ithaca, New York
M.A. economics, Princeton University, Princeton, New Jersey

Job characteristics

I have a diverse role in the business analytics and mathematical sciences department at IBM. My main focus has been writing software that applies optimization and simulation to real world business problems, such as disaster response, inventory management, manufacturing operations, and commodity transportation. On any given day, I can be involved in four or more projects at once, with duties ranging from software development, mathematical modeling, and assisting on patent applications and research papers, to helping market our solutions and capabilities to new clients. I use a variety of software tools and languages, such as Java, SQL, CPLEX, SPSS, and Matlab. Overall, I get to be a part of every aspect of the solutions we develop. In the future, I plan on getting involved in even more areas within our department, such as applications of artificial intelligence and machine learning.

Background

I can trace back my interest in mathematics to my childhood. I recall hearing about the famous "speeding trains" problem on television once (one train leaves Chicago at 11:00 going at 65 mph, another leaves St. Louis at 11:30 going at 80 mph, and so on and so forth). That night, my father showed my brother and me how to solve it using algebra. I think what really intrigued me then, and still does, is that math is a tool, a technology. I love applying math to solve problems.

I explored different subjects in college and after, but I kept gravitating toward mathematical fields. No other field provided me with the same types of intellectual challenges. Getting to have a job where I use applied math for a living is pretty much as good as I imagine it gets.

Applied math in the industry

Business analytics is a field that encompasses the general application of mathematics to business problems. Nearly every applied math topic can be found in the solutions that people in my field devise for everyday business activities. Need to predict when a manufacturing tool will fail? Use machine learning. Want to minimize the costs of busing children to school? Use combinatorial optimization. Need to understand the best strategy for boarding passengers onto jets? Use simulation. The list goes on and on.

This is an extraordinary time to pursue a career in applied math in general. Data is being created and collected in hosts of new areas, especially those driven by social media, and whoever can best analyze and use that data will excel in almost any industry. Further, computing power has reached the point where sophisticated mathematics can be fully realized in a way that wasn't possible before. Due to cloud computing, world class computing resources are no longer confined to a handful of people, but to anyone with a clever algorithm to implement, or a new model to apply. It is not a coincidence that world leaders talk about mathematics education as the key to competing successfully in the 21st century. Applied math is the most essential discipline in this phase of the information age.

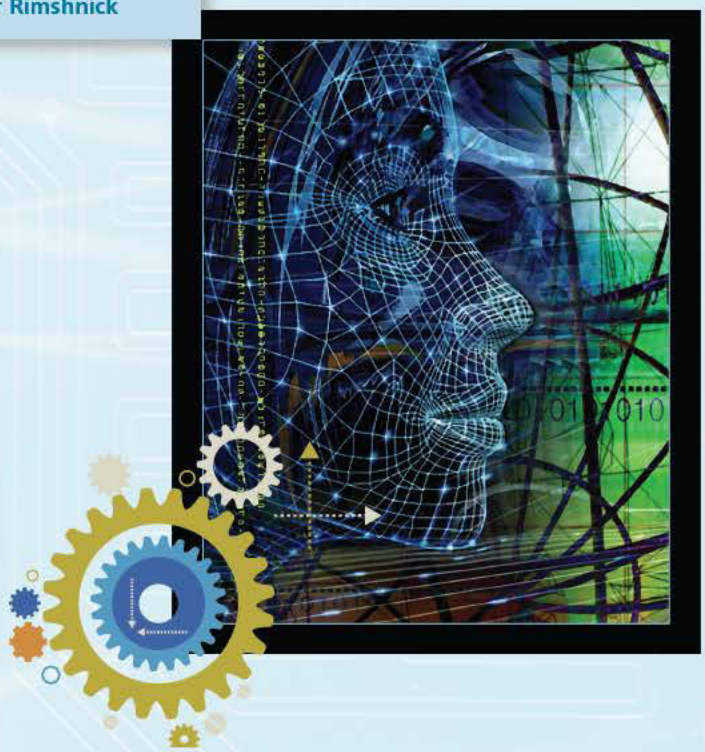
Career advice and expectations

One lesson I learned after college was that the types of jobs I was interested in, and the type of job I have now, aren't necessarily ones that come up through normal career search channels. Instead of just using typical avenues, I'd advise young people in my field to be creative and bold in how they seek opportunities. One way to do this is to turn the typical job search on its head; instead of searching for openings with a specific description and worrying about the company later, do the opposite—research companies that do the type of thing you are interested in and directly contact them to see if they have any openings for you. Professors are also a great resource; often they will have numerous industry connections, and many will have worked in industry themselves.

> "Turn the typical job search on its head; instead of searching for openings with a specific description, and worrying about the company later, do the opposite – research companies that do the type of thing you are interested in and directly contact them to see if they have any openings for you."
>
> **— Peter Rimshnick**

Salary

Starting positions: around $100,000; mid-level $150,000 to $200,000; senior positions: $250,000 or more.



Lindsay Hall

Software Engineer
Google Inc.
New York, New York

B.S. math and computer science (joint major), Harvey Mudd College, Claremont, California

Job characteristics

I currently work as a software engineer on the Google Docs team. Although most people think that software engineers don't do anything except write code, I probably spend less than half of my time in actual programming. A lot of my time is spent working on designs, in discussions with coworkers, and in meetings and talks. Google has a very communication-based culture, so I'm always talking with the people on my team about whatever it is I'm working on. Any code that gets written at Google goes through a peer review process, so even when I am programming, I'm working with at least one other person.

Engineers at Google work really hard, but also have a lot of fun! The New York City office where I am based is like a playground—we have cafés, game rooms, rock band rooms, a slide, a ladder through the ceiling that connects the 4th floor to the 5th floor, and my team religiously plays foosball after lunch every day. We also have offsite activities, trips, and team dinners. Google wants to make sure that its employees are happy, enjoy being at work, and love spending time with their coworkers—so I legitimately look forward to going to work every day.

> I never realized how important math was to being a programmer, or how many diverse industries are built on top of a mathematical foundation. If you broaden your perspective on what you can do with your interests and passions, you might find yourself in a career that you never imagined—but end up loving.
>
> **— Lindsay Hall**

Background

I've always been interested in math, specifically the logical reasoning and problem-solving aspect. As a kid, I was really into logic games and puzzles, and doing word problems was always my favorite part of math class. On the first day of my computer science class in high school, our teacher had us spend the entire class doing logic puzzles, and explained that being a computer scientist was all about creative thinking and problem solving.

As I looked at college programs, the joint major in math-computer science at Harvey Mudd sparked my interest since it combined two subjects that I was really interested in and didn't want to choose between. In addition to giving a solid foundation to the fields of math and computer science separately, the joint major emphasized classes such as algorithms, which fall in the intersection of math and computer science.

Deciding to pursue software engineering as a full-time career came after three summer internships with Google, where I worked on the YouTube and Google Docs teams. I worked on projects that required me to pull from my knowledge of programming languages, data structures, algorithms, statistics, and many more areas of both computer science and math. I fell in love with the company's culture, which strove to create an environment that would foster teamwork, creativity, and open communication. At the end of my third internship, I applied to convert to a full-time employee, and I've been working full time since September 2012.

Applied math in the industry

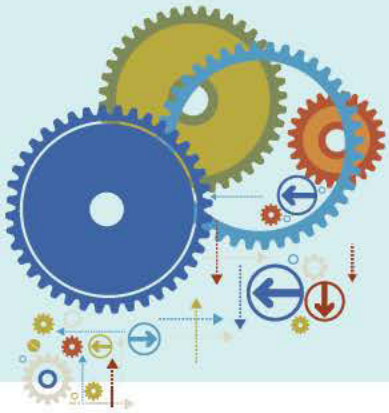
Too many people think that computer science and math are unrelated, with the exception of "theoretical" areas of computer science like complexity theory. Wrong! I use math—either directly or indirectly—every single day in my position. How do programmers know what data structure is the most efficient? What about the pros and cons of different algorithms? If an application becomes potentially slower due to a change, how do you know if it's a statistically significant difference? How do you process and analyze massive quantities of data quickly? Viewed from different perspectives, these are both computer science and mathematical problems, and being an effective computer scientist requires an in-depth understanding of the math behind each of these problems.

Career advice and expectations

My biggest piece of advice would be to not limit yourself to your current understanding of what your major or career choice involves. When I was younger, I used to think that I'd hate being a computer scientist because I didn't want to sit in front of a computer and write code all day. My opinion on sitting in front of a computer and writing code all day hasn't changed, but my opinion on being a computer scientist definitely has! Similarly, I never realized how important math was to being a programmer, or how many diverse industries are built on top of a mathematical foundation. If you broaden your perspective on what you can do with your interests and passions, you might find yourself in a career that you never imagined—but end up loving.

Salary

According to the Bureau of Labor Statistics, the mean annual wage for a software engineer was $100,420 in 2011.



John Parkinson

Principal/Actuary
The Savitz Organization
Philadelphia, Pennsylvania

B.A. mathematics and economics, East Stroudsburg University, East Stroudsburg, Pennsylvania

Job characteristics

I am an actuary in the administrative outsourcing department at an employee benefits consulting firm. Pension actuaries typically help companies who sponsor pension plans determine their pension plan's financial liabilities. Valuing these liabilities is dependent on quantifying expectations of future events, both demographic and financial. In today's low-interest rate environment, actuarial valuations actually make news when a comparison of assets to liabilities demonstrates significant underfunding for a company's (or city's or state's) pension plan. This underfunding can have important implications—not only to the plan sponsor but, potentially, to government tax policy.

Over the years, I have migrated into the area of administrative outsourcing of pension plans. In this area, we take over the administrative management of a pension plan's benefits, which involves data management, programming of web and benefit calculation tools for plan participants to use, as well as development of applications to track and manage participant servicing.

What I like about my specific line of work is that it allows me to work in a variety of different fields at once—data management, programming, people management, client consulting, pension law, and customer relations. In addition, the data we manage and the programs we write are essentially digitized versions of real retirement benefits for real people. We help make a difference in people's retirement security. Providing client consulting and services to plan participants can also generate a fair amount of stress at times. But I think stress comes with the problem-solving territory.

I generally have the flexibility that allows a good life/work balance. In fact, over the years, I've also been able to maintain a second career in music, playing trombone in one of Philadelphia's best cover bands, Chico's Vibe. Though it's a stretch to say that a musician has a career in applied mathematics, the relationship between math and music (from notation to the creation of sound and harmony) is fascinating.

Background

I had an unreasonable fear of math in high school. It wasn't until I went to college as an economics major and realized that a good grasp of calculus would contribute greatly to my understanding of economic principles that I dared to really give mathematics a go. Thanks in large part to professors who were passionate about mathematics and the teaching of it, I came to love calculus.

The class that probably set me on a path to a career that involved math was econometrics. It brought my econ and math worlds together. Applying regression techniques to economic problems and theory was fascinating. While not a direct road, the actuarial profession was a natural fit.

Applied math in the industry

Applied mathematics is at the heart of what actuaries do: actuaries analyze the financial costs of risk and uncertainty and use mathematics, statistics, and financial theory to quantify the expected financial impact of future events. I expect that stochastic modeling will be the future norm in the actuarial profession as practitioners figure out how to communicate the results of stochastic modeling to plan sponsors and participants in a way that is as meaningful and easy to understand as deterministic 'best estimates' that are still most prevalent.

> Applied mathematics is at the heart of what actuaries do: actuaries analyze the financial costs of risk and uncertainty and use mathematics, statistics, and financial theory to quantify the expected financial impact of contingent events.
>
> **— John Parkinson**

Career advice and expectations

Undergraduates should investigate an actuarial career and the corresponding professional exams as early as possible. Getting a head start on actuarial exams is a big career plus. I presume that anyone who reads this already excels at math. I recommend that you take a finance class and a public speaking class in college. A little exposure to both can pay big dividends.

Salary

Per the Department of Labor, the median pay for actuaries (in 2010) was about $87,000. Starting salary is about $40,000 for someone who has passed an exam or two. Senior position salaries can go into six figures.

Christopher Cameron

Researcher
Procter & Gamble
Cincinnati, Ohio
B.S. mathematics, minor in computational science, Clarkson University, Potsdam, New York

Job characteristics

Currently, I work in the products research/product development (baby and toddler care) department. I work on baby wipes—improving and developing new products to delight consumers. My main role is to understand consumer needs and wants and to translate those insights into technical specifications. In order to do that, I have to design, execute, and analyze consumer research, and develop methodologies, technical test methods, prototypes, and models. I also work with formulators, quality assurance, marketing and regulatory personnel, and plant engineers and other global partners in the process.

One of the aspects I really enjoy is the variety of work and people on the global and multi-functional teams in all the above areas. Within the same week, I could have talked to moms about a specific habit, perfected a test method, connected the two of them together with a model, and then updated a product design to match.

> Companies can be very data driven. If the right math or analysis is not used, then the data might not be telling the correct story. Modeling, analysis, and methodology are needed in order to innovate and create cheaper, better, and faster processes and products.
>
> **— Christopher Cameron**

I work a 40-hour week. The work flexibility is excellent. There are many options to work with management to choose what best meets your needs. There are options for working from home, flexing time, or compressed work week (more hours some days, less other days).

A great benefit at the company I work for, and one of the deciding factors for me to work in industry, are the continued training opportunities in addition to encouragement for skill development. There is a lot of formal training inside the company specific to your business, job, and brand, as well as an opportunity to take outside training to further grow your personal and technical skills, knowledge, and career.

Background

My awareness of math started in high school when I learned to use logic and formulas to solve problems. I was fascinated by how you could break down problems into easy steps. My interest in math really sparked through my years of college. After my first year at Clarkson University, I concentrated in math, but also took a variety of classes where I could learn mathematical problem-solving skills (such as econometrics, math modeling, game theory, statistics, supply chain, quality management and lean management system). I started enjoying the application side more and more and wanted more real-life experience to see a variety of actual problems as opposed to made-up ones.

Having a degree in math, my decision was to either continue pursuing higher education or to find a job where I could apply my math skills. Luckily, Clarkson University had a strong career center and enabled co-ops. I was able to intern and co-op at different companies and learn more about applying my math skills to areas such as business continuity, manufacturing, six Sigma and lean toolkits, and consumer research capability.

Applied math in the industry

Companies can be very data driven. If the right math or analysis is not used, then the data might not be telling the correct story. Modeling, analysis, and methodology are needed in order to innovate and create cheaper, better, and faster processes and products.

In industry, I see a lot more emphasis on making decisions with data as well as on developing and using modeling prior to actual testing. Models can vary from incorporating design choices, costs, technical tests, customer data, consumer responses, or plant capability. Expertise is needed to consult, set these up, analyze, and help make decisions.

Career advice and expectations

I would recommend to others interested in math to try and be exposed to a variety of research and industrial companies, in addition to further education options, to see what is out there, what direction you could take, and how you could apply yourself.

More information

To find more information about careers at P&G go to www.experiencepg.com.

Karim Azer

Principal Scientist
Merck Research Laboratories, Merck & Co., Inc.
Rahway, New Jersey

B.S. mathematics and computer science (double major), Rutgers - The State University of New Jersey, New Brunswick, New Jersey
M.S., Ph.D. applied mathematics, Courant Institute of Mathematical Sciences (New York University), New York, New York

Job characteristics

I am a principal scientist currently leading the hypertension disease area in the modeling and simulation (M&S) department at Merck. In this role, I am responsible for supporting hypertension discovery and development programs through the use of pharmacological, biological, and statistical models. I am also involved in the application of physiological and pharmacological models in a variety of disease areas, and to enable decisions on development and discovery programs in these areas. I have a special interest in the integration of drug, disease, and trial design models, and also lead some technical initiatives and technologies in model qualification and clinical trial simulation.

I work on the application of various types of mathematical models to address needs in drug development, such as, what doses should be studied in a particular phase of development, what is the likelihood that this compound can achieve an improvement in efficacy that would be considered best in class (delta=X), and what is the optimal dosing regimen for this combination therapy given performance characteristics of single agents? Some of my daily activities include working with product development teams or individuals to discuss modeling needed and answer a critical question related to a compound in development, presenting analysis results to these teams, developing mathematical methods and models, keeping up with the latest research, and coaching people.

What I like best about my profession is that I can contribute to improving people's quality of life. Not only can I contribute to this great cause, but I can do so in an environment in which I'm continually learning, on the cutting edge of research, and surrounded by brilliant researchers, many of whom are principal thought leaders in their fields.

Background

One of the running jokes in my family is that I was born with a special interest in mathematics. I can't remember a time when I was not interested in mathematics, or when mathematics was not my favorite subject. It was my dream as a child to grow up to be a mathematician.

I became interested in modeling of blood flow in arteries after reading an article that was given to me by Dr. Jeff Sachs. There was certainly no shortage of required coursework at the Courant Institute at NYU—and this felt like quite a burden when I first started. It turns out though that these courses also proved to be vital when I was working on my thesis research and subsequently in my current research work at Merck. Some of those courses were real and complex variables, numerical methods, PDEs, ODEs and fluid mechanics. I really enjoyed the PDEs and fluids courses, and this reinforced the interests I started with.

Applied math in the industry

In the future, I see applied mathematics as being as integral to drug development as is basic biology and chemistry, and being critical not only for the development of innovative medicine, but also for survival in the business of drug development. This will be especially true as we find novel ways and technologies to probe the human body and collect native information about how our body functions, how it is designed, and how it is altered with age, disease, or drug intervention.

> "In the future, I see applied mathematics as being as integral to drug development as is basic biology and chemistry, and being critical not only for the development of innovative medicine, but also for survival in the business of drug development."
>
> **— Karim Azer**

Career advice and expectations

As a hiring manager, I see that students coming into the workplace are very well prepared, having mastered more than one technical area, and with a fairly diverse technical background. Mathematics students pursuing biomathematics careers have fairly solid backgrounds in biology, in addition to the standard dose of mathematics taught at the PhD level. Expect to be immersed in a multidisciplinary environment alongside scientists with cross-disciplinary expertise.

My advice to mathematics students is to develop both a breadth and depth of knowledge and understanding of fundamental areas of mathematics. Do your best to take courses from other disciplines and expose yourself to a wide range of fields and applications. Get advice from academic and industry practitioners from different industries, and learn about their work. Finally, engage in the area of research that you enjoy most and find most fulfilling.

More information

There are different venues for learning about the role of mathematics in industry, and specifically in the pharmaceutical industry. Merck's website, www.merck.com, provides information about Merck's research areas. SIAM conferences, such as the SIAM Conference on Life Sciences, provide a venue for meeting with mathematicians and computational scientists working in industry, and hearing about their work. Finally, research articles published in the literature are a window into the research and activities that take place within an industrial organization.

Kimberly J. Drake

Mathematician
Naval Surface Warfare Center, Carderock Division
Philadelphia, Pennsylvania
B.S. mathematics and computer science
(double major with a teaching certificate),
Montclair State University, Upper Montclair, New Jersey
M.S. mathematics, Ph.D. applied mathematics
(concentration in computational science),
North Carolina State University, Raleigh, North Carolina

Job characteristics

I love working for the Navy. I have a lot of choice in the projects on which I work in the machinery research and engineering department. Broadly, it could be said that I develop algorithms and technologies to solve problems related to machinery systems typically used by the Navy. Much of the work that I do on a daily basis relates to modeling and simulation and to using computers to solve problems. Most recently, I have been developing a model of fuel consumption on surface ships.

Background

During college, I participated in a semester-long internship at the Lawrence Livermore National Laboratory (LLNL) sponsored by the Department of Energy. The internship program was extremely well-run and students were exposed to all kinds of science and technology projects in the northern California area. I was exposed to world-class scientists who were using their scientific skills to solve problems that could really impact people's lives. By the time I left LLNL, my career plans had changed; I had originally planned on studying pure math as a graduate student and then teaching, but after my time there, I decided to pursue a career in applied math instead.

Career advice and expectations

People working in applied mathematics and computational science should expect to work in interdisciplinary groups. While my work is mathematical, I work with engineers, chemists, and other system specialists to solve problems. There are many opportunities for mathematicians in this sector. Mathematical modeling is an area that the Navy invests more time, energy, and money in every year.

Salary

Salaries range from $70,000 to $150,000 and above for starting, mid-level, and senior positions. This is dependent on education level, length of service, and location.

Employees at Naval Surface Warfare Center Carderock Division - Ship Systems Engineering Station (NSWCCD-SSES) take a tour under the hull of the decommissioned USS Yorktown (CG 48) at the Philadelphia Navy Yard's drydock 5 on June 27. Allan Karpovitch, with Major Programs Branch, and Ashley Ferguson, with 2S Cog/Gas Turbine Life Cycle Support Branch, led the tour and explained that the ship is being prepared for removal of the propellers and shafts for use as spares in the active fleet.

(U.S. Navy photo by Public Affairs Specialist Joseph Battista/Released).

People working in applied mathematics and computational science should expect to work in interdisciplinary groups. While my work is mathematical, I work with engineers, chemists, and other system specialists to solve problems.

— Kimberly J. Drake

Barry F. Smith

Senior Computational Mathematician
Argonne National Laboratory
Lemont, Illinois

B.S. mathematics, Yale University, New Haven, Connecticut
Ph.D. mathematics, Courant Institute of Mathematical Sciences (New York University), New York, New York

Job characteristics

As a senior computational mathematician in the mathematics and computer science division, I develop general-purpose numerical algorithms and software for scientific and engineering simulations of interest to the Department of Energy (DOE). The DOE has a very wide range of research and development activities, so there are always new and interesting problems to work on. One must remain cognizant of what funding sources are available and ensure that one's work relates to the needs of the employer.

Background

Since junior high school, I have always been good at mathematics and enjoyed it. In college, while majoring in mathematics, I found I enjoyed spending my time playing around with computers more than doing math homework. In the fall of my senior year, I took my first numerical analysis class, taught by Bill Gropp, and I realized what I could do with my life. The combination of computing and mathematics made numerical analysis the perfect fit for me.

Career advice and expectations

As modeling and simulation become an increasing part of science and engineering, the skills of applied mathematicians and numerical analysts should continue to be in demand. But one must ensure they have the breadth of knowledge to remain relevant; a strong combination of both theory and practice is crucial. You must be willing to get your hands dirty sweating out the details of a balky code or incomplete theory.

> As modeling and simulation become an increasing part of science and engineering, the skills of applied mathematicians and numerical analysts should continue to be in demand. But one must ensure they have the breadth of knowledge to remain relevant; a strong combination of both theory and practice is crucial.
>
> **— Barry F. Smith**

Take summer positions at a variety of industrial and laboratory sites. Even if you end up at a university, the contacts and practical knowledge you obtain will continue to pay off. Learn how to use a debugger and learn how to program in at least three programming languages. Don't be afraid to experiment and to break things. Learn a variety of different topics so you can combine them in new and unique ways.

The Department of Energy Computational Science Graduate Fellowship (CSGF) www.krellinst.org/csgf/ is a great way to develop a career in numerical analysis.

Salary

Salary ranges from $100,000 to $200,000 depending on education and experience.

Wu Li

Senior Research Engineer
NASA Langley Research Center
Hampton, Virginia

B.S. mathematics, Zhejiang Normal University, Jinhua, China
M.S. mathematics, Zhejiang University, Hangzhou, China
M.S. computer sciences, Ph.D. mathematics, Pennsylvania State University, University Park, Pennsylvania

Job characteristics

I am currently a senior research engineer in the aeronautics systems analysis branch, working on the supersonic research project.

I usually work on a vertical integration from theory to practice: interacting with customers to determine the required technical capabilities, developing a practical solution strategy based on as much theoretical foundation as possible, implementing the solution by using a computer code, and building an easy-to-use interface for customers. Our objective is to help the research and development of economically and environmentally viable supersonic aircrafts.

Some of my daily activities include developing mathematical models, solution algorithms, or user interfaces; discussing modeling or solution issues with customers or team members; planning future research tasks; researching relevant literature; and documenting results. I also evaluate proposals funded by NASA, serve as technical monitor for funded proposals, and supervise graduate students working on NASA projects.

Background

I wanted to do something that would have a lasting influence on science and society. My best ability was in mathematics, and that determined my career path. I believe mathematics has its own elegance and beauty, just like arts or music, but in an intellectual and logical sense.

Before working for NASA, I was a professor of applied mathematics at Old Dominion University in Norfolk, Virginia. While there, I also worked as a consultant at the Institute for Computer Applications in Science and Engineering (ICASE) on a multidisciplinary research project funded by NASA's Langley Research Center, which led to my career change from a university professor to civil servant at NASA.

> "I believe mathematics has its own elegance and beauty, just like arts or music, but in an intellectual and logical sense."
>
> **— Wu Li**

It was when I started working as a consultant for NASA that I began to understand the huge gap between mathematical research and practice. The paper titled "Real Life Mathematics" by Bernard Beauzamy struck a chord in my heart and best describes my conversion from mathematical research to mathematical practice; it gave me confidence that real life mathematics could make a difference.

Salary

At NASA, the pay is based on civil servant grade and step. The salary range from Grade 11 (Step 1) to Grade 15 (Step 10) is $57,408 to $155,500.

Mark Zandi

Chief Economist
Moody's Analytics
West Chester, Pennsylvania

B.S. economics, Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania
Ph.D. economics, University of Pennsylvania, Philadelphia, Pennsylvania

Job characteristics

As chief economist for Moody's Analytics, I set the research agenda for a staff of approximately 60 economists located in the U.S., London, and Sydney. We produce analyses and forecasts for economies ranging from India to Indianapolis, and for clients ranging from governments to hedge funds. I spend much of my time assessing the global economy's growth prospects, considering different economic policy proposals, and evaluating different risks to the economy and financial system.

My job entails a substantial amount of research, writing, and speaking. I also travel extensively, giving speeches and talks at conferences and to clients. The most interesting thing about my job is that nearly each day brings a new economic issue or concern that I must work to understand and evaluate, and then to articulate what I've learned to my clients. I suspect that—like for most professions—as an economist, if you are right just a bit more than you are wrong, you will be successful.

> "Economics is grounded in mathematical theory and comes alive when the theory is tested against data and empirical analysis."
>
> **— Mark Zandi**

Background

I knew I wanted to be an economist just a couple of weeks into my Econ 101 class as a freshman at the University of Pennsylvania. The course made clear to me that economics is an intriguing combination of mathematics and the social sciences. I wasn't completely enamored with the abstraction of pure math, nor the casual empiricism of most social sciences. Economics is grounded in mathematical theory and comes alive when the theory is tested against data and empirical analysis. I have been a professional economist since leaving graduate school. I briefly worked for Wharton Econometrics (an economic consulting firm), started my own economic consulting firm, and sold that firm to Moody's.

Salary

Salaries range widely for economists depending on the industry and region of the country. The best place to find out more about salaries for business economists is to visit the National Association of Business Economics website: www.nabe.com.

Bill Mawby

Manager of Statistical and Mathematical Support Services
Michelin America Research and Development Corporation
Greenville, South Carolina

B.S. natural systems, The Defiance College, Defiance, Ohio
Ph.D. biomathematics, North Carolina State University, Raleigh, North Carolina

Job characteristics

In my role as manager of statistical and mathematical support, I help create proposals, lead projects, guide technical personnel, contribute technically to projects, and evaluate results.

My position has two features that really motivate me to do better work: a constant variety of problems and a direct impact on business results. Workload and schedule are dictated entirely by project needs, but this does not typically involve a lot of overtime. Daily work is split rather evenly between administrative work, project meetings, creating documents, and doing mathematical research. Employees without the managerial role spend most of their time doing mathematical research, with perhaps 25% of the remaining time spent on meetings and documentation.

Background

I arrived at my career path through a mixture of chance and necessity. My undergraduate training and interest was in biology, but I soon concluded that this field would require mathematics if any progress in understanding biological processes and systems was ever going to be made. I went to graduate school for biomathematics in order to pursue this dream. There were two professors, Dr. Bernie Mikula at Defiance and Dr. Harvey Gold at NCSU, who nurtured my interest, but it was the book series on "Towards a Theoretical Biology" that probably did the most to convert me. Work-study experiences at Argonne National Laboratory and Roswell Park Memorial Institute also largely influenced my choices.

After graduate school, I tried being an independent consultant, but mostly due to my distaste for the business end of the endeavor, I chose a more mainstream job as a statistician at Michelin Tire Corporation. I found that mathematics, like quickness in sports, can find profitable application in any field. Over the last 25 years, I have held positions as Principal Statistician for Research and Development, Corporate Statistician, and Manager of STATMATH (statistical and mathematical support services).

> Mathematics, like quickness in sports, can find profitable application in any field.
>
> **— Bill Mawby**

Applied math in the industry

The applications of mathematics, including quality control statistics; design of experiments; sampling plans; finite element work; physical modeling via differential and partial differential equations; reliability; forecasting; data mining; optimization; and stochastic processes can be seen in all manner of research, industry, and commercial and administrative processes.

Salary

Salaries range from about $75,000 to about $150,000.

Anshul Gupta

Research Staff Member
IBM T. J. Watson Research Center
Yorktown Heights, New York

Bachelor of Technology (B.Tech) computer science, Indian Institute of Technology, New Delhi, India
Ph.D. computer science, University of Minnesota, Minneapolis, Minnesota

Job characteristics

In the mathematical sciences department, I do basic research and develop algorithms and software to solve problems in science, engineering, and optimization. Many of these problems involve simulating a physical system using a computer program, where real-world experiments may be too costly or impractical. For example, with the help of software, an automobile company can simulate a large number of crash scenarios to improve the safety of a vehicle. Real crash tests may be expensive and not accurate enough. These problems are usually so complex that they are often solved either on clusters of several computers or on supercomputers containing a large number of processors. The algorithms and software that I develop help solve some of the underlying mathematical equations involved in these simulations efficiently on a large number of processors.

Background

I did not start out with a major in mathematics; instead, my background is in computer science. During my undergraduate years, parallel computing (using several processors simultaneously to run a large computer program faster) was an emerging and exciting new area of computer science. In graduate school, I learned that some of the most challenging problems requiring parallel computing are numerical in nature. I therefore focused my attention on applying parallel computing to numerical problems.

Applied math in the industry

An interesting application of mathematics in the computer industry is in computer chip technology. Just like a lot of other things, computer chips and the circuits laid out on them are also simulated to detect possible defects before a chip goes into manufacturing. In order to build faster processor chips, one creates larger and more complex simulations, which in turn, require faster processors.

Salary

Starting: around $100,000; mid-level: $150,000 to $200,000; senior positions: $250,000 or more.

Public Awareness

www.siam.org/publicawareness

SIAM works with its membership, the media, institutions, academia, corporations, students, other scientific societies, and the public to advance the applications of mathematics and computational science to engineering, industry, science, and society.

SIAM seeks to further educate and enlighten students, aspiring mathematicians, and the general public about the real-world relevance of mathematics through:

- **SIAM Connect**
  connect.siam.org
  Online and interactive news page covering the latest news and information in the field
- **Nuggets**
  www.siam.org/publicawareness/nuggets
  Brief articles explaining computational science research for the general public
- **Math Matters, Apply It!**
  www.siam.org/careers/matters
  Colorful, downloadable flyers of real-world uses of math
- **Why do Math**
  whydomath.org
  Engaging multimedia illustrations of math in everyday life
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  Twitter: twitter.com/SIAMconnect
  Youtube: youtube.com/user/SIAMConnects

Acknowledgments

Works cited, contributors:

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More detailed career profiles of all individuals are available at:

www.siam.org/careers/thinking/profiles.php

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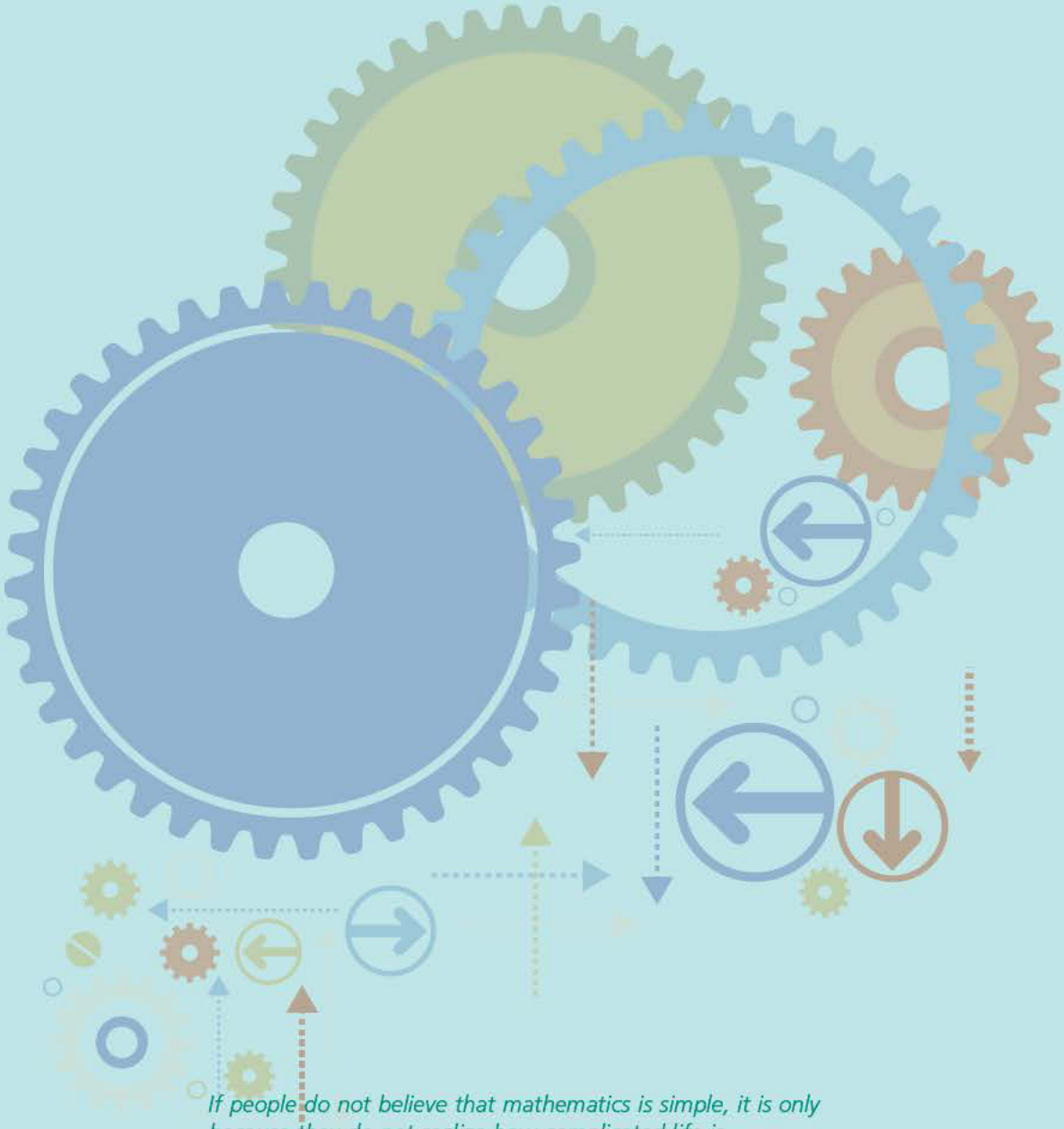
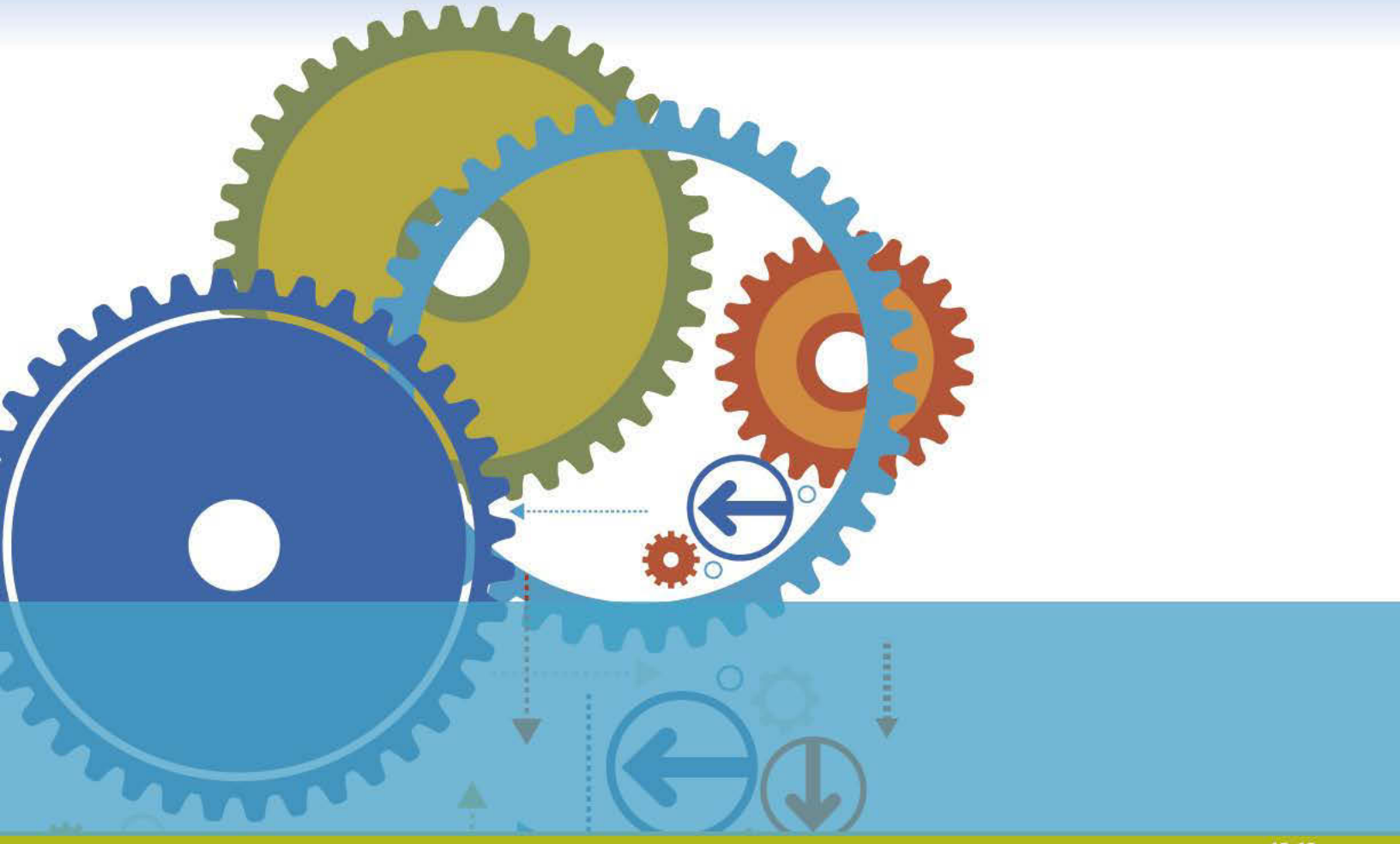


If people do not believe that mathematics is simple, it is only because they do not realize how complicated life is.

— John von Neumann

There is no branch of mathematics, however abstract, which may not some day be applied to phenomena of the real world.

— Nikolai Lobachevsky
Source: N. Rose, *Mathematical Maxims and Minims*, Raleigh NC. Rome Press Inc., 1988.

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