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ABSTRACT

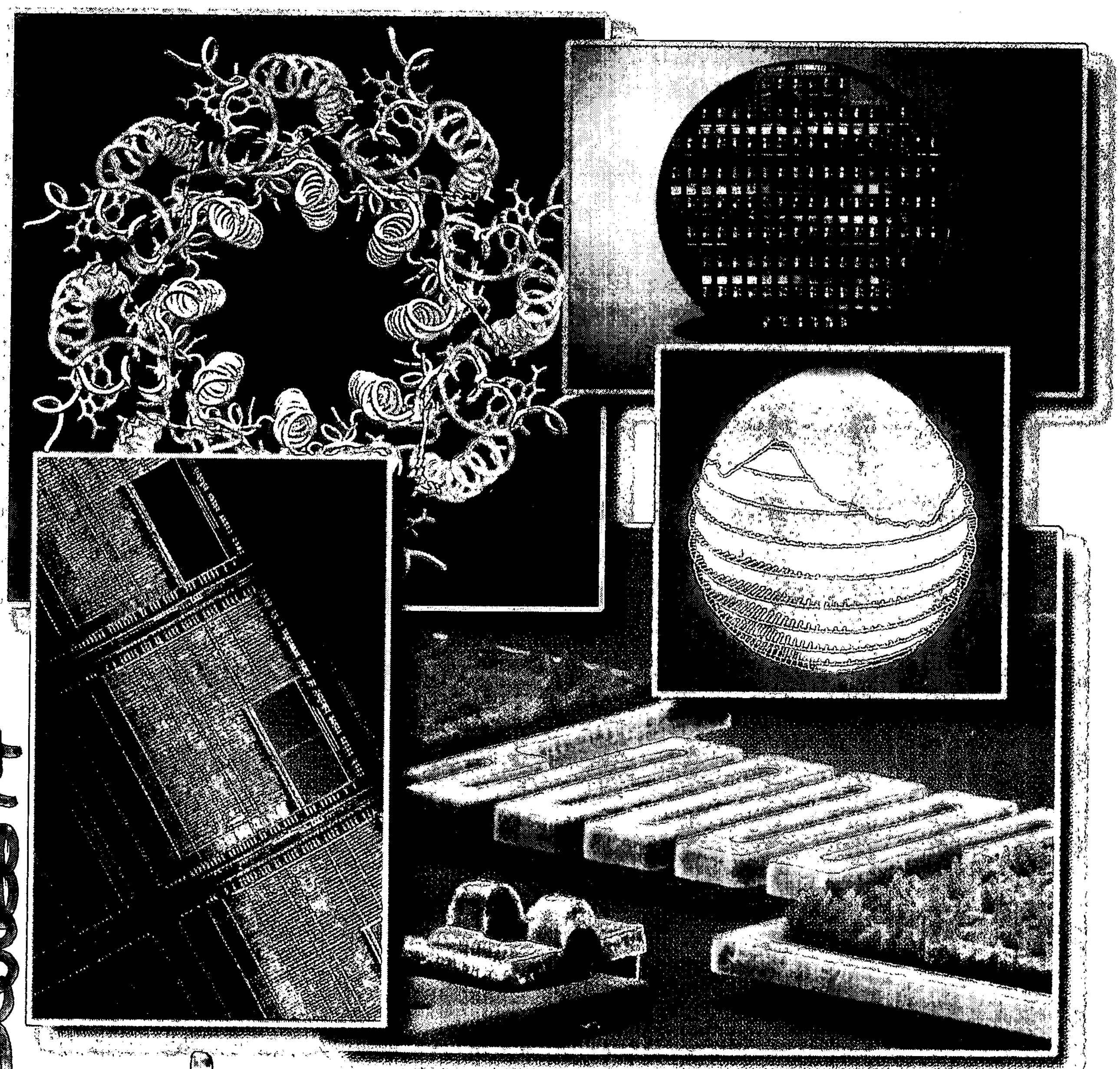
This booklet provides some answers to questions on how mathematics is used in the world of work, what kinds of problems it solves, and why it is the key to so many careers, particularly to the jobs of the 21st century. Part of that preparation is mathematical knowledge, tools such as derivatives, probability, and matrices as well as central themes like the art of abstraction. Another part of preparation is experience using those ideas in real applications and experience in finding the general patterns among specific problems in engineering, science, finance, medicine, and many other areas. This booklet discusses those problems that applied mathematicians can solve, the environments in which they work, the education necessary to succeed, and the personal experiences of some applied mathematicians. References contain 12 print and 7 electronic additional sources of information. (ASK)

Careers in Applied Mathematics and Computational Sciences

CAREERS

in Applied Mathematics & Computational Sciences

How is mathematics used in the world of work? What kinds of problems does it solve? Why is it the key to so many careers, to the jobs of the 21st century? What do you need to learn to build a career around applied mathematics? These pages have some answers.



SIAM. Society for Industrial and Applied Mathematics

Mathematics has burst the old boundaries that limited what an engineer could design, a scientist could know, or an executive could manage. Subtle interactions, masses of data, and complex systems are all within the scope of the tools and ideas of applied mathematics.

In the past, engineers could only test changes by making them, an expensive cycle of build and bust. Now mathematical models are coupled with computation to simulate new designs before they are built — like the Boeing 777 aircraft, the first "paperless airplane." Wind tunnels are old news in the airframe industry; the cutting edge is computational simulation.

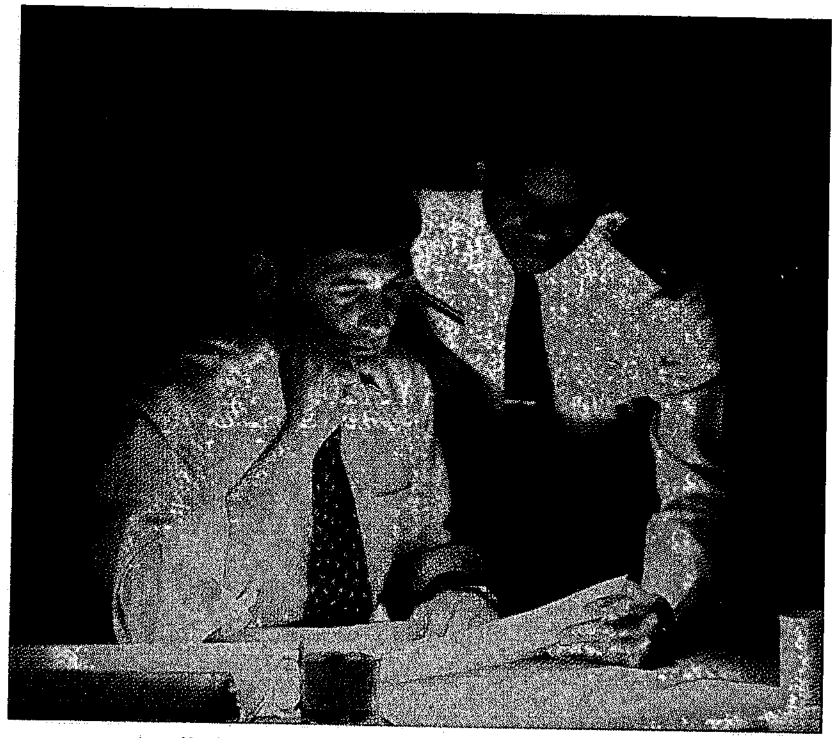
Genetic engineering, designer drugs, diesel engines, digital TV, financial markets, paper mills, electric power, insurance rates, inflation statistics, computer chips, compact disks, credit cards, car doors, circuit boards... mathematics is everywhere in modern business and industry.

Applied mathematics tackles questions like these:

- A newspaper poll asks a thousand people if they approve or disapprove of casino gambling in their state. How will millions vote when the issue is on the ballot?
- How do you cram enough data through a billion-dollar communications network — fiber optics, coaxial cable, satellites — to deliver high-quality video and reliable voice at competitive prices?
- When we pick up a quarter, our brain sends complicated signals to our nerves and muscles. How do you design a mechanical hand to grip a coin and drop it in a slot?
- Competition is fierce. Jobs are shifting. You can't learn everything in school and you won't have time on the job. Formal education is the time to lay a foundation, to learn something worth knowing, something not everyone can do. Mathematics isn't quick and easy. But once you have the skills, you are the one prepared for change.

Companies such as the Aerospace Corporation often mentor students.

Part of that preparation is mathematical knowledge, tools like derivatives, probability, and matrices as well as central themes like the art of abstraction. Another part of preparation is experience using those ideas in real applications, experience in finding the general patterns among specific problems in engineering, science, finance, medicine, and many other areas. With preparation in mathematics and background in another field, you can enjoy the dual pleasures of applied mathematics, using your mind and seeing the results. This booklet tells you more about the problems that applied mathematicians solve, the environments in which they work, the education they need to succeed, and the experiences of some individuals who are themselves applied mathematicians. The references on pages 17-18 list additional sources of information, both print and electronic.



Applied mathematicians must communicate well to learn about new problems.

Applied Mathematicians and Computational Scientists:

Where Do They Work and What Do They Do?

Applied mathematicians work in a wide range of organizations:

- Government labs like Oak Ridge National Lab, Sandia, Lawrence Livermore, and Los Alamos; and agencies like the National Security Agency, and the Center for Communications Research and the Supercomputing Research Center, both divisions of the Institute for Defense Analysis Center, NASA's Institute for Computer Applications in Science and Engineering;
- Not-for-profit contractors like the Mitre Corporation;
- Engineering research organizations like AT&T Laboratories-Research, Bell Laboratories, Bell Communications Research, Exxon Research and Engineering, GTE Laboratories, and the NEC Research Institute;

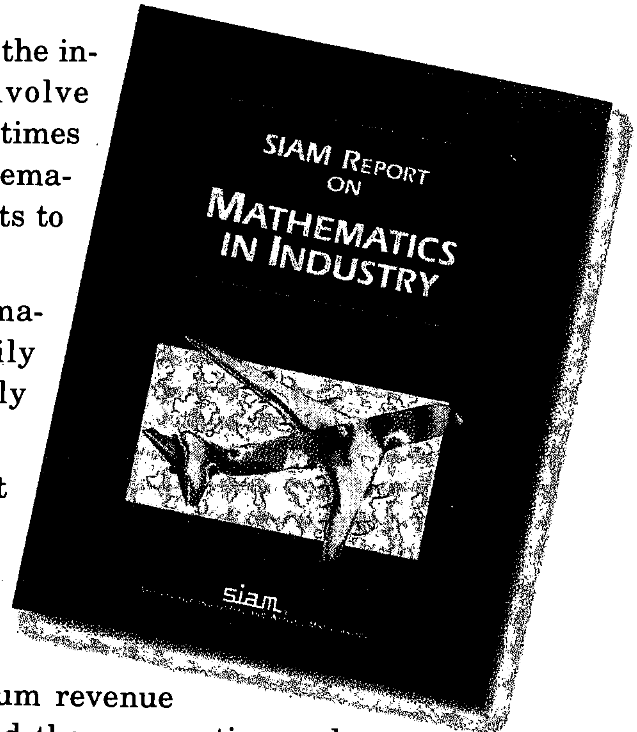
◊ Computer service firms like EDS and software firms like MacNeal-Schwendler Corporation, The Mathworks, Wolfram Research, Xerox, Silicon Graphics, Adobe, and Microsoft;
◊ Energy systems firms like Lockheed-Martin Energy Research Corporation;
◊ Electronics and computer manufacturers like IBM, Cray, Honeywell, Motorola, and Lucent Technologies;
◊ Consulting firms like David Wagner Associates;
◊ Aerospace and transportation equipment manufacturers like Boeing, General Motors, Aerospace Corporation, Ford, and United Technologies;
◊ Financial services firms like Solomon Brothers, Citibank, Morgan Stanley, and Prudential;
◊ Communications services providers like AT&T, GTE, and US West Communications;
◊ Chemical or pharmaceutical manufacturers like Kodak, DuPont, SmithKline, and Syntex;
◊ Producers of petroleum and petroleum products like Amoco and Exxon;
◊ University-based research organizations like the Institute for Mathematics and Its Applications, the Institute for Advanced Study, and the Mathematical Sciences Research Institute.

Margaret Cheney of Rensselaer Polytechnic Institute uses computer models to simulate applications.

The list goes on, through all phases of the economy and through organizations big and small, established and start-up, famous and obscure. Of course, applied mathematicians are found in colleges and universities, too!

Outside of academia, applied mathematicians are usually part of interdisciplinary teams. On average, these groups are divided evenly among mathematicians, computer scientists, and engineers with a smaller proportion of physical scientists.

There are plenty of exceptions to such averages, though. If the primary business of the organization is not engineering —perhaps it's finance or pharmaceuticals — then the interdisciplinary mix could involve economists or biochemists. Sometimes groups composed entirely of mathematicians work as internal consultants to other parts of their organization.



The problems these applied mathematicians tackle are extraordinarily diverse. Some of the successfully solved problems include:

- An automobile production plant is falling far short of the capacity for which it was designed. Why?
- How should an airline set ticket prices to ensure maximum revenue while allowing for no-shows and the aggravation and expense of overbooking?
- Which credit card collection strategies produce the most revenue in the long term?
- Computer chips are "printed" much like photographs from a negative. But manufacturing the "negative" is too expensive to permit cut-and-try testing of proposed layouts and the corresponding "print." Are there accurate mathematical models of the exposure process? Can they be coupled with efficient computational implementations to obtain practical, low-cost simulations to guide chip design and manufacture?
- A chemical manufacturer must shift one of its product lines to a new family of compounds that will not harm the ozone layer. Since it cannot test possible new products by releasing them into the atmosphere, it must develop models of atmospheric chemistry that simulate the complex chemical reactions in the atmosphere, the action of the sun, etc. 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?

The "Math That Counts" series in *SIAM News* provides many more examples of mathematics at work; see *http://www.siam.org/siamnews/mtc/mtc.htm*. Visit *http://forum.swarthmore.edu/maw/* for information on Mathematics Awareness Week. To view *Mathematical Sciences Career Information: AMS-SIAM Project for Nonacademic Employment*, see *http://www.siam.org/careers.htm* or *http://www.ams.org/careers/*.

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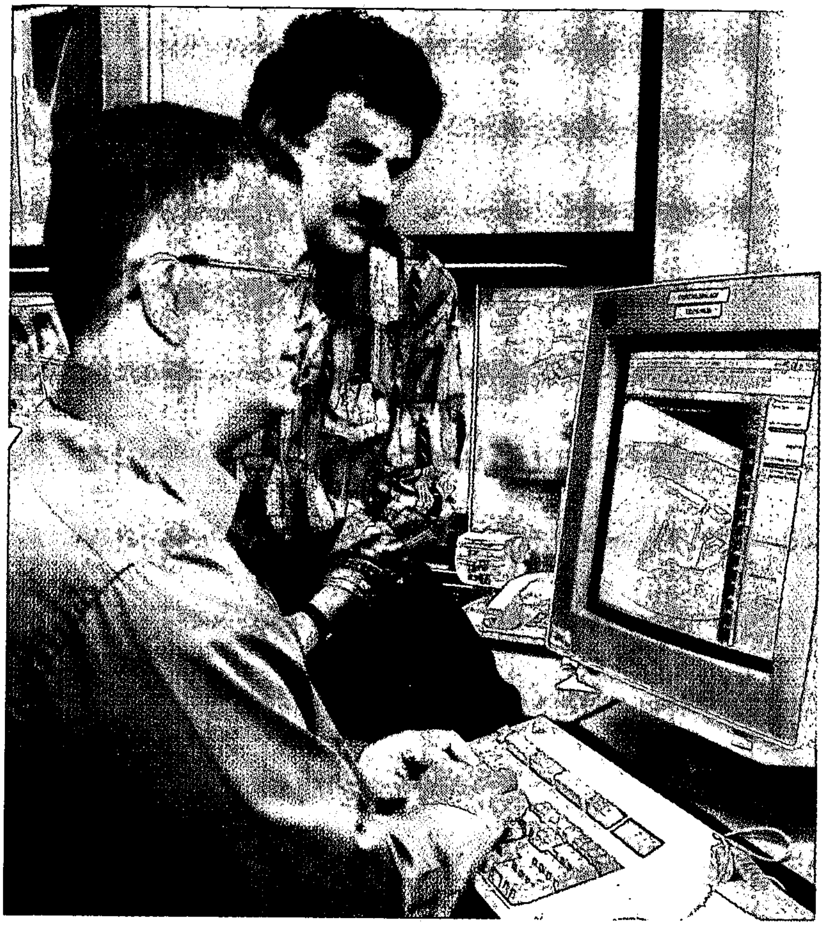
The Industrial Environment

Just like the academic setting with which you are so familiar, business, industry, and government demand mathematical expertise, although usually in the context of applications. But the working environment in industry differs from academia in other important ways.



Numerical simulations are performed to solve difficult design problems.

Interdisciplinary work — specialists from different disciplines working together to solve one problem — is relatively uncommon in universities. It is the norm in industry.

Likewise, many of the faculty you know undoubtedly work alone on much of their research, while in industry group efforts are essential because problems are typically large and complex.

In industry, computing is ubiquitous. As one industrial applied mathematician put it, "The set of industrial problems you can solve with pencil and paper has measure zero." Sometimes the end product of industrial work is software. Sometimes the end product is the insight generated by simulations. Sometimes computation is the medium for interdisciplinary exchange, such as when a mathematician implements a sophisticated mathematical tool in a form that can be used by non specialists.

The challenges that industrial applied mathematicians attack are determined by their organizations' needs, which often include a tight timetable as well as specific technical requirements. The time constraints can mean leaving a problem before it is completely solved in the mathematical sense — a partial solution may be good enough for the moment. In compensation, the partial solutions that applied mathematicians provide often have an immediate, visible influence on the organization's welfare.

For more detailed descriptions of the working environment in industry, see the *SIAM Report on Mathematics in Industry* (http://www.siam.org/mii/miihome.htm), *Some Views of Mathematics in Industry from Focus Groups* (http://www.siam.org/wallace/wallsiam.html), and the *1994 SIAM Forum Final Report* (http://www.siam.org/forum/forum94.htm).

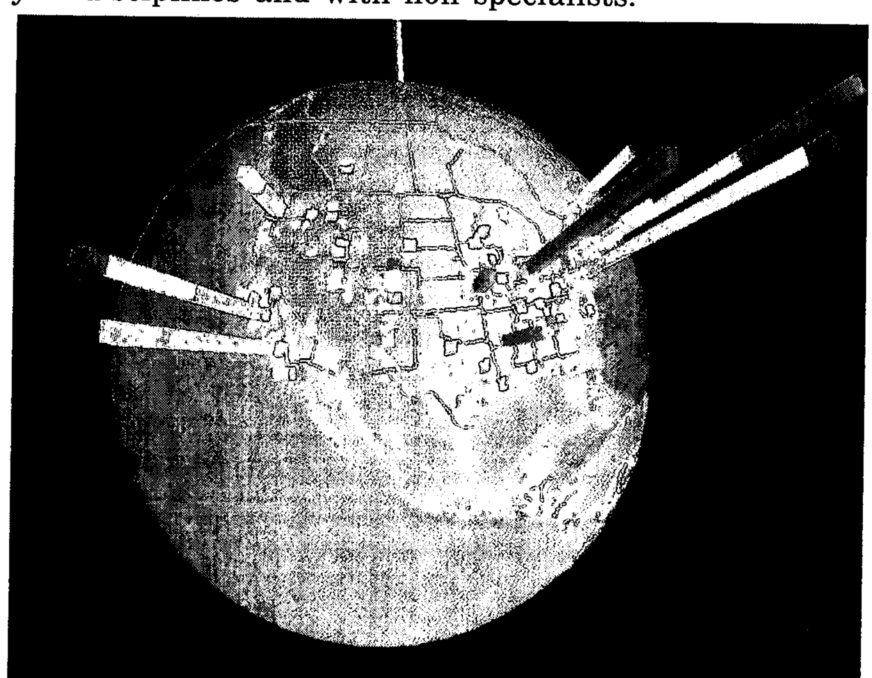
What Employers Expect

Nonacademic employers demand more of applied mathematicians than just a knowledge of mathematics. Effective industrial professionals are good problem solvers. Problem solving demands depth in one specific area of mathematics as well as breadth in mathematics in general and in other relevant fields.

Breadth in mathematics often includes knowledge of such areas as modeling and simulation, numerical methods, statistics, probability, differential equations, and operations research and optimization. Breadth also requires scientific interests outside of mathematics that are relevant to corporate needs. The most common "second discipline" of industrial mathematicians is computer science; other common choices are physics, electrical engineering, and mechanical engineering.

Industrial employers also expect mathematicians to communicate well on all fronts — reading, writing, speaking, and listening — with specialists from a variety of disciplines and with non specialists. Industrial mathematicians must communicate well to learn about new problems, to understand important ideas in new areas of interest to the company, and to tell customers and managers about solutions they have found.

Successful industrial mathematicians are also able to work in teams, they have a good attitude about their work, and they are flexible enough to move into new areas when needed.

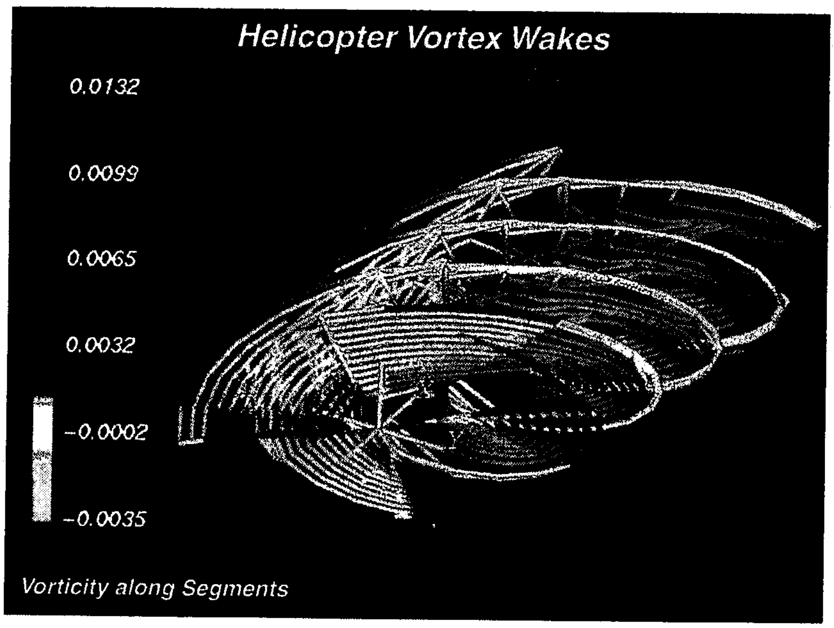


This graphical representation shows world wide web traffic at a point in time.

Preparing for Industrial Employment

To prepare for a possible career in applied mathematics outside of academia, build your program around the skills that employers need: breadth and depth in mathematics, communication and computational skills, knowledge of a relevant area outside of mathematics, and problem-solving ability.

Develop a good background in mathematics by choosing appropriate courses. Build breadth as well as depth, recognizing that the balance between the two will vary with the level of your degree. Choose areas that interest you and that are relevant to your probable future employment, not just ones that appear on someone else's list.



Learn to compute, either through intensive course work or through experience with several large projects involving significant computation.

Build a disciplinary base outside of mathematics. Attend courses in another department and participate actively in its seminars. Learn the basic concepts, vocabulary, and patterns of thought of your chosen second discipline, whether it is a field of engineering or applied science or something less traditional like finance or economics.

Seek industrial experience while you are still a student. Find a co-op or summer job to help you decide if industrial work is right for you, to develop a base of skills and accomplishments to show to potential future employers, and to help you get your first job. Participate in industrial problem-solving projects and seminars to develop additional experience with industrial problems and to practice communicating in varied settings.

The *SIAM Report on Mathematics in Industry* (http://www.siam.org/mii/miihome.htm) contains additional suggestions specifically for students. Another source is "Preparing for a job outside academia" by S. Benkowski, *Notices of the American Mathematical Society*, 41 (1994), pp. 917-919.

Profiles in Mathematics

The following people have agreed to share their experience with using mathematics in their professions in the hope that you will further your work in mathematics.

Barbara Hamilton

Manager, Information Support Services
Center for Communications Research
B.S. Mathematics, Central Michigan University
M.A. Mathematics, Central Michigan University

In college Barbara found mathematics more interesting than other subjects. Her friends, learning of her studies, assumed that she intended to teach. Although she thought teaching math would be fun, she knew that there were other opportunities in the field.

Barbara has had three jobs, first with the National Security Agency (NSA), then with Renaissance Technologies, and currently with the Center for Communications Research in Princeton, NJ.

At NSA she worked in cryptology, the study of codes and ciphers. She examined streams of data, attempting to discover any properties of the data which could predict future data. The fields of mathematics she regularly used were statistics, probability theory, number theory, group theory, Fourier analysis, and modern algebra. Computer programming was necessary in the search for patterns, for evaluation of the statistical significance of possible patterns, and for designing and testing models of the data.

Renaissance is a small technical trading firm that manages a commodities trading fund. Technical trading is based on using mathematical models of price histories to predict future prices. "My main project there was documenting models and algorithms utilized by the company. I also assisted researchers in preparing technical reports. Writing skills, ability to read computer codes, and familiarity with both statistics and mathematics were required. Although I was not doing mathematical research, I needed to understand mathematical methods to recognize the function and purpose of an algorithm. When mathematical ideas are converted to computer code, the author's intent is often not easily recognizable. I needed to convey my understanding of the algorithm in such a way that research mathematicians could use the software without examining the code."

At the Center for Communications Research, Barbara is a librarian responsible for books, journals, and software. "I make decisions about which books are must-haves and which are unnecessary. I assist researchers with literature searches and I work with administrators to make sure that our software is operational. Because I have a degree in mathematics there is a freer flow of information between the researchers and me — we speak the same language."

Robert Young

Vice President
Salomon Brothers Inc.

- B.S. Electrical Engineering, University of Pennsylvania
- M.S., Ph.D. Mathematics, New York University, Courant Institute of Mathematical Sciences

Robert Young is a vice president in Mortgage Research for Salomon Brothers Inc., in New York City. The staff members of the Mortgage Research division support mortgage-backed securities sales and trading. They are responsible for maintaining production systems and the relevant software used to produce daily reports about the market. They write up the market commentary that reports on expected trends and the reasons for past trends. It is also their job to perform the relative value analysis needed, for instance, to identify which securities are cheap, and they perform research on models used to value securities.

"Mathematics is used quite a bit, although often not at a high level," says Robert. "For instance, we use basic algebra, which sounds simple, but understanding and interpreting the meaning of a solution is very important." In addition, statistical regression, basic calculus, variants of Newton's method for finding zeros of a function, optimization methods, and stochastic partial differential equations are used.

"Stochastic calculus is used a lot in modern finance theory," he says. "We use it for the theory that our term structure interest rate model is based on. The term structure interest rate model is a basic calculation tool used by many mortgage market participants."

Among the courses he recommends for a mathematics student interested in a career in finance are stochastic calculus, stochastic partial differential equations, statistics, calculus, finance, economics, options theory, operations research, and computer courses.

Christina L. Baker

Cost Estimator
Naval Sea Systems Command

- B.S. Mathematics and Statistics, Virginia Polytechnic Institute and State University

Christina Baker prepares cost estimates for budgetary purposes in support of constructing the Navy fleet. It is her division's responsibility to develop the cost estimates that are submitted yearly through the Department of Defense's budgetary cycle and eventually become part of the President's budget. Christina has been with the organization for three years and moved into her current position after going through a two-year Cost Analysis Intern Program, which included classroom training and on-the-job training.

In her current position, she finds the areas she uses most are from statistics, such as regression analysis, sampling, hypothesis testing, and descriptive statistics. Much of the analysis requires modeling and most of this work is done using the computer. A good working knowledge of spreadsheet applications is also useful. Christina recommends that a student interested in working in her field have good grades, good communication skills, and be ready at any time to adapt to change.

Patricia A. Caldwell

Partner

Gordian Group, L.P.

- B.S. Mathematics, Virginia Polytechnic Institute and State University
- M.B.A., State University of New York, Albany

Patricia Caldwell is one of four partners in the Gordian Group, a financial advisory firm located in New York City that specializes in the restructuring of financially distressed companies. Gordian works with troubled companies, their creditors, and other constituencies in out-of-court restructuring and bankruptcies.

Generally, the companies that seek Patricia's services have in excess of $100 million of debt. Often the companies are in default with their creditors. Patricia and her firm help the troubled companies negotiate with creditor groups, who may also hire financial advisors to represent them in the negotiations. "The mathematics used to solve these financial problems is not sophisticated," she admits. "However, I think my ability to think logically, solve problems, and look for creative solutions is the result of my mathematics training."

"I became interested in finance because of my mathematics background," Patricia says, "and I believe I was viewed favorably when I went into finance because of that background." She recommends that students in the mathematical sciences interested in a career in finance take some economics and business courses to get a flavor for the areas where mathematics is applied. She believes these courses, with their quantitative content, are usually easy for the mathematics majors to grasp. Investing in the stock market and checking the business section of the newspaper is also a good way to learn about what goes on in the financial community.

Juan D. Cardenas

Financial Engineer
Summit Systems Inc.

- B.S. Mathematics, Stanford University
- M.S., Ph.D. Mathematics, New York University, Courant Institute of Mathematical Sciences

Juan Cardenas is a financial engineer for Summit Systems Inc., a software company based in New York City. Its product is a front-to-back office risk-management system, mainly focused on interest rate derivatives and primarily used by investment banks.

Juan's group is responsible for developing, implementing, and documenting pricing models, algorithms for yield curve construction, hedging, and, in general, analysis that requires more sophisticated mathematics. "Frequently this involves interacting with clients, be they traders, risk managers, or quantitative analysts," says Juan. "The organization relies on the financial engineering group to verify that the numbers that are produced by the different analyses are correct."

Among the courses Juan finds useful in his work are numerical analysis (covering linear algebra and differential equations), probability and statistics, and partial differential equations. He mentions that other courses of interest to a mathematician going into finance are corporate finance and operations research, as well as a programming language such as C or C++. "Do not ignore areas of mathematics different from your area of concentration," notes Juan. "The nature of problems you will be faced with will vary, and breadth of knowledge in mathematics will be very useful."

Cary E. Crawford

Project Scientist
Mason & Hanger Corporation

- B.S. Mathematics, Southwestern Oklahoma State University
- M.S. Applied Mathematics, University of Oklahoma

Cary Crawford is a Project Scientist and Staff Assistant in the Safeguards Department of Mason & Hanger Corporation in Amarillo, Texas, where he performs statistical analysis and administrative support for programs providing safeguards for the assembly and dismantling of nuclear weapons. It is Cary's job to set up the plans for sampling the nuclear material inventory and to develop statistics that take into account physical properties such as security guards and cameras. The goal is to reduce the number of samples needed and the amount of radiation exposure. As part of his job he uses a range of statistical methods, trend analysis, statistical software packages, and computer simulations.

Currently Cary is involved with a joint DOE National Lab team responsible for negotiations with the Russian nuclear laboratories in setting up programs for materials protection control and accountability. He uses many statistical concepts for validation testing as well as mathematical modeling.

A background in probability and statistics, discrete mathematics, and modeling and simulation is required for Cary's position. He found his position with Mason & Hanger three months after receiving his masters degree. His initial contact for the position was made at a job fair he learned about through the university placement office. Cary recommends that someone interested in industry think their future through and tie in a minor relevant to their goal.

David Brian Fruchey

Senior Technical Specialist
Northrop Grumman
B.A., M.A. Mathematics, California State University, Fullerton

David Fruchey leads senior engineers and scientists in the design and analysis of future military systems. His section, Operational Requirements Analysis, has two primary roles inside Northrop Grumman: analysis of tactical systems to determine their operational requirements and the performance of Man-In-The-Loop (MITL) Simulator analysis of advanced weapons systems.

Mathematics is used at every step of the design and analysis phases to assess the mission effectiveness of proposed and existing systems. "We begin by developing an analysis plan and simulation requirements document and finish by analyzing the raw data and preparing a final report, including statistical results," says David. Data on mission, system, and crew performance, such as system survivability, system effectiveness, crew workload, enemy encounters, etc., is collected during simulator tests. The raw data is processed using traditional statistical methods, and the results are compared across different system versions or tactical concepts. "This analysis becomes part of the weapon system profile," he says, "and is used in engineering trade studies."

"My best advice to someone seeking a career in the defense industry" says David, " is to develop their analytical skills over a broad range of problems." He recommends a background that includes modeling courses, probability and statistics, and applied mathematics. Beyond that he encourages students to work on writing, oral communications and presentation, and computer programming. He also urges them to seek out opportunities to participate in internships or summer work programs in industry. Once on the job, he notes it is important to be able to work as part of a team. "This means being willing to state your analysis or idea, accept constructive criticism, and integrate other engineers' good ideas into your work," says David. "And lastly, never be afraid to tackle a bigger problem than you think you can handle, but always seek the advice of senior engineers and scientists - they have usually handled a similar problem."

Fern Y. Hunt

Mathematician
National Institute of Standards and Technology

- A.B., Bryn Mawr College
- M. S., Ph.D., New York University, Courant Institute of Mathematical Sciences

Fern Hunt is a research mathematician in the Applied and Computational Mathematics Division of the Information Technology Laboratory. The Laboratory provides mathematical and computational support to the more than 1500 physicists and engineers at NIST who conduct research on the composition and performance of complex materials, developing very-high-precision techniques for the standards and measurements associated with these studies. In response to rapid advances in computer and information technology, the division's mission has been enlarged to support and develop techniques in image compression and analysis; efforts are underway to strengthen collaboration with scientists working in this and other areas of information technology.

Fern finds that being a mathematician in a scientific but nonacademic environment means frequent collaboration with non mathematicians and a lack of rigid departmental lines, which makes it easier to work together than it would be in an academic setting. Her research is more directed than it would be in academia and she uses many current results, for example, in areas such as dynamical systems and stochastic processes. Fern has found that in her job, which demands creativity and a broad command of techniques in analysis and applied mathematics, it is important that she be able to do mathematical research on problems of potential as well as immediate application to NIST's mission.

Julia S. Kimbell

Applied Mathematician
Chemical Industry Institute of Toxicology

- B.A. Mathematics, Middlebury College
- M.A., Ph.D., Mathematics, Duke University

Julia Kimbell works on simulation modeling of airflow within the respiratory tract for CIIT's Non-Cancer Program. CIIT performs mechanistic science in the public interest, examining why and how chemical elements cause toxicity. Much of Julia's work involves the development of mathematical models to simulate the flow of air in the respiratory tract. The models are used to determine where chemicals end up in the respiratory tract as a result of the air flow.

The environment in which Julia works is team oriented and multidisciplinary. It was her desire to work in a team with other scientists that initially attracted Julia to CIIT. Her experience working on a team project in graduate school gave her the idea to send letters to the research and development firms in Research Triangle Park, an area of North Carolina with a concentration of firms doing basic research. She received a response from the director of a cancer modeling project at CIIT who was looking for someone with her skills.

Her area of specialty is differential geometry and she finds her study of differential equations and numerical analysis to be particularly useful in her job. Although she is given the time to pick up what background is necessary in technical areas outside mathematics, she finds her lack of training in the scientific method — record keeping and hypothesis testing — to be something she has had to overcome. She thinks someone with a mathematics background who is interested in an application field and has some skills in programming and numerical analysis would enjoy a position in basic research.

Curtis Reutner

Air Pollution Meteorologist
Texas Natural Resources Conservation Commission
B.S. Mathematics, Emporia State University

Curt Reutner is an Air Pollution Meteorologist working on models used to forecast atmospheric conditions, such as ozone levels, in major metropolitan areas. He is currently involved in an effort to incorporate data expected from a new weather satellite earth station capable of providing an atmospheric profile in cloud-free areas.

The models with which Curt's division works incorporate data obtained from a variety of sites. Data is collected 365 days a year, with some sites producing data every five minutes. Part of his job is analysis of the results produced by the atmospheric models to determine if the output is reasonable. He must then determine if some input data is invalid and should be flagged so that it is not used by the model.

Curt finds a wide range of mathematics and physics courses useful in his work in meteorology, particularly the study of vectors and spherical geometry. While putting together presentations he occasionally regrets not having taken an art course. He believes it is best to gain as broad an educational experience as possible and to never stop the learning process.

William J. Satzer, Jr

Senior Research Specialist
3M

B.A. Mathematics, University of St. Thomas
Ph.D. Mathematics, University of Minnesota

William Satzer leads a small group in developing new materials for bonding and adhesive applications. His group includes physicists and electrical engineers, who work closely with chemists, chemical engineers, and materials scientists. Although Bill has worked on large-scale computational problems at 3M, his current task is to exploit a new 3M material technology and to help 3M bring several new products to market.

At 3M, applications of mathematics occur in many areas, including computational chemistry, optics, coating and deposition processes, statistical process control, fluid mechanics, and in many different aspects of chemical engineering. "Mathematics appears in many different contexts," Bill says, "but always in the guise of supporting some stage of product development." One clear example of the contribution of mathematics to the success of a product occurred in the course of developing and optimizing a class of materials. "Special-purpose optimization algorithms developed at 3M gave us the capability to identify very promising material designs computationally and to verify their relative insensitivity to variations arising in manufacturing," he notes.

The mathematics courses he has found useful include numerical linear algebra, Fourier analysis, probability, and statistics. He would also recommend a course in signal processing for anybody bound for a career involving the collection and analysis of data. More broadly, Bill says, "I'd recommend an education which emphasizes breadth and flexibility — not just in scientific and engineering disciplines, but also in economics, finance, management, and accounting. Technical managers need skills to plan projects, develop budgets, and manage people.

Additional Resources

Societies

Additional information on careers in mathematics may be obtained from the following societies:

American Mathematical Society (AMS)
201 Charles Street
Providence, RI 02904-2213
ams@ams.org
http://www.ams.org
(401) 455-4000
fax: (401) 331-3842

American Statistical Association (ASA)
1429 Duke Street
Alexandria, VA 22314-3415
asainfo@amstat.org
http://www.amstat.org
(703)684-1221
fax: (703) 684-2037

Association for Computing Machinery (ACM)
1515 Broadway
New York, NY 10036
acmhelp@acm.org
http://www.acm.org
(212) 869-7440
fax: 212-944-1318

Association for Women in Mathematics (AWM)
4114-F Computer & Space Sciences Building
University of Maryland
College Park, MD 20742-2461
awm@math.umd.edu
(301) 405-7892
fax: 301-314-9363

Computing Research Association (CRA)
1875 Connecticut Avenue NW, Suite 718
Washington, DC 20009
info@cra.org
http://www.cra.org
(202)234-2111
fax: (202) 667-1066

Institute for Operations Research and the Management Sciences (INFORMS)
940-A Elkridge Landing Road
Linthicum, MD 21090-2909
informs@jhuvms.hcf.jhu.edu
http://www.informs.org
(410) 850-0300
fax: (410) 684-2964

Mathematical Association of America (MAA)
Dolciani Mathematical Center
1529 Eighteenth Street, N.W.
Washington, DC 20036-1358
maahq@maa.org
http://www.maa.org
(202) 387-5200
fax: (202) 265-2384

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http://www.siam.org
(215) 382-9800
fax: (215) 386-7999

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See society information on page 17 for web sites.

Mathematical Sciences Career Information: AMS-SIAM Project for Nonacademic Employment
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SIAM Report on Mathematics in Industry
`http://www.siam.org/mii/miihome.htm`

Some Views of Mathematics in Industry from Focus Groups
`http://www.siam.org/wallace/wallsiam.html`

1994 SIAM Forum Final Report
`http://www.siam.org/forum/forum94.htm`

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Inspired by the vision that applied mathematics should play an important role in advancing science and technology in industry, a small group of professionals from academe and industry met in Philadelphia in 1951 to start an organization whose members would meet periodically to exchange ideas about the uses of mathematics in industry. This meeting led quickly to the organization of the Society for Industrial and Applied Mathematics (SIAM).

The goals of SIAM were to advance the application of mathematics to science and industry, promote mathematical research that could lead to effective new methods and techniques for science and industry, and provide media for the exchange of information and ideas among mathematicians, engineers, and scientists.

These goals haven't changed; they are more valid today than ever before.

Applied mathematics, in partnership with computing, has become essential in solving many real-world problems. Its methodologies are needed, for example, in modeling physical, chemical, and biomedical phenomena; in designing engineered parts, structures, and systems to optimize performance; in planning and managing financial and marketing strategies; and in understanding and optimizing manufacturing processes.

Problems in these areas arise in companies that manufacture aircraft, automobiles, engines, textiles, computers, communications systems, chemicals, drugs, and a host of other industrial and consumer products, and also in various service and consulting organizations. They arise in many research initiatives of the federal government such as those in global change, biotechnology, and advanced materials.

SIAM fosters the development of the methodologies needed in these application areas. It is fitting that the acronym SIAM represents the society's slogan—Science and Industry Advance with Mathematics.

SIAM members are applied and computational mathematicians, computer scientists, numerical analysts, engineers, statisticians, and mathematics educators. They work in industrial and service organizations, universities, colleges, and government agencies and laboratories all over the world.

To serve this diverse group of professionals:

- ◇ SIAM publishes nine peer-reviewed research journals; *SIAM Review*, a quarterly journal of peer-reviewed expository and survey papers; *SIAM News*, a news journal reporting on issues and developments affecting the applied and computational mathematics community; *Theory of Probability and Its Applications*, a translation of a Russian journal; and about 25 books per year.
- ◇ SIAM conducts an annual meeting and many specialized conferences, short courses, and workshops in areas of interest to its members.
- ◇ SIAM sponsors nine special interest activity groups, which provide additional opportunities for professional interaction and informal networking.
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top left: Structure of the light harvesting complex II, a pigment-protein complex

top right: Silicon wafer

center right: measurement points taken by a coordinate measuring machine of a "perfect" stainless steel sphere showing systematic errors in the machine's performance.

bottom left: microchip

bottom right: A polysilicon heater measuring 4 micrometers across used in a NIST-developed miniaturized pop-up switch.

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