

The average annual salary for operations research analysts in the Federal Government in nonsupervisory, supervisory, and managerial positions was \$77,730 in 2001.

### Related Occupations

Operations research analysts apply advanced analytical methods to large, complicated problems. Workers in other occupations that stress advanced analysis include systems analysts, computer scientists, and database administrators; computer programmers; engineers; mathematicians; statisticians; and economists and market and survey researchers. Because its goal is improved organizational effectiveness, operations research also is closely allied to managerial occupations, such as computer and information systems managers, and management analysts.

### Sources of Additional Information

Information on career opportunities for operations research analysts is available from:

► Institute for Operations Research and the Management Sciences, 901 Elkridge Landing Rd., Suite 400, Linthicum, MD 21090. Internet: <http://www.informs.org>

For information on operations research careers in the Armed Forces and U.S. Department of Defense, contact:

► Military Operations Research Society, 101 South Whiting St., Suite 202, Alexandria, VA 22304. Internet: <http://www.mors.org>

## Statisticians

(O\*NET 15-2041.00)

### Significant Points

- Many individuals with degrees in statistics enter jobs that do not have the title statistician.
- A master's degree in statistics or mathematics is the minimum educational requirement for most jobs with this title.
- Although little or no change is expected in employment of statisticians over the 2000-10 period, job opportunities should remain favorable for individuals with statistical degrees.

### Nature of the Work

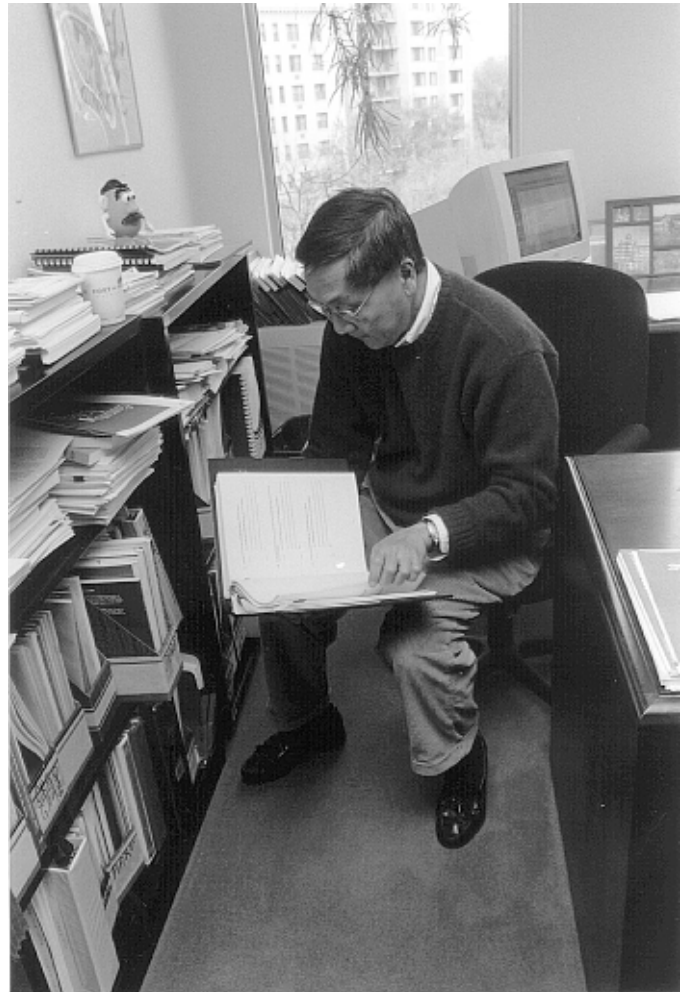
Statistics is the scientific application of mathematical principles to the collection, analysis, and presentation of numerical data. Statisticians contribute to scientific inquiry by applying their mathematical knowledge to the design of surveys and experiments; collection, processing, and analysis of data; and interpretation of the results. Statisticians often apply their knowledge of statistical methods to a variety of subject areas, such as biology, economics, engineering, medicine, public health, psychology, marketing, education, and sports. Many applications cannot occur without the use of statistical techniques, such as designing experiments to gain Federal approval of a newly manufactured drug.

One technique that is especially useful to statisticians is sampling—obtaining information about a population of people or group of things by surveying a small portion of the total. For example, to determine the size of the audience for particular programs, television-rating services survey only a few thousand families, rather than all viewers. Statisticians decide where and how to gather the data, determine the type and size of the sample group, and develop

the survey questionnaire or reporting form. They also prepare instructions for workers who will collect and tabulate the data. Finally, statisticians analyze, interpret, and summarize the data using computer software.

In business and industry, statisticians play an important role in quality control and product development and improvement. In an automobile company, for example, statisticians might design experiments to determine the failure time of engines exposed to extreme weather conditions by running individual engines until failure and breakdown. Working for a pharmaceutical company, statisticians might develop and evaluate the results of clinical trials to determine the safety and effectiveness of new medications. And at a computer software firm, statisticians might help construct new statistical software packages to analyze data more accurately and efficiently. In addition to product development and testing, some statisticians also are involved in deciding what products to manufacture, how much to charge for them, and to whom the products should be marketed. Statisticians also may manage assets and liabilities, determining the risks and returns of certain investments.

Numerous statisticians also are employed by nearly every government agency. Some government statisticians develop surveys that measure population growth, consumer prices, or unemployment. Other statisticians work for scientific, environmental, and agricultural agencies and may help to determine the amount of pesticides in drinking water, the number of endangered species living in a particular area, or the number of people afflicted with a particular



Statisticians work in many different fields organizing surveys, collecting data, and analyzing the results.

disease. Other statisticians are employed in national defense agencies, determining the accuracy of new weapons and defense strategies.

Because statistical specialists are used in so many work areas, specialists who use statistics often have different professional designations. For example, a person using statistical methods on economic data may have the title econometrician, while statisticians in public health and medicine may hold titles such as biostatistician, biometrician, or epidemiologist.

### Working Conditions

Statisticians usually work regular hours in comfortable offices. Some statisticians travel to provide advice on research projects, supervise and set up surveys, or gather statistical data. Some may have duties that vary widely, such as designing experiments or performing fieldwork in various communities. Statisticians who work in academia generally have a mix of teaching and research responsibilities.

### Employment

Statisticians held about 19,000 jobs in 2000. One-fifth of these jobs were in the Federal Government, where statisticians were concentrated in the Departments of Commerce, Agriculture, and Health and Human Services. Most of the remaining jobs were in private industry, especially in the research and testing services and management and public relations industries. In addition, many professionals with a background in statistics were among the 20,000 full-time mathematics faculty in colleges and universities in 2000, according to the American Mathematical Society. (See the statement on teachers—postsecondary elsewhere in the *Handbook*.)

### Training, Other Qualifications, and Advancement

Although more employment opportunities are becoming available to well-qualified statisticians with bachelor's degrees, a master's degree in statistics or mathematics is usually the minimum educational requirement for most statistician jobs. Research and academic positions in institutions of higher education, for example, require a graduate degree, usually a doctorate, in statistics. Beginning positions in industrial research often require a master's degree combined with several years of experience.

The training required for employment as an entry-level statistician in the Federal Government, however, is a bachelor's degree, including at least 15 semester hours of statistics or a combination of 15 hours of mathematics and statistics, if at least 6 semester hours are in statistics. Qualifying as a mathematical statistician in the Federal Government requires 24 semester hours of mathematics and statistics with a minimum of 6 semester hours in statistics and 12 semester hours in an area of advanced mathematics, such as calculus, differential equations, or vector analysis.

About 80 colleges and universities offered bachelor's degrees in statistics in 2000. Many other schools also offered degrees in mathematics, operations research, and other fields that included a sufficient number of courses in statistics to qualify graduates for some beginning positions in the Federal Government. Required subjects for statistics majors include differential and integral calculus, statistical methods, mathematical modeling, and probability theory. Additional courses that undergraduates should take include linear algebra, design and analysis of experiments, applied multivariate analysis, and mathematical statistics.

In 2000, approximately 110 universities offered a master's degree program in statistics, and about 60 offered a doctoral degree program. Many other schools also offered graduate-level courses in applied statistics for students majoring in biology, business, economics, education, engineering, psychology, and other fields. Acceptance into graduate statistics programs does not require an

undergraduate degree in statistics, although good training in mathematics is essential.

Because computers are used extensively for statistical applications, a strong background in computer science is highly recommended. For positions involving quality and productivity improvement, training in engineering or physical science is useful. A background in biological, chemical, or health science is important for positions involving the preparation and testing of pharmaceutical or agricultural products. Courses in economics and business administration are helpful for many jobs in market research, business analysis, and forecasting.

Good communications skills are important for prospective statisticians in industry, where they often need to explain technical matters to persons without statistical expertise. An understanding of business and the economy also is valuable for those who plan to work in private industry.

Beginning statisticians generally are supervised by an experienced statistician. With experience, they may advance to positions with more technical responsibility and, in some cases, supervisory duties. However, opportunities for promotion increase with advanced degrees. Master's and Ph.D. degree holders usually enjoy independence in their work and become qualified to engage in research, develop statistical methods, or, after a number of years of experience in a particular area, become statistical consultants.

### Job Outlook

Little or no change is expected in employment of statisticians over the 2000-10 period. However, job opportunities should remain favorable for individuals with statistical degrees, although many of these positions will not carry the explicit job title statistician. This is especially true of jobs that involve the analysis and interpretation of data from other disciplines such as economics, biological science, psychology, or engineering. In addition to the limited number of jobs resulting from growth, a number of openings will become available as statisticians retire, transfer to other occupations, or leave the workforce for other reasons.

Among graduates with a bachelor's or master's degree in statistics, those with a strong background in an allied field, such as finance, engineering, or computer science, should have the best prospects of finding jobs related to their field of study. Federal agencies will hire statisticians in many fields, including demography, agriculture, consumer and producer surveys, Social Security, healthcare, and environmental quality. Competition for entry-level positions in the Federal Government is expected to be strong for those just meeting the minimum qualification standards for statisticians, because the Federal Government is one of the few employers that considers a bachelor's degree to be an adequate entry-level qualification. Those who meet State certification requirements may become high school statistics teachers. (For additional information, see the statement on teachers—preschool, kindergarten, elementary, middle, and secondary elsewhere in the *Handbook*.)

Manufacturing firms will hire statisticians with master's and doctoral degrees for quality control of various products, including pharmaceuticals, motor vehicles, chemicals, and food. For example, pharmaceutical firms employ statisticians to assess the safety and effectiveness of new drugs. To address global product competition, motor vehicle manufacturers will need statisticians to improve the quality of automobiles, trucks, and their components by developing and testing new designs. Statisticians with knowledge of engineering and the physical sciences will find jobs in research and development, working with teams of scientists and engineers to help improve design and production processes to ensure consistent quality of newly developed products. Many statisticians also will find

opportunities developing statistical software for computer software manufacturing firms.

Business firms will rely heavily on workers with a background in statistics to forecast sales, analyze business conditions, and help solve management problems in order to maximize profits. In addition, consulting firms increasingly will offer sophisticated statistical services to other businesses. Because of the widespread use of computers in this field, statisticians in all industries should have good computer programming skills and knowledge of statistical software.

### Earnings

Median annual earnings of statisticians were \$51,990 in 2000. The middle 50 percent earned between \$37,160 and \$69,220. The lowest 10 percent had earnings of less than \$28,430, while the highest 10 percent earned more than \$86,660.

The average annual salary for statisticians in the Federal Government in nonsupervisory, supervisory, and managerial positions was \$68,900 in 2001, while mathematical statisticians averaged \$76,530. According to a 2001 survey by the National Association of Colleges and Employers, starting salary offers for mathematics/statistics graduates with a bachelor's degree averaged \$46,466 a year.

### Related Occupations

People in numerous occupations work with statistics. Among these are actuaries; mathematicians; operations research analysts; systems analysts, computer scientists, and database administrators; computer programmers; computer software engineers; engineers; economists and market and survey researchers; financial analysts and personal financial advisors; and life, physical, and social science occupations.

### Sources of Additional Information

For information about career opportunities in statistics, contact:

► American Statistical Association, 1429 Duke St., Alexandria, VA 22314. Internet: <http://www.amstat.org>

For more information on doctoral-level careers and training in mathematics, a field closely related to statistics, contact:

► American Mathematical Society, 201 Charles St., Providence, RI 02940. Internet: <http://www.ams.org>

Information on obtaining a statistician position with the Federal Government is available from the Office of Personnel Management (OPM) through a telephone-based system. Consult your telephone directory under U.S. Government for a local number or call (912) 757-3000; Federal Relay Service: (800) 877-8339. The first number is not tollfree, and charges may result. Information also is available from the OPM Internet site: <http://www.usajobs.opm.gov>.

## Systems Analysts, Computer Scientists, and Database Administrators

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### Significant Points

- As computer applications expand, systems analysts, computer scientists, and database administrators are projected to be among the fastest growing occupations.
- Relevant work experience and a bachelor's degree are prerequisites for many jobs; for more complex jobs, a graduate degree is preferred.

### Nature of the Work

The rapid spread of computers and information technology has generated a need for highly trained workers to design and develop new hardware and software systems and to incorporate new technologies. These workers—computer systems analysts, computer scientists, and database administrators—include a wide range of computer specialists. Job tasks and occupational titles used to describe these workers evolve rapidly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers.

*Systems analysts* solve computer problems and enable computer technology to meet individual needs of an organization. They help an organization realize the maximum benefit from its investment in equipment, personnel, and business processes. This process may include planning and developing new computer systems or devising ways to apply existing systems' resources to additional operations. Systems analysts may design new systems, including both hardware and software, or add a new software application to harness more of the computer's power. Most systems analysts work with a specific type of system that varies with the type of organization they work for—for example, business, accounting, or financial systems, or scientific and engineering systems. Some systems analysts also are referred to as *systems developers* or *systems architects*.

Analysts begin an assignment by discussing the systems problem with managers and users to determine its exact nature. They define the goals of the system and divide the solutions into individual steps and separate procedures. Analysts use techniques such as structured analysis, data modeling, information engineering, mathematical model building, sampling, and cost accounting to plan the system. They specify the inputs to be accessed by the system, design the processing steps, and format the output to meet the users' needs. They also may prepare cost-benefit and return-on-investment analyses to help management decide whether implementing the proposed system will be financially feasible.

When a system is accepted, analysts determine what computer hardware and software will be needed to set it up. They coordinate tests and observe initial use of the system to ensure it performs as planned. They prepare specifications, work diagrams, and structure charts for computer programmers to follow and then work with them to "debug," or eliminate errors from, the system. Analysts, who do more in-depth testing of products, may be referred to as *software quality assurance analysts*. In addition to running tests, these individuals diagnose problems, recommend solutions, and determine if program requirements have been met.

In some organizations, *programmer-analysts* design and update the software that runs a computer. Because they are responsible for both programming and systems analysis, these workers must be proficient in both areas. (A separate statement on computer programmers appears elsewhere in the *Handbook*.) As this becomes more commonplace, these analysts increasingly work with object-oriented programming languages, as well as client/server applications development, and multimedia and Internet technology.

One obstacle associated with expanding computer use is the need for different computer systems to communicate with each other. Because of the importance of maintaining up-to-date information—accounting records, sales figures, or budget projections, for example—systems analysts work on making the computer systems within an organization compatible so that information can be shared. Many systems analysts are involved with "networking," connecting all the computers internally—in an individual office, department, or establishment—or externally, because many organizations now rely on e-mail or the Internet. A primary goal of