

## TABLE OF CONTENTS

<b>INTRODUCTION .....</b>	<b>2</b>
<b>COVERAGE .....</b>	<b>2</b>
<b>MODIFICATIONS TO AND CANCELLATIONS OF OTHER EXISTING OCCUPATIONAL SERIES AND STANDARDS.....</b>	<b>3</b>
<b>PART I – OCCUPATIONAL INFORMATION .....</b>	<b>4</b>
<b>GENERAL SERIES DETERMINATION GUIDELINES .....</b>	<b>4</b>
<b>CLASSIFYING PROFESSIONAL SCIENTIFIC WORK.....</b>	<b>5</b>
<b>DISTINGUISHING BETWEEN PROFESSIONAL AND TECHNICAL WORK.....</b>	<b>6</b>
<b>OFFICIAL TITLING PROVISIONS.....</b>	<b>7</b>
<b>FUNCTIONAL CLASSIFICATION CODES.....</b>	<b>8</b>
<b>INFORMATION BY SERIES IN NUMBER ORDER .....</b>	<b>9</b>
<b>OCCUPATIONAL INFORMATION BY SERIES.....</b>	<b>10</b>
GENERAL MATHEMATICS AND STATISTICS, 1501 .....	10
ACTUARIAL SCIENCE, 1510 .....	11
OPERATIONS RESEARCH, 1515 .....	14
MATHEMATICS, 1520.....	17
MATHEMATICAL STATISTICS, 1529 .....	19
STATISTICS, 1530.....	22
<b>DISTINGUISHING AMONG THE COVERED OCCUPATIONS .....</b>	<b>28</b>
<b>IMPACT OF AUTOMATION.....</b>	<b>28</b>
<b>ADDITIONAL OCCUPATIONAL CONSIDERATIONS.....</b>	<b>29</b>
<b>CROSSWALK TO THE STANDARD OCCUPATIONAL CLASSIFICATION.....</b>	<b>30</b>
<b>PART II – GRADING INFORMATION .....</b>	<b>32</b>
<b>HOW TO USE THIS GRADING INFORMATION.....</b>	<b>32</b>
<b>POSITION EVALUATION SUMMARY WORKSHEET .....</b>	<b>33</b>
<b>FACTOR LEVEL DESCRIPTIONS .....</b>	<b>34</b>
FACTOR 1 – KNOWLEDGE REQUIRED BY THE POSITION.....	34
FACTOR 2 – SUPERVISORY CONTROLS .....	37
FACTOR 3 – GUIDELINES .....	40
FACTOR 4 – COMPLEXITY .....	42
FACTOR 5 – SCOPE AND EFFECT .....	47
FACTOR 6 – PERSONAL CONTACTS AND	
FACTOR 7 – PURPOSE OF CONTACTS.....	50
FACTOR 8 – PHYSICAL DEMANDS .....	52
FACTOR 9 – WORK ENVIRONMENT.....	53
<b>FACTOR ILLUSTRATIONS.....</b>	<b>54</b>
<b>FACTOR 1 ILLUSTRATIONS.....</b>	<b>54</b>
<b>FACTOR 4 ILLUSTRATIONS.....</b>	<b>71</b>
<b>FACTOR 5 ILLUSTRATIONS.....</b>	<b>83</b>
<b>PART III – EXPLANATORY MATERIAL .....</b>	<b>91</b>

## INTRODUCTION

This job family standard (JFS) provides series definitions, titling instructions, and grading criteria for nonsupervisory professional positions in the Mathematical Sciences Group, 1500, for General Schedule (GS) and other “white collar” pay plans. In the General Schedule position classification system established under chapter 51 of title 5, United States Code, the positions addressed here would be two-grade interval positions.

This JFS is divided into three parts. Part I contains occupational information that is applicable to Federal work covered by the JFS without regard to pay plan or classification system. Part II provides the grading criteria for positions classified in accordance with GS grade definitions. Part III includes explanatory material about the development of this JFS.

The term “General Schedule” or “GS” denotes the major position classification system and pay structure for white collar work in the Federal government. Agencies no longer subject to chapter 51 have replaced the GS pay plan indicator with agency-unique pay plan indicators. For that reason, reference to General Schedule or GS has been omitted from much of this JFS.

### Coverage

This job family standard covers the following occupational series:

<b>Series</b>		<b>Series</b>	
<b>General Mathematics and Statistics</b>	<b>1501</b>	<b>Mathematics</b>	<b>1520</b>
<b>Actuarial Science</b>	<b>1510</b>	<b>Mathematical Statistics</b>	<b>1529</b>
<b>Operations Research</b>	<b>1515</b>	<b>Statistics</b>	<b>1530</b>

## Modifications to and Cancellations of Other Existing Occupational Series and Standards

Issuance of this JFS establishes, renames, supersedes, or cancels occupational series and classification standards as described in the following table.

Previous Series or Guidance	Action Taken / How to Classify Work Previously Covered
<b>Mathematics and Statistics Group 1500</b>	<ul style="list-style-type: none"> <li>• Renames this occupational group the Mathematical Sciences Group.</li> </ul>
<b>General Mathematics and Statistics 1501</b>	<ul style="list-style-type: none"> <li>• Establishes this series.</li> </ul>
<b>Actuary 1510</b>	<ul style="list-style-type: none"> <li>• Supersedes this classification standard, last revised in June 1967.</li> <li>• Renames this series, Actuarial Science, 1510.</li> <li>• Classify work previously covered by this series to the <b>Actuarial Science Series, 1510</b>.</li> </ul>
<b>Operations Research 1515</b>	<ul style="list-style-type: none"> <li>• Supersedes this classification standard, last revised in June 1996.</li> </ul>
<b>Mathematics 1520</b>	<ul style="list-style-type: none"> <li>• Supersedes this classification standard, last revised in June 1965.</li> </ul>
<b>Mathematical Statistician 1529</b>	<ul style="list-style-type: none"> <li>• Supersedes this classification standard, last revised in February 1961.</li> <li>• Renames this series, Mathematical Statistics, 1529.</li> <li>• Classify work previously covered by this series to the <b>Mathematical Statistics Series, 1529</b>.</li> </ul>
<b>Statistician 1530</b>	<ul style="list-style-type: none"> <li>• Supersedes this classification standard, last revised in February 1961.</li> <li>• Renames this series, Statistics, 1530.</li> <li>• Classify work previously covered by this series to the <b>Statistics Series, 1530</b>.</li> </ul>
<b>Cryptography 1540</b>	<ul style="list-style-type: none"> <li>• Cancels this series as a series available for general use.</li> <li>• Reserves the series name and code “1540” for information purposes only; treatment of this series will be addressed in the next edition of the <a href="#">Handbook of Occupational Groups and Families</a>.</li> </ul>

## PART I – OCCUPATIONAL INFORMATION

Part I is intended for use by all agencies in evaluating professional positions in the Mathematics Sciences Group, 1500. It provides series definitions, titling instructions, and detailed occupational information for this job family.

### General Series Determination Guidelines

For a variety of reasons, selection of the correct series for a position is an essential part of the entire human resources management process. For example, qualification requirements used in recruiting are based on the series of the position; career ladders are influenced by the series; and organizational structure is often designed with consideration of the series of assigned positions.

Determining the correct series for a position is usually apparent by reviewing the assigned duties and responsibilities and then comparing them to the series definitions and general occupational information the job family standard (JFS) provides. Generally, the series determination for a position is based on the primary work of the position, the highest level of work performed, and the paramount knowledge required to do the work of the position. Normally, it is fairly easy to make this decision. However, in other instances, determining the correct series may not be as obvious.

Use the following guidelines to determine the predominant series when the work of a position matches more than one job family or occupational group. Also, when the work of a position falls into more than one series within this job family, it may be difficult to determine which particular series predominates. In such situations, apply the guidelines below in the order listed to determine the correct series.

- **Paramount knowledge required.** Although there may be several different kinds of work in the position, most positions will have a paramount knowledge requirement. The paramount knowledge is the most important type of subject matter knowledge or experience required to do the work.
- **Reason for existence.** The primary purpose of the position or management's intent in establishing the position is a positive indicator for determining the appropriate series.
- **Organizational mission and/or function.** Positions generally align with the mission and function of the organization to which they are assigned. The organization's function is often mirrored in the organizational title and may influence the appropriate series.
- **Recruitment source.** Supervisors and managers can help by identifying the occupational series that provides the best qualified applicants to do the work. This is closely related to the paramount knowledge required.

Although the work of some positions may require applying professional mathematical or related knowledge and skills, classification as professional positions in the Mathematics Sciences Group, 1500, may not be appropriate. The [Additional Occupational Considerations](#) section of this JFS provides examples where the work may involve applying related knowledge and skills, but not to the extent that it warrants classification to this job family.

Additional information may be found in OPM's publication [The Classifier's Handbook](#).

## Classifying Professional Scientific Work

**Professional scientific work** involves exercising discretion, analytical skill, judgment, personal accountability and responsibility for creating, developing, integrating, applying, and sharing an organized body of knowledge that characteristically is:

- uniquely acquired through extensive education or training at a recognized college or university;
- equivalent to the curriculum requirements for a bachelor's or higher degree with major study in or pertinent to the specialized field; and
- continuously studied to explore, extend, and use additional discoveries, interpretations, and applications to improve data quality, materials, equipment, applications, and methods.

### Interdisciplinary Professional Positions

An interdisciplinary position is a position involving duties and responsibilities closely related to more than one professional occupation. As a result, you could classify the position into two or more professional occupational series. The nature of the work is such that persons with education and experience in two or more professions may be considered equally well qualified to do the work. In both categories the position description should show clearly that the position is interdisciplinary and indicate the various series in which the position could be classified. The final classification of the position is determined by the qualifications of the person selected to fill it.

For further guidance on the use and classification of interdisciplinary positions, refer to [The Classifier's Handbook](#).

## Distinguishing Between Professional and Technical Work

It is important to determine whether a position is comprised of technical or professional work. It is not always easy to differentiate between the two because some tasks are common to both. The developmental work of professional positions and the demanding work of high level technical positions are sometimes similar. Typical distinctions between technician and professional work follow.

### **Professional Work Involves:**

- Applying a range and depth of knowledge acquired specifically through intensive learning of the phenomena, theories, and concepts of a scientific body of knowledge.
- Creating, exploring, evaluating, and sharing solutions for scientific, mathematical, and/or statistical problems, methods, conditions, and issues.
- Understanding theories, concepts, principles, and their relationships underlying the practice of a professional scientific discipline to achieve improvements in the efficiency and quality of work performed and/or to protect the public's interests in the quality of life, health, infrastructures, and natural resources.
- Identifying, analyzing, advising, consulting, and reporting on scientific, theoretical, and factual data, conditions, and problems.
- Independently assessing, resolving, and predicting the relationships and interactions of data and findings under varying conditions.
- Reasoning using existing knowledge and assumptions in a professional scientific field to conceptualize unexplored areas and phenomena.
- Staying abreast of professional literature, and analyzing and evaluating research issues and data.
- Applying professional knowledge and skills; scientific, mathematical, and/or statistical theories; and assumptions, interactions, and relationships.
- Exploring, creating, and extending solutions, and applications of a particular professional scientific field, discipline, industry, or technology.
- Understanding and applying predetermined procedures, methods, and standardized practices or approaches in a specialized field of industry, technology, or science.

### **Technical Work Involves:**

- Understanding and applying predetermined procedures, methods, and standardized practices or approaches in a narrow, specialized field of industry, technology, or science.
- Using and completing recurring methods, standardized procedures, and established processes for a specialized field in industry, technology, or science.
- Handling difficult work requiring originality, independent initiative, and practical judgment.
- Carrying out tasks, methods, procedures, and computations based on oral instructions and/or precedents, guidelines, and standards.
- Collecting, observing, testing, and recording factual and scientific data within the oversight and management of professional employees.
- Foreseeing the effects of procedural changes or appraising the validity of results on the basis of experience and practical reasoning.
- Staying abreast of existing and new practical methods and applications through on-the-job and classroom training.
- Applying practical knowledge and skills; scientific mathematical, and/or statistical practices, methods, and standards; and using tools in practical situations.
- Supporting a particular industry, technology, or professional scientific field.

## Official Titling Provisions

Title 5, United States Code, requires OPM to establish the authorized official position title that includes a basic title (e.g., Mathematical Statistician) that may be appended with one or more prefixes and/or suffixes. Agencies must use the official position titles for human resources management, budget, and fiscal purposes. Instructions for assigning official position titles are provided for specific series in this section.

### Supervisors and Leaders

- Add the prefix “Supervisory” to the basic title when the agency classifies the position as supervisory. If the position is covered by the General Schedule refer to the [General Schedule Supervisory Guide](#) for additional titling and grading information.
- Add the prefix “Lead” to the basic title when the agency classifies the position as leader. If the position is covered by the General Schedule refer to the [General Schedule Leader Grade Evaluation Guide](#) for additional titling and grading information.

### Research Positions

- Add the prefix “Research” to the basic title when the work satisfies the criteria for research as defined in the [Research Grade Evaluation Guide](#).

### Specialty or Parenthetical Titles

Specialty titles are typically displayed in parentheses and referred to as parenthetical titles. OPM has not prescribed parenthetical titles for five of the series in this JFS:

- General Mathematics and Statistics, 1501;
- Actuarial Science, 1510;
- Operations Research, 1515;
- Mathematics, 1520; and
- Mathematical Statistics, 1529.

For these five series agencies may supplement the basic position titles with agency established specialty titles if necessary for recruitment or other human resources needs. However, for the Statistics series, 1530, this standard prescribes the use of the following specialty titles:

<b>Agriculture</b>	<b>Engineering</b>
<b>Biology</b>	<b>Health</b>
<b>Demography</b>	<b>Medicine</b>
<b>Economics</b>	<b>Operations and Administration</b>
<b>Education</b>	<b>Social Science</b>

Agencies may use only the above listed specialty titles to supplement the basic titles for the Statistics series, 1530.

### Organizational Titles

Organizational and functional titles do not replace, but complement official position titles. Agencies may establish organizational and functional titles for internal administration, public convenience, program management, or similar purposes. Examples of organizational titles are Branch Chief and Division Chief. Examples of functional titles are Chief of Operations and Chief of Policy Development.

## Functional Classification Codes

**Functional Classification for Professional Work.** The National Science Foundation (NSF) manages a system of functional classification codes to describe the work done by scientists and engineers. NSF uses these data to conduct studies of the science and engineering workforce. To meet the needs of the NSF, OPM requires agencies to document and maintain functional classification codes for positions in science and engineering occupations. [The Guide to Personnel Data Standards](#) provides a list of the applicable occupations and definitions of the functional classification codes. Use established internal agency procedures to assign the appropriate code for positions covered by series in this JFS. A complete list of valid functional classification codes is given below.

Category	Code
Research	11
Research contract and grant administration	12
Development	13
Testing and evaluation	14
Design	21
Construction	22
Production	23
Installation, operations, and maintenance	24
Data collection, processing, and analysis	31
Scientific and technical information	32
Standards and specifications	41
Regulatory enforcement and licensing	42
Natural resource operations	51
Clinical practice, counseling, and ancillary medical services	81
Planning	91
Management	92
Teaching and training	93
Technical assistance and consulting	94
Other – Not elsewhere classified	99

<b>Information by Series in Number Order</b>	
<b>General Mathematics and Statistics, 1501</b>	<ul style="list-style-type: none"> <li>• <a href="#">Series Definition</a></li> <li>• <a href="#">Titling</a></li> <li>• <a href="#">Occupational Information</a></li> </ul>
<b>Actuarial Science, 1510</b>	<ul style="list-style-type: none"> <li>• <a href="#">Series Definition</a></li> <li>• <a href="#">Titling</a></li> <li>• <a href="#">Occupational Information</a></li> </ul>
<b>Operations Research, 1515</b>	<ul style="list-style-type: none"> <li>• <a href="#">Series Definition</a></li> <li>• <a href="#">Titling</a></li> <li>• <a href="#">Occupational Information</a></li> </ul>
<b>Mathematics, 1520</b>	<ul style="list-style-type: none"> <li>• <a href="#">Series Definition</a></li> <li>• <a href="#">Titling</a></li> <li>• <a href="#">Occupational Information</a></li> </ul>
<b>Mathematical Statistics, 1529</b>	<ul style="list-style-type: none"> <li>• <a href="#">Series Definition</a></li> <li>• <a href="#">Titling</a></li> <li>• <a href="#">Occupational Information</a></li> </ul>
<b>Statistics, 1530</b>	<ul style="list-style-type: none"> <li>• <a href="#">Series Definition</a></li> <li>• <a href="#">Titling</a></li> <li>• <a href="#">Occupational Information</a></li> </ul>

## Occupational Information by Series

<b>GENERAL MATHEMATICS AND STATISTICS, 1501</b>		<a href="#"><u>Qualification Standards</u></a>
<b>Series Definition</b>	<p>This series covers positions that manage, supervise, lead, or perform scientific work of a mathematical, statistical, or actuarial nature. This series is applicable when the work of the position:</p> <ul style="list-style-type: none"> <li>• is covered by two or more professional series in the Mathematical Sciences Group, 1500, and no one professional series predominates; or</li> <li>• is not covered by any one professional series in the Mathematical Sciences Group, but is related closely to work in the Mathematical Sciences Group, 1500.</li> </ul> <p>This series requires a <a href="#"><u>functional classification code</u></a>.</p>	
<b>Titling</b>	<p>There is no basic title specified for this series. Agencies may construct titles that appropriately describe the work. Do not use titles authorized for other series to construct titles for this series.</p>	
<b>Occupational Information</b>	<p><b>General Occupational Information</b></p> <p>There is no specific occupational information for this series due to its broad coverage. See other individual series in this job family for occupational information.</p> <p>The criteria for classifying positions to this series are distinct from the criteria for classifying an <a href="#"><u>interdisciplinary position</u></a>. For further guidance, refer to <a href="#"><u>The Classifier's Handbook</u></a>.</p> <p><a href="#"><u>⇐BACK TO TABLE OF CONTENTS</u></a></p>	

<b>ACTUARIAL SCIENCE, 1510</b>		<u><a href="#">Qualification Standards</a></u>
<b>Series Definition</b>	<p>This series covers positions that manage, supervise, lead, or perform scientific work in the field of actuarial science. Actuarial science involves professional knowledge of the disciplines of mathematics, statistics, business, finance, economics, and insurance. The work requires applying this knowledge to programs or problems related to the financial risks posed by life, health, retirement/pension, and property/casualty entities and contingencies.</p> <p>This series requires a <a href="#">functional classification code</a>.</p>	
<b>Titling</b>	<p>The basic title for this occupation is <i>Actuary</i>.</p>	
<b>Occupational Information</b>	<p><b>General Occupational Information</b></p> <p>Actuaries in the Federal Government evaluate the financial status of Federal programs designed to help protect individuals, businesses, and pension plans against adverse financial contingencies. They also play an active role in designing, modifying, and administering these Government programs and in providing the facts and estimates that serve as the foundation for management decisions and actions in administering these programs. These programs include:</p> <ul style="list-style-type: none"> <li>- Old Age, Survivors, and Disability Insurance (commonly known as Social Security);</li> <li>- Supplemental Security Income (cash assistance for low income, aged, blind, and disabled persons);</li> <li>- Medicare (hospital insurance and supplementary medical insurance for the aged and disabled);</li> <li>- Medicaid (health care for low income persons);</li> <li>- Unemployment Insurance;</li> <li>- Pension Benefit Guarantee Insurance;</li> <li>- private pensions and other employee benefit plans;</li> <li>- property insurance programs such as crop, hail, and flood insurance;</li> <li>- life and health insurance, retirement and disability pensions, and other benefits for Federal military and civilian employees;</li> <li>- insurance plans protecting mortgages, loans, savings, and investments;</li> <li>- estate, gift, and other tax regulations applicable to trusts, pension funds, insurance programs, gifts, etc.; and</li> <li>- pension and unemployment benefits for retired employees.</li> </ul> <p>Many Federal programs involve Federal trust funds that have specific financing sources that must be adequate to cover promised benefits and other expenditures.</p> <p><b>Actuarial Functions</b></p> <p>Actuaries deal with the financial, economic, and social aspects of a rapidly changing world. Today there are frequent discoveries in science and medicine, and growing complexities in business and finance. Actuaries ensure the financial viability of programs designed to protect individuals, groups, and businesses against the uncertain risk of future financial loss. They evaluate their past projections against actual experience to determine the economic and social forces at work. Actuaries apply these findings to create future projections.</p> <p>Because most programs involve a large amount of data, actuaries often study samples. They ensure that their study samples accurately reflect the population studied and that they are using the most suitable statistical tools to solve a problem.</p>	

(continued)

**ACTUARIAL SCIENCE, 1510 (continued)****Major Actuarial Services**

Actuaries provide the following nine principal services:

- **Cost Estimation** – involves projecting future program cost estimates to form the basis for estimating staffing needs and service capabilities.
- **Financial Status Evaluation** – requires the actuary to compare estimated future program revenues and expenditures, often over long periods, to assess trust fund adequacy. Federal law frequently requires formal public reports on program financial status.
- **Insurance Valuation** – involves calculating and compiling:
  - mortality, morbidity, and disability tables;
  - retirement, withdrawal, and remarriage rates;
  - joint and survivorship values;
  - annuity and insurance values; and
  - reserve and trust fund values.

These valuations are used to determine the stability of programs, the value of assets and liabilities, and compliance with legal requirements.

- **Financial Projection** – involves estimating future expenditure levels for benefits, administration, and other Federal program costs. In many cases, the actuaries also estimate future program revenues. The projections involve the following activities:
  - estimating future program participants such as insured persons, beneficiaries, and taxpayers;
  - calculating growth rates for various economic and programmatic factors such as the consumer product index, wages, health care prices, and utilization; and
  - projecting incidence of certain risks such as death, disability, hospital admission, and pension plan termination.

Some of these projections are used in documents such as the Annual Budget, Social Security and Medicare Board of Trustees reports, and the Consolidated Financial Statement of the U.S. Government.

- **Legislative Proposal Evaluation** – involves estimating or projecting the cost, impact, and actuarial soundness of proposed legislation. The actuaries must prepare their study findings and supporting evidence in nontechnical language for presentation to lay persons. To ensure proper interpretation and implementation of their recommendations, some actuaries work closely with attorneys and other personnel who are drafting proposed legislative and regulatory changes.
- **Calculating Program Cost** – involves determining pay and salary premiums, wage thresholds, health service payment updates, cost of living benefit increases, beneficiary coinsurance levels, and a host of other statutory factors.
- **Consultation** – involves advising policy makers on how to create effective and reliable programs for addressing financial security. Some Government actuaries frequently work closely with members of Congress and their staffs, key administration officials, national advisory commissions, and others. They promote these relationships to ensure that their proposals will function as intended and that the financial and operational implications are carefully considered.

Occupational Information (continued)

(continued)

**ACTUARIAL SCIENCE, 1510 (continued)**

Occupational Information (continued)

- **Improving Public Understanding** – involves making presentations and participating in public forums to explain financial status, costs, technical operations, and other program characteristics. Actuaries frequently take a leading role in improving public understanding of complex programs.
- **Publishing Professional Findings** – involves presenting research, study, and analytical findings at professional conferences and in professional journals for critical review by qualified professionals. Critiques in these forums play a necessary and invaluable role in advancing both the profession and individual actuaries. Actuaries may perform many functions that require an actuarial background, but do not require writing an equation, proving a theorem, or performing any activity that involves applied mathematics. Their unique contribution is to communicate to their readers the mathematical considerations that underlie their and others' research, analysis, and study findings.

Actuaries typically specialize in one or more of the following categories of actuarial work:

- **Retirement Benefits** – including employer-sponsored defined benefit and defined contribution pension plans, social security, and other cash retirement income sources.
- **Health Insurance** – including individual policies (e.g., “Medigap”), employer-sponsored plans, Government programs, and delivery systems such as health maintenance organizations, preferred provider organizations, and fee-for-service indemnity plans.
- **Other Group Insurance** – including protection offered through employers, unions, trade and professional associations, and other organizations against the financial risks posed by such factors as death, disability, workplace accidents or illnesses, and legal fees.
- **Other Individual Insurance** – including life insurance, annuities, disability insurance, and reinsuring other insurance products for high claim amounts.
- **Finance** – including corporate finance, financial intermediation, capital management, and financial risk management.
- **Investments** – including pension and other accumulated reserve funds, asset management, and asset/liability matching.
- **Property and Casualty Insurance** – including business insurance, malpractice and other professional liability insurance, worker's compensation, homeowner's insurance, and automobile insurance.

[⇐BACK TO TABLE OF CONTENTS](#)

<b>OPERATIONS RESEARCH, 1515</b>		<u><a href="#">Qualification Standards</a></u>
<b>Series Definition</b>	<p>This series covers positions that manage, supervise, lead, or perform scientific work that involves designing, developing, and adapting mathematical, statistical, econometric, and other scientific methods and techniques. The work also involves analyzing management problems and providing advice and insight about the probable effects of alternative solutions to these problems. The primary requirement of the work is competence in the rigorous methods of scientific inquiry and analysis.</p> <p>This series requires a <a href="#">functional classification code</a>.</p>	
<b>Titling</b>	<p>The basic title for this occupation is <i>Operations Research Analyst</i>.</p>	
<b>Occupational Information</b>	<p><b>General Occupational Information</b></p> <p>Operations research is:</p> <ul style="list-style-type: none"> <li>• an advisory function that utilizes a structured approach to problem solving;</li> <li>• a rigorous process of scientific inquiry and analysis applicable to unique or recurring problems that confront decision makers; and</li> <li>• the systematic examination and development of alternative courses of action to define and clarify the advantages and disadvantages of available choices.</li> </ul> <p>The primary purpose of operations research analysis is to provide decision makers with sound, scientific, and quantitative information as a basis for making decisions. These decisions are often made under the following types of conditions:</p> <ul style="list-style-type: none"> <li>• uncertainty arising from a lack of current experience and knowledge;</li> <li>• conflicts in objectives;</li> <li>• a variety of possible alternative; and/or</li> <li>• the failure of current systems to meet goals.</li> </ul> <p><b>Types of Operations Research Work</b></p> <p>Operations research analysts perform the following two broad types of work:</p> <ul style="list-style-type: none"> <li>• <b>Methods Development and Assessment</b> – involves applying expert knowledge of particular classes of problems and the ability to develop associated problem solving methods. Analysts may specialize in one or more areas including queuing theory, optimization methods, simulation, or artificial intelligence. They advise other operations research analysts, scientists, or engineers on techniques best suited for analyzing their problems.</li> <li>• <b>Problem Solving</b> – involves the ability to work directly to correct deficiencies or improve the performance of systems, processes, or operations. Analysts doing this type of work are expert in methods of problem solving and also have an in-depth knowledge of recurring or persistent subject matter problems.</li> </ul> <p><b>Multidisciplinary Approaches</b></p> <p>A key requirement of operations research analysis is the ability to work across disciplinary boundaries and to develop multidisciplinary solutions to complex problems. For example, evaluating the capability of a high performance fighter/bomber to reach and destroy its target may involve issues relating to:</p> <ul style="list-style-type: none"> <li>• aeronautical, electrical, electronic, and mechanical engineering;</li> <li>• physics;</li> <li>• mathematics; and</li> <li>• economics.</li> </ul>	

(continued)

**OPERATIONS RESEARCH, 1515 (continued)**

Analysts usually deal with a variety of broad issues, subject matter areas, and problems. Each assignment presents a different question. Over time, analysts may gain considerable knowledge of some specialty fields, yet operations research knowledge remains paramount. Analysts often borrow and adapt analytical methods and modify techniques from other scientific, technical, and analytical disciplines. Similarly, professionals in other fields may use the operations research approach to solve problems in their disciplines.

**The Operations Research Analysis Process**

The framework for the operations research analysis process is best understood in terms of concepts and phases.

**Concepts**

Three key concepts—systems, relationships, and models—are important in understanding the analytical process involved in problem solving. Each concept is described below:

- A **system** is a group of interrelated, interacting, or interdependent elements forming a complex whole. A process or operation may be a system. In this job family standard, the term *system* refers to the process and operation of analysis.
- A **relationship** is a statement about the similarities, differences, or interactions of two or more quantities or measurements called variables. For example, a tall person probably weighs more than a short person. The two measurements of height and weight are relative variables. There are other variables that relate to weight, such as the person's bone structure and body type. A person's height and any of the other variables may establish a relationship. Much of the work of operations research lies in identifying the proper variables and their true relationships for use in solving a particular problem or evaluating alternatives.
- A **model** is a representation of the relationships that define a system or situation under study. It may be a set of mathematical equations, a computer program, a hand-played game, a written scenario, an experiment, or other type of representation ranging from verbal statements to physical objects. Models permit the manipulation of variables to determine how a process, object, or concept would behave in different situations, without using the time, risk, or expense of actual real world implementation.

**Phases**

The analytical process has four phases: problem definition, model development, hypothesis testing and investigation, and predictions/explanations. Each phase is described below.

- **Problem Definition** – usually takes the form of “what if” questions. In formulating problem statements, analysts examine the objectives and criteria of systems to make sure they are studying the right problems. They determine the context of problems to identify the:
  - principal decisions made;
  - relevant variables and true relationships;
  - alternative choices;
  - measures of effectiveness or success that distinguish among the alternatives; and
  - constraints.

Occupational Information (continued)

(continued)

## Operations Research, 1515 (continued)

Occupational Information (continued)

- **Model Development** – represents the important factors of the problem and their relationships to selected features of the real world. Models permit experimentation and extend the evaluation of system performance and reliability beyond the scope of practical testing. Analyses done with models may be the only means to forecast performance for certain kinds of systems, for example, the world economy or combat.

Using models leads to discovering cause and effect relationships that may otherwise go undetected. Analysts develop or select models with which they can experiment to develop and explore choices or hypotheses. They determine if the models describe the systems under study and test their reality by measuring their sensitivity to various values of appropriate variables. After showing that a model is a fair representation of reality, or that its limitations are acceptable for the current study, the model can be useful for analyses.

Mathematical models cannot solve some problems. These problems usually include intangible characteristics that quantitative terms cannot express. Foremost among such characteristics is the presence of the human element.

- **Hypothesis Testing and Investigation** – is repeated throughout the analytical process. The process involves successive integration of analogies, patterns, and relationships, and usually involves feedback and further restructuring. For new types of problems, analyses constitute a continuous cycle of formulating problems, selecting the objectives, designing better alternatives, collecting data, building new models, weighing costs against performance, questioning assumptions and data, reexamining objectives, and identifying new alternatives.
- **Predictions/Explanations** – are the end result of analyses. Analysts predict future events or explain past events. They recommend the best alternatives, if they are found, and present relevant tradeoffs and limitations so decision makers can make informed choices or take appropriate action.

[⇐BACK TO TABLE OF CONTENTS](#)

<b>MATHEMATICS, 1520</b>		<u><a href="#">Qualification Standards</a></u>
<b>Series Definition</b>	<p>This series covers positions that manage, supervise, lead, or perform scientific work that involves:</p> <ul style="list-style-type: none"> <li>• conducting research on basic mathematical principles, methods, procedures, techniques, or relationships; or</li> <li>• developing mathematical methods to solve a variety of scientific, engineering, economic, and/or military problems where precise specification of the relationships, rigor and economy of mathematical operations, and logical deduction are the controlling considerations.</li> </ul> <p>This series requires a <a href="#">functional classification code</a>.</p>	
<b>Titling</b>	<p>The basic title for this occupation is <i>Mathematician</i>.</p>	
<b>Occupational Information</b>	<p><b>General Occupational Information</b></p> <p>Traditionally mathematics consists of two generic types of work: pure or abstract mathematics, and applied mathematics.</p> <ul style="list-style-type: none"> <li>• <b>Pure or Abstract Mathematics</b> – is sometimes referred to as basic research. Relatively few mathematicians perform basic research. This work involves studying and developing principles for their own sake and possible future rather than immediate usefulness. Pure or abstract mathematics applies to areas of mathematics such as: <ul style="list-style-type: none"> <li>– differential geometry;</li> <li>– topology;</li> <li>– combinatorics;</li> <li>– discrete equations;</li> <li>– network theory; and</li> <li>– graph theory.</li> </ul> </li> <li>• <b>Applied Mathematics</b> – concerns mathematical aspects of the physical, natural, and social sciences. In a restricted sense, the term refers to using mathematical principles as tools in the fields of physics, chemistry, engineering, biology, and the social sciences. Many mathematicians perform work in applied mathematics. Typical areas of applied mathematics are: <ul style="list-style-type: none"> <li>– linear and nonlinear ordinary and partial differential equations;</li> <li>– numerical analysis;</li> <li>– finite element and finite differences methods;</li> <li>– integral equations;</li> <li>– inverse scattering;</li> <li>– neural nets;</li> <li>– computational geometry;</li> <li>– visualization;</li> <li>– virtual reality;</li> <li>– robotics;</li> <li>– solid and fluid modeling;</li> <li>– linear and nonlinear control; and</li> <li>– nonlinear dynamics.</li> </ul> </li> </ul>	

(continued)

**MATHEMATICS, 1520 (continued)**

Occupational Information (contd)

Mathematicians perform these types of activities:

- modeling mathematical problems in various disciplines;
- analyzing mathematical models;
- developing computational methods and computer codes; and
- comparing the computational results with observations or experiments.

[⇐BACK TO TABLE OF CONTENTS](#)

<b>MATHEMATICAL STATISTICS, 1529</b>		<u><a href="#">Qualification Standards</a></u>
<b>Series Definition</b>	<p>This series covers positions that manage, supervise, lead, or perform:</p> <ul style="list-style-type: none"> <li>• scientific work that involves designing, developing, and adapting mathematical methods and techniques to statistical processes; or</li> <li>• research that relates to the basic theories and science of statistics.</li> </ul> <p>This series requires a <a href="#">functional classification code</a>.</p>	
<b>Titling</b>	<p>The basic title for this occupation is <i>Mathematical Statistician</i>.</p>	
<b>Occupational Information</b>	<p><b>General Occupational Information</b></p> <p>Mathematical statisticians perform duties in which the “problem” is the basic work unit. The size and complexity of the problem varies extensively. Solving a problem usually requires that the mathematical statistician use standard research procedures. These procedures, sometimes referred to as the scientific method, include the following seven basic work processes:</p> <ul style="list-style-type: none"> <li>• defining problems;</li> <li>• conducting background research;</li> <li>• planning;</li> <li>• conducting investigations;</li> <li>• reducing findings to facts;</li> <li>• interpreting findings; and</li> <li>• documenting findings.</li> </ul> <p>The science of mathematical statistics is a body of theories and methods for obtaining knowledge. Mathematical statisticians do not merely rely on a collection of facts; instead they are characterized by the techniques that they develop to design models for collecting quantified data. Mathematical statisticians design and use methods that provide the technical framework for such activities as:</p> <ul style="list-style-type: none"> <li>• developing sampling strategies to collect data;</li> <li>• discovering the meaning of facts;</li> <li>• performing methodological research;</li> <li>• analyzing data and generating inferences about the real world based on analysis;</li> <li>• ensuring the accuracy of measurements that data represent;</li> <li>• evaluating the precision and validity of estimates;</li> <li>• investigating sources and magnitude of error in data;</li> <li>• planning and executing sample or census surveys;</li> <li>• designing and conducting experiments;</li> <li>• analyzing experimental design;</li> <li>• performing operations research; and</li> <li>• instituting procedures for quality control in production.</li> </ul>	

(continued)

**MATHEMATICAL STATISTICS, 1529 (continued)**

Occupational Information (continued)

Mathematical statisticians apply or are guided by concepts, theories, methods, and techniques such as:

- probability;
- statistical estimation;
- data analysis;
- linear model analysis;
- time series analysis;
- survey design;
- questionnaire design;
- statistical quality control;
- sampling theory;
- methodological research and development;
- statistical and mathematical modeling; and
- random processing of problems related to testing, estimation, and prediction.

Their objective in this work is to design or use techniques that provide a basis for investigating the reliability, validity, precision of measurement, probability of inferences, and risk of error in statistical outcomes.

Statistical means of inquiry may be applicable to any area of investigation. After mathematical statisticians develop substantive knowledge of a subject matter, they may readily transfer their professional knowledge to another subject matter field. The methods are fundamentally the same whether the employee applies them to:

- analyze physical phenomena;
- design, conduct, and analyze medical experiments;
- develop management control data;
- examine quantitative material in economics; or
- investigate other scientific fields.

The mathematical statisticians' work assignments follow a variety of patterns. For example:

- **As part of research teams, they:**
  - measure, correlate, and reduce to numerical form phenomena that is best observed using mathematical or statistical methods; and
  - frequently serve as staff advisors to various subject matter specialists on the potentials and limitations of statistical methods.
- **As leading statistical agency authorities, they:**
  - make recommendations to senior officials on interpreting multiple, conflicting, or incomplete data;
  - advise senior officials on technical issues central to initiating new statistical programs or major revisions to current statistical programs;
  - research new sampling and/or estimation techniques for statistics;
  - publish state-of-the-art statistical study findings; and
  - make presentations at professional meetings and conferences.
- **In collecting data, they:**
  - serve as program technical advisors;
  - design or adapt mathematical and statistical tools;
  - develop methods and select techniques that other statisticians and/or subject matter specialists use;
  - conduct methodological research to improve sample surveys or experimental designs; and
  - conduct evaluations of data collection, reduction, processing, and analysis methodologies.

(continued)

**MATHEMATICAL STATISTICS, 1529 (continued)**

Occupational Information (continued)

- **As consultants and mathematical statistical analysts, they:**
  - develop or review sampling plans and all the essential elements of sample design, including:
    - determining sample size;
    - allocating optimum total sample size to strata or clusters;
    - specifying methods of sample selection and estimation; and
    - measuring the magnitude and direction of bias, if any; and
  - conduct research and development to improve the design and performance of sample surveys, experimental designs, and clinical trials, including:
    - applying mathematical statistical theory, techniques, and methods to statistical studies and surveys;
    - analyzing the accuracy and validity of prior statistical data;
    - determining if planned operations and processes are appropriate;
    - recommending improvements for collecting and analyzing statistical data;
    - preparing and disseminating technical documentation of work;
    - being on the forefront of developing new statistical methods and performing cutting edge research to solve statistical problems; and
    - developing and conducting statistical computing research involving record linkage, time series modeling, seasoned adjustment, and demographic forecasting.
- **In conducting mathematical statistical research**, in contrast to subject matter research, mathematical statisticians help to develop new, or improve existing, statistical theories and techniques.

[⇐BACK TO TABLE OF CONTENTS](#)

<b>STATISTICS, 1530</b>		<u><a href="#">Qualification Standards</a></u>								
<b>Series Definition</b>	<p>This series covers positions that manage, supervise, lead, or perform scientific work or provide professional consultation in applying statistical theories, techniques, and methods to gather, analyze, interpret, and/or report quantified information.</p> <p>This series requires a <a href="#">functional classification code</a>.</p>									
<b>Titling</b>	<p>The basic titles for this occupation are <i>Survey Statistician</i> or <i>Statistician</i>.</p> <p>Use the title <i>Survey Statistician</i> for positions primarily concerned with:</p> <ul style="list-style-type: none"> <li>• overall planning or executing complete surveys of any size, or parts of large surveys, including initial negotiations or development of the survey; and</li> <li>• establishing general specifications and detailed time schedules that govern the following:                             <ul style="list-style-type: none"> <li>– data content, collection, and dissemination;</li> <li>– instrument design;</li> <li>– analysis; and</li> <li>– modifying systems design.</li> </ul> </li> </ul> <p>Use the title <i>Statistician</i> when the work of the position does not satisfy the criteria for use of the title Survey Statistician.</p> <p>Use the appropriate specialty title shown in the left column of the table below with the basic titles, Survey Statistician or Statistician, when the work matches the corresponding bulleted criteria in the right column. If work does not match the criteria, do not use a specialty title.</p> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;"><b>Specialty Titles</b></th> <th style="text-align: left;"><b>Criteria</b></th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"><b>Agriculture</b></td> <td> <ul style="list-style-type: none"> <li>• crop production and crop acreage;</li> <li>• livestock production and inventories;</li> <li>• farm commodity prices and incomes;</li> <li>• consumption of agricultural products;</li> <li>• farm labor, farm property values;</li> <li>• finance, marketing, and transportation; and</li> <li>• related agricultural topics.</li> </ul> </td> </tr> <tr> <td style="vertical-align: top;"><b>Biology</b></td> <td> <ul style="list-style-type: none"> <li>• managing and controlling biotic forms and protection;</li> <li>• tracking the life processes of plants and animals including animal and fish population inventories; and</li> <li>• experiments in pest control.</li> </ul> </td> </tr> <tr> <td style="vertical-align: top;"><b>Demography</b></td> <td> <ul style="list-style-type: none"> <li>• human populations and their characteristics including:                             <ul style="list-style-type: none"> <li>– distribution, migration and growth, fertility/fecundity, mortality, marriage and divorce; and</li> <li>– individual social and economic characteristics such as age, education, occupation, and attitudes.</li> </ul> </li> </ul> </td> </tr> </tbody> </table>		<b>Specialty Titles</b>	<b>Criteria</b>	<b>Agriculture</b>	<ul style="list-style-type: none"> <li>• crop production and crop acreage;</li> <li>• livestock production and inventories;</li> <li>• farm commodity prices and incomes;</li> <li>• consumption of agricultural products;</li> <li>• farm labor, farm property values;</li> <li>• finance, marketing, and transportation; and</li> <li>• related agricultural topics.</li> </ul>	<b>Biology</b>	<ul style="list-style-type: none"> <li>• managing and controlling biotic forms and protection;</li> <li>• tracking the life processes of plants and animals including animal and fish population inventories; and</li> <li>• experiments in pest control.</li> </ul>	<b>Demography</b>	<ul style="list-style-type: none"> <li>• human populations and their characteristics including:                             <ul style="list-style-type: none"> <li>– distribution, migration and growth, fertility/fecundity, mortality, marriage and divorce; and</li> <li>– individual social and economic characteristics such as age, education, occupation, and attitudes.</li> </ul> </li> </ul>
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(continued)

**STATISTICS, 1530 (continued)**

<b>Titling (continued)</b>	<b>Specialty Titles (continued)</b>	<b>Criteria (continued)</b>
	<b>Economics</b>	<ul style="list-style-type: none"> <li>• characteristics of economic activity such as:                             <ul style="list-style-type: none"> <li>– inputs, outputs, and product lines;</li> <li>– industry concentrations, inventories, and capital expenditures;</li> <li>– payroll and employment, labor force, consumption, and international trade; and</li> <li>– investments, prices, income, savings, taxation, money and credit, value added, personal consumption expenditures, gross domestic product, and other topics not related to agriculture.</li> </ul> </li> </ul>
	<b>Education</b>	<ul style="list-style-type: none"> <li>• the educational function including problems of teaching and learning, and such topics as staff, students, income, property, organization, and curricula of educational institutions.</li> </ul>
	<b>Engineering</b>	<ul style="list-style-type: none"> <li>• engineering activity and experimentation including statistical quality control;</li> <li>• acceptance sampling procedures for raw materials; and</li> <li>• manufactured or processed products.</li> </ul>
	<b>Health</b>	<ul style="list-style-type: none"> <li>• the causes, incidence, and cost of accidents, disease, and disabling illness including epidemiological research and administering medical care, disability insurance, and public health programs.</li> </ul>
	<b>Medicine</b>	<ul style="list-style-type: none"> <li>• studies in etiology (cause), diagnosis, treatment, prevention, and cure of human disease based on laboratory, clinical, or epidemiological research.</li> </ul>
	<b>Operations and Administration</b>	<ul style="list-style-type: none"> <li>• studies on the problems of management and operations related to:                             <ul style="list-style-type: none"> <li>– jobs, people, material, equipment, methods, attitudes;</li> <li>– working conditions, financial management, program evaluation; and</li> <li>– control, cost modeling, and statistical analysis of accounting systems.</li> </ul> </li> </ul>
	<b>Social Science</b>	<ul style="list-style-type: none"> <li>• rural and urban sociology;</li> <li>• criminology;</li> <li>• racial problems; and</li> <li>• social work, social insurance, and welfare services administered by State and local Government, excluding economics.</li> </ul>
<b>Occupational Information</b>	<b>General Occupational Information</b>	
	<p>The word statistics means a group of facts stated numerically. Statistics also refers to:</p> <ul style="list-style-type: none"> <li>• the body of theory and methods used to collect, classify, and evaluate quantitative facts as a basis for inference;</li> <li>• a body of techniques to obtain valid, measurable results from incomplete information; and</li> <li>• a scientific system for describing, organizing, analyzing, interpreting, and presenting information in numerical form.</li> </ul>	

(continued)

**STATISTICS, 1530 (continued)****Survey Statisticians**

A survey is a scientific method of gathering information from a sample of individuals, households, firms, institutions, or other units of analysis so that results can be generalized to the entire population. The validity of survey results depends on selecting the sample so that each unit has a measurable chance of selection and collecting information using standardized, replicable procedures. Survey statisticians apply statistical theories and techniques to:

- plan, organize, and operate programs for collecting, verifying, adjusting, processing, summarizing, analyzing, and presenting information numerically; and
- conduct research to evaluate data quality.

Survey statisticians collect primary data from original sources and secondary data from records, instruments, or reports established for historical, administrative, regulatory, or quality control purposes. They also select or sample data.

Although the decisions of survey statisticians rest on a sound foundation of statistical principles, they also require other specialized knowledge.

Occupational Information (continued)

The responsibilities of survey statisticians involve the following:

- defining useful measurements for specific purposes;
- determining the best and most efficient ways to collect quantitative information;
- determining the feasibility of reducing a problem to one in which objective measurements can be taken;
- planning, organizing, and overseeing the operation of a survey;
- selecting the most appropriate survey methods within cost considerations;
- devising measurement methods to assess the completeness of a survey sampling universe;
- devising surveys or processes that will capture the missing elements in a survey sampling universe;
- developing procedures to ensure that the sampling universe for repetitive surveys are kept up to date;
- developing or reviewing questionnaires, instructions, and schedules to ensure structural soundness;
- planning the development of related data for comparison;
- establishing systems of classification and coding;
- organizing a reporting system on a production basis;
- establishing the sequence of collection, summarization, and representation;
- planning necessary quality checks and controls;
- solving statistical problems that occur in survey collection and summarization processes;
- reducing the survey process as far as possible to a routine that support personnel can manage;
- establishing procedures for data storage and retrieval;
- planning data dissemination systems; and
- conducting in-depth analysis of data and disseminating the results of those analyses.

In some situations, a single statistician may be responsible for the entire survey process. In other situations, particularly with large statistical organizations, survey statisticians may specialize in particular functions such as survey planning, data collection, data processing, or data analysis and dissemination as described below:

- **Survey Planning** – involves developing and formulating overall plans for complete surveys or parts of surveys by using general objectives and methods. In survey planning, statisticians develop:
  - overall procedures;
  - forms design;
  - cost estimates;

(continued)

**STATISTICS, 1530 (continued)**

Occupational Information (continued)

- activity and time schedules;
- timetables;
- specific plans for quality control and production control systems;
- staff requirements;
- general data collection specifications;
- general data processing requirements;
- general survey documentation;
- particular statistical methods and techniques applicable to the subject matter involved; and
- statistical software and computer programs to perform analysis of statistical data and findings.

- **Data Collection** – involves establishing general data collection specifications that translate into detailed, practical plans for data collection systems. In data collection, statisticians:
  - write training manuals, procedural manuals, and related materials;
  - design scientific instruments and procedures governing the administrative and technical features of the data collection system;
  - plan and implement pretesting plans for survey instruments; and
  - estimate and control budgetary and financial, supply and space, human resources, public relations, and other general administrative management requirements of the data collection system.

Statisticians can perform the actual data collection phase of the survey in compliance with all previous plans and procedures, quality checks appropriate for the particular survey, and troubleshooting methods applicable to problems in the field. Their assignments typically include responsibility for explaining:

- unexpected data or trends; and
- inconsistent survey findings.

- **Data Processing** – involves establishing general processing specifications that translate into detailed, practical plans for data processing systems. In data processing, statisticians:
  - design large systems to control incoming data collection materials; and
  - develop plans for production management that include staffing plans, procedures, backlog scheduling, and programming for tabulation methods.

- **Data Analysis and Dissemination** – involves interpreting findings to draw substance and meaning from them and planning statistical publications where knowledge of statistical presentation (e.g., tabulation, classification, and charting techniques) is a paramount requirement. In data analysis and dissemination, statisticians:
  - conduct statistical analyses of data using appropriate statistical methodologies;
  - summarize initial data;
  - review, analyze, coordinate, and/or revise statistical reports, volumes, and releases; and
  - consolidate published or publishable statistical research and writings into complete documents or books such as statistical compendia (Statistical Abstract or Historical Statistics).

The proper technical documentation of the statistical methods statisticians use is an essential part of data publication and requires professional knowledge and understanding of the statistical principles that serve as a basis for surveys.

In all of these activities, survey statisticians preserve the statistical validity intended in the original survey design and must exercise professional knowledge of pertinent statistical principles and techniques.

(continued)

**STATISTICS, 1530 (continued)**

Occupational Information (continued)

**Statisticians**

Statisticians may use data derived from a probability sample. They are usually responsible for the design, size, and characteristics of the probability samples that are necessary to ensure the reliability of data.

Statisticians may provide advice or be directly involved in collecting primary data. They examine data collected by others to help them understand its implications and limitations for the problem under study. Further, statisticians evaluate data collection and statistical methodologies, and develop better data collection methods.

Statisticians organize data into a format that facilitates the required analysis and communicates the results to data users. The organization of data takes different forms depending upon the problem under investigation. For example, if one is interested in changes over time, statisticians present the data in a different manner than when one is interested in the current period's totals. The problem may involve comparing data easily with masses of similar data and analyzing differences, or developing complex models to support in-depth analysis of data, illustrate and interpret findings, and disseminate findings to a variety of constituents.

Statistical functions are numerous and vary extensively, but fully qualified statisticians are typically able to determine:

- whether the problem is amenable to statistical inquiry;
- kinds of data needed;
- necessary data sources;
- new or improved methods for obtaining data, and their estimated cost and limitations; and
- the most appropriate methods for analyzing and interpreting data.

Statisticians are responsible for:

- analyzing findings, evaluating the statistical limitations of available data, and specifying the range of logically possible explanations of the findings;
- discovering the meaning of facts; and
- presenting original or derived data in their most pertinent form, which may include text, graphs, charts, tables, and models.

These responsibilities require knowledge of:

- statistical theory;
- statistical methods and techniques; and
- statistical software and computer programs to perform computer analysis of statistical data and findings.

(continued)

**STATISTICS, 1530 (continued)**

Occupational Information (continued)

Some statisticians apply statistical theory and methods to solve problems in a subject matter field. To ensure effectiveness, statisticians must acquire considerable knowledge not only about the detail but also about the theory of the subject under study. The work requires that they become familiar with both the general and the specific knowledge of the field. They must understand the:

- general magnitude and characteristics of the subject under study;
- various categories of data;
- technical language involved;
- major controlling factors in the field and their general relationships;
- cycles, trends, sources, validity, limitations, and interrelationships of the data involved;
- need for selecting facts to quantify, and determining which are relevant, important, or extraneous;
- agency programs and objectives and the special and continuing problems involved; and
- data collection mechanisms and limitations.

Statistical techniques apply to any subject matter field in which numerical expression may represent the facts. In applied statistics the statistician uses these techniques to solve specific problems requiring quantitative data or problems inherent in selecting, collecting, analyzing, interpreting, and presenting such information. The statistician seeks to derive meaningful relationships from data, and/or to measure the significance of quantified data usually relating to a particular subject matter field.

Examples of the various kinds of statistical techniques that statisticians use include:

- analysis of frequency distributions;
- analysis and modeling of multivariates;
- sampling;
- analysis of variance;
- determining confidence limits; and
- estimating magnitudes.

A high order of judgment is required in adapting or applying appropriate techniques and interpreting results. Such judgment is necessary to initially determine whether a problem is amenable to statistical inquiry and to formulate and plan the entire investigation.

[⇐BACK TO TABLE OF CONTENTS](#)

## Distinguishing Among the Covered Occupations

### Mathematical Statistics, 1529, versus Mathematics, 1520

Mathematical statistics differs from mathematics in the following areas:

- concentration on the body of mathematical theory related to probability and inference; and
- mathematical processes and techniques associated with statistics.

### Mathematical Statistics, 1529, versus Statistics, 1530

Mathematical statistics differs from statistics in the following areas:

- focus on mathematical techniques and methods of the statistical process; and
- scope of mathematical theory necessary to the job function.

Mathematical statisticians design statistical tools. They are concerned less with applying statistical techniques than with the usefulness of statistical tools in terms of the quality, reliability, and validity of the data they yield.

## Impact of Automation

Automation greatly affects the way mathematical and statistical products and services are delivered. Many mathematical and statistical professionals do scientific computation and data reduction work that involves translating mathematical equations into compatible computer programs. Techniques that lend themselves well to information technology include:

- computer simulations;
- optimization;
- matrix methods;
- ordinary and partial differential equations;
- Monte Carlo methods; and
- Boolean Algebra.

The information technology tools involved and the skill required to use them generally replace or supplement work previously done manually or by machines. Automation does not change the primary purpose of the work or the paramount knowledge required to do the work, which is a professional knowledge of mathematics, statistics, or actuarial science. Properly classifying positions in these occupations is based on the relevant knowledge and skills required to do the professional mathematics, statistics, and/or actuarial duties of the position.

### Additional Occupational Considerations

Some positions may include professional work requiring knowledge and skills typically associated with the Mathematical Science Group, 1500. In some cases, a closer look at the work may reveal that classification to a series in this job family may not be always be appropriate. The [General Series Determination Guidelines](#) section of this JFS offers guidance on selecting the most appropriate series.

The following table provides examples of work that is similar to that performed in the 1500 job family, but not to the extent that the paramount knowledge required, the reason for the position’s existence, the mission and/or function of the organization, and the recruitment source for the best qualified candidates would warrant classification to a series in this JFS.

NOTE: In the table that follows, the term job family position classification standard is abbreviated as JFS.

If Work Involves ...	See This Standard or Series Definition:
Adjudicating claims by applying knowledge of insurance laws, regulations, and procedures.	<a href="#">0105, Social Insurance Administration</a>  <a href="#">0107, Health Insurance Administration</a>  <a href="#">0991, Workers’ Compensation Claims Examining</a>  <a href="#">0993, Railroad Retirement Claims Examining</a>  <a href="#">0996, Veteran Claims Examining</a>
Applying specialized methods to quantify, measure, and understand economic problems, phenomena, and relationships.	<a href="#">0110, Economist</a>
Performing professional work related to the behavior, capacities, traits, interests, and activities of human and animal organisms.	<a href="#">0180, Psychology</a>
Evaluating the effectiveness, efficiency, and productivity of the management of Government programs or operations.	<a href="#">0343, Management and Program Analysis</a>
Planning and programming the budget system by applying knowledge of financial laws, constraints, and programming rules.	<a href="#">JFS for Professional and Administrative Work in the Accounting and Budget Group, 0500</a>
Performing nonprofessional technical support work in actuarial, mathematical, statistical, operations research, or other sciences, or administrative support processes that relate to these sciences.	<a href="#">1521, Mathematics Technician</a>  <a href="#">1531, Statistical Assistant</a>  <a href="#">1541, Cryptanalysis</a>

<b>Crosswalk to the Standard Occupational Classification</b>					
<p>The Office of Management and Budget requires that all Federal agencies that collect occupational data use the Standard Occupational Classification (SOC) system for statistical data reporting purposes. The Bureau of Labor Statistics uses SOC codes for the National Compensation Survey and other statistical reporting. OPM and other Federal agencies maintain a “crosswalk” between OPM authorized occupational series and the SOC codes to serve this need. This requirement and these SOC codes have no effect on the administration of any Federal human resources management system. The information in this table is for information only and has no direct impact on classifying positions covered by this job family standard. The SOC codes shown here generally apply only to nonsupervisory positions in these occupations. As changes occur to the SOC codes, OPM will update this table. More information about the SOC is available at <a href="http://stats.bls.gov/soc">http://stats.bls.gov/soc</a>.</p>					
<b>Federal Occupational Series and Position Titles and Their Related Standard Occupational Classification System Codes</b>					
<b>Federal Occupational Series</b>	<b>Standard Occupational Classification Code Based on Occupational Series</b>		<b>Position Title</b>	<b>Standard Occupational Classification Code Based on Position Title</b>	
General Mathematics and Statistics, 1501	15-2099	Mathematical Science Occupations, All Other	No Specified Title	15-2099	Mathematical Science Occupations, All Other
Actuarial Science, 1510	15-2011	Actuaries	Actuary	15-2011	Actuaries
Operations Research, 1515	15-2031	Operations Research Analysts	Operations Research Analyst	15-2031	Operations Research Analysts
Mathematics, 1520	15-2021	Mathematicians	Mathematician	15-2021	Mathematicians
Mathematical Statistics, 1529	15-2041	Statisticians	Mathematical Statistician	15-2041	Statisticians
Statistics, 1530	15-2041	Statisticians	Statistician	15-2041	Statisticians
			Statistician (Agriculture)	15-2041	Statisticians
			Statistician (Biology)	15-2041	Statisticians
			Statistician (Demography)	15-2041	Statisticians
			Statistician (Economics)	15-2041	Statisticians
			Statistician (Education)	15-2041	Statisticians
			Statistician (Engineering)	15-2041	Statisticians
			Statistician (Health)	15-2041	Statisticians
			Statistician (Medicine)	15-2041	Statisticians

(continued)

<b>Federal Occupational Series and Position Titles and Their Related Standard Occupational Classification System Codes (continued)</b>				
<b>Federal Occupational Series</b>	<b>Standard Occupational Classification Code Based on Occupational Series</b>		<b>Position Title</b>	<b>Standard Occupational Classification Code Based on Position Title</b>
			Statistician (Operations and Administration)	15-2041 Statisticians
			Statistician (Social Science)	15-2041 Statisticians
			Survey Statistician	15-2041 Statisticians
			Survey Statistician (Agriculture)	15-2041 Statisticians
			Survey Statistician (Biology)	15-2041 Statisticians
			Survey Statistician (Demography)	15-2041 Statisticians
			Survey Statistician (Economics)	15-2041 Statisticians
			Survey Statistician (Education)	15-2041 Statisticians
			Survey Statistician (Engineering)	15-2041 Statisticians
			Survey Statistician (Health)	15-2041 Statisticians
			Survey Statistician (Medicine)	15-2041 Statisticians
			Survey Statistician (Operations and Administration)	15-2041 Statisticians
			Survey Statistician (Social Science)	15-2041 Statisticians

## PART II – GRADING INFORMATION

Part II provides grading information for use in determining the appropriate grade of nonsupervisory two-grade interval professional positions in the Mathematical Sciences Group, 1500. These grading criteria are applicable to General Schedule positions classified under chapter 51 of title 5, United States Code. They may also be used as appropriate to determine work levels for other Federal position classification systems. You will find more complete instructions for evaluating positions in the following OPM publications: [Introduction to the Position Classification Standards](#) and [The Classifier's Handbook](#).

### How To Use This Grading Information

Evaluate positions on a factor by factor basis using the factor level descriptions (FLDs) provided in this standard. Compare each factor in the position description to the appropriate FLDs and illustrations. If the factor information in the position description fully matches an FLD for the series and specialty, you may assign the level without reviewing the illustrations. FLDs are progressive or cumulative in nature. For example, each FLD for Factor 1 – Knowledge Required by the Position encompasses the knowledge and skills identified at the previous level. Use only designated point values.

The FLDs in this standard cover nonsupervisory positions at grades GS-5 through GS-15. Evaluate supervisory, leader, test and evaluation, research grants, and research positions by applying the appropriate [functional guide](#).

Use the occupation- and specialty-specific [factor illustrations](#) following the FLDs as a frame of reference for applying factor level concepts. Do not rely solely on illustrations in evaluating positions, because they reflect a limited range of actual work examples. The level of work described in some illustrations may be higher than the threshold for a particular factor level. If the factor information in the position description fails to fully match a relevant illustration, but does fully match the FLD, you may still assign the level.

For each factor, record the factor level used, the points assigned, and relevant comments on the [Position Evaluation Summary Worksheet](#). Convert the total points to a grade using the Grade Conversion Table, and record the grade in the Summary section of the Worksheet. The shaded portions of the table reflect the most commonly found grades in this job family.

**Grade Conversion Table**

Point Range	GS Grade
855-1100	5
1105-1350	6
1355-1600	7
1605-1850	8
1855-2100	9
2105-2350	10
2355-2750	11
2755-3150	12
3155-3600	13
3605-4050	14
4055-4480	15

## Position Evaluation Summary Worksheet

Organization \_\_\_\_\_

Position # \_\_\_\_\_

Evaluation Factors	Factor Level Used (FL#, etc.)	Points Assigned	Comments
1. Knowledge Required by the Position			
2. Supervisory Controls			
3. Guidelines			
4. Complexity			
5. Scope and Effect			
6/7. Personal Contacts and Purpose of Contacts			
8. Physical Demands			
9. Work Environment			
<b>S U M M A R Y</b>	<b>Total Points</b>		
	<b>Grade Conversion</b>		

Additional Remarks:

Title, Series, and Grade Assigned:

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Agencies may copy for local use.

## Factor Level Descriptions

### FACTOR 1 – KNOWLEDGE REQUIRED BY THE POSITION

Factor 1 measures the nature and extent of information or facts that an employee must understand to do acceptable work (e.g., steps, procedures, practices, rules, policies, theories, principles, and concepts) and the nature and extent of the skills necessary to apply that knowledge. You should only select a factor level under this factor when the knowledge described is required and applied.

<b>Level 1-5</b>		<b>750 Points</b>												
Series	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center; padding: 5px;"><b>General Mathematics and Statistics</b></td> <td style="text-align: center; padding: 5px;"><b>1501</b></td> <td style="text-align: center; padding: 5px;"><b>Mathematics</b></td> <td style="text-align: center; padding: 5px;"><b>1520</b></td> </tr> <tr> <td style="text-align: center; padding: 5px;"><b>Actuarial Science</b></td> <td style="text-align: center; padding: 5px;"><b>1510</b></td> <td style="text-align: center; padding: 5px;"><b>Mathematical Statistics</b></td> <td style="text-align: center; padding: 5px;"><b>1529</b></td> </tr> <tr> <td style="text-align: center; padding: 5px;"><b>Operations Research</b></td> <td style="text-align: center; padding: 5px;"><b>1515</b></td> <td style="text-align: center; padding: 5px;"><b>Statistics</b></td> <td style="text-align: center; padding: 5px;"><b>1530</b></td> </tr> </table>	<b>General Mathematics and Statistics</b>	<b>1501</b>	<b>Mathematics</b>	<b>1520</b>	<b>Actuarial Science</b>	<b>1510</b>	<b>Mathematical Statistics</b>	<b>1529</b>	<b>Operations Research</b>	<b>1515</b>	<b>Statistics</b>	<b>1530</b>	
<b>General Mathematics and Statistics</b>	<b>1501</b>	<b>Mathematics</b>	<b>1520</b>											
<b>Actuarial Science</b>	<b>1510</b>	<b>Mathematical Statistics</b>	<b>1529</b>											
<b>Operations Research</b>	<b>1515</b>	<b>Statistics</b>	<b>1530</b>											
FLD	<p>Knowledge of and skill in applying:</p> <ul style="list-style-type: none"> <li>• basic mathematical, statistical, or financial theories;</li> <li>• basic authoritative references;</li> <li>• routine formulas, operating procedures, and data processing practices;</li> <li>• related technical tasks (e.g., computer programming, financial management, or engineering); and</li> <li>• professional academic training in methods and principles</li> </ul> <p>sufficient to:</p> <ul style="list-style-type: none"> <li>• perform routine, scientific, or technical tasks and projects;</li> <li>• perform recurring tasks or calculations;</li> <li>• follow oral or written technical instructions and work in close cooperation with other workers; and</li> <li>• complete training assignments that familiarize the employee with the organization’s program requirements, techniques, and procedures.</li> </ul>													

<b>Level 1-6</b>				<b>950 Points</b>	
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics 1520</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics 1529</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics 1530</b>	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	Professional knowledge of and skill in applying:				
	<ul style="list-style-type: none"> <li>principles, theories, concepts, and methodology of the specific occupation;</li> <li>automated systems and computer programs;</li> <li>data sources;</li> <li>statutory and regulatory provisions</li> </ul>				
sufficient to:					
<ul style="list-style-type: none"> <li>research, analyze, interpret, evaluate, and perform difficult, but well precedented assignments;</li> <li>learn techniques and gain knowledge through either job experience and/or extended professional training (e.g., relevant graduate study) that supplements technical understanding;</li> <li>conduct analytical investigations using scientific methodology and problem solving;</li> <li>perform, interpret, and correlate various calculations, analyses, and computations for unknown factors or relationships that are primarily matters of a factual nature or involve mechanisms that are well understood;</li> <li>use computers and information technology and their varied applications to accomplish projects, designs, plans, and reports; and</li> <li>select and modify appropriate methods of operation, analyze and interpret results, and prepare reports.</li> </ul>					

<b>Level 1-7</b>				<b>1250 Points</b>	
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics 1520</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics 1529</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics 1530</b>	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	Professional knowledge of and skill in applying a wide range of complex analytical, mathematical, statistical, or actuarial theories, principles and practices sufficient to:				
	<ul style="list-style-type: none"> <li>perform the full range of specialized duties;</li> <li>plan, coordinate, and execute studies of marked difficulty and responsibility;</li> <li>apply modeling techniques and procedures;</li> <li>develop mathematical algorithms;</li> <li>write statistical computer programs;</li> <li>design and perform computer simulations;</li> <li>analyze data using probability statistics and trend analysis;</li> <li>design sample surveys; and</li> <li>modify established methods.</li> </ul>				

<b>Level 1-8</b>				<b>1550 Points</b>
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics 1520</b> <a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics 1529</b> <a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics 1530</b> <a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	Mastery of and skill in applying broad areas of classical and modern advanced actuarial science, operations research, mathematics, or statistics; or specialized areas within the respective disciplines sufficient to:			
	<ul style="list-style-type: none"> <li>• complete assignments that involve initiating, applying, and planning major developmental studies;</li> <li>• execute and control projects that represent an important segment of the agency’s operating programs and/or projects;</li> <li>• serve as a consultant and technical advisor to senior subject matter specialists and/or agency officials responsible for broad program operations;</li> <li>• receive recognition as an authority in a particular specialty;</li> <li>• provide significant and innovative recommendations for advancing programs and/or methods;</li> <li>• use findings of specialized studies, new analytical developments, and modified processes to resolve novel or obscure problems that affect broad program operations;</li> <li>• evaluate the data resulting from applying mathematical or statistical tools, models, methods, and techniques; and</li> <li>• act as the authoritative source of technical input to publications or other documents that are the basis for formulating public policy.</li> </ul>			

<b>Level 1-9</b>				<b>1850 Points</b>
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics 1520</b> <a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics 1529</b> <a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>		<b>Statistics 1530</b> <a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	Mastery of and skill in applying the principles, theories, and methodologies of a specialty area as it relates to the respective disciplines of mathematics, statistics, operations research, or actuarial science sufficient to:			
	<ul style="list-style-type: none"> <li>• provide expert consultation to heads of major organizations, high-ranking Government officials, and key personnel within or outside the Federal Government;</li> <li>• formulate, test, and evaluate new theories, principles, concepts, and practices of the discipline;</li> <li>• advance state-of-the-art theories beyond established parameters;</li> <li>• serve as an authoritative representative of the agency within or outside the Federal Government (e.g., by serving as an expert in a specialty area at professional conferences);</li> <li>• earn recognition as a major contributor to published research studies or pioneering efforts that produce advanced theories, innovative applications, new scientific principles, or new research techniques; and</li> <li>• provide management with expert technical guidance and recommendations for achieving the agency’s objectives.</li> </ul>			

**FACTOR 2 – SUPERVISORY CONTROLS**

This factor covers the nature and extent of direct or indirect controls exercised by the supervisor, or a designated individual, over the work performed, the employee’s responsibility, and review of completed work. The controls apply to both how supervisors assign and review work. The supervisor determines what information the employee needs to perform the assignments (e.g., instructions, priorities, deadlines, objectives, and boundaries). Review controls may range from detailed inspection of work in progress, to simply confirming that the work adheres to agency policy. The employee’s responsibilities complement the supervisory controls (e.g., if the supervisor does not establish the sequence in which the work is to be done, it becomes an employee responsibility). The primary components of this factor are presented below in three categories: **How Work Is Assigned, Employee Responsibility, and How Work Is Reviewed.**

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

<b>Level 2-1</b>		<b>25 Points</b>
FLD	<p><b>How Work Is Assigned</b> – The supervisor or a delegated alternate assigns work that consists of routine requirements and developmental tasks designed to prepare the employee for higher level work. They provide:</p> <ul style="list-style-type: none"> <li>• detailed instructions on how to use and select specific methods, procedures, and techniques; and</li> <li>• deadlines and priorities.</li> </ul> <p><b>Employee Responsibility</b> – The employee:</p> <ul style="list-style-type: none"> <li>• performs work as instructed;</li> <li>• consults with the supervisor or designated employee when clarification of instructions is necessary; and</li> <li>• receives guidance on problems and work methods not specifically covered by the original instructions.</li> </ul> <p><b>How Work Is Reviewed</b> – The supervisor or a delegated alternate closely checks work in progress and work results for accuracy, and evaluates the employee’s rate of development. As the employee progresses professionally and becomes more competent in certain work areas, the supervisor gradually relaxes control over work in progress, but continues to closely review and evaluate the work for accuracy.</p>	

<b>Level 2-2</b>		<b>125 Points</b>
FLD	<p><b>How Work Is Assigned</b> – The supervisor or designated employee instructs the employee on work objectives and its scope, limitations, expected deadlines, and priorities. The supervisor may provide more detailed instructions when assigning work of a type that the employee has not previously done.</p> <p><b>Employee Responsibility</b> – The employee:</p> <ul style="list-style-type: none"> <li>• uses initiative in carrying out recurring assignments;</li> <li>• works independently, but within the framework the supervisor established;</li> <li>• conforms with established practices and prescribed procedures; and</li> <li>• refers problems not covered by the instructions or guides to the supervisor for help or a decision.</li> </ul> <p><b>How Work Is Reviewed</b> – The supervisor or designated employee:</p> <ul style="list-style-type: none"> <li>• reviews completed work closely to verify accuracy and conformance to policy or procedural requirements and any special instructions;</li> <li>• reviews findings and conclusions to ensure they are supported by facts; and</li> <li>• reviews in detail the more difficult work that the employee has not previously done.</li> </ul>	

<b>Level 2-3</b>		<b>275 Points</b>
FLD	<p><b>How Work Is Assigned</b> – The supervisor or designated employee outlines or discusses possible problem areas and defines objectives, plans, priorities, and deadlines. Assignments have clear precedents requiring successive steps in planning and execution.</p> <p><b>Employee Responsibility</b> – The employee:</p> <ul style="list-style-type: none"> <li>• independently plans and carries out assignments in conformance with accepted policies and practices;</li> <li>• adheres to instructions, policies, and guidelines in exercising judgment to resolve commonly encountered work problems and deviations; and</li> <li>• brings controversial information or findings to the supervisor’s attention for direction.</li> </ul> <p><b>How Work Is Reviewed</b> – The supervisor or designated employee:</p> <ul style="list-style-type: none"> <li>• provides assistance on controversial or unusual situations that do not have clear precedents;</li> <li>• reviews completed work for conformity with policy, the effectiveness of the employee’s approach to the problem, technical soundness, adherence to deadlines, and accomplishment of objectives; and</li> <li>• performs limited review of the methods used to complete the assignment.</li> </ul>	

<b>Level 2-4</b>		<b>450 Points</b>
FLD	<p><b>How Work Is Assigned</b> – The supervisor outlines available resources and overall objectives of the work. The employee and supervisor, in consultation, discuss scope of the assignment, approaches, timeframes, and possible execution phases.</p> <p><b>Employee Responsibility</b> – The employee:</p> <ul style="list-style-type: none"> <li>• plans and carries out the assignment;</li> <li>• resolves most of the conflicts that arise;</li> <li>• coordinates the work with others as necessary;</li> <li>• interprets policy and regulatory requirements;</li> <li>• keeps the supervisor informed of progress and potentially controversial problems, concerns, and issues;</li> <li>• develops changes to plans and/or methodology; and</li> <li>• provides recommendations for improvements to meet program objectives.</li> </ul> <p><b>How Work Is Reviewed</b> – The supervisor reviews completed work for soundness of overall approach, adherence to requirements, achievement of expected results, and the feasibility of recommendations. The supervisor usually does not review methods used.</p>	

	<b>Level 2-5</b>	<b>650 Points</b>
<b>FLD</b>	<p><b>How Work Is Assigned</b> – The supervisor provides administrative direction for projects in terms of broadly defined missions or functions of the agency.</p> <p><b>Employee Responsibility</b> – The employee:</p> <ul style="list-style-type: none"><li>• is responsible for a significant agency or equivalent level program or function;</li><li>• defines objectives;</li><li>• interprets policies promulgated by authorities senior to the immediate supervisor and determines their effect on program needs;</li><li>• exercises a wide degree of independent professional discretion and judgment; and</li><li>• independently plans, designs, and carries out the work to be done.</li></ul> <p><b>How Work Is Reviewed</b> – The supervisor:</p> <ul style="list-style-type: none"><li>• reviews work for potential impact on broad agency policy objectives and program goals;</li><li>• normally accepts work as being technically authoritative; and</li><li>• normally accepts work without significant change.</li></ul>	

## FACTOR 3 – GUIDELINES

This factor covers the nature of guidelines and the judgment employees need to apply them. The availability of specific, applicable guidelines may vary with individual assignments; thus, the judgment employees use similarly varies with the assignment. The existence of detailed plans and other instructions may make innovation in planning and conducting work unnecessary or undesirable. However, in the absence of guidance provided by prior agency experience with the task at hand or when objectives are broadly stated, the employee may use considerable judgment in developing an approach or planning the work. The following are examples of guidelines used in professional work in the Mathematical Sciences Group, 1500:

- Agency regulations, directives, procedures, rulings, and initiatives
- Legislation and requirements covering program operations (e.g., Employee Retirement Income Security Act, Social Security Act, Retirement Protection Act)
- Data merging system documentation
- Professional association and private sector standards of practice, conduct, procedures, and certification (e.g., American Hospital Association, Blue Cross Blue Shield)
- Military directives
- Agency developed systems performance, testing, and life cycle management handbooks, specifications, and instructions
- Agency developed technical manuals and standard operating procedure guidance (e.g., statistical analysis, cost analysis/estimating, auditing, optimization, design of experiments, quality assurance, and mathematical modeling)
- Computer software and hardware manuals
- Precedent data, studies, models, and cases
- Tables, charts, forms, and maps (e.g., life expectancy, properties, interest rates, productivity, mileage)
- Guidelines, circulars, and regulations of other agencies and organizations such as the Office of Management and Budget, Office of Personnel Management, Department of Labor, Department of the Treasury, Pension Benefit Guaranty Corporation, Internal Revenue Service, and functional regulations (e.g., the Federal Acquisitions Regulations)
- Files and records, such as previous audit reports
- Technical reports (e.g., reports of capabilities, performance, effectiveness, test results)
- Treaties (e.g., U.S. Canada Salmon Treaty)
- Established data collection, sampling, investigative, and examining procedures
- Traditional budgetary practices, procedures, and policies

Do not confuse guidelines with the knowledge described under Factor 1 – Knowledge Required by the Position. The primary components of this factor are: **Guidelines Used** and **Judgment Needed**.

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

	<b>Level 3-2</b>	<b>125 Points</b>
FLD	<p><b>Guidelines Used</b> – The employee uses a number of guidelines that are directly applicable to the assignment. Guidelines prescribe established procedures and techniques and provide clear precedents.</p> <p><b>Judgment Needed</b> – The employee:</p> <ul style="list-style-type: none"> <li>• uses judgment in selecting and applying the most appropriate guidelines;</li> <li>• determines the appropriateness and applicability of any minor deviations within existing guidelines; and</li> <li>• refers to the supervisor situations to which the existing guidelines cannot be applied or that require significant deviations.</li> </ul>	

<b>Level 3-3</b>		<b>275 Points</b>
FLD	<p><b>Guidelines Used</b> – The employee uses a wide variety of reference materials and manuals; however, they are not always directly applicable to the work, or they have gaps in specificity. Precedents are available outlining the preferred approach to more general problems or issues.</p> <p><b>Judgment Needed</b> – The employee is expected to apply guidelines accurately and articulate the reasons for modifying specific guidelines to address unusual situations.</p>	

<b>Level 3-4</b>		<b>450 Points</b>
FLD	<p><b>Guidelines Used</b> – The employee uses guidelines and precedents that are very general regarding agency policy statements and objectives. Guidelines specific to assignments are often scarce, not applicable, or have gaps in specificity that require considerable interpretation and/or adaptation for application to issues and problems.</p> <p><b>Judgment Needed</b> – The employee uses judgment, initiative, and resourcefulness in deviating from established methods to:</p> <ul style="list-style-type: none"> <li>• modify, adapt, and/or refine broader guidelines to resolve specific complex and/or intricate issues and problems;</li> <li>• deal with specific issues or problems;</li> <li>• research trends and patterns;</li> <li>• develop new methods and criteria; and/or</li> <li>• propose new policies and practices.</li> </ul>	

<b>Level 3-5</b>		<b>650 Points</b>
FLD	<p><b>Guidelines Used</b> – The employee uses guidelines such as broad policy statements, basic legislation, recent scientific findings, or reports that are often ambiguous and require extensive interpretation.</p> <p><b>Judgment Needed</b> – The employee uses considerable judgment and ingenuity and exercises broad latitude to:</p> <ul style="list-style-type: none"> <li>• determine the intent of new or revised guidelines;</li> <li>• develop policy and guidelines for specific areas of work; and</li> <li>• interpret policy statements, regulations, and methods development plans.</li> </ul>	

## FACTOR 4 – COMPLEXITY

This factor covers the nature, number, variety, and intricacy of tasks, steps, processes, or methods in the work performed; the difficulty in identifying what needs to be done; and the difficulty and originality involved in performing the work. The primary components of this factor are: **Nature of Assignment, What Needs To Be Done,** and **Difficulty and Originality Involved.**

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

<b>Level 4-2</b>		<b>75 Points</b>															
<b>Series</b>	<table style="width: 100%; border: none;"> <tr> <td style="width: 30%; padding: 5px;"><b>General Mathematics and Statistics</b></td> <td style="width: 10%; padding: 5px;"><b>1501</b></td> <td style="width: 30%; padding: 5px;"><b>Mathematics</b></td> <td style="width: 10%; padding: 5px;"><b>1520</b></td> <td style="width: 20%; padding: 5px;"><a href="#">Illustration(s)</a></td> </tr> <tr> <td style="padding: 5px;"><b>Actuarial Science</b></td> <td style="padding: 5px;"><b>1510</b></td> <td style="padding: 5px;"><a href="#">Illustration(s)</a></td> <td style="padding: 5px;"><b>Mathematical Statistics</b></td> <td style="padding: 5px;"><b>1529</b></td> </tr> <tr> <td style="padding: 5px;"><b>Operations Research</b></td> <td style="padding: 5px;"><b>1515</b></td> <td style="padding: 5px;"><b>Statistics</b></td> <td style="padding: 5px;"><b>1530</b></td> <td style="padding: 5px;"><a href="#">Illustration(s)</a></td> </tr> </table>	<b>General Mathematics and Statistics</b>	<b>1501</b>	<b>Mathematics</b>	<b>1520</b>	<a href="#">Illustration(s)</a>	<b>Actuarial Science</b>	<b>1510</b>	<a href="#">Illustration(s)</a>	<b>Mathematical Statistics</b>	<b>1529</b>	<b>Operations Research</b>	<b>1515</b>	<b>Statistics</b>	<b>1530</b>	<a href="#">Illustration(s)</a>	
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<b>Actuarial Science</b>	<b>1510</b>	<a href="#">Illustration(s)</a>	<b>Mathematical Statistics</b>	<b>1529</b>													
<b>Operations Research</b>	<b>1515</b>	<b>Statistics</b>	<b>1530</b>	<a href="#">Illustration(s)</a>													
<b>FLD</b>	<p><b>Nature of Assignment</b> – Work consists of specific related tasks that provide experience in the methods, practices, and procedures of the field.</p> <p><b>What Needs To Be Done</b> – The employee decides what needs to be done by choosing from various alternatives. The employee may rely on established procedures and practices when making these decisions.</p> <p><b>Difficulty and Originality Involved</b> – When doing the work, the employee must recognize differences among a few easily distinguishable situations.</p>																

<b>Level 4-3</b>		<b>150 Points</b>	
<b>Series</b>	<b>General Mathematics and Statistics</b> <b>1501</b>	<b>Mathematics</b> <b>1520</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b> <b>1510</b>	<b>Mathematical Statistics</b> <b>1529</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b> <b>1515</b>	<b>Statistics</b> <b>1530</b>	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<p><b>Nature of Assignment</b> – Work consists of assisting and participating with senior staff in:</p> <ul style="list-style-type: none"> <li>• responding to more complex requests for technical data concerning mathematical and statistical programs;</li> <li>• consulting on the proper use of data and applying data to specific mathematical or statistical problems; and</li> <li>• performing analytical services.</li> </ul>		
	<p><b>What Needs To Be Done</b> – The employee decides what needs to be done by:</p> <ul style="list-style-type: none"> <li>• analyzing scientific data through computational processes;</li> <li>• comparing data from various reference sources or research agencies to identify correlating factors; and</li> <li>• interpreting the data and explaining the mathematical or statistical techniques and limitations, and the significance of their use to the specific problem; and</li> <li>• planning and preparing special reports, statistical materials, and mathematical documentation.</li> </ul>		
	<p><b>Difficulty and Originality Involved</b> – The employee must recognize and apply an understanding of interrelationships among different functions and activities to determine the most appropriate technique for processing or presenting data.</p>		

<b>Level 4-4</b>				<b>225 Points</b>		
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics</b>	<b>1520</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b>	<b>1529</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics</b>	<b>1530</b>	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<p><b>Nature of Assignment</b> – Work consists of carrying out the technical aspects of various mathematical or statistical programs or activities, processes, and methods.</p>					
	<p><b>What Needs To Be Done</b> – To decide what needs to be done, the employee must:</p> <ul style="list-style-type: none"> <li>• research, analyze, test, and evaluate information, unusual circumstances, and conventional issues, conditions, and problems;</li> <li>• reconcile different, incomplete, and often conflicting information and alternatives;</li> <li>• evaluate problems and situations with conflicting requirements when solutions may have serious implications for industry, commercial concerns, the environment, or the general public; and</li> <li>• determine economic, effective, and feasible solutions to meet the project requirements and constraints.</li> </ul>					
	<p><b>Difficulty and Originality Involved</b> – The employee uses judgment and originality to:</p> <ul style="list-style-type: none"> <li>• plan the sequence, direction, and progress of the work;</li> <li>• interpret and justify actions, determinations, and recommendations;</li> <li>• discern or devise creative solutions and actions that resolve issues, conditions, and problems;</li> <li>• modify, adapt, and/or refine existing applications, processes, precedents, and techniques; and</li> <li>• persuade others to accept, adopt, and act on recommendations and determinations.</li> </ul>					

<b>Level 4-5</b>		<b>325 Points</b>		
<b>Series</b>	<b>General Mathematics and Statistics</b> 1501		<b>Mathematics</b> 1520	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b> 1510	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b> 1529	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b> 1515	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics</b> 1530	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<p><b>Nature of Assignment</b> – Work consists of various duties of marked complexity, significance, and importance performed in areas where precedents are inadequate, inappropriate, or nonexistent.</p>			
	<p><b>What Needs To Be Done</b> – The employee decides the most effective approach or methodology by:</p> <ul style="list-style-type: none"> <li>• identifying, developing, and integrating pertinent information through various data collection/analysis procedures and technologies;</li> <li>• anticipating major problems; and</li> <li>• recognizing future needs.</li> </ul>			
<p><b>Difficulty and Originality Involved</b> – The employee must:</p> <ul style="list-style-type: none"> <li>• develop innovative approaches to complex situations or problems that are unique and amorphous;</li> <li>• develop mathematical or statistical relationships that are new or significant departures from the relationships established in previous problems, studies, or investigations, causing outcomes that are usually original in nature;</li> <li>• apply and adapt sophisticated analytical, mathematical, or statistical techniques and occasionally principles of related disciplines such as engineering, finance, or economics to resolve problems;</li> <li>• generate ideas for new programs, policies, or approaches;</li> <li>• visualize the impact of alternative strategies and methods;</li> <li>• assess the feasibility, effectiveness, and necessity of unusual approaches; and</li> <li>• identify the effects associated with implementing proposed standards, regulations, and policies.</li> </ul>				

<b>Level 4-6</b>		<b>450 Points</b>	
<b>Series</b>	<b>General Mathematics and Statistics</b> 1501	<b>Mathematics</b> 1520	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b> 1510	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b> 1529
	<b>Operations Research</b> 1515	<b>Statistics</b> 1530	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<p><b>Nature of Assignment</b> – Work consists of assignments that involve solving problems characterized by:</p> <ul style="list-style-type: none"> <li>• impacts on broad functional areas and processes; and</li> <li>• exceptional breadth and intensity of effort.</li> </ul>		
	<p><b>What Needs To Be Done</b> – The employee must decide what needs to be done in an environment characterized by undefined factors and conditions. The employee must conduct extensive investigations and analyses of the nature and scope of problems to make those decisions.</p>		
	<p><b>Difficulty and Originality Involved</b> – The employee must continually:</p> <ul style="list-style-type: none"> <li>• plan and lead efforts to address issues in areas where precedents do not exist;</li> <li>• develop new concepts, theories, approaches, or programs to solve problems that have previously resisted solution; and</li> <li>• often pursue several activities concurrently or sequentially with the support of others within or outside the agency.</li> </ul>		

**FACTOR 5 – SCOPE AND EFFECT**

This factor covers the relationships between the nature of work; i.e., the purpose, breadth, and depth of the assignment, and the effect of work products or services both within and outside the organization. Effect measures whether the work output facilitates the work of others, provides timely services of a personal nature, or impacts the adequacy of research conclusions. The concept of effect alone does not provide sufficient information to properly understand and evaluate the impact of the position. The scope of the work completes the picture allowing consistent evaluations. Only consider the effect of properly performed work. The primary components of this factor are: **Scope of the Work** and **Effect of the Work**.

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

<b>Level 5-1</b>		<b>25 Points</b>	
<b>Series</b>	<b>General Mathematics and Statistics</b> 1501	<b>Mathematics</b> 1520	
	<b>Actuarial Science</b> 1510	<b>Mathematical Statistics</b> 1529	
	<b>Operations Research</b> 1515	<b>Statistics</b> 1530	
<b>FLD</b>	<b>Scope of the Work</b> – Work involves:		
	<ul style="list-style-type: none"> <li>• specific, routine duties that include a few separate tasks or procedures; and</li> <li>• assignments that familiarize the employee with the organization’s programs and services.</li> </ul>		
<b>Effect of the Work</b> – Work results facilitate the work of others and have little impact beyond the immediate organizational unit.			

<b>Level 5-2</b>		<b>75 Points</b>	
<b>Series</b>	<b>General Mathematics and Statistics</b> 1501	<b>Mathematics</b> 1520	
	<b>Actuarial Science</b> 1510	<b>Mathematical Statistics</b> 1529	
	<b>Operations Research</b> 1515	<b>Statistics</b> 1530	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<b>Scope of the Work</b> – Work involves:		
	<ul style="list-style-type: none"> <li>• applying specific standards, methods, and procedures to carry out tasks;</li> <li>• assisting others by relieving them of routine work associated with larger studies; and</li> <li>• completing a segment of an assignment or project of broader scope.</li> </ul>		
<b>Effect of the Work</b> – Work results affect the overall accuracy, reliability, acceptability, and timeliness of the final work products or services developed or delivered by higher graded coworkers.			

<b>Level 5-3</b>					<b>150 Points</b>
Series	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics</b>	<b>1520</b>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b>	<b>1529</b>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics</b>	<b>1530</b>
FLD	<b>Scope of the Work</b> – Work involves:				
	<ul style="list-style-type: none"> <li>• providing solutions or services that reflect a familiarity with established principles, concepts, and theories of related professional science fields and their interrelated interests and technologies;</li> <li>• adhering to precedents and established techniques to resolve a variety of traditional problems, issues, or conditions and to provide routine customer services; and</li> <li>• problem solving or research activity for a variety of conventional problems or situations.</li> </ul>				
<b>Effect of the Work</b> – Work results affect the:					
<ul style="list-style-type: none"> <li>• economy, efficiency, feasibility, security, integrity, accuracy, adequacy, and safety of a wide range of project activities and services such as field studies and/or laboratory services;</li> <li>• wellbeing of life and the general public;</li> <li>• program credibility with internal and external customers; and</li> <li>• utilization, development, protection, and management of natural resources in the immediate vicinity.</li> </ul>					

<b>Level 5-4</b>					<b>225 Points</b>
Series	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics</b>	<b>1520</b>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b>	<b>1529</b>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics</b>	<b>1530</b>
FLD	<b>Scope of the Work</b> – Work involves:				
	<ul style="list-style-type: none"> <li>• formulating, defining, and interpreting data presentation requirements, planning approaches, and policy;</li> <li>• developing standards for analyzing, testing, or assessing emerging technology or methods;</li> <li>• originating new and improved applications and strategies for existing and new concepts and principles; and/or</li> <li>• providing consultant or advisory services.</li> </ul>				
<b>Effect of the Work</b> – Work results affect:					
<ul style="list-style-type: none"> <li>• efficiency and credibility of applications that guarantee that the product meets agency and industry specifications;</li> <li>• decisions of key officials to adopt and/or accept new or conceptual approaches, technology, or materiel (e.g., weapons or system components, ordnance);</li> <li>• a large number of military or industrial operations;</li> <li>• the safe and effective use of new systems or approaches; and</li> <li>• systems compatibility.</li> </ul>					

<b>Level 5-5</b>		<b>325 Points</b>				
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics</b>	<b>1520</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b>	<b>1529</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Statistics</b>	<b>1530</b>	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<b>Scope of the Work</b> – Work involves:					
	<ul style="list-style-type: none"> <li>• formulating and exploring new theories and phenomena;</li> <li>• providing expertise and advice on program planning and policy making functions covering a broad range of mathematical, statistical, or scientific programs; and/or</li> <li>• developing, testing, and advising on theoretical concepts and new or improved technologies and methods.</li> </ul>					
<b>Effect of the Work</b> – Work results affect the:						
<ul style="list-style-type: none"> <li>• work of other mathematical, statistical, or science experts;</li> <li>• strategic planning of organizational resources;</li> <li>• development of agency policy; and</li> <li>• program mission, performance, and necessity.</li> </ul>						

<b>Level 5-6</b>		<b>450 Points</b>				
<b>Series</b>	<b>General Mathematics and Statistics</b>	<b>1501</b>		<b>Mathematics</b>	<b>1520</b>	
	<b>Actuarial Science</b>	<b>1510</b>	<a href="#"><u>Illustration(s)</u></a>	<b>Mathematical Statistics</b>	<b>1529</b>	<a href="#"><u>Illustration(s)</u></a>
	<b>Operations Research</b>	<b>1515</b>		<b>Statistics</b>	<b>1530</b>	<a href="#"><u>Illustration(s)</u></a>
<b>FLD</b>	<b>Scope of the Work</b> – Work involves:					
	<ul style="list-style-type: none"> <li>• selecting productive areas for analysis, and defining and developing the technical scope and aims of assignments;</li> <li>• exploiting established and emerging methods on applications that meet industry needs; and</li> <li>• a highly specialized research environment with the potential to revolutionize system design processes for an industry.</li> </ul>					
<b>Effect of the Work</b> – Work results affect the:						
<ul style="list-style-type: none"> <li>• success and continuation of key programs essential to the agency’s mission;</li> <li>• vitality and integrity of mathematical, statistical, or science programs on a long-term and/or continuing basis;</li> <li>• protection and quality of life, health, and/or property of the general public and national or international resources;</li> <li>• continuing advancement of science and technology in research, industrial activities, academia, the Federal sector, and the private sector; and/or</li> <li>• ability to evaluate changes and trends in an industry or scientific discipline.</li> </ul>						

## FACTOR 6 – PERSONAL CONTACTS AND FACTOR 7 – PURPOSE OF CONTACTS

These factors include face-to-face and remote dialogue – e.g., telephone, email, and video conferences – with persons not in the supervisory chain. (Personal contacts with supervisors are under Factor 2 – Supervisory Controls.) The levels of these factors consider the work required to make the initial contact, difficulty of communicating with those contacted, the setting in which the contact takes place, and the nature of the discourse. The setting describes how well the employee and those contacted recognize their relative roles and authorities. The nature of the discourse defines the reason for the communication and the context or environment in which the communication takes place. For example, the reason for communicating may be to exchange factual information or to negotiate. The communication may take place in an environment of significant controversy and/or with people of differing viewpoints and goals.

Only credit points under Factors 6 and 7 for contacts that are essential for successfully performing the work and that have a demonstrable impact on its difficulty and responsibility. Factors 6 and 7 are interdependent, so use the same personal contacts to evaluate both factors.

Determine the appropriate level for Personal Contacts and the corresponding level for Purpose of Contacts. Obtain the point value for these factors from the intersection of the two levels as shown on the [Point Assignment Chart](#) at the end of this section.

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

<b>PERSONAL CONTACTS</b>	
<b>Level 1</b>	Other professionals, technicians, and support personnel in the immediate office or related units within the agency. Limited contact with employees outside the office.
<b>Level 2</b>	Employees in the same agency, professionals and specialists from related occupations, and/or members of the general public in a moderately structured setting. Typical contacts are: <ul style="list-style-type: none"> <li>• scientists and engineers;</li> <li>• military personnel;</li> <li>• client organization representatives.</li> </ul>
<b>Level 3</b>	Individuals or groups inside and outside the employing agency representing high levels of organizations internal and external to the Federal Government. Typical contacts are: <ul style="list-style-type: none"> <li>• management officials or senior technical staff of corporations;</li> <li>• medical and legal professionals;</li> <li>• contractors; and</li> <li>• State and local officials;</li> <li>• Government, academia, and professional organizations;</li> <li>• representatives of Congressional committees.</li> </ul>
<b>Level 4</b>	High ranking officials from outside the employing agency at national or international levels in highly unstructured settings. Typical contacts are: <ul style="list-style-type: none"> <li>• members of Congress or their professional staffs/representatives;</li> <li>• leading officials of foreign Governments; and</li> <li>• Presidential advisors and/or cabinet level appointees of major departments and agencies;</li> <li>• State governors and mayors of large cities or their professional staffs/representatives;</li> <li>• presidents of large national or international firms; or</li> <li>• leaders of national stakeholder and/or interest groups.</li> </ul>

<b>Purpose of Contacts</b>	
<b>Level A</b>	To obtain, clarify, or exchange information or facts needed to complete an assignment.
<b>Level B</b>	To plan, coordinate, or advise on work efforts or to resolve issues or operating problems. Contacts involve influencing or persuading people who have a cooperative attitude and goals in common with those of the employee. Contacts typically involve identifying options for resolving problems.
<b>Level C</b>	To influence and persuade persons or groups to comply with established policies or to accept established methods. Also to negotiate or establish rapport to gain information. Contacted personnel may be skeptical or uncooperative.
<b>Level D</b>	To justify, defend, negotiate, or settle matters involving significant or controversial topics. Work usually involves active participation in conferences, meetings, hearings, or presentations. Problems or issues are of such considerable consequence or importance that they are not susceptible to resolution at lower echelons in Government. Persons contacted typically have diverse scientific approaches, viewpoints, goals, or objectives. The employee must achieve a common understanding of the problem and a satisfactory solution by persuasion, compromise, or developing suitable alternatives.

<b>POINT ASSIGNMENT CHART</b>					
		<b>Purpose of Contacts</b>			
<b>Level</b>		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>Personal Contacts</b>	<b>1</b>	<b>30</b>	<b>60</b>	<b>130*</b>	<b>230*</b>
	<b>2</b>	<b>45</b>	<b>75</b>	<b>145</b>	<b>245</b>
	<b>3</b>	<b>80</b>	<b>110</b>	<b>180</b>	<b>280</b>
	<b>4</b>	<b>130*</b>	<b>160</b>	<b>230</b>	<b>330</b>

**\*THIS COMBINATION IS UNLIKELY**

**FACTOR 8 – PHYSICAL DEMANDS**

NOTE: Laws and regulations governing pay for irregular or intermittent duty involving unusual physical hardship or hazard are in *section 5545(d), title 5, United States Code, and Subpart I, part 550, title 5, Code of Federal Regulations.*

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

<b>Level 8-1</b>		<b>5 Points</b>
FLD	<p>The work is sedentary. Some work may require periods of walking, standing, bending, or driving a motor vehicle. Employees frequently carry research records and other similar materials. The work does not require any special physical effort.</p>	

<b>Level 8-2</b>		<b>20 Points</b>
FLD	<p>The work requires some physical exertion such as:</p> <ul style="list-style-type: none"> <li>• long periods of standing;</li> <li>• walking over rough, uneven, or rocky surfaces;</li> <li>• recurring bending, crouching, stooping, stretching, reaching, or similar activities; and</li> <li>• recurring lifting of moderately heavy items (i.e., less than 22.5 kilograms (50 pounds)), or cumbersome items (e.g., small animals, weapon components).</li> </ul> <p>The work may require specific, but common physical characteristics and capacities such as above average agility and dexterity.</p>	

**FACTOR 9 – WORK ENVIRONMENT**

NOTE: Laws and regulations governing pay for irregular or intermittent duty involving unusual physical hardship or hazard are in *section 5545(d), title 5, United States Code, and Subpart I of Part 550 of Title 5, Code of Federal Regulations.*

NOTE: These factor level descriptions (FLDs) apply to all 1500P occupational series in this JFS.

<b>Level 9-1</b>		<b>5 Points</b>
FLD	Works in an adequately lighted, heated, and ventilated environment. The work area involves everyday risks or discomforts that require normal safety precautions typical of such places as offices, laboratories, meeting and training rooms, libraries, or commercial vehicles.	

<b>Level 9-2</b>		<b>20 Points</b>
FLD	Work involves moderate risks or discomforts that require special safety precautions and/or use of protective clothing or gear such as masks, gowns, coats, boots, goggles, gloves, shields, or life preservers. Work is done in an environment of moving parts, carts, or machines, and/or near or with contagious diseases or irritant chemicals.	

## Factor Illustrations

Illustrations are provided in this part as a tool to give insight into the meaning of the FLDs for Factors 1, 4, and 5. Consider each illustration in its entirety and in conjunction with the FLDs. Do not rely solely on these illustrations in evaluating positions.

For additional information about the proper use of illustrations, see the [How To Use This Grading Information](#) section of this JFS.

### Factor 1 Illustrations

#### **LEVEL 1-6: ACTUARY, 1510 (ILLUSTRATION 1)**

Professional knowledge of and skill in applying the principles, concepts, and methodology of actuarial science; and knowledge of:

- actuarial processing of various factors;
- basic analytical and actuarial techniques; and
- agency program and operating procedures

sufficient to:

- analyze beneficiary and benefit data to determine actuarial relationships;
- develop factors for use in expanding items in a sample by linking sample totals to related known data for a corresponding whole group (i.e., a universe);
- make logical adjustments, where necessary, to preserve consistent relationships among expanded data elements;
- review, prior to publication, worksheets and final tables showing benefit data to ensure conformance to conventional procedures and the reasonableness of results; and
- perform regulatory actuarial examinations of life underwriters' financial statements and other official filings to determine valuation of reserves, gross and taxable premiums, and compliance with legal requirements for license renewal.

[←BACK TO TABLE OF CONTENTS](#)

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#### **LEVEL 1-6: ACTUARY, 1510 (ILLUSTRATION 2)**

Professional knowledge of and skill in applying the principles, concepts, and methodology of actuarial science; and knowledge of:

- actuarial processing of various mathematical factors;
- routine analytical and actuarial techniques; and
- agency program and operating procedures

sufficient to:

- apply routine actuarial formulas to obtain rates and values for various plans of insurance and annuities;
- apply established procedures and make actuarial calculations for use in an annual statement;
- develop administrative support procedures for use in computations and compilations; and
- apply alternate mortality tables to compare an underwriter's risk listings with the reserve funds reported.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-6: OPERATIONS RESEARCH ANALYST, 1515**

Professional knowledge of and skill in applying the principles, concepts, and methodology of mathematics and analysis sufficient to:

- perform minor phases of a larger assignment pertaining to the design, development, and testing of weapons control software systems;
- prepare required recurring reports, correspondence, and documentation;
- work closely with a senior operations research analyst in using routine cost estimating methods such as analogy, engineering or scientific methodology, and extrapolation;
- use cost estimating outputs to assess the impact various factors have on the costs to design, research, develop, operate, maintain, and dispose of a particular weapon system;
- identify the most appropriate phase of the budgetary cycle (planning, programming, justification, execution, etc.) for initiating new programs; and
- identify and analyze all elements affecting costs for a project of limited scope.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-6: MATHEMATICIAN, 1520**

Knowledge of and skill in applying:

- mathematical analyses of flight data;
- standard computations;
- measurements involving advanced algorithms, specialized techniques, methods, instruments, and software; and
- computer equipment common to the organization

sufficient to:

- document results and accomplish tasks that require only a limited degree of originality;
- consider the physical relationships pertinent to a specific phase of aerospace research;
- assist a senior mathematician or subject matter specialist;
- process or analyze test data from various sources, such as radar, global positioning satellites, or cinetheodolite film;
- use technical software to merge, plot, or convert raw data into a usable format;
- set up differential equations on a computer to obtain calculated transient engine curves, formulate and analyze equations, plan and initiate computer configuration, and interpret results; and
- perform assignments of limited depth and scope by independently applying mathematical methods that relate to one narrow specialization, technique, or method (e.g., differential equations).

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-6: MATHEMATICAL STATISTICIAN, 1529**

Knowledge of and skill in applying general mathematics and related subject matter and tools such as:

- standard automated systems equipment, and statistical software;
- statistical philosophy, methods, and techniques;
- advanced algebra;
- differential and integral calculus;
- theory of differential equations;
- set theory and matrices;
- mathematical statistics including the calculus of probability, probability theory, sampling theory, and systematic methods of curve fitting; and
- theory of experimental design

sufficient to:

- perform mathematical statistical work covering the entire scientific method of investigation, background research, reduction and analysis of data, and documentation;
- execute a series of standard tasks or calculations;
- use basic authoritative references on mathematical statistics;
- analyze factual information and recognize significant factors, relationships, and trends;
- write technical reports on findings of statistical investigations;
- develop schemes for quality surveillance of parts of major continuing statistical data collection systems;
- consult with a senior mathematical statistician and with other subject matter professionals on specific statistical problems in collecting or analyzing data, determining cause(s) of problems, and developing solutions; and
- participate in reviewing prospective new topics in the theory of sampling and non-sampling errors and in statistical inference.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-6: STATISTICIAN, 1530 (ILLUSTRATION 1)**

Professional knowledge of and skill in applying:

- standard precedents that form the basis for assigned studies;
- statistics in a subject matter field (e.g., economics, biology); and
- common statistical techniques

sufficient to:

- plan and effectively perform limited studies that have specific, program objectives and involve recurrent and predictable factors;
- analyze factual information and recognize significant factors, relationships, and trends;
- prepare cross tabulations or frequency listings of selected variables to assess the validity of data before a senior statistician does more complex work;
- prepare literature searches as background for further research; and
- prepare parts of internal documentation or proof documentation with researchers.

[⇐BACK TO TABLE OF CONTENTS](#)

(continued)

**LEVEL 1-6: STATISTICIAN (ENGINEERING), 1530 (ILLUSTRATION 2) (CONTINUED)**

Professional knowledge of and skill in applying:

- statistical methods to engineering related projects;
- standard precedents, such as munitions systems performance, that form the basis for assigned studies; and
- information obtained from electronic devices such as sensors or radar relating to the test requirements

sufficient to:

- write technical reports, plan and prepare graphic and tabular presentations of data, and present technical documentation in a professional manner, as in a quality assurance assignment;
- develop a study plan and assess progress in accordance with established engineering objectives and specifications;
- recognize unexpected problems or variations in results; and
- prepare preliminary interpretations or tentative recommendations.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-6: SURVEY STATISTICIAN, 1530 (ILLUSTRATION 3)**

Professional knowledge of and skill in applying:

- standard precedents that form the basis for assigned studies;
- information obtained from multiple sources of raw data that relate to the subject matter under study;
- standard quantitative techniques;
- customized software that maps geographic regions using counties and zip codes; and
- statistically sound survey methods

sufficient to:

- determine whether completed surveys satisfy established survey administration requirements;
- identify the number of survey administrators or field interviewers in an area, the number of interviews to distribute to each interviewer, and the type of interview the respondent receives;
- ensure that respondents adequately complete a sufficient number of surveys; and
- determine whether the non-response rate is too high to be statistically valid, and as appropriate, target those individuals who did not complete the survey for a second attempt to interview.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: ACTUARY, 1510 (ILLUSTRATION 1)**

Professional knowledge of and skill in applying a wide range of theories, principles, concepts, and methods of actuarial science used in the medical field; and knowledge of:

- valuation techniques;
- data obtained from multiple sources;
- special charts, tables, and guides indicating rates, trends, and historical data; and
- medical terminology, records, forms, guides, and reference materials

sufficient to:

- perform professional actuarial duties of substantial breadth relating to a variety of health care issues;
- analyze program data to advise and assist statisticians in developing methodology;
- produce appropriate medical data using the most current actuarial, computer programming, survey, and other techniques;
- analyze data collected from a wide variety of sources to determine the nature and extent of the problem, interpret actuarial implications, and recommend options for resolution;
- plan and conduct special recurring and nonrecurring studies of the mortality and disability experience under an insurance program; and
- plan and lay out the work for performing investigations of such items as mortality, disability, withdrawal, retirement, and remarriage that affect the valuation of assets and liabilities of an insurance program.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: ACTUARY, 1510 (ILLUSTRATION 2)**

Professional knowledge of and skill in applying a wide range of theories, principles, concepts, and methods of actuarial science used in the insurance industry; and knowledge of:

- valuation techniques;
- legislation and regulation related to life insurance;
- terminology, principles, and provisions of various types of insurance policies; and
- agency program policies

sufficient to:

- determine the use of reserve factors in the valuations of an insurance fund covering equity investment risks;
- formulate procedures for use in computing actuarial values of individual insurance contracts;
- conduct and formally report on the actuarial phases of site examinations of life insurance companies (unless it involves unusual scope or complications such as a merger or conversion to a computerized system);
- analyze funds for soundness and trends including lapse ratios, unearned premiums, deficiency reserves, double indemnity provisions, supplemental contracts, and other elements; and
- plan, lay out, and perform investigations of such items as mortality, disability, withdrawal, retirement, and remarriage that affect the valuation of the assets and liabilities of an insurance program.

[←BACK TO TABLE OF CONTENTS](#)

(continued)

**LEVEL 1-7: ACTUARY, 1510 (ILLUSTRATION 3) (CONTINUED)**

Professional knowledge of and skill in applying a wide range of theories, principles, concepts, and methodology of actuarial science; and knowledge of:

- valuation techniques;
- defined benefit pension plans;
- Employee Retirement Income Security Act (ERISA), agency regulations, and related policies and procedures;
- tax legislation and regulations pertaining to trusts, pension funds, insurance programs, and gifts; and
- agency program policies

sufficient to:

- plan and execute a variety of studies and analyses that relate to preparing periodic estimates of the future size and composition of a population eligible for an insurance benefit;
- plan, lay out, and perform studies that affect the valuation of the assets and liabilities of an insurance program, such as mortality, disability, withdrawal, retirement, and remarriage;
- plan and perform comprehensive actuarial analysis of a wide variety of pension plan terminations;
- develop the actuarial input into cases, including complex benefit and actuarial value calculations;
- coordinate the actuarial work on cases, including providing technical direction and expert advice to the contractor;
- evaluate the efficiency, cost, and completeness of the contractor's work, and serve as a liaison between the agency and the contractor;
- analyze pension plan documents to determine benefit entitlements and ensure compliance with the ERISA;
- perform all aspects of actuarial valuation according to statute for cases, including:
  - calculating guaranteed benefits and total benefits;
  - calculating present values of these benefits;
  - assigning benefit values to priority categories; and
  - allocating assets according to priority categories;
- advise senior departmental and agency staff on actuarial issues, answer questions raised by outside actuaries, and provide litigation support for the Office of the General Counsel; and
- modify established actuarial methods.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: OPERATIONS RESEARCH ANALYST, 1515**

Professional knowledge of, and skill in applying a wide range of theories, concepts, and methods of analytical, mathematical, or statistical principles and practices to military weapons programs; and knowledge of:

- analytical processes, such as:
  - setting up the problem;
  - conducting background research;
  - collecting and reducing data;
  - displaying data for analysis;
  - formulating mathematical expressions; and
  - drawing conclusions;
- analytical techniques such as design of experiments and computer modeling/simulation;
- subject matter specialties (e.g., aircraft survivability, risk analysis, or lethality) related to weapons systems;
- statutory provisions; and
- agency program policies

sufficient to participate in a variety of projects under the direction of a senior analyst to:

- determine tradeoff relationships between system operating costs and level of performance;
- determine the optimum test design that minimizes the amount of testing while still providing adequate data for decision making;
- determine the effect of equipment age on system performance;
- evaluate the appropriate mix of support equipment to obtain maximum effectiveness on the battlefield; and
- work as a team member in an organization that conducts operations research investigations of military weapons and materiel systems.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: MATHEMATICIAN, 1520 (ILLUSTRATION 1)**

Professional knowledge of and skill in applying:

- a specialized branch of mathematics (e.g., numerical analysis, special functions, matrix theory, or computation methods);
- basic mathematical relationships unique to the area of application;
- precedents of related studies;
- analog and digital math models and other specialized techniques; and
- recent mathematical advances in the particular area of responsibility

sufficient to:

- design simulation experiments, analyze results, and prepare appropriate technical reports;
- determine test and evaluation requirements for software associated with major reconfiguration or modification of sophisticated automated systems (e.g., weapons) including applications, diagnostic, and maintenance programs;
- prepare evaluation of test activities;
- develop or participate in determining appropriate mathematical and statistical methods for operational analyses, interpretation, and evaluation of specific tests for system components;
- adapt and apply existing mathematical methods and techniques in a specialized branch of mathematics to specific subject matter applications; and
- formulate problems, select a range of values and intervals, and determine the method of solution that best fits the essential types of calculations.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: MATHEMATICIAN, 1520 (ILLUSTRATION 2)**

Professional knowledge of and skill in applying:

- a specialized branch of mathematics (e.g., partial and ordinary differential equations, numerical analysis, special functions, matrix theory, or computation methods) associated with aerospace technology;
- complex mathematical relationships and problems related to the principles of aerodynamics;
- mathematical phases of research and development projects;
- precedents of related studies; and
- recent mathematical advances in the area of specialty

sufficient to:

- investigate orbital dynamics of earth satellites;
- determine methods to derive and predict dynamics; and
- analyze tracking data obtained through surveillance activities, including:
  - determining the objectives of such analyses and priorities of major phases;
  - providing consultative services to scientists in other Federal agencies on projects associated with re-entry studies;
  - formulating mathematical models and associated computation methods to analyze special problem areas and evaluate system performance;
  - developing data to facilitate choice of optimum time of satellite launch; and
  - reducing orbital equations by simplifying assumptions that cause no adverse effects on final results.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: MATHEMATICAL STATISTICIAN, 1529**

Professional knowledge of and skill in applying:

- stratification and clustering in probability sampling;
- alternative variance estimating;
- inference procedures for complex survey data;
- design effects;
- mathematical/statistical theory;
- mathematical methods;
- survey and sample design techniques;
- complex applied sample and variance estimating;
- statistical error modeling; and
- complex computer-designed software

sufficient to:

- research, plan, and implement projects that involve developing new or modifying existing sampling, surveying, and design methods that include:
  - developing and programming imputation models to predict missing values in a demographic study or economic survey;
  - comparing variance estimation; and
  - developing/programming representative samples for field survey projects;
- serve as an advisor to peers on mathematical statistical topics (e.g., theory of sampling and non-sampling errors and theory of statistical inference);
- develop statistical standards to evaluate data quality;
- develop aspects of survey and sampling designs that ensure continuity between data collection and analysis of data; and
- write methodological and/or technical reports of substantive survey findings for publication.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-7: STATISTICIAN (AGRICULTURE), 1530 (ILLUSTRATION 1)**

Professional knowledge of, and skill in applying:

- agricultural theories and techniques;
- methods, principles, and characteristics of statistical resources and procedures associated with agricultural sciences or of specialized agricultural studies such as farming or crop production; and
- relevant statutory provisions and objectives

sufficient to:

- serve as a commodity statistician capable of handling assignments in any of several major commodity program groups;
- plan and conduct agricultural surveys (e.g., production of oranges in warm, rainy climates);
- prepare estimates, forecasts, and reports of considerable scope and difficulty relating to groups of crops, commodities, or items that:
  - are of major importance within the overall agricultural production and economy of a state; and
  - comprise a significant segment of the assigned commodity program group.

[←BACK TO TABLE OF CONTENTS](#)

(continued)

**LEVEL 1-7: STATISTICIAN, 1530 (ILLUSTRATION 2) (CONTINUED)**

Professional knowledge of and skill in applying:

- statistical theory and techniques;
- the methods, principles, and characteristics of a particular statistical specialty (e.g., survey design) or of the statistical resources and procedures of a subject matter field; and
- relevant statutory provisions and objectives

sufficient to:

- accomplish work that typically includes several related studies or several segments of a large data collection project that the employee coordinates simultaneously;
- recognize and evaluate significant and critical factors in research;
- solve complex problems (or advise others on the solution of such problems);
- draw inferences using statistical data;
- ascertain what frequency listings or cross tabulations would be needed to assess data validity and to identify inconsistencies in the data;
- calculate prevalence rates and create adjusted rates;
- prepare parts of documentation for public release;
- prepare comprehensive and publishable reports; and
- co-author statistical presentations, journal articles, or reports.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-8: ACTUARY, 1510 (ILLUSTRATION 1)**

Mastery of and skill in applying advanced theories, practices, methods, and principles of actuarial science; and knowledge of program requirements and operations of the agency sufficient to:

- provide expert consultation to senior level staff in the agency and to other actuaries, analysts, and personnel on social or health insurance issues, study approaches, research techniques amenable to actuarial methods, and the validity of actuarial assumptions and methods;
  - plan, coordinate, and analyze recent financial experience and prepare estimates of future experience based on general social, economic, and demographic factors using a variety of actuarial techniques;
  - present recommendations, conclusions, and findings accepted as authoritative by program officials and colleagues; and
  - formulate major policy and binding commitments for the organization served;
- or**
- independently plan and execute a variety of projects and make authoritative and final decisions requiring considerable technical and administrative judgment;
  - plan, coordinate, and evaluate new estimation methodologies and models and refine existing models for program operations and for proposed changes; and
  - provide guidance to team members on methodologies and techniques used in projecting social or health insurance expenditures.

[←BACK TO TABLE OF CONTENTS](#)

(continued)

**LEVEL 1-8: ACTUARY, 1510 (ILLUSTRATION 2) (CONTINUED)**

Mastery of and skill in applying advanced theories, principles, concepts, methods and practices of actuarial science; and knowledge of:

- valuation techniques;
- automated systems and computer programs;
- data sources;
- specific knowledge of defined benefit pension plans; and
- program requirements and operations of the agency

sufficient to:

- perform the calculations necessary to support the present value of future benefits in the agency's financial statements and Annual Report to Congress;
- plan, coordinate, and evaluate new estimation methods and refine existing methods that form a part of these liability calculations;
- conduct studies of experience in single plan and multi-employer plan populations to validate assumptions and methods;
- recommend significant changes to valuation software, review the technical specifications of changes and test software once the changes have been made; and
- serve as a technical advisor to other departments and financial personnel about the implications of these results;

**or**

- coordinate large or unique actuarial work proposed for execution by contractors by evaluating the efficiency, cost, and completeness of the contractor's work, and serving as a liaison between the agency and the contractor;
- perform all aspects of actuarial valuation as required under the Employee Retirement Income Security Act (ERISA), agency regulations, and related policies and procedures, including:
  - calculating guaranteed benefits and total benefits;
  - calculating present values of these benefits;
  - assigning benefit values to priority categories; and
  - allocating assets according to priority categories; and
- provide technical advice to departmental and agency staff on actuarial issues, answer questions raised by outside actuaries, and provide litigation support for the Office of the General Counsel on matters impacting legal or regulatory interpretation or the agency pension program.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-8: OPERATIONS RESEARCH ANALYST, 1515 (ILLUSTRATION 1)**

Mastery of and skill in applying advanced, analytical, mathematical, or statistical theories, principles, concepts, methods, and techniques related to:

- statistical analysis;
- parametric and non-parametric analysis;
- computer modeling;
- decision theory;
- mathematical programming;
- regression analysis; and
- economic analysis

sufficient to:

- design and develop the most appropriate techniques to solve problems, enhance performance, or increase efficiency and effectiveness;
- provide expert judgments concerning the validity of assumptions made and the criteria to evaluate alternatives;
- conceptualize systems and reduce them to the most effective, simplified, and manageable representation and treatment; and
- simulate a process, developing a detailed model of the most critical features of the process.

[←BACK TO TABLE OF CONTENTS](#)

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**LEVEL 1-8: OPERATIONS RESEARCH ANALYST, 1515 (ILLUSTRATION 2)**

Mastery of and skill in applying advanced, analytical, mathematical, or statistical theories, principles, concepts, methods, and techniques related to:

- statistical analysis;
- parametric and non-parametric analysis;
- computer modeling;
- decision theory;
- mathematical programming;
- regression analysis; and
- economic analysis

sufficient to:

- serve as a senior analyst in an organization responsible for developing analytical models and methods;
- identify actual or potential problem areas, trends, and similar factors to improve agency program operations and management systems; and
- recommend new or amended legislation, policies, procedures, and management systems as they relate to agency programs and Federal or State agencies with similar program responsibilities.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-8: MATHEMATICIAN, 1520**

Mastery of and skill in applying advanced theories, principles, concepts, and practices of a broad range of techniques in mathematics, computer modeling, and mathematical programming sufficient to:

- develop specifications and apply new computer software programs and/or modify existing programs to perform mathematical analysis of phenomena observed during experimental investigations;
- ensure quality of program design and validate that newly created software accurately simulates the desired physical phenomena and replicates experimental findings;
- perform as an advisor and authority for other researchers in the areas of mathematical modeling, analysis, and computer programming methods;
- provide technical advice regarding the development of simulation methods, computer techniques, and the utilization of operational mathematics in analysis of microelectronic systems;
- devise and implement pilot programs to determine the feasibility of computer solutions to existing problems; and
- disseminate findings through published technical reports, papers, and presentations at symposia and conferences.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-8: MATHEMATICAL STATISTICIAN, 1529**

Mastery of advanced mathematical and statistical theories, principles, concepts, and practices, and skill in applying this knowledge to:

- statistical procedures;
- complex mathematics;
- data or quantitative analysis;
- complex sample designs;
- data collection techniques;
- reduction of data from multiple sources;
- research and experimentation techniques (e.g., observation, documentation, etc.);
- computer techniques such as:
  - numerical and statistical analysis;
  - probability theory;
  - wave propagation modeling; and/or
  - numerical simulation;
- state-of-the-art statistical or mathematical tools; and
- publications of statistical studies in the area of specialization

sufficient to:

- translate raw data of fish populations by species and stock into mathematical models to describe and explain fluctuations of stock in the ocean (i.e., how fish populations vary over time, growth of individual fish, reproductive processes, and mortality rates);
- or**
- develop simulated populations for testing alternative economic theories about consumer substitution behavior and the implications for sampling and estimation of price indexes;
- write and/or present comprehensive statistical reports and scientific manuscripts based upon the data collected and analyzed; and
- make recommendations to fishery commission officials, geneticists, biologists, and other professionals regarding the extent to which fishing should be controlled to ensure the survival of fish species;
- or**
- perform a comprehensive evaluation of the statistical properties of current or prospective complex sample designs or estimation methods; and
- make recommendations to agency officials about the viability of proposed new methodologies or the interpretation of test results;
- or**
- provide project leadership for specialized programs.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-8: STATISTICIAN (HEALTH), 1530**

Mastery of :

- advanced statistical theories, principles, concepts, methods, techniques, and practices;
- specialized statistical functions (e.g., techniques of statistical surveys);
- resources, precedents, practices, and principles within an area of specialization and its related areas;
- the benefits of, and demand for, statistical research that others are doing in the area of specialization;
- agency programs; and
- skill in applying this knowledge in health sciences subject matter such as heart disease, diabetes, osteoporosis, or injuries

sufficient to:

- provide advice and consultation on a variety of problems involving the theory or application of statistical methods;
- evaluate new statistical methods for broad and comprehensive projects;
- plan, direct, and coordinate a variety of specialized and complex statistical research projects and make authoritative and final decisions requiring considerable technical and administrative judgment;
- serve, either on a continuing or special assignment basis, as consultant and advisor to top level subject matter specialists or agency officials responsible for broad research, administrative, or operational programs;
- demonstrate a specific substantive area of expertise and potentially be considered an agency resource for this field;
- apply complex modeling techniques to determine statistical associations in the health field (e.g., logistic regression, survival rates, and Cox models);
- serve as lead author on presentations, journal articles, or agency reports; and/or
- initiate agreements with officials from other agencies for joint projects and research.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-9: ACTUARY, 1510**

Mastery of and skill in applying advanced actuarial theories, principles, concepts, and practices (e.g., cost estimating, insurance valuation) in one or more specialized areas, and knowledge of agency operations, systems, and practices sufficient to:

- develop special techniques, formulas, assumptions, and methods to resolve unprecedented actuarial problems associated with insurance plan termination;
- review requests for financial and/or actuarial data required for planning and/or policy purposes;
- provide authoritative evaluations of projected program costs, impact, and actuarial soundness;
- make presentations before Congress or at national or international professional meetings and conferences, or have significant involvement in drafting proposed legislative changes to ensure proper interpretation and implementation of actuarial recommendations;
- add to or advance the state of the art in actuarial processes;
- represent the agency on interagency work groups established to develop industry actuarial policies and solutions to critical issues; and
- serve as an agency senior consultant to agency/corporate officials, and actuarial and/or computer science peers on highly complex actuarial issues, debates, studies, research, and analysis projects.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-9: MATHEMATICIAN, 1520**

Mastery of and skill in applying the theories and advanced state-of-the-art concepts and principles of one or more specialized areas of mathematics (e.g., numerical analysis, numerical methods, theoretical and applied numerical mathematics, or mathematical modeling) sufficient to:

- serve as the department or agency expert on highly complex mathematical issues/debates for a wide range of mathematical and/or computer science peers;
- review theoretical assumptions, conduct hypothesis testing, and evaluate the appropriateness of proposals;
- produce results in areas of particular interest to the scientific community that have eluded the efforts of highly competent investigators and researchers; and
- author a number of professionally acclaimed publications that advance the state-of-the-art in mathematical methods.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-9: MATHEMATICAL STATISTICIAN, 1529**

Mastery of and skill in applying advanced:

- mathematical and statistical theories, concepts, and practices; and
- concepts, principles, and practices of a biological or scientific discipline

sufficient to:

- serve as a leading regulatory agency authority in the areas of:
  - clinical evaluation, design, and methodology;
  - bio-statistical analysis; and
  - evaluation of combination drugs and mortality trials for specialized drugs (e.g., cardio-renal drugs);
- define, develop, and implement significant data collection methodologies for a complex and comprehensive nationwide survey and research program;
- make presentations at national and/or international professional meetings and conferences; and
- publish study findings that advance state-of-the-art approaches to the work.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 1-9: STATISTICIAN (HEALTH), 1530**

Mastery of and skill in applying advanced principles and concepts of applied statistical methods and health sciences to a specific subject matter area within the field of medicine or health, or to a particular statistical function; and comprehensive knowledge of the laws, policies, and regulations governing the agency's major programs sufficient to:

- anticipate new developments and emerging trends in the field;
- conduct strategic planning with respect to survey design, analytic direction, and workload management;
- conduct research into methodological issues in measuring biases in data from various subpopulation groups;
- serve as an expert consultant to officials of foreign countries, foreign research organizations, and university staff on the design and analysis of collaborative international studies; and
- coordinate and direct large international studies to make comparisons and develop conclusions.

[←BACK TO TABLE OF CONTENTS](#)

## Factor 4 Illustrations

### LEVEL 4-2: ACTUARY, 1510

**Nature of Assignment** – Work consists of onsite training related to the organization and functions of the agency. Duties are designed to prepare the employee for high level professional assignments.

**What Needs To Be Done** – The employee:

- analyzes the issues involved in assignments;
- evaluates particular circumstances of each situation; and
- chooses an appropriate problem resolution approach.

**Difficulty and Originality Involved** – Exercises judgment to:

- apply standard actuarial techniques;
- evaluate the results of the assigned task; and
- prepare reports, memoranda, or descriptive materials that summarize accomplishments.

[⇐BACK TO TABLE OF CONTENTS](#)

### LEVEL 4-2: MATHEMATICIAN, 1520

**Nature of Assignment** – Work consists of a limited range of activities that require using standard or established procedures. Duties are designed to prepare the employee for higher level professional assignments.

**What Needs To Be Done** – The employee:

- identifies problems;
- evaluates the particular circumstances of the assigned task;
- recommends changes and procedural improvements; and
- selects alternative methods for problem resolution based on standard professional principles.

**Difficulty and Originality Involved** – Exercises judgment to:

- apply mathematical principles and practices;
- evaluate results for the assigned tasks; and
- prepare reports, memoranda, or descriptive materials that summarize accomplishments.

[⇐BACK TO TABLE OF CONTENTS](#)

### LEVEL 4-2: MATHEMATICAL STATISTICIAN, 1529

**Nature of Assignment** – Work consists of onsite training on the effective use of standard mathematical and statistical techniques as they relate to the organization and functions of the agency.

**What Needs To Be Done** – The employee applies established methods and procedures to the problems being studied.

**Difficulty and Originality Involved** – Exercises judgment to:

- plan assignment details;
- examine source material; and
- adapt standard mathematical and statistical techniques to the particular requirements of the assignment.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-3: MATHEMATICIAN, 1520**

**Nature of Assignment** – Work involves projects in which complex features are limited and problems generally require using various standard methods.

**What Needs To Be Done** – The employee operates independently to:

- evaluate alternative methods or approaches to problem resolution; and
- select a method from a variety of mathematical analyses, computations, measurements, and evaluation options.

**Difficulty and Originality Involved** – Exercises judgment and limited originality to:

- use and, as appropriate, modify and adapt standard mathematical methods and procedures;
- do required calculations;
- analyze and interpret findings; and
- prepare technical correspondence such as reports, graphs, tables, or other descriptive documents.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-3: MATHEMATICAL STATISTICIAN, 1529**

**Nature of Assignment** – Work consists of assisting and participating with senior staff in experimental design and interpretation of information for biological studies (e.g., impact of Alaskan fisheries on Pacific salmon).

**What Needs To Be Done** – The employee:

- ensures statistical accuracy in planning data collection procedures;
- analyzes the issues involved;
- designs experiments (e.g., selects the most effective means of tracking salmon from infancy to mortality);
- performs data analysis;
- maintains statistical databases;
- writes reports;
- chooses the appropriate approach to solve problems from available agency alternatives; and
- assists senior staff with computing statistical problems related to the Pacific Salmon Treaty.

**Difficulty and Originality Involved** – Exercises judgment and limited originality to:

- recognize subtle distinctions in statistical results that require deviation from conventional rules;
- define the data analysis problems;
- select and adapt techniques if necessary; and
- establish the sequence of activities.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-3: STATISTICIAN (AGRICULTURE), 1530**

**Nature of Assignment** – Work consists of processes such as:

- reviewing project plans and procedures to conduct agricultural surveys;
- analyzing and preparing estimates, forecasts, and reports; and
- examining survey forms to determine validity of data and to ensure that they are representative of actual conditions at the county, district, and State levels.

**What Needs To Be Done** – The employee:

- decides such matters as the type of data to collect, and the type of questionnaire to use; and
- selects, from several alternatives, the most appropriate method or procedure for these purposes.

**Difficulty and Originality Involved** – Exercises judgment and originality to:

- design general data collection and analytical procedures;
- recognize significant factors, relationships, and trends while analyzing pertinent facts, such as the discrepancies between crop and livestock activity, the size of farms, and the history of production;
- determine appropriate checks and necessary calculations;
- analyze results;
- develop recommendations; and
- write technical reports on specific assigned studies or prepare preliminary drafts of more comprehensive reports.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-4: ACTUARY, 1510**

**Nature of Assignment** – Work consists of various professional actuarial problems related to pension plan funding levels. Work requires adapting actuarial techniques and methods to salvage potentially under-funded pension plans and calculating individual pensions for plans in trusteeship.

**What Needs To Be Done** – The employee:

- conducts comprehensive actuarial analyses of terminated pension plans;
- processes plans with several hundred participants, a large present value of guaranteed benefits, and unique benefit features;
- analyzes plan documents to determine benefit entitlement and amount of accrued benefit for all participants; and
- explains mathematical methods used to determine benefits for participants entering pay status and participants in pay status with benefit changes.

**Difficulty and Originality Involved** – Exercises judgment and originality to:

- evaluate the relative importance of benefits and present values of those benefits to assign priority categories to the benefit values according to legislation and agency regulations;
- make decisions regarding the valuation and the present and/or actuarial soundness of terminating plans and plans having reportable events;
- modify plans that are not in compliance with current laws, regulations, and policies; and
- plan and complete all processing steps and actions from the time a plan is placed in trusteeship until final benefit determinations are issued for all participants.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-4: OPERATIONS RESEARCH ANALYST, 1515**

**Nature of Assignment** – Work involves adapting a variety of established analytical techniques to accomplish a variety of tasks such as:

- modeling the cumulative amount of emissions from mobile sources at the local, State, or Federal level;
- analyzing the relationship between recorded emissions on short tests and Federal test procedures using regression analysis and associated techniques;
- modeling and analyzing the effects of various fuels and fuel additives; or
- correlating emissions test results from various division laboratories to ensure a high level of quality control.

**What Needs To Be Done** – The employee:

- assesses conditions such as variables, expected outcomes, and anticipated problems of the assignment;
- recognizes the relative significance of applicable relationships and their potential impact on the project;
- examines a variety of methods, techniques, and processes; and
- chooses the appropriate process for completing the project.

**Difficulty and Originality Involved** – Exercises judgment and originality to:

- plan, organize, and perform the chosen process;
- recognize and evaluate the importance of critical factors relative to the assignment;
- determine the limitations of available guides and precedents;
- solve problems despite the fact that available guides do not fully cover the assignment; and
- complete the assignment despite the presence of conflicting or inconclusive data.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-4: MATHEMATICIAN, 1520**

**Nature of Assignment** – Work consists of a wide range of assignments involving mathematical reduction of time, space, and position information used to identify the location of bombs, airplanes, boats, missing tanks, and other military acquisitions. Work demands careful evaluation and interpretation of findings and conclusions.

**What Needs To Be Done** – The employee works in an environment where issues and problems are not always susceptible to conventional analysis. In this environment, the employee:

- develops an approach to the assignment;
- decides whether conventional guidelines, such as operation manuals, are reliable or feasible for use relative to the specifics of the assignment;
- selects appropriate methods or techniques from a variety of possible alternatives; and
- calculates corrections to variables such as velocity to reflect wind speed, angles, air pressure, and other environmental effects.

**Difficulty and Originality Involved** – Exercises judgment and originality to:

- investigate significant variables such as position, acceleration, velocity, and direction;
- examine underlying relationships such as instrument accuracy, location, and angle; and
- develop recommendations and/or conclusions.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-4: MATHEMATICAL STATISTICIAN, 1529**

**Nature of Assignment** – Work consists of various mathematical statistics problems requiring the mathematical modeling of numerous variables or parameters; modeling simulates natural or actual occurrences in a specialized area. Examples include genetics, aircraft flight patterns, or weapons testing.

**What Needs To Be Done** – The employee:

- develops mathematical models and performs mathematical analysis to indicate trends, the likelihood of various outcomes, performance levels, and ideal conditions;
- selects and adapts the mathematical statistical tools or techniques used to reduce data and to prepare reports and/or recommendations;
- constructs histories of behavior changes;
- determines the appropriate sample size and technique to address all relevant concerns; and
- assesses that data indicate what is technically expected to occur.

**Difficulty and Originality Involved** – Exercises judgment and originality to:

- recognize limitations of precedent studies;
- modify survey design and methodology;
- solve problems where pertinent specifications, models, or data are not available; and
- test many mathematical models for projects that involve parties with diverse interests and missions (e.g., whole weapon testing versus testing components of a weapon).

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-4: STATISTICIAN, 1530**

**Nature of Assignment** – Work involves planning, researching, and implementing the full scope of analytical projects requiring application of statistical theory.

**What Needs To Be Done** – The employee:

- evaluates Medicare trust fund operations;
- conducts and evaluates surveys;
- directs studies on prices, utilization, and factors related to health care costs;
- provides consultative services on matters related to Medicare, Medicaid, and national health care programs; and
- bases interpretations, forecasts, and recommendations on statistical findings.

**Difficulty and Originality Involved** – Exercises judgment and originality to:

- reconcile merged data and develop statistically reliable methods and strategies to impute missing data elements;
- develop and implement methods and procedures for collecting, processing, compiling, editing, and analyzing statistical and actuarial data; and
- participate in data handling and survey quality control, including:
  - detecting errors and biases;
  - developing statistical imputations;
  - comparing other data sources; and
  - assessing data matches.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-5: ACTUARY, 1510**

**Nature of Assignment** – Work involves difficult and diverse projects requiring in-depth analysis of actuarial issues and related information technology and data issues.

**What Needs To Be Done** – The employee:

- designs sophisticated tests to ensure that the valuation system is producing accurate results consistent with both actuarial principles and audit standards;
- develops new techniques to accurately reflect changes in the agency’s reporting requirements, data needs, or procedures; and
- develops innovative approaches to incorporate into a system that is subject to audit the effects of new legislation and guidance, changes in the software environment, and unique issues raised by complex plans.

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- choose aspects of the program to be improved or modified;
- weigh computer processing as well as the actuarial aspects of a problem; and
- craft mathematical solutions that involve innovative approaches and applying concepts outside the normal bounds of actuarial theory.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-5: OPERATIONS RESEARCH ANALYST, 1515**

**Nature of Assignment** – Work involves planning, designing, and developing performance requirements and methods to ensure valid user tests of complex systems in an operational environment.

**What Needs To Be Done** – The employee:

- evaluates the organization’s performance information needs;
- identifies available performance measurement alternatives;
- analyzes each alternative in terms of public safety, cost to the agency, and cost to the industry;
- develops advantages and disadvantages of each alternative; and
- presents decisions to management.

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- evaluate advice of experienced and respected professionals with different opinions and interpretations;
- assess alternatives that have political or economic sensitivities;
- address local community and public action groups that may challenge conclusions; and
- recognize, in mathematical and analytical findings, relationships that may be new or may significantly depart from the relationships discovered in previous studies.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-5: MATHEMATICIAN, 1520**

**Nature of Assignment** – Work involves leading long-term weapon employment projects in which the employee:

- acts as mathematical consultant to ballistics personnel on problems involving theory of dynamic stability and analysis of mechanisms;
- provides expert advice on simulation methods, computer techniques, and use of operational mathematics in weapons systems analysis; and
- conducts comprehensive evaluations of projects/programs related to ballistics.

**What Needs To Be Done** – The employee:

- formulates and solves complex mathematical problems;
- identifies ways to improve mathematical processes;
- develops optimum system parameters and boundaries;
- performs mathematical analyses and computer simulations to determine dynamic properties of particles, rigid and non-rigid bodies, and structures;
- determines impact of temperature or force on structural designs and electronic circuitry;
- determines configuration and develops equations of motion for dynamic analysis of systems; and
- applies numerous mathematical techniques to solve optimization problems.

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- test munitions when the state of the weapon varies from experimental to production to termination phases;
- develop entirely new or vastly improved test, evaluation, and application standards, techniques, and instructions to process and present ballistic data; and
- use computer applications that are evaluative or developmental in nature.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-5: MATHEMATICAL STATISTICIAN, 1529**

**Nature of Assignment** – Work involves technical direction and coordination of major wildlife (e.g., salmon or seal) preservation, management, and tracking projects. As a leader on one or more projects, the employee provides technical direction and ensures collaboration for a team of scientists and/or technicians at remote sites. Assignments include working in a broad range of activities and making onsite decisions in highly specialized data collection and analysis functions.

**What Needs To Be Done** – The employee:

- explores mathematical, statistical, information handling, and other techniques from related fields for potential application to the problem at hand;
- acquires a thorough understanding of the substantive problems that relate to the program area or scientific discipline;
- applies a variety of mathematical and statistical principles and techniques such as:
  - probability theory;
  - estimation;
  - inference;
  - quality control;
  - acceptance sampling;
  - sequential and other sampling plans;
  - experimental design;
  - clinical research methods;
  - tests of significance; and
  - data reduction to a myriad of situations and problems; and
- develops analytical and/or mathematical models for use in preparing evaluation criteria or data collection/reduction requirements.

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- solve novel, obstinate, and obscure problems that require:
  - extending existing methods;
  - developing new mathematical or other approaches; and
  - working under time pressure without compromising data quality.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-5: STATISTICIAN (AGRICULTURE), 1530**

**Nature of Assignment** – Work involves estimates of the production of specific specialty crops or commodities such as fruits and vegetables. Varying complexities require the employee to:

- determine the most appropriate technical methods to apply for each commodity;
- plan and conduct surveys, and prepare estimates, forecasts, and reports related to crops production;
- adapt or develop necessary statistical input, edit, and output specifications for specialty commodities; and
- analyze data for major regional agricultural commodities to advise and assist others in developing methodology.

**What Needs To Be Done** – The employee:

- formulates and recommends new or revised programs relating to the functions and activities of statistical estimation, including survey design, implementation, summarization, and analysis;
- reviews and evaluates the accuracy of all survey input and output parameters and related data for assigned commodities;
- stays informed about economic and weather related factors that may affect the crops assigned;
- uses knowledge of geographic centers of specific crop production areas to evaluate potential changes in production levels; and
- interprets survey and related data to make recommendations and decisions regarding estimates and forecasts.

**Difficulty and Originality Involved** – Exercises considerable ingenuity and originality to:

- complete assignments in areas where precedents often do not exist;
- develop new and improved methods and techniques for computation, formulation, and assembly of data forecasts, questionnaires, and crop survey and forecast reports;
- initiate or modify technical policy, conduct preliminary analyses, evaluate proposed projects and studies; and
- establish technical regulations and instructions for statistical work.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-6: ACTUARY, 1510 (ILLUSTRATION 1)**

**Nature of Assignment** – Work involves functioning as a senior agency actuary for preparing cost estimates on legislative proposals to change the Medicaid or Medicare programs.

**What Needs To Be Done** – The employee, as an agency representative and technical authority:

- determines the appropriate course of analysis;
- conducts extensive simultaneous studies in largely undefined areas;
- devises and presents the agency’s implementation plan based on these studies; and
- provides advisory services to the agency head or corporate officials in the medical community regarding preparation of briefing materials, Congressional testimony, Congressional inquiries, and the impact of new regulations on existing procedures (e.g., forms, systems, computer programming, and operations).

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- define implications of legislative proposals for which no precedent exists;
- develop new concepts;
- design new computational models;
- calculate the agency impact of proposed legislative changes; and
- provide technical assistance and expertise to agency attorneys in litigation.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-6: ACTUARY, 1510 (ILLUSTRATION 2)**

**Nature of Assignment** – Work involves providing expert advice to agency officials on:

- the impact of new or changing actuarial policies on the financial status of the agency, defined benefit pension plans, or actuarial systems, procedures, and practices;
- issues that require study and evaluation and for which precedents are not applicable; and
- options and recommendations for management decisions.

**What Needs To Be Done** – The employee, as an agency representative and technical authority:

- provides analysis, technical insight, advice, and recommendations on:
  - unprecedented, complex, sensitive actuarial matters with national impact;
  - rulings and decisions that affect the agency as a whole; and
  - proposed recommendations and laws;
- evaluates advantages and disadvantages of various approaches; and
- conducts special studies on the effects of proposed regulations and/or legislation.

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- provide analysis, prepare estimates, and make recommendations with potentially large financial consequences to the agency and/or plan sponsors, often in a short time frame and with little data; and
- develop creative techniques to address issues.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-6: MATHEMATICIAN, 1520**

**Nature of Assignment** – Work involves:

- serving as a senior mathematician responsible for developing and conducting analytical and simulation studies necessary to define and evaluate advanced combat control systems;
- directing and participating in developing models and analyzing results; and
- participating on an agency development team responsible to conceptualize and design new combat control systems and techniques.

**What Needs To Be Done** – The employee:

- develops mathematical models and simulation requirements;
- designs, conducts, and evaluates simulation experiments;
- prepares complex, technical reports;
- identifies and considers previously undefined human/machine interface situations and problems in combat situations; and
- acts as expert advisor to agency management in combat systems simulation.

**Difficulty and Originality Involved** – Exercises considerable judgment and originality to:

- perform work in undefined and unprecedented areas;
- solve combat systems problems not previously addressed; and
- develop new mathematical processes compounded by requirements for simultaneous analysis.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-6: MATHEMATICAL STATISTICIAN, 1529**

**Nature of Assignment** – Work involves functioning as a senior advisor and project leader engaged in planning, developing, and carrying out broad, complex agency statistical analyses.

**What Needs To Be Done** – The employee, as a technical authority:

- develops new statistical methods necessary for accomplishing assignments;
- defines the associated statistical problems so that solutions will be scientifically sound, relevant, and comply with regulatory requirements; and
- provides advisory services to the agency head regarding congressional testimony, inquiries, and the impact of new legislation on existing procedures.

**Difficulty and Originality Involved** – Exercises considerable ingenuity and originality to:

- resolve problems that require multidimensional approaches; and
- establish concepts and theories to resolve unyielding problems for which traditional mathematical/statistical methods are neither applicable nor easily adaptable.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 4-6: STATISTICIAN (HEALTH), 1530**

**Nature of Assignment** – Work involves:

- serving as a primary agency consultant in specialized statistical activities such as data collection and analysis of the performance of health care providers in a nationwide program;
- defending and achieving acceptance of new, controversial statistical methodologies;
- providing authoritative counsel to senior agency officials on the optimum use of statistical technology; and
- recognizing and advising on the possible expected contribution of statistics and the limitations of statistical methods in the solution of complex problems.

**What Needs To Be Done** – The employee, as a lead agency consultant:

- reviews clinical trial protocols for adequacy of study design, sample size, and statistical methods used by the regulated industry;
- develops new, controversial, and officially untried analytical methods; and
- provides advisory services to the agency head regarding Congressional testimony, inquiries, and the impact of new legislation on current survey or census methodologies.

**Difficulty and Originality Involved** – Exercises considerable originality and creativity to:

- visualize statistical methods as they relate to broad studies;
- research advanced statistical techniques to resolve complex, philosophic problems; and
- establish policy relating to complex statistical and administrative problems.

[⇐BACK TO TABLE OF CONTENTS](#)

## Factor 5 Illustrations

### **LEVEL 5-2: SURVEY STATISTICIAN, 1530**

**Scope of the Work** – Work involves performing specific statistical calculations to support a variety of projects assigned to higher grade statisticians.

**Effect of the Work** – Work facilitates timely completion of broader projects.

[⇐BACK TO TABLE OF CONTENTS](#)

### **LEVEL 5-3: ACTUARY, 1510**

**Scope of the Work** – Work involves conducting a variety of conventional actuarial assignments that are limited in scope and difficulty. Assignments are well preceded and have short-term objectives that require using well established mathematical statistical methods and concepts.

**Effect of the Work** – Work generally becomes the foundation for subsequent phases or processes.

[⇐BACK TO TABLE OF CONTENTS](#)

### **LEVEL 5-3: OPERATIONS RESEARCH ANALYST, 1515**

**Scope of the Work** – Work involves developing target performance history that results from statistical and mathematical analysis of data from the appropriate repositories. Typically, higher grade employees establish the goals, constraints, measures of effectiveness, and value criteria.

**Effect of the Work** – Work facilitates the work of other professionals. Data analysis results support other studies or identify problems that require immediate action.

[⇐BACK TO TABLE OF CONTENTS](#)

### **LEVEL 5-3: MATHEMATICAL STATISTICIAN, 1529**

**Scope of the Work** – Work involves participation in a team environment to evaluate potential impacts of pollutants on fish population and marine communities. Chemical and biological data are used to identify threshold levels for contaminant effects on bottom dwelling fish and assess these effects using multivariate statistical models.

**Effect of the Work** – Work affects the quality and usefulness of field and laboratory results and the ability to meet research and administrative deadlines and objectives.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-3: STATISTICIAN (DEMOGRAPHY), 1530**

**Scope of the Work** – Work involves conducting recurring or continuing studies that consist of clearly defined units, parts of major projects, or segments of higher grade statistician assignments.

**Effect of the Work** – Work affects conclusions of demographic studies. Reports provide technical details that may facilitate similar or more extensive investigations.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-4: ACTUARY, 1510**

**Scope of the Work** – Work involves leading projects that are broad in scope and require considerable advanced planning. Work requires:

- dividing the project into sections and overseeing completion of each section; and
- documenting the results of the project(s).

**Effect of the Work** – Valuations and cost estimates form the basis for:

- short-range projections concerning beneficiary population;
- benefit outlay contribution rates and incomes;
- fund transfers, budget preparation, legislative proposals; and
- administrative cost distributions.

Accuracy of the results is essential to current and short-range operational and agency administrative planning.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-4: OPERATIONS RESEARCH ANALYST, 1515**

**Scope of the Work** – Work involves providing expert analytical advice and guidance to managers and scientists within or outside the agency. Work requires:

- conducting data analysis, modeling, and special studies of endangered species in a designated geographical area;
- analyzing the tracking data of sea turtle migration patterns;
- monitoring birth and mortality rates;
- providing advice on experimental design (i.e., the best way to collect data to ensure statistically significant findings); and
- developing computer programs to conduct analysis and simulations.

**Effect of the Work** – Work minimizes field experimentation costs. It also affects the agency's ability to study endangered species and to ensure program efficiency.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-4: MATHEMATICIAN, 1520**

**Scope of the Work** – Work involves planning, developing, evaluating, and executing assignments that are broad in scope and of marked complexity, significance, and importance. Work requires:

- a specialized knowledge of a subject matter area (e.g., orbital dynamics) or of a specific branch of mathematics (e.g., numerical analysis); and
- providing consultative and/or advisory services.

**Effect of the Work** – Work facilitates the work of engineers who assess dynamics of motion, trends, or changes over time. Work results also allow the display of scientific data in an understandable and useable form.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-4: MATHEMATICAL STATISTICIAN, 1529**

**Scope of the Work** – Studies and projects usually represent an important segment of the agency's primary research program or statistical projects. Work involves:

- developing sampling or data tabulation specifications, assessing the completeness of the sampling universe, or preparing statistical reports;
- using broad, highly varied methods to perform statistical calculations and analyses and to prepare estimates and projections for large statistical data collection projects;
- analyzing various mathematical statistical issues; and
- formulating, planning, executing, and controlling major statistical studies or continuing projects.

**Effect of the Work** – Work output has an important impact on planning efforts and provides a basis for introducing process improvements to the data merging functions.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-4: SURVEY STATISTICIAN, 1530**

**Scope of the Work** – Work involves:

- determining and analyzing hazardous trends in the mining industry;
- analyzing contributory causes and conditions of mining accidents, injuries, and illnesses;
- in-depth studies to define true causes of accidents or illnesses; and
- maintaining statistical databases to obtain information on fatal accidents.

**Effect of the Work** – Work has considerable effect on the reliability of data that researchers collect in their specialized surveys throughout the agency. Work results may affect:

- the agency's policy making activity;
- factors to be assessed when analyzing data;
- application and use of final statistics;
- the design, rewording, and restructuring of survey questionnaires so that they better meet the growing and changing needs of the basic statistical function;
- the regular and orderly transmission of employment and injury tabulations and summaries; and
- identification of mining hazards and improvement of safety policies, practices, and enforcement.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-5: ACTUARY, 1510**

**Scope of the Work** – Work involves empirical studies to:

- design methods of modeling complex pension plans;
- influence the direction and scope of studies and certify the accuracy of the assumptions, methods, and data for research use;
- propose new approaches/theories including recommendations to change software and test updated software to facilitate the evaluation of actuarial practices and assumptions (e.g., actuarial interest rates); and
- develop and refine the specific methods used in calculating the agency’s financial statements.

**Effect of the Work** – Work:

- opens significant new avenues for further study;
- results in important changes to existing or proposed systems; and
- directly affects consolidated budgets, Governmentwide financial statements, and pension benefit systems.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-5: OPERATIONS RESEARCH ANALYST, 1515**

**Scope of the Work** – Work involves originating ideas for a series of self-initiated projects. Project results may have an impact that extends beyond the immediate organization.

**Effect of the Work** – Work:

- provides the scientific and quantitative basis for critical agency decisions, policy, and subsequent regulatory actions;
- influences the direction and scope of studies conducted by subordinate organizations;
- answers important questions;
- opens significant new avenues for further study;
- represents an important contribution to the validation or modification of methodology relating to the topic area; and
- results in important changes to existing or proposed systems.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-5: MATHEMATICIAN, 1520**

**Scope of the Work** – Work involves the precise specification of relationships (e.g., calculating the specific impact of proposed changes on the time it takes to complete the design of an aircraft/spacecraft). Work requires:

- examining the quality of a tool such as a grid, and participating in grid design to make sure that the grid is suitable to obtain necessary information;
- developing models and methods of analysis using expertise in a particular discipline or field;
- representing the agency in internal activities for topics related to geometry (e.g., how to improve the mathematical definition of the aircraft);
- coordinating laboratory activities such as task selection, which hardware/software to use, which project the laboratory will take; and
- keeping up with technological changes.

**Effect of the Work** – Work:

- frequently contributes to improving processes, tools, or construction of mathematical models. For example, the mathematician adapts computer software to process thousands of independent variables at a time for use in the multidisciplinary science of aircraft or spacecraft design;
- forms the theoretical basis for further research or planning, and impacts Government regulation, policy, and procedure in specialized areas of electronics, data visualization, video imaging, and software development; and
- assists other mathematicians and those who apply mathematics to a specialized subject matter area such as Atmospheric Sciences, Structural Engineering, or Aerodynamics.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-5: MATHEMATICAL STATISTICIAN, 1529**

**Scope of the Work** – Work involves controlling the amount of fish caught to prevent low reproduction rates for particular species and stocks of fish. Work requires:

- providing estimates of likelihood and sampling error rates; and
- estimating the number of fish being caught and how many should be caught to sustain adequate fish populations.

**Effect of the Work** – Work:

- facilitates biologists in determining country of fish origin and thereby, fish ownership;
- indicates when stock abundance is low;
- results in recommendations on how intensely certain stocks are to be fished and the vulnerability of particular stocks fished in given locations;
- influences policies, penalties, and operations of fisheries where vessels used for industry fishing go to intercept fish on their way to spawning ground; and
- affects national and international fishing practices to ensure adequate fish populations.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-5: STATISTICIAN (MEDICINE), 1530**

**Scope of the Work** – Work involves resolving technical aspects of regulations and policy relating to biologic-type products. Work requires:

- conducting data collection research programs that involve a wide variety of issues from designing and selecting samples to tabulating and analyzing results;
- documenting the statistical aspects of any research when new theory and methods need development; and
- providing expert and authoritative advice to officials and scientists of the agency in the areas of biomedical/biometrics statistical applications.

**Effect of the Work** – Work represents major segments of broad statistical research programs. Advisory and consultation services affect other national and foreign Government agencies and regulated industry with respect to statistical aspects of specialized (e.g., biostatistical) applications.

[←BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-6: ACTUARY, 1510 (ILLUSTRATION 1)**

**Scope of the Work** – Work involves:

- planning, developing, and directing actuarial analysis of critical projects that could affect defined benefit plans nationwide;
- dealing with representatives of the pension, insurance, financial, and investment communities as an authoritative agency official;
- serving on external and internal panels and committees; and
- meeting with members of Congress or their staff to discuss complex pension policy issues.

**Effect of the Work** – Work affects legislative/policy recommendations or guidance, and may affect defined benefit pension plan sponsors and participants in all Federally defined benefit plans. Policy recommendations may affect the long-term financial health of the agency.

[←BACK TO TABLE OF CONTENTS](#)

(continued)

**LEVEL 5-6: ACTUARY, 1510 (ILLUSTRATION 2) (CONTINUED)**

**Scope of the Work** – Work involves:

- maintaining primary responsibility for all actuarial aspects of the Pension Insurance Management System (PIMS); including managing outside actuarial contractors and overseeing actuarial assumptions and data used in the model;
- designing and certifying all actuarial aspects of the model;
- developing guidelines that serve as quality control measures for actuarial data used in the model;
- overseeing empirical work designed to evaluate actuarial practices and assumptions (e.g., actuarial interest rates);
- approving financial estimates for the model; and
- designing and certifying alternative funding rules evaluated in the model.

**Effect of the Work** – Work facilitates the agency’s ability to:

- evaluate long-term impact on actuarial practices, assumptions, and trends;
- develop reports to monitor particular actuarial developments with long-term impact on the agency’s financial condition; and
- prepare statements and evaluations that serve as the basis for the agency’s study of future potential legislative proposals and policy development.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-6: MATHEMATICAL STATISTICIAN, 1529**

**Scope of the Work** – Work involves serving as a consultant to high level officials and counterparts in other agencies, educational institutions, professional associations, and Governments. The mathematical statistician works on projects of general interest and significance to the Government (e.g., endangered wildlife species).  
Work requires:

- conducting extensive applications in time series analysis, sampling, analysis of variance, etc., to resolve critical agency problems;
- ensuring proper interpretation and implementation of technical recommendations by drafting proposed legislative changes to a critical agency program or system;
- planning, developing, and directing major programs where the analysis and original studies are of such major importance and scope that extremely large data sources or legislative coordination is required; and
- representing the agency or command at conferences, briefings, and meetings concerning long-range goals, state-of-the-art technology, or the advantages or disadvantages of various complex methods.

**Effect of the Work** – Work has ongoing, far reaching implications and may be the basis for evaluating the sustainability of major programs. The employee provides technical leadership that affects numerous industries (e.g., fisheries, lumber), political activist groups, nations, treaties, natural resources, wildlife, and general populations. Work attracts attention from others in the scientific community seeking to make comparisons or develop similar tools.

[⇐BACK TO TABLE OF CONTENTS](#)

**LEVEL 5-6: STATISTICIAN (HEALTH), 1530 (ILLUSTRATION 1)**

**Scope of the Work** – Work involves planning, developing, and directing extensive (e.g., nationwide) statistical analysis programs. Work requires conducting nationwide analyses of health care services to:

- identify areas that need improvement;
- quantify levels of customer satisfaction by geographic area;
- establish trends and predictors of good health among different age groups; and
- assess the integrity of billing and collection procedures.

**Effect of the Work** – Work affects agencywide and/or Governmentwide scientific procedures and may serve as a catalyst for legislative coordination, or may have a major impact on national legislation. The work may also impact programmatic activities and operating policies of a major department or agency of the Federal Government.

[←BACK TO TABLE OF CONTENTS](#)

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**LEVEL 5-6: SURVEY STATISTICIAN, 1530 (ILLUSTRATION 2)**

**Scope of the Work** – Work involves advanced statistical methodologies, procedures, or programs with significant impact on the nation, and planning, developing, and directing extensive statistical data collection projects (e.g., nationwide). The work impacts many agency surveys by:

- identifying methodologies that need improvement;
- assessing the impact methodological changes have on results; and
- developing novel methodologies that result in dramatic changes in statistical data collection programs throughout the profession.

**Effect of the Work** – Work affects agencywide and/or Governmentwide statistical data collection projects and may serve as a catalyst for legislative coordination or have a major impact on national legislation. The work also may impact procedures and operating policies of major departments or agencies of the Federal Government. For example, national census data provides indicators of the need for Federal programs and may influence the way the Federal Government distributes billions of dollars.

[←BACK TO TABLE OF CONTENTS](#)

## PART III – EXPLANATORY MATERIAL

### KEY DATES AND MILESTONES

In 1998, the Office of Personnel Management (OPM) notified agencies that we were continuing an earlier effort to develop a Job Family Position Classification Standard for Professional Work in the Mathematical Sciences Group, 1500. We had suspended the earlier effort because of a lack of staffing resources. The 1500 occupational group includes the Computer Science Series, 1550. We excluded the 1550 series from the effort because we believed it might be better aligned with the Information Technology Group, 2200. The 1550 series will be the subject of a separate study to determine its final disposition.

In conjunction with the study, we conducted factfinding at 15 installations representing collectively 10 major agencies. After completing the factfinding, we developed a draft job family standard (JFS) which we released electronically in 2001 for agency review, comment, and test application. At that time, we arranged with those agencies that had the largest covered populations to take the primary role in reviewing and commenting on the draft. OPM calls this arrangement the “lead agency” approach. In addition to the lead agencies, we invited and encouraged all agencies to comment on the draft. This appendix addresses concerns expressed by reviewing agencies and describes our responses to them. It also provides information that may help agencies to manage transition from cancelled occupational standards to this JFS.

Another important milestone is that many Federal “white collar” positions are no longer evaluated by the General Schedule grading criteria. In recognition of this situation, OPM now defines series without a prefix of GS (e.g., series GS-1501 is now shown as 1501). We have also changed the format of this JFS to support those users who do not classify positions according to the General Schedule. Part I contains occupational information that is applicable to Federal work covered by the JFS without regard to pay plan or classification system. Part II provides grading information for positions classified according to the General Schedule grade definitions in chapter 51 of title 5, United States Code. Part III explains the development of this standard.

### RESULTS OF AGENCY REVIEW, COMMENT, AND TEST APPLICATION

**A. JOB FAMILY STANDARDS – GENERAL INFORMATION.** During the development of this job family standard (JFS), we exploited every opportunity for simplifying and streamlining its content. We relied heavily on the help of agency subject-matter experts and human resources management officials to do this. We also incorporated changes into this JFS based on lessons we learned from our work on earlier JFS issuances.

**1. Name Changes.** We changed the name of the occupational group, “Mathematics and Statistics Group” to “Mathematical Sciences Group.” We made this change to reflect broad agency recognition of statistics, actuarial, and mathematical work as scientific in nature. For consistency, we also changed the designation of this job family standard to include the words, “Mathematical Sciences Group.”

Our policy is to prescribe functional names for occupational series, and position titles for positions performing work in that series. For example, “accounting” is a function and is the name we use for the accounting occupation (i.e., Accounting Series, 0510). “Accountant” is the title we prescribe for positions that involve doing work predominantly in the accounting series. Consistent with this policy, we changed the names of three occupational series in the Mathematics and Sciences Group as shown below.

Series	Former Series Name	New Series Name
1510	Actuary	Actuarial Science
1529	Mathematical Statistician	Mathematical Statistics
1530	Statistician	Statistics

**2. Classifying Professional Scientific Work.** In response to the draft of this JFS and earlier standards, agencies requested that we provide guidance on classification issues related and perhaps unique to professional scientific work. One specific request was that we provide instructions for assigning functional classification codes to professional scientific positions. The guidance is available in [The Classifier’s Handbook](#). As a convenience for the agencies, however, we have incorporated the guidance into this JFS.

**3. Issue – Distinguishing Between Professional and Technical Work.** We have included in this job family standard (JFS), guidance to determine whether work is professional or technical in nature. The guidance is available in [The Classifier’s Handbook](#). We have added the material to this JFS in recognition of the fact that line managers and others who use it may do so infrequently. By placing this guidance in this JFS, we eliminate the need for them to reference another document. We believe this change in a small way contributes to the efficiency and convenience of the classification process.

**B. THE 1500 JOB FAMILY STANDARD FOR PROFESSIONAL WORK – SPECIFIC ISSUES.** When we announced this study, we requested agency comments on a number of specific issues. This section describes those issues and provides a summary of the agency comments on them. It also describes the actions we have taken in response to the agency comments, and the rationale for our actions.

### **1. Issue – Establish a General Mathematics and Statistics Series, 1501**

**Agency Comments:** The majority of agencies indicated a strong preference for establishing a “miscellaneous” series for the Mathematical and Statistical Occupational Group.

**Our Response:** We established a miscellaneous series, the General Mathematics and Statistics Series, 1501. This new series gives agencies the capability to appropriately classify work that consists of a mix of mathematical, statistical, and related work. The new occupation gives agencies a classification option that for many years has been available for other occupational groups.

## **2. Issue – Retaining Specialty Areas (represented by parenthetical titles) in the Statistics Series, 1530.**

**Agency Comments:** Most agencies commented that the existing parenthetical titles facilitate recruitment efforts and should be retained. A couple of agencies with medical and health research functions suggested the addition of a “Biomedical” specialty. One agency suggested combining some of the specialties to eliminate any overlap in current specialty titles. Only one agency opposed the use of parenthetical titles for specialty areas.

**Our Response:** With one exception, we retained the existing 1530 parenthetical titles. The one exception is that we abolished the parenthetical title, “General.” We did this because we are allowing agencies to use any basic title with the newly-established General Mathematical and Statistic Series, 1501. The agency choice of a basic title with the 1501 series eliminates the need for a parenthetical title, General, with the 1530 series.

We did not authorize use of a new parenthetical title, “Biomedical.” We disapproved that change because we already authorize use of relevant parenthetical titles (e.g., Health, Biology, and Medicine) with the 1530 series.

In response to agency comments, we clarified that agencies may apply parenthetical titles to both Survey Statisticians as well as to Statisticians.

## **3. Issue - Establish Specialty Areas and Parenthetical Titles for Series in this JFS in Addition to Those Authorized with the Statistics Series, 1530.**

**Agency Comments:** The majority of agencies indicated that there was no need for specialty areas/parenthetical titles for any series other than the Statistics Series, 1530.

Two agencies recommended parenthetical titles for the Mathematical Statistics Series, 1529. One of the two agencies suggested we authorize the specialty areas and parenthetical titles defined for the Statistics Series, 1530 for use with the series, 1529. The other agency recommended we recognize health, biology, and medicine specialties and establish for them the related parenthetical titles, “Biomedical Research,” “Bioinformatics,” and “Health.”

A third agency suggested we recognize specialty areas for the Operations Research Series, 1515. The agency also recommended we establish for the specialties, the related parenthetical titles “Various Engineering Fields,” “Ships,” “Aircraft,” “Cost Analysis,” and “Computers.”

**Our Response:** The [Introduction to Position Classification Standards](#) provides guidance on this issue. The guidance instructs agencies that when we do not prescribe use of parenthetical titles, or specifically proscribe their use, agencies may append official position titles with any meaningful parenthetical title of their choosing. We believe there is no compelling argument to rescind the flexibility that this guidance gives to the agencies. Accordingly, we have not prescribed parenthetical titles for series other than the Statistics Series, 1530.

**4. Issue - Assessing Impact on Grades.** We observed our usual practice of requesting that agencies test the draft job family standard by applying it to actual positions. We requested also that they report to us the impact of the draft application on the grades of tested positions.

**Agency Comments:** Agencies applied the draft JFS to 421 positions. They reported no grade impact due to its application. They did report five downgrades, but acknowledged they were due to inaccurate grade evaluations based on application of the existing standard.

In addition to grade impact, agencies indicated that the test showed the need for clearer distinctions among factor level descriptions (FLDs) 1-7, 1-8 and 1-9 in Factor 1, Knowledge Required by the Position. Agencies also asked for more occupation-specific illustrations.

**Our Response:** We made significant changes to the FLDs for Factor 1 and also (although not specifically requested to do so) for Factor 4, Complexity. We also added a number of occupation-specific illustrations for Factors 1 and 4, and also for Factor 5, Scope and Effect. As requested, many of the newly-added illustrations are companion to the higher level FLDs. We believe these changes, taken as a whole, will improve the accuracy of classification efforts.

### ***C. THE 1500 JOB FAMILY STANDARD FOR PROFESSIONAL WORK – MISCELLANEOUS ISSUES.***

#### **1. Issue - Distinguishing between Grade 15 and Executive Level Positions**

**Agency Comments:** One group of reviewers suggested that many of the higher factor level descriptions (FLDs) for several factors in this job family standard (JFS) seemed "...more descriptive of a Senior Executive Service (SES) position than a GS position."

**Our Response:** The law at 5 U.S.C. 5104 defines the criteria for all GS grade levels. Some years ago, the Civil Service Commission (predecessor agency to the Office of Personnel Management) developed a Primary Standard in Factor Evaluation System (FES) format to provide the classification community with a generic tool that might be applied to positions in all occupations. All interested parties have long accepted the Primary Standard and its FES higher factor level descriptions (FLDs) as consistent with the law.

We prepared this JFS in FES format. When we prepared this JFS, we confirmed that its FLDs met FLD criteria in the Primary Standard and as a consequence were in compliance with the law. We understand and recognize that the higher FLD criteria may be quite demanding. However, we are obligated by statute to develop standards that are consistent with the law's current grade level criteria. Accordingly, we have not made changes to weaken the higher FLDs in this JFS.

#### **2. Issue – Cancellation of the Cryptography Series, 1540**

We proposed canceling series, 1540 because our records showed it had no population.

**Agency Comments:** A few reviewers suggested that we not cancel series 1540. The reviewers believed that a number of executive agencies used the series, but for security reasons did not report employment in it.

**Our Response:** We contacted the agencies the reviewers believe employ personnel in series, 1540. None of the contacted agencies expressed concern with our proposal to cancel the series. Accordingly, we cancelled 1540 as a series available for general use. We have reserved the code “1540” and the occupational series name, “Cryptography,” for use by the intelligence community. This information will be placed in the next revision of the [Handbook of Occupational Groups and Families](#) with a list of reserved series.