

Position Classification Standard for Mathematical Statistician Series, GS-1529

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SERIES DEFINITION

This series includes all classes of positions the primary duties of which are to advise on, administer, or perform professional work requiring the design, development and adaptation of mathematical methods and techniques to statistical processes, or research in the basic theories and science of statistics.

GENERAL CHARACTERISTICS OF MATHEMATICAL STATISTICS

One standard dictionary defines the word *statistics* as "the science of the collection and classification of facts as a ground for induction; the systematic compilation of instances for the inference of general truths." The science of mathematical statistics, however, is not a body of subject-matter knowledge -- as is the case in traditional sciences-but rather a body of theories and methods for obtaining knowledges. It is not, moreover, the collection of facts which characterizes the mathematical statistician, but the techniques with which he designs models or plans for the collection of quantified data, discovers the meaning of the facts and insures the accuracy of the measurements which the data represent, and evaluates their precision and validity.

The techniques designed or used by the mathematical statistician provide a basis for investigations of stability, reliability, validity, and precision of measures, and permit the examination of probability of inferences being correct and the evaluation of the risk of error associated with inferences. His skills are essential to research, development, and application of the science of sampling, to the development of mathematical models, and to the adaptation of the theory of random processes to problems of testing, estimation, prediction and control.

The methods designed and used by the mathematical statistician provide the technical framework for such activities as the planning and execution of surveys and censuses, the design and control of experiments, operations research, and the institution of controls for quality and production. The use of statistical means of inquiry may be applicable to any area of investigation, and the skills of the mathematical statistician are readily transferable from one subject-matter field to another. His methods are fundamentally the same whether he is employed in the analysis off physical phenomena, the recording of medical experiments, the development of management control data, the examination of quantitative material in economics, or inquiry into any other field.

Work assignments of mathematical statisticians follow a variety of patterns. As part of research teams, mathematical statisticians support the research effort by providing the means of measuring and correlating those phenomena which can be expressed in or reduced to numerical form and which cannot as readily be observed by other methods. Frequently they serve as staff advisors to various subject-matter specialists on the potentials and limitations of statistical methods.

In very large programs requiring the collection of mass data from people and the resultant data-reduction, processing, analysis and publication, mathematical statisticians may serve as technical advisors at any step of the program. In this capacity they design or adapt the mathematical tools, develop the methods and select the techniques which are then put to use by other statisticians and/or subject-matter specialists.

As consultants and mathematical statistical analysts they develop or review sampling plans and all the essential elements of sample design, including determination of sample size and optimum allocation of total sample size to strata or clusters; specification of methods of sample selection, and estimation; development and measurement of the magnitude and direction of bias, if any; control of non-sampling errors. They also write reports and conduct research and development to improve sample survey or experimental designs.

Some mathematical statisticians also conduct mathematical statistical research which, as contrasted with subject-matter research, is designed to develop new, or improve existing, statistical theories and techniques.

MATHEMATICAL STATISTICS DIFFERENTIATED FROM OTHER OCCUPATIONS

The mathematical statistician differs from the mathematician in his concentration on that body of mathematical theory related to probability and inference and the allied mathematical processes and techniques which have come to be associated with statistics.

The mathematical statistician differs from other professional statisticians by his preoccupation with the mathematical techniques and methods of the statistical process and by the scope of mathematical theory necessary to his function. He is the designer of statistical tools and is concerned less with the application of statistical techniques than with the implication of statistical tools in terms of the quality, reliability and validity of the data they yield.

The mathematical statistician differs from the subject-matter specialist in that his concern is with the internal validity and precision of his measurements rather than with the implications of these measures on the science involved. The mathematical statistician requires only a superficial knowledge in the subject-matter of the statistics he handles. The nouns he uses are abstract symbols, and the techniques of the mathematical statistician require little more than language facility to be applicable in a variety of fields.

Although the foregoing offers criteria for delineating mathematical statistics from closely allied occupations, these lines are of necessity drawn, so to speak, with a broad brush. Only a large and complex statistical organization will allow the precise degree of specialization indicated above, and most mathematical statistician positions will be found to contain aspects of related occupations.

In the case of the delineation between mathematical statistics and mathematics, for example, the use or non-use of probability theory and inductive reasoning cannot be counted upon as a rigid

test for series determinations. The theory of probability may prove a useful tool in the hands of a "pure" mathematician and the mathematical statistician may use extensive knowledge of many fields of pure mathematics.

Similarly, the mathematical statistician may engage in other statistical functions, such as survey management or data analysis, requiring relatively simple mathematics and considerable subject-matter knowledge. Indeed, where a mathematical statistician is working alone or on a small statistical staff, he may be expected to perform or advise on any phase of the statistical process. In such a circumstance his particular experience and familiarity with specific subject-matter data could seem to inhibit his transferability across subject-matter lines. Close examination into such a situation will indicate, however, that if a mathematical statistician's degree of sophistication in mathematics is in fact required, this inhibition is more apparent than real.

Series determinations for positions which contain aspects of related occupations must be made within the framework of the entire occupational situation. The organizational structure, working relationships, and management attitudes and objectives may have a bearing on the final determinations. Since mathematical statisticians as a group tend to be highly creative individuals, the play of incumbent capabilities on the position may have a particular bearing on series as well as grade determination.

Positions which involve the use of electronic computing or data processing equipment in the performance of mathematical statistical work are subject to the same factors which affect the entire occupational area relative to this equipment. The rapidly changing and evolutionary conditions in this occupational area may be expected to require frequent re-study and modification. In general, however, for purposes of this standard, the following criteria apply: If the computing equipment is used either frequently or occasionally as only one of the several tools necessary to the solution of mathematical statistical problems, the position is that of a mathematical statistician. If, on the other hand, the use of electronic computer potential to a variety of statistical or data-regular assignment pattern relates exclusively to the adaptation processing problems, care should be taken to determine if the position belongs in one of the computer occupations ([GS-0332](#) or [GS-2210](#)).

ASSIGNMENT PATTERN OF MATHEMATICAL STATISTICIANS

Assignments given to mathematical statisticians are typically of the "problem" type, that is, the "problem" is the basic work unit. The size and complexity of these problems vary extensively, but solution of the problem usually requires the mathematical statistician to use standard research procedures. These procedures, sometimes referred to as "the scientific method" include the following seven basic work processes:

1. *Problem definition.* - Formulation of the problem requires a precise statement in the language of mathematical statistics.

2. *Background research.* - Examination of the literature pertaining to the problem is necessary to ascertain what is known and what others are doing in the problem area and in related fields.
3. *Planning.* - Determination of the specific steps necessary to investigation of the subject under study requires the visualization and formulation of the entire length and breadth of the study.
4. *Investigation.* - Following out these detailed step-by-step plans may involve measurements or observations under controlled experimental conditions, or logical mathematical calculations and analysis, or both.
5. *Reduction of findings.* - Summing up of the findings of the investigation requires the transformation of raw data into forms amenable for examination and testing.
6. *Analysis and inference.* - Interpretation of findings in order to draw substance and meaning from them is necessary to derive the solution to the problem.
7. *Documentation.* - Findings typically are presented in a formal report or paper, but they may also be presented orally or in a letter or memorandum.

A fully trained mathematical statistician typically has the ability to perform each of the seven work processes outlined above with full professional responsibility for the entire scientific method of investigation.

MATHEMATICAL STATISTICIAN, GS-1529-05

This class is essentially a training category. Incumbents in these positions may assist with any of the seven work processes, above, but carry no responsibility for any step in its entirety. Work assignments typically relate to a few closely related processes and are usually broken down into detailed tasks.

Work is performed under close supervision. Mathematical statisticians of higher grades provide specific directions on methods to be used, sequence of operations to follow, and degree of accuracy required. All finished work is subject to thorough professional review. Applicable literature, available data, specific formulas, and other detailed guides are received with each assignment. The use of these detailed guides generally precludes the need for original thinking at this level.

Qualifications statement. - Knowledge of general mathematics through elementary differential and integral calculus. Knowledge of mathematical statistics which includes probability theory and sampling. Familiarity with basic mathematical tables used in statistics and the appropriate literature and other source material necessary to the assignment. Ability to follow oral or written technical instructions, to write clear and precise English, to work in close cooperation with other workers, and to progress in the field.

MATHEMATICAL STATISTICIAN, GS-1529-07

These positions usually include responsibility for one or more, but not all, of the seven basic work processes described above. Typically the problem definition and planning processes are provided by higher-graded employees, and mathematical statisticians at this level are assigned other steps such as background research, investigation, reduction and analysis of data, or documentation.

Work is performed under direct supervision and is subject to detailed review and approval by mathematical statisticians of higher grades.

Directly applicable guides such as standard methods and formulas, tables, literature, previous studies, and reports are available for most assignments. When these are not available, workers at this level have readily accessible advice from supervisors and colleagues in higher grades. Some original thinking is required in the planning of assignment details and in examination of source material and adaptation of standard techniques to the peculiarities of the assignment.

As employees at this level develop they are expected to apply greater degrees of intellectual curiosity about both the problems under study and the techniques used, and to make appropriate suggestions for improvement of methodology.

Qualifications statement. - Knowledge of general mathematics such as advanced algebra, differential and integral calculus, theory of differential equations, etc. Knowledge of mathematical statistic including probability theory, sampling theory, and theory of design of experiments.

As required, knowledge of computation methods including familiarity with standard mechanical, electrical, and electronic computation equipment. As required, some knowledge of the subject matter of the statistics involved.

Familiarity with basic authoritative reference works on mathematical statistics and some knowledge of source material relative to the subject matter of the assignment.

Ability to write clear and precise English, to work in close cooperation with others, and to meet and deal effectively with people in giving or securing information.

MATHEMATICAL STATISTICIAN, GS-1529-09

These positions involve performance of mathematical statistical work covering the entire scientific method of investigation represented by the seven basic work processes. Problems assigned are of limited scope and difficulty; for example, they may have short-term objectives, require the application of well-established mathematical statistical methods and concepts, and be closely similar to other problems on which the organization has a considerable body of precedent. The technical mathematical statistical features may be complex but are well understood and are within the range of abilities typically expected of a professional statistician familiar with the organization's work. Assignments at this level are unlikely to result in original contribution to the field.

Work is supervised by a higher-graded mathematical statistician who outlines the assignment and indicates particular problems and anticipated results. The incumbent takes the initiative in locating and adapting relevant source material, established methodology and precedent, but the supervisor may provide assistance. Work is subject to occasional review of progress; requests for further supervisory assistance are initiated by incumbent; and final results are reviewed for general consistency, and adequacy.

In general, precedents are available in the form of previous studies on related subjects, standard methods in textbooks, hand-books, or other literature, and possibly, from manuals of procedure. Most assignments, however, have features which preclude the direct application of these guides, and mathematical statisticians at this level must select and adapt methods and piece together the best techniques applicable to his problem.

Originality is required in the problem definition and planning processes, in the selection and adaptation of techniques and in the establishment of sequencing and procedure. Little or no innovation or modification of basic technique is required.

Qualifications statement. - Good knowledge of theory and methods of mathematical statistics including the calculus of probability, sampling theory, theory of design of experiments, systematic methods of curve fitting, etc. As required, good knowledge of advanced mathematics such as set theory, matrices, etc.

Good knowledge of computation methods including standard mechanical and electrical computation machines and, as required, knowledge of electronic computing equipment.

Good knowledge of the basic or primary source material, both published and unpublished, pertaining to mathematical statistical philosophy, methods and techniques.

Knowledge of the regulations and objectives of the organization as they affect assigned statistical work. As required, knowledge of the subject matter of the statistical assignment.

Ability to analyze factual information, to recognize significant factors, relationships and trends. Ability to write technical reports on findings of statistical investigations. Ability to work in

close cooperation with others and to meet and deal effectively with others in the exchange of technical services, information, and opinion.

MATHEMATICAL STATISTICIAN, GS-1529-11 AND ABOVE

Positions which require the personal performance of mathematical statistical work at levels involving responsibility for independent accomplishment of significant research assignments or assignments as members of research teams should be evaluated by reference to the Guide for Evaluation of Positions in Basic and Applied Research.

Although all mathematical statisticians do not engage in research, the environment of this occupation is the typical climate of scientific research, and the attitudes, approaches and assignment patterns of mathematical statisticians tend to resemble those in scientific research generally. Therefore, positions of mathematical statisticians engaged in non-research activities may be evaluated by this Guide to the extent that the evaluation criteria provided are applicable. In other words, the use or non-use of this Guide for mathematical statistician position is dependent on the usability of the evaluation criteria of the Guide for any given mathematical statistician position, rather than on the nature of the statistical assignment.

Positions in this series for which the use of this Guide at grades GS-11 and above is not feasible should be evaluated as to grade level by reference to grade level criteria presented in standards for the [Statistician Series, GS-1530](#), and the [Mathematician Series, GS-1520](#).