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OBJECTIVES

OF

ACCOUNTING AND FINANCIAL REPORTING

IN THE

FEDERAL GOVERNMENT

EXPOSURE DRAFT

UNITED STATES
GENERAL ACCOUNTING OFFICE

FEBRUARY 29, 1980

DIVISION OF FINANCIAL AND
GENERAL MANAGEMENT STUDIES

The Accounting and Auditing Act of 1950 makes the
General Accounting Office (GAO) responsible for establishing
the accounting standards that Federal agencies are to follow.
In carrying out this responsibility, GAO established such
standards in 1952 and has revised them periodically since
their original issuance. In recent years there has been many
advances in accounting theory and practice and we, in light
of these advances, deem it prudent to reexamine these Federal
standards on a conceptual basis to see if changes are needed
or desirable.

Our goal is to develop a conceptual framework under
which consistent Federal accounting requirements can be main-
tained. These requirements would include both accounting
standards and operational requirements. The effort is forward
looking. The expected long-range benefits are more useful
financial information.

Although much has been done in recent years to establish
new standards in the private sector, we cannot unquestioningly
accept such standards for government.

We believe that government is sufficiently different
from profit and nonprofit entities in the private sector
to warrant separate accounting standards studies. Perhaps
the most significant difference is the basic environment
in which government operates. It is different from business
enterprises. In business the bottom line is profit, but in
government there does not exist a so easily measured item.
Profit is the item by which a business's worth is recognized
and measured. It is also a means by which control is exer-
cised. In a free market system profits indicate economic
operations and unprofitable businesses will be forced out
of the market place. In the government control over how
economically an entity operates is achieved through other
means such as laws, regulations, and constant monitoring of
many facets of operations.

Also, in government the principal resource provider, the
taxpayer, is more distant than the customer in private busi-
ness. Customer demand habits influence business more easily
than taxpayers influence government. There is not an open

market as in business with which to test the value of the
service and products of government. Moreover, in government
the continuity of leadership and harmony of purpose which
exist in business is frequently interrupted by a change
of administration. Finally, in government, management's
choices for spending money to achieve its goals are more
limited than in business.

The Federal Government shares may of the differences
between business and government with State and local govern-
ments. The Federal Government is different from other governments
in that its effect on the national economy and its relationship
with foreign governments often introduce unique factors
into its accounting. (We will not be sure exactly how much
this uniqueness will affect Federal accounting standards
until we complete the standards development process.)

The standards are being developed in four stages:
Objectives, Fundamentals, Standards, and Operational Criteria.
An example of what can be expected in each stage follows:

> Objectives--Accounting must provide information
>   useful in assessing management
>   performance and stewardship.

> Fundamentals--Time-Period Concept - to provide a proper
>   assessment of managements' performance
>   and stewardship all expenses need to be
>   recognized in the period incurred and all
>   revenues will be recognized in the period
>   earned.

> Standards--One expense that needs to be recognized in
>   the period incurred is bad debt expense.
>   Accordingly, receivables must be reviewed to
>   establish an appropriate allowance for bad
>   debt expense for the period.

> Operational Criteria--In order to calculate bad debt
>   expense for the period an agency
>   should (1) age receivables to
>   allow for an analysis of past-due
>   accounts and write-off those
>   determined to be uncollectible,
>   or (2) determine a percentage of
>   receivables that are uncollectable
>   based on experience data.

Only the objectives stage is covered in this document. Subsequent documents will deal with the remaining stages.

This document is divided into two parts. The first part addresses the overall structure of accounting theory and practice. It identifies two levels of accounting theory which constitute the conceptual framework of accounting practice. Two levels of accounting practice are also identified, and the components and boundaries of each of the four levels are summarized.

The second part addresses the first level of the conceptual framework, the objectives of accounting and financial reporting in the Federal Government. It establishes the objectives by first identifying the users of accounting and financial information and then by identifying their information needs. The objectives statement also discusses the qualitative characteristics of financial reporting since they have a direct bearing on the usefulness of information contained in the reports.

Similar efforts are underway by the Financial Accounting Standards Board (FASB) and the National Council on Governmental Accounting (NCGA). The FASB is currently involved in establishing a conceptual framework for accounting and financial reporting for business enterprises and has already issued the first part of the framework, the objectives statement. The NCGA is currently doing research for State and local government accounting. In developing the objectives statement we drew upon the Financial Accounting Standards Board's work on the conceptual framework efforts and on the National Council of Governmental Accounting's research on State and local governments. We also tried to use the same terminology to avoid confusion in accounting literature.

This document is issued as an exposure draft to Federal departments and agencies, to members in the accounting profession, and to other interested persons in the financial community. We encourage your review of this document and solicit your comments on how it can be improved and whether the basic objectives seem to be the appropriate ones for the Federal Government. Please send these comments by April 21, 1980, to:

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                              Sincerely yours,

                              D. L. Scantlebury
                              Director

Enclosure

OVERVIEW OF THE CONCEPTUAL FRAMEWORK

AND STANDARDS PROJECT

The Budget and Accounting Procedures Act of 1950 requires the General Accounting Office (GAO) to take the initiative in establishing accounting principles and standards applicable in the Federal Government. In a continuing effort to improve financial management, GAO has recently begun to reexamine the accounting and financial reporting requirements in the Federal sector. This paper presents an overall structure of accounting theory and practice in the Federal Government and an overview of the method to be followed in reevaluating the current requirements.

Accounting and financial reporting in the Federal Government can be organized into a structure containing two major components, one dealing with accounting theory and one dealing with accounting practice. The one dealing with accounting theory consists of the concepts which provide the basis for accounting practice. As such it is called the "conceptual framework" of accounting and financial reporting. The one dealing with accounting practice consists of requirements that must be followed when identifying, processing, recording, and reporting economic transactions. As such, it is called the "practice requirements" of accounting and financial reporting.

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The conceptual framework consists of two levels:
(1) objectives and (2) fundamentals. The practice require-
ments component also consists of two levels: (1) standards
and (2) operational criteria. The overall structure of
Federal Government accounting theory and practice is a system-
atic progression of the four previously mentioned levels;
each succeeding level is built upon the basis provided by
the previous lower level.

This paper defines the conceptual framework and the
practice requirements at each related level by summarizing
their components and boundaries. Subsequent efforts will develop
these levels in detail, incorporating existing GAO requirements,
where appropriate.

CONCEPTUAL FRAMEWORK--OBJECTIVES

The objectives of Federal Government accounting are the
most basic items from which other parts of accounting theory
and practice are derived. The objectives are the goals
toward which accounting and financial reporting are directed.
The primary objective of Federal Government accounting and
financial reporting is to provide information useful in
assessing management's performance and stewardship. To
evaluate performance and stewardship, financial reports must
provide information useful in assessing:

--<u>Financial viability</u>:   the ability of the entity to continue to provide the same level of resources.

--<u>Fiscal compliance</u>:   whether financial and related laws and regulations were followed.

--<u>Program Activity</u>:   the degree of activity under various programs, including the costs of inputs and the value of outputs.

Another objective of accounting and financial reporting not directly necessary in assessing performance and stewardship but dependent upon viability, compliance, and program activity is <u>resource allocation</u>. Resource allocation is the process of assigning and distributing budget authority, deciding on use of resources in carrying out operations, and choosing government securities from a creditor's standpoint.

The objectives will be developed in three logically sequential stages: (1) users of financial information will be identified, (2) their information needs will be determined, and (3) the general form and content of financial information that satisfies user needs will be ascertained. However, before identifying users, two significant factors affecting the objectives and the achievability of objectives must be discussed.

First, certain environmental factors must be considered inherent in formulating objectives of accounting and financial reporting in the Federal Government. The purpose of the Federal Government is to provide for the safety, welfare, and overall benefit of all citizens of our country. As such,

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the goal is to provide as much as possible to all citizens

with the resources available to it, as opposed to earning profits

and wealth for selected parties. Further, the means to control

Federal Government operations are different from those in the

private sector. In the Federal Government control is achieved

by laws and regulations. These and other environmental factors

will be developed further in the objectives statement.

Second, certain limitations of accounting and financial

reporting affecting the achievability of objectives will be

discussed. The three following limitations will be enumerated:

1. Imprecision in financial information exists
   (particularly in financial statements) because
   of the unavoidable use of estimates.

2. The cost of providing all necessary information
   to satisfy the needs of all users will surely
   outweigh the total benefit. As a result, financial
   reports will not satisfy the need of each and every
   user individually but rather the primary needs of
   the principal users collectively.

3. The total information needs of those making
   decisions about the Federal Government extend
   beyond those which financial information can supply.
   Financial information is limited to providing data
   on economic resources and is but one source of the
   total information needed by those making decisions
   about the Federal Government.

The degree to which objectives are achieved will necessarily

be constrained by these limitations.

Users will then be identified, their needs will be

delineated, and the general type of financial information

that will satisfy these needs will be discussed. Subjects

to be considered and discussed in the objectives phase
include the relative importance of users or user groups, users'
varying degrees of knowledge and understanding of accounting
and financial reporting, the scope of financial reporting
and the range of users considered in formulating objectives,
and the qualitative characteristics which determine the
usefulness of financial reports.

CONCEPTUAL FRAMEWORK--FUNDAMENTALS

Fundamentals are the second building block of the
conceptual framework. Fundamentals are concepts which serve as
guidelines for determining and establishing standards. Whereas
objectives focus on a desired end product and provide the basis
from which to proceed, fundamentals are the initial steps or
means to achieving the objectives.

Fundamentals include concepts derived from the environ-
ment in which the Federal Government operates. They are
broad in scope and are the foundations of standards.
Examples of fundamentals include:

1. Entity concept

2. Matching concept

3. Measurement concept

4. Concepts of the accounting system

Fundamentals also include the elements of accounting and
financial reporting. Elements are definitions and

classifications of transactions, rights, and claims to rights; liabilities; and equities. Also, in this phase the elements will be discussed in context with traditional Federal financial statements.

PRACTICE REQUIREMENTS--STANDARDS

The term "principles" is often used synonymously with "standards." Generally, "principles" mean comprehensive and fundamental laws, doctrines, or assumptions that are intended to be pervasive. "Standards," on the other hand, refer to rules or requirements established by authority, custom, or general consent. Standards are more specific than principles by implication. Although the meanings of each are close, for our purposes the term "principles" will be used in the broad generic sense to refer to any aspect of the accounting structure.

"Standards" has a specific meaning in the overall structure. <u>Standards are essentially rules for recognizing and reporting economic transactions and events.</u> The standards provide the criteria, rules, and requirements for:

1. Recognizing economic transactions and events.

2. Measuring or valuing components of transactions.

3. Assigning economic resources obtained or used to time periods.

4. Reporting transactions and events.

Standards are the next level after fundamentals and, as such, are more specific. Examples of standards include

requirements for recognizing liabilities, revenues, or
expenditures; criteria for valuing foreign currency or
receivables; and rules for allocating overhead costs, where
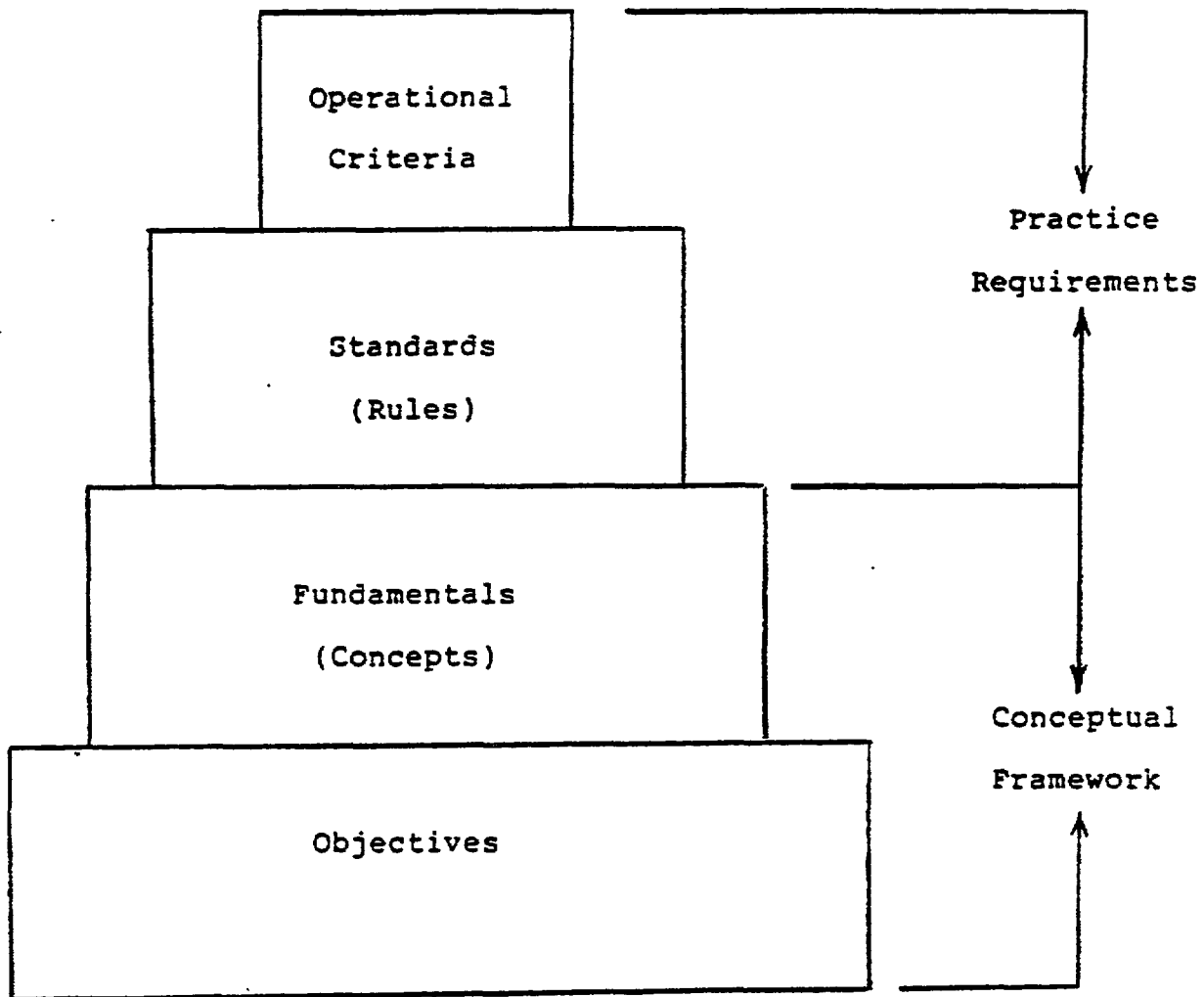applicable.

PRACTICE REQUIREMENTS--OPERATIONAL CRITERIA

The operational criteria level is composed of the most
detailed aspects of the accounting framework. This level
includes the procedural or system aspects that essentially
facilitate application of the standards. It consists of the
way in which standards are applied to produce reportable
financial information, safeguard resources, and maximize
their efficient and effective use. Examples include:

1. The processing of transactions and source
    documents.

2. Procedures and controls in processing and
    recording transactions and compiling reports.

3. The account structure and records maintained.

4. Audit trails.

This level includes those system requirements which
are not specific detailed acts or procedures but which
are subject to approval by GAO as part of an accounting system
design. It excludes "desk" procedures and operations manuals,
which are considered part of the implementation phase of
the accounting system. In developing this level we will

further identify boundaries separating detailed items con-
sidered implementation of operating systems from those items
considered design of systems.

FIGURE 1

THE ACCOUNTING STRUCTURE

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┌─────────────────────┐        ┌───────────────────────┐
│   Operational        │        │                       │
│   Criteria           │        │                       ↓
│                      │              Practice
┌────────────────────────────┐        Requirements
│                            │              ↑
│      Standards             │              │
│      (Rules)               │              │
│                            │              │
┌──────────────────────────────────┐        │
│                                  │        │
│     Fundamentals                 │        ↓
│     (Concepts)                   │      Conceptual
│                                  │      Framework
┌────────────────────────────────────────┐  ↑
│                                        │  │
│        Objectives                      │  │
│                                        │  │
└────────────────────────────────────────┘
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Proposed Statement on

Accounting and Financial Reporting

of the Federal Government

Issued for Comment

OBJECTIVES OF

ACCOUNTING AND FINANCIAL REPORTING

PREFACE

The Budget and Accounting Procedures Act of 1950
requires the General Accounting Office (GAO) to take the
initiative in establishing accounting principles and stand-
ards applicable in the Federal Government. In a continuing
effort to improve financial management, GAO has recently
begun to reexamine the current accounting and financial
reporting requirements in the Federal sector. This statement
is the first in a series of statements intended to establish
the basis for accounting and reporting requirements.
Subsequent statements will focus on current requirements.

The purpose of this statement is to establish the
objectives of Federal Government accounting and financial
reporting. Objectives constitute the first level of a two-level
conceptual framework; the second level is fundamental concepts.
The overall Federal Government accounting and financial
reporting structure includes a standards and a procedural
level in addition to the conceptual framework levels.

This statement is not intended to specify accounting
standards, procedural requirements, or reporting practices,
as does the General Accounting Office Policy and Procedures
Manual for Guidance of Federal Agencies. Rather it is
intended to provide fundamental concepts for establishing
accounting and reporting standards and other requirements.

Current requirements in the manual are not always consistent with the objectives in this statement, and the objectives in this statement will not always be met by current requirements in the manual. In subsequent statements, GAO expects to reevaluate the requirements in the manual and make additions, deletions, modifications, or interpretations of requirements, where appropriate, on the basis of the adoption of the conceptual framework.

C o n t e n t s

OBJECTIVES OF ACCOUNTING AND

FINANCIAL REPORTING IN THE FEDERAL GOVERNMENT

INTRODUCTION

1. This statement establishes the objectives of accounting
    and financial reporting in the Federal Government.
    Developing the objectives is the first task in estab-
    lishing the accounting structure. This statement does
    not specify accounting standards or procedures, nor does
    it contain conclusions on the number or form of financial
    statements or disclosures. Rather it sets forth basic
    goals which underlie financial accounting requirements.

2. The overall accounting and financial reporting structure
    in the Federal Government has two major components,
    the conceptual framework and the practice requirements.
    The objectives is the first of two levels in the conceptual
    framework. The next level is the fundamental concepts.
    The practice requirements component also includes
    two levels, standards and operational critieria.
    This statement is the first of a planned series
    which will include all four levels.

3. Although this statement is intended to establish the   .
    objectives of accounting and financial reporting, the
    qualitive factors which financial reports must contain

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also are covered since they have a direct bearing on

usefulness of reported information. Also paragraph 25

discusses the range of possible entities for the purpose

of identifying the users of financial reports. The entities

are not defined, however as the entity question will

be covered in its entirety in our statement on the second

level of the conceptual framework, the fundamental

concepts. Topics also to be covered in the fundamental

concepts level includes the elements of accounting and

financial reporting, financial statements (form and content),

and measurement and valuations.

OBJECTIVES DEFINED AND SUMMARIZED

4. "Objectives" are the goals or aims toward which

   accounting and financial reporting is directed. They

   are derived directly from the needs of intended

   users. These needs basically center around the

   activities of a Federal Government entity and focus

   on evaluating performance and stewardship. Therefore,

   the primary objective of Federal Government accounting

   and financial reporting is to provide information

   useful in assessing management's performance and

   stewardship. To do this, however, information must

disclose whether applicable laws and regulations
were adhered to, the nature and extent of activities
under various programs, and the ability of the entity
to continue and to achieve program goals. This Federal
Government accounting and financial reporting should
provide information useful in assessing:

--Financial viability: the ability of the entity
to continue to provide the
same level of resources.

--Fiscal compliance: whether financial and related
laws and regulations were
followed.

--Program Activity: the degree of activity under
various programs including the
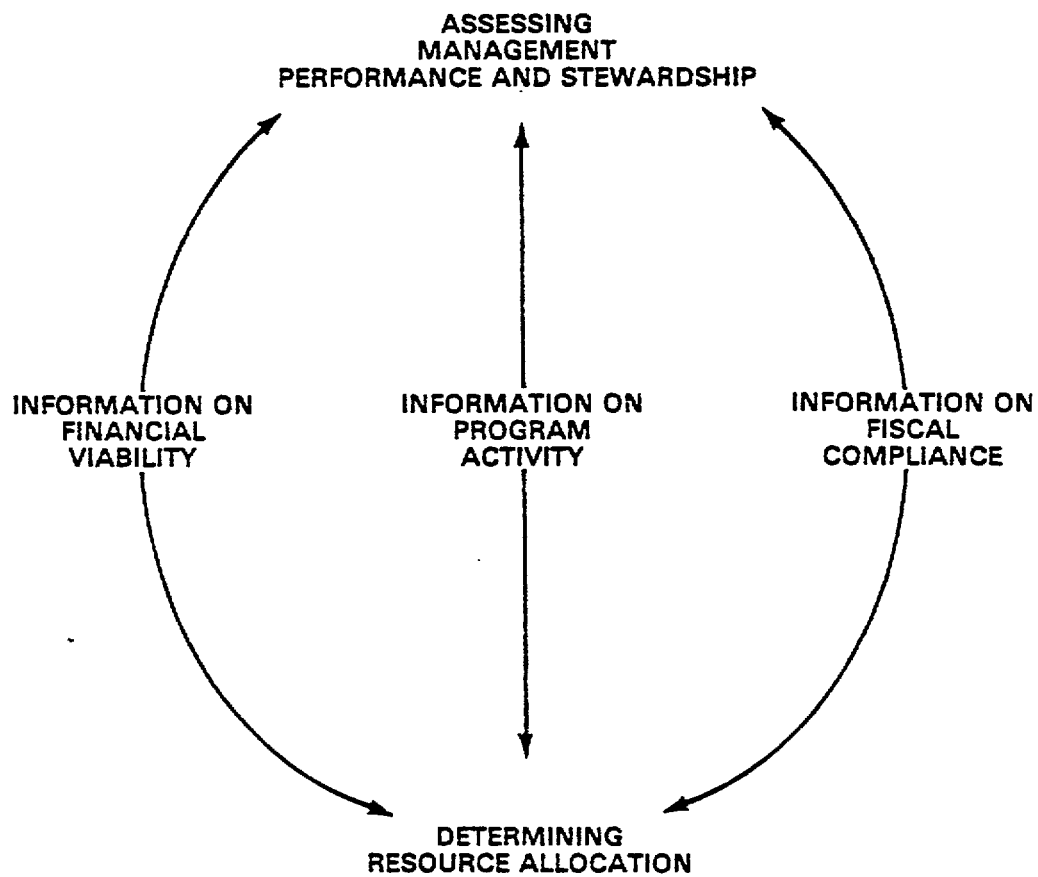costs of inputs and the value of
outputs.

5. Another level of objectives includes resource allocation.
Resource allocation basically involves the decision
process of choosing among alternatives for assigning
resources. It is the process of distributing budget
authority, deciding on the use of resources in carrying
out operations, and choosing government securities from
a creditor's standpoint. This objective is not necessary
in directly assessing performance and stewardship, how-
ever, it is dependent upon viability, compliance, and
program activity.

6. To help users assess management's performance and stewardship and to decide on resource allocation, information that is useful must be presented in terms describing economic resources. Information on economic resources under an entity's control, economic obligations of an entity in terms of resources, and resource flows help indicate financial viability. Economic resources consumed as inputs and produced as outputs help indicate program activity, and fiscal compliance, both externally and internally mandated, is measured in terms of economic resources. Accounting and financial reporting, therefore, must bear on economic resources and must focus on the creation, use, and rights to resources. However, the degree and manner in which the objectives are attained depends on the nature and extent of the information that acounting and financial reporting can supply about economic resources.

7. The objectives of accounting and reporting depend upon the needs of users. These objectives can be viewed as a cycle of needs, with information necessary to assess management's stewardship and performance at its head. The next level of user needs includes information necessary to assess financial viability, program activity, and fiscal compliance. The next level of user needs

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focuses on information necessary to make resource allocation decisions. Management performance and stewardship is assessed by first determining financial viability, program activity, and fiscal compliance. Likewise allocation decisions are based on viability, program activity, and compliance. This cycle is presented in Figure 1.
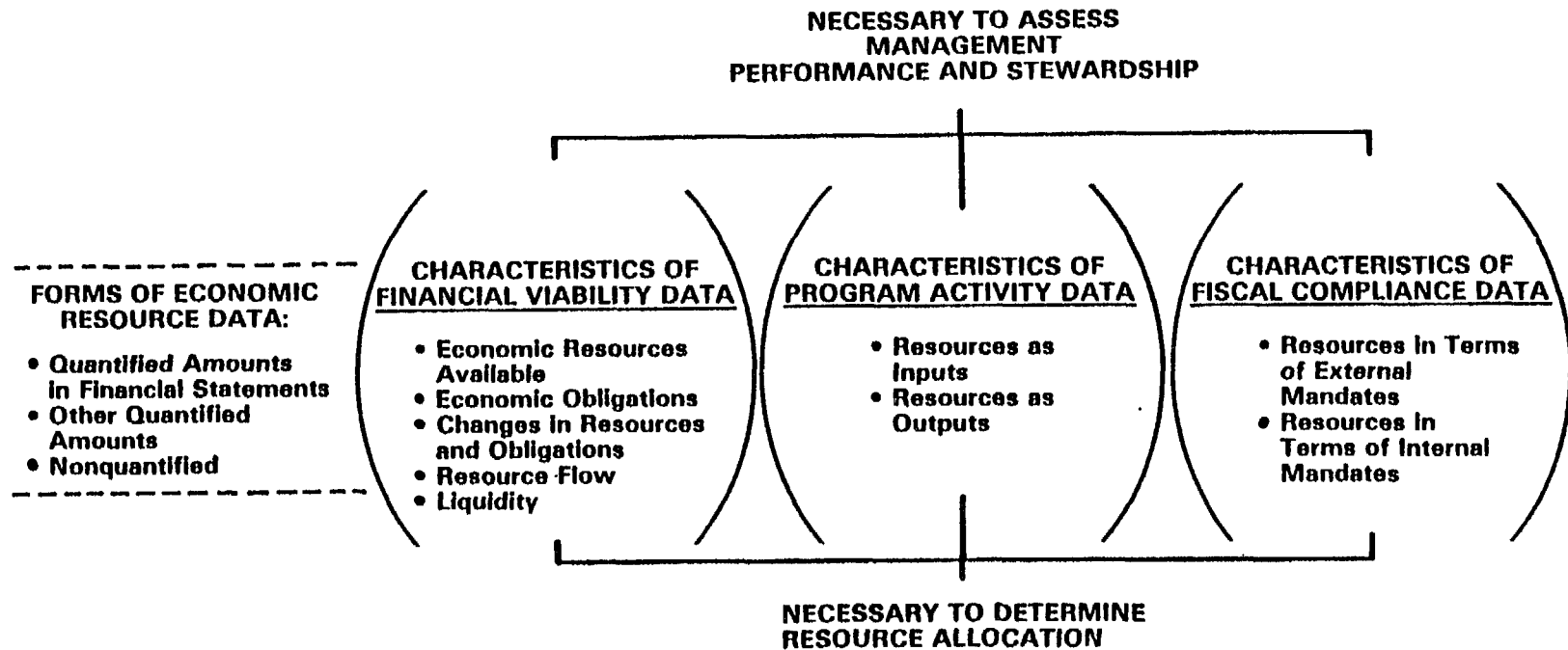
8. To satisfy user needs information about economic resources is necessary. Economic resource data is necessary to assess financial viability, program activity, and fiscal compliance, which in turn, enables an assessment of performance and stewardship and a determination of resource allocation. The characteristics of economic resource data can be couched in terms of viability (resources available, obligations, changes in resources and obligations), program activity (resources as inputs and outputs), and compliance (resources in terms of external and internal mandates). In addition, economic resource information can be reported in various forms such as quantified amounts in financial statements, quantified amounts not in financial statements, and nonquantified data. The characteristics of economic resource data and the forms of reporting it relating to the objectives is presented in Figure 2.

FIGURE 1
FEDERAL GOVERNMENT
ACCOUNTING AND FINANCIAL REPORTING
CYCLE OF INFORMATION NEEDS

ASSESSING
MANAGEMENT
PERFORMANCE AND STEWARDSHIP

INFORMATION ON   INFORMATION ON   INFORMATION ON
FINANCIAL   PROGRAM   FISCAL
VIABILITY   ACTIVITY   COMPLIANCE

DETERMINING
RESOURCE ALLOCATION

FIGURE 2

FEDERAL GOVERNMENT
ACCOUNTING AND FINANCIAL REPORTING
ECONOMIC RESOURCE DATA

NECESSARY TO ASSESS
MANAGEMENT
PERFORMANCE AND STEWARDSHIP

**FORMS OF ECONOMIC
RESOURCE DATA:**

- Quantified Amounts
  in Financial Statements
- Other Quantified
  Amounts
- Nonquantified

**CHARACTERISTICS OF
FINANCIAL VIABILITY DATA**

- Economic Resources
  Available
- Economic Obligations
- Changes in Resources
  and Obligations
- Resource Flow
- Liquidity

**CHARACTERISTICS OF
PROGRAM ACTIVITY DATA**

- Resources as
  Inputs
- Resources as
  Outputs

**CHARACTERISTICS OF
FISCAL COMPLIANCE DATA**

- Resources in Terms
  of External
  Mandates
- Resources in
  Terms of Internal
  Mandates

NECESSARY TO DETERMINE
RESOURCE ALLOCATION

FINANCIAL REPORTING

9. This statement of objectives pertains to the reporting
    of useful financial information. Financial information
    has traditionally been compiled and presented in finan-
    cial statements; however, some financial information
    can be better presented by other means or can be
    presented only by other means. Financial statements
    are, for the most part, compiled from data contained
    in the formal accounting records and accounting
    system; however, financial reports can and should
    contain information obtained from other sources.
    This information can be qualitative as well as quantitative
    and can include, for example, as further descriptions of
    resources owned; program results data, such as number and
    types of citizens benefiting from certain programs;
    management's expectations, forecasts, and plans; and how
    the operations of a specific Federal agency may affect
    individual members of society.

10. Financial statements prepared from the accounting records
    have been considered the primary means of communicating
    financial information. This information is principally
    quantitative, and it reflects resource data on transactions
    entered into or internally committed to enter into by an
    agency and is shown in exhibits and schedules. Financial

information other than financial statements can be
conveyed in the form of narratives, graphs, matrixes,
or tables.

11. For the purposes of this statement, financial reports
    refers to general-purpose financial reports which
    are prepared periodically. Special-purpose reports,
    prepared on an as needed basis, are excluded since
    the information in them is generally compiled as
    the requirements necessitate.

12. As further indicated in paragraph 21, financial infor-
    mation is but one source of the total information used
    by those making decisions about the Federal Government.
    Financial information obviously cannot satisfy all
    needs of all users. For example, financial information
    provides evidence of compliance with laws and regula-
    tions and provides indications that resources were
    efficiently used, but it does not provide conclusive
    evidence of total compliance or overwhelming evidence
    of efficient operations. However, financial information
    in reports of an entity are often audited by independent
    accountants and auditors, who render opinions on
    them to enhance confidence in their reliability.
    Auditors reports are often included in an entity's
    report. Auditors may also review operations

of an entity and report on such matters as efficiency and economy, program results, and legal and regulatory compliance. Their opinions and conclusions provide additional evidence of an entity's performance.

ENVIRONMENTAL CONTEXT OF OBJECTIVES

13. The environment in which the Federal Government operates is similar in many ways to that in which profitmaking enterprises operate. Examples follow.

    1.   They both are integral parts of the same economic system and use the same resources to produce their goods or provide services.

    2.   In some cases they both make similar products and provide similar services.

    3.   Accounting and financial reporting is an integral part of the information used by management and other interested parties in assuring resources are used efficiently and effectively.

14. However, there are obviously basic differences which affect the objectives. The purpose of the Federal Government is to provide goods and services to the public for the safety, welfare, and overall benefit of society. As such, its goal is to provide as much as possible with what is available to it, without increasing its capital or acquiring wealth, without earning profits, and without paying returns or

dividends to select interest groups. In this environment, the emphasis is on resource flow, sources and uses of resources, and budgetary position.

15. Another significant environmental factor affecting the objectives is the remote and indirect relationship between the sources of resources obtained by the Federal Government and the services or goods provided. Although there are many activities in the Federal Government where goods or services are provided to specific individual consumers directly and they are charged at least part of the costs, the vast majority of goods and services are provided without charge to the public as a whole. There is no open market in which to establish objective values of the goods and services provided, and society must pay taxes to obtain them.

16. Perhaps the most important environmental factor affecting the objectives is the way the Federal Government is regulated. In the private sector built-in controls in the form of the free market system necessitate the need to operate economically. Without alternative controls there are no objective assurances that Government will operate efficiently, effectively, and economically since there exist,

". . . 1. the absence of the need to operate
profitably, 2. the lack of an open market test
of the value of the organization's output,
3. the remote and indirect relationship, if
any, between the resource contributor and the
goods or services recipient, and 4. . . . the
ability to force resource contribution via
taxation . . . ." 1/

Operations in the Federal Government are consequently

subject to considerable legal and regulatory controls

over organizational structures, personnel policies and

procedures, and sources and uses of resources.

17. These environmental factors must be considered inherent

in formulating objectives of accounting and financial

reporting in the Federal Government. For information

to be informative and useful, it must reflect the

environmental constraints. Undoubtedly it must

indicate (1) sources and uses of resources, resource

flows, and budgetary position rather than wealth

or profits, (2) the resources provided the public

and the related costs rather than sales and cost

of sales, and (3) legal and regulatory compliance

rather than net income or earnings per share.

1/Fund Accounting: Theory and Practice, Lynn and Freeman,
    1974, Prentice-Hall, p. 5.

LIMITATIONS OF FINANCIAL INFORMATION

18. The overall objective of accounting and financial
    reporting is to provide useful financial information to
    users. However, financial information, and in particular
    the information in financial statements, is informative
    and useful only within the limits of accounting. Certain
    characteristics in accounting require considerable
    judgments to be made. These judgments are not always
    unanimously agreed on by all those involved. Neverthe-
    less, knowledge of some of the limitations helps
    in understanding the judgments made by accountants,
    as well as the financial information itself.

19. Financial statements contain approximate and estimated
    valuations. In the accounting process, the recognition
    of resources affected by a transaction often results
    from a choice among alternatives. One alternative
    among many for measuring the value of resources
    affected by a transaction can emphasize the value
    of resources used, whereas another alternative
    can emphasize the value of resources owned. For
    example, when allocating the costs incurred in per-
    forming a service for a specified period, an agency
    may choose to allocate the cost of a vehicle used
    on the basis of miles driven in relation to total

estimated lifetime miles of the vehicle. Another

agency may choose to allocate the cost of a vehicle

used solely on the basis of the function of time--one

period of time used of the total estimated life

of five periods would yield a value of the vehicle

owned at four periods. Despite the belief that

financial statements are highly precise, most

valuations are approximations and estimations.

20. Determining the type and amount of financial infor-
mation about the Federal Government that should

appear in financial reports is based on user needs.

However, the specific needs of each user taken

collectively may require such a vast amount of

financial information that the cost of providing

it would far exceed the collective benefit.

Generally the benefits should be expected to equal

the costs of providing them. However, it seems

virtually impossible to assign a value to benefits

to be derived from reporting certain information

and then compare it with the cost of providing the

information, before or at the time the information is

provided. However, to establish control over the cost

of providing information, the type and amount of

information to be provided is based on aggregate

user needs. The extent to which the objectives
of accounting and financial reporting are achieved
is therefore based on the aggregate user needs
rather than individual user needs.

21. Financial information is but one source of the total
information used by those making decisions about the
Federal Government. Other sources include political
events and political climate; legal requirements and
constraints; policies and regulations; and economic
conditions, expectations, and overall outlook. Finan-
cial information is not an end in itself to use in
making decisions about future operations or to
draw conclusions about past operations; rather
it is limited basically to reflecting data on economic
transactions and events involving an entity.

22. Despite these numerous limitations, information pro-
vided by accounting and financial reporting has been
proven to be necessary in assessing past performance
and deciding on future operations. However, the
degree to which the objectives can be satisfied
must be subject to these limitations, and under-
standing these limitations should help users in

assessing more fully how their needs can be satisfied
through use of financial information.

USERS IDENTIFIED

23. Financial information about the Federal Government,
    either collectively as an entity or as single agencies,
    may be used by more individuals with more diverse
    backgrounds and varying levels of understanding than
    financial information provided by any other single entity.
    As a result, the objectives of accounting and financial
    reporting must be directed toward the needs of as
    many users as possible.

24. The objectives have been established in three sequen-
    tial stages: (1) identifying users of financial
    information, (2) determining their information needs
    (objectives), and then (3) ascertaining the general form
    ·and content of information that satisfies these needs. .

25. In identifying users the Federal entity which is to
    be the frame of reference must be identified.
    While the purpose here is not to define the entity
    or establish the criteria to determine it, the
    possible entities involved must be identified so

that the full scope of potential users can be
included. Subsequent phases of the accounting
structure will define the entity. The entity
may include, for example, any one or any combination
of the following:

   1. The Federal Government as a whole.

   2. Programs of the Federal Government.

   3. The executive branch.

   4. The legislative branch.

   5. The judicial branch.

   6. Any department, agency, or organizational
       unit conducting relatively autonomous
       operations under any one of the above
       three branches.

   7. Any other organizational unit not
       included above but considered an instru-
       mentality of the Federal Government (such
       as some Government corporations).

This list is intended neither to establish definitive
entities nor to identify the boundaries separating
entities. It merely points out that users external
to an entity about which financial information is
provided can be part of the Federal Government as
well as external to the Federal Government.

26. Users of financial information are divided into
     two major types, those external to the reporting
     entity and those considered internal to it.

Those internal users have a special fiduciary

relationship with the entity generally as either

employees (including management) or special agents to

the entity. Internal users are involved in the

day-to-day operations, including planning, conducting,

and reviewing business activities. The information

they seek directly affects daily operations. These

users consist principally of management and their

advisors.

27. External users are interested in financial information

for purposes other than direct hands-on planning,

managing, or conducting daily operations. They

are divided into five major groups, as follows:

    1. The public--citizens interested in governmental
            affairs.

    2. Investors and creditors--businesses, banks,
                           investment houses,
                           and other institu-
                           tional investors/
                           lenders.

    3. Professional and
        other analysts--political scientists,
                      economists, financial
                      analysts, accountants,
                      lawyers, journalists,
                      researchers, teachers,
                      and students.

    4. Oversight bodies--legislators and their
                      advisors, regulatory
                      authorities and reporting
                      agencies, boards of
                      directors, and the
                      President and his
                      advisors.

> 5. Other interested
>   parties--labor unions, State and local
>   governments, other nonprofit
>   organizations, and direct program
>   recipients.

These user groups bear no relationship to user needs, since each group does not have unique needs that general-purpose reporting must address. Users were grouped here for convenience.

28. The diverse needs of users are based in part on their relationship to the reporting entity as well as their understanding of business transactions. The users identified in paragraphs 26 and 27 have varying associations with the reporting entity, as well as varying degrees of expertise and knowledge of accounting and financial reporting. Users' associations with the entity have a direct relationship to the authority over the nature and extent of information to be included in general-purpose financial reports. Internal users have a high degree of authority, as do external users in the oversight bodies group. On the other end of the spectrum, the public lacks both the authority, and the time and resources necessary to obtain needed information. In addition, users who are well-informed of accounting and financial matters can derive an in-depth understanding of

financial reports, whereas users with limited knowl-
edge can glean only the most basic and simplistic
information without the help of others. Despite the
wide range of financial knowledge and degree of
authority over the reporting entity that users possess,
no particular user group has information needs
less valid than others. Consequently, no group
is considered more important than another, and
for the purpose of establishing objectives, all
groups are considered equal.

29. As previously indicated, this objectives statement
applies to general-purpose financial reporting.
These reports are reports on a consistent periodic
basis as opposed to special reports, which are prepared
as the need occurs. External as well as internal
user needs can be satisfied by general-purpose
reports. Basically the overall needs of each group
are the same. The difference, however, occurs in
the degree of detail the financial information must
contain in order to satisfy the needs of each group.

30. Internal users require greater detail because they
actually manage and operate the entities' affairs.
For example, both external and internal users need to
know the extent of fiscal compliance. External users'

needs may be satisfied with financial information
at the program level, whereas internal users may
need information at the most detailed level of
each component activity of a program. External
users may require information, for example, on
a low-income housing program which shows total
resources provided compared with congressional
limitations on such items as home improvements,
restoration of ghetto areas, and rental subsidies
on housing projects. Internal users, on the other
hand, would need information on the type of resources
provided (i.e., cash, tangible property, contractor
services) compared with internally allotted amounts
for home improvements and restoration of ghetto
areas. Further, internal users may need information
comparing actual with budgeted amounts on detailed
levels of ghetto restoration, such as streets, gutters,
lighting, structured repairs, and interior repairs.

31. Although the objectives of accounting and financial
reporting for external and internal users are the same,
the information in the reports will vary considerably.
Financial reports prepared for internal users may
differ in presentation from those prepared for external
users, and subsequent statements on the Federal

accounting and financial reporting structure will
address these differences, where appropriate.

OBJECTIVES

32. THE PRIMARY OBJECTIVE OF ACCOUNTING AND FINANCIAL
REPORTING IN THE FEDERAL GOVERNMENT IS TO PROVIDE
USEFUL INFORMATION FOR ASSESSING MANAGEMENT'S
PERFORMANCE AND STEWARDSHIP.

A. Assessing stewardship and performance basically involves
determining what an entity has achieved and what it can
achieve in the future. In assessing past performance,
information must provide indications on
        --financial viability,
        --program activity, and
        --fiscal compliance.
Information on past performance is also essential
in drawing conclusions about the future. One obvious
indication of potential is whether past performance
compared favorably with initial plans and forecasts.
The implication here is if management performed favorably
in the past, it can perform favorably in the future.

B. In satisfying the overall objective of assessing
    stewardship and performance, information must first
    provide users a means to assess financial viability,
    program activity, and fiscal compliance. To do this
    information must be presented in terms describing
    economic resources. The objectives of accounting
    and financial reporting are viewed as a cycle of
    information needs. Paragraph 7 and Figure 1 explain
    the cycle.

C. Information which indicates how efficient and effect-
    ive management operates help users assess steward-
    ship and performance. In showing efficiency the
    information must indicate how economically management
    used the resources entrusted to it. In showing
    effectiveness the information must indicate how well
    management did in achieving program objectives.
    Economy and program objectives are further discussed
    in the following objectives.

33. AN OBJECTIVE OF ACCOUNTING AND FINANCIAL REPORTING
    IN THE FEDERAL GOVERNMENT IS TO PROVIDE INFORMATION
    USEFUL IN ASSESSING FINANCIAL VIABILITY.

A. "Financial viability" refers to the ability of an
    entity to provide the same level of resources that it

either has provided in the past or has indicated

it expects to provide in the future. For users

to obtain these indications, financial reports

should describe economic resources which reflect

an entity's current position, past performance,

and future expectations and should show

    --resources available to management,

    --obligations in terms of resources,

    --changes in resources and obligations,

    --resource flows, and

    --liquidity.

B. Resource data showing past performance delineates

total resources available, total resources applied

or disbursed, and obligations incurred, settled,

and existing at a specified time. However, to help

enable users to assess whether program objectives

have been or are being achieved and whether resources

entrusted to management have been used efficiently and

economically, additional information about resources

should be reported. Such information includes programs

administered by management, as well as plans and

objectives covering the same periods. Comparisons

in terms of resources and obligations per program

between actual and initially planned provides

indications on how well resources were managed.

C. Resource data showing current position indicates resources available, obligations existing, and liquidity levels at particular times. This information helps users determine whether obligations due in the current and succeeding months can be settled with resources currently available or whether additional obligations may have to be incurred to settle existing obligations. On the basis of past trends, data showing current position may also help users determine future resource needs. For example, past trends showing the amounts of certain property, such as property acquired for leasing by the General Services Administration, may show a steady rise in property acquired, indicating current amounts available may be insufficient to satisfy future needs. In such cases additional property may be needed.

D. Although information about the past performance and the current position of an entity is imperative in formulating future expectations, additional information is necessary to give users further indications on the entity's ability to continue to

provide resources in the future. Such information
should point to the quality and quantity of goods
and services to be provided in the future, along
with the resources needed to provide them and the
obligations expected to be incurred and settled.
Information in this category includes long- and
short- range objectives, program plans, and forecasted
data. Knowledge of an entity's plans for operations
enables users to make judgments on the ability
of the entity to provide future goods and services
and on the resources it needs to carry out its
plans.

E. Financial information about viability can be provided
    by financial statements, other financial data,
    nonfinancial quantified data, and nonquantified
    data. Financial statements bear directly on resources
    related to transactions of the entity or affecting
    it. To show viability these statements must show
    total resources under the entity's control as well
    as obligations and commitments to provide resources.
    The statements must also show resources obtained
    and given up by management and total contingencies.
    This data can be grouped into various categories,
    such as property, plant, and equipment; investment in

Federal Government securities; and appropriation
authority. Other financial data can be included in
in reports, such as per capita or per State dollar
amounts of resources provided. Nonfinancial quantified
data can include specific numbers of resources in con-
trol of the entity by various categories. Qualitative
information can also include explanations of quantitative
data from the entity's point of view.

34. AN OBJECTIVE OF ACCOUNTING AND FINANCIAL REPORTING IN
THE FEDERAL GOVERNMENT IS TO PROVIDE INFORMATION
USEFUL IN ASSESSING PROGRAM ACTIVITY.

A. A program in the context of this statement refers the
process of achieving or attempting to achieve a desired
end result. It includes plans and activities directed
in a systematic manner for the purpose of achieving
this goal. An example may be a school lunch program.
The goal or desired end result is to insure that school
children are fed nutritious mid-day meals. The plans and
activities of this school lunch program may include:
(1) examining food served at schools to determine
nutritious value of food content, (2) determining schools
throughout our country attended by children of low
income families unable to provide nutritious lunches to
their children, or (3) granting money subsidies to low

income families. Information compiled by program or
project is essential for assessing performance and
stewardship and deciding on resource allocation.
Program activity refers to compiling data by program
or any subcomponent of a program.

B.   "Program activity" information must bear on the use of
     resources as inputs and the production of resources
     as outputs under various programs and projects. For
     report users to obtain these indications, financial
     reports must show

          --inputs in terms of cost of resources,

          --outputs in terms of resources, distributed and

          --planned program activity, both past and future,
            in terms of inputs and outputs.

     "Cost of resources" refers to the goods and services
     consumed in accomplishing a specific purpose. "Resources
·   Distributed" refers to the goods and services pro-
     vided to the public or other consumers. "Planned
     program activity" refers to anticipated distribution
     of resources based on anticipated levels of costs. By
     its very nature planned activity data is goal-and
     attainment-oriented. Information on the cost of
     resources, distribution of resources, and planned
     program activity is necessary for users to assess

management's stewardship and performance, both
past and expected.

C. Information showing past performance includes
program costs, program production and distribution,
by program, and past program plans. This information
allows users to compare effort (cost of resources)
with accomplishment (resources provided) within
a program and obtain some indication of efficient
and effective use of resources. Comparisons can
also be made between various activities within
a program or between programs. For example,
comparisons can be made between various activities
of a recreation program, such as arts and crafts or
athletics, or between the overall recreation
programs and the education programs. This information
also is useful in assessing whether program goals have
been or are being achieved. Initial plans in terms
of inputs and outputs can be compared with actual
costs and actual goods and services provided.
Information about program activity is useful also
in drawing conclusions about future expectations.
Previous plans compared with actual costs incurred
and resources provided can show program objectives
still remaining to be achieved. Program objectives

remaining to be achieved can indicate costs to
be incurred to complete prior plans.

D. Financial information about activity levels can be
provided by financial statements, other financial
data, nonfinancial quantified data, and nonquanti-
fied data. Financial statements can depict operations
by program showing costs of services or goods completed
and values of resources provided. Other financial
information can include details of costs and values
in formats and detail appropriate for users. Other
financial data and nonfinancial quantitative information
may include numbers of beneficiaries of a program
activity or numbers of resources consumed during
the activity. Nonquantified data can include narratives
describing programs and program objectives. Reports
may also include information in addition to that
specified by standards, other requirements, or
custom.

35. AN OBJECTIVE OF ACCOUNTING AND FINANCIAL REPORTING
IN THE FEDERAL GOVERNMENT IS TO PROVIDE INFORMATION
USEFUL IN ASSESSING FISCAL COMPLIANCE.

A. Financial reports should include indications of the
entity's compliance with laws and regulations.

Providing such information is necessary to assess how the entity, its management, and its employees discharged their accountability. Although information on financial viability and program activities provides an indication of accountability, information on fiscal compliance provides more objective evidence of accountability.

B.   In the private sector, the profit factor is built-in control which determines continued existence of an entity. As a result, some of the most objective terms of evidence of management's accountability are reported net income, earnings per share, and accumulated wealth of the business. Because this built-in control does not exist in the Federal Government, legal and regulatory limitations on economic activities are usually imposed on departments and agencies. Such limitations include ceilings on spending and restrictions on use of resources. Examples of information which can indicate compliance with limitations are sources and uses of resources per program compared with related limitations imposed in both measurable dollar amounts and specific purposes.

C.   Financial information about fiscal compliance can be

provided by financial statements, other financial
data, nonfinancial quantified data, and nonquantified
data. Financial statements can show operations by
authorization categories and the related authorization
amounts, commitments, and obligations incurred.
Other financial and nonfinancial quantified data
can show dollar amounts and other numeric amounts
in detailed formats not appropriate for statements.
Examples include details of authorizations and
uses of personnel, building space, or travel and
transportation. Nonquantified data, such as
narratives on exising internal controls which help
insure compliance, also may be included.

36. AN OBJECTIVE OF ACCOUNTING AND FINANCIAL REPORTING IN
THE FEDERAL GOVERNMENT IS TO PROVIDE INFORMATION USEFUL
IN ASSISTING IN RESOURCE ALLOCATION DECISIONS.

A. Resource allocation decisions basically involve choosing
among alternatives for assigning resources relating to
budgeting, operations, and investing in government
securities by creditors. However, in order for informa-
tion to be useful in the resource allocation decision
process it must provide indications on

   --financial viability,

   --program activity, and

This information must be presented in terms of past
performance, present condition, and future expectations.

B. Agency management involved in budget preparation and
execution and oversight bodies involved in budget authori-
zation and execution are primarily concerned in the allo-
cation of resources between programs, components of pro-
grams, agencies, and units within agencies. Information
which delineates program activity both past and planned
will provide sufficient input into budget preparation and
authorization. Information on fiscal compliance will
have a direct bearing on budget execution in terms of
assessing its effectiveness.

C. Agency management involved in daily operations is con-
cerned about the allocation of available resources among
alternatives for accomplishing program objectives. For
example, in a low income housing program alternatives for
achieving a higher quality of housing for low income
families may include subsidizing rent payments, purchasing
new applicances, or improving the energy efficiency of
rental units. Information depicting financial viability
in terms of liquidity or resource flow can assist manage-
ment in making a decision by showing that higher costing
items (such as appliances) can be purchased and provided
to low income families at the current time. Projected

to low income families at the current time. Projected
liquidity may indicate such purchases at a future date
will not be able to be made.

D. Creditors of the United States are predominately com-
prised of individuals who purchase government securities.
Although the government's ability to pay its debt is not
doubted seriously since it maintains the ability to force
resource contributions via taxes, creditors are still
interested in financial viability. Information showing
resources available, obligations, and resource flow over
different periods of time can indicate trends in the
government's borrowings and trends in interest rates on
government securities. As a result, future interest rate
trends on government securities may be determined. This
information would be useful to a creditor in making a
decision to invest in the alternative which best meets
his needs as far as maximum return, risk, and term of
investment.

QUALITATIVE FACTORS OF INFORMATION
IN FINANCIAL REPORTS

37. To satisfy user needs to the maximum extent possible,
certain qualitative factors must be considered in
determining the presentation of information in
financial reports. The primary objective of account-
ing and financial reporting is to provide useful

information about economic reality that helps users
make decisions. The preparer of financial reports
is always confronted with alternative possible
presentation of information as to the nature
type, kind, and content), extent and amount, and
format. To maximize the decision usefulness of
information, the choice among alternative present-
ation must be based on the following factors:

     1. Relevance.

     2. Reliability.

     3. Meaningfulness.

     4. Comparability.

     5. Neutrality.

     6. Materiality.

38. "Relevance" refers to information having a direct
bearing on the decisions confronting users. Information
is relevant if it directly contributes to conclusions
and decisions reached by users or if it changes
users' conclusions and judgments. The degree of
relevance depends on how pertinent and timely it is.

39. "Reliability" refers to information which is dependable
and which was a high degree of actually representing
what it purports to represent. Reliability is based
on corroboration. Information that can be corroborated
by sources independent of each other is highly reliable.

The extent to which information is accurate, complete, and proper determines the degree of reliability.

40. "Meaningfulness" refers to information that is understandable, clear, concise, and succinct. Obviously the usefulness of information increases with increased meaningfulness. However, because of the varying degrees of knowledge of accounting and financial reporting possessed by users, their ability to understand financial information varies. Consequently, information in financial reports must contain the quality of maximum meaningfulness, which considers users both with high and low degrees of knowledge.

41. "Comparability" refers to information which can be compared with other information. The degree of comparability is determined by how consistent and uniform it is from period to period and from entity to entity. Obviously the more comparable the information, the more valuable it is and its usefulness increases. Noncomparable information between entities and between periods significantly reduces its usefulness in decisionmaking.

42. "Neutrality" refers to information which is presented in a manner that is free from slant, inclination, or prejudice. The method of presentation selected

must present fair and truthful information. Neutrality also has a direct inverse relationship to information that is misstated or misleading. However, increased neutrality increases the objectivity and usefulness, especially when the users have divergent interests.
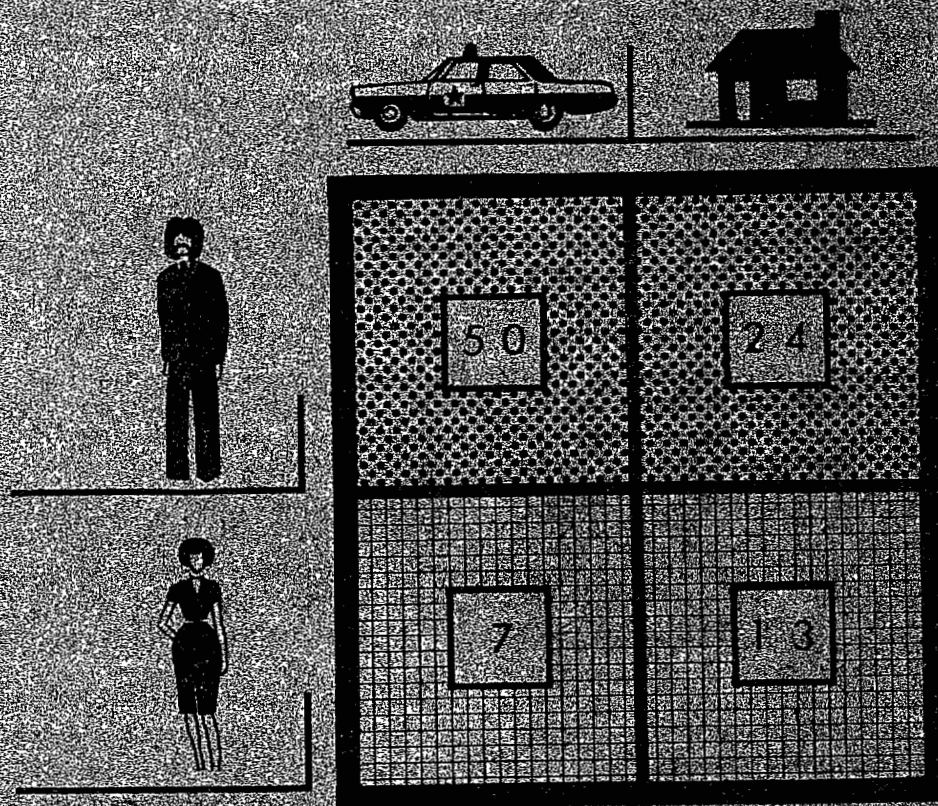
43. "Materiality" refers to the significance of an item of information which could appear, does appear, or does not appear in a financial report. Generally, materiality is that amount, or item of information, that could influence a decision of a user. Materiality is determined by whether the omission or misstatement of an item has a chance of changing the decision of a reasonable individual relying on correct information. Materiality relates to qualitative as well as quantitative information.

44. These six qualitative factors interact. An attempt should be made to present financial information which contains a high degree of each characteristic. However, obtaining a high degree of one may necessitate the sacrifice of a certain degree of another. Increased relevance may sacrifice a certain amount of neutrality, for example, and vice versa. Nevertheless, the total usefulness of information rests upon achieving the highest practicable optimal mix of meaningfulness, reliability, relevance, comparability, neutrality, and materiality.

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AN AUDIT USE OF THE
CHI—SQUARE TEST FOR
INDEPENDENCE:

A CASE STUDY

FINANCIAL AND GENERAL MANAGEMENT STUDIES DIVISION

UNITED STATES GENERAL ACCOUNTING OFFICE

**DIVISION OF FINANCIAL AND
GENERAL MANAGEMENT STUDIES**

This case study describes a GAO audit staff's use of the chi-square test for independence. The test was part of the analysis to evaluate the Law Enforcement Education Program. Our intent in issuing this booklet is to illustrate how the chi-square test can contribute to GAO's work and to help auditors recognize when it can be used.

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Director

CASE STUDY (CS 7)   JULY 1976

AN AUDIT USE OF THE CHI—SQUARE
TEST FOR INDEPENDENCE:

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Financial and General Management
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Contents

CHAPTER I

INTRODUCTION

This case study describes a GAO audit staff's use of the chi-square test for independence. The test was part of the analysis to evaluate the Law Enforcement Education Program.

Our intent in issuing this booklet is to illustrate how the chi-square test can contribute to GAO's work and to help auditors recognize when it can be used.

In GAO audits, two or more groups or subgroups are often compared for differences. For example, welfare recipients who receive job-related services might be compared to welfare recipients who received none to determine if the two groups differ in current employment status. Or members of armed forces reserve units who were satisfied with their drills might be compared with those who were dissatisfied to determine if satisfaction is related to grade level.

When the data from such comparisons are drawn from samples rather than from the entire population, some kind of statistical test should be used to determine the degree of confidence that can be attached to sample results. As used here, the expression "degree of confidence" is how sure we can be that the results would be similar if data were collected for the entire population instead of for a sample. The chi-square test for independence is one of the statistical tests to establish this. (See appendix I for the methods of computing and interpreting this test.)

This test is used when the available data is categorical, as opposed to continuous. Examples of categorical data are sex (male or female), race (often expressed in two or more categories), location (e.g., urban, suburban, or rural), and marital status (single, married, divorced, or separated). Continuous data, on the other hand, is data that can take any value on a scale (although the scale itself can have lower and upper limits), for example, weights and heights of adults, aptitude test scores, or baseball players' batting averages.

Although the chi-square test is used with categorical data, data that is basically continuous might be found recorded in categorical form only. For example, a program participant's income might only be recorded in categories, such as under $2,000, $2,000 to $5,000, or more than $5,000.

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Even data that is recorded continuously may actually be more categorical than continuous; that is, it may cluster around certain points. For example, in an analysis of discharged veterans' years of military service, the scale could run from less than 1 year to over 40 years. However, examining the sample data may show that the years of service cluster around three points: 3 years (the period of service for one enlistment); 20 years (the point at which retirees get half pay); and 30 years (the point at which they can retire with full pay). When data clusters around a limited number of points on a scale, the appropriate test is the chi-square test, to be used after the data is arranged in categories.

CHAPTER 2

THE AUDIT APPROACH

The objective of the Law Enforcement Education Program (LEEP) is to improve the criminal justice system by providing educational opportunities to persons working in or considering criminal justice careers. The system includes the police force, probation and parole, the courts, and corrections. The program is administered by the Law Enforcement Assistance Administration, which provides money to colleges for loans and grants to students of criminal justice.

To help determine if LEEP's objective was being accomplished, GAO developed a questionnaire to obtain the opinions and experiences of former program participants. We obtained lists of students who had completed the program at 50 randomly selected schools in school years 1972 and 1973. From these lists, 550 persons were randomly selected to receive the questionnaire. We asked about participants' experience in the program, their present employment status, what they had learned, and how LEEP affected their decisions concerning a criminal justice career. Responses were received from 465 (85 percent) of the sample.

The chi-square test for independence was used several times in analyzing the responses. Two of these applications are detailed in chapter 3.

APPLYING THE CHI-SQUARE TEST

The data showed that 96 respondents who had no criminal
justice experience before entering the program sought such
employment after completing the program.   About 39 percent
of these failed to find such employment.   Table I breaks
down the data by sex.

Table 1

Sex and Job-seeking
Success of Participants
(Number)

Sex	Found a job	Could not find a job	Total (note a)
Male	50	24	74
Female	7	13	20
	57	37	94

[a]Two respondents did not identify their sex and therefore
are not included in the table.

The table shows that for our sample, sex is associated
with success in finding a job in criminal justice--a larger
proportion of males than females found jobs. This con-
clusion is more obvious when one looks at the percentages
shown in table 2.

TABLE 2

Sex and Job-seeking Success
of Participants
(percent)

Sex	Found a job	Could not find a job	Total
Male	68	32	100
Female	35	65	100
	61	39	100

Tables 1 and 2 clearly show that females in our sample
were much less likely to obtain a job in the criminal justice
field than were males. But remember that we had only a

sample of participants. We had to find out whether this same result might be expected if the same data were obtained for all students who completed the program at the 50 colleges in 1972 and 1973. This is where the chi-square test was useful.

Chi-square compares the actual results with what probably would have happened if the two factors (in this case, sex and employment) were unrelated. The test requires computing a chi-square value and using a statistical table to interpret that value. We applied the chi-square test and found we could be 95-percent confident that our conclusion that sex is related to success in finding a job would hold true for the universe of participants.

Another aspect of the data concerned those employed in the criminal justice field at the time they answered the questionnaire. The data showed that most were working as police rather than in other parts of the criminal justice system. However, as shown in table 3, more of those with previous criminal justice experience were employed with the police than those without previous experience.

Table 3

Participants' Previous Criminal Justice Experience and Professional Area

| Previous criminal justice experience | Professional area | | | |
	Police	Other (note a)	Total	Percent becoming police
Yes	256	41	297	86
No	36	23	59	61
	292	64	356	82

a Includes probation and parole, courts, and corrections.

From a chi-square test, we found we could be 99-percent confident that the same conclusions would hold for the entire population.

The chi-square test results were the basis for statements included in our report to the Congress, "Problems in Administering Programs to Improve Law Enforcement Education" (GGD-75-67, June 11, 1975).

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CHAPTER 4

OTHER APPLICATIONS

GAO has found the chi-square test to be a useful tool in evaluating social service programs such as the upward bound program. The technique also has been used in reviews of the aid to families with dependent children program, the developing institutions program within the Office of Education and others. In each case the test was used to establish and evaluate associations between the variables tested.

In reviewing the aid to families with dependent children program, GAO used the test to determine whether the services provided helped welfare recipients achieve self-support or reduced dependency. For example, in table 4 we can see that those welfare recipients who received developmental services did proportionately better, in terms of reduced dependency through employment, than those who did not. The chi-square test was used to establish that this association was not a product of chance related to our sample selection.

TABLE 4

Developmental Services
and Reduced Dependency Through Employment
(Denver, Colorado)

Services received?	Dependency reduced?		
	Yes	No	Total
Yes	14	62	76
No	0	49	49
	14	111	125

A somewhat different application of the chi-square test was involved in our review of the developing institutions program, which provides funds to "financially struggling" colleges and universities. GAO wanted to identify those factors influencing Office of Education choices of schools to participate in the program. The chi-square test was used to identify the variables that appeared to have some relationship to receiving funds, e.g., public vs. private or percentage of nonwhite enrollment. Variables identified as significantly related to whether or not the school received program funding, were then further analyzed to identify factors which tended to explain the amount of funds allocated. While the chi-square

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test did not play a visible role in the second analysis, it did limit the number of variables considered.

GAO has used the chi-square test extensively to analyze data obtained from questionnaires. This use should not be surprising since most questionnaire data is in the form of categories or ranges. Typically, respondents indicate their answers by checking a block, thereby placing themselves in a category. The test is commonly used to see how answers to certain questions are associated. The review of the Law Enforcement Education Program described earlier is one example. Another example is a recent evaluation of State Employment Service operations in eight states. GAO tested the relationship between the type of job an applicant sought (white collar or blue collar) and whether the applicant contacted the Service when looking for a job.

This list of GAO's uses of the chi-square test for independence is by no means all inclusive. It is designed mainly to illustrate the variety of ways in which the test may be helpful. Generally speaking, whenever the data obtained from a sample is in the form of categories or ranges, or can be put into that form, and the analyst is interested in finding a relationship between two of the variables, he should consider using the chi-square test for independence.

COMPUTATION AND INTERPRETATION
OF CHI-SQUARE VALUES

The chi-square test for independence involves computing a chi-square value and then using a statistical table to interpret that value. **Computing the chi-square value requires four steps.** These steps will be illustrated by using the data from table 3, which is as follows:

| Previous criminal | Professional area | | |
justice experience	Police	Other	Total
Yes	256	41	297
No	36	23	59
	292	64	356

For the purpose of the chi-square computation, this table has two rows and two columns (totals not included) and four cells. The "Police" column has two cells ("Yes" and "No") and the "Other" column has two cells. The steps in the computation are as follows:

1. For each of the cells, compute the expected value-- the value that would be found if one variable had no relation to or association with the other variable. **(The present entries in the table--256, 36, 41, and 23--are known as the observed values.)** The expected value for a cell is computed by multiplying

$$\frac{\text{column total}}{\text{total sample}} \quad \frac{\text{row total}}{\text{total sample}} \quad X \quad \text{Total sample}$$

The expected value for each of the four cells are computed as follows:

Cell							Expected Value
Column 1, row 1	$\frac{292}{356}$	X	$\frac{297}{356}$	X	356	=	243.6
Column 1, row 2	$\frac{292}{356}$	X	$\frac{59}{356}$	X	356	−	48.4
Column 2, row 1	$\frac{64}{356}$	X	$\frac{297}{356}$	X	356	−	53.4
Column 2, row 2	$\frac{64}{356}$	X	$\frac{59}{356}$	X	356	−	10.6

8

If the expected values are put in a table and expressed also in percentages, the table would be as follows:

Previous criminal justice experience	Police Number	Police Percent	Other Number	Other Percent	Total
Yes	243.6	82	53.4	18	297.0
No	48.4	82	10.6	18	59.0
	292.0	82	64.0	18	356.0

2. For each cell, subtract the expected value from the observed value. Then, since this table has four cells, subtract 0.5 from the difference between the observed and expected value to obtain the corrected difference. (If the table has six or more cells, the correction factor is not used. The reason for using a correction factor in a four-cell table will not be explained in this case study.) Square the corrected differences. **The following table** shows the difference, the corrected difference, and the corrected difference squared for the data in table 3.

Cell	Observed	Expected	Difference (note a)	Corrected Difference	Corrected difference squared
Column 1, row 1	256	243.6	12.4	11.9	141.6
Column 1, row 2	36	48.4	12.4	11.9	141.6
Column 2, row 1	41	53.4	12.4	11.9	141.6
Column 2, row 2	23	10.6	12.4	11.9	141.6

[a]In the chi-square computation, all differences are assumed to be positive

3. Divide the difference squared for each cell by the expected value. For table 3, these quotients are:

Column 1, row 1	0.581
Column 1, row 2	2.926
Column 2, row 1	2.652
Column 2, row 2	13.358

4. Add the quotients for each of the cells. The sum is the chi-square value. In our example, it is 19.517.

The chi-square value is essentially a measure of the degree to which the observed cell values differ in total from the values that would have been found had the variables not been correlated.

To interpret the chi-square value, a table showing chi-square distribution is needed. The higher the chi-square value, the higher the likelihood of a relationship. **The** following is a portion of this table:

	Confidence Level		
Degrees of freedom	.90	.95	.99
1	2.706	3.841	6.635
2	4.605	5.991	9.210
3	6.251	7.815	11.345
4	7.779	9.488	13.277

The first step in interpreting the chi-square value is to compute degrees of freedom by multiplying the number of columns in the table minus one by the number of rows minus one. Table 3 has two columns and two rows. Therefore, the number of degrees of freedom is 1. We then look at the row in the distribution table for 1 degree of freedom and find that our chi-square value of 19.517 far exceeds the value that would indicate a 99-percent confidence level. Therefore, we conclude that the difference between those with previous criminal justice experience and those with no such experience is significant at more than a 99-percent confidence level. We are thus very sure that the difference would hold for the entire population and not only for our sample.

734479

Use Of Statistical Sampling Techniques

UNITED STATES
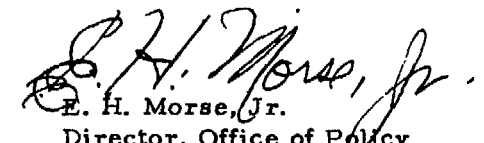## GENERAL ACCOUNTING OFFICE

Use Of Statistical

Sampling Techniques

UNITED STATES
GENERAL ACCOUNTING OFFICE
SEPTEMBER 1988

FOREWORD

Statistical sampling techniques, properly applied, can contribute significantly to obtaining reliable analyses in our audit work with a reduction in manpower. These techniques also enable us to project our findings with precision and confidence.

This pamphlet describes a sampling plan used in an actual GAO audit and describes some alternative plans that could also have been used with additional savings in manpower.

This material is being distributed to highlight the usefulness of these techniques and to encourage wider use of them, where appropriate, in our audit work.

E. H. Morse, Jr.
Director, Office of Policy
and Special Studies

September 15, 1968

Basic distribution in GAO:
   GS-11's and above in the accounting
      and auditing divisions
   Transportation Division - 10

In an audit at 12 agency locations, statistical sampling techniques were used to estimate the "error" rates at each of the locations.

The audit program specified the need for reliable error rate findings at <u>each</u> of the locations visited. In order to satisfy this objective, a fairly large sample size was needed at each location.

Attribute "Sample Size" tables were used to obtain sample sizes. The criteria that were used to determine the sample sizes needed were: (*)

1. Expected error rate not worse than: 10%
2. Desired sampling precision: ± (plus or
    minus)   3%
3. Desired confidence in sample results: 95%

(*) See Table 2-A, page 7-13, Audit Sampling Memorandums

The above criteria were uniformly applied in arriving at sample sizes for 11 of the selected locations. A 100 percent audit was specified for one location with a universe of 190.

The following table summarizes the audit sampling plan and actual error rate findings:

1

T A B L E A

Location	Number in Universe	Number in Sample	Sample Items With Error		Sampling Precision at 95% Confidence	Estimated Total Items With Error
			Number	Percent		
1	4,183	370	44	11.9%	±3.2%	500
2	4,498	356	56	15.7	3.6	710
3	2,350	318	15	4.7	2.2	110
4	19,721	377	127	33.7	4.7	6,650
5	14,145	375	123	32.8	4.7	4,640
6	3,525	354	172	48.6	4.9	1,710
7	14,705	372	136	36.6	4.8	5,380
8	5,148	328	27	8.2	2.9	420
9	4,366	308	31	10.1	3.2	440
10	2,810	355	5	1.4	1.1	40
11	913	353	71	20.1	3.3	180
12[a]	190	190	33	17.4	-	33
	76,554	4,056	840	27.2%	±1.8%	20,813

[a]No sampling variability because of 100 percent audit.

Note: Individual location error rates were obtained by dividing the number of errors found at the location by the total number of items in the location sample. The overall error rate was obtained by dividing the estimated total items with error by the number of items in the universe.

It may be recognized from the above table that the overall sampling precision is not a simple average of the sampling precision obtained at each of the locations. Sampling precision is obtained by use of the standard error formula for stratified sampling (see Audit Sampling Memo 9-9). The disproportionate assignment of the total sample among individual locations, in effect, establishes 12 separate strata for sampling purposes. The calculation results in an overall error of 1.8% at the 95% level of confidence. Thus, in this case, it may be stated with 95% confidence that the number of errors in the universe is from 25.4% (27.2 - 1.8) to 29.0% (27.2 + 1.8) of the universe or from 19,445 to 22,201.

While the agency has several hundred individual locations, it was not intended that our audit findings be projected agency-wide. The final report presents our audit findings for the 12 locations and contains selected individual location findings as examples of the various types of errors found. The appendix to the report includes a detailed summary of individual location findings.

The audit performed is a common repetitive type and is well suited for a presentation which shows how various sample plans could have effectively reduced the amount of the overall time required to perform the audit.

The alternate plans presented below are affected primarily by the audit objectives. The alternate plans are practical and worth considering in future audit deliberations. In each case, statistical sampling will permit defensible results within preselected limits of precision and confidence.

The discussion that follows is not intended as a criticism of the audit which was performed or the validity of its stated objectives. Nor is it implied that alternate plans presented have universal application in every audit situation.

SAMPLE PLAN A

Audit Objective	To find the "error" rate for each location and for the 12 locations combined within preselected limits of precision and confidence.
Considerations:	The number of items to be audited at each location (sample size) will be determined by the worse expected error rate, the size of the universe, 95 percent confidence, and precision consistent with the location error rate and audit requirements.

2

3

Method: · A preliminary random sample at each location will be used to estimate the error rate. The error rate found is to be used with the desired precision and confidence to determine the final sample size.

The actual audit plan provided uniform criteria for use at all locations for determining sample sizes. Application of the uniform criteria resulted in an overall sample size of 4,056. Alternate Plan A, however, differs from the actual audit plan in that sample sizes are to be determined for each location based on the results of a preliminary sample.

As may be noted from Table A, the actual findings at most of the locations were considerably different than the uniform criteria used to determine sample sizes. The actual findings ranged from a low of 1.4 percent to a high of 48.6 percent and only those findings at locations 1, 8, and 9 were close to the 10% ± 3% uniform criteria used for determining sample sizes. In this situation, the use of uniform criteria unnecessarily increased the amount of the overall time needed to perform the audit.

For instance, if the auditor determines that a finding of 10% ± 3% at an individual location is adequate for the audit purpose, he may also believe that a finding of 40% ± 12% is equally adequate. For location 7 (see Table A), the application of the 10% ± 3% criteria resulted in a sample size of 372 items. However, a preliminary random sample would have probably revealed an error rate of approximately 40 percent (actual error rate was 36.6 percent). If the auditor considered a finding of 40% ± 12% adequate, the sample size at location 7 could have been reduced from 372 to 64.

Alternate Plan A is based on the above except that the desired sampling precision was not increased in proportion to the expected error rate i.e.; 10% ± 3%; 20% ± 6%; 30% ± 9%; 40% ± 12%. By referring to Table B it can be seen that the expected error rate and sampling precision for location 8 is 10% ± 3% while the expected error rate and sampling precision for location 7 is 40% ± 7%. The sampling precision (tolerable error) is an audit judgment and will depend upon the degree of precision which the auditor believes will be needed to convince agency officials and other readers of our reports of the need to take necessary action to correct the situation being reported on. Certainly, there should be very few instances where we find it necessary to obtain sample sizes large enough to provide sampling precision of plus or minus 3 percent when the error rate is 40 percent.

Implementation of Alternate Plan A requires that the following (or similar) instructions be included in the audit program:

1. At the assigned location, select at random a preliminary sample of 150 items from the universe subject to audit.

2. The items in the preliminary sample are to be audited in accordance with the instructions set forth in the audit program.

3. When the preliminary sample audit is completed, calculate the error rate (number of errors found/150).

4. Round the resulting error rate to the nearest higher 5 percent interval. (e.g., if resulting error rate is 11.4%, round to 15%; if 18.2%, round to 20%, if 23.8%, round to 25%; etc.)

5. Select the final sample size from the appropriate sample size table or by use of a formula if appropriate sample size tables are not available. (See Audit Sampling Memo 7-19 for an example of a calculation of a sample size by using the sample size formula.)

The audit program should make it clear that the preliminary sample selected and audited is _part_ of the final sample. When the final sample size has been determined (e.g., 260), only the number of additional items (110) needed to bring the preliminary sample size (150) up to the final sample size (260) are to be selected and audited. Results from the audit of the additional items are then combined with results previously obtained from the preliminary sample items to arrive at the final sample results for the location universe.

Under Alternate Plan A, preliminary error rate findings, based on samples of 150, would not vary appreciably from the audit results obtained for each location during the actual audit.

The most likely sampling plan, resulting from Alternate Plan A, is summarized below in Table B.

T A B L E   B

| Location | Number in Universe | Sample Size Criteria[a] | | Sample Size Required | Sample Size Actually Used |
		Worse Rate of Occurrence (preliminary)	Tolerable Error With 95% Confidence		
1	4,183	15%	±4%	290	370
2	4,498	20	5	230	356
3	2,350	5	2.5	260	318
4	19,721	35	6	240	377
5	14,145	35	6	240	375
6	3,525	50	7	190	354
7	14,705	40	7	190	372
8	5,148	10	3	360	328
9	4,366	15	4	290	308
10	2,810	5	2.5	270	355
11	913	25	5	220	352
12	190	-	-	190	190
				2,970	4,055

[a] Preselected based on acceptable tolerable errors for the varying preliminary error rate findings.

Alternate Plan A reduces the overall number of sample items needed from 4,056 to 2,970. With approximately 1,100 fewer items to audit, more than 25 percent of the work in this area is saved.

Assuming that error rate findings remain the same, Table C below compares the sampling precision provided by Alternate Plan A with the precision actually obtained in the audit.

T A B L E   C

| Location | Error Rate | Tolerable Error with 95 Percent Confidence | |
		Actual	Plan A
1	11.9%	±3.2%	±3.6%
2	15.7	3.6	4.6
3	4.7	2.2	2.4
4	33.7	4.7	5.9
5	32.8	4.7	5.9
6	48.6	4.9	6.9
7	36.6	4.8	6.8
8	8.2	2.9	2.7
9	10.1	3.2	3.4
10	1.4	1.1	1.3
11	20.1	3.3	4.6
12	17.4	-	-
	27.2%	±1.8%	±2.3%

The actual audit _initially_ committed manpower to select and audit 4,056 sample items. Alternate Plan A, by specifying preliminary samples of 150 at each location (1,800 overall), _initially_ commits less than half of the budgeted time for selection and audit. Preliminary sample results then provide the necessary information to select sample sizes at each location consistent with the "worse expected error rate" and acceptable levels of sampling precision.

ALTERNATE PLAN B

Audit Objective: To find the overall "error" rate, within prescribed limits of precision and confidence, for the universe of 76,554 items at 12 different agency locations.

Considerations: For audit purposes, the universes at the individual locations lose their individual identities. Under Alternate Plan B, each location universe is important only to the extent that it is a part of the overall universe of interest.

Method: The overall final sample size will be selected to provide acceptable limits of precision and confidence. The number of sample items for each location will be selected on a proportionate allocation basis.

Alternate Plan B differs from the actual audit and Alternate Plan A in that defensible sampling results are specified only at the overall level.

The overall final sample size must be sufficiently large to provide the predetermined precision and confidence acceptable to the responsible audit group.

The physical location of the 12 agency sites makes it desirable to avoid the use of a preliminary sample approach for arriving at a final sample size. With unequal parts of the overall universe at 12 different locations, preliminary sampling would result in considerable delays while individual location audit teams completed assigned preliminary sample quotas and made results available for final sample size determination.

Fortunately, statistical sampling provides a "back door" approach for arriving at overall final sample size in keeping with acceptable levels of desired sampling accuracy.

Tables can be prepared for guidance in selecting the final sample size which will provide acceptable levels of precision and confidence regardless of the eventual error rate disclosed by the audit.

Table D below, for example, shows the sampling precision, with 95% confidence, for error rate intervals of 5%, based on sample sizes of 300, 400, and 500 from a universe of 76,554.

TABLE D

If Overall Error Rate Finding is:	Sampling Variability with 95% Confidence is:		
	For Sample of 300	For Sample of 400	For Sample of 500
5%	±2.5%	±2.1%	±1.9%
10	3.4	2.9	2.6
15	4.0	3.5	3.1
20	4.5	3.9	3.5
25	4.9	4.2	3.8
30	5.2	4.5	4.0
35	5.4	4.7	4.2
40	5.5	4.8	4.3
45	5.6	4.9	4.4
50	5.7	4.9	4.4

Based on the actual audit finding of 27.2% overall, the precision provided by the sample sizes shown is as follows:

| 27.2% | ±5.0% | ±4.4% | ±3.9% |

The above table, which can easily be expanded to include any sample size, allows the audit group to exercise the necessary judgment for selecting a sample size consistent with the audit objective as to the desired precision of sampling results.

The audit group need only select the sample size that provides the acceptable precision regardless of the error rate finally disclosed by the audit.

The Plan B audit objective and sampling plan preclude statistically reliable findings at the individual location level. Assuming an overall sample size of 500, sampling quotas for individual locations would be too small for valid findings.

However, Plan B reduces the audit sample size needed from 4,056 (actual audit) or 2,970 (Plan A audit) to 300, 400, or 500 depending on the desired precision.

The savings in audit time, therefore, are very significant especially if audit time per sample item is considerable.

In any case, the audit group should weigh the need and contribution of statistically reliable results at the location level against the increased costs of obtaining them.

Actually, the final report, under Plan B, can include individual location findings provided that proper language is used and no statistical significance is attached to the results at the individual locations.

ALTERNATE PLAN C

Audit Objective: To find the overall Agency error rate in a universe of 1,280,000 items. The agency comprises 200 widely dispersed locations each of which contains an unequal part of the total item universe.

Considerations: A simple unrestricted sampling plan, requiring a random selection of items from the entire universe, could be used.

If all universe items were physically located in the same place, this would probably be the easiest and best approach.

In this situation, however, unrestricted random selection would undoubtedly result in sample items being chosen from all or most of the 200 agency locations.

Travel costs incurred, due to the need to conduct very small audits at all or most of the agency locations, could make this approach prohibitively expensive.

Method: Two-stage random sampling for attributes.

The plan is "two-stage" because sampling is required at two separate and distinct levels.

A sample of primary units (individual agency locations) is first selected at random, and from the selected sample of primary units, a random sample of secondary units (items of audit interest) is taken.

For the purposes of this audit, the first stage universe is the 200 individual agency locations, and the second stage universe is the 1,280,000 items of audit interest.

The actual audit and Alternate Plans A and B limited the universe of interest to the 76,544 items at the 12 selected agency locations. Alternate Plan C differs from the actual audit and other plans presented in that the error rate for the entire agency (200 locations) is what is of interest rather than the error rate of just 12 of the 200 locations.

Our professional staff will probably find that assistance will be needed in devising a two-stage sampling plan. Also, assistance will probably be needed in interpreting the results of such a sampling plan. This assistance can be obtained from the statistician in the Office of Policy and Special Studies.

Alternate Plan C - Sampling Procedure and Audit Results

Sampling sizes used for implementation of Alternate Plan C are as follows:

First Stage Sample = 20 (agency locations)
Second Stage Sample = 75 (items from first stage universes)

Table E below summarizes the sampling plan and audit results for the 20 randomly selected agency locations in the first stage sample.

Results for locations 1 through 12 are essentially the same as those found in the actual audit. (See Table A.) Universes have been rounded and error rates reflect the slight changes necessitated by sample sizes of 75. Locations 13-20 are hypothetical but consistent with error rate findings and universe sizes of the 12 locations actually audited.

TABLE E

Sample Location	Number in Universe	Number in Sample	Sample Items With Error		Estimated[a] Universe Items With Error
			Number	Percent	
1	4,000	75	9	12.0%	480
2	4,500	75	12	16.0	720
3	2,500	75	4	5.3	133
4	20,000	75	26	34.7	6,940
5	14,000	75	25	33.3	4,662
6	3,500	75	36	48.0	1,680
7	15,000	75	28	37.3	5,595
8	5,000	75	6	8.0	400
9	4,500	75	8	10.7	482
10	3,000	75	1	1.3	39
11	1,000	75	15	20.0	200
12	500	75	13	17.3	86
13	13,000	75	17	22.7	2,951
14	2,000	75	21	28.0	560
15	5,000	75	26	34.7	1,735
16	6,000	75	20	26.7	1,602
17	10,000	75	31	41.3	4,130
18	7,000	75	2	2.7	189
19	1,000	75	15	20.0	200
20	5,000	75	24	32.0	1,600
	126,500	1,500	339	27.2[b]	34,384

[a]Column figures arrived at by projecting sample error rate findings to total items in location universes. (e.g., for location 1; 12% of 4,000 = .12(4,000) = 480)

[b]27.2% is the weighted overall error rate for the 20 locations in the first stage sample.

Note: The overall error rate of 27.2% is calculated as follows:

$$\frac{\text{total est. universe items with error}}{\text{total of 20 location universes}} \quad \frac{34,384}{126,500} \quad .272 \text{ or } 27.2\%$$

In this sampling situation, the overall error rate is not the arithmetic average of the individual location error rates nor can it be calculated by dividing the total errors found in the sample (339) by total items in the second stage sample (1,500).

Both these methods result in an overall error rate of 22.6% which is incorrect because it is unweighted.

If proportionate allocation had been used in assigning second stage sample sizes, either of the two methods above would give the correct overall error rate because the individual location results would be self-weighting.

Sampling Variability

The formula for calculating the sampling variability for two-stage sampling for attributes is rather complex. It takes into account and combines the contribution to sampling variability from each stage of sampling.

For the 27.2% error rate finding under Plan C, the sampling variability, with 95% confidence, works out to be $\pm$ 6.0%.

This variability, for the Plan C example, is abnormally high due to the wide variation among individual location error rates. In the actual audit, individual location error rate findings ranged from 1.4% to 48.6% which is about maximum variation in sampling for attributes.

(In sampling for attributes, a 50% "error" rate is maximum in that it results in the largest sampling variability. This is so because error rate findings of 60% have the same variability as 40%, 70% as 30%.......99% as 1%.)

If the Plan C sampling procedure was unchanged and individual location error rates were between 5% and 20%, the sampling variability would be reduced to $\pm$ 1.8% with 95% confidence.

In two-stage sampling for attributes, the number of items in the second stage sample, from each location, have very little effect on overall sampling variability.

Thus, if second stage sample sizes used in Plan C were increased from 75 to 500 or even 1,000, the overall sampling variability of the 27.2% finding would only be reduced approximately two-tenths of one percent. However, with second stage sample sizes at 75, an increase of first stage locations from 20 to 40 would reduce the sampling variability to $\pm$ 3.6%.

In two-stage sampling for attributes, therefore, the number of locations in the first stage sample has a much greater effect on sampling variability than the number of

items in the second stage samples providing they are sufficiently large.

Estimating the Total Universe Items with "Error"

The 27.2% error rate finding in the 126,500 item universe of the 20 sampled locations is assumed to hold true for the entire 200 agency location universe of 1,280,000 within calculated limits of precision and confidence.

Therefore:

Total Estimated items with
 "Error"   = 1,280,000(.272) =   348,160
Sampling Variability   = 1,280,000(.060) = $\pm$ 76,800

Summary - Plan C

Plan C, with overall sample size of 1,500, representing 75 sample items at each of 20 agency locations, permits the audit group to project findings agency-wide.

Plan C sampling procedure is equally valid for finding the error rate and sampling variability for one line item of data or many line items of data on the same sample document.

The sampling variability found in the example is unusually high due to the extreme variation in individual location error rates. It is more "normal" for a two-stage sampling plan, as used in this example, to produce a sampling variability of approximately $\pm$ 2%.

Two-stage sampling requires that first stage locations be selected at random. This requirement may be inconsistent with available regional office manpower.

OVERALL SUMMARY

Actual Audit and Alternate Plans, A, B, C

	Audit Objective	Audit Universe	Procedure Used	Overall Sample Size	Time Saved[a]
Actual Audit	To find "error" rate within acceptable limits of precision and confidence at each of 12 locations and overall.	12 locations of varying size universes containing 76,544 items of audit interest.	Individual location sample sizes determined from "tables". Sampling criteria (10% $\pm$ 3.0% – 95% confidence) uniformly applied at 11 of 12 locations audited.	4,056	-
Plan A	(same as above)	(same as above)	Individual location sample sizes based on results of preliminary samples of 150. Final sample sizes based on preliminary error rate findings and acceptable precision and confidence for each location.	2,970	1,086 units
Plan B	To find "error" rate within acceptable limits of precision and confidence at the overall (12 locations combined) level.	The 76,554 items of audit interest at the 12 agency locations.	Overall sample size determined from precisions calculated for various sample sizes and for each 5% interval of possible worse error rate.	300, 400, or 500	3,556 units[b]
Plan C	To find overall agency "error" rate. (200 locations)	The 1,280,000 items of audit interest at 200 agency locations.	Two-stage sampling: 20 first stage locations 75 second stage sample items	1,500 and 20 locations	2,556 units[c]

[a] Based on average time units, i.e., the average amount of time required to audit one sample item. Experience has shown that audit time per item can vary from several minutes to a full day or more depending on the nature of the audit, back-up documents required, number of line items examined, etc. Does not include time spent selecting and locating sample items.

[b] Based on overall sample size of 500.

[c] Time saved is partially offset by the requirement to audit 8 additional locations.