RICE UNIVERSITY

INFORMATION FOR URBAN DECISIONS: SOME POTENTIAL SYSTEMS

by

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Numerous factors, including increasing complexity, judicial supervision and heightened public awareness of the issues, contribute to pressures placed on local government officials for higher quality and greater responsiveness in the making of decisions which affect community growth and change. Recent improvements in information technology could offer some prospects for improved delivery of data needed to make decisions. However, political problems in determining information needs and obtaining data from local sources tend to reduce the effectiveness of potential systems. Equally difficult are technical considerations which govern information processing once data becomes available. Adequate techniques exist for statistical analysis and graphic communication of successfully processed data, but at present, these systems can only be used by those willing to learn the detailed technical requirements of each program. Several systems are proposed to bridge this gap for decision makers in such diverse fields as social program evaluation, school facility management, health care delivery and land use planning. A local data collection agency, similar to the U. S. Census Bureau, is proposed to supply baseline and present-state data to such information systems. However, prospects for development and implementation of such systems are clouded by increasing political concern for individual privacy, conflicting opinions among experts about the value of computerized information systems, and the prospects for unforeseen societal change brought about
by the development of a technocracy in control of these systems. Finally, a warning is issued to those who would entirely substitute the quantitative data available from computerized information systems for the empathetic, qualitative decision-making of traditional local government.
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INTRODUCTION
In The City, New York Mayor John Lindsay comments:

There is not a mayor in the country who could not produce a thousand letters, each detailing a horror story of what happened to one citizen seeking to get a simple complaint answered. The shuffling among departments, the lack of information, the absence of any center for decisional responsibility -- all these are commonplace in city government, which moves many people to think it is based on an idea by Franz Kafka.¹

Information, or more correctly, the lack of it, is a key element in this and similar discussions of problems in the conduct of urban affairs. The concept of an integrated urban information delivery system has been advanced as a means of improving the quality of decision-making in local government, and thereby, hopefully, improving the quality of urban life itself.

Alan Westin defines such an information system as:

one in which a governmental agency generates extensive data with computers and communications networks, analyzes these data by certain system-defining categories, and applies the output in a systematic manner to questions of public policy which concern that agency...²

Public interest in the potential development of such systems has recently increased, for a number of reasons. Roye L. Lowry cites two contributing factors:

Requirements in law associated with the expansion of federal aid programs in recent years have specified information requirements that must be met as conditions for establishing eligibility to receive grant-in-aid funds.

The introduction of the concept of a planning-programming-budgeting system (PPBS) and its extension over the whole broad range of federal activities and into the realm of state and local governments is another powerful force that stimulates the development of information systems.³

Lowry also notes the influence computer technology itself plays in advancing the prospects for such systems, through its rapid expansion
into corresponding roles in the business and defense sectors of the economy. This growth has been accompanied by continuous changes in the relationship between users and sources of information. Similar changes have occurred in the relationship between user and data handling devices. As John Diebold says:

Today one can no longer think of just the computer. One must think in the more comprehensive terms of information technology or information systems. This fact is brought home dramatically by a review of costs. Ten years ago, the computer or central processor represented some 75 percent of the total cost of an automatic data-processing system. The so-called peripheral equipment - input/output devices, outside storage and communications links - accounted for some 25 percent. This is changing rapidly and by 1972 the cost relationships will be completely reversed. The cost of information processing and storage within the computer system will decrease 97 percent between 1963 and 1972, while the cost of communicating with the computer center will decrease by some 50 percent. The computer is emerging from its glassed-in throne room and, as it becomes increasingly accessible to those needing its services, the links between it and society proliferate both in number and in complexity.

This paper concerns itself with the prospects for creation of an integrated urban information delivery system to take advantage of these changes. To do so, it must consider a range of topics, covering the full sweep of government interests, and dealing with matters of both policy and technology. The order in which these subjects are discussed says something about the interrelated elements which comprise urban society. Thus, it is necessary to identify information needs before attempting to find sources to supply those needs, and it is equally important to consider the detailed technical processes by which data is now processed, before moving on to the more speculative discussions of potential system configurations and consequences.
CHAPTER I
LOCAL INFORMATION NEEDS
This chapter will consider the information needs of local decision makers. These needs have developed as a result of different pressures and requirements, which together reflect the increasing difficulty of governing large cities. These same difficulties have led to a burgeoning number of different agencies and organizations, which collectively require greater amounts and types of information in order to fulfill their functional responsibilities. Understanding these diverse requirements, in turn, leads to an attempt to categorize information needs, and ultimately to describing the components of an information delivery system which could adequately supply needed data.

Historically local government responsibilities have been limited to meeting the basic needs of people to provide for their health, safety, and welfare. Until recently, these three responsibilities have been defined in the narrowest terms, such as epidemic disease control; police or fire protection; or secondary education. Such accepted roles for local government have been broadened, in recent years, in response to increased social needs and changes in public attitudes; and led to alterations in the traditional relationships between the different levels of government, from federal to local.

Although specific judicial decisions (such as the 1954 desegregation verdict), are frequently cited as the start of the trend toward increased complexity in local decision-making, this shift has actually been in progress for at least as long as the migration from rural to urban suburban areas. Partially a result and partially a cause of this shift, has been the assumption, voluntary or otherwise, by local government, of increased responsibility for the provision of social services to people.
These increased responsibilities have taken the form of new programs and action projects undertaken in areas where no such services previously existed, as in pollution control, or where previously adequate services provided by the private sector have been found to be inadequate in terms of quality or availability, as in health care. Federal participation in local programs, usually through funding, has resulted in an increasing number of regulations, reporting requirements and similar functions which collectively make local government operations more complex than ever before.

Judicial supervision of local government activities, already high at the time of the 1954 decision, has steadily increased. While school desegregation has remained a principal concern, the courts have expanded their interests in equal opportunity and justice into such areas as housing, police and municipal services. Paralleling these developments has been an increase in public participation in local governmental processes, brought about by or leading to (depending on one's viewpoint) a rise in the influence of the mass media.

These trends have collectively resulted in an unprecedented increase in the complexity of local government functioning and decision-making. No longer can individual services be provided, helter-skelter, to portions of the community. No longer can decisions be made in private with bland assurance that the people will consent to whatever their leaders do. No longer can alternatives be selected without careful consideration or examination of the consequences. More and more, the responsibility of decision-making is not so much one of actually making the decision, as much as justifying that decision to the voters. More-
over, coordination of the many interrelated functions is often more
difficult than choosing an action area in which to work.

These factors contribute to the realization that a major weakness
in the decision-making process is a lack of adequate information.
There is often no data on which decisions can be based, and subse-
quently justified; or with which reports can be prepared; programs
evaluated; or new action areas identified. Moreover, this lack of
adequate information has delayed the development of objective tech-
niques to support and improve the entire decision-making process.
Thus, rational attempts to examine the problems of local government
are forestalled by a lack of base line data. Improved fiscal manage-
ment techniques, such as PPBS (Planning, Programming, Budgeting Systems)
are used without sufficient information to adequately analyze the ele-
ments of local government operations.

In short, no sound basis exists for improving the quality of local
government, as long as adequate information is unavailable to de-
termine existing and future community needs, and compare them to pre-
sent programs. Information users, at the local level, belong to one
of four categories: elected officials (and their political opponents);
appointed officials (such as operating agency heads, fiscal managers
and planners); special interest groups; and the news media (representing
the public). Although the discussions which follow emphasize the role
of government officials (elected and appointed), the needs of the other
categories of users are similar.

The information needs of local officials will, of course, vary with
their areas of responsibility. However, the following generalizations do apply to all:

1. Far more data is required to fulfill responsibilities than would be apparent from casual observation of the problem.

2. Much data necessary to adequately make decisions is not readily available because of technical or political constraints.

3. No easy techniques exist to enable decision makers to analyze, understand, and communicate their findings to others.

4. Lack of adequate data and techniques can lead to poor decisions and lessen public confidence in the decision-makers.

To illustrate these statements, consider such typical problems as the assignment of students to schools for desegregation purposes or the evaluation of social action programs to determine relative effectiveness.

The Houston Independent School District, under federal court order, was forced to abolish a neighborhood school system in favor of one in which students were assigned to schools by zones drawn so as to incorporate more minority group members. The zones were to be drawn in such a way that their boundaries were "equidistant" from adjacent schools. These zones were then expanded or contracted in geographic area in proportion to their physical capacity to hold students. The zones were also to be drawn in such a way as to eliminate or reduce the crossing or hazards or natural barriers, such as freeways, railroads, and bayous. Finally, to the extent possible, the zones were to be drawn so as to minimize travel time to and from school.5

Data required to fulfill these requirements goes far beyond the
demographic information needed to show where students of different ethnic groups live. Also needed was data reflecting the physical capacity of each school, population density in the area, the location of hazards and barriers, as well as travel time on surface streets in the school area. The demographic data and school capacity figures were easy to acquire, since the school district routinely collected such information, either to meet federal requirements, or for its own operations. Population density data (needed to scale the zone size more accurately than geographic area allowed) was never obtained and a uniform figure was assumed (which led to severe overcrowding in some inner-city schools).

Traffic hazards and natural barriers were difficult to identify, because the court order did not define the terms precisely, and existing maps and traffic counts proved to be inaccurate or out of date. Travel time data was unobtainable. In the end, the zones were drawn on the basis of field surveys, rules of thumb, 'eyeball' analysis of maps and arbitrary assumptions of appropriate boundary lines. Working under impossible deadlines, (for the manual techniques used), the drawing of school zones was completed less than two weeks prior to the start of classes. Confusion over schools to attend, splitting of neighborhoods, assignment to schools requiring the crossing of severe traffic hazards, overcrowding or undercrowding of schools and similar problems turned the first months of school into a chaotic experience for the entire community.

Of lesser emotional concern, but potentially as important, is the role played by officials responsible for the evaluation of ongoing social
action projects. Such decision makers are constantly faced with the task of evaluating the effectiveness of particular projects, and deciding whether they should be continued or abandoned in favor of newer proposals. This responsibility is assigned to the local City Demonstration Agency (CDA) in communities awarded Model Cities Program grants. Briefly, the Model Cities program was established to create a coordinated delivery system for the entire spectrum of social and physical services provided to inner-city residents. Often considered an early form of revenue sharing, the program included a modicum of community participation in both the planning and operation of action projects. In Houston, a local Residents' Commission, comprised of elected officials is augmented by the CDA professional staff, which included an Evaluation Department.

Information needed to evaluate the effectiveness of ongoing projects consists of a wide range of quantitative and qualitative measurements, including data which reflects the services provided and adherence or deviation from planned operations including personnel levels and budget expenditures. In addition to these project level measurements, other factors, such as overall agency performance (in the case of those groups having more than one ongoing project) and program area performance can provide the decision makers with valuable insights. Similarly, data in the form of maps, which display the distribution of clients serviced by the project, can enable overall effectiveness to be weighed. Thus, a project that kept scrupulously to its budget, had no great fluctuations in staff level (an indication of employee disenchantment) and served a large number of people, might still be of less value than another project, if its clients were concentrated in such a small area that other
segments of the Model Neighborhood were never served.

Data sources for this decision-making task are the agencies themselves. Despite assurances of honesty, however, their information is often suspect, and corroborating evidence must be obtained. Thus, a neighborhood survey of a 500-family sample is conducted by the evaluators to insure that services are equitably distributed and really serving the needs of the people. Other data sources are also required, depending on the particular project. These include baseline data from the federal census, outside agency data from organizations such as the police department or hospital district and similar information which can collectively show the effectiveness of projects, programs and the entire Model Cities effort.

As in the case of the Houston Independent School District school zone draftsmen, CDA evaluators are forced to use only a portion of the potentially available data. Some of the data is politically out of reach, such as police department crime reports, due to the refusal of the police chief to cooperate. Much of the other potentially valuable data is available, but the volume involved in handling the records of 100,000 people requires some sort of computerized information system in order to perform even the most simple calculations. These cases are typical of local decision makers' information needs.

To better identify the variety of those needs, the accompanying matrix, Figure 1, was prepared. Essentially, it shows the objectively defined information needs of each local agency, by data category. These categories are comprised of related data collections whose affinity stems from similiar-
## Local Information Users

### Data Needs:
- □ Summary
- ■ Detailed

### City of Houston
- Mayor and Council
- Aviation
- Fire
- Health
- Model Cities
- Planning
- Police
- Public Service
- Public Works
- Tax
- Traffic & Transportation

### Harris County
- Commissioners’ Court
- Assessor-Collector
- Environmental Control
- Hospital District
- Superintendent of Schools
- Welfare & Food Stamps

### Other Local Jurisdictions
- Drainage Districts
- School Districts
- Junior College Districts
- Navigation Districts
- Water Districts

### Regional Agencies
- Houston-Galveston A.C.
- Gulf Coast Waste Disp. A.

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Figure 1, Local Information Needs
ties in collection, storage or use. Thus, the Land Use, Value and Ownership category includes data which is separately collected, (Land Use by the Fire Department, Value and Ownership by the Assessor-Collector), but which is stored by the same basic geographic unit, the land parcel. Moreover, users of land use data usually desire land value information. If these categories are viewed as bodies of associated data, a rational approach can be developed towards the collection, processing and communicating of the data included within each group.

Typical information contained in these data categories include:

1. **Economic - Employment**
   
   Banking, retail and wholesale trends, regional economic indicators, tax receipts, labor and unemployment statistics, cost-of-living figures and places of work.

2. **Education**
   
   Public and private secondary, primary, vocational, special education and technical schools, facilities and transportation.

3. **Environment, Energy and Resources**
   
   Geographic, terrain features; flora, fauna, watershed, subsurface drainage, air and water quality; gas and electric production, transmission; natural resources.

4. **Government Organization, Programs**
   
   Jurisdiction, operational areas, funding, services provided, officials, clients, effectiveness, facilities, plans.

5. **Health, Vital Statistics**
   
   Disease, births, deaths, medical care, hospital facilities.

6. **Housing, Construction**
   
   Residential distribution, building costs, plans, market aggregation.
7. **Justice, Public Safety**

   Criminal and Civil actions, court dockets, police and fire services, accident rates, crime control.

8. **Land Use, Value and Ownership**

   Land, by use categories, parcel level data, land value, ownership.

9. **Population**

   Demographic distributions, age, race, sex, households, education, income, workplace, occupations.

10. **Recreation**

    Amusements, culture, parks, playgrounds, beaches, pools, golf courses, tennis courts, bike trails, campgrounds.

11. **Transportation and Communication**

    Travel times, road network, traffic counts, transit routes, origin-destination data, parking facilities, telephone, telegraph use, radio and television stations.

12. **Welfare and Social Services**

    Aid to families with dependent children, unemployment compensation, veterans' benefits, day care centers, religious facilities.

This information would form the nucleus for a system capable of meeting all the information needs of local decision makers. Such a system would improve the local decision-making process by:

1. Enabling users to obtain data across jurisdictional lines, through centralization of the data collection, storage and retrieval processes now dispersed throughout local government agencies.

2. Enabling users to easily compare different data types, through processing techniques which would compensate for variations in collection procedures, units tabulated and data age.

3. Enabling users at various levels of government to obtain data tailored for their needs by selecting appropriate scale factors, aggregations and summaries.

4. Enabling users to perform sophisticated statistical analysis of the data they select, without extensive experience in statistical methodology.
5. Similarly enabling users to perform sophisticated graphic and tabular communications operations on their data to obtain maps, charts and hard copy tabulations of data for discussion or explanation.

In order to provide any of these capabilities, such a system would have to include these elements:

1. A user-oriented English language command, file management and editing program with clear explanations of all available options and services.

2. Adequate central computer facilities to store, retrieve analyze and display data on command from remote users.

3. User-oriented remote terminals to bring the information system right into the decision maker's office, and thereby eliminate the mystery and distrust many now have toward computers.

Such a system could act as an important catalyst in improving the quality of life in urban areas. Before speculating about that, however, more pragmatic considerations must be dealt with. The next chapter will discuss potential sources for data to include in the system. Following that, two chapters are devoted to technical considerations in data handling, and finally, several potential systems are described.
CHAPTER II
DATA SOURCES & ACQUISITION DIFFICULTIES
A large body of data exists which could meet the information needs outlined in the preceding chapter. At present, however, this information is not readily available, for a variety of reasons. The problems with which one is confronted in attempting to acquire this information form the basis of discussion for this chapter. These problems include the large number of sources, the incompatibility of data collection procedures, the political sensitivity of particular sources, and overreaction to the threat of personal privacy invasion.

Sources:
As in any issue which includes a discussion of governmental organization, the question of urban information source identification inevitably encounters the predictable bureaucratic entanglements. The accompanying matrices, Figures 2, 3, and 4, readily illustrate the overlapping and duplicated nature of data collection activities within the three levels of government; federal, state and local. These duplications exist for several reasons.

Perhaps the main reason why more than one agency collects similar types of information is that the data available from an existing source is for some reason unuseable by another agency. Rather than attempt to change the existing procedures or techniques, it is far easier and from a psychological viewpoint, more satisfying for the potential user to collect the required data, in just the right form, with his own techniques.

Another reason for this duplication stems from the nature of the data itself. If information of a personal nature is required, there are
**LOCAL SOURCES**

- Primary
- Secondary

**CITY DEPARTMENTS**
- Aviation
- Fire
- Health
- Model Cities
- Parks and Recreation
- Police
- Public Service
- Public Works
- Tax
- Traffic and Transportation

**COUNTY DEPARTMENTS**
- Assessor-Collector
- Environmental Control
- Hospital District
- Superintendent of Schools
- Welfare and Food Stamps

**OTHER LOCAL JURISDICTIONS**
- Drainage Districts
- School Districts
- Junior College Districts
- Navigation District
- River and Basin Authorities
- Water Districts

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*Figure 2, LOCAL INFORMATION SOURCES*
STATE SOURCES
• Primary
○ Secondary

Office of the Governor
Air Control Board
Office of Economic Opportunity
Education Agency
Employment Commission
Department of Health
Highway Department
Industrial Commission
Mental Health & Retardation
Parks and Wildlife
Public Welfare
Railroad Commission
Water Development Board
Water Quality Board
Water Rights Commission
Board of Insurance
Department of Public Safety
Aeronautics Board

Figure 3, STATE INFORMATION SOURCES
FEDERAL SOURCES

- Primary
- Secondary

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Figure 4, FEDERAL INFORMATION SOURCES
often legal constraints on the release of such data by the original collector. Rather than having to settle for aggregated or summarized information, it may again be necessary to establish new collection procedures.

Economics may play a role in the decision to collect data, if potential sources place too high a value on the information they possess.

The Incompatibility of Data Collection Procedures

Besides encouraging the duplications of effort described above, differences in data collection techniques can create problems of a much more consequential nature. Even if the data collected by an agency is just what is needed by another user, it could be of absolutely no value, if there are differences in coding techniques or communications difficulties between the originating and receiving computers.

Differences in coding techniques are usually encountered in relatively simple categorization attempts such as those which indicate a basic characteristic of the subject. Within this area are the usual variations in codes used to record sex, marital status, and similar variables of a limited nature. For the most part, these differences can be overcome with the addition of a little translation logic to the user's software. Thus, the computer would be instructed to convert the symbol used by the source for a particular characteristic into the equivalent symbol in the user's operation.

Such remedies are not as easy, however, when the basic coding system is either so incompatible or so diverse that simple translations will
not suffice. This may be the case in such classification efforts as land use or industrial coding. To convert a long list of classifications into a different system, especially when subjective decisions make the difference in allocation, may well be more expensive and time consuming than a whole new data collection effort.

Even these difficult problems may be easier to resolve than differences between computers. Due to the large number of independent companies which form the data processing industry, and the lack of effective standardization requirements, data processed by one manufacturer's computer will often be unreadable by another manufacturer's hardware. As in the case of the simple coding differences, software can be developed which translates from one machine language to another, but time and money often make such procedures less attractive than an entirely new collection attempt.

The Political Sensitivity of Particular Sources

Even if the technical problems of obtaining information can be resolved, and a useful source identified among all the computing groups, the user must still face the most important problem: justifying his need and convincing the source to trust him with potentially dangerous (to the source) information.

This problem stems from the political nature of our society, which despite Civil Service and the professionalization of government officials reminds each potential source of the allegiance he has to whichever group happens to be presently in power. Since little, if any, of the information collected could not be of use in proving or contesting a
political point, requests for specific data are usually met with a barrage of questions about the intended use and the user's affiliations. In the past, the concept of "public" information and the inherent right of any citizen to such data has been sufficient reason in itself. Recently, however, an increasing amount of data has been classified as "privileged" and access greatly limited. As a result, the dealings between source and user have taken on much of the complexion of adversary relationships, to the point that court orders are occasionally required to pry data loose from reluctant sources.

Providing some justification for the careful investigation of a potential user's intentions is the responsibility placed on sources for the safeguarding of the privacy of individual data. This stems from the very real fears, felt by all segments of society, of dossiers, central data banks and the early establishment of a 1984-type regime. Says Stanley Rothman:

For the New Left, the computer has replaced Wall Street, for the Right the computer has become synonymous with "big government".

Data collection groups, especially those engaged in survey research, are increasingly aware of these concerns and feel obliged to promise their research subjects that no other groups will ever see the answers given to their questions. While these guarantees are productive in the short run, in that they make it easier to conduct such surveys, in the long run these assurances may well be counterproductive to the safeguarding of personal privacy, in that each new data need must be met with yet another survey, resulting in numerous collections of private information, each having its own security and privacy problems.
The net result of these problems is that it is increasingly difficult to obtain useful information to support the variety of data needs described in the preceding chapter. This situation may be reversible, but not without fundamental changes in the attitudes of those who would use and those who could supply adequate urban information. Before speculating about systems which could bring about such changes, it is necessary to discuss more technical considerations which govern the handling of data, once it becomes available.
CHAPTER III
TECHNICAL CONSIDERATIONS IN DATA ACQUISITION & PROCESSING
The preceding chapters have described urban information needs and potential data sources. The purpose of this and the next chapter is to describe what can be done with information once it is made available. In order to avoid the pitfalls of data source-user relationships as much as possible, the information example used here, the 1970 Census, was selected because its use eliminates many of these potential difficulties.

If the following discussions take on an increasingly technical appearance, it is precisely because it is at this point that policy decisions are reduced, and technical considerations are increased in importance.

This chapter will concentrate on problems of data acquisition, storage, retrieval and processing encountered in handling the 1970 Census. The next chapter will discuss techniques for analyzing and communicating the information contained in the Census. These experiences would for the most part be repeated in the use of other data, varying only in the techniques which must be used to initially process the information in question.

Data Acquisition

In order to understand the procedures by which 1970 Census data is acquired, it is necessary to explain some Census Bureau concepts and tabulation techniques. While the Bureau does not create for the user many of the obstacles cited in the preceding chapter, it does operate under clear-cut regulations which govern the types and quantities of data which can be released. Census operations also are conducted under stringent economic controls, which force the user to bear a large share of the costs involved in information acquisition, processing and display.
Data release restrictions are set forth in Title B, Section 9, United States Code, and regulations of the Census Bureau prohibit the release of any data which could be related to specific individuals. In response to these restrictions, a variety of small area summaries have always been used by the Bureau for its data tabulation activities. Areas for which census information has usually been tabulated range in scale from the entire nation down to the city block. As data users sophistication in dealing with statistical information has increased, the Bureau has provided data aggregated by smaller and smaller areas, making finer-grained analyses possible.

Paralleling the trend to smaller area aggregations has been the trend among users toward easier access to high-speed computing hardware.

A fundamental shift in the Census Bureau-user relationship was experienced after the 1960 Census, when, for the first time, a significant number of users had the ability to use machine-readable information, and the Bureau found itself besieged with requests for magnetic tape and punch card versions of data usually distributed in printed form. This shift was accelerated when computer-oriented users discovered that machine readable data provided by the Census Bureau frequently contained more data than equivalent published reports, due to restrictions in the volume of information which could economically be printed.

In response to these new needs, planning for the 1970 Census included from the beginning a large degree of concern for the needs of sophisticated, computer-oriented users. A number of concepts which greatly affect the acquisition of 1970 Census data emerged from this planning effort.1
Foremost in the new ideas is the notion of a series of "counts" of the data contained in census questionnaires, to be aggregated by a variety of geographic areas, with categories of data available in proportion to the particular area. Six counts are planned of areas ranging from the city block to cities of 100,000 or more people with corresponding variations in data availability from 250 to 150,000 "cells" for each tabulation.

Each count is to be made available in a series of "summary tapes" which contain the appropriate data, in a standard format, for each geographic area of the particular count. These tapes, created on a state by state basis, form the major element of the machine-readable data tabulation activities of the 1970 Census, and were developed through extensive experimentation and pretesting of the census system.12

Acquisition of the summary tapes direct from the Census Bureau was soon recognized as a potential bottleneck in the data distribution process, and another new concept was created to reduce the problem to a minimum. The Bureau has designated cooperating local summary tape users who have the required technical ability as "Summary Tape Processing Centers" and encourages those who request machine-readable data directly from the Bureau to rely instead on their local centers. The result has been the establishment of a network of secondary sources for census data, through which large numbers of users can obtain information tailored to their specific needs, without tying up the capabilities of the primary source, the Census Bureau itself.

A number of Census Bureau employees, recognizing the need for an agency
to assist the Summary Tape Centers in acquiring and processing the tapes, left the Bureau to form a non-profit organization, Data Use and Access Labs, Inc, or "DUALabs". For a base fee, any Summary Tape Center can join the DUALabs users group and get access to any tapes it needs, in addition to a wide variety of services such as special software development, representation to the Census Bureau and similar assistance. A major element of this help is the "compression" of summary tapes for users who wish to reduce their expenditures but still obtain complete data for their studies. DUALabs merely takes the original summary tapes and runs them through a program which compresses their volume by removing nonsignificant blanks which appear. This has a pronounced effect on the number, and hence, the cost of tapes required for a given area, often resulting in an 80% reduction in the number of tapes involved. DUALabs furnishes the user appropriate software to "decompress" these tapes, to return them to their original format, which can be done as necessary. In the meantime, the user has benefited a number of ways.

First, the time required for copying tapes is reduced by the same amount as their volume, and the user gets a proportionately faster response to his order of tapes. The number of tapes themselves are reduced, and a lower cost results in both the expense of tapes (which average $15.00 each, just for the magnetic tape itself), and the cost of transporting them (not a small consideration, since each tape, with its protective canister, can run four or five pounds). Finally, capital need not be tied up in a large number of tapes and their storage areas, which can get to be a major consideration if the summary tape center intends to maintain a complete set of tapes for the United States - about 2,000 tapes in all.
Thus the distribution system for many users is of a threefold nature, from the Census Bureau, through DUALabs, to the local Summary Tape Processing Center. While the system has been in operation only a limited time, no major difficulties have developed, except at the origination. For undisclosed reasons, the Census Bureau has experienced severe slippages in its own deadlines for creation of the original summary tapes. Thus, the First Count Tapes, which were scheduled for delivery between August 1970 and December 1970, in actuality only started to become available after January 1971. Second Count Tapes, which were scheduled for October 1970 to April 1971, are at this writing tentatively promised for delivery in July 1971 with no firm guarantee that this will in fact be the case.13

Moreover, this lag has not been confined to machine-readable data; the traditional printed reports and new microfilm tabulations have also been delayed.

Rather than dwell on these problems at greater length, it would be more useful to consider the next question: "What do you do with the data once it's been acquired?"

Geographic Conventions, Data Storage & Retrieval & Processing
Whether Summary Tapes were acquired from the Census Bureau, DUALabs, or a Summary Tape Processing Center, a variety of problems must be dealt with before the data contained in them will be of any use. This section will describe how data for a study area must be identified by geographic code and extracted from the State level tapes before it can economically be processed or displayed. These factors will vary from
count to count, and from area to area. The First Count is used here as an example because it is the only data available at this writing, but similar problems will no doubt be experienced with later aggregations as well.

The first consideration which must be made in obtaining study area data from the first count tapes is to identify the Census Geographic areas which encompass the study area. Typically, a number of census tracts and all or part of their associated block groups will cover the area in question. These tracts and block groups are identified by inspection of one or more map sheets from the Census Bureau's Metropolitan Map Series for the general area of the study. These maps show all governmental streets and similar boundaries which break a city up into its census areas. As shown in the accompanying illustration, Figure 5, block group boundaries are not included, but must instead be identified by outlining the areas which have blocks numbered with the same higher order digit (all 100's, 200's etc.) as illustrated in Figure 6.

Once the tract and block group numbers are identified for a study area, a special summary tape can be extracted from the state tapes, using a piece of software such as DUALabs' GEOPICK program. GEOPICK reads a set of user supplied data cards and writes a tape containing those records requested from the main file. This tape, then contains exactly the same data in the exact same format, as it was originally produced by the Census Bureau, but only for this study area's geographic constituents. The reason for creation of this special tape is to reduce as much as possible, the computer time required to perform subsequent operations on the data. While it is possible to use the statewide summary tape, there are obvious disadvantages in searching an entire
Figure 5, CENSUS BLOCK MAP.

Figure 6, CENSUS BLOCK MAP, with Tract and Block Group Boundaries accented.
state's records each time data is needed for a small area in a particular city.

With the special Summary Tape available, preliminary processing can begin. This processing will depend on the uses the data will be put to, but generally will consist of some combination of the following functions.

**Combination** - because a principal reason for the Census is to reapportion congressional districts, data on areas which straddle district lines is aggregated separately within the First Count. Thus, it is possible to have two or more records for a specific block group contained on the summary tape. In order to achieve a one-to-one correspondence between the number of records and the number of geographic areas within the study area, it is necessary to combine these disaggregated records together. A FORTRAN IV program which performs this function, appropriately called "COMBIN", is illustrated in Appendix I.

**Proportioning** - since study areas will frequently be chosen without reference to Census geographic areas, the tape which was extracted by GEOPICK will contain additional, border areas, in relation to their areas within the study zone. A FORTRAN IV program called "PROPOR", which creates a new tape reflecting these values, is illustrated in Appendix I.

**Totalization** - many analysis techniques, including percentage taking, require a total value for the study area, with which individual values can be compared. In addition, totals and subtotals may be necessary for improved understanding of areas larger than the basic units used in
this count. To produce totals and subtotals from the special summary

**tpae**, a **FORTRAN IV** program called "**TOTALS**" has been developed. This
program is also illustrated in Appendix I.

The data resulting from the preliminary processing described above
forms the basis for subsequent work. The next chapter will describe
how portions of this information can be used for analysis and communi-
cation.
CHAPTER IV

TECHNICAL CONSIDERATIONS IN DATA ANALYSIS & DISPLAY
The preceding chapter has shown how small area information from the 1970 Census can be derived from large data files, and processed for subsequent analysis. This chapter will conclude the discussion of these technical considerations by showing how the data obtained using the techniques described in Chapter III can be extracted and tabulated for use in a variety of "off-the-shelf" software packages which together provide a wide selection of tabular presentations, statistical analysis and graphic display possibilities.

Characteristic of these packages is the requirement that data be presented in a particular format, one either fixed by the program, or in the case of the more sophisticated packages, defined by the user. To meet the needs of those programs which require data in specific formats, a FORTRAN IV program called "XTRACT" was developed to allow the user to specify a variety of formats and output media through which data from the special Summary Tape can be obtained for input to other programs. As is, "XTRACT" provides a convenient framework for insertion of any FORTRAN manipulation element which may be required. The discussion which follows will describe three sets of user oriented software packages, and shows how the special Summary Tape data created by GEOPICK, processed by COMBIN, PROPOR, TOTALS, and XTRACT is used to fulfill the user's urban information needs.

In addition to supplying the compressed state summary tapes, the decompression routines and GEOPICK, DUALabs provides members of its users group with a variety of summary tape tabulation programs, designated Models One through Six. Although each program allows the user to specify geographic areas for retrieval, in a manner similar
to GEOPICK's it is far more efficient, especially if the data is to be used for additional purposes, to create a special summary tape with GEOPICK and allow the tabulation programs to simple list all that is on the tape. Those programs also have the capability to summarize selected data items, but again, it is usually better to do this with a program such as TOTALS and have its values printed out as a group of records. The functions performed by COMBIN are not available with any of the DUALabs software, so this must be done with a special summary tape if the values tabulated are to accurately reflect the study area's condition.

Typical of the six DUALabs tabulation programs is Model Two which allows the user to designate for printout up to 19 of the 55 tables of data contained in the First Count Tapes. As shown in the accompanying illustration, Figure 7, Model Two prints out a heading, record and page numbers, a set of geographic identifiers and the proper headings for each data cell, in addition to the data itself. An important consideration in using this program for tabulating data on a variety of geographic areas is to make sure that a consistent series of tables are used, reducing the possibility of confusion and incorrect interpretation.

Statistical analysis of data contained in the summary tapes is possible through the use of one of a variety of "canned" programs or statistics systems. Perhaps the best of these is DATA\textsc{text}, developed by the Department of Social Relations at Harvard University under a variety of grants from government and private groups.\textsuperscript{15} DATA\textsc{text} allows the non-computer oriented user to specify operations to be performed in a series
| 001 | COUNT OF ALL PERSONS | 01741912 |
| 002 | ALL HOUSING UNITS | 00587581 |
| 015 | AGGREGATE $ MONTHLY CONTRACT RENT OF UNITS FOR WHICH RENT IS TABULATED BY OCC. STATUS AND RACE |  |
|     | TOTAL RENTER OCCUPIED | 0000000002339070 |
|     | NEGRO RENTER OCCUPIED | 0000000003546775 |
|     | VACANT FOR RENT | 0000000003706415 |
| 016 | AGGREGATE $ VALUE OF UNITS WITH ALL PLUMBING FACILITIES FOR WHICH VALUE IS TABULATED BY OCC. STATUS AND RACE |  |
|     | TOTAL OWNER OCCUPIED | 00000000021424632 |
|     | NEGRO OWNER OCCUPIED | 00000000001918937 |
|     | VACANT FOR SALE | 000000000481625 |
| 017 | AGGREGATE $ MONTHLY CONTRACT RENT OF UNITS WITH ALL PLUMBING FACILITIES BY OCC. STATUS AND RACE |  |
|     | TOTAL RENTER OCCUPIED | 00000000023028965 |
|     | NEGRO RENTER OCCUPIED | 0000000003418020 |
|     | VACANT FOR RENT | 0000000003656105 |
| 018 | ALL PERSONS BY AGE AND SEX MALES |  |
|     | UNDER 5 YEARS | 00085046 |
|     | 5-9 | 00018566 |
|     | 10-14 | 00019000 |
|     | 15-19 | 00058600 |
|     | 20-24 | 00076247 |
|     | 25-34 | 00017969 |

Figure 7, TYPICAL MODEL TWO OUTPUT
of English language commands. Capabilities of the system include qualified retrieval of input data according to logical operators, basic statistics, factor analysis, and multiple regressions. Use of XTRACT allows the DATATEXT user to easily create a set of input data to conform to any format he may require. By preprocessing portions of the data with XTRACT, the average DATATEXT run time can be somewhat reduced, which is a significant consideration when the system is being run in a partitioned, multiprocessing environment, since it takes up a large amount of internal storage area, and consequently costs more to run. A typical DATATEXT tabulation is shown in Figure 8.

Graphic display techniques are a relatively new aspect of data analysis having a short history compared to statistical analysis and tabulation efforts. The oldest, most widely known, and most flexible graphics system is SYMAP, which was developed at Northwestern University and further refined at Harvard University. SYMAP, (for Synagraphic Mapping), is a user oriented system capable of producing, on a conventional computer line printer, a variety of maps to illustrate statistical differences in spatially variable data. It is particularly useful in understanding the distribution patterns of demographic and environmental factors, such as racial composition or air pollution. SYMAP produces three basic types of maps, depending on the combination of options selected by the user. The three types, contour, conformant, and proximal, are each useful in particular studies. Most often specified by urban researchers is the contour option, since the blending of aggregated data together by interpolation most closely approaches the true distribution of elements within an urban area. A variety of applications exist for XTRACT and other special purpose programs in using SYMAP to display
DATA-TEXT SYSTEM DEMONSTRATION RUN

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CONTINGENCY TABLE NO. 4

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<td>14 35.0</td>
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<td>1</td>
<td></td>
<td></td>
<td>7 17.5</td>
</tr>
</tbody>
</table>

TOTAL PERCENT

| 7 13 11 9 | 40 100.0 |

MEAN

| 1.43 2.08 | 1.64 2.00 | 1.82 |

CHISQUARE STATISTIC = 22.3500 WITH 12 DEGREES OF FREEDOM (SIGNIFICANT AT THE 0.034 LEVEL)

LAMBDA (ASYMMETRIC) = 0.333
LAMBDA (SYMMETRIC) = 0.312
GAMMA (ORDINAL) = 0.113
TAU B STATISTIC = 0.087
TAU C STATISTIC = 0.088
SOMERS D STATISTIC = 0.000
PHI COEFFICIENT = 0.746
C COEFFICIENT = 0.599
CRAMER V STATISTIC = 0.529
NO. OF MISSING UNITS = 8

CROSSTABS DIAGNOSTIC REPORTS

WILD SCORE OCCURRENCES (WILD SCORES ARE TREATED AS BLANKS)

UNIT 0654 VAR(0029)= 8.00000
UNIT 3214 VAR(0029)= 15.0000
UNIT 2111 VAR(0029)= 15.0000
UNIT 2112 VAR(0029)= 11.0000

Figure 8, TYPICAL DATATEXT OUTPUT
the patterns contained in Census Summary Tape data.

SYMAP is a restricted format system in that it expects data to be input in a specific location on punch cards, one value to a card. XTRACT fulfills this requirement, and further allows prior calculations to be made. This is particularly important with SYMAP since accurate representation of patterns within an area is often dependent upon the display of relative, rather than absolute, values. For example, population density cannot be illustrated merely by mapping the number of people in an area, because SYMAP has no way of determining where one area stops and another begins. Instead, this information must be known beforehand, and the relative values calculated in XTRACT before input to SYMAP.

Another use of SYMAP is to provide graphic capabilities as a framework for displaying tabular data. For example, it is possible to generate a SYMAP OTOLEGENDS package which provides information similar to the tabular output of the DUALabs software, but simultaneously presented, in their proper locations, on a map, to enable statistical comparisons to be made without flipping back and forth between tables, and with ready comprehension of the geographic location of different values as well.

In order to enhance the appearance and ease the comprehension of SYMAP line printer maps, which tend to be somewhat coarse in their original form, a variety of photographic and printing techniques can be used. Examples of raw SYMAP output and the results achieved through the use of these different techniques are included in Appendix II.
This chapter and its predecessor have illustrated the various technical considerations which govern the use of urban data once it is made available. As can be seen from these discussions, getting the information from the source is only half the job. Equally difficult are the various extraction, manipulation, analysis and display operations which must be performed if the information is to be of any use in making decisions.

The techniques described in Chapters Three and Four could form one component of an integrated urban information delivery system. They were used as examples because 1970 Census data is easy to acquire. Each technique described up to now is a separate function, which must be performed, under existing conditions, through use of a computer by computer-oriented people who are willing to take the time to learn specific details of each program's operating requirements. This pretty well characterizes the present state of urban information technology. The systems which are described in the next chapter are intended to bridge this artificial gap between decision makers and information systems, and thereby increase the flow of data.
CHAPTER V

SOME POTENTIAL INFORMATION SYSTEMS
The Model Cities program described in Chapter One furnishes a good example for the development of an urban information system, because the CDA's responsibilities form a microcosm of city government responsibilities. The evaluation component of CDA provides a specific example of the factors which must be considered in choosing between ongoing and proposed projects which are competing for the same limited resources. As described in Chapter One, the evaluation staff must consider a wide range of data in performing its functions. The system proposed here would fully meet these needs, by enabling non-computer oriented personnel to easily operate an extremely sophisticated computer.

As shown in Figure 9, the system would consist of three major components: data files, the user-oriented management program, and various analysis-display systems. Users need only type into a television-like Cathode Ray Tube terminal in order to fully interact with the entire system. All manipulation of data, creation of work files, processing for statistical analysis and display; the entire computer-oriented part of the system's functions, would be handled automatically by the management program's user-oriented segment. This portion of the system would contain all explanations, data directories, and activation options, which would allow the user to start up the system, determine its capabilities and limitations, learn what functions could be performed - in short, to understand, without any knowledge of computers, exactly how to get the information he wants in whatever form he wants it.

In order to do this, of course, the system must supply most of the machine commands and similar information to the computer. The importance of the management program, therefore, cannot be overemphasized.
Figure 9, SCHEMATIC DIAGRAM
MODEL CITIES EVALUATION INFORMATION SYSTEM
Without its capabilities the user would have to laboriously learn programs similar to those discussed in preceding chapters for each separate collection of data in the system. Fortunately, this can be eliminated, because management programs do exist, and it should be possible to configure one to meet this particular system's needs. In operation, the management system would support up to ten simultaneous users, who could access identical or different data bases, extract whatever information they were interested in, and select the statistical or graphics package (or both) with which they wished to process their data.

At present, the user will still be required to have some understanding of the commands expected by such systems as DATATEXT or SYMAP. Thus, the Model Cities Information System does not fulfill all the requirements set forth at the beginning of this paper. The reason for this deficiency is that prospective users of this particular system are expected to have some computer orientation, at least to the extent that they are familiar with the requirements of the large analysis and display techniques.

Of course, it would not be terribly difficult to extend the system's capabilities to include built-in commands for DATATEXT or SYMAP. In fact, this capability would be included in three other information systems proposed here. Each of these systems would emulate the operations of the Model Cities system, varying only in their data bases, command phrasing and terminal locations.

First, an Education Facilities Information System could be developed
to assist the entire Houston Independent School District to improve
the planning, construction, maintenance and use of its schools. The
system data base would include spatially variable data on schools
and their sites; population patterns and trends; construction and
maintenance costs; vandalism and fire incidents; and similar facilities
data. It could be readily expanded to provide additional information
on ethnic distributions, transportation factors, land use and geographic
barriers, and other information needed to reassign students to schools,
should new court orders upset the present situation.

Next, a Health Care Delivery Information System could be developed,
to assist the entire Houston medical community in their efforts to im¬
prove the quality and extend the range of health services provided to
the area. This system's data base would include demographic and health
data for individuals; medical facilities capacities and use; environ¬
mental and social information on causes of disease; vital statistics;
and monitoring capabilities to enable early detection of epidemics and
other health emergencies.

Finally, a Physical Planning Information System could be developed to
provide data to planning agencies at the local and regional level and
to private land developers, construction firms, architects, urban de¬
signers and engineers. The system's data base would include environ¬
mental and geographic data; land use, ownership and value; transporta¬
tion and population information. It would assist planners and developers
in determining proper sites for new housing, retail and industrial
buildings, and help bring order to the present uncontrolled spread of
urbanized areas.
It is not proposed that a single system perform these diverse functions, although each could simultaneously be supported by the same central computer (as could ten or twenty additional users). Instead, these systems should be developed to fulfill specific information requirements for individual agencies or groups. Keeping these systems separate, although apparently inefficient, would also have some advantages, including greater responsiveness to user's needs and reduced threats to individual privacy.

Efficiency could best be attained in the data collection phase of system development. The observations made in Chapters Two and Three point out the advantages to be gained in dealing with one source, such as the Census Bureau, as opposed to the many sources at the local level. Serious consideration should be given to the suggestion that all non-operational data collection activities at the local level be made the responsibility of one agency. Surveys, local censuses, market aggregation studies, and similar collection efforts could be carried out continuously by one agency delegated to perform these functions. This would free other agency personnel for more productive work, reduce or eliminate duplication of effort, and increase standardization of procedures. Savings achieved through this centralization of the data collection process could offset any inefficiencies in the decentralization of information systems.

The development of urban information systems could have benefits beyond the improvements in data delivery previously described. These benefits could include a reduction in operating costs; increased objectivity in decision-making; and increased quality in urban research.
Lower operating costs could develop through the elimination of needless duplication in data collection. More importantly, reducing the difficulty experienced in using information is bound to result in increased usage, and hence, lower unit costs as expenses are prorated over more users.

Increased objectivity of decision-making could result from improved quality and ease of access to data, which would encourage decision makers to place more confidence in available information. Increased access to information by political opponents, news media and the general public could also encourage greater objectivity, be reducing the likelihood that decisions will go unnoticed.

Finally, research in urban problems could be greatly improved by increases in the quality and quantity of available information. Large-scale simulation systems, statistical analysis techniques and social indicator monitoring, to mention the most obvious, would all benefit from improvements in base line and present-state data.

The development of these systems could not, by itself, guarantee any improvement in the quality of urban life. It could not even guarantee improvement in the quality of decision-making. Yet the chance exists that such systems could result in drastic improvements in both. At the very least, the creation of urban information systems will silence forever the age old lament: "INSUFFICIENT DATA".
CONCLUSION
The preceding chapter has stated the rationale for development of urban information systems. It would not be intellectually honest to conclude this paper without giving some consideration to the impact such systems could potentially have upon society. Three areas in which the development of improved data delivery capabilities could alter existing patterns are governmental organization, political processes, and social order.

The effect of the development of integrated urban information systems would first become apparent in required changes within the governmental organization. The very act of determining the true information needs of affected agencies could require a healthy, soul-searching examination of apparent and real functional orientation. Access to information hitherto unavailable could encourage some organizations to broaden their fields of activity. Conversely, the quantity of newly available data could, unless anticipated, further overload the existing organizational structure, and contribute to additional problems and frustrations. Worse yet, an uncritical application of computer-based information capabilities could help to perpetuate useless efforts. Thus:

It is possible that the existence of the computer, or more precisely, the manner of its use may, by obscuring the direction signs, actually complicate and obfuscate and make it more difficult to attack problems frontally.

In 1933, when John L. Rice became New York City's Commissioner of Health, the City required medical examinations and certificates for all who handled food. Several hundred thousand persons were required to have such certificates. Medical examinations and check-up visits to food establishments were haphazard. The records were a shambles. If the Department had had access to a computer, every kind of control would instantly have been possible and probably the scandals about corruption, inefficiency, and abuse of the food handler program would never have occurred. In which case a useless program might still be in effect.
But there were no computers; so Dr. Rice looked at the program and decided that from a public health viewpoint such controls were meaningless. He scrapped the entire program. Results: no more certificates, no medical examinations, no inspectors, no records, no waste of public funds; a triumph of good judgement over the bureaucratic method.

From another viewpoint, organizational importance may be so dependent on information that wholesale data collection could be rationalized because of its potential value. The prospect of improved simulation capabilities contributes to this viewpoint, because present modeling appears to be hampered by lack of a sufficiently broad data base.

In anticipation of improved analytic capabilities, a "collect everything" psychology could develop, in which:

more detailed and "personal" information from individuals, groups, and organizations is needed to provide a "true" general data base for analysis. As this trend increases, information and the technology to use it become a powerful potential resource in the society; we could enter an era in which...organizations...would rise and fall according to their capacity to recognize, gain access to, and use rapidly the basic information pools of the "data-rich" society.19

Implicit in this quotation is the prospect that political processes will also be altered by basic changes in the availability of information. Awareness of this, as much as of the costs involved, may account for any reluctance voiced when decision makers consider proposed information systems.

Much of the information collected by existent systems can have the effect of destroying entrenched myths concerning the state of society and the effectiveness of past governmental policy. An important question thus concerns the behaviour of the political executive in this crucial phase: does the political executive attempt to edit findings of the information system, limit publication, or failing this, attempt to relegate the system to the status of a study group? During this period the status of traditional agencies may rise in terms of their influence with the political executive, given their ability to handle policy and information "through channels".20
The voting public, or "Collectivity", will also play a role in the political changes brought about by creation of urban information systems.

The outputs of the information system will obviously have policy implications for the Collectivities... The Collectivity at this stage, if it does not agree with the findings and analysis of the information system, may organize to either discredit these findings or establish their own information system to countervail the government system. A second possible tactic for the Collectivity is to attempt to build general political support in the electorate for its cause vis-a-vis the information system, and thus indicate to the political executive that the policy implications of the information system's work are politically too costly.

The development of a new technocratic elite, those who control the information delivery system, may by itself be responsible for as much societal change as the preceding examples combined. The education, attitudes, and interests of those who design, develop and operate the systems may influence the uses to which such powerful tools are put, or if denied that alternative, encourage them to contribute to rising controversy about the systems use, in a manner similar to that of some atomic scientists. From any standpoint, such a prospect is not entirely encouraging.

Finally, it should be kept in mind that the data available from an information system will only be as good as the collective quality of the data collection, storage, retrieval, processing, analysis and communication capabilities of the system. Such systems must always be viewed as tools to assist the user in quantitatively understanding issues and alternatives, not as substitutes for the qualitative, substantive and often intuitive means by which decisions have traditionally been made.
APPENDIX I

1970 CENSUS SUMMARY TAPE PROCESSING PROGRAMS
1970 Census Processing Software

The programs which follow illustrate some of the technical operations which must be performed in order to use machine-readable data from the 1970 Census of Population and Housing. These programs were written in FORTRAN IV for use on an IBM System 360 Model 44, with 128,000 bytes of core, running under the OS/360 Operating System. With some modification, the same programs could be made to run on smaller IBM computers or those built by another manufacturer. The only fixed requirements are for a FORTRAN IV compiler (capable of processing a 3600 byte Format statement), at least two tape drives and, at the minimum, about 20,000 bytes of available core.

No control statements have been included in the listings, since these will vary widely from one installation to another. However, these conventions have been observed, to simplify designation of the proper input-output devices:

<table>
<thead>
<tr>
<th>Device</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card Reader</td>
<td>5</td>
</tr>
<tr>
<td>Line Printer</td>
<td>6</td>
</tr>
<tr>
<td>Card Punch</td>
<td>7</td>
</tr>
<tr>
<td>Input Tape Drive (Read Only)</td>
<td>9</td>
</tr>
<tr>
<td>Output Tape Drive (Write Only)</td>
<td>10</td>
</tr>
</tbody>
</table>
COMBIN

COMBIN, as explained in Chapter III, is used to combine Census geographic records for areas such as block groups, when the data which describes these areas is disaggregated due to the presence of a governmental or legislative boundary, which necessitates separate tabulations for each section of the area.

All that COMBIN requires to perform this operation is a copy of a special Summary Tape, previously extracted from a State Tape through the use of "GEOPICK" or a similar program, and a blank tape on which to write the newly combined version of the records.

COMBIN also furnishes the user with a tabulation of all records processed, highlighting those which were combined. A complete listing of the program is illustrated in Figure 1-1. Typical output is shown in Figure 1-2.
1970 CENSUS PROCESSING SOFTWARE FOR FIRST COUNT SUMMARY TAPES

PROGRAM NAME: COMB IN
WRITTEN BY: JERRY PFEFFER
URBAN DESIGN GRADUATE PROGRAM
RICE UNIVERSITY
HOUSTON, TEXAS

DATE: MAY 15, 1971

FUNCTION PERFORMED: COMBINES DATA OF CENSUS GEOGRAPHIC AREAS WHICH ARE BISECTED BY CONGRESSIONAL DISTRICT OR SIMILAR DISTRICT BOUNDARIES, AND WERE SEPARATELY AGGREGATED ON SUMMARY CENSUS TAPES

INPUT REQUIRED:
TAPE:
SPECIAL SUMMARY TAPE (ON 9)
PREVIOUSLY EXTRACTED WITH 'GEOPICK'

OUTPUT PROVIDED:
TAPE:
COMBINED SPECIAL SUMMARY TAPE (ON 10)
PRINTED:
LIST OF ALL AREAS PROCESSED, INDICATING AREAS WHICH WERE COMBINED

VARIABLE DICTIONARY (IN ORDER OF APPEARANCE)

N1, N2........PAIR OF 'FLIP-FLOP' VALUES WHICH ARE READ ACCORDING TO STATUS OF PREVIOUS SET...IF PREVIOUS VALUES WERE COMBINED, BOTH ARE READ...OTHERWISE, PREVIOUS VALUE OF N? IS SHIFTED TO N1 AFTER N1 HAS BEEN WRITTEN, THEN A NEW VALUE OF N2 IS READ IN

N..............RECORD COUNTER
NP.............PAGE COUNTER
ZTEST............LOGICAL TEST VALUE ('TRUE' OR 'FALSE') WHICH IS SET ACCORDING TO STATUS OF N1 AND N2..."TRUE" IF THEY HAVE THE SAME GEOGRAPHIC IDENTIFIERS...AND HENCE ARE TO BE COMBINED..."FALSE" OTHERWISE
MAX.............INTERNAL VALUE WHICH IS SET FOR SINGLE OR OVERPRINTING OF OUTPUT, DEPENDING ON COMBINATION STATUS

DIMENSION N1(411), N2(411)
LOGICAL ZTEST

INITIALIZE COUNTERS

N = 0
NP = 1

WRITE (6,150) NP

START OF PRIMARY I-O LOOP

CONTINUE

TAPE READ

READ (9,100,END=999) (N1(K),K=1,411)

START OF SECONDARY I-O LOOP

CONTINUE

TAPE READ

READ (9,100,END=989) (N2(K),K=1,411)

FIGURE 1-1
LISTING OF PROGRAM 'CUMBIN'

67 C INITIALIZE LOGICAL TEST OF SIMILARITY
68 C
69 C ZTEST = .FALSE.
70 C
71 C TEST FOR SIMILARITY
72 C
73 C IF (N1(I).EQ.N2(I).AND.N1(J).EQ.N2(J)) GO TO 1100
74 C
75 C GO TO 1000
76 C
77 C 1100 CONTINUE
78 C
79 C ZTEST = .TRUE.
80 C
81 C TEST FOR SUPPRESSION
82 C
83 C DO 1001 K = 3, 411
84 C
85 C IF (N1(K).GE.0.AND.N2(K).GE.0) GO TO 1002
86 C IF (N1(K).GE.0.AND.N2(K).LT.0) GO TO 1001
87 C IF (N1(K).LT.0.AND.N2(K).GE.0) GO TO 1004
88 C IF (N1(K).LT.0.AND.N2(K).LT.0) GO TO 1001
89 C
90 C C COMBINE VALUES
91 C
92 C 1001 K = 3, 411
93 C
94 C N1(K) = N1(K) + N2(K)
95 C
96 C 1002 CONTINUE
97 C
98 C 1004 CONTINUE
99 C
100 C 1001 CONTINUE
101 C
102 C C TAPE WRITE
103 C
104 C WRITE (10,100) (N1(K),K=1,411)
105 C
106 C MAX = 1
107 C IF (ZTEST) MAX = 5
108 C
109 C N = N + 1
110 C IF (N.NE.(NP*50)+1) GO TO 3010
111 C NP = NP + 1
112 C WRITE (*,150) NP
113 C
114 C 3010 CONTINUE
115 C
116 C C PRINTER WRITE
117 C
118 C WRITE (6,199)
119 C DO 3050 K = 1, MAX
120 C WRITE (6,200) N, (N1(I),I=1,2)
121 C
122 C 3050 CONTINUE
123 C
124 C C END OF PRIMARY I-D LOOP
125 C
126 C IF (ZTEST) GO TO 2001
127 C
128 C C SHIFT VALUES
129 C
130 C DO 2050 K = 1, 411
131 C
132 C 2050 CONTINUE

FIGURE 1-1 (continued)
CARD COL.
NO. 1 2 3 4 5 6 7 8
1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890

133 C END OF SECONDARY I-O LOOP
134 C
135 C GU TU 2002
136 C
137 C FORMATS FOR ALL READS AND WRITES
138 C
139 100 FORMAT (24X,14,74X,11,17X,1318,8116,8X,4116,17218,7/,21218,104X)
140 C
141 150 FORMAT ('1',1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY',
142 1' JERRY PFEFFER',10X,'PAGE ',12,/',"0",'OUTPUT',17X,'TRACT/_BG',/,
143 2" ',"NUMBER',7X,'BOLD PRINT INDICATES COMBINED RECORD',/)
144 C
145 199 FORMAT (' ')
146 C
147 200 FORMAT ('+',14,17X,14,13)
148 C
149 999 CONTINUE
150 C
151 C FIRST END OF PROGRAM CCMBIN
152 C
153 C STOP 1
154 C
155 999 CONTINUE
156 C
157 C SECOND END OF PROGRAM CCMBIN
158 C USED IF ONE VALUE REMAINS WHEN END-OF-FILE IS ENCOUNTERED
159 C
160 C TAPE WRITE
161 C
162 WRITE (10,100) (N1(K),K=1,411)
163 N = N + 1
164 C
165 C PRINTER WRITE
166 C
167 WRITE (6,199)
168 WRITE (6,200) N, (N1(I),I=1,2)
169 C
170 C STOP 2
171 C
172 C
173 C
174 C
175 C
176 C
177 C
178 C
179 C
180 C
181 C
182 C
183 C
184 C
185 C
186 C
187 C
188 C
189 C
190 C
191 C
192 C
193 C
194 C
195 C
196 C
197 C
198 C
199 C
200 C

CARDS IN LISTING

FIGURE 1-1
(continued)
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**FIGURE 1-2**
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**FIGURE 1-2**
(continued)
PROPOR

As previously described, it is often necessary to proportionally-allocate values of geographically-defined data to areas which straddle study area boundaries. This function is performed by PROPOR.

Two sets of data are required by the program. In addition to a combined special Summary Tape, a deck of cards, sequenced in the same order as the tape, must also be furnished. The deck is comprised of one card for each area on the tape (determined by inspection of the appropriate output from COMBIN). Each card contains the value of the percentage of its corresponding area within the study area, punched as an integer value, right-justified, in columns 30-32. Thus, a card of an area wholly within the boundaries of the study area would be punched with the value "100" in these columns. A record with only 60% of its area included in the study area would have "60" punched in columns 31 and 32.

PROPOR will write a new tape which reflects the approximate values which should be allocated to the study area. In addition, the program provides a tabulation of the input values, percentages and allocated values for each area processed. Appropriate totals and averages are also presented for each data class. A listing of the program is contained in Figure 1-3. Typical output is shown in Figure 1-4.
LISTING OF PROGRAM 'PROPOR'

1970 CENSUS PROCESSING SOFTWARE FOR FIRST COUNT SUMMARY TAPES

PROPERM NAME: PROPUR
WRITTEN BY: JERRY PFEIFFER
URBAN DESIGN GRADUATE PROGRAM
RICE UNIVERSITY
HOUSTON, TEXAS
DATE: MAY 15, 1971

FUNCTION PERFORMED: TAKES PERCENTAGES OF VALUES FOR GEOGRAPHIC AREAS WHICH STRADDLE STUDY AREA BOUNDARIES

INPUT REQUIRED:
- SPECIAL SUMMARY TAPE, EXTRACTED BY 'GECPICK' AND COMBINED BY 'COMBIN'
- CARDS: ONE PER EACH AREA ON TAPE, INDICATING PERCENTAGE WITHIN STUDY AREA

OUTPUT PROVIDED:
- PROPORTIONED SPECIAL SUMMARY TAPE PRINTED:
  - TABULATION OF AREAS PROCESSED...ORIGINAL POPULATION AND HOUSING COUNTS...PERCENTAGE WITHIN STUDY AREAS...ALLOCATED POPULATION AND HOUSING COUNTS...ASSOCIATED GEOGRAPHIC IDENTIFIERS...TOTALS OF BOTH POPULATION AND HOUSING COUNTS FOR STUDY AREA...AVERAGE PERCENTAGE OF AREAS WITHIN STUDY AREA

VARIABLE DICTIONARY (IN ORDER OF APPEARANCE)

INPUT..........ORIGINAL VALUES READ FROM TAPE 9
OUTPUT..........PROPORTIONED VALUES WRITTEN ON TAPE 10
NPAGE..........PAGE NUMBER
NTPOP..........ORIGINAL POPULATION RUNNING TOTAL
NTHOU..........ORIGINAL HOUSING RUNNING TOTAL
NPAP...........ALLOCATED POPULATION RUNNING TOTAL
NAPOP.........ALLOCATED HOUSING RUNNING TOTAL
NTAPE...........COUNT OF TAPE LOGICAL RECORDS READ
NCARDS.........COUNT OF CARDS READ
N..............COUNT OF RECORDS WRITTEN
NPCT..........PERCENTAGE OF AREA WITHIN STUDY AREA
PCT............REAL (FLOATING POINT) NAME FOR NPCT
NAVPCT........AVERAGE PERCENTAGE

INTEGER OUTPUT

DIMENSION INPUT(411), OUTPUT(411)

INITIALIZE COUNTERS, RUNNING TOTALS

NPAGE = 1
NTPOP = 0
NTHOU = 0
NPAP = 0
NAPOP = 0
NTAPE = 0
NCARDS = 0
N = 0

WRITE (6,300) NPAGE
WRITE (6,301)

START OF I-O LOOP

2002 CONTINUE
LISTING OF PROGRAM *PRUPUR*

CARDCOL.

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64

C 68 C TAPE READ
69 C READ (9,100,END=998) (INPUT(K),K=1,411)
70 C NTAPE = NTAPE + 1
71 C CARD READ
72 C READ (5,130,FNM=999) NPCT
73 C NCARDS = NCARDS + 1
74 C N = N + 1
75 C IF (N.NE.(NPAGE*50)+1) GO TO 1200
76 C NPAGÉ = NPAGÉ + 1
77 C WRITE (6,300) NPAGE
78 C WRITE (6,301)
79 C 1200 CONTINUE
80 C PCI = NPCT
81 C TRANSFER GEOGRAPHIC IDENTIFIERS
82 C OUTPUT(1) = INPUT(1)
83 C OUTPUT(2) = INPUT(2)
84 C TEST FOR SUPPRESSION
85 C DO 1001 K = 3, 411
86 C IF (INPUT(K).LT.0) GO TO 1002
87 C TAKE PERCENTAGE
88 C OUTPUT(K) = IFIX((INPUT(K) * (PCT/100.)) + .5)
89 C GO TO 1003
90 C 1002 CONTINUE
91 C OUTPUT(K) = INPUT(K)
92 C 1003 CONTINUE
93 C 1001 CONTINUE
94 C TAPE WRITE
95 C WRITF (10,100) (OUTPUT(K),K=1,411)
96 C PRINTER WRITE
97 C WRITE (6,400) N, (INPUT(I),I=1,4),NPCT, (OUTPUT(I),I=3,4),
98 C 1 (INPUT(I),I=1,2), N
99 C ADD VALUES TO RUNNING TOTALS
100 C NTPUP = NTPUP + INPUT(3)

FIGURE 1-3 (continued)
LISTING OF PROGRAM 'PROPOR'

CARD COL.  1  2  3  4  5  6  7  8
NO.    1234567890123456789012345678901234567890123456789012345678901234567890

113    NTIHOU = NTIHOU + INPUT(4)
114    NAHOU = NAHOU + OUTPUT(1)
115    NAHOU = NAHOU + OUTPUT(4)
116    C    END OF I-O LOOP
117    C    GO TO 2C02
118    C
119    998    CONTINUE
120    C    INPUT(4)
121    C    OUTPUT(3)
122    C    OUTPUT(4)
123    C
124    138    C
125    139    GO TO 2C02
126    140    141
127    999    CONTINUE
128    150    C    A0
129    151    C    A0
130    152    C    A0
131    153    C    A0
132    154    C    A0
133    155    C    A0
134    156    C    A0
135    157    C    A0
136    158    C    A0
137    159    C    A0
138    160    C    A0
139    161    C    A0
140    162    C    A0
141    163    A0
142    164    C    A0
143    165    C    A0
144    166    C    A0
145    167    C    A0
146    168    C    A0
147    169    C    A0
148    170    C    A0
149    171    100    FORMAT (24X,I4,74X,I1,17X,13I8,8I16,8X,4I16,172I8,/,212I8,104X)
150    172    C
151    173    190    FORMAT (29X,I13)
152    174    C
153    175    300    FORMAT ('1','1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY ',
154    176    1'JERRY PFEFFER',10X,'PAGE',11)
155    177    C
156    178    301    FORMAT ('0','1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY ',
157    179    1'TOTAL POPULATION',7X,'
180    1'TOTAL HOUSING',5X,'PERCENT IN AREA',6X,'ALLOCATED POP.',3X,
181    2'ALLOCATED HOUSING',2X,'TRACT/BD',4X,'#',/)
182    181    C
183    400    FORMAT ('1','13,17,12,4X,5I20,13,12,17)
184    182    C
185    401    FORMAT ('0','TOTALS, AVERAGES',5I20,6X,'# ARFAS',13)
186    184    C
187    500    FORMAT ('1','10X','END OF PROPORTIONING DUE TO END OF TAPE FILE')
188    186    C
189    501    FORMAT ('1','10X','END OF PROPORTIONING DUE TO END OF CARD FILE')
190    188    C
191    502    FORMAT ('0','10X','LOGICAL TAPE RECORDS READ:',15,/,
192    190    1'TP',25X,'CARDS READ:',15, '/',1')
193    192    C
194    193    C    END OF PROGRAM PROPOR
195    194    C
196    195    C    STOP
197    196    C
198    196    END
199    197    CARDS IN LISTING
200    198

FIGURE 1-3  (continued)
### 1970 Census Processing Software Developed by Jerry Pfeffer

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<td>100</td>
<td>12</td>
<td>211</td>
<td>8</td>
</tr>
<tr>
<td>49</td>
<td>201 1</td>
<td>2005</td>
<td>718</td>
<td>100</td>
<td>12</td>
<td>211</td>
<td>8</td>
</tr>
<tr>
<td>50</td>
<td>201 1</td>
<td>2005</td>
<td>718</td>
<td>100</td>
<td>12</td>
<td>211</td>
<td>8</td>
</tr>
</tbody>
</table>

### 1970 Census Processing Software Developed by Jerry Pfeffer

- **Figures 1-4**
TOTALS

Higher level decision makers will frequently need summary data which is not directly available from the 1970 Census. To meet this need, TOTALS was developed. It allows the user to request up to 10 subtotals and a grand total by which individual records contained on a special Summary Tape can be aggregated.

Two sets of data are required by the program. The same card deck used in PROPOR can be used in TOTALS. Instead of reading the columns which contain percentage value, TOTALS scans the card to determine which of the subtotals the area's values should be assigned to. The appropriate subtotal, referred to as an integer from 1 to 10, should be punched right justified, in columns 69 and 70. One card should precede this card deck indicating the number of subtotals desired, also as an integer from 1 to 10, punched right justified in columns 1 and 2.

TOTALS writes a new tape containing the subtotals and grand total, which can be processed by the same software designed to handle the block group level tapes. In addition, the program furnishes a printed output which graphically indicates the distribution of block groups by subtotal. This tabulation also itemizes the numbers of block groups processed, the count of all persons within each subtotal area, and the percentage these people represent of the total. This last feature should be of particular value to those who wish to extend the one-man, one-vote principle to smaller representative districts.

TOTALS is illustrated in Figure 1-5. A typical output listing is shown in Figure 1-6.
**CARD NO.**

1 2 3 4 5 6 7 8

127467890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890

**68**

<table>
<thead>
<tr>
<th>CARD</th>
<th>COL.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C</td>
<td>1970 CFNSUS PROCESSING SOFTWARE FOR FIRST COUNT SUMMARY TAPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>C</td>
<td><strong>PROGRAM NAME:</strong> TOTALS</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td><strong>WRITTEN BY:</strong> JERRY PFEFFER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>C</td>
<td>URBAN DESIGN GRADUATE PROGRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>C</td>
<td>RICE UNIVERSITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>HOUSTON, TXAS</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>C</td>
<td><strong>DATE:</strong> MAY 15, 1971</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>C</td>
<td><strong>FUNCTION PERFORMED:</strong> PROVIDES TAPE OUTPUT FOR UP TO 10 SUBTOTALS AND A GRAND TOTAL FOR GEOGRAPHIC AREAS WHERE DATA EXISTS ON A SUBSET OF THE FIRST COUNT 1970 CFNSUS SUMMARY TAPE, PREVIOUSLY EXTRACTED FROM A STATE TAPE THROUGH THE USE OF 'GECPICK' UK SIMILAR PROGRAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>C</td>
<td><strong>INPUT REQUIRED:</strong> TAPE: IN STANDARD CENSUS BUREAU FORMAT CARDS: CARD 1 - NUMBER OF SUBTOTALS DESIRED (MAX 10) REMAINING CARDS - SUBTOTAL WHICH AREA IS PART OF 1 CARD FOR EACH AREA ON TAPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>C</td>
<td><strong>OUTPUT PROVIDED:</strong> TAPE: AS DESCRIBED ABOVE PRINTED: HISTOGRAM TABULATION OF AREAS SUBTOTaled, POPULATION FIGURES FOR EACH SUBTOTAL &amp; GRAND TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>C</td>
<td><strong>VARIABLE DICTIONARY (IN ORDER OF APPEARANCE)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>C</td>
<td>INPUT..................ACTUAL DATA VALUES FROM TAPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>C</td>
<td>OUTPUT.............SUBTOTAL ARRAYS INTO WHICH INPUT IS SORTED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>C</td>
<td>TOTAL...............TOTAL ARRAY WHICH RECEIVES ALL VALUES OF INPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>C</td>
<td>NCOU....COUNTER WHICH KEEPS TRACK OF ALL VALUES READ IN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>C</td>
<td>NCOU....COUNTER WHICH KEEPS TRACK OF NUMBER OF VALUES IN EACH SUBTOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>C</td>
<td>NCOU....COUNTER WHICH RECORDS HIGHEST VALUE OF NCOU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>C</td>
<td>MAX............NUMBER OF SUBTOTALS REQUESTED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>C</td>
<td>TABLE............ARRAY WHICH DISPLAYS HISTOGRAM OF AREAS ASSIGNED TO EACH SUBTOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>C</td>
<td>PRFCNT............SUBTOTAL EACH AREA IS ASSIGNED TO NAME COMES FROM FIRST USE OF PROGRAM TO TABULATE DATA BY PRECINCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>C</td>
<td>INTEGER OUTPUT, TOTAL, PRECNT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>C</td>
<td>DIMENSION INPUT(411), OUTPUT(10,411), TOTAL(411), NCOU(10), 1 TABL(10,100,2), SUB(2), TOT(2), HOG(11,2), HUR(33), 2 PCTS(10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>C</td>
<td>DATA BLANK /* */</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>C</td>
<td>DATA TOT(1), TOT(2), TOT,'AL /*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>C</td>
<td>DATA SUB(1), SUB(2), 'SURT', 'TOTAL'/*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>C</td>
<td>DATA UNER/<em>-----</em>/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>C</td>
<td>READ NUMBER OF SUBTOTALS REQUESTED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>C</td>
<td>READ (5, 130) MAX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>C</td>
<td>MAXPLS = MAX + 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>C</td>
<td>NCOU = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>C</td>
<td>NCOUXX = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>C</td>
<td>INITIALIZE TOTAL TO 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>C</td>
<td>WU 1500 K = 1, 411</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>C</td>
<td>TOTAL(K) = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>C</td>
<td>1500 CONTINUE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1-5**
**LISTING OF PROGRAM 'TOTALS'**

```
61 C      INITIALIZE NCOUTR TO 0, LABEL SUBTOTALS
62 C      DO 1501 I = 1, MAX
63 C      NCOUTR(I) = 0
64 C      CONTINUE
65 C      INITIALIZE OUTPUT TO 0
66 C      DO 1502 I = 1, MAX
67 C      DO 1503 X = 1, 411
68 C      OUTPUT(I,X) = 0
69 C      CONTINUE
70 C      INITIALIZE TABLE TO BLANKS
71 C      DO 1510 I = 1, MAX
72 C      DO 1511 K = 1, 100
73 C      TABLE(I,K,1) = BLANK
74 C      TABLE(I,K,2) = BLANK
75 C      CONTINUE
76 C      PLACE PHRASE "SUBTOTAL" IN HEADINGS
77 C      DO 1525 I = 1, MAX
78 C      HDG(I,1) = $SUB(I)
79 C      HDG(I,2) = $SUB(I)
80 C      CONTINUE
81 C      PLACE PHRASE "TOTAL" IN HEADING
82 C      HDG(MAXPLS,1) = $TOT(1)
83 C      HDG(MAXPLS,2) = $TOT(2)
84 C      CONTINUE
85 C      PLACE UNDERLINES IN ARRAY "HOR"
86 C      DO 1530 I = 1, 33
87 C      HOR(I) = UNDER
88 C      CONTINUE
89 C      START OF INPUT LOOP
90 C      CONTINUE
91 C      TAPE READ
92 C      READ (9,100,END=999) TRACT, BLOCK, (INPUT(K),K=3,411)
93 C      CARD READ
94 C      READ (B,130,END=999) PRECNT
95 C      NCOUNT = NCOUNT + 1
96 C      NCOUTR(PRECNT) = NCOUTR(PRECNT) + 1
97 C      TABLE(PRECNT,NCOUTR(PRECNT),1) = TRACT
98 C      TABLE(PRECNT,NCOUTR(PRECNT),2) = BLOCK
99 C      IF (NCOUNT .GE. NCOUTR(PRECNT)) GO TO 1512
100 C     NCOUNT = NCOUTR(PRECNT)
```

*FIGURE 1-5 (continued)*
LISTING OF PROGRAM 'TOTALS'

CARD COL. NO. 1 2 3 4 5 6 7 8

123456789012345678901234567890123456789012345678901234567890

133 1412 CONTINUE
134 C
135 C CHECKS FOR SUPPRESSION CODE ON TAPE (-1)
136 C IF ENCOUNTERED, SKIPS ADD TO PREVENT ERROR
137 C
138 C DO 1001 K = 3, 411
139 C IF (INPUT(K) LE. 0) GO TO 1001
140 C OUTPUT(PRECNT,K) = OUTPUT(PRECNT,K) + INPUT(K)
141 C 1001 CONTINUE
142 C GO TO 2000
143 C
144 C FIND OF INPUT LOOP
145 C
146 C 999 CONTINUE
147 C
148 C TAPE WRITE FOR SUBTOTALS
149 C DO 1504 I = 1, MAX
150 C WRITE (10,100) (OUTPUT(I,K),K=1,411)
151 C 1504 CONTINUE
152 C
153 C CALCULATES TOTAL
154 C DO 1506 I = 1, MAX
155 C DU 1507 K = 3, 411
156 C TOTAL(K) = TOTAL(K) + OUTPUT(I,K)
157 C 1507 CONTINUE
158 C CONTINUE
159 C
160 C TAPL WRITE FOR TOTAL
161 C WRITE (10,100) (TOTAL(K),K=1,411)
162 C
163 C WRITE (1550 I = 1, MAX
164 C DU 1550 K = 3, 411
165 C PCIT(1) = (OUTPUT(1,3) * 100, I) / TOTAL(3)
166 C 1550 CONTINUE
167 C
168 C START OF PRINTFD OUTPUT
169 C
170 C WRITE (6,1)
171 C
172 C WRITE (6,139) (HOR(I), I=1,33)
173 C
174 C WRITE (6,140) (HOR(I,J),J=1,2),I=1,MAXPLS
175 C
176 C WRITE (6,144)
177 C
178 C WRITE (6,141) ((I),I=1,MAX)
179 C
180 C WRITE (6,144)
181 C
182 C WRITE (6,139) (HOR(I), I=1,33)
183 C
184 C WRITE (6,144)
185 C
186 C WRITES HISTOGRAM
187 C
188 C DU 1515 K = 1, NCOUTT
189 C L = NCOUTT + 1 - K
190 C WRITE (6,150) ((TABLE(L,J),J=1,2),I=1,MAX)
191 C
192 C WRITE (6,144)
193 C
194 C CONTINUE
195 C
196 C 1515 CONTINUE
197 C
198 C

FIGURE 1-5
(continued)
LISTING OF PROGRAM 'TOTALS'

CREDIT CCL NO.
1234567890 1234567890

199 WRITE (6,139) (HOR(I),I=1,33)
200 C WRITE (6,144)
201 C WRITE (6,142) (NCOUNT(I),I=1,MAX),NCOUNT
204 C WRITE (6,144)
205 C WRITE (6,139) (HOR(I),I=1,33)
207 C WRITE (6,144)
208 C WRITE (6,143) (OUTPUT(I,3),I=1,MAX),TOTAL(3)
211 C WRITE (6,144)
212 C WRITE (6,139) (HOR(I),I=1,33)
214 C WRITE (6,145) (PCTST(I),I=1,MAX),PCTT
216 C WRITE (6,144)
217 C WRITE (6,139) (HOR(I),I=1,33)
219 C WRITE (6,144)
220 C WRITE (6,142)
221 C FORMATS FOR ALL READS AND WRITES
222 C
223 C FORMAT ('I',1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY ',
224 C 'JERRY PFFFFRF'),/
225 C
226 C
227 C 2 FORMAT ('**')
228 C
229 C 100 FORMAT (24X,A4,74X,A1,17X,13I8,8I16,8X,4I16,172I8,/,212I8,104X)
230 C
231 C 130 FORMAT (6A8X,12)
232 C
233 C 139 FORMAT ('*',33A4)
234 C
235 C 140 FORMAT ('*',32X,11(1X,2A4))
236 C
237 C 141 FORMAT ('*',32X,114X,12,3X))
238 C
239 C 142 FORMAT ('* NUMBER OF BLOCK GROUPS TOTALED:*11(5X,13,1X))
240 C
241 C 143 FORMAT ('*,11X,'COUNT OF ALL PERSONS:*11(1X,18))
242 C
243 C 144 FORMAT ('**!',13I11('!*'),8X),!'*)
244 C
245 C 145 FORMAT ('**!',10X,'PERCENT OF POPULATION:*11(7X,F6.2,1X))
246 C
247 C
248 C 140 FORMAT (12)
249 C
250 C END OF PROGRAM TOTALS
251 C
252 C STOP
253 C
254 C CARDS IN LISTING

FIGURE 1-5
(continued)
### 1970 Census Processing Software Developed by Jerry Pfeffer

**Table: Subtotal Count of All Persons**

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
<th>Column 6</th>
<th>Column 7</th>
<th>Column 8</th>
<th>Column 9</th>
<th>Column 10</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>305 1</td>
<td>304 1</td>
<td>304 1</td>
<td>304 1</td>
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<td>304 1</td>
<td>304 1</td>
<td>304 1</td>
<td>304 1</td>
<td>304 1</td>
</tr>
</tbody>
</table>

**FIGURE 1-6**
As discussed in Chapter IV, it is often necessary to transfer data from one file or storage medium to another. Obtaining data for input to a program such as DATATEXT or SYMAP is one such application. XTRACT provides an efficient framework for this sort of processing. Configured as it is in Figure 1-7, XTRACT allows the user to obtain a punched deck of cards containing any desired value included on a specially created or state-wide Summary Tape. In addition to this tape, the user must furnish a card punched with the sequence number of the data cell on the tape he desires to obtain. This value can be determined by counting the number of items which precede the desired value in the list furnished in Part II, 1970 Census Users' Guide, and adding the integer "3" (two cells are used for processing tract and block group codes; the third represents the desired value). The resultant value should be punched as an integer, right justified, in columns 1 through 3.

In its present configuration, XTRACT will punch the desired value (one to a card) as a real number, in columns 1 to 20, for input to SYMAP. The associated tract and block group numbers will be punched in columns 75 to 80. As mentioned in the listing, it would be no problem for a user familiar with FORTRAN to replace the "OUTPUT" value assignment card (number 60 in the listing) with one or more cards which allow manipulation or other processing of the data before assigning a value to "OUTPUT". Similarly, the output format or media could be altered by changing the appropriate cards. In addition, XTRACT furnishes a listing of the value processed. Typical output is shown in Figure 1-8.
LISTING OF PROGRAM 'XTRACT'

1  C  1-70 CENSUS PROCESSING SOFTWARE FOR FIRST COUNT SUMMARY TAPES
2  C
3  C PROGRAM NAME: XTRACT
4  C WRITTEN BY: JERRY PFEFFER
5  C URBAN DESIGN GRADUATE PROGRAM
6  C RICE UNIVERSITY
7  C HOUSTON, TEXAS
8  C DATE: MAY 15, 1971
9  C FUNCTION PERFORMED: EXTRACTS DATA FROM SPECIAL SUMMARY CENSUS TAPE
10 C FOR LATER INPUT TO OTHER PROGRAMS
11 C INPUT REQUIRED: TAPE:
12 C SPECIAL SUMMARY TAPE (ON 9)
13 C CARDS:
14 C RECORD REQUESTED...INTEGER VALUE OF LOCATION
15 C IN CENSUS SEQUENCE...I.E., '3' FOR 'COUNT OF
16 C ALL PERSONS', '4' FOR 'TOTAL HOUSING UNITS', ETC.
17 C OUTPUT PROVIDED: CARDS
18 C REQUESTED VALUE, ASSOCIATED IDENTIFIERS
19 C PRINTED
20 C LISTING OF ALL VALUES PUNCHED
21 C
22 C VARIABLE DICTIONARY (IN ORDER OF APPEARANCE)
23 C
24 C INPUT............ORIGINAL VALUES FROM TAPE
25 C OUTPUT............VALUE TO BE PUNCHED
26 C N..................RECORD COUNTER
27 C NP..................PAGE COUNTER
28 C NREQD..............SUBSCRIPT OF INPUT DESIRED IN OUTPUT
29 C
30 C DIMENSION INPUT(411)
31 C INTEGER OUTPUT
32 C
33 C INITIALIZE COUNTERS
34 C
35 N = 0
36 NP = 1
37 WRITE (6,150) NP
38 C CARD READ
39 C READ (9,101,END=998) NREQD
40 C START OF 1-N LOOP
41 C 2001 CONTINUE
42 C TAPE READ
43 C READ (9,100,END=999) (INPUT(I),I=1,411)
44 N = N + 1
45 C SHIFT VALUE TO OUTPUT
46 C NOTE: ANY PROCESSING CAN BE PERFORMED AT THIS STEP,
47 C BY REPLACING THIS STATEMENT WITH AN ACCEPTABLE FORTRAN MANIPULATION
48 C OF THE VALUES OF INPUT
49 C OUTPUT = INPUT(NREQD)
50 C CARD WRITE
51 C WRITE (7,1) OUTPUT, (INPUT(I),I=1,2)
52 C IF (N.NE.(NP+50)+1) GO TO 1001

FIGURE 1-7
LISTING OF PROGRAM 'XTRACT'

CARD COL. 1 2 3 4 5 6 7 8
NO. 123456789012345678901234567890123456789012345678901234567890

87 np = np + 1
88 write (6,150) np
89 continue
70 printer write
71 c
72 c
73 write (6,2) n, (input(i),i=1,2), output
74 go to 2001
75 c
76 c
77 c
78 998 continue
79 999 continue
80 c
81 formats for all reads and writes
82 c
83 1 format (119,*,*,54x,14,12)
84 2 format (',15,10x,14,12,110)
85 c
86 c
87 100 format (24x,14,74x,i1,i7x,13i8,8i16,8x,4i16,172i8,/,212i8,104x)
88 c
89 101 format (13)
90 c
91 150 format (',1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY ',
92 'jerry pfeffer',10x,'page ',12/,*,0',9x,'tract/bg',3x,'output',/)
93 c
94 c
95 c
96 stop
97 end
98 cards in listing

FIGURE 1-7 (continued)
1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY JERRY PFEFFER

TRACT/BG OUTPUT

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FIGURE 1-8
1970 CENSUS PROCESSING SOFTWARE DEVELOPED BY JERRY PFEFFER

TRACT/AG OUTPUT

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APPENDIX II

GRAPHIC CONSIDERATIONS IN USE OF SYMAP OUTPUT
Two major drawbacks exist in the use of SYMAP output. These are the coarse texture of the original maps, and the lack of visual "cues" by which the viewer can orient himself. The discussion which follows provides some insight into ways in which the latter problem can be eliminated, and the former at least minimized.

Figure 11-1 shows a portion of a SYMAP printout as it comes from the computer. The coarseness is due to the relatively large grain of the symbolism which is used to produce the map; the standard 1/8" x 1/10" lineprinter character. Using a full-size map with such coarseness can lead to a number of problems. Often, the viewer will attach great meaning to the individual characters, incorrectly assuming that each element relates to a specific area, such as a city block. The large size of the symbols may also result in poor quality reproduction. Electro-static printing, (such as "Xerox"), will often produce a misleading copy, due to the characteristic "drop-off" within dark areas of such "edge-recognition" techniques.

The best way to minimize this problem is to use one of the various photo-reduction techniques available to reduce the size and relative coarseness of the map to the point that the individual characters blend into one another, in a manner similar to the "half-tone" illustrations used in the newspapers and magazines. An example of a map reduced to 50% of its original size is shown in Figure 11-2.

Although this map is somewhat improved in appearance by this reduction, even the addition of a title would not greatly improve the viewer's comprehension of the values represented by the different symbolisms. What
Figure 11-2. SYMAP OUTPUT AFTER 50% REDUCTION
is lacking is the presence of visual cues by which the viewer can readily orient himself. These cues are always present in conventional maps, in the form of roads, rivers, railroad tracks and similar elements which comprise the "fabric" of the map. In a SYMAP output, all of these cues are missing, (unless laboriously and inefficiently supplied as components of an OTOLEGENDS package). The best way to provide such elements is by taking advantage of the photo-reduction step in map processing to add the necessary cues.

Figure 11-3 illustrates a transparent overlay of a street map. If this were simply placed over a SYMAP output, the result would be a more confusing image than without the overlay, because the base symbolism would show through rivers, streets, and building areas alike. Since the map in question was intended to show relative property values within city blocks, the symbolism should be visible only in those bounded areas. An intermediate white overlay, shown in Figure 11-4 was prepared to block out the unwanted symbols. In this illustration, those areas which were left transparent are shown as black; the white areas are those which will be blocked out.

The street map, with this intermediate overlay below, is then placed over the SYMAP output, and photographed for reproduction. The finished product is shown in Figure 11-5.

Other techniques, including color reproduction, are available but economic and technical considerations usually place them outside the range of practicality. Format restrictions have placed them outside the scope of this paper. It can be seen, however, that with a little
CBD Ecology
Land Value Dynamics

Figure 11-3, STREET OVERLAY
Figure 11-4, INTERMEDIATE WHITE OVERLAY
(black areas are transparent)
experimentation, great improvements can be made in the quality and legibility of maps produced by computer.
APPENDIX III

A PROPOSED INFORMATION SYSTEM FOR

THE MODEL CITIES EVALUATION DEPARTMENT

HOUSTON, TEXAS
The following material has been taken from a formal proposal prepared by the author under the auspices of the Southwest Center for Urban Research, for an Evaluation Information System for the Model Department, Houston, Texas.

Features of the proposed Evaluation Information System include:

* On-line storage and retrieval of basic information on each of the fifty-four or more Model Cities projects.
* Augmented information, also on-line, for those projects selected for intensive evaluation.
* Similar information on the City Demonstration Agency and the entire Model Cities program in Houston.
* Interactive processing and display capabilities through time-sharing and remote terminals located at the CDA offices.
* Data retrieval and analysis capabilities by project, operating agency, and program category.
* Development of workfiles based on either raw or processed data for subsequent analysis using sophisticated batch-oriented statistics packages.
* Activation of batch programs from remote terminals.
* Integration of data collection procedures for optimum cross-referencing of related variables.

System Description

Using an interactive English language time sharing file management system, a wide variety of information about each Model Cities project and the Model Cities area in general will be stored on-line in an IBM
System/360 Model 50 computer located at the Baylor College of Medicine in the Texas Medical Center. Authorized users at the Model Cities Department offices, SCUR and other designated locations will be able to retrieve this information and perform required operations such as display, comparison, statistical analysis, cost-benefit calculations and hard-copy generation, using Datapoint 2200 Cathod Ray Tube terminals and associated peripherals, communicating with the computer over leased and dial-up telephone lines at the rate of 120 characters of information per second. (As an example, all of the above paragraph could be displayed in 6 seconds at the transmission rate we are proposing.)

Information storage capacities will be elastic, so that additional information may be added to specific files without the necessity for reconfiguration of the entire files structure. This feature of the system will be of particular value in the intensive study of specific projects, such as those performed by SCUR and the CDA under their present evaluation program.

To ensure complete confidentiality of all information contained in the files, clear-cut fail-safe security procedures will constitute a major element of the system. Back-up records will be stored in a fire-proof vault to ensure rapid recovery in the event of catastrophic failure or damage to the computer installation. The use of widely available higher-level languages throughout the system will ensure its ready relocation should changes occur in the installation environment.

Specific parts of the system will provide capabilities such as the preparation of workfiles from raw data, and the activation, through
the terminals, of major batch-oriented analysis and display systems to
manipulate the workfile information and print out results either at
the terminal or on-site, at the user's discretion. (See Figure III-1.)

Data Description
A wide variety of information will be collected and processed through
the various elements of the Model Cities Evaluation System, including;

* Basic project data
  Financial situation
  Services performed
  Employee characteristics

* Expanded project data
  as desired for intensive evaluation

* Model Cities Department data
  similar to project information

* Model Cities area data
  demographic characteristics (1970 U.S. Census data)
  facilities location, land use, other planning data

* Program Category data
  similar to project data, but aggregated by categories
  such as Health, Education, etc.

* Contracting Agency data
  similar to project data, but aggregated by agency,
  such as Houston Independent School District, City
  Health Department, etc. Also available by agency
  category, such as public and private.
Figure III-1, SYSTEM FLOW
Additional classes of information can readily be added to these categories, as needs become apparent.

Software Components

The following programs and system will form the basic software package:

* Interactive on-line file management program:
  Provides authorized terminal users access to files for data input and retrieval by all categories described above. Recognizes user priority, terminal configuration and location, to provide suitable format and replay capabilities for interaction. Monitors system usage and prepares accounting records for all users and files. Includes complete directory of data and system explanations as required by various users.

* On-line workfile and batch processing management program:
  Allows user to manipulate workfiles created by file program and activate large scale batch-oriented programs such as DATATEXT and SYMAP to use workfiles data, all through time-sharing terminals to eliminate need to submit jobs on-site.

* Statistical analysis and display systems:

DATATEXT

DATATEXT is a large system for performing statistical analyses, developed by the Department of Social Relations, Harvard University.

DATATEXT is designed to process social science surveys of large size. In each run, data is read, recoded and transcribed onto a disk in binary representation. This
recoded disk is rewound and used as the input to any of the various statistical programs, (such as the cross-tabulation program), which the user requests. The recoding functions available to transform data items include basic arithmetic operations, exponentiation, and several mathematical functions, (square root, natural logarithm, etc.). Several logical operators, (AND, OR, NOT), and relational operators, (GREATER THAN, EQUAL, and NOT EQUAL), are available to qualify the recoding operations.

DATATEXT provides the options of calculating cell percentages involving the quotient of the cell count divided by the row sum, the column sum, or total for the table. Several functions of bivariate statistics are available by simple request, including the Chi square, Fisher's exact test, and Phi coefficient.

The system's documentation, written for social science analysts, assumes no prior knowledge of data processing techniques. The text introduces the reader to those fundamentals of data processing needed to understand the operation of the system, and then gradually builds his knowledge in the use of the DATATEXT language.

**RASS**

RASS, the Remote Access Statistical System, permits the user to interact with the computer while he is performing
statistical analyses, format-free input, alternatives, extensive error checking and protection, and tutorial instructions. The communication between the user and the computer is carried out in a conversational manner; thus, the user can solve his problem from a remote terminal without knowing anything about computers or programs.

Five groups of analyses are available through RASS, including basic statistics, cross tabulation, correlation, regression, factor analysis, multivariate correlation, discriminant functions and exponential smoothing.

SYMAP

SYMAP is the best known, most comprehensive, and most widely used computer mapping program currently available. It uses a standard high-speed printer to print typewriter-like characters, on a standard 11 x 15 inch computer print-out sheet. Lines can be roughly approximated with printer characters, and areas can be shaded with up to 10 progressively darker shades. The darkest shades are created by overprinting two or more printer characters.

The program is maintained by the Harvard Laboratory for Computer Graphics, where it is supported by a technical staff, ongoing research, and teaching materials such as correspondence courses and seminars.

SYMAP enables three basic types of maps to be produced
through its three primary options: the conformal option, where the areas shaded are approximate representatives of the polygonal geographic areas that they represent; the contour option, where the data values are assigned to particular points (such as block face centers or block or tract centroids) and the program shades contours by establishing equal-width intervals representing the range of values between each pair of points; and the proximal option where the data values are again assigned to particular points and the program shades the respective values from each point to an imaginary line equidistant between each pair of adjacent points.

In addition, SYMAP has a large number of statistical-support options which permit calculations of means, standard deviations, histograms, and percentile groups — all within the same mapping program package.

**Data Collection Systems**

* Interactive off-line data input using stand-alone capabilities of DATAPoint 2200 CRT terminals (see Hardware Components).
* Manual data collection systems, using forms designed and produced under terms of the system development contract.
* Integration of financial information package or periodic transfer of necessary data to evaluation system.
* Address Reporting System data and displays developed under present SCUR contract.
* Annual Survey data developed under present SCUR contract.
Hardware Components

The following machines will constitute the major elements of the system:

* Main computing capability

IBM System/360 Model 50 3rd Generation Computer -
A major user-oriented system, configured to provide immediate response to users of both time-sharing and batch modes, made possible by the large-scale memory capacity of 1,128,000 bytes of core - one of the largest capacities available in this area.

* Time-sharing Terminals

Computer Terminal Corporation Datapoint 2200's -
A major breakthrough in the development of low-cost so-called "intelligent" terminals, providing small scale computing ability within the terminal to enable the user to store and recall data as it comes from the main computer, to control a variety of peripheral devices such as hard-copy printers, and to format and prompt the entry of raw data off-line onto tape cassettes, for subsequent transmission at high rates to the main computer for addition to files.

System Development and Maintenance

SCUR and its associates will, during the initial six month period covered by the proposed development contract, design, program, integrate, test, optimize and document the system, in consultation with designated representatives of the Model Cities Department. Mutually-agreeable landmarks in this process will be identified and approval sought for each completed phase of the work. Throughout this initial six month period, continuous testing, modification and evaluation of this system
will be carried out in conjunction with representatives of the Model Cities staff. Initial training of users will be done at this time, as well. At the end of the initial six-month period, the system will be declared operational.

For the next six months of system usage, periodic monitoring and evaluation of the system, based on the experience of users and system developers will determine what modifications, if any, should be made to improve or expand the system's capabilities. Necessary changes will be implemented prior to the conclusion of the second six months of system operation. User training will continue during this period.

Subsequent modifications will be made under appropriate supplemental contracts with SCUR, under terms similar to the initial development contract. Please refer to Figure III-2, "Phase Diagram".

Documentation and Training

Extensive documentation of the system and training of Model Cities staff members will be provided as part of the system development contract:

* Documentation

Complete program and hardware documentation will be provided as required, in keeping with established standards of the data processing industry and the Houston City Data Processing Department.

* Training

Required training will be provided for designated users, under the terms of the system development contract.
Figure III-2, PHASE DIAGRAM
Maintenance and Modification

* Maintenance

Hardware - Time-sharing terminal and related communications equipment maintenance will be provided without additional cost as part of the lease provisions to be included in the system development and maintenance contract. Main frame computer maintenance will be included in the hourly rate charges for time on the machine.

* Modification

All changes in the type, number or operations of programs, terminals, communications devices, main computer and associated peripherals will be performed under terms to be contained in the development and maintenance contracts.

Responsibilities

* SCUR

Systems definition, design of data collection techniques, training of Model Cities staff in system use, acquisition of off-the-shelf software, user manuals, supplies.

* Urban Systems Laboratory, University of Houston

Software development, system monitoring, software documentation, U. S. Census data, ACG-DIME file implementation.

* Institute of Computer Science, Baylor College of Medicine

System integration with System/360, computer time, on-site communications devices, on-line storage, back-up tape security.

* Model Cities Department

Systems definition and approval, necessary data, staff members for data collection, training for use.
* Houston City Data Processing Department

Documentation procedure guidelines, output from financial management system, ACG-DIME file and related software, data as necessary, assistance to Model Cities staff in system evaluation.

* International Business Machines Corporation

System/360 hardware and software as required, including communications devices on-site.

* Computer Terminal Corporation

Datapoint 2200 CRT Terminals, software, peripherals, supplies, maintenance, communication devices in terminals.

* Southwestern Bell Telephone Company

Leased and dial-up communications lines, as required, maintenance and data access arrangements.


5. For a more detailed explanation of the court's requirements, see: Delores Ross, a minor, by her next friend, Mary Alice Benjamin, et al., Plaintiffs, United States of America, Plaintiff-Intervenor, vs. Robert Eckles, as President of the Board of Trustees of the Houston Independent School District, Defendants, United States District Court Decree, June 30, 1970.


7. Melvin Webber states:

   "Seemingly straightforward facts about social things and events are seldom, if ever, value neutral. They inevitably intervene into the workings of the systems they describe. The information supplier, whatever his motives and methods, is therefore, inevitably immersed in politics. The kinds of facts he selects to report, the way he presents them, the groups they are distributed to, and the inferences he invites each work to shape subsequent outcomes - subsequent facts.


10. It has been demonstrated that with enough effort, it is possible to get individual data from the most discretely aggregated statistical collections, thereby nullifying the efforts put into sophisticated privacy protection methods. For a more detailed discussion, see:


12. A pre-test of the planned 1970 census was conducted in New Haven in 1967, as a part of a three-year Census Use Study. Eleven reports were issued to document the study's findings. Representative titles include: Computer Mapping, Data Interests of Local Agencies, and Data Uses In Urban Planning. Please refer to the Bibliography for a detailed list.


15. For a detailed description of DATATEXT's capabilities and requirements, see: David J. Armor and Arthur S. Couch, The DATATEXT Primer, MS (to be published by the Free Press).


17. The Model Cities Evaluation Information System is described in detail in a proposal written by the author under the auspices of the Southwest Center for Urban Research. Excerpts from the text of the proposal are contained in Appendix III.


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Metropolitan Planning Commission, 1968.

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Myers, Charles A. Computers in Knowledge-Based Fields. Cambridge:
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