Chapter 7

COMPUTERS

Computers provide a way to process research data quickly and economically. In this section you will find information on different uses of computers, how to prepare data to be processed by computers, and a guide to the different choices one faces in using the computer. Sample printouts are given to illustrate the capabilities of available computer program packages. Sometimes researchers avoid using computers because of the difficulty presented by technical terms and equipment. The explanations that follow attempt to take the “mystery” out of computers by defining computer-related terms and describing the equipment available.
The computer can be a useful tool for community-based research for its ability to process data and generate reports. However, you can either save or waste time and money, depending on the wisdom of your decisions concerning its use. This chapter outlines some of the factors to consider in choosing methods of processing data and specific applications of computer technology.

Information collected systematically by such means as survey interviews, needs assessments, questionnaires, and record keeping systems is called data. The term data processing refers to the operations performed on data, usually by means of automatic equipment. Today, electronic equipment for the processing of data can vary from an inexpensive calculator to a high speed computer system. The project collecting a hundred or less data items (to be analyzed using descriptive statistical techniques) might well use a programmable calculator for satisfactory and cost effective results. Such calculators are available with ready-to-run statistical program for under $200 (1981). Calculators can satisfy a multitude of office and accounting needs, thus maximizing the use of program funds. In making the decision to use a computer, you need to consider the things computers can and can't do.

Computers Can

- Process large quantities of information very quickly
- Perform statistical operations with great accuracy
- Process large quantities of data inexpensively, relative to human labor
- Retrieve stored information in a selective way
- Print reports according to a specified format
- Print multiple copies of reports at low cost

Computers Can Not

- Think
- Make decisions, other than those based on the numerical calculations programmed
- Draw conclusions
- Process data without accurate, very specific instructions
- Process information with human error

It is a common practice today to “blame the computer” when things go wrong with paperwork, telephones, traffic lights, and other automated things in our lives. The computer, however, is only a machine that performs exactly according to instructions. The errors in computerized tasks are, with very rare exceptions, caused by human mistakes in instructions to them. An old saying among computer users that describes this is, “garbage in, garbage out.” Before undertaking any work with a computer, the user should be prepared to accept sole responsibility for errors, and possibly some great frustration in the learning process. Once the basic concepts of computer use and the specific details of a data processing application are learned, the computer can serve as a very efficient and cost effective means of data analysis.

DATA PREPARATION

The interpretation of information from an idea to coded data can take many forms. One of the common fears held about using a computer concerns the taking away of the “human element” in the process. Keeping the human element in research depends largely upon the quality and thoroughness of the choices made concerning the representation of data and the interpretation of results. Planning for the coding of data (representing data according to a set format) and planning for the later analysis (examination of the relationship between the data items) should be completed before the data collection begins. Otherwise, the researcher may, more than likely, find needed information missing or incomplete when the time for processing is at hand. Presented below is a discussion of different types of data and some examples of data preparation for automated processing by calculator or computer.

In designing a research topic, a set of questions is developed. This set of questions is then answered for each unit included in the study. That basic unit, or case, can be either a single respondent in a group survey, or a larger unit such as one of several communities being compared. Each of these questions answered or measurements taken within each unit in the study is called a variable. In other words, the responses or measurements can vary from unit to unit, but for each case within the unit there will be recorded one value for each of the variables. Two examples of variables that might be included in a survey are “age” and “sex.” The value of “age” for a given respondent would be recorded in years; whereas, the value of the variable “sex” would be either male or female. Once values have been recorded for the variables, the cases can be compared to determine relationships according to different procedures. Several of these procedures were discussed in the preceding chapter on statistics. The use of the calculator or a computer can speed these procedures, but the process of determining the questions to be asked (that is, defining the variables), and recording the values (according to some pre-defined, consistent plan) must occur whether or not a computer is used. There is no computer magic, and the human decision-making that takes place before any data are collected will largely determine the quality of the outcome.

Although the computer can read alphabetic characters and symbols, as well as numbers, the data are usually represented as numbers for the purposes of calculations. This does not limit the types of data that can be processed by means of a computer to characteristics that can be measured quantitatively. To summarize some of the concepts introduced in Chapter 6, STATISTICS, data which are measurable or do follow a consistent
progression are described as quantitative. Examples of quantitative variables are “age,” “highest grade level completed,” and “income.” Data which do not follow a measurable, orderly progression, but are more abstract or unordered are described as qualitative. Examples of qualitative variables are “sex,” “area of residence,” and “marital status.” Assigning values to the possible responses to qualitative variables requires careful thought and planning. In other words, the different qualities that may be answers to a particular question must be thought of ahead of time and included during the design of the questionnaire, interview form, or other instrument, if all possible responses are to be indicated. Categorizing and assigning numbers to the values is a step in preparing the setup for data processing.

For the purposes of creating a step-by-step coding example, a few questions will be chosen from an imaginary questionnaire titled, “Urban Adjustment Survey.” The variables are “Respondent Number,” “Sex,” “Age,” “Marital Status,” “Tribe,” “Blood Quantum,” and “Frequency Speak Native Language.” The data might be collected according to the format below.

For the purposes of creating a step-by-step coding example, a few questions will be chosen from an imaginary questionnaire titled, “Urban Adjustment Survey.” The variables are “Respondent Number,” “Sex,” “Age,” “Marital Status,” “Tribe,” “Blood Quantum,” and “Frequency Speak Native Language.” The data might be collected according to the format below.

In this example, the codes for the variable “Tribe” would be too lengthy to list on the questionnaire and a separate key would be used for coding purposes. A sample coding key for tribes is presented in Appendix B. The small numbers under the space for responses represent the card columns where the information will be punched on computer cards, one digit per column. If the punched card method is used, then 80 columns are available per card (96 columns for some newer machines, but most facilities still use the 80 columns). Deciding the card column assignments is known as defining the fields of data. The system for coding is decided upon by the researcher prior to the collecting of data. Specific examples of this process are shown in the previous chapter on SURVEY RESEARCH.

The following may be useful to you to remember in defining the data fields:

- A respondent identification number simplifies changing or adding information to a case
- Other identifying information, such as date completed or interviewer, may be useful in clearing up any later difficulties with the data
- Enough digits or spaces are important to allow for the maximum responses (e.g. two digits would allow a recording of 99 maximum, three digits would allow 999)
- If more than one 80-column card is required for each case, the cards should be numbered (often the last one or two digits of the 80 columns are reserved for a card number)
- If more responses are possible than those identified, another category called “other” can be created for a variable (to keep the value of the information, a space for comments can be created, and these comments can be quoted or summarized in the research report)

A key is sometimes compiled which defines the fields of data and corresponding card columns. Such a key may be useful in coding the data, but may not be necessary if the card columns are indicated on the form used for data gathering. In Figure 7.2, an example of a key defines the fields of data presented earlier in Figure 7.1.
Continuing the above example, a sample coding form is shown in Figure 7.3, filled out according to the data recorded above (for one respondent) in the sample questionnaire. Tablets with the card columns numbered at the top are readily available. These coding forms help minimize keypunching mistakes and are usually the only data format acceptable to keypunching services.

Although other mediums are available for recording and storing data, cards are most often used by the first time or small scale computer user. The advantages and disadvantages of the various input and output mediums are discussed in the following section.

INPUT AND OUTPUT

The computer, an information processing machine, simply accepts information or input and gives results or output. This process occurs according to a set of instructions given by the user. These instructions are called programs. Devices for reading input, storing information (mass storage), and generating output are called peripheral equipment. This equipment is connected to the central processing unit, or CPU, which performs arithmetic operations, directs temporary storage of information in memory, and controls the functioning of the peripheral units. The diagram in Figure 7.5 shows a basic computer system.
To use a computer, you do not need to know the mechanical details about the machine; however, decisions do need to be made about the peripherals that will be used to input data and output results. Devices that input data include punched card readers, mark sense readers (which detect pencil marks on pre-printed forms), and terminal keyboards. Examples of output devices that display or write the results are line printers, card punches, plotters, terminal printers and CRT screens. The input devices most commonly chosen by those using the computer for the first time are punched cards and timesharing terminals (keyboard and CRT terminal display). Output is commonly printed on line printers. Some of the commonly used mediums include:

**Punched cards:** Holes punched in a pattern represent numbers, letters, and symbols on a paper card. Data cards are punched by the user or a commercial service, on a keypunch machine for input purposes and the cards that are the result of computer output are prepared automatically on a card punch. Machines called verifiers are sometimes used to check the correctness of the punched data. The type of card used most frequently has 80 columns; however, IBM introduced in 1970 a card that contains 96 columns of data.

**Magnetic tape:** Data are recorded on magnetic tape as magnetized marks. The recording and reading of data is performed by the same machine, a tape drive, which is operated by an employee of the computer center. Magnetic tape is usually \( \frac{1}{2} \) inch wide (or, more recently, cassettes are used). It is a very popular medium for storing data for long periods of time, where cards might be subject to warping or other age problems. Tapes are so inexpensive that the user often purchases and stores the tapes himself.

**Magnetic disk:** The term used for a stack or pack of round disks, upon which data can be recorded as magnetized spots. Access to the data is usually faster than tape, but use charges generally are greater than for tape. This medium is used to store data and programs which are being used frequently, where the user does not want to carry around and constantly re-read large card decks.

**Printers:** Typically 14 5/8" wide line printer output with 132 columns of characters across the page and 55 to 60 rows vertically per page. Terminal printers usually have 8½" wide paper with 72 to 80 characters across the page.

In Figure 7.6, the advantages and disadvantages of the most commonly used input, output, and storage mediums are detailed.
Once the decision is made as to the desired input and output format, instructions are given to the computer in the form of a computer program, or set of instructions for the processing of data. Fifteen years ago, those persons using a computer usually had to learn a computer language in order to write a program or processing the data and performing calculations. Today many already written or "packaged," programs are available for processing data relating to social and economic studies. Some of these packages include good operating instructions for the beginning user. In addition to performing calculations, these package programs usually label the results for clear reporting. With these programs, in addition to simply providing coded data, the user must create a set of commands to the program for reading the data, requesting the specific calculations to be performed, and labeling and writing the output. This is much easier than writing a program from scratch and generally the diagnostics for detecting errors in the set-ups are very good.

**PROGRAM PACKAGES**

Program packages are highly recommended for the user who needs to process data, yet doesn't want to invest large amounts of time required to learn computer programming. One such package that is readily available at colleges, universities, and some computer service businesses is the *Statistical Package for the Social Sciences*. This set of "canned" programs will perform a wide variety of calculations and will label the output clearly, according to a set of given instructions. The package is well known for its excellent documentation and user's guide (see under the author, Nie, in Additional Sources). Some examples of the capabilities and kind of report output that is available with SPSS follow.

**Example 1:** This sample printout, Figure 7.7, is from the program FREQUENCIES of the *Statistical Package for the Social Sciences* (SPSS). The program has labelling capabilities and is particularly useful for reporting purposes. In this example, a progress report is being printed for the project, "American Indian Center---Urban Adjustment Survey." The variable summarized is "Tribe," with the numbers listed under "Code" having been defined as representing the tribe labels listed to the left. The absolute frequency is the number of times each tribe is listed in the sample. The relative frequency represents a percentage of the total, for each tribe listed. The adjusted frequency refers to the percentage calculated with missing values excluded. For example, if we had asked that the value "0" (zero) mean "not certain," this response would be calculated excluding the cases having that response. This provides the ability to selectively disregard certain answers in calculating the results. The cumulative frequency totals the frequencies, or accumulates the values vertically down the column.
Example 2: This example of a FREQUENCIES output from SPSS illustrates the value of the cumulative frequency calculation. For example, if community planning efforts required information concerning the educational level of community members, this table would indicate that 49.2% of the sample had completed the 11th grade or less.

<table>
<thead>
<tr>
<th>TRIBE</th>
<th>NOT CERTAIN</th>
<th>ALABAMA</th>
<th>APACHE</th>
<th>CHEYENNE</th>
<th>CHIPPEWA</th>
<th>CHOCTAW</th>
<th>HOPI</th>
<th>KICKAPOO</th>
<th>MONO CA</th>
<th>NAVAJO</th>
<th>PAIUTE CA</th>
<th>PIMA</th>
<th>PONCA</th>
<th>QUECHAN</th>
<th>SEMINOLE</th>
<th>SIOUX</th>
<th>UTE</th>
<th>WINNEBAGO</th>
<th>YAQUI</th>
<th>MISSION</th>
<th>CREEK</th>
<th>OTHER CALIFORNIA INDIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE</td>
<td>0.</td>
<td>4.</td>
<td>8.</td>
<td>31.</td>
<td>36.</td>
<td>38.</td>
<td>64.</td>
<td>76.</td>
<td>106.</td>
<td>115.</td>
<td>133.</td>
<td>144.</td>
<td>146.</td>
<td>152.</td>
<td>162.</td>
<td>172.</td>
<td>192.</td>
<td>204.</td>
<td>211.</td>
<td>219.</td>
<td>220.</td>
<td>221.</td>
</tr>
<tr>
<td>ABSOLUTE</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>20</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>RELATIVE</td>
<td>1.5</td>
<td>1.5</td>
<td>7.7</td>
<td>1.5</td>
<td>6.2</td>
<td>1.5</td>
<td>3.1</td>
<td>1.5</td>
<td>1.5</td>
<td>4.6</td>
<td>6.2</td>
<td>3.1</td>
<td>1.5</td>
<td>4.6</td>
<td>3.1</td>
<td>30.8</td>
<td>7.7</td>
<td>4.6</td>
<td>1.5</td>
<td>1.5</td>
<td>3.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

TOTAL 65 100.0

Example 2: This example of a FREQUENCIES output from SPSS illustrates the value of the cumulative frequency calculation. For example, if community planning efforts required information concerning the educational level of community members, this table would indicate that 49.2% of the sample had completed the 11th grade or less.
Example 3: This histogram of the variable “Indian Blood Quantum” illustrates one option of the program *FREQUENCIES from SPSS*. This type of visual display of data is useful in research reports to present information in an interesting, as well as descriptive, format.

Figure 7.9 EXAMPLE OF A HISTOGRAM

AMERICAN INDIAN CENTER——-URBAN ADJUSTMENT SURVEY
BLOOD QUANTUM

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>NOT CERTAIN</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>FOURTH TO HALF</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>OVER HALF</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>FULL BLOOD</td>
<td></td>
</tr>
</tbody>
</table>

FREQUENCY

VALID CASES 65
MISSING CASES 0

Example 4: This example of output from program CROSSTABS illustrates the type of breakdowns of data that can be obtained and displayed. This chart shows a breakdown of the variables “Frequency Speak Native Language” by “Blood Quantum,” illustrating the number and percentage of responses for “Blood Quantum” for each frequency interval represented in the sample.
A minimal setup for SPSS will require the user to define a variable list (a list of short names for the variables used), labels for the variables (a list of labels to indicate a longer label to be printed out as identification for variables), values for the responses (a list of words describing what the numerical responses stand for), an input format (set of instructions indicating which card columns have which variable values), a definition of the input medium (for example, whether the data would be read from cards, tape, or disk file), an indication of the number of cases to be processed, and an indication of the SPSS program(s) to be used for processing. In Appendix B, an example SPSS setup for the sample Needs Assessment questionnaire presented in Chapter 2 is listed in detail.

A WORD ON PROGRAMMING LANGUAGES

For the majority of community projects, program packages can fill data processing needs. For others that require specific applications, the development of an original program may be necessary. For example, some accounting systems set up with a small home or office computer might require an original program. To learn a programming language you will need much study and practice, with the emphasis on practice. Several self-teaching books are listed in the bibliography for this chapter. Here is a brief description of the more common programming languages:

**Basic** (Beginner's All-purpose Symbolic Instruction Code)

A simple and straightforward language, with relatively few rules, which is particularly appropriate for beginners. BASIC is a versatile language which is commonly used for time-sharing systems, medium to the largest computers as well as mini- and microcomputers. It has unusually poor control of printing format.

**Cobol** (Common Business-Oriented Language)

This language was originally developed for commercial purposes, and is particularly popular for business and accounting applications. COBOL reads quite like English, yet has more rules than many other languages. It is more awkward than most for calculations, but excellent control of printing format.

**Fortran** (Formula Translator)

Although this language was originally developed for mathematical capabilities, FORTRAN has become a common language for publishing social science applications. The arithmetic statements in this language are similar to algebraic statements.

**RPG** (Report Program Generator)

This language has a specialized function, that of preparing reports. The instructions are straightforward and simple, yet specific or formalized. Although mathematical computations are possible, the advantages of RPG lie with the input and output, or file management and report writing features.

Other programming languages in common use include **PL/1** (Programming Language 1) and **APL** (A Programming Language). These languages are used more frequently for mathematical applications.

Some knowledge of programming is always very useful to the user setting up an already existing package program, like SPSS. The decision to learn a computer program depends on the interests of the user, the availability of assistance, the availability of computer resources, and (above all) the availability of a large amount of time. The description of several program packages in Figure 7.11, may be useful in making the decision to use an available package. Another alternative to consider, if you have a specialized computer application, is that of hiring a computer programmer to write the program for you. This may save a great deal of time and funds in generating a custom program, but will still probably cost much more than use of a packaged program.

Summary

The main advantage of using a computer for data processing relates to the speed and accuracy at which large amounts of data can be handled. The instructions and methods for examining the data remain the same whether a pencil, a small calculator, or a large computer is used. Constructing a computer setup and preparing data take time. Some of the advantages of investing this time are the report writing capabilities and the speed at which intermediate runs and output can be gained. Particularly with community-based research, the intermediate reports on data collection progress can be valuable in providing information back to researchers and to the community before the study is completed. Cross-tabulations can be valuable in discovering possible correlations at an early stage in the project, enabling the researcher and/or advisory committee to focus on a particular topic if the crosstabs indicate a likely relationship. When progress is reported gradually, advisory committees can truly provide advice on redirection or confirm the course of the research.
### Program Packages

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMD (Bio-Med)</strong></td>
<td>Statistical</td>
<td>A package of statistical programs designed for the use of social science and biomedical data, intended for the user familiar with advanced statistics. Includes programs for descriptive statistics, linear and nonlinear least squares, multiple group stepwise discriminant analysis, factor analysis, principal component analysis, time series, univariate and multivariate analysis of variance, and variance component estimation.</td>
</tr>
<tr>
<td><strong>DATA-TEXT</strong></td>
<td>Statistical</td>
<td>A general purpose system for the statistical analysis of social science data, with advantages in processing an unlimited number of variables in correlation and factor analysis routines. Relatively expensive to run, yet more cost effective than other packages with large amounts of data.</td>
</tr>
<tr>
<td><strong>ESP (Economic Software Package)</strong></td>
<td>Statistical</td>
<td>Package for the statistical analysis of time series by ordinary least squares and two-stage least squares methods, designed for computational and data processing requirements encountered in econometric research.</td>
</tr>
<tr>
<td><strong>FAMULUS</strong></td>
<td>Bibliographic</td>
<td>Designed to process reference collections maintained by researchers. FAMULUS contains programs for editing, sorting, merging, galley printing, indexing, and searching according to keywords. FAMULUS also allows for the storing and printing of abstracts.</td>
</tr>
<tr>
<td><strong>MINITAB</strong></td>
<td>Statistical</td>
<td>General purpose, easy for beginners in statistical and line plotter package. Capabilities include univariate parametric statistics (standard deviation, t-test, one-way analysis of variance, multiple regression, etc) and nonparametric statistics. Also offers random data generation capabilities, flexible histogram, and two and three dimensional plotting routines. Error scanning &amp; diagnosis is extensive and explicit for beginners.</td>
</tr>
<tr>
<td><strong>OSIRIS</strong></td>
<td>Statistical</td>
<td>Package designed for the analysis of social science data, with capabilities including data generation, correction and modification of data files, transformation of data, and univariate and multivariate analysis programs. Other features include unique statistical programs which perform multivariate analysis using qualitative data, provisions for handling missing data, weighting, case selection, and file documentation.</td>
</tr>
<tr>
<td><strong>PSTAT</strong></td>
<td>Statistical</td>
<td>Package for the analysis of social science data, including capabilities for stepwise regression, factor analysis, crosstabulation, and multivariate analysis of variance. System is well adapted for time-sharing systems.</td>
</tr>
<tr>
<td><strong>SAS (Statistical Analysis System)</strong></td>
<td>Statistical</td>
<td>Capabilities include transforming or deleting variables or cases, flexible commands for reading, printing, sorting, merging, sorting data, and report writing. Package also has procedures for converting SPSS, OSIRIS, BMDP, or DATA-TEXT files into files for use with SAS. Adapted for time-sharing systems.</td>
</tr>
<tr>
<td><strong>SOUPAC</strong></td>
<td>Statistical</td>
<td>The package of statistical data processing programs includes populations statistics, analysis, and nonparametric statistics. May be expensive to run.</td>
</tr>
<tr>
<td><strong>SPSS (Statistical Package for the Social Sciences)</strong></td>
<td>Statistical</td>
<td>Developed for the analysis of social science data, the package includes descriptive statistics, aggregate statistics, crosstabulation, correlation, regression, discriminant analysis, and factor analysis. The package use is designed for those without previous programming experience and the explanations of statistical procedures in the accompanying manual are excellent.</td>
</tr>
</tbody>
</table>
WHERE TO GO FOR SERVICES

One of the most available and least expensive sources for computer services is a college or university. Although some limit service to research projects funded through the college, many do accommodate outside users. Costs may be more reasonable because the college does recover some funds for computer use through student tuition, but one of the main reasons why this source is recommended is the availability of consultant services. Most college facilities provide a reasonable amount of consultant time, free of charge. The billed cost for computer time generally also includes the use of keypunch machines and CRTs and, sometimes, verifier machines for checking keypunch accuracy. For persons in remote areas, time-sharing computing by telephone connected equipment, can often be purchased from college or computer service facilities. These facilities usually have provisions for mailing computer output to the user.

Private companies or individuals can provide greater personal assistance, but usually at greater cost. Many nationally used record-keeping systems have been adapted to computer processing by consultants who are willing to process data on a regular basis. Purchasing such services can be more economical overall than designing a data processing system and training a staff. Also, computerized accounting systems are readily available. Usually, the general collecting and summarizing of data for program needs can often be purchased; whereas, special applications sometimes needed in research must be designed.

A difficulty commonly encountered in obtaining computer services lies in the terminology connected with computer concepts and equipment. Although the terms may seem numerous, many consultants are sensitive to the needs of the novice users and will explain the meanings when asked. Figure 7.12 is a short glossary of the more common terms encountered in obtaining computer services. As computers become more incorporated into everyday life, the development of good self-teaching books, program packages, and consultants increases.

Figure 7.12 GUIDE TO COMPUTER RELATED TERMS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis</td>
<td>An examination of anything into parts or elements, separately or in relation to the whole.</td>
</tr>
<tr>
<td>Bug</td>
<td>Slang for an error in a set of instructions given to the computer.</td>
</tr>
<tr>
<td>Card</td>
<td>Common term for punched card, a paper card which holds 80 to 96 columns of alphabetic or numerical information, according to a pattern created by the presence or absence of punched holes.</td>
</tr>
<tr>
<td>Case</td>
<td>The basic comparative unit included in a study, such as a respondent or a community.</td>
</tr>
<tr>
<td>Coding</td>
<td>Writing data or instructions in a form which can be interpreted by the computer program.</td>
</tr>
<tr>
<td>Computer</td>
<td>Machine which accepts information (numbers or letters or the alphabet), processes the information according to a set of instructions, and produces results.</td>
</tr>
<tr>
<td>CRT</td>
<td>A Cathode Ray Tube is a television screen display and may be utilized as a computer-linked terminal.</td>
</tr>
<tr>
<td>Data</td>
<td>A group of facts or statistics, sometimes referred to as raw data. The term “data” refers to the plural, i.e. “the data are...”.</td>
</tr>
<tr>
<td>Data Processing</td>
<td>Operations performed on data, usually by means of automatic equipment.</td>
</tr>
<tr>
<td>Debugging</td>
<td>Finding and correcting the errors in a set of computer instructions.</td>
</tr>
<tr>
<td>Disk</td>
<td>A pack or stack of magnetic disks, upon which data can be recorded as a series of magnetic spots.</td>
</tr>
<tr>
<td>File</td>
<td>A group of related records, so defined by the user.</td>
</tr>
<tr>
<td>Flowchart</td>
<td>A diagram showing the logical sequence of events in a set of computer instructions.</td>
</tr>
<tr>
<td>Hard Copy</td>
<td>A copy of the output results printed on paper.</td>
</tr>
<tr>
<td>Hardware</td>
<td>The physical machines that read, process, store, and write data.</td>
</tr>
<tr>
<td>High Level Language</td>
<td>A set of symbols, often resembling English, which can be used to input instructions to a compiler. Examples of some of these languages are BASIC, FORTRAN, COBOL, PL/1, and APL. The compiler is a program which then translates the instructions into computer machine language.</td>
</tr>
<tr>
<td>Input Device</td>
<td>A machine that reads previously recorded data. Examples of input devices are punched card readers, mark sense document reader, keyboard, and light pen.</td>
</tr>
<tr>
<td>Mark Sense</td>
<td>A process of recording data which is read according to the presence or absence of pencil marks in specified locations on a form.</td>
</tr>
<tr>
<td>Medium</td>
<td>The physical material upon which data are recorded. Examples of mediums are punched cards, magnetic tape &amp; magnetic disk.</td>
</tr>
</tbody>
</table>
Microcomputer: A small computer, often costing only a few hundred dollars, and used primarily for home or small business use.

Output Device: A machine that displays or writes computer output. Examples include the line printer, card punch, terminals, and digital plotter.

Peripherals: Equipment connected to the computer (such as printer, card readers, tape drives), to perform input-output operations.

Plotter: A peripheral device which can draw graphic representations of data according to computer program output.

Program: A set of instructions in a particular computer language, which gives commands to perform a series of operations. Examples of these operations include the reading of data, performing calculations, and printing results.

Read: To sense data from a source medium, such as cards or tape.

Record: A set of related data, such as a case, considered as a unit.

Software: Instructions given by the user to the computer.

Tape: Often the short term for magnetic tape, a recording medium which stores data as magnetized marks.

Teletypewriter: A peripheral interactive terminal which produces hard copy.

Time-sharing system: A system of computer use by more than one user at the same time, usually by means of several terminals.

Value: The response indicated for each variable.

Variable: A measurement or quality obtained for each unit in a study.

Write: To record data on a medium.

Cost for computer services depends largely on the experience of the user. A great deal of processing can be obtained for under $100 when the user is experienced. Otherwise, a great deal of computer time can be wasted in debugging, or removing the errors from a program or package setup. Purchasing the services of a consultant can in many instances reduce the costs of wasted computer time, in addition to helping the user avoid frustration. Most computing facilities offer keypunch services by experienced operators. Machine verification, or checking for errors through the use of a verifying machine, is usually included in the charges. The decision of whether to do data recording in-house or to hire the services depends on the availability of staff, training, and the need for accuracy.

In a remote area, a time-sharing setup with data entry at your organization center may be a more efficient system. Choice may not be simply based on dollars and cents, for the training that staff can receive from doing data processing in-house can be a valuable resource for the future.

Personal computers are very useful for word processing (or the creation, modification, and storage of text). For organizations that have a great deal of report or proposal writing, the word processor enables quick changes and error-free printing. This can greatly assist the organization when many comments from community members or staff members are added to the text. The ease and time saved in editing tend to encourage more comments, and therefore more community participation in the writing process. Also, many people find word processing systems useful for improving writing skills, due to the ease of rewriting. At this time, statistical program packages for personal computers are not very well developed.

Personal computers (from such manufacturers as Apple, IBM, Osborne, Radio Shack) are economical for individual organizations to purchase; however, the technical expertise needed to program and to maintain them is expensive and difficult to obtain in non-urban locations. For those persons contemplating a home computing system, a glance at Libes' *Small Computer Systems Handbook* may help in making the decision. Personal computers are generally owned by persons who are willing to invest a great deal of time in learning and experimenting with their use.

Computers can be an economical way to process data and produce reports. Alternatives, such as programmable calculators and processing services might be considered carefully before undertaking computer processing, for working with a computer requires time, funds and patience in exchange for the end product. A certain amount of frustration is experienced by everyone who uses a computer, when things do not go as planned. Perhaps this is caused by the difficulty in remembering that the computer is only a machine; it doesn't think. The functioning of the computer is only as good as the quality of the instructions given to it.

Positive aspects of investing time in learning how to process data by computer include the accuracy gained, and the technical knowledge gained for future projects. As a tool for community-based research, the computer can be of great value in producing intermediate reports for community discussion and involvement in the research process.
ADDITIONAL SOURCES


This is an introduction to COBOL statements, arithmetic coding, accessing card files & tape files, mass storage (disk files), printed reports for beginners.


This discusses FORTRAN statements, arrays, subprograms, debugging, machine and assembly language. Emphasis is on the WATFOR, WATFIV compilers. (Beginner to intermediate level.)


This is a beginners guide to computer concepts, input & output and FORTRAN statements. This includes exercises for self-teaching and is written clearly.


The text discusses the concept of automated data processing, an overview of computer systems, storage systems, flowcharting, the impact of computers, systems analysis, writing a computer program in BASIC, and characteristics of selected computer systems. (Beginner level).


This includes discussions on the advantages of the small or home computer, digital logic, central processors, microprocessors, interfacing, mass storage systems, computer software, and applications. This is an optimistic guide aimed at those who already decided to develop a small system, yet the discussion should be valuable in assisting persons to decide if available resources are adequate. (Intermediate to advanced level).


This discusses the concept of computers, the central processor, peripheral units, programming, basic computer techniques, the role of computers in commerce and industry, and the use of computers for scientific work. (Beginner to intermediate level).


Although an introduction to the SPSS program package, this text give excellent descriptions of coding data for input, and several statistical procedures such as descriptive (frequencies, histograms, mean, standard deviation), Chi-square, T-Test, Bivariate Correlations, Multiple Regression, Analysis of Variance, Discriminant Analysis, and Factor Analysis. This is the comprehensive text for the package, and is written at the beginner to intermediate level.


This is a helpful guide in making the decision of whether or not to use computers. This discusses the history of computer technology; how computers work (digital computer organization); getting information in and out of the computer; introduction to BASIC computer programming language. This is well written and realistic. (Beginners level).


This presents elements of FORTRAN, input and output, data statements and modes for arithmetic, introduction to modern digital computing systems. (Intermediate level).


This is a self-teaching guide. This describes the logic of computer processing, the relationship between a job description, a flowchart, a program, and elements of flowcharting. (Beginner to intermediate level).


This includes information on BASIC statements, files processing, flowcharting, subroutines, libraries, and paper tape usage. This includes problems for self-instruction. (Beginners level).